DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 SAN MARCO BOULEVARD
JACKSONVILLE, FLORIDA 32207-8175

REPLY TO
ATTENTION OF

NOV 23 2016

CESAJ-PM-M

MEMORANDUM FOR SEE DISTRIBUTION LIST

SUBJECT: Final Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP) for Time Critical Removal Action (TCRA), Congressionally Authorized Areas within the Northwest Peninsula, Culebra Island, Puerto Rico, Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS) Project No. I02PR006816, Culebra, Puerto Rico

The Jacksonville District, U.S. Army Corps of Engineers (Corps) is enclosing for your records the Final UFP-QAPP for TCRA at the Congressionally Authorized Areas within the Northwest Peninsula associated with the DERP-FUDS Project No. I02PR006816, Culebra, Puerto Rico.

Should you need additional information, please contact Wilberto Cubero, Project Manager, at 904-232-1426 or by email at Wilberto.Cubero-delToro@usace.army.mil. You may also contact the undersigned at (904) 232-1758 or by e-mail at John.E.Keiser@usace.army.mil.

Sincerely,

Encl

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

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FINAL
UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN (UFP-QAPP)

TIME CRITICAL REMOVAL ACTION (TCRA)
SPECIFIC AREAS WITHIN THE NORTHWEST PENINSULA
CULEBRA ISLAND, PUERTO RICO

DERP-FUDS Project No. I02PR006816

Contract No. W912DY-10-D-0023
Task Order No. 0022
HGL Project No. H10022

Prepared for

U.S. Army Corps of Engineers

November 2016

Revision Log

Revision No.	Revision Date	Comments

FINAL
UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN (UFP-QAPP)

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Prepared for

U.S. Army Corps of Engineers

Prepared by:

HydroGeoLogic, Inc.
5030 Bradford Drive, Building 1, Suite 230
Huntsville, Alabama 35805

November 2016

FINAL QUALITY ASSURANCE PROJECT PLAN

EXECUTIVE SUMMARY

ES.1 This Quality Assurance Project Plan (QAPP) has been prepared by HydroGeoLogic, Inc. (HGL) to support the Time Critical Removal Action (TCRA) at specific Congressionally-authorized locations within the Northwest Peninsula (NWP) of Culebra Island (Defense Environmental Restoration Program-Formerly Used Defense Site [DERP-FUDS] Project No. I02PR006816), Puerto Rico, specifically within portions of Carlos Rosario Beach, Flamenco Beach, Tamarindo Beach, the Flamenco Campground, and the Carlos Rosario Trail. This work is being conducted for the U.S. Army Corps of Engineers (USACE) under Contract No. W912DY-10-D-0023, Task Order No. 0022.

ES.2 Previous investigations have indicated that munitions and explosives of concern (MEC) is present on the NWP, resulting from its use between 1935 and 1975 for aerial gunnery training, bombing, and naval gunfire support training using live-fire and practice munitions. These materials present an unacceptable risk from explosive hazards to ACDEC, DNER, and FWS personnel and recreational users. The objective of the TCRA is to identify and dispose of MEC within specific areas of the NWP where receptors may come into contact with explosive hazards.

ES.3 DGM and advanced classification (AC) followed by intrusive investigation of anomalies will be completed in areas accessible to the equipment. Analog metal detections will be used in a mag and dig approach elsewhere. In a pond at the campground area, an underwater investigation will be completed. Advanced geophysical classification will be used to (1) detect anomalies resulting from discarded military munitions (DMM), unexploded ordnance (UXO), and other metallic debris and (2) classify anomalies so that informed decisions can be made as to whether the anomaly is a TOI and should be removed, or is a non-TOI and may be left in place. Geophysical data collected using electromagnetic induction (EMI) sensors in a dynamic mode will be used to initially detect and document the locations of subsurface anomalies. Geophysical data collected using advanced EMI sensors in a cued (static) mode will then be used to classify each anomaly as follows: (1) highly likely to be TOI; (2) highly unlikely to be TOI; or (3) Inconclusive. Detected items classified as “TOI” and “inconclusive” will be targeted for removal. Items classified as non-TOI will be left in place. Analog survey data will be used to detect anomalies resulting from DMM, UXO, and other metallic debris. For analog survey areas, all subsurface anomalies will be investigated and MEC/material potentially presenting an explosive hazard (MPPEH)/munitions debris (MD) will be removed.

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LIST OF ACRONYMS/ABBREVIATIONS

%D	percent difference
%R	percent recovery
ACDEC	Authority of Conservation and Development of Culebra
ASR	Archives Search Report
BDU	Bomb Dummy Unit
BIP	blown-in-place
CA	Corrective Action
CCB	continuing calibration blanks
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESAJ	U.S. Army Corps of Engineers, Jacksonville District
cm	centimeters
CoC	chain-of-custody
COPC	chemicals of potential concern
COR	Contracting Officer Representative
CSM	conceptual site model
DDESB	DoD Explosives Safety Board
DERP	Defense Environmental Restoration Program
DFW	definable features of work
DGM	digital geophysical method
DID	data item description
DL	detection limit
DMM	discarded military munitions
DoD	Department of Defense
DQI	data quality indicators
DQO	data quality objective
DUA	data usability assessment
EB	equipment blank
EE/CA	Engineering Evaluation/Cost Analysis
Ellis	Ellis Environmental Group
EM	Engineer Manual
EMI	electromagnetic induction
EPA	Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
ESS	Explosives Safety Submission
FS	Feasibility Study
FUDS	Formerly Used Defense Site

GIS	geographic information system
GPS	global positioning system
H&S	Health and Safety
HAZMAT	hazardous material
HE	high explosive
HGL	HydroGeoLogic, Inc.
IAW	in accordance with
ICB	initial calibration blanks
ICV	initial calibration verification
IDQTF	Intergovernmental Data Quality Task Force
INPR	Inventory Project Report
ISO	industry standard object
IVS	instrument verification strip
LCL	lower control limit
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
MB	method blank
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
ME	marginal exceedance
MEC	munitions and explosives of concern
MM	MetalMapper
MMRP	Military Munitions Response Program
MPC	measured performance criteria
MPPEH	material potentially presenting an explosive hazard
MRS	munitions response site
MS	matrix spike
MSD	matrix spike duplicate
MTA	MTA, Inc.
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWP	Northwest Peninsula
PAL	project action level
PDF	portable document format
PDT	project delivery team

PM	Project Manager
PR DNER	Puerto Rico Department of Natural and Environmental Resources
PREQB	Puerto Rico Environmental Quality Board
PWS	performance work statement
QA	quality assurance
QAPP	Quality Assurance Project Plan
QASP	Quality Assurance Surveillance Plan
QC	quality control
QSM	Quality Systems Manual
RAC	Risk Assessment Code
RCA	root cause analysis
RI	Remedial Investigation
RPD	relative percent difference
RRD	range-related debris
RSL	Residential Screening Levels
SI	Site Inspection
SNR	signal-to-noise ratio
SOP	standard operating procedure
SSFR	Site-Specific Final Report
SUXOS	Senior UXO Supervisor
TB	trip blank
TCRA	time critical removal action
TOI	target of interest
UCL	upper control limit
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
WERS	Worldwide Environmental Remediation Services

FINAL
QUALITY ASSURANCE PROJECT PLAN

INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared by HydroGeoLogic, Inc. (HGL) to support the Time Critical Removal Action (TCRA) at specific Congressionally-authorized locations within the Northwest Peninsula (NWP) of Culebra Island (Defense Environmental Restoration Program-Formerly Used Defense Site [DERP-FUDS] Project No. I02PR006816), Puerto Rico, specifically within portions of Carlos Rosario Beach, Flamenco Beach, Tamarindo Beach, the Flamenco Campground, and the Carlos Rosario Trail. This work is being conducted for the U.S. Army Corps of Engineers (USACE) under Contract No. W912DY-10-D-0023, Task Order No. 0022.

The QAPP provides information on five areas: (1) Project Management and Objectives, (2) Measurement and Data Acquisition, (3) Field Sampling Rationale, (4) Assessment and Oversight, and (5) Data Review. This document meets the requirements and elements set forth in the *Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (QSM)*, Version 5.0 (DoD, 2013), and the Intergovernmental Data Quality Task Force (IDQTF) *Uniform Federal Policy for Quality Assurance Project Plan Manual (UFP-QAPP)* (IDQTF, 2005) and the UFP-QAPP optimized worksheets (IDQTF, 2012); the Geophysical Classification for Munitions Response-QAPP template produced by the Interstate Technological and Regulatory Council (ITRC) (ITRC, 2015); and the UFP-QAPP for Advanced Geophysical Classification for Munitions Response (Version 1.0) (IDQTF, 2016). This QAPP provides a process for obtaining data of sufficient quality and quantity to satisfy project needs. It describes the functional activities, data quality objectives (DQOs), and measures necessary to obtain adequate data for a given purpose. Data acquisition, reporting, and evaluation will be completed in accordance with (IAW) this QAPP. As any new procedures are required, addenda to this document will be issued.

All staff participating in project/field efforts are required to read this plan and become familiar with the analytical procedures and the implementation of these procedures to ensure that analytical/sample goals are met consistently. In addition, key personnel are responsible for mentoring assigned staff in aspects of this QAPP that would have a potential impact on the work assigned to them.

WORKSHEETS #1 AND #2
TITLE AND APPROVAL PAGE

Appendix E: Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP), Time Critical Removal Action (TCRA) for Specific Congressionally Authorized Areas Within the NWP, Culebra Island, Puerto Rico, Formerly Used Defense Site Property Number I02PR0068
Document Title

USACE
Lead Organization

Kenneth Rapuano, HGL
Preparer's Name and Organizational Affiliation

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Preparer's Address, Telephone Number, and Email Address

November 2016
Preparation Date

Approval Signatures:

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Stephen Davis, CIH, CSP, HGL
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WORKSHEETS #1 AND #2 (CONTINUED)
TITLE AND APPROVAL PAGE

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Lead Organization's Contracting Officer Representative (COR)
USAESCH COR:

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Rebecca Terry, USAESCH
Printed Name/Organization

HGL PM:

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WORKSHEETS #1 AND #2 (CONTINUED)
TITLE AND APPROVAL PAGE

Site Name/Project Name: TCRA, Northwest Peninsula, Culebra Island
Site Location: Culebra Island, Puerto Rico
Contractor Name: HGL
Contract Number: W912DY-10-D-0023
Contract Title: Huntsville Center - Worldwide Environmental Services Contract (WERS)
Task Order Number: 0022

1. Identify guidance used to prepare the QAPP: Uniform Federal Policy for Quality Assurance Project Plans (IDQTF, 2005 and 2012; ITRC, 2015; IDQTF, 2016); DoD QSM Version 5.0; EPA QA/G-5; and EM 200-1-15

2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act of 1986, and National Contingency Plan.

3. Identify approval entities: USACE

4. The QAPP is (select one): **project-specific** Generic

5. List dates of scoping sessions that were held: Project Kickoff Meeting held July 12, 2016.

6. List dates and titles of QAPP documents written for previous site work, if applicable: None.

7. List organizational partners (stakeholders): USACE (lead agency), Puerto Rico Environmental Quality Board (PREQB) (lead regulator), Puerto Rico Department of Natural and Environmental Resources (PR DNER), U.S. Fish and Wildlife Service (USFWS), Authority of Conservation and Development of Culebra (ACDEC), National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), and US Environmental Protection Agency (EPA) Region 2.

8. List data users: HGL, USACE, PREQB

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below.

All QAPP worksheets are applicable.

WORKSHEETS #3 AND #5
PROJECT ORGANIZATION AND QAPP DISTRIBUTION

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
Rebecca Terry	Contracting Officer's Representative (COR)	USAESCH	(256) 895-1788	Rebecca.K.Terry@usace.army.mil
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Derek Anderson	Project Manager	HGL	(706) 372-5138	danderson@hgl.com
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Jan Kool	Program QA Manager	HGL	(703) 736-4545	jkool@hgl.com
Tim Deignan	Project AC QC Geophysicist	HGL	(303) 524-3473	tdeignan@hgl.com
Ken Rapuano	Project Chemist	HGL	(703) 736-4546	krapuano@hgl.com
Jeff Martin	Database Manager	HGL	(703) 736-4533	jmartin@hgl.com
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TBD	UXO Quality Control Specialist (UXOQCS)	HGL	TBD	TBD
TBD	UXO Safety Officer (UXOSO)	HGL	TBD	TBD
Rolando Soler	Project Biologist	Caribbean Marine Services	(787) 220-1185	
TBD	Field Team Leader (FTL, sampling)	Parsons	TBD	TBD
Steve Rembish	Risk Assessor	Parsons	(512) 719-6067	Steve.J.Rembish@parsons.com
Patti Berry	AC Project Manager	Parsons	(678) 969-2410	Patricia.Berry@parsons.com
John Baptiste	Senior AC Geophysicist	Parsons	(303) 764-6067	John.Baptiste@parsons.com
Jae Yun	Field AC Geophysicist	Parsons	(678) 969-2463	Jae.Yun@parsons.com
Amek Carter	Laboratory PM	Lancaster	(717) 556-7252	amekcarter@eurofinsus.com
Tammy Chang	Data Validation PM	Parsons	(512) 719-6092	Tammy.Chang@parsons.com

Lancaster = Eurofins Lancaster Laboratories, Inc.
TBD = to be determined

Project Organization:

The project organizational chart is presented in Figure 3.1 (Appendix B).

WORKSHEETS #4, #7, AND #8
PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

Organization: HGL

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Janardan Patel	Program Manager	M.S. Environmental Engineering Management Experience: 27 years	PMP	
Derek Anderson	PM	B.S. Agricultural Engineering (Environmental Focus) Experience: 18 years	P.E. Civil Engineering, North Carolina, AZ LEED-AP	
Jan B. Kool, Ph.D.	Program QA Manager	B.S., Geology and Soil Science, M.S., Geology and Soil Science Ph.D., Soil Physics Experience: 32 years	P.G. CMQ/OE	
Tim Deignan	Project AC QC Geophysicist	B.S. Geophysical Engineering Experience: 26 years AC Experience: 1 year experience with AC at Pole Mountain, Spencer Range, and Southwest Proving Ground; experience in designing blind seed programs and interfacing with subcontractors and other project delivery team (PDT) members during work plan, technical project planning, and execution of field activities.	RPGp, State of California; Oasis Montaj Geophysical Data Processing for UXO 3 day -UXAnalyze- instruction by ESTCP; UX Analyze, annual training	
Ken Rapuano	Project Chemist	B.S., Chemistry M.S., Chemistry Experience: 29 years	Certified Hazardous Materials Manager; Certified Quality Auditor	
TBD	SUXOS	TBD	DoD Explosives Safety Board (DDESB) Technical Paper 18	
TBD	UXOQCS	TBD	DDESB Technical Paper 18	
TBD	UXOSO	TBD	DDESB Technical Paper 18	
TBD	Field Personnel	TBD	DDESB Technical Paper 18 (if applicable)	
TBD	Field Personnel	TBD	DDESB Technical Paper 18 (if applicable)	

WORKSHEETS #4, #7, AND #8 (CONTINUED)
PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

Organization: Parsons

Name	Project Title/Role	Education/Experience	Specialized Training/ Certifications	Signature/Date
Steve Rembish, Ph.D.	Risk Assessor	B.S., Biochemistry; Ph.D., Toxicology Experience: 20 years	--	
Patti Berry	AC Project Manager	B.S., Engineering Science and Mechanics; M.S., Management Experience: 15 year AC Experience: 1-year experience PM for the Camp Sibert Remedial/ Removal Action AC project.	PMP	
John Baptiste	AC Senior Geophysicist	B.A., Geology Experience: 16 years AC Experience: 4 years experience using advanced geophysical sensors; experience with theoretical and practical aspects of detecting and selecting TOI to include 4 types of grenades, 37-mm through 155-mm projectiles, 4 types of mortars, 6 types of rockets and motors, general purpose and practice bombs, spotting charges, various fuzes, and Livens projectiles; non-TOI include ordnance fragments, rocket fins, mortar base plates, 4.2-inch mortar half-shells, non-hazardous fuzes, fuze couplers, venturis, nose cones, and horseshoes; expert in use of EM61-MK2, MetalMapper (MM) advanced EMI sensor, TEMTADS 2X2 advanced EMI sensor, and MM 2X2 advanced EMI sensor as well as high-precision GPS, inertial motion sensors, and control/integration software such as Geosoft Oasis Montaj; Project/Senior Geophysicist for Camp Beale Pilot Study and Demonstration Project, Marpi Field RI/FS Treatability Study, and Camp Sibert Remedial/Removal Action projects using the MM and/or TEMTADS 2X2 where responsibilities included data processing and analysis and development of the classifier for the project and all classification decisions.	Registered Geophysicist, CA; Oasis Montaj Geophysical Data Processing for UXO 3 day -UXAnalyze-instruction by ESTCP	

WORKSHEETS #4, #7, AND #8 (CONTINUED)
PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

Organization: Parsons (Continued)

Name	Project Title/Role	Education/Experience	Specialized Training/ Certifications	Signature/Date
Jae Yun	AC Field Geophysicist	B.S., Soil and Water Engineering Experience: 15 years AC Experience: 2 years experience using advanced geophysical sensors; Field Geophysicist for the Camp Sibert Remedial/Removal Action AC project using the MM where responsibilities included overseeing and/or conducting digital geophysical method (DGM) survey using towed array and man-portable EM61-MK2 configurations, analysis of DGM data, MM cued survey using the MM, and managing field QC of anomaly investigation, data collection, and processing; managed field operations for the first ESTCP Pilot Program at Camp Sibert Site 18 using classification and advanced sensors; site managed 5 ESTCP demonstration projects involving advanced sensors.	Oasis Montaj Geophysical Data Processing for UXO 3 day UXAnalyze instruction by ESTCP	
TBD	Field Personnel	TBD	TBD	
TBD	Field Personnel	TBD	TBD	

Organization: Lancaster

Name	Project Title/Role	Education/Experience	Specialized Training/ Certifications	Signature/Date
Amek Carter	Project Manager	B.S., Biology Experience: 24 years	--	
Dorothy Love	QA Director	B.S., Environmental Health Experience: 36 years	--	
Rick Karam	Director of Operations	B.S., Environmental Studies Experience: 16 years	--	

WORKSHEET #6
COMMUNICATION PATHWAYS

Communication Driver	Initiator (role) (1)(2)	Recipient(s) (role) (1)	Procedure
General communication between USACE and other PDT members	USACE PM or designee	Appropriate PDT member(s)	Communicates directly as needed (verbally and/or in writing).
ACDEC and Regulatory interface	USACE CESAJ PM	Regulators (PREQB, PR DNER, USFWS, NOAA, and EPA) ACDEC	All materials and information about the project will be forwarded to PREQB, PR DNER, USFWS, NOAA, NMFS, and EPA by the CESAJ PM, or by the HGL PM with permission from the COR and CESAJ PM.
Regulatory oversight	Regulators (PREQB, PR DNER, USFWS, NMFS, NOAA, and EPA)	USACE CESAJ PM, USACE PM	Communicate directly as needed (verbally and/or in writing).
Project management, Task Order administration and logistics	HGL PM	USACE PM, USACE CESAJ PM, and appropriate PDT member(s)	Communicate directly as needed (verbally and/or in writing). The PM will communicate project related issues, including changes in schedule, changes in scope of fieldwork or delays, and recommendations to stop work, to the USAESCH PM by phone, email, or fax by Close of Business, next business day. The PM will also provide project information to the USAESCH PM through monthly progress reports, email updates, teleconference calls, and meetings. They will document deviations from QAPP and corrective action (CA) in memoranda to USAESCH PM, and will notify USACE of laboratory CA within 24 hours of notification from the laboratory or project chemist.
Mobilization and surface clearance activities are complete	HGL PM	Parsons AC PM	Upon completion of surface clearance activities, the HGL PM informs the Parsons AC PM.
Daily reports	HGL SUXOS	HGL PM and Parsons lead technical and site personnel	Documents progress in daily report and submits to HGL PM for onward distribution to PDT. Daily reports will be submitted to USACE PM within 24 hours of work completion that day whenever possible. Field progress reports will vary based on the objectives of each definable feature of work (DFW). Examples of these reports are geophysical surveying, intrusive investigation, and daily production reports.

WORKSHEET #6 (CONTINUED)
COMMUNICATION PATHWAYS

Communication Driver	Initiator (role) (1)(2)	Recipient(s) (role) (1)	Procedure
Stop work due to safety issues	HGL UXOSO (or USACE OESS)	HGL SUXOS, USACE OESS, and other field personnel	If unsafe work conditions are noted, the UXOSO will stop work immediately. Work will not be allowed to resume until the unsafe condition is corrected. The UXOSO will notify the Corporate H&S Officer immediately when a stop work situation is encountered. In some cases, such as inclement weather (for example, lightning or high winds), no CA is required and work may resume when the UXOSO and Corporate H&S Officer determine that conditions allow.
	HGL SUXOS	HGL PM	Verbally notify HGL PM as soon as possible after work stoppage.
	HGL PM	USACE PM	Notify USACE PM verbally or via e-mail as soon as possible after work stoppage.
QAPP changes before fieldwork	HGL Chemist	USACE PM	If errors or changed conditions require the modification of the QAPP before fieldwork begins, the Project Chemist will prepare revised text. All changes to the QAPP will require final approval from USACE and regulatory agencies.
QAPP changes during project execution	HGL SUXOS HGL PM Parsons AC PM	USACE PM Regulatory Agencies	The SUXOS and sample team will notify the Project Chemist of field deviations from QAPP within 2 business days and provide rationale for changes. The AC PM will notify the PM of field deviations from QAPP within 2 business days and provide rationale for changes. He or she will document changes in field daily progress reports and memoranda to the PM, review field operations daily and evaluate need for field CAs (in collaboration with PM), and document CA in the daily logs and in memoranda to PM and USAESCH PM. All changes to the QAPP will require final approval from USACE and regulatory agencies.
Geophysical QC variances	HGL QC Geophysicist	HGL Project Geophysicist, HGL Corporate QC Manager, and HGL PM	QC Geophysicist notifies HGL Project Geophysicist and PM immediately.
	HGL PM	USACE PM and USACE Project Geophysicist	HGL PM notifies USACE within 24 hrs. USACE PM notifies regulator as necessary.

WORKSHEET #6 (CONTINUED)
COMMUNICATION PATHWAYS

Communication Driver	Initiator (role) (1)(2)	Recipient(s) (role) (1)	Procedure
Geophysical QA Concerns	USAESCH PM, USAESCH Geophysicist	HGL PM, Parsons AC PM, and technical personnel	HGL and Parsons respond to geophysical QA concerns within 24 hours with a CA plan.
Field team finds MEC item(s)	HGL SUXOS	HGL PM, USACE OESS	Verbally notifies HGL PM and USACE OESS immediately and then awaits permission to respond and/or conduct disposal operation
	HGL PM	USACE PM, USACE CESAJ PM	Verbally notifies USACE and USACE CESAJ immediately.
	USACE CESAJ PM	Regulator and other PDT members	Notify other PDT members as necessary.
Field team ready to conduct MEC disposal operations	HGL SUXOS	HGL PM and personnel listed in 17A.16	Notifies personnel listed in 17A.16; and organizations.
	HGL PM	USACE PM, and PDT	HGL PM notifies USACE PM verbally and other USACE PDT members via e-mail.
Field corrective actions	HGL SUXOS	HGL PM	CA resulting from either failure to follow QAPP requirements or due to changes in site conditions will be documented by the SUXOS; the SUXOS will communicate the need for CA to the PM on the same business day. SUXOS may initiate interim CA in the field subject to final approval by the PM and Program QA Manager.
Sample receipt discrepancies (for example, broken or missing samples, improper preservation, or missing analysis requests)	Lancaster PM	HGL PM	The laboratory PM will communicate discrepancies in sample receipt to the HGL PM on the same business day that the discrepancy is identified. The PM, in consultation with the Project Chemist, will instruct the laboratory PM on the appropriate course of action.
Laboratory QC variances	HGL Chemist	HGL PM, USAESCH PM, USACE CESAJ PM	The Project Chemist will prepare variance requests in collaboration with laboratory PMs for transmittal to USACE for approval.
Analytical CAs	HGL Chemist	HGL PM, USAESCH PM, USACE CESAJ PM	Need for laboratory CAs will be determined by the Project Chemists and/or laboratory PM or QA Manager and will be documented in memoranda to PM and USAESCH PM.

WORKSHEET #6 (CONTINUED)
COMMUNICATION PATHWAYS

Communication Driver	Initiator (role) (1)(2)	Recipient(s) (role) (1)	Procedure
Data verification issues (for example, incomplete records)	HGL Chemist	HGL PM	The Data Validators will contact the laboratory directly in cases where the discrepancy is a simple report generation error (such as a skipped page or data missing for a subcontracted analytical method). For systematic problems, such as incorrectly formatted data reports or failure to include required data QC elements, the Data Validators will contact the Project Chemists. The Project Chemists will work with the laboratory PM to ensure that properly formatted data reports are delivered to the data validators on a timely basis.

(1) Names and contact information for personnel provided on Worksheets #4, 7, & 8.
(2) The initiator may designate another qualified individual to communicate with the recipient(s); however, the initiator shown is responsible for the communication being made.

WORKSHEET #9
PROJECT SCOPING SESSION PARTICIPANTS SHEET

Planning Session: Kickoff Meeting
Date: July 12, 2016
Time: 1330-1430 CT
Location: Teleconference
Purpose: Discuss the overall goals, implementation of the project tasks, and general approach for the Time Critical Removal Action at the NWP.

Attendees:

Name	Org	Role	Number	Email
John Keiser	CESAJ	FUDS Program Manager	(904) 232-1758	John.E.Keiser@usace.army.mil
Rebecca Terry	USAESCH	COR	(256) 895-1788	Rebecca.K.Terry@usace.army.mil
Kelly Longberg	USAESCH	TM	(256) 895-1408	Kelly.D.Longberg@usace.army.mil
Kelly Enriquez	USAESCH	Project Geophysicist	(256) 895-1373	Kelly.D.Enriquez@usace.army.mil
Mike D'Auben	USAESCH	Project Chemist	(256) 895-1460	Michael.J.D'Auben@usace.army.mil
Wilberto Cubero	CESAJ	District PM	(904) 232-1426	Wilberto.Cubero-Deltoro@usace.army.mil
Amanda Parker	CESAJ	PAO	(904) 232-1576 (904) 614-2240	Amanda.D.Parker@usace.army.mil
Donna West-Barnhill	CESAJ	PAO - Contractor	(803) 713-7174 (803) 622-9773	Donna.L.West2@usace.army.mil
Derek Anderson	HGL	PM	(706) 372-5138	danderson@hgl.com
Scott Schroepfer	HGL	Deputy PM	(256) 970-2120 (707) 330-6411	sschroepfer@hgl.com
Justin Kirk	HGL	TM	(210) 546-2140	jkirk@hgl.com
Tim Deignan	HGL	Project AC Geophysicist	(303) 524-3473	tdeignan@hgl.com
Patti Berry	Parsons	AC PM	(678) 969-2410	patricia.berry@parsons.com
John Baptiste	Parsons	Project AC Geophysicist	(303) 579-0909	John.E.Baptiste@parsons.com

Mr. Cubero, CESAJ, provided the Action Memorandum for team review. He was tasked with checking with USFWS regarding nesting areas for beach monitoring requirements, reviewing and revising the Commonwealth and regulatory points of contacts, and checking with the Mayor of Culebra whether a restriction can be placed on camping permits issued during TCRA fieldwork, or whether evacuating the site during working hours would be preferred. Ms. Terry, USAESCH, was tasked with confirming whether QA sampling would be required. Mr. Anderson, HGL, was tasked with providing the project schedule.

USFWS has confirmed sea turtle nesting areas on the portions of Flamenco, Tamarindo and Carlos Rosario beaches that are part of the TCRA. The biologist (or sea turtle monitor) was not present during the meeting to confirm the zone classification. However, Mr. Cubero was informed that more than 4 nests per year have occurred in these areas/beaches. Therefore, these areas would need to be surveyed twice a week, 75 days prior to initiation of fieldwork activities

as per the SOPs. Mr. Cubero requested the nest area classifications and will provide them to the team as soon as Mr. Cubero have received them.

Also, it was confirmed that ACDEC cannot close the entire campground during the TCRA work. Close coordination with ACDEC and USACE PAO will be conducted during any fieldwork activities and keep them informed during the planning and progress of the project. ACDEC is willing to close or not allow camping in some areas/zones during fieldwork activities as well as to evacuating the campground, when necessary. It is possible that project representation will be required in a meeting with ACDEC to discuss with the tenants of the kiosks the TCRA work and the coordination process to be followed. ACDEC provided PDT with a map showing how the campground is divided by zones/areas and completed initial planning of the TCRA fieldwork.

Additionally, Ms. Terry later confirmed that QA splits were not needed, and Mr. Anderson provided a project schedule.

WORKSHEET #10
CONCEPTUAL SITE MODEL

10.1 OVERVIEW

10.1.1 The primary purpose of this worksheet is to describe the conceptual site model (CSM) for the project site. In order to provide the basis for this, this worksheet also summarizes observations from previous investigations, secondary data, information from site reports, and other relevant supporting information.

10.2 SITE DESCRIPTION AND BACKGROUND

10.2.1 Site Location

10.2.1.1 The site is located on Culebra Island, Commonwealth of Puerto Rico, approximately 17 miles east of the main island of Puerto Rico (Figure 10.1 in Appendix B). The southern portion of the NWP is located in the northwestern point of the main island of Culebra; also known as Lot 91. This portion of the peninsula is approximately 408 acres in size and is bounded by the Caribbean Sea to the northeast and southwest, and bounded to the northwest by a portion of the USFWS Culebra Island National Wildlife Refuge and to the southeast by the remainder of the island. NWP TCRA areas are under munitions response site (MRS) 16.

10.2.2 Topography

10.2.2.1 Culebra Island is comprised of sandy beaches, irregular rugged coastlines, lagoons, coastal wetlands, steep mountains, and narrow valleys. Ninety percent of the island is mountainous; the island has volcanic origins. The southern portion of the NWP has irregular, rugged coastlines with sandy beaches, lagoons, coastal wetlands, and mountainous terrain.

10.2.3 Vegetation

10.2.3.1 Vegetation is moderately to extremely dense within the NWP. Hazardous vegetation include the Mesquite acacia or thorny brush, which may be present on NWP. Also the poisonous Manchineel tree (also called Manzanillo Tree on Culebra) is known to be present on NWP and near Flamenco Lagoon. Threatened and endangered vegetation consists of fifty species listed in Appendix E.

10.2.4 Geology

10.2.4.1 Culebra is underlain primarily by volcanic and plutonic rocks of Late Cretaceous age. Andesite lava, lava breccia, and tuffs are the dominant volcanic rocks with intrusions by diorite and diorite porphyry; these rocks are characterized by fractures formed in a joint pattern. Some faulting is also present, with major faults aligned in a northwest-southeast direction. Alluvium, predominately composed of silt and clay with minor quantities of sand and gravel, is deposited in the few existing river valleys near the coast. Alluvium interfingers with coral, beach, and mangrove habitat deposits along the coast (USGS, 1996).

10.2.5 Soils

10.2.5.1 The soil cover is homogeneous with only one soil association, the Descalabrado-Guayama. This association is described as composed of shallow, well drained, strongly sloping to very steeply sloping soils derived from the underlying volcanic rocks. Permeability is moderate and ranges from 0.6 to 2.0 inches per hour (USGS, 1996). Loamy organic-rich soils are found in areas of dense vegetation and grasses, while sandy soils are found on tidal flats or areas near the beach. Many of the beaches on Culebra, including Flamenco Beach and Carlos Rosario Beach have clean white to tan sand, while other beaches are rocky with a mix of cobbles and pieces of dead coral reef.

10.2.6 Hydrology

10.2.6.1 There are no permanently flowing surface water streams on Culebra; potable water is obtained from a utility pipeline from the main island by way of Vieques Island (Parsons, 2007). Three large ephemeral streams drain the hills north of Great Harbor to the south, and one large ephemeral stream has developed along an old, washed-out jeep road on the north side of the island toward Brava Beach. These ephemeral streams generally only carry water after heavy precipitation. There are many small ephemeral gullies and ditches throughout the island.

10.2.7 Hydrogeology

10.2.7.1 Ground water in Culebra occurs in alluvial deposits and in the volcanic and plutonic rocks. Alluvial deposits are located along major stream valleys that reach the coast. The alluvium is mostly composed of silt and clay with limited quantities of sand and gravel (USGS, 1996). The total estimated thickness of the unconsolidated deposits in the embayments (alluvium and weathered rock) is less than 18 m (Gómez-Gómez, et al, 2014). Fractures and joints within the volcanic and plutonic rock formations store water in small quantities. Most of these fractures and joints diminish in number and size with depth and pinch out at about 300 feet below land surface. Water-table conditions prevail in the bedrock aquifer. The specific yield for the bedrock aquifer was estimated at less than 1 percent by comparing changes in water levels with records of pumpage and estimates of recharge (USGS, 1996).

10.2.7.2 A 1995 study listed 77 wells on the island of Culebra, of which only 16 were being used for any purpose. The report stated that well water from 10 wells was being used to flush toilets, water and clean horses, water livestock, and water plants. The remaining six wells were listed as owned by the Puerto Rico Aqueduct and Sewer Authority; however, only two were listed as being pumped, and no information was provided about the use of this water (Parsons, 2007).

10.2.7.3 Direct rainfall is the only source of recharge for the Culebra aquifer system. However, recharge from rainfall only occurs during storms that last 2 to 4 days. Such storms take place only two to three times a year. About 1 percent of the rainfall infiltrates to the aquifer during these events. Annual recharge ranges from 0 to 6.8 percent of annual rainfall (USGS, 1996).

10.2.7.4 The depth to the water table beneath the ridges may be 100 feet or more, and may be less than 10 feet in the lower part of the valleys. The water flows toward the sea; however, evaporation prevents much of the water from being discharged. In coastal embayments, the water table usually is 1 to 2 feet AMSL. Salt water encroachment is common due to low heads and proximity to the sea (USGS, 1996). Most wells on the island of Culebra are shallow, dug wells

that supply water to livestock. To augment the water supply of the island, several wells were drilled within an upland depression; however, the sustained yield of these wells was less than 20 m^3/d (Gómez-Gómez, et al, 2014).

10.2.7.5 Groundwater is characterized by naturally high mineral concentrations, with dissolved-solids concentrations ranging from 500 to 1,000 milligrams per liter (mg/L). This condition is a result of airborne particulates that fall on the land surface and infiltrate the aquifer during periods of recharge. High mineral concentrations on Culebra exceed USEPA standards for drinking water in most cases; therefore, the public water supply on Culebra is provided by a utility pipeline from the main island of Puerto Rico by way of Vieques Island. In some households, municipal water is supplemented with rooftop cisterns or groundwater for non-drinking water uses.

10.2.8 Endangered Species, Sensitive Habitats, and Historical or Cultural Resources

10.2.8.1 The main island of Puerto Rico and its associated islands support many federally listed threatened and endangered species (see Appendix E). Among this diverse group of fauna and flora are multiple species, such as migratory birds, that are known to exist, potentially exist, or temporarily use areas within the Culebra Island. According to the National Wildlife Refuge System, portions of Culebra Island are considered National Wildlife Refuge area. According to the PR DNER, the conservation priority areas within the southern portion of NWP are as follows:

- All of the lagoons
- All beaches
- The designated critical habitat area for the Virgin Islands Boa
- Flamenco Peninsula

10.2.8.2 There are no known cultural or archeological resources within this project site (Parsons, 2007).

10.2.9 Site Access

10.2.9.1 The site is accessible via boat or existing roads. Local workers are regularly present within the site to manage recreational areas. The Flamenco Beach Campground consists of commercial vendor structures and an expansive tent-camping area. Additionally, Flamenco Beach, Carlos Rosario Trail and Beach, and Tamarindo Beach receive thousands of visitors yearly. Access to the site is unrestricted to the public.

10.2.9.2 Digital geophysical mapping (DGM) data collection will not be performed in heavily vegetated areas due to limitations on vegetation removal. Analog geophysical instruments will be used in heavily vegetated areas. Otherwise, no other impediments to geophysical data collection (such as electromagnetic interference) are present.

10.3 HISTORICAL DOD USE

10.3.1 The public lands in the Culebra Island Archipelago were placed under the control of the U.S. Department of Navy in 1901. The Culebra Island Archipelago was used for training

purposes by the U.S. Navy and U.S. Marines, and the North Atlantic Treaty Organization (NATO). The U.S. Marines used portions of Culebra Island as a training facility from 1902 through 1941. The NWP was used as a bombing and gunnery range from 1935 through 1975. Aircraft bombing and strafing of the NWP ended around 1970, while the use of live-fire naval gunfire support training ended in 1971. Subsequent naval support training was conducted using practice rounds until ordnance use was terminated on September 30, 1975. Between 1975 and 1982, the facilities were turned over to the General Services Administration. In 1982, the Quit Claim Deed was executed that transferred the NWP lands from the U.S. Department of the Interior to the Commonwealth of Puerto Rico.

10.4 CURRENT AND PROJECTED LAND USE

10.4.1 Currently, the southern portion of NWP of Culebra Island includes wildlife conservation and recreational areas. The Culebra Conservation and Development Authority manages the land comprising the southern portion of NWP. Limited receptor access is present on northern portion of Flamenco Beach; fencing and natural barriers such as dense vegetation and rocky cliffs make access to many areas difficult beyond the Flamenco Beach and Campground areas. Receptor access is also present on the western beach area, Carlos Rosario Beach, by the Carlos Rosario Trail that runs along the southern side of the southern portion of NWP from the Flamenco Beach area. The site is expected to continue to be used for wildlife conservation and for recreation in the future.

10.4.2 The potential presence of large, high explosive (HE) munitions in, or near, heavily used public beaches (e.g., Flamenco, Carlos Rosario and Tamarindo beaches), trails, and nearby businesses pose a significant imminent risk to public health, safety, and the environment.

10.5 PREVIOUS INVESTIGATIONS

10.5.1 1991 Inventory Project Report

10.5.1.1 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 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 DoD. It is therefore eligible for the DERP."

10.5.2 1995 Archives Search Report

10.5.2.1 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 munitions debris (MD) on Flamenco Beach, Flamenco Peninsula.

10.5.3 1995 Interim Remedial Action

10.5.3.1 In 1995, MTA, Inc. (MTA) completed an interim remedial action on 3.66 acres of the Flamenco Beach Campground near Flamenco Beach to dispose of munitions and explosives of concern (MEC) within 2 feet of the ground surface at the campground (MTA, 1995). Work was

conducted on the site between 12 May and 26 May 1995. MTA found 11 MEC (UXO) items including 5" HE naval projectiles, 40mm tracer rounds, Bomb Dummy Unit (BDU)-33s, and various flares.

10.5.4 1997 Final Engineering Evaluation/Cost Analysis

10.5.4.1 The 1997 Engineering Evaluation/Cost Analysis (EE/CA) investigation included surface and subsurface sample grids on NWP, Isla Culebrita, Cayo Botella, Cayo del Agua, Cayo Lobo, and Cerro Balcon (Environmental Science and Engineering [ESE], 1997). MEC items were found in all areas except Cayo Lobo and Cerro Balcon, where only ordnance-related scrap was identified. Items found included 20mm high-explosive incendiary devices, Mk76 practice bombs, Mk50 5-inch projectiles, 37mm projectiles, 5-inch rockets, 76mm projectiles, 3- and 6-inch naval projectiles, 81mm mortars, and a grenade. The MEC items found in grids located specifically in the southern portion of NWP are listed in Table 10.1 and identified on Figure 10.2 (Appendix B).

10.5.5 2004 UXO Construction Support

10.5.5.1 The 2004 UXO Construction Support Report, Culebra Island Wildlife Refuge (Ellis Environmental Group [Ellis], 2004) documented clearance efforts conducted by Ellis on NWP. Ellis performed four phases of clearance from January 2001 to February 2004. Phase I consisted of construction support by clearing roadways, a wind generator foundation, a desalination plant foundation, and re-grading the site. Phase II of the construction support was not exercised because of 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.

10.5.5.2 During the UXO Construction Support project, Ellis excavated 6,121 holes and recovered 15,479 pounds of scrap metal and 249 MEC items. Fifteen (15) of the 249 MEC items were found within the boundary of the southern portion of NWP. Table 10.1 includes a list of the MEC items found during the UXO Construction Support project.

Table 10.1
MEC Items Found During Previous Investigations

Item[1]	Quantity	Reference	Location/ID
.50-caliber cartridge cases	1	ASR	Flamenco Peninsula
5-inch rocket	1	ASR	Flamenco Peninsula
11.75-inch tiny tim aerial rocket	1	ASR	Flamenco Beach
Candle, illumination, from 5"/ 38 naval projectile	1	1995 MTA TCRA	NWP Grid No. 1
Bomb, practice, 25 pound, MK 76/BDU-33	1	1995 MTA TCRA	NWP Grid No. 2
Projectile, 40mm, M81A1 TP-T	1	1995 MTA TCRA	NWP Grid No. 2
Projectile, 40mm, M81A1 TP-T	1	1995 MTA TCRA	NWP Grid No. 2
BLP, 3 inch, with tracer	1	1995 MTA TCRA	NWP Grid No. 2

Table 10.1 (Continued)
MEC Items Found During Previous Investigations

Item[1]	Quantity	Reference	Location/ID
Projectile, 3"/ 50 HE	1	1995 MTA TCRA	NWP Grid No. 2
Projectile, 40mm, M81A1 TP-T	1	1995 MTA TCRA	NWP Grid No. 2
Fuze, BD, from 5"/ 38 projectile	1	1995 MTA TCRA	NWP Grid No. 3
Fuze, BD, from 5"/ 38 projectile	1	1995 MTA TCRA	NWP Grid No. 4
Fuze, BD, from 5"/ 38 projectile	1	1995 MTA TCRA	NWP Grid No. 4
Projectile, 40mm, Bofors	1	1995 MTA TCRA	NWP Grid No. 4
Candle, illumination, from 5"/ 38 naval projectile	1	1995 MTA TCRA	NWP Grid No. 4
Naval gun fire, 3 inch	2	1997 EE/CA	NWP NP-3
Candle, illumination, 3 inch	3	1997 EE/CA	NWP NP-4
Naval gun fire, 5 inch	9	1997 EE/CA	Flamenco Beach FB-6, NWP NP-16, NP-17, NP-18, NP-20
Naval gun fire, 6 inch	1	1997 EE/CA	NWP NP-21
Projectile, 37mm HE	1	1997 EE/CA	Flamenco Beach FB-6
Warhead, rocket, 5-inch	1	1997 EE/CA	Flamenco Beach FB-6
Candle, illumination, 5-inch	11	1997 EE/CA	Flamenco Beach FB-6, NWP NP-4, NP-15, NP-19, NP-22
Grenade, w/o fuze	1	1997 EE/CA	NWP NP-17
Fuze, projectile base	1	1997 EE/CA	NWP NP-21
Various UXO	15	2001-2002 UXO Construction Support, Ellis	NWP
Candle, illumination, 5-inch	1	2002 Ellis Grid Log	2029724.479N 2529724.682E
Bomb, 100 pound	1	2002 Ellis Grid Log	2029921.471N 25279.397E
Bomb, 1,000 pound	1	2002 Ellis Grid Log	2029922.685N 252796.915E
Candle, illumination, 5-inch	1	2002 Ellis Grid Log	2029922.685N 252796.915E
Mortar, 81mm	1	2002 Ellis Grid Log	2029924.127N 252920.989E
MK 80 series bomb body	1	2007 SI Report - Recon	NWP
MK 76 practice bomb body	25+	2007 SI Report - Recon	NWP
Aircraft flare tray	2	2007 SI Report - Recon	NWP
MK 80 series bomb body	1	2007 SI Report - Recon	NWP
5" Projectile	1	2008-2009 USACE NTCRA	Flamenco Beach
5" HE Projectile	1	Congressional Study Fieldwork	ID No. 2
BDU-13	1	Congressional Study Fieldwork	3
2.75" Rocket WH	1	Congressional Study Fieldwork	5
20mm HE Projectile	1	Congressional Study Fieldwork	6
BDU-13	1	Congressional Study Fieldwork	7
5" HE Projectile	1	Congressional Study Fieldwork	8
2.75" Rocket WH	1	Congressional Study Fieldwork	9
5" MK41Projectile	1	Congressional Study Fieldwork	10

Table 10.1 (Continued)
MEC Items Found During Previous Investigations

Item[1]	Quantity	Reference	Location/ID
5"APHE Projectile	1	Congressional Study Fieldwork	11
75mm Projectile	1	Congressional Study Fieldwork	12
75mm Projectile	1	Congressional Study Fieldwork	13
5" HE Projectile	1	Congressional Study Fieldwork	14
Signal Flare	1	Congressional Study Fieldwork	16
100lbs GP Bomb	1	Congressional Study Fieldwork	17
5" MK39 Projectile	1	Congressional Study Fieldwork	19
Candle, illumination	1	Congressional Study Fieldwork	21
Candle, illumination	1	Congressional Study Fieldwork	22
3" APHE Projectile	1	Congressional Study Fieldwork	23
Candle, illumination	1	Congressional Study Fieldwork	24
5" APHE Projectile	1	Congressional Study Fieldwork	26
5" HE Projectile	1	Congressional Study Fieldwork	27
5" HE Projectile	1	Congressional Study Fieldwork	28
5" HE Projectile	1	Congressional Study Fieldwork	29
5" HE Projectile	1	Congressional Study Fieldwork	30
100lbs GP Bomb	1	Congressional Study Fieldwork	31
Candle, illumination	1	Congressional Study Fieldwork	32
5" HE Projectile	1	Congressional Study Fieldwork	33
5" HE Projectile	1	Congressional Study Fieldwork	34
Flare	1	Congressional Study Fieldwork	35
3" HE Projectile	1	Congressional Study Fieldwork	36
81mm White Phosphorous Mortar	1	Congressional Study Fieldwork	37
Partial 81mm White Phosphorous Mortar	1	Congressional Study Fieldwork	38

Table 10.1 (Continued)
MEC Items Found During Previous Investigations

Item[1]	Quantity	Reference	Location/ID
Partial 3" HE Projectile	1	Congressional Study Fieldwork	39
500 lb Bomb MPPEH	1	Congressional Study Fieldwork	40
Signal Flare	1	Congressional Study Fieldwork	41
Signal Flare	1	Congressional Study Fieldwork	42
Unknown - Young girl was reportedly burned from small 5"-6" long cylindrical item.	4	2013 - Reported by Local Authorities	NWP
Unknown - Tentatively Identified as High Velocity Aircraft Rocket Warhead	1	2014 - Reported by Local Authorities	NWP
(1) Projectile 3" and (3) unknown items	4	2015 - Reported by Local Authorities	NWP (Playa Blanca)

(1) Not all items listed in Table 10.1 are shown on Figure 10.2.

10.5.6 2004 Archives Search Report Supplement

10.5.6.1 The ASR Supplement was completed by the USACE Rock Island District as an addition to the 1995 ASR (USACE, 2004). No site visit was conducted in support of the ASR Supplement. This report provides detail of aerial training conducted by the Navy between 1935 and 1975 and identifies 20 range/sub-range areas. Figure 10.4 depicts Navy sub-range areas. The boundaries of the following sub-ranges encompass areas within the southern portion of NWP:

- Naval Gunfire Target Area: This range was a naval gunfire and air-to-ground range with its target located on NWP. Munitions included general small arms, .50-caliber small arms, Mk80s series general purpose bombs, M1 105mm HE, Mk21 8-inch armor piercing, 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, was used as a target for bombing and rocket fire. Munitions include Mk80s series general purpose bombs and 2.75-inch rockets.
- Air-to-Ground North: This target was located at the northern tip of NWP. 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 southern portion of NWP. 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.

10.5.7 2005 Revised Inventory Project Report

10.5.7.1 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 (RAC) scores. The southern portion of NWP and the portion of Flamenco Beach are contained within the boundaries of MRS 02 (Culebra Island and Cays), which was given a RAC score of 1.

10.5.8 2005 Supplemental Archives Search Report

10.5.8.1 The Supplemental ASR was completed by the USACE St. Louis District in 2005 as an addition to the 1995 and 2004 ASRs (USACE, 2005b). The Supplemental ASR provided historical information pertaining to site operations and identified the key areas of focus for the SI. This document provided a detailed summary of military activities conducted on Culebra Island and the surrounding cays. The document summarized planned and/or executed maneuvers and training conducted at the site, including specific time periods, locations, and munitions used.

10.5.9 2007 Site Inspection

10.5.9.1 A Site Inspection (SI) of Culebra Island and the surrounding cays was completed in 2007 (Parsons, 2007). The objective of the 2007 SI was to determine whether the MRSs delineated in the 2005 Revised INPR warranted further investigation under the MMRP. The southern portion of NWP and a portion of Flamenco Beach are contained within the boundaries of MRS 02. IAW Public Law 93-166, SI data were not collected from the NWP portion of MRS 02. However, due to the presence of MD and MEC previously found within the southern portion of NWP, the 2007 SI recommendation was to proceed to Remedial Investigation (RI)/Feasibility Study (FS) status for MRS 02.

10.5.10 2009 Non-Time Critical Removal Action, Flamenco Beach

10.5.10.1 In 2008-2009, a Non-TCRA Action on Flamenco Beach (USAE, 2009). USAE performed digital geophysical mapping of 12.3 acres and reacquired target anomalies. Findings included 6 MD items and one MEC (UXO) item (a 5” projectile) on Flamenco Beach.

10.5.11 2012 Congressional Study Report

10.5.11.1 The study was conducted between June 2011 and December 2011, pursuant to PL 111-383, SEC. 2815, “Former Naval Bombardment Area, Culebra Island, Puerto Rico” that requires the Secretary of Defense to conduct a study, at the request of the Commonwealth of Puerto Rico. The study included a geophysical/intrusive investigation (transects/grids) of the Study Area, or the southern portion of the NWP, as well as an munitions constituent (MC) investigation. During the geophysical investigation, the field team recovered 36 UXO items. UXO encountered included 5-inch HE naval projectiles, 2.75-inch rockets, 3-inch naval projectiles, 40mm projectiles, 75mm projectiles, 81mm mortars, 100-pound General Purpose (GP) bombs, a 500-pound GP bomb, and BDU-33 practice bombs. A list of UXO items recovered during the field work is included in Table 10.1. The study confirmed that there was potentially hazardous MEC presence within the southern portion of the NWP, and recommended further evaluation (DoD, 2012).

10.5.11.2 In addition to the geophysical investigation, over 100 soil, surface water, and sediment samples were collected within the Study Area. All samples were analyzed for MC, including

explosives and metals, and analytical results were compared to preliminary screening values to determine if there was evidence of an MC release (DoD, 2012).

10.5.11.3 MC detected in soil and evaluated in the risk assessment included metals (antimony, chromium, copper, lead and zinc) and explosives (2-amino-4,6-dinitrotolune, 4-amino-2,6-dinitrotoluene, 2,4,6-trinitrotoluene, and methyl-2,4,6-trinitrophenyl-nitramine [tetryl]). Copper in sediment, and copper, lead, and zinc in surface water were also evaluated in the risk assessment (DoD, 2012).

10.5.11.4 Copper and 2,4,6-trinitrotoluene were detected in soil above their human health preliminary screening values, and results indicated that they may pose an unacceptable human health risk in soil at the Study Area. However, the study determined that an unacceptable human health risk from MC would not be expected through exposure to surface water or sediment within the Study Area (DoD, 2012).

10.5.11.5 Five metals (antimony, chromium, copper, lead, zinc) and four explosives (2-amino-4,6-dinitrotolune, 4-amino-2,6-dinitrotoluene, 2,4,6-trinitrotoluene, and methyl-2,4,6-trinitrophenylnitramine [tetryl]) were present in soil above their preliminary ecological screening values. Additionally, one metal (copper) was detected in sediment and three metals (copper, lead, and zinc) were detected in surface water above their preliminary ecological screening values. The study indicated that exposure to these compounds in soil, sediment, and surface water may pose an unacceptable risk to ecological receptors within the Study Area (DoD, 2012).

10.5.12 2016 TCRA Action Memorandum

10.5.12.1 In May 2016, CESAJ completed a TCRA Action Memorandum for Specific Congressionally Authorized Areas within the NWP. The specific areas covered within the Action Memorandum were portions of Carlos Rosario Beach, Flamenco Beach, Tamarindo Beach, the Flamenco Campground, and Carlos Rosario Trail. The Action Memorandum selected response actions to be performed under the TCRA including surface and subsurface removal of MEC by conducting identification (visual and geophysics), confirmation, surface and subsurface removal, and disposal of recovered munitions. The primary objective of the TCRA is to mitigate and minimize the threat posed by the potential proximity of munitions to recreational users of the beach and campground, whose activities may present exposure to and potentially trigger an unintentional detonation of an item.

10.6 CONCEPTUAL SITE MODEL

10.6.1 The CSM for the NWP is summarized in Table 10.2. This table describes the known or suspected contamination sources, potential/suspected location and distribution of contamination, contamination source or exposure medium, current and future receptors, and potentially complete exposure pathways. The CSM is a “living document” based on existing knowledge that will be updated as more information becomes available.

Table 10.2
Preliminary Conceptual Site Model, NWP Culebra

Site Details	Known or Suspected Contamination Source(s)	Potential/Suspected Location and Distribution[1]	Source or Exposure Medium	Current and Future Receptors	Potentially Complete Exposure Pathway
NAME: Specific Areas, NWP, Culebra Island **Acreage**: 31.83-acre clearance area within 408-acre area of interest **Suspected Past DoD Activities (*release mechanisms*)**: Aerial bombing, maneuvers, naval gun and artillery firing, and amphibious training **Current and Future Land Use**: Wildlife conservation and recreation	MEC and MD from the following munitions types have been recovered on site: General small arms .50-cal small arms Mk80 general purpose bombs M1 105mm HE Mk21 8-in AP Mk5 16-in AP 2.75-in rockets 5-in rockets 11.75-in Tiny Tim Rocket Mk82 500-lb bombs M43 81mm mortar 3-in to 16-in projectiles 20mm projectiles 75mm projectiles 76mm projectiles Pyrotechnic Rounds 81mm White Phosphorous Mortar Various HE, incendiary, and practice bombs MC from MEC and MD on site.	Flamenco Beach (4.3 acres): anomaly densities ranging from 786-1,040 anomalies per acre.	Surface or subsurface soil	Current and Future: Site workers, recreational users, trespassers, and ecological receptors.	Exposure of human receptors to surface and/or subsurface MEC
		Flamenco Campground (17.06 acres): 786-1,040 anomalies per acre.	Surface or subsurface soil, sediment, and surface water		Exposure of human and ecological receptors to MC within soil, sediment, and surface water at concentrations above relevant screening criteria
		Carlos Rosario Trail (3.67 acres): 0-785 anomalies per acre			
		Carlos Rosario Beach (5 acres): 0-785 anomalies per acre.			
		Tamarindo Beach (1.8 acres): 0-785 anomalies per acre.			

[1] Anomaly densities are based on the 2012 Congressional Study Report.

WORKSHEET #11A
MEC DATA QUALITY OBJECTIVES

This worksheet describes the MEC DQOs developed for the project, including the environmental problem, the related decisions that need to be made, the type and quantity of data, and level of data quality needed to ensure that those decisions are based on sound scientific data. The following DQO elements are based on the EPA's seven-step DQO process defined in EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*, EPA/240/B-06/001, February 2006, and the USACE *Technical Project Planning Process (TPP)*, Engineer Manual (EM) 200-1-2, February 29, 2016.

1. State the problem.	Previous investigations (listed in WS #10) have indicated that MEC in the form of UXO (Table 10.1) may be present on the NWP, resulting from its use between 1935 and 1975 for aerial bombing, maneuvers, naval gun and artillery firing and amphibious training using live-fire and practice munitions. As shown in the CSM, these materials present an unacceptable risk from explosive hazards to ACDEC, DNER, and FWS personnel and recreational users.
2. Identify the goal of the study.	Identify the principal study goal: The goal of the TCRA is to identify and dispose of MEC within specific areas of the NWP. Identify alternative outcomes: AC will be conducted to the maximum extent practicable, in areas designated for DGM. In DGM areas where AC is conducted, a subsurface anomaly will be classified as a target of interest (TOI) and removed, or will be classified it as non-TOI and left in place. In DGM areas not conducive to AC, subsurface anomalies meeting agreed upon threshold values will be intrusively investigated. In areas where analog methods are used for survey, all subsurface anomalies will be investigated and MEC/material potentially presenting an explosive hazard (MPPEH)/MD will be removed. State how the data will be used in solving the problem: Advanced geophysical classification will be used to 1) detect anomalies resulting from discarded military munitions (DMM), UXO, and other metallic debris and 2) classify anomalies so that informed decisions can be made as to whether the anomaly is a TOI and should be removed, or is a non-TOI and may be left in place. Geophysical data collected using electromagnetic induction (EMI) sensors in a dynamic mode will be used to initially detect and document the locations of subsurface anomalies. Geophysical data collected using advanced EMI sensors in a cued (static) mode will then be used to classify each anomaly as follows: 1) highly likely to be TOI; 2) highly unlikely to be TOI; or 3) Inconclusive. Detected items classified as "TOI" and "inconclusive" will be targeted for removal. Items classified as non-TOI will be left in place. Analog survey data will be used to detect anomalies resulting from DMM, UXO, and other metallic debris. For analog survey areas, all subsurface anomalies will be investigated and MEC/MPPEH/MD will be removed. The results of geophysical detection and classification and analog surveys, and the subsequent intrusive investigation must meet established DQOs to allow the anticipated land reuse to take place after the removal of TOI or anomalies.
3. Identify information inputs.	The primary data required to guide or support choices during the DQO process are: (1) Up-to-date CSM summarizing site conditions based on previous studies (e.g., INPR, ASR, Supplemental ASR) including: a. Removal action MEC objectives (WS #11A.2) b. Site history and uses (WS #10.3 and 10.4) c. Removal action boundaries (WS #10.2) d. Types and quantities of MEC known or suspected to be present (WS #10.5) e. Expected distribution of MEC present

	f. MEC incident reports (if any) g. Topography, geology, vegetation (WS #10.2) h. Land use considerations (WS #10.4) i. Reasonably anticipated future uses (WS #10.4) j. Current and future receptors (WS #10.4) k. Exposure pathways (WS #10.6) l. Access restrictions or other obstacles to investigation (WS #10.2) m. Endangered species, sensitive habitats, and historic or cultural resources that could be affected by traffic or other disturbances occurring during the investigation or subsequent removal action (WS #10.2) n. Assumptions, data gaps, and sources of uncertainty (WS #10.6) (2) Surface clearance results, including: a. Surface clearance results (database) b. Photos (photo log) c. Disposal records d. Updated CSM (3) Detection survey results, including: a. Areas covered (Standard Operating Procedure [SOP] DGM-04 and/or AC-04 and/or SOP 505.10.01) b. System QC test results (SOP DGM-01 and/or AC-02 and/or SOP 506.10.01) c. Instrument Verification Strip (IVS) results (IVS Technical Memorandum) d. Surveyed validation seed and QC seed locations (QC and QA Production Area Seed Reports) e. Data collection point responses and locations (SOP DGM-04 and/or AC-04 and/or SOP 505.10.01) f. Data analysis results, including i. Anomaly locations (cued target list) ii. Unique anomaly identification numbers (cued target list) iii. Z-component amplitude and/or dipole response for each anomaly (cued target list) iv. Detection survey data validation report v. Detection survey data usability evaluation (4) Cued survey results, including: a. System QC results (project QC database) b. IVS results (project QC database) c. Background data (advanced classification [AC] data files) d. Surveyed validation seed and QC seed locations and types (QC and QA seed tracking logs) e. Unique anomaly identification numbers and locations (cued target list) f. Site-specific munitions library (geophysical data deliverable) g. Definition of items representing unacceptable explosive hazard h. Classification of anomalies with confidence metric (ranked dig list) i. Cued survey data validation report j. Cued survey data usability evaluation (5) Intrusive investigation results, including a. Excavation results (database) b. Photos (photo log) c. Disposal records d. Stop-dig threshold verification (Verification and Validation Report) e. Comparison of excavated “validation digs” to predictions (Verification and Validation Report) f. Final data usability evaluation g. Updated CSM

4. Define the boundaries of the study.	Target Population: The target population for this study includes the following MEC confirmed or suspected to exist in the study area provided in Table 11A.1. Characteristics of interest: The characteristics of interest are those characteristics (e.g., size, symmetry, aspect ratio, object density, and wall thickness) that will allow classifiers to determine whether an anomaly is a likely TOI or non-TOI. Spatial and temporal boundaries and scale: This study is designed to detect and correctly classify all TOI exceeding the detection threshold and meeting measurement criteria within the established spatial boundaries. Based on the performance work statement (PWS) performance standard of finding all MEC 37mm diameter or greater down to a depth of 8 times the item's diameter, the detection threshold for the project will be evaluated for a horizontal 37mm projectile at 12 inches bgs since that is the most difficult of all munitions items expected at the site to detect. While 20mm projectiles are smaller, they are expected to be located at much shallower depths and produce higher responses than a 37mm projectile at 12 inches bgs. The detection threshold for the project will be specified in the Target Selection Technical Memorandum. The horizontal boundaries of the project are defined by the clearance areas shown on Figure 10.3 (Appendix B). The vertical boundary for each munition is the munition-specific maximum depth of detection based on the detection threshold discussed above. Vertical boundaries for each munition are shown on Table 11A.1. There are no established temporal boundaries for this project. The scale of the DGM surveys are 100 ft by 100 ft grids and smaller for trail areas with 100% DGM coverage at 0.6 m line spacing that would meet the objective of not missing an anomaly that could indicate a TOI (a horizontal 37mm projectile at 12 inches bgs).
5. Develop the analytic approach.	The project approach involves using the results from dynamic geophysical surveys and cued data acquisition to detect and classify geophysical anomalies as "TOI" (i.e., highly likely to be a munition) and "non-TOI" (i.e., highly unlikely to be a munition). Anomalies that cannot be classified as either likely TOI or likely non-TOI will be classified as "inconclusive." Anomalies on the list will be ranked in order of greatest likelihood to be a TOI to greatest likelihood to be a non-TOI, based on their confidence metrics. All anomalies classified as either "TOI" or "inconclusive" will be designated for intrusive investigation and subsequent removal if the item is found to be MEC. Areas of the removal footprint inaccessible to dynamic geophysical surveys or high anomaly density areas will be addressed using analog instruments and intrusive investigation (i.e., "mag and dig"). "High anomaly density areas" are those areas where the elevated anomaly density makes cued data acquisition impractical or impossible based on a quantitative analysis of the detection data and cued analysis capabilities. The project approach involves three primary components: Dynamic Surveys, Cued Data Acquisition, and Analog Removal. The decision rules for these components are listed below. (1) Decision Rules for Dynamic Surveys: • If a detected anomaly exceeds the selection threshold (details on WS #17A), then it will be identified for intrusive investigation (Carlos Rosario and Tamarindo Beaches) or evaluation using Cued Data Acquisition (Flamenco Beach and open areas of Flamenco Campground). (2) Decision Rules for Cued Data Acquisition and Intrusive Investigation: • If any of the following four criteria are met, the anomaly will be selected as a TOI: 1. The polarizability matches (within specifications established on Worksheet #22) that of an item in the project-specific TOI library, 2. Estimates of the size, shape, symmetry, and wall thickness calculated from the polarizability indicate the item is a long, cylindrical, and thick-walled, or 3. There is a group of anomalies having similar polarizabilities that, after investigation, are discovered to be TOI.

	4. Anomalies with poor inversion fit coherence that, after considering all available information, cannot be ruled as non-TOI will be considered "inconclusive" and added to the dig list. • If an anomaly is classified as a TOI (i.e., highly likely to be a munition) based on a high decision statistic indicating a good match to a TOI in the classification library (details on WS #17A), then it will be labeled as a dig target on the ranked dig list and it will be intrusively investigated. • If an anomaly is classified as inconclusive based on low fit confidence or other criteria indicating unreliable inversion results (details on WS #17A), then it will be labeled as a dig target on the ranked dig list and it will be intrusively investigated. • All intrusive results will be reviewed with regard to classification decisions by an AC data analyst. If intrusive results do not agree with the source(s) predicted by the AC data, the dig team will be sent back to confirm that no additional sources remain in the predicted location. • If an anomaly is classified as a non-TOI (i.e., highly unlikely to be a munition) based on low decision statistic indicating poor matches to all TOI in the classification library (details on WS #17A), then it will be identified as a non-dig target on the ranked dig list and it will not be intrusively investigated. • If the intrusive investigation locates MEC, then the item(s) will be removed and disposed of by demolition (details on WS #17A). • If a dynamic detection data indicate a portion of the site has more sources than cued classification techniques can reliably estimate polarizabilities (details on WS #17A), then the anomaly density will be reduced using analog methods. (3) Decision Rules for Analog Removal: • If a subsurface anomaly is detected using the analog detection instrument, then it will be intrusively investigated (details on WS #17A). • If the intrusive investigation locates MEC, MD, or other debris, then the item(s) will be removed and disposed of as detailed on WS #17A.
6. Specify performance or acceptance criteria.	Measured performance criteria (MPCs) are the criteria that collected data must meet to satisfy the DQOs. Project-specific MPCs are presented in WS #12A. Geophysical and intrusive investigations shall achieve applicable MPCs as confirmed/modified by the IVS Report. Failure to achieve the MPCs may have an impact on end uses of the data, which will be discussed in the Data Usability Assessment (DUA) Report WS #37A.
7. Develop the plan for obtaining data.	Steps 1 through 6 of the DQO process were used to develop the overall project design. The design is broken down into a series of specific elements, termed DFW. WS #17A includes more detailed descriptions of each DFW. For dynamic detection surveys, cued classification, and intrusive investigation, the site will be broken into multiple survey units: Flamenco Beach (4.3 acres) and Flamenco Campground Open Area (9.06 acres) and Carlos Rosario Beach (1.61 acres) and Tamarindo Beach (0.67 acres) to be surveyed by DGM; Flamenco Campground Vegetated Area (8 acres), Carlos Rosario Trail (3.67 acres), Carlos Rosario Vegetated Area (3.39 acres), and Tamarindo Vegetated Area (1.13 acres) for analog survey and removal. The area that will require Analog Removal will be determined after the dynamic detection data has been evaluated. It will be divided into approximately 1-acre survey units at that time. A survey unit is a portion of the site for which survey data, including QC results and results for blind QC seeds and validation seeds, will be collected and reported as a unit, for evaluation by the project team.

Table 11A.1
Target Munitions (Confirmed and Suspected)

Munition (including nomenclature if known)	MEC Type (UXO, DMM, or both)	Expected Depth of Penetration (inches) [1]
20mm projectile HE	N/A	Near surface
37mm projectile HE	UXO	12
2.75-inch rocket warhead	UXO	22
BDU-33	UXO	31
5-inch projectile[2]	UXO	40
5-inch rocket warhead	UXO	40
Flare	UXO	Near surface

[1] Expected detection depths are stated as 8 times the item's diameter, as per the PWS. Both the 20mm projectiles and flares are expected to be found near the surface.
[2] Total of 7 found: 3 HE; 1 MK39; 1 MK41; 1 Illumination Candle; and 1 Naval gun fire.

WORKSHEET #11B
MC DATA QUALITY OBJECTIVES

This worksheet describes the MC DQOs developed for the project, including the environmental problem, the related decisions that need to be made, the type and quantity of data, and level of data quality needed to ensure that those decisions are based on sound scientific data. The following DQO elements are based on the EPA's seven-step DQO process.

1. State the problem.	The potential presence of MEC within specific areas of the NWP, is a safety hazard. MC contamination may result from on-site detonation of MEC items during the TCRA. It is not known whether the condition presents an unacceptable risk that will require remedial response.
2. Identify the goal of the study.	The goal of the TCRA is to identify and dispose of MEC within specific areas of the NWP. If MEC/MPPEH is identified during the investigation that requires disposal, soil adjacent to the demolition location will be sampled to evaluate potential MC impact to soil.
3. Identify information inputs.	Informational inputs for MC are analytical results from post-demolition sampling and EPA Residential Screening Levels (RSLs). The analytical results will be the average concentration at each location for a 6.3 cubic foot volume sample (a 2 ft radius CRREL 7-pt wheel sample, with a depth 0 to 6 inches). RSLs are risk-based screening levels applicable to evaluate exposure to an average concentration over a volume of soil reasonably anticipated in a residential scenario (typically one quarter to one half acre in area).
4. Define the boundaries of the study.	The boundary of the MC sampling is the proposed clearance areas within portions of Carlos Rosario Beach, Flamenco Beach, Tamarindo Beach, the Flamenco Campground, and the Carlos Rosario Trail as shown in Figure 10.3 (Appendix B). The vertical boundary of MC sampling will be 0 to 6 inches. The scale of decision making (the smallest unit for which a decision will be made) is approximately 6.3 cubic feet.
5. Develop the analytic approach.	The analytic approach involves collecting a composite soil sample using the CRREL 7-point wheel method at post-detonation locations. The decision rules are as follows: (1) If no MEC is detonated, no MC sampling will be conducted. (2) An MC soil sample will be collected at post-detonation locations and analyzed for explosives (see WS #15 for list of explosives). Samples will be collected from a depth interval of 0 to 6 inches in areas where sufficient media is present. If only rocks or bedrock are present, no samples will be collected. (3) If an MC analyte is undetected or is detected at concentrations less than 100 times the screening levels, then it will be assumed that there is no immediate risk due to MC contamination, and there will be no further action taken as part of the TCRA. (4) If an MC analyte is detected at concentrations equal to or greater than 100 times the screening levels, the analyte will be referred to the USACE for coordination with the project Stakeholders to determine if follow-on action as part of the TCRA is required. The intent of the TCRA is to address the immediate threat of MEC related hazards, if follow on actions are recommended, the USACE will address them under the CERCLA process.
6. Specify performance or acceptance criteria.	Soil sample data for explosives (Method 8330B) will be required to be of definitive quality, and MC investigation data collected during the TCRA will be performed and accepted IAW the procedures specified in the DoD QSM.
7. Develop the plan for obtaining data.	WS #17B includes the detailed plan for obtaining MC sample data.

WORKSHEET #12A
METHOD MEASUREMENT PERFORMANCE FOR MEC-RELATED TASKS

Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
QC Seeding (Analog)	Representativeness	UXOQCS or designee places small and large industry standard objects (ISOs) as blind seeds and coverage seeds in analog removal area(s) IAW Table 22A.1.	Review of Production Area QC Seeding Report
QC Seeding (DGM)	Representativeness	Blind QC seeds will be placed at the site by the contractor. Blind QC seeds must be detectable as defined by the DQOs (11A.4) and located throughout the horizontal and vertical survey boundaries defined in the DQOs (11A.4). Seed items will consist of small schedule 80 ISOs; medium schedule 40 ISOs; and inert 37mm projectiles and 2.75-in Rocket warheads, as available. Blind QC seeds will be distributed such that the field team can be expected to encounter between one and three per team per day.	Review of Production Area QC Seeding Report
Site Preparation	Completeness/Accuracy	Staking grid corners and removal area boundaries Performing surface clearance for MEC/MPPEH: Remove surface metal as necessary to reduce the interference with the geophysical survey. Performing vegetation removal.	Review of QC reports.
Analog Removal	Sensitivity	Ability to detect a horizontal 37mm projectile at a depth of 12 inches bgs	Function tests at an instrument test strip will be used to validate the proper operation of handheld detectors by personnel on a daily basis
Analog Removal	Completeness/Accuracy/ Comparability	100% of blind seeds must be recovered	Review of seed recovery results
Detection Survey (DGM)	Completeness	100% of the site is surveyed	Verification of conformance to measurement quality objectives (MQOs) for in-line spacing and cross-line spacing (see Worksheet #22A)
Detection survey (DGM)	Sensitivity	The EM61-MK2 detection threshold will be set to detect a horizontal 37mm projectile at a depth of 12 inches bgs or 5X the local average background noise, whichever is higher.	Initial and ongoing function tests and IVS surveys Validation/QC seed detection Analysis of background variability across the site

WORKSHEET #12A (CONTINUED)
METHOD MEASUREMENT PERFORMANCE FOR MEC-RELATED TASKS

Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
Detection survey (DGM)	Accuracy/Completeness	100% of validation seeds must be detected	Review of validation seed detection results per 100 ft by 100 ft grid
Detection survey (DGM)	Completeness/ Comparability	Complete project-specific databases and target lists delivered.	Data verification/data validation
Reacquisition	Completeness/ Comparability	If the reacquired anomaly cannot be located within a 1-meter radius of the location provided on dig sheets, the locations will be rechecked by the QC Geophysicist and a CA may be determined.	The reacquisition team will use RTK GPS to flag the location of the reacquired anomaly within a 1-meter radius of the location provided on dig sheets.
Classification survey	Completeness/ Comparability	Library must include signatures for all munitions known or suspected to be present at the site, as listed in the CSM (Table 10.2)	Verification of site-specific library
Classification survey	Representativeness/ Accuracy	Background data will be collected at least once every two hours of cued survey data collection. Background locations will be selected such that background data will be representative of the various subsurface conditions expected to be encountered within each grid at the site	Data verification/data validation
Classification survey	Completeness	All detected anomalies classified as: 1. TOI 2. Non-TOI 3. Inconclusive	Data verification
Classification survey	Accuracy/ Comparability	Cued survey must correctly classify 100% of validation seeds	Review of validation seed classification results
Classification survey	Completeness/ Comparability	Background data, cued target data, munitions libraries, modeling results and any other supporting documentation used to make classification decisions are delivered	Data verification Data validation
Classification survey	Accuracy/Completeness	100% of predicted non-TOI that are intrusively investigated are confirmed to be non-TOI	Visual Inspection of recovered items
Intrusive Investigation (AC)	Accuracy	100% of recovered object sizes qualitatively match predicted size	Visual inspection of recovered items for items classified as TOI

WORKSHEET #12A (CONTINUED)
METHOD MEASUREMENT PERFORMANCE FOR MEC-RELATED TASKS

Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
Classification analysis / Intrusive Investigation	Accuracy	Inversion results correctly predict one or more physical properties (e.g. size, symmetry, or wall thickness) of the recovered non-TOI items	Visual inspection and qualitative evaluation of recovered items from the validation digs (see Worksheet #22)
Intrusive Investigation	Completeness/ Comparability	Complete Microsoft Access intrusive results database delivered including records reconciling inversion results to the physical properties of the recovered items	Data verification Data validation
MEC/MPPEH Handling	Accuracy	Should MPPEH be encountered, only UXO-qualified personnel (UXO Technician II or higher) will perform identification of the item and ascertain its condition. The SUXOS and UXOSO must be in agreement on the nature and condition of a MEC item before any action is taken.	Joint SUXOS and UXOSO determination that a MEC item is acceptable to move. After determining an item is acceptable to move, the SUXOS and UXOSO will determine the most expeditious route for safe movement of the MEC item to the disposal point. UXOQCS verifies that MDAS is properly documented in a DoD Form 1348-1A.

WORKSHEET #12B
METHOD MEASUREMENT PERFORMANCE CRITERIA TABLES

12.0 MEASUREMENT PERFORMANCE CRITERIA

12.0.1 The overall QC objective for this project is to develop and implement procedures for sample collection, laboratory analysis, field measurement, and data reporting that will provide data of a degree of quality consistent with its intended use as described in the DQO process (Worksheet #11A). Worksheet #12 and the associated tables present the performance criteria for the analytical measurements performed in support of this project.

12.1 DATA QUALITY INDICATORS

12.1.1 Measurement performance criteria usually are expressed in terms of the data quality indicators (DQIs) precision, accuracy, representativeness, completeness, comparability, and sensitivity, which are known collectively as PARCCS. Of the PARCCS, parameters, precision, accuracy, completeness, and sensitivity can be quantitatively measured and assessed. The parameters of comparability and representativeness are primarily qualitative in nature.

12.1.1 Quantitative Data Quality Indicators

12.1.1.1 Quantitative DQIs can be measured and assessed by performing QC checks and evaluating the results against numerical acceptance criteria. Where available, the method- and matrix-specific measurement performance criteria presented in the QSM will be used by the off-site laboratories to control quantitative DQIs. Where the QSM does not list QC criteria, the control limits for routine analyses generated by the project laboratory will be used. These QC limits will be sufficient to ensure that the analytical methods are performed under acceptable conditions and that results can be used as reported for the intended purposes, as described in Worksheet #37.

12.1.2 Qualitative Data Quality Indicators

12.1.2.1 The DQIs of representativeness and comparability have only a limited ability to be evaluated using QC analysis results. These DQIs are primarily controlled by project planning and execution. Performance requirements for these DQIs will be addressed based on the existing site data and conditions.

12.1.2.1 <u>Representativeness</u>

12.1.2.1.1 Representativeness is the degree to which data accurately and precisely expresses a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Although representativeness is a qualitative measurement, it is evaluated through a multi-step process beginning with evaluation of precision and accuracy data. Project design (see Worksheets #14 and #16) is one of the critical inputs that determine if the data collected is representative of the population sampled.

12.1.2.1.2 Representativeness of individual samples will be controlled by sample collection and handling IAW the requirements of Worksheets #14 and #16 and the HGL SOPs (identified in

Worksheet #21 and provided in Appendix I of the Work Plan). The sample containers and preservation methods presented in Worksheets #19 and #30 will be used to ensure that samples arriving at the laboratory retain the appropriate degree of representativeness. The holding times presented in Worksheets #19 and #30 have been established to ensure that samples retain representativeness at the time of extraction and analysis.

12.1.2.1.3 Representativeness will also be assessed using field and laboratory blank samples. A method blank (MB) will be analyzed with every analytical or preparation batch (as appropriate to the analytical method) to determine potential contamination introduced during routine laboratory procedures. Initial calibration blanks (ICBs) and continuing calibration blanks (CCBs) will be analyzed as required by analytical methods. Field blanks such as trip blanks (TBs) and equipment blanks (EBs) are used to assess potential contamination due to field and transport conditions. The assessment of blank samples will determine if compounds detected in the environmental samples are site-related or have been introduced through shipping, storage, field procedures, or laboratory procedures.

12.1.2.2 Comparability

12.1.2.2.1 Comparability expresses the confidence with which one data set can be compared to another. Comparability also involves a multi-step evaluation and can be related to accuracy and precision as these quantities are measures of data reliability. Data is comparable if site considerations, collection techniques, and measurement procedures, methods, and sensitivity limits are equivalent for the samples within a sample set.

12.2 DATA QUALITY CATEGORIES

There are two general categories of data that will be generated for use in project decision making: (1) screening data and (2) definitive data. The data validation requirements for each matrix and analytical parameter and matrix are specific to each project data source and end use. These requirements are summarized in Worksheet #11 of each site-specific QAPP. The full process is described in the format presented in Worksheet #36. The screening and definitive data validation protocols for this project are presented in Appendix Q. The data usability evaluation procedures are presented in Worksheet #37.

12.2.1 Screening Data

Screening data is generated by rapid methods of analysis with less rigorous sample preparation, calibration, or QC requirements than are necessary to produce definitive data. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent instead of elaborate extraction/digestion and cleanup. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Screening data may be considered of unknown quality without corresponding definitive confirmation data. Several screening methods identified for use in this project have no corresponding definitive method and results from these methods will not require confirmation.

Some methods that routinely produce definitive data can also produce screening level data if the data validation process is not performed or is reduced. This does not necessarily indicate a lower

level of data quality; it is an indication of the usability of the affected results. This reduced level of data validation will depend on the end use of the data and this determination will be made on a site-specific basis. The analytical methods that will only be required to produce screening level data and the associated sample matrices are indicated in Worksheets #11, Worksheet #23, and Worksheet #36. The data QC elements that correspond to a screening level of data review are identified in the method-specific Worksheet #12 tables. Data that are of screening level quality will receive no validation or validation that includes only these screening level elements up through those that correspond to Stage 2A data review as defined by *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009).

12.2.2 Definitive Data

Definitive data is generated using rigorous analytical methods, such as approved EPA reference methods. The data can be generated in a mobile or fixed-base laboratory. Definitive data is analyte-specific, and both identification and quantitation are confirmed for each analyte. Definitive analytical methods have standardized QC and documentation requirements and produce data for which analytical error (bias) can be determined. For data to be classified as definitive, the data must be validated after the results are reported in order to verify that the appropriate QC measures were taken and were in control. Also, the sample must be collected in a manner that is representative of current site conditions, as described in the field SOPs (Worksheet #21 and Appendix I). Definitive data is not restricted in its use unless quality problems identified in the validation process require data qualification. The analytical methods that will be required to produce definitive level data are indicated in Worksheet #11, Worksheet #23, and Worksheet #36. The data QC elements that are required to complete a definitive level of data review are identified in the method-specific Worksheet #12 tables. The minimum for definitive data is validation that includes both the screening level elements (up through Stage 2A) and definitive level elements included in Stage 2B. For this project, definitive data validation will also include Stage 3 and Stage 4 review elements and the final data validation level will correspond to a Stage 4 data review as defined by *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009). Stage 4 data validation corresponds with the former EPA designation of Level IV.

12.3 MEASUREMENT PERFORMANCE CRITERIA TABLES

12.3.1 The data quality elements presented in the Worksheet #12 tables are divided into two broad categories: screening level elements and definitive level elements. Each data quality element is associated with one or more of the DQIs discussed in Section 12.1. In addition to the PARCCS parameters, some methods also include analyte identification as a DQI. Analyte identification is an essential performance component of those methods and is included even though is not a PARCCS parameter.

12.3.2 The analytical acceptance criteria presented in the Worksheet #12 tables are linked to the data validation protocols presented in Attachment A. Each project laboratory is required to ensure compliance with method and SOP requirements regardless of the level of data validation that will be performed on the resulting data. If a QC element does not meet control criteria, the appropriate qualifier, as defined in Attachment A, will be applied to all associated results. The

overall impact of QC discrepancies, including data gaps resulting from rejected data points, will be assessed IAW Worksheet #37.

12.3.3 The analytical methods presented in the Worksheet #12 tables are from the EPA's SW-846 methods compendium (EPA, 2015). The DQIs presented in these tables are from the analytical methods as modified by the requirements presented in QSM version 5.0.

12.3.1 Blank Evaluation

12.3.1.1 It should be noted that the Worksheet #12 tables present acceptance criteria for reporting data associated with low levels of blank contamination. It is acceptable for the laboratory to report analytical data with low levels of blank contamination meeting the Worksheet #12 acceptance criteria. However, during the data validation process, *all* detected values in blanks will be used to evaluate the associated sample data, *regardless of whether the reported blank results meet the acceptance criteria presented in Worksheet #12*. This is the one of the few cases where QC data that meets *reporting* acceptance requirements may still result in qualification of the associated data.

12.3.2 SOP Reference Structure

12.3.2.1 To simplify internal referencing, HGL uses a numbering system to designate sampling, extraction, and analytical method SOPs. Field sampling SOPs are designated using the HGL SOP reference numbers; the corresponding SOPs are identified in Worksheet #21 and are presented in Appendix I of the Work Plan. Laboratory SOPs are designated "L-[number]" for analytical methods and "P-[number]" for sample preparation methods. The laboratory SOPs that correspond to these SOP references are identified in Worksheet #23. All laboratory SOPs identified in Worksheet #23 are included in Attachment J to this QAPP.

WORKSHEET #12B.1
MEASUREMENT PERFORMANCE CRITERIA TABLE – EXPLOSIVES BY SW-846 METHOD 8330B

Analytical Group	HPLC
Analytical Method/SOP[1]	L-1
Matrix	Soil
Sampling Procedure[2]	ENV-01.03

DQI	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	Frequency of QC Check	QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)
Screening Level Data Quality Elements (EPA Stage 2A)				
Accuracy/Bias	Analyte-specific (see Worksheet #15.1)	Laboratory control sample (LCS) recoveries	1 per preparation batch (maximum of 20 samples)	A
		Matrix spike/matrix spike duplicate (MS/MSD) recoveries	1 per 20 field samples (selected by field team)	S&A
	Method-specific (see Worksheet #15.1)	Surrogate spikes	Every sample, blank, and standard	A
Precision	Relative percent difference (RPD) ≤20%	MS/MSD RPD	1 per 20 field samples (selected by field team)	S&A
		LCS/laboratory control sample duplicate (LCSD[3]) RPD	1 per preparation batch (maximum of 20 samples)	A
	RPD ≤50%	Field duplicate analyses[4]	1 per 10 field samples (selected by field team)	S&A
Accuracy/Bias and Representativeness	No analytes detected >½ limit of quantitation (LOQ) or >1/10 the amount measured in any sample or 1/10 the PAL (whichever is greater)	MB	1 per preparation batch (maximum of 20 samples)	A
Sensitivity	DL for each analyte < limit of detection (LOD)	DL study	Preliminary determination, confirmed quarterly	A
	LOQ for each analyte below associated regulatory limits, preferably by a factor of ≥3	LOQ study	Preliminary determination, confirmed quarterly	A

WORKSHEET #12B.1 (CONTINUED)
MEASUREMENT PERFORMANCE CRITERIA TABLE – EXPLOSIVES BY SW-846 METHOD 8330B

Analytical Group	HPLC
Analytical Method/SOP[1]	L-1
Matrix	Soil
Sampling Procedure[2]	ENV-01.03

DQI	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	Frequency of QC Check	QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)
Sensitivity (continued)	LOD ≤ LOQ for each analyte	LOD study and LOQ study	Preliminary determination, confirmed quarterly	A
Completeness	≥95%	Data completeness check	After sampling and analysis complete	S&A
Definitive Level Data Quality Elements (EPA Stages 2B, 3, and 4)				
Accuracy/Precision	For each analyte, %RSD ≤15% for mean RF or r^2 ≥0.99 for curve	Five-point calibration for all analytes (minimum of six points required if using r^2 to evaluate)	Prior to sample analysis and recalibration as required	A
Accuracy/Precision	%D ≤20% for each analyte	Second source calibration verification	1 per initial calibration	A
Accuracy/Precision	%D ≤20% for each analyte	Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence	A
Sensitivity	LOQ for each analyte	At or above low concentration of calibration curve	Each initial calibration	A
Analyte Identification	Position shall be set using the midpoint standard of the calibration curve; on days when initial calibration is not performed, the initial CCV is used	Retention time window position establishment for each analyte and surrogate	Once per initial calibration and at the beginning of the analytical shift	A
	Results between primary and second column RPD ≤40%	Confirmation column	All positive results must be confirmed	A

[1] Reference number from QAPP Worksheet #23.
[2] Reference number from QAPP Worksheet #21.
[3] LCSDs are not a method requirement; however, if this information is provided, it will be evaluated.
[4] For low-level results (detected value ≤5x LOQ) or when one result is a nondetection, the control limit is absolute difference ≤LOQ. Nondetected values will be assigned the nominal value of the LOD for making this comparison.

WORKSHEET #13
SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
2012 MEC/MD and soil data	2012 Congressional Study Report	Data will be used to update the CSM.	Geophysical and intrusive investigation data was collected over 6.5 acres. Extensive surface/subsurface soil, sediment and surface water sampling was conducted. Copper and lead were identified as chemicals of potential concern (COPC) in the surface water. Copper was identified as a COPC in the sediment. The study concluded that human and ecological receptors may come into contact with COPCs in the soil via dermal contact or incidental ingestion, but human receptors are not anticipated to be performing intrusive activities at the site, so the subsurface soil exposure pathways were indicated as incomplete. The study also concluded that ecological receptors are not expected to be in contact with the subsurface soil, so the subsurface soil exposure pathways are incomplete for ecological receptors.	None

WORKSHEET #13 (CONTINUED)
SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
2007 MEC/MD and soil data, Physical profile (geology, soil, surface water, hydrogeology)	*Site Inspection Report, Northwest Peninsula of Culebra Island, Puerto Rico* (Parsons, 2007)	Data will be used to update the CSM.	Soil samples were collected using incremental sampling methods, whereas TCRA MC samples will be collected from discrete locations. TCRA samples will be limited to explosives analysis to demonstrate that no additional MC is deposited from disposal operations. The SI demonstrated that the MC exposure pathway is incomplete. Analytical data are assumed to meet appropriate quality standards as stated in the RI. Locations of MEC/MD were used to demonstrate that a TCRA was required.	MEC/MD data was limited to surface observations only.
2005 Archive Search Report Supplement	Archives Search Report Supplement, Findings, Ordnance and Explosive Waste, Culebra Island Archives Search Report Supplement, Findings, Ordnance and Explosive Waste, Culebra Island National Wildlife Refuge, Culebra, Puerto Rico (USACE, Rock Island District, 2005b).	Data will be used for identification of the types of MC/MEC potentially present on the NWP.	Historical use of munitions	None

WORKSHEETS #14 AND #16
PROJECT TASKS AND SCHEDULE

The activities to be conducted on the NWP to achieve the project DQOs (Worksheet #11) comprise five primary components: surface clearance, QC seeding, detection survey, classification survey, and intrusive investigation. While these five primary components are the focus of the project, the field operations involve multiple elements, or "definable features of work," that will be required to achieve the project goals. This subchapter provides a summary of these definable features of work and the associated component tasks. A detailed discussion of each of the primary project components and the related definable features of work is included on Worksheet #17, and the specific field procedures to be used for the activities described in this summary are included in the various SOPs appended to this UFP-QAPP (Appendix I). The project schedule is provided in Appendix K.

Table 14.1
Definable Features of Work and Associated Tasks

Definable Feature of Work (Activity)	Associated Tasks	Planned Duration	Related SOPs (*see Worksheet #21*)	Deliverable(s)	Deliverable Due Date
DFW 1: Mobilization	Complete readiness review. Mobilization of equipment and personnel to the site.	3 days	All SOPs	Not applicable.	Not applicable.
DFW 2: Environmental Survey and Beach Monitoring	Qualified and independent Project Biologist will conduct an initial environmental survey prior to fieldwork and beach surveys 75 days before clearance activities begin, including vegetation removal and removal of UXO, and until ordnance or vegetation removal actions are completed.	75 days Prior to intrusive 90 Days Intrusive		Daily Biologist Survey Reports.	7 days after completion All in Final Report
DFW 3: Site Preparation (Grid Installation and Surface Clearance)	Staking grid corners and removal area boundaries Performing surface clearance for MEC/MPPEH: Remove surface metal as necessary to reduce the interference with the geophysical survey Vegetation removal	14 days	Procedures described in Worksheet 17A 505.01.1 510.01.1	Grid coordinates and maps Surface Clearance Memorandum QC Results (Daily QC Report) Team Leader Grid Sheet - (MEC/MPPEH Only) (or electronic equivalent), Team Leader Grid Sheet - (MD, range-related debris [RRD], and Other Debris) (or electronic equivalent), Project QC database	1 day after completion of installation for all elements 1 day after collection 7 days after completion 7 days after completion 7 days after completion
DFW 4: Conduct Validation Seeding, QC Seeding, and Construct IVS	Bury validation seed items according to the Verification and Validation Plan Bury QC seed items IAW the QC Seed Plan with QC seed information controlled as described in the QC Firewall Plan	8 days	DGM-02 AC-02	QC Seed Plan, QC Seed Firewall Plan, Draft Verification and Validation Plan Production Area QC Seed Report	Upon completion 7 days after completion

Table 14.1 (Continued)
Definable Features of Work and Associated Tasks

Definable Feature of Work (Activity)	Associated Tasks	Planned Duration	Related SOPs (*see Worksheet #21*)	Deliverable(s)	Deliverable Due Date
DFW 5: Assemble and Verify Correct Operation of Geophysical Sensor to Be Used for the Detection Survey (IVS Data Collection)	Assemble and perform initial checks on EM61-MK2 man portable unit Conduct survey of the IVS for the EM61-MK2 Prepare IVS Technical Memorandum	10 days	DGM-01	Raw and processed data IVS Technical Memorandum	1 day after collection 7 days after completion
DFW 6: Conduct Detection Survey	Conduct DGM survey over select areas to identify the locations of metallic objects for the follow-on cued surveys using AC Collect data in parallel lines, spaced at 0.6 meters RTK global positioning system (GPS) used for data location Correct data points for yaw, pitch, and roll based on orientation sensor data collected with dynamic data	8 days	DGM-03 506.01.1 510.01.1	Raw data files, field notes Access database with dig results	Friday following collection Daily updates; final 7 days after completion
DFW 7: Conduct Detection Survey Processing and Target Selection	Process DGM data for grids and generate cued target and proposed background location lists Evaluate target selection criteria and describe final selection method in Target Selection Technical Memorandum Validate DGM data and select targets for cued survey areas (Flamenco Beach and Campground) and the direct intrusive investigation areas (Carlos Rosario and Tamarindo Beaches) Document QC evaluations, root cause analyses, and corrective actions	10 days	DGM-04	Weekly QC Report Processed data files and maps, processing notes, target list Project QC Database Target Selection Technical Memorandum	Weekly Friday following collection Friday following collection/upon request 5 days after start of detection data collection

Table 14.1 (Continued)
Definable Features of Work and Associated Tasks

Definable Feature of Work (Activity)	Associated Tasks	Planned Duration	Related SOPs (*see Worksheet #21*)	Deliverable(s)	Deliverable Due Date
DFW 8: Validate Dynamic Survey and Cued Target List	Determine detection data usability with regard to MPCs. A DUA completed for the dynamic data, following project team's acceptance of the final cued target list	7 days	No SOP procedures are described in Worksheet 17A	Dynamic DUA	7 days after acceptance of cued target list
DFW 9: Assemble Advanced Geophysical sensor and Test Sensor at IVS	Assemble and perform initial checks on advanced EMI sensor Conduct initial cued IVS testing for the advanced EMI sensor Incorporate results in IVS Technical Memorandum (see DFW 5)	5 days	AC-01 AC-02	Raw and processed data IVS Technical Memorandum	1 day after collection 7 days after completion
DFW 10: Collect Cued Data	Collect Cued data at DGM survey anomaly locations at Flamenco Beach and in the open areas of Flamenco Campground and background data Validate cued data	25 days	AC-05 AC-06	Raw data files, field notes Project QC Database	Friday following collection Friday following collection/upon request
DFW 11: Conduct Cued Data Processing	Process cued data Conduct QC evaluation of cued data Document QC evaluations, root cause analyses, and corrective actions	30 days	AC-07	Weekly QC Reports Processed data, processing notes, supporting classification images Project QC Database	Per report Friday following collection Friday following collection/upon request
DFW 12: Classify Anomalies and Make Dig/No-Dig Decisions	Rank and classify target list using the best library fit as the decision metric Make dig/no dig decisions for all cued targets	5 days	AC-07	Access database with training dig results Ranked dig list	Daily updates; final 7 days after completion 14 days after completion of cued processing
DFW 13: Validate Cued Survey and Classification	Determine cued data usability with regard to MPCs Select 10% (not to exceed 200) targets classified as non-TOI that will be excavated with the targets classified as TOI.	5 days	AC-09	Cued DUA	7 days after acceptance of ranked dig list

Table 14.1 (Continued)
Definable Features of Work and Associated Tasks

Definable Feature of Work (Activity)	Associated Tasks	Planned Duration	Related SOPs (*see Worksheet #21*)	Deliverable(s)	Deliverable Due Date
DFW 14: Intrusive Investigation	Reacquire dig list anomalies Record reacquisition data and mark anomaly for investigation Excavate training digs for AC areas Intrusively investigate reacquired anomalies per intrusive guidelines Conduct QC evaluation of intrusive data; reinvestigate anomalies if necessary	22 days	501.01.1 502.01.1 504.01.1 505.01.1 506.01.1 DGM-05	Daily QC Report, Weekly QC Report, disposal reports Access database with reacquisition, and dig results	Per report Daily updates; final 7 days after completion
DFW 15: Verify Intrusive Results	Review dig results versus predicted results	7 days	AC-08 AC-09	Comparison results	7 days after completion of intrusive investigation
DFW 16: Conduct Final DUA	Determine data usability with regard to MPCs, performed after the completion of intrusive investigation Include analysis of the instrument and classification performance and recommendations for improving the process within report	7 days	No SOP, procedures are described in Worksheet 17A	Final DUA	7 days after acceptance of intrusive results
DFW 17: Analog Removal	Conduct analog removal in areas where terrain or extensive tree canopy prevents DGM methods from reliably detecting 37mm projectiles to a depth of 12 inches bgs. Remove vegetation as required IAW Section 17A.4.2. Identify subsurface anomalies for immediate investigation or mark for subsequent investigation Intrusively investigate and resolve detected and/or flagged anomalies Identify/classify MPPEH Remove MEC and MD found Document removal results and record grid status.	23 days	501.01.1 502.01.1 504.01.1 505.01.1	QC Results (Daily QC Report) Team Leader Grid Sheet - (MEC/MPPEH Only) (or electronic equivalent), Team Leader Grid Sheet - (MD, RRD, and Other Debris) (or electronic equivalent), Grid Drawing Sheet (or electronic equivalent), Access database with analog removal results, Project QC database	1 day after collection 7 days after completion 7 days after completion 7 days after completion 7 days after completion 7 days after completion

Table 14.1 (continued)
Definable Features of Work and Associated Tasks

Definable Feature of Work (Activity)	Associated Tasks	Planned Duration	Related SOPs (*see Worksheet #21*)	Deliverable(s)	Deliverable Due Date
DFW 18: MPPEH/MEC Handling, Certification, and Disposal	Conduct demolition operations IAW approved Explosives Safety Submission (ESS) Perform any necessary site restoration Inspect, certify, and verify MPPEH Package material documented as safe (MDAS) and store in secure location pending disposal Ship MDAS offsite to approved disposal facility and obtain necessary disposal documentation	121 days	501.01.1 502.01.1 504.01.1	DD Form 1348-1A Explosives Usage Records Magazine Data Cards Demolition Summary Sheets Demolition Shot Records MDAS Disposal Documentation	All in Final Report
DFW 19: Demobilization	MPPEH/Explosives Records Assessment MDAS documentation (DD Form 1348-1a)	1 day	501.01.1	MPPEH/Explosives Records	All in Final Report
DFW 20: MC Sampling	Collect samples for MC analysis at post-detonation locations Record GPS coordinates of sample locations	TBD	ENV-01.03	Daily QC Reports Field logbooks Chain-of-Custody forms Air Bills Sample Log-in, Instrument print-out and raw data Laboratory review checklists, PM Checklists, Data Validation Reports.	1 day after collection All in Final Report

WORKSHEET #15
REFERENCE LIMITS AND EVALUATION TABLES

The following tables provide the comprehensive analyte lists for the analytical methods that will be addressed by this project. The associated limits for sensitivity and accuracy are also included in each table. IAW the project DQOs presented in Worksheet #11B, the project action levels (PALs) presented in Worksheet #15.1 are set at 100 times the residential soil Regional Screening Levels (RSLs) established by the EPA (May 2016). The RSLs used as a basis for the PALs correspond to a risk level of 1×10^{-6} for carcinogenic chemicals and to a hazard index of 0.1 for non-carcinogenic chemicals. All target chemicals have LODs that are lower than the corresponding PAL. In order to maintain consistency with QAPPs for other projects on Culabra, the ecological screening values (ESVs) developed by the Los Alamos National Laboratory (LANL) (EcoRisk Database v.3.3, 2015) are also presented in Worksheet #15.1; however, these ESVs will not be used to determine if additional cleanup is required within the context of this TCRA.

The accuracy control limits presented in the Worksheet #15 tables are based on those presented in the 2013 DoD QSM for Environmental Laboratories, version 5.0. Lancaster provided its statistical limits for explosives in soil for review. Although the Lancaster statistical limits were wider than the QSM limits for all target analytes, Lancaster takes no exceptions to using the DoD limits for soil as presented in QSM version 5.0. For organic methods, HGL has adopted a convention of using a default minimum lower control limit (LCL) of 10 percent to establish a minimum non-zero standard of performance. Organic data will also use the default minimum upper control limit (UCL) of 120 percent (aqueous) or 125 percent (solid). In those cases where the QSM lists an LCL or UCL below the default minimum, the default has been used. If the QSM marginal exceedance (ME) limit for an analyte is at or below the default LCL or UCL, no ME limit is allowed for that analyte at the affected end of the control limit range. Where the control limits are not specified in the QSM, the project laboratory's internally derived control limits or method-specified control limits are presented. This is indicated by underlining the non-QSM limits in the method-specific Worksheet #15 tables. Laboratory-derived control limits and the ME limits calculated from them are also subject to the default minimum LCL and UCL requirements.

Note that the following method-specific worksheets include ME limits; however, all the analytes listed in Worksheet #15.1 are designated as target analytes of concern. When discrepancies are observed in QC analyses associated with these analytes, the laboratory is required to perform an investigation and CA even if the discrepancy in other ways meets the frequency and magnitude criteria for an ME, unless the discrepancy introduces a potential high bias and all associated results are non-detections. The ME limits presented in Worksheet #15.1 are only to be used to support the data validation protocols described in Appendix Q and should be consulted by the data validator when evaluating the effect of nonconforming LCS data where CA is not performed or is not effective.

In all cases, the laboratory is required to report concentrations at or greater than the detection limit (DL) as detected results. Results reported as detections with quantitation below the corresponding LOQ will be reported by the laboratory with the qualification of J to indicate that the result is considered an estimate due to being quantified below the calibrated range.

Nondetected results and results below the corresponding DL will be reported by the laboratory as nondetected results quantitated as the LOD and qualified U. Laboratory-assigned qualifiers may be subsequently modified during the data validation process (see Worksheet #36 and Appendix Q).

The laboratory-specific sensitivity limits and control limits are presented in Worksheet #15.1 are subject to change over time based on periodic review at the laboratory. When sensitivity or control limits are updated, the laboratory will present the most up-to-date limits in the associated data reports. Where Worksheet #15.1 indicates control limits stipulated by the QSM, these limits are required and cannot be altered without prior review and consent from HGL and USACE.

WORKSHEET #15.1
REFERENCE LIMITS AND EVALUATION TABLE, EXPLOSIVES IN SOIL BY SW-846 METHOD 8330B

Analyte	CAS Number	Lancaster Sensitivity Limits (µg/kg)			PAL (µg/kg)	LANL ESV (µg/kg)(1)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		DL	LOD	LOQ				Upper Limit	Lower Limit
1,3,5-Trinitrobenzene	99-35-4	40	80	120	22,000,000	10,000	80-125	74	No ME
1,3-Dinitrobenzene	99-65-0	40	80	120	63,000	73	73-125	65	127
2,4,6-Trinitrotoluene	118-96-7	40	80	120	360,000	7,600	71-125	63	128
2,4-Dinitrotoluene	121-14-2	40	80	120	170,000	290	75-125	68	128
2,6-Dinitrotoluene	606-20-2	40	80	120	36,000	4,100	79-125	73	No ME
2-Amino-4,6-dinitrotoluene	35572-78-2	40	80	120	1,500,000	14,000	71-125	62	132
2-Nitrotoluene	88-72-2	40	80	120	320,000	9,900	70-125	61	133
3-Nitrotoluene	99-08-1	40	80	120	63,000	12,000	67-129	57	139
4-Amino-2,6-dinitrotoluene	19406-51-0	40	80	120	1,500,000	12,000	64-127	53	138
4-Nitrotoluene	99-99-0	40	80	120	2,500,000	22,000	71-125	62	133
HMX	2691-41-0	100	200	300	39,000,000	16,000	74-125	66	132
Nitrobenzene	98-95-3	100	200	300	510,000	2,200	67-129	57	139
Nitroglycerin	55-63-0	800	2200	2400	63,000	13,000	73-125	64	132
PETN	78-11-5	800	2200	2400	1,300,000	100,000	72-128	63	137
RDX	121-82-4	40	80	120	610,000	2,300	67-129	57	139
Tetryl	479-45-8	100	200	300	1,600,000	1,500	68-135	57	146
Surrogate									
3,4-Dinitrotoluene	610-39-9	NA	NA	NA	NA	NA	62-133	NA	NA

Underlining indicates laboratory-specific control limits for compounds with no limits presented in the QSM.

(1) Los Alamos National Laboratory (LANL), EcoRisk Database v 3 3, 2015.

CAS – Chemical Abstracts Service
µg/kg – micrograms per kilogram
ME – marginal exceedance
NA – not applicable

WORKSHEET #17A
SAMPLING DESIGN AND RATIONALE FOR MEC-RELATED TASKS

This worksheet describes the project design and the tasks that will be required to successfully complete field operations during this project and achieve the DQOs described on WS #11A. A surface and subsurface removal action will be performed within specific areas of the 31.83-acre TCRA boundary shown on **Figure 14.1** in Appendix B using the survey methods indicated in Table 17A.1. DGM and intrusive investigation of the pond within the Flamenco Campground is anticipated to be conducted during the dry season of 2017. Investigation of the pond will be addressed in a separate QAPP update. The following subsections specify HGL's technical approach, broken down into a series of DFWs, for completion of the MEC and MPPEH clearance. Figure 17.1 in this section provides a decision tree for preliminary tasks and anomaly detection (DFW 3 through DFW 8). Figure 17.2 in this section provides a geophysical classification decision tree for cued surveys (DFW 9 through DFW 13). Figure 17.3 in this section provides a geophysical classification decision tree for intrusive investigation (DFW 14 through DFW 16).

Table 17A.1
Survey Methods for NWP TCRA

Location	Estimated Acreage	Survey Method	Advanced Classification
Flamenco Beach	4.30	Digital Geophysical Mapping (DGM)	Yes
Flamenco Campground Open Areas	9.06	DGM	Yes
Flamenco Campground Vegetated	8.00	Analog	No
Carlos Rosario Trail	3.67	Analog	No
Carlos Rosario Beach	1.61	DGM	No
Carlos Rosario Vegetated Area	3.39	Analog	No
Tamarindo Beach	0.67	DGM	No
Tamarindo Vegetated Area	1.13	Analog	No

- Flamenco Beach (4.30 acres): From the mean low water line to the vegetation line.
- Flamenco Campground (17.06 acres): From the vegetation line to the campground fence line.
- Carlos Rosario Trail (3.67 acres): 20 feet (ft) from either side of the trail centerline, excluding areas that cannot be reached due to physical constraints such as steep slopes or existing fences.
- Carlos Rosario Beach (5.00 acres): From the mean low water line to the vegetation line and extended 50 ft into the vegetation line (tree line).
- Tamarindo Beach (1.8 acres): From the mean low water line to the vegetation line and extended 50 ft into the vegetation line (tree line).
- Anomalies will be detected within the paved parking lot and road leading into the campground. Excavations will be determined based on results of detection surveys.

17A.1. THREE-PHASE INSPECTION PROCESS

17A1.1 Preparatory Phase

17A.1.1.1 The preparatory phase will be completed before beginning each DFW. A meeting will be scheduled in advance of the work activity, if necessary, to ensure that there is sufficient time for any necessary corrective actions. The following will be completed during this phase:

- Review specifications, references, and plans;
- Check field equipment to ensure that it is appropriate for intended use and has been tested, submitted, and approved;
- Assign responsibilities and ensure that field staff have necessary knowledge, training, expertise, and information to perform jobs;
- Verify arrangements for support services;
- Inspect work area to verify that required preliminary work has been completed;
- Review appropriate activity hazard analyses (AHAs); and
- Ensure that applicable process and procedures have been approved by the contracts officer.

17A.1.1.2 QAPP and operating procedures will be reviewed by the UXOQCS during this phase to ensure that they describe the prequalifying requirements or conditions, equipment, materials, methodology, and QC provisions. Discrepancies between existing conditions and approved plans and procedures will be resolved or corrective actions will be taken for unsatisfactory and nonconforming conditions identified during a preparatory phase inspection. This will be verified by the UXOQCS or his designee before approval to begin work is granted.

17A.1.1.3 The UXOSO will review the APP (Appendix D) and the appropriate AHAs to ensure that applicable safety requirements have been achieved. Preparation phase inspection results will be documented using the Preparatory Phase Checklist and will be summarized in the DQCR. The personnel qualifications checklist will be used to ensure that personnel meet or exceed the training standards outlined by DoD, USACE, and OSHA, including applicable hazardous waste operator training. HGL forms and checklists associated with the completion of the preparatory phase activities are presented in Appendix F.

17A.1.2 Initial Phase

17A.1.2.1 This phase will be performed when the fieldwork has been initiated for a given DFW. The purpose of this phase will be to accomplish the following:

- Inspect the work in progress for compliance with QC requirements;
- Verify adequacy of QC controls to ensure full contract compliance;
- Establish an acceptable level of workmanship;
- Review field operations for compliance with appropriate SOPs;

- Verify that documentation related to field activities is complete;
- Verify that required PPE and other safety procedures are in compliance with the QC specifications contained in the APP and AHA; and
- Resolve differences of interpretation that may affect the quality of work.

17A.1.2.2 Additional preparatory and initial phases may be conducted on the same work being performed if (1) the quality of ongoing work is unacceptable, (2) there are changes in the on-site production supervision or work crew, (3) work is resumed after a substantial period of inactivity (2 weeks or more), or (4) other problems develop.

17A.1.2.3 The UXOQCS will be responsible for ensuring that all discrepancies between site practices and approved plan specifications are identified, documented, and resolved. Corrective actions for unsatisfactory conditions or practices will be verified by the UXOQCS or his designee before granting approval to proceed. Initial phase results will be documented on the Initial Phase Checklist and summarized in the DQCR. A copy of HGL Form 15.11, Initial Phase Checklist, is included in Appendix F.

17A.1.3 Follow-up Phase

17A.1.3.1 This phase will be conducted for each DFW until it has been completed. The purpose of this phase is to ensure compliance with contract requirements and will include the following:

- Verify that the work has been completed in compliance with contract requirements and applicable standards;
- Ensure that the quality of workmanship was maintained and achieved;
- Validate all fieldwork to ensure that no data gaps exist and schedule additional field activities to address any existing data gaps;
- Verify that analytical work was performed by the approved laboratory; and
- Verify that safety inspections were performed.

17A.1.3.2 The UXOQCS is responsible for on-site monitoring of the practices and operations taking place, and for verifying continued compliance with the specifications and requirements of the contract, approved project plans, and procedures. The UXOQCS will oversee and observe activities as specified in the initial inspection and will verify that corrective actions for unsatisfactory or nonconforming conditions have been taken before granting approval to continue work. Final follow-up phase checks will be conducted and all deficiencies corrected before starting additional features of work. Final follow-up checks will be documented and summarized in the DQCR.

17A.2 DFW 1: Mobilization

17A.2.1 The PM will conduct a readiness review with technical staff to ensure that the team has the proper tools, equipment, and safety gear to complete field tasks IAW the work plan. Following successful completion of the readiness review, tools, equipment, and safety gear will

be sent to the site and personnel will travel to the site. Table 17A.2 summarizes the anticipated staffing for the project field team.

Table 17A.2
Project Field Team

HGL Team Composition	Parsons Team Composition	Subcontractors
SUXOS UXOSO/UXOQCS Geophysicist QC UXO Technician III UXO Technician II (3 Each) UXO Technician I (3 Each)	Geophysicist AC (2 Each) UXO Technician II (2 Each)	Biologist Surveyor Vegetation Removal (12 Each) Security

17A.3 DFW 2: Initial Environmental Survey and Beach Monitoring

17A.3.1 Prior to beginning intrusive activities, the SUXOS, UXOSO, and Project Biologist, along with representatives of DNER and USFWS and the USACE OE Safety Specialist, will conduct a joint environmental survey, and develop a layout plan of the operating area to document conditions of areas in and adjacent to the site of the work, storage areas, and access routes. The following items shall also be identified on the layout plan: wetlands, endangered and protected species or habitats, and cultural or historical resource areas.

17A.3.2 A fully qualified and independent Project Biologist will conduct beach monitoring surveys 75 days before clearance activities begin, including vegetation removal and removal of UXO, IAW the Environmental Protection Plan (Appendix E). If sea turtle nests are found on beaches being cleared of MEC, the biologist, the SUXOS, and/or monitoring personnel will communicate daily with the USFWS Boqueron Endangered Species Specialist and the Culebra Islands NWR Manager as to whether new nests have been located, and if so, their locations within the work area. If agreed upon by USFWS, 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 Project Biologist will train beach clearance crews before beginning vegetation removal, digital geophysical mapping (DGM), and MEC 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. The Biologist or SUXOS will include photographic documentation of natural resource conditions and vegetation conditions prior to (and after) any necessary removal of vegetation.

17A.3.3 *Documentation*: The project Biologist will document activities and inspections in Daily Biologist Survey Reports.

17A.4 DFW 3: Conduct Site Preparation (HGL)

17A.4.1 Site preparation will consist of staking the grid corners, removing area boundaries, and performing a surface clearance. Vegetation will be removed to improve visibility for detection of surface MPPEH and to reduce interference with the DGM and analog teams and their

instruments. HGL personnel will mark the grid corners and site boundaries with wooden stakes or other visible markers using an RTK GPS with sub-meter accuracy and/or traditional total station surveying when a GPS signal cannot be obtained. The Project Biologist will conduct environmental surveys until ordnance or vegetation removal actions are completed.

17A.4.2 No trees, shrubs, or turf will be removed, cut, or disturbed unless specifically necessary for investigation purposes. Vegetation removal will be conducted in compliance with the *Final Supplemental SOPs for Endangered Species Conservation and their Critical Habitat, Addendum 1 – February 2015, CESAJ* (see Appendix I) and only to the extent required to support the clearance objectives of each grid. The SUXOS, or authorized designee, will identify the areas requiring vegetation clearance. Vegetation will be cleared to a degree that permits reliable MEC detection without disturbing or destroying plant root structures. The preferred distance from ground level is approximately 6 inches for both manual and mechanical vegetation clearance. MEC avoidance will be practiced during all vegetation clearance operations. A team comprising a Biologist to assist with threatened and endangered species avoidance, brush clearance personnel, and a UXO escort to assist with avoidance will conduct operations under supervision of the SUXOS, or designee. Any surface MPPEH located will be marked and dealt with IAW the procedures described in SOP 502.01.1 and 504.01.1 (Appendix I) and the section below titled "MPPEH/MEC Handling, Certification, and Disposal." Large pieces of surface metal unrelated to MPPEH will be removed during vegetation removal or identified and located for later removal prior to geophysical data collection.

17A.4.3 The surface clearance will be accomplished within the TCRA boundary (See Figure 14.1 and Table 17A.1) in areas designated for DGM survey and according to the procedures described in SOP 505.01.1 (Appendix I). The surface clearance team will remove all visible metallic items as necessary to reduce the interference with the DGM survey. All MD and/or MEC recovered during the surface sweeps will be dealt with IAW the procedures described in SOP 502.01.1 and 504.01.1 (Appendix I) and the section below titled "MPPEH/MEC Handling, Certification, and Disposal."

17A.4.4 All surface clearance operations will be performed under the direct supervision of the UXO Technician III team leader. Before any surface removal operations are performed, the members of the MEC removal team will check their analog instrument function using the MPCs listed on WS #12A. MEC teams will use basic sweep techniques by forming a sweep line and marking lanes with pin flags or lines to establish 5-foot lanes within each grid, and sweeping the area using analog instrumentation. The SUXOS will determine which technique will be used to mark the sweep boundaries based on site conditions. Individual sweep lanes will be established at a maximum of 5-foot intervals. Team members will locate surface MPPEH and remove visible metallic items as necessary to reduce the interference with the geophysical survey. The Team Leader will record the locations and photograph any discovered and document information on the items found in the Project database or on the Team Leader Grid Sheet (Appendix F) if electronic records are not accessible. Coordinates will be recorded using a handheld GPS.

17A.4.5 Any MEC or MPPEH encountered on the surface within the designated surface removal footprint will be handled and disposed of as described in the section below titled "MPPEH/MEC Handling, Certification, and Disposal."

17A.4.6 The Team Leader will record the following surface clearance information for each grid surveyed:

- General Grid Information
  - Grid ID
  - Team number
  - Date(s) of removal
  - Sketch of grid conditions
  - Comment
- MEC Information
  - Grid ID
  - Location ID
  - Date found
  - Item type
  - MEC type (UXO, DMM, MC)
  - Photo ID
  - Nomenclature
  - Description
  - Quantity
  - Depth
  - Final disposition
  - Number of MEC/MPPEH logged on MEC/MPPEH grid sheet

- MD, Range Related Debris, and Other Debris Information
  - Grid ID
  - Team number
  - Team leader
  - Date
  - MD/munitions types found (frag, munitions component, debris description)
  - Seed items found
  - Total weight of MD in grid
  - Total weight of other debris in grid

17A.4.7 This information will be logged in the electronic database or on the Team Leader Grid Sheet (MEC/MPPEH only), Team Leader Grid Sheet (MD, RRD, and other debris), and Grid Drawing Sheet (Appendix F) if electronic records are not available. Following completion of the grid, the team leader will log the progress on the Grid Status Sheet (Appendix F), or electronic equivalent. Documentation for each grid designated to be surface cleared by the UXO Team Leader will be subjected to verification by the UXOQCS or designee using the MPCs described on WS #12A.

17A.4.8 *Documentation*: Surface Clearance Memorandum, Daily QC Reports, Team Leader Grid Sheet (MEC/MPPEH only) (or electronic equivalent), Team Leader Grid Sheet (MD, RRD, and other debris) (or electronic equivalent), Grid Drawing Sheet (or electronic equivalent), Grid Status Sheet (or electronic equivalent) Project QC database.

17A.5 DFW 4: Conduct Validation Seeding, Quality Control Seeding, and Construct IVS (HGL and USACE)

17A.5.1 Government personnel will bury validation seeds according to the Validation Seed Plan to be developed by the Government. HGL personnel will develop the QC Seed Plan, and bury QC seeds as described in SOP DGM-02.01 (Appendix I). All QC seeds will be located using an RTK GPS when possible (tree cover), and members of the seed team will have no further role in the collection, processing, or analysis of the geophysical data. QC seed information will be controlled as described in the QC Seed Firewall Plan. Generally, QC seeds will be 2-inch-long, 5/8-inch-diameter bolts; small and medium schedule 80 ISOs; and inert 20mm, 37mm and 57mm projectiles, as available.

17A.5.2 A single IVS will be constructed for this TCRA IAW SOPs AC-02 and DGM-01.01 (Appendix I). It will be designed for use by the advanced EMI sensor in static mode and by the EM61-MK2 sensor in dynamic mode. Three ISOs will be buried in the IVS ideally including a small and medium ISO, and 37mm projectile. Cued data will only be collected over the center line of the IVS, which will include a cleared blank space to be used for background corrections in addition to the three seed items. Seeds will be buried at approximately five times their inner diameters (i.e., 15 centimeters [cm] for the small ISO and 25 cm for the medium ISO) in horizontal orientations. Items in the IVS will be separated by at least 5 meters.

17A.5.3 *Documentation*: Validation Seed Plan (USACE); QC Seed Plan (HGL); QC Seed Firewall Plan; seeding results (spreadsheet, maps(s), and photographs); IVS Technical Memorandum (combined for detection and cued surveys); Draft Verification and Validation Plan (for cued surveys); and Production Area Seeding Report.

17A.6 DFW 5: Verify Correct Operation of Geophysical Sensor to Be Used for the Detection Survey (Parsons)

17A.6.1 The IVS will be surveyed with the EM61-MK2 as described in **SOP DGM-01.01** (Appendix I). After completing the initial static and dynamic IVS testing, an IVS Technical Memorandum will be prepared detailing the IVS setup, surveys, and results including documentation of compliance with the dynamic IVS MQOs provided in WS #22A. The IVS Technical Memorandum will be provided to the project team for review and concurrence. It is expected that the cued IVS survey for the advanced EMI sensor (DFW 9) will be performed at the same time as the EM61-MK2 IVS survey, and the discussion/results for both surveys will be combined into one IVS Technical Memorandum.

17A.6.2 *Documentation*: IVS Technical Memorandum (combined for detection and cued surveys)

17A.7 DFW 6: Conduct Detection Surveys (Parsons)

17A.7.1 DGM data will be collected at Flamenco Beach (4.30 acres), open areas of Flamenco Campground (9.06 acres), Carlos Rosario Beach (1.61 acres), and Tamarindo Beach (0.67 acres) as specified in Table 17A.1 and identified on Figure 14.1 in Appendix B to identify the locations of metallic objects in the subsurface for follow-on intrusive investigation (Carlos Rosario and

Tamarindo Beaches) and cued survey (Flamenco Beach and Flamenco Campground). The detection surveys will be performed using the EM61-MK2 as described in SOP DGM-03.01 (Appendix I). Survey lines will be collected using a 0.6-meter line spacing, with survey coverage required to meet the MQO in WS #22A. Based on an effective 1-meter sensor footprint, the line spacing should be more than sufficient to meet this objective and to detect all potential TOI, including 37mm projectiles, even if the operator deviates slightly from the intended line path. DGM data will be collected in conjunction with RTK GPS data.

17A.7.2 Vegetated areas of the Flamenco Campground (8.0 acres), Carlos Rosario Beach (3.39 acres), and Tamarindo Beach (1.13 acres), and the steep terrain of Carlos Rosario Trail (3.67 acres) will prevent the use of the EM61-MK2 for DGM data collection. Therefore, these areas will be cleared with analog metal detectors as described in SOP 505.01.1 (Appendix I). The exact extent of analog removal will be based on the areas where the EM61-MK2 cannot gain access or is not effective because of the overhead tree canopy. DFW 15 describes the analog subsurface removal process. Any MPPEH recovered during this clearance will be dealt with according to the procedures outline in SOPs 502.01.01 and 504.01.1 (Appendix I) and the section below titled "MPPEH/MEC Handling, Certification, and Disposal."

17A.7.3 *Documentation*: Raw data (.TEM and .CSV format), Daily QC Reports, Project QC Database, Database containing mag and dig results.

17A.8 DFW 7: Conduct Data Processing and Document Locations of Anomalies – (HGL, Parsons, and USACE)

17A.8.1 Dynamic EM61-MK2 data will be processed as described in **SOP DGM-04** (Appendix I). The data processor will assess the data to identify any areas where the anomaly density is too high to select individual anomalies for intrusive investigation and cued surveys. Areas with excessive anomaly density will be considered for analog removal methods as described in SOP 505.01.1 (Appendix I).

17A.8.2 Anomalies will be identified using a threshold based on the expected EM61-MK2 response of a 37mm projectile at a depth of 12 inches bgs. The amplitude threshold will be set below the lowest peak response value (by two standard deviations of the noise) to account for noise due to cart bounce, etc. The selection threshold will also take into consideration that the signal-to-noise ratio (SNR) is good enough to reliably detect items at the site. Use of a size filter for additional screening will also be evaluated. A Target Selection Memorandum will be prepared and submitted to the project team for review and concurrence after site specific conditions and some EM61-MK2 DGM data have been evaluated. Validation of the dynamic data will be performed through comparison of the data to the MQOs specified in WS #22A and as described in WS #35A. Two lists of anomalies – one for the cued survey areas (Flamenco Beach and Campground) and the other for the direct intrusive investigation areas (Carlos Rosario and Tamarindo Beaches) – will be delivered following the completion of target selection along with the Dynamic Data Validation Report.

17A.8.3 Background data collection locations for the cued survey will be selected using the DGM survey results. Background locations will be selected to meet the requirements described in SOP AC-05 (Appendix I). Each background location selected will be checked by collecting

five cued advanced EMI sensor points, at the selected location and offset approximately 0.35 m in each cardinal direction. If comparison of the decays for any of those five cued data points indicate the presence of metallic objects, that location will either be cleared and rechecked or will not be used for background data collection during the cued survey.

17A.8.4 Cued data acquisition will not commence until after the cued target list has been reviewed and approved by the project team. Any anomalies added to the cued target list based on the project team's review of the Target Selection Memorandum, the data validation results, and the data anomaly list will be collected before the cued data collection team demobilizes from the site. A DUA will be completed for the DGM data using the four step process described in WS #37A following the project team's acceptance of the final cued target list.

17A.8.5 *Documentation*: Target Selection Technical Memorandum, processed data files and maps, processing notes, project QC database, Weekly QC Reports

17A.8.6 *Decision point*: Is anomaly density acceptable for cued survey? Have MQOs been achieved?

17A.9 DFW 8: Validate Detection Survey (HGL, Parsons, and USACE)

17A.9.1 DGM data will be validated as described in WS #35A. Intrusive investigation and cued data acquisition will not commence until after the applicable target lists have been reviewed and approved by the project team. Any anomalies added to the cued target list based on the project team's review of the Target Selection Memorandum, the data validation results, and the DGM data anomaly list will be collected before the cued data collection team demobilizes from the site. A DUA will be completed for the DGM data using the four step process described in WS #37A following the project team's acceptance of the final target lists.

17A.9.2 *Documentation*: DGM Data Validation Report and Detection Survey DUAs

17A.9.3 *Decision point*: Is DGM data acceptable for use in developing cued target lists?

17A.10 DFW 9: Assemble Advanced Geophysical Sensor and Test Sensor at IVS (Parsons)

17A.10.1The advanced EMI sensor will be assembled as described in SOP AC-01 (Appendix I).

17A.10.2 To test the advanced EMI sensor and verify that it is functioning correctly, an initial cued IVS survey will be performed as described in SOP AC-02 (Appendix I). After performance of the initial IVS testing, an IVS Technical Memorandum will be prepared detailing the IVS setup, surveys, and results including documentation of compliance with the cued IVS MQOs provided in WS #22A. The IVS Technical Memorandum will be provided to the project team for review and concurrence. It is expected that the cued IVS survey will be performed at the same time as the EM61-MK2 IVS survey (DFW 5), and the discussion/results for both surveys will be combined in one IVS Technical Memorandum.

17A.10.3 *Documentation*: IVS Technical Memorandum (combined for detection and cued surveys)

17A.11 DFW 10: Collect Cued Data (Parsons)

17A.11.1 Cued data will be collected at DGM survey anomaly locations at Flamenco Beach and in the open areas of Flamenco Campground as described in SOP AC-06 (Appendix I), with background data collected as described in SOP AC-05 (Appendix I).

17A.11.2 After the cued data are downloaded from the data acquisition computer, the data processor will review the dataset to validate that it meets the MQOs listed on WS #22A, including the following:

- Instrument function test
- IVS derived polarizabilities
- IVS derived positions
- GPS quality
- Offset from selected to measured position
- Production area background measurements
- Transmit current levels
- Offset between multiple sensors
- Valid inertial measurement unit function

17A.11.3 The results of these checks will be summarized in the project QC database and Weekly QC Reports.

17A.11.4 *Documentation*: Raw data (UX-Analyze compatible file format), project QC database, Weekly QC Reports

17A.11.5 *Decision point*: Have MQOs been achieved?

17A.12 DFW 11: Conduct Cued Data Processing (Parsons and HGL)

17A.12.1 Cued data will be processed using UX-Analyze-Advanced as described in SOP AC-07 (Appendix I).

17A.12.2 Both single and multiple object inversion routines are used to determine intrinsic and extrinsic parameters for potential sources that closely match the collected cued data. Once these parameters have been determined for potential sources, the intrinsic parameters (polarizabilities) modeled for potential sources can be compared to the same parameters for library objects to determine the degree of match between the two. Output from data processing will include all inversion results and decision metrics derived from library matching. The decision metrics will give a reasonable indication of whether a given target will be classified as TOI or not, but specific decisions for each target will be performed under DFW 12.

17A.12.3 *Documentation*: Backgrounds, raw/leveled data, and inversion/library comparison results

17A.12.4 *Decision point*: Have MQOs been achieved?

17A.13 DFW 12: Classify Anomalies and Make Dig/No-Dig Decisions (Parsons, HGL, and USACE)

17A.13.1 Classification of cued data will generally be performed as described in SOP AC-07 (Appendix I) in that comparisons of the collected data to the munitions library compiled for the project will be the primary metric used to guide the dig/no-dig decision on the ranked dig list to be submitted following classification.

17A.13.2 The site specific library will consist of polarizabilities from the standard 2x2 library included with UX-Analyze and polarizabilities collected by Parsons as part of an ESTCP library update. The site specific library will be updated as necessary based on the results of training digs performed, based on comparison of targets to a more comprehensive library, and on the cluster/feature space analysis, such that most targets identified as digs are based on a threshold-based metric match to the library. However, some targets may be classified as digs at the analyst's discretion regardless of library match metric. Justification will be provided for any analyst-added digs.
17A.13.3 Objects will be classified into one of the following three categories:

- **Category 1**: TOI (highly likely to be MEC)
- **Category 2**: Non-TOI (highly unlikely to be MEC)
- **Category 3**: Inconclusive (data cannot be analyzed)

17A.13.4 Objects will be placed on a ranked anomaly list, arranged in order from highest likelihood the object is a TOI to highest likelihood the object is a non-TOI. A stop-dig threshold between TOI and non-TOI (i.e., the last TOI on the dig list) will be defined by the analyst. The USACE will review the classification results with regard to the validation seeds and other pertinent validation data prior to acceptance. Changes may be made to the classifier used and the dig list as a result, as necessary, prior to acceptance. A cued survey DUA will be completed using the four step process described in Worksheet #37 following the project team's acceptance of the final ranked dig list.

17A.13.5 *Documentation*: Ranked dig list figures and maps, Database containing training dig results

17A.13.6 *Decision point*: Are all QC seeds classified as digs? Are all validation seeds classified as digs? Have MPCs been achieved?

17A.14 DFW 13: Validate Cued Survey and Classification (Parsons and USACE)

17A.14.1 Cued data will be validated as described in WS #35A. A DUA will be completed using the four step process described in WS #37 following the project team's acceptance of the final ranked dig list. As part of the validation process, the project team will select 10% (not to exceed 200) targets classified as non-TOI that will be excavated with the targets classified as TOI. Prior to the intrusive investigation, a data analyst will provide a short description as to why each of the selected targets was classified as a non-TOI (e.g. too small, too thin-walled, asymmetric) as described in SOP AC-09 (Appendix I).

17A.14.2 *Documentation*: Cued Data Validation Report and Cued Survey DUAs

17A.14.3 *Decision point*: Is cued data acceptable for use in separating TOI from non-TOI?

17A.15 DFW 14: Excavate Buried Objects (HGL)

17A.15.1 Detailed descriptions of the anomaly excavation procedures and intrusive results documentation required for this project are included in SOPs 505.01.1 and 506.01.1 (Appendix I). Training digs for the AC areas will be excavated first to allow for concurrent modification of the classification results, as necessary. Anomalies will be excavated in order to maximize the efficiency of the intrusive process. All intrusive investigation will be performed using an EM61-MK2 for anomaly reacquisition and hole clearance and an RTK GPS (Trimble R8 or similar) for source location. A Schonstedt Model GA-52Cx magnetometer and/or Whites All-Metal detector (or equivalent analog instruments) may be used to pinpoint source locations within open holes, but is not necessary for this investigation. The Whites All-Metal detector (or equivalent analog instrument) may be used to reduce the amount of "hot-rock" digs. Prior to intrusive operations, HGL will coordinate with ACDEC to evacuate campgrounds and beach areas IAW the ESS.

17A.15.2 For the AC areas, the intrusive investigation will include the excavation of the 10% (not to exceed 200) validation targets described above as well as at least 10% (not to exceed 200) verification targets. The final number of verification digs and their relation to classifier decision points (decision metric stop-dig threshold, cluster boundaries, analyst-added digs, etc.) will be determined after consultation amongst the project team.

17A.15.3 For the non-AC areas (Carlos Rosario and Tamarindo Beaches), all anomalies on the final list for these areas will be excavated.

17A.15.4 If water is encountered while excavating buried objects that impacts the safety of the operation, low-volume pumps or water diversion may be used to dewater excavations.

17A.15.5 The anomaly resolution requires the intrusive investigation process to conclude once the signal is removed or identified, thus ensuring no MEC or MPPE is left.

17A.15.6 *Documentation*: Database of excavation results, photographs, Daily QC Reports, Weekly QC Reports, disposal reports.

17A.16 DFW 15: Verify Recovered Non-TOI Are Consistent with Predictions Based on Advanced Sensor Data (Parsons and project team)

17A.16.1 All sources recovered during the intrusive investigation will be compared to the predicted results as described in SOPs AC-08 and AC-09 (Appendix I); verification targets will be excavated as described above.

17A.16.2 *Documentation*: Comparison results

17A.16.3 *Decision point*: Was the stop-dig threshold correct?

17A.17 DFW 16: Conduct Final DUA (Parsons)

17A.17.1 The final DUA will be performed after the completion of intrusive investigation as described on WS #37A. The report will include an analysis of the instrument and classification performance. It will also include lessons learned during the collection/classification process and recommendations for improving the process, as applicable.

17A.17.2 *Documentation*: Final DUA

17A.18 DFW 17: Analog Removal

17A.18.1 Analog surveys will be used to locate subsurface anomalies for intrusive investigation in areas where terrain or extensive tree canopy prevents DGM methods. The subsurface analog removal will be performed according to the procedures described in SOP 505.01.1 (Appendix I). Subsurface Analog Removal will be conducted using handheld sensors – the Whites All-Metal detector (or equivalent analog instruments) with the capability of ground balancing to reduce detection of magnetic soils/and or rocks ("hot rocks") to identify subsurface anomalies based on the audible output to the analog sensor. Analog geophysical instruments will arrive on site in a ready state. Analog geophysical instruments will be operationally tested on a test plot to ensure that adequate instrument settings for their tasks are achieved. As anomalies are identified by the instrument operator(s), they will be investigated as detected ("mag and dig") or marked for subsequent intrusive investigation ("mag and flag"). Prior to intrusive operations, HGL will coordinate with ACDEC to evacuate campgrounds and beach areas IAW the ESS.

17A.18.2 All subsurface removal operations will be performed under the direct supervision of the UXO Technician III Team Leader. Before any analog subsurface removal operations are performed, the members of the MEC removal team will check their analog instrument function according to the MQOs listed on WS #22A. Prior to conducting subsurface removal in a grid, the removal team will mark approximately 5-foot-wide removal lanes throughout the grid using survey tape or similar. Team members will locate anomalies for intrusive investigation, investigating them using either "mag and dig" or "mag and flag" methods.

17A.18.3 Detected anomalies will be intrusively investigated by UXO-qualified personnel using either hand digging or mechanical methods (e.g., mini-excavator). The minimum separation distances. presented in the approved ESS will be enforced during all intrusive MEC operations. When multiple teams are working in proximity to one another, the team separation distance specified in the approved ESS will be maintained during intrusive activities. All minimum separation distances are based on the appropriate munitions with the greatest fragmentation distance, which are also presented in the approved ESS.

17A.18.4 During subsurface activities, the UXO technicians will use handheld geophysical instruments to locate and pinpoint anomalies. The UXO technicians will carefully remove the earth overburden to expose the source of a subsurface metallic anomaly, and positively identify the source of the anomaly. Excavations using heavy equipment will be conducted offset laterally for the suspected MEC item or anomaly being investigated and will not be conducted within one foot of the anomaly source. Following this initial excavation, the excavation team will conduct a

visual and instrument-assisted examination of the excavation. This process will be repeated until the audible signal from the handheld magnetometer indicates the anomaly source is close to the surface of the excavation. Once this determination has been made, additional soil will be removed by hand until the anomaly is located. Excavations will be continued until the anomaly source is resolved.

17A.18.5 The UXOQCS will conduct a 25% instrument-assisted re-sweep of each analog area in random patterns and 5% meandering digital data coverage using the PDM8. If the PWS clearance criteria are not achieved, the grid will fail and it will be re-swept.

17A.18.6 Each Team Leader will mark the locations of and photograph any MEC discovered and document information in the project database or on the Team Leader Grid Sheet for MEC/MPPEH (Appendix F) if electronic records are not accessible. Any MPPEH encountered during intrusive activities will be handled and disposed of as described in Section 17A.16, MPPEH/MEC Handling, Certification, and Disposal. Once the source of an anomaly has been identified and any necessary MEC operations have been completed, the excavation will be filled in and tamped to the approximate consistency and grade of the surrounding soil and any removed sod will be replaced. To the greatest extent possible, the excavation site will be restored to its original condition.

17A.18.7 The Team Leader will record the following analog removal information for each grid surveyed:

- General Grid Information
  - Grid ID
  - Team number
  - Team leader
  - Date(s) of removal
  - Sketch of grid conditions
  - Comment
- MEC Information
  - Grid ID
  - Location ID
  - Coordinates
  - Date found
  - Item type
  - MEC type (UXO, DMM, MC)
  - Photo ID
  - Nomenclature
  - Description
  - Quantity
  - Depth
  - Final disposition
- MD, RRD, and Other Debris Information
  - Grid ID
  - Team number

- Team leader
- Date
- MD/munitions types found (frag, munitions component, debris description)
- Seed items found
- Total weight of MD in grid
- Total weight of other debris in grid
- Number of MEC/MPPEH logged on MEC/MPPEH grid sheet

17A.18.8 This information will be logged in the electronic database or on the Team Leader Grid Sheet (MEC/MPPEH Only), Team Leader Grid Sheet (MD, RRD, and Other Debris), and Grid Drawing Sheet (Appendix F) if electronic records are not available. Following completion of the grid, the team leader will log the progress on the Grid Status Sheet (Appendix I), or electronic equivalent. Documentation for each grid deemed to be completed by the UXO Team Leader will be subjected to verification by the UXOQCS or designee using the MPCs described on WS #12A.

17A.18.9 *Documentation*: Team Leader Grid Sheet (MEC/MPPEH Only) (or electronic equivalent), Team Leader Grid Sheet (MD, RRD, and Other Debris) (or electronic equivalent), Grid Drawing Sheet (or electronic equivalent), Grid Status Sheet (or electronic equivalent), project QC database.

17A.18.10 *Decision point*: Have MPCs been achieved?

17A.19 DFW 18: MPPEH/MEC Handling, Certification, and Disposal

17A.19.1 MEC Identification

17A.19.1.1 Any MPPEH that cannot be verified to be free of explosive hazards or is suspected to present an explosive hazard will be considered to be MEC. Any MEC encountered during excavation will be clearly marked and its position will be recorded by RTK GPS (Trimble R8 or similar) or handheld GPS. Data regarding type, size, depth, condition, location, etc. of MEC located during the removal action will be recorded and all MEC encountered will be photographed. The UXO supervisor/team leader (UXO Technician III) will evaluate the item(s) found and immediately report the condition of the item(s) to the SUXOS and UXOSO. The SUXOS and UXOSO must be in agreement on the nature and condition of a MEC item before any action is taken.

17A.19.2 MEC Removal

17A.19.2.1 If the source of an excavated anomaly is considered to be MPPEH, it will be uncovered sufficiently to obtain a positive identification of the item. If the item is identified as MEC, a determination will subsequently be made as to whether the item is acceptable to move. Only the SUXOS and UXOSO, jointly, will make the determination if a MEC item is acceptable to move. After determining if an item is acceptable to move, the SUXOS and UXOSO will determine the most expeditious route for safe movement of the MEC item to an approved consolidation point. The location for a consolidation point will be determined by the SUXOS and

UXOSO based on safety considerations, and approved by the USACE OESS and documented in daily production reports.

17A.19.2.2 MEC items deemed acceptable to move may, IAW the approved ESS, be moved for consolidation or to move the item further from public roadways for detonation. No MEC identified for destruction will be removed outside the project site boundary. Any consolidated shots will be conducted IAW the approved ESS.

17A.19.2.3 MEC items not deemed acceptable to move will be blown-in-place (BIP). If a MEC item cannot be safely BIP under the existing conditions, the PM, SUXOS, and UXOSO will be notified, and a determination will be made how to resolve the situation safely.

17A.19.3 MEC Storage

17A.19.3.1 MEC will not be stored at the site. If demolition of MEC items cannot be completed on the day the item is found, it will be guarded until demolition can occur.

17A.19.4 Disposal of MEC/MPPEH

17A.19.4.1 *General MEC Disposal Procedures*

17A.19.4.2 During disposal of MEC and related material, safety will be the primary concern. The primary requirements are to protect personnel, the public, and the environment from fire, blast, noise, fragmentation, and toxic releases. Planned detonation of explosives will be conducted IAW the requirements outlined in DoD 6055.9-M and the applicable Fragmentation Data Review Forms, which are included in the approved ESS.

17A.19.4.3 Explosive operations will follow the procedures outlined in the ESS, EM 385-1-97, and HGL SOP 502.01.1, *Explosive Demolition Operations* (Appendix I). Standard electric or nonelectric demolition equipment may be used, including remote firing devices. The UXOSO has the overall responsibility to comply with the minimum requirements listed below and has the authority to upgrade as the situation dictates.

17A.19.4.4 Demolition operations will not begin at a work site until all non-essential personnel are outside the minimum separation distances established for the ordnance and net explosive weight being detonated. MEC that cannot be moved will be BIP. Engineering controls may be used to reduce the intentional detonation minimum separation distances. The goal of engineering controls during MEC disposal operations is to avoid and minimize the potential impacts on the environment. If implemented, these controls will be used IAW the ESS.

17A.19.4.5 The Project Biologist will inspect the beach that would be used for 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. Prior to detonation, the Project Biologist 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 Project Biologist 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 bird(s) leave the area. In addition, if blast impacts will extend into nearshore waters, the Project Biologist will observe for sea turtles and marine mammals. If these species are observed the detonation shall be postponed until the animal(s) leave the impact zone or more than 30 minutes have elapsed since it was last sighted. Immediately before detonation, the Project Biologist 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.

17A.19.4.6 No in-water detonations are anticipated during this TCRA. The SOPs for Endangered Species Conservation, USACE, Jacksonville District, references in-water detonations. However, not all procedures in the SOPs are applicable to the TCRA.

17A.19.4.7 Disposal operations will be under the direct control of the demolition team leader: an experienced and trained UXO Technician III charged with the responsibility for all demolition activities within the area. The UXOSO will be responsible for training all personnel regarding the nature of the materials handled, the hazards involved, and the necessary precautions to be taken, and will also be present during all on-site disposal operations. The UXOSO will ensure that the appropriate authorities are notified prior to any on-site demolitions.

The following will be in place prior to disposal operations:

- Puerto Rico Individual Explosive License
- Puerto Rico Storage Permit

The following entities will be notified of intent to detonate prior to detonation:

- USCG, Mr. Efrain Lopez, Marine Information Specialist (787) 289-2097), efrain.lopez1@uscg.mil, USCG Sector San Juan and, CWO Anthony Cassisa, (787) 289-2073, anthony.j.cassisa@uscg.mil. Warning broadcast to mariners over VHF for a scheduled demolition shot (Notice to Mariners [NOTMAR]).
- FAA Coordination Facility (787) 253-8664, Mr. Felipe Fraticelli, for a Notice to Airmen on flight restriction above the demolition area. Additional points of contact include Mr. Hector Plaza, (787) 525-6070, and Mr. Hector Rivera, FAA Office (404) 520-4241.
- Municipal Police (787) 742-0106 for any activity on Flamenco Beach. The HGL SUXOS or UXOSO will coordinate directly with the police department to overcome any language difficulties on demolition operations.
- Puerto Rican State Police (787) 742-3501, for any activities on Culebra. The HGL SUXOS or UXOSO will coordinate directly with the police department to overcome any language difficulties on demolition operations.

17A.19.4.7 Completion of demolition operations will be evaluated by the SUXOS using the MPCs described on WS #12A.

17A.19.4.8 *Material Potentially Presenting an Explosive Hazard*
MPPEH will be processed and disposed of IAW Chapter I, Section 11 of EM 385-1-97. Additionally, site personnel will adhere to HGL SOP 504.01.1, *MPPEH Inspection and Management* (Appendix I), which establishes overall practices for HGL UXO-qualified personnel inspecting, processing, securing, safeguarding, and managing MPPEH during MEC activities. Certification and disposal of MPPEH and MDAS will be monitored by the UXOQCS using the MPCs described on WS #12A.

17A.19.4.9 Within, or adjacent to, each grid actively undergoing subsurface clearance, a UXO Technician III will establish a temporary collection point for MD. Smaller MD items will be placed in plastic buckets or suitable containers. During operations, surface clearance teams will inspect each surface anomaly for the presence of explosives. MD items that are free of explosives contamination and do not require venting will be placed in the grid collection points. Upon completion of operations in that grid, the material in the temporary collection points will be collected. The UXO Technician III will perform a second inspection of the material to ensure that it is free of explosives and other hazardous materials (HAZMATs). The SUXOS will certify the inspection of each item a third time as the MD is placed in secured containers. The OESS or UXOQCS will verify that all MD and items placed in secured containers are free of explosive hazards and HAZMATs.

17A.19.4.10 *Material Documented as Safe*

17A.19.4.11 MPPEH that is inspected, verified, and certified to be free of explosive hazards will be classified as MDAS. MDAS generated during the project will be stored in a secure area inside locked containers. Once the field investigation is complete, the sealed containers will be shipped to a DoD-approved facility for proper disposal. Certification and disposal of MDAS will be monitored by the UXOQCS using the MPCs described on WS #12A.

17A.19.4.12 *MPPEH Documentation*

17A.19.4.13 The SUXOS will certify and the USACE OESS or UXOQCS will verify that debris is free of explosive hazards. If the OESS is not available, the UXOQCS will sign as the verifier. DD Form 1348-1A will be used as the certification/verification documentation. All DD 1348-1A forms will clearly show the typed or printed names of the SUXOS and OESS/UXOQCS, as well as the organization, signature, and home and field office telephone numbers for the persons certifying and verifying that the debris is free of explosive hazards. The form will state the following if only MD is being processed:

This certifies and verifies that the munitions debris listed has been 100 percent properly inspected and, to the best of our knowledge and belief, is free of explosive hazards.

17A.19.4.14 If range related debris is processed with MD, the form will state the following:

This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, free of explosive hazards, engine fluids, illuminating dials, and other visible liquid hazardous, toxic, and radioactive waste (HTRW) materials.

17A.19.4.15 The container will be closed and clearly labeled on the outside with the following information: the first container will be labeled with a unique identification that will start with USACE / Installation Name / Contractor Name / 001 / Seal's Unique Identification, and subsequent containers will be labeled sequentially. The SUXOS will ensure that a DD Form 1348-1A is completed for each container prior to transfer. The form will contain the following information:

- Location of where material was obtained
- Basic material content (type of metal: for example, steel or mixed)
- Estimated weight
- Unique identification number of each container
- Seal identification number

17A.19.4.16 In addition to the DD Form 1348-1A, MDAS shipments will be transferred to the recycler under a chain-of-custody (CoC).

17A.19.4.17 All material will be accounted for in the daily and weekly reports. All MDAS will be disposed of at a recycler, where it will be processed through a smelter prior to resale or release IAW all governing regulations. If it is discovered during the material transfer and shipping process that a seal has been broken or the CoC of the material cannot be verified, the material in question will be subject to reinspection following the established MPPEH process. The MDAS subcontractor will provide two documents:

(1) CoC: Upon receiving the unopened labeled containers, each with its unique identified and unbroken seal ensuring a continued CoC, and after reviewing and concurring with all provided supporting documentation, the MDAS recycler will sign for having received and agreed with the provided documentation that the sealed containers contained no explosive hazards when received. This document will be signed on company letterhead and state that the contents of sealed containers will not be sold, traded, or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content.

(2) Certification of Destruction Letter: The MDAS recycler will send notification and supporting documentation verifying that the sealed containers have been smelted and are therefore only identifiable by their basic content. This documentation will be submitted as an appendix to the final Site-Specific Final Report (SSFR).

17A.20 DFW 19: Demobilization

17A.20.1 When the SUXOS and UXOQCS have documented that all intrusive investigation is complete the UXOQCS will conduct a MPPEH/Explosives Records Assessment to ensure that all MPPEH and donor explosives are accounted for. MDAS will be properly documented and shipped offsite for demilitarization via smelting. Following successful completion of the records assessment, tools, equipment, and safety gear will be shipped from the site and personnel will demobilize.

Figure 17.1
Geophysical Classification Decision Tree – Preliminary Tasks and Anomaly Detection Survey

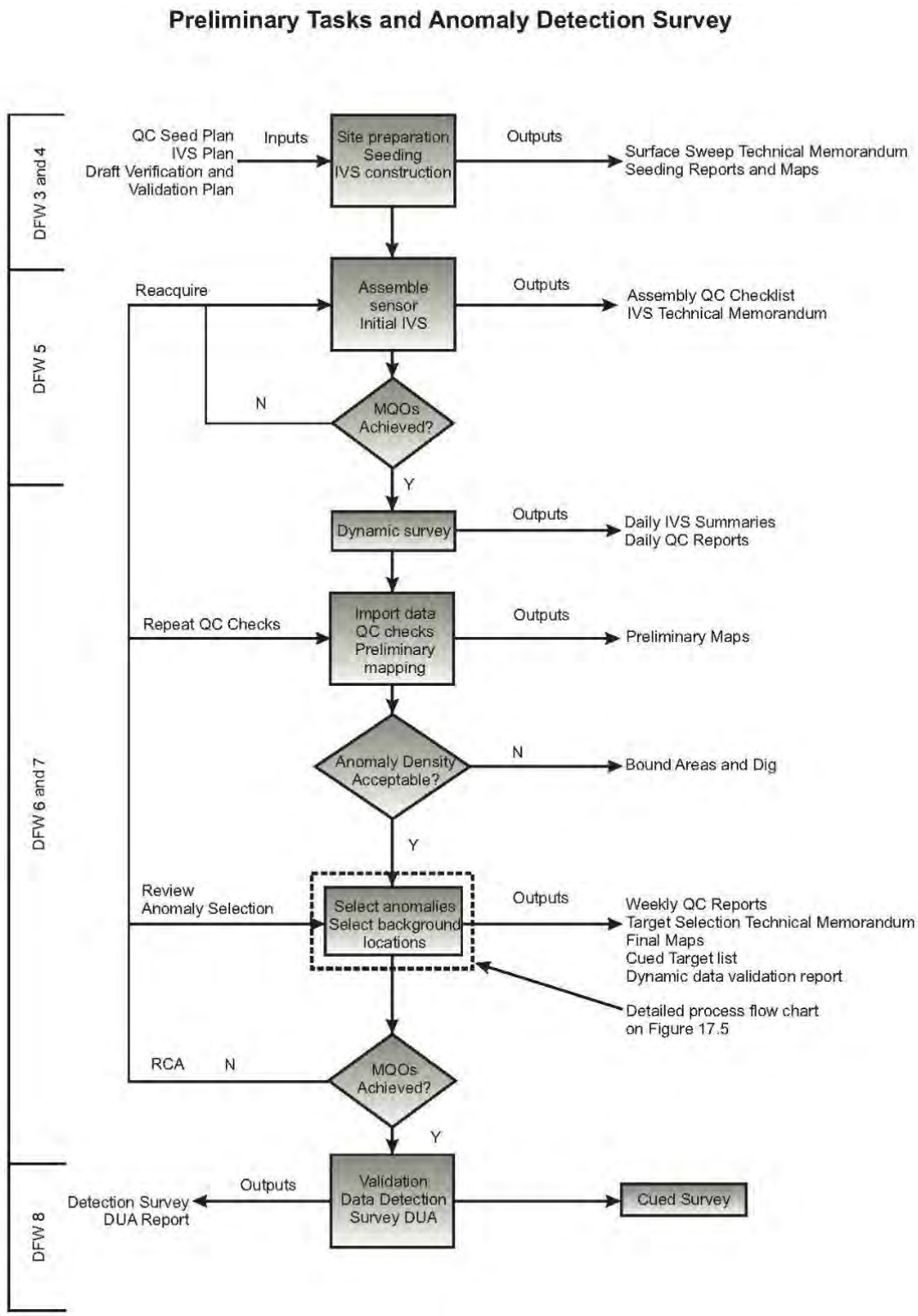


Figure 17.2
Geophysical Classification Decision Tree – Cued Survey

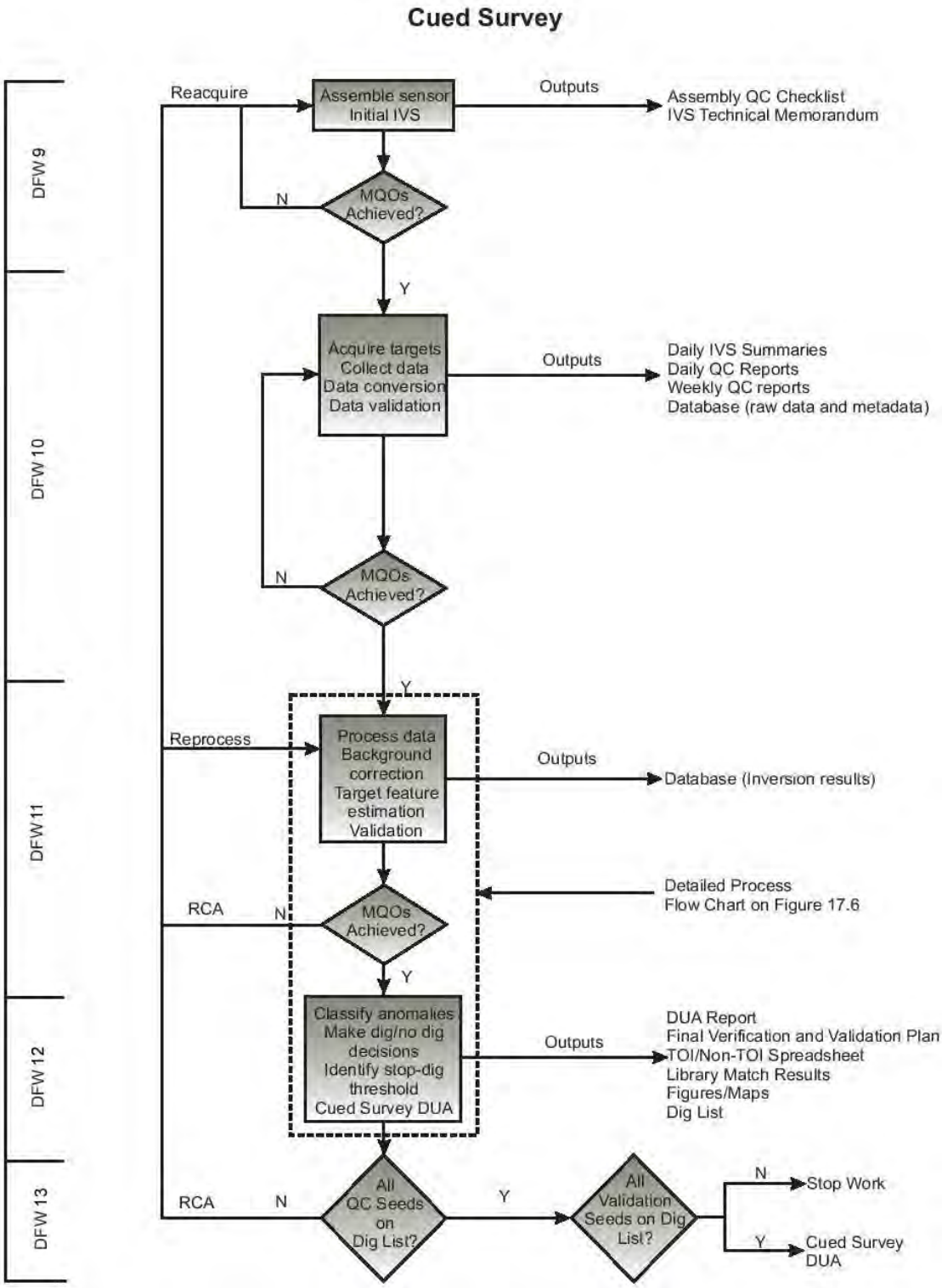
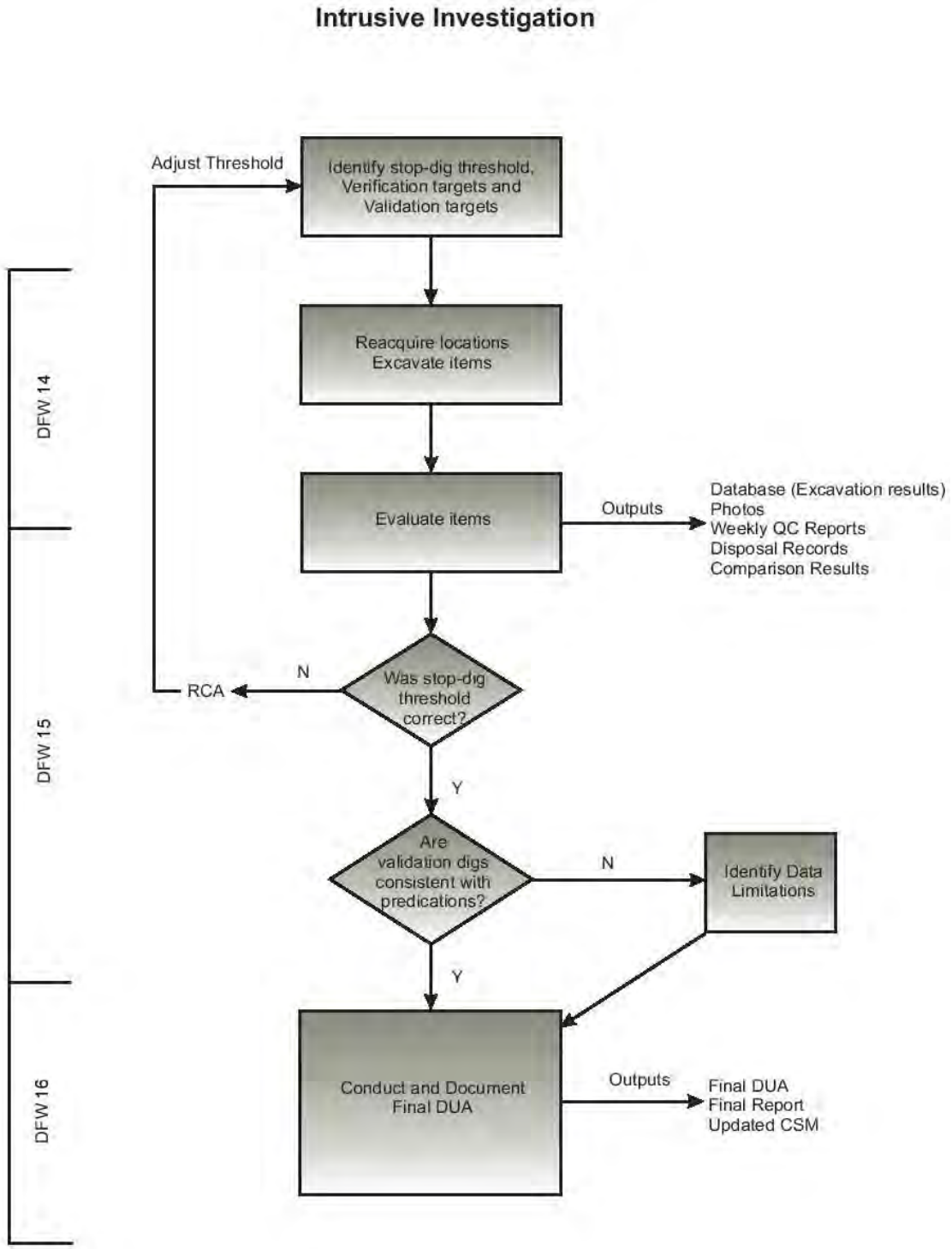


Figure 17.3
Geophysical Classification Decision Tree – Intrusive Investigation



WORKSHEET #17B
MC SAMPLING DESIGN AND RATIONALE

This worksheet describes the project design and the tasks that will be required to successfully complete MC sampling activities during this project and achieve the DQOs described on Worksheet #11B. MC sampling will be performed at MEC detonation locations conducted within the TCRA areas shown on Figure 10.3 (Appendix B).

DFW 20 (continued from WS #17A): MC Sampling

17B.1 Samples for MC analysis will be collected from 0-6 inches below ground surface at post-detonation locations. The objective of this task is to determine whether MEC detonation operations at the site have resulted in a release of MC that exceed the screening levels presented in Worksheet #15.

17B.2 Sample locations will be based on the location of the MEC detonation operations and will be determined in the field.

17B.3 Soil samples will be collected using the Cold Regions Research and Engineering Laboratory (CRREL) 7-point wheel composite method IAW SOP ENV-01.03, *Soil Sampling Procedures* (Appendix I). Soil samples will be analyzed for explosives listed in Worksheet #15.

17B.4 Sample collection procedures are addressed further on Worksheet #18 and in SOP ENV-01.03, *Soil Sampling Procedures* (Appendix I), and analytical procedures are summarized on Worksheets #19 & 30 and Worksheet #23. The GPS coordinates of samples collected will be recorded by the Contractor Sampling Lead. Sample handling and custody requirements are described on Worksheets #26 & 27.

17B.6 *Documentation*: Field logbooks, Daily QC Reports, Chain-of-Custody forms, Air Bills, Sample Log-in, Instrument print-out and raw data, Laboratory review checklists, PM Checklists, Data Validation Reports.

17B.7 *Decision point*: Have MPCs been achieved?

WORKSHEET #18
SAMPLING LOCATIONS AND METHODS

List all site locations that will be sampled and include sample/ID number, if available. (Provide a range of sampling locations or ID numbers if a site has a large number.) Specify matrix and, if applicable, depth at which samples will be taken. Only a short reference for the sampling location rationale is necessary for the table. The text of the QAPP should clearly identify the detailed rationale associated with each reference. Complete all required information, using additional worksheets if necessary.

The sampling and analysis program will be based on the result of the MEC data collection, which the project team will use to determine the location and final number of post-BIP soil samples.

Sample ID	Matrix	Depth	Type	Analyte/ Analytical Group	Sampling SOP	Comments
NWP-TCRA-CPST-S-MMDDYY-001	Soil	0-6" bgs	Hand trowel	Explosives	ENV-01.03	SOP para. *5.3.3 Seven-point Wheel Method for Soil*
NWP-TCRA- CPST -S-MMDDYY-00X[1]	Soil	0-6" bgs	Field Duplicate[2]	Explosives	ENV-01.03	SOP para. *5.3.3 Seven-point Wheel Method for Soil*
NWP-TCRA-CPST-S-MMDDYY-001MS/MSD	Soil	0-6" bgs	MS/MSD[2]	Explosives	ENV-01.03	SOP para. *5.3.3 Seven-point Wheel Method for Soil*
NWP-TCRA-CPST-S-MMDDYY-002	Soil	0-6" bgs	Hand trowel	Explosives	ENV-01.03	SOP para. *5.3.3 Seven-point Wheel Method for Soil*
NWP-TCRA-CPST-S-MMDDYY-003 thru 012[3]	Soil	0-6" bgs	Hand trowel	Explosives	ENV-01.03	SOP para. *5.3.3 Seven-point Wheel Method for Soil*

[1] Labeled so that analysts cannot distinguish duplicate samples
[2] Collect at rate of 1/10 samples (10%)
[3] Final ID to be based on number of detonation events.

bgs – Below ground surface
CPST – Post-detonation composite sample
MMDDYY – Month/Day/Year
MS/MSD – Matrix Spike/Matrix Spike Duplicate
S – Soil

WORKSHEET #19 & 30
SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

For each matrix and analytical group list the sample volume, container specifications, preservation requirements, and maximum holding time.

Laboratory: Eurofins Lancaster, 2425 New Holland Pike, Lancaster, PA 17605-2425, Amek Carter, amekcarter@eurofinsus.com, (717) 556-7252
Required accreditations/certifications: DoD ELAP
Sample Delivery Method: Air/FedEx

Analyte/Analyte Group	Matrix	Method/SOP[1]	Accreditation Expiration Date	Container(s) (number, size, & type per sample)[2]	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Explosives	Soil	Preparation Method/SOP: SW8330B/P-1, P-2 Analysis Method/SOP: 8330B/L-1	11/30/16[3]	1 x 1 gallon Ziploc bag	Cool to < 6°C	14 days	40 days	21 days

[1] Laboratory Standard Operating Procedures are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis.
[2] Sample size is a minimum, the containers listed will be filled to compensate for any required re-analysis or re-extractions. For samples requiring MS/Matrix Spike Duplicate, containers listed should be doubled.
[3] Lancaster confirmed that it is currently in the process of renewing its certification and anticipates that there will be no discontinuity in certification coverage during support of this project.

WORKSHEET #20
FIELD QUALITY CONTROL SUMMARY

This worksheet applies to MC Sampling (MEC-related QC is addressed in WS #22A) and summarizes the QC samples to be collected and analyzed for the project. It shows the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix. Note that if samples are collected over the estimated number shown, additional QC samples will be collected at the rate shown.

Matrix	Analytical Group	Estimated No. of Field Samples	Field Duplicates	Matrix Spike / Matrix Spike Duplicates	Estimated Number of Total Analyses
Soil	Explosives	12	10%	5%/5%	16

WORKSHEET #21
FIELD STANDARD OPERATING PROCEDURES

The applicable field SOPs to be used during the TCRA at Culebra, Puerto Rico are listed in the below table. Copies of these field SOPs are provided in **Appendix I**. The SOPs presented in Appendix I include any project specific modifications.

Reference Number	Title, Revision Date, and/or Number	SOP Originating Organization	Related Equipment Types	Modified for Project? (Y/N)	Comments
AC-01	Assemble the 2X2 System and Verify Correct Operation, Revised 8/02/2016	Parsons	Advanced EMI sensor, RTK GPS, orientation sensor	Y	See Appendix I
AC-02	Advanced Classification Instrument Verification Strip (IVS), Revised 8/02/2016	Parsons	Advanced EMI sensor, RTK GPS, orientation sensor, inert munitions and/or ISOs, hand tools	Y	See Appendix I
AC-05	Collect Static Background Measurements, Revised 8/27/2015	Parsons	Advanced EMI sensor, RTK GPS, orientation sensor, sled, skid steer	N	See Appendix I
AC-06	Collect Cued Target Measurements, Revised 8/27/2015	Parsons	Advanced EMI sensor, RTK GPS, orientation sensor, sled, skid steer	N	See Appendix I
AC-07	Process Cued 2X2 Data, Revised 8/02/2016	Parsons	--	Y	See Appendix I
AC-08	Verify Recovered Objects are Compatible with Predictions, Revised 8/28/2015	Parsons	--	N	See Appendix I
AC-09	Validate Classification Process, Revised 8/28/2015	Parsons	--	N	See Appendix I
DGM-01	IVS Construction and Testing, Revised 8/27/2015	Parsons	Analog geophysical instrument(s), EM61-MK2 sensors, RTK GPS	N	See Appendix I
DGM-02	Seeding, Revised 8/28/2015	Parsons	Analog geophysical instrument(s), EM61-MK2 sensor, digital camera, RTK GPS	N	See Appendix I
DGM-03	EM61-MK2 Data Acquisition, Revised 8/28/2015	Parsons	EM61-MK2 sensors, tow vehicle, array structure, RTK GPS	N	See Appendix I
DGM-04	EM61-MK2 Data Processing, Revised 8/28/2015	Parsons	--	N	See Appendix I

WORKSHEET #21 (CONTINUED)
FIELD STANDARD OPERATING PROCEDURES

Reference Number	Title, Revision Date, and/or Number	SOP Originating Organization	Related Equipment Types	Modified for Project? (Y/N)	Comments
DGM-05	EM61-MK2 Reacquisition & Anomaly Resolution, Revised 8/28/2015	Parsons	EM61-MK2, RTK GPS	N	See Appendix I
ENV-01.03	Soil Sampling, Revised 10/07/15	Parsons	--	N	See Appendix I
CHEM-01	Chemistry Data Review and Management	Parsons	--	N	See Appendix I
501.01.1	Explosive Materials Accountability and Management	HGL	--	N	See Appendix I
502.01.1	Explosive Demolition Operations	HGL	Radios, demolition kit, first-aid equipment, fire extinguisher, sand bags, shovel	N	See Appendix I
503.01.1	Explosives Storage Inspection and Security	HGL	--	N	See Appendix I
504.01.1	MPPEH Inspection and Management	HGL	Analog geophysical instrument(s), first-aid equipment, fire extinguisher	N	See Appendix I
505.01.1	Analog MEC Clearance Operations	HGL	Analog geophysical instrument(s), first-aid equipment, fire extinguisher, shovel	N	See Appendix I
506.01.1	Digital MEC Clearance Operations	HGL	Analog and digital geophysical instrument(s), first-aid equipment, fire extinguisher, shovel, tape measure	N	See Appendix I
510.01.1	MEC Anomaly Avoidance Support	HGL	Analog geophysical instrument(s), first-aid equipment, fire extinguisher	N	See Appendix I
--	Supplemental Standard Operating Procedures for Endangered Species Conservation and their Critical Habitat, DERP-FUDS Property I02PR0068, Culebra, Puerto Rico	CESAJ	--	Y	See Appendix I

WORKSHEET #22A
FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION FOR MEC-RELATED DFWS

This worksheet describes the field equipment needed for the project and the associated calibration, maintenance, testing, and inspection procedures for that field equipment. This worksheet also documents the field equipment's frequency of activity, acceptance criteria, and corrective action requirements.

Table 22A.1
Dynamic Survey (Instrument: EM61-MK2 and Analog Sensor)

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Instrument Functionality (Analog System)	DFW 3; DFW 4; DFW 6; DFW 17 / SOP 510.01.1; SOP 505.01.1	Daily	Operator/Daily QC Report/UXOQCS	Each operator demonstrates, in a test plot separate from the IVS, positive detection on a daily basis to the presence of 37mm projectile buried at a depth of 12 inches in best and worst case orientation and 5-inch HE projectiles buried at a depth of 40 inches (or equivalent ISOs).	Repair or replace instrument, then repeat test
Coverage, Detection, and Recovery (Analog)	DFW 6; DFW 17 / SOP 505.01.1	Evaluated for each 100 ft by 100 ft grid.	Field Team Leader/Daily QC Report; Grid Status Records /UXOQCS	QC seed items will be distributed such that each team will encounter between one and three detection seeds per team per day and coverage seeds such that each operator encounters between one and three total seeds per day	Root cause analysis (RCA)/CA CA assumption: grid fails; re-clear

Table 22A.1 (Continued)
Dynamic Survey (Instrument: EM61-MK2 and Analog Sensor)

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Anomaly Resolution	DFW 17/ SOP 505.01.1	Evaluated for 100 ft by 100 ft grid.	Field Team Leader/Daily QC Report; Grid Status Records/UXOQCS	UXOQCS will conduct a 25 percent instrument-assisted resweeps of each grid in random patterns. Finding no MEC or MPPEH excluding small arms ammunition (.50 cal and smaller), and no MD or RRD equivalent to, or greater than 37mm in diameter or width on the surface of the MRS. Finding no subsurface MEC or MPPEH shallower than 8x the item's diameter.	RCA/CA CA assumption: excavation fails; re-clear
Geodetic Equipment Functionality	DFW 3 / SOP 505.01.1	Daily	Operator/Daily QC Report/UXOQCS	Measured position of control point within 10 cm of ground truth	CA assumption: redo affected work.
Initial dynamic positioning accuracy (IVS, EM61-MK2)	DFW 5 / SOP DGM-01.01	Once prior to start of dynamic data acquisition	Project Geophysicist/ IVS Technical Memorandum/ QC Geophysicist	Derived positions of IVS target(s) are within 25 cm of the ground truth locations	CA: Make necessary adjustments, and re-verify

Table 22A.1 (Continued)
Dynamic Survey (Instrument: EM61-MK2 and Analog Sensor)

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Ongoing Instrument Function Test (EM61-MK2)	DFW 6 / SOP DGM-03.01	Beginning and end of each day and each time instrument is turned on	Field Team Leader/ running QC summary / Project or QC Geophysicist	Response within 20% of initial response (comparison with the mean static spike minus mean static background)	CA: make necessary repairs and re-verify
Ongoing dynamic positioning precision (EM61-MK2)	DFW 6 / SOP DGM-03.01	Beginning and end of each day	Project Geophysicist/ running QC summary/ QC Geophysicist	Derived positions of IVS target(s) within 25 cm of the average locations	RCA/CA
Reacquisition and anomaly resolution precision (EM61-MK2)	DFW 6 / SOP DGM-03.01	Beginning and end of each day	Project Geophysicist/ running QC summary/ QC Geophysicist	Derived positions of IVS target(s) within 25 cm of the average locations	RCA/CA
In-line measurement spacing (EM61-MK2)	DFW 6/ SOP DGM-03.01	Verified for each data collection day using existing UX Detect tools based upon sensor center position	Project Geophysicist/ running QC summary/ QC Geophysicist	100% ≤ 0.25 m between successive measurements	RCA/CA CA assumption: data set fails, (recollect portions that fail)
Coverage (EM61-MK2)	DFW 6 / SOP DGM-03.01	Verified for each 100 ft by 100 ft grid using existing UX Detect tools based upon sensor center position	Project Geophysicist/ running QC summary and Dynamic Data Validation Report/ QC Geophysicist	100% at ≤0.7 m cross-track measurement spacing (excluding site specific access limitations, e.g., obstacles, unsafe terrain)	CA CA assumption: Gaps require fill-in lines to achieve required coverage unless no indication of subsurface metal in gap (1)

(1) Analyst will review data surrounding identified gaps to determine the possibility that subsurface metal is present in the gap. If the analyst and USACE Geophysicist agree that the data surrounding the gap indicates there is no potential for subsurface metal in the gap, it will not be recollected.

Table 22A.1 (Continued)
Dynamic Survey (Instrument: EM61-MK2 and Analog Sensor)

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Dynamic detection performance (EM61-MK2)	DFW 6 / SOP AC-04, SOP DGM-04	Evaluated by 100 ft by 100 ft grid	QC Geophysicist; lead agency QA Geophysicist/ Dynamic Data Validation Report/ lead agency QA Geophysicist	All GSV seeds detected with at least 75% of minimum expected response at maximum horizontal offset Positional accuracy of GSV seed ≤ 0.35m + ½ line spacing for data collected with RTK GPS positioning, ≤ 0.50m + ½ line spacing for data collected with fiducial positioning.	RCA/CA
Valid position data (EM61-MK2)	DFW 6 / SOP DGM-03.01	Per measurement	Field Team Leader/ running QC summary/ Project Geophysicist	GPS status flag indicates fix and confirmation that fix should be indicative of DOP <4.0(2)	CA: Interpolate positions for minor (<3 m) GPS fluctuations along straight lines (path before and after gap indicates line was straight); longer out-of-spec data rejected

(2) GPS planning software will be used to confirm that expected DOP is less than 4.0 throughout the planned survey period each day; daily expected DOP graphs will be saved to the project file.

Table 22A.2
Cued Survey (Instrument: MM 2X2/TEMTADS; Classification Tool: UX-Analyze)

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Verify correct assembly	DFW 9 / SOP AC-01	Once following assembly	Field Team Leader/ instrument assembly checklist/ Project Geophysicist	As specified in **SOP AC-01**, Assembly checklist	CA: Make necessary adjustments, and re-verify
Initial system functionality test	DFW 9 / SOP AC-01	Once following assembly	Field Team Leader/ instrument assembly checklist/ Project Geophysicist	Library match metric ≥ 0.95 for each of the five sets of inverted polarizabilities	CA: make necessary repairs or adjustments and re-verify
Initial IVS background measurement (five background measurements, one centered at the flag and one offset at least 35 cm in each cardinal direction)	DFW 9 / SOP AC-02	Once during initial system IVS test	Field Team Leader/ IVS Technical Memorandum/ Project Geophysicist	All decay amplitudes lower than project threshold (threshold dependent upon soil response)	CA: clear and resurvey or reject/replace BG location
Initial derived polarizabilities accuracy (IVS)	DFW 9 / SOP AC-02	Once during initial system IVS test	Project Geophysicist/ IVS Technical Memorandum/ QC Geophysicist	Library Match metric ≥0.9 for each set of inverted polarizabilities	RCA/CA
Derived target position accuracy (IVS)	DFW 9 / SOP AC-02	Once during initial system IVS test	Project Geophysicist/ IVS Technical Memorandum/ QC Geophysicist	All IVS item fit locations within 0.25 m of ground truth locations	RCA/CA
Ongoing IVS background measurements	DFW 10 / SOP AC-02	Beginning and end of each day as part of IVS testing	Project Geophysicist/ tracking summary/ QC Geophysicist	All decay amplitudes lower than project threshold	RCA/CA CA assumption: rejection of BG measurement (unless RCA indicates system failure)
Ongoing derived polarizabilities precision (IVS)	DFW 10 / SOP AC-02	Beginning and end of each day as part of IVS testing	Project Geophysicist/ tracking summary/ QC Geophysicist	Library Match to initial polarizabilities metric ≥ 0.95 for each set of three inverted polarizabilities	RCA/CA

Table 22A.2 (Continued)
Cued Survey (Instrument: MM 2X2/TEMTADS; Classification Tool: UX-Analyze)

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Ongoing derived target position precision (IVS)	DFW 10 / SOP AC-02	Beginning and end of each day as part of IVS testing	Project Geophysicist/ tracking summary/ QC Geophysicist	All IVS items fit locations within 0.25 m of average of derived fit locations	RCA/CA
Initial measurement of production area background locations (five background measurements: one centered at the flag and one offset at least 35 cm in each cardinal direction)	DFW 10 / SOP AC-05	Once per background location	Field Team Leader/ background location report/Project Geophysicist	All decay amplitudes lower than project threshold	CA: reject BG location and find alternate or review project threshold if measured responses seem correct based on varying site conditions
Ongoing production area background measurements	DFW 10 / SOP AC-05	Once per background measurement Background data collected a minimum of every two hours during production	Field Team Leader/ failures noted in field log and tracking summary/ Project Geophysicist	All decay amplitudes lower than project threshold	CA: BG measurement rejected. Earlier/later BG point used if BG measurements are consistent throughout the day; re-collect affected data if varying BG results indicate loss of point is significant
Ongoing production area background measurements		Evaluated for each background measurement	Operator/ tracking summary/ Project Geophysicist	Background point collected within 0.4 m of initial collection location for that point	CA: BG measurement rejected; re-collect affected targets
Ongoing instrument function test		Beginning and end of each day as part of IVS testing	Field Team Leader/tracking summary/Project Geophysicist	Response (mean static spike minus mean static background) within 25% of predicted response for all monostatic Tx/Rx combinations	CA: make necessary repairs and re-verify

Table 22A.2 (Continued)
Cued Survey (Instrument: MM 2X2/TEMTADS; Classification Tool: UX-Analyze)

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Transmit current levels		Evaluated for each sensor measurement	Field Team Leader/ tracking summary/ Project Geophysicist	Peak transmit current must be ≥ 5A for lithium ion batteries; ≥ 80% of initial currents measured for lead acid batteries when fully charged	CA: stop data acquisition activities until condition corrected
Orientation Data		Evaluated for each sensor measurement	Field Team Leader/tracking summary /Project Geophysicist	Ensure orientation data are valid: orientation data reviewed for out of range data.	CA: stop data acquisition activities until condition corrected or project team decides on acceptable work around.
Ongoing production area measurements	DFW 10 / SOP AC-06	Evaluated for each dynamic target	Operator/ tracking summary/ Project Geophysicist	Cued measurement collected within 0.4 m of all dynamic targets.	CA: Collect cued measurement directly over dynamic target
Confirm adequate spacing between units	DFW 10 / SOP AC-05	Evaluated at start of each day (or grid)	Field Team Leader/ Field Logbook/ Project Geophysicist	Minimum separation of 25 m	CA: Recollect all coincident measurements
Confirm response is not saturated	DFW 10 / SOP AC-07	Evaluated for each cued measurement	Data analyst/ tracking summary/ Project Geophysicist	Monitor for response clipping (identifiable as consecutive measurements of similar response [flat-line] for individual Tx/Rx pair data, typically above 800 mV/A)	CA: Cued measurements exhibiting saturation will be classified as either TOI, if the data indicates such despite saturation, or "inconclusive" if the data indicates non-TOI.
Confirm inversion model supports classification (1 of 3)	DFW 10 / SOP AC-07	Evaluated for all models derived from a measurement (i.e. single item and multi-item models)	Project Geophysicist/ Measurement QC summary/ QC Geophysicist	Derived model response must fit the observed data with a fit coherence ≥ 0.8	CA: Target classified as inconclusive or recollected unless analyst can justify poor coherence (dynamic target looks like noise, pick on edge of anomaly, etc.)

Table 22A.2 (Continued)
Cued Survey (Instrument: MM 2X2/TEMTADS; Classification Tool: UX-Analyze)

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Confirm inversion model supports classification (2 of 3)	DFW 10 / SOP AC-07	Evaluated for each derived target	Project Geophysicist/ Measurement QC summary/ QC Geophysicist	Fit location estimate of item ≤ 0.4 m from center of sensor	CA: Re-shot at location specified by in-field inversion unless fit location is within 0.4 m of another cued target
Confirm inversion model supports classification (3 of 3)	DFW 10 / SOP AC-07	Evaluated once per 100 ft by 100 ft grid for all seeds	QC Geophysicist; lead agency QA Geophysicist/ Measurement Inversion model QC summary/USACE QA Geophysicist	100% of predicted seed positions ≤ 0.15 m from known position (x, y, z)	RCA/CA
Confirm reacquisition GPS precision	DFW 10 / SOP AC-07	Daily	UXO tech or field tech/ Project QC database/ Project Geophysicist	Benchmark positions repeatable to within 10 cm	RCA/CA
Classification Performance	DFW 12 / SOP AC-08	Evaluated once per 100 ft by 100 ft grid for all seeds	QC Geophysicist; USACE QA Geophysicist/ Ranked Dig List/ USACE QA Geophysicist	100% of QC and validation seed items placed on dig list	RCA/CA
Classification Performance	DFW 12 / SOP AC-08	Evaluated once per 100 ft by 100 ft grid for all seeds with predicted sizes based on three usable polarizabilities	QC Geophysicist; USACE QA Geophysicist/ Ranked Dig List/ USACE QA Geophysicist	100% of predicted sizes match seed item ground truth	RCA/CA

Table 22A.3
Intrusive Investigation

Measurement Quality Objective	DFW/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Dynamic detection performance (analog surveys)	DFW 6 / SOP 505.01.1	Evaluated by 100 ft by 100 ft grid	UXO Team Leader/ running QC summary/ UXOQCS	All seed items recovered and returned to UXOQCS	RCA/CA
Anomaly Resolution (DGM, non-AC areas)	DFW 14 / SOP 506.01.1	Rate varies depending on lot size.	UXOQCS	90% confidence <1% unresolved anomalies. Accept on zero.	Lot fails. Redo lot.
Confirm derived features match ground truth (1 of 2)	DFW 15 / SOP AC-09	Evaluated for all targets classified as digs based on three usable polarizabilities	Project Geophysicist/Measurement Inversion Model QC Summary or Intrusive database/ QC Geophysicist	100% of fit locations ≤0.25 m from recovered item positions (x, y, z).	RCA/CA
Confirm derived features match ground truth (2 of 2)	DFW 15 / SOP AC-09	Evaluated for all targets classified as digs based on three usable polarizabilities	Project Geophysicist/Dig List and Intrusive database/ Project or QC Geophysicist	100% of predicted size estimates qualitatively match recovered object size(1)	RCA/CA
Verification of TOI/non-TOI threshold	DFW 15 / SOP AC-08	Evaluated once for project By adding up to 200 digs beyond last TOI to the dig list. (See Appendix L).	Project Geophysicist/ Verification and Validation Report/ QC Geophysicist	100% of predicted non-TOI intrusively investigated are non-TOI	RCA/CA/Adjust threshold
Classification validation	DFW 15 / SOP AC-09	Evaluated once for project By adding up to 200 digs beyond classified as non-TOI to the dig list. (See Appendix L).	Project Geophysicist/ Verification and Validation Report/ QC Geophysicist	100% of predicted non-TOI qualitatively matches predictions (1)	Document in DUA

(1) It is acceptable for items with recovered or predicted size close to the small/medium or medium/large boundaries (e.g. a 37mm projectile, small ISO, large ISO, or 105mm projectile) to be placed in either size category.

WORKSHEET #22B
FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION FOR MC SAMPLING

This worksheet describes the field equipment needed for MC sampling and the associated calibration, maintenance, testing, and inspection procedures for that field equipment. This worksheet also documents the field equipment's frequency of activity, acceptance criteria, and corrective action requirements. GPS equipment used for MC sampling will be calibrated, maintained, tested, and inspected IAW Table 22A.1, Measurement Quality Objective for Geodetic Equipment Functionality.

☒ Worksheet Not Applicable (State Reason): No additional MC sampling field equipment or instruments require calibration, maintenance, testing, or inspection.

WORKSHEET #23
ANALYTICAL SOP REFERENCES TABLE

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
L-1	1-P-QM-WI -9029396: Nitroaromatics and Nitramines by Method 8330B in Water and Solids using HPLC with UV Detection, Revision 2; 10/13/2015	Definitive	HPLC/UV	Lancaster	No
P-1	1-P-QM-WI -9015173: Ultrasonic Extraction of Nitroaromatics and Nitramines by Method 8330/8330A/8330B in Solids, Revision 14; 06/23/2016	NA	Preparation method	Lancaster	No
P-2	1-P-QM-PRO-9030806: Sample Preparation of Solid Samples for Extraction and Analysis by SW-846 8330B, Revision 3; 09/08/2016	NA	Preparation method	Lancaster	No

WORKSHEET #24
ANALYTICAL INSTRUMENT CALIBRATION TABLE

In all cases, the CA required in this worksheet will be the responsibility of the bench analysts and the laboratory Section Manager responsible for each method. Where an instrumental problem cannot be resolved by CA/routine maintenance, the affected instrument must be removed from service. Following necessary repairs, the instrument will be recalibrated and determined to be fully functional before being cleared for return to service.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	SOP Reference[2]
HPLC/UV	Minimum five-point initial calibration (ICAL) for target analytes for linear or six-point for quadratic; lowest concentration standard at or below the LOQ.	At instrument setup and after initial calibration verification (ICV) or CCV failure, prior to sample analysis.	%RSD of calibration factor for each analyte ≤method-specific maxima linear – $r^2 \geq 0.990$	1) Evaluate system 2) Recalibrate as necessary	L-1
	ICV (must be from a second source)	Immediately following initial calibration	Each target compound %D ≤method-specific maxima	1) Evaluate system 2) Recalibrate as necessary	L-1
	Retention time verification	Update at start of run or daily	All standards within retention time window	1) Correct problem 2) Re-analyze all samples analyzed since the last retention time check	L-1
	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	Each target compound %D ≤method-specific maxima	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control CCV	L-1

[1] Method-specific criteria are provided in the method-specific Worksheet #12.
[2] Analytical SOP References Table (Worksheet #23).

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WORKSHEET #25
ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[1]
HPLC/UV	Replace columns, detector flow cell windows and ball-valve cartridges as needed, clean/change filters, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	L-1

[1] Reference from the Analytical SOP References table (Worksheet #23).

WORKSHEET #26 & 27
SAMPLE HANDLING, CUSTODY, AND DISPOSAL

This worksheet provides the procedures for handling, labeling, packaging, shipping, and disposal of soil samples collected for MC analysis, to include sample custody requirements. Personnel responsible for these activities are identified in Table 26/27.1.

26/27.1 SAMPLE HANDLING

26/27.1.1 Immediately after each sample has been collected, the following procedures will be used to initially prepare the sample containers for shipment to the laboratory:

1. Seal the container by wrapping tape around the lid or Zip-loc of the container. Use PVC tape on bottles containing samples for inorganic constituent analysis.
2. Place containers in bubble pack.
3. If using glass containers, place all glass containers in a Ziploc-type bag and seal.
4. Use a permanent marker to write the sample ID on the outside of the Zip-loc bag.
5. Line insulated shipping cooler with a large trash bag and place samples into the lined, insulated cooler, and then cool (to 4 ± 2 °C) using wet ice. **Samples will be placed on ice as soon as possible following collection.**
6. Place all samples in designated cooler. Make sure all samples in the cooler are listed on the COC form. See paragraph 26/27.6 below for additional information to be included on the COC form.

26/27.2 SAMPLE LABELING

26/27.2.1 Sample labels will include, at a minimum, project name, project number, sample ID, date/time collected, analysis group or method, preservative, and sampler's name. Labels will be taped to the jar or sample bag prior to sample collection to ensure that they do not separate.

26/27.3 SAMPLE PACKAGING

26/27.3.1 Once all of the samples for the day are collected, the following procedures will be used to complete the sample packaging procedures for shipment to the laboratory:

1. Seal completed COC form in a sealable plastic bag and tape to the inside of the cooler lid.
2. Pour out water from melted ice and replace with double bagged fresh ice.
3. If using bottles, place sample bottles in upright position in such a way they do not touch.
4. Close trash bag and seal with tape.
5. Fill empty spaces in cooler with ice or packaging material.

6. Tape shut cooler drain plug.
7. Securely seal shipping container/cooler with packing tape and custody seals (provided by laboratory).
8. Place "This side up" labels on all four sides of the cooler and "Fragile" labels on two sides of the cooler.
9. Attach a copy of the laboratory's USDA soil permit (Appendix J) to one of the remaining sides of the outside of the cooler, along with the shipping labels required by USDA.
10. Ship container/ cooler to the laboratory via overnight express.

26/27.4 SAMPLE SHIPPING

26/27.4.1 Field samples collected from the project site will be sent to:

Eurofins Lancaster Laboratories, Inc.
Attn: Amek Carter
2425 New Holland Pike
Lancaster, PA 17605-2425
Ph: (717) 556-7252

26/27.5 SAMPLE CUSTODY PROCEDURES

26/27.5.1 Coolers will be shipped to the laboratory via overnight shipping, with the air bill number indicated on the CoC (to relinquish custody).

26/27.5.2 All laboratory sample receipt, internal custody, and sample archiving procedures shall be completed IAW Lancaster SOPs: L-1, P-1, and P-2.

26/27.5.3 Upon receipt, the laboratory will document cooler temperatures IAW laboratory SOPs. Once the cooler has been examined and logged in, the laboratory will contact the HGL Project Chemist and discuss the status of the sample shipment.

26/27.5.4 Upon opening the cooler at the analytical laboratory, the receiving clerk will sign the CoC. Then the sample containers in the cooler will be unpacked and checked against the client's CoC. Any discrepancies noted with the samples will be noted on the CoC upon receipt. The clerk will deliver the CoC (and any other paperwork) to the Laboratory PM for entry into the Laboratory Information Management System (LIMS) and for client notification.

26/27.5.5 The laboratory will send sample login forms to the Parsons data validator to check that the sample IDs and parameters are correct. The field logbook will identify the sample ID with the location, depth, date/time collected, and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the CoC.

26/27.6 CHAIN-OF-CUSTODY DOCUMENTATION

26/27.6.1 CoC forms will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID, date/time collected, number and type of containers, preservative information, analysis method, and comments. The CoC will also have the sampler's name and signature. The CoC will link the location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the LIMS database for each sample.

126/27.7 SAMPLE DISPOSAL

26/27.7.1 The field samples and all extracts will be stored at the laboratory for 30 days after a final report has been submitted to HGL. The laboratory hazardous waste manager will be responsible for the final sample disposal upon notice from the Contractor Project Chemist.

26/27.8 NON-CONFORMANCE

26/27.8.1 The Laboratory Project Manager will contact the Contractor Project Chemist to resolve any issues encountered during sample receipt and login. The Contractor Project Chemist will coordinate with the Contractor Sampling Lead and other personnel as necessary to resolve the issues.

Table 26/27.1
Responsibilities for Sample Handling, Custody, and Disposal

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample labeling	Contractor Sampling Team Lead/designee	Para. 26/27.2; WS #18; ENV-01.03
Chain-of-custody form completion	Contractor Sampling Team Lead/designee Lancaster Receiving Supervisor	Para. 26/27.5; Para. 26/27.6
Packaging	Contractor Sampling Team Lead/designee	Para. 26/27.3
Shipping Coordination	Contractor Project Chemist	
Sample Receipt, inspection, log-in	Lancaster Receiving Supervisor	Para. 26/27.4, L-1
Sample custody and storage	Lancaster PM	Para. 26/27.5, L-1
Sample disposal	Lancaster PM	Para. 26/27.7, L-1

WORKSHEET #28
ANALYTICAL QUALITY CONTROL AND CA

The following tables provide general guidance for the evaluation of QC analyses and the implementation of CAs for out-of-control situations. The method-specific acceptance criteria are presented in the applicable table in Worksheet #12 and Worksheet #15.

WORKSHEET #28.1
METHOD QC TABLE – EXPLOSIVES BY SW-846 METHOD 8330B

QC Element	Frequency	Project-specific Performance Criteria[1]	CA	Person(s) Responsible for CA	DQI
MB	Every analytical batch (maximum of 20 samples)	Target analytes not detected >½ LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	1) Rerun 2) Evaluate batch 3) Reextract or qualify results as necessary	Section Manager/ Laboratory Analyst	Accuracy/Bias and Representativeness
LCS (and LCSD, if performed)	Every analytical batch (maximum of 20 samples)	Analyte-specific %R and RPD acceptance criteria	1) Rerun 2) Evaluate batch 3) Reextract or qualify results as necessary	Section Manager/ Laboratory Analyst	Accuracy/Bias (and Precision)
MS/MSD	As indicated on CoC forms, and as required for batch control	Analyte-specific %R and RPD acceptance criteria (NA to air methods or if parent sample concentration ≥4x the spike level)	1) Evaluate MS/MSD to assess matrix interference 2) Evaluate batch and qualify results as necessary	Section Manager/ Laboratory Analyst	Accuracy/Bias and Precision
Surrogate Recovery	Every sample	Surrogate-specific %R acceptance criteria	1) Rerun 2) Reextract or qualify results as necessary	Section Manager/ Laboratory Analyst	Accuracy/Bias
Retention time window position	Once per initial calibration and at the beginning of the analytical shift	All peaks associated with positive results must elute within the established retention time window	1) Correct problem 2) Recalibrate instrument 3) Reanalyze results as necessary	Section Manager/ Laboratory Analyst	Analyte Identification
Confirmation column	All positive results must be confirmed	Result not confirmed using second column or detector	1) Analyst must evaluate data to determine if unconfirmed result is a detection 2) Section manager must review analyst's determination	Section Manager/ Laboratory Analyst	Analyte Identification
		Results between primary and second column RPD ≤40%; not required for TPH methods	1) Analyst must select result to report IAW method requirements and laboratory SOP 2) Section manager must review analyst's determination	Section Manager/ Laboratory Analyst	Accuracy/Bias

[1] Method-specific acceptance criteria are presented in the corresponding tables of Worksheets #12 and 15.

WORKSHEET #29
PROJECT DOCUMENTS AND RECORDS

The following is a list of site records that should be used and maintained for each site investigation and for the project as a whole, as well as the personnel responsible for generating and verifying the records. All records should be maintained in the HGL, Parsons, laboratory, and other subcontractor project files for a minimum of five years.

29.1 PROJECT DOCUMENTS AND RECORDS FOR MEC-RELATED TASKS

29.1.1 All final document files, including reports, figures, and tables, will be submitted in electronic format (both Microsoft Office 2007 or later and portable document format (.pdf)). Any document files, logs, including reports, figures, and tables will be made available to the in-site USACE OESS upon request from the OESS.

29.1.1 Geographic Information System (GIS) Electronic File Management

29.1.1.1 A project-specific GIS will be used to store and manage all relevant geospatial-related data and information. HGL will manage and maintain project data and update the CSM in GIS IAW data item description (DID) WERS-007.01, EM 200-1-2, EM 1110-1-1200, EM 200-1-15 and applicable Interim Guidance Documents. The final GIS deliverable will include all documentation, reports, meeting minutes, databases, etc., created developed or modified under this TO in original and PDF format. GeoSpatial data activities will include the following:

- Maintain and update property GIS data for all landowners within the project boundaries. Property owner privacy will be preserved. Property owner names shall not be disseminated in any documents.
- Perform a pre- and post-project response action geospatial data analysis using a GIS.
- Consolidate all available existing data that is applicable to the project into the GeoDatabase. Analyze the data and relay pertinent information to the PDT. If an existing GIS database is available, it will be provided by the Government. The analyses 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.
- Incorporate layers that overlay on maps of the site that identify physical features, and MPPEH/MD found during the investigation. Examples include: streets, anomalies, MEC positively identified, identifiable MD, sampling location, cultural resources, and environmental, biological, and socio-economic variables.
- Perform civil surveys IAW EM 200-1-15 and DID WERS-007.01.

29.1.2 DGM Electronic File Management

29.1.2.1 DGM data files will be delivered IAW the requirements in DID WERS-004.01 Attachment C. It is expected that all advanced EMI sensor and EM61-MK2 data transfer will be accomplished via ftp site. If the large size of the advanced EMI sensor data files makes the process cumbersome, the data will be transferred on an external hard drive.

29.1.2.2 EM61-MK2 detection data will be split or consolidated into survey units for storage and target selection, although initial QC checks for all data, with the exception of coverage, will be performed by date. Coverage QC will be performed for entire survey units. Raw cued data will be named by target ID, processed cued data will be organized, stored, and QC checked by date. Daily QC files (i.e. IVS, static, and function checks) and advanced EMI sensor background files will be stored in separate databases and folders from the production data, although they will also be named and organized by date in their respective folders.

29.1.2.3 Parsons and HGL geophysicists will use the latest version of UX-Analyze for processing and interpreting advanced EMI sensor and EM61-MK2 data. TOI libraries used for classification will be developed using the library provided with UX-Analyze, data collected during previous projects, and data collected as part of ESTCP's ongoing library expansion project (MR-201424). The TOI libraries will be included in advanced EMI sensor data deliverables to document what library was used for classification.

Table 29.1
Project Documents and Records for MEC-Related Tasks

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
UXOSO Logbook	Record all important events	HGL UXOSO	Daily	Hard Copy/Onsite during fieldwork, then Project File/HGL Huntsville Office	Available to USACE on request
Surface Clearance Memorandum	Records completion of surface clearance for geophysical activities	HGL UXOQCS	Once	.DOCX or .PDF/Project File/HGL Huntsville Office	Available to USACE on request
QC Seed Plan	Describes intended seed types and locations for QC seeds to be placed	HGL QC Geophysicist	Once, prior to seeding	.DOCX/Onsite during seeding and in secure folder on HGL network (limited to QC personnel)/HGL-Denver Office	Via e-mail
QC Seed Firewall Plan	Describes methods used to limit QC seed information to Parsons QC personnel	HGL QC Geophysicist	Once, prior to seeding	.DOCX/Project HGL-Denver Office	Via e-mail and with Final QAPP (Appendix O)

Table 29.1 (Continued)
Project Documents and Records for MEC-Related Tasks

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
Daily Status Reports	Report notable events to project team	HGL SUXOS	Daily	.DOCX or .PDF/Project File/HGL Huntsville Office	Via e-mail, and included with Site Specific Final Reports
Daily Biologist Survey Reports	Report notable Environmental Survey and Beach Monitoring events to project team	Project Biologist	Daily	.DOCX or .PDF/Project File/HGL Huntsville Office	Via e-mail, and included with Site Specific Final Reports
Daily QC Report	Report QC events to project team	HGL UXOQCS	Daily, when QC events occur	.DOCX or .PDF/Onsite during fieldwork, then Project File/ HGL Huntsville Office	Via e-mail, and included with Site Specific Final Reports
Weekly Geophysical QC Report	Report of DGM QC results	Parsons Project Geophysicist/ HGL QC Geophysicist	Weekly	.DOCX/Project File/ HGL Huntsville Office	Via e-mail
Team Leader Logbook(s)	Record important team-specific events	HGH Team - Team Leader(s)	Daily	Hard Copy/Onsite during fieldwork, then Project File/ HGL Huntsville Office	Available on request
Field Change Request Form	Record non-critical (i.e., minor) deviations from the QAPP (*"non-critical" deviations are defined as those that will not impact project objectives*)	HGL SUXOS	As needed	.DOCX or .PDF/Project File/ HGL Huntsville Office	Via e-mail, and included with SSFR

Table 29.1 (Continued)
Project Documents and Records for MEC-Related Tasks

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
Root Cause Analysis	Document MPC failures and causes, as well as corrective actions taken, actions taken to prevent recurrence, and actions taken to monitor effectiveness of corrective action	HGL UXOQCS / QC Geophysicist	If MPC failures are noted	.DOCX or .PDF/Project File/ HGL Huntsville Office	Via e-mail, and included with DUA and SSFR
Photograph Log	Documents all photographs taken and video recorded to document work and/or site conditions, and to record MEC items recovered	HGL SUXOS	As needed	.JPG/Onsite during fieldwork, then Project File/ HGL Huntsville Office	Available on request
Production Area QC Seeding Report	Documents seed types, depths, locations, and orientations	HGL Seed Team Lead	Once, following completion of seeding	.DOCX and .XLSX or .ACCDB/ QC seed information stored in secure folder on HGL's network (limited to QC personnel)/HGL Denver Office	Via email
Grid Sheets	Documents the progress of the surface clearance	HGL SUXOS	Once following completion of surface clearance	Hard Copy or .PDF/Project File/Geophysical Database/HGL Huntsville Office	Upon request
IVS Technical Memorandum	Documents the results of the initial IVS tests	HGL Team - Project Geophysicist	Once, following initial IVS test (EM61-MK2 and advanced EMI sensor)	.DOCX/Project File/HGL Huntsville Office	Via e-mail
SOP Checklists	Document completion of SOPs	As noted on SOP Checklists	As required by SOP	.DOCX or .PDF/Onsite during fieldwork, then Project File/ HGL Huntsville Office	Via e-mail with associated data

Table 29.1 (Continued)
Project Documents and Records for MEC-Related Tasks

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
Seed Tracking Log	Document seed placement and record recovery	HGL UXOQCS and QC Geophysicist	As seeds are detected/recovered	.Geosoft database or .XLSX /QC Geophysicist's PC/HGL Huntsville Office	Via e-mail/Available on request
DUAs	Document the results of the detection and cued classification surveys and intrusive investigation with regard to DQOs	Parsons Project Geophysicist	Once after acceptance of cued target list for each grid once after acceptance of final ranked dig list for each grid, and once after intrusive investigation	.DOCX/Project File/HGL Huntsville Office	Via e-mail, included with SSFR
Target Selection Technical Memorandum	Describe the process to be used to select targets in the advanced EMI sensor and EM61-MK2 detection data	Parsons Project Geophysicist	Once, 5 days after the start of detection data collection	.DOCX/Project File/HGL Huntsville Office	Via e-mail, included with SSFR
Final Ranked Dig List	List locations and characteristics of DGM anomalies selected for intrusive investigation; list locations, characteristics, and classification decisions for cued survey targets and order by likelihood of being TOI	Parsons Project Geophysicist	After cued data analysis and classification; before intrusive investigation of DGM anomalies	.GDB and .ACCDB/Onsite during fieldwork, and Project File/Geophysical Database/HGL Huntsville Office	Via ftp site during project; included with SSFR
Reacquisition Results	Record location and pre-excavation response of reacquired DGM anomalies	Parsons Reacquisition Team Leader(s)	During reacquisition of DGM anomalies	.ACCDB/Onsite during fieldwork, and Project File/Geophysical Database/HGL Huntsville Office	Via ftp site during project; included with SSFR

Table 29.1 (Continued)
Project Documents and Records for MEC-Related Tasks

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
Intrusive Investigation Results	Record results of intrusive investigation, including DGM anomaly source description, characteristics, and coordinates	HGL Intrusive Team Leader(s)	During intrusive investigation of DGM anomalies	Hard Copy/Onsite during fieldwork, and Project File/Geophysical Database/HGL Huntsville Office	PDF and data included with SSFR
Analog Clearance Grid Sheets	Document the completion of analog removal (surface or subsurface) and record the results of the removal.	HGL Intrusive Team Leader(s)	At least daily during analog removal activities	Hard Copy/Onsite during fieldwork/Geophysical Database/ HGL Huntsville Office	PDF and data included with SSFR
Analog QC data	Documents QC metrics for analog surveys	HGL QC Geophysicist	At least weekly during DGM collection	.ACCDB, .gdb, or .pdf/Project File/Geophysical Database/HGL Denver Office	Via ftp site during project; included with SSFR; available on request
Anomaly Resolution Results	Record results of anomaly resolution QC checks	HGL Intrusive Team Leader(s)	During anomaly resolution QC checks	Hard Copy/Onsite during fieldwork, and Project File/ Geophysical Database/HGL Huntsville Office	PDF and data included with SSFR
DGM Data Deliverable	Document the results of geophysical surveys	Parsons Project Geophysicist	Weekly during DGM data collection	.TEM, MaglogNT, or .CSV (raw data); .GDB, .XYZ, and .MAP (processed data)/Geophysical Database/Project File/HGL Huntsville Office	Via ftp site or external hard drive during project; included with SSFR
DGM QC Deliverable	Documents QC metrics for geophysical surveys	HGL QC Geophysicist	At least weekly during DGM collection	.ACCDB, .gdb, or .pdf/Project File/Geophysical Database/HGL Denver Office	Via ftp site during project; included with SSFR; available on request

Table 29.1 (Continued)
Project Documents and Records for MEC-Related Tasks

Document/Record	Purpose	Primary Generator [1]	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
Supporting Classification Images	Summarize modeling and library match information for each cued target	Parsons Project Geophysicist	Weekly during DGM data collection	Project File Geophysical Database/HGL Huntsville Office	Via ftp site or external hard drive during project; included with SSFR
DD Form 1348-1A	Certify MPPEH as MDAS; maintain CoC for MDAS	HGL SUXOS	As required for batches of MPPEH	Hardcopy or .PDF/Onsite during fieldwork, and Project File/Parsons-Denver Office	Included with SSFR
Explosives Disposition	To document the material destroyed	HGL SUXOS	Each demolition operation	Hardcopy/Onsite during fieldwork, and Project File/HGL Huntsville Office	Included with SSFR
MDAS disposal documentation	To certify that MDAS has been disposed of IAW project requirements	Disposal Contractor	After each shipment of MDAS off site	.PDF/Project File/Geophysical Database/HGL Huntsville Office	Included with SSFR
Magazine Data Card	To record additions to or withdrawals from the inventory of donor explosives	HGL SUXOS	Each time donor explosives are placed into or removed from magazine	Hardcopy/Onsite during fieldwork, and Project File/HGL Huntsville Office	Included with SSFR
SSFR	To document the completion of the removal action and describe the process	HGL Project Manager	Once after completion of field work and final DUA Report	.PDF/Project File/HGL Huntsville Office	Hardcopy and electronic files

[1] The primary generator may designate another qualified individual to prepare the document or record; however, the primary generator is responsible for assuring the quality and accuracy of that document/record, and providing the preparer's signature when appropriate.

29.2 PROJECT DOCUMENTS AND RECORDS FOR MC-RELATED TASKS

The following is a list of the kinds of site records that will be used and maintained for MC-related tasks, as well as the personnel responsible for generating and verifying each record. All records will be maintained in the Parsons, HGL, laboratory, and other subcontractor (such as construction, design, or data validation firms) project files for a minimum of 5 years. Electronic files will be maintained on a limited-access password-protected SharePoint site; hardcopy files will be maintained in the project file system at the applicable office location. Hardcopy documents generated or used on site will be maintained at the site office for the duration of site activities before transfer to the office filing location.

Record	Generation	Verification
Sample Collection Documents and Records		
Field notes (bound logbook)	Field staff	FTL
Sample documentation forms	Field staff	FTL
Tailgate safety meeting forms	UXOSO	Corporate H&S Officer
Daily QC reports	UXOQCS/FTL	PM
CoC records	Field staff	FTL
Air bills	Field staff	FTL
Custody seals	Field staff	FTL
CA forms	PM	Program QA Manager
Photographs	Field staff	PM
Geographic Information System data	Field staff	Database Manager
On-site Analysis Documents and Records		
Equipment calibration logs	Field Staff	UXOQCS/FTL
Equipment maintenance, testing, and inspection logs	Field Staff	UXOQCS/FTL
Equipment calibration logs	Field Staff	UXOQCS/FTL
Field sampling data sheets	Field Staff	UXOQCS/FTL
Field-generated data	Field Staff	UXOQCS/FTL
Waste disposal records	SUXOS/FTL	PM
Off-site Analysis Documents and Records (performed by laboratory personnel unless otherwise indicated)		
Sample receipt, custody, and tracking records	Sample Receipt Staff	Laboratory PM
Standard traceability logs	Analytical Staff	Section Manager/QA Manager
Equipment calibration logs	Analytical Staff	Section Manager/QA Manager
Sample preparation logs	Analytical Staff	Section Manager/QA Manager
Analytical run logs	Analytical Staff	Section Manager/QA Manager
Equipment maintenance, testing, and inspection logs	Analytical Staff	Section Manager/QA Manager
Analytical discrepancy forms	Analytical Staff	Section Manager/QA Manager

WORKSHEET #29 (CONTINUED)
PROJECT DOCUMENTS AND RECORDS

Record	Generation	Verification
Reported analytical results	Analytical Staff	Section Manager/QA Manager
Reported results for standards, QC checks, and QC samples	Analytical Staff	Section Manager/QA Manager
Data package completeness checklists	Analytical Staff/Section Manager	Laboratory PM/QA Manager
Sample disposal records	Assigned Laboratory Staff	Laboratory Operations Manager/QA Manager
Extraction and cleanup records	Analytical Staff	Section Manager/QA Manager
Raw data (stored electronically)	Analytical Staff	Laboratory Database Manager/QA Manager
Electronic database deliverables (EDDs)	Laboratory Database Manager	Database Manager (HGL)
Telephone logs, emails, faxes, and correspondence	Laboratory PM	Laboratory Operations Manager
Data Assessment Documents and Records		
Data validation reports	Data Validator	Data Validation PM/Project Chemist
Automated data review reports	Data Validator	Data Validation PM/Project Chemist
Database QC spreadsheets	Project Staff	Database Manager
DUAs	Project Chemist	PM
Quality Assurance Documents and Records		
Readiness reviews	PM	UXOQCS/ Program QA Manager
Management reviews (minor nonconformance)	PM	Program QA Manager
Management reviews (major nonconformance)	Program Manager	Program QA Manager
Field sampling audits	Audit Lead	Program QA Manager
Deliverables		
Project planning documents, including QAPP, Work Plan, Project Management Plan, Site Safety and Health Plan, Community Relations Plan, QA Surveillance Plan	PM	Program QA Manager
Project deliverables	PM	Program QA Manager
Telephone logs, emails, faxes, and correspondence	All project staff	PM
Permits	SUXOS/FTL	PM
Site maps	Graphics Staff	PM
Design documents	Design Staff	PM
EDDs	Project Database Staff	Database Manager

WORKSHEETS #31A, #32A, AND #33A
ASSESSMENTS AND CORRECTIVE ACTION FOR MEC-RELATED TASKS

Assessments:

This table provides information on the required periodic assessments for MEC-related tasks that will be performed during the course of the project to ensure the planned project activities are implemented IAW this UFP-QAPP. The type, frequency, and responsible parties of planned assessment activities to be performed for the project are summarized in the table below.

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Fieldwork Readiness Review	Once before mobilization	Internal	HGL	HGL Program Manager	HGL Project Manager	HGL Project Manager	HGL Program Manager
Health and Safety Assessment	Once during field activities	Internal	HGL	HGL Project Health and Safety (H&S) Manager, or designee	HGL UXOSO	HGL UXOSO	HGL Project H&S Manager and SUXOS
Site Preparation Assessment	Following completion of brush cutting, if required, and grid placement	Internal	HGL	Parsons Project Geophysicist (grid locations) and Site Geophysicist (adequacy of brush clearing)	HGL SUXOS	HGL SUXOS	Parsons Site Geophysicist
Surface Clearance Assessment	Following completion of surface clearance	Internal	HGL	HGL SUXOS	HGL SUXOS	HGL SUXOS	HGL SUXOS
Seeding Assessment	Following completion of seeding	Both	HGL / USACE	HGL QC Geophysicist and USACE Geophysicist	HGL Seed Team Lead	HGL Seed Team Lead	HGL QC Geophysicist and USACE Geophysicist
DGM Data Deliverable Assessment	Weekly	Internal	HGL	HGL QC Geophysicist	Parsons Project Geophysicist	Parsons Project Geophysicist	HGL QC Geophysicist
Classification Assessment	Once prior to submittal of ranked dig list	Internal	HGL	HGLQC Geophysicist	Parsons Project Geophysicist	Parsons Project Geophysicist	HGL QC Geophysicist

WORKSHEETS #31A, #32A, AND #33A (CONTINUED)
ASSESSMENTS AND CORRECTIVE ACTION FOR MEC-RELATED TASKS

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Analog Removal Assessment	Per grid	Internal	HGL	HGL QC Geophysicist	HGL SUXOS	HGL SUXOS	HGL QC Geophysicist
Anomaly Resolution Assessment	Per grid	Internal	HGL	HGL UXOQCS	Parsons SUXOS	HGL SUXOS	Parsons UXOQCS
Intrusive Results Assessment	Weekly	Internal	HGL	Parsons QC or Project Geophysicist	Parsons SUXOS	HGL SUXOS	Parsons QC or Project Geophysicist
MPPEH/ Explosives Records Assessment	Once prior to demobilization	Internal	HGL	HGL UXOQCS	HGL SUXOS	HGL SUXOS	HGL UXOQCS
Review Geospatial Data	For each GIS data submittal	External (see QA Surveillance Plan [QASP])	USACE	Applicable USACE PDT Members	HGL GIS Manager	HGL GIS Manager	HGL PM
Field Activities	See QASP	External (see QASP)	USACE	Applicable USACE PDT Members	HGL PM and relevant personnel	SUXOS and other relevant personnel	HGL UXOQCS and QC Geophysicist
Geophysical Surveys	See QASP	External (see QASP)	USACE	USACE Project Geophysicist	HGL PM and Parsons Project Geophysicist	Parsons Project Geophysicist	HGL QC Geophysicist
Review SSFR	For each submittal	External (see QASP)	USACE	Applicable USACE PDT Members	HGL PM	HGL PM and relevant personnel	HGL PM

WORKSHEETS #31A, #32A, AND #33A (CONTINUED)
ASSESSMENTS AND CORRECTIVE ACTION FOR MEC-RELATED TASKS

Corrective Action:

Based on the findings of project assessments above, corrective action may be required. A "corrective action" is defined as an action taken by a project to eliminate the cause(s) of nonconformity in order to prevent recurrence. For assessment findings that require corrective action, deficiencies will be documented and communicated to the appropriate project personnel. Corrective action will then be implemented and a follow-up assessment will be performed to verify the results of the corrective action. Procedures for handling UFP-QAPP deviations during each type of assessment are summarized in the table below.

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Time Frame for Response
Fieldwork Readiness Review	Internal e-mail	HGL Project Manager	3-5 business days	Internal e-mail	HGL Program Manager	3–5 business days
Preparatory, initial, and follow-up inspections	Internal e-mail	HGL Project Manager HGL SUXOS	1-3 business days	Follow-up inspection	HGL Project Manager HGL SUXOS	24 hours after notification
Health and Safety Assessment	Written assessment report	HGL SUXOS, HGL PM, UXOSO	3-5 business days	Letter or memo	HGL Project H&S Manager	24 hours after notification
QAPP Compliance and MEC Operations Assessment	Written assessment report	HGL PM, HGL SUXOS, HGL SUXOS, and HGL UXOQCS	3-5 business days	Letter or memo	HGL MEC Operations Manager and HGL QC Manager	3–5 business days
Site Preparation Assessment	Internal e-mail	HGL SUXOS	1-3 business days	Internal e-mail	Parsons Site Geophysicist and Project Geophysicist	24 hours after notification
Surface Clearance Assessment	Internal e-mail	HGL SUXOS	24 hours	Internal e-mail	HGL SUXOS	24 hours after notification
Seeding Assessment	E-mail	HGL Seed Team Lead	24 hours	E-mail and/or RCA	HGL QC Geophysicist and USACE Geophysicist	24 hours after notification
DGM Data Deliverable Assessment	Internal e-mail, SOP checklist(s) noting deficiency	Parsons Site Geophysicist and Project Geophysicist	1-5 business days	Internal e-mail and/or RCA	HGL QC Geophysicist	24 hours after notification

WORKSHEETS #31A, #32A, AND #33A (CONTINUED)
ASSESSMENTS AND CORRECTIVE ACTION FOR MEC-RELATED TASKS

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Time Frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Time Frame for Response
Classification Assessment	Internal e-mail	Parsons Project Geophysicist	1-2 business days	Internal e-mail and/or RCA	HGL QC Geophysicist	1-2 business days
Analog Removal Assessment	Internal e-mail	HGL SUXOS	1-2 business days	Internal e-mail and/or RCA	HGL QC Geophysicist	1-2 business days
Anomaly Resolution Assessment	Internal e-mail	HGL SUXOS	24 hours	Internal e-mail and/or RCA	HGL UXOQCS	24 hours
Intrusive Results Assessment	Internal e-mail	HGL SUXOS	1-5 business days	Internal e-mail and/or RCA	HGL QC or Parsons Project Geophysicist	1-2 business days
MPPEH/Explosive Records Assessment	Internal e-mail	HGL SUXOS	24 hours	Internal e-mail	HGL UXOQCS	24 hours
Review Geospatial Data	Electronic Submittal QA Form, Geospatial QA Form	HGL PM and HGL GIS Manager	14 calendar days	E-mail or appropriate QA Form with responses	Lead Organization and Design Center PMs	10 business days
Field Activities	Corrective Action Requests, Geophysical QA Forms, QAR, HNC-948, Memorandum for Record	HGL PM and SUXOS (*and other technical personnel if appropriate*)	1-5 business days (immediately if serious deficiency)	E-mail or appropriate QA Form with responses	Lead Organization and Design Center PMs	1-2 business days
Geophysical Surveys	Corrective Action Requests, Geophysical QA Forms	HGL PM and Parsons Project Geophysicist	1-5 business days (immediately if serious deficiency)	E-mail or appropriate QA Form with responses	Lead Organization and Design Center PMs, and USACE Project Geophysicist	1-2 business days
Review SSFR	CEHNC Form 7, KO Transmittal Memo	HGL PM	14 calendar days	CEHNC Form 7 with completed responses	Lead Organization and Design Center PMs	10 business days

WORKSHEETS #31B, #32B, AND #33B
ASSESSMENTS AND CORRECTIVE ACTION FOR MC SAMPLING

Assessments:

Assessment Type	Responsible Personnel and Organization	Number and Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Review of QAPP, SOPs, and Site Safety and Health Plan with Field Staff	HGL SUXOS/FTL	Prior to sampling startup and with all new field staff prior to assignment	October 2016	Completed acknowledgement signature pages	48 hours following assessment
Work performed IAW programmatic and site-specific QAPP.	HGL UXOQCS/FTL	Ongoing during all phases of field work	November 2016-March 2017	Daily progress reports	24 hours following conclusion of business day
Logbook and Field Forms Review	HGL UXOQCS/FTL	Daily	November 2016-March 2017	NA; corrections will be made directly to reviewed documents	24 hours following assessment
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with Staff	HGL Project Chemist	Prior to sampling mobilization, as new laboratories are contracted	December 2016	Receipt of copies of certifications. Email traffic concerning lab capacity prior to sampling startup. QAPP sign-off sheet received from laboratory.	48 hours following assessment
General Site Safety Meeting	HGL UXOSO	Daily	November 2016-March 2017	Verbal debriefing and daily sign-off log; a Supervisor Injury Employee Report, if a safety incident occurs.	Weekly; any safety incidents will be reported to the PM and Corporate H&S Officer immediately
Tailgate Safety Meeting	HGL UXOSO	Daily	November 2016-March 2017	Team-oriented briefing for the day's specific operation and peculiar safety issues for that operation.	Weekly; any safety incidents will be reported to the PM and Corporate H&S Officer immediately
Field Sampling and CoC Form Review Against QAPP Requirements	HGL Sample Coordinator	Daily	November 2016-March 2017	Corrections will be made directly to reviewed documents; communication may be in the form of email	24 hours following assessment

WORKSHEETS #31B, #32B, AND #33B (CONTINUED)
ASSESSMENTS AND CORRECTIVE ACTION FOR MC SAMPLING

Assessments (Continued):

Assessment Type	Responsible Personnel and Organization	Number and Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Data Validation	HGL Project Chemist	Per Sample Delivery Group	March 2017	Communication may be in the form of email traffic clarification of the analytical report or CAs due to deficiencies identified in the validation process.	24 hours following assessment
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	HGL Project Chemist	As discrepancies are identified in the validation process	March 2017	Memorandum or email to PM and Project Chemist	72 hours following assessment

Assessment Response and CA:

Assessment Type	Individual(s) Notified of Findings	Assessment Response Documentation	Time Frame for Response	Responsibility for Implementing CA	Responsibility for Monitoring CA
Review of QAPP, SOPs, and Site Safety and Health Plan with Field Staff	HGL SUXOS/UXOSO/FTL	Completed acknowledgement signature pages	48 hours following assessment	HGL FTL	HGL FTL
Work performed IAW programmatic and site-specific QAPP	HGL SUXOS/PM	Interim CA documented pending final approval	By close of same business day	HGL FTL	HGL PM and QA Officer
Logbook and Field Form Review	HGL SUXOS/FTL	Corrections will be made directly to reviewed documents	NA	HGL FTL	HGL SUXPOS/FTL
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with Staff	HGL Project Chemist	Response to email or memorandum	48 hours after notification	Laboratory PM	HGL Project Chemist
Tailgate Safety Meeting	HGL UXOSO	Included as part of the process of the Supervisor Injury Employee Report	24 hours after notification	HGL PM	HGL Corporate H&S Manager
Field Sampling and CoC Form Review Against QAPP Requirements	HGL Sample Coordinator	Response to email	48 hours after notification	HGL FTL	HGL FTL

WORKSHEETS #31B, #32B, AND #33BW (CONTINUED)
ASSESSMENTS AND CORRECTIVE ACTION FOR MC SAMPLING

Assessment Response and CA (Continued):

Assessment Type	Individual(s) Notified of Findings	Assessment Response Documentation	Time Frame for Response	Responsibility for Implementing CA	Responsibility for Monitoring CA
Data Validation	HGL Project Chemist	If required, laboratory reports will be amended and corrections noted in the analytical narrative and contained with the validation report.	1 business week	Data Validation PM	HGL Project Chemist
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	HGL Project Chemist	If required laboratory reports will be amended and corrections noted in the analytical narrative.	72 hours after notification	Laboratory PM	Laboratory QA Officer HGL Project Chemist

WORKSHEET #34
DATA VERIFICATION AND VALIDATION INPUTS

This worksheet lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements, including those in the contract, methods, SOPs, and the QAPP.

Item	Description	Verification (completeness)	Validation (conformance to specifications)
	Planning Documents/Records		
1	Approved QAPP	X	
2	Contract	X	
4	Field SOPs	X	
5	Laboratory SOPs	X	
	Field Records		
6	Field logbooks	X	X
7	Equipment calibration records	X	X
8	CoC forms (SOP 504.01.1)	X	X
9	Sampling diagrams/surveys	X	X
10	**Intrusive MEC Field Records**		
10a	Dig Sheets	X	X
10b	Team Leader Grid Sheet	X	
10c	Grid Drawing Sheet	X	
10e	DD Form 1348-1A	X	X
10f	Demolition Summary Sheet	X	X
10g	MDAS disposal documentation	X	X
10h	Explosives Usage Record	X	X
10i	Magazine Data Card	X	X
10j	Demolition Shot Record	X	X
10k	Intrusive Results	X	X
11	**Geophysics Field Records**		
11a	Weekly Geophysical QC Report	X	X
11b	Production Area QC Seeding Report or QC Seed Tracking Log (SOP DGM-02)	X	X
11c	Field logbooks	X	X
11d	Sensor Function Test Results (Detection Survey)	X	X
11e	IVS Construction Records	X	X
11f	Instrument Assembly Checklist (Cued Survey) (SOP AC-01)	X	X
11g	Sensor Function Test Results (Cued Survey)	X	X
11h	Preparatory Background Data Checklist (SOP AC-05)	X	X
11i	Initial Background Data Checklist (SOP AC-05)	X	X
11j	Recovered Object Verification Checklist (SOP AC-08)	X	X
11k	Classification Process Validation Checklist (SOP AC-09)	X	X
12	Relevant correspondence	X	X
13	Change orders/deviations	X	X
14	Field audit reports	X	X
15	Field CA reports	X	X

Item	Description	Verification (completeness)	Validation (conformance to specifications)
	Geophysics Electronic Data		
16	Raw data files	X	X
17	Converted data files	X	X
18	Data Processing Log (Detection Survey)	X	
19	Target List	X	X
20	Final Data Archive (for each delivered area subset)	X	X
21	Cued Measurement Data (Target Measurement Data, Background Measurement Data, and Target Features Database)	X	X
22	Classification Images (pdf/png files)	X	
	Analytical Data Package		
23	Cover sheet (laboratory identifying information)	X	X
24	Case narrative	X	X
25	Internal laboratory CoC	X	X
26	Sample receipt records	X	X
27	Sample chronology (e.g., dates and times of receipt, preparation, and analysis)	X	X
28	Communication records	X	X
29	Project-specific PT sample results	X	X
30	LOD/LOQ establishment and verification	X	X
31	Standards Traceability	X	X
32	Instrument calibration records	X	X
33	Definition of laboratory qualifiers	X	X
34	Results reporting forms	X	X
35	QC sample results	X	X
36	CA reports	X	X
37	Raw data	X	X
38	Electronic data deliverable	X	X

WORKSHEET #35A
DATA VERIFICATION PROCEDURES FOR MEC-RELATED TASKS

"Verification" is a completeness check that is performed before the data review process is conducted to determine whether the required information is available for validation. It involves a review of all data inputs to ensure that they are present. This step of the data review process answers whether or not the required data inputs are present. "Validation" is performed to identify and qualify data that do not meet the MPCs specified on WS #12A. Data requiring validation are summarized on WS #34A. The information in these tables shows what data inputs are required for data validation as well as the processes used to conduct the validation.

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
General MEC Field Documentation	QAPP	Verification only; confirm documentation is complete for each day of field activities and any required signatures are present.	UXOQCS	UXOQCS Daily QC Report
			SUXOS	Daily Status Reports
			SUXOS	Team Leader Logbook(s)
			SUXOS	Field Change Request Form
			UXOQCS/Parsons Project Geophysicist	Root Cause Analysis
			UXOQCS	Photographic Log
		Verification; confirm documentation is complete for each day of field activities and any required signatures are present. Validation; Ensure the results of all relevant MPCs are attained and correctly documented in the deliverable.	UXOQCS	Daily QC Report
			UXOQCS	Surface Clearance Seeding QC Tracking Log
			UXOQCS	Analog Removal Seeding QC Tracking Log
General Geophysics Documentation	QAPP	Verification only; confirm documentation is complete for each day of field activities and any required signatures are present.	Parsons Project Geophysicist	Field logbooks
		Verification; confirm Weekly Geophysical QC Reports on file cover entire duration of field effort. Validation; ensure the results of all relevant MQOs are attained and correctly documented in the deliverable.	Parsons Project Geophysicist (verification) / HGL QC Geophysicist (validation)	Weekly Geophysical QC Report Final Data Archive (for each delivered survey unit)
Detection Survey – IVS	QAPP; SOP DGM-01; SOP AC-02	Verification; confirm documentation is complete, including dates and applicable signatures. Validation; Initial IVS surveys have been conducted according to SOPs DGM-01 and AC-02. All specifications have been achieved, or exceptions noted. If appropriate, corrective actions have been completed.	HGL QC Geophysicist	IVS Technical Memorandum
Detection Survey - Seeding	QAPP; SOP DGM-02	Verification; confirm documentation is complete, including dates and applicable signatures. Validation; Seeding has been conducted according to SOP. DGM-02 and the QC Seed Plan. All specifications have been achieved, or exceptions noted. If appropriate, corrective actions have been completed.	HGL QC Geophysicist	Production Area QC Seeding Report or QC Seed Tracking Log
			Seed Team Lead	Production Area Seeding QC Checklist

WORKSHEET #35A (CONTINUED)
DATA VERIFICATION PROCEDURES FOR MEC-RELATED TASKS

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
Detection Data Collection	QAPP; SOP DGM-03	Verification only; confirm documentation is complete for all processing steps.	Parsons Project Geophysicist	Weekly Geophysical QC Report
		Verification; confirm documentation is complete, including dates and applicable signatures. Validation; MQOs have been achieved, with any exceptions noted. If appropriate, corrective actions have been completed.	Parsons Project Geophysicist	DGM Data
Detection Data Processing	QAPP; SOP DGM-04	Verification; confirm documentation is complete, including dates and applicable signatures. Validation; Sensor Function Test Results meet project MQOs and processing has completed according to SOP DGM-04 and SOP AC-04, as appropriate. MQOs have been achieved, with any exceptions noted. If appropriate, corrective actions have been completed.	Parsons Project Geophysicist	Sensor Function Test Results (Detection Survey)
Cued Survey - IVS	QAPP; SOP AC-01; SOP AC-02	Verification; confirm documentation is complete, including dates and applicable signatures. Validation; Initial IVS Survey has been conducted according to SOP AC-02. All specifications have been achieved, or exceptions noted. If appropriate, corrective actions have been completed.	Parsons Project Geophysicist	Instrument Assembly Checklist (Cued Survey)
Cued Data Collection	QAPP; SOP AC-05; SOP AC-06	Verification; confirm documentation is complete, including dates and applicable signatures. Validation; Instrument Assembly and data collection have completed according to SOPs AC-05 and AC-06, as appropriate. Sensor Function Test Results meet project MQOs with any exceptions noted. If appropriate, corrective actions have been completed.	Parsons Project Geophysicist	Weekly Geophysical QC Report Cued Measurement Data (Target Measurement Data, Background Measurement Data, and Target Features Database)
Cued Data Processing	QAPP; SOP AC-07	Verification; confirm documentation is complete, including dates and applicable signatures. Validation; cued data processing has been completed according to SOP AC-07. MQOs have been achieved, with any exceptions noted. If appropriate, corrective actions have been completed.	Parsons Project Geophysicist	Processed Cued Databases

WORKSHEET #35A (CONTINUED)
DATA VERIFICATION PROCEDURES FOR MEC-RELATED TASKS

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
Classification	QAPP; SOP AC-07	Verification only; confirm documentation is complete for each cued anomaly. Verification; confirm documentation is complete, including dates and applicable signatures.	Parsons Project Geophysicist	Classification Images (pdf/png files)
		Validation; classification has been completed according to SOP AC-07. MQOs have been achieved, with any exceptions noted. If appropriate, corrective actions have been completed.	HGL QC Geophysicist	QC Seed Tracking Log
Intrusive	QAPP; SOP 505.01.1 and 506.01.1	Verification; Confirm that Intrusive Results are on file listing items recovered from all investigated anomalies Validation; Ensure dig sheet data are complete and adequately describe the reacquisition results and dig results, including the correct item type, MEC type, nomenclature, description, quantity, and post dig response, for all listed items; ensure that items "left in place" are clearly noted and described; ensure that anomalies not investigated are clearly noted and explained.	UXOQCS/Parsons Project Geophysicist	Intrusive Results
Surface Clearance	QAPP; SOP 505.01.1	Verification; Verify that all magnetometer/metal detector test data and surface clearance grid status sheets are on file spanning the duration of the project Validation; Ensure the results of all relevant MPCs are attained and correctly documented in the deliverable.	UXOQCS	Daily Instrument Test Report Surface Clearance Grid Status Log
Analog Removal	QAPP; SOP 505.01.1	Verification; Verify that all magnetometer/metal detector test data, analog removal records, and analog grid status sheet are on file spanning the duration of the project. Validation; Ensure the results of all relevant MPCs are attained and correctly documented in the deliverable.	UXOQCS	Daily Instrument Test Report Analog Grid Status Log Analog Removal Records
Explosives Storage and Transport	SOP 501.01.1	Verification; Confirm that DD Form 1348-1As are on file spanning the duration of the project. Validation; Ensure all MDAS handled and transported off site is accounted for and that the COC for those transfers is correctly documented.	SUXOS and UXOQCS	DD Form 1348-1A

WORKSHEET #35A (CONTINUED)
DATA VERIFICATION PROCEDURES FOR MEC-RELATED TASKS

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
		Verification; Verify that Explosives Usage Records are on file for all demolition operations conducted during the project. Validation; Ensure the record of each demolition event agrees with the related Magazine Data Card entries.	SUXOS	Explosives Usage Record
		Verification; Verify that the inventory records are on file for all magazines spanning the duration of the project. Validation; Ensure the record of each demolition event agrees with the related Explosive Usage Records; ensure that there is no remaining inventory of donor explosives.	SUXOS	Magazine Data Card
Demolition Operations	SOP 502.01.1	Verification; Verify that Demolition Summary Sheet is on file for demolition operations conducted during the project Validation; Ensure all MEC destroyed by demolition and all demolition events are listed	SUXOS	Demolition Summary Sheet
		Verification; Verify that the shot records are on file for all demolition operations conducted over the duration of the project. Validation; Ensure the record of each demolition event agrees with the related dig sheet or Magazine Data Card entries.	SUXOS	Demolition Shot Record
MPPEH Handling	QAPP; SOP 504.01.1	Verification; Verify that MDAS Disposal Documentation have been received and are on file for all MDAS shipped off site during the project. Validation; Ensure disposal documents account for all shipments of MDAS transported off site and they certify the disposal of the material IAW project requirements.	SUXOS	MDAS disposal documentation

WORKSHEET #35B
DATA VERIFICATION PROCEDURES FOR MC SAMPLING

Verification Input	Description	Responsible for Verification
CoC (shipping)	CoC forms will be reviewed upon completion and verified against the packed sample coolers and site sampling requirements. This QC check will be verified by initialing the CoC form next to the shipper's signature. A copy of the CoC form will be retained in the project file and the original and one copy will be taped inside the cooler in a waterproof bag.	HGL FTL
Log review	Log reviews will be performed on a daily basis. This review will be performed to verify that all field monitoring equipment was maintained, calibrated, and operated properly. In addition, the review denotes all required information has been correctly documented in the field logbooks and sample documentation sheets.	HGL FTL
CoC (receipt)	CoC forms will be reviewed and compared to cooler contents. Any discrepancies (sample bottles, sample IDs, requested methods) will be communicated to the Laboratory PM for resolution with the HGL PM.	Laboratory Sample Receipt Manager Laboratory PM
Analytical data package	Laboratory data packages are required to include all data elements that will constitute a Stage 4 (formerly Level IV) deliverable. All data used to prepare analytical data packages will be reviewed at multiple levels throughout the laboratory. The requirements for this review process are described in the laboratory's quality manual. No data packages will be delivered to HGL without the necessary approval.	Laboratory QA Officer
Analytical data package	Analytical data packages will be reviewed to ensure that the appropriate analytical samples have been collected, appropriate site IDs have been used, and the correct analytical methods have been applied.	HGL Sample Coordinator
Analytical data package[1]	Analytical reports will be reviewed to establish that all required forms, case narratives, samples, CoC forms, logbooks, and raw data have been included.	Parsons Data Validator
EDD (export)	All EDDs will be verified against the requirements of a SEDD Stage 2A EDD (compliant with the latest EDD version [Version 5.2]) prior to transmittal to HGL.	Laboratory Database Manager
EDD (import)	Any EDD nonconformance from the laboratory will be reviewed and addressed before the data is processed further. This check is performed on the EDD to ensure that it is in the correct format and that it contains the correct standard values. All data qualifiers must meet EPA's Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. Any errors or warnings will be addressed before processing the data further.	HGL Database Manager
Project database	All data qualifiers applied to the project database by manual entry will receive a 100% QC check for accuracy and completeness. Prior to final approval, each EDD output will receive a 10% QC check of electronically reported results against the hardcopy laboratory reports. The eQAPP, EDDs and location data, will be uploaded to FUDSCHEM. All uploaded files will be verified for accuracy.	HGL Database Manager

[1] This verification step is performed as part of the data validation process described in Worksheet #36 and Attachment A.

WORKSHEET #36A
DATA VALIDATION PROCEDURES FOR MEC

The Verification and Validation Plan (August 2016) for MEC is included in Appendix L. The Verification and Validation Plan (August 2016) describes how each of the decision-making thresholds for detection and classification will be tested and identifies how anomalies will be selected for the threshold verification and validation digs. It addresses the contractor's QC seeding plan, the threshold verification digs, and validation digs. (The placement of Government validation seeds is addressed in the Government's QASP.) The number, type, and placement of QC seeds depend on project-specific DQOs. The final number and distribution of threshold verification digs and validation digs depends on the DQOs, as well as actual performance in the field against established MPCs. For that reason, the validation approach evolves as the project is implemented. The Verification and Validation Plan is finalized following cued data processing.

WORKSHEET #36B
DATA VALIDATION PROCEDURES FOR MC SAMPLING

Validation Stage	Matrix	Analytical SOP[1]	Validation Criteria	Data Validator
Data Review Step IIa				
Data Verification (Stage 1)	Soil	L-1	Package Completeness Narrative: Additional items noted for resolution or clarification	Parsons Data Validator
Data Validation – Stage 4	Soil	L-1	Holding Times: Worksheet #19 DQIs: Method-specific criteria presented in Worksheets #12, #15, #24, and #28 Evaluation and Qualification criteria are presented in Appendix Q, Table Q.1	Parsons Data Validator
Data Review Step IIb				
Senior Review	Soil	L-1	See Worksheet #37	HGL Project Chemist
Overall Assessment	Soil	L-1	See Worksheet #37	HGL PM

[1] Refer to Worksheet #23.

WORKSHEET #36B (CONTINUED)
DATA VALIDATION PROCEDURES FOR MC SAMPLING

An overview of the data validation process is presented in the following table. This process is described in full in Attachment A.

Validation Stage	Validation Input	Description	Person Responsible for Validation
Data Review Step IIa			
Data Verification	Laboratory data reports (see Worksheet #35)	The data validator will verify data package completeness, review case narratives, evaluate sample delivery and condition, and evaluate preparation and analysis holding times (Worksheet #19 and #30).	Parsons Data Validator
Data Validation	Laboratory data reports	The data validator will perform an evaluation of sample- and batch-related QC results (see Appendix Q, Table Q.1) for screening or screening and definitive QC elements, as required for each method on a site-specific basis.	Parsons Data Validator
Data Review Step IIb			
Senior Review	Data validation reports	Senior review of reports to approve of all validation results and final qualifiers; overall evaluation of analytical performance against QAPP requirements.	HGL Project Chemist
Overall Assessment	Project documentation (Worksheet #31, #32, and #33)	Complete project dataset and documentation: Determine whether the sampling plan was executed as specified (that is, the number, location, and type of field samples were collected and analyzed as specified in the Work Plan); evaluate whether sampling procedures were followed with respect to equipment and proper sampling support (for example, techniques, equipment, decontamination, volume, temperature, and preservatives).	HGL PM

WORKSHEET #37A
DATA USABILITY ASSESSMENT FOR MEC

The DUA is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment determines whether the project execution and resulting data meet the project DQOs (see WS #11A) and MPCs (see WS #12A) for MEC-related tasks. All types of data (e.g., surface clearance, DGM, intrusive, etc.) will be considered with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data. The following sections summarize the processes to determine whether the collected data are of the right type, quality, and quantity to support the environmental decision-making for the project, and describes how data quality issues will be addressed and how limitations of the use of the data will be handled.

37A.1 SUMMARY OF USABILITY ASSESSMENT PROCESSES

37A.1.1 Data gaps may be present if (1) data are not collected, (2) data are not evaluated with regard to the necessary parameters, or (3) data are determined to be unusable. The need for further investigation or corrective action will be determined on a case-by-case basis, depending on whether data can be recovered, extrapolated from other data, and/or whether the missing data are needed based on the results of other recorded data. Once completed the data usability report will be included as an appendix to the SSFR.

37A.1.2 The following individuals will participate in the DUA:

(1) USACE PM
(2) HGL PM
(3) Project quality assurance manager
(4) Project geophysicist
(5) QC geophysicist
(6) Field geophysicist (lead)
(7) SUXOS
(8) UXOQCS
(9) Other technical personnel as necessary

37A.1.3 The following documents will be reviewed as part of the DUA:

(1) Quality Assurance Project Plan
(2) Contract specifications
(3) Quality Assurance Surveillance Plan
(4) Daily QC Reports
(5) Weekly QC Reports
(6) IVS Technical Memorandum
(7) Final Validation Plan
(8) Site-specific library
(9) Target list
(10) Classification Technical Memorandum
(11) Validation Dig Report
(12) Analog removal grid records

37A.1.4 The DUA will follow a four-step process:

(1) Review the project objectives and sampling design:
   a. Are the DQOs (WS #11A) and MPCs (WS #12A) still applicable?
   b. Are the underlying assumptions in the DQOs and MPCs still valid?
   c. If the DQOs or MPCs have been changed, have the changes been documented?
   d. Is the sampling design consistent with project objectives?

(2) Review the data verification and validation outputs and evaluate conformance to MPCs documented on WS #12A:
   a. Have the data been verified and validated as described on WS #35A and #36A?
   b. Evaluate conformance to MPCs documented on WS #12A. Are there impacts from non-conformance on data usability?

(3) Document data usability, update the CSM, and draw conclusions:
   a. Have the DQOs been achieved?
   b. Can the data be used as intended, considering implication of deviations and corrective actions?
   c. Are there limitations on data use?
   d. What new information can we add to the CSM?
   e. Update the CSM and document usability conclusions in the data usability summary report.

(4) Document lessons learned and make recommendations:
   a. Could the DQOs, MPCs, or sampling design have been improved for similar future studies?
   b. Summarize lessons learned and make recommendations for changes.

37A.1.5 During data validation (WS #35A and #36A), non-conformances will be documented, and data will be qualified accordingly. All data are usable as qualified by the relevant HGL personnel, with the exception of rejected data. The data are considered usable if the relevant MPCs are achieved and both the verification and validation steps are considered to have yielded acceptable data. During verification and validation steps, data may be qualified by the person validating the data. Qualifiers are typically intended to indicate minor QC deficiencies, which will not affect the usability of the data. All qualifiers will be documented in the Data Usability Report and SSFR. When major QC deficiencies are encountered, data will be rejected and, in most cases, will not be considered usable for making project decisions. Where applicable, project data will be checked to ensure that values and any relevant qualifiers are appropriately transferred to the project electronic database. Deviations from the UFP-QAPP will be reviewed to assess whether corrective action is warranted and to assess impacts on achievement of DQOs.

37A.2 USABILITY ASSESSMENT DOCUMENTATION

37A.2.1 The results of dynamic DUAs will be reported in a Dynamic Data Usability Report. The results of cued DUAs will be documented in Cued Data Usability Reports. All results will be reported for an overall quality assessment in the MEC Data Usability Report (see Table 37A.1), which will be completed after intrusive investigation of the survey area(s). Each Data Usability Report will document the Usability Assessment based on the four-step process described above. The assessment will include whether each MEC-related data element has been verified and validated according to WS #35A and WS #36A, whether the DQOs (WS #11A) and MPCs (WS #12A) have been attained, and whether the data can be used as intended.

Table 37A.1
MEC Data Usability Report

STEP 1: REVIEW PROJECT OBJECTIVES AND SAMPLING DESIGN			
Evaluation	**Yes/No**	**Reference (1)**	**Comments (2)**
Are the DQOs and MPCs still applicable?			
Are the underlying assumptions in the DQOs and MPCs still valid?			
If DQOs or MPCs have been changed, are the changes documented?			
Is the sampling design consistent with project objectives?			
STEP 2: REVIEW THE DATA VERIFICATION AND VALIDATION OUTPUTS AND EVALUATE CONFORMANCE TO MPCs (Data Inputs listed on Worksheet #34A)			
Evaluation	**Yes/No**	**Reference (1)**	**Comments (2)**
Have the data been verified?			
Have the data been validated?			
STEP 3: DOCUMENT DATA USABILITY, UPDATE THE CSM, AND DRAW CONCLUSIONS			
Evaluation	**Yes/No**	**Reference (1)**	**Comments (2)**
Have the DQOs been achieved?			
Can the data be used as intended?			
Are there limitations on data use?			
Has the CSM been updated with any new information?			
STEP 4: DOCUMENT LESSONS LEARNED AND MAKE RECOMMENDATIONS			
Evaluation	**Yes/No**	**Reference (1)**	**Comments (2)**
Could the DQOs, MPCs, or sampling design have been improved for similar future studies?			
Have lessons learned and recommendations been documented?			

(1) The reference field lists the primary location in the SSFR or DUA where related data are presented, along with any sections of the report where the validation of that data is discussed.

(2) The comments field presents a brief explanation of any issues. Note that any such issues may be further explained in other parts of the DUA.

WORKSHEET #37B
DATA USABILITY ASSESSMENT FOR MC

This worksheet documents procedures that will be used to perform the DUA for MC-related tasks. The DUA is performed at the conclusion of data collection activities, using the outputs from data verification and data validation. It is the data interpretation phase, which involves a qualitative and quantitative evaluation of environmental data to determine if the project data are of the right type, quality, and quantity to support the decisions that need to be made. It involves a retrospective evaluation of the systematic planning process, and, like the systematic planning process, involves participation by key members of the project team. The DUA evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence.

37B.1 SUMMARY OF USABILITY ASSESSMENT PROCESSES

37B.1.1 HGL will determine if quality control data is within specifications (MPC) through the data assessment and data validation process. HGL will use all data not rejected during validation to determine the nature of contamination. The data assessment team will perform the operations summarized in Worksheet #35B and Worksheet #36B to evaluate sampling team and laboratory compliance with the requirements with this QAPP and other project planning documents. HGL will work with USACE and project regulators if there is a concern about the statistical validity of the sample results or to determine if sample locations with rejected data need to be re-sampled.

37B.1.2 The following individuals will participate in the DUA:

(1) USACE PM
(2) USACE TM
(3) USACE Chemist
(4) HGL PM
(5) Project QA Manager
(6) Project Chemist
(7) Risk Assessor
(8) Other technical personnel as necessary

37B.1.3 Data Validation:

Data validation will be the first step of the usability assessment. See WS #28B for DQIs associated with the analytical measurements to be used on the project. All data qualifiers will be evaluated and any possible impact to the overall data quality will be discussed in the DUA Report. Any data gap due to the field and/or lab error will be pointed out in the report.

37B.1.4 The DQIs for MC described in Worksheet #12B will be assessed, including any QC results that indicate trends or biases in the data set. Individual sample results that include non-detections with LODs elevated above the PALs due to dilution will be evaluated as potential data gaps. Deviations from planned performance will be documented and evaluated to determine whether corrective action is advisable. Potential corrective actions will range from resampling and/or reanalysis of data, to qualification or exclusion of the data for use in the data

interpretation. In the event that corrective action is not possible, the limitations, if any, of the data with regard to achieving the DQOs will be noted.

37B.1.5 In conjunction with the review of performance against the DQI requirements, the investigators will need to make decisions for the use of qualified values, which are a consequence of the formalized evaluation/validation process. Data qualifiers will be applied to individual data results. Data usability decisions will be made based on the assessment of the usability of each of these results for the intended purpose. Evaluation will describe the uncertainty (such as bias and imprecision) of the qualified results. Multiple discrepancies in DQIs may require technical judgment to determine the overall effect on the usability of the associated data. Decisions about usability of qualified data for use in risk assessment will be based on the EPA guidance, which allows for the use of estimated values. Finally, data users may choose to determine final data usability qualifiers as a result of this overall examination and decision process.

37B.1.6 The data validation protocols described in Table Q.1 include instructions for rejecting (R-qualifying) results associated with severe non-conformances. Following data validation, a critical component of the data usability process is the evaluation of all results qualified R during the data qualification process. The HGL Project Chemist and Project Manager, in consultation with the USAESCH Project Chemist, will evaluate the impact of the identified QC discrepancies on the affected results and make a final determination as to whether each result is usable with respect to the DQOs even if severe technical discrepancies are associated with those results. In such cases where the affected result is determined to be usable, the R qualifier will be removed and replaced with an appropriate qualifier as determined by the data usability team. The final decision to accept or reject such results will be documented in the appropriate data quality evaluation documents.

37B.2 USABILITY ASSESSMENT DOCUMENTATION

37B.2.1 A Data Validation Report will be created for each sample delivery group SDG to provide documentation whether data generated were in control throughout sample analysis. Each data validation report will include a discussion of all QC parameters evaluated, the acceptance criteria used to evaluate each QC parameter, a list of all QC exceedances as well as the extent of the exceedance, the samples associated with each exceedance, and the qualifiers applied. Any lab trending in the QC samples, such as high biased lab control sample for a particular analyte will be discussed. Data summary tables will be generated in order for the data reviewer to review the results in an organized manner.

37B.2.2 An overall data usability report will describe the data usability evaluations and will include sufficient information to support the data usability conclusion. The report will also include the rationale for the data used and will present any data limitations. Discussion of the accuracy, precision, representativeness, completeness, and comparability of the data set and deviations from planned procedures and analysis and the impact on the project objectives will also be discussed in the report.

REFERENCES

Department of Defense (DoD), 2012. Study Relating to the Presence of Unexploded Ordnance in a Portion of the Former Naval Bombardment Area of Culebra Island, Commonwealth of Puerto Rico, conducted pursuant to Section 2815 of the Ike Skelton National Defense Authorization Act for Fiscal Year 2011, Public Law 111-383, April.

DoD, 2013. Quality Systems Manual for Environmental Laboratories (QSM), Version 5.0.

Ellis Environmental Group (Ellis), 2004. Site Specific Final Report: UXO Construction Support, Culebra Island National Wildlife Refuge, Culebra Island, Puerto Rico. June.

Environmental Protection Agency (EPA), 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*, EPA/240/B-06/001, February.

EPA, 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*, EPA/540/R-08/005, January.

Environmental Science and Engineering, Inc. (ESE), 1997. Final Engineering Evaluation and Cost Analysis (EE/CA) for the Former Culebra Island Naval Facility, Culebra Island, Puerto Rico. March.

Gómez-Gómez, Fernando, Rodríguez-Martínez, Jesús, and Santiago, Marilyn, 2014, Hydrogeology of Puerto Rico and the outlying islands of Vieques, Culebra, and Mona: U.S. Geological Survey Scientific Investigations Map 3296, 40 p. plus 2 pls., http://dx.doi.org/10.3133/sim3296.

Intergovernmental Data Quality Task Force (IDQTF), 2005. *Uniform Federal Policy (UFP) for Quality Assurance Project Plan Manual* (EPA-505-B-04-900A), Final, Version 1, March.

IDQTF, 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets*. March.

IDQTF, 2016. UFP-QAPP for Advanced Geophysical Classification for Munitions Response, Version 1.0. March.

Interstate Technological and Regulatory Council (ITRC), 2015. Uniform Federal Policy for Quality Assurance Project Plans Template, Geophysical Classification for Munitions Response, December.

MTA, Inc. (MTA), 1995. Interim Remedial Action, Draft Final Removal Report, Culebra Island National Wildlife Refuge, Puerto Rico. June.

Parsons, 2007. Final Site Inspection Report, Culebra Island Site, Puerto Rico. September.

U.S. Army Corps of Engineers (USACE), 1991. DERP-FUDS Findings and Determination of Eligibility, Culebra Island NWR, P. R., Project No. I02PR006800. Prepared by USACE Jacksonville District.

USACE, 1995. Archives Search Report Findings for Culebra Island National Wildlife Refuge, Culebra, Puerto Rico. Project No. I02PR006802. Prepared by USACE Rock Island District. February.

USACE, 2004. ASR Supplement for the Culebra Island NWR. Prepared by USACE Rock Island District. 26 November.

USACE, 2005a. Revised Inventory Project Report, Culebra, Puerto Rico, Project No. I02PR0068. Prepared by USACE Jacksonville District. June.

USACE, 2005b. Supplemental Archives Search Report for Culebra, Puerto Rico. Project No. I02PR0068. Prepared by USACE St. Louis District. September.

USACE, 2009. Site Specific Final Report Non-Time Critical Removal Action, (TCRA), Culebrita and Culebra Beaches, Municipality of Culebra, Puerto Rico.

USACE, 2016. *Technical Project Planning Process (TPP)*, EM 200-1-2, February 29.

U.S. Geological Survey (USGS). 1996. Atlas of Ground-Water Resources in Puerto Rico and the U.S. Virgin Islands. Water-Resources Investigations Report 94-4198.

Section III – Qualified Receiver

3b. Qualified Receiver Storage Manager Receipt Acknowledgement:

I acknowledge receipt of the unopened labeled container(s) listed herein each with its unique identified and unbroken seal ensuring a continued chained of custody, and after reviewing and agreeing with all the provided supporting documentation, I sign for having received the provided documentation that the sealed containers contained no explosive hazards when received.

Print or type name:	Signature:	Month/Day/Year:

3c. Demilitarization/Destruction Processor Acknowledgement:

I acknowledge receipt of this material and certify and verify that each item or items listed herein were demilitarized and/or destroyed so as to no longer resemble AEDA beyond the requirement listed in DoD 4160.21-M-1 and is only identifiable by its basic content.

Print or type name:	Signature:	Month/Day/Year:

3e. Qualified Receiver Manager Demilitarization/Destruction Certification:

I acknowledge this material has undergone demilitarization/destruction in accordance with DoD 4160.21-M-1and Engineer Manual 1110-1-4009 and that the contents of these sealed containers will not be sold, traded or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content.

Print or type name:	Signature	Month/Day/Year:

4a. Special Instructions:

1. The SUXOS will produce the required number of the original CoC certification copies for distribution in accordance with HGL MMRP SOP 15.03.
2. The *Transporter* will be provided *1 original CoC certification copy* and complete Section II, blocks 2a. through 2.c.with signature.
3. The *Transporter* will turn over *this CoC certification copy* to the Qualified Recycler Manager upon delivery.
4. The *Qualified Recycler Manager* upon receipt of the material will verify and certify the CoC certification document information is complete and accurate by completing Section III. 3a.through 3e. with signatures.
5. The *Qualified Recycler Manager* after completing the demilitarization/destruction of the material listed on this CoC certification document will provide the Generator with a signed company letterhead stating:

   "Upon receiving the unopened labeled containers each with its unique identified and unbroken seal ensuring a continued chained of custody, and after reviewing and concurring with all the provided supporting documentation, sign for having received and agreeing with the provided documentation that the sealed containers contained no explosive hazards when received. The contents of these sealed containers will not be sold, traded or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content".
6. The *Qualified Recycler Manager* will complete the attached DD FORM 1348–Issue Release/Transfer Document, blocks 22 and 23 and return this form along with this CoC certification document and Certificate of Destruction letter to the Generator address shown in block 1b.

4b. Discrepancies.

HGL MR Form 15.07 (Revised Jun 2012)

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ATTACHMENT 5 (continued)

Section I – Generator Release (Continued)	1.d. Container Numbers:	1.e. Unique Seal Identification No:	1.f. Gross weight (lbs):	1.g. Net weight (lbs):	1.h. Tare weight (lbs):
1.					
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HGL MR Form 15.07 (Revised Jun 2012)

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HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM	STANDARD OPERATING PROCEDURE	
	Approved by:	Corporate QA Manager Technical Lead
Analog MEC Clearance Operations		**SOP No.: 505.01.1**
		SOP Category: MMRP
		Revision No.: 3
		Revision Date: May 2016
		Review Date:

Approved By:

_____ _____

Jan Kool, Ph.D. Date
Corporate QA Manager

_____ _____

Neil Feist Date
MMRP Operations Manager

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1.0 PURPOSE

This standard operating procedure (SOP) establishes standard safe practices for analog detection and anomaly removal during munitions response (MR) projects conducted by HydroGeoLogic, Inc. (HGL) personnel. These procedures are typically referred to as "mag-and-dig" or "mag-and-flag" operations.

2.0 SCOPE AND APPLICATION

This SOP applies to all HGL employees involved in analog operations while conducting munitions and explosives of concern (MEC) surface and subsurface anomaly detection, investigation and removal. All HGL employees tasked with performing these procedures will be qualified in accordance with the U.S. Department of Defense Safety Board (DDESB) Technical Paper 18.

3.0 GENERAL REQUIREMENTS

- Perform all work in a manner consistent with Occupational Safety and Health Administration established standards and requirements.
- Conduct all activities in conformance with the project-specific Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP).
- Justify any deviations from specified requirements to the project manager and the Military Munitions Response Program Manager for approval and inclusion in the approved project plans. Do not compromise applicable laws and regulations when implementing deviations. Thoroughly describe both deviations from requirements and the newly modified process in the justification documentation.

4.0 DEFINITIONS AND ABBREVIATIONS/ACRONYMS

4.1 DEFINITIONS

Essential Personnel: U.S. Department of Defense and contractor personnel necessary for the safe and efficient completion of field operations conducted in an exclusion zone (EZ). Multi-discipline and multiple MEC teams project teams performing tasks required to execute the project may be in the EZ while MEC procedures are being performed as long as team separation distances (TSDs) are maintained.

Exclusion Zone (EZ): A safety zone established around MEC operations work area. Only essential personnel and authorized/escorted visitors are allowed within the EZ.

- Examples of EZs include safety zones around MEC intrusive activities and safety zones where MEC is intentionally detonated.
- For chemical warfare material projects sites, the EZ is the area within the No Significant Effects (NOSE) zone.

MEC Operations: Defined as MEC identification; access procedures such as excavation, either by hand or using heavy equipment; handling of UXO, explosives or explosive items; or disposal, including movement, transportation, and final disposal of MEC.

Minimum Separation Distance (MSD): The distance at which personnel in the open must be from an intentional or unintentional detonation.

Munitions and Explosives of Concern (MEC): Specific categories of military munitions that may pose unique explosive risks, including:

- UXO, as defined in 10 U.S.C. §101(e)(5);
- Discarded military munitions (DMM), as defined in 10 U.S.C. §2710(e)(2); or
- Munitions constituents (for example, TNT, RDX), as defined in 10 U.S.C. §2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Team Separation Distance (TSD): The distance that teams of essential personnel must be separated by during the conduct of MEC activities on an MMRP site. Normally this the K40 distance of the net explosive weight of the munition with the greatest fragmentation distance (MGFD) for the site.

Unexploded Ordnance (UXO): As defined by 10 U.S.C. §101(e)(5)(A) through (C), UXO includes 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 to operations, installations, personnel, or material; and
- Remain unexploded whether by malfunction, design, or any other cause.

4.2 ABBREVIATIONS/ACRONYMS

APP	Accident Prevention Plan
DDESB	U.S. Department of Defense Explosives Safety Board
DMM	discarded military munitions

EMM	Earthmoving equipment
EZ	exclusion zone
GPS	Global Positioning System
HGL	HydroGeoLogic, Inc.
MEC	munitions and explosives of concern
MGFD	munition with the greatest fragmentation distance
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
MSD	minimum separation distance
NOSE	No Significant Effects
PPE	personal protective equipment
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
TNT	2,4,6-Trinitrotoluene
TSD	team separation distance
USACE	U.S. Army Corps of Engineers
USC	United States Code
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	UXO Safety Officer

5.0 PROCEDURE FOR ANALOG DETECTION AND MEC CLEARANCE

5.1 ANALOG DETECTION AND MEC CLEARANCE REQUIREMENTS

On sites where mag-and-dig or mag-and-flag operations are in progress, all non-UXO-qualified personnel will be under the direct supervision of UXO-qualified personnel. Only

essential personnel are allowed in the EZ during intrusive MEC operations. If non-essential personnel require access, stop all intrusive operations while they are in the EZ.

During analog MEC clearance operations, HGL personnel must adhere to the APP/SSHP and the following general safety practices:

- Conduct operations only during daylight hours.
- Allow only qualified UXO Technicians to handle MEC.
- Do not conduct MEC operations until all applicable plans for the site in question are prepared and approved.
- Conduct operations on the concept of limiting exposure to the minimum number of personnel, for the minimum amount of time, to the minimum amount of MEC consistent with safe and efficient operations.
- Prior to any action taken on a MEC item, definitively identify all fuzing, including fuze type by function and the physical state/condition (armed or unarmed) of the fuze, i.e., burned, broken, parts exposed/ sheared, etc.
- All personnel must attend the Daily Safety Briefing before entering the operating area.
- Anyone can stop operations if they observe an unsafe act or situation.
- Immediately report safety violations and/or unsafe acts/practices to the UXOSO.

5.2 ANALOG CAPABILITIES

Analog operations are particularly effective in areas where vegetation and terrain limit the use of digital systems, or when it is ineffective or cost prohibitive to use digital equipment because the MEC items and other metallic fragments and debris at the site are too similar to be distinguished.

5.2.1 Analog Advantages

Advantages of analog geophysical surveys include the following:

- Geophysical operators can use real-time field observations.
- Surveys provide a precise anomaly location.
- Anomalies can be excavated immediately following the survey.
- Surveys can be conducted with fewer vegetation and topographic constraints.

5.2.2 Analog Disadvantages

Limitations for analog surveys include the following:

- Detection is generally not as deep as digital instruments.
- Survey quality depends on operator training and demonstrated performance and is also affected by human factors, such as attentiveness/distraction and hearing ability.
- It is more challenging to develop rigorous QC measures capable of assessing the consistency of each operator's effectiveness and performance for the duration of the survey and the measures are less precise than for digital geophysical methods.
- A higher percentage of smaller (below failure criteria) are typically detected during analog surveys. This results in a higher number of intrusive investigations versus digital geophysical surveys.
- Electronic data cannot be further evaluated.
- Resulting electronic records are not permanent.
- Geophysical instruments have depth of detection capabilities related to the size of the coils and transmitter power. Handheld analog instruments typically have smaller coils and less transmitter power than their digital counterparts and, therefore, typically have more shallow maximum depths of detection than their digital counterparts.

5.3 ANALOG MEC CLEARANCE PROCEDURES

5.3.1 Establish Site Layout and Investigation Boundaries

Establish site layout and clearance boundaries in accordance with project requirements (for example, Global Positioning System [GPS], licensed surveyor, or compass and measuring tape). An UXO Technician II or higher:

- Escorts survey crews in the field, if applicable.
- Checks the intended boundary point locations with a geophysical instrument before driving stakes into the ground to prevent driving stakes into buried MEC hazards.

5.3.2 Analog Clearance Procedures

Teams will implement the MEC clearance by establishing lanes and sweeping the lanes using analog geophysical instruments. Teams will establish lanes by laying lines (ropes) or other suitable means such as marking lanes with pin flags. Unless otherwise noted, lanes will be established at a maximum of 5-foot intervals to ensure 100 percent coverage of the clearance footprint. The SUXOS typically determines which techniques will be used to mark and sweep boundaries based on site conditions.

During analog MEC clearance activities, the UXO technicians will:

- Operate the geophysical instrument at a pace that ensures the entire lane is searched and that the instrument is able to appropriately respond to subsurface anomalies.
- Use geophysical instruments to locate and pinpoint the anomaly.
- Carefully remove the earth overburden to expose the source of the subsurface metallic anomaly and positively identify the source of the anomaly.
- Ensure anomalies are resolved in accordance with the project planning documents.

The UXO Team Leader will periodically perform QC checks behind the UXO team to ensure that the MEC clearance objectives detailed in the project planning documents are achieved.

5.4 MEC AND MPPEH PROCEDURES

Upon encountering a MEC item, a minimum of one UXO Technician II and one UXO Technician III will identify and mark the item for future disposition in accordance with the approved project planning documents. Only the SUXOS and UXOSO, jointly, will determine if a MEC item is acceptable to move.

5.4.1 MEC Disposal

Conduct all MEC disposal procedures in accordance with the project specific planning documents and HGL SOP 502.01.1 *Explosive Demolition Operations*.

5.4.2 MPPEH Processing

Process all MPPEH in accordance with the project specific planning documents and HGL SOP 504.01.01 *MPPEH Inspection, Management and Processing*.

6.0 EQUIPMENT PROCEDURES

Upon arrival at the site, verify the condition and functionality of the equipment as follows:

- Inspect all instruments and equipment that require maintenance and/or calibration upon arrival, regardless of source, and periodically as required in the manufacturers' equipment manual.
- Check instrument and equipment functionality to ensure operational readiness.
- Tag equipment found to be damaged or defective as "unserviceable" and return it to the source for repair or replacement.
- Inspect equipment required for daily use in accordance with project plans.

- Remove or replace equipment from service if a functionality check indicates it is not operating correctly and it cannot be field repaired immediately.
  - Remove from service until it can be repaired, or
  - Replace with a like model or an approved substitute. Meet the same specifications for accuracy and precision in the replacement equipment as for the equipment removed from service.

6.1 EARTHMOVING EQUIPMENT PROCEDURES

6.1.1 For Removing Soil Overburden

Earthmoving equipment (EMM) may be used to excavate overburden from suspected MEC. Do not use EMM to excavate within 12 inches of a suspected MEC. Once the EMM is within 12 inches of the suspected MEC, complete the excavation by hand excavation methods. Personnel who are not UXO qualified may operate the EMM only when supervised by a UXO Technician III or higher.

- If more than one EMM is to be used onsite, the same minimum separation distances for multiple work teams applies.
- There is no need to harden/shield the EMM to protect its operator when EMM is used to remove soil overburden to within 12 inches from the anomaly.

6.1.2 For Intentional Excavation of MEC

If the intent of the mechanized MEC procedures are to intentionally dig up anomalies that could be MEC, without practicing anomaly avoidance techniques, the equipment must be hardened/armored appropriately. The operator must also be afforded protection for blast overpressure to the K24 factor, if hearing protection is used the K18 factor can be used.

If mechanized MEC procedures are being performed, the MSD for unintentional detonations for non-essential personnel will be the maximum fragmentation range-horizontal.

6.2 GEOPHYSICAL INVESTIGATION EQUIPMENT REQUIREMENTS

For analog MEC clearances, the following geophysical investigation equipment are typically used:

- Flux-gate magnetometers:
  - Schonstedt GA 52-CX
  - Schonstedt GA 72-CD

- Forester FEREX 4.032
- Ebinger MAGEX 120 LW
- Vallon EL 1302D1 or 1303D
- Chicago Steel Tape (magna-trak 102)

- Frequency-Domain Electromagnetic Induction Metal Detectors:
  - White's All Metals Detector
  - Fisher 1266X
  - Garrett
  - Geophex GEM3
  - Foerster Minex
  - Minelabs Explorer II

6.3 EQUIPMENT FUNCTION CHECKS

Check equipment function daily on all geophysical instruments by using the instrument in a designated test plot (function check area) to verify response to known target anomalies. Determine instrument settings based on the response results from the test plot. After completing the function check, record the geophysical instrument type, serial number and results on the Equipment/Instrument Calibration/Maintenance Log IAW project plans.

7.0 SAFETY

Before conducting intrusive MEC operations, the UXO Team Leader must conduct a daily tailgate safety meeting covering emergency procedures, operations, MEC, and all other hazards associated with the work site. Use the Tailgate Safety Meeting Log to record the meeting.

7.1 MEC SAFETY PROTOCOLS

Death or injury can occur from MEC and explosive related accidents. The age or condition of a MEC hazard does not necessarily decrease the effectiveness. MEC that exposed to the elements for an extended time can become more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded The general MEC safety precautions and protocols are:

- Remain alert at all times for MEC and related scrap or MPPEH hazards.
- Observe the cardinal principle of limiting the exposure to a minimum number of personnel, for the minimum amount of time, to a minimum amount of hazardous material consistent with a safe and efficient operation during construction activities involving ordnance, explosives, ammunition, severe fire hazards, or toxic materials.

- Always assume MEC hazards contain a live charge until determined otherwise.
- Clearly mark the location of any ordnance item found so it can be easily located and avoided.
- Follow the procedures of the approved project planning documents.
- Upon locating any MEC hazards, immediately notify the UXO Technician to take appropriate measures.
- Consider MEC that has been exposed to fire as extremely hazardous. Chemical and physical changes to the contents may have occurred that render it more sensitive than its original state.DO NOT touch, move or jar any ordnance items regardless of the markings or apparent condition. Under no circumstances handle any MEC during avoidance activities or move in an attempt to make a positive identification.
- DO NOT touch, pickup up, kick, or move anything unfamiliar or unknown.
- DO NOT roll an unknown item over or scrape the item to identify markings.
- DO NOT approach or enter a munitions site if an electrical storm is occurring or approaching. If a storm approaches during site operations, leave the site immediately and seek shelter.
- DO NOT transmit by radio or cellular phone in the vicinity of suspect MEC hazards.
- DO NOT walk across an area where the ground surface cannot be seen and that has not been cleared of MEC hazards by the UXO Technician.
- DO NOT rely on color codes for positive identification of ordnance items or their contents.
- DO NOT drive vehicles into a suspected MEC area; use clearly marked lanes.
- DO NOT carry matches, cigarettes, lighters or other flame-producing devices into a MEC site.
- DO NOT be misled by markings on the MEC item stating "practice bomb," "dummy," or "inert." Practice ordnance can have explosive charges used to mark and/or spot the point of impact; or the item could be marked incorrectly.

– W A R N I N G –

Removing or taking any munitions, explosive or unexploded ordnance or munitions related debris from the site by any employee is strictly prohibited.

7.2 OTHER HAZARDS

Hazards that may be present during the anomaly and MEC subsurface clearance operations may include sharp metal, industrial chemicals, and other hazards as described below:

- *Metal Debris*: Metal debris, to include munitions debris and cultural debris (nails, banding, barbed wire, etc.), are typically encountered during intrusive operations. Wear the appropriate personal protective equipment (PPE) to protect personnel from hazards caused by sharp objects.
- *Chemicals*: Locating industrial-type chemicals is a possibility during intrusive MEC activities. If sealed drums, contaminated soils, or other suspect conditions that indicate a potential health or safety hazard are encountered:
  - Stop work and follow proper notification procedures identified in project planning documents.
  - The SUXOS notifies the Project Manager using established notification procedures.
  - Do not continue work in the area where the hazard was discovered until the SUXOS and UXOSO evaluate the situation and confer with the Project Manager and HGL's Corporate Health and Safety Director, and all agree it is safe to proceed.

7.3 EXCLUSION ZONES AND MINIMUM SEPARATION DISTANCES

7.3.1 Exclusion Zones

During intrusive MEC operations, only essential project personnel may be within the EZ.

- The UXOSO and UXO Team Leaders monitor and keep the EZ intact until intrusive operations are complete.
- If a MEC larger than the identified MGFD is encountered, notify the appropriate authority and use an EZ appropriate for the found munition.

7.3.1.1 Essential Personnel and Authorized Visitors

Only project personnel necessary for the safe and efficient completion of the field operations are allowed in an EZ. Multi-discipline and multiple MEC teams project teams performing tasks required to execute the project may be in the EZ while MEC procedures are being performed as long as TSDs are maintained. Team locations must be closely coordinated with the SUXOS and UXOSO. Authorized visitors are allowed within the EZ under the restrictions and requirements of EM 385-1-97.

Personnel are not allowed to work in the EZ without the following:

- Briefing on the use of the buddy system
- PPE in accordance with the APP/SSHP
- Applicable training and certifications
- Understanding of the APP/SSHP
- Approval of SUXOS

7.3.2 Minimum Separation Distance

7.3.2.1 Unintentional Detonations

Evacuate all non-essential personnel from within the EZ/MSD during intrusive operations in areas with known or suspected MEC.

7.3.2.2 Intentional Detonations

Evacuate all personnel from within the MSD during intentional detonation of MEC items.

8.0 RESPONSIBILITIES

HGL employees performing the activities addressed by this SOP are responsible for meeting the requirements detailed herein. HGL employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

8.1 PERSONNEL

8.1.1 Senior UXO Supervisor

The SUXOS is ultimately responsible for ensuring all MEC operations are performed in accordance with this SOP and the project planning documents.

8.1.2 UXO Safety Officer

Communicates directly with the Corporate Health and Safety Director on all matters concerning safety. Ensures all explosive safety procedures are performed in accordance with project planning documents.

8.1.3 UXO Quality Control Specialist

Communicates directly with the Corporate Quality Assurance Officer on all matters concerning quality control. Oversees quality control of all site explosive operations and procedures, ensuring compliance with project planning documents.

8.1.4 UXO Team Leader

The UXO Team Leader directs all intrusive MEC teams during field operations.

9.0 QUALITY CONTROL

Refer any discrepancies found with procedural steps or safety issues pertaining to this SOP to the responsible supervisor for corrective action.

- The HGL Senior UXO Operation Manager annually reviews this SOP for completeness, accuracy, and safety.
- The HGL UXO Safety Manager maintains, manages, and annually reviews this SOP for procedural, quality control and safety issues.
- The UXO Safety and Quality Manager receive all questions, comments, or recommendations regarding this SOP.
- Project Managers and supervisors ensure that all site personnel read, understand, and follow this SOP.

10.0 RECORDS

Project participants are responsible for providing objective documentation in sufficient detail showing that they have met the requirements of this SOP. Collect, retain, and maintain the documentation resulting from this SOP with the project record files IAW project planning documents.

11.0 REFERENCES

HydroGeoLogic, Inc. (HGL), Standard Operating Procedure (SOP) 502.01.1, Explosive Demolition Operations.

HGL, SOP, 504.01.1 Material Potentially Presenting an Explosive Hazard Inspection, Management and Processing.

U.S. Army Corps of Engineers (USACE), Engineer Manual (EM) 385-1-97.

USACE, EM 200-1-15.

U.S. Department of Defense Explosives Safety Board (DDESB) Technical Paper 18.

DoD Manual 6055-09-M.

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HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM	STANDARD OPERATING PROCEDURE	
	Approved by:	Corporate QA Manager Technical Lead
Digital MEC Clearance Operations		**SOP No.: 506.01.1**
		SOP Category: MMRP
		Revision No.: 2
		Revision Date: June 2016
		Review Date:

Approved By:

_____ _____

Jan Kool, Ph.D.
Corporate QA Manager

Date

_____ _____

Neil Feist
MMRP Operations Manager

Date

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1.0 PURPOSE

This standard operating procedure (SOP) establishes standard safe practices for performing digital munitions and explosives of concern (MEC) clearance operations during munitions response projects conducted by HydroGeoLogic, Inc. (HGL) unexploded ordnance (UXO)-qualified personnel.

2.0 SCOPE AND APPLICATIONS

This SOP applies to all HGL employees involved in anomaly and MEC subsurface clearance operations. All HGL employees tasked with performing MEC-related activities must qualify in accordance with the Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18. Perform all work in a manner consistent with Occupational Safety and Health Administration established standards and requirements. Conduct all activities in conformance with the project-specific Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP).

Justify any deviations from specified requirements to the project manager and the Military Munitions Response Program Manager for approval and inclusion in the approved project plans. Do not compromise applicable laws and regulations when implementing deviations. Thoroughly describe both deviations from requirements and the newly modified process in the justification documentation.

3.0 DEFINITIONS AND ABBREVIATIONS/ACRONYMS

3.1 DEFINITIONS

Essential Personnel: U.S. Department of Defense and contractor personnel necessary for the safe and efficient completion of field operations conducted in an exclusion zone (EZ). Multi-discipline and multiple MEC teams project teams performing tasks required to execute the project may be in the EZ while MEC procedures are being performed as long as team separation distances (TSDs) are maintained. Examples of essential personnel include:

- Contractor work team members including the UXO Safety Officer (UXOSO), UXOQCS, SUXOS;
- U.S. Army Corps of Engineers (USACE) Ordnance and Explosives Safety Specialist; and
- Geophysical equipment operator.

Exclusion Zone (EZ): A safety zone established around MEC operations work area. Only essential personnel and authorized/escorted visitors are allowed within the EZ.

- Examples of EZs include safety zones around MEC intrusive activities and safety zones where MEC is intentionally detonated.
- For chemical warfare material projects sites, the EZ is the area within the No Significant Effects (NOSE) zone.

Munitions and Explosives of Concern (MEC): Specific categories of military munitions that may pose unique explosive risks, including:

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- Discarded military munitions (DMM), as defined in 10 U.S.C. §2710(e)(2); or
- Munitions constituents (for example, TNT, RDX), as defined in 10 U.S.C. §2710(e)(3), present in high enough concentrations to pose an explosive hazard.

MEC Operations: Defined as MEC identification; access procedures such as excavation, either by hand or using heavy equipment; handling of UXO, explosives or explosive items; or disposal, including movement, transportation, and final disposal of MEC.

Minimum Separation Distance (MSD): The distance at which personnel in the open must be from an intentional or unintentional detonation.

Team Separation Distance (TSD): The distance that essential personnel must be separated by during the conduct of MEC activities on an MMRP site. Normally this the K40 distance of the munition with the greatest fragmentation distance (MGFD) for the site.

Unexploded Ordnance (UXO): As defined by 10 U.S.C. §101(e)(5)(A) through (C), UXO includes 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 to operations, installations, personnel, or material; and
- Remain unexploded whether by malfunction, design, or any other cause.
- A more detailed description of the term UXO is provided in Public Law (P.L.) 106-65, section 3031 (c)(5)(A)

3.2 ABBREVIATIONS/ACRONYMS

APP	Accident Prevention Plan
BIP	blow-in-place

CD	cultural debris
DDESB	U.S. Department of Defense Explosives Safety Board
DGM	digital geophysical mapping
DMM	discarded military munitions
EMM	Earth Moving Machinery
EZ	exclusion zone
GPO	Geophysical Prove-out
GPS	global positioning system
GSV	geophysical system verification
HGL	HydroGeoLogic, Inc.
IVS	Instrument Verification Strip
MD	munitions debris
MEC	munitions and explosives of concern
MGFD	munitions with the greatest fragmentation distance
MPPEH	material potentially presenting an explosive hazard
MSD	minimum separation distance
NEW	net explosive weight
NOSE	no significant effects
P.L.	Public Law
PPE	personal protective equipment
RCWM	recovered chemical warfare materiel
RRD	range-related debris
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
SUXOS	senior unexploded ordnance supervisor
TP	Technical Paper
TSD	team separation distance
USACE	U.S. Army Corps of Engineers

UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer

4.0 GENERAL REQUIREMENTS

On sites where digital MEC clearance operations are in progress, all non-UXO-qualified personnel will be under the direct supervision of UXO-qualified personnel. Only essential personnel are allowed in the EZ during intrusive MEC operations. If non-essential personnel require access, stop all intrusive operations while they are in the EZ.

During MEC clearance operations, HGL personnel must adhere to the APP/SSHP and the following general safety practices:

- Conduct operations only during daylight hours.
- Allow only qualified UXO Technicians to handle MEC.
- Do not conduct MEC operations until all applicable plans for the site in question are prepared and approved.
- Conduct operations on the concept of limiting exposure to the minimum number of personnel, for the minimum amount of time, to the minimum amount of MEC consistent with safe and efficient operations.
- Prior to any action taken on an ordnance item, definitively identify all fuzing, including fuze type by function and the physical state/condition (armed or unarmed) of the fuze, i.e., burned, broken, parts exposed/ sheared, etc.
- All personnel must attend the Daily Safety Briefing before entering the operating area.
- Anyone can stop operations if they observe an unsafe act or situation.
- Immediately report safety violations and/or unsafe acts/practices to the UXOSO.

4.1 DIGITAL MEC CLEARANCE REQUIREMENTS

4.2 DIGITAL CAPABILITIES

Digital geophysical tools are capable of recording and geo-referencing geophysical measurements. Most digital instruments have the capability to output a digital signal that can be co-registered with global positioning system (GPS) information to develop a two-dimensional map of the anomalies detected.

4.2.1 Digital Advantages

Digital instruments typically have higher sensitivity than analog instruments, are capable of noise reduction techniques, and advanced data analysis techniques. Advantages of digital geophysical surveys include the following:

- Uniform process for data collection and analysis.
- Geo-referenced location of data and anomalies.
- No operator subjectivity (to investigate an anomaly or not).
- Ability to further evaluate electronic data.
- A permanent electronic record.
- Ability to define rigorous QC measures capable of detecting all/most possible failure modes for the geophysical survey.

4.2.2 Digital Disadvantages

Challenges for performing digital geophysical mapping include the following:

- Decreased effectiveness in high clutter areas.
- Vegetation and topographic constraints.
- Quality dependent on operator training and demonstrated performance.
- Ability to define anomaly selection criteria that meet the project team's needs in terms of identifying all targeted anomalies while not selecting large numbers of non-targeted anomalies.

5.0 EQUIPMENT REQUIREMENTS

Upon arrival at the site, verify the condition and functionality of the equipment as follows:

- Inspect all instruments and equipment that require maintenance and/or calibration upon arrival, regardless of source, and periodically as required in the manufacturers' equipment manual.
- Check instrument and equipment functionality to ensure operational readiness.
- Tag equipment found to be damaged or defective as "unserviceable" and return it to the source for repair or replacement.
- Inspect equipment required for daily use in accordance with project plans.
- Remove or replace equipment from service if a functionality check indicates it is not operating correctly and it cannot be field repaired immediately.
    - Remove from service until it can be repaired, or

- Replace with a like model or an approved substitute. Meet the same specifications for accuracy and precision in the replacement equipment as for the equipment removed from service.

5.1 EARTHMOVING EQUIPMENT REQUIREMENTS AND PROCEDURES

5.1.1 For Removing Soil Overburden

Earth Moving Machinery (EMM) may be used to excavate overburden from suspected MEC. EMM will not be used to excavate within 12 inches of a suspected MEC. Once the EMM is within 12 inches of the suspected MEC, the excavation will be completed by hand excavation methods. Personnel who are not UXO qualified may operate the EMM only when supervised by a UXO Technician III or higher.

- If more than one EMM is to be used onsite, the same minimum separation distances for multiple work teams applies.
- There is no need to harden/shield the EMM to protect its operator when EMM is used to remove soil overburden to within 12 inches from the anomaly.

5.1.2 For Intentional Excavation of MEC

If the intent of the mechanized MEC procedure is to intentionally dig up anomalies that could be MEC without practicing anomaly avoidance techniques, the equipment must be hardened/armored appropriately. The operator must also be afforded protection for blast overpressure to the K24 factor, if hearing protection is used the K18 factor can be used.

If mechanized MEC procedures are being performed, the MSD for unintentional detonations for non-essential personnel will be the maximum fragmentation range-horizontal.

5.2 GEOPHYSICAL INVESTIGATION EQUIPMENT REQUIREMENTS

For digital MEC clearances, the following geophysical investigation equipment are typically used:

- Flux-gate magnetometers:
  - Schonstedt GA 52-CX
  - Schonstedt GA 72-CD
  - Forester FEREX 4.032
  - Ebinger MAGEX 120 LW
  - Vallon EL 1302D1 or 1303D
  - Chicago Steel Tape (magna-trak 102)

- Frequency-Domain Electromagnetic Induction Metal Detectors:
  - White's All Metals Detector
  - Fisher 1266X
  - Garrett
  - Geophex GEM3
  - Foerster Minex
  - Minelabs Explorer II
- Production - Time Domain Electromagnetic Induction Metal Detectors
  - Geonics EM61
  - Geonics EM61-MK2
  - Schiebel AN PSS-12
  - Vallon VMH3
- Advanced - Time Domain Electromagnetic Induction Metal Detectors
  - ALLTEM
  - BUD
  - Handheld BUD
  - MetalMapper
  - MPF EMI
  - TEMTADS
  - TEMTADS MP 2x2 Cart

5.3 EQUIPMENT FUNCTION CHECKS

5.3.1 Handheld Instrument Function Checks

Check equipment function daily on all handheld geophysical instruments by using the instrument in a designated test plot (function check area) to verify response to known target anomalies. Instrument settings will be determined based on the response results from the test plot. After completing the function check, record the geophysical instrument type, serial number and results on the Equipment/Instrument Calibration/Maintenance Log IAW project planning documents.

5.3.2 Digital Instrument Function Checks

The geophysical system verification (GSV) is the preferred method for verification of digital geophysical systems on munitions projects. The GSV process consists of an Instrument Verification Strip (IVS) and a blind seeding program within the production site. A Geophysical Prove-out (GPO) may be required if the selected DGM instrument sensor response can't be predicted or the geophysicist cannot determine how to select anomalies for a particular sensor. If the geophysicist selects such an instrument, then the instrument should be evaluated at a

GPO to estimate the detection depth capabilities of the instrument prior to beginning the MEC fieldwork.

The purpose of the IVS is to ensure the DGM instrument functionality prior to collecting data within a production area. The IVS also may be used to determine the background noise at the site to aid in anomaly selection. In addition, the IVS is used to quantify the expected errors in recorded response due to variations (instrument bounce, anomaly orientation, etc.).

Digital instruments should be functioned checked in accordance with project planning documents. After completing the function check, record the geophysical instrument type, serial number and results on the Equipment/Instrument Calibration/Maintenance Log.

6.0 PROCEDURES

6.1 DIGITAL MEC CLEARANCE PROCEDURES

The digital geophysical mapping (DGM), processing of geophysical data, anomaly selection, and generation of dig lists aspects of the digital survey process are not included in this SOP. This SOP covers the anomaly resolution aspects of digital geophysical surveys. There are three key aspects to anomaly resolution: anomaly reacquisition, anomaly excavation (including reporting dig results), and post-dig verification sampling.

6.1.1 Anomaly Reacquisition

Anomaly reacquisition is a critical element of DGM systems because this task must physically match anomalies on dig lists with their sources. In order to resolve all anomalies on the dig list and pass project specific QC standards, the UXO intrusive team must clear the entire footprint of the DGM anomaly. The UXO intrusive team typically performs the following reacquisition process:

- Using a method to navigate to the selected location. Typically accomplished with GPS or using measuring tapes.
- Reproducing a signal at that location with the geophysical instrument selected and referenced in the project planning documents.
- Placing a plastic pin flag and/or painting the ground surface near the reacquired source.

6.1.2 Anomaly Excavation

The disposition and final location details of each anomaly excavated are normally recorded on the final dig sheets. The reported dig results should be reviewed by the interpreting

geophysicist, who must have authority to require additional reacquisition and/or excavation activities be performed for anomalies having characteristics that are not explained by the reported dig results. The UXO intrusive team typically conducts anomaly excavation as follows:

1. Excavate each anomaly from the side of anomaly location and carefully remove overburden to expose anomaly features for evaluation.
2. If suspect MEC is encountered, the UXO Technician II and UXO Technician III (team leader) will determine the items condition. If determined to be MEC, notify the SUXOS and follow the MEC disposition guidance in the project planning documents.
3. Record the anomaly characteristics required on the dig sheets. Typical information required on the dig sheets includes:
   - Team number
   - Date investigated
   - Reacquisition instrument reading, typically millivolts
   - Reacquisition offset distance and direction
   - Anomaly type (for example, UXO, munitions debris [MD], cultural debris [CD], Seed, Other)
   - Anomaly orientation, depth, length, and weight
   - Anomaly quantity
   - Anomaly description
   - Post-dig instrument reading, typically millivolts
4. Collect, process, and dispose of the anomaly item(s). Adhere to the following procedure for anomaly removal:
   - If a recovered anomaly is classified as MEC, the SUXOS and UXOSO determines whether the item is acceptable to move.
   - If the item ***can*** be safely moved, remove and relocate the item pending further disposition, depending on project planning document guidance.
     - Inspect under the removed item to ensure additional anomalies are removed from the anomaly footprint.
   - If the item ***cannot*** be safely moved, designate it blow-in-place (BIP) and execute the BIP procedure. Do not move MEC designated as BIP for any reason. If needed, use engineering controls to decrease the possibility of damage to personnel or property.

  - Upon disposition, inspect the anomaly location to ensure anomalies are removed from the anomaly footprint.
- Collect anomalies classified as material potentially presenting an explosive hazard (MPPEH) for further inspection.

5. Dispose of all MEC and MPPEH in accordance with the approved procedures in the project planning documents.
6. Photographs of investigated anomalies may be required. Typically, at minimum, photographing MEC items is required.
7. After removing the anomaly (anomalies), the UXO team will ensure the entire anomaly footprint free of anomalies in accordance with project planning documents.
8. If required, the UXO intrusive team will collect post-dig instrument readings to ensure the selected anomaly has been resolved and the digital instrument reading is now below the project threshold.

6.1.3 Post-dig Anomaly Resolution

Post-dig anomaly resolution sampling is conducted after intrusive investigations to verify that the source of the anomaly has been removed during the intrusive investigation. The original geophysical instrument used to identify anomalies, or one that performs better than the original, should be used to verify that the anomalies have been resolved.

The project QC and quality assurance plans should detail the number of anomalies that required post-dig verification sampling. The UXOQCS will implement the post-dig anomaly resolution process in accordance with project planning documents.

6.2 MEC AND MPPEH PROCEDURES

Upon encountering a MEC item, a minimum of one UXO Technician II and one UXO Technician III will identify and mark the item for future disposition in accordance with the approved project planning documents. Only the SUXOS and UXOSO, jointly, will determine if a MEC item is acceptable to move.

6.2.1 MEC Disposal

Conduct all MEC disposal procedures in accordance with the project specific planning documents and HGL SOP 15.01 Explosive Demolition Operations.

6.2.2 MPPEH Processing

Process all MPPEH in accordance with the project specific planning documents and HGL SOP 15.03 MPPEH Inspection, Management and Processing.

7.0 RESPONSIBILITIES

HGL employees performing MEC subsurface clearance operations are responsible for meeting the requirements detailed in this SOP. HGL employees conducting technical review of task performance are responsible for following appropriate portions of this SOP.

7.1 PERSONNEL REQUIREMENTS

7.1.1 Senior UXO Supervisor

The SUXOS is ultimately responsible for ensuring all MEC operations are performed in accordance with this SOP and the project planning documents.

7.1.2 UXO Safety Officer

Communicates directly with the Corporate Health and Safety Director on all matters concerning safety. Ensures all explosive safety procedures are performed in accordance with project planning documents.

7.1.3 UXO Quality Control Specialist

Communicates directly with the Corporate Quality Assurance / Quality Control (QC) Officer on all matters concerning QC. Oversees QC of all site explosive operations and procedures, ensuring compliance with project planning documents.

7.1.4 UXO Team Leader

The UXO Team Leader directs all intrusive MEC teams during field operations.

8.0 SAFETY

Before conducting intrusive MEC operations, the UXO Team Leader must conduct a daily tailgate safety meeting covering emergency procedures, operations, MEC, and all other hazards associated with the work site. Use the Tailgate Safety Meeting Log to record the meeting.

8.1 MEC SAFETY PROTOCOLS

Death or injury can occur from MEC and explosive related accidents. The age or condition of a MEC hazard does not necessarily decrease the effectiveness. MEC that exposed to the elements for an extended time can become more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded. The general MEC safety precautions and protocols are:

- Remain alert at all times for MEC and related scrap or MPPEH hazards.
- Observe the cardinal principle of limiting the exposure to a minimum number of personnel, for the minimum amount of time, to a minimum amount of hazardous material consistent with a safe and efficient operation during construction activities involving ordnance, explosives, ammunition, severe fire hazards, or toxic materials.
- Always assume MEC hazards contain a live charge until determined otherwise.
- Clearly mark the location of any ordnance item found so it can be easily located and avoided.
- Follow the procedures of the approved project planning documents.
- Upon locating any MEC hazards, immediately notify the UXO Technician to take appropriate measures.
- Consider MEC that has been exposed to fire as extremely hazardous. Chemical and physical changes to the contents may have occurred that render it more sensitive than its original state. DO NOT touch, move or jar any ordnance items regardless of the markings or apparent condition. Under no circumstances handle any MEC during avoidance activities or move in an attempt to make a positive identification.
- DO NOT touch, pickup up, kick, or move anything unfamiliar or unknown.
- DO NOT roll an unknown item over or scrape the item to identify markings.
- DO NOT approach or enter a munitions site if an electrical storm is occurring or approaching. If a storm approaches during site operations, leave the site immediately and seek shelter.
- DO NOT transmit by radio or cellular phone in the vicinity of suspect MEC hazards.
- DO NOT walk across an area where the ground surface cannot be seen and that has not been cleared of MEC hazards by the UXO Technician.
- DO NOT rely on color codes for positive identification of ordnance items or their contents.

- DO NOT drive vehicles into a suspected MEC area; use clearly marked lanes.
- DO NOT carry matches, cigarettes, lighters or other flame-producing devices into a MEC site.
- DO NOT be misled by markings on the MEC item stating "practice bomb," "dummy," or "inert." Practice ordnance can have explosive charges used to mark and/or spot the point of impact; or the item could be marked incorrectly.

– W A R N I N G –

Removing or taking any munitions, explosive or unexploded ordnance or munitions related debris from the site by any employee is strictly prohibited.

8.2 OTHER HAZARDS

Hazards that may be present during the anomaly and MEC subsurface clearance operations may include sharp metal, industrial chemicals, and other hazards as described below:

- *Metal Debris*: Metal debris, to include munitions debris and cultural debris (nails, banding, barbed wire, etc.), are typically encountered during intrusive operations. Wear the appropriate personal protective equipment (PPE) to protect personnel from hazards caused by sharp objects.
- *Chemicals*: Locating industrial-type chemicals is a possibility during intrusive MEC activities. If sealed drums, contaminated soils, or other suspect conditions that indicate a potential health or safety hazard are encountered, do the following:
  - Stop work and follow proper notification procedures.
  - The SUXOS notifies the Project Manager using established notification procedures.
  - Do not continue work in the area where the hazard was discovered until the SUXOS and UXOSO evaluate the situation and confer with the Project Manager and HGL's Corporate Health and Safety Director, and all agree it is safe to proceed.

8.3 EXCLUSION ZONES AND MINIMUM SEPARATION DISTANCES

8.3.1 Exclusion Zones

During intrusive MEC operations, only essential project personnel may be within the EZ.

- The UXOSO and UXO Team Leaders monitor and keep the EZ intact until intrusive operations are complete.
- If a MEC larger than the identified MGFD is encountered, notify the appropriate authority and use an EZ appropriate for the found munition.

8.3.1.1 Essential Personnel and Authorized Visitors

Only project personnel necessary for the safe and efficient completion of the field operations are allowed in an EZ. Multi-discipline and multiple MEC teams project teams performing tasks required to execute the project may be in the EZ while MEC procedures are being performed as long as TSDs are maintained. Team locations must be closely coordinated with the SUXOS and UXOSO. Authorized visitors are allowed within the EZ under the restrictions and requirements of EM 385-1-97.

Personnel are not allowed to work in the EZ without the following:

- Briefing on the use of the buddy system
- PPE requirements in accordance with the APP/SSHP
- Applicable training and certifications
- Understanding of the APP/SSHP
- Approval of SUXOS

8.3.2 Minimum Separation Distance

8.3.2.1 Unintentional Detonations

Evacuate all non-essential personnel from within the EZ/MSD during intrusive operations in areas with known or suspected MEC.

8.3.2.2 Intentional Detonations

Evacuate all personnel from within the MSD during intentional detonation of MEC items.

9.0 QUALITY CONTROL

Refer any discrepancies found with procedural steps or safety issues pertaining to this SOP to the responsible supervisor for corrective action.

- The HGL Senior UXO Operation Manager annually reviews this SOP for completeness, accuracy, and safety.
- The HGL UXO Safety Manager maintains, manages, and annually reviews this SOP for procedural, QC and safety issues.

- The UXO Safety and Quality Manager receive all questions, comments, or recommendations regarding this SOP.
- Project Managers and supervisors ensure that all site personnel read, understand, and follow this SOP.

10.0 RECORDS

Project participants are responsible for providing objective documentation in sufficient detail showing that they have met the requirements of this SOP. Collect, retain, and maintain the documentation resulting from this SOP with the project record files IAW project planning documents.

11.0 REFERENCES

HydroGeoLogic, Inc. (HGL), Standard Operating Procedure 502.01.1, Explosive Demolition Operations.

HGL, Standard Operating Procedure, 504.01.1 Material Potentially Presenting an Explosive Hazard Inspection, Management and Processing.

U.S. Army Corps of Engineers (USACE), Engineer Manual 385-1-97.

USACE, Engineer Manual 200-1-15.

U.S. Department of Defense Explosives Safety Board (DDESB), Technical Paper 16.

DDESB Technical Paper 18.

DoD Manual 6055-09-M.

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HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM	STANDARD OPERATING PROCEDURE	
	Approved by:	Corporate QA Manager Technical Lead
Munitions and Explosives of Concern Anomaly Avoidance Support	**SOP No.: 510.01.1**	
	SOP Category: MMRP	
	Revision No.: 04	
	Revision Date: July 2016	
	Review Date:	

Approved By:

_____ _____

Jan Kool, Ph.D. Date
Corporate QA Manager

_____ _____

Neil Feist Date
MMRP Operations Manager

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1.0 PURPOSE

This standard operating procedure (SOP) describes the procedures for all HydroGeoLogic, Inc. (HGL) and subcontractor personnel performing munitions and explosives of concern (MEC) anomaly avoidance support during field operations where there is a potential for encountering MEC hazards.

2.0 SCOPE AND APPLICATIONS

This MEC SOP discusses surface and subsurface anomaly avoidance procedures and techniques to be used while conducting munitions, hazardous, toxic, radioactive waste (HTRW)-related activities during investigative, design, and remedial actions. These procedures were developed using the following:

- U.S. Department of Defense (DoD) Manual 6055.09-M DoD.
- DoD Explosives Safety Board (DDESB) Technical Paper 18.
- U.S. Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-97.

Intrusive anomaly investigation and/or MEC removal is not authorized unless stated in the Performance Work Statement (PWS) or Scope of Work (SOW) and addressed in project work and safety plans. Anomaly avoidance techniques must be employed on properties known or suspected to contain MEC or chemical agent to avoid surface explosive hazards, chemical hazards, and, subsurface anomalies. Anomaly avoidance techniques are implemented for activities that include, but are not limited to:

- Surveying and mapping
- Environmental and natural resource assessments
- Surface and subsurface sampling
- Boring and drilling
- Groundwater monitoring
- Installation of signs and fences

3.0 GENERAL REQUIREMENTS

Perform all work in a manner consistent with Occupational Safety and Health Administration established standards and requirements. Conduct all activities in conformance with the Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP). Justify any deviations from specified requirements to the project manager and/or the relevant program manager. Thoroughly describe both deviations from requirements and the newly modified process in the justification documentation.

4.0 DEFINITIONS AND ABBREVIATIONS/ACRONYMS

4.1 DEFINITIONS

Anomaly Avoidance: Techniques employed on property known or suspected to contain MEC or chemical agent, regardless of configuration, to avoid contact with potential surface or subsurface hazards, to allow entry into the area for the performance of required operations.

Hazardous, Toxic, and Radioactive Waste Activities (HTRW): Activities undertaken for:

- The U.S. Environmental Protection Agency's (EPA) Superfund program,
- The Defense Environmental Restoration Program (DERP), including Formerly Used Defense Sites (FUDS),
- Installation Restoration Program (IRP) sites at active DoD facilities,
- HTRW actions associated with Civil Works projects, and
- Any other mission or non-mission work performed for others at HTRW sites.

HTRW actions during the investigative/design phase of a HTRW project on a site with known UXO or unknown fillers require anomaly avoidance procedures for MEC support. HTRW activities during the remedial action phase (construction) of a HTRW project on a site with known or UXO with unknown fillers may require either standby support or subsurface removal.

Military Munitions: All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the Coast Guard, the Department of Energy, and the National Guard.

Includes: confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.

Does not include: wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, except as noted above.

Munitions and Explosives of Concern (MEC): Specific categories of military munitions that may pose unique explosives safety risks, including:

- UXO, as defined in 10 U.S.C. 101(e)(5)(A) through (C);
- Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or

- Munitions constituents (such as, TNT or RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC): Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710).

Munitions Debris: Remnants of munitions remaining after munitions use, demilitarization, or final disposition. Examples of munitions remnants include fragments, penetrators, projectiles, shell casings, links, and fins. Also includes inert munitions-related material recovered during an MEC removal.

Recovered Chemical Warfare Materiel (RCWM): Non-stockpile chemical warfare materiel (CWM) that was previously discarded, buried, or fired and discovered either unexpectedly or during planned environmental restoration operations that DoD has either secured in place or placed under DoD control pending final disposition. CWM is normally secured in a DDESB-approved storage location or interim holding facility, pending final disposition.

Unexploded Ordnance (UXO): As defined by 10 U.S.C. §101(e)(5)(A) through (C), 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 to operations, installation, personnel, or material; and
- Remain unexploded whether by malfunction, design, or any other cause.

UXO-Qualified Personnel: Personnel who:

- Meet the training requirements for UXO Technician and Personnel and have performed successfully in military explosive ordnance disposal (EOD) positions; or
- Are qualified to perform in the following service contract act contractor positions: UXO Technician II, UXO Technician III, and UXO Safety Officer (UXOSO), UXO Quality Control Specialist (UXOQCS), and SUXOS.

Refer to DDESB Technical Paper (TP) 18 for detailed information for approved contract titles and qualifications.

4.2 ABBREVIATIONS/ACRONYMS

bgs	below ground surface
CWM	chemical warfare materiel
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DMM	discharged military munitions
DoD	U.S. Department of Defense
DPT	direct push technology
EM	Engineering Manual
EOD	explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
ER	Engineering Regulation
FUDS	Formerly Used Defense Site
GPS	global positioning system
HGL	HydroGeoLogic, Inc.
HTRW	hazardous, toxic and radiological waste
IAW	in accordance with
IDW	investigated derived waste
IRP	Installation Restoration Program
MC	munitions constituents
MEC	Munitions and Explosives of Concern
P.L.	Public Law
PA/SI	Preliminary Assessment/Site Inspection
PWS	Performance Work Statement
RCWM	Recovered Chemical Warfare Materiel
SSHP	Site Safety and Health Plan
SOP	standard operating procedure
SOW	Scope of Work
SUXOS	Senior Unexploded Ordnance Supervisor

TP	Technical paper/pamphlet
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
UXO	Unexploded Ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
WP	Work Plan

5.0 PROCEDURES

5.1 UXO TEAM

For anomaly avoidance on a site with potential MEC, HGL provides an UXO Team consisting of a minimum of two personnel, one of whom must be a UXO Technician II or above (see exception in following paragraph). The senior UXO-qualified person serves as the UXO Team Leader and has ultimate responsibility for ensuring all MEC anomaly avoidance support activities are performed in accordance with this SOP, the work plan, and/or the SSHP. The UXO Team Leader directs all MEC anomaly avoidance support during field operations.

UXO Tech I may escort personnel who are not directly involved in MEC-related activities (e.g., sweep personnel, support workers, visitors to cultural sites) on property known or suspected to contain MEC, but have an operational requirement and authorization to access such property. Although escort by a UXO Tech I is typically performed under the supervision of UXO Qualified Personnel, the responsible commander or authority may approve UXO Tech I personnel to perform escort duties without supervision. Such approval must be, based on an approved risk assessment and implementation of methods to
mitigate potential exposures.

5.1.1 UXO Qualified Personnel

- Provide MEC recognition, location, and explosive safety functions.
- Conduct explosive safety briefing for all site personnel and visitors.
- Conduct a surface access survey to locate all surface and near-surface anomalies.
- Work closely with the USACE/client personnel on all MEC-related matters.
- Coordinate and report MEC discoveries in accordance with project planning documents.

5.1.2 Non UXO-Qualified Personnel

- Obtain training in recognizing the potential hazards associated with MEC.

- Remain with the UXO Technician all times unless otherwise cleared to work without a UXO escort. Personnel must be escorted by UXO qualified personnel until the UXO escort has completed the access survey and the anomaly free areas have been marked.
- Follow the instructions given by the UXO Technician if an accident occurs.
- Exercise caution when walking on site; follow UXO Technician directions.
- Non UXO-qualified personnel will follow behind the UXO escort.

5.2 ANOMALY AVOIDANCE PROCEDURES

Conduct anomaly avoidance procedures during field investigation activities whenever there is a potential for encountering MEC. The purpose of the procedures is to avoid any potential surface and subsurface MEC hazards during these activities. Anomaly avoidance procedures are outlined in the following subsections including, but not limited to:

- Establishing site access routes and site boundaries, and conducting MEC avoidance survey;
- Clearing and grubbing;
- Land surveying and mapping;
- Conducting Preliminary Assessments/Site Inspections (PA/SI) on FUDS and Base Realignment and Closure Sites;
- Geophysical surveying; and
- Assessing environmental and natural resources:
    - surface soil sampling
    - subsurface soil sampling
    - boring and drilling
    - ground water monitoring
    - test pits and trenches excavations

5.2.1 Access Survey and MEC Avoidance Procedures

The UXO escort must conduct a surface access survey and a subsurface surface survey for anomalies before any type of activities commence, including foot and vehicular traffic. The UXO escort is responsible for conducting the access survey using the following steps:

- Conduct an access survey of the footpath and/or vehicular lanes approaching and leaving work areas with known or suspected MEC. Typically, the access route will be twice as wide as the widest vehicle that will use the route.

- Conduct an access survey around the proposed work site that is large enough to support all planned operations. The size of the area will take into account the maneuverability of the equipment, parking of support vehicles, and any supporting equipment.
- Use geophysical instrumentation capable of detecting the smallest known or anticipated MEC to locate anomalies just below the ground surface that may be encountered because of erosion from rain, or because of continual foot or vehicular traffic. If the emplacement depth is greater than the detection capabilities, then the escort must complete the geophysical survey in intervals until the required depth is reached (for example, every 6 inches, 1 foot, 2 feet, etc.).
- Clearly mark the route(s) for future entry control.
- If anomalies or surface MEC are encountered, they will be marked, and the work area will be relocated to an anomaly free area to avoid contact.
- No personnel will be allowed outside surveyed areas.

5.2.2 Clearing and Grubbing

Initial clearing and grubbing operations may be required before field activities. The objective of clearing and grubbing is to create unhindered access for the field teams. In areas with potential MEC hazards, the UXO Team must:

1. **Hazard identification and clearing and grubbing.**
   - Survey the proposed clearing and grubbing area with a geophysical instrument. Mark hazards with survey flagging or pin flags.
   - Begin clearing and grubbing within the area established by the survey.
   - Qualified UXO Technicians must escort grubbing teams at all times.
   - Exercise caution when using mechanical grubbing equipment.
   - Keep the lowest part of the cutting deck of the grubbing equipment at least 6 inches above ground level to avoid potential contact with any MEC hazards remaining after the initial survey.
2. **MEC Hazards.**
   - Stop all operations if MEC hazard is encountered during clearing and grubbing.
   - Take no further action until the UXO Technician has notified all applicable parties and the appropriate safety concerns are resolved in accordance with the WP or SSHP.

5.2.3 Land Surveying and Mapping Procedures to Locate Anomalies

Land surveying teams in areas with potential MEC must have a minimum of one UXO Technician II or above assigned to perform MEC anomaly avoidance.

The UXO Technician:

- Conducts an access survey of the routes to and from the proposed survey site and an area around the site.
- Visually inspects the surface of each proposed survey point for any indication of MEC or MEC-related contamination.
- Uses a handheld geophysical instrument to assess the presence or absence of subsurface anomalies at the locations where survey points/stakes installation is planned. If responses indicate an anomaly, the UXO Technician disallows survey point/stake installation at that specific location, and selects an alternate location.

5.2.4 Sampling and Drilling Procedures

5.2.4.1 Surface Soil Sampling (Zero to 6 Inches)

The following paragraphs describe anomaly avoidance procedures for surface soil sampling between 0 and 6 inches below ground surface (bgs) in areas with potential MEC.

- Conduct a surface access survey of the routes to and from the proposed investigation site as well as a support area around the investigation site.
- Visually inspect the surface of each proposed surface soil sampling site for any indication of MEC or MEC-related contamination.
- Survey the proposed sample locations using hand-held geophysical instruments.
- Select an alternate location to collect surface soil samples if anomalies are detected at a proposed sampling location or too many anomalies are detected in a general area of interest.

5.2.4.2 Subsurface Soil Sampling (below 6 Inches) and Monitoring Well Installation

The following paragraphs describe anomaly avoidance procedures for subsurface soil sampling and monitoring well installations in an area with potential MEC. Subsurface soil sampling is defined as the collection of samples below a nominal depth of approximately 6 inches with a split-spoon, Shelby tube, direct push sampler, or bucket auger (hand auger) soil sampler using drilling techniques. Drilling techniques are also used to install groundwater monitoring wells for HTRW investigations. The UXO Team adheres to the following procedures:

- Conduct a surface access survey of the routes to and from the proposed investigation site as well as an area around the investigation site.
- Conduct a subsurface survey of the proposed drill hole location(s) with a hand-held, geophysical instrument to detect subsurface MEC anomalies.
- Prominently mark location of any anomalies detected with survey flagging or non-metallic pin flags for avoidance.
- Select a new sampling or borehole location if an anomaly is detected.
- Incrementally complete the down-hole geophysical survey to undisturbed soil depth if the subsurface sampling depth is greater than the geophysical detection capabilities.

5.2.4.3 Incremental Geophysical Survey for Conventional MEC Avoidance

For intrusive sampling (subsurface sampling and well drilling) in areas with suspected MEC, the team completes follows this procedure:

1. **Begin the installation.**
   - Complete the access survey of the area.
   - Complete the geophysical survey and install a pilot hole at the sample or drill location if no anomalies detected.
   - As long as no anomalies are detected, the pilot hole will be advanced to the maximum reach of the auger or to the maximum depth of the proposed drill hole.
   - Inspect the pilot hole upon reaching the final depth. Provide a total clearance depth equal to the pilot hole depth plus 2 feet.
   - During installation, inspect for anomalies every 2 feet using a geophysical instrument configured for down-hole use, unless otherwise specified by the WP or SSHP.
   - When working in impact areas, the UXO team may discontinue incremental screening once a depth of 30 feet bgs is reached or the depth of MEC penetration has been exceeded, whichever is less.
   - For all other areas, incremental screening will be determined based on an assessment of the sites characteristics and history.

2. **If anomalies are detected:**

   Stop installation immediately and backfill the pilot hole in accordance with project-specific procedures.

   HTRW sampling personnel select a new location.

   Prominently mark any anomalies detected with survey flagging or pin flags.

5.2.4.4 Test Pits and Trench Excavations

Test pits and trench excavations are used to identify and characterize large subsurface HTRW areas of concern. Adhere to the following procedure:

- Conduct an access survey of the routes to and from the proposed excavation locations.
- If an anomaly is detected, select a new excavation location
- If the proposed excavation depth is greater than the geophysical instrument detection capabilities, the UXO team must:
  - Identify underground utilities and obtain a dig permit in accordance with (IAW) the WP or SSHP.
  - HTRW personnel may begin excavation in 1-foot increments.
  - At the end of each 1-foot increment, the UXO team will screen for anomalies. If an anomaly is detected, the HTRW team must modify the excavation to avoid the anomaly.
  - If MEC is encountered, all operations will cease. The UXO team will access the item and follow MEC procedures detailed in the WP or SSHP.
  - Once the MEC hazard is removed from the excavation, excavation using anomaly avoidance may continue.
- In the event potentially hazardous waste, debris, or drums are encountered during test pit or trenching operations, stop all excavation activities. The HTRW Site Safety Officer adheres to the following procedure:
  - Assess the situation and direct a change to the personal protective equipment for site workers, if necessary.
  - Notify the appropriate personnel in accordance with the WP or SSHP.
  - Handle wastes in accordance with the Investigation-Derived Waste (IDW) Management, Transportation, and Disposal Plan (IDW Plan).

5.2.4.5 Soil Sampling with Direct Push Technology

The following paragraphs describe anomaly avoidance procedures for soil sampling and use of direct-push technology (DPT) in areas with potential MEC. Soil sampling with DPT typically involves manual or mechanical penetration at the desired location, followed by withdrawal and collection of a soil sample. The UXO Team adheres to the following procedure:

- Conduct a surface access survey of the routes to and from the proposed investigation site as well as an area around the investigation site.
- Follow the same anomaly-avoidance procedures as described previously for subsurface soil sampling and monitoring well installations for soil sampling and DPT installations as follows:
- Incremental down-hole geophysical survey for metallic anomalies.
- Conduct actual sampling and geophysical instrument screening through the DPT bore hole.
- Backfill the sampling location in accordance with project-specific procedures after collection of the soil samples.

5.2.5 Groundwater Monitoring

Groundwater monitoring activities include measuring groundwater elevations, measuring free product thickness, and collecting analytical samples. Unless a path is clearly marked, HTRW sampling personnel must be escorted by UXO-qualified personnel when conducting groundwater monitoring/aquifer characterization activities in areas with potential MEC.

5.2.6 Preliminary Assessment and Site Inspection

On sites were MEC hazards may be present, UXO-qualified personnel conduct anomaly avoidance measures to prevent non-UXO-qualified personnel who are conducting PA/SI work on the site from contacting MEC hazards.

5.3 MUNITIONS AND EXPLOSIVES OF CONCERN

5.3.1 MEC ENCOUNTERED

If MEC/UXO is encountered, the UXO Technician:

- Stops the team, draws attention to the hazard, and marks the hazard with a high-visibility pin flag, paint, or surveyors tape.

- If safe to do so, attempts to identify the MEC hazard via markings and other external features such as shape, size, and external fittings.
- Records the MEC hazard item(s) location, record global positioning system (GPS) coordinates if possible.
- Photographs the hazard.
- Makes notifications required in the project planning documents.

The team continues activities after these steps are completed.

5.3.2 MEC DISPOSITION

The UXO escort is not authorized or equipped to perform MEC disposition. MEC discoveries will be reported to the designated personnel/agencies identified in project planning documents. In the event that MEC is encountered that cannot be avoided or, based on its fuzing or current condition, presents an imminent hazard, the UXO escort will immediately notify the personnel/agencies designated in project planning documents.

6.0 QUALITY CONTROL

The HGL Senior UXO Operation Manager ensures this SOP is reviewed annually for completeness, accuracy, and safety.

The HGL UXO Safety Manager maintains, manages, and annually reviews this SOP for procedural, quality control, and safety issues. Direct all questions, comments, or recommendations regarding this SOP to HGL's UXO Safety Manager. Project Managers and supervisors ensure that all site personnel read, understand, and follow this SOP. Bring any discrepancies with procedural steps or safety issues pertaining to this SOP to the attention of the responsible supervisor for corrective action.

6.1 AUTHORITY

The senior UXO-qualified person on site has final on-site authority on all munitions and MEC procedures and safety issues. This individual has direct reporting and communications responsibility with all responsible authorities as directed by the HGL Project Manager.

6.2 CERTIFICATIONS

HGL provides UXO-qualified personnel who meet the certification levels specified by DDESB Technical Paper 18 and USACE EM 385-1-97.

6.3 EQUIPMENT

- Perform a daily equipment function check on all geophysical instruments and GPS equipment. Describe the performance results of the equipment check in the logbook or in an instrument maintenance and calibration log following each functionality test.
    - If an equipment function check indicates that any piece of equipment is not operating correctly and it cannot be field repaired immediately, remove the equipment from service until it can be repaired.
    - Alternately, the equipment may be replaced with a like model or an approved substitute. Replacement equipment must meet the same specifications for accuracy and precision as the equipment removed from service.
- Inspect and function-check all equipment, regardless of source, to ensure completeness and operational readiness. Return for replacement or repair any equipment found damaged or defective.
- Inspect all instruments and equipment that require routine maintenance and/or calibration upon arrival and periodically as required in the manufacturer's equipment manual.

6.3.1 Geophysical and Support Equipment

The type of geophysical equipment depends on site conditions and the intended work to be conducted. For the purpose of anomaly avoidance, the following geophysical equipment are typically used:

- Magnetometers
- All-metals detectors
- Downhole monitors

Additional equipment items that may be required for marking hazards are as follows:

- Pin flags (as required)
- Brightly colored surveyors tape (as required)
- High visibility, biodegradable spray paint (as required)
- GPS.

7.0 SAFETY

If MEC is encountered during any phase of work, follow the procedures in the project planning documents. In general, adhere to the following MEC safety precautions and protocols:

- Observe this cardinal principle when work may involve ordnance, explosives, ammunition, severe fire hazards, or toxic materials: limit the exposure to a minimum number of personnel, for the minimum amount of time, to a minimum amount of hazardous material consistent with a safe and efficient operation.
- Always assume MEC hazards contain a live charge until determined otherwise.
- Understand that the age or condition of a MEC hazard does not decrease the effectiveness. MEC that has been exposed to the elements for an extended period of time becomes more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded.
- DO NOT touch, move or jar any ordnance items regardless of the markings or apparent condition. Under no circumstances handle any MEC during avoidance activities or moved in an attempt to make a positive identification.
- DO NOT touch, pick up, kick, or move anything that is unfamiliar or unknown.
- DO NOT roll the item over or scrape the item to identify markings.
- DO NOT approach or enter a munitions site if an electrical storm is occurring or approaching. If a storm approaches during site operations, leave the site immediately and seek shelter.
- DO NOT transmit radios or cellular phones in the vicinity of suspect MEC hazards.
- DO NOT walk across an area where the ground surface cannot be seen or that has not been cleared of MEC hazards by the UXO Technician.
- DO NOT rely on color codes for positive identification of ordnance items nor their contents.
- DO NOT drive vehicles into a suspected MEC area until anomaly avoidance techniques have been implemented.
- DO NOT be misled by markings on the MEC item stating "practice" or "dummy." Practice ordnance can have explosive charges used to mark and/or spot the point of impact, or the item could be marked incorrectly.
- Clearly mark the location of any ordnance item found during anomaly avoidance activities so it can be easily located and avoided.

— WARNING —
REMOVING OR TAKING ANY MUNITIONS, EXPLOSIVE OR UNEXPLODED ORNANCE OR MUNITIONS-RELATED DEBRIS FROM THE SITE BY ANY EMPLOYEE IS STRICTLY PROHIBITED.

7.1 DAILY TAILGATE SAFETY MEETING

Before entering an area requiring MEC anomaly avoidance, the UXO Team Leader must conduct a safety brief covering emergency procedures, operations, MEC hazards, and anomaly avoidance procedures.

8.0 REFERENCES

U.S. Army Corps of Engineers (USACE). Engineer Manual (EM) 385-1-97.

U.S. Department of Defense (DoD) Explosives Safety Board (DDESB) Technical Paper (TP) 18.

DoD Manual 6055-09-M.

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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. Please note: 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.

4.0 POINTS OF CONTACT FOR SOPs COORDINATION AND REPORTING

Name	Organization	Telephone/Email
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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.