FINAL

UNIFORM FEDERAL POLICY–QUALITY ASSURANCE PROJECT PLAN

for

REMEDIAL INVESTIGATION / FEASIBILITY STUDY

at

FORT TAYLOR

KEY WEST, MONROE COUNTY, FLORIDA

FUDS Project Nos. I04FL022701, I04FL022702, and I04FL022703

Prepared for:

U.S. Army Corps of Engineers

Contract No. W912DY 17 D 0005
Task Order No. W912DY17F0184

Prepared by:

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Huntsville, Alabama 35806

October 2019

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

Executive Summary

ES.1 This Quality Assurance Project Plan (QAPP) has been prepared by Parsons to support the Remedial Investigation (RI) and, if necessary, a subsequent Feasibility Study (FS) at the Interior Fort and Casemates, Artillery Ranges - Land and Disposal Areas, and Artillery Ranges - Water Munitions Response Sites (MRSs) within the Fort Taylor Formerly Used Defense Site (FUDS) Property No. I04FL0227. This work is being conducted for the U.S. Army Corps of Engineers (USACE), Jacksonville District under Contract No. W912DY-17-D-0005, Task Order No. 17F0184.

ES.2 Previous investigations have indicated that munitions and explosives of concern (MEC) are present within the Interior Fort and Casemates of MRS 01 and Land and Disposal Area of MRS 02. Findings included various size Parrott rounds and cannonballs. The Artillery Ranges – Water Areas (MRS 03), which is mostly tidal water areas, consists of two overlapping artillery ranges for Civil War Era guns and modern artillery. The firing points of the ranges were within the fort and the impact areas are listed to be in the Atlantic Ocean and the Gulf of Mexico. These materials may present an unacceptable risk from explosive hazards to landowners, recreational users, and state park personnel. The objective of the RI/FS process is to determine the nature and extent of MEC and munitions constituents (MC) contamination within the MRSs, and to determine if MEC and/or MC present an unacceptable risk and, if so, develop and evaluate remedial alternatives.

ES.3 The purpose of this RI is to define the horizontal and vertical extent of MEC and MC contamination to support the identification of unacceptable explosive risks within the Interior Fort and Casemates (MRS 01), Artillery Ranges - Land and Disposal Areas (MRS 02), and Artillery Range – Water Areas (MRS 03) MRSs, including the moat surrounding the Fort. On the land portions of the FUDS, the RI will consist of digital geophysical mapping (DGM) and advanced geophysical classification (AGC), followed by intrusive investigation of anomalies. On the water portions of the site, underwater DGM and instrument aided divers, followed by intrusive investigations, will be completed. DGM data in the Interior Fort and Casemates will include maximum coverage where physically possible. In the land portion of the Artillery Range, 16.8 acres of grids will be surveyed using electromagnetic induction (EMI) sensors in dynamic mode. The data will be used to identify geophysical anomalies and document the horizontal distribution of anomalies. AGC will be used to differentiate MEC from other metallic debris at the MRSs through the collection of cued (static) geophysical data over identified DGM anomalies using advanced EMI sensors. Cued data will be analyzed to classify each anomaly as a target of interest (TOI), potential MEC, non-TOI, or inconclusive. Successful application of classification will support AGC as a potential detection technology for remedial action at the site if unacceptable risk is determined to be present in the MRS. Data collection in the moat will include complete coverage using EMI sensors propelled by an unmanned boat. The water portion of the Artillery Ranges will include transect surveys and grids using instrumented aided divers in the near shore areas and DGM using a specialized scientific vessel in the offshore areas. Confirmation that potential concentrated munitions use areas (CMUAs) are contaminated with MEC or a significant amount of munitions debris (MD) and the vertical extent of MEC contamination will be determined through the intrusive investigation of transect and grid anomalies following cued data collection. This information will then be used to differentiate between potential CMUAs and non-CMUAs (NCMUAs) within the MRS.

ES.4 Surface soil, subsurface soil, surface water, and sediment samples will be collected and analyzed to characterize the presence of MC contamination within MRS 01 and MRS 02. Samples will be collected within the CMUAs at MEC/munitions debris locations and in background areas. These locations will be determined upon completion of the geophysical portion of the RI/FS field activities. If deemed necessary by the Project Delivery Team, a second phase of sampling will be conducted to further delineate the horizontal and vertical extent of MC at the MRSs on land.

Table ES.1 Changes to Recommended Text in Fort Taylor-QAPP Template

Section	New Text	Explanation
Worksheet #12 General	None	No significant changes made to Advanced Geophysical Classification (AGC) MPCs.
Worksheet #22 Ongoing detection survey positioning precision (IVS; EM61-MK2)	Revised acceptance criteria to require derived position of instrument verification strip (IVS) targets to be within 25 centimeters (cm) of ***ground truth*** rather than ***average locations***.	Based on requests from USACE Geophysicists on previous projects. Average allows for more potential offset and is unnecessary.
Worksheet #22 In-line measurement spacing (EM61-MK2)	The metric was changed from 100% to 98%.	During dynamic data collection, the global positioning system (GPS) antenna occasionally moves far enough between data points to cause an in-line measurement failure, but that movement does not adversely affect the detection or screening capabilities.
Worksheet #22 Coverage	Added: "Corrective action (CA) assumption: Gaps require fill-in lines to achieve required coverage unless no indication of subsurface metal in gap" to failure response.	Gaps with no nearby anomalies and too small to contain a TOI will be identified at the discretion of the data analyst and recommended for no further data collection. Each such gap will require confirmation from the USACE Geophysicist that it does not need to be filled.
Worksheet #22 Valid Position Data	Removed: "DOP less than 4.0" from acceptance criteria.	Dilution of precision (DOP) is not exported with .csv files for either the MetalMapper (MM) or MPV (neither exports. HD5). Given current satellite coverage, real-time kinematic (RTK) GPS fix is sufficient to indicate that horizontal DOP is < 4.0.
Worksheet #22 Valid Position Data (EM61-MK2)	Failure response allows interpolation of positions between RTK fixed points along straight lines (path before and after gap indicates line was straight) for up to 3 meters.	Interpolating positions over straight lines and short distances provides sufficient positional accuracy.
Worksheet #22 Detection survey repeatability (EM61-MK2)	Acceptance criteria changed to: quality control (QC) seed response on profile within selected anomaly is equal to or greater than the target selection threshold	Differing types of inert munitions/industry standard objection (ISO)s will be buried at various depths and orientations. Calculating the expected response for each ranges from impractical for munitions with known expected responses in either horizontal or vertical orientations to impossible for munitions without known expected responses (M1 mine fuze) or those buried in orientations other than horizontal or vertical.
Worksheet #22 Ongoing production area background measurements	Added: ***All decay amplitudes lower than project threshold or*** original and ongoing measurements at each location differ by a factor of five or less	There is currently no way to determine if "original and ongoing measurements differ by a factor of five or less" using UX-Analyze.

Table ES.1 Changes to Recommended Text in Fort Taylor-QAPP Template

Section	New Text	Explanation
Worksheet #22 Ongoing production area background measurements	Change failure response to: CA: Document environmental changes, as applicable. Background measurement rejected if no changes. With QC and QA Geophysicists' approval, earlier/later background point used if background measurements are consistent throughout the day; re-collect affected data if varying background results indicate loss of point is significant remove recollection and add "Earlier/later background point used if background measurements are consistent throughout the day; recollect affected data if varying background results indicate loss of point is significant."	Clarifies that using a similar background measurement from earlier/later in the day would be an effective replacement for a failed point if backgrounds are consistent throughout the day.
Worksheet #22 Confirm inversion model supports classification (1 and 2 of 3)	Failure response column describes response instead of referencing SOP.	Failure responses are simple enough to describe in sufficient detail in the table.

Table of Contents

Executive Summary i
Table of Contents iv
Acronyms and Abbreviations vii
INTRODUCTION 1
Worksheets #1 & 2: Title and Approval Page 2
Worksheets #3 & 5: Project Organization and QAPP Distribution 4
Worksheets #4, 7, & 8: Personnel Qualifications and Sign-off Sheet 6
Worksheet #6: Communication Pathways and Procedures 8
Worksheet #9: Project Planning Session Summary 11
Worksheet #10: Conceptual Site Model 14
Worksheet #11.1: MEC Data Quality Objectives 28
Worksheet #11.2: MC Data Quality Objectives 37
Worksheet #12: Measurement Performance Criteria 40
Worksheet #13: Secondary Data Uses and Limitations 47
Worksheet #14 & 16: Project Tasks and Schedule 48
Worksheet #15: Reference Limits and Evaluation Tables 52
Worksheet #17: Survey Design and Project Workflow 56
Worksheet #18: Sampling Locations and Methods 80
Worksheets #19 & 30: Sample Containers, Preservation, and Hold Times 83
Worksheet #20: Field Quality Control Summary 84
Worksheet #21: Field Standard Operating Procedures 85
Worksheet #22: Equipment Testing, Inspection, and Quality Control 89
Worksheet #23: Analytical SOP References Table 99
Worksheet #24: Analytical Instrument Calibration Table 100
Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection 103
Worksheets #26 & 27: Sample Handling, Custody, and Disposal 104
Worksheet #28: Analytical Quality Control and Corrective Action 108
Worksheet #29: Data Management, Project Documents and Records 119
Worksheet #31, 32, & 33: Assessments and Corrective Action 125
Worksheet #34: Data Verification & Validation Inputs 129
Worksheet #35: Data Verification and Validation Procedures for MEC and MC Related Tasks 132
Worksheet #36: Geophysical Classification Process Validation 138
Worksheet #37: Data Usability Assessment for MEC 140
References 150

LIST OF FIGURES

Figure 10.1 General Location Map 15
Figure 10.2 MRS Location Map 16
Figure 10.3 Previous Investigation Map 20
Figure 10.4 CSM for Land MRSs 26
Figure 10.5 CSM for Water MRSs 27
Figure 17.1 Interior Fort and Casemates MRS 01 61
Figure 17.2 Artillery Ranges – Land and Disposal Area/Moat MRS 02 62
Figure 17.3 Artillery Ranges – Water – Near Shore Areas MRS 03 63
Figure 17.4 Artillery Ranges – Water – Dive Site/Keys and Remaining Water Areas MRS 03 64
Figure 34.1 Data Verification, Validation, and Usability Assessment Process 129

LIST OF TABLES

Table ES.1 Changes to Recommended Text in Fort Taylor-QAPP Template ii
Table 4.1 Key Project Personnel 6
Table 4.2 Other Project Personnel 7
Table 4.3 Laboratory Personnel 7
Table 10.1 Potential Munitions 22
Table 10.2 Preliminary Conceptual Site Model, Interior Fort and Casemates MRS 23
Table 10.3 Preliminary Conceptual Site Model, Artillery Ranges – Land & Disposal Area MRS 24
Table 10.4 Preliminary Conceptual Site Model, Artillery Ranges - Water MRS 25
Table 11.1 Target Munitions (Confirmed and Suspected) 31
Table 12.1 Measurement Performance Criteria for MEC-Related Land Tasks 40
Table 12.2 Measurement Performance Criteria for MEC-Related Water Tasks 43
Table 12.3 Measurement Performance Criteria for Sample Collection 44
Table 12.4 Measurement Performance Criteria for Metals in Soil and Water 45
Table 12.5 Measurement Performance Criteria for Explosives in Soil and Water 46
Table 15.1 APPL, Inc. PALs and Reference Limits for Metals in Soil 53
Table 15.2 APPL, Inc. PALs and Reference Limits for Explosives in Soil 53
Table 15.3 APPL, Inc. PALs and Reference Limits for Metals in Sediment 54
Table 15.4 APPL, Inc. PALs and Reference Limits for Explosives in Sediment 54
Table 15.5 APPL, Inc. PALs and Reference Limits for Metals in Surface Water 55
Table 15.6 APPL, Inc. PALs and Reference Limits for Explosives in Surface Water 55
Table 19.1 Analytical Requirements, Sample Containers, Preservation, and Hold Times (APPL, Inc.) 83
Table 22.1 Dynamic Survey (Instrument: EM61-MK2, and Analog Sensor) 89
Table 22.2 Cued Survey (instrument: METALMAPPER 2x2 and MPV; classification tool: UX-Analyze and UXO Lab) 92

Table 22.3 Underwater Dynamic and Analog Sensors 96
Table 22.4 Intrusive Investigation 98
Table 23.1 APPL, Inc. Analytical Standard Operating Procedures 99
Table 24.1 Analytical Instrument Calibration, APPL, Inc. 100
Table 25.1 Analytical Instrument and Equipment Maintenance, Testing, and Inspection for APPL, Inc. 103
Table 26.1 Responsibilities for Sample Handling, Custody, and Disposal 105
Table 28.1 Metals Analysis QC/Corrective Actions – APPL, Inc. 108
Table 28.2 Explosives Analysis QC/Corrective Actions – APPL, Inc. 113
Table 28.3 Measurement Performance Criteria – APPL, Inc. 118
Table 29.1 Project Documents and Records for MEC-Related Tasks 120
Table 29.2 Project Sample Collection and Field Records 124
Table 29.3 Project Assessments 124
Table 29.4 Laboratory Records (APPL, Inc. Laboratories) 124
Table 36.1 Overview of Analytical Data Validation for All Analytes 139
Table 36.2 Data Validation Codes and Definitions 139
Table 37.1 Data Usability Assessment for Dynamic Data 142
Table 37.2 Data Usability Assessment for Cued Data 144
Table 37.3 Final Data Usability Assessment 146
Table 37.4 Data Usability Assessment for Analytical Data 149

APPENDICES

APPENDIX A ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN
APPENDIX B ARCHAEOLOGICAL MONITORING PLAN
APPENDIX C ENVIRONMENTAL PROTECTION PLAN/BIOLOGICAL MONITORING PLAN
APPENDIX D EXPLOSIVES MANAGEMENT PLAN
APPENDIX E EXPLOSIVES SITE PLAN
APPENDIX F DIVING AND SNORKELING PLAN
APPENDIX G RISK ASSESSMENT WORK PLAN
APPENDIX H VERIFICATION AND VALIDATION PLAN
APPENDIX I PROJECT SCHEDULE
APPENDIX J FIELD FORMS
APPENDIX K STANDARD OPERATING PROCEDURES
APPENDIX L SYSTEMATIC PROJECT PLANNING
APPENDIX M INNOVATIVE TECHNOLOGY PLAN
APPENDIX N WASTE MANAGEMENT PLAN
APPENDIX O PERFORMANCE WORK STATEMENT

Acronyms and Abbreviations

%R	percent recovery
AGC	advanced geophysical classification
AMP	Archaeological Monitoring Plan
amsl	above mean sea level
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
BIP	blown-in-place
BMP	Biological Monitoring Plan
BTV	background threshold value
CA	corrective action
CCB	continuing calibration blanks
CCV	continuing calibration verification
CEHNC	U.S. Army Engineering and Support Center, Huntsville
CEMVR	U.S. Army Engineer District, Rock Island
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESAJ	U.S. Army Engineer District, Jacksonville
cm	centimeters
CMUA	concentrated munitions use areas
CoC	chain-of-custody
COPC	chemicals of potential concern
COPEC	chemicals of potential ecological concern
COR	Contracting Officer's Representative
COTS	commercial off-the-shelf
CSM	conceptual site model
DD	Decision Document
DERP	Defense Environmental Restoration Program
DFW	definable feature of work
DGM	digital geophysical mapping
DID	data item description
DL	detection limit
DMM	discarded military munitions
DoD	Department of Defense
DQI	data quality indicator
DQO	data quality objective
DUA	data usability assessment
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EMI	electromagnetic induction
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EPP	Environmental Protection Plan
ERA	Ecological Risk Assessment
ESP	Explosives Site Plan
ESV	ecological screening value
EU	exposure unit
FAA	Federal Aviation Administration
FAC	Florida Administrative Code
FD	field duplicate

Acronyms and Abbreviations (*continued*)

FDEP	Florida Department of Environmental Protection
FGDC	Federal Geographic Data Committee
FKNMS	Florida Keys National Marine Sanctuary
FS	Feasibility Study
Ft	feet
FUDS	Formerly Used Defense Site
FWC	Florida Fish and Wildlife Conservation Commission
GIS	geographic information system
GPS	global positioning system
H&S	Health and Safety
HE	high explosive
HHRA	Human Health Risk Assessment
HHSV	human health screening value
ICSA	Interference Check Sample A
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ICSAB	Interference Check Sample B
ICV	initial calibration verification
IDQTF	Intergovernmental Data Quality Task Force
INPR	Inventory Project Report
ISM	incremental sampling methodology
ISO	industry standard object
IVS	instrument verification strip
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LIMS	laboratory information management system
LOD	limit of detection
LOQ	limit of quantitation
MB	method blank
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
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
NCMUA	non-concentrated munitions use areas
NMFS	National Marine Fisheries Service
NMRD	non-munitions related debris
NOAA	National Oceanic and Atmospheric Administration
PAL	project action level
PDF	portable document format
PDT	project delivery team
PM	Project Manager

Acronyms and Abbreviations (*continued*)

PWS	performance work statement
QA	quality assurance
QAPP	Quality Assurance Project Plan
QASP	Quality Assurance Surveillance Plan
QC	quality control
QSM	Quality Systems Manual
RAWP	Risk Assessment Work Plan
RCA	root cause analysis
RI	Remedial Investigation
ROE	right-of-entry
RL	reporting limit
RPD	relative percent difference
RRD	range-related debris
RSD	relative standard deviation
RSL	Regional Screening Levels
RTK	real-time kinematic
RTS	robotic total station
SDG	sample delivery group
SI	Site Inspection
SOP	standard operating procedure
SPP	systematic planning process
SRM	solid reference material
SSHO	Site Safety and Health Officer
SU	sample unit
SUXOS	Senior UXO Supervisor
TOI	target of interest
UAV	unmanned aerial vehicle
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
WRS	WRS Infrastructure and Environment, Inc.
WW	World War

FINAL QUALITY ASSURANCE PROJECT PLAN

INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared by Parsons to support the Remedial Investigation (RI) and, if necessary, a subsequent Feasibility Study (FS) at the Interior Fort and Casemates, Artillery Ranges – Land and Disposal Area, and Artillery Ranges - Water Areas Munitions Response Sites (MRSs) within Fort Taylor Formerly Used Defense Site (FUDS) Property No. I04FL0227. This work is being conducted for the U.S. Army Corps of Engineers (USACE) under Contract No. W912DY-17-D-0005, Task Order No. 17F0184.

The QAPP provides information covering 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 5.1 (DoD, 2017), and the Intergovernmental Data Quality Task Force (IDQTF) *Uniform Federal Policy (UFP) for Quality Assurance Project Plan Manual*, *Advanced Geophysical Classification for Munitions Response (AGC-QAPP), Version 1.0, March 2016* (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 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 & 2: Title nd Approval P ge

1.1 PROJECT ID NTIFYING IN ORMATION

Site Name/ 2 Project Name: 2	Fort Taylor Formerly Used Defense Site/ 2 Remedial Investigation/Feasibility Study 2
Site Location/No.: 2	Key West, Monroe County, Florida / I04FL0227 2
Contract/TO No.: 2	W912DY-17-D-0005 / Task Order 17F0184 2

1.2 CONCURRING SIGNATUR S

The below signatures indicate the representatives of the subject organizations have reviewed this 2 UFP-QAPP and concur with its implementation as written. 2

USACE 8c
Project Manager c

ARAICO.FRANK.X.1230086830 Digitally signed by ARAICO.FRANK.X.1230086830 Date: 2019.10.18 12:23:03 -04'00'

Frank Araico, USACE Project Manager 2 — Date 2

USACE c
Contracting Officer's c
Representative (COR) c

TERRY.REBECCA.K.1230 2 1043 Digitally signed by 2 TERRY.REBECCA.K.1230621043 2 Date: 2019.10.17 13:26:35 -05'00' 2

Becky Terry, USACE COR 2 — Date 2

Contractor 2
Project Manager 2

Patricia J Berry — 10/17/19

Patti Berry Parsons Project Manager 2 — Date 2

Contractor 2
Quality Manager 2

Tom Ka achak Digitally signed by Tom Kartachak t Date: t019.10.16 16:18:09 -05'00' t

Tom Kartachak, Parsons Quality Manager — Date 2

Contractor
Certifying PE 2

STEPHEN A. CIULLA CERTIFICATE No.42141 STATE OF FLORIDA PROFESSIONAL ENGINEER

10/12/2019

Stephen Ciulla, PE — Date 2

Relevant plans and reports from previous investigations are described on Worksheet #10.

1.3 QAPP IDENTIFYING INFORMATION

Guidance Used:	Uniform Federal Policy for Quality Assurance Project Plans, Advanced Geophysical Classification for Munitions Response (AGC-QAPP), Version 1.0, March 2016, and EM 200-1-15	
Regulatory Program:	Comprehensive Environmental Response, Compensation, and Liability Act; Formerly Used Defense Site (FUDS) Program	
Approval Entity:	U.S. Army Corps of Engineers	
Data Users:	U.S. Army; Florida Department of Environmental Protection; Parsons	
QAPP Type:	The UFP-QAPP is a project-specific UFP-QAPP.	
Lead QAPP Preparer:	Jae Yun; jae.yun@parsons.com; 678-209-7620	
Scoping Session Dates:	*Session*	*Date*
	Systematic Project Planning (SPP) Meeting	1-2 May 2018
	SPP Meeting	31 July 2019
	Further scoping session details are presented on Worksheet #9.	
Previous UFP QAPPs:	Fort Taylor – Site Inspection; Parsons; April 2008	

Worksheets #3 & 5: Project Organization and QAPP Distribution

QAPP Recipients	Title	Organization	Telephone Number	E mail Address
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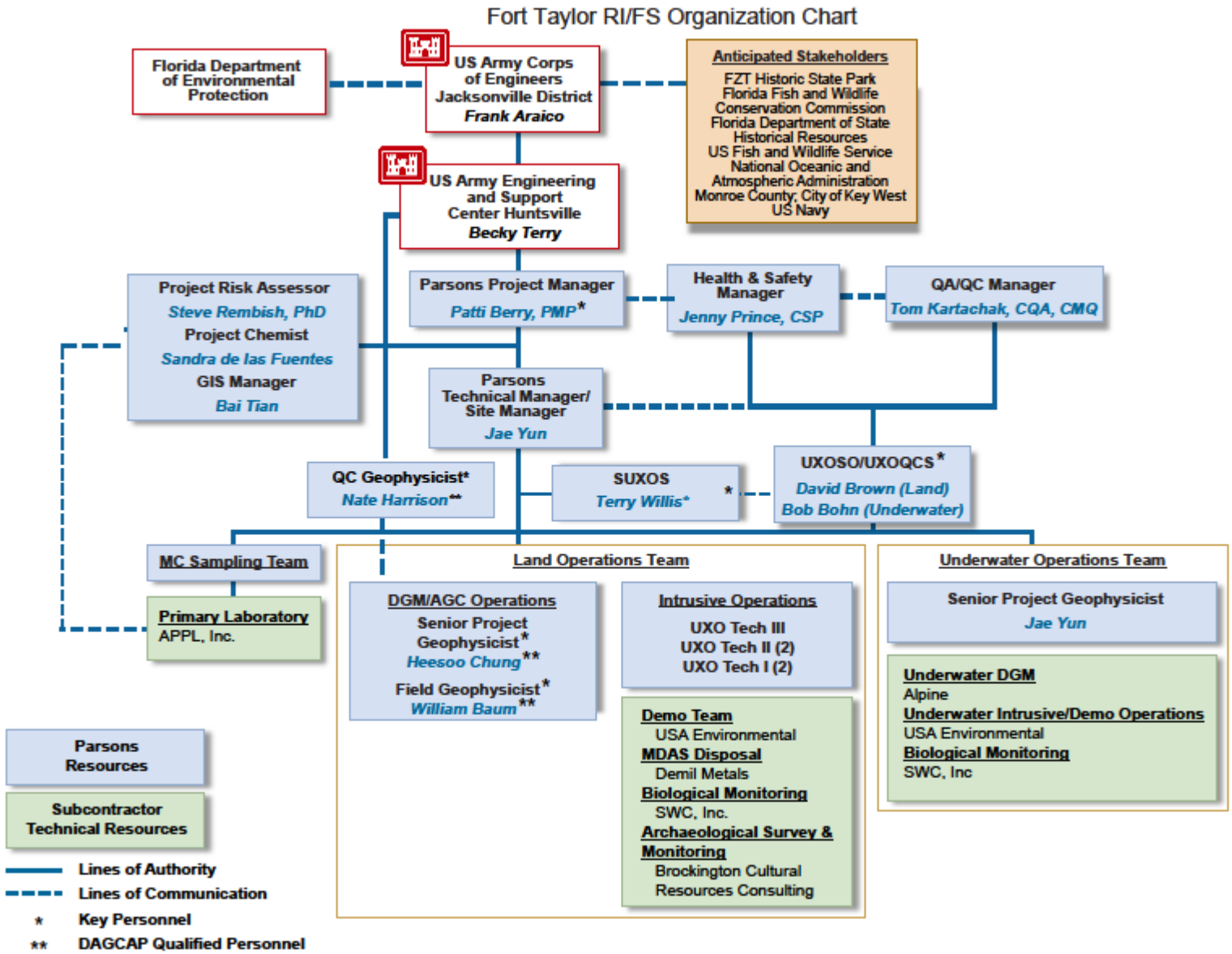
Shaun Hamilton	Project Manager	SWC, Inc.	(305) 481-0742	shaun@swcinc.net
Scott Butler	Project Manager	Brockington Cultural	(770) 596-7651	scottbutler@brockington.org


Fort Taylor RI/FS Organization Chart
Florida Department of Environmental Protection
US Army Corps of Engineers Jacksonville District
Frank Araico
Anticipated Stakeholders
FZT Historic State Park
Florida Fish and Wildlife Conservation Commission
Florida Department of State Historical Resources
US Fish and Wildlife Service
National Oceanic and Atmospheric Administration
Monroe County, City of Key West
US Navy
US Army Engineering and Support Center Huntsville
Becky Terry
Project Risk Assessor
Steve Rembish, PhD
Project Chemist
Sandra de las Fuentes
GIS Manager
Bai Tian
Parsons Project Manager
Patti Berry, PMP*
Health & Safety Manager
Jenny Prince, CSP
QA/QC Manager
Tom Kartachak, CQA, CMQ
Parsons Technical Manager/ Site Manager
Jae Yun
QC Geophysicist*
Nate Harrison**
SUXOS
Terry Willis*
UXOSO/UXOQCS*
David Brown (Land)
Bob Bohn (Underwater)
MC Sampling Team
Primary Laboratory
APPL, Inc.
Land Operations Team
DGM/AGC Operations
Senior Project Geophysicist*
Heesoo Chung**
Field Geophysicist*
William Baum**
Intrusive Operations
UXO Tech III
UXO Tech II (2)
UXO Tech I (2)
Demo Team
USA Environmental
MDAS Disposal
Demil Metals
Biological Monitoring
SWC, Inc.
Archaeological Survey & Monitoring
Brockington Cultural Resources Consulting
Underwater Operations Team
Senior Project Geophysicist
Jae Yun
Underwater DGM
Alpine
Underwater Intrusive/Demo Operations
USA Environmental
Biological Monitoring
SWC, Inc
Parsons Resources
Subcontractor Technical Resources
Lines of Authority
Lines of Communication
* Key Personnel
** DAGCAP Qualified Personnel

Worksheets #4, 7, & 8: Personnel Qualifications and Sign-off Sheet

Table 4.1 Key Project Personnel

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Frank Araico	USACE Project Manager		n/a	*Signature on Worksheets #1 & #2*
Becky Terry	USACE COR		n/a	*Signature on Worksheets #1 & #2*
Patti Berry	Parsons Project Manager	M.S., Management B.S., Engineering Science and Mechanics; MMRP Experience: 20 years AC Experience: 5-years' experience; PM for the Camp Sibert Remedial/ Removal Action AC project; PM for Culebra TCRA AC project.	Project Management Professional (PMP)	*Signature on Worksheets #1 & #2*
Jae Yun	Parsons Deputy Project Manager	B.S., Engineering Science; Experience: 18 years AC Experience: 6 years		10/17/19
Heesoo Chung	Parsons Project Geophysicist (Senior Geophysicist)	B.S., Geophysical Sciences, 2001 Experience: 18 years directly related UXO geophysical experience at DoD sites	DoD Advanced Geophysical Classification Accreditation Program (DAGCAP) Project Geophysicist UX-Analyze software training	10/16/19

Table 4.2 Other Project Personnel

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Kelly Longberg	CEHNC Technical Manager	n/a	n/a	n/a
Kelly Enriquez	CEHNC Geophysicist	n/a	n/a	n/a
Mike D'Auben	CEHNC Risk Assessor	n/a	n/a	n/a
Barry Hodges	CEHNC Project Chemist	n/a	n/a	n/a
Nate Harrison	Parsons QC Geophysicist	M.S., Geology, 2004; B.S., Geology, minor in Geophysics, 2000; Experience: 13 years of detection and classification of UXO using advanced technologies	Project QC Geophysicist in DAGCAP accreditation; Visual Sample Plan (VSP) software training; UX-Analyze software training	10/16/19
Steve Rembish	Parsons Project Risk Assessor	Ph.D., Toxicological Sciences, 1995 Experience: 21 years		10/16/19
Sandra de las Fuentes	Parsons Project Chemist	BA in Microbiology from UT Austin, 1986. Experience: 31 years	Member of the American Chemical Society # 31639246. Incremental sampling field training by CRREL. DoD ELAP and QSM Educational Program Training, 2017	10/17/19

Table 4.3 Laboratory Personnel

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Gregory Salata	APPL, Inc. Laboratory PM	BA, Chemistry; Ph.D., Oceanography / 30 years' analytical laboratory experience		10/17/19
Sharon Dehmlow	APPL, Inc. QA Officer	BS, Chemistry / 25 years' analytical laboratory experience, 5 years' lab director, and 2 years QA Officer		10/17/19

Worksheet #6: Communication Pathways and Procedures

Communication Driver	Initiator (role) (1)(2)	Recipient(s) (role) (1)	Procedure
General communication between USACE and other project delivery team (PDT) members	CESAJ PM or designee	Appropriate PDT member(s)	Communicates directly as needed (verbally and/or in writing).
Regulatory interface	CESAJ PM	Regulators (Florida Department of Environmental Protection [FDEP])	All materials and information about the project will be forwarded to the FDEP by the USACE PM, or by the Parsons PM with permission from the COR and USACE PM.
Regulatory agency contacts	Regulators (FDEP)	USACE PM and COR	Communicate directly as needed (verbally and/or in writing).
Project management, Task Order administration and logistics	Parsons PM	USACE PM, COR, 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 USACE PM and COR by phone, email, or fax by Close of Business, next business day. The PM will also provide project information to the USACE PM and COR through monthly progress reports, email updates, teleconference calls, and meetings. They will document deviations from QAPP and corrective action (CA) in memoranda to the USACE PM and COR and will notify the USACE PM and COR of laboratory CA within 24 hours of notification from the laboratory or project chemist.
Daily reports	Parsons SUXOS/SM	Parsons PM and Parsons lead technical and site personnel	Documents progress in daily report and submits to Parsons PM for distribution to the PDT. Daily reports will be submitted to the 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.

Communication Driver	Initiator (role) (1)(2)	Recipient(s) (role) (1)	Procedure
Stop work due to safety issues	Field personnel, Parsons SSHO (or USACE OESS)	Parsons SUXOS, USACE OESS, and other field personnel	If unsafe work conditions are noted, the SSHO will stop work immediately. Work will not be allowed to resume until the unsafe condition is corrected. The SSHO will notify the Corporate Health and Safety (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 SSHO and Corporate H&S Officer determine that conditions allow.
	Parsons SUXOS	Parsons PM	Verbally notify Parsons PM as soon as possible after work stoppage.
	Parsons PM	USACE PM	Notify USACE PM and COR verbally or via e-mail as soon as possible after work stoppage.
QAPP changes before fieldwork	Parsons PM	USACE PM	If errors or changed conditions require the modification of the QAPP before fieldwork begins, the Parsons PM will prepare revised text. All changes to the QAPP will require final approval from USACE and regulatory agencies.
DGM location changes	PM/Site Manager	Fort Taylor State Park Manager	Major changes to DGM locations will be submitted to the Fort Taylor State Park Manager at least three days prior to change and will be given daily status updates.
Vegetation removal methods	PM, Site Manager, or SUXOS	Fort Taylor State Park Manager	The necessity to use methods for vegetation removal in certain areas will be communicated to the Fort Taylor State Park Manager and Biologist at least one week prior to use. Communications will include a map of the area and reason why it is required.
Intrusive operations	PM, Site Manager, or SUXOS	Fort Taylor State Park Manager	Any intrusive activities will be communicated to the Fort Taylor State Park Manager at least one week prior. Communications will include a map of the area and exclusion zone.
Waste management	Site Manager/SUXOS/ UXOQCS	Parsons PM, USACE PM, COR	Notifies Parsons PM and other organizations as necessary.
Minor QAPP changes during project execution	Parsons SUXOS, Project Geophysicist, QC Geophysicist	Parsons PM, Parsons QC Manager, Parsons Project Geophysicist	Minor QAPP changes will be noted on the Daily QC reports and forwarded to the Project Geophysicist, Parsons PM, or Project Chemist, and the Project QC Manager, at the end of each day.
Major QAPP changes during project execution	Parsons PM	USACE PM and COR	Within 24 hours, Parsons PM will submit a field change request form to the Parsons QA Manager and USACE PM for approval. Following approval, USACE PM informs FDEP via email.
Geophysical QC variances	Parsons QC Geophysicist	Parsons Project Geophysicist, Parsons Corporate QC Manager, and Parsons PM	QC Geophysicist notifies Parsons Project Geophysicist and PM immediately.
	Parsons PM	USACE PM, COR, and USACE Project Geophysicist	Parsons PM notifies USACE within 24 hrs. USACE PM notifies regulator as necessary.
Geophysical QA Concerns	Design Center Lead, CEHNC Geophysicist	Parsons PM, Parsons PM, and technical personnel	Parsons respond to geophysical QA concerns within 24 hours with a CA plan.

Communication Driver	Initiator (role) (1)(2)	Recipient(s) (role) (1)	Procedure
Field team finds munitions and explosives of concern (MEC) item(s)	Parsons SUXOS	Parsons PM, USACE PM, COR, USACE OESS	Verbally notifies Parsons PM and USACE OESS immediately and then awaits permission to respond and/or conduct disposal operation
	Parsons PM	USACE PM, COR	Verbally notifies CEHNC and CESAJ immediately.
	USACE PM	Regulator and other PDT members	Notify other PDT members as necessary.
Field team ready to conduct MEC disposal operations	Parsons SUXOS	Parsons PM	Notifies Parsons PM and other organizations as necessary.
	Parsons PM	USACE PM, and PDT	Parsons PM notifies USACE PM verbally and other USACE PDT members via e-mail.
Field corrective actions	Parsons SUXOS	Parsons 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)	AAPL PM	Parsons PM	The laboratory PM will communicate discrepancies in sample receipt to the Parsons 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	Parsons Chemist	Parsons PM, USACE PM, COR, and USACE Chemist	The Project Chemist will prepare variance requests in collaboration with laboratory PMs for transmittal to USACE for approval.
Analytical CAs	Parsons Chemist	Parsons PM, USACE PM, COR	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 CEHNC PM.
Data verification issues (for example, incomplete records)	Parsons Chemist	Parsons 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 Planning Session Summary

9.1 PLANNING SESSION: SPP MEETING #1

Date: 1-2 May 2018
Location: Key West, Florida
Purpose: Discuss the proposed RI/FS for the Fort Taylor FUDS with project Stakeholders. Review the proposed RI/FS technical approach to include UFP-QAPP Worksheet #10 - Conceptual Site Model (CSM), Worksheet #11 - Data Quality Objectives (DQOs), and Worksheet #17 - Survey Design and Project Workflow to confirm that all SPP Project Team members are in concurrence.
Participants:

Name	Org	Role	Number	Email
Frank Araico	CESAJ	PM	(904) 232-1804	Frank.X.Araico@usace.army.mil
Donna West-Barnhill	CESAJ FUDS Contractor	Public Relations	(904) 232-2179	Donna.L.West2@usace.army.mil
Becky Terry	CEHNC	COR	(256) 895-1788	Rebecca.K.Terry@usace.army.mil
Kelly Longberg	CEHNC	TM	(256) 895-1408	Kelly.D.Longberg@usace.army.mil
Kelly Enriquez	CEHNC	Project Geophysicist	(256) 895-1373	Kelly.D.Enriquez@usace.army.mil
Todd Henderson	CEHNC	Contract Specialist	(256) 895-3953	Jeffrey.T.Henderson@usace.army.mil
Barry Hodges (via telephone)	CEHNC	Project Chemist		
John Winters	FDEP	RPM	(850) 245.8999	John.Winters@dep.state.fl.us
Ellen Andrews	FDEP	Historic Preservationist	(850) 245.2971	Julia.E.Andrews@dep.state.fl.us
Anthony Knott	FDEP	Park Manager	(305) 292.6850	Anthony.Knott@dep.state.fl.us
Steve McAlearney (via telephone)	City of Key West	PM	(305) 809-3747	smcalearney@cityofkeywest-fl.gov
Lisa Gregg (via telephone)	Florida FWC	Environmental Permitting	(850) 617-9621	Lisa.gregg@MyFWC.com
Matthew Lawrence	NOAA	PM	(305) 434-9383	Matthew.Lawrence@noaa.gov
Greg Bergstrom (via telephone)	U.S. Coast Guard Sector Key West	Waterways Management Division Supervisor	(305) 292-8772	Greg.C.Bergstrom@uscg.mil
Edward Russell	U.S. Navy	NASKW IRP/MRP Program Manager	(305) 797-4461	Edward.O.Russell@navy.mil
Edward Barham	U.S. Navy	NASKW	(305) 293-2911	Edward.Barham@navy.mil
Laura Kelley	Parsons	PM	(678) 969-2437	Laura.Kelley@parsons.com
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Steve Rembish	Parsons	Risk Assessor		Steve.J.Rembish@parsons.com
Mike Coon	Parsons	MEC Operations Manager	(425) 457-1734	Michael.Coon@parsons.com
Nagi Khadr (via telephone)	Parsons	QC Geophysicist	(303) 501-2393	Nagi.Khadr@parsons.com
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Bill Rottner	Alpine	PM Underwater DGM	(201) 397-3164	wrottner@alpineocean.com
Sandy Walters	SWC	President	(305) 294-1238	sandy@swcinc.net
Shaun Hamilton	SWC	Project Tech	(305) 481-0742	shaun@swcinc.net
Scott Butler	Brockington	Archaeologist	(770) 596-7651	scottbutler@brockington.org

Notes/Comments:

A presentation was given on May 1, 2018 to include project members involved, project history, previous investigations, goals of the project, and proposed RI/FS activities. A Site Visit of Fort Zachary Taylor Historic State Park was conducted on the afternoon of May 1, 2018 as part of the SPP Meeting. Worksheets 10, 11, and 17 were presented and discussed on May 2, 2018. Worksheets 12 and 22 were not discussed due to time constraints. Details of the SPP Meeting are documented in the SPP Meeting Memorandum, provided in Appendix L, which includes meeting minutes and the complete presentation providing site maps and figures and other pertinent information. FDEP comments on the SPP Meeting Memorandum are included in Appendix L.

Consensus Decisions Made:

- The SPP Team agreed with the general presentation of the Technical Approach without any notable exceptions.
- Additional discussions will be held regarding ISM.

9.2 PLANNING SESSION: SPP MEETING #2

Date: 31 July 2019
Location: Key West, Florida
Purpose: Discuss the proposed RI/FS for the Fort Taylor FUDS with project Stakeholders. Review the proposed RI/FS technical approach and discuss comments received from FDEP on the Draft Final UFP-QAPP.
Participants:

Name	Org	Role	Number	Email
Frank Araico	CESAJ	PM	(904) 232-1804	Frank.X.Araico@usace.army.mil
Donna West-Barnhill	CESAJ FUDS Contractor	Public Relations	(904) 232-2179	Donna.L.West2@usace.army.mil
Becky Terry	CEHNC	COR	(256) 895-1788	Rebecca.K.Terry@usace.army.mil
Kelly Longberg	CEHNC	TM	(256) 895-1408	Kelly.D.Longberg@usace.army.mil
Kelly Enriquez	CEHNC	Project Geophysicist	(256) 895-1373	Kelly.D.Enriquez@usace.army.mil
Barry Hodges (via telephone)	CEHNC	Project Chemist		
John Winters (via telephone)	FDEP	RPM	(850) 245.8999	John.Winters@FloridaDEP.gov
Jim McCarthy (via telephone)	FDEP	RPM		Jim.McCarthy@FloridaDEP.gov
Bill Stanton	FDEP	Historic Preservationist	(850) 245.3110	William.stanton@FloridaDEP.gov
Anthony Knott	FDEP	Park Manager	(305) 292.6850	Anthony.Knott@dep.state.fl.us
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Edward Barham	U.S. Navy	NASKW	(305) 293-2911	Edward.Barham@navy.mil
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Jae Yun (via telephone)	Parsons	Deputy PM	(678) 969-2463	Jae.Yun@parsons.com
Steve Rembish	Parsons	Risk Assessor		Steve.J.Rembish@parsons.com
Mike Coon (via telephone)	Parsons	MEC Operations Manager	(425) 457-1734	Michael.Coon@parsons.com
Heesoo Chung (via telephone)	Parsons	Project Geophysicist	(303) 869-9309	Heesoo.chung@parsons.com
Don Shaw (via telephone)	USAE	Program/PM Underwater Dive Operations	(813)343-6406	dshaw@usatampa.com

Name	Org	Role	Number	Email
Bill Rottner (via telephone)	Alpine	PM Underwater DGM	(201) 397-3164	wrottner@alpineocean.com
Sandy Walters	SWC	President	(305) 294-1238	sandy@swcinc.net
Scott Butler (via telephone)	Brockington	Archaeologist	(770) 596-7651	scottbutler@brockington.org

Notes/Comments:

A presentation was given on July 31, 2018 to include project history, previous investigations, goals of the project, and proposed RI/FS activities. Comments received from FDEP on the Draft Final UFP-QAPP were discussed. Details of the SPP Meeting are documented in the SPP Meeting Memorandum, provided in Appendix L, which includes meeting minutes and the complete presentation providing site maps and figures and other pertinent information. FDEP comments on the UFP-QAPP are included in Appendix L.

Consensus Decisions Made:

- The SPP Team agreed that a Technical Memorandum will be prepared to address the technical approach for MC sampling at the conclusion of the DGM/AGC and intrusive investigation.
- See meeting minutes in Appendix L for additional decisions.

Worksheet #10: Conceptual Site Model

10.1 OVERVIEW

The purpose of this worksheet is to describe the preliminary CSMs for Fort Taylor. The CSM is based on site-specific details such as location, history, physical characteristics, current and future land use, and potentially complete exposure pathways and scenarios to be considered for the human health and ecological risk evaluations. Additionally, the CSM includes a munitions summary and exposure profile, and a summary of the historical MC and hazardous and toxic waste data. This site-specific data provides a basis for the technical approach and sampling plan. The CSM will be revised as additional information and investigation results are obtained throughout the RI/FS process.

10.2 SITE DESCRIPTION AND BACKGROUND

10.2.1 SITE LOCATION

Fort Taylor, FUDS Property No. I04FL0227, is located in the city of Key West, Monroe County, Florida on the western-most tip of the Florida Keys. **Figure 10.1** shows the site location. The FUDS consists of three MRSs. The Interior Fort and Casemates MRS 01 is three acres and includes the walls of the fort. The Artillery Ranges – Land and Disposal Area MRS 02 consists of 34 land acres plus a 3-acre moat surrounding the fort. The Artillery Ranges – Water Area MRS 03 is comprised of 99,977 tidal water acres (within the Gulf of Mexico and Atlantic Ocean). **Figure 10.2** shows the FUDS and MRS boundaries.

10.2.2 CLIMATE

The climate of Key West is semi-tropical. The area is greatly influenced by the proximity of the Atlantic Ocean and Gulf of Mexico. Surface winds blow predominately from the east with changes to the east southeast during the summer and northeast during winter. The average yearly wind velocity is 11.2 miles per hour. The coldest month in Key West is January; the warmest is July. The lowest recorded temperature is 41 degrees Fahrenheit and the highest recorded temperature is 95 degrees Fahrenheit (Parsons, 2008). Total yearly precipitation at Key West averages approximately 40 inches (U.S. Climate Data, 2018). The wet season is May to November; 72 percent of the rains falls in this season. The Atlantic hurricane season officially spans from June 1 through November 30. Since 1900, over twenty hurricanes have struck or affected Key West.

10.2.3 TOPOGRAPHY

The Fort Taylor area is situated at the western-most tip of Key West. The majority of the land was formed from dredging material from the main ship channel. The area is nearly flat with an average elevation of less than 10 feet. There are no streams on site. Surface drainage is toward the ocean and to a moat surrounding the casemate walls.

10.2.4 VEGETATION

Plant communities on site may consist of coastal upland, scrub and/or hammock where vegetative cover ranges from sparse to thick and includes salt-spray tolerant grasses and herbs, palmettos, sand pine, and scrub oak.

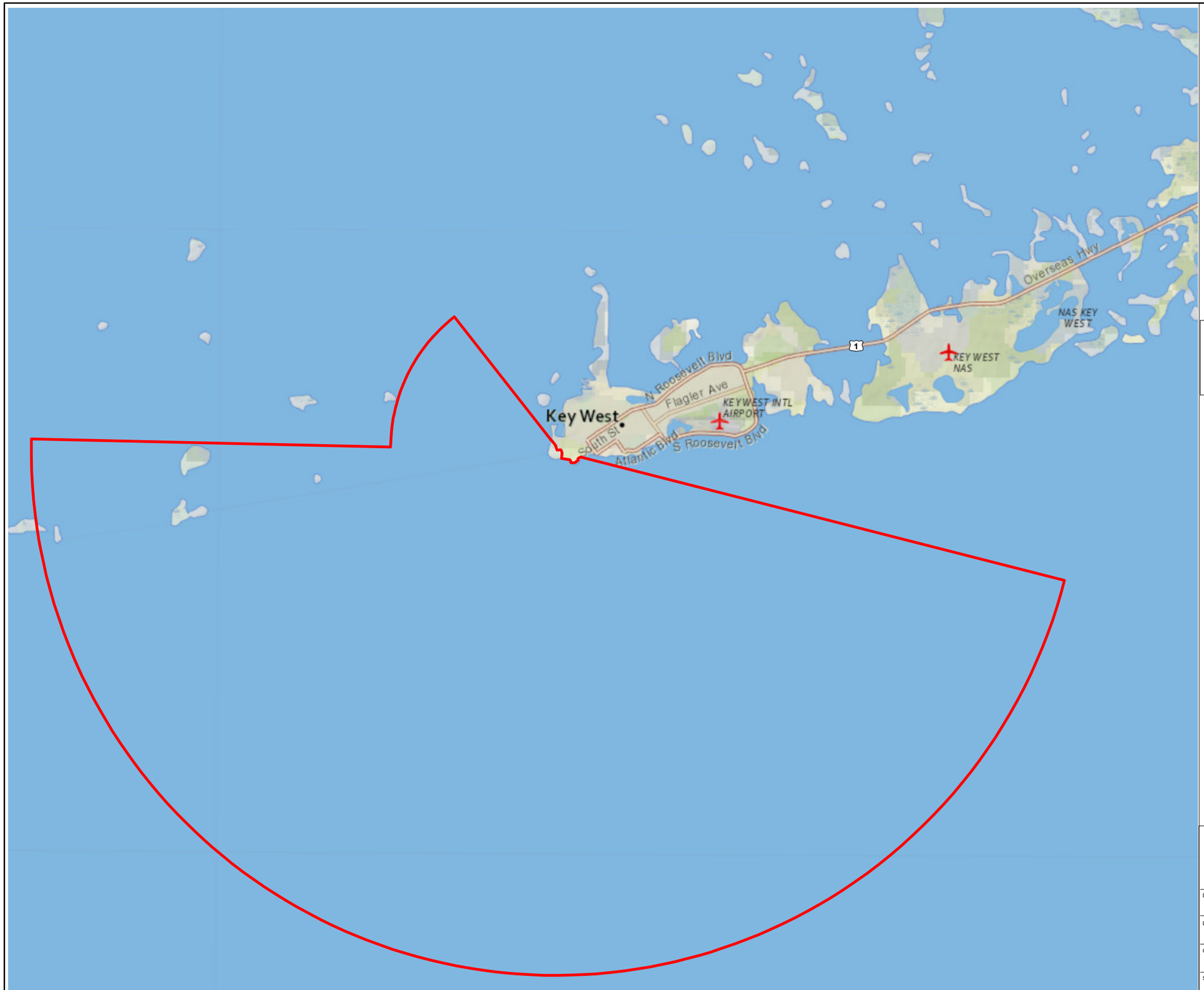


Figure 10.1

General Location Map
Fort Taylor
FUDS Project No. I04FL0227

Monroe County, Florida

Legend

FUDS Property Boundary

2 1 0 2 Miles

N

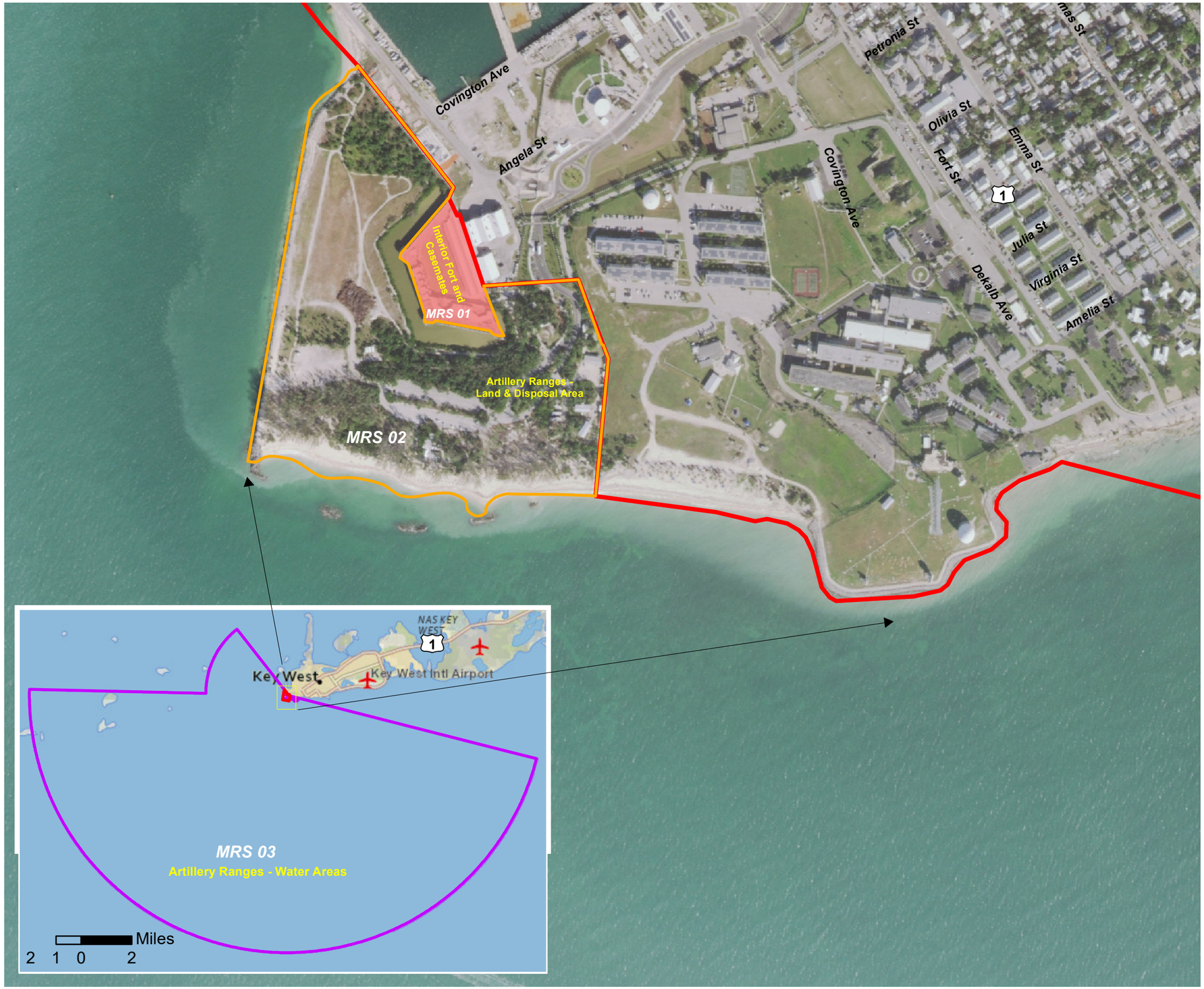
PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	General Location Map		
DRAWN BY: BT			
CHECKED BY: JY	SCALE: As Shown	PROJECT NUMBER:	
SUBMITTED BY: PB	DATE: August 2018	PAGE NUMBER: 15	
	FILE:		

Figure 10.2

MRS Location Map
Fort Taylor
FUDS Project No. I04FL022701

Monroe County, Florida



Legend

- FUDS Property Boundary
- MRS 01
- MRS 02 Boundary
- MRS 03 Boundary

Image: 2017 Orthophoto

Feet
200 100 0 200

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	MRS Location Map	
DRAWN BY: BT	SCALE: As Shown	PROJECT NUMBER: 100132.0002.110068.03000.LABOR
CHECKED BY: JY	DATE: June 2019	PAGE NUMBER: 16
SUBMITTED BY: PB	FILE:	

10.2.5 GEOLOGY

The Florida Keys is a narrow chain of small islands extending from Solider Key on the north to Key West on the south and west, a total distance of about 150 miles. Like the southern part of the mainland, the bedrock is limestone. The bedrock of the lower Keys began as an underwater east-west mound of unstable oolite. As it grew higher by the addition of more ooids, the mound gradually became broader to the south as well as the north and eventually covered the underlying corals. Tidal currents cut channels in the unstable oolite at right angles to the long direction of the mound. When the sea level lowered during glacial times, the exposed oolitic material hardened. The subsequent rise in sea level enabled the ocean waves to attack the mound. These waves concentrated on the old tidal channels originally formed while the mound was composed of loose ooids and eventually formed narrow channels that today separate the lower keys from each other.

10.2.6 SOILS

The soil of the Fort Taylor site is classified as urban land. Urban land is typically covered by asphalt, concrete, or other impervious surfaces that have been altered by dredging and filling for development (FDEP, 2008). The soil properties and characteristics vary across the site. The ASR Supplement classifies the soil as “sand/gravel sand” (USACE, 2004).

10.2.7 HYDROLOGY

Intertidal marine flats border both sides of the Florida Keys. These are shallow water areas, barely covered at low tide, which gradually slope into the deeper water of the surrounding platform. The site is bordered by the waters of the Gulf of Mexico and the Atlantic Ocean. According to the 1996 ASR, there are no streams on site. Surface drainage is toward the ocean and to a moat surrounding the casemates (USACE, 1996).

10.2.8 HYDROGEOLOGY

The principal geologic unit of the Lower Keys is Miami Limestone. Small, shallow freshwater to slightly brackish groundwater lenses occur on Key West. Fort Taylor is located on the southwestern tip of Key West, where saltwater intrusion occurs to the exclusion of fresh groundwater. As freshwater sources on the Keys are ephemeral and insufficient in volume, all potable drinking water on Key West is provided by the Florida Keys Aqueduct Authority via a 130-mile pipeline from a well field tapping the Biscayne aquifer on the mainland of Florida. No groundwater wells are registered within a four-mile radius of Fort Taylor. (Parsons, 2008)

10.2.9 ENDANGERED SPECIES, SENSITIVE HABITATS, AND HISTORICAL OR CULTURAL RESOURCES

The Fort Taylor FUDS is an important ecological place due to the presence of habitat for Threatened and Endangered (T&E) species and the inclusion of the site in a Coastal Zone Management area (Parsons, 2008). Florida’s imperiled species are fish and wildlife species that meet criteria to be listed as federally endangered, federally threatened, state threatened or species of special concern. In addition, there are a number of tree species, mostly native, that are protected by the City of Key West. Attachments E and F of Appendix C – Environmental Protection Plan (EPP) present the protected species that could be encountered within the MRSs. In addition, seagrass, protected by the National Marine Fisheries Service (NMFS) and State regulatory agencies, is distributed extensively in mostly shallow waters (20 feet or less) but, depending on water clarity, has been found to as deep as 90 feet. The three species of seagrass found in the vicinity of Fort Taylor are identified in the EPP (Appendix C).

According to the National Register Information System, National Historic Landmarks, and National Register of Historic Places databases, the Fort Taylor site is a National Historic Place (1971) and Landmark (1973). The site does not qualify as a National Heritage Area or historic district (National Register of Historic Districts). According to the Florida Master Site File archaeological and cultural review of the site, Fort Taylor is also registered as a Civil War archaeological and culturally significant area (Parsons, 2008). An Archaeological Monitoring Plan (AMP) is included in Appendix B.

10.3 CURRENT AND PROJECTED LAND USE

Key West is a popular tourist destination. The FUDS property is currently owned by the state of Florida as Fort Zachary Taylor Historic State Park and is a National Historic Landmark. Fort Taylor is operated as Fort Zachary Taylor Historic State Park by the Florida Division of Recreation and Parks. The Park includes beaches, forested areas, residences, and the fort. The property deed includes use restrictions, a recapture clause, and a reverter clause. Limited access restrictions include specific visitation hours. The lower casemate areas of the fort are closed to the public due to safety reasons. The Artillery Ranges – Water MRS, owned by the Federal Government, is used for a federal shipping channel and marine sanctuary. Key West National Wildlife Refuge lies within the Artillery Range - Water Areas MRS boundary. Dredging is conducted in the ship channel. The property is used for research and outdoor recreational activities including boating, fishing, snorkeling, and other beach-related activities. No known public injury incidents have been reported. The site contains habitat suitable to support numerous federally-protected species. The land use is expected to continue as a state park and wildlife refuge.

10.4 PREVIOUS INVESTIGATIONS

10.4.1 1991 PRELIMINARY ASSESSMENT/INVENTORY PROJECT REPORT

A Preliminary Assessment (USACE, 1991) of ordnance contamination was completed for Fort Taylor by USACE, New England District in June 1991. A brief site visit was conducted on May 16, 1989 by CESAJ personnel, who performed a visual survey of the excavations containing unexploded ordnance (UXO). A Risk Assessment Code (RAC) score of 2 was assigned to the site; a RAC score of 1 indicates highest risk and a RAC score of 5 indicates no risk. A Findings and Determination of Eligibility, dated June 10, 1991, concluded that the site was formerly used by the DoD and 51 acres of Fort Taylor were eligible for Defense Environmental Restoration Program (DERP)-FUDS.

10.4.2 1996 ARCHIVES SEARCH REPORT

The ASR (USACE, 1996) was completed by USACE, Rock Island District (CEMVR) in 1996. The ASR team reviewed all reports, newspaper articles; historical documents and reference material pertaining to the use and history of Fort Taylor. The ASR team interviewed the park manager, a local historian, and an official from USFWS about historic and current practices at Fort Taylor. A site visit was conducted on December 6, 1994. The team observed ordnance on display in the on-site museum and ordnance items gathered from on-site into a room closed to the public. The items in this room were described as mostly empty cartridge cases, empty cannon balls, empty Parrott rifle shells and solid Parrott rifle projectiles. One fuzed item was noted. One heavily corroded item was identified as potentially being a 3-inch armor piercing projectile. Post Korean War-era cartridge cases on-site were attributed to the fort's use as a U.S. Navy salvage yard. Within the concrete casemate near Battery Osceola, several cannons are exposed. Along the moat, the ASR team noted a berm, described as a "suspected non-ordnance burial area". The offshore ordnance area was not inspected, but was recommended as a potential FUDS. It was concluded that the casemates were potentially contaminated.

Although placing live rounds in the walls of the fort would increase the effect of enemy fire upon the fort, inadvertent placement of live rounds cannot be completely discounted. The Disposal Area was determined to have ordnance contamination due to confirmed findings since the closure of the site. The remaining land area (land not included in the Casemate or Disposal Area) was determined to be uncontaminated. There is no evidence that chemical warfare materiel was used at Fort Taylor. The ASR recommended sampling or monitoring for Hazardous, Radiological, and Toxic Waste (HRTW) due to the site's use as a salvage yard.

10.4.3 2008 SITE INSPECTION

The Site Inspection (SI) included qualitative reconnaissance that was conducted in April 2008 throughout the Interior Fort and Casemates MRS and the Artillery Ranges - Land and Disposal Area MRS (**Figure 10.3**). Twenty-seven 4-inch Parrott Rounds, one 6-inch Parrott round, and seven 5-inch cannonballs were found within the Interior Fort and Casemates MRS. Soil samples were collected in both MRSs. No explosives were found in any of the samples. Lead was detected above human health screening levels and lead, mercury, and zinc were detected at concentrations greater than ecological screening values in surface soil at the Interior Fort and Casemates MRS. Mercury was detected slightly above the ecological screening value in surface soil within the Artillery Ranges – Land and Disposal Area MRS. However, during the November 7-8, 2018 SPP Meeting, the PDT agreed that since mercury was not a major component of the munitions previously used at the FUDS and due to the possible anthropogenic source of mercury, it could be eliminated from the RI/FS as a chemical of potential concern (COPC). Based upon the findings, the SI recommended the two MRSs proceed to RI/FS.

10.4.4 2014 REVISED INVENTORY PROJECT REPORT

A revised INPR was issued in April 2014 to administratively realign the existing MMRP project into three separate projects as identified in the SI. Two new MMRP projects and a revision to the original MMRP project were approved as follows: Project 01 – Interior Fort and Casemates (3 acres); Project 02 – Artillery Ranges – Land and Disposal Area (61 acres); and Project 03 – Artillery Ranges – Water (99,977 acres).

Figure 10.3

Previous Investigation Map
Fort Taylor
FUDS Project No. I04FL0227

Monroe County, Florida

Legend

- Possible Munitions Location
- Soil Sample Location
- Surface Water/Sediment Sample Location
- Qualitative Reconnaissance Track
- FUDS Property Boundary

Image: 2017 Orthophotos

300 150 0 300 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	**Previous Investigation Map**		
DRAWN BY: BT			
CHECKED BY: JY	SCALE: As Shown	PROJECT NUMBER:	
SUBMITTED BY: PB	DATE: August 2018	PAGE NUMBER: 20	
	FILE:		

10.5 CONCEPTUAL SITE MODEL

10.5.1 The CSM is a description of an MRS and its environment that can be used to depict the nature of potential contamination, its location, and the possible interactions of human and environmental receptors with that contamination. The CSM summarizes which potential receptor exposure pathways for MEC and MC are (or may be) complete and which are (and are likely to remain) incomplete. An exposure pathway is considered incomplete unless *all four* of the following elements are present (U.S. Environmental Protection Agency [USEPA], 1989):

- a source of contamination;
- an environmental transport and/or exposure medium;
- a point of exposure at which the contaminant can interact with a receptor; and
- a receptor and a likely route of exposure at the exposure point.

10.5.2 If any single factor is not present, the pathway is incomplete. An incomplete exposure pathway indicates there are no current means by which a receptor (human or ecological) can be exposed to either MEC or MC. In this case, no hazards or risks from exposure to MEC or MC would be expected. This information can be used to focus the investigation of the site by suggesting which complete or potentially complete exposure pathways need to be evaluated. The CSM is a 'living document' that is based on existing knowledge and, therefore, can and should be updated throughout the course of the project as more data become available.

10.5.3 The Fort Taylor property was a harbor defense location from 1845 through the Civil War, the Spanish American War, and World War (WW) I and WWII, and was transferred to the State of Florida in 1979. The current configuration of the Interior Fort and Casemates MRS fort walls were built in 1898 and filled with sand dredged from the ship channel, Civil War-period ordnance, weapons, and empty projectiles. The fort was originally constructed in the ocean on a rocky shoal, approximately 1200 feet from the shore. The Artillery Ranges – Land and Disposal Area MRS was also originally in the ocean until the Navy dredged sediment from the shipping channel to build it between 1947 and 1966. The Navy owned this property from 1947 to 1979 when a majority of it was transferred to the State of Florida. The state then built the moat along the fort wall in 1989. Historical documents are unclear as to the activities the Navy conducted during its ownership. The Artillery Ranges – Water MRS may have been used by the Army during periods of time from 1845 to 1947. There are no historical records indicating use by the Navy during its ownership from 1947 to 1979.

10.5.4 The site is accessible via existing dirt and paved roads by vehicle and by foot, and by water and coastline by boat, swimming, and by foot. The Interior Fort and Casemates are part of the Fort Zachary Taylor Historic State Park and are used for recreational purposes. Portions of the site are closed to the public and restricted by the park. The Artillery Ranges – Land and Disposal Area MRS is part of the Fort Zachary Taylor Historic Site. This MRS is also contains residences and is used for recreation including, picnicking, hiking, swimming, snorkeling, fishing, and bird watching. The Artillery Ranges – Water MRS, owned by the Federal Government, is used for a federal shipping channel and marine sanctuary. Dredging is conducted in the ship channel. The Water MRS is used for research, recreational boating, fishing, diving, marine commerce, and commercial fishing. No change is expected in the future for the MRSs.

10.5.5 For the purposes of this RI/FS, the preliminary CSMs were developed in accordance with EM 200-1-12. The preliminary CSMs indicate that MEC in the form of UXO or discarded military munitions (DMM) are present at the MRS based on the munitions recovered during previous investigations, as presented in **Table 10.1**. It is anticipated that MEC will be most likely found in one or more "concentrated munitions use areas" (CMUAs), which are suspected to be present where former artillery targets were located. Outside of the former target areas there is a much lower likelihood of MEC presence. These are former range buffer areas where an errant training round may have landed. These

areas are categorically referred to as "non-concentrated munitions use areas" (NCMUAs). CMUAs/NCMUAs at the MRSs will be characterized by high (CMUAs) or low densities (NCMUAs) of surface and/or subsurface anomalies, and most importantly the presence of MEC or MD. There are typically no fixed locations for offshore artillery targets as they were towed, moving targets.

10.5.6 Potentially complete exposure pathways are present within the MRSs that might result in residents, on-site workers, site visitors, recreational users, commercial workers, and construction/excavation workers (e.g., utility workers) being exposed to munitions in soil. Munitions found within the MRSs during previous investigations, or those noted within historical documents as being used at the MRSs, are shown in **Table 10.1**.

Table 10.1 Potential Munitions

Civil War, 10-in, Smoothbore	12-inch AP, M1912 and M1913
Civil War, Projectiles, General	12-inch AP, M1913
Civil War, Projectiles, Smoothbore	3-inch, HE, M1915
Civil War, Shell, Parrott (6-inch, 4-inch, and 3-inch)	90mm, HE, M71, and HE-T, M71A1

10.5.7 The preliminary CSM for MC indicates that explosives and MC metals (copper, lead, and zinc) are potentially present in surface and subsurface soil at the land-based MRSs. Groundwater contamination is not anticipated at the project site. Potentially complete exposure pathways are present at the Interior Fort and Casemates MRS and the Artillery Ranges MRS – Land and Disposal Area that might result in residents, on-site workers, site visitors, recreational users, and construction/excavation workers (e.g., utility workers) being exposed to MC in soil, surface water, or sediment.

10.5.8 The preliminary CSMs for the Interior Fort and Casemates MRS, the Artillery Ranges – Land and Disposal Area MRS, and Artillery Ranges – Water MRS are summarized in **Tables 10.2, 10.3, and 10.4**. The CSM 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. Pictorial CSMs for land (**Figure 10.4**) and water (**Figure 10.5**) scenarios are provided to convey this information and facilitate communication with stakeholders in an easy to understand format. A CSM is based on existing knowledge; therefore, it will be updated as more information becomes available.

Table 10.2 Preliminary Conceptual Site Model, Interior Fort and Casemates MRS

Site Details	Known or Suspected Contamination Source(s)	Potential/Suspected Location and Distribution	Source or Exposure Medium	Current and Future Receptors	Potentially Complete Exposure Pathway
NAME: Fort Zachary Taylor Interior Fort and Casemates MRS 01 **Acreage**: 3 acres **Suspected Past DoD Activities (*release mechanisms*)**: Ordnance and other materials were used to fill the fort walls during modernization **Current and Future Land Use**: The MRS is currently used for recreational purposes. Future use not expected to change.	• *Civil War, 10-in, Smoothbore* • *Civil War, Projectiles, General* • *Civil War, Projectiles, Smoothbore* • *Civil War, Shell, Parrott (one 6-inch and 4-inch)*	CMUAs: Increased potential to find residual MEC/ material potentially presenting an explosive hazard (MPPEH).	Surface or subsurface soil	Potential current and future receptors include on-site workers, site visitors, recreational users, researchers, and construction/excavation workers (e.g., utility workers). Future land use is anticipated to be similar to current use.	Exposure to surface or subsurface MEC.
	MC in soil. Explosives, Metals (Copper, Lead, and Zinc)	Potentially present in soil.	Surface and subsurface soil.		Exposure to surface soil through incidental ingestion, dermal contact, and inhalation of resuspended soil particles.

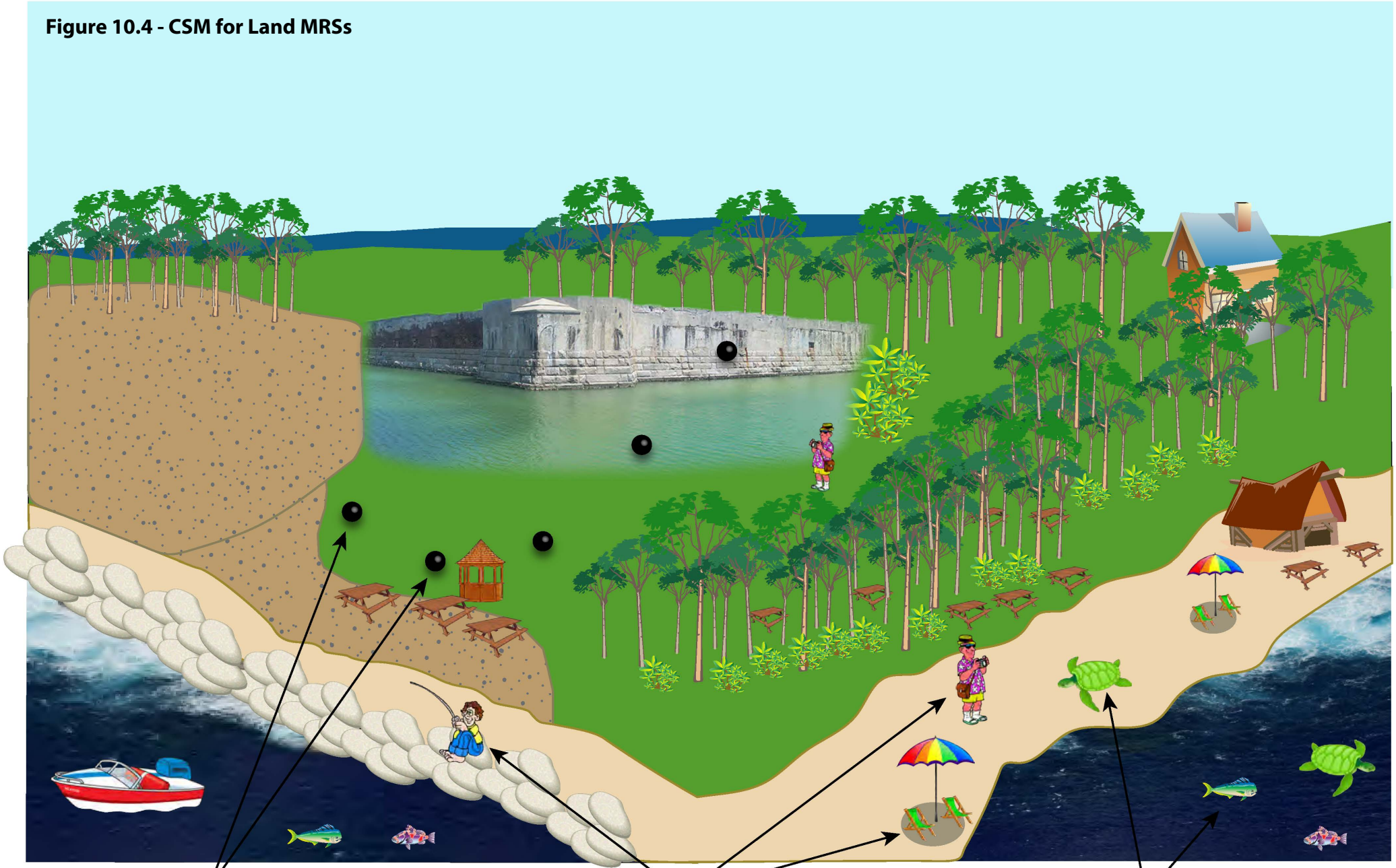
Table 10.3 Preliminary Conceptual Site Model, Artillery Ranges – Land & Disposal Area MRS

Site Details	Known or Suspected Contamination Source(s)	Potential/Suspected Location and Distribution	Source or Exposure Medium	Current and Future Receptors	Potentially Complete Exposure Pathway
NAME: Artillery Ranges – Land & Disposal Area MRS 02 **Acreage**: 37 acres (34 land; 3 moat) **Suspected Past DoD Activities (*release mechanisms*)**: Unclear from historical documents what activities were conducted here during Navy ownership but it appears there was dumping of various scrap materials. **Current and Future Land Use**: The MRS is currently used for residential and recreational purposes. Future use not expected to change.	• *Civil War, 10-in, Smoothbore* • *Civil War, Projectiles, General* • *Civil War, Projectiles, Smoothbore* • *Civil War, Shell, Parrott* • *Civil War, Cannonball*	CMUAs: Increased potential to find residual MEC/ MPPEH.	Surface or subsurface soil	Potential current and future receptors include residents, on-site workers, site visitors/recreational users, and site workers. Future land use is anticipated to be similar to current use.	Exposure to surface or subsurface MEC.
	MC in soil, sediment, and surface water Explosives, Metals (Copper, Lead, and Zinc)	Potentially present in soil, surface water, or sediment.	Surface and subsurface soil, sediment, and surface water.		Exposure to surface soil through incidental ingestion, dermal contact, and inhalation of resuspended soil particles. Exposure to surface water through incidental ingestion and dermal contact. Exposure to sediment through dermal contact.

Table 10.4 Preliminary Conceptual Site Model, Artillery Ranges – Water MRS

Site Details	Known or Suspected Contamination Source(s)	Potential/Suspected Location and Distribution	Source or Exposure Medium	Current and Future Receptors	Potentially Complete Exposure Pathway
NAME: Fort Zachary Taylor Artillery Ranges – Water MRS 03 **Acreage**: 99,977 acres **Suspected Past DoD Activities (*release mechanisms*)**: MRS is a water range/impact area located offshore. There are no known targets for practice artillery firing based on historical research. **Current and Future Land Use**: The MRS is currently used for recreational, research, and commercial purposes. Future use not expected to change.	• *12-inch, AP, M1912 and M1913* • *3-inch, HE, M1915* • *90mm, HE, M71 and HE-T, M71A1* • *Civil War, 10-inch, Smoothbore*	CMUAs: Increased potential to find residual MEC/ MPPEH.	Surface or subsurface sediment	Potential current and future receptors include site workers, site visitors, recreational users, commercial workers, and researchers. Future land use is anticipated to be similar to current use.	Exposure to surface or subsurface MEC.

Figure 10.4 - CSM for Land MRSs

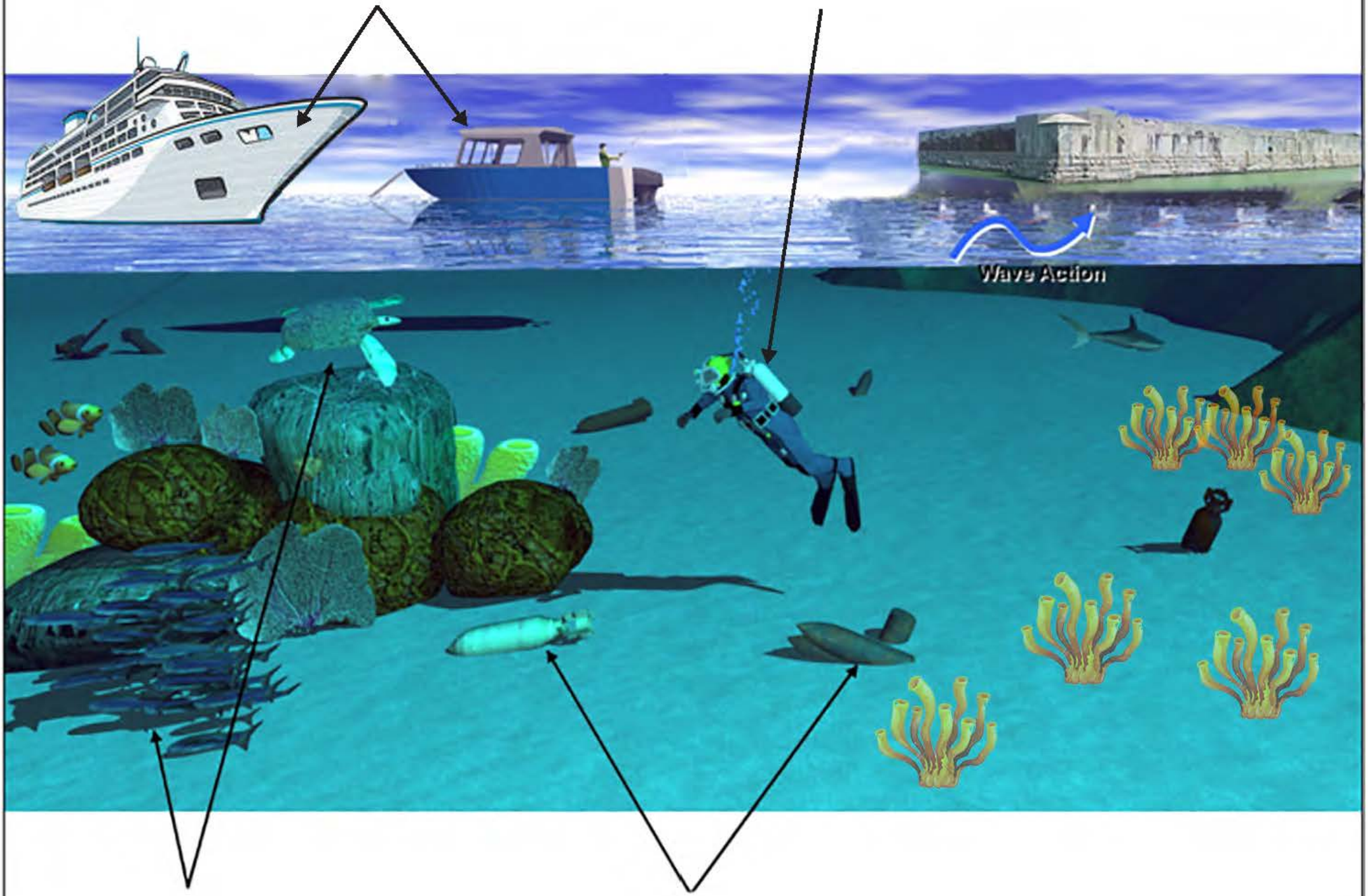


Bombs and Projectiles (Source of Hazard)

Shoreline Visitors Including Divers, Birdwatchers Swimmers, Surfers, Fishermen, and Beachcombers:
Incidental contact with MEC and MC washed onto shore or present in shallow water.

Aquatic Organisms:
Incidental contact with MEC and MC.

Figure 10.5 - CSM for Water MRSs



Commercial & Recreational Activities:
Incidental contact with MEC.

Divers and Swimmers:
Incidental contact with MEC.

Aquatic Organisms:
Incidental contact with MEC.

Bombs and Projectiles (Source of Hazard)

Worksheet #11.1: MEC Data Quality Objectives

11.1 OVERVIEW

11.1.0.1 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 overall goal of this project is to obtain acceptance of an RI/FS, Proposed Plan, and DD for the Interior Fort and Casemates and Artillery Ranges MRSs in accordance with the CERCLA, as amended, and DoD, Army and USACE regulations and guidance. The information collected to meet the DQOs presented in this worksheet will be sufficient to characterize the nature and extent of any MEC and assess human health and ecological risks present at the Interior Fort and Casemates and Artillery Ranges MRSs.

11.1.0.2 The following DQO elements are developed during project planning sessions using a SPP. Examples of SPP include 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; Intergovernmental Data Quality Task Force Uniform Federal Policy (UFP)-Quality Assurance Project Plans Manual; and the USACE *Technical Project Planning Process (TPP)*, Engineer Manual (EM) 200-1-2, February 29, 2016.

11.1.1 STEP 1: STATE THE PROBLEM

Evidence from previous investigations at the Interior Fort and Casemates MRS, Artillery Ranges - Land and Disposal Area MRS, and the Artillery Ranges – Water MRS, suggest that MEC in the form of UXO and DMM may be present at the site resulting from its use during the Civil War, Spanish-American War, WWI, and WWII as a harbor defense. Depending on the types and distribution of MEC present, there may be an unacceptable risk from explosive hazards to residents, workers, and visitors. Further study is needed to characterize the types and locations of potential MEC hazards; delineate CMUAs, buffer zones, and unused zones; evaluate baseline risks to human health; and gather data to assist in evaluating alternatives for mitigating unacceptable risks.[1]

11.1.2 STEP 2: IDENTIFY THE GOALS OF THE DATA COLLECTION

Principal study question: Does the presence of explosive hazards at this MRS or investigation area[2] pose an unacceptable risk to human health?

Remedial Investigation:

The project team will collect geophysical and physical data to refine the CSM and answer the following questions:

1) What are the horizontal and vertical extents of MEC contamination?

1 EM 200-1-15 defines CMUAs as munitions response sites (MRS) or areas within a MRS where there is a high likelihood of finding UXO or DMMs and that have a high amount of munition debris within them as a result of historical munitions use and fragmentation. CMUAs are most commonly target areas on ranges; however, they also include explosion sites, open burn / open detonation areas, and potentially disposal sites where munitions have been disposed of over a relatively large area (i.e., not small, isolated burial pits).

2 As used in this document, the term "investigation area" can refer to the entire MRS or any portion of it.

2) Within the MRS, what are boundaries of areas where:
    a. CMUAs exist and MEC is likely to be present?
        i. What is the anomaly density in these areas?
        ii. What is the depth distribution profile?
    b. MEC presence is less likely, but may be found at discrete random locations.
        i. What is the amount of MEC contamination that could potentially be present in these areas?
        ii. What is the depth distribution profile?
    c. There is no evidence of MEC contamination?
3) What types of MEC are/may be present within investigation areas?
4) What is the background anomaly density?
5) What are the site-specific capabilities and limitations of the detection instruments?
    a. How is confidence in detection depth verified and reported?
    b. How is the horizontal width of the instrument verified?

<u>Baseline Risk Determination</u>:

The project team will update the CSM using RI results and conduct a baseline risk determination to answer the following questions:

1) What is the frequency of access to the MRS? (workers, residents, etc.)
    a. How frequently do people access the site?
    b. Are there any physical or legal restrictions that affect site access?
    c. Are there land/deed restrictions enforced on the site?
2) Using the "Amount of MEC" determined from the RI geophysical and intrusive investigation, and the "Accessibility" for the MRS, what is the likelihood of encounter?
3) What are the potential interactions between MEC and receptors based on the amount and distribution of MEC and the current and reasonably anticipated future land use?
4) If there is an encounter with MEC, what is the likelihood that there will be energy imparted on an item based on land use?
5) Based on the types of MEC present, and the specific munitions sensitivities, what is the probability that human interaction will cause an item to function?
6) Based on the type of MEC present, what is the severity of an unintentional detonation?
7) Based on all of the above, is there an unacceptable risk from MEC hazards?

<u>Identify alternative outcomes (RI/Baseline Risk Determination)</u>:

1) There is no unacceptable risk.
2) There is an unacceptable risk; therefore, remedial alternatives will be developed and evaluated in a FS.
3) Data are insufficient to make a determination.

11.1.3 STEP 3: IDENTIFY INFORMATION INPUTS

- Up-to-date CSM summarizing munitions use and site conditions based on previous studies
- Current and reasonably anticipated future land use
- Current and reasonably anticipated future human receptors
- Cultural resources
- Biological resources
- Detection survey results and background densities
- Visual Sample Plan (VSP) analysis results
- Background densities
- Bathymetry data
- Target of Interest (TOI) library
- Cued survey results
- Intrusive investigation results
- QC results
- QA results
- Analysis Verification reports
- Munitions composition and sensitivities
- Expected severity of unintentional detonations
- Physical evidence of target areas (e.g., craters resulting from HE use, fragments) discovered during site reconnaissance, transect installation, DGM survey, etc.
- Site access conditions
- Park schedules, hours of operations
- Frequency of use by potential receptors
- USGS-documented land use data
- NOAA depth charts
- Weather data
- Local community events
- Local Dive Shop information
- Land use restrictions
- National Marine Sanctuary restrictions

11.1.4 STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

Generally, the boundary of the study is the MRS boundary, which was established based on historical documentation of the former Interior Fort and Casemates and Artillery Ranges boundaries. The MRS boundary represents the area where, by definition, there is known or suspected MEC contamination. This study will further define that boundary by characterizing the nature and extent of contamination. The boundary may be extended horizontally using a step-out methodology if a MEC item is discovered at the currently defined MRS boundary. Other boundaries, or limitations of the study are described below:

Target population (MEC): The target population for this study includes any metallic anomalies detected from the ground surface to depth of instrument detection as determined through the geophysical system verification (GSV) process during the DGM survey. This population will be studied to differentiate which anomalies are consistent with ordnance used, stored, or discarded at this site versus those anomalies that result from non-MEC metallic objects. The target population for the remedial response process is UXO and DMM. This RI will also account for MD as an indicator of the types of munitions

used, associated distribution (horizontal and vertical), and as an indicator of MEC hazards and MC contamination. At this time, the CSM indicates that the following MEC may be present at the site.

Table 11.1 Target Munitions (Confirmed and Suspected)

Known or suspected U.S. MEC (including nomenclature, if known)	MEC Type	Potential Hazards
Interior Fort and Casemates MRS 01		
Civil War, 10-inch, Smoothbore	UXO/DMM	Explosive
Civil War, Projectiles, General	UXO/DMM	Explosive
Civil War, Projectiles, Smoothbore	UXO/DMM	Explosive
Civil War, Shell, Parrott 6-inch	UXO/DMM	Explosive
Civil War, Shell, Parrott 4-inch	UXO/DMM	Explosive
Artillery Range-Land and Disposal Area, Moat MRS 02		
Civil War, 10-inch, Smoothbore	UXO/DMM	Explosive
Civil War, Projectiles, General	UXO/DMM	Explosive
Civil War, Projectiles, Smoothbore	UXO/DMM	Explosive
Civil War, Shell, Parrott	UXO/DMM	Explosive
Artillery Range-Water MRS 03		
12-inch, AP M1912	UXO/DMM	Explosive
12-inch, AP M1913	UXO/DMM	Explosive
3-inch, HE, M1915	UXO/DMM	Explosive
90mm, HE, M71	UXO/DMM	Explosive
90mm, HE-T, M71A1	UXO/DMM	Explosive
Civil War, 10-inch, Smoothbore	UXO/DMM	Explosive

Characteristics of interest:

- Indications of HE use
- Indications that UXO or DMM may persist
- Indications a complete exposure pathway may exist

Spatial and temporal boundaries:

- Horizontal boundaries:
  - The horizontal boundaries of the project are defined by the MRS boundaries, the Park boundaries, and the walls of the Interior Fort and Casemates.
  - Land and underwater terrain/features may require transect placement adjustments to allow data collection across the MRS.
  - Archeological features will be avoided as specified by the Park.
  - Step-out transects may extend the horizontal boundary as needed to define CMUAs.

- Vertical boundaries:
  - The vertical extent of MEC on land is from the ground surface to depth of instrument detection as determined through the GSV process.
  - The vertical extent of MEC in the water areas is from the surface of the seafloor to the maximum depth in which anomalies can be excavated by hand (approximately 24 inches), or to a coral reef, consolidated hard bottom or bedrock, whichever is reached first. Anomalies not resolved due to sub seafloor depths of greater than 24 inches will be documented as unresolved if a signal remains.
  - Underwater conditions within the moat may require height adjustments of the PRMS system for optimal detection.

- Temporal boundaries:
  - Turtle nesting occurs from mid-April through October. Turtle nesting areas may be present on site and will be avoided. In coordination with the Park Service personnel, these locations will be identified and field crews will be provided pictures and other documentation describing the appearance and characteristics of the areas or sensitive ecological areas.
  - Weather: The wet season is May to November; 72 percent of the rains falls in this season. Surface winds blow predominately from the east with changes to the east southeast during the summer and northeast during winter. The average yearly wind velocity is 11.2 miles per hour. The Atlantic hurricane season officially spans from June 1 through November 30.

11.1.5 STEP 5: DEVELOP THE PROJECT DATA COLLECTION AND ANALYSIS APPROACH

Overview:

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). The anomaly selection threshold (details on Worksheet #17) will be set appropriately in order to focus efforts on the larger anomalies that could be MEC or pieces of MEC large enough to be identified. 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 "inclusive" will be designated for intrusive investigation and subsequent removal if the item is found to be MEC.

Interior Fort and Casemates MRS

The project team will collect hand towed EM61-MK2 DGM data in 100% of all open areas not occupied by cultural features within the Interior Fort, approximately 1 acre. All the data will be used to develop AGC cued target lists. A MM 2x2 cued survey will be conducted on anomalies above the selection threshold (details on Worksheet #17), estimated to be no more than 200 anomalies. Thirty cued survey TOIs will be intrusively investigated, representing at least an 85% reduction from detection to dig – a more than reasonable number given the size of the expected and suspected munitions listed in Table 11.1. The casemates will have EM61-MK2 DGM over 1.8 acres and analog investigation over 0.2 acres. The DGM data will be collected to develop AGC cued target lists. Using similar rationale for the Interior Fort, a cued survey of 400 anomalies will be conducted, followed by an investigation of 60 cued survey TOIs. Blind QC seeds and validation seeds will be placed to assess survey performance. If the anomaly count vastly exceeds the estimated numbers, those anomalies to cue should still provide good characterization of the MEC extent at the MRS.

Artillery Ranges – Land & Disposal Area, Moat

The project team will collect bathymetry and single sensor EM61-MK2 DGM data using Parsons Robotic Marine System (PRMS) at 1 meter spacing (0.5 transect miles of bathymetry and 2.35 DGM acres). The data will be used to determine depth and underwater conditions which will be utilized to adjust the sensor height for optimal detection within the moat. Given the recent history of the moat, it is expected that no more than one hundred and ten anomalies will be reacquired and investigated using divers with handheld metal detectors to determine the nature and vertical extent of MEC contamination, if present.

Artillery Ranges – Land & Disposal Area, Land Areas

EM61-MK2 DGM data will be collected over approximately 16.8 acres of the MRS. Grids will be selected to maximize the use of DGM and AGC. The method is based on a 95% confidence such that areas outside of the CMUAs have less than or equal to 0.1 UXO per acre. Based on an expected anomaly density of one half that of the Interior Fort and Casemates, a cued survey using the MM 2x2 will be conducted on no more than 1,700 TOIs. Up to 300 anomalies will be reacquired and intrusively investigated. Blind QC seeds and validation seeds will be placed to assess survey performance.

Artillery Ranges – Water, Near Shore Areas, Analog and Dig

Divers will investigate transects using handheld analog instruments aided by the Shark Marine System at 30m spacing within the first 100m of near shore area, approximately 0.95 acres or 3,890m of transects. The 30m transect spacing provides sufficient coverage in the areas of higher tourist activity to traverse and detect with 95% probability a 520ft diameter circular target area. All of the anomalies will be investigated in the low concentration areas and a percentage within the high concentration areas, identified through the analog survey, to characterize the nature and vertical extent of MEC contamination, if present.

Artillery Ranges – Water, Near Shore Areas, DGM

The project team will collect transects using a Geometrics G882 magnetometer coupled with a Sonardyne Scout USBL system. The USBL will be referenced to the RTK DGPS survey location. The DGM survey will be conducted at 100 m spacing in an area between 100m – 1,000m offshore. Approximately 6.7 acres or 8,000m of transects will be collected. The 100m transect spacing provides sufficient coverage in the near shore areas to traverse and detect with 95% probability a 720ft diameter circular target area. Divers will reacquire and investigate up to 150 anomalies using handheld metal detectors aided by the Shark Marine System. The anomaly list will be picked along the low and high concentration areas of the transects and approved by the PDT. Anomaly selection will be used to characterize the nature and vertical extent of MEC contamination, if present.

Artillery Ranges – Water, Dive Sites/Keys

The project team will collect 3 acres of bathymetry and 2 acres of DGM data around each of 10 dive sites using a multibeam echo sounder and dual Geometrics G882 magnetometer. Transects will be spaced 30m to 100m apart in a circular pattern around each dive site location based on site conditions to best optimize the survey to sufficiently delineate each site. Divers will investigate up to 300 anomalies, approved by the PDT, in both low and high concentration areas across all 10 dive sites to characterize the nature and vertical extent of potential MEC contamination.

Artillery Ranges – Water, Remaining Lands

The project team will collect 6.5 acres of both DGM transects and grids in the NCMUAs within the MRS. Six 0.5-acre grids totaling 3 acres and seven transects totaling 3.5 acres are planned to demonstrate that MEC contaminated areas are bounded with at least 95% confidence such that areas outside of the CMUAs have less than or equal to 0.5 UXO per acre. Investigation of up to 240 anomalies will be approved by the PDT to achieve 95% confidence level that NCMUAs have less than or equal to 0.5 UXO per acre. If more than 240 anomalies are required to achieve the NCUMA confidence level, the PDT will be notified, and the additional anomalies will be investigated, if warranted.

Baseline Risk Determination: The project team will update the CSM using RI results and conduct a baseline risk determination in compliance with HQUSACE Memorandum dated, 3 January 2017, Subject, *Trial Period for Risk Management Methodology at Formerly Used Defense Sites Military Munitions Response Program (MMRP) Projects*. The risk determination will evaluate the amount and type of MEC,

land use, site accessibility, probability of human interaction with MEC, the probability for an incident to occur, and the severity of unintentionally causing the item to function.

The project approach involves Dynamic Surveys, Cued Data Acquisition, Intrusive Investigation, and Analog Removal. The decision rules for these components are listed below.

Decision rules:

(1) If no high anomaly density areas have been identified based on data analysis using VSP, then no CMUAs are present in the MRS.

(2) If high anomaly density areas are identified based on data analysis using VSP, then delineate the site(s) into high-density areas and low-density areas; high density areas will be treated as potential CMUAs, while low-density areas will be assumed to be NCMUAs.

MEC Characterization Decisions for Potential CMUAs:

- If MEC or MD are found in a potential CMUA, then the CMUA is considered confirmed and a MEC risk determination will be conducted.
- If no MEC or MD are found in a potential CMUA, then the area is not a confirmed CMUA (i.e., another rationale for the high anomaly density exists) and it will be combined with the NCMUA for the MEC risk determination.
- If a CMUA is confirmed and MEC are found on the surface or in the subsurface, then the "Amount of MEC" for the MEC risk determination will use Row 1 on Matrix 1 (Likelihood of Encounter) (See Risk Assessment Work Plan [RAWP] in Appendix G).
- If a CMUA is confirmed and no MEC are found, but MD indicative of MEC is found on the surface or in the subsurface, then the "Amount of MEC" for the MEC risk determination will use Row 2 on Matrix 1 (Likelihood of Encounter) (See RAWP in Appendix G).

MEC Characterization Decisions for NCMUAs:

- If MEC density <0.1 MEC/acre (for MRS 02) or 0.5 MEC/acre (for MRS 03) cannot be established at 95% confidence for the NCMUA, then re-delineate areas and recalculate and/or resample to achieve 95% confidence. For the MEC risk determination, NCMUAs where the <0.1 MEC/acre (for MRS 02) or 0.5 MEC/acre (MRS 03) cannot be established at 95% confidence will either be combined with identified CMUAs or the "Amount of MEC" will use Row 3 on Matrix 1 (Likelihood of Encounter) (See RAWP in Appendix G).
- If a 95% confidence is established that MEC densities meet the specified targets in the NCMUA and MEC or MD were found, then the "Amount of MEC" for the MEC risk determination will use Row 4 (for 0.5 MEC/acre) or Row 5 (for 0.1 MEC/acre) on Matrix 1 (Likelihood of Encounter) (See RAWP in Appendix G).
- If a 95% confidence is established that MEC densities meet the specified targets in the NCMUA and no MEC or MD were found, then the "Amount of MEC" for the MEC risk determination will use Row 6 on Matrix 1 (Likelihood of Encounter) (See RAWP in Appendix G).

Land Dynamic Surveys:

- DGM surveys will be conducted in all accessible areas where the width of the EM61-MK2 sensors can pass. Obstructed areas or areas with heavy metallic interference will be surveyed using analog methods if the EM61-MK2 cannot pass through on two consecutive lanes.
- For beach grids, if DGM data is not reacquired and intrusively investigated within four weeks, the data will be recollected or analog surveys will be conducted.

- If a detected anomaly exceeds the selection threshold (details on Worksheet #17), then it will be identified for evaluation using cued data acquisition.

Cued Data Acquisition and Intrusive Investigation:

- If the expected civil war era munitions items cannot be secured from the Park Museum for inclusion in the site-specific TOI library, training data will be requested for unidentified items that either reveal themselves during the cluster analysis stage or have UXO-like properties but do not closely match any library item (details in SOP AC-08). If TOI are found at training digs, the item(s) will be added to the library and the Data Analyst will re-rank and classify the target 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 Worksheet #17), 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 Worksheet #17), 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 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 Worksheet #17), 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 Worksheet #17).
- If dynamic detection data indicate a high-density area or portion of the site has more sources than cued classification techniques can reliably estimate polarizabilities (details on Worksheet #17), then the anomaly density will be reduced using analog methods (i.e., surface sweep).

Analog Investigation:

- If a subsurface anomaly is detected using the analog detection instrument, it will be intrusively investigated (details on Worksheet #17).
- If the intrusive investigation locates MEC, MD, or non-munitions related debris (NMRD), then the item(s) will be removed and disposed of as detailed on Worksheet #17.

Underwater Dynamic Surveys:

- Underwater DGM surveys will be conducted in all planned areas unless water depth is less than four feet (i.e., near shore area) or the sea bottom undulation, coral habitat, or sea state conditions prevent the sensor from maintaining a constant offset from the sea floor within detection range or compromise the quality of the DGM data. Analog surveys may be used under these conditions.
- If a detected anomaly exceeds the selection threshold (details on Worksheet #17) then it will be identified and added the target list.
- If the selected anomaly is determined not to be caused from a known metallic source or possible noise from the volatile underwater environment, the anomaly will be imputed to create an anomaly density map.

- Anomalies within the high-density and low-density areas will be presented on a map for the project team to evaluate and to determine intrusive strategies to best characterize the areas.
- Underwater DGM anomalies selected for investigation will be reacquired either visually or by analog underwater all metal detectors (anomalies maybe on the surface or subsurface).
- Intrusive investigations will be performed by hand, using hand tools, and will only occur in unconsolidated sediments, procedures will be monitored by the project biologist.
- If the UXO diver cannot locate the DGM target within a 10-foot radius: the DGM target will be remarked and searched within the 10-foot radius: if it still cannot be located it will be considered a "no find". A Root Cause Analysis will be conducted if "no finds" exceed 15%.
- If no MEC-related items are found in an area based on intrusive investigation, then the area will be considered un-impacted by MEC and no additional investigation will be planned.
- If anomalies are identified as MEC or indicators of MEC at the boundaries of the MRS, the extent of the hazard will be bound by radial transects.

Underwater Analog Surveys:

- Analog surveys are planned for the near-shore areas. If a single anomaly source is detected by the UXO SCUBA diver along the transect (50ft) with no other anomalies the diver will investigate the anomaly.
- If multiple anomaly sources are detected by the UXO SCUBA diver along the transect, representative of a high-density area, up to five of the sources will be investigated to characterize the area or until MEC is uncovered.

11.1.6 STEP 6: SPECIFY PROJECT-SPECIFIC MEASUREMENT PERFORMANCE CRITERIA

MPCs are the criteria that collected data must meet to satisfy the DQOs. Project-specific MPCs are presented in Worksheet #12. 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 (Worksheet #37).

11.1.7 STEP 7: SURVEY DESIGN AND PROJECT WORKFLOW

The MPCs established during Step 6 of the DQO process (documented in Worksheet #12) were used to develop the sample design, which is described in Worksheet #17. The sample design is broken down into a series of specific processes and data collection steps, or DFWs.

Worksheet #11.2: MC Data Quality Objectives

11.2 OVERVIEW

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.

11.2.1 STEP 1: STATE THE PROBLEM

Past munitions detonations or degradation of munitions in CMUAs/NCMUAs may have resulted in MC being released to environmental media (soil, subsurface soil, surface water, or sediment). If MC contamination is present, it may pose a risk to human and ecological receptors.

CMUAs are currently not delineated and so it is unknown where MEC, thus MC contamination, is most likely.

MC was detected at concentrations above screening levels in one sample collected within the Interior Fort and Casemate MRS and one sample collected within the Artillery Ranges – Land and Disposal Area MRS.

MC contamination resulting from prior DoD usage is not expected in areas not affected by munitions use activities.

11.2.2 STEP 2: IDENTIFY THE GOALS OF THE DATA COLLECTION

Do analytes that are known to be MCs of site-specific munitions exist at CMUAs above background and project action limits (PALs)? If so, what is the horizontal and vertical extent?

What is the horizontal and vertical extent of the previously identified MC contamination.

If MC contamination is present, do concentrations pose unacceptable risks to human or ecological receptors at the MRS?

Based on the nature and extent of MC contamination established by the RI and the results of the risk assessment, are further response actions required at the MRS?

Alternative Outcomes Include:

- A recommendation for No Action if unacceptable human health or ecological risks do not exist.
- An evaluation of remedial alternatives in the FS if unacceptable risks do exist.

11.2.3 STEP 3: IDENTIFY INFORMATION INPUTS

- Historical data, aerial photographs.
- Munitions suspected to be used at the site.
- Results of geophysical surveys and subsequent intrusive investigation (for determining the extent of CMUAs and, subsequently, sample locations).
- Field sampling data and laboratory analysis results for soil, sediment, or surface water.
- Land use and receptors.

11.2.4 STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

Boundaries of the MRSs are defined on **Figure 10.2**.

The RI is limited to areas where ROE is granted. A majority of the land within the 3 acre Interior Fort and Casemates MRS and the Artillery Land and Disposal Area MRS are owned by the State.

If no indications of MEC are discovered (i.e., MD), then the MRS will be determined to be free of MEC contamination within the limits of the investigation and no MC samples will be collected.

In areas (i.e., grids) where intrusive investigations have identified a CMUA, or in grids where UXO/MD are present, samples will be collected via ISM. Sample units (SUs) will be 100 ft x 100 ft and will be equal to a residential exposure unit (EU). EUs for all other receptors will be 5 acres. Therefore, in some cases multiple SUs will be included in an EU. In areas were MC samples detect analyte exceedances, step out SUs and vertical extent investigation samples will be collected. The horizontal and vertical extent of the investigation will be the locations where MC concentrations are less than the PALs or equivalent to background.

MC analytes and sample media are limited to those listed in Worksheet #15.

11.2.5 STEP 5: DEVELOP THE PROJECT DATA COLLECTION AND ANALYSIS APPROACH

If CMUAs are not identified, no MC sampling will be conducted except as described in Section 11.2.7 at the SI exceedance location in the Interior Fort and Casemates MRS 01 and at the location of the Parrott round found along the trail in MRS 02 – Artillery Ranges – Land and Disposal Area. If MEC/MD is not identified in the moat or at the edge of the moat, no MC sampling will be conducted in the moat.

If MC concentrations in soil, surface water, or sediment samples are ≤ PALs (see Worksheet #15) and background, then there is no evidence of a release and no further analysis is required.

If MC concentrations in soil are > PALs (see Worksheet #15) and background, then there is evidence of a release (i.e., COPCs are present) and additional surface and/or subsurface samples may need to be collected to delineate extent of COPCs in soil and evaluate risk associated with potential exposure to MC in soil.

11.2.6 STEP 6: SPECIFY PROJECT-SPECIFIC MEASUREMENT PERFORMANCE CRITERIA

Sampling and analysis shall achieve applicable MPCs as stated in Worksheet #12, unless MPC failures can be adequately explained or justified.

11.2.7 STEP 7: SURVEY DESIGN AND PROJECT WORKFLOW

Samples will be analyzed for explosives and select metals. All samples collected for delineation purposes (i.e., step-out samples) will be analyzed only for those COPCs exceeding screening levels. A SU (0.25 acres) will be placed where MC exceedances in soil were previously identified during the SI at the Interior Fort and Casemates MRS 01. A vertical extent sample will be collected at a depth of 6 to 24 inches at the original sample location.

For the Interior Fort and Casemates MRS, it is anticipated that up to two additional SUs will be required to determine if there is evidence of a release of MC at the locations of MEC or MD finds. For the Artillery Ranges - Land and Disposal Area MRS, a SU will be placed where the Parrott round was found along the trail. It is anticipated that up to 9 additional SUs will be required to determine if there is evidence of a release of MC in the area.

Discrete surface water and sediment sample pairs will be collected at locations within the moat where MEC/MD are identified. If areas of MEC/MD contamination are found along the bank or near the edge of the moat during the investigation of the Land Area MRS, surface water/sediment sample pairs will be collected at select locations adjacent to those areas. Sampling locations will be evaluated in the field and will be biased toward areas where the localized topography influences runoff into the moat. Moat sediments are dredge materials and metals may be present at industrial levels, given where the dredge material came from. It is anticipated that at least four surface water/sediment pairs will be collected from within the moat and/or along the bank or near the edge of the moat. Sediment samples will be collected from a depth of 0 to 6 inches.

QC samples will be collected as follows:

- Interior Fort and Casemates MRS – All surface and subsurface soil SUs (except for background samples) will be collected in triplicate.
- Land and Disposal Area, Land Area MRS – All surface and subsurface soil SUs (except for background samples) will be collected in triplicate.
- Land and Disposal Area, Moat – Six surface water/sediment QC samples (three each media, locations to be determined in the field).

All QC samples will be analyzed for the same analytes as the applicable investigation samples.

Additional step out sampling to delineate horizontal and vertical extent will be considered if there is evidence of a release of MC to the environment. The presence of MC at concentrations greater than PALs and greater than background will constitute evidence of a release. Delineation samples will be analyzed for detected COPCs only. Delineation samples will be collected as follows:

- Surface Soil – If there is evidence of a release of MC, delineation samples will be collected using a statistically based sample design to obtain a statistically defensible EPC for use in risk assessment. The delineation sampling approach, if necessary, will be presented to the PDT as a technical memorandum. In high density MEC/MD areas, the same delineation sampling approach will be used to determine the extent of the soil contamination area based on the DGM results and the results of the intrusive investigation. The number of delineation samples will vary depending on how many exceedances are found but will be based on a sufficient number of samples to determine, with 95% confidence, that the site mean is less than a screening value.
- Subsurface Soil – At each of the PAL or background level exceedance SU, subsurface soil samples will be collected using ISM from 6 to 24 inches below ground surface. If contamination is identified, the same sampling procedure will be followed in six-inch intervals until the contamination has been delineated.
- Sediment Samples – If the initial samples indicate evidence of a release of MC, then additional samples will be collected from random sample locations. The number of step-out samples will vary depending on how many exceedances are found, but will be based on a sufficient number of samples to determine, with 95% confidence, that the site mean is less than a screening value.

Worksheet #12: Measurement Performance Criteria

12.1 MEASUREMENT PERFORMANCE CRITERIA FOR MEC-RELATED TASKS

The field operations for this project involve multiple DFWs. These DFW are listed on Worksheet #14 & #16 and a detailed discussion of each one is included on Worksheet #17. The specific field procedures to be used for the activities described in this summary are included in the various standard operating procedures (SOPs) provided in Appendix K. The below table summarizes the MPCs that have been established for the DFW associated with the MEC-related tasks. The quality of these procedures and the related results will be evaluated for compliance with DQOs in accordance with the procedures described in Worksheet #37.

Table 12.1 Measurement Performance Criteria for MEC-Related Land Tasks

Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
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 sufficient for passage of EM61-MK2 man portable system and MM2x2 sensor. Check weather forecasts for underwater DGM and analog diving.	Review of QC reports.
UXO Avoidance (detection instrument function)	Sensitivity	Audible response to presence of subsurface metallic test item	Operator checks instrument to confirm response to subsurface "industry standard objects" (ISOs) in IVS (function test)
UXO Avoidance (interference)	Accuracy/bias	No interfering metallic objects detected	UXOQCS or designee checks instrument operator for interfering metallic objects by scanning with instrument
QC Seeding (Analog)	Representativeness	UXOQCS or designee places schedule 80 small, medium, and large industry standard objects (ISOs) and applicable site-specific inert munitions, as available, as blind QC seeds in analog removal areas. Blind QC seeds will be distributed such that each operator can be expected to encounter 1-2 large/deep seeds and 1-3 small/shallow seeds per lot[1]. The analog removal area will make up approximately 0.25 acres of the Casemates.	Review of Analog Production Area QC Seeding Report

Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
QC Seeding (DGM/AGC)	Representativeness	Blind QC seeds will be placed at the site by the contractor. Blind QC seeds must be detectable as defined by the DQOs and located throughout the horizontal and vertical survey boundaries defined in the DQOs. Seed items will consist of schedule 80 small and medium ISOs, schedule 40 large ISOs, and applicable site-specific inert munitions, as available. Blind QC seeds will be distributed such that the DGM field team can be expected to encounter one to three seeds per team, per day, on average.	Review of DGM Production Area QC Seeding Report
Validation Blind Seeding (QA Seeding) (DGM/AGC)	Representativeness	Blind QA seeds will be placed by the contractor as directed by the Government. All detail regarding QA seeds will be firewalled from all contractor personnel not involved in seed installation. Therefore, no further detail regarding the type or number of QA seeds will be provided in this QAPP.	Review of Production Area QA Seeding Report by Government
Detection survey (DGM)	Sensitivity	The detection threshold will be the higher of the minimum expected response for a horizontal 4" Parrott shell at a depth of 30 cm below ground surface (bgs) based on site conditions and IVS results or five times the site-specific background noise. (Footnote: Of all confirmed and suspected munitions on the site listed in Table 11.1, the 4" Parrott shell is expected to have the smallest response. To confirm this, inert munitions examples of the smaller rounds will be measured during the IVS testing phase. If access to the inert rounds cannot be obtained, a surrogate as agreed upon by the project team will be used instead.)	Initial and ongoing function tests and IVS surveys Validation/QC seed detection Analysis of background variability across the site
Detection survey (DGM)	Accuracy/Completeness	100% of validation seeds within the surveyed areas must be detected.	Review of validation seed detection results per MRS
Detection survey (DGM)	Completeness/ Comparability	Complete project-specific databases and target lists delivered.	Data verification/data validation
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, or the classifier must include a method for correctly classifying any munitions not included in the library. [(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

Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
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 within the surveyed areas.	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
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

(1) Areas that are not accessible to DGM will be combined into one “lot” for analog removal.
(2) Cued data will be collected over site-specific inert munitions, as available, and their response signatures will be added to the project’s TOI classification library.

Table 12.2 Measurement Performance Criteria for MEC-Related Water Tasks

Measurement Performance Activity (or DFW)	Data Quality Indicator	Specification	Activity Used to Assess Performance
Function Test (instrument functionality)	Accuracy/Completeness	The field team will collect data statically with and without a test item to verify a response. Due to potential background interference with underwater magnetometry data, quantifying exact values will be difficult to repeat.	Data verification of QC datasets
Dynamic Repeatability	Accuracy/Completeness	The field team will survey the IVS seed items to detect a response to meet the minimum detection value based on the as built IVS offset test values.	Data verification of QC datasets
Along-line measurement spacing	Accuracy/Completeness	The data sampling rate will have 98 percent of the dataset to be less than or equal to 0.25 meters.	Data verification of production datasets
Speed	Accuracy/Completeness	The velocity of the survey will have 95 percent of the dataset to be less than 8 miles per hour for open water magnetometer surveys and 4 miles for EM61-MK2S surveys	Data verification of production datasets
Altitude	Accuracy/Completeness	The sensor offset distance off the sea floor will be evaluated during the as built IVS offset altitude tests in which for 95 percent of the transect or grid will be achieved not impeded by underwater obstacles.	Data verification of production datasets
Detection survey (DGM)	Sensitivity	A detection threshold of 5 times the background noise or IVS as built offset minimum detection values (nT of the Total Field) will be used for underwater magnetometer survey.	Data verification of production datasets
Target Selection	Completeness/ Comparability	The project geophysicist will develop the dig list based on the project design parameters.	Data verification of production datasets
Geodetic equipment functionality	Accuracy/Completeness	The measured positional offset of a known control point will be measured daily to be within 1 meter for RTK/USBL and within1.5 meters for diver navigation systems.	Data verification of QC datasets
Geodetic Accuracy	Accuracy/Completeness	Project controls points will be measured monthly to be within 5 cm.	Data verification of QC datasets
DGM Transect Deviation	Completeness/ Comparability	All planned and accessible Analog and DGM transects will be followed within 10 meters designed transect.	Data verification of production datasets
Analog Repeatability (instrument functionality)	Accuracy/Completeness	Each operator and instrument will survey the analog strip for audible response to presence of subsurface metallic test item	Data verification of QC datasets
Anomaly Resolution	Completeness/ Comparability	UXOQCS will perform 15 percent QC on the day's intrusive production.	Visual inspection of recovered
Anomaly Resolution/ Intrusive Results	Completeness/ Comparability	QC Geophysicist and UXOQCS will compare the signature and approximate size of the detected anomaly and determine if the intrusive results match.	Visual inspection of recovered

12.2 MEASUREMENT PERFORMANCE CRITERIA FOR MC-RELATED TASKS

The tables below summarize the MPC that have been established for the MC-related tasks to be conducted during the RI/FS. The quality of the sampling procedures and laboratory results will be evaluated for compliance with DQOs through a review in accordance with the procedures describe in Worksheet #37. Sample collection procedures and analytical methods/SOPs are summarized on Worksheet #21 and Worksheet #23, respectively.

Table 12.3 Measurement Performance Criteria for Sample Collection

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measure ment Performance	QC Sample Assesses Error for Sam pling (S), Analytical (A) or Both (S&A)
Completeness	Planned number of samples matches number of samples collected.	Project Chemist reviews Chain-of-Custody (CoCs) vs. Work Plan	S
Completeness	Planned QC samples matches number of QC split samples collected	Project Chemist reviews CoCs vs. Work Plan	S
Completeness	CoC form lists correct samples and analyses	Project Chemist reviews CoCs vs. Work Plan	S&A
Accuracy	CoC form correctly filled out and signed	Project Chemist reviews CoCs	S&A

Table 12.4 Measurement Performance Criteria for Metals in Soil and Water

Laboratory: APPL, Inc.
Matrix: Soil and Water
Procedure: Incremental (Surface and Subsurface Soil); Discrete (Sediment and Surface Water)
Method: **Metals** using SW846 6020A

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sam pling (S), Analytical (A) or Both (S&A)
Accuracy	<1/2 LOQ	Method Blank (MB) and Grinding Blank (for ISM)	A
Accuracy	%R, See Worksheet #28	Laboratory Control Sample (LCS)	A
Accuracy/ Precision/Bias	%R, See Worksheet #28	Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	A
Precision/Bias	20% relative percent difference (RPD)	MS and MSD	S&A
Precision	The RPD for results above the LOQ must not exceed 50%	Field Duplicate (FD) (discrete/grab sampling only)	S&A
Precision	The relative standard deviation (RSD) for all three results >LOQ must be <20%.	Lab Triplicates (ISM only)	A
Precision	The RSD for all three results >LOQ must be <35%.	Field Triplicates (ISM only)	A
Accuracy/Bias Matrix effects	±10% Difference (D)	Serial Dilution (if MS/MSD fail)	A
Accuracy/Bias Matrix effects	80-120% R	Post-Digestion Spike Analysis (if MS/MSD fail)	A
Accuracy	±20% of the true value	Interference Check Standard (only applicable to 6020A)	A
Accuracy	±10% of the true value	Initial Calibration Verification (ICV)/Continuing Calibra-tion Verification (CCV)	A
Accuracy	±20% of the true value	Low Level Calibration Verification	A
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check	S&A

Table 12.5 Measurement Performance Criteria for Explosives in Soil and Water

Laboratory: APPL, Inc.
Matrix: Soil and Water
Procedure: Incremental (Surface and Subsurface Soil); Discrete (Sediment and Surface Water)
Method: Explosives using SW846 8330B (for Incremental and discrete samples)

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias	<1/2 Limit of Quantitation (LOQ) or >1/10 sample concentration or >1/10 regulatory limit.	MB and Grinding Blank (for ISM) (1)	A
Accuracy/Bias	%Recovery (R), See Worksheet #28	LCS and Reference Standard Material (RSM) for ISM	A
Precision	The Relative Percent Difference (RPD) for results above the LOQ must not exceed 50% for soil and not exceed 40% for water	FD (discrete/grab sampling only)	S&A
Precision	The RSD for all three results >LOQ must be <20%.	Lab Triplicates (ISM only)	A
Precision	The RSD for all three results >LOQ must be <35%.	Field Triplicates (ISM only)	A
Accuracy/Bias	%R, See Worksheet #28	MS and MSD	A
Precision	RPD, See Worksheet #28	MS and MSD	S&A
Accuracy/Bias	%R, See Worksheet #28	Surrogate Spike	A
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check	S&A

(1) The grinding blank and the method blank can be one and the same; therefore, the most stringent criteria will be used for evaluation.

Worksheet #13: Secondary Data Uses and Limitations

No secondary data will be used to make decisions during these RI/FSs; however, the following table lists the primary supporting documents for this project and the ways they might be used during project implementation.

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Munitions Use	DERP-FUDS INPR (CESAJ, 2014) – Fort Taylor, Key West, FL, Site No. I04FL022701	CESAJ	Data will be used as reference for the site history, types of MEC, and general site information	No Limitations
Range History; Munitions use and disposal; MC sampling results	Site Inspection Report (Parsons 2008)	Parsons, 3577 Parkway Lane, 100, Norcross, GA 30092	Data will be used as reference for the site history, types of MEC and MC, and general site information	No Limitations
Range History; Munitions use and disposal	Archives Search Report for Fort Taylor; 1996	CEMVR, 1500 Rock Island Lines Railroad, Rock Island, Illinois	Data will be used as reference for the site history, types of MEC, potential MC, geographical features, and general site information.	No Limitations
Range History; Munitions use and disposal	Final Preliminary Assessment for Fort Taylor; June 1991	USACE, New England Division	Data will be used as reference for the site history, types of MEC, potential MC, geographical features, and general site information.	No Limitations

Worksheet #14 & 16: Project Tasks and Schedule

The below table outlines the activities to be conducted on Fort Taylor MRS to achieve the project DQOs (Worksheet #11). The major phases involved in the project include site mobilization and preparation, collection and processing of geophysical data, selection of target anomalies, intrusive investigation of anomalies, environmental sampling, and demobilization. A detailed presentation of each step is included in Worksheet #17, while the complete schedule of events for the Fort Taylor MRS RI/FS can be found in Appendix I.

DFW	Activity	Responsible party	Deliverable(s)	Deliverable due date
DFW 1: **Prepare Site**	• Layout grids in investigation areas • Vegetation clearance (if allowed) • Surface sweep	Parsons Site Management	a. Surface Sweep Technical Memorandum	N/A
DFW 2: **GIS Management**	• Geographic Information System (GIS) Data Management	Parsons GIS Manager	Geospatial Data Sets	With UFP-QAPP, with Draft RI Report, and at the end of the project
DFW 3: **Quality Control Seeding & IVS Construction** (Seeding Land)	• Bury QC seeds • Bury Validation seeds • Install IVSs in Land and Water	Seed Team Lead	a. QC Seed Plan b. Draft Verification and Validation Plan c. Production Area QC Seed Report	a. Upon Completion b. 7 days after completion c. 7 days after completion
DFW 4 and DFW 8: **Assemble and Verify Correct Operation of Detection Sensors & Confirm Sensor Functionality** (IVS Data Collection)	• Assemble and perform initial checks on MM 2x2, EM61-MK2, and G882Magnetometer • Conduct initial dynamic and cued IVS testing • Prepare IVS Technical Memorandum	Site Geophysicist and Project Geophysicist	a. Raw and processed data b. IVS Technical Memorandum	a. 1 day after completion b. 7 days after completion
DFW 5: **Conduct DGM Detection Survey (MRS01 & MRS02)**	• Conduct land/moat DGM surveys • Verify land detection data	Site Geophysicist	a. Raw data files and field notes b. Access database with dig results	a. Friday following collection b. Weekly updates
DFW 5: **Conduct DGM Detection Survey (MRS03)**	• Conduct water DGM surveys • Verify water detection data	Site Geophysicist, Alpine Geophysicist.	a. Raw data files and field notes b. Access database with dig results	a. Friday following collection b. Weekly updates

DFW	Activity	Responsible party	Deliverable(s)	Deliverable due date
DFW 6: **Process Data and Document Anomaly Locations (MRS01 & MRS02)**	• Process land 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 • Conduct QC evaluation of DGM data and submit to QA for target list concurrence; update dig list if necessary • Document QC evaluations, root cause analyses and corrective actions	Project Geophysicist and QC Geophysicist	a. Weekly QC Reports b. Target Selection Technical Memorandum c. Processed data files and maps, processing notes, Cued Target List d. Project QC Database	a. Weekly b. 5 days after start of data collection c. Friday following data collection d. Weekly
DFW 6: **Process Data and Document Anomaly Locations (MRS03)**	• Process underwater DGM data for transects and grids • Conduct QC evaluation of the DGM data and submit to QA for target list concurrence	Project Geophysicist, QC Geophysicist, and Alpine Geophysicist	a. Weekly QC Reports b. Processed data files and maps, processing notes, c. Project QC Database	a. Weekly b. 5 days after start of the data collection c. Friday following data collection
DFW 7: **Validate Detection Survey**	• Determine detection data usability with regard to MPCs	QC Geophysicist	Detection DUA	a. 7 days after acceptance of cued target list
DFW 8: **Assemble advanced geophysical sensor for cued survey and test sensor at IVS**	• Assemble and perform initial checks on MM 2x2, • Conduct initial dynamic and cued IVS testing • Prepare IVS Technical Memorandum	Site Geophysicist and Project Geophysicist	a. Raw and processed data b. IVS Technical Memorandum	a. 1 day after completion b. 7 days after completion
DFW 9: **Collect Cued Data**	• Collect cued data over all targets on the cued target list developed from the detection data	Site Geophysicist	a. Raw data files and field notes b. Project QC Database	a. Friday following collection/upon request b. Weekly
DFW 10: **Process Cued Data**	• Process cued data • Conduct QC evaluation of cued data • Document QC evaluations, root cause analyses, and corrective actions	Project Geophysicist and QC Geophysicist	a. Weekly QC Reports b. Processed data, processing notes, supporting classification images c. Project QC Database	a. Per report b. Friday following collection/ upon request
DFW 11: **Classify Anomalies and Make Dig/No Dig Decisions (MRS01 & MRS02 - Land)**	• Make dig/ no dig decisions for all cued targets	Project Geophysicist	a. Ranked dig list	a. 7 days after completion of cued processing

DFW	Activity	Responsible party	Deliverable(s)	Deliverable due date
DFW 11: **Classify Anomalies and Make Dig/No Dig Decisions (MRS02 - Moat & MRS03)**	• Make dig/ no dig decisions for all underwater targets	Project Geophysicist, QC Geophysicist, Alpine Geophysicist, and Biologist	a. Underwater dig list	a. 7 days after completion of processing
DFW 12: **Validate Cued Survey and Classification**	• Determine cued data usability with regard to MPCs	QC Geophysicist	a. Cued DUA b. Final Verification and Validation plan	a. 7 days after acceptance of ranked dig list
DFW 13: **Excavate Buried Objects (Ranked Dig List) (MRS01 & MRS02 - Land)**	• Reacquire dig list anomalies • Record reacquisition data and mark anomaly for investigation • Intrusively investigate reacquired anomalies per intrusive guidelines • Conduct QC evaluation of intrusive data; reinvestigate anomalies if necessary • Perform any necessary site restoration	SUXOS, Project Geophysicist, and QC Geophysicist	a. Daily QC Report, Weekly QC Report, disposal reports b. Access database with reacquisition, and dig results	a. Per report b. Daily updates; final 7 days after completion
DFW 13: **Excavate Buried Objects (Ranked Dig List) (MRS02-Moat & MRS03)**	• Reacquire dig list anomalies with underwater navigation system • Record reacquisition data and assess anomaly for investigation • Intrusively investigate reacquired anomalies per intrusive guidelines • Conduct QC dive on 15 percent of anomalies.	Water SUXOS, Dive Supervisor, and QC Geophysicist	a. Daily QC Report, Weekly QC Report, disposal reports b. Access database with reacquisition, and dig results	a. Per report b. Daily updates; final 7 days after completion
DFW 14: **Verify Intrusive Results non-TOI**	• Review dig results versus predicted results	Project Geophysicist	a. Access database with reacquisition, and dig results	a. 7 days after completion of the intrusive
DFW 15: **Conduct Analog Removal (MRS01 & MRS02 -Land)**	• Conduct analog surveys across analog subsurface removal footprint • Identify subsurface anomalies for immediate investigation or flag for follow-up • Intrusively investigate and resolve detected and/or flagged anomalies • Identify/classify MPPEH • Remove MEC and MD found • Document removal results and record grid status	SUXOS / UXOQCS, QC Geophysicist, Dive Supervisor	a. Daily QC Report, Weekly QC Report, disposal reports b. Access database with reacquisition, and dig results	a. Per report b. Daily updates; final 7 days after completion

DFW	Activity	Responsible party	Deliverable(s)	Deliverable due date
DFW 15: **Conduct Analog Removal (MRS02 -Moat and MRS03)**	• Conduct analog surveys across predetermined transect lines in near shore shallow areas • Assess environment and identify anomalies and document location • Intrusively investigate anomaly • Document removal results	Water SUXOS, Dive Supervisor, and QC Geophysicist	a. Daily QC Report, Weekly QC Report, disposal reports b. Access database with reacquisition, and dig results	a. Per report b. Daily updates; final 7 days after completion
DFW 16: **Conduct Final DUA**	• Determine data usability with regard to MPCs	QC Geophysicist	a. Final Data Usability Assessment	a. 7 days after acceptance of intrusive results Daily updates; final 7 days after completion
DFW 17: **MPPEH/MEC Handling, Certification, and Disposal**	• Conduct demolition operations in accordance with approved Explosives Site Plan (ESP) • Perform any necessary site restoration • Inspect, certify, and verify MPPEH • Package MDAS and store in secure location pending disposal • Ship MDAS offsite to approved disposal facility and obtain necessary disposal documentation	SUXOS / UXQCS / UXOSO	a. DD Form 1348-1A b. Explosive Usage Records c. Magazine Data Cards d. Demolition Summary Sheets e. Demolition Shot Records f. Material Documented as Safe (MDAS) Disposal Documentation	All as an appendix to the RI Report
DFW 18: **MC Sampling**	• Conduct soil and sediment samples at MEC and MD items	Sample Coordinator	a. Daily QC Report for environmental sampling b. Well installation, development, and sampling forms c. Analytical data submittal d. Electronic laboratory data submittal	a. Daily during sampling activities b. With RI Report c. With RI Report d. With RI Report
DFW 19: **Demobilization**	• Demobilize from site	All personnel	a. None	N/A

Worksheet #15: Reference Limits and Evaluation Tables

This worksheet provides the parameters to be analyzed and their associated detection limits (DLs), limits of detection (LODs), and limits of quantitation (LOQs) in order to satisfy the overall DQOs for laboratory analysis. The PALs, as referenced in the DQOs, are also included. The PALs are used to determine COPCs and are based on the most conservative (lowest value) of the human health screening value (HHSV) and the ecological screening value (ESV).

Background threshold values (BTV) for soil will also be developed (see Section 3.1.1.2 of the RAWP in Appendix G). Analyte concentrations will be compared to the BTV. If the concentration of an analyte is greater than the BTV, the concentration will then be compared to the PAL. If the concentration of an analyte is greater than the PAL, and greater than the BTV, it will be identified as a COPC and evaluated in a risk assessment. The COPC list is then further refined for the human health risk assessment (HHRA) and the ecological risk assessment (ERA) by comparing the medium-specific concentration to the HHSV to identify human health COPCs and to the ESV to identify chemicals of potential ecological concern (COPEC).

Soil PALs: HHSVs for soil are based on the FDEP Florida Administrative Code (FAC) §62-777 Soil Cleanup Target Levels (FDEP, 2018), direct exposure residential and leachability based on marine surface water criteria. The soil ESVs are selected from USEPA Region 4 Ecological Screening Levels for Soil (USEPA, 2018). The PAL is the lowest of the HHSV and ESV.

Surface Water PALs: HHSVs for surface water are based on the FDEP FAC §62-777 Groundwater and Surface Water Cleanup Target Levels (FDEP, 2018), marine surface water criteria. The surface water ESVs are selected from USEPA Region 4 Ecological Screening Levels for Marine Surface Water (USEPA, 2018). The PAL is the lowest of the HHSV and ESV.

Sediment PALs: HHSVs for sediment are based on the FDEP FAC §62-777 Soil Cleanup Target Levels (FDEP, 2018), direct exposure residential and leachability based on marine surface water criteria. Soil screening values were used in the absence of sediment-specific values. The sediment ESVs are selected from USEPA Region 4 Ecological Screening Values for Marine Sediment (USEPA, 2018). The PAL is the lowest of the HHSV and ESV.

Analytical methods listed below are consistent with the laboratory's certificate issued by the State of Florida. The laboratory is DoD Environmental Laboratory Accreditation Program (ELAP) certified. In some cases the Achievable Laboratory Limits may be greater than the human health and/or ecological screening values. In these cases, the PAL will be set equal to the LOD. In these cases, an analyte may be reported as undetected (U flagged), but may be present at the site at a concentration greater than the PAL. If the analyte is never detected, it would not be considered a COPC and would not be included in the quantitative risk assessment. This situation, while not expected, would result in an underestimate of the risk. Therefore, any analyte that is never detected, but has reporting limit greater than the PAL will be identified in the uncertainty section of the risk assessment and the potential underestimation of the risk will be acknowledged.

Table 15.1 APPL, Inc. PALs and Reference Limits for Metals in Soil

Method: Metals using SW846 6020A

Analyte	Chemical Abstract Services (CAS) Number	Human Health Screening Value(1) (mg/kg)	Ecological Screening Value(2) (mg/kg)	Project Action Limits (mg/kg)	Achievable Laboratory Limits		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Copper	7440-50-8	150	28	28	2.5	0.20	0.040
Lead	7439-92-1	400	11	11	0.10	0.05	0.020
Zinc	7440-66-6	26,000	46	46	2.5	1.5	0.75

mg/kg = milligrams per kilogram

Table 15.2 APPL, Inc. PALs and Reference Limits for Explosives in Soil

Method: Explosives using SW846 8330B

Analyte	CAS Number	Human Health Screening Value(1) (mg/kg)	Ecological Screening Value(2) (mg/kg)	Project Action Limits (mg/kg)	Achievable Laboratory Limits		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
2-Amino-4,6-dinitrotoluene	35572-78-2	--	14	14	0.10	0.075	0.0340
4-Amino-2,6-dinitrotoluene	19406-51-0	--	12	12	0.10	0.075	0.0340
1,3-Dinitrobenzene	99-65-0	0.4	0.034	0.075*	0.10	0.075	0.0220
2,4-Dinitrotoluene	121-14-2	0.07	6	0.075*	0.10	0.075	0.0275
2,6-Dinitrotoluene	606-20-2	0.005	4	0.075*	0.10	0.075	0.0310
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	--	0.018	0.075*	0.10	0.075	0.0375
Nitrobenzene	98-95-3	0.6	2.2	0.6	0.10	0.075	0.0275
Nitroglycerin	55-63-0	--	13	13	0.20	0.150	0.0606
2-Nitrotoluene	88-72-2	7.3	0.19	0.19	0.10	0.075	0.0375
3-Nitrotoluene	99-08-1	3.6	0.13	0.13	0.10	0.075	0.0375
4-Nitrotoluene	99-99-0	7	0.14	0.14	0.10	0.075	0.0375
Pentaerythritol tetranitrate (PETN)	78-11-5	--	2.2	100	0.50	0.250	0.1080
1,3,5-Trinitrobenzene	99-35-4	0.09	0.3	0.09	0.10	0.075	0.0130
2,4,6-Trinitrotoluene	118-96-7	0.3	7.5	0.3	0.10	0.075	0.0310
HMX	2691-41-0	--	16	16	0.10	0.075	0.0375
RDX	121-82-4	1.3	2.3	1.3	0.10	0.075	0.0255

Yellow highlighted limits are greater than project action limits.
mg/kg = milligrams per kilogram
-- No limit established.
(1) HHSVs derived from FDEP FAC §62-777 Soil Cleanup Target Levels, direct exposure residential and leachability based on marine surface water criteria (https://floridadep.gov/waste/district-business-support/documents/table-ii-soil-cleanup-target-levels). Website last modified June 29, 2018.
(2) ESVs derived from USEPA Region 4 Ecological Screening Levels for Soil, last updated 2018 (https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf)
* The Achievable Laboratory Limit is greater than the human health and/or ecological screening values. The PAL is equal to the LOD.

Table 15.3 APPL, Inc. PALs and Reference Limits for Metals in Sediment

Method: Metals using SW846 6020A

Analyte	CAS Number	Human Health Screening Value(1) (mg/kg)	Ecological Screening Value(2) (mg/kg)	Project Action Limits (mg/kg)	Achievable Laboratory Limits		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Copper	7440-50-8	150	18.7	18.7	2.5	0.20	0.040
Lead	7439-92-1	400	30.2	30.2	0.10	0.050	0.020
Zinc	7440-66-6	26,000	124	124	2.5	1.5	0.75

mg/kg = milligrams per kilogram

Table 15.4 APPL, Inc. PALs and Reference Limits for Explosives in Sediment

Method: Explosives using SW846 8330B

Analyte	CAS Number	Human Health Screening Value(1) (mg/kg)	Ecological Screening Value(2) (mg/kg)	Project Action Limits (mg/kg)	Achievable Laboratory Limits (Soil)		
					LOQ (4) (mg/kg)	LOD (mg/kg)	DL (mg/kg)
2-Amino-4,6-dinitrotoluene	35572-78-2	--	0.052	0.075*	0.10	0.075	0.0340
4-Amino-2,6-dinitrotoluene	19406-51-0	--	0.07	0.075*	0.10	0.075	0.0340
1,3-Dinitrobenzene	99-65-0	0.4	0.037	0.075*	0.10	0.075	0.0220
2,4-Dinitrotoluene	121-14-2	0.07	0.029	0.075*	0.10	0.075	0.0275
2,6-Dinitrotoluene	606-20-2	0.005	0.131	0.075*	0.10	0.075	0.0310
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	--	–	1.4	0.10	0.075	0.0375
Nitrobenzene	98-95-3	0.6	1.853	0.6	0.10	0.075	0.0275
Nitroglycerin	55-63-0	--	0.133	0.15	0.20	0.150	0.0606
2-Nitrotoluene	88-72-2	7.3	–	0.9	0.10	0.075	0.0375
3-Nitrotoluene	99-08-1	3.6	–	1.4	0.10	0.075	0.0375
4-Nitrotoluene	99-99-0	7	--	0.9	0.10	0.075	0.0375
Pentaerythritol tetranitrate (PETN)	78-11-5	--	–	--	0.50	0.250	0.1080
1,3,5-Trinitrobenzene	99-35-4	0.09	0.015	0.075	0.10	0.075	0.0130
2,4,6-Trinitrotoluene	118-96-7	0.3	0.112	0.112	0.10	0.075	0.0310
HMX	2691-41-0	--	0.162	0.162	0.10	0.075	0.0375
RDX	121-82-4	1.3	0.155	0.155	0.10	0.075	0.0255

Yellow highlighted limits are greater than project action limits.
mg/kg = milligrams per kilogram
-- No limit established.
(1) HHSVs derived from FDEP FAC §62-777 Soil Cleanup Target Levels, direct exposure residential and leachability based on marine surface water criteria (https://floridadep.gov/waste/district-business-support/documents/table-ii-soil-cleanup-target-levels). Website last modified June 29, 2018. Used soil screening values in the absence of sediment-specific values.
(2) ESVs derived from USEPA Region 4 Ecological Screening Values for Marine Sediment, last updated 2018 (https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf)
* The Achievable Laboratory Limit is greater than the human health and/or ecological screening values. The PAL is equal to the LOD.

Table 15.5 APPL, Inc. PALs and Reference Limits for Metals in Surface Water

Method: Metals using SW846 6020A

Analyte	CAS Number	Human Health Screening Value(1) (µg/L)	Ecological Screening Value(2) (µg/L)	Project Action Limits (µg/L)	Achievable Laboratory Limits		
					LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Copper	7440-50-8	2.9	3.1	2.9	2.0	1.5	0.55
Lead	7439-92-1	8.5	8.1	8.1	3.0	0.40	0.19
Zinc	7440-66-6	86	81	81	20	15	7.5

µg/L = micrograms per liter
-- No limit established.

Table 15.6 APPL, Inc. PALs and Reference Limits for Explosives in Surface Water

Method: Explosives using SW846 8330B

Analyte	CAS Number	Human Health Screening Value(1) (µg/L)	Ecological Screening Value(2) (µg/L)	Project Action Limits (µg/L)	Achievable Laboratory Limits (Soil)		
					LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
2-Amino-4,6-dinitrotoluene	35572-78-2	--	20	20	0.50	0.30	0.13
4-Amino-2,6-dinitrotoluene	19406-51-0	--	27	27	0.50	0.30	0.10
1,3-Dinitrobenzene	99-65-0	72(3)	20	20	0.50	0.30	0.13
2,4-Dinitrotoluene	121-14-2	9.1	9.1	9.1	0.50	0.30	0.13
2,6-Dinitrotoluene	606-20-2	0.4	36	0.4	0.50	0.30	0.13
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	--	--	--	0.50	0.30	0.13
Nitrobenzene	98-95-3	90	380	90	0.50	0.30	0.13
Nitroglycerin	55-63-0	--	239	239	0.50	0.30	0.13
2-Nitrotoluene	88-72-2	550(3)	1185	550	0.50	0.30	0.13
3-Nitrotoluene	99-08-1	380(3)	1384	380	0.50	0.30	0.13
4-Nitrotoluene	99-99-0	550(3)	1438	550	0.50	0.30	0.13
Pentaerythritol tetranitrate (PETN)	78-11-5	--	--	--	2.5	1.5	0.61
1,3,5-Trinitrobenzene	99-35-4	19(3)	11	11	0.50	0.30	0.13
2,4,6-Trinitrotoluene	118-96-7	49(3)	54	49	0.50	0.30	0.13
HMX	2691-41-0	1,300	330	330	0.50	0.30	0.12
RDX	121-82-4	180(3)	190	180	0.50	0.30	0.12

µg/L = micrograms per liter
-- No limit established.
(1) HHSVs derived from FDEP §FAC 62-777 Groundwater and Surface Water Cleanup Target Levels, marine surface water criteria (https://floridadep.gov/waste/district-business-support/documents/table-i-groundwater-and-surface-water-cleanup-target). Website last modified February 9, 2019.
(2) ESVs derived from USEPA Region 4 Ecological Screening Levels for Marine Surface Water, last updated 2018 (https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf)
(3) Marine surface water criteria are based on the LC50. These values are used in the absence of human health specific screening values.

Worksheet #17: Survey Design and Project Workflow

17.1 INTRODUCTION

17.1.1 GENERAL APPROACH

17.1.1.1 The project objectives for the RI at Fort Taylor are to obtain data to sufficiently characterize the nature and extent of MEC and/or MC contamination present at the Fort Taylor MRSs, and to evaluate potential hazards or risks related to identified contamination. The boundaries of the Fort Taylor MRSs are shown on 10.2. The general technical approach is based on the CSM for Fort Taylor, which is described on Worksheet #10.

17.1.1.2 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 Worksheet #11. These DQOs include a design for obtaining data for both MEC and MC to support the RI/FS for the Fort Taylor MRSs. The design for obtaining data described in the DQOs summarizes the technical approach for the investigation area, including DGM surveys, intrusive investigations of anomalies, and collection of environmental samples including soil, surface water, and sediment.

17.1.1.3 The field operations involve multiple DFWs that will be required to achieve the project goals. The DFW involved with this RI are listed on Worksheet #14/16 and they are explained further in this worksheet, with references to relevant SOPs (Worksheet #21 and Appendix K), MPCs (Worksheet #12), and other sections of the UFP-QAPP, as necessary. Note that various site activities may take place concurrently, as appropriate.

17.1.2 FORT TAYLOR MRS

The primary components of the MEC sampling design for the RI/FS involve DGM and analog surveys, and data evaluation as follows:

- The land based component of the project will include 100 percent coverage of Interior Fort and Casemates of MRS 01, DGM will be conducted on up to 3 acres of the fort with the EM61-MK2A where accessible, areas not accessible will be surveyed with analog methods. For MRS 02 the Artillery Range Land and Disposal Area, DGM coverage will include 16.8 acres of the available 34 acres of the MRS. The acreage will be sufficient to determine 95% confidence of less than or equal to 0.1 UXO per acre. Once all the land DGM is concluded in MRS 01 and MRS02, the detected anomalies from the EM61-MK2A will be cued using the MM 2x2 sensors. The excavation of DGM anomalies will be dependent on classification decisions. All cued data collected will be analyzed by the project geophysicist for classification as TOI, non-TOI, or inconclusive.
- The moat located in MRS 02 surrounding the fort covering approximately 3 acres will be surveyed with a submersible EM61-MK2A HP sensor. The sensor will be towed on a rigid platform attached to the PRMS. Detected anomalies will be reacquired and investigated by UXO divers.
- The remaining water-based component of the project included in MRS 03 of the Artillery Ranges consist of the Near Shore Area, the Water Dive Sites/Keys, and Remaining Water Areas. These areas will be surveyed with a combination of analog divers and underwater DGM transects and grids. Bathymetry surveys are also planned for the underwater DGM areas to establish sea bottom topography for the underwater DGM sensors.

- The Artillery Ranges Near Shore Area will consist of using divers with handheld metal detectors (Minelab Excalibur II or similar) at 30 meters transect spacing for the first 100 meters from the shore line totaling approximately 1 acre of coverage. The divers will document the location and intrusive findings using the underwater Shark Marine System. The remaining Near Shore Area between 100 meters and 1000 meters will be surveyed with Geometrics G882 Marine Magnetometer towed by a scientific vessel at a transect spacing of 100 meters totaling 6.7 acres of DGM coverage. The detected underwater anomalies will be approved by the project team will be reacquired and intrusively investigated by the UXO divers.
- The Artillery Ranges Dive Sites will include 2 acres of underwater DGM transects using the Geometrics G882 Marine Magnetometer at spacings of 30 meters to 100 meters based on the geometry of the dive site and other environmental or biological conditions. A total of 10 dive sites are planned for the DGM and intrusive investigations. Intrusive investigation will include up to 300 anomalies in both low and high concentration areas to adequately characterize the nature and vertical extent of the potential MEC contamination.
- The Artillery Ranges Remaining Lands will consist of 6.5 acres of underwater DGM transects and grids using the Geometrics G882 Marine Magnetometer. Six 0.5 acre grids and seven 0.5 acre transects (1000-meter-long) will be surveyed within predetermined areas of the remaining lands. Intrusive investigation of up to 240 anomalies within the 6. 5 acres will provide 95 percent confidence that NCMUAs have less than or equal to 0.5 UXO per acre. If the number of anomalies requiring investigation exceeds 240, the PDT will be notified, and the additional anomalies will be investigated to achieve NCMUA confidence levels, if warranted.

17.2 DEFINABLE FEATURES OF WORK

17.2.1 DFW 1 - MOBILIZATION/SITE PREPARATION

17.2.1.1 PREPARATION

Preparations for mobilization will commence upon approval of this UFP-QAPP. Upon receipt of document approval, the field team will be notified, travel and lodging arrangements will be made, and the requisite copies of the applicable documents will be assembled. The field management team will have already reviewed the available documentation relating to the site, the UFP-QAPP, and additional data obtained during previous site visits.

17.2.1.2 EQUIPMENT MOBILIZATION

Equipment and materials will be shipped to the site via commercial carrier, transported to the site by the field team, or obtained locally, as appropriate. Equipment may include, but is not limited to, analog instruments (i.e., Schonstedt or equivalent), DGM instruments (i.e., EM61-MK2A, Geometrics G-882, and MM 2x2), sampling supplies, documents, first aid kits, fire extinguishers, GPS units, digital cameras, seed items, marking tape, etc. Site vehicles will be rented and, in most cases, will be four wheel drive vehicles that will accommodate site personnel and equipment. Larger equipment (e.g., rubber tire back hoe, boats, and underwater platforms) will either be rented from a local vendor or supplied by subcontractors.

17.2.1.3 RIGHTS-OF-ENTRY

The project sites are located within the boundaries of Fort Taylor. The rights-of-entry (ROE) from the Park Service will be required for performance of this RI.

17.2.1.4 ESTABLISH SITE FACILITIES

Site support facilities will be established prior to the start of investigation activities. The site facilities will have electrical power and Internet access. An office and break trailer will be established. Details regarding the various facilities needed to complete the RI are described in the following paragraphs:

- Site Office: The site office comprises project trailers with electrical power in an area with cellular telephone service. The site office will be the primary point for onsite administration, receiving routine deliveries, personnel training, equipment storage and sign-in and briefing.
- Equipment Staging Area: The equipment staging area will be located by the site office and will be the primary location where trucks, trailers, and other equipment are organized and stored when they are not being used. A local marina from which the dive boats and scientific vessel for DGM are launched will be considered a staging area for the water component of this project.
- Waste Holding Area: Once required, a waste holding area will be established for staging investigation-derived waste (IDW) containers prior to offsite disposal, including those containing munitions-related waste. The area will be enclosed and clearly marked.

17.2.1.5 SET-UP UTILITIES

17.2.1.5.1 Electrical service for the site office will be obtained either from the nearest accessible power pole(s) or from a rented generator. No additional power supplies or power poles will be installed.

17.2.1.5.2 Portable toilets will be available at the Site Office and other convenient locations but it is anticipated the park will have public bathrooms.

17.2.1.6 COMMUNICATIONS

The primary means of on-site communication will be achieved using hand-held radios. The secondary means of communication will be cellular telephones. Each field team will remain together throughout field activities. If cellular service is determined to be unreliable, the hand-held radios will be used to notify personnel in the site office of an emergency. Site office personnel will then notify and coordinate emergency service response as needed. If cellular coverage is determined to be reliable, there will be a minimum of one operational cell phone per field team available at all times for emergency use. Communication equipment will be checked daily after the morning safety briefing. For marine operations in MRS 03 a satellite phone will be used along with radios for communications if cellular service is determined to be unreliable in the water.

17.2.1.7 SITE-SPECIFIC TRAINING AND BRIEFINGS

17.2.1.7.1 Prior to field activities, all team members will be given site-specific training involving:

- Activities to be performed;
- Safe work practices;
- Known and suspected MEC at the site;
- Actions to take upon encountering suspect MEC; and
- Archaeological, Biological, and historical resources awareness.

17.2.1.7.2 This training is described further in the APP (Appendix A), AMP (Appendix B), and EPP (Appendix C).

17.2.1.7.3 The field team will be briefed each day prior to commencement of field activities. Daily briefings will include a discussion of weather conditions, the coming day's activities, the previous day's findings, emergency response and evacuation procedures, and a review of the general procedures to deal with MEC, if encountered.

17.2.1.8 TRANSECT AND GRID LAYOUT

17.2.1.8.1 Before conducting geophysical surveys, the locations of the transects and grids will be established. For land MRSs, RTK Net will be used when possible. Florida Participates in the RTK Net (Cellular Based RTK) program. There is a continuously operating reference station (CORS); a cell tower that is tied to a USGS monument less than a mile from the project site. RTK Net is the preferred option for RTK surveys because it does not require a base station or a PLS to install control points thus less potential for offset errors and consistency for location accuracy.

There are also 7 monuments installed within the Fort/surrounding area for use with a RTK base station if the RTK net system isn't available for the land MRSs. To the extent practicable, these monuments may satisfy the surveying and mapping requirements of the MRS 03, but additional monuments will be added as needed. For water investigations a repeater boat will be used to relay the RTK base station signals to the survey vessel. Markers such as flags, stakes, or survey paint will be used to denote grid corners and other points as necessary.

17.2.1.8.2 **Figures 17.1 thru 17.4** show the idealized locations for transects and grids planned for the land and water MRSs for Fort Taylor. The figures display the locations where analog and DGM surveys are planned but maybe adjusted based on site conditions. Land DGM coverages presented in **Figures 17.1 and 17.2** show 100 percent coverage of up to 3 acres in MRS 01 and 16.8 acres planned within the 34-acre grid system of MRS 02. The 16.8 acres of DGM surveys will be conducted on 100ft by 100ft grids within MRS 02 to confirm a NCMUA. Water transects presented in **Figure 17.3** detailing the Near Shore areas of MRS 03 will be preloaded on the Shark Marine System to aid UXO SCUBA divers and the navigation software of the scientific vessel towing the underwater magnetometer. The preloaded transects will ensure the planned areas are surveyed correctly and determine if resurveys are necessary. The remaining water areas and dive sites shown in **Figure 17.4** also include preloaded transects and grid locations to ensure adequate coverage.

17.2.1.8.3 Prior to data collection, vegetation and debris removal will be conducted, if necessary, to allow for unimpeded passage of the DGM data collection team and their instruments. The primary reasons for vegetation and debris removal are to improve visibility for detection of surface MEC/MPPEH and to reduce interference with the DGM and AGC teams and their instruments. Vegetation removal using handheld equipment will be conducted when terrain or environmental concerns permit. 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 3 inches for vegetation clearance. The Site Manager, or authorized designee, will identify the areas requiring vegetation clearance in coordination with Park personnel. Field crews will be provided pictures and other documentation describing the appearance and characteristics of this endangered species and conduct surveys to identify the presence of this plant in areas favorable for its existence. The EPP (Appendix C) will be followed during all vegetation removal to avoid endangered species habitat.

17.2.1.8.4 All surface metal unrelated to MPPEH/MEC will be removed during vegetation clearance or the location documented for later removal prior to geophysical data collection.

Documentation: Surface Sweep Technical Memorandum

17.2.1.9 UXO ESCORT AND ANOMALY AVOIDANCE

17.2.1.9.1 During field activities, survey crews, vegetation clearance teams, geophysical survey crews, and other non-UXO trained personnel will be accompanied by a qualified MEC escort (a UXO Technician II or higher) when the non-UXO trained personnel are conducting activities in areas with potential for MEC hazards. The MEC escort (a UXO Technician II or higher) will conduct UXO avoidance including visual surveys for surface MEC and an analog survey of proposed intrusive locations to ensure the location is anomaly free prior to intrusive activities being conducted. The procedures for MEC escort (a UXO Technician II or higher) and anomaly avoidance are described in SOP MEC 3.00, MEC Anomaly Avoidance (Appendix K).

17.2.1.9.2 MEC encountered during these activities will be handled and disposed of using the procedures described under the "MPPEH/MEC Handling, Certification, and Disposal" section 17.2.17.

Figure 17.1

Interior Fort and Casemates MRS 01
Fort Taylor
FUDS Project No. I04FL022701

Monroe County, Florida

Legend

- FUDS Property Boundary
- Interior Fort and Casemates MRS
- Proposed Sample Unit (up to 2 More Locations TBD at MPPEH Findings)

Site Location in Florida

N

200 100 0 200 Feet

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	**Interior Fort and Casemates MRS 01**		
DRAWN BY: BT			
CHECKED BY: JC	SCALE: As Shown	PROJECT NUMBER: 100132.0002.110068.03000.LABOR	
SUBMITTED BY: DS	DATE: June 2019	PAGE NUMBER: 61	
	FILE:		

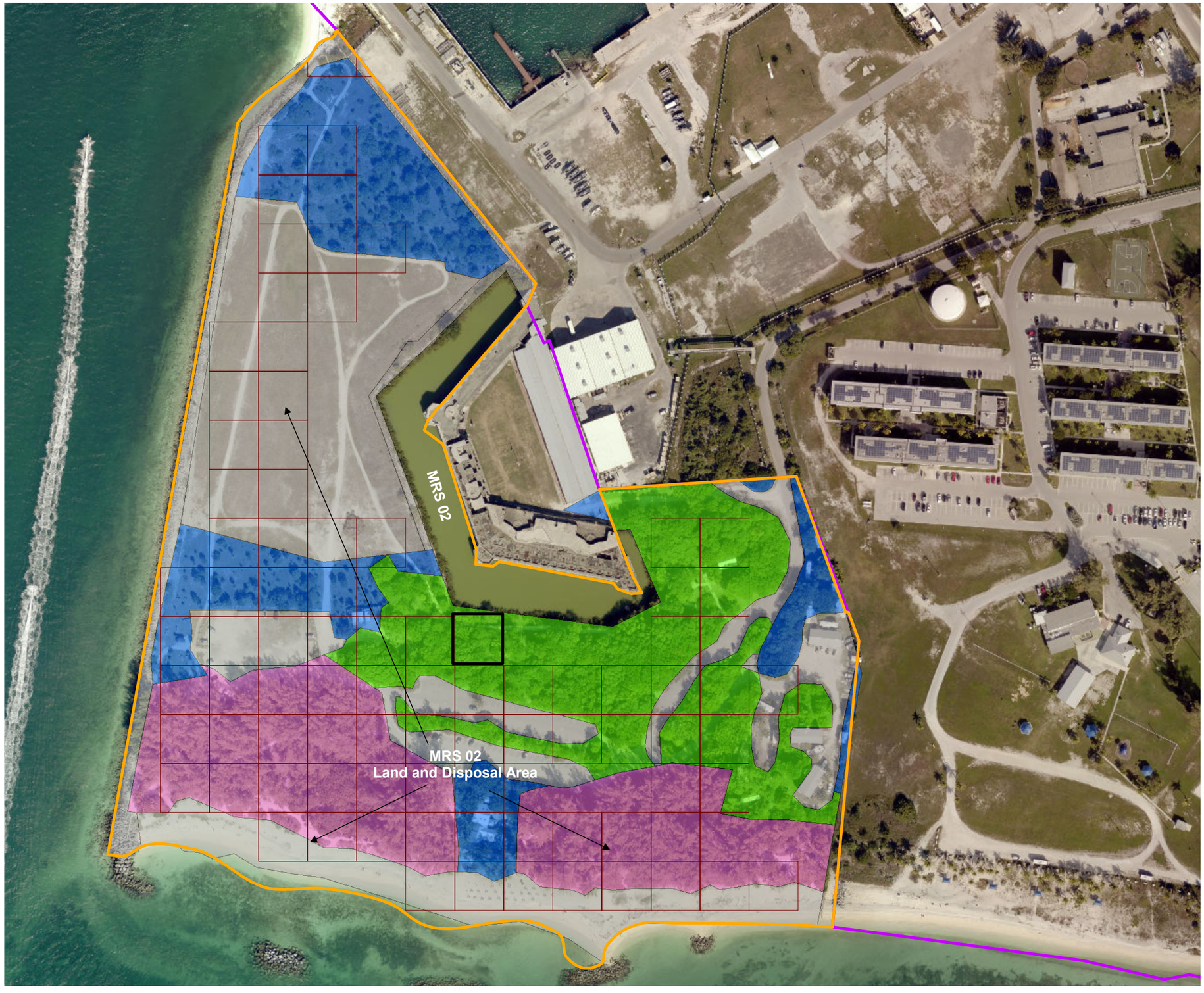


Figure 17.2

Artillery Ranges -
Land and Disposal Area/Moat
MRS 02
Fort Taylor
FUDS Project No. I04FL022702

Monroe County, Florida

Legend

- FUDS Property Boundary
- MRS Boundary
- 30 x 30 Meter Grids
- Open Area – EM61-MK2 Towed Array – RTK (13.7 Acres)
- Light Vegetation – EM61-MK2 Pedestrian – RTS (5.8 Acres)
- Medium Vegetation – EM61-MK2 Pedestrian – RTS (7.0 Acres)
- Heavy Vegetation – EM61-MK2 – Line and Station (6.7 Acres)
- Proposed Sample Unit (up to 9 More Locations TBD at MPPEH Findings)

Site Location in Florida

N

Meters
50 25 0 50

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	**Artillery Ranges - Land and Disposal Area/Moat MRS 02**		
DRAWN BY: BT			
CHECKED BY: JY	SCALE: As Shown	PROJECT NUMBER: 977405.0001.90001	
SUBMITTED BY: PB	DATE: November 2018	PAGE NUMBER: 62	
	FILE:		

Figure 17.3

Artillery Ranges - Water Areas
Near Shore Areas MRS 03
Fort Taylor
FUDS Project No. I04FL022701

Monroe County, Florida

Legend

- FUDS Property Boundary
- MRS 03 Boundary
- Proposed near Shore Transect (0-100 M)
- Proposed off Shore Transect (100-1,000 M)

N

Image: 2017 Orthophoto

150 75 0 150 Meters

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	**Artillery Ranges - Water Areas Near Shore Areas MRS 03**	
DRAWN BY: BT		
CHECKED BY: JY	SCALE: As Shown	PROJECT NUMBER: 977405.0001.90001
SUBMITTED BY: PB	DATE: June 2019	PAGE NUMBER: 63
	FILE:	

Figure 17.4

Artillery Ranges - Water (Dive Sites)/ (Remaining Water) - MRS 03 Fort Taylor FUDS Project No. I04FL022701

Monroe County, Florida

Legend

- Dive Site / Key Location
- Proposed DGM Grid
- 30-Meter spaced Transects
- Proposed DGM Transect
- MRS Boundary

Site Location in Florida

N

Meters
2,000 1,000 0 2,000

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Artillery Ranges - Water - (Dive Sites)/ (Remaining Water) - MRS 03	
DRAWN BY: BT		
CHECKED BY: JY	SCALE: As Shown	PROJECT NUMBER: 100132.0002.110068.03000.LABOR
SUBMITTED BY: PB	DATE: June 2019	PAGE NUMBER: 64
	FILE:	

17.2.2 DFW 2 - GIS DATA MANAGEMENT

17.2.2.1 OVERVIEW

This DFW addresses the procedures and data formats pertaining to the use of geospatial information and the production of electronic submittals for the site. Parsons will perform activities related to gathering and maintaining geospatial information in accordance with Data Item Description (DID) HNC-006.02, or as agreed by the project team during QAPP preparation. Geospatial information used for the RI will be in Universal Transverse Mercator (UTM) Zone 17, and datum of WGS84. Where reported, elevations will be in North American Vertical Datum 1988 (NAVD88). Geospatial data layers will conform to the Defense Installation Spatial Data Infrastructure Spatial Data Standards for Facilities Infrastructure and Environment (SDSFIE). Metadata will be prepared for the core geospatial data layers in accordance with Federal Geographic Data Committee (FGDC) metadata standards. The general requirements for management of the GIS are described in SOP GIS-01, Geospatial Data Management (Appendix K).

17.2.2.2 GEOSPATIAL INFORMATION FORMATS

Spatial data for the project will be provided in a Spatial Data Transfer Standard (SDTS) format at the completion of the project in an Environmental Systems Research Institute (ESRI®) (ArcView/ArcInfo) system, version 10.x or higher. Vector data incorporated into the GIS will be stored in ESRI shapefile or personal geodatabase formats. These files will be delivered upon completion of the project. Examples of vector data sets include physical, cultural, biological, and ordnance related items. Raster GIS data will be used in either tagged image file (TIF) or multi-resolution seamless image database (MrSID)-compliant formats with accompanying world files (.tfw or .sdw). TIF files will be delivered upon completion of the project with associated world file (.tfw). Examples of raster data sets are aerial photography and scanned topographic maps. Tabular data will be provided in ANSI structured query language (SQL) language format at the end of the project, as well as in Microsoft Excel, Microsoft Access, or Oracle database formats during the course of the project. These file types as well as comma delimited (.csv) text files will be delivered where feasible, upon completion of the project. ArcGIS map files (.mxd) for plates, figures, and drawings used in the Final Report will be included in the electronic deliverable. This submission may be by compact disc (CD) or digital video disc (DVD).

17.2.2.3 METADATA

Metadata will be created in accordance with FGDC standards that will describe the key information about each geospatial dataset. The metadata will contain information about the data source, its location, where it originated, how it is structured, key attributes, and other miscellaneous items of interest to the project team.

17.2.2.4 GIS SUBMITTALS

17.2.2.4.1 As discussed above, geospatial data sets will be delivered to the USACE Technical Manager in native ESRI shapefile or personal geodatabase format in compliance with SDSFIE. Metadata will be delivered with the files. Data will be submitted on CD or DVD.

17.2.2.4.2 Final mapping will be generated using the GIS. Site maps plotted from these design files will be provided on reproducible drawings. The size of these drawings will be based on the information to be displayed. A legend showing the standard National Geodetic Survey symbols used for the mapping, a map index showing the site in relationship to other sites within the boundary lines of the project area, a border, and a standard USACE title block will be shown on each map.

17.2.3 DFW 3: QUALITY CONTROL SEEDING AND IVS CONSTRUCTION

17.2.3.1 QC SEED PLAN

17.2.3.1.1 The Parsons QC Geophysicist will prepare a QC Seed Plan that will describe the type, frequency, and distribution of QC seeds. The QC Seed Plan and Worksheet #12 describe the types of items that will be used. The independent seeding team(s) will bury the QC seed items following the procedures in SOPs DGM-02: Seeding (for analog survey areas) and AGC-03: QC Seed Placement and Evaluation (for DGM/AGC areas) (Appendix K). In areas where DGM data will be collected, a designated seeding team will measure the locations of QC seed items with RTK GPS or Robotic Total Station (RTS); analog QC seed positions will be recorded with hand-held GPS or tape measures, although the primary location criteria for these seeds will be the grids in which they are placed. Members of the designated seed team will not be involved in any production data collection. SOP AC-20: Blind Seed Firewall Plan (Appendix K) describes the methods that will be used to prevent individuals involved with production data collection or analysis from accessing the QC seed information. Recovery will be confirmed via intrusive results, which will contain the grid information for each recovered seed. QC seed item information will be delivered to USACE in the Production Area QC Seeding Report. The Parsons QC Geophysicist will compare the DGM anomaly lists and AGC results to the known locations of blind seeds to confirm that the work meets the MQOs and MPCs in the QAPP. They will also evaluate daily datasets promptly to identify seed item detection or classification problems quickly. The Parsons QC Geophysicist will review analog clearance reports to confirm that the Analog QC Seed MQOs and MPCs in the QAPP are met.

17.2.3.1.2 Parsons personnel will also bury validation seeds according to the Validation Seed Plan to be developed by the Government (Appendix H). The seed team(s) will include a MEC escort (a UXO Technician II or higher) for MEC avoidance (see SOP MEC 03: MEC Avoidance and Escort [Appendix K]). No Parsons personnel will have access to the validation seed information aside from the validation seed installation team(s). SOP AC-20: Blind Seed Firewall Plan (Appendix K) describes the methods that will be used to prevent individuals involved with production data collection or analysis from accessing the validation seed information. All installation information related to the validation seeds will be deleted (digital) or delivered to the Government (non-digital field noted and any other documentation) upon confirmation that the Government has received and accepted the validation seed ground truth.

17.2.3.1.3 No seeding is planned for underwater work in MRS 03 or in the moat area of MRS 02.

17.2.3.2 IVS CONSTRUCTION

17.2.3.2.1 A Geophysical System Verification (GSV) process will be implemented at Fort Taylor to demonstrate that the instruments and data collection strategies selected for the site function as intended for the duration of the field investigation. Within this process, three separate Instrument Verification Strips will be used to verify the proper functioning of the geophysical systems used during the project.

17.2.3.2.2 There will be one IVS used for surveys in both MRS01 & MRS02 (Land surveys). It will be designed for use by single towed EM61-MK2A sensor in dynamic mode and MM 2x2 in cued mode and will include a cleared blank space to be used for background corrections. One medium ISO40 and one large ISO40 will be buried in this IVS. Seeds will be buried at approximately five times their inner diameters (i.e., 25cm for the medium ISO and 50cm for the large ISO) in horizontal orientations. Items in this IVS will be separated by at least 5 meters. The construction of this IVS will be performed in accordance with SOPs DGM-01: IVS Construction and Testing and AC-02: Test Sensor and System at IVS (Appendix K). A “noise strip” will also be located adjacent to the IVS and will be used to determine the background noise level for dynamic surveys and to collect background data for cued surveys. The

results of the initial IVS tests for each of the survey instruments data evaluations will be summarized in separate letter reports, which will be provided electronically to the PDT for review and concurrence.

17.2.3.2.3 The IVS for water surveys performed in MRS03 will be established underwater (sea bottom), within the boundary of MRS03 to monitor equipment functionality and geodetic accuracy of the underwater sensors (G882 Magnetometer). The underwater component of the project will be conducted concurrently with but independent of the land DGM efforts. Prior to the construction of the IVS, Parsons and Alpine will work together to locate an appropriate area for its placement based on depth, current, and vessel traffic. Alpine will then perform a magnetic pre-survey of the area using the USBL and RTK GPS to find a suitable area that is free of anomalies. Once a suitable (flat, unobstructed, and anomaly free) location has been established for the underwater IVS, a large ISO with or without a line attached to a surface buoy will be installed at the seabed. In areas with significant vessel traffic or fishing activities, the seed items will be installed without a surface buoy in order to avoid disturbance. The large ISO will be attached to non-metallic weights and individually deployed from the survey vessel. The large ISO will be lowered from a navigation node on the survey vessel to the seabed on their weights using a slip line and raised approximately 0.3 meters. The vessel will then maneuver to the as-planned seed item location. When the slip line is vertical, the items will set on the seafloor and the line to the surface will be measured. For retrieval of the ISO seed at the end of the project, a line from the seed item to an additional weight will be deployed off to the side of the seed item. The location of the additional weight will be recorded to allow a grappling hook to be deployed to catch the line for retrieval. In areas with-out significant vessel traffic or fishing activities, a line with a small surface float will be attached to the additional weight for easier retrieval. As needed, an inspection class ROV (VideoRay) will be deployed to provide visual observation capability from the surface during installation. Divers will be available, if needed, based on the video inspection. Once the IVS is constructed multiples passes will be conducted over the ISO at different vertical and horizontal offsets to establish baseline values and project detection thresholds. In addition to the IVS a background line will be established preferably in the deeper waters where suitable background values can be achieved for the project. IVS surveys will be conducted daily with multiple passes as needed to meet the IVS baseline detection values. A function test will also be conducted twice a day on land by passing a test item under the magnetometer with the magnetometer in a fixed position to ensure detection functionality.

17.2.3.2.4 A third IVS and noise line will be constructed under water in the Moat area of MRS02. Its design will be similar to the IVS in MRS03 with a pre-survey to identify an area free of anomalies. It will be designed for use by the submersible EM61-MK2S sensor towed by Parsons' PRMS autonomous vessel. One schedule 40 Large ISOs will be anchored down within the area and attached to a buoy for navigation purposes. The Location of the ISO will be recorded using RTK GPS using the buoy location on the water surface or using a survey rod if the bottom of the moat can be reached. Multiple passes will be conducted at different vertical and horizontal offsets to establish baseline values and detection values. The IVS and noise line will be survey daily.

Documentation: Draft Verification and Validation Plan (Appendix H); Validation Seed Plan (USACE); QC Seed Plan (Parsons); SOP AC 20, Blind Seed Firewall Plan with completed Personnel Inside Firewall Form; seeding results (spreadsheet, maps(s), and photographs); IVS Technical Memorandum; Production Area Seeding Report

17.2.4 DFW 4: ASSEMBLE AND VERIFY CORRECT OPERATION OF DETECTION SENSORS

17.2.4.1 The EM61-MK2A single coil system, and the PRMS EM61-MK2S system will be assembled according to their specifications. The Parsons Site Geophysicist will confirm correct assembly of the

three EM61-MK2 configurations. The Alpine Site Geophysicist or survey operator will assemble the G-882 magnetometer according to its specifications and verify its correct assembly.

17.2.4.2 The MRS01/MRS02 IVS will be surveyed with the EM61-MK2 single coil system as described in SOP DGM-01: IVS Construction and Testing (Appendix K). After completing the initial dynamic IVS testing, a Dynamic IVS Technical Memorandum will be prepared detailing the IVS setup, surveys, and results, including documentation of compliance with the dynamic IVS MQOs provided in Worksheet #22. The IVS Technical Memorandum will be provided to the project team for review and concurrence.

17.2.4.3 The MRS 03 IVS will be surveyed with the G-882 magnetometer to confirm the underwater geophysical system detects the ISOs. Due to the difficulty controlling the position of the magnetometer as it passes over the test items, the IVS metrics will be qualitative detection of the ISOs rather than the quantitative response and offset requirements typically used for land-based IVSs. A separate IVS memo detailing IVS setup, surveys, and results will be provided for the G-882 IVS.

17.2.4.4 The MRS02 Moat IVS will be surveyed with the HP EM61-MK2S towed by Parsons' PRMS vessel to confirm the underwater geophysical system detects the ISOs. Like the MRS03 IVS, this moat IVS' metrics will be qualitative detection of the ISOs rather than the quantitative response and offset requirements typically used for land-based IVSs. A separate IVS Memo detailing IVS setup, surveys, and results will be provided for the EM61-MK2S/PRMS IVS.

17.2.5 DFW-5: CONDUCT DGM DETECTION SURVEY

17.2.5.1 Single-sensor hand-towed EM61-MK2A will be used to identify the locations of metallic objects in the subsurface for the follow-on cued survey data in the Interior Fort and Casemates area. Singe-sensor EM61 data will be required to meet the 0.7m line spacing coverage MQO in Worksheet #22. Lines will be collected using a 0.6m line spacing to allow for some deviation from the intended line path. Hand-towed data will be positioned using either RTK GPS, RTS, or by using line and station markers dependent on whether tree canopy interferes with the GPS signal. Based on a 1m sensor width, the line spacing should be more than sufficient to meet this objective and to detect all potential TOIs, even if the operator deviates slightly from the intended line path. All hand-towed EM61-MK2 data collection will be performed in accordance with SOP DGM-03 (Appendix K). Any areas where obstructions prohibit DGM operations will be investigated using analog methods described below in DFW 16: Analog Removal.

17.2.5.2 Single-sensor hand-towed EM61-MK2A will also be used to identify subsurface metallic objects for follow-on cued survey over 16.8 acres distributed across the Artillery Ranges -Land and Disposal Area. The hand-towed EM61 survey in this area will be performed according to the same objectives and standards described in section 17.2.5.1 (above).

17.2.5.3 In MRS 03, Alpine will complete underwater DGM surveys along designated transects and grids with a Geometric G-882 Cesium Vapor Magnetometer as the primary instrument towed behind a specialized scientific survey vessel. The system will be configured as a single sensor for transects and dual sensor (horizontal gradiometer) for grids. The underwater DGM surveys will be conducted in three areas of MRS 03, The Near Shore, the Dive Sites, and Remaining Water Areas. The DGM survey of the Near Shore Areas will be conducted between 100m – 1,000m offshore at a transect spacing of 100m. The coverage will include 9 transects at 100m intervals totaling approximately 8000m (6.7 acres) placed parallel to the coast line. In the Dive Sites/Keys Area, the underwater DGM coverage will collect 3 acres of bathymetry and 2 acres of DGM data around each of 10 dive sites using a multibeam echo sounder and Geometrics G882 magnetometer. Transects will be spaced 30m to 100m apart in a circular pattern around each dive site to adequately cover and sufficiently delineate each site. In the Remaining Water Areas, the underwater DGM surveys will include 6.5 acres of both DGM transects

and grids to confirm NCMUAs within MRS 03. Six 0.5-acre grids, approximately 200m by 10m and seven transects totaling 3.5 acres are planned to demonstrate that MEC contaminated areas are bounded with at least 95% confidence such that areas outside of the CMUAs have less than or equal to 0.5 UXO per acre. In all three areas of MRS03, underwater navigation and geodetic data will be captured using a Sonardyne Scout USBL system connected to a RTK GPS fixed pole on the vessel providing sub meter GPS accuracy for the underwater sensors. In addition to the location data, altimeter data will be collected to ensure optimal sensor height above the seafloor. Using marine biology maps and bathymetry data, the survey team will avoid underwater hazards (i.e., shipwrecks, marine debris, reefs) that could interfere with or damage the sensor(s) and contact with sensitive ecological environments. Survey velocity will be adjusted to keep the magnetometer within 1-2 meters of the seafloor to ensure detection of potential MEC. The Parsons Geophysicist will review all G-882 DGM data, DGM reports, and anomaly selections, to ensure that project requirements are met. Parsons and Alpine will also have an EM61-MK2 submersible system on site if site conditions require a change to the sensor type.

17.2.5.4 In the MRS02 Moat Area, Parsons will collect bathymetry and DGM data in the moat surrounding the fort using a multibeam echo sounder and a submersible EM61-MK2S sensor towed behind Parson's remotely-operated unmanned surface vessel (PRMS). Bathymetry data will be used to determine depth and underwater conditions that will be utilized to adjust the sensor height for optimal detection within the moat. The PRMS vessel will be operated from the adjacent shore using a joystick connected to a laptop installed with custom navigation software. It will communicate via radio with the onboard controller allowing the operator to guide the vessel along a pre-determined survey path based on RTK GPS waypoints. The survey will collect 100 percent of the Moat area at one meter line spacing at speeds below 3 miles per hour (yielding 0.5 transect miles of bathymetry data and 2.35 acres of DGM data).

17.2.6 DFW-6: PROCESS DATA AND DOCUMENT LOCATIONS OF ANOMALIES

17.2.6.1 Processing geophysicists will analyze and process the EM61-MK2 data as described in SOP DGM 04: EM61-MK2 Data (Appendix K). Anomalies will be identified for cued data collection using a selection threshold determined as the higher of the minimum expected response for a horizontal 4" Parrott shell at a depth of 30 cm bgs or five times the site-specific background noise as measured at the IVS. Of all confirmed and suspected munitions on the site listed in Table 11.1, the 4" Parrott shell is expected to have the smallest response. To confirm this, inert munitions examples of the smaller rounds will be measured during the IVS testing phase. If access to the inert rounds cannot be obtained, a surrogate as agreed upon by the project team will be used instead. The data processor will also assess the data to identify any areas where the anomaly density is too high to select individual anomalies for the cued AGC survey. Should any high-density areas exist, they will be cleared using analog removal methods as described below in DFW 16: Analog Removal.

17.2.6.2 Background data collection locations for the cued survey will be selected using the dynamic survey results. Background locations will be selected to meet the requirements described in SOP AC-06: Collect Cued Background Measurements (Appendix K). Each background location selected will be checked by collecting five cued MM 2x2 points, one at the selected location and one offset approximately 0.5 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.

17.2.6.3 For DGM Data collected in the surveys of MRS 03 and MRS 02 Moat area, the data processor will use industry standard preprocessing software and Geosoft's Oasis Montaj for data analysis to process and format geophysical data in accordance with QAPP requirements. The data processor

will process the data using latency corrections, leveling with a de-median filter, and gridding. Anomalies will be selected using an automated peak picking algorithm and a threshold based on five times the background level to develop an anomaly list. This approach will detect complete munitions and fragments that indicate munitions use. The data processor will review the anomaly list and recommend additional selections prior to submitting the data to USACE for review and acceptance. Anomalies identified in the surveys of MRS03 and MRS02 Moat Area will not be investigated further using AGC methods, data processing will be similar to the land based surveys and anomaly selection will be based on offset detection limits tested using the G882 magnetometer and EM61-MK2S during the IVS.

17.2.6.4 A dynamic survey DUA will be completed using the four-step process described in Worksheet #37 following the project team's acceptance of transect and grid target lists. These will include the lists for targets identified for either or both cued data collection with AC sensors and intrusive investigation.

17.2.7 DFW-7: VALIDATE DETECTION SURVEY

17.2.7.1 Dynamic EM61-MK2 data will be validated as described in Worksheet 35. Any cued data acquisition conducted in a survey unit prior to that survey unit's dynamic target list being reviewed and approved by the project team will be considered at-risk. 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 dynamic data anomaly list will be collected before the cued data collection team demobilizes from the site. A data usability assessment (DUA) will be completed for the dynamic data using the four-step process described in Worksheet 37 following the project team's acceptance of the final cued target list.

Documentation: Documentation: Detection Survey DUA, Target Selection Technical Memorandum

Decision point: Is dynamic data acceptable for use in developing cued target lists?

17.2.8 DFW-8: ASSEMBLE ADVANCED GEOPHYSICAL SENSOR FOR CUED SURVEY AND TEST SENSOR AT IVS

17.2.8.1 The MM2x2 will be assembled as described in SOP AC-01: Assemble and Verify Operation (Appendix K). The Parsons Site Geophysicist will confirm correct assembly of the sensor.

17.2.8.2 To test the MM2x2 and verify that it is functioning correctly, an initial cued IVS survey will be performed as described in SOP AC-02: Test Sensor and System at IVS (Appendix K). 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 Worksheet 22. The IVS Technical Memorandum will be provided to the project team for review and concurrence.

Documentation: MM2x2 Instrument Assembly Checklist, Cued MM2x2 IVS Technical Memorandum

17.2.9 DFW-9: COLLECT CUED DATA

17.2.9.1 Cued MM2x2 data will be collected at dynamic anomaly locations as described in SOP AC-07: Collect Cued Target Measurements (Appendix K), with background data collected as described SOP AC 06: Collect Cued Background Measurements (Appendix K).

17.2.9.2 Cued data will be collected at approximately 200 and 400 anomalies in the Interior Fort and Casemates, respectively and at approximately 1,700 anomalies in the Artillery Range - Land Areas, not including the moat which will not be investigated with AGC.

17.2.9.3 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 Worksheet #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 (if applicable)
- Valid inertial measurement unit (IMU) function
- Response saturation

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

Documentation: Raw data (.h5 and .CSV), project QC database, Weekly QC Reports, Background Validation Report

Decision point: Have MQOs been achieved?

17.2.10 DFW-10: CONDUCT CUED DATA PROCESSING

17.2.10.1 The project geophysicist or geophysical data processor will process and classify the cued data using Geosoft's Oasis Montaj software with the UX-Analyze add-on as described in SOP AC 08: Process Cued Data (Appendix K). The primary metric for ranking the dig list and classifying anomalies as TOI or non-TOI will be comparison with the TOI library. UX-Analyze uses 1-, 2-, and 3-dipole inversion routines 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 11: Classify Anomalies and Make Dig/No-dig Decisions.

Documentation: processed data, and inversion/library comparison results, project QC database

Decision point: Have MQOs been achieved?

17.2.11 DFW-11: CLASSIFY ANOMALIES AND MAKE DIG/NO-DIG DECISIONS

17.2.11.1 Classification of cued data will generally be performed as described in SOP AC 08: Process Cued Data (Appendix K) 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.

17.2.11.2 The site-specific library will consist of polarizabilities from the most recent version of the DoD TOI Library maintained by the USACE. This library includes signatures for all munitions known or suspected to be present at the site, as listed in the CSM (Table 10.1). The primary source of those signatures will be the DoD Advanced Classification TOI Library. The current version of the DoD TOI Library contains only two Civil War era munitions; the 6-inch READ Short Shell projectile and the 4.52-

inch Parrott projectile. As the majority of the Civil War era munitions suspected to be present at the site are not in the current version of the DoD TOI Library, test pit data will be collected over any site-specific inert munitions that are made available to the project team at the site. The munitions' response signatures will be added to the site-specific classification library. It will also 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 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, particularly large axially-symmetric objects potentially representative of Civil War Era munitions that are not represented in the current library and for which inert examples are unlikely to be available for testing. Justification will be provided for any analyst-added digs.

17.2.11.3 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).

17.2.11.4 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 Project Geophysicist. The QC Geophysicist will review the ranked anomaly list to confirm that QC seed item classifications meet the project MQOs. 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.

Documentation: Ranked dig lists figures and maps, database containing training dig results

Decision point: Are all QC seeds classified as digs? Are all validation seeds classified as digs? Have MPCs been achieved?

17.2.12 DFW-12: VALIDATE CUED SURVEY AND CLASSIFICATION

17.2.12.1 Cued data will be validated as described in Worksheet #35. 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 lists. It is expected that separate dig lists will be submitted for the Interior Fort and Casemates Area and the Artillery Ranges – Land and Disposal Area. Verification and validation digs will be selected over both areas as described in the Verification and Validation Plan, which will be updated, as necessary, throughout the project. The draft version of the Verification and Validation Plan (Appendix H) indicates that up to 100 verification targets and 100 validation targets will be excavated between MRS 01 and MRS 02. The validation targets will be selected by the project team from anomalies classified as non-TOI; the verification targets will be determined based on the last TOI in order in the ranked dig list as described in the Verification and Validation Plan. Prior to the intrusive investigation, a data analyst will provide a short description as to why each of the selected validation targets was classified as a non-TOI (e.g., too small, too thin-walled, asymmetric) as described in SOP AC 10: Validate Classification Process (Appendix K).

Documentation: Cued DUA, Verification and Validation Plan

Decision point: Is cued data acceptable for use in classifying sources as TOI or non-TOI?

17.2.13 DFW-13: EXCAVATE BURIED OBJECTS

17.2.13.1 Detailed descriptions of the cued anomaly excavation procedures and intrusive results documentation required for this project are included in SOP MEC-05: DGM Intrusive Investigation (Appendix K). Training digs will be excavated first to allow for concurrent modification of the classification results, as necessary, to be followed by targets classified as TOIs. The intrusive investigation will include the excavation up to 100 verification digs and 100 validation digs as described above. All classification target intrusive investigations will be performed using an EM61-MK2A for anomaly reacquisition and hole clearance, and an RTK GPS, RTS, or survey tapes for positioning for source location. A Schonstedt Model GA-52Cx (or similar) analog metal detector may be used to pinpoint source locations within open holes but is not necessary for this investigation.

17.2.13.2 Any single point geophysical anomalies in MRS 01 & 02 where cued advanced classification data is not collected (e.g. anomalies where excessive noise or anomaly density prevents the picking of TOIs) will be reacquired and marked in the field in accordance with the procedures described in SOP DGM-05, any anomalous polygon areas identified will be intrusively characterized without removal of the entire anomaly source: Reacquisition and Anomaly Resolution (Appendix K). SOP MEC-05: DGM Intrusive Investigation also describes the procedures that will be used after intrusive investigation to confirm anomalies have been resolved.

17.2.13.3 Anomalies Identified in the underwater DGM surveys of the moat area of MRS 02 will be investigated by UXO qualified divers. Anomaly locations within the moat of MRS 02 will be reacquired from the water surface using RTK GPS on float platform tethered to a buoy clump which will be dropped from the reacquired surface location. The divers will investigate the buoy clump location at the bottom of the moat for an anomaly source with their handheld all metals detector to confirm the anomaly if visibility permits. If visibility is diminished, the UXO qualified divers will use underwater flashlights and professional judgment to safely identify the source and decide if the item is hazardous or not. It is anticipated that full visibility could be limited, so during these conditions all decisions will be channeled through the Dive Supervisor, SUXOS, and UXOSO prior to moving or bringing any item to the surface.

17.2.13.4 Anomalies Identified in the underwater surveys of MRS 03 will be reacquired either visually (anomalies may be on the surface of the ocean floor or subsurface) or by analog underwater all metals detectors guided by the Shark Marine System consisting of a touch screen computer with a floating GPS antenna suspended above the UXO qualified diver. The target ID and location will be loaded into the Shark Marine System to aid in directing the divers to the correct location and anomaly ID. Once the UXO qualified divers have confirmed the location, the center will be marked, and the divers will check a 10ft radius around the mark for the anomaly source until the anomaly is found. If the anomaly source is detected below sea bottom, the UXO qualified divers will intrusively investigate by hand, using hand tools, and will only occur in unconsolidated sediments. Procedures will vary depending on if seagrasses are present or not. The UXO qualified diver will follow the appropriate SOPs when performing intrusive investigations. The vertical extent for the investigation of MEC is from the surface of the seafloor to the depth capable for hand excavation by UXO qualified divers (approx. 24 inches) or to consolidated hard bottom or bedrock, whichever is reached first. Once the DGM anomaly is identified, the following data will be collected and documented:

- Target ID
- Description of item (MEC by type, MD by type, NMRD by type)
- Item Count
- Dig Date
- Distance from the reacquired location
- Bearing from the reacquired location
- Depth, inches

- Weight (pounds)
- Length (inches)
- Once the excavation is complete, a digital photo will be taken with a tape measure showing the length, width, and depth of each excavation site. A slate with the Target ID number will be included in the photo.
- Spoils from the excavation site will be pushed back into the hole and a photo demonstrating the completed action will be taken. A slate with the Target ID number will be included in the photo.

17.2.13.5 The anomaly list will be picked along the low and high concentration areas of the transects and approved by the project delivery team. In the Dive Sites/Keys area of MRS 03, divers will investigate up to 300 anomalies, approved by the project team, in both low and high concentration areas across all 10 dive sites. In the Remaining Water Areas of MRS 03, divers will investigate up to 240 anomalies that will be approved by the project team to achieve 95% confidence level that NCMUAs have less than or equal to 0.5 UXO per acre.

Documentation: Database of excavation results, photographs, Daily QC Reports, Weekly QC Reports

17.2.14 DFW-14: VERIFY INTRUSIVE RESULTS FROM CUED SURVEY

17.2.14.1.1 All sources recovered during the intrusive investigation will be compared to the predicted results as described in SOPs AC 09, Verify Recovered Objects are Compatible with Predictions and AC 10, Validate Classification Process (Appendix K); verification targets will be excavated as described under DFW 12.

Documentation: Validation and Verification Report

Decision point: Was the stop-dig threshold correct?

17.2.15 DFW-15: ANALOG REMOVAL

17.2.15.1 In MRS 02, Analog surveys will be performed in heavily vegetated or unpassable areas inaccessible to DGM data collection methods. Analog surveys will be limited in MRS 01 to only the obstruction areas located in the casemate. The subsurface analog removal will be performed according to the procedures described in SOP MEC-04, Analog UXO Surface Sweep and Subsurface Investigations (Appendix K). Subsurface Analog Removal will be conducted using handheld analog detection instruments, such as the Schonstedt Model GA-52Cx series fluxgate magnetometer or the ML-3 magnetic locator (or similar). The analog instrument will be used to identify subsurface anomalies based on the sensor's audible output. Whichever sensor is used, it will be maintained on the setting proven to locate the failure criteria seeds in the instrument test strip (Worksheet #22). 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").

17.2.15.2 Analog subsurface MEC removal operations will be performed under the direct supervision of the UXO Technician III Team Leader. Before 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 Worksheet #22. 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. The Team Leader will then assemble the team members in a line, with one team member assigned to each lane, and the team will work systematically to travel through the grid. Team members will locate anomalies for intrusive investigation, investigating them using either "mag and dig" or "mag and flag" methods.

17.2.15.3 Detected anomalies will be intrusively investigated by UXO-qualified personnel using either hand digging or mechanical methods (e.g., mini-excavator). The MSDs presented in the approved ESP will be enforced during intrusive MEC operations. If multiple teams are working in proximity to one another, the TSD specified in the approved ESP will be maintained during intrusive activities. All MSDs will be based on the appropriate MGFD, which is also presented in the approved ESP. Excavations will be continued until the anomaly source is resolved or until the specified maximum removal depth for the MRS is reached, whichever is less. No excavations shall be made over the maximum removal depth.

17.2.15.4 The Team Leader will mark the locations of and photograph MEC discovered and document information on the Grid Map, and in the project database or on the Analog Removal Grid Sheet for MEC/MPPEH (Appendix J) if electronic records are not accessible. MPPEH encountered during intrusive activities will be handled and disposed of as described in Section 17.2.17, Handle, Certify, and Dispose of MPPEH/MEC. Once the source of an anomaly has been identified and 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 extent possible, the excavation site will be restored to its original condition. Once MEC removal is complete in a grid, the UXO Team Leader will log the progress on the Grid Status Sheet (Appendix J), 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 Worksheet #12.

17.2.15.5 In the Near Shore areas of MRS 03, within the first 100 meters from the shoreline where surf is anticipated to be the most volatile, UXO qualified divers will survey the proposed transect paths of the sea floor at 30m intervals parallel to the shoreline and investigate anomalies using handheld all metals detectors along with Shark Marine System for navigation. The predetermined transect paths will be loaded into the Shark Marine System to guide the divers and also track actual paths surveyed by the divers. The divers will identify and investigate single point anomalies and identify potential anomalous areas by documenting locations of the single point anomalies and dimensions of the anomalous areas where not all anomalies will be investigated but a minimum of three anomalies. Intrusive operations will be conducted and documented similarly to Section 17.2.13.3.

Documentation: Analog Removal Grid Sheet (MEC/MPPEH Only) (or electronic equivalent), Analog Removal Grid Sheet (MD, RRD, and NMRD) (or electronic equivalent), Grid Map (or electronic equivalent), Grid Status Sheet (or electronic equivalent), project QC database.

Decision Point: Have MPCs been achieved?

17.2.16 DFW-16: CONDUCT FINAL DUA

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

17.2.17 DFW-17: MPPEH/MEC HANDLING, CERTIFICATION, AND DISPOSAL

17.2.17.1 MEC Identification

MPPEH that cannot be verified to be free of explosive hazards or is suspected to present an explosive hazard will be handled as MEC. MEC encountered during excavation will be clearly marked and its position will be recorded by 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 to allow subsequent verification of the identification by the UXOQCS. 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. No MPPEH/MEC will be moved without positive identification of the item(s) and an evaluation of its condition.

17.2.17.2 MEC Removal

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 or not it is fuzed. MPPEH that is suspected to present an explosive hazard will be handled as MEC.

MEC items deemed acceptable to move may, in accordance with the approved ESP, be moved for consolidation and/or storage, or be moved away from public roadways for detonation. A separate determination on disposal will be made by the SUXOS and UXOSO for each occurrence. No MEC identified for destruction will be removed outside the project site boundary. Consolidated shots will be conducted in accordance with the approved ESP.

MEC items not deemed acceptable to move will be 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.

17.2.17.3 MEC Storage

Use of an Explosives Storage Magazine for storage of MEC is not anticipated. Donor explosives for demolition operations will be purchased on an as-needed basis.

17.2.17.4 Disposal of MEC/MPPEH

17.2.17.4.1 Material Potentially Presenting an Explosive Hazard

MPPEH encountered during the remedial action shall be inspected, handled, certified, and disposed of in accordance with SOP MEC-02, MPPEH Inspection, Certification, and Final Disposition (Appendix K). MPPEH that cannot be verified to be free of explosive hazards or is suspected to present an explosive hazard will be treated as MEC (see below). A detailed account of all MPPEH encountered during the investigation will be maintained.

17.2.17.4.2 Munitions and Explosives of Concern

Acceptable to move MEC items may be consolidated for demolition. Items that cannot be moved will ideally be BIP the day they are discovered. If a MEC item cannot be detonated on the day it is found, the item will be guarded until the item(s) can be detonated in accordance with the approved ESP (Appendix E). Management procedures for demolition explosives are described in the Explosives Management Plan (Appendix D) and the approved ESP (Appendix E). Demolition/disposal operations will be conducted in accordance with the approved ESP (Appendix E) and the procedures described in SOP MEC-01, Demolition Operations (Appendix K).

Documentation: Explosives Usage Records, Magazine Data Cards, Demolition Summary Sheets, Demolition Shot Records.

17.2.17.4.3 Material Documented as Safe

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 off-site for proper disposal in accordance with the Waste Management Plan (Appendix N) and SOP MEC-02, MPPEH Inspection, Certification, and Final Disposition (Appendix K).

Documentation: DD Form 1348-1A, MDAS disposal documentation.

17.2.17.4.4 Other

If MEC-related items are recovered during the investigation that are not addressed in the approved ESP and/or the above sections on MEC disposal, the SUXOS shall inform the USACE OESS, and the Parsons and USACE PMs so appropriate measures can be discussed, developed, and implemented for dealing with those item(s).

17.2.18 DFW-18: MC SAMPLING

17.2.18.1 OVERVIEW

17.2.18.1.1 MC sampling will be conducted at the Interior Fort and Casemates MRS and the Artillery Ranges – Land and Disposal Area, Land Area MRS to determine if releases of MC from munitions activities have occurred that may pose a risk to human health and the environment. The collection of MC samples is not planned for any of the Artillery Ranges – Water Areas (near shore, Dives Sites/Keys, or remaining open areas). MC sampling will be conducted based on the identification of MEC or concentrations of MEC or MD during the DGM and intrusive tasks as described in the following paragraphs.

17.2.18.1.2 For purposes of this RI, analytes detected above PALs (Worksheet 15) and above background concentrations will be considered COPCs. Until sampling and analysis are completed, all MC analytes are considered "preliminary" COPCs. If COPCs are identified, additional samples will be collected to delineate the extent of the detected COPCs. Delineation samples will be analyzed for detected COPCs only. If delineation samples are determined to be necessary following collection of the initial samples, the proposed quantities and locations will be presented to the Project Team for concurrence prior to sample collection.

17.2.18.1.3 Worksheet 15 contains the PALs for the analytes evaluated at the Fort Taylor MRSs. The selected Laboratory is using the most sensitive commercially available method that is approved for use by the DOD. However, in some cases, the LOD for the available analytical methods is greater than the project LOQ goal for a given chemical. In such cases, the LOD will be used as the PAL. The process used to establish the PALs is described further in the Risk Assessment Work Plan (Appendix G). Following collection of the data, the Contractor's Project Chemist or designee will evaluate the sensitivity of the data collected to determine whether the DLs, LODs, and LOQs presented on WS #15 were met. Sensitivity of target compounds may be affected by matrix interference, high levels of target or non-target analytes, sample volume available for collection, etc. If the sensitivity requirements are not met for a particular analyte, the Contractor Team will evaluate whether the data can still be used for project decisions.

17.2.18.2 BACKGROUND SAMPLING

Background metals concentrations will be established for surface and subsurface soil for the Interior Fort and Casemates MRS and the Artillery Ranges – Land and Disposal Area, Land Area MRS through the collection of up to eight 100' x 100' SUs (one replicate each) using the Incremental Sampling Method (ISM) from an area not impacted from past military operations. The background samples will be collected in areas of similar soil type to the investigation areas (i.e., dredged soils similar to those found at the MRS). If sufficient area is not available within the FUDS boundary for eight SUs, one 50' x 50' SU will be collected as eight replicates, where possible. Ten each surface water and sediment background samples will be collected from areas not affected by MRS activities, if suitable locations can be found. In all cases, the background threshold value (BTV) for each metal will be the 95% Upper Tolerance Limit (UTL) of the background data set. If a sample exceeds the BTV, then two sample hypothesis testing will be conducted to determine if the site data set is significantly different from the background data set.

17.2.18.3 SOIL SAMPLING

17.2.18.3.1 Soil sampling will be conducted to identify the presence of MC contamination in surface soil related to MEC and MD findings, as well as to delineate the lateral and vertical extent of MC contamination previously identified during the SI.

17.2.18.3.2 The previous MC exceedances within the Interior Fort and Casemates MRS are as follows:

- Interior Fort and Casemates MRS - lead was identified as a human health COPC, while lead and zinc were identified as COPECs in one sample collected during the 2008 SI.

To address the SI exceedance location, one 30-increment SU (100' x 100') will be collected in triplicate surrounding the original sampling point at a depth of 0 to 6 inches (see Figure 17.1). A vertical extent discrete sample will be collected at a depth of 12 to 18 inches below the original sampling location. The lateral and vertical extent samples will be analyzed for only those COPCs that previously exceeded screening levels (lead and zinc).

17.2.18.3.3 Once MEC or a CMUA is identified, a single 30-increment SU (same size as DGM grid, up to 100' x 100') will be collected to determine whether there is a release of MC to surface soil. Soil sampling locations will be determined in the field and will sample locations of high anomaly densities and areas where high concentrations of MEC/MD are identified in the intrusive investigation results. For the Interior Fort and Casemates MRS, it is anticipated that up to two additional SUs will be required to determine if there is evidence of a release of MC at the locations of MEC or MD finds. For the Artillery Ranges - Land and Disposal Area, Land Area MRS, it is anticipated that up to 10 SUs will be required to determine if there is evidence of a release of MC in the area. One SU is proposed where MPPEH was recovered along a bike trail in 2007 (see Figure 17.2). Each SU will be collected for the analysis of explosives and metals identified in Worksheet #15. Soil sampling will be conducted in accordance with SOP ENV-01, Soil Sampling (Appendix K).

17.2.18.3.4 Sample results will be evaluated to determine if a release of MC contamination has occurred. A release will have occurred if explosives or metals are detected at concentrations greater than the PALs (Worksheet #15), or if metals are detected significantly above the established background levels (95% UTL of the background data set). Based on the results, additional surface soil or subsurface soil samples will be collected and analyzed (for the detected COPCs only) until both the lateral and vertical extent of the contamination is determined.

- Surface Soil – If there is evidence of a release of MC, delineation samples will be collected using a statistically based sample design to obtain a statistically defensible EPC for use in risk assessment. The delineation sampling approach, if necessary, will be presented to the PDT as a technical memorandum. In high density MEC/MD areas, the same delineation sampling approach will be used to determine the extent of the soil contamination area based on the DGM results and the results of the intrusive investigation. The number of step-out samples will vary depending on how many exceedances are found, but will be based on a sufficient number of samples to determine, with 95% confidence, that the site mean is less than a screening value.
- Subsurface Soil – At each of the PAL or background level exceedance SUs, subsurface soil samples will be collected using ISM from 12 to 18 inches below ground surface. If contamination is identified, the same sampling procedure will be followed in six-inch intervals until the contamination has been delineated.

17.2.18.3.5 Additional sampling details are provided on Worksheet #18 and analytical procedures are summarized on Worksheets #19 & 30 and Worksheet #23. Sample handling and custody

requirements are described on Worksheets #26 & 27. PALs have been developed for results comparison and determination of COPCs and are summarized on Worksheet #15.

17.2.18.4 SURFACE WATER/SEDIMENT SAMPLING

Sampling will include collecting discrete surface water and sediment sample pairs within the moat at locations where MEC/MD are identified. Surface water and sediment samples will also be collected at locations along the bank or near the edge of the moat at locations of MEC/MD contamination identified during the Land and Disposal Area MRS investigation. The sample locations will be determined in the field and will be biased toward areas where the localized topography influences runoff into the moat. Sediment samples will be collected only where a sufficient amount of sediment exists. An iterative step-out approach will be implemented until the extent of sediment contamination is bounded both laterally and vertically. The follow-on samples will be analyzed for the detected COPCs only. Surface water and sediment samples will be analyzed for explosives and metals and will be collected in accordance with SOP ENV-05, Surface Water and Sediment Sampling (Appendix K). Additional sampling details are provided on Worksheet #18 and analytical procedures are summarized on Worksheets #19 & 30 and Worksheet #23. Sample handling and custody requirements are described on Worksheets #26 & 27. PALs have been developed for results comparison and determination of COPCs and are summarized on Worksheet #15.

17.2.18.5 QC SAMPLES

QC samples of each media will be sampled during the investigation to evaluate the contract laboratory's procedures and quality control. All QC samples will be submitted for the same analyses as the primary field samples. QC samples will be collected as follows:

- Interior Fort and Casemates MRS – All SUs will be collected in triplicate.
- Land and Disposal Area, Land Area MRS – All SUs will be collected in triplicate.
- Land and Disposal Area, Moat – Six surface water/sediment QC samples (three each media, locations to be determined in the field).

17.2.18.6 GROUNDWATER SAMPLING

The installation and sampling of groundwater monitoring wells will not be conducted based on the findings of the 2008 SI.

17.2.19 DFW-19: DEMOBILIZATION

Upon completion of field activities all personnel, equipment and materials will be removed from the site. All work zone demarcation materials will be removed, the site surfaces inspected and general cleanup activities completed.

Worksheet #18: Sampling Locations and Methods

During any sampling collection or associated activities (sample handling, decontamination, waste management), personnel will follow the directives of the APP/SSHP (**Appendix A**); to include compliance with established protocols and wearing appropriate personal protective equipment (PPE) (verified compliant on a task specific basis by the UXOSO).

Sampling Location	ID Number (1)	Matrix	Sample Type	Depth	Analytical Group	Concentration Level	Est. No. of Samples	Replicates	Sampling SOP	Rationale for Sampling Location
Interior Fort and Casemates MRS										
SI MC Contamination, Surface Soil; see Worksheet #17, Section 17.2.18.3	FT01-SU01-S-0.5	Soil	Incremental	0–6 inches	Detected COPCs (Pb, Zn)	Low	1 (Phase I)	3	**ENV-01**	Step-out sample to assess lateral extent of SI MC contamination
SI MC Contamination, Subsurface Soil, see Worksheet #17, Section 17.2.18.3	FT01-SU01-SS-18	Soil	Discrete	6-24 inches	Detected COPCs (Pb, Zn)	Low	1 (Phase I)	NA	**ENV-01**	Assess vertical extent of SI MC contamination
MEC/MD Locations, Surface Soil, see Worksheet #17, Section 17.2.18.3	FT01-SU#-S-0.5	Soil	Incremental	0-6 inches	Explosives/ Metals	Low	2 (Phase I)	3	**ENV-01**	Evaluate if MEC-related activities resulted in MC COPCs
MEC/MD Step-out, Surface Soil, see Worksheet #17, Section 17.2.18.3	FT01-SU#-S-0.5	Soil	Incremental	0-6 inches	Detected COPCs	Low	1 (Phase II)	3	**ENV-01**	Assess lateral extent of MC contamination
MEC/MD Step-out, Subsurface Soil, see Worksheet #17, Section 17.2.18.3	FT01-SU#-SS-18	Soil	Incremental	12-18 inches	Detected COPCs	Low	1 (Phase II)	3	**ENV-01**	Assess vertical extent of MC contamination

Sampling Location	ID Number (1)	Matrix	Sample Type	Depth	Analytical Group	Concentration Level	Est. No. of Samples	Replicates	Sampling SOP	Rational for Sampling Location
Land and Disposal Area, Land Area MRS										
CMUA or MEC/MD Locations, Surface Soil, see Worksheet #17, Section 17.2.18.3	FT02-SU#-S-0.5	Soil	Incremental	0-6 inches	Explosives/ Metals	Low	10 (Phase I)	3	**ENV-01**	Evaluate if MEC-related activities resulted in MC COPCs
CMUA or MEC/MD Step-out, Surface Soil, see Worksheet #17, Section 17.2.18.3	FT02-SU#-S-0.5	Soil	Incremental	0-6 inches	Detected COPCs	Low	2 (Phase II)	3	**ENV-01**	Assess lateral extent of MC contamination
CMUA or MEC/MD Step-out, Subsurface Soil, see Worksheet #17, Section 17.2.18.3	FT02-SU#-SS-18	Soil	Incremental	12-18 inches	Detected COPCs	Low	2 (Phase II)	3	**ENV-01**	Assess vertical extent of MC contamination
Land and Disposal Area, Moat MRS										
MEC/MD in Moat, Sediment; see Worksheet #17, Section 17.2.18.4	FT02-SD-0.5	Sediment	Discrete	0–6 inches	Explosives/ Metals	Low	2 (Phase I)	NA	**ENV-05**	Evaluate if MEC-related activities resulted in MC COPCs
MEC/MD – Edge of Moat, Sediment; see Worksheet #17, Section 17.2.18.4	FT02-SD-0.5	Sediment	Discrete	0-6 inches	Explosives/ Metals	Low	2 (Phase I)	NA	**ENV-05**	Evaluate if MEC-related activities resulted in MC COPCs
MEC/MD in Moat, Surface Water; see Worksheet #17, Section 17.2.18.4	FT02-SW	Surface Water	Discrete	NA	Explosives/ Metals	Low	2 (Phase 1)	NA	**ENV-05**	Evaluate if MEC-related activities resulted in MC COPCs
MEC/MD – Edge of Moat, Surface Water, see Worksheet #17, Section 17.2.18.4	FT02-SW	Surface Water	Discrete	NA	Explosives/ Metals	Low	2 (Phase 1)	NA	**ENV-05**	Evaluate if MEC-related activities resulted in MC COPCs
QC Samples, see Worksheet #17, Section 17.2.18.3	FT02-SD-0.5	Sediment	Discrete	0-6 inches	Explosives/ Metals	Low	1 (Phase I)	NA	**ENV-05**	Assess Laboratory Quality Control
QC Samples, see Worksheet #17, Section 17.2.18.3	FT02-SW	Surface Water	Discrete	NA	Explosives/ Metals	Low	1 (Phase I)	NA	**ENV-05**	Assess Laboratory Quality Control

Sampling Location	ID Number (1)	Matrix	Sample Type	Depth	Analytical Group	Concentration Level	Est. No. of Samples	Replicates	Sampling SOP	Rational for Sampling Location
Land and Disposal Area, Moat (Continued)										
Moat – Step-out, Sediment, see Worksheet #17, Section 17.2.18.4	FT02-SD-0.5	Sediment	Discrete	0-6 inches	Detected COPCs	Low	4 (Phase II)	NA	**ENV-05**	Assess lateral extent of MC contamination
QC Samples, see Worksheet #17, Section 17.2.18.3	FT02-SD-0.5	Sediment	Discrete	0-6 inches	Detected COPCs	Low	1 (Phase II)	NA	**ENV-05**	Assess Primary Lab Quality Control
Moat – Step-out, Sediment, see Worksheet #17, Section 17.2.18.4	FT02-SD-18	Sediment	Discrete	12-18 inches	Detected COPCs	Low	5 (Phase II)	NA		Assess vertical extent of MC contamination
QC Samples, see Worksheet #17, Section 17.2.18.3	FT02-SD-18	Sediment	Discrete	12-18 inches	Detected COPCs	Low	2 (Phase II)	NA	**ENV-05**	Assess Primary Lab Quality Control
Other										
Background Surface Soil, see Worksheet #17, Section 17.2.18.2	FTBG-S-0.5	Soil	Incremental	0-6 inches	Metals	Low	8	1	**ENV-01**	Evaluate background metals concentrations in surface soil
Background Subsurface Soil	FTBG-SS-18	Soil	Incremental	12-18 inches	Metals	Low	8	1	**ENV-01**	Evaluate background metals concentrations in subsurface soil
Background Sediment	FTBG-SD-0.5	Sediment	Discrete	0-6 inches	Metals	Low	10	NA	**ENV-01**	Evaluate background metals concentrations in sediment
Background Surface Water	FTBG-SW	Surface Water	Discrete	NA	Metals	Low	10	NA	**ENV-01**	Evaluate background metals concentrations in surface water

(1) Denotes prefix for sample numbers; full sample ID methodology is presented in Worksheets #26 and 27.

Worksheets #19 & 30: Sample Containers, Preservation, and Hold Times

This worksheet summarizes the analytical methods for each sampling matrix, including the required sample volume, containers, preservation, and holding time requirements. Details concerning sampling handling are included on Worksheets #26 & 27.

Table 19.1 Analytical Requirements, Sample Containers, Preservation, and Hold Times (APPL, Inc.)

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference (1)	Sample Volume	Containers (number, size, and type) (2)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil/Sediment (Discrete)	Metals	Low	Preparation Method/SOP: SW3050B or SW3051A/ PRE3050B Analysis Method/SOP: SW6020A / ANA6020	1g	4 oz (125 mL) amber glass wide-mouth jar with Teflon lined screw cap	None (can be shipped with iced samples, if necessary)	180 days
Water	Metals	Low	Preparation Method/SOP: SW3015A / PRE3010A Analysis Method/SOP: SW6020A / ANA6020	50ml	500mL plastic	HNO_3 to pH < 2	180 days
Soil (ISM)	Metals	Low	Preparation Method/SOP: SW3050B or SW3051A/ PRE3050B or PRE3051A Analysis Method/SOP: SW6020A / ANA6020	1 g	1x 1-gallon plastic bag (incremental samples)	None (can be shipped with iced samples, if necessary)	180 days
Soil/Sediment (Discrete)	Explosives	Low	Preparation Method/SOP: SW8330A/MSE018 Analysis Method/SOP: 8330A/HPL8330	10g	4 oz (125 mL) amber glass wide-mouth jar with Teflon lined screw cap	Cool to < 6°C	14 days/40 days
Water	Explosives	Low	Preparation Method/SOP: SW3535A / MWE3535 Analysis Method/SOP: 8330A/HPL8330	500ml	2 x 500mL amber glass	Cool to < 6°C	7 days/40 days
Soil (ISM)	Explosives	Low	Preparation Method/SOP: SW8330B/MSE018IS Analysis Method/SOP: 8330B/HPL8330	10 g	1x 1-gallon plastic bag (incremental samples)	Cool to < 6°C (after air-drying, samples can be held at room temperature [22±4°C] or cooler)	14 days to extraction / 40 days for analysis

(1) Laboratory SOPs 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/MSD containers listed should be tripled for water samples.

Worksheet #20: Field Quality Control Summary

This worksheet 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.

	Incremental Sampling Methodology					
Matrix	Analytical Group	Estimated No. of Sample Units(1)	Field Triplicate	Matrix Spike / Matrix Spike Duplicates	Equipment Blanks (2)	Estimated Number of Total Analyses
Surface Soil	Metals	Up to 21	Up to 13(3)	5% (2– Estimated)	0	49
Surface Soil	Explosives	Up to 21	Up to 13(3)	5% (2 – Estimated)	0	49
Subsurface Soil	Metals	Up to 12	Up to 4(3)	5% (1 – Estimated)	12 – Estimated	33
Subsurface Soil	Explosives	Up to 12	Up to 4(3)	5% (1 – Estimated)	12 – Estimated	33

	Discrete Sampling Methods					
Matrix	Analytical Group	Estimated No. of Field Samples	Field Duplicate	Matrix Spike / Matrix Spike Duplicates	Equipment Blanks (2)	Estimated Number of Total Analyses
Sediment	Metals	20(4)	10% (2 – Estimated)	5% (1 – Estimated)	0	23
Sediment	Explosives	10	10% (1 – Estimated)	5% (1 – Estimated)	0	12
Surface water	Metals	20(4)	10% (2 – Estimated)	5% (1 – Estimated)	N/A	23
Surface water	Explosives	10	10% (1 – Estimated)	5% (1 – Estimated)	N/A	12

(1) Includes 8 background SUs.

(2) For ISM surface soil and sediment sampling, only disposable equipment will be used; therefore, equipment blanks are not needed.

(3) One replicate will be collected in each of 8 background SUs.

(4) Includes 10 background samples analyzed for metals only.

N/A = not applicable

Worksheet #21: Field Standard Operating Procedures

The applicable field SOPs to be used during the RI at Fort Taylor are listed in the below table. Copies of these field SOPs are provided in Appendix K. SOPs for dive and snorkel operations are included in Appendix F – Diving and Snorkeling Plan.

Reference Number	Title, Revision Date, and/or Number	SOP Originating Organization	Related Equipment Types	Modified for Project? (Y/N)	Comments
AC-01	Assemble and Verify Operation, Revised 10/11/2017	Parsons	MM2x2 sensor, RTK GPS, RTS positioning system, orientation sensor	N	See Appendix K
AC-02	Test Sensor and System at IVS, Revised 10/18/2017	Parsons	MM2x2 sensor, RTK GPS, RTS, orientation sensor, inert munitions and/or ISOs, hand tools	N	See Appendix K
AC-03	QC Seed Placement and Evaluation, Revised 10/10/2017	Parsons	Analog geophysical instrument(s), RTK GPS, RTS	N	See Appendix K
AC-06	Collect Cued Background Measurements, Revised 10/12/2017	Parsons	MM2x2 sensor, RTK GPS, RTS, orientation sensor	N	See Appendix K
AC-07	Collect Cued Target Measurements, Revised 10/10/2017	Parsons	MM2x2 sensor, RTK GPS, RTS orientation sensor	N	See Appendix K
AC-08	Process Cued Data, Revised 03/21/2018	Parsons	--	N	See Appendix K
AC-09	Verify Recovered Objects are Compatible with Predictions, Revised 10/12/2017	Parsons	--	N	See Appendix K
AC-10	Validate Classification Process, Revised 10/12/2017	Parsons	--	N	See Appendix K
AC-12	Collect Data for Additions to TOI Library, Revised 10/12/2017	Parsons	MM2x2 sensor	N	See Appendix K
AC-20	Blind Seed Firewall Plan, Revised 10/12/2017	Parsons	--	N	See Appendix K
DGM-01	IVS Construction and Testing, Revised 8/27/2015	Parsons	Analog geophysical instrument(s), EM61-MK2 sensors, RTK GPS, RTS	N	See Appendix K
DGM-02	Seeding, Revised 8/28/2015	Parsons	Analog geophysical instrument(s), EM61-MK2 sensor, digital camera, RTK GPS, RTS	N	See Appendix K

Reference Number	Title, Revision Date, and/or Number	SOP Originating Organization	Related Equipment Types	Modified for Project? (Y/N)	Comments
DGM-03	EM61-MK2 Data Acquisition, Revised 8/28/2015	Parsons	EM61-MK2 sensors, tow vehicle, array structure, RTK GPS, RTS	N	See Appendix K
DGM-04	EM61-MK2 Data Processing, Revised 8/28/2015	Parsons	--	N	See Appendix K
DGM-05	Anomaly Reacquisition and Resolution, Revised 4/25/2018	Parsons	EM61-MK2, RTK GPS, RTS	N	See Appendix K
UDGM-01	Assembly of the PRMS and Verification of Correct Operation, Revised 11/30/2018	Parsons	EM61-MK2, RTK GPS, PRMS components	N	See Appendix K
Alpine Document #11320	Alpine SOP for Instrument Verification Strip (IVS) Installation and Use, 20 October 2017	Alpine	Survey vessel, RTK GPS, marine communications equipment, marine magnetics/EM system, SSS system, bathymetry system, electronic data acquisition, storage, and post processing equipment, ISOs, mooring components, survey rod with level	N	See Appendix K
Alpine Document #11648	Alpine SOP for UXO – Marine Magnetometer Surveys, Revised 14 October 2017	Alpine	Survey vessel, RTK GPS, marine communications equipment, marine magnetics system, electronic data acquisition, storage, and post processing equipment	N	See Appendix K
Alpine Document #11320	Alpine SOP for Multibeam Hydrographic Surveys, Revised 12 October 2017	Alpine	Survey vessel, RTK GPS, heave, pitch, and roll equipment and control monuments, marine communications equipment, depth sounding and sound velocity profiling equipment, electronic data acquisition, storage, and post processing equipment	N	See Appendix K
Alpine Document #11648	Alpine SOP for Side Scan Sonar Surveys, 14 March 2016	Alpine	Survey vessel, RTK GPS, SSS system equipment, marine communications equipment, marine magnetics system, electronic data acquisition, storage, and post processing equipment	N	See Appendix K
Alpine Document #20181204	Alpine SOP for Ultra Short Baseline Positioning System Surveys, 05 December 2018	Alpine	Survey vessel, RTK GPS, marine communications equipment, marine magnetics system, electronic data acquisition, storage, and post processing equipment	N	See Appendix K
DSOP-01	SCUBA Pre Dive Brief, July 2017	USAE	--	N	See Appendix F

Reference Number	Title, Revision Date, and/or Number	SOP Originating Organization	Related Equipment Types	Modified for Project? (Y/N)	Comments
DSOP-02	Dive Supervisor Check List, July 2017	USAE	--	N	See Appendix F
DSOP-03	SCUBA Dive Log, July 2017	USAE	--	N	See Appendix F
DSOP-04	Dive Equipment Loadout, July 2017	USAE	--	N	See Appendix F
DSOP-05	Dive System Equipment Inspection, July 2017	USAE	--	N	See Appendix F
DSOP-06	Line Pull and Hand Signals, July 2017	USAE	--	N	See Appendix F
DSOP-07	Underwater Operations in Marine Habitats, July 2017	USAE	--	N	See Appendix F
DSOP-08	Underwater Remotely Operated Vehicle Operations, July 2017	USAE	VideoRay PRO 3 XE GTO, smart tether navigation and positioning system, detachable 900-kHz multibeam sonar	N	See Appendix F
DSOP-09	Underwater Operations, July 2018	USAE	Sub-Salve Bomb Recovery System, pull lines, lifting bag/balloon, tripod system	N	See Appendix F
DSOP-10	Underwater Demolition/Disposal Operations, July 2017	USAE	Vulcan tool	N	See Appendix F
MEC-01	Demolition Operations, Revised 11/29/2018	Parsons	--	N	See Appendix K
MEC-02	MPPEH Inspection, Certification, and Final Disposition, Revised 07/10/2018	Parsons	--	N	See Appendix K
MEC-03	MEC Avoidance and Escort, Revised 2/18/2015	Parsons	Analog geophysical instrument(s)	N	See Appendix K
MEC-04	Analog UXO Surface Sweep and Subsurface Investigations, Revised 05/15/17	Parsons	Analog geophysical instrument(s), eye wash, fire extinguisher, first-aid/trauma kit, shovel, trowel	N	See Appendix K
MEC-05	Intrusive Investigation of DGM Anomalies (Including Advanced Classification), Revised 07/10/2018	Parsons	Metal detector, GPS, ruler or tape measure	N	See Appendix K
GIS-01	Geospatial data management, Revised 10/20/2017	Parsons	--	N	See Appendix K

Reference Number	Title, Revision Date, and/or Number	SOP Originating Organization	Related Equipment Types	Modified for Project? (Y/N)	Comments
CHEM-01	Chemistry Data Management, Revised 5/20/15	Parsons	--	N	
ENV-00	Sampling Daily Quality Control Report, Revised 3/6/15	Parsons	--	N	
ENV-01	Soil Sampling, Revised 10/7/15	Parsons	Sampling tools, sample containers, logbook, RTK GPS, RTS, Chain of Custody (CoC) forms	N	
ENV-05	Surface Water and Sediment Sampling, Revised 6/30/15	Parsons	Sampling tools, sample containers, logbook		
H&S-01	Hearing Conservation, Revised 2/17/2015	Parsons	Hearing protection, dosimeters		
H&S-02	Medical Surveillance, Medical Records, and Emergency Care, Revised 1/26/2018	Parsons	Personal Protective Equipment (PPE)		See Appendix K
H&S-03	Emergency Response & Contingency Plan, Revised 07/13/2018	Parsons	First aid kits, fire extinguishers, eyewash station, communication devices		See Appendix K
H&S-04	Hazard Communication, Revised 2/17/15	Parsons	Safety Data Sheets (SDS), Placards		See Appendix K
H&S-05	Heavy Equipment and Vehicle Safety, Revised 1/15/16	Parsons	Speedometer, fuel gauge, horn, windshield, defrost/defog device, mirrors, cab/roof, non-slip surface on steps, power operated starting device, seat/lap belt, brakes, helmet/hardhat		See Appendix K
H&S-06	Severe Weather Operations, Revised 07/05/2018	Parsons	--		See Appendix K
H&S-07	Fire Fighting, Revised 07/05/2018	Parsons	Fire extinguisher		See Appendix K
H&S-11	Fatigue Management Plan, Revised 04/17/2018	Parsons	--		See Appendix K
	FKNMS Best Management Practices for Vessel, Aircraft, and Debris Recovery and Removal Operations, 4/23/2018	FKNMS	--	N	See Appendix K

Worksheet #22: Equipment Testing, Inspection, and Quality Control

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 22.1 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 sensor, Schonstedt 52)	DFW 3; DFW16 **SOP DGM-02; SOP AC-03; SOP MEC-03; SOP MEC-04**	Daily	Operator/Daily QC Report/UXOQCS	Each operator demonstrates positive detection of the presence of a medium ISO buried at a depth of 24 inches bgs in the worst-case orientation	CA: Repair or replace instrument, then repeat test
Detection (Analog Sensor, Schonstedt 52)	DFW 16 **SOP MEC-04**	QC seed items will be distributed such that 1-2 deep seeds and 1-3 shallow seeds are detected by each operator per lot(1)	Field Team Leader/ Daily QC Report; Grid Status Records/UXOQCS	All seed items in each lot should be returned to the UXOQCS upon completion of the lot	RCA/CA CA assumption: grid fails; re-clear
Anomaly resolution (Analog Sensor, Schonstedt 52)	DFW 16 **SOP MEC-04**	Evaluated for the entire analog lot of 50 anomalies.	Field Team Leader/ Daily QC Report; Grid Status Records/UXOQCS	Field team leader checks 27 open holes based on analog lot size of 50 to confirm no remaining response or known response is documented.	RCA/CA CA assumption: excavation fails; re-clear
Geodetic equipment functionality (RTK GPS and RTS)	DFW 3; DWF 4; DFW 5; DFW 9; DFW 13 **SOP DGM-02; SOP DGM-03; SOP DGM-05;**	Daily for RTK GPS/Per setup for RTS	Operator/Daily QC Report/UXOQCS	Measured position of control point within 10 cm of ground truth	CA assumption: redo affected work.
Initial detection survey positioning accuracy (IVS; EM61-MK2)	DFW 4 **SOP DGM-01**	Once prior to start of dynamic data acquisition for EM61-MK2	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

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Initial instrument function test (EM61-MK2)	DFW 4 **SOP DGM-01**	Once following assembly	Project Geophysicist/ IVS Technical Memorandum/QC Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all channels	CA: Repair or replace instrument, then repeat test
Ongoing instrument function test (EM61-MK2)	DFW 5 **SOP DGM-03**	Beginning and end of each day and each time instrument is turned on	Field Team Leader/ running QC summary/ Project or QC Geophysicist	Response (mean static spike minus mean static background) within 20% of initial response for all channels.	CA: make necessary repairs and re-verify
Ongoing detection survey positioning precision (IVS; EM61-MK2)	DFW 5 **SOP DGM-03**	Beginning and end of each day	Project Geophysicist/ running QC summary/ QC Geophysicist	Derived positions of IVS target(s) within 25 cm of the ground truth locations	RCA/CA
In-line measurement spacing (EM61-MK2)	DFW 5 **SOP DGM-03**	Verified for each data collection day using existing UX Detect tools based upon sensor center position	Project Geophysicist/ running QC summary/ QC Geophysicist	98% ≤ 0.25 m between successive measurements	RCA/CA CA assumption: data set fails, (recollect portions that fail)
Coverage (EM61-MK2)	DFW 5 **SOP DGM-03**	Verified for each survey unit or grid	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)
Detection survey repeatability (EM61-MK2)	DFW 5 **SOP DGM-03**	Verified for each survey unit or grid	Project Geophysicist/ running QC summary and Dynamic Data Validation Report/QC Geophysicist	QC seed response on profile within selected anomaly is equal to or greater than the target selection threshold	RCA/CA

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Detection survey performance (EM61-MK2)	DFW 5; DFW 6 **SOP DGM-03; SOP DGM-04**	Verified for each survey unit or grid	QC Geophysicist; Lead Agency QA Geophysicist/ Dynamic Data Validation Report/ Lead Agency QA Geophysicist	All blind QC seeds must be detected and positioned within 40 cm radius of ground truth.	RCA/CA
Valid position data (EM61-MK2)	DFW 5; DFW 6 **SOP DGM-04;**	Per measurement	Field Team Leader/ running QC summary/ Project Geophysicist	GPS status flag indicates RTK/RTS fix	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
Secondary anomaly characteristic threshold verification (when screening is used)	DFW 6 **SOP DGM-04;** **SOP AC-05**	Collect cued data from an additional 100 anomalies excluded based on secondary characteristic (size, decay, etc.) screening	QC Geophysicist	Cued data analysis confirms 100% of excluded anomalies are non-TOI	CA: Cue all screened anomalies

(1) Areas deemed inaccessible to DGM will be combined into one “lot” for analog removal.

Table 22.2 Cued Survey (instrument: METALMAPPER2x2 and MPV; classification tool: UX-Analyze and UXO Lab)

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Verify correct assembly (MM2x2)	DFW 8 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 sensor function test (MM2x2)	DFW 8 SOP AC-01	Once following assembly	Field Team Leader/ instrument assembly checklist/ Project Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all monostatic Tx/Rx combinations	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 ½ sensor spacing in each cardinal direction, MM2x2)	DFW 8 SOP AC-02; SOP AC-06	Once during initial system IVS test	Field Team Leader/ IVS Technical Memorandum/ Project Geophysicist	All five measurements (decay amplitude) within the noise level of each other and library match from all four offset measurements > 0.9	CA: clear and resurvey or reject/replace BG location
Initial derived polarizabilities accuracy (IVS,MM2x2)	DFW 8 SOP AC-01; 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
Initial derived target position accuracy (IVS, MM2x2)	DFW 8 SOP AC-01; 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 derived polarizabilities precision (IVS, MM2x2)	DFW 9 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 ≥ 0.9 for each set of three inverted polarizabilities	RCA/CA

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Ongoing derived target position precision (IVS, MM2x2)	DFW 9 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, MM2x2)	DFW 9 SOP AC-06	Once per background location	Field Team Leader/ background location report/Project Geophysicist	All five measurements (decay amplitude) within the noise level of each other and library match from all four offset measurements > 0.9	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 9 SOP AC-06	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 or differ from original measurement by a factor of 5 or less	CA: Document environmental changes, as applicable. BG measurement rejected if no changes With QC and QA Geophysicists' approval, 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 instrument function test (MM2x2)	DFW 9 SOP AC-07	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 20% of initial response for all monostatic Tx/Rx combinations	CA: make necessary repairs and re-verify
Transmit current levels (MM2x2)	DFW 8; DFW 9 SOP AC-07	Evaluated for each sensor measurement	Field Team Leader/ tracking summary/ Project Geophysicist	Transmit current must be ≥ 8A	CA: reject failing points; stop data acquisition activities until condition corrected if persistent

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Valid orientation data (MM2x2)	DFW 9; DFW 10 SOP AC-07	Evaluated for each sensor measurement	Field Team Leader/tracking summary /Project Geophysicist	Orientation data reviewed and appear reasonable within bounds appropriate to site	CA: unreasonable data rejected; stop data acquisition activities until condition corrected if persistent
Confirm Reacquisition GPS precision (for RTK GPS/Per setup for RTS)	DFW 3; DWF 4; DFW 5; DFW 9; DFW 13 SOP DGM-02; SOP DGM-03; SOP DGM-05	Daily for RTK GPS/Per setup for RTS	Field Team Leader/tracking summary /Project Geophysicist	All checks within 0.10 m of known survey location	CA assumption: redo affected work.
Confirm all background measurements are valid	DFW 9; DFW 10 SOP AC-06	Evaluated for each background measurement	Project Geophysicist/ Background summary/ QC Geophysicist	Ensure background variation foes not impact ability to classify correctly	RCA/CA: Background measurement rejected and removed from active background measurements database Earlier/later BG point used if BG measurements are consistent throughout the day; recollect affected data if varying BG results indicate loss of point is significant
Confirm adequate spacing between units (MM2x2)	DFW 9; DFW 10 SOP AC-07	Evaluated at start of each day (or grid)	Field Team Leader/ Field Logbook/ Project Geophysicist	Minimum separation of 50 m	CA: Recollect all coincident measurements
Ongoing production area measurements (MM2x2)	DFW 9; DFW10 SOP AC-07	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 response is not saturated (MM2x2)	DFW 9; DFW 10 SOP AC-07; SOP AC-08	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.

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Confirm inversion model supports classification (1 of 3) (MM2x2)	DFW 9; DFW 10 SOP AC-07; SOP AC-08	Evaluated for all models derived from a measurement (i.e. 1-, 2-, and 3-dipole results)	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.)
Confirm inversion model supports classification (2 of 3) (MM2x2)	DFW 9; DFW 10 SOP AC-07; SOP AC-08	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 in-field or post-processed inversion location unless fit location is within 0.4 m of another cued target
Confirm inversion model supports classification (3 of 3) (MM2x2)	DFW 9; DFW 10 SOP AC-07; SOP AC-08	Evaluated for all seeds	QC Geophysicist; lead agency QA Geophysicist/ Measurement Inversion model QC summary/ USACE QA Geophysicist	100% of predicted seed positions ≤ 0.25 m radially from known position (x, y). Z ≤ 0.15 m	RCA/CA
Classification performance (MM2x2)	DFW 11 SOP AC-08	Evaluated 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

(1) Small ISO at 30 cm depth will not be surveyed as part of cued data collection IVS testing.
(2) MM2x2 and MPV response comparisons will be the absolute value of the max/min response on or after the first time gate used in inversion each transmitter/receiver pair.

Table 22.3 Underwater Dynamic and Analog Surveys

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Instrument functionality (Analog sensor, Minelab Excalibur II)	DFW 3; DFW15	Daily	Operator/Daily QC Report/UXOQCS	Each operator demonstrates positive detection of the presence of a medium ISO buried at a depth of 24 inches bgs in the worst-case orientation	CA: Repair or replace instrument, then repeat test
Geodetic equipment functionality (Trimble RTK 5800, Trimble Geo XT)	DFW 3; DFW 4; DFW 5; DFW 13 Alpine Doc 11320 IVS Alpine Doc 11320 USBL	Daily	Operator/Daily QC Report/UXOQCS	Measured position of control point within 5 cm of ground truth for RTK and 1.5 meters for diver navigation systems.	CA assumption: redo affected work.
Initial detection survey positioning accuracy (IVS; (EM61-MK2S, G882 Magnetometer))	DFW 4 UDGM-01 Alpine Doc 11320 IVS Alpine Doc 11320 USBL	Once prior to start of dynamic data acquisition for G882 Magnetometer and EM61-MK2S	Project Geophysicist/ IVS Technical Memorandum/QC Geophysicist	Derived positions of IVS target(s) are within 2 m of the ground truth locations	CA: Make necessary adjustments, and re-verify
Initial instrument function test (EM61-MK2S, G882 Magnetometer)	DFW 4 UDGM-01 Alpine Doc 11320 IVS Alpine Doc 11320 USBL	Once following assembly	Project Geophysicist/ IVS Technical Memorandum/QC Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all channels for EM61 only, Magnetometer will record response value only	CA: Repair or replace instrument, then repeat test
Ongoing instrument function test (EM61-MK2S, G882 Magnetometer)	DFW 5 UDGM-01 Alpine Doc 11320 IVS Alpine Doc 11320 USBL	Once per day	Field Team Leader/ running QC summary/ Project or QC Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all channels for EM61 only, Magnetometer will record response value only	CA: make necessary repairs and re-verify

Table 22.3 Underwater Dynamic and Analog Surveys

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Ongoing detection dynamic repeatability and survey positioning precision (IVS; G882 Magnetometer, EM61-MK2S)	DFW 5 UDGM-01 Alpine Doc 11320 IVS Alpine Doc 11320 USBL	Once per day	Project Geophysicist/ running QC summary/ QC Geophysicist	Derived positions of IVS target(s) within 2 m of the ground truth locations and a response of at least the minimum detection value of the as built IVS.	RCA/CA
In-line measurement spacing (G882 Magnetometer, EM61-MK2S)	DFW 5 UDGM-01 Alpine Doc 11320 IVS Alpine Doc 11320 USBL	Verified for each data collection day using existing UX Detect tools based upon sensor center position	Project Geophysicist/ running QC summary/QC Geophysicist	98% ≤ 0.25 m between successive measurements	RCA/CA; CA assumption: data set fails, (recollect portions that fail)
Speed (G882 Magnetometer, EM61-MK2S)	DFW 5 UDGM-01 Alpine Doc 11320 IVS Alpine Doc 11320 USBL	Verified for each data collection day using existing UX Detect tools based upon sensor center position	Project Geophysicist/ running QC summary/ QC Geophysicist	95 percent of the survey is less than 8 miles per hour (mph); 4 mph for moat or as demonstrated at the IVS	RCA/CA CA assumption: data set fails, (recollect portions that fail)
Altitude (G882 Magnetometer, EM61-MK2S)	DFW 5 UDGM-01 Alpine Doc 11320 IVS Alpine Doc 11320 USBL	Verified for each data collection day using existing UX Detect tools based upon sensor center position	Project Geophysicist/ running QC summary/ QC Geophysicist	95 percent of the useable survey is less than the altitude offset as demonstrated at the IVS	RCA/CA CA assumption: data set fails, (recollect portions that fail or omit the failed sections if enough coverage is collected)

Table 22.4 Intrusive Investigation

Measurement Quality Objective	DFW/SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Confirm derived features match ground truth (1 of 2) (MM2x2)	DFW 14 **SOP AC-09**	Evaluated for all recovered items	Project Geophysicist/ Measurement Inversion Model QC Summary or Intrusive database/ QC Geophysicist	100% of recovered (excluding inconclusive category) item positions ≤ 0.25 m from predicted position (x, y, z)	RCA/CA
Confirm derived features match ground truth (2 of 2) (MM2x2)	DFW 14 **SOP AC-09**	Evaluated for all recovered items	Project Geophysicist/ Dig List and Intrusive database/ Project or QC Geophysicist	100% of recovered objects (excluding inconclusive category) qualitatively match predicted size	RCA/CA
Verification of TOI/non-TOI threshold (MM2x2)	DFW 14 **SOP AC-09**	Dig 100 anomalies beyond last TOI on dig list	Project Geophysicist/ Verification and Validation Report/ QC Geophysicist	100% of predicted non-TOI intrusively investigated are non-TOI	RCA/CA. Adjust threshold
Classification validation (MM2x2)	DFW 14 **SOP AC-10**	Dig 100 non-TOI anomalies selected by PDT	Project Geophysicist/ Verification and Validation Report/ QC Geophysicist	100% of predicted non-TOI qualitatively matches predictions	Document in DUA
Underwater Geodetic/Re-acquisition Functionality (Trimble RTK 5800, Trimble Geo XT)	DFW 5	Daily	Site Geophysicist/ QC Geophysicist	Measured position of control point within 5 cm of ground truth for RTK and 1.5 meters for diver navigation systems.	RCA/CA

Worksheet #23: Analytical SOP References Table

The applicable SOPs to be used for analysis of samples collected during the RI at NBS/NOD are listed in the below tables. The laboratory SOP references were provided by APPL, Inc., and are presented in Appendix K.

Table 23.1 APPL, Inc. Analytical Standard Operating Procedures

Lab SOP Number	SOP Title Revision Date Revision Number (1)	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)
Preparation Methods						
PRE3050B	ACID DIGESTION OF SEDIMENTS, SLUDGES, AND SOILS BY EPA METHOD 3050B Rev. 5, 01/25/18	Definitive	Soil: Metals	NA	APPL, Inc.	N
PRE3010A	ACID DIGESTION OF AQUEOUS SAMPLES AND EXTRACTS FOR TOTAL AND DISSOLVED METALS FOR ANALYSIS BY ICP SPECTROSCOPY OR ICP MASS SPECTROSCOPY BY EPA METHOD 3010A, Rev, 2, 01/25/18	Definitive	Water: Metals	NA	APPL, Inc.	N
PREMETALSIS	Incremental Sampling (IS) techniques for Digestion of Soil Samples, Rev 2, 01/2018	Definitive	Soil ISM: Metals	NA	APPL, Inc.	N
MSE018	EPA METHOD 8330 MECHANICAL ORBITAL SHAKER EXTRACTION FOR SOLID EXPLOSIVE SAMPLES, REV. 1, 1/24/18	Definitive	Soil: Explosives	NA	APPL, Inc.	N
MSE018IS	Mechanical Shaker Extraction for Solid Explosive Samples using Incremental sampling (IS) techniques EPA METHOD 8330B; Rev. 6, 01/26/18	Definitive	Soil ISM: Explosives	NA	APPL, Inc.	N
MWE3535	SOLID PHASE EXTRACTION FOR AQUEOUS EXPLOSIVE SAMPLES EPA METHOD 3535A, REV. 3, 01/24/18	Definitive	Water: Explosives	NA	APPL, Inc.	N
Analytical Methods						
ANA6020	INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY BY EPA METHOD 6020; REVISION 8; 08/10/17	Definitive	Soil and Water: Metals	ICP-MS	APPL, Inc.	N
HPL8330	EXPLOSIVE COMPOUNDS: DIODE ARRAY DETECTOR BY HIGH PRESSURE LIQUID CHROMATOGRAPHY, REV. 10, 12/05/17	Definitive	Soil and Water: Explosives	HPLC	APPL, Inc.	N
Laboratory Policy SOPs						
SHR001	RECEIVING SAMPLES; SECTION 5; REVISION 8; DATE 06/12/17	N/A	N/A	N/A	APPL, Inc.	N
SHR012	SAMPLE DISPOSAL AND WASTE COLLECTION, STORAGE AND DISPOSAL; SECTION 5; REVISION 17; DATE 11/7/16	N/A	N/A	N/A	APPL, Inc.	N
DOC011	SAMPLE COC DATABASE; SECTION 4; REVISION 5; DATE 08/02/17	N/A	N/A	N/A	APPL, Inc.	N

(1) Laboratory SOPs 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.

Worksheet #24: Analytical Instrument Calibration Table

The Analytical Instrument Calibration Table and the specific analytical method SOP references are provided in Appendix K.

Table 24.1 Analytical Instrument Calibration, APPL, Inc.

Instrument	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible for Corrective Action	SOP Reference
ICP-MS (Method 6020)	Linear Dynamic Range (LDR) or High-level Check Standard	N/A	At initial set-up and checked every 6 months with a high standard at the upper limit of the range.	Within ±10% of true value.	Dilute samples within the calibration range, or re-establish/verify the LDR.	Analyst or certified instrument technician	ANA6020
ICP-MS (Method 6020)	Tuning	N/A	Prior to ICAL.	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height.	Retune instrument and verify.	Analyst or certified instrument technician	ANA6020
ICP-MS (Method 6020)	Initial Calibration (ICAL) for All Analytes Minimum one high standard and a calibration blank.	Cu. Pb, Zn Soil ICAL range: 0.01 mg/kg – 10 mg/kg Water ICAL range: 0.1 µg/L – 100 µg/L	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, $r^2 \geq 0.99$.	Correct problem, then repeat ICAL.	Analyst or certified instrument technician	ANA6020
ICP-MS (Method 6020)	Initial Calibration Verification (ICV)	N/A	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes, within ± 10% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Analyst or certified instrument technician	ANA6020
ICP-MS (Method 6020)	Continuing Calibration Verification (CCV)	N/A	After every 10 field samples and at the end of the analysis sequence.	All reported analytes within ± 10% of the true value.	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and recalibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst or certified instrument technician	ANA6020

Instrument	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible for Corrective Action	SOP Reference
ICP-MS (Method 6020)	Low-level Calibration Check Standard (Low Level ICV)	N/A	Daily.	All reported analytes within ± 20% of the true value.	Correct problem and repeat ICAL.	Analyst or certified instrument technician	ANA6020
ICP-MS (Method 6020)	Initial and Continuing Calibration Blank (ICB/CCB)	N/A	Before beginning a sample run, after every 10 field samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst or certified instrument technician	ANA6020
ICP-MS (Method 6020)	Interference Check Solutions (ICS) (also called Spectral Interference Checks)	N/A	After ICAL and prior to sample analysis.	ICS-A: Absolute value of concentration for all non- spiked project analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.	Analyst or certified instrument technician	ANA6020
HPLC (Method 8330B)	Initial Calibration (ICAL) for all analytes (including surrogates) 5-point ICAL for linear calibration (6-points for quadratic)	Soil ICAL range: 40 µg/kg – 2000 µg/kg Water ICAL range: 0.08 µg/L – 32 µg/L	At instrument setup and after ICV or CCV failure, prior to sample analysis.	8330B: ICAL must meet one of the three options below: Option 1: RSD for each analyte ≤ 20%; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.	Correct problem then repeat initial calibration	Analyst or certified instrument technician	HPL8330
HPLC (Method 8330B)	Second source calibration verification (ICV)	N/A	Once after each initial calibration	Analytes within ± 20% (8330B) of expected value (initial source)	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Analyst or certified instrument technician	HPL8330
HPLC (Method 8330B)	RT window width	N/A	At method set-up and after major maintenance	RT width is ± 3 times standard deviation for each analyte RT from 72-hour study.	N/A	Analyst or certified instrument technician	HPL8330

Instrument	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible for Corrective Action	SOP Reference
HPLC (Method 8330B)	Establishment and verification of the RT window for each analyte and surrogate	N/A	Once per ICAL and at the beginning of the analytical shift for establishment of RT; and with each CCV for verification of RT	Using the midpoint standard or the CCV at the beginning of the analytical shift for RT establishment; analyte must fall within established window during RT verification	N/A	Analyst or certified instrument technician	HPL8330
HPLC (Method 8330B)	Continuing Calibration Verification (CCV)	N/A	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	Analytes within ± 20% (8330B) of expected value (initial source).	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; Or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and recalibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst or certified instrument technician	HPL8330

Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Worksheet #25 provides information on analytical instruments and equipment, maintenance, testing, and inspection. To ensure that the analytical instruments and equipment are available and in working order when needed, all laboratory analytical equipment will undergo maintenance and testing procedure in accordance with the laboratory SOPs (provided in Appendix K).

Table 25.1 Analytical Instrument and Equipment Maintenance, Testing, and Inspection for APPL, Inc.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP-MS	Check windings	N/A	Visually inspect for wear or damage	8 hrs of operation	N/A	Replace windings	Analyst or certified manufacture instrument technician	ANA6020
ICP-MS	Clean nebulizer	N/A	Visually inspect for wear or damage	Daily prior to operation	N/A	Flush with DI water	Analyst or certified manufacture instrument technician	ANA6020
ICP-MS	Clean spray chamber	N/A	Visually inspect for dirt or deterioration	As necessary	N/A	Rinse with DI water	Analyst or certified manufacture instrument technician	ANA6020
ICP-MS	Clean Torch	N/A	Visually inspect for dirt or deterioration	Monthly	N/A	Clean with a 10% HNO3 solution and soak any parts with buildup overnight in a 5% HNO3 solution. Rinse with DI water and air dry.	Analyst or certified manufacture instrument technician	ANA6020
HPLC	Change guard cartridge, inlet filter and PTFE frit	N/A	Review pressure profile	As needed, based on pressure profile	N/A	Replace them and check often	Analyst or certified instrument technician	HPL8330
HPLC	Change analytical column	N/A	Check peak tailing, decreased sensitivity, retention time changes, etc.	When chromatography indicates	N/A	N/A	Analyst or certified instrument technician	HPL8330
HPLC	Replace mobile phase daily	N/A	N/A	Daily	N/A	N/A	Analyst or certified instrument technician	HPL8330

Worksheets #26 & 27: Sample Handling, Custody, and Disposal

26.1 SAMPLE NUMBERING

26.1.1 A sample numbering system will be implemented to identify each sample collected during the investigation using a unique Sample ID. The numbering system will ensure each sample is uniquely labeled and will provide a tracking procedure to allow retrieval of information about each sample collected. QC samples will be numbered using the same system and notes will be made in the field notebook to record which samples are QC samples; duplicates will not be identified to the laboratory.

26.1.2 Every Sample ID will have a location-specific prefix to indicate the sample location. The prefixes for the planned sample locations are listed on Worksheet #18. Included in the prefix will be the designations "01" for the Interior Fort and Casemates MRS, "02" for the Artillery Ranges Land and Disposal Area MRS (both Land and Moat areas), or "BG" indicating a background sampling location. If additional sample locations are developed during the RI, the Parsons Sample Team Lead will coordinate with the Parsons Project Chemist to define additional location-specific prefixes as needed. The environmental medium collected will also be reflected in the sample number using "S" for surface soil, "SS" for subsurface soil, "SD" for sediment, and "SW" for surface water. Incremental samples will be designated by SU, using "SU" as the designator and a unique number identifying the SU (i.e., SU01, SU02, SU03). The final three designations will indicate the sample depth in ft, a unique, sequential identifier for the sample (i.e., 01, 02, etc.), and the date the sample was collected. Triplicates collected for incremental samples will further have "A", "B", or "C" denoting each of the replicates collected (i.e., 02A, 02B, 02C). The sample number will be as follows:

Location-specific Prefix – Sample Unit (soil samples only) - Medium – Depth (soil and sediment only) – Unique Identifier- Date

26.1.3 For example:

- The sample number "FT01-SU01-S-0.5-02B-041019 would indicate the second replicate (of a triplicate set) from the first surface soil SU collected from the Interior Fort and Casemates MRS at a depth of 0 to 6 inches on April 10, 2019.
- The sample number "FT01-SU01-SS-18-03B-041019 would indicate the third replicate (of a triplicate set) from the first subsurface soil SU collected from the Interior Fort and Casemates MRS at a depth of 12 to 18 inches on April 10, 2019.
- The sample number "FT02-SD-0.5-01-041019 would indicate the first sediment sample collected from Fort Taylor Artillery Ranges – Land and Disposal Area MRS at a depth of 0 to 6 inches on April 10, 2019.
- The sample number "FT02-SW-01-041019 would indicate the first surface water sample collected from Fort Taylor Artillery Ranges – Land and Disposal Area MRS on April 10, 2019.

26.2 SAMPLE HANDLING

26.2.1 To ensure sample authenticity and data defensibility, proper sample handing system procedures will be followed from the time of sample collection to final sample disposal. The Contractor Sampling Lead or designee is responsible for completing the sample bottle label and CoC form, sample collection, storage of samples in the field pending shipment to the laboratory, sample packing, and coordination of sample shipment via overnight courier.

26.2.2 The laboratory receiving staff and/or custodian will acknowledge the receipt of shipped samples upon their arrival at the laboratory. The laboratory analytical technicians will prepare and analyze the field samples in accordance with the analytical SOPs. The field samples and all extracts will be stored at the laboratory for 30 days after a final report has been submitted to Parsons. The laboratory hazardous waste manager will be responsible for the final sample disposal upon notice from the Parsons Project Chemist.

Table 26.1 Responsibilities for Sample Handling, Custody, and Disposal

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT		SOP Reference
Sample Collection (Personnel/Organization)	Parsons Sampling Lead or designee	Refer to this WS, section 26.4.
Sample Packaging (Personnel/Organization)	Parsons Sampling Lead or designee	Refer to this WS, section 26.4.
Coordination of Shipment (Personnel/Organization)	Parsons Project Chemist	Refer to this WS, section 26.4.
Type of Shipment/Carrier	Overnight (FedEx anticipated, but other carriers may be used as/if necessary)	N/A
SAMPLE RECEIPT AND ANALYSIS		
Sample Receipt (Personnel/Organization)	Sample receiving supervisor, APPL, Inc.	SHR001
Sample Custody and Storage (Personnel/Organization)	Sample receiving supervisor, APPL, Inc.	SHR001
Sample Preparation (Personnel/Organization)	Analyst, APPL, Inc.	Refer to WS #23, Table 23.1 (preparation methods)
Sample Determinative Analysis (Personnel/ Organization)	Analyst, APPL, Inc.	Refer to WS #23, Table 23.1 (analytical methods)
SAMPLE ARCHIVING		
Field Sample Storage (No. of days from final lab report submittal)	30 days	SHR012
Sample Extract/Digestate Storage (No. of days from extraction/digestion)	30 days	Refer to WS #23, Table 23.1
SAMPLE DISPOSAL		
Personnel/Organization	Sample receiving supervisor, APPL, Inc.	SHR012
Number of Days from final lab report	30 days	SHR012

26.3 SAMPLE LABELING

26.3.1 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 sample container prior to sample collection to ensure that they do not separate. An example of APPLs sample container label is included in Appendix J.

26.4 FIELD SAMPLE CUSTODY PROCEDURES (SAMPLE COLLECTION, PACKAGING, SHIPMENT, AND DELIVERY TO LABORATORY)

26.4.1 Samples will be collected by field team members under the supervision of Parsons Sample Team Lead. Sample will be preserved as described on Worksheets #19 & 30. Samples will be cushioned if necessary with packaging material and placed into coolers and the CoC will be placed in a plastic bag and taped to the inside of the cooler lid. Custody seals will be placed on each cooler in a manner that the cooler cannot be opened without breaking the seal. Each custody seal shall be signed and dated by the person packaging the cooler and the seals shall be covered by clear packing tape to

prevent accidental loss or damage during shipping. Coolers will be shipped to the laboratory via overnight shipping, with the air bill number indicated on the CoC (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples.

26.4.2 The following address will be used for sample shipment:

Primary Laboratory: APPL, Inc.
ATTN: Greg Salata
908 N. Temperance Ave.
Clovis, CA 936141
Tel: 559-275-2175

26.5 LABORATORY SAMPLE CUSTODY PROCEDURES (RECEIPT OF SAMPLES, ARCHIVING, DISPOSAL)

26.5.1 All laboratory sample receipt, internal custody, sample archiving, and disposal procedures shall be completed in accordance with the laboratory specific SOPs. The laboratory policy SOPs are SHR001 (Receiving Samples), SHR012 (Disposing, waste and storage) and DOC 011 (COC documentation). These SOPs are listed in WS 23.1 and included in Appendix K. All documentation shall be available upon request or during a review of the laboratory for inspection.

26.6 SAMPLE IDENTIFICATION PROCEDURES

26.6.1 Upon removing the custody seals/tape and opening the cooler at the analytical laboratory, the receiving clerk will sign the CoC and take the temperature (not applicable for incremental sample coolers) using the temperature blank (if absent, a representative sample container shall be used). 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 sample receipt form. All cooler temperatures and the status of any broken or damaged sample containers shall be noted on the sample receipt form. The laboratory shall contact the Parsons Project Chemist or designee immediately upon discovery of non-compliant temperatures, broken or damaged sample containers, or any other issues that may possibly impact sample analysis and/or data quality. 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.

26.6.2 The laboratory will assign each sample shipment to a unique sample delivery group (SDG) number. The laboratory shall log in the samples received and assign each field sample a laboratory sample ID based on the designated SDG and the information on the CoC. The laboratory shall send (via email) the sample login forms generated by the LIMS along with the signed CoCs and sample receipt forms/checklist to the Parsons Project Chemist or designee as soon as possible after sample receipt.

26.7 CHAIN-OF-CUSTODY PROCEDURES

26.7.1 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, matrix, 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. A copy of APPLs COC is included in Appendix J.

26.8 NON-CONFORMANCE

26.8.1 The Laboratory PM will contact the Parsons Project Chemist to resolve issues encountered during sample receipt and login. The Parsons Project Chemist will coordinate with the Parsons Sampling Lead and other personnel as necessary to resolve the issues

Worksheet #28: Analytical Quality Control and Corrective Action

The tables in this worksheet provide information on the QC samples, frequency, method or SOP QC acceptance limits, corrective actions, person responsible for the corrective actions, and measurement performance criteria.

Table 28.1 Metals Analysis QC/Corrective Actions – APPL, Inc.

Matrix		Soil/Sediment and Water				
Analytical Group		Metals				
Analytical Method/SOP Reference		EPA Method SW6020A/ ANA6020				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Internal Standards (IS)	Every field sample, standard and QC sample.	IS intensity in the samples within 30-120% of intensity of the IS in the ICAL blank.	If recoveries are acceptable for QC samples, but not field samples, the field samples may be considered to suffer from a matrix effect. Reanalyze sample at 5- fold dilutions until criteria is met. For failed QC samples, correct problem, and rerun all associated failed field samples.	Analyst Lab QA Officer Project Chemist	Accuracy / Sensitivity	QC acceptance criteria specified by DoD QSM v 5.1
Method Blank (MB)	One per preparatory batch.	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct problem. If required, re-prep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst Lab QA Officer Project Chemist	Accuracy / Sensitivity	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.
Laboratory Control Sample (LCS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst Lab QA Officer Project Chemist	Accuracy / Precision - Analytical	QC acceptance criteria specified by DoD QSM v 5.1
Matrix Spike (MS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project- specific requirements. Contact the client as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Precision - Analytical	For matrix evaluation, use QC acceptance criteria specified by DoD QSM v 5.1

Matrix		Soil/Sediment and Water				
Analytical Group		Metals				
Analytical Method/SOP Reference		EPA Method SW6020A/ ANA6020				
Analytical Organization		APPL Inc.				
QC Sample	**Frequency & Number**	**Analytical/Prep Method and SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD).	Examine the project- specific requirements. Contact the client as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Precision - Analytical	For matrix evaluation, use QC acceptance criteria specified by DoD QSM v 5.1
Dilution Test	One per preparatory batch if MS or MSD fails.	Five-fold dilution must agree within ± 10% of the original measurement.	No specific CA, unless required by the project.	Analyst Lab QA Officer Project Chemist	Accuracy / Precision - Analytical	Per the DoD QSM v 5.1
Post Digestion Spike (PDS) Addition	One per preparatory batch if MS or MSD fails (using the same sample as used for the MS/MSD if possible).	Recovery within 80-120%.	No specific CA, unless required by the project.	Analyst Lab QA Officer Project Chemist	Accuracy / Precision - Analytical	Per the DoD QSM v 5.1
LOQ verification check standard	Verify quarterly	Recovery of each analyte within in-house laboratory established control limits.	If the LOQ fails acceptance criteria, repeat the LOQ verification. No data is generated until all criteria are met.	Analyst Lab QA Officer Project Chemist	Sensitivity	Per labs in-house established control limits.
Soil drying procedure (Incremental Samples only)	Each sample, LCS, and Method Blank.	Laboratory must have a procedure to determine when the sample is dry to constant mass. Record date, time, and ambient temperature on a daily basis while drying samples. Commercial proficiency testing (PT) samples must reflect the grinding, extraction, and analysis steps as a minimum.	NA	NA	NA	NA

Matrix		Soil/Sediment and Water				
Analytical Group		Metals				
Analytical Method/SOP Reference		EPA Method SW6020A/ ANA6020				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
		Record date, time, and ambient temperature on a daily basis while drying samples. If a laboratory utilizes a self-spiked LCS, the fortification must be performed prior to any preparation steps performed (drying, grinding, etc.) Drying should be performed in the laboratory, not the field. Commercial PT samples must reflect the grinding, extraction, and analysis steps as a minimum. LCS and Blank matrix can be Ottawa sand, clean soil, or other vendor provided clean matrix.				
Soil sieving procedure (Incremental samples only)	Each sample, LCS, and Method Blank.	Weigh entire sample. Sieve entire sample with a 10-mesh sieve. Breakup pieces of soil (especially clay) with gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless this is a project specific requirement. Collect and weigh any portion unable to pass through the sieve. As per client request, a digital photograph of all oversized munitions-related fragments will be taken from on top of the 10-mesh sieve.	NA	NA	NA	NA
Soil grinding Procedure (Incremental samples only)	Initial demonstration at start up and any time major equipment is changed or when	Grind entire sample that passes through the 10-mesh sieve in a puck mill. Initial Demonstration of the Grinding Equipment:	NA	NA	NA	NA

Matrix		Soil/Sediment and Water				
Analytical Group		Metals				
Analytical Method/SOP Reference		EPA Method SW6020A/ ANA6020				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
	a reduction in the number or time of grinding cycles occurs. Each required ISM sample, LCS (if ground), Blank and Matrix Spike sample must use the same grinding process (i.e., same time intervals and number of grinding cycles.)	The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to < 75 µm by passing representative portions of ground sample through a 200-mesh sieve (ASTM E11).				
Soil grinding blank (Incremental samples only)	The Grinding Blank must be processed: after the LCS (if ground), Or after a client identified sample with known contamination, or at the end of the batch. One per batch of ISM samples.	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (e.g., ground and subsampled) and analyzed in the same manner as a field sample. No reported analytes must be detected > ½ LOQ. Grinding blanks will be composited for analysis and one grinding blank per batch will be analyzed. For batch preparation, the Grinding Blank and the Method Blank can be one in the same. If cross-contamination is a concern, then more than one Grinding Blank per batch may be necessary.	Blank results must be reported and the affected samples must be flagged accordingly if blank criteria are not met. If required, re-prep and reanalyze Method Blank and all QC samples and field samples processed with the contaminated blank.	Analyst Lab QA Officer Project Chemist	Accuracy / Sensitivity	No reported analytes must be detected > ½ LOQ

Matrix		Soil/Sediment and Water				
Analytical Group		Metals				
Analytical Method/SOP Reference		EPA Method SW6020A/ ANA6020				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Soil subsampling Process (Incremental samples only)	Each sample, duplicate, LCS, and Method Blank.	Entire ground sample is mixed, spread out on a large flat surface (e.g., baking tray), and 30 or more randomly located increments are removed from the entire depth and breadth to obtain the appropriate subsample size.	NA	NA	NA	NA
Soil sample triplicate (Incremental samples only)	At the subsampling step, one sample per batch. Cannot be performed on any type of blank sample.	The RSD for results above the LOQ must not exceed 20%. Sample triplicates are randomly selected unless the project specifies the sample to be used.	Corrective action must be taken if this criterion is not met (e.g., the grinding process should be investigated to ensure that the samples are being reduced to a sufficiently small particle size).	Analyst Lab QA Officer Project Chemist	Accuracy / Precision	The RSD for results above the reporting limit (RL) must not exceed 20%

Table 28.2 Explosives Analysis QC/Corrective Actions – APPL, Inc.

Matrix		Soil/Sediment and Water				
Analytical Group		Explosives				
Analytical Method/SOP Reference		EPA Method SW8330B / HPL8330				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Soil drying procedure	Each sample, LCS, and Method Blank.	Laboratory must have a procedure to determine when the sample is dry to constant mass. Record date, time, and ambient temperature on a daily basis while drying samples. the entire sample must be air dried at room temperature. Commercial proficiency testing (PT) samples must reflect the grinding, extraction, and analysis steps as a minimum. Record date, time, and ambient temperature daily while drying samples. If a laboratory uses a self-spiked LCS, the fortification must be performed prior to any preparation steps performed (drying, grinding, etc.) Drying may introduce a bias and is not recommended for certain compounds. Drying should be performed in the laboratory, not the field. Commercial PT samples must reflect the grinding, extraction, and analysis steps as a minimum. LCS reference material is not required to be air dried if the vendor specifies that drying is not required.	NA	Analyst/Technician	NA	NA

Matrix		Soil/Sediment and Water				
Analytical Group		Explosives				
Analytical Method/SOP Reference		EPA Method SW8330B / HPL8330				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
		LCS and Blank matrix can be Ottawa sand, clean soil, or other vendor provided clean matrix.				
Soil sieving procedure(Incremental samples only)	Each sample, LCS, and Method Blank.	Weigh entire sample. Sieve entire sample with a 10-mesh sieve. Breakup pieces of soil (especially clay) with gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless this is a project specific requirement. Collect and weigh any portion unable to pass through the sieve. As per client request, a digital photograph of all oversized munitions-related fragments will be taken from on top of the 10-mesh sieve.	NA	Analyst/Technician	NA	NA
Soil grinding Procedure (Incremental samples only)	Initial demonstration at start up and any time major equipment is changed or when a reduction in the number or time of grinding cycles occurs. Each required ISM sample, LCS (if ground), Blank and Matrix Spike sample must use the same grinding process (i.e., same time intervals and	Grind entire sample that passes through the 10 mesh sieve in a puck mill. Initial Demonstration of the Grinding Equipment: The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to < 75 µm by passing representative portions of ground sample through a 200-mesh sieve (ASTM E11).	NA	NA	NA	NA

Matrix		Soil/Sediment and Water				
Analytical Group		Explosives				
Analytical Method/SOP Reference		EPA Method SW8330B / HPL8330				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
	number of grinding cycles.)					
Soil grinding blank (Incremental samples only)	The Grinding Blank must be processed: after the LCS (if ground), or after a client identified sample with known contamination, or at the end of the batch.	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (e.g., ground and subsampled) and analyzed in the same manner as a field sample. No reported analytes must be detected > 1/2 LOQ. Grinding blanks will be composited for analysis and one grinding blank per batch will be analyzed. For batch preparation, the Grinding Blank and the Method Blank can be one in the same. If cross-contamination is a concern, then more than one Grinding Blank per batch may be necessary.	Blank results must be reported and the affected samples must be flagged accordingly if blank criteria are not met. If required, re-prep and reanalyze Method Blank and all QC samples and field samples processed with the contaminated blank.	Analyst Lab QA Officer Project Chemist	Accuracy / Sensitivity	No reported analytes must be detected > 1/2 LOQ
Soil subsampling Process (Incremental samples only)	Each sample, duplicate, LCS, and Method Blank.	Entire ground sample is mixed, spread out on a large flat surface (e.g., baking tray), and 30 or more randomly located increments are removed from the entire depth and breadth to obtain the appropriate subsample size.	NA	Analyst/Technician	NA	NA
Soil sample triplicate (Multi Incremental samples only)	At the subsampling step, one sample per batch. Cannot be performed on any type of blank sample.	The RSD for results above the LOQ must not exceed 20%. Sample triplicates are randomly selected unless the project specifies the sample to be used.	Corrective action must be taken if this criterion is not met (e.g., the grinding process should be investigated to ensure that the samples are being reduced to a sufficiently small particle size).	Analyst Lab QA Officer Project Chemist	Accuracy / Precision	The RSD for results above the reporting limit (RL) must not exceed 20%.

Matrix		Soil/Sediment and Water				
Analytical Group		Explosives				
Analytical Method/SOP Reference		EPA Method SW8330B / HPL8330				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Solid reference material (SRM) (Incremental samples only	One per preparatory batch of Incremental Samples.	A solid reference material containing all reported analytes must be prepared (e.g., ground and subsampled) and analyzed in exactly the same manner as a field sample. Control limits are provided by the SRM manufacturer. A SRM that is used for a LCS can be ground as a single batch and subsampled repeatedly as long as the SRM is within expiration date. If a laboratory utilizes a self-spiked LCS, the fortification must be performed prior to any preparation steps performed, such as drying, grinding, and sieving.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available	Analyst Lab QA Officer/ Project Chemist	Accuracy / Precision - Analytical	QC acceptance criteria specified by SRM manufacturer
Method Blank	One per preparatory batch Grinding Blank may be used as the batch method blank.	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct problem. If required, re-prep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Analyst Lab QA Officer Project Chemist	Accuracy / Sensitivity	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.
Laboratory Control Sample (LCS)	One per preparatory batch.	A laboratory must use the QSM v5.1 Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not	Correct problem. If required, re-prep and reanalyze the LCS and all samples in the associated preparatory batch for the failed analytes, if sufficient sample material is available.	Analyst Lab QA Officer Project Chemist	Accuracy / Precision - Analytical	QC acceptance criteria specified by DoD QSM v5.1

Matrix		Soil/Sediment and Water				
Analytical Group		Explosives				
Analytical Method/SOP Reference		EPA Method SW8330B / HPL8330				
Analytical Organization		APPL Inc.				
QC Sample	Frequency & Number	Analytical/Prep Method and SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
		specified.				
Matrix spike (MS) / Matrix Spike Duplicate (MSD)	One per preparatory batch.	A laboratory must use the QSM v5.1 Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. RPD ≤ 30% (between MS and MSD or sample and MD).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Analyst Lab QA Officer Project Chemist	Precision - Analytical	QC acceptance criteria specified by DoD QSM v5.1
Surrogate Spike	All field and QC samples.	QC acceptance criteria specified by the project, if available; otherwise use QSM v5.1 Appendix C limits Or in-house LCS limits if analyte(s) are not listed.	Correct problem, then re-prep and reanalyze all failed samples for all surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Analyst Lab QA Officer Project Chemist	Accuracy / Precision - Analytical	QC acceptance criteria specified by DoD QSM v5.1
Confirmation of positive results (second column)	All positive results must be confirmed.	Calibration and QC criteria are the same for the confirmation analysis as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	Report from both columns. Apply J-flag if RPD > 40%. Discuss in the case narrative.	Analyst Lab QA Officer Project Chemist	Precision - Analytical	QC acceptance criteria specified by DoD QSM v5.1
LOQ verification check standard	Verify quarterly	Recovery of each analyte within in-house laboratory established control limits.	If the LOQ fails acceptance criteria, repeat the LOQ verification. No data is generated until all criteria are met.	Analyst Lab QA Officer Project Chemist	Sensitivity	Per labs in-house established control limits.

Table 28.3 Measurement Performance Criteria – APPL, Inc.

Analyte	CAS No.	Soil		Water	
		MS/MSD and LCS/LCSD		MS/MSD and LCS/LCSD	
		%R	RPD	%R	RPD
Metals (SW6020A)					
COPPER (CU)	7440-50-8	84-119	20	85-118	20
LEAD (PB)	7439-92-1	84-118	20	88-115	20
ZINC (ZN)	7440-66-6	82-119	20	83-119	20
Explosives (SW8330B)					
1,3,5-TRINITROBENZENE	99-35-4	80-116	20	73-125	20
1,3-DINITROBENZENE	99-65-0	73-119	20	78-120	20
2,4,6-TRINITROTOLUENE	118-96-7	71-120	20	71-123	20
2,4-DINITROTOLUENE	121-14-2	75-121	20	78-120	20
2,6-DINITROTOLUENE	606-20-2	79-117	20	77-127	20
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	71-123	20	79-120	20
2-NITROTOLUENE	88-72-2	70-124	20	70-127	20
3-NITROTOLUENE	99-08-1	67-129	20	73-125	20
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	64-127	20	76-125	20
4-NITROTOLUENE	99-99-0	71-124	20	71-127	20
HMX	2691-41-0	74-124	20	65-135	20
NITROBENZENE	98-95-3	67-129	20	65-134	20
NITROGLYCERIN	55-63-0	73-124	20	74-127	20
PETN	78-11-5	72-128	20	73-127	20
RDX	121-82-4	67-129	20	68-130	20
TETRYL	479-45-8	68-135	20	64-128	20
SURROGATE: 1,2-DINITROBENZENE (S) for Explosives	N/A	78-119	N/A	83-119	N/A

Worksheet #29: Data Management, Project Documents and Records

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)) on CD-ROM. CDs containing .pdf files will also include Adobe™ Acrobat Reader®.

29.1.2 DGM data files will be delivered in accordance with the requirements in DID HNC-003.02 Attachment C. All DGM data will be transferred via ftp site, if possible given the available internet connection. If the large size of the data files makes the process cumbersome, the data will be transferred on an external hard drive.

29.1.3 Transect data and target files will be named, QC checked, and processed according to the date collected. Grid-based data will be split or consolidated into individual grids for storage and target selection, although initial QC checks for all data, with the exception of coverage, will be performed by date. All pertinent target and modeling information will be exported from the daily results databases for consolidation in an Access database. Daily QC files (i.e. IVS, static and function checks) 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. Parsons Geophysicists will use the latest version of Oasis Montaj and UX-Analyze for processing and interpreting MM and EM61-MK2 data.

29.1.4 A project-specific GIS will be used to store and manage all relevant geospatial-related data and information. All geospatial data will conform to the Federal Geographic Data Committee Geospatial Positioning Accuracy Standards, Part 2: National Standard for Spatial Data Accuracy and to Part 4: Standards for Architecture, Engineering, and Construction, and Facility Management. Each GIS data set will be accompanied by metadata conforming to the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata and provided in a database that complies with the Spatial Data Standards for Facilities, Infrastructure, and Environment. The final GIS submittal will contain all required ArcGIS.mxd files and layout files for all drawings contained in the final report.

29.1.5 Land surveys will meet or exceed the Third Order, Class II specification. Horizontal GPS data will be repeatable to within 3cm. In addition, the location, identification, coordinates, and elevations of all established control points will be plotted on one or more site maps. Each control point will be identified on the map by its name and number and the final adjusted coordinates.

29.1.6 Environmental System Research Institute, Inc. (ESRI)–compliant formats (shapefiles, coverages, or geodatabases) will be used to present GIS data, with supporting tabular data provided in Microsoft Excel, Microsoft Access, or both, as needed.

29.1.7 The below table lists the data quality-related documentation prepared to support the RI/FS.

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
Site Manager Logbook	Record all important events	Parsons SM	Daily	Hard Copy /Onsite during fieldwork, then Project File/Parsons-Peachtree Corners Office	Available to USACE on request
QC Seed Plan	Describes intended seed types and locations for QC seeds to be placed	Parsons QC Geophysicist	Once, prior to seeding	.DOCX/Onsite during seeding and in secure folder on Parsons network (limited to QC personnel)/Parsons-Denver Office	Via e-mail and with Final RI/FS QAPP
Validation Seed Plan	Describes intended seed types and locations for validation seeds to be placed	USACE Geophysicist	Once, prior to seeding	.DOCX or .XLSX/Onsite during seeding (limited to Seed Team Lead)/USACE Office	Via e-mail
QC/Validation Seed Firewall Plan	Describes methods used to limit QC seed information to Parsons QC personnel and validation seed information to only seed team and USACE Geophysicist	Parsons QC Geophysicist	Once, prior to seeding	.DOCX/Project File/Parsons-Peachtree Corners Office	Via e-mail and with Final RI/FS QAPP
Validation and Verification Plan	Describes how many validation and verification digs will be investigated and how they will be selected.	Parsons Project Geophysicist	Once at project startup/ Revised as necessary	.DOCX/Project File/Parsons-Peachtree Corners Office	Via e-mail and with Final RI/FS QAPP
Daily Status Reports	Report notable events to project team	Parsons SUXOS	Daily	.DOCX/Project File/Parsons-Peachtree Corners Office	Via e-mail, and included with RI Reports
Daily QC Report	Report QC events to project team	Parsons UXOQCS	Daily, when QC events occur	.DOCX or .PDF/Onsite during fieldwork, then Project File/ Parsons-Peachtree Corners Office	Via e-mail, and included with RI Reports
Weekly Geophysical QC Report	Report of DGM QC results	Parsons Project and QC Geophysicists	Weekly	.DOCX/Project File/ Parsons-Peachtree Corners Office	Via e-mail
Team Leader Logbook(s)	Record important team-specific events	Contractor Team Leader(s)	Daily	Hard Copy/Onsite during fieldwork, then Project File/ Parsons-Peachtree Corners Office	Available on request
Analog Data Deliverable	Document the completion of analog investigations	Parsons Intrusive Team	Weekly during analog operations.	.DOCX/Project File/ Parsons-Peachtree Corners Office	Via e-mail or project file sharing site
Land Survey Control Pont Report	To document the site survey of the control monuments, grid corners, and validation seeds.	Professional Land Surveyor	Once, following completion of seeding	XLSX/Validation seed locations are stored in secure folder	Via Email
VSP Analysis	Document the completion of DGM and analog transect investigations	Parsons/USAE/Alpine	Once, following completion of transects	DOCX/Project File/ Parsons-Peachtree Corners Office	Via e-mail or project file sharing site

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
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*)	Parsons SUXOS	As needed	.DOCX or .PDF/Project File/ Parsons-Peachtree Corners Office	Via e-mail, and included with RI Reports
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	Parsons UXOQCS	If MPC failures are noted	.DOCX or .PDF/Project File/ Parsons-Peachtree Corners Office	Via e-mail, and included with RI Reports
Photograph Log	Documents all photographs taken and video recorded to document work and/or site conditions, and to record MPPEH/MEC items recovered	Parsons Site Manager and SUXOS	As needed	.JPG/Onsite during fieldwork, then Project File/ Parsons-Peachtree Corners Office	Available on request
Production Area QC Seeding Report	Documents seed types, depths, locations, and orientations	Parsons Seed Team Lead	Once, following completion of seeding	.DOCX and .XLSX or .ACCDB/ QC seed information stored in secure folder on Parsons's network (limited to QC personnel)/ Parsons-Peachtree Corners Office	Data via email
IVS Technical Memoranda	Documents the results of the initial IVS tests	Parsons Project Geophysicist	Following initial IVS test	.DOCX/Project File/ Parsons-Peachtree Corners Office	Via e-mail, and included with RI Reports
Transect/ Grid Status Sheet	Record the completion status of all transects/grids	Parsons UXOQCS	Daily	.DOCX or .ACCDB/Onsite during fieldwork, then Project File/Parsons-Peachtree Corners Office	Available on request
SOP Checklists	Document completion of geophysical SOPs	Parsons Field Geophysicist	As required by SOP	.DOCX or .PDF/Onsite during fieldwork, then Project File/ Parsons-Peachtree Corners Office	Via e-mail with Daily/Weekly QC Reports
Seed Tracking Log	Document seed placement and record recovery	Parsons UXOQCS	During seed burial; as seeds are detected/recovered	.Geosoft database or .XLSX /QC Geophysicist's PC/ Parsons-Peachtree Corners Office	Available on request

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
DUA	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, once after acceptance of final ranked dig list for each survey unit, and once after intrusive investigation	.DOCX/Project File/ Parsons-Peachtree Corners Office	Via e-mail, included with Site-specific Final Report
Target Selection Technical Memorandum	Describe the process to be used to select targets in the MM 2X2 and EM61-MK2 detection data	Parsons Project Geophysicist	Once, 5 days after the start of detection data collection	.DOCX/Project File/ Parsons-Peachtree Corners Office	Via e-mail, included with Site-specific Final Report
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, classification and training digs; before intrusive investigation of DGM anomalies	.GDB and .ACCDB/Onsite during fieldwork, and Project File/ Geophysical Database/ Parsons-Peachtree Corners Office	Via ftp site during project; included with Site-specific Final Report
Reacquisition Results	Record location of reacquired DGM anomalies	Contractor Reacquisition Team Leader(s)	During reacquisition of DGM anomalies	.ACCDB/Onsite during fieldwork, and Project File/ Geophysical Database/ Parsons-Peachtree Corners Office	Via ftp site during project; included with Site-specific Final Report
Intrusive Investigation Results	Record results of intrusive investigation, including DGM anomaly source description, characteristics, and coordinates	Contractor Intrusive Team Leader(s)	During intrusive investigation of DGM anomalies	Hard Copy/Onsite during fieldwork, and Project File/ Geophysical Database/ Parsons-Peachtree Corners Office	PDF and data included with Site-specific Final Report
Analog Removal Records	Document the completion of analog removal (surface or subsurface) and record the results of the removal.	Contractor Intrusive Team Leader(s)	At least daily during analog removal activities	.ACCDB/Onsite during fieldwork/Parsons-Austin Office	Via ftp site during project;
Anomaly Resolution Results	Record results of anomaly resolution QC checks	Parsons Field Team Leader	During intrusive investigation of DGM anomalies	.ACCDB/Onsite during fieldwork, and Project File/Parsons-Peachtree Corners Office	Via ftp site during project; included with RI Report
Site-specific Munitions Library (Version 1)	Library of expected MEC polarizability curves for classification	Parsons Project Geophysicist	Prior to starting cued data collection/update as needed as described in SOP AC-12	.GDB/Onsite during fieldwork/Parsons-Peachtree Corners Office	Via ftp site during project; included with DGM Cued Data Deliverable

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
Background Location Report	Summarizes results of initial background data collection	Parsons Project Geophysicist	After initial background data collection/updated as necessary	.DOCX/ Onsite during fieldwork/ Parsons-Peachtree Corners Office	Via email
DGM Data Deliverable	Document the results of geophysical surveys	Parsons Project Geophysicist	Weekly during DGM data collection	.BIN, .STN, .P61, .M61, .TEM, or .CSV (raw data); .GDB and .MAP (processed data)/Captured digitally on LAN server, Project File/Parsons-Peachtree Corners Office	Via ftp site (DGM data) or external hard drive during project; included with RI Reports
DGM QC Deliverable	Documents QC metrics for geophysical surveys	Parsons Project Geophysicist	At least weekly during DGM collection	.ACCDB/Captured digitally on LAN server, Project File/Parsons-Peachtree Corners Office	Via ftp site during project; included with RI reports; available on request
Supporting Classification Images	Summarize modeling and library match information for each cued target	Parsons Project Geophysicist	After cued data processing	.PNG/ Captured digitally on LAN server, Project File/Parsons-Peachtree Corners Office	Via ftp site (DGM data) or external hard drive during project; included with RI reports
Analysis Verification Report	Documents the comparison between intrusive investigation results and AC predictions	Parsons Project Geophysicist	After completion of verification digs	.DOCX/ Onsite during fieldwork/ Parsons-Peachtree Corners Office	Via email
Classification Report	Documents the decision logic for dig/no-dig decisions.	Parsons Project Geophysicist	After cued data processing	.DOCX/ Onsite during fieldwork/ Parsons-Peachtree Corners Office	Via email
Validation Report	Documents the comparison between intrusive results for TOI and AC predictions	Parsons Project Geophysicist	After completion of intrusive investigation	.DOCX/ Onsite during fieldwork/ Parsons-Peachtree Corners Office	Via email
DD Form 1348-1A	Certify MPPEH as MDAS; maintain CoC for MDAS	Parsons SUXOS	As required for batches of MPPEH	.PDF/Onsite during fieldwork, and Project File/Parsons-Peachtree Corners Office	Included with RI Report
Demolition Summary Sheet	To document the item(s) destroyed	Parsons SUXOS	Each demolition operation	Hardcopy/Onsite during fieldwork, and Project File/Parsons-Peachtree Corners Office	Included with RI Report
MDAS disposal documentation	To certify that MDAS has been disposed of in accordance with project requirements	Disposal Contractor	After each shipment of MDAS off site	.PDF/Project File/Parsons-Peachtree Corners Office	Included with RI Report
Explosives Usage Record	To record quantities of explosives used	Contractor DTL/ Parsons UXOQCS	Each demolition operation	Hardcopy/Onsite during fieldwork, and Project File/Parsons-Peachtree Corners Office	Included with RI Report

Document/Record	Purpose	Primary Generator (1)	Completion/ Update Frequency	Format/Storage Location/Archival	Delivery/Availability
Demolition Shot Record	To document the item(s) destroyed and the explosives used during demolition shots	DTL	Each demolition operation	Hardcopy/Onsite during fieldwork, and Project File/Parsons-Peachtree Corners Office	Included with RI Report

(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

Table 29.2 Project Sample Collection and Field Records

Record	Generation	Verification	Storage location/archival
Field logbook or data collection sheets	Field Task Lead, Parsons	Field Team Member, Parsons	Project File/Parsons-Peachtree Corners Office
Chain-of-Custody Forms	Sampler, Parsons	Field Team Lead, Parsons	Project File/Parsons-Peachtree Corners Office
Air Bills	Sampler, Parsons	Field Team Lead, Parsons	Project File/Parsons-Peachtree Corners Office
Contractor Daily QC Reports	Field Task Lead, Parsons	Field Team Member, Parsons	Project File/Parsons-Peachtree Corners Office
Deviations	Field Task Lead, Parsons	Field Team Member, Parsons	Project File/Parsons-Peachtree Corners Office
Corrective Action Reports	Field Task Lead, Parsons	Field Team Member, Parsons	Project File/Parsons-Peachtree Corners Office
Correspondence	Various Project Team Members	Various Project Team Members	Project File/Parsons-Peachtree Corners Office

Table 29.3 Project Assessments

Record	Generation	Verification	Storage location/archival
Data Validation Report	Data Validator, Parsons	Project Chemist, Parsons	Project File/Parsons-Peachtree Corners Office
DUA Report	Data Validator, Parsons	Project Chemist, Parsons	Project File/Parsons-Peachtree Corners Office

Table 29.4 Laboratory Records (APPL, Inc. Laboratories)

Record	Generation	Verification	Storage location/archival
Sample Log-in	Sample Receiving	PM	LIMS
Instrument Print-Out and Raw Data	Organic and Metals departments	Analyst and Section supervisor(s)	LIMS
Review Checklists (Analyst)	Organic and Metals departments	Analyst and Section supervisor(s)	LIMS
PM Review Checklists	Report generation department	PM and/or QA officer	LIMS

Worksheet #31, 32, & 33: Assessments and Corrective Action

31.1 PLANNED PROJECT ASSESSMENTS

This table provides information on the required periodic assessments that will be performed during the course of the project to ensure the planned project activities are implemented in accordance with 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	Parsons	Parsons Sector Manager and Program Manager	Parsons PM	Parsons PM	Parsons Program Manager
Project Review	Quarterly	Internal	Parsons	Parsons Sector Manager and Program Manager	Parsons PM	Parsons PM	Parsons Program Manager
Health and Safety Assessment	Once during field activities	Internal	Parsons	Contractor Project H&S Manager, or designee	UXOSO	UXOSO	Parsons Project H&S Manager and UXOSO
Site Preparation Assessment	Following completion of transect survey and grid placement	Internal	Parsons	Parsons Project Geophysicist (transect or grid locations) and Site Geophysicist (adequacy of brush clearing)	Parsons SUXOS	Parsons SUXOS	Parsons Site Geophysicist
Seeding Assessment	Following completion of seeding	Both	Parsons/ USACE	Parsons QC Geophysicist and USACE Geophysicist	Parsons Seed Team Lead	Parsons Seed Team Lead	Parsons QC Geophysicist and USACE Geophysicist
DGM Data Deliverable Assessment (RI data)	Weekly	Internal	Parsons	Parsons Project Geophysicist (RI data)	Parsons Site Geophysicist (RI data)	Parsons Site Geophysicist (RI data)	Parsons Project Geophysicist (RI data)
Classification Assessment	Once prior to submittal of ranked dig list(s)	Internal	Parsons	Parsons QC Geophysicist	Parsons Project Geophysicist	Parsons Project Geophysicist	Parsons QC Geophysicist
Anomaly Resolution Assessment	Per lot	Internal	Parsons	Parsons UXOQCS	Parsons SUXOS	Parsons SUXOS	Parsons UXOQCS

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Per forming 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 Correc tive Actions
Intrusive Results Assessment	Weekly	Internal	Parsons	Parsons UXOQCS or Project Geo-physicist	Parsons SUXOS	Parsons SUXOS	Parsons QC or Project Ge-ophysicist
MPPEH/Explosives Records Assess-ment	Once prior to demo-bilization	Internal	Parsons	Parsons UXOQCS	Parsons SUXOS	Parsons SUXOS	Parsons UXOQCS
Review Geospatial Data	For each GIS data submittal	External (see [QASP])	Parsons	Applicable USACE PDT Members	Parsons PM and GIS Manager	Parsons GIS Man-ager	Parsons PM
RI/FS Field Activities	See QASP	External (see QASP)	USACE	Applicable USACE PDT Members	Parsons PM and relevant person-nel	Parsons SUXOS and other relevant per-sonnel	Parsons UXOQCS and Contractor QC Geophysi-cist
Geophysical Surveys	See QASP	External (see QASP)	USACE	USACE Project Geophysicist	Parsons PM and Project Geophysi-cist	Parsons Project Geophysicist	Parsons QC Geophysicist
Sampling and Analysis	See QASP	External (see QASP)	USACE	USACE Project Chemist	Parsons PM and Project Chemist	Parsons Project Chemist and Sam-pling Lead	Parsons Project Chemist and Sampling Lead
Review RI Report	For each submittal	External (see QASP)	USACE	Applicable USACE PDT Members	Parsons PM	Parsons PM and relevant personnel	Parsons PM

31.2 ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES

Based on the findings of project assessments, 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	Parsons PM	3-5 business days	Internal e-mail	Parsons Sector Manager and Program Manager	3–5 business days
Project Review	Internal e-mail	Parsons M	3-5 business days	Internal e-mail	Parsons Sector Manager and Program Manager	3–5 business days
Health and Safety Assessment	Written assessment report	Parsons SUXOS/ Team Leaders/UXOSO	3-5 business days	Letter or memo	Parsons PM and H&S Manager	24 hours after notification
QAPP Compliance and MEC Operations Assessment	Written assessment report	Parsons PM, SUXOS, and UXOQCS	3-5 business days	Letter or memo	Parsons PM	3–5 business days
Site Preparation Assessment	Internal e-mail	Parsons Site Manager	1-3 business days	Internal e-mail	Parsons Site Geophysicist and Project Geophysicist	24 hours after notification
Seeding Assessment	E-mail, SOP checklist(s) noting deficiency	Parsons Seed Team Lead	24 hours	E-mail and/or RCA	Parsons QC Geophysicist and USACE Geophysicist	24 hours after notification
DGM Data Deliverable Assessment (RI)	Internal e-mail, SOP checklist(s) noting deficiency	Parsons Site Geophysicist (RI data)	1-5 business days	Internal e-mail and/or RCA	Parsons Project and QC Geophysicists (RI data)	24 hours after notification
Classification Assessment	Internal e-mail	Parsons Project Geophysicist	1-2 business days	Internal e-mail and/or RCA	Parsons QC Geophysicist	1-2 business days
Anomaly Resolution Assessment	Internal e-mail	Parsons SUXOS	24 hours	Internal e-mail and/or RCA	UXOQCS	24 hours
Intrusive Results Assessment	Internal e-mail	Parsons SUXOS	1-5 business days	Internal e-mail and/or RCA	Parsons UXOQCS or Project Geophysicist	1-2 business days
MPPEH/Explosive Records Assessment	Internal e-mail	Parsons SUXOS	24 hours	Internal e-mail	Contractor UXOQCS	24 hours
Review Geospatial Data	Electronic Submittal QA Form, Geospatial QA Form	Parsons PM and GIS Manager	14 calendar days	E-mail or appropriate QA Form with responses	Lead Organization and Design Center PMs	10 business days

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
RI/FS Field Activities	Corrective Action Requests, Geophysical QA Forms, QAR, HNC-948, Memorandum for Record	Parsons 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	Parsons PM and 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
Sampling and Analysis	Chemistry QA Forms	Parsons PM and Project Chemist	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 Chemist	1-2 business days
Review RI Report	CEHNC Form 7, KO Transmittal Memo	Parsons PM	14 calendar days	CEHNC Form 7 with completed responses	Lead Organization and Design Center PMs	10 business days

31.3 QUALITY ASSURANCE MANAGEMENT REPORTS

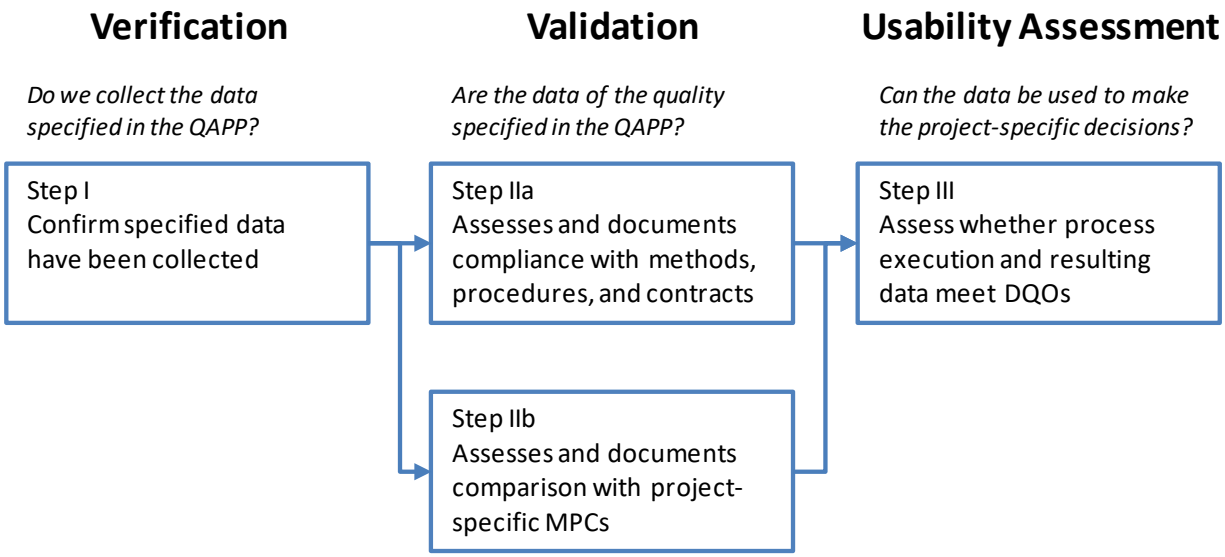
In order to demonstrate that DQOs have been achieved, periodic QA management reports will be prepared to ensure that the project stakeholders are updated on project status and the results of all QA assessments. The frequency and type of planned QA management reports, the delivery date, the personnel responsible for report preparation, and the report recipients are identified below.

Type of Report	Frequency	Projected Delivery Date(s)	Primary Person(s) Responsible for Report Preparation	Report Recipient(s)
IVS Technical Memorandum	Following completion of IVS data collection	7 days	Project Geophysicist	USACE
DGM Microsoft Access QC Database	Weekly	Records complete for delivered data Friday following completion	Project Geophysicist	USACE Geophysicist
MEC Data Usability Report (see Worksheet #37)	Once after all data are generated and validated	14 days	SUXOS, and Project Geophysicist	Contractor Project Manager
MC Data Validation Report (see Worksheet #36)	Once after all data are generated and validated	14 days	Contractor Project Chemist	Contractor Project Manager
MC Data Usability Report (see Worksheet #37)	Once after all data are generated and validated	14 days	Contractor Project Chemist	Contractor Project Manager
RI Report	Once after all data are generated and validated	See Project Schedule (Appendix I)	Contractor Project Manager	USACE and other recipients specified in the performance work statement

Worksheet #34: Data Verification & Validation Inputs

This worksheet lists the inputs that will be used during data verification, validation, and usability assessment. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in data or sample collection and analysis 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 (Worksheets #12 and #22). The procedures for data verification and validation are described on WS #35 and WS #36, respectively. The data usability assessment (DUA) is an evaluation of the data set making up a delivery unit, to determine whether the data support their intended uses. It is an evaluation of conformance to the MPCs presented in Worksheet #12. The data verification, validation, and usability assessment process is summarized in **Figure 34.1**.

Figure 34.1 Data Verification, Validation, and Usability Assessment Process



34.1 VERIFICATION AND VALIDATION INPUTS FOR MEC-RELATED TASKS

Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
Field Records			
SUXOS Logbook	X		Uses output from previous steps
Daily Status Reports	X		
Daily QC Report	X	X	
Weekly Geophysical QC Report	X	X	
Team Leader Logbook(s)	X		
Field Change Request Form	X		
Root Cause Analysis/NCRs	X		
Photograph Log	X		
Transect/Grid Status Sheet	X		
AC Sensor Assembly Checklist	X		
Seed Tracking Log *(firewalled)*	X	X	
Site-specific TOI Library	X	X	
DGM QC Deliverable (1)	X	X	
DGM Data Deliverable (2)	X	X	
Supporting Classification Images	X		
Reacquisition Results	X	X	
Intrusive Investigation Results	X	X	
Anomaly Resolution Results	X	X	
DD Form 1348-1A	X	X	
Demolition Summary Sheet	X	X	
MDAS disposal documentation	X	X	
Explosives Usage Record	X	X	
Magazine Data Card	X	X	
Demolition Shot Record	X	X	
Analog Data Deliverable	X	X	
Surface Sweep Technical Memo	X	X	
Interim and Final Reports/Deliverables			
Production Area QC Seeding Report *(firewalled)*	X	X	Uses output from previous steps
IVS Technical Memoranda	X		
Target Selection Technical Memorandum	X		
DUA for Dynamic Data	X		
Background Location Report	X	X	
Final Ranked Dig List	X	X	
DUA for Cued Data	X		
Analysis Verification Report	X	X	
Validation Report	X	X	

(1) DGM QC deliverable includes an Access database used to track IVS, Function Test and other MQO results.
(2) DGM data deliverable includes raw and processed data files; target files; Access database used to track processing, site-specific munitions library.

34.2 VERIFICATION AND VALIDATION INPUTS FOR MC-RELATED TASKS

Item	Description	Verification (completeness)	Validation (conformance to specifications)
	Planning Documents/Records		
1	Approved QAPP	X	
2	Contract	X	
3	Field SOPs	X	
4	Laboratory SOPs	X	
	Field Records		
5	Field logbooks	X	
6	Equipment calibration records	X	
7	Chain-of-Custody Forms	X	X
8	Relevant Correspondence	X	X
9	Change orders/deviations, when applicable	X	
10	Field corrective action reports, when applicable	X	
	Analytical Data Package		
12	Cover sheet (laboratory identifying information)	X	
13	Case narrative	X	X
14	Internal laboratory chain-of-custody	X	
15	Sample receipt records	X	X
16	Sample chronology (i.e. dates and times of receipt, preparation, & analysis)	X	X
17	Communication records	X	
18	DL/LOD/LOQ establishment and verification	X	X
19	Standards Traceability	X	X
20	Instrument calibration records	X	X
21	Definition of laboratory qualifiers	X	
22	Results reporting forms	X	X
23	QC sample results	X	X
24	Corrective action reports, when applicable	X	X
25	Raw data including manual integrations when applicable*	X	X
26	Electronic data deliverable**	X	X

* When manual integrations are performed, raw data records shall include a complete audit trail for those manipulations (i.e., the chromatograms obtained before and after the manual integration must be retained). This requirement applies to all analytical runs including calibration standards and QC samples. The person performing the manual integration must sign and date each manually integrated chromatogram and record the rationale for performing the manual integration.

** Compliant with USACE ADR-SEDD data and FUDSCHEM per HNC-005.02. The laboratory shall load the SEDD into the FUDSChem database, check it for compliance to the electronic UFP-QAPP ((eQAPP), and notify the contractor of SEDD certification by the FUDSChem database administrator. In addition, a separate SEDD 2A EDD shall be submitted to the contractor via email. Data in the electronic copy must agree completely with the data in the hard copy report.

Worksheet #35: Data Verification and Validation Procedures for MEC and MC 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. "Validation" is performed to identify and qualify data that do not meet the MQOs specified on WS #22A. Data requiring verification and validation are summarized on WS #34A. The information in these tables shows what data inputs are required for data verification and validation as well as the processes used to conduct the verification and validation.

35.1 VERIFICATION PROCEDURES FOR MEC-RELATED TASKS

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	Site Manager Logbook
			Site Manager	Daily Status Reports
			SUXOS	Team Leader Logbook(s)
			Site Manager	Field Change Request Form
			UXOQCS/Parsons Project Geophysicist	Root Cause Analysis
			UXOQCS	Photograph 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 Sweep 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) / Parsons QC Geophysicist (validation)	Weekly Geophysical QC Report Final Data Archive (for each delivered survey unit)
			USACE QA Geophysicist	DGM QA Form (Data Submittal)
DFW 3; DFW 4; DFW 8	QAPP; SOP DGM-01; SOP	Verification; confirm documentation is complete, including dates and applicable signatures.	Parsons Project Geophysicist	IVS Technical Memorandum, AC Sensor Assembly Checklist

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
(Seeding Land)	AC-01; SOP AC-02	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.	USACE QA Geophysicist	Written acceptance of 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.	QC Geophysicist	Production Area QC Seeding Report QC Seed Tracking Log
			Seed Team Lead	Production Area Seeding QC Checklist
			USACE QA Geophysicist	Written acceptance of Production Area QC Seeding Report
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	QC Database
DFW 6: Process Dynamic DGM Data	QAPP; SOP DGM-04 SOP AC-05	Verification; confirm documentation is complete weekly, at minimum. Validation; MQOs have been achieved, with any exceptions noted. If appropriate, corrective actions have been completed.	Parsons Project Geophysicist	DGM Data Deliverable DGM QC Deliverable
		Verification only; confirm each week that report includes list of RCA/NCRs and FCRs and their approval statuses weekly, at minimum	Parsons Project Geophysicist	Weekly Geophysical QC Report
		Verification; confirm records complete weekly, at minimum. Validation; MQOs have been achieved for seed detection, with exceptions noted. RCA/NCRs and corrective actions have been completed, if appropriate.	QC Geophysicist	Seed Tracking Log
		Verification only; confirm document is complete and approved and includes determination of the source selection method.	Parsons Project Geophysicist	Target Selection Technical Memorandum
			USACE QA Geophysicist	Written acceptance of Target Selection Technical Memorandum
		Verification only; confirm document is complete and fully documents dynamic data usability upon completion of dynamic data processing.	Parsons Project Geophysicist	DUA for Dynamic Data
			USACE QA Geophysicist	Written acceptance of Dynamic DUA
		Verification; confirm submittal is on time, complete, and fully documents dynamic data usability	USACE QA Geophysicist	DGM QA Form (Data Submittal)

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
		Validation; confirm MQOs have been achieved, particularly regarding QC and QA seed detection, with any exceptions noted; RCAs/NCRs and corrective actions have been completed, if appropriate		
DFW 9: Collect Cued Data in Grids	QAPP; SOP AC-07; SOP AC-06	Verification; confirm documentation is complete weekly, at minimum Validation; MQOs have been achieved for data collection, with exceptions noted. RCA/NCRs and corrective actions have been completed, if appropriate.	Parsons Project Geophysicist	DGM Data Deliverable DGM QC Deliverable RCA/NCRs
		Verification; confirm records are complete and include discussion of background threshold and background locations to be used during cued data collection. *Validation*; MQOs have been achieved for background data collection, with exceptions noted. RCA/NCRs and corrective actions have been completed, if appropriate.	Parsons Project Geophysicist	Background Location Report
		Verification only; confirm each week that report includes QC test results summary, list of RCA/NCRs and FCRs and their approval statuses, and the QC verification log	Parsons Project Geophysicist	Weekly Geophysical QC Report
DFW 9: Process Cued Data	QAPP; SOP AC-08; SOP AC-27	Verification; confirm documentation is complete weekly, at minimum. Validation; MQOs have been achieved for data processing, with exceptions noted. RCA/NCRs and corrective actions have been completed, if appropriate.	Parsons Project Geophysicist	DGM Data Deliverable DGM QC Deliverable Supporting Classification Images RCA/NCRs
DFW 10: Classify Anomalies	QAPP; SOP AC-08; SOP AC-27	*Verification only*; confirm site-specific TOI Library meets MQOs prior to classification.	Parsons Project Geophysicist	Site-specific TOI Library
			USACE QA Geophysicist	Written acceptance of site-specific TOI library
		Verification only; confirm documentation is complete and documents anomaly characteristics and coordinates for each cued anomaly.	Parsons Project Geophysicist	Final Ranked Dig List
		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.	QC Geophysicist	QC Seed Tracking Log
		Verification; confirm submittal is on time, complete, and fully documents dynamic data usability Validation; confirm MQOs have been achieved, particularly regarding QC and QA seed detection, with any exceptions	USACE QA Geophysicist	DGM QA Form (Data Submittal)

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
		noted; RCAs/NCRs and corrective actions have been completed, if appropriate		
DFW 12: Validate Cued Survey and Classification	QAPP	*Verification only*: confirm document is complete and fully documents cued data usability upon completion of cued data processing.	Parsons Project Geophysicist	DUA for Cued Data
			USACE QA Geophysicist	Written acceptance of Cued DUA
DFW 12: Validate Cued Survey and Classification	QAPP; SOP MEC-04; SOP MEC-05	Verification; Confirm that reacquisition and resolution results are on file	QC Geophysicist	Reacquisition and Resolution Results
		Validation; Ensure data are complete and adequately describe the reacquisition and resolution results	USACE QA Geophysicist	DGM QA Form (Anomaly Resolution)
DFW 13: Excavate Buried Objects	QAPP; SOP AC-09; SOP AC-10; SOP MEC-04; MEC SOP-05	Verification; Confirm that Intrusive Results are on file listing items recovered from all investigated anomalies	UXOQCS	Intrusive Results
		Validation; Ensure dig sheet data are complete and adequately describe the 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	USACE QA Geophysicist	DGM QA Form (Anomaly Resolution)
		Verification; confirm records are complete and fully document the comparison between intrusive results and predicted object characteristics. *Validation*; MQOs have been achieved for classification, with mismatches noted and explained. RCA/NCRs and corrective actions have been completed, if appropriate.	Parsons Project Geophysicist	Analysis Verification Report
			USACE QA Geophysicist	Written acceptance of Analysis Verification Report DGM QA Form (Anomaly Resolution)
		Verification: confirm records are complete and fully document the comparison between intrusive investigation results for non-TOI and the rationale for classifying as non-TOI. *Validation*: MQOs have been achieved for classification, with mismatches noted and explained. RCA/NCRs and corrective actions have been completed, if appropriate	Parsons Project Geophysicist	Validation Report
			USACE QA Geophysicist	Written acceptance of Validation Report DGM QA Form (Anomaly Resolution)
		Verification only: confirm document is complete and fully documents data usability upon completion of field work.	Parsons Project Manager	Final DUA
			USACE QA Geophysicist	Written acceptance of Final DUA

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
Explosives Storage and Transport	Explosives Management Plan (Appendix D); SOP MEC-02	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
		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 Explosives Usage Record 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	Explosives Usage Record
Demolition Operations	SOP MEC-01	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	SOP MEC-02	Verification; Verify that MDAS Disposal Documentation has been received and is 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 in accordance with project requirements	SUXOS	MDAS disposal documentation

35.2 VERIFICATION PROCEDURES FOR MC-RELATED TASKS

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field logbook	UFP-QAPP, WP, SOPs	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample IDs are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field measurement was performed and results are documented.	Daily – Parsons Field Team Lead At conclusion of field activities – Parsons Project Manager
Chain-of-custody forms	UFP-QAPP, WP, SOPs	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Daily – Parsons sampler At conclusion of field activities – Parsons Project Chemist
Laboratory Deliverable	UFP-QAPP, WP, SOPs	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the CoCs to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Before release – Lab Project Manager, APPL, Inc. Upon receipt – Parsons data validator
Electronic Deliverables	UFP-QAPP, WP, SOPs	Verify all electronic data deliverables are submitted in SEDD version 2A, checked with ADR.net software and that data completely matches the hardcopy laboratory results.	Parsons Project Chemist
Corrective Action Reports	UFP-QAPP, WP, SOPs	For any non-compliance noted, verify that corrective action was implemented according to plan.	Parsons Project Chemist

Worksheet #36: Geophysical Classification Process Validation

"Validation" is performed to identify and qualify data that do not meet the MPCs specified on Worksheet #12. Data requiring validation are summarized on Worksheet #34. The information in these tables shows what data inputs are required for data validation as well as the processes used to conduct the validation.

36.1 VALIDATION PROCEDURES FOR MEC-RELATED TASKS

Validation Input	Description of Validation Process	Responsible for Validation
Daily QC Report	Ensure the results of all relevant MPCs are attained and correctly documented in the deliverable	Contractor QC Geophysicist
Weekly Geophysical QC Report	Ensure the results of all relevant MPCs are attained and correctly documented in the deliverable	Contractor QC Geophysicist
SOP Checklists	Ensure the correct procedures have been followed in accordance with defined SOPs	Contractor Project Geophysicist
Seed Tracking Log	Ensure all seeds are listed on tracking log and that the complete listing of all seeds recovered confirms the relevant MPCs have been achieved	Contractor QC Geophysicist and UXOQCS
Dig Sheets	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, post dig response, and disposition 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
DGM Transect Data	Ensure the transect data collected is sufficient to detect a 250-ft radius HD area with 90% confidence using the Post-Survey Probability of Traversal module in VSP.	Contractor QC Geophysicist
DGM LD Area Grid Data	Ensure that the amount of data collected agrees with VSP requirements based on proposed LD area size and that no MEC were recovered during intrusive investigations in these grids.	Contractor QC Geophysicist
DGM Data Deliverable	Ensure the results of all relevant MPCs are attained and correctly documented in the deliverable	Contractor Project Geophysicist and QC Geophysicist
DD Form 1348-1A	Ensure all MDAS handled and transported off site is accounted for and that the CoC for those transfers is correctly documented	SUXOS and UXOQCS
Demolition Summary Sheet	Ensure all MEC/MPPEH destroyed by demolition and all demolition events are listed	SUXOS
MDAS disposal documentation	Ensure disposal documents account for all shipments of MDAS transported off site and they certify the disposal of the material in accordance with project requirements	Contractor Project Manager
Explosives Usage Record	Ensure the record of each demolition event agrees with the related Magazine Data Card entries	UXOQCS
Magazine Data Cards	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 and UXOQCS
Demolition Shot Record	Ensure the record of each demolition event agrees with the related dig sheet or Magazine Data Card entries	SUXOS and UXOQCS

36.2 VALIDATION PROCESS FOR MC-RELATED TASKS

Table 36.1 Overview of Analytical Data Validation for All Analytes

Data Validator	Contractor Project Chemist and designee(s)
Analytical Group/Method:	All Chemical Analyses
Data deliverable requirements:	Level IV data packages and EDDs
Analytical specifications:	Per UFP-QAPP and DoD QSM version 5.1
Measurement performance criteria:	Per UFP-QAPP
Percent of data packages to be validated:	100%
Percent of raw data reviewed:	100%
Percent of results to be recalculated:	10%
Validation procedure:	Per UFP-QAPP, National Functional Guidelines, current revisions for organic and inorganic methods, and DoD QSM version 5.1
Data validation codes:	See table below
Electronic validation program/version:	SEDD version 2a/checked with ADR.net/FUDSCHEM Validation Tool (1)

(1) The laboratory shall load the SEDD into the FUDSChem database, check it for compliance to the electronic UFP-QAPP (eQAPP), and notify the contractor of SEDD certification by the FUDSChem database administrator. In addition, a separate SEDD 2A EDD shall be submitted to the contractor via email.

Table 36.2 Data Validation Codes and Definitions

Data Validation Codes	Definitions
U	Analyte was not detected and is reported as less than the Limit of Detection (LOD). The LOD has been adjusted for any dilution or concentration of the sample.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result was an estimated quantity, but the result may be biases high.
J-	The result was an estimated quantity, but the result may be biased low.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
R	The sample results (including non-detects) are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Note: Analytical laboratories will report all concentrations down to the Detection Limit (DL) and flag any results between the DL and LOQ with "J". All non-detected will be reported as <LOD, per DoD QSM version 5.1.

Worksheet #37: Data Usability Assessment

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 Worksheet #11). All types of data (e.g., DGM, intrusive, sampling, analytical, 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.

37.1 SUMMARY OF USABILITY ASSESSMENT PROCESS FOR MEC

37.1.1 MEC-related 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. The project-specific DQOs (WS #11A), MPCs (WS #12A), and MQOs (WS #22A) for MEC-related tasks define the various standards project data must achieve to ultimately be considered usable.

37.1.2 DUAs will be completed at three stages during the project: (1) after dynamic data collection; (2) after cued data collection; and (3) following the completion of the field investigation. A DUA for dynamic data must be completed, and the associated dynamic data must be deemed usable, before those data can be carried forward to the cued data collection stage. Similarly, a DUA for cued data collection must be completed, and the associated cued data must be deemed usable, before those data can be carried forward for intrusive investigation. For this reason, if considered practical and/or necessary, DUAs may be completed for batches of data (i.e., more than one DUA for dynamic data may be completed). The completed DUAs will be included in the final report.

37.1.3 The documents to be reviewed at each stage are listed in the DUA templates provided in **Tables 37.1 through 37.3**. The Project Geophysicist will lead the completion of the DUAs for dynamic and cued data, while the Parsons PM will lead the completion of the final DUA. The following individuals may also participate in the DUA process:

1. USACE PM
2. Project Quality Assurance Manager
3. Project Geophysicist
4. Field Geophysicist (lead)
5. SUXOS
6. UXOQCS
7. Other technical personnel as necessary

37.1.3 The DUAs for dynamic and cued data will follow a three-step process, while the final DUA will follow a four-step process:

(1) Review the project objectives and sampling design:

- Are the DQOs (Worksheet #11) and MPCs (Worksheet #12), and MQOs (WS#22) still applicable and are the underlying assumptions still valid?
- If the DQOs, MPCs, or MQOs have been changed, have the changes been documented?
- Is the sampling design consistent with project objectives?

(2) Review the data verification and validation outputs:

- Have the data been verified as described on Worksheet #35?
- Have the data been validated as described on Worksheet #35?

(3) Document data usability, update the CSM, and draw conclusions:

- Have the applicable DQOs and MPCs been achieved?
- Can the relevant data be used as intended, considering implication of deviations and corrective actions?
- Are there limitations on data use?
- Is there new information to be added to the CSM and, if so, does the CSM need to be updated?

(4) Document lessons learned and make recommendations:

- Should the DQOs, MPCs, or sampling design be updated for future delivery units?
- Are there other recommendations for future delivery units?

37.1.4 During data validation (Worksheets #35 and #36), non-conformances will be documented, and data will be qualified accordingly. All data are usable as qualified by the relevant Parsons personnel, with the exception of rejected data. The data are considered usable if the relevant DQOs, MPCs, and/or MQOs 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 DUA. 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. These checks include comparison of hard copy data and qualifiers to the electronic database. Once data have been uploaded into the electronic database, another check will be performed to ensure that data were loaded accurately. Deviations from the UFP-QAPP will be reviewed to assess whether corrective action is warranted and to assess impacts on achievement of DQOs and MPCs.

37.1.2 USABILITY ASSESSMENT DOCUMENTATION

The results of the DUAs will be recorded in a report for each type of DUA (i.e., DUA for dynamic data, DUA for cued data, and final DUA). Each report will document the DUA based on the multi-step process described above and will use the templates provided in Tables 37.1 through 37.3. For each step, the DUA will answer the relevant questions concerning the data and comments will be entered to explain the conclusions reached.

Table 37.1
Data Usability Assessment for Dynamic Data

STEP 1: PROJECT OBJECTIVES AND SAMPLING DESIGN		
Evaluation	Yes/No	Comments (1)
Are the relevant DQOs, MPCs, and MQOs for dynamic data still applicable?		
If relevant DQOs, MPCs, or MQOs for dynamic data have changed, are changes documented?		
Is the dynamic sampling design consistent with project objectives?		

STEP 2: REVIEW THE DATA VERIFICATION AND VALIDATION OUTPUTS			
Activity	DFW 3: IVS Construction and Sensor Operation Verification		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
IVS Technical Memorandum: EM61-MK2			
Production Area QC Seed Report			
Activity	DFW 4 and 5: Conduct DGM Transect and Grid Surveys and DFW 6: Process Dynamic DGM Data		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
DGM Data Deliverable(s)			
DGM QC Deliverable(s)			
RCA/NCR(s)			
FCR(s)			
Weekly Geophysical QC Reports			
Seed Tracking Log			
Target Selection Technical Memo			

STEP 3: DOCUMENT DATA USABILITY, UPDATE CSM AND DRAW CONCLUSIONS		
Evaluation	Yes/No	Comments (1)
Have the relevant DQOs/MPCs for dynamic data been met?		
Can the dynamic data be used as intended?		
Are there limitations on dynamic data use?		

Table 37.1
Data Usability Assessment for Dynamic Data

Is there new information to be added to the CSM and, if so, does the CSM need to be updated?		
STEP 4: DOCUMENT LESSONS LEARNED AND MAKE RECOMMENDATIONS		
Evaluation	Yes/No	Comments (1)
Should the DQOs, MPCs, or sampling design be updated for future delivery units?		
Are there other recommendations for future delivery units?		

(1) Comments should be added as required to clarify the conclusions of the evaluation steps. References should be included to records, if appropriate.

(2) References should be included to records, if appropriate.

Table 37.2
Data Usability Assessment for Cued Data

STEP 1: PROJECT OBJECTIVES AND SAMPLING DESIGN			
Evaluation	Yes/No	Comments (1)	
Are the relevant DQOs, MPCs, and MQOs for cued data still applicable?			
If relevant DQOs, MPCs, or MQOs for cued data have changed, are changes documented?			
Is the cued sampling design consistent with project objectives?			
STEP 2: REVIEW THE DATA VERIFICATION AND VALIDATION OUTPUTS			
Activity	DFW 3: IVS Construction and Sensor Operation Verification; and DFW 4 and 5: Conduct DGM Transect and Grid Surveys; and DFW 6: Process Dynamic DGM Data		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
DUA for Dynamic Data			
Activity	DFW 3: IVS Construction and Sensor Operation Verification		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
IVS Technical Memorandum: AC			
AC Sensor Assembly Checklist			
Activity	DFW 7: Collect Cued Data in Grids		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
Background Location Report			
DGM Data Deliverable(s)			
DGM QC Deliverable(s)			
RCA/NCR(s)			
FCR(s)			
Weekly Geophysical QC Reports			
Seed Tracking Log			

Table 37.2
Data Usability Assessment for Cued Data

STEP 2: REVIEW THE DATA VERIFICATION AND VALIDATION OUTPUTS (cont d.)			
Activity	DFW 8: Process Cued Data and DFW 9: Classify Anomalies		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Vali dation of the Activity (2)
Site-specific TOI Library			
DGM Data Deliverable(s)			
DGM QC Deliverable(s)			
Supporting Classification Images			
RCA/NCR(s)			
FCR(s)			
Weekly Geophysical QC Reports			
Seed Tracking Log			
Final Ranked Dig List			

STEP 3: DOCUMENT DATA USABILITY, UPDATE CSM AND DRAW CONCLUSIONS		
Evaluation	Yes/No	Comments (1)
Have the relevant DQOs/MPCs for cued data been met?		
Can the cued data be used as intended?		
Are there limitations on cued data use?		
Is there new information to be added to the CSM and, if so, does the CSM need to be updated?		

STEP 4: DOCUMENT LESSONS LEARNED AND MAKE RECOMMENDATIONS		
Evaluation	Yes/No	Comments (1)
Should the DQOs, MPCs, or sampling design be updated for future delivery units?		
Are there other recommendations for future delivery units?		

(1) Comments should be added as required to clarify the conclusions of the evaluation steps. References should be included to records, if appropriate.

(2) References should be included to records, if appropriate.

Table 37.3
Final Data Usability Assessment

STEP 1: PROJECT OBJECTIVES AND SAMPLING DESIGN			
Evaluation	Yes/No	Comments (1)	
Are the relevant DQOs, MPCs, and MQOs still applicable?			
If relevant DQOs, MPCs, or MQOs have changed, are changes documented?			
Is the sampling design consistent with project objectives?			
STEP 2: REVIEW THE DATA VERIFICATION AND VALIDATION OUTPUTS			
Activity	DFW 3: IVS Construction and Sensor Operation Verification; and DFW 4 and 5: Conduct DGM Transect and Grid Surveys; and DFW 6: Process Dynamic DGM Data		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
DUA for Dynamic Data			
Activity	DFW 3: IVS Construction and Sensor Operation Verification; and DFW 7: Collect Cued Data in Grids; and DFW 8: Process Cued Data and DFW 9: Classify Anomalies		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
DUA for Cued Data			
Activity	DFW 11: Anomaly Reacquisition and Resolution and DFW 12: Intrusive Investigation		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
Reacquisition Results			
Intrusive Investigation Results			
Anomaly Resolution Results			
Photograph Log			
Seed Tracking Log			
Activity	DFW 10: Validate Cued Survey and Classification		
Data Output/ Record	Verified? (Y/N)	Validated? (Y/N)	Briefly Describe How the Data Output Supports Verification and/or Validation of the Activity (2)
Analysis Verification Report			
Validation Report			

Table 37.3
Final Data Usability Assessment

STEP 3: DOCUMENT DATA USABILITY, UPDATE CSM AND DRAW CONCLUSIONS		
Evaluation	Yes/No	Comments (1)
Have the relevant DQOs/MPCs been met?		
Can the data be used as intended?		
Are there limitations on data use?		
Is there new information to be added to the CSM and, if so, does the CSM need to be updated?		
STEP 4: DOCUMENT LESSONS LEARNED AND MAKE RECOMMENDATIONS		
Evaluation	Yes/No	Comments (1)
Should the DQOs, MPCs, or sampling design be updated for future delivery units?		
Are there other recommendations for future delivery units?		

(1) Comments should be added as required to clarify the conclusions of the evaluation steps. References should be included to records, if appropriate.

(2) References should be included to records, if appropriate.

37.2 USABILITY ASSESSMENT FOR MC-RELATED DATA

37.2.1 SUMMARY OF USABILITY ASSESSMENT PROCESSES

37.2.1.1 This worksheet documents procedures that will be used to perform the DUA. The DUA for analytical data is performed at the conclusion of data collection activities, using the outputs from data verification and data validation. This data interpretation phase 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.

37.2.1.2 Data validation will be the first step of the usability assessment. See Worksheet #28 for data quality indicators 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 data validation report. Any data gap due to the field and/or lab error will be pointed out in the report. Project risk assessor will perform risk assessment based on validated data.

37.2.2 DOCUMENTATION GENERATED

37.2.2.1 A data validation report will be created for each SDG, including a summary of all QA/QC results associated with the SDG to provide documentation whether data generated were in control

throughout sample analysis. Topics of discussion include Accuracy/Biased Contamination, Precision of field duplicate and/or lab duplicate, Sensitivity, Representativeness, Data Usability, and Completeness. Criteria listed in the Worksheet #12 will be examined to determine if the Measurement Performance Criteria were met. Any lab trending in the QC samples, such as high biased lab control sample for a particular compound or metal will be discussed.

37.2.2.2 Data summary tables will be generated in order for data reviewer to review the results in an organized manner.

37.2.2.3 The data validation report will describe the rationale for the data used and present any data limitations. The report will include a 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.

37.2.2.4 Maps will be generated with validated data, when appropriate.

37.2.3 PROCEDURES TO ASSESS PROJECT-SPECIFIC OVERALL MEASUREMENT ERROR

Parsons will determine if quality control data is within specifications (MCP) through the data assessment and data validation process (Worksheet #36).

37.2.4 PERSONNEL RESPONSIBLE FOR PERFORMING USABILITY ASSESSMENT

The following personnel are responsible for performing usability assessments:

- Contractor Project Manager
- Contractor Project Chemist
- Contractor Sampling Lead

37.2.5 IMPACTS OF QUALIFIED DATA AND PLAN DEVIATIONS

Parsons will utilize all data not rejected during validation to determine the nature and extent of contamination, and to support the risk assessment. Parsons 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.

37.2.6 USABILITY ASSESSMENT DOCUMENTATION

All analytical results will be reported for an overall quality assessment in the Data Validation Report. The Data Validation Report will identify precision and accuracy exceedances with respect to the laboratory performance for each batch of samples, as well as comparability of field and laboratory duplicates. Data tables will be produced to reflect detected and non-detected analytes for each test. Data qualifiers will be provided in the data tables and discussed in the Data Validation Report. A step by step template is provided in Table 37.4.

Table 37.4
Data Usability Assessment for Analytical Data

Activity	Evaluation Criteria	Briefly Describe if the Data Output Supports Verification and/or Validation of the Activity
Step 1	**Review the project's objectives and sampling design** Review the key outputs defined during systematic planning (i.e. PQOs or DQOs and MPCs) to make sure they are still applicable. Review the sampling design for consistency with stated objectives.	
Step 2	**Review the data verification and data validation outputs** Review available QA reports, including the data verification and data validation reports. Perform basic calculations and summarize the data (using graphs, maps, tables, etc.). Look for patterns, trends, and anomalies (i.e., unexpected results). Review deviations from planned activities (e.g., number and locations of samples, holding time exceedances, damaged samples, non-compliant results, and SOP deviations) and determine their impacts on the data usability. Evaluate implications of unacceptable QC sample results.	
Step 3	**Verify the assumptions of the selected statistical method** Verify whether underlying assumptions for selected statistical methods (if documented in the QAPP) are valid. Common assumptions include the distributional form of the data, independence of the data, dispersion characteristics, homogeneity, etc. Depending on the robustness of the statistical method, minor deviations from assumptions usually are not critical to statistical analysis and data interpretation. If serious deviations from assumptions are discovered, then another statistical method may need to be selected.	
Step 4	**Implement the statistical method** Implement the specified statistical procedures for analyzing the data and review underlying assumptions. For decision projects that involve hypothesis testing, consider the consequences for selecting the incorrect alternative; for estimation projects (e.g., establishing a boundary for surface soil contamination), consider the tolerance for uncertainty in measurements.	
Step 5	**Document data usability and draw conclusions** Determine if the data can be used as intended, considering implications of deviations and corrective actions. Discuss data quality indicators. Assess the performance of the sampling design and Identify limitations on data use. Update the conceptual site model and document conclusions. Prepare the data usability summary report which can be in the form of text and/or a table.	

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