DIGITAL GEOPHYSICAL MAPPING/ ELECTROMAGNETIC SURVEYS

CULEBRA WATER RANGES – FLAMENCO BAY WATER AREA (MRS 03) AND LUIS PEÑA CHANNEL (MRS 12)

CULEBRA, PUERTO RICO

Final
Phase 2 Remedial Investigation Work Plan

May 14, 2015

FINAL
PHASE 2 REMEDIAL INVESTIGATION WORK PLAN

Digital Geophysical Mapping / Electromagnetic Surveys Culebra Water Ranges – Flamenco Bay Water Area (MRS 03) and Luis Peña Channel (MRS 12)

Culebra, Puerto Rico

May 14, 2015

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ABBREVIATIONS AND ACRONYMS

AP	armor piercing
ApA	anomalies per acre
APP	Accident Prevention Plan
ARAR	applicable or relevant and appropriate requirement
ASR	Archives Search Report
cal	caliber
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CRL	Corporate Reference Library
CSM	conceptual site model
dBA	A-weighted decibels
DERP	Defense Environmental Restoration Program
DFW	definable feature of work
DGM	digital geophysical mapping
DID	Data Item Description
DNER	Department of Natural and Environmental Resources
DoD	Department of Defense
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
DR	Daily Report
EBS	Environmental Baseline Survey
EE/CA	Engineering Evaluation and Cost Analysis
EEG	Ellis Environmental Group, Inc.
EM	electromagnetic
EPP	Environmental Protection Plan
EQB	Environmental Quality Board
ESA	Endangered Species Act
FAR	Federal Acquisitions Regulations
FCR	Field Change Request
FOL	field operations lead
FS	Feasibility Study
FUDS	Formerly Used Defense Site
GIS	geographic information system
GPS	global positioning system
GQCM	geophysics quality control manager
HAZWOPER	Hazardous Waste Operations and Emergency Response

ABBREVIATIONS AND ACRONYMS
(Continued)

HD	high definition
HE	high explosives
HIPS	Hydrograph Information Processing System
INPR	Inventory Project Report
ISO	industry standard object
IVS	instrument verification strip
KO	Commanding Officer
MBE	multibeam echosounder
MC	munitions constituent
MD	munitions debris
MEC	munitions and explosives of concern
MLW	mean low water
mm	millimeter
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
NAD83	North American Datum 1983
Navy	Department of the Navy
NCR	nonconformance report
NHA	National Heritage Area
NHL	National Historic Landmarks Program
NMFS	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRIS	National Register Information System
PjM	Project Manager (TtEC)
PM	Project Manager (USACE)
PNNL	Pacific Northwest National Laboratory
PPE	personal protective equipment
PWS	Performance Work Statement
QA	quality assurance
QC	quality control
QCM	Quality Control Manager
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RTK	real-time kinematic

ABBREVIATIONS AND ACRONYMS
(Continued)

SHM	Safety and Health Manager
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SSS	sidescan sonar
T&E	threatened and endangered
T&M	time and materials
TEMA	Towed Electromagnetic Array
TMP	Technical Management Plan
TPP	Technical Project Planning
TtEC	Tetra Tech EC, Inc.
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USBL	ultra-short baseline
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
VHF	very high frequency
VSP	Visual Sample Plan

1.0 INTRODUCTION

1.1 PROJECT AUTHORIZATION

1.1.01 Tetra Tech EC, Inc. (TtEC) is the prime contractor to the U.S. Army Engineering and Support Center, Huntsville (USAESCH) under Contract W912DY-10-D-0015, Task Order 0003. This Task Order was established to perform a munitions and explosives of concern (MEC) Remedial Investigation/Feasibility Study (RI/FS) of the Culebra Water Ranges, located in Culebra, Puerto Rico. Relevant portions of the Performance Work Statement (PWS) are included as Appendix A.

1.1.02 This project falls under the Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS). The work conducted for this project will be performed in a manner consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Sections 104 and 121; Executive Order 12580; and the National Oil and Hazardous Substances Pollution Contingency Plan. All activities involving work in areas potentially containing material potentially presenting an explosive hazard will be conducted in full compliance with USAESCH, Department of Defense (DoD), Department of Army, U.S. Army Corps of Engineers (USACE), and local requirements regarding personnel, equipment, and procedures. Activities under this PWS fall under the applicable provisions of 29 Code of Federal Regulations (CFR) 1910.120.

1.2 PROJECT PURPOSE AND SCOPE

1.2.01 The purpose of this phase (Phase 2) of the RI is to conduct a geophysical survey to detect metallic anomalies at two underwater Munitions Response Sites (MRSs)—MRS 03 and MRS 12. MRS 03 and MRS 12 are located offshore east and west-southwest, respectively, of the Northwest Peninsula of Culebra, Puerto Rico. MRS 03, also known as the Flamenco Bay Water Area (FUDS Project No. I02PR006812M01), and MRS 12, also known as the Luis Peña Channel Water Area (FUDS Project No. I02PR006803M01), will be referred to herein as Flamenco Bay and the Luis Peña Channel, for consistency.

1.2.02 The primary field activity performed during Phase 2 of the RI will be to conduct digital geophysical mapping (DGM) with a Towed Electromagnetic Array (TEMA) survey. The TEMA towfish incorporates three high-power electromagnetic (EM) coils (high-power variant of the EM61-MKII) covering a 3-meter-wide swath. This system will be used to detect metallic objects on or under the seafloor. The TEMA-MK3 towfish also includes a camera that will provide real-time video to the operators on the vessel to help prevent contact with sensitive habitats such as coral reefs or seagrass beds. In deeper water, it will be actively flown to maintain an approximate 1 to 2 meter altitude above the bottom. In shallow water, the TEMA-Lite will be deployed. The TEMA-Lite features the same instrumentation as the TEMA-MK3 and is floated at the surface by paddleboards and maneuvered by hovercraft to enable access to shallow areas with minimal vessel and instrument draft.

1.2.03 EM survey operations will be constrained in the sensitive habitat areas that were defined as a result of the Environmental Baseline Survey (EBS). The survey will be conducted in accordance with the Supplemental Environmental Standard Operating Procedures for Endangered Species Conservation and their Critical Habitat, February 2014 (and Addendum 1, February 2015) contained in Appendix B-1. In areas without seagrass beds and with sand bottom (such as portions of MRS 03), the hovercraft-towed TEMA-Lite can be floated right up onto the beach. For sensitive habitat areas with water depth greater than 4 feet deep, the TEMA will only be deployed where it can be flown approximately 1 to 2 meters above the highest point and not within a 10-meter horizontal radius buffer around the sensitive habitat. These sensitive habitat avoidance measures will limit areas that can be surveyed as well as the minimum size of MEC items that can be detected.

1.2.04 The TEMA operator will see the coral in the live video and then begin to raise the towfish. The estimated time required to observe and maneuver the TEMA is based on the following:

- The average reaction time of a human is approximately between 0.2 second to 0.25 second, and recognition of visual images is no less than 0.4 second, all of which combined can be rounded up to 1 second.
- The winch system can pay in cable at 1 meter per second.
- The survey boat will be moving at 1 to 2 knots, which is 0.5 to 1 meter per second.
- There will be visibility of over 10 meters (likely 20+ meters).

1.2.05 Based on these parameters, the operator will have 10 to 20 seconds of lead time, allowing for 1 second of reaction time, 1 second winch spin up, and 0.5 meter per second winch pay-in speed.

1.2.06 These values will yield 4 meters of altitude change; assuming a speed of 2 knots, only 10 meters of visibility, and a slow winch pay-in speed, there will be 8 seconds of time to alter the towfish altitude up to 4 meters.

1.2.07 Images from the high-definition (HD) video (as well as stills from a digital single-lens reflex Nikon camera on the TEMA-MK3) will be recorded and used to identify Endangered Species Act– (ESA) listed corals in relation to potential MEC items.

1.2.08 There is no fixed depth that defines deep vs. shallow; this is a condition-dependent value. For the most part, the areas that were surveyed during the EBS are considered "deep." These are the areas, approximately 3 meters deep, that the vessel towing the TEMA-MK3 can safely operate in.

1.2.09 The TEMA-Lite will be collecting HD video images that will be used to determine the location of ESA-listed corals in relation to MEC items. The camera will be located in a wet box mounted on a "boogie board" that will have a transparent bottom that is flush with the bottom of the TEMA-Lite. Surveys will be conducted in the shallowest areas at high tide and will not be conducted in coral areas with less than 6 inches of water. No portion of the TEMA-Lite will have greater than a 6-inch draft when operating in areas with less than 1 foot of water.

1.2.010 The launching and boarding sites to be used for the TEMA-Lite will be locations that are currently accessible by road and used to launch and recover kayaks and paddle boards. At MRS 03, the sand beach areas of Flamenco will be used, and in MRS 12, mainly those of Tamarindo Bay.

1.2.011 The hovercraft noise as measured in air is only 83 A-weighted decibels (dBA). For comparison, a very loud restaurant is 82 dBA and a lawn mower 90 dBA. The hovercraft will generate less underwater noise than many standard boats because the source of the sound is not in contact with the water but instead transmitted through the air into the water. Owing to the great difference of acoustic characteristic impedance between air and water, the sound transmission loss from an airborne source into water is very high. Therefore, the USACE does not consider noise from the hovercraft to be any more of an issue than it would be from any other marine vessel, and consider the use of a hovercraft to be sufficiently addressed in the existing standard operating procedures (SOP).

1.2.012 Sensitive habitat is any area where contact with the bottom is not allowed according to the SOPs developed by the USACE in coordination with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) office and the U.S. Fish and Wildlife Service (USFWS). The TEMA-MK3 boat-towed system will operate in water deeper than 2 meters at altitudes of:

- 0 to 0.5 meter in sandy areas,
- 0.5 to 1 meter in areas with seagrass, and
- About 1 to 2 meters in areas with corals.

1.2.013 The 10-meter radius is the safe operating distance that the TEMA-MK3 can be flown around obstructions and areas with steep slopes. This does not apply to the TEMA-Lite. The TEMA-Lite will work in areas with 6 inches to 2 meters water depth, always floating on the surface. The SOPs developed by the USACE and the USFWS allow for data collection with the TEMA-Lite in as little as 6 inches of water.

1.2.014 Areas where the systems cannot be operated within the above mentioned parameters will be excluded, because they are not accessible.

1.2.015 Other data collection methods, including the use of MEC divers with hand-held EM units, could be employed to survey within the areas shallower than 2 feet, and in areas with slopes too great to survey with the TEMA; however, that is outside the scope of this project.

These areas are not large enough to impact attaining the Data Quality Objectives (DQO) for the project.

1.3 WORK PLAN ORGANIZATION

1.3.01 This work plan has been prepared in accordance with Data Item Description (DID) WERS-001.01 (Work Plans) and Engineer Manual 1110-1-4009 Chapter 4 – Work Plans. The sections that comprise the Work Plan are discussed below.

- Section 1, Introduction, of this Work Plan details the overall scope and objective of the project, presents the organization of the work plan, and presents an overview of the site and its history.
- Section 2, Technical Management Plan, details the organizational structure, lines of authority, and communication of the survey team.
- Section 3, Field Investigation Plan, describes the approaches to be taken for the procedures that will be implemented to complete the required field work.
- Section 4, Quality Control (QC) Plan, describes TtEC's procedures for controlling and measuring the quality of work performed, including the organization, responsibilities, and policies to be implemented.
- Section 5, Explosives Management Plan, describes details for management of explosives used to destroy MEC recovered during the project, including acquisition receipt, storage, transportation, and inventory. This plan is not included in this Work Plan for the RI but will serve as a placeholder section.
- Section 6 is the Environmental Protection Plan (EPP), which provides general information and lists applicable requirements to protect resources and threatened or endangered species.
- Section 7, Property Management Plan, describes how property management will be performed.
- Section 8, Interim Holding Facility Siting Plan for Recovered Chemical Warfare Materiel (RCWM) Projects, is not applicable to this project and will serve as a placeholder section only.
- Section 9, Physical Security Plan for RCWM Project Sites, is not applicable to the project and will serve as a placeholder section only.
- Section 10, References, includes a list of references used in the preparation of this Work Plan.

1.3.02 Additional information and plans are included in this Work Plan as appendices:

- Task Order Scope of Work: Relevant portions from the PWS are included as Appendix A.

- Supplemental Environmental SOPs: The SOPs were prepared by USACE and are included as Appendix B-1; they identify procedures to follow for endangered species and critical habitat conservation during underwater investigations.
- Site Maps: Appendix C contains all maps prepared in support of this Work Plan.
- Points of Contact: Various points of contact are listed in Appendix D to this Work Plan.
- Accident Prevention Plan (APP): The APP is attached as Appendix E of this Work Plan. The APP describes the health and safety procedures, personal protection standards, and environmental health hazards applicable to this project.
- Contractor Forms: Relevant forms and templates are provided in Appendix F including:
  - Survey Log Sheet
  - Example Daily Report
  - TEMA Daily Start-up QC Checklist
  - TEMA Video Acquisition Daily Start-up QC Checklist
  - Example Daily QC Report
  - Preparatory Phase Checklist
  - Initial Phase Checklist
  - Field Change Request
  - Field Change Request Log
  - Nonconformance Report
  - Design Change Notice
  - Visitor Log
- Contractor Personnel Qualifications Certifications Letter: Qualification certifications of key personnel are included in Appendix G.
- Technical Project Planning (TPP) Work Sheets and Documentation: Appendix H contains the TPP Work Sheets, conceptual site models (CSMs) for MEC and munitions constituents (MC), and minutes from the TPP meetings.
- Survey MEC Exposure Risk Assessment: Appendix I assesses the risk to the survey team from MEC.
- Transect Sampling for Unexploded Ordnance (UXO) Target Detection: Appendix J summarizes the probability of traversing and detecting a target area of specific size and shape for different transect spacings.

1.4 PROJECT PROPERTY DESCRIPTION

1.4.01 Culebra Island is located approximately 17 miles east of the island of Puerto Rico and is approximately 9 miles from the Island of Vieques (Figure 1-1).

Figure 1-1. Location Map of Culebra

1.5 PROJECT HISTORY

1.5.01 The Culebra Island Archipelago (including the Northwest Peninsula of Culebra and these two water range MRSs) was used as an impact range for aerial bombs and rockets, missiles, mortars, and naval projectiles from 1903 until 1975. The southern portion of the Northwest Peninsula of Culebra lies between the two water range MRSs. This peninsula was used as a target for aerial bombing, aerial rockets, strafing, and naval gunfire from roughly 1941 until 1975. Most of the gunfire was indicated to have been fired from ships in the water east of the peninsula and directed at targets on its eastern beach and ridges and plateaus. The upland targets included white painted drums, Sherman tanks, trucks, panels, and circular targets painted on the ground. A movable cable target system was constructed in this area and used for a short time.

1.5.02 The areas between the ridges on the peninsula were used as impact areas for conventional and napalm-laden bombs. Landing practice operations also took place on the beach areas of Flamenco Bay. Some of these exercises were accompanied by the firing of illuminating flares and white phosphorus projectiles. Floating target structures may also have been towed off-shore into Flamenco Bay or the waters of Luis Peña Channel and used for training. Most of the munitions discovered to date on the Northwest Peninsula appear to have resulted from naval gunfire, illumination flares, and practice bombs. Since relatively flat trajectory projectiles were typically fired from the ships, it appears unlikely that many projectiles fired from the northeast would have impacted on the western slope of the peninsula ridge. However, there may have been overshoots resulting in the potential for MEC in the Luis Peña Channel.

1.5.03 No confirming evidence has been discovered that upland targets were ever placed on the steep western slopes of the peninsula or shoreline areas to the south. The steepness and inaccessibility of these slopes would have made the placement and maintenance of upland targets very difficult. It is also not known with certainty whether floating targets were ever used on the western side of the Northwest Peninsula in the Luis Peña Channel. Naval firing from the west is believed to have been less likely because of the relatively shallow water in many areas and restrictive reefs and small cays. In consideration of these factors, prior MEC investigations in the upland areas of the Northwest Peninsula have focused primarily on its eastern side and northern portion (including the beach and shoreline areas of Flamenco Bay) where evidence of upland targets has been found. The Archives Search Report stated that the TtEC biological dive team observed munitions at Flamenco Beach. This was the only report of MEC or munitions debris (MD) in the water of Flamenco Bay. The Archives Search Report also documented a local scuba dive instructor who said he spotted many underwater ordnance items around Culebra, with the highest concentration in the Luis Peña Channel and water west of Flamenco Peninsula. It was not indicated whether these items were MEC or MD.

1.5.04 The RI for Flamenco Bay and the Luis Peña Channel is being conducted in three phases: Phase 1, the EBS, to develop basemaps to guide the following phases; Phase 2, the DGM, to provide an assessment of the distribution and density of metallic items and debris fields that may be MEC; and Phase 3, an intrusive investigation to help determine which metallic items are indeed MEC and sampling to determine if any chemical contaminants from MEC are present in sediments. The Phase 1 EBS activities have been completed. The primary field activities performed during the EBS included acquisition of multibeam echosounder (MBE) bathymetry, sidescan sonar (SSS) imagery, and underwater video and still photography used to perform a benthic terrain and habitat assessment. The purpose of the EBS was to provide information to help characterize the nature and extent of sensitive marine habitats such as coral reefs and seagrass beds and endangered or threatened species within the boundaries of Flamenco Bay and the Luis Peña Channel. The objective of the EBS field activities was to identify areas and boundaries of sensitive habitat and to determine where towed operations and sampling can be safely conducted without damaging these resources during the follow-on phases of the field investigation that include the Phase 2 activities utilizing towed geophysical sensors and the Phase 3 intrusive activities. Underwater investigation activities that were conducted as part of the EBS consisted of visual observations, boat operations, and remote sensing surveys.

1.5.05 Data from the EBS are being used to guide the Phase 2 work described in this work plan by providing information and basemaps that show benthic terrain and delineations of sensitive habitats within these two MRSs. Following completion of the RI, an FS will be performed to identify and compare remedial alternatives, followed by development of a Proposed Plan that recommends a preferred remedy and Record of Decision that documents the selected remedy for Flamenco Bay and the Luis Peña Channel.

1.6 CURRENT AND PROJECTED LAND USE

1.6.01 In 1901, Culebra's public land was placed under Department of the Navy (Navy) control. The Island and adjacent cays were used as impact areas and firing ranges for aerial bombs and rockets, missiles, mortars, small arms, artillery projectiles, and naval projectiles by the Navy and U.S. Marine Corps from 1903 until 1975. In 1978, part of the public land was transferred to the Commonwealth of Puerto Rico and the rest to the USFWS. Lands were transferred to the Commonwealth through a Quitclaim Deed and a Cooperative Management Agreement signed by the Government of Puerto Rico and the Department of the Interior in 1982.

1.6.02 The Finding and Determination of Eligibility, dated December 24, 1991, qualified 2,660 acres of Culebra Island and adjacent cays as eligible for consideration under the DERP-FUDS. However, upon subsequent review of historical material from the National Archives, it was determined that all of Culebra Island and the adjacent cays should be considered a FUDS except the Northwest Peninsula, which is not eligible under the 1982 Quitclaim Deed and Public Law 93-166, and the tract that was controlled by the Navy after 1986. The revised area covered by the DERP-FUDS projects for Culebra Island and adjacent cays consists of approximately 8,430 acres. Figure 1-2 shows the DERP-FUDS project for Culebra.

Figure 1-2. DERP-FUDS Projects for Culebra

1.6.03 The objectives of all the DERP-FUDS projects are to reduce risk to human health and the environment and reduce the hazards to public safety presented by military munitions through implementation of effective, legally compliant, and cost-effective response actions. In order to gather additional information that would help to determine the nature and extent of MC or MEC contamination on Culebra Island MRSs, it was agreed by the TPP Team, comprising federal and Commonwealth of Puerto Rico agencies, to conduct underwater investigations and to prepare an RI/FS. The main objectives of the underwater investigations are to: a) characterize and map benthic habitats within investigation areas; b) determine, identify, and map endangered or threatened species, in particular coral colonies; c) gather the necessary information to determine potential effects (e.g., location of species versus location of suspected MEC) on endangered or threatened species during remedial investigations and cleanup activities; d) determine presence or absence of MC and MEC; e) characterize the nature and extent of MC and MEC presence; and f) determine if the MC or MEC pose an unacceptable risk to human health and the environment, which would require further considerations or a response action.

1.7 PREVIOUS INVESTIGATIONS

1.7.01 This section summarizes previous investigations conducted at Culebra. The following sections are taken, in part, from the Final Site Inspection Report (Parsons 2007) and include more recent investigations that have been performed since this report was issued.

1.7.1 1991 Inventory Project Report

1.7.1.01 An Inventory Project Report (INPR) was signed on December 24, 1991, establishing the Culebra Island site as a FUDS, defining a site boundary, and assigning the FUDS Project No. I02PR006800 (USACE 1991). The Findings and Determination of Eligibility concluded that "the site, except for 87.5 acres still under control of the Navy, has been determined to be formerly used by the Department of Defense. It is therefore eligible for the Defense Environmental Restoration Program (DERP)."

1.7.2 1995 Archives Search Report

1.7.2.01 The Archives Search Report (ASR) was completed by the USACE Rock Island District in February 1995 (USACE 1995) after reviewing available records, photographs, and reports that documented the history of the site. As part of the ASR, a site visit was conducted in October 1994, during which the team identified MD on Cayo Botella, Cayos Geniqui, and Cayo del Agua. In addition, MD was identified on Flamenco Beach, Flamenco Peninsula, and the hillside near Cerro Balcon. The ASR listed several ordnance items verified on-site by either explosive ordnance disposal personnel or the ASR field team. Table 1-1 lists MEC items previously found.

Table 1-1. Munitions and Explosives of Concern (MEC) Items Previously Identified in or Adjacent to MRS 03, MRS 12

Item	Quantity	Notes	MRS	Reference	Location	Date
Candle, illumination, from 5-inch 38 naval projectile	1	Filled with 50% of illumination composition	2	MTA TCRA	Northwest Peninsula Grid No. 1	1995
Bomb, practice, 25 pound, MK 76/BDU-33	1	Appeared spotting had functioned but too corroded to certify	2	MTA TCRA	Northwest Peninsula Grid No. 2	1995
Projectile, 40mm, M81A1 TP-T	1	Tracer present	2	MTA TCRA	Northwest Peninsula Grid No. 2	1995
Projectile, 40mm, M81A1 TP-T	1	Tracer partly burnt	2	MTA TCRA	Northwest Peninsula Grid No. 2	1995
BLP, 3 inch, with tracer	1	Condition not determined due to corrosion	2	MTA TCRA	Northwest Peninsula Grid No. 2	1995
Projectile, 3 inch, 50 HE	1	Armed, PD, fuze	2	MTA TCRA	Northwest Peninsula Grid No. 2	1995
Projectile, 40mm, M81A1 TP-T	1	Tracer Present	2	MTA TCRA	Northwest Peninsula Grid No. 2	1995
Fuze, BD, from 5-inch 38 projectile	1	Tracer Residue Present	2	MTA TCRA	Northwest Peninsula Grid No. 3	1995
Fuze, BD, from 5-inch 38 projectile	1	Condition not determined due to corrosion	2	MTA TCRA	Northwest Peninsula Grid No. 4	1995
Projectile, 40mm, Bofors	1		2	MTA TCRA	Northwest Peninsula Grid No. 4	1995
Candle, illumination, from 5-inch 38 naval projectile	1	Filled with 75% of illumination composition	2	MTA TCRA	Northwest Peninsula Grid No. 4	1995
Naval gun fire, 3-inch	1	Surface, fired, unfuzed	2	EE/CA	Northwest Peninsula NP-1	1997
Rocket, 5-inch, HVAR	1	Sheared on surface	2	EE/CA	Northwest Peninsula NP-11	1997
Naval gun fire, 3-inch	2	4 and 5-inch depth	2	EE/CA	Northwest Peninsula NP-12	1997
Bomb, practice, MK 23	1	Unknown depth	2	EE/CA	Northwest Peninsula NP-12	1997
Projectile, 20mm HEI	1	3-inch depth	2	EE/CA	Northwest Peninsula NP-12	1997
Fuze, sheared base		Unknown depth, number, or type	2	EE/CA	Northwest Peninsula NP-12	1997
Candle, illumination, 5 inch	3	6-inch depth	2	EE/CA	Northwest Peninsula NP-15	1997
Bomb, practice, MK 76 w/MK 4 spotting charge	2	Unknown depth, sheared fuzes	2	EE/CA	Northwest Peninsula NP-15	1997
Naval gun fire, 6 inch	2	5-inch depth, sheared fuzes	2	EE/CA	Northwest Peninsula NP-16	1997

Table 1-1. MEC Items Previously Identified (continued)

Item	Quantity	Notes	MRS	Reference	Location	Date
Mortar, 81mm	1	7-inch depth	2	EE/CA	Northwest Peninsula NP-16	1997
Naval gun fire, 5 inch	1	7-inch depth, sheared fuze	2	EE/CA	Northwest Peninsula NP-16	1997
Naval gun fire, 3 inch	1	6-inch depth, sheared fuze	2	EE/CA	Northwest Peninsula NP-16	1997
Naval gun fire, 3 inch	1	4-inch depth, sheared fuzes	2	EE/CA	Northwest Peninsula NP-17	1997
Naval gun fire, 5 inch	1	5-inch depth, sheared fuze	2	EE/CA	Northwest Peninsula NP-17	1997
Naval gun fire, 5 inch	2	6-inch depth, sheared fuzes	2	EE/CA	Northwest Peninsula NP-17	1997
Naval gun fire, 6 inch	1	6-inch depth, sheared fuze	2	EE/CA	Northwest Peninsula NP-17	1997
Grenade, w/o fuze	1	No fuze	2	EE/CA	Northwest Peninsula NP-17	1997
Naval gun fire, 5 inch	1	Partial	2	EE/CA	Northwest Peninsula NP-17	1997
Naval gun fire, 5 inch	2	5-inch depth, no fuzes	2	EE/CA	Northwest Peninsula NP-18	1997
Candle, illumination, 5 inch	1	Surface	2	EE/CA	Northwest Peninsula NP-19	1997
Naval gun fire, 5 inch	1	Surface	2	EE/CA	Northwest Peninsula NP-20	1997
Naval gun fire, 6 inch	2	Surface, sheared fuzes	2	EE/CA	Northwest Peninsula NP-21	1997
Mortar, 81mm	1	Surface, no fuze	2	EE/CA	Northwest Peninsula NP-21	1997
Fuze, projectile base	1	Surface	2	EE/CA	Northwest Peninsula NP-21	1997
Candle, illumination, 5 inch	2	Surface, no fuze	2	EE/CA	Northwest Peninsula NP-22	1997
Naval gun fire, 3 inch	2	6-inch depth, fired fuzes	2	EE/CA	Northwest Peninsula NP-3	1997
Candle, illumination, 5 inch	2	Surface	2	EE/CA	Northwest Peninsula NP-4	1997
Candle, illumination, 5 inch	1	Unknown depth	2	EE/CA	Northwest Peninsula NP-4	1997
Naval gun fire, 5 inch	1	Fired mod 2 fuze, 8-inch depth	2	EE/CA	Flamenco Beach FB-6	1997
Projectile, 37mm HE	1	No fuze, 5 inch depth	2	EE/CA	Flamenco Beach FB-6	1997
Warhead, rocket, 5-inch	1	Sand filled with fired fuze, 4- inch depth	2	EE/CA	Flamenco Beach FB-6	1997
Candle, illumination, 5-inch	2	Flares, no fuze, 4-inch depth	2	EE/CA	Flamenco Beach FB-6	1997
Various UXO	249	Various UXO identified on Northwest Peninsula	2	UXO Construction Support, Ellis	Northwest Peninsula	2001-2002

Table 1-1. MEC Items Previously Identified (continued)

Item	Quantity	Notes	MRS	Reference	Location	Date
Candle, illumination, 5-inch	1	10-inch depth, unfuzed, magnesium filled	2	Ellis Grid Log	2029724.479N 2529724.682E	2002
Bomb, 100 pound	1	Surface, fuzed, HE	2	Ellis Grid Log	2029921.471N 25279.397E	2002
Bomb, 1,000 pound	1	12-inch depth, fuzed, HE	2	Ellis Grid Log	2029922.685N 252796.915E	2002
Candle, illumination, 5-inch	1	10-inch depth, fuzed, magnesium filled	2	Ellis Grid Log	2029922.685N 252796.915E	2002
Mortar, 81mm	1	18-inch depth, fuzed, w/p filled	2	Ellis Grid Log	2029924.127N 252920.989E	2002
Bomb, 100 pound	1	Surface, fuzed, HE, BIP	3	USACE, USN EOD	Flamenco Beach, underwater MRS03	2014, Jan
Bomb, 100 pound	1	Surface, fuzed, HE, BIP	3	USACE, USN EOD	Flamenco Beach, underwater MRS03	2014, Apr

Source: Parsons (2007)

1.7.3 1995 Interim Remedial Action

1.7.3.01 In 1995 MTA, Inc. completed an interim remedial action on 3.66 acres of the Flamenco Bay Campground (MRS 02) near Flamenco Beach to dispose of UXO within 2 feet of the ground surface at the campground (MTA 1995). Work was conducted on the site between May 12 and May 26, 1995. MTA found 11 items of UXO and munitions-related scrap.

1.7.4 1997 Final Engineering Evaluation/Cost Analysis

1.7.4.01 In March 1997, Environmental Science and Engineering, Inc. submitted the *Final Engineering Evaluation and Cost Analysis (EE/CA) for the Former Culebra Island Naval Facility, Culebra Island, Puerto Rico* (ESE 1997). The EE/CA investigation included surface and subsurface sample grids on Flamenco Peninsula, Isla Culebrita, Cayo Botella, Cayo del Agua, Cayo Lobo, and Cerro Balcon, where only ordnance-related scrap was identified. Items found included 20 millimeter (mm) high-explosive incendiary devices, Mk76 practice bombs, Mk50s, 37-mm projectiles, 5-inch rockets, 76-mm projectiles, 3- to 6-inch naval projectiles, 81-mm mortars, and a grenade.

1.7.5 2004 UXO Construction Support

1.7.5.01 In June 2004, Ellis Environmental Group, LC (EEG) submitted the *Site-Specific Final Report, UXO Construction Support, Culebra Island Wildlife Refuge, Culebra Island, Puerto Rico* (EEG 2004). The report documented clearance efforts conducted by EEG on the Northwest Peninsula. Ellis performed four phases of clearance from January 2001 to February 2004. Phase I consisted of clearance support by clearing roadways, a wind generator foundation, and a desalination plant foundation, as well as re-grading the site. Phase II of the construction support was not exercised due to a stop in funding for the construction project. Phase III included surface clearance of 70 acres of bird nesting area and 4-foot-depth subsurface clearance of roadways, firebreaks, and an observation post. Phase IV consisted of demilitarization of scrap, construction of a fence and information kiosk, and development of public awareness information. The public awareness information included a video, UXO safety poster, and UXO safety brochure.

1.7.5.02 During UXO Construction Support project, Ellis excavated 6,121 holes and recovered 15,479 pounds of scrap metal and 249 UXO items. Fifteen (15) of the 249 UXO items were found within the boundary of the southern portion of the Northwest Peninsula principal area of interest.

1.7.6 2004 Archives Search Report Supplement

1.7.6.01 The ASR Supplement was completed by the USACE Rock Island District as an addition to the 1995 ASR (USACE 2004). This report provides details of aerial training conducted by the Navy between 1935 and 1975 and identifies range/sub-range areas. Of the identified areas, boundaries of the following sub-ranges encompass areas within or adjacent to MRSs 03 and 12:

- Water West: Part of this area in included in MRS 12. A local diver reported underwater ordnance in this area. Suspect munitions include Mk II 6-inch high explosive (HE) projectiles.
- Water Center: This area is included in MRS 12. A local diver reported underwater ordnance in this area. Suspect munitions include Mk II 6-inch HE projectiles.
- Naval Gunfire Target Area: This range was a naval gunfire and air-to-ground range with its target located on Northwest Peninsula. Munitions included general small arms, .50-caliber small arms, Mk80s series general purpose bombs, M1 105mm HE, Mk21 8-inch armor piercing (AP), Mk5 16-inch AP, 2.75-inch rockets, and the 11.75-inch Tiny Tim rocket.
- Agua Cay: This area, also known as Water Key, is part of MRS 02 and was used as a target for bombing and rocket fire. Munitions include Mk80 series general purpose bombs and 2.75-inch rockets.
- Air-to Ground North: This target was located at the northern tip of Northwest Peninsula. Munitions used include general small arms, .50-caliber small arms, Mk82 500-pound general purpose bombs, 2.75-inch rockets, and 11.75-inch Tiny Tim rockets.
- Air-to Ground South: This target was located at the northern tip of Northwest Peninsula. Munitions used include general small arms, .50-caliber small arms, Mk82 500-pound general purpose bombs, 2.75-inch rockets, and 11.75-inch Tiny Tim rockets.

1.7.6.02 No site visit was conducted in support of the ASR Supplement.

1.7.7 2005 Revised Inventory Project Report

1.7.7.01 A Revised INPR was completed in June 2005 (USACE 2005a). The Revised INPR further clarified the military use of the Island of Culebra and divided the original site, Property No. I02PR0068, into 14 separate MRSs. One hazardous and toxic waste project was identified and assigned the number 00, and 13 Military Munitions Response Program (MMRP) project areas were identified and assigned Risk Assessment Code scores. MRSs 03 and 12 were each assigned as Risk Assessment Code 1.

1.7.8 2005 Supplemental Archives Search Report

1.7.8.01 The Supplemental ASR was completed by the USACE St. Louis District in 2005 as an addition to the 1995 ASR (USACE 2005b). The Supplemental ASR is the source of most of the historical information pertaining to site operations and identified the key areas of focus for the 2007 site inspection. This document provided a detailed summary of military activities conducted on Culebra Island and the surrounding cays. The document summarizes planned and/or executed maneuvers and training conducted at the site, including specific time periods, locations, and munitions used.

1.7.9 Cultural and Archeological Resources

1.7.9.01 The following is taken from the Final Site Inspection Report (Parsons 2007):

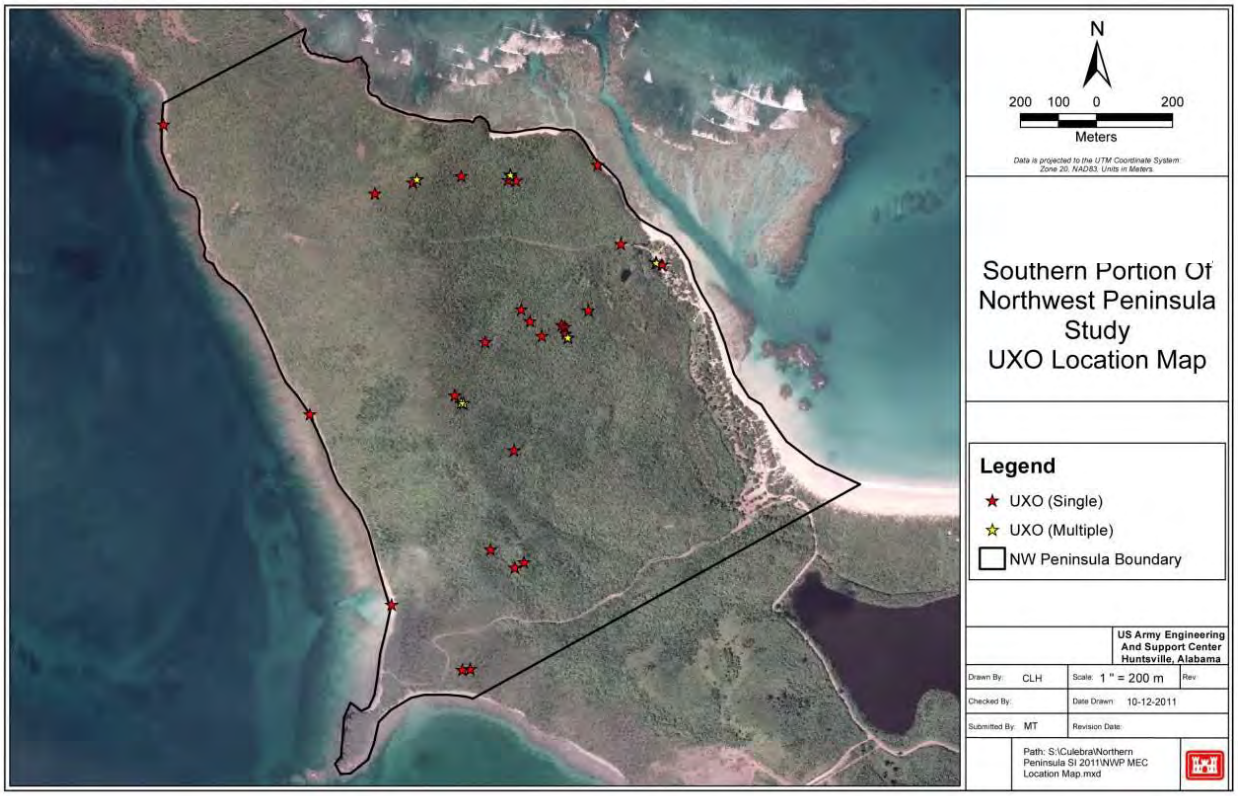
> "According to the National Register Information System (NRIS), National Historic landmarks (NHL) list, national Heritage Areas (NHA) list, and national park Service (NPS), there is only one registered cultural resource within the boundaries of the Culebra Island site. On the Isla Culebrita is an historic lighthouse called Faro Isla de Culebritas. The lighthouse is not open to the public due to building deterioration. According to the Puerto Rica State Historic Preservation Office (SHPO), there are no known architectural resources within the boundaries of the Culebra Island site; however, an architectural survey has not yet been conducted for Culebra. An archeological survey performed at Lower Camp in 1992 found evidence of prehistoric and historic inhabitants distributed over a half-acre area within the Lower Camp site."

1.7.10 USACE's Assessment of the Northwest Peninsula Area

1.7.10.01 On behalf of the DoD, a Congressionally mandated study was performed by the USACE under Public Law 111-383 in 2011 to assess the presence of UXO in the portion of the Northwest Peninsula transferred to the Commonwealth of Puerto Rico. A summary of their estimate of the types and amounts of UXO, as reported in DoD (2012), is presented below.

1.7.10.02 The Northwest Peninsula was used for live gunnery practice between 1936 and January 1, 1972. During this period, approximately 750,000 naval rounds were fired into the Northwest Peninsula. Of these, an estimated 80 percent (600,000) were 5 inch/38 caliber (cal) and 5-inch/54 cal projectiles and an estimated 10 percent (75,000) were 3-inch/50 cal, 6-inch/47 cal, and 8-inch/55 cal gun ammunition. The balance included other types of military munitions including 16-inch/50 cal, and munitions for both mortars and howitzers. Additionally, during 1942 to 1968, approximately 320,000 naval aviation munitions (e.g., bombs and rockets) were used (dropped or fired) within the Northwest Peninsula (U.S. Navy 1973).

1.7.10.03 Since 1995, 70 UXO have been encountered within approximately 19 acres of the Study Area. This total, which includes 36 UXO discovered during this study, equates to approximately 3.7 UXO per acre. The locations of the 36 UXO discovered during USACE's 2011 assessment are shown on Figure 1-3.



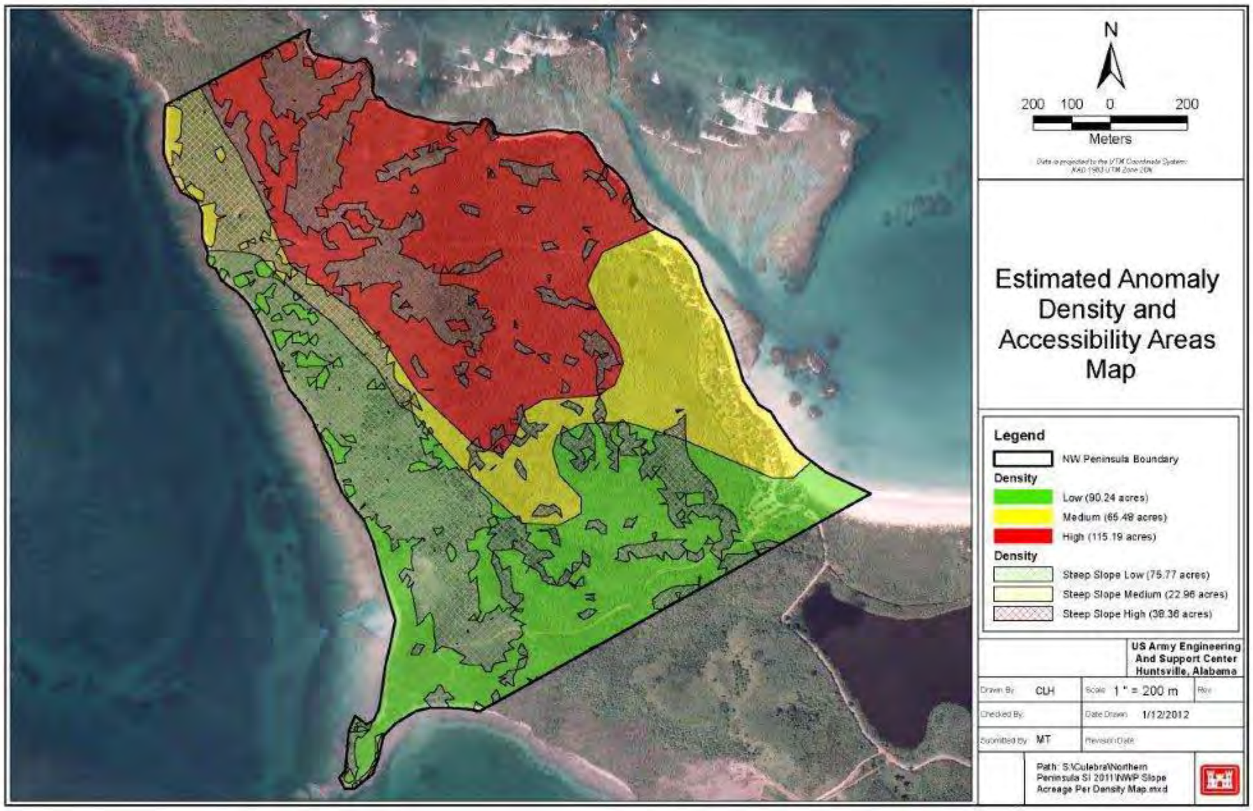
source: DoD (2012)

Figure 1-3. Locations of Individual or Multiple UXO

1.7.10.04 The predominant military munition encountered within the Study Area as UXO was the 5-inch high explosive naval projectile. Other UXO encountered included the following types of military munitions: 2.75-inch rockets, 3-inch naval projectiles, 40-mm projectiles, 75-mm projectiles, 81-mm mortars, 100-pound General Purpose bombs, a 500-pound General Purpose bomb, and Bomb Dummy Unit-33 practice bombs.

1.7.10.05 The USACE divided the Study Area into three areas based upon the number of metallic anomalies they detected during the geophysical survey, their estimate of the density of those metallic anomalies within each area, and the steepness of the terrain (see Figure 1-4). The three areas reflect an estimated anomaly density of:

- Low (Green): 0 to 785 anomalies per acre
- Medium (Yellow): 786 to 1,040 anomalies per acre
- High (Red): 1,041 to 1,400 anomalies or more per acre



source: DoD (2012)

Figure 1-4. Estimated Anomaly Density and Accessibility Areas Map

1.7.11 Environmental Baseline Survey

1.7.11.01 An EBS was conducted by TtEC in December 2012 and January 2013 as Phase 1 of the current RI. The survey included multibeam echosounder and sidescan surveys of 100 percent of the surveyable area of MRS 03 and MRS 12. A video survey was also conducted during this time. The purpose of the EBS was to determine appropriate equipment and methodologies for follow-on DGM/EM surveys (Phase 2 of the RI) and more intrusive investigations (Phase 3 of the RI) in order to prevent damage to threatened/endangered (T&E) species and/or critical habitat.

1.8 INITIAL SUMMARY OF MEC RISK

1.8.01 A risk assessment provided in Appendix I shows there is a very low risk of the survey team coming into contact with MEC during the proposed Phase 2 survey.

1.8.02 Although the risk of the survey team contacting MEC is very low during the Phase 2 survey, MEC is a safety hazard and, as such, may constitute an imminent and substantial endangerment to the general public, on-site personnel, and the environment. Numerous MEC and MD items have previously been recovered from Culebra (see Section 1.6), and there is potential for additional items to be present. Members of the public have access to Flamenco Bay and Luis Peña Channel; consequently, there is potential for public access to MEC where present.

1.8.03 Potential MEC at the Flamenco Bay and Luis Peña Channel sites consists of both munitions known or suspected to have been used and the types of MEC and MD that have previously been recovered or observed. Types of munitions anticipated based on the ASR and EE/CA findings include:

- Small caliber ammunition;
- Rockets;
- Grenades;
- Projectiles;
- Artillery;
- Mortars;
- Mines; and
- Various fuzes associated with the above munitions.

1.8.04 All field personnel will be given recognition training on the types of munitions known or suspected to be present prior to commencing any field activities. This phase (Phase 2) of the RI includes no intrusive activities, but in the event MEC is encountered, all personnel will be instructed to avoid any physical contact with the item or surrounding terrain, to record its location and associated sensor or imagery data, and provide this information to the USACE. For public safety reasons, the location of the MEC finds will not be included in survey reports. There is a possibility MC may also be present at the site, although there are currently no data available to make this determination and sampling for MC will not be performed until Phase 3 of the RI is performed. In certain concentrations and site conditions, MC may pose risks to human health or the environment.

1.9 INITIAL CONCEPTUAL SITE MODEL

1.9.01 A CSM is a description of a site and its environment that can be used to summarize potential sources and areas of contamination and pathways that may lead to possible exposures to human and environmental receptors. A CSM is also used to focus the design and plans for implementing the investigation of the potential source areas or areas where potential exposures may occur. The CSM is a “living document” based on existing knowledge and updated throughout the course of the project as more data become available.

1.9.02 An initial CSM was developed in relation to the MEC and MC in these two MRSs in accordance with Engineer Manual 1110-1-1200. One form of CSM is a flow chart that shows the potential MEC and MC contamination as well as the receptors that may come into contact with any potential contamination via various media and migration pathways. This flow chart form of CSM is presented in Figure 1-5. Given the site history presented above, the potential primary source of MEC and possibly the associated MC are the marine sediments on the floor of Flamenco Bay and in the Luis Pena Channel. MEC items may have been directly deposited in the Flamenco Bay sediments as the result of firing at floating targets, undershoots of the targets on the Northwest Peninsula, errant aerial dropping relative to the upland targets, or intentional cover fire or flares during beach landing training. To a lesser extent, some MEC may have been transported into Flamenco Bay by upland runoff and erosion. MEC in the Flamenco Bay sediments may have been subsequently transported and redistributed within the Bay by tidal forces, wave action, or localized currents. Sediment and any MEC items within it may also have been moved around by the mechanical activity of boats or beach maintenance equipment. The processes of sedimentation and scouring would be working to cover and uncover, respectively, items deposited on the surface of the sediment. These potential sources and transport processes are illustrated in the CSM presented in Figure 1-5. MEC items may also have been directly deposited in the Luis Pena Channel sediments as the result of overshoots of the targets on the Northwest Peninsula, errant aerial dropping relative to the upland targets, or firing at floating targets. Once again, some small amount of MEC may have been transported into the Luis Peña Channel by upland run-off and erosion. MEC deposited in the Luis Peña Channel sediments may have been transported locally by the same natural transport processes noted above. MEC items that were previously deposited in either MRS may have been subsequently covered over by more recent sediment deposits. Figure 1-5 also provides a preliminary indication of which exposure pathways to MEC and MC may be “complete” and warrant further assessment.

1.9.03 People may be exposed to any MEC or MC associated with items in the sediment as the result of recreational use of these waters through wading, swimming, snorkeling, fishing, diving, camping, and boating. Others may access or utilize these waters as part of the management or study of their coral and underwater ecological habitats or the plants and animal species of the shorelines. People’s exposures may be via direct contact with MEC items or MC in the sediments located in the shallow water or through contact with items by anchors or diving gear in somewhat deeper waters. Secondary exposure to MC in the surface water or that has been absorbed by biota is a possibility, but is unlikely to be significant from a human health or ecological perspective.

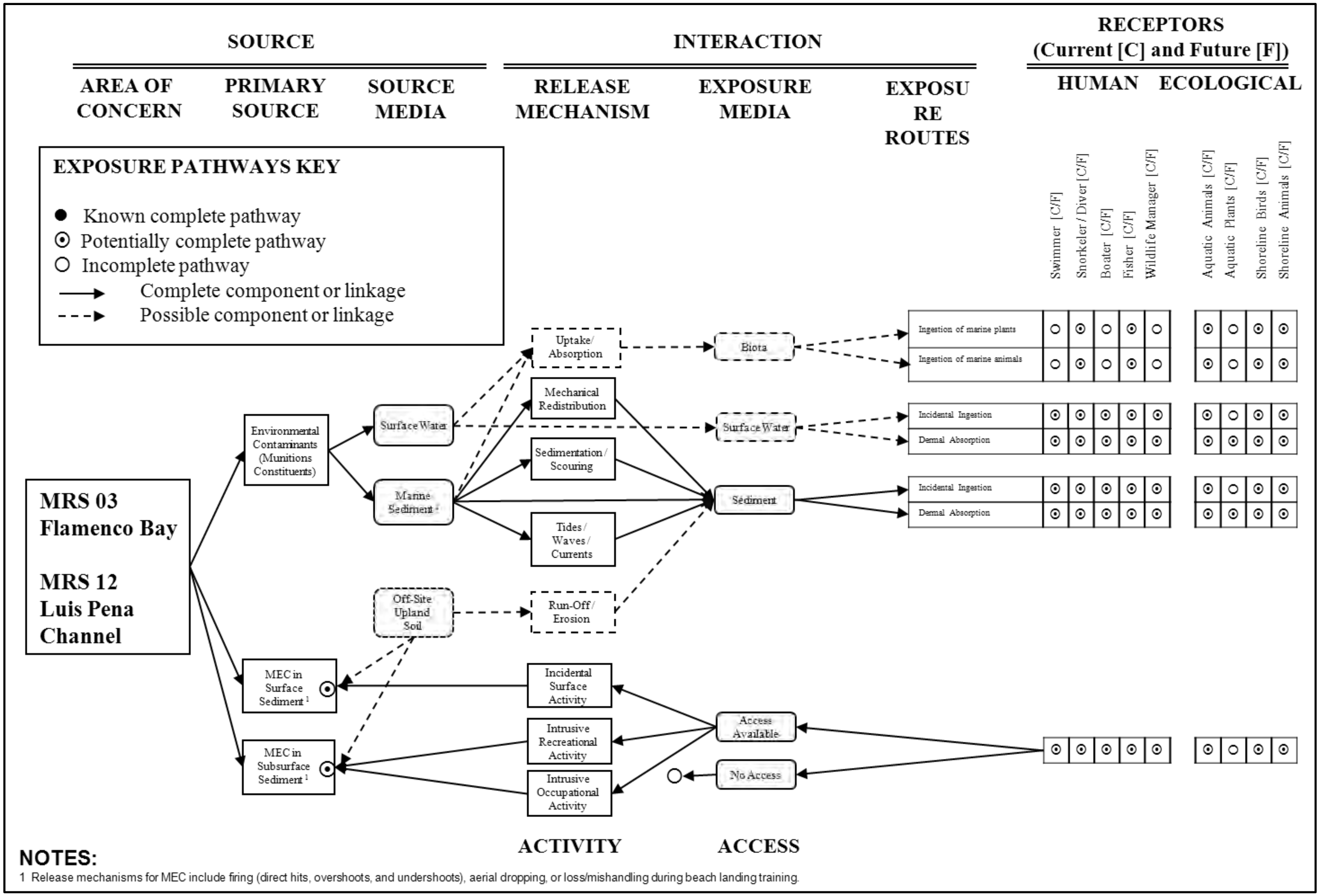


Figure 1-5. Preliminary Conceptual Site Model for Potential Exposure to MEC and MC at the Culebra Water Ranges MRS 03 and MRS 12

1.9.04 Based on this CSM, MEC may be present in the sediments of Flamenco Bay and the Luis Peña Channel. No specific locations are known at this time to be concentrated MEC source areas due to the lack of prior investigation. However, locations closest to the shorelines of the Northwest Peninsula where a large number of training targets were located are more likely to be where the MEC was originally deposited. In addition, the locations closest to the shorelines in both MRSs would typically be most accessible and provide the greatest opportunity for people to come into contact with any items that are present given the receptors listed on the CSM and the types of activities they would be expected to engage in. Accordingly, both MRSs were divided into subareas for the in-water surveys based on the depth of water. Three primary depth zones were defined for these MRSs using publicly available bathymetry (see Figures 1-6 and 1-7 for MRS 03 and MRS 12, respectively):

- Zone A Near Shore (mean low water [MLW] to MLW-10′) – This is the depth range in which wading, swimming, snorkeling, some fishing, some boating, and some wildlife management exposures are more likely to occur. In the sandy beach areas of Zone A, the 30 feet of marine environment nearest to the beach is specifically designated as Zone A′ given the even greater potential for human exposure and contact with possible MEC in this strip.
- Zone B Intermediate (MLW-10′ to -25′) – This is the depth range in which novice diving and less incidental fishing, boating, and wildlife management exposures are more likely to occur.
- Zone C Intermediate (> MLW-25′) – This is the depth range in which more experienced diving and more specialized fishing, boating, and wildlife management exposures are more likely to occur.

1.9.05 These preliminary CSMs are included with the TPP documentation in Appendix H of this Work Plan. The CSMs will be updated as new information is available and presented to the stakeholders during the TPP meetings in support of the RI/FS project. The TPP documentation is included in Appendix H. A separate Phase 2 data report will not be prepared. The Phase 2 survey data will be presented at the post-survey TPP meeting and within the Phase 3 Work Plan, and RI Report, as gridded EM data, anomaly density plots, and target lists. There is no separate Phase 2 data report in the project scope.

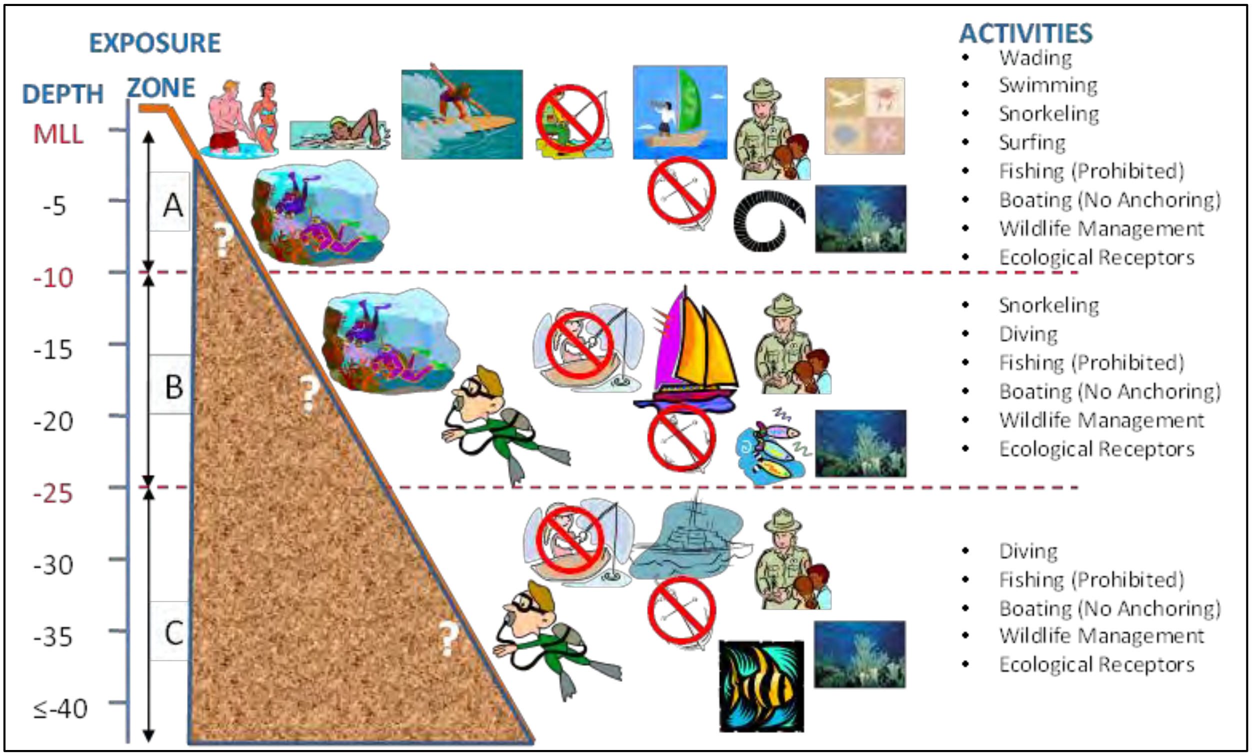


Figure 1-6. Potential Human and Ecological Receptors Culebra Water Ranges – MRS 03

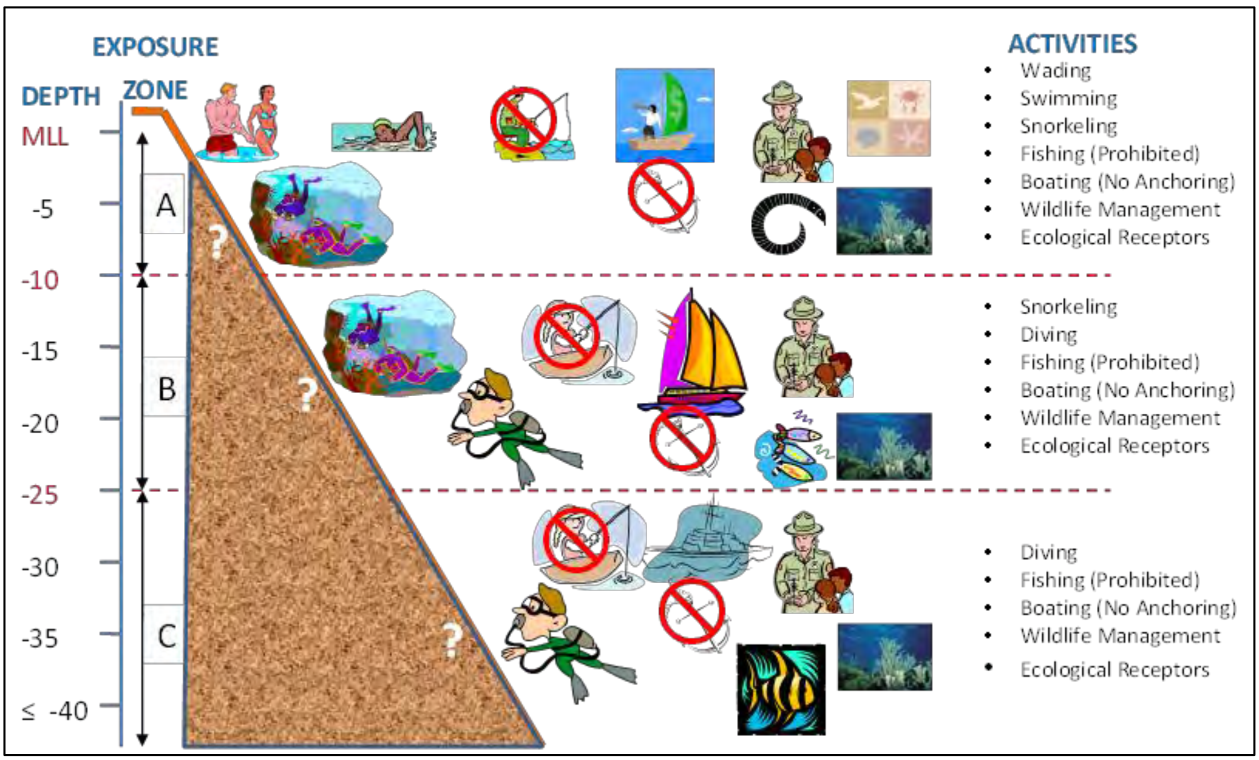


Figure 1-7. Potential Human and Ecological Receptors Culebra Water Ranges – MRS 12

2.0 TECHNICAL MANAGEMENT PLAN

2.1 INTRODUCTION

2.1.01 The purpose of the Technical Management Plan (TMP) is to provide the approach and procedures that will be used to execute the tasks required to meet the project objectives for Phase 2 of the RI. Field procedures for Phase 2 of the RI include non-intrusive marine geophysical surveys. The TMP focuses on project objectives, organization, personnel, communication and reporting, deliverables, schedule, billing, public relations, duties and responsibilities, as well as the functional relationship between the different organizations specific to Phase 2 of the RI. Additional and remaining elements of the TMP will be addressed in subsequent plans for Phase 3 of the RI.

2.2 OBJECTIVES

2.2.01 The objective of Phase 2 of the RI is to determine the location and distribution of metallic objects in the survey areas using a towed or floated DGM system within the boundaries of MRS 03 Flamenco Bay and MRS 12 Luis Peña Channel. To achieve this objective, a survey line plan that characterizes each MRS sufficiently to provide at least a 90 percent probability that areas of higher electromagnetic anomaly density that may contain MEC will be identified and located will be specified. In addition, survey line spacings that provide even greater coverage and a finer scale characterization of the potential presence of MEC will be used to account for the potential exposure footprints associated with the activities expected to be performed in Depth Zones B and A of the MRSs, as identified in Section 1.9.04 above. The resulting characterization from a survey plan that considers both of these objectives will be sufficient to ultimately meet the data needs for the RI (following Phase 3). The overall purpose of Phase 2 of the RI is to determine the likely distribution of MEC items within the study areas based on the observed distribution of the detected electromagnetic anomalies. The process of developing the DQOs for Phase 2, which were defined and then refined during the initial TPP meetings, has led to a number of general statements or specifications. These included:

- The presence of MEC, or indicators of MEC, is the key condition for future site management decision making and, as such, is the principal parameter of interest to be identified by the Phase 2 (and later Phase 3) survey investigation and data analysis;
- The quantity, density, and distribution of subsurface anomalies and surficial MEC should be estimated based on the results of a Phase 2 survey;
- This survey should be performed along a pattern of parallel transects with the survey line spacings selected to ensure at least a 90 percent probability of traversing and detecting a potential area of elevated total anomaly density of approximately 100 anomalies per acre (ApA);
- Closer survey line spacings should be employed in those portions of the MRSs where there is a greater potential for direct human exposure; and
- Anomaly locations will be mapped to 1-meter positional accuracy.

2.2.02 Phase 2 of the RI will be performed to determine the location and density of metallic objects in the MRSs using the towed or floated TEMA system. A survey line plan was developed that will provide the coverage needed to achieve the established DQOs and the specifications presented above to characterize the survey areas with regard to location and density of metallic objects. No intrusive investigation will be conducted during Phase 2 of the project. The TPP Team will develop and coordinate further investigations for Phase 3 of the RI based on the Phase 1 and 2 RI results.

2.2.03 Based on the CSMs presented above, both MRSs were divided into subareas for the in-water surveys based on the depth of water. As was noted, three depth zones were defined for purposes of this survey based on the potential for exposure and type of potential exposure to MEC:

- Zone A Near Shore (MLW to MLW-10′) (with the first 30 feet of water area in the sandy beach areas – Zone A′);
- Zone B Intermediate (MLW-10′ to MLW -25′); and
- Zone C Intermediate (> MLW-25′).

2.2.04 The Zone A (and Zone A′) portions of both MRSs require the highest level of survey coverage and detailed characterization information due to the higher probability that they contain MEC source areas and likely preferential exposure points. Zones B and C, respectively, would require relatively less coverage and detailed information in consideration of these two same factors. The bathymetric data from the Phase 1 EBS were then used to locate and calculate the fraction of the total MRS in each depth zone category.

2.2.05 Multiple types of surveys will be performed in these waters as part of Phase 2 of the RI. Because different survey devices/techniques have different effective swath widths, a certain survey transect spacing (assuming roughly parallel survey lines separated by a specified distance) will result in different coverage of the seabed for different surveys. As the EM survey has the narrowest survey line swath width, the transect design was based on ensuring sufficient EM coverage. In so doing, coverage for the other detectors will be more than sufficient for the RI. In addition, the Phase 1 EBS identified areas which will be inaccessible for the Phase 2 investigation survey. The lack of coverage in these areas was accounted for in the design of the Phase 2 survey relative to achieving the specified DQOs and/or overall specifications. The Phase 2 DQOs are listed in Table 2-1. The DQO Table adheres to the seven-step standard DQO nomenclature and content guidelines. The table initially presents DQOs pertaining to the overall Phase 2 Survey and, thereafter, presents activity-specific DQOs pertaining to:

- DGM Data Collection;
- Positioning Accuracy and Consistency;
- Potential Munitions Item Detectability; and
- Video and Photographic Data Collection.

Table 2-1. Project Data Quality Objectives (DQOs) for the Phase 2 Survey

Goals / Objectives	Step 1 State the Problem	Step 2 Identify the Decision	Step 3 Identify Inputs to the Decision	Step 4 Define the Study Boundaries	Step 5 Develop a Decision Rule	Step 6 Specify Tolerable Limits on Decision Errors	Step 7 Optimize the Design for Obtaining Data
Description	***Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem***	***To identify the decision that requires new environmental data to address the contamination problem***	***To identify the information that will be required to support the decision and specify which inputs require new environmental measurements***	***To define the spatial and temporal boundaries that the data must represent to support the decision***	***To develop a logical "if...then..." statement that defines the conditions that would cause the decision maker to choose among alternative actions***	***To specify the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data***	***To identify a resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs***
Overall Phase 2 Survey (DQO 1)							
1. The Phase 2 Digital Geophysical Mapping (DGM) Survey of the Offshore Areas of the Northwest Peninsula to Locate Potential Munitions and Explosives of Concern (MEC) within the Formerly Used Defense Site (FUDS) Boundaries	2. Past training activities involving the Northwest Peninsula of Culebra Island have resulted in expended munitions and unexploded ordnance being present in the offshore environment around the Peninsula in what has been designated MRS 03 (Flamenco Bay and the waters off the eastern side of the Northwest Peninsula) and MRS 12 (Luis Pena Channel and the waters off the western and southwestern side of the Northwest Peninsula). MEC have previously been recovered from these areas and there have been other reports that MEC is still present in these offshore areas. These MEC are likely to be present due to overshoots and undershoots relative to upland targets on the Northwest Peninsula. 3. The waters and seabed sediments of MRS 03 and MRS 12 contain sensitive ecological habitats in many locations within the MRS boundaries, including a number of protected coral species. In addition, recreational and occupational activities occur (e.g., wading, swimming, snorkeling, surfing, diving, boating [but no anchoring], and wildlife management) that could bring people into potential contact with MEC in the sediments at different water depths. The presence of MEC on the seabed or buried in the near-surface sediments would pose a direct contact risk to these people and ecological resources. 4. A collection of site managers, regulatory agencies, and natural resource trustees have come together to evaluate MRS 03 and MRS 12 to determine if MEC poses an unacceptable risk to the public or the environment. These include: the U.S. Army Corps of Engineers (Huntsville and Jacksonville); U.S. Environmental Protection Agency Region 2 (Puerto Rico and New York City); Puerto Rico Environmental Quality Board (PREQB); Puerto Rico Department of Natural and Environmental Resources (DNER); U.S. Fish and Wildlife Service (USFWS); the National Oceanic and Atmospheric Administration (NOAA) and the National Marine Fisheries Service (NMFS). 5. MRS 03 and MRS 12 are being investigated and evaluated through a Remedial Investigation/ Feasibility Study (RI/FS) in a manner consistent with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) under the Defense Environmental Restoration Program (DERP) and these areas have been designated FUDS.	6. Does the MEC contamination in MRS 03 or MRS 12 pose an unacceptable risk to human health and the environment (and, therefore, require further evaluation and/or a response action) or is no further action necessary?	7. The Archive Search Report (ASR) findings on the historical munitions-related activities that took place on the Northwest Peninsula 8. The data collected and results of the Engineering Evaluation / Cost Analysis (EE/CA) performed to the upland area of the Northwest Peninsula 9. The results of the Phase 1 Environmental Baseline Survey (EBS) performed for MRS 03 and MRS 12 (e.g., bottom types, locations of protected coral, locations of other obstacles on the seabed) 10. The density distribution of EM anomalies throughout MRS 03 and MRS 12 that could be potentially be MEC contamination 11. The nature of the MEC contamination present in MRS 03 and MRS 12 (i.e., munitions types (makes and models), whether they are an explosive hazard (i.e., material potentially presenting an explosive hazard (MPPEH)), their sensitivity to detonation if contacted) 12. The extent of the MEC contamination present in MRS 03 and MRS 12 (i.e., the spatial distribution of MEC within each MRS and the depth of the MEC contamination relative to the seabed) 13. The potential for the MEC contamination to migrate within the MRSs or to become buried in the sediment or alternately to be exposed from the sediment by natural forces 14. The location of the MEC contamination with respect to the sensitive environmental habitats and the protected corals 15. Anecdotal reports about the presence of MEC contamination from local residents or users of the waters within MRS 03 and MRS 12	16. Spatial – The lateral or horizontal extents of the investigation are the established FUDS boundaries for both MRS 03 and MRS 12 17. Spatial – The vertical depth of interest into the seabed for both MRS 03 and MRS 12 are the depths of practical intrusion into the sediment by the recreational and occupational activities identified for the conceptual site model (CSM) for potential exposures to MEC 18. Spatial – The MRSs have been divided up into 3 primary Depth Zones: Depth Zone A (<10-foot water depth); Depth Zone B (10 to 25-foot water depth); and Depth Zone C (>25-foot water depth) 19. Temporal – Information must be collected or compiled in time to support the analyses associated with the Phase 2 Survey phase of the RI, which is scheduled to be completed by April 2015. 20. Temporal – Survey data must be collected when the weather, wind, waves and tides allow for safe and protective sampling activities	See the Survey Component-Specific Decision Rules Below	See the Survey Component-Specific Tolerable Limits on Decision Errors Below	See the Survey Component-Specific Designs Below

Table 2-1. Project Data Quality Objectives (DQOs) for the Phase 2 Survey (continued)

Goals / Objectives	Step 1 State the Problem	Step 2 Identify the Decision	Step 3 Identify Inputs to the Decision	Step 4 Define the Study Boundaries	Step 5 Develop a Decision Rule	Step 6 Specify Tolerable Limits on Decision Errors	Step 7 Optimize the Design for Obtaining Data
Description	***Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem***	***To identify the decision that requires new environmental data to address the contamination problem***	***To identify the information that will be required to support the decision and specify which inputs require new environmental measurements***	***To define the spatial and temporal boundaries that the data must represent to support the decision***	***To develop a logical "if...then..." statement that defines the conditions that would cause the decision maker to choose among alternative actions***	***To specify the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data***	***To identify a resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs***
Survey Component: DGM Data Collection (DQO 2)							
1. Approach and Coverage of the MRSs with Respect to DGM Data Collection	2. MEC that is MPPEH may be present anywhere within MRS 03 or MRS 12 on or within the near-surface sediment of the seabed. 3. A DGM survey can be performed to characterize some portion of the MRSs to locate items that may be MPPEH. 4. There are limitations in the ability of electromagnetic (EM) detector systems to detect metallic objects within the sediment below the seabed (i.e., smaller items, are less to be detected if they are located deeper in the sediment). 5. EM detectors can locate metallic items on the seabed or within the sediment below the seabed to some depth within the footprint of the survey path (i.e., detector swath width and survey line length). 6. The DGM survey can report the locations and the strength of the anomalous electromagnetic response produced by these metallic objects which can be charted. 7. DGM information collected within the footprint of the survey path can also be used to interpolate the density of anomalies that may be MPPEH in the areas between the completed survey paths where DGM data was not collected. All performance metrics for DGM will be met.	8. How much of MRS 03 and MRS 12 must be DGM surveyed to collect the information needed to support the RI and allow a determination to be made as to whether the presence of MEC poses an unacceptable risk to human health or the environment?	9. The primary purpose of the DGM survey in the MRSs or a portion of an MRS: - Searching for a cluster of metallic items that may be MPPEH or an area with a higher density of anomalous DGM responses that could indicate the presence of MPPEH - Characterizing the density of items that may be MPPEH in an area of higher human exposure potential. Note: Survey coverage in the portions of MRSs that are in Depth Zone B were judged to need greater coverage (i.e., smaller transect spacings) than in Depth Zone C and the survey coverage in the portions of MRSs that are in Depth Zone A were judged to need greater coverage than in Depth Zone B due to the potentially smaller exposure footprints in going from Depth Zone B to Depth Zone A. Note: During the Phase 2 Survey, only the locations of potential MEC items (which would be flagged as an anomalous elevated EM response caused by metallic objects that may be MEC) would be documented as no intrusive investigation will be performed to identify the sources of the anomalies or to allow them to be classified as MEC or MPPEH.	10. Spatial – The lateral or horizontal boundaries within with the Phase 2 Survey is to be performed are the established FUDS boundaries for both MRS 03 and MRS 12. 11. Spatial – The MRSs have been divided up into 3 Depth Zones (i.e., Depth Zones A, B and C, as defined above based on the different potential for exposure to MEC with water depth associated with the recreational and occupational activities identified for the CSM for potential exposures. In addition, Depth Zone A was subsequently further divided into Depth Zone A' (i.e., the first 30 lateral or horizontal feet out from the MLW line) and the remainder of Depth Zone A (i.e., out to a water depth of 10'). 12. Spatial – The portions of the MRSs that can be accessed to survey will be constrained to those areas where the detector systems can be positioned without endangering the sensitive habitats and protected corals as defined by the Phase 1 EBS and the subsequent SOPs developed for Phase 2. 13. Temporal – The survey should be conducted when conditions within the MRSs (e.g., tides, waves, storm surge) minimize the potential damage to the sensitive habitats and protected corals.	14. If the area within MRS 03 or MRS 12 is within Depth Zone A/A', B or C, then the survey should be designed to locate a cluster of metallic items that may be MPPEH or an area with a higher density of anomalous DGM readings that could indicate the presence of MPPEH with defined characteristics and a suitably high level of confidence. 15. If the area within MRS 03 or MRS 12 is within Depth Zone A/A′ or B, then the survey should be designed to have greater coverage (i.e., smaller survey line spacings). 16. If the TEMA-MK3 detector platform is being used, then DGM data will be collected only if the system can be kept 10m laterally away from and 3m above coral reefs and slope areas. Otherwise no DGM data will be collected at that location. 17. If the TEMA-Lite detector platform is being used, then DGM data will be collected only if the system can be kept 2 meters laterally away from exposed reef and 0.15 meter (6 inches) above submerged coral reefs and slope areas with less than 2m of overlying water). Otherwise, no DGM data will be collected at that location. 18. If the results for the survey lines on the outer boundaries of the MRS in Depth Zone C show anomaly densities 3x higher than the local background level (indicating the potential for MEC to be present outside of the current MRS/FUDS boundary), then the extension of the survey beyond the MRS boundary using the same Depth Zone C survey design will be discussed with the U.S. Army Corps of Engineers and the Project Delivery Team.	19. At minimum, the survey design for all portions of the MRSs should be able to traverse and detect a cluster of metallic items that may be MPPEH or an area with a higher density of anomalous EM readings that is circular with a radius of 400 feet and has a characteristic density of 90 anomalies per acre (ApA) over a background anomaly density of 10 ApA with at least 90% probability. 20. Due to the increased potential for exposure in the portions of the MRSs with shallower water, the survey lines in Depth Zone B should be spaced to have a minimum coverage of 10% of the total Depth Zone, the survey lines in Depth Zone A (that are not in A') should be spaced to have a minimum coverage of 25% of the total Depth Zone, and the survey lines in Depth Zone A' should be spaced to have a minimum coverage of 100%.	21. Use the Visual Sample Plan (VSP) with the inputs identified in Sections 2.2.06 through 2.2.014 of the Work Plan, which leads to the following separations between survey lines: (1) for Depth Zone B, the required separation between survey lines for a detector swath width of 3 meters and a required coverage of 10% is 100 feet (a geometrical calculation); (2) for Depth Zone A (that is, not A′), the required separation between survey lines for a detector swath width of 3 meters and a required coverage of 25% is 30 feet (a geometrical calculation); and (3) for Depth Zone A′, the required separation between survey lines for a detector swath width of 3 meters and a required coverage of effectively 100% is 10 feet (a geometrical calculation). 22. Check the validity of the identified survey design assumptions using the data collected during the Phase 2 Survey. If significant differences are identified between the pre-Phase 2 Survey–assumed parameters and those actually measured, assess the implications of the differences on the likelihood that the survey achieved the Phase 2 DQOs. If it is indicated that a DQO was not met, discuss the situation with the U.S. Army Corps of Engineers and the Project Delivery Team to identify possible corrective action during Phase 3.

Table 2-1. Project Data Quality Objectives (DQOs) for the Phase 2 Survey (continued)

Goals / Objectives	Step 1 State the Problem	Step 2 Identify the Decision	Step 3 Identify Inputs to the Decision	Step 4 Define the Study Boundaries	Step 5 Develop a Decision Rule	Step 6 Specify Tolerable Limits on Decision Errors	Step 7 Optimize the Design for Obtaining Data
Description	*Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem*	*To identify the decision that requires new environmental data to address the contamination problem*	*To identify the information that will be required to support the decision and specify which inputs require new environmental measurements*	*To define the spatial and temporal boundaries that the data must represent to support the decision*	*To develop a logical "if...then..." statement that defines the conditions that would cause the decision maker to choose among alternative actions*	*To specify the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data*	*To identify a resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs*
							23. Geo-reference the TEMA data using real-time kinematic (RTK) level GPS and, when the towfish is submerged, an ultra-short baseline (USBL) acoustic positioning system. During DGM, navigate the vessels to the line plan utilizing HYPACK (a navigation software package that shows the vessel position relative to the planned line in real-time and displays a left-right indicator that shows how close the vessel is following the planned line) and display the towed TEMA-MK3's position, as tracked by the USBL, in real time behind the survey vessel (see also Work Plan Section 2.11.3).
Survey Component: Positioning Accuracy and Consistency (DQO 3)							
1. Documentation of the Locations Surveyed and the Anomalies Detected within the Surveyed Areas	2. The boundaries and the locations surveyed internal to the MRSs during the Phase 2 Survey must be documented for the RI Report and the Administrative Record. 3. The locations of the transect lines that were surveyed during the Phase 2 Survey and the locations of the anomalies that were detected along those survey lines must be identified with sufficient accuracy to allow defensible geospatial analysis of the anomaly densities and distributions within each MRS and Depth Zone. 4. The locations of the anomalies detected along the Phase 2 Survey lines must be identified with sufficient accuracy to also allow those anomalies to be reliably reacquired during the Phase 3 Intrusive Investigation, if required.	5. How accurately must the survey lines and the detected anomalies be documented?	6. While the required accuracy of legal boundaries in offshore environments has not been standardized, 1-meter accuracy is the current best practice. 7. When a diver is re-acquiring an anomaly for intrusive investigation and classification, they are typically required to search an area within a 1-meter radius of the specified location and not find the source of an anomaly before they classify that target as a "no find." 8. Sub-meter accuracy on documenting the position of detected anomalies effectively minimizes delays and costs in re-acquiring the anomalies for intrusive investigation.	9. Spatial – Same as for the DGM Data Collection survey component above.	10. If the MRS and Depth Zone boundaries, survey lines, and detected anomalies can be identified to within 1m accuracy within the offshore environment, then the positioning will be acceptable for the purposes of the RI and the Administrative Record. 11. If lateral deviations from the planned survey lines become too large and/or persist for too long a period of time, then that length of the survey line will be re-surveyed until the limitations on the deviations are not exceeded.	12. 1m accuracy for point locations 13. Maximum allowable lateral deviations from the planned survey lines: - Depth Zones C and B: No more than 5m for more than 500 feet traversed (approximately 1 minute at maximum detector platform speed) - Depth Zone A (that is not A'): No more than 1m for more than 25 feet traversed - Depth Zone A': No more than 0.5m for more than 10 feet traversed	14. Use of a Real Time Kinematic (RTK) satellite-based Global Positioning System (GPS) in combination with a Global Acoustic Positioning System (GAPS) will provide sub-meter accuracy for these locations.

Table 2-1. Project Data Quality Objectives (DQOs) for the Phase 2 Survey (continued)

Goals / Objectives	Step 1 State the Problem	Step 2 Identify the Decision	Step 3 Identify Inputs to the Decision	Step 4 Define the Study Boundaries	Step 5 Develop a Decision Rule	Step 6 Specify Tolerable Limits on Decision Errors	Step 7 Optimize the Design for Obtaining Data
Description	***Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem***	***To identify the decision that requires new environmental data to address the contamination problem***	***To identify the information that will be required to support the decision and specify which inputs require new environmental measurements***	***To define the spatial and temporal boundaries that the data must represent to support the decision***	***To develop a logical "if...then..." statement that defines the conditions that would cause the decision maker to choose among alternative actions***	***To specify the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data***	***To identify a resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs***
Survey Component: Potential Munitions Item Detectability (DQO 4)							
1. Detectability Requirements for Different Potential Munitions Types in Different Survey Situations	2. EM detectors can locate metallic items on the seabed or within the near-surface sediment below the seabed to some depth within the footprint of the survey path (i.e., as defined by the detector swath width and survey line length). 3. Item detectability is strongly influenced by the distance between the object (on the seabed or in the sediment below the seabed) and the detector coils. Smaller items can be detected when this separation distance in smaller, but only larger items can be detected as this separation distance becomes greater. 4. A "detection" is typically associated with the case when the response produced by the detection system at the location of a possible item is noticeably greater than the response produced fairly uniformly by the "background" conditions when metallic items of potential interest are known to not be present. 5. EM systems are limited in their ability to detect metallic objects within the sediment below the seabed (i.e., smaller items are less likely to be detected if they are located deeper in the sediment). 6. The detector system must be kept at a suitable distance above the seabed at locations within sensitive ecological habitats or where there are protected coral. In areas without coral or sensitive habitat features, the detector system can be brought close to the seabed and smaller items may be detected at deeper depths within the sediment. In areas with coral or sensitive habitat features, the detector system must be raised up farther from the seabed and only larger items may be detected in the shallower sediment. 7. Use of a higher power EM coil detection system will allow smaller items to be detected at a given depth in the sediment.	8. What types of the set of potentially present munitions need to be detected and at what depths in the sediment?	9. The munitions types potentially associated with these MRSs include: 20mm high explosive (HE) incendiary devices, Mk76 practice bombs, Mk50s, 37mm projectiles, 5-inch rockets, 76mm projectiles, 3- to 6-inch Navy projectiles, and 81mm mortars. 10. The munition type with the least metallic mass are probably the 20mm projectiles and the munition type with the most metallic mass are probably the 6-inch naval projectiles. 11. High power EM coils can detect a given item 45% to 80% farther away than standard EM coils. 12. The largest munitions types associated with the site (i.e., the large artillery and rockets) are likely to be detected at depths up to 2 feet below the seabed if the detector coils are maintained at an altitude less than 2 meters above the seabed. 13. The smallest munitions types associated with the site (i.e., the 20 mm projectiles) are likely to be detected at depths from 1 to 1.5 feet below the seabed only if the detector coils are maintained at an altitude less than 0.5m above the seabed. 14. The munitions types with sizes/masses in between these two extremes are likely to be detected at depths from 1.5 to 2.5 feet below the seabed if the detector coils are maintained at an altitude less than 1.5 meters above the seabed and possibly detected if the detector coils are maintained at an altitude of 2 meters above the seabed. 15. Measurements of the detector system altitude collected concurrently with the EM response, position, and time so that the variability in the system's ability to detect the smaller munitions types associated with the site can be identified, mapped, and explicitly considered.	16. Spatial – The vertical depth of interest into the seabed for both MRS 03 and MRS 12 are the depths of probable intrusion into the sediment by individuals participating in the recreational and occupational activities identified for the CSM for potential exposures to MEC. 17. Spatial – The detector systems should be positioned as close to the seabed as possible provided the sensitive ecological habitats and protected coral are not disturbed.	18. If there are no sensitive ecological features or protected coral in the area, then the detector system should be kept as close to the seabed as practical. 19. If there are sensitive ecological features or protected coral in the area, then the detector system should be kept as close to the seabed as practical while maintaining the established setback distances. 20. If the detector coils are maintained at an altitude less than 2 meters above the seabed, then the larger projectile munitions types associated with the site will likely be detected. Otherwise, they may not be detected at these locations and these locations will contribute to a false negative rate for the system and survey relative to the larger items. 21. If the detector coils are maintained at an altitude less than 2 meters above the seabed, then the smaller projectile munitions types associated with the site will probably not be detected if those items are not on the seabed or buried just below the seabed. These locations will contribute to a false negative rate for the system and survey for these smaller items (which would be greater than for the larger items). 22. If the detector coils are not maintained at an altitude less than 2 meters above the seabed in an "accessible" area (consistent with the approved SOPs), then that area will be re-surveyed.	23. The largest munitions types associated with the site must be detected with a relatively high likelihood nearly all of the time during the Phase 2 Survey. 24. The smallest munitions types associated with the site must be detected as often as possible and practical during the Phase 2 Survey.	25. Utilize the detector systems with the high power EM coils. 26. Ensure that at least 90% of the time during the Phase 2 Survey the detector system will be maintained at an altitude at or below 2m (excluding areas that are not accessible for physical or ecological reasons). 27. Re-collect EM data such that at least 90% of the time during the Phase 2 Survey the detector system will be maintained at an altitude at or below 2 meters (excluding areas that are not accessible for physical or ecological reasons). See Table 4-2 for measurement quality metrics pertaining to EM data collection completeness.

Table 2-1. Project Data Quality Objectives (DQOs) for the Phase 2 Survey (continued)

Goals / Objectives	**Step 1** **State the Problem**	**Step 2** **Identify the Decision**	**Step 3** **Identify Inputs to the Decision**	**Step 4** **Define the Study Boundaries**	**Step 5** **Develop a Decision Rule**	**Step 6** **Specify Tolerable Limits on Decision Errors**	**Step 7** **Optimize the Design for Obtaining Data**
Description	***Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem***	***To identify the decision that requires new environmental data to address the contamination problem***	***To identify the information that will be required to support the decision and specify which inputs require new environmental measurements***	***To define the spatial and temporal boundaries that the data must represent to support the decision***	***To develop a logical "if...then..." statement that defines the conditions that would cause the decision maker to choose among alternative actions***	***To specify the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data***	***To identify a resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs***
Survey Component: Video and Photographic Data Collection (DQO 5)							
1. Video and Still Photography Collected During the Phase 2 Survey	2. Video and still photography will be collected during the Phase 2 Survey to be used to provide additional context on the conditions present along the survey lines and to help identify items (munitions or otherwise) that are present on the seabed. 3. To be most useful for these purposes, the video and still photographs need to be of the highest quality possible, clear, and well lit. 4. The video and still photographs to be taken during the Phase 2 Survey will be collected using cameras mounted to the detector platform and will be potentially subject to motion blur. Note: Additional video and photographic data will be collected during the Phase 3 effort using a remotely operated vehicle (ROV) or divers which would effectively eliminate most motion blur problems. 5. Natural light may be limited at the seabed at water depths associated with Depth Zone C. 6. Currents and other natural forces or the motion of the detector platform may cause local disturbances that could increase the turbidity and reduce the visibility captured in the video or still photographs at that location. 7. The images collected during the survey must be able to be monitored remotely in real-time so that adjustments may be made, if warranted. (Surface floated TEMA-Lite excepted. Video will be reviewed each day for the TEMA-Lite)	8. How should video and still photographs be taken during the Phase 2 Survey to maximize their utility in collecting information for the RI and for planning the Phase 3 Intrusive Investigation?	9. Video or Still Photography – The resolution/ definition of each image collected in terms of pixel density 10. Video or Still Photography – The amount of light present relative to the amount needed for a well-lit image 11. Video or Still Photography – The detector platform speed at which motion blur will degrade the image 12. Video – The number of frames per second collected	13. Spatial – Typically within 0.5 to 2 meters of the seabed along the survey lines in all three Depth Zones.	14. If video or still photographic images are discovered to be degraded by real-time monitoring, then a real-time assessment must be made to determine whether adjustments in the survey parameters can be made that would improve the images and not jeopardize the quality of the DGM data being collected.	15. Since additional, possibly higher quality images, will be collected during the Phase 3 effort, obtaining very high quality video or still photograph images during the Phase 2 Survey is not required in all cases. 16. Good quality imagery should be collected in situations where there is potential MPPEH or a potentially significant historical or cultural artifact present on the seabed. 17. TEMA Video Acquisition Daily Start-up QC Checklist must be followed.	18. Underwater Camera on the TEMA MK3: - Maximum platform forward speed = 4 knots - Maximum platform turning/repositioning speed 22.5 degrees/second - Self-supplied light source up to 100,000 lumens (10,000 lumens minimum) - Video – High Definition video with 1080 horizontal lines of vertical resolution - Video – 24 frames per second - Still Photographs – At least 2 megapixels per image 19. Underwater Camera on the TEMA-Lite (i.e., GoPro): - Maximum platform forward speed = 4 knots - Maximum platform turning/repositioning speed 22.5 degrees/second - Self-supplied light source NA for surface tow - Video - High Definition video with 1080 horizontal lines of vertical resolution - Video - 24 frames per second - Still Photographs – At least 2 megapixels per image

2.2.06 Calculations were performed to identify survey line spacings that would be effective in traversing and detecting a possible undiscovered offshore area of high anomaly density that could contain MEC that was released by the historical training activities and altered in characteristics by the natural forces at work in the waters of these MRSs. This design evaluation was performed using the Visual Sample Plan (VSP) software (Version 7). VSP has been used for transect spacing design for many years for upland ranges and MRSs. However, the VSP software also has been applied by its developers (Pacific Northwest National Laboratory [PNNL]) to design survey spacings for underwater sites. One example that was very similar in its objective was the transect design for the wide area assessment investigation in the waters of Lake Erie for the Former Erie Army Depot and Toussaint River Site. PNNL (2014) states that the transect design tools in VSP provide a statistically defensible method for specifying the required number and location of transect surveys that cover a small proportion of a total study area (i.e., 1 to 3 percent) to identify target areas of an anticipated size, shape, and magnetic anomaly density. Once surveys are conducted, high density area flagging routines are applied, and anomaly density estimates are derived to separate potential target areas from areas that may require no further remediation. The former Erie Army Depot was used for almost a half century (i.e., from 1918 to 1966) by the Department of the Army for testing and proof-firing of artillery and as an ordnance storage and issue center. Munitions fired from the on-shore firing line would generally land in Lake Erie. PNNL was tasked to develop a transect survey design that would use an underwater towed-array system to detect magnetic anomalies along the floor of a water body. The transect survey design for this site was developed with the aid of the VSP software. For this application, PNNL used VSP's transect design, anomaly flagging, target-area delineation, and spatial anomaly density estimation and mapping modules (ESTCP 2007). PNNL also used VSP in an analysis of the Blossom Point Marine Transect Survey (ESTCP 2008).

2.2.07 To identify the spacing needed between survey transects to achieve a specified probability of traversing and detecting potential target areas of concern for the former Erie Army Depot, PNNL specified several operational parameters, including:

- width of the survey transect;
- transect pattern on the site;
- the size and shape of any target area that should be detected;
- density and distribution of anomalies in the target area;
- density of background anomalies at the site; and
- the instrument false negative rate.

2.2.08 After the parameters were entered by PNNL, a transect spacing was computed by VSP. VSP can be used to identify the spacing needed between transects to achieve a specified probability of traversing and detecting an area with defined characteristics in an underwater environment. However, the key challenge is then specifying the characteristics of the area in the marine environment being sought and the associated VSP input parameters.

2.2.09 The Phase 2 DQOs specify the requirements of the Phase 2 Survey relative to determining a transect spacing for Depth Zone C. The following Figures 2-1, 2-2, and 2-3 show the VSP input screens used to enter the parameters needed to calculate a transect spacing to locate a "target" area or area of localized high anomaly density. First, it should be noted that "target" is the term used generally by VSP for the area of high anomaly density being looked for in a search. The high anomaly density areas that are one of the primary focuses of the Phase 2 surveys being performed in MRS 03 and MRS 12 were not "targets" in the sense of locations that were aimed at during repeated and prolonged firing or bombing. Rather, the MRS 03 and MRS 12 areas were originally safety fans or buffer areas associated with short-shot/long-shots relative to the actual "targets" that were on the land. Subsequent to the active firing period, items in the water have likely moved and may have re-concentrated in depressions or low spots in the seabed or along cliffs or reefs edges.

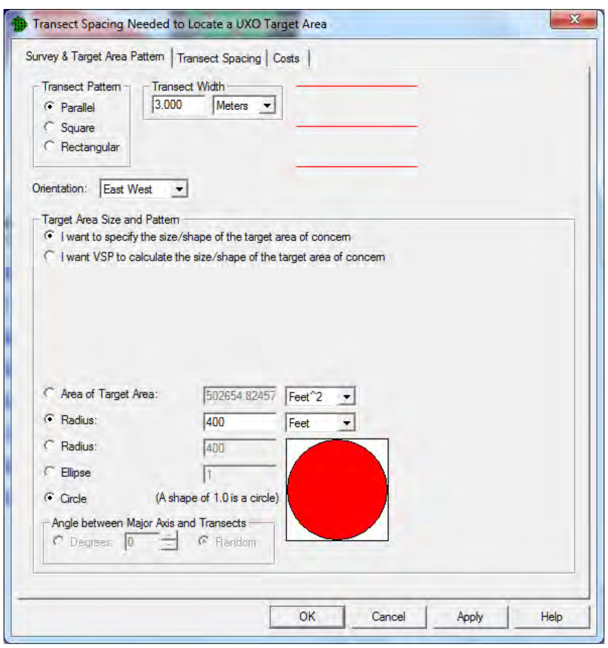


Figure 2-1. VSP Input Screen 1

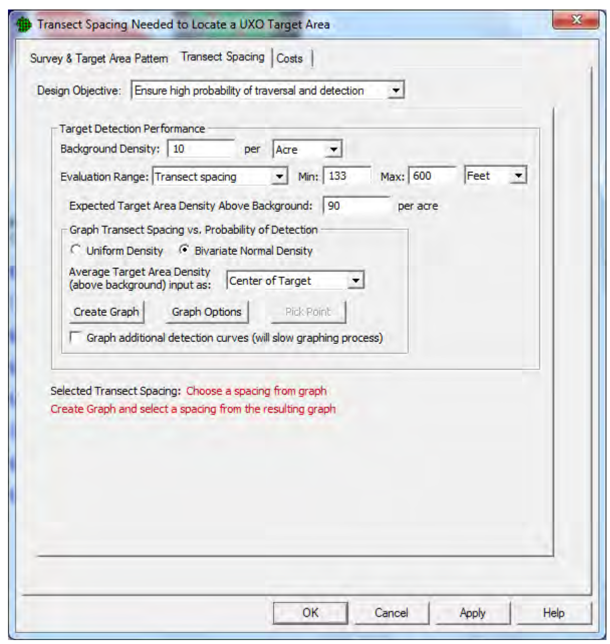


Figure 2-2. VSP Input Screen 2

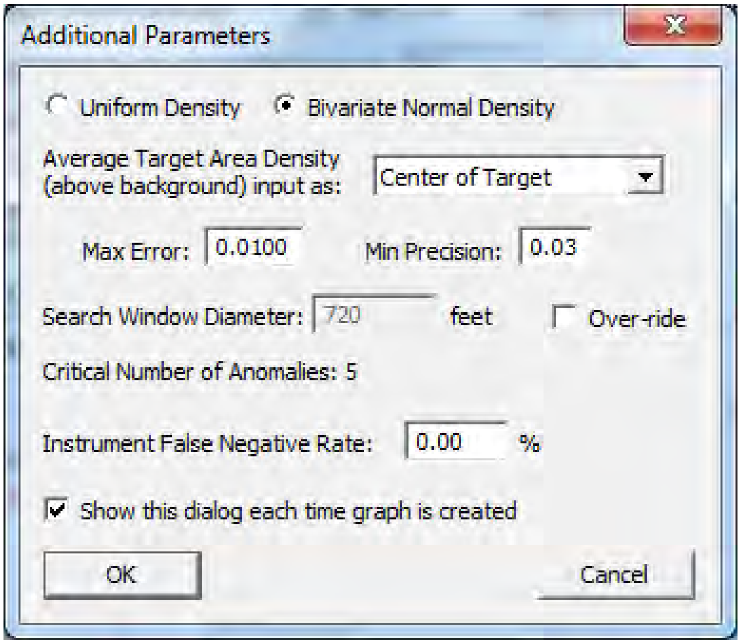


Figure 2-3. VSP Input Screen 3

2.2.010 Each required VSP input for this type of transect spacing design is discussed below in order of their appearance in the VSP input screens.

2.2.011 Screen 1 (refer to Figure 2-1):

- Transect Pattern – A pattern of parallel survey lines was chosen. This pattern is the most operationally simple and practical pattern to apply in an offshore environment where the survey lines must be performed with boats or floating platforms with somewhat less directional mobility than systems on land. It is noted that in actual application, the straight parallel survey lines sometimes will be laid out as parallel wavy lines to allow them to follow shorelines or other distinctive non-rectangular features.
- Transect Width – A 3-meter transect width corresponding to the width of the multi-coil detector array on either the TEMA-MK3 or the TEMA-Lite was assumed for the design. A 3-meter detector width was proposed and was specified for the VSP design because it generates more DGM data and allows a better evaluation of any particular anomaly than a narrower detector. For example, a 3-meter detector array produces three times more data per transect length than a 1-meter-wide detector array, has a somewhat greater detection capability due to the additive effect of multiple transmitters, is associated with more precise horizontal (x,y) positional information, and provides a fallback should one of the units in the array develop a technical problem. It also is the case that, all other VSP transect spacing design inputs being the same, a wider detector array leads to a wider transect spacing than a narrower detector array for the same required confidence level of traversal and detection. The baseline transect spacing calculated by VSP for a 3-meter

detector array to achieve a 90 percent probability of traversal and detection (i.e., approximately 350 feet – see Figure 2-4 in paragraph 2.2.014) is reduced to approximately 125 feet if the detector array is changed to 1 meter with all the same other inputs. As such, a wider detector array is advantageous from a number of perspectives.

- Orientation – This input does not matter in this case because VSP is not being used to plot the resulting transects on a site map within VSP that is oriented within a particular reference system. In addition, the assumed shape of the "target" area for the search is a circle. As such the orientation of the survey transects relative to the "targets" does not affect the probability of traversal or detection (see below).
- Target Area Size and Pattern:
  - Specification Option – Since the second option ("I want VSP to calculate the size/shape of the target area of concern") is only applicable to certain surface launched/fired or air launched/fired munitions types in relation to land-based targets, the first option was selected ("I want to specify the size/shape of the target area of concern").
  - Size/Shape of Target – Various factors could influence the specification of the size and shape of this area for MRS 03 and MRS 12. The selections considered what a high density area of concern associated with the historic munitions use might look like on land (e.g., on the Northwest Peninsula of Culebra), what the outer portions of the safety fan or buffer area associated with this upland area might look like, and then considered what changes to the size and density may have occurred because of the passage of time in the marine environment (e.g., as the result of damping, deflection, dispersion, and migration by natural forces, the rates of which will be dependent on benthic habitat type [e.g., sand versus coral]). These changes are likely to have resulted in a reduction of the possible size of a localized high anomaly density area. A circular shape is the most conservative choice for this VSP input parameter if the circle diameter is equated to the shorter axis of a potential oval target area (as was done for this design). The limited available information was used to estimate the radius of a circle or the shorter dimension of a potential oval target. Accordingly, the design does not assume that the orientation of a possible oval target area is known a priori such that the survey transects could or would be fortuitously oriented in every instance so as to intercept them on the broadside. As such, an assumption of a circular area in this manner leads to the narrowest (i.e., most conservative) survey line spacing. The results of the Phase 1 EBS video survey identified locations where MEC might be located and the areas where groups of multiple items that could be MEC were observed. These areas were on the order of 800 to 1,000 feet in characteristic dimension. As there has been no prior DGM survey in these MRSs and the locations highlighted by the Phase 1 EBS video survey were not further

intrusively investigated to date, little more can be inferred from the currently available information. The natural forces that could move munitions that are deposited in the water around are location-specific and affected by the physical features and hydraulic patterns of each location, and thus there are no established "typical" target sizes for marine environments. The 400-foot radius assumed for the VSP design is consistent with the information currently available. Accordingly, a radius of 400 feet was chosen to apply for the transect design.

2.2.012 Screen 2 (refer to Figure 2-2):

- Design Objective – Consistent with the form of the Phase 2 DQO established for the MRSs, the selection was to "Ensure a high probability of traversal and detection" of the high density area.
- Target Detection Performance:
  - Background (Anomaly) Density – No prior site-specific anomaly density information for the marine environment is available for these two MRSs. As such, other information was considered in the specification of this parameter for the VSP transect spacing design. An EE/CA was performed in 1997 for the southern portion of the Northwest Peninsula of Culebra and a number of grids were surveyed and anomaly densities were calculated. Grids FB-1 through FB-4, FB-6 and FB-10 were considered background locations on land. The average ApA for these grids was 10.6. It was anticipated that the marine environment would have a background anomaly density that was comparable or less than this value. Because the Phase 1 Pre-Survey was not performed in any area outside the MRS boundaries, the DGM survey equipment cannot be deployed in an area where there is not confidence that the survey would not damage any sensitive coral or where physical obstructions could damage or destroy the survey equipment. As such, an evaluation of the DGM data collected within all parts of the two MRSs is planned in the form of a spatial analysis of the Phase 2 survey data. This analysis is expected to show that much of the area "around the edges" of each MRS has lower anomaly densities than the other portions of the MRSs and that these anomaly densities could be interpreted as "background." The detection probability is lower when the background anomaly density is higher (i.e., more like the density in the "high density areas" being searched for), so a marine background value of 10 ApA was assumed. The same spatial analysis of the collected Phase 2 DGM survey data will be used to evaluate whether this assumption and a number of the other assumed VSP input parameters were accurate or representative of the actual observed site conditions.
  - Expected Target Area Density Above Background – The 1997 EE/CA also surveyed a number of upland grids in the target areas of the southern portion of the Northern Peninsula. The average anomaly density in these target locations on land was 763

ApA, and the range was 122 ApA to 1,725 ApA. MRSs 03 and 12 were originally the marine portions of the safety fans associated with these targets (most likely the leading edge of the undershoot area [MRS 03] or the overshoot area [MRS 12]). As the lowest upland grid had an anomaly density of 122 ApA, the undershoot area in the water that was a distance farther from the targets themselves would be expected to have a lower density. In addition, the energetic marine environment also would be expected to have dispersed the items that would cause the anomalies. As such, a total expected target anomaly density of 100 ApA was assumed, which made the expected target area density above background 90 ApA.

- Evaluation Range for the Transect Spacing – This range of transect spacings was explored in iterative fashion by performing a sensitivity analysis of the VSP results for different input parameter combinations reflecting the ranges of uncertainty or variability associated with each input parameter given the information currently available. The goal was to identify the range of spacings that would result in a probability of traversal and detection that met the DQO. This sensitivity analysis included exploring the effect of higher and lower anomaly densities in the "high density areas" than the baseline value assumed, higher and lower background anomaly densities compared to the baseline value assumed, assuming a bivariate normal anomaly distribution vs. a uniform anomaly distribution within the high density areas, and whether the elevated anomaly density estimated for the "high density areas" applied to the center or edge of the assumed bivariate distribution. The results of these runs were examined in terms of the transect spacing that would provide at least 90 percent confidence of traversing and detecting a high anomaly density area with the specified characteristics (as per the DQO). The noted Evaluation Range covered the vast majority of these cases and indicated parallel survey line spacings in the general range of 150 to 450 feet were associated with meeting the DQO.

- Grid Transect Spacing vs. Probability of Detection:
  - High Density Area of Concern Anomaly Distribution – The distribution of the "high density area" being searched for was assumed to be bivariate normal. This is the default selection for VSP. While little is known about the actual density distribution for possible anomaly clusters in the marine environment in these MRSs, this selection was made to be more conservative (i.e., leading to a narrower rather than a wider transect spacing) than selection the alternative of a uniform density distribution would typically be. This distribution may better reflect a situation where items may have migrated and re-clustered around a local depression or seabed obstruction. All other things being equal, assuming that the outer edges of a possible high density area have a higher anomaly density (as is typically the case with the uniform density

assumption) generally increases the probability of detection considerably at the outer edges, leading to wider transect spacings for the same DQO probability of traversal and detection with all other VSP inputs being the same. [NOTE: See the discussion of the next input parameter as well as there are connections between the two parameters.]

- Average Target Area Density (above background) – The input value of 90 ApA was specified to be applied as the maximum value of the bivariate normal distribution (i.e., at the peak) over and above the specified background anomaly density. VSP calls this part of the distribution the "Center of Target" anomaly density. Assuming a bivariate normal distribution with the co-specification that the anomaly density was the density at the center (or peak) of the distribution (and not the target average or the density at the outer edge of the distribution where anomaly densities would be the relatively lowest) is an example of two VSP inputs that must be linked and be self-consistent with the site's CSM. Each of the other two possible choices for where VSP applies the input anomaly density would have generally implied a higher anomaly density at the edge of the distribution and a greater probability of detecting the "high density area" than the application of this numerical density value to the center of the distribution. As such, the assumption of a bivariate normal distribution with the specified anomaly density applied at the center of the distribution is believed to be the conservative approach. Because there has been no prior DGM survey work in these MRSs and the natural forces that have caused the current distribution of anomaly-created objects are expected to be very location specific, the actual current distribution of anomalies within the MRSs cannot be known or estimated with much certainty. The spatial analysis of the collected Phase 2 DGM survey data will ultimately show what the distribution is. Even given this uncertainty, the selection of a bivariate normal distribution with the specified elevated anomaly density applied at the center of the distribution would not be expected to artificially inflate the probability of detection at the edges of the high density areas or artificially widen the transect spacing for the design.

2.2.013 Screen 3 (refer to Figure 2-3):

- Additional Parameters:
  - Maximum Error – The maximum error does not affect the magnitude of the transect spacing produced by VSP, only the time it takes VSP to calculate that spacing. Increasing and decreasing the maximum error has a small, but noticeable effect on the run-time of the VSP module (with smaller maximum errors requiring longer runs to achieve that threshold). This parameter was left at the default value of 0.01. The PNNL instructors at the VSP training courses recommend that this parameter be left

at the default because that value was established to optimize VSP's Monte Carlo simulation iteration performance over a wide range of scenarios.

- Minimum Precision – The minimum precision also is a parameter that primarily affects the simulation calculations. This parameter was left at the default value of 0.03. The PNNL developers also recommend that this parameter be left at the default because that value was established to optimize VSP's Monte Carlo simulation iteration performance over a wide range of scenarios. Changing this parameter does not change the average value of transect spacing produced by VSP over a number of runs with the same inputs, but a larger minimum precision threshold would lead to a somewhat greater variability in the transect spacing results for a set of repeated runs using the same VSP input parameters. The VSP developers have set these defaults in consideration of countless applications of the tool to provide a good balance of model calculation speed and transect spacing reproducibility with managed output variability. The VSP transect spacing cited and used in the design was associated with the central value or average of repeated runs with the same inputs.
- Search Window Diameter – This parameter refers to the diameter of the circular search window used during simulations to identify areas in which density is greater than the specified background density. The selection of an appropriate window diameter is dependent on the size of the target area of interest, transect width, and spacing between transects. The optimum window diameter is one that has sufficient traversed area within the window without including such a large area that potential high-density areas can be masked by the surrounding low-density areas also in the window. As a general rule, the window diameter should be less than the diameter, or two times the radius, of the target area of interest and no smaller than the spacing between the original transect design. A default value for this parameter is calculated by VSP to be 1.8 times the radius of the assumed high density area. As this radius was 400 feet, the default Search Window Diameter was calculated to be 720 feet. This default value was not overridden.
- Critical Number of Anomalies – This parameter is calculated by VSP and refers to the number of detected anomalies required inside a window to identify it as significantly greater than background.
- Instrument False Negative Rate – This parameter accounts for the fact that collected data may not be representative of the actual density because the electromagnetic detector may not identify all detectable anomalies. For example, a false negative rate of 5 percent would indicate the detector, on average, would fail to detect 5 percent of the detectable anomalies traversed (background and target area). It is generally assumed that the detector always detects individual anomalies of interest and above a specified pick threshold, thus a false negative rate of zero percent is used for a default value. As such, initial design runs of VSP were performed assuming an Instrument

False Negative Rate of zero percent. However, in a marine environment, this rate would probably only be zero or near zero for very large items or where the detector array can be maintained at a minimum separation from the seabed. Accordingly, areas with near flat topography should generally have low false negative rates. The Instrument False Negative Rate would be higher for smaller items located deeper in the sediment or where the detector array must be moved higher above the seabed to avoid a sensitive ecological species or physical obstruction. Sensitivity runs with the Instrument False Negative Rate as high as 40 percent were performed.

2.2.014 Using these inputs, the baseline VSP design for Depth Zone C yielded a 90 percent probability of traversal and detection at a transect spacing of approximately 349 feet between adjacent survey swaths (343 feet between survey line centers) (see Figure 2-4). The VSP-generated report for this Zone C baseline design is included in Appendix J.

Figure 2-4. Baseline Transect Spacing Meeting the DQO of 90 Percent Probability of Traversal and Detection

2.2.015 The sensitivity of the maximum transect spacing to the Instrument False Negative Rate was then evaluated. Increasing the Instrument False Negative Rate within VSP while holding all other input parameters constant does not change the calculated transect spacing for those inputs. The more likely impact of an increased Instrument False Negative Rate is the artificially lower resulting number of recorded or detected anomalies that will be associated with that location in the DGM survey. If this artificially lower number of detected anomalies is associated with the outer edge of an area of high anomaly density, the post-Phase 2 DGM survey spatial analysis of the detected anomalies may not associate that location with the adjacent high anomaly density area or may not find that that location meets the high anomaly density area threshold at all. If an Instrument False Negative Rate of approximately 30 percent is considered, the VSP analysis indicates that a transect spacing of 271 feet between adjacent survey lines (281 feet between survey line centers) is required to meet the DQO (see Figure 2-5).

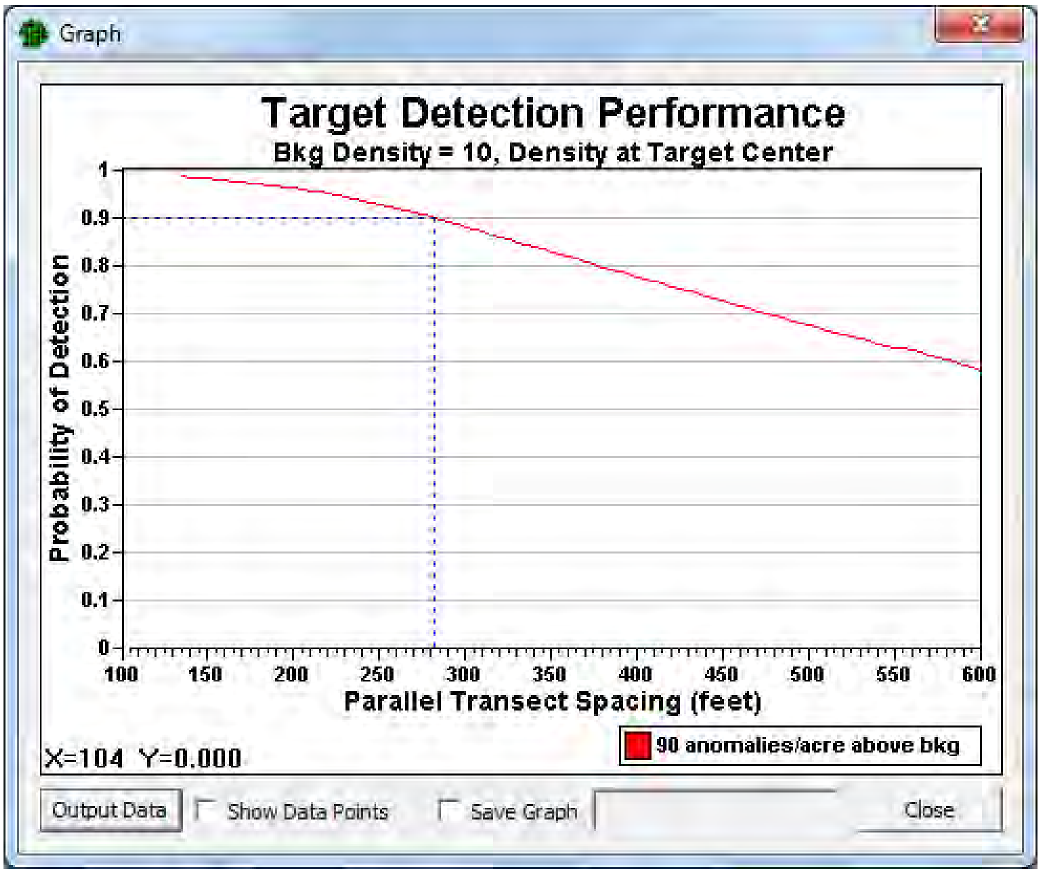


Figure 2-5. Transect Spacing Meeting the DQO of 90 Percent Probability of Traversal and Detection with an Instrument False Negative Rate of 30 Percent

2.2.016 In consideration of this important uncertainty and that there are uncertainties associated with some of the other inputs to the transect spacing design, tighter survey lines on 250-foot spacings were selected to be applied as the baseline line survey design for Zone C in both MRSs to meet the DQO of 90 percent probability of traversal and detection. This survey line spacing represents approximately a 3.8 percent survey coverage of the Zone C areas. The validity of the survey design assumptions used to arrive at this spacing and coverage will be checked using the data collected during the Phase 2 DGM survey. A spatial analysis of the collected data will be performed to evaluate whether a number of the assumed VSP input assumptions were accurate or representative of actual site conditions. All detected anomalies (potentially caused by MEC, MD, or inert debris) that pass quality control will be included in the spatial analysis that will be performed to locate the areas of high anomaly density within each MRS. The implications of any significant differences between the parameters assumed for the transect spacing design and those actually measured during the survey will be assessed. If it is indicated that a DQO was not met, the situation will be discussed with the USACE and the Project Delivery Team for possible corrective action during Phase 3.

2.2.017 The portions of the MRSs in Depth Zone B were judged to require greater coverage and characterization on a somewhat smaller spatial scale (i.e., smaller transect spacings) than in Depth Zone C due to the potentially smaller exposure area footprints that may be associated with the activities expected to be routinely performed in Zone B (relative to Zone C) as reflected in the conceptual site models described above for each MRS. Similarly, the portions of the MRSs that are in Zone A (that are not in Zone A′) were judged to warrant even greater coverage than for Zone B due to the potentially still smaller exposure area footprints in these subareas. Finally, the portions of the MRSs right along the shorelines of the sandy beach areas (i.e., Zone A′) were judged to need 100 percent survey coverage in the accessible areas because of the greatest potential for localized exposure by site users. Accordingly, survey line spacings were established to provide an even finer spatial scale characterization of the anomaly densities in Depth Zones B, A, and A′ relative to the Depth Zone C line spacing developed using VSP to meet the project DQO. The following relationship pertaining to an idealized rectangular area to be surveyed relates the required percent coverage of the area by the DGM transect survey to the associated transect spacing assuming regularly-spaced parallel transects:

Required Survey Area Coverage (COV) % / 100 = Area Surveyed / Total MRS Area

where:

Area Surveyed = the effective detector array swath width (W) times the total length of transect surveyed (L)

Total MRS Area = the sum of the effective detector array swath width (W) and the spacing between adjacent parallel survey transects (SP) times the total length of transect surveyed (L)

2.2.018 This resulting approximate expression for the transect spacings in feet is then:

$$SP = [W / (COV/100)] - W$$

2.2.019 For the various Depth Zone exposure zones, this translates to:

- For Depth Zone B, the required survey coverage of 10 percent was judged to be sufficient to adequately characterize the potential exposure area footprints associated with the activities expected to be performed in this Zone. For a detector swath width of 3 meters and a required coverage of 10 percent, the resulting survey line separation is 100 feet (using the geometrical calculation).
- For Depth Zone A (that is not Zone A′), the required survey coverage of 25 percent was judged to be sufficient to adequately characterize the potential exposure area footprints

associated with the activities expected to be performed in this zone. For a detector swath width of 3 meters and a required coverage of 25 percent, the resulting survey line separation is 30 feet (using the geometrical calculation).

- For Depth Zone A′, the required survey coverage was judged to be 100 percent. For a detector swath width of 3 meters and a required coverage of 100 percent, the resulting survey line separation is effectively 6.5 feet (i.e., 2 meters) (a geometric characteristic of the detector array configuration).

2.2.020 These Depth Zone-specific survey line spacings all achieve the specified DQO that the survey be performed along a pattern of parallel transects with the survey lane spacings selected to ensure at least a 90 percent probability of traversing and detecting a potential source area of elevated anomaly density of approximately 100 ApA. The survey line spacings for Depth Zones B, A, and A′ meet this DQO and go further to characterize these zones with a smaller spatial scale. Table 2-2 shows the estimated length of survey transects and overall coverage for each Depth Zone in each MRS, accounting for the areas identified to be inaccessible during Phase 1. Figures C-2 and C-3 in Appendix C illustrate the survey lines for MRS 03 and MRS 12, respectively. Every effort has been made to represent the line plans shown in Appendix C as accurately as possible. A combination of contouring and lines oriented perpendicular to the anticipated surf/swell may be used. The final line plans will be adjusted based on site conditions.

2.2.021 The Phase 2 EM survey results will be reviewed using the geo-statistical analysis and mappings (e.g., special analysis) to see what they imply about the distribution and density of anomalies (and potential areas of high anomaly density) and to determine if any of the key assumptions used in the design of the EM survey were or were not borne out by the new data. If the assumptions were found to not be accurate in some way, the implication of this inaccuracy will be identified and a determination made of how to adjust the Phase 3 work to compensate such that the stated DQOs might still be met.

2.2.022 Step outs will be considered if a potential source area is identified in the EM data at an MRS boundary within an accessible area that is water covered (i.e., no on land data collection will be performed under this work assignment). The need for step outs will be assessed based on the evaluation of the Phase 2 results. Step outs, if necessary, will be performed as part of the Phase 3 operations after intrusive investigations have confirmed the presence of MEC at the margins of the site boundaries. The scope, DQOs, and approach to be used for Phase 3 will be developed after reviewing the results of the Phase 2 Survey.

Table 2-2. Summary of the Phase 2 Survey Design

Depth Zone	Area Fraction of MRS (%)	Size (acres)	Transect Spacing (ft)	Probability of Traversing/ Detecting High Density Area (%)	Approximate Length of Transects (ft)	Transect Width[1/] (ft)	Approximate Area of Transects (acres)	Inaccessible Area Due to Slope or Shallow Water (acres)	Percent Coverage of Accessible Area (%)	Percent Coverage of the Area within this Depth Zone (%)
MRS 03		**195.07**	**area of MRS Shapefile**							
A′ – Sandy Beaches[2,3/] [<MLW-10']	1.95	3.88	6.6	100	26,425.46	9.84	4.38	0	100.00	100.00
A - Near Shore[2/] [<MLW-10']	62.51	121.95	30	100	190,510.93	9.84	43.04	12.4	32.98	35.29
B - Intermediate [MLW-10' to -25']	17.54	34.21	100	~100	17,367.32	9.84	3.92	3.0	12.57	11.47
C - Open Water [>MLW-25']	19.95	38.91	250	>90	6,403.41	9.84	1.45	3.1	4.03	3.72
SUBTOTALS	**102**	**195.07**	–	–	**240,707.12**	–	**52.79**	**18.45**	**29.24**	**26.53**
MRS 12		**833.54**	**area of MRS Shapefile**							
A′ – Sandy Beaches[2,3/] [<MLW-10']	1.51	12.76	6.6	100	40,165.03	9.84	6.66	0	100.00	100.00
A - Near Shore[2/] [<MLW-10']	12.91	107.57	30	100	267,069.98	9.84	60.33	9.7	61.66	56.08
B - Intermediate [MLW-10' to -25']	14.36	119.66	100	~100	43,859.94	9.84	9.91	17.0	9.65	8.28
C - Open Water [>MLW-25']	72.74	606.31	250	>90	99,569.22	9.84	22.49	29.2	3.9	3.71
SUBTOTALS	**102**	**846.30**	–	–	**450,664.17**	–	**99.39**	**55.92**	**12.57**	**11.74**
	TOTAL	**1,045.25**	–	–	**691,371.29**	–	**152.17**	**74.37**	**15.67**	**14.56**

Notes:

1/ In-water survey transect width assumed to be 3 meters.

2/ Depth Zones A′ and A in MRS 03 and 12 contain land that is inaccessible, but also water-covered area that is accessible by hovercraft but was not included in the original MRS area boundaries. Including coverage estimates in these areas causes the Percent Coverage of Accessible Area value to exceed 100%. An example of this can be seen in Appendix C, Figures C-2 and C-3.

3/ Area of MRS boundary Shapefiles for MRS 03 contains land that is inaccessible, but also water-covered area that is accessible by hovercraft but was not included in the original MRS area boundaries. Including coverage estimates in these areas causes the Percent Coverage of Accessible Area value to exceed 100 percent.

2.3 RI ORGANIZATION

2.3.01 The RI project organization consists of representatives from TtEC as depicted in Figure 2-6. Appendix C lists the key points of contact for the Task Order for the RI. The roles of each of the Project Delivery Team members are described below.

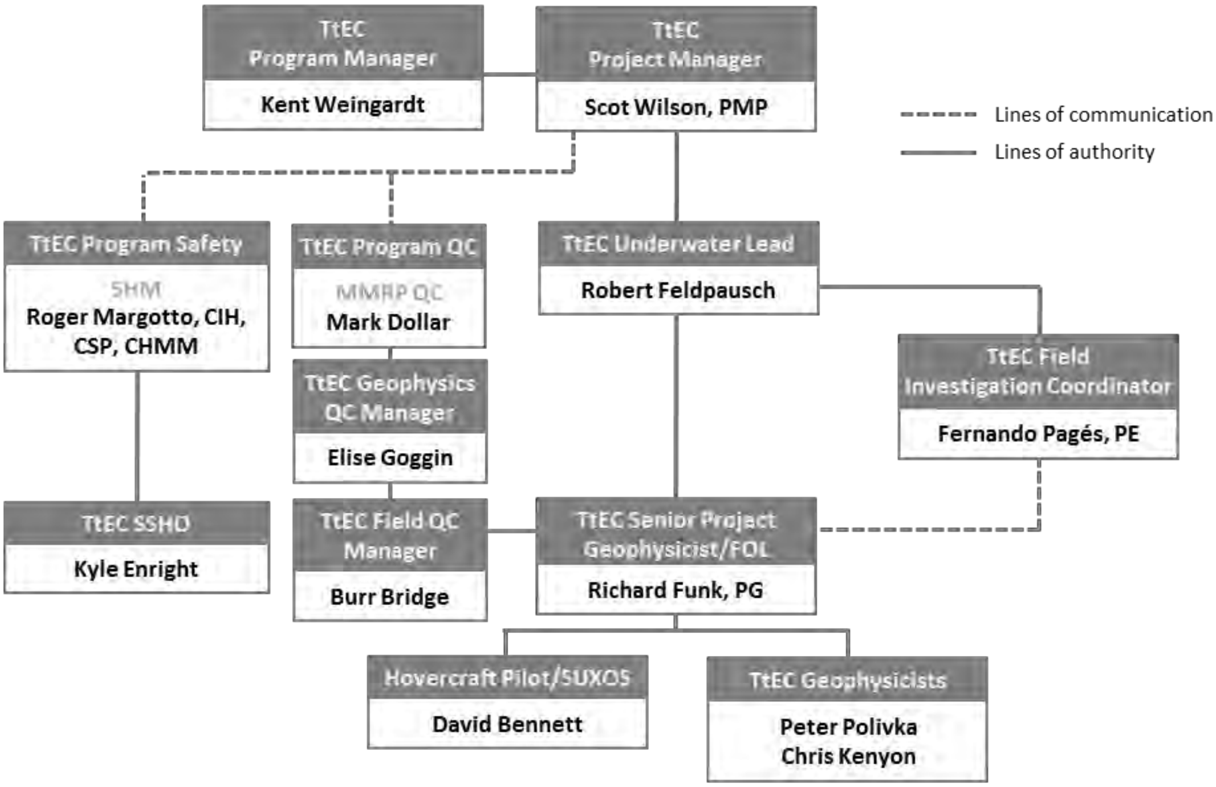


Figure 2-6. RI Organization

2.4 TETRA TECH EC PERSONNEL

2.4.01 The RI will be conducted by the personnel outlined below.

2.4.1 Program Management

2.4.1.01 TtEC program management is provided by following individuals:

- The program manager is Kent Weingardt. The program manager is responsible for ensuring contract requirements are met during the performance of the Task Order.
- The program safety manager is Roger Margotto. As program safety manager, Roger is the chief resource for all matters regarding safety and industrial hygiene. He directs and manages all company personnel functioning in safety positions, and provides technical support in safety, health, environmental compliance, industrial hygiene, hazardous materials, and other technical matters. He also reviews all project APPs, Site Safety and Health Plan (SSHPs), and AHAs and supports the projects when there are changes and questions.

- The MMRP program QC manager is Mark Dollar. Mark is responsible for implementation/oversight of the Munitions Response Quality Assurance (QA)/QC program for TtEC. He performs oversight of a full spectrum of quality tools and procedures for all MR projects. This includes implementing a comprehensive quality training program for TtEC UXO Quality Control Specialists, developing QC plans, Uniform Federal Policy for Quality Assurance Project Plans, and reviewing project plans and reports. He supervises all UXO Quality Control Specialists within the TtEC Munitions Response Program.
- The geophysics QC manager (GQCM) is Elise Goggin. Elise is responsible for the performance of QC oversight for marine DGM operations. She performs QC checks of DGM collection operations and DGM data processing to ensure the metrics measuring each definable feature of work (DFW) are achieved. As well, she interfaces with the survey team and data processors to ensure best practices and industry standards are followed to include all guidance provided in the DIDs.

2.4.2 Project Manager

2.4.2.01 The Project Manager (PjM), Scot Wilson, is responsible for the strategic and tactical leadership, management, and administration of the Task Order and is supported at the corporate level with health and safety, project controls, quality, finance, procurement, engineering, and environmental and regulatory compliance. The PjM is responsible for the day-to-day management of project activities, monitoring the project budget, updating the status the project schedule, and ensuring project compliance.

2.4.3 Field Investigation Coordinator

2.4.3.01 Fernando Pagés will serve as the Field Investigation Coordinator for the RI/FS. Fernando is based in Puerto Rico with knowledge of the personnel and resources for effective implementation of the project. The Field Investigation Coordinator is responsible for coordinating RI/FS resources on-site to support the project field investigation.

2.4.4 Underwater Lead

2.4.4.01 The marine survey lead, Robert Feldpausch, will oversee the technical management of the field program. The underwater lead ensures timely resolution of project-related technical, quality, and safety questions associated with in-water survey operations; coordinates and oversees in-water hydrographic and geophysical work performed by TtEC field and office technical staff, including data collection and interpretation; and coordinates preparation and review of hydrographic and geophysical deliverables.

2.4.5 Field Operations Lead/Quality Control Manager/Senior Project Geophysicist

2.4.5.01 The field operations lead (FOL) and senior project geophysicist, Richard Funk, is responsible for implementation of the field program. The FOL oversees day-to-day field operations for in-water geophysical mapping and ensures that proper staffing and resources are available on-site, that personnel have reviewed and understand their responsibilities, and that data collection activities are conducted in accordance with the approved plan and cited standards. For the RI, the FOL will also serve as the field QC manager (QCM) and is responsible for all aspects of data quality. This individual must ensure that data collection procedures and data processing and interpretation procedures are observed and that the resulting data meet the performance specifications in the approved plan.

2.4.6 Geophysicists/Scientists

2.4.6.01 Geophysicists are responsible for reviewing and understanding their responsibilities as assigned and for general safety at the project site. They will carry out the daily field activities, which include deployment and operation of survey equipment and acquisition of high-quality survey data under the supervision of the FOL.

2.4.7 Observers

2.4.7.01 Each team performing underwater investigation work will be accompanied on the boat, or from shore or a second boat for hovercraft operations, by qualified, trained, and experienced personnel who have had a briefing by a qualified biologist to act as observers in order to identify the presence or absence of threatened or endangered species. Training and briefing of project personnel by the project biologist will be completed prior to performing any in-water work in accordance with the Final Supplemental SOPs for Endangered Species Conservation and their Critical Habitat during Underwater Investigations (February 2014) and Addendum 1 (February 2015), hereafter referred to as the Environmental SOPs (see Appendix B-1).

2.5 COMMUNICATION AND REPORTING

2.5.1 Recordkeeping

2.5.1.01 All aspects of administering the Task Order must be substantiated by permanent records, such as written correspondence, notes, and photographs. It is essential to summarize important non-written communications with notes covering conferences, telephone calls, and discussions, giving the date, location, parties involved, and important topics discussed. Written correspondence is the most deliberate, as well as the most important, of the three general types of contractual communication (i.e., person to person, telephone calls, and written correspondence).

2.5.1.02 The Administrative Record for this project is stored at the Culebra Foundation on Culebra and also at the USACE Antilles Office in San Juan.

2.5.2 Office Communications and Reporting

2.5.2.01 The TtEC PjM is responsible for issuing the following documents throughout the duration of the Task Order:

- Meeting minutes (due 5 business days after a meeting);

- Record of telephone conversations (due with the Project Status Report); and
- Project Status Reports (in accordance with DID WERS-016).

2.5.3 Field Communications and Reporting

2.5.3.01 The following communications will be documented in a chronological communications log maintained by the on-site FOL:

- When and why work is stopped for safety reasons;
- Health and safety violations;
- Personnel changes and reason for changes; and
- Any deviations from the approved Work Plan that occur in the field (for example, equipment changes, analysis, or problems encountered).

2.5.3.02 During field work, Daily Reports (DRs) will be completed to detail the personnel on-site, production, equipment, lessons learned, and summaries of safety and QC tasks. During the RI, the DR will include, at a minimum, weather information at the time of survey, field instrument measurements and calibrations (if applicable), any problems encountered, and any Government personnel directives.

2.6 DELIVERABLES

2.6.01 Project deliverables will meet the schedule requirements of the project and will be prepared in accordance with the applicable DID format referenced in the PWS. Deliverables will undergo internal TtEC technical and QC reviews prior to submittal to other organizations. The primary deliverables for associated with the RI are:

- Work Plan
- Chart and contact list showing potential MEC detections
- RI Report

2.6.02 The RI Report will include items presented in Table 2-3 and summarized in the sections below.

Table 2-3. Summary of Data Deliverables

Version	Product	Format
Draft	Report	Electronic (.pdf)
Draft Final	Report	Electronic (.pdf)
	Report	Electronic (.pdf) Paper
Final	EM returns/coverage	Geotiff
	Contact list Results	Excel spreadsheet ESRI shapefile

2.6.1 DGM/EM Survey Data

2.6.1.01 TtEC will provide the survey data results, including coverage, collected and analyzed data, and a description of the number and distribution of metallic contacts present in the area. The RI Report will document and evaluate the limits of detection for each sensor used. Areas that were surveyed outside the limits of detection will be flagged as incomplete and included in the data gap analysis. The areas noted as incomplete will be evaluated for additional DGM effort during the Phase 3 field work. The data text will be provided in Portable Document Format (.pdf) format, data products in the form of maps, and digital data in standard geographic information system formats. Geophysics data will be submitted in accordance with DID WERS-004.01 submittal requirements.

2.6.2 DGM/EM Deliverables

2.6.2.01 A combination of HYPACK, Oasis Montaj, ArcGIS and TtEC-developed software will be used to generate final data products. Charts displaying the EM response and detected features will be generated in the project datum at a scale appropriate for site evaluation.

2.6.2.02 In addition to delivering the final DGM/EM chart as described above, the anomaly detection data will also be provided in an Excel spreadsheet containing the feature location, detected signal level, sensor altitude, and other attribute data useful for target assessment. Geophysics data will be submitted in accordance with DID WERS-004.01 submittal requirements.

2.6.2.03 T&E species sightings and any measures taken when present within distances of the Phase 2 field operations established in the Environmental SOPs (see Appendix B-1) will be completed and submitted as described in Section 6 (Environmental Protection Plan).

2.7 SCHEDULE

2.7.01 A project schedule for this phase of the project and associated tasks has been prepared for work planning purposes (Figure 2-7, placed at end of Section 2 for convenience). This schedule will be updated, when necessary, and submitted to USAESCH with the associated progress report. The included schedule is based on the current Draft Work Plan and the anticipated time needed for stakeholder review, TtEC's response to comments and Draft Final and Final Work Plan preparation. Revisions to the project schedule will be included with the project status reports.

2.7.02 The normal working days will be 6 days per week up to 12 hours per day depending on the hours of available daylight and site conditions. The longer working hours are required for equipment set-up and transit time to and from the munition response sites.

2.8 PERIODIC REPORTING

2.8.01 Over the course of the project, periodic reports such as weekly/monthly project status reports and DRs will be required to document project activities. TtEC will prepare these reports in accordance with the PWS, the applicable DIDs, and the project schedule. Specific reports associated with this RI phase are discussed in Section 2.6 of this Work Plan.

2.9 COSTING AND BILLING

2.9.01 This Task Order was awarded to TtEC as a combination of firm fixed price tasks and cost plus fixed fee tasks. The firm fixed price/firm fixed price tasks are billed based on work completed in accordance with the negotiated milestones or accepted unit rates. The cost plus fixed fee tasks are billed based on monthly progress. Milestones will be considered met or completed when the required QC documentation has been submitted, QA completed, and the submittal is accepted. A milestone payment schedule has been established for this Task Order.

2.10 PROJECT PUBLIC RELATIONS SUPPORT

2.10.01 Site personnel will not disclose any data generated or reviewed during this and each phase of the Task Order and will refer all requests for information concerning site conditions to the USACE Jacksonville District Project Manager (Wilberto Cubero) and the Public Affairs Specialist (Amanda Parker) with a copy furnished to the USAESCH (Roland Belew). Information gathered by this project is the property of the DoD and distribution to any other source is prohibited.

2.11 FIELD OPERATION MANAGEMENT PROCEDURES

2.11.01 This subsection lists the major field operation components of the DGM/EM survey. Detailed descriptions and field procedures to be followed during each of these steps are presented in the subsequent chapters and appendices of this Work Plan. Field operations for Phase 2 of the RI are separated into the following primary steps:

- Mobilization
- Equipment setup and instrument validation
- DGM/EM survey
- Demobilization

2.11.02 TtEC will manage and be responsible for all aspects of the field work during the DGM/EM survey phase (Phase 2 of the RI). All work will be performed in accordance with the approved Phase 2 Work Plan. The on-site FOL will be responsible for the on-site operations, ensuring project goals and data quality objectives are met and that work is conducted in a safe and effective manner. The FOL/QCM/Senior Geophysicist will be responsible for the management of on-site field data as they are generated.

2.11.1 General Approach

2.11.1.01 The DGM/EM survey will be conducted within the boundaries of MRS 03 and 12. Upon completion of the DGM/EM survey and subsequent data analysis, the survey team will evaluate the results for use in developing additional project work plans for the intrusive investigation activities and/or remediation. Phase 3 of the RI will include intrusive investigation of metallic anomalies that will characterize the nature and define the extent of MEC contamination. The results of these investigations will be used to focus the collection of media samples for the MC analysis, which will also be performed during Phase 3 of the RI.

2.11.2 Mobilization

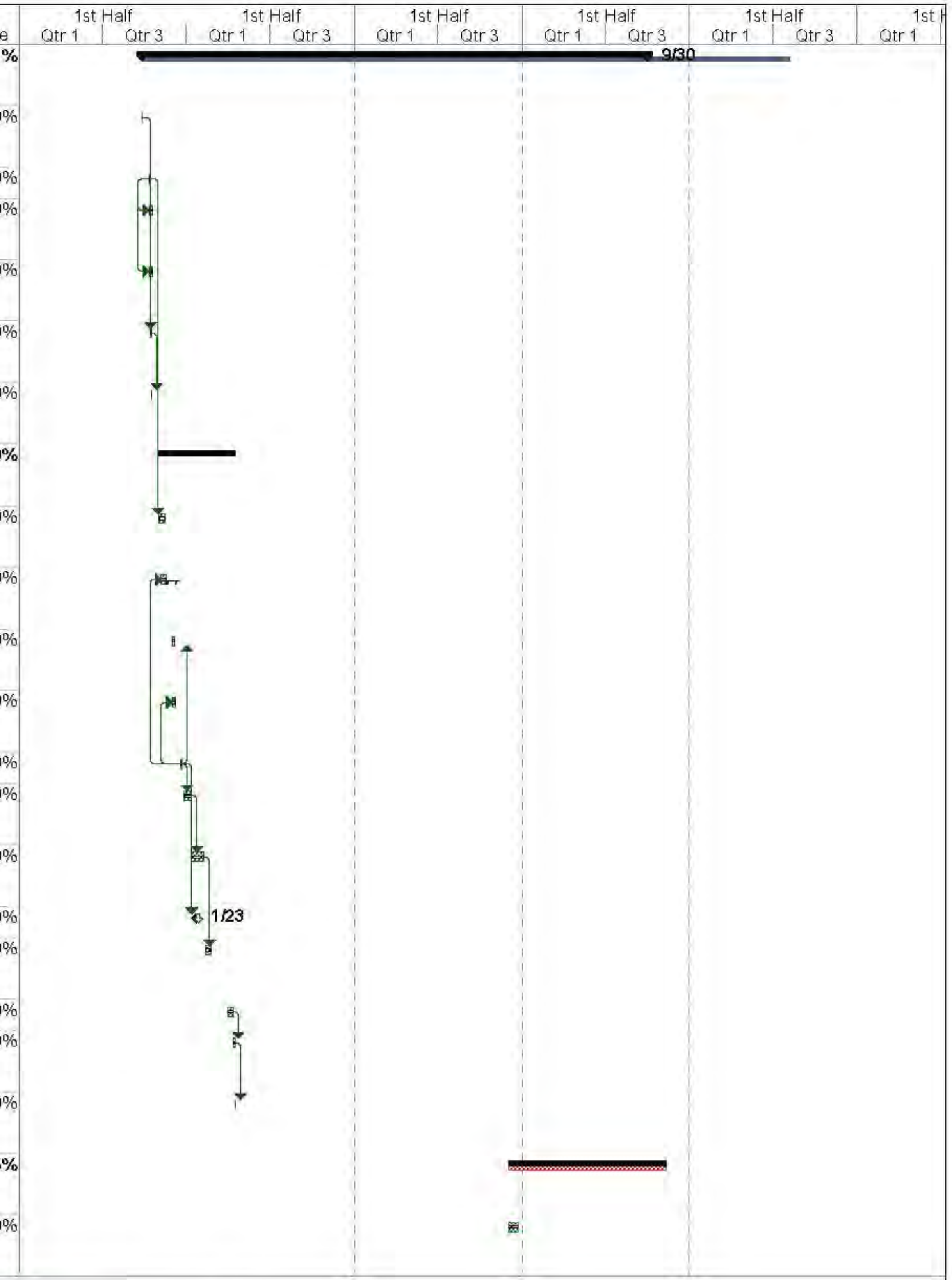
2.11.2.01 Preparation for mobilization will commence upon receipt of the notice-to-proceed. Upon receipt of the notice to proceed, the survey team will be notified, travel and lodging arrangements will be made, and the requisite copies of the applicable project and reference documents will be assembled.

2.11.2.02 Mobilization of the survey team and equipment will be conducted based on the sequence of the field tasks. All field personnel will attend site-specific training upon mobilization, including endangered species recognition and avoidance procedures to follow when doing the survey as required in the Environmental SOPs in Appendix B. The survey team and support personnel will mobilize to the site and establish the field office and support facilities, receive equipment deliveries, and prepare equipment for use. Site preparation activities include establishing support facilities and establishing docking and marine access arrangements, and establishing survey coordinates and parameters. The field crew will complete the installation of survey equipment on the vessels and perform required equipment installations and test prior to the survey.

2.11.3 DGM/EM Survey

2.11.3.01 Non-intrusive marine geophysical surveys will be conducted using the defined survey line plans in Flamenco Bay and Luis Peña Channel extending from approximately 4 feet mean lower low water to the offshore boundary of each site. The modification of the Environmental SOPs and the utilization of the TEMA-Lite will now allow for DGM in many areas with 0.5 to 4 feet of water. The DGM/EM survey will be conducted to evaluate the distribution of metallic items which are potential MEC items. The DGM/EM survey will be conducted using a float–mounted and/or towed TEMA to detect and map potential marine MEC items. The TEMA data will be geo-referenced using real-time kinematic (RTK) level GPS and, when the towfish is submerged, an ultra-short baseline (USBL) acoustic positioning system. During DGM, the vessels will navigate to the line plan utilizing HYPACK, a navigation software package that shows the vessel position relative to the planned line in real time. The software also displays a left-right indicator that shows how close the vessel is following the planned line. Additionally, it will display the towed TEMA-MK3’s position, as tracked by the USBL, in real time behind the survey vessel.

ID	Task Name	Duration	Start	Finish	% Complete
1	**RI/FS Culebra Underwater Ranges Phase I and II**	**787 d**	**Mon 9/26/11**	**Tue 9/30/14**	**91%**
2	Contract Award	1 d	Mon 9/26/11	Mon 9/26/11	100%
3	Kickoff Phone Conference	1 d	Tue 10/11/11	Tue 10/11/11	100%
4	Proposed Schedule	7 d	Tue 10/11/11	Mon 10/17/11	100%
5	Kickoff Meeting Minutes	7 d	Tue 10/11/11	Mon 10/17/11	100%
6	Army Contractor Manpower Reporting 1	1 d	Sat 10/15/11	Sat 10/15/11	100%
7	Army Contractor Manpower Reporting 2	1 d	Sun 10/16/11	Sun 10/16/11	100%
8	**Task 1a, Technical Project Planning (TPP) Phase 1 (EBS Survey)**	**168 d**	**Tue 11/1/11**	**Mon 4/16/12**	**100%**
9	Organize & Coordinate TPP Meeting	15 d	Tue 11/1/11	Tue 11/15/11	100%
10	Pre-TPP Meeting Materials	10 d	Mon 11/7/11	Wed 12/14/11	100%
11	AAPP	4 d	Fri 12/2/11	Mon 12/5/11	100%
12	Conceptual Site Model	7 d	Thu 12/1/11	Wed 12/7/11	100%
13	***Conduct 1st TPP Meeting**	2 d	Mon 12/19/11	Tue 12/20/11	100%
14	Prepare & Submit for Review Draft TPP Memorandum	14 d	Tue 12/27/11	Wed 1/11/12	100%
15	USACE and CX Review & Comment on Draft TPP Memorandum	27 d	Thu 1/12/12	Tue 2/7/12	100%
16	***Government Development of Fieldwork SOPs**	56 d	Mon 1/23/12	Mon 4/9/12	100%
17	Incorporate Comments, Prepare & Submit for Review Draft TPP Memorandum	10 d	Mon 2/13/12	Wed 2/22/12	100%
18	Response to USACE review comments	10 d	Sun 4/1/12	Tue 4/10/12	100%
19	Project Delivery Team back check	5 d	Wed 4/11/12	Sun 4/15/12	100%
20	Acceptance of Final TPP Phase 1 Memorandum	1 d	Mon 4/16/12	Mon 4/16/12	100%
21	**Task 1b Technical Project Planning Meeting Phase 2**	**244.4 d**	**Tue 12/3/13**	**Mon 11/10/14**	**65%**
22	Organize & Coordinate TPP Meeting	15 d	Tue 12/3/13	Mon 12/23/13	100%



Task		Summary		Inactive Milestone		Duration-only		Start-only			
Critical		Task		Inactive Summary		Manual Summary Rollup		Finish-only			
Milestone		Inactive Task		Manual Task		Manual Summary		Critical			

Figure 2-7. Proposed Phase 2 DGM/EM Survey Schedule (page 1 of 4)

ID	Task Name	Duration	Start	Finish	% Complete
23	Pre-TPP Meeting Materials	10 d	Mon 12/23/13	Fri 1/3/14	100%
24	****Conduct 2nd TPP Meeting***	2 d	Tue 1/14/14	Wed 1/15/14	100%
25	Prepare & Submit for Review Draft TPP Memorandum	10 d	Thu 1/16/14	Wed 1/29/14	100%
26	USACE and CX Review & Comment on Draft TPP Memorandum	30 d	Thu 1/30/14	Wed 3/12/14	35%
27	Incorporate Comments, Prepare & Submit for Review Draft TPP Memorandum	10 d	Thu 3/13/14	Wed 3/26/14	35%
28	Regulator Review of Draft TPP Memorandum	30 d	Thu 3/27/14	Wed 5/7/14	30%
29	Pre TPP Meeting Materials	10 d	Tue 3/18/14	Mon 3/31/14	100%
30	*** Conduct 3rd TPP Meeting (not attened by Tt)**	**79.4 d**	**Tue 7/22/14**	**Mon 11/10/14**	**87%**
31	**Conduct 4th TPP Meeting (3rd Scoped TPP)**	**2 d**	**Wed 10/22/14**	**Thu 10/23/14**	**87%**
32	Prepare TPP Meeting Presentation	3 d	Tue 7/22/14	Thu 7/24/14	100%
33	USACE Review of Draft TPP Meeting Presentation	5 d	Fri 7/25/14	Thu 7/31/14	100%
34	Response to USACE review comments	3 d	Fri 8/1/14	Tue 8/5/14	100%
35	Project Delivery Team back check	5 d	Wed 8/6/14	Wed 10/22/14	100%
36	Conduct TPP meeting #4	4 d	Mon 10/27/14	Fri 10/31/14	100%
37	Prepare TPP meeting Adendum	5 d	Fri 10/31/14	Fri 11/7/14	50%
38	Acceptance of Final TPP Phase 2 Memorandum	1 d	Fri 11/7/14	Mon 11/10/14	0%
39	**Task 4, RI/FS Phase 1 Field Activities**	**981 d**	**Fri 11/30/12**	**Fri 8/7/15**	**93%**
40	Initial Mobilization (Logistics and Site Setup)	6 d	Fri 11/30/12	Wed 12/5/12	100%
41	***Task 4a MRS 3 Phase 1 Baseline Survey***	**12 d**	**Thu 1/3/13**	**Fri 1/18/13**	**100%**
42	Optional Task 4a1, Bathymetry	4 d	Thu 1/3/13	Tue 1/8/13	100%
43	Optional Task 4a2, Side Scan Sonar	2 d	Wed 1/16/13	Thu 1/17/13	100%
44	Task 4a3, ROV/AUV	5 d	Mon 1/14/13	Fri 1/18/13	100%
45	***Task 4b MRS 12 Phase 1 Baseline Survey***	**16 d**	**Sat 12/8/12**	**Sun 12/23/12**	**100%**
46	Optional Task 4b1, Bathymetry	8 d	Sat 12/8/12	Sat 12/15/12	100%

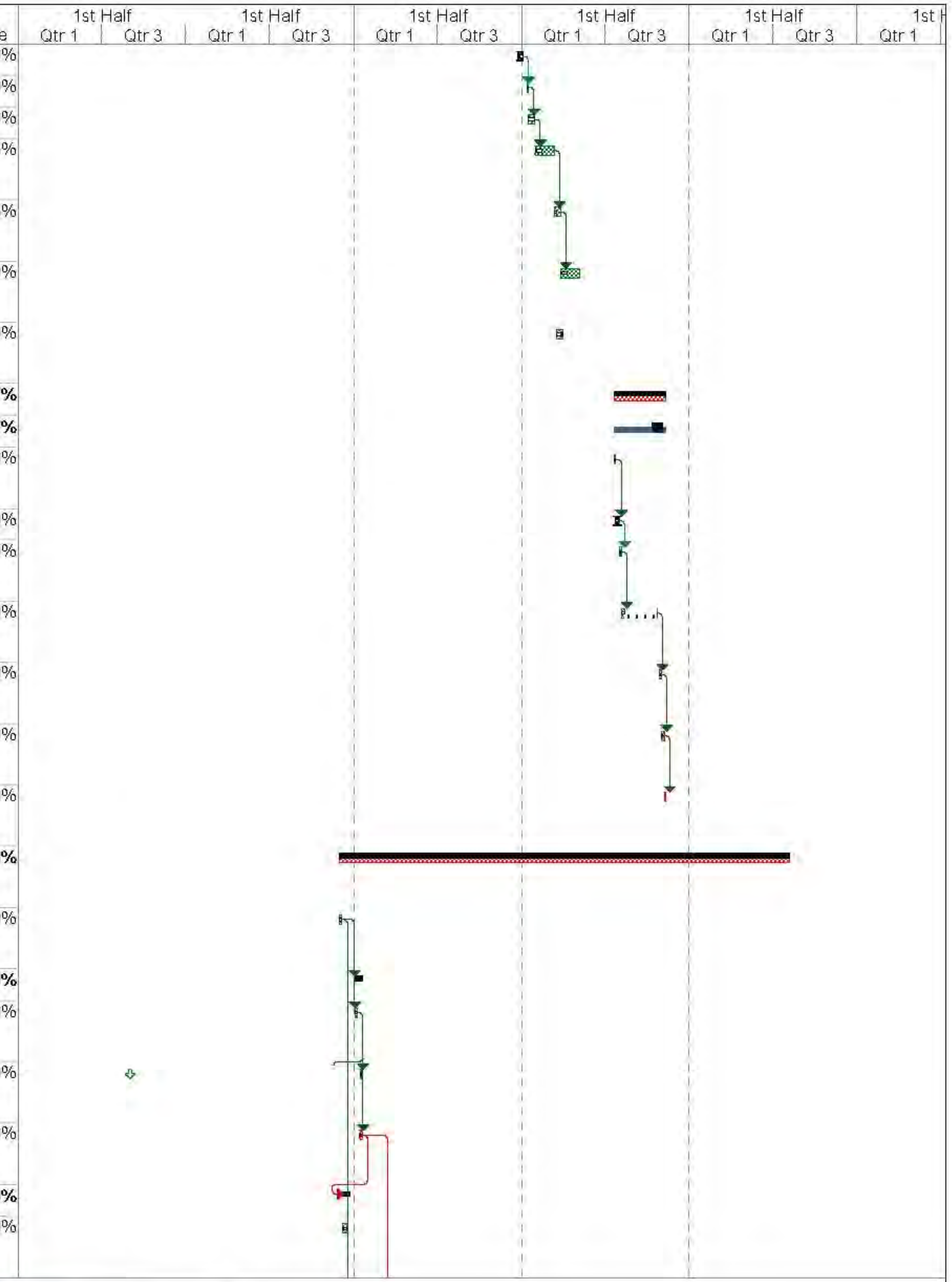
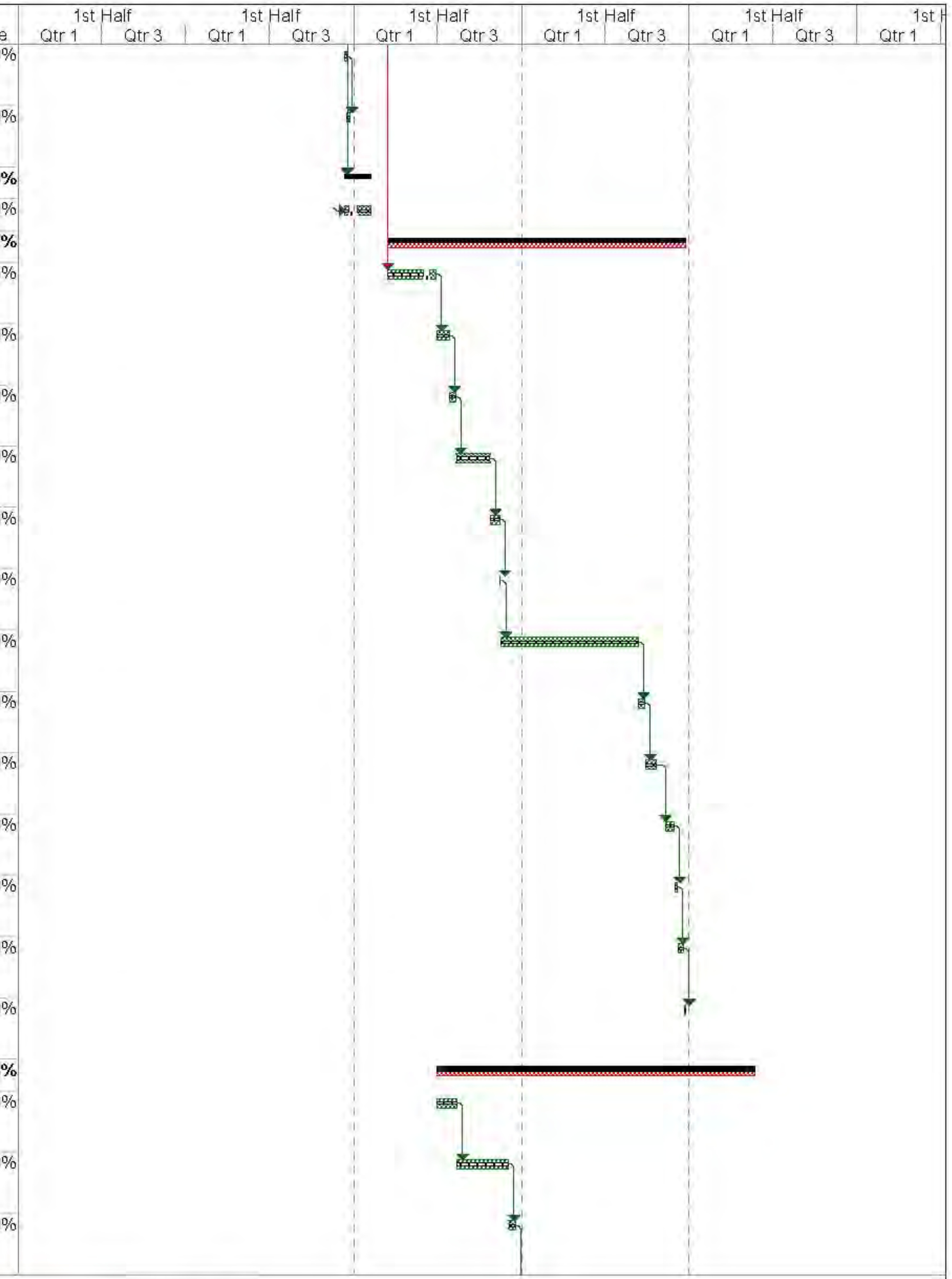


Figure 2-7. Proposed Phase 2 DGM/EM Survey Schedule (page 2 of 4)

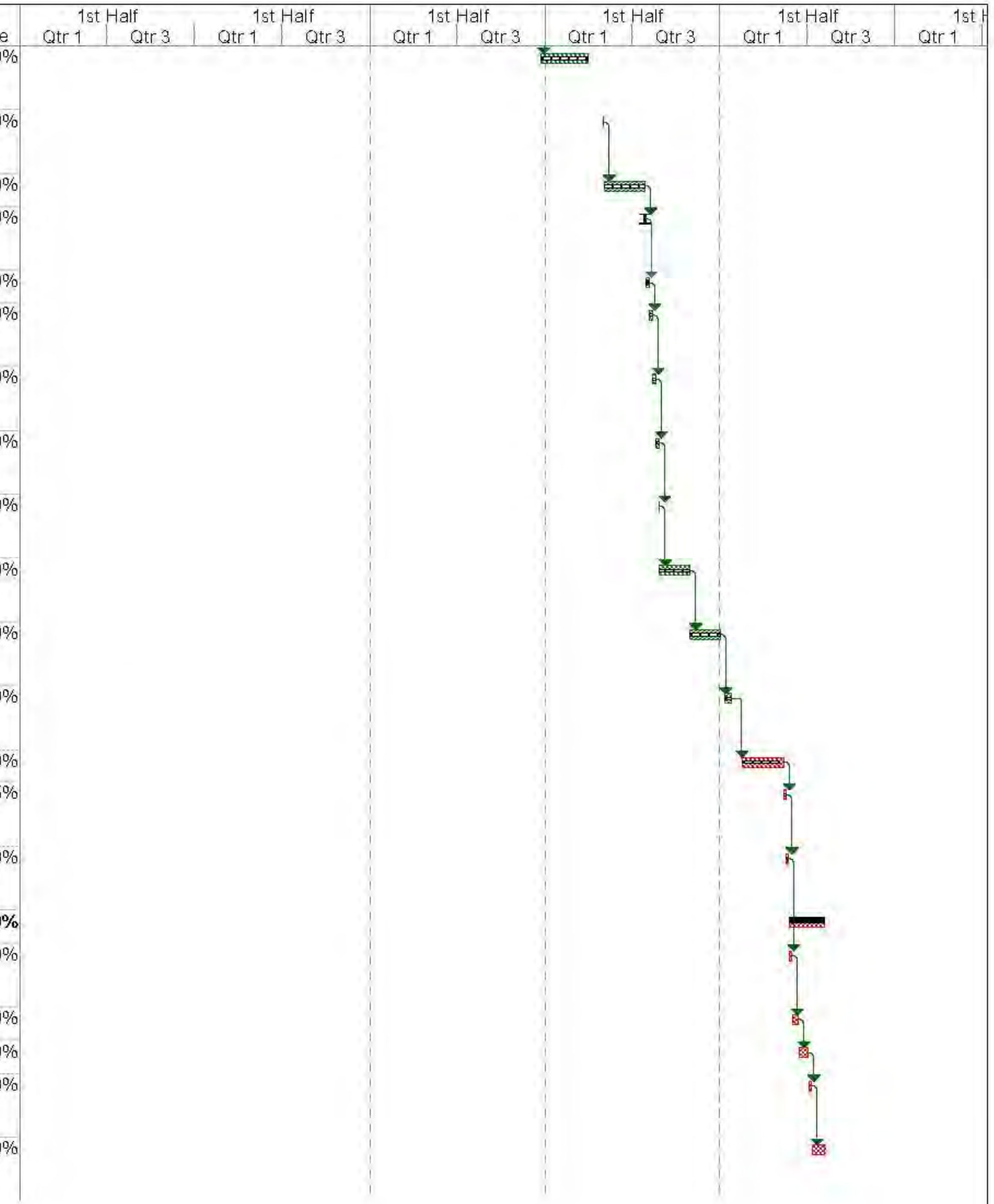
ID	Task Name	Duration	Start	Finish	% Complete
47	Optional Task 4b2, Side Scan Sonar	3 d	Thu 12/13/12	Sat 12/15/12	100%
48	Optional Task 4b3, ROV/AUV	8 d	Sun 12/16/12	Sun 12/23/12	100%
49	**Task 12, Environmental Sampling and Analysis**	**44.25 d**	**Wed 12/12/12**	**Thu 2/7/13**	**100%**
50	**Task 12c1 Phase I Beach Monitoring*	31 d	Wed 12/12/12	Thu 2/7/13	100%
51	**Task 14, Baseline Survey Report**	**461 d**	**Sat 3/16/13**	**Mon 12/22/14**	**97%**
52	Prepare Draft EBS Report	90 d	Sat 3/16/13	Fri 6/28/13	85%
53	USACE Review and Comment of Draft EBSSurvey Report	20 d	Mon 7/1/13	Fri 7/26/13	100%
54	Incorporate USACE Comments on Draft Baseline EBS Report	10 d	Mon 7/29/13	Fri 8/9/13	100%
55	Project Delivery Team Backcheck of Final EBS Report (Government Shutdown Impacted)	53 d	Mon 8/12/13	Wed 10/23/13	100%
56	Contractor prepares Draft Final EBS Report	15 d	Thu 10/24/13	Wed 11/13/13	100%
57	Contractor sends Draft Final EBS Report to Regulators for review	1 d	Fri 11/15/13	Fri 11/15/13	100%
58	Regulator Review and Comment on EBS Report (PREQB consultant delay)	214 d	Mon 11/18/13	Thu 9/11/14	100%
59	Address regulator comments from review	10 d	Fri 9/12/14	Thu 9/25/14	100%
60	PREQB Comment Response by Government	17 d	Mon 9/29/14	Tue 10/21/14	100%
61	Prepare Draft Final EBS Rev 1	15 d	Mon 11/10/14	Fri 11/28/14	100%
62	Prepare Final EBS Survey Report	5 d	Mon 12/1/14	Fri 12/5/14	100%
63	Project Delivery Team Backcheck of Final EBS Report	10 d	Mon 12/8/14	Fri 12/19/14	100%
64	Approval of Final EBS Report	1 d	Mon 12/22/14	Mon 12/22/14	100%
65	**TASK 2d Phase 2 Work Plans**	**495 d**	**Mon 7/1/13**	**Fri 5/22/15**	**98%**
66	Prepare and Submit Draft Phase II Survey Workplan	32 d	Mon 7/1/13	Tue 8/13/13	100%
67	USACE Review and Comment of Draft Phase II Survey Workplan (Government Shutdown Impacted)	80 d	Wed 8/14/13	Tue 12/3/13	100%
68	Incorporate USACEComments and prepare and submit Draft Phase II Survey Workplan	10 d	Wed 12/4/13	Tue 12/17/13	100%



Task		Summary		Inactive Milestone		Duration-only		Start-only
Critical		Task		Inactive Summary		Manual Summary Rollup		Finish-only
Milestone		Inactive Task		Manual Task		Manual Summary		Critical

Figure 2-7. Proposed Phase 2 DGM/EM Survey Schedule (page 3 of 4)

ID	Task Name	Duration	Start	Finish	% Complete
69	Project Delivery Team Backcheck	71 d	Mon 12/23/13	Mon 3/31/14	100%
70	USACE PM sends to CX for review	1 d	Fri 5/2/14	Fri 5/2/14	100%
71	CX Review (Government Delay)	61 d	Mon 5/5/14	Mon 7/28/14	100%
72	USACE PM Sends CX comments to Contractor	1 d	Tue 7/29/14	Tue 7/29/14	100%
73	Contractor addresses CX comments and sends back to U!	5 d	Wed 7/30/14	Tue 8/5/14	100%
74	Project Delivery Team concurence with comments	5 d	Wed 8/6/14	Tue 8/12/14	100%
75	Contractor prepares Draft Final Phase II Work Plans	5 d	Wed 8/13/14	Tue 8/19/14	100%
76	Project Delivery Team Back Check of Draft Final Work Pla	5 d	Wed 8/20/14	Tue 8/26/14	100%
77	USACE PM sends Draft Final Work Plans to Regulators fc	1 d	Wed 8/27/14	Wed 8/27/14	100%
78	Regulator Review and Comment on Phase II Survey Work	45 d	Thu 8/28/14	Wed 10/29/14	100%
79	Address regulator comments from review and TPP meetin	45 d	Thu 10/30/14	Wed 12/31/14	100%
80	Government back check of regulator review comments	10 d	Mon 1/12/15	Fri 1/23/15	100%
81	Agency review of comment responses and Work Plan	63 d	Mon 2/16/15	Wed 5/13/15	90%
82	Prepare Final Phase II Work Plan	3 d	Thu 5/14/15	Mon 5/18/15	85%
83	Approval of Final Phase II Work Plan and NTP	4 d	Tue 5/19/15	Fri 5/22/15	60%
84	**Task 4, RI/FS Phase 2 Field Activities**	**54 d**	**Tue 5/26/15**	**Fri 8/7/15**	**0%**
85	Phase II Mobilization	4 d	Tue 5/26/15	Fri 5/29/15	0%
86	***Task 4a MRS 3 Phase II EM Survey***	10 d	Mon 6/1/15	Fri 6/12/15	0%
87	***Task 4b MRS 12 Phase II EM Survey***	15 d	Mon 6/15/15	Fri 7/3/15	0%
88	Phase II Demobilization	5 d	Mon 7/6/15	Fri 7/10/15	0%
89	Post Survey Data Processing	20 d	Mon 7/13/15	Fri 8/7/15	0%



Task		Summary		Inactive Milestone		Duration-only		Start-only	
Critical		Task		Inactive Summary		Manual Summary Rollup		Finish-only	
Milestone		Inactive Task		Manual Task		Manual Summary		Critical	

Figure 2-7. Proposed Phase 2 DGM/EM Survey Schedule (page 4 of 4)

3.0 FIELD INVESTIGATION PLAN

3.0.01 Phase 2 of the RI will include a DGM/EM survey to detect and locate metallic items which are potential MEC items. Constraints that may limit the survey include areas that the EBS identified as having sensitive habitats such as shallow coral reefs that may be damaged by the TEMA as well as those related to maintaining the safety of the field crew, vessels, and equipment.

3.0.02 The collection of high-resolution bathymetry data that was done as part of the EBS in both MRS areas is critical to the success of the subsequent DGM effort. Magnetometer/ gradiometer and electromagnetic sensors inherently have very short detection ranges for anything but the largest MEC items. In a marine environment, with a sensor that must be flown on or very close to the bottom to provide useful data, it is absolutely imperative to have a very accurate three-dimensional model of the bottom to avoid damage to the equipment and sensitive marine life, such as corals, during survey operations. The multibeam bathymetry collected during the EBS is the basis for this model.

3.0.03 The field investigation is being conducted in three phases: Phase 1, the EBS, to develop basemaps to guide the following phases, completed in 2013; Phase 2, the DGM/EM survey, to provide an assessment of the distribution and density of metallic items and debris fields that may be MEC; and Phase 3, which will be an intrusive investigation. This document describes the activities for Phase 2 of the RI.

3.1 OVERALL APPROACH TO RI/FS ACTIVITIES

3.1.1 Site Characterization Processes

3.1.1.01 The DGM/EM survey will be conducted within MRSs 03 and 12 through a minimum cost survey plan designed to provide a 90 percent confidence that a given area has metallic targets above background level if present. A minimum cost survey plan means that the survey plan was designed to collect only required data to achieve the 90 percent confidence for the detection of the design impact area according to the sample design developed via VSP. Phase 2 of the RI will include the following components:

- Plan the survey using VSP, a software tool designed by PNNL to design statistically defensible sampling plans. VSP was used to ensure the DQO established through the TPP that the survey “should ensure at least a 90% probability” that the survey lines will traverse and detect a potential source area of elevated anomaly density would be achieved.
- Conduct a DGM/EM survey with the floating TEMA-Lite in very shallow water and the dynamically flown TEMA-MK3 in deeper water to maintain altitude levels that are low enough to provide a reasonable probability of detection for many MEC items.
- Avoid those areas where habitat protection guidelines preclude the use of a towfish.
- No sediment sampling or other intrusive methods will be conducted as part of Phase 2.

3.2 IDENTIFICATION OF AREAS OF CONCERN

3.2.01 The habitat areas within Flamenco Bay (MRS 03) and the Luis Peña Channel (MRS 12) are shown in Figure 3-1. Prior to the start of DGM/EM survey operations, the survey team, which includes local scientists, will review the EBS results and high-resolution aerial imagery, as well as local knowledge sources to delineate and avoid areas of sensitive habitat to minimize risk of damage to these resources during DGM/EM surveys.

3.2.02 The survey team will then perform non-intrusive marine geophysical surveys from approximately the minimum depth of 6 inches required by the TEMA-Lite and hovercraft for the shallow water operations, and an approximately 3-meter shallow water limit for the larger vessel TEMA operations.

3.2.03 In areas with depths less than approximately 2 meters, surveys will be conducted with the float-mounted TEMA-Lite (surface tow), and the system will be towed by a four-person hovercraft or other means as appropriate to the location (e.g., hand lines by personnel on shore).

3.2.04 In depths between approximately 2 and 4 meters, the TEMA may be suspended from floats to allow more controlled operation while maintaining low enough altitude above the bottom to achieve better probability of detection of smaller items.

3.2.05 Shallow areas containing coral may not be surveyed if either the depth falls below the minimum specified altitude, or wave conditions increase the risk of accidental contact with the coral. Other data collection methods, including the use of MEC divers with hand-held EM units, could be employed to survey within the excluded areas; however, that is outside the scope of this project.

3.2.06 Areas with slopes exceeding approximately 15 degrees cannot be surveyed with the towfish since it is not possible to maintain acceptable altitudes for good detection probability without having unacceptable levels of risk of impacting the bottom and damaging habitat or equipment. Other data collection methods, including the use of MEC divers with hand-held EM units, could be employed to survey within the areas with slopes too great to survey with the TEMA; however, that is outside the scope of this project.

3.2.07 The areas where different deployment methods for the TEMA will be used and the slope areas where the TEMA cannot be actively flown are shown in Figure 3-2.

3.2.08 Surface MEC will be identified from video and/or still photography collected during the DGM/EM survey. The TEMA-MK3 will employ a real-time HD video feed from the towbody that will be recorded and monitored, and a still camera (e.g., a GoPro) will collect stills for later review. The surface towed TEMA-Lite Hovercraft will employ a GoPro camera to collect video and still photography for later review. Additional high-resolution photos/video will be taken during the Phase 3 intrusive investigations to show potential MEC relative to sensitive habitats.

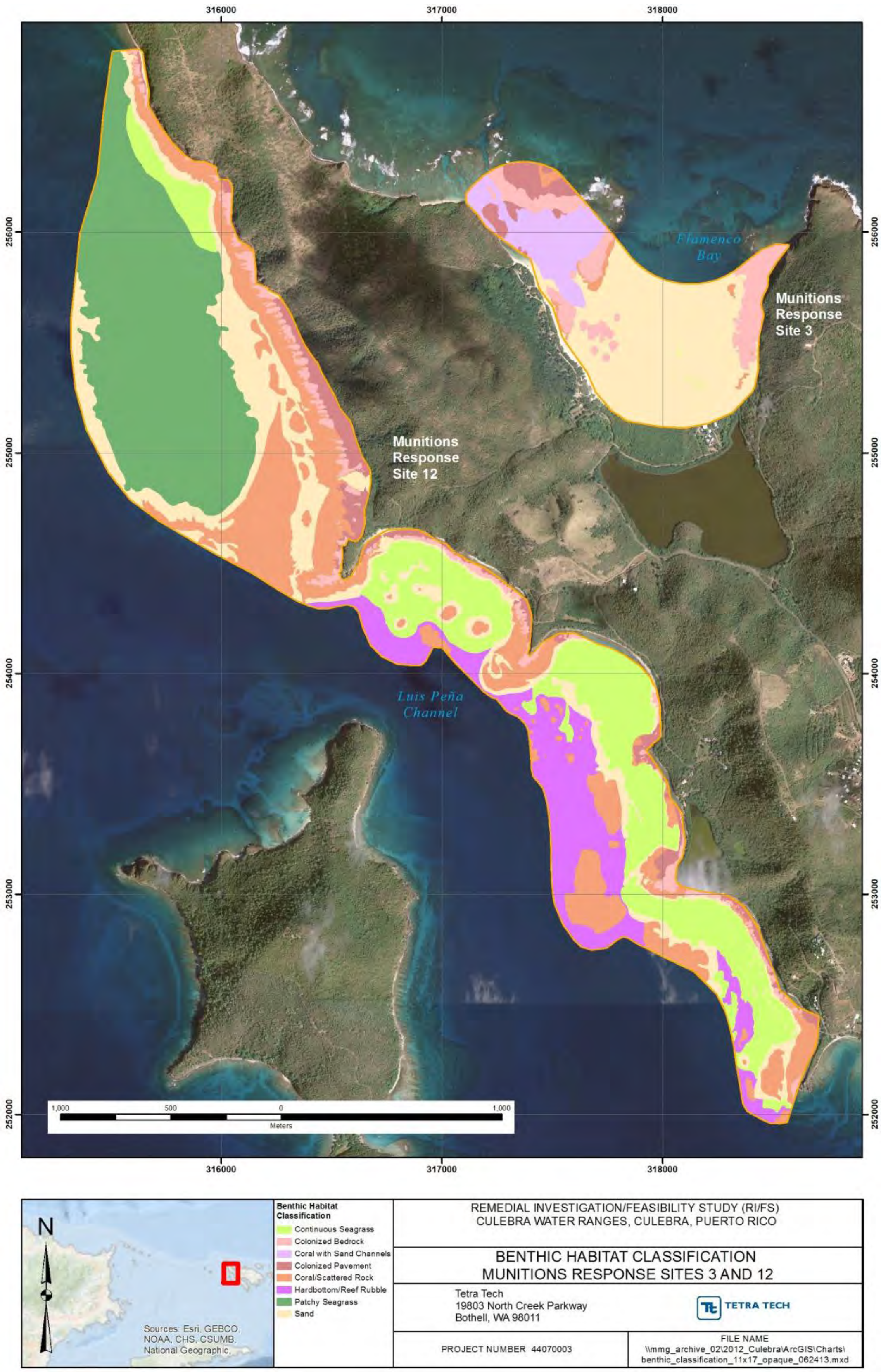


Figure 3-1. EBS Benthic Classification Areas

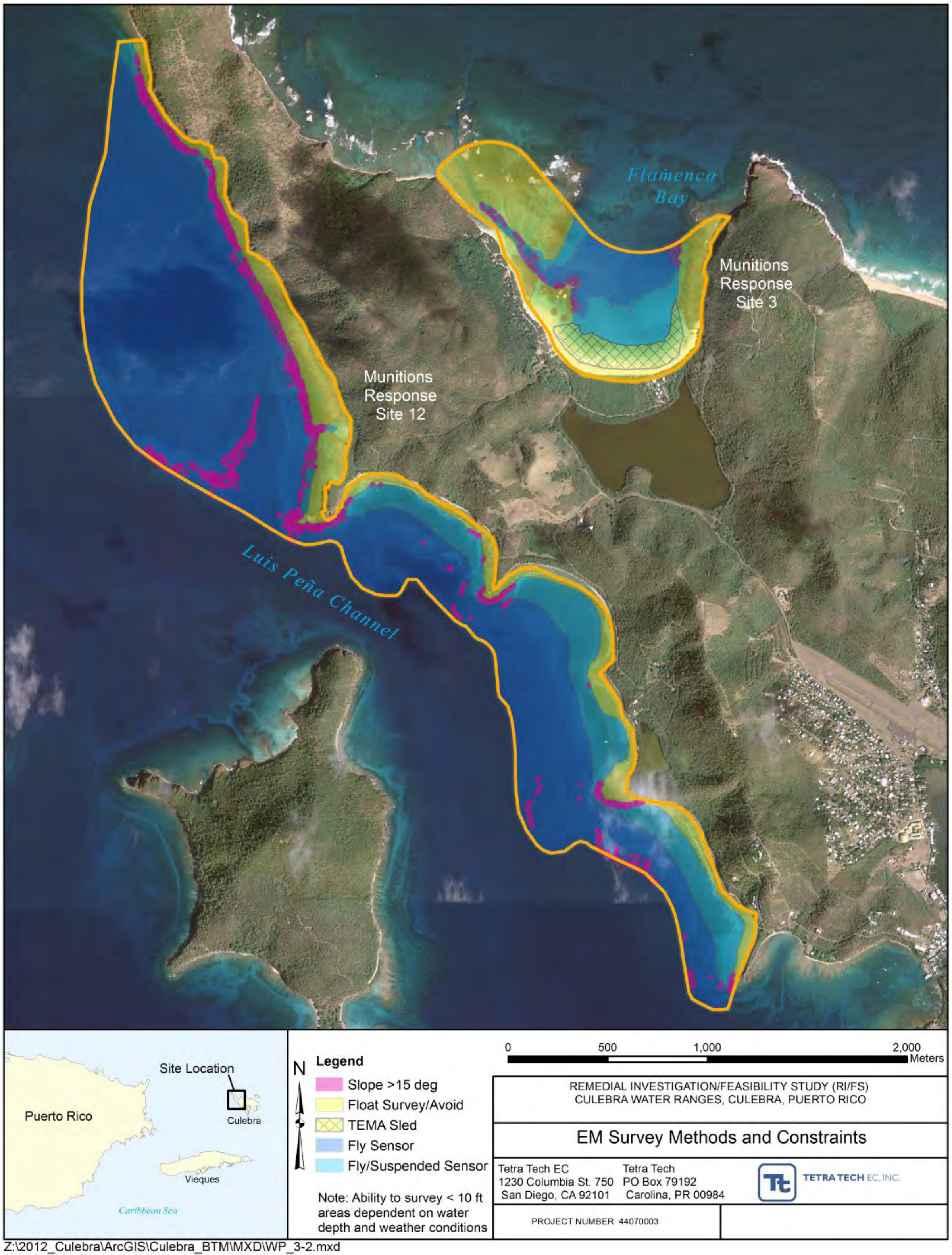


Figure 3-2. Suspended Sensor/Fly Sensor Deployment Methods/Slope Constraints

3.3 LOCATION SURVEYS AND MAPPING PLAN

3.3.1 DGM/EM Survey

3.3.1.01 The primary objective of the DGM/EM survey is to provide a wide area assessment survey to assess the distribution of potential MEC items for the RI and to guide planning for Phase 3 operations.

3.3.1.02 Due to site conditions and the challenges of performing DGM operations underwater and within areas with sensitive habitat, the sensor coil height will be constantly varying. This will affect sensor detection capability with the changing sensor height above the seabed, and can affect the ability to identify high-density anomaly areas. The sensor coil altitude will be continuously recorded via altimeters mounted on the TEMA systems. Data gaps related to altitudes above 2 meters will be identified and mapped during post-analysis. The instrument verification strip (IVS) plan includes testing of the sensors at different altitudes with industry standard object (ISOs) so that the variability in detection based on altitude can be approximated (see Appendix B for the IVS plan).

3.3.1.03 The TEMA system will be either surface towed on floats or, in deeper water, towed behind a 30- to 34-foot surface vessel, and dynamically flown above the bottom, using a winch for altitude control. The TEMA altitude will be recorded and will depend on the area being surveyed. Within sand bottom areas, the TEMA can be flown within 1 meter of the bottom (target of 0.5 meter). In areas where contact is not permitted, the TEMA will be flown higher (1 to 2 meters altitude). These estimates are not easily defined, as they will vary based on weather conditions and operational experiences gained while on-site. The Environmental SOPs (Appendix B-1) will be followed during Phase 2 data collection. TtEC has done testing of ISO detection with the TEMA system. Table 3-1 shows the response with respect to offset distance corrected for background of bench tests conducted with the TEMA. Table 3-2 shows the detection results for daily TEMA IVS data from a field project. The data shown in both Tables 3-1 and 3-2 were collected with the TEMA set to standard power (12 volts). The sensor was kept below 1 meter altitude during data collection. Because the TEMA utilizes the high-power variant of the EM61-MKII, it is expected that items on the order of a medium ISO (~81 mm mortar) will be detected at up to 1 meter altitude nearly all the time, with smaller items being detected some of the time, depending on the flight altitude of the platform when operated in standard power. Based on the results of the IVS, the system may be run in high-power (24 volts), which will increase the range of detection for all items by 45 to 80 percent depending on target characteristics.

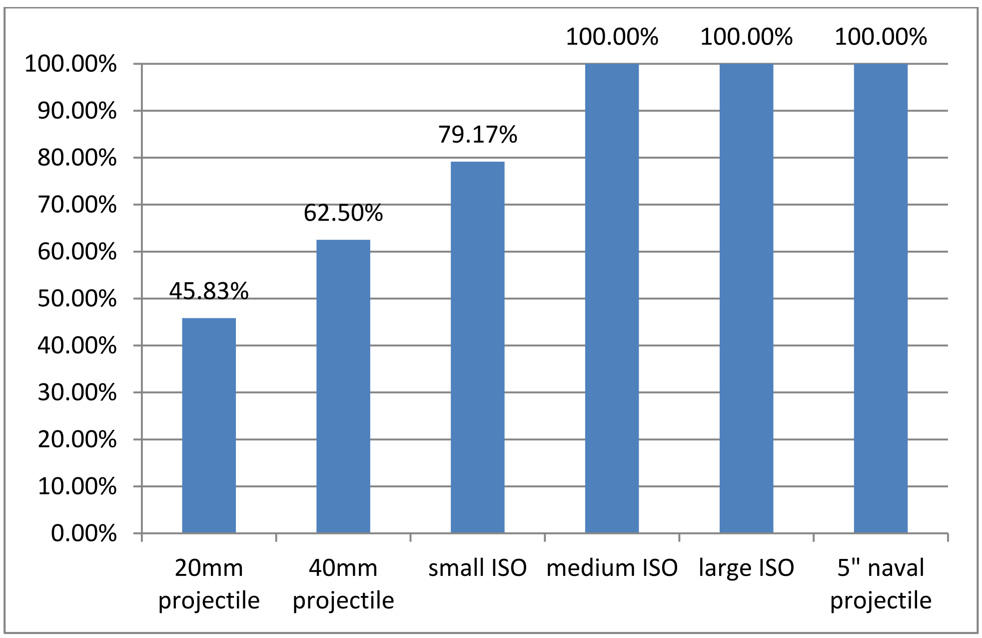
Table 3-1. Summary of TEMA Signal Response for ISOs (12-volt setting, not high power)

ISO Size	Distance (nominal - cm)	Orientation	Distance (measured - cm)	Average Response (mV)
small	20	Horizontal	20	320.89
small	30	Horizontal	30	138.58
small	50	Horizontal	50	28.34

Table 3-1. Summary of TEMA Signal Response for ISOs (12-volt setting, not high power) (continued)

ISO Size	Distance (nominal - cm)	Orientation	Distance (measured - cm)	Average Response (mV)
small	70	Horizontal	70	8.61
small	30	Vertical	30	1,381.04
small	50	Vertical	50	295.69
small	70	Vertical	70	78.00
medium	50	Horizontal	50	368.68
medium	75	Horizontal	75	76.88
medium	100	Horizontal	100	21.16
medium	50	Vertical	50	1,635.74
medium	75	Vertical	75	309.74
medium	100	Vertical	100	78.63
large	50	Horizontal	50	2,424.69
large	100	Horizontal	100	124.51
large	150	Horizontal	150	17.55
large	50	Vertical	50	5,580.05
large	100	Vertical	100	281.11
large	150	Vertical	150	33.65

Table 3-2. Summary of TEMA IVS Item Detections from a Recent Underwater Munitions Field Project Site (TEMA Altitude <1 meter)



3.3.1.04 Specific calibrations for the TEMA and data collection systems are detailed in Section 4 of this Work Plan and in the quality assurance project plan.

3.3.1.05 Positioning for the TEMA survey will vary depending on whether the system is being surface towed or submerged. When surface towed on floats, an antenna for an RTK GPS will be mounted on the system and positions measured directly from the GPS. For submerged operations, the tow vessel will have RTK GPS on board and the towfish will be tracked using a

USBL acoustic positioning system. The USBL system has an integrated initial positioning system and requires no calibration. The accuracy of this system is among the best at 0.2 percent of slant range and can achieve 0.03 degree accuracy for roll, pitch, and heading. Previous work that involved the TEMA being positioned with the Global Acoustic Positioning System provided sub-meter accuracy versus emplaced item positions in the IVS.

3.3.2 Data Spatial Density

3.3.2.01 The line plan for the TEMA survey was designed using the VSP design tool developed by PNNL as described above in Section 2.2.

3.3.2.02 The site will be surveyed using a line plan that is dependent on water depth ranges corresponding to levels of risk of exposure and other site constraints (see Table 2-2). The initial line spacings were based on achieving the minimum specified probability of traversing and detecting a potential source area of a presumed size and specified anomaly density characteristics using the 3-meter width/single pass TEMA system. These line spacings were then reduced further to provide higher coverage in areas with higher human exposure potential and correspondingly greater probabilities of traversing and detecting a potential source area in Depth Zones A and B.

3.3.2.03 As an additional quality check, allowable deviation from planned transect spacing will be limited as follows:

- Within Zones B and C up to 5 meters, with short areas of greater than 5 meters for up to 20 meters in length (i.e., a deviation of 6 meters for only 12 meters in length will not require gap fill).
- Within Zone A to 5 meters, with short areas of greater than 5 meters for up to 10 meters in length.
- Within Zone A′ to 1 meter, with short areas of greater than 1 meter for up to 2 meters in length.

The allowable deviation will help verify that the VSP confidences of detecting in high density areas have been met.

3.3.3 Equipment Specifications

3.3.3.01 The TEMA is a TtEC-developed EM array using high-power variants of the MKII marinized industry standard Geonics EM coil. The TEMA is normally configured as a towfish (shown in Figure 3-3) where the system is actively flown in the water column, but can also be configured on floats. (Figure 3-4 shows one floating option. The TEMA as shown in Figure 3-3 can also be floated.) The floats are secured to the tow vessel by floating line (e.g., polypropylene) to avoid snags on coral or other submerged obstacles, and the cables attached to the sensors are also suspended by buoys/floats along their length.

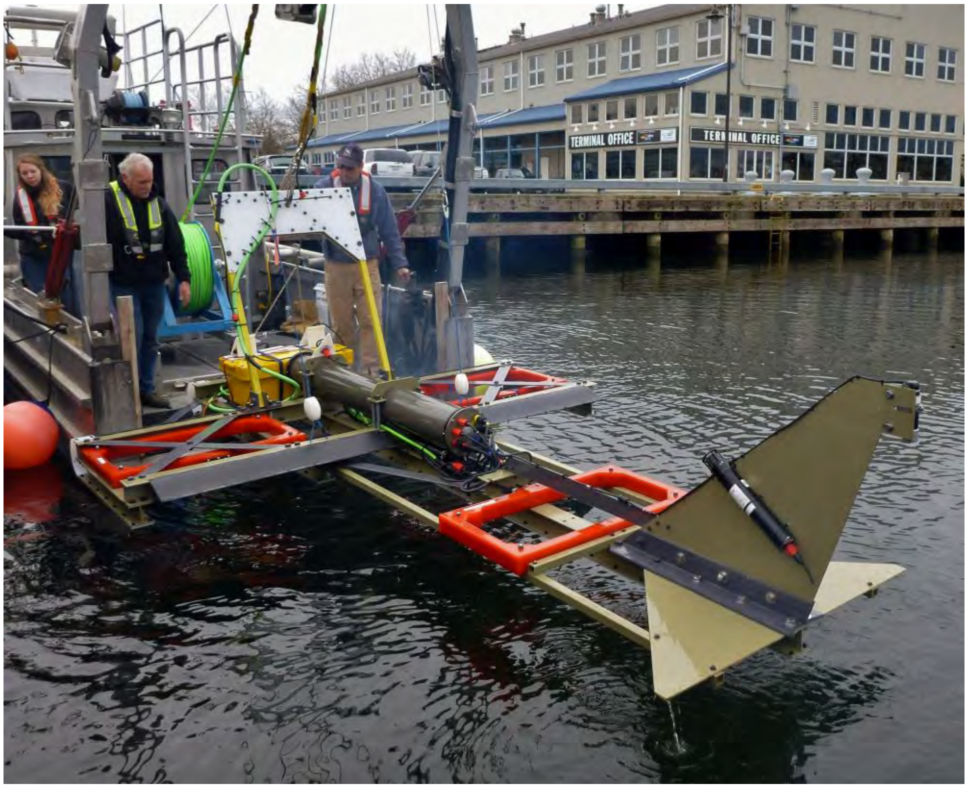


Figure 3-3. Launching the TEMA-MK3 Configured for Active Towing Operations

Figure 3-4. Launching TEMA-Lite on Floats

3.3.3.02 The TEMA-MK3 towfish (Figure 3-3) is approximately 5 meters long and 3 meters wide, with an overall height of just over 1 meter at the tail. While being towed and actively flown, the data collection will be along lines of equal water depth (i.e., contouring). This minimizes the need to perform sharp turns. When a turn is required, the TEMA-MK3 is brought up to the surface and, if the boat maintains speed over 1.5 knots, the TEMA-MK3 drafts less than the boat. The space required to make a turn is dependent on speed and wind and currents. The distance required to safely make a turn will be determined on-site. The TEMA-Lite (Figure 3-4) is 3 meters wide by about 4 meters long. The TEMA-Lite will be pushed in front of a custom, purpose-built hovercraft, which will result in a vessel and instrument draft of approximately 3 to 4 inches.

3.3.3.03 Table 3-3 contains a summary of the various systems that will be used and the purpose or value of their use. The systems are described in detail in the following sections.

Table 3-3. Summary of Technologies

Technology	Purpose/Value
TEMA-MK3	Towed EM array used for mapping metallic objects
TEMA-Lite	Floated EM array used for mapping metallic objects in shallow water
Positioning Equipment	Used to track the instrument locations and the vessel motion, and geo-reference features identified in the EM data.

3.3.4 Survey Vessel

3.3.4.01 A TtEC-owned vessel, or a similar vessel, will be mobilized to perform the Phase 2 RI activities. These vessels are equipped for coastal shallow water surveys with all required U.S. Coast Guard equipment, positioning instrumentation, equipment racks with operator stations, equipment mounts, and a hydraulic A-Frame and winch for deploying towed equipment. Both the TtEC 29.5-foot and the 34-foot aluminum survey vessels have a vessel draft of 2.5 feet (Figures 3-5 and 3-6). To obtain data in areas where depth to sensitive habitat is approaching the 4-foot specified minimum water depth below the vessel and/or survey equipment, the equipment will be mounted on a hovercraft (Figure 3-7), TtEC's Mark V Zodiac, or an equivalent inflatable. TtEC will not bring the survey vessel or equipment into areas where the minimum water depth below the vessel and equipment cannot be maintained to avoid potential damage to sensitive habitat.

Figure 3-5. TtEC's 29.5-foot Aluminum Survey Vessel

Figure 3-6. TtEC's 34-foot Aluminum Survey Vessel

Figure 3-7. TtEC's Hovercraft Survey Vessel

3.4 GEOSPATIAL INFORMATION AND ELECTRONIC SUBMITTALS

3.4.01 This section presents the methods, equipment, and accuracy required for conducting location surveys and mapping, and managing geospatial information in support of the RI.

3.4.1 Geodesy Settings

3.4.1.01 The project data will be horizontally (X, Y) referenced to North American Datum 1983 (NAD83) State Plane, Puerto Rico/Virgin Islands with units of meters. Elevation data will be collected in NAD83 ellipsoid and converted to PRVD02 orthometric heights using the NGS 2012A geoid. Table 3-4 presents the geodesy settings to be used for the project. Horizontal and vertical positioning will be achieved using RTK GPS, either stand-alone or in conjunction with a USBL system.

Table 3-4. Survey Geodesy Settings

Parameter	Setting
Projection	Universal Transverse Mercator
Zone	Zone 20 North
Horizontal Datum	NAD83
Vertical Datum	NAVD88
Distance Unit	Meters
Depth Unit	Meters
Geoid Model	National Geodetic Survey GEOID09 (or the latest GEOID available for the project area)

3.4.2 Accuracy

3.4.2.01 All data positional accuracies will be documented. The accuracy assessment will include the type and accuracy of the position sensor(s) used for the data and any other factors that could affect the data location accuracy. For example, the accuracy of the towed EM data from the TEMA system is a function of the accuracies of the GPS used for vessel position, the USBL, the EM sensors, and the offset measurements of each of the sensors.

3.4.3 Map Requirements

3.4.3.01 The project maps shall be prepared in accordance with Engineer Manual 1110-1-4009 and DID WERS-007.01 to accurately depict the layers from the baseline environmental survey and the EM survey.

3.4.4 Monument Description

3.4.4.01 The control points and monuments used for this survey will be the same as those used in the EBS survey. Additional control points may need to be established based on site conditions.

3.4.5 Digital Format for Geographic Information System Data

3.4.5.01 A geographic information system (GIS) has been developed for the project to aid in the development of the CSM and to maintain and manage all project and geospatial data. The GIS was developed in accordance with DID WERS-007.01, Engineer Manual 200-1-2, Engineer Manual 1110-1-4009, and applicable interim guidance documents.

3.4.5.02 The geospatial data for the RI/FS will include the following:

- A comprehensive CSM.
- Available existing data applicable to the project will be consolidated into the geodatabase and analyzed to relay pertinent information to the Project Delivery Team. If an existing GIS database is available, it will be provided by the government.
- The analysis of data from the GIS will support all conclusions of the CSM.
- The pre-RI analysis will encompass social, environmental, and/or economic entities that will be or may be impacted by response-action activities.
- The post-RI and FS analysis will detail entities impacted by RI/FS activities and impacts of future response action activities (if applicable). The pre- and post-RI and FS analysis may detail the fieldwork strategies, areas of concern, survey requirements, environmental concerns, milestones, and/or other factors that affect product delivery and future action planning.
- Entities that may be affected by response actions include, but are not limited to, landowners, homeowners, rental tenants, schools, utilities, roads, businesses, recreational areas, tourists, air traffic, water bodies, and/or industries.
- The geodatabase will be a living repository that is refined throughout the life of the RI/FS and the entire project.
- Layers that overlay on maps of the site that identify physical features and areas of

possible debris found during the RI will be incorporated. Examples include streets, anomalies, MEC positively identified, identifiable MD, sampling location, cultural resources, and environmental, biological, and socio-economic variables.

- Archaeological site location(s) will not be released to the public without written permission from USACE.
- Civil surveys will be performed in accordance with Engineer Manual 1110-1-4009 and DID WERS-007.01.
- Property owner privacy will be preserved. Property owner names will not be disseminated in any documents.

3.4.5.1 Sources and Standard

3.4.5.1.01 The project geospatial data will include all information from the Project Site Microsoft Access project database (Engineer Manual 1110-1-4009). All digital GIS data will be created in an ArcView compatible format. All data will conform to the Spatial Data Transfer Standard and be ESRI-compliant (geodatabases). The standards are designed for computer assisted mapping methods that must interface with other surveying firms, government contractors and customers. DGM/EM survey coverage will be provided as a geo-referenced Tagged Image File Format (GeoTIFF). Supporting tabular data will be provided in ANSI SQL language compatible format, such as Microsoft Access. The GIS point, polyline and area vector data will be provided in ArcGIS format including geodatabases and .shp files and will include all appropriate metadata. The final electronic submittal will also include layout files for all plates, figures, and drawings conveyed in the report.

3.4.5.2 File Backup

3.4.5.2.01 The GIS data will be backed up daily and data processing progress will be documented on a data tracking spreadsheet.

3.4.6 Quality Control

3.4.6.01 QC checks will be completed periodically to confirm accurate data storage and backup. This process will be accomplished by reviewing survey logs and data processing logs. The FOL/Field QC manager will verify the performance of these QC activities. All data will then be checked by the GQCM (see Section 4.3.2).

3.5 DATA COLLECTION AND PROCESSING PROCEDURES

3.5.1 General Requirements and Procedures

3.5.1.01 The requirements in this section are applicable to all field activities including boating activities, marine geophysical mapping, and data verification. Historical review, administrative activities, or training conducted off-site are not subject to the requirements in this section. Environmental SOPs for the activities have been provided by the USACE and are presented in Appendix B-1 of this document.

3.5.1.1 Daily Briefings/Verification

3.5.1.1.01 At the beginning of each working day, the project FOL or designee will hold a daily briefing. At a minimum, the daily briefings will include:

1. Review of safety practices and emergency procedures
2. Review and testing of communication systems
3. Review of any site-specific or applicable task-specific hazards

3.5.1.1.02 Other topics that will be discussed, as necessary, include QC, changes to the work schedule, equipment maintenance, and any other issues that may affect the activities being performed that day or in the near future.

3.5.1.1.03 A qualified biologist will brief the survey team on the identification and recognition of endangered/threatened species and sensitive habitats as well as the procedures to avoid harm. The briefing will be documented prior to the start of field activities for any personnel who have not yet had this training. The biologist will be briefing the survey team on the Environmental SOPs and the points of contact to notify if any injured or stranded wildlife are spotted. The biologist will also be in the field with the survey team to ensure SOP compliance.

3.5.1.1.04 During the daily briefing, the FOL will also discuss selected work sites and/or tasks for the day. Each survey team member will receive the instructions necessary to perform the assigned work. Attendance at the daily briefing will be documented in the FOL's field logbook/logsheet and/or on daily briefing forms.

3.5.1.2 Tailgate Briefing

3.5.1.2.01 If the survey team is divided into groups working in separate areas of the site or on separate tasks, a tailgate briefing may be required during which the team lead for that activity discusses specific safety hazards or mitigation measures specific to the assigned task or work area. The daily briefing at the site will fulfill the requirement for a tailgate briefing if all relevant information is presented regarding the hazards associated with all assigned work.

3.5.1.3 Equipment Testing and Maintenance

3.5.1.3.01 All equipment used by the survey team will be verified to be working properly prior to use each day. The functionality of marine mapping instrumentation will be ensured by using the calibration and QC testing discussed in Section 4.5.

3.5.1.3.02 All mapping equipment testing will be verified and documented in the field log book or on appropriate field forms by the FOL or designee. If any equipment requires repair or new equipment is brought on-site, it must be inspected and confirmed to be operational by the FOL or designee prior to use. The FOL or designee will also inspect any other equipment, including marine vessels and safety equipment, to be used each day to ensure that the equipment is in proper working order. Inspections will be documented in the filed log book or on appropriate forms.

3.5.2 Positioning

3.5.2.01 All positioning data for the survey will be based on RTK GPS or MarineSTAR differential global satellite navigation system, whichever is more accurate, to provide sub-meter position accuracies both horizontally and vertically.

3.5.2.02 Towfish positioning will be accomplished via GPS for the float configuration, or a combination of GPS and a USBL acoustic positioning system or high-resolution cable counter determined layback. The USBL that will be used is a GPS-aided inertial platform that measures position, heading, roll, pitch, and heave as well as the angle and distance to the transponder, so that it can independently determine the towfish position and attitude. The cable counter is used by the winch operator to monitor the amount of cable that is out. Layback can also be used for backup if the USBL encounters problems (e.g., multipath can be an issue in water shallower than the fish layback, generally under 4 meters).

3.5.3 Site Control Network

3.5.3.01 Geodetic control at the site was established for the hydrographic and underwater video surveys. These control point locations may need to be re-established. They will facilitate GPS base station control for DGM (areas with a sufficient view of the sky that are accessible for base station setup) as well as for QC points for the GPS rover systems.

3.5.4 EM Survey

3.5.4.01 The TEMA survey will be conducted as a series of nominally parallel lines with line spacing between approximately 10 and 250 feet, depending on depth, as defined in Section 2.2. The survey line plans are shown on the charts in Appendix C. All accessible areas of each MRS will be surveyed, but there are a few constraints that will preclude full coverage as addressed in the following sections.

3.5.4.02 The method of deployment of the TEMA will be dependent on site conditions, sea state and weather conditions. Generally it will be floated in water depths less than approximately 1.5 to 2 meters, may be suspended from floats or flown in depths up to approximately 3 meters, or actively flown as a towfish, with the depth controlled by a winch, in water depths greater than 3 meters.

3.5.4.03 Figure 3-2 shows the water depth derived areas where each type of data collection will take place.

- Dark blue areas are where the TEMA will be actively flown.
- The light blue areas are where the TEMA will either be suspended below floats or actively flown, depending on site-specific conditions.
- The yellow areas are the shallowest areas where the floating TEMA-Lite will be deployed.
- The hashed yellow area is where the TEMA is expected to be used as a sled in contact

with the bottom.

- The purple areas show regions with slopes greater than 15 degrees that will either be avoided or where the TEMA will have to be flown at a greater altitude to avoid contact with the bottom.

3.5.4.04 During the bathymetric surveys, areas that were less than 10 feet deep were not surveyed. With a 3-foot draft of the MBE, operation into less than 10 feet of water would not leave the required 4-foot buffer. Therefore, very few areas of less than 10 feet water depth were ensonified by the MBE. The yellow areas on Figure 3-2 are anticipated to be where float surveys may be done.

3.5.4.05 The areas surveyed will be limited by a combination of the need to protect sensitive habitat areas and to ensure the safety of the equipment and operators. For example, much of MRS 03 is very shallow and subject to significant wind and wave action. Surveys of areas of coral and other sensitive habitat with less than approximately 4 feet water depth may be attempted with the hovercraft-pushed TEMA-Lite configuration if wave action permits. Shallow areas that do not contain sensitive habitats and areas with sensitive habitats with somewhat deeper water may not be able to be surveyed unless seas are essentially flat because wave action can result in contact of the vessel or equipment with the bottom.

3.5.4.06 Coverage with the subsurface-towed TEMA will be further restricted in areas with slopes of greater than approximately 15 degrees. There are limits on how quickly the towfish can change depths and in areas of excessive slope, the TEMA either has to be flown too high to reliably detect metallic objects the size of smaller MEC items or there is a very significant risk of contacting the bottom and damaging sensitive habitat and/or the equipment.

3.5.4.07 Due to the challenging and complex nature of the site, a procedure for determination of the appropriate DGM configuration, deployment, and altitude of flight has been developed. The TEMA DGM Decision Tree (Figure 3-8) clearly presents what steps must be taken and which conditions must be met in order to proceed with either the vessel-towed TEMA-MK3 or the hovercraft-deployed TEMA-Lite.

Figure 3-8. DGM Operations Decision Tree

3.5.5 TEMA Data Processing

3.5.5.01 The MBE sounding data collected during the EBS was processed using HYPACK and CARIS Hydrographic Information Processing System (HIPS) software, respectively, to generate the XYZ soundings in the survey coordinate system and units. Bathymetric surfaces were generated for the EBS report and were used for planning the Phase 2 surveys. Water depth contours were generated, and the 10-foot and 25-foot contours were used to refine the VSP depth zones for the line path determination. The MBE data were also used to determine areas with slopes that are greater than 15 percent. These areas pose a challenge to data collection, and line plan development will take this into account, either by avoidance, line azimuth, or both.

3.5.5.02 The DGM/EM data will be processed through the TtEC-developed programs that accept the raw DGM/EM data files, compute attitude and offset corrected positions for each of the coils, and output the data in a format suitable for further processing in Oasis Montaj. The Oasis software is used to map the data, perform the target picks, and generate output mapping and tabular data products. Final data presentation materials will be generated using a combination of Oasis Montaj and ArcGIS software.

3.5.6 Quality Assurance/Quality Control for TEMA Data

3.5.6.01 TtEC's data quality is established at the time of data collection through proper setup and operation of the survey systems, and cannot be enhanced during processing, other than to remove obviously invalid data. Survey, data processing, and QA procedures will comply with the applicable guidelines provided by the USACE.

3.5.6.02 Data quality will be assessed explicitly: a single data element is compared directly to a standard or known control (as is the case with the GPS check to a known control point to verify that it is functioning correctly). Alternatively, quality can be assessed implicitly: combinations of data elements are compared to members of their own set for internal consistency (as is the case with data spikes, such as in EM data, the spike is compared to the previous and successive data points and determined to be noise). Additionally, quality can be measured quantitatively (numerically, e.g., EM battery voltages need to remain above 10.5V) or qualitatively, requiring interpretation on the part of an operator (e.g., odd behavior of the vessel navigation during data collection, noting that EM readings are excessively noisy).

3.5.6.03 For each step of the setup and operation of the survey system, a series of checks is run on the equipment and data collection software configuration. These checks will be documented in the survey collection logs and a dedicated QC electronic log and the results will be included in the RI Report. Where possible, a quantitative measurement of data quality is identified for each data type acquired. Procedures are constructed to measure this quantity as near as practicable to the point of acquisition. These measurements of quality are continually assessed throughout the acquisition and processing phases of the project. Where a quantitative measure of data quality cannot be developed, an interpretive or qualitative method is contrived to estimate data quality.

3.5.6.04 Field methods used for measuring data quality begin with position accuracy. The GPS system will be checked on a daily basis (once per day) to check that positional accuracy is better than 0.3 meter. The survey crew will check selected terrestrial control points with an RTK

GPS rover. The RTK GPS measurements will match the published position to within 0.1 meter x, y, and z. This check will be conducted prior to the start and at the end of the survey. A daily water level check or a temporary bench mark near the vessel dock(s) will be used to check the GPS units on the vessels. This check is done by comparing the reported temporary benchmark position, or water surface elevation between the survey system navigation reported tide level, and the QC GPS rover. The QC GPS water level and survey system tide level will match to within 0.3 meter. Details on the positioning QC are given in Table 4-2.

3.5.6.05 EM data from the TEMA are subject to interpretive and quantitative measurements of data quality. The daily QC procedure for the TEMA will be as follows:

- After sensor warm up, null the TEMA-MK3 EM61 sensors and perform a function test by inserting a hammer or other large metal object (same object for all coils each day) into each coil individually. The function test will be considered complete when the response from the coils is within ±10 percent of the original values. This is due to the necessity of having the TEMA-MK3 on the deck of the survey vessel during this function check. Since the TEMA-Lite will be beached during the function test, a fixed ±20 percent will be used.
- In order to measure background noise, re-null TEMA-MK3 once launched and at mid-water depth, then perform a pseudo-static test (3-minute duration) and calculate the standard deviation for each coil based on a 30- to 60-second average. Based on previous work, this pseudo-static test works as well as static tests on land and provides better results than attempting to place the TEMA-MK3 on the bottom (see example Daily Quality Control Report [DQCR] in Appendix F). The static test for the TEMA-Lite will be conducted on the beach after the function test.
- Collect TEMA data over the IVS. The TEMA must remain within 1 meter of the bottom. Collect data in both directions sufficient enough to analyze at least one crossing of the IVS item(s) for each of the three coils. A minimum of three lines in alternating directions are required.

3.5.6.06 An IVS letter report will be submitted at the beginning of the project that will include:

- As-built drawing of the IVS,
- Pictures of seed item(s),
- Geophysical data maps,
- Summary of the IVS results,
- Proposed data collection techniques and methodologies, and
- Instrument- and process-specific criteria for defining the quality of the geophysical data.

3.5.6.07 The IVS will contain two 10-foot-long or a single 20-foot-long sections of carbon steel black pipe (or similar). The design is subject to revision to account for site-specific conditions at the installation site for the IVS. The IVS will be emplaced from a surface vessel utilizing snorkelers if needed. IVS items will not be buried, but instead placed on the bottom attached to a line and anchored at both ends.

3.5.6.08 During acquisition, operators monitor data quality on the EM collection and HYPACK acquisition screens. The general noise level of the responses and useable swath width are visible on the displays. These displays require interpretation and are used as the first quality check on EM data.

3.5.6.09 The visualization tools available in the processing software provide clear indications of any problems in the data or in the time correlation of the EM and position data. Any errors in these areas will result in identifiable data artifacts. Conducting at least preliminary processing of the data will allow any problems to be caught and corrected quickly, and will ensure that a full, high-quality data set is collected.

4.0 QUALITY CONTROL PLAN

4.1 GENERAL

4.1.01 This QC Plan has been prepared by TtEC in accordance with Engineer Manual 1110-1-4009, Chapter 4, the PWS, and Contract W912DY-10-D-0015, Task Order 0003 specifications for the performance of an RI/FS at MRS 03 and MRS 12 on Culebra. All QC documentation will be submitted as part of or as supporting documentation for the Final RI Report. All QC records and documentation will be kept on-site and made available for USAESCH's inspection upon request.

4.2 TTEC PERSONNEL AND QC

4.2.01 All TtEC personnel involved in field operations at Culebra will implement this QC Plan per Engineer Manual 1110-1-4009, Chapter 4 and specific TtEC corporate procedures found in TtEC's electronic Corporate Reference Library (CRL). Although the CRL is proprietary, the PjM will make all CRL references available to the USAESCH Commanding Officer (KO). The CRL procedures applicable to the QC effort are listed in Table 4-1.

Table 4-1. TtEC Corporate Procedures

Procedure Number	Subject
PO-8	Document Control
QPM-1	Quality Program Manual
QP-3	Qualification/Certification Quality Program Audit Personnel
QP-9	DOD Contractor Quality Control
QP-10	Control of Measuring and Testing Equipment
QP-11	Control of Nonconforming Conditions
QP-12	Corrective Action
QP-13	Surveillance Procedure
ENG-3	Developing and Issuing Engineering Documents
QP-14	Lessons Learned Procedure

4.3 DUTIES AND RESPONSIBILITIES

4.3.01 Project quality is the responsibility of the entire survey team. The team's comprehension of this QC Plan is of primary significance for quality objectives to be accomplished; thus, the training and indoctrination of the key personnel in the quality objectives will be conducted. The project organization is headed by the PjM, the single focal point for successful accomplishment of all phases of the project. The PjM is given full authority and responsibility for project execution, and the PjM is supported by direct and indirect line managers with the functions and responsibilities outlined below.

4.3.1 Project Manager

4.3.1.01 The PjM, Scot Wilson, approves the QC Plan, implements procedures, and has direct responsibility for day-to-day operations of the project. The PjM's responsibilities related to QC include, but are not limited to:

- Implementation of all applicable TtEC policies and procedures;
- Identification of the qualifications and selection of project staff, subcontractors, and suppliers;
- Submission of all contract deliverables; and
- Analysis of QC failures (with the GQCM and the appropriate QC person) and implementation of corrective actions.

4.3.2 Geophysics Quality Control Manager

4.3.2.01 The GQCM, Elise Goggin, reports directly to the TtEC MMRP QC Manager and has an indirect reporting line to the PjM in terms of deliverables and requirements to comply with the PWS. Although separate and independent from the PjM, the GQCM is part of the problem-resolution process and must maintain close and open communication with the PjM. The GQCM is responsible for:

- Implementing the QC Plan;
- Initiating QC surveillance and inspection consistent with the QC Plan and program QC policies and procedures;
- Identifying, evaluating, initiating, and approving corrective action to ensure work complies with the contract;
- Recommending changes to the QC Plan;
- Providing weekly project QC updates to the Project Manager; and
- Directly communicating with USAESCH QA project oversight.

4.3.3 MMRP Quality Control Manager

4.3.3.01 The MMRP QC Manager, Mark Dollar, approves the QC Plan and is part of the problem-resolution process. The MMRP QC Manager:

- Establishes and maintains the MMRP Quality Program;
- Works directly with TtEC and the USACE to ensure implementation of the Program QC Plans;
- Acts as focal point for coordination of quality matters across all aspects of the project and resolves quality control issues;
- Suspends project activities if quality standards are not maintained;

- Interfaces with USACE on quality-related items;
- Performs review of surveillance reports conducted by project Quality Control personnel; and
- Responds to a field program issue with potential corrective action (verbal, written, or electronic).

4.3.4 Field Operations Lead/Quality Control Manager (FOL/QCM)/Senior Project Geophysicist

4.3.4.01 See discussion of FOL/QCM/Senior Project Geophysicist in Section 2.4.5. The FOL/QCM/Senior Project Geophysicist, Richard Funk, is responsible for:

- Completing reports and other documentation and maintaining a daily log of activities;
- Implementing the three-phase control process: preparatory, initial, and follow-up inspections;
- Implementing the operator proficiency test prior to project operations;
- Conducting QC indoctrination training for project personnel and site visitors;
- Issuing stop-work requests when conditions warrant; and
- Instituting Field Change Requests (FCRs) and nonconformance reports (NCRs).

4.3.4.1 Stop-Work Authority

4.3.4.1.01 The FOL/QCM has the authority to stop work whenever a condition is identified that has a negative effect on the quality of the product being delivered or that is likely to impact a T&E species or habitat as outlined in Section 6 and the Environmental SOPs in Appendix B-1.

4.3.4.2 Stop-Work Request

4.3.4.2.01 A stop-work request may be issued for a portion of a process, limiting the stop-work request to that portion of the process that is not in compliance. The FOL/QCM will document the situation and communicate the issue to the PjM and MMRP QC Manager (within 12 hours via telephone and/or email). The FOL/QCM will document this action on the Stop-Work Request Form and will maintain a compilation of the stop-work actions on the Stop-Work Request Log.

4.4 AUDIT PROCEDURES

4.4.01 Audits will be conducted and audit records maintained per TtEC Procedure QPM-1: Quality Program Manual. Audits will be conducted by personnel qualified in accordance with TtEC Corporate Procedure QP-3: Qualification/Certification of Quality Program Audit Personnel.

4.5 QC PROCESS

4.5.01 QC and QA on this project will be a three-tier process. This three-tier approach uses the three phases of control inspections to ensure all project objectives have been met. The first step (Tier 1) of the QC/QA process incorporates the initial survey team training captured in the preparatory phase inspection. This is followed by the second step (Tier 2), Process QC after implementation of the work activity, formally documented on an Initial Inspection form. Process QC, daily routine QC observations, completes the three-phase control process by conducting initial and follow-up inspections on all the DFWs to ensure processes are in control and opportunities for improving processes are captured and implemented. QC checks are built into the DFW to monitor and identify potential problems before the process goes to the next step—all QC checks are identified in Table 4-2. The last step (Tier 3) is Product QC, which is carried out using surveys to verify the product meets the requirements of the Work Plan. Personnel conducting QC and QA have stop-work authority and are organizationally independent from the processes.

4.5.02 Application of measurement quality objectives developed as part of Phase 2 will ensure high-quality data will be obtained. Table 4-2 provides the measurement quality metrics that will be achieved to ensure project objectives are met.

Table 4-2. Measurement Quality Metrics

Technology Type	Measurement Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency	Action if Quality Failure Occurs
Digital Geophysical Mapping – TEMA	Function Check TEMA-MK3	After sensor warm up (2-5 minutes), null the EM61 sensors and perform a function test using a hammer or other large metal object	Large stable signal spike. No particular value is specified as this will change with null due to precise position of TEMA on deck; therefore, a value within ± 10 percent of the original readings will be used.	Once daily	Deck Check cabling. Check for water intrusion into EM coils. Check for foreign objects on TEMA towfish. Re-null and retest system. Repair/replace components as necessary.
	Function Check TEMA-Lite	After sensor warm up (2-5 minutes), null the EM61 sensors and perform a function test using a hammer or other large metal object	Large stable signal spike repeatable to within ± 20 percent of the values.	Once daily	Deck Check cabling. Check for water intrusion into EM coils. Check for foreign objects on TEMA towfish. Re-null and retest system. Repair/replace components as necessary.
	Noise Check TEMA-MK3	Re-null TEMA once launched and at mid-water depth, then perform a pseudo-static test (3-minute duration).	Calculate the standard deviation for each coil based on a 30- to 60-second average. Standard deviation of readings should not exceed 6 mV on channel 2.	Once daily, again after system power is cycled	Check cabling, look for loose cable runs. Check for foreign objects on TEMA towfish. Re-null and retest system. Repair/replace components as necessary.
	Noise Check TEMA-Lite	After Function Check, perform a static test (3-minute duration) with system beached on the shoreline.	Calculate the standard deviation for each coil based on a 30- to 60-second average. Standard deviation of readings should not exceed 6 mV on channel 2.	Once daily, again after system power is cycled	Check cabling, look for loose cable runs. Check for foreign objects on TEMA towfish. Re-null and retest system. Repair/replace components as necessary.

Table 4-2. Measurement Quality Metrics (continued)

Technology Type	Measurement Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency	Action if Quality Failure Occurs
	Precision/ Repeatability	Seeded linear metallic target(s) (IVS)	For initial test, run reciprocal headings over seed feature to obtain full coverage of IVS. The TEMA must remain within one meter of the bottom for 90% of the time over the IVS. Collect data in both directions for each sensor. A minimum of three lines in alternating directions are required. IVS items are to be located to within 1 meter of their reported position.	Initial test – once per survey. Subsequent checks daily at the start of the day.	If no detection: 1. Deck test EM system and repair/replace if necessary. If position error: 2. Check vessel navigation (RTK GPS) and USBL and adjust/repair/replace as needed. 3. If a stable offset is noted, recheck seed item location.
	Completeness	Visual evaluation of data real-time for verification that intended coverage goals are met; confirmation in post-processing.	Coverage plots (i.e., matrix fill / coverage plots) will be utilized to monitor coverage completeness in real time. Along Track Sample Spacing – 98% of the down line measures will not exceed 0.25 meter. Survey Height – 90% of the survey altitude readings will be at or below 2 meters.	By dataset	If coverage is not adequate, conduct holiday fill survey to fill in the missing data coverage. Areas that experience along track gaps that do not meet the 98% coverage rule will be re-collected. Areas that experience gaps caused by survey altitude that do not meet the 90% coverage rule will be re-collected. Areas that exceed 0.25 meter along track or 2 meter altitude due to terrain or obstructions will be mapped and removed from the coverage analysis.

Table 4-2. Measurement Quality Metrics (continued)

Technology Type	Measurement Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency	Action if Quality Failure Occurs
	Sensitivity	Compare daily IVS results to the initial IVS test data	The TEMA measured response S/N will be compared to the S/N of the initial IVS run. The TEMA S/N level will be within ± 20 percent of the values established during the initial IVS run.	Once per day	1. Re-run IVS. 2. Test EM system and repair/replace if necessary. 3. Check vessel navigation and USBL and adjust/repair/replace as needed.
Geodetic Equipment	Functionality/ Accuracy	1. GPS Positioning – Survey crew will check selected terrestrial control points with RTK GPS rover. 2. Water level check – Use RTK GPS rover or temporary bench mark at vessel dock to check water surface elevation. Compare to survey system navigation reported tide level.	1. RTK GPS measurements will match published position to within 0.1 meter x, y, and z. 2. RTK GPS water level and survey system tide level will match to within 0.3 meter.	1. Prior to the start and at the end of survey 2. Daily	1. Verify system configuration and settings. 2. If using POS MV, post-process position in POSPac and re-check result. 3. Re-test as appropriate. 4. Repair/replace components as required

4.5.1 Tier 1 QC Process

4.5.1.1 Training

4.5.1.1.01 The FOL/QCM will verify site personnel have the following training, as required:

- Work Plan and APP/SSHP training
- 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Course
- 8-hour HAZWOPER Annual Refresher Course (if applicable)
- Site-specific QC procedures and pass/fail criteria
- Supervisors have the appropriate 30-Hour Occupational Safety and Health Administration Supervisor Training
- Ongoing QC training
- Training/briefing by a qualified staff member on the environmental protection requirements and protection of threated and/or endangered species and critical habitat as per Section 6.3 (paragraph 6.3.02) of this plan and the Environmental SOPs in Appendix B-1.

4.5.1.1.02 The FOL/QCM will conduct periodic quality-related briefings during the morning safety meeting. These briefings will cover quality-related topics provided by the TtEC Corporate QC Program Manager and those determined by the FOL/QCM. Suggested topics include, but are not limited to, results from QC activity such as surveillance, inspections, the three-phase control process, process improvement, and changes to procedures and approved FCRs.

4.5.1.2 Preparatory-Phase Inspections

Timing of Preparatory Phase QC

4.5.1.2.01 A preparatory-phase inspection will be performed prior to beginning each DFW, which will include:

- Site-specific training,
- IVS certification, and
- Geophysical survey.

4.5.1.2.02 The specific QC activities performed during the preparatory phase, and the results of those activities, will be documented on the Preparatory Phase Inspection Report, which will be attached to the DQCR. Any checklists used during the preparatory inspection will be attached to the Preparatory Phase Inspection Report. These reports/forms are in Appendix F.

FOL/QCM Actions in Preparatory QC Phase

4.5.1.2.03 The following QC actions are performed by the FOL/QCM for each preparatory-phase inspection:

- Verify appropriate plans and procedures are developed, approved, and available.

- Verify personnel identified are available and meet the requirements and qualifications of PWS for the position.
- Verify the required training has been performed and is documented.
- Verify identified equipment is available, functional, and appropriate for the job.
- Verify the preliminary work and coordination have been accomplished.
- Verify level of quality expected is understood.
- Verify the Work Plan and applicable SOPs have been reviewed and understood by the workers (have field personnel communicate their understood work effort to the FOL/QCM).
- Brief process improvement program.

Discrepancies

4.5.1.2.04 Discrepancies between existing conditions and approved plans/procedures will be resolved and corrective actions taken for unsatisfactory and nonconforming conditions identified during a preparatory-phase inspection.

Job Hazards

4.5.1.2.05 The Site Safety and Health Officer (SSHO) will discuss job hazards with site personnel and verify the necessary safety measures are in place and ready for use. The APP and SSHP are provided in Appendix E and will be reviewed with all team members.

4.5.2 Tier 2 QC Process – Process QC

This component of the QC function is an integral part of each process and will be managed by the FOL/QCM. The FOL/QCM will work closely with the PjM and the field supervisors to identify and meet project and quality objectives. Identified quality criteria for the inputs and outputs of each process will be used as a basis for the assessment of each process. Process QC completes the three-phase control process by conducting initial and follow-up (surveillance) inspections to ensure processes are under control, and opportunities for improving processes are captured and implemented. Use of proactive process QC is a preventative approach to quality.

4.5.2.1 Initial-Phase Inspection

4.5.2.1.01 An initial-phase inspection will be performed by the FOL/QCM the first time a DFW is performed. The purpose of the inspection will be to check the preliminary work for compliance with procedures and contract specifications. Another aim is to establish the acceptable level of workmanship, check safety compliance, review the preparatory-phase inspection, and check for omissions and resolve differences of interpretation. The Initial-Phase Inspection Report is included in Appendix F.

Initial Phase Actions

4.5.2.1.02 The following actions will be performed for each DFW:

- Verify deficiencies identified during the preparatory phase have been corrected.
- Establish requirements of quality of workmanship.
- Resolve differences of interpretation.
- Review Work Plan and applicable documents to ensure requirements are being met.
- Observe performance of work and verify adequacy of work.

Discrepancies

4.5.2.1.03 Discrepancies between site practices and approved plans/procedures will be resolved. Corrective actions for unsatisfactory conditions or practices will be verified by the FOL/QCM, prior to granting approval to proceed.

Documentation of Initial QC Phase Actions

4.5.2.1.04 The specific QC activities performed during the initial QC phase, and the results of those activities, will be documented on an Initial-Phase Inspection Report and attached to the DQCR.

4.5.2.2 Follow-up Phase Inspection (Surveillance)

4.5.2.2.01 The FOL/QCM will conduct the follow-up phase inspection on scheduled and unscheduled bases. The purpose of the inspection is to ensure continuous compliance with contract requirements, PWS, and SOPs and to verify the quality of workmanship. The following will be performed for each DFW:

- Inspections/surveillance to ensure the work is in compliance with the PWS and the Work Plan,
- Inspections/surveillance to ensure the required level of workmanship is maintained,
- Inspections/surveillance to ensure each project logbook is properly filled out and maintained,
- Inspections/surveillance to ensure the data management system is properly tracked and backed up, and
- Documentation of follow-up results, either negative or positive, on a QC Surveillance Report (attached to the DQCR).

4.5.2.3 Equipment Calibration, Testing, and Maintenance Requirements

4.5.2.3.01 Each piece of equipment will be listed on field data sheets according to make, model, and serial number. Checklists of equipment tests and calibrations will be filled out and retained in the project files. In addition, calibration and testing procedures may be stored on magnetic media or in field logbooks. If equipment is sent to the manufacturer for repair or maintenance, it will be recalibrated. Documentation of any recalibrations will be maintained in the project files.

4.5.2.4 Daily Instrument Checks

4.5.2.4.01 Every instrument operator will check the instrument daily for proper functionality. The operator will test the instrument on known anomalies in the IVS. If the instrument does not function properly in accordance with manufacturer's criteria, the instrument operator will notify the TtEC project office and request repair and/or a replacement instrument. Daily instrument checks will be documented in the team logbook and the Daily Instrument Prove-Out Report. The FOL/QCM will inspect during Initial inspection and observe weekly (at minimum) during QC surveillance activities. See Table 4-2 for a breakdown of equipment inspection requirements.

4.5.2.5 Records

4.5.2.5.01 The FOL/QCM will maintain calibration and maintenance records concerning instrument calibration, maintenance, and operator qualification at the TtEC project office. These records will be part of the QC record. All survey teams will maintain a logbook to document individual survey team's activities.

4.5.2.6 Maintenance

4.5.2.6.01 The FOL/QCM will supervise the maintenance and inspection of all other equipment to include vehicles, radios, monitoring equipment, and any personal protective equipment (PPE). The FOL/QCM will maintain the records for all such maintenance and inspection in the TtEC project office.

4.5.2.7 QC Records

4.5.2.7.01 The FOL/QCM will maintain all QC records, including the access database, instrument calibration/maintenance records, instrument operator qualification records, training certificates, vehicle maintenance records, etc. These records will be maintained in the TtEC project office for examination by the USAESCH On-Site Ordnance and Explosives Safety Specialist and other authorized government representatives.

4.5.2.8 Layout of Work

4.5.2.8.01 Layout of the work will be from established base lines and benchmarks indicated on existing site drawings and the project GIS. When no base lines or benchmarks are provided, the establishment of reference benchmarks will be documented in the surveying field books.

4.5.2.9 Subcontractor QC

4.5.2.9.01 Subcontractors performing work on the project will be responsible for complying with the requirements of their respective subcontracts. TtEC has overall responsibility for maintaining conformance to the quality requirements of the contract, including responsibility for subcontracted items and services. The requirements for personnel qualifications, technical performance levels, QC procedures, acceptability levels, and documentation will be included as part of the subcontract documents.

4.5.2.10 Document Control

4.5.2.10.01 The PjM will establish a document control plan in accordance with TtEC Procedure PO-8: Document Control.

4.5.2.11 Data Management

4.5.2.11.01 The GQCM will implement a three-phase control process to ensure quality data management processes and ongoing QC surveillance. See Table 4-2 for quality inspection points.

4.6 DEFICIENCIES AND NONCONFORMANCE

4.6.01 Deficiencies and nonconforming conditions will be managed in accordance with TtEC Procedures QP-11, Control of Nonconforming Conditions, and QP-12, Corrective Action. Deficiencies discovered during inspection or other Project QC functions will be documented in the DQCR. Nonconforming conditions will be documented on an NCR. All deficiencies will be resolved prior to completion of the project and in the timeliest manner possible. The DQCR will include a report on each deficiency/nonconforming condition and the corrective action(s) completed and closed-out for the day. A corrective action request is required for deficiencies identified from the following sources:

- TtEC quality program audits,
- Management assessments,
- Audits performed by Program QA/QC in accordance with project-specific plans, and
- Audits of TtEC, performed by the client or regulatory agency.

4.6.1 QC Responsibilities

4.6.1.01 It is the responsibility of all personnel on the project to report deficiencies and nonconforming conditions to their supervisors or managers as soon as they are identified. Deficiencies and nonconforming conditions are not necessarily a “bad thing”; however, they do have a negative connotation. Deficiencies and nonconforming conditions should be considered opportunities to improve the process. Notification will be made to the USAESCH Project Manager (PM) and survey team should these conditions occur.

4.6.1.02 The determination of the root cause of a deficiency or nonconformance is an integral part of the QC process. The depth and extent of the root cause analysis depends on the situation. It may be as simple (i.e., minor) as an overlooked step or procedure, or it could be a complicated process. Input will be obtained as necessary from field personnel and technical advisors in order to identify the factors leading to the problem. Root-cause analysis is the responsibility of the PjM with the assistance of GQCM. Criteria considered in the analysis will include:

- Staff qualifications and training,
- Adequacy of procedures,
- Adequacy of equipment,
- Adequacy of QC measures, and
- Root cause.

4.6.1.03 The root cause is always "upstream" from where the problem was detected. Two strategies that should be employed for determining the root cause of a deficiency for this project are: 1) tracing the problem back to the source, and 2) evaluating the cause using basic questions such as who, what, when, where, why, and how. "Why" is arguably the most beneficial question when attempting to arrive at a root cause. This question may need to be asked multiple times before the cause is identified. For example "Why did 'A' happen?" Answer: "Because of 'B,'"; "Why did 'B' happen?" Answer: "Because of 'C.'" This process is carried on until the ultimate cause is identified.

4.6.2 Corrective Action

4.6.2.01 Following the root-cause analysis, the GQCM will perform analysis of potential solutions (i.e., corrective actions) to determine which remedy could most effectively correct the problem. The process will include all appropriate personnel and will be documented via meeting notes and information listed in the proper sections of both the NCR form and the Corrective Action Request form. Potential remedies considered may include:

- Supplemental personnel training,
- Changes of equipment or modification of equipment currently in use,
- Acquisition of supplemental equipment,
- Implementation of new procedures or modification of existing procedures,
- Rework of the deficient process or a portion of the process, and/or
- Changes in QC procedures.

4.6.2.02 It is the PjM's responsibility to decide the appropriate corrective action to implement. However, all parties involved prior to implementation should agree on this decision. Successful implementation of corrective action will be documented on the NCR and tracked. The GQCM will verify through follow-up-phase surveillance whether the corrective action implemented has corrected the deficiency/nonconforming condition and is sufficient to prevent recurrence.

4.6.2.03 Once the USACE Project Delivery Team and the Contracting Officer have determined that a significant corrective action or field change is required, the USACE PM will notify the regulators via email. It is anticipated that the corrective action/change notification and any supporting documentation, as necessary, will be provided within 48 hours to the regulators.

4.7 LESSONS LEARNED

4.7.01 Lessons learned will be captured, documented, and submitted in the Site-Specific Final Report using TtEC Procedure QP-14: Lessons Learned Procedure. The FOL/QCM will include lessons learned on the daily and weekly QC reports. The FOL/QCM will recap all such lessons learned in the Final Report.

4.8 CONTROL OF CONTRACT SUBMITTALS

4.8.01 The PjM will ensure all contract submittals (e.g., Work Plan, Weekly and Monthly Reports, Records of Meetings and Conversations, Accident Reports) are prepared in compliance with the PWS. The Project Manager will verify conformance of all submittals with the current DIDs.

4.9 CHANGES TO EXISTING DOCUMENTS AND FIELD CHANGE REQUESTS

4.9.01 FCRs will be managed per TtEC Procedure ENG-3: Developing and Issuing Engineering Documents. The PjM will submit all proposed Work Plan changes to the USAESCH Project Manager, who will request concurrence from the Project Delivery Team before forwarding them to the KO for approval. Once approved, the FOL/QCM will conduct, at the earliest opportunity, training and briefings to all field personnel on the approved document changes. This training on changes to existing documents could occur during the daily safety meetings or through a more formal presentation.

5.0 EXPLOSIVES MANAGEMENT PLAN

5.0.01 Section 5 is not applicable to the project and will serve as a placeholder section only.

6.0 ENVIRONMENTAL PROTECTION PLAN

6.1 INTRODUCTION

6.1.01 This EPP was prepared in accordance with Data Item Description MR-005-12, the PWS, and the Environmental SOPs developed by the USACE (Appendix B-1). The purpose of this EPP is to establish general procedures for avoiding, minimizing, and mitigating potential impacts to environmental and cultural resources during RI field activities and comply with substantive requirements of applicable or relevant and appropriate requirements (ARARs). This EPP describes sensitive natural resources specifically within the MRSs Flamenco Bay (MRS 03) and the Luis Peña Channel (MRS 12) and sets forth methods to protect and conserve those resources during the RI field activities. Phase 1 of the RI (the EBS) was completed and included photographing and collecting of video and to performing of bathymetry surveys to document benthic site conditions, define and delineate benthic and coral reef habitats, sensitive or critical habitat areas, and document features of the underwater environment in these two MRSs. Information from the EBS is being used to help identify and protect these areas and the species that inhabit them from harm during towed sensor operations during Phase 2 of the RI. This EPP will be updated as required for inclusion in the work plan for Phase 3 of the RI.

6.1.02 Flamenco Bay is a shallow bay comprising approximately 195 acres that extends up the east side of the Northwest Peninsula and the west side of Flamenco Point in Puerto Rico. Flamenco Bay is currently used for recreational swimming, diving, and snorkeling activities. The Luis Peña Channel is made up of waters that comprise the Luis Peña Water Refuge, approximately 835 acres of water along the west coast of Culebra from the Northwest Peninsula to Scorpion Point. The Luis Peña Water Refuge is managed by the Department of Natural and Environmental Resources (DNER),which has identified 41 types of uses (Valdez-Pizzini et al. 2008), including recreational swimming, boating snorkeling, and diving. Fishing is another use documented in the area (Hernández-Delgado 2003a; Pagán-Villegas et al. 1999), although since 2004 its practice is illegal inside the Reserve (Valdez-Pizzini et al. 2008; DNER 2010a).

6.1.03 Where impacts to sensitive biological resources cannot be avoided, this EPP outlines potential measures that can be implemented to mitigate such impacts. These mitigation measures were developed based upon a site-specific analysis that addresses unique concerns for work within and along the beaches of the Culebra Water Ranges and incorporates best management practices and guidelines that have been implemented for intensive field programs previously performed by other MMRP contractors on Culebra. Several SOPs for conservation of endangered species and their critical habitat during underwater investigations were developed by USACE and comprise:

- A Final February 2014 (Addendum 1, February 2015) Supplemental SOP for Endangered Species Conservation and their Critical Habitat during Underwater Investigations (most up-to-date information is contained in this document related to corals) including three further SOPs as follows:

- April 2012 Final SOP for Endangered Species Conservation and their Critical Habitat during Underwater Investigations (Appendix A of the 2014 SOP);
- An April 2011 Addendum to the 2008 SOP (contains mainly terrestrial based species information) (Appendix B to the April 2012 SOP); and
- A July 2008 Final SOP for Endangered Species Conservation and their Habitat (Appendix A to the April 2012 SOP).

6.1.04 These SOPs are referenced throughout the EPP and are included in this Work Plan as Appendix B-1. As stated in Section 4.6 of the 2012 SOP, the July 2008 SOP and its 2011 Addendum remain in effect. The February 2014 SOP is meant to supplement, not replace, previous SOPs; it provides the most up-to-date information regarding listed corals.

6.1.05 The following are some of the sources that were consulted for identifying biological and cultural resources known to exist or potentially existing at the Culebra Water Ranges site:

- 2012 SOPs (including sub-appendices A and B) (Appendix B-1);
- 2014 Supplemental SOPs (February 2014 and Addendum 1, February 2015) for Endangered Species Conservation and their Critical Habitat during Underwater Investigations (Appendix B-1)
- Ecological Services in the Caribbean (website) (USFWS 2011a)
- Draft Stock Assessment: West Indian Manatee (*Trichechus manatus*) Puerto Rico Stock (Antillean subspecies, Trichechus manatus manatus) (USFWS 2009)
- Draft Site Inspection Report, Northwest Peninsula of Culebra (Parsons 2011)
- Culebra National Wildlife Refuge (website) (USFWS 2008)
- DNER website (http://www.drna.gobierno.pr/)
- Draft Puerto Rico Coastal and Estuarine Land Conservation Plan (DNER 2010b)
- Elkhorn Coral (website) (NMFS 2011a)
- Sea Turtles (website) (NMFS 2011b)
- Federal Register. Final Rule. Endangered and Threatened Wildlife and Plants: Final Listing Determinations on Proposal to List 66 Reef-Building Coral Species and to Reclassify Elkhorn and Staghorn Corals (NMFS 2014)
- Resource Category 1 Designation: The Seagrass Beds of Culebra Island, Puerto Rico (USFWS 1992)
- Environmental Protection Plan, Non-Time Critical Removal Action, Municipality of Culebra, Puerto Rico Final Work Plan (EEG 2006)
- 2012-2013 Field Data Collection Report for EBS (TtEC 2013)
- National Wetlands Inventory website

(http://107.20.228.18/Wetlands/WetlandsMapper.html)

- National Register Information System (NRIS), National Register of Historic Places
- List of National Historic Landmarks – National Historic Landmarks Program (NHL)
- List of National Heritage Areas (NHAs), National Heritage Areas Program
- Coastal Zone Management Program (National Oceanic and Atmospheric Administration [NOAA])
- NOAA National Marine Fisheries Service (NMFS)
- National Marine Sanctuaries and Marine Protected Areas (NOAA)

6.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

6.2.01 This project is being performed as part of a FUDS Program. Through a site inspection (Parsons 2007), it was determined that MRSs 03 and 12 warrant further investigation under the MMRP. FUDS response activities are conducted in accordance with the DERP statute (10 U.S. Code [USC] Section 2701 et seq.), CERCLA (42 USC Section 9601 et seq.), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Regulations Part 300). An RI/FS will be performed by TtEC for the two MRSs that comprise the Culebra Water Ranges. The Phase 2 RI field activities are the subject of this EPP.

6.2.02 The identification of ARARs is an iterative process that must be considered throughout the CERCLA process. As such, the list of identified requirements and their relevance may change as more information is obtained during the RI/FS process. The RI is used to ascertain site conditions and types and extents of contamination. Site remedies are not evaluated until the FS. During the RI, limited ARARs that potentially directly relate to site activities have been determined. Federal ARARs are presented in paragraph 6.2.06; however, coordination with appropriate Commonwealth of Puerto Rico agencies such as DNER and the Environmental Quality Board (EQB) are appropriate for determining requirements and practices that are protective of the environment during this RI and have been included within this EPP, but some of these are not considered to be ARARs.

6.2.03 Federal laws and regulations with substantive requirements must be considered for identification of site-specific ARARs during the RI. ARARs can be:

- Chemical-specific (governing the level or extent of site remediation relative to a specific constituent);
- Location-specific (pertaining to existing site features and location); and
- Action-specific (pertaining to proposed site remedies and implementation of the selected site remedy)

6.2.04 Chemical-specific ARARs are not addressed in this EPP because these will not come into play until the FS if MC are found during sediment sampling and are compared to data quality objectives that the survey team determines for the FS evaluation. Limited location- and/or action-specific ARARs are listed for the RI. Paragraph 6.2.06 contains the ARARs for the RI.

6.2.05 Following are some notes regarding the ARARs for the RI:

- Chapter 4 of the EPA guidance document entitled *CERCLA Compliance with Other Laws Manual, Part II* (EPA 1989) states that "While EPA interprets CERCLA §121(e) to exempt lead agencies from obtaining Federal, State, or local permits (or documents similar to permits) or from complying with the administrative requirements for on-site remedial activities, it is strongly recommended that lead agencies, nevertheless, consult as specified with administering agencies for on-site actions. The administering agencies have the expertise to determine the impacts of a remedial action on particular aspects of the environment and what steps should be taken to avoid and mitigate adverse impacts."
- EPA guidance recommends that the lead federal agency consult with the state when identifying state ARARs for removal actions (EPA 1988). In essence, the CERCLA/NCP requirements at 40 CFR § 300.515 for removal actions provide that the lead federal agency request that the state identify chemical-, location-, and action-specific state ARARs upon completion of site characterization. At the present time, Puerto Rico–specific ARARs are not identified because site characterization has not been completed. The purpose of the RI is for site characterization.

6.2.06 Federal ARARs for Phase 2 of the RI:

1. **50 CFR 17 or 50 CFR 226, Endangered Species Act of 1973, as amended and 16 USC 1531 et seq. (50 CFR 402).** Seven threatened species of coral are known to be present in these MRSs. In addition, several T&E species of turtle, including critical habitat for several species, are present in these MRSs. Several T&E whale species may also be present. On land, there is one species of tree, one reptile species, and one cactus species listed. These T&E species, including candidate species, are described in Section 6.3 below. Substantive requirements of this regulation require that on-site activities must be conducted in a manner that does not result in a take of these species and actions must not destroy critical habitat. No takes are authorized and penalties may be issued to personnel whose actions result in a "take." Personnel on this project will be trained to recognize these species and their critical habitat as well as the actions that minimize potential for a take to occur and prevent destruction of critical habitat; they will also be informed that penalties may be imposed on persons whose action results in a take.
2. **The Migratory Bird Treaty Act; 16 USC 701-712.** This Act makes it unlawful to (or attempt to) pursue, hunt, take, capture, or kill any migratory bird, part, nest, egg, or product. All but a few bird species naturally occurring in the U.S. are protected under this Act. On-site activities must be conducted in a manner that does not result in a take of these species.

3. **Marine Mammal Protection Act of 1972 (MMPA); 16 USC 1361, 50 CFR 12.** It is unlawful for any person or federal agency to take (harass or kill any marine mammal) on the high seas, in U.S. waters, or on land under the jurisdiction of this Act. On-site activities must be conducted in a manner that does not result in a take of these species.

6.2.07 Puerto Rico Commonwealth ARARs for Phase II of the RI

1. **Puerto Rico Law 147 (Protection, Conservation, and Management of Coral Reefs in Puerto Rico).** This law protects coral reef, seagrass beds and related resources in Commonwealth of Puerto Rico waters.
2. **Puerto Rico Wildlife Law 241 to protect, conserve and enhance the wildlife species both native and migratory in Puerto Rico.** This law would apply to sea turtles, manatees, and other wildlife in and around the marine areas of MRS 3 and 12."

6.3 ENDANGERED AND THREATENED SPECIES

6.3.01 According to the USFWS, in Puerto Rico and the U.S. Virgin Islands there are 78 protected species including 29 animals. According to the Caribbean and U.S. Virgin Islands T&E species database for the Culebra Archipelago, there are seven endangered species (three with critical habitat); three threatened species (one with critical habitat); and one species that has been delisted, but is subject to a monitoring plan (USFWS 2011a). In addition, seven threatened coral species, listed by NMFS, may also be present in the Culebra Water Ranges (NMFS 2014). On October 20, 2009, NMFS received a petition from the Center for Biological Diversity to list 83 species of corals as T&E and to designate critical habitat for these corals. Seven of the 82 coral species have the potential to occur in waters around Culebra and listing of these corals may be warranted. Several endangered whales may be present during certain times of the year around Culebra though they are not likely present in the shallower waters of these MRSs. There are two listed endangered species of plant and two listed reptiles that are not likely to be found in areas of work for the Culebra Water Ranges due to location and project tasks to be performed. On September 2, 2014, NMFS published a Final Rule to list the Central and Southwest Atlantic distinct population segment of scalloped hammerhead shark (*Sphyrna lewini*) as a threatened species under the ESA and is considering critical habitat.

6.3.02 Other than roseate tern and brown pelican, the T&E species listed in Table 6-1 are described in Section 3.0 of the 2012 SOP, in Appendix B of the 2012 SOP, or in the February 2014 SOP (including the Addendum 1, February 2015) along with photographs typical of the species and identification of breeding/nesting behaviors and critical habitat designations. Reptile and plant (terrestrial) species are addressed in Appendix B to the 2012 SOP in Appendix B-1. All project personnel will be fully briefed by a qualified staff member (e.g., project biologist) on this EPP, the 2012 SOP (including Appendices A and B) and the 2014 SOP (and its February 2015 Addendum 1) requirements prior to beginning the RI in order to raise awareness and protect T&E species and sensitive or critical habitats. An emphasis will be made as to the potential for civil and criminal penalties to be issued to individuals who harm, harass, or kill T&E species. These documents, including this EPP, will be available to all survey teams during the RI/FS.

6.3.03 Threatened and/or endangered species that may be present in the Culebra Water Ranges, including listed corals are included in Table 6-1. Logs will be maintained during the RI detailing endangered or threatened species sightings in both terrestrial and marine habitats as required in Section 4.1.6 of Appendix A of the Environmental SOPs (Appendix B-1).

Table 6-1. Listed or Proposed Threatened or Endangered Species

Common Name	**Scientific Name**	**Group**	**Status[1/]**	**Distribution**
Loggerhead Sea Turtle	*Caretta caretta*	Reptile	T	Coastal Zones
Green Sea Turtle	*Chelonia mydas*	Reptile	T, CH	Coastal Zones
Leatherback Sea Turtle	*Dermochelys coriacea*	Reptile	E, CH	Coastal Zones
Hawksbill Sea Turtle	*Eretmochelys imbricate*	Reptile	E, CH	Coastal Zones
Brown Pelican	*Pelecanus occidentalis*	Bird	D, MP	Coastal Zones, No Nesting
Roseate Tern	*Sterna dougallii*	Bird	T	Coastal Areas and Offshore Cays, Nesting
Culebra Giant Anole	*Anolis roosevelti*	Reptile	E, CH	Arboreal forest
Virgin Islands Tree Boa	*Epicrates monensis granti*	Reptile	E	Forest and Shrublands
Wheeler’s peperomia	*Peperomia sheeleri*	Tree	E	Mesic, Semi-Evergreen Forest
[No Common Name]	*Leptocereus grantianus*	Cactus	E	Subtropical Dry Forest, Rock Substrate
Antillean Manatee	*Trichechus manatus manatus*	Mammal	E	Coastal Zones
Elkhorn Coral	*Acropora palmata*	Invertebrate	T, CH	Coral Reefs
Staghorn Coral	*Acropora cervicornis*	Invertebrate	T, CH	Coral Reefs
Boulder Star Coral	*Orbicella annularis*	Invertebrate	T	Coral Reefs
Mountainous Star Coral, [No common name]	*Orbicella faveolata, Orbicella franksi*	Invertebrate	T	Coral Reefs
Pillar Coral	*Dendrogyra cylindrus*	Invertebrate	T	Coral Reefs
Rough Cactus Coral	*Mycetophyllia ferox*	Invertebrate	T	Coral Reefs
Blue Whale	*Balaenoptera musculus*	Mammal	E	Oceans
Sperm Whale	*Physeter macrocephalus*	Mammal	E	Oceans
Sei Whale	*Balaenoptera borealis*	Mammal	E	Oceans
Fin or Finback Whale	*Balaenoptera physaluis*	Mammal	E,	Oceans
Humpback Whale	*Megaptera novaeangliae*	Mammal	E, De	Oceans
Scalloped Hammerhead Shark	*Sphyrna lewini*	Fish	T	Oceans
Nassau Grouper	*Epinephelus striatus*	Fish	E	Coral Reefs
Goliath Grouper	Epinephelus *itajara*	Fish	E	Coral Reefs

1/ E=Endangered; T=Threatened; CH=Critical Habitat; D=Delisted due to Recovery; MP= Monitoring Plan; Proposed = May be subject to listing as endangered or threatened, but not listed at the present time; De – depleted
Sources:
NMFS 2011a, b, c; USFWS 2011b; NMFS 2014; Environmental SOPs (see Appendix B-1)

6.3.04 Chapter 9 of the ESA prohibits the taking of listed species without special exemption. There is no authorized take of any listed species during this project and no exemptions will be granted. Individuals whose action results in a take may be subject to penalties under the ESA. Taking is defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. If any take does occur, work will stop immediately and the take will be reported. Under terms of sections 7(b)(4) and 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided such taking is in compliance with an incidental take statement.

6.4 CRITICAL HABITAT DESIGNATIONS

6.4.01 On Culebra, critical habitat designations for several listed species have been made as follows (USFWS 2011b; NMFS 2008).

6.4.02 Hawksbill Sea Turtle: On Culebra, critical habitat designation has been made for areas of beachfront on the north shore of the island from mean high tide inland to a point 150 meters from shore Playa Resaca, Playa Brava, and Playa Larga. These critical habitat areas are not within the survey areas of Flamenco Bay or the Luis Peña Channel though these turtles may be present.

6.4.03 Elkhorn and Staghorn Coral: The NMFS has designated critical habitat for Elkhorn and Staghorn corals in Puerto Rico that encompasses the entire Island and associated cays of Culebra. Coral is discussed further in Section 6.6.1.

6.4.04 Green Sea Turtle: On Culebra, critical habitat designation has been made in the waters surrounding the island of Culebra from the mean high water line seaward to 3 nautical miles (5.6 km). The surrounding islands and cays are also critical habitat for green sea turtles. Seagrass beds such as those in the Luis Peña Channel provide shelter and food for green sea turtles. Seagrass beds are discussed further in Section 6.6.2.

6.4.05 Culebra Giant Anole: On Culebra, critical habitat designation has been made under the ESA for most of the remaining forests on Culebra Island, comprising Monte Resaca, Punta Flamenco, Playa Resaca, and Playa Brava.

Methods to Avoid or Minimize Impacts to T&E Species

6.4.06 Site personnel will coordinate closely with the USACE representative as well as federal and Commonwealth of Puerto Rico environmental agencies as required in the Environmental SOPs included as Appendix B-1 to this Work Plan, to avoid and minimize potential impacts to listed species and their habitat. There is no authorized "take" of any of these species during the EBS fieldwork. These SOPs were developed to avoid or minimize impacts take to T&E species listed, pursuant to the ESA including their critical habitats (where identified) during underwater investigations on Culebra Island and the adjacent cays. If take occurs, work must stop immediately and the take must be reported.

6.4.07 Site personnel will follow the requirements included in these SOPs to avoid and/or minimize possible impacts to T&E species and their habitats. Measures to avoid or minimize possible impacts that TtEC will follow during this work are included in Section 4.2 of the February 2014 Supplemental SOP, Section 4.0 of the 2012 SOP, as well as in both Appendices A and B of the 2012 SOP.

6.4.08 Section 4.1.6 of the April 2012 SOP will be followed. TtEC will maintain a log detailing T&E species sightings in terrestrial and marine habitats. The log will include, but not be limited to, the following information: date and time; location coordinates using a GPS unit; species; one or more photographs, if possible; and any actions taken (e.g., species identification and distance from working area, reasons to cease operation, reasons to determine that operation may be resumed, among others) during the work period. All data shall be provided to USACE.

6.4.09 Descriptions of and specific measures to be taken for protection of various species are identified in the following sections of this EPP as follows:

- Marine mammals, including manatees and sea turtles (Section 6.5)
- Coral reefs and seagrass beds (Sections 6.6.1 and 6.6.2)
- Nesting birds (Section 6.6.3)
- Terrestrial endangered plants (Section 6.11)
- Terrestrial endangered reptiles (Section 6.6.4)

6.4.010 The Puerto Rico DNER has jurisdiction on every resource in Puerto Rico (marine and terrestrial). Project activities will be coordinated with the DNER Bureau of Fisheries and Wildlife. In addition, other agencies also have jurisdiction regarding endangered species and must be coordinated with/consulted as appropriate, if not coordinated through the DNER. The coordinating official on T&E species on Culebra is the Chief of the USFWS, Caribbean Field Office in Boquerón for species under their jurisdiction (sea turtles inland, manatees, birds, and terrestrial species). For aquatic species (sea turtles in water, corals, and marine mammals), the Coordinating Official for NMFS has jurisdiction. For activities being conducted adjacent or within the Culebra National Wildlife Refuge, the Refuge Manager also has jurisdiction.

6.4.011 In the event that a T&E species is harmed or incidentally taken during the RI/FS activities, work will stop, and the TtEC PjM will notify the USACE PM and the DNER coordinating official, and others will be notified as required (e.g., Refuge Manager, NOAA Coordinating Official, USFWS). Following this EPP and the 2014 SOP and its three appended SOPs for work in Flamenco Bay or the Luis Peña Channel will help minimize potential impacts to T&E species and minimize harm to sensitive or critical habitat areas.

6.5 MARINE MAMMALS AND SEA TURTLES

6.5.01 Several species of marine mammal (whales, sea turtles, and manatee) could be present in the offshore or potentially nearshore areas around Culebra.

6.5.02 The MMPA protects all marine mammals and prohibits the take of marine mammals in U.S. waters and by U.S. citizens on the high seas. Additionally, six species (sperm, sei, fin, blue, and humpback whales, and the West Indian manatee) are listed as endangered under the ESA (see Table 6-1). All of these species are managed by NMFS, with the exception of West Indian manatee (*Trichechus manatus*), which is managed by the USFWS. A subspecies of the West Indian manatee, the Antillean manatee (*Trichechus manatus manatus*), occurs in Puerto Rico and is endangered. The following describes these species and the sections of the Environmental SOPs that contain further information.

6.5.03 Whale species listed in Table 6-1 (T&E species) as well as other species that are not endangered or threatened but are protected under the MMPA may be present at times, though their presence around Culebra, especially in the two water ranges, is not likely and work activities are not likely to impact the species. Whales are addressed in Sections 3.6 through 3.10 of the 2012 SOP. There are procedures to follow to minimize potential impacts to marine mammals from project activities which are included in the SOPs.

6.5.04 Manatees have been reported irregularly in Culebra Island through the years, the individuals usually staying only for a couple of weeks. Although Culebra Island has available habitat, it lacks fresh water, which may hinder a longer stay by manatees (USFWS 2009). Manatees are described in Section 3.5 of the 2012 SOP.

6.5.05 Several species of T&E sea turtles—the loggerhead sea turtle (described in Section 3.1 of the 2012 SOP), green sea turtle (described in Section 3.2 of the 2012 SOP), leatherback sea turtle (Section 3.3 of the 2012 SOP), and the hawksbill sea turtle (described in Section 3.4 of 2012 SOP)—may be present in the waters around Culebra. Seagrass beds (see Section 6.6.2 below) and coral reefs (see Section 6.6.1 below) are an important habitat for sea turtles for foraging and feeding. Seagrass beds are designated as critical habitat for the green sea turtle, as is the area surrounding Culebra to 3 nautical miles offshore, including surrounding islands and cays. Damage to seagrass beds and coral reefs must be avoided during field activities and extra vigilance is required when operating boats near these habitats as potential contact with sea turtles is more likely. In addition, during breeding season, turtles make nests and lay eggs on beaches on Culebra Island and the adjacent cays, making them susceptible to boating activities being performed in shallow water or on beaches during particular times of the year.

Measures to Mitigate Potential Impacts to Marine Mammals and Sea Turtles

6.5.06 One major threat to sea turtles includes destruction and alteration of nesting and foraging habitats. Turtles are also vulnerable in their pelagic stages as juveniles and adults, when they may be caught in fishing nets, struck by boats, or caught in debris.

6.5.07 All of the general and specific conservation measures in Section 4.0 of the 2012 SOP will be followed during the RI. Specific conservation measures are identified in Section 4.2 (Staging Area Sea Turtle Nesting Monitoring), Section 4.4 (Marine Mammals and Sea Turtles Avoidance Measures), and Section 4.3 (Coral and Seagrass Avoidance Measures). In addition, Section 4.5 (Diving Operations and Equipment) will also be followed during the RI activities (when diving operations are included in RI activities) in order to avoid harming of sea turtles and marine mammals and habitat during these activities. Some site activities performed in the Luis Peña Channel may require coordination and scheduling around dates of high green sea turtle activity if the seagrass beds are within the work area. More procedures are included in Appendix A to the 2012 SOP. Where information is provided in more than one location in these SOPs, the most stringent is to be applied.

6.5.08 Beach surveys are an important component of sea turtle protection if staging areas are required in beach areas. In order to select staging areas on beaches and minimize potential impacts to sea turtles and their nests from, on, or near shore survey activities, TtEC will coordinate with the DNER Endangered Species Division (Mr. Carlos Diez). Nest monitoring will be performed in accordance with Section 4.2 of the 2012 SOP and Beach Monitoring and Designation of Beach Zones sections in Appendix A to the 2012 SOP (as applicable) based on activities being performed, though the RI does not include MEC clearance or vegetation clearance activities. The standard beach monitoring protocol will include having the Project Biologist perform morning beach patrols to identify the potential presence of new nests prior to and during the nesting season. The priorities for the beach monitoring protocol are to identify and record nesting behavior (tracks), site selection (sand, vegetation, and borderline), and threats to hatch success (predators, poachers, seawater, and desiccation). As part of the protocol, if sea turtle nests are found, the Project Biologist, their supervisor, and/or monitoring personnel will communicate daily with the USFWS Boquerón Endangered Species Specialist and the Culebra Islands National Wildlife Refuge Manager. Communications will help ascertain whether new nests have been located and their locations within the work area.

6.5.09 When it is not nesting season, the Project Biologist or appropriately trained personnel will conduct morning beach surveys prior to crews commencing daily activities to determine whether sea turtle nesting has occurred. The same priorities for the protocol inside a nesting season, and described above, will be followed.

6.5.010 To document the observed marine mammals and sea turtles, the wildlife observers will report the marine mammals and sea turtles seen during the survey in logs, noting the direction of transit when applicable. These logs will be included as part of the final RI report.

6.5.011 Any collisions with or sighting of injured or incapacitated marine mammals or sea turtles will be reported immediately to the USACE, USFWS, NMFS, and DNER as required in Section 4.4.12 of the 2012 SOP.

6.6 SENSITIVE ENVIRONMENTS AND HABITATS

6.6.01 The Culebra National Wildlife Refuge comprises about 1,480 acres, includes 23 islands and rocks in addition to the four tracts on the main island of Culebra and associated cays, including Luis Peña. The refuge is well known as a nesting site for a variety of seabirds and preserves important habitat for endangered sea turtles.

6.6.02 Conservation priority areas for Culebra include all of the lagoons and beaches on Culebra, the Flamenco Peninsula, all cayos and cays around Culebra, and the Canal Luis Peña Natural Preserve. Flamenco Point and the Northwest Peninsula, and all beaches are managed by the USFWS or DNER for wildlife conservation and recreational use.

6.6.03 Flamenco Bay includes the tourist areas most visited in Culebra and endangered turtle nesting areas. The Luis Peña Channel is located in the Marine Natural Reserve and has coral reef barriers and endangered turtle nesting areas.

6.6.04 The following sections address the varieties of sensitive environments that may be found in the Culebra Water Ranges.

6.6.1 Coral Reefs

6.6.1.01 The DNER, through the Bureau of Fisheries and Wildlife Program, is responsible for conservation and management of coral reefs in Puerto Rico under Law 147, July 15, 1999 (Law for the Protection, Conservation, and Management of Coral Reefs in Puerto Rico). At the national level this coral reef program is part of the Coral Reef Initiative under Executive Order 13809 (Coral Reef Protection), which seeks to "preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment." The NMFS Southeast Region's coral reef ecosystem conservation activities in Puerto Rico are managed by the Southeast Fisheries Science Center and the Southeast Regional Office, including the Caribbean Field Office. The activities are also executed pursuant to the Coral Reef Conservation Act, which provides funding for NOAA's Coral Reef Conservation Program. Coral reef ecosystem conservation activities also support and strengthen efforts related to the implementation of NOAA mandates under the Magnuson-Stevens Fishery Conservation and Management Act and the ESA. Hurricanes, namely Hurricane Hugo, caused widespread damage to coral reefs in Puerto Rico; in addition, other factors, such as pollution and damage from commercial and recreational activities, are causing continued decline. Coral reef restoration efforts continue to be made in Puerto Rico, with limited success.

6.6.1.02 Elkhorn coral (*Acropora palmata*) and staghorn coral (*Acropora cervicornis*) are both coral species in the genus Acropora. The NMFS designated critical habitat in Puerto Rico for both elkhorn and staghorn corals in November 2008 and in May 2006, NMFS listed both species as threatened. Staghorn and elkhorn coral are two of the three most important Caribbean corals in terms of their contribution to reef growth and fish habitat. Other corals, including boulder star coral (*Orbicella annularis*), mountainous star coral (*Obicella faveolata, Orbicella franksi*), pillar coral (*Dendrogyra cylindrus*), and rough cactus coral (*Mycetophyllia ferox*), may also be present, are listed as threatened, and provide essential habitat for fish and reef structure that is protective of inner lagoons and cays.

6.6.1.03 Coral reefs in the Luis Peña Channel are documented since 1927 (Valdez-Pizzini et al. 2008) where most are patch reefs (Pagán-Villegas et al. 1999) and fringing reefs (Vicente 1995) and are described to maintain an extensive development of coral communities healthier than the vast majority of reef communities around Puerto Rico (Hernández-Delgado 2000; Hernández-Delgado and Sabat 2000).

6.6.1.04 Since 1980, populations have collapsed throughout their range from disease outbreaks with losses compounded locally by hurricanes, increased predation, bleaching, elevated temperatures, and other factors. These species are also particularly susceptible to damage from sedimentation.

6.6.1.05 Threats to coral reefs include:

- disease, such as white band disease
- hurricanes
- predation
- bleaching
- algae overgrowth
- sedimentation
- temperature and salinity variation
- low genetic diversity

6.6.1.06 Descriptions, including photographs, of listed corals are included in Sections 3.11 through 3.13.5 of Appendix A of the Environmental SOPs (see Appendix B-1 of this Work Plan).

6.6.2 Seagrass Beds

6.6.2.01 The Culebra seagrass beds have been proposed by the USFWS for designation as Resource Category 1 because these areas are unique and irreplaceable on a national or eco-regional level. Seagrass beds are considered a habitat area of particular concern as a subset of EFH in the U.S. Caribbean under the Magnuson-Stevens Fishery Conservation and Management Act because they provide important ecological functions and/or are especially vulnerable to degradation. Collaboration with NMFS is required for federal projects that may have adverse impacts upon EFH. Seagrass beds are extensive in the Luis Peña Channel (Hernández-Delgado 2003a) comprising the most abundant marine habitat in the Luis Peña Channel (Hernández-Delgado et al. 2002). These beds provide important habitat for a variety of species, including the endangered green sea turtle. Projects undertaken must not decrease the integrity of this habitat. The Environmental Baseline Survey performed prior to the RI ascertained the location and extents of these seagrass beds so that subsequent survey activities can avoid, or in the case of intrusive activities, minimize damage to these beds. Coordination and collaboration with Puerto Rico DNER is required for any activity occurring within a seagrass bed.

6.6.2.02 The following information is excerpted from Resource Category 1 Designation: The Seagrass Beds of Culebra Island (USFWS 1992).

> "There are about 49 species of plants that have become fully adapted to marine environments. These species are called seagrasses because of their external morphological similarity to terrestrial grasses. These marine flowering plants have undergone very little speciation since and represent less than l % of the 250,000 flowering plants known worldwide. Although little speciation has occurred, seagrasses have developed a necessary adaptation called hydrophilic pollination. There is no equivalent of insect pollinators in aquatic plants.
>
> The association of seagrasses with other tropical or subtropical, shallow marine systems (mangroves and coral reefs) has been known to exist since Cretacean times. However, recent seagrass bed systems developed as the continental and insular shelves became flooded during the Holocene transgression following the Wisconsian Glaciation. Seagrass beds have therefore accumulated and trapped huge amounts of sediments, created and modified shorelines, and probably sustained large turtle, manatee, and fish populations within the West Indian tropics for long periods of time. Seagrass beds continue to keep pace with rising sea levels and fulfill physical and biological functions which ensure the ecological integrity of our coastlines.
>
> There are 4 species of seagrasses within the Culebra archipelago: turtle grass (*Thalassia testudinum*), manatee grass, shoal grass (*Halodule wrightii*), and sea vine (*Halophilia decipiens*). Turtle and manatee grasses are usually found growing together in shallow, protected environments with unconsolidated substrates. Manatee grass occurs as monotypic stands in wave-exposed sandy bottoms. *H. decipiens* is usually found in deeper water but may occur in shallow, turbid water. Shoal grass, with or without manatee grass, is usually found colonizing blowouts or other barren exposed bottoms. *Ruppia maritimea* (widgeon grass) is found only in very shallow semi-enclosed lagoons where salinities of 25 parts per trillion or less may be found because low salinities are required for Ruppia to reproduce sexually. On the other hand, extremely high salinities exclude seagrasses from Flamenco Lagoon, the largest lagoon in Culebra."

6.6.2.03 The seagrass beds of the Culebra archipelago support a large juvenile population of green turtles and are identified as critical habitat for this species.

Measures to Mitigate Potential Impacts to Coral Reefs and Seagrass Beds

6.6.2.04 Coral and seagrass avoidance measures are included in Section 4.3 (Coral and Seagrass Avoidance Measures) of the 2012 SOP, as well as the 2014 (February 2015 Addendum 1) SOP (see Appendix B-1 of this Work Plan). These measures will be followed at all times during the RI/FS activities. Notifications to the NMFS Boquerón Office and DNER will be made in accordance with Section 4.3.9 of the 2012 SOP should any coral be damaged or injured. Any activities causing the damage will be ceased and the coral will be left in place. If any boat runs aground, the boat operator will follow the procedures in Section 4.3.10 of the 2012 SOP. Diving operation procedures are included in Section 4.5 of the 2012 SOP.

6.6.3 Nesting Areas for Birds

6.6.3.01 The cays and coastal areas of Culebra are known nesting areas for shorebirds and seabirds with abundant suitable habitat amongst the rocky shores and cliffs and associated coastal vegetation. The largest seabird nesting colony occurs at Peninsula Flamenco, where 50,000 sooty terns nest. Most of the nesting for birds occurs in the spring and summer months (April through September) though birds may reside year-round. Migratory birds also frequent Culebra along routes of migration and the Culebra National Wildlife Refuge areas provide a haven for these species.

6.6.3.02 Several species of marine birds nest on the island of Culebra and surrounding cays as follows, one of which is listed as threatened species (EEG 2006):

- Brown noddy
- Laughing gull
- Red-billed tropicbird
- White-tailed tropicbird
- Audubon’s shearwater
- Bridled tern
- Roseate tern (threatened)
- Cayenne tern
- Sooty tern
- Royal tern
- Sandwich tern

6.6.3.03 It is not anticipated that activities performed during the RI will have adverse impact on nesting seabirds or shorebirds as the nesting areas will not be directly disturbed and disposal of munitions are not likely to be performed during the RI. Boating operations may be performed near shore where nesting birds are present, which could cause disturbance to nesting birds if present. TtEC will coordinate site activities in consultation through the USACE with USFWS and DNER personnel as required to minimize potential impacts to nesting birds and will attempt to coordinate work schedules so that impacts are lessened for nesting birds.

6.6.4 Terrestrial Reptiles

6.6.4.01 Two endangered and/or threatened species of reptile are present on Culebra and its adjacent cays. Species include the Culebra giant anole (*Anolis roosevelti*) and the Virgin Islands tree boa (*Epicrates monensis granti*). Sections 2.1 and 2.2 of Appendix B to the 2012 SOP contain information and photographs of these species. Critical habitat has been designated for the Culebra giant anole at Monte Resaca, Punta Flamenco, Playa Resaca, and Playa Brava. No critical habitat has been designated for the Virgin Island tree boa on Culebra. Impacts to these species are not likely during the RI/FS because this work will be performed on water, though during travel to and from the sites, these species could be encountered. Sections 3.0, 3.2, and 3.3 of Appendix B to the 2012 SOP will be followed to avoid impacts to these species during the work. The project biologist will brief employees at project start so that these species can be recognized and avoided. All sightings of these species will be recorded on a daily log and reported to the USACE. If the Culebra giant anole is sighted during any field activities, the USACE and USFWS must be notified immediately as specified in Appendix B to the 2012 SOP as these are extremely rare.

6.7 WETLANDS

6.7.01 There are no freshwater wetlands in Culebra. Estuarine and marine wetlands, including conservation priority area lagoons, are the wetland types that could potentially be impacted by work during the RI. Marine wetlands represent 27 percent of the total wetland resources in Puerto Rico. Seagrass beds are included in this category of wetland and are described in Section 6.6.2 above. Long stretches of beach and shore habitats, along with associated buffer areas, are becoming increasingly rare due to agriculture and recreational or commercial activities and development. The principal habitats of concern in Puerto Rico's coastal and estuarine environment are: shoreline, wetland, and adjacent coastal upland areas. Each of these habitats provides a key contribution to the ecological integrity of the overall coastal environment and "ecological significance" is determined by the quality of existing natural habitats, the diversity of species present, and the existence of threatened or endangered species (DNER 2010a).

6.7.02 The USFWS Wetlands Online Mapper was used to identify wetlands within the Culebra Water Ranges. There are several marine and estuarine wetland areas identified in small bays along the Luis Peña Channel of the main island of Culebra and there are extensive seagrass beds in the Luis Peña Channel (Hernández-Delgado 2002; Valdez-Pizzini et al. 2008). Extensive areas of Flamenco Bay are identified as estuarine or marine wetlands. These sensitive areas were delineated as part of the RI/FS performed by TtEC so that they can be protected during work activities.

6.7.03 It is anticipated that impacts to wetlands will not occur during the Phase 2 of the RI as intrusive investigations will not be performed and conservation measures will be followed for performing work near seagrass beds.

6.8 CULTURAL AND ARCHAEOLOGICAL RESOURCES

6.8.01 The NRIS, NHL list, NHA list, and the National Park Service list one registered property, Faro Isla de Culebritas, which is part of the Lighthouse System of Puerto Rico. This lighthouse is not within the areas that will be worked in during the RI. There are known prehistoric sites on Culebra Island (USFWS n.d.); however, these are documented to be on land and not in the areas where the RI will be conducted. A literature assessment by Valdés Pizzini et al. (2008) showed that there is not extensive information about cultural and archaeological resources for the Luis Peña Channel Reserve.

6.8.02 During the EBS (Phase 1 of the RI), no potential cultural and archaeological artifacts were identified during the course of site activities. During Phase 2 of the RI, if data from geophysical surveys, photos, or video identify potential cultural or archaeological items or structures, the USAESCH PM will be notified. If any known or suspected cultural or archaeological items are found, the location will be marked, a photo will be taken (if possible), and the USAESCH PM will be notified of the finding. Work in the immediate area of an artifact will be halted until a qualified person, typically the State Historic Preservation Officer, can inspect the item.

6.9 WATER RESOURCES

6.9.01 Groundwater on Culebra is scarce and only known to occur in alluvial deposits and in fractures in volcanic and plutonic rocks. Average annual rainfall is 30 to 50 inches, and all aquifer recharge comes from direct rainfall. The public water supply on Culebra comes from a desalination plant located near Lower Town. In some households, municipal water is supplemented with rooftop cisterns or groundwater for non-drinking water uses. There are no permanently flowing surface water streams on Culebra (Parsons 2011).

6.9.02 Groundwater and freshwater resources will not be adversely impacted by project activities and are not the focus of the RI. Care will be exercised to minimize adverse impacts to estuarine or marine wetlands and to preserve sensitive habitats and ecologically and economically important marine and estuarine water resources.

6.10 COASTAL ZONES

6.10.01 The management of the coastal zone was adopted on July 12, 1978, as the Coastal Land Use Plan of Puerto Rico. The lead agency for coastal zone management in Puerto Rico is the DNER, whose primary responsibility is to protect the natural resources of Puerto Rico. The

Planning Board is the government agency responsible for administering the certification process with the Federal Support Program. The NMFS also has jurisdiction in coastal zones. The Coastal Zone of Culebra as described in the Puerto Rico Coastal Zone Management Program (DNER 2008) as "a strip of land one thousand linear meters inland, measured from the coastline, as well as the additional distance necessary to incorporate key natural systems of the coastal environment. In addition, it includes the territorial waters of Puerto Rico and the corresponding submerged lands (three marine leagues, 9 nautical miles or 10.35 land miles), the islands of Vieques, Culebra, Mona, Monito, Desecheo, Caja de Muertos and all keys and small islands within them." All project activities taking place for the Culebra Water Ranges are considered within the Coastal Zone.

6.10.02 In order to access the MRSs, work crews and equipment must be transported by boat. In addition, sonar and marine geophysical detection equipment and snorkeling operations will be used during the RI. Any anchorage areas will be carefully examined following procedures in the 2014 Supplemental SOP and its appendices to protect coral reefs and seagrass beds. Information from bathymetric surveys, snorkel surveys, and remotely operated vehicle photo-documentation collected during the RI will be used to further delineate sensitive habitats and procedures to avoid damage to these resources. Information contained in the 2014 Supplemental SOP and its appendices will be amended as necessary with supplementary information and followed to ensure that anchorage of boats or grounding of boats on sensitive coral reefs does not occur during the follow-on RI. The EBS was performed to help characterize the benthic environment and delineate sensitive habitats and coral reef areas so that provisions to avoid adverse impacts can be planned for during the RI.

6.10.03 TtEC will utilize public or private docks for launching boats. TtEC will not be landing boats onto beaches and will avoid damaging coral reefs, turtle and bird nesting areas, and seagrass beds during this work as outlined in Sections 6.4 through 6.6 of this EPP and the referenced SOPs. Coordination with the USFWS and DNER on this project, as well as meeting regulations or other requirements of the DNER during the RI, will ensure this project adheres to coastal zone management objectives and marine and estuarine water resources. Munitions disposal operations, if they occur (potentially during Phase 3 of the RI but not Phase 2), will be performed in accordance with well-established procedures and through coordination with various agencies.

6.11 TREES AND SHRUBS

6.11.01 There will be no removal of trees or shrubs on this project because this work is being performed wholly within marine areas using existing dock facilities. Beach surveys will not disturb or harm trees and access to work sites will utilize existing docks, roads, trails, and paths whenever possible.

6.11.02 Appendix B to the 2012 SOP, Section 2.3, contains information on Wheeler's peperomia (*Peperomia wheeleri*) and *Leptocereus grantianus*, an unnamed species of spineless cactus, both of which are considered endangered. Information contained in these sections as well as the mitigation measures in Sections 3.0 and 3.4 of this appendix will be communicated to project personnel by the project biologist so that these species can be avoided if there is potential for impact through vegetation disturbance in areas where these species may be present. In addition, association of other canopy species may be an indicator of the potential presence of the Wheeler's peperomia, and particular attention will also be paid to these types of forest canopies. If any of these species are present where work will be conducted or along an intended travel route, the route will be adjusted so that these species are not contacted. Reporting of any finds of these species in work areas or paths will be logged and reported to the USACE as required in Appendix B to the 2014 Supplemental SOP.

6.12 EXISTING WASTE DISPOSAL SITES

6.12.01 There are no known munitions waste disposal sites within the Culebra Water Ranges of Flamenco Bay or the Luis Peña Channel. MEC was used during training exercises and is considered UXO. Discarded military munitions, which are military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal, are not known to be present in these MRSs.

6.13 PROJECT WASTE MANAGEMENT

6.13.01 The following sections describe wastes that may be generated during the RI and the disposition of these wastes. Wastes will be managed, transported, and disposed of in accordance with federal and Commonwealth of Puerto Rico regulations and requirements.

6.13.1 Unexploded Ordnance

6.13.1.01 It is anticipated that MEC, if discovered during the RI, will be identified, photographed, and left in place and position documented.

6.13.1.02 Phase 2 of the RI is a marine EM survey by surface vessel and hovercraft of MRS 3 and MRS 12. These sites are public recreational areas with no restrictions on use or activities. There is no potential for UXO contact or exposure during Phase 2 field activities. However, if the survey team identifies an item that is MEC and it is determined that disposal activities for the MEC are warranted (explosive hazard poses a high risk to site receptors), the related work and its conservation measures plan will be closely developed and coordinated with the TPP Team.

6.13.2 Common Trash

6.13.2.01 Common trash such as food wastes, food containers, and office-related trash will be collected off boats on a daily basis and disposed of in the office trash receptacle. This receptacle will be regularly picked up and disposed of in a local sanitary waste facility as arranged with the Municipality of Culebra.

6.13.3 Vehicle and Boat Maintenance Fluids

6.13.3.01 Project vehicle and boat maintenance (e.g., oil changes), if required during the project, will be performed by TtEC personnel, or a vendor on Culebra. Disposal and/or recycling of waste materials will be performed in accordance with local rules and regulations.

6.13.4 Sanitary Wastes

6.13.4.01 Sanitary wastes from boats equipped with U.S. Coast Guard–approved marine sanitation devices and grey water from hand washing will be regularly pumped out at/by an approved facility at a public or private dock.

6.14 WASTE TRANSPORTATION AND DISPOSAL

6.14.01 Waste profile sheets are not anticipated to be required based on the anticipated wastes that will be generated during the RI because no special waste or hazardous waste will be generated.

6.14.02 If required (e.g., if unanticipated contaminated wastes require special waste disposal), profile sheets will be coordinated with the intended facility based on their waste acceptance criteria. Waste profile sheets will be submitted for review and signature by the USACE representative. If the disposal facility issues permits for receiving waste, the permit will accompany the waste to the disposal facility when shipped.

6.14.03 Likewise, based on anticipated wastes that will be generated during the RI, manifests are not required, though straight bills of lading may be used to track shipments or for payment purposes.

6.14.04 Munitions are regulated for transportation on public roads though there will be no transportation of MEC items from their in situ location to any land-based disposal area during the RI. No other wastes listed above are regulated for transport on public roadways by the U.S. Department of Transportation, Hazardous Material Regulations. As such, these wastes may either be self-transported to the disposal/recycling facility or a local solid waste vendor affiliated by contract for disposal to the intended facility by contract.

6.14.05 All waste generated during field activities will be properly containerized and disposed of in accordance with all applicable federal and Puerto Rico regulations and through approved channels.

6.14.06 Solid waste facilities will be chosen based on their waste handling permit and waste acceptance criteria. Wastes will only be sent to facilities that are operating in compliance with their permits and applicable federal and Puerto Rico regulatory requirements.

6.15 CONTINGENCY FOR UNANTICIPATED WASTE

6.15.01 If unanticipated wastes are generated during project activities, TtEC will notify the PjM and Safety and Health Manager (SHM), as well as the USACE PM to determine the proper and safe course of action to properly characterize, containerize, transport, and dispose of the waste. The SHM will ensure hazardous waste trained personnel are identified, and will initiate and identify appropriate sampling and analysis, containerization requirements, waste storage requirements, proper shipping descriptions per the U.S. Department of Transportation, Hazardous Material Regulations, initiate waste profile sheets and manifests for the appropriate Resource Conservation and Recovery Act licensed and permitted facilities, and ensure that the paperwork is completed from point of generation to disposal in accordance with federal and Puerto Rico regulations.

6.15.02 If a waste is discovered during the RI and the waste is not related to project activities, TtEC will notify the PjM, SHM, and the USACE PM. The USACE PM will determine proper federal and local agency notifications to make (e.g., if the waste is not the result of project activities). TtEC will not handle the waste if it is not generated as part of the project.

6.15.03 Depending on the USACE generator status (large, small, or conditionally exempt small quantity generator), hazardous waste disposal (if hazardous wastes are generated) must occur within the required timeframes specified under the regulations (e.g., large quantity generators have 90 days and small quantity generators have 180 days from accumulation start date).

6.15.04 TtEC will also notify the client representative, the Contracting Officer as the Generator of Record, to ensure provisions are made for signature of the waste profile sheet, land disposal restriction, and uniform hazardous waste manifest, and to determine the generator category and disposal timeframe requirements. TtEC personnel cannot sign any of these Generator of Record documents as TtEC or as Agents of the Government unless designated specifically in the contract agreement.

6.16 IMPACT MINIMIZATION MEASURES

6.16.01 Impact minimization procedures, in addition to those discussed throughout this EPP, will include briefing all on-site personnel on applicable health and safety issues as well as the need for minimizing impacts on sensitive biological resources as outlined in this EPP. Methods for recognizing, avoiding, and minimizing potential impacts on the plant and animal species and habitats of concern will be stressed during the on-site training.

6.16.02 Close coordination with environmental resource agencies before and during the project will help ensure impacts to sensitive environments, critical habitats, T&E species, as well as impacts to recreational activities are minimized throughout this project.

6.16.03 Areas disturbed during the RI activities will be kept to the minimum required to accomplish the project tasks.

6.17 BURNING

6.17.01 Burning of materials within or around the Culebra Water Ranges will not be performed during the RI.

6.18 DUST AND AIR POLLUTION CONTROL

6.18.01 Widespread dust control is not anticipated on this project because much of the project takes place on the water. However, control of fugitive dust on the project may include best management practices such as keeping speeds down on dirt or gravel roads to minimize generation of dusts and housekeeping efforts to prevent buildup of dirt or mud on boat decks, equipment, docks, and ramps to prevent the dirt or mud from drying out and causing dust in work areas.

6.18.02 Other emissions sources include vehicles and boats used to transport personnel. All vehicles and equipment will be in good working order, inspected, and will meet applicable vehicle emissions requirements. Vehicles will not be left idling for extended periods of time.

6.19 SPILL CONTROL PLAN

6.19.01 Reporting of spills to state agencies will occur only after discussions with the TtEC PjM and USAESCH PM. Spills on the water are immediately reportable.

6.19.02 For oil or chemical spill notification, call the National Response Center at **800-424-8802.**

6.19.1 Spill Potential

6.19.1.01 Due to the nature of the operations, a spill of pollutants to the environment could occur. The most likely spill is a spill of fuel to water which could occur during operation of boats, primarily during refueling operations. Refueling operations, however, will not be done on the water, other than at the dock. Refueling will be performed following best management practices, including slowing down when filling fuel tanks; knowing the size of the tank, and avoiding topping off the tank. Fuel collars, absorbent pads, and fuel/air separators are tools that can be used to help avoid spills or to contain excess fuel that has accidentally spilled. A fuel collar is a doughnut of absorbent material that fits around the fueling nozzle and catches splashes or drips during refueling. Absorbent pads can be used to wipe up excess fuel or to capture fuel from leaks. A fuel/air separator can prevent the escape of fuel from the air vent during filling.

6.19.1.02 In addition, boats will be maintained in proper working order and subject to a preventative maintenance schedule. Boat operators will also conduct a pre-launch boat inspection every day.

6.19.1.03 In the event of a spill, the largest quantity of pollutant (gasoline) that can reasonably be lost at any one time during refueling is 10 gallons of fuel. If a leak of fuel or other fluids, such as hydraulic or transmission fluid, occurs on a boat, field personnel will promptly attempt to plug the hole and/or turn off pumps if safe to do so.

6.19.1.04 If the spill occurs on the ground, the material spilled will be bermed with dirt so that the fluid does not spread along the ground surface. Any spills originating from small containers (e.g., fuel cans) will be contained by the use of absorbent materials. Any spill cleanup materials will be contained and managed for disposal according to federal and Puerto Rico regulations.

6.19.2 Other Preventive Spill Control Measures

6.19.2.01 Containers of liquids containing petroleum products (e.g., gas or diesel) or other chemicals with potentially hazardous constituents (paints, lubricants, etc.) will be kept closed when not in use, maintained in original containers with labels affixed, and will be kept in appropriate storage areas (e.g., flammable storage cabinets).

6.19.2.02 TtEC plans to conduct all fueling, maintenance, and repair of vehicles and boats off-site. This practice will decrease the amount of pollutants that need to be stored on the site. Those liquids of a hazardous nature that are absolutely necessary to conduct field operations will be stored in the minimum required quantities.

6.19.2.03 Any spills originating from small containers (e.g., fuel cans) will be contained by the use of absorbent materials.

6.19.3 Emergency Spill Response and Notification

6.19.3.01 The procedures described below will be followed in the event of a spill on-site.

6.19.3.02 All spills, leaks, and fires involving oil or hazardous substances must be reported to the PjM and the SHM as well as the client representative and the National Response Center. The person reporting the leak or spill is required to provide the following information:

- His/her name
- Location of spill and facility number, if known
- Number of injured personnel and nature of injuries, if known
- Substance spilled
- Estimated amount spilled
- Extent of spill
- Estimated rate at which the substance is currently being released
- Estimated time the spill occurred
- Any other pertinent information

6.19.3.03 Minor and major spill procedures are outlined below.

6.19.3.1 Minor Spill Procedure

6.19.3.1.01 A minor spill would involve no immediate threat to human health or the environment (e.g., not cause sheen or discoloration on the water), cause minimal property damage, be readily cleaned up by TtEC crewmembers, be a known substance, and not exceed the reportable quantity for that material. In the event of a minor spill, the appropriate response action is for the responsible person to notify the client and the PjM as well as the National Response Center and supply the responders with as much information as possible. In the case of a spill of contaminated or hazardous materials, the following procedures will be followed:

- Stop the source of the spill if safe to do so (e.g., upright a container, shut off valve, etc.).
- Notify a supervisor (FOL, SSHO).
- SSHO or FOL will immediately notify the PjM, SHM, and client and relay pertinent information. Notify the National Response Center, U.S. Coast Guard, and EQB as required (contact information for agencies is included in Section 6.19.3.3).
- Identify protective clothing or equipment required to respond.
- Contain the spill.
- Neutralize and/or solidify any product.
- Transfer material into appropriate waste containers as directed by the FOL or PjM. Transfer the waste to the appropriate storage area for management and disposal at the direction of the FOL or PjM.
- Document the incident.

6.19.3.2 Major Spill Procedure

6.19.3.2.01 In the event of a major spill where human health and/or the environment is at risk (e.g., spill is to a surface water, persons are injured, there is a risk of fire or explosion from the materials, material spilled is not known, the spilled material is more than can be reasonably handled with on hand resources in a few minutes time, or spills that have or are likely to enter a storm drain or other conveyance), the following procedures shall be followed.

- A spill to surface water may not constitute an immediate hazard to workers; however any spill to surface water is agency reportable and is to be treated as an emergency.
- Isolate the spill area, shut down equipment if safe to do so, and evacuate upwind.
- Keep others from entry into the area.
- If anyone is injured, at risk, or there is a fire or explosion, call 911.
- Notify the FOL and/or SSHO.
- SSHO or FOL will immediately notify the PjM, SHM, and client and relay pertinent information. Notify the National Response Center, U.S. Coast Guard, and EQB (contact

information for agencies is included in Section 6.19.3.3).

- If source of spill is not unknown and other hazards are not likely to exist (e.g., fires, exposures, or explosions), assess extent of spill and identify potential pathways of dispersion. Cover or isolate these pathways in advance of the spill, if feasible, but only if exposures can be avoided.
- Note type, amount, and location of material released. Provide Material Safety Data Sheets for response personnel.

6.19.3.3 Agency Contact Information for Spills

6.19.3.3.01 In the event of a reportable spill, TtEC will notify the following:

- U.S. Coast Guard Sector San Juan (1-787 289-2041)
- National Response Center (1-800-424-8802)
- EQB (1-787-767-8031)

6.20 STORAGE AREAS AND TEMPORARY FACILITIES

6.20.01 A temporary office facility and equipment storage space will be located for use (location is to be determined).

6.21 ACCESS ROUTES

6.21.01 Existing roads will be used to access and transport personnel to dock facilities.

6.22 CONTROL OF WATER RUN-ON AND RUN-OFF

6.22.01 This investigation involves work within marine waters and not land-based activities. There will not be any drainage patterns that are altered by site activities and therefore mitigation procedures will not be required to control water run-on or run-off. Furthermore, TtEC will not conduct any activities that discharge pollutants into waterways or waterbodies. Spill prevention practices and response procedures will be in place to minimize the chances for spills and releases. Waste management and disposal will comply with federal and Puerto Rico regulations.

6.23 DECONTAMINATION OF EQUIPMENT

6.23.01 There is no anticipated decontamination required on this project.

6.24 MINIMIZING AREAS OF DISTURBANCE

6.24.01 Boating activities will be performed to the extent required to map and survey the benthic environment while minimizing harm through direct contact with coral reefs, seagrass beds, and marine mammals or sea turtles. Work areas will be planned in advance so that appropriate resource agencies can review them and scheduled activities will cause minimal potential for impact to the environment. Maps, charts, and aerial photos will help ensure that the areas worked in are minimally disturbed and sensitive areas (coral reefs and seagrass beds) can be avoided. Equipment checks will be performed daily before and during work to ensure data collection is completed with minimal amount of potential rework. Boat trips to and from the launch will be minimized to the extent possible through proper pre-trip planning to minimize boat traffic overall and the most direct routes with the least potential for impacts to coral reefs and seagrass beds will be used to access the work areas.

6.25 POST-ACTIVITY CLEANUP

6.25.01 Following completion of both daily work and the project, all boats and equipment will be properly secured and stowed. Periods of potential severe weather will require paying particular attention to securing and stowing of gear as required to minimize the potential for damage or materials to be dispersed by wind or rain. Cleaning of boats will only be done in a designated onshore location and laydown area. Trash and sanitary waste will be removed and placed in designated waste receptacles. All waste will be properly disposed of prior to demobilization from the project.

7.0 PROPERTY MANAGEMENT PLAN

7.0.01 This Property Management Plan has been prepared in accordance with DID MR-005-09 and Federal Acquisition Regulations (FAR), Part 45.5 and it supplements to provide detailed information on the types, quantities, and sources of equipment and materials that will be required to perform field and office operations on this Task Order. Field operations include all activities to be performed to complete the fieldwork. Office operations include all tasks performed in support of project management and the implementation of project work in the field through completion consistent with the requirements of the Scope of Work (Appendix A). The types of equipment recommended, selected, and proposed for this work are those that have been tested and proven in the industry and, therefore, are reliable to use in performing the various activities associated with this project. The quantities proposed are needed to help perform the work in a timely and cost-effective manner as dictated by the project schedule.

7.1 FIELD EQUIPMENT

7.1.1 Survey Equipment

7.1.1.01 Survey vessel and equipment that will be used during the Phase 2 RI are described in detail in Section 3, Field Investigation Plan.

7.1.2 Transportation Equipment

7.1.2.01 Various types of transportation equipment will be required during field operations. Vehicles required during the project may include standard automobiles and pickup trucks with vessel trailers.

7.1.3 Safety Gear

7.1.3.01 The RI is non-invasive and no contact with potential MEC is expected. Appropriate PPE for vessel operations will be worn and may include, but is not limited to, boots, leather work gloves, latex or nitrile gloves, hardhats, and safety glasses. Personnel will typically conduct their operations in Level D PPE consisting of standard work clothes with long pants, safety boots (as needed), hard hats (when overhead hazard is present), safety glasses or face shields (as needed), and hearing protection (as needed). Personnel working away from active field investigations will not be required to wear safety boots or hard hats.

7.1.4 Communication Equipment

7.1.4.01 Communications equipment to be used includes handheld two-way radios, very high frequency (VHF) radios, and cellular telephones.

7.1.5 Office Equipment

7.1.5.01 The majority of the survey equipment to be used on this project, including the vessel, will be brought to the site from the TtEC office in Bothell, Washington, with support from the office in TtEC office in Carolina, Puerto Rico. Most of the equipment (for example, vessel, TEMA-MK3, TEMA-Lite, hovercraft, underwater video, GPS equipment, radios, computer-aided design and drafting or GIS workstations, computers, printers, plotters, etc.) is owned by TtEC, and the charges to the project will be as proposed for this Task Order. However, some items may need to be rented or purchased for fieldwork.

7.1.6 Consumable Supplies

7.1.6.01 Consumable supplies planned for the purchase in support of the RI/FS include but are not limited to:

- Fuel for vessels, vehicles and equipment;
- Disposable gloves and leather work gloves;
- Potable water;
- Eye wash;
- First aid kits;
- Fire extinguishers;
- Log books; and
- Ink cartridges for printers and copy paper.

7.1.7 Vendors and Associated Costs

7.1.7.01 TtEC will provide the majority of the field and office equipment; however, certain types of equipment and materials will be rented, leased, or purchased from vendors with proven records of furnishing well-maintained, reliable, and updated equipment that can be used to successfully complete the field and office operations. General cost estimates on the types, quantities, and sources of equipment proposed for the RI/FS are summarized in Table 7-1. The majority of consumable supplies will be provided by local vendors; however, some consumables may be purchased from specialty vendors.

Table 7-1. List of Equipment

Office/Field Operations	Equipment Type (or equivalent)	Number of Units	Anticipated Source	Status
Communication during fieldwork	VHF radios, Motorola handheld radios and cellular telephones	8-15	TtEC	Own*
Interpretation of field data and information processing	Field laptop computers, printer, scanner	3	TtEC and local vendor	Own* and purchase
Survey Operations	TEMA-MK3	1	TtEC	Own*
	TEMA-Lite	1	TtEC	Own*
	underwater cameras	4-10	TtEC	Own*
	GPS	4-6	TtEC	Own*
	USBL	1	TtEC	Own*
Survey Operations	Vessels	2-3	TtEC	Own*

Table 7-1. List of Equipment (continued)

Office/Field Operations	Equipment Type (or equivalent)	Number of Units	Anticipated Source	Status
Transportation of personnel and equipment	Jeep, pickup, golf cart, etc. Pickup truck(s) Vessel trailer(s) Equipment trailer	4-6 1-2 2 1	Local Vendor TtEC TtEC TtEC	Lease Own* Own* Own*
Field office	Portable trailer/rental house or apartment	1	Local Vendor	Lease
Sanitation	Portable toilets	3	Local Vendor	Rent
Remote office processing of data and development of maps/graphics	Desktop computers, laptop computers, GIS workstation, printers/copiers/plotters	4	TtEC	Own*
Photo documentation of fieldwork	Digital cameras	2	TtEC	Own*
Field safety	AED	1	TtEC	Own*

* Equipment is owned and maintained by TtEC and will be rented to the project at the contract rates.

7.1.8 Procurement Procedures

7.1.8.01 Equipment will be leased or rented, and consumables and supplies will be purchased in a procurement process in strict conformance with the FAR and Defense Federal Acquisition Regulations. There are no known instances where purchase of equipment on behalf of the government will be required on this project. TtEC will follow standard procurement procedures for all purchases. TtEC will acquire at least three quotes for each item and a comparison of rental versus purchase of each item will be performed in accordance with FAR thresholds.

7.1.9 Leased and Rented Vehicles

7.1.9.01 The leased vehicles will be selected using the comparison of rate quotes from at least three commercial vendors. The number of vehicles will be determined by one vehicle for approximately four personnel working on-site. The type of vehicles used will be determined by the site's physical conditions, such as terrain, weather conditions, and distances between lodging, the site office, and the fieldwork area. Any exceptions will be justified by TtEC and approved by the Contracting Officer.

7.1.10 Consumable Supplies and Personal Property

7.1.10.01 TtEC's disclosed accounting practices prescribe that all materials and supplies required for the performance of the contract and Task Order will be direct charged to that order, and such materials and supplies are not included in the basis for overhead computation. The only exception is limited to home office supplies and equipment such as letterhead, pens, pencils, standard personal computers, office furnishings, etc. Field office supplies are typically direct charged to the project and not included in the overhead computation.

7.1.11 Property Storage Plan

7.1.11.01 The site office will be used to store purchased items for the RI/FS. If needed, an off-site storage unit will be rented. TtEC-owned property will be segregated from government property.

7.1.12 Ultimate Disposal Plan

7.1.12.01 Non-consumable items purchased on time and material (T&M) tasks will be reassigned to other government projects at the end of the project. TtEC will provide an inventory to USAESCH and request further direction for transfer/disposal details.

7.1.13 Property Tracking Plan

7.1.13.01 An inventory list will be maintained by TtEC for the non-consumable items purchased on T&M tasks for the RI/FS. When applicable, the serial number, model or manufacturer, date purchased, present location of item, cost, current status (functional, need of repair, needs batteries, etc.), and a description of the item are recorded on the inventory list. A property tracking log report will be submitted to USAESCH that will list all TtEC-acquired property that is directly charged to the Task Order on T&M tasks. The property tracking log report will be submitted at the conclusion of the field investigation.

7.1.14 Loss Notification

7.1.14.01 For all non-consumable items purchased on the inventory for the RI/FS, TtEC will notify the Contracting Officer if the item is lost, damaged, stolen, or destroyed.

8.0 INTERIM HOLDING FACILITY SITING PLAN FOR RECOVERED CHEMICAL WARFARE MATERIEL (RCWM) PROJECTS

8.0.01 Section 8 is not applicable to this project and will serve as a placeholder section only.

9.0 PHYSICAL SECURITY PLAN FOR RCWM PROJECT SITES

9.0.01 Section 9 is not applicable to the project and will serve as a placeholder section only.

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APPENDIX A

SCOPE OF WORK

SCOPE OF WORK

This work plan describes the EM survey to be conducted in accordance with paragraph 3.4.1.4, Optional Task 4.a4 (Magnetometer/EM Survey), and 3.4.2.4, Optional Task 4.b4 (Magnetometer Survey) of the Performance Work Statement (PWS) for the Remedial Investigation / Feasibility Study, Culebra Water Ranges, Culebra, Puerto Rico, I02PR0068. The relevant section from the PWS is excerpted below.

3.4 Task 4, RI/FS Field Activities: This is a Cost Plus Fixed Fee Price task.

Objective: Conduct a remedial investigation in accordance with CERCLA, characterizing the nature and extent of MEC contamination at the required munitions response sites (MRS) meeting the project DQOs as defined during the TPP process. This task shall include all field activities necessary to execute this task except MC sampling. MC sampling requirements are covered under Task 12, Environmental Sampling & Analysis.

3.4.1 Task 4a, MRS 03 Flamingo Bay Water Area (195 acres), FUDS Project No. I02PR006803M01. Refer to historical project documentation of site location, historical information, and boundaries.

3.4.1.1 Optional Task 4a1, Bathymetry. This task is Cost Plus Fixed Fee (CPFF).

3.4.1.2 Optional Task 4a2, Side Scan Sonar. This task is Cost Plus Fixed Fee (CPFF).

3.4.1.3 Task 4.a3, ROV/AUV Underwater Video. This task is Cost Plus Fixed Fee (CPFF).

3.4.1.4 Optional Task 4.a4, Magnetometer/ EM Survey. This task is Cost Plus Fixed Fee (CPFF).

3.4.1.5 Optional Task 4.a5, Intrusive Investigation. This task is Cost Plus Fixed Fee (CPFF).

3.4.2 Optional Task 4b, MRS 12 Luis Pena Channel Water Areas (835 acres), FUDS Project No. I02PR006812M01. Refer to historical project documentation of site location, historical information, and boundaries

3.4.2.1 Optional Task 4b1, Bathymetry. This task is Cost Plus Fixed Fee (CPFF).

3.4.2.2 Optional Task 4b2, Side Scan Sonar. This task is Cost Plus Fixed Fee (CPFF).

3.4.2.3 Optional Task 4.b3, Remote Operated Vehicle. This task is Cost Plus Fixed Fee (CPFF).

3.4.2.4 Optional Task 4.b4, Magnetometer/ EM Survey. This task is Cost Plus Fixed Fee (CPFF).

3.4.2.5 Optional Task 4.b5, Intrusive Investigation. This task is Cost Plus Fixed Fee (CPFF).

3.4.3 The following applies to all MRSs:

Performance Standard: Field work, data quantity and quality, and analysis of said data (does not include area where Rights-of-entry were not obtained) provides the following results in the RI report:

- Demonstrate that the work was performed in accordance with the applicable laws, regulations, and guidance documents;
- Demonstrate that areas with elevated anomaly density or with potential to contain MEC are traversed and that there is at least 90% chance of detecting these areas.
- Demonstrate that the boundaries of all identified MEC contaminated areas have been delineated to an accuracy of at least +/- half the transect spacing, maximum 250 feet.
- Demonstrate that data inputs from the RI into the FS will enable remediation cost estimates with an accuracy of +50%/-30%. The work and reporting shall address the surface and sub-surface metallic anomaly density distribution (anomaly/acre) across identified MEC contaminated areas and other remediation cost drivers such as vegetation type and density, terrain conditions, soil type, exclusion zone evacuation costs, etc each to a level of accuracy within the range specified herein.

Additionally:

- Perform the RI field activities in accordance with the accepted Work Plan, QASP and UFP-QAPP.
- Proper processing and disposition of UXO, DMM and MC encountered in accordance with approved plan(s).
- All Material Potentially Presenting an Explosive Hazard (MPPEH) and munitions debris processed in accordance with Chapter 14, EM 1110-1-4009 and Errata Sheet No. 2.
- Meet the project DQOs as defined by the TPP process.
- All geophysics shall be IAW geophysics DID or as agreed to by the PDT Marine field work QC shall be recommended by the Contractor in the QCP. Government QA is expected to be limited to visual observation of the Contractors field work and QC operations due to the dynamics of this high energy environment. The government recognizes that submerged metallic items have the potential to move great distances due to the local current and surf conditions and that prolonged seeding of test items may not be feasible. The government requests that the Contractor submit a modified QC Requirements table for government acceptance for the marine and beach portions of the project to meet the needs of the project and still insure acceptable data quality to meet the project objectives. For this task order 1 acre of transects equals 14,520 lf (2.75 miles) of transects 3 feet wide. One acre's worth of grids equals seventeen (17) 2500 sf grids or four (4) 10,000 sf grids.

AC: Conduct the RI in accordance with the accepted/approved WP, UFP-QAPP, and ESP. QC data submitted meets requirement described in the most recent geophysics and chemistry DIDs or QCP that has been accepted by the PDT.

- No more than 3-4 CARs/948s for non-critical violations and/or 1 CAR/948 for critical violation. No unresolved corrective action requests.
- All final data and QC tests/documentation submitted. Government QA acceptance of QC tests/documentation gained.
- No Class "A" Safety accidents, contractor at fault; <1 non-explosive Class C accidents; and <2 non-explosive related Class D accidents, IAW AR 385-40.
- Major safety violations, no more than 1 non-explosive related safety violation.
- Minor safety violations, no more than 2 safety violations.
- Zero letters of reprimand, grievances, or formal complaints.

Measurement / Monitoring: Period inspection/review of field work. Verify compliance with accepted WP, UFP-QAPP and Dive Plans as applicable. Quality control tests/documentation submitted per the QASP for government review. Additionally, statistical confidence will be calculated using the Visual Sampling Plan software, UXO Estimator or other approved statistical method. Boundary precision will be determined by evaluation of the sampling footprint as it relates to the reported contaminated/uncontaminated areas in question. Anomaly density profile and other remediation cost driver precision will be verified by QA of methods used.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements:

- Restore all areas to their original condition; all access/excavation/detonation holes shall be backfilled.
- Maintain a detailed accounting of all UXO, DMM, MD and range-related debris encountered per DID WERS-004.01. This accounting shall include: amounts of UXO, DMM and MD; nomenclature; location and depth of UXO/DMM; location of MD; and final disposition. The accounting system shall also account for all demolition materials utilized on-site. Digital photographs of UXO and DMM and examples of MD found during the investigation are to be taken.
- All UXO, DMM and MC encountered during this munitions response shall be processed in accordance with the approved work and safety plans.
- To the maximum extent practicable, the permanent record shall include sensor data that is digitally-recorded and geo-referenced. Exceptions to the collection of sensor data that is digitally-recorded and geo-referenced should be limited primarily to cases where impracticable.
-Perform visual survey of surface MEC
-Perform biological survey of all species of coral and other threatened and endangered plant species.

APPENDIX B

STANDARD OPERATING PROCEDURES

Appendix B-1	Supplemental Standard Operating Procedures for Endangered Species Conservation and Their Critical Habitat, February 2014 (Addendum 1, February 2015); also includes 2012 and 2008 SOPs
Appendix B-2	Standard Operating Procedure – Hovercraft Operations
Appendix B-3	Final Standard Operating Procedure for Digital Geophysical Mapping
Appendix B-4	Standard Operating Procedure for Geophysical Data Processing and Management
Appendix B-5	Geophysical System Verification and Instrument Verification Strip Plan

APPENDIX B-1

SUPPLEMENTAL STANDARD OPERATING PROCEDURES FOR ENDANGERED SPECIES CONSERVATION AND THEIR CRITICAL HABITAT, FEBRUARY 2014 (FEBRUARY 2015 ADDENDUM 1)

This Appendix contains the following:

- February 2015 Addendum 1 to the Supplemental Standard Operating Procedures for Endangered Species Conservation and Their Critical Habitat, February 2014
- Supplemental Standard Operating Procedures for Endangered Species Conservation and Their Critical Habitat, February 2014
  - Appendix A: SOPs for Endangered Species Conservation and their Critical Habitat during Underwater Investigations – April 2012
    - *Appendix A*—SOPs for Endangered Species Conservation and their Habitat (July 2008)
    - *Appendix B*—Addendum to the 2008 SOPs (April 2011)
  - Appendix B: Guide with the Minimum Information Required for the Daily Observer Log Sheet
  - Appendix C: Recommended Coral Relocation and Reattachment Protocol
  - Appendix D: List of seabirds that occur in the Project Area
  - Appendix E: Equation to calculate the potential extent of acoustic impacts from underwater detonations

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

CESAJ-PM-M

FEB 25 2015

MEMORANDUM FOR SEE DISTRIBUTION LIST

SUBJECT: Final Supplemental Standard Operating Procedures (SOP) for Endangered Species Conservation and their Critical Habitat (Addendum 1 – February 2015), Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS) Property No. I02PR0068, Culebra, Puerto Rico

The Jacksonville District, U.S. Army Corps of Engineers is enclosing for your records a copy of the Final Supplemental SOP for Endangered Species Conservation and their Critical Habitat (Addendum 1 – February 2015). A copy of the draft Addendum was provided to the resource agencies via e-mail for review and comment on December 1st, 2014. Review comments from the National Marine Fisheries Service (NMFS) and the Puerto Rico Environmental Quality Board (EQB) were received on December 5th, 2014 and January 7th, 2015, respectively. Responses to comments as well as the revised Addendum 1 were provided to NMFS and EQB on February 13, 2015.

Should you need additional information, please contact me at 904-232-1758 or by e-mail at John.E.Keiser@usace.army.mil or Mr. Wilberto Cubero at 904-232-1426 or by e-mail at Wilberto.Cubero-Deltoro@usace.army.mil.

Sincerely,

Encls

John E. Keiser, P.E.
FUDS Program Manager
Military/Interagency &
International Service Branch

Distribution List Final Supplemental SOP for Endangered Species Conservation and their Critical Habitat (Addendum 1 – February 2015), DERP-FUDS Property No. I02PR0068, Culebra, Puerto Rico	
Ms. Wilmarie Rivera Federal Facilities Coordinator PR Environmental Quality Board 1375 Ponce de León Avenue San Juan, PR 00926-2604	Ms. Marelisa Rivera US Fish and Wildlife Service Road 301, Km 5.1 Boquerón, PR 00622
Dr. Lisamarie Carrubba NOAA Fisheries Caribbean Field Office Road 301, Km 5.1 Boquerón, PR 00622	Dr. Craig Lilyestrom Director, Marine Resources Division Department of Natural & Environmental Resources PO Box 366147 San Juan PR 00936-6147
Mr. Julio Vazquez US EPA Region 2 Special Project Branch/Federal Facilities Section 290 Broadway – 18th Floor New York, NY 10007-1866	Ms. Diane E. Wehner NOAA Office of Response and Restoration 290 Broadway Rm 2059 New York, NY 10007
Ms. Ana Roman US Fish and Wildlife Service Culebra National Wildlife Refuge Manager Road 301, Km 5.1 Boquerón, PR 00622	Mr. Richard Henry US Fish and Wildlife Service 2890 Woodbridge Ave. Edison, NJ 08837
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FINAL

Supplemental Standard Operating Procedures for Endangered Species Conservation and their Critical Habitat

DERP-FUDS Property No. I02PR0068
Culebra, Puerto Rico

US Army Corps of Engineers
Jacksonville District

February 2014
(Addendum 1 February 2015)

ADDENDUM 1

SUPPLEMENTAL STANDARD OPERATING PROCEDURES
ENDANGERED SPECIES CONSERVATION AND HABITAT PROTECTION
DERP-FUDS PROJECT NO. I02PR0068, CULEBRA, PUERTO RICO

1.0 PURPOSE AND NEED

The purpose of this document is to 1) supplement, not replace, the *February 2014 Supplemental Standard Operating Procedures (SOPs) for Underwater Investigations for Defense Environmental Restoration Program for Formerly Used Defense Site (DERP-FUDS) Project No. I02PR006802, Culebra, Puerto Rico,* 2) serve as guidance for USACE and its Contractors in order to avoid or minimize impacts to listed species and their designated critical habitat and species proposed for Endangered Species Act (ESA) listing during geophysical surveys, intrusive investigations/MC environmental sampling, and controlled detonation activities, 3) satisfy the substantive requirements of the ESA, 4) incorporate newly listed species, and 5) update the POC list for coordination and reporting.

2.0 LISTED OR PROPOSED FOR LISTING SPECIES

A description of threatened or endangered species and their habitat as well as species proposed for listing that are known to occur or have the potential to occur in the waters around Culebra Island and adjacent cays have been discussed in the previously developed and coordinated SOPs listed below.

a. SOPs for Endangered Species Conservation and their Habitat – July 2008

b. Addendum to the July 2008 SOPs – April 2011

c. SOPs for Endangered Species Conservation and their Critical Habitat during Underwater Investigations – April 2012

d. Supplemental SOPs for Endangered Species Conservation and their Critical Habitat during Underwater Investigations – February 2014

Subsequent to the February 2014 supplement, ESA listing decisions became final and additional species have been proposed for listing as threatened or endangered under the ESA. The species for which ESA listing decisions are now final and additional species now proposed for ESA-listing are discussed below:

a. On September 10, 2014, the National Marine Fisheries Service (NMFS) published a final rule in the Federal Register (79 FR 53851) to list 20 coral species as threatened under the ESA (effective date October 10, 2014). Five of these species are known to occur in Puerto Rico including: Pillar Coral (*Dendrogyra cylindrus*), Rough Cactus Coral (*Mycetophyllia ferox*), Lobed Star Coral (*Orbicella annularis*), Mountainous Star Coral (*Orbicella faveolata*), and Boulder Star Coral (*Orbicella franksi*)(genus *Orbicella* formerly known as *Montastraea*). In addition, the determination to maintain the status of Elkhorn Coral (*Acropora palmata*) and Staghorn Coral (*Acropora cervicornis*) as threatened rather than changing their listing to endangered was included in this final rule. <u>Please note</u>: the listed species common names above were taken from the final rule (79 FR 53851) and supersede those in 2012 SOPs for Endangered Species Conservation and their Critical Habitat during Underwater Investigations – April 2012, Page 21 Section 3.13 Species of Corals Proposed for Listing under the ESA, Page 23: Section 3.13.2.1, and Page 24 Section 3.13.2.3.

b. On September 2, 2014, NMFS published a final rule in the Federal Register (79 FR 38213) to list the Central and Southwest (SW) Atlantic Distinct Population Segment (DPS) of Scalloped Hammerhead Shark (*Sphyrna lewini*) as a threatened species under the ESA. NMFS is also considering critical habitat for the Central & SW Atlantic DPSs. These DPSs include the U.S. Caribbean. NMFS does not currently have any explosive guidelines specific to sharks. For the scalloped hammerhead a conservative estimate is application of the predictive equations and example calculations for fish from 2014 SOPs, Appendix E, Section 4.2. However, this species isn't expected to be common in the work area given the shallow depths and overfishing. Because this is an underwater species that doesn't need to surface to respire, perhaps the highest potential for observation would be through diver survey prior to any intrusive work. However, sharks could still swim into the area and not be seen. Sharks should be far more resilient to pressure wave injury than air bladdered fish, turtles, and marine mammals because they have no swim bladder (or air containing organs). External injury (eyes, gills, scale loss, contusions) or auditory damage could occur if the shark is fairly close to the blast. However, mortal injury or death is unlikely. Therefore, the acoustic impact calculations for fish from the 2014 SOPs will be used to establish zones of influence for sharks during in-water detonation/blow-in-place activities.

c. On September 2, 2014, NMFS issued a proposed rule and request for comments (79 FR 51929) and announced a 12-month finding and listing determination on a petition to list the Nassau Grouper (*Epinephelus striatus*) as threatened or endangered under the ESA. The 105 day document comment period ends on December 31, 2014.

d. On November 5, 2014, NMFS announced a 12-month finding (79 FR 65628) and listing determination on a petition to list the Queen Conch (*Strombus gigas*) as threatened or endangered under the ESA. NMFS completed the status review and determined that there was not enough evidence to warrant listing at this time.

3.0 MEASURES TO AVOID OR MINIMIZE POTENTIAL IMPACTS

The measures in the SOPs listed in Section 2.0 above will be implemented to minimize the risk of unintended impacts to these newly listed species, species proposed for ESA-listing, and all other threatened or endangered species and their habitat during RI/FS underwater investigation. Activities that may pose potential impacts to listed species include, but are not limited to running aground, accidental collision or vessel strike, personnel during snorkeling and diving operations, equipment [e.g. multi-beam, side scan sonar, remotely operated vehicle (ROV), hand-held magnetometers, electromagnetic (EM) platforms, and video cameras], intrusive investigations requiring excavation of the marine bottom, removal and transport of anomalies from underwater locations to terrestrial collection points, and accidental detonation.

By implementation of these measures, adverse impacts to listed species or their habitats are expected to be avoided or minimized. It should be noted that the Contractor will be required to implement these SOPs during any underwater work.

The POC list for coordination and reporting from the February 2014 Supplemental SOP has been updated and is presented below.

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US Army Corps of Engineers
Jacksonville District

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LIST OF ACRONYMS

DERP	Defense Environmental Restoration Program
DM	Decision Matrix
DNER	Department of Natural and Environmental Resources
EBS	Environmental Baseline Survey
EQB	Environmental Quality Board
EM	Electromagnetic
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESP	Explosives Site Plan
FS	Feasibility Study
FUDS	Formerly Used Defense Sites
FWS	U.S. Fish and Wildlife Service
GPS	Global Positioning System
MC	Munitions Constituent
MD	Munitions Debris
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Sites
Navy	Department of Navy
NMFS	National Marine Fisheries Service
QC	Quality Control
RI	Remedial Investigation
ROV	Remote Operated Vehicle
SCUBA	Self Contained Underwater Breathing Apparatus
SLRA	Screening Level Risk Assessment
SOPs	Standard Operating Procedures
TPP	Technical Project Planning
UIT	Underwater Investigation Team
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
UXO	Unexploded Ordnance
WP	Work Plan

SUPPLEMENTAL STANDARD OPERATING PROCEDURES
ENDANGERED SPECIES CONSERVATION AND HABITAT PROTECTION
DERP-FUDS PROJECT NO. I02PR0068, CULEBRA, PUERTO RICO

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) is conducting Environmental Baseline Surveys (EBS) on Culebra Island Munition Response Sites (MRSs) underwater portions. The EBS is the first of three (3) phases of the Remedial Investigation (RI) being conducted within these areas. The RI is comprised of the following phases:

a. Phase I – Hydrographic Survey and Underwater Visual Surveys.

b. Phase II - Geophysical Surveys to detect metallic anomalies.

c. Phase III - Intrusive Investigations/Munitions Constituents (MC) Environmental Sampling.

The overall objective of the RI/Feasibility Study (FS) is to determine the nature and extent of any contamination related to munitions and explosives of concern (MEC) and/or MC within the underwater portions of these MRSs. The main objectives of the underwater investigations are to a) characterize and map benthic habitats within investigation areas, b) determine, identify and map endangered or threatened species, in particular coral colonies, c) gather the necessary information to determine potential effects (e.g. location of species versus location of suspected MEC) on endangered or threatened species during remedial investigations and cleanup activities, d) determine presence or absence of MC and MEC, e) characterize the nature and extend of MC and MEC presence, and f) determine if the MC or MEC pose an unacceptable risk to human health and the environment, which would require further considerations or a response action.

2.0 PURPOSE AND NEED

The purpose of this document is to 1) supplement, not replace, the *April 2012 Standard Operating Procedures (SOPs) for Underwater Investigations for Defense Environmental Restoration Program for Formerly Used Defense Site (DERP-FUDS) Project No. I02PR006802, Culebra, Puerto Rico* 2) serve as guidance for USACE and its Contractors in order to avoid or minimize impacts to listed, or proposed for listing, species and their designated critical habitat during geophysical surveys, intrusive investigations/MC environmental sampling, and controlled detonation activities, and 3) satisfy the substantive requirements of the Endangered Species Act (ESA).

3.0 LISTED OR PROPOSED FOR LISTING SPECIES

A description of threatened or endangered species and their habitat as well as species proposed for listing that are known to occur or have the potential to occur in the waters around Culebra Island and adjacent cays have been discussed in previously developed and coordinated SOPs. The following SOPs are being incorporated by reference into this document and they can be found in **Appendix A**:

a. SOPs for Endangered Species Conservation and their Habitat – July 2008

b. Addendum to the July 2008 SOPs – April 2011

c. SOPs for Endangered Species Conservation and their Critical Habitat during Underwater Investigations – April 2012

4.0 MEASURES TO AVOID OR MINIMIZE POTENTIAL IMPACTS

The following measures will be implemented to minimize the risk of unintended impacts to threatened or endangered species and their habitat during RI/FS underwater investigation. Activities that may pose potential impacts to listed species are, but not limited to running aground, accidental collision or vessel strike, personnel, snorkeling and diving operations, equipment (e.g. multi-beam, side scan sonar, remotely operated vehicle (ROV), hand-held magnetometers, electromagnetic (EM) platforms, and video camera), intrusive investigations requiring excavation of the marine bottom, removal and transport of anomalies from underwater locations to terrestrial collection points and accidental detonation.

By implementation of these measures, adverse impacts to listed species or their habitats are expected to be avoided or minimized. It should be noted that the Contractor will be required to implement these SOPs during any underwater work as well as the previously coordinated SOPs included in Appendices A.

4.1 General Conservation Measures

4.1.1 Date of Commencement: The Contractor will provide USACE with a written notification of the date of commencement of underwater investigation work and a detailed description of the work to be implemented based on the Work Plan (WP) that will be coordinated and reviewed by Technical Project Planning (TPP) Team. USACE will provide the date of commencement to the TPP Team at least 10 days prior to initiating fieldwork.

4.1.2 Training/Briefing: Prior to initiating work all personnel shall receive training or briefings regarding the importance of endangered species, their characteristics, how they can be identified, potential and critical habitats, types of material in which they may hide, actions to take if are sighted, and avoidance measures to be followed as detailed in the SOPs. For additional information refer to **Appendix A**. This training or briefing shall be prepared and offered by qualified personnel (e.g. biologist, marine biologist, environmental scientist, among others). The Contractor shall submit their qualifications to the USACE for review and approval. The training or briefing will also include safety and emergency procedures.

4.1.3 Civil and Criminal Penalties: The Contractor shall instruct all personnel associated with the project of the potential presence of threatened or endangered species. All personnel shall be advised that there are civil and criminal penalties for harming, harassing, killing or otherwise altering the natural behavior or condition of threatened or endangered species protected under the ESA, the Puerto Rico Wildlife Law, the Puerto Rico Coral Reef Conservation Law and the Regulation to Govern the Endangered and Threatened Species of the Commonwealth of Puerto Rico. ESA gives both the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) responsibility for enforcing its provisions. The Commonwealth regulations to protect endangered and threatened species are enforced by the Puerto Rico Department of Natural and Environmental Resources (DNER).

4.1.4 Qualified Personnel: Each team performing underwater investigation work shall be accompanied on the boat, but not necessarily in the water, by qualified and experienced personnel (e.g. biologist, marine biologist, environmental scientist, among others) in order to identify the presence or absence of threatened or endangered species. The Contractor shall submit their qualifications to the USACE. The self contained underwater breathing apparatus (SCUBA) divers or snorkelers can request that the designated and qualified personnel on the boat to enter the water to identify and determine if a suspected threatened or endangered species is present in the study area.

4.1.5 Reports: The Contractor shall maintain a log detailing endangered or threatened species sightings in terrestrial and marine habitats. The log shall include, but not be limited to, the following information: date and time, location coordinates using a Global Positioning System (GPS) unit, species, one or more photographs, if possible, and any actions taken (e.g. species identification and distance from working area, reasons to cease operation, reasons to determine that operation may be resumed, among others) during the work period. All data shall be provided to USACE to be shared with the TPP. **Appendix B** includes a guide with the minimum information required for the Daily Observer Log Sheet.

4.2 Non-Intrusive Geophysical Underwater Investigation Conservation Measures

The following supplements but does not replace conservation measures established in the SOPs listed in Section 3.0 above.

4.2.1 All transect sections with scattered coral, reef, or colonized hard bottom will be surveyed with a method which results in no contact with the sea floor or with coral heads that extend close to the water surface. Detailed information on the appropriate equipment selection process will be provided in the WP and coordinated with the TPP Team. The equipment/system used in any underwater MRS portion will depend primarily on personnel safety, depth of water, and type of habitat present.

4.2.2 While several systems and EM platforms may be used during geophysical surveys, it is possible that in areas with varying amounts of submerged aquatic vegetation (e.g. seagrass) a system that is designed to come in contact with the sea floor may be used. For Quality Control (QC) purposes, prior to conducting the survey, a single transect across an area of submerged aquatic vegetation coverage will be surveyed using the proposed system. Qualified personnel will perform an assessment of the test area to determine if any adjustment is necessary to minimize disturbance to sand, macro algae and seagrass. After work is complete, the surveyed area will be inspected to ensure no impact to submerged aquatic vegetation has occurred.

4.2.3 In shallow water areas (1 to 4 feet) where contact with the bottom is not desired, the EM coil will be floated or will be suspended beneath a floating platform.

4.2.4 In areas with coral that are too deep for the floated system, or in areas containing coral heads with high relief, an ROV platform may be used to propel the EM coil along the transect while ensuring contact with the coral head is avoided. If the ROV EM platform is not suitable for selected transect segments these segments will be surveyed by divers or snorkelers as an instrument aided visual transect.

4.2.5 Divers/snorkelers will use handheld magnetometers to identify metallic anomalies, which may represent MEC or MPPEH. All equipment shall be used in a manner to avoid physical contact with corals.

4.2.6 QC will be established at all times to ensure appropriate pre-selected equipment is used throughout underwater investigation work as coordinated with TPP Team.

4.2.7 Anomalies along transects may be investigated upon discovery. Intrusive investigation will be conducted following measures listed in the next section (4.3).

4.3 Intrusive Underwater Investigation and Material Potentially Presenting an Explosive Hazard (MPPEH) Relocation Conservation Measures

Certified unexploded ordnance (UXO) divers/snorkelers will conduct the anomaly intrusive investigations. If the anomaly is at the surface, the investigation will be completed without disturbing the area or item, and if the anomaly is buried in sediments it will be uncovered by excavating down to the anomaly using hand tools, then the investigation will be performed to determine the vertical extent and boundaries of contamination and possible remedial actions.

Following are the measures to be implemented to protect listed species and their habitat during intrusive investigation. It should be noted that during all intrusive investigation phases qualified observers shall be present to scan the work area for sea turtles and marine mammals and take necessary measures to protect the species.

4.3.1 Excavations will be conducted in unconsolidated sediments and seagrass areas only. If the anomaly is located within coral or hardbottom areas the anomaly will be investigated visually only. However, if the anomaly is not encrusted in hardbottom or coral and can be easily removed by hand and has no coral colonization by listed or proposed corals, it can be removed and relocated to the designated processing area.

4.3.2 Divers will film and take pictures of the area around the anomaly to be investigated. If the anomaly is located in corals or hardbottom areas, divers will investigate an area with a three (3) meter radius, the center of which is the anomaly. Within that area, divers will determine the distance to and location of all listed and proposed coral. The pictures shall include measurements of distance between anomalies and listed or proposed corals and size of item. Care will be taken to avoid damaging corals or seagrass, if present.

4.3.3 If the anomaly is suspected to be MPPEH, a visual device will be placed temporarily next to the munition to provide a reference point for later investigation. This device shall have enough weight to remain in place without skipping along the bottom to avoid impact to corals until the investigation is complete. Once the investigation is complete, it will be removed.

4.3.4 UXO divers/snorkelers investigating anomalies within seagrass areas will be careful to maintain root systems as much as possible. Pre and post pictures shall be taken and shall include a measurement of the area investigated. Should intact plugs of seagrass be removed they will be replanted following the removal of the anomaly. As a possible method, the seagrass can be cut on three sides and rolled up. After work is complete, the excavated area will be filled with sand, if necessary, then the seagrass will be rolled back into place and staked with biodegradable stakes to enable the grass to reestablish quickly.

4.3.5 Each MPPEH item will be evaluated as a separate scenario. A Decision Matrix (DM) will be developed to provide timely decisions and methods of relocation and disposal. The DM will be included in the RI Phase III WP.

4.3.6 When feasible, if the anomaly is not munition related, the anomaly is not cemented in hard substrate, and ESA-listed or proposed corals are not attached to it, it will be brought to the surface and relocated to the designated terrestrial processing area for appropriate disposal. If non listed corals are attached, as feasible and as detailed in **Appendix C**, the recommended Coral Relocation and Reattachment Protocol will be followed.

4.3.7 No intrusive investigation, MEC/MPPEH removal, or MEC/MPPEH handling in MRSs adjacent to beaches will be conducted during the 48-hour period following the emergence of sea turtle hatchlings.

4.3.8 Anomalies or MPPEH Acceptable to Move: Anomalies that are 1) exposed or only shallowly buried in soft sediments, 2) are acceptable to move, and 3) its removal will not cause damage to listed species (e.g. listed corals are not attached) or their designated critical habitat will be relocated to the designated terrestrial processing site for disposal (see Section 4.4 for more information). Prior to removal, the UXO team must agree that the MEC/MPPEH is acceptable to move.

4.3.8.1 Prior to the anomaly/MEC/MPPEH removal effort, qualified personnel will verify the locations of listed and proposed corals, designated critical habitat and seagrass within the immediate vicinity. Listed and proposed coral species location will be identified with temporary underwater buoys or visual devices as a visual aid for the UXO team while setting up equipment for the removal. All removal actions shall be documented. Pre and post pictures of the area shall be taken with a scale measure next to the anomaly/MEC/MPPEH.

4.3.8.2 For soft sediment and seagrass areas, once an anomaly is reacquired, the MEC/MPPEH UXO investigation team will expose and recover the anomaly source using hand tools (such as spades, trowels, shovels). For coral and hardbottom areas, if the anomaly is not encrusted in hardbottom or coral and can be easily removed by hand and has no coral colonization by listed or proposed corals, it can be removed and relocated to the designated processing area. If non listed corals are attached, as feasible and as detailed in **Appendix C**, the recommended Coral Relocation and Reattachment Protocol will be followed. The MEC/MPPEH UXO investigation team will transfer recovered MEC/MPPEH to the shore or designated terrestrial location for processing and disposal.

4.3.8.3 Removal may occur by hand or by using lifting equipment (e.g. remotely with a lifting balloon). MEC that are acceptable to move but will cause an unacceptable risk to diver due size and weight of MEC will be moved remotely. Care will be taken to avoid damaging corals or seagrass during removal. However, corals that are not listed or proposed for listing, although it is not desired, may be damaged during MEC removal or disposal as a necessity. This may happen if corals are attached or in contact with the MEC item. As feasible and as detailed in **Appendix C**, the recommended Coral Relocation and Reattachment Protocol will be followed.

4.3.8.4 The terrestrial processing site will be located within the boundaries of the Munition Response Area (MRA). Its potential location will be provided in WP to the TPP. MPPEH items will not be transported out of the MRA.

4.3.9 Anomalies or MPPEH Not Acceptable to Move: Anomalies or MPPEH that are deeply buried or that are located in areas where removal of the item could result in damage to listed or proposed coral species or destruction or adverse modification of designated critical habitat will be accurately mapped by GPS and left in place.

4.3.9.1 These items will be marked by the placement of a solid clump next to it to provide a reference point for later investigation/action. For the purposes of these SOPs, a clump is defined as a heavy weight (such as a 7 pound mushroom anchor) that is placed 12-inches north of the item. The clump is not attached to a line or buoy but provides the divers with a visual reference for future identification. The clump location and placement shall not impact listed or proposed coral species. If the placement of a solid clump is not feasible (e.g. presence of listed species), the item will be accurately mapped by GPS.

4.3.9.2 The areas surrounding the anomaly or MPPEH will be filmed paying particular attention to corals and biology in the immediate vicinity. If the anomaly is located in corals or hardbottom areas, divers will investigate an area with a three (3) meter radius, the center of which is the anomaly. Within that area divers will determine the distance to and location of all listed and proposed coral. The pictures shall include measurements of distance between anomalies and listed or proposed corals and size of item. These films will be used later when identifying a suitable method for disposal. If it is determined that BIP is required and it is estimated that the potential blast impact radius is greater than 3 meters, additional investigation may be required.

4.3.10 Environmental Sampling: Samples will be taken at locations where Munition Debris (MD) or suspected MPPEH items are observed. Detailed information on the environmental sampling will be provided in the WP to the TPP Team. Any sampling work shall avoid impacts to protected species.

4.4 MEC/MPPEH Disposal/Detonation Site Conservation Measures

4.4.1 Prior to removal of MEC/MPPEH from underwater locations, the Contractor in coordination with USACE will establish a designated terrestrial MEC/MPPEH disposal/detonation site. All recovered underwater MEC/MPPEH will be transferred to this site for processing and inspection to determine disposal method. Following appropriate inspection procedures, items that do not pose a risk will be designated or reclassified to Material Documented as Safe (MDAS) and transported off of Culebra for final disposal.

4.4.2 The MEC/MPPEH processing and disposal/detonation site will be established on a beach to provide convenient access by UXO removal teams working in the offshore waters and to minimize disturbance of vegetation and protected species on Culebra. The site will not be located in lagoon areas.

4.4.3 Qualified and experienced personnel will inspect the beach that would be used for MEC/MPPEH processing and detonation for the presence of sea turtles, sea turtle nests, and signs of recent sea turtle activity. An area not recently used by sea turtles and at least 100 meters from any place of active sea turtle use would be selected as the detonation site to the maximum extent practicable. Daily beach surveys will be conducted by qualified personnel to determine whether sea turtles are using beaches within the MRS. It should be noted that the contactor shall follow additional conservation measures provided in the July 2008 (pages 6-9) and April 2012 (Section 4.2) SOPs.

4.4.4 During MEC/MPPEH transfer and processing, qualified observer would continue to survey the beaches for signs of sea turtle activity. No human activity would occur until beaches are clear of sea turtles. Any active sea turtle nests will be marked and a 100-meter protection zone will be created around each nest to prevent incidental damage during detonation. It should be noted that the contactor shall follow additional conservation measures provided in the July 2008 (pages 6-9) and April 2012 (Section 4.2) SOPs.

4.4.5 All MEC/MPPEH detonation/processing will be performed during daylight hours to minimize the possibility that hatchlings would emerge from the nests during working hours. Detonation will be delayed until 48 hours have passed from the time of hatchling observation on the beach.

4.4.6 There are listed and migratory seabird species that have the potential to occur in the project area. The Roseate Tern (*Sterna dougallii*) is listed as threatened and the Brown Pelican (*Pelecanus occidentalis*) was delisted due to recovery but is being monitored. A complete list of seabirds that occur in the project area is included in **Appendix D**. Prior to detonation, a qualified observer will check the beach and adjacent waters for the presence of protected and listed seabird species by scanning the area with 10 X 50 binoculars. The qualified observer will also survey the beaches for signs of bird nesting. If bird nests are found within the detonation site and/or blast impact area, no detonation will be conducted in that area. If any protected bird species are within 200 meters of the detonation site, MEC detonation will be delayed until after the animal(s) leave the area. In addition, if blast impacts will extend into nearshore waters, a qualified observer for sea turtles and marine mammals shall be required. If these species are observed the detonation shall be postponed until the animal has left the impact zone or more than 30 minutes have elapsed since it was last sighted.

4.4.7 Immediately prior to detonation, a qualified observer will scan the overhead sky for the presence of any birds. If birds are in flight within 100 meters of the detonation site, the detonation will be delayed until no birds are within 100 meters of the detonation site.

4.4.8 The MEC/MPPEH will be demolished and/or demilitarized by controlled detonation using explosives to be provided by local vendors on as-needed basis. When feasible, all demolition events will be covered with sandbags to mitigate the blast effects and to reduce the risk of shrapnel being ejected. Additional measures may be implemented based on the calculations to adjust and establish exclusion areas. Munition debris (MD) will be recovered after detonation for appropriate disposal.

4.5 In-Water Detonation/Blow-in-Place (BIP) Conservation Measures

In-water detonations of MEC/MPPEH, including BIP, may occur during this project. All BIPs shall be closely coordinated with TPP Team. In-water detonations present unique challenges to the avoidance of unintended adverse impacts on protected marine species. As such, in addition to the measures listed above and established in previous SOPs, special conservation measures are described in this section to reduce the potential for adverse impacts should underwater detonations occur. Additional measures will be provided in the WP and/or Explosive Site Plan (ESP) to the TPP Team.

4.5.1 When possible, the MEC/MPPEH will be relocated to the designated terrestrial processing site for disposal as long as it is acceptable to move and it can be physically moved. The Senior UXO Supervisor and UXO Safety Officer must agree that the item is acceptable to move.

4.5.2 Appropriate sand substrate areas will be chosen during all phases of the investigation as potential MEC disposal sites based on safety considerations and minimizing impacts to resources of concern to the maximum extent practicable. These areas will be used only if MEC/MPPEH are unstable or represent a safety concern.

4.5.3 Prior to any detonation (24 hours minimum), the Contractor, in coordination with USACE staff, shall contact NMFS, FWS, the Environmental Protection Agency (EPA), the Puerto Rico Environmental Quality Board (EQB), the Puerto Rico Department of Natural and Environmental Resources (DNER) and the U.S. Coast Guard (USCG) to inform them of a planned underwater detonation.

4.5.4 Detonations will be done during daylight hours only, and under conditions of good visibility that ensure the exclusion zone is clear of marine mammals and sea turtles.

4.5.5 No detonation shall occur when protected marine species (marine mammals, sea turtles and corals) are known or suspected within the exclusion zone. The exclusion zone delineation will also consider the potential level of acoustic impacts following the Young's (1991) equation in **Appendix E**. It should be noted that the excerpts from NMFS's explosive guidance provided in Appendix E are in draft form and a complete review and approval process is still pending. The guidance is provided to assist with determinations of the potential extent of acoustic impacts to sea turtles and marine mammals so that decisions can be made as to which items cannot be detonated without further coordination with the TPP Team. The water surface within the entire exclusion zone will undergo a visual search for protected marine species a minimum of 30 minutes prior to detonation. Should a protected marine mammal or sea turtle species be observed, the detonation shall be postponed until the animal has been observed outside of the exclusion zone, or more than 30 minutes have elapsed since it was last sighted.

4.5.4 Constant vigilance over the exclusion zone will be maintained for a minimum of 30 minutes following a detonation, and a thorough water surface inspection of the zone shall be completed immediately following a detonation to search for injured or dead protected marine species and surrounding coral and hardbottom habitat impacts. Impacts to coral and hardbottom habitat will be documented using pictures and measures and the information provided to the TPP Team. Should an injured or dead protected species be observed, immediately contact the appropriate response hotline (Marine Mammals: (877) 433-8299; Sea Turtles: (727) 824-5312; and DNER (787) 645-5593). Emergency handling procedures for an injured sea turtle or mammal will be provided by NOAA.

4.5.5 All observed stranding of protected marine species should be reported to the appropriate hotline, regardless of whether or not the stranding is the result of a detonation or other component of the project.

4.5.6 Constant vigilance for the presence of protected marine species during all aspects of the project, particularly in-water activities, is required.

4.5.7 Visual surveys within the vicinity of the work areas for that day shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one half hour.

4.5.8 To the extent practicable and depending the ordnance type, appropriate techniques will be implemented to avoid and minimize damage to marine habitat. Detailed information will be provided in the ESP to the TPP Team.

4.5.9 All in–water work shall be conducted following the marine mammals and sea turtles avoidance measures established above and in previously coordinated SOPs.

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APPENDIX A

SOPs for Endangered Species Conservation and their Critical Habitat during Underwater Investigations – April 2012

FINAL

Standard Operating Procedures for Endangered Species Conservation and their Critical Habitat during Underwater Investigations

DERP-FUDS Property No. I02PR0068

Culebra, Puerto Rico

US Army Corps of Engineers
Jacksonville District

April 2012

US Army Corps of Engineers
Jacksonville District

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LIST OF ACRONYMS

DERP	Defense Environmental Restoration Program
DNER	Department of Natural and Environmental Resources
EBS	Environmental Baseline Survey
EQB	Environmental Quality Board
ESA	Endangered Species Act
FUDS	Formerly Used Defense Sites
FWS	U.S. Fish and Wildlife Service
MC	Munitions Constituent
MEC	Munitions and Explosives of Concern
MRS	Munitions Response Sites
Navy	Department of Navy
NMFS	National Marine Fisheries Service
SOPs	Standard Operating Procedures
TPP	Technical Project Planning
UIT	Underwater Investigation Team
USACE	U.S. Army Corps of Engineers

STANDARD OPERATING PROCEDURES FOR ENDANGERED SPECIES CONSERVATION AND THEIR CRITICAL HABITAT DURING UNDERWATER INVESTIGATIONS AT DERP-FUDS PROPERTY No. I02PR0068, CULEBRA ISLAND, PUERTO RICO

1.0 INTRODUCTION

Culebra Island is located approximately 17 miles east of the island of Puerto Rico and is approximately 9 miles from the Island of Vieques (**Figure 1**).

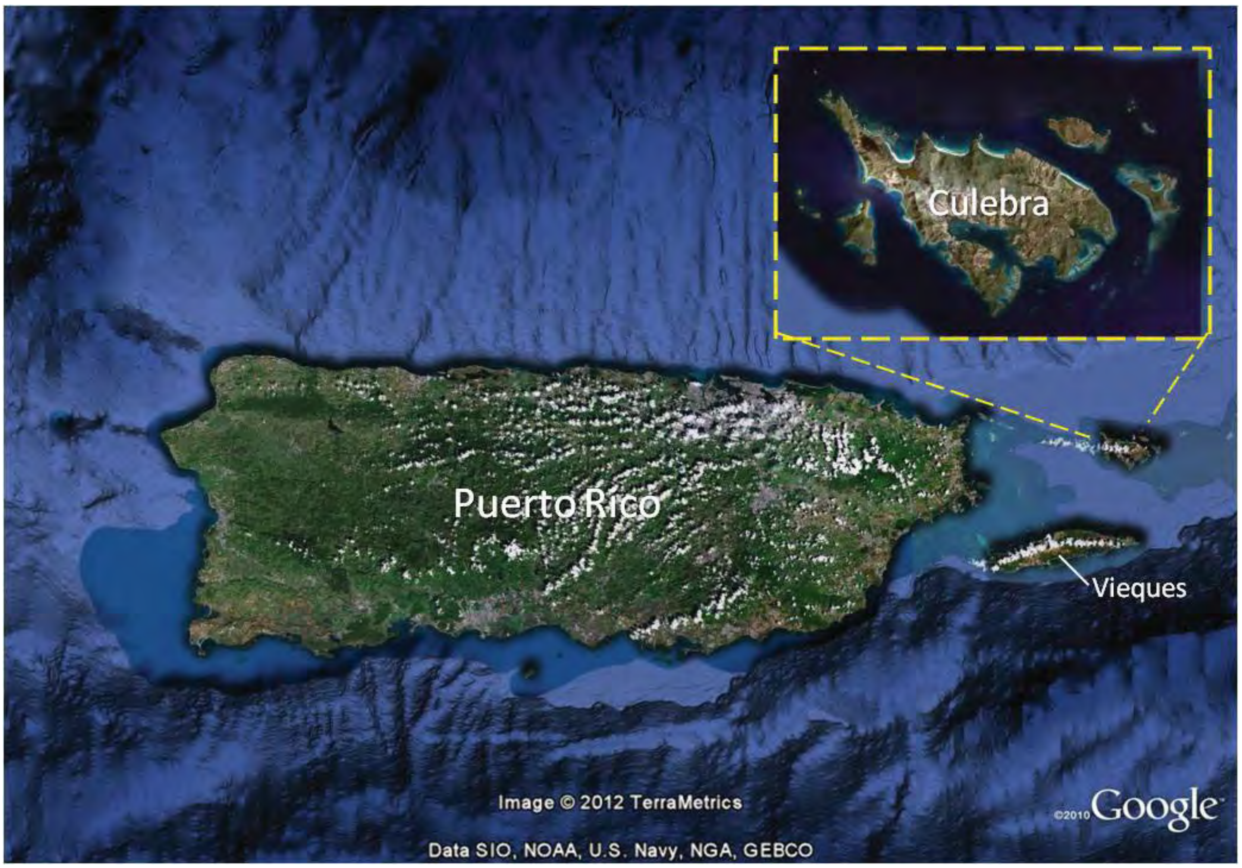

Figure 1. Location Map of Culebra.

In 1901, Culebra's public land was placed under the Department of Navy (Navy) control. The Island and adjacent cays were used as impact areas and firing ranges for aerial bombs and rockets, missiles, mortars, small arms, artillery rounds, and naval projectiles by the Navy and U.S. Marine Corps from 1903 until 1975. In 1978, part of the public land was transferred to the Commonwealth of Puerto Rico and the rest to the U.S. Fish and Wildlife Service (FWS).

Lands were transferred to the Commonwealth through a Quitclaim Deed and a Cooperative Management Agreement signed by the Government of Puerto Rico and the Department of the Interior in 1982.

The Finding and Determination of Eligibility, dated December 24, 1991, qualified 2,660 acres of Culebra Island and adjacent cays as eligible for consideration under the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS). However, upon subsequent review of historical material from the National Archives, it was determined that all of Culebra Island and the adjacent cays should be considered a FUDS, except the Northwest Peninsula which is not eligible under the 1982 Quitclaim Deed and Public Law 93-166, and the tract that was controlled by the Navy after 1986. The revised area covered by the DERP-FUDS projects for Culebra Island and adjacent cays consists of approximately 8,430 acres. **Figure 2** shows the DERP-FUDS project for Culebra.

Figure 2. DERP-FUDS Projects for Culebra.

The objectives of all the DERP-FUDS projects are to reduce risk to human health and the environment and reduce the hazards to public safety presented by military munitions through implementation of effective, legally compliant, and cost-effective response actions. In order to gather additional information that would help to determine the nature and extent of munitions constituent (MC) or munitions and explosive of concern (MEC) contamination on Culebra Island Munitions Response Sites (MRS), it was agreed by the Technical Project Planning Team (TPP Team) comprised of Federal and Commonwealth of Puerto Rico agencies to conduct underwater investigations and to prepare an Environmental Baseline Survey (EBS). The main objectives of the underwater investigations are: a) characterize and map benthic habitats within investigation areas, b) determine, identify and map endangered or threatened species, in particular coral colonies, c) gather the necessary information to determine potential effects (e.g. location of species versus location of suspected MEC) on endangered or threatened species during remedial investigations and cleanup activities, d) determine presence or absence of MC and MEC, e) characterize the nature and extend of MC and MEC presence, and f) determine if the MC or MEC pose an unacceptable risk to human health and the environment, which would require further considerations or a response action.

2.0 PURPOSE AND NEED

The purpose of this document is to develop a series of Standard Operating Procedures (SOPs) to avoid or minimize impacts to threatened and endangered species listed, pursuant to the Endangered Species Act (ESA), and their critical habitats during the DERP-FUDS underwater investigations on Culebra Island and adjacent cays. Also, serve as a guide for the underwater investigation team (UIT) providing them a general description of the listed species known to be found in the waters around Culebra and for which the surrounding waters and marine substrate were designated as critical habitat.

For the purpose of this document underwater investigation activities consist of visual observations, boating and diving operations, and remote sensing surveys. No intrusive investigation will be conducted. Based on the EBS results, additional SOPs or other measures would be developed and coordinated with the TPP for further investigation phases.

The information used to describe the listed species and their habitat was obtained from state/federal agencies fact sheets, recovery and management plans, petitions, the Federal Register and internet search, among other sources.

3.0 LISTED THREATENED OR ENDANGERED SPECIES

The purpose of this section is to provide a general description of threatened and endangered species that are known to occur or have the potential to occur in the waters around Culebra Island and adjacent cays. Species include the Loggerhead (*Caretta caretta*), Green (*Chelonia* *mydas*), Leatherback (*Dermochelys coriacea*) and Hawksbill (*Eretmochelys imbricata*) sea turtles, West Indian manatee (*Trichechus manatus manatus*), Humpback (*Megaptera novaeangliae*), Finback (*Balaenoptera physalus*), Sei (*Balaenoptera borealis*), Sperm (*Physeter macrocephalus*) and Blue (*Balaenoptera musculus*) whales and Elkhorn (*Acropora palmata*) and Staghorn (*Acropora cervicornis*) corals.

3.1 Loggerhead Sea Turtle (*Caretta caretta*)

Description: The loggerhead is characterized by a large head with blunt jaws. The carapace and flippers are a reddish-brown color; the plastron is yellow. The carapace has five pairs of costal scutes with the first touching the nuchal scute. There are three large inframarginal scutes on each of the bridges between the plastron and carapace. Adults grow to an average weight of about 200 pounds (**Figure 3**). This species was listed as threatened on July 28, 1978.

Figure 3. Loggerhead Sea Turtle
Source: http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm

Nesting Season and Development: Nesting season extends from about May through August with nesting occurring primarily at night and it is infrequent in Puerto Rico. Loggerheads are known to nest from one to seven times within a nesting season (mean is about 4.1 nests per season) at intervals of approximately 14 days. Mean clutch size varies from about 100 to 126 along the southeastern U.S. coast. Incubation ranges from about 45 to 95 days, depending on incubation temperatures, but averages 55 to 60 days for most clutches in Florida. Hatchlings generally emerge at night. Remigration intervals of 2 to 3 years are most common in nesting loggerheads, but remigration can vary from 1 to 7 years. Age at sexual maturity is believed to be about 20 to 30 years. The species feeds on mollusks, crustaceans, fish, and other marine animals.

Distribution/Habitat: The loggerhead sea turtle can be found throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and ship wrecks are often used as feeding areas. Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Nests are typically made between the high tide line and the dune front. Most loggerhead hatchlings originating from U.S. beaches are believed to lead a pelagic existence in the North Atlantic gyre for an extended period of time, perhaps as long as 10 to 12 years, and are best known from the eastern Atlantic near the Azores and Madeira. Post-hatchlings have been found floating at sea in association with *Sargassum* rafts. Once they reach a certain size, these juvenile loggerheads begin recruiting to coastal areas in the western Atlantic where they become benthic feeders in lagoons, estuaries, bays, river mouths, and shallow coastal waters. These juveniles occupy coastal feeding grounds for a decade or more before maturing and making their first reproductive migration, the females returning to their natal beach to nest.

3.2 Green Sea Turtle (*Chelonia mydas*)

Figure 4. Green Sea Turtle
Photo: Andy Bruckner, NOAA
Source: http://www.nmfs.noaa.gov/pr/species/turtles/green.htm

Description: The green sea turtle grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. Color is variable. Hatchlings generally have a black carapace, white plastron, and white margins on the shell and limbs. The adult carapace is smooth, keelless, and light to dark brown with dark mottling; the plastron is whitish to light yellow. Adult heads are light brown with yellow markings. Identifying characteristics include four pairs of costal scutes, none of which borders the nuchal scute, and only one pair of prefrontal scales between the eyes (**Figure 4**). This species was listed under the ESA on July 28, 1978. The breeding populations in Florida and the Pacific coast of Mexico are listed as endangered; elsewhere the species is listed as threatened.

Nesting Season and Development: The nesting season varies with the locality. In Puerto Rico, it is roughly June through October. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. A female may lay as a many as nine clutches within a nesting season (overall average is about 3.3 nests per season) at about 13-day intervals. Clutch size varies from 75 to 200 eggs, with an average clutch size of 136 eggs reported for Florida. Incubation ranges from about 45 to 75 days, depending on incubation temperatures. Hatchlings generally emerge at night. Age at sexual maturity is believed to be 20 to 50 years.

Distribution/Habitat: The green turtle is globally distributed and generally found in tropical and subtropical waters along continental coasts and islands between 30° North and 30° South. In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore (reefs and seagrass beds) waters from Texas to Massachusetts, the U.S. Virgin Islands, and Puerto Rico.

Critical habitat was designated in 1998 for green turtles in coastal waters around Culebra (**Figure 5**).

Figure 5. Green Sea Turtle Critical Habitat.

3.3 Leatherback Sea Turtle (*Dermochelys coriacea*)

Figure 6. Leatherback Sea Turtle
Source: http://en.wikipedia.org/wiki/Leatherback_sea_turtle

Description: The leatherback is the largest, deepest diving, and most migratory and wide ranging of all sea turtles. The adult leatherback can reach 4 to 8 feet in length and 500 to 2000 pounds in weight. Its shell is composed of a mosaic of small bones covered by firm, rubbery skin with seven longitudinal ridges or keels. The skin is predominantly black with varying degrees of pale spotting; including a notable pink spot on the dorsal surface of the head in adults. A toothlike cusp is located on each side of the gray upper jaw; the lower jaw is hooked anteriorly. The paddle-like clawless limbs are black with white margins and pale spotting (**Figure 6**). Hatchlings are predominantly black with white flipper margins and keels on the carapace. Jellyfish are the main staple of its diet, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed. The leatherback turtle was listed under the ESA as endangered in 1970.

Breeding Season and Development: On Culebra nesting occurs from about February to August with the peak occurring around April to May. Female leatherbacks nest an average of 5 to 7 times within a nesting season, with an observed maximum of 11 nests. The average interesting interval is about 9 to 10 days. The nests are constructed at night in clutches of about 70 to 80 yolked eggs. The white spherical eggs are approximately 2 inches in diameter. Typically incubation takes from 55 to 75 days, and emergence of the hatchlings occurs at night. Most leatherbacks return to their nesting beaches at 2 to 3-year intervals. Leatherbacks are believed to reach sexual maturity in 6 to 10 years.

In the U.S., small nesting populations occur on the Florida east coast (35 females/year), Sandy Point, U.S. Virgin Islands (50 to 100 females/year), and Puerto Rico (30 to 90 females/year). The leatherback is the most pelagic of the sea turtles. Adult females require sandy nesting beaches backed with vegetation and sloped sufficiently so the crawl to dry sand is not too far. The preferred beaches have proximity to deep water and generally rough seas. Culebra beaches most used by the species are Flamenco, Brava, Resaca and Soni Beach.

Distribution/Habitat: The leatherback turtle is distributed worldwide in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans. It is also found in small numbers as far north as British Columbia, Newfoundland, and the British Isles, and as far south as Australia, Cape of Good Hope, and Argentina.

3.4 Hawksbill Sea Turtle (*Eretmochelys imbricata*)

Figure 7. Hawksbill Sea Turtle
Photo: Caroline Rogers, USGS
Source: http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm

Description: The Hawksbill Turtle (*Eretmochelys imbricate*) is small to medium-sized compared to other sea turtle species. Adults weigh 100 to 150 lbs (45 to 68 kg) on average, but can grow as large as 200 lbs (91 kg). Hatchlings weigh about 0.5 oz (14 g). The carapace (top shell) of an adult ranges from 25 to 35 inches (63 to 90 cm) in length and has a "tortoiseshell" coloring, ranging from dark to golden brown, with streaks of orange, red, and/or black. The shells of hatchlings are 1-2 inches (about 42 mm) long and are mostly brown and somewhat heart-shaped. The plastron (bottom shell) is clear yellow. The rear edge of the carapace is almost always serrated, except in older adults, and has overlapping "scutes". The hawksbill turtle's head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. Hawksbill turtles are unique among sea turtles in that they have two pairs of prefrontal scales on the top of the head and each of the flippers usually has two claws (**Figure 7**). This species was listed under the ESA as endangered in 1970.

Nesting Season and Development: The nesting season varies with locality, nesting occurs all year long. Hawksbills nest at night and, on average, about 4.5 times per season at intervals of approximately 14 days. In Florida and the U.S. Caribbean, clutch size is approximately 140 eggs, although several records exist of over 200 eggs per nest. They nest under the vegetation on the high beach and nests have been observed having the last eggs of the clutch as close as 3 inches from the sand's surface. Remigration intervals of 2 to 3 years predominate. The incubation period averages 60 days. Hawksbills recruit into the reef environment at about 35 cm in length and are believed to begin breeding about 30 years later. However, the time required to reach 35 cm in length is unknown and growth rates vary geographically. As a result, actual age at sexual maturity is not known.

Distribution/Habitat: Hawksbill turtles use different habitats at different stages of their life cycle, but are most commonly associated with healthy coral reefs. The ledges and caves of coral reefs provide shelter for resting hawksbills both during the day and at night. Hawksbills are known to inhabit the same resting spot night after night. Hawksbills are also found around rocky outcrops and high energy shoals. These areas are optimum sites for sponge growth, which certain species are the preferred food of hawksbills. They are also known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent.

3.5 Antillean Manatee (*Trichechus manatus manatus*)

Description: Manatees are marine mammals found in marine, estuarine, and freshwater environments. The West Indian manatee, *Trichechus manatus*, includes two distinct subspecies, the Florida manatee (*Trichechus manatus latirostris*) and the Antillean manatee (*Trichechus manatus manatus*). While morphologically distinctive, both subspecies have many common features. Manatees have large, seal-shaped bodies with paired flippers and a round, paddle-shaped tail. They are typically grey in color (color can range from black to light brown) and occasionally spotted with barnacles or colored by patches of green or red algae. The muzzle is heavily whiskered and coarse, single hairs are sparsely distributed throughout the body. Adult manatees, on average, are about nine feet long (3 meters) and weigh about 1,000 pounds (200 kilograms). At birth, calves are between three and four feet long (1 meter) and weigh between 40 and 60 pounds (30 kilograms) (**Figure 8**). This species was listed under the ESA as endangered in 1967.

Figure 8. Antillean Manatee
Source: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A007

Behavior, Development and Diet: The manatee maneuvers through the water moving its paddle-like tail up and down and steering with its flippers. It often rests suspended just below the water's surface with only the snout above water. It feeds underwater, but must surface periodically to breathe. Although the manatee can remain underwater for as long as 12 minutes, the average time is 4-1/2 minutes.

Manatees reach breeding maturity between 3 and 10 years of age. The gestation period is approximately 13 months. Calves may be born at any time during the year. Usually a single calf is born, but twins do occur. An adult manatee will usually give birth to a calf every 2 to 5 years. The low reproductive rate makes the species less capable of rebounding from threats to its survival. They nurse underwater for about three minutes at a time from a nipple located behind their mother's forelimb. Born with teeth, calves begin eating plants within a few weeks but remain with their mother for up to 2 years. Manatees may live for several decades.

Manatees are herbivores that feed opportunistically on a wide variety of marine, estuarine, and freshwater plants, including submerged, floating, and emergent vegetation. Common forage plants include and are not limited to: cord grass, alga, turtle grass, shoal grass, manatee grass, eel grass, and other plant types. Manatees also require sources of freshwater, obtained from both natural and anthropogenic sources.

Distribution/Habitat: All of the studies suggest that manatees in Puerto Rico are more commonly observed in coastal areas from San Juan, eastward to the east coast, (and including Culebra and Vieques Islands) and then south and west, past Jobos Bay, to the west coast, and then about as far to the northwest as Rincon. Manatees are concentrated in several "hot spots" including Ceiba, Vieques Island, Jobos Bay and Boquerón Bay, and are less abundant along the north coast, between Rincón and Dorado.

3.6 Humpback Whale (*Megaptera novaeangliae*)

Description: Humpback whales are well known for their long "pectoral" fins, which can be up to 15 feet (4.6 m) in length. Their scientific name, *Megaptera novaeangliae,* means "big-winged New Englander" as the New England population was the one best known to Europeans. These long fins give them increased maneuverability; they can be used to slow down or even go backwards.

Figure 9. Humpback Whale
Source: http://www.nmfs.noaa.gov/pr/images/cetaceans/humpbackwhale_noaa_large.jpg

Similar to all baleen whales, adult females are larger than adult males, reaching lengths of up to 60 feet (18 m). Their body coloration is primarily dark grey, but individuals have a variable amount of white on their pectoral fins and belly. This variation is so distinctive that the pigmentation pattern on the undersides of their "flukes" is used to identify individual whales, similar to a humans fingerprint (**Figure 9**).

In June 1970, humpback whales were designated as "endangered" under the Endangered Species Conservation Act (ESCA). In 1973, the ESA replaced the ESCA, and continued to list humpbacks as endangered.

Behavior, Development and Diet: Humpback whales travel great distances during their seasonal migration, the farthest migration of any mammal. The longest recorded migration was 5,160 miles (8,300 km). This trek from Costa Rica to Antarctica was completed by seven animals, including a calf. One of the more closely studied routes is between Alaska and Hawaii, where humpbacks have been observed making the 3,000 mile (4,830 km) trip in as few as 36 days.

During the summer months, humpbacks spend the majority of their time feeding and building up fat stores (blubber) that they will live off of during the winter. Humpbacks filter feed on tiny crustaceans (mostly krill), plankton, and small fish and can consume up to 3,000 pounds (1360 kg) of food per day. Several hunting methods involve using air bubbles to herd, corral, or disorient fish. One highly complex variant, called "bubble netting," is unique to humpbacks. This technique is often performed in groups with defined roles for distracting, scaring, and herding before whales lunge at prey corralled near the surface.

In their wintering grounds, humpback whales congregate and engage in mating activities. Humpbacks are generally "polygynous" with males exhibiting competitive behavior on wintering grounds. Aggressive and antagonistic behaviors include chasing, vocal and bubble displays, horizontal tail thrashing, and rear body thrashing. Males within these groups also make physical contact; striking or surfacing on top of one another. These bouts can cause injuries ranging from bloody scrapes to, in one recorded instance, death. Also on wintering grounds, males sing complex songs that can last up to 20 minutes and be heard 20 miles (30 km) away. A male may sing for hours, repeating the song several times. All males in a population sing the same song, but that song continually evolves over time.

Gestation lasts for about 11 months. Newborns are 13 to 16 ft (4 to 5 m) long and grow quickly from the highly nutritious milk of their mothers. Weaning occurs between 6 and 10 months after birth. Mothers are protective and affectionate towards their calves, swimming close and frequently touching them with their flippers. Males do not provide parental support for calves. Breeding usually occurs once every two years, but sometimes occurs twice in three years.

Distribution/Habitat: Humpback whales live in all major oceans from the equator to sub-polar latitudes. In the western North Atlantic ocean, humpback whales feed during spring, summer, and fall over a range that encompasses the eastern coast of the U.S. (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland. In winter, whales from the Gulf of Maine mate and calve primarily in the West Indies. Not all whales migrate to the West Indies every winter, and significant numbers of animals are found in mid- and high-latitude regions at this time.

During migration, humpbacks stay near the surface of the ocean. While feeding and calving, humpbacks prefer shallow waters. During calving, humpbacks are usually found in the warmest waters available at that latitude. Calving grounds are commonly near offshore reef systems, islands, or continental shores. Humpback feeding grounds are in cold, productive coastal waters (**Figure 14**).

3.7 Fin or Finback Whale (*Balaenoptera physalus*)

Description: Fin or finback whales are the second-largest species of whale, with a maximum length of about 75 ft (22 m) in the Northern Hemisphere, and 85 ft (26 m) in the Southern Hemisphere. Fin whales show mild sexual "dimorphism", with females measuring longer than males by 5-10%. Adults can weigh between 80,000-160,000 lbs (40-80 tons).

Figure 10. Fin or Finback Whale
Source: http://www.cetaceanalliance.org/cetaceans/Bp_home.htm
Photos © Tethys Research Institute.

Fin whales have a sleek, streamlined body with a V-shaped head. They have a tall, "falcate" dorsal fin, located about two-thirds of the way back on the body, that rises at a shallow angle from the animal's back. The species has a distinctive coloration pattern: the back and sides of the body are black or dark brownish-gray, and the ventral surface is white. The unique, asymmetrical head color is dark on the left side of the lower jaw, and white on the right side. Many individuals have several light-gray, V-shaped "chevrons" behind their head, and the underside of the tail flukes is white with a gray border (**Figure 10**).

Within the U.S., the fin whale is listed as endangered throughout its range under the ESA and is listed as "depleted" throughout its range under the Marine Mammal Protection Act of 1972.

Behavior, Development and Diet: Fin whales can be found in social groups of 2-7 whales and in the North Atlantic are often seen feeding in large groups that include humpback whales, minke whales, and Atlantic white-sided dolphins. Fin whales are large, fast swimmers and the killer whale (*Orcinus orca*) is their only non-human predator.

During the summer, fin whales feed on krill, small schooling fish (e.g., herring, capelin, and sand lance), and squid by lunging into schools of prey with their mouth open, using their 50-100 accordion-like throat pleats to gulp large amounts of food and water. They then filter the food particles from the water using the 260-480 "baleen" plates on each side of the mouth. Fin whales fast in the winter while they migrate to warmer waters.

Little is known about the social and mating systems of fin whales. Similar to other baleen whales, long-term bonds between individuals are rare. Males become sexually mature at 6-10 years of age; females at 7-12 years of age. Physical maturity is attained at approximately 25 years for both sexes. After 11-12 months of gestation, females give birth to a single calf in tropical and subtropical areas during midwinter. Newborn calves are approximately 18 ft (6 m) long, and weigh 4,000-6,000 lb (2 tons). Fin whales can live 80-90 years.

Distribution/Habitat: Fin whales are found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes, and less commonly in the tropics. They occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally (**Figure 14**).

3.8 Sei Whale (*Balaenoptera borealis*)

Description: Sei whales are members of the baleen whale family and are considered one of the "great whales" or rorquals. Two subspecies of sei whales are recognized, *B. b. borealis* in the Northern Hemisphere and *B. B. schlegellii* in the Southern Hemisphere.

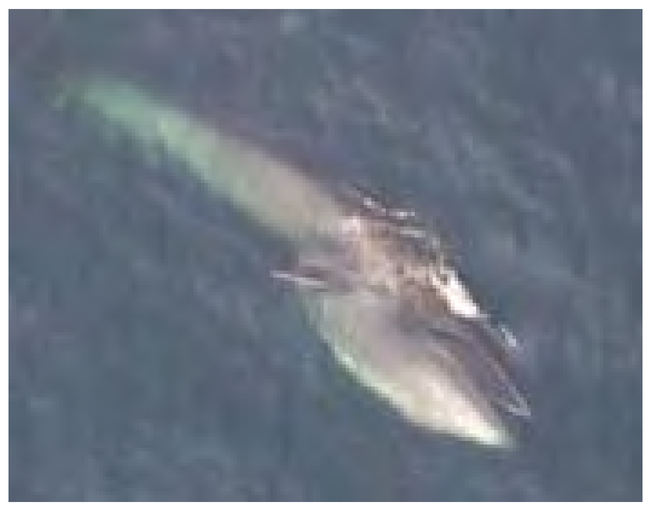

Figure 11. Sei Whale
Source: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/seiwhale.htm#more

These large animals can reach lengths of about 40-60 ft (12-18 m) and weigh 100,000 lbs (45,000 kg). Females may be slightly longer than males. Sei whales have a long, sleek body that is dark bluish-gray to black in color and pale underneath. The body is often covered in oval-shaped scars (probably caused from cookie-cutter shark and lamprey bites) and sometimes has subtle "mottling". This species has an erect "falcate", "dorsal" fin located far down (about two-thirds) the animals back. They often look similar in appearance to Bryde's whales, but can be distinguished by the presence of a single ridge located on the animal's "rostrum". Bryde's whales, unlike other rorquals, have three distinct prominent longitudinal ridges on their rostrum. They have 219-410 baleen plates that are dark in color with gray/white fine inner fringes in their enormous mouths. They also have 30-65 relatively short ventral pleats that extend from below the mouth to the naval area. The number of throat grooves and baleen plates may differ depending on geographic population (**Figure 11**).

When at the water's surface, sei whales can be sighted by a columnar or bushy blow that is about 10-13 feet (3-4 m) in height. The dorsal fin usually appears at the same time as the blowhole, when the animal surfaces to breathe. This species usually does not arch its back or raise its flukes when diving.

This species was listed under the ESA as endangered in 1970.

Behavior, Development and Diet: They are usually observed singly or in small groups of 2-5 animals, but are occasionally found in larger (30-50) loose aggregations. Sei whales are capable of diving 5-20 minutes to opportunistically feed on plankton (e.g., copepods and krill), small schooling fish, and cephalopods (e.g., squid) by both gulping and skimming. They prefer to feed at dawn and may exhibit unpredictable behavior while foraging and feeding on prey. Sometimes seabirds are associated with the feeding frenzies of these and other large whales.

Sei whales become sexually mature at 6-12 years of age when they reach about 45 ft (13 m) in length, and generally mate and give birth during the winter in lower latitudes. Females breed every 2-3 years, with a gestation period of 11-13 months. Females give birth to a single calf that is about 15 ft (4.6 m) long and weighs about 1,500 lbs (680 kg). Calves are usually nursed for 6-9 months before being weaned on the preferred feeding grounds. Sei whales have an estimated lifespan of 50-70 years.

Distribution/Habitat: Sei whales have a cosmopolitan distribution and occur in subtropical, temperate, and subpolar waters around the world. They prefer temperate waters in the mid-latitudes, and can be found in the Atlantic, Indian, and Pacific Oceans. During the summer, they are commonly found in the Gulf of Maine, and on Georges Bank and Stellwagen Bank in the western North Atlantic. The entire distribution and movement patterns of this species is not well known. This species may unpredictably and randomly occur in a specific area, sometimes in large numbers. These events may occur suddenly and then not occur again for long periods of time. Populations of sei whales, like other rorquals, may seasonally migrate toward the lower latitudes during the winter and higher latitudes during the summer. They prefer subtropical to subpolar waters on the continental shelf edge and slope worldwide and they are usually observed in deeper waters of oceanic areas far from the coastline (**Figure 14**).

3.9 Sperm Whale (*Physeter macrocephalus*)

Figure 12. Sperm Whale
Source: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm

Description: Sperm whales are the largest of the odontocetes (toothed whales) and the most sexually dimorphic cetaceans, with males considerably larger than females. Adult females may grow to lengths of 36 feet (11 m) and weigh 15 tons (13607 kg). Adult males, however, reach about 52 feet (16 m) and may weigh as much as 45 tons (40823 kg). It is distinguished by its extremely large head, which takes up to 25 to 35% of its total body length. It is the only living cetacean that has a single blowhole asymmetrically situated on the left side of the head near the tip. Sperm whales have the largest brain of any animal (on average 17 pounds (7.8 kg) in mature males), however, compared to their large body size, the brain is not exceptional in size.

There are between 20-26 large conical teeth in each side of the lower jaw. The teeth in the upper jaw rarely erupt and are often considered to be vestigial. It appears that teeth may not be necessary for feeding, since they do not break through the gums until puberty, if at all, and healthy sperm whales have been caught that have no teeth.

Sperm whales are mostly dark gray, but oftentimes the interior of the mouth is bright white, and some whales have white patches on the belly. Their flippers are paddle-shaped and small compared to the size of the body, and their flukes are very triangular in shape. They have small dorsal fins that are low, thick, and usually rounded (**Figure 12**).

This species was listed under the ESA as endangered in 1970.

Behavior, Development and Diet: Because sperm whales spend most of their time in deep waters, their diet consists of many larger organisms that also occupy deep waters of the ocean. Their principle prey are large squid weighing between 3.5 ounces and 22 pounds (0.1 kg and 10 kg), but they will also eat large demersal and mesopelagic sharks, skates, and fishes. The average dive lasts about 35 minutes and is usually down 1,312 feet (400 m), however dives may last over an hour and reach depths over 3280 feet (1000 m).

Female sperm whales reach sexual maturity around 9 years of age when they are roughly 29 feet (9 m) long. At this point, growth slows and they produce a calf approximately once every five years. After a 14-16 month gestation period, a single calf about 13 feet (4 m) long is born. Although calves will eat solid food before one year of age, they continue to suckle for several years. Females are physically mature around 30 years and 35 feet (10.6 m) long, at which time they stop growing. For about the first 10 years of life, males are only slightly larger than females, but males continue to exhibit substantial growth until they are well into their 30s. Males reach physical maturity around 50 years and when they are 52 feet (16 m) long. Unlike females, puberty in males is prolonged, and may last between ages 10 to 20 years old. Even though males are sexually mature at this time, they often do not actively participate in breeding until their late twenties.

Most females will form lasting bonds with other females of their family, and on average 12 females and their young will form a family unit. While females generally stay with the same unit all their lives in and around tropical waters, young males will leave when they are between 4 and 21 years old and can be found in "bachelor schools", comprising of other males that are about the same age and size. As males get older and larger, they begin to migrate to higher latitudes (toward the poles) and slowly bachelor schools become smaller, until the largest males end up alone. Large, sexually mature males that are in their late 20s or older, will occasionally return to the tropical breeding areas to mate.

Distribution/Habitat: They inhabit all oceans of the world. They can be seen close to the edge of pack ice in both hemispheres and are also common along the equator, especially in the Pacific. Sperm whales are found throughout the world's oceans in deep waters between about 60° N and 60° S latitudes. Their distribution is dependent on their food source and suitable conditions for breeding, and varies with the sex and age composition of the group. It migrations are not as predictable or well understood as migrations of most baleen whales. In some mid-latitudes, there seems to be a general trend to migrate north and south depending on the seasons (whales move poleward in the summer). However, in tropical and temperate areas, there appears to be no obvious seasonal migration.

Sperm whales tend to inhabit areas with a water depth of 1968 feet (600 m) or more, and are uncommon in waters less than 984 feet (300 m) deep. Female sperm whales are generally found in deep waters (at least 3280 feet, or 1000 m) of low latitudes (less than 40°, except in the North Pacific where they are found as high as 50°). These conditions generally correspond to sea surface temperatures greater than 15°C, and while female sperm whales are sometimes seen near oceanic islands, they are typically far from land (**Figure 14**).

Immature males will stay with female sperm whales in tropical and subtropical waters until they begin to slowly migrate towards the poles, anywhere between ages 4 and 21 years old. Older, larger males are generally found near the edge of pack ice in both hemispheres. On occasion, however, these males will return to the warm water breeding area. No critical habitat has been designated for this species.

3.10 Blue Whale (*Balaenoptera musculus*)

Figure 13. Blue Whale
Source: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bluewhale.htm

Description: The blue whale is a cosmopolitan species of baleen whale. In the Northern Hemisphere, they are generally smaller than those in the Southern Ocean. Maximum body length in the North Atlantic was about 88.5 feet (27 m) and the largest blue whale reported from the North Pacific was about 88 feet (26.8 m). Adults in the Antarctic can reach a maximum body length of about 108 feet (33 m) and can weigh more than 330,000 pounds (150,000 kg). As is true of other baleen whale species, female blue whales are somewhat larger than males. Blue whales are identified by the following characteristics: a long-body and comparatively slender shape; a broad, flat "rostrum" when viewed from above; a proportionately smaller dorsal fin than other baleen whales; and a mottled gray color pattern that appears light blue when seen through the water (**Figure 13**).

This species was listed under the ESA as endangered in 1970.

Behavior, Development and Diet: Scientists have yet to discern many details regarding the life history of the blue whale. The best available science suggests the gestation period is approximately 10-12 months and that blue whale calves are nursed for about 6-7 months. Most reproductive activity, including births and mating, takes place during the winter. Weaning probably occurs on, or en route to, summer feeding areas. The average calving interval is probably two to three years. The age of sexual maturity is thought to be 5-15 years. There are no known differences in the reproductive biology of blue whales in the North Pacific and North Atlantic oceans.

The primary and preferred diet of blue whales is krill (euphausiids). In the North Atlantic, blue whales feed on two main euphausiid species: *Thysanoëssa inermis*and and *Meganyctiphanes norvegica*. In addition, *T. raschii*and and *M. norvegica* have been recorded as important food sources of blue whales in the Gulf of St. Lawrence. In the North Pacific, blue whales prey mainly on *Euphausia pacifica*and secondarily on *T. spinifera*. While other prey species, including fish and copepods, have been mentioned in the scientific literature, these are not likely to contribute significantly to the diet of blue whales.

Distribution/Habitat: They are found in oceans worldwide and are separated into populations by ocean basin in the North Atlantic, North Pacific, and Southern Hemisphere. They follow a seasonal migration pattern between summering and wintering areas, but some evidence suggests that individuals remain in certain areas year-round. The extent of knowledge concerning distribution and movement varies with area and migratory routes are not well known but, in general, distribution is driven largely by food requirements.

Blue whales inhabit sub-polar to sub-tropical latitudes. Poleward movements in spring allow the whales to take advantage of high zooplankton production in summer. Movement towards the subtropics in the fall allows blue whales to reduce their energy expenditure while fasting, avoid ice entrapment in some areas, and engage in reproductive activities in warmer waters of lower latitudes. Although the species is often found in coastal waters, blue whales are thought to occur generally more offshore than humpback whales, for example (**Figure 14**).

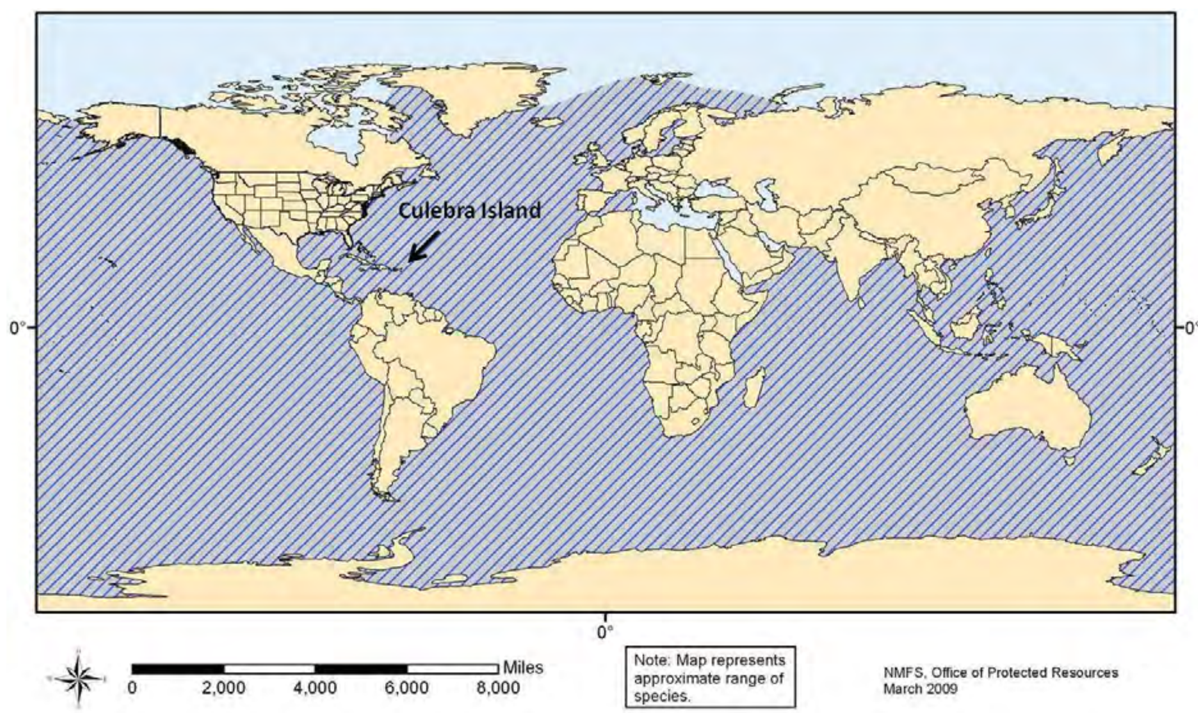

Figure 14. Approximate range map for Humpback, Sei, Sperm and Blue whales.

3.11 Elkhorn coral (*Acropora palmata*)

Figure 15. Elkhorn Coral
Source: http://www.nmfs.noaa.gov/pr/species/invertebrates/elkhorncoral.htm

Description: It is a large, branching coral with thick and sturdy antler-like branches (**Figure 15**) and is found in shallow reefs, typically in water depths from 0-35 feet, as these corals prefer areas where wave action causes constant water movement. Colonies are fast growing: branches increase in length by 2-4 inches (5-10 cm) per year, with colonies reaching their maximum size in approximately 10-12 years. Over the last 10,000 years, elkhorn coral has been one of the three most important Caribbean corals contributing to reef growth and development and providing essential fish habitat. This species was listed under the ESA as endangered on May 4, 2006.

Color: Living colonies are yellow, brown or golden with light rims.

Habitat: Elkhorn coral was formerly the dominant species in shallow water (3 ft-16 ft [1-5 m] deep) throughout the Caribbean and on the Florida Reef Tract, forming extensive, densely aggregated thickets (stands) in areas of heavy surf. Coral colonies prefer exposed reef crest and fore reef environments in depths of less than 20 feet (6 m), although isolated corals may occur to 65 feet (20 m).

Distribution/Reproduction: Elkhorn coral is found on coral reefs in southern Florida, the Bahamas, and throughout the Caribbean.

The dominant mode of reproduction for elkhorn coral is asexual, with new colonies forming when branches break off of a colony and reattach to the substrate. Sexual reproduction occurs via broadcast spawning of gametes into the water column once each year in August or September. Individual colonies are both male and female (simultaneous hermaphrodites) and will typically release millions of "gametes". The coral larvae (planula) live in the plankton for several days until finding a suitable area to settle, but very few larvae survive to settle and metamorphose into new colonies. The preponderance of asexual reproduction in this species raises the possibility that genetic diversity may be very low in the remnant populations.

3.12 Staghorn coral (*Acropora cervicornis*)

Figure 16. Staghorn Coral
Source: http://www.nmfs.noaa.gov/pr/species/invertebrates/staghorncoral.htm

Description: It is a branching coral with cylindrical branches ranging from a few centimeters to over 6.5 feet (2 m) in length (**Figure 16**). This coral exhibits the fastest growth of all known western Atlantic corals, with branches increasing in length by 4-8 inches (10-20 cm) per year. This species was listed under the ESA as endangered on May 4, 2006.

Color: Living colonies are light, grayish to yellowish-brown.

Habitat: Staghorn coral occur in back reef and fore reef environments from 0-100 feet (0 to 30 m) deep. The upper limit is defined by wave forces, and the lower limit is controlled by suspended sediments and light availability. Fore reef zones at intermediate depths of 15-80 feet (5-25 m) were formerly dominated by extensive single species stands of staghorn coral until the mid 1980s.

Distribution/Reproduction: Staghorn coral is found in the Atlantic Ocean, Caribbean Sea, and western Gulf of Mexico. Specifically, staghorn coral is found throughout the Florida Keys, the Bahamas, the Caribbean islands, and Venezuela. The northern limit of staghorn coral is around Boca Raton, FL.

The dominant mode of reproduction for staghorn coral is asexual fragmentation, with new colonies forming when branches break off a colony and reattach to the substrate. Sexual reproduction occurs via broadcast spawning of gametes into the water column once each year in August or September. Individual colonies are both male and female (simultaneous hermaphrodites) and will release millions of "gametes". The coral larvae (planula) live in the plankton for several days until finding a suitable area to settle, but very few larvae survive to settle and metamorphose into new colonies. The preponderance of asexual reproduction in this species raises the possibility that genetic diversity is very low in the remnant populations

The NMFS has designated critical habitat for elkhorn and staghorn corals in four areas: Florida, Puerto Rico, St. John/St. Thomas, and St. Croix. **Figure 17** shows the designated areas for Puerto Rico. In addition, a 4(d) rule (50 CFR Part 223) establishing “take” prohibitions for elkhorn and staghorn corals went into effect on November 28, 2008. Take includes collect, bother, harm, harassment, damage to, death, or other actions that affect health and survival of listed species.

Figure 17. Elkhorn and Staghorn Corals Critical Habitat.

3.13 Species of Corals Proposed for Listing under the ESA

On 20 October 2009, the National Marine Fisheries Service (NMFS) received a petition from the Center for Biological Diversity to list 83 species of corals as threatened or endangered under the Endangered Species Act (ESA) and to designate critical habitat for these corals. NMFS reviewed the petition and determined that the requested listing actions may be warranted for 82 of the 83 coral species. All of the Atlantic coral species have the potential to be found in waters around Culebra. These species are: Lamarck's Sheet Coral (*Agaricia lamarcki*), Boulder Star Coral (*Montastraea annularis*), Mountainous Star Coral (*Montastrae faveolata*), *Montastraea franksi*, Pillar Coral (*Dendrogyra cylindrus*), Elliptical Star Coral or Pineapple Coral (*Dichocoenia stokesii*) and Rough Cactus Coral (*Mycetophyllia ferox*). As of the day of this document, no final decision on whether to list these species has been made by NMFS. **Figure 18** shows a range map for the seven species of coral proposed for listing under ESA.

Figure 18. Range map for the seven species of coral proposed for listing under ESA.

3.13.1 Lamarck's Sheet Coral (*Agaricia lamarcki*)

Description: Colonies form large, mostly thick plates, broad, rounded or acute, often overlapping each other. The upper surface bears concentric rows of ridges with relatively wide, straight or reticulate, valleys. The white, star-like, polyps are in the valleys' center. The septa alternate in height and thickness. Generally, the taller and thicker primary septa extend close to the columella before dropping sharply into the corallite pit, while the thinner secondary septa appear shorter, because they slope

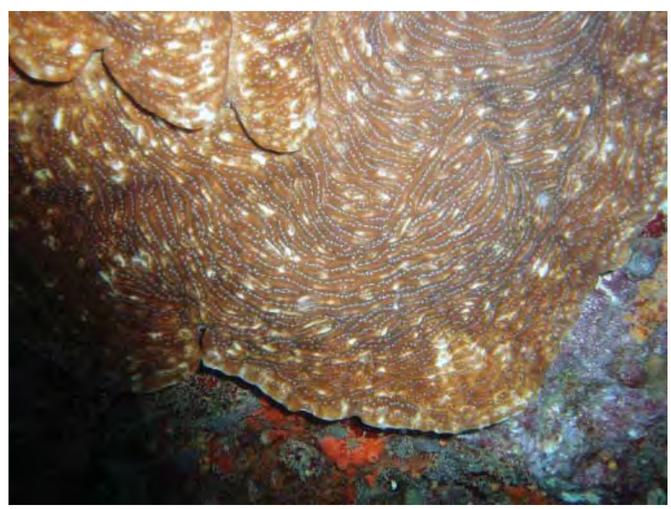

Figure 19. Lamarck's Sheet Coral
Source: http://coralpedia.bio.warwick.ac.uk/en/corals/agaricia_lamarcki.html

gradually into the corallite pit. The underside of the colony is smooth, without polyps (**Figure 19**).

Color: Yellow-brown to golden-brown to brown, sometimes with bluish or grayish tints, with contrasting white polyps (**Figure 19**).

Habitat: On sloping reefs and along walls, between 16-165 feet (5-50 m), but most common between 65-115 feet (20 and 35 m).

Distribution: Occasional in Florida and the Bahamas, common in the Caribbean (**Figure 18**).

3.13.2 *Montastraea* Complex

3.13.2.1 Boulder Star Coral (*Montastraea annularis*)

Description: The colonies grow in several morphotypes that were originally described as separate species. The species occurs as long, thick columns with enlarged, dome-like tops; large, massive mounds; sheets with skirt-like edges; irregularly bumpy mounds and plates or as smooth plates. Colonies up to 10 feet (3 m) in diameter. The surface is covered with distinctive, often somewhat raised, corallites (**Figure 20**).

Figure 20. Boulder Star Coral
Source: http://coralpedia.bio.warwick.ac.uk/images/Montastraea%20annularis01.JPG

Color: Shades of green to brown, yellow-brown and gray.

Habitat: Inhabit most reef environments and the species is often the predominant coral between 22-82 feet (7-25 m). The flattened plates are most common at deeper reefs, down to 165 feet (50 m).

Distribution: Common to abundant Florida, Bahamas and Caribbean (**Figure 18**).

3.13.2.2 Mountainous Star Coral (*Montastraea faveolata*)

Description: This species has been called the "dominant reef-building coral of the Atlantic". *Montastraea faveolata* buds extratentacularly to form head or sheet colonies with corallites that are uniformly distributed and closely packed, but sometimes unevenly exsert. Septa are highly exsert, with septocostae arranged in a variably conspicuous fan system, and the skeleton is generally far less dense than those of its sibling species. Active growth is typically found at the edges of colonies, forming a smooth outline with many small polyps (**Figure 21**).

Figure 21. Mountainous Star Coral
Source: http://coralpedia.bio.warwick.ac.uk/images/Montastraea%20faveolata01.JPG

Color: It is usually pale brown but may be bright, fluorescent green over the dark brown.

Habitat: *M. faveolata* is found from 3-100 feet (1-30 m) in backreef and fore-reef habitats, and is often the most abundant coral between 30-65 feet (10-20 m) in fore-reef environments.

Distribution: This species occurs in the Caribbean, the Gulf of Mexico, Florida, and the Bahamas. May also be present in Bermuda, but this requires confirmation (**Figure 18**).

3.13.2.3 *Montastraea franksi*

Description: This species builds massive, encrusting plate or subcolumnar colonies via extratentacular budding. The characteristically bumpy appearance of this species is caused by relatively large, unevenly exsert, and irregularly distributed corallites. *M. franksi* is distinguished from its sibling *Montastraea* species by this irregular or bumpy appearance; a relatively dense, heavy, and hard skeleton (corallum); thicker septo-costae with a conspicuous septocostal midline row of lacerate teeth; and a greater degree of interspecies aggression (**Figure 22**).

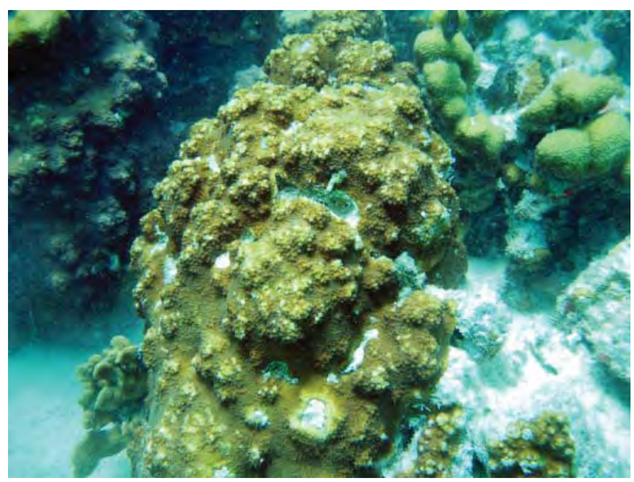

Figure 22. *Monstastraea franki*
Source: http://coralpedia.bio.warwick.ac.uk/images/Montastraea%20franksi01.JPG

Color: It is basically orange-brown with many pale patches on the lumpy surface, but may be grey or greenish-brown (**Figure 22**).

Habitat: This species mostly grows in the open like other species of this genus but smaller, encrusting colonies are common in shaded overhangs. It is uncommon in very shallow water, but becomes common deeper.

Distribution: This species occurs in the Caribbean, the Gulf of Mexico, Florida, and the Bahamas (**Figure 18**).

3.13.3 Pillar Coral (*Dendrogyra cylindrus*)

Description: Colonies form numerous, heavy, cylindrical spires, that grow upwards from an encrusting base mass. The colonies can attain a height of 10 feet (3 m), with a pillar diameter of more than 4 inches (10 cm). Polyps are normally extended during the day, giving the colony a fuzzy appearance and obscuring the long, meandroid, corallite series (**Figure 23**).

Figure 23. Pillar Coral
Source: http://coralpedia.bio.warwick.ac.uk/en/corals/dendrogyra_cylindrus.html

Color: Light tan to golden brown and chocolate brown.

Habitat: Colonies are typically found on flat gently sloping back reef and fore reef environment in depths of 3-82 feet (1-25 m). The species does not occur in extremely exposed locations.

Distribution: This species occurs in the Caribbean, the southern Gulf of Mexico, Florida, and the Bahamas (**Figure 18)**.

3.13.4 Elliptical Star Coral or Pineapple Coral (*Dichocoenia stokesii*)

Description: Colonies form rounded heads, domes or flattened plates. The distinctive character of this species is the oval corallites which protrude conspicuously above the surface between the corallites (coenesteum). Corallites are markedly oval and become elongated, almost meandroid, before dividing. Corallites are well separated from each other, and the surface between them is granular (**Figure 24**).

Color: Though sometimes green, they are usually orange-brown with white septo-costae.

Habitat: It is uncommon but has been found in most reef environments within its range, including both back and fore reef environments, rocky reefs, lagoons, spur and groove formations, channels, and occasionally at the base of reefs. This species occurs in depths from 6-236 feet (2-72 m); when found in exposed reefs at depths less than 65 feet (20 m), its hemispherical heads are more abundant than usual.

Figure 24. Elliptical/Pineapple Coral
Source: http://coralpedia.bio.warwick.ac.uk/en/corals/dichocoenia_stokesii.html

Distribution: This species occurs in the Caribbean, the Gulf of Mexico, Florida (including the Florida Middle Grounds), the Bahamas, and Bermuda (**Figure 18**).

3.13.5 Rough Cactus Coral (*Mycetophyllia ferox*)

Description: Colonies consist of flat plates with radiating valleys. It is a widely recognized valid species with colonies comprised of thin, weakly attached plates with interconnecting, slightly sinuous, narrow valleys. Tentacles are generally absent and corallite centers tend to form single rows. The walls of the valleys commonly join to form closed valleys, a feature not seen in other members of *Mycetophyllia*. The ridges are usually small and square, with a groove on top. The ridges, or walls between valleys, are commonly quite thin, and are irregular, and valleys are narrower (**Figure 25**).

Figure 25. Rough Cactus Coral
Source: http://coralpedia.bio.warwick.ac.uk/en/corals/mycetophyllia_ferox.html

Color: Valleys and walls are contrasting shades of grays and browns.

Habitat: This species is most common in fore reef environments from 5-30 meters (but is more abundant from 10-20 meters), but also occurs at low abundance in certain deeper back reef habitats and deep lagoons.

Distribution: This species occurs in the Caribbean, southern Gulf of Mexico, Florida, and the Bahamas (**Figure 18**).

4.0 MEASURES TO AVOID OR MINIMIZE POSSIBLE IMPACTS

The following measures will be implemented to avoid or minimize impacts to threatened or endangered species and their habitat during underwater investigation activities. Because the proposed action consists of data collection, no intrusive work will be performed and munitions disposal are not considered. Adverse impacts to protected species or their habitats are not expected.

The Contractor will be required to implement these SOPs, as well as the previously developed SOPs included in the attached Appendices A and B as part of any underwater work.

4.1 General Conservation Measures

4.1.1 Date of Commencement: The Contractor will provide to the U.S. Army Corps of Engineers (USACE) with a written notification of the date of commencement of underwater investigation work and a detailed description of the work to be implemented based on the Work Plan (WP) that will be coordinated and reviewed by TPP Team. USACE will provide the date of commencement to the TPP Team at least 10 days prior to initiating fieldwork.

4.1.2 Training/Briefing: Prior to initiating work all personnel shall receive training or briefings regarding the importance of endangered species, their characteristics, how they can be identified, potential and critical habitats, types of material in which they may hide, actions to take if are sighted, and avoidance measures to be followed as detailed in these SOPs. This training or briefing shall be prepared and offered by qualified personnel (e.g. biologist, marine biologist, environmental scientist, among others). The Contractor shall submit their qualifications to the USACE for review and approval. The training or briefing will also include safety and emergency procedures.

4.1.3 Civil and Criminal Penalties: The Contractor shall instruct all personnel associated with the project of the potential presence of threatened or endangered species. All personnel shall be advised that there are civil and criminal penalties for harming, harassing, killing or otherwise altering the natural behavior or condition of threatened or endangered species protected under the ESA, the Puerto Rico Wildlife Law, and the Regulation to Govern the Endangered and Threatened Species of the Commonwealth of Puerto Rico. ESA gives both the FWS and NMFS responsibility for enforcing its provisions. The Commonwealth regulations to protect endangered and threatened species are enforced by the Puerto Rico Department of Natural and Environmental Resources (DNER).

4.1.4 Qualified Personnel: Each team performing underwater investigation work shall be accompanied on the boat, but not necessarily in the water, by qualified and experienced personnel (e.g. biologist, marine biologist, environmental scientist, among others) in order to identify the presence or absence of threatened or endangered species. The Contractor shall submit their qualifications to the USACE. The divers can request to the designated and qualified personnel on the boat to enter in the water to identify and determine if a suspected threatened or endangered species is present in the study area.

4.1.5 Coordination: All related work will be coordinated with the TPP Team prior to initiation as described in Part 4.1.1. The Contractor will provide a preliminary schedule and the areas (including the proposed transects and grids) where investigation will be performed and all the equipment to be used. Changes to the schedule and working areas will be provided to the TPP Team. The Contractor will make any required project notifications to the appropriate USACE personnel, who will in turn notify the regulators and resource agencies.

4.1.6 Reports: The Contractor shall maintain a log detailing endangered or threatened species sightings in terrestrial and marine habitats. The log shall include, but not limited to, the following information: date and time, location coordinates using a Global Positioning System (GPS) unit, species, one or more photographs, if possible, and any actions taken (e.g. species identification and distance from working area, reasons to cease operation, reasons to determine that operation may be resumed, among others) during the work period. All data shall be provided to USACE to be shared with the TPP.

4.1.7 Detonation Activities: Because the proposed action consists of data collection and characterization of benthic habitats, intrusive investigation or munitions detonations will not be conducted under this phase. If MECs are indentified during underwater work, they will be left in place and GPS coordinates of the MEC's location will be obtained for further investigations. MEC location will be shared with the TPP as "Privilege and Confidential." Due to public safety concerns, the MEC location shall not be released to the public. Based on the EBS results, additional SOPs or other conservation measures will be closely developed and coordinated with the TPP for further investigation phases and disposal activities.

4.1.8 If the UIT determines that weather conditions are unsafe (e.g. heavy rain, strong wind and rough seas), underwater investigation will not be conducted in order to minimize the potential for accidental groundings.

4.1.9 Underwater investigation activities will be conducted during day time hours (7:00am-5:00pm) only.

4.1.10 If during underwater activities the Contractor observes items that may have historic or archeological value, the Contractor will obtain GPS coordinates of the items' locations and notify the USACE of the observation. In consultation with the State Historic Preservation Officer, the USACE will use this information to assess the significance of the items in compliance with the National Historic Preservation Act.

4.2 Staging Area and Sea Turtle Nesting Monitoring

4.2.1 Contractor shall identify any onshore staging areas needed for execution of these investigations so that sea turtle nest monitoring can be conducted prior to initiating mobilization to ensure no impacts occur to this species.

4.2.2 The sea turtle nests monitoring will be limited to the areas used by the Contractor personnel. The beach monitoring efforts will consist of nests sighting and identification. The Contractor will avoid any sea turtle nests that are encountered. Any nest encountered shall be clearly marked (e.g. using flagging). The Contractor personnel shall stay at least 26 feet (8 meters) away from the marked area to avoid impacts to the nest(s). All nest sightings and actions taken shall be documented as described in Part 4.1.6. Additional conservation measures are provided in Appendices A and B.

4.2.3 Staging areas shall not require any removal of coastal vegetation. These areas shall consist of temporary tents or similar structures that can be easily removed.

4.2.4 Any areas proposed for use as staging area that form part of the Culebra National Wildlife Refuge shall be closely coordinated with the refuge manager. Points of contact are provided in Part 5.0.

4.2.5 The smaller offshore cays should not be used as staging areas; only cays that can be safely accessed by boats should be identified for use. Temporary mooring buoys should be employed to access staging areas to avoid repeated anchoring and impacts to marine bottom as per previous SOPs (refer to Parts 4.3 - 4.4 and Appendix A for more information).

4.2.6 Monitoring shall be conducted daily by qualified personnel (e.g. biologist, marine biologist, environmental scientist, among others) to identify the potential presence of new nests or sea turtle tracks during the activity period (refer to Appendix A for detailed information).

4.2.7 If sea turtle nests are found, the Contractor personnel will notify USACE, who will notify the FWS Boquerón Endangered Species Specialist, NMFS Boquerón Office and DNER

POC. If agreed the nest locations will be clearly marked and the staging area will be relocated. This information shall be documented as described in Part 4.1.6.

4.3 Coral and Seagrass Avoidance Measures

4.3.1 Prior to initiation of field activities the UIT shall receive a boating safety briefing and information regarding location and identification of coral reefs, colonized hardbottom and seagrass (refer to Part 4.1.2 for more information). Also, the information contained in these SOPs and its Appendices, and the types of actions that constitute a violation to the 4(d) rule (50 CFR Part 223) shall be discussed.

4.3.2 Vessel operator shall carry and consult appropriate NOAA nautical charts, NOAA benthic habitat maps and aerial photographs to locate potential coral reefs, colonized hardbottom and seagrass areas. Combining information from aerial photographs with hydrographic data will help to ensure that nautical charts are accurate.

4.3.3 Real-time data (e.g. GPS with nautical chart and depth finder on boat) will be continuously observed to verify water depths and vessel location. For additional information, please refer to Parts 4.3.5 and 4.4.3.

4.3.4 Vessel operator and UIT shall maintain a vigilant watch for coral reefs, colonized hardbottom and seagrass areas to avoid running aground or striking protected species. As part of the WP for conducting the underwater investigations and EBS, the Contractor shall provide and specify the type of equipment to be used and their recommended safety depths to avoid impacts to endangered and threatened species.

4.3.5 From the water's surface, some coral areas appear golden-brown. These areas should be avoided to keep from running aground. The operator shall stay at a minimum of 4 feet from the bottom of the vessel to the top of coral areas.

4.3.6 If no moorings are available, the vessel will be anchor in unvegetated sandy areas away from corals and seagrasses, so the anchor, chain and line do not contact or damage coral or seagrass areas.

4.3.7 Vessels shall be maintained away from areas with corals and seagrasses (see Part 4.3.5). Operations shall be conducted in such manner that bottom scour or prop dredging will be avoided when corals or seagrasses are present.

4.3.8 The following actions are prohibited:

a. Walk on, sit on or stand on coral
b. Collect coral (dead or alive)
c. Anchoring on coral/seagrass
d. Touch coral with hands or equipment
e. Discharge any pollutant or contaminant
f. Dump trash

4.3.9 If during the underwater investigation work any coral is injured, whatever activity causing the damage will be stopped, the injured coral will be left in place and the U.S. Coast Guard (USCG), NMFS Boquerón Office and DNER should be immediately notified. If listed corals are injured, the Contractor shall also contract the NOAA Office of Law Enforcement at 1-800-853-1964. The following information must be provided:

a. The time, date, and location (latitude/longitude) of the incident.
b. The name and type of the vessel involved.
c. The vessel's speed during the incident.
d. A description of the incident.
e. Water depth.
f. Environmental conditions (e.g. wind speed and direction, sea state, cloud cover, and visibility).
g. The type of coral or description, if possible.
h. A description of the damage caused to any coral, if possible.

4.3.10 If the vessel runs aground, the operator shall perform the following:

a. Turn of the engine.
b. Do not try to use the engine to power off the reef, hardbottom or seagrass.
c. Raise the propeller, and allow the boat to drift free.
d. Radio the Coast Guard, Marine Patrol or VHF Channel 16 for assistance.
e. If any coral or seagrass is injured the Contractor shall follow the procedures described in Part 4.3.9.

4.4 Marine Mammals and Sea Turtles Avoidance Measures

4.4.1 Vessel strike avoidance measures were also provided in Appendix A, page 12, items 1-6. These measures have been updated and for the purpose of underwater investigation activities, the Contractor shall follow and implement the avoidance measures provided under this section.

4.4.2 The Contractor shall instruct all personnel associated with the underwater investigation work of the potential presence of marine mammals (e.g. manatees and whales) and sea turtles and the need to avoid collisions with these species. The Contractor shall be held responsible for any marine mammal and sea turtle harmed, harassed, or killed as a result of underwater activities (including vessel operations supporting these activities) and general boating activities needed to go to and from the study areas. All appropriate precautions shall be followed and the operator will avoid excessive speed as described in Parts 4.4.7 and 4.4.8.

4.4.3 All vessels associated with the underwater investigations shall operate at "no wake/idle" speeds at all times while in waters where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes whenever possible. Boats used to transport personnel shall be shallow-draft vessels, preferably of the light-displacement category, where navigational safety permits.

4.4.4 Mooring bumpers shall be placed on all vessels wherever and whenever there is a potential for marine mammal or sea turtle to be crushed between two moored vessels. The bumpers shall provide a minimum stand-off distance of four feet.

4.4.5 Vessel operator and UIT should maintain a vigilant watch for marine mammals and sea turtles to avoid striking sighted protected species.

4.4.6 If a marine mammal or sea turtle is sighted within 300 feet (100 yards) of the project area, all appropriate precautions shall be implemented by the Contractor to ensure protection of these species. These precautions shall include the operation of all moving equipment no closer than 150 feet (50 yards) of a marine mammal or sea turtle. If a marine mammal or sea turtle is closer than 150 feet (50 yards) to moving equipment or the study area, the equipment shall be shut down and all activities shall cease to ensure protection of the species. Underwater activities shall not resume until the marine mammal(s) or sea turtle(s) have left the study area naturally. Animals must not be herded away or harassed into leaving.

4.4.7 When marine mammals or sea turtles are sighted while a vessels is underway, the operator will remain parallel to the animal's course. Vessel operator will avoid excessive speed or abrupt changes in direction until the animal has left the area.

4.4.8 Vessel operator will reduce vessel speed to 10 knots or less when mother/calf pairs, groups, or large assemblages of marine mammals are observed near an underway vessel, when safety permits. A single marine mammal at the surface may indicate the presence of submerged animals in the vicinity; therefore, prudent precautionary measures will be exercised. The vessel should attempt to route around the animals, maintaining a minimum distance of 300 feet whenever possible.

4.4.9 Marine mammals and sea turtles may surface in unpredictable locations or approach slowly moving vessels. When an animal is sighted in the vessel's path or in close proximity to a moving vessel and when safety permits, the vessel operator will reduce speed and shift the engine to neutral. Vessel operator will not engage the engines until the animals are clear of the area.

4.4.10 Monitoring: The UIT shall monitor for the presence of marine mammals and sea turtles.

4.4.11 All sightings and actions taken shall be reported as described in Part 4.1.6.

4.4.12 Injured or Dead Protected Species Reporting: Any collisions or sighting of any injured or incapacitated marine mammals or sea turtles shall be reported immediately to the USACE, FWS, NMFS, and DNER and information listed in Part 4.3.9 must be provided. For additional contact information, please refer to Section 5.0.

- Report stranded marine mammals to Southeast U.S. Stranding Hotline: (305) 862-2850
- Report stranded sea turtles to the NMFS Southeast Regional Office: (727) 824-5312
- NMFS Boquerón Office: (787) 851-3700
- FWS Boquerón Office: (787) 851-7297
- FWS Culebra NWR Office: (787) 742-0115
- DNER: (787) 645-5593

4.5 Diving Operations and Equipment

4.5.1 All underwater investigation work will be conducted by qualified and trained divers and will be planned in a manner that avoids direct impacts to threatened or endangered species and sensitive habitats within the project area. Anchoring practices described in Part 4.3 shall be implemented.

4.5.2 Prior to initiation of daily operations the UIT will check the weather conditions, inspect the vessel and verify that all the required equipment is available, in good condition, working correctly, and calibrated. The Contractor will maintain a log detailing equipment inspections.

4.5.3 The UIT will make sure that underwater conditions (e.g. visibility, current speeds) and weather are suitable for diving to ensure safety for divers and for sensitive underwater habitats.

4.5.4 Based on dive site conditions, the amount of divers in the water will be determined by the Contractor.

4.5.5 The following general "best diving practices" will be followed:

a. The point of entry and exit will be carefully selected to avoid coral or underwater sensitive areas.
b. Divers will make sure that all equipment is well secured before entering in the water.
c. Divers will make sure that they are neutrally buoyant at all times.
d. Safe distance from coral areas to be provided in the WP shall be maintained.
e. Good finning practice and body control will be followed to avoid accidental contact with coral or stirring up the sediment.
f. Divers will stay off the bottom and will never stand or rest on corals or other sessile benthic invertebrates.

4.5.6 To support or supplement the underwater investigation activities the following equipment, but not limited to, will be used: remotely operated vehicle (ROV), side scan sonar towfish, underwater metal detectors, benthic/diver sleds, towing cables and lifting lines, underwater cameras, marking buoys and floats, and GPS. The Contractor shall provide and specify the type of equipment to be used and their recommended safety depths to avoid impacts to endangered and threatened species (see Parts 4.1.1 and 4.1.5).

4.5.7 All equipment will be used in a manner to avoid physical contact or harassment of any protected species and it shall not interfere with diving operations. Hand-held equipment that would be carried by divers shall not contact corals or disturb the bottom or seagrasses in the area.

4.5.8 Site conditions, marine structures present, real-time information and existing water depth will be constantly monitored by trained operators to determine the appropriate use of equipment needed to minimize the risk of physical contact with protected species and sensitive habitats.

4.5.9 Any unintentional injury to protected species during diving operations will be reported immediately as described in Parts 4.3.9 and 4.4.12.

4.6 Supplemental Information

The July 2008 SOPs developed for Culebra DERP-FUDS and its April 2011 Addendum remain in effect. Copies of these documents are included in the attached Appendices A and B. The SOPs in the current document are meant to supplement, not replace, previous SOPs and are directed toward underwater investigation activities. The SOPs in the current document also provide the most up-to-date information regarding listed corals.

5.0 POINTS OF CONTACT FOR SOPs COORDINATION AND REPORTING

Name	Organization	Telephone/Email
Tom Freeman Project Manager	USACE, Jacksonville	Desk: 904-232-1040 Thomas.R.Freeman.III@usace.army.mil
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Iván Acosta Chief, Special Projects Section	USACE, Jacksonville	Desk: 904-232-2050 Ivan.Acosta@usace.army.mil
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David McCullough Archaeologist	USACE, Jacksonville	Desk: 904-232-3685 David.L.McCullough@usace.army.mil
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Lisamarie Carrubba Director, Caribbean Field Office	NMFS	Desk: 787-851-3700 Lisamarie.Carrubba@noaa.gov
José Rivera Habitat Conservation Division	NMFS	Desk: 787-405-3605 Jose.A.Rivera@noaa.gov
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Damaris Delgado Bureau of Coast, Reserves and Refuges	DNER	Desk: 787-999-2200 ext. 2107 ddelgado@drna.gobierno.pr
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LIST OF APPENDICES

A. SOPs for Endangered Species Conservation and their Habitat (July 2008)

B. Addendum to the 2008 SOPs (April 2011)

APPENDIX A

SOPs for Endangered Species Conservation and their Habitat (July 2008)

Standard Operating Procedures For Endangered Species Conservation And their Habitat on DERP-FUDS Project No. I02PR006802. Culebra, Puerto Rico

US Army Corps of Engineers
Jacksonville District

Standard Operating Procedures
For Endangered Species Conservation and their Habitat on
DERP-FUDS Project No. I02PR006802. Culebra, Puerto Rico

PURPOSE

The intent of this document is to develop a series of standard operating procedures (SOPs) to avoid or minimize impacts to threatened and endangered species listed pursuant to the Endangered Species Act (ESA) during the DERP-FUDS work at locations designated for cleanup on Culebra and adjacent cays and in surrounding waters that serve as habitat for these species. Species include the endangered hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles, the threatened green sea turtle (*Chelonia mydas*) and its designated critical habitat 3 nautical miles around Culebra and its surrounding islands and cays, the threatened elkhorn (*Acropora palmata*) and staghorn corals (*Acropora cervicornis*), the West Indian manatee (*Trichechus manatus*), and avian species. These SOPs are in accordance with on-going communication with staff from the U.S. Fish and Wildlife Service (FWS), the National Marine Fisheries Service (NMFS) and the Puerto Rico Department of Natural and Environmental Resources (DNER), as well as pursuant to the Interim Guidelines provided by FWS to work on lands of Culebra National Wildlife Refuge, with the U.S. Army Corps of Engineers (USACE) Regulations and Environmental Operating Principles. These SOPs were prepared to supplement existing and future USACE contracts for work on Culebra and surrounding islands and cays under the DERP/FUDS Program and to satisfy the substantive requirements of Section 7 of the Endangered Species Act. These SOPs do not address requirements related to access approvals from FWS on lands that are within the Culebra National Wildlife Refuge.

SEA TURTLES

Culebra has some of the most important sea turtle nesting beaches in the US Caribbean. Three species of sea turtles utilize these beaches throughout the year. The endangered leatherback and hawksbill sea turtles are the most common nesters, and the threatened green sea turtle also nests on beaches in the project area. The beaches on Culebrita, Cayo Norte, and Playa Larga, Brava and Resaca on Culebra were designated as critical habitat under the Endangered Species Act by FWS in recognition of their vital importance to the future of these species (50 CFR 17.95). Similarly, waters surrounding the island of Culebra (50 CFR 226.208) from the mean high water line seaward to 3 nautical miles (5.6 km) are designated as critical habitat for the green sea turtle. These waters include Culebra’s outlying Keys including Cayo Norte, Cayo Ballena, Cayos Geniquí, Isla

Culebrita, Arrecife Culebrita, Cayo de Luis Peña, Las Hermanas, El Mono, Cayo Lobo, Cayo Lobito, Cayo Botijuela, Alcarraza, Los Gemelos, and Piedra Steven where cleanup efforts are anticipated. Sea grass beds within these waters are foraging habitat for the species. In addition, the benthic habitat, including seagrass beds, coral reefs, and colonized hardbottom, around Culebra and its surrounding islands and cays provides foraging and refuge habitat for sea turtles.

Nesting Seasons

The following nesting season information was obtained from the USFWS sea turtle fact sheets and local agencies.

Green Sea Turtle: The nesting season varies with the locality. In Puerto Rico, it is roughly June through October. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. A female may lay as a many as nine clutches within a nesting season (overall average is about 3.3 nests per season) at about 13-day intervals. Clutch size varies from 75 to 200 eggs, with an average clutch size of 136 eggs reported for Florida. Incubation ranges from about 45 to 75 days, depending on incubation temperatures. Hatchlings generally emerge at night. Age at sexual maturity is believed to be 20 to 50 years. Nesting data for Puerto Rico, specifically for Culebra beaches shall be obtained from the FWS. However, the DNER indicated that nesting of green turtles in Culebra beaches is infrequent and not as common as the other species.

Green Sea Turtle

Hawksbill Turtle: The nesting season varies with locality, in Culebra, as per DNER, nesting occurs all year long with the peak between August to November. Hawksbills nest at night and, on average, about 4.5 times per season at intervals of approximately 14 days. In Florida and the U.S. Caribbean, clutch size is approximately 140 eggs, although several records exist of over 200 eggs per nest. They nest under the vegetation on the high beach and nests have been observed having the last eggs of the clutch as close as 3 inches from the sand's surface. Remigration intervals of 2 to 3 years predominate. The incubation period averages 60 days. Hawksbills recruit into the reef environment at about 35 cm in length and are believed to begin breeding about 30 years later. However, the time required to reach 35 cm in length is unknown and growth rates vary geographically. As a result, actual age at sexual maturity is not known.

Hawksbill Sea Turtle

Leatherback Turtle: On Culebra nesting occurs from about February to August with the peak occurring around April to May. Female leatherbacks nest an average of 5 to 7 times within a nesting season, with an observed maximum of 11 nests. The average internesting interval is about 9 to 10 days. The nests are constructed at night in clutches of about 70 to 80 yolked eggs. The white spherical eggs are approximately 2 inches in diameter. Typically incubation takes from 55 to 75 days, and emergence of the hatchlings occurs at night. Most leatherbacks return to their nesting beaches at 2 to 3-year intervals. Leatherbacks are believed to reach sexual maturity in 6 to 10 years. Culebra beaches most used by the species are Flamenco, Brava and Resaca.

Leatherback Sea Turtle

Acroporid Corals

Since the preparation of some of the Culebra Project work plans, two coral species have been listed as threatened by the National Marine Fisheries Service effective May 8, 2006. Elkhorn coral (*Acropora palmata*) and staghorn coral (*Acropora cervicornis*) belong to the most abundant group of corals in the world and once represented the most dominant reef building species throughout Florida and the Caribbean. Elkhorn corals are found in shallow reefs, typically in water depths from 0-35 feet, as these corals prefer areas where wave action causes constant water movement. Staghorn corals are found in water depths ranging from 1-160 feet, although they are most common in depths from 10-60 feet. In addition to growing on reefs, staghorn corals often form colonies on bare sand. Acroporid corals have relatively high growth rates (5-6 inches per year) for corals and exhibit branching morphologies that provide important habitat for other reef organisms. The abundance of these corals has been declining for several decades due in part to hurricane damage and disease.

Acropora cervicornis

Acropora palmata

<u>Measures to Avoid or Minimize Possible Impacts Resulting from Munitions Clearance and Detonation Activities</u>

Vegetation Removal:

A standard 70 meter setback (from mean high water) is usually designated to avoid impacts to hawksbill sea turtle nesting habitat during nesting season. Based on the characteristics of the nesting habitat in Culebra and the surrounding cays, an appropriate setback will have to be established for beaches that are part of the cleanup project. For instance, hawksbill sea turtle nesting habitat might be designated from the line of woody vegetation instead of from the high water line. Measuring and flagging the setback on project beaches might be easier if measured landward from the edge of the existing woody vegetation since the high water line may change daily.

Beach Monitoring

To the maximum extent practicable detonation activities shall be realized when it is not sea turtle nesting season and when hatchlings are not present on beaches. To the maximum extent practicable, ground intrusive activities, including detonation, will not occur during the peak nesting seasons from March to November.

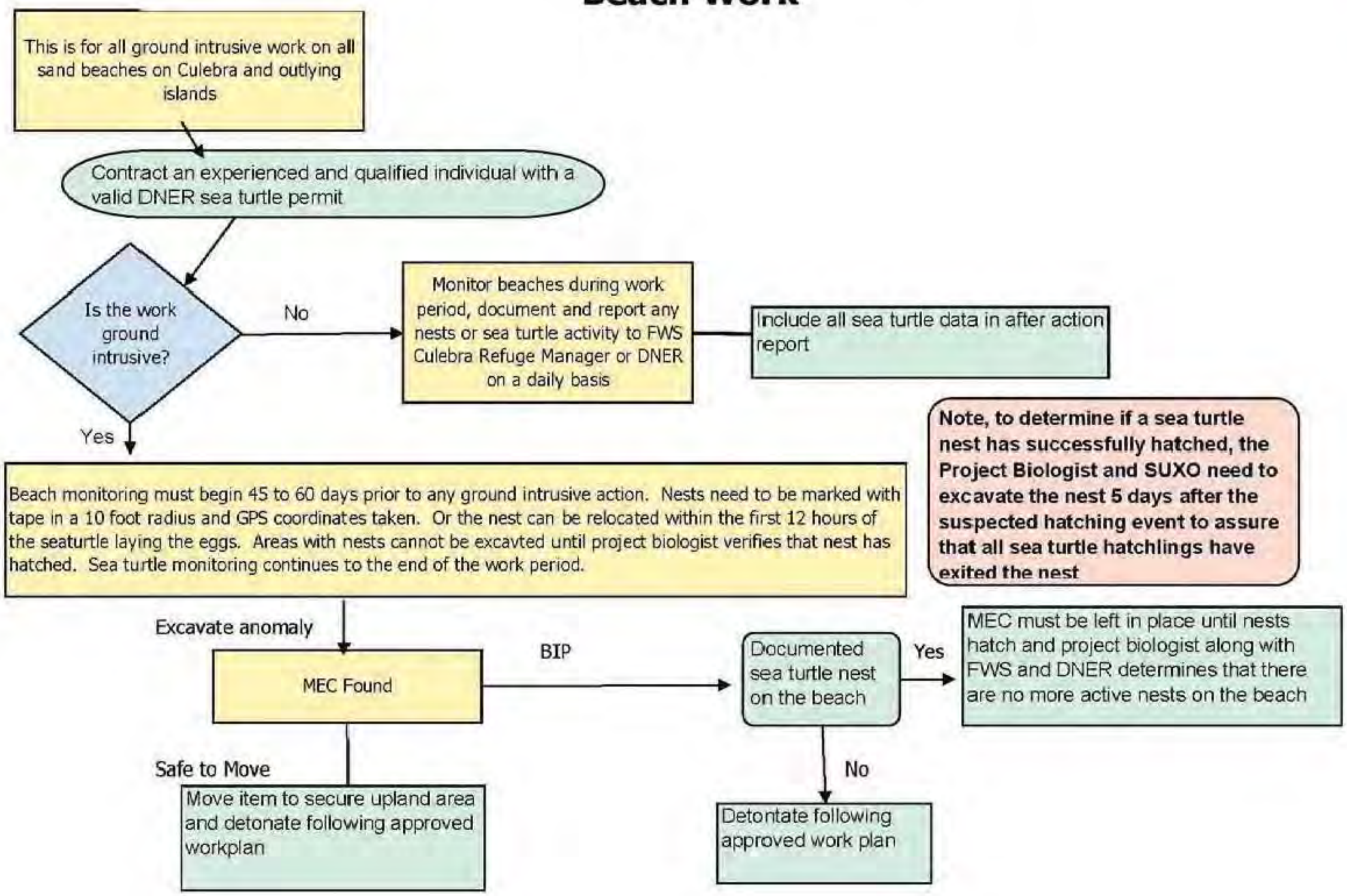
Prior to commencement of clearance activities, including vegetation removal and removal of unexploded ordnance, on Culebra, Culebrita, Cayo Norte and Cayo Luis Peña the contractor shall appoint a Project Biologist whose qualifications shall be submitted for the approval of the contracting officer and the FWS. All beach clearance activities, including vegetation removal and removal of unexploded ordnance, will be closely coordinated with FWS. In lieu of an independent Project Biologist, a USACE biologist could assist the contractor in this effort provided the USACE biologist has the appropriate training for conducting beach surveys. The Project Biologist shall perform morning beach patrols to identify the potential presence of new nests prior to and during the nesting season. When it is not nesting season, the Project Biologist or appropriately trained personnel shall conduct morning beach surveys prior to crews commencing daily activities to determine whether sea turtle nesting has occurred and to ensure that activities may be accommodated in a window of time when no nests are present.

If sea turtle nests are found on beaches being cleared of unexploded ordnance, the Project Biologist, the UXO supervisor, and/or monitoring personnel will communicate daily with the FWS Boqueron Endangered Species Specialist and the Culebra Islands NWR Refuge Manager as to whether new nests have been located, and their locations within the work area. If agreed upon by FWS, nest locations will be clearly marked to ensure clearance personnel avoid nests and no clearance activities will take place in the area until the hatchlings emerge and vacate the nest. Otherwise, nests will be relocated to a safe beach within 6-12 hours following nesting. The relocation program will be carried out by the Project Biologist and experienced personnel with the required DNER endangered species permits. This approach has been utilized by DNER personnel on Vieques from 1990-2000 to protect sea turtle nests from military operations with a hatching success of relocated nests of over 80%.

The Project Biologist shall also be responsible for training beach clearance crews prior to the initiation of clearance activities regarding the importance of endangered species, in particular the status of sea turtles at this location; the potential penalties associated with violations of the ESA; measures for crawl and nest identification; and sea turtle biology.

As an additional tool for sea turtle conservation, the following decision tree was prepared by the FWS to provide guidance on the sequence of events during ground-intrusive beach work. Project biologist shall work closely with UXO personnel to ensure these steps are followed.

Sea Turtle Conservation Measures for Ground Intrusive Beach Work



Designation of Beach Zones for Vegetation Removal and Munitions Detonation:

The information contained in this section was provided by the USFWS based on zones established during clearing activities for a Navy-led project in Vieques. The designation of zones based on number of nests, restrictions within the zones, etc. must be developed in coordination with the FWS to be specific to Culebra. The Corps shall require UXO contractors through the Project Biologist, to establish three work zones, based on sea turtle nesting data, and site inspections to ensure sea turtle nest protection during vegetation removal and munitions detonation activities. It shall be the Project Biologists responsibility to obtain specific nesting data for the beach area where the contractors will be working. This data can be obtained from the FWS Ecological Services Office in Cabo Rojo or the DNER office on Culebra or Fajardo.

The work zones proposed are:

Zone 1. No restrictions because sea turtle nesting is not expected within the area (rocky shore, no sand, etc).

Zone 2. Minor restrictions because of low historical sea turtle nesting events (fewer that 4 nests per year have occurred within the zone). Zone 2, beaches will be surveyed twice a week, 75 days prior to the activity by experienced and qualified personnel. Surveys should cover both the open sand and the area below the vegetation. No driving on the beach will occur. If no nests are found, cutting of trees smaller than 3 inches in diameter may occur. Manual cutting using machetes is the preferred alternative to allow for re-growth. If power tools such as chain saws are required, the FWS recommended pruning low branches instead of removing the trees (except for mesquite trees). Both techniques would allow for re-growth of suitable habitat. Mechanized removal of vegetation using mowers of vehicles should not be used near beach areas. When nests are found, a protection or exclusion zone of 8m should be designated around the nest and marked with flagging tape. Vegetation removal outside of the exclusion zone may occur if conducted manually. Vegetation removal within the nest area should be postponed until 5 days after hatching is documented, unless UXO is found in the vicinity of the nest.

Vegetation removal within the hawksbill sea turtle nesting habitat should not occur from June to mid December (peak of the nesting season). Hawksbill sea turtle nesting habitat varies from 10 m to 25m from the edge of the woody vegetation.

Zone 3. Major restrictions because 4 or more historical sea turtle nesting events have occurred within the zone. Zone 3, beaches will be surveyed every morning by a qualified biologist utilizing pedestrian surveys beginning 75 days prior to the scheduled start date of the project and until ordnance or vegetation removal actions are completed. Minimizing the amount of woody vegetation such as sea grape cleared would help minimize impacts to nesting hawksbill sea turtles. The rest of the conditions are the same as Zone 2.

When no nests are found on Zone 3 beaches, vegetation cutting may be conducted outside of the peak nesting season of the hawksbill sea turtle. A protection zone of 10 meters (measured landward from the edge of the woody vegetation) should be established to protect leatherback and green sea turtle nesting habitat. If leatherback and/or green sea turtle nests are left in situ (in place), vegetation removal activities should not occur within 10 meters of the landward edge of the nest track. The preferred alternative for cutting the vegetation, if nests are in situ, is hand cutting using machetes or power tools.

Vehicular Traffic

It should be noted that driving on sand beaches as a means of site access should be regarded as a measure of last resort after all other site access options have been explored. A designated entrance and an exit at the beach area, and monitoring of nesting events by qualified and experienced personnel is needed for vehicular beach access. If vehicular access is needed, we recommend the vehicular access be limited to the intertidal zone (below mean high water). Driving above the intertidal zone should not be allowed. All known nests should be marked by stake and survey tape or string in an area at least 20 feet (6 meters) in any direction from the center of the nest. No activities should enter in this area. Other alternative routes should be explored to avoid driving on sea turtle nesting beaches.

Vessel Traffic

For beach access from the ocean, should landing a vessel on the beach be necessary, the landing site shall be coordinated with the FWS Culebra National Wildlife Refuge personnel and the DNER. The route of the vessel shall be coordinated with NMFS to ensure that impacts to designated critical habitat and listed coral species are avoided. However, landing vessels on beaches should be regarded as a measure of last resort.

Beach activities on Culebrita, need to be coordinated with NMFS and FWS, the following vessel access SOPs will be implemented to minimize impacts to sea turtle refuge and foraging habitat, designated critical habitat, and listed coral species:

1. Culebrita will be accessed by entering Bahia Tortuga, the bay north of Beach E (as identified in the Engineering Evaluation/Cost Analysis for the cleanup of beaches on Culebrita and Flamenco Beach on Culebra). Contractors will tie boats to existing mooring buoys or, if the draft of vessels is shallow, anchor in the unvegetated, sandy zone between the seagrass beds and the beach.

2. No additional access points to beaches A, B, C, or D will be established as the contractor will bring all equipment and supplies to Beach E for offloading and transport overland or will offload personnel and equipment from an unanchored vessel into a inflatable craft that will then transit to access point previously established in coordination with NMFS and FWS. These access points do not currently exist and would have to be agreed upon.

In meetings with USACE, FWS, DNER, EQB and NMFS, it was agreed that the following cays will not be part of the cleanup project as they are inaccessible. The cays are:

1. Cayo Tiburón
2. Whale Rock
3. El Mono
4. Cayo Mono
5. Alcarazza/Fungi Bowl
6. The Washer

It was further agreed that access to the some of the cays that will be part of the cleanup project will be as follows:

1. Cayo Botella – contractors will use the Culebrita Island access in the bay northwest of the largest beach (Beach E) or anchor boats in the sandy bottom area south of the cay and use a inflatable craft, kayak, or swim to access the cay from the southeast where there is a small sand channel between areas of coral reefs.

2. Cayo Norte – boats will anchor in sand bottom in the small bay off the beach on the southeast of the island.

3. Pajarito Cay – from anchorage or mooring in Culebrita or Cayo Norte, access will be by inflatable craft entering the south side of the cay.

4. Cross Cay/Cayo Lobo – boats can anchor in unvegetated sandy bottom in the bay on the southeast side of the cay and anchors will not be dropped in areas containing coral colonies or seagrass beds.

The Corps, in coordination with the FWS, NMFS and DNER personnel have agreed that, in order to avoid impacts to listed coral species and designated critical habitat, the installation of mooring buoys to access Palada Cay/Cayo Geniqui, Cayo de Agua, Cayo Yerba and Cayo Ratón (also called Los Gemelos/Twin Rocks) will be completed if the clean-up activities will take place on these cays for more than two weeks. Prior to installation of mooring buoys at any given location in Culebra waters, the proposed locations shall be assessed for presence/absence of unexploded ordnance and to select final locations in unvegetated, sandy bottom. If the mooring buoys are not installed, the contractor will use a transit vessel to transport personnel to a site near each cay. The transit vessel will not weigh anchor and personnel will access the cays via an inflatable craft.

The following areas were identified using aerial photography, nautical charts and area maps and are proposed for installation of mooring buoys:

1. Cayo Geniquí/Palada Cay: Mooring buoy in 20-30 feet of water in the hardbottom area south of the cay to moor the transport boat. Access to the cay will be via inflatable craft.

2. Cayo del Agua: Mooring buoy in 20-30 feet of water on the south side of the cay to moor the transport boat. Access to the cay will be via inflatable craft.

3. Los Gemelos/Twin Rocks (Cayos Ratón and Yerba): Transit vessel will moor to the buoy serving Cayo del Agua and a inflatable craft will be used to access the cays.

These mooring buoy locations shall be coordinated with the United States Coast Guard.

In addition to establishment of access points, the following protocols shall be followed to minimize impacts to sea turtle refuge and foraging habitat, designated critical habitat, and listed coral species:

1. Access to the cays that have not been determined to be inaccessible and therefore form part of cleanup efforts will be dependent on wind, wave, and current conditions. During periods of rough seas, cays will not be accessed in order to minimize the potential for accidental groundings.

2. The transport boat utilized to provide access to the smaller cays will remain offshore and will not weigh anchor

Clearance crews and equipment will be ferried to the cays with an inflatable-type craft and the landing point for this craft will be determined in coordination with NMFS and FWS.

<u>NMFS Protected Species Vessel Strike Avoidance Measures and Reporting</u>

Background
The National Marine Fisheries Service (NMFS) has determined that collisions with vessels can injure or kill protected species (e.g., endangered and threatened species, and marine mammals). The following standard measures should be implemented to reduce the risk associated with vessel strikes or disturbance of these protected species to discountable levels. NMFS should be contacted to identify any additional conservation and recovery issues of concern, and to assist in the development of measures that may be necessary.

Protected Species Identification Training
Vessel crews should use an Atlantic and Gulf of Mexico reference guide that helps identify protected species that might be encountered in U.S. waters of the Atlantic Ocean, including the Caribbean Sea, and Gulf of Mexico. Additional training should be provided regarding information and resources available regarding federal laws and regulations for protected

species, ship strike information, critical habitat, migratory routes and seasonal abundance, and recent sightings of protected species.

Vessel Strike Avoidance

In order to avoid causing injury or death to marine mammals and sea turtles the following measures should be taken when consistent with safe navigation:

1. Vessel operators and crews should maintain a vigilant watch for marine mammals and sea turtles to avoid striking sighted protected species.

2. When whales are sighted, maintain a distance of 100 yards or greater between the whale and the vessel.

3. When sea turtles or small cetaceans are sighted, attempt to maintain a distance of 50 yards or greater between the animal and the vessel whenever possible.

4. When small cetaceans are sighted while a vessel is underway (e.g., bow-riding), attempt to remain parallel to the animal's course. Avoid excessive speed or abrupt changes in direction until the cetacean has left the area.

5. Reduce vessel speed to 10 knots or less when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity; therefore, prudent precautionary measures should always be exercised. The vessel should attempt to route around the animals, maintaining a minimum distance of 100 yards whenever possible.

6. Whales may surface in unpredictable locations or approach slowly moving vessels. When an animal is sighted in the vessel's path or in close proximity to a moving vessel and when safety permits, reduce speed and shift the engine to neutral. Do not engage the engines until the animals are clear of the area.

Additional Requirements for the North Atlantic Right Whale

The NMFS guidance includes additional requirements for the North Atlantic right whale, but these do not apply for the Culebra activities.

Injured or Dead Protected Species Reporting

Vessel crews should report sightings of any injured or dead protected species immediately, regardless of whether the injury or death is caused by your vessel.
Report marine mammals to the Southeast U.S. Stranding Hotline: 877-433-8299
Report sea turtles to the NMFS Southeast Regional Office: 727-824-5312
If the injury or death of a marine mammal was caused by a collision with your vessel, responsible parties should remain available to assist the respective salvage and stranding network as needed. NMFS' Southeast Regional Office should be immediately notified of the strike by email (takereport.nmfsser@noaa.gov) using the attached vessel strike reporting form.

For additional information, please contact the Protected Resources Division at:
NOAA Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701
Tel: (727) 824-5312
Or visit their website at: http://sero.nmfs.noaa.gov

Considerations for Other Species

The Corps and its contractors shall avoid contact with any bird or reptile found injured or otherwise in the way of the cleanup activities, until adequate coordination is done with the resource agencies. Detonation of UXO on cays should be conducted outside of the seabird nesting season. Some seabirds nest year round, in the event an item needs to be detonated near nests, the birds should be captured and held prior to the blow in place. This should be coordinated with the Project Biologist, FWS and DNER. In the event of manatee sighting in the vicinity of a work area, the work will stop until the animal(s) are at a safe distance.

Point of Contact for SOP Coordination

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APPENDIX B

Addendum to the 2008 SOPs (April 2011)

FINAL

Addendum to the Standard Operating Procedures for Endangered Species Conservation and their Habitat

DERP-FUDS Project No. I02PR006802

Culebra, Puerto Rico

US Army Corps of Engineers

Jacksonville District

April 2011

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Final Addendum to the Standard Operation Procedures for Endangered Species Conservation and their Habitat on DERP-FUDS Project No. I02PR006802, Culebra, Puerto Rico

1.0 INTRODUCTION

In 2008, the U.S. Army Corps of Engineers (USACE) in coordination with the National Marine Fisheries Services (NMFS) Protected Resources Division and the U.S. Fish and Wildlife Services (FWS) developed a series of standard operating procedures (SOPs) to avoid or minimize impacts to listed species and their critical habitats pursuant to the Endangered Species Act (ESA) during Formerly Used Defense Site (FUDS) work at locations designated for investigation and cleanup on Culebra Island, its adjacent cays and in surrounding waters that serves as habitat for these species.

In recent communications, the FWS recommended to the USACE to modify the existing SOPs in order to include terrestrial listed species that have the potential to occur in the project areas and were not covered under the July 2008 SOPs. Based on FWS recommendations and on-going communications with their staff this addendum has been prepared.

The intent of this document is to 1) supplement the 2008 SOPs 2) serve as guidance for the USACE and its contractors in order to avoid or minimize impacts to terrestrial listed species and their designated critical habitat, and 3) satisfy the substantive requirements of the ESA.

2.0 TERRESTRIAL LISTED THREATENED OR ENDANGERED SPECIES

The purpose of this section is to provide a detailed description of the threatened and endangered terrestrial species and their habitat to be found in Culebra Island and its adjacent cays. Species include the Culebra giant Anole (*Anolis roosevelti*), Virgin Islands tree boa (*Epicrates monensis granti*), Wheeler's perperomia (*Peperomia wheeleri*) and *Leptocereus grantianus* (no common name).

The information used to describe the listed species and their habitat was obtained from state/federal agencies fact sheets, recovery and management plans, the Federal Register and internet search, among other sources.

2.1 Culebra Giant Anole (*Anolis roosevelti*)

2.1.1 General Description: The Culebra Island Giant Anole (*Anolis roosevelti*) is an extremely rare or possibly extinct lizard of the *Anolis* genus. It is native to Culebra Island, Puerto Rico. It is a rather large lizard reaching a length of approximately 160 mm snout-vent length. The color in life is brownish-grey with two lines on each side. One line begins around

Figures 1 and 2. Culebra Giant Anole. Source: http://eolspecies.lifedesks.org/node/1797

the ear and extends posteriorly to the groin; the other begins in the shoulder region and extends posteriorly into the groin. There is a distinct light spot on the temple, and the eyelids are yellow. The throat fan is grey except for the lower rear quarter which is light yellow. The tail is yellowish-brown and the underside of the belly is whitish. The tail is deeply scalloped and supports a large fin along most of its length. This fin is high: the third from the distal most ray is twice as long as the depth of the tail, and the fourth proximal ray is as long as the depth of the tail (**Figure 1 and 2**). The edge of the tail fin is scalloped between rays in *A. roosevelti*, as opposed to straight in *A. cuvieri*. *Anolis roosevelti* is additionally distinguished from *Anolis cuvieri* by being grey, not green or brown; by lacking postanal scales in males (present in *A. cuvieri*); by smooth scales under the base of the tail (keeled in *A. cuvieri*), and by its large size **Figure 3** shows *A. cuvieri* for comparison purposes.

2.1.2 Breeding Season and Behavior: Reproduction behavior is unknown. The only information available on its food and foraging behavior is that the species was sighted feeding on the fruits of Ficus trees. There are no information on population number and trends. There have been no confirmed observations of the species since 1932.

Figure 3. *Anolis cuvieri*. Source: http://www.drna.gobierno.pr/ biblioteca/banco-de-fotos/Slide9.JPG/view fotos/Slide9.JPG/view

2.1.3 Habitat and Distribution: This lizard is presumably arboreal and restricted to the large Ficus and gumbo-limbo trees. There is no other information on its ecology on the island. In 1977, FWS determined that the *Anolis roosevelti* is an endangered species under the provisions of the ESA and declared most of the remaining forest in Culebra Island as critical habitat. The critical habitat area comprises Monte Resaca, Punta Flamenco, Playa Resaca, and Playa Brava. **Figure 4** shows the designated critical habitat areas for the Culebra Island Giant Anole.

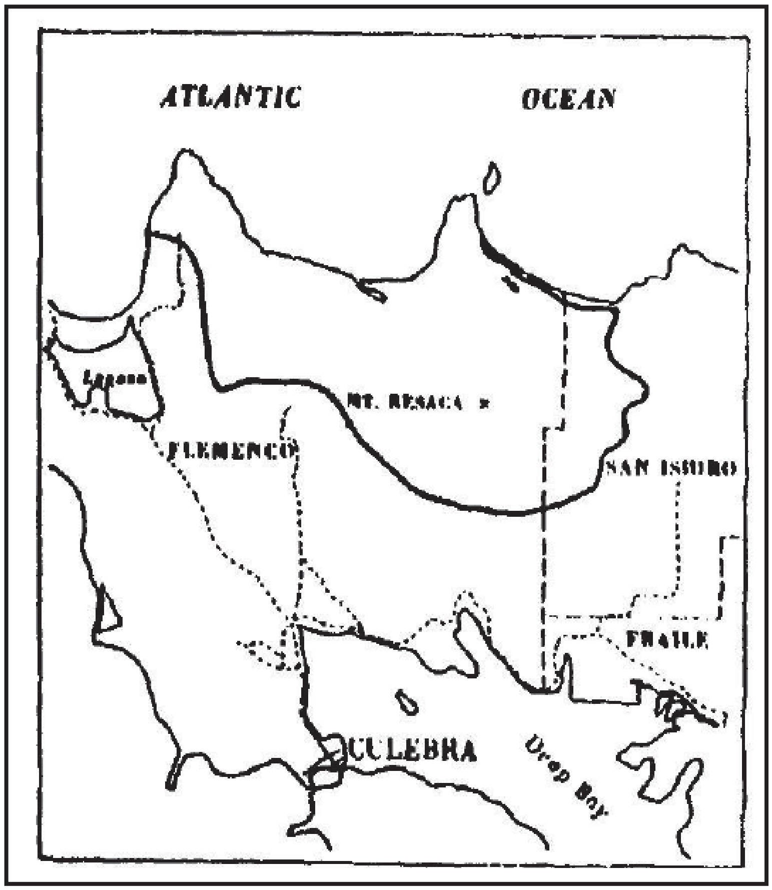

Figure 4. Boundaries of the critical habitat designated for the Culebra Island Giant Anole. Source: Critical Habitat Designations for PR and USVI (FWS 2007).

2.2 Virgin Islands Tree Boa (*Epicrates monensis granti*)

2.2.1 General Description: The adult body color is light plumbeous brown with darker blotches partially edged with black. The ventral surface is greyish-brown speckled with darker spots. This snake grows to slightly less than a meter snout-vent length (**Figure 5**). The Virgin Island (VI) boa was listed as an endangered species in 1979. Critical habitat has not been designated for this species.

2.2.2 Behavior: The VI boa is considered a nocturnal or crepuscular (active at twilight or sunrise) species, but can be active during daylight hours. Little is know of their food habits.

Figure 5. Virgin Island Tree Boa. Source: http://www.flickr.com/photos/deep-blue/2588456233/

2.2.3 Habitat and Distribution: The VI boa is considered endemic to Puerto Rico and the VI. The historical distribution of the VI boa suggests that this species was widely distributed throughout Puerto Rico and the VI, including the northeastern side of Puerto Rico, the offshore cay of Cayo Diablo, Culebra Island, and St. Thomas in USVI; Tortola, and Virgin Gorda in British Virgin Islands (BVI). Although the number of individuals at Culebra Island has not been determined, individuals have been sighted.

The VI boa's habitat has been described from two forest associations: subtropical dry forest and subtropical moist forest. The subtropical dry forest zone is the driest life zone found in VI, Vieques, southwestern Puerto Rico, plus all of Mona Island, Culebra Island and Desecheo. The dry forest habitat is characterized by small (<5m/ 15 ft) deciduous trees with small, coriaceous or succulent leaves and thorns, spines, and secondary defensive compounds, with high density of inter-digitating branches and vines greater than 1 cm (0.4 in) in diameter connecting adjacent tree canopies, and with a rainfall less than 750 mm (30 in) per year.

The species has also been sighted in mangrove forests including Button wood *(Conocarpus erectus)* and red mangrove, *(Rhizophora mangle)* on Culebra Island and Cayo Ratones. It was also found the VI boa in disturbed lower vegetation and artificial structures. Foraging boas are not restricted to trees, as they also use salt-tolerant shrub lands just above the high tide line.

2.3 Wheeler's Peperomia (*Peperomia wheeleri*)

2.3.1 General Description: *Peperomia wheeleri* is an evergreen, glabrous, erect herb which may reach 1 meter in height. The stems root only at the base and may be up to 1 centimeter in diameter. The opposite leaves are entire, fleshy, elliptic to elliptic-obovate, with 3 or 5 main veins ascending from the base. The lower side of the leaf is inconspicuosly black punctate. Inflorescenses are spikes, 10 to 16 centimeters long and 5 millimeters in diameter, which are borne solitary and opposite the leaves or at the leaf axils. Flowers are minute, approximately 0.5 millimeter in diameter (**Figure 6**).

2.3.2 Habitat and Distribution: The species is known to occur in Culebra Island and has been documented in the municipalities of Isabela and Quebradillas.

Culebra Island has an irregular topography and occurs on volcanic and intrusive rocks. The vegetation of this island is classified as belonging to subtropical dry forests. *P. wheeleri* is found in a more mesic environment, the semi-evergreen seasonal forest that consists of two strata, a tree canopy and herbaceous layer. The canopy reaches approximately 16 feet in height. Mature trees are approximately 7 to 15 feet apart (3 to 5 meters), separate by large granodiorite boulders. Roots form an entangled mass. *P. wheeleri* is a component of the understory of this semi-evergreen seasonal forest. This small herb grows on the humus which accumulates on these granodiorite boulders. Removal of the forest canopy alters the microclimatic conditions within this forest, resulting in the elimination of the humus substrate necessary for the survival of the species.

Figure 6. Wheeler's Peperonia. Source: http://www.fws.gov/caribbean/es/Images/Endangered/Peperomia_wheeleri.JPG

P. wheeleri is associated with the following canopy species: *Clusea rosea*, *Bursera simaruba* and *Ficus citrifolia*. It is also associated with other species growing in the herbaceous strata: several species of *Tillandsia*, *Anthurium acaule*, *Whittmackia lingulata* and *Epidendrum cochleatum*.

2.4 *Leptocereus grantianus* (No Common Name)

2.4.1 General Description: *Leptocereus grantianus* is a sprawling or suberect, nearly spineless cactus, which may reach up to 2 meters in height and 3 to 5 centimeters in diameter. The elongated stems have 3 to 5 prominent ribs with broadly scalloped edges. Ribs of young joints are thin, and the small areoles or spine-bearing areas may bear from one to three minute, nearly black spines which disappear as the joints grow older and the ribs become thicker. The flowers are solitary at terminal areoles, from 3 to 6 centimeters long, and nocturnal. The ovary and flower tube bear distinct areoles. The outer perianth segments are linear, green, and tipped by an areole like those of the tube and ovary. The inner perianth segments are numerous, cream-colored, oblong-obvate, obtuse, and about 8 millimeters long. Stamens are many and have yellow anthers. The stigma lobes are several and short. The fruit is subglobose to ellipsoid and about 4 centimeters in diameter (**Figure 7**).

This species is similar to another endemic species, *L. quadricostatus*, known from southern and southwestern Puerto Rico. These species differ primarily in flower morphology and in the characteristic areoles.

2.4.2 Habitat and Distribution: It is endemic to Culebra Island, and island located just off the northeastern corner of Puerto Rico. The species is found in the subtropical dry forest life zone in dry thickets which grow on a crumbling rock substrate on a steep bank just above the shoreline. Associated species include the sea grape (*Coccoloba uvifera*) and almacigo (*Bursera simaruba*). This species is currently known to occur in Punta Melones, Villas de Mi Terruño at Sardineras Ward, and Punta Soldado. In addition, the species has been introduced in a private property located at Fraile Ward, and at the Observation Point located within the Culebra National Wildlife Refuge in Punta Flamenco.

Figure 7. *Leptocereus grantianus*. Source: http://www.fws.gov/caribbean/ES/Images/Leptocereus_grantianus.jpg

L. grantianus was determined to be an endangered species in 1993 pursuant to ESA. Critical habitat has not been designated for this species.

3.0 MEASURES TO AVOID OR MINIMIZE POSSIBLE IMPACTS

The following measures will be implemented to avoid or minimize impacts to terrestrial threatened or endangered species and their habitat during investigation and cleanup work on Culebra Island and its adjacent cays.

3.1 General Procedures

3.1.1 Protected Species Identification Training/Briefing: Prior to initiate work all personnel shall receive training or briefings regarding the importance of endangered species, their characteristics, how they can be identified, potential habitats, types of material in which their may hide, actions to take if are sighted and avoidance measures to be followed. This training or briefing shall be prepared and offered by qualified personnel (e.g. biologist, environmental scientist, botanist, among others).

3.1.2 Civil and Criminal Penalties: The Contractor shall instruct all personnel associated with the project of the potential presence of threatened or endangered species. All personnel shall be advised that there are civil and criminal penalties for harming, harassing or killing threatened or endangered species protected under the ESA and Commonwealth of Puerto Rico Endangered Species Regulation.

3.1.3 Qualified Personnel: Each team performing vegetation clearance/removal (e.g. pruning, trimming, and cutting) shall be accompanied by qualified and experienced personnel in order to identify the presence or absence of threatened or endangered species. The Contractor shall submit their qualifications to the USACE and the FWS.

3.1.4 Coordination: All related work will be coordinated with the resource agencies (FWS, DNER and NMFS) prior initiation. The Contractor will provide a preliminary schedule and the areas (including the proposed transects and grids) where investigation or cleanup activities will be performed. Changes to the schedule and working areas will be provided to the resource agencies. Any access and work on the adjacent cays will be closely coordinated with FWS and DNER. Seabirds breeding season (May-August) shall be considered during the cays access coordination.

3.1.5 Reports: The Contractor shall maintain a log detailing sightings. The log shall include, but not limited to, the following information: date and time, location, species, and any actions taken during the work period. All data shall be forwarded to USACE Environmental Branch.

3.1.6 Detonation Activities: If determined that detonation activities are required, the related work and its conservation measures will be closely coordinated with the resource agencies.

3.2 Culebra Giant Anole Avoidance and Monitoring

3.2.1 In order to avoid impacts to this species transects/grids monitoring surveys will be conducted by qualified personnel to determine its presence or absence. The areas where the vegetation will be cleared shall be inspected prior to proceed with vegetation clearance.

3.2.2 According to the obtained information, this species is presumably active in daytime. For that reason, if it is sighted the vegetation clearance work shall cease to ensure the protection of the species. The activities will not be resumed until the animal has moved, at least, 100 feet outside the transect/grid limits or is at a safe distance.

3.2.3 The vegetation where the species was sighted shall not be cleared, until coordination with FWS has been completed.

3.2.4 The capture or collection of this species is prohibited. This species is protected under ESA.

3.2.5 It should be noted that this species has not been sighted since 1932. If this species is identified during investigation or cleanup work, the USACE Environmental Branch and FWS personnel must be notified immediately. It location shall be documented and provide it to FWS in order to facilitate additional field investigations. The USACE and FWS points-of-contact (POC) are included in Section 4.0.

3.3 Virgin Islands Tree Boa

3.3.1 Boa Monitoring: Boas have the potential to occur within the work area limits, in trees or bushes, under stored materials or inactive equipment stored in shady locations. Qualified personnel shall conduct the boa monitoring. Boas are active mostly during the night. Therefore, a daily search around and in machinery shall be completed at the beginning of each working day, prior to start-up of engines of quarry machinery, bulldozers, trucks, etc. Particular attention should be paid to motors and other warm areas that may be entered at night by the animals in an attempt to warm themselves.

3.3.2 If search of machinery does not discover any specimens, areas that are about to be cleared of vegetation shall be inspected next, especially piles of brush, leaf litter and rotting vegetation. These areas may be prodded gently with a blunt stick.

3.3.3 Relocation Actions: If a boa is discovered, all work shall stop within a 50 foot radius of the boa's location. One person shall keep watch on the boa while another contacts the designated boa monitor. If it is sighted within the transect limits, the boa shall be allowed to leave the site naturally. If the boa does not show any intention of leaving the area naturally, it will be relocated off the transect limits to an area with similar characteristic (e.g. vegetation cover) in order to resume the activities. If relocation is required 1) the boa monitor shall contact the USACE, FWS, and DNER POCs 2) shall provide the proposed relocation site location and its description, and 3) then will perform the capture, and relocation of the boa. The FWS and/or DNER POCs shall agree with the relocation site prior its relocation. The captured animal must be maintained in a cool, shady place (not inside a parked car) until relocation is completed.

3.3.4 The areas where boas have been relocated shall be clearly marked, documented, and provided to the USACE, FWS and DNER POCs.

3.3.5 Capture and Relocation Supplies and Equipment: At least three items should be provided by the contractor to the boa monitor, and maintained available on-site to handle and carry snakes if they are spotted: These are: a blunt snake hook, netting or burlap bags with closing ties, and a 6 x 6 or 8 x 8 foot tarpaulin.

3.4 Listed Vegetation Avoidance Measures

3.4.1 Cutting or pruning of any of these species (*Peperomia wheeleri* and *Leptocereus grantianus*) is prohibited. These species are listed as endangered and are protected under ESA.

3.4.2 Prior to the beginning of any vegetation clearance, the Contractor's qualified personnel shall identify if any of the listed species described in Section 2 are present or absence within the work area. The Contractor shall contact the FWS in order to obtain additional information (e.g. GIS shapefiles, location maps, etc.) on the locations and populations of these species. This information will be used to determine the transects/grids dimensions and their final locations. During the investigation activities qualified personnel shall conduct visual surveys to ensure the presence or absence of these species and to avoid or minimize possible impacts.

3.4.3 Vegetation clearance in areas where specimens of Wheeler's Peperomia are found shall be closely coordinated with FWS and DNER. Removal of the forest canopy could alter the microclimatic conditions within the forest, resulting in the elimination of humus substrate necessary for the survival of the species. This species is associated with the following canopy species: *Clusea rosea*, *Bursera simaruba* and *Ficus citrifolia*. It is also associated with other species growing in the herbaceous strata: several species of *Tillandsia*, *Anthurium acaule*, *Whittmackia lingulata* and *Epidendrum cochleatum*. Particular attention should be paid to these areas.

3.4.4 Cutting or pruning vegetation within Wheeler' Peperomia habitat, including forested areas with boulders that are densely covered by bromeliads, orchids or anthuriums, shall be avoided to the maximum extend possible in order to maintain the microclimate conditions that contribute to the suitability of this endangered species.

3.4.5 Cutting or pruning of any species of cacti shall be avoided in order to prevent impacts to *Leptocereus grantinanus* species.

3.4.6 If any of these species (*Peperomia wheeleri* and *Leptocereus grantianus*) is found within the proposed transect/grid, the route will be realigned. The species shall be clearly marked in order to ensure its protection.

4.0 POINT OF CONTACT FOR SOP COORDINATION

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APPENDIX B

Guide with the minimum information required for the Daily Observer Log Sheet

DAILY OBSERVER LOG SHEET
DERP-FUDS PROPERTY NO. I02PR0068
CULEBRA, PUERTO RICO

PROJECT INFORMATION	
Contractor:	Munition Response Site#:
USACE Contract#:	Project Location:
Observer Name (and Company):	Observer Location:
Date: Time:	Shift Start: Shift End:
Sunrise: Sunset:	Crew:

Weather and Visibility Information

Location	Time	Glare	Water Clarity	Seas (wave height)	Visibility	Wind Speed and Direction	Conditions on Land	Estimated % Cloud Cover

Sighting Log

Time	Location Coordinates	Species	Total Number	Adults	Juveniles	Closest Distance to Vessel	Activity or Behavoir and Direct of Movement	Time Last Seen

Daily Summary

Species	Total Number	Total Number Outside 50 feet	Total Number Inside 50 feet	Action Taken

Remarks:
____
____

Observer Signature: ____

APPENDIX C

Recommended Coral Relocation and Reattachment Protocol

Coral Relocation and Reattachment Protocol
for
DERP-FUDS Project No. I02PR006802,
Culebra, Puerto Rico

In order to minimize impacts to coral species, non-listed corals with diameters >4.0 in (>10.2 cm), or branched corals will be detached and relocated, to the extent possible, to the area where they are already located in adequate substrate where deemed safe from the expected impact prior to munitions and explosives of concern (MEC) and/or Material Potentially Presenting an Explosive Hazard (MPPEH) removal or disposal. If corals that are listed or proposed for listing are attached to MEC/MPPEH, no relocation or MEC/MPPEH removal effort will be conducted. Instead, additional coordination with the Technical Project Planning (TPP) Team is a requirement for situations where ESA-listed corals or corals proposed for listing are present in areas or on MEC/MPPEH in such a way that the removal of MEC/MPPEH would affect these corals.

For non-listed corals measuring 10 cm or more in diameter or branching corals, the following protocol has been developed as a guideline to decrease coral stress during transplant. It is recommended that two teams or individuals be utilized during the relocation process: one team/individual responsible for removing corals and a second team/individual mobilized and prepared for reattachment activities.

GENERAL CONSIDERATIONS FOR CORAL HANDLING AND TRANSPORTATION

- Each coral may be carried by hand or in a bucket to the relocation site.
- In order to reduce stress to the coral from transport and to increase the likelihood of success, the coral colonies should remain submerged in seawater at all times.
- Corals should be handled as little as possible.
- Detached coral colonies should not be in contact with each other to prevent additional harm to their structures and tissue.
- If a bucket or container is used for transportation and transportation will be above water (such as on a vessel to get from the removal site to the transplant site), the seawater should be routinely changed to avoid prolonged exposure to increased water temperatures.
- Corals should be reattached the same day they are removed; they should not be stored overnight in transport containers.
- Prior to any relocation, photograph (two pictures - one from the top and one from the side) the corals with a ruler or other object showing the size of the colony in the photograph. This can be used to determine whether there is any tissue loss or death during the relocation.

- Record the coordinates where the coral is removed from and the species being relocated.
- Clear all encrusting organisms from the edges of the corals.
- Prevent damage to the edges of corals.
- When possible, remove the entire coral colony in one piece.
- When removal of the entire colony is not possible, a partial removal of the colony will be completed to maintain the phenotypic genetic composition of corals from the investigation site. In this case, field notes should indicate this decision was made.
- Notes should be made regarding orientation of the coral in its natural setting to mimic that position at relocation site. The water depth at which the corals are transplanted should also be the same as those from which corals are removed.
- Place corals upright in transport containers, avoiding contact with other corals.
- Avoid touching coral tissue with bare hands. Gloves should be worn while handling the corals.

Recommended tools for removal and reattachment:

- rubber or dive gloves
- putty knife
- other thin bladed tools with beveled edges
- baskets or buckets
- chisels with thin blades
- chipping hammer
- underwater paper to record and track coral movements
- wire brush
- masonry nails
- Portland Type II cement and/or marine epoxy

IDENTIFICATION OF ADEQUATE RELOCATION SITE

The selection of the relocation site should consider the following:

- The substrate is hard bottom, free of sediment bedload
- No fire corals (*Millepora* spp.), sponges or harmful algae in the vicinity that could hamper coral colony survival and growth.
- High benthic topographic relief
- No predators observed in the vicinity
- The size of the site allows for the relocation activity to be conducted without harming other corals. Keep in mind the preparation of the site, coral colony size and the materials used to reattach the coral.

CORAL RELOCATION

Once the specific reattachment locations have been identified, the following protocol/guidelines should be followed during the reattachment process:

- Document the site coordinates and substrate type and depth
- Prepare the reattachment surface with a wire brush, removing biota, such as algae, and any sediment to expose rock substrate. Care should be taken to avoid contacting existing corals with wire brush.

For massive corals:

- Drive masonry nails, at least three, into the substrate at the site where the coral colony will be placed. Larger corals will require additional nails.
- Prepare a thick mixture of Portland Type II cement with molding plaster added, as necessary, to accelerate hardening of cement. Marine epoxy could be used instead of cement.
    - o Place cement/epoxy over the masonry nails. The amount of cement should be enough for the colony to be inserted in the mixture so that there are no empty spaces between the coral colony and the mixture.
    - o Insert the detached coral in the cement mixture, exerting some downward pressure.
    - o Minimize exposure of coral skeleton by placing cement in voids or along dead coral edges.

- For branched corals:
    - o Using wire and/or cable ties to fasten the colony to the masonry nails.
    - o The colony should not move once fastened. If it does, epoxy could be added in certain points.
    - o Corals may also be attached to appropriate substrate with wire and/or cable ties or by wedging fragments into small crevices and voids.

- Document the reattachment process by taking pictures of the colony, from the top and the side once the process is finished, including a scaled reference item in the picture. Take notes on the method used to reattached the colony.

The following links can be used as reference for the process described above:

- http://www.youtube.com/watch?v=_XaUttAUHv4 (NOAA 2009)
- http://www.youtube.com/watch?v=qRlfOu7fERw (NOAA 2011)

Once all of the transplantation activities have been completed, a detailed effort should be undertaken to map the transplanted colonies. A map of all reattached corals shall be developed and submitted to the TPP Team. This map must be geo-referenced using high accuracy GPS technology, show locations and depths of corals, and should be created immediately upon completion of the transplantation project, while coral transplants are still easily identifiable. Geo-referencing may be accomplished either by 1) geo-referencing each individual coral location or 2) referencing a central marker or staked GPS position, relative to which all corals are mapped. Still photography shall be used to document transplantation activities.

APPENDIX D

List of seabirds that occur in the Project Area

Culebra National Wildlife Refuge
U. S. Fish and Wildlife Service

Culebra Archipelago's Seabirds

Fifteen species of seabirds nest on fourteen islands and cays of the Culebra Archipelago and other 12 species occasionally visit the archipelago and surrounding waters at different times of the year (as showed in table 2 and 3). This fact makes to the present day the Culebra NWR one of the most important reserves in the Caribbean for seabirds. As part of the current management activities, the Service protects and conserves these essential nesting areas for seabirds. However, there are some aspects that increase habitat vulnerability for these species, as predators and human disturbances.

Table 2. Culebra Archipelago Seabirds

Species Name	Nesting?	Species Name	Nesting?
Audubon's Shearwater	Yes	Least Tern	Yes
Masked Booby	Yes	Great Shearwater	No
Brown Booby	Yes	Manx Shearwater	No
Red-footed Booby	Yes	Wilson's Storm-Petrel	No
White-tailed Tropicbird	Yes	Leach's Storm-Petrel	No
Red-billed Tropicbird	Yes	Double-crested Cormorant	No
Laughing Gull	Yes	Common Tern	No
Royal Tern	Yes	Arctic Tern	No
Sandwich Tern	Yes	Pomarine Skua	No
Cayenne Tern	Yes	Black Noddy	No
Roseate Tern	Yes	Herald's Petrel	No
Bridled Tern	Yes	Brown Pelican	Yes
Sooty Tern	Yes	Magnificent Frigatebirds	No*
Brown Noddy	Yes		

*need to be confirmed, potential areas for nesting occur

Tabla 3. Seabird areas on Culebra Archipelago

Seabird areas on Culebra Archipelago	Bird Name	Observed or Nesting	Nesting Period	Resident or Migratory
Flamenco Peninsula	Sooty Tern	nesting	March to September	Migratory
Luis Peña Cay	Audubon's Shearwater	nesting	February to July	Migratory
	White-tailed Tropicbird	nesting	February to September	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
Del Agua Cay	Audubon's Shearwater	nesting	February to July	Migratory

	White-tailed Tropicbird	nesting	February to September	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Brown Noddy	nesting	April to August	Migratory
Ratón Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Roseate Tern	nesting	April to July	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Brown Noddy	nesting	April to August	Migratory
Yerba Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Roseate Tern	nesting	April to July	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Sooty Tern	nesting	March to September	Migratory
	Brown Noddy	nesting	April to August	Migratory
Lobo Cay	Audubon's Shearwater	nesting	February to July	Migratory
	White-tailed Tropicbird	observed	February to September	Migratory
	Red-billed Tropicbird	observed	May to September	Migratory
Lobito Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Laughing Gull	nesting	April to September	Migratory
	Royal Tern	nesting	May to July (Sept to April)	Migratory
	Sandwich Tern	nesting	May to July (Sept to April)	Migratory
	Cayenne Tern	nesting	May to July	Migratory
	Bridled Tern	nesting	April to August	Migratory
Noroeste Cay	White-tailed Tropicbird	nesting	February to September	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Sooty Tern	nesting	March to September	Migratory
	Brown Noddy	nesting	April to August	Migratory
Molinos Cay	White-tailed Tropicbird	nesting	February to September	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Roseate Tern	nesting	April to July	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Sooty Tern	nesting	March to September	Migratory
	Brown Noddy	nesting	April to August	Migratory
Alcarraza Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Masked Booby	nesting	Throughout the year	Resident
	Brown Booby	nesting	Throughout the year	Resident
	Bridled Tern	nesting	April to August	Migratory
	Sooty Tern	nesting	March to September	Migratory
	Brown Noddy	nesting	April to August	Migratory

Matojo Cay	Audubon's Shearwater	nesting	February to July	Migratory
	Red-billed Tropicbird	nesting	May to September	Migratory
	Royal Tern	nesting	May to July (Sept to April)	Migratory
	Laughing Gull	nesting	April to September	Migratory
	Sandwich Tern	nesting	May to July (Sept to April)	Migratory
Geniquí Cays	Red-billed Tropicbird	nesting	May to September	Migratory
	Brown Booby	nesting	Throughout the year	Resident
	Laughing Gull	nesting	April to September	Migratory
	Bridled Tern	nesting	April to August	Migratory
	Brown Noddy	nesting	April to August	Migratory
	Red-footed Booby	nesting	Throughout the year	Resident
Culebrita Island	Audubon's Shearwater	nesting	February to July	Migratory
	White-tailed Tropicbird	observed	February to September	Migratory

General comments:

As showed in table 3, throughout the year, the Culebra Island offshore cays receive a lot of seabirds for nesting, roost or just visit the cays and surrounding waters for feeding. Some of these species are observed during the year as regular residents or visitors: Red-footed Booby, Brown Booby, Magnificent Frigatebirds, and Brown Pelican. The first two species nest regularly in cays and the last species need to be confirmed for nesting but are regularly observed roosting on trees, shrubs or flying over the cays.

Seabirds are pelagic birds. This means that they just come to land to nest and after that, these pass the rest of the time flying over the ocean looking for food. The nesting season of seabirds consists of the period of time that birds are present or near lands doing courtships, nesting area selections, nesting periods, etc. This period is finished when fledglings or juveniles abandon the colony area. The most critical months in Culebra Island for seabirds are from February to August. During this period, the seabirds, and depending on the species, are in the process of courtship, selection of nesting areas, laying eggs, feeding their chicks, and protecting their fledglings from predators. Areas more used by birds in the Culebra Archipelago are Yerba, Molinos, Alcarraza, Geniqui, Lobito, Agua, Raton and Matojo cays and Flamenco Peninsula.

The most common and dangerous perturbations in the seabirds colonies are predators and human disturbances. In the Culebra offshore cays, introduced predators such as cats and rats, can eat eggs and chicks. Also, other predators (i.e., goats and deer) in the cays can manipulate and change the nesting habitat by grazing. Human disturbances as loud noise made by jet skis, boats, and other sources, or just the presence of one or more persons near the colony (ies) may cause abandonment of nests by adults which may cause eggs overheat and predated by ants, rats or cats. It is very important not to disturb the colonies during nesting season. Any work or activity necessary to do near or in colony areas, should be completed outside of nesting period.

APPENDIX E

Equation to calculate the potential extent of acoustic impacts from underwater detonations

2. Overview of Impacts to Protected Species

Underwater explosions may affect marine life by causing death, injury, temporary threshold shifts (TTS or recoverable hearing loss), or behavioral reactions, depending on the distance an animal is located from a blast. An underwater explosion is composed of an initial shock wave, followed by a succession of oscillating bubble pulses. A shock wave is a compression wave that expands radially out from the detonation point of an explosion. At a distance from a detonation, the propagation of the shock wave may be affected by several components including the direct shock wave, the surface-reflected wave, the bottom-reflected wave, and the bottom-transmitted wave. The direct shock wave results in the peak shock pressure (compression) and the reflected wave at the air-water surface produces negative pressure (expansion). For an explosion with the same energy and at the same distance, an underwater blast is much more dangerous to animals than an air blast. The shock wave in air dissipates more rapidly and tends to be reflected at the body surface; in water the blast wave travels through the body and may cause internal injury to gas-filled organs due to impedance differences at the gas-liquid interface.

Beyond the distance from a detonation causing injury, explosives use in designated critical habitat, during certain times of year, or occurring in other biologically important habitats (e.g., migration corridors, spawning and nesting areas, and juvenile habitats) could have potentially adverse consequences on animals. In response to noise, behavioral reactions could potentially result in impairment of feeding, sheltering, reproduction, or other biologically important functions of animals. Exposure to a noise can also result in temporary or permanent hearing impairment, depending on the sound pressure level and exposure duration. Therefore, the hearing abilities of animals and behavioral disturbance are important considerations when assessing the potential impacts from projects resulting in noise.

2.1. Effects on Sea Turtles

Explosions are known to injure and kill sea turtles (Duronslet et al. 1986, Gitschlag 1990, Gitschlag and Herczeg 1994, Klima et al. 1988, O'Keefe and Young 1984). NMFS studied the effects of offshore oil and gas structure removals using 23 kg (50 lb) of nitromethane (Klima et al. 1988). Loggerhead (*Caretta caretta*) and Kemp's ridley (*Lepidochelys kempii)* sea turtles were located at distances of 213.4 m (700 ft), 365.8 m (1,200 ft), 548.6 m (1,800 ft), and 914.4 m (3,000 ft) from the platform removed with explosives. The charges were placed inside platform pilings at a depth of 5 m below the mudline. Four sea turtles within 365.8 m of the detonation were unconscious, as well as an individual at 914.4 m (3,000 ft). Sea turtles were expected to have drowned if not recovered from the water following the detonation. All turtles exposed to the blast exhibited everted cloacas and vasodilation lasting 2-3 weeks.

The sea turtle ear appears to be adapted to both aerial and aquatic environments. Sea turtles have a primitive reptilian ear and are considered to be hearing generalists, having limited hearing abilities at lower frequencies. Although there is some variation in sea turtle hearing measurements between species and size classes (Ketten and Bartol 2006), the available data suggest that species of sea turtles are likely sensitive to frequencies from approximately 100 Hertz (Hz) to 2,000 Hz (Lenhardt 1994, Lenhardt et al. 1996, McCauley et al. 2000a and 2000b, Moein et al. 1994, O'Hara and Wilcox 1990), with greatest underwater hearing sensitivities below 1,000 Hz (Ketten and Bartol 2006). Behavioral reactions to the sound produced from explosions may be important if they occur in biologically important areas such as foraging areas, near nesting beaches during nesting season, or in developmental juvenile habitats.

2.3. Effects on Marine Mammals

Blast damage in marine mammals has been investigated using both submerged terrestrial mammals (Goertner 1982, Yelverton et al. 1973, Richmond et. al 1973) and cadavers (Myrick et al. 1990, Ketten et. al 2003). At close ranges to a detonation, mortality and life threatening injuries may occur. At increasing distance from the blast, the effects of the shock wave lessen, but effects such as hearing loss and behavioral responses may still occur. There are a variety of factors that may affect noise effects on marine mammals. Marine mammals are at greatest risk of injury when they are at the same depth as, or slightly above, the explosion (Keevin and Hempen 1997). Risks drop off quite sharply above and below this depth; however, the pressure waves produced from an explosion may propagate very differently, depending on environmental factors. Additionally, smaller marine mammals are more susceptible to blast injury than larger animals at the same exposure levels. Frequently occurring or repeated detonations over a given time period may cause behavioral changes that disrupt biologically important behaviors or result in TTS.

The hearing abilities of marine mammals are generally classified as lower-frequency hearing for mysticetes (baleen whales) and higher-frequency hearing for odontocetes (toothed whales). Based on anatomical studies, mysticetes are believed to generally hear sounds in the 0.01 to 20 kHz range, depending on the species (e.g., Helweg et al. 2000, Parks et al. 2001, 2007). Odontocetes generally hear over a much broader range of higher frequencies from approximately 0.2 to 180 kHz (e.g., Cook et al. 2006, Erbe 2002, Houser and Finneran 2006, Kastelein et al 2003, Szymanski et al. 1999) with best hearing between approximately 5 and 100 kHz, depending on the species. Increasingly, more hearing measurements are becoming available for more odonotcete species and have been summarized elsewhere (Nedwell et al. 2004); however, the general range of hearing abilities described above can be used for planning projects that result in infrequent, impulsive sounds from underwater detonations of explosives.

2.4. Behavioral Reactions to Detonations

At ranges beyond those causing injury, animals are susceptible to behavioral disturbances from underwater noise in the frequencies of their hearing range. Explosions produce loud, broadband noise that is audible to many species, but the main frequencies produced are often influenced by the medium being blasted (e.g., rock, concrete, and pilings) and blasting technique (e.g., placement inside or outside the structure, burial or borehole depth, and type of charge). Important behavioral effects on feeding, resting, and reproduction should always be considered during project planning.

Based on the duration of noise produced from construction activities, repeated exposure to acoustic energy (e.g., pile driving, geophysical surveys, dredging, and vessel noise) could potentially result in a broader range of behavioral effects than single, impulsive energy waves, such as those resulting from detonations. Detonations resulting in a single, instantaneous detonation would not be expected to result in significant behavioral disturbance; however, temporary reactions or startle responses to the noise may occur. Likely reactions to a single detonation may range from no reaction (Madsen and Møhl 2000), annoyance, attraction to or avoidance of the noise, or a startle response from the sudden onset of the noise (SRS Technologies 2001). Observed reactions could include diving, surfacing, schooling, increased respiration, or swimming away from the noise (Collins et al. 2001, Richardson et al. 2001, Nowacek et al. 2007). The effects of startle responses are usually temporary and minor, although sudden onset of impulsive noises may have potentially adverse consequences (Jehl and Cooper 1980, SRS Technologies 2001).

Recommended exposure levels in which behavioral reactions are expected appear in Table 1. Single, discrete detonation events are generally not expected to result in significant changes in behavior under most circumstances; however, certain life history stages or behavioral states need consideration when assessing impacts of noise. In the southeast U.S., project areas in or near known spawning grounds, calving areas, nesting beaches, important foraging areas, migration corridors, or designated critical habitat may be more likely to disturb animals. These areas may have seasonal or environmental characteristics that are important to protected species. NMFS is available to assist with identifying any areas of potential concern near a project area.

Table 1. Onset of behavioral responses to a single impulsive noise.

Impact Zone	**Cetaceans**[a]	**Sea Turtles**[b]	**Fishes** [c]
Harassment (Behavior)	$\geq$ 160 dB_{rms} re 1 μPa	166_{rms} dB re 1 μPa or 155 dB re 1 μPa-s	160 $_{peak}$ dB re 1 μPa

[a]Recommended interim criteria for marine mammals
[b]Based on McCauley et al 2000a
[c]Recommended level based on data from Skalski et al. 1992.

Although most single detonations typically don't result in significant behavioral changes, the level of behavioral response of an animal can be strongly dependent on the repetitiveness of the disturbing stimulus. As a guiding principal, projects involving multiple detonations per day should be evaluated for their potential to significantly affect the behavior of an animal. For any projects in which repetitive explosions may occur, the potential for adverse behavioral effects must be evaluated on a project-by-project basis with NMFS.

3. Defining Zones of Influence

Defining zones of influence allows NMFS and project planners to estimate the potential area affected and determine appropriate mitigation measures for protected species.

1. **Mortality Zone:** The distance from a detonation within which mortality may occur.

2. **Injury Zone:** the distance from a detonation within which non-lethal injury may occur, but mortality is not expected.

3. **Danger Zone:** The distance from a detonation within which both injury and mortality may occur.

4. **Harassment Zone (TTS):** the distance from a detonation within which temporary hearing loss may occur.

5. **Harassment Zone (Behavior):** the distance from a detonation within which behavioral reactions may occur.

6. **Watch Zone:** an additional buffer zone that may be monitored to detect animals that are heading towards the impacted area. The watch zone radius may vary depending on the type of project and species potentially occurring in the project area.

Different zones of influence should be considered when determining the range of effects from any given noise. Useful terms to describe zones of influence and estimate probable impacts from explosions (and avoidance of) are 1) a mortality zone, 2) an injury zone, 3) a danger zone (mortality and injury zones combined), 4) a harassment zone (TTS), 5) a harassment zone (behavior), and 6) a watch zone (Figure 1). Defining zones of influence is also important to establish common terminology to discuss potential impacts to protected species. The term *impact zone* may also be used in reference to the distance from an explosion within which the potential for adverse effects may occur, including the potential for mortality, injury, and harassment.

4. Calculating Zones of Influence

NMFS' Southeast Region currently accepts three general methods to calculate zones of influence, depending on the activity type: 1) energy and pressure thresholds; 2) unconfined blasts; and 3) confined blasts using stemmed charges. The zones of influence needed for a project area and how they are estimated will vary depending on the method used, as well as project-specific details.

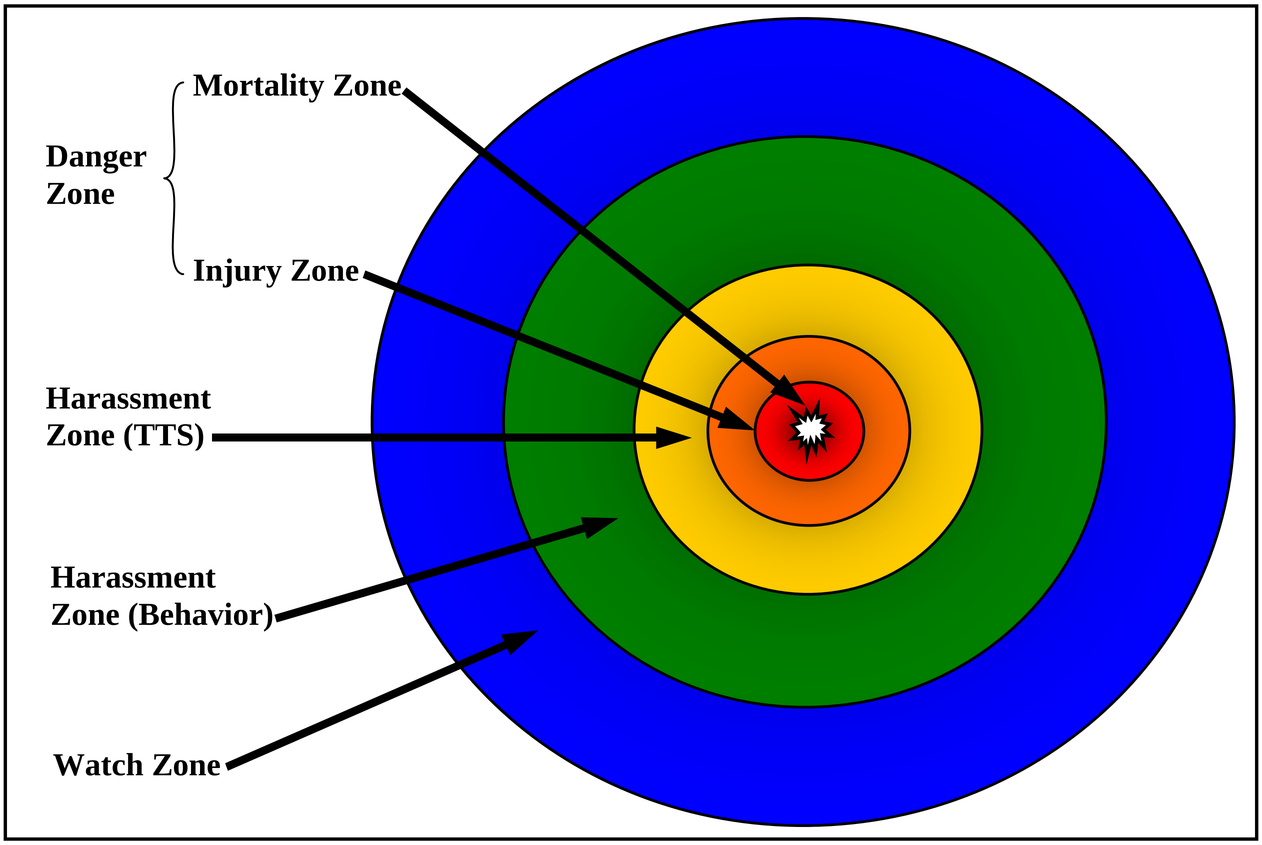

Figure 1. An example of zones of influence from explosives detonated in open water.

4.1. Energy and Pressure Thresholds

Threshold criteria for marine mammals and sea turtles were initially established for ship shock trials of the SEAWOLF submarine and the WINSTON S. CHURCHILL vessel, and description and derivation of these criteria can be found in the environmental impact statements prepared for these activities (Department of the Navy 1998 and 2001). Recently, these criteria have been revised and are currently undergoing further review by NMFS and may be applied to other protected vertebrate species. Standard impulsive and acoustic metrics used in this document are defined below.

Peak Pressure: peak pressure is commonly used to measure maximum positive pressure or peak amplitude of impulsive sources with units of psi.

Positive Impulse: Positive impulse is the time-averaged pressure disturbance from an explosive source with units in psi-ms.

Sound Exposure Level (SEL): SEL is the time cumulative sum of squares pressure divided by the duration of the sound. SEL levels have units of dB re 1 μPa^2•s and other an assessment of risk to multiple exposures, such as pile driving.

Energy flux density (EFD): EFD is the time integral of the squared pressure divided by the impedance. EFD levels have units of dB re 1 μPa^2•s.

1/3-Octave band: The 1/3 octave selected is the hearing range at which the subject animals' hearing is believed to be most sensitive.

It is noteworthy that the EFD and SEL metrics are converted to decibels in a slightly different way, but are very similar. The SEL and EFD metrics often are used to refer to the same quantity, namely, the time integral of square pressure divided by the product of sound speed and density. This definition for EFD, however, is not strictly correct for complex pressure fields; SEL may be a more appropriate metric in an analysis of potential impacts from explosive sources. However, both SEL and EFD are reported in the literature and are comparable metrics. NMFS recommends that SEL should be used whenever possible.

Marine Mammal and Sea Turtle Mortality Thresholds

To determine the potential physical injury from explosions, pressure thresholds are used based on the mass of the animal. Studies with animals have shown that as the mass of the animal increases, the pressure required to result in lung injury increases. Pressure is commonly measured as positive impulse or peak pressures. Threshold levels can be established to estimate distances from an explosion in which different impacts varying in severity may occur, that may characterize levels at which harassment, injury, or death may be expected. Although body mass is associated with blast injury, there is no not association with auditory and behavioral effects discussed below. Predictive equations for lung injury Equation 1 and example thresholds based on body mass of sea turtles and marine mammals appear in Table 2.

The recommended threshold level for the onset of mortality in sea turtles and marine mammals from explosions (Yelverton and Richmond 1981) is given by:

1% mortality can be estimated by: $\text{LN } I = 2.588 + 0.386 \text{ Ln } M$, and

50% mortality can be estimated by $\text{LN } I = 3.019 + 0.386 \text{ Ln } M$

where I is positive impulse (psi-ms) and M is body mass (kg).

Example 4.1

Using the above equation to find the threshold level at which the onset of mortality (1%) is expected for a 27 lb (10 kg) juvenile green sea turtle in the Laguna Madre, Texas, we find:

<u>10 kg green sea turtle</u>

$\text{LN } I = 2.588 + 0.386 \text{ Ln } (10)$

$\text{LN } I = 2.588 + 0.889$

$\text{LN } I = 3.477$

Finding the inverse natural log to solve for impulse (I) yields:

$I = e^{3.477}$

$I = 2.71828^{4.33}$

$I = 32.36$ psi-ms

In general, smaller animals and their associated smaller impulse values result in larger impact zones. This equation does not consider the possible effects of animal depth; however, it is generally applicable to general estimating the onset of mortality for blasting projects in coastal areas, and it is highly conservative since it estimates the injury range at which only 1% of animals would be expected to experience lung injury. Following the calculation of the appropriate threshold level, the shock wave needs to be modeled to determine the range from the detonation at which the threshold level will be realized. These calculations are complex and require knowledge of the project details, environment, shock wave theory and modeling. These calculations are discussed in greater detail in Department of Defense (2001 and 2007).

To predict auditory effects from single explosions, two different acoustic energy thresholds (dual criteria) may be used to predict effects to sea turtles and marine mammals: a sound exposure level (SEL) and a pressure threshold (Table 2). The auditory criteria resulting in permanent

Table 2. Zones of influence for marine mammals and sea turtles from explosions.

Impact Zone	*Criterion Definition*	**Threshold Level**
Mortality Zone	Onset of severe lung injury (1% of animals; dependent on body mass)	$\ln I = 2.588 + 0.386 \ln M$[a]
Injury Zone	Onset of PTS	≥46 psi, 230 $_{peak}$ dB re 1 μPa, or 198 dB re 1 μPa^2-s
Harassment Zone (TTS)	Onset of TTS	≥23 psi[b], 224_{peak} dB re 1 μPa[c]; or 183 dB μPa^2-s at frequencies in any 1/3 octave band above 100 Hz for odontocetes and sea turtles; or above 10 Hz for mysticetes.

[a]Yelverton and Richmond 1981
[b]Finneran et al 2002
[c]Southall et al. 2007

threshold shift (PTS or non-recoverable hearing loss) and TTS are applicable to single detonation events that do not result in repeated exposures to noise. Since auditory effects have not been shown to be associated with the size of the animal, specific threshold levels can be used.

However, repeated exposures to noise resulting from consecutive detonations of explosions may result in different threshold levels, this does not typically occur and is limited to some types of military testing and training exercises and special blasting requirements of some construction projects. Longer durations to noise exposure may result in greater magnitude effects on animals, and may require additional consideration when conducting a risk assessment. In general, longer duration noises have a greater likelihood to result in hearing loss, than shorter, impulsive noises of the same intensity.

Some specific models have been developed for some activities using these criteria (e.g., explosive removal of offshore oil and gas structures in the Gulf of Mexico) and are discussed elsewhere (Dzwilewski and Fenton 2003). When deciding which criteria to use, each threshold level must be calculated to determine the more conservative criteria that yields the larger zone of influence. NMFS currently recommends that the SEL be estimated to account for the total energy produced during detonations; however, peak pressure is also acceptable. In cases where empirical data exist, dual criteria exist for the impact threshold. If SEL levels are not used, the equivalent dB unit of measurement used should always be clearly reported.

Summary of Threshold Criteria
These criteria may be used to establish impact zone areas in which probable impacts can be expected, and appropriate mitigation measures designed to avoid or minimize the risk of harm to protected species. A discussion of the calculations conducted for these criteria are provided in the environmental impact statement prepared for the shock trial of the *Mesa Verde* (Department of Defense 2008). NMFS regards these criteria (Table 3) as the preferred approach to estimating impacts on sea turtles and marine mammals; however, potential impacts to sturgeon and the smalltooth sawfish are more difficult to quantify by discrete threshold levels and is dependent on the size class and/or life history stage of fishes in the project area. Additionally, many project planners often do not have the necessary information on the project to model the required distance at which the thresholds are realized. In absence of all the information necessary to complete the calculations, reasonable assumptions may be necessary to model shock wave propagation and determine dual criteria thresholds for protected species.

With information on the noise characteristics of the detonation and species affected, accurate estimates of impact zones can be determined for sea turtles and marine mammals. Some limitations of the criteria include assumptions about the propagation of shock waves, depth of charge, and variations in propagation environments at different project areas. Although specific threshold criteria can be set for protected species, modeling of threshold levels from explosions may be limited by modeling capabilities, and conservative assumptions regarding impact zones and potential effects to species may be needed. Because there are many other variables to consider, NMFS may request field verification measurements to be made prior to establishing final zones of influence when a large degree of uncertainty exists.

4.2. Unconfined Blasts
Unconfined or open-water blasts include a wide variety of explosives uses for construction, demolition, and other marine projects. For unconfined blasts, precise injury zones cannot be calculated without calculating pressure measurements. These equations are considered very conservative; and, therefore, are acceptable for protected species mitigation during project planning. Young (1991) developed predictive equations based on observed safe ranges (radius) from a detonation, and be used to predict the danger zone for protected species:

$$\text{Fish Danger Zone (ft)} = 95\ (\text{fish weight in lb})^{-.13}(\text{max lb/delay})^{.28}(\text{depth of charge in ft})^{.22}$$

$$\text{Sea Turtle Danger Zone (ft)} = 560\ \sqrt[3]{\text{max lb/delay}}$$

$$\text{Calf Porpoise Danger Zone (ft)} = 578\ (\text{max lb/delay})^{.28}$$

$$\text{20-ft Whale Danger Zone (ft)} = 327\ (\text{max lb/delay})^{.28}$$

The equation to estimate danger zones for fishes is based on data from open-water blasts in shallow water. Although it is based on a limited range of conditions, the equation is appropriate for sturgeon due to their association with riverine and coastal shallow-water habitats. Although the above models are based on observed safe ranges from an explosion where no apparent injury or mortality was observed, they do not precisely predict differing levels of effects within the range between the detonation point and safe distance (e.g., the specific distances in which mortality and injury are expected are not known). However, these models are very conservative predictors to avoid serious injury and mortality. NMFS considers the equations developed by Young to be very conservative at avoiding serious injury and harassment. Although they were not developed to predict distances to avoid non-serious injury (PTS), these effects of PTS may be found within these conservatively estimated danger zones.

Many variables are often unknown in planning phases, and these models are useful for predicting safe ranges to avoid mortality when more precise harassment zone modeling cannot be completed. NMFS may request an estimation of these zones of influence for section 7 consultation under the ESA, or when applying for an incidental harassment authorization under the MMPA if determined to be necessary. In such cases, a conservative estimate of a non-serious injury and harassment zone should be estimated based upon available information from similar projects or field measurements. If sufficient information is available, a more rigorous analysis of environmental impact modeling for zones of influence should be completed.

Example 4.2
A hypothetical demolition project plans to remove an existing two-lane causeway and construct a new six-lane causeway over an estuarine bay. A total of 8 blast events will be conducted over a 30-day period. For one detonation sequence, a total net explosive weight (NEW) of 200 lb (60-lb, two 50-lb, and a 40-lb charge) will be detonated with three 25 ms delays between each detonation. The charges will be detonated at a depth of 20 ft to sever support structures for removal. The species occurring in the project area and information for the detonation sequence appears in the table below.

Species in Project Area	**Abundance in Bay (0)**	**Charge Weights/Series (lb)**	**Max. NEW/25 ms Delay**
Gulf sturgeon	60	40	60
green sea turtle	3	50	
Kemp's ridley sea turtle	2	50	
loggerhead sea turtle	18	60	
bottlenose dolphins	37		

Subadult Gulf sturgeon utilize the project area during the scheduled blasting activities of January-February. Subadult sturgeon foraging in the area have weights ranging from 0.7 lb to 5.3 lb (Clugston et al. 1995).

Example Calculations
The equations to predict the danger zone for fishes, sea turtles, and dolphins to mortality and serious injury can be solved for each species by:

$$\begin{aligned}\text{Fish Danger Zone (ft)} &= 95\,(.70)^{-.13}(60)^{.28}(20)^{.22}\\ &= 95\,(1.05)(3.15)(1.93)\\ &= 95\,(6.38)\\ &= 606\text{ ft}\end{aligned}$$

$$\begin{aligned}\text{Sea Turtle Danger Zone (ft)} &= 560\,\sqrt[3]{60}\\ &= 560\,(3.91)\\ &= 2{,}192\text{ ft}\end{aligned}$$

$$\begin{aligned}\text{Dolphin Calf Danger Zone (ft)} &= 578\,(60)^{.28}\\ &= 578\,(3.15)\\ &= 1{,}821\text{ ft}\end{aligned}$$

In the above example, the Gulf sturgeon danger zone (606 ft) is much smaller than that predicted for sea turtles (2,192 ft) and dolphins (1,821 ft). For sea turtles and dolphins, size of animals and depth of charge are not needed to solve the equation because they are based upon observed safe ranges. Although this may be convenient to solving the calculation, the resulting danger ranges for sea turtles and dolphins are conservatively large as a result. The danger zones predicted for sea turtles and marine mammals using these equations for explosive charges < 1,000 lb result in quite larger distances than those calculated using the energy and pressure criteria, and often approximate, but are slightly more conservative than, harassment zones predicted by the dual criteria thresholds for TTS. However, additional distances may be needed to account for these potential effects if they are determined to be beyond the danger range.

Visually Observable Species
For visually observable species, the size of the area to be monitored is usually determined by the species affected over the largest area, which in the above example are sea turtles. When estimations of zones of influence are necessary using the equations developed by Young, it may be desirable to compare the zones of influence predicted with the safe range equations with similar projects that have calculated more precise zones of influence for sea turtles and marine mammals using the dual criteria thresholds (Table 1). Field measurements are desirable requirements of operation plans of common types of activities to verify the predicted zones of influence.

Species Not Visually Observable
The most sensitive size class is accounted for by using the lowest mass of subadult Gulf sturgeon in the area (0.70 lb). Since sturgeon cannot be effectively monitored by visual observers, physical barriers, bubble curtains, or reducing the NEW of the charge might be considered by project planners. If such measures cannot be effectively deployed, seasonal restrictions may be an appropriate measure to avoid potential mortality altogether. The Young equation is considered appropriate for Gulf sturgeon because it was developed based on data for shallow-

depth, open-water explosions. In addition to their common association with shallow-water habitats, sturgeon generally spend most of their time on the bottom, where fishes are less vulnerable from open-water explosions (Young 1991), but not necessarily from buried charges. However, this open-water equation conservatively estimates safe ranges for species of sturgeon. It is important to note that as depth of the charge increases or the mass of the fish decreases, the distance of the safe range from the explosion will increase for a charge of equivalent NEW. Keevin and Hempen (1997) provide a thorough summary of other models to estimate lethal zones for fishes when additional parameters are known.

In summary, NMFS' Southeast Regional Office considers these conservative equations sufficient for mitigation planning purposes to avoid injury and mortality when more precise calculations of zones of influence cannot be completed. Additional considerations of impacts associated with non-lethal injury and harassment may be necessary, and may be dependent on the details of the project.

4.3. Confined Blasts Using Stemmed Charges

Confined blasts in boreholes are a method in which the explosive charge is placed in a borehole and capped with an inert material such as angular rock or crushed stone. Confined borehole blasting or stemmed charges are used primarily during channel and harbor deepening. Confined blasts increase the work done by the explosives while decreasing the amount of pressure released into the water column (Hempen et al. 2005, Nedwell and Thandavamoorthy 1992). Detonations in open water will produce both higher amplitude and higher frequency shock waves than contained detonations; thus, the technique of stemming charges results in reduced pressures and lower aquatic organism mortality than the same explosive charge weight detonated in open water (Hempen et al. 2007, Nedwell and Thandavamoorthy 1992).

The inert material must be irregularly shaped since regularly-shaped materials may be expelled during detonation and will not effectively "dampen" the blast wave. To be effective, the stemming material should be within 1/20 to 1/8 of the borehole diameter. The stemming material is not acceptable if it contains more than 10% fines (smaller than 1/20 of the borehole diameter). Stemming material should be placed at a minimum vertical length of three borehole diameters above the placed charge within sound rock or concrete. Since this approach has been based on specific measurements of underwater rock blasting projects, blasting methods that do not follow established methods for confined blasting should use an unconfined blast model to determine the appropriate impact zone or estimate zones of influence, such as that provided in section 4.2 above, or conduct field experiments to measure pressure and energy propagation from the specified blasting method so that new models may be derived.

The following equations are recommended to estimate the zone~~s~~ of influence for confined, stemmed charges (Hempen et al. 2007, Jordan et al. 2007):

Danger Zone Radius (ft) = $260 \sqrt[3]{\text{lb/delay}}$

Harassment Zone Radius (ft) = $520 \sqrt[3]{\text{lb/delay}}$

Watch Zone Radius (ft) = three times the distance of the mortality and injury zone

Example 4.3

Using the same blast scenario provided in example 4.2, but with confined, stemmed blasts instead of open-water, the zone of influence equations yield:

Danger Zone Radius (ft) $= 260\sqrt[3]{60}$
$= 1{,}018$ ft

Harassment Zone Radius (ft) $= 520\sqrt[3]{60}$
$= 2{,}036$ ft

Watch Zone Radius (ft) $= 3(260\sqrt[3]{60})$
$= 3{,}054$ ft

Based on studies to date (Hempen et al. 2005, Nedwell and Thandavamoorthy 1992), the above equation is believed to be highly conservative in estimating zones of influence for protected species, and mitigation based on this model has been tested in the field (Jordan et al. 2007). A limitation of this model, as with the above open-water blast equations, is that it does not estimate threshold levels for various types of effects from a confined blast, but estimates a conservative safe range from injury and mortality for all species. Although there would be a greater risk of mortality the closer an animal comes to the point of detonation, the distance is conservatively protective since both injury and mortality are assumed to have an equal chance of occurring if an animal were within the danger zone.

Hempen et al. (2007) estimated a mortality zone for fishes based on a low lethal level of 40 psi for stemmed charges. NMFS believes this level may be appropriate for larger size classes of fish, but not for smaller size classes (see Figure 2). If only large animals are found in a project area, the 40-psi criteria may be appropriate. NMFS recommends the equations above be used for estimating impacts to all size classes during project planning.

5. Assessing Impacts to Protected Species

Analytical frameworks are useful decision-making tools for protected species management. Analytical frameworks can be used to break down, or deconstruct, an activity into individual components, identify the potential effects of the noise components in the environment, and determine the level of risk posed by the noise-producing activity (Figure 4). Each noise component can be characterized by considering many factors such as the propagation characteristics of the noise, the environmental characteristics and habitat type, and species found in the area. Once all the important variables of the action and species are considered, a risk

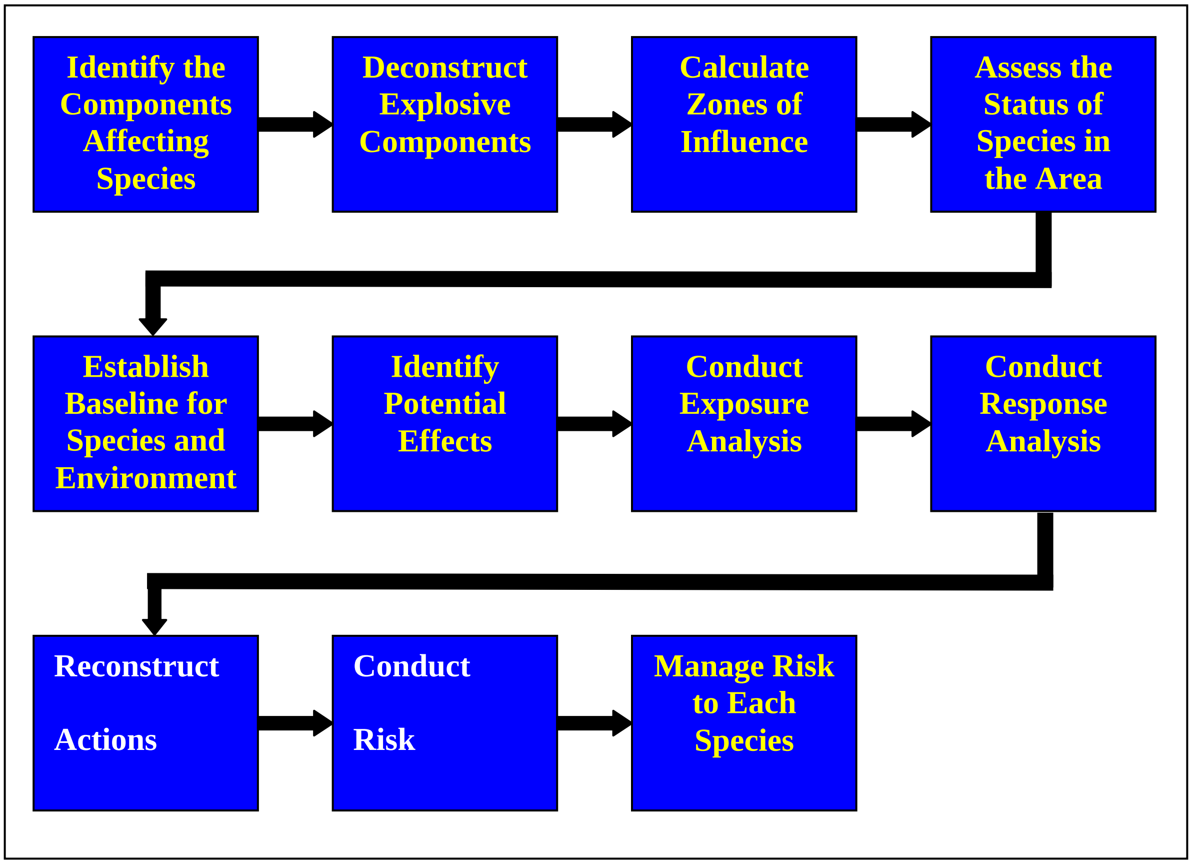

Figure 4. A general analytical framework to assess risk to protected species from explosions.

assessment is performed to determine the probability of undesirable effects occurring, and any measures to minimize or avoid those effects can then be considered.

Analytical frameworks utilize mathematical models or conceptual approaches to assess the potential risks to different species. The types of effects routinely considered include the potential for injury or death, the potential for harassment to occur, and habitat effects resulting from the activity. Information on any protected species in the project area is needed to properly assess any potential impacts. Information such as species abundance, animal behavior, hearing abilities, habitat characteristics, critical habitat designations, and other available information in the project area need to be considered. For example, a project can be deconstructed into its main components such as time of year, project duration, charge weights, number of explosions per day, and other variables (see *Summary of Information Needed* section below). Noise from the project can further be deconstructed into pressure units (psi) and dB units (EFD). Using the threshold criteria or models discussed in previous sections, zones of influence can be calculated to determine probable effects to protected species or critical habitat. For any effects that need mitigating, a number of different mitigation tools may be used to avoid or minimize impacts to protected species and their habitats.

Information Needed to Assess Impacts

A complete description of the activity and an assessment of impacts to protected species from explosives should be submitted with a request for consultation or incidental take authorization to NMFS. NMFS may also consider other actions associated with the use of explosives that may affect protected species such as vessel traffic, dredging, construction noise, effects on habitat quality, and other potential effects of the action. Any additional activities that may result in impacts to protected species or those identified in consultation with NMFS should also be identified. An analysis of all activity components that may affect protected species should be conducted, and those resulting in potentially adverse affects identified. For explosives use, a detailed blasting plan should be submitted with, or integrated within the impact analysis for a particular activity. The information needed for NMFS to assess activities using explosives includes:

- A description of the types of targets or structures on which explosives will be used;
- The type of explosives used;
- Details of the use of delays, stemming, charge placement, and depth of detonation;
- The total number of detonations or detonation sequences for the project, and number per day;
- The maximum explosive weight detonated per 25 ms period for each detonation sequence;
- The number of delays used and delay time for each detonation sequence;
- The time of year (months) the blasting is planned; and
- The total number of days blasting is expected to occur;
- A description of habitat in which explosives will be used including depth, salinity, water temperature, substrate type, and biota;
- A description of protected species and habitat in the project area;
- A summary of potential effects to species and habitat from the activity;
- An estimation of the zones of influence to protected species indicating the method by which they were calculated. Models and mitigation methods may be approved on a case-by-case basis, or as new information becomes available regarding blast modeling or exposure criteria for protected species;
- An analysis of effects to protected species;
- An analysis of effects on protected species habitats and primary constituent elements (PCEs) of any critical habitat, if designated in the project area;
- A proposed mitigation/monitoring plan for the project; and
- Observer qualifications

A well-prepared blasting plan can partially fulfill the recommendations for biological assessments (BAs) and environmental assessments (EAs). Guidelines on the preparation of a BAs and EAs, and information regarding section 7 consultation can be found on the Southeast Regional Office web site at http://sero.nmfs.noaa.gov/pr/pdf/BA_guide_comboeh081105.pdf.

Information regarding applying for an incidental take authorization under the Marine Mammal Protection Act may be found at http://www.nmfs.noaa.gov/pr/permits/incidental.htm.

6. Measures to Reduce the Risk of Harm to Protected Species

Environmental mitigation should be a part of every blasting plan and include appropriate measures identified in the risk assessment for the species and habitats found in the project area. For common activities requiring explosives, such as oil and gas structure decommissioning, some standard recommendations have been developed in coordination with NMFS. A "suite" of measures that applies to all the protected species found in a project area is desirable for flexibility in project planning, as well as for species-specific management needs. Because fish are not readily observable, visual surveys alone cannot avoid impacts; therefore, additional mitigation should be considered when protected species of fish are present in a project area. The suite of measures below should be considered when preparing protected species mitigation measures for blasting plans. Implementation of these measures does not necessarily ensure that all impacts will be avoided. Project-specific recommendations may be discussed during consultation with NMFS.

1. Establish zones of influence based upon protected species found in the project area, using an appropriate model.

2. The lowest NEW per detonation should be used to complete the work for a particular construction, severance, or demolition activity. Using smaller NEWs is associated with smaller impact zones where protected species (listed species and marine mammals) could be harmed. Shaped and fracturing charge designs are being developed and refined by the demolition industry that increase the efficiency of the work, resulting in smaller NEWs than for "bulk" charges. Water gel explosives have a lower detonation velocity, generating less shock energy than some other high-detonation velocity explosives (e.g., dynamite) and have lesser impacts on aquatic animals.

3. The use of delays should be maximized between individual blasts to separate the total NEW into a blast episode, creating a series of discrete, consecutive blasts. A blast episode consists of a single blast or a series of blasts that are detonated with a delay to lower the overpressure at a received distance in the environment. Discrete detonations using delays effectively reduce the zones of influence. For delay intervals less than 25 milliseconds (ms), NMFS recommends that zones of influence for protected species be estimated by calculating the distances for the summed explosive weight detonated per 25 ms period.

4. The use of bubble curtains, physical barriers, and other mitigation techniques to dampen the shock wave from detonations should be considered. The effectiveness of mitigation techniques may vary depending on the environment (e.g., currents and water depth), number and NEW of the explosives used, and other project details. Bubble curtains dampen or attenuate the sound transmitted through the bubble curtain. A bubble curtain for explosives may consists of shock-resistant materials at various depths and distances from an explosion. The bubble curtain should be effective at reducing pressure to levels below those resulting in harm to the species found in the project area.

5. The perimeter of impact zones should be established and demarcated (e.g., with landmarks or brightly colored buoys) for visual reference when conditions permit. Land- or ship-based observations may use binoculars and the naked eye to monitor the zones of influence. Fixed focus, vector binoculars are useful to establish distance from the project site and identify species. When aerial surveys are proposed, an aerial survey plan should be submitted to NMFS for approval with the mitigation plan.

6. Qualified observers should be used that have completed an approved training program to monitor the zones of influence. Each observer should be equipped with a two-way radio dedicated to protected species communication, polarized sunglasses, binoculars, a red flag or other backup communication, and any necessary data recording equipment.

7. Monitoring should be conducted from the highest vantage point(s) and/or other locations that provide the best, clear view of the entire zone of influence. These vantage points may be on the structure being removed or on nearby surface vessels such as crew boats.

8. A sufficient number of observers should be used to effectively monitor the established zones of influence under variable charge sizes and environmental conditions. The number of observers used may be dependent on numerous factors including whether aerial or vessel/shore-based observations are used, the size of the zones of influences, distance from shore, sea state, and observer fatigue.

9. For large zones of influence, or to augment visual observations, passive acoustic monitoring may be utilized to detect vocal species of marine mammals when animals are not readily observable at the surface. However, passive listening should not be used as a replacement for an adequate number of visual observers.

10. If divers are used during the demolition, they should be instructed to scan subsurface areas around the removal site for the presence/absence of protected species during the course of removal operations.

11. The chief observer should have authority to immediately halt activities should a protected species be observed within the impact zone, or is in the watch zone and in imminent danger of injury by heading toward the impact zone.

12. Surveys should be conducted before and after each blast episode. The duration and method of surveys should be determined in consultation with NMFS. Post-detonation observations are to start at the removal site and proceed in the direction of wind and current movement from the blast location.

13. Surface and/or aerial protected species surveys should be conducted in environmental conditions adequate for effective visual observation. Aerial surveys should be conducted during daylight hours and cease when marine conditions are not adequate for visual observations, or when the pilot/removal supervisor determines that helicopter operations must be suspended. Detonations should be delayed until conditions improve sufficiently for monitoring to be effectively completed.

14. When a protected species is sighted or heard within the impact zone, detonations should be postponed until it is verified to be outside of the impact zone.

15. Blasting should be limited to daylight hours (between one hour after sunrise and one hour before sunset). If pre-detonation and post-detonation surveys are to be conducted, pre-detonation surveys shall not begin prior to sunrise and detonations must not occur if the post-detonation survey cannot be concluded prior to sunset.

16. Detonation of scare charges to intentionally harass sea turtles or marine mammals into leaving a project area is prohibited. Scare charges using detonation cord are potentially harmful to fishes (California Department of Fish and Game 2002) if the mass of the explosives is not considered. In some cases, scare charges may be necessary to reduce the risk of mortality to sturgeon and smalltooth sawfish in the immediate area of a blast. Detonation caps not exceeding 0.5 g (Collins et al. 2001) may be approved on a case-by-case basis for use as scare charges for sturgeon and smalltooth sawfish. Scare charges not exceeding 0.5 g are also recommended to avoid the attraction of marine mammals, sea turtles, and piscivorous fishes that are stunned or wounded by the scare charge.

17. All protected species entering the impact zone should be allowed to move out of the area under their own volition. Enticing marine mammals to bow-ride or intentionally harassing animals into leaving the area is prohibited.

18. All "shock-tubes" and detonation wires should be recovered and removed after each blast.

19. The chief observer should submit a post-project report within 30 days of completion of the project to the permitting agency. The report should include project information, including but not limited to, a description of the project and explosives used, survey information, environmental conditions, and observations of protected species. Reports should be available to NMFS upon request.

20. Report dead or injured protected species to your local stranding network contacts. A list of sea turtle stranding responders is available at http://www.sefsc.noaa.gov/seaturtleSTSSN.jsp.
    A list of marine mammal stranding network responders for each state is available at http://www.nmfs.noaa.gov/pr/health/networks.htm or may be reported to the marine mammal stranding hotline at 877-433-8299.
    All other dead or injured protected species should be reported to NMFS' Southeast Regional Office by telephone at (727) 824-5312, or by FAX at (727) 824-5309.

Additional Considerations

The following mitigation measures may be recommended under some circumstances to avoid impacts to important habitats and behaviors of protected species.

1. Avoid blasting techniques in regions that may affect any primary constituent elements of critical habitat designated for a listed species.

2. When blasting in inshore habitats, blasting should be conducted at low tide, above the water line to reduce the transmission of energy into the water column.

3. Sequence work to minimize impacts to biologically important areas such as migration corridors, important foraging areas, spawning habitats, near nesting beaches, calving areas, or in juvenile or developmental habitats protected species. These considerations may involve temporal or seasonal considerations when blasting in biologically important habitats.

4. No debris from the blasting operations should be left on the seafloor unless the structure is to be decommissioned as an artificial reef. The amount of debris scattered by blasting should be minimized to the greatest extent practicable (e.g., the use of blast mats). Methods should be used to minimize benthic and habitat disturbances such as removing structures below the mudline, use of blasting mats, and removing debris off the seafloor with appropriate methods, and in consultation with NMFS.

APPENDIX B-2

STANDARD OPERATING PROCEDURES FOR HOVERCRAFT OPERATIONS

STANDARD OPERATING PROCEDURE – HOVERCRAFT OPERATIONS

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) is intended for use with the 4-seat Neoteric Hovertrek™ hovercraft.

This SOP is to be used in conjunction with the manufacturer's operation and training manual, the site-specific Activity Hazard Analysis (AHA) which considers hazards of the location and conditions in which the craft will be operated, and any other project-specific requirements.

This SOP follows the Hovercraft Training Centers' (2006) *Hovercraft Pilot and Maintenance Training Manual*. A copy of this manual will be available onboard the hovercraft.

1.1 GENERAL REQUIREMENTS

Hovercraft operating on waterways (lakes, rivers, near-coastal waterways, etc.) are regulated as boats under the jurisdiction of the United States Coast Guard (USCG) and must comply with USCG rules and regulations. When operated on land, depending upon location (e.g., public roadways), they may be subject to jurisdiction of the United States Department of Transportation (USDOT) rules and regulations. Boating requirements have been incorporated into this SOP as applicable.

The 4-person hovercraft has an overall length of 13 feet, 8 inches when on cushion and 12 feet overall length when off cushion.

The operator shall be responsible for the safety of all personnel on board the boat he or she is operating and for the integrity of all hovercraft and safety equipment.

1.2 OPERATOR TRAINING REQUIREMENTS

Personnel who operate hovercraft must have the following training and qualification:

- **All hovercraft operations**
  - Must have successfully completed a hovercraft operation training course from a qualified training provider and be familiar with the operation of the specific craft being operated.
  - Do not carry passengers until you have at least 5 hours of hovering experience.
  - Must be designated by Tetra Tech Project Manager as the hovercraft operator for the project.
  - Hovercraft operators shall possess basic knowledge to troubleshoot common mechanical problems that can occur onboard.

- **On-water operation**
  - Must have successfully completed a USCG-approved boating safety training course.
- **On-land operation**
  - If operating on or crossing public roadways subject to USDOT jurisdiction, must have valid state-issued driver's license and proof of insurance (*at a minimum; other requirements may also apply*).
- **Towing Trailer**
  - The person responsible for towing the trailer and hovercraft will either be the qualified hovercraft operator or another person designated by the Project Manager with experience in towing.
- **Hovercraft Occupants**
  - Each designated hovercraft operator shall give a safety briefing to hovercraft occupants prior to launch. Hovercraft are to be occupied during use by not less than one qualified operator plus one additional person. In the event that the "additional person" is not a qualified hovercraft operator, a basic safety and operations demonstration will be conducted before launching.

2.0 INSPECTIONS

2.1 PRE-OPERATION INSPECTIONS

Prior to each hovercraft operation, a pre-operation inspection will be performed by the hovercraft operator. The trailer (when used), cover, and hovercraft will be inspected in accordance with the following checklist. If deficiencies are found during inspection or startup, the deficiency will be documented and corrected prior to operation of the equipment.

2.1.1 Trailer

1. Tire pressure in all three tires should be 55 pounds per square inch (psi) (37,900 pascals [Pa]); the same for the hover on/off trailer.
2. Check swing arms to ensure they will stay open. Tighten if necessary.
3. Rock wheels from side to side to check bearings. There should be a slight looseness. Make sure that wheel bolts are tight and always carry a wheel wrench in the tow vehicle.
4. Lubricate winch, hitch, hitch ball and rollers with SAE 30 oil or WD-40. (This is best done with the hovercraft off the trailer.)

2.1.2 Cover

To remove the cover when the hovercraft is secured to its trailer:

1. Undo at front and pull out the cover's lower edge until all rope slack has been used up.
2. Remove rubber bungees, one from each side.

3. Undo and remove ratchet tie down at rear and open swing arms to clear skirts.
4. Lift hitch end of trailer holding winch, undo ratchet and slack off winch rope until craft begins to slide backwards off trailer. NOTE: If the winch handle starts to rotate, never try to grab it as serious injury can occur.
5. Slide hovercraft backward about 6 inches (15.2 centimeters [cm]) and engage winch ratchet; lower trailer hitch.
6. Remove cover by lifting over craft's front edge. Roll cover back from the front and release cover off the buckets. To replace the cover, reverse this process. Reinstall stern first. NOTE: Depending on cover design, it may not be necessary to include steps 4 and 5.

2.1.3 Hovercraft

1. While the craft is on trailer, inspect and repair any under hull damage.
2. Remove gas tank(s) if fitted with fuel line disconnects and fill with 92-octane gasoline and 2-cycle snowmobile oil mixed 40:1. Use TCW3 NAMMA Standard 2 cycle oil.
3. Replace tank(s) and connect gas gauge sender wires. Check battery connections are tight.
4. With the hovercraft sitting on the ground, lift the bow about 2 feet (61 cm) using the front segment air supply holes as handgrips. Drop the craft and simultaneously step backwards. This will puff the skirts and any improperly fitted segments will deform. Repair as necessary.
5. Remove bucket bungees if fitted and store with trailer ratchet tie down.
6. Visually inspect controls (throttle, choke, rudders and reverse buckets) for freedom of movement. Correct any faults.
7. Detect and remove all loose objects within the hovercraft such as tools, rope, broken bolts, goggles, empty cans and even socks or a piece of rag. If a bolt is discovered, its source must be located and any problem repaired. Check belt tension: force of 10 lb. in (4.5 kg) center of belt should produce about 1/8 inch (3 millimeter [mm]) deflection. Re-shim if necessary. Belt should be 50 mm wide (narrower on Poly Grip belt [36 mm]) (62 meters wide for 100 horsepower [hp] craft) and must run toward the rear of the hovercraft, with very slight pressure against the sprocket sheave.
8. Look for unusual wear or excessive rub spots or for fretting at joints. Make sure all bolts are properly tightened. Make a mental picture of wear and compare again when next inspected for possible deterioration; be very observant.
9. Check fan blades for unusual nicks or damage. Fan blades can be sanded smooth with 40-grit sandpaper when necessary.
10. Using recoil starter, pull engine over once or twice and note any scraping, sticking, or unusual sounds. (Not possible for 100 hp craft.)
11. Raise rear navigation light to operating height.

12. Unscrew gas tank vent(s) counter (anti) clockwise until firmly locked open. (These can vibrate closed and cause engine failure.)
13. Brush grass and dust from the engine air filters.
14. Remove leaves, grass, etc. from the engine and fan intake meshes.
15. Ensure carburetor settings are correct for the elevation and air temperature where vehicle will be operated.
16. Ensure hull drain plug is tight. Replace or repair any damaged or defective part, component, or machinery and re-glass any holes in the hull.
17. Repair any damaged skirt segments.
18. Make sure craft is free of loose objects and remove small stones, grass, leaves, snow, etc., from within craft, from intake mesh, and from around engine cooling system and exhaust system. If operating in sub-freezing conditions spray fan, mesh and bell with anti-freeze or "PAM" oil to prevent ice build-up.
19. Visually check, from time to time, for any damaged bolts, fasteners, components, parts and for signs of joints fretting or coming loose.
20. Tool kit, spare skirts, ties, fuses, and a 20 ft. (5-meter) length of rope are on board. Additional emergency equipment as required by USCG and/or EM-385-1-1 (for projects that require compliance with this manual) also must be onboard and be in serviceable condition.
21. Some hovercraft are equipped with a telescopic boat hook and paddle. Remember that on craft equipped with a battery box, the lid can be used in an emergency as a paddle.

2.2 POST-OPERATION INSPECTION

1. Remove all loose equipment such as coolers, towels, etc.
2. Disconnect hovercraft from towing vehicle, remove drain cap or plug. Close gas vent(s) during washing; elevate trailer so rear skirts of hovercraft sit on the ground. Six-passenger craft must be propped up for washing. Do not leave unattended in this altitude for a prolonged period or in windy conditions. If using a hover on/hover off trailer, remove the craft from the towing vehicle and raise hitch for drainage purposes. Wash the hovercraft while on trailer.
3. Wash entire hovercraft with soapy water using a rag or sponge. Spray off and wipe down using a chamois. During this entire process, pay great attention to inspection of every part of the hovercraft with the purpose of discovering potential problems. A power car wash will speed the cleaning process but is not so useful for inspection purposes.
4. Correct any excessive wear, rubbing, loose bolts, broken or frayed wires, etc.
5. Open gas vents when finished.

2.3 REGULAR MAINTENANCE AND INSPECTIONS

The manufacturer's user manual shall be consulted to determine the frequency and types of routine inspection and maintenance and specific maintenance to be performed in addition to this SOP which identifies the basic inspection and maintenance requirements. An example Operations and Maintenance Log has been developed and is included as Attachment 1 to this SOP. The maintenance log for each craft should be a permanent component of the craft records and maintained in a chronological manner for each operation, inspection, and repair activity. The log may be maintained on Rite in the Rain® paper or in a logbook and is to be filled out by the operator.

According to the operations manual, the routine maintenance schedule should be followed as specified in this section in addition to the pre- and post-operation inspections listed above. Any repairs aside from routine maintenance will be by authorized personnel as recommended by the manufacturer.

Information and specifications for maintenance of the engine; lubrication of the engine, fan shaft and control bearings, torsion steering post, and trailer; specification for gasoline, oil, grease; procedures for changing of spark plugs, fuses, and other maintenance and repair activities; cleaning of the craft; as well as troubleshooting and diagnostics are specified in the operations manual and should be referred to before attempting repair, maintenance, or re-fueling of craft.

2.3.1 Five hour inspection

Following 5 hours of craft operation, thoroughly inspect all structure and machinery for damage, wear and tear, etc. Correct any faults and remove any debris from within the craft. If rudder, throttle, or choke cables are freezing up in cold weather, re-fill with silicon-based oil. Check belt tension 1/8 in (3 mm) deflection when a load of 10 lbs. (4.5 kg) is applied to center of belt. Re-shim engine to correct tension. Belt must run or track toward the rear sprocket sheave.

2.3.2 Twenty-five–Hour Inspection

Following 25 hours of normal operation, repeat maintenance as above. In addition, replace spark plugs, wash and re-oil air filter if necessary. Thoroughly check all bolts for tightness, mounts for cracks, rubber bushes for wear and replace all defective components or parts where necessary. Repaint exhaust system with black high temperature paint. Inspect control system; lubricate rear rudder bushings and oil bucket actuator push rods with SAE 30 oil if actuators are exposed. Grease fan shaft bearings every 25 hours using automotive quality grease.

2.3.4 Other Routine Maintenance

Maintenance of the machinery module consists of greasing the fan shaft bearings with axle grease after the first 25 hours of operation, then subsequently every 50 hours. Neoteric hovercraft on most models, have a small drain hole under the starter motor; after every 5 hours of operation, blast WD-40 inside this hole. This will prevent the starter motor brushes from sticking if corroded. Another plastic cap is fitted by Neoteric in the engine block just above the starter motor Bendix. Every 5 hours, open this plug and give three squirts of SAE 30 motor oil.

Operations in salt water mean extra care. On engines so equipped, remove the manual starter after 5-10 hours of operation and wash in WD-40 or kerosene, then oil internals with SAE 30 motor oil.

Belt tension and alignment can be adjusted using thin shims placed under the four 3/8 socket head cap screws holding the engine. Adjustment might be required after 50 hours if the craft has been operating in dusty conditions, as this can cause excessive wear to the small sprocket and belt. Tension must be firm but not drum tight. The engine is installed upside down, so spark plug access is difficult. Plugs must be removed and cleaned if full of oil. Screw-on plug caps must be tightened using pliers. Take care when installing plugs not to dislodge the cylinder head thermocouple sensors. Plug threads should be coated with anti-gall or anti-seize lubricant. Always check all mechanical components for fretting, for oil leaks or for any sign of loose fittings. Every 50 hours, check accessible bolts and fittings for tightness.

The intake filter box should be cleaned as per this manual every 20 hours, unless operated in dusty conditions when daily cleaning will be required. The electrical auxiliary mount plate is attached at the end of the inline seat or to the battery box. This is enclosed inside a neoprene splash enclosure. Mounted to this plate is the main ground, a terminal block, the voltage regulator and rectifier, a 30 amp master fuse; the starter solenoid and the fuel pump if so equipped. A no-maintenance battery is installed; note that the terminal lugs must be tight. Loose terminals can cause arcing, which can produce large voltage spikes; these can damage parts of the onboard electrical system.

Skirts must be kept in good condition; replace when frayed or torn. Skirts can be patched using similar weight fabric using an industrial sewing machine.

Lubricate all moving parts regularly and, after each outing, wash the hovercraft completely using a bucket of soapy water and a cloth. Not only is this a proper cleaning procedure but, more importantly, it serves as an inspection process; each part of the craft can be observed while hand washing. Often this is a good way to find loose or missing fittings. Hose off the soapy water. Some customers coat their hovercraft with a silicone wax and report improvements in the ease of cleaning. A chamois is useful for wiping off and will not damage the polycarbonate windshield. Fine rubbing compound or Brasso™ can be used to remove spots or scratches in the body. Any nicks or rough edges on the fan can be smoothed up using sandpaper.

2.3.5 Refueling

Refuel the hovercraft with manufacturer's recommended fuel mixture. Ensure that refueling is performed in a manner that reduces the potential for spills or releases to occur; including:

- Whenever possible, refuel over land (not on the water).

- Do not overfill the fuel tanks and allow enough room for expansion of fuel in the tanks.
- Inspect fittings, vents, caps, and other fuel system components regularly
- Refuel over portable drip pan and have sorbent pads handy to cleanup minor spills.
- Always attend the nozzle when refueling.
- Know your local and project-required spill reporting procedures.

3.0 HOVERCRAFT TRAILERING (LOAD AND UNLOAD) PROCEDURES

Maximum trailer speed is 70 miles per hour (mph) and tire pressures should be set at 55 psi. Always carry a spare wheel and tire, also inflated to 55 psi. Trailer loading and unloading is easiest accomplished on a smooth hard surface. Ensure the craft is not overloaded with equipment that will overload the bearings and axle weight capacity of the trailer or hovercraft.

3.1 LOADING HOVERCRAFT ONTO TRAILER

1. Remove the trailer from the towing vehicle and place it facing forward in front of the hovercraft. Open swing arms to allow maximum clearance.
2. Attach winch rope to the tie-down cleat on the bow. Encircle the cleat from above and winch from below the cleat. Be careful not to overload cleat (max. load 500 lbs.)
3. Lift the trailer at towing hitch end and take up slack in winch rope. Begin to winch the trailer under the front of the Training Hovercraft, making sure that the rear trailer pipe does not pinch skirting; make full use of trailer rollers. Ensure clutch is engaged on winch.
4. Continue winching while pulling down on hitch so as to engage rollers under hovercraft. Once rollers are under front hull of hovercraft pull hitch down, continue winching until second set of rollers engages the hovercraft skids; do not hold the craft at a steep angle for extended time, as fuel can drain from the gas tank vent pipe(s), etc. Never overload winch rope as damage can result. If the winch rope fails, the winching process is not being performed correctly. Do not replace rope with steel cable or heavy rope. The rope is designed to fail and protect the cleat from damage.
5. Winch until craft reaches the balance point then lower hitch to ground and winch all the way forward until front of craft is engaged in rubber pads on the trailer front stop.
6. If craft alignment is out, lift and slide rear of hovercraft until each swing arm fits properly atop the rear cleats and the skids are aligned with the rear rollers.
7. Place trailer ratchet tie down between swing arms and tighten. Craft and trailer are now ready for road travel.

3.2 UNLOADING HOVERCRAFT FROM TRAILER

1. Unhitch trailer and lower trailer hitch to ground.
2. Undo ratchet tie down and open swing arms; remove cover or bucket bungees.

3. Unhook winch ratchet, let out 6 inches of slack in winch rope. Re-hook winch ratchet and lift hitch until craft starts to roll backwards.
4. With hovercraft hanging on winch rope, unhook winch ratchet. Hold trailer in the air so as to encourage craft to slide back. Always hold winch crank handle. Stop and apply winch clutch before skirts catch on first cross member of trailer and lift skirts around ends of cross member. Release winch clutch and continue un-winching while trailer is pushed from under craft by the craft’s weight. The craft must roll on the trailer rollers. When the craft is about 3/4 the way off, the trailer must be pulled down until parallel with the ground. The winch clutch should not be engaged. Never try to catch the rotating winch lever if it gets free, as this can cause injury to hands. Allow the winch to spin freely. For the last 4' of unloading, hold the trailer horizontal with the ground and pull from under hovercraft. Allow the hovercraft to drop off the rear rollers. As the craft falls, push back slightly to prevent too rapid an egression of the trailer. This is very important to prevent skirt catching. If skirt catching occurs, the trailer is not being operated correctly.

4.0 HOVERCRAFT STARTUP PROCEDURES

1. Ensure fan guard and drain plug are both properly secured.
2. Open all gas tank vents.
3. Squeeze fuel line primer bulb until firm (might require 6 or more squeezes); close throttle; open choke; check kill switch button is connected; crank engine using right hand, or the key, while left hand holds the choke lever fully backwards. Do not crank for more than 5-7 seconds. If engine does not fire, investigate. When engine fires, quickly reach for the throttle and apply rapid rotation in bursts so as to keep the cold engine running. Judiciously release choke. If engine starts to die, reapply choke while rotating the throttle to ensure engine remains running. Hovercraft with fuel injection, these processes are not required. Start by engaging fuel pump.
4. Enter the craft by stepping over the front seat; if side-by-side seating, with the front seat all the way to the rear of the craft. Use safety hand holds on instrument panel.
5. Ensure lanyard switch cap (safety pull-off tether switch) is in place.
6. Twist throttle should be in the off position, otherwise chokes will not work.
7. Rotate choke lever to full “On” position and hold (required if engine is cold or has not been running for 30 minutes or more.) Fuel injected engines do not have a choke.
8. Turn start key (always use left hand) if craft is equipped with electric start or pull recoil starter handle until engine starts. You may need help holding the choke lever.
9. If engine fails to start, put choke lever off, prime once more, open throttle and continue to pull recoil starter or turn electric start key.

10. If engine starts and runs on one cylinder, try to throttle engine until other cylinder fires. It might require the reactivating of the choke. Idle speed for engine should be 1400 RPM (This is very important.)
11. If engine fails to start, remove plugs and dry spark plug electrodes if wet. After replacing plugs, repeat steps from 1 above. If engine refuses to start, refer to engine manual or an experienced snowmobile, ultralight or hovercraft mechanic.
12. Allow engine to warm up before developing full power. Do not apply full power until cylinder head temperature indicates 150ºF (66ºC). The exhaust gas temp gauge operates only when exhaust gas temp exceeds 600ºF (315ºC). If engine is warm (cylinder head temp above 150º F (66ºC), choking is not required for starting.
13. Always attach the tether switch to your person, but test kill switch while engine is running.
14. Before proceeding on an excursion, check that a life jacket for each person, a tool kit, spare spark plugs, fuses, pliers, spare skirt and at least 20 skirt ties and a 20-ft length (6-meter) of rope are on board. Attach kill switch lanyard to your person.
15. Hover on the spot to check hovercraft’s trim before taking off and assure that there are no malfunctions.
16. If the engine is a fuel injected type; there will be no choke. Turn the ignition key to on, turn fuel pump switch on then open the throttle until you hear a *Zizzzz* sound. This primes the engine. Then turn the key to activate the starter motor. As soon as the engine fires open the throttle, keep the engine running until it warms up. When stopping the fuel injected engine it’s important to turn the fuel pump off first then the key. This depressurizes the fuel rail.
17. Either engine can be started by hand if the battery is flat. Use the manual recoil start rope. In the case of the fuel injected engine there must be enough battery power to run the fuel pump even at a reduced pressure while you pull the recoil starter.

5.0 GENERAL HOVERCRAFT SAFETY PRECAUTIONS

The following are general safety precautions to follow when operating or riding in hovercraft. Additional requirements will be contained in the project safety plan and AHAs as required based on site-specific evaluation of hazards. Attachment 2 contains a list of minimum required safety and emergency equipment and recommended additional safety equipment to be onboard the craft.

1. For extended cruising, it is recommended to use foam type earplugs or earmuffs. If communications while travelling are required, Power Com wireless voice-activated headsets may be used. Craft generates approximately 83 dBA. *Note: Hovercraft can be a noise nuisance to wildlife and the public, especially at higher rpm. Be courteous in*

operation of hovercraft in sensitive environments and in public or recreational environments.

2. Hovercraft occupants operating on water will wear a USCG-approved Type II or better life jacket (personal flotation device [PFD]) that is orange in color.
3. Avoid wearing any clothing that may blow off or flap in the wind, such as visors or oversized shirts, loose draw strings, hats, scarves, glasses, etc. These items could be drawn into the engine or fan, causing damage or injury. Likewise, secure loose equipment and materials onboard the craft prior to starting up craft.
4. Special precautions should be taken, especially when on snow and ice or operating in cold conditions or colder waters:

    a. A person can live only a few minutes in near-freezing water, so an exposure suit is advisable depending on local conditions. A yachtsman's exposure suit is the safest and warmest garment available. Rescue immersion suits, such as Mustang suits, have proven their worth.
    b. Wear warm, insulated, waterproof gloves.
    c. Protect the face by wearing a ski mask or balaclava, wearing goggles, and using a breath deflector to keep fogging of goggles down.
    d. Snowmobile boots (or equivalent) with liners and thick woolen socks are advisable.

5. Wear appropriate tint safety glasses or goggles as appropriate to keep dust particles away from the eyes and keep sun glare down.
6. In warm weather, wear appropriate broad-spectrum sunscreen.
7. Never travel across unfamiliar terrain at high speed. Always keep speed at safe levels based on the terrain.
8. Avoid hovering on snow when it begins to build up on the craft and fills the skirts and ducting. Practice will be necessary in order for the operator to learn the best operating procedure for each type of snow condition. Use caution until familiar with terrain and snow types.
9. If the craft is operated in freezing rain where extensive ice build-up occurs around the fan and fan intake bell, spray with non-stick cooking spray such as "Pam" and, if ice has formed, use antifreeze or glycol.
10. Avoid rapid transitions from ice to water as this may cause the craft to "nose-in" or "plow-in".
11. Once you have stopped on water and shut the engine off, the skirt and side ducts will quickly fill with water. When restarting the engine, cautiously increase rpm and wait 10 to 20 seconds until all water is purged from the ducts and skirting before accelerating.

12. If re-entering the craft from water, lift yourself over the side body using the safety grab handles for support, or catch hold of a side-by-side seat if so equipped. Personnel in the craft may assist as necessary.
13. When operating over ice, snow, or pavement at higher speeds, never execute rapid turns as this can cause the craft to suddenly become airborne. If you should feel the nose begin to lift move forward and at the same time, very slowly reduce the throttle to slow down. Note: Tetra Tech operation of hovercraft is not for thrills; operate at safe speeds at all times.
14. Power is control - If you want to accelerate, stop, turn, side slip, or go backwards, it takes a lot of power. It's important to throttle up to maximum power when performing these maneuvers. (See the engine fan power curve in operations manual.) As a general rule, it is always wiser to add power rather than to reduce it!
15. If running at night, all required navigation lights will be present and operable and onboard navigation equipment may be required to comply with USCG regulation (on water). Night operations will be addressed further in site-specific safety plans and AHAs if required. Typical projects will only operate hovercraft until ½ hour before sunset and ½ hour after sunrise.
16. If project will require hovercraft to travel to remote areas over water, each designated craft operator will file a written float plan in accordance with the USCG regulations and file it with the Project Manager or other designated representative. An example USCG Float Plan is included in Attachment 3.
17. Maintain sufficient fuel for the outing. Use one-third of the fuel to get to the destination, one-third to return, and keep one-third in reserve.
18. Monitor weather forecast before the outing and regularly during outing to avoid potentially severe weather and allow sufficient time to seek shelter in safe location.
19. When operating in restricted waters, near shipping channels, in rough fast flowing water or near obstacles that could damage or capsize the craft, plan for emergency rescue in case the motor falls or you become incapacitated from operating the craft and you are in personal danger. Include potential rescue means and methods in your health and safety plan and AHA.

5.1 HOVERCRAFT LIMITING CONDITIONS

The following manufacturer specified limitations apply to operation of the hovercraft. Note: Other conditions as identified on a site-specific basis per the hazard analysis may dictate other limiting conditions for operation of hovercraft or operation at less than the thresholds listed below to provide for safety of crew.

- Do not operate hovercraft when wind speeds are greater than 25 mph over hard surfaces or over a Beaufort Scale force 5.

- Do not operate hovercraft when waves are greater than 2 feet chop, otherwise World meteorological Organization (WMO) code 3.
- Do not operate hovercraft when ambient temperatures are below -30ºF or above 110ºF.
- Do not operate hovercraft on slope-gradient that exceeds 1 in 6 (16.7% slope) based on standing start, smooth surface, 400 pound payload, 65 hp engine. Safe work on slopes will be evaluated and calculated on a site-specific basis.
- Not intended for routine “on-road” or on pavement use.

5.2 SITE-SPECIFIC LIMITING CONDITIONS FOR SURVEY

- The launching and boarding sites to be used for the TEMA-Lite will be locations that are currently accessible by road and currently used to launch and recover kayaks and paddle boards.
  - At MRS 03, the sand beach areas of Flamenco will be used;
  - At MRS 12, the sand beach areas of Tamarindo Bay will mainly be used.
- Due to the challenging and complex nature of the site, a procedure for determination of the appropriate DGM configuration, deployment, and altitude of flight has been developed. The TEMA DGM Decision Tree (next page) clearly presents what steps must be taken, and which conditions must be met in order to proceed with either the vessel-towed TEMA-MK3 or the hovercraft-deployed TEMA-Lite.
- This TEMA DGM Operations Decision Tree will be utilized each day and results recorded in the log sheet.
- Surveys will be conducted in the shallowest areas at high tide and will not be conducted in coral areas with less than 6 inches of water. No portion of the TEMA-Lite will have greater than a 6-inch draft when operating in areas with less than 1 foot of water. This determination is based on field conditions at the time of the survey. The areas that will be excluded will depend on many factors including:
  - Sea state
  - Wind
  - TEMA performance at the site
  - Marine mammal and sea turtle activity
- The minimum altitude over shallow coral is 6 inches.
- This will be determined by operating at high-tide within the shallowest areas which will provide for 6 inches of water. Work will proceed from deeper water to shallower water. This allows for the collection of bathymetry data from the TEMA-Lite altimeter, which can be used to determine areas that are likely to have less than a foot of water present.
  - ***The shallowest areas will only be attempted during high tide and flat seas.***
  - ***Clearance from the FOL is required when surveying over coral in less than 1 foot of water (this is recorded in the daily report).***


TEMA DGM OPERATIONS DECISION TREE
TEMA Survey Operations Determination
Water Clarity Sufficient >20ft?
No
Do Not Survey
Yes
Survey Area Water Depth <10ft?
No
Yes
Is Sea State / Swell Low?
No
Do Not Survey
Yes
Is Sea State / Swell Low?
No
Do Not Survey
Yes
Tall Corals Slopes >15deg?
Yes
Do Not Survey
No
Sand Bottom? Beach Area?
Yes
Survey with TEMA-Lite Hovercraft
No
Sand Bottom Present?
Yes
Survey w/TEMA MK3 as a sled
No
Is the Reef Exposed?
Yes
Try Again at High Tide
No
Sand Bottom with Seagrass Present?
Yes
Survey w/TEMA MK3 0.5-1m altitude
No
Survey with TEMA-Lite Hovercraft
No
Is the Reef Still Exposed?
Yes
Colonized Pavement Deep Reef?
Yes
Survey w/TEMA MK3 1-2m altitude
Do Not Survey

6.0 REFERENCES

Hovercraft Training Centers. 2006. Hovercraft Pilot and Maintenance Training Manual.

ATTACHMENT 1 – OPERATION AND MAINTENANCE LOG (EXAMPLE)

Date	Engine Hours Start	Engine Hours Stop	Cumulative Hours	Operation and Maintenance [1/]	Name
4 Apr 14	0	2	2	First test flight, Lake Washington. Used 2.5 gallons of gas. Checked spark plug color. Washed craft and stowed.	R. Funk
5 Apr 14	2	3	5	Performed second test flight, Ebey Slough. Used 2.9 gallons of gas. Wash and perform 5 hour inspection (no adjustments required). Removed small branch debris from fan housing area.	R. Funk

1/ Document any deficiencies found during inspections and maintenance, as well as any repairs or adjustments made.

ATTACHMENT 2 – MINIMUM REQUIRED AND RECOMMENDED SAFETY AND EMERGENCY EQUIPMENT

The following safety and/or emergency equipment is required to be onboard or intrinsic to hovercraft:

Over-water (includes USCG required equipment for powered watercraft less than 12 meters in length):

- Type II or better USCG-approved Type II or better PFD for every occupant in craft (worn). A positively buoyant wet or dry suite may be substituted for a PFD if worn. Type III PFD or automatic inflating PFD may be used provided they are approved in the project health and safety plan
- Flame arrester (backfire preventer) fitted to carburetor of gasoline engine
- Minimum 20-foot section of line
- Tool kit with screwdrivers, pliars, ratchet/sockets and spare parts such as skirts, spark plugs, skirt ties ties, and fuses sufficient for minor repairs and mechanical problems
- One air horn (unless craft is equipped with sound signaling device)
- One Type IV ring buoy (24 inches in diameter with 90 feet buoyant line attached to vessel.
- One 1-A:10-BC (minimum) fire extinguisher.
- A selection of pyrotechnic and non-pyrotechnic visual distress signals for day and night signaling
- Anchor with adequate line attached to boat.
- Electric bilge pump.
- Kill switch with tether to operator
- Sorbent pads and collection bag (in the event of small fuel spill in craft)
- Emergency hospital location and emergency contact list.

Work in Remote Areas

- A survival kit containing (at a minimum) – first aid kit, high-energy preserved foods, drinking water, blankets, heat source, signaling devices, and other contents as suitable to the environment as per the hazard assessment.
- Working two-way communication device (radios, cellular telephones, satellite telephone). Consider marine radio with channel 16 for working in and on navigable waterways.
- GPS unit, maps, charts, or other navigation equipment as per the hazard assessment.

Work after Sunset or Before Sunrise

- Navigation lights meeting USCG requirements. Hazard assessment may also require spotlight.
- GPS unit or other navigation equipment as per the hazard assessment.

Consider the following depending upon conditions

- DEET for insect repellant; sunscreen, extra layers of clothing, raingear, cold weather gear, a hat (with chin strap), drinking water.

ATTACHMENT 3 – EXAMPLE FLOAT PLAN

FLOAT PLAN

www.cgaux.org

INSTRUCTIONS: Complete this plan before you go boating and leave it with a reliable person who can be depended upon to notify the Coast Guard, or other rescue organization, should you not return or check-in as scheduled. If you have a *change of plans* after leaving, be sure to notify the person holding your Float Plan.

Do NOT file this plan with the Coast Guard.

www.uscgboating.org

VESSEL

IDENTIFICATION:

Name & Home Port ____________________

Doc. / Registration No. ____________________

Year & Make ____________________

Length ______ Type PWR Draft _____ (Inch/CM) Hull Mat. Fiber

Hull Color(s) ____________________

Prominent Feature(s) ____________________

____

PROPULSION:

Primary - Type Gas IO No. Eng __ Fuel Capacity _____

Auxiliary - Type none No. Eng __ Fuel Capacity _____

TELECOMMUNICATIONS:

Radio Call Sign ____________________

DSC MMSI Number ____________________

Radio-1: Type VHF-FM Ch / Freq. Monitored __________

Radio-2: Type __________ Ch / Freq. Monitored __________

Cell Phone ____________________

Pager ____________________

NAVIGATION: (Check all on board)

☐ Maps ☐ Charts ☐ Compass ☐ GPS / DGPS

☐ Radar ☐ Loran C ☐ Sounder ☐ __________

SAFETY & SURVIVAL

VISUAL DISTRESS SIGNALS:

☐ Day Only type

☐ Night Only type

☐ Day & Night type

PFDs: (Do not count Type IV devices)

____ Quantity on board

AUDIBLE DISTRESS SIGNALS:

☐ Horn / Whistle

☐ Bell

☐ __________

GROUND TACKLE:

☐ Anchor - line length ______ ft.

OTHER GEAR / SUPPLIES:

☐ Lifeboat / Life Raft ☐ Flashlight / Searchlight

☐ Dinghy / Skiff ☐ Signal Mirror

☐ Food / Water ☐ Drogue / Sea Anchor

☐ EPIRB none ☐ __________

☐ Foul Weather Gear ☐ __________

PERSONS ON BOARD

OPERATOR: Age M/F Notes (Special medical condition, Can't swim, etc.)

Name ____________________ ___ ___ ____________________

Address ____________________ Experience: w/Boat ☐ w/Area ☐

City ____________ State ____ Zip code ______ Home Phone ____________

Vehicle (Year, Make & Model) ____________________ Vehicle License No. ____________

Where will trailer be parked? ____________________ Trailer License No. ____________

PASSENGERS: Name & Home Phone Age M/F Notes (Special medical condition, Can't swim, etc.)

1. ____________________ ___ ___ ____________________
2. ____________________ ___ ___ ____________________
3. ____________________ ___ ___ ____________________
4. ____________________ ___ ___ ____________________
5. ____________________ ___ ___ ____________________

Attach Supplemental Passenger List if additional passengers on board.

ITINERARY

	DATE	TIME	LOCATION	MODE OF TRAVEL	REASON FOR STOP	CHECK-IN TIME
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						

Attach Supplemental Itinerary if additional space required.

Contact 1 ____________________ Phone Number ____________

Contact 2 ____________________ Phone Number ____________

If you have a genuine concern for the safety or welfare of any persons on board this vessel, who have not returned or checked-in within a reasonable amount of time, then follow the step-by-step instructions on the **Boating Emergency Guide** included with this plan, or on the World Wide Web at:

http://www.uscgaux.org/~floatplan/BoatingEmergencyGuide.htm

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BOATING EMERGENCY GUIDE

You will need the following items before you begin: 1) The **Float Plan**, if one was given to you; 2) **Pen** or **Pencil**; 3) Clean sheet of **paper** or **writing tablet**; and 4) **Telephone Directory**.

Step 1

Is there a genuine concern for the safety or welfare of any persons on board the vessel, who have not returned or checked-in within a reasonable amount of time?

If YES, continue with **Step 2**. If NO, then **Stop**. No further action is required at this time.

Step 2

Were you given a prepared Float Plan by anyone onboard the vessel?

If YES, continue with **Step 3**. If NO, then go to **Step 5**.

Step 3

On the Float Plan, locate the two contact lines, below the "Itinerary" at the bottom of the Float Plan. Call the telephone number of Contact-1.

<table>
<tr><th>IF:</th><th>THEN:</th></tr>
<tr><td>A person answered the phone...</td><td>Take notes during your conversation.
1. Let the person know that you are responding to a late return or check-in by the individuals designated on the Float Plan.
2. Determine if the person you are talking to, or anyone else at that location, has recently had contact with anyone on the vessel, and when and where that contact occurred.
3. Are you still concerned about the safety or welfare of any persons on board the vessel?
<table>
<tr><th>IF:</th><th>THEN:</th></tr>
<tr><td>Yes</td><td>Continue with Step 4.</td></tr>
<tr><td>No</td><td>Stop. No further action is necessary at this time.</td></tr>
</table></td></tr>
<tr><td>Otherwise...</td><td>Continue with Step 4.</td></tr>
</table>

Step 4

Call the telephone number for Contact-2.

<table>
<tr><th>IF:</th><th>THEN:</th></tr>
<tr><td>A person answered the phone...</td><td>Take notes during your conversation.
1. Let the person know that you are responding to a late return or check-in by the individuals designated on the Float Plan.
2. Determine if the person you are talking to, or anyone else at that location, has recently had contact with anyone on the vessel, and when and where that contact occurred.
3. Are you still concerned about the safety or welfare of any persons on board?
<table>
<tr><th>IF:</th><th>THEN:</th></tr>
<tr><td>Yes</td><td>Continue with Step 6.</td></tr>
<tr><td>No</td><td>Stop. No further action is necessary at this time.</td></tr>
</table></td></tr>
<tr><td>Otherwise...</td><td>Continue with Step 6.</td></tr>
</table>

Step 5

Take a moment to jot down the facts you know about each item in the checklist below:

> Do not speculate! Speculation of a fact may mislead search and rescue personnel and add to the overall search and rescue time, adversely affecting the outcome.

- ❑ Period of time the vessel has been overdue.
- ❑ Purpose of the trip or voyage.
- ❑ Description of vessel (color, size, shape, etc.)
- ❑ Vessel's departure point and destination.
- ❑ Places the vessel planned to stop during transit.
- ❑ Navigation equipment on board (such as GPS, Compass, Maps, Charts, LORAN C, etc.)
- ❑ Survival equipment on board (life jackets, EPIRB, flares, etc.)
- ❑ Number of people on board the vessel, as well as personal habits e.g. dependability, reliability, etc.
- ❑ Was the vessel already moored, or did a vehicle tow it to the location?
- ❑ License plate number and description of the vehicle of the towing and/or crew transport vehicle.
- ❑ Communications equipment on board including radio frequencies monitored, cellular telephone numbers of people aboard.
- ❑ Additional points of contact in the area.
- ❑ Were there any pending commitments (work, appointments, etc.)?

Continue with **Step 6.**

Step 6

1. Contact your local Law Enforcement agency.
2. Let the dispatcher know that you are responding to a late return or check-in by the persons on board.
   a. The dispatcher will guide you from there. The dispatcher will provide you with the necessary contact or agency connection (if one was not given on the Float Plan) to get a Search And Rescue (SAR) mission started. This is usually handled this way because it puts you closest to the agency conducting the rescue mission, eliminating an unnecessary middleman.
   b. The dispatcher will let you know if they would like a follow-up call from you on the outcome.
3. The dispatcher will instruct you from there.

Continue with **Step 7.**

Step 7

Be patient... you've done everything you can possibly do for now. Stay off of the phone, so emergency personnel can contact you with additional information and/or questions concerning the Search And Rescue (SAR) effort.

End of Guide

APPENDIX B-3

FINAL STANDARD OPERATING PROCEDURE FOR DIGITAL GEOPHYSICAL MAPPING

FINAL STANDARD OPERATING PROCEDURE
FOR
DIGITAL GEOPHYSICAL MAPPING

MRS 03 and MRS 12, Culebra, Puerto Rico

Prepared under:

Contract Task Order 0003

Contract No. W912DY-10-D-0015

DCN: TTEC-WERS-15-0308

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Review Signature: ______________________________ Date: 12-31-2014

Richard Funk, Tetra Tech EC, Inc.
Senior Geophysicist, SOP Author

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APPROVALS

This Standard Operating Procedure (SOP) contains the procedures and other information that will be needed by Tetra Tech EC, Inc. (TtEC) field staff to conduct geophysical surveys and target reacquisition during the Phase 2 DGM for munitions and explosives of concern (MEC) or other material potentially presenting an explosive hazard (MPPEH) at the project site. By their signatures, the undersigned certify this SOP is approved for implementation at the project site and will be used to conduct geophysical surveys.

29 Dec. 2014

Richard Funk
Senior Geophysicist, SOP Author
(425) 482-7629

Date

29 Dec. 2014

Dave Bennett
Senior UXO Supervisor
(508) 951-7383

Date

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SUPERVISOR'S STATEMENT

I have read and understand this SOP. To the best of my knowledge, the geophysical surveying described in this SOP can be performed in a safe, healthful, and environmentally-sound manner. I have confirmed that all persons assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the worker's statement. I will ensure that the SOP contains current procedures. If a major change to the SOP is necessary, I will ensure that active processes are suspended until the SOP is revised and approved. If unexpected safety, health, or environmental hazards are identified, I will ensure the process is stopped until the hazards have been eliminated.

29 Dec. 2014

Scot Wilson
Project Manager
(303) 626-3193

Date

WORKER'S STATEMENT

I have read this SOP and received the training necessary to perform the procedures addressed in the SOP. If I identify a hazard not addressed in the SOP, or encounter an operation I cannot perform in accordance with the SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

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LIST OF ACRONYMS

APP	Accident Prevention Plan
CPR	cardiopulmonary resuscitation
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
EM	electromagnetic
FOL	Field Operations Manager
GPS	Global Positioning System
ID	Identification
IVS	Instrument Verification Strip
MEC	Munitions and Explosives of Concern
MP	man-portable
MPPEH	Material Potentially Presenting an Explosive Hazard
mV	millivolts
QA	quality assurance
QC	quality control
QCM	Quality Control Manager
RTK	Real-Time Kinematic
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
TCRA	Time-Critical Removal Action
TDEM	time-domain electromagnetic
TOI	Target of Interest
TtEC	Tetra Tech EC, Inc.
USBL	ultra-short baseline
UXOQCS	UXO Quality Control Specialist
VTA	vehicle-towed array

1. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide procedures for performing geophysical surveys to detect Munitions and Explosives of Concern (MEC) or other Material Potentially Presenting an Explosive Hazard (MPPEH) during work at the project site. These procedures will be conducted in accordance with the Time-Critical Removal Action (TCRA) Work Plan (of which this SOP is a part) and the Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP).

2. SCOPE

This SOP applies to the collection of geophysical data and associated coordinate data, as well as reacquisition of targets for intrusive investigation. A differential global positioning system (DGPS) will be coupled with the geophysical instrumentation to record the x and y coordinates for the collected geophysical data. In general, cost-effective geophysical investigation technologies applicable include, but are not limited to, time-domain electromagnetic (TDEM) induction or magnetics used on towed or floated array (TEMA/MGA) acquisition platforms. The objective of the geophysical investigation is to detect subsurface metallic objects that may potentially be munitions. These objects may present a hazard for site workers and other personnel at the project site.

A geophysical test program (instrument verification strip [IVS]) will be initiated prior to the start of field activities. The primary objectives of the test program are to validate the use/selection of detection instruments and to ensure the geophysical data acquisition personnel have the requisite experience to perform the work.

The Digital Geophysical Mapping (DGM) Field Lead, in collaboration with the UXO Quality Control Specialist (UXOQCS), is responsible for the maintenance of this procedure. Approval authority for changes rests with a qualified geophysicist, and the UXOQCS.

Personnel requirements and responsibilities are described in the Phase 2 Work Plan.

3. TRAINING REQUIREMENTS

All Tetra Tech EC, Inc. (TtEC) field personnel will meet the training requirements presented below. Attendance sheets with attached curricula will be used to document completion of each training session.

Training Agenda

1. Phase 2 WP (including SOPs)
2. APP/SSHP review
3. Schedule and work hours
4. Site rules

5. Work teams and goals
6. Field data collection
    a. Documentation and recordkeeping
    b. Logbook, or electronic logs
    c. Data file management
7. Equipment training
    a. EM61-MK2-HP (TEMA-MK3 & TEMA-Lite configurations)
    b. Positioning systems (ultra-short baseline [USBL] and GPS, as needed)
    c. Data collection software
    d. Pre-operational certification
8. Safety
    a. Project munitions types
    b. MEC/MPPEH hazards and identification
    c. First aid/cardiopulmonary resuscitation (CPR)
    d. Review of emergency response equipment
    e. Talk/walk-through of emergency procedures
    f. Emergency drill
    g. Daily health and safety briefing
    h. Daily site-specific munitions training

The site-specific training will include step-by-step review of this SOP to ensure all geophysical team members clearly understand the procedures for geophysical data collection and target reacquisition.

All personnel assigned to the geophysical investigation teams require initial training at the IVS area prior to conducting any fieldwork as discussed in Section 5. IVS training will encompass the following aspects of the DGM investigation:

- DGPS
- EM61-MK2-HP (towed TEMA-MK3 and floated TEMA-Lite configurations, as required)
- HyPack and TEMA data collection software

Prior to initiation of geophysical survey data collection, training sessions will be held for all personnel responsible for geophysical surveying, and for the downloading and real-time quality control (QC) of field data. Survey methodology, data requirements, reacquisition procedures, and field notes protocol will be explained in detail. The presentations will include a discussion of the survey approach and how the data collection and field documentation tasks integrate into the overall program. Training will also include review of the internal QC procedures and project reporting requirements. The DGM Field Lead (FOL)/field QC manager (QCM) will be responsible for this training and any follow-up training deemed necessary. Documentation of the training will be maintained in the training log.

4. EQUIPMENT AND PROCEDURES

The data collection during the TCRA will be performed using the following equipment:

- **TEMA-MK3**—The EM61-MK2-HP is a time-domain metal detector that detects both ferrous and non-ferrous metals. The system operates by generating a pulsed primary electromagnetic field in the earth, which induces eddy currents in metallic objects located in the ground. These eddy currents decay over time, producing a secondary electromagnetic field. It is this secondary field which is measured by the receiver coils. The array consists of three 0.5-meter x 1.0-meter coils with the long axis of each coil oriented perpendicular to the array. The effective width of the array is approximately 10 feet (3 meters). Data are digitally collected at a rate of approximately 12 to 15 hertz, and real-time positioning provided by GAPS USBL and/or high-resolution DGPS systems. The EM61-MK2-HPs that will be configured for the TEMA will use four time-gates of bottom coil response only, centered at 261, 376, 527, and 727 µs.

Figure 4-1. Planned TEMA-MK3 Configuration for Active Towing Operations

Figure 4-2. Planned TEMA-Lite Configuration on Floats

- **Geonics EM-61 MK 2 Man-Portable**—The man-portable (MP) system uses the same technology as the vehicle-towed array (VTA); however, a single 0.5-meter by 1-meter coil would be used for the MP system. Collection of MP data is not anticipated for the Phase 2 work.
- **Differential Global Positioning System**—The DGPS receives satellite signals with an antenna above the TEMA at a known offset. The base station radio signals, or satellite based corrections can provide real-time kinematic (RTK) positioning accuracy to approximately 3.5 to 10 centimeters. This geopositioning method has been determined to be the most effective for use at the project site because of open and unobstructed site characteristics. Additionally, the system was selected for its ease of use and data collection capabilities.

The DGPS data are merged with the EM61-MK2-HP in real time during field operations for both TEMA configurations. The data stream is processed and analyzed using a combination of software developed by TtEC, Geomar and Geosoft (Oasis Montaj) to provide acceptable positioning accuracy for the target of interest (TOI) readings. Procedures include system setup, data collection, and QC measures. Personnel who perform geophysical data acquisition are responsible for understanding these procedures.

4.1 System Setup

1. Set up DGPS systems.
   - Erect DGPS base station over approved survey control point.
   - Establish and maintain base station location(s) from the beginning of the project. When using multiple base station locations throughout the duration of the project, ensure all base station coordinates "tie" together (tolerance ± 0.1 meter) prior to performing data collection or target reacquisition.
   - Set up DGPS base station and collect reference data daily. Ensure radio modem for RTK operation is functioning and transmitting required data. Use normal power setting. If high power setting is necessary, notify FOL and Senior Unexploded Ordnance Supervisor (SUXOS) prior to using.
   - Set up rover DGPS to collect field data file as designated during training. Synchronize timepieces/computers to DGPS UTC time.
   - Check DGPS antenna offsets from EM61-MK2-HP coils as entered into TEMA software (tolerance ±1 inch).
   - For TEMA-Lite, allow 30 seconds of static position data collection prior to beginning survey, for TEMA MK3 check that USBL reports successful alignment.
   - Ensure RTK lock is achieved prior to survey operations. When performing data acquisition or target reacquisition, always occupy at least one approved control point (e.g., survey grid corner, monument, etc.). RTK lock will not occur if PDOP and HDOP values are greater than a value of 6. No navigation or position data will be collected or used unless RTK lock is achieved. Contact the FOL before data collection is attempted without real-time corrections (post process data).
2. Set up EM61-MK2-HP TDEM.
   - For TEMA-Lite operations, ensure EM61 MK2 backpack switch is in "4" mode, and cables from the Laptop, altimeter and DGPS are connected as designated during training. Synchronize computer, cameras and timepieces to DGPS UTC time and DGPS systems have RTK lock.
   - For TEMA-MK3 operations, ensure EM61-MK2-HP and DGPS systems have RTK lock and that the GAPS USBL is in alignment.
   - Turn on EM61-MK2-HP and allow to warm up for 2 to 5 minutes.
   - Allow 30 seconds (TEMA-Lite) of static EM61-MK2-HP data collection prior to beginning survey.
   - Ensure that RTK lock is achieved prior to and during survey operations. When performing data acquisition or target reacquisition, always travel across at least one

approved control point (e.g., survey grid corner, monument, IVS etc.) per data acquisition file.

4.2 Data Collection

General DGM mapping procedures are described below:

1. Collect beginning of the day QC procedures; equipment warm-up, personnel (MP only), static/spike, cable shake, static position, lag correction and IVS for dynamic positioning and repeatability.
2. Continually monitor the acquisition track path, sensor signal intensity, battery strength, RTK lock, and memory capacities of all instrumentation for TEMA operations.
3. Document all activities such as switching out batteries, changing acquisition personnel duties, replacing cable, and all significant weather changes.
4. Collect end of day QC procedures; static/pseudo-static,
5. Notify site personnel when survey of designated area is complete.

One member of the team will be responsible for maintaining the logbook/electronic logsheet and will record the following information:

- Grid or survey area identification (ID)
- Time survey started
- Time survey completed
- Names of team members
- Weather conditions
- Geophysical team designation (e.g., MK3, Lite)

Each page of the logbook will be dated, sequentially numbered, and identified by the logbook number. All entries will be signed. The team leader will place photocopies of the logbook pages in the appropriate folder located in the processing center at the end of each workday.

The following procedures will be accomplished at the end of each day.

- All field equipment will be secured in an appropriate, safe location.
- Documentation and logbook pages will be photocopied and placed in the appropriate folder located in the site office.
- The data files will be submitted to the processing center data manager by the geophysical team leads.
- The completed survey areas will be recorded in the tracking log.
- The positioning track maps and logbook pages will be accessible for verification by the UXOQCS, who may inspect them weekly.

4.3 Quality Control Measures

The QC regimen during field operations involves collecting QC data prior to, and after, each data acquisition session. The specific methods for performing each QC test for the TEMA MK3 and TEMA-Lite configurations will be reviewed and practiced by field personnel during site-specific training exercises at the IVS. Any new EM61-MK2-HP system (coils and/or electronics) that is a replacement on the project will be tested and validated at the IVS prior to use in field activities.

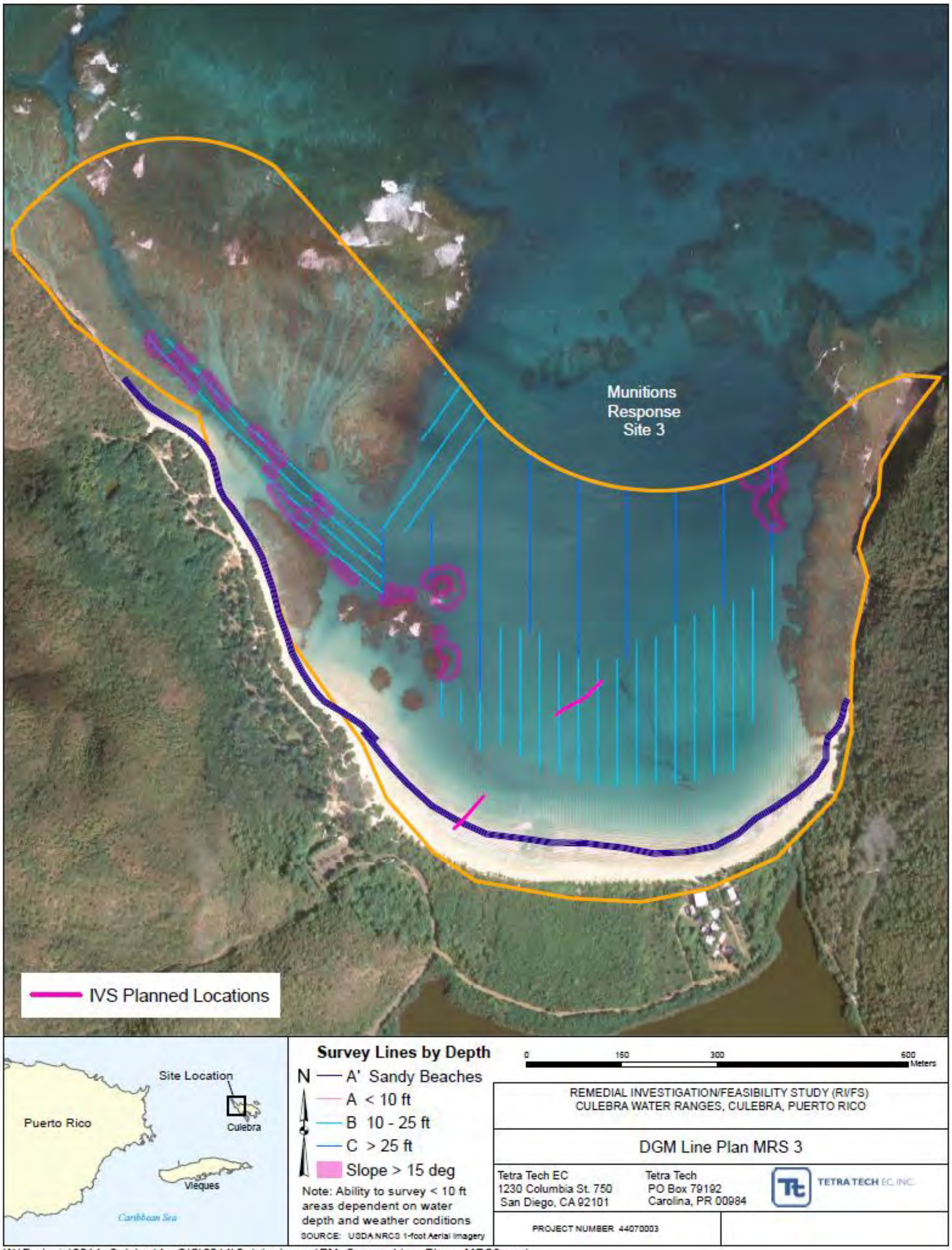
The TEMA systems will acquire data over the IVS at the beginning of each day, in order to check the sensitivity of the electromagnetic (EM) system and the accuracy of the DGPS.

5. INSTRUMENT VERIFICATION STRIP

The IVS will be used for equipment validation and to ensure the geophysical data acquisition personnel have the requisite experience to perform the work. Data from the IVS will also aid in the development of site-specific data interpretation criteria for the project.

5.1 Location

The IVS locations will vary based on site conditions, but will be in a generally clean area (i.e., free of metal) and positioned approximately as shown on Figures C-2 and C-3 of the Phase 2 Work Plan and included below.



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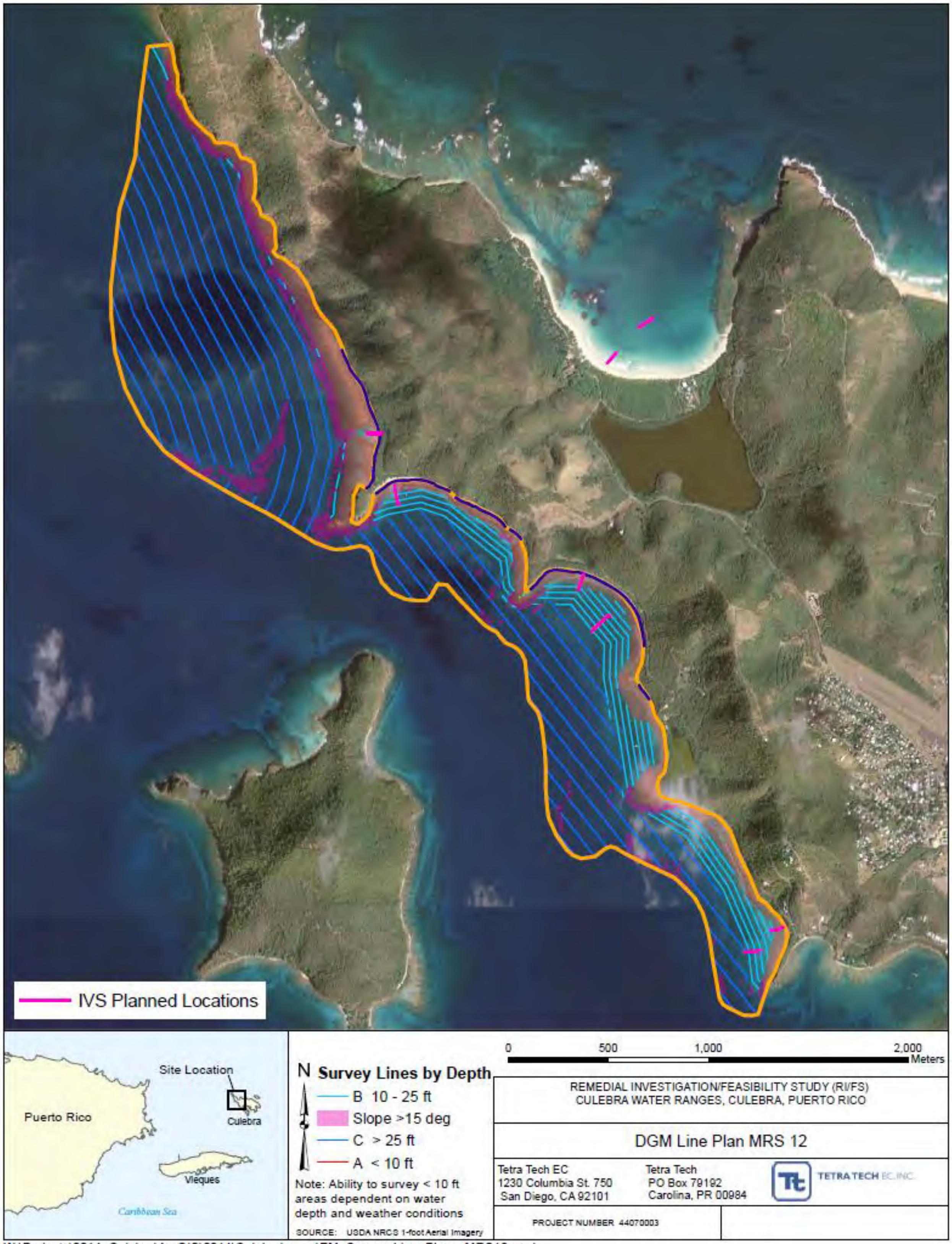

W:\Projects\2014_Culebra\ArcGIS\2014\Culebra\maps\EM_Survey_Line_Plans_MRS12.mxd

5.2 Design

The areas selected for the IVS will be in areas with sand bottom and generally shallow water (estimated at 1 to 5 meters). TtEC will use the IVS to demonstrate that the, geophysical mapping, and data analysis systems can meet the project objectives.

The specific elements of the program that will be assessed at the IVS are the following:

- Spatial sample density (i.e., line and station spacing)
- Navigation and positioning methodologies
- Sensor and positioning system platform (stability, noise characteristics, and ergonomics)
- Data processing, analysis, interpretation, and data management
- Quality assurance (QA)/QC, and documentation protocol for data acquisition, processing and analysis, and data management

The evaluation of these components will result in the production of internal, field-specific guidelines to be used during the large-scale geophysical program. TtEC personnel will adhere to these guidelines during all phases of the large-scale geophysical program to ensure the end product is acceptable to.

TtEC's data quality is established at the time of data collection through proper setup and operation of the survey systems, and cannot be enhanced during processing, other than to remove obviously invalid data. Survey, data processing, and QA procedures will comply with the applicable guidelines provided by the U.S. Army Corps of Engineers (USACE).

Data quality will be assessed explicitly: a single data element is compared directly to a standard or known control. Alternatively, quality can be assessed implicitly: combinations of data elements are compared to members of their own set for internal consistency. Additionally, quality can be measured quantitatively (numerically) or qualitatively, requiring interpretation on the part of an operator.

For each step of the setup and operation of the survey system, a series of checks is run on the equipment and data collection software configuration. These checks will be documented in the survey collection logs and a dedicated QC electronic log. Where possible, a quantitative measurement of data quality is identified for each data type acquired. Procedures are constructed to measure this quantity as near as practicable to the point of acquisition. These measurements of quality are continually assessed throughout the acquisition and processing phases of the project. Where a quantitative measure of data quality cannot be developed, an interpretive or qualitative method is contrived to estimate data quality.

Field methods used for measuring data quality begin with position accuracy. The GPS system will be checked on a daily basis (once per day) to check that positional accuracy is better than 0.3 meter. Survey crew will check selected terrestrial control points with RTK GPS rover. The

RTK GPS measurements will match published position to within 0.1 meter x, y and z. This check will be conducted prior to the start and at the end of the survey. A daily water level check or a temporary bench mark near the vessel dock(s), will be used to check the GPS units on the vessels. This check is done by comparing the reported temporary benchmark position, or water surface elevation between the survey system navigation reported tide level, and the QC GPS rover. The QC GPS water level and survey system tide level will match to within 0.3 meter. Details on the positioning QC are given in Table 4-2.

EM data from the TEMA are subject to interpretive and quantitative measurements of data quality. The daily QC procedure for the TEMA will be as follows:

- After sensor warm-up, null the TEMA-MK3 EM61 sensors and perform a function test by inserting a hammer or other large metal object (same object for all coils each day) into each coil individually. The function test will be considered complete when the response from the coils is within ±10 percent of the original values. This is due to the necessity of having the TEMA MK3 on the deck of the survey vessel during this function check. Since the TEMA-Lite will be beached during the function test, a fixed ±20 percent will be used.
- In order to measure background noise, re-null TEMA-MK3 once launched and at mid-water depth, then perform a pseudo-static test (3-minute duration) and calculate the standard deviation for each coil based on a 30- to 60-second average. Based on previous work, this pseudo-static test works as well as static tests on land and provides better results than attempting to place the TEMA on the bottom (see example Daily Quality Control Report [DQCR] in Appendix F of the Phase 2 Work Plan). The static test for the TEMA-Lite will be conducted on the beach after the function test.
- Collect TEMA data over the IVS. The TEMA must remain within 1 meter of the bottom. Collect data in both directions sufficient enough to analyze at least one crossing of the IVS item(s) for each of the three coils. A minimum of three lines in alternating directions are required. Ideally each path over the IVS will be unique (either offset or approaching from a different azimuth) if possible.

An IVS letter report will be submitted at the beginning of the project that will include:

- As-built drawing of the IVS,
- Pictures of seed item(s),
- Geophysical data maps,
- Summary of the IVS results,
- Proposed data collection techniques and methodologies, and
- Instrument- and process-specific criteria for defining the quality of the geophysical data.

The IVS will contain two 10-foot-long or a single 20-foot-long sections of carbon steel black pipe (or similar). The design is subject to revision to account for site-specific conditions at the installation site for the IVS. The IVS will be emplaced from a surface vessel utilizing snorkelers if needed. IVS items will not be buried, but instead placed on the bottom attached to a line and anchored at both ends.

During acquisition, operators monitor data quality on the EM collection and HYPACK acquisition screens. The general noise level of the responses and useable swath width are visible on the displays. These displays require interpretation and are used as the first quality check on EM data.

The visualization tools available in the processing software provide clear indications of any problems in the data or in the time correlation of the EM and position data. Any errors in these areas will result in identifiable data artifacts. Conducting at least preliminary processing of the data will allow any problems to be caught and corrected quickly, and will ensure that a full, high-quality data set is collected.

The primary use of the test strip will be to validate each EM61-MK2-HP system's sensitivity as well as to confirm the geophysical data acquisition procedures for the project. The DGM data will be interpreted to provide a location of each IVS item to show that the positioning systems are achieving the performance metrics for the project.

5.3 Procedures

Prior to the emplacement of the IVS, TtEC will acquire digital geophysical data with the TEMA system to detect existing targets that could potentially affect the design of the IVS area. The existing anomalies might need to be avoided for the IVS and noise strip. The orientation for the IVS lane will be based on site conditions (ease of run in and run out area for the TEMA, obstacles etc.). Once a suitable area has been selected that is free of anomalies the IVS lane will be constructed with the linear metallic object. At the end of the IVS lane or adjacent to the IVS lane will be a dynamic noise strip that is also free of anomalies that will be used to determine the background noise for the site.

Data will be collected over the IVS lane with the TEMA MK3 and TEMA-Lite at production survey speeds. The TEMA systems will be required to make three passes over the IVS in alternating directions, then will then make one pass down the noise strip. The IVS will be surveyed at the beginning of the survey day, additional IVS passes will be conducted if any EM61-MK2-HP sensor components (e.g. coil, coil cable or electronics package) are changed during the day.

6. QUALITY CONTROL/QUALITY ASSURANCE

TtEC-specific instrument and functional checks will be performed at the beginning of every data acquisition session and/or once daily at the IVS. The performance measurement criteria for all

DGM-related tasks are provided in Table 4-2 of the Phase 2 Work Plan which is included below. DGM QC procedures are intended to monitor the performance of all measurement criteria.

6.1 Field Data Collection

Site-Specific Limiting Conditions for Survey

Due to the challenging and complex nature of the site, a procedure for determination of the appropriate DGM configuration, deployment, and altitude of flight has been developed. The TEMA DGM Decision Tree (see Figure 6-1) clearly presents what steps must be taken, and which conditions must be met in order to proceed with either the vessel towed TEMA-MK3, or the hovercraft deployed TEMA-Lite.

This TEMA DGM Operations Decision Tree will be utilized each day and results recorded in the log sheet.

Surveys will be conducted in the shallowest areas at high tide, and will not be conducted in coral areas with less than 3 meters for the TEMA-MK3 or 6 inches of water for the TEMA-Lite. This determination is based on field conditions at the time of the survey. The areas that will be excluded will depend on many factors including:

- Sea state
- Wind
- TEMA performance at the site
- Marine mammal and sea turtle activity
- The minimum altitude over shallow coral is 6 inches, deep corals is 3 meters.

This will be determined by operating at high-tide within the shallowest areas which will provide for 3 meters/6 inches of water. Work will proceed from deeper water to shallower water. In the case of the TEMA-Lite, this allows for the collection of bathymetry data from the altimeter, which can be used to determine areas that are likely to have less than a foot of water present.

- The shallowest areas will only be attempted during high tide and flat seas.
- ***Clearance from the FOL is required when surveying over coral in less than 1 foot of water (this is recorded in the daily report).***

Figure 6-1. DGM Operations Decision Tree

6.2 Field Data Processing

Geophysical data reduction, analyses, and interpretation activities will be completed on a daily basis following data collection to verify that the survey objectives are met and to aid in the planning or modification, if necessary, of the next day's field activities. A data processing center will be established at the field office where data reduction and transfer activities will be completed. Upon completion of the each day's geophysical survey operations, DGM data, along with DGPS/USBL sensor positional information, will be downloaded from the field data logging systems to a computer maintained at the data processing center. These data will then be processed and interpreted on-site and/or transferred off-site via the Internet to the Project Geophysicist for interpretation.

6.3 DGM Data Processing and Interpretation

Geophysical data will be processed and interpreted using internally developed target characterization software in conjunction with Geosoft Oasis Montage software. Several steps will be implemented to process the geophysical data prior to analysis and interpretation. These steps include the following: proper positioning of geophysical sensor data; shifting of sensor data to a common, relative background; and QC checks of the processed data. Upon completion of processing, high-resolution color-coded image maps depicting subsurface anomalies will be generated for each grid surveyed, with the data displayed in millivolts (mV).

The map scale selected for each grid will ensure that individual anomalies are clearly visible. Generally, the EM61 response over a subsurface conductor is a single positive peak. However, the attributes of an EM61 anomaly (shape and magnitude) are dependent upon the size, shape, orientation, depth, and electrical and magnetic properties of the subsurface object, along with the physical and chemical parameters of the surrounding soils. These attributes are also somewhat dependent upon the degree of cultural interference influencing the observed data.

Table 6-1. Measurement Quality Metrics (Table 4-2 of Phase 2 Work Plan)

Technology Type	Measurement Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency	Action if Quality Failure Occurs
Digital Geophysical Mapping – TEMA	Function Check TEMA-MK3	After sensor warm-up (2-5 minutes), null the EM61 sensors and perform a function test using a hammer or other large metal object	Large stable signal spike. No particular value is specified as this will change with null due to precise position of TEMA on deck; therefore, a value within ± 10 percent of the original readings will be used.	Once daily	Deck Check cabling. Check for water intrusion into EM coils. Check for foreign objects on TEMA towfish. Re-null and retest system. Repair/replace components as necessary.
	Function Check TEMA-Lite	After sensor warm-up (2-5 minutes), null the EM61 sensors and perform a function test using a hammer or other large metal object	Large stable signal spike repeatable to within ± 20 percent of the values.	Once daily	Deck Check cabling. Check for water intrusion into EM coils. Check for foreign objects on TEMA towfish. Re-null and retest system. Repair/replace components as necessary.
	Noise Check TEMA-MK3	Re-null TEMA once launched and at mid-water depth, then perform a pseudo-static test (3-minute duration).	Calculate the standard deviation for each coil based on a 30- to 60-second average. Standard deviation of readings should not exceed 6 mV on channel 2.	Once daily, again after system power is cycled	Check cabling, look for loose cable runs. Check for foreign objects on TEMA towfish. Re-null and retest system. Repair/replace components as necessary.
	Noise Check TEMA-Lite	After Function Check, perform a static test (3-minute duration) with system beached on the shoreline.	Calculate the standard deviation for each coil based on a 30- to 60-second average. Standard deviation of readings should not exceed 6 mV on channel 2.	Once daily, again after system power is cycled	Check cabling, look for loose cable runs. Check for foreign objects on TEMA towfish. Re-null and retest system. Repair/replace components as necessary.

Table 6-1. Measurement Quality Metrics (continued)

Technology Type	Measurement Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency	Action if Quality Failure Occurs
	Precision/ Repeatability	Seeded linear metallic target(s) (IVS)	For initial test, run reciprocal headings over seed feature to obtain full coverage of IVS. The TEMA must remain within one meter of the bottom for 90% of the time over the IVS. Collect data in both directions for each sensor. A minimum of three lines in alternating directions are required. IVS items are to be located to within 1 meter of their reported position.	Initial test – once per survey. Subsequent checks daily at the start of the day.	If no detection: 1. Deck test EM system and repair/replace if necessary. If position error: 2. Check vessel navigation (RTK GPS) and USBL and adjust/repair/replace as needed. 3. If a stable offset is noted, recheck seed item location.
	Completeness	Visual evaluation of data real-time for verification that intended coverage goals are met; confirmation in post-processing.	Coverage plots (i.e., matrix fill / coverage plots) will be utilized to monitor coverage completeness in real time. Along Track Sample Spacing - 98% of the down line measures will not exceed 0.25 meter. Survey Height – 90% of the survey altitude readings will be at or below 2 meters.	By dataset	If coverage is not adequate, conduct holiday fill survey to fill in the missing data coverage. Areas that experience along track gaps that do not meet the 98% coverage rule will be re-collected. Areas that experience gaps caused by survey altitude that do not meet the 90% coverage rule will be re-collected. Areas that exceed 0.25 meter along track or 2 meter altitude due to terrain or obstructions will be mapped and removed from the coverage analysis.

Table 6-1. Measurement Quality Metrics (continued)

Technology Type	Measurement Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency	Action if Quality Failure Occurs
	Sensitivity	Compare daily IVS results to the initial IVS test data	The TEMA measured response S/N will be compared to the S/N of the initial IVS run. The TEMA S/N level will be within ± 20 percent of the values established during the initial IVS run.	Once per day	1. Re-run IVS. 2. Test EM system and repair/replace if necessary. 3. Check vessel navigation and USBL and adjust/repair/replace as needed.
Geodetic Equipment	Functionality/ Accuracy	1. GPS Positioning – Survey crew will check selected terrestrial control points with RTK GPS rover. 2. Water level check – Use RTK GPS rover or temporary bench mark at vessel dock to check water surface elevation. Compare to survey system navigation reported tide level.	1. RTK GPS measurements will match published position to within 0.1 meter x, y and z. 2. RTK GPS water level and survey system tide level will match to within 0.3 meter.	1. Prior to the start and at the end of survey 2. Daily	1. Verify system configuration and settings. 2. If using POS MV, post-process position in POSPac and re-check result. 3. Re-test as appropriate. 4. Repair/replace components as required

APPENDIX B-4

STANDARD OPERATING PROCEDURE FOR GEOPHYSICAL DATA PROCESSING AND MANAGEMENT

STANDARD OPERATING PROCEDURE
FOR
GEOPHYSICAL DATA PROCESSING AND MANAGEMENT

SOP 02

MARINE GEOPHYSICAL SURVEY FOR MEC

TETRA TECH

MARCH 2010

UPDATED JUNE 14, 2011

APPROVALS

This Standard Operating Procedure (SOP) contains the procedures and other information that will be needed by Tetra Tech field staff to conduct geophysical data processing and data management during the Marine Geophysical Surveys for MEC. By their signatures, the undersigned certify this SOP is approved for implementation and will be used to direct geophysical data processing and management operations.

____________________________ 3/5/2010

Carol Hutley Date
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(360) 668-2039

____________________________ 6/14/10

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Geophysics Group Manager
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____________________________ 6/14/11

Richard Funk Date
In-water Study Field Operations Lead
(425) 482-7629

SUPERVISOR'S STATEMENT

I have read and understand this SOP. To the best of my knowledge, the processing described in this SOP can be performed in a safe, healthful, and environmentally sound manner. I have confirmed that all persons assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the worker's statement. I will ensure the SOP contains current procedures. If a major change to the SOP is necessary, I will ensure that active processes are suspended until the SOP is revised and approved. If unexpected safety, health, or environmental hazards are identified, I will ensure the process is stopped until the hazards have been eliminated.

____________________________ _________

Richard Funk Date
In-water Study Field Operations Lead
(425) 482-7629

WORKER'S STATEMENT

I have read this SOP and received the training necessary to perform the procedures addressed in the SOP. If I identify a hazard not addressed in the SOP, or encounter an operation I cannot perform in accordance with the SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	**Date**	**Supervisor's Name**	**Date**

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ATTACHMENT 1 TRACKING LOG

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1. PURPOSE

The purpose of this standard operating procedure (SOP) is to provide specific procedures for geophysical data processing and data management during the Marine Geophysical Survey for MEC. These procedures will be conducted in accordance with the approved UFP-SAP (of which this SOP is a part) and the Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP).

2. SCOPE

This SOP for geophysical data processing applies to the data collected during the geophysical surveys. It also applies to all aspects of geophysical data management and quality control (QC) from collection, through processing and analysis, to production of investigation maps/packages and data transfer to the project database and geographic information system (GIS). The major elements of this procedure are electronic data transfer, data processing, data interpretation, data archiving, and data tracking.

Differential global positioning system (DGPS), ultra-short baseline acoustic positioning system (USBL) and cable counter are the most common methods for recording the locations of targets of interest (TOI) during the survey. "Positioning system" is used as the default term in this SOP to refer to any of these survey systems.

The Geophysical Quality Control Manager (GP QC), in collaboration with the Quality Assurance Manager (QAM), is responsible for the maintenance of this SOP. Approval authority rests with a qualified geophysicist, and the QAM.

Personnel requirements and responsibilities are described in the UFP-SAP Work Plan.

3. TRAINING REQUIREMENTS

All Tetra Tech geophysical processing personnel will meet the training requirements presented in SOP 02. Additional training for the data processing teams is summarized in this section. The topics to be covered are listed below. Attendance sheets with attached curricula will be used to document completion of each orientation session. Determination of the adequacy of the level of training of assigned staff is the responsibility of the Geophysical Task Manager (GTM) in conjunction with the QAM.

Training Agenda

1. Project summary
2. SOP review
3. Data processing training
4. Data interpretation training
5. Data management training

Training sessions will be held prior to initiation of data collection and intrusive activities for all personnel responsible for data processing, interpretation, recording, maintaining, and reviewing data. Data requirements and data entry will be explained in detail. The presentations will include an overall discussion of the project database and how the data processing and interpretation tasks are integrated into the overall program. The designated Data Manager (DM) or GTM will be responsible for this training and any follow-up training deemed necessary.

4. PROCEDURES

4.1 TRANSFER OF FIELD DATA AND DATA TRACKING

Several files are generated by the geophysical and positioning systems for each site surveyed. The files are stored on the data logger, positioning system receiver and/or survey computer (s) during data acquisition activities. At the end of the day, the data collected by each field team will be turned over to the on-site DM. These files are uploaded to the data management server at the site or to another designated site, as appropriate. The following file types are generated for each survey:

- Geophysical data file(s) with signal intensity measurements (i.e. HyPack .raw, .hsx, .7k, SeaLink .mag, Discover .jsf etc.)
- Positioning system data file(s) (if separate, usually integrated in real time into the above mentioned files)

- Digital photo files (*.jpg) (if needed)

All Geophysical Array and positioning system data files will be electronically logged upon receipt (Attachment 1). The following items will be recorded on the Geophysical Data Tracking Log for each Geophysical Array and positioning system file collected:

- Transect(s) number (as necessary)
- Date collected
- Hypack file name
- Hypack file start and stop times
- Geophysical Array file name
- Geophysical Array file start and stop times
- Positioning method(s)

The position data and the Geophysical Array data from the geophysical mapping systems will be processed and interpreted on site or at the designated processing center. The following items will be added to the electronic data tracking sheet:

- Date data file processed
- Initials of processor
- Merge data file name (*.xyz) imported into Oasis

Interpretation will be performed at the site or at the designated processing center and will include establishment of selected TOI locations as needed. Selection will be in accordance with the data quality objectives presented in the QAPP, and will consider the most probable munitions at the site. The TOI locations will be added to the project database. The following items will be added to the electronic tracking sheet:

- Date TOI file created

4.2 GEOPHYSICAL DATA PROCESSING

The fundamental processing and analysis procedures function together as quantitative and intuitive processes. Quantitative processes are usually standard practices, such as removal of

Geophysical Array instrument drift/bias and corrections for instrument lag/latency. These standard procedures can usually be rigidly formulated and automated for a specific objective. Other processes are more intuitive in nature (e.g., "noise" characteristics, and design and implementation of GIS/database queries for prioritization of targets). These processes generally depend on the experience of the personnel involved, especially their level of experience on munitions sites.

The data processors will download the data files to their computers for processing and upload the processed files back to the data management computer when processing is completed. This process will be verified by the use of a data tracking sheet. The data tracking sheet will be reviewed for completeness by a data processor and the DM on a daily basis.

The data acquisition file naming convention for the Geophysical Array and DGPS systems will include the date and a file sequence identifier at a minimum. A minimum of once per day, the positioning system and geophysical sensor files will be uploaded to the site processing computer and stored under a file folder system similar to the following:

Main File Folder: Project_Name

Subfolders **Aqusition (raw data)**

Subfolders Hypack

PR_mmddyy_MG7

(2 letter project ID, date, survey type and vessel ID number)

SeaLink

Processing (processed files)

Subfolders Caris

Oasis

4.2.1 Standard Data Processing

The Geophysical Array data and the position data are merged together either in real-time using HYPACK data acquisition software or collected separately and merged later using Geosoft Oasis Montaj™.

These data are imported into a Geosoft Oasis Montaj™ project. Any instrument drift or instrument latency corrections are performed at this point. Predefined scripts that are proven at the IVS test bed are used to process the data to minimize any human error associated with the data processing sequence. Data are interpolated using minimum curvature gridding routine to generate color-coded images of the Geophysical Array signal intensities for each data acquisition session. The track path will be transcribed onto the color-coded images of the sensor intensity to aid in data interpretation.

4.2.2 Advanced Data Processing

No advanced data processing (e.g., filtering) is anticipated for this project for the data. However, all processing operations and parameters are digitally logged in the Oasis Montaj*.log files for each data acquisition session.

4.3 GEOPHYSICAL DATA INTERPRETATION

Upon completion of processing, high-resolution color-coded image maps depicting TOI will be generated for the survey area using Oasis Montaj™. Tetra Tech geophysicists will identify and manually select TOI based on their amplitude and shape above local background values. These target locations are automatically transcribed onto the color-coded image. As a QC check on the interpreter, Oasis Montaj™ will be used to automatically select target locations for comparative purposes. *Although automatic target selection routines can be effective, they are based solely on amplitude and not TOI shape*. Manual target selection is usually necessary to provide the best information for TOI disposition, location, and depth.

The data interpretation for this project will consist of the following approach:

Step 1—Use Scripts to Import Data, Check Quality, and Interpolate

Import the *.xyz file into an Oasis Montaj™ database, perform quality checks. Perform instrument drift and latency corrections and calculate gradients. When quality checks meet metrics, data are considered "final processed data." Interpolate Geophysical Array data channels using final processed data to create color-coded images. Document all processing parameters and the interpolation (i.e., gridding) parameters used to construct the image in the *.con file.

Step 2—Automatic Target Selection: Oasis Montaj™

Use Oasis Montaj™ to automatically select potential targets by employing the ucepeakdipoles.gx function. Transcribe these potential target locations onto the color-coded image used for manual interpretation in Step 3. Ucepeakdipoles.gx selects targets ONLY by signal amplitude and not shape. The data interpreter utilizes the targets selected automatically as a quality check on the manual interpretation during Step 3.

The Oasis Montaj™ ucepeakdipoles.gx automatic selection routine prevents the interpreter from being overly subjective during the manual interpretation phase, because it is strictly based on quantitative criteria. The parameters that will be used for the automatic target selection will be determined by the Tetra Tech interpretation geophysicist based on the data from the instrument verification strip (IVS). These parameters will be documented and used throughout this project to ensure the consistency of the interpretation. If any changes to the parameters are necessary, the Project Manager will be notified.

Step 3—Manually Select Target Locations

The interpreter manually selects (digitizes) the x-y target locations within each survey grid using the final processed data and the interpretation criteria derived from the IVS. The target information is stored in an Oasis Montaj™ target database.

TOI may be selected using the following data characteristics:

- Amplitude, shape, and relationship between Geophysical Array signals.
- Footprint of the TOI (i.e., two-dimensional shape), including lateral gradients and the number of acquisition lines the TOI appears on.
- Shape of the data acquisition path.
- Background characteristics of the data points surrounding the TOI (i.e., noise, presence of nearby TOI).
- Other pertinent information gathered from the acquisition team (i.e., digital comments).

- TOI will be classified as "dig" or "no dig" based on the TOI selection criteria developed from the IVS.

Step 4—Generate TOI Information File (*.csv)

Upon completion of target selection process, export the TOI information file (*.csv).

The *.csv file will contain, at a minimum, the TOI unique identification number, interpreted location, estimated depth, Geophysical Array signal intensity values, and priority (dig or no dig).

4.4 GEOPHYSICAL DATA ARCHIVING

All geophysical and position data will be archived daily. The entire database and all associated data files will be backed up on the Tetra Tech server on a nightly basis. Maintenance of the backup data will be verified by the QAM in accordance with the schedule specified in the QAPP.

5. QUALITY ASSURANCE/QUALITY CONTROL

QC checks include ensuring that the establishment of TOI is reproducible by senior staff. A portion of the site will be chosen at random and reinterpreted by the Geophysics QC Manager. A 90 percent TOI correlation must be achieved between the production geophysicist and the Geophysics Manager for anomalies classified as "dig". In the event that a 90 percent correlation is not met, a root cause analysis will be performed to determine the source of the discrepancy, and corrective action will be implemented. "Dig" anomalies selected during the review that were not selected during the production interpretation will be automatically added to the TOI sheet.

ATTACHMENT 1

TRACKING LOG

GEO DATA TRACKING LOG

Marine Geophysical Survey for MEC

TETRA TECH EC, INC.

GEOPHYSICAL DATA TRACKING LOG

Transect Number	Date Collected	Hypack File Name	Geo Array File Name	Hypack Start Times	Hypack End Time	Geo Array Start Times	Geo Array End Time	Positioning Method (Boat/ Towfish)	Date Processed	Data Processor Initials	*.xyz Data filename for import into Oasis Project	Comments

APPENDIX B-5

GEOPHYSICAL SYSTEM VERIFICATION AND INSTRUMENT VERIFICATION STRIP PLAN

GEOPHYSICAL SYSTEM VERIFICATION AND INSTRUMENT VERIFICATION STRIP PLAN

Culebra Water Ranges – Flamenco Bay Water Area (MRS 03) and Luis Peña Channel (MRS 12)

Prepared under:

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May 14, 2015

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Reviewed by:

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Project Manager

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1. INTRODUCTION AND PROBLEM STATEMENT

The Culebra Island Archipelago, including the Northwest Peninsula of Culebra and the two marine areas of concern—the Flamenco Bay Water Area (Munitions Response Site [MRS] 03) and Luis Peña Channel (MRS 12)—was used as an impact range for aerial bombs and rockets, missiles, mortars, and naval projectiles from 1903 until 1975. The southern portion of the Northwest Peninsula of Culebra lies between the two water range MRSs (Figure 1). This peninsula was used as a target for aerial bombing, aerial rockets, strafing, and naval gunfire from roughly 1941 until 1975. The areas between the ridges on the peninsula were used as impact areas for conventional and napalm-laden bombs. Landing practice operations also took place on the beach areas of Flamenco Bay. Some of these exercises were accompanied by the firing of illuminating flares and white phosphorus rounds. Floating target structures may also have been towed offshore into Flamenco Bay or the waters of Luis Peña Channel and used for training. Most of the munitions discovered to date on the Northwest Peninsula appear to have resulted from naval gunfire, illumination flares, and practice bombs. The Archives Search Report[1] from Phase I of this investigation stated that the Tetra Tech EC, Inc. (TtEC) biological dive team observed munitions at Flamenco Beach. This was the only report of munitions and explosives of concern (MEC) or munitions debris (MD) in the waters of Flamenco Bay. The Archives Search Report also documented a local scuba dive instructor who said he spotted many underwater ordnance items around Culebra, with the highest concentration in the Luis Peña Channel and water west of Flamenco Peninsula.

The project team has determined that additional information concerning the capability of TEMA systems to meet data quality objectives is necessary before using the TEMA system to collect survey data of the water range MRSs to determine the anomaly locations of potential MEC items in subtidal areas. These data will be used in support of remedial design to identify clusters and discrete anomaly locations that would be investigated for the presence of MEC as part of the remedial action.

[1] USACE (U.S. Army Corps of Engineers). 1995. Archives Search Report—Findings for Culebra Island National Wildlife Refuge. Culebra, Puerto Rico. Property Number I02PR0068. Defense Environmental Restoration Program for Formerly Used Defense Sites Ordnance and Explosive Waste. USACE Rock Island District. February.

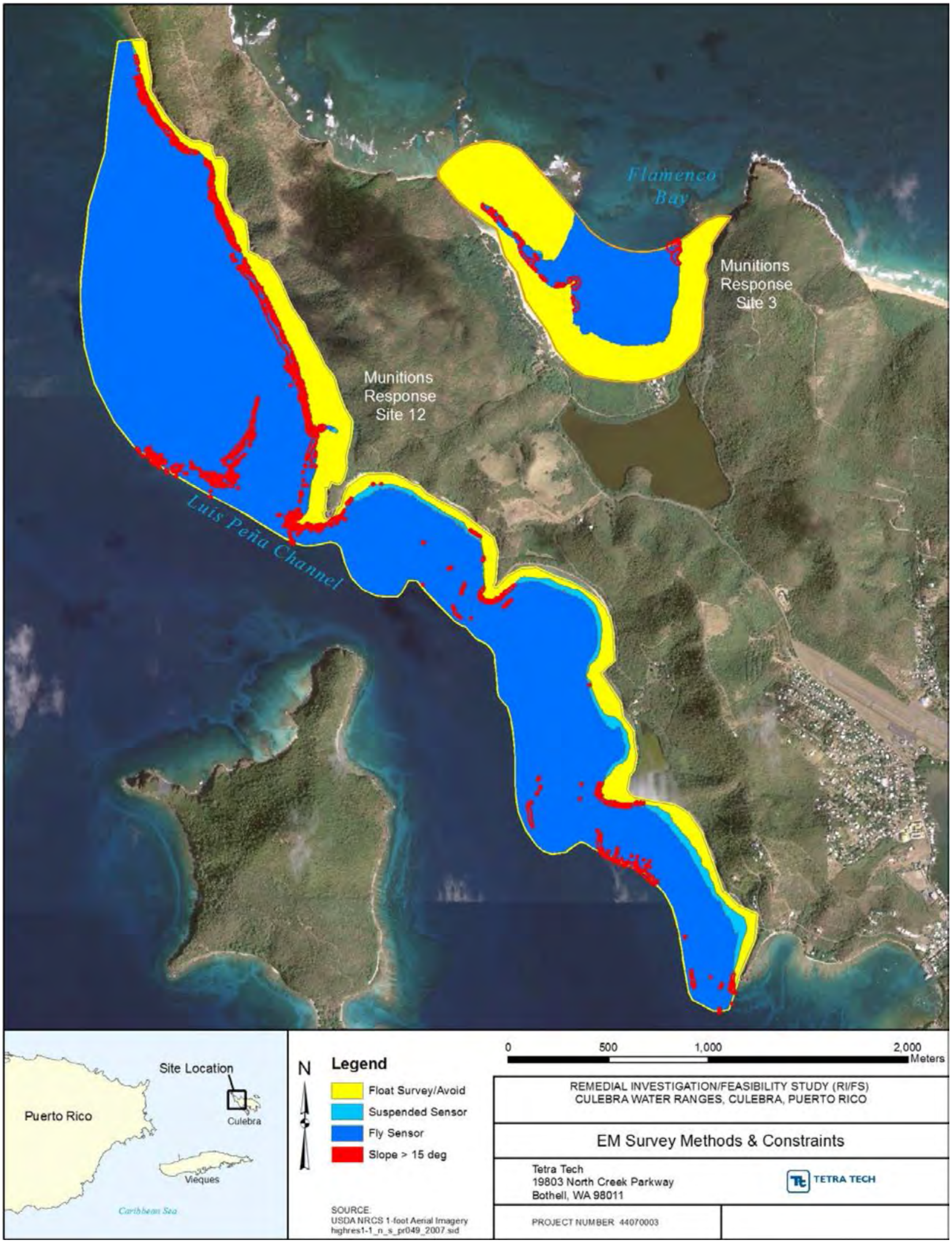


Figure 1. Survey Areas: Flamenco Bay Water Area (MRS 03) and Luis Peña Channel (MRS 12). Colors denote deployment method/slope constraints

2. GEOPHYSICAL SYSTEM VERIFICATION

The evaluation and cleanup of current and former military sites contaminated with buried munitions relies primarily on electromagnetic (EM) induction to detect the munitions. Electromagnetic induction is a well-understood geophysical technology that can be accurately modeled for specific targets. To ensure quality data acquisition at the site, a Geophysical System Verification (GSV) process will be implemented. The GSV is a simplified but more rigorous verification of the geophysical system than the traditional Geophysical Prove-Out (GPO), which was in the past the standard method for system validation.

The GSV design for this project is based on a study by the Environmental Security Technology Certification Program (ESTCP)[2] and will be composed of an Instrument Verification Strip (IVS). The traditional GPO, which consisted of tens to hundreds of targets, will be replaced with an IVS containing approximately six targets. The objective of the IVS is to verify that the geophysical detection system is operating properly. The IVS targets should not only be detected but the targets observed in the EM data should be consistent with physics-based model predictions.

3. INSTRUMENT VERIFICATION STRIP

3.1 Initial IVS Location

The IVS will be located in a zone shown to be free from pre-existing magnetic anomalies, and containing a sand bottom. The IVS will be placed in a location that has water depths between 0.5 meter (m) and approximately 4 m or 5 m below mean low-low water (MLLW) and no greater than 10 m below MLLW. The placement of the IVS will allow for adequate vessel maneuverability at both ends, with no less than 300 feet of run in. The initial IVS will contain six items, while the daily IVS will only contain a single item, a section of pipe. It is anticipated that the initial IVS will be conducted in MRS 03, due to the sand bottom present there.

3.2 IVS Targets

The IVS will be constructed using industry standard objects (ISO). ISOs will be a critical component of the GSV because both the IVS and seeded items rely on the availability of well-characterized targets to verify the sensor performance. Three sizes of commonly available pipe sections have been selected and characterized (Figure 2). These ISO are easily obtained and are made to the same specifications regardless of where they are obtained. Table 1 provides the specifications of the three ISOs that will be used in the IVS.

[2] ESTCP (Environmental Security Technology Certification Program). 2009. *Geophysical System Verification (GSV): A Physics-based Alternative to Geophysical Prove-Outs for Munitions Response.* July.

Figure 2. Industry Standard Objects Characterized for Use as Munitions Surrogates (medium-size at center, large-size on the right)

Table 1. Industry Standard Object (ISO) Items

Item	Nominal Pipe Size	Outside Diameter	Length	Part Number[1]	ASTM Specification
Small ISO	1"	1.315" (33 mm)	4" (102 mm)	44615K466	A53/A773
Medium ISO	2"	2.375" (60 mm)	8" (204 mm)	44615K529	A53/A773
Large ISO	4"	4.500" (115 mm)	12" (306 mm)	44615K137	A53/A773

NOTE: Table taken from the 2009 ESTCP GSV report.
[1] Part number from the McMaster-Carr catalog.

3.3 IVS Target Distribution

The Towed Electromagnetic Array (TEMA), which will be used to conduct geophysical surveys in the Flamenco Bay Water Area (MRS 03) and Luis Peña Channel (MRS 12), is composed of an array of three EM sensors. The center to center distance between each sensor is approximately 1 m across track. Therefore, the IVS is designed with targets located on similarly spaced parallel tracks as shown in Figure 3. The location of items has been determined based primarily on size, providing additional spacing between larger items that will produce large anomalies. Table 2 provides a list of the IVS items and their associated coordinates and orientations. The target positions are provided in a relative coordinate system centered on the south end of the line.

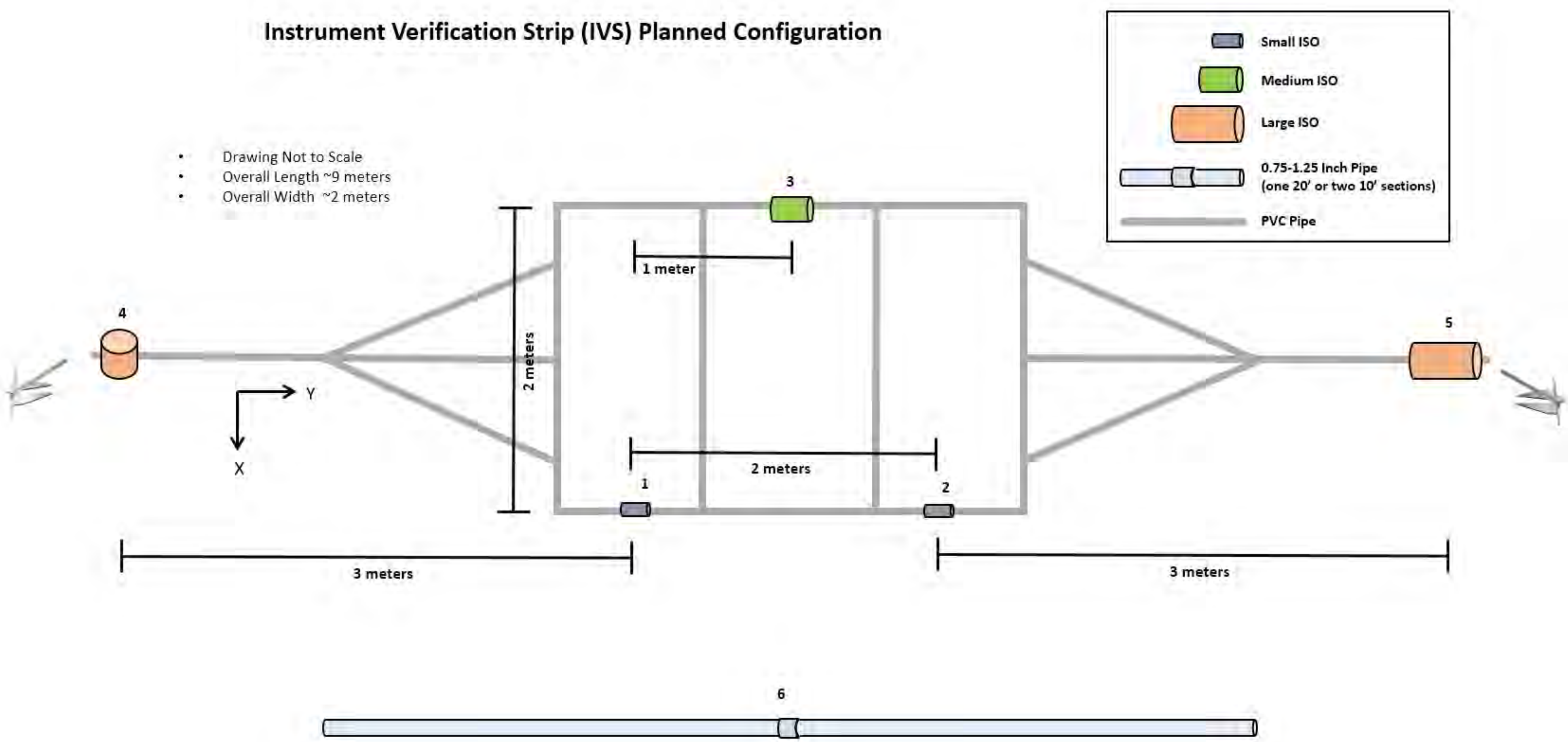


Figure 3. IVS Planned Configuration

Table 2. IVS Target Layout Parameters

Item Number	Item Type	Orientation	Azimuth
1	Small ISO	Horizontal	Perpendicular
2	Small ISO	Horizontal	Perpendicular
3	Medium ISO	Horizontal	Perpendicular
4	Large ISO	Vertical	NA
5	Large ISO	Horizontal	Perpendicular
6	0.75- to 1.25-inch Pipe	Horizontal	Perpendicular

3.4 IVS Target Placement

The orientation of the targets affects the response measured by EMI (electromagnetic induction). To improve the quantitative analysis of the target measurements, each horizontally oriented target should be affixed such that its orientation will be retained throughout the duration of the project (Figure 3). The target orientation will be determined in advance for each item and must be carefully verified at the time of placement. The IVS will be surface laid, not buried.

3.5 IVS Target Placement Positioning

Quantitative system verification requires that the physical parameters of the IVS targets be known. Physical parameters include the item types, their orientations, and locations. The location of the IVS targets will be measured with a real-time kinematic global positioning system (RTK GPS) or ultra-short baseline (USBL) acoustic positioning system.

If a USBL is utilized, it will be integrated with an RTK GPS and have an uncertainty equal or less the 0.2 percent of the slant range (*IXSEA GAPS Technical Specification*, February 2011). Therefore, the total uncertainty of the USBL system is the combined uncertainty of the GPS plus the uncertainty of the USBL.

For example, the maximum water depth in the vicinity of the IVS is up to 10 m (~33 feet). If the USBL is within 100 feet laterally of the target, then the slant range is ~110 feet and the uncertainty is approximately 0.2 foot. The horizontal uncertainty of the RTK GPS (0.1-0.2 foot) is added to this value and the total uncertainty is determined to be approximately 0.3 to 0.4 foot. To ensure this level of accuracy is obtained, multiple measurements of the target position will be recorded and a statistical average of the data will determine the target's final location.

The following is a step-by-step procedure placing the IVS items.

TEMA-Lite IVS Deployment

1. Prepare the IVS setup in accordance with pre-built plan (Figure 3).
2. Prepare IVS targets (ID numbers, photos, attach to frame).
3. Locate one end of IVS anchor line.
4. Install buoy at that end.

5. Position the IVS frame.
6. Record ISO item positions with RTK GPS.
   a. If conditions allow, the surveyor will use the "plumb stick" method to position the item. Using a plumb rod, the surveyor will position one end on item.
   b. The surveyor will check plumb and position RTK GPS receiver over plumb stick. Once stick is plumb, RTK GPS coordinates will be taken.
   c. If "plumb stick" method cannot be accomplished due to environmental situations, the following method will be used to take RTK GPS readings:
      i) A clump weight will be positioned on each item (after installation) and a buoy on the water surface.
      ii) Buoy line will be plumbed from the water surface via the support boat and position recorded with RTK GPS.
   d. The surveyor will proceed to the next item and repeat.

Note: Repeat process at each 0.5-m depth interval.

TEMA-MK3 IVS Deployment

For the TEMA-MK3 IVS runs, the USBL will be used to position the targets. The target positioning method for the USBL is described below.

1. The two USBL transponders (slightly negatively buoyant) will be attached to the IVS PVC frame.
2. The IVS will be placed in 4 to 6 m of water.
3. The survey vessel will transit over the IVS and record the transponder positions.
4. The USBL data will be recorded. The longer the transponder is interrogated to establish the seed item location, the more accurate the position will be because the pool of errors is reduced by multiple fixes. The most accurate method is to "box" the item by fixing from all aspects; these data can then be processed post-mission to give the most accurate position.

The full IVS will be run at the beginning of the project and then the modified IVS (pipe section only) will be run once per day each day that TEMA data are collected during the project.

3.6 TEMA-Lite Initial IVS Data Collection

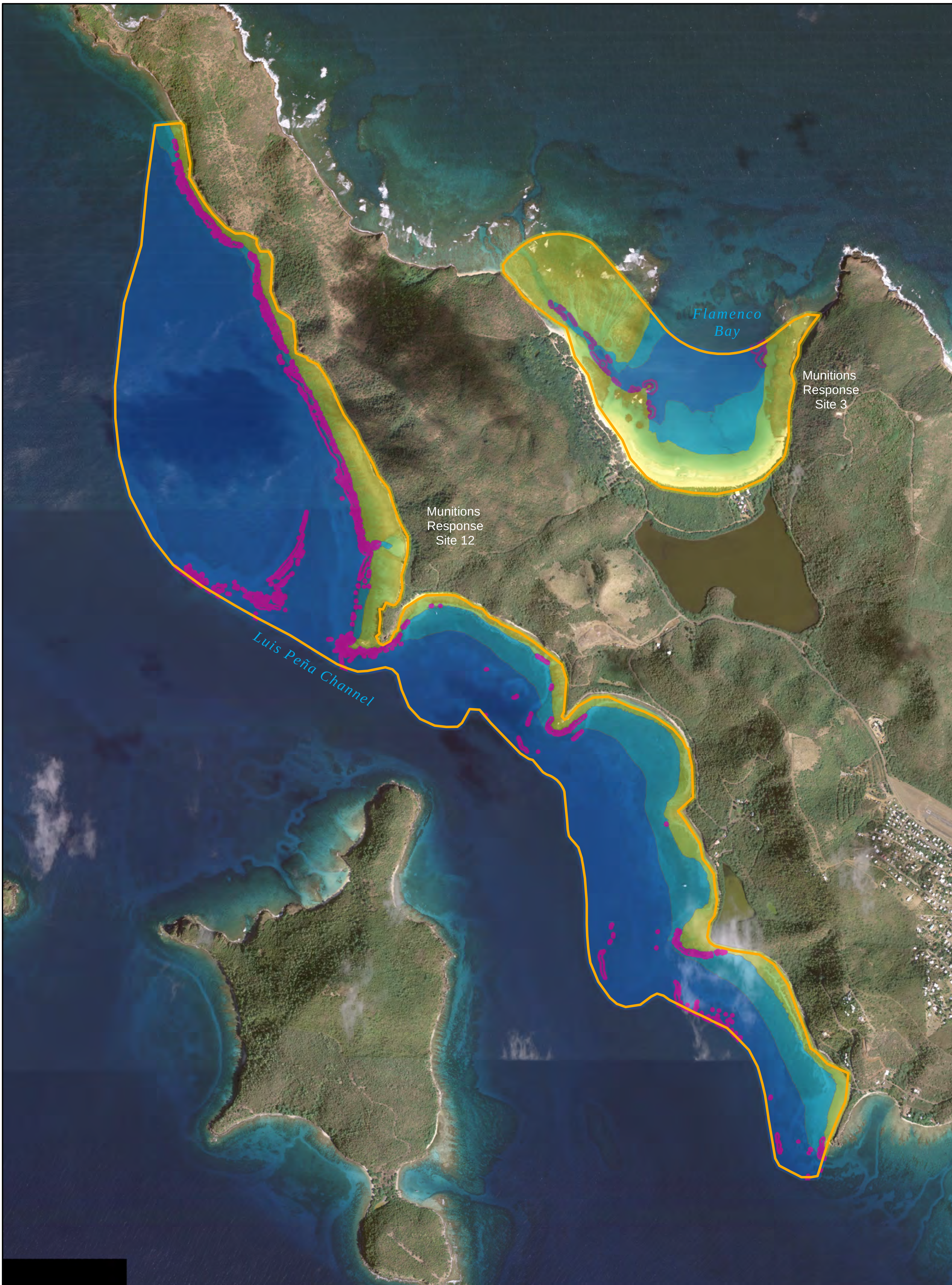
The initial IVS will be placed in ~0.5 m to 3 m of water, in 0.5-m increments, and the TEMA-Lite will be run over it (0.5 m, 1 m, 1.5 m, 2 m, etc.) until the large ISOs are no longer detectable. The IVS ISO will be located via RTK GPS.

3.7 TEMA-MK3 IVS Initial IVS Data Collection

The initial IVS will be retrieved and have GAPS transponders mounted onto its PVC frame so that the IVS can be positioned via the GAPS USBL onboard the survey vessel. The IVS will be moved into deeper water (approximately 4 to 6 m), and then the TEMA-MK3 will be flown over the IVS at 1 m, 1.5 m, 2 m, 2.5 m, etc., until the large ISOs are no longer detectable.

APPENDIX C

SITE MAPS



Survey Lines by Depth

- < 10 ft
- 10 to 25 ft
- > 25 ft
- Slope >15 deg

Note: Ability to survey < 10 ft areas dependent on water depth and weather conditions

SOURCE: USDA NRCS 1-foot Aerial Imagery

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)
CULEBRA WATER RANGES, CULEBRA, PUERTO RICO

Figure C-1: VSP Water Depth Zones

Tetra Tech EC
1230 Columbia St. 750
San Diego, CA 92101

Tetra Tech
PO Box 79192
Carolina, PR 00984

TETRA TECH EC, INC.

PROJECT NUMBER 44070003

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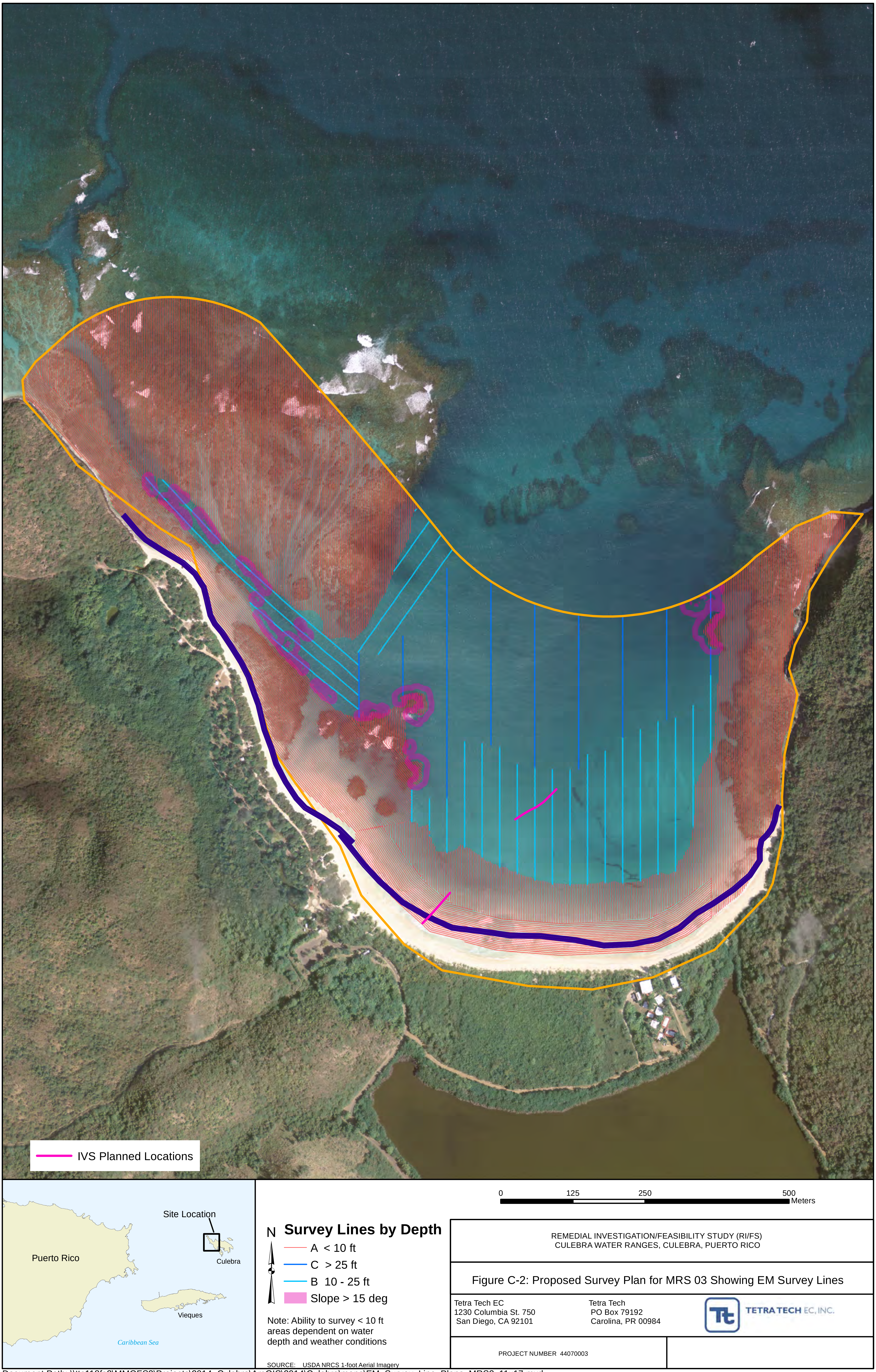


REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)
CULEBRA WATER RANGES, CULEBRA, PUERTO RICO

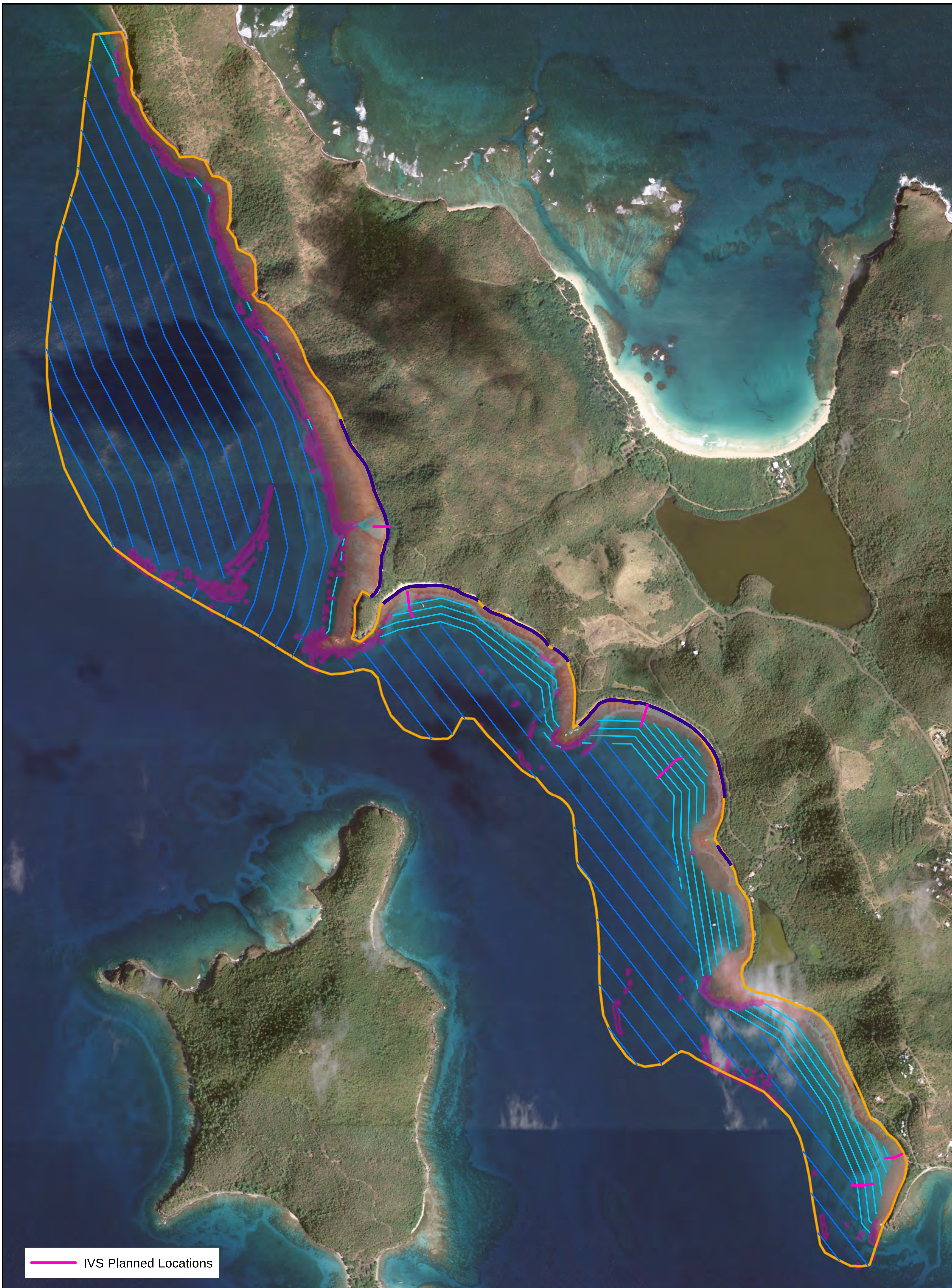
Figure C-2: Proposed Survey Plan for MRS 03 Showing EM Survey Lines

Tetra Tech EC
1230 Columbia St. 750
San Diego, CA 92101

Tetra Tech
PO Box 79192
Carolina, PR 00984

TETRA TECH EC, INC.

PROJECT NUMBER 44070003



0 375 750 1,500 Meters

N

Survey Lines by Depth

- A < 10 ft
- B 10 - 25 ft
- C > 25 ft
- Slope >15 deg

Note: Ability to survey < 10 ft areas dependent on water depth and weather conditions

SOURCE: USDA NRCS 1-foot Aerial Imagery

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)
CULEBRA WATER RANGES, CULEBRA, PUERTO RICO

Figure C-3: Proposed Survey Plan for MRS 12 Showing EM Survey Lines

Tetra Tech EC
1230 Columbia St. 750
San Diego, CA 92101

Tetra Tech
PO Box 79192
Carolina, PR 00984

TETRA TECH EC, INC.

PROJECT NUMBER 44070003

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APPENDIX D

POINTS OF CONTACT

Points of Contact

Organization	Name	Telephone
U.S. Army Corps of Engineers Jacksonville District 701 San Marco Boulevard Jacksonville, FL 32207-0019	Wilberto Cubero-Deltoro, Project Manager Email: Wilberto.Cubero-delToro@usace.army.mil	Desk (904) 232-1426 Cell (904) 316-8248
U.S. Army Corps of Engineers Jacksonville District 701 San Marco Boulevard Jacksonville, FL 32207-0019	Paul DeMarco, Biologist Email: Paul.M.DeMarco@usace.army.mil	Desk (904) 232-1897
U.S. Army Corps of Engineers Jacksonville District 701 San Marco Boulevard Jacksonville, FL 32207-0019	Wendy Weaver, Archaeologist Email: Wendy.Weaver@usace.army.mil	Desk (904) 232-2137
U.S. Army Corps of Engineers Jacksonville District 701 San Marco Boulevard Jacksonville, FL 32207-0019	Amanda Parker, Public Affairs Specialist Email: Amanda.D.Parker@usace.army.mil	(904) 232-1576
U.S. Army Corps of Engineers Ordnance and Explosives Design Center P.O. Box 1600 Huntsville, AL 35807-4301	Roland Belew, PMP, Project Manager Email: Roland.G.Belew@usace.army.mil	Desk (256) 895-9525 Cell (256) 503-0661 Cell (256) 213-8209
U.S. Army Corps of Engineers Ordnance and Explosives Design Center P.O. Box 1600 Huntsville, AL 35807-4301	Kelly D. Enriquez, Geophysicist Email: Kelly.D.Enriquez@usace.army.mil	(256) 895-1373
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PRDNER-Carr.8838 Sector El Cinco Rio Piedras, SJ, PR 00936	Damaris Delgado, President Bureau of Coasts, Reserves, and Refuges, DNER Email: d.delgado@drna.goberierno.pr	(757) 999-2200 Extension 2107
PRDNER-Carr.8838 Sector El Cinco Rio Piedras, SJ, PR 00936	Nilda Jimenez Marrero Marine Resource Division, DNER Email: njimenez@drna.goberierno.pr	(787) 772-2022
PRDNER-Carr.8838 Sector El Cinco Rio Piedras, SJ, PR 00936	Craig Lilyestrom, Director Marine Resource Division, DNER Email: Craig.Lilyestrom@drna.goberierno.pr	(787) 772-2022

Organization	Name	Telephone
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US Fish and Wildlife Service Culebra National Wildlife Refuge PO Box 190 Culebra, PR 00622	Edwin Muñiz, Field Supervisor Email: Edwin_Muñiz@fws.gov	(787) 851-7297
US Fish and Wildlife Service Culebra National Wildlife Refuge PO Box 190 Culebra, PR 00622	Ms. Marelisa Rivera, Deputy Field Supervisor Email: Marelisa_Rivera@fws.gov	(787) 851-7297 Extension 206
*USEPA Centro Europa Building Suite 4171492 Ponce de Leon Avenue San Juan, PR 00907-4127	Karl Soderberg, Regional Administrator Email: not provided	(787) 977-5870
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USFWS P.O. Box 510 Boqueron, PR 00622	Susan Silander, Project Leader Email: Susan_Silander@fws.gov	(787) 851-7258 Extension 306

Organization	Name	Telephone
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APPENDIX E

ACCIDENT PREVENTION PLAN

FINAL, REVISION 1

ACCIDENT PREVENTION PLAN

Phase 2 Remedial Investigation Digital Geophysical Mapping / Electromagnetic Surveys Culebra Water Ranges – Flamenco Bay Water Area (MRS 03) and Luis Peña Channel (MRS 12)

Culebra, Puerto Rico

April 30, 2015

Task Order 0003
Contract No. W912DY-10-D-0015

Prepared for:

U.S. Army Corps of Engineers, Jacksonville District
701 San Marco Boulevard
Jacksonville, FL 33207
&
U.S. Army Engineering and Support Center, Huntsville
4820 University Square

Huntsville, AL 35816-1822

Prepared by:

TETRA TECH EC, INC
1050 NE Hostmark Street, Suite 202
Poulsbo, Washington 98370

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Exhibit 2 Corporate Health and Safety Program Procedures List
Exhibit 3 Zero Incident Performance®
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ATTACHMENTS

Attachment A Activity Hazard Analyses
Attachment B Select Environmental Health and Safety Procedures (on CD only)
Attachment C Inspection and Reporting Forms

ABBREVIATIONS AND ACRONYMS

AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
BLS	Bureau of Labor Statistics
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
CSP	Certified Safety Professional
DART	Days Away/Restricted or Transfer
DID	Data Item Description
DMM	discarded military munitions
EBS	Environmental Baseline Survey
EC	Emergency Coordinator
EHS	Environmental Health and Safety
EM	Engineer Manual
EMR	experience modification rating
FCR	Field Change Request
FOL	Field Operations Lead
FS	feasibility study
GFCI	ground fault circuit interrupter
HTRW	hazardous, toxic, and radioactive waste
MC	munitions constituent
MEC	munitions and explosives of concern
MRS	munitions response site
MSDS	Material Safety Data Sheet
OSHA	Occupational Safety and Health Administration
PE	Professional Engineer
PFD	personal flotation device

ABBREVIATIONS AND ACRONYMS
(Continued)

PjM	Project Manager
PM	Project Manager (USACE)
PPE	personal protective equipment
RI	remedial investigation
ROV	remotely operated vehicle
SDS	Safety Data Sheet
SHM	Safety and Health Manager
SOP	Standard Operating Procedure
SSHO	Site Safety and Health Officer
TEMA	Towed Electromagnetic Array
TtEC	Tetra Tech EC, Inc.
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USCG	U.S. Coast Guard
UXO	unexploded ordnance
WERS	Worldwide Environmental Remediation Services
ZIP	Zero Incident Performance®

1.0 INTRODUCTION

1.01 This Accident Prevention Plan (APP) refers to written procedures that are a part of Tetra Tech EC, Inc.'s (TtEC's) Environmental, Safety, and Quality Programs. The plan specifies the written corporate procedure by number. The cover page to this document has the signatures of the plan preparer, the Safety and Health Manager (SHM), who is a Certified Industrial Hygienist (CIH), and the Program Manager.

1.02 This APP was prepared for the U.S. Army Engineering and Support Center, Huntsville (USAESCH) in accordance with applicable sections of the Data Item Description (DID) Worldwide Environmental Remediation Services (WERS)-005.01 under Contract Number W912DY-10-D-0015. The APP assigns responsibilities, establishes standard operating procedures, and sets forth contingencies that may arise while operations are being performed and establishes policies and procedures to protect workers and the public (if applicable) from the potential hazards posed by site work. The elements of this plan comply with the informational requirements of Occupational Safety and Health Administration (OSHA) (29 Code of Federal Regulations [CFR] and the Safety and Health Requirements Manual, Engineer Manual [EM] 385-1-1 (2008 consolidated 2011), and TtEC's Environmental, Health, and Safety programs.

1.1 SIGNATURE SHEET

1.1.1 Plan Preparer

Prepared by: Jennifer Peters
Senior Safety and Health Specialist (360) 598-8108

1.1.2 Plan Approver

Approved by: Kent Weingardt
Program Manager (619) 471-3532

1.1.3 Plan Concurrence

Roger N Margotto, CIH

Concurrence: Roger Margotto, CIH, CSP, CHMM
Safety and Health Manager
(619) 471-3503

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2.0 BACKGROUND INFORMATION

a. Contractor: Tetra Tech EC, Inc.

b. Contract Number: W912DY-10-D-0015 (Task Order 0003)

c. Project Name: Phase 2 Remedial Investigation at Culebra Water Ranges, Culebra, Puerto Rico

d. Project Description and Location

The overall project being performed under this contract, Task Order 0003, is performance of a Remedial Investigation (RI)/Feasibility Study (FS) [RI/FS] at the Culebra Water Ranges, which comprise two munitions response sites (MRSs), Flamenco Bay (MRS 03) and the Luis Peña Channel (MRS 12) in Culebra, Puerto Rico (Figures 2-1 and 2-2). This phase of the project, the Phase 2 RI, is being performed prior to the RI/FS and is the sole activity covered by this APP. A separate APP is being prepared for the Phase 3 RI fieldwork activities that include intrusive investigations.

The objective of Phase 2 of the RI is to determine the likely distribution (number and density) of metallic objects in the survey areas that may be munitions and explosives of concern (MEC) items within the boundaries of MRS 03 Flamenco Bay and MRS 12 Luis Peña Channel through non-intrusive scientific surveys.

Data will be collected by personnel operating from boats using survey instrumentation deployed from a boat. The data collected during Phase 2 involves use of the towed or floated Towed Electromagnetic Array (TEMA) system, which will follow a survey line plan that provides a 90 percent probability of accurately characterizing the survey area. The TEMA towfish incorporates three high-power electromagnetic coils covering a 3-meter-wide swath. This system will be used to detect metallic objects on or under the seafloor. The TEMA towfish also includes a camera that will provide real-time video to the operators on the vessel to help prevent contact with sensitive habitats or entry into critical habitat areas that were identified during the Environmental Baseline Survey (EBS). In shallow water, the TEMA will be configured on a float system. In deeper water, it will be actively flown to maintain an approximately 1- to 2-meter altitude above the bottom.

Based on an evaluation of risk, there is a very low risk of the marine survey team coming into contact with MEC during the Phase 2 survey. However, in the event of MEC being detected during the survey, the hovercraft is piloted by a Senior Unexploded Ordnance (UXO) Supervisor (SUXOS) who will be available to assist the survey team with MEC avoidance as necessary.

Information from the EBS survey and the Phase 2 RI, including locations of possible UXO items derived from the geophysical survey and identified in the underwater video and/or intrusive sampling, will be used to determine the general locations and extents of contaminated areas requiring remediation that will be evaluated during the follow-on Phase 3 RI. A separate or updated APP will be submitted for Phase 3 of the RI.

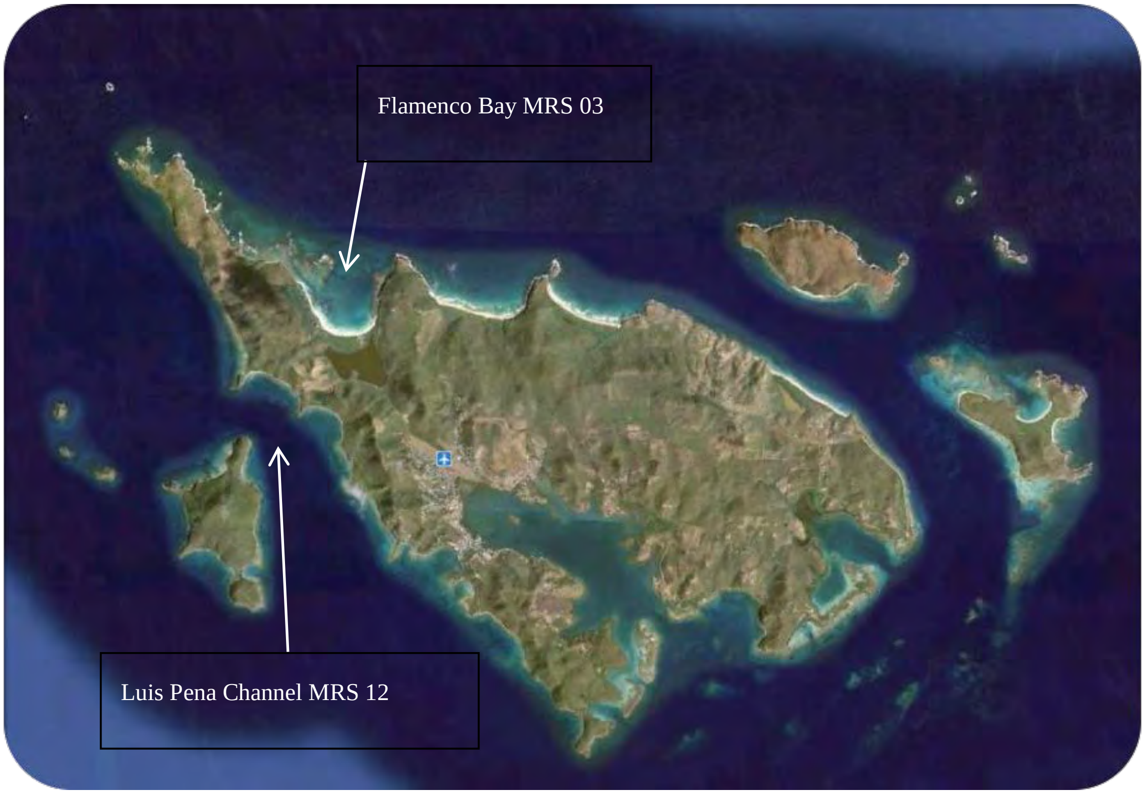

Figure 2-1. Regional Location Map

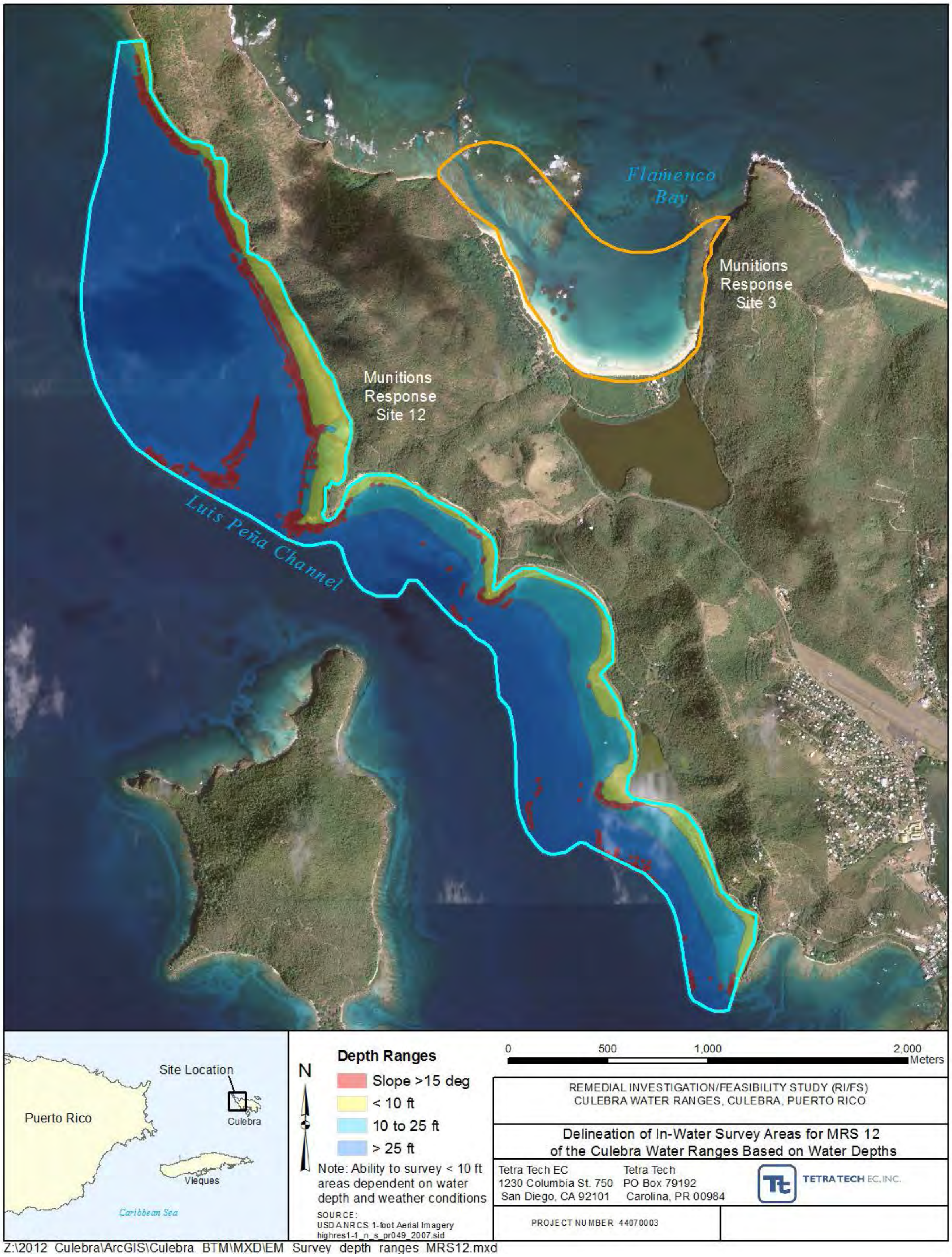

Figure 2-2a. Site Location Map MRS 12

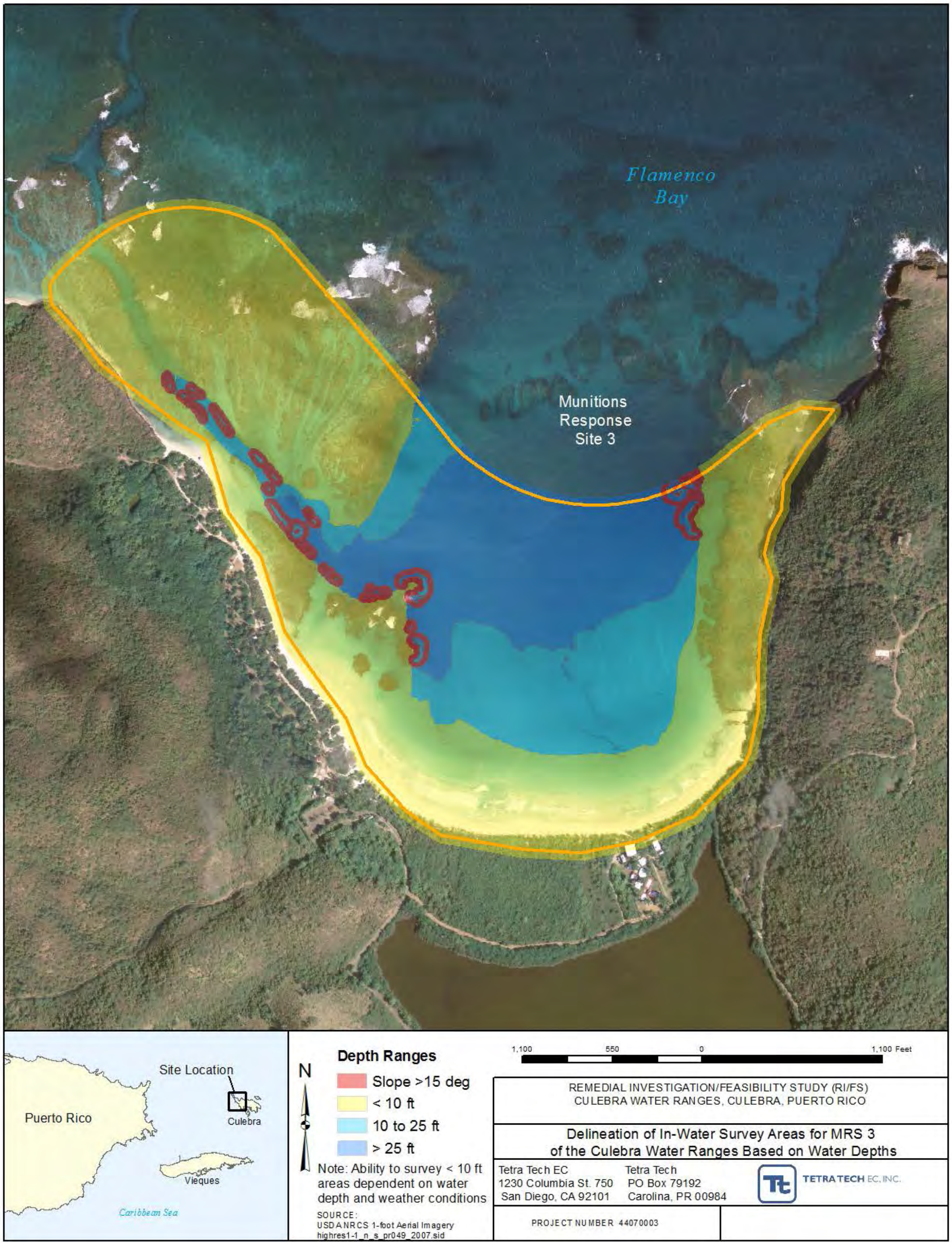

Figure 2-2b. Site Location Map MRS 03

e. Table 2-1 below presents safety statistics for TtEC for the last 3 calendar years, as compared to the national averages for our industry. This comparison uses data collected by the U.S. Department of Labor, Bureau of Labor Statistics (BLS) for different types of employers, segregated by North American Industry Classification System (NAICS) codes.

Table 2-1. Comparison of TtEC and 2013 Bureau of Labor Statistics (BLS) Data for NAICS Code 562910 (TRIR and DART Rates)

	NAICS 562910 Remediation Services 2013	**TtEC 2012**	**TtEC 2013**	**TtEC 2014**
Total Recordable Incident Rate (TRIR)	2.7	0.30	0.59	0.91
Days Away/Restricted Duty/Transfer Rate (DART)	1.6	0.15	0.59	0.30

Additional information:

0.7 DA Bureau of Labor Statistics (BLS) 2013
0.9 RT BLS 2013

f. Phases of work requiring Activity Hazard Analysis (AHAs) are listed in Section 10.0.

3.0 STATEMENT OF HEALTH AND SAFETY POLICY

3.01 TtEC's goal is to maintain a safe and healthy work environment during the performance of the project activities. The work being conducted for the Phase 2 RI is not considered hazardous, toxic, or radioactive waste work as per EM 385-1-1 (USACE 2008); thus, a Site Safety and Health Plan is not specifically required. This APP has been developed to fulfill the goal of maintaining a safe and healthy work environment during the RI and achieve the following objectives:

- Instruct TtEC employees and contractors on procedures to minimize the potential for injury or exposure to hazardous conditions.
- Train TtEC employees and contractors on the proper action to be taken if a hazardous condition cannot be avoided by use of engineering controls.
- Provide guidelines for emergency response for known hazards and hazardous situations.
- Specify actions required to comply with applicable U.S. Department of Labor, OSHA, and other local regulations or other requirements.

3.02 This APP is a contractual requirement based on Appendix A of EM 385-1-1. Updates or revisions to the APP require acceptance by the TtEC SHM and submittal to the Government Designated Authority for acceptance. This APP and attachments must be on the project site at all times.

4.0 RESPONSIBILITIES AND LINES OF AUTHORITY

4.01 This section identifies the roles and responsibilities of TtEC personnel and contractors conducting field activities at the site. Personnel will be drawn from the company to ensure that managers and field representatives have the qualifications, training, and experience to safely conduct their respective tasks while also providing a safe work environment for contractors.

4.1 PROJECT ENVIRONMENTAL SAFETY MANAGER

4.1.01 The SHM will review and approve this APP and any amendments prior to their adoption. The SHM will assist with implementation of the APP and provide project support on health and safety issues. The SHM will consult with the Project Manager (PjM) if revision of this APP is required and if revision is required, the revised APP will be submitted to the Government Designated Authority for approval. The SHM will verify field personnel training, medical surveillance, and other requirements. The SHM will advise the PjM regarding industrial hygiene concerns, interpretation and evaluation of analytical exposure data, and other safety related issues, as needed. Contractor health and safety plans will be reviewed by the SHM.

4.1.0.2 The SHM for the Phase 2 RI at Culebra Water Ranges, Culebra, Puerto Rico, is:

Roger Margotto, CIH, CSP, CHMM
TtEC Program Safety and Health Manager
1230 Columbia Street, Suite 750
San Diego, California 92101
(619) 471-3503 office
(619) 988-0520 mobile
roger.margotto@tetratech.com

4.2 PROJECT MANAGER

4.2.01 The PjM is responsible for ensuring that the APP are prepared, reviewed, approved, and implemented. The PjM will not initiate field activities until the APP has been approved by the SHM and assigned personnel have received the required level of project-specific health and safety instruction. The PjM will review and evaluate field and laboratory data as they become available during the course of the project and consult with the SHM and SSHO if revisions to the APP are required. The PjM is responsible for the overall health and safety performance and compliance with applicable regulations and is the senior contact in the event of a site emergency. In addition, the PjM will ensure that health and safety activities are conducted according to APP requirements and according to other, relevant company policies and procedures. On-site injuries, illnesses, and accidents will be reported to the client by the PjM, SSHO, or the SHM.

4.2.02 The PjM for the Phase 2 RI at Culebra Water Ranges, Culebra, Puerto Rico, is:

Scot Wilson, PMP
Project Manager
1050 NE Hostmark Street, Suite 202
Poulsbo, WA 98370
(360) 598-8111 office
(360) 626-3193 mobile
scot.wilson@tetratech.com

4.3 FIELD OPERATIONS LEAD

4.3.01 The Field Operations Lead (FOL) is responsible for coordination of the Phase 2 RI activities on-site. The FOL is responsible for ensuring that all work is performed in accordance with the contract requirements in a safe and healthful manner. As a line manager, the FOL has the same responsibilities for health and safety program implementation as the PjM. The FOL will:

- Ensure that work crews have adequate resources to effectively conduct field activities.
- In conjunction with the SSHO, ensure that proper protective equipment is being used by all personnel.
- Ensure that appropriate disciplinary actions are taken when health and safety requirements are not being followed or when unsafe practices occur.
- Oversee work practices to verify that they are in accordance with this APP.
- Understand and be familiar with the APP.
- Participate in the daily tailgate safety meetings.
- Observe project personnel for signs of chemical or physical trauma or fatigue.
- Immediately notify the SSHO and the SHM of any illness, accident, injury, or near-miss incident.
- Correct any hazards disclosed by project workers or the SSHO.
- Act as the alternate Emergency Coordinator (EC).

4.3.02 The FOL has the authority to suspend field activities if the health and safety of personnel are in danger.

4.3.03 The FOL for the Phase 2 RI at Culebra Water Ranges, Culebra, Puerto Rico, is:

Richard Funk, PG
FOL/Quality Control Manager
(425) 482-7629 office
(206) 605-3482 mobile
richard.funk@tetratech.com

4.4 SITE SAFETY AND HEALTH OFFICER

4.4.01 The SSHO for the Phase 2 RI will be present on-site during the conduct of field operations and is responsible for all health and safety activities and the delegation of duties to the health and safety staff in the field. The SSHO is also the boat captain on this project. The SSHO is responsible for implementing the APP, ensuring that appropriate personal protective equipment (PPE) is used relative to the hazard that may be encountered, verifying that communication systems are in place, monitoring conformance with safety and emergency response procedures, giving safety briefings, seeing that safety equipment is maintained, and conducting safety drills and exercises. The SSHO has stop work authorization, which will be executed upon determination of an imminent safety hazard or potentially dangerous situation. Work cannot restart until clearance has been authorized by the SSHO. The SSHO is responsible for maintaining the site health and safety logbooks.

4.4.02 The SSHO possesses the knowledge and experience necessary to ensure that all elements of the APP are implemented and enforced on-site. The TtEC SSHO has a minimum of 5 years of experience and has completed a minimum of the OSHA 30-hour Construction Safety course and at least 24 hours of formal safety and health related coursework every four years. Every SSHO is certified as having completed training in first aid and cardiopulmonary resuscitation (CPR) by a recognized organization (such as the American Red Cross Association).

4.4.03 TtEC Environmental Health and Safety (EHS) Procedure 1-2 (EHS 1-2; see Attachment B for copies of EHS procedures) states that the SSHO is responsible for:

- Ensuring that TtEC employees understand the requirements of TtEC EHS programs and procedures through training and communication.
- Developing or assisting with the development of EHS plans in conjunction with project personnel.
- Assisting management with EHS plan implementation.
- Performing specific tasks in accordance with EHS plans.
- Fulfilling the specific responsibilities for project EHS personnel that are identified within each EHS procedure.

4.4.04 Additional responsibilities of the SSHO, as described in the TtEC EHS program, include but are not limited to:

- Investigating accidents, injuries, illnesses, near-misses, and other incidents.
- Ensuring that employees are trained on the hazards of hazardous substances used on any project, maintaining Material Safety Data Sheet (MSDS) and Safety Data Sheet (SDS) files to provide easy access to all employees, and performing inspections to ensure that all containers are labeled.

- Ensuring that the APP is read, understood, and signed by all field personnel including subcontractors. (The APP will be maintained and updated as needed, and one copy will be placed on or near the site safety bulletin board and postings.)
- Ensuring that tailgate safety meetings are conducted on days that work is performed. Ensuring that all meetings and any other additional training are documented.
- Assessing employee exposure through specified monitoring protocols and ascertaining that protective measures are appropriate.
- Verifying that project safety equipment is inspected, as required by the EHS program.
- Reporting to the Client within 24 hours all incidents required to be reported by EM 385-1-1 (USACE 2008); and reporting immediately to the client if any fatal injury occurs, one or more persons are admitted to a hospital, or if damage to government property occurs.
- Informing the PjM of any site personnel with medical restrictions.
- Determining and posting emergency phone numbers and routes to medical facilities and arranging for emergency transportation to the medical facilities.
- Serving as the Project Hazard Communication Coordinator.
- Serving as the Primary EC.

4.4.05 The SSHO for the Phase 2 RI at Culebra Water Ranges, Culebra, Puerto Rico, is:

Kyle Enright
(425) 482-7604 office
(425) 457-3255 mobile
kyle.enright@tetratech.com

4.5 WORK PARTY

4.5.01 Members of the work party, defined as personnel and contractors working on the project, are required to comply with the health and safety requirements presented in this APP and, if appropriate, in their corresponding company health and safety manuals. This project is supported by others as described in the Work Plan such as project geophysicists and a Field Investigation Coordinator. The Field Investigation Coordinator lives and works in Puerto Rico and has a wealth of local knowledge that will enhance the health and safety of the project team. The responsibilities of the work party members include, but are not limited to, the following:

- Read and understand this APP, including referenced procedures or plans.
- Participate in daily tailgate meetings and any project-specific training.
- Implement safe work practices and good personal hygiene for hazardous waste operations.

- When unsafe conditions or work practices are observed at the site, stop the work and notify a supervisor.
- Maintain and use PPE in good working condition.
- Respond to site emergencies, if necessary, and direct evacuation or summon emergency assistance.

4.6 COMPETENT PERSONS

4.6.01 Competent person(s) for anticipated health and safety-related issues that may arise on the project will be designated by the PjM and stated by name in the AHA or section of this APP where a competent person is specifically required by task. If the name of the competent person is not known after the APP and AHAs are finalized, the name of the competent person will be added to the plan by Field Change Request (FCR) when the person is designated. No work will be performed unless a designated competent person is on-site for any work that requires a competent person as required by OSHA and the EM 385-1-1.

4.6.02 Qualified personnel will be used for boating and/or hovercraft operation as overseen by the FOL, Richard Funk. Qualifications of personnel will be verified and documented.

4.7 LINES OF AUTHORITY

4.7.01 Figure 4-1 shows an organization chart depicting the lines of authority.

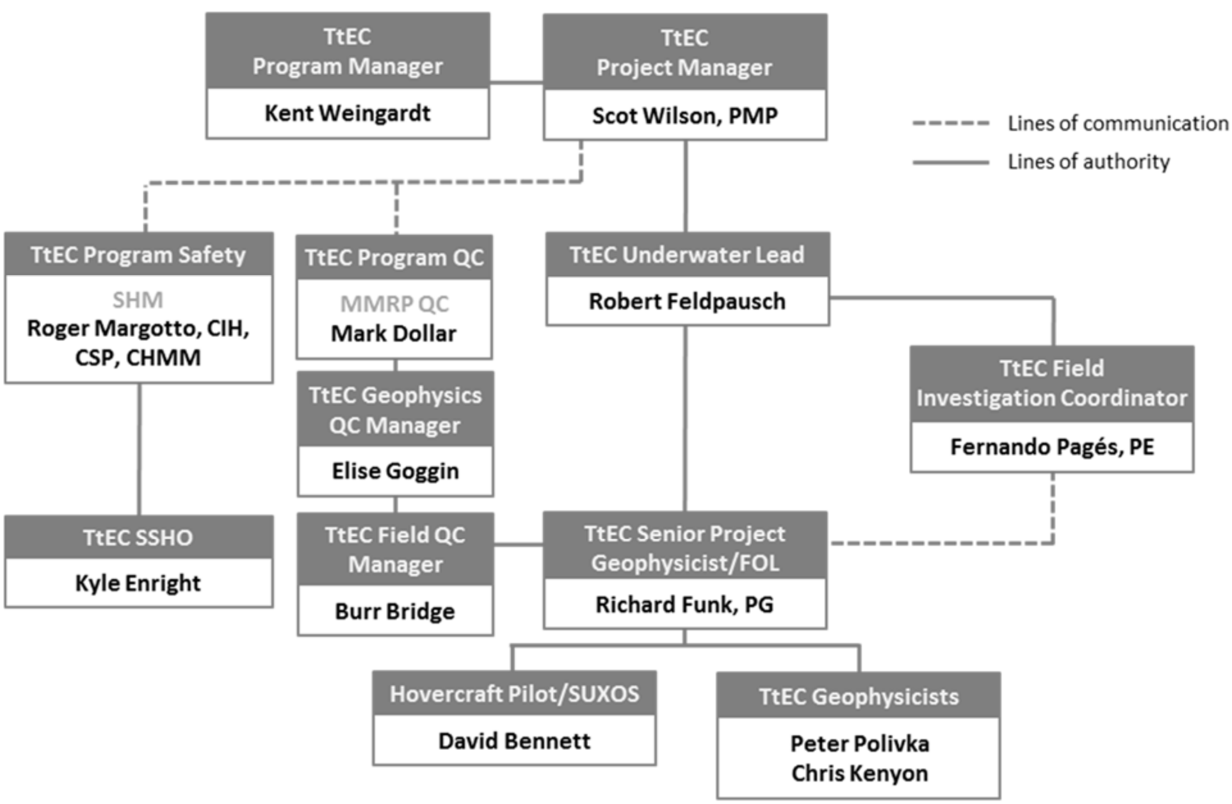

Figure 4-1. Organization Chart, Phase 2 RI

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5.0 SUBCONTRACTORS AND SUPPLIERS

5.1 IDENTIFICATION OF SUBCONTRACTORS AND SUPPLIERS

5.1.01 Subcontractors and suppliers anticipated during the course of the project include:

- Lodging/Office Space Rental – Out to bid

5.2 MEANS FOR CONTROLLING AND COORDINATING SUBCONTRACTORS

5.2.01 TtEC directs the subcontractor's supervisor regarding the tasks to be performed and the manner in which the tasks are performed. Subcontractors are responsible for assigning specific tasks to their employees; ensuring that their employees are properly trained and are in compliance with applicable regulations; and allocating sufficient time, materials, and equipment to safely complete activities in accordance with this APP and their individual health and safety plans.

5.3 SAFETY RESPONSIBILITIES OF SUBCONTRACTORS AND SUPPLIERS

5.3.01 This APP recognizes that projects such as this require that subcontractors and suppliers become involved during the course of the project. All subcontractors are responsible for compliance with this APP and other applicable regulations. Subcontractor personnel must receive a briefing from the SSHO prior to unescorted access to the project site. They must fulfill the requirements established by this plan. They must acknowledge receipt of the plan and the hazard communication briefing. On-site subcontractors are responsible for providing their personnel with appropriate PPE as specified by the plan. Subcontractor and third-party personnel have the authority to request a work area hazard assessment by the SSHO prior to the commencement or continuation of work. Any member of the work party observing an imminent safety hazard or potentially dangerous situation will immediately suspend field activities.

5.3.02 Most subcontractors have their own health and safety plans and/or company policies that are specific to their specialty services. TtEC management is responsible for making sure that subcontractor employees follow the policies and procedures of TtEC and the APP. If subcontractor safety plans are more restrictive, the subcontractor supervisors must ensure that their safety plans are also followed. Subcontractors' health and safety plans are reviewed by the SSHO and the SHM.

5.3.03 Hazards not listed in this APP but known by the subcontractor, or known to be associated with a subcontractor's specialty, must be identified by and addressed in the subcontractor's health and safety plan and during the daily tailgate meeting prior to beginning work. The subcontractor will inform the SSHO and the PjM. The subcontractors will also develop AHAs for review by the SSHO and the SHM or they will coordinate the completion of AHAs with the SSHO for subsequent review by the SHM.

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6.0 TRAINING

6.01 The Phase 2 RI portion of this project covered by this APP is not subject to the rules and regulations of 29 CFR 1910.120 (hazardous waste operations and emergency response). Although personnel on the project may have this training, and it will be applicable for tasks performed during Phase 3 of the RI, it is not required in Phase 2 or addressed in this APP. All new TtEC employees receive new employee training as required by corporate Human Resources and as specified in the Project Orientation, Rules and Safety Guidelines Handbook. Other training required on this project includes the following. Table 6-1 presents a summary of the required training.

Table 6-1. Training Summary

Personnel	Requirements
All General Site Workers	Site-specific orientation training. Hazard Communication Training to meet new standard. UXO Awareness Training.
Project FOL	First aid/CPR training in addition to General Site Worker training.
Site Safety and Health Officer	First aid/CPR training and General Site Worker training plus OSHA’s 30-hour Construction Safety course.
Boat Operator	Boating safety course meeting the criteria of the U.S. Coast Guard Auxiliary, National Association of Safe Boating Law Administrators or equivalent, and motorboat handling training, based on the type of boats they will operate.
Hovercraft Operator	Qualified hovercraft operations course (all operations) and a U.S. Coast Guard-approved boater safety course. Operator must have 5 hours experience in hovercraft operations prior to having others in craft.
Boat and Hovercraft Occupants	Safety briefing on boat operations and boat safety and emergency equipment, man overboard and abandon ship procedures.
Two workers, in addition to SSHO and Project Supervisors	First aid/CPR and Bloodborne Pathogens.
Users of portable fire extinguishers	OSHA-compliant fire extinguisher education [29 CFR 1910.157(g)].
Users of personal hearing protection and those enrolled in hearing conservation program	OSHA hearing conservation program and hearing protector use training [29 CFR 1910.95(i),(k)].

6.1 UNEXPLODED ORDNANCE AWARENESS TRAINING

6.1.01 There is no intrusive work and there is no handling or identification of MEC, including UXO allowed during the Phase 2 RI. The MRSs that are the subject of this phase of the RI and subsequent RI/FS may contain MEC items. Personnel working on this phase of the RI in the field will have UXO awareness training as part of the site orientation training with review of this

APP. The hovercraft operator is a qualified SUXOS. The SUXOS will provide UXO awareness training to the field crew and will be available to support MEC avoidance to the survey team should MEC be observed in either MRS during the survey.

6.1.02 The term MEC, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, includes UXO, as defined in 10 United States Code (USC) 101(e)(5); discarded military munitions (DMM), as defined in 10 USC 2710(e)(2); or munitions constituents (MC) (e.g., trinitrotoluene, Royal Demolition Explosive), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard. UXO are military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard; and remain unexploded whether by malfunction or design.

6.1.03 Munitions have the potential to kill or cause serious injury if improperly handled. UXO is the most dangerous form of MEC, as these items have been fired and did not detonate as planned, therefore, poses a higher risk of detonation. UXO is the form of MEC that is anticipated to be found at the Culebra Water Ranges based on prior use history.

6.1.04 Do not touch or attempt to identify any items during the survey.

6.1.1 MEC History at Culebra

6.1.1.01 The Culebra Island Archipelago (including the Northwest Peninsula of Culebra and the two water range MRSs) was used as an impact range for aerial bombs and rockets, missiles, mortars, and naval projectiles from 1903 until 1975. The southern portion of the Northwest Peninsula of Culebra lies between the two water range MRSs. This peninsula was used as a target for aerial bombing, aerial rockets, strafing, and naval gunfire from roughly 1941 until 1975. Most of the gunfire was indicated to have been fired from ships in the water east of the peninsula and directed at targets on its eastern beach and ridges and plateaus. The planned targets included white painted drums, Sherman tanks, trucks, panels, and circular targets painted on the ground. A movable cable target system also was constructed in this area and used for a short time.

6.1.1.02 The areas between the ridges on the peninsula were used as impact areas for conventional and napalm-laden bombs. Landing practice operations also took place on the beach areas of Flamenco Bay. Some of these exercises were accompanied by the firing of illuminating flares and white phosphorus rounds. Floating target structures may also have been towed off-shore into Flamenco Bay or the waters of Luis Peña Channel and used for training. Most of the munitions discovered to date on the Northwest Peninsula appear to have resulted from naval gunfire, illumination flares, and practice bombs. Since relatively flat trajectory projectiles were typically fired from the ships, it appears unlikely that many rounds fired from the northeast would have impacted on the western slope of the peninsula ridge. However, there may have been overshoots resulting in MEC landing in the Luis Peña Channel.

6.2 BOAT/HOVERCRAFT OPERATOR TRAINING AND CERTIFICATION

6.2.01 Boats used for the Phase 2 RI will be operated by experienced crewmembers who have successfully completed a boating safety course meeting the criteria of the U.S. Coast Guard (USCG) Auxiliary, National Association of Safe Boating Law Administrators or equivalent, and motorboat handling training, based on the type of boats they will operate, provided by qualified instructors. Boat operations will comply with TtEC's Boating Safety Procedure, EHS 6-6, and U.S. Coast Guard regulations.

6.2.02 Only qualified operators designated by TtEC Project Management, who have attended and successfully completed a qualified hovercraft operations course (all operations) and a USCG-approved boater safety course (for on-water operations) are allowed to operate hovercraft. The operator must have 5 hours experience in hovercraft operations prior to having others in craft. In addition, the operator will be familiar with and have experience operating the particular hovercraft in use and will follow established safety procedures and operation procedures outlined in the operations manual, the Hovercraft Operations Standard Operating Procedure (SOP). The Hovercraft SOP is included in Appendix B-2 of the Phase 2 Work Plan. When operating hovercraft on navigable waterways, the operator will follow the boating regulations and rules of the road established by the USCG.

6.3 SITE-SPECIFIC TRAINING

6.3.01 Prior to commencement of field activities, the SSHO will provide site-specific training to all personnel assigned to the site; this training will address the activities, procedures, monitoring, and equipment for the site operations. Training will include site and base layout, hazards, emergency response actions including: evacuation route(s), emergency services at the site, the hazard communication program, and will highlight all provisions contained within this APP. Boater/Hovercraft safety training will be given to all persons riding in boats/hovercraft used on this project. This training will also allow field-workers to clarify anything they do not understand and will reinforce each individual's responsibilities regarding safety and health for their particular activity. If additional training is required for completion of field tasks during site work, the SHM or SSHO will either conduct the training or manage site personnel to ensure that tasks are conducted by appropriately trained personnel.

6.4 ON-SITE SAFETY BRIEFINGS

6.4.01 Project personnel and visitors will participate in daily on-site health and safety briefings conducted by the SSHO, or designee, to assist site personnel in safely conducting their work activities. Safety briefings will be conducted at the start of new work activities using AHAs, which are provided in Attachment A. The briefings will include information on new operations, changes in work practices, or changes in the site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements, and identify performance deficiencies related to safety during daily activities or as a result of safety inspections, and review any events (such as near misses, injuries, or material release). Work will be stopped and a safety briefing will be conducted following any event that could compromise the safety of personnel or the environment.

6.5 FIRST AID AND CPR

6.5.01 The SSHO will identify those individuals who have completed current first aid and CPR training. At a minimum, two persons—the FOL (Richard Funk) and SSHO (Kyle Enright)—will be current in CPR/first aid. The names of all CPR/first aid qualified workers will be posted on the site bulletin board and will be added to this APP when the project starts.

6.5.02 A first aid kit meeting the requirements of EM 385-1-1, Section 03.B.01 (USACE 2008), will be readily available at each work site by having the kit out and ready for use. The location of each first aid kit must be clearly marked, and kits will be protected from the weather and maintained clean. The kit must contain all the items listed in Table 3-1 of the EM 385-1-1 manual and include one pocket mouthpiece or CPR barrier and latex gloves. The kit will be inspected weekly, and items will be replaced as they are used. Personnel trained in first aid and CPR will also have training in bloodborne pathogens and the protective measures to be used when providing CPR and first aid.

6.5.03 Effective December 1, 2013, all workers must have received training in the new OSHA HAZCOM standard incorporating the new labeling requirements, use of pictograms of chemical hazards, and the new SDS form that is replacing the MSDS. MSDSs and/or SDSs will be maintained on file in field office for each chemical product used on the project. These MSDSs/SDSs will be made available to each employee on request. The content of the MSDS/SDS will be discussed with the employee before they begin work. Workers who may be exposed to hazardous chemicals will be trained to recognize chemical contact hazards in the workplace, the physical properties and health hazards of hazardous chemicals, and the personal protective measures that will be taken to control exposures.

7.0 SAFETY AND HEALTH INSPECTIONS / SAFETY AND HEALTH EXPECTATIONS, INCENTIVE PROGRAMS, AND COMPLIANCE

7.1 SAFETY AND HEALTH INSPECTIONS

7.1.01 EHS 3-3, EHS Inspections, describes various inspection programs within TtEC. The procedure employs the use of checklists and requires daily, weekly, monthly, and quarterly inspections. Weekly inspections and the monthly inspection are documented on a form that is part of EHS 3-3. Equipment will be inspected prior to use to ensure that it is in proper working order.

7.1.02 Daily inspections and any deficiencies are noted on a deficiencies log as required by EM 385-1-1, Section 01.A.12d. The weekly inspection is conducted by the FOL or SSHO and the monthly inspection is performed by the PjM. The inspections are tracked for follow-up action on each of the respective forms. The monthly inspection is submitted to the SHM (a CIH) for review and follow-up. The SHM may conduct unannounced inspections at any time and will conduct the quarterly inspections. The SHM submits the quarterly inspection report to the SSHO, PjM, and the Program Manager.

7.1.1 Boat/Hovercraft Inspections

7.1.1.01 A small boat inspection checklist for use by boat crews is provided in Attachment C. The Hovercraft Operations SOP in Appendix B-2 of the Work Plan contains the operation and maintenance procedures and inspection schedule for the hovercraft operations. Boat and/or hovercraft inspections will be conducted by the boat/hovercraft operator initially for each boat brought to the jobsite and periodically thereafter throughout the duration of the project though the boat operator is responsible for pre-launch checks to ensure the boat is equipped with all required safety equipment and is in condition for launch.

7.1.2 Receipt Inspection for Heavy Equipment

7.1.2.01 Construction equipment, if used during the Phase 2 RI, will be subject to a receipt inspection by a TtEC person experienced in heavy equipment operations prior to acceptance at the project site. The inspections and tests will be in accordance with the manufacturer's recommendations. Most vendors provide a form for notation of any existing damage to the equipment to be filled out on receipt. The equipment should be inspected carefully to determine its condition, including any damage, missing or nonfunctional equipment. Pictures of any damage shall be taken and saved in the equipment file.

7.1.2.02 The agreement should be used as a basis to determine that everything contracted for (e.g., the equipment, its condition, manuals, spares, documentation of inspections, and certifications) has been delivered. All discrepancies should be noted on the form. A pre-inspection of the equipment prior to transport to the project site will be conducted. Particular attention should be given to the following items:

- All safety equipment and its condition.
- Operator certification on the equipment, when provided.
- Posted operating and safety instructions are present.
- All pollution control devices and their condition.
- All safety locking mechanisms and back up alarms.
- Safe entry and egress, with steps, ladders, handholds, and platforms provided as required, including safe access to perform routine checks, maintenance, and refueling operations.
- Leaking fluids, such as hydraulic oil, engine oil, transmission fluid, and coolant.
- Deteriorated or cracked hydraulic and coolant hoses which could result in leaks or spills.
- Presence of the manufacturer operation and maintenance manual.

7.1.2.03 Equipment with deficient conditions relating to safety or protection of the environment will not be placed into service until the deficiencies have been corrected and documented.

7.1.3 Daily Heavy Equipment Inspections

7.1.3.01 All heavy equipment will be subject to a daily (when in use) inspection for safety and operability, including manufacturers recommend daily inspections by the FOL. The SSHO will be notified of any deficiency immediately. The daily equipment inspection will be conducted at the start of the shift and provided to the SSHO.

7.1.4 Vehicle Inspections

7.1.4.01 Site vehicles will be subjected to a daily inspection for safety and operability. The inspection will include all safety related items such as windshield wipers, seat belts, tires, steering and brakes.

7.1.5 Communication Equipment

7.1.5.01 Cellular telephones and field radios will be tested each morning to ensure that batteries are properly charged and these units are functioning. It will be essential to verify that communication lines across the site and with emergency service providers are available at all times.

7.1.6 Tools

7.1.6.01 Power and hand tools will be inspected before use by the user. Any worn or damaged tools will be taken out of service for repair or replacement.

7.2 SAFETY AND HEALTH EXPECTATIONS, INCENTIVE PROGRAMS, AND COMPLIANCE

7.2.1 Safety Program Goals

7.2.1.01 TtEC believes that all incidents are preventable through careful planning, tasking, and error-free execution of the work. Company management personnel also believe that everyone is accountable for working safely and for identifying and controlling workplace hazards. This is the foundation of the TtEC Zero Incident Performance® (ZIP) philosophy. TtEC has adopted ZIP as a central goal and promotes it vigorously in all operations, because to accept a goal of anything more than zero is to assume and accept that some of our coworkers will get hurt. This is an unacceptable concession.

7.2.1.02 In pursuing this goal, TtEC anticipates zero recordable injury cases for the current and all subsequent years, no property loss events greater than $500, no first aid cases, or serious environmental releases (greater than reportable quantity). In achieving this goal, TtEC further anticipates a steady drop in recordable injury rates, Days Away/Restricted or Transfer (DART) incident rates and DART severity rates to well below industry averages. TtEC also expects EMR rates to remain less than 1.0 with a gradual lowering of the rate over time.

7.2.1.03 The TtEC Corporate Health and Safety Programs have a strong philosophy and policy regarding health and safety. Refer to the following exhibits (at the back of this APP):

Exhibit 1 – Environmental Safety and Quality Policy

Exhibit 2 – Corporate Health and Safety Program Procedures List

Exhibit 3 – Zero Incident Performance®

Exhibit 4 – Zero Incident Performance Pledge

7.2.2 Safety Incentives

7.2.2.01 Safety incentive programs are developed for large projects or programs. The incentive programs are site- and contract-specific. An incentive program has not been developed for this project; however, the PjM has the option of nominating employees who perform exemplar work for a Star of the Month award. This award program recognizes achievements in all fields including safety. Employees selected for the award receive a certificate and cash award.

7.2.3 Pre-Task Safety and Health Analysis

7.2.3.01 This plan requires the preparation of an AHA for each task. Four AHAs have been prepared and are included in Attachment A. This plan also requires that these task analyses be reviewed with all workers and that workers acknowledge their review of safety and health requirements for each task. Where subcontractors are used to perform certain work activities, the

SSHO will ask the subcontractor to provide an AHA for review or the SSHO will work with the subcontractor in the preparation of the AHA for review. The AHA must be reviewed by the SHM. As new activities are identified or the work environment of the task changes, new or revised AHAs are prepared by TtEC. These revisions or new AHAs will be submitted to the SHM and the client representative for review.

7.2.3.02 Each worker performing tasks described in an AHA must receive training in the AHA and be allowed to make comments and suggestions regarding the AHA to ensure that all hazards are properly identified and that control measures are in place to mitigate these hazards.

7.2.4 Policies Regarding Noncompliance

7.2.4.01 TtEC has a discipline program that is discussed in all new employee orientations and is also written in the TtEC Project Orientation, Rules and Safety Guidelines Handbook (TtEC 2014), a booklet that is given to every company employee. Briefly, the rules implement a progressive disciplinary program. However, if at any time there is a significant compromise of safety procedures, immediate termination of an employee is allowed by the procedure. The SSHO will immediately report to the PjM and SHM observations of noncompliance in the performance of the subcontractor or workers.

7.2.5 Manager and Supervisor Accountability for Safety

7.2.5.01 TtEC EHS 1-1 of the Corporate Safety Program requires that:

> "Line Management, the Project Manager, and supervisors, ensure that all company activities are executed in accordance with TtEC EHS programs, procedures, and applicable regulations. Line managers have primary EHS responsibility and have EHS personnel support to help them fulfill this responsibility."

8.0 ACCIDENT REPORTING

8.01 EHS 1-7, Event Reporting and Investigation, details the procedures and the forms used by TtEC for investigations and reports. All personnel working on site are expected to participate in the event reporting and notification process and to notify their supervisor of all incidents, including near misses. When an incident occurs, the site FOL will verbally notify the PjM immediately. The PjM must notify the Program Manager. The SSHO will notify the SHM.

8.02 After the verbal report, the FOL or SSHO must complete a written TtEC event report form within 24 hours. This form can be either prepared manually using the form found in the company procedure or the form can be completed electronically using a corporate TtEC database. Within 72 hours, a completed investigation report must be submitted. The investigation report is part of the initial written report form. These forms can be completed by persons involved in the incident, except that the investigation must be completed by a supervisor and/or the SSHO. All reports are reviewed by the PjM and the SHM upon submission. Within the reporting system, corrective actions and persons responsible for those corrective actions are identified. Corrective actions will be implemented as soon as reasonably practical. The system requires follow-up to ensure completion of corrective actions.

8.03 In accordance with DID WERS-005.01, the USAESCH Contracting Officer will be notified as soon as possible via telephone of any serious mishaps that occur at a given jobsite and a follow-up ENG Form 3394 Incident Report (see Attachment C) being sent to their office within 5 days of the event. A serious mishap is considered an accidents/incident which results in a fatality, injury of employees, lost workdays, and/or government property damage assessed at a cost of $2,000 or more. The contracting officer must also be notified immediately if any incident could bring adverse attention or publicity to the U.S. Army Corps of Engineers.

8.04 For all reportable injuries (fatality or one or more employee hospitalizations), OSHA will be notified by the SHM within 8 hours of the incident.

8.05 All recordable injuries, near miss incidents, high loss potential incidents, property damage incidents costing more than $500, first aid cases, and environmental spills (greater than reportable quantity) will be noted on TtEC's Program Incident Database (TOTAL). This database summarizes the accident/incident history of the program from the start of the contract and on a year-to-date basis.

8.1 IMMEDIATE NOTIFICATION OF MAJOR ACCIDENTS

8.1.01 Immediate reporting of incidents is required within TtEC. In addition, the USAESCH Contracting Officer will be immediately notified by the PjM (or a designee) of an accident (see list below) that is required to be reported by the USACE and EM 385-1-1. An accident that must be reported immediately to USAESCH is any injury requiring more than first aid or any government property damage in excess of $2,000. An ENG Form 3394 will be filled out and submitted to the Contracting Officer and SHM.

8.1.02 The following is a list of accidents or events to be immediately reported:

a. Fatal injury/illness;

b. Permanent totally disabling injury/illness;

c. Permanent partial disabling injury/illness;

d. One or more persons hospitalized as inpatients as a result of a single occurrence;

e. $200,000 or greater accidental property damage or damage in an amount specified by USACE in current accident reporting regulations (currently we report government property damage $2,000 or greater);

f. Arc flash incident/accident that results in a Class A or B injury;

g. USACE aircraft destroyed or missing;

h. One or more individuals become ill or have a medical condition which is suspected to be related to a site condition, or a hazardous or toxic agent on the site; and

i. Incidents and accidents involving cranes, rigging, falls from heights, or release of hazardous energy.

9.0 PLANS (PROGRAMS, PROCEDURES) REQUIRED BY THE SAFETY MANUAL (AS APPLICABLE)

9.01 TtEC has established written corporate requirements for compliance with regulations and implementing TtEC policy to prevent accidents and injuries. This section describes how some of these programs are implemented specifically for this project. The following sections are in the order shown in Appendix A to EM 385-1-1.

9.1 LAYOUT PLANS

9.1.01 This project will utilize a temporary office facility during fieldwork. Equipment storage and parking for site vehicles will be provided at the office location. Boats and hovercraft will be launched from a public or privately secured launch and dock facility.

9.1.02 It is not anticipated that any rights of entry or access agreements be secured for work on this project.

9.2 EMERGENCY RESPONSE PLANS

9.2.01 Emergency response has been planned for potential injuries or medical emergencies, explosions and fires, severe weather, man overboard or abandon ship situations, earthquakes, and spills.

9.2.1 Procedures and Tests

9.2.1.01 On this project, the SSHO is the primary Emergency Coordinator (EC) and the FOL (or boat captain if FOL is not present) is the alternate EC. In the event of an emergency situation such as fire or explosion, the EC will activate an air horn for approximately 15 seconds indicating the initiation of evacuation procedures. All personnel will assemble in a safe area identified by the EC. For the Phase 2 RI, the immediate assembly area will be one of two boats (including hovercraft) involved in the survey tasks, depending on whether or not the boat/hovercraft is involved in the fire or explosion. The location of the assembly area should be upwind of the fire or explosion. The assembly area will be used to account for all personnel and assess if anyone is missing. As soon as possible, and while the safety of all personnel is confirmed, emergency agency notification will commence. Following assembly, the boats/hovercraft will proceed to the dock and assemble in the evacuation area. The evacuation area(s) and routes from the evacuation area for each of the two MRSs are shown in Figures 9-1 and 9-2.

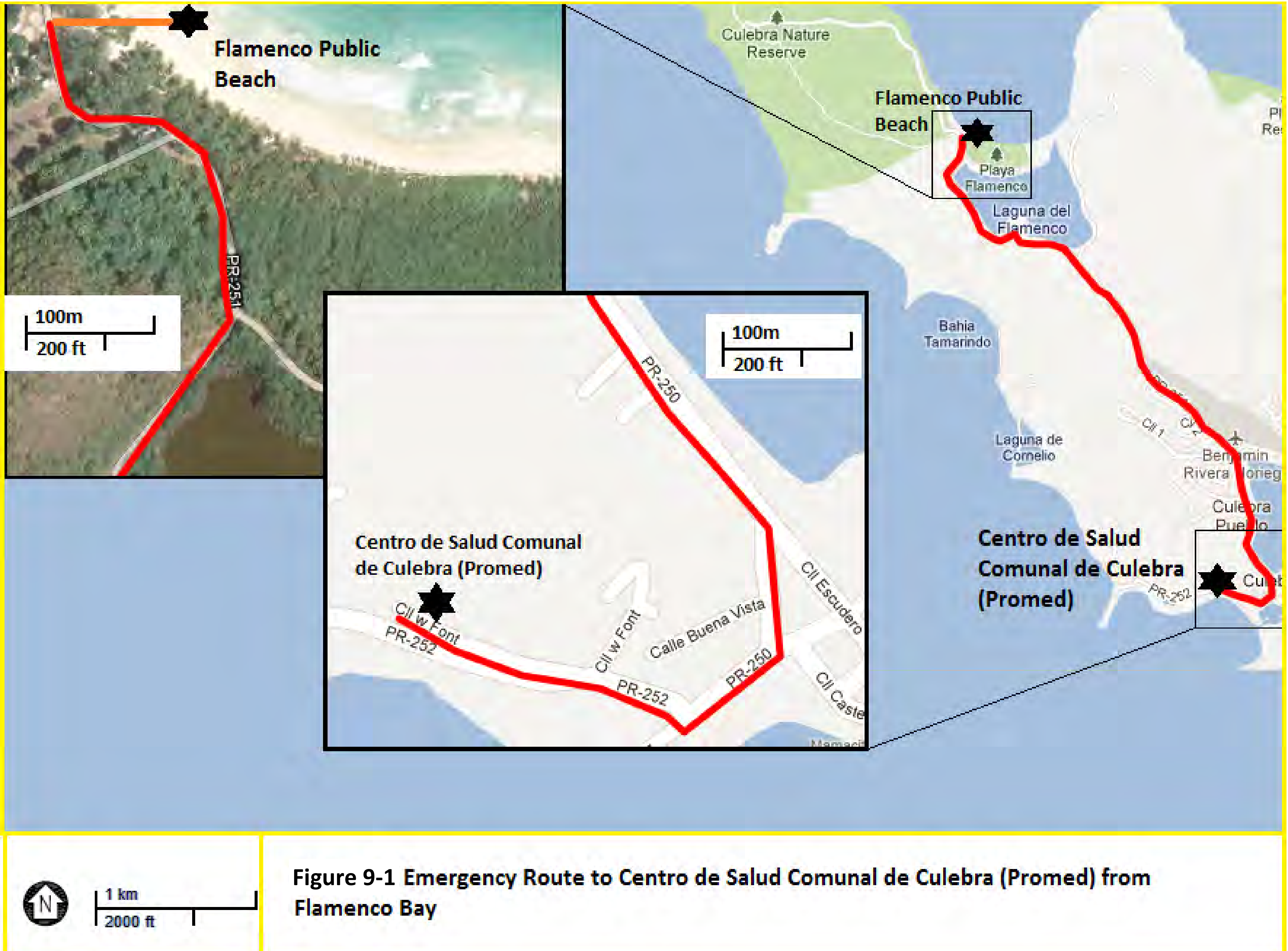

Figure 9-1 Emergency Route to Centro de Salud Comunal de Culebra (Promed) from Flamenco Bay

Figure 9-2 Emergency Route to Centro de Salud Comunal de Culebra (Promed) from Luis Pena Channel

9.2.1.02 For efficient and safe site evacuation and assessment of the emergency situation, the FOL or SSHO will have authority to initiate proper action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The SSHO must ensure that access is provided for emergency equipment and that equipment that may cause combustion has been shut down once the alarm has been sounded.

9.2.1.03 Before starting work, the SSHO will establish safe egress routes from the work location at each site to the site evacuation area. From this point, the map showing the route to the nearest clinic and hospitals (Figures 9-1 and 9-2) will be used if medical services are required.

9.2.1.04 An evacuation exercise will be practiced within 1 week of the start of the project and randomly during the course of the project. After the practice drill or after any actual evacuation, all involved site personnel will attend a briefing to evaluate the evacuation. The employees will discuss the evacuation and anything that could be done to improve or change future evacuations. The results of this briefing will be documented on a safety meeting attendance form. A copy of the evaluation report will be sent to the SHM.

9.2.2 Spill Plans

9.2.2.1 Spill Prevention

9.2.2.1.01 The project should not involve the handling of large containers of hazardous materials, however gasoline and oil are used on the boats and a spill or leak could occur. In addition to training, the following procedures will be implemented to prevent and minimize releases of hazardous materials:

- Do not conduct hazardous materials operations when the weather could cause significant risk to the surrounding area if a spill should occur.
- Pre-launch checks will be done before the boat is backed into the water and includes checking the engine oil and/or fuel mixtures in the tanks.
- Any mixing of fuel and oil will be done in a separate UL approved metal flammable liquid storage container prior to filling the vessel tanks. This will ensure the gas/oil mixture is correct.
- Whenever possible, perform fuel mixing and transfer in an environmentally safe area where spills can be easily cleaned.
- Whenever possible, transfer all materials in or over a bermed or “protected” area. A protected area is one that is covered with an impermeable material, such as polyethylene.
- Perform preventative maintenance on construction equipment and boats/hovercraft to minimize chances for hose and other equipment failure.

- Follow good housekeeping operations and store hazardous materials in authorized storage areas.
- Use only UL-listed metal cans for portable gasoline storage containers.
- Keep hazardous material containers closed when not in use.

9.2.2.1.02 Maintain a supply of basic spill response materials and protective equipment on-site to include:

- Absorbent sheets, pillows, booms, or absorbent material
- Open-top 55-gallon drums or other appropriate containers with lids
- Brooms, shovels, and other tools, such as squeegees

9.2.2.2 Spill Response

9.2.2.2.01 All spills, leaks, and fires involving oil or hazardous substances must be reported to the PjM and the SHM as well as the USAESCH Project Manager (PM). The person reporting the leak or spill is required to provide the following information:

- His/her name
- Location of spill and facility number, if known
- Number of injured personnel and nature of injuries, if known
- Substance spilled
- Estimated amount spilled
- Extent of spill
- Estimated rate at which the substance is currently being released
- Estimated time the spill occurred
- Any other pertinent information

9.2.2.2.02 The USAESCH PM, in coordination with the PjM, will manage notifications to regulatory agencies. In addition, all spills will be reported to the SHM. Project personnel will not report spills directly to any agency unless specifically requested by the client representative or the Contracting Officer. Minor and major spill procedures are outlined below.

9.2.2.3 Minor Spill Procedure

9.2.2.3.01 A minor spill would involve no immediate threat to human health or the environment (e.g., not cause sheen or discoloration on the water), cause minimal property damage, and not exceed the reportable quantity for that material. In the event of a minor spill, the appropriate response action is for the responsible person to notify the client and the PjM and supply the responders with as much information as possible. In the case of a spill of contaminated or hazardous materials, the following procedures will be followed:

- Notify the FOL, the PjM, and the SHM.
- Identify protective clothing or equipment required to respond.
- Contain the spill.
- Neutralize and/or solidify any product.
- Transfer material into appropriate waste containers as directed by the FOL or PjM. Transfer the waste to the appropriate storage area for management and disposal at the direction of the FOL or PjM.
- Document the incident.

9.2.2.4 Major Spill Procedure

9.2.2.4.01 In the event of a major spill where human health and/or the environment is at risk (e.g., spill is to a surface water, persons are injured, there is a risk of fire or explosion from the materials, material spilled is not known, the spilled material is more than can be reasonably handled with on hand resources in a few minutes time, or spills that have or are likely to enter a storm drain or other conveyance), the following procedures shall be followed.

- A spill to surface water may not constitute an emergency; however any spill to surface water is reportable and is to be treated as an emergency.
- Isolate the spill area, shut down equipment if safe to do so, and evacuate upwind.
- Keep others from entry into the area.
- If anyone is injured, at risk, or there is a fire or explosion, call 911.
- Notify the FOL and SSHO.
- SSHO or FOL will immediately notify the PjM, SHM, and client and relay pertinent information.
- If source of spill is not unknown and other hazards are not likely to exist (e.g., fires, exposures, or explosions), assess extent of spill and identify potential pathways of dispersion. Cover or isolate these pathways in advance of the spill, if feasible, but only if exposures can be avoided.
- Note type, amount, and location of material released. Provide MSDSs for response personnel.

9.2.3 Firefighting Plan

9.2.3.01 Motor boats or skiffs over 26 feet will have a minimum of two 1-A:10BC fire extinguisher available. Motor boats or skiffs (including hovercraft that are less than 26 feet long) will have one 1-A:10BC fire extinguisher onboard. Each fire extinguisher shall be inspected by the SSHO or boat/hovercraft operator at least once every week to ensure that it is sufficiently charged and that the nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately. The number and sizes of extinguishers required will depend on the vessel size and applicable regulations.

9.2.3.02 Workers will not fight any fires other than incipient stage fires and personnel will be trained in the use and limitations of fire extinguishers. The fire extinguishers are intended to fight only fires that have recently occurred and can reasonably be extinguished immediately. In no case will workers attempt to fight any fire that cannot reasonably be extinguished within 30 seconds to 1 minute (the fire extinguishers have only enough agent for small fires).

9.2.3.03 Prior to fighting any fire or during the course of fighting a fire, the Municipality of Culebra Fire Department will be called. Always summon help immediately if a fire on board a boat occurs. Fire prevention planning is addressed in Section 9.17 of this APP.

9.2.3.04 The following sections describe procedures for fighting small and large fires.

9.2.3.1 Small Fire Procedure

9.2.3.1.01 In the event of a small fire (one that can be extinguished with the available portable fire extinguisher the following will occur:

- Evacuate nonessential personnel upwind of the fire (on open deck), designate a person to contact 911 to get fire services en route;
- If onboard a boat or hovercraft during a fire, designate a person to signal the support boat so it can come alongside or nearby to retrieve personnel if the abandon ship order (Section 9.2.5) is given;
- Ensure person with extinguisher has an escape route in the event the fire does not extinguish;
- Extinguish the fire by aiming the extinguisher nozzle at the base of the fire, pull the pin, depress the handle, and sweep the nozzle side to side in a fluid motion at the base of the fire;
- Remain at the location, contact SSHO and PjM, and meet emergency services to ensure the fire is out.

9.2.3.2 Large Fire Procedure

9.2.3.2.01 In the event of a large fire (one that cannot be extinguished with the available portable fire extinguisher the following will occur:

- Evacuate nonessential personnel upwind of the fire (on open deck) and designate a person to contact 911 to get fire services en route – with large fires on a boat, it may be prudent to make the call to abandon ship as the immediate action and have the support boat call for emergency services;

- If onboard a boat/hovercraft during a fire, designate a person to signal the support boat so it can come alongside or nearby to retrieve personnel if the abandon ship (Section 9.2.5) order is given;
- Get personnel to a safe location upwind. If on a boat or hovercraft, evacuate to at least 200 feet away from the boat involved in the fire and upwind;
- Advise the fire department as required; and
- Notify SSHO and PjM.

9.2.3.3 Explosion Procedure

9.2.3.3.01 In the event of an explosion, immediately evacuate the area to an upwind location and call emergency services (911). If the explosion occurs on a boat or hovercraft, the boat operator may make an abandon ship call. The support boat should be deployed to a safe distance (200 feet minimum) from the boat involved in the explosion and if any persons are in the water, prepare to rescue persons in the water. If persons are injured, attempt to assist them out of the area to a safe location before rendering first aid if you can safely do so. If the explosion occurs on a boat, follow the direction of the boat operator for abandoning ship (see Section 9.2.5).

9.2.4 Posting of Emergency Telephone Numbers

9.2.4.01 Table 9-1 shows emergency contact numbers. This table is placed on clipboards, which are then placed on the dashboard of every vehicle used by the workers and on every boat. Also on this clipboard will be a map (see Figures 9-1 and 9-2) showing egress routes from the work site area to the evacuation area and routes to the local medical facility.

Table 9-1. Emergency Contact Information

Contact	Firm or Agency	Telephone Number
Culebra Police Department	Municipality of Culebra Police	**Emergency 911** (787) 742-3501/0106
Culebra Fire Department	Municipality of Culebra Fire Department	**Emergency 911** (787) 742-3530
Local Emergency Hospital and Ambulance Services	Promed Medical Center, Culebra, Puerto Rico	**Emergency 911** (787) 742-3511
Advanced Care Emergency Hospital	San Pablo del Este Hospital Fajardo, Puerto Rico	**(787) 740-0333 (emergency)** (787) 863-0505 (main)
WorkCare® Case Intervention		1-800-455-6155 1-888-449-7787
Coast Guard	Duty Officer	(787) 729-2301
Coast Guard 24-hour Emergency Number	Rescue Coordination Center, San Juan, Puerto Rico	(787) 289-2042
Puerto Rico Department of Natural Resources Conservation Rangers	Cuerpo de Vigilantes	(787) 742-0720

Table 9-1. Emergency Contact Information (continued)

Contact	Firm or Agency	Telephone Number
USACE Project Manager, Wilberto Cubero-Deltoro	CESAJ	(904) 232-1426 (main) (904) 316-8248 (cell)
USACE Project Manager, Roland Belew	USAESCH	(256) 895-9525 (main) (256) 503-0661 (cell)
USACE Designated Dive Coordinator, John Houvener	USACE, Baltimore District	USACE Designated Dive Coordinator, John Houvener
WorkCare	Occupational Medicine Contact	1-800-455-6155
Program Manager, Kent Weingardt	TtEC	(619) 471-3532
Project Manager, Scot Wilson	TtEC	(360) 598-8111 (360) 626-3193 (cell)
Geophysics Lead, Robert Feldpausch	TtEC	(425) 482-7862 (main) (425) 503-2468 (cell)
CIH/SHM, Roger Margotto	TtEC	(619) 988-0520 (cell)
Field Operations Lead/Alternate Emergency Coordinator, Richard Funk, PG	TtEC	(425) 482-7629 (main) (973) 216-9296 (cell)
Field Investigation Coordinator Fernando Pagés Rangel	TtEC	(626) 688-1017 (main) (787) 791-0803 (alternate)
SSHO/Primary Emergency Coordinator Kyle Enright	TtEC	(425) 457-3255 (cell) Marine Radio Channel 16 (Emergency)
SUXOS/Hovercraft Operator, David Bennett	TtEC	(303) 289-0113 (cell) Marine Radio Channel 16 (Emergency)
National Poison Control Center	National Poison Control Center	(800) 222-1222
CHEMTREC	CHEMTREC	(800) 424-9300
National Response Center	National Response Center	(800) 424-8802

9.2.5 Man Overboard/Abandon Ship

9.2.5.01 Prior to the start of field activities, the boat/hovercraft operator and SSHO will give a detailed health and safety briefing on the location and use of all vessel safety equipment and the procedures for addressing on-board emergencies (i.e., fire or explosion onboard, mechanical failure, man overboard situation, abandon ship, etc.) and a man overboard/abandon ship drill will be rehearsed. The buddy system is to be used onboard boats so that man overboard retrieval can be performed expediently in the event a person goes into the water.

9.2.5.02 All boats, including hovercraft, will meet USCG license and registration requirements and be equipped to safely support maximum rated crew and passenger sizes. Information on the types and configuration of boats and hovercraft used on this project is included in the Work Plan. The maximum number of passengers and weight shall be conspicuously posted on each vessel. The number of passengers shall not exceed the number of personal flotation devices (PFDs). Each boat/hovercraft shall have sufficient room, freeboard, and stability to safely carry cargo and the number of persons allowed with consideration given to the weather and water conditions in which it will be operated. Boats under 20 feet shall be equipped with kill switches and shall meet 33 CFR 183, which requires level flotation after flooding or swamping (hovercraft are exempt from this provision of 33 CFR 183).

9.2.5.03 Personnel working from small boats or skiffs, on structures or equipment extending over or next to the water (except where guard rails or personal fall protection systems are provided), or whenever there is a drowning hazard, will wear an inherently buoyant Type II or higher (capable of turning its wearer in a vertical or slightly backward position in the water). Automatic inflating PFDs can be used providing that they are approved in the APP, an AHA addresses its use, the PFD is not used by persons less than 90 pounds, and it is inspected, maintained, and stored in accordance with the manufacturer's instruction. In addition, each boat (those less than and up to 26 feet and those over 26 feet and less than 65 feet in length), in accordance with EM 385 1-1 Section 05.J.06 and TtEC Boating Procedure EHS 6-6, shall be equipped with at least one Type IV PFD, ring buoy, 24 inches in diameter with 90 feet of buoyant line attached, designed to be thrown to a person in the water and grasped and held by the user until rescued. A buoyant boat cushion equipped with straps or float rings are two common examples of additional types of life rings that can qualify as a Type IV PFD and help in a rescue.

9.2.5.04 PFDs will be of an international orange (or orange/red) or ANSI 107 yellow-green color. PFDs shall have an attached whistle and emergency light or other suitable device in the event of a man overboard. During evening operations (not currently planned), the PFDs will be equipped with flashing beacons.

9.2.5.05 In addition, each boat/hovercraft will have at least one sound signaling device (air horn), U.S. Coast Guard compliant navigation lights, visual distress signals (pyrotechnic and non-pyrotechnic), and at least one vessel-mounted or hand-held radio to communicate with shore-based support facilities and other vessels operating nearby. Each boat less than 26 feet in length will have at least one 1-A:10-B:C fire extinguisher and each boat 26 feet in length or longer will have at least two1-A:10-B:C fire extinguishers. The boat operator will also look for and avoid other vessels operating in the area at all times. Boating operations will be suspended during severe weather or rough seas.

9.2.5.06 Other equipment required to be onboard boats on this project includes (note: the SOP for hovercraft operations lists additional equipment to be onboard hovercraft):

- A tool kit sufficient for the boat operator to troubleshoot common mechanical problems;
- Appropriate spare parts such as a propeller, spark plugs, shear pins, patch kits, air pumps, etc.);
- A backboard or Stokes litter equipped with flotation to assist an injured or unconscious person out of the water or evacuate an injured person in areas where there are no roads or

vehicle accessibility on the "duck" vessel (e.g., snorkeling team performing in-water work or emergency where man overboard situation occurs);

- A survival kit containing some additional first aid equipment, high energy food, drinking water, blankets, heat source, signaling devices, waterproof matches, and other items necessary to ensure survival for a minimum of 24 hours for the entire crew; and
- TtEC personnel shall utilize the "one-third rule" in boating fuel management. Use one-third of the fuel to get to the destination, one-third to return, and keep one-third in reserve.

9.2.5.1 Man Overboard Procedure

9.2.5.1.01 In the event of a man overboard, the following will occur:

- The person who observes the man overboard shall shout out "man overboard" and what side of the boat (port or starboard).
- The person who goes overboard should shout out to those on the boat if it is not noticed that they are in the water or use the whistle on the PFD if present.
- Throw a life ring over the side as near as possible to the person in the water.
- Notify the boat operator as quickly as possible and make sure to keep track of the person in the water so they are not lost.
- Direct the boat operator to the direction of the person so that recovery can be made.

9.2.5.2 Abandon Ship Procedure

9.2.5.2.01 In the event an abandon ship order is issued, the following will occur:

- Follow the direction of the boat operator, who will direct personnel to the appropriate station onboard the vessel.
- Ensure PFD is securely fastened.
- Note the location of and distance to the nearest land and stay with your group until instructed to abandon ship.
- Deploy rescue raft (if equipped) on windward side of the boat and await orders to board.
- Boat/hovercraft operator or designated person will activate the ships emergency communication devices (marine distress call via radio, air horn, marine flares, etc.) as capable based on the nature of the emergency and will grab survival kit as applicable.
- Enter the water by the safest means. If ladder is present, use ladder to get into the water before jumping overboard.
- If the boat is on fire or there is risk of explosion, stay at least 200 yards from the boat.

- If raft is equipped, stay in raft and try to flag down a rescue boat and paddle toward shore. If the current tries to take you away from shore, try to paddle perpendicular to the current, toward areas where more land is visible or more boaters may be present.
- As a group, or if personnel are separated and in the water, remain calm. To conserve energy and reduce risk of hypothermia, float on your back with your knees bent toward your chest. If together as a group, huddle together.

9.2.6 Medical Support

9.2.6.01 The following contains information on procedures to follow for onsite and offsite medical support, including first aid and non-emergency and emergency care, location of medical support facilities and arrangements with medical care providers. Table 9-1 contains emergency contact information with names, addresses, and phone numbers. Figures 9-1 and 9-2 show emergency routes from each MRS to the local hospital on Culebra.

9.2.6.1 Medical Surveillance and Fitness for Duty

9.2.6.1.01 For the Phase 2 RI, exposure to potentially hazardous substances is not expected to occur and participation in a 29 CFR 1910.120 compliant medical surveillance program is not required. Corporate Medical Surveillance Program requirements for new hires include a complete pre-employment physical and drug screen and employees on this project who will perform snorkeling activities will have evidence of annual medical clearance by a licensed physician and have a copy of their medical clearance on file at the site before they are allowed to participate in these activities.

9.2.6.1.02 Physician services for TtEC are provided by Work Care, 300 South Harbor Boulevard, Suite 600, Anaheim, CA 92805 (Phone: 1-800-455-6155; Case Intervention 1-888-449-7787). Actual employee medical exams are conducted by Work Care-affiliated clinics.

9.2.6.1.03 Employees will be given a medical data sheet to fill out during the site orientation training. The filled out sheets will be given to the SSHO. This sheet is voluntary; however, it is important, as it identifies each employee’s allergies, medications they are taking, and medical conditions that may be important in the event of an emergency where they are unable to communicate to medical providers. These sheets are kept confidential and are used in the event of an emergency situation, should it occur on the project.

9.2.6.2 First Aid

9.2.6.2.01 Only qualified personnel will provide first aid and stabilize an individual needing assistance. Life support techniques such as CPR and treatment of life-threatening problems such as airway obstruction and shock will be given top priority. At least two persons, including the FOL and SSHO will be certified in first aid techniques and CPR. EHS 4-1, Bloodborne Pathogens, will be followed when first aid/CPR are administered (information on bloodborne pathogens is included in Section 11. Professional medical assistance will be obtained at the earliest possible opportunity, even in first aid cases. Ensure that WorkCare® has been contacted.

9.2.6.2.02 An industrial first aid kit will be available at the field office and on each boat. The kit must be filled as required by EM 385-1-1, Table 3-1 (USACE 2008). The kit will include a bloodborne pathogen kit.

9.2.6.3 On-Site Medical Support

9.2.6.3.01 In the event of an injury requiring first aid (non-emergency):

- Administer first aid if qualified; if not qualified, immediately seek out a person qualified to administer first aid.
- Notify the SSHO of the name of the individual involved, their location, and the nature of injury.
- Medical follow up and care with a clinic may be required for first aid incidents on a non-emergency basis. This will be determined through consultation with WorkCare by calling 1-800-455-6155. Non-emergency medical care, if needed, will be provided by the Promed Medical Center (Telephone: 787-742-3511).
- Notify the USAESCH PM, TtEC PjM, and SHM, if not already notified.
- Complete the TtEC Incident Report and Investigation form and ENG Form 3394 as appropriate.

9.2.6.3.02 In the event of an emergency where first aid is being rendered, always notify 911 promptly.

9.2.6.4 Off-Site Medical Support

9.2.6.4.01 In the event of serious personal injury (fatality, patient unconscious, possibility of broken bones, severe bleeding that will not stop, severe burns, blood loss, shock, trauma, chest pain, difficulty breathing, seizure, electrocution, disorientation, suspected poisoning), the first responder shall immediately:

- Call 911 and give the appropriate patient information and their location.
- Administer first aid if qualified; if not qualified, immediately seek out a person qualified to administer first aid.
- Notify the SSHO of the name of the individual involved, their location, and the nature of injury.

9.2.6.4.02 Upon notification of a serious personal injury, the SSHO shall immediately:

- Notify Culebra Emergency Services at Promed Medical Center (911) if not done already and give the appropriate patient information and their location (depending on nature of injury, Promed Medical Center Emergency Services may call for Air Ambulance transport to an acute care facility;

- Assist the injured party as deemed appropriate;
- Provide a copy of the injured party's medical data sheet to responding medical personnel;
- Designate someone to accompany the injured party to the hospital;
- Call WorkCare;
- Notify the USAESCH PM, TtEC PjM, and SHM, if not already notified; and
- Complete the TtEC Incident Report and Investigation form and ENG Form 3394 as appropriate.

9.2.6.4.03 Serious injuries occurring at the jobsite will be treated at or with coordination from the Culebra Promed Medical Center (Telephone: 787-742-3511). Serious trauma or medical emergencies may require the Promed Medical Center to arrange for airlift to the Fajardo or San Juan, Puerto Rico medical facilities or other specialized facilities as noted below. Route maps with directions to the Promed Medical Center from the project sites are provided in Figures 9-1 and 9-2.

9.2.6.4.04 Local ambulance service will be used to transport the injured worker to the hospital by calling 911. While worker is being transported to hospital, WorkCare will be contacted.

9.2.6.5 On-site – Culebra Community Medical Center

9.2.6.5.01 The Promed Medical Center (Telephone: 787-742-3511) is located at Calle William Font Final, Culebra, PR 00775. Figures 9-1 and 9-2 show emergency routes from each MRS to this hospital.

9.2.6.6 Off-site – Fajardo San Pablo del Este Hospital

9.2.6.6.01 The Fajardo medical facility, San Pablo del Este Hospital (Telephone: 787-863-0505) is located at General Valero Avenue # 404 in Fajardo, Puerto Rico.

9.3 PLAN FOR PREVENTION OF ALCOHOL AND DRUG ABUSE

9.3.01 TtEC has a Drug Free Workplace Program. All contractors and subcontractors on this project are subject to drug and alcohol testing at any time. Supervisors, managers, and the SSHO are to determine the fitness of their workers including whether their workers may be under the influence of any drugs or alcohol. This includes over-the-counter medications and prescription medications. At the beginning of the project, during the initial site orientation and training, all workers are reminded of the program and policies. The policy is also described in the Work Rules. Workers are encouraged to confidentially list their medications on a medical information form that is provided to them and retained by the SSHO. If a worker is involved in an accident or is injured, the worker(s) involved may be asked to be tested. If supervisors observe any worker who appears to be under the influence of drugs or alcohol, the supervisor may request testing of the worker.

9.4 SITE SANITATION PLAN

9.4.01 It is anticipated that the field office used for this project will have plumbing with working sinks and toilets as well as showering facilities. The main boat used for surveys will have an approved marine sanitation device that complies with USCG requirements. This device will be pumped as necessary at an approved pump station and has a facility for washing hands. Workers will discard all food debris and other trash in a designated container onboard the boat. This container will be emptied at the end of each day in the trash bin at the TtEC field office.

9.4.02 Potable water will be provided to workers for washing hands and face and for drinking. TtEC will provide this potable drinking water either in containers, with disposable cups, marked "drinking water" and not to be used for any other purpose, or as bottled water from a vendor. Any outlets or containers that dispense non-potable water will be labeled as "Caution – water unsafe for drinking, washing, or cooking."

9.5 ACCESS AND HAUL ROAD PLAN

9.5.01 Not applicable.

9.6 RESPIRATORY PROTECTION PLAN AND PERSONAL PROTECTIVE EQUIPMENT

9.6.1 Respiratory Protection

9.6.1.01 Use of respirators is not currently required for the RI because there are no contaminants of concern and no inhalation exposure routes.

9.6.1.02 Potential dust generation will be controlled in part by practicing good housekeeping on boats and launch areas. Boat and boat ramps and docks will be kept reasonably free of accumulated soil if tracked onboard. At the end of shift, other areas where equipment on the boat deck will be washed down to the extent that gross material accumulations on equipment are not allowed to dry on the equipment.

9.6.2 Personal Protective Equipment

9.6.2.01 The SHM has reviewed the applicable work plans and other available information and has evaluated each major work activity to determine the appropriate level of PPE needed for the work. This evaluation included a consideration of potential hazards present; work operations to be performed; potential routes of exposure; concentrations of contaminants present or reasonably expected; characteristics, capabilities, and limitations of PPE; and any hazards that the PPE may create or exacerbate (e.g., heat stress). Evaluation findings and recommendations are listed in the AHA matrix and include the date the evaluation was conducted, the activity evaluated, PPE recommendations, and the name of the person(s) performing the assessment.

9.6.2.02 The basic level of PPE selection includes a standard work uniform (long pants, ¾-length sleeve shirt). In addition, a hard hat (when overhead safety hazards exist); sturdy leather deck shoes; safety glasses with side shields; hearing protection (as required); leather work gloves (when indicated in AHAs); and a Class 2 high visibility safety vest when working within traffic areas and additional weather appropriate clothing will be worn. When working on boats where there are not sufficient guardrails or where there is a drowning hazard, a Type II or better PFD (including auto-inflatable PFD) will be worn.

9.6.2.03 Reasons to upgrade level of protection:

- Known or suspected presence of dermal hazards
- Occurrence or likely occurrence of gas or vapor emission
- Change in work task that will increase contact or potential contact with hazardous materials
- Request of the individual performing the task

9.6.2.04 Reasons to downgrade level of protection:

- New information indicating that the situation is less hazardous than was originally anticipated
- Change in site condition that decreases the hazard
- Change in work task that will reduce contact with hazardous materials

9.7 HEALTH HAZARD CONTROL PROGRAM

9.7.01 Hazards on this project include physical and environmental hazards related to working on and in the water related to boating operations such as potential drowning or near drowning hazards, hypothermia and heat stress related illnesses, and severe weather. Other physical hazards include slips, trips, and falls, noise exposure, and struck by or pinch points related to equipment operation. Biological hazards include potential for contact with poisonous or dangerous marine life, stinging or biting insects or poisonous plants, and potential bloodborne pathogens if CPR or first aid is rendered. Chemical hazards include those presented by use of and refueling of boats with gasoline and engine oil. Chemical hazards are addressed through the project hazard communication program addressed in Sections 6.0 and 9.8.

9.7.02 This APP address mitigation and control of the site specific hazards anticipated on this project, which may be physical, chemical, environmental, and biological in nature. Those hazards not addressed specifically by EM 385 1-1, Appendix A – Plans, Section 8.0 are included in Section 11 of this APP and are incorporated into the AHAs and include:

- Physical Hazards – Slips, trips, and falls; noise; head and back injuries, electrical hazards; and illumination.

- Biological Hazards – Poisonous or dangerous animals and plants and bloodborne pathogens.

9.8 HAZARD COMMUNICATION PROGRAM

9.8.01 At the time of the preparation of this APP, the specific hazardous materials or chemicals that will be brought onto the project site are anticipated to be minimal, consisting mainly of gasoline and engine oil or lubricants used for boat operations and maintenance. When any material or chemical is brought onto the site, MSDSs/SDSs will be provided to the SSHO. Materials that may be brought on-site include fuels and lubricants for equipment.

9.8.02 The SSHO will file the MSDSs/SDSs in a notebook that will be available in the field office. The SSHO will review the MSDSs/SDSs with the workers, and this training will be documented on the daily safety meeting form. All workers will have general hazard communication training that specifically requires that workers notify the SSHO when any new material is brought onto the site and how the program is managed on the site. The corporate program is used as a reference (EHS 4-2).

9.8.03 All containers will be labeled as to content and hazards of the material in the container.

9.9 PROCESS SAFETY MANAGEMENT PLAN

9.9.01 Not applicable.

9.10 LEAD ABATEMENT PLAN

9.10.01 Not applicable.

9.11 ASBESTOS ABATEMENT PLAN

9.11.01 Not applicable.

9.12 RADIATION SAFETY PROGRAM

9.12.01 Not applicable.

9.13 ABRASIVE BLASTING

9.13.01 Not applicable.

9.14 HEAT/COLD STRESS MONITORING PLAN

9.14.01 With the possible combination of ambient factors such as high air temperature, high humidity, low air movement, high radiant heat, and protective clothing (e.g., snorkel ensemble), the potential for heat stress is a concern. The potential exists for:

- Heat rash
- Heat cramps
- Heat exhaustion

- Heat stroke

9.14.02 EHS 4-6 describes the heat stress management and prevention program. At 70 degrees Fahrenheit (°F) ambient temperature, the supervisor on-site will initiate the procedures in the program.

9.14.03 This information is discussed during a safety “tailgate” meeting before each workday where heat stress may be a factor. Workers are encouraged to increase consumption of water and electrolyte containing beverages such as Gatorade® during warm weather. Water and electrolyte containing beverages will be provided on-site and will be available for consumption during work breaks.

9.14.04 At a minimum, workers will break every 2 hours for 10- to 15-minute rest periods. In addition, workers are encouraged to take rests whenever they feel any adverse effects, especially those effects that may be heat related. The frequency of breaks may need to be increased upon worker recommendation or decision of the SSHO and a supervisor.

9.14.05 Heat stress monitoring is used, when appropriate, to estimate workloads and establish work/rest times based on 1) Wet Bulb Globe Temperature (WBGT) instrumentation and calculations, 2) monitoring physiological conditions and adjusting work/rest periods, or 3) using personnel heat stress monitors.

9.14.06 Workers need to protect themselves from sunburn. Workers should wear clothing that protects them from the sun or otherwise wear a sunscreen lotion with a skin protection factor of 15 or greater. TtEC will provide sunscreen lotion to all workers. Use of a sunscreen lotion that is resistant to perspiration is preferred. Hats are also a good preventative measure for sun exposure to the head.

9.14.07 The EHS procedure also describes a cold stress prevention program. At certain times of the year, workers may be exposed to the hazards of working in colder environments and work in the water, even if ambient temperatures in the air are high, potential for cold stress is possible. Potential hazards that could occur on this project include hypothermia as well as hazards related to slippery surfaces, brittle equipment, and cold effects that lead to poor judgment and taking short cuts on the job. The effects of wind chill upon the body even in weather that is not considered extremely cold, can cause cold stress, particularly when coupled with wet weather. TtEC will implement cold stress prevention program elements contained in EHS 4-6 when there is a potential for cold related injuries. Workers should be protected from exposure to cold so the core body temperature does not fall below the Threshold Limit Value of 96.8ºF (36ºC).

9.15 CRYSTALLINE SILICA MONITORING PLAN (ASSESSMENT)

9.15.01 Not applicable.

9.16 NIGHT OPERATIONS LIGHTING PLAN

9.16.01 Not applicable. Work will be performed during daylight hours.

9.17 FIRE PREVENTION PLAN

9.17.01 Fire prevention and protection measures require preplanning. Each boat (including hovercraft) used by TtEC personnel less than 26 feet shall carry at least one 1-A:10:BC fire extinguisher (for use in gasoline, oil and grease fires) approved by Underwriters Laboratories (UL). Motor boats or skiffs over 26 feet will have a minimum of two 1-A:10BC fire extinguisher available. Each fire extinguisher shall be inspected by the SSHO or boat/hovercraft operator at least once every week to ensure that it is sufficiently charged and that the nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately.

9.17.02 All gasoline engines, except outboard motors and hovercraft where they are not required, installed in a boat must have an approved flame arrestor (backfire preventer) fitted to the carburetor.

9.17.03 A mounted fire extinguisher is required in every vehicle including heavy equipment. Extinguishers mounted on heavy equipment and in the cab of pickup trucks will be a minimum 10-B:C dry chemical type. Fire extinguishers in the cabs of all vehicles must be mounted or secured. Fire extinguishers in the beds of all pickup trucks must be mounted or secured.

9.17.04 Employees will follow safe work practices to include proper storage of flammable and combustible liquids. Smoking is permitted only in those areas designated specifically by the PjM or SSHO and posted as smoking areas.

9.17.05 Personnel will follow hot work procedures to ensure that work is performed in a safe environment. Additional fire prevention measures are given in the AHAs developed for this project.

9.17.06 In the event of a fire or explosion, the Municipality of Culebra Fire Department will be summoned immediately, a head count will be taken, and fire or explosion responses and evacuation procedures will be implemented as described in Section 9.2.3 of this APP.

9.18 WILD LAND FIRE MANAGEMENT PLAN

9.18.01 Not applicable.

9.19 HAZARDOUS ENERGY CONTROL PLAN

9.19.01 Control of hazardous energy during installation, start-up, and maintenance will follow TtEC EHS 6-4 and OSHA 1910.147. EHS 6-4, Lockout/Tagout, establishes the TtEC Control of Hazardous Energy Program. This program applies to all TtEC operations, except as follows:

- Work on cord- and plug-connected electrical equipment where the plug is under the control of the employee performing the work
- Hot tap operations
- Work involving minor changes and adjustments to equipment during routine operations (such as small tooling adjustments)

9.19.02 Refer to details of this program in EHS 6-4. Details of methods used to control hazardous energy for a defined task must be documented in the AHA for that task.

9.20 CRITICAL LIFT PROCEDURES

9.20.01 Not applicable.

9.21 CONTINGENCY PLAN FOR SEVERE WEATHER

9.21.01 The SSHO will monitor weather forecasts each morning, evening, and periodically throughout the day. The hurricane season for Puerto Rico is June 1 through November 30. Hurricanes, tropical storms, and lesser storms that may occur during daily cycles in the tropics, can bring winds, rain, and thunder/lightning. With adverse weather, the seas respond accordingly and hazardous surface water conditions can develop. The local National Oceanic and Atmospheric Administration (NOAA) broadcast local forecasts on the Weather Radio Station WNJ-693 on a frequency of 162.450 megahertz. This as well as other forecasts on the internet can be monitored to obtain severe weather advisories and warnings. These include the NOAA National Hurricane Center at www.nhc.noaa.gov and the NOAA National Weather Forecast Office in San Juan, Puerto Rico at www.srh.noaa.gov/sju and the Caribbean Hurricane Network at http://stormcarib.com.

9.21.02 In the event of adverse weather conditions, the SSHO will determine if work can continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Extreme temperatures (> 100 ºF or < 0 ºF)
- Treacherous weather-related working conditions (extreme rain, high winds [> 30 miles per hour])
- Visible lightning within 10 miles
- Limited visibility (fog)
- Weather forecasts where severe weather hazards are likely to occur (e.g., tropical storms, hurricanes)
- Other factors as appropriate that are identified in conjunction with lesser weather related hazards (e.g., pronounced ground swell or rip currents).

9.21.03 Prior to beginning work, the SSHO will review the weather forecast for the day to screen for anticipated severe weather conditions, warn the field crews accordingly, heighten awareness, and ensure proper planning. In the event that work is suspended, the SSHO will notify personnel or survey teams by cellular telephones, marine or project radios or in person as applicable.

9.22 FLOAT PLAN

9.22.01 TtEC will follow EHS 6-6 Boating Procedures on this project. The SSHO or Field Investigation Coordinator shall be aware of the location of all project boats and personnel using them at all times. If several boats and crews are involved or are traveling to remote areas, each designated boat operator shall file a written float plan with the SSHO or Field Investigation Coordinator. The USCG example Float Plan is included in Attachment C. The float plan shall include the following:

- The names of the boat operator and passengers;
- A description and registration numbers of the boat;
- Radio call sign or cellular telephone number if boat is so equipped;
- A trip itinerary with expected time and location of return; and
- Steps the SSHO or Field Investigation Coordinator will take to initiate a search response if the expected time of return is exceeded.

A Float Plan shall be prepared by each designated boat operator and approved by the PjM, and SSHO and/or qualified person prior to the activity.

9.23 SITE-SPECIFIC FALL PROTECTION AND PREVENTION PLAN

9.23.01 Where engineering controls such as guardrails cannot be installed or used, personnel working 6 feet above any surface are required to wear safety harnesses and safety lanyards attached to an anchorage that can support 5,000 pounds. Fall protection is not anticipated on this project. If this changes, a Fall Protection Plan must be developed and implemented.

9.24 DEMOLITION PLAN

9.24.01 Not applicable.

9.25 EXCAVATION/TRENCHING PLAN

9.25.01 Not applicable.

9.26 EMERGENCY RESCUE (TUNNELING)

9.26.01 Not applicable.

9.27 UNDERGROUND CONSTRUCTION FIRE PREVENTION AND PROTECTION PLAN

9.27.01 Not applicable.

9.28 COMPRESSED AIR PLAN

9.28.01 Not applicable.

9.29 FORMWORK AND SHORING ERECTION AND REMOVAL PLANS

9.29.01 Not applicable.

9.30 PRECAST CONCRETE PLAN

9.30.01 Not applicable.

9.31 LIFT SLAB PLANS

9.31.01 Not applicable.

9.32 STEEL ERECTION PLAN

9.32.01 Not applicable.

9.33 SITE SAFETY AND HEALTH PLAN FOR HTRW WORK

9.33.01 Not applicable. The Phase 2 survey activities are not intrusive and do not meet the requirements of hazardous, toxic, and radioactive waste (HTRW) (site cleanup) work per Section 28 of EM 385-1-1 or OSHA 29 CFR 1910.120.

9.34 BLASTING SAFETY PLAN

9.34.01 Not applicable.

9.35 DIVING PLAN

9.35.01 Not applicable.

9.36 CONFINED SPACE PLAN

9.36.01 Not applicable.

10.0 RISK MANAGEMENT PROCESSES

10.01 AHAs for the planned activities are included in Attachment A of this APP. If any new tasks are identified or if planned activities vary from the written AHAs, the SSHO will develop or alter the existing AHAs with the assistance of the workers and subcontractors to address the specific activities. All AHAs will be reviewed by the SHM and the USAESCH PM.

AHA	Activity
1	Mobilization and Site Setup
2	Boating and TEMA Surveys
3	Site Restoration and Demobilization
4	Hovercraft Operations

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11.0 OTHER PROJECT HAZARDS

11.1 NOISE

11.1.01 On projects where noise levels may exceed a time-weighted average of 84 decibels, A scale (dBA), hearing protection will be made available to all exposed employees. Additionally, sound-level monitoring using a sound level meter may be conducted on-site if the SSHO determines that equipment noise is louder than normally encountered with the equipment. Annual audiograms are required for personnel who are exposed to 85 dBA time-weighted average or greater for 8 or more hours per day. Personnel with a standard threshold shift will be restricted from high noise exposure or will be required to wear hearing protection at all times. EHS 4-4 is a hearing conservation program complying with OSHA regulations (29 CFR 1910.95).

11.2 SLIPS, TRIPS, AND FALLS

11.2.01 Working in and around the site, both on land and on boats or boat platforms, may pose slip, trip, and fall hazards due to slippery and wet surfaces. The terrain at boat launch areas and access points may be steep or uneven and vegetation may pose hidden trip or fall hazards to workers. Waves, ground swell, or boat maneuvering on the water may cause personnel to lose balance or items to shift on board the boat posing slip, trip, and fall hazards. Portable ladders, if used, will be of the proper rating and configuration and will be tied off. Workers will use three points of contact when climbing or descending any ladder.

11.2.02 Slips, trips, and falls are a leading cause of injuries in field-related work settings. Potential adverse health effects include falling to the ground and becoming injured or twisting an ankle or more severe injuries to the back, head, or neck. Falling or stepping onto a sharp object is also a hazard and can lead to cuts, lacerations, or puncture wounds.

11.2.03 Site personnel will be instructed to look for these potential safety hazards and immediately inform the SSHO about any new hazards as well as taking actions to correct the hazard upon discovery. If the hazard cannot be immediately removed, action must be taken to warn site workers about the hazard and appropriate precautions must be taken. Proper housekeeping such as keeping work areas reasonably free of trash and debris and maintaining tools and equipment neatly in designated storage areas must be maintained. Small holes and pits along high foot traffic areas should be covered or barricaded to prevent injury.

11.2.04 Supervisors will remind personnel and subcontractors daily to maintain sure footing on all surfaces. Prior to first time entry, the supervisor and the SSHO will inspect all work areas prior to the start of work to look for hazards. Hazards in the work area will be identified with high-visibility spray paint, traffic cones, or barricade tape. The work areas must be illuminated to at least 30 foot-candles (EM 385-1-1, Table 7-1).

11.3 HEAD AND BACK INJURIES

11.3.01 At a minimum, workers will don hard hats (when overhead or struck-by hazards exist), closed toe sturdy footwear (i.e., not sandals, flip-flops, or crocs, but sturdy leather deck shoes with good soles), and eye protection (such as appropriately shaded safety glasses) prior to performing any site activities.

11.3.02 Hazards associated with heavy or awkward lifting are more frequent in the early morning hours (prior to muscles becoming limber) and later in the day (as a result of fatigue). The following provisions will be used to minimize hazards of this nature:

- Use machinery, lifting-assist devices (two-wheeled carts or dollies), or multiple personnel for heavy lifts, where possible. (TtEC prohibits lifting more than 50 pounds without assistance.)
- Use proper lifting techniques.
- Plan all lifts: place heavy items on shelves between the waist and chest and lighter items on higher shelves. Also, if the load must be carried to another location, plan and inspect the route to ensure that slipping/tripping hazards are absent.
- Stretch and limber muscles prior to and after extended periods/frequent lifts.
- “Test” the lift; before attempting to fully lift or move an object, give the object a “nudge” to assess its approximate weight and your ability to safely lift and move it without injury. If a worker is not confident that he/she can complete the lift without injury, the worker should either get a lifting aid (such as a dolly or mechanical hoist), get help from others, or both.
- Move as close to the load as possible, and ensure that good hand holds are obtainable. Wear gloves where necessary to improve hand holds.
- Lift with the legs, not the back; bend knees and avoid turning and twisting at the waist when lifting, carrying, or depositing loads.
- Break lifts into steps if the vertical distance from the starting point to the placement of the lift is excessive.
- Periods of high-frequency lifts or extended-duration lifts should include sufficient breaks to guard against fatigue and injury.

11.3.03 Other considerations associated with lifting injuries and muscle strains include the following:

- Assess the area available to maneuver the lift.
- Rearrange the area, remove clutter, and minimize the necessity of twisting and turning.

- Evaluate the area of the lift.
  - Investigate conditions of the walking/working surfaces where the lift will occur, over the planned path of travel, and at the location the load will be deposited.
  - Conditions such as poor housekeeping/clutter, slippery surfaces, and rough or uneven terrain may magnify the potential for injury during a lift.
- Take into account your overall physical condition.
  - Report previous injuries on a Medical Data Sheet or inform supervisor of limitations.
  - DO NOT attempt to lift items that will put you at risk.
  - Break loads that must be carried into smaller, manageable loads, and get assistance whenever significant lifting tasks are involved.

11.3.04 By evaluating applicable contributing factors, planning lifts, and incorporating feasible control measures, the potential for injury associated with lifting can be minimized.

11.4 FALLING OBJECTS

11.4.01 No personnel will work under suspended equipment at any time. The SSHO will ensure that an adequate area is clear of personnel while the equipment is in operation.

11.5 ELECTRICAL HAZARDS

11.5.01 In order to prevent accidents caused by electric shock, the SSHO will inspect any electrical connections on a daily basis. The SSHO will shut down and lock out any equipment that is found to have frayed or loose connections until a qualified electrician is contacted and repairs are made. The equipment will be de-energized and tested before any electrical work is done. The equipment will be properly grounded prior to, and during, work. In addition, ground fault circuit interrupters (GFCIs) will be installed for each circuit between the power source and tool for outdoor use. If generators are used to supply power, these generators will contain GFCIs.

11.5.02 Requirements for electrical safety include:

- Electrical wiring and equipment will be listed by a nationally recognized testing laboratory (Underwriters Laboratories, Canadian Standards Association, and others).
- Flexible cords (extension cords) will contain the number of conductors required for service plus a ground wire. Cords will be rated for hard usage (S, SE, SEO, SO, SOO, ST, STO, STOO). This rating is not required to be listed on the cord itself; check the wrapping or label that comes with the cord to ensure that the cord meets this requirement. Flexible cords are not allowed to pass through doors, windows, or be placed on the ground where they are subject to being run over by vehicles. If flexible cords must pass through walls, the cords will be protected by bushings or fittings.

- Flexible cords must be inspected on each day of use. No splices or fraying is allowed.
- Flexible cords will not be secured with staples, hung from nails, or suspended by bare wire. Plastic tie straps, commonly used today, are acceptable.
- Bulbs in portable lamps must be protected by a substantial guard attached to the lamp holder handle.

11.5.1 Portable Generators

11.5.1.01 Portable generators, if used, must meet the requirements for grounding as specified in the National Electrical Code (NEC) National Fire Protection Association 70. NEC 250-6 has certain exemptions for the grounding of portable and vehicle-mounted generators. Refer to EM 385-1-1, Section 11.D.01 (USACE 2008) for additional details. Portable generators and any other gasoline or diesel fired equipment will be operated in open air only where there is sufficient ventilation to prevent accumulation of exhaust gases including carbon monoxide.

11.6 ANIMALS, INSECTS, AND PLANTS

11.6.01 Wild animals on land and marine animals pose hazards to workers who come into contact with them. Problematic stinging or biting insects may be present at all times of the year and likely may present problems to workers. Insects may carry a variety of diseases. Poisonous plants such as the Manzanillo tree or thorny plants such as acacia thorns may also be present on land or adjacent to the beaches.

11.6.02 The following biological hazards may be present at the site. The SSHO will instruct the field crew in the recognition and procedures for encountering biological hazards at the site. In addition, a project biologist will be on staff for this project when work is being performed. The project biologist will assist the SSHO and brief employees on hazardous marine life and terrestrial plants and wildlife that could pose a danger to employees performing their required tasks (e.g., snorkeling), including recognition and avoidance of the species.

11.6.1 Stinging Insect Hazard Identification and Mitigation

11.6.1.01 Insects, including bees, wasps, hornets, centipedes, and scorpions are known to be present in Culebra, Puerto Rico, making the chance of a bite or sting possible. Some individuals may have severe allergic reactions to an insect sting that can result in a life threatening condition.

11.6.1.02 Several species of scorpions inhabit the islands of Puerto Rico, namely the West Indian species. Local centipedes and scorpion stings are painful, but none are known to be fatal.

11.6.1.03 The SSHO will instruct the field crew in the recognition and procedures for encountering stinging insects at the site noting that these insects may be present or have nests/shelter in the ground, in shrubs or trees, debris piles, and other structures. Additionally, any individuals who have been bitten or stung by an insect will notify the SSHO. The following is a list of preventive measures:

- Wear proper protective clothing (work boots, socks, and pants). Tuck pant legs into socks when possible.
- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.

11.6.1.04 Field personnel who may have insect allergies will provide this information to the SSHO prior to commencing work, and shall have their prescription allergy medication on site. In addition, workers are encouraged to have over-the-counter Benadryl (diphenhydramine) available for use should they not have a prescription for known severe allergies.

11.6.1.05 Mild insect stings should be treated by applying a baking soda paste or ice wrapped in a wet cloth. Bee stingers should be gently scraped off the skin, working from the side of the stinger. If insect bites become red or inflamed or symptoms such as nausea, dizziness, shortness of breath, etc., appear, medical care will be sought. Immediate care is needed if a person is allergic to insect stings. If an allergic person receives an insect sting, seek immediate medical attention, keep the victim calm, and check vital signs frequently. Rescue breathing should be given if necessary to supply oxygen to the victim.

11.6.2 Biting Insect Hazard Identification and Mitigation

11.6.2.01 Spiders such as the black widow or brown recluse are known to be present on Culebra. If a person is bitten, these bites pose adverse health effects that require prompt professional medical attention. For most, these spider bites do not pose life-threatening conditions; however, severe tissue damage and skin lesions and other effects can occur that cause permanent damage if medical attention is delayed.

11.6.2.02 The black widow bite is characterized by a pinprick sensation and burning around the bite area. After 15 minutes to an hour after the bite, intense pain may be felt in the bite area, which spreads. Bite victims may exhibit profuse sweating, muscle pain and spasms, breathing difficulty, difficulty speaking, poor coordination, and generalized swelling of the extremities.

11.6.2.03 The brown recluse bite is characterized by blistering at the bite location, followed by burning sensation 30 to 60 minutes after the bite. A large red swollen, often pulsating lesion with a characteristic bulls-eye may appear. The bite victim will exhibit a generalized rash, have joint pain, chills, fever, nausea, and vomiting and onset of severe pain. Necrosis of tissue may occur around the bite area, which can spread.

11.6.2.04 Mosquitoes, biting flies, fleas, and ticks are known to be present and may pose a bite hazard to workers. Mosquitoes can carry disease such as dengue, which can be fatal in some instances.

11.6.2.05 According to the Centers for Disease Control, dengue is endemic to Puerto Rico and is a leading cause of illness and death in the tropics and subtropics. As many as 100 million people are infected yearly. Dengue is caused by any one of four related viruses transmitted by mosquitoes. The most effective protective measures are those that avoid mosquito bites. When infected, early recognition and prompt supportive treatment can substantially lower the risk of developing severe disease.

11.6.2.06 The principal symptoms of dengue are high fever and at least two of the following:

- Severe headache
- Severe eye pain (behind eyes)
- Joint pain
- Muscle and/or bone pain
- Rash
- Mild bleeding manifestation (e.g., nose or gum bleed, petechiae, or easy bruising)
- Low white cell count

11.6.2.07 Watch for warning signs as temperature declines 3 to 7 days after symptoms began.

11.6.2.08 Go IMMEDIATELY to an emergency room or the closest health care provider if any of the following warning signs appear:

- Severe abdominal pain or persistent vomiting
- Red spots or patches on the skin
- Bleeding from nose or gums
- Vomiting blood
- Black, tarry stools (feces, excrement)
- Drowsiness or irritability
- Pale, cold, or clammy skin
- Difficulty breathing

11.6.2.09 Lyme disease is caused by bites from infected ticks that are common in and near wooded areas, tall grass, and brush. Ticks are small, ranging from the size of a comma up to about one-quarter inch. When embedded into the skin, they may resemble a small freckle. Tick season extends from spring through summer, but may extend year-round in areas without significant cold weather.

11.6.2.010 Lyme disease is caused by infection from a deer tick that carries a spirochete. During the painless tick bite, the spirochete may be transmitted into the bloodstream, which could lead to the worker contracting Lyme disease. Lyme disease may cause a variety of medical conditions including arthritis, which can be treated successfully if the symptoms are recognized early and medical attention is received. Treatment with antibodies has been successful in preventing more serious symptoms from developing. If left untreated, Lyme disease can cause serious nerve or heart problems as well as a disabling type of arthritis.

11.6.2.011 Symptoms can include a stiff neck, chills, fever, sore throat, headache, fatigue, and joint pain. This flu-like illness is out of season, commonly happening between May and October when ticks are most active. A large expanding skin rash usually develops around the area of the bite. More than one rash may occur. The rash may feel hot to the touch and may be painful. Rashes vary in size, shape, and color, but often look like a red ring with a clear center. The outer edges expand in size. It is easy to miss the rash and the connection between the rash and a tick bite. The rash develops from three days to as long as a month after the tick bite. Almost one-third of those with Lyme disease never get the rash. Joint or muscle pain may be an early sign of Lyme disease. These aches and pains may be easy to confuse with the pain that comes with other types of arthritis. However, unlike many other types of arthritis, this pain seems to move or travel from joint to joint.

11.6.2.012 Lyme disease can affect the nervous system. Symptoms include stiff neck, severe headache, and fatigue usually linked to meningitis. Symptoms may also include pain and drooping of the muscles on the face, called Bell’s Palsy. Lyme disease may also mimic symptoms of multiple sclerosis or other types of paralysis. Lyme disease can also cause serious but reversible heart problems, such as irregular heartbeat. Finally, Lyme disease can result in a disabling, chronic type of arthritis that most often affects the knees. Treatment is more difficult and less successful in later stages. Often, the effects of Lyme disease may be confused with other medical problems.

11.6.2.013 It is recommended that personnel check themselves when in areas that could harbor ticks, wear light color clothing and visually check themselves and their buddy when coming from wooded or vegetated areas. If a tick is found biting an individual, the SSHO will be contacted immediately. The tick can be removed by pulling gently at the head with tweezers. The affected area should then be disinfected with an antiseptic wipe. The employee will be offered the option for medical treatment by a physician, which typically involves prophylactic antibiotics. If personnel feel sick or have signs similar to those above, they will notify the SSHO immediately.

11.6.2.014 To help minimize bites from insects, apply insect repellent prior to fieldwork and as often as needed throughout the work shift. Apply DEET (vapor-active repellent) to any exposed skin surface (except eyes and lips), and apply the permethrin repellent spray to field clothing. Note: Allow the permethrin to dry before using the treated clothing.

11.6.2.015 In addition:

- Wear proper protective clothing (work boots, socks, and pants). Tuck pant legs into socks when possible.

- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.
- Inspect yourself in the mirror at the end of the day for ticks and/or evidence of bites such as swollen or reddened areas, areas tender or warm to the touch. Report instances of suspected bites to the SSHO. Prompt discovery and reporting, observation for signs and symptoms, and follow-up medical care are crucial.

11.6.3 Wild Animal Hazard Identification and Mitigation

11.6.3.01 Wild animals such as stray dogs or cats, mice, or other mammals may be encountered. These animals may bite and can carry rabies and should be avoided.

11.6.3.03 Workers shall use discretion and avoid all contact with wild animals and shall not feed wild animals or improperly discard food waste or lunchroom trash. Trash shall be disposed of in proper receptacles with covers. If these animals present a problem or significant rodent populations are encountered, the SHM will be notified and will develop a plan to alleviate the problem.

11.6.4 Sharks and Other Hazardous Marine Life

11.6.4.01 The sites that are the focus of the RI are part of the marine nearshore environment. A variety of different shark species may be present ranging from small reef sharks to larger and more rarely seen sharks such as ocean whitetip sharks. Sharks may be attracted to certain activities or scents in the water and on occasion, an unprovoked shark attack may occur, though rarely. A prevalence of sharks in the area or ocean whitetip shark sightings in the area may warrant caution or hazard evaluation if any person enters the water (not anticipated during this phase of the RI).

11.6.4.02 Another type of marine life that can injure people who come into contact with them (including when lines are retrieved and handled after brushing up against them) is the cnidarian, commonly called the jellyfish. More than 100 species of jellyfish are toxic to humans. Cnidarians have tentacles that have stinging cells called nematocysts, which are coiled like springs and, when contact is made, send a stinger into the skin with a toxin. Contact with jellyfish (including some species of corals) can cause skin rashes, and in more severe cases or contact with more toxic species, can cause cardiovascular and respiratory system collapse. There are three classes of jellyfish in the Caribbean (all except the box jellyfish, which is the most toxic): true jellyfish, which are the most common variety; sea anemones and corals; and the most dangerous in the Caribbean, the Portuguese man-of-war, though contact with the Portuguese man-of-war in Puerto Rico is reportedly rare.

11.6.4.03 Most jellyfish stings can be treated by first removing any remaining tentacles using a towel or gloved hand, followed by rinsing the area with hot water (not scalding hot); if hot water is not available, use salt water rather than fresh water, as fresh water may cause more pain.

Soaking the affected area in hot water and over-the-counter medications such as acetaminophen or ibuprofen may help with the pain. Always seek medical attention if signs and symptoms of anaphylaxis are observed with any sting, and always seek medical attention if stung by a Portuguese man-of-war, as these stings often lead to more severe reactions and, in some instances, death.

11.6.4.04 The red lionfish, a tropical native of the Indian and Pacific oceans, has undergone an invasive population explosion in the waters of the Caribbean, including Puerto Rico. Lionfish have distinctive brown or maroon and white stripes or bands covering the head and body. They have fleshy tentacles above their eyes and below the mouth and fan-like pectoral fins with long separated dorsal spines. An adult lionfish can grow as large as 18 inches, while juveniles may be as small as 1 inch or less. Lionfish can be found in nearly all marine habitat types found in warm marine waters of the tropics, and have been found in water depths from 1 to 1,000 feet on hard bottom, mangrove, seagrass, coral, and artificial reefs.

11.6.4.05 Lionfish spines deliver a venomous sting that can last for days and cause extreme pain, sweating, respiratory distress, and even paralysis. Their venom glands are located within two grooves of the spine and the venom is a combination of protein, a neuromuscular toxin, and a neurotransmitter called acetylcholine. After the spine punctures the skin, the venom enters the wound when exposed to the venom glands within the grooves of the spine. If you are stung by a lionfish, seek medical attention immediately. If placing hands or stepping into the water, one should be aware of lionfish hazards and avoid contact with this fish and be extra vigilant around coral reefs and shallow water areas. In addition, as the lionfish is an invasive species, reporting of lionfish sightings to local fish and wildlife agencies may be warranted.

11.6.5 Poisonous Plant Hazard Identification and Mitigation

11.6.5.01 The potential for contact with poisonous plants exists when in undeveloped and wooded areas. In Puerto Rico, the Manchineel (often referred to as Manzanillo) tree is one such poisonous plant. The Manchineel tree grows to a height of 40 to 50 feet, predominantly along sandy seashores. It has green leaves that are shiny in appearance. The tree and its parts contain strong toxins, some of which are unidentified. It has a milky white sap that contains Phorbol and other skin irritants, producing strong allergic dermatitis. Standing beneath the tree during rain will cause blistering of the skin from mere contact with this liquid; even a small drop of rain with the milky substance in it will cause the skin to blister. Burning the tree may cause blindness if the smoke reaches the eyes. The fruit can also be fatal if eaten.

11.6.5.02 A person experiencing symptoms of poisoning will likely exhibit blistering at the site of contact, usually within 12 to 48 hours. Reddening, swelling, burning, and itching at the contact site may also occur, often painful. Other reactions may include respiratory effects such as asthma or anaphylaxis in highly sensitive individuals. Employees will be trained in the identification of these species and will be advised to wear protective clothing such as gloves and long sleeve shirts when working conditions permit. Employees should also consider applying barrier lotions to the skin that has potential to contact these species.

11.7 BLOODBORNE PATHOGENS

11.7.01 Bloodborne pathogens enter the human body and blood circulation system through punctures, cuts, or abrasions of the skin or mucous membranes. They are not transmitted through ingestion (swallowing), through the lungs (breathing), or by contact with whole, healthy skin. However, under the principle of universal precautions, all blood should be considered infectious, and all skin and mucous membranes should be considered to have possible points of entry for pathogens.

11.7.02 Potential bloodborne pathogen exposures include:

- Contact with contaminated medical equipment or medical waste or sharps;
- Medical emergency response operations such as administering first aid or CPR; and
- Two primary bloodborne pathogens include hepatitis B and human immunodeficiency virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS).

11.7.03 To reduce the risk of contracting a bloodborne pathogen, take the following precautions:

- Avoid contact with blood and other bodily fluids;
- Use protective equipment when giving first aid/CPR, such as disposable gloves and breathing barriers; and
- Thoroughly wash your hands with soap and water immediately after giving care.

11.7.04 When cleaning up blood or other bodily fluids:

- Clean up the spill immediately or soon as possible after the spill occurs.
- Use disposable gloves and other PPE when cleaning spills.
- Wipe up the spill with paper towels or other absorbent materials.
- After the area has been wiped up, flood the area with a solution of ¼ cup of liquid chlorine bleach to 1 gallon of fresh water and allow it to stand for at least 20 minutes.
- Dispose of the contaminated material used to clean up the spill in a labeled biohazard container.

11.7.05 The SSHO should be notified of any potential contact with blood or bodily fluids resulting from first aid or CPR administered on the job. Site personnel will be given bloodborne pathogens training.

11.8 ACCIDENTAL GROUNDINGS

11.8.01 While it is possible for vessels to accidentally become grounded, many precautions are in place to minimize the potential for this. If it is determined that weather conditions are unsafe (e.g., heavy rain, strong wind, and rough seas), boating operations in specific areas, or altogether as conditions dictate, will not be conducted in order to minimize the potential for accidental groundings.

11.8.02 If the vessel runs aground, the operator shall perform the following:

1. Turn off the engine.
2. Avoid using the engine to power off the reef, hardbottom, or seagrass.
3. Raise the propeller, and allow the boat to drift free.
4. Radio the Coast Guard, Marine Patrol, or VHF Channel 16 for assistance.
5. Report any coral and seagrass bed damage from the grounded vessel according to procedures provided in the SOP in Appendix B of the Work Plan.

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12.0 REFERENCES

TtEC (Tetra Tech EC, Inc.). 2012. Environmental Baseline Survey Work Plan. January.

TtEC. 2014. Project Orientation, Rules and Safety Guidelines Handbook. January.

USACE (U.S. Army Corps of Engineers). 2008. Safety and Health Requirements Manual. Engineering Manual (EM) 385-1-1. September 15 (Consolidated August 2011).

U.S. Department of Labor. Part 1910. Occupational Safety and Health Administration, Occupational Safety and Health Standards. 29 *Code of Federal Regulations* (CFR).

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EXHIBITS

ESQ

ENVIRONMENTAL SAFETY AND QUALITY

POLICY

Tetra Tech EC, Inc. (TtEC) is committed to ensuring the health, safety, and well being of our employees and the communities in which we work, enhancing and protecting the environment, and providing quality services to our clients. Our Environmental, Safety and Quality (ESQ) Policy provides the framework and underlying principles for our Environmental Management System and is an integral part of how we conduct business.

All TtEC associates have the right to work in a safe and healthful workplace as well as the responsibility to help create and work in a safe and environmentally protective manner:

- We will complete our work successfully, with a great deal of attention to health and safety by:
  - Incorporating pollution prevention and loss prevention principles into our work process.
  - Employing well-trained personnel who understand and have the knowledge to fulfill their ESQ responsibilities.
- We will fully comply with all laws and regulations pertaining to our business, including company policies and procedures and the requirements of ISO 14001.
- We will commit ourselves to complying with the terms of our contracts and to meeting the four project objectives—knowing scope, budget, schedule, and level of quality.
- We will provide the level of quality our internal and external clients expect and pay for and use its attainment as our measure of success.
- We will safely and properly plan our work and work our plan.
- We will communicate and document the execution of our work.
- We will gather data and make decisions inclusively and involve employees and others affected by ESQ decisions inclusively.
- We will dedicate ourselves to continuous improvement by:
  - Establishing and periodically updating ESQ improvement objectives and targets.
  - Recognizing outstanding employee and project ESQ performance.

These commitments are defined in, and are fundamental to, our **Client Service Quality®**, **Do It Right®**, and **Shared Vision®**, **Zero Incident Performance®** operating philosophies.

Don Rogers
President and CEO

Donald Rogers

TETRA TECH EC, INC.

TETRA TECH EC, INC. CORPORATE HEALTH AND SAFETY PROGRAM PROCEDURES LIST

EHS 1-1	Responsibilities for Program Implementation
EHS 1-2	Awareness and Recoginition Program
EHS 1-3	Employee Participation Program
EHS 1-4	Subcontractor Selection and Management
EHS 1-5	Visitor Safety
EHS 1-7	Event Reporting and Investigation
EHS 1-9	Recordkeeping
EHS 1-10	External Regulatory Inspections and Notifications
EHS 1-11	Training
EHS 2-1	Emergency Preparedness
EHS 3-1	Ergonomics
EHS 3-2	Procedures – Environmental Health and Safety Plan(s)
EHS 3-3	EHS Inspections
EHS 3-4	Site and Contamination Control
EHS 3-5	Activity Hazard Analysis
EHS 3-6	Work Rules
EHS 3-7	Hazardous Material Storage and Transportation
EHS 3-8	Fall Protection
EHS 3-9	Hoisting and Rigging
EHS 3-10	Electrical Safety
EHS 3-11	Hand and Portable Power Tools
EHS 3-12	Scaffolding
EHS 3-13	Motorized Vehicles and Equipment
EHS 3-14	Fire Prevention
EHS 3-15	Underground Utilities
EHS 4-1	Bloodborne Pathogens
EHS 4-2	Hazard Communication
EHS 4-3	Radioactive and Mixed Waste Programs
EHS 4-4	Hearing Conservation
EHS 4-5	Medical Screening and Surveillance
EHS 4-6	Temperature Extremes

TETRA TECH EC, INC. CORPORATE HEALTH AND SAFETY PROGRAM PROCEDURES LIST

EHS 5-1	Personal Protective Equipment
EHS 5-2	Respiratory Protection
EHS 6-1	Confined Space Entry
EHS 6-2	Drill Rigs
EHS 6-3	Excavation and Trenching
EHS 6-4	Lockout/Tagout
EHS 6-5	Welding/Hot Work
EHS 6-6	Boating
EHS 6-7	Drum and Container Handling
EHS 6-8	Demolition
EHS 6-9	Line Breaking
EHS 7-1	UXO Initial Site Assessment
EHS 7-2	UXO Drilling Operations
EHS 7-3	UXO Quality Control
EHS 7-4	UXO Safety Concepts
EHS 7-5	UXO Demolition Safety Precautions
EHS 8-1	Asbestos Control

ZIP

Zero Incident Performance®

We value the safety and well being of all associates. We work on the premise that all accidents are preventable. Our goal of **Zero Incident Performance®** is supported by the integration of safety concepts, principles and practices into each work effort and project phase.

Zero Incident Performance

Zip

Do it safe... Do it right

TETRA TECH EC, INC.

Zero Incident Performance® Pledge

As a member of the Tetra Tech EC, Inc. Team,
I am dedicated to the goal of Zero Incident Performance:

- I believe that all incidents are preventable.
- I believe that Zero Incident Performance is achievable through proper planning, tasking, and execution of plans and procedures as written.
- I believe that the investigation of "near misses" provides an opportunity for improvement before a loss occurs.
- I will make every effort to understand how to properly perform each task that I am assigned.
- I will perform each task in a safe and environmentally protective manner with the appropriate level of quality.
- I will help to fix things that are wrong.
- I will immediately report all incidents including "near misses" to my supervisor.

TETRA TECH EC, INC.

ATTACHMENT A

ACTIVITY HAZARD ANALYSES

Activity Hazard Analysis (AHA)

Job/Task: Mobilization and Site Setup	Overall Risk Assessment Code (RAC) (Use highest code)					M
Project Location: Culebra Water Ranges, Culebra, Puerto Rico	**Risk Assessment Code (RAC) Matrix**					
Contract Number: W912DY-10-D-0015	**Severity**	**Probability**				
Date Prepared: April 29, 2015		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Jennifer Peters, Sr. EHS Specialist	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
Reviewed by (Name/Title): Roger Margotto, CIH, CSP, CHMM, Tetra Tech EC Safety and Health Manager (SHM)	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)
In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved safety plan. TtEC Corporate Safety Programs will also be available on site for review of specific materials and mitigation measures. Personal Protective Equipment for this AHA will consist of hard hat (when overhead safety hazards exist), sturdy leather deck shoes, safety glasses with side shields, standard work uniform (long pants, ¾ length sleeve shirt). Hearing protection (as required). Work gloves worn when indicated, Class 2 high visibility safety vest when working within traffic areas.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

	RAC Chart
"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk**
	H = High Risk
	M = Moderate Risk
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**L = Low Risk**

AHA 1 – Mobilization and Site Setup

Job Steps	Hazards	Controls	RAC
1. Set up shore-based work areas	Workers could be exposed to chemical hazards during fueling.	Delineate the refueling zone, and use PPE as required in the MSDS/SDS by the type of material being used. The tasks performed, ambient air monitoring, temperature, and visual observation will be used to verify the selection of PPE. Identify all chemical hazards and receive training regarding the safe handling of chemicals (refer to MSDSs or SDSs). The SSHO will maintain copies of all MSDSs/SDSs at the site and conduct Hazard Communication training with all project personnel.	L
	Noise from the site setup could cause hearing loss to workers.	Hearing protection is required when sound levels exceed 84 dBA continuously. This rule applies to personnel working near heavy equipment, generator use, or operating engines.	L

AHA 1 – Mobilization and Site Setup			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Set up shore-based work areas (cont'd)	Slip, trip, and fall hazards could be present.	Visually inspect work areas; eliminate slip, trip, and fall hazards if feasible, otherwise barricade/ isolate the hazards. Keep work areas neat and orderly. Always place supplies, hoses, cords and other equipment in areas away from normal foot traffic, and equipment and tools in a safe location that does not present a trip hazard to work areas. Maintain proper illumination in all work areas. Work is authorized during daylight hours only.	L
	Sharp objects could cause puncture.	Wear cut-resistant work gloves when handling sharp edges and items with pinch points, such as barricades, EZ-up shade structures, folding chairs, etc. Whenever possible, blunt sharp edges and double over wire ends (fencing, material bundles, etc.). Workers should not stand or walk on either equipment or supplies.	L
	Musculo-skeletal strains from lifting and moving materials/ equipment manually.	Use mechanical lifting equipment and hand-trucks whenever possible. Otherwise, use proper lifting techniques, such as keeping the back and neck straight, lifting with the legs without twisting, and getting help when moving bulky/heavy materials and equipment. Employees will not lift more than 50 pounds alone. Encourage a steady, sustainable work pace.	M
	Worker exposure to extreme temperatures and sunburn.	Monitor for heat stress and follow safety plans. SSHO will implement EHS 4-6, Temperature Extremes. Wear a SPF 15 or greater broad spectrum sunscreen on exposed areas and wear a hat with a bill or brim. Provide shaded break areas and plenty of fluids to be consumed for hydration.	L
	Eye injury.	Safety glasses (clear or tinted) are the minimum required eye protection for all work areas during setup and shut down.	L
	Lack of communication in widely dispersed areas could lead to a delayed response in an emergency.	Ensure that each work team has a phone, or access to a phone, for emergency communication. Verify emergency numbers and functions of telephones and radios. Use the buddy system. Verify routes to local hospital.	L
	Contact with wild animals, biting or stinging insects, and poisonous plants could cause injury upon contact.	Workers will apply DEET to work clothing and skin area following manufacturer's instructions as a preventative measure for biting insects. Workers will exercise caution when working in brushy or grassy areas, wood or debris piles, and recessed areas. Site orientation will include briefing on local hazardous flora and fauna, signs and symptoms of exposure and precautions to take. Workers with allergies will let the SSHO know using the medical data sheet and will carry their own prescription medication as applicable. First aid and medical attention as required. Report any bites, stings, or rashes to the SSHO.	L

AHA 1 – Mobilization and Site Setup			
Job Steps	**Hazards**	**Controls**	**RAC**
2. Backing of boats or hovercraft on trailers	Failure of proper backing can cause struck by and pinch point injuries or property damage.	Use spotters for all backing operations. Ensure spotter stands in line of sight of the person backing the vehicle. All personnel who back a trailer are trained and qualified to do so and are designated by the PjM for such activities. Use boat checklist in APP prior to launching boat. Verify understanding of hand signals used for backing, going forward, stopping, and turning left or right. Use parking brake and ensure operator is not moving vehicle before unhitching boat from trailer. Follow EHS 6-6, Boating Procedure. Ground personnel involved in backing operations will wear class 2 high visibility vest.	M

AHA 1 – Mobilization and Site Setup		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**
Site Vehicles	Drivers must have current State or Puerto Rico-issued driver's license.	Daily vehicle inspection by drivers.
Boat and hovercraft	Qualified Operators will have USCG-approved boater safety qualifications identified in the APP and experience in use of the boats on the project. Hovercraft operators will have hovercraft training and operation course and will be TtEC-designated operators. Ensure operations manuals for boat and hovercraft are reviewed and that operations manuals are available onboard.	Inspect daily, and before use. Use the boating checklist form. Follow procedures in EHS 6-6, Boating Procedure, and the Hovercraft Standard Operating Procedure.
First aid kit, fire extinguisher, eyewash station	Use of emergency equipment including first aid kits, fire extinguishers and eyewash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO.	Fire Extinguisher • Initially and at least monthly thereafter by SSHO First Aid Kit • Weekly and after use for restocking by SSHO Eye Wash Station • Weekly by SSHO • Potable water changed weekly unless a preservative solution is used

AHA 1 – Mobilization and Site Setup		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**
RTK GPS unit, TEMA unit (towfish or float)	Hydrographer to check each day prior to operations.	An experienced operator will use.
Type II or better PFD to be worn	User will inspect each day before use.	An experienced operator will use. SSHO will instruct in proper use.
Personal Protective Equipment	Users must be trained in the proper use, limitations, inspection, donning and doffing, and replacement of PPE used.	Daily inspection by user before use.

Acronyms:

AHA – Activity Hazard Analysis
APP – Accident Prevention Plan
dBA – decibels, A-scale
CFR – Code of Federal Regulations
DEET – N,N-diethyl-meta-toluamide
EHS – Environmental, Health, and Safety
EM – Engineer Manual
GPS – global positioning system
MSDS – Material Safety Data Sheet
PFD – personal flotation device
PPE – personal protective equipment
RAC – Risk Assessment Code
RTK – real-time kinematic
SDS – Safety Data Sheet
SSHO – Site Safety and Health Officer
TEMA – Towed Electromagnetic Array
TtEC – Tetra Tech EC
USCG – U.S. Coast Guard

AHA Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Activity Hazard Analysis (AHA)

<table>
<tr><td>Job/Task: Boating and TEMA Surveys</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>M</td></tr>
<tr><td>Project Location: Culebra Water Ranges, Culebra, Puerto Rico</td><td colspan="6">Risk Assessment Code (RAC) Matrix</td></tr>
<tr><td>Contract Number: W912DY-10-D-0015</td><td rowspan="2">Severity</td><td colspan="5">Probability</td></tr>
<tr><td>Date Prepared: April 29, 2015</td><td>Frequent</td><td>Likely</td><td>Occasional</td><td>Seldom</td><td>Unlikely</td></tr>
<tr><td rowspan="2">Prepared by (Name/Title): Jennifer Peters, Sr. EHS Specialist</td><td>Catastrophic</td><td>E</td><td>E</td><td>H</td><td>H</td><td>M</td></tr>
<tr><td>Critical</td><td>E</td><td>H</td><td>H</td><td>M</td><td>L</td></tr>
<tr><td rowspan="2">Reviewed by (Name/Title): Roger Margotto, CIH, CSP, CHMM, Tetra Tech EC Safety and Health Manager (SHM)</td><td>Marginal</td><td>H</td><td>M</td><td>M</td><td>L</td><td>L</td></tr>
<tr><td>Negligible</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td rowspan="5">Notes: (Field Notes, Review Comments, etc.)
In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved safety plan. TtEC Corporate Safety Programs will also be available on site for review of specific materials and mitigation measures. Personal Protective Equipment for this AHA will consist of sturdy leather deck shoes, safety glasses with side shields and appropriate shading, standard work uniform (long pants, ¾ length sleeve shirt). Hearing protection (as required). Work gloves worn when indicated, and Type II or better personal flotation device.</td><td colspan="6">Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above)</td></tr>
<tr><td colspan="4">“Probability” is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.</td><td colspan="2">RAC Chart</td></tr>
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H = High Risk</td></tr>
<tr><td colspan="4" rowspan="2">Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.</td><td colspan="2">M = Moderate Risk</td></tr>
<tr><td colspan="2">L = Low Risk</td></tr>
</table>

AHA 2 – Boating and TEMA Surveys			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Mobilization and Setup	N/A	See AHA 1, Mobilization and Site Setup for hazards and controls associated with mobilization and setup which may be performed once or repeated daily as needed to support boating and TEMA survey operations.	N/A
2. Boating Note: Hovercraft activities are included in AHA #4.	Failure to meet EM 385-1-1 Section 19 in general and specifically 19F requirements for use of boats could cause injury or death.	Follow the requirements of EM 385-1-1 and EHS 6-6, Boating Procedure, using the inspection checklist provided in the APP. All boat operators are qualified and trained in boat use and procedures and are designated by TtEC management as boat operators. Ensure boat passengers have been briefed on the location, use, and inspection of emergency equipment onboard and the procedures to follow in the event of a shipboard emergency. Practice drills will be done prior to or during first deployment for situations such as man overboard, fires and explosions, and abandon ship.	M

AHA 2 – Boating and TEMA Surveys			
Job Steps	**Hazards**	**Controls**	**RAC**
2. Boating (continued)	Fueling of boat – potential for fire, environmental release. Run out of fuel when operating.	No smoking or other sources of ignition when fueling. Engine must be off. There must be a properly rated fire extinguisher available onboard. Refuel in a manner to prevent any spills, especially spills into the water and ensure visual observation or other means to prevent overfilling is followed in accordance with manufacturer instruction. (If there is any sheen in the water the spill must be reported). Check for fuel leaks in the boat, if fuel lines are located in the boat.). Ensure there is enough fuel supply for the trip and the return to dock plus 1/3 in reserve.	M
	Boat could malfunction and drift into open water if engine does not work.	Ensure communications are working on boat. Have anchor and enough line to deploy in the event of motor/engine malfunction. Ensure that a Float Plan is filed in accordance with the APP using the example USCG Float Plan in the APP when a float plan is required. File this plan daily with the PjM or designee before leaving the dock and notify them of your return. Perform required preventive maintenance on boat motor in accordance with manufacturer's instruction.	M
	Grounding.	Use caution in the shallow areas. Use depth meter and spotting to avoid striking the bottom or grounding.	L
	Personnel can slip or trip while on the dock and when getting on or off the boat.	Personnel should use appropriate footwear (sturdy leather deck shoes) to ensure that there is enough tread on the soles to minimize slipping. Look out for trip hazards such as equipment and lines on boat deck. Those hazards that cannot be removed must be marked. When climbing up or down or on and off boats, always ensure three points of contact and use ladders when provided onboard boat. Do not climb on rigging.	L
	Sunburn for personnel in boat.	Use broad spectrum sunscreen SPF 15 or greater as necessary on all exposed skin areas. Wear a hat with a bill or brim. Suggest wearing of neck protector if neck is exposed to sun or Bimini top on boat is not installed for shade.	L
	Severe weather can cause dangerous seas and hazardous boating conditions.	Monitor the local and national weather service broadcasts prior to mobilization by boat and during the day. Pay attention to weather advisories and storm warnings, namely hurricanes. Monitor actual water conditions for dangerous wave or ground swell action. Follow provisions in the APP for severe weather.	M
	Heat or cold stress may be experienced.	Boat occupants will be monitored for signs and symptoms of heat stress and cold stress (in colder weather, wet weather, or if wind chill is a factor) in accordance with the APP and EHS 4-6, Temperature Extremes. Hydration and work/rest regimens will be followed. Survival kits on the boat will include blankets in the event of hypothermia for boat occupants. Boat occupants will be prepared with raingear and a change of clothing in the event they get wet and chilled. Boat survival kit, if used, will be restocked with necessary equipment. Adequate drinking water and electrolyte fluids will be available for boaters. Boat cabin shall have air conditioning or at a minimum, shade for employees to rest in.	M

AHA 2 – Boating and TEMA Surveys			
Job Steps	**Hazards**	**Controls**	**RAC**
2. Boating (continued)	Boat could be struck by other boats in area.	Boat operator is in charge of situational awareness while on the water. Boat operator will not be doing other tasks when boat is in operation. Monitor Channel 16 and U.S. Coast Guard rules for lighting and other vessel operations. Use air horn in the event of a boat coming close.	M
3. Setup of TEMA equipment	Injury or accidents such as pinch points, struck by, caught between hazards with equipment especially when on a boat	Training of personnel using this equipment will include familiarity with the hazards due to weight distribution, lines and other equipment used to secure the equipment on boat deck, procedures for safe setup of equipment prior to deployment. Familiarization will include manufacturer's guidelines and instructions and site specific procedures included in the Work Plan. Equipment operations manuals will be referred to and will be available on-site. Equipment will be inspected before use, each day by the user. Safety equipment onboard will include an industrial first aid kit and required USCG safety equipment. Personnel will be informed of its' location and use and emergency procedures. A minimum of 2 persons will be first aid/CPR trained.	M
4. Deployment and operation of TEMA Survey equipment	Back injury and strains could occur and loads could shift on boat.	Site personnel will be instructed on proper lifting techniques (keep back straight, lift with legs, limit twisting, etc.). Mechanical devices should be used to reduce manual handling of materials and tag lines for stabilization shall be used as necessary rather than direct hand contact. Team lifting should be utilized if mechanical devices are not available. An individual will not lift loads greater than 50 pounds. Have boat operator position boat to minimize effect of ground swell or wave/wind action when deploying the TEMA towfish, float, or other deployed equipment into the water from the boat deck. Do not deploy equipment if weather or dangerous sea state conditions exist. Monitor the weather forecasts.	M
	Struck by or caught between, object dropped on feet.	Wear sturdy leather deck shoes on deck. Keep fingers and hands and feet (and entire body as required) out of pinch points and lines. Ensure one person is in charge of lifts and deployment and that others are aware of intentions and signals used. Wear hard hat if overhead hazards exist or worker head could be struck.	M
	Noise.	Hearing protection with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) will be worn as necessary in accordance with the level of noise produced by vessel engines, power tools, lifts and other motor driven equipment.	L
	Ropes and lines can cause burns to hands by friction and pinch points.	Workers will wear leather palm gloves when handling lines and deploying equipment. Do not get hands on or in lines that are being controlled by mechanical winch. Lock out and tagout procedures, if required per manufacture guidelines for working on equipment, will be followed. Keep loose clothing and hair secure when there are moving lines and pinch points present.	L

AHA 2 – Boating and TEMA Surveys			
Job Steps	**Hazards**	**Controls**	**RAC**
5. Retrieval of TEMA Equipment	Struck by or caught between, object dropped on feet.	Wear sturdy deck shoes on deck. Keep fingers and hands and feet (and entire body as required) out of pinch points and lines. Ensure one person is in charge of lifts and deployment and that others are aware of intentions and signals used. Wear hard hat if overhead hazards exist or worker head could be struck.	M
	Ropes and lines can cause burns to hands by friction and pinch points.	Workers will wear gloves when handling lines and retrieving equipment. Do not get hands on or in lines that are being controlled by mechanical winch. Lock out and tagout procedures, if required per manufacture guidelines for working on equipment will be followed. Keep loose clothing and hair secure when there are moving lines and pinch points present.	L
	Back injury and strains could occur and loads could shift on boat.	Site personnel will be instructed on proper lifting techniques (keep back straight, lift with legs, limit twisting, etc.).	M

AHA 2 – Boating and TEMA Surveys		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**
Site vehicles	Drivers must have current State or Puerto Rico-issued driver's license.	Daily vehicle inspection by drivers.
Boats	Qualified Operators will have U.S. Coast Guard approved boater safety qualifications identified in the APP and experience in use of the boats on the project.	Inspect daily, and before use. Use the boating checklist form. Follow procedures in EHS 6-6, Boating Procedure.
First aid kit, fire extinguisher, eyewash station	Use of emergency equipment including first aid kits, fire extinguishers, and eyewash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO.	Fire Extinguisher • Initially and at least monthly thereafter by SSHO First Aid Kit • Weekly and after use for restocking by SSHO Eyewash Station • Weekly by SSHO • Potable water changed weekly unless a preservative solution is used
RTK GPS unit, TEMA unit (towfish or float)	Hydrographer to check each day prior to operations.	An experienced operator will use.

AHA 2 – Boating and TEMA Surveys		
Type II or better PFD to be worn	User will inspect each day before use.	An experienced operator will use. SSHO will instruct in proper use.
Personal Protective Equipment	Users must be trained in the proper use, limitations, inspection, donning and doffing, and replacement of PPE used.	Daily inspection by user before use.

Acronyms:

AHA – Activity Hazard Analysis
APP – Accident Prevention Plan
dBA – decibels, A-scale
CFR – Code of Federal Regulations
EHS – Environmental, Health, and Safety
EM – Engineer Manual
GPS – global positioning system
PFD – personal flotation device
PPE – personal protective equipment
RAC – Risk Assessment Code
RTK – real-time kinematic
SSHO – Site Safety and Health Officer
TEMA – Towed Electromagnetic Array
TtEC – Tetra Tech EC, Inc.

AHA Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

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Activity Hazard Analysis (AHA)

Job/Task: Site Restoration and Demobilization	**Overall Risk Assessment Code (RAC) (Use highest code)**					**M**
Project Location: Culebra Water Ranges, Culebra, Puerto Rico	**Risk Assessment Code (RAC) Matrix**					
Contract Number: W912DY-10-D-0015	**Severity**	**Probability**				
Date Prepared: April 29, 2015		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Jennifer Peters, Sr. EHS Specialist	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title): Roger Margotto, CIH, CSP, CHMM, Tetra Tech EC Safety and Health Manager (SHM)	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.) In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved safety plan. TtEC Corporate Safety Programs will also be available on site for review of specific materials and mitigation measures. Personal Protective Equipment for this AHA will consist of hard hat (when overhead safety hazards exist), sturdy leather deck shoes, safety glasses with side shields, standard work uniform (long pants, ¾ length sleeve shirt). Hearing protection (as required). Work gloves worn when indicated, Class 2 high visibility safety vest when working within traffic areas.	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)	
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk** **H = High Risk**
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk** **L = Low Risk**

AHA 3 – Site Restoration and Demobilization			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Remove, disassemble, and pack up shore based work areas	Workers could be exposed to chemical hazards during fueling.	Delineate the refueling zone, and use PPE as required in the MSDS/SDS by the type of material being used. The tasks performed, ambient air monitoring, and temperature and visual observation will be used to verify the selection of PPE. Identify all chemical hazards and receive training regarding the safe handling of chemicals (refer to MSDSs/SDSs). The SSHO will maintain copies of all MSDSs/SDSs at the site and conduct Hazard Communication training with all project personnel.	L
	Noise from the tools and equipment could cause hearing loss to workers.	Hearing protection is required when sound levels exceed 84 dBA continuously. This rule applies to personnel working near heavy equipment, generator use, or operating heavy equipment	L

AHA 3 – Site Restoration and Demobilization			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Remove, disassemble, and pack up shore based work areas (continued)	Slip, trip, and fall hazards could be present.	Visually inspect work areas; eliminate slip, trip, and fall hazards if feasible, otherwise barricade/ isolate the hazards. Keep work areas neat and orderly. Always place supplies, hoses, cords and other equipment in areas away from normal foot traffic, and equipment and tools in a safe location that does not present a trip hazard to work areas. Maintain proper illumination in all work areas. Work is authorized during daylight hours only.	L
	Sharp objects could cause puncture.	Wear cut-resistant work gloves when handling sharp edges and items with pinch points, such as barricades, EZ-up shade structures, folding chairs, etc. Whenever possible, blunt sharp edges and double over wire ends (fencing, material bundles, etc.). Workers should not stand or walk on either equipment or supplies.	L
	Musculo-skeletal strains from lifting and moving materials/ equipment manually.	Use mechanical lifting equipment and hand-trucks whenever possible. Otherwise, use proper lifting techniques, such as keeping the back and neck straight, lifting with the legs without twisting, and getting help when moving bulky/heavy materials and equipment. Employees will not lift more than 50 pounds alone. Encourage a steady, sustainable work pace.	M
	Worker exposure to extreme temperatures.	Monitor for heat stress and follow safety plans. SSHO will implement EHS 4-6, Temperature Extremes. Wear a SPF 15 or greater broad spectrum sunscreen on exposed areas and wear a hat with a bill or brim. Provide shaded break areas and plenty of fluids to be consumed for hydration.	L
	Eye injury.	Safety glasses (clear or tinted) are the minimum required eye protection for all work areas during setup and shut down.	L
	Head injury.	Wear hard hat when overhead hazards exist.	L
	Lack of communication in widely dispersed areas could lead to a delayed response in an emergency.	Ensure that each work team has a phone, or access to a phone, for emergency communication. Verify emergency numbers and functions of telephones and radios. Use the buddy system. Verify routes to local hospital.	L
	Contact with wild animals, biting or stinging insects, and poisonous plants could cause injury upon contact.	Workers will apply DEET to work clothing and skin area following manufacturer’s instructions as a preventative measure for biting insects. Workers will exercise caution when working in brushy or grassy areas, wood or debris piles, and recessed areas. Site orientation will include briefing on local hazardous flora and fauna, signs and symptoms of exposure and precautions to take. Workers with allergies will let the SSHO know using the medical data sheet and will carry their own prescription medication as applicable. First aid and medical attention as required. Report any bites, stings, or rashes to the SSHO.	L

AHA 3 – Site Restoration and Demobilization			
Job Steps	**Hazards**	**Controls**	**RAC**
2. Backing of boat or hovercraft trailers	Failure of proper backing can cause struck by and pinch point injuries or property damage.	Use spotters for all backing operations. Ensure spotter stands in line of sight of the person backing the vehicle. All personnel who back a trailer are trained and qualified to do so and are designated by the PjM for such activities. Use boat checklist in APP prior to launching boat. Verify understanding of hand signals used for backing, going forward, stopping, and turning left or right. Use parking brake and ensure operator is not moving vehicle before unhitching boat from trailer. Have a person on dock hold line on boat to tie boat securely to dock. Ground personnel involved in backing operations will wear class 2 high visibility vest.	M
3. Securing boat or hovercraft to trailer	Boat or hovercraft could come loose during transport if not properly secured.	All personnel who secure boats or hovercraft on trailers are trained and qualified to do so and are designated by the PjM for such activities. Ensure hitch and tie lines are in good condition before use.	M
4. Offloading equipment and tools from boats	Equipment offloading from boat could cause strains or could fall.	Use buddy system and proper lifting techniques for offloading tools and equipment from boats. Use mechanical devices as necessary. Forklift, hoists, etc. require competent or qualified personnel for use.	M
	Personnel can slip or trip while on the dock and when getting on or off the boat.	Personnel should use appropriate footwear (sturdy leather deck shoes) to ensure that there is enough tread on the soles to minimize slipping. Look out for trip hazards. Those hazards that cannot be removed must be marked. When climbing up or down always ensure three points of contact.	L
	Personnel at public dock could be struck by operating equipment, boats, or backing trailers.	Wear class 2 high visibility vest when working around traffic. Use spotters. Watch the area around you for changing hazards and personnel. Try to set up work area out of the way or off to the side of other operations being conducted.	L
	Person could fall into water and potentially drown or be crushed between boat and dock.	Ensure type II or better PFDs are work when on dock and transferring from boat to dock where falls into the water exist. Ensure dock has throwable type IV PFD in the event a person falls overboard. Ensure boat is properly secured to dock and gap is not such that persons can fall in between. Ensure height between boat and dock is a manageable distance or use portable step for workers to get in and out of boat and dock.	M
	Eye injury.	Safety glasses (clear or tinted) are the minimum required eye protection for all work areas during setup and shut down.	L
	Head injury.	Wear hard hat when overhead hazards exist.	L

AHA 3 – Site Restoration and Demobilization			
Job Steps	**Hazards**	**Controls**	**RAC**
5. Securing materials in truck decks and transporting materials	Items could fall or fly out of truck bed during transit	Secure loads evenly and as low as possible in bed of trucks. Use proper straps to secure items that could shift or fall. Cover loads of light materials with net or tarp tied down to prevent items from being lost out of truck.	L
	Overloading of truck could cause truck damage or increased risk of accident	Do not overload truck beyond its rated load capacity. Have user manual in truck and refer to it for loading capacity.	L

AHA –3 Site Restoration and Demobilization		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**
Site Vehicles	Drivers must have current State or Puerto Rico-issued driver's license.	Daily vehicle inspection by drivers.
Boats, hovercraft, and trailers	Qualified Operators will have U.S. Coast Guard approved boater safety qualifications identified in the APP and experience in use of the boats on the project. Hovercraft operators will have hovercraft training and operation course and will be TtEC-designated operators. Operate boats, hovercraft, and trailers in accordance with manufacturer instruction. Ensure equipment operations manual is onsite and available.	Inspect daily, and before use. Use the boating checklist form and Hovercraft Standard Operating Procedure.
PPE	Training as required by EM 385-1-1, Section 30.	Daily inspection by users using attached checklist.
Type II or better PFD to be worn	User will inspect each day before use.	An experienced operator will use. SSHO will instruct in proper use.
Material handling equipment such as heavy equipment, hoists, lifts, or forklift	Operator will be qualified in the use of equipment and experienced in use of the particular equipment used. Equipment that required certification or license will only be used by persons with that qualification. PjM will designate competent persons if forklift or hoisting is performed.	An experienced/qualified operator will use. Receipt inspection upon arrival at site and daily inspection prior to uses before each day's use.
First aid kit, fire extinguisher, eyewash station	Use of emergency equipment including first aid kits, fire extinguishers and eyewash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO	Fire Extinguisher • Initially and at least monthly thereafter by SSHO First Aid Kit • Weekly and after use for restocking by SSHO

AHA –3 Site Restoration and Demobilization		
		Eye Wash Station • Weekly by SSHO • Potable water changed weekly unless a preservative solution is used

Acronyms:

AHA – Activity Hazard Analysis
dBA – decibels, A-scale
CFR – Code of Federal Regulations
DEET – N,N-diethyl-meta-toluamide
EM – Engineer Manual
MSDS – Material Safety Data Sheet
PFD – personal flotation device
PjM – Project Manager (TtEC)
PPE – personal protective equipment
RAC – Risk Assessment Code
SDS – Safety Data Sheet
SSHO – Site Safety and Health Officer
TtEC – Tetra Tech EC, Inc.

AHA Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

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Activity Hazard Analysis (AHA)

<table>
<tr><td>Job/Task: Hovercraft Operations</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>M</td></tr>
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<tr><td>Negligible</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td rowspan="6">Notes: (Field Notes, Review Comments, etc.)
In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved APP. TtEC Corporate Safety Programs will also be available on-site for review of specific materials and mitigation measures. Refer to EHS 6-6, Boating. Refer to EM 385-1-1 Section 19, Floating Plant and Marine Activities, and Section 05.J. Personal Flotation Devices. Personal Protective Equipment for this AHA will consist of hard hat (when overhead safety hazards exist), sturdy leather deck shoes, safety glasses with side shields, standard work uniform. Hearing protection is required when operating hovercraft. Work gloves when indicated. Type II or better PDF required. Class 2 high visibility vest during backing operations.</td><td colspan="6">Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)</td></tr>
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<tr><th colspan="4">AHA 8 – Hovercraft Operations</th></tr>
<tr><th>Job Steps</th><th>Hazards</th><th>Controls</th><th>RAC</th></tr>
<tr><td rowspan="2">1. Travel with hovercraft on trailer to launch location and launching of hovercraft.</td><td>Lack of experience in trailer towing operations could lead to injury or property damage.</td><td>The person towing the trailer/hovercraft (typically hovercraft operator) will be designated by the TtEC Project Manager and will have demonstrated experience in towing trailers.</td><td>M</td></tr>
<tr><td>Failure to follow pre-launch inspections could lead to improper trailering or towing of craft or result in</td><td>Hovercraft operator will follow the SOP for Hovercraft Operations before towing and during launch to ensure the craft is loaded and secured correctly onto the trailer. Perform hovercraft pre-operation inspection checklist in the SOP. Document and correct any deficiencies. Ensure trailer is in good condition; inspect tires, tie downs, and winch. Ensure trailer lights are</td><td>M</td></tr>
</table>

AHA 8 – Hovercraft Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
	unsafe operation	operational. Ensure hovercraft operations manual is onboard and available for reference.	
1. Travel with hovercraft on trailer to launch location and launching of hovercraft (continued)	Failure of proper backing or stopping with truck and trailer can cause struck by and pinch point injuries or property damage.	Use spotters for all backing operations. Ensure spotter stands in line of sight of the person backing the vehicle and trailer. Verify understanding of hand signals used for backing, going forward, stopping, and turning left or right. All personnel who back a trailer are trained and qualified to do so and are designated by their supervisor. Typically, this person should be the qualified hovercraft captain. Use parking brake and wheel chocks, and ensure operator is not moving vehicle before coming between truck and trailer. Ground personnel will wear class 2 high visibility vest during backing operations.	M
	Improper offloading of craft from trailer could cause injury or damage to craft or trailer	Follow the offloading requirements contained in the Hovercraft Operations SOP and operations manual. Whenever possible, offloading of the craft should be two-person operation. Watch for pinch points between lines, trailer and craft, and winch assembly. Keep toes out from under trailer hitch in case it drops to the ground. Wear leather work gloves. Use a dedicated spotter for all trailer backing operations. Spotter will wear a class 2 high visibility vest.	M
	Other vehicle and boat traffic at launch could cause struck by hazards.	Use proper etiquette and rules posted at the marina or launch point. Allow the persons ahead of you space to finish their operations before proceeding. Likewise, when launching, watch out for other vehicles and boats that may encroach into your operating space or launch next to you (if space allows). If they are backing adjacent to you, do not turn your back on them. Safely secure your boat away from the launch point and move the vehicle and trailer out of the way to the designated parking area (if parking will be done). Ground personnel will wear a class 2 high visibility vest.	M
	Musculo-skeletal strains from lifting and moving materials/ equipment manually.	Use proper lifting techniques, such as keeping the back and neck straight, lifting with the legs without twisting at waist, and getting help when moving bulky/heavy materials and equipment. Employees will not lift more than 50 pounds alone. Encourage a steady, sustainable work pace.	M
	Personnel can slip or trip while on the dock and when getting on or off the hovercraft, including falls into water.	Personnel should use appropriate footwear (leather deck shoes) to ensure that there is enough tread on the soles to minimize slipping. Look out for trip hazards such as ropes and cleats on dock. When climbing onto or off a hovercraft, always ensure three points of contact. Always place supplies, hoses, cords, and other equipment in areas away from normal foot traffic, and equipment and tools in a safe location that does not present a trip hazard to work areas. Wear a type II or better PFD when working on deck of hovercraft or on docks without adequate guard rails.	M

AHA 8 – Hovercraft Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
2. Pre-launch of hovercraft and startup of hovercraft	Improper or inexperienced operation of hovercraft can lead to injuries and accidents	Only qualified operators designated by Tetra Tech Project Management, who have attended and successfully completed a qualified hovercraft operations course (all operations) and a USCG-approved boater safety course (for on-water operations) are allowed to operate hovercraft. The operator must have 5 hours experience in hovercraft operations prior to having others in craft. In addition, the operator will be familiar with and have experience operating the particular hovercraft in use and will follow established safety procedures and operation procedures outlined in the operations manual, the Hovercraft Operations SOP, and APP (including applicable portions of EM 385-1-1, especially Section 19F). When operating hovercraft on navigable waterways, the operator will follow the boating regulations and rules of the road established by the USCG.	M
	Failure to conduct pre-flight inspection or perform required maintenance of craft could lead to unsafe conditions, spills, or breakdown of hovercraft.	Hovercraft operator will go through the "pre-flight checklist" in the Hovercraft Operation SOP prior to launching hovercraft on a daily basis and document the inspection. Post flight inspections and regular routine craft maintenance will be maintained as well. These requirements are also incorporated into the SOP. Hovercraft operator will maintain a maintenance log (example included in SOP) to document regular maintenance and inspection as required by the operating manual as well as repairs and adjustments made. The maintenance log will be kept with the hovercraft along with the operations manual. Hovercraft operator will go over safety precautions and requirements with crew and document training as well as emergency precautions. A copy of the operation manual will be maintained onboard for reference.	M
	Failure to have proper safety and emergency equipment onboard craft before departing launch site	Hovercraft operator will inspect craft to ensure all required USCG-required, hovercraft-specific, and TtEC safety and emergency equipment is present, in good condition, within service dates, and secured properly onboard (or intrinsic to) craft. A list of safety and emergency equipment is contained in the Hovercraft Operation SOP. Crew shall be informed of the location of and use of emergency equipment.	M
	Improper training of hovercraft crew could lead to instability of craft or other unsafe conditions	Craft operator will brief all hovercraft occupants on basics of hovercraft operation and craft stability as well as the do and do not aspects of riding in hovercraft while in motion as well as emergency procedures in the event of a breakdown or man overboard. Crew will be instructed to secure all equipment and clothing so as not to get caught up in or drawn into fan or thrusters. Do not exceed the crew and equipment weight capacity of craft per operations manual.	M

AHA 8 – Hovercraft Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
2. Pre-launch of hovercraft and startup of hovercraft. (cont'd)	Noise exposure to motor could cause hearing loss	Crew will don hearing protection before starting up hovercraft. Ground crew at launch may also require hearing protection if in vicinity of operating hovercraft. Hearing protection is required when sound levels exceed 84 dBA continuously.	M
	Debris or dust generated by air cushion or fan could cause eye or body injury.	Ensure personnel do not stand directly behind fan when starting or operating fan and stay clear of the skirt area when starting on land where dust and debris could be stirred up. Try to launch from area that does not cause debris or dust to be stirred up whenever possible. Ensure personnel (crew) are in hovercraft prior to starting it and leave hovercraft after stopping it. Wear safety glasses with side-shields when operating, riding in, or working around active hovercraft. Ensure access to portable emergency eye-wash is available onboard hovercraft in the event a person gets foreign object in eye.	M
	Failure to have tools and equipment on board could lead to inability to make minor repairs and adjustments en-route if required.	A small tool kit and lubricant as specified in the SOP as well as spare fuses, spark plugs, etc. will be present on-board the hovercraft for performing routine repairs and small maintenance tasks if required during active deployment.	M
	Improper starting procedures followed could lead to flooding or damage to craft.	Operator will follow the starting procedure outlined in the Hovercraft Operation SOP when starting hovercraft. This procedure is based on the operation manual from hovercraft manufacturer.	
3. Travel in and operate hovercraft	Improper positioning of personnel and equipment in hovercraft could cause craft to be unstable or could lead to loss of maneuverability	Ensure equipment and personnel are securely positioned in craft with even distribution of weight in craft. Ensure crew understands the basics of craft maneuverability and stability, especially in making turns. Crew must remain in seated position during travel. Do not exceed the crew and equipment weight capacity of craft per operations manual.	M
	Failure to recognize objects and hazards in travel path in a timely manner during travel could lead to injury	Travel at safe operating speeds at all times to allow enough time to recognize, avoid, and/or safely maneuver around obstacles and objects (e.g., coral or rock reef projections, flotsam, other boats, etc. Operator will be familiar with operations manual and training manual for proper maneuvering in different scenarios.	M

AHA 8 – Hovercraft Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
3. Travel in and operate hovercraft. (cont'd)	Lack of communication in widely dispersed areas could lead to a delayed response in an emergency.	Ensure that each boat has working cell phones (check reception) and access to a working marine radio with Channel 16 (either onboard or available in nearby support craft. Ensure operators have ability to make contact with other boats, as well as TtEC related shore operations, and know what channel to talk on for radio chatter. Verify that marine radio communication via Channel 16 is operational. Use the buddy system on boats, no boat operator will travel to and from work alone. Verify routes to local hospital and know location of dock in the event of an emergency (See Figures in APP).	L
	Noise exposure to motor could cause hearing loss	Crew will wear hearing protection while craft is operating. Hearing protection is required when sound levels exceed 84 dBA continuously.	M
	Rough weather (wind, heavy seas) could cause loss of some maneuverability of craft, cause craft to strike objects or cause craft to unintentionally enter unsafe areas.	Operator will be familiar with the techniques for operating craft in calm conditions as well as conditions where wind, wave, or surge is present. Know how to operate reverse thrust system, throttle, as well as port and starboard forward and reverse thrust levers. Monitor weather conditions, sea state, and forecast at start of day and continue to monitor during the day. Hovercraft operator will halt operations if conditions are such that the craft cannot be effectively and safely controlled or exceed the safe operations rating of the manufacturer. Limitations of hovercraft operations are included in the Hovercraft Operation SOP. Additional limitations will be at the discretion of the operator and may be lesser than the thresholds specified by the manufacturer.	M
	Breakdown of hovercraft could lead to stranding or drifting of craft into deeper water or hazardous areas	Ensure an anchor and sufficient line is available for emergency deployment from craft for area being worked in. Ensure marine radio is available and working for emergency notification at a minimum. Cellular telephones and/or two-way radios may be used to contact other TtEC vessels for assistance if required. Standby vessels will also have radio equipment and can be contacted in the event rescue is required. If TtEC vessel or other vessel in area cannot readily or safely assist, contact the USCG on marine radio channel 16. Follow emergency boating procedures in the APP.	M
	Hovercraft could run out of fuel when operating or traveling	Ensure there is enough fuel supply for the trip and the return to dock plus one-third in reserve.	M

AHA 8 – Hovercraft Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
3. Travel in and operate hovercraft. (cont'd)	Swamping of hovercraft could lead to fuel release or equipment being lost or damaged	Ensure equipment is secured onboard. Ensure fuel ports and vents are secured during operation as specified in operations manual. Hovercraft will not sink when swamped as it is equipped with intrinsic buoyancy; however may be less stable when flooded. Engage electric bilge pump switch and keep crew seated and evenly distributed in craft. Protect sensitive equipment that could be damaged by water prior to leaving the launch site.	M
	Falls overboard could lead to exposure to water environment, hazardous sea life, or drowning	All crew personnel will wear USCG-approved Type II or better personal flotation devices when onboard the hovercraft as specified in the APP. Follow man-overboard/abandon ship procedures in the APP. Provide care for potential environmental exposures (cold water immersion, hypothermia, hazardous sea life, etc.) as appropriate as outlined in the APP. Ensure a means of rescue and retrieval is available such as Type IV throwable PFD with 90-feet of floating line and a means or method to retrieve personnel back into the hovercraft.	M
	Heat or cold stress may be experienced on the water or in the event of becoming wet (fall into water, flooded craft)	Hovercraft occupants will be monitored for signs and symptoms of heat stress and cold stress (in colder weather, wet weather, or if wind chill is a factor) in accordance with the APP. Hydration and work/rest regimens will be followed. Survival kits on the craft (or staged nearby on the dock or support vessel) will include blankets in the event of hypothermia or to prevent hypothermia for boat occupants. Hovercraft occupants will be prepared with raingear and a change of clothing in the event they get wet and chilled. Hovercraft survival kit, if used, will be restocked with necessary equipment. Adequate drinking water and electrolyte fluids will be available onboard. Implement EHS 4-6 – Temperature Extremes. Seek shade if temperatures become too hot, before signs and symptoms of heat stress occur. Use bimini top when possible to provide shade onboard hovercraft.	M
	Sunburn for boat occupants.	Use broad-spectrum sunscreen SPF 15 or greater as necessary on exposed areas. Wear a hat to protect head from sunburn or deploy bimini top on hovercraft when possible.	L
	Vessel could be struck by or strike other boats in area.	Hovercraft operator is in charge of situational awareness while on the water and operator will not be doing other tasks. Monitor Channel 16 (if equipped) and follow USCG rules for lighting, mooring, at anchor, rights of way, signaling, and other vessel operations. Use ships whistle (horn) in the event of a boat coming close. Display proper navigation lights and day shapes as appropriate.	M

AHA 8 – Hovercraft Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
4. Perform fueling activities	Workers could be exposed to gasoline and spills could occur.	Hovercraft with internal tanks will be refilled either at a service station (on trailer) or at a marina with public fuel dispensing capabilities. Delineate the refueling zone by keeping combustibles away. Review the Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) for gasoline and know the hazards. The Hovercraft Operator is responsible for safety during refueling. Have some spill pads present. Ensure a visual or other means of overfill prevention is present so as not to overfill the tank and cause a spill. Keep control of the nozzle at all times during refilling. Position upwind so as not to breathe the gasoline vapors. Follow additional spill prevention measures as specified in the APP (Section 9.0) to minimize the potential for spills; and follow spill response measures in the APP (Section 9.0) if spills do occur. Any sheen in the water must be reported.	L
	During fueling of craft, there is potential for fire; potential fire on startup.	No smoking or other sources of ignition when fueling. Engine must be off and cooled. There must be a properly rated fire extinguisher available onboard craft and at refueling areas as specified in the APP. Refuel in a manner to prevent any spills as noted in the above. A blower must be available and used on inboard craft to evacuate accumulation of vapors prior to starting the craft. Train boat occupants in the location of and proper use of vessel fire extinguisher.	M
5. Conduct surveys from hovercraft	Multi-tasking of craft operator or crew could lead to hazards	Hovercraft operator job is to operate the craft and follow the prescribed survey patterns while ensuring safety of the crew and boat. Craft operator will not perform other tasks while operating vessel and will idle operations that are not safe. Persons evaluating bathymetric survey gear or other equipment will conduct visual inspections of work areas for hazards and changing conditions and will notify craft operator of what tasks will be performed. Plan the task ahead and ensure it is synchronous with operation of craft.	M
	Potential instability of craft when personnel are maneuvering or performing tasks or falls overboard	Craft will have appropriate displacement and draft for conducting surveys in the area and will have depth sensing equipment if hovercraft skits are deflated (craft resting in water). The tide cycles and water depth will be evaluated for the activities. Craft operator will ensure that turning of the craft and direction of turning does not place boat onto shore or cause deck to become unstable. Operate craft at slow speeds. Workers will not be leaning over the side of the craft to perform work tasks when craft is in motion unless authorized to do so by craft operator. A fall into shallow water head-first could cause severe injury.	M

AHA 8 – Hovercraft Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
	Musculoskeletal strains from lifting and moving materials/ equipment manually.	Use mechanical lifting equipment and hand-trucks whenever possible. Otherwise, use proper lifting techniques, such as keeping the back and neck straight, lifting with the legs without twisting, and getting help when moving bulky/heavy materials and equipment. Employees will not lift more than 50 pounds alone. Encourage a steady, sustainable work pace.	M

AHA – Hovercraft Operations		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
Site vehicles and boat trailers	Drivers must have current state or Puerto Rico–issued driver's license. Driver with trailer must have experience in trailer towing and backup operations.	Daily vehicle inspection by drivers.
Neoteric Hovercraft	Qualified Operators will have USCG-approved boater safety qualifications, and when required, USCG licenses with appropriate rating for the craft being operated and experience in use of the boats they operate. Qualified Operators will have successfully completed Hovercraft Training Course from qualified training provider and prior to carrying crew, must have a minimum of 5 hours operational experience.	Inspect daily before and after use as specified in the Hovercraft Operation SOP. Follow startup and maintenance procedures in the SOP and operations manual.
PFDs	Training in proper use and limitations of PFDs. Boat captain will brief workers on the use and limitations of PFDs and the location stowed on boats (when stowed vs. worn). Training in how to inspect and what to inspect for different types of PFDs.	Daily inspection by users. Auto-inflatable PFDs may be worn during scientific related work during surveys, however these type of PFDs require additional training and inspection by users and must be included in the APP.
Fire extinguishers	Fire extinguisher training including use/limitations.	At least monthly by SSHO or designee.
Bathymetric survey gear	Training in proper use of and calibration of this equipment.	Daily by qualified user. Function check daily by qualified user in accordance with manufacturer's requirements and industry practices.

AHA – Hovercraft Operations		
First aid kits and other emergency equipment	Use of emergency equipment/first aid kits must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, by or under direction of the Hovercraft Operator. The Hovercraft Operator is responsible for USCG and other required emergency and safety and emergency equipment onboard the boat.	Safety and emergency equipment list is included in the SOP. Inspect daily prior to launch. Inspect first aid kit and eyewash initially and at least weekly thereafter or after use for restocking. (29 CFR 1926.50[d][2]) Potable water changed weekly unless a preservative solution is used.

Abbreviations and Acronyms:

AHA – Activity Hazard Analysis
APP – Accident Prevention Plan
CFR – Code of Federal Regulations
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental Health and Safety
EM – Engineer Manual
MSDS – Material Safety Data Sheet
PFD – personal flotation device
PM – Project Manager
RAC – Risk Assessment Code
SOP – Standard Operating Procedure
SPF – sun protection factor
TtEC –Tetra Tech EC, Inc.
USCG – U.S. Coast Guard

AHA Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE
1.			
2.			
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10.			

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ATTACHMENT B

SELECT ENVIRONMENTAL HEALTH AND SAFETY PROCEDURES (ON CD ONLY)

EHS 1-1: Responsibilities for Program Implementation

Last Revision By: **Linda LaMonico** on **12/01/2008**
Created By: **Lisa Kaminski** on **06/09/2008**

Purpose: The purpose of this program is to outline personnel responsibilities relative to implementing the Tetra Tech EC, Inc. (TtEC) Environmental, Health and Safety (EHS) program and achieving the objectives of the Environmental, Safety and Quality (ESQ) policy.

Status:	Complete		Donald Rogers
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1.0 PURPOSE

The purpose of this program is to outline personnel responsibilities relative to implementing the Tetra Tech EC, Inc. (TtEC) Environmental, Health and Safety (EHS) program and achieving the objectives of the Environmental, Safety and Quality (ESQ) policy.

2.0 SCOPE

This program applies to all TtEC operations.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 Employees

TtEC and subcontractor employees have the responsibility to:

a. Work in a safe, healthful, and environmentally compliant manner, in accordance with TtEC programs, TtEC procedures, TtEC work rules, and applicable laws and government regulations.

b. Be an active participant in the project's Voluntary Protection Program (VPP), when applicable.

c. Participate in resolving problems and corrective actions.

d. Strive for Zero Incident Performance® (ZIP).

e. Stop work if an imminent danger situation exists.

f. Notify their supervisor immediately of any work-related injury, illness, spill, release, permit exceedence, or high loss potential incident; of any environmental issue or safety hazard in the workplace; or of any concern regarding the TtEC program. If employees are unable to obtain resolution at the local level they are required to notify ESQ Program Directors or call the Compliance Hotline at 1-800-468-3191.

g. Attend EHS training.

All TtEC and subcontractor employees performance is evaluated regarding compliance with EHS regulations and program requirements.

3.1.2 Line Management

Line Management, the Project Manager or Officer Manager, ensures that all company activities are executed in accordance with TtEC EHS programs, procedures, and applicable regulations. Line managers have primary EHS responsibility and have EHS personnel support to help them fulfill this responsibility. Line managers have the responsibility to integrate loss control principles into all operations and to ensure that:

a. TtEC's safety culture is preserved by demonstrating commitment and program involvement.

b. Safety remains a major project goal and is not subordinated to other demands.

c. Project-specific continuous improvement goals and objectives are based on the TtEC's ZIP Operating Philosophy and apply to self perform and subcontractor operations alike.

d. Project goals and objectives are developed based on EHS events and issues, and are communicated to TtEC employees and subcontractors.

e. All projects are implemented in compliance with all environmental, safety and health laws and regulations, EHS program requirements, and Environmental Management System (EMS) requirements.

f. EHS plans are developed, approved, and implemented in accordance with TtEC requirements.

g. Personnel understand the requirements of the project EHS plan(s) and each individual understands his/her responsibility for plan implementation.

h. Personnel have all required training and are capable of performing all assigned tasks.

i. Corporate professionals or external resources, such as private consultants, are available for project support as needed.

j. Project staff members are aware of, and have access to, technical information that TtEC maintains in the Corporate Reference Library, various EHS databases, and online regulatory subscription services. Additional EHS reference books and technical information are also available to project staff upon request.

k. Facilities and equipment meet TtEC and government regulations.

l. Work rules are enforced.

m. Inspections and incident investigations are conducted per program requirements.

n. Effective corrective actions are implemented in a timely manner following inspections, audits, incident investigations, etc.

o. Employees, including subcontractors, are not only encouraged, but are required to notify their supervisor of any actual or potential health and safety hazards in the workplace and develop safe work methods and controls to be implemented in project Activity Hazard Analyses (AHAs). Employees, and subcontractors, are also assured that not only will they not be harassed for reporting problems, they may be rewarded for it.

p. Clients are notified of TtEC incident reporting procedures.

q. Appropriate disciplinary action is implemented by line supervision when necessary.

r. Environmental and Safety Coordinators (ESC) are assigned for each home office, in coordination with the Manager, EHS Services.

Management responsibilities necessary to maintain a safe, healthful, and environmentally compliant workplace are identified in each procedure of the TtEC EHS program.

3.1.3 EHS Personnel

EHS personnel assist management with implementation of TtEC EHS programs and procedures, and help to ensure that operations are performed in compliance with applicable laws and regulations. EHS personnel have the responsibility to:

a. Ensure that TtEC employees understand the requirements of TtEC EHS programs and procedures through training and communication. (ESS)

b. Develop or assist with the development of EHS plans in conjunction with project personnel. (ESS)

c. Approve or obtain approval of all EHS plans. (PESM)

d. Assist management with EHS plan implementation. (ESS, PESM)

e. Perform specific tasks in accordance with EHS plans. (ESS, PESM)

f. Ensure that TtEC employees receive required EHS regulatory training. (PESM)

g. Function as a technical resource of all environmental compliance, safety, loss control, and industrial hygiene issues. (PESM)

h. Fulfill the specific responsibilities for project EHS personnel that are identified within each EHS procedure. (ESS, PESM)

i. On each project with an EHS plan, an Environmental and Safety Supervisor (ESS), is assigned to assist line management with EHS Program implementation. The ESS may have collateral duties.

3.1.4 Environmental and Safety Coordinator

The ESC has responsibility to coordinate the administrative EHS functions in offices. The ESC has the responsibility to:

a. Assist in coordinating EHS training by identifying training needs, and conducting or arranging for training.

b. Ensure that appropriate EHS records are maintained and forwarded to the Director, ESQ in accordance with EHS programs.

c. Assist in completing and forwarding copies of incident reports and investigations to the Manager, EHS Services, and the Director, Health and Safety Programs.

d. Assist in implementing EHS committees.

e. Assist in developing, implementing, and maintaining EHS awareness programs.

f. Assist the Operations Manager in conducting and documenting quarterly office and warehouse EHS inspections and in closing out and documenting corrective actions taken.

g. Ensure Emergency Response Plans are written, implemented, maintained, and communicated to employees.

h. Ensure mechanism exists in the office to identify, communicate, and correct employe EHS concerns.

i. Ensure an adequate ergonomics program is implemented.

3.1.5 Managers, EHS Services

The Managers, EHS Services have responsibility to:

a. Establish goals, direction, and performance standards to EHS personnel within their region.

    i. Ensure availability of required resources within region.
    ii. Manage work loads and distribution of area staffing (employee mix).
    iii. Ensure professional development of staff.

b. Communicate and monitor performance of EHS personnel.

c. Provide feedback and status reports, including statistics to the Director, EHS Programs.

d. Provide senior technical support to operations management.

e. Raise/elevate issues of potential noncompliance to ESQ Program Directors.

f. Ensure, in coordination with the Operations Manager, that an ESC is assigned to each home office.

g. Provide oversight, evaluation, and training for collateral duty personnel, and approve project assignments.

h. Monitor projects being conducted in region through continued interface with area, office, and project management.

i. Support proposal and Business Development efforts.

j. Approve EHS plans, as appropriate.

k. Make technical and regulatory interpretations as required.

3.1.6 ESQ Service Directors

The Director, Environmental Health and Safety Services, and Director, Quality Services have responsibility to:

a. Maintain ultimate authority in respective disciplines for program implementation, technical issues, and staffing decisions.

b. Maintain and update program standards, and ensure that they meet appropriate regulatory and TtEC requirements.

c. Provide input on staffing issues including performance appraisals and professional development.

d. Participate in ESQ program audits.

e. Identify and ensure appropriate resolution of issues related to respective technical area.

f. Identify technical information needs and disseminate technical information.

g. Support proposal and business development efforts and coordinate technical support on major proposals.

h. Perform internal and external project support.

i. Update and maintain training programs relative to their technical areas.

j. Foster departmental integration through leadership and example.

k. Ensure that incidents are properly investigated with appropriate follow-up and closure.

3.1.7 Vice President, Environmental, Safety and Quality Services

The Vice President, ESQ Services is responsible for all departmental activities and has the responsibility to:

a. Provide overall direction and leadership of the ESQ program.

b. Provide the necessary support to line management to ensure that Corporate ESQ and EMS programs are implemented.

c. Coordinate EHS related national contracts.

d. Provide major proposal and business development support.

e. Maintain the TtEC ESQ programs and guidance documents.

f. Make recommendations to TtEC management to improve the quality of the TtEC ESQ program.

g. Oversee ESQ training program development and implementation to help ensure that TtEC and subcontractor employees perform their jobs in accordance with ESQ programs, procedures, and applicable laws and regulations.

h. Manage the TtEC medical surveillance program.

i. Ensure effective communication to all TtEC employees on EHS issues, incidents, and regulations.

j. Prepare final VPP self-evaluation reports to each applicable OSHA region as described in Section 3.2 below.

These responsibilities may be delegated to the ESQ Program Directors.

3.2 Voluntary Protection Program (VPP) Annual Self-Evaluation

For projects that have adopted the VPP, line management shall conduct an annual self-evaluation of the five elements of VPP and the project-specific VPP requirements. In the last quarter of each year, line management for each active VPP project performs an annual self-evaluation of the five elements of VPP for the previous year.

This evaluation is not the same as a safety audit; it is a review and assessment of the effectiveness of the VPP elements:

a. Management Leadership
b. Employee Involvement
c. Worksite analysis
d. Hazard Prevention and Control
e. Health and Safety Training

The annual self-evaluation shall assess the project's natural work groups, including subcontractors, and applicable components of the EHS program to verify VPP implementation and achievement of goals and objectives. Self-evaluations should also include an assessment of action items completed and recommendations for improvements.

The line manager shall transmit a copy of the project's VPP self-evaluation to the TtEC Vice President, ESQ Services.

The Vice President, ESQ Services will prepare the final report to each applicable OSHA region in narrative form, and include a description of any success stories, such as:

a. Reductions in worker's comp rates
b. Increases in employee involvement
c. Improvements in employee morale, etc.

Line management will also provide the following information to the TtEC Vice President ESQ Services for self-performed and applicable subcontractor work for inclusion in the annual VPP report:

- Annual rate of injury incidence
- Lost workday cases
- Employment figures
- Hours worked by employees and subcontractors

Significant project organizational or ownership changes, or changes with the authorized collective bargaining agent(s), require that new VPP Statements of Commitment be signed. These changes require notification and signed statements be sent to the applicable OSHA Regional VPP Administrator within 60 days.

4.0 GUIDANCE

4.1 Definitions

4.1.1 Environmental and Safety Coordinator (ESC)

The ESC and a TtEC employee assigned to coordinate EHS activities in a home office. The ESC performs EHS activities on a part-time basis, and has collateral duties. The ESC is designated by the Manager, EHS Services and is usually a member of the ESQ department. However, where no ESQ personnel are located in the home office, the ESC is selected from other departments. Employees who have completed the Environmental and Safety Supervisor (ESS) course will be given priority to perform ESC responsibilities. ESC responsibilities are defined throughout the EHS procedures.

4.1.2 Environmental and Safety Supervisor (ESS)

The ESS is a project employee assigned to oversee and assist with the implementation of the EHS plan and EMS and EHS programs. The ESS is qualified as the Health and Safety Supervisor required by 29 Code of Federal Regulations (CFR) 1910.120. The ESS may either be a dedicated full-time position or a collateral duty function. The ESS reports through the project organization to both the Site Manager and the Project Environmental and Safety Manager (PESM). ESS responsibilities are defined throughout the EHS procedures.

The ESS is qualified by the Director, EHS Services in accordance with EHS 1-11. The PESM designates specific employees to a project to perform the ESS role.

4.1.3 Project Environmental and Safety Manager (PESM)

The PESM is the TtEC employee assigned to assist the Project Manager in the development of a project-specific EHS plan and in the implementation of EMS and EHS programs. The PESM is a Senior EHS Scientist and typically oversees multiple projects. The PESM has approval authority for EHS issues, and assumes 'key person' roles such as "Certified Industrial Hygienist," "Corporate Health and Safety Officer," "Environmental Compliance Manager," or "EHS Manager" for the project. The PESM reports to both the Project or Program Manager and the Manager, EHS Services. PESM responsibilities are defined throughout the EHS procedures

5.0 REFERENCES

Please Describe Your Reference Here	Place Your Link in this Column
1. Voluntary Protection Program (VPP) Policy	
2. Environmental Management System (EMS)	
3.	
4.	

EHS 1-2: Awareness and Recognition Programs (Previously HS1-2)

Purpose
The purpose of this program is to provide minimum standards and guidelines for establishing Environmental, Health and Safety (EHS) awareness and recognition programs for Tetra Tech EC, Inc. (TtEC).

Version Date:	**06/27/2008** - New	**Approved by:**	Donald Rogers
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1.0 PURPOSE

2.0 SCOPE

3.0 MINIMUM REQUIREMENTS

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5.0 REFERENCES

1.0 PURPOSE

The purpose of this program is to provide minimum standards and guidelines for establishing Environmental, Health and Safety (EHS) awareness and recognition programs for Tetra Tech EC, Inc. (TtEC).

2.0 SCOPE

This Program applies to all operations.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 Line Management

The Operations, Program, or Project Manager, together with the responsible EHS personnel, shall implement an awareness program in accordance with Section 3.0 of this Program, is responsible for providing an adequate budget to carry out the program, and shall ensure its implementation.

3.1.2 EHS Personnel

The Environmental and Safety Coordinator (ESC), or Environmental and Safety Supervisor (ESS) shall assist in developing and implementing awareness programs, including any record keeping requirements of the program.

The Managers, EHS Services shall provide oversight of the awareness and recognition programs. Oversight shall include review of the content and implementation of the awareness and recognition programs, and ensuring consistency with this Program.

3.2 General Requirements

Awareness programs and activities are meant to focus attention on issues that may have an impact on environmental awareness or protection, safety or the well being of TtEC employees and subcontractors. This focus is also maintained through implementation of other programs including:

a. Committees - through rotating membership and publishing of minutes.
b. Meetings - through presentation of issues and procedures relevant to the local workplace and providing an opportunity for questions and discussions.
c. Incident investigation and reporting - by providing for casual analysis and follow-up on workplace hazards and environmental compliance issues.
d. Inspections - through proactive identification of environmental issues and hazard analysis, identification of findings, assessment of compliance, and closure of corrective actions.

When properly implemented, the above programs are considered part of the overall EHS Awareness Program. This program will discuss additional methods of communication, which serve to raise and maintain awareness, and provide for the recognition of desired behavior and achieved goals.

3.3 Awareness Program Requirements

3.3.1 Bulletin Boards or Posting Areas

Offices and project sites with office or field trailers shall provide a bulletin board or posting area designated for EHS postings. At a minimum, the following shall be posted:

a. Corporate ESQ Policy
b. Compliance Hot Line Poster
c. Zero Incident Performance Pledge Poster
d. Legally required posters, e.g., OSHA Notice
e. EHS Work Rules
f. DIR Principles
g. Emergency Phone Numbers and Procedures
h. Evacuation Route Maps
i. OSHA 300 Summary (During February for previous calendar year)
j. Committee Meeting Minutes (most recent), if applicable
k. EHS Bulletins and memos regarding new regulations, EHS lessons learned, Environmental Management System (EMS) postings, or other pertinent EHS topics.

Bulletins and memos can be from any source. The bulletins shall involve issues of local concern. Each bulletin shall include a statement of the problem or issue; impacts on the site or the employee; a brief summary of related company rules or government regulations; and actions individuals can take to avoid the problems discussed or to improve the Company's standing relative to the issue. For readability, the bulletins shall be limited to one page in length.

3.4 Corporate Recognition Programs

The President's Award for Health and Safety Excellence. This award will be given each year if a program, project, or office demonstrates an advanced level of commitment to Health and Safety issues through an outstanding record of achievement in this area and performance well in excess of TtEC and client expectations. Each December, the Director, Health and Safety will solicit nominations. The recipient will be chosen by the Corporate Managers from nominations submitted which detail the achievements of the Office or Project. The recipient(s) of the President's Award for Health and Safety Excellence will be presented with a plaque.

The President’s Award for Environmental Excellence. This award will be given each year if a program, project, or office demonstrates an advanced level of commitment to TtEC’s Environmental Management System. Each December, the Director, Environmental Programs will solicit nominations. The recipient will be chosen by the Corporate Managers from nominations submitted which detail the achievements of the Office or Project. The recipient(s) of the Presidents Award for Environmental Excellence will be presented with a plaque. The first issue of this Award will be in 1999 for 1998 performance.

3.5 Approval and Budgeting

The Operations, Program, or Project Manager with the support of executive management is responsible for budgeting to implement Awareness Programs and project or office Recognition Programs.

Recognition Programs that include financial incentives must be included in the project or EHS Incentive Plan and reviewed and approved in accordance with Section 5.0, Personnel Practices Procedure, PP-2, Compensation.

3.6 Subcontractors

TtEC subcontractors shall be included in Awareness Programs when appropriate.

Office or project recognition programs may include subcontractors at the discretion of the Project or Operations Manager.

4.0 GUIDELINES

4.1 Definitions

4.1.1 Awareness Program

A program designed to promote safe work and environmentally compliant practices, or effective implementation of the Environmental Management System, through the use of communications, gifts, and events. Awareness activities are not performance based.

4.1.2 Recognition Program

A program designed to promote a high level of environmental, health and safety performance through positive reinforcement of appropriate behavior. Recognition programs consist of publicly granting awards for achievements in the area of EHS.

4.1.3 Major Project

A contract with multiple delivery orders or a single field project with an estimated minimum of 50,000 work hours per year. The work hours include both TtEC and subcontractor hours.

4.2 Awareness Program Guidelines (Optional)

This section provides guidelines and optional program elements that may be used to enhance a workplace EHS Awareness Program.

4.2.1 Posters

Project and office sites should display informational posters or banners on EHS topics in areas routinely used by site personnel. These posters should be changed monthly.

Posters should be selected based on the particular issues having a significant impact on the operations of the site. These issues should be identified through analysis of previous incidents; audit findings; inspection results; activity hazard analyses; notices of non-compliance; committee or employee suggestions; exposures of concern; or regulatory requirements. For this reason, poster subscription services, although easy, may not always be effective in providing the appropriate messages.

4.2.2 Awareness Gifts

Awareness gifts are designed to focus attention on EHS issues and are not associated with specific goals or achievements like recognition awards. They may be given out spontaneously or as a part of a planned program. EHS awareness gifts should be useful but of nominal value. They should be directly related to a specific EHS issue or include a message about the issue. Examples would be a home smoke alarm during October (National Fire Prevention Month) or a cap or tee shirt with a safety or environmental compliance message.

4.2.3 Critical Topic Campaigns

The uses of awareness materials and gifts are most effective when they are combined in a structured, needs-based program called a Critical Topic Campaign (CTC). To implement a CTC the Office/Program/Project Manager, together with the ESC, should:

a. Conduct a needs analysis and determine which EHS topics are likely to be the most critical to the success of the operations for a coming period (usually a year);

b. Coordinate the activities or elements in a campaign fashion during a specified period of time, e.g., one month, to reinforce a specific issue or message.

c. Select three or four separate activities or elements to implement for each critical topic. Examples are:

   i. Posters/banners
   ii. Awareness gifts
   iii. Bulletins/memos
   iv. Contests
   v. Recognition Awards/Booklets
   vi. Special Meetings
   vii. Special Training
   viii. Guest Speakers or Demonstrations
   ix. Special Event (lunch, picnic, etc.)

4.3 Office and Project Recognition Programs (Optional)

Recognition programs should relate to other programs or site objectives such as a Critical Topic Campaign or Pollution Prevention objective. *Office and Project Recognition Programs are not required by this program.* However, when they are used as part of the EHS program, they shall adhere to the following requirements:

a. ***Personal Achievement Awards*** . Personal achievement awards may be given when a period is completed without incident and without breech of procedure or site rules. Personal achievement awards shall not be given solely on the basis of achieving a period of time without an accident/incident. Personal achievement awards shall be distributed to all program participants that meet the award criteria, even if they no longer work at the site at the time of distribution.

b. ***Group Achievement Awards*** . Group achievement awards may be given to all eligible site or office personnel when a goal or significant milestone is achieved. If the site or office is divided into more than one group, a reasonable degree of equity in numbers of personnel in each group and exposure to hazards must be ensured.

NOTE: Although Personal and Group Achievement Awards should be based on meeting established goals, these goals and the awards need not be announced to site personnel at the beginning of the period. They can be distributed with an explanation upon achievement of the award. This method may serve to reduce the temptation to withhold incident reports, as well as the assumption that awards are expected or owed as part of the compensation package. Also, Achievement Awards will not be given to those whose actions or suggestions result from execution of normal and expected job responsibilities.

c. ***Special Awards*** . The Office/Project Manager may also establish a grand prize drawing consisting of one or a few prizes of significant value to be awarded at the completion of the project or a significant period of time. This award may be granted based on nominations of personnel who make significant contributions to the EHS program with final selection by the group. Another way to award a grand prize is through a lottery system. In this type of program, personnel earn lottery chances each time they receive interim achievement awards. People who consistently earn the interim achievement awards then have the greatest chance of winning the grand prize. Employees with supervisory responsibilities will not usually be eligible for grand prizes associated with personal achievement awards.

d. ***Positive Participation Awards*** . Consideration should be given to establishing awards for positive participation in the EHS Program. Examples are awards for: the best EHS suggestion; safety slogan contests; committee or inspection team participation; observed safe and environmentally compliant behavior; significant efficiency improvements that impact environmental excellence or health and safety. Professional or designated EHS personnel will not be eligible for Positive Participation Awards.

e. ***EHS Slogan Contest*** . Annual EHS slogan contests may be used to promote environmental safety awareness. A prize for the best slogan may be awarded. The selected slogans may be used in a variety of ways including banners, posters, communications headers, and as imprints on awareness gifts.

f. ***Value of Awards*** . Achievement awards based on completing a specified period of time without incidents or violations should be either EHS-related gifts or cash equivalent (cash, check, gift certificate, points toward catalog purchase). The Program, Project or Operations Manager will make a recommendation regarding the value of the award based upon site -or office-specific criteria. This recommendation will be approved per Section 3.5.

TtEC's recent safety theme - *Save a Fellow Employee,* was an awareness campaign developed as a result of employee involvement and incentive initiatives, and will help focus on safety of others. See Zip Bulletin 182.

Employees, including subcontractors when appropriate, are made aware of the projects positive recognition programs, including any specific rewards and recognition programs that may be established for meeting project EHS goals and objectives, demonstrating exemplary actions, or assisting in project and/or employees in providing a safer workplace.

4.4 Postings

4.4.1 Lost-Time Incident (LTI) Sign

Each major project site should post a sign at the site which indicates the number of days and/or man-hours worked since the last lost-time accident. The ESS should ensure the LTI sign remains current. Statistics displayed on the sign should include those compiled for both TtEC and its subcontractors. The LTI sign should contain the TtEC name and the project name.

4.4.2 Zero Incident Performance (ZIP) Banner

Each major project site should post a Zero Incident Performance Banner at the entrance to the worksite. The banners should be visible from a distance and displayed in well-lighted areas.

5.0 REFERENCES

Please Describe Your Reference Here	Place Your Link in this Column
1. PP-2, Compensation	
2. Environmental Management System (EMS)	
3. Zip Bulletin 182	
4.	

EHS 1-7: Event Reporting and Investigation

Last Revision By: **Linda LaMonico** on **11/16/2010**
Created By: **Cindy Leong** on **10/07/2009**

Purpose: The purpose of this program is to: (a) specify the types of events to be reported and investigated, including both safety and quality-related events; (b) define internal Tetra Tech EC, Inc.(TtEC) and external event notification requirements; (c) ensure proper management and follow-up of each event; (d) meet regulatory notification and investigation requirements; (e) provide a mechanism to identify Environmental, Safety and Quality (ESQ) issues and areas for improvement and recognize job well done through the Zero Incident Performance® (ZIP) Slip.

Status:	Complete		Donald Rogers
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1.0 PURPOSE

The purpose of this program is to:

a. Specify the types of events to be reported and investigated, including both safety and quality-related events.

b. Define internal Tetra Tech EC, Inc. (TtEC) and external event notification requirements.

c. Ensure proper management and follow-up of each event.

d. Meet regulatory notification and investigation requirements.

e. Provide a mechanism to identify Environmental, Safety and Quality (ESQ) issues and areas for improvement and recognize job well done through the Zero Incident Performance® (ZIP) Slip.

2.0 SCOPE

Event reporting requirements apply to all operations of TtEC and its subsidiaries (the "Company"), including subcontractor activities. The term “Event Reports” in this procedure encompasses Quality Event Reports (QERs), Near Miss, and EHS Event Reports.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 All Personnel

All personnel shall immediately report any event (see Section 4.1.1) to their supervisor. The report can be verbal or in writing.

Employees, including subcontractors, are required to participate in the investigation process as directed, and comply with corrective actions identified. Employees are also made aware of trends and may be asked to help develop lessons learned to prevent similar events from occurring.

3.1.2 Line Management

Line Management, including the Office Manager for office events and the Project Manager (PM) for project events shall:

a. Be responsible for all client notifications - (Prior to initiation of project field activities, the Project Manager shall coordinate with the client to determine the appropriate agency notification responsibilities and procedures).

b. Implement the appropriate internal notifications (see Table 1) as required by this program as soon as an event becomes known.

c. The supervisor responsible for directly overseeing the work shall ensure completion of the Event Report. The supervisor shall directly participate in the causal analysis investigation.

d. Ensure that corrective actions have been completed and properly documented.

3.1.3 Environmental Safety and Quality Personnel

Environmental Safety and Quality Personnel (Environmental Safety Coordinator, Environmental Safety Specialist, and Project Quality Control personnel) shall:

a. Ensure that all notifications are made promptly.

b. Ensure that all reports are fully completed.

c. Ensure that all insurance and workers compensation forms are completed and submitted as necessary.

d. Participate in event investigations of all Occupational Safety and Health Administration (OSHA) recordable injuries/illnesses, spills, releases, and other investigations.

e. Communicate information about the event to applicable site and/or office employees.

3.1.4 Project Quality Control Manager

The Project Quality Control Manager shall review and approve QER investigation results, proposed remedial actions, determine the Event Risk in accordance with CRL Guideline HSG 2-7, Risk Prioritization, and identify the need to verify the effectiveness of corrective actions taken based on severity of Event Risk. The Project Quality Control Manager's evaluation of corrective action effectiveness should be summarized in the Comments section. Ineffective corrective actions should be elevated to the Director, Quality Programs for further evaluation and potential additional programmatic corrective actions.

3.1.5 Project Environmental and Safety Manager (PESM)

The PESM shall review and approve event investigation results, proposed remedial actions, determine the Event Risk in accordance with CRL Guideline HSG 2-7, Risk Prioritization, and identify the need to verify the effectiveness of corrective actions taken based on severity of Event Risk. The PESM's evaluation of corrective action effectiveness should be summarized in the Comments section. Ineffective correction actions should be elevated to the Director, EHS Services for further evaluation and potential additional programmatic corrective actions.

3.1.6 Director, EHS Services

The Director, EHS Services shall:

a. Notify OSHA of any injuries or illnesses occurring within OSHA jurisdiction as required.

b. Review/maintain log - which includes information on basis causes, immediate causes, and management control issues - of all investigations.

c. Distribute summaries of events with periodic management reports.

d. Communicate significant events to key personnel within the Company.

e. Review basic causes of Company events to identify trends.

f. Recommend EHS program modifications as necessary.

g. Immediately notify the Tetra Tech Health and Safety Manager of any serious accident and provide follow-up information on serious accidents.

h. Provide Monthly Injury Reports to the Tetra Tech Health and Safety Director.

3.2 Notifications

In addition to the reporting responsibilities specified in Section 3.1, the responsible supervisor is required to notify Work Care at 800-455-6155 (available 24 hours) of employee illness or injuries. Work Care's main office must be notified promptly of all injuries and illnesses so the affected employee receives prompt and appropriate medical advice. The call to Work Care must be made in addition to taking the affected employee to the local clinic. EHS 2-1, Emergency Preparedness, provides guidance for medical response and actions.

The responsible supervisor is also required to ensure notifications are made as outlined in Table 1.

The phone numbers and other means of contact for Company personnel shall be posted with the emergency notification list and/or integrated into the site-specific emergency notification list.

3.3 Event Report Generation

The information portion of the Event Report should be generated by the end of the supervisor's work shift on the day of the event, if possible, but no later than 24 hours after the event was reported by the supervisor and employee(s) involved in the event. The investigation completion time is provided in Section 3.4.

The Event Report and Investigation may be completed electronically in the Company Incident Database located on Lotus Notes or by hardcopy using Attachment A, Event Report and Investigation Form, or Attachment B, Quality Event Report Form. (Attachment C, Event Sketch, may be used to graphically depict **events**).

The forms are intended to be self-explanatory. If the supervisor or the employee has any questions regarding completion of the report, an ESQ representative should be contacted for support.

Both the employee(s) and the employee's supervisor must sign the Event Report.

For low loss-potential near misses, the ZIP Slip may be substituted for the standard Event Report. (See CRL Procedure PP-10, Employee Recognition).

3.4 Event Investigations

Event investigations are to be initiated and completed as soon as possible, but should be completed no later than 10 working days after the event has been reported.

Guidance for conducting investigations and cause analysis may be found in Section 4.3.

Table 1. Internal Notifications By Supervisor

EVENT TYPE	SUPERVISOR NOTIFIES...	TIMING[1]	... WHO NOTIFIES	TIMING[1]
Spill/release or Permit Exceedence	ESS	Immediately	PESM and Director, EHS Services	Immediately if external reporting required
	Project Manager	Immediately	Client and Area/Program Manager Government agency if required by contract/plan and Director, EHS Services not available (See 3.5.2)	Immediately if external reporting required
Fatality, Hospitalization of 1 or more persons, Fire, or Explosion	ESS	Immediately	PESM and Director, EHS Services OSHA reporting (See 3.5.1) Insurance AIG through Chartis @ 1-800-910-2667 (Company personnel only) (Not required inside Washington State)	Immediately Immediately Immediately
	Project Manager	Immediately	Area/Program Manager	Immediately

			VP Construction Client	Immediately Immediately
Confirmed or Potential OSHA Recordable	ESS	Immediately	PESM and Director, EHS Services Insurance AIG through Chartis @ 1-800-910-2667 (Not required in Washington State)	Same day Same day Same day
	Project Manager	Immediately	Area/Program Manager VP Construction, VP Remediation, VP C&E, COO Client, if required	Same day Same day 24 hours or as specified by contract
Equipment/Property/ Vehicle Damage	ESS	Immediately	PESM and Director, EHS Services	24 hours
	Project Manager	Immediately	Client (client property) Client (other property, if required) Equipment Manager Area/Program Manager VP Construction	Immediately 24 hours 24 hours 24 hours 24 hours
Potential Insurance Claim, other than Worker's Compensation	Project Manager	Immediately	Law Department and Procurement	24 hours
Office Events	ESC	Immediately	Operations Manager Director, EHS Services	24 hours
Quality Events	Project Manager Project QC Manager	Immediately Same Day	Program or Operations Manager Director of Quality Programs	24 hours 24 hours

[1]Timing - Immediately - Real time verbal discussion or notification in writing
Same Day
24 hours - written event report copy; Client notification, or as specified in contract or project specification
ESS Environmental Safety Specialist
ESC Environmental Safety Coordinator
PESM Project Environmental and Safety Manager
QC Quality Control
VP Vice-President

Investigations that fall within the scope of the OSHA Process Safety Management Standard must meet the requirements of 29 Code of Federal Regulations (CFR) 1910.119(m). Projects that must meet this standard shall include the appropriate reporting requirements in project specific procedures or plans.

Project QC personnel should participate in the QER Cause Analysis and in determining an appropriate Action Plan.

Completed investigation reports should be submitted within 10 working days to:

a. Project Manager or Office Manager for review and signature

b. PESM or Project QC Manager (for QERS) for review and signature

c. ESS (for projects) or ESC (for offices) for review and signature

d. Director, EHS Services/Quality Services as applicable

Electronic submittal within 10 working days meets these reporting requirements. Additional reporting requirements are listed in Table 1.

The Project or Office Manager and the PESM, or Project Quality Manager must sign the report indicating their satisfaction with thoroughness of the investigation and the report and their concurrence that the action items address the identified causes. This constitutes the peer review, and the report, particularly the description, should be clear to readers not familiar with the project or incident.

3.5 External Notifications

3.5.1 OSHA Notification

Notification to OSHA is required within 8 hours if the event resulted in one or more fatalities and/or three or more hospitalized individuals. The 8-hour notification of OSHA is also required if a fatality or hospitalization of three individuals occurs within 30 days after the event.

The Director, EHS Services, has the responsibility for making the OSHA notification. The senior site EHS representative shall make the notification if the Director, EHS Services is unavailable.

The Project Manager is responsible for notifying the client of any required OSHA notifications.

3.5.2 Agency Notifications for Spills, Releases, and Permit Exceedences

It is the Company's policy that *if a spill, release, or permit exceedence is determined to be reportable, the Company or the client shall perform the reporting in a timely fashion as defined by federal, state, or local laws and regulations* . Notifications shall be made per contract requirements or the project Communications Plan. Prior to initiation of project field activities, the Project Manager shall coordinate with the client to determine the appropriate agency notification responsibilities and procedures. During the conduct of project activities, the client shall be notified regarding the spill, release, or permit exceedence and the Company's notification determination.

The Project Manager, in conjunction with the PESM must determine whether a spill, release, or permit exceedence exceeds reportable quantities to a regulatory agency under federal, state, and/or local laws and regulations or permit conditions. This determination must be made quickly because many laws and regulations require that notifications be made within short time frames (immediately upon knowledge, but no later than 24 hours).

If a spill or release is determined <u>not</u> to exceed reportable quantities, the PESM shall evaluate whether the spill or release poses a threat to human health (for example, has or may release into known drinking water sources, has or may cause contamination of surface soils/materials/air accessible to the public, and so forth). If a spill or release is determined to pose a threat to human health, the Project Manager, with the assistance of the Director, EHS Services, as necessary, shall consult with the client to determine whether the spill or release should be reported to a regulatory agency.

3.6 Documentation

A copy of each Event Report shall be retrievable for the project or office files. The Event Report database may serve this purpose.

3.6.1 Documentation of Agency and Client Notifications

All agency and client notifications shall be documented on the **<u>Event</u>** Report form. Other documentation generated regarding verbal or written agency notifications (if required), including agency response to such notification, shall either be maintained in the project file or preferably, attached to the Event Report.

In instances where the client conducts the reporting, documentation shall be obtained from the client indicating that the agency was notified in accordance with federal, state, or local regulations and maintained in the project files. If the client verbally notifies the Company that the notification was made, the Project Manager shall document the conversation. In these cases, communications shall be recorded internally in accordance with EHS 1-10, External Regulatory Inspections and Notifications, for Environmental Management System reporting requirements.

If the spill, release, or permit exceedence is determined not to be reportable, the Event Report and Investigation shall include the rationale for not reporting the spill, release, or permit exceedence to a regulatory agency.

3.7 Training

The Director, EHS Services, and the Director, Quality Services, have the responsibility for ensuring that site and office supervisory personnel have the appropriate training to conduct event investigations.

ESSs shall be trained on a project-specific basis by the PESM to implement the spill/release and permit exceedence reporting requirements in conjunction with training on the requirements of the project-specific EHS Plans per Corporate Reference Library procedure EHS 3-2, Procedures—Environmental, Health & Safety Plan(s).

Personnel serving in a project or office supervision, or office supervision, ESQ position shall have completed and passed the Company provided self-study course entitled "Practical Loss Control Leadership within 3 months of initial assignment."

4.0 GUIDANCE

4.1 Definitions

4.1.1 Event

For the purposes of this program, an event is:

a. An injury or illness that meets the OSHA recordability criteria

b. Ergonomic-related pain complaints

c. An exposure to a hazardous substance above the allowable exposure unit.

d. A property/vehicle/equipment/heavy equipment/truck/passenger damage case that results in damage greater than $500.

e. A fire or explosion.

f. A spill or release resulting from the Company, or subcontractor activities, including spills or releases from operations at a client facility of which Company employees have become aware.

g. Discovery of chemicals or waste products in an office.

h. A permit exceedance.

i. Safety-related events reported by an enforcing authority (ISO 14001 Registrar requirement).

j. Customer, or enforcing authority, complaints regarding the implementation of the Company's EMS or Quality Management System (QMS).

k. External regulatory inspections that result in findings or citations.

l. Quality events as defined in Section 4.1.3.

m. Near-miss occurrences, as defined in Section 4.1.2 below[1]

4.1.2 Near Miss

A “near miss” is an event, that has a reasonable probability in resulting in one of the outcomes described above if the circumstances were different and for which modifications to management programs will reduce the probability of occurrence or the severity of the outcome (see examples of Immediate and Basic causes in Attachment A.

4.1.3 Quality Event

QERs should be generated for the following two situations:

a. When project quality deficiency reports identify a **significant condition adverse to quality**. A significant condition adverse to quality is one that, if uncorrected, could have a serious adverse effect on operability, level of quality, or presents a high loss potential.

b. When an event reveals an opportunity for improved performance through modification of our management system.

4.1.4 Recognition and EMS Communication

ZIP Slips (See PP-10, Employee Recognition Programs) may be used to document employee recognition for a job well done, suggestions for improvement, or minor safety issues that should be resolved.

ZIP Slips may be used to document external inquires or complaints regarding the Company's EMS or project-specific environmental aspects.

4.2 Continuous Improvement

TtEC's event investigation procedure and event report database is a tool used by the (ESQ) organization for continuous improvement by:

- Identifying the root causes of each event
- Tracking and trending
- Selecting appropriate corrective action(s), and person(s) responsible for corrections
- Providing Lessons Learned
- Identifying additional EHS orientation and training topics
- Identifying future health and safety goals and objectives

Corporate ESQ management periodically disseminates valuable information contained in the event/investigation program, company wide to employees in the form of ZIP Bulletins, Flash Reports, and Lessons Learned.

The EMS Coordinator should also review the Event Report database to identify trends and incorporate results into the continuous improvement of the EMS.

4.3 Cause Analysis

4.3.1 Immediate Cause

Determine the immediate causes, using the examples on the form. If one or more of the examples fits the circumstance, use those words in the cause description. Explain, e.g., Improper Lifting – employee attempted to lift box by bending at the waist and twisting while lifting. Be sure that the event description is sufficiently detailed to support the causal analysis in this section. An assumption of cause (e.g., improper lifting) from the injury (low back pain) is not acceptable.

4.3.2 Basic Cause

Like the Immediate Causes, use the guidewords on the form whenever appropriate and explain. For example, improper motivation may be because the correct way takes more time or effort; short cutting standard procedure is tolerated or positively reinforced; or the person thinks there is no personal benefit to always doing the job correctly.

Investigators should determine if a change in the work conditions, scope, methods or personnel contributed to the event. This may occur due to inadequate assessment of hazard potential or inadequate application of hazard controls. If "Change" was contributing, it will most likely be identified in combination with other basic causes.

Note: The investigator is encouraged to review the Practical Loss Control Leadership chapters on *Causes and Effects of Loss* and *Accident/Event Investigation* before doing the causal analysis. The investigation team should refer to the S.C.A.T. Chart available from the PESM when analyzing causes of high loss potential events, especially where motivation is suspected of being a Basic Cause.

4.3.3 Remedial Actions

Include all actions taken or those that should be taken to *prevent recurrence* . Be sure that actions address the causes. For example, training (safety meetings) may be a necessary response for lack of knowledge, but may be inadequate for improper motivation.

4.4 Loss Control Leadership for Non-Supervisory Personnel

All non-supervisory and non-ESQ positions (excluding craft workers) assigned to conduct field activities should complete the Practical Loss Control Leadership self-study course within one year of initial assignment.

5.0 REFERENCES

Please Describe your Reference Here	Place Your Link in this Column
1. OSHA 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals	
2. EHS 1-10, External Regulatory Inspections and Notifications	
3. EHS 2-1, Emergency Preparedness	
4. EHS 3-2, Procedures - Environmental, Health & Safety Plan(s)	
5. Environmental Management System	

6. HSG 2-7, Risk Prioritization	
7. PP-10, Employee Recognition	
8.	
9.	

6.0 ATTACHMENTS

Please Provide a Description of the Attachment	Place Your Attachments Here
1. Attachment A - Event/Near Miss Report and Investigation	EHS 1-7, Att A, 2007.doc
2. Attachment B - Quality Event Report Form	EHS 1-7, Att B, 2007.doc
3. Attachment C -Event Sketch	EHS 1-7, Att C, 2007.doc

Corporate ESQ Report # **Insert number here**
Project Name: **Insert name here**

EHS 1-7, Attachment A
Event/Near Miss Report and Investigation

Checkboxes can be toggled on ☒ and off ☐ to show an "X" or not show an "X." Double-click on the box to activate a dialog box that shows possible selections. To preserve formatting when you cut and paste text, use the "paste special" command to paste: EDIT, PASTE SPECIAL, UNFORMATTED TEXT.

Guidance for filling out this form is provided in CRL Procedure EHS 1-7.

Section 1, General Information

Short Description/Title Below: (limited to 125 characters). This is the description that will appear in the database listing.

Type of Event/Near Miss (check all that apply):

Was a person injured or made ill:
☐ By something at work ☐ By something outside the work environment ☐ No injury or illness

Did this event occur in one of our major offices? ☐ Yes ☐ No List Office:

Did this event occur in a foreign country? ☐ Yes ☐ No

Did this event involve:

A strain?	☐ Yes ☐ No	Fire?	☐ Yes ☐ No
A motor vehicle accident?	☐ Yes ☐ No	Property damage (>$500)?	☐ Yes ☐ No
A repetitive motion injury?	☐ Yes ☐ No	Spill/release?	☐ Yes ☐ No
A fall?	☐ Yes ☐ No	Permit exceedence?	☐ Yes ☐ No
Being struck by something?	☐ Yes ☐ No		

Event Information

Case #:	Site Case #:	Workers Comp #:

Where did the event occur?	Project # (4 digits):
Site/Location Name:	Delivery Order #'s:
Date of event:	Military time:
TtEC Supervisor on duty:	Was Supervisor at event scene? ☐ Yes ☐ No

Event Location:

What employee/employer category was involved in this event?
☐ TtEC permanent
☐ TtEC craft/temp service
☐ Subcontractor
☐ Other

Employer of affected employee?

Weather conditions:	Adequate Lighting at Scene? ☐ Yes ☐ No

What was the employee doing, or what was happening, just before the event occurred? Describe the activity below, as well as the tools, equipment, or material the employee was using. Be specific. For example, "climbing a ladder while carrying roofing materials," "spraying chlorine from hand sprayer," or "daily computer key-entry."

Corporate ESQ Report # **Insert number here**
Project Name: **Insert name here**

EHS 1-7, Attachment A
Event/Near Miss Report and Investigation

What happened? What was the contact or event and how did it occur? Tell us below how the injury occurred. For example, "When the ladder slipped on the wet floor, the worker fell 20 feet," "worker was sprayed with chlorine when gasket broke during replacement," or worker developed soreness in wrist over time." Attach file if necessary.		
Section 2, Affected Employee Information		
Include injured person, driver/operator, or employee whose activities resulted in the event. A new event report must be created for each injured employee.		
Employee's name:	Sex ☐ Male ☐ Female	
Date of Hire:	Job classification:	Number of months at TtEC:
Work hours on shift prior to event:	Years in job classification (##):	
Did event relate to routine task for job classification? ☐ Yes ☐ No		
Section 3, Injury/Illness Information *(If not applicable, check here ☐ and go to Section 4)*		
Nature of injury of illness: Describe body part affected and how it was affected below. Be more specific than "hurt," "pain," or "sore." For example, "strained back."		
What object or substance directly harmed the employee? For example, "concrete floor," "chlorine," "radial arm saw." If this question does not apply to the event, leave it blank.		
Was First Aid provided? ☐ Yes ☐No		
Did the injury/illness result in ☐ Days away (with or without restricted days) ☐ Restricted days only ☐ No or unknown		
Did employee die? ☐ Yes ☐No		
Medical treatment does not include examination, diagnostic tests, or First Aid. See ZIP Bulletin 109 for OSHA definition of First Aid. Attach treatment report/doctor's note or send copies to Director, EHS Services. Was medical treatment provided? ☐ Yes ☐ No		
Section 4, Vehicle and Property Damage Information *(If not applicable, check here ☐ and go to Section 5)*		
Damaged vehicle make:	Damaged vehicle model:	
Damaged vehicle VIN:	Vehicle owner:	
Property damaged:		
Describe property damage:		

EHS 1-7, Attachment A
Event/Near Miss Report and Investigation

Section 5, Environmental Release ***(If not applicable, check here ☐ and go to Section 6)***	
Environmental Release	
Substance spilled or released:	
From where:	To where:
Estimated quantity/duration:	CERCLA Hazardous substance? ☐ Yes ☐ No
RQ exceeded? ☐ Yes ☐ No	Specify RQ:
Reportable to agency? ☐ Yes ☐ No	Specify (place telecom in project file):
Responsibility to report: ☐ TtEC ☐ Client ☐ Other	Time frame:
Written report (place report in project file): ☐ Yes ☐ No	
Response action taken:	
Permit Exceedence	
Type of permit:	Permit #:
Date of exceedence:	Parameter(s):
Criteria:	Exceedence levels:
Exceedence duration:	Reportable to agency: ☐ Yes ☐ No
Specify (place telecom in project file):	Written report: ☐ Yes ☐ No
Time frame:	
Response action taken:	

Section 6, Notifications		
Insert names of TtEC personnel notified below:		
Name:	Date:	Time:
Name:	Date:	Time:
Name:	Date:	Time:
Name:	Date:	Time:
Client rep notified:	Date:	Time:
By whom:		
Agency notified:	Date:	Time:
By whom:		
Agency Contact Name:		

Section 7, Persons Preparing Report	
Signature of this form verifies that all supplied information is accurate.	
Employee's name (print):	Sign:
Employee's name (print):	Sign:
Supervisor's name (print):	Sign:
Supervisor's phone number:	
Date:	
Note to supervisor: Supervisor is to forward a copy of the Event Report to immediate supervisor, PESM, ESS or ESC, and other personnel as identified in Table 1 of this procedure ASAP, but no later than 24 hours.	

EHS 1-7, Attachment A
Event/Near Miss Report and Investigation

Section 8, Attach Sketches or Photos		
Report Number:		
Send sketch by mail, fax, or attach an electronic file. EHS 1-7, Attachment C, contains a template that can be used for creating sketches of accidents.		
Vehicle Events		
Write in the street names and, if possible, the points of the compass. Attach black-and-white hard-copy photos or JPG or BMP files (JPG file sizes are typically smaller) as appropriate. If the sketch appears on a police report or insurance form, this need not be completed. Attach the other report or send a hard copy to the Director, EHS Services.		
Section 9, Investigative Report		
Date Information:		
Date of event:	Date of investigative report:	
Event Cost:		
Other event costs: $	WC claim value: $	Estimated loss: $
Cause Analysis		
Was the activity addressed in an AHA? ☐ Yes (attach applicable section) ☐ No		
Immediate Causes		
What actions and conditions contributed to this event? Check all that apply:		

Substandard Acts	
☐ Operating equipment without authority	☐ Horseplay
☐ Failure to warn	☐ Using equipment improperly
☐ Failure to secure	☐ Failure to follow procedure
☐ Operating at improper speed	☐ Personnel not properly qualified
☐ Making safety devices inoperable	☐ Failure to communicate
☐ Removing safety devices	☐ Operating equipment outside of specified parameters
☐ Using defective equipment	☐ Failure to check equipment prior to acceptance
☐ Failure to use PPE properly	☐ Acceptance of defective equipment
☐ Improper loading	☐ Failure to provide proper equipment
☐ Improper placement	☐ Improper servicing/maintenance of equipment
☐ Improper lifting	☐ Other substandard acts
☐ Improper position for task	☐ Servicing equipment in operation
☐ Under influence of alcohol/drugs	

Substandard Conditions	
☐ Guards or barriers	☐ Exposure to hazardous materials
☐ Protective equipment	☐ Extreme temperature exposure
☐ Tools/equipment or materials	☐ Illumination
☐ Congestion	☐ Ventilation
☐ Warning system	☐ Visibility
☐ Fire and explosion hazards	☐ Radiation
☐ Poor housekeeping	☐ Hazardous environmental conditions
☐ Noise exposure	☐ Other substandard conditions

EHS 1-7, Attachment A
Event/Near Miss Report and Investigation

Enter brief explanation of each ***immediate cause*** below:

Basic Causes	
What specific personal or job factors contributed to this event? Check all that apply:	
Personal Factors	**Job Factors**
☐ Inadequate physical/physiological capability	☐ Inadequate leadership and/or supervision
☐ Inadequate mental/psychological capability	☐ Inadequate engineering
☐ Physical or physiological stress	☐ Inadequate purchasing
☐ Lack of knowledge	☐ Inadequate maintenance
☐ Lack of skill	☐ Inadequate tools and equipment
☐ Improper motivation	☐ Inadequate work standards
☐ Other personal factors	☐ Excessive wear and tear
	☐ Abuse and misuse
	☐ Change
	☐ Other job factors

Enter brief explanation of each ***basic cause*** below:

Section 10, Action Plan	
What has or should be done to control each of the causes listed? Consider the following Management Programs in developing remedial actions:	
☐ Leadership and administration	☐ Health control
☐ Training	☐ System evaluation
☐ Planned inspections	☐ Engineering controls and change management
☐ Task analysis and procedures	☐ Personal communications
☐ Task observation	☐ Group meetings
☐ Emergency preparedness	☐ General promotion
☐ Rules and work permits	☐ Hiring and placement
☐ Accident/event analysis and corrective and preventive action	☐ Materials and services management
☐ Personal protective equipment	

EHS 1-7, Attachment A
Event/Near Miss Report and Investigation

Remedial Actions			
Actions	Person Responsible	Target Date	Completion Date
1.	1.		
2.	2.		
3.	3.		
4.	4.		

Section 11, Persons Performing Investigation	
Investigator's name:	Date:
Investigator's name:	Date:
Investigator's name:	Date:

Management Review	
Note: Signature verifies that all supplied information is accurate; the description supports the causal analysis; and the Action Plan is sufficient to address the causes.	
Project/Office Manager Approval: ☐ Yes ☐ No	
Comments:	
Sign:	Date of Approval:
ESQ (PESM) Approval: ☐ Yes ☐ No	
Comments:	
Sign:	Date of Approval:
Note: Attach additional information as necessary. Supervisor to forward copy of Investigative Report to the PM or Office Manager or ESQ as soon as possible, but no later than 72 hours after the event. A copy shall be sent to the Director, EHS Services, within 24 hours of completion of the report. Attach here.	

Corporate ESQ Report #	**Insert number here**
Project Name:	**Insert name here**

EHS 1-7, Attachment B
Quality Event Report and Investigation

Checkboxes can be toggled on ☒ and off ☐ to show an "X" or not show an "X." Double-click on the box to activate a dialog box that shows possible selections. To preserve formatting when you cut and paste text, use the "paste special" command to paste: EDIT, PASTE SPECIAL, UNFORMATTED TEXT.

Guidance for filling out this form is provided in CRL Procedure EHS 1-7.

Section 1, Event Description and Investigation			
Date of event:			
Office/Project Location:		Organization or Department:	
Means of identification:			
☐ Client concern	☐ Nonconformance report	☐ Audit report	☐ Corrective action request
☐ Supervisory review	☐ Peer review	☐ Project review	☐ Other (describe):
Enter Short Description/Title (limited to 125 characters) below. This is the description that will appear in the database listing.			
Issue Summary: Summarize the concern, problem, or situation that needs to be addressed. Identify who was involved and their role (e.g., performer, inspector, auditor).			
Section 2, Persons Preparing Report			
Signature of this form verifies that all supplied information is accurate.			
Employee's name (print):		Sign:	
Employee's name (print):		Sign:	
Supervisor's name (print):		Sign:	
Supervisor's phone number:			
Date:			
Note to supervisor: Supervisor is to forward a copy of the Event Report to immediate supervisor, PESM, ESS or ESC, and other personnel as identified in Table 1 of this procedure ASAP, but no later than 24 hours.			
Section 3, Investigative Report			
Date of investigative report:			
Other event costs: $	WC claim value: $	Estimated loss: $	
Cause Analysis			
Immediate Causes			
What actions and conditions contributed to this event? Check all that apply:			
Substandard Acts			
☐ Operating equipment without authority		☐ Inadequate inspection/peer review	
☐ Failure to follow/improper execution of procedure		☐ Poor judgment	
☐ Using equipment improperly		☐ Failure to communicate—written and/or verbal	
☐ Improper servicing/maintenance of equipment		☐ Acceptance of defective equipment/material	
☐ Under influence of alcohol/drugs		☐ Other substandard acts	
☐ Horseplay			

Corporate ESQ Report # **Insert number here**
Project Name: **Insert name here**

EHS 1-7, Attachment B
Quality Event Report and Investigation

Substandard Conditions	
☐ Personnel not properly qualified or trained	☐ Inadequate oversight
☐ Defective equipment/material	☐ Inadequate procedure/instruction
Enter brief explanation of each ***immediate cause*** below:	
Basic Causes	
What specific personal or job management system factors contributed to this event? Check all that apply:	
Personal Factors	**Job Factors**
☐ Inadequate physical/physiological capability	☐ Inadequate leadership and/or supervision
☐ Inadequate mental/psychological capability	☐ Inadequate engineering
☐ Physical or physiological stress	☐ Inadequate purchasing
☐ Lack of knowledge	☐ Inadequate maintenance
☐ Lack of skill	☐ Inadequate tools and equipment
☐ Improper motivation	☐ Inadequate work standards
☐ Other personal factors	☐ Excessive wear and tear
	☐ Abuse and misuse
	☐ Change
	☐ Other job factors
Enter brief explanation of each ***basic cause*** below:	
Section 4, Action Plan	
What has or should be done to control each of the causes listed? Consider the following Management Programs in developing remedial actions:	
☐ Leadership and administration	☐ Engineering controls and change management
☐ Training	☐ Personal communications
☐ Planned inspections	☐ Group meetings
☐ Critical task analysis and procedures	☐ General promotion of Loss Control principles
☐ Task observation	☐ Hiring and placement
☐ Rules and work permits	☐ Materials and services management
☐ Accident/event analysis and corrective and preventive action	☐ Quality control
☐ System evaluation	

Corporate ESQ Report # **Insert number here**
Project Name: **Insert name here**

EHS 1-7, Attachment B
Quality Event Report and Investigation

Remedial Actions			
Actions	Person Responsible	Target Date	Completion Date
1.	1.		
2.	2.		
3.	3.		
4.	4.		

Section 5, Persons Performing Investigation	
Investigator's name:	Date:
Investigator's name:	Date:
Investigator's name:	Date:

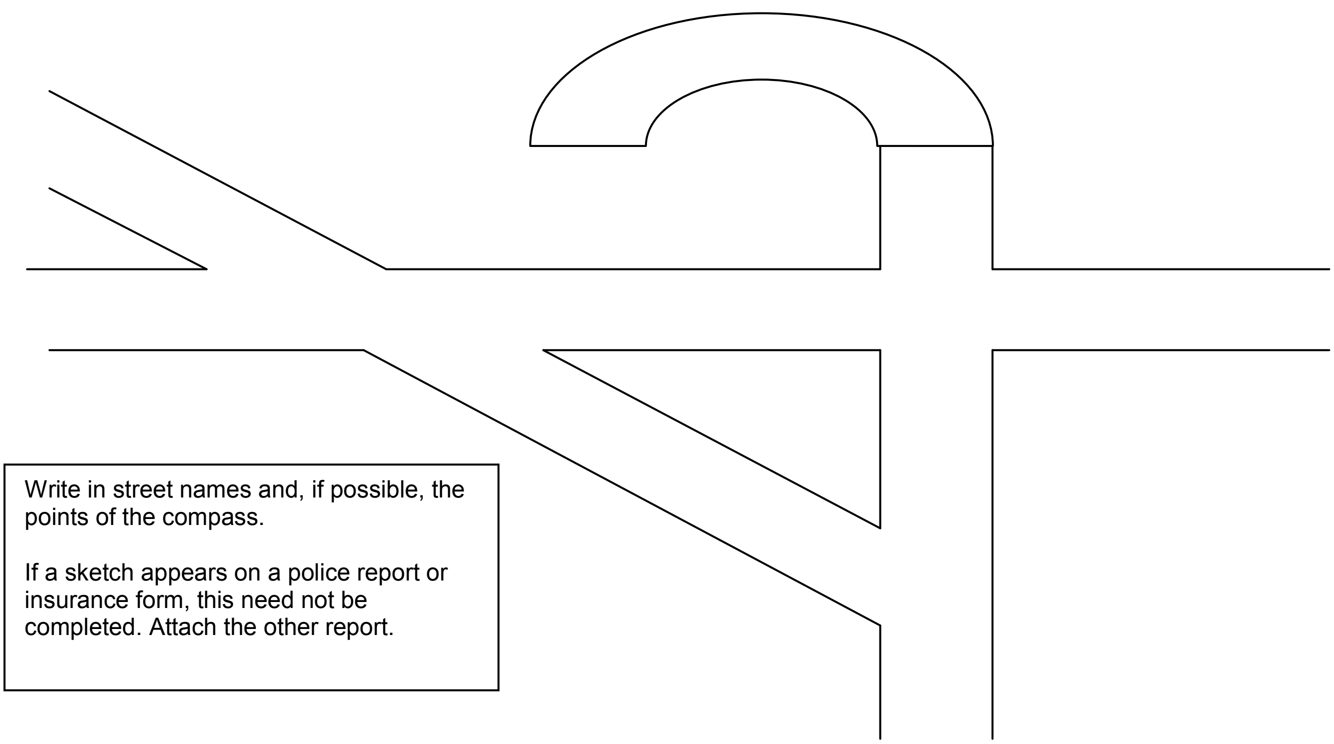
Management Review	
Note: Signature verifies that all supplied information is accurate; the description supports the causal analysis; and the Action Plan is sufficient to address the causes.	
Project/Office Manager Approval: ☐ Yes ☐ No	
Comments:	
Sign:	Date of Approval:
ESQ (PESM, QA) Approval: ☐ Yes ☐ No	
Comments:	
Sign:	Date of Approval:
Note: Attach additional information as necessary. Supervisor to forward copy of Investigative Report to the PM or Office Manager or ESQ as soon as possible, but no later than 72 hours after the event. A copy shall be sent to the Director, EHS Services, within 24 hours of completion of the report. Attach here.	

EHS 1-7, Attachment C
Event/Near Miss Report and Investigation Sketch Template and Instructions

Event/Near Miss Report and Investigation Sketch Template

Event Sketch

Vehicle Events



EHS 3-1: Ergonomics (Previously HS3-1)

Purpose
The purpose of this program is to establish minimum requirements for the implementation of an effective ergonomics program at Tetra Tech EC, Inc. (TtEC). The program is focused on the prevention of cumulative trauma disorders, particularly those associated with the use of computer keyboards and injuries associated with lifting and material handling.

Version Date:	**05/21/2002** - Revised	**Approved by:**	Donald Rogers
Original Issue Date:	**02/01/95**		
Category:	Company Procedures	**Sections:**	ESQ - Environmental Health & Safety Programs
Sub Category:	Departmental/Discipline	**Document Type:**	Procedure
Keyword Index:	Field Activities/Environmental H&S, Monitoring, Operational Control, Training	**Document Owner:**	Philip Bartley

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1.0 PURPOSE

The purpose of this program is to establish minimum requirements for the implementation of an effective ergonomics program at Tetra Tech EC, Inc. (TtEC). The program is focused on the prevention of cumulative trauma disorders, particularly those associated with the use of computer keyboards and injuries associated with lifting and material handling.

2.0 SCOPE

This program applies to all TtEC operations.

3.0 MAINTENANCE

The Executive Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with TtEC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director Compliance and Corporate Counsel.

4.0 DEFINITIONS

4.1 Ergonomics

The science that studies the physical effects of workstations, tools, and equipment on the human body.

4.2 Cumulative Trauma Disorder

A term for health disorders arising from repeated biomechanical stress due to ergonomic hazards. Other terms used include: repetitive motion injury, occupational overuse syndrome, and repetitive strain injury. Cumulative trauma disorders (CTDs) are a class of musculoskeletal disorders involving damage to the tendons, tendon sheaths, synovial lubrication of the tendon sheaths, and the related bones, muscles, and nerves of the hands, wrists, elbows, shoulders, neck and back. Frequently occurring CTDs include: carpel tunnel syndrome, epicondylitis (tennis elbow), tendinitis, tenosynovitis, synovitis, stenosing tenosynovitis of the fingers, DeQuervain's Disease, and low back pain.

4.3 Ergonomic Hazard

A workplace condition that poses a biomechanical stress to the worker. They include, but are not limited to: faulty work station layout, improper work methods, improper tools, excessive tool vibration, and job design problems that include aspects of work flow, posture, work/rest regimens, and repetition rate.

4.4 Ergonomic Risk Factor

A condition of a job or activity that contributes to the risk of developing CTDs. Examples include: repetitiveness of activity, force required, and awkwardness of posture. They are considered in light of their combined effect in inducing CTDs, i.e., risk factors are synergistic element of ergonomic hazards.

4.5 Health Care Provider/Medical Surveillance Program Administrator

A physician/physicians specializing in occupational health, registered nurse specializing in occupational health, or other health personnel working under the supervision of these individuals.

4.6 Qualified Person

A person with thorough training and experience sufficient to identify ergonomic hazards in the workplace and recommend an effective means of correction.

4.7 Systems Approach

A comprehensive program that addresses workplace processes, activities and conditions as interdependent systems in order to identify and to eliminate or reduce all types of hazard, including ergonomic hazards, to employees.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Line Management

Line managers are responsible for:

- reviewing and implementing health and safety recommendations which are intended to reduce the probability that ergonomic disorders will occur.
- contacting ESQ to perform an office ergonomic survey when:
  - a new employee is hired
  - an employee moves to another workstation
  - an employee obtains new furniture
  - an employee's assignment changes that significantly increases their computer use
  - an employee informs their supervisor that they are experiencing symptoms which

may be associated with their workstation

- ensuring office-based employees receive ergonomic awareness training, conduct workstation self-assessments, and report any physical discomfort or problems with their workstation immediately.

5.1.2 Environmental, Health and Safety Personnel

The Environmental and Safety Coordinator (ESC) for each office or the Environmental and Safety Supervisor (ESS) for each project is responsible for surveying each workplace per the requirements of this programs, to identify ergonomic hazards and to make recommendations, when necessary, for corrective actions to reduce the probability that ergonomic disorders will occur.

The ESC shall also respond to employee or supervisory requests for an ergonomic survey.

5.2 Pre-Placement Medical Evaluations

Pre-placement medical evaluations are not required for office personnel.

TtEC job descriptions contain general information regarding the physical exertion required for each job position including standing, walking, bending, climbing, and lifting. For participants in the TtEC medical surveillance program (hazardous waste workers), per EHS 4-5, Medical Surveillance, this information will assist the Corporate Medical Consultant (CMC) to evaluate an individual's ability to perform the job tasks required by their job position. The objective of this evaluation is to identify pre-existing physical conditions which might be aggravated by routine job duties. The results of the medical evaluation will enable Human Resources and operations personnel to determine when reasonable accommodations can be made to avoid aggravation of pre-existing ergonomic disorders or conditions.

Pre-employment back evaluations are recommended for craft workers who may be at greater risk of developing low back pain or low back injury. This evaluation may be requested by contacting our Corporate Medical Consultant (CMC) and may be performed by the local medical provider under the approval and direction of our CMC.

5.3 Workplace Evaluations

Surveys shall be performed by qualified persons to identify and evaluate tasks which might result in injuries due to ergonomic hazards. The focus of the surveys will be: 1) Computer workstations which are used by a single person on an average of more than 20 hours per week and those which are used by multiple persons, and 2) Operations which involve the manual lifting and moving of objects of excessive weight or asymmetric size.

5.3.1 Computer Workstation Surveys

Workstation Ergonomic Checklist (Attachment A) shall be used for the evaluation of all computer workstations which are used by a single person on an average of more than 20 hours per week or by multiple persons. This checklist is based on guidelines established in the American National Standard for Human Factors Engineering of Visual Display Terminal Workstations.

If the results of the computer workstation survey indicate that the workstation does not meet the desired characteristics or the workstation is not being properly used, recommendations shall be made to modify the workstation and/or provide additional training.

5.3.2 Material Handling

Potential material handling hazards for field operations will be initially identified during the development of Environmental, Health and Safety (EHS) plans pursuant to EHS 3-2, EHS Plans. Potential hazards are to be addressed through the hazard analysis portions of these plans. The effectiveness of the control measures are to be reviewed during inspections (EHS 3-3, Inspections), ESQ audits (C-2, Audits), and routine observations of workplace activities.

During inspections or audits, or when performing routine observations of workplace activities, Attachment B or an equivalent should be used as a screening tool to identify tasks with ergonomic hazards or risk factors. When ergonomic hazards or risk factors for lifting tasks are identified, the NIOSH "Work Practices Guide for Material Handling" are available as guidelines for evaluating the task.

Recommendations shall be made as necessary to modify the work activity and/or provide additional training. The NIOSH evaluation criteria accounts for the following variables for each lifting task: weight of object, horizontal location, vertical location, vertical travel distance, frequency of lifting, and duration of period of lifting.

5.3.3 Frequency of Workplace Surveys

Computer workstation surveys shall be conducted:

- ergonomic evaluation upon initial assignment, upon a move, upon use or receipt of new furniture/chairs, computers, monitors, (etc). and upon request of an employee, supervisor or office manager.
- for new hires within one month of workstation permanency
- when an employee moves to another workstation
- when an employee obtains new furniture
- when an employee informs their supervisor that they are experiencing symptoms which may be associated with their workstation
- when requested by an employee or his/her supervisor

Material handling surveys will be conducted as part of the TtEC EHS inspection and audit programs, EHS 3-3, Inspections, and C-2, Audits.

5.3.4 Action Items and Follow-up Report

The ESS or ESC shall develop an Action Item and Closure Report (Attachment C or an equivalent) that identifies the recommendations, proposed schedule for implementation and responsible parties. The Operations Manager (for field sites) shall complete and forward the Action Item and Closure Report within 60 days of receipt to the ESS or ESC. The ESS or ESC shall send copies to Manager, EHS Services and to the Director, EHS Services. The ESS or ESC will notify the Operations Manager and manager, EHS Services when Closure Reports are delinquent.

5.3.5 Records

Manager**,** EHS Services shall maintain copies of all ergonomics surveys and completed Action Item and Closure Reports.

5.4 Hazard Prevention and Control

5.4.1 Workstation Configuration

The recommended design specifications for TtEC work stations are:

- Adequate work space to perform the job;
- Consideration of individual body size in relation to design of chair, height of work surface, and access to various elements of the work station, including the monitor screen;
- Work surface, monitor and keyboard height within parameters established in the American National Standard for Human Factors Engineering of Visual Display Terminal Workstations (ANSI/HFS 100-1988), or preferably, a height adjustable work station (including capability to adjust monitor height and keyboard height if VDT is used);
- Adequate leg room;
- No direct reflection of light on screen, adequate illumination (normally 28-50 footcandles), minimum contrast between a monitor screen and the surrounding work area; and
- Direction of air supply ducts away from person.

The recommendations for chair design are:

- Adjustable seatpan, and lumbar-supportive backrest that can be adjusted for height and depth to individual users;
- five legs;
- adjustable for height;
- laterally and vertically adjustable armrests;
- backrest adjustable for tilt and;
- chair can swivel

Recommendations for miscellaneous workstation accessories include:

- VDT workstations: footrest, natural shaped keyboard, adjustable copy holder, wrist rest, mouse rest, antiglare screen (if needed or wanted).

All newly purchased TtEC workstations, desks, and/or chairs shall meet the above specifications. Existing furniture shall be modified as necessary on the basis of the evaluation using the workstation ergonomic checklist.

5.4.2 Work Practice Controls for Computer Workstations

Work practice controls for workstations include setting the work station up correctly, proper posture, taking eye breaks, and exercises.

The set-up of a VDT workstation should be as follows:

- The center of the screen should be at chin level. Position the screen at 14 to 24 inches from the eyes.
- Adjust the chair to fit body. Keep the back supported, knees at hip level, feet flat on floor or on a footrest.

- Place keyboard low enough so arms hang loosely, shoulders are relaxed, and the upper arm is at a right angle to the forearm.

- Set document holder close to screen and at same distance from eyes to avoid frequent head and eye movements and refocusing.

- Every 20 minutes, focus on an object at least 20 feet away. Move eyes up down, sideways, and diagonally. Eliminate sources of reflective glare. Correct posture includes holding head and spine upright and sitting well back in the chair - aim buttocks where seat and backrest meet.

- Keep wrist in line with hands and forearms. Maintain a light touch on keyboard.
- Allow hand to rest on mouse.
- Support lower arms by using the chair armrests to eliminate need to hold up arms and shoulders.

5.4.3 Material Handling Controls

Material handling equipment such as lift trucks, hand trucks, lift gates, etc. shall be utilized whenever possible.

When mechanical lifting and moving aids cannot be used, team lifting shall be used as a minimum for loads over 50 pounds and for awkward loads. When team lifting is not indicated, personnel are to be trained in and required to use proper lifting techniques.

5.4.4 Hand Tool Selection

Hand tools shall be selected to minimize the following stressors: chronic muscle contraction or steady force, extreme or awkward finger/hand/arm positions, repetitive forceful motions, excessive gripping, pinching, pressing with hand and fingers.

5.5 Personal Protective Equipment

TtEC shall not provide personal protective equipment (PPE) for reducing ergonomic risk factors without the authorization of the CMC or Manager, EHS Services. This includes, but is not limited to, "back" belts, wrist splints, and forearm wraps for "tennis" elbow.

5.6 Training

The employees identified below and supervisors of such employees shall be trained in accordance with the requirements specified in this section.

- Employees who use a computer workstation on an average of more than 20 hours per week;
- Employees who share work station with multiple persons;
- Employees who conduct operations which involve the manual lifting and moving of objects of excessive weight or asymmetric size; and
- Employees identified through the ergonomic survey as requiring training.

The training shall be geared toward field or office duties, as appropriate. It shall include, but not be limited to:

- Types of ergonomic disorders, especially CTD's and back/upper body strains;
- What risk factors cause or contribute to ergonomic disorders;
- How to recognize and report symptoms;
- Ergonomic hazards associated with their assigned tasks;
- Proper workstation design, use, and posture, if applicable;
- Proper lifting techniques; and

- Work practice controls.
- Summary TtEC Ergonomic program with employees.
- Employees who experience symptoms/pain possibly associated with their workstatioin.

This training shall be conducted as part of office or site-specific orientation.

6.0 REFERENCES

ANSI (American National Standards Institute) Human Factors Engineering of Visual Display Terminal Workstations.
Compliance Procedure C-2, Audits
Environmental, Health & Safety - Programs Procedure EHS 3-2, Procedures - Environmental, Health & Safety Plan(s)
Environmental, Health & Safety - Programs Procedure EHS 3-3, Inspections
Environmental, Health & Safety - Programs Procedure EHS 4-5, Medical Surveillance
NIOSH (National Institute for Occupational Safety and Health) Revised Guide for Manual Lifting.
OSHA (U.S. Department of Labor, Occupational Safety and Health Administration) Ergonomics Program Management Guidelines for Meatpacking Plants (1991).
Personal Health Design Bytes of Advice for Comfort and Health, Loudonville, NY (1992).

7.0 ATTACHMENTS

Attachment A - Workstation Ergonomic Checklist
Attachment B - Identification of Ergonomic Risk Factors
Attachment C - Action Item and Closure Report

EHS 3-1 ATTACHMENT A
WORKSTATION ERGONOMIC CHECKLIST

Click the icon below to download and complete.

EHS 3-1 Att A-Revision2.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 3-1 ATTACHMENT B
IDENTIFICATION OF ERGONOMIC RISK FACTORS

Click the icon below to download and complete.

EHS 3-1 Attachment B.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 3-1 ATTACHMENT C
ERGONOMICS ACTION ITEM AND CLOSURE REPORT

Click the icon below to download and complete.

EHS 3-1 Attachment C040301.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 3-1 ATTACHMENT A

TETRA TECH EC, INC.

WORKSTATION ERGONOMIC CHECKLIST

Location:____

Date survey conducted:__________________________________

Person(s) using workstation:______________________________

Average daily use:______ Less than 4 hours/day _____ 4 or more hours/day

Maximum hours per day workstation used by one person:______

REQUIRED CHARACTERISTICS	YES	NO
Employee had office ergonomics training.		
Light sources and light colored documents are not seen as reflections on screen.		
Monitor can be positioned to avoid glare.		
Monitor has glare screen.		
Top third of monitor screen is no higher than eye height.		
Employee with bifocals/trifocals is able to see screen without bending head or neck up/backward.		
Angle of monitor can be adjusted and is within 18-24 inches from operator eyes.		
Monitor, keyboard and mouse are aligned in front of operator allowing operator to view monitor directly w/o turning head.		
Keyboard/mouse height is adjustable and can be used with shoulders, arms & wrists in a neutral position.		
Mouse is on the same level as the keyboard.		
Mouse shape & button activation is comfortable and easy to operate. Fingers rest softly on mouse and are not held above mouse.		
Reaching for and operating the mouse greater than 90° arm extension is avoided.		
Armrests of chair or desk, support forearms/elbows while employee performs workstation tasks.		
Forearms are approximately parallel to the ground when using keyboard.		
Does the employee use the mouse extensively (i.e., more frequently than the keyboard)? For example, the mouse may be used as the primary input device for CADD, graphics, and spreadsheet tasks.		
Hands/wrists/lower arms do not rest on sharp or hard edge while typing.		
Chair seat pan angle and height are adjustable while seated.		
Chair backrest angle and height are adjustable while seated.		
Chair can swivel.		
Chair base has 5 spokes.		
Chair armrests are height and laterally adjustable.		

EHS 3-1 ATTACHMENT A

Wrist rest for mouse or keyboard is desired by employee or is needed (circle those that apply).		
Foot rest desired by employee or is needed.		
There is adequate leg clearance for the operator beneath the working surface.		
Document holder is desired by employee or is needed. If present, holder is adjustable for height and angle.		
Employee frequently uses telephone while using computer.		
Telephone can be used with head upright (not tilted) and shoulders relaxed (not elevated) if employee does workstation tasks at same time. Employee uses which of the following: shoulder rest, head set, speaker phone		
Forced air and air conditioning ducts are directed away from employee		
Does employee have any special needs due to physical limitations, height or unusual computer usage? Explain: ____ ____ ____		

Survey conducted by: _________________

Reason for survey: Annual:___ New employee:___ Office move:____ Employee complaint (explain):______ Follow-up:________

____

Other:____

____

Comments:____

____

____

____

____

____

____

Recommendations:____

____

____

____

____

____

____

EHS 3-1 ATTACHMENT B

TETRA TECH EC, INC.

IDENTIFICATION OF ERGONOMIC RISK FACTORS

PROJECT OR OFFICE ___________________________________ TASK/AREA ____________________________
SURVEY PERFORMED BY _______________________________ DATE ___________________________________

RISK FACTOR	PRESENT	NOT PRESENT	COMMENT/CONTROLS BEING UTILIZED
Lifting or moving objects of excessive weight or asymmetric size			
Repetitive and/or prolonged activities			
Awkward postures of the upper body (reaching above the shoulder or			
Forceful exertions (usually with hands)			
Prolonged static posture			
Continued physical contact with work surfaces (e.g., contact with edges)			
Excessive vibration			
Cold temperatures			
Inappropriate or inadequate hand tools			
Slippery footing			
Other (identify here):			
Employee questions/comments	NA	NA	

TETRA TECH EC, INC.

ERGONOMICS ACTION ITEM AND CLOSURE REPORT

Office or Project:

Date(s) of Survey(s):

RECOMMENDATION	ACTION ITEM	RESPONSIBLE PARTY	SCHEDULE	DATE COMPLETED
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				

Reviewed by: ______________________________ ________________________

Operations or Project Manager Date

Please return completed form to ESS or ESC within 60 days.

Copies to: EHS Services Manager / Director, EHS Services

EHS 3-13: Motorized Vehicles and Equipment

Purpose

Version Date:	**07/28/98** - New	**Approved by:**	Donald Rogers
Original Issue Date:	**07/28/98**		
Category:	Company Procedures	**Sections:**	ESQ - Environmental Health & Safety Programs
Sub Category:	Departmental/Discipline	**Document Type:**	Procedure
Keyword Index:		**Document Owner:**	Philip Bartley

Table of Contents

See Construction Procedure CP-7 "Construction Tools and Equipment".

Follow safe work practices included in the TtEC Project Rules Handbook, Sections 2.7 through 2.12.

EHS 3-3: EHS Inspections

Last Revision By: **Linda LaMonico** on **11/15/2010**
Created By: **Nicole Bush** on **11/09/2010**

Purpose: The purpose of this procedure is to establish a process for periodic inspections of project sites, offices and warehouses.

Status:	Complete		Donald Rogers
Version Date - Type:	11/09/2010 - Revised	**Original Issue Date:**	02/01/95
Category:	Company Procedures	**Sections:**	ESQ - Environmental Health & Safety Programs
Sub-Category:	Departmental/Discipline	**Document Type:**	Procedure
Keyword Index:	EHS Compliance/Waste Management, Field Activities/Environmental H&S, Training, Monitoring, Nonconformance and Corrective and Preventive Action	**Document Owner**	Grey Coppi

Table of Contents:

See Below

1.0 PURPOSE

The purpose of this procedure is to establish a process for periodic inspections of project sites, offices and warehouses.

2.0 SCOPE

This procedure applies to all Tetra Tech EC, Inc. (TtEC) ("the Company") project sites, offices, and warehouses, including subcontractor activities.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 Project Manager

The Project Manager (PM) is responsible for:

a. Planning and budgeting for inspections as part of the project planning process in accordance with Task Initiation Procedure, PO-2 and the Project's Risk Management Plan.

b. Ensuring that inspections are conducted in accordance with this procedure.

c. Reviewing Environmental Health and Safety (EHS) inspection reports with on-site management.

3.1.2 Site Manager

The Site Manager (SM) or PM is responsible for:

a. Participating in weekly EHS inspections as practicable.

b. Ensuring that action items are developed, documented, and implemented and tracked to closure.

3.1.3 Site Supervisors

Site Supervisors are responsible for:

a. Conducting weekly EHS inspections for their area(s) of responsibility.

b. Ensuring that weekly inspection action items are implemented and documented in the project files.

3.1.4 Operations Manager

The Operations Manager for each office and warehouse is responsible for ensuring that:

a. Inspections of the office and, if applicable, warehouse are conducted on a quarterly basis.

b. Action items are implemented and documented in a timely manner.

3.1.5 Director, EHS Services

The Director, EHS Services, is responsible for:

a. Reviewing and updating the inspection checklists as necessary.

b. Monitoring conformance with the Project Environmental and Safety Manager (PESM) inspection requirements.

c. Developing Lessons Learned Reports, Event Reports, or ZIP Bulletins for selected inspection findings

3.1.6 PESM

The PESM is responsible for:

a. Approving and documenting PESM inspection frequency.

b. Performing the PESM inspections and/or designating the appropriate technical specialist, as necessary, per the project schedule and budget.

c. Immediately communicating significant violations or potential violations to the Project Manager and the Director, EHS Services.

d. Preparing PESM inspection reports, issuing the report, and posting to the Company PESM inspection Database located on Lotus Notes within 10 days of the inspection.

e. Tracking closure of each PESM inspection.

f. Providing training in proper inspection techniques and as required to address action items.

g. Reviewing EHS inspection reports.

3.1.7 ESS

The ESS is responsible for:

a. Performing informal daily inspections of the worksite and documenting observations in the safety logbook.

b. Assisting the PM or SM with weekly inspections.

c. Reviewing the weekly and monthly inspection checklists for completeness, thoroughness, and trends. Trends of action items in weekly and monthly EHS inspection results should be reviewed for similar situations in other areas.

d. Providing the SM or PM and PESM with a status of action items each month.

3.1.8 Office Environmental and Safety Coordinator

The Office Environmental and Safety Coordinator (ESC) is responsible for:

a. Assisting with quarterly inspections of the office and, if applicable, the warehouse.

b. Training alternate office personnel on how to conduct office inspections.

3.2 Inspection Types

3.2.1 Weekly EHS Inspections

For projects encompassing 1-week duration or more of consecutive workdays, the Site Supervisor shall conduct a weekly inspection of his/her area(s) of responsibility at the project site. The inspection shall:

a. Include site conditions, employee and Subcontractor behaviors and work practices, pollution prevention and waste management practices, wastewater and other environmental conditions, or any other applicable requirements specified in the project EHS Plan(s).

b. Be documented in an inspection report identifying the date, time, site conditions/operations, activities observed, personnel conducting the inspection, findings, recommended action items, individual responsible for implementation of each action item, and schedule for implementation. Attachment B may be used to document the inspection.

3.2.2 PESM Inspections

PESM inspections are budgeted inspections of remediation, clean construction, and consulting and engineering (C&E) projects. The PESM will either perform the inspection and/or designate an appropriate technical specialist. The PESM shall utilize a hierarchal risk based approach to determine inspection frequency at remediation, C&E, and clean construction projects.

a. Specific checklist to be used for a given inspection will be determined by the PESM, based on the scope and risks of the project. The pertinent portions of each applicable checklist should be covered during at least one inspection annually.

b. For programs with multiple task orders, the PESM will identify the task orders which should be inspected. Inspection frequency will be risk based to include an assessment of project scope, complexity, staffing, potential environmental, health, and safety standards.

c. Inspections should occur soon after site mobilization and initiation of site activities.

Subsequent PESM inspections shall be based upon the results of previous inspections; greater risk = increased inspection frequency. The PESM shall coordinate the date and time of the inspection with the PM and the SM.

For C&E field projects the PESM shall evaluate the need for field inspections. The determination of whether an inspection(s) is required should consider the factors described in paragraph b. above

Inspection frequency should be identified in the project EHS Plan.

3.2.3 Communicating Significant Inspection Findings

The PESM shall ***immediately*** call the Director, EHS Services to report significant inspection findings including those that might require agency reporting. The Director, EHS Services, in conjunction with the legal department, will help the Project Manager and PESM determine if the finding requires agency reporting. If a determination is made that a finding must be reported, the client and agency will be notified in accordance with EHS 1-7, Event Reporting and Investigation.

3.2.4 PESM Inspection Reporting

The PESM shall post inspection reports, including checklists (Attachment C) and action items (Attachment E or equivalent), to the PESM Inspection Database within 10 days of the inspection.

All Action Items should be classified by the PESM as either Major or Minor, or recommendation . Major findings shall receive first priority schedule for addressing action items.

3.2.5 Inspection Closure

Action items should be addressed as described in the Action Item Report by the Project Manager and forward the completed Action Item Report to the PESM.

The PESM shall review the completed Action Item Report to ensure completeness and appropriate closure of all Action Items. The PESM shall post completed Action Item Reports to the PESM Inspection Database and close the inspection.

3.2.6 Office/Warehouse Inspections

The Operations Manager shall ensure that EHS inspections are conducted at least quarterly at each office and warehouse, except for fire extinguishers and first aid kits which shall be inspected monthly. Attachment F, or an equivalent, shall be used to conduct and document the inspection. The Operations Manager shall send a copy of the completed Inspection Checklist to the Director EHS Services.

The Operations Manager shall ensure implementation and documented closure of all action items using the Action Item Report (Attachment E) or equivalent. The Operations Manager shall send the completed Action Item Report to the Director, EHS Services, within 30 days of conducting the inspection.

3.3 Root Cause Analysis of Inspection Results

Inspection results should be analyzed for root causes. At least annually, the Director, EHS Services OR Director, Quality Programs, or his/her designee, shall review PESM inspection findings to identify trends.

This review should be documented and forwarded to the ESQ Program Directors, and to the Chief Executive Officer.

The ESQ Program Directors and the Chief Executive Officer will utilize the analysis to develop program and environmental objectives and targets, as appropriate.

3.4 Training

The Director, EHS Services, shall ensure that individuals responsible for conducting inspections understand the Company's program requirements; applicable federal, state and local laws and regulations; and proper inspection techniques.

3.5 Recordkeeping

Records of all inspections and closure of identified Action Items related to EHS inspections shall be documented and maintained by the office or project as follows:

a. Informal Inspections - Project Files
b. Weekly Inspections - Project Files
c. PESM Inspection Report - PESM Inspection Database
d. Completed PESM Inspections Action Item Report - PESM Inspection Database
e. Completed Office/Warehouse Inspections and Action Item Reports - Operations Manager

4.0 GUIDELINES

4.1 Definitions

4.1.1 Major Finding

A finding that indicates the real-time presence of a potential or imminent hazard, significant regulatory violation,or may result in imminent harm to people, property or the environment. Major findings are typically observed in the field at the time of inspection, and require immediate corrective action to reduce the risk of loss. Major findings must receive top priority for correction.

4.1.2 Minor Finding

An observed finding which by itself is not a direct hazard, or potential harm to human health or the environment. Minor findings are usually associated with documentation, programmatic deficiencies, recordkeeping, reporting, or management/organizational practices.

4.1.3 Examples of different types of findings:

Example #1: Findings associated with Stormwater Control Systems

a. **Major** - A significant breach in erosion control feature (e.g., missing or deteriorated hay bales).

b. **Minor** - Failure to maintain documentation of required periodic inspections of erosion control features.

Example #2: Compliance with OSHA Ladder Standards

a. **Major** - Defective extension ladder observed.

b. **Minor -** Failure to ensure all ladders are routinely inspected.

4.2 Informal Inspections

The ESS and all Company employees and Company subcontractor employees should be continuously aware of workplace and environmental conditions and the work practices of their fellow workers. If a substandard condition of work practice is identified, it shall be brought to the attention of the individual or supervisor, and corrected. Hazard Report and Suggestion Form (Attachment A) can be used to report substandard conditions or work practices. ZIP Slip (Attachment G) can be used to report exceptional practices or substandard conditions. ZIP Slips may be completed electronically using the Company Zip Slip Database. The Compliance Hot Line can also be utilized for anonymous reporting (See PP-18, Employee Reporting, Hotline and Non Retaliation).

4.3 PESM Inspection Process and Components

4.3.1 Project Documents Review

The inspector should review project documents (Contract, TIP, Work Plans, EHS Plan(s), any pertinent decision documents, subcontractor approvals, permits, etc.) before the inspection.

4.3.2 Inspection Checklist/Project-Specific Protocol

The PESM should utilize the appropriate PESM Inspection Checklists (Attachment C) to perform the site inspection. Only the portions of the checklist applicable to the project being inspected will be utilized. The PESM should modify the inspection checklist as necessary for major projects.

Detailed environmental compliance checklists are very useful for the first PESM inspection of a site to ensure nothing is overlooked. (This is especially helpful if you are not the Project Regulatory Compliance Specialist and are not familiar with site activities). For subsequent PESM inspections, the Project's Regulatory Compliance and Waste Management Plans (or relative sections of the EHS Plan or Work Plans) may be used as the basis for the inspection to ensure site is implementing the Plan/s.

4.3.3 On-Site Inspection Elements

The PESM Inspection shall include:

a. High risk activities (HIPO) and a visual inspection of the site. Areas of the project site that may be accessed and inspected include but are not limited to, exclusion zones, buildings, and waste storage areas.

b. Completion of applicable and selected portions of the PESM Inspection Checklists or equivalent documentation (Attachment C).

c. A review of on-site records (e.g., permits, agency approvals, waste analyses, waste profiles, waste manifests, discharge monitoring reports, training records, etc.).

d. Positive recognition of conformance.

e. Non-conformance noted by the PESM that can be remedied during the conduct of the inspection will be corrected. Conformance and non-conformance shall be documented on the PESM Inspection Checklists.

f. Training of project and subcontract personnel, when possible, to address non-conformances.

g. Identification of any observed positive practices.

The PESM will stop work if any conditions or work practices are identified which pose imminent danger to the environment or to the safety and health of personnel.

5.0 REFERENCES

Please Describe Your Reference Here	Place Your Link in this Column
1. Environmental Health & Safety Programs, Procedure EHS 1-7, Event Reporting and Investigation	
2. Personnel Practices Procedure PP-18, Employee Reporting, Hotline, and Non-Retaliation	
3. Project Initiation and Operations Procedure PO-2, Task Initiation (TIP)	
4.	
5.	
6.	

6.0 ATTACHMENTS

Please Provide a Description of the Attachment	Place Your Attachments Here
A. Hazard Report and Suggestion Form	ehs 1-7 Attachment B040301.doc
B. EHS Weekly Checklists and Action Item Report	EHS 3-3 Attachment B, 7-11-06.doc
C. PESM Inspection Checklist(s)	EHS3-3 Attachment C Air, 8-10-09.doc

	EHS 3-3, Attachment C, Asbestos, 6-28-06.doc EHS 3-3 Attachment C Conservation, 6-21-06.doc EHS 3-3 Attachment C Drinking, 6-21-06.doc EHS 3-3, Attachment C EHS Programs, 6-5-06.doc EHS3-3 Attachment C FieldConstruction,9-25-09.doc EHS3-3 Attachment C HazWaste, 7-6-09.doc EHS 3-3 Attachment C Lead, 6-30-09.doc EHS 3-3 Attachment C Oil and Haz Subst, 7-6-09.doc EHS 3-3 Attachment C PCB, 6-27-06.doc EHS 3-3 Attachment C Solid, 6-27-06.doc EHS3-3 Attachment C UST & AST, 7-9-09.doc EHS 3-3 Attachment C Wetlands, 8-1-09.doc EHS 3-3 Attachment C Wastewater, 6-30-09.doc EHS 3-3 Attachment C Hazwaste Perm, 6-29-06.doc EHS 3-3 Attachment C, Radioactive Mat DOE, 7-25-2005.doc EHS 3-3 Attachment C, Radioactive Mat NRC, 7-25-2005.doc EHS 3-3 Attachment C, Radioactive Mat, 7-2005.doc
E. Action Item Report	

	EHS 3-3 Attachment E.doc
F. EHS Office/Warehouse Inspection Checklist	EHS 3-3 Attachment Fgc122809.doc
G. ZIP Slip	

EHS 4-1: Bloodborne Pathogens (Previously HS4-1)

Purpose

The purpose of this program is to define the requirements for working with potential bloodborne pathogens and to provide a written Exposure Control Plan (ECP) to minimize or eliminate an employee's potential exposure to bloodborne pathogens. The ECP has been prepared to comply with the Occupational Safety and Health Administration (OSHA) regulation for Bloodborne Pathogens, 29 Code of Federal Regulations (CFR) 1910.1030.

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Original Issue Date:	**02/01/95**		
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6.0 REFERENCES

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1.0 PURPOSE

The purpose of this program is to define the requirements for working with potential bloodborne pathogens and to provide a written Exposure Control Plan (ECP) to minimize or eliminate an employee's potential exposure to bloodborne pathogens. The ECP has been prepared to comply with the Occupational Safety and Health Administration (OSHA) regulation for Bloodborne Pathogens, 29 Code of Federal Regulations (CFR) 1910.1030.

2.0 SCOPE

The program applies to all Tetra Tech EC, Inc. (TtEC) employees who may have occupational exposure to blood or other potentially infectious material.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with TtEC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director Compliance and Corporate Counsel.

4.0 DEFINITIONS

4.1 Blood

Human blood, human blood components, and products made from human blood.

4.2 Bloodborne Pathogens

Pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to the following:

- Hepatitis B Virus (HBV)
- Human immunodeficiency virus (HIV)

4.3 Contaminated

The presence, or the reasonably anticipated presence, of blood or other potentially infectious materials on an item or surface.

4.4 Contaminated Laundry

Laundry that has been soiled with blood or other potentially infectious materials, or may contain sharps.

4.5 Contaminated Sharps

Any contaminated object that can penetrate the skin including, but not limited to: needles, scalpels, broken glass, broken capillary tubes, and exposed ends of dental wires.

4.6 Decontamination

The use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal.

4.7 Engineering Controls

Controls that isolate or remove the bloodborne pathogens hazard from the workplace.

4.8 Exposure Incident

A specific eye, mouth, other mucous membrane, nonintact skin, or parenteral contact with blood or other potentially infectious materials that results from the performance of an employee's duties.

4.9 Handwashing Facilities

A facility providing an adequate supply of running potable water, soap and single use towels or hot air drying machines.

4.10 HBV

Hepatitis B Virus.

4.11 HIV

Human Immunodeficiency Virus.

4.12 Licensed Healthcare Professional

A person legally permitted to independently perform HBV vaccination and post exposure evaluation and follow-up.

4.13 Occupational Exposure

Reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties.

4.14 Other Potentially Infectious Materials

All human body fluids, tissue, organs, or HIV/HBV-containing cultures or solutions.

4.15 Parenteral

Piercing mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions.

4.16 Personal Protective Equipment

Specialized clothing worn by an employee for protection against a hazard.

4.17 Qualified Personnel

TtEC personnel currently certified in Basic First Aid, Cardiopulmonary Resuscitation (CPR), or similar certification assigned to conduct tasks involving potential exposure to bloodborne pathogens or other potentially infectious materials.

4.18 Regulated Waste

Liquid or semiliquid blood or other potentially infectious material; contaminated items that would release blood or other potentially infectious materials in a liquid or semiliquid state if compressed; items that are caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials.

4.19 Sharp

A sharp object contaminated with infectious material, (e.g., needles, broken glass) or anything that can pierce, puncture, or cut your skin.

4.20 Source Individual

Any living or dead individual whose blood or other potentially infectious materials may be a source of occupational exposure to the employee. This includes trauma victims.

4.21 Sterilize

The use of a physical or chemical procedure to destroy all microbial life, including highly resistant bacterial endospores.

4.22 Universal Precautions

An approach to infection control in which all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens.

4.23 Work Practice Controls

Controls that reduce the likelihood of exposure by altering the manner in which a task is performed.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Environmental, Health and Safety Personnel

The Environmental and Safety Supervisor (ESS) or Environmental and Safety Coordinator (ESC) shall assist local operations management with the implementation of this program including provision for employee information and training.

5.1.2 Medical Providers

The TtEC local medical provider (LMP) and Corporate Medical Consultant (CMC) shall provide for administration of the HBV vaccine and post-exposure follow-up provisions of this program.

5.2 General Requirements

The TtEC Bloodborne Pathogen Program consists of identifying job classifications or tasks where potential occupational exposure to bloodborne pathogens may exist, and ensuring that an adequate ECP is implemented. The following sections describe the overall ECP for TtEC business operations. This plan may need to be supplemented with additional information in the site-specific EHS plans if the site job classifications or tasks are not adequately addressed by the ECP. Additionally, the ECP shall be reviewed and updated annually and whenever necessary to reflect new or modified tasks and procedures.

The primary elements of the ECP are:

- Exposure Determination;
- Control Methods, including use of universal precautions, engineering and work practice controls, personal protective equipment, and proper housekeeping and labeling;
- Hepatitis B (HBV) Vaccination;
- Post-Exposure Follow-Up;
- Employee Information and Training; and
- Recordkeeping.

5.3 Exposure Determination

The TtEC job classifications and tasks which may result in occupational exposure are:

First Aid and CPR Qualified Individuals - Tasks for this job classification include administration of first aid to individuals where exposure to blood or other potentially infectious materials could result. Only TtEC personnel currently certified in first aid and CPR, regardless of job classification or duties, shall perform first aid or CPR.

Investigation/Remediation Personnel at Infectious Waste Sites - Tasks for this job classification include air, soil and water sampling, waste handling and removal operations, and other duties at a site where direct contact with infectious waste occurs.

Other Job Classifications - Tasks for this job classification would include all tasks performed where there is an anticipated or actual exposure to blood or other potentially infectious materials. If applicable, a specific exposure determination by job classification and task shall be completed and included in the site-specific EHS plans.

5.4 Universal Precautions

Universal precautions, whereby human blood and certain human bodily fluids are treated as if known to be infectious, shall be used to prevent direct physical contact. These precautions include the use of barriers, isolation, personal protective equipment (PPE), and first aid kits containing a mouth to mouth (artificial respiration) face shield when necessary. The most recent recommendations issued by the Center for Disease Control regarding universal precautions will be used as guidance.

5.4.1 Engineering and Work Practice Controls

Engineering and work practice controls shall be used to eliminate or minimize employee exposure. The policy of TtEC is to use these controls rather than PPE. PPE will be used only if engineering and work practice controls do not adequately control or eliminate occupational exposure.

Engineering controls used shall be examined on a monthly basis and maintained or replaced as necessary. Examples include the use of a sharps disposal container or specially marked bags for contaminated first aid materials.

Work practice controls, including handwashing, personal hygiene, and avoidance of sharps shall be implemented. The following work practice controls will be implemented as necessary at work sites where potential occupational exposure exists:

- Handwashing facilities shall be present on each job site. If provision of handwashing facilities is not feasible, then antiseptic handcleansers or toweletts must be used, followed by soap and running water as soon as possible.

- Employees shall wash hands immediately, or as soon as possible after removal of gloves or contact with blood or other potentially infectious materials.

- Eating, drinking, smoking, applying cosmetics, and handling contact lenses are prohibited in areas of potential exposure.

- Equipment that may have been contaminated with blood or other potentially infectious materials shall be examined and decontaminated, if feasible. If the equipment cannot be decontaminated it shall be labeled as a biohazard. Information regarding the biohazard shall be communicated to all handling, shipping, and service personnel.

5.4.2 Personal Protective Equipment

TtEC employees shall use, as directed, appropriate company-provided PPE. Appropriate PPE is that which does not permit blood or other potentially infectious materials to reach the employees clothes or body under normal conditions and duration of use.

PPE shall be provided, maintained, and properly disposed of at each work site where potential exposure exists. PPE shall be accessible at each work site and include hypo-allergenic gloves or other alternatives as necessary.

Potentially contaminated PPE shall be removed prior to exiting the work area. It shall be placed in a regulated container for disposal.

Appropriate gloves (e.g., latex and/or puncture resistant gloves) shall be worn when contact with blood or other potentially infectious materials is expected and when handling or touching contaminated items or surfaces.

Disposable gloves shall not be reused and shall be replaced if torn or punctured, or the ability to function as a barrier is compromised.

Surgical masks, in combination with eye protection (e.g., goggles or glasses with side shields) or face shield, shall be worn when splashes may result in eye, nose, or mouth contamination.

5.5 Housekeeping and Labeling

All equipment and environmental surfaces shall be cleaned and decontaminated after contact with blood or other potentially infectious materials.

Regulated waste shall be placed in containers that are closeable, constructed to prevent leaks, labeled with a biohazard label, and sealed prior to moving.

All contaminated laundry shall be disposed of as regulated waste or sent to a facility capable of handling infectious waste. Complete information regarding the nature of the waste and potential hazards shall be disclosed to the laundry facility.

All regulated waste containers shall be labeled with the “Biohazard” legend.

5.6 Hepatitis B Virus (HBV) Vaccination

All vaccinations shall be administered by the LMP or CMC using qualified personnel and procedures recommended by the U.S. Public Health Service.

The HBV vaccine and vaccination series shall be made available to all investigation/remediation workers at infectious waste sites, and other job classifications where contact with bloodborne pathogens or other infectious material is expected due to the routine nature of the job duties. The vaccination shall be made available after training and within 10 days of initial assignment to duties involving potential exposure unless the employee has already received the complete vaccination series, antibody testing demonstrates immunity, or medical reasons preclude it. This requirement will be specified in the site-specific EHS plan.

The HBV vaccine and vaccination series shall be made available to first aid and CPR qualified workers on a post-exposure basis only.

If declined, the HBV vaccine shall be made available as soon as possible, but in no event later than 24 hours following provision of first aid involving the presence of blood or other infectious materials regardless of whether an "exposure incident" has occurred. If an exposure incident has occurred, all required post exposure follow-up procedures shall be implemented. Additionally, any first aid incident must be reported to the ESS or ESC before the end of the work shift.

If any employee declines participation in the HBV vaccination series made available, they must acknowledge the declination on the TtEC Employee HBV Vaccine Declination Form (Attachment A). If an employee who has previously declined the vaccine, later requests the vaccine, the vaccine shall be provided at that time.

5.7 Post-Exposure Follow-Up

All TtEC employees included in the scope of this program are entitled to a confidential post-exposure evaluation and follow-up, following an "exposure incident." This includes prophylaxis, including a HBV vaccination within 24 hours of possible exposure.

All medical evaluations and procedures will be performed by or under the supervision of the LMP or CMC by a licensed health care professional in accordance with the recommendations of the U.S. Public Health Service. All laboratory tests shall be conducted by an accredited laboratory.

The post-exposure evaluation and follow-up shall consist of the following:

- Documentation of route of exposure and circumstances under which it occurred.
- Identification testing, and documentation of source individual if feasible and not prohibited by law. Testing of the source individual is not necessary if the individual is known to be infected with HBV/HIV. Results of source individual testing shall be made available to the exposed employee. The exposed employee will be informed of applicable disclosure laws.
- Collection and testing of blood. The exposed employee's blood will be collected as soon as possible after consent. If the employee consents to testing of blood, but does not give consent for HIV testing, the blood shall be held for 90 days. The employee may elect HIV testing during this time frame.
- Post exposure prophylaxis when necessary.

- Counseling.
- Evaluation of reported illness.

The LMP or CMC shall be provided with the following by the ESS or ESC:

- A copy of this program and the OSHA regulation, 29 CFR 1910.1030.
- Description of employee's duties related to the incidents.
- Documentation of route of exposure and circumstances under which the exposure occurred.
- Results of source individual testing, if available.
- All appropriate medical records, including vaccination status (The CMC maintains this information for TtEC).

The written opinion of the LMP or CMC shall be provided to the TtEC employee within 15 working days of the evaluation. The opinion shall be limited to the following:

- Whether the employee should or has received the HBV vaccination.
- That the employee has been informed of the results.
- That the employee has been told of any medical conditions resulting from exposure that require further treatment.

All TtEC employee medical records shall be kept in accordance with the TtEC Medical Surveillance Program, EHS 4-5.

5.8 Employee Information and Training

Training shall be provided initially and annually thereafter to employees covered by the scope of this program. This includes qualified first aid personnel and site investigation/remediation personnel working at infectious waste sites, who have the potential for occupational exposure. Training will include the following:

- An accessible copy of 29 CFR 1910.103 and an explanation of its contents;
- A general explanation of the epidemiology and symptoms of bloodborne diseases;
- An explanation of the modes of transmission of bloodborne pathogens;
- An explanation of the employer's exposure-control plan and the means by which the employee can obtain a copy of the written plan;
- An explanation of the appropriate methods for recognizing tasks and other activities that my involve exposure to blood and other potentially infectious materials;
- An explanation of the use and limitations of methods that will prevent or reduce exposure including appropriate engineering controls, work practices, and personal protective equipment;

- Information on the types, proper use, location, removal, handling, decontamination, and disposal of personal protective equipment;
- An explanation of the basis for selection of personal protective equipment;
- Information on the HBV vaccine, including information on its efficacy, safety, method of administration, and the benefits of being vaccinated, and that the vaccine and vaccination will be offered free of charge;
- Information on the appropriate actions to take and persons to contact in an emergency involving blood or other potentially infectious materials;
- An explanation of the procedure to follow if an exposure incident occurs, including the method of reporting the incident and the medical follow-up that will be made available;
- Information of the post-exposure evaluation and follow-up that the employer is required to provide for the employee following an exposure incident;
- An explanation of the signs and labels and/or color coding required by 29 CFR 1910.1030 (g)(1);
- An opportunity for interactive questions and answers with the person conducting the training session.

Note: Training may also be provided as site-specific training.

5.9 Recordkeeping

Medical records for affected employees shall include the following:

- Name, social security number, employee number;
- HBV vaccination status;
- Copies of all medical examinations, testing, and followups;
- Physician's written opinion; and
- Copy of information provided to the physician.

Medical records are kept confidential and are not disclosed to anyone without written consent of the employee. Records are maintained for duration of employment plus 30 years.

Training records shall include the following:

- Date of training session;
- Contents or summary of training session;
- Names and qualifications of trainees; and

Records shall be maintained for three years from the date of training in accordance with Recordkeeping EHS 1-9. Availability of all records is in accordance with standard TtEC policy.

6.0 REFERENCES

Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping

Environmental, Health & Safety - Programs Procedure EHS 4-5, Medical Surveillance
OSHA (U.S. Department of Labor, Occupational Safety and Health Administration) 29 CFR 1910.1030, Occupational Safety and Health Standards, General Industry.
United States Department of Labor, Office of Information USDL: 92-436, Mon., July 6, 1992.

7.0 ATTACHMENTS

Attachment A - Employee HBV Vaccine Employee Declination Form

EHS 4-1 ATTACHMENT A
EMPLOYEE HBV VACCINE EMPLOYEE DECLINATION FORM

Click the icon below to download and complete.

EHS 4-1 Attachment A.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 4-1 ATTACHMENT A

TETRA TECH EC, INC.

EMPLOYEE HBV VACCINE DECLINATION FORM

I understand that due to my occupational exposure to blood or other potentially infectious materials, I may be at risk of acquiring Hepatitis B virus infection. I have been given the opportunity to be vaccinated with Hepatitis B vaccine, at no charge to myself. However, I decline Hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring Hepatitis B, a serious disease. If in the future I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with Hepatitis B vaccine, I can receive the vaccination series at no charge to me.

Employee Name (Print): ______________________________

Employee Signature: ______________________________ Date: ____________________

Witness Name (Print): ______________________________

Witness Signature: ______________________________ Date: ____________________

EHS 4-2: Hazard Communication (Previously HS4-2)

Purpose

The purpose of this program is to ensure that employees understand the potential hazards of chemicals used in the workplace in accordance with the Hazard Communication Regulation (HAZCOM), 29 CFR 1910.1200.

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1.0 PURPOSE

The purpose of this program is to ensure that employees understand the potential hazards of chemicals used in the workplace in accordance with the Hazard Communication Regulation (HAZCOM), 29 CFR 1910.1200.

2.0 SCOPE

This program applies to all Tetra Tech EC, Inc. (TtEC) operations where employees have potential exposure to hazardous chemicals as a result of their normal job duties or a foreseeable emergency. This program does not apply to hazardous wastes. However, TtEC will provide employees with information on the potential hazards of wastes in accordance with 29 CFR 1910.120(e) and (i).

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with TtEC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director Compliance and Corporate Counsel.

4.0 DEFINITIONS

4.1 Chemical Manufacturer

A work place where chemical(s) are produced for use or distribution.

4.2 Exposed Worker

Any worker subjected to a hazardous chemical in the workplace through any route of entry (inhalation, ingestion, skin contact, absorption, etc.).

4.3 Foreseeable Emergency

Any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that could result in an uncontrolled release of a hazardous chemical into the workplace.

4.4 Hazardous Chemical

Any chemical that constitutes a physical or health hazard. Chemicals with a label containing the words CAUTION, WARNING, or DANGER indicate the chemical is hazardous. Consumer products are not considered hazardous where it can be demonstrated that the products are used in the workplace in the same manner as for normal consumer use.

4.5 Material Safety Data Sheet (MSDS)

Written or printed material describing characteristics, hazards, and controls associated with a specific chemical or combination of chemicals.

4.6 Work Area

A room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Environmental, Health and Safety Personnel

The Environmental Health and Safety Supervisor (ESS) or Office Environmental and Safety Coordinator (ESC) shall ensure that:

- A list(s) of hazardous chemicals is developed for each work site or office;
- A current MSDS is maintained on file;
- MSDSs are available to employees; and
- Employees understand how to read an MSDS, know the location of the MSDSs and understand the potential hazards of the chemicals with which they are working.

5.1.2 Procurement

Procurement personnel are responsible for ensuring that:

- An MSDS is received with all new shipments of hazardous chemicals;
- Contacting the supplier when an MSDS is not received; and
- A copy of the MSDS is forwarded to the ESS or ESC.

5.2 General Guidelines

The HAZCOM regulation sets requirements for information and training on hazardous chemicals used in the work place. Federal law requires that all states comply with hazard communication regulations, and many states and local governments have adopted their own “equally or more stringent” hazard communication standards. Therefore, applicable state and local requirements must be consulted when conducting projects in states that have their own standards. The following are guidelines for complying with federal requirements.

5.3 Labeling

The HAZCOM regulation requires that the employer ensure the following:

- Each container of hazardous chemicals in the work place is labeled, tagged, or marked with the following information:
  - Identity of the hazardous chemical(s);
  - Appropriate hazard warnings; and
  - Name and address of the chemical manufacturer, importer, or other responsible party.
- Existing labels on incoming containers of hazardous chemicals are not removed or defaced, unless the container is immediately marked with the required information.
- Labels or other forms of warning are legible, are in English, and are prominently displayed on the container, or readily available in the work area throughout each work shift.

5.3.1 Label Warning Systems

The types of common label warning systems are:

1. The National Fire Protection Association (NFPA) Standard defines five degrees of hazard in each of the following three categories: Emergency health hazard, fire hazard, and instability or reactivity hazard. NFPA warning labels are an acceptable means of labeling hazardous chemicals provided that employees are trained on the NFPA labeling system.

2. The Consumer Product Safety Commission requires precautionary labeling on every hazardous chemical intended for household use. Basic precautionary information and labeling terms have been identified by the Manufacturing Chemists Association including the following:

   - Toxic
   - Highly toxic
   - Flammable
   - Extremely flammable
   - Corrosive
   - Irritant
   - Poison

3. The Department of Transportation (DOT) requires shipping containers of hazardous chemicals to be labeled in accordance with the appropriate hazard class. DOT has established nine hazard classes:

- Explosives
- Gases
- Flammable liquids
- Flammable solids
- Oxidizers/ Organic peroxide
- Poisons/infectious substances
- Radioactive materials
- Corrosives
- Miscellaneous hazardous materials

All TtEC projects shall use the name of the hazardous chemical and the NFPA system for labeling portable and stationary containers that are not appropriately labeled. This includes containers that are for general use (e.g., gasoline cans) and containers that have materials transferred to them from original containers.

“Prop 65” rules in California require special warnings when personnel may be exposed to substances "Known to the State” to be carcinogens or reproductive hazards. If materials which are subject to “Prop 65” are used at a California site, review the warnings referenced below during the HAZCOM portion of site-specific training. In addition, the Site Environmental, Health and Safety (EHS) plans will identify contaminants of concern that fall under “Prop 65”.

- For exposure to a chemical known to the state to cause cancer:

  “WARNING: This product contains a chemical known to the State of California to cause cancer.”

- For exposure to a chemical known to the state to cause reproductive toxicity:

  “WARNING”: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.”

5.3.2 Personal Responsibilities

Personnel using or handling any chemical shall complete the following steps when handling chemicals:

1. Read the label on the container. If special instructions are provided, they will usually be part of the label;

2. Look for information concerning special precautions for personal protection;

3. Note appropriate first aid in case of an exposure;

4. Become familiar with the various types of labels and their warnings; and

5. Consult the MSDS for further warnings or requirements.

5.3.3 Specific Labeling Requirements

Hazardous substances that have specific labeling requirements under other standards include the following:

- Carcinogens
- Lead
- Asbestos
- Hydrogen, oxygen, and anhydrous ammonia
- Cotton dust
- Formaldehyde

5.4 Material Safety Data Sheets

5.4.1 General Information

The MSDS is used to relay chemical hazard information from the manufacturer/importer to the employer and employee. The HAZCOM regulation requires an MSDS for each hazardous material product an employee packages, handles, or transfers. The HAZCOM regulation does not require an MSDS sheet for hazardous wastes. Only those hazardous chemicals brought onto the job site by the contractor are required to have an MSDS sheet. However, the site-specific EHS plans will contain similar information on the known or potential site contaminants.

5.4.2 MSDS Contents

MSDSs that are received with incoming shipments of hazardous chemicals shall be maintained in an on-site file or office file by the ESS or ESC and shall be made available to all site or office employees. Each MSDS shall include the following information:

- Trade name of the chemical (if appropriate);
- Name, address, and telephone number for hazard and emergency information;
- Date of MSDS preparation;
- Chemical and common name of all ingredients;
- Occupational Safety and Health Administration (OSHA) permissible exposure limits, American Conference of Governmental Industrial Hygienists threshold limit values and other applicable limits;
- Physical and chemical characteristics;
- Physical hazards;

- Primary route(s) of entry into the body, such as inhalation, ingestion, or skin absorption;
- Acute and chronic health hazards, including signs and symptoms of exposure and medical conditions aggravated by exposure;
- Carcinogenic hazards;
- Emergency and first aid procedures;
- Precautions for safe handling and use; and
- Engineering/exposure control measures and personal protective equipment.

Attachment A provides an overview of the information contained in an MSDS.

Upon receipt of an MSDS (with a shipment of chemicals or otherwise) the following steps shall be performed:

1. The MSDS shall given to the ESS or ESC who inspects it for completeness. If incomplete, the MSDS is returned to the manufacturer with a request for a complete MSDS. Attachment B or an equivalent should be used to contact the supplier or manufacturer. After sending the letter the supplier or manufacturer should be contacted by phone.
2. If the MSDS is complete, the ESS or ESC places a copy of the complete MSDS into the site project or office file.
3. If a revised version of an MSDS is received, the old version of the MSDS is stapled to the revised MSDS and placed in the site project or office file.

If no MSDS is received with a shipment of chemicals Attachment B or an equivalent shall be used to request an MSDS from the supplier or the manufacturer. After sending the letter, the supplier or manufacturer should be contacted by telephone.

Copies of all correspondence, telephone contact and MSDSs shall be maintained in the project or office files.

MSDSs are a good source of information for those seeking quick hazardous material references. In the case of emergencies, however, not all of the pertinent information is provided and at times the information may be more damaging than helpful. Response to any emergency requires quick judgement calls. If there is any question of which first aid procedures to follow, it is best to call the emergency number provided on each MSDS specific to the material in question.

5.5 Non-Routine Activities

All TtEC employees and subcontractors must be informed of the hazards associated with chemicals involved in non-routine activities. For the purpose of this guideline, non-routine activities include, but are not limited to, line breaking/pipe opening, confined space entry, tank cleaning, and other maintenance of process equipment.

Hazards of non-routine tasks are addressed in site-specific EHS plans and Activity Hazard Analyses and are reviewed with the work crew during phase preparatory meetings or daily briefings.

5.6 Employee Information and Training

Employee information and training shall be provided as part of the employee's EHS training. This documentation includes the initial hazardous waste training certificate and site-specific or office training documentation.

The following are required elements of the information and training program:

- An overview of HAZCOM;
- A review of any operations in their work areas that involve hazardous materials;
- The location and availability of the written Hazard Communication Program, including the list(s) of hazardous chemicals and MSDSs;
- Methods and observations that may be used for detecting the presence or release of hazardous chemicals;
- An understanding of the physical and health hazards of hazardous chemicals in the work area;
- How to understand the information in MSDSs;
- How to read the warnings on container labels including the NFPA system;
- When and how to report leaks and spills;
- How to recognize the symptoms of overexposure and how to protect against it; and
- How to implement exposure control methods including work practices, engineering controls, administrative controls, personal protective equipment, and emergency procedures.

Hazard communication training is provided during initial training, site-specific and office orientation, supervisor training, and 8-hour refresher training as specified in EHS 1-11, Training. Attachment C or an equivalent may be used to document training and ensure training is in compliance with the Hazcom regulations.

In the event that a new chemical hazard or new task is introduced in the workplace, the ESS or ESC shall conduct additional training that includes the following:

- Objectives of the task, if applicable;
- Physical and health hazards associated with the new chemical hazard or task;
- Methods to detect the presence or release of the hazardous chemicals;
- Procedures and practices recommended to protect themselves from the hazards;
- Emergency procedures in the event of a hazardous situation or exposure; and
- Location and availability of the written program, lists of chemicals, and MSDS.

Documentation is maintained for each employee trained in hazard communication in accordance with EHS, 1-9, Recordkeeping.

5.7 Subcontractors

Subcontractors working for TtEC shall be required to meet the EHS requirements outlined in their contracts. To help meet these requirements, subcontractors are informed of TtEC procedures by the ESS and instructed on where to find information on hazardous chemicals being used on the project.

6.0 REFERENCES

29 CFR 1910.1200, Hazard Communication.
49 CFR 100-181, Hazardous Materials Transportation.
Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping
Environmental, Health & Safety - Programs Procedure EHS 1-11, Training
OSHA (U.S. Department of Labor, Occupational Safety and Health Administration)
U.S. Department of Transportation (DOT)

7.0 ATTACHMENTS

Attachment A - MSDS Overview
Attachment B - MSDS Letter to Supplier or Manufacturer
Attachment C - Hazard Communication Checklist

EHS 4-2 ATTACHMENT A

MSDS OVERVIEW

Click the icon below to launch or download.

EHS 4-2 Attachment A.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 4-2 ATTACHMENT B

MSDS LETTER TO SUPPLIER OR MANUFACTURER

Click the icon below to launch or download.

EHS 4-2 Attachment B.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 4-2 ATTACHMENT C

HAZARD COMMUNICATION CHECKLIST

Click the icon below to launch or download.

EHS 4-2 Attachment C.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 4-2 ATTACHMENT A

TETRA TECH EC, INC.
MATERIAL SAFETY DATA SHEET OVERVIEW

The following is provided to aid in the understanding of a typical Material Safety Data Sheet (MSDS). The actual format of the MSDS may vary.

Section I gives the identity of the chemical as it is on the label. Included is the name and address of the company that makes or imports the chemical, the emergency phone numbers to call for emergency or additional information, and the date the MSDS was prepared.

Section II shows where you will find the hazardous component, chemical identification, and common names. Worker exposure limits to the Occupational Safety and Health Administration permissible exposure limits and American Conference of Governmental Industrial Hygienists threshold limit values and other recommended safe exposure limits are included. Even if the chemical makeup is a trade secret the safety precautions are still given.

Section III describes the physical and chemical characteristics of the hazardous chemical, which can be complicated. If there is uncertainty, a supervisor or a glossary of common terms should be consulted for a better understanding of how the items could effect you in different work situations.

- The boiling point and melting point is where a liquid at a certain temperature will change from liquid to breathable gas.
- Vapor pressure, vapor density, and evaporation rate are especially important for toxic gases and vapors.
- Solubility in water and specific gravity tells you if a chemical will dissolve in water, sink or float.

Section IV helps judge the risk of fires and explosions. The flash point refers to the minimum temperature needed to initiate explosive conditions. Flammability limits indicate the concentration of the substance in the form of a gas or vapor that is needed for the gas or vapor ignite. It also gives instructions as to what to use (e.g., water, C02 foam) to put out a fire and any special hazards associated with the fire fighting procedures.

Section V reveals the reactivity of the chemical, i.e., under what conditions it is stable or not stable. The data indicate how possible reactions may be reduced and describes spill prevention and storage precautions.

Section VI describes the chemical's primary route(s) of entry into the body (e.g., inhalation, ingestion) and presents exposure symptoms (e.g., headaches, nausea, dizziness and rashes). Some effects occur right after exposure (e.g., a skin bum), while others have long-term or chronic effects (e.g., cancer). It also tells of existing conditions such as asthma that can be made worse by exposure to the chemical. Lastly, first aid procedures are offered should you be exposed and become ill or injured.

Section VII provides precautions for a safe handling and use of the chemical, explaining what to do if there is a spill, leak, or any accidental release, the waste disposal methods to be taken, and any precautions in the handling and storage of the chemical.

Section VIII describes the protective clothing and equipment (e.g., respiratory, gloves, eye protection) that should be used with the chemical as well as the appropriate work/hygienic practices.

Many of the terms used in MSDSs can be abbreviated and are technical in nature. A glossary of common terms used in MSDSs can be used as an aid in comprehension.

EHS 4-2 ATTACHMENT B
MSDS LETTER TO SUPPLIER OR MANUFACTURER

TETRA TECH EC, INC.

Date

Manufacturer Name
Street Number
City, State Zip Code

Dear Sirs:

We recently received a shipment of chemicals from your firm that was deficient in the following:

____ No Material Safety Data Sheet (MSDS) was present for the chemicals received.

____ The MSDS received did not contain adequate information as follows.

Listed below are the products requiring the above information. Pursuant to 29 CFR 1910.1200, I respectfully request that the appropriate MSDS for these items be sent to the above address, marked to my attention. Your cooperation is greatly appreciated.

Sincerely,

TETRA TECH EC, INC.

ESS or ESC
Title

EHS 4-2 ATTACHMENT C

TETRA TECH EC, INC.
HAZARD COMMUNICATION CHECKLIST

Project/Office Name: ____

Location: ________________________________ Date: ________________________________

Form Completed By: ____

____ 1. Have we prepared a list of all the hazardous chemicals in our workplace?

____ 2. Are we prepared to update our hazardous chemical list?

____ 3. Have we obtained or developed a material safety data sheet (MSDS) for each hazardous chemical we use?

____ 4. Have we developed a system to ensure that all incoming hazardous chemicals are checked for proper labels and MSDS?

____ 5. Do we have procedures to ensure proper labeling or warning signs for containers that hold hazardous chemicals?

____ 6. Are our employees aware of specific information and training requirements of the Hazard Communication Standard?

____ 7. Are our employees familiar with the different types of chemicals and the hazards associated with them?

____ 8. Have our employees been informed of the hazards associated with performing nonroutine tasks?

____ 9. Do our employees understand how to detect the presence or release of hazardous chemicals in the workplace?

____ 10. Are employees trained about proper work practices and personal protective equipment in relation to the hazardous chemicals in their work areas?

____ 11. Does our training program provide information on appropriate first aid, emergency procedures, and the likely symptoms of overexposure?

____ 12. Does our training program explain the types of labels and warnings used in each work area?

____ 13. Does the training describe where to obtain data sheets and how employees may use them?

____ 14. Have we worked out a system to ensure that new employees are trained before beginning work?

____ 15. Have we developed a system to identify new hazardous chemicals before they are introduced into a work area?

____ 16. Do we have a system for informing employees when we learn of new hazards associated with a chemical we use?

EHS 4-4: Hearing Conservation

Last Revision By: **Linda LaMonico** on **11/20/2009**
Created By: **Lisa Kaminski** on **11/16/2009**

Purpose: The purpose of this procedure is to establish the Tetra Tech EC, Inc. (TtEC) Hearing Conservation Program to prevent hearing loss from on-the-job noise exposure and to comply with the requirements of Occupational Safety and Health Administration (OSHA) 29 CFR 1910.95 and 29 CFR 1926.52 regulations for occupational noise exposure.

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1.0 PURPOSE

The purpose of this procedure is to establish the Tetra Tech EC, Inc. (TtEC) Hearing Conservation Program to prevent hearing loss from on-the-job noise exposure and to comply with the requirements of Occupational Safety and Health Administration (OSHA) 29 CFR 1910.95 and 29 CFR 1926.52 regulations for occupational noise exposure.

2.0 SCOPE

This procedure applies to all TtEC field or construction operations.

3.0 MINIMUM REQUIREMENTS

3.1 Definitions

Audiogram - A chart, table or graph resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

dB (A) (A-Weighted Sound Level Scale) - A quantity, in decibels, read from a standard sound level meter that is switched to the weighting network labeled "A." The A-weighted sound level measures the approximate relative "noisiness" of a given environment.

Decibel - The unit in which the levels of various acoustical quantities are expressed. Typical quantities so expressed are sound pressure level, noise level.

Exchange Rate - (also known as dose-trading relation, or doubling rate). When sound levels increase, the allowed exposure time must be decreased. The exchange rate is the amount by which the permitted sound level may increase if the exposure time is halved. OSHA uses a 5 db (A) exchange (or doubling) rate, NIOSH and ACGIH use a 3 db (A) exchange rate.

Hearing Loss - At a specified frequency, an amount, in decibels, by which the individual's hearing acuity is less than the selected norm.

Noise Reduction Rating (NRR) - A rating given to a hearing protector to assess the noise attenuation capability.

Permissible Exposure Level - PEL - refers to the sound pressure levels and exposure duration established by the USDOL-OSHA under 1910.95 and 1926.52 to which workers may be exposed.

Standard Threshold Shift - A change in the hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2,000, 3,000, and 4,000 Hertz (Hz), in either ear. A Confirmed Shift caused by noise exposure is considered to be an OSHA recordable.

Threshold Limit Values - TLV refer to the sound pressure levels and durations of exposure that represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect on their ability to hear and understand normal speech.

3.2 Responsibilities

3.2.1 Line Management

Site Supervisors are responsible for:

- Ensuring that hearing protection is both worn and worn in the proper manner when required.
- Including consideration of noise operation and operator protection when obtaining construction heavy equipment and other tools.

3.2.2 Project Environmental Safety Manager (PESM)

The PESM is responsible for:

- Proving technical support and oversight to the Health and Safety Officer/Environmental Safety Supervisor (HSO/ESS).
- Ensuring that the HSO/ESS has adequate training and experience to perform noise monitoring and hearing conservation duties.
- Ensuring that confirmed Standard Threshold Shifts (STS) are recorded on the OSHA 300 log.

3.2.3 HSO/ESS

- Verifying that site employees are trained and have audiometric examinations prior to the start of work;
- Providing hearing protection to workers and ensuring proper fitting of hearing protection devices;
- Posting high noise warning and hearing protection signs in affected areas;
- Conducting exposure monitoring of high noise areas;
- Providing information to workers on the hearing conservative program;
- Monitoring personnel or representative individuals to determine noise exposures, when activity or equipment changes occur;
- Maintaining site hearing conservation program records;
- Overseeing the requirements of the hearing conservation program at the site;
- Informing the PESM and affected workers of any overexposures identified during monitoring;
- Evaluating and Selecting Hearing Protection equipment, assuring an appropriate selection is available to workers;
- Initiating an Event Report in accordance with EHS 1-7 when a STS of greater than 10 dB (A) in either ear has been reported by the Corporate Medical Consultant (CMC);

- Notifying affected employees and the PESM of a STS upon notification by the CMC.

3.2.4 Medical Personnel

The Corporate Medical Consultant (CMC) is responsible for:

- Determining if a STS has occurred when reviewing the audiometric examination results;
- Providing Director, Health and Safety with an annual summary of STSs which occurred to TtEC employees;
- Conducting audiometric testing, reviewing results, maintaining quality control over contractor audiometric test booth performance in accordance with 1910.95 and maintaining records of audiometric tests; and
- Notifying the HSO/ESS if an STS is observed.

4.0 PROCEDURES

4.1 Applicable Regulations

Unless noted otherwise, this procedure implements the OSHA 29 CFR 1910.95 and 1926.52 requirements.

4.2 Hearing Conservation Program

TtEC will maintain a Hearing Conservation Program for employees who are exposed to noise levels in excess of the action level (85 dB (A). Engineering and/or administrative methods to maintain worker exposure below the action level will be used whenever feasible. Whenever these control methods are not feasible, employees are included in the Hearing Conservation Program which includes noise exposure monitoring, audiometric testing, use of hearing protective devices, and employee training and access to information and recordkeeping.

4.3 Action Level

The action level is a noise exposure level equal to or greater than an 8-hour time weighted average (TWA) of 85 dB (A) slow response, 5 dB (A) exchange rate, or a dose equivalent of 50% as measured by a noise dosimeter without regard to any attenuation provided by the use of personal protective equipment.

4.4 Hearing Protection

Hearing protection will be required when employee exposure exceeds the action level or while using equipment resulting in a noise exposure in excess of 90 dB (A), or when working in areas where warning signs indicate that the use of hearing protection is required. Workers must always use hearing protection when noise levels exceed 115 dB (A).

Whenever hearing protection is required workers will be offered a choice between one or two types of ear plugs and one type of ear muffs. All hearing protectors used must meet the noise attenuation requirements for the exposure.

The adequacy of hearing protection used will be evaluated by the ESS or designee.

4.5 Exposure Monitoring

Noise exposure monitoring shall be conducted when information indicates that an employee's exposure may be equal to or greater than the action level.

Monitoring shall be conducted in accordance with the TtEC EHS Field Procedures Guides HSG1-5, Noise Monitoring, including the following components:

- The identity of all workers that may be exposed to noise at or above the action level.
- Area monitoring or representative personal monitoring. Personal Monitoring (noise dosimetry) will be used when area monitoring is not feasible due to worker mobility sound levels varying over time, or significant impulse noise exists.
- All continuous, intermittent, and impulsive sound levels between 80 and 130 dB(A) will be integrated into noise measurement.
- The use of properly calibrated instruments.
- Repeat monitoring whenever workplace changes occur that may result in increased personnel exposure or render protective equipment inadequate.
- Employee notification if they are exposed at or above the action level.
- The opportunity for affected workers to observe exposure monitoring measurements.

4.6 Audiometric Testing

Audiometric testing will be provided to workers included in the Hearing Conservation Program. All such identified employees will undergo baseline and annual audiometric testing.

For the baseline audiometric testing, workers must be preceded by 14 hours without exposure to workplace noise (hearing protection may be used for a substitute for the 14 hour period). Workers will avoid high levels of non-occupational noise during the 14 hour period immediately preceding the audiometric examination.

<u>General Requirements</u>

Audiometric tests will be performed using qualified personnel meeting the requirements of 29 CFR 1910.95 (g) and (h).

Audiometric testing equipment will be operated and meet the requirements of 29 CFR 1910.95, Appendix C, *Audiometric Testing Instruments,* Appendix D, *Audiometric Test Rooms* , and Appendix E, *Acoustic Calibration of Audiometers* .

Baseline Audiogram. A baseline audiogram will be established for employees exposed above the action level within six months of exposure. The baseline audiogram forms the basis for comparison to subsequent audiograms.

Annual Audiogram. An audiogram will be repeated at least annually for affected employees. Results are compared to the baseline audiogram by the CMC to determine validity and any shifts in employee hearing acuity.

Procedure for Standard Threshold Shift. If an STS is observed, the affected employee will be retested within 30 days and the results reviewed by an audiologist, otolaryngologist, or qualified practitioner to determine if further evaluation is needed.

If an STS has occurred, the following actions will be taken:

1. The HSO/ESS informs the employee in writing of the condition within 21 days of receipt of results, informs the PESM, who ensures that the case is recorded on the OSHA 300 log as a recordable illness. A copy of the physician's report is furnished to the employee.

2. The individual is trained in the use and care of one or more hearing protective devices, is fitted for one or more devices, and is required by the ESS to wear the device(s) when on the job. If the employee already wears protective devices, retraining and refitting will be provided, and if necessary a more efficient device or devices will be supplied.

3. Additional testing may be advised if a medical pathology of the ear occurs, particularly if wearing hearing protection is suspected of causing the condition.

4. An annual audiogram will be substituted for the baseline audiogram when a threshold shift is persistent or there is significant hearing improvement.

4.7 Employee Training

Employees included in the Hearing Conservation Program shall receive hearing conservation training initially and at least annually. Training will consist of the following:

- Effects of noise on hearing;
- Purpose of hearing protectors;
- Advantages and disadvantages of various types of hearing protection;
- Instructions for selecting, fitting, using, and caring for hearing protection devices;
- Purpose of audiometric testing; and
- Explanation of audiometric test procedures;
- Results of recent area noise surveys

4.8 Noise Reduction

Engineering controls must be applied whenever possible to reduce or eliminate noise for the workplace. Engineering controls include the use of silencers, mufflers, sound barriers, dampers, isolators. Administrative controls include moving worker activities away from high noise sources and limiting the time in a high noise area (worker rotation).

4.9 Hearing Protection

Hearing Protection will be used when noise levels or a reduction in exposure time are not feasible.

4.10 Warning Signs

Warning signs indicating the presence of a high noise area and the requirement to wear hearing protection will be visibly posted and enforced at the work location whenever ambient noise level exceeds 85 dB (A).

4.11 Recordkeeping

Audiometric Testing Records. An accurate record of all audiometric testing in accordance with the 29 CFR 1910.95(m) is maintained by the CMC in the employee's medical record.

Exposure Records. Records of noise exposure monitoring are maintained in the project EHS records in accordance with EHS 1-9, Recordkeeping for a minimum of two
years. The CMC will maintain the individual records for the 30 years required by OSHA.

Training Records. Hearing Conservation Program training records are maintained in the project EHS records by the ESS and in the employee EHS records by the Director, Health and Safety. Records will be maintained in accordance with EHS 1-9, Recordkeeping.

4.12 Government Contracts

Most government contracts have more stringent requirements as follows:

- United States Army Corps of Engineers (USACE) - Military related contracts must implement EM 385 1-1 Section 0.5C, which generally implements American Conference of Governmental Industrial Hygienist (ACGIH) controls.
- United States Department of Energy - The USDOE sites are directly subject to ACGIH control levels.

5.0 GUIDANCE

5.1 Background

Occupational Noise Exposure for construction is addressed in 29 CFR 1926.52 and General Industry is addressed in 29 CFR 1910.95. OSHA has maintained that Construction is covered by the less detailed 1926 standards; however, interpretations provided over the years on 1926 have referred back to the 1910 standards, such as for Hearing Conservation Programs.

The major differences between the OSHA standards, and the standards required for government contracts are the thresholds at which certain actions occur. The OSHA generally uses higher thresholds, including a 5 dB doubling rate. Government contracts use a 3 dB doubling rate. A comparison of the two systems is provided in Tables 1, 2 and 3. Table 3 also provides National Institute of Occupational Safety and Health (NIOSH) guidance.

Several states have also adopted some or all of the ACGIH recommendations. States have also imposed additional requirements, such as quarterly hearing protection audits that may be applicable.

Users should be aware of the standard(s) that are applicable to their project, and consult with their PESM to ensure that appropriate requirements are addressed.

5.2 Hearing Protection Noise Reduction Determinations

Noise Reduction Rating (NRR) factors should be adjusted for field use. The NRR are determined in a laboratory, and typically, 7 dB (A) is subtracted to adjust to field use, and the remainder subtracted to determine the estimated exposure under the hearing protection (Example: An area has a measured noise level of 90 dB (A). An earplug indicates a NRR of 22. Subtract 7 dB to correct for field use. The remainder (15 dB) is the reduction that can be applied, resulting in a exposure of 75 dB (A). The highest NRR on earplugs is about 33.

If earplugs or earmuffs alone do not provide adequate protection, they may be used together as dual hearing protection. If dual protection is used, use the highest NRR of the two devices, subtract 7 dB (A) from that NRR, add 5 dB (A) to the resultant NRR and subtract this from the A-weighted TWA to determine the protected TWA (Example - an area has a noise level of 98 dB (A). Earplugs with a NRR of 32 are planned, with earmuffs having a NRR of 15. Subtracting 7 from 32 dB equals 25, plus 5 dB from the additional protection of the earmuffs equals a TWA reduction of 30 dB, reducing the TWA noise level to 68 dB).

Calculated values reflect realistic values only to the extent that the protectors are properly fitted and worn. NIOSH has proposed NRR reductions of hearing protectors (25% for muffs, 50% for formable earplugs, and 70% for other ear plugs). Consult with the PESM for the appropriate NRR adjustments.

Devices that do not have a NRR will not be allowed for use as hearing protection (e.g., AM/FM earmuffs, white noise muffs, entertainment type earbuds, earphones, and similar.

5.3 Additional Information

29 CFR 1910.95, Occupational Noise Exposure (General Industry) requires a copy of the OSHA standard will be provided to affected employees upon request and posted at locations where the action level for noise is exceeded.

Noise reduction efforts - For heavy equipment, projects should consider "buy quiet" programs when purchasing or renting equipment. Selecting equipment that operates quieter, or has an operator cab meeting newer ANSI standards will often eliminate the need to wear hearing protection and increase worker productivity.

Noise measurements in the area or under typical work conditions should be conducted to determine the noise levels, and durations. Worker Exposures above the TWA or action level indicate that hearing protection is required. Hearing protection should be selected and matched to the conditions. Using low protection will result in worker exposure over the TWA and eventual hearing loss. Using too high a protection will result in workers not being able to hear warnings, radio communications, etc. without removing the protection and exposing themselves unprotected to the ambient noise.

6.0 REFERENCES

Please Describe Your Reference Here	Place Your Link in this Column
1. 29 CFR 1910.95, Occupational Noise Exposure and Appendices	http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9735
2. 29 CFR 1926.52, Occupational Noise Exposure	http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10625
3. 29 CFR.1926.101, Hearing Protection	http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10625
4. 2009 TLV and BEIs (American Conference of Governmental Industrial Hygienists	To Order: www.acgih.org/
5. EHS 1-9, Recordkeeping	
6. HSG1-5, Noise Monitoring	
7. EHS 1-7, Event Reporting and Investigation	
8. U.S. Army Corps of Engineers Safety & Health Requirements Manual (EM-385-1.1, September 2008, Section 0.5C	http://www.usace.army.mil/publications/eng-manuals/em385-1-1/c-5.pdf
9. National Institute for Occupational Safety and Health (NIOSH)	http://www.cdc.gov/NIOSH

7.0 TABLES

Table 1 - Noise Exposure Limits When TWA Level = 90 dB (A)

3 dB (A) Exchange Rate Allowable Level dB (A)	Maximum Permitted Daily Duration (hours)	5 dB (A) Exchange Rate Allowable Level dB (A)
90	8	90
93	4	95
96	2	100
99	1	105
102	0.5	110
105	0.25	115

Table 2 - Noise Exposure Limits When TWA Level = 85 dB (A)

3 dB (A) Exchange Rate Allowable Level dB (A)	Maximum Permitted Daily Duration (hours)	5 dB (A) Exchange Rate Allowable Level dB (A)
85	8	85
88	4	90
91	2	95
94	1	100

97	0.5	105
100	0.25	110

Table 3 - Summary Comparison of Requirements and Recommendations

Agency	**ACGIH**	**NIOSH**	**OSHA**	**USDOE and USACE**
Requirement or Recommendation	Recommendation	Recommendation	Requirement	Requirement
Exchange Rate	3	3	5	3
Threshold	85 for 8 hours; the allowable TLVs for noise range from 80 dB for a 24 hour period to 139 dB for 0.11 seconds	85 for 8 hours; an 8 hour Time Weighted Average (TWA) of 85 dB	90 for 8 hours; the allowable PELs for noise range from 8 hours at 90 dB* to 115 dB for 0.25 hours	85 for 8 hours; the allowable TLVs for noise range from 80 dB for a 24 hour period to 139 dB for 0.11 seconds
Impulse/Impact noise	140 dB	N/A	140 dB peak	140 dB
Action Level to Trigger Hearing Conservation Program	85dB	85dB	85dB	85dB
Attenuation	Hearing protection must be able to attenuate the exposure to a TWA of 85 dB	Hearing protection must be able to attenuate the exposure to a TWA of 85 dB	Hearing protection must be able to attenuate the exposure to a TWA of 90 dB or to 85 dB for those with a standard threshold shift/not had a baseline evaluation	Hearing protection must be able to attenuate the exposure to a TWA of 85 dB
Sound level for mandatory use of hearing protection	90dB	85dB	90dB	90dB
Voluntary use of hearing protection	N/A	N/A	85 dB	N/A

***All dB weightings are A scale unless otherwise noted.**

EHS 4-5: Medical Screening and Surveillance

Last Revision By: **Linda LaMonico** on **12/01/2008**
Created By: **Lisa Kaminski** on **11/13/2008**

Purpose: The purpose of this program is to ensure that the Tetra Tech EC, Inc. (TtEC) medical screening and surveillance program addresses the needs of TtEC personnel, employee medical records are up-to-date and properly maintained, and that the TtEC medical surveillance program meets the requirements of applicable regulations.

Status:	Complete		Donald Rogers
Version Date - Type:	10/10/2008 - New	**Original Issue Date:**	02/01/95
Category:	Company Procedures	**Sections:**	ESQ - Environmental Health & Safety Programs
Sub-Category:	Departmental/Discipline	**Document Type:**	Procedure
Keyword Index:	Monitoring, Operational Control, Training	**Document Owner**	Philip Bartley

Table of Contents:

1.0 PURPOSE

2.0 SCOPE

3.0 MINIMUM REQUIREMENTS

4.0 GUIDANCE

5.0 REFERENCES

6.0 ATTACHMENTS

1.0 PURPOSE

The purpose of this program is to ensure that the Tetra Tech EC, Inc. (TtEC) medical screening and surveillance program addresses the needs of TtEC personnel, employee medical records are up-to-date and properly maintained, and that the TtEC medical surveillance program meets the requirements of applicable regulations.

2.0 SCOPE

This program applies to medical examinations and biological monitoring provided to TtEC personnel included in the TtEC medical screening and surveillance program. It is assumed all medical exams/tests necessary for a given project/site have been identified by a Project Environmental and Safety Manager (PESM).

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 Director, Environmental, Safety & Quality (ESQ)

The Director, Environmental, Safety and Quality (ESQ) Services is responsible for updating this procedure.

The Director, ESQ shall periodically review the quality assurance and quality control program of the Corporate Medical Consultant (CMC). The Director, ESQ will also review and consider feedback from project or office managers, Environmental, Health and Safety (EHS) personnel, contracts personnel, Local Medical Providers (LMPs), and others when conducting reviews of the CMC.

3.1.2 Environmental, Health and Safety Personnel

The PESM assists in implementation of the program at TtEC offices and projects. The PESM assists the Environmental and Safety Supervisor (ESS) in defining additional medical surveillance parameters or biological monitoring for projects.

The ESS is responsible for ensuring that personnel working on a project have the required medical surveillance examinations and have current documentation of a qualified physician's opinion approving the worker for hazardous waste site work, asbestos work, and respirator qualification, as necessary.

3.1.3 Corporate Medical Consultant (CMC)

The CMC will be Board Certified in Occupational Medicine and will:

- Provide consultation to Director, ESQ regarding all aspects of the TtEC medical surveillance program;
- Manage the day-to-day operation of the program;
- Quality Local Medical Providers (LMPs);
- Review the work of the LMPs and perform selected clinic audits;
- Provide input to project specific medical surveillance parameters, as requested;
- Provide periodic status reports of the TtEC Medical Surveillance program to the Director, ESQ;
- Review and approve the fitness for duty for each TtEC employee as requested;
- Maintain all employee medical and exposure records;
- Notify the TtEC Director, ESQ of all requests for medical information;
- Develop, maintain and implement a quality assurance/quality control program.

3.2 Information Provided To The CMC

The Director, ESQ ensures that the CMC receives the following information required by the Occupational Safety and Health Administration (OSHA):

- Copies of OSHA 29 CFR 1910.120 and other applicable regulations;
- Copies of applicable EHS plans for the hazardous waste sites or other work locations, as requested;
- A copy of TtEC's medical surveillance program protocols and procedures; and
- Copies of personal exposure monitoring data or appropriate employee exposure data;

- Access to the job site if requested

The PESM shall ensure that the CMC receives project-specific medical surveillance requirements in advance of examination scheduling.

3.3 Scheduling of Initial Medical Surveillance Examinations

Exams are scheduled for those working on projects requiring medical clearance or initial testing per CFR 1910.120, contract or ES&H Plan. EHS personnel and Human Resources (HR) Department personnel are authorized to initiate medical surveillance examinations for TtEC personnel. The CMC should be contacted directly by EHS or HR and provided with the following information: the employee name, social security number, office or project location, phone number, preferred timeframe for the examination, type of examination required (pre-employment, baseline, periodic/annual, project specific or exit) and other special testing required. The CMC will then schedule the examination directly with the employee and the LMP and provide email confirmation of the examination appointment to the employee or the appropriate EHS representative in cases where email is not available.

Pre-employment drug screening and post-occurrence drug testing is carried out in accordance with the procedure PP-14, Substance Abuse Program.

3.4 CMC Procedures

When requested by the Director, ESQ or PESM, the CMC will qualify and recommend additional LMP for new offices or project locations. The CMC will maintain a current listing of all LMPs and will consult with the Director, ESQ when making changes to this listing.

The CMC shall provide detailed guidance to the LMPs regarding testing protocols, logistics, billing procedures, and quality assurance requirements. The CMC is responsible for ensuring that the LMPs follow the detailed guidance.

The CMC will obtain and furnish each TtEC employee and the ESS or office Environmental & Safety Coordinator (ESC), a written Work Status Report which includes the following:

- An opinion as to whether the employee has any detectable medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use;
- The recommended limitations upon the employee's assigned work;
- The results of the medical examination and tests; and
- A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

The CMC will complete a Certification for Hazardous Waste and Respirator Use following each hazardous waste examination and provide a copy to the ESS or ESC.

The CMC shall maintain an accurate record of all medical surveillance examinations performed for TtEC employees. All records shall be cataloged and maintained in secure, access controlled storage for the term of the contract. All employee medical records will be turned over to Director, ESQ or other designated medical facility on request.

4.0 GUIDANCE

4.1 Annual/Periodic Physical Examination Protocol

Employees should be provided an annual/periodic physical examination within 30 days of the anniversary of their previous physical examination if their job assignment still requires an exam per regulation, contract or ES&H plan specifics. Employees who wear a respirator less than 30 days/year or employees who are only involved in site visits, but not actual site work, may be on a 2-year periodicity for physical examinations as directed by the CMC. The contents of the annual medical examination are the same as the initial exam except as follows:

- Chest X-ray to be performed every five years unless the physician determines that increased periodicity is necessary.
- 12-lead resting EKG. The EKG will be performed according to the following schedule: every three years for those under the age of 40, every two years for those 40 to 50 years of age, and annually for those more than 50 years of age.

4.2 Termination/Reassignment Physical Examination Protocol

Physical examinations are made available to employees who participated in the medical surveillance program when they terminate employment with TtEC or upon reassignment to a job position which does not require participation in the program except as follows:

Hazardous Waste Site Activity Since Last Examination	Termination/Reassignment Examination Decision
No	Examination not offered unless required by project specifications or other OSHA standards
Yes	CMC will determine if examination is indicated unless required by project specification or other OSHA standards. The decision will be based upon the nature of the previous site(s)' contaminants and job site activities, documented exposure levels, and/or the results of the previous medical examination.

The CMC will provide documentation for each employee's medical file for which a termination/reassignment examination was waived. The documentation will include the rationale for waiving the examination.

When termination/reassignment medical examinations are performed, the content shall be the same as for the annual/periodic examination except that the chest X-ray is to be performed unless one has been performed in the last 12 months.

Employees who do not wish to avail themselves of the termination/reassignment examination will be requested to complete and sign the Medical Examination Refusal form included as Attachment A. If the employee does not take the examination and does not sign the refusal form, then TtEC's efforts to make the examination available will be documented in the project and employee's medical file.

Project specifications may require exit examinations when personnel leave the project or when a project ends. If the CMC feels that the exit examination can be waived, then the client should be notified for concurrence and appropriate contract modifications made as necessary.

4.3 Biological Monitoring

Additional medical surveillance parameters and biological monitoring may be performed as appropriate based on the potential for exposures to specific chemicals during site activities. The PESM or ESS and the CMC will determine the need for additional medical surveillance and biological monitoring on a project-specific basis.

4.4 Injury or Illness Examinations

Any employee who is injured, becomes ill, or develops signs or symptoms due to possible overexposure involving hazardous substances or health hazards should be provided consultation and/or examination as directed by the CMC and PESM.

4.5 Return to Work Examinations

Return to work clearance should be obtained from the LMP for all occupational and nonoccupational injuries and illnesses which resulted in or involved:

- Hospitalization
- Five (5) lost workdays - days away from work
- Unconsciousness
- Seizures

Return to work clearances may also be required when indicated by the LMP, CMC, PESM, or the Human Resources Department.

4.6 Release of Medical Records

Employees who wish to obtain copies of medical records should notify the Director, ESQ Services, complete the Employee Release of Medical Records (Attachment B), and forward to the Director, ESQ Services.

5.0 REFERENCES

Please Describe Your Reference Here	Place Your Link in this Column
1. 29 CFR 1910.95, Occupational Noise Exposure	
2. 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response	
3. 29 CFR.1926.1020, Access to Employee Exposure and Medical Records	
4. OSHA (U.S. Department of Labor, Occupational Safety and Health Administration)	
5.	
6.	
7.	

6.0 ATTACHMENTS

Please Provide a Description of the Attachment	Place Your Attachments Here
A. Medical Examination Refusal Form	EHS 4-5 Attachment A.doc
B. Employee Release of Medical Records	EHS 4-5 Attachment B.doc
C.	
D.	

TETRA TECH EC, INC.

MEDICAL EXAMINATION REFUSAL FORM

I, ______________________________________, acknowledge the Tetra Tech EC, Inc. (TtEC) has instructed me, and has provided me with full opportunity, to take an exit medical exam upon termination of my employment at the ____________________________________ Project Site(s)/TtEC office. I understand that this exam was offered to me at no charge. I also understand that this exam is an important part of the Health and Safety Program for workers at hazardous waste sites.

I have elected to refuse to take this exam. I understand that my refusal to take the exam at this time may result in failure to discover potentially preventable health problems and recognize that TtEC is not obligated to provide any further examination.

I have worked at the following sites during my employment with TtEC:

_______________________________________ ____

_______________________________________ ____

_______________________________________ ____

_______________________________________ ____

_______________________________________ ____

____________________________	__________________________________	______________
Employee Name (print)	Employee Signature	Date
____________________________	__________________________________	______________
Witness Name (print)	Witness Signature	Date

TETRA TECH EC, INC.

EMPLOYEE RELEASE OF MEDICAL RECORDS

TO: Director, Health and Safety Programs

Please provide copies of medical records being maintained by Tetra Tech EC, Inc. for:

Employee Name: ______________________________

Social Security Number: ______________________________

Address: ______________________________

____

____

Telephone Number: ______________________________

Project(s) Worked On: ______________________________

Dates of Employment: ______________________________

Copies of these records should be sent to: (***Note: Tetra Tech EC prefers to release this information to the employee's personal physician)***

☐ Employee ☐ Personal Physician ☐ Authorized Representative

Name: ______________________________

Address: ______________________________

____

____

Telephone Number: ______________________________

______________________________ ______________

Employee Signature Date

EHS 4-6: Temperature Extremes

Last Revision By: **Linda LaMonico** on **08/05/2009**
Created By: **Lisa Kaminski** on **11/18/2008**

Purpose: The purpose of this procedure is to prevent heat and cold stress related injuries and illnesses at field operations.

Status:	Complete		Donald Rogers
Version Date - Type:	11/18/2008 - Revised	**Original Issue Date:**	02/01/95
Category:	Company Procedures	**Sections:**	ESQ - Environmental Health & Safety Programs
Sub-Category:	Departmental/Discipline	**Document Type:**	Procedure
Keyword Index:	EHS Compliance/Waste Management, Monitoring, Operational Control, Training	**Document Owner**	Philip Bartley

Table of Contents:

See Below

1.0 PURPOSE

The purpose of this procedure is to prevent heat and cold stress related injuries and illnesses at field operations.

2.0 SCOPE

This procedure applies to all Tetra Tech EC, Inc. ("the Company") and subcontractor field personnel that may be exposed to heat or cold stress during the performance of their field work assignments.

3.0 MINIMUM REQUIREMENTS

3.1 Responsibilities

3.1.1 Line Management

General responsibilities are found in EHS 1-1, Responsibilities for Program Implementation. Procedure specific responsibilities are:

Site Supervisors have the responsibility to:

a. Evaluate the work activities and anticipated temperatures that may affect worker productivity or harm workers.

b. Provide resources and facilities necessary to prevent health effects from temperature extremes.

c. Enforce work rules related to such prevention.

3.1.2 Environmental, Health and Safety Personnel

The Project Environmental and Safety Manager (PESM) will make the initial determination of heat and cold stress prevention requirements as part of the site EHS Plan (see EHS 3-2, EHS Plans) and oversee the implementation of this program on a project basis for all Company field programs.

The Environmental Safety Supervisor (ESS) will assist with implementation of heat and cold stress prevention programs. The ESS will, in most cases, be the person responsible for monitoring heat and cold stress on the job, determining work/rest and work/warm-up schedules where used, and will implement emergency response or corrective action, if needed. The ESS will train site personnel on the effects of temperature extremes and the site prevention program, and will maintain records related to this program.

The ESS will implement the appropriate heat stress or cold stress requirements when temperatures indicate a potential heat or cold stress condition. The ESS will work with the line management to implement work rest regimens or other administrative controls such as ceasing certain activities, changing PPE, or engineering controls such as warming areas, cooling areas or shifting work schedules.

3.2 General Program Requirements

Adverse temperature conditions must be considered when planning site operations. Heat and cold stress injuries are completely avoidable with the proper education and work monitoring.

Implementing organizations will determine if contractual or regulatory requirements apply. Numerous Federal Agencies (e.g. USCOE, DOE) will contractually impose requirements related to temperature extremes. Also several states have passed regulations with requirements that will be applicable when working in those areas. In these cases, the information in the Guidance section and the attachments may become requirements.

4.0 GUIDANCE

This section contains optional guidance information to successfully execute the procedure.

4.1 Definitions

4.1.1 Body Core Temperature

The temperature of the organs within the trunk of the body.

4.1.2 Deep Frostbite

The tissue beneath the skin is solid to the touch; it may involve a full thickness freeze to the bone. This is an extreme emergency and can result in permanent tissue loss.

4.1.3 Frostbite

Freezing of body tissue.

4.1.4 Frostnip or Incipient Frostbite

A cold related injury that progresses slowly and is painless while developing. The victim is usually unaware that he/she has frost nip. The skin first becomes reddened, then changes to white; no freezing of tissue occurs.

4.1.5 Heat Cramp

Painful muscle spasms usually occurring on the arms, legs, and abdomen; caused by excessive loss of body electrolytes from profuse sweating.

4.1.6 Heat Exhaustion/Fatigue

Heat Exhaustion is a form of shock that occurs when the body loses large amounts of water and electrolytes from excessive perspiration after exposure to heat and physical activity; also called heat prostration. Symptoms include profuse sweating, pale, cool, sweaty skin and other symptoms identified in Attachment 1, Section 1.3.

Heat fatigue refers to the temporary state of discomfort and mental or psychological strain arising from prolonged heat exposure. Works unaccustomed to the heat are particularly susceptible and can suffer, to varying degrees, a decline in task performance, coordination, alertness, and vigilance.

4.1.7 Heat Rash

Profuse tiny raised red vesicles (blister-like) on affected areas of the skin which cause a prickling sensation during heat exposure.

4.1.8 Heat Stroke

A life-threatening condition caused by rapidly rising body core temperature that occurs when the body's temperature regulating mechanisms are overwhelmed. Sweating stops and the skin is dry and hot.

4.1.9 Hyperthermia

A rise in body core temperature above 99.6° F.

4.1.10 Hypothermia

Decreased body core temperature from prolonged exposure to freezing or near-freezing temperatures. This is the most life-threatening cold injury and affects the entire body with possible localized severe cooling. Hypothermia is defined as the deep body temperature dropping below 96.8°F (36°C).

4.1.11 Superficial Frostbite

Frostbite which affects the skin and tissue just beneath the skin. The skin is firm and waxy, tissue beneath is soft and numb. The skin turns purple and may tingle and burn during warming.

4.1.12 Wet-Bulb Globe Temperature (WBGT) Index

Method used to measure the environmental factors (e.g., temperature, relative humidity) which impact the body's physiological responses to heat.

4.1.13 Wind-Chill Factor or Equivalent Chill Temperature (ECT)

An index describing the effect of the cooling power of moving air on exposed flesh. The effect of wind velocity at a certain temperature is expressed as the equivalent cooling effect of a lower temperature with still air.

4.1.14 Work/Recovery Regimen

The ratio of time spent working to time spent resting in an area designed to relieve heat related conditions. This ratio is expressed in one hour periods. Example: A work/recovery regimen of 75% work, 25% rest corresponds to 45 minutes work, 15 minutes rest each hour.

4.2 General Program Guidance

Excessively hot or cold working environments can produce a number of different injuries. Critical to the ability to care for those injuries is a basic understanding of the way in which the body maintains its temperature and how it physiologically adjusts to extremes of heat and cold.

Preventing Heat and Cold Stress is prevented by planning in advance, and by training affected personnel in the symptoms of temperature extremes. OSHA has not established a temperature extremes standard, instead relying on the general duty clause.

The US Army Corps of Engineers has established requirements for work under its control in EM-385-1-1 (3 NOV 03) in section 06.I and adopting the ACGIH Guidelines.

The ACGIH Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices has updated its recommendations in 2005 and 2007. These recommendations are incorporated in the appropriate sections.

Several states have also passed regulations or temperature extremes (e.g. Washington, California).

Three attachments are attached to provide information related to temperature extremes:

- Attachment 1 provides information on the body's physiological responses to heat and cold stress.
- Attachment 2 provides information on Heat Stress Monitoring and Work/Rest Regimens.
- Attachment 3 provides information on Cold Stress Monitoring and Work Recovery Regimens.

Proper care of victims who are suffering from the effects of heat or cold exposure will help to minimize injuries and speed recovery. On the other hand, improper treatment of these emergencies can result in serious injury, disability, or death.

The most effective first aid for any injury is prevention. When acceptable monitoring and prevention programs are followed, there should be no victims.

4.3 Heat Stress

A heat stress prevention program will be implemented when ambient temperatures exceed 70°F (21° C) for personnel wearing **permeable** clothing. Wet Bulb Globe Temperature Index (WBGT) or physiological monitoring will be conducted. When a WBGT Index is not available, or workers are wearing impermeable clothing, or the WBGT is not representative to the actual work area (enclosed work areas, work over asphalt or reflective materials etc.) **physiological** (pulse, temperature) **monitoring** may be used in its place.

WBGT devices located away from the project (up to several miles) maybe used for monitoring the project if the general weather and measured work surfaces are similar.

4.3.1 Selection of Chemical Protective Clothing

The PESM will review site data and working conditions and select the personal protective equipment ensemble that best protects the employees from site hazards. The risk of heat related illness will be fully considered in balancing the risks and benefits of the PPE.

4.3.2 Hydration

The Company will supply cool potable water or other suitable drinks (e.g., sport electrolyte replacements) for fluid replacement. Employees involved in the heat stress prevention program will be trained and encouraged to drink at a rate of approximately 8 oz. every 20 minutes. Individual disposable cups will be used and kept in closed containers or dispensers. Alternately, cool bottled water or sports drinks in individual sealed bottles may be provided.

4.3.3 Cool Rest Areas

Shaded rest areas will be provided. On large remediation projects, air conditioned rest areas should be provided for workers exposed to heat stress conditions. In low humidity locations, evaporative coolers or misting devices and fans can be used to provide cool down locations. On smaller projects, personnel can use air-conditioned vehicles as cool down areas.

4.3.4 Other Prevention Elements

The PESM, ESS and the Project Manager will incorporate other elements into the heat stress prevention program as necessary. The selected elements will be described in the EHS plans. Engineering controls are preferred. Where their use is not feasible, the program must incorporate administrative/work practice controls, personal protective equipment, or a combination. Examples of prevention program elements include:

a. Engineering Controls

- Air conditioned cabs for heavy equipment and vehicles (such controls may eliminate the need for other program elements).

- Fans, blowers, or misters

- Cool water for drenching personnel in impermeable clothing. This can be provided through a garden hose, a garden sprayer filled with ice water, a clean drum full of water for "hard hat dipping" for containers of ice water and clean towels in the rest area to hasten cool down.

b. Administrative and Work Practice Controls

- Adjusting work schedules to do the bulk of the work during the cooler parts of the day.

- Acclimating workers.

- Implementing work/rest regimens (See Attachment 2 for Work/Rest Regimen Procedures)

c. Personal Protective Equipment

- Ice Vests

- Circulating water vests

- Vortex tubes and air circulating vests

Where ice vests and circulating water vests are used, rest periods of approximately 15 minutes should be taken when ice packs or batteries need to be changed. Continuous work over long periods of time with these devices may present an increased musculoskeletal injury risk due to the extra weight. Since the duration of the cooling effectiveness of these devices will vary with heat and work loads, users must be instructed to leave the area to replenish ice or batteries at the first sign of loss of cooling.

d. Monitoring

A program of environmental and physiological monitoring must be established in order to use work/rest regimens to verify the effectiveness of the regimens. The monitoring procedures are described in Attachment 2.

4.3.5 Training

All site personnel must receive training on the following topics:

a. Health effects of hot environments and symptoms of heat related illness.

b. Personal risk factors; including use of some medications (e.g. blood pressure, allergy, renal or sweat gland functions), physical condition, insufficient sleep; attempting full work loads when not fully acclimatized and dehydration due to consumption of alcohol, consumption of caffeine or other diuretics.

c. Effect of personal protective equipment on heat stress conditions.

d. Preventive measures

- Physiological monitoring methods and thresholds
- Acclimatization

e. Fluid replacement; including taking frequent breaks for fluid replacement on an as-needed basis, maintaining hydration and electrolyte balances.

f. Elements of the site Heat Stress Prevention Program.

g. First aid and emergency response

Records shall be maintained in accordance with EHS 1-9, Recordkeeping.

4.4 Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trenchfoot or immersion foot, and hypothermia as well as slippery surfaces, brittle equipment, poor judgment and taking short cuts. ACGIH guidelines are provided in Attachment 3. The Company will implement the following cold stress prevention program elements when there is a potential for cold related injuries. Workers should be protected from exposure to cold so the core body temperature does not fall below the Threshold Limit Value of 96.8°F (36°C).

4.4.1 Personnel Protective Equipment

The following personal protective equipment will be provided as necessary to Company employees when conditions indicate a potential for cold-related injury. Subcontractors will be expected to supply appropriate equipment to their employees.

a. Hard hat liners, face covers

b. Gloves or glove liners, chemical sock and glove warmers

c. Rain gear or water impermeable coveralls and gloves for potentially wet operations

d. Fleeced boot liners where rubber steel-toe boots are used

e. Winter coveralls

4.4.2 Engineering Controls

A variety of engineering controls shall be evaluated to minimize cold stress. These include:

a. General or spot heating should be used to increase temperature at the workplace.

b. If fine work is to be performed with bare hands in a cold environment, special provisions should be made to keep the workers' hands warm. Warm air jets, radiant heaters, or contact warm plates can be used.

c. The work area should be shielded from winds and drafts that may affect the wind chill factor.

d. The air velocity in refrigerated rooms should be minimized as much as possible, and should not exceed 2.2 mile/hour (1m/sec) in the work zone.

e. At temperatures below freezing, metal handles of tools and control bars should be covered with thermal insulating material.

f. Unprotected metal chair sets should not be used as they conduct heat away from the body.

g. When necessary, equipment and processes should be substituted, isolated, relocated, or redesigned to reduce cold stress at the worksite.

h. Power tools, hoists, cranes, or lifting aids should be used to reduce metabolic workload.

i. Heated warming shelters such as tents and cabins should be made available if work is performed continuously in an equivalent chill temperature of 20°F or below.

j. The ESS may implement a work-rest schedule to reduce exposure to cold stress.

k. Scheduled rest breaks should be enforced.

l. Personnel exposed to the cold should be provided the opportunity for frequent intake of warm, sweet, caffeine-free, nonalcoholic liquids or soup.

m. Work should be moved to warmer areas whenever possible.

n. Extra workers should be assigned to highly demanding tasks.

o. Workers should be allowed to pace themselves, taking breaks when needed.

p. Workers shall be trained in the prevention, symptoms, and emergency response to cold stress.

q. Utilize the "buddy system" to monitor cold stress symptoms among the workers.

r. Allow new employees time to adjust or "acclimate" to cold conditions.

s. Minimize the need to sit or stand in one place for long periods of time.

t. Minimize the amount of work time spent in a cold environment.

u. Allow for the weight and bulkiness of protective clothing when estimating work performance goals and tasks.

4.4.3 Warm Rest Areas

The Company will make warm rest areas, e.g., heated trailers, available for rest breaks in cold weather. Employees will be permitted and encouraged to use the heated trailers whenever they experience symptoms of cold stress.

4.4.4 Work/Warm-Up Schedules

The work/warm-up schedule found in the ACGIH for cold stress will be followed as a guideline unless a government project, where they are required by ACOE or DOE regulation (Attachment 3). In addition, the Company will make warm-up periods available to employees who need to change into dry clothing to prevent immersion foot or hypothermia.

4.4.5 Training

All Company employees and subcontractors will be trained in:

a. The effects of cold stress, including frostbite, immersion foot and hypothermia.

b. Conditions that can lead to hypothermia, including work practices, clothing, activity levels, wind chill.

c. Personal risk factors, including use of some medications, physical condition, insufficient sleep, dehydration due to consumption of caffeine, alcohol or other diuretics.

d. Recognition of the symptoms.

e. Methods employees can use to protect themselves.

f. First aid procedures and recognition of medical emergencies.

Records shall be maintained in accordance with EHS 1-9, Recordkeeping.

5.0 REFERENCES

Please Describe Your Reference Here	Place Your Link in this Column
1. ACGIH (American Conference of Government Industrial Hygienists) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, 2007	
2. Fundamentals of Industrial Hygiene. Third Edition, 1988	
3. National Safety Council	
4. NIOSH (National Institute for Occupational Safety and Health)	
5. NIOSH/OSHA/EPA/USCG/EPA	
6. Occupational Exposure to Hot Environments, Revised Criteria 1986	
7. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities - October 1985	
8. EHS 1-1, Responsibilities for Program Implementation	
8. EHS 1-9, Recordkeeping	
9. EHS 3-2, Environmental, Health & Safety Plan(s)	
10. US Army Corps of Engineers, Safety & Health Manual (EM 385-1-1) Nov 2003, Section 06.J.04	

6.0 ATTACHMENTS

Please Provide a Description of the Attachment	Place Your Attachments Here
1. Heat and Cold Stress Information	EHS 4-6, Attachment 1 final 11-8-08.doc
2. Heat Stress Monitoring and Work/Rest Regimens	EHS 4-6, Attachment 2 Final 11-11-08.doc
3. Cold Stress Monitoring and Work/Recovery Regimens	EHS 4-6, Attachment 3 final 11-8-08.doc
4. Example - WBGT Monitoring Form	Attachment 4 Example WBGT Monitoring Form 11-11-08.doc
5.	

ATTACHMENT 1

HEAT AND COLD STRESS INFORMATION

1.0 HEAT STRESS

Hot weather can cause physical discomfort, loss of efficiency, and personal injury. The human body strives to maintain a constant core temperature of 98.6^{o} F (37^{o} C). If this temperature is to be maintained, heat loss must equal heat production. This balance is maintained by variations in the blood flow to the outer part of the body. When the core temperature rises, blood vessels beneath the skin dilate, and the blood brings increased heat to the skin, where it is dissipated by radiation and convection. This works only as long as the skin temperature is higher than the temperature of the outside environment. Heat loss by radiation convection is impossible when the temperature of the outside air approaches or exceeds the temperature of the skin. The body will now rely on dissipation through evaporation of sweat. But the sweat mechanism also has limits. The normal adult can sweat only about one liter per hour and can sweat at that rate for only a few hours at a time. In addition, sweating is effective only if the relative air humidity is low. Sweat evaporation ceases entirely when the relative humidity reaches 75 percent.

Of particular concern in heat stress monitoring is the use of personal protective clothing which decreases natural body ventilation and greatly increases the temperature and humidity to the skin. If precautions are not taken, heat stress will progress into a heat-related injury. Heat-related injuries fall into three major categories: heat cramps/fatigue, heat exhaustion, and heat stroke.

1.1 Heat Cramps

Heat cramps are the least common and least severe of heat injuries. Heat cramps are thought to occur when the electrolytic balance in the blood between water, calcium, and sodium (salt) is altered. Low blood salt level, from profuse sweating and inadequate salt consumption, is the usual cause, as well as poor conditioning..

1.1.1 Symptoms

a. Severe muscle cramps and pain, especially of the upper legs, calves, and abdomen, and occasionally in the arms

b. Faintness and dizziness

c. Possible nausea and vomiting

1.1.2 Treatment

Emergency care will include:

a. Remove victim from the hot environment and allow victim to rest and cool down

b. Provide small amounts of cool water or use a commercial sport drink and allow victim to sip this solution to hydrate. Avoid drinks with caffeine or alcohol.

c. To relieve pain, gently stretch the involved muscle group; gently message cramps as long as it does not increase the pain or discomfort.

The victim should avoid exertion of any kind for 12 hours. A victim of heat cramps is prone to recurrence.

1.2 Heat Fatigue

Heat Fatigue is most likely to affect new or un-acclimatized workers.

1.2.1 Symptoms

a. Loss of energy, extreme tiredness

b. Stumbling, staggering, or loss of balance. The loss of balance is a particular risk to workers on elevated surfaces or climbing.

c. Excessive skin redness as body moves blood to surface

d. Lack of judgment recognizing the onset of heat fatigue and taking action to remove themselves from the environment for cool down and hydration

1.2.2 Treatment

a. Remove from the hot work environment for cool down

b. Provide fluids (cool water or sport drinks to re-hydrate the victim

c. Extend cool-down period or cessation of work for the day with extra hydration and rest

d. Enhance observations by other workers and physiological monitoring

e. Provide individual work/rest regimens until acclimatized

1.3 Heat Exhaustion

1.3.1 Symptoms

Heat exhaustion is the most common heat injury and usually occurs in an individual who is involved with heavy physical exertion in a hot, humid environment, and is wearing protective clothing. Heat exhaustion is a mild state of physical shock caused by the pooling of blood in the vessels just below the skin, causing blood to flow away from the major organs of the body. Due to prolonged and profuse sweating, the body also loses large amounts of salt and water.

The symptoms of heat exhaustion include:

a. Profuse sweating

b. Pale, cool, sweaty skin

c. Headache and extreme weakness, fatigue

d. Nausea and possible vomiting

e. Dizziness and faintness

f. Collapse and possible brief unconsciousness

g. Body core temperature from 100.4^{o} F (38^{o} C) to 104^{o} F (40^{o} C), although skin temperature may even be slightly below normal.

1.3.2 Treatment

Emergency care will include:

a. Remove victim from the hot environment and out of the exclusion zone

b. Lie victim down with feet slightly raised

c. Remove as much clothing as reasonable (especially personal protective clothing); loosen what cannot be removed

d. Apply cold, wet compresses to the skin; fanning will also aid in cooling

e. If the victim is fully alert, allow him/her to drink water at the same rate, that was used for the emergency care of heat cramps

f. If the victim vomits, do not give fluids by mouth, transport him/her to a hospital immediately (dehydration is the most critical problem in heat exhaustion victim; intravenous fluids will have to be given)

g. Take temperature every 10 minutes, if the victim's temperature is above 101°F (38.3 C) or shows a steady increase, transport to a hospital immediately and start sponging him/her off with cool water

1.4 Heat Stroke

Heat stroke is a true life-threatening emergency having a mortality rate of 20 to 70 percent. This condition results when the heat regulating mechanisms of the body break down and fail to cool the body sufficiently. The body temperature rises to between 104^{o} F and 110° F (40.6 – 43.3° C); no sweating occurs in about 50 percent of the victims. Because no cooling takes place, the body stores increasingly more heat, and eventually brain cells are damaged, causing permanent disability or death.

There are two basic kinds of heat stroke: classic heat stroke and exertional heat stroke. Classic heat stroke, in which people lose the ability to sweat, generally effects the elderly or chronically ill. Exertional heat stroke, in which victims retain the ability to sweat, is accompanied by physical exertion and muscle stress. Exertional heat stroke is the type that will be most commonly encountered on a field operation requiring strenuous physical activity.

1.4.1 Symptoms

a. Oral temperature of 104^{o} F (40^{o} C) or higher

b. Hot, reddish skin, skin is usually dry

c. Headache

d. Dry mouth

e. Shortness of breath

f. Nausea or vomiting

g. Increasing dizziness and weakness

h. Mental confusion and anxiety; victims may show unusual irritability, aggression, combative agitation, or hysterical behavior

i. Convulsions, sudden collapse and possible unconsciousness; all heat stroke victims having varying levels of consciousness, ranging from disorientation to coma

1.4.2 Treatment

Emergency care will include:

a. Remove the victim from the hot environment and from the exclusion zone

b. Call for trained emergency medical personnel **immediately**

c. Remove as much clothing as reasonable (especially personal protective clothing); cut clothing with bandage scissors, if necessary, being careful not to injure victim

d. Pour cool water over the victim, avoiding his nose and mouth

e. Fan the victim

f. Place cold packs under the arms and against neck, groin and ankles

g. Wrap victim in a wet blanket

h. Continue a combination of these methods until the oral temperature falls below 103^{o} F (39.4^{o} C) (take measures to prevent chilling, if necessary, i.e., use slower cooling if the victim starts shivering

i. Elevate the head and shoulders slightly during cooling

j. Never give the victim anything to drink unless fully conscious and vomiting is unlikely

Because heat stroke involves the entire body, a number of complications may result including brain swelling, convulsions, coma, kidney failure, liver failure, high blood pressure and heart failure.

Therefore, always transport the victim to a hospital even if the body core temperature has lowered to near normal.

1.5 Heat Stroke Verses Heat Exhaustion

The two most reliable and distinct differences between heat stroke and heat exhaustion are:

1.5.1 Heat Stroke

a. Skin flushed (red); may be dry; hot to touch (note: Personnel who have been wearing impermeable clothing may have wet skin from earlier sweating that has ceased.)

b. Oral temperature above 104°F (40^{o} C)

1.5.2 Heat Exhaustion

a. Skin pale; wet or clammy; cool to touch

b. Oral temperature usually normal

2.0 COLD STRESS

Hypothermia is a drop in the core body temperature below 96.8^{o} F (36^{o} C). The first symptoms of hypothermia are uncontrollable shivering and the sensation of cold at about 95^{o} F (35^{o} C); this is followed by a slowed and sometimes irregular heart beat, a weakened pulse and a drop in blood pressure. Vague or slow slurred speech, memory lapses, apathy, incoherence and drowsiness can occur. Other symptoms may include cool skin, slow, irregular breathing, apparent exhaustion, and fatigue after rest.

2.1 Prevention

Hypothermia is caused by prolonged exposure to a cold environment, whether air, water, or snow and ice. Adequate dry clothing with appropriate insulating capacity must be provided to workers to prevent hypothermia, especially if work is performed in air temperatures below 40° F (4.4^{o} C). Wind chill is a critical factor. Work at a slow but steady pace. The job should be a "no sweat" operation.

Unless there are unusual or extenuating circumstances, cold injury to other than the extremities (hands, feet, and head) is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against hypothermia. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are special precautions that should be considered for these workers. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

2.2 Treatment

First aid for <u>mild</u> <u>hypothermia</u> will be performed as follows:

a. End the exposure - get the victim out of the cold and wet

b. Replace wet clothing with dry or add insulation to clothing

c. Offer warm, non-alcoholic fluids

d. Increase exercise

e. Seek shelter from wind, wet and cold

CAUTION: If the victim remains cold for a number of hours, chemical changes may have taken place which, on re-warming, may cause major medical problems for the victim and which could result in death. Severely hypothermic victims are best warmed in the hospital under controlled conditions. If a severely hypothermic victim cannot be transported to a hospital within a few hours, re-warming should begin in the field.

2.3 Frostbite

2.3.1 Prevention

Frostbite can be prevented by wearing sufficient protection to prevent skin from coming into prolonged contact with a freezing environment. The following steps can be taken.

a. Wear sufficient clothing. Mittens are better than gloves. Face masks and wool stocking caps are better than hats. Wind and waterproof hoods protect the face and neck.

b. Clothing should be loose enough to prevent constriction of blood vessels. Boots must be roomy enough to permit movement of the toes with no feeling of tightness.

c. Do not contact conductive metals or contact gasoline or other solvents with bare skin as rapid evaporation of solvents may quickly lead to frozen tissues in a cold environment.

d. Exercise the toes and fingers to maintain circulation.

e. Observe the condition of your partners' face, hands and ears frequently for signs of frostbite.

f. Avoid smoking and drinking alcoholic beverages.

2.3.2 Symptoms

Frostbite can occur either before or after the onset of hypothermia when body tissue (usually an extremity) is exposed to freezing temperatures. Frostbite occurs when the fluids surrounding tissue cells freezes. The danger of frostbite increases with increased wind chill and/or reduced temperatures below 32^{o} F (0^{o} C). Frostbite can also occur if tissues are in prolonged contact with a frozen material or object. Skin contact with frozen metal, for example, can result in frostbite in a short period of time, even in a warm environment.

There are three degrees of frostbite:

a. First degree - freezing without blistering or peeling, "frostnip"

b. Second degree - freezing with blistering and/or peeling, and

c. Third degree - freezing resulting in the death of skin tissue and possibly the death of underlying tissues as well

Symptoms of frostbite include the following:

a. The skin changes color to white or grayish-yellow, progresses to reddish-violet, and finally turns black as the tissue dies

b. Pain may be felt at first, but subsides

c. Blisters may appear, and

d. The affected area is cold and numb

2.3.3 Treatment

First aid for superficial (first degree) frostbite is as follows:

a. Place a warm body part next to the frozen area, applying firm, steady pressure.

b. DO NOT RUB THE AREA. Rubbing may cause further damage to already injured skin.

c. Protect the area from further freezing.

First aid for deep frostbite (second and third degree) is as follows:

a. KEEP THE FROZEN PART FROZEN!

b. Prevent further injury: avoid rubbing and further freezing of unaffected tissue.

c. If the part has thawed, the part should NOT be allowed to refreeze or bear weight. A victim with thawed feet should be carried out.

d. Give the victim plenty of fluids and evacuate to medical assistance as soon as possible.

2.4 Trench Foot

2.4.1 Symptoms

This condition may be caused by long, continuous exposure to cold without freezing, combined with persistent dampness or actual immersion in water. Edema (swelling), tingling, itching, and severe pain occur, and may be followed by blistering, death of skin tissue, and ulceration. When other areas of the body are affected besides the feet, the condition is known as chilblains.

2.4.2 Prevention

Trench foot and chilblains can be prevented by keeping the body as dry as possible at all times. Waterproof boots should be worn when required, but provisions must be made for preventing excessive perspiration to accumulate inside the boots. Socks should be changed at least twice daily and the boots wiped dry inside with each change of socks. The feet should also be wiped dry and foot powder applied.

2.4.3 Treatment

Affected body parts should not be rubbed or massaged, but bathed in water using plain white soap. Dry thoroughly and elevate the body part, allowing the body part to be exposed at room temperatures. If the feet are affected, do not walk during treatment.

(Internal Note – this attachment is a total revision and no revision bars are shown)
ATTACHMENT 2

HEAT STRESS MONITORING AND WORK/REST REGIMENS

1.0 Introduction 1
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5.3 Body Core Temperature 7
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1.0 INTRODUCTION

Establishing a work/rest regimen that allows work to be completed in a timely manner while providing adequate rest time to prevent heat stress requires involvement of the ESS, Project Supervisors, and individuals involved. In many cases, particularly when wearing normal field type clothing (i.e., level D), awareness and communication are the key elements to a successful program. Allowing and encouraging rest periods on an "as needed" basis while ensuring vigilance for initial symptoms of heat stress, encourages this success.

There are times when this approach is not appropriate. When heat stress contributing protective clothing (e.g., respirators, impermeable coveralls) are worn for extended periods, or when "as needed" work/rest regimens adversely impact either the individuals exposed to the heat source or work completion, a more formal work/rest regimen will be established.

Formal work/rest regimens are based on when Action Levels and TLV limits are approached and: 1) monitoring ambient conditions (e.g., with a Wet Bulb Globe Temperature Index (WBGT), estimating work loads and establishing work/rest times, 2) monitoring physiological conditions and adjusting work/rest periods, 3) applying Job Specific Controls.

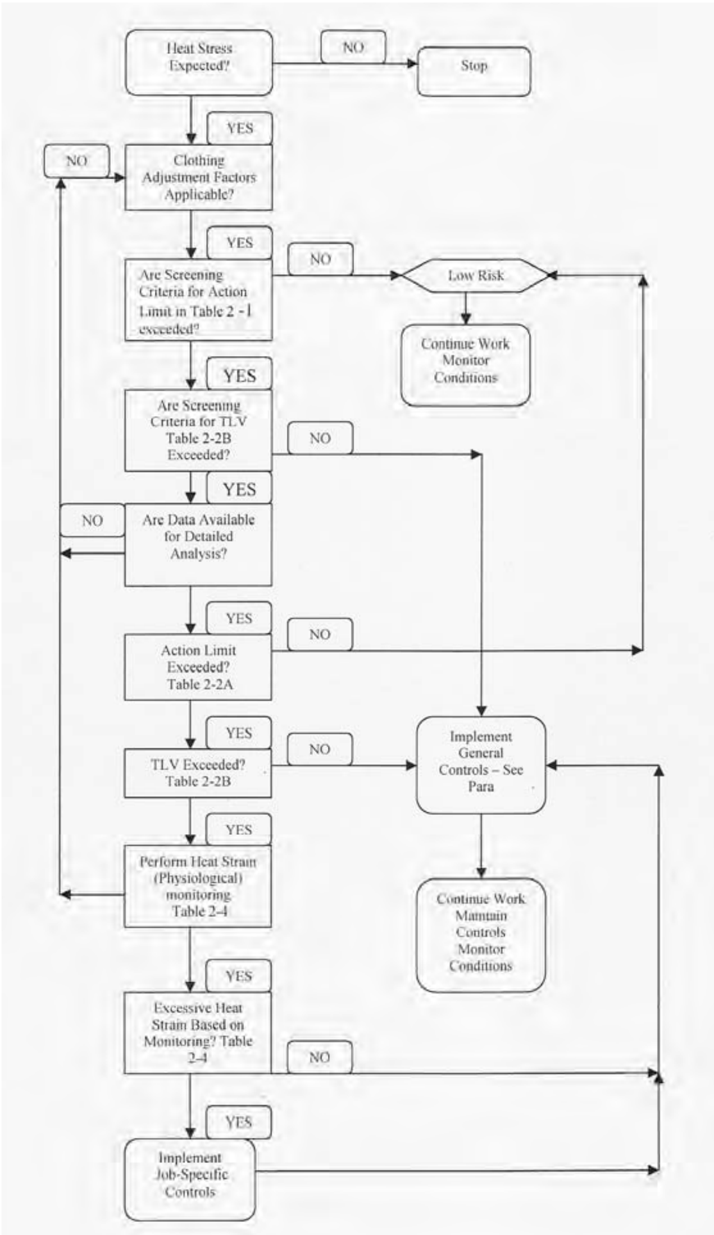
The WBGT, physiological monitors, and personnel heat stress monitors will be used in accordance with manufacturer's instructions. Personnel heat stress monitors will be approved for use by the PESM.

This attachment includes guidance for monitoring and preventing heat stress and heat strain in accordance with the 2007 ACGIH. The 2007 ACGIH Guidelines were revised to include an Action Level and a Threshold Limit Value based on WBGT measurements). The goal is to maintain body core temperatures within +/- 1.8° F of 98.6° F (+/-1° C. of 37° C) The TLV represents conditions under which it is believed that nearly all acclimatized, adequately hydrated, unmedicated, healthy workers may be repeatedly exposed without adverse health effects. The Action Limit is similarly protective of unacclimatized workers and represents conditions for which a heat stress management program should be considered.

This guidance is not a fine line between safe and dangerous. Therefore professional judgment is of particular importance in assessing the level of heat stress and physiological heat strain to provide for protecting nearly all healthy workers with due consideration of individual types and type of work.

The decision process shown in Figure 1-1 should be started if 1) a qualitative exposure assessment indicates the possibility of heat stress, 2) there are reports of discomfort due to heat stress, or 3) professional judgment indicates heat stress conditions.

Figure 1-1 – Evaluating Heat Stress and Strain



<u>Note: At the option and judgement of the ESS, physiological monitoring may be commenced at any time, supplementing or replacing WBGT monitoring.</u>

2.0 WBGT-BASED WORK/RECOVERY REGIMENS

2.1 Work/Recovery Regimens

When required, the WBGT Index will be used in conjunction with the work load, protective clothing, and other factors to determine the appropriate work/recovery regimen and need for physiological monitoring for personnel.

The ESS will monitor the temperature, work loads, and protective clothing. The WBGT will be adjusted based on the clothing adjustment factors. The Work Loads and the WBGT will then be used to determine the Work and recovery cycles for the workers involved.

The work/recovery regimen using the WBGT procedure will be used as a guideline, as the WBGT is only an index of the environment. Table 2-1 identifies the Clothing Adjustment factors.

Table 2-1 Clothing-Adjustment Factors for Some Clothing Ensembles

Clothing Type	Addition to WBGT Index
Work Clothes (Long Sleeve Shirt and Pants)	0° F (0° C)
Cotton (woven material) Coveralls	0° F (0° C)
Double Layer woven Clothing	5.4° F (3° C)
SMS Polypropylene Coveralls	1.0° F (.5° C)
Polyolefin Coveralls	1.8° F (1° C)
Limited-Use Vapor Barrier coveralls	19.8° F (11° C)

Notes on Table 2-1:
For example, WBGT Index is 86 ° F. If double layer woven overalls (5.4° F) are used with acclimatized workers the Corrected Index Temperature is 91.9 ° F.

These values must not be used for completely encapsulating suits, often called Level A. Clothing Adjustment factors cannot be added for multiple layers. ***The coveralls assume that only modesty clothing is worn underneath, not a second layer of clothing.***

These values may also apply to other protective clothing, such as rain suits, when worn where the body is fully covered and the worker does not have the option of opening or venting the clothing while working (e.g. individuals in a radiological zone or other hazardous areas.

Tables 2-2-A and 2-2-B outline the work/recovery regimens based upon WBGT temperature and workload.

Table 2-2A Permissible Heat Exposure Action Limit Values
(Values are given in °F and (° C) WGBT Index)*

Allocation of Work in a Cycle of Work and Recovery	Work Load Category			
	Light	Moderate	Heavy	Very Heavy
75% to 100%	82.4 (28.0)	77.0 (25.0)		--
50% to 75%	83.3 (28.5)	78.8 (26.0)	75.2 (24.0)	--
25% to 50%	85.1 (29.5)	80.6 (27.0)	77.9 (25.5)	76.1 (24.5)
0% to 25%	86.0 (30.0)	84.2 (29.0)	82.4 (28)	80.6 (27)

Table 2-2B Permissible Heat Exposure Threshold Limit Values)
(Values are given in °F and (°C) WBGT)*

Allocation of Work in a Cycle of Work and Recovery	Work Load Category			
	Light	**Moderate**	**Heavy**	**Very Heavy**
75% to 100%	87.8 (31.0)	82.4 (28.0)	---	--
50% to 75%	87.8 (31.0)	84.2 (29.0)	81.5 (27.5)	--
25% to 50%	89.6 (32.0)	86.0 (30.0)	84.2 (29.0)	82.4 (28.0)
0% to 25%	90.5 (32.5)	88.7 (31.5)	86.9 (30.5)	86.0 (30.0)

Notes on Table 2-2-A & 2-2-B:

a. The values in Table 2-2A & 2-2B are for fully acclimatized workers wearing light weight pants and long sleeved shirts. For conditions other than this, use this table with the Clothing Adjustment factors from Table 2-1. For unacclimatized workers, the Action Limit Values should be used as TLVs.

b. These values assume that workers drink frequently and have properly increased salting of food prior to exposure.

c. These values are guidelines. Actual levels may be modified based on individual physiological response and actual work and rest conditions.

d. These values assume that the rest location is cool enough to alleviate heat load conditions.

e. See Table 2-2C for Work Load Categories.

f. Values in the table are applied by reference to the "Work-Rest Regimen" section and assume 8-hour workdays in a 5-day workweek with conventional break.

g. Because of the physiological strain associated with Heavy and Very Heavy work among less fit workers, regardless of the WBGT Index, criteria values are not provided for continuous work and for up to 25% rest in an hour for Very Heavy work. The screening criteria are not recommended, and a detailed analysis and/or physiological monitoring should be used.

h. WBGT Index values are expressed to the nearest .5°C and .1°F

Table 2-2C provides examples of work activity categories for use in table 2-2A and 2-2B. Recovery rest areas should be near the work areas, shaded, and with adequate supplies of cool water. Aids to assist in evaporative cooling such as fans or blowers should be considered.

Table 2-2C Work Load Categories

Categories	**Example Activities**
Resting	Sitting quietly
Light	Sitting with light manual work with and or hands and arms, and driving. Standing with some light arm work and occasional walking.

Moderate	Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling. Normal walking.
Heavy	Intense arm and trunk work, carrying, shoveling, manual sawing, pushing and pulling heavy loads; walking at a fast rate.
Very Heavy	Very intense activity at fast to maximum pace,

2.2 Acclimatization

Acclimatization is a gradual physiological adaptation that improves an individual's ability to tolerate heat stress. Full heat acclimatization requires physical activity under heat-stress conditions similar to those anticipated for the work. With a recent history of heat-stress exposures of at least 2 continuous hours (e.g. 5 of the last 7 days to 10 of 14 days) a worker can be considered acclimatized for the purposes of the TLV shown in table 2-2B.. Its loss begins when the activity under those heat-stress conditions is discontinued, and a noticeable loss occurs after 4 days and may be completely lost in 3 to 4 weeks. Because acclimatization is to the level of the heat stress exposure, a person will not fully acclimatize to a sudden higher level, such as during a heat wave.

Numerous factors can affect acclimatization and a worker's ability to work in heat, including age and off-work activities (amount of sleep, consumption of alcoholic beverages, prescription and nonprescription mediations (e.g. antihistamines and other medications that decrease the body's ability to carry water or reduce sweating).

2.3 WBGT Determination

WBGT device should be operated in accordance with the manufacturer's instructions. The location of the WBGT device should be evaluated based on the work. Work inside buildings (no wind), within depressions or excavations, over asphalt or black liners (such as HPDE) would dictate that the device should be located near the area to account for the difference in the globe temperature due to radiance and reflection. Work on open soil/gravel will have a lesser affect on the readings and will allow the readings to be indicative of a large area (up to several miles). (Note WBGT Index readings for the area can frequently be obtained on a real-time basis from weather stations, or from the internet).

3.0 HEAT STRAIN GENERAL WORK CONTROLS

General controls for Heat Strain prevention and control include:

- Provide accurate verbal and written instructions, annual training programs and other information about heat stress and strain.
- Encourage drinking small volumes (approximately 1 cup) of cool, palatable water (or other acceptable fluid replacement drink, (e.g. sport drink) about every 20 minutes.
- Permit self-limitation of exposures and encourage co-worker observation to detect signs and symptoms of heat strain in others.
- Counsel and monitor those who take medications that may compromise normal cardiovascular, blood pressure, body temperature regulation, renal or sweat gland functions and those who abuse or are recovering from the abuse of alcohol or other intoxicants.
- Encourage healthy life-styles, idea body weight and electrolyte balance

- Adjust expectations of those returning to work after absence from hot exposure situations and encourage consumption of salty foods (with approval of physician if on a salt-restricted diet).
- Consider preplacement medical screening to identify those susceptible to systemic heat injury.
- Monitor the heat stress conditions and reports of heat related disorders.

4.0 JOB SPECIFIC CONTROLS FOR HEAT STRAIN STRESS

When excessive heat strain is observed or predicted based on monitoring, the some or all of the following Job Specific Controls should be considered:

- Engineering controls that reduce the metabolic rate, provide general air movement, reduce process heat and water vapor release, and shield radiant heat sources, among others.
- Administrative controls that set acceptable exposure times, allow sufficient recovery, and limit physiological strain.
- Personal protection that is demonstrated effective for the specific work practices and conditions at the location.

5.0 PHYSIOLOGICAL MONITORING

5.1 Monitoring Frequencies

Physiological monitoring will commence at the discretion of the ESS, or when WBGT Index monitoring is not used and the ambient temperatures exceed 70^{o} F (21^{o} C). Physiological monitoring may be used whenever work/recovery regimens are implemented to verify the effectiveness of the work/rest ratio including the cool down periods. Physiological monitoring should be used whenever workers have the potential to exceed the TWA or TLV, and must be used when personnel are working in impermeable clothing

Work in impermeable protective clothing should include consideration of a buddy rule (no lone workers), particularly at higher temperatures. The observers should be watching for sudden or severe fatigue, lightheadedness, loss of balance, loss of judgment or clumsiness that may indicate heat fatigue or heat stress.

The monitoring frequencies may be adjusted for individuals after experience with their work in heat stress environments has been gained provided the work involved, PPE, and other factors remain the same.

Attachment 4 is an Example forms that may be used for WBGT monitoring and individual physiological monitoring

5.2 Pulse Rate Monitoring

The level of stress may also be monitored by an individual's pulse rate. If either of the following occur, the individual should be removed from heat stress exposure:

- A sustained (several minutes) heart rate is in excess of 180 beats per minute (bpm) minus the individual's age in years (180-age), for individuals with normal cardiac performance. or

- A recovery heart rate greater than 120 bpm one minute after a peak work effort

The affected individual should be removed from the heat stress exposure and allowed to recover.

A recovery heart rate less than 110 bpm at indicates the individual can return to work but the work period should be adjusted. Shorten the next work period by one third while maintaining the same rest period. Increase the monitoring on the individual.

Pulse rates can be taken with an electronic pulse meter, or manually with a stopwatch for 30 seconds.

5.3 Body Core Temperature

Obtaining an accurate body core temperature for sustained work can be difficult, as the body will start to cool as soon as work is stopped or if protective clothing is removed and evaporation rates are increased. Monitor personnel as soon as possible to obtain an accurate temperature following the manufacturer's instructions for the particular instrument used. A body core temperature greater than 101.3^o F (38.5^o C) for medically selected and acclimatized personnel, or greater than 100.4^o F (38^o C) in unselected, unacclimatized workers may mark excessive heat strain and an individual's exposure to heat stress should be discontinued.

Average Body temperature varies between individuals and within individuals, typically fluctuating 1 degree F above or below the scientific "norm" of 98.6^o F (37^o C) oral temperature, depending on activity and general health.

Temperatures taken at the ear (tympanic temperature) has been developed. Current information indicates that an ear temperature reading will be 0.5 to 1.0^o F (0.3 to 0.6^o C) higher than an oral temperature reading, since the eardrum shares blood supply with the hypothalamus in the brain. An armpit (axillary) temperature is typically 0.5 to 1.0^o F (0.3 to 0.6^o C) lower than an oral temperature reading and may take up to 10 minutes to get an accurate reading.

Temporal or forehead thermometers use skin temperature to determine the body temperature. Due to the variations of the location and effects of evaporation, these are not as accurate as electronic and ear thermometers, however they offer other benefits of speed and accessibility when an individual may be fully suited.

Take the oral, ear or temporal temperature immediately at the start of the rest period. If the temperature exceeds 99.5^o F (37.5^o C) (oral or adjusted to oral) shorten the next work period by a third. Do not return the worker to hot work in semi-permeable or impermeable clothing until the body temperature is less than 99.5^o F (37.5^o C).

Body temperatures may be taken with disposable oral thermometers or infrared ear drum scanners. Temporal infrared thermometers are also available and may be considered to be less intrusive to the workers than oral or ear measurement devices.

(Note- Instruments coming in contact with skin or body fluids (sweat, saliva, etc) should either be used with disposable covers or sanitized between use.)

5.4 Removal from Exposure

If an individual requires a shortening of the work period on more than two consecutive monitoring periods, or repeatedly over a few days, they should be removed from exposure to hot environments, wearing semi-permeable, impermeable protective clothing until examined and cleared for such work by the consulting physician.

> **If a worker appears to be disoriented or confused, suffers inexplicable irritability, malaise, or chills, the worker should be removed for rest in a cool location with rapidly circulating air and kept under skilled observation. Absent medical advice**

to the contrary, treat this as an emergency with immediate transport to a hospital. An emergency response plan is necessary.

The heat stroke victim is often manic, disorientated, confused, and delirious or unconscious. treat this as an emergency with immediate transport to a hospital. The victim's body core temperature is greater than 104^o F (40^o C). If signs of heat stroke appear, start aggressive cooling immediately. Emergency care and hospitalization are essential. An emergency response plan is necessary.

Prolonged increases in deep body temperature and chronic exposures to high level of heat stress are associated with other disorders, such as temporary infertility (male and female), elevated heart rate, sleep disturbance, fatigue and irritability. During the first trimester of pregnancy, a sustained core temperature greater than 102.2^o F (39^o C) may endanger the fetus.

ATTACHMENT 3

COLD STRESS MONITORING AND WORK/RECOVERY REGIMENS

1.0 INTRODUCTION

Cold Stress TLVs are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV Objective is to prevent the deep body temperature from falling below 96.8^o F (36^o C) and to prevent cold injury to body extremities. For a single, occasional exposure to a cold environment, a drop in the core temperature to no lower than 95^o F (35^o C) should be permitted. In addition to provisions for total body protection, the TLV objective is to protect all parts of the body with emphasis on hands, feet, and head from cold injury.

This attachment includes guidance for monitoring and preventing cold stress in accordance with the 2007 ACGIH.

2.0 COLD STRESS EVALUATION AND CONTROL

Workers that will subject to working in cold environments should be familiarized with the symptoms and effects of cold work. This should include awareness of the effects of medication, use of alcohol on the worker, as well as recognizing the symptoms of frostnip, frostbite, and hypothermia.

The ESS with support by the PESM should evaluate the workplace conditions and implement the controls appropriate for the work being performed and the work environment.

2.1 Thresholds

For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of -25.6^o F (-32^o C). Superficial or deep local tissue freezing will occur only at temperatures below 30.2^o F (-1^o C) regardless of wind speed. Table 1provides the Equivalent Chill Temperatures on exposed flesh.

At air temperatures of 35.6^o F (2^o C), or less, it is imperative that workers who have become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and treated for hypothermia.

Special protection of the hands is required to maintain manual dexterity for the prevention of accidents, including:

- If fine work is to be performed with bare hands for more than 10-20 minutes in a temperature below 60.8^o F (16^o C), special provisions should be made for keeping workers hands warm, such as warm air jets, radiant heaters or contact warm plates. Metal handles of tools and control bars should be covered with thermal insulating materials below 30.2^o F (-1^o C).
- If the air temperature falls below 60.8^o F (16^o C) for sedentary, 39.2^o F (4^o C) for light, 19.4^o F (-7^o C) for moderate work, and fine manual dexterity is not required, then gloves should be used by workers.
- To prevent frostbite, the workers should wear anti-contact gloves.

- When cold surfaces below 19.4^o F (-7^o C) are probable, a warning to workers should be given to prevent inadvertent contact by bare skin.
- If air temperatures are 0^o F (-17.5^o C) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so they can be handled and used without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 39.2^o F (4^o C), including:

- Workers should wear cold protective clothing appropriate for the level of cold and physical activity.
- If the air velocity at the work site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.
- If only light work is involved and the worker may become wet on the job site, the outer type of clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent and the outerwear changed as it becomes wetted. Outer garments should have provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If a worker's clothes have become wet by sweat, the worker should change into dry clothes before entering the cold area. Workers should change socks and any removable liners or felt insoles at regular daily intervals, or use vapor barrier boots.
- If exposed area of the body cannot be protected sufficiently to prevent sensation of excessive cold or frostbite, protective items should supplied in auxiliary heated versions.
- If the available clothing does not give adequate protection to prevent frostbite or hypothermia, work should be modified or suspended until adequate clothing is available or until weathers conditions improve.
- Workers handling evaporative liquids (gasoline, alcohol, etc) at air temperatures below 39.2^o F (4^o C) should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporate cooling.

2.2 Work Warming Regimens

For work performed continuously in the cold at an equivalent chill temperature (ECT) or below 19.4^o F (-7^o C), heated warming shelters should be made available nearby with workers encouraged to use these shelters at regular intervals. The frequency of use should be dependent of the severity of the exposure. Table 2 provides a Work/Warm-up schedule for a four-hour schedule.

The onsite of shivering, minor frostbite, the feeling of excessive fatigue, drowsiness, or euphoria are indications for immediate return to the shelter. When entering the heated shelters, outer clothing should be removed and the remainder of clothing loosened or opened to permit sweat evaporation or a change of dry clothing provided.

Dehydration occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee or other diuretics should be limited.

For work practices at or below 10.4^o F (-12^o C) the following should be considered:

- Workers should be under constant protective observation (buddy system or supervision)
- The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work must be performed, rest periods should taken in heated shelters and the opportunity for changing into dry clothing provided.

- New employees should not be required to work fulltime in the cold during the first few days until they become accustomed to the working conditions and the required protective clothing.
- The weight and bulkiness of clothing should be factored into the estimates of required work performance and weights to be lifted by the worker.
- Work should be organized so that sitting still or standing still for long periods is minimized. Unprotected metal chairs should not be used. The worker should be protected from drafts to the greatest extent possible.
- Eye protection for workers employed out-of-doors in a snow or ice covered condition should be supplied. Special safety goggles to protect against ultraviolet light and glare that can cause temporary conjunctivitis and or temporary loss of vision, and blowing ice crystals when there is an expanse of snow coverage.
- Workers should be instructed in safety and health procedures related to cold environments work, including:
    - Proper rewarming procedures
    - First aid treatment
    - Proper eating and drinking habits
    - Recognition of impending frostbite
    - Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
    - Safe work practices

2.3 Workplace Monitoring

Suitable thermometry should be arranged at the any workplace where the environment is below 60.8° F (16° C) so that overall compliance with the TLV can be maintained. Whenever the air temperature falls below 30.2° F (-1° C), the dry bulb temperature should be measured and recorded at least every 4 hours.

Wind speed should be monitored and recorded when the rate exceeds 5 mph (2 m/s). When monitoring, the Equivalent Chill Temperature (ECT) should be recorded with the temperature and wind speed.

Individual employees should be excluded from working in cold at 30.2° F (-1° C) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -11.2° F (-24° C) with no wind, or -18° F (0° C) with wind speeds above 5 mph should be medically evaluated as suitable for such temperatures.

Provisions for providing first aid for trauma sustained in freezing or subzero conditions are required because an injured worker is predisposed to cold injury and should be protected against preventing hypothermia or freezing of damaged tissues in addition to providing the first aid.

Table 1 - Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (° F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperatures (° F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
Wind Speeds > 40 mph have little additional Effect	**LITTLE DANGER** In < hr with dry skin. Maximum danger of false sense of security				**INCREASING DANGER** Danger from freezing of exposed flesh within one minute				**GREAT DANGER** Flesh may freeze within 30 seconds			
	Trenchfoot and immersion foot may occur at any point on this chart Grayed areas = Equivalent Chill Temperature requiring dry clothing to maintain core body temperature above 96.8° F (36° C) per cold stress TLV											

* Developed by U.S Army Research Institute of Environmental Medicine, Natick, MA. As provided in American Conference Of Governmental Industrial Hygienists TLVs and BEIs 2006

TABLE 2 – WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT

Air Temperature Sunny Sky		No Noticeable Wind		5 mph Wind (8 k/hr)		10 mph Wind (16 K/hr)		15 mph Wind (24 k/hr)		20 mph Wind (32 k/hr)	
^{o}F (Approx)	^{o}C (Approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max Work Period	Number of Breaks	Max Work Period	Number of Breaks	Max Work Period	Number of Breaks
-15 to -19	-26 to -28	Normal breaks	1	Normal breaks	1	75 min.	2	55 min.	3	40 min.	4
-20 to -24	-29 to -31	Normal Breaks	1	75 min.	2	55 min.	3	40 min	4	30 min.	5
-25 to -29	-32 to 34	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-Emergency work should cease	
-30 to -34	-35 to -37	55 min.	3	40 min.	4	30 min.	5	Non-Emergency work should cease			
-35 to -39	-38 to -39	40 min.	4	30 min.	5	Non-Emergency work should cease					
-40 to -44	-40 to -42	30 min.	5	Non-Emergency work should cease							
-45 & below	-43 & below	Non-Emergency work should cease									

Notes:

1 Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of ten (10) minutes in a warm location and with an extended break (e.g. lunch) at the end of the 4-hour work period in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step low. For example, at -30 F (-35 C) with no noticeable wind (step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (step 5).

2. The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph - light flag moves, 10 mph – light flag fully extended, 15 mph – raises newspaper sheet, 20 mph – blowing & drifting snow.

3. TLVs apply only for workers in dry clothing.

Attachment 4 Example WBGT Monitoring Form

TETRA TECH EC, INC.

HEAT STRESS MONITORING LOG

DATE: _______ WBGT Location:_____________________________________

TIME	WBGT	AIR TEMP	NOTES & NOTIFICATIONS

WBGT – Wet Bulb Globe Temperature
Heat Strain potential Worker Body Core Temp: 101.3 F for acclimated Workers, 100.4 F for unacclimated workers

Monitor Name:____

EHS 5-1: Personal Protective Equipment (Previously HS5-1)

Purpose

The purpose of this program is to ensure that personal protective equipment (PPE) is selected in accordance with 29 CFR 1910.132, properly used and maintained, and that Tetra Tech EC, Inc. (TtEC) personnel are properly trained in the inspection, use and maintenance of PPE.

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1.0 PURPOSE

The purpose of this program is to ensure that personal protective equipment (PPE) is selected in accordance with 29 CFR 1910.132, properly used and maintained, and that Tetra Tech EC, Inc. (TtEC) personnel are properly trained in the inspection, use and maintenance of PPE.

2.0 SCOPE

This program applies to all TtEC operations including the activities of contractors on TtEC-managed projects.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with TtEC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director Compliance and Corporate Counsel.

4.0 DEFINITION

4.1 Personal Protective Equipment (PPE)

Items which are worn and are designed to protect the health and safety of an employee. This includes, but it is not limited to, chemical resistant shoes, boots, gloves, chemical protective clothing, hard hats, safety glasses, hearing protection, cooling/heating vests, life-lines and harnesses, and respirators. Additional program requirements for respirators are provided in EHS 5-2, Respiratory Protection.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 All TtEC Personnel

All personnel required to use PPE are responsible for wearing the appropriate PPE when required, inspecting the PPE prior to use, properly wearing the PPE, and as necessary, properly maintaining the PPE.

5.1.2 Line Management

Site supervisors are responsible for understanding the specific PPE requirements for each project task and ensuring that PPE is provided and worn when required and in the intended manner.

5.1.3 Environmental, Health and Safety Personnel

The Project Environmental and Safety Manager (PESM) is responsible for:

- Ensuring that PPE is selected in accordance with the hazard assessment requirements of 29 CFR 1910.132(d)
- Approving changes to PPE requirements through plan modifications or by incorporating criteria into the project plan which enable the Environmental and Safety Supervisor (ESS) to authorize changes to the PPE requirements.

ESS is responsible for:

- Monitoring PPE usage
- Recommending modifications to PPE requirements to project management and the PESM, as necessary
- Ensuring that project personnel have the proper training on the PPE which they are required to use, and performing training and retraining, as necessary
- Providing notifications to laundries which clean TtEC work clothing in accordance with 29 CFR 1910.120(k)(7).

5.2 Intended Use

PPE is intended for use when engineering controls, procedures, and/or work practices are not feasible, when control measures are shown to be ineffective for exposure minimization, when uncertainty exists regarding the nature and level of potential exposure, and as a precautionary measure to prevent exposure due to accidental releases of hazardous materials.

5.3 Hazard Assessment and Selection

Hazard assessments shall be performed during the preparation of all Environmental, Health and Safety (EHS) plan. See EHS 3-2 for a discussion of EHS Plans. The hazard assessment shall include consideration for:

- Potential chemical, physical and biological hazards present
- Work operations to be performed,
- Potential routes of exposure,
- Concentrations of contaminants present, and
- Characteristics, capabilities and limitations of PPE, and any hazards that the PPE presents or magnifies such as heat stress.

The EHS plan shall be used as the written documentation of the hazard assessment to comply with 29 CFR 1910.132(d)(2), and shall include the identification of the workplace evaluated, the person certifying that the evaluation has been performed, and the date(s) of the hazard assessment.

5.4 PPE Requirements

All PPE shall be of safe design and construction for the work to be performed and shall meet applicable ANSI standards and/or OSHA regulations.

PPE used exclusively for site work shall be provided at no cost to TtEC personnel. Leather safety shoes and prescription safety glasses are not provided to personnel by TtEC.

The office or site person responsible for issuance of PPE shall ensure that PPE properly fits each affected employee except that proper respirator fit will be evaluated in accordance with EHS 5-2, Respiratory Protection.

Eye and/or face protection shall be provided when hazards exist from flying particles, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation. Regarding eye and/or face protection:

- Side shields shall be used whenever site plans require the use of safety glasses. Employees who wear prescription lenses must use ANSI approved industrial prescription safety glasses with fixed side shields and/or prescription inserts for full face respirators as necessary to meet project requirements. The cost of eye examinations is the responsibility of the employee.

- Filter lenses for operations which involve injurious light radiation shall be in accordance with 29 CFR 1910.133(a)(5).

- A full face respirator is required whenever operations involve corrosive liquids and the operation requires the use of a respirator to provide for maximum eye protection; if the operation does not require a respirator, then splash goggles at a minimum shall be worn. Face shields are not a substitute for splash goggles.

Hard hats shall be provided whenever hazards from falling objects, overhead hazards, low clearance hazards exist, or required by project EHS plans.

Provisions shall be made in office locations for personnel to store and transport PPE required for field projects. Individuals shall be provided with equipment and an equipment bag large enough to hold the PPE normally required for the field projects which they support.

5.5 Work Clothing

TtEC's work uniform shall be cotton coveralls for personnel performing field work at hazardous waste sites. Exceptions to the cotton coverall requirement can be made by the PESM when the risk of contaminating personal clothing is remote. Personnel should not wear their personnel clothing (other than undergarments and socks) under the cotton coveralls. Attachment A or an equivalent shall be used to notify the laundry.

Home laundering of company-provided work clothing is not allowed. Each office or project shall provide for laundering of work clothing. When an outside laundry service is utilized, the laundry shall be notified in accordance with 29 CFR 1910.120(k)(7). The sample letter included as

Attachment A shall be used as a template for notification of laundries.

If work clothing becomes grossly contaminated with a hazardous material, i.e., requiring removal to prevent prolonged skin contact, the uniform is to be disposed of in the appropriate manner. Under no circumstances should grossly contaminated work clothing be taken home or sent to an outside laundry.

5.6 Inspection

Each employee is responsible for inspecting his/her PPE before and after each use.

Any damaged or defective PPE is to be taken out of service immediately, and repaired or replaced.

The Emergency Coordinator is responsible for ensuring that PPE maintained for emergency use is inspected as necessary.

5.7 Cleaning, Maintenance, and Disposal

Used, disposable PPE items are placed in containers at job sites for disposal. The PESM shall determine the proper method of disposal.

Non-disposable items such as hard hats and rubber boots are to be decontaminated at the job site. Personnel are responsible for cleaning their own PPE after each work shift unless other arrangements are made for the project. Site-specific cleaning procedures are listed in the EHS plans for each job site.

Non-disposable PPE is stored in the employees' lockers, equipment bags, or other suitable locations when not in use.

5.8 Medical Evaluation

Medical surveillance examinations for personnel required to wear PPE will include an evaluation of the person's ability to tolerate the physical stresses posed by protective equipment. See EHS 4-5, Medical Surveillance, for additional information regarding the TtEC medical surveillance program.

5.9 Training

5.9.1 Initial Training

Training in PPE inspection, use and maintenance is conducted as part of the initial hazardous waste 40-hour training. This training provides personnel with an understanding of the inspection, use (including donning, doffing, adjusting, and wearing), limitations, care, and maintenance of PPE.

5.9.2 Site-Specific Orientation

Site-specific orientations shall be used to communicate selection decisions to site personnel to meet the requirements of 29 CFR 1910.132(d)(1)(ii). The site-specific orientation shall ensure that site personnel:

- Understand when PPE is necessary, what PPE is necessary, the limitations of the PPE, and the proper disposal of the PPE;
- Understand how to use the specific PPE required by the project; and
- Has retained the basic PPE knowledge from the initial training.

5.9.3 Retraining

Retraining shall be performed:

- Whenever TtEC personnel have reason to believe that a person does not have the requisite understanding and skill to properly and safely use PPE;
- When changes in the workplace or work plans require modifications to the types of selected PPE; and
- As necessary, to inform TtEC personnel of changes to the requirements of this program.

5.10 Documentation

PPE training shall be documented through a written certification that contains the name of each person trained, the date(s) of the training, and the identification of the subject of the certification. Training certification may be accomplished as follows:

- For initial, supervisor and refresher training, TtEC shall maintain a copy of the course agenda in conjunction with the course certificate.
- For site-specific orientation, site-specific training and required retraining, the training sign-in sheet shall contain the required information identified above.

Training records shall be maintained in accordance with EHS 1-9, Recordkeeping.

6.0 REFERENCES

29 CFR 1910.120(k)(7), Hazardous Waste Operations and Emergency Response.
29 CFR 1910.132, Personal Protective Equipment, General Requirements.
29 CFR 1910.133, Personal Protective Equipment, Eye and Face Protection.
29 CFR 1910.134, Respiratory Protection.
Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping
Environmental, Health & Safety - Programs Procedure EHS 3-2, Environmental, Health & Safety Plan(s)
Environmental, Health & Safety - Programs Procedure EHS 4-5, Medical Surveillance
Environmental, Health & Safety - Programs Procedure EHS 5-2, Respiratory Protection
OSHA (U.S. Department of Labor, Occupational Safety and Health Administration)

7.0 ATTACHMENTS

Attachment A - Laundry Notification Letter

EHS 5-1 ATTACHMENT A
LAUNDRY NOTIFICATION LETTER

Click the icon below to launch or download.

EHS 5-1 Attachment A.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

EHS 5-1 ATTACHMENT A

TETRA TECH EC, INC.

LAUNDRY NOTIFICATION LETTER

Date

XYZ Laundry
Clean Street
Whitewash, NJ 12345

To Whom It May Concern:

The purpose of this letter is to inform you of the nature of the operations at Tetra Tech EC, Inc. (TtEC) ABC Project, to provide you with information on the site contaminants, and to document the notification required by OSHA 29 CFR 1010.120(k)(7).

TtEC's ABC Project involves the (Provide information on the general scope of the project in two or three sentences).

The known contaminants at the site include (Provide or attach a listing of the known site contaminants). The levels of these contaminants in the (State media) are (Describe general levels of contaminants). The potential health hazards of from these contaminants are (Describe potential health hazards from exposure or attach information from the HASP).

Personnel at this site wear outer disposable clothing which minimizes contamination of the clothing which you receive for laundering. (Modify previous sentence if disposable clothing is not worn or not worn for all job tasks. When disposable clothing is not worn, explain why not and why contamination of the clothing would be minimal.) In addition, any clothing which becomes grossly contaminated will be disposed of in an appropriate manner and will not be sent to you for laundering.

Please provide your employees with the above information. If you have any questions, do not hesitate to contact me or (Name of PESM or ESO).

Sincerely,
TETRA TECH EC, INC.

John Smith
Project Manager

cc: Project EHS File

EHS 6-4: Lockout/Tagout (Previously HS6-5)

Purpose
The purpose of this program is to establish the minimum requirements and procedures for performing lockout/tagout on machines and equipment in accordance with 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tagout).

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6.0 REFERENCES

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1.0 PURPOSE

The purpose of this program is to establish the minimum requirements and procedures for performing lockout/tagout on machines and equipment in accordance with 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tagout).

2.0 SCOPE

This program applies to all Tetra Tech EC, Inc. (TtEC) operations, except as follows:

- Work on cord and plug connected electrical equipment where the plug is under the control of the employee performing the work;
- Hot tap operations; and
- Work involving minor changes and adjustments to equipment during routine operations (such as small tooling adjustments).

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with TtEC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director Compliance and Corporate Counsel.

4.0 DEFINITIONS

4.1 Affected Employee

An employee whose job requires them to operate or use a machine or equipment on which servicing, maintenance, or other work is performed under lockout/tagout or whose job requires them to work in an area in which equipment is locked out.

4.2 Authorized Employee

A person who locks out or implements a lockout/tagout system procedure on machines or equipment. Authorized and affected employees may be the same person when the authorized employee's duties also include performing work on a machine or equipment upon which lockout/tagout is implemented.

4.3 Energized

Connected to an energy source or containing residual or stored energy.

4.4 Energy Isolating Device

(Isolation Points) - A mechanical device that may be used to physically prevent the transmission, flow, or release of energy, including but not limited to the following:

- electrical circuit breakers;
- slide gate;
- disconnect switches;
- piping flanges;
- control switches; and
- other similar devices.

4.5 Energy Source

Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, potential, or other energy.

4.6 Lockout

The placement of a lockout device and tag on a lockout device ensuring that the energy isolation device and equipment cannot be operated until the device is removed.

4.7 Lockout Device

A device that physically controls the configuration of an energy isolation point. Lockout devices include but are not limited to the following:

- locks
- chains
- valve covers
- circuit breaker hasps
- blind flanges
- slip blinds, and
- multiple lock hasps

4.8 Supervisor Lock

A lock installed by an authorized supervisor for the purpose of maintaining control of a machine or piece of equipment for a period greater than one work shift.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Authorized Employees

Authorized employees shall lockout and tag all energy isolation devices which are required to be locked out by this procedure. The employee shall complete all permits and tags in accordance with instructions and shall remove their locks and tags and return them at the end of their shift or the end of the procedure.

5.1.2 Line Management

Supervisors shall ensure proper implementation of the lockout/tagout procedure including approval of permits and maintenance of personal locks and a log of lock assignments. In group lockout procedures the supervisor shall lock and tag all the appropriate energy isolation devices and deposit his/ her key in the lockbox.

5.1.3 Environmental, Health and Safety Personnel

The Environmental and Safety Supervisor (ESS) is responsible for providing the training required in this procedure to supervisors and craft employees, and conducting periodic inspections to ensure this procedure is effectively implemented. The ESS shall also implement lockout/tagout procedures as required.

5.2 General Requirements

Following are the steps to be followed in preparing for, applying, and releasing a machine or piece of equipment from lockout. These steps shall be completed, in order, using the corresponding permit included as Attachment A. While work is being performed under the lockout, a copy of the completed permit shall be posted at the equipment controls or work area as appropriate.

1. Complete the general information in Section A of the permit

2. Identify Isolation Points

   The first step required to isolate a piece of equipment is to identify the sources of hazardous energy present. To identify the sources, the authorized employee shall complete the following steps:

   - Survey the equipment and related schematics, blueprints, or as-builts, if available, for hazardous energy sources;

   - Identify the isolation points and device positions for controlling each source of hazardous energy; and

   - Identify the isolation method to be used on each source.

   The above information shall be documented in Section B of the Lockout/Tagout Permit as each point is identified.

3. Notifications

   Prior to applying a lockout, the authorized employee shall notify affected employees of the equipment to be locked out and sign Section C of the Lockout/Tagout Permit on the "Notifier" line.

4. Equipment Shutdown

   Shut down the equipment or place into the desired configuration using normal operating procedures. The authorized employee shall sign Section C of the Lockout/Tagout Permit on the "Shutdown by" line.

5. Equipment Isolation

   To apply a lockout to a piece of equipment, complete the following steps:

   - Place each energy isolation device into a position that will prevent the transmission of hazardous energy; and

   - The authorized employee shall lockout devices to each isolation point and control the key for each lock at all times. Only one key is permitted per lock.

   Complete Section D of the permit as each device is placed and sign the "Isolator" line in Section C.

   Notes:

   - Any lockout device not containing an integral locking mechanism must be used in conjunction with a keyed lock.

   - Any energy isolation point not capable of being locked out must be controlled physically through such means as removal of handles and disconnecting.

6. Release of Stored Energy

   After the equipment has been locked and tagged as required in Section D all remaining stored energy must be released. Methods for the release of stored energy include, but are not limited to the following:

   - Discharge and grounding of capacitors,

   - Bleeding pressure from vessels and lines, and

   - Releasing mechanical sources of energy to engage blocks.

   If stored energy has the potential to re-accumulate; therefore, verification of isolation shall continue until work is complete. After releasing stored energy complete Section E of the permit.

7. Lockout/Tagout Verification

   After completing the lockout of the desired piece of equipment the effectiveness of the lockout must be verified by the authorized employee by attempting to operate the machine. After attempting to operate the machine, sign Section C of the permit on the "Verifier" line.

8. Performance of Work

   After verifying and receiving the supervisor's approval signature, work may be performed on the equipment which was locked/tagged.

9. Lockout/Tagout Removal

After work has been completed the following steps shall be followed to release equipment from lockout tagout:

- The area affected by the lockout shall be inspected to ensure that releasing the machine does not present a hazard to people and property,
- Lockout devices and tags shall be removed,
- Isolation devices returned to their operating positions,
- The equipment started, and
- Affected employees shall be notified of the release.

Section F of the permit shall be completed as the equipment is returned to service.

5.3 Testing/Positioning

When necessary to interrupt lockout/tagout for testing or repositioning, the steps contained in Section 5.2 shall be followed.

5.4 Group Lockouts

When multiple people are scheduled to work on a system, the following group lockout procedure should be implemented as follows:

- The Site Supervisor shall place their lock on the energy isolation device(s) using a multilock hasp.
- Authorized employees shall place their individual locks on the multilock hasp.
- When the group has completed their work, the supervisor shall verify all employee locks have been removed before the supervisor removes his/her lock.

5.5 Tagout

The use of tags without locks is prohibited, except in those cases where it is physically impossible to attach a locking device to an isolation point. When it is necessary to use tags without locks the following shall be completed.

- The isolation point shall be placed in the correct position to prevent the flow of energy;
- The device shall be physically disconnected;
- A tag shall be placed on the disconnected device; and
- Employees shall be warned not to tamper with the tag or isolation point.

5.6 Equipment-Specific Lockout/Tagout Procedures

As TtEC does not normally perform lockouts of machinery on a repetitive basis the LO/TO permit contained in Attachment A is designed for initial and one-of-a-kind lockouts. Should it become necessary to repetitively lockout the same piece of equipment, specific procedures and permits for the equipment shall be developed.

Information contained in the equipment-specific procedure and permit should be the same as the information in the Attachment A permit. The procedures shall be generated by trained and knowledgeable project personnel and be reviewed and approved by the Project Environmental and Safety Manager (PESM).

Equipment-specific procedures are not required when all of the following conditions are present:

- The machine has no potential for stored energy or the reaccumulation of energy after shutdown; and
- The equipment has a single, readily identifiable, and isolated source of energy; and
- Isolation and lockout of the source will completely deenergize and deactivate the equipment; and
- The machine is locked out and isolated from that energy source during servicing and maintenance; and
- A single lockout device will achieve a locked-out condition; and
- The servicing or maintenance does not create a hazard to other employees.

5.7 Shift Changes

When necessary to maintain the status of a locked out machine or device past the end of the shift when the lockout was initially installed the following procedures shall be adhered to:

- The incoming authorized employee shall place their lock hasp on the lockout point and complete a new permit.

- The outgoing employees shall remove their lock(s) after the new lock(s) are applied.
- If multiple shifts are not used, the initial locks may be left in place until the following day or until the equipment is released from lockout/tagout.
- The new shift supervisor shall sign the permit before work is begun on the new shift. The last supervisor whose name is on the lockout/tagout tags permit is responsible for all activities related to the work activity.

5.8 Failure to Clear Locks

If a person should fail to clear a lockout and their lock remains in place, the supervisor will attempt to contact the person who applied the lock and resolve the issue.

If the person cannot be contacted, the supervisor will investigate the situation and determine that removal of the lock will not create a hazard in the work zone. The supervisor will then verify that the work zone is clear, and blocking devices have been removed and the system has been restored to the normal configuration. The supervisor will then cut the lock off and restore energy to the system.

A written incident and investigation report per EHS 1-7, Incident Reporting and Investigating, shall be prepared by the supervisor stating the reason for cutting the lock, why the lock was not removed, and the procedure used to ensure the safety of personnel in the area. The individual whose lock was cut off must be notified ASAP.

5.9 Subcontractors

The supervisor shall be familiar with the nature of any subcontractor work on-site that may involve hazardous energy and assure that they follow work practices that are at least as strict as this procedure.

For any lockout/tagout requirements, the supervisor shall review and approve all subcontractor work set up, apply his locks to the scheme, and sign the appropriate lockout/tagout procedure checklist.

5.10 Periodic Inspections

Periodic inspections pursuant to EHS 3-3, Inspections, shall be completed during the monthly inspections by the ESS, PESM or other qualified personnel to ensure that the lockout tagout program is being effectively implemented. As a minimum the following shall be done:

- Existing lockouts will be reviewed for effectiveness;
- Permits for each existing lockouts shall be reviewed for adequacy;
- Incident reports and past permits shall be reviewed to determine if deficiencies in the program exist;
- Corrections to the system will be made as warranted; and
- Results will be logged in the health and safety logbook.

5.11 Training

Following are the training requirements for various personnel involved with or affected by lockout/tagout.

- Authorized Employees shall receive training in the following prior to being allowed to use lockout/tagout procedures:
  - Recognition of hazardous energy sources;
  - Types and magnitudes of energies available at the site;
  - Methods and means needed for energy isolation and control; and
  - The requirements of this procedure and 29 CFR 1910.147.

- Affected Employees shall be instructed in the following:
  - Purpose of the lockout tagout program;
  - Use and requirements of this procedure and 29 CFR 1910.147;
  - Prohibitions of restarting or tampering with equipment that has been locked out; and
  - Prohibitions of tampering with locks and tags installed on equipment.

Personnel not employed by TtEC shall be briefed in the requirements of this program during site-specific orientations, when applicable.

Training records shall be maintained in accordance with EHS1-9, Recordkeeping.

6.0 REFERENCES

29 CFR 1910.147, The Control of Hazardous Energy (Lockout/Tagout).
Environmental, Health & Safety - Programs Procedure EHS 1-7, Incident Reporting and Investigation
Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping
Environmental, Health & Safety - Programs Procedure EHS 3-3, Inspections
OSHA (U.S. Department of Labor, Occupational Safety and Health Administration)

7.0 ATTACHMENTS

Attachment A - Lockout Tagout Permit

EHS 6-4 ATTACHMENT A
LOCKOUT TAGOUT PERMIT

Click the icon below to download and complete.

EHS 6-4 Attachment A.doc

Select the "Detach" button in the pop-up window to save a copy to a disk or hard drive.

TETRA TECH EC, INC.

LOCKOUT/TAGOUT PERMIT

Project Name: ______________________________ **Location:** ________________________

SECTION A	SECTION C
DATE:________________ SHIFT:____________________________________	REQUESTOR:________________
EQUIPMENT DESCRIPTION:_______________________________________	NOTIFIER:__________________
EQUIPMENT LOCATION:____	SHUT DOWN BY:_____________
REASON FOR LOCKOUT/TAGOUT:___________________________________	ISOLATOR:_________________
SUPERVISOR ON DUTY:____	VERIFIER:_________________
AUTHORIZED EMPLOYEE:____	APPROVED BY:______________
LOCKOUT LOCATIONS:____	

SECTION B ISOLATION INFORMATION			SECTION D EQUIPMENT ISOLATION				SECTION F LOCKOUT/TAGOUT REMOVAL		
Device Description	Location	Isolation Position	Applied By	Lock #	Date	Time	Removed By	Date	Time

SPECIAL INSTRUCTIONS FOR REMOVAL OR RELEASING STORED ENERGY

Wednesday, November 09, 2011
12:35 PM

EHS 6-6 : Boating

Last Revision By: Kennedy Lugo on 09/17/2010
Created By: Lisa Kaminski on 10/22/2009

Purpose:	The purpose of this program is to establish minimum requirements for boating safety.		
Version Date:	01/27/2010 - Revised	**Original Issue Date:**	02/01/95
Category:	Company Procedures	**Sections:**	ESQ - Environmental Health & Safety Programs
Sub Category:	Departmental/Discipline	**Document Type:**	Procedure
Keyword Index:	Field Activities/Science Training	**Document Owner:**	Grey Coppi
Approved By:			

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1.0 PURPOSE

The purpose of this program is to establish minimum requirements for boating safety.

2.0 SCOPE

This procedure applies to all Tetra Tech EC, Inc. (TtEC) projects.

3.0 MAINTENANCE

The Director, EHS Programs is responsible for updating this procedure. Approval authority rests with TtEC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure.

4.0 DEFINITIONS

4.1 Boat

Any powered or nonpowered watercraft utilized for the transport of personnel on a body of water.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Line Management

The Project Manager (PM) is responsible for coordinating with the appropriate TtEC Project Environmental and Safety Manager (PESM) to implement the requirements of this procedure. The PM shall provide the necessary management support and allocate sufficient project resources to permit project personnel to operate boats in a safe manner.

Site managers and supervisors are responsible for implementation of this boating safety program in the field.

5.1.2 Environmental, Health and Safety Personnel

The PESM shall ensure that the requirements of this program are incorporated into site Environmental Health and Safety (EHS) plans.

5.2 General Requirements

5.2.1 Boat Towing and Launching

TtEC personnel who will tow a boat on a trailer to the launching site will be experienced in this capacity and be responsible for reviewing the Boating Checklist (Attachment 1) prior to departure. Ensure that the boat is not loaded with project equipment that will overload the bearings and axle weight capacity. This equipment should be carried in another or the towing vehicle.

A person experienced in towing a boat, launching, or piloting a vessel must be designated by the Project Manager. This person must be designated by the Project Manager. This person must have the U.S. Coast Guard approved small boat safety training course.

Pre-launch checks will be done before the boat is backed into the water and includes checking the engine oil and/or fuel mixtures in the tanks. Any mixing of fuel and oil will be done in a separate UL approved flammable liquid storage container prior to filling the vessel tanks. This will ensure the gas/oil mixture is correct..

Whenever possible, perform fuel mixing and transfer in an environmentally safe area where spills can be easily cleaned.

To launch the vessel, back part way down the boat ramp, remove the rear tie down straps to the trailer, ensure the boat plug is installed and continue backing into the waters edge. Place the fenders/bumpers on the side that will be in contact with the pier to prevent damage. Ensure that the bow and stern lines are being handled by personnel on the pier as the vessel is backed further into the water until the vessel is floating freely. An alternative is to have the coxswain in the boat lower the engine and start it when the rear is in the water and floating free from the trailer. He can carefully back the boat with the engine clear of the trailer. Pull the truck and trailer forward and park and secure. Secure the bow and stern lines to the dock and load additional equipment. Lower the engine/out drive if necessary and start the engine. Once warm, turn off the engine and restart to ensure that the motor is working properly.

For vessel recovery, reverse the process listed above. Back the truck and trailer down the ramp and place the truck in park with the emergency brake on. Keep the bow winch connected to the vessel until the vessel is out of the water on the trailer. Raise the motor/outdrive and secure in the up position. The vessel is not to be towed or loaded with a person on the vessel. Once the vessel is trailered, remove additional equipment as necessary to reduce weight and secure the vessel to the trailer with bow and stern straps and the safety chain near the winch.

5.2.2 Boat Operators

Only designated TtEC personnel who meet the training requirements under USACOE EM 385-1-1 section 19.F. shall operate a boat during the course of a project.

Boat operators shall possess basic knowledge to troubleshoot common mechanical problems that can occur on the board. The boat operator shall be responsible for the safety of all personnel on board the boat he or she is operating and for the integrity of all boat and safety equipment.

Each designated boat operator shall give a safety briefing to boat occupants prior to leaving shore. **Boats are to be occupied during use by not less than one qualified operator plus one additional person.** In the event that the "additional person" is not a qualified operator, a basic safety and operations demonstration will be conducted before launching.

5.2.3 Boat Passengers

Project personnel riding as passengers in a boat shall comply with U.S. Coast Guard requirements.

5.3 Float Plan

A float plan shall be developed by the Environmental and Safety Supervisor (ESS) or FOL for all trips made by boat using the US Coast Guard example Float Plan located in Attachment 2. The ESS or SM/FOL shall be aware of the location of all project boats and personnel using them at all times. If several boats and crews are involved or are traveling to remote areas, each designated boat operator shall file a written float plan with the ESS or SM/FOL. The float plan shall include the following:

- The names of the boat operator and passengers;
- A description and registration numbers of the boat;
- Radio call sign or cellular telephone number if boat is so equipped;
- A trip itinerary with expected time and location of return;

- Steps the ESS or SM/FOL will take to initiate a search response if the expected time of return is exceeded; and
  - A Float Plan shall be prepared by each designated boat operator and approved by the PM, and ESS, and/or qualified person prior to the activity.

5.4 Boat Registration and Numbering

The ESS or SM/FOL shall ensure that all project boats meet U.S. Coast Guard or state boat registration and numbering requirements. The US Coast Guard requires that all motorized boats be numbered in the state of principal use. Many states also require that certain non-motorized boats be numbered (sailboats, rafts, and dinghies). A valid certificate or number showing the numbers issued to the boat is required to be on board the boat whenever the boat is in use. Boat registration numbers are required to be painted or permanently attached to each side of the forward half of the boat. Boat registration must be updated annually.

5.5 U.S. Coast Guard-Approved Equipment

All TtEC project boats will meet or exceed U.S. Coast Guard requirements for safety equipment. These requirements are summarized below for small craft (less than 12 meters in length). The ESS or SM/FOL shall consult with the PESM if larger craft are required.

5.5.1 Flame Arresters

All gasoline engines, except outboard motors, installed in a boat must have an approved flame arrestor (backfire preventer) fitted to the carburetor.

5.5.2 Sound Signaling Devices

Although not required for small craft, all TtEC boats shall carry at least one air horn or similar sound-signaling device.

5.5.3 Personal Flotation Devices

All TtEC personnel and passengers shall wear an approved personal flotation device (PFD) at all times when operating or being transported in a boat. A positively buoyant wet suit or dry suit may be substituted for a PFD. PFDs shall be Type II or higher (capable of turning its wearer in a vertical or slightly backward position in the water) unless the Project Environmental Safety Manager approves Type III based on conditions. Automatic inflating PFDs can be used providing that they are approved in the Health and Safety Plan, an AHA addresses its use, the PFD is not used by persons less than 90 pounds and, it is inspected, maintained and stored in accordance with the manufacturer's instruction. In addition, each boat up to 26 feet in length shall be equipped with at least one Type IV PFD, ring buoy, 24 inches in diameter with 90 feet of buoyant line attached, designed to be thrown to a person in the water and grasped and held by the user until rescued. A buoyant boat cushion equipped with straps and a float ring are two common examples of additional types of life rings that can qualify as a Type IV PFD and help in a rescue.

5.5.4 Fire Extinguishers

Each boat used by TtEC personnel less than 26 feet shall carry at least one 1-A:10:BC fire extinguisher (for use in gasoline, oil and grease fires) approved by Underwriters Laboratories (UL). Motor boats or skiffs over 26 feet will have a minimum of two 1-A:10BC fire extinguisher available. Larger craft will have additional requirements. Each fire extinguisher shall be inspected by the ESS or SM/FOL at least once every week to ensure that it is sufficiently charged and that the nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately. The number and sizes of extinguishers required will depend on the vessel size and applicable regulations.

5.5.5 Navigation Lights

Each boat operated at night shall be equipped with navigation lights and these lights shall be utilized at all times when operating between sunset and sunrise. Navigational lighting shall be in compliance with U.S. Coast Guard requirements. Boats shall be operated at reduced speeds at night and when visibility is reduced.

5.5.6 Visual Distress Signals

All TtEC boats shall carry a selection of pyrotechnic and nonpyrotechnic visual distress signals. Pyrotechnic visual distress signals include red flares, orange smoke, and aerial red meteor or parachute flares. Nonpyrotechnic visual distress signals include an orange distress flag and a flashlight or other electric distress light. No single signaling device is ideal under all conditions and for all purposes. Pyrotechnic visual distress signals shall not be used past the expiration date.

5.5.7 Pollution Control

The Refuse Act of 1989 prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil, and other liquid pollutants) into the waters of the United States. The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances in quantities that may be harmful into U.S. navigable waters. No person may intentionally drain oil or oily wastes from any source into the bilge of any vessel. Larger vessels equipped with toilet facilities must be equipped with a U.S. Coast Guard-approved marine sanitation device.

TtEC employees shall report any significant oil spills to water to the PESM who must report the spill to the U.S. Coast Guard or other applicable regulatory agency. The procedure for incident reporting and investigation shall be followed when reporting the spill. (See EHS 1-7, Event Reporting and Investigation).

5.6 Load Capacity

Boats shall not be loaded (passengers and gear) beyond the weight capacity printed on the U.S. Coast Guard information plate attached to the stern. In addition, several factors must be considered when loading a boat: distribute the load evenly, keep the load low, do not stand up in a small boat or canoe, and do not overload the boat.

5.7 Tool Kit

All TtEC motorized boats shall carry a tool kit sufficient for the boat operator to troubleshoot common mechanical problems such as fouled spark plugs, flooded carburetor, electrical shorts, etc. Boats operated in remote areas shall also carry appropriate spare parts (propellers, shear pins, patch kits, air pumps, etc). The tool kit shall be maintained by the boat operator with supplies replaced immediately upon use.

5.8 Survival Kit

All TtEC boats utilized in remote areas shall carry a survival kit. The survival kit shall contain, at a minimum, a first aid kit, high-energy canned or preserved foods, drinking water, blankets, a heat source, signaling devices waterproof matches, and other items as necessary to ensure survival for a minimum of 24 hours for the entire crew. Survival suits may be required by the EHS plans for operations in cold environments.

5.9 Communications

All TtEC boats operated in remote areas shall carry a two-way radio or cellular telephone that enables communication back to the field camp or other pre-established location. Exceptions to this requirement must be negotiated with the PESM. Additional communication and locating methods may be utilized such as SPOT Messenger, GPS and satellite telephones.

5.10 Boating Accident Report

The U.S. Coast Guard requires filing of a boating accident report within 24 hours of an accident. TtEC personnel involved in a boating accident shall follow the procedure outlined in EHS plans and EHS 1-7, Event Reporting and Investigating for accident and injury reporting. This procedure will provide for proper notification of the U.S. Coast Guard.

5.11 Good Housekeeping

TtEC personnel using a boat shall properly stow and secure all gear and equipment against unexpected shifts when underway. Decks and open spaces must be kept clear and free from clutter and trash to minimize slip, trip, and fall hazards.

5.12 Fuel Management

TtEC personnel shall utilize the "one-third rule" in boating fuel management. Use one-third of the fuel to get to the destination, one-third to return, and keep one-third in reserve.

5.13 Training

Boat operators shall be trained on and pass the test of U.S. Coast Guard boating safety requirements. All operators and passengers shall be trained on the requirements of this program. Training records shall be maintained in accordance with EHS 1-9, Recordkeeping.

5.14 Operations

Operations of motor boats/skiffs in can be hazardous to personnel considering other boaters, weather conditions, the task assigned and the condition of the boat/skiff you are operating. Ensure Attachment 1, Work Boat Inspection Checklist is completed before departing the launch area.

When operating in restricted waters, near shipping channels, in rough fast flowing water or near obstacles that could damage or capsize the boat, plan for emergency rescue in case the boat motor fails or you become incapacitated from operating the boat and you are in personal danger. Consideration would be for a second motor or a safety boat operating in the area or other rescue capability available.

6.0 REFERENCES

Please Describe Your Reference Here	Place Your Link in this Column
1. 33 CFR Subchapter S, Boating Safety	
2. Environmental, Health & Safety Programs, Procedure EHS 1-7 Event Reporting & Investigation	
3. Environmental, Health & Safety Programs, Procedure EHS 1-9 Recordkeeping	
4. U.S. Department of Transportation, U.S. Coast Guard	
5. http://www.floatplancentral.org	http://www.floatplancentral.org
6.	
7.	

7.0 ATTACHMENTS

Please Provide a Description of the Attachment	Place Your Attachments Here
1. Attachment 1, Boating Checklist	EHS 6-6 Boat Inspection List 12-08-09 PLBgc122809.doc
2. Attachment 2, U.S. Coast Guard Float Plan	USCG Float Plan.pdf
2.	

ATTACHMENT C

INSPECTION AND REPORTING FORMS

SMALL BOAT INSPECTION CHECKLIST			Date of Inspection:
Contractor			Contract No.
Inspected by (Signature)			
Safety and Health Requirement to Reference EM 385-1-1. Section 19.F	Yes	No	N/A
Is each operator properly licensed?			
Is hull in satisfactory condition? (Any obvious leaks?)			
Are the lights properly maintained, assuring that they can be seen between sunset and sunrise?			
Is condition of fuel supply hose satisfactory?			
Is boat equipped with a white stern light, having a 0.2-mile visibility?			
Is the maximum number of passengers that can be safely transported posted on all launched, motorboats and skiff?			
Does horsepower of engine meet hull specifications?			
Is signal device provided on the vessel to give signals required by applicable navigation rules?			
Are visual distress signal devices (day and night) present and up to date?			
Is type and size of anchor and attached line suitable for size of boat?			
Are paddles and/or oars onboard and in good condition?			
Is bilge pump and discharge (if so equipped) properly located and in good operating condition?			
Is fully stocked First Aid kid of proper size onboard?			
Are navigation lights working properly?			
Has a Type II / Type V or better USCG personal flotation device (PFD) been provided to all boat passengers and properly worn?			
Are PFDs inspected for defects which would alter their buoyancy before and after each use?			
Are defective PFDs or PFDs with less than 13 pounds buoyancy removed from service?			
Are PFDs equipped with retro-reflective tape meeting EM385-1-1.			
Is each boat equipped with at least one USCG-approved life ring or ring buoy with at least 90 feet 3/8" solid braid polypropylene line or equivalent attached?			
Is the motor boat equipped with a kill switch?			
Are boat seats securely bolted to the boat desk?			
Are launches and motorboats equipped with fire extinguishers of at least the size and ratings specified?			

(For Safety Staff only)	REPORT NO.	EROC CODE	**UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT** *(For Use of this Form See Help Menu and USACE Suppl to AR 385-40)*	**REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)**

1. ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE	MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER		☐	

2. PERSONAL DATA

a. Name *(Last, First, MI)*	b. AGE	c. SEX ☐ MALE ☐ FEMALE	d. SOCIAL SECURITY NUMBER	e. GRADE

f. JOB SERIES/TITLE	g. DUTY STATUS AT TIME OF ACCIDENT	h. EMPLOYMENT STATUS AT TIME OF ACCIDENT
	☐ ON DUTY ☐ TDY ☐ OFF DUTY	☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER ☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL ☐ TEMPORARY ☐ STUDENT ☐ OTHER *(Specify)* ______

3. GENERAL INFORMATION

a. DATE OF ACCIDENT *(month/day/year)*	b. TIME OF ACCIDENT *(Military time)* hrs	c. EXACT LOCATION OF ACCIDENT	d. CONTRACTOR'S NAME (1) PRIME: (2) SUBCONTRACTOR:

e. CONTRACT NUMBER	f. TYPE OF CONTRACT	g. HAZARDOUS/TOXIC WASTE ACTIVITY
______ ☐ CIVIL WORKS ☐ MILITARY ☐ OTHER *(Specify)* ______	☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER *(Specify)* ______	☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER *(Specify)* ______

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY	(CODE) #	b. TYPE OF CONSTRUCTION EQUIPMENT	(CODE) #

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY (CODE) #	b. ESTIMATED DAYS LOST	c. ESTIMATED DAYS HOSPITALIZED	d. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED	(CODE)	g. TYPE AND SOURCE OF INJURY/ILLNESS	(CODE)
PRIMARY ______	#	TYPE ______	#
SECONDARY ______	#	SOURCE ______	#
f. NATURE OF ILLNESS/INJURY ______	(CODE) #		

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT	(CODE) #	b. PERSONAL FLOATATION DEVICE USED? ☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE	b. TYPE OF COLLISION	c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
☐ PICKUP/VAN ☐ AUTOMOBILE	☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END	(1) FRONT SEAT			
☐ TRUCK ☐ OTHER *(Specify)* ______	☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER *(Specify)* ______	(2) REAR SEAT			

8. PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	b. OWNERSHIP	c. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*

a. TYPE OF VESSEL/FLOATING PLANT	(CODE) #	b. TYPE OF COLLISION/MISHAP	(CODE) #

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

11. CAUSAL FACTOR(S) *(Read Instruction Before Completing)*

a. (Explain YES answers in item 13)

	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐

a. *(CONTINUED)*

	YES	NO
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident	☐	☐

b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES *(If yes, attach a copy.)* ☐ NO

12. TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	(Month) (Day) (Year)

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE

b. INDIRECT CAUSE(S)

14. ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).

DESCRIBE FULLY:

15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING (Month/Day/Year)	b. ANTICIPATED COMPLETION (Month/Day/Year)		
c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT CORPS ______ CONTRACTOR ______	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect)*	f. OFFICE SYMBOL

16. MANAGEMENT REVIEW *(1st)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19. COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE	DATE

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10. **ACCIDENT DESCRIPTION** *(Continuation)*

13a. **DIRECT CAUSE** *(Continuation)*

13b. **INDIRECT CAUSES** *(Continuation)*

14. **ACTION(S) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(S)** *(Continuation)*

GENERAL. Complete a separate report for each person who was *injured*, *caused*, or *contributed* to the accident (excluding uninjured personnel and witnesses). Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs (OWCP) shall be at the descretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es). If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16. and 17.

INSTRUCTIONS FOR SECTION 1—ACCIDENT CLASSIFICATION. *(Mark All Boxes That Are Applicable.)*

a. GOVERNMENT. Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.

(1) INJURY/ILLNESS/FATALITY—Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 (injury), CA-2 (illness), or CA-6 (fatality) to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.

($2,000 or more)

(2) PROPERTY DAMAGE—Mark the appropriate box if accident resulted in any damage of $2000 or more to government property (including motor vehicles). also see ER385-1-99 for new classes of accidents.

(3) VEHICLE INVOLVED—Mark if accident involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY—Mark if the accident involved an in-house USACE diving activity.

b. CONTRACTOR.

(1) INJURY/ILLNESS/FATALITY—Mark if accident resulted in any contractor lost-time injury/illness or fatality.

($2,000 or more)

(2) PROPERTY DAMAGE—Mark the appropriate box if accident resulted in any damage of $2000 or more to contractor property (including motor vehicles). also see ER385-1-99 for classes of accidents

(3) VEHICLE INVOLVED—Mark if accident involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY—Mark if the accident involved a USACE Contractor diving activity.

c. PUBLIC.

(1) INJURY/ILLNESS/FATALITY—Mark if accident resulted in public fatality or permanent total disability. (The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander).

(2) VOID SPACE—Make no entry.

(3) VEHICLE INVOLVED—Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" is marked.

(4) VOID SPACE—Make no entry.

INSTRUCTIONS FOR SECTION 2—PERSONAL DATA

a. NAME—(MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS). Enter last name, first name, middle initial of person involved.

b. AGE—Enter age.

c. SEX—Mark appropriate box.

d. SOCIAL SECURITY NUMBER—(FOR GOVERNMENT PERSONNEL ONLY) Enter the social security number (or other personal identification number if no social security number issued).

e. GRADE—(FOR GOVERNMENT PERSONNEL ONLY) Enter pay grade. Example: O-6; E-7; WG-8; WS-12; GS-11; etc.

f. JOB SERIES/TITLE—For *government civilian employees* enter the pay plan, full series number, and job title, e.g. GS-0810/Civil Engineer. For *military personnel* enter the primary military occupational specialty (PMOS), e.g., 15A30 or 11G50. For *contractor employees* enter the job title assigned to the injured person, e.g. carpenter, laborer, surveyor, etc.,

g. DUTY STATUS—Mark the appropriate box.

(1) ON DUTY—Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.

(2) TDY - Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.

(3) OFF DUTY - Person was not on official business at time of accident

h. EMPLOYMENT STATUS—(FOR GOVERNMENT PERSONNEL ONLY) Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3—GENERAL INFORMATION

a. DATE OF ACCIDENT—Enter the month, day, and year of accident.

b. TIME OF ACCIDENT—Enter the local time of accident in military time. Example: 1430 hrs (not 2:30 p.m.).

c. EXACT LOCATION OF ACCIDENT—Enter facts needed to locate the accident scene. (installation/project name, building number, street, direction and distance from closest landmark, etc.,).

d. CONTRACTOR NAME

(1) PRIME—Enter the exact name (title of firm) of the prime contractor.

(2) SUBCONTRACTOR—Enter the name of any subcontractor involved in the accident.

e. CONTRACT NUMBER—Mark the appropriate box to identify if contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.

f. TYPE OF CONTRACT—Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.

g. HAZARDOUS/TOXIC WASTE ACTIVITY (HTW)—Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program (IRP) HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site (FUDS) activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4—CONSTRUCTION ACTIVITIES

a. CONSTRUCTION ACTIVITY—Select the *most appropriate* construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

1. MOBILIZATION	14. ELECTRICAL
2. SITE PREPARATION	15. SCAFFOLDING/ACCESS
3. EXCAVATION/TRENCHING	16. MECHANICAL
4. GRADING (EARTHWORK)	17. PAINTING
5. PIPING/UTILITIES	18. EQUIPMENT/MAINTENANCE
6. FOUNDATION	19. TUNNELING
7. FORMING	20. WAREHOUSING/STORAGE
8. CONCRETE PLACEMENT	21. PAVING
9. STEEL ERECTION	22. FENCING
10. ROOFING	23. SIGNING
11. FRAMING	24. LANDSCAPING/IRRIGATION
12. MASONRY	25. INSULATION
13. CARPENTRY	26. DEMOLITION

b. TYPE OF CONSTRUCTION EQUIPMENT—Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

1. GRADER
2. DRAGLINE
3. CRANE (ON VESSEL/BARGE)
4. CRANE (TRACKED)
5. CRANE (RUBBER TIRE)
6. CRANE (VEHICLE MOUNTED)
7. CRANE (TOWER)
8. SHOVEL
9. SCRAPER
10. PUMP TRUCK (CONCRETE)
11. TRUCK (CONCRETE/TRANSIT MIXER)
12. DUMP TRUCK (HIGHWAY)
13. DUMP TRUCK (OFF HIGHWAY)
14. TRUCK (OTHER)
15. FORKLIFT
16. BACKHOE
17. FRONT-END LOADER
18. PILE DRIVER
19. TRACTOR (UTILITY)
20. MANLIFT
21. DOZER
22. DRILL RIG
23. COMPACTOR/VIBRATORY ROLLER
24. OTHER

INSTRUCTIONS FOR SECTION 5—INJURY/ILLNESS INFORMATION

a. SEVERITY OF INJURY / ILLNESS - Reference para 2-10 of USACE Suppl 1 to AR 385-40 and enter code and description from list below.

NOI NO INJURY
FAT FATALITY
PTL PERMANENT TOTAL DISABILITY
PPR PERMANENT PARTIAL DISABILITY
LWD LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
NLW RECORDABLE CASE WITHOUT LOST WORKDAYS
RFA RECORDABLE FIRST AID CASE
NRI NON-RECORDABLE INJURY

b. ESTIMATED DAYS LOST—Enter the estimated number of workdays the person will lose from work.

c. ESTIMATED DAYS HOSPITALIZED—Enter the estimated number of workdays the person will be hospitalized.

d. ESTIMATED DAYS RESTRICTED DUTY—Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

e. BODY PART AFFECTED—Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	CODE	BODY PART NAME
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH
	CN	NOSE
	CR	THROAT, OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EB	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER
HEAD, EXTERNAL	H1	EYE EXTERNAL
	H2	BOTH EYES EXTERNAL
	H3	EAR EXTERNAL
	H4	BOTH EARS EXTERNAL
	HC	CHIN
	HF	FACE
	HK	NECK/THROAT
	HM	MOUTH/LIPS
	HN	NOSE
	HS	SCALP
KNEE	KB	BOTH KNEES
	KS	KNEE
LEG, HIP, ANKLE, BUTTOCK	LB	BOTH LEGS/HIPS/ ANKLES/BUTTOCKS
	LS	SINGLE LEG/HIP ANKLE/BUTTOCK
HAND	MB	BOTH HANDS
	MS	SINGLE HAND
FOOT	PB	BOTH FEET
	PS	SINGLE FOOT
TRUNK, BONES	R1	SINGLE COLLAR BONE
	R2	BOTH COLLAR BONES
	R3	SHOULDER BLADE
	R4	BOTH SHOULDER BLADES
	RB	RIB
	RS	STERNUM (BREAST BONE)
	RV	VERTEBRAE (SPINE; DISC)
	RZ	TRUNK BONES OTHER
SHOULDER	SB	BOTH SHOULDERS
	SS	SINGLE SHOULDER
THUMB	TB	BOTH THUMBS
	TS	SINGLE THUMB
TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
	V2	LUNGS, BOTH
	V3	KIDNEY, SINGLE
	V4	KIDNEYS, BOTH
	VH	HEART
	VL	LIVER
	VR	REPRODUCTIVE ORGANS
	VS	STOMACH
	VV	INTESTINES
	VZ	TRUNK, INTERNAL; OTHER

f. NATURE OF INJURY/ILLNESS - Select the most appropriate nature of injury / illness from the list below. This nature of injury / illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury / illness name on the line and place the corresponding CODE letters in the box provided.

* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
*TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION
	TB	BACK STRAIN.
	TC	CONTUSION; BRUISE; ABRASION
	TD	DISLOCATION
	TF	FRACTURE
	TH	HERNIA
	TK	CONCUSSION
	TL	LACERATION, CUT
	TP	PUNCTURE
	TS	STRAIN, MULTIPLE
	TU	BURN, SCALD, SUNBURN
	TI	TRAUMATIC SKIN DISEASES/ CONDITIONS INCLUDING DERMATITIS
	TR	TRAUMATIC RESPIRATORY DISEASE
	TQ	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL/ INFECTIVE/PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER; STRESS; NERVOUS CONDITION
	T8	TRAUMATIC INJURY — OTHER (EXCEPT DISEASE, ILLNESS)

**A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which doses not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
**NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	R9	RESPIRATORY DISEASE, OTHER
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC—OTHER
DISABILITY, OCCUPATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION; STROKE
	DD	ENDEMIC DISEASE (OTHER THAN CODE TYPES R&S)
	DE	EFFECT OF ENVIRONMENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER, EMOTIONAL STRESS NERVOUS CONDITION
	DR	RADIATION
	DS	STRAIN, MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY, OTHER

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
SKIN DISEASE OR CONDITION	SB	BIOLOGICAL
	SC	CHEMICAL
	S9	DERMATITIS, UNCLASSIFIED

g. TYPE AND SOURCE OF INJURY/ILLNESS (CAUSE) - Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident (see example 1, below). Examples:

(1) An employee tripped on carpet and struck his head on a desk.
TYPE: 210 (fell on same level) SOURCE: 0110 (walking/working surface)

NOTE: This example would NOT be coded 120 (struck against) and 0140 (furniture).

(2) A Park Ranger contracted dermatitis from contact with poison ivy/ oak.
TYPE: 510 (contact) SOURCE: 0920 (plant)

(3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.
TYPE: 410 (punctured by) SOURCE: 0830 (metal)

(4) An employee was driving a government vehicle when it was struck by another vehicle..
TYPE: 800 (traveling in) SOURCE: 0421 (government-owned vehicle, as driver)

NOTE: The Type Code 800, "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	TYPE OF INJURY NAME
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL, SLIPPED, TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED, TRIPPED (NO FALL)
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED, LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH (INJURED PERSON MOVING)
0520	CONTACTED BY (OBJECT WAS MOVING)
	EXERTED
0610	LIFTED, STRAINED BY (SINGLE ACTION)
0620	STRESSED BY (REPEATED ACTION)
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN

CODE	SOURCE OF INJURY NAME
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE (FLOOR, STREET, SIDEWALKS, ETC)
0120	STAIRS, STEPS
0130	LADDER
0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0150	BOILER, PRESSURE VESSEL
0160	EQUIPMENT LAYOUT (ERGONOMIC)
0170	WINDOWS, DOORS
0180	ELECTRICITY

CODE	SOURCE OF INJURY NAME
0200	ENVIRONMENTAL CONDITION
0210	TEMPERATURE EXTREME (INDOOR)
0220	WEATHER (ICE, RAIN, HEAT, ETC.)
0230	FIRE, FLAME, SMOKE (NOT TOBACCO)
0240	NOISE
0250	RADIATION
0260	LIGHT
0270	VENTILATION
0271	TOBACCO SMOKE
0280	STRESS (EMOTIONAL)
0290	CONFINED SPACE
0300	MACHINE OR TOOL
0310	HAND TOOL (POWERED: SAW, GRINDER, ETC.)
0320	HAND TOOL (NONPOWERED)
0330	MECHANICAL POWER TRANSMISSION APPARATUS
0340	GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK)
0350	VIDEO DISPLAY TERMINAL
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL
0370	HEATING EQUIPMENT
0380	WELDING EQUIPMENT
0400	VEHICLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE
0421	DRIVER OF GOVERNMENT VEHICLE
0422	PASSENGER OF GOVERNMENT VEHICLE
0430	COMMON CARRIER (AIRLINE, BUS, ETC.)
0440	AIRCRAFT (NOT COMMERCIAL)
0450	BOAT, SHIP, BARGE
0500	MATERIAL HANDLING EQUIPMENT
0510	EARTHMOVER (TRACTOR, BACKHOE, ETC.)
0520	CONVEYOR (FOR MATERIAL AND EQUIPMENT)
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST
0540	HOIST, SLING CHAIN, JACK
0550	CRANE
0551	FORKLIFT
0560	HANDTRUCK, DOLLY
0600	DUST, VAPOR, ETC.
0610	DUST (SILICA, COAL, ETC.)
0620	FIBERS
0621	ASBESTOS
0630	GASES
0631	CARBON MONOXIDE
0640	MIST, STEAM, VAPOR, FUME
0641	WELDING FUMES
0650	PARTICLES (UNIDENTIFIED)
0700	CHEMICAL, PLASTIC, ETC.
0711	DRY CHEMICAL—CORROSIVE
0712	DRY CHEMICAL—TOXIC
0713	DRY CHEMICAL—EXPLOSIVE
0714	DRY CHEMICAL—FLAMMABLE
0721	LIQUID CHEMICAL—CORROSIVE
0722	LIQUID CHEMICAL—TOXIC
0723	LIQUID CHEMICAL—EXPLOSIVE
0724	LIQUID CHEMICAL—FLAMMABLE
0730	PLASTIC
0740	WATER
0750	MEDICINE
0800	INANIMATE OBJECT
0810	BOX, BARREL, ETC.
0820	PAPER
0830	METAL ITEM, MINERAL
0831	NEEDLE
0840	GLASS
0850	SCRAP, TRASH
0860	WOOD
0870	FOOD
0880	CLOTHING, APPAREL, SHOES
0900	ANIMATE OBJECT
0911	DOG
0912	OTHER ANIMAL
0920	PLANT
0930	INSECT
0940	HUMAN (VIOLENCE)
0950	HUMAN (COMMUNICABLE DISEASE)
0960	BACTERIA, VIRUS (NOT HUMAN CONTACT)

CODE	SOURCE OF INJURY NAME
1000	PERSONAL PROTECTIVE EQUIPMENT
1010	PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES
1020	RESPIRATOR, MASK
1021	DIVING EQUIPMENT
1030	SAFETY BELT, HARNESS
1040	PARACHUTE

INSTRUCTIONS FOR SECTION 6 — PUBLIC FATALITY

a. ACTIVITY AT TIME OF ACCIDENT—Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the *most* appropriate primary activity area (water related, non-water related or other activity), the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

1. Sailing
2. Boating—powered
3. Boating—unpowered
4. Water skiing
5. Fishing from boat
6. Fishing from bank dock or pier
7. Fishing while wading
8. Swimming/supervised area
9. Swimming/designated area
10. Swimming/other area
11. Underwater activities (skin diving, scuba, etc.)
12. Wading
13. Attempted rescue
14. Hunting from boat
15. Other

NON-WATER RELATED RECREATION

16. Hiking and walking
17. Climbing (general)
18. Camping/picnicking authorized area
19. Camping/picnicking unauthorized area
20. Guided tours
21. Hunting
22. Playground equipment
23. Sports/summer (baseball, football, etc.)
24. Sports/winter (skiing, sledding, snowmobiling etc.)
25. Cycling (bicycle, motorcycle, scooter)
26. Gliding
27. Parachuting
28. Other non-water related

OTHER ACTIVITIES

29. Unlawful acts (fights, riots, vandalism, etc.)
30. Food preparation/serving
31. Food consumption
32. Housekeeping
33. Sleeping
34. Pedestrian struck by vehicle
35. Pedestrian other acts
36. Suicide
37. "Other" activities

b. PERSONAL FLOTATION DEVICE USED—If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7—MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE—Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

b. TYPE OF COLLISION—Mark appropriate box.

c. SEAT BELT—Mark appropriate box.

INSTRUCTIONS FOR SECTION 8—PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM—Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number (NSN) whenever applicable.

b. OWNERSHIP—Enter ownership for each item listed. (Enter one of the following: *USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE)*

c. $ AMOUNT OF DAMAGE—Enter the total estimated dollar amount of damage (parts and labor), if any.

INSTRUCTIONS FOR SECTION 9—VESSEL/FLOATING PLANT ACCIDENT

a. TYPE OF VESSEL/FLOATING PLANT—Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel/floating plant.

VESSEL/FLOATING PLANTS

1. ROW BOAT	7. DREDGE/DIPPER
2. SAIL BOAT	8. DREDGE/CLAMSHELL, BUCKET
3. MOTOR BOAT	9. DREDGE/PIPE LINE
4. BARGE	10. DREDGE/DUST PAN
5. DREDGE/HOPPER	11. TUG BOAT
6. DREDGE/SIDE CASTING	12. OTHER

b. COLLISION/MISHAP—Select from the list below the object(s) that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

1. COLLISION W/OTHER VESSEL	7. HAULAGE UNIT
2. UPPER GUIDE WALL	8. BREAKING TOW
3. UPPER LOCK GATES	9. TOW BREAKING UP
4. LOCK WALL	10. SWEPT DOWN ON DAM
5. LOWER LOCK GATES	11. BUOY/DOLPHIN/CELL
6. LOWER GUIDE WALL	12. WHARF OR DOCK
	13. OTHER

INSTRUCTIONS FOR SECTION 10—ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT—Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11—CAUSAL FACTORS

a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

(1) DESIGN—Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?

(2) INSPECTION/MAINTENANCE—Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?

(3) PERSON'S PHYSICAL CONDITION—Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?

(4) OPERATING PROCEDURES—Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?

(5) JOB PRACTICES—Were any of the provisions of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?

(6) HUMAN FACTORS—Was the person under undue stress (either internal or external to the job)? Did the task tend toward overloading the capabilities of the person; i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

(7) ENVIRONMENTAL FACTORS—Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

(8) CHEMICAL AND PHYSICAL AGENT FACTORS—Did exposure to chemical agents (either single shift exposure or long-term exposure) such as dusts, fibers (asbestos, etc.), silica, gases (carbon monoxide, chlorine, etc.), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by-products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?

(9) OFFICE FACTORS—Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

(10) SUPPORT FACTORS—Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc?

(11) PERSONAL PROTECTIVE EQUIPMENT—Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc.) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?

(12) DRUGS/ALCOHOL—Is there any reason to believe the person's mental or physical capabilities, judgement, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

b. WRITTEN JOB/ACTIVITY HAZARD ANALYSIS—Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. *If one was performed, attach a copy of the analysis to the report.*

INSTRUCTIONS FOR SECTION 12—TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?—For the purpose of this section "trained" means the person has been provided the necessary information (either formal and/or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.

b. TYPE OF TRAINING—Mark the appropriate box that best indicates the type of training; (classroom or on-the-job) that the injured person received before the accident happened.

c. DATE OF MOST RECENT TRAINING—Enter the month, day, and year of the last *formal* training completed that covered the activity-task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13—CAUSES

a. DIRECT CAUSES—The direct cause is that single factor which most directly lead to the accident. See examples below.

b. INDIRECT CAUSES—Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.
Direct cause: failure to provide fall protection at elevation.
Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee (possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. (note USACE vehicle was in proper/safe working condition).
Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.
Indirect cause: Failure of employee to pay attention to driving (defensive driving).

INSTRUCTIONS FOR SECTION 14—ACTION TO ELIMINATE CAUSE(S)

DESCRIPTION—Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15—DATES FOR ACTION

a. BEGIN DATE—Enter the date when the corrective action(s) identified in Section 14 will begin.

b. COMPLETE DATE—Enter the date when the corrective action(s) identified in Section 14 will be completed.

c. TITLE AND SIGNATURE—Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE Supervisor shall also sign the report. Upon entering the information required in 15.d, 15.e and 15.f below, the responsible USACE supervisor shall forward the report for management review as indicated in Section 16.

d. DATE SIGNED—Enter the month, day, and year that the report was signed by the responsible supervisor.

e. ORGANIZATION NAME—For GOVERNMENT employee accidents enter the USACE organization name (Division, Branch, Section, etc.) of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15.c. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

f. OFFICE SYMBOL—Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15.e.

INSTRUCTIONS FOR SECTION 16—MANAGEMENT REVIEW (1st)

1ST REVIEW—Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15.c shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief (2nd review) for review and comment.

INSTRUCTIONS FOR SECTION 17—MANAGEMENT REVIEW (2nd)

2ND REVIEW—The FOA Staff Chief (i.e., FOA Chief of Construction, Operations, Engineering, Planning, etc.) shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18—SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW—The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc, are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19—COMMAND APPROVAL

4TH REVIEW—The FOA Commander shall (to include the person designated Acting Commander in his absence) review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.

FLOAT PLAN

www.cgaux.org

INSTRUCTIONS: Complete this plan before you go boating and leave it with a reliable person who can be depended upon to notify the Coast Guard, or other rescue organization, should you not return or check-in as scheduled. If you have a *change of plans* after leaving, be sure to notify the person holding your Float Plan.

Do NOT file this plan with the Coast Guard.

www.uscgboating.org

VESSEL

IDENTIFICATION:

Name & Home Port ____________________

Doc. / Registration No. ____________________

Year & Make ____________________

Length ______ Type PWR Draft _____ (Inch/CM) Hull Mat. Fiber

Hull Color(s) ____________________

Prominent Feature(s) ____________________

____

PROPULSION:

Primary - Type Gas IO No. Eng __ Fuel Capacity _____

Auxiliary - Type none No. Eng __ Fuel Capacity _____

TELECOMMUNICATIONS:

Radio Call Sign ____________________

DSC MMSI Number ____________________

Radio-1: Type VHF-FM Ch / Freq. Monitored __________

Radio-2: Type __________ Ch / Freq. Monitored __________

Cell Phone ____________________

Pager ____________________

NAVIGATION: (Check all on board)

☐ Maps ☐ Charts ☐ Compass ☐ GPS / DGPS

☐ Radar ☐ Loran C ☐ Sounder ☐ __________

SAFETY & SURVIVAL

VISUAL DISTRESS SIGNALS:

☐ Day Only type

☐ Night Only type

☐ Day & Night type

PFDs: (Do not count Type IV devices)

____ Quantity on board

AUDIBLE DISTRESS SIGNALS:

☐ Horn / Whistle

☐ Bell

☐ __________

GROUND TACKLE:

☐ Anchor - line length ______ ft.

OTHER GEAR / SUPPLIES:

☐ Lifeboat / Life Raft ☐ Flashlight / Searchlight

☐ Dinghy / Skiff ☐ Signal Mirror

☐ Food / Water ☐ Drogue / Sea Anchor

☐ EPIRB none ☐ __________

☐ Foul Weather Gear ☐ __________

PERSONS ON BOARD

OPERATOR:

Name ____________________ Age ___ M/F ___ Notes (Special medical condition, Can't swim, etc.) __________

Address ____________________ Experience: w/Boat ☐ w/Area ☐

City ____________ State ____ Zip code ________ Home Phone __________

Vehicle (Year, Make & Model) ____________________ Vehicle License No. __________

Where will trailer be parked? ____________________ Trailer License No. __________

PASSENGERS:

	Name & Home Phone	Age	M/F	Notes (Special medical condition, Can't swim, etc.)
1.				
2.				
3.				
4.				
5.				

Attach Supplemental Passenger List if additional passengers on board.

ITINERARY

	DATE	TIME	LOCATION	MODE OF TRAVEL	REASON FOR STOP	CHECK-IN TIME
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						
Depart						
Arrive						

Attach Supplemental Itinerary if additional space required.

Contact 1 ____________________ Phone Number __________

Contact 2 ____________________ Phone Number __________

If you have a genuine concern for the safety or welfare of any persons on board this vessel, who have not returned or checked-in within a reasonable amount of time, then follow the step-by-step instructions on the **Boating Emergency Guide** included with this plan, or on the World Wide Web at:

http://www.uscgaux.org/~floatplan/BoatingEmergencyGuide.htm

ME2(b) Rev(1.20.05)

BOATING EMERGENCY GUIDE

You will need the following items before you begin: 1) The **Float Plan**, if one was given to you; 2) **Pen** or **Pencil**; 3) Clean sheet of **paper** or **writing tablet**; and 4) **Telephone Directory**.

Step 1

Is there a genuine concern for the safety or welfare of any persons on board the vessel, who have not returned or checked-in within a reasonable amount of time?

If YES, continue with **Step 2**. If NO, then **Stop**. No further action is required at this time.

Step 2

Were you given a prepared Float Plan by anyone onboard the vessel?

If YES, continue with **Step 3**. If NO, then go to **Step 5**.

Step 3

On the Float Plan, locate the two contact lines, below the "Itinerary" at the bottom of the Float Plan. Call the telephone number of Contact-1.

<table>
<tr><th>IF:</th><th>THEN:</th></tr>
<tr><td>A person answered the phone...</td><td>Take notes during your conversation.
1. Let the person know that you are responding to a late return or check-in by the individuals designated on the Float Plan.
2. Determine if the person you are talking to, or anyone else at that location, has recently had contact with anyone on the vessel, and when and where that contact occurred.
3. Are you still concerned about the safety or welfare of any persons on board the vessel?
<table><tr><th>IF:</th><th>THEN:</th></tr><tr><td>Yes</td><td>Continue with Step 4.</td></tr><tr><td>No</td><td>Stop. No further action is necessary at this time.</td></tr></table></td></tr>
<tr><td>Otherwise...</td><td>Continue with Step 4.</td></tr>
</table>

Step 4

Call the telephone number for Contact-2.

<table>
<tr><th>IF:</th><th>THEN:</th></tr>
<tr><td>A person answered the phone...</td><td>Take notes during your conversation.
1. Let the person know that you are responding to a late return or check-in by the individuals designated on the Float Plan.
2. Determine if the person you are talking to, or anyone else at that location, has recently had contact with anyone on the vessel, and when and where that contact occurred.
3. Are you still concerned about the safety or welfare of any persons on board?
<table><tr><th>IF:</th><th>THEN:</th></tr><tr><td>Yes</td><td>Continue with Step 6.</td></tr><tr><td>No</td><td>Stop. No further action is necessary at this time.</td></tr></table></td></tr>
<tr><td>Otherwise...</td><td>Continue with Step 6.</td></tr>
</table>

Step 5

Take a moment to jot down the facts you know about each item in the checklist below:

> Do not speculate! Speculation of a fact may mislead search and rescue personnel and add to the overall search and rescue time, adversely affecting the outcome.

- ❑ Period of time the vessel has been overdue.
- ❑ Purpose of the trip or voyage.
- ❑ Description of vessel (color, size, shape, etc.)
- ❑ Vessel's departure point and destination.
- ❑ Places the vessel planned to stop during transit.
- ❑ Navigation equipment on board (such as GPS, Compass, Maps, Charts, LORAN C, etc.)
- ❑ Survival equipment on board (life jackets, EPIRB, flares, etc.)
- ❑ Number of people on board the vessel, as well as personal habits e.g. dependability, reliability, etc.
- ❑ Was the vessel already moored, or did a vehicle tow it to the location?
- ❑ License plate number and description of the vehicle of the towing and/or crew transport vehicle.
- ❑ Communications equipment on board including radio frequencies monitored, cellular telephone numbers of people aboard.
- ❑ Additional points of contact in the area.
- ❑ Were there any pending commitments (work, appointments, etc.)?

Continue with **Step 6.**

Step 6

1. Contact your local Law Enforcement agency.
2. Let the dispatcher know that you are responding to a late return or check-in by the persons on board.
   a. The dispatcher will guide you from there. The dispatcher will provide you with the necessary contact or agency connection (if one was not given on the Float Plan) to get a Search And Rescue (SAR) mission started. This is usually handled this way because it puts you closest to the agency conducting the rescue mission, eliminating an unnecessary middleman.
   b. The dispatcher will let you know if they would like a follow-up call from you on the outcome.
3. The dispatcher will instruct you from there.

Continue with **Step 7**.

Step 7

Be patient... you've done everything you can possibly do for now. Stay off of the phone, so emergency personnel can contact you with additional information and/or questions concerning the Search And Rescue (SAR) effort.

End of Guide

APPENDIX F

CONTRACTOR FORMS

LIST OF FORMS

Survey Log Sheet F-1
Example Daily Report F-2
TEMA Daily Start-up QC Checklist F-3
TEMA Video Acquisition Daily Start-up QC Checklist F-4
Example Daily QC Report F-5
Preparatory Phase Checklist F-8
Initial Phase Checklist F-10
Field Change Request F-11
Field Change Request Log F-12
Nonconformance Report F-13
Design Change Notice F-14
Visitor Log F-15

Tetra Tech EC, Inc. Survey Log Sheet

Date:	Julian Date: #####	Reach / Area:	To:	Survey Name: #N/A
Survey Vessel:		Surveyor(s):		Time Zone: UTC
Survey Type: Multibeam		Captain:		Job Name Modifier:
		Client:		

Device Information

	POS MV 320	Leica	Leica RTK GPS	Trimble AG 132
Starboard:	0.00	1.90	-0.20	0.01
Forward:	0.00	-7.40	14.11	0.14
Vertical:	0.00	-9.60	-5.86	-8.30
Yaw:				
Pitch:				
Roll:				
Latency:				

SVP File:

Patch Test Date:

Start Time	Stop Time	Raw File Name	Line Type	Survey Direction	Survey Speed		Comments

CONTRACT NUMBER W912DY-10-D-0015 CONTRACT TASK ORDER NUMBER: 003

03/15/14

SITE LOCATION: MRS 03 & MRS 12, Culebra, Puerto Rico
ACTIVITY: Phase 2 RI DGM Survey

USACE PM: Roland Belew
CONTRACTOR PM: Scot Wilson

Start Time: 07:00 **End Time: 19:00**

Field Operations Lead – ☒ Richard Funk

Onsite – Technical Personnel

☒ Cory Graves	☒ Peter Polivka	☐ Omi Rodrigues
☐ Scot Wilson	☐ Fernando Pages	☒ Ariel Rivera
	☒ Kyle Enright	☐

Onsite – Captain(s)

☒ Eric Taylor	☒ Alejandro Beale	☐

Vessels Onsite

☒ Ugle Duckling (34ft)	☒ Inflatable	☒ Hovercraft

Equipment and Software Onsite

☒ USBL System	☒ TEMA-Lite	☒ 110/220V Generators (3)
☒ ROV	☒ TEMA-MK3	☒ Geophysical Winch w/Cable
☒ Oasis Montaj	☒ Hypack/HySweep Key	☒ CARIS HIPS/SIPS & PosPac
☒ 2500 Dodge	☒ TEMA trailer	☒ Leica RTK GPS (3)
☒ Rental Vehicle	☒ Applanix POS MV	☒ U-water Video Cameras (10)

Work Performed

☐ Project Kickoff Meetings	☐ Travel to/from site	☐ Mob/demob
☐ System Testing	☐ Data Processing	☐ TEMA-MK3 Survey
☐ TEMA-Lite Decision Tree utilized today.	☐ Decision Tree PASS	☐ TEMA-Lite Survey
	☐ Decision Tree FAIL	

Weather Conditions

-

Work Accomplished

-

Work Planned

-

Problems Encountered

- None.

1 Prepared by: Richard Funk

TETRA TECH

Report: 1

Tetra Tech Marine Mapping Group
December 2013
TEMA Daily Start-up QC Checklist

Date: mm/dd/yy

Page 1 of 1

Personnel On Board

☒ Lou Schwartz	☒ Richard Funk	☐ Ariel Rivera	☐ Cory Graves	☐
☒ Kayleigh Wilson	☒ Trevor Thomas	☒ Omi Rodriguez	☐ Ransom White	☐

QC Checklist

GPS

☒ Survey monument verification with rover GPS
☒ Water level check/QC of shipboard GPS

TEMA Start-up

☒ Energize the system. (Power on main 24V power supply)
☒ Allow for 2-5 min coil/electronics warm-up
☒ Setup TEMA Acquisition software
☒ Null coils, perform pseudo-function test File name: _____
☒ Verify GAPS beacon is powered up and Is set to the proper frequency Beacon Frequency: _____
☒ Launch TEMA, re-null and perform pseudo-static test File name: _____

GAPS Start-up

☒ Power up system, and check that inputs are functioning
☒ Verify noise level is below 90dB
☒ Start tracking, verify that the beacon is being tracked

**Full or initial setup would require checking equipment and offsets and I/O port settings*

Sound Speed

☒ Check sound speed profile in GAPS once per day (perform CTD cast):
~1490 m/s for fresh water
~1560 m/s for sea water
GAPS Sound Speed File name: _____

IVS

☒ Run IVS a minimum of 3 lines in alternating directions File name: _____
3 Number of lines run at IVS
☒ Process IVS data, confirm performance of TEMA within specifications

Hypack

☒ Create new project (Project_mmddyy_DataTypeBoat) Ex: CU_MMDDYY_EM7
☒ Verify Hypack and Hysweep hardware settings and enter in log sheet
☒ Verify Geodesy settings
☒ Verify measurement units
☒ Enable all desired layers (targets, lines, backgrounds, matrix, etc.), nothing over 25MB
☒ Start Hypack Survey (and Hysweep Survey only required for MBE data collection)
☒ Test for audible and visual alarms

Quality Control

See Daily QC report with same file name for QC results

Problems experienced? ☐ Yes ☐ No
Comments:

TETRA TECH

Report: 1

Tetra Tech Marine Mapping Group
December 2013
TEMA Video Acquisition Daily Start-up QC Checklist

Date: mm/dd/yy

Page 1 of 1

Personnel On Board

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☒ Kayleigh Wilson	☒ Trevor Thomas	☒ Omi Rodriguez	☐ Ransom White	

QC Checklist

Underwater Camera TEMA MK3

Start-up

- ☒ Power on the camera
- ☒ Start the video acquisition software
- ☒ Set the data file path and name
- ☒ Examine video for acceptable image quality
- ☒ Start Recording (run short test at dock, play back file to confirm system is working properly)

GAPS USBL Tracking (TEMA MK3)

- ☒ Power on the GAPS
- ☒ Start the web interface and start tracking
- ☒ Start the "GAPS to GGA" python script

GPS overlay (if used)

- ☒ Confirm position and time stamp overlay is being written (check time sync with computer)
- ☒ If the camera is towed, confirm the overlay position is that of the camera.

Hypack Navigation Software

- ☒ Configure and display the towfish location using both the USBL and layback for verification.
- ☒ Use the coverage driver to monitor video coverage during acquisition.

Underwater Camera TEMA Lite (GoPro)

Start-up

- ☒ Power on the camera
- ☒ Check time sync with GPS/GMT time
- ☒ Set GoPro to simultaneous HD Video and still photography
- ☒ Begin photography acquisition **Acquisition start time**: ______

Quality Control

- ☒ TEMA MK3 Collect and review a minimum of one minute of data to ensure the equipment is functioning properly and providing adequate imagery.
- ☐ TEMA Lite verify that the GoPro is recoding before deployment (led flashing)

Problems experienced? ☐ Yes ☐ No
Comments:

TETRA TECH

EXAMPLE DAILY QC REPORT

CONTRACT NUMBER N62470-08-D-1001 **CONTRACT TASK ORDER NUMBER: KR03**

SITE LOCATION: JACKSON PARK, WASHINGTON
ACTIVITY: PERFORM MARINE EM SURVEY OF OU 3 M PIER AREA

NAVY RPM: **RAY KOBESKI**
CONTRACTOR PM: **JOHN TREPANOWSKI**

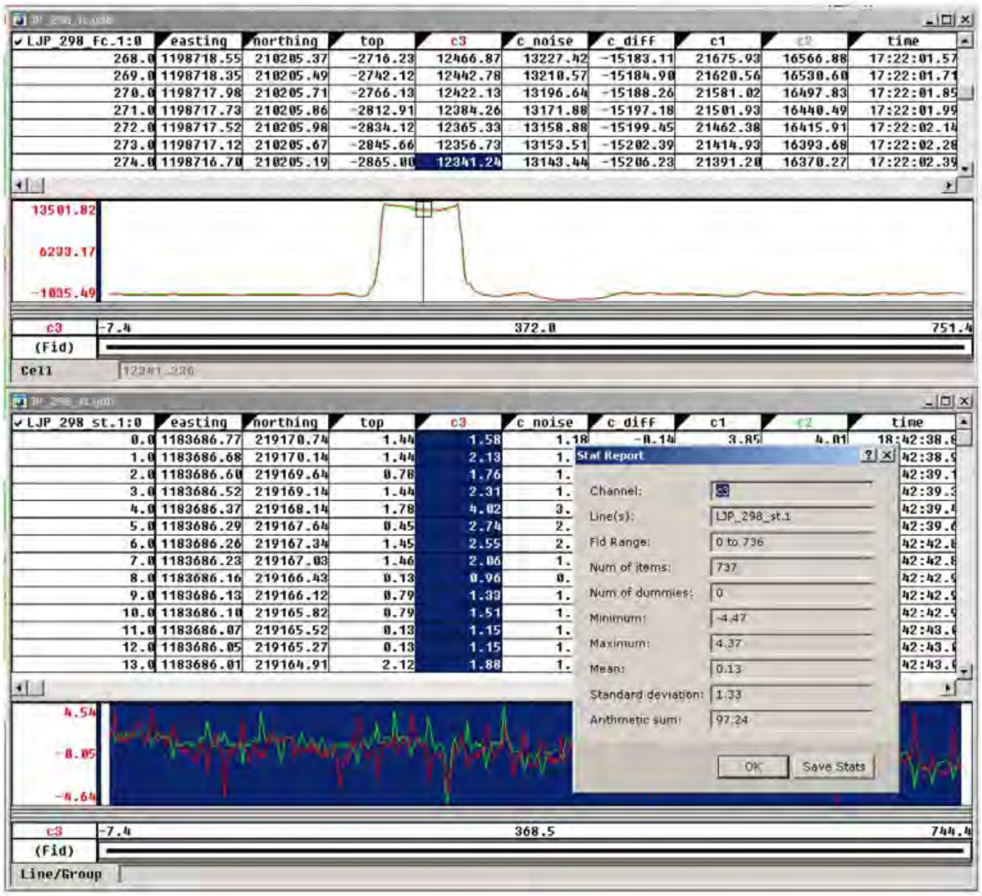
10/24/12

298

DGM QC Report

Function Test Files **JP_298_fc.gdb** **Static Test File** **JP_298_st.gdb**

Coil 1 (Port) c3 results of the function test and the static test



1 Prepared by: Richard Funk

TETRA TECH

CONTRACT NUMBER N62470-08-D-1001 CONTRACT TASK ORDER NUMBER: KR03

SITE LOCATION: JACKSON PARK, WASHINGTON
ACTIVITY: PERFORM MARINE EM SURVEY OF OU 3 M PIER AREA

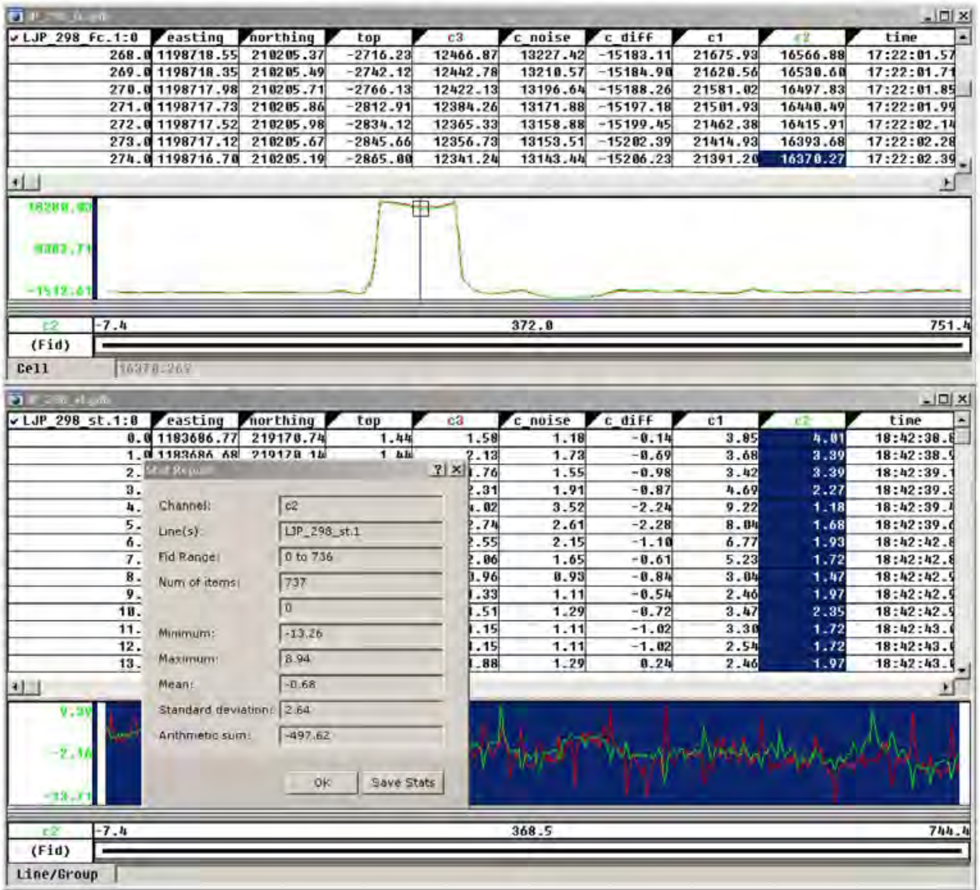
NAVY RPM: RAY KOBESKI
CONTRACTOR PM: JOHN TREPANOWSKI

10/17/12

291

DGM QC Report

Coil 1 (Port) c2 results of the function test and the static test



2 Prepared by: Richard Funk

TETRA TECH

CONTRACT NUMBER N62470-08-D-1001 CONTRACT TASK ORDER NUMBER: KR03

SITE LOCATION: JACKSON PARK, WASHINGTON
ACTIVITY: PERFORM MARINE EM SURVEY OF OU 3 M PIER AREA

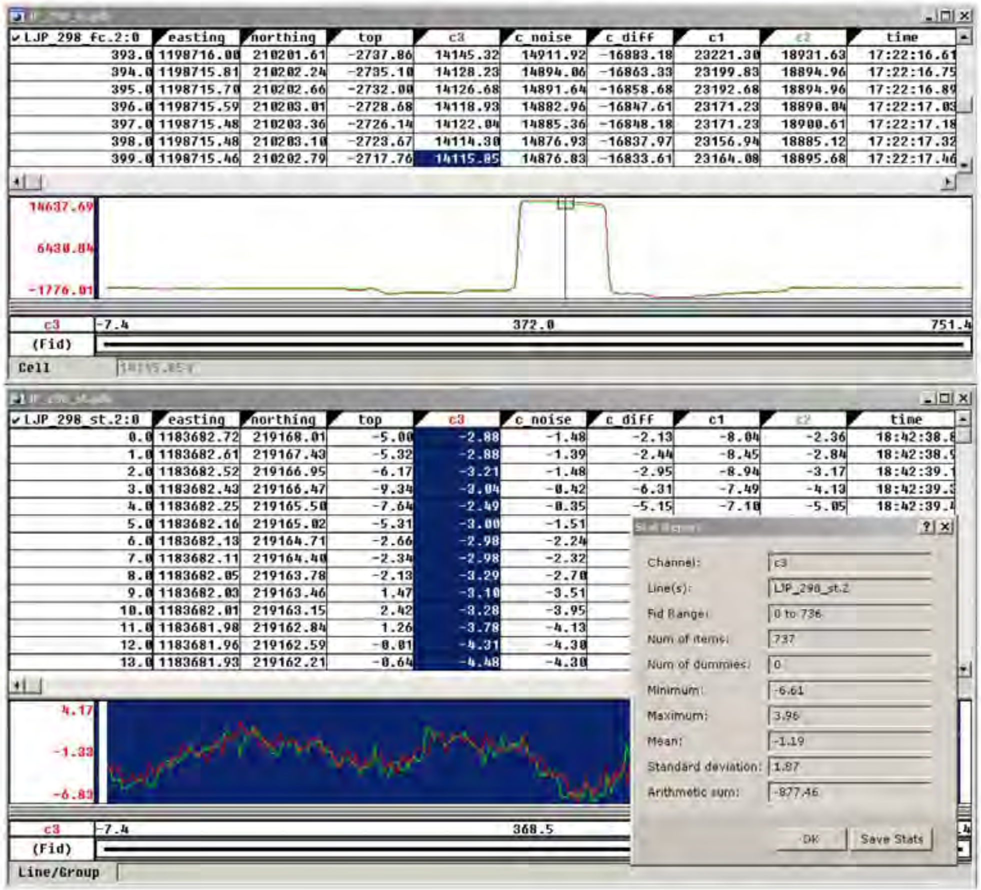
NAVY RPM: RAY KOBESKI
CONTRACTOR PM: JOHN TREPANOWSKI

10/17/12

291

DGM QC Report

Coil 2 (Center) c3 results of the function test and the static test



LJP_298_fc.2:0	easting	northing	top	c3	c_noise	c_diff	c1	c2	time
393.0	1198716.00	210201.61	-2737.86	14145.32	14911.92	-16883.18	23221.30	18931.63	17:22:16.61
394.0	1198715.81	210202.24	-2735.10	14128.23	14894.06	-16863.33	23199.83	18894.96	17:22:16.75
395.0	1198715.70	210202.66	-2732.00	14126.68	14891.64	-16858.68	23192.68	18894.96	17:22:16.89
396.0	1198715.59	210203.01	-2728.68	14118.93	14882.96	-16847.61	23171.23	18898.04	17:22:17.03
397.0	1198715.48	210203.36	-2726.14	14122.04	14885.36	-16848.18	23171.23	18900.61	17:22:17.18
398.0	1198715.48	210203.10	-2723.67	14114.30	14876.93	-16837.97	23156.94	18885.12	17:22:17.32
399.0	1198715.46	210202.79	-2717.76	14115.85	14876.83	-16833.61	23164.08	18895.68	17:22:17.46

LJP_298_st.2:0	easting	northing	top	c3	c_noise	c_diff	c1	c2	time
0.0	1183682.72	219168.01	-5.00	-2.88	-1.48	-2.13	-8.04	-2.36	18:42:38.8
1.0	1183682.61	219167.43	-5.32	-2.88	-1.39	-2.44	-8.45	-2.84	18:42:38.9
2.0	1183682.52	219166.95	-6.17	-3.21	-1.48	-2.95	-8.94	-3.17	18:42:39.1
3.0	1183682.43	219166.47	-9.34	-3.04	-0.42	-6.31	-7.49	-4.13	18:42:39.3
4.0	1183682.25	219165.50	-7.64	-2.49	-0.35	-5.15	-7.10	-5.05	18:42:39.4
5.0	1183682.16	219165.02	-5.31	-3.00	-1.51				
6.0	1183682.13	219164.71	-2.66	-2.98	-2.24				
7.0	1183682.11	219164.40	-2.34	-2.98	-2.32				
8.0	1183682.05	219163.78	-2.13	-3.29	-2.70				
9.0	1183682.03	219163.46	1.47	-3.10	-3.51				
10.0	1183682.01	219163.15	2.42	-3.28	-3.95				
11.0	1183681.98	219162.84	1.26	-3.78	-4.13				
12.0	1183681.96	219162.59	-0.01	-4.31	-4.30				
13.0	1183681.93	219162.21	-0.64	-4.48	-4.30				

3 Prepared by: Richard Funk

TETRA TECH

PREPARATORY PHASE CHECKLIST

(CONTINUED ON SECOND PAGE)

SPEC SECTION	DATE
Enter Spec Section # Here	Enter Date (DD/MMM/YY)

CONTRACT NO.	DEFINABLE FEATURE OF WORK	SCHEDULE ACT NO.	INDEX #
Enter Cnt# Here	Enter DFOW Here	Enter Sched Act ID Here	Enter Index# Here

PERSONNEL PRESENT

GOVERNMENT REP NOTIFIED ____ HOURS IN ADVANCE YES ☐ NO ☐

NAME	POSITION	COMPANY/GOVERNMENT

SUBMITTALS

REVIEW SUBMITTALS AND/OR SUBMITTAL REGISTER. HAVE ALL SUBMITTALS BEEN APPROVED? YES ☐ NO ☐

IF NO, WHAT ITEMS HAVE NOT BEEN SUBMITTED?

ARE ALL MATERIALS ON HAND? YES ☐ NO ☐

IF NO, WHAT ITEMS ARE MISSING?

CHECK APPROVED SUBMITTALS AGAINST DELIVERED MATERIAL. (THIS SHOULD BE DONE AS MATERIAL ARRIVES.)

COMMENTS:

MATERIAL STORAGE

ARE MATERIALS STORED PROPERLY? YES ☐ NO ☐

IF NO, WHAT ACTION IS TAKEN?

SPECIFICATIONS

REVIEW EACH PARAGRAPH OF SPECIFICATIONS.

DISCUSS PROCEDURE FOR ACCOMPLISHING THE WORK

CLARIFY ANY DIFFERENCES.

PRELIMINARY WORK & PERMITS

ENSURE PRELIMINARY WORK IS CORRECT AND PERMITS ARE ON FILE.

IF NOT, WHAT ACTION IS TAKEN?

4296/2B (9/99) SHEET 1 OF 2

TESTING

IDENTIFY TEST TO BE PERFORMED, FREQUENCY, AND BY WHOM

WHEN REQUIRED?

WHERE REQUIRED?

REVIEW TESTING PLAN.

HAS TEST FACILITIES BEEN APPROVED?

SAFETY

ACTIVITY HAZARD ANALYSIS APPROVED? YES ☐ NO ☐

REVIEW APPLICABLE PORTION OF EM 385-1-1

MEETING COMMENTS

NAVY/ROICC COMMENTS DURING MEETING

OTHER ITEMS OR REMARKS

OTHER ITEMS OR REMARKS:

QC MANAGER DATE

4296/2B (9/98) SHEET 2 OF 2

INITIAL PHASE CHECKLIST		SPEC SECTION Enter Spec Section # Here	DATE Enter Date (DD/MMM/YY)
CONTRACT NO Enter Cnt# Here	DEFINABLE FEATURE OF WORK Enter DFOW Here	SCHEDULE ACT NO Enter Sched Act ID Here	INDEX # Enter Index# Here

PERSONNEL PRESENT

GOVERNMENT REP NOTIFIED _____ HOURS IN ADVANCE YES ☐ NO ☐

NAME	POSITION	COMPANY/GOVERNMENT

PROCEDURE COMPLIANCE

IDENTIFIY FULL COMPLIANCE WITH PROCEDURES IDENTIFIED AT PREPARATORY. COORDINATE PLANS, SPECIFICATIONS, AND SUBMITTALS.

COMMENTS: ______________________________

PRELIMINARY WORK

ENSURE PRELIMINARY WORK IS COMPLETE AND CORRECT. IF NOT, WHAT ACTION IS TAKEN?

WORKMANSHIP

ESTABLISH LEVEL OF WORKMANSHIP.

WHERE IS WORK LOCATED? ______________________________

IS SAMPLE PANEL REQUIRED? YES ☐ NO ☐

WILL THE INITAL WORK BE CONSIDERED AS A SAMPLE? YES ☐ NO ☐

(IF YES, MAINTAIN IN PRESENT CONDITION AS LONG AS POSSIBLE AND DESCRIBE LOCATION OF SAMPLE) ______________________________

RESOLUTION

RESOLVE ANY DIFFERENCES.

COMMENTS: ______________________________

CHECK SAFETY

REVIEW JOB CONDITIONS USING EM 385-1-1 AND JOB HAZARD ANALYSIS.

COMMENTS: ______________________________

OTHER

OTHER ITEMS OR REMARKS

____
QC MANAGER DATE

4298/2C (9/98) SHEET 1 OF 1

TETRA TECH
Contract No. W912DY-10-D-0015
Contract Task Order 0003

FIELD CHANGE REQUEST (FCR)

TASK ORDER # ____________ FCR # ____________ DATE ____________
LOCATION: ____________ NTR / RPM ____________

1. Document to be changed. Identify revision, date, section, drawing, etc.

2. Description of existing requirement and proposed change (Attach sheet if necessary)

3. Reason for Change (Attach sheet if necessary)

4. Originator: (print name and sign)		**Title**	**Date**
Reviewed by: (print name and sign)		**Title**	**Date**
Site Superintendent (Print name and sign)	**Date**	**Task Order Manager (Print name and sign)**	**Date**
Tt Program QC Manager (Print Name and Sign)	**Date**	**NTR Acknowledgement (Print name and sign)**	**Date**

Field Change Request.xls Page 1 of 1

FCR / DCN LOG

Task Order Number: **Contract No. W912DY-10-D-0015 5 Task Order 0003**

Task Order Name: Digital Geophysical Mapping /Electromagnetic Surveys
Culebra Water Ranges –
Flamenco Bay Water Area (MRS 03) and Luis Peña Channel (MRS 12)

FCR# / DCN#	DESCRIPTION OF Change	Date Initiated	Status

NONCONFORMANCE REPORT / DEFICIENCY LOG

Task Order Number: **Contract No. W912DY-10-D-0015 5 Task Order 0003**

Task Order Name: ______________________

NCR #	DESCRIPTION OF CONDITIONS / ITEMS AFFECTED	DATE				REMARKS
		ISSUE	DISPOSITION / APPROVAL	RE-INSPECTION	CLOSURE	

TETRA TECH
Contract No. W912DY-10-D-0015
Contract Task Order 0003

DESIGN CHANGE NOTICE (DCN)

TASK ORDER # ______________ DCN # ______________ DATE ______________

LOCATION ______________ NTR / RPM ______________

1. Document to be changed. Identify revision, date, section, drawing, etc.

2. Description of Change (Items involved, submit sketch, if applicable): (Use continuation sheet if necessary)

Engineering "HOLD" placed on all activities in area defined herein pending receipt of formally revised document(s) and / or DCN.
Released for construction basis of modifications prescribed by this DCN.

3. Reason for Change (Attach additional information if nedded)

4. Originator (Print name and sign)		Title	Date
Reviewed by: (Print name and sign)		Title	Date
Task Order Manager (Print name and sign)	Date	Program Quality Manager (Print name and sign)	Date
NTR Acknowledgement (Print name and sign)	Date	RPM Approval (Print name and sign)	Date

Design Change Notice.xls Page 1 of 1 Design Change Notice

TETRA TECH EC, INC.

VISITOR LOG

PROJECT NAME. & LOCATION:

Contract No. W912DY-10-D-0015 5 Task Order 0003

Digital Geophysical Mapping /Electromagnetic Surveys Culebra Water Ranges – Flamenco Bay Water Area (MRS 03) and Luis Peña Channel (MRS 12)

Date	Name	Company/Agency	Time In	Time Out

Page_____

APPENDIX G

CONTRACTOR PERSONNEL QUALIFICATIONS CERTIFICATIONS LETTER

12 August 2013
TTEC-WERS-13-TO0003-021

Mr. Roland Belew
Project Manager/Contracting Officer Representative
U.S. Army Engineering and Support Center, Huntsville
4820 University Square
P.O. Box 1600
Huntsville, AL 35807-4301

Subject: **Personnel Qualifications Certification for Key Assignments, Phase 2 Remedial Investigation Culebra Water Ranges MRS 03 and 12; Culebra, Puerto Rico, Contract No. W912DY-10-D-0015, Task Order 0003**

Dear Mr. Belew,

This letter has been prepared by Tetra Tech EC, Inc. (TtEC) to provide certification of key personnel assigned to the above referenced contract. This personnel qualifications certification letter, with attachments, is provided to demonstrate that TtEC's personnel assignments for core labor categories meet the training and experience requirements for the position held. A summary table of key personnel is provided in Attachment A, and resumes (Attachment B) are provided to document personnel qualifications and experience.

In accordance with Data Item Description WERS-012.01, the below representative of TtEC certify that the listed personnel meet or exceed contract requirements for the functions they will perform.

Tetra Tech EC, Inc.

Scot Wilson, PMP
Project Manager

Attachments: Attachment A – Summary of Key Personnel
Attachment B – Resumes for Key Personnel

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Attachment A
Summary of Key Personnel
Culebra Water Ranges Phase 2 RI

Name	Affiliation	Title	Assigned Role
Kent Weingardt, PE, PMP	TtEC	WERS Program Manager/Project Engineer	Program Manager
Scot Wilson, PMP	TtEC	Project Manager	Project Manager
Johnnie Bratton	TtEC	Senior Director, Procurement and Contracts Administration	Senior Contracts Manager
Paul White, CQA	TtEC	Corporate Quality Manager	Corporate Quality Manager
Dave Keller	TtEC	UXO/Diving Safety Manager	Corporate Health & Safety Officer
Richard Funk	TtEC	Project Geophysicist	Field Operations Lead
David Bennett	TtEC	Senior UXO Supervisor	Senior UXO Supervisor
Kyle Enright	TtEC	SSHO	Safety Officer
Elise Goggin	TtEC	Geophysics Quality Manager	Geophysics Quality Control Manager
Burr Bridge	TtEC	Field Quality Control Manager (QCM)	Field QCM
Peter Polivka	TtEC	Geophysicist	Geophysicist
Chris Kenyon	TtEC	Geophysicist	Geophysicist
Jennifer Peters	TtEC	Senior Compliance Specialist	Regulatory Specialist
Edwin Rodriguez-Class, PhD	TtEC	Biologist	Biological Monitor
Ariel Rivera Vicente	TtEC	Biologist	Biological Monitor (alternate)
Ron Marnicio, PhD, PE	TtEC	Consulting Scientist/National Risk Assessment Discipline Lead	Risk Assessor
Roger Margotto, CIH, CSP, CHMM	TtEC	Supervising Health and Safety Scientist	Certified Industrial Hygienist

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Attachment B
Resumes of Key Personnel
Culebra Water Ranges Phase 2 RI

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Kent Weingardt, PE, PMP
Program Manager

- BS, Chemical Engineering
- Professional Engineer (PE) – Chemical (CA), 2001
- Certified Project Management Professional (PMP), 1995
- More than 23 years of project/program management and engineering experience in the engineering, design, munitions, and environmental industries.

Work Experience

More than 23 years of project/program management and engineering experience in the engineering, design, munitions and environmental industry. During this time, has worked on a wide variety of engineering, field implementation, and construction projects taking on increasing levels of responsibility and oversight. Has worked as a Process Engineer, Field Engineer, Project Engineer, Program/Project Manager, Proposal Manager and Engineering Staff Supervisor. Current responsibilities include: preparing proposals and project cost estimates; negotiating contracts; coordinating multi-disciplinary teams to prepare designs and project work plans; preparing construction/equipment specifications; procuring equipment, materials and subcontractors; managing office and field crews, monitoring and controlling project budgets, schedules, quality and scope; maintaining excellent client relations and communication; business development. Additionally, has overseen staff engineering departments and managed personnel work-loads and ensured quality deliverables from the department.

Program Manager, NAVFAC SW EMAC. Responsible for overall management of this FFP multi-award contract for remediation projects. Four projects were awarded for a combined value of $28.5M, two of which were located in logistically-challenging areas. Secured over 30% of the baseline awards for this contract vehicle in competing with five other firms. **To date, logged over 85,000 hours on these complex remediation projects without an OSHA recordable or lost time incident.**

Project Manager, Time Critical Removal Action – MRP Site UXO5, NAVWPNSTA Seal Beach Detachment Fallbrook, CA. Prepared planning documents including an Explosives Safety Submission to support a TCRA at the 13-acre munitions site. A surface clearance, burial pit excavation and geophysical mapping was performed as part of this project. Over 3,000 lbs. of scrap metal was recovered and recycled from the surface of the site. Fifteen drums of inert munitions debris (MDAS) were also recovered and are schedule for demilitarization at an offsite facility. **Over 2,000 labor hours were logged on-site for the TCRA without a safety incident.** As part of this project, we developed the approach and work plans to acquire and analyze soil samples to develop a background data set for metal constituents from four (4) geological formations present.

Project Manager, Non-Time Critical Removal Action – IR Site 24A Former Small Arms/Practice Grenade Range, Former NAVWPNSTA Seal Beach Detachment Concord, CA. Prepared planning documents to perform this NTCRA to excavate lead-contaminated soils, screen soils for lead fragment removal, and stabilize soils prior to off-site disposal. Project also included surface/near-surface munitions clearance and on-site munitions demolition as necessary.

Project Manager/Engineering Lead, Mare Island Marine Corps Firing Range Clean-Up and Restoration, CA. Prepared EE/CA, Action Memorandum, and Work Plans for project to restore a 20-acre former firing range including lead contamination, ordnance related items, radiological items.

Work Experience

Scot Wilson
Project Manager/Senior UXO Supervisor

- MS, Information Systems and Operations
- Over 20 years of experience in diving and munitions response projects.
- Former Navy EOD and Diving Officer and Navy Diving Supervisor.
- Project Manager for U.S. Navy at Jackson Park Housing Complex in WA. Work included conducting a 35-acre surface sweep for DMM and diving operations to investigate and recover DMM at over 800 magnetic anomaly sites at the bottom of Ostrich Bay. All field tasks were completed ahead of schedule and under budget while maintaining a perfect safety record.

Mr. Wilson is a graduate of the Navy's Explosive Ordnance Disposal School, a Master Explosive Ordnance Disposal Technician, and a Navy Diving Officer, with over 20 years' experience in diving and unexploded ordnance (UXO) field operations. Since joining Tetra Tech in 2009, he has been the Project Manager for multiple project sites including the Navy's underwater and terrestrial munitions cleanup projects at Jackson Park and the U.S Army Corps of Engineers UXO Remedial Investigation Culebra Puerto Rico. In addition, he serves as Tetra Tech's UXO technical lead for the projects with UXO components. He has provided UXO project management, technical guidance, and oversight at over 15 UXO field projects throughout the country while maintaining a perfect safety record.

Project Manager, NAVFAC Southwest RAC V, Remedial Investigation/Feasibility Study, Task Order KR02, Formal Dispute Resolution Support and RI/FS Project Plans for Munitions Investigation for OU 3M Jackson Park Housing Complex, Bremerton Washington. Coordinated authorship among 5 contributors to the RI/FS work plan document. Was responsible for document review and quality assurance. Responsible for responding to comments from reviewers, including EPA Region 10, Suquamish Tribe, and Naval Facilities Command North West. Document was submitted in draft form with no major comments. In addition, developed and authored the Pilot Study Work Plan Supplement for OU3-M RI/FS Work Plans. The project earned the highest award fee evaluation possible.

Project Manager, NAVFAC Southwest RAC V, Task Order KR04, Explosives Safety Submission and Conceptual Remedial Design, Bremerton Naval Complex, WA. Authored the Explosive Safety Submission for the OU3-M Pilot Study in half the time listed in the project schedule Wrote amendment to 2006 Explosive Safety Submission for OU3-M RI/FS to include an innovative underwater collection point allowing the Navy to open a previously closed public recreation area. Developed new techniques for munitions dredging during the Conceptual Remedial Design to minimize the amount of sediment that must be processed saving thousands of dollars in off-site disposal. The project earned the highest award fee evaluation possible.

Project Manager, NAVFAC Southwest RAC V, Jackson Park OU3-M Site, Task Order KR07, Phase 2 RI/FS for OU 3-M, Jackson Park Housing Complex, WA. Managed and directed a $4.1 million task order with a project staff of 16 people during the 2009 field season at the Jackson Park OU3-M site. This work included conducting a 35-acre surface sweep for discarded military munitions (DMMs) and diving operations to investigate and recover DMM at over 800 magnetic anomaly sites at the bottom of Ostrich Bay. All field tasks were completed ahead of schedule and under budget while maintaining a perfect safety record. Following the field work, he authored the NOSSA After Action Report, the Remedial Investigation/Feasibility Study Report, and dispute resolution documents supporting the Navy during negotiations with the regulators for acceptance of the remedial alternatives. The project earned the highest award fee evaluation possible ensuring the company received the maximum available fee.

Project Manager, NAVFAC NUS CLEAN Contract, Jackson Park OU3-M Site, Task Order KR03, UXO Underwater EM Survey of Jackson Park Pier Area. Managed and directed a $500,000 task order to conduct an underwater electromagnetic induction survey for magnetic anomalies over a 10 acres parcel surrounding Pier Two in Ostrich Bay. This data will be used to help select the preferred remedy for the remediation of Ostrich Bay. The task includes preparing a QAPP and Survey Plan, conducting the survey, and preparing the survey report. This survey used Tetra Tech's proprietary underwater EM array sensor suite. This sensor allows conducting surveys next to large structures like piers and ships that would not be possible with a magnetometer.

(Scot Wilson, continued)

EOD Experience (USACE UXO Tech #3260)

Military UXO Experience

1984–1984	NAVSCHOLEOD EOD Assistant Training
1984–1988	EOD Assistant, EOD Mobile Unit 1, Hawaii (WestPac Deployment on USS Pyro)
1994–1995	NAVSCHOLEOD EOD Technician Training
1994–1996	Officer in Charge, EOD Mobile Unit 3 Det 51, San Diego CA (Atlantic Deployment USS Inchon)
1997–1998	Officer in Charge, EOD Det Northwest, Whidbey Island WA
2001–2003	Operations Officer, EOD Mobile Unit 3, San Diego CA
2003–2005	Executive Officer/ Commanding Officer, EOD Mobile Unit 17, Whidbey Island, WA

Civilian UXO Experience

2009–2013	Project Manager for Jackson Park OU 3M Underwater Munitions Removal, Tetra Tech
2009–Present	UXO Technical Lead for the Tetra Tech Munitions Response Program (over 20 projects)
2010–2012	Project Manager for Jackson Park Marine UXO EM Survey
2011–2013	Project Manager for the Watts Constructors MEC soil screening project at Naval Base Kitsap
2011–Present	Project Manager for WERS USACE TO003 at Culebra PR for MRS 3 and 12.
2012–Present	Project Manager for NAVFAC NW TriEco Joint Venture JP02 Underwater Supplemental UXO RI at Jackson Park, Washington

Project Management Institute

THIS IS TO CERTIFY THAT

Scot Wilson

HAS BEEN FORMALLY EVALUATED FOR DEMONSTRATED EXPERIENCE,
KNOWLEDGE AND SKILLS TO LEAD AND DIRECT PROJECT TEAMS AND IS HEREBY
BESTOWED THE GLOBAL CREDENTIAL

Project Management Professional

IN TESTIMONY WHEREOF, WE HAVE SUBSCRIBED OUR SIGNATURES UNDER THE SEAL OF THE INSTITUTE.

Beth Partleton - Chair, Board of Directors

Mark A. Langley - President and Chief Executive Officer

PMI Project Management Institute

PMP® Number **1436776**

PMP® Original Grant Date **29 July 2011**

PMP® Expiration Date **28 July 2014**

Naval School

Explosive Ordnance Disposal

Certificate of Completion

Presented to

LT Scot M. Wilson, USN

For having successfully completed the prescribed course of study for

EXPLOSIVE ORDNANCE DISPOSAL

PHASE I & II - NAVY

on this, the Third day of May 1995.

CDR J. R. Lake, USN

Commanding Officer

David Bennett
Sr UXO Supervisor/UXO QC/Environ Safety Supervisor

- UXO Certified Specialist (EOD)
- Qualified Diving Supervisor
- Qualified Hovercraft Pilot

Work Experience

Senior UXO Supervisor has more than nineteen years combined experience in the United States Navy Explosive Ordnance Disposal (EOD) and commercial UXO industry. Extensive experience in range clearance, military/civilian diving operations and management of all phases of the UXO industry.

Senior UXO Supervisor (SUXOS), Silver Wings Golf Course/Ft. Rucker, AL. Senior UXO Supervisor for the Silver Wings Golf Course Project/Time Critical Removal Action. Responsible for the set-up of all site equipment and assets. Managed all daily operations to include: EM-61 data collection, surface sweep and intrusive operations.

SUXOS, Naval Base Kitsap/Bangor, Silverdale, WA. Senior UXO Supervisor for the sifting operations at the Former Dunnage Yard on NBK Bangor Silverdale, WA. Managed all daily operations to include daily briefings, overseeing of all sifting operations and management of all recovered MDAS and scrap metal.

SUXOS, RI Delta Range, Delta, CO. Senior UXO Supervisor for the Remedial Investigation of the Delta Range Project/Time Critical Removal Action. Responsible for the set-up/demobilization of all site equipment and assets. Managed all daily operations to include: EM-61 data collection, soil sampling, Detector Aided Reconnaissance (DAR), surface sweep and intrusive operations.

UXO Team Leader, Al Karj, Saudi Arabia. Conducted remediation and removal of (5) Bradley Fighting Vehicles, (1) M577 Command Vehicle, (1) M113 Armored Personnel Carrier and (1) A10 Aircraft from a storage vault. Vehicles/aircraft had been destroyed by friendly fire during first Gulf War. All vehicles/aircraft were contaminated with Depleted Uranium and were being removed from Saudi Arabia. All vehicles/aircraft were craned from the vault checked for any UXO items, then sized and placed into 40' Sea Land containers for shipment to the United States. Additionally soil sifting operations were conducted to remove Depleted Uranium from all soils recovered from the site. Observed all necessary safety precautions wearing Tyvex overalls, booties, respiratory protection and observing hot lines and work zone precautions. High and Low volume air samplers were run during all operations. Close interaction with the Saudi Arabian Army, US Army and Army Corps of Engineers was maintained.

SUXOS, RI Delta Range, Delta, CO. Senior UXO Supervisor for the Remedial Investigation of the Delta Range Project. Was responsible for the set-up/demobilization of all site equipment and assets. Managed all daily operations to include: EM-61 data collection, survey of project boundaries, soil sampling, Detector Aided Reconnaissance (DAR), surface sweep, intrusive and demolition operations. Was responsible for and maintained explosive inventories, closely coordinated with local supplier to purchase and maintain explosive inventory. Managed multi-phase process so that the project finish two weeks ahead of schedule for an increased profit of $300,000.

UXO Team Leader/ Assistant SUXOS, Navy DRI/Lowry Site, Aurora, CO. Conducted surface sweep operations. Conducted intrusive operations using EM-61 data and dig sheets. Assumed duties of SUXOS during home leave and vacations of SUXOS.

UXO Quality Control, Fort McClellan, Anniston, AL. Quality Control Inspector during range clearance operations. Conducted Preparatory, Initial and Daily inspections. Conducted quality control checks of clearance operations utilizing the EM-61.

UXO Diver, Jackson Park, Bremerton, WA. UXO diver conducting target classification of over 800 underwater anomalies in Ostrich Bay. Conducted diving operations in support of the Jackson Park pilot study program.

Quality Control, Rocky Mountain Arsenal, Denver, CO. Quality Control Inspector for the construction of the RCRA equivalent cover for the Enhanced Hazardous Waste Landfill (ELF). Inspected placement and construction of the various landfill layers. Utilized various testing methods to ensure proper adherence to quality standards of the various layers of the landfill construction.

05/19/2003 07:43 5085631269 TTMMR PAGE 02/04

[redacted]

Naval School
Explosive Ordnance Disposal

Certificate of Completion

Presented To

Electronic's Technician First Class
David E. Bennett, USN

For having successfully completed
the prescribed course of study for

EXPLOSIVE ORDNANCE DISPOSAL PHASE II - NAVY

11 May 1992

Date

JOHN J. WALSH, CDR, USN

Commanding Officer

MAY 19 2003 04:58 5085631269 PAGE.02

Johnnie Bratton
Senior Contracts Manager

- AAS (Associate of Applied Science), Contracts Management, Community College of the Air Force
- Over 30 years of management experience with contracts and subcontracts in the federal and commercial arenas
- involved in all phases of awards, claim settlements and negotiations for services and construction contracts and subcontracts
- extensive knowledge of federal statutes, regulations and orders and is skilled in interpreting and applying federal labor laws

Work Experience

Over thirty years of management experience with contracts and subcontracts in the federal and commercial arenas. Involved in all phases of awards, claim settlements, and negotiations for services and construction contracts and subcontracts. Experienced in management of complex cost-reimbursement, fixed-price and fixed unit rate contracts. Extensive knowledge of federal statutes, regulations and orders and is skilled in interpreting and applying federal labor laws.

Senior Director, Procurement and Contracts Administration, TtEC. Directs federal and commercial procurement activities, and supervises staff, including hiring, termination, performance appraisal, delegation of authority, work assignment and definition of roles and areas of responsibility. Ensures training and development of staff to increase proficiency in satisfying job responsibilities. Serves as primary point of contact for departmental reviews and audits. Also serves as primary point of contact for TtEC's Small Business Program and promotes equal employment opportunities. Conducts strategic planning for continuous improvement and development of the Procurement Department.

Contracts Manager, WERS, USAESC-Huntsville, AL. For this five-year, $945M ID/IQ contract, oversees prime contract administration, proposal preparation, procurement, projec
t controls, accounting, invoicing, cost engineering, and Government property management. Interfaces with USAESCH contract specialists to ensure adherence to contract and TO-specific requirements.

Contracts Manager, U.S. Army, Rocky Mountain Arsenal Program Management Contract, CO. Responsible for cost and scheduling, estimating, procurement, contract and subcontract administration, government property, accounting, human resources, and information systems. Interfaces with Government's Contracting Officer on matters concerning subcontract formation and administration, and assists Project Controls Manager with administration and reporting of prime contract issues. Revised Rocky Mountain Arsenal's subcontract structure by writing operational procedures resulting in increased administrative efficiencies. Led the Procurement Department from a Marginal rating by the client in 2003 to its current Superior rating. Created a Contractor Purchasing System Review Desktop Guide for use by Subcontract Administrators to assist in preparation for audits. Monitors and ensures compliance with applicable Federal Acquisition Regulation, Defense Federal Acquisition Regulation, and Corporate and Project Reference Libraries. Responsible for preparation of Annual Work Plan and Subcontracting Implementation Plan. Provides direct interface with the client's project controls organization on issues regarding cost, budget, and schedule. Developed an Organizational Conflict of Interest Mitigation Plan.

Paul White, CQA
Corporate Quality Manager

- BA, Geological Sciences
- ASQC Certified Quality Auditor, #16066
- 38 years of experience including quality assurance and quality control
- Maintained and improved the quality system to support 460 task orders for $1.2B US Army Rocky Mountain Arsenal (RMA) Program Management Contract over a 20 year period
- Quality programs for the clearance and Removal of 186,000 cy of munitions debris- contaminated soil and recovery of 8,779 MEC items
- Over 6 million hours at RMA with no lost time incidents, including during MEC and CWM tasks

Work Experience

Thirty-eight years of experience including quality assurance and quality control during construction, remediation and environmental investigations, field and laboratory auditing, corporate program auditing, development of quality assurance program and project plans. Field oversight for hazardous waste site remedial investigation and remedial, munitions and explosives of concern (MEC), chemical warfare material (CWM) and clean construction.

Corporate Quality Manager, WERS, USAESC-Huntsville, AL. For this five-year, $945M ID/IQ contract, responsible for quality assurance and quality control for all aspects of the task orders. Tasks include plan preparation, document review, field oversight, and auditing.

Program Quality Assurance/Corporate Quality Control Manager, Department of Army, Rocky Mountain Arsenal Program Management Contract. Directed QA/QC program activities for this $1.2B remediation contract at the Army's largest, most technically complex and politically sensitive environmental restoration and waste management project. Rocky Mountain Arsenal encompasses 26.6 square miles (all but 5.5 square miles have been deleted from the NPL), and included 3,000 acres and nearly 800 structures contaminated with a variety of compounds, in addition to sarin and mustard (chemical warfare materiel (CWM)) and munitions and explosives of concern (MEC). Oversaw QC for more than 460 TOs, with as many as 160 conducted concurrently. Developed the Program Management Contract Quality Management Plan which met the requirements of ANSI/ASQC, "Quality Assurance Requirements for Environmental Programs," and supporting quality procedures. Responsible for staff of up to 30 QA/QC personnel, as well as positions for document control and waste tracking. Responsible for oversight of project implementation, quality improvement initiatives, Lessons Learned program, and quality awareness (bulletins, posters, etc.).

Ensured heightened awareness of quality was maintained in all staff and subcontractors. Quality program requirements included the preparation of Construction Quality Assurance Plans, presentation of quality requirements at pre-bid conferences, quality program orientation for new employees, identification of quality requirements for bid packages, and review of subcontractor bids. Oversaw surveillance performed by QA/QC and H&S staff on active task orders, as well as audits on selected task orders. Off-site laboratories for geotechnical and analytical analyses were also audited regularly. Projects included hazardous waste remediation through excavation and placement in landfills and RCRA covers for landfills.

Corporate Quality Control Manager/Quality Control Specialist, NAVFAC Northwest RAC II. As QC Specialist, performed on-site QC for the Naval Arctic Research Laboratory remediation in Point Barrow, AK. Also authored sections of the Contractor QC Plan for the geophysical surveys and intrusive sampling for UXO clearance conducted at Naval Air Facility Adak, AK.

Corporate Quality Control Manager/Project Quality Assurance Manager, New Cure, Inc., Operating Industries Inc. Superfund Site. Responsible for preparation and implementation of the Quality Assurance Plan and Construction Quality Assurance Plans, and ensured compliance with requirements of Record of Decision and Consent Decree for this 190-acre landfill. Plans were developed to meet the requirements of EPA QAMS 005 (Interim Guidelines and Specification for Preparing Quality Assurance Project Plans) and EPA - Quality Assurance and Quality Control for Waste Contaminated Facilities.

Richard Funk
Field Operations Lead, Principal Project Geophysicist

- MS, Geological Sciences/Geophysics
- Registered Professional Geologist, TN
- 16 years of experience with over 10 years specializing in the design and management of high-resolution integrated geophysical programs for marine investigations including dredge design and monitoring geotechnical, geologic, hydrogeologic, cultural resource features, and OE/UXO/MEC.
- Principal Investigator for the Environmental Security Technology Certification Program project MM-0808 to demonstrate a practical approach to detecting and locating unexploded ordnance and munitions debris in the aquatic environment.

Work Experience

Over 15 years of experience in geophysical (terrestrial and marine) data collection, processing, and interpretation. Experience includes the design and management of integrated geophysical programs that have utilized electromagnetic, seismic, resistivity, gravity, and borehole geophysical methods to investigate and assess, geotechnical, geologic, hydrogeologic, cultural resource features, and ordnance end explosives (OE). Experience also includes more than nine years of UXO investigations (terrestrial and marine) on sites from New Jersey to Adak Island, Alaska.

Project Geophysicist,, NAVFAC Atlantic, Hydrographic and Ground-Truthing Surveys and Characterization of the Benthic Habitat within the Proposed Undersea Warfare Training Range (USWTR), Jacksonville, FL. Part of the team providing hydrographic and geophysical surveys at Navy test ranges offshore of the east coast of Florida, approximately 60 to 90 miles. Responsible for the collection, processing, analysis and reporting of geophysical data to map the seabed and surface features for the combined ranges (920 square nautical miles) with depths from 40 to about 700 meters.

Project Geophysicist,, NAVSEA, Naval Undersea Warfare Center Division Newport, Rhode Island, Barking Sands Underwater Range Expansion (BSURE), Kauai, HI. Participated in bathymetry survey covering an area of approximately 1200 square nautical miles with depths ranging from 25 to 5,000 meters.

Co-Principal Investigator and Geophysical Manager, Environmental Security Technology Certification Program (ESTCP), MM-0808, Wide Area Assessment for Marine UXO, Seattle, WA. Co-PI for the ESTCP project MM-0808 to demonstrate a practical approach to detecting and locating UXO and munitions debris in water bodies (lakes, rivers, ocean areas). This demonstration will establish a feasible approach to marine wide-area assessment for water depths ranging from one to 110-ft. The Wide Area Assessment includes the collection of multibeam bathymetry (including back-scatter), sidescan sonar, subbottom profiling and magnetometry with our Tetra Tech developed Marine Gradiometer Array (MGA). The MGA is a scalable 7-10 sensor gradiometer that directly measures the 3-Dimensonal magnetic field vector, or analytic signal. Our approach integrates supplemental sensor information to aid in discrimination of UXO from non-UXO background clutter. The Environmental Security Technology Certification Program is a Department of Defense (DoD) program that promotes innovative, cost-effective environmental technologies through demonstration and validation at DoD sites.

Project Manager / Geophysical Manager, NAVFAC Washington, Naval Air Station (NAS) Patuxent River – Munitions Site UXO 1, Site Investigation for MEC, Patuxent River, MD. Tetra Tech conducted a site investigation for underwater MEC in the marine portion of Munitions Site UXO 001 NAS Patuxent River (PAX River) in Chesapeake Bay. This is the first marine UXO site to be surveyed with 100% coverage with both magnetometer and electromagnetic induction (EM) meter. Data will help determine the extent of the remaining MEC and munitions debris and help the Navy accurately scope follow-on investigations at the site. Managed the surveys in varying water depths (0 to 12 feet MLLW) using Tetra Tech's proprietary marine gradiometer array (MGA), as well as the towed electromagnetic induction array (TEMA) providing on-land accuracy on-water for both magnetometer and EM.

Project Manager/Geophysical Manager, NAVFAC Atlantic, Site Investigation for Naval Training Center (NTC) Great Lakes, IL. As project manager oversaw geophysical aspects of the project to conduct a multibeam survey supporting a site investigation for underwater UXO/MEC and contaminated sediments. Directed deployment of Tetra Tech's custom-designed 4-meter-wide marine gradiometer array (MGA) for 150 hours of data acquisition in water depths from 3 to 35 meters. Ground-truthing sediment samples and deployment of a drop camera used to examine high-priority targets.

Kyle Enright, EIT
Site Safety and Health Officer

- BS, Construction Engineering, 2006
- Engineer in Training
- OSHA 30-Hour Construction ESS Certification OSHA 30-Hour Construction ESS Certification
- 40-Hour OSHA Hazardous Waste Health and Safety Training
- Extensive experience performing hydrographic surveys with differential global positioning system (DGPS) and single-beam bathymetry equipment.

Work Experience

EIT with experience performing hydrographic surveys with GPS and bathymetric equipment, including surveys on rivers and waterbodies across the United States and its territories. Has 7 years of experience conducting vessel-mounted LiDAR, single-beam and high-resolution multi-beam systems to perform hydrographic surveys to map waterway conditions and associated structures, providing data quality assurance and quality control, data processing, report development, and acting as Field Lead and Project Manager on various projects. Has received OSHA 30-hour construction safety certification and 40-hour OSHA hazardous waste training.

Field Lead/Hydrographer/Technician, Tetra Tech, Carraizo Reservoir Bathymetric Survey, Puerto Rico. Mobilized vessel of opportunity with multibeam echosounder, RTK GPS and high accuracy motion reference unit to collect bathymetric data within the Carriazo Reservoir. This body of water is used for drinking water for the San Juan and the capacity is shrinking due to sediment accumulation. The reservoir was surveyed with MBE and a dual frequency single beam echosounder. The dual frequency SBE and sediment samples aided in bottom type characterization and existence of a "fluff" layer.

U.S. Army Corps of Engineers, Louisville District, Pier 23 Replacement, Seattle, WA. Assisted environmental engineer responsible for design of the sediment remediation portion of the Army Reserve Pier 23 Replacement Project. After demolition of the 600-foot timber section of the pier, a sediment remediation will be performed within the Commencement Bay/Nearshore Tideflats Superfund Site prior to replacement of the pier section.

Field Lead/Hydrographer/Technician, Tetra Tech, Condado Lagoon Bathymetric Survey, San Juan, Puerto Rico. Mobilized vessel of opportunity with multibeam echosounder, RTK GPS and high accuracy motion reference unit to collect bathymetric data within Condado Lagoon. The goal of this survey was to aid restoration efforts based on benthic habitat zones and their correlation to specific depths. The data set aided divers to narrow their searches to specific areas based on benthic communities' behavior. Additional value was provided to calculate fill volumes to restore ideal lagoon depths that will promote restoration of underwater life.

Field Lead/Hydrographer, Lockheed Martin, Frog Mortar Creek Bathymetry Survey, Baltimore, MD. Field lead and sole hydrographer for the acquisition of multibeam survey data in the Frog Mortar Creek portion of Chesapeake Bay outside of Baltimore, MD. Client required an existing conditions survey for placement and construction of an outfall for Lockheed Martin. The goal is for the outfall structure and draining fluids to be below the waterline and minimize its existence to the area. Survey had a 2-man crew using the 18-ft R/V *MIJITT*.

Field Lead/Hydrographer/Technician, U.S. Navy, Great Lakes Naval Training Facility, Waukegan, IL. Mobilized near coastal survey vessel to map out survey area in preparation for Magnetic Gradiometer Array (MGA) survey of a dormant naval shooting range in Lake Michigan. The bathymetric data aided in safe operations for the MGA towfish and added informative value to the end deliverable.

Field Lead/Hydrographer, Seattle City Light, Boundary Dam Multi-beam, Vessel Mounted LiDAR, Scanning Sonar, Terrestrial Laser Scanning and ROV Survey, Metaline Falls, WA. Supported geophysical and ROV survey operations and data processing to documentation of current state of Boundary Dam upstream, plunge pool and tailrace. Operating within the highly restricted plunge pool presented a challenging GPS environment for vessel positioning. Redundant positioning in the form of dual robotic total stations were utilized to track the survey vessel realtime, in addition traditional GPS was augmented with GLONASS capable units. Multiple terrestrial scan locations formed the backbone of a composited, coherent data set with hundreds of millions of measurement returns.

Elise Goggin
Geophysics Quality Control Manager

- BS, Engineering Geophysics6 years' experience in geophysical surveying, including QA support.
- Subject matter expert for USACE on near surface geophysics

Work Experience

Knowledgeable geophysicist with over 6 years of geophysical surveying experience. She served as subject matter expert on near surface geophysics at USACE Huntsville before joining TtEC, predominantly focused on detection and discrimination of Unexploded Ordnance (UXO). Experienced with a range of applicable software (e.g., Geosoft Oasis Montaj, ArcGIS, MagMap, MagLog, Visual Sample Plan) and equipment (e.g., Geonics - EM61-MK2, EM31; Geometrics - MetalMapper, G-858 Magnetometer; ASI - Supersting; Gravimeters - Lacoste and Romberg, Scintrex CG-5), she has extensive experience in collecting and processing advanced EMI data. She is also experienced working with regulators and stakeholders on both traditional characterization/remediation projects and classification projects. In both terrestrial and marine environments, she has collected, processed and analyzed electromagnetic and magnetic data to locate UXO.

Near Surface Geophysics Subject Matter Expert. USACE Huntsville, Alabama. Subject Matter Expert on near surface geophysics. Predominantly focused on the detection and discrimination of UXO. Provided quality assurance support for geophysical data collection on Formerly Used Defense Sites (FUDS) and other UXO sites. Collected, processed and analyzed electromagnetic and magnetic data to locate UXO. Both land and marine. Extensive experience in collecting and processing Advanced EMI data. (Mass. Military Reservation, Camp Ellis, Ft. Rucker) Participated in the ESTCP Classification Demonstration at Pole Mountain. Missed zero targets of interest and eliminated over 75% of clutter digs. Experience working with regulators and stakeholders on both traditional characterization/remediation projects and classification projects. Provided geophysical basis of estimate for characterization/remediation projects. Worked with CRREL to collect resistivity data to characterize the effects of climate change and anthropogenic activity on permafrost thickness.

Newmont Mining, Inc., Nevada and Colorado. Collected, processed, and interpreted gravity, magnetic, CSEM, DC resistivity and induced polarization data. Involved extensive field work for large scale surveys in remote locations.

Burr Bridge
Field Quality Control Manager

- BS, Management, 1973
- Certified Hydrographer, ACSM #256
- Over 35 years experience in software development for instrumentation, data analysis, and support of various types of operations.
- 40 Hour HAZWOPER Training
- 15 years of experience using C++, and 10 years of experience using MFC and STL, as well as Python, Java, Pascal, Basic, FORTRAN, TCP/IP client/server and UDP network communications programming, RS-232/422 serial data collection and communications, multithreaded, real-time applications, hardware control/instrumentation programming, SourceSafe configuration management software, Relational database development.

Work Experience

More than 20 years of experience supporting field survey programs and more than 35 years in software development for instrumentation, data analysis and support of various types of operations. Manages or conducts all aspects of hydrographic and related surveys, from planning through field data collection, processing and generation of data products and reports. Experience with HYPACK, ArcGIS, Caris, Fledermaus, SonarWiz, and a variety of other survey and processing software applications. Extensive experience in C++, Python and several other languages, APIs, and communications protocols. Develops software for real-time data collection, process control, and to support survey data post-processing.

Lead Hydrographer/Data QC, Environmental Baseline Study and Marine EM Survey Planning/Support for Culebra Water Ranges MRS 3 & 12, Culebra, Puerto Rico. Supported field operations, performed data analysis, processing and QC of bathymetry and video data collected for an environmental baseline study that was the first phase of a munitions cleanup operation in two of the munitions response sites, Flamingo Bay and the Luis Pena Channel, in the waters adjacent to Culebra. Developed software to geo-reference and provide data products for underwater photographs and video collected during the baseline survey. Developed survey plans and software to support real time data collection and post-processing for upcoming munitions survey to be conducted with the Tetra Tech developed Towed EM Array (TEMA).

Technical Support/Data QC, Wide Area Assessment for Marine UXO, Environmental Security Technology Certification Program (ESTCP), MM-0808, Martha's Vineyard, MA. Technical support and data QC for the ESTCP project MM-0808 to demonstrate a practical approach to detecting and locating UXO and munitions debris in water bodies (lakes, rivers, ocean areas). This project demonstrated a feasible approach to marine wide-area assessment for water depths ranging from 1 to 110 feet. The Wide Area Assessment included the collection of multibeam bathymetry, sidescan sonar, sub-bottom profiling and magnetometry with the Tetra Tech developed Marine Gradiometer Array (MGA).

Hydrographer/Software Developer, Ostrich Bay UXO Cleanup Project, Jackson Park, WA. Under contract to the U.S. Navy, participated in multi-sensor survey operations to map potential UXO before and after remediation operations to evaluate the relative effectiveness of several approaches for UXO removal. Wrote real-time support and post-processing analysis software for surveys and participated in survey operations. In the course of multiple survey projects, conducted multiple high resolution multibeam bathymetry and target detection surveys to assess current conditions and identify any potential hazards to towfish operations. Supported magnetometer array and towed EM array surveys to detect and locate discarded munitions in the vicinity of the old weapons depot piers. Developed software applications to aid in the real time navigation and subsequent processing of the towed EM array and magnetometer/gradiometer data.

Multibeam Sonar Specialist/Hydrographer, NAVSEA, Barking Sands Underwater Range Expansion (BSURE) Project, Kauai, HI. Under contract to NAVSEA to perform a deep water survey of a U.S. Navy acoustic test range off the coast of Kauai, HI, mobilized a vessel with a RESON 7150 multibeam sonar and associated support equipment, and conducted integration and acceptance testing of the sonar. Conducted a 13-day bathymetry survey covering an area of approximately 1200 NM^2 with depths ranging from 25 to 5,000 meters.

Peter Polivka
Geophysicist

- PhD (in process), Earth Science Systems
- MS, Civil and Environmental Engineering, 2013
- Experienced in seismic data collection, processing and interpretation.
- Facility in ArGIS, AutoCAD, and Inventor software
- Member of Geological Society of America, American Geophysical Union, Seismological Society of America, and others

Work Experience

Geophysicist with 2+ years experience, with special emphasis on seismic research and data collection.

Research Assistant, Earth Observatory of Singapore (EOS), Singapore. In research assistant capacity at EOS, a research institution that conducts fundamental research on geohazards in and around Southeast Asia, assisted with survey design, acquisition, and processing of seismic reflection data. Helped evaluate and construct kinematic tectonic model.

Student Contractor, US Geological Survey, Seattle Field Office, WA. Operated GEODE systems to collect seismic data. Assisted in organizing and processing seismic data.

Field Geologist, Troost Geological Consulting, WA. Conducted borehole logging over water, data and sample management, and coordinated office and field teams.

Chris Kenyon
Geophysicist

- MS, Earth, Ocean, and Atmospheric Sciences (focus on Geology and Geophysics), in process
- BS, Geophysics, 2011
- Proficient in MATLAB with experience in programming and software development; also experienced in ArcGIS and GMT, as well as coding in multiple languages

Work Experience

Geophysicist proficient in MATLAB and experienced in handling large, complex datasets.

Graduate Research Assistant, Oregon State University, Corvallis, OR. Planned and installed multiple seismic stations in the Oregon Coast Range for thesis project. Participated in 2.5 week research cruise deploying ocean bottom seismometers and running both multi-channel seismic reflection and bathymetric surveys off the coast of western Chile. Manipulated large seismic data sets in command line ASCII format, SEGY, Excel, and MATLAB. Altered software and programming routines in MATLAB to run tomographic inversions on large datasets.

Jennifer Peters
Regulatory Specialist

- BA, Biology
- 13 years of regulatory compliance in environmental remediation RCRA, CERCLA, TSCA, CAA, and CWA
- 3 years munitions experience

Work Experience

Thirteen years of experience in environmental compliance and health and safety support. She has been providing environmental compliance, quality control (QC), and health and safety support for the US Navy RAC program and a wide variety of other federal and commercial projects in the northwest and nationwide. She conducts internal HAZWOPER refresher, waste management and U.S. Department of Transportation hazardous materials/security training. I prepare numerous project related health and safety as well as environmental plans including Spill Control and Countermeasures plans, Stormwater Pollution Prevention Plans, Waste Management Plans, Sampling and Analysis Plans, Munitions Investigation Plans and review applicable permit conditions for projects during initial project planning stages, as well as helping seek permit coverage as required. She has experience with decision documents under state and federal cleanup programs.

Regulatory Specialist/Health and Safety Specialist/Field Operations Support USACE, Kansas City District, ARRA, Former ASARCO Smelter Residential Soil Sampling Project, Tacoma, WA. Prepared health and safety plan and AHAs for the project. Conducted safety training for field personnel. Acted as health and safety specialist and worked on teams in role of team leader conducting residential soil sampling for lead and arsenic to determine yards that did not meet the established cleanup levels by vertical and horizontal extent. Worked in the on-site field laboratory performing soil sample processing and XRF analysis.

Regulatory Compliance Specialist, CERCLA Document Preparation and Review, Navy RAC Projects (RAC 3, RAC V), Jackson Park Housing Complex/Naval Hospital Bremerton, WA. Assisted the project managers in the preparation and review of CERCLA documents including RI/FS Work Plans, RI/FS Reports, TCRA Report, Proposed Plan, and development of the ROD for these two munition response sites in Washington. Participated in dispute resolution process when the disputes arose amongst the Project Team. Identified site and project specific ARARs and worked with the Navy and TtEC team to resolve comments on the plans during document reviews.

Regulatory Compliance Specialist/Compliance Support, RAC 3, Task Order 25 –Demolition and Environmental Cleanup, Former Cape Sabine DEW Line Station, AK and Point McIntyre DEW Line Station, AK. Prepared project plans and coordinated coverage for permits with State and federal agencies for the two projects. Provided on site environmental compliance, QC, and waste management support during the field seasons in remote arctic areas of Alaska. Coordinated waste shipment from remote project site, through Canada to disposal facilities in Washington and Oregon. Helped prepare closure reports.

Task Order Manager, Northwest Remedial Action Contract (RAC) 3. Management of two Remedial Action Contract Task Order (RAC 3) that include various munitions response support tasks and the preparation of fast track CERCLA documentation including preparation of Remedial Investigation/Feasibility Study (RI/FS) reports and RI Work Plans for Operable Units (OU) B-1 and OU B-2 sites on Adak Island, Alaska. The Task Order also includes supporting the Navy during meetings with EPA and State regulatory agencies and during the informal dispute process.

Task Order Manager, U.S. Navy, EFA Northwest, Remedial Action Contract 3, Sampling and Removal of Unknown Drums and Tank at FB-03, Finger Bay, Adak, AK. Management and mobilization and assembled a project team of this very short notice task order project. Mobilized personnel and equipment to conduct drum and tank removal and sampling as a Level-B immediate/rapid response within an active munitions investigation area.

Edwin Omar Rodriguez-Class, PhD
Project Biologist

- PhD, Marine Biology from Bircham International University.
- 16 years of experience as a biologist, conducting research development and implementation, monitoring, and other published field studies in a variety of marine and terrestrial habitats.
- Studied the physical, geological, and biological processes that regulate the form and development of the terrestrial landscape in the coastal systems of Puerto Rico.
- 2,600 hours of marine mammals monitoring and 250 hours of sea turtles/nesting sites monitoring.

Work Experience

Sixteen years of experience as a wildlife biologist and environmental scientist, conducting wildlife research development and implementation, monitoring and other published field studies in a variety of marine and terrestrial habitats. Technical experience includes managing field sampling compliance projects, developing and implementing scientific research to help ecosystem-based management of terrestrial and marine resources. He has managed and implemented 301(h)/403(c) sampling and compliance programs. Has been part of a scientific team working in the preparation of Biological Evaluations, Mitigation Plans and Wetland Jurisdictional Determinations Studies to comply with sensitive marine and terrestrial species as the Elkhorn Coral Acropora palmata, and the Puerto Rican Nightjar *Caprimulgus noctitherus* in compliance with Section 7 of the Endangered Species Act (ESA) with U.S. Fish and Wildlife Service and the National Marine Fisheries Service. He has been also involved in mediating issues between project proponents, stakeholders and regulatory agencies. He has conducted biological Critical Issues Analysis to determine location of an LNG pipeline crossing a natural reserve and protected areas for a site on the south coast of Puerto Rico. Dr. Rodríguez-Class has worked as part of the scientific personnel developing supporting documents for Environmental Impact Statements in landfills. Additional experience includes conducting research and surveys to marine resources management in Puerto Rico, Costa Rica, Nicaragua, Mexico, and the United States; and Epibenthic Communities and Reef Fishes. Additionally, Dr. Rodríguez-Class is one of the leading scientist in the sharks and ecological marine soundscape research fields in Puerto Rico.

Biologist, Aguirre Gasport Project, Salinas, Puerto Rico. Part of a scientific team working in the coordination of environmental studies to comply with federal and local regulation. Additional tasks involve the participation in characterization, identification, and preparation of the natural resources consideration for the Aguirre Gasport Project in Jobos Bay. Considerations include Critical Habitat, Essential Fish Habitat, and federally listed species evaluation and compliance.

Biologist, Water Quality Improvement and Seagrass Restoration Project, San Juan, Puerto Rico. Part of a scientific team working in the characterization, identification and preparation of the benthic survey for the Condado Lagoon Restoration Project.

Senior Scientist, Wetland Jurisdictional Determination Study, Yauco Landfill Expansion Project and Conservation Protocol for the Puerto Rican Nightjar (**Caprimulgus noctitherus*****) inside the Yauco Landfill Project, Yauco, Puerto Rico.*** Senior Scientist performing a wetland jurisdictional determination study as requested by the US Army Corps of Engineers (USACE) as part of the permitting process for the Yauco Landfill Expansion project. This study was conducted within the proposed limits of the aforementioned project with the main objective of identifying and estimate possible jurisdictional wetland areas within the project site. Additionally, participated in building a Habitat Conservation Protocol for the Puerto Rican Nightjar (*Caprimulgus noctitherus*).

Senior Biologist, Dorado Del Mar Beach. Dr. Rodriguez-Class is the senior biologist for the Biological Assessment of the epibenthic communities and Mitigation Plan of the Dorado Del Mar Beach restoration project.

Scientist and Field Manager/Field Sampling Leader, Regional Wastewater Treatment Plant (RWWTP) 301 (h)/403 (c)/Dye and Mixing Zone/Bacteriological Waiver Demonstration Compliance Studies and Epibenthic Communities, Arecibo, Aguadilla, Carolina, Mayagüez, Barceloneta, Cataño, Ponce and San Juan, Puerto Rico. Dr. Rodríguez-Class was the Field Manager/Field Sampling Leader at the Regional Wastewater Treatment Plant (RWWTP) 301 (h)/403 (c)/Dye and Mixing Zone/Bacteriological Waiver Demonstration Compliance Studies and Epibenthic Communities in compliance with Sections 301 (h) and 403 (c) of the Clean Water Act and the Environmental Protection Agency (EPA). On board Kruger B. Research Vessel.

Ariel Rivera-Vicente
Project Biologist (Alternate)

- MS, Zoology, University of Hawaii
- 7 years' experience as environmental scientist, conducting research, development, and implementation
- Prepared greenhouse gas inventories, developed research to support ecosystem-based management of terrestrial/marine resources, application of sensory ecology research to help minimize fishing by-catch of non-target species
- GIS experience in spatial analysis of coastal resource use in support of sustainable management practices

Work Experience

Seven years experience in environmental research development and implementation. Training and capacity building experience includes leading workshops on vulnerability and risk assessment for coastal community preparedness to Climate Change. Technical experience includes preparing greenhouse gas inventories for public and private entities, developing scientific research to help ecosystem-based management of terrestrial and marine resources, resolving conflicts between private development and local resource user groups, and applied sensory ecology research to help minimize fishing by-catch of non-target species. GIS experience includes spatial analysis of coastal resource use and availability to develop sustainable management practices and minimize resource use conflicts. Additional experience includes research and surveys to assess economic viability of a conservation-based start-up business.

Environmental Scientist, Aguirre Offshore LNG Facility, Puerto Rico. ***C***ontinually provides support for FERC filing, development of NEPA and local Puerto Rico environmental documents, and public participation plans for an offshore natural gas facility.

Environmental Scientist, Planning for Climate Change in the Coastal Environment, Galapagos, Ecuador. Mr. Rivera-Vicente was the main facilitator of a team of instructors that provided a capacity building training to government representatives from Panama, Ecuador, Costa Rica, and Colombia. During the training, participants learned to prepare a vulnerability assessment and develop adaptation measures to prepare for the effects of Climate Change on their respective costal zones.

Environmental Scientist, Greenhouse Gas Emission Inventory for the Papahānaumokuākea Marine National Monument, NOAA National Marine Sanctuary Program, Honolulu, Hawaii. Mr. Rivera-Vicente was part of a team that a prepared a greenhouse gas inventory and emissions management plan. The services provided proactive, cost-effective measures for efficient use of energy, water, and other resources. All measures implemented were directed to achieve the objectives of NOAA's energy management plan and reduce operating costs through adoption of high performance operating practices.

Environmental Scientist, Market Study of Conservation Service Industry in Hawaii, The Nature Conservancy, Honolulu, Hawai'i. In conjunction with the Pacific Business Center, Mr. Rivera-Vicente designed and conducted surveys to assess the economic viability of a company proposing to provided forest conservation services in Hawai'i. Economic data from the survey was combined with spatial analysis using GIS software to determine demand and industry trends over 5 years.

Environmental Scientist, Analysis of the Biocontrol Regulatory Framework and the Potential Role of the Private Sector in Hawai'i, The Nature Conservancy, Honolulu, Hawaii. Mr. Rivera-Vicente performed a comprehensive analysis of federal and state regulations that address biocontrol research and implementation in Hawai'i. Through consultation with local stakeholder groups Mr. Rivera-Vicente developed recommendations to improve effectiveness and efficiency of both the federal and state regulatory framework. Additionally, Mr. Rivera-Vicente identified opportunities for private sector organizations to provide support to the Hawai'i biocontrol community.

Environmental Scientist, Marine Debris At-sea Detection and Removal Strategy for the North Pacific, Marine Debris Program, National Oceanic and Atmospheric Administration, Honolulu, Hawai'i. Mr. Rivera-Vicente helped plan and facilitate a meeting of marine debris stakeholders in order to develop a strategy for detection of marine debris at-sea. Specific tasks included synthesizing all knowledge gaps identified at the stakeholder meeting and develop a comprehensive plan to address these gaps. The plan included a framework of actions needed, and recommendations of potential partnerships that would maximize resource use within the marine debris community and establish new relationships outside of it.

Work Experience

Over 23 years of experience in the environmental consulting field, most recently as Tetra Tech's discipline lead for risk assessment, responsible for ensuring technical quality in all of the company's human health, ecological, and other risk-related work products. Served as lead UXO explosive hazard and toxic residuals risk assessor on a number of sites across the country that have been investigated and remediated under EPA, state, and DoD/federal facility oversight frameworks.

Ronald Marnicio, PhD
PE Risk Assessor

- PhD, Mechanical Engineering/Engineering and Public Policy; MS, Mechanical Engineering; BS, Mechanical Engineering/ Engineering and Public Policy
- Professional Engineer, OH, #E-53320
- 20 years in technical leadership for contracts/programs for federal and state agencies, with 23 years of environmental remediation experience
- Exceptional knowledge of federal and state laws, regulations, and guidance

Lead Risk Assessor, US Navy, Risk-Based Screening Analysis and Sampling Plan Design, Jackson Park Housing Complex/Naval Hospital Bremerton, Operable Unit 3, Terrestrial, WA. Developed and applied a GIS-based Munitions Hazard Assessment (MHA) tool for differentiating and prioritizing upland areas of the site for characterization and further remediation relative to potential exposures to MEC. The MHA was based on an evaluation of MEC presence, type and sensitivity, and possible interaction with people in the context of current and future site usage. The basic framework was tailored to better reflect the geographical and spatial features of the site that could have an impact on exposures and hazards. Historic and current munitions hazard factors (relating to presence, ordnance characteristics, and exposure conditions) were identified and represented as nine distinct GIS layers. The GIS approach facilitated the presentation of results to site stakeholders, such as regulators and the public. Also used the results of this assessment to focus and design a site-wide MEC sampling program that is currently being implemented.

Lead Risk Assessor, USAESCH, RI/FS at Properties Associated with the Former Camp Chaffee, AR. Responsible for all risk assessment and explosive safety assessments relative to the public for an RI/FS to characterize the nature and extent of MEC and MC at properties associated with the Former Camp Chaffee. Initial steps have included preparing MRSPPs for multiple areas of the former camp, identifying the location of anomalies that were not intrusively investigated during the previous engineering evaluation/cost analysis project, and providing technical support to negotiations for rights-of-entry with property owners to conduct remedial activities.

Lead Risk Assessor, USACE New England District, MMR, MA. Prepared and oversaw risk assessments at various stages for over seven investigative areas at the MMR. Accomplishments include:

- Developed/implemented a MEC WP for conducting assessments of the threat to groundwater posed by MC and residues associated with the past training activities at MMR. The WP provides an overall process and logic for conducting these threat assessments and covers a broad range of technical components, including: data quality objectives, establishing a decision-making context, data management and evaluation, site classification, contaminant release and leaching modeling, groundwater transport, process and data validation and verification activities.
- Directed/reviewed HHRAs for seven different ranges at the site, using a hybrid risk assessment protocol developed specifically for this site.

Lead Risk Assessor, USACE Fort Worth District, RI/FS at the Former Camp Swift, Bastrop, TX. Developed preliminary conceptual site models (CSMs) and associated supplemental MEC and MC sampling programs for a large re-used area in Texas that was formerly part of Camp Swift. The initial efforts involved understanding the work performed previously in some areas as part of an EE/CA, and designing an efficient and defensible supplemental sampling program to meet data quality objectives established to collect the information needed to complete an RI/FS.

Work Experience

Over 30 years of leadership experience as a manager of health, safety, and technical programs. Also served in progressive leadership positions as an Air Force officer. Extensive experience in all phases of organizing, managing, and decision- making; training and supervising personnel; conducting quality assurance assessments; preparing budgets; and writing, public speaking, and teaching. Also possesses an extensive working knowledge of EPA, OSHA, and DOT regulations, with an emphasis on regulations relating to safety, hazardous waste management, and hazardous materials transportation.

Roger Margotto, CIH, CSP, CHMM
Certified Industrial Hygienist

- BA, Chemistry
- ABIH Certified Industrial Hygienist, #5571
- BCSP Certified Safety Professional, #11894
- IHMM Certified Hazardous Material Manager (Master Level), #2005
- Over 24 years of experience developing and implementing H&S programs for munitions response and hazardous waste sites
- Extensive knowledge of state and federal occupational H&S regulations and statues, including over 17 years of experience with EM 385-1-1 and OSHA
- Serves as the CIH for the USAESCH Worldwide Munitions Response and WERS Contracts

CIH/Regional Health and Safety Manager, DMVA and National Guard Bureau, Environmental Remediation Services for Delta Range, Colorado. Responsible for all H&S for this RI for a Colorado Army National Guard training range near Delta, CO. The project involves conducting a geophysical survey of select areas on the range to identify anomalies and recovering the anomalies in order to characterize and assess human risk on the range. The range will also be inspected for indications of disposal of munitions constituents. Soil samples will be collected at the suspect locations. Developed H&S documents and ensured on-site staff were fully trained.

CIH/Health and Safety Specialist, NAVFAC SW, RAC III, RAC IV, RAC V, California. Develops, implements, and manages H&S discipline for all remediation activities. Provides advice/training to over 300 staff and team partners, conducts quarterly safety audits, monitors H&S performance, and promotes proactive approaches to prevention. Ensures site-specific H&S plan is compliant with corporate- and contract-specific guidelines and regulations; prepares Accident Prevention Plans emphasizing worker safety as Priority One. Reduced remediation costs by developing targeted personal protective equipment applications so workers use safety equipment that enhances productivity. Authored/reviewed 120+ Site Safety and Health Plans; used Activity Hazard Analyses as a daily tool to communicate safe work performance at the worker level. Provided rapid H&S solutions for unexpected encounters with hazardous materials, including safe handling of mercury, and ensured radiation survey work incorporated safety and radiation protection. Instrumental in receiving the ROICC San Francisco Bay Safety STAR Award for tank closures at Alameda Point; the 2007 Naval Base San Diego FEAD Construction Safety Award; and the 2007 Commanding Officer's Safety Award for "embrac[ing] personnel safety beyond mere compliance with the laws and regulations, and promot[ing] safety as an intrinsic corporate value." Also awarded numerous National Safety Council (NSC) Perfect Record Awards for SW RAC III in 2000, 2002, 2003, and 2005 through 2007; SW RAC IV in 2006 through 2009; and SW RAC V in 2008, 2009, and 2011.

CIH/Health and Safety Specialist, USACE Omaha, TERC IV, New Mexico. Responsible for all H&S activities associated with $80M in A-E services and restoration. Achieved the NSC Perfect Record Award in 2000, 2002, 2003, 2005, and 2006. Developed H&S documents and procedures that merged Air Force and Tetra Tech H&S requirements. Reduced compliance costs by more than $100K by developing generic site safety and health plans that could be quickly tailored to task order-specific needs. Provided training on more than 20 OSHA topics. Coordinated safety requirements with Tetra Tech, US Air Force, and USACE personnel.

APPENDIX H

TECHNICAL PROJECT PLANNING (TPP) WORK SHEETS AND DOCUMENTATION

TECHNICAL PROJECT PLANNING MEMORANDUM

For TPP Meeting # 3

Culebra Water Ranges
Culebra, Puerto Rico
FUDS Project Number: I02PR0068

Prepared For:

U.S. Army Corps of Engineers, Jacksonville District
701 San Marco Boulevard
Jacksonville, FL 32207

and

U.S. Army Engineering and Support Center, Huntsville
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Huntsville, AL 35816-1822

Worldwide Environmental Remediation Services (WERS)
Contract Number: W912DY-10-D-0015
Task Order 003

Prepared By:
Tetra Tech EC, Inc.
101 Quality Circle, Suite 140
Huntsville, AL 35906

December 2014

Technical Project Planning Memorandum

Subject: Documentation of Technical Project Planning (TPP) Meeting No. 3 for the Remedial Investigation and Feasibility Study, Culebra Water Ranges, Culebra, Puerto Rico

Site: Water Ranges Munitions Response Site (MRS) 3 and MRS 12, Culebra, Puerto Rico

Contract: Contract Number W912DY-10-D-0015, Delivery Order 003

This document provides a record of TPP meeting number 3 for task order TO003 for the Culebra Water Ranges, Culebra, Puerto Rico. The meeting was held on October 22 and 23, 2014, at the U.S. Army Engineer District, Patio Conference Room, Antilles Office, San Juan, Puerto Rico. The October 22 meeting began at 8:45 A.M. and concluded at approximately 4:00 P.M. This memorandum only covers Tetra Tech's TO003 afternoon presentation on 22 October. Throughout the presentation, TPP team members in attendance and on the conference call were provided an opportunity to comment on the Draft Final Phase II Work Plan for the Electromagnetic Induction (EM) Survey.

Attendees:

Puerto Rico Environmental Quality Board (PREQB):
Wilmarie Rivera, Federal Facilities Coordinator
Katarina Rutkowski, TRC Solutions, Inc., Consultant
Cindy Martin, TRC Solutions, Inc., Consultant
Jim Pastorick, UXO-Pro, Consultant

Marine Resources Division, Puerto Rico Department of Natural and Environmental Resources (PRDNR):
Dr. Craig Lilyestrom, Director
Tim Reilly, Lighthouse Technical Consultants, Consultant

National Marine Fisheries Service (NMFS):
Dr. Lisamarie Carrubba, Natural Resource Specialist, Endangered Species Branch

National Oceanic and Atmospheric Administration (NOAA):
Diane Wehner, Regional Resource Coordinator, Office of Response & Restoration

US Fish and Wildlife Service (USFWS):
Marelisa Rivera, Deputy Field Supervisor, Caribbean Ecological Services Field Office
Ana Roman, Culebra National Wildlife Refuge Manager

Ms. Susan Silander, Project Leader, Caribbean Islands NWR Complex

US Environmental Protection Agency (USEPA):
Angela Carpenter, Chief, Special Projects Branch
Daniel Rodriguez, Remedial Project Manager, Vieques Field Office
Julio F. Vázquez, Remedial Project Manager, Special Projects Branch, Federal Facilities Section

US Army Corps of Engineers (USACE):
John Keiser, Program Manager, Jacksonville District FUDS program manager
Wilberto Cubero, Project Manager,
Tom Freeman, Senior Technical Advisor
Kelly Enriquez, Geophysicist
Sarah Dyer, Technical Manager
Jose Mendez, Project Manager Forward
Amana Parker, Public Affairs Specialist, Corporate Communications Office
Paul DeMarco, Biologist
Donna West-Barnhill, Concurrent Technologies Corporation

Parsons:
Patti Berry, Project Manager
Steve Rembish, Risk Assessor
Jae Yun, Geophysics
Mark Padover, Lead Field Scientist, Aqua Survey, Inc.

USA Environmental (USAE):
Tom Bourque, Project Manager
Brad McCowen, Program Manager
Matt Tucker, Technical Advisor
Margaret Zaice, Project Engineer

Tetra Tech EC (Tetra Tech):
Scot Wilson, Project Manager
Dr. Ron Marnicio, National Lead Risk Assessor,
Richard Funk, Lead Marine Geophysicist
Fernando Pages, Director, Tetra Tech Puerto Rico

<u>Attendees (on Telephone):</u>
National Oceanic and Atmospheric Administration, National Marine Fisheries Service:
Jose Rivera, Fisheries Biologist

US Environmental Protection Agency:
Tom Hall, TechLaw, Inc., Consultant

US Army Corps of Engineers:
Roland Belew, Project Manager/COR

Presentation:

Prior to Tetra Tech doing their presentation on MRSs 03 and 12, Mr. Freeman **(USACE)** provided some historical information on the prior use of MRS 03 and MRS 12. He noted that MRSs 03 and 12 were not target areas, but they are adjacent to the main target area—the Northwest Peninsula. He indicated that what has been found most often in this area are illumination rounds, but 500- and 1,000-pound bombs also have been found on the Northwest Peninsula. The military primarily fired 5-inch aircraft rockets in this area, but they also used 3-, 5-, 6-, 8- and 16-inch naval rounds. Mr. Freeman commented that in MRSs 03 and 12 the main items of interest are under- and over-shoots (from the targets that were on the Northwest Peninsula). Mr. Freeman also briefed that the southern portion of MRS 12 was used for Marine Corps activities. The Marines established defensive positions, and troops in landing craft fired 81 mm mortars onto shore.

Mr. Rodriquez **(USEPA)** asked why MRS 12 is shaped the way it is. Mr. Freeman said the Project Delivery Team (PDT) previously determined the MRS boundaries, and they were based, in part, on accessibility. The areas at the tip of the Northwest Peninsula are very rocky with significant wave action. Mr. Rodriguez said he did not recall that decision. Mr. Freeman noted it was around 10 years ago when the Corps asked for input, and the sizes and shapes of the MRS were decided based on accessibility and use.

Mr. Freeman reminded the team that, because of the public law when the land was deeded to the Commonwealth, the Corps cannot do any remedial action on the Northwest Peninsula;

specifically, it cannot expend funds. The Corps can work in the water and on the beaches up to the mean high tide.

Tetra Tech began their presentation at 1:00 P.M. following the completion of Mr. Freeman's briefing on the historical use of MRS 03 and MRS 12.

Mr. Wilson (**Tetra Tech**) started by introducing his team. Richard Funk is Tetra Tech's Senior Lead Marine Geophysicist, Dr. Ron Marnicio is the company's National Lead Risk Assessor and Visual Sample Plan expert, and Fernando Pages is the director of their Puerto Rico office.

Mr. Wilson then began the PowerPoint briefing, presenting the first five introduction slides that covered the agenda, project location, and project outline. Slides 6 and 7 covered the proposed schedule for the Phase II EM survey fieldwork.

The presentation continued with slide 8 covering the Phase II details including the incorporation of the environmental SOPs into the work plan and having a field biologist on-site for the duration of the field work. Slide 8 also covered the sensor configurations that will be used for the EM survey. There were no comments, questions, or discussion on the first eight slides.

Slide 9 displayed a target area map from the Culebra Archive Search Report that was previously used by Mr. Freeman (**USACE**) to discuss the historical military use of the island. Slide 10 presented an anomaly density figure of the Northwest Peninsula for the purpose of discussing the conceptual site model for MRS 03 and MRS 12. Mr. Wilson provided an explanation of the anticipated areas and concentrations of anomalies based on firing locations in the historical record. He emphasized that MRS 03 and MRS 12 were not historical target areas but these sites experienced undershoots and overshoots from the targets located on the Northwest Peninsula. He also pointed out that the results of the USA Environmental intrusive investigation of MRS 13 provided supporting evidence that overshoots were the main source of underwater MEC on the western side of peninsula based on the high number of expended illumination rounds that were recovered.

Mr. Rodriguez (**USEPA**) asked when the density map shown on slide 10 was compiled and if it considered previous investigations. Mr. Tucker (**USA Environmental**) addressed the question and said the density map was produced in 2011, and it includes data from all previous investigations and reported "finds."

Mr. Rodriguez (**USEPA**) asked a follow-on question on how an illumination round works.

Mr. Hall (**USEPA Consultant**) then provided a detailed technical summary on the use and functioning of illumination rounds based on his experience as a U.S. Army Artillery Officer.

Mr. Belew **(USACE**) said the Archive Search Report explains the use of the illumination rounds. The military was firing 5-inch naval gunfire rounds, so the illumination rounds were used to light up the targets on the ridge.

Ms. Rutkowski (**PREQB Consultant)** continued the discussion of slide 10 by asking if it were possible for undershoots to land in the water to the northeast of the MRS 03. Mr. Wilson stated that it would be possible but not likely due to the high elevation angles of the guns firing at targets on the ridge of the peninsula. Also, undershoots would tend to skip on the surface of the water and impact the land.

The discussion of the conceptual site models for MRSs 03 and 12 continued with an explanation of the three zones (A, B, and C) used to separate the MRSs into depth ranges based on use and human exposure.

Mr. Pastorick **(PREQB Consultant)** asked if it is less important to find munitions in medium and deep water as opposed to near shore and shallow water. Mr. Wilson said the investigation design is not to find individual items; the intent is to detect clusters and densities of anomalies. The equipment can detect 20 and 40 mm projectiles in the right conditions, but that is not necessarily what the teams are trying to do. Mr. Funk said it is not less important to find items farther out, but Tetra Tech opted to place the transects closer together near shore. Mr. Wilson explained that Tetra Tech based the transect/investigation design by establishing three zones: Zone A – Near Shore, Zone B – Intermediate, and Zone C – Open Water). The Visual Sample Plan (VSP) was used to design the transects in Zone C, and the spacing meets the 90 percent confidence requirement. The transect spacing in Zones A and B was not dictated by the VSP. Knowing that the data will be used in the risk assessments and other analysis for the Feasibility Study, Tetra Tech opted to gather more data in the areas where the majority of activity is. Waders, swimmers, and other recreational users tend to stay closer to shore. Ms. Carpenter **(USEPA)** asked what percent of the areas will be investigated. Mr. Wilson said it would be close to 100 percent in Zone A.

Mr. Wilson then showed slide 11, an image from an underwater geophysics EM survey of a 20 mm firing range at the Great Lakes that visually demonstrates the scale of underwater MEC sites to illustrate how the transect spacing designed for MRSs 03 and 12 will allow VSP to detect features of interest.

While discussing slide 11, Ms. Wehner (**NOAA**) asked what the output of Phase 2 fieldwork will be. There will not be a separate report for Phase 2, but the data will be included in the Phase 3 Work Plan as well as in the Remedial Investigation/Feasibility Study Report. She then asked if the size of the symbol indicates the size of the anomaly and what is driving the decision about how long the transects should be. The symbol size does not indicate the size of the anomaly; the image shows the distribution of 40 mm rounds at a site in the Great Lakes. The transect length was determined based on the maximum distance a 20 mm round could go if all conditions were perfect and it landed without detonating. The Phase 3 Work Plan will include all the data from Phase 2 field work as well as known sites identified through previous investigations and local knowledge.

Ms. Wehner (**NOAA**) then asked a follow-on question, wanting to know if every anomaly identified in Phase 2 would be intrusively investigated in Phase 3. Mr. Wilson explained that they will investigate the anomalies that appear to be munitions. Tetra Tech will not know what they will do in Phase 3 until they see the data. If there is a cluster of anomalies, they may look at everything within a grid. Ms. Enriquez (**USACE**) noted that the purpose of this investigation is to make sure an area is well characterized. The Phase 3 Work Plan will include decision logic to guide the contractors as they determine which items to investigate.

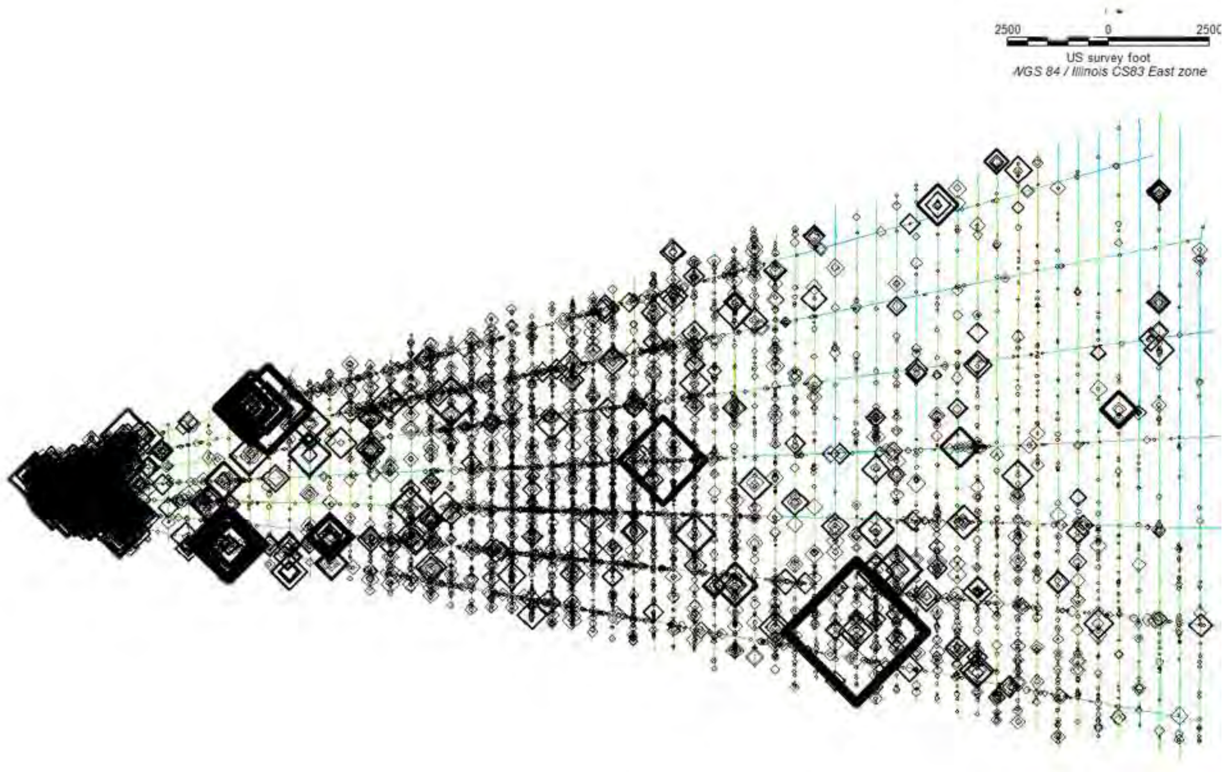

Image from an underwater geophysics EM survey of a 20 mm firing range at the Great Lakes

Slide 12 presented the Phase II survey metrics in table form. Mr. Reilly (**PRDNR Consultant)** commented that the table was very confusing, specifically in reference to the percent coverage column. Mr. Funk (**Tetra Tech**) explained that the table would be revised to make it easier to understand.

ACTION ITEM: Tetra Tech to revise the Phase II Survey Metrics Table.

Mr. Wilson (**Tetra Tech**) then showed slide 13, a map of the habitat classifications in MRSs 03 and 12 with the locations of potential munitions identified. The items have attributes that make them look like munitions, but they have not yet been characterized. These are from the visual inspections completed for the Environmental Baseline Survey. Mr. Wilson noted that what the teams have seen thus far appears to be consistent with under and over fires as well as the natural process of items moving closer to shore. He also showed a map of the coral species in MRSs 03 and 12 that will be updated to reflect the newly listed species.

Mr. Wilson (**Tetra Tech**) noted that, based on the illumination rounds found previously, it appears the military was firing at an angle across the Northwest Peninsula. It is more likely to find munitions on the backside of the target (MRS 12) because of the items skipping. There could also be munitions near the tank on Flamenco Beach, based on the geography of the area. The targets were on the front of the ridge. If the munitions hit the target, then they would function properly.

Dr. Carrubba (**NMFS**) expressed concerns that the map does not show all the corals in MRSs 03 and 12. Mr. Wilson said they understand that coral can be found anywhere in their study area. Dr. Carrubba said Carlos Rosario is very shallow, and she is concerned that 10-foot-wide transects could damage the coral. Mr. Wilson said he will be able to address that concern better later in the presentation.

Mr. Wilson (**Tetra Tech**) showed slide 14, which contained revised maps of the proposed transects. He explained that some areas are excluded from investigation because of the slope of the sea floor. The teams will survey along the sides of the slopes with the first transect spaced 5 meters away. There was considerable discussion about the MRS sizes and shapes.

A lengthy discussion followed about Tetra Tech's approach for collecting more data in Zone A. Mr. Pastorick **(PREQB Consultant)** indicated it could bias the data, but ultimately, he expressed that if the transect design for Zone C is adequate, then it is more than adequate for Zone A, so it does not really matter.

In response to slide 14, Dr. Carrubba (**NMFS**) noted that more of the coral is near shore where there are more transects, so there is a greater risk the coral will be damaged. She does not want teams in the water at coral reefs.

Ms. Rutkowski **(PREQB Consultant)** also commented on slide 14 saying there should be different Data Quality Objectives (DQOs) for each of the three zones, and two different ones for Zone A.

Mr. Funk (**Tetra Tech**) then showed slide 15 containing a table that indicates what items can be found based on the coil height in the least favorable conditions. The equipment will also take still photos. Mr. Funk then showed slides 16 and 17 containing photographs of the electromagnetic array equipment and explained the minimal impact to natural resources from the hovercraft.

Mr. Wilson (**Tetra Tech**) then played a short video clip showing the use of the hovercraft and its ability to maneuver in shallow areas. During the video, which was filmed in a shallow pond, the hovercraft ran over a log, which caused some sediment from the muddy bottom to become re-suspended in the water column.

There was a lengthy discussion following the video about avoiding coral damage and the potential to stir up sediment. Dr. Carrubba (**NMFS**) said she is still concerned about Tetra Tech knowing which areas to exclude from investigation to avoid coral. She acknowledged that the hovercraft is less intrusive than a diver, but either way, there is the potential to hit the coral. The National Marine Fisheries Service have not authorized any takes. Dr. Carrubba requested the Work Plan include a decision tree for addressing areas with coral. **Action Item**: This comment will be addressed by adding a decision tree for the hovercraft use in the work plans and including a hovercraft use log in the daily reports during field work.

Mr. Reilly (**PRDNR Consultant**) asked about investigations along the shoreline. In the previous Time-Critical Removal Action, the crews investigated down to the low tide line. This investigation will go to the mean high tide line, so there will be an overlap.

Mr. Pastorick **(PREQB Consultant)** asked if the Work Plan shows different DQOs for each of the three zones as well as two for Zone A. Mr. Wilson said Tetra Tech is revising the DQOs to address those concerns. Because the line spacing for Zone A' is 10 feet and provides 100% coverage, the DQO metric for an acceptable data gap in that zone will be reduced to 1 meter. The line spacing for Zone A is 30 feet and the DQO metric for an acceptable data gap in this zone will remain 5 meters. Mr. Pastorick asked what version of the Work Plan the team would receive next. Mr. Wilson said they are preparing responses to comments, and the regulators will review those responses. Once the regulators concur with the responses to comments, Tetra Tech will incorporate those into the Work Plan with track changes.

<u>**ACTION ITEM –** Tetra Tech will revise the DQOs based on the comments received during the TPP meeting.</u>

There was a lengthy discussion about the zoned method of investigation proposed for Flamenco Beach not being proposed for other MRSs. This was especially true for Culebrita where 20 mm rounds have been recovered during previous investigations. The regulators and resource agencies expressed concern about the different approaches. Ms. Rutkowski **(PREQB Consultant)** underscored that the Corps needs to be consistent across all MRSs.

Following the completion of the Phase II briefing, the team then reviewed and discussed the comments submitted by the PDT on the Phase II Work Plan that was distributed to the PDT prior to the meeting. Each agency's comments were displayed and comments needing further discussion were addressed. The first comments reviewed were provided by NMFS. Dr. Carrubba (**NMFS**) underscored her concern about the ability to maneuver the towed array around obstacles, the investigation approach in shallow vs. deep water, and the transect spacing in areas with coral. She said the team needs to avoid areas with high coral, and she will push for less dense transects in shallow areas such as Carlos Rosario. Dr. Carrubba also noted that if they see the sea turtles fleeing the area, then the equipment is too loud.

Mr. Cubero (**USACE**) said the biologist will be able to observe these conditions. Additionally, the hovercraft crews will be fully briefed and will know to follow the SOPs.

The team then reviewed comments from NOAA. Dr. Wehner (**NOAA**) asked what the end product of Phase 2 will be. Mr. Wilson explained that maps of anomalies will be inputs into the Phase 3 Work Plan and also in the Remedial Investigation report. She then asked if there would be step outs for anomalies. Mr. Wilson responded that if an anomaly is a munition, then there will be a step out, but it will be mag and dig because the geophysical teams will already be gone.

The team then reviewed comments from EPA. Someone commented about the Work Plan allowing for a 5-meter deviation in a 10-foot spaced transect. Mr. Funk (**Tetra Tech**) said if there is a reason for the deviation, the team will document the reason and move on.

Mr. Pastorick (**PREQB Consultant**) said such a large deviation would lead to a data gap and will not match the DQOs. The group discussed this at length. Mr. Funk explained that the survey vessel Captain would be documenting where the data are being collected and will be able to document any movement away from an acceptable deviation.

<u>**ACTION ITEM**: Tetra Teach will revise the DQOs to address this concern. There will be a separate DQO for Zone A and Zone A' with an acceptable data gap metric for each zone.</u>

EPA had a comment about the use of the VSP. Someone asked if the Phase 2 results will be put back into the VSP. They will. Mr. Pastorick (**PREQB Consultant**) noted Phase 3 field work will be based on the results in Phase 2, so it appears the process of selecting anomalies to investigate is being done outside of the Work Plan. Tetra Tech noted that VSP post-analysis will be completed and the teams will be able to see anomaly densities. They will have Decision Rules to determine what items need to be investigated in Phase 3. Mr. Pastorick said the selection of anomalies is an important decision that needs to be part of the Work Plan. Mr. Wilson said there will be a TPP meeting prior to Phase 3, so the selection process can be discussed prior to the fieldwork.

Ms. Enriquez (**USACE**) noted it will be a difficult process, and the Work Plan will need contingencies for when crews are not able to reacquire the item initially recorded in Phase 2. Mr. Wilson said there will likely be two different investigation methods. There will be grids in areas where multiple anomalies were detected. The team will attempt to dig all those items, but some may have migrated out. They will record whatever they find. In areas with fewer anomalies, they will try to investigate discreet items, but some of them may have moved. They may have to step out to see if they can locate the item. If they cannot find them, then it will documented as a "no find."

Mr. Pastorick (**PREQB Consultant**) asked how big the grid would be. Mr. Wilson said it would depend; it could be 100 feet by 100 feet. If there is a large anomaly area, it may not be practical to investigate the entire area, so the team will need to determine what portion to investigate.

EPA had a comment about the DQOs, and Mr. Wilson (**Tetra Tech**) noted they are revising them for the next version of the Work Plan.

The team then addressed comments from PREQB. There was a comment/question about the data from the Environmental Baseline Survey. Tetra Tech reminded the agencies they were provided all the Phase I survey data on digital hard drives with the draft final version of the EBS report. If PREQB sees something in the data they want Tetra Tech to consider, PREQB needs to let Tetra Tech know. PRDNR will review the data as well and may comment.

Dr. Lilyestrom (**PRDNR**) asked if the Corps knows where the warships anchored. Mr. Wilson said the Archive Search Report shows anchorage in the Luis Pena channel. Mr. Freeman confirmed it was generally around Cayo Luis Pena. It was primarily an anchorage area and was not used to transfer ordnance. The only place ordnance was transferred was in Lower Camp. Dr. Lilyestrom asked about the protocol when investigating anomalies (if it is old). Mr. Wilson said records are noted for each anomaly. If an item is determined to be an archeological feature, it will be documented and reported to the historic and preservation office but will not be released to the public.

Marelisa Rivera (**USFWS**) noted that Tetra Tech may be working during nesting seasons and needs to be sure to have a biologist with experience in nest avoidance. Mr. Cubero (**USACE**) explained that for MRSs 09 and 13, PRDNR did a presentation to the field team to help the crews understand what to look for and how to avoid harming the environment. He suggested the resource agencies do the same for the other projects.

There being no further items to discuss, the meeting adjourned.

TPP Meeting 3 Attendees:

US Army Corps of Engineers

Technical Project Planning (TTP) Meetings

22-Oct-14

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US Army Corps of Engineers

TTP Continuation List

22-Oct-14

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Paul DeMarco	[illegible]	USACE-PD-EC	904-232-1897	Paul.M.DeMarco@usace.army.mil
Cindy Martin	Cynthia V Martin	TRC-TECHSOP. EQB	978 656 3588	cmartin@ ~~[illegible]~~ trcsolutions.com
John Keiser	[illegible]	USACE	904-232-1758	john.e.keiser@usace.army.mil
Wilberto Cubero	[illegible]	USACE	904-232-1426	wilberto.cuberoalicea@usace.army.mil
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on Phone:				
Tom Hall	Tech Law Inc.			
Roland Belew	USACE HNC			
Jose Rivera	NMFS			

US Army Corps of Engineers

TPP ATTENDANCE

23-Oct-14

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Wilmarie Rivera	[illegible]	PREQB	787-767-8056	Wilmarierivera@jca.gobierno.pr
Katarina Ratkowski	[illegible]	TRC/PREQB	8603054339	kratkowski@trcsolutions.com
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Julio F Vázquez	[illegible]	US EPA	212 637 4323	vazquez.julio@epa.gov
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US Army Corps of Engineers

TPP ATTENDANCE

23-Oct-14

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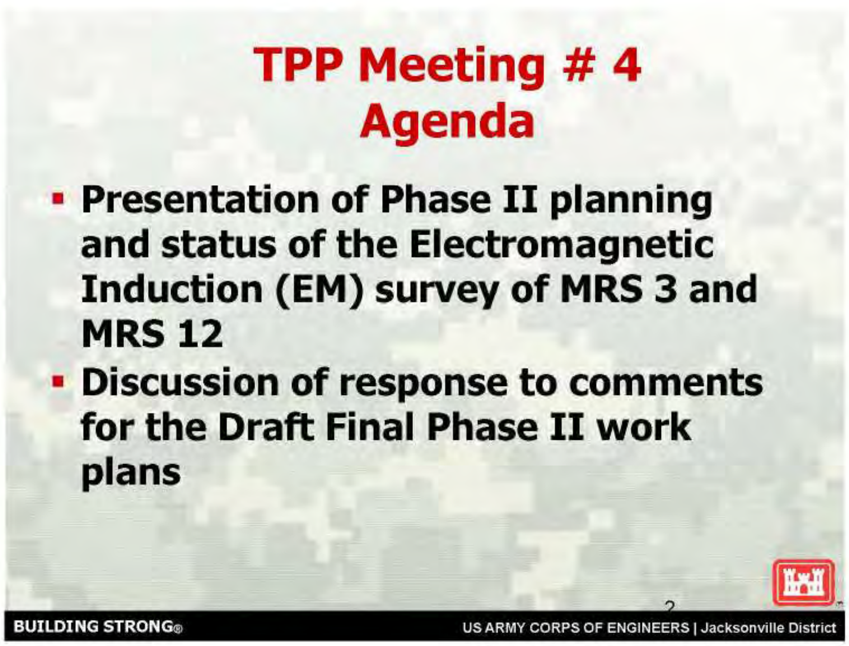
Patti Berry	Patricia J Berry	Parsons - Norcross	678-969-2840	patricia.berry@parsons.com
Steve Rembish	[illegible]	Parsons-Austin	512.567.6090	steve.j.rembish@parsons.com
Richard Funk	[illegible]	Tetra Tech	425-482-7629	richard.funk@tetratech.com
SCOT WILSON	[illegible]	TETRA TECH	360 598-8111	SCOT.WILSON@TETRATECH.COM
Ron Marnicio	Ronald J Marnicio	Tetra Tech	617 443-7551	ronald.marnicio@tetratech.com
Margaret Zaice	Margaret Zaice	USA Environmental	256-665-5702	mzaice@usatampa.com
TOM FREEMAN	[illegible]	USACE - Jacksonville	314.374.0220	tom.freeman@usace.army.mil
John Keiser	[illegible]	" "	(904)232-1758	john.e.keiser@usace.army.mil
Wilberto Cubero	[illegible]	USACE-Jacksonville	904-232-1426	wilberto.cubero-deltoro@usace.army.mil
ON PHONE:				
Tom Hall	Tech Law Inc.			
Roland Belew	USACE HNC			
Jose Rivera	NMFS			

TPP Power Point Presentation Slides



Project Location

- **Two marine sites on Culebra Island**
  - Flamenco Bay
    MRS 03 ~195 acres
  - Luis Peña Channel
    MRS 12 ~835 acres

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Fieldwork for MRS 3 & 12 Being Conducted in 3 Phases

- **Phase I – Environmental Baseline Survey to map habitat and bathymetry was completed Feb 2013**
- **Phase II – EM Sensor Survey to detect metallic anomalies planned for February-March 2015**
- **Phase III – Intrusive Investigation to investigate detected anomalies and determine nature and extent of UXO, timing of Phase III is TBD following completion of Phase II next spring**

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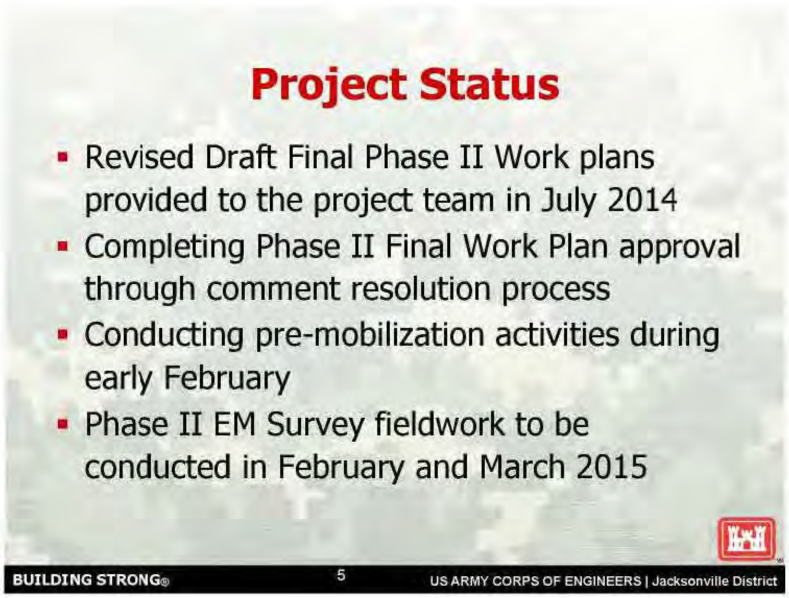
Project Status
Revised Draft Final Phase II Work plans provided to the project team in July 2014
Completing Phase II Final Work Plan approval through comment resolution process
Conducting pre-mobilization activities during early February
Phase II EM Survey fieldwork to be conducted in February and March 2015
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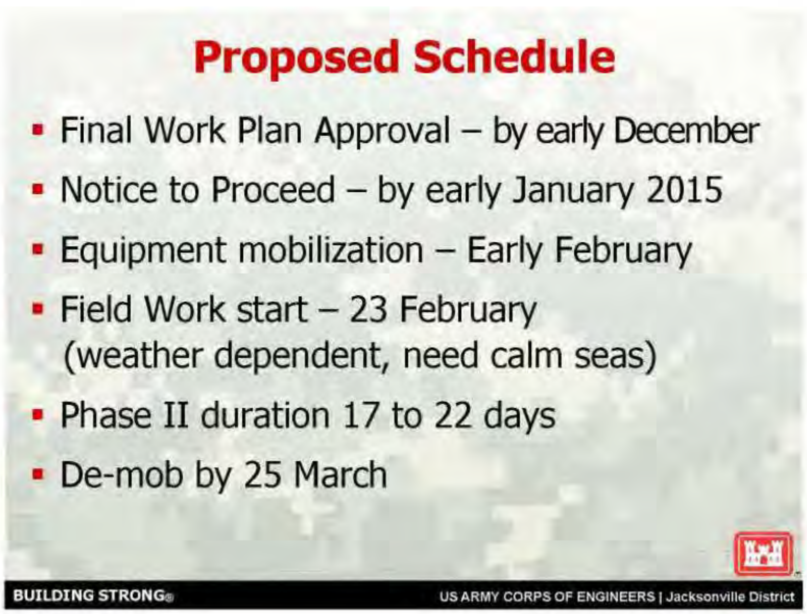
Proposed Schedule
Final Work Plan Approval – by early December
Notice to Proceed – by early January 2015
Equipment mobilization – Early February
Field Work start – 23 February (weather dependent, need calm seas)
Phase II duration 17 to 22 days
De-mob by 25 March
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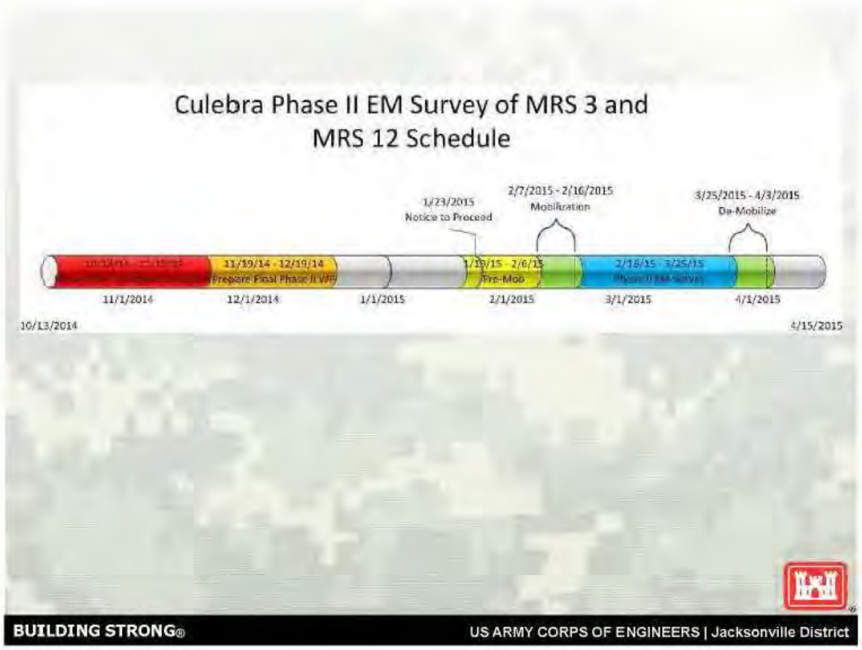
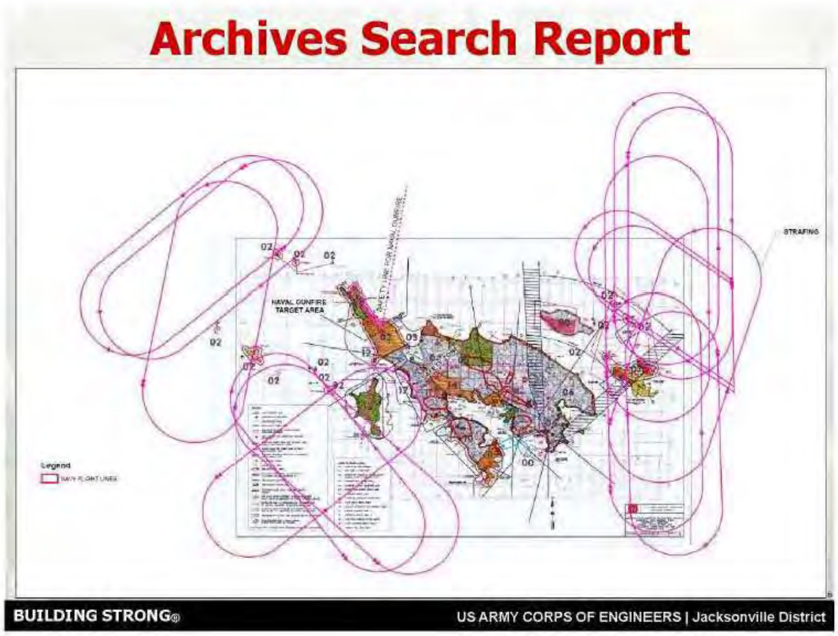


Phase II Details

- Supplemental Environmental SOPs incorporated into work plan and field biologist on site during survey
- EM survey track plan revised to incorporate use of surface EM array and hovercraft in shallow areas of MRS 3 and 12
- Two EM sensor array configurations will be used, an underwater towed system in deeper water and a zero draft surface array in shallow water


Archives Search Report
STRAFING
NAVAL GUNFIRE TARGET AREA
Legend
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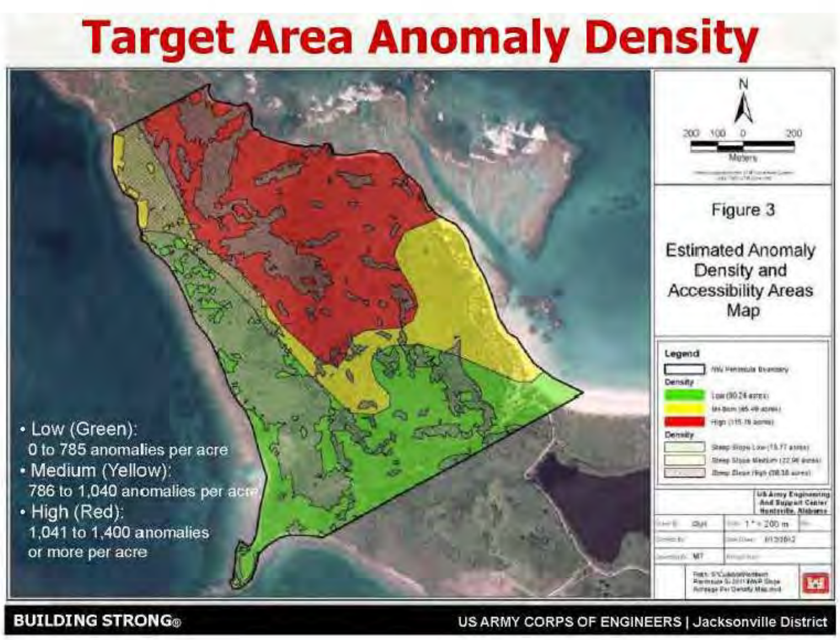
Target Area Anomaly Density
N
200 100 0 200
Meters
Figure 3
Estimated Anomaly Density and Accessibility Areas Map
Legend
Density
• Low (Green):
0 to 785 anomalies per acre
• Medium (Yellow):
786 to 1,040 anomalies per acre
• High (Red):
1,041 to 1,400 anomalies or more per acre
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MRS03 vs NTC Great Lakes

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Phase II Survey Metrics

MRS	Approximate Fraction of MRS	Size	Transect Spacing	Approximate Length of Transects		Width of Transects[1]	Approximate Area of Transects	Percent Coverage
	(%)	(acres)	(ft)	(ft)	(nm)	(ft)	(acres)	(%)
MRS 3-Flamingo Bay Water Area		**195**						
A - Near Shore [<MLW-10']	46.15	90	[illegible]	[illegible]	35.1	10	[illegible]	[illegible]
B - Intermediate [MLW-10' to -25']	17.54	34	100	[illegible]	3.0	10	[illegible]	[illegible]
C - Open Water [>MLW-25']	20.47	40	250	[illegible]	1.1	10	[illegible]	[illegible]
	SUBTOTAL	**195**		[illegible]	**39.1**		[illegible]	
MRS 12-Luis Peña Channel Water Area		**835**						
A - Near Shore [<MLW-10']	12.89	108	10-20	[illegible]	49.1	10	[illegible]	[illegible]
B - Intermediate [MLW-10' to -25']	14.34	120	100	[illegible]	7.2	10	[illegible]	[illegible]
C - Open Water [>MLW-25']	72.61	606	250	[illegible]	16.5	10	[illegible]	[illegible]
	SUBTOTAL	**834**		[illegible]	**72.9**		**101**	
	TOTAL	**1030**		[illegible]	**112.0**		[illegible]	

NOTES:
1 In-Water survey transect width assumed to be 3m.

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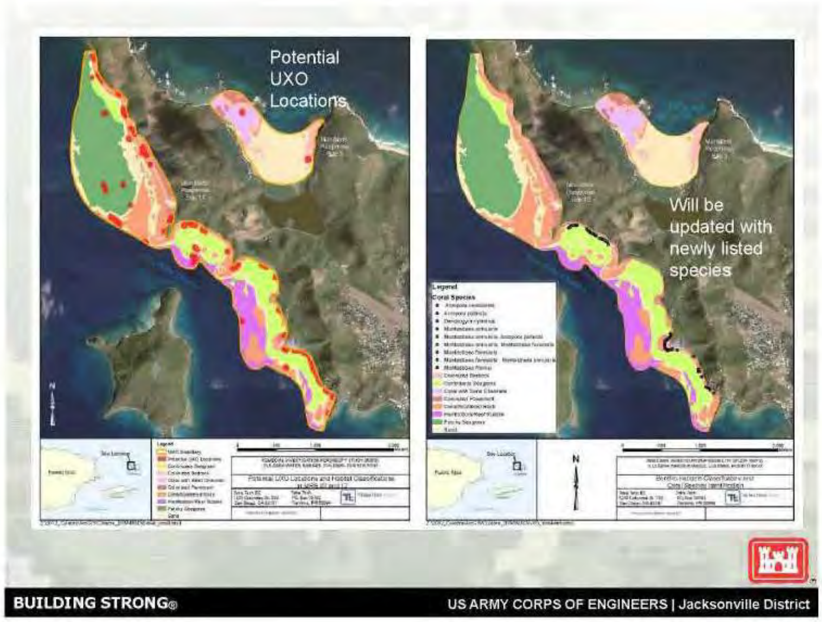
Potential
UXO
Locations
Will be
updated with
newly listed
species
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MRS 3 & MRS 12 Track Plans
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High Power EM Coil Detection Ranges Vs Standard EM Coil

	Minimum Signal at 11x Depth					
Item	11x Depth	Distance from Coil (+.42m)	Standard EM61 Response	Tt EM61MK2-HP additional 45-80% detection depth		
	(m)	(m)	Gate 2 (mV)	Plus 45% (m)	Plus 80% (m)	
155-mm projectile	1.71	2.13	2.8	3.0885	3.834	Likely at >2m
4.2-in mortar	1.17	1.59	5.3	2.3055	2.862	
105-mm projectile	1.16	1.58	4.9	2.291	2.844	
105-mm HEAT projectile	1.16	1.58	3.6	2.291	2.844	
81-mm mortar	0.89	1.31	1.7	1.8995	2.358	Likely at >1.5m Possible at 2m
3-in Stokes mortar	0.84	1.26	5.6	1.827	2.268	
75-mm projectile	0.83	1.25	4.9	1.8125	2.25	
2.75-in rocket warhead	0.77	1.19	3	1.7255	2.142	
2.36-in rocket propelled grenade	0.66	1.08	2.6	1.566	1.944	
60-mm mortar	0.66	1.08	3.9	1.566	1.944	
40-mm grenade	0.44	0.86	1.6	1.247	1.548	likely at >0.5m possible at >1m
37-mm projectile	0.41	0.83	2.7	1.2035	1.494	
hand grenade	0.61	1.03	0.9	1.4935	1.854	

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Underwater Towed EM Array

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Surface Array Details

- 'Zero Draft' – Paddle boards float on the surface and hovercraft rides on a cushion of air above the surface
- No protrusions (i.e. keel, propeller)
- Hovercraft loading is 10 $^{lbs}/_{sq.ft.}$ (same as a seagull standing on one foot)
- Hovercraft used as a tug to push paddle board array
- Maximum noise level of 83 dB A. (Less than a lawn mower ~90-106 dB)

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Agency Comment Responses

- Discussion on comment responses
- Comment resolution

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Comments or Questions

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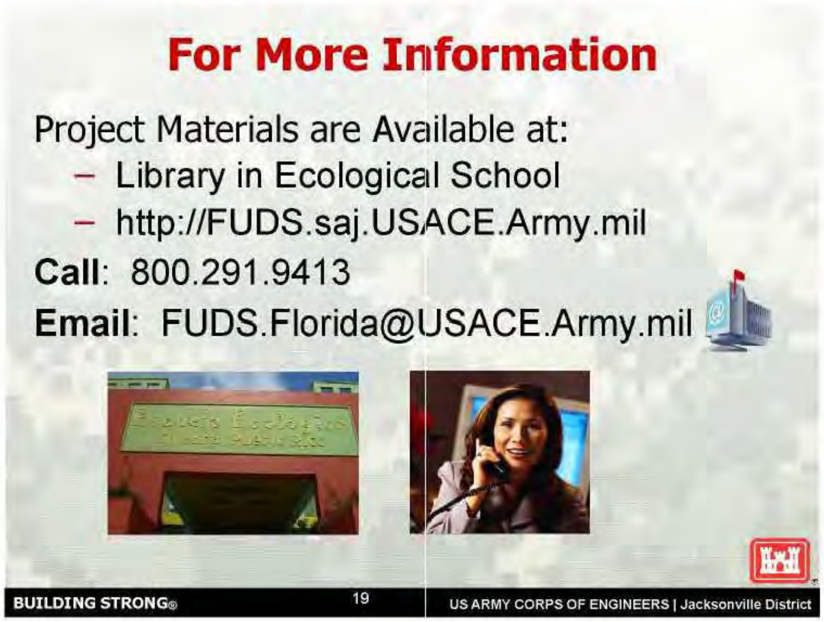
For More Information
Project Materials are Available at:
– Library in Ecological School
– http://FUDS.saj.USACE.Army.mil
Call: 800.291.9413
Email: FUDS.Florida@USACE.Army.mil
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TECHNICAL PROJECT PLANNING MEMORANDUM

For TPP Meeting # 2

Culebra Water Ranges
Culebra, Puerto Rico
FUDS Project Number: I02PR0068

Prepared For:

U.S. Army Corps of Engineers, Jacksonville District
701 San Marco Boulevard
Jacksonville, FL 32207

and

U.S. Army Engineering and Support Center, Huntsville
4820 University Square
Huntsville, AL 35816-1822

Worldwide Environmental Remediation Services (WERS)
Contract Number: W912DY-10-D-0015
Delivery Order 003

Prepared By:
Tetra Tech EC, Inc.
101 Quality Circle, Suite 140
Huntsville, AL 35906

January 2014

Technical Project Planning Memorandum

Subject: Documentation of Technical Project Planning (TPP) Meeting No.2 for the Remedial Investigation and Feasibility Study, Culebra Water Ranges, Culebra, Puerto Rico

Site: Water Ranges Munitions Response Site (MRS) 3 and MRS 12, Culebra, Puerto Rico

Contract: Contract Number W912DY-10-D-0015, Delivery Order 003

This document provides a record of TPP meeting number 2 for the Culebra Water Ranges, Culebra, Puerto Rico, held on January 14 and 15, 2014, at the U.S. Army Engineer District, Patio Conference Room, Antilles Office, San Juan, Puerto Rico. During the meeting, the TPP team members in attendance were provided an opportunity to comment on the Environmental Baseline Survey report that was prepared following completion of Phase I Fieldwork in January of 2013. The meeting on January 14th began at 9:00 AM and concluded at approximately 5:00 P.M. Presentations were made by the three contractors that hold contracts to conduct the RI/FS investigations at the Culebra underwater MRS sites. Tetra Tech began their presentation at 14:00 following the completion of USAE's briefing and concluded at 15:30. The second scheduled day was not needed for presentations and was used for scoping meetings between the contractors and the Corps of Engineers representatives.

Attendees:

The meeting was attended by persons representing the U.S. Army Corps of Engineers (USACE) – Huntsville District (USAESCH), Jacksonville District (CESAJ) and the Antilles Office in San Juan. Participation by government agencies included Puerto Rico Environmental Quality Board (PREQB); Puerto Rico Department of Natural and Environmental Resources (PRDNER); Fish and Wildlife Service (USFWS); National Oceanic and Atmospheric Administration (NOAA); and the National Marine Fisheries Service (NMFS). Contractor representatives from Tetra Tech EC (TtEC), Parsons, and USAE Environmental were in attendance as presenters. A list of attendees is provided at the end of this memorandum.

Presentation:

Following the completion of USAE's presentation, Mr. Scot Wilson and Mr. Richard Funk of Tetra Tech conducted a PowerPoint briefing on the results of the Phase I Environmental Baseline Survey. The presentation included figures of the areas surveyed, the vessels and equipment used, the results of the survey, and how the results would be used in planning the Phase II and Phase III fieldwork. In addition to the PowerPoint briefing, posters of the proposed Phase II EM survey tracks were displayed. Handouts of the presentation and CD's containing the meeting materials and draft Phase II work plan were also provided to all attendees.

During the presentation, there were three comments and questions from the agency representatives.

Ms. Nilda Jimenez (PRDNR) asked if Tetra Tech would be conducting Phase II and Phase III fieldwork concurrently as was briefed by USAE or separately.

Mr. Wilson (Tetra Tech) responded that the Phase II and Phase II field work would be conducted separately with time for the agencies to review the Phase II results prior to Phase III field work.

Dr. Lisamarie Carrubba (NMFS) commented that the Phase I video did not provide the locations of all listed and proposed for listing corals and asked if additional video would be collected during phase II or III.

Mr. Wilson (Tetra Tech) explained that additional high resolution video would be collected by the EM sensor array during Phase II and this would allow identification of protected species that were located on or around each of the anomalies that will be investigated during Phase III. This will allow agencies to assess the potential impact and participate in mitigation planning.

Ms. Marlelisa Rivera (USFWS) commented that the proposed timing of Tetra Tech's Phase II field work would coincide with turtle nesting and Tetra Tech would need to consider this in their planning.

Mr. Wilson (Tetra Tech) acknowledged Ms. Rivera's concern and noted that the work will be performed following the approved Environmental SOPs and that Tetra Tech would work with USFWS to ensure nests were not disturbed.

TPP Meeting 2 Attendees:

Ana M. Roman	Deputy Project Leader Culebra Refuge Manager	US Fish and Wildlife Services	787-396-7711	ana_roman@fws.gov
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Lisamarie Carrubba	NMFS PRD	NOAA/Fisheries	787-851-3700	lisamarie.carrubba@noaa.gov
Jose Rivera	Biologist	NOAA	787-405-3605	jose.a.rivera@noaa.gov
Roland Belew	Project Manager	USACE	256-895-9525	roland.g.belew@usace.army.mil
Thomas Freeman	Project Manager	USACE	904-232-1040	tom.freeman@usace.army.mil
Wilberto Cubero	Environmental Scientist	USACE	904-232-2750	wilberto.cubero-deltoro@usace.army.mil
Kelly Enriquez	Project Geophysicist	USACE	256-895-1373	kelly.d.enriquez@usace.army.mil
Teresa Carpenter	Technical Manager	USACE	256-895-1659	teresa.m.carpenter@usace.army.mil
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Thomas Bourque	Project Manager	USA Environmental	808-255-2320	tbourque@usatampa.com
Jose Mendez	Project Manager	CESAJ-DP	787-729-6893	jose.mendez@usace.army.mil
Brad McCowan	Program Manager	USA	256-217-2570	bmccowan@usatampa.com
Patricia Berry	Project Manager	Parsons	678-969-2410	patricia.berry@parsons.com
Scot Wilson	Project Manager	Tetra Tech	360-598-8111	scot.wilson@tetratech.com
Marlelisa Rivera	Deputy Field Supervisor	USFWS - CESTO	787-851-7297 X	marelisa_rivera@fws.gov

	CESTO		206	
Nilda M Jimenez	Program Coordinator	DNER	787-645-5593	njimenez@drna.gobierno.pr
Yolande Martinez	Envornmental Emergencies Response Manager	EQB	787-409-5543	yolandamartinez@j.a.gobierno.pr
Richard Funk	Project Geophysicist	Tetra Tech	206-605-3482	richard.funk@tetratech.com

APPENDIX I

SURVEY MEC EXPOSURE RISK ASSESSMENT

MEC Risk Assessment for Culebra TO003 Phase II EM Survey Work Plan

1. Assessment of risk: There is a very low risk of the marine EM survey team coming into contact with MEC during the proposed Phase II survey.

Site Description:

MRS 03

Flamenco Bay is a tourist beach visited by thousands each year. There are no land use controls, and the site enjoys unlimited access and use for all recreational activities including wading, swimming, snorkeling, diving, surfing, and kayaking.

MRS 12

Carlos Rosario and Tamerindo beach are also popular tourist spots with no land use controls and unlimited use for all recreational activities including wading, swimming, snorkeling, diving, surfing, and kayaking.

2. Risk Mitigation:

a. Both MRSs have had full bathymetric and video surveys conducted by the same survey team in 2012/13 to produce detailed bathymetric maps with centimeter accuracy. Both sites are well known to the survey field staff. Locations of possible MEC are already known by the survey team.

b. The survey vessel will not enter water shallower than 2 meters and will remain a minimum of 4 feet from the highest point on the bottom.

c. The survey vessel transits to and from the sites and is not launched from and does not land on the beaches.

d. In shallow water (2 meters or less), the hovercraft will be used to conduct the survey. This is a zero draft survey platform, which ensures nothing will contact the bottom.

e. The hovercraft is piloted by the project SUXOS and he will be on-site during the entire survey.

f. The survey will be conducted at a speed of 1.5 knots, allowing the survey vessel to stop in less than a boat length.

g. The EM sensor array has forward-looking high definition (HD) cameras that provide real-time obstacle avoidance. Contact with the bottom by the sensor platform can be prevented by stopping the survey vessel and/or simultaneously raising the high speed winch.

APPENDIX J

TRANSECT SAMPLING FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) TARGET DETECTION

Summary

This report summarizes the probability of traversing and detecting a target area of specific size and shape for different transect spacings. Simulation details and a power curve estimate how well the specified design would detect the target. The selected design statement is:

If 3-meter-wide transects with a parallel pattern are spaced 344 feet between transects (353.843 feet on centers) over the entire site, these transects have an approximately 90% chance of traversing and detecting any 800-foot-diameter (400-foot-radius) circular target area having a bivariate normal distribution with a target center density of 90 anomalies per acre above the background density of 10 anomalies per acre. This assumes the instrument false negative rate is 0% and flagged windows have at least 95% confidence they have density greater than background.

The following table summarizes the sampling design developed.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Ensure high probability of traversing and detecting a target area that has a specified size and shape
Required Probability of Traversing the Target	100%
TARGET AREA AND TRANSECT INPUTS	
Type of Sampling Design	**Transects**
Transect Pattern	**Parallel**
Transect Width	**3 meters**
Target Area Definition	**User Specified**
Area of target area	**502654.82 ft^2**
Shape of target area of concern	**Circular**
Radius of target area of concern	**400 feet**
SIMULATION PARAMETERS FOR PROBABILITY OF DETECTION	
Formula for calculating the probability of traversing and detecting target area	Monte Carlo Simulation (method described below)
Background Density of the Site	10 anomalies / acre
Expected Target Area Density Above Background	90 anomalies / acre at target center
Distribution of target area density above background	Bivariate Normal
Transect spacing evaluation range	150 to 450 feet
Minimum precision	0.03
Maximum error	0.01
Search Window Diameter	720 feet
PROPOSED TRANSECT DESIGN AND COST INFORMATION	
Number of selected sample areas [1/]	0
Specified sampling area [2/]	0.00 acres
Computed spacing between transects	344 feet
Computed spacing between transect centers	353.843 feet
Number of transects to be surveyed	0
Transect Coverage	0.00% of total site area
Linear transect coverage	0.00 km
Area of transect coverage	0.0000 acres
Total cost of sampling [c]	$1,000.00

1/ The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
2/ The sampling area is the total surface area of the selected colored sample areas on the map of the site.
3/ See the Cost of Sampling section for an explanation of the costs presented here.

Site Map With Proposed Transect Design

No map within VSP project.

Primary Sampling Objective

The primary purpose of sampling at this site is to traverse and detect target areas of a given size and shape with required high probability. The transect design tools provide a statistically defensible method to use transect survey data that covers only a small proportion of the total study area.

Selected Sampling Approach

The specified sampling approach was random parallel transect sampling. If parameters change from those specified in the table above, then the probability of detecting the target area will be different from those computed by VSP and reported here.

Simulation Details

To generate an estimated probability on a graph, VSP runs a Monte Carlo simulation based on the entered parameters. For each iteration, VSP creates a square site with the target area centered at the origin and rotated at a random angle. A parallel transect pattern is placed randomly so that 3 meters wide transects are parallel to the x axis.

VSP calculates the total area of the site traversed by transects, A_b , which can vary for each iteration. The expected number of detected background anomalies, λ_b , is calculated as $\lambda_b = D_b A_b (1 - P_{fn})$ where D_b is the background density of 10 anomalies / acres and P_{fn} is the instrument false negative rate of 0. A random number of detected background anomalies is generated using a Poisson distribution with parameter λ_b. VSP randomly places these anomalies within the traversed areas of the site.

To simulate the number of additional anomalies in the target area, VSP uses an approximation technique to randomly place additional detected anomalies in the traversed areas of the target area. Portions of transects overlapping the target area are divided into small sections. For each section, the quantile of the target area in which it lies is determined, the expected number of additional anomalies is determined, and a random number of detected anomalies is determined using a Poisson distribution and placed within the section.

VSP uses a moving window along each transect to determine which areas have density significantly greater than background density. The window moves 1/6 of the search window diameter for each iteration. Where D_a is the actual density for the current window, the null and alternative hypotheses for determining if the area inside the window has density significantly greater than background density, D_b , are as follows:

Null Hypothesis: $H_o : D_a \leq D_b$

Alternative Hypothesis: $H_a : D_a > D_b$

VSP checks each window to see if the actual number of detected anomalies is significantly greater than the expected number of anomalies for a Poisson distribution. If any windows intersecting the target area are flagged as significant, then we determine the target area has been detected.

250 iterations are run to begin the simulation to estimate a probability of detection. If the specified Maximum Error has not been achieved, additional iterations are run until the Maximum Error is met. If the total number of iterations is *n* and the proportion of target areas detected is *p*, then another iteration is run if

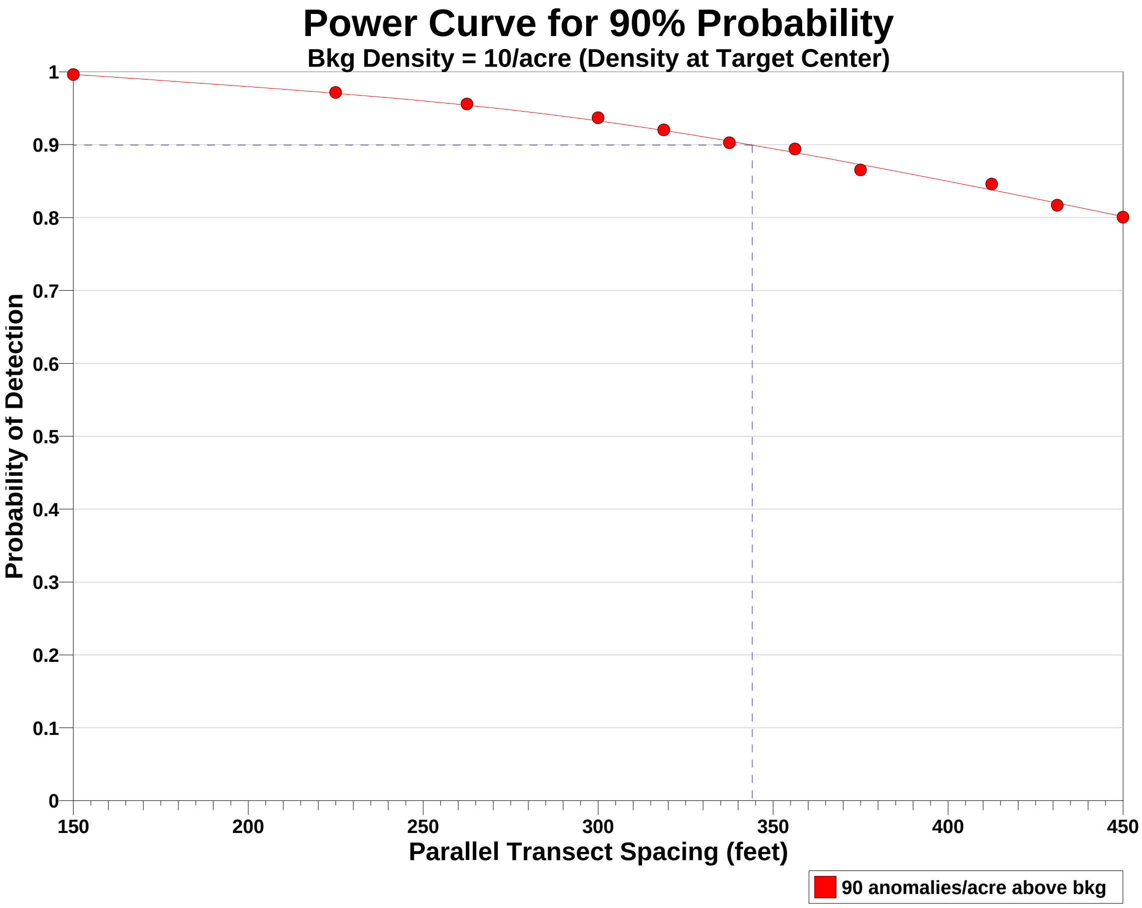
Maximum Error < $1.96 * \sqrt{\frac{p(1-p)}{n}}$

The quantity $1.96 * \sqrt{\frac{p(1-p)}{n}}$ is the 95th percentile of the standard error of the mean for a binomial distribution. We are 95% certain that the estimated probability is close to the true probability (within the maximum error). When all iterations are completed, VSP tabulates the estimated probability the target area has been detected, *p* / *n*. VSP repeats this process for a number of transect spacings determined by simulation results and the minimum precision specified. The results are plotted in the power curve below.

Target Detection Power Curve

The following figure is a target detection performance diagram. It shows the probability of detecting the specified target area for a range of transect spacings. The estimated probability of detecting the target area is on the vertical axis, and a range of possible transect spacings are shown on the horizontal axis.

The legend at the bottom of the graph indicates the color of the line representing the target area densities above background used. Lines are fit by first smoothing the points using a moving average, then fitting the line using a cubic spline.



The transect spacings and the simulated probabilities of detecting the target area are shown in the table below:

Curve	Transect Spacing	Estimated Probability of Detecting the Target Area
1	150	0.996094
1	225	0.971607
1	262.5	0.955734
1	300	0.936953
1	318.75	0.92007
1	337.5	0.902632
1	356.25	0.894063
1	375	0.865321
1	412.5	0.845896
1	431.25	0.81684
1	450	0.800522

Cost of Sampling

Not Applicable.