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FINAL MUNITIONS AND EXPLOSIVES OF CONCERN QUALITY ASSURANCE PROJECT PLAN AMENDMENT DIVE BOMBING TARGETS UNEXPLODED ORDNANCE 09 (UXO 09) NAVAL AUXILIARY LANDING FIELD FENTRESS REMEDIAL INVESTIGATION NAS OCEANA VA

11/01/2014

CH2M HILL

Worksheet #1—Title and Approval Page

Final

Munitions and Explosives of Concern Quality Assurance Project Plan Amendment

Dive Bombing Targets (UXO 09) Naval Auxiliary Landing Field Fentress Remedial Investigation

Naval Air Station Oceana Virginia Beach, Virginia

Contract Task Order WE60

November 2014

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

CH2MHILL®

Virginia Beach, Virginia

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CH2M HILL – Munitions Response Manager/Date

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NAVFAC Mid-Atlantic – Navy Technical Representative/Date

Mike Green
NAVFAC Atlantic – MRP Quality Assurance Officer/Date

Steve Mihalko
Virginia Department of Environmental Quality – Remedial Project Manager/Date

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Executive Summary

This Munitions and Explosives of Concern Quality Assurance Project Plan (MEC-QAPP) Amendment supports the additional Remedial Investigation (RI) activities being performed at the former Dive Bombing Targets (DBTs), Unexploded Ordnance (UXO) 09, Munitions Response Site (MRS), located at Naval Auxiliary Landing Field (NALF) Fentress, Chesapeake, Virginia, and serves as a guideline for the field activities and data quality assessment. NALF Fentress is under the command of Naval Air Station (NAS) Oceana, Virginia Beach, Virginia. CH2M HILL prepared this document under the Department of the Navy (Navy) Comprehensive Long-Term Environmental Action Navy 8012 Contract N62470-11-D-8012, Contract Task Order WE60, for submittal to Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic and the Virginia Department of Environmental Quality (VDEQ). VDEQ is the lead regulatory agency. This MEC-QAPP will help ensure that RI data collected or compiled are scientifically sound, of known and documented quality, and suitable for intended uses.

The goal of this RI is to define the nature and extent of MEC at the DBTs. The areas to be investigated during the RI field activities are adjacent to the previously investigated DBT areas and encompass approximately 53 acres and additional areas directly beyond the original MRS boundary to the north, east and west, encompassing approximately 33 acres, as part of additional proposed RI activities for a total area of 86 acres. (**Figures 9a and 9b**).

RI activities were completed November 2013 through March 2014 and will be documented in an RI report once the additional RI activities have been completed. Findings from the anomaly investigation during the RI activities included: nineteen AN-MK23 practice bombs and thirty-five small arms ammunition items (thirty-one .22 caliber, three .50 caliber, and one 7.62mm) at the North DBT, as well as, forty-eight AN-MK23 practice bombs, three rocket/grenade items and two small arms ammunition items at the South DBT. All items were recovered, inspected, and classified as MDAS, while two projectile air burst simulators were found at the South DBT and classified as MEC.

These results indicate that there is a potential for MEC to be present beyond the original proposed investigation area. As such, additional areas are recommended to determine the extent of potential MEC.

The objectives of the RI are to:

- Determine the nature and extent of MEC at the site.
- Perform an explosive safety hazard assessment for MEC using the MEC hazard assessment guidance.
- Determine whether further action is warranted.

These objectives will be accomplished in two phases, as follows:

1. DGM Survey: Conduct a DGM survey along 87 evenly spaced transects, 10 meters (33 feet) apart, to achieve characterization of the extent of the impacted areas and resulting in a survey coverage of 10 percent over the 53 acres adjacent to the DBTs as shown on **Figure 9a**.

   As part of additional RI activities, conduct a DGM survey in the areas directly beyond the boundary of the DBT MRS as shown on **Figure 9b**. The investigation area will extend 50 meters (164 feet) beyond the MRS boundary on the north, east and west sides. A total of 41 transects will be spaced 10 meters (33 feet) apart, resulting in a survey coverage of 10 percent over 33 acres adjacent to the original MRS.

   The DGM results for all 86 acres of the site will be evaluated for the RI report.

2. Intrusive Investigation: Reacquire and excavate a statistically significant quantity of DGM anomalies identified during both the 2013 DGM transects survey and the additional RI activities over 53 acres and 33 acres respectively, for a total of 86 acres to be investigated. The selected anomalies (randomly chosen from the geophysical anomalies identified by a geophysicist as potentially representing MEC) will be intrusively

investigated to locate the source of each anomaly (that is, MEC, material potentially presenting an explosive hazard [MPPEH] or non-munitions related debris). This work will be performed under a Naval Ordnance Safety and Security Activity (NOSSA) - and Department of Defense Explosives Safety Board (DDESB)-approved Explosives Safety Submission (ESS), amended as appropriate.

An environmental investigation to assess soil, groundwater, and sediment for potential MC contamination will not be conducted because MC are not considered to be present based on historical use of the DBTs. Results of the DGM survey and intrusive investigation will be presented in the RI report.

This MEC-QAPP is intended to be the primary work plan for the activities being performed at the DBTs and serves as a guideline for the field activities and data quality assessment. The Health and Safety Plan (HASP), which provides an interface with CH2M HILL's overall health and safety program, is being prepared as a separate document. The HASP will be appended to the Accident Prevention Plan (APP). The Geophysical Investigation Plan is provided as **Appendix A** and standard operating procedures are provided as **Appendix B**.

This document is being developed in general accordance with the following guidance documents:

- *United States Environmental Protection Agency (EPA) Guidance for Quality Assurance Project Plans, Quality Assurance Management System* (EPA, 2002)
- *Uniform Federal Policy for Quality Assurance Project Plans* (EPA, 2005)

This document consists of 37 worksheets, which are based on the September 2009 MEC Uniform Federal Policy - QAPP format (Navy, 2009). Worksheets that are not applicable to MEC/MPPEH characterization (for example, worksheets specific to sampling and chemical analysis) have been designated as "Not Applicable." All tables are embedded within the worksheets, and figures are included at the end of each worksheet, where applicable.

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9a RI Area to be Investigated
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Appendixes

A Geophysical Investigation Plan
B Standard Operating Procedures

Abbreviations and Acronyms

AM	Activity Manager
APP	Accident Prevention Plan
AQM	Activity Quality Manager
bgs	below ground surface
CA	corrective action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DBT	dive bombing target
DDESB	Department of Defense Explosives Safety Board
DFOW	definable feature of work
DGM	digital geophysical mapping
DQO	data quality objective
ECP	entry control point
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ESS	Explosives Safety Submission
EZ	exclusion zone
°F	degrees Fahrenheit
FP	Follow-up Phase
FS	Feasibility Study
FTL	Field Team Leader
GIP	Geophysical Investigation Plan
GIS	Geographic Information System
GSV	Geophysical System Verification
H&S	health and safety
HASP	Health and Safety Plan
IAW	in accordance with
ID	identification
IP	Initial Phase
IVS	Instrument Verification Strip
MC	munitions constituents
MDAS	material documented as safe
MEC	munitions and explosives of concern
MEC HA	Munitions and Explosives of Concern Hazard Assessment
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objective
MR	munitions response
MRM	Munitions Response Manager
MRP	Munitions Response Program
MRS	Munitions Response Site
NALF	Naval Auxiliary Landing Field
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command

Navy	Department of the Navy
NOSSA	Naval Ordnance Safety and Security Activity
NTR	Navy Technical Representative
OIC	Officer in Charge
ORR	Operational Readiness Review
PA	Preliminary Assessment
PAL	project action limit
PM	Project Manager
POC	point of contact
PP	Preparatory Phase
PQO	project quality objective
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
RI	Remedial Investigation
RPM	Remedial Project Manager
RRR	Recognize, Retreat, Report
SI	Site Inspection
SOP	standard operating procedure
SSC	Site Safety Coordinator
STC	Senior Technical Consultant
SUXOS	Senior Unexploded Ordnance Supervisor
TBD	to be determined
UFP	Uniform Federal Policy
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
VDEQ	Virginia Department of Environmental Quality

Worksheet #2—QAPP Identifying Information

Site Name/Number: Naval Auxiliary Landing Field (NALF) Fentress – Dive Bombing Targets (DBTs)/UXO 09

Operable Unit: Not Applicable

Contractor Name: CH2M HILL

Contract Number: N62470-11-D-8012, Contract Task Order WE60

Contract Title: Comprehensive Long-term Environmental Action – Navy 8012

1. **This Munitions and Explosives of Concern Quality Assurance Project Plan (MEC-QAPP) was prepared in accordance with the requirements of the following U.S. Environmental Protection Agency (EPA) documents:**
   - *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP) (EPA, 2005)
   - *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, Quality Assurance Management System* (EPA, 2002)
   - *EPA Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006)
2. **Identify regulatory program:**

   Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
3. **This <u>project-specific</u> MEC-QAPP is for the Remedial Investigation (RI) activities at the NALF Fentress DBTs.**
4. **List dates of scoping sessions that were held:**

Scoping Session	Date
Naval Air Station (NAS) Oceana Partnering Meeting	11/15/12
Naval Air Station (NAS) Oceana Partnering Meeting	08/26/14

5. **List dates and titles of any QAPP documents written for previous site work that are relevant to the current investigation:**

Title	Author/Date
Draft Abbreviated Work Plan, Dive Bombing Targets Site Investigation, Site Inspection Munitions Response Program – Sites in Virginia, Naval Auxiliary Landing Field Fentress, Naval Air Station Oceana, Virginia Beach, Virginia	CH2M HILL/October 2010
Draft Geophysical Investigation Plan, NALF Fentress Dive Bombing Targets, Naval Air Station Oceana, Virginia Beach, Virginia	CH2M HILL/March 2012a
Technical Memorandum, Geophysical Investigation Results and Proposed Pre-Remedial Investigation Reconnaissance and Remedial Investigation Approach, Former Dive Bombing Targets – NALF Fentress, Naval Air Station Oceana, Virginia	CH2M HILL/November 2012b
Final Technical Management Plan, Pre-Remedial Investigation Reconnaissance, Dive Bombing Targets – Naval Auxiliary Landing Field Fentress	CH2M HILL/February 2013a

6. **List organizational partners (stakeholders) and connection with lead organization:**
   - Lead organization: Department of the Navy (Navy) Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic
   - Installation: NAS Oceana
   - Lead Regulatory Agency: Virginia Department of Environmental Quality (VDEQ)

Worksheet #2—QAPP Identifying Information (continued)

7. Lead organization:

- NAVFAC Navy Technical Representative (NTR) (Krista Parra),
- NAVFAC Munitions Response Program (MRP) Quality Assurance Officer (QAO) (Mike Green)
- NALF Fentress Officer in Charge (OIC) (Lieutenant Jimmy Navarro)

8. If any required QAPP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted QAPP elements and provide an explanation for their exclusion below:

The worksheets that are not applicable to this MEC format of the UFP-QAPP (QAPP) are as follows: **Worksheets #15, #19, #20, #23-28,** and **#30**. These worksheets pertain to samples that are collected and sent to an analytical laboratory. Because this phase of the project does not involve collecting samples from the site, there is no information to enter into these worksheets. These worksheets are designated as "Not Applicable" in the document.

UFP-QAPP Worksheet #	Required Information	Included or Excluded
A. Project Management		
Documentation		
1	Title and Approval Page	Included
2	Table of Contents QAPP Identifying Information	Included
3	Distribution List	Included
4	Project Personnel Sign-off Sheet	Included
Project Organization		
5	Project Organizational Chart	Included
6	Communication Pathways	Included
7	Personnel Responsibilities and Qualifications Table	Included
8	Special Personnel Training Requirements Table	Included
Project Planning/Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	Included
10	Problem Definition, Site History, and Background. Site Maps (historical and present)	Included
11	Site-Specific Project Quality Objectives (PQOs)	Included
12	Measurement Performance Criteria Table	Included
13	Sources of Secondary Use Data and Information Secondary Use of Data Criteria and Limitations Table	Included
14	Summary of Project Tasks	Included
15	Reference Limits and Evaluation Table	Excluded
16	Project Schedule/Timeline Table	Included

Worksheet #2—QAPP Identifying Information (continued)

UFP-QAPP Worksheet #	Required Information	Included or Excluded
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	Included
18	Sampling Locations and Methods/Standard Operating Procedure Requirements Table Sample Location Map(s)	Included
19	Analytical Methods/Standard Operating Procedure (SOP) Requirements Table	Excluded
20	Field Quality Control (QC) Sample Summary Table	Excluded
21	Project Sampling SOPs References Table Sampling SOPs	Included
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Included
Analytical Tasks		
23	Analytical SOPs Analytical SOP References Table	Excluded
24	Analytical Instrument Calibration Table	Excluded
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Excluded
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	Excluded
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain-of-Custody Form and Seal	Excluded
QC Samples		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	Excluded
Data Management Tasks		
29	Project Documents and Records Table	Included
30	Analytical Services Table Analytical and Data Management SOPs	Excluded
C. Assessment Oversight		
31	Planned Project Assessments Table Audit Checklists	Included
32	Assessment Findings and Corrective Action (CA) Responses Table	Included
33	Quality Assurance (QA) Management Reports Table	Included
D. Data Review		
34	Verification (Step I) Process Table	Included
35	Validation (Steps IIa and IIb) Process Table	Included
36	Validation (Steps IIa and IIb) Summary Table	Included
37	Usability Assessment	Included

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Worksheet #3—Distribution List

Name of QAPP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Krista Parra	Navy Technical Representative (NTR)	NAVFAC Mid-Atlantic	(757) 341-0395	krista.parra@navy.mil
Mike Green	MRP Quality Assurance Officer (QAO)	NAVFAC Atlantic	(757) 322-8108	mike.green@navy.mil
Steve Mihalko	Remedial Project Manager (RPM)	VDEQ	(804) 698-4202	stephen.mihalko@deq.virginia.gov
Stephen Falatko	Munitions Response Manager (MRM)	CH2M HILL	(703) 376-5099	stephen.falatko@ch2m.com
Joe Kenderdine	Project Manager (PM)	CH2M HILL	(703) 376-5156	joseph.kenderdine@ch2m.com
Tim Garretson	Munitions Response (MR) Senior Technical Consultant (STC)	CH2M HILL	(904) 374-5633	timothy.garretson@ch2m.com
Tamir Klaff	MR Senior Geophysicist	CH2M HILL	(202) 596-1199	tamir.klaff@ch2m.com
Nelson Figeac	Unexploded Ordnance Safety Officer (UXOSO)/UXO Quality Control Specialist (UXOQCS) for UXO related activities; Field Team Leader (FTL)/Site Safety Coordinator (SSC) for non-UXO related activities	CH2M HILL	(757) 288-0374	nelson.figeac@ch2m.com
Ted Dingle	Senior UXO Supervisor (SUXOS)	CH2M HILL	(757) 955-0591	theodore.dingle@ch2m.com

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Worksheet #4—Project Personnel Sign-Off Sheet

Name	Title/Role	Telephone Number (optional)	Signature/E-mail Receipt	Date Read
Krista Parra	NAVFAC NTR	(757) 341-0395		
Steve Mihalko	VDEQ RPM	(804) 698-4202		
Stephen Falatko	CH2M HILL/MRM	(703) 376-5099		
Joe Kenderdine	CH2M HILL/PM	(703) 376-5156		
John Tomik	CH2M HILL/Activity Quality Manager (AQM)	(757) 671-6259		
George DeMetropolis	CH2M HILL/MR Safety and Quality Manager	(619) 564-9627		
Tim Garretson	CH2M HILL/MR STC	(904) 374-5633		
Tamir Klaff	CH2M HILL/MR Senior Geophysicist	(202) 596-1199		
Nelson Figeac	CH2M HILL/UXOSO and UXOQCS	(757) 288-0374		
Ted Dingle	CH2M HILL/SUXOS	(757) 955-0591		
Mark Orman	CH2M HILL/Health and Safety (H&S) Manager	(414) 712-4138		

Organization: Subcontractors

Name	Title/Role	Telephone Number (optional)	Signature/E-mail Receipt	Date MEC QAPP Read
Michael Surveying & Mapping PC	Professional Land Surveyor Subcontractor/PM	(757) 873-1762		
NAEVA Geophysics, Inc.	Digital Geophysical Mapping (DGM) Subcontractor/PM	(434) 978-3187		
To be determined (TBD)	Utility Locator Subcontractor/PM	TBD		
USA Environmental, Inc.	MEC Subcontractor/PM	(757) 689-4818		

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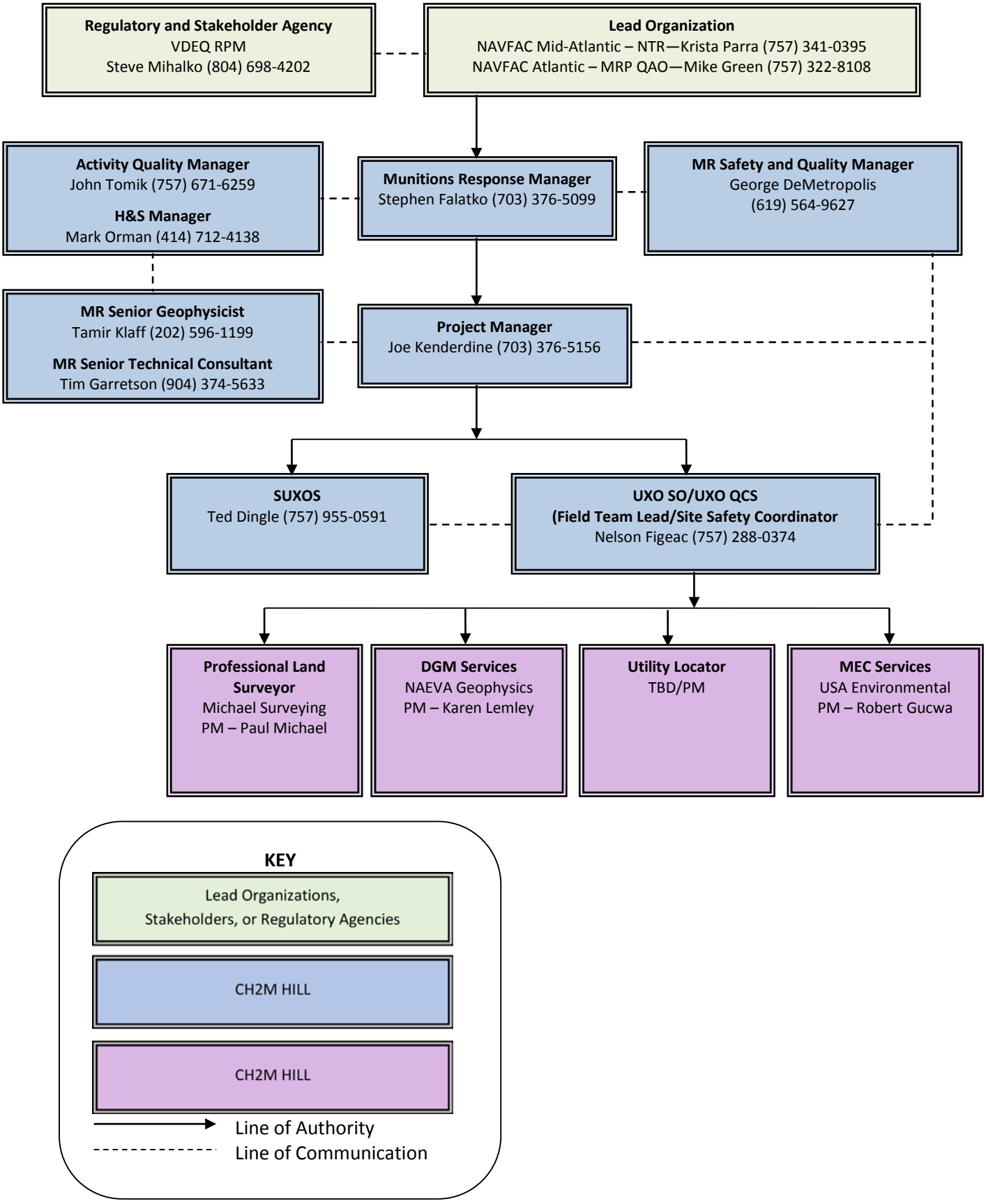
Worksheet #5—Project Organizational Chart



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Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or Email	Procedure
Communication with Navy (lead agency)	NAVFAC NTR for NAS Oceana	Krista Parra	(757) 341-0395 krista.parra@navy.mil	Primary point of contact (POC) for Navy, stakeholder and agency managers; can delegate communication to other internal or external POCs. Any issue that may affect project work should be reported to NAVFAC NTR immediately.
Communication with NALF Fentress	Fentress OIC	Jimmy Navarro	(757) 433-2259 jimmy.navarro@navy.mil	Primary POC for NALF Fentress; will be provided with daily reports of all field activities. If field issues occur that affect the mission of the facility, the NTR and OIC or his delegated personnel should be notified immediately.
Communication with VDEQ (regulatory agency)	RPM - VDEQ	Steve Mihalko	(804) 698-4202 stephen.mihalko@deq.virginia.gov	Primary POC for VDEQ; can delegate communication to other internal or external POCs. Upon notification of field changes, VDEQ will have 24 hours to approve or comment on the field changes.
Communication regarding overall project status and implementation and primary POC with Navy NTR and VDEQ	MRM - CH2M HILL	Steve Falatko	(703) 376-5099 stephen.falatko@ch2m.com	MRP POC for CH2M HILL; can delegate communication to other contract staff as appropriate. Issues reported to the Navy NTR immediately and followed up in writing within 2 business days.
Management of MRP Implementation	PM – CH2M HILL	Joe Kenderdine	(703) 376-5156 joseph.kenderdine@ch2m.com	Primary POC for MR field and project-specific activities; timing dependent on nature of communication and predefined schedules as applicable and as requested by stakeholder agencies.
Technical communications for project implementation and data interpretation	AQM - CH2M HILL	John Tomik	(757) 671-6259 john.tomik@ch2m.com	Contact AQM regarding questions/issues encountered in the field, input on data interpretation, as needed. AQM will have 24 hours to respond to technical field questions as necessary. Responses will be communicated to the PM via email or phone.
Communications regarding project management and implementation of all project phases, and primary POC with Navy RPM	PM - CH2M HILL	Joe Kenderdine	(703) 376-5156 joseph.kenderdine@ch2m.com	Forwards all information and materials about the project to Navy RPM on a daily basis. Oversees the overall project status. Is informed of project status by CH2M HILL field personnel. If field changes occur during field activities, works with the Navy RPM to communicate field changes to the NAS Oceana MRP Team via email within 24 hours.
MEC-QAPP implementation in the field	SUXOS – CH2M HILL	Ted Dingle	(757) 955-0591 theodore.dingle@ch2m.com	Facilitates CH2M HILL's internal communication (PM to field team members). Coordinates schedules and field activities with MEC and DGM subcontractors. Communicates with subcontractors by phone, followed up with e-mail to document decisions and actions. Documents deviations from the WP in the field logbook and notifies PM immediately. Executes deviations only after PM approval. Implements project H&S requirements. Provides daily progress reports/updates to the CH2M HILL PM by phone or email.

Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or Email	Procedure
Field CA	UXOQCS/UXOSO - CH2M HILL	Nelson Figeac	(757) 288-0374 nelson.figeac@ch2m.com	The need for CA for field and analytical issues will be decided by the UXOQCS/UXOSO and MR Safety and Quality Manager. The MR Safety and Quality Manager will oversee that QAPP requirements are met by the field staff. The UXOQCS/UXOSO will notify the PM of any needed field CAs. The PM will have 24 hours to respond to the request for field CA.
Health and Safety	UXOSO/UXOQCS for UXO related activities; FTL/SSC for non-UXO related activities - CH2M HILL	Nelson Figeac	(757) 288-0374 nelson.figeac@ch2m.com	Responsible for the adherence of team members to the site safety requirements described in the Health and Safety Plan (HASP). Reports H&S incidents and near-misses to PM immediately by phone.
Technical communications for MEC-QAPP implementation, data interpretation	Senior Geophysicist - CH2M HILL	Tamir Klaff	(202) 596-1199 tamir.klaff@ch2m.com	Contact Senior Geophysicist regarding questions/issues encountered in the field, input on data interpretation, as needed. Senior Geophysicist will have 24 hours to respond to technical field questions as necessary. Responses will be communicated to the PM via email or phone.
Field and Data Collection CAs	Senior Geophysicist - CH2M HILL	Tamir Klaff	(202) 596-1199 tamir.klaff@ch2m.com	Any CAs for field and data collection issues will be developed by the SUXOS and/or the Senior Geophysicist and reported to the PM within 24 hours.
MR-related CAs	MR Safety and Quality Manager - CH2M HILL	George DeMetropolis	(619) 564-9627 george.demetropolis@ch2m.com	Any MR-related CAs for field and data collection issues will be developed by the SUXOS, UXOQCS/UXOSO and/or the MR Safety and Quality Manager and reported to the PM within 24 hours.
Technical communications for project implementation, and data interpretation	AQM - CH2M HILL	John Tomik	(757) 671-6259 john.tomik@ch2m.com	Contact AQM regarding questions/issues encountered in the field, input on data interpretation, as needed. AQM will have 24 hours to respond to technical field questions as necessary. Responses will be communicated to the PM via email or phone.
Implementation of MEC-related portions of the MEC-QAPP	MEC Subcontractor - USA Environmental	Robert Gucwa	(757) 689-4818 rgucwa@usatampa.com	Plans, coordinates, and supervises all explosives operations; supervises all personnel inside the exclusion zones (EZs).
MEC-related QC provisions corrective actions	UXOQCS/UXOSO - CH2M HILL	Nelson Figeac	(757) 288-0374 nelson.figeac@ch2m.com	Any MR-related CAs for field and data collection issues will be developed by the SUXOS, UXOQCS/UXOSO and/or the MR Safety and Quality Manager and reported to the PM within 24 hours.

Worksheet #7—Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Krista Parra	NTR	NAVFAC Mid-Atlantic	Provides project oversight and direction, assists with coordination of project activities between CH2M HILL and installation operations personnel, provides technical review of deliverables, and serves as primary regulatory interface for the Navy and the project team.
Jimmy Navarro	Officer In Charge	NALF Fentress	Assists with coordination of project activities between CH2M HILL and installation operations personnel.
Mike Green	MRP QAO	NAVFAC Atlantic	Provides quality review of MRP-related projects and activities for NAVFAC, including review of MEC-QAPP documents.
Steve Mihalko	RPM	VDEQ	Provides regulatory review of project documents and activities for the Commonwealth of Virginia.
Steve Falatko	MRM	CH2M HILL	Responsible for CH2M HILL MRP project implementation at NAS Oceana.
Joe Kenderdine	PM	CH2M HILL	Manages project, oversees all project activities, and is responsible for all aspects of the work performed under this MEC-QAPP. Directs and oversees staff.
John Tomik	AQM	CH2M HILL	Provides program-level review of MEC-QAPP. Provides oversight and approval for all technical issues related to the project.
George DeMetropolis	MR Safety and Quality Manager	CH2M HILL	Provides approval for all MRP-related issues for the project. Implements CH2M HILL's standard munitions QC procedures and conducts audits to confirm that QC protocols are being followed.
Tim Garretson	MR STC	CH2M HILL	Technical lead for MR program conformance to approved processes and procedures. Provides oversight and review of MR-related activities.
Tamir Klaff	Senior Geophysicist	CH2M HILL	Provides oversight and review of all DGM-related activities.
Mark Orman	H&S Manager	CH2M HILL	Develops and approves project HASP.
Nelson Figeac	UXOQCS/UXOSO (FTL/SSC)	CH2M HILL	Provides technical oversight and support for MEC-QAPP revisions and field work implementation. Supervises and coordinates all field activities. Implements the MEC-related QC provisions of the project. Implements the HASP, including MEC-related and general safety components. Will act as the FTL and SSC for non-UXO related tasks.
Ted Dingle	SUXOS	CH2M HILL	Implements approved MEC QAPP. Plans, coordinates, and supervises all explosives operations. Coordinates all aspects of QC and H&S with the UXOQCS/UXOSO.
Paul Michael	PM	Professional Land Surveyor Subcontractor (Michael Surveying & Mapping)	Implements approved MEC QAPP for land surveying (if necessary).

Worksheet #7—Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibilities
Karen Lemley	PM	DGM Services Subcontractor (NAEVA Geophysics)	Implements approved MEC QAPP for DGM.
TBD	PM	Utility Locator Subcontractor (TBD)	Implements approved MEC QAPP for utility locating before MEC clearing (if necessary).
Robert Gucwa	PM	MEC Services Subcontractor (USA Environmental)	Implements approved MEC QAPP for intrusive investigation of DGM-identified anomalies and MEC/MPPEH Management and Disposal.

Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/Organizational Affiliation	Location of Training Records/Certificates
Remedial Investigation	Hazardous waste operations and emergency response 40-hour training or 8-hour annual refresher, as appropriate	Registered training organization	Agency- and contractor-specific	FTL and SSC; Navy and regulatory agency representatives	FTL and SSC from CH2M HILL; UXO personnel; onsite visitors from Navy and regulatory agencies	Contractor, Navy, or regulatory agency human resources department
Fieldwork	MEC Awareness Training†	CH2M HILL UXO Technician	Before mobilization	All non-UXO technicians who will work at the site	FTL and SSC from CH2M HILL Field team members from subcontractor	Project folder

Note:

† MEC Awareness training for non-UXO technicians is often referred to as Recognize, Retreat, Report (RRR or 3-R) training. This training is intended to make the trainees aware of the potential presence of MEC, ways to recognize potential MEC, and what to do if potential MEC is observed. This training DOES NOT enable the trainee to identify the type of MEC or handle the potential MEC item.

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Worksheet #9-1—Project Scoping Session Participants Sheet

Project Name: RI for Dive Bombing Targets **Projected Date(s) of Sampling:** July 2013 **PM:** Joe Kenderdine/CH2M HILL	**Site Name:** Dive Bombing Targets **Site Location:** NALF Fentress, NAS Oceana, Virginia Beach, Virginia

Date of Session: November 15, 2012
Scoping Session Purpose: Obtain NAS Oceana Partnering Team consensus on the RI approach

Name	Title	Affiliation	Phone #	E-mail Address
Krista Parra	Navy NTR	NAVFAC Mid-Atlantic	(757) 341-0395	krista.parra@navy.mil
Steve Mihalko	RPM	VDEQ	(804) 698-4202	stephen.mihalko@deq.virginia.gov
Laura Cook	Activity Manager (AM)	CH2M HILL	(757) 671-6214	laura.cook@ch2m.com
Steve Falatko	MRM	CH2M HILL	(703) 376-5099	stephen.falatko@ch2m.com
Joe Kenderdine	PM	CH2M HILL	(703) 376-5156	joseph.kenderdine@ch2m.com

Comments/Decisions

The team discussed pre-RI reconnaissance and RI approach for the DBTs. A Pre-RI Reconnaissance is warranted to determine the nature of MEC present in the subsurface; and the Pre-RI results will be documented in the RI report.

The Pre-RI reconnaissance will include a limited intrusive investigation of the 2012 DGM anomalies. Following the Pre-RI reconnaissance, the RI activities will include conducting DGM at approximately 53 acres adjacent to the previous DBT investigation areas. The NAS Oceana Partnering Team agreed that no munitions constituents (MC) sampling is required because the munitions used at the DBTs included practice bombs which contain only black powder.

The RI schedule was reviewed and it was noted that vegetation reduction would need to be completed before March 15, 2013, when the Migratory Bird Treaty Act takes effect. The proposed area to be investigated was also reviewed and the team discussed not investigating the southwest investigation area that has been used for farming and adding additional area to the southern target where more DGM anomalies were detected.

Action Items

CH2M HILL: Proceed with the preparation of the pre-RI reconnaissance TMP.

Consensus Decision

The team agreed with the RI approach presented in the *Geophysical Investigation Results and Proposed Pre-Remedial Investigation Reconnaissance and Remedial Investigation Approach Technical Memorandum, Former Dive Bombing Targets - NALF Fentress Naval Air Station Oceana, Virginia* (CH2M HILL, 2012b).

In addition, the Team agreed that existing Site Inspection (SI) planning documents can be used for the pre-RI reconnaissance and that the RI planning documents will be completed before beginning intrusive investigation of anomalies at the RI phase.

Worksheet #9-2—Project Scoping Session Participants Sheet

Project Name: RI for Dive Bombing Targets **Projected Date(s) of Sampling:** July 2013, Feb-Mar 2015 **PM:** Joe Kenderdine/CH2M HILL	**Site Name:** Dive Bombing Targets **Site Location:** NALF Fentress, NAS Oceana, Virginia Beach, Virginia

Date of Session: August 26, 2014
Scoping Session Purpose: Obtain NAS Oceana Partnering Team consensus on the RI approach

Name	Title	Affiliation	Phone #	E-mail Address
Krista Parra	Navy NTR	NAVFAC Mid-Atlantic	(757) 341-0395	krista.parra@navy.mil
Steve Mihalko	RPM	VDEQ	(804) 698-4202	stephen.mihalko@deq.virginia.gov
Steve Falatko	MRM	CH2M HILL	(703) 376-5099	stephen.falatko@ch2m.com
Ngozi Ibe	Task Manager	CH2M HILL	(703) 376-5017	ngozi.ibe@ch2m.com

Comments/Decisions

The Team reviewed the site history, pre-RI activities and RI activities completed to date. The Team discussed the results of the RI activities. Steve Falatko then presented the proposed additional RI approach to the team which included a review of the additional area to be investigated, the methodology, and schedule.

Steve Mihalko questioned whether the investigation would include the taxiway if findings indicated items might extend that far. Krista Parra responded that the investigation would not include the taxiway. Steve Mihalko then asked whether the taxiway was part of the original DBT area, as this may affect how far southeast we need to investigate. He observed that it did not seem necessary to investigate across the taxiway as was proposed. Steve Falatko responded that it would not be much additional effort to collect data across the taxiway.

Steve Falatko further discussed the schedule reiterating that vegetation reduction would need to be done before March 15 because of the migratory bird restrictions.

Action Items

CH2M HILL: Proceed with preparing an amendment to the MEC-QAPP and send amended pages and figures to the Partnering Team.

Consensus Decision

The team agreed with the additional RI activities approach presented during this Partnering Meeting. Amended pages of the MEC-QAPP will be forwarded to the Partnering Team once completed. Additional RI activities to proceed according to the proposed schedule presented.

In addition, Steve Mihalko requested that he be informed once RI activities commenced as he may take the opportunity to conduct a site visit to observe intrusive operations.

Worksheet #10—Problem Definition

This worksheet provides a summary of the background information and key elements of the conceptual site model (CSM) for the DBTs (investigation history, physical setting, release history, and the potential exposure pathways and receptors of the DBTs), followed by the environmental questions to be answered during the RI field activities.

Site Background and History

NALF Fentress (**Figure 1**), under the command of NAS Oceana, is located approximately 7 miles southwest of NAS Oceana, in Chesapeake, Virginia. Established in 1940, the installation comprises approximately 2,500 acres, with approximately 8,700 additional acres in restrictive easements. The facility is currently used by squadrons stationed at NAS Oceana or Naval Support Activity Norfolk Chambers Field for field carrier landing practice operations (Malcolm Pirnie, 2008).

Two adjacent DBTs, located west of the existing runway in the central portion of NALF Fentress, were identified on an archival map dated 1955 and are shown on **Figure 2**. Maps from 1954, 1963, and 1974 show no evidence of the targets. The first, northernmost target (North DBT), is located at the end of runway 1-19. The second, southernmost target (South DBT), was identified on the 1955 map as the “new” DBT and was located approximately 500 feet southwest of the existing target. Each target covered approximately 6.5 acres. The areas where the DBTs were located are currently forested and undeveloped, except for the all-terrain vehicle trails crossing the southernmost portion of the site. The MRP-eligible acreage for the DBTs is approximately 13 acres.

The site potentially contains MEC and/or MPPEH as a result of the historical range operations at the DBTs. Munitions used at the former DBTs probably included practice bombs with small signal cartridges to indicate the point of impact. The site history with respect to military use that may have resulted in MEC and/or MPPEH being present at the Munitions Response Site (MRS) was obtained from the Preliminary Assessment (PA) report (Malcolm Pirnie, 2008).

The DBTs are characterized as flat, with an elevation of approximately 13 to 15 feet above mean sea level. Both areas are heavily wooded, and vegetation at the targets includes loblolly pine, sweet gum-tulip poplar, with some low-lying brush and grasses. The DBTs are situated on a forested-shrub wetland.

Investigation History

2008 Preliminary Assessment

A PA was conducted by Malcolm Pirnie in 2008. The DBT sites were inspected to identify possible MEC and/or MPPEH and any sources of MC-related contamination at the sites. Remnants from three AN-MK 43 miniature practice bombs were found near the South DBT (Malcolm Pirnie, 2008).

2009-2010 Site Inspection

An SI was conducted by CH2M HILL between October 2009 and October 2010 to evaluate the potential presence or suggested absence of MEC and/or MPPEH at the DBTs. In October 2009, a site reconnaissance was performed at the North and South DBTs. The field team used a global positioning system, landmarks, and/or site features identified in the PA to locate the center of the DBTs. Accessible areas at the target centers were visually surveyed to confirm the findings of the PA and to locate evidence of any existing MEC and/or MPPEH. An analog hand-held magnetometer (Schonstedt GA-52Cx) was used to perform a limited geophysical sweep to detect ferrous metallic objects within the areas of interest at the DBTs. The findings of the site reconnaissance activities performed at the DBTs are documented in the SI report (CH2M HILL, 2011).

In October 2010, a CH2M HILL field team performed a limited, screening-level geophysical survey at the DBTs that was intended to determine whether geophysical anomalies indicated patterns consistent with bomb targets

Worksheet #10—Problem Definition Overview (continued)

(high density at the center with decreasing density with distance from the center). Data were collected using an EM61-MK2 TDEM metal detector (EM61) with a global positioning system (with approximately 3-meter accuracy), with the objective of locating subsurface metal potentially associated with MEC and/or MPPEH.

Accessible areas at each DBT were visually surveyed to confirm the findings of the PA and seek evidence of any MEC and/or MPPEH. During this investigation, AN-MK23 practice bombs and an unfuzed Grenade, Hand: Smoke, M18 were observed on the surface. It was noted that the signal cartridges in two of the practice bombs were intact. Local Navy Explosive Ordnance Disposal (EOD) personnel were notified and they responded and removed these items.

The SI report was finalized in 2011 and recommended further investigation at the DBTs, including additional vegetation removal and DGM survey activities, with positioning at an accuracy sufficient for reacquiring the anomalies. The SI report also recommended an intrusive investigation to inspect and identify a selected subset of the anomalies. If the sources of the anomalies were identified as MEC and/or MPPEH, sampling for MC would be required (CH2M HILL, 2011).

2012 Digital Geophysical Mapping Survey

Following the SI, a DGM survey was conducted in June 2012 along 1-meter-wide transects, spaced at 10 meters (33 feet) apart (**Figure 3**). The DGM survey characterized the density and extent of subsurface geophysical anomalies (some of which may represent MEC and/or MPPEH) within the DBT areas. The DGM survey was conducted along 30 transects, consisting of 15 transects in the North DBT area and 15 transects in the South DBT area. A total of 518 anomalies were identified above a target threshold of 3 millivolts (slightly greater than the background geophysical response) — 145 anomalies in the North DBT area and 373 anomalies in the South DBT. The DGM survey results are presented in **Figures 4 and 5** (NAEVA, 2012).

Figures 6 and 7 present results of a geostatistical analysis of anomaly density for each area. Visual Sample Plan software (Battelle Memorial Institute, 2012) was used to estimate anomaly densities in each area. The average target density at the North DBT area was calculated to be 260 targets per acre, with the highest concentration of targets near the center to the northeast of the DBT area. The total number of anomalies estimated in the North DBT area is 1,690. The average target density at the South DBT area was calculated to be 667 targets per acre, with the highest concentrations also near the center to the northeast of the DBT area. The total number of anomalies estimated in the South DBT area is 4,335. These findings provided strong lines of evidence that MEC and/or MPPEH may be present in the subsurface and based on the 2012 DGM survey results, a pre-RI reconnaissance was recommended to investigate the nature of MEC and/or MPPEH in the subsurface.

The NAS Oceana Partnering Team agreed during the project scoping session on November 15, 2012 that no MC sampling is required because the munitions used at the DBTs included practice bombs which contain only black powder.

2013 Pre-RI Reconnaissance

The pre-RI reconnaissance at the DBTs was conducted from March 11 to March 14, 2013, and included a limited intrusive investigation at individual geophysical anomaly locations via excavation with hand tools. During the investigation activities:

- A total of 93 anomalies were reacquired in the North DBT and intrusive investigation of these anomalies was completed; 26 of these anomalies were AN-MK23 practice bombs.
- A total of 96 anomalies were reacquired in the South DBT and intrusive investigation of these anomalies was completed; 59 of these anomalies were AN-MK23 practice bombs.
- Onsite demolition operations were conducted on the 85 excavated AN-MK23 practice bombs.

Worksheet #10—Problem Definition Overview (continued)

All 85 AN-MK23 practice bombs recovered during the pre-RI reconnaissance were located less than 2 feet below the subsurface. Results of the pre-RI reconnaissance confirmed the presence of AN-MK23 practice bombs in the subsurface at the DBTs.

November 2013- March 2014 Remedial Investigation

The RI field activities were conducted from November 2013 to March 2014. The RI included vegetation reduction, land surveying, and DGM surveying, anomaly reacquisition, intrusive investigation of DGM-identified anomalies, and MEC/MPPEH management and disposal activities. The DBT MRS was divided into the north DBT (N-DBT) and south DBT (S-DBT). Items found at the site during the RI included:

North DBT:

- 19 AN-MK23 practice bombs classified as MDAS
- 35 expended small arms ammunition items (thirty-one .22 caliber, three .50 caliber and one 7.62mm) classified as MDAS

South DBT:

- 48 AN-MK23 practice bombs classified as MDAS
- 2 expended .50 caliber small arms ammunition items classified as MDAS
- 3 rocket/grenade items classified as MDAS
- 2 projectile air burst simulators classified as MEC. Demolition operations were performed on both items in accordance with the ESS.

Release History

The site was formerly used for dive bombing target practice. Probable munitions used at the DBTs included practice bombs (MK 43, AN-MK23, BDU-33, BDU-48/B, MB-2 and MB-2 [modified], MK 3, MK 4, MK 19 mod[s] 0 and 1, MK 76 Mod 4, and MK 106 Mod 0), MK 4 signal cartridges, CXU-2/B spotting/witness charges, and MK 5 bomb signal cartridges (Malcolm Pirnie, 2008). Although the depth to which bombs dropped on or fired at the DBTs may have penetrated the subsurface by several feet, all 85 AN-MK23 practice bombs found during the pre-RI reconnaissance in March 2013 were less than 2 feet below the subsurface. In March 2014, in addition to a number of items classified as MDAS, two projectile air burst simulators classified as MEC were recovered during RI activities.

During the limited, screening-level geophysical survey conducted at the DBT MRSs in October 2010, AN-MK23 practice bombs and an unfuzed Grenade, Hand: Smoke, M18 were observed on the surface (CH2M HILL, 2012b), providing evidence that former activities have resulted in MEC being released into the environment. Findings from the 2014 RI activities, which included 67 AN-MK23 practice bombs, further served to confirm this finding.

Physical Setting

Geology

The DBTs are located within the Atlantic Coastal Plain physiographic province, which is underlain with unconsolidated sediments generally of Quaternary ages. These surficial deposits include undivided sand, clay, gravel, and peat, which were deposited in marine, fluvial, aeolian, and lacustrine environments (Malcolm Pirnie, 2008).

Worksheet #10—Problem Definition Overview (continued)

Hydrology

NALF Fentress lies within the boundaries of three drainage basins: the Chesapeake Bay watershed in the north, the Southern Watersheds Area in the south, and Owls Creek watershed in the east. The Southern Watersheds Area is a collective of the North Landing River, Northwest River and Back Bay watersheds. Surface waters drain into the Chesapeake Bay via Great Neck, Wolfsnare, and London Bridge creeks; to the Southern Watersheds Area via West Neck Creek; and to Owls Creek watershed via Owls Creek and its tributaries (Geo-Marine, 2006).

Surface waters at NALF Fentress include extensive wetlands, a network of artificial drainages, and channeled streams, including a major portion of Pacaty Creek (Malcolm Pirnie, 2008).

Several drainage ditches are located within the boundary of the DBTs (Malcolm Pirnie, 2008).

Ecological Setting

There are no known federally listed threatened and endangered species onsite. One state-listed species of concern— the canebrake rattlesnake—has historically been located on the Station. The Migratory Bird Treaty Act is also in effect from March 15 to September 30.

Climate and Weather

The climate of Virginia Beach is classified as humid subtropical. Winters are very mild and snowfall is light.

Summers are hot and humid, with warm evenings. The mean annual temperature is 59.6 degrees Fahrenheit (°F), with an average annual snowfall of 8.1 inches, although snowfall averages are lower to the south away from the Chesapeake Bay. Average annual rainfall is 45 inches. The wettest seasons are the spring and summer, although rainfall is fairly constant all year round. The highest recorded temperature was 105 °F in July 2010, and the lowest recorded temperature was 4 °F in January 1985 (http://www.noaa.gov/).

Cultural Resources

There are no cultural resources located within the DBTs (Malcolm Pirnie, 2008).

Current and Future Land Use

NALF Fentress is a military use airport owned by the Navy under the operational control of NAS Oceana. The airfield primarily supports day and night field carrier landing practice operations by Navy aircraft.

The DBTs are no longer used for dive bombing target practice and are currently located in a wooded area with no specified designated use. This wooded area is situated on a forested-shrub wetland, with all-terrain vehicle trails crossing a portion of the South DBT. The DBTs are not surrounded by a gate or fencing, but are within the confines of NALF Fentress and general public access is restricted; however, Navy and Department of Defense personnel have access to the DBTs. Possible future land use of the DBTs includes construction of helipads.

MEC Conceptual Site Model

The CSM provides a description of the sources of MEC, pathways that could result in exposure to explosive hazards and the receptors and activities that currently occur on the site or could occur in the future. The source of MEC items identified at the DBTs is attributed to historical site use associated with releases of practice bombs during dive bombing target practice. Based on the March 2013 pre-RI reconnaissance, and the 2013-2014 RI activities, the practice bombs were located less than 2 feet below the subsurface and would likely remain buried and stationary.

Worksheet #10—Problem Definition Overview (continued)

Potential Receptors and Exposure Pathways

The following sections provide a general description of the human and ecological receptors that are currently present or may be present at the DBTs, and their potential exposure routes to MEC in soil, as summarized in the CSM (**Figure 8**).

Human Receptors and Exposure Routes

Based on current and potential future uses of the DBTs, potential human receptors include current/future Navy personnel, authorized visitors, contractors, and adult and adolescent trespassers (Malcolm Pirnie, 2008).

The primary exposure routes for MEC to Navy personnel, authorized visitors, and contractors include direct exposure to MEC in surface and/or subsurface soil during construction or other intrusive activities. The primary exposure routes for MEC to trespassers include contact with MEC on the ground surface (Malcolm Pirnie, 2008). Although these exposure routes are considered to be complete, demolition operations were performed on the surface MEC identified during the October 2010 limited screening-level geophysical survey as well as the MEC identified during the 2013-2014 RI, in accordance with the ESS. Remaining MEC are anticipated to be within 2 feet bgs.

Ecological Receptors and Exposure Routes

Ecological receptors may come into direct contact with MEC in the surface or subsurface soil via feeding or burrowing activities that result in disturbance of soils (Malcolm Pirnie, 2008). Although these exposure routes are considered to be complete, demolition operations were performed on the surface MEC identified during the October 2010 limited screening-level geophysical as well as the MEC identified during the 2013-2014 RI, in accordance with the ESS. Remaining MEC are anticipated to be within 2 feet bgs, as such, direct exposure to surface MEC is considered to be relatively minor.

General Remedial Investigation Approach

The initial RI approach includes a DGM survey, intrusive investigation of identified geophysical anomalies, MEC/MPPEH management and a MEC Hazard Assessment (MEC HA).

A DGM survey will be conducted along 87 evenly spaced transects, 10 meters (33 feet) apart, to characterize the extent of the affected areas and resulting in a survey coverage of 10 percent over the 53 acres adjacent to the DBTs as shown in **Figure 9a**.

Additional Remedial Investigation Approach

The additional RI approach includes surface MEC/MPPEH removal, a DGM survey, intrusive investigation of select identified geophysical anomalies, MEC/MPPEH management, and a MEC HA.

A DGM survey will be conducted in the areas directly beyond the boundary of the DBT MRS as shown on **Figure 9b**. The investigation area will extend 50 meters (164 feet) beyond the MRS boundary on the north, east and west sides. A total of 41 transects will be spaced 10 meters (33 feet) apart, resulting in a survey coverage of 10 percent over the additional 33 acres.

Worksheet #10—Problem Definition Overview (continued)

Following the DGM survey, a statistically significant subset of the geophysical anomalies identified in the DGM surveys will be randomly selected for intrusive investigation for each DBT. The Estimating a Proportion statistical method, described below, will be used to determine the quantity of anomalies to be investigated to obtain a 95 percent confidence (with a ± 5 percent sampling error) in the distribution of the different types of sources of anomalies. The selected anomalies (randomly chosen from the geophysical anomalies identified by a geophysicist as potentially representing MEC) will be intrusively investigated to locate the source of each anomaly (that is, MEC, MPPEH or non-munitions-related debris). This work will be performed under a Naval Ordnance Safety and Security Activity (NOSSA)-endorsed and Department of Defense Explosives Safety Board (DDESB)-approved Explosives Safety Submission (ESS).

Currently, CERCLA has no special provisions for dealing with explosive hazards. The *Munitions and Explosives of Concern Hazard Assessment (MEC HA) Methodology* (EPA, 2010) will be used for assessing potential explosive hazards to human receptors at the site. The MEC HA is intended to fit into military munitions response program activities and the regulatory structure of the CERCLA process.

The results of the RI and additional RI DGM survey and intrusive investigation activities will be compiled with the results of the DGM survey and intrusive investigation conducted within the original DBT boundaries (during the SI), to evaluate the nature and vertical/horizontal extent of MEC at the DBTs and adjacent areas. Results of the RI and MEC HA will be used to decide whether further action is warranted.

MEC and Environmental Questions to be Answered

The goal of the study is to identify whether MEC are present in the areas (approximately 53 acres in the initial RI investigation and an additional 33 acres in the follow on RI investigation for a total of 86 acres) adjacent to the previous DBT investigation areas. The environmental questions to be answered during the RI are:

- What is the nature and extent of MEC?
- What are the explosive safety hazards posed by any MEC potentially present at the site?
- Are remedial actions necessary and critical?

Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?

The data will be used by the Navy and VDEQ to make decisions about the path forward for the DBTs including both the 53 acres in the initial RI investigation and the additional 33 acres in the follow on RI investigation, adjacent to the DBTs. CH2M HILL will use the data to prepare an RI report.

What are the project action limits (PALs)?

The goal of the study is to identify whether MEC items are present in soil in and around the DBTs. The principal questions to be answered by the study are:

- Is MEC present in soil adjacent to the DBTs?
- Where MEC is present, what is the general nature and extent of the contamination in soil in and around the DBTs?
- Is an explosive hazard posed to human receptors from MEC in soil at the site?

What will the data be used for?

Data collected during the RI will be used to evaluate the nature and extent of MEC/MPPEH and to assist with future decision-making processes with regards to the DBTs and the 86 acres (approximately 53 acres in the initial RI investigation and an additional 33 acres in the follow on RI investigation) adjacent to the DBTs. Specific data uses are outlined below.

DGM data collected will be used to:

- Identify geophysical anomalies that represent potential subsurface MEC/MPPEH.
- Evaluate the lateral extent of distribution of geophysical anomalies at the site.
- Assist in planning the MEC/MPPEH intrusive investigation.

Data collected during the intrusive investigation will be used to:

- Determine the nature (i.e. source) of the geophysical anomalies.
- Evaluate the horizontal and vertical (within 24 inches of the ground surface) extent of the anomaly sources (and thereby MEC/MPPEH) at the site.
- Assist in preparation of the MEC HA that will be included in the RI Report.

With regard to the MEC HA, the information will be used to assess the three components of the Explosives Hazard assessment: severity, accessibility, and sensitivity. Each of these three components is assessed by input factors as follows:

- **Severity** (potential consequences of the effect, like injury or death on a human receptor should an MEC item function as designed). This component is based on two input factors: (1) Energetic Material Type and (2) Location of Additional Human Receptors (that is, in addition to the “initiating human”).
- **Accessibility** (the likelihood that a human receptor will be able to come in contact with an MEC item). This component is defined based on site accessibility, potential contact hours, amount of MEC, minimum MEC depth relative to the maximum receptor intrusive depth, and migration potential.
- **Sensitivity** (the likelihood that a MEC item will function as designed if a human receptor interacts with it). This component is based on classification and size of the MEC.

Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Each input factor has two or more categories and each category is associated with a numeric score reflecting the relative contributions of the different input factors to the MEC HA. The sum of the input factor scores places the site within one of four Hazard Levels. The resulting baseline Hazard Level reflects the interaction between the current human activities in the MRS and the types, amounts, and conditions of MEC items with the MRS as determined by the RI. The MEC HA score should not be interpreted as a quantitative measure of explosive hazard. Each of the four Hazard Levels reflects attributes that describe groups of MRSs and site conditions ranging from the highest to the lowest.

What types of data are needed?

- Project Information (such as personnel, teams, instrument model numbers, transect identification numbers, and locations)
- Field Notes (such as safety meetings, logbooks, photographs, and field requests for management)
- DGM and UXO Team notes (such as transects, files, personnel, methods, instruments, coordinates, and descriptions of items found)
- DGM data from the 87 transects investigated during the initial RI, and the 41 additional transectsDGM Data Process Notes and Delivery Data (such as file names, processing performed, QC of data, and delivery dates)
- Verification that geophysical equipment is operating in accordance with the Geophysical Investigation Plan (**Appendix A**)
- Results from the intrusive investigation of DGM-identified anomalies - Identification of quantities and types of MEC by a qualified UXO technician
- MEC HA specific information, which includes:
  - Type (general category, e.g., mortar, projectile, etc.)
  - Size
  - Mark/Model
  - Energetic Material Type
  - Fuze (Yes or no), Type, Condition
  - MEC Depth
- All QC procedures (such as QC on notes, processing, data, and comparison of DGM results to intrusive results and field activities)

How "good" do the data need to be to support the environmental decision?

Sufficient definitive data with adequate QC is required to demonstrate that the MEC investigation has been performed and was effective. Sufficiency of data will be judged based on compliance with the contract and the approved MEC QAPP. Data quality will be judged based on compliance with performance criteria for geophysical detection, reacquisition, and intrusive operations, as specified in **Worksheet #12** of this MEC QAPP.

An extensive program of QC/QA is defined in **Worksheets #34, #35**, and **#36**.

How much data are needed?

A statistically significant quantity of identified anomalies from the total site DGM survey that represent potential subsurface MEC is needed. Data collected from excavated locations will allow the Navy and VDEQ to identify the nature of MEC in the subsurface, which will be used to evaluate remedial alternatives to mitigate or control the unacceptable hazards.

Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Where, when, and how should the data be collected/generated?

- DGM data will be collected from 87 evenly spaced transects, spaced 10 meters (33 feet) apart.
- DGM data will also be collected from 41 additional transects, evenly spaced 10 meters (33 feet) apart as part of the follow on RI investigation.
- The schedule is identified on QAPP **Worksheet #16**. RI activities were completed November 2013 through March 2014. The additional RI activities field event is planned to occur December 2014 through March 2015. Site preparation activities including vegetation reduction and land surveying of the DGM transects and site boundary will be completed by March 31, 2015 in order to minimize the impact to the Migratory Bird Treaty Act which takes effect from March 15 to September 30.
- Data will be collected in accordance with the procedures outlined in this MEC QAPP.

Who will collect and generate the data?

CH2M HILL's geophysical subcontractor personnel will perform the DGM survey. UXO personnel from CH2M HILL's MEC contractor, USA Environmental, Inc., will reacquire the positions of selected anomalies using length measurements from surveyed transect stakes and perform the intrusive investigation of each anomaly. The results of each excavation will be recorded in paper or digital logbooks.

How will the data be archived?

All files will be made available for QC verification during the project to verify that the field procedures are properly implemented. All data files, hard copies, and field notes will be maintained for the duration of the project. Electronic data will be stored on the local CH2M HILL server and will be uploaded into the NAVFAC munitions database and subsequently uploaded into NIRIS.

The data will be archived in accordance with (IAW) Navy guidance. At the end of the project, archived data will be returned to the Navy.

PQOs listed in the form of if/then qualitative and quantitative statements.

The level of data to be collected during this initial investigation of the site does not allow for a quantitative risk-based decision. Therefore, specific "quantitative" PQOs are not currently developed. Data from this investigation may be used during future project activities to further develop PQOs for any additional investigations or activities.

General "qualitative" PQOs are provided below, in the form of if/then statements, to summarize the objectives of this investigation.

DGM survey

1. **IF** the geophysical data identify no locations with metallic anomalies in the subsurface of the survey area, **THEN** it will be concluded that MEC are not present in the subsurface of the survey area.
2. **IF** the geophysical data identify locations with metallic anomalies in the subsurface of the survey area, **THEN** selected anomalies (randomly chosen from the geophysical anomalies identified by a geophysicist as potentially representing MEC) will be reacquired and excavated.

Intrusive Investigation

1. **IF** an anomaly within a 1-meter lateral radius of a magnetic signal to a depth of 2 feet bgs is not recovered, **THEN** the target anomaly will be classified as a no-find and it will be concluded that sufficient data may not be available to fully evaluate the presence or absence of MEC at that location.

Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

2. **IF** an anomaly is identified and a metallic signal is still detected after excavation reaches a depth of 2 feet bgs, **THEN** it will be assumed that a potential MEC item may be too large or too deep to be removed.
3. **IF** an item is identified as non-munitions related scrap or other refuse, and removal of the item would take a considerable effort (more than 10 minutes) to remove, **THEN** the item will be recorded as "left in place" in field logs and annotated as such in the database.
4. **IF** an anomaly extends deeper than 2 feet bgs and cannot be removed, **THEN** the anomaly will be recorded in field notes as "left in place" and reported as "deeper than 2 feet bgs" in the database.

Once the intrusive investigation is complete, if MEC items are found and the exposure pathways to human receptors are complete, then the explosive hazards to human receptors will be evaluated in the qualitative MEC hazard evaluation, which will be prepared as part of the RI Report. The decision rules for the qualitative MEC hazard evaluation findings are:

1. IF the qualitative MEC hazard evaluation concludes that an unacceptable explosive hazard is present at the site, THEN further action will be required and remedial alternatives will be developed in an FS.
2. IF the qualitative MEC hazard evaluation concludes that no explosive hazard is present at the site, THEN no further action with institutional controls is required.

Data collected during the RI and historical data will be evaluated, and decisions on whether hazard posed by MEC in soil is acceptable or unacceptable will be made by considering all lines of evidence. The results will be used to identify whether an explosive hazard exists at the DBTs.

Worksheet #12-1—Measurement Performance Criteria Table – Environmental Restoration

Definable Feature of Work Data Type	Geophysical Anomaly Measurement Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
Analog instrument functional test	Accuracy and Sensitivity	Confirmation of analog system (used by UXO Technicians for pinpointing anomaly source during intrusive investigation) detection capabilities	Items are detected in the expected location in Instrument Verification Strip (IVS).	Daily (before and at the completion of instrument use)
General EM61-MK2 DGM Systems Functioning	Completeness	Confirmation of sufficient equipment warm-up	Minimum of 10 minutes before EM61-MK2 use	Daily, before instrument use
	Accuracy	Confirmation of DGM system dynamic positioning accuracy	Positional error of IVS seed items not to exceed 50 centimeters (20 inches) during daily IVS survey	Daily (before and at the completion of DGM survey activities)
	Repeatability	Confirmation of consistency of DGM system response	Response to standardized item in the "Static Background and Static Spike" test will not vary by more than ±20 percent. Additionally, the "Repeat Data" test will be qualitatively analyzed for consistency of system response.	Daily (before and at the completion of DGM survey activities)
EM61-MK2 DGM Data Collection	Coverage	Confirmation of downline DGM data density	At least 98% of possible sensor readings are captured along each transect at 20 centimeters (8 inches) or less, and that no data gaps of 60 centimeters (2 feet) or greater exist.	At the completion of each transect's DGM survey
	Coverage	Confirmation of DGM survey coverage (transect spacing)	Transect spacing is evenly spaced, 10 meters (33 feet) apart (±20%), except where trees or other obstructions prohibit such spacing.	At the completion of transect layout (to confirm spacing) and DGM survey (to confirm coverage)
	Accuracy	Confirmation of DGM anomaly positioning accuracy	A selected anomaly must be within 1 meter (3.3 feet) of each QC seed item or the lack of a selected anomaly can be adequately explained.	Each occurrence
Intrusive Operations Anomaly Resolution Data	Accuracy	QC to sample identification of munitions-related anomaly sources	Type, condition, and fuzing state (no fuze, unarmed fuze, armed fuze) of munitions-related items correctly identified.	Each occurrence
	Accuracy	QC review of identification of blind seed item location	100% of all blind seeds installed by the UXOQCS are removed and their location identified to within 1 meter (3.3 feet).	At the completion of the transect that contained a blind seed item
	Completeness	QC audit of anomaly identification data; QC of excavation following to ensure removal of targets to specific depth	At least 10% of investigated anomalies ≤ to 2 feet below ground surface are investigated by UXOQCS to confirm removal of source of anomaly. Anomalies ≥ 2 feet below ground surface will not be resolved.	Daily and weekly

Worksheet #12-1—Measurement Performance Criteria Table – Environmental Restoration (continued)

Definable Feature of Work Data Type	Geophysical Anomaly Measurement Data Quality Indicator	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
	Completeness	QC audit of anomaly identification forms (Daily Transect Tracking Logs – electronic)	Anomaly identification forms (electronic) completely and correctly filled out for each anomaly	Daily
	Completeness	QC audit of MEC accountability	100% of MEC items logged are verified as blown-in-place or otherwise disposed of.	Weekly

Worksheet #12-2—Definable Features of Work Auditing Procedure

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Pre-mobilization Activities	Document Management and Control	Verify appropriate measures are in place to manage and control project documents	Preparatory Phase (PP)	Once	Appropriate measures are in place to manage and control project documents.	Do not proceed with field activities until criterion is passed.
	Data Management	Verify appropriate measures are in place to manage and control project data	PP	Once	Appropriate measures are in place to manage and control project data.	Do not proceed with field activities until criterion is passed.
	Subcontractor Procurement	Ensure procurement of subcontractors and verify qualifications, training, licenses	PP/Initial Phase (IP)	Once	Subcontractors' qualifications, training, and licenses are up to date and acceptable.	Ensure subcontractor provides qualifications, training, and licenses or change subcontractor.
	MEC QAPP	Verify the MEC QAPP has been developed and approved	PP/IP	Once	MEC QAPP has been prepared and approved, all parties agree to the technical and operational approach.	Do not proceed with field activities until criterion is passed.
Mobilization/ Site Preparation	Onsite Document Review	Verify Project Plans are approved and review with project team and get appropriate signatures	PP/IP	Once	Document is approved and has been reviewed and acknowledged by appropriate project team members.	Personnel who are not familiar with the Project Plans may not proceed with field activities until criteria are passed.
	Establish Communication and Logistics	Verify functionality of communications equipment and logistical support is coordinated	PP/IP	Once	Communications and other logistical support are coordinated.	Do not proceed with field activities until criterion is passed.
	Local Agencies and Emergency Services Notification	Verify local agencies and emergency services have been notified of site activities if required by contract	PP/IP	Once	Emergency services and local agencies are aware of site activities.	Do not proceed with field activities until criterion is passed.
	Verify site specific training	Verify all site specific training has been performed and acknowledged	PP/IP	Once	Site specific training is performed and acknowledged.	Do not proceed with field activities until criterion is passed.
	Site Boundary	Verify boundary matches project plans/statement of work	PP/IP	Once	Boundary is correct	Stop activities until boundary is verified and matches statement of work coverage
Utility Clearance	Work Method	Verify Independent 3rd party utility clearance was conducted in conjunction with Miss Utility of Virginia	PP/IP	Once	Independent 3rd party utility clearance or Miss Utility of Virginia not conducted.	Stop activity until full compliance can be assured.

Worksheet #12-2—Definable Features of Work Auditing Procedure (continued)

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Instrument Verification Strip	Work Methods	Verify measurement quality objectives (MQOs) established in Geophysical System Verification (GSV) Plan have been accomplished.	PP/IP	Once	MQOs identified in GSV Plan have been achieved.	Continue with instrument verification strip (IVS) until MQOs are achieved. If concurrence is not met Corrective Action Request issued by field staff to MR Senior Geophysicist.
DGM Survey	Equipment Testing	Check results of QC tests performed as specified in Geophysical Investigation Plan (GIP)	FP	Each occurrence	QC tests must pass standards defined in the GIP.	If a QC test does not pass, data must be recollected or a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
	Work Methods	Verify DGM Survey conducted IAW GIP.	IF/FP	Daily	DGM Survey conducted IAW GIP.	Stop activity until full compliance can be ensured and any activities not performed within compliance are re-evaluated and re-performed if necessary.
		Confirm that DGM survey MQOs established during GSV are being met.	FP	Each Occurrence	DGM survey MQOs are being met.	If the MQOs are not being met, data must be recollected or a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
Anomaly Reacquisition	Equipment Testing	Verify equipment testing has been performed and equipment is functional.	IP/FP	Once/ Daily/ As Required	Equipment passed functionality test as required by this MEC-QAPP.	Repair or replace instrument.
	Work Methods	Verify work methods are established and communicated.	IP/FP	Daily	Work methods are established and communicated and being performed IAW this MEC-QAPP and SOPs.	Stop activities until the MEC-QAPP and SOPs can be followed and any activities not performed within compliance are re-evaluated and re-performed, if necessary

Worksheet #12-2—Definable Features of Work Auditing Procedure (continued)

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Intrusive investigation of DGM-identified anomalies	Equipment Testing	Verify equipment tested IAW the MEC QAPP.	IP/FP	Daily	Equipment testing performed and tests passed.	Repair or replace instrument.
	Work Methods	Verify operations are conducted IAW ESS, MEC-QAPP, MEC Removal SOPs, and the HASP: • Survey • DGM Anomaly Investigation • Ammunition and Explosives Transportation • Explosives Storage and Accountability • Disposal/Demolition Operations • Scrap Inspection Operations	IP/FP	Daily	Work performed IAW MEC QAPP, referenced MEC SOPs, and the HASP.	Stop activity until full compliance can be confirmed and any activities not performed within compliance are re-evaluated and re-performed if necessary.
	Work Methods	DGM Identified targets cleared using EM61-MK2.	FP	Daily	Removal of anomaly source verified with EM61-MK2.	Stop activity until full compliance can be confirmed and any activities not performed within compliance are re-evaluated and re-performed if necessary.
Anomaly Removal Verification	Work Method	UXOQCS will verify 10% of anomalies have been cleared.	FP	Daily	Anomaly signature, metal 2-inch x 2-inch or greater, MPPEH, MEC left within area or anomaly location	Stop activity until full compliance can be confirmed and any activities not performed within compliance are re-evaluated and re-performed if necessary.
	Data Management	Verify that all specifications of the discovered items (anomaly identification [ID], nomenclature or description, depth, weight, quantity, orientation and azimuth [directional MEC only], filler, and disposition) have been recorded using the digital handheld field device and uploaded into the project database.	IP/FP	Daily	Documentation of recovered investigation findings is accurate.	Receive proper or complete recovered investigation findings from investigation team leader and refresh documentation requirements to responsible parties.

Worksheet #12-2—Definable Features of Work Auditing Procedure (continued)

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Anomaly Removal Verification (cont.)	Data Management	Verify that the anomaly recovered during intrusive excavations is appropriate to the amplitude of the initial anomaly detected during the DGM.	IP/FP	Daily	Recovered anomaly is appropriate to the amplitude of the initial anomaly detected during the DGM.	Return to the location of the source of the anomaly excavation to determine if additional anomalies are present. If anomalies being recovered continue to be inappropriate for the amplitude as detected during the DGM, a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
Demilitarization of MEC/MPPEH	Final inspection of MEC/MPPEH	UXOQCS conducts final inspection of MEC/MPPEH.	FP	Each occurrence	All crevices and aspects of the item can be visually inspected to verify free of explosive material.	MEC/MPPEH item is re-processed by detonation or any other demilitarization method outlined within the ESS.
Material Transportation	Material Documented as Safe (MDAS) Packaging and Labeling	Inspection of MDAS packaging and labeling	FP	Each occurrence	Labeling and packing of MDAS conforms to Ammunition and Explosives Safety Ashore (Naval Sea Systems Command Ordnance, 2011. Publication 5, Volume 1, 7th Rev. Change 10).	MDAS will not be shipped until it conforms to OP5.
Demobilization	Demobilize from the site	Verify equipment and personnel have been demobilized from the site and the site is returned to pre-mobilization condition.	FP	Once	All personnel and equipment have been demobilized and the site is in pre-mobilization condition.	Restore site to pre-mobilization condition, package and ship all equipment offsite, demobilize crew

Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Preliminary Assessment (PA) Report	*Final Preliminary Assessment – Naval Air Station Oceana, Dam Neck Annex and Naval Auxiliary Landing Field Fentress, Virginia*	Malcolm Pirnie, 2008	Information from this report will be used to define the DBTs and potential MEC that may have been used at the Site.	Limited historical records were available/identified during the PA.
SI Report	*Final Site Inspection Report, Munitions Response Program, Munitions Response Sites at Dam Neck Annex and Naval Auxiliary Landing Field Fentress, Naval Air Station Oceana, Virginia Beach, Virginia*	CH2M HILL, 2011	Information from this report will be used to confirm the existence of MEC AN-MK23 practice bombs and an unfuzed Grenade, Hand: Smoke, M18) at the south DBT, as well as the identification of several subsurface anomalies at the DBTs.	None
Geophysical Investigation Results Technical Memorandum	*Geophysical Investigation Results and Proposed Pre-Remedial Investigation Reconnaissance and Remedial Investigation Approach Technical Memorandum, Dive Bombing Targets - NALF Fentress, Naval Air Station Oceana, Virginia.*	CH2M HILL, 2012b	The 2012 DGM survey along 15 transects in the North DBT area and 15 transects in the South DBT area will used to estimate the anomaly densities in these areas and provide strong evidence that MEC is present in the subsurface.	None
ESS	*Amendment 01 - Explosives Safety Submission for the Naval Auxiliary Landing Field Fentress, Dive Bombing Targets, Naval Air Station Oceana, Virginia Beach, Virginia*	CH2M HILL, 2013b	The ESS will be used during the MR activities at the DBTs.	None
ESS	*Amendment 02 - Explosives Safety Submission for the Naval Auxiliary Landing Field Fentress, Dive Bombing Targets, Naval Air Station Oceana, Virginia Beach, Virginia*	CH2M HILL, 2014	The ESS will be used during the MR activities at the DBTs.	None

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Worksheet #14—Summary of Project Tasks

Activities to be performed at the DBTs have been divided into definable features of work and the tasks to be completed are outlined in the table below. **Sections 14.1** through **14.14** provide the detailed methodology for each task. The criteria for selection of the geophysical anomalies for intrusive investigation are presented in **Worksheet #17**. Procedures for these tasks, including QC checks, recording and correcting data, data processing, data management, and information management will be performed in accordance with the SOPs listed below and presented in Attachment B.

Definable Feature of Work	Tasks	SOP
Pre-mobilization Activities	• RI MEC QAPP development and approval • Geographic Information System (GIS) setup • Subcontractor procurement • Document management and control • Data management • Comprehensive work approval process	SOPs will be provided by subcontractors (vegetation clearing [if required], MEC, and DGM) upon procurement
Mobilization/Site Preparation	• Utility clearance – flag and spray paint detected underground utilities • Mobilize crew and equipment • Onsite document review • Communications and logistics establishment • Local agencies and emergency services notification, if required • Site-specific training • Emplacement of blind QC seeds in DGM survey area • Establish Exclusion Zones (EZs), Entry Control Points (ECPs), and rally points • MPPEH will be managed IAW the ESS • Site layout - flagging site boundary and transect stake placement	SOPs will be provided by MEC subcontractor upon procurement
Anomaly Avoidance	• Equipment testing and setup. • Survey (border, transects, DGM, and DGM target reacquisition) confirmation • Site visits	MRP-SOP-0001 Munitions Response Program, SOP, Surface Munitions and MEC & Subsurface Anomaly Avoidance
DGM Survey	• Equipment setup and testing • DGM survey	SOPs will be provided by DGM survey subcontractor upon procurement
DGM Data Processing	• Pre- and Post-data processing • Data block submittals	No SOP. The Geophysical Investigation Plan will be followed
Anomaly Reacquisition	• Equipment testing and setup • Survey confirmation	SOPs will be provided by MEC subcontractor upon procurement
Intrusive investigation of DGM-identified anomalies and removal verification	• Team separation • Equipment testing and setup • Anomaly investigation • Record recovered items • Anomaly removal verification • Notification and guard recovered MEC/ material potentially presenting an explosive hazard (MPPEH) for further disposition by Navy	ESS SOPs will be provided by MEC subcontractor upon procurement

Worksheet #14—Summary of Project Tasks (continued)

Definable Feature of Work	Tasks	SOP
MEC/MPPEH Management and Disposal	• MEC/MPPEH accountability and transfer to Navy • MPPEH processing • Disposal of MDAS	ESS SOPs will be provided by MEC Subcontractor upon procurement
Demobilization	• Demobilize crew and equipment	--
Final Report and Closeout	• Preparation of After Action Report • Preparation of RI Report • Data archiving • Procurement closeout	--

Pre-Mobilization Activities

Before mobilization to the site occurs, planning activities will be performed to enhance timely project execution. This MEC-QAPP has been developed to provide detail for how the project will be performed and the quality standards to which it will be compared. Before mobilization to the site occurs, this plan will be reviewed and approved by CH2M HILL, the Navy, and regulators to ensure that the scope is executed, and health and safety protocols are adhered to as outlined herein. Additionally, coordination will take place to ensure geographic information system information and equipment are available and updated for project activities, document and data management procedures are in place, and all subcontractors have been procured. Subcontractor qualifications, certifications, and licenses will be reviewed before subcontractor selection.

A pre-investigation meeting will be held in advance of the proposed mobilization date for field activities with the Navy that will also serve as the pre-construction and mutual understanding meeting. At the meeting, CH2M HILL will present an overview of the intrusive investigation and discuss project scope, schedule, health and safety concerns, QC procedures, and any site logistical issues to develop a mutual understanding of project details.

Mobilization/Site Preparation

Utility Clearance

Miss Utility and NAS Oceana public works department personnel will be contacted prior to beginning work to mark out utilities. A utility locator will be subcontracted to identify and mark out subsurface utilities. Utilities will be identified using all reasonably available as-built drawings, electronic locating devices, and any other means necessary to maintain the safety of field personnel and the protection of the Base infrastructure.

Mobilization

Mobilization consists of transporting personnel and equipment to the work site and establishing temporary facilities and site controls, consisting of portable sanitary facilities, decontamination area, and site refuge area. General mobilization activities are listed below:

- Identify/procure, package, ship, and inventory project equipment.
- Notify local agencies, including police, hospital, and fire department (onsite and offsite), as appropriate, of the site activities and ensure that they are appropriately equipped to respond to site emergencies.
- Finalize operating schedules.
- Organize support facilities.
- Establish a project command post in an area that is convenient to intrusive activities, but outside the EZs.

Worksheet #14—Summary of Project Tasks (continued)

- Assemble and transport the work force.
- Test and inspect equipment during mobilization and continue daily throughout the duration of project to ensure proper functionality and prevent damage. Repair or replace as necessary to ensure quality performance.
- Establish onsite communications (for example, mobile phones, two-way radios) between team members.
- Conduct site-specific training on the MEC-QAPP, HASP, and MEC procedures and hazards, including "3R training" (recognize, retreat, report). Minimum training requirements are listed in **Worksheet #8.**
- Verify that all onsite personnel review this MEC-QAPP and all applicable SOPs and appendices.
- Verify that all forms and project documentation are in order and project team members understand their responsibilities with regard to completion of project reporting requirements.
- Inform Base and security personnel of site activities and duration of work.

During mobilization, a kickoff and site safety meeting will be conducted. This meeting will include a review of the MEC QAPP review and acknowledgment of the HASP by all site personnel. Additionally, a morning safety meeting will be conducted each day to review the tasks to be performed that day and any potential hazards. Additional meetings will be conducted as needed, as new personnel, visitors, and/or subcontractors arrive at the site.

Site Preparation and EZs

Site preparation activities include establishing boundaries; vegetation removal, if required; and EZs. Anomaly avoidance techniques will be implemented by a UXO escort to avoid any potential surface or subsurface MEC; surface MEC avoidance will be performed during vegetation removal operations. If MEC or MPPEH is identified during site preparations, the item will be disposed of IAW the ESS.

Establish Exclusion Zones

EZs and ECPs will be required and enforced throughout implementation of the RI field activities, IAW the ESS (CH2M HILL, 2013b). While an EZ is in effect, access to these areas will be limited to essential personnel and authorized visitors. Non-essential personnel will be prohibited from entering established EZs. Signs and/or barriers will be located at ECPs to the EZ.

Geophysical Control Points

Four permanent geophysical control points were previously established near the subject project area. The control points are permanent in nature and set at locations that can be expected to remain undisturbed. The horizontal control on the permanent control points are based on the Virginia State Plane Coordinates, South Zone (NAD83).

Transect Layout

DGM will be performed along transects around the original MRS boundary of the DBTs and along transects just beyond the boundary of the MRS on the north, east and west sides, as shown by **Figures 9a and 9b**. (Transect surveys and intrusive investigations were previously conducted within those boundaries.). The ends of each transect will be marked with non-metallic stakes along the transect center line at a maximum spacing of 25 meters (82 feet), to be no taller than 45 centimeters (18 inches) and driven to a depth of 15 centimeters (6 inches). For each transect, the beginning and ending end stakes will be marked with the transect ID and the letter A (beginning end stake) and Z (ending end stake), respectfully. The intermediate transect stakes will begin with B and increase. The stake spacing will be decreased, as needed, in order to maintain unobstructed, line-of-sight from one stake to the next along each transect. For example, stakes will be placed at turning points along transects where transects may bend around trees or other immovable obstructions.

Worksheet #14—Summary of Project Tasks (continued)

Blind Seed Location Survey

As provided in Section 3.4.2 of the GIP (Appendix A), one QC seed per 3,050 linear meters (10,000 linear feet) will be planted throughout the non-mapped portion of the site. Therefore, at least 6 QC seeds will be installed along the proposed 17,500 meters of transects. An additional 4 QC seeds will be installed along the 9,320 meters (30,577 feet) of transects proposed as part of the additional RI activities. The QC seeds will be consistent with the GIP specifications. The UXOQCS will plant and collect the location of the seeds in anomaly avoidance mode with a Land Surveyor. The accuracy of the seed location survey will be within 15 centimeters (6 inches).

Anomaly Avoidance

Anomaly avoidance techniques will be implemented by a CH2M HILL UXO technician to avoid any potential contact with surface or subsurface MEC/MPPEH by non UXO-qualified personnel (e.g. vegetation reduction, survey, DGM and sampling crews). Subsurface anomaly avoidance will be performed during intrusive sampling operations. If a MEC item or MPPEH is recovered during site preparations, the item will be disposed of IAW the ESS.

DGM Survey

The DGM survey will be conducted using an EM61-MK2 coupled with fiducial marks. The DGM team will demonstrate system performance by executing the IVS and equipment testing and setup. The DGM team will then collect geophysical data along 87 transects spaced at approximately 10 meters (3.3 feet) across 53 acres and an additional 41 transects spaced at approximately 10 meters (33 feet) across 33 acres to locate subsurface anomalies that may represent subsurface MEC/MPPEH (**Figures 9a and 9b**). As discussed in Section 3.1.2 of the GIP (included in **Appendix A**), the MQO of lane spacing is to maintain appropriate lane spacing to ensure appropriate coverage of the area. The intended lane spacing will be 10 meters (3.3 feet), with a ±20 percent leeway allowance, with the exception of locations where vegetation (that cannot be cut) or terrain cause greater deviation. The DGM subcontractor SOP describes the procedures to be used to acquire geophysical data by using electromagnetic detectors, positioned with fiducial methods.

After an analysis of the DGM data, the DGM subcontractor will process and interpret the geophysical data and the project QC Geophysicist will provide QC review of the data and statistical selection of the geophysical anomalies.

DGM Data Processing

DGM data processing details and deliverable requirements are presented in the GIP (**Appendix A**).

Anomaly Reacquisition

The selected anomalies will be reacquired with an EM61-MK2 and intrusively investigated in accordance with Section 6.1.3 of the ESS (CH2M HILL, 2013b). Geophysical anomalies identified for excavation will be reacquired using fiducial, or measuring tapes from transect stakes. Each anomaly location will be flagged using a polyvinyl chloride flag with the unique anomaly identifier recorded in indelible ink. The flag will be placed 1 foot north of the actual reacquired anomaly location.

Intrusive Investigation of DGM Identified Anomalies and Removal Verification

MEC removal operations will be performed via hand excavation to identify the source of individual anomalies to a maximum depth of 2 feet bgs. Handheld metal detectors (e.g., Schonstedt GA-52Cx or White's XLT) may be used by UXO Technicians to assist in pinpointing the source(s) of anomalies; however, final confirmation of a cleared hole will be performed with an EM61-MK2 by a UXO technician with a quality control check by the UXOQCS.

Details associated with this operation are included in the SOPs presented in **Appendix B**. The SOPs will be provided by the subcontractors once procured. The following basic techniques will be used for anomaly excavation:

Worksheet #14—Summary of Project Tasks (continued)

- The UXO technician will investigate within a 1-meter radius, to a maximum depth of 2 feet bgs, of the flagged anomaly using an appropriate geophysical instrument for pinpointing assistance.
- Until identified otherwise, the anomaly is assumed to be MEC. Excavation will be initiated adjacent to the subsurface anomaly. The excavation will continue until the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with an appropriate geophysical instrument.
- Using progressively smaller and more-delicate tools to remove the soil carefully, the excavation team will expand the sidewall to expose the metallic item for inspection and identification without moving or disturbing the item.
- Once the item is exposed for inspection, the excavation team will determine if it is MEC and/or MPPEH.
- Recovered MEC and MPPEH will be assessed and their explosives safety status documented in accordance with the ESS (CH2M HILL, 2013b).
- If the item is not MEC, it will be removed and the area will be rechecked with an EM61-MK2 to ensure that a MEC item was not hidden beneath the removed item. The excavation team will then annotate the results of the excavation on the dig sheet and move on to the next marked DGM anomaly.
- Anomaly locations inspected, along with results of the inspection, will be documented by the MEC subcontractor and provided to the CH2M HILL SUXOS.

Detailed information on the intrusive investigation process will be in the MEC Subcontractor's SOP, which will be submitted after the subcontractor has been procured.

For each anomaly location inspected, QC inspections of the intrusive investigation will proceed as follows:

- After the dig team intrusively investigates an anomaly location, the hole is to be left open to the depth investigated and the polyvinyl chloride flag placed in the hole or bent after the investigation is completed.
- The UXOQCS will inspect the intrusively investigated anomaly locations using an EM61-MK2 to determine whether all detectable metallic items within a 1-meter radius of the hole and within the 2-foot excavation depth have been identified and investigated. If the source of the anomaly is below 2 feet bgs, the source of the anomaly will remain in place.
- All holes related to intrusive investigations will be filled back to original grade or covered before departing the project site each day following QC verification.
- Anomaly locations inspected, along with results of the inspection and corrective actions planned (in the event that the UXOQCS decides that inspection results require a change in intrusive team procedures or a re-performance of any work), will be documented and provided to CH2M HILL SUXOS.
- Additional QC analysis of intrusive results vs. original amplitude of geophysical anomalies will be performed by the CH2M HILL Project QC Geophysicist. Anomaly locations that are determined to need re-investigation through this process will be re-inspected.

MEC/MPPEH Management and Disposal

All explosive operations will follow the procedures outlined in TM 60A-1-1-31 (Army, 1989). Demolition operations will be performed daily, or the MEC will be properly secured until operations can be conducted. Demolition operations will be performed within the MRS. Recovered MEC and MPPEH will be evaluated by the SUXOS and UXOSO and classified as either acceptable to move or unacceptable to move. Recovered MEC/MPPEH classified as unacceptable to move will be blown-in-place. If MEC/MPPEH is acceptable to move, it may be carried by hand within the MRS for demolition. If the MEC/MPPEH item cannot be disposed on the day of discovery, the item will be flagged, secured, and continually guarded until such time as demolition operations occur. Base security will also be notified.

Worksheet #14—Summary of Project Tasks (continued)

All recovered MEC and MPPEH will be destroyed onsite by detonating the items with donor explosives IAW the ESS.

An MEC/MPPEH holding area will be established. MEC/MPPEH will be managed IAW Section 6.3 of the ESS.

Demolition Team

The Demolition Team will be composed of a minimum of three UXO-qualified individuals and will be responsible for identifying demolition locations, developing site security controls and engineering controls for the demolition events, and delivering and guarding any explosives delivered to the site. The Demolition Team Supervisor will coordinate with the UXOSO, who is not a member of the Demolition Team. The Demolition Team Supervisor will inspect each post-detonation location after a minimum of 5 minutes have passed to confirm a complete detonation, assess fire hazards, assess the response, and recover potential remaining explosives that were not consumed in the explosion.

Demolition Operations

Before demolition operations begin, the SUXOS will notify and coordinate with local emergency services to reduce public exposure, maintain safety, and keep the public informed. The emergency contacts and phone numbers are provided in the HASP.

All nonessential personnel to the operations will be evacuated to a distance greater than the established minimum fragmentation distance for the MEC being detonated. Before priming of demolition charges, all avenues of entry will be physically blocked and positive control will be maintained. Entry control points (ECPs) shall be established IAW the ESS (CH2M HILL, 2013b). Radio communications shall be maintained among all concerned parties. Avenues of ingress will not be opened without the express permission of the Demolition Team Supervisor.

While preparing MEC for detonation, the Demolition Team Supervisor will ensure that the number of personnel onsite is kept to the minimum required to safely accomplish the disposal mission. The MEC disposal process will be performed in accordance with demolition practices outlined in TM 60A-1-1-31 and manufacturer's guidelines.

During demolition operations, the Demolition Team Supervisor will control and be responsible for explosive disposal operations to ensure the following:

- The area is clear and remains clear of unauthorized personnel.
- The UXOSO shall have sole custody of and maintain the firing device, and shall not delegate or authorize connection to the firing device or initiation of the pyrotechnic chain until the maximum fragmentation distance is secured for horizontal and vertical fragmentation distances. Only the UXOSO may give permission to the Demolition Team Supervisor to prime a detonation and ignite or fire a detonation.
- The Demolition Team Supervisor shall confirm by verbal communication and document the time of communication approval from the UXOSO to authorize a detonation.
- Preparatory activities for demolition are summarized below and detailed in the applicable SOPs listed in **Worksheet #21b**:
  - Review of the DDESB-approved ESS for conformance to plan criteria.
  - Review and conform to Explosive Management Plan guidance and requirements.
  - CH2M HILL will notify the Navy NTR prior to conducting demolition activities.
  - Identify MEC or MPPEH item and applicable technical publication or ORDATA II Database (http://ordatamines.maic.jmu.edu), for functioning, hazards, safeties, warnings, and/or notes.

Worksheet #14—Summary of Project Tasks (continued)

- Identify MEC or MPPEH item and applicable technical publication or ORDATA II Database (http://ordatamines.maic.jmu.edu), for functioning, hazards, safeties, warnings, and/or notes.
- Document (demo/safety logbooks) Demolition Team Supervisor and UXOSO review of commercial explosives manufacturer's: safety notes, warnings instructions, and Material Safety Data Sheets for explosives and as applicable initiation or firing device or systems manufacture's guidelines.
- Review POC list, emergency upwind rally points and evacuation points, location and directions to hospital; ensure that detonation and safety support vehicles have directions and map to the hospital with communications; and ensure demolition vehicle has two 20-pound BC-rated fire extinguishers.
- Ensure emergency response equipment identified within HASP is on hand.
- Ensure two means of communication are available.
- Designate essential personnel to be involved in the operation.
- Acquire protective work materials and implement approved engineering controls.

Following the completion of demolition activities, CH2M HILL will notify and provide a summary of the demolition activities and outcome to the Navy NTR.

Unintentional Detonation

These emergency procedures provide a plan in the event of an explosive emergency and provide procedures to be followed to limit the extent of injury and damage until qualified professionals can arrive to provide assistance.

After an explosion occurs, additional explosions may occur. Therefore, the response to unintentional detonations should involve a minimal number of personnel. Emergency steps are as follows:

- Contact emergency services
- Minimal number of personnel (one person if possible) provides first aid
- Additional personnel withdraw to safe rally point
- One UXO-qualified person meets first responders and escorts them to the explosion site

MEC Data Reporting

The collection of accurate and detailed data is essential to documenting MEC-related discoveries and resulting disposition of MEC for future reference. Digital tracking forms for MEC and MPPEH will be used to list data for each MEC/MPPEH item encountered. The tracking form will be filled out with the following information:

- **Unique identity number**—Also to be incorporated in photographs of the item (by using a dry erase board, for example)
- **Location**—Northing and easting coordinates
- **Depth to Item**—If the item is partially buried, depth to the center of the mass of the item (recorded in inches)
- **Orientation**—Geographical direction (N, S, E, W) the item is pointing, unless vertical
- **Type and Nomenclature**—Type of ordnance and nomenclature, as specifically as possible; to also be incorporated in photographs of the item (by using a dry erase board, for example)
- **Filler**—Type of filler, such as none, inert, high explosive, white phosphorus, illumination, incendiary, chemical, or smoke
- **Fuze**—Type of fuze, such as none, filler plug, inert, point detonating, powder train, or base detonating

Worksheet #14—Summary of Project Tasks (continued)

- **Date and Time Found**—Date when the MEC/MPPEH item was found and approximate time it was found
- **Team or Individual**—Team number or individual's name that found the MEC/MPPEH/ item
- **Disposal**—Disposal status
- **Date Disposed**—Date when the MEC/MPPEH item was disposed
- **Photo identification (ID)**—Photo number(s) from camera or ID number if included in photo
- **Comments**—Any noteworthy comments

MDAS Management

Before release of the material for disposal, material will be inspected in the containers to ensure that it is free of explosives. DD Form 1348-1A will be used as 100 percent inspection/100 percent re-inspection documentation. All DD Form 1348-1A documentation will clearly show the following information in typed or printed letters:

- Name of SUXOS and the government representative (or designee)
- Organization
- Two signatures from UXO Technician III's not in the same chain of command (i.e., SUXOS and the UXOSO, SUXOS, and a government representative)
- Contractor's office
- Field office phone number(s) of the persons certifying and verifying the MDAS
- Basic material content (type of metal [e.g., steel, mixed])
- Estimated weight
- Unique identification of each sealed container
- Location where MDAS was obtained
- Seal identification, if different from the unique identification of the sealed container

CH2M HILL will coordinate with the NAVFAC NTR to maintain the chain of custody and final disposition of the certified and verified materials. The certified and verified materials will be released to an approved processing facility for disposal. If the chain of custody is broken, the affected MDAS will undergo a second 100 percent inspection, a second 100 percent re-inspection, and be documented to verify its explosive safety status (identified as either MDAS or other debris).

Disposal of MDAS

MDAS will be accumulated in appropriately sized containers, characterized, transported, and disposed of IAW the ESS (CH2M HILL, 2013b).

Demobilization

Full demobilization of equipment and personnel will occur when site activities are complete and appropriate QA/QC checks have been performed.

Worksheet #14—Summary of Project Tasks (continued)

Final Report and Closeout

After Action Report

An After Action Report will be prepared for the DBTs when it is determined that munitions response actions are complete. The After Action Report will be prepared IAW NOSSA Instruction 8020.15D (NOSSA, 2013) to document the results of the MEC intrusive investigations. The reports will provide a summary of all MEC found during the investigation, summarize all the MEC removal activities, and provide an evaluation of the selected removal methods and their relative effectiveness.

RI Report

The RI report will be prepared and will include a summary of previous SI and a site history; a physical features description; a summary of completed field activities, including DGM and anomaly investigation results; an evaluation of site characterization data, including nature and extent of MEC; a MEC Hazard Assessment; and revised MRS prioritization protocol. The RI report will also identify and describe any additional MR actions.

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Worksheet #15a—Reference Limits and Evaluation Table (Environmental Response)

Matrix:
Analytical Group:
Concentration Level:

Analyte	Chemical Abstract Service Number	Tap Water Regional Screening Levels	Maximum Contaminant Levels	Project Quantitation Limit Goal	Laboratory-Specific Limits	
					Quantitation Limits	Method Detection Limits

Not Applicable

Worksheet #15b—Reference Limits and Evaluation Table (Munitions Response)

As discussed in **Worksheet #11**, data collected during this investigation will be used to evaluate removal alternatives in an FS. Therefore, due to the nature of this investigation, there are no traditional reference or action limits that can be established for this phase of the RI.

MEC Item	PAL	PAL Reference	Project Quantitation Limit Goal	Validated Detection Limits for Specific Munitions Detection System

Not Applicable

Worksheet #16—Project Schedule/Timeline Table

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date of Initiation	Anticipated Date of Completion		
MEC QAPP					
Draft MEC QAPP	CH2M HILL	02/11/2013	06/11/2013	Draft MEC QAPP	06/11/2013
Navy MR Review	NAVFAC	06/12/2013	06/13/2013	Comments on Draft MEC QAPP	
Draft Final MEC QAPP	CH2M HILL	06/14/2013	07/02/2013	Draft MEC QAPP	07/02/2013
Partnering Team Review	NAVFAC and VDEQ	07/02/2013	08/23/2013	Comments on Draft MEC QAPP	
Final MEC QAPP	CH2M HILL	08/26/2013	10/31/2013	Final MEC QAPP	10/31/2013
Amend Existing MEC QAPP					
Draft MEC-QAPP	CH2M HILL	08/26/2014	10/16/2014	Draft QAPP	10/16/2014
Navy MR Review	NAVFAC	10/17/2014	10/23/2014	Comments on Draft MEC-QAPP	
Draft Final MEC-QAPP	CH2M HILL	10/24/2014	10/29/2014	Draft Final MEC-QAPP	10/29/2014
Partnering Team Review	NAVFAC and VDEQ	10/30/2014	11/12/2014	Comments on Draft Final MEC-QAPP	
Final MEC-QAPP	CH2M HILL	11/20/2014	11/26/2014	Final MEC-QAPP	11/26/2014
Amend Existing ESS					
Draft ESS	CH2M HILL	03/15/2013	03/21/2013	Draft ESS	03/21/2013
NAVFAC Review	NAVFAC	03/22/2013	04/08/2013	Comments on Draft ESS	04/08/2013
Naval Ordnance Safety and Security Activity (NOSSA) Review	NOSSA	04/09/2013	05/22/2013	Comments on Draft ESS	05/22/2013
Resolution of NOSSA Comments	CH2M HILL	05/23/2013	06/03/2013		
Submit Final ESS/NOSSA Endorsement	NOSSA	06/04/2013	07/24/2013	Final ESS	07/24/2013
Receive DDESB Acceptance of ESS	DDESB	10/03/2013	10/03/2013		
ESS Amendment 2					
Draft ESS Amendment 2	CH2M HILL	08/25/2014	09/16/2014	Draft ESS Amendment 2	09/16/2014
NAVFAC Review	NAVFAC	09/17/2014	09/24/2014	Comments on Draft ESS	

Worksheet #16—Project Schedule/Timeline Table

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date of Initiation	Anticipated Date of Completion		
NOSSA Review	NOSSA	10/01/2014	10/31/2014	Comments on Draft ESS	
Submit Final ESS/NOSSA Endorsement	NOSSA	11/07/2014	12/07/1204	Final ESS	12/07/2014
Receive DDESB Acceptance of ESS	DDESB	02/14/2015	02/14/2015		
Field Investigation					
DGM Subcontractor Procurement	CH2M HILL	09/16/2013	10/25/2013		
MEC Service Subcontractor Procurement	CH2M HILL	09/16/2013	10/25/2013		
Field Investigation – surface clearance (if necessary)	CH2M HILL	11/11/2013	11/15/2013		
Field Investigation – DGM Survey	CH2M HILL and DGM subcontractor	11/18/2013	11/22/2013		
Field Investigation – Intrusive Investigation and MEC/MPPEH Management	CH2M HILL and MEC Service subcontractor	01/20/2014	02/07/2014		
Additional Field Investigation					
DGM Subcontractor Procurement	CH2M HILL	10/01/2014	11/21/2014		
MEC Service Subcontractor Procurement	CH2M HILL	10/20/2014	12/12/2014		
Field Investigation – Vegetation Reduction and Land surveying	CH2M HILL	12/08/2014	12/19/2014		
Field Investigation – DGM Survey	CH2M HILL and DGM subcontractor	01/05/2015	01/06/2015		
Field Investigation – Intrusive Investigation and MEC/MPPEH Management	CH2M HILL and MEC Service subcontractor	02/23/2015	02/27/2015		
RI Report					
RI Report	CH2M HILL	03/02/2015	09/08/2015		

Worksheet #17—Sampling Design and Rationale

This worksheet describes the MEC sampling design and rationale that will be used to select the DGM geophysical anomalies for intrusive investigation. This process will be performed to meet the requirements and objectives of the intrusive investigation as they are defined in **Worksheet #11**. The DFOWs for the RI at the DBTs are presented in **Worksheet #14** and the location where any additional supporting documentation for the DFOWs is listed in the table below.

Definable Feature of Work	SOP	Supporting Document(s)
Pre-Mobilization Activities	-	MEC-QAPP
Mobilization/Site Preparation	-	MEC-QAPP, ESS
Anomaly Avoidance	CH2M HILL MR-001 Anomaly Avoidance SOP	MEC-QAPP
DGM Survey	SOPs will be provided by DGM survey subcontractor upon procurement	MEC-QAPP, GIP, Geophysical System Verification
DGM Data Processing	GIP is provided in Appendix A	MEC-QAPP, GIP
Anomaly Reacquisition	SOPs will be provided by DGM subcontractor upon procurement	MEC-QAPP, ESS
Intrusive investigation of DGM identified anomalies and removal verification	SOPs will be provided by MEC subcontractor upon procurement	MEC-QAPP, ESS
MEC//MPPEH Management and Disposal	SOPs will be provided by MEC subcontractor upon procurement	MEC-QAPP, ESS
Demobilization	-	MEC-QAPP
Final Report and Closeout	-	MEC-QAPP

Statistical Anomaly Selection

Not all of the geophysical anomalies identified during the DGM survey will represent MEC. Furthermore, it is not possible to investigate every anomaly located within the 53 acres adjacent to the DBTs. As such, a statistically significant subset of the geophysical anomalies identified in the DGM surveys will be randomly selected for intrusive investigation for each DBT. The Estimating a Proportion statistical method, described below, will be used to determine the quantity of anomalies to be investigated to obtain a 95 percent confidence (with a ± 5 percent sampling error) in the distribution of the different types of sources of anomalies.

When a population size is large (i.e. [n] np ≥ 5 and n(1-p) ≥ 5) or unknown, the necessary sample size of DGM anomalies to be intrusively investigated can be calculated using the following statistical sample size formulas:

$$n_0 = \frac{Z_\alpha^2 pq}{e^2}$$

Where:

Z_α = desired confidence level
p = proportion of DGM anomalies classified as munitions-related
q = proportion of DGM anomalies classified as non- munitions -related (q = 1-p)
e = acceptable margin of error for proportion being estimated
n_0 = statistical sample size for a large population

Worksheet #17—Sampling Design and Rationale (continued)

When the population size is known, the following finite population correction can be used to reduce the number of anomalies required to obtain the same confidence level:

$$n_1 = \frac{n_0}{1+\left(\frac{n_0}{N}\right)}$$

Where:

n_1 = adjusted statistical sample size for a finite population
n_0 = statistical sample size for a large population
N = size of the population (number of DGM anomalies)

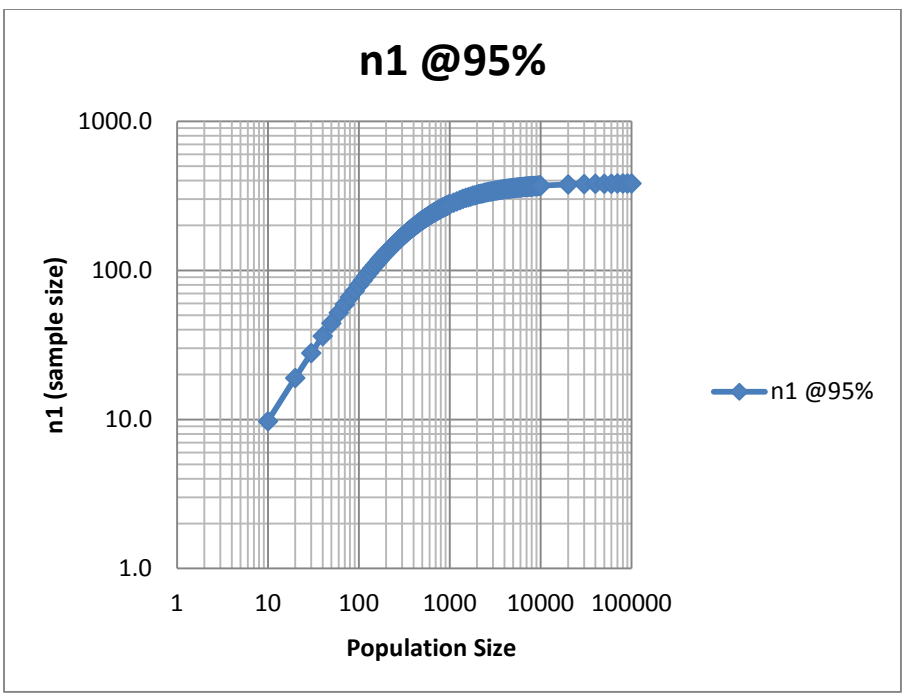
When estimating the variance of proportional variables (i.e., munitions-related or non-munitions-related), it is most conservative to estimate a population proportion of 50 percent (p=0.5); the result is that variance (pq) is maximized, and therefore the required sample size is also maximized.

Using a z-statistic for a 95 percent confidence level (Z_α=1.96) and a margin of error of 5 percent (e=0.05), the solution for n_0 becomes:

$$n_0 = \frac{Z_\alpha^2 pq}{e^2} = \frac{1.96_\alpha^2(0.5)(0.5)}{0.05^2} = 384$$

This formula calculates that a maximum of 384 randomly selected DGM anomalies need to be classified to determine with 95 percent confidence and ± 5 percent sampling error the proportion of MEC-related to non-MEC-related DGM anomalies in a large or unknown population.

Based on the number of anomalies identified in the DGM surveys, the finite population correction, as shown in the example below, will be used to decide if the quantity of anomalies to be intrusively investigated may be reduced while maintaining 95 percent confidence in the distribution of the different types of sources of anomalies.



Worksheet #17—Sampling Design and Rationale (continued)

For the purpose of illustration, the finite population correction for a total population of 5,000 anomalies is solved below. Note that this is an example only, and the actually quantity of anomalies selected for intrusive investigation will be determined after the completion of the DGM surveys.

$$n_1 = \frac{n_0}{1+\left(\frac{n_0}{N}\right)} = \frac{384}{1+\frac{384}{5000}} = 356.6$$

In this example, if 5,000 subsurface anomalies are identified along the transects within the DBTs, intrusive investigation of 357 randomly-selected anomalies would allow us to determine with 95 percent confidence and ± 5 percent sampling error if munitions-related items are present among the subsurface anomalies identified along those transects.

After conducting the Estimating a Proportion statistical analysis, a random number selector will be applied to the target list to select the anomalies for intrusive investigation.

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Worksheet #18—Sampling Locations and Methods and Standard Operating Procedure Requirements Table

Data collection activities performed at the site will include DGM transect surveys spaced at 10m intervals across the 53 acres adjacent to the initial DBT boundaries, as shown on **Figures 9a** and **9b**.

Location	Exclusion Areas	Matrix	Depth relative to Ground Surface	Survey Methodology	Degree of Investigation or Coverage	SOP Reference
10 percent of the 53 acres adjacent to the DBTs	None	Soil	Unknown	Geonics EM61-MK2 Schonstedt	A statistically significant quantity of anomalies will be re-acquired for intrusive investigation.	SOPs for Geophysical Mapping, Geonics EM61 – MK2 (Appendix B)
10 percent of the 33 acres just beyond the MRS boundary	None	Soil	Unknown	Geonics EM61-MK2 Schonstedt	A statistically significant quantity of anomalies will be re-acquired for intrusive investigation.	SOPs for Geophysical Mapping, Geonics EM61 – MK2 (Appendix B)

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Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers	Sample Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/Analysis)

Not Applicable

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Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of Matrix Spike/Matrix Spike Duplicate	No. of Field Blanks	No. of Equip. Blanks	No. of Volatile Organic Analyte Trip Blanks	No. of Proficiency Test Samples	Total No. of Samples to Lab

Not Applicable

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Worksheet #21—Project Sampling SOP References Table (Munitions Response)

Reference Number	Title, Revision Number and/or Date	Originating Organization	Equipment Type	Modified for Project Work?	Comments
ES-P02-05-02-P	Operational Readiness Review (ORR)	CH2M HILL	ORR Form	No	
MRP-SOP-0001	Surface Munitions and Explosives of Concern (MEC) & Subsurface Anomaly Avoidance	CH2M HILL	Schonstedt GA-52Cx	No	
EM61-MK2	Standard Operating Procedures for Geophysical Mapping, Geonics EM61 – MK2	NAEVA Geophysics	Geonics EM61 – MK2	No	
OPS-03	Demolition/Disposal Operations	USA-E	None	No	
OPS-04	DGM Anomaly Investigations	USA-E	Schonstedt GA-52Cx	No	
OPS-05	Digital Geophysical Mapping	USA-E	Geonics EM61-MK2	No	
OPS-13	MPPEH Management	USA-E	None	No	
OPS-14	MEC Analog Detection and Removal Actions	USA-E	Schonstedt GA-52Cx	No	
None	EM61-MK2 Setup and Use For Reacquire and Post Intrusive Checks	USA-E	Geonics EM61-MK2	No	

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Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

See also **Worksheet #12-1.**

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference	Comments
EM61-MK2	Verification	At the beginning of each work day when used. (Some tests are also run at the end of the day.) DGM system is warmed up before use and QC tests are run to ensure stability and functionality.	System passes QC test measures	Inspect/repair equipment until functioning properly.	Equipment operator	EM61-MK2 and OPS-05	MR QC Geophysicist to confirm test performed through data collection notes and data evaluation.
Schonstedt or White's XLT (or equivalent)	Verification	At the beginning of each work day when used	System responds to items in Equipment Check Area	Inspect/repair equipment until functioning properly.	Equipment operator	MRP-SOP-0001, OPS-04, and OPS-14	UXOQCS verifies daily equipment check of handheld magnetometers.

[1] Activities may include: calibration, verification, testing, and/or maintenance.

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Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)

Not Applicable

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Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference

Not Applicable

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Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference

Not Applicable

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Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
SAMPLE RECEIPT AND ANALYSIS
SAMPLE ARCHIVING
SAMPLE DISPOSAL

Not Applicable

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Worksheet #27—Sample Custody Requirements Table

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):
Sample Identification Procedures:
Chain-of-custody Procedures:

Not Applicable

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Worksheet #28—Laboratory QC Samples Table

Matrix:
Analytical Group:
Analytical Method/SOP Reference:

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank						
Laboratory Control Standard						
Internal Standards						
System Monitoring Compounds/Surrogates						

Not Applicable

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Worksheet #29—Project Documents and Records Table

Document/Report/Form	Generator	DFOW	Frequency of Completion	Location/Where Maintained
Field Notebook	CH2M HILL FTL	All fieldwork	Daily	CH2M HILL local server, hard copy onsite then in project file
Work Plans (MEC-QAPP)	CH2M HILL	Pre-mobilization activities	Once prior to beginning fieldwork	CH2M HILL local server, hard copy onsite then in project file
CA Forms	CH2M HILL	All fieldwork	As necessary	CH2M HILL local server and project file
Digital handheld field devices (for example, PDAs)	CH2M HILL DGM Subcontractor MEC Subcontractor	DGM survey, anomaly reacquisition, intrusive investigation of DGM- identified anomalies, and anomaly verification	Daily	CH2M HILL local server, hard copy onsite (digital handheld field device and hand written), and then in project file
Equipment/Instrument Check Logs	CH2M HILL MEC Subcontractor Reacquisition Subcontractor	Anomaly Reacquisition/Intrusive investigation of DGM identified anomalies/Anomaly Removal Verification	As required by this MEC-QAPP	CH2M HILL local server, hard copy onsite then in project file
Daily QC Reports (PP, IP, and FP)	CH2M HILL	All fieldwork	Daily	CH2M HILL local server, hard copy onsite then in project file
Field Photograph Log	CH2M HILL	All fieldwork	Daily/As necessary	CH2M HILL local server
Daily Project Reports	CH2M HILL	All fieldwork	Daily	CH2M HILL local server, hard copy onsite then in project file
Daily H&S Documents	CH2M HILL	All fieldwork	Daily	CH2M HILL local server, hard copy onsite then in project file
Training Records	CH2M HILL Subcontractors	All fieldwork	Prior to mobilization to the site	Hard copy onsite and with Human Resources
Meeting Agendas, Minutes, Presentation, etc	CH2M HILL	All DFOWs	As necessary	CH2M HILL local server
RI Report	CH2M HILL	Final report	Once upon completion of site activities	CH2M HILL local server

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Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory/ Organization	Backup Laboratory/ Organization

Not Applicable

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Worksheet #31—Planned Project Assessments Table

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 CA	Person(s) Responsible for Monitoring Effectiveness of CA
Geophysical Data Quality Assessment	Daily during DGM survey	External	NAEVA Geophysics	DGM Subcontractor QA Manager, Karen Lemley	PM/CH2M HILL, MR Senior Geophysicist/ H2M HILL	MR Senior Geophysicist/ CH2M HILL	PM/CH2M HILL
Field Performance Audit to verify removal of excavated anomaly sources	Once at the end of the intrusive investigation	Internal	CH2M HILL	SUXOS and/or MR Senior Geophysicist	MEC Subcontractor, DGM Subcontractor	UXOQCS/CH2M HILL	PM/CH2M HILL
Field Performance Audit	Once during field event	Internal	CH2M HILL	SUXOS and/or MR Senior Geophysicist	MEC Subcontractor, DGM Subcontractor	FTL/CH2M HILL	PM/CH2M HILL
Data storage and transfer system check	Prior to initial data collection and once weekly	Internal	CH2M HILL	MR Senior Geophysicist	FTL	FTL/CH2M HILL	PM/CH2M HILL

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Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	CH2M HILL PM	Within 1 week of audit	Memorandum	CH2M HILL SUXOS CH2M HILL MR Senior Geophysicist	Within 1 week of receipt of CA Form

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Worksheet #32-1—Corrective Action Form

Person initiating corrective action (CA): _____ Date: _____

Description of problem and when identified (Submit a drawing/sketch if necessary):

_____
_____
_____
_____
_____

Cause of problem, if known or suspected:

_____
_____
_____
_____
_____

Resolution/Sequence of CA: (including date implemented, action planned and personnel/data affected)

_____
_____
_____
_____
_____

CA implemented by: _____ Date: _____

CA initially approved by: _____ Date: _____

Follow-up date: _____

Final CA approved by: _____ Date: _____

Information copies to:

_____
_____
_____
_____

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Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members

Yes No 1) Is the approved work plan being followed?

Comments _____

_____

Yes No 2) Was a briefing held for project participants?

Comments _____

_____

Yes No 3) Were additional instructions given to project participants?

Comments _____

_____

DGM Operations

Yes No 1) Are routine inspections and QC checks of the equipment being performed as outlined in this MEC-QAPP?

Comments _____

_____

Yes No 2) Is the proposed location of transect lines clearly communicated with DGM Survey Team?

Comments _____

_____

Yes No 3) Is data collection being performed as required by the MEC-QAPP?

Comments _____

_____

Yes No 4) Are data stored properly and uploaded for transfer in a timely manner?

Comments _____

_____

Yes No 5) Are photographs taken and documented?

Comments _____

_____

Worksheet #32-2—Field Performance Audit Checklist (continued)

Document/Data Control

Yes No 1) Are all work plan documents available onsite for review?

Comments _____

_____

Yes No 2) Are daily reports and other documentation completed as required by the MEC QAPP?

Comments _____

_____

Yes No 3) Are equipment QC data and collected field data properly transferred for review?

Comments _____

_____

Worksheet #33—QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date	Person Responsible for Report Preparation	Report Recipient(s)
Daily QC Report	Daily	Following day	UXOQCS for UXO related activities; FTL for non-UXO related activities	Navy
QC Meeting Minutes	Post Meeting	Within 7 days	UXOQCS for UXO related activities; FTL for non-UXO related activities	Navy
Preparatory Inspection Forms	Once for each applicable DFOW (prior to start of task)	With daily reports the following day after meeting	UXOQCS for UXO related activities; FTL for non-UXO related activities	Navy
Initial Inspection Forms	Once for each applicable DFOW (prior to start of task)	With daily reports the following day after meeting	UXOQCS for UXO related activities; FTL for non-UXO related activities	Navy
Follow-Up Inspection Forms	Once for each applicable DFOW (document in daily reports)	Document in daily reporting	UXOQCS for UXO related activities; FTL for non-UXO related activities	Navy
RI Report	Post-field event	See **Worksheet #16**	PM/CH2M HILL	Stakeholders, see **Worksheet #4**

The RI report will include the following:

- Executive Summary
- Introduction: Describe the objectives and scope of the RI, as well as the organization of the RI report.
- Environmental Setting: Describe the current and historical land uses associated with NALF Fentress and the DBTs, discuss previous investigations conducted at the site, and summarize the physical characteristics of the site, such as climate, geology, hydrology, and ecology.
- RI Activities: Provide details of the data gathering methods and approaches used during the field activities.
- Investigation Findings: Present the analytical data pertaining to each media type, DGM and intrusive results, and assesses the nature and extent of MEC at the site.
- MEC Hazard Assessment (MEC HA)
- Conclusions and Recommendations: Summarize the results of the RI and the potential MEC hazard, as well as provide recommendations for additional activities at the site.

Supplemental information, such as figures, tables, survey data, DGM data, intrusive anomaly data, and the MEC HA supporting calculations, will be included as appendices to the report.

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Worksheet #34—Verification (Step I) Process Table

A preparatory phase inspection will be performed prior to beginning each DFOW to review applicable specifications and verify the necessary resources, conditions and controls are in place and compliant before the start of work activities. An initial phase inspection will be performed at the beginning of each DFOW to observe/review the application of procedures to ensure their adequacy, ensure adequate resources are applied to the activity and that a clear understanding exists as to the quality control requirements of the DFOW. The responsible person will inspect the relevant items from the checklist in the SOP, as appropriate.

Definable Feature of Work	Verification Description	Verification Documentation	Responsible for Verification (name, organization)
Pre-mobilization Activities	Prior to mobilization to the site, verify – project personnel have proper training and required certification to perform site activities and achieve project measurement quality objectives. – site access has been approved for project personnel, including subcontractor and that appropriate security measures are in place for personnel and equipment.	QC Forms	PM/CH2M HILL, UXOQCS/CH2M HILL
Mobilization/Site Preparation	Prior to mobilization to the site, verify on site personnel – have reviewed the approved ESS, MEC-QAPP, and applicable SOPs, and – understand the project objectives, procedures, and measurement quality objectives.	QC Forms	PM/CH2M HILL, and UXOQCS/CH2M HILL
Anomaly Avoidance	Prior to any site activities, verify that project personnel – are familiar with MRP-SOP-0001 (MEC Surface and Subsurface Anomaly Avoidance), and – have completed “3R” training.	QC Forms/MRSIMS	UXOQCS/CH2M HILL
DGM Survey	Prior to DGM survey activities, verify that DGM personnel – are familiar with the geophysical survey methods for the GSV and DGM survey, including navigation and data collection procedures detailed in the , GIP, and appropriate SOPs and – will conduct DGM survey activities in accordance with the approved MEC-QAPP.	QC Forms/MRSIMS	MR Senior Geophysicist/CH2M HILL
DGM Data Processing	Prior to DGM data processing, verify – data collection is complete, data have been recorded accurately, and data transfer procedures are adequate, and – DGM data processors are familiar with the methods and procedures detailed in the GIP and will process and interprate DGM data in accordance with the approved MEC-QAPP.	QC Forms/MRSIMS	MR Senior Geophysicist/CH2M HILL

Worksheet #34—Verification (Step I) Process Table (continued)

Definable Feature of Work	Verification Description	Verification Documentation	Responsible for Verification (name, organization)
Anomaly Reacquisition	Prior to anomaly reacquisition, verify reacquisition personnel – are familiar with applicable SOPs and will reacquire selected anomalies in accordance with the approved MEC-QAPP.	QC Forms/MRSIMS	MR Senior Geophysicist/CH2M HILL and UXOQCS/CH2M HILL
Intrusive investigation of DGM-identified anomalies and removal verification	Prior to intrusive operations, verify intrusive investigation personnel – are familiar with the procedures detailed in the ESS and applicable SOPs and – will conduct intrusive operations in accordance with the approved ESS and MEC-QAPP.	QC Forms	MR Senior Geophysicist/CH2M HILL and UXOQCS/CH2M HILL
MEC/MPPEH Management and Disposal	Prior to MEC/MPPEH management and disposal operations, verify that UXO personnel – are familiar with the procedures detailed in the ESS and applicable SOPs and – will conduct MEC/MPPEH management and disposal operations in accordance with the approved ESS and MEC-QAPP.	QC Forms	UXOQCS/CH2M HILL
Demobilization	Prior to demobilization, verify – on-site activities are complete and – the site has been restored to preexisting conditions.	QC Forms	PM/CH2M HILL, UXOQCS/CH2M HILL
Final Report and Closeout	N/A		

Worksheet #35—Validation (Steps IIa and IIb) Process Table

Follow-up inspections are conducted to ensure that procedures are being correctly performed, no changed conditions exist which may affect the quality of work and lessons learned are being captured and applied.

Definable Feature of Work	Frequency of Inspection	Validation Description/Documentation	Validation Documentation	Responsible for Validation (name, organization)
Pre-mobilization Activities	N/A	No Follow-up required for this DFOW	N/A	N/A
Mobilization/Site Preparation	N/A	No Follow-up required for this DFOW	N/A	N/A
Anomaly Avoidance	Minimum of one team per day	Inspection to validate that MRP-SOP-0001 (MEC Surface and Subsurface Anomaly Avoidance), is being followed	QC Forms	UXOQCS/CH2M HILL
DGM Survey	Minimum of one team per day	Inspection to confirm – Part 1 of the GSV Process (IVS) has been conducted in accordance with the GSV Plan, and – the results of the IVS survey indicate the DGM system will meet the project measurement quality objectives. Inspection of DGM activity records to validate – subcontractor-provided SOPs and the GIP are being followed, – survey coverage is in accordance with approved project plans, and – data measurement quality objectives are being achieved.	QC Forms/MRSIMS	MR Senior Geophysicist/CH2M HILL
DGM Data Processing	Per data set	Inspection of DGM data processing to validate – data processing procedures detailed in the GIP are being followed and – data and interpretation results are usable.	QC Forms/MRSIMS	MR Senior Geophysicist/CH2M HILL
Anomaly Reacquisition	Minimum of one team per day	Inspection of anomaly reacquisition activities and results to validate – applicable SOPs are being followed and – selected anomalies are reacquired within acceptable limits of positional accuracy.	QC Forms/MRSIMS	MR Senior Geophysicist/CH2M HILL and UXOQCS/CH2M HILL

Worksheet #35—Validation (Steps IIa and IIb) Process Table (continued)

Definable Feature of Work	Frequency of Inspection	Validation Description/Documentation	Validation Documentation	Responsible for Validation (name, organization)
Intrusive investigation of DGM-identified anomalies and removal verification	Minimum of one team per day	Inspection of intrusive investigation activities and results to validate – the ESS and applicable SOPs are being followed and – anomaly sources are resolved in accordance with the approved ESS and MEC-QAPP.	QC Forms/MRSIMS	MR Senior Geophysicist/CH2M HILL and UXOQCS/CH2M HILL
MEC/MPPEH Management and Disposal	Weekly and per demolition event	Inspection of MEC/MPPEH Management and disposal activities and records to validate – the ESS and applicable SOPs are being followed and – all MEC/MPPEH items are tracked and disposed of in accordance with the approved ESS and MEC-QAPP.	QC Forms	UXOQCS/CH2M HILL
Demobilization	N/A	Inspection of demobilization activities and records to verify – all equipment and personnel have been removed from the site and – the site has been restored to pre-existing conditions.	QC Forms	PM/CH2M HILL, UXOQCS /CH2M HILL
Final Report and Closeout	N/A	No Follow-up required for this DFOW		

Worksheet #36—Geophysical Data Validation (Steps IIa and IIb) Summary Table

Verification and validation of RI data will involve the following five-step process to ensure data quality:

- Step 1 will consist of a review of preparatory QC activities, including verification of personnel training and qualifications and initial IVS demonstration activities
- Step 2 will consist of a review of initial and follow-up phases of QC inspections and certification
- Step 3 will consist of a review of DGM data acquisition, processing, and interpretation, including associated documentation
- Step 4 will consist of a review of MEC clearance operations, including review of follow-up QC checklists and compliance with the surveillance requirements of the MEC-QAPP
- Step 5 will consist of a review of intrusive investigation results to validate the completion of RI field activities and the appropriate handling of recovered MEC and MPPEH items

The five steps will be documented and reviewed by the PM, MR Senior Geophysicist, and UXOQCS before submission to the Navy. Upon Navy approval, the package will be provided to the regulatory agencies and stakeholders, as required. The following sections describe each process step. Additional details are included in the Geophysical Investigation Plan and Geophysical System Verification Plan (Appendix A).

Step 1: Pre-operational Team Training and Site Preparation

Step 1 consists of verification of personnel training and qualifications and demonstration of DGM system performance at the IVS. Surveillance checks will verify completion and documentation of mandatory pre-operational preparation, including training, personnel qualifications, equipment status, and accurate SOPs for project activities. This process will document that the pre-operational actions in the SOPs have been met and that project personnel are qualified and prepared to conduct DGM surveys and intrusive investigations. A checklist of any identified deficiencies will be provided to the Project Manager, MR Senior Geophysicist, and UXOQCS. A record of the completed checklists will be maintained in the project QC file as discussed in scoping sessions and the operational readiness review.

Step 2: QC Inspection and Surveillance

Step 2 consists of documentation that QC inspection and surveillance activities are conducted in accordance with contract specifications and approved SOPs. This process will verify that the geophysical survey, intrusive investigation, and MEC/MPPEH handling protocols are followed. The following activities are included in the Step 2 inspection:

a. Verify that personnel performing geophysical and intrusive MEC work are properly trained, including required certification of UXO Technicians, prior to initiating RI fieldwork
b. Verify that the construction of the IVS, including a background DGM survey of the IVS location and the placement of IVS seed items, is in compliance with the requirements of the GSV Plan to allow appropriate demonstration of DGM system performance
c. Verify that DGM system (personnel and equipment) performance has been demonstrated at the IVS in accordance with the GSV Plan before initiating the RI DGM survey
d. Verify that the DGM survey team has conducted the DGM survey in accordance with the GIP and appropriate SOP
e. Review DGM results to verify that the geophysical survey is complete and has been conducted in accordance with the GIP

Worksheet #36—Geophysical Data Validation (Steps IIa and IIb) Summary Table (continued)

f. Verify that the analysis of DGM data and selection of anomalies for intrusive investigation has been conducted and documented in accordance with the GIP

g. Verify that intrusive investigations have been conducted in accordance with the ESS and appropriate SOPs

h. Verify that intrusive investigations have been completed, and that all recovered MEC and MPPEH items have been properly identified and managed for treatment and disposal

i. A record of the completed activities will be maintained in the project QC file and reported in the RI Report and periodic progress reports. Steps 3 – 5, described below, address specific Step 2 activities.

Step 3: Inspection of DGM Data Acquisition and Analysis

Step 3 consists of the independent verification of the geophysical data for Step 2 (b through f). The MR Senior Geophysicist will verify that the DGM data were correctly acquired, processed and interpreted. This QC is in addition to the 100-percent QA performed by the Navy's QAO, as necessary. This combined effort will begin during the initial IVS survey and will continue throughout the duration of RI DGM activities. DGM system performance will be demonstrated through the IVS survey before commencing RI DGM survey operations and will continue throughout DGM activities through the blind seeding portion of the GSV. An IVS Letter Report will be prepared immediately following the initial IVS survey to present the IVS survey results. The DGM system (personnel and equipment) will meet the measurement quality objectives outlined in **Table 36-1** throughout RI DGM activities.

TABLE 36-1
Geophysical Measurement Quality Objectives

Measurement Quality Objective	Measurement Performance Criteria	Test Method
General System Verification		
DGM System Positioning. Accurate coordinates are being obtained from DGM positioning systems.	Positional error of IVS targets will not exceed 3.3 ft (1.0 m).	Results of daily IVS DGM survey vs. IVS seed locations will be evaluated to ensure compliance.
DGM System Munitions Detection. DGM system response is within industry standards for detection.	Response to standardized item will not vary more than ±20% of expected value[a] in static test.	Results of static test will be quantitatively reviewed to ensure compliance.
DGM System data repeatability. DGM system response is consistent from the beginning to the end of an operation.	Response to IVS targets is comparable to published or calculated results for that item.	Results of IVS surveys over seed items in strip will be qualitatively reviewed for repeatability.
DGM Surveys		
Downline Data Density. Sufficient data is collected along each transect to detect MEC items.	At least 98% of possible sensor readings are captured along each transect at 8 in (20 cm) or less, and no transect (or portion thereof) contains a data gap of 2 feet (60 cm) or greater.	All DGM data collected and used for anomaly selection will be evaluated to verify that MPC is met.
Survey Coverage (Transect Spacing). Proper lane spacing is maintained for appropriate coverage of the area.	Lane spacing is not greater than 33 ft (10 m), with a ±20% leeway allowance, with the exception of locations where vegetation (that cannot be cut) or terrain cause greater deviation.	All DGM data collected and used for anomaly selection will be evaluated to verify that MPC is met.
Positioning Precision. Positioning of detected anomalies is precise (repeatable) enough to allow effective reacquisition of the anomaly.	Blind QC seed items are detected with a precision of 3.3 ft (1.0 m).	All blind QC seed items will be evaluated to verify that an anomaly location is selected within this standard or can be otherwise explained.

[a] NRL/MR/6110--09-9183 (Provided as **Figure A-5** in the Geophysical System Verification Plan, Appendix A to the MEC-QAPP)

Worksheet #36—Geophysical Data Validation (Steps IIa and IIb) Summary Table (continued)

Step 4: Inspection of Intrusive Investigation Operations

Step 4 consists of documentation of QC surveillance operations to address Step 2 (g). An SOP-specific compliance check, along with review of appropriate QC surveillance forms, will document that the intrusive investigation is conducted in accordance with the ESS and appropriate SOPs. A copy of each QC surveillance report will be stored in the project QC file and included in periodic progress reports.

Step 5: Final Inspection of Intrusive Investigation Results

Step 5 consists of a review of intrusive investigation results to address Step 2 (h). This step will verify that DGM anomaly sources have been located and removed and that recovered MEC and MPPEH items have been handled in accordance with the ESS and appropriate SOPs. During intrusive investigation, excessive “no contact” findings will trigger the generation of a Root Cause Analysis to determine if a quality issue exists with either the geophysical data used for anomaly selection or the intrusive investigation process. As part of the root cause analysis, the project team will determine the extent of data affected by the quality issue and provide planned corrective actions and/or recommendations, if necessary. After corrective actions have been implemented, any portions of the site impacted by the quality issue will be re-worked.

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Worksheet #37—Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

- If all QC criteria are met, then the data are usable.
- If QC criteria are not met, then data are suspect and cannot be used until confirmed.

Describe the evaluative procedures used to assess overall measurement error associated with the project.

- If significant inconsistency in data is determined the data will be evaluated to assess impact on decision-making.
- If significant deviations are noted between QC of equipment, background information, and field data, the cause will be further evaluated to assess impact on decision making.

Describe the documentation that will be generated during the usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

- Graphical representations and site representative figures will be produced to reflect the areas which are most likely to contain MEC and which do not.
- The RI report will identify any data usability limitations and make recommendations for future investigations, if necessary.
- A data quality evaluation section will be included as part of the RI report to summarize the results of the data collection and interpretation.
- The RI report will identify any data usability limitations and make recommendations for CA if necessary.

Identify the personnel responsible for performing the usability assessment.

- The PM, MR Senior Geophysicist, and other team members will be responsible for collecting and compiling the data. The data will then be presented to the Navy and VDEQ, who will evaluate the data usability according to project objectives.

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Figures

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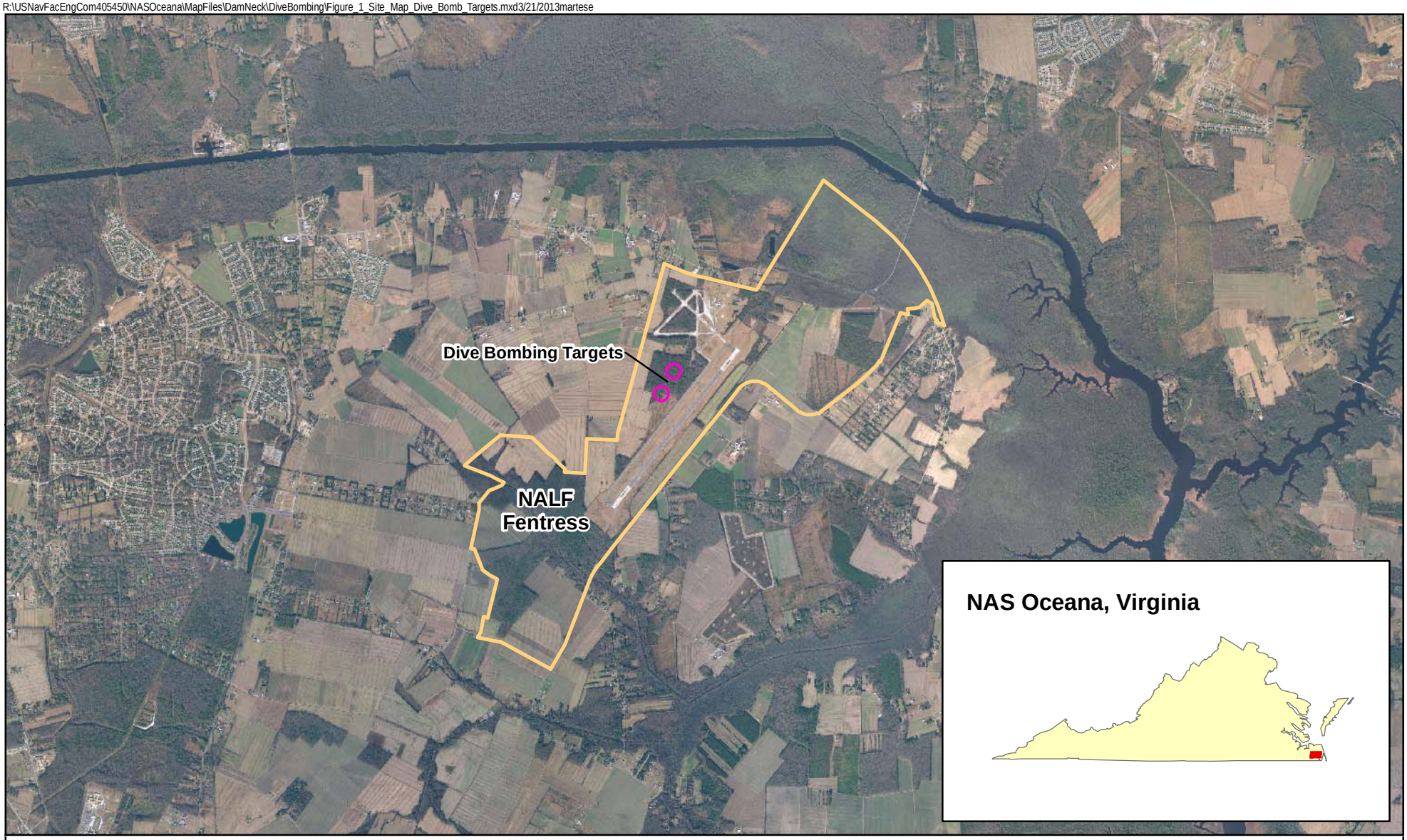

Legend

- NALF Fentress Boundary
- MRP Sites

N
W E
S

0 0.5 1
Miles

Figure 1
Site Location Map for the Dive Bombing Targets
NALF Fentress - Naval Air Station Oceana
Virginia Beach, Virginia

CH2MHILL

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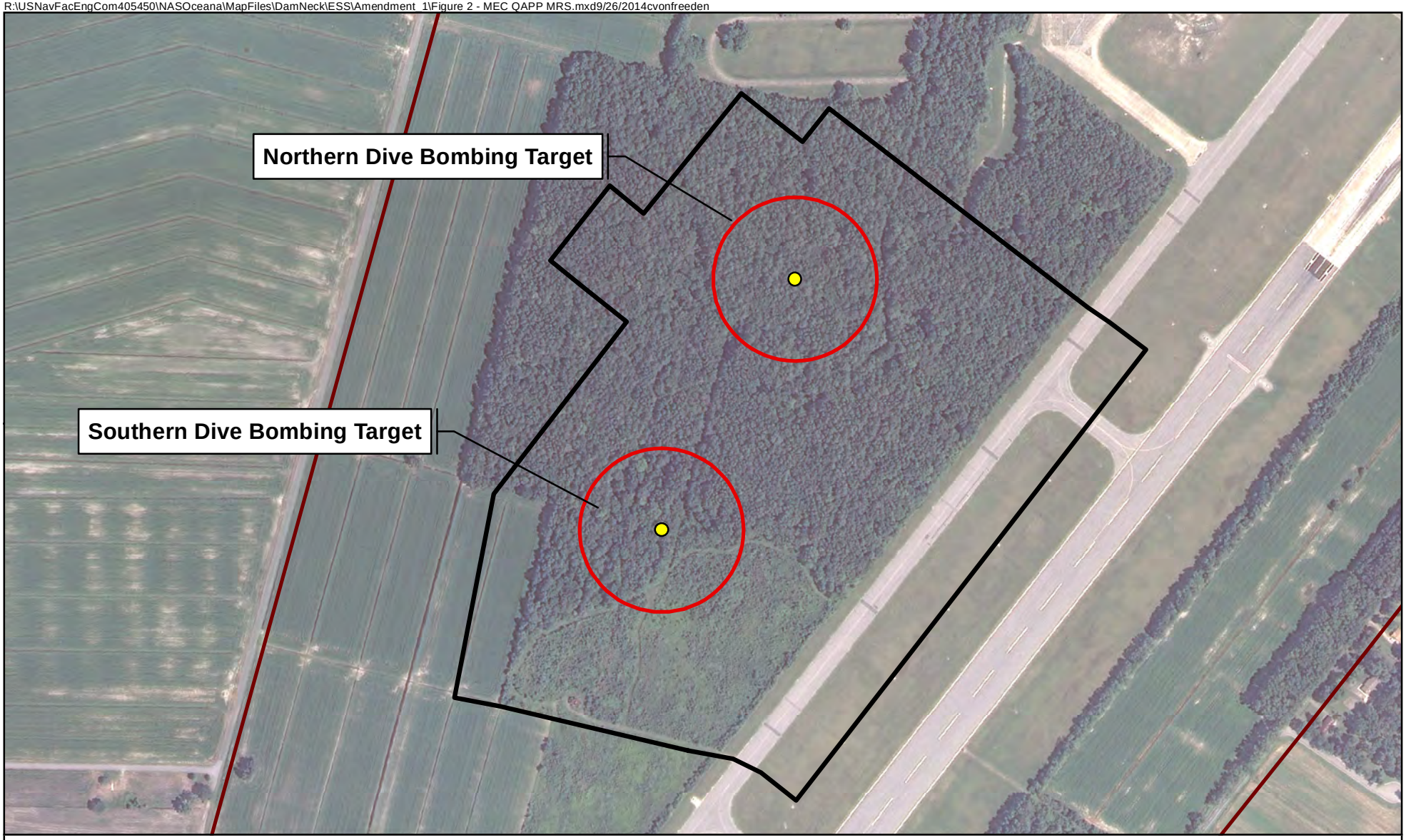

Legend

- Target Center
- Dive Bombing Target
- Munitions Response Site Boundary
- NALF Fentress Boundary

N
W E
S

0 250 500
Feet

Figure 2
Dive Bombing Target MRS
MEC QAPP Amendment
NALF Fentress
Chesapeake, Virginia

CH2MHILL

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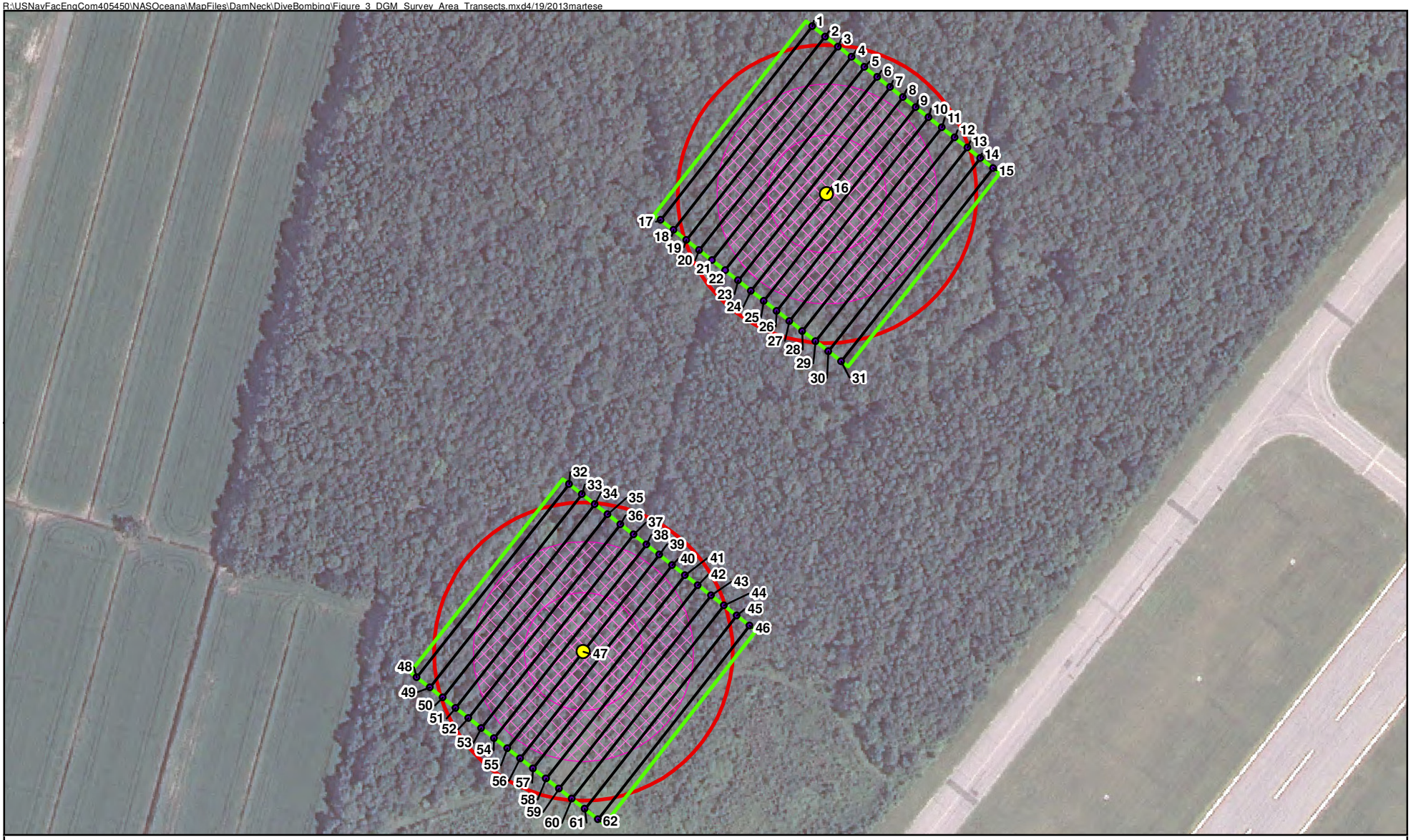


Legend

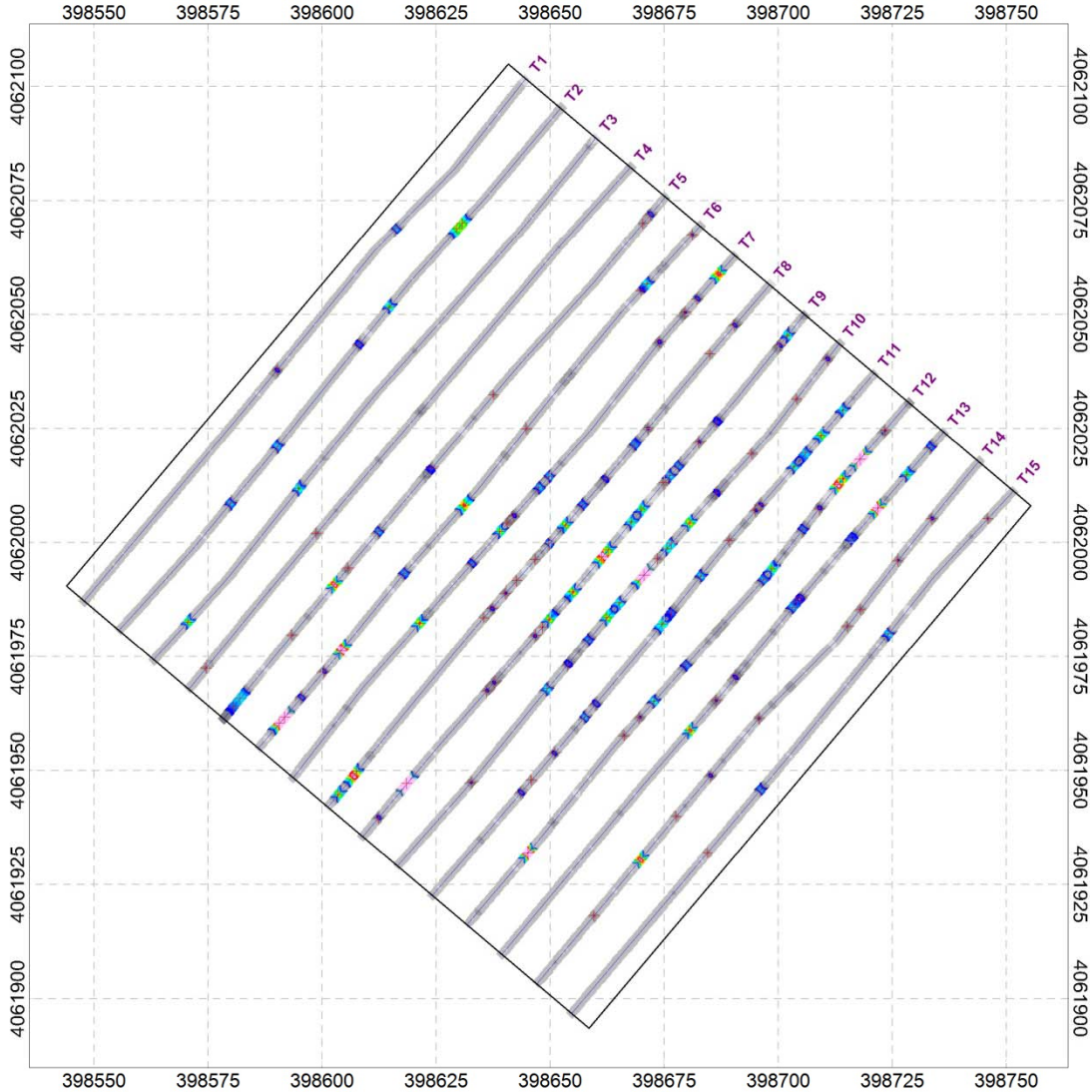
- 150 meter Transect Lines
- MRP Sites
- Target Areas
- Target Transect Outline

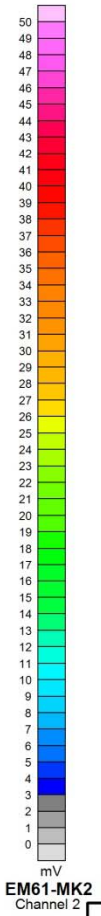
N
W E
S

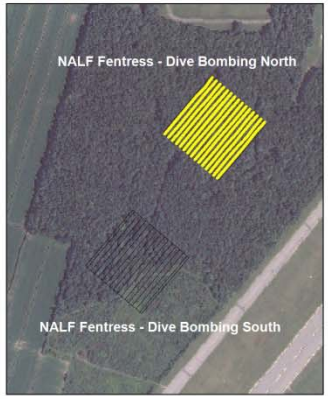
0 275 550 Feet

Figure 3
DGM Survey Area – 2012 Transects
NALF Fentress - Naval Air Station Oceana
Chesapeake, Virginia

CH2MHILL







Legend

- North Target Area Boundary
- Selected Target
- Transect Line Paths

N

25 0 25 50
(meters)
NAD83 / UTM zone 18N

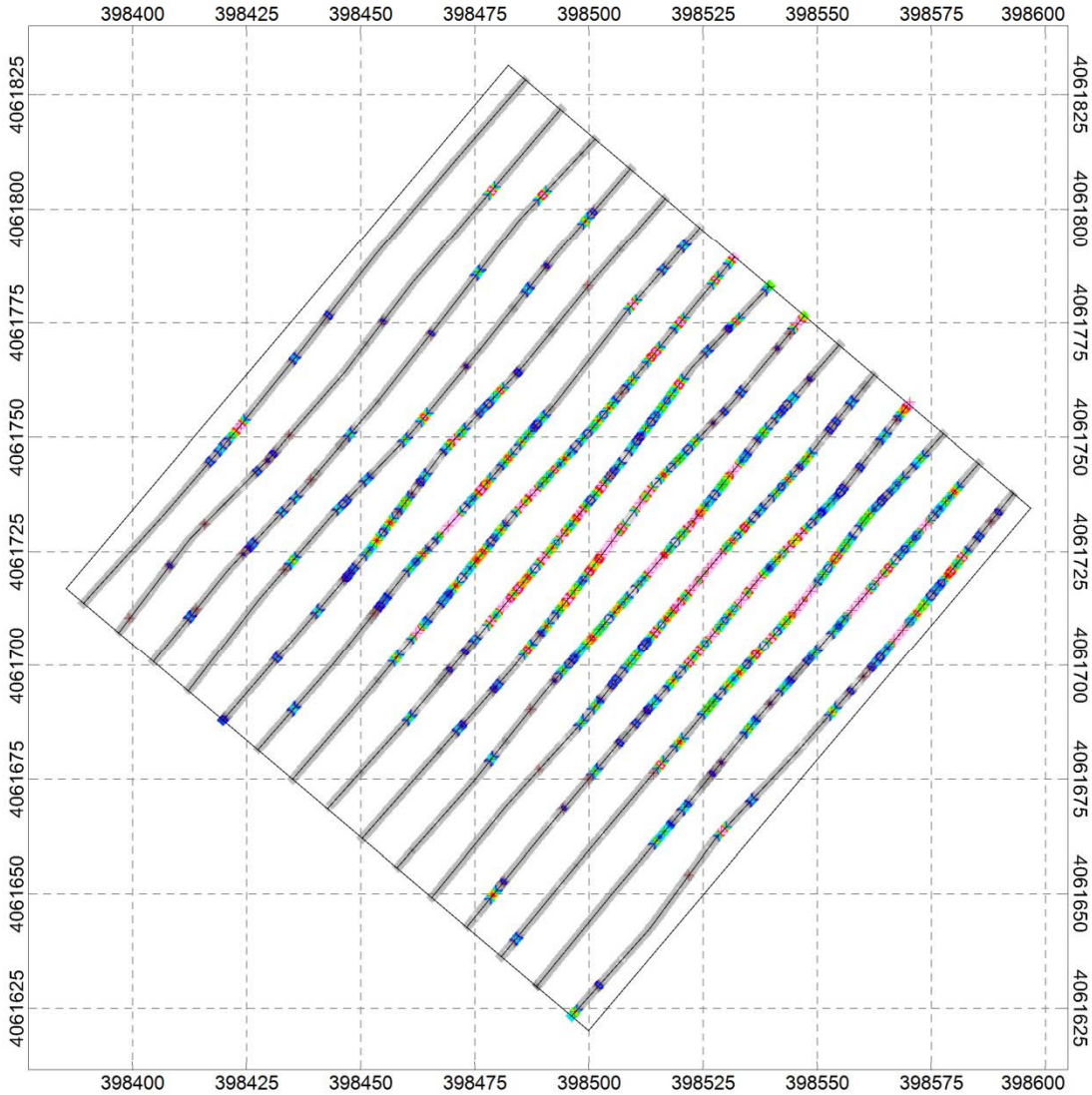
CH2MHILL

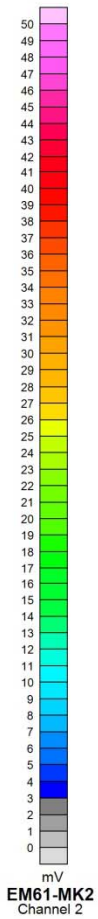
Figure 4

DGM Survey Results - North Target Area
NALF Fentress - Naval Air Station Oceana
Chesapeake, Virginia
Source: NAEVA Geophysics Inc

Date of Survey: April 16, 2012

Map Approver: T. Klaff





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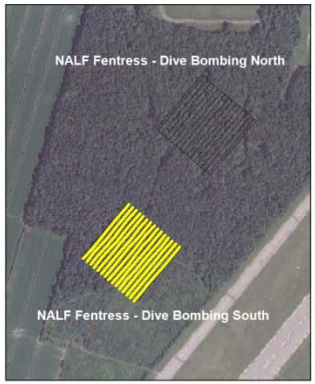


Legend

- South Target Area Boundary
- Selected Target
- Transect Line Paths

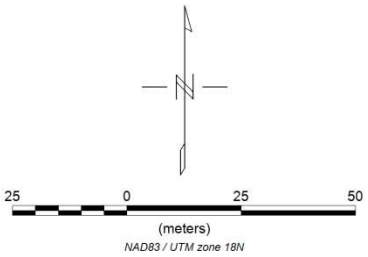
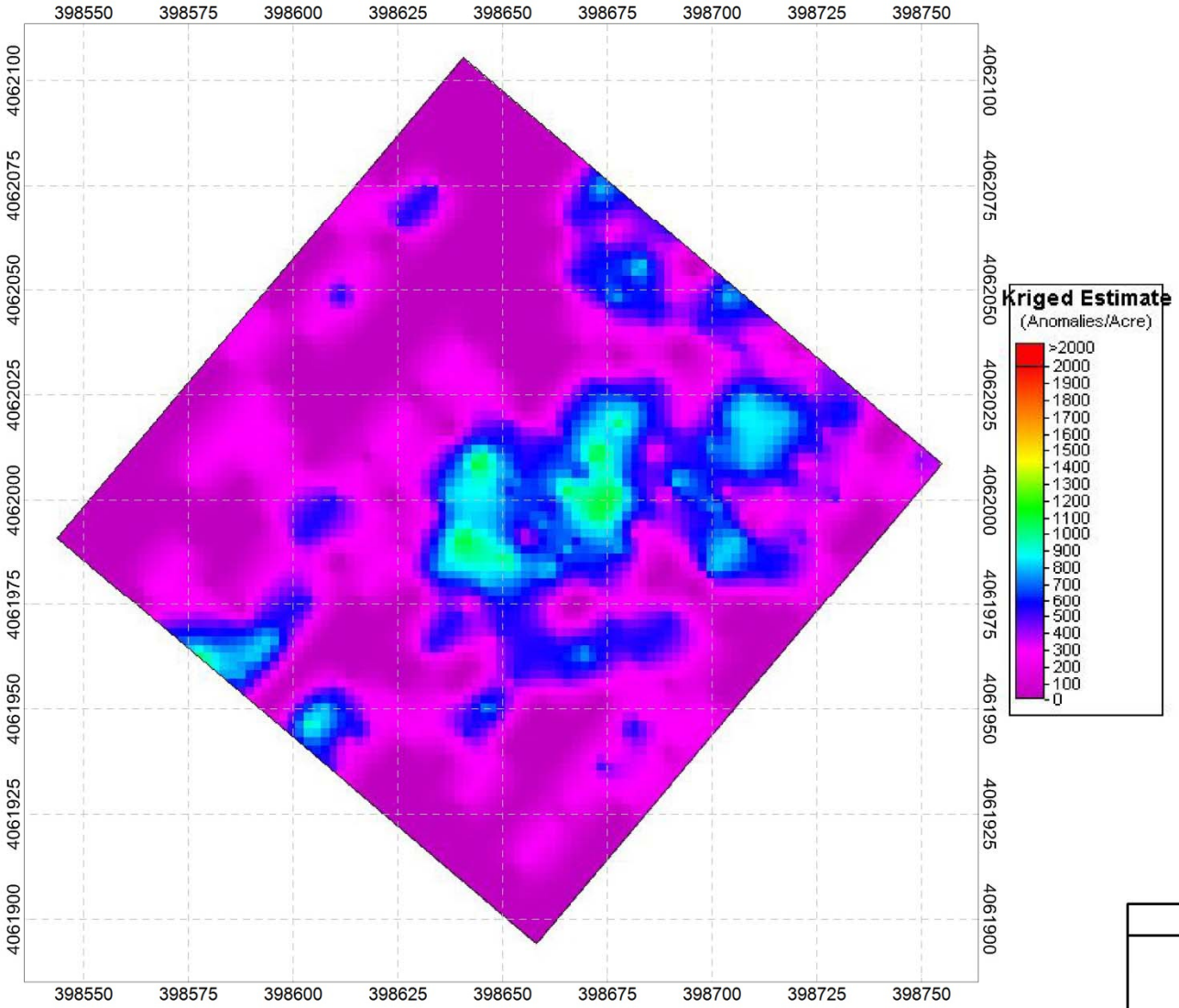


Figure 5

DGM Survey Results - South Target Area
NALF Fentress - Naval Air Station Oceana
Chesapeake, Virginia
Source: NAEVA Geophysics Inc

Date of Survey: April 17, 2012

Map Approver: T. Klaff



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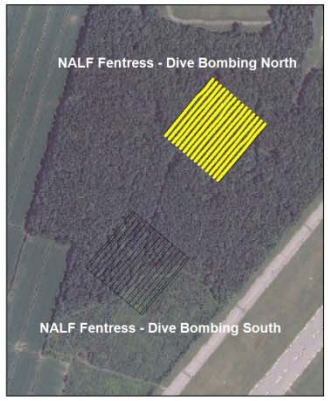


Legend

North Target Area Boundary

N

25 0 25 50

(meters)

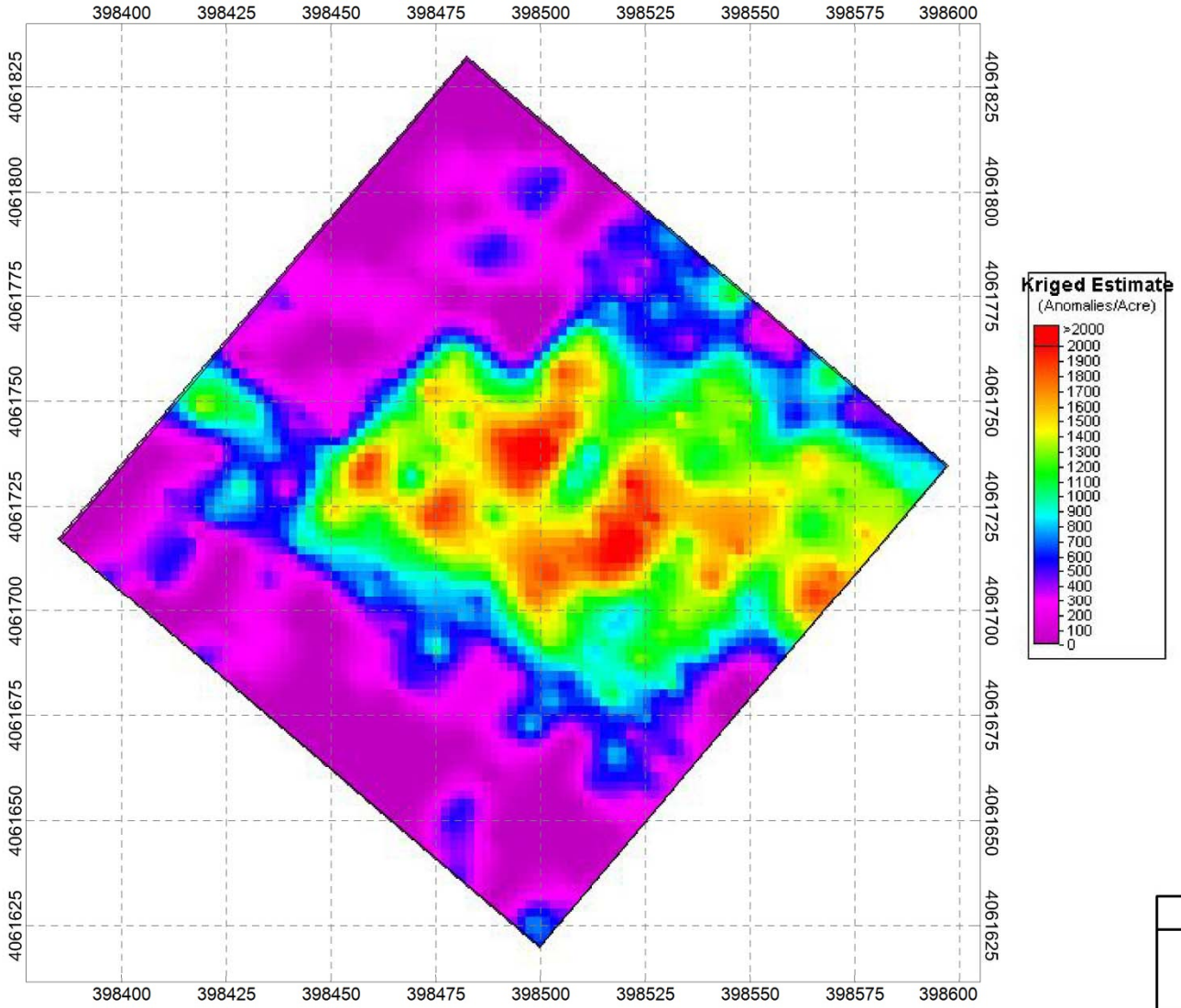
NAD83 / UTM zone 18N

Figure 6

Geostatistical Analysis - Anomaly Density Estimate
Northern Dive Bomb Target Area
NALF Fentress - Naval Air Station Oceana
Chesapeake, Virginia

Date of Map Creation: April 25, 2012

Map Approver: T. Klaff



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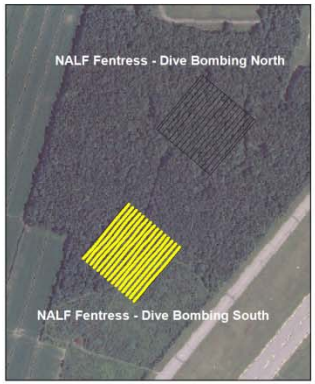


Legend

South Target Area Boundary

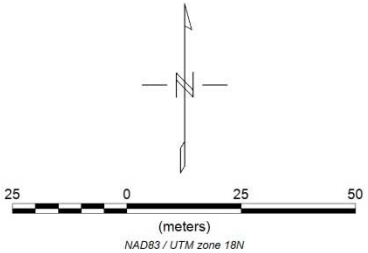
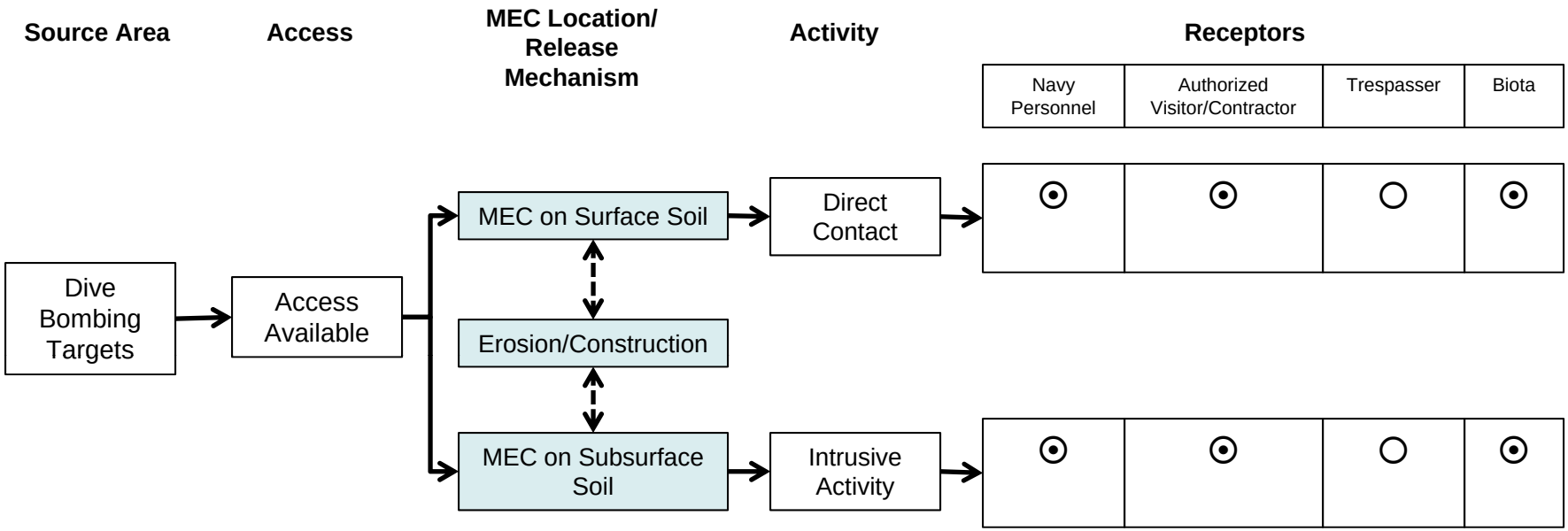


Figure 7

Geostatistical Analysis - Anomaly Density Estimate
Southern Dive Bomb Target Area
NALF Fentress - Naval Air Station Oceana
Chesapeake, Virginia

Date of Survey: April 17, 2012
Date of Map Creation: April 25, 2012

Map Approver: V Rystrom

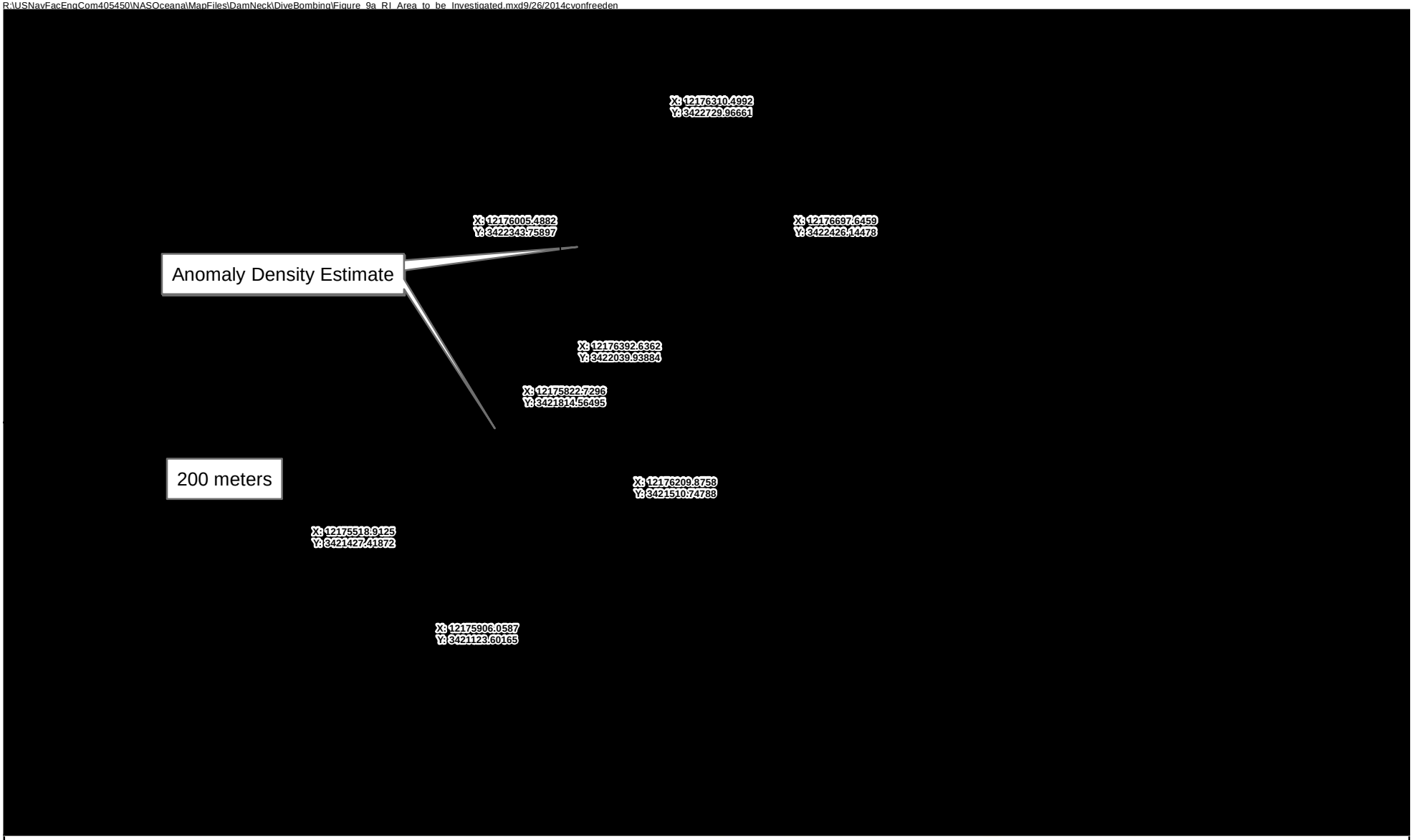


⊙ - Potentially Complete Pathway
○ - Incomplete Pathway

Source: Figure 5.10-4 (Malcolm Pirnie, 2008)

Figure 8
Conceptual Site Model for MEC Exposure
Dive Bombing Targets Remedial Investigation
NALF Fentress – Naval Air Station Oceana
Chesapeake, Virginia

R:\USNavFacEngCom405450\NASOceana\MapFiles\DamNeck\DiveBombing\Figure_9a_RI_Area_to_be_Investigated.mxd9/26/2014cvonfreeden



Legend

- Surveyor walk line
- Transects
- 2012 DGM Transect Outline (~13 acres) 30
- RI Area to be Investigated (~53 acres)
- MRP Sites
- Installation Boundary

N
W E
S

0 50 100
Meters

Figure 9a
RI Area to be Investigated
North Dive Bombing Target Area
NALF Fentress - Naval Air Station Oceana
Chesapeake, Virginia

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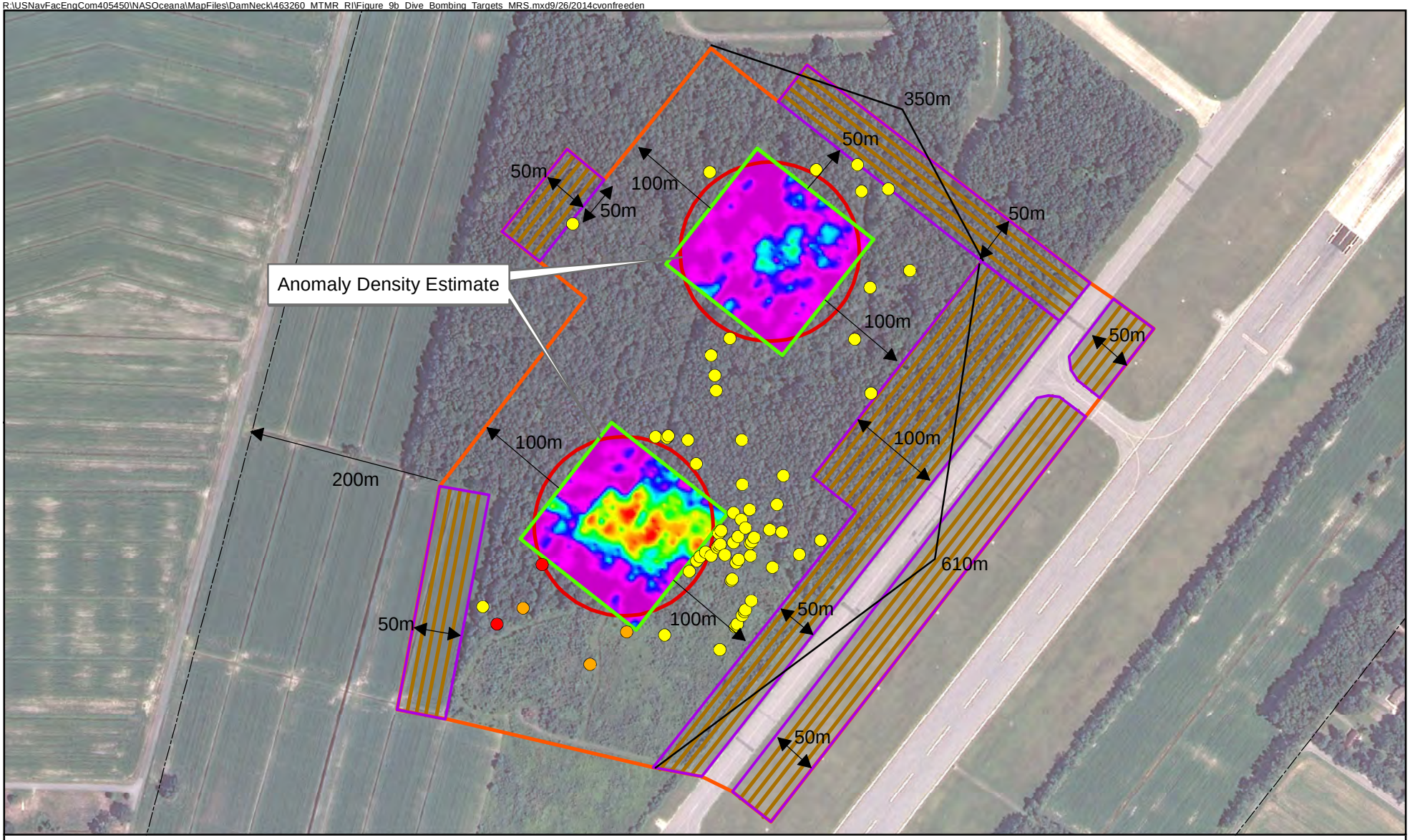
R:\USNavFacEngCom405450\NASOceana\MapFiles\DamNeck\463260_MTMR_RI\Figure_9b_Dive_Bombing_Targets_MRS.mxd9/26/2014cvonfreeden



Legend

- MDAS Items (MK23)
- MDAS Items (grenade/rocket)
- MEC Items (air burst simulator)
- Investigation Transect - 10m spacing
- 2012 DGM Transect Outline (~13 acres)
- MRS Boundary
- Proposed Additional Investigation Areas
- MRP Sites
- Installation Boundary

N
W E
S

0 55 110
Meters

Figure 9b
Proposed Additional Investigation Areas
Dive Bombing Targets MRS
Remedial Investigation
NALF Fentress - Naval Air Station Oceana
Chesapeake, Virginia

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Appendix A
Geophysical Investigation Plan

Final

Geophysical Investigation Plan
Dive Bombing Targets at Naval Auxiliary Landing Field Fentress - Remedial Investigation

Naval Air Station Oceana
Virginia Beach, Virginia

Contract Task Order WE60

September 2013

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

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Date

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Tamir L. Klaff

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John Tomik
CH2M HILL – Activity Quality Manager

Date

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Attachment

Geophysical System Verification Plan

Acronyms and Abbreviations

cm	centimeter(s)
DBTs	dive bombing targets
DGM	digital geophysical mapping
ft	foot or feet
GIP	Geophysical Investigation Plan
GSV	geophysical system verification
ID	identification
in.	inch(es)
ISO	industry standard object
m	meter(s)
MEC	munitions and explosives of concern
MEC-QAPP	Munitions and Explosives of Concern-Quality Assurance Project Plan
MPC	measurement performance criterion
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objective
MRP	Munitions Response Program
NALF	Naval Auxiliary Landing Field
NAS	Naval Air Station
PA	Preliminary Assessment
PDF	portable document format
QC	quality control
RI	Remedial Investigation
SI	Site Inspection
SUXOS	Senior UXO Supervisor
UTM	universal transverse Mercator
UXO	unexploded ordnance

SECTION 1

Geophysical Operations Overview

This Geophysical Investigation Plan (GIP) provides details of the equipment, approach, methods, operational procedures, and quality control (QC) methods to be used in performing the geophysical investigation at the Dive Bombing Targets (DBTs), Unexploded Ordnance (UXO) 09, located at Naval Auxiliary Landing Field (NALF) Fentress in Chesapeake, Virginia. NALF Fentress is approximately 7 miles southwest of Naval Air Station (NAS) Oceana, in Virginia Beach, and comprises approximately 2,500 acres, with approximately 8,700 additional acres in restrictive easements. The facility is currently used by squadrons stationed at NAS Oceana or Naval Support Activity Norfolk Chambers Field for field carrier landing practice operations (Malcolm Pirnie, 2008). Background information on the former DBTs can be found in Worksheet 10 of the Munitions and Explosives of Concern (MEC) Quality Assurance Project Plan (MEC -QAPP).

The following topics are covered in this GIP: safety issues; geophysical measurement quality objectives (MQOs); description of the site; anticipated MEC types, quantities, compositions, and depths; site physical conditions; adverse geophysical conditions; site utilities and manmade features that may affect the geophysical operation; data acquisition and reporting; and geophysical program QC requirements.

Digital geophysical instruments will be used during digital geophysical mapping (DGM) survey operations that record instrument response digitally, allowing for the subsequent download and interpretation of the data. DGM instruments will be operated by the DGM subcontractor.

Analog geophysical instruments used during operations such as clearing locations for emplacement of survey stakes will be analog, meaning these instruments will be used to detect metallic items in the subsurface on a real-time basis and the instrument response will not be recorded. Analog instruments generally indicate the presence of metallic items through sound or visual display. These analog instruments will be operated by an unexploded ordnance (UXO) Technician III or II.

1.1 Safety Issues

Project personnel are required to adhere to the project Health and Safety Plan. The DBTs and surrounding vicinity are heavily wooded and minimal surface metal is anticipated. However, if surface metal is observed at the site, it will be removed from the DBTs before DGM operations begin. MEC avoidance will be practiced during the geophysical survey. MEC avoidance will be provided by one UXO Technician III, who will also serve at the Field Team Leader (FTL). DGM survey personnel will not access areas outside of the survey area or access routes, as directed by the FTL. Personnel are prohibited from touching, handling, moving, or investigating any item that resembles MEC or material potentially presenting an explosive hazard (MPPEH). Upon encountering a potential MEC/MPPEH item, DGM personnel will retreat to a designated rally point and immediately inform the FTL. The FTL will report any MEC encounters to the Facility Fire Response and Navy Remedial Project Manager.

1.2 DGM Personnel Qualifications

DGM operations will be conducted by personnel experienced in MEC geophysical operations and led by a qualified MEC geophysicist. All non-UXO technical personnel will have 3R (Recognize, Retreat, and Report) Training. Throughout DGM operations, DGM support personnel will strictly adhere to the general practices given in this GIP and specifically in the project Health and Safety Plan.

1.3 Areas to be Investigated

The area to be investigated during the DGM survey is shown on **Figure 8** in the MEC QAPP. The DGM survey will be conducted along 87 transects spaced at approximately 10 meters (33 feet) to achieve characterization of the extent of the affected areas and resulting in a survey coverage of 10 percent over the 53 acres adjacent to the DBTs.

SECTION 2

Background

2.1 Past, Current, and Future Site Uses

Detailed discussions of the past uses of the sites are provided in Worksheet 10 of MEC-QAPP. Additional information is in the Preliminary Assessment (PA) report (Malcolm Pirnie, 2008) and Site Inspection (SI) report (CH2M HILL, 2011).

2.2 Anticipated MEC Types, Composition, and Quantities

Refer to MEC -QAPP (CH2M HILL, 2013), SI (CH2M HILL, 2011), and PA (Malcolm Pirnie, 2008) documents.

2.3 Anticipated Depth of MEC Items

Although the depth to which bombs dropped on or fired at the DBTs may have penetrated the subsurface by several feet, all 85 AN-MK23 practice bombs found during the pre-remedial investigation (RI) reconnaissance in March 2013 were less than 2 feet below the subsurface.

2.4 Vegetation and Topography

Refer to MEC-QAPP (CH2M HILL, 2013), SI (CH2M HILL, 2011), and PA (Malcolm Pirnie, 2008) documents.

2.5 Geologic Conditions

Refer to MEC-QAPP (CH2M HILL, 2013), SI (CH2M HILL, 2011), and PA (Malcolm Pirnie, 2008) documents.

2.6 Shallow Groundwater Conditions

Refer to MEC-QAPP (CH2M HILL, 2013), SI (CH2M HILL, 2011), and PA (Malcolm Pirnie, 2008) documents.

2.7 Adverse Geophysical Conditions

There are no known adverse geophysical conditions that might affect DGM operations.

2.8 Site Utilities

A utility locator will be subcontracted to identify and mark out subsurface utilities as necessary. Utilities will be identified using all reasonably available as-built drawings, electronic locating devices, and any other means necessary to maintain the safety of field personnel and the protection of the Base infrastructure.

2.9 Manmade Features Potentially Affecting Geophysical Operations

There are two man-made bunkers in the Northern DBT that are located within the DGM survey area. The bunkers to appear to be earthen mounds; however, if ferrous metals were used to construct these bunkers, the DGM data collected in the vicinity of these bunkers might be affected.

2.10 Site-specific Dynamic Events

No site-specific dynamic events (for example, unusually strong winds or harsh weather conditions) that might affect the DGM survey operations at the site are anticipated. Although it is possible that weather conditions may impede operations at some time during the project, no significant delays or effects on geophysical instruments resulting from weather are expected.

2.11 Overall Site Accessibility and Impediments

Coordination will be required with NAS Oceana and NALF Fentress personnel because the facility is active.

Some investigation areas are not accessible due to surface water present during the vegetation reduction activities in March 2013 because the DBTs are situated on a forested-shrub wetland.

SECTION 3

Geophysical Investigation

The geophysical system verification (GSV) process will be used to validate the DGM system to be used for the DGM surveys. The GSV Plan is provided as an Attachment to this plan.

3.1 DGM MQOs

The primary objective of the DGM activities at the site is to detect metallic items that may be MEC or MPPEH. MQOs specific to the EM61-MK2 surveys to be performed at the site are summarized in the following subsections.

3.1.1 General Geophysical Systems Functioning

DGM Systems Positioning

The MQO for DGM systems positioning is that the coordinates being obtained from the positioning systems are at a sufficient accuracy to allow for appropriate relocation of geophysical anomalies for intrusive investigation. Positioning will be accomplished using fiducial positioning. This MQO will be evaluated by comparing the DGM derived positions of the emplaced IVS targets with known ground truth. The measurement performance criterion (MPC) for this is that the derived positions will be within 3.3 ft (1.0 m) of the established ground truth positions

DGM Systems Data Repeatability

The MQO for DGM systems data repeatability is that the systems respond consistently from the beginning to the end of an operation. The MPC for this is that the response to a standardized item will not vary more than ±20 percent. This will be evaluated by ensuring that, on a daily basis, the geophysical system being used passes QC Test # 5, *Static Background and Static Spike,* as outlined in Section 3.4.1. Results of QC Test # 6, *Repeat Data*, will also be qualitatively[1] reviewed for repeatability.

3.1.2 DGM Surveys

Downline Data Density

The MQO for downline (along each survey transect) data density is to have sufficient data collected along each transect to detect MEC items. The MPC for this is that at least 98 percent of possible sensor readings are captured along each transect at 8 in. (20 cm) or less. In addition, any transect (or portion thereof) containing a data gap of 2 feet (60 cm) or greater does not meet the MQO. This will be evaluated by verifying that all of the DGM data collected and used for anomaly selection meet this standard.

Survey Coverage (Transect Spacing)

The MQO for lane spacing is to maintain appropriate lane spacing to ensure appropriate coverage of the area. The MPC for this is that the lane spacing is no greater than 3.3 feet (1 meter [m]) (the width of the EM61-MK2 system), with an intended lane spacing of 33 feet (10 meters), with a ±20 percent leeway allowance, with the exception of locations where vegetation (that cannot be cut) or terrain cause greater deviation.

Positioning Precision

The MQO for horizontal positioning precision is that positioning of detected anomalies is precise (repeatable) enough to allow effective reacquisition of the anomaly. The MPC for this objective is a precision of 3.3 ft (1m). The survey positioning precision is validated by the use of blind seeded targets (i.e. targets that are emplaced in locations that are not know by the DGM subcontractor). A blind seed is deemed to be detected if one of the set of DGM subcontractor selected targets is located within a 3.3 ft (1m) radius of the seed. This MQO will be evaluated

[1] Comparisons are qualitative because sources of error, including horizontal orientation of the instrument, system bounce, item orientation, and actual item distance from system transmitter and receiver coils can cause high variability in signal response. Quantitative validation of the system response to an industry standard object (ISO) is performed during QC Test #5 (Static Background and Static Spike), described in Section 3.4.1.

by verifying that all blind seeds have an anomaly location selected within this standard or can be otherwise explained.

3.2 Geophysical Instrumentation

The following subsections detail the geophysical equipment to be used for the investigation.

3.2.1 Analog Geophysical Instruments

The analog geophysical instrument to be used during non-DGM operations where a geophysical instrument is needed to detect metallic items in real time will be a Schonstedt GA-52Cx magnetic locator. This hand-held gradiometer detects the magnetic field of ferrous objects and responds to the difference in the magnetic field between two sensors spaced approximately 20 in. apart. The response is a change in the frequency of the signal emitted by the instrument's speaker.

3.2.2 DGM Instrument

The DGM instrument that has been presumptively selected based on site conditions and project objectives is the Geonics EM61-MK2. Positioning will be accomplished using fiducial methods. The DGM system will be configured in a man-portable mode (either wheel-based or "stretcher" mode, depending on ground cover).

The EM61-MK2 is a high-resolution, time-domain electromagnetic instrument designed to detect, with high spatial resolution, shallow metallic objects. The EM61-MK2's transmitter generates a pulsed primary magnetic field, which then induces eddy currents in nearby metallic objects. The EM61-MK2 offers the ability to measure the eddy currents at three distinct time intervals, or four intervals if no top coil measurements are recorded. Earlier time gates provide enhanced detection of smaller metallic objects, so the four-interval method will be used for this project.

3.3 Data Acquisition, Processing and Reporting

3.3.1 Field Data Sheets

Field information to be recorded in the Munitions Response Program Enterprise (MRP Enterprise) system field devices will include the following:

- Site identification (ID)
- Transect ID (or other identifier of surveyed area)
- Field team leader name
- Field team members' names
- Date of data collection
- Instrument used
- Positioning method used
- Instrument serial numbers
- File names in data recorders
- Data collection sampling rate
- Transect numbers, survey direction, fiducial locations, start and end points
- Weather conditions
- Grid conditions
- Terrain conditions
- Cultural conditions
- Survey area sketch
- Associated QC data file names
- Field notes (other)

3.3.2 Data Processing

EM61-specific software will be used for initial data processing, and the output will be imported into Geosoft Oasis Montaj for additional processing, graphical display, anomaly selections, and QC. The types of processing that may be performed on the data include the following:

- Positional offset correction
- Sensor bias, background leveling, and/or standardization adjustment
- Sensor drift removal
- Latency or lag correction
- Geophysical noise identification and removal (spatial, temporal, motional, terrain induced)
- Contour level selection with background shading
- Digital filtering and enhancement (low pass, high pass, band pass, convolution, correlation, non-linear, etc.)

3.3.3 Interpretation/Anomaly Selection

MEC-experienced data processing geophysicists will use the following criteria, supplemented by site- and system-specific criteria established during instrument validation, for selecting and locating anomalies:

- Maximum amplitude of the response with respect to local background conditions
- Lateral extent (plan size) of the area of response
- Three-dimensional shape of the response
- Decay curve characteristics
- Location of the response with respect to the edge of the grid, unsurveyable areas, land features, cultural features, or utilities within or adjacent to the grid
- Potential distortions in the response from interference of nearby cultural features

3.3.4 Target Locations

The target analysis process culminates in the creation of digital target location sheets that contain target information location and amplitude and can be used for future investigation operations (if performed).

3.3.5 Transect Maps

With each target sheet, the DGM subcontractor will also provide a transect map containing the following information:

- Client
- Project
- Contractor
- Map creator
- Map approver
- Date map was created
- Map file name (full path and file extension)
- Scale
- Transect identification
- Transect stake locations
- Contoured data
- Anomaly locations with unique identification numbers
- North arrow, legend, title block, etc.

3.3.6 Records Management

All files will be made available for QC verification during the project to verify that the field and data processing procedures are properly implemented. All raw data files, final processed data files, hard copies, and field notes will be maintained for the duration of the project.

3.3.7 Final Reports, Maps, and Geophysical Mapping Data

No later than 3 work days after collection, the DGM subcontractor will provide each day's data for QC inspection via the Internet using a File Transfer Protocol site, electronic mail (email) attachments for small files under 5 megabytes, or digital compact disk. Such data are considered to be in raw form. These data will be corrected for sensor offsets, diurnal variations, latency, heading error (if magnetometer is used), and drift. The DGM subcontractor also will provide a digital planimetric map, in Geosoft format and coincident with the location of the geophysical survey, so that each day's geophysical data set can be registered within the original mission plan survey map.

All geophysical field data will be provided to CH2M HILL in delineated fields as x, y, z, v1, v2, and so on, where x and y are universal transverse Mercator (UTM) grid plane coordinates in easting (meters) and northing (meters) directions and z (elevation is an optional field in feet), v1, v2, v3, and so on are the instrument readings. The last data field will be a time stamp. Each data field will be separated by a comma or tab. No individual file will be more than 100 megabytes in size and no more than 600,000 lines long. Each grid of data will be logically and sequentially named so that the file name can be easily correlated with the grid name used by other project personnel.

Within days of data collection, the processed geophysical field data, all final maps, and supporting geophysical interpretations will be provided to CH2M HILL. All geophysical data will be accompanied by a report (standard report format out of MRP Enterprise) documenting the field activities associated with the data and the processing performed. Information provided by the MRP Enterprise report is summarized in **Table 1**.

All sensor data will be correlated with navigational data, based on a local "third order" (1:5,000) monument or survey marker. If a suitable point is not available, a land surveyor will establish a minimum of two new monuments or survey markers with a minimum of third-order accuracy.

3.4 DGM Systems QC

An extensive QC program will be applied to the DGM operations at the site. **Figure 1** shows an overall chart of the QC steps.

3.4.1 QC Tests

Each of the DGM systems will be field tested to confirm proper operating conditions. Several basic QC tests will be performed in addition to instrument-specific tests. A description of each basic QC test, its acceptance criteria, and its frequency is provided below and summarized in **Table 2**.

1. **Equipment Warm-up**. The EM61-MK2 system will be turned on and allowed to warm up for a minimum of 10 minutes before use. Equipment warm-up will be performed the first time an instrument is turned on for the day or has been turned off for a sufficient amount of time for the specific instrument to cool down.

2. **Personnel Test.** This test checks the response of instruments to personnel and their clothing/proximity to the system. On a daily basis, the EM61-MK2 system being used that day will be checked for its response to the personnel operating the system. The response will be observed in the field for immediate corrective action and transmitted back to the processor, and analyzed and checked for spikes in the data that could create false anomalies. The personnel test will be conducted at the beginning of the survey operation for each work day.

3. **Vibration Test (Cable Shake).** This test checks the response of instruments to vibration. On a daily basis, the EM61-MK2 will be checked for its response to vibrations in the system's cables. The response will be observed in the field for immediate corrective action and transmitted back to the processor and analyzed and checked

for spikes in the data that could create false anomalies. The vibration test will be conducted at the beginning of the survey operation for each work day.

4. **Static Background and Static Spike**. Static tests will be performed by positioning the EM61-MK2 within or near the survey boundaries in an area free of metallic contacts and collecting data for at least 3 minutes. During this time, the instrument will be held in a fixed position without a “spike” (small industry standard object [ISO]) placed on a stand at a carefully measured distance and orientation and then with a small ISO spike (1 minute without spike, 1 minute with spike, 1 minute without spike). The purpose of the static test is to detect unusual levels of instrument or ambient noise. The purpose of the spike test is to observe that the system is responding within industry standards. The static background and static spike test will be conducted at least every 4 hours, including the beginning and end of each survey operation.

5. **Repeat Data.** This test is performed to verify repeatability of the data and will be performed after the initial survey over an area. At least 2 percent of the survey area will be resurveyed.

3.4.2 QC Seed Items

At least one QC seed item, a small ISO (discussed in the GSV Plan, provided as an Attachment) will be seeded every 3,050 linear meters (10,000 linear feet), on average, in the land-based survey areas. Therefore, at least 6 QC seeds will be installed along the proposed 17,500 meters of transects. The seed items will be tagged with labels identifying them as inert and providing a contract reference, a point of contact address, phone number, and a target identifier. CH2M HILL personnel will perform seeding using hand tools. The seed locations will be checked using a hand-held analog geophysical instrument to confirm that no existing anomalies are present at the seed location. Once placed, the locations of all seeded items will be surveyed using conventional survey equipment or measured distance from centerline stakes. The items will be placed at easily detectable depths in order to have a high enough signal-to-noise ratio to compare to known industry standard target values. Detection of the QC seed items will be monitored by CH2M HILL and if an item is not detected, a root-cause analysis will be performed and corrective actions identified.

3.4.3 QC of DGM Data and Deliverables

The DGM subcontractor will perform QC of geophysical data and data deliverables at each step of the processing path. **Figure 2** shows the processing path and the QC steps performed. Data will not move to the next stage until they have passed the QC check. The CH2M HILL QC Geophysicist will perform a final QC check on the data before final delivery to the Navy.

QC checks to be performed on field forms, pre-processed data, and processed data can be found in **Table 1**.

3.4.4 Corrective Measures

Specific corrective measures are related to the type of geophysical equipment used; however, the following are the basic corrective measures to be followed in association with DGM surveying:

- Replacement of sensors if they fail to meet instrument check requirements.
- Resurvey of transects if seeded items are not identified (do not show in the DGM data). When there is a failure to select a seed item from the data but the item is clearly present in the DGM data, a re-analysis of the DGM data will be performed instead of a resurvey.

3.5 Analog Geophysical Systems QC

QC over the analog geophysical instruments will be accomplished through daily checks that the instruments are functioning before using them for field activities. Each instrument will be operated over a small ferrous metallic item. If the instrument is not able to detect the item, the instrument will be taken out of use until it is repaired.

SECTION 4

References

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CH2M HILL, 2013. *Draft Munitions and Explosives of Concern Quality Assurance Project Plan, Former Dive Bombing Targets – NALF Fentress Remedial Investigation*. June.

Malcolm Pirnie, Inc. 2008. *Final Preliminary Assessment, Naval Air Station Oceana, Dam Neck Annex and Naval Auxiliary Landing Field Fentress, Virginia.* October.

Tables

TABLE 1
Processing Documentation Requirements
GIP for NALF Fentress - Dive Bombing Targets RI
Chesapeake, Virginia

Information Type	"Raw" Data Delivery Report	Final Data Delivery Report	Must be in File Headers
Site ID	X	X	X
Geophysical instrument type used	X	X	
Positioning method used	X	X	
Instrument serial numbers (geophysical and positioning)	X	X	
Coordinate system and unit of measure	X	X	
Transect ID (or other identifier of surveyed area)	X	X	X
Date of data collection	X	X	X
Raw data file names associated with delivery	X	X	
Processed data file names associated with delivery	X	X	
Name of Project CH2M HILL QC Geophysicist	X	X	
Name of Site Geophysicist	X	X	
Name of data processor	X	X	
Data processing software used	X	X	
Despiking method and details	X	X	
Sensor drift removal and details	X	X	
Latency/lag correction and details	X	X	
Sensor bias, background leveling and/or standardization adjustment method and details		X	
Portable document format (PDF) document showing graphical results of each field quality control test	X	X	
Geophysical noise identification and removal (spatial, temporal, motional, terrain induced) and details		X	
Other filtering/processing performed and details		X	
Gridding method		X	
Anomaly selection and decision criteria details		X	
Geosoft ".xyz"and ".grd" files for unit of survey being delivered (e.g., transect or area agreed upon with Geophysicist)		X	
Geosoft ".grd" file for unit of survey being delivered		X	
Geosoft ".map" file for unit of survey being delivered		X	
PDF of Geosoft map for unit of survey being delivered		X	
Geosoft ".map" mosaic of all processed data to date		X	
PDF mosaic of Geosoft map of all processed data to date		X	
Other processing comments		X	
Date data processing is completed	X	X	
Data delivery date	X	X	
Scanned copy of field notes and field mobile data collection device notes (if applicable)	X		

TABLE 2
DGM Instruments Standardization Tests and Acceptance Criteria
GIP for NALF Fentress - Dive Bombing Targets RI
Chesapeake, Virginia

Test	Test Description	Acceptance Criteria	Power On	Beginning of Day	Beginning and End of Day	2% of Total Area Surveyed
1	Equipment Warm-up	Equipment specific (typically 5 minutes)	X			
2	Personnel Test *(Land-based system only)*	Based on instrument used. Personnel, clothing, etc. should have no effect on instrument response		X		
3	Vibration Test (Cable Shake)	Data profile does not exhibit data spikes		X		
4	Static Background & Static Spike	± 20% of standard item response, after background correction			X	
5	Repeat Data	Qualitative comparison of data.				X

Figures

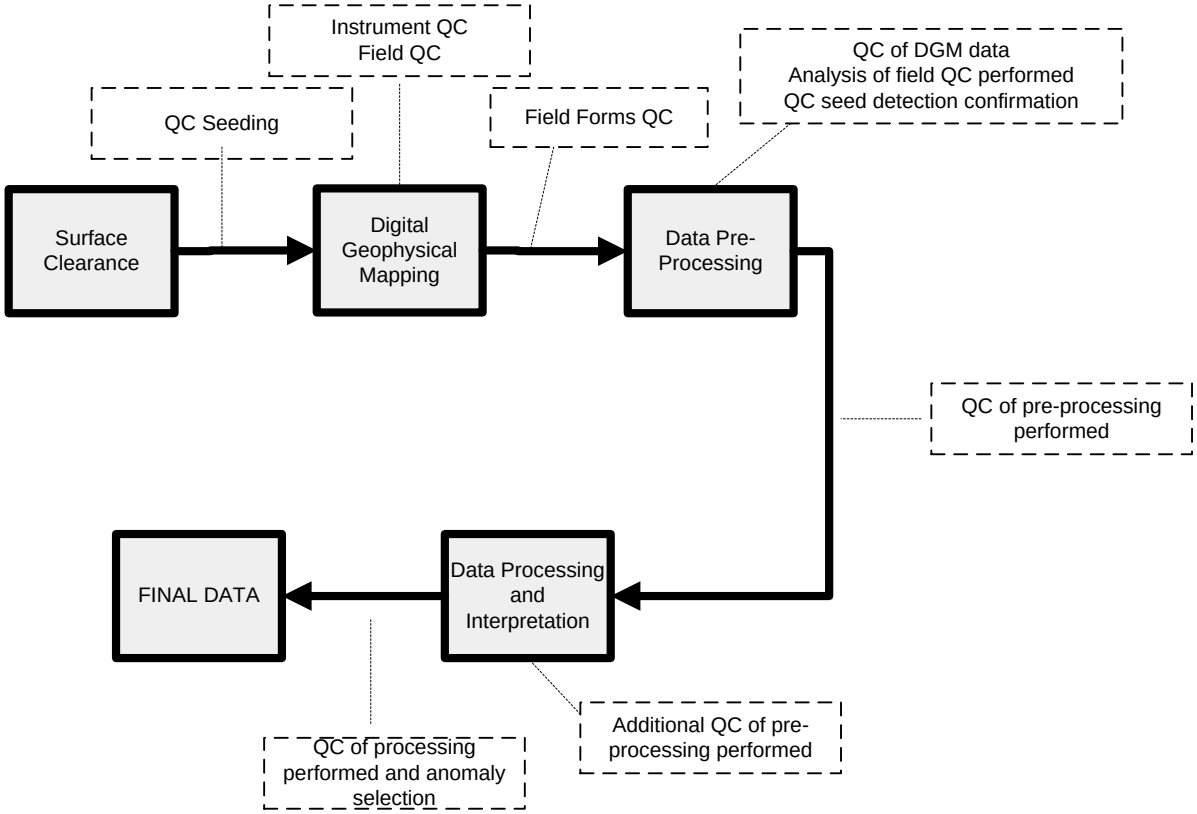

FIGURE 1
Overview of DGM Process QC
GIP for NALF Fentress - Dive Bombing Targets RI
Chesapeake, Virginia

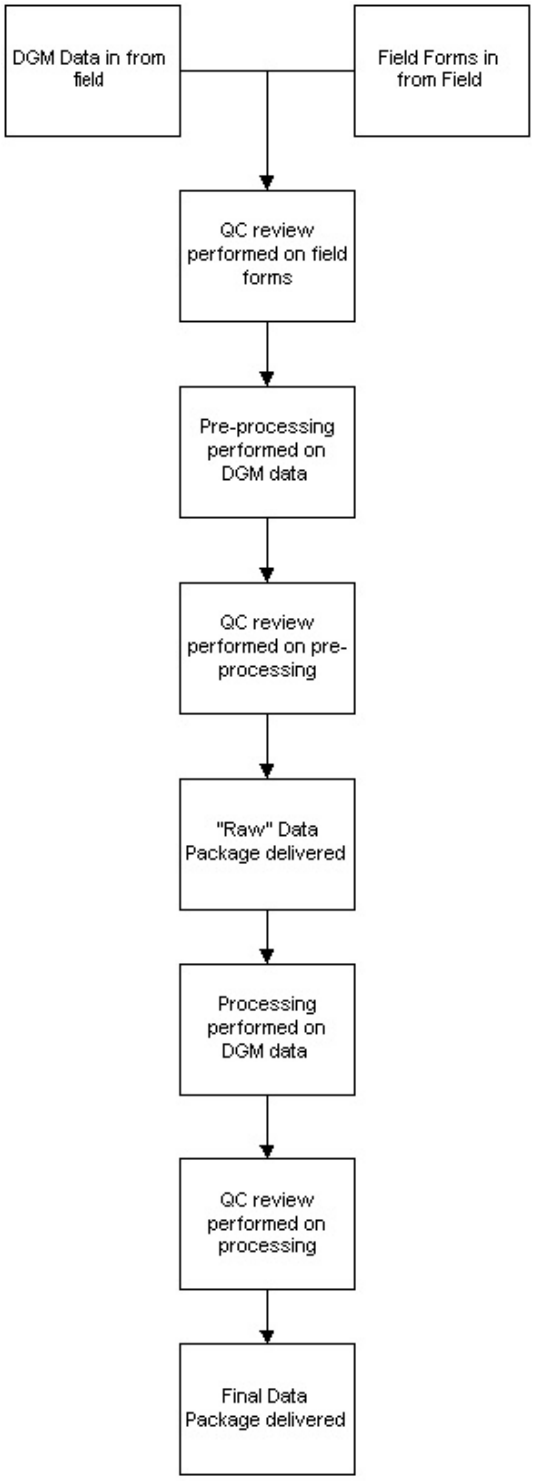

FIGURE 2
QC of DGM Data – Process Flow Path
GIP for NALF Fentress - Dive Bombing Targets RI
Chesapeake, Virginia

Attachment
Geophysical System Verification Plan

Final

Geophysical System Verification Plan
Dive Bombing Targets at Naval Auxiliary Landing Field Fentress – Remedial Investigation

Naval Air Station Oceana
Virginia Beach, Virginia

Contract Task Order WE60

September 2013

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

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Acronyms and Abbreviations

cm	centimeter(s)
DGM	digital geophysical mapping
ft.	foot or feet
GSV	geophysical system verification
in.	inch(es)
ISO	industry standard object
IVS	instrument verification strip
m	meter(s)
MEC	munitions and explosives of concern
MQO	measurement quality objective
NRL	Naval Research Laboratory
QC	quality control
SOP	standard operating procedure
UXO	unexploded ordnance

SECTION 1

Geophysical System Verification

Geophysical system verification (GSV) is a physics-based, presumptively selected technology process in which signal strength and sensor performance are compared to known response curves of industry standard objects (ISOs) to verify digital geophysical mapping (DGM) systems before and during site surveys. The GSV process is designed to perform initial verification of the DGM system using an instrument verification strip (IVS), followed by a blind seeding program for continued verification throughout the field operations.

1.1 IVS

The initial phase of the investigation to locate Munitions and Explosives of Concern (MEC), material potentially presenting an explosive hazard, and non-munitions related metallic items in the subsurface at each site will be verification of the presumptively selected DGM system using an IVS.

1.1.1 Personnel and Qualifications

The following individuals will be involved in the IVS process:

- CH2M HILL Quality Control (QC) Geophysicist
- DGM subcontractor's Site Geophysicist
- DGM subcontractor's Field Geophysicist or Geophysical Technician
- DGM subcontractor's Data Processor

DGM subcontractor personnel involved in the IVS process will meet the following qualifications:

- **Site Geophysicist:** will have a degree in geophysics, geology, geological engineering, or a closely related field, and have a minimum of 2 years of directly related geophysical experience. This individual will be capable of competently managing personnel, equipment and data on projects requiring multiple geophysical field teams and geophysical data processors and will have at least 1 year of experience in performing geophysical operations on a MEC site.
- **Field Geophysicist:** will have a degree in geophysics, geology, geological engineering, or a closely related field; a minimum of 2 years of directly related geophysical experience; and at least 1 year of experience in performing geophysical operations on a MEC site.
- **Geophysical Technician:** will have at least 6 months of experience in geophysical data collection on MEC-related projects.
- **Geophysical Data Processor:** will have a degree in geophysics, geology, geological engineering, or a closely related field, and will have at least 6 months of experience in processing geophysical data related to MEC projects.

1.1.2 DGM System

The presumptively selected DGM system to be verified and used for the production surveys will consist of the Geonics EM61-MK2 time-domain electromagnetic metal detector, with positioning provided by fiducial methods. The system and positioning methods are discussed in detail in the Geophysical Investigation Plan, of which this document is an attachment.

1.1.3 Location and Length of IVS

An IVS strip was established for prior work performed by CH2M HILL at the Dive Bombing Targets at the Naval Auxiliary Landing Field Fentress in Chesapeake, Virginia. The following sections provide all the information needing for setting up a new IVS if the existing IVS cannot be used. The IVS establishment steps will be skipped if the existing IVS is used.

1.1.4 ISOs

The ISO items (**Figure A-1**) to be used in the IVS are 1 inch (in.) (2.54 centimeters [cm]) by 4 in. (10.16 cm) steel pipes (Part Number: 44615K466) from the McMaster-Carr online catalog (http://www.mcmaster.com/):

Shape:	Straight Nipple, Threaded Both Ends
Schedule:	40
Pipe Size:	1 in. (1.315 in. outer diameter)
Length:	4 in.
Finish:	Black welded steel

Instrument response curves for this ISO have been developed by the Naval Research Laboratory (NRL). These response curves demonstrate their standard response under their best orientation and worst orientation at multiple distances from the instrument's bottom transmit/receive coil. The best orientation would be perpendicular to the EM61-MK2 instrument plane to cause the highest peak amplitude response. The worst orientation would be parallel to the instrument plane and perpendicular to the direction of travel to cause the lowest peak amplitude response (NRL/MR/6110--09-9183[1]).

1.1.5 IVS Procedures

A qualified and experienced MEC DGM operations geophysical team will employ the system to be verified over the IVS. **Figure A-2** illustrates the IVS process and the procedures to be employed during site work.

1. An IVS area will be selected with preference for the following (although none of the conditions are vital for IVS success):
   (a) Terrain, geology and vegetation similar to that of most of the project site
   (b) Geophysical noise conditions similar to those expected across the survey area
   (c) Site of sufficient size to accommodate all necessary IVS tests and equipment and for adequate spacing (at least 10 feet (ft.) [3 meters (m)]) of the ISO items to avoid ambiguities in data evaluation
   (d) Readily accessible to project personnel
   (e) Proximity to the actual survey site (if not within the site)
2. A "background" DGM survey will be performed by the DGM subcontractor with the instrument to be validated over the IVS. This step will allow background geophysical conditions to be recorded, will help evaluate the appropriateness of the location (for example, few existing anomalies), and will verify that ISOs are not seeded near existing anomalies. The data will be post-processed (that is, filtered and positions attached to the geophysical data) and provided to the CH2M HILL QC Geophysicist for evaluation.
3. Following verification that the IVS area is clear of subsurface anomalies (or that existing anomalies can be avoided during seeding), two ISO items will be buried perpendicular to the plane of the EM61-MK2 system's transmit/receive coil (vertically) at depths of approximately 3 and 7 times their diameter. The approximate IVS setup will be as shown on **Figure A-3**.

   Measurements of the item depths will be to the center of mass of each item. CH2M HILL personnel will bury the ISOs to the appropriate depths for seed items. The background survey data and anomaly avoidance techniques will be used to ensure that end stakes and ISOs are not placed on top of or near existing anomalies. Personnel will emplace ISOs and record the emplacement data (depth, orientation, and azimuth).
4. Conventional Total Station survey equipment will be used to record the center of each ISO location and the IVS endpoints. The holes will then be filled with soil and a polyvinyl chloride surveyor's flag or 6-inch wooden survey stake placed at each ISO location.

   A DGM survey will be performed by the DGM subcontractor over the IVS area, including the transects described in **Table A-1** and shown on **Figure A-4**. The data will be processed and interpreted by the DGM

[1] NRL. 2009. EM61-MK2 Response of Three Munitions Surrogates, NRL/MR/6110--09-9183. March 12.

subcontractor and provided to the CH2M HILL QC Geophysicist for confirmation within 12 hours of completion of the survey.

5. If the initial MQOs have not been met, the CH2M HILL QC Geophysicist will meet with the DGM subcontractor to discuss whether modifications to instrumentation or procedures can be made to the DGM system in order to meet the measurement quality objectives (MQOs).
6. If the MQOs cannot be met by the DGM subcontractor, the CH2M HILL QC Geophysicist will meet with the project team to discuss a resolution (that is, modification of an MQO) before completing the IVS process.
7. Once the surveys have been performed and the system has met the initial (or modified) MQOs, the IVS process will be complete.

1.1.6 MQOs

The testing in the IVS area will verify the ability of the system to achieve the specific MQOs outlined in **Table A-2**. The system will not be used for site surveys until it is able to meet the IVS MQOs or until the project team agrees on the reasoning behind an MQO not being met and an appropriate revised MQO has been established.

Production survey MQOs will be achieved through the ISO blind seeding program and other QC tests, as discussed in the Geophysical Investigation Plan. The IVS MQOs, measurement performance criteria, and test method to be used during the IVS process are summarized in **Table A-2** and discussed in detail in the following subsections.

General System Verification

DGM System Positioning

The MQO for DGM system positioning is that the coordinates being obtained from the positioning system are of sufficient accuracy to allow for appropriate relocation of geophysical anomalies for intrusive investigation. The measurement performance criterion for this is that the positional error at known monuments will not exceed 3.3 ft (1.0 m). This will be evaluated during the IVS process by ensuring that the anomalies representing the ISO seeds in the IVS data are positioned within this distance from the measured locations.

DGM System Munitions Detection

The MQO for munitions detection is to demonstrate that the system in use is capable of detecting munitions within industry standards. This is demonstrated through a physics-based, presumptively selected technology process in which signal strength and sensor performance are compared to validated industry values. For the EM61-MK2, this process involves demonstrating that the maximum amplitude response over a standard item falls within the sensor response curve for that item, as determined through NRL demonstration tests for that item (**Figure A-5**). Once it has been established that the system is responding comparably, a cross-correlation of industry experience with detection of munitions items can be assumed. In other words, the depths and orientations of munitions items which the EM61-MK2 has been shown to be effective at detecting under test scenarios[2] and other projects can be expected.

Because minor changes in the coil height as it passes over the item and slight variations in the path traveled down the IVS can significantly affect the amplitude response received from the instrument, the IVS results will be qualitatively evaluated. A finding that the geophysical instrument itself is responding within a specific threshold will be accomplished through the spike test results (Section 1.1.7), wherein the distance from the coil and orientation of the item can be strictly controlled.

[2] NRL/MR/6110--08-9155 (EM61-MK2 Response of Standard Munitions Items), Final Report for the Evaluation of (Unexploded Ordnance) UXO Detection Technology at the Standardized UXO Test Sites Aberdeen and Yuma Proving Grounds, Standardized UXO Technology Demonstration Site Program, SERDP, November 2007. Demonstrator scoring results: http://aec.army.mil/usaec/technology/uxo01f.html.

Data Handling

The MQO for data handling is that all data must be delivered in a timely manner and in a useable format. Because of the need for rapid feedback during IVS operations to effectively test potential DGM systems, the measurement performance criterion for data handling during IVS activities will require that initial data be completed and delivered to the CH2M HILL QC Geophysicist within 12 hours of collection. Final processed data for the IVS will be delivered to the CH2M HILL QC Geophysicist within 3 working days of collection. This will be evaluated based on the actual delivery of data during the IVS process.

1.1.7 QC

Achievement of the instrument evaluation MQOs will be verified by the CH2M HILL QC Geophysicist. The selected IVS area, the process of emplacing the IVS items, and the survey locations will be verified through observation during the IVS process. Geophysical subcontractor-provided standard operating procedures (SOPs) (to be provided as an addendum to this GSV Plan after subcontractor selection) will be reviewed to confirm that equipment and procedures are being checked according to documented SOPs. The QC tests listed in **Table A-3** and detailed in the following subsections will be performed on the geophysical system being used:

1. **Equipment Warm-up**. All geophysical equipment will be warmed up for a minimum of 10 minutes. Equipment warm-up will be performed the first time an instrument is turned on for the day or has been turned off for a sufficient amount of time for the specific instrument to cool down.

2. **Personnel Test.** This test checks the response of instruments to personnel and their clothing/proximity to the system. On a daily basis, the instrument coils/sensors for those instruments being used that day will be checked for their response to the personnel operating the system. The response will be observed in the field for immediate corrective action and transmitted back to the processor, then analyzed and checked for spikes in the data that could create false anomalies. The personnel test will be conducted at the beginning of the survey operation for each work day.

3. **Vibration Test (Cable Shake).** This test checks the response of instruments to vibration. On a daily basis, the instrument coils/sensors for those instruments being used that day will be checked for their response to vibrations in the cables. The response will be observed in the field for immediate corrective action and transmitted back to the processor and analyzed and checked for spikes in the data that could create false anomalies. The vibration test will be conducted at the beginning of the survey operation for each work day.

4. **Static Background and Static Spike**. Static tests are performed by positioning the survey equipment within or close to the survey boundaries in an area free of metallic contacts and collecting data for a specific period, while holding the instrument in a fixed position without a “spike” (small ISO placed at an accurately measured distance and orientation from the transmitter coil, as in the example shown in **Figure A-6**) and then with a “spike.” The purpose of the static test is to identify any unusual levels of instrument or ambient noise. The static background and static spike test is conducted at the beginning and end of each survey operation. This is the test that essentially “opens” and “closes” a survey area (grid, grid block, set of transects, etc.)

   The ISO can be placed above or below the EM61-MK2 transmitter coil as long as the distance is measured from the center of mass of the item to the horizontal plane of the coil (top of coil if item placed above coil, bottom of coil if item placed below), as illustrated in **Figure A-7**.

1.1.8 Data Analysis and Interpretation

All data collected at the IVS test strip will be post-processed and analyzed. Instrument-specific data processing SOPs will be provided as an addendum to this Plan after subcontractor selection.

1.1.9 IVS Data Evaluation

The CH2M HILL QC Geophysicist will evaluate the data provided by the geophysical subcontractor and validate for the project team whether the selected geophysical system meets the IVS MQOs.

SECTION 2

Blind Seeding

As a continuing part of the GSV process, ISOs will be used as blind QC seeds in the areas to be surveyed to provide ongoing verification that the DGM system is properly functioning and the munitions detection and positioning MQOs are continuing to be met.

2.1 Seeds Placement

Seeds will be buried vertically at a depth of approximately 6 in. (15 cm) below ground surface, with the depth being measured to the center of mass of the item, as illustrated in **Figure A-7**. Depths will be recorded in field notes. The field team leader will be responsible for labeling each QC seed with a unique identifier. These seeds can either be labeled with a paint pen or with a weather-resistant label taped to or secured within the seed. The location of blind seeds will not be shared with personnel performing DGM surveys and data processing/interpretation until those tasks have been completed.

2.2 Validation

After each data set is delivered to CH2M HILL by the DGM subcontractor, the CH2M HILL QC Geophysicist will overlay the locations of the blind seeds and verify that the munitions detection and positioning MQOs are continuing to be met. Should an issue be detected (such as a data trend indicating a MQO limit is being approached) or an MQO is not met, a comprehensive root-cause analysis will be performed and a corrective action identified.

SECTION 3

IVS Reporting

Results of the IVS process will be documented in a technical memorandum after the IVS process has been performed. The report will include a summary of the IVS operations, an as-built map of the IVS plot, and IVS results. Results of the blind seeding evaluation will be provided as part of the Remedial Investigation report.

Tables

TABLE A-1
IVS Transects Descriptions and Purpose
GSV Plan for NALF Fentress–Dive Bombing Targets RI
Chesapeake, Virginia

Transect	Description	Purpose
A	Offset by 0.75m	Demonstrate horizontal drop off of item response
B	Directly over center of strip	Verify response vs. established response curves
C	Offset by 0.37m (1/2 intended lane separation) from center of strip	Demonstrate horizontal drop off of item response
D	Offset by 0.75m (on opposite side of strip from Transect A)	Demonstrate horizontal drop off of item response
E	Offset by ~3m from strip	Measure background noise

TABLE A-2
Project Measurement Quality Objectives
GSV Plan for NALF Fentress–Dive Bombing Targets RI
Chesapeake, Virginia

Measurement Quality Objective	Measurement Performance Criteria	Test Method During IVS
General System Verification		
DGM System Positioning. Accurate coordinates are being obtained from DGM positioning systems.	Positional error of ISO seeds will not exceed 3.3 ft (1.0 m).	Results of IVS DGM survey vs. IVS seed locations will be evaluated to ensure compliance.
DGM System Munitions Detection. DGM system response is within industry standards for detection.	Response to ISO is comparable to published or calculated results for that item.	Results of IVS surveys over seed items in strip will be qualitatively reviewed.
	Response to standardized item will not vary more than ±20%of expected value[1] in static test.	Results of static test will be quantitatively reviewed to ensure compliance.
Data Handling		
All data must be delivered in a timely manner and in a useable format.	IVS data is completed and delivered within 12 hours.	Evaluate based on actual delivery of data.

[1] NRL/MR/6110--09-9183 (Provided as **Figure A-5**)

TABLE A-3
Geophysical Instrument Standardization Tests and Acceptance Criteria
GSV Plan for NALF Fentress–Dive Bombing Targets RI
Chesapeake, Virginia

Test	Test Description	Acceptance Criteria	Power on	Beginning of day	Beginning and end of day
1	Equipment Warm-up	Equipment specific (typically 5 minutes)	X		
2	Record Sensor Positions	+/- 4 in. (10 cm)		X	
3	Personnel Test	Based on instrument used. Personnel, clothing, etc. should have no effect on instrument response.		X	
4	Vibration Test (Cable Shake)	Data profile does not exhibit data spikes.		X	
5	Static Background & Static Spike	+/- 20% of standard item response, after background correction.			X

Figures

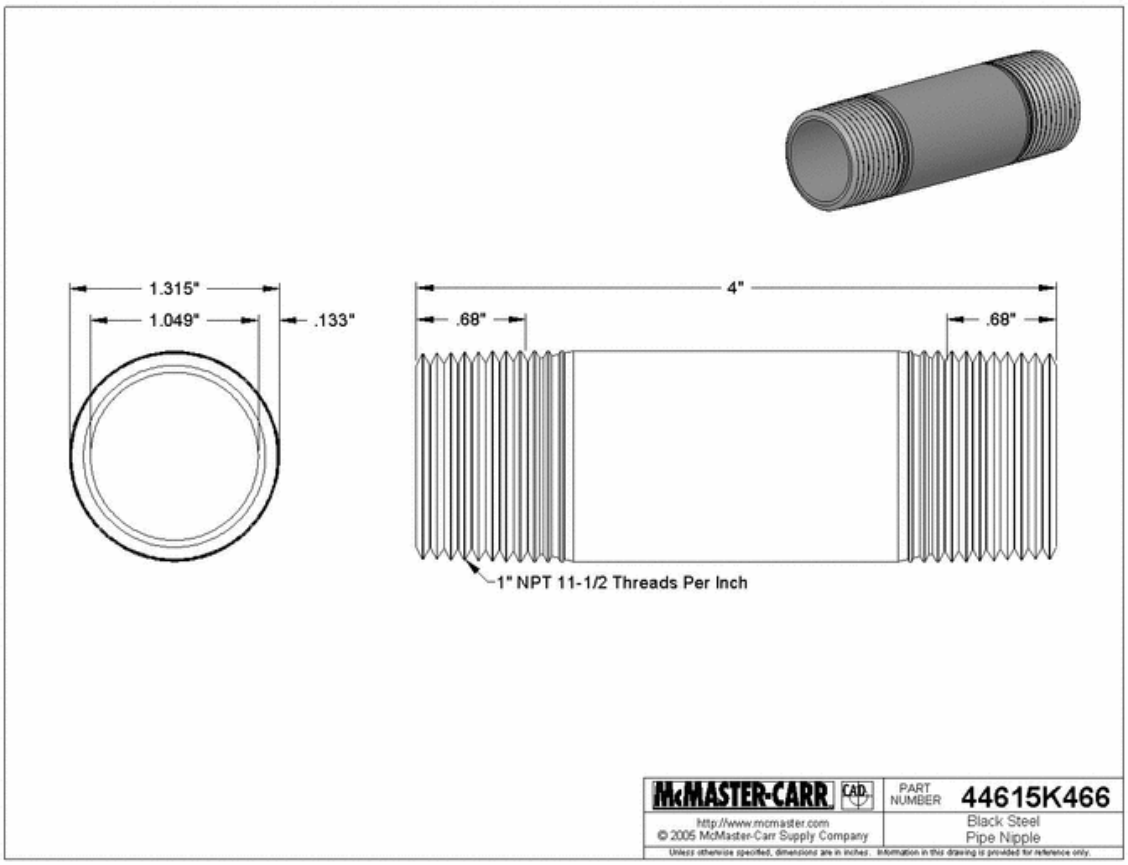


FIGURE A-1
Industry Standard Object
GSV Plan for NALF Fentress –Dive Bombing Targets RI
Chesapeake, VA

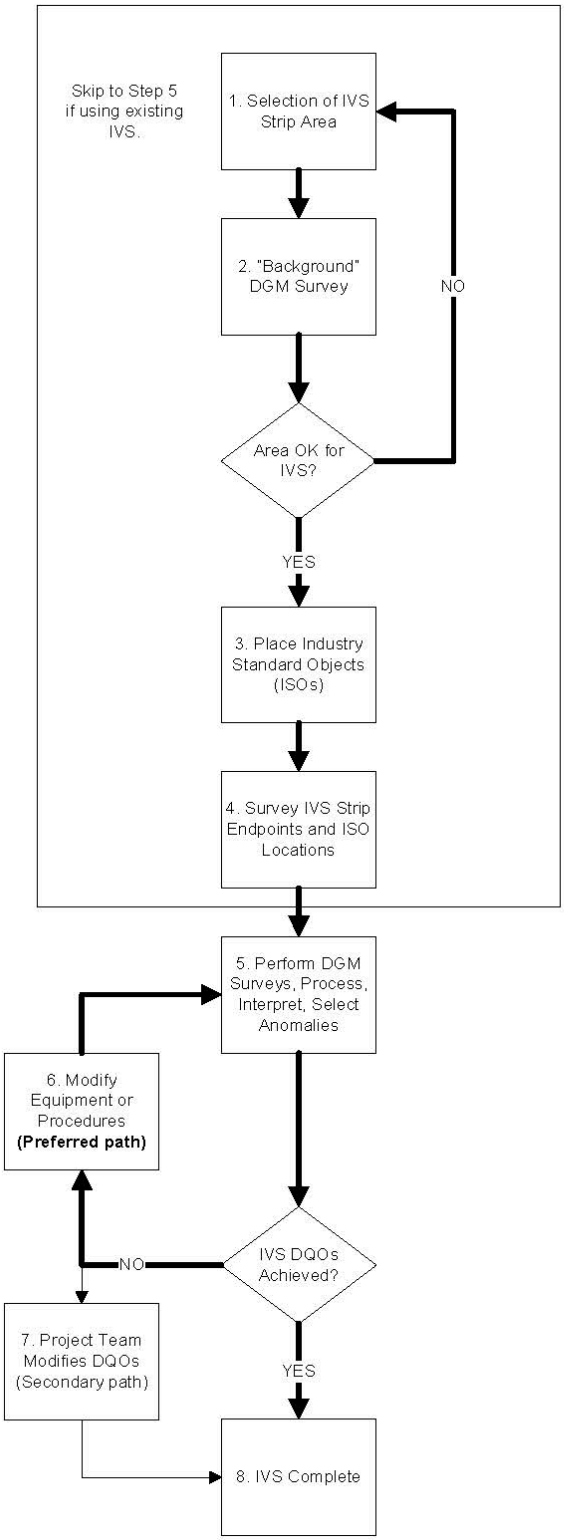


FIGURE A-2
IVS Process
GSV Plan for NALF Fentress –Dive Bombing Targets RI
Chesapeake, VA

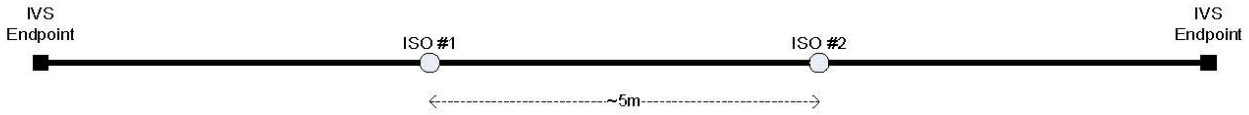


FIGURE A-3
IVS Strip
GSV Plan for NALF Fentress–Dive Bombing Targets RI
Chesapeake, VA

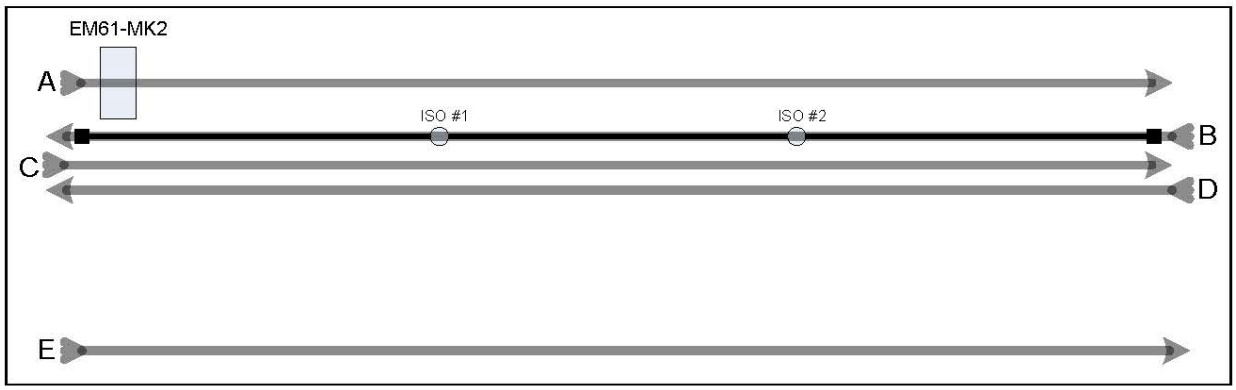
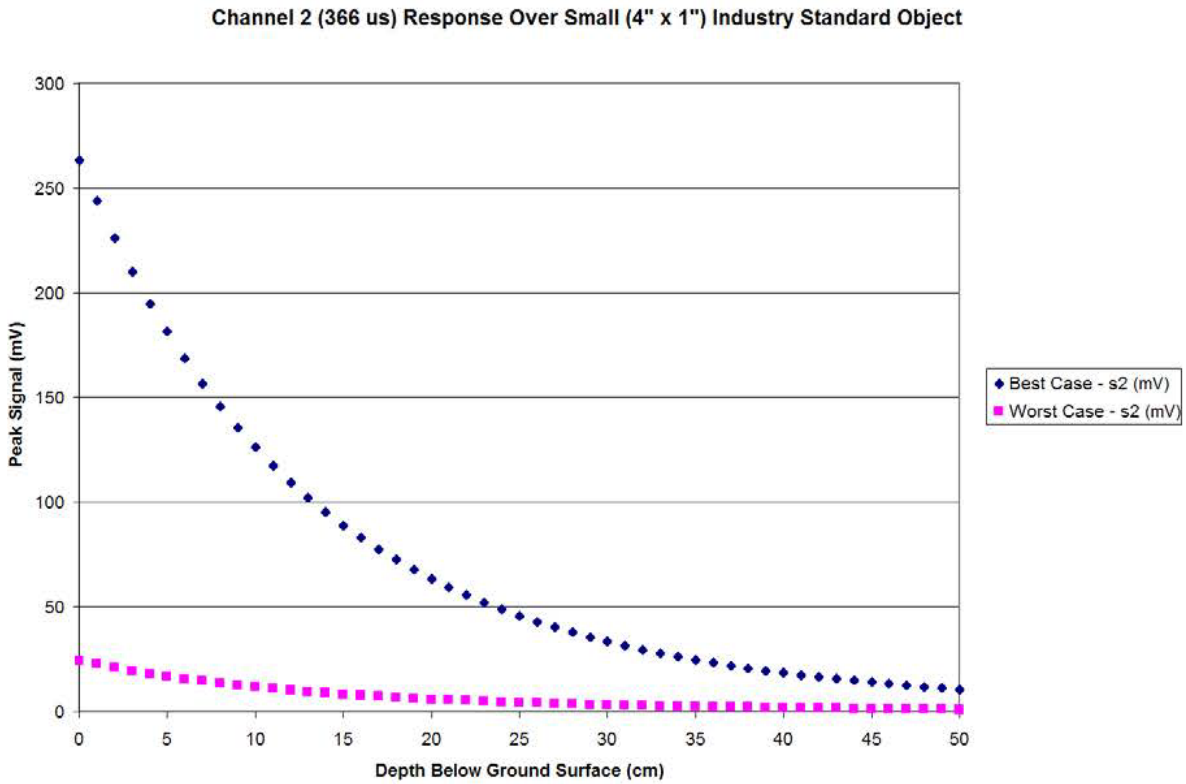


FIGURE A-4
IVS Transects
GSV Plan for NALF Fentress–Dive Bombing Targets RI
Chesapeake, VA



Reference: NRL/MR/6110-09-9183

FIGURE A-5
NRL Results for Small (4 inch x 1 inch) ISO Tested under EM61-MK2 Bottom Coil
GSV Plan for NALF Fentress–Dive Bombing Targets RI
Chesapeake, VA

FIGURE A-6
Example Spike Test Setup
GSV Plan for NALF Fentress–Dive Bombing Targets RI
Chesapeake, VA

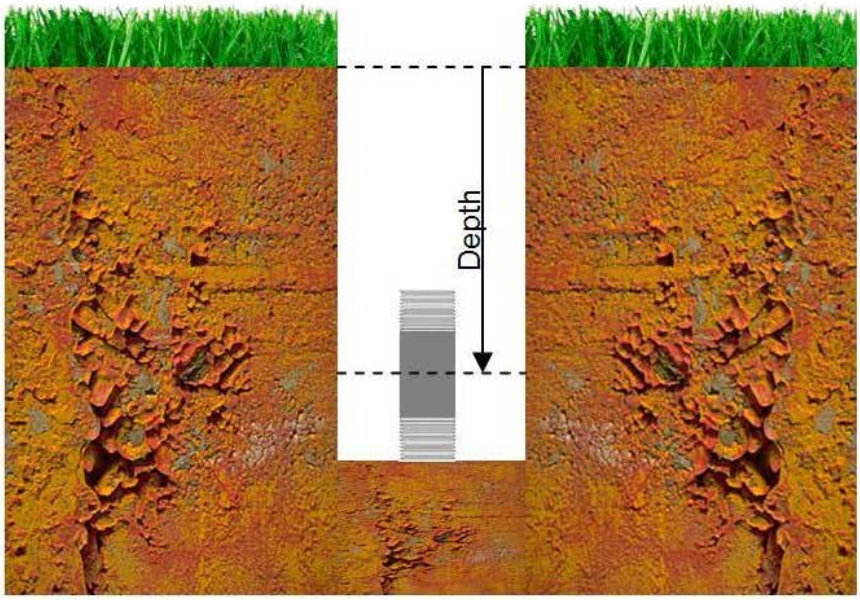


FIGURE A-7
QC Seed Burial Illustration
GSV Plan for NALF Fentress–Dive Bombing Targets RI
Chesapeake, VA

Appendix B
Standard Operating Procedures

NAeVA GEOPHYSICS INC.

THE LEADER IN SUBSURFACE DETECTION

Subsurface Geophysical Surveys

GPR
MAGNETICS
ELECTROMAGNETICS
SEISMICS
RESISTIVITY
UTILITY LOCATION
UXO DETECTION
BOREHOLE CAMERA
STAFF SUPPORT

Standard Operating Procedures for Geophysical Mapping

Geonics EM61 – MK2

UXO 07: Moving Target Mortar Range-South (Dam Neck Annex)
UXO 09 Dive Bombing Targets (Naval Auxiliary Landing Field Fentress)
Naval Air Station Oceana
Virginia Beach, Virginia

Contract Task Order WE60 & WE69

October 2013

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Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide specific procedures for data collection, processing and equipment for the geophysical investigations at UXO 07 Moving Target Mortar Range-South (MTMR-S) at Dam Neck Annex and at UXO 09 Dive Bombing Targets (DBTs) at Naval Auxiliary Landing Field (NALF) Fentress located within Naval Air Station Oceana, Virginia Beach, Virginia.

Equipment and Theory

This SOP is applicable for the Geonics EM61-MK2 and Trimble's 5700/R7/R8 RTK (Real Time Kinematic) GPS.

The EM61-MK2 is a high-resolution time-domain electromagnetic instrument designed to detect, with high spatial resolution, shallow ferrous and non-ferrous metallic objects. In comparison with other metal detectors, especially magnetometers, it is much better suited for work in close proximity to man-made structures and in areas of dense subsurface metallic debris (i.e. impact ranges). The Standard EM61-MK2 system consists of two air-cored coils, a digital data recorder, batteries and processing electronics. The EM61-MK2's transmitter generates a pulsed primary magnetic field, which then induces eddy currents in nearby metallic objects. Each of the two spatially separated receiver coils measures these eddy currents. The EM61-MK2 offers the ability measure the eddy currents at three distinct time intervals in the bottom coil or four intervals if no top coil measurements are recorded (as planned for this work). Earlier time gates provide enhanced detection of smaller metallic objects. Secondary voltages induced in both coils are measured in millivolts (mV). The arrangement of coils is such that there is a vertical separation of 40 cm. Assuming accurate data positioning, target resolution of approximately 0.5 meters can be expected. The data are collected into Geomar's Nav61MK2 program and temporarily stored in an Allegro CX prior to downloading to a laptop computer.

Trimble's 5700 GPS is a 24-channel dual frequency RTK receiver that uses both L1 and L2 satellites. This system operates with a base and a rover unit; the base sends corrections to the rover via radio link, thus maintaining a 3cm horizontal accuracy and a 5cm vertical accuracy. For configuration with the EM61-MK2, the rover is set to output a GGA NMEA string at 1 Hz, which is captured into the NAV61MK2 program and on the Allegro CX.

Instrument Standardization

All instruments will be assembled and calibrated (where required) as specified in their User Manuals. Additionally, each instrument will be field tested daily to ensure that the instrument is operating properly (explained in Section 7).

Data Acquisition

Whether the survey area is established as grids or as transect lines, the EM61-MK2 is operated at a walking pace by one or two people. Data collected on wheels at a rate of one reading/10 cm or in tandem mode (the instrument is carried by two operators) readings triggered at 10 readings/second. Selection of the appropriate method is based primarily on local terrain conditions. When GPS positioning is used data are collected in automatic mode at 10 readings/second regardless of collection method.

Instrument Setup

When the instrument is operated in wheel mode, it is setup according to Geonics EM61-MK2 manual. For tandem mode, the EM61-MK2 coils are centered and suspended on two 10ft long fiberglass poles. The instrument is attached to the poles using the top coil with zip ties and webbing. The webbing wraps around the poles and is attached to the bottom coil clamps. For both modes of data collection, the cables are taped and secured to prevent them from getting tangled and possibly disturbed by movement or vegetation. If GPS is used, a tripod is attached to the top coil and the satellite antenna is fastened to the top.

Navigation

Depending on site conditions, navigation of the system is accomplished through either Fiducial (FID) method or Global Positioning System (GPS/RTK) method.

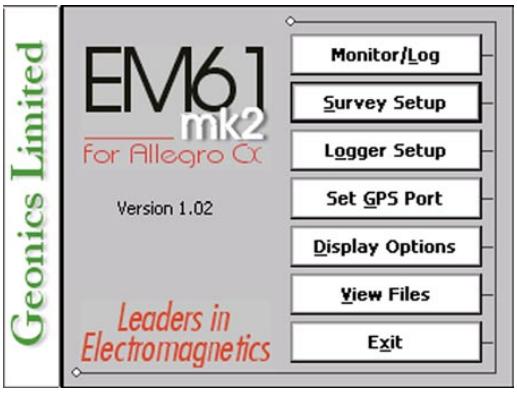
The FID method is used in wooded areas where GPS positioning is unavailable. This method uses painted ropes positioned across each grid for the placement of fiducial marks within the recorded data. Local coordinates are warped to geodetic using reference locations (stakes) surveyed in by licensed surveyors on evenly spaced centers.

The second method of navigation is GPS/RTK. The base station is setup on a control point and corrections are sent via radio link to the rover receiver. The rover GPS antenna is mounted over the center of the EM61-MK2 coil and provides real time positional tracking capabilities that is streamed into the same software program as the EM61-MK2 data.

Data collection Steps

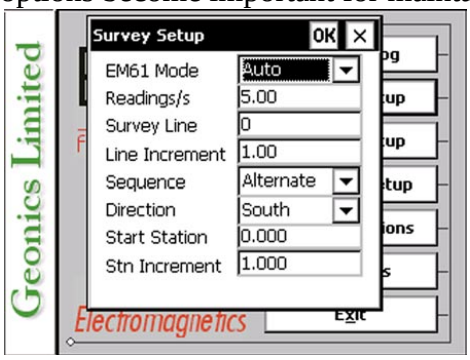
The following steps are followed to begin surveying with the **<u>EM61-MK2 with fiducial positioning</u>**:

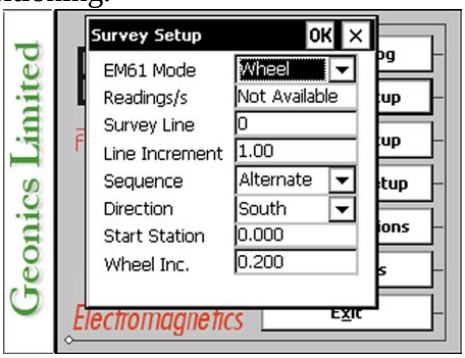
1. Turn on the EM61-MK2 by pushing in the fuse on the top of the console/electronics.
2. Allow the instrument to warm up for at least 15 minutes.
3. Turn on the Allegro CX, and open the EM61MK2 program. The screen below will be displayed.



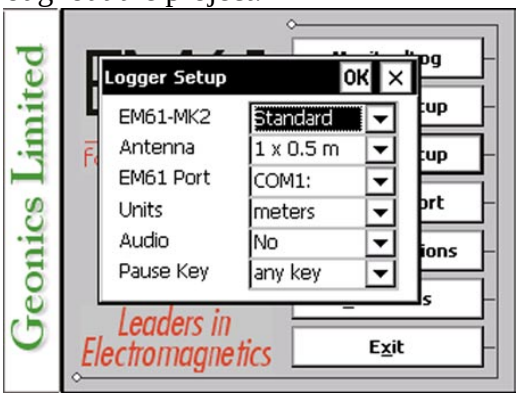
4. Click on “Survey Setup”, and specify the following options. Depending on surface conditions, the Mode is set to “Auto” and Readings/s is set to “10” or the Mode is set

to “Wheel”, Readings/s to “Not Available”, and Wheel Inc. to 0.1. The remaining options become important for maintaining positioning.



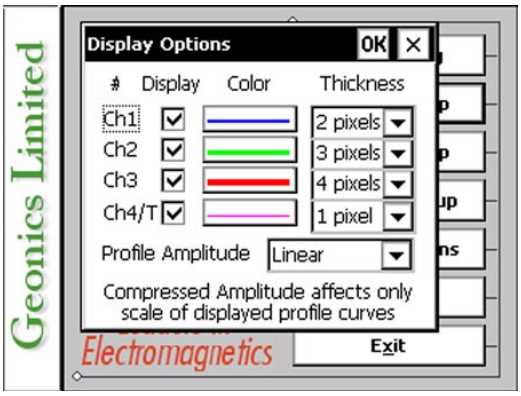


5. Click on “Logger Setup”, and specify the following options. These settings will remain as defaults throughout the project.

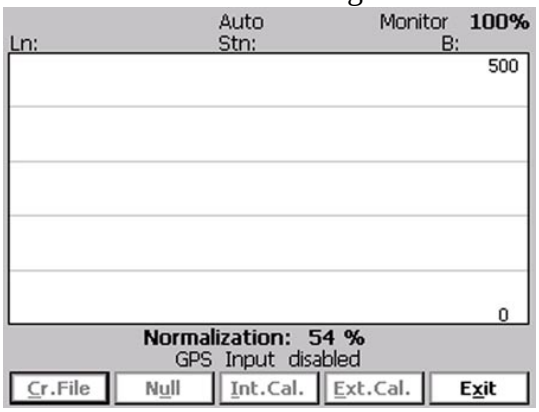


6. Click on “GPS Port Setup”, and make sure the *GPS Input* is set to “Disabled”, and all other options are grayed out.

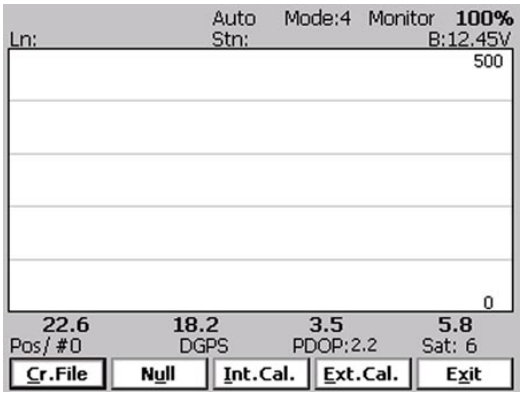
7. Click on “Display Options”, and specify the following options. These options are also operator preferences for aesthetics and do not affect the collected data.

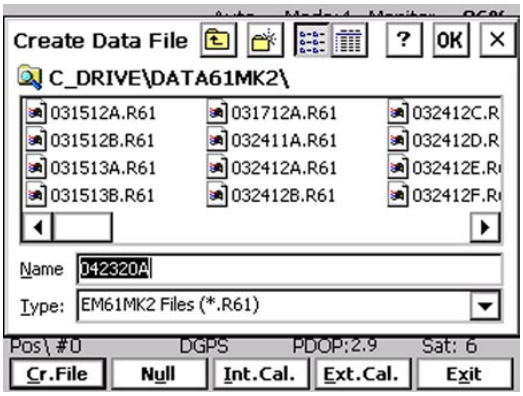


8. Once all parameters are set, click on "Monitor/Log". The screens shown below will be displayed while the instrument is normalizing.



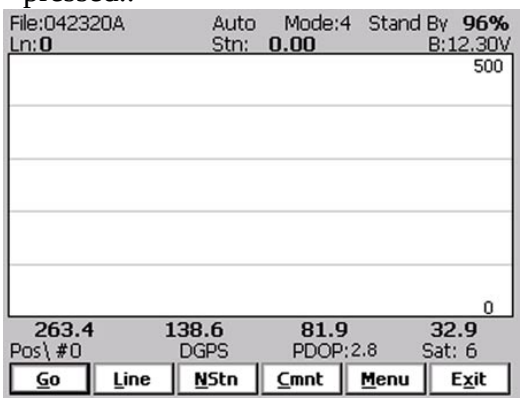
9. Once the Instrument has finished normalizing, find a quiet spot and *Null* the instrument. Then click on *Cr. File* and name and save the file.

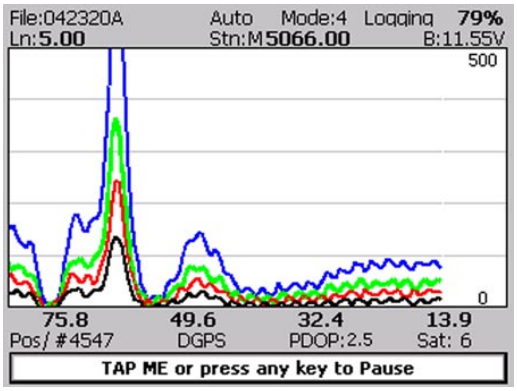




10. Line up on the grid or transect and select *Go*. The software will begin logging the readings, and a *Pause* button will appear at the bottom of the screen. As the operator crosses over each rope (reference location) the fiducial button is hit adding a marker in the data which is later used in the editing of the data to accurately position the data. At the end of the line, tap the *Pause* button or hit enter on the keypad. One thing to note is the difference between fiducial collection in tandem mode and fiduical collection in wheel mode. When data are collected in wheel mode, once the *Go*

button is pressed the instrument does not start taking readings until the wheels are turning or the instrument is moving, since the readings are triggered by the odometer in the wheels. For data collected in tandem mode, the instrument is set automatic, so as soon as the *Go* button is pressed the instrument is recording readings. The operator needs to make sure that they are ready to go prior to pressing the *Go* button. The most effective way to collect data in Tandem mode without GPS is to start behind the grid and as the center of the instrument crosses the "start" line the *Go* button is pressed..

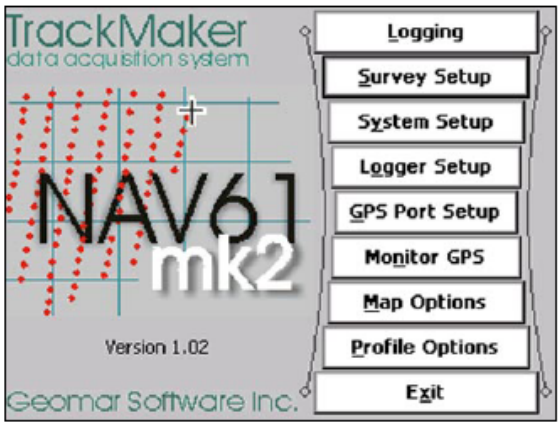




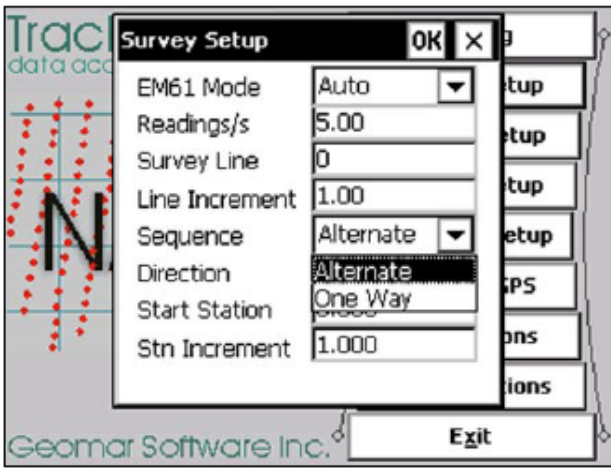
11. On the screens shown above, the EM61-MK2 data are monitored.
12. At the end of the file, select the *Exit* button. The file automatically saves at the end of every line.

The following steps are followed to begin surveying with the **EM61-MK2 with RTK GPS positioning assuming the GPS base station and GPS QC check have already been preformed**:

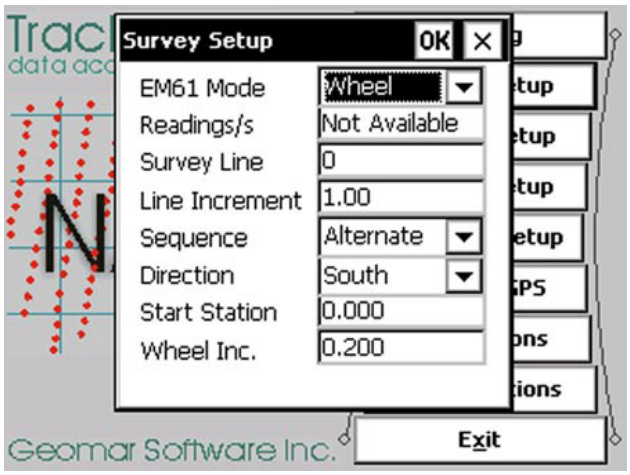
1. Turn on instrument by pushing in the fuse on the top of the console/electronics
2. Allow instrument to warm up for at least 15 minutes
3. Turn on Allegro CX and open NAV61MK2 program. The screen below will be displayed.



4. Click on "Survey Setup" and specify the below options. For this GPS/RTK Method, the Mode is set to "Auto" and Readings/s is set to "10". For Fid Method, the Mode is set to "Wheel", Readings/s is "Not Available", and Wheel Inc. now shows up instead of Stn Increment and it is set to 0.1.

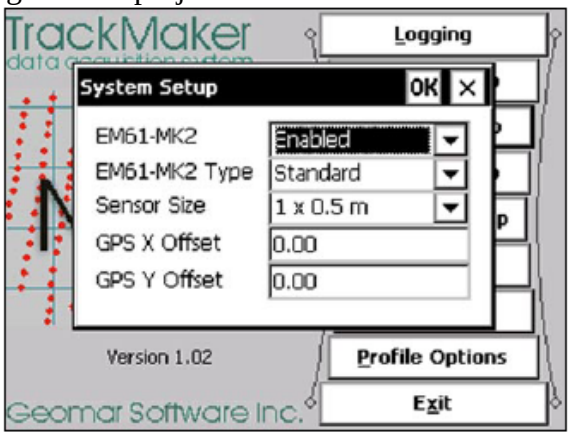


GPS/RTK Method

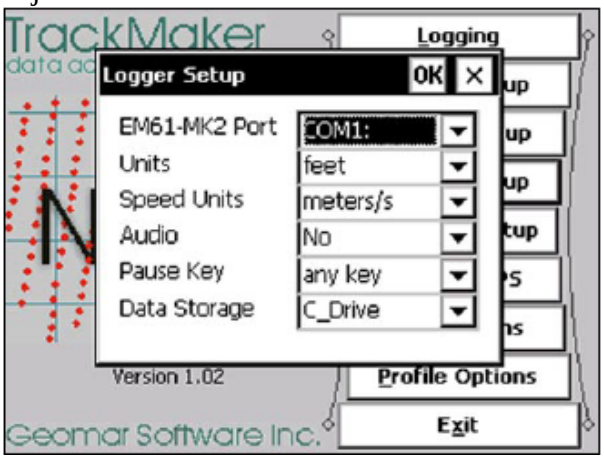


Fiducial Method

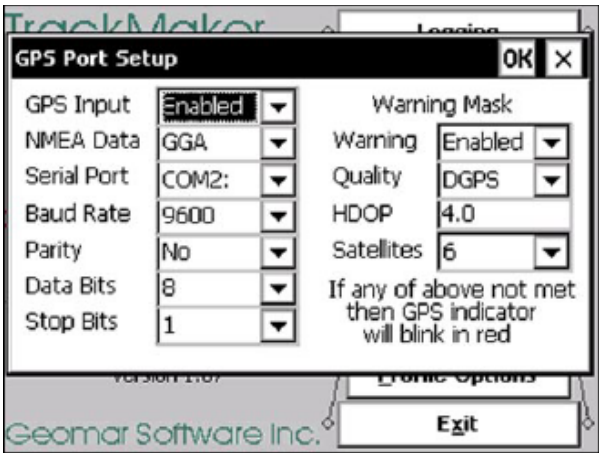
5. Click on "System Setup" and specify the below options. These setting will usually remain the same throughout the project.



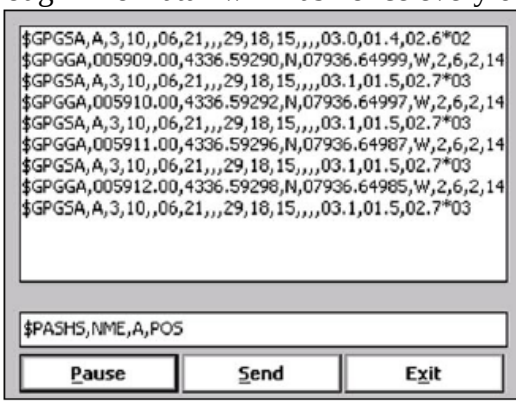
6. Click on "Logger Setup" and specify the below options. These setting will remain the same throughout the project.

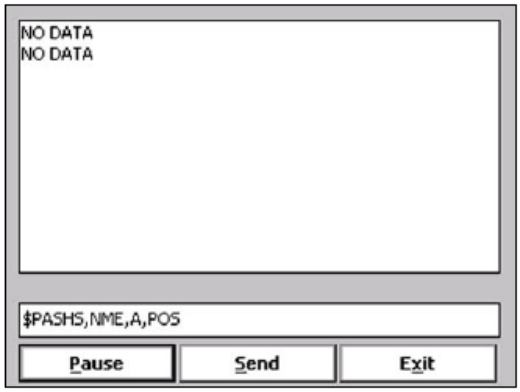


7. Click on "GPS Port Setup" and specify the below options. When using GPS the below setting will be used. On the left side of the screen is where parameters can be set for alerts to go off if the GPS string is inadequate.

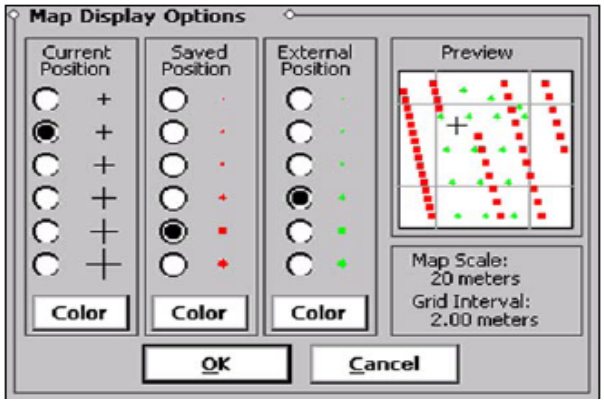


8. Click on "Monitor GPS" and the below window will open. If the NMEA string is coming in correctly, the screen will appear like the one on the left. If there is a problem with the baud rate, "No Data" will appear once a second. If there is nothing coming through "No Data" will flash once every 6 seconds.

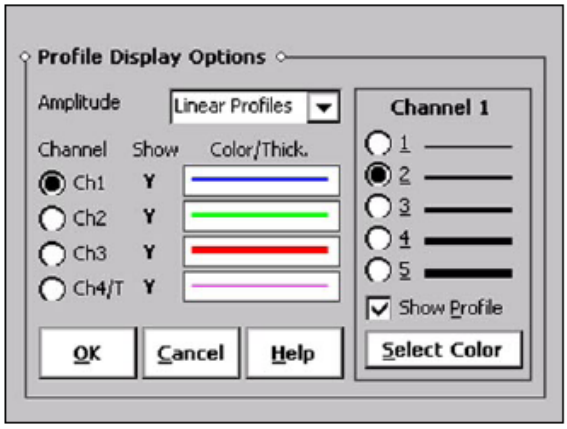




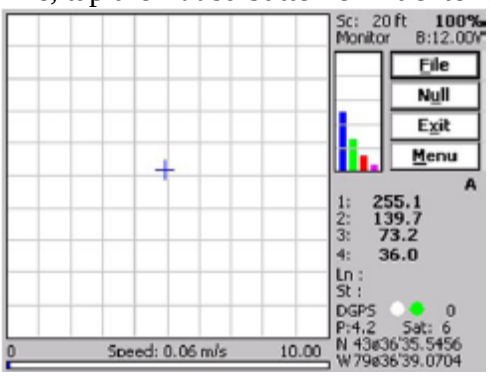
9. Click on "Map Options" and specify the below options. These are more operator preferences for aesthetics then for performance of the software.

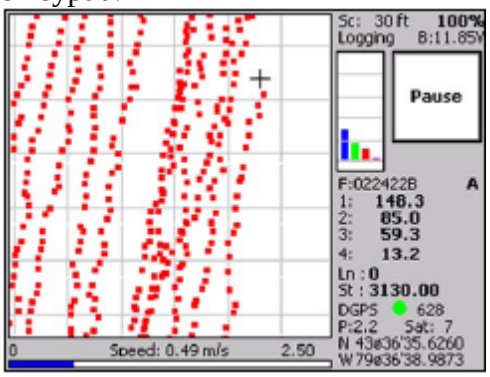


10. Click on "Profile Options" and specify the below options. These are more operator preferences for aesthetics then for performance of the software.



11. Once all the parameters are set click on the logging screen. The below screens will be displayed. Find a quiet spot and *Null* the instrument, then click on *File* and name your file and save it. Line up on the grid or transect and select *Go*. The software will start logging the readings and a large *Pause* button will appear on the screen. At the end of the line, tap the *Pause* button or hit enter on the keypad.





12. On the above screens, both the EM61-MK2 data and the GPS/RTK data are monitored, as well as the data coverage.
13. At the end of the file, the *Exit* button is selected. The file automatically saves at the end of every line.

Data Storage and Preliminary Processing

EM61-MK2 data are temporarily stored in the Allegro data logger via Geonics' EM61MK2 or Geomar's NAV61 software and then downloaded into a laptop computer for further on-site processing using Geonics' DAT61MK2 or Geomar's Trackmaker and Geosoft Oasis Montaj software.

Initial data processing is performed by the field team and includes reviewing data for integrity and general repeatability. In the case of traditional surveying methods, positional data are edited based on the known locations of fiducial marks.

Post Processing

Once the initial editing steps have been performed, the data are turned over to NAEVA's processors for advanced analysis, target selection, and preparation of deliverables. The processor will go through five steps before the final data packages are delivered.

Step 1) QC of the field forms that have been uploaded from the PDA into the database. This QC check insures that the forms are filled out correctly with the following item

- The appropriate grid block name
- Transects associated with the block
- QC test file names (Static/Spike Tests, Personnel Test, Cable Shake Test and Latency Tests)
- Block file name
- Repeat file name
- Instrument used (EM61MK2 Wheeled, EM61MK2 Tandem)
- Collection/navigation method (RTK or FID)
- Daily conditions
- Cultural features

Step 2) Preprocessing of the QC tests and block data. The QC test data are actually finalized here but the block data are preprocessed. This step is to check the data for the following:

- Data quality
- Location
- Coverage
- Line path positioning
- Down line density
- Check of QC tests

First, a folder needs to be created where the Geosoft files are to be saved. Next open Geosoft and create a new project in the folder you just made (File – Project – New). There are separate projects for the QC tests and DGM Block(s).

After the project is created, several script files can be used in Geosoft that help expedite the preprocessing/processing procedures. They are listed below with a brief description. Alternately, each step may be conducted manually.

- **QC_Static_QC1.gs, QC_Static_QC2_etc.gs and QC_IVS.gs**. These scripts are partially interactive. *_QC1.gs includes Static/Spike, Personnel and Cable Shake test lines. *_QC2.gs includes just the Static/Spike test lines and the *_IVS.gs contains the IVS test line(s). The scripts do the following:

  - Asks you to name the new Geosoft database it is about to create.
  - Asks you to locate then import the Geosoft xyz file.
  - Asks for the correct import template. For this project, there are two different import templates: GPS/RTK and FID (Locals).
  - Asks for the file name that was just imported.
  - Set X and Y as current (either in UTM or FID locals).
  - Preliminary auto levels and preliminary lag (lags IVS Test ONLY) corrects channels 1, 2, 3 & 4. The leveling gx is similar to the drift correct in Geosoft except we use a median filter. Preliminary leveling for channel 1 is Low window = 0, High window = 80 and Window length = 100. Preliminary leveling for channel 2 is Low window = 0, High window = 75 and Window length = 100. Preliminary leveling for channel 3 is Low window = 0, High window = 65 and

Window length = 100. Preliminary leveling for channel 4 is Low window = 0, High window = 60 and Window length = 100.
    - Refine the leveling in the selected targeting channel. A larger or smaller window length if needed i.e. a larger window length may be needed over very high response features. Manual leveling if needed.
    - Refine lag/latency of the data if needed (IVS test ONLY).
    - Create Geosoft maps and print as PDFs.
    - Add QC information to QC Analysis Spreadsheet.
    - Export out completed processed Geosoft xyz file with header information.

The following are for the DGM Block Data:

- **01_Setup.gs**. This script is partially interactive. It does the following:
    - Asks you to name the new Geosoft database it is about to create.
    - Asks you to locate then import the Geosoft xyz file.
    - Asks for the correct import template. For this project, there are two different import templates: GPS/RTK and FID (Locals).
    - Asks for the file name that was just imported.

  If there is more than one block xyz file then **02_Import.gs** will be needed. It goes through the same steps as the 01_Setup script except naming and creating a new database. In most cases, there is just one xyz file with an associated repeat xyz file. After all block xyz files are imported, the next script to run is:
- **03_Import_Repeat.gs**. Again this script is partially interactive and does the following:
    - Asks you to locate then import the Geosoft repeat xyz file.
    - Asks for the correct import template. For this project, there are two different import templates: GPS/RTK and FID (Locals).
    - Asks for the file name that was just imported.

  If there is more than one repeat xyz file then run this script again until all repeats are imported.
- **04_Preprocessing.gs** (different ones for GPS/RTK and FID)
    - Warp FID Locals to appropriate coordinate system (FID Locals Preprocessing)
    - Set X_UTM and Y_UTM as current.
    - Makes x_d and y_d channels by using the differences filter by 1.
    - Creates a data_density channel then runs a math expression “data_density = sqrt((x_d*x_d)+(y_d*y_d)).
    - Creates and displays a data density map showing a 1m footprint for possible gaps and flags any readings over 0.2m.
    - Creates and displays a GPS Quality map (GPS/RTK Preprocessing)
    - Preliminary auto levels and preliminary lag corrects channels 1, 2, 3 & 4. The leveling gx is similar to the drift correct in Geosoft except we use a median filter. Preliminary leveling for channel 1 is Low window = 0, High window = 80 and Window length = 100. Preliminary leveling for channel 2 is Low window = 0, High window = 75 and Window length = 100. Preliminary leveling for channel 3 is Low window = 0, High window = 65 and Window length = 100. Preliminary

leveling for channel 4 is Low window = 0, High window = 60 and Window length = 100.

- Grids raw, leveled and leveled lagged data using MinCurv or Kriging with a grid cell of 0.2 and a blanking distance of 0.6.
- Creates and displays preliminary contour maps of the selected targeting channel with line paths.
- Selects the appropriate lines and asks for the combined preprocessed xyz file name to be exported with the correct export template. Exported as a Geosoft xyz file with header information.
- Selects the appropriate lines and asks for the combined preprocessed repeat xyz file name to be exported with the correct export template. Exported as a Geosoft xyz file with header information.

To finish the preprocessing, the following steps are to be taken:

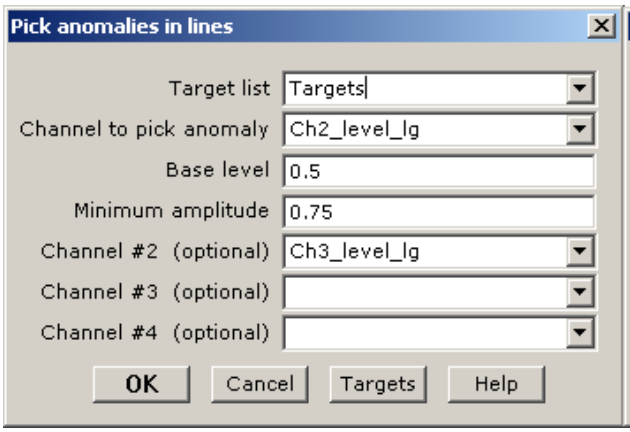
- Add appropriate culture files to the preliminary maps and any GIS/CADD information.
- Create Geosoft maps and pdf files of the preliminary repeat profiles.
- Fill out the Database (MRSIMS).

Step 3) QC of the preprocessing. The QC criteria are as follows:

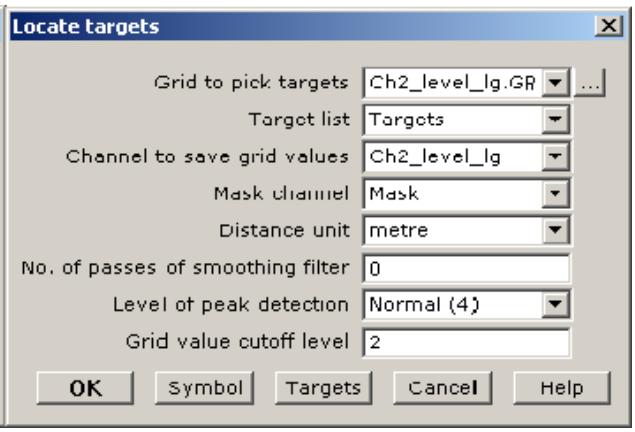
- Check Location & Coverage
- Check grid block name & corresponding grid cells
- Check that the appropriate file names are listed in the correct area in the database
- Check header information on the xyz files.
- Fill out QC of the preprocessing in the database
- Create a DGM Raw Data/Preprocessing Delivery Report
- Upload preprocessing xyz file & Raw Data Delivery Report to CH2M HILL's ftp site.

Step 4) Final processing stage. The final processor opens the Geosoft project created in Step 2 and performs the following:

- Refines the leveling in the selected targeting channel. A larger or smaller window length if needed i.e. a larger window length may be needed over very high response features. Manual leveling if needed.
- Refine lag/latency of the data if needed
- Add filters to the data if needed. Some filters you would expect to see are non-linear, low pass & high pass.
- Grid the data with MinCurv or Kriging. The parameters for both are a grid cell of 0.2 & a blanking distance of 0.6. Kriging better defines high response anomalies. MinCurv on the other hand will usually create false anomalies between lines near high response anomalies.
- Select anomalies in Geosoft's UX-Detect Module by using either "Pick Peaks Along Profile" or "Blakely Test". "Pick Peaks Along Profile" is used for transect surveys and "Blakely Test" is mainly used for 100% coverage surveys.



Pick Peaks Along Profile



Blakely Test

- Refine target selection. Check validity and position. Targets found to be invalid or incorrectly located are adjusted or removed. Additionally, anomalies not selected by UX-Detect, yet deemed to represent a potential UXO target, are being manually selected.
- Export out completed grid block processed Geosoft xyz file with header information.
- Split target Geosoft databases into their grid cells.
- Re-sort the target database by shortest path and if needed, add any additional four point polygon targets (Data Gap Polygons or Heavily Saturated Area Polygons) to the end of the target list. Export a Geosoft xyz file with header information.
- Create and display a colored contour Geosoft map(s) of the grid cell(s) with the following; title block, color scale, index map, legend, target locations & target numbers.
- Create a pdf of the colored contoured grid cell map(s).
- Create and display final repeat profiles with line path profiles.
- Create pdfs of the final repeat profiles.
- Fill out DGM processing form in the database (MRSIMS).
- Export out repeat processed Geosoft xyz file with header information.
- Create a final delivery package that includes the following:
  - All the Geosoft colored contour grid cell maps that are included in the grid block.
  - All the pdfs for the grid cell maps that are included in the grid block.
  - Repeat Geosoft maps with their pdfs. The repeat maps will go into the QC by block folder on the ftp site.
  - Processed Geosoft xyz files of the grid block & repeat data. The repeat xyz files will go into the QC by block folder on the ftp site.
  - Geosoft grd files for the grid block.
  - Target lists in both xls & xyz formats (the xls is in MRSIMS format).

Step 5) QC of the processed data. The QC criteria are as follows:

- Check to see if leveling and the lag is appropriate.
- Check anomaly selections on the maps, xyz file and xls file.
- Check maps title block, index map and legend (map & pdf).
- Check repeat data profiles (map & pdf).

- Check header information on xyz files.
- Check entries on the processing form in the database (MRSIMS).
- Get QC data (maps, pdf's & xyz files) for the corresponding block. Add repeat data (maps, pdf's & xyz files). Zip it. Upload to CH2M HILL ftp site.
- Fill out QC form in the database then create a "Final Data Delivery Report". Add this report to the final delivery package listed above. Zip it. Upload to CH2M HILL ftp site.

Quality Control

The following quality control (QC) procedures are performed and documented during the data collection process and reviewed by a qualified geophysicist on a daily basis.

1. Equipment Warm-up: For at least 15 minutes
2. Record Sensor Positions: Positioning accuracy of the final processed data will be demonstrated by operating the equipment over one or more known points. The accuracy of the data positioning will be assessed by calculating the difference between a known location over which a positioning instrument is held and the displayed position. The sensor position test will be conducted at the beginning of the survey operation for each workday.
3. Personnel Test: This test checks the response of instruments to personnel and their clothing/proximity to the system. On a daily basis, the instrument coils/sensors for those instruments being used that day will be checked for their response to the personnel operating the system. The response will be observed in the field for immediate corrective action and transmitted back to the processor, and analyzed and checked for spikes in the data that can possibly create false anomalies. The personnel test will be conducted at the beginning of the survey operation for each workday.
4. Cable Shake Test: On a daily basis, the instrument coils/sensors for those instruments being used that day will be checked for their response to vibrations in the cables. The response will be observed in the field for immediate corrective action, transmitted back to the processor, analyzed, and checked for spikes in the data that can possibly create false anomalies. The vibration test will be conducted at the beginning of the survey operation for each workday.
5. Static Background and Static Spike: Static tests will be performed by positioning the survey equipment within or near the survey boundaries in an area free of metallic contacts and collecting data for a 3-minute period. During this time, the instrument will be held in a fixed position without a spike (known standard), with a spike and then without a spike. The purpose of the static test is to determine whether unusual levels of instrument or ambient noise exist. The static background and static spike test will be conducted at the beginning and end of each grid block.
6. Repeat Data: This test is performed to verify repeatability of the data and will be performed after the initial survey over an area. At least 2% of the survey lines will be repeated. Repeatability of the instrument is further evaluated in the daily collection of the IVS.

All work will follow the extensive QC program laid out in the Work Plan. In addition, the NAEVA will demonstrate the performance of each DGM system prior to its use at an Instrument Verification Strip (IVS), as described in the GSV Plan. The continued performance of each DGM system used will also be documented daily at an IVS.

MRP – SOP – 0001

MUNITIONS RESPONSE PROGRAM (MRP)

STANDARD OPERATING PROCEDURE (SOP)

SURFACE MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)

& SUBSURFACE ANOMALY AVOIDANCE

1.0 OBJECTIVE:

Provide safe procedures to avoid Munitions and Explosives or Concern (MEC) during visitor/personnel escort, land survey, vegetation reduction, sediment sampling, soil boring, drilling, direct push technology-core sampling, or other environmental or construction activities conducted in an environment where the presence of MEC is suspected.

2.0 PURPOSE:

This SOP provides guidance for avoiding surface MEC (e.g., Unexploded Ordnance (UXO), Discarded Military Munitions (DMM)), Material Potentially Presenting an Explosive Hazard (MPPEH), and subsurface anomalies.

3.0 APPLICABILITY:

This SOP applies MEC avoidance procedures per Department of Army Engineering Pamphlet (EP) 75-1-2 Munitions and Explosives of Concern Support During Hazardous Toxic and Radioactive Waste (HTRW) and Construction Activities.

4.0 TECHNCIAL GUIDANCE:

This SOP lists processes and procedures that comply with the following sources:

- DOD 6055.09-M, Ammunition and Explosives Safety Standards, February 2008
- USN Environmental Restoration Program (MRP Chapter 12) August 2006
- NAVSEA OP 5Volume 1, Ammunition and Explosives Safety Ashore, July 2009;
- NOSSA Instruction 8023.11(series), Standard Operating Procedure Development
- USAF Manual 91-201, Explosive Safety Standards, November 2008
- DA Pamphlet 385-64, Ammunition and Explosives Safety Standards, October, 8, 2008
- DA Field Manual (FM) 21-16, Unexploded Ordnance (UXO) Procedures, August, 1994
- DA Engineering Manual (EM) 1110-1-4009, Military Munitions Response Actions, June, 2007
- DA Engineering Pamphlet (EP) 1110-1-18, Military Munitions Response Process, April 2006
- DA Engineering Manual (EM) 385-1-97, Explosives, Health and Safety, September 2008
- **Note: Electronic copies for the sources listed above are available via CH2M HILL SUXOS Laptop Computer**

5.0 SOP VALIDATION RECORD:

SOP Title: MEC Anomaly Avoidance.....Work Instruction Identification/ SOP: # MRP-SOP-0001

Author: K. Lombardo Date: December 1, 2009.....Revision Date: 02/16/2012

Review: G. DeMetropolis, Date: February 16, 2012 .....Approval; J. Bowles

Validation Date: December 14, 2009 .....Process Observer: Kevin Lombardo, December 14, 2009

6.0 HAZARDOUS MATERIALS:

Hazardous Chemicals: None; Product Name: N/A; Material Safety Data Sheets: N/A; Health Hazards: N/A

7.0 EMERGENCY RESPONSE INFORMATION

Work Site Name (location) address/building # Street):

_____

Nearest intersection (cross streets) or entrance gate:

_____

Safe Area Rally Point (gate/building or intersection) Note: Rally Point should be upwind of work location:

_____

UXO Qualified Technician Incident Commander: (name) _____

Personnel Injury or Medical Distress:

1. Summon Emergency Medical Services (EMS)
2. Administer Fist Aid and/or CPR
3. Notify Project Manager
4. PM implements CH2M HILL SOP 111, Incident Notification, Reporting, and Investigations.

Fire:

1. Evacuate personnel from the Munitions Response Site and Area to safe rally point
2. Notify Fire Department of "Work site Name," fire location, and personnel safe rally point
3. Obtain head count, ensuring all personnel are present and or accounted for.
4. Notify Project Manager
5. PM implements CH2M HILL SOP 111, Incident Notification, Reporting, and Investigations.

(Fire/Rescue radio call sign): _____ **Phone #** _____

Medical Services radio call sign: _____ **Phone #** _____

Range Control radio call sign: _____ **Phone #** _____

Project Manager POC: _____ **Phone #** _____

Identify local disaster warning system (radio, PA, phone, other):_____
Flag(s): _____
Warning Bells/Horns/Sirens/Lights/Strobes: _____
Public Address System: _____
Weather Radio Channel: _____
Other: _____

8.0 PERSONNEL ROLES AND RESPONSIBILITY

Note: Roles and responsibilities are dependent upon work plan direction; one or all roles and responsibilities may be applicable.

1. Project/Construction Manager (P/CM): Provides the necessary resources and personnel to safely and efficiently accomplish the scope of work. Ensures CH2M HILL unexploded ordnance (UXO) personnel shall be qualified in accordance with:
   - OPNAVINST 8020.14/MCO P8020.11 (series).
   - And are certified to perform the job assigned and that the certification is current. Contractors who perform those duties described in NAVSEA OP5, paragraph 2-3 involving ammunition and explosives shall comply with NAVMED P117 Article 15-107.
   - Prior to site operations, CH2M HILL will verify training, medical qualification statements by physicians, and conformance to substance abuse testing and reporting programs.
   - Shall confirm active explosive certification program conformance for personnel compliance to requirements for UXO personnel identified IAW DDESB Technical Paper (TP) 18, and monitors these personnel for conformance to the Bureau of Alcohol, Tobacco, Firearms, and Explosives, Safe Explosives Act 2003 Certification requirements for "Employee Possessor," and or "Responsible Person."
2. Senior UXO Supervisors or Unexploded Ordnance Technician III or II: Supervises the operational resources necessary to implement, and accomplish this procedure and requirements set forth within the Work, Health, Safety, Quality and Accident Prevention Plans. May stop work at anytime to prevent accidents, remedy unsafe conditions, stop an unsafe act, or question the safety of a process or procedure or

observe non conformance to this SOP and/or plans. Provides a Site Specific Tailgate Safety Briefing to include MEC, construction, industrial, environmental, and natural safety hazard awareness. Provides the plan of day. As applicable provides a Hazardous Materials briefing for items used, consumed, or required for this SOP. Brief personnel on communications, security, emergency/medical response, evacuation, rally points, IAW with project instructors, and plans. Also, informs personnel to prevent disclosure of classified work, site observations, or information.

3. Non-UXO Qualified Personnel are obligated to follow guidance within this SOP, Work, Health and Safety and Accident Prevention Plans.

9.0 PRE-OPERATIONAL CHECK LIST	
1. ( ) CH2M HILL Inc. Safety Risk Evaluation (SRE) and Explosives Safety Submission Determination (ESSD) (Navy Projects)	2. ( ) Project Task/Work/ Instructions
3. ( ) Work Plan/Accident Prevention Plan/ Health and Safety Plan	4. ( ) Personal Protective Equipment (PPE) IAW Safety Plan
5. ( ) Emergency P.O.C List	6. ( ) Directions and map to hospital
7. ( ) Communications (2 methods)	8. ( ) First aid/Fire Extinguisher/- (GPS/compasses optional)

10.0 ANOMALY DETECTION EQUIPMENT (as required by project instruction)
( ) Ferrous Metal Detector (Schonstedt GA 52CX or Ferex 4.021 MK 26 Mod 0 or equivalent), with extra batteries, carry case, & instruction manual (as required by project instructions)
( ) All Metals Detector (White Spectrum XLT or equivalent) with extra battery, carry case, & instruction manual (as required by project instructions)
( ) Down-hole Instrument Direct Push Technology – Schonstedt MG 230 Gradiometer maximum 2.12-inch "Outside Diameter" (OD) Probe Head - Extra batteries and instruction manual (as required by project instructions)

11.0 EXPLOSIVE ORDNANCE RECONNAISSANCE EQUIPMENT
WARNING **Direct physical contact with or movement of MEC or MPPEH is not authorized.** ( ) Tape Measure, ruler, pen/paper, item for scale perspective (e.g. dollar bill),
( ) Camera (digital), with spare batteries (as required by project instructions)
( ) Small dry erase white board and dry erase marker for photograph item number, date, time, location, and description.

12.0 GENERAL INFORMATION	
CATEGORY **Surface MEC/Anomaly Avoidance**	**DIRECTIONS** **(S)** = Safety, **(O)** = Operations, **(Q) =** Quality Control
Note: (o) PM shall obtain MISS Utilities Check and or local Dig (intrusive) permits prior to intrusive actions (such as use of direct push technology, drilling, and use of hand augers) **(WARNING)** **Fire: (s)** Do not attempt to fight a fire, evacuate area, move upwind or crosswind to safe rally point, notify fire department. **Wildlife: (s)** Aggressive/defensive – Avoid wildlife –withdraw from area **Hunters: (s)** Withdraw from area, retreat to vehicle, contact project authority **CWM: (s)** Evacuate upwind to safe rally point, mark area on map, contact PM **Severe Weather (lighting, winds, and storms): (s)** Evacuate to vehicle, follow PM guidance	
13.0 SAFETY	
Munitions Response Group Safety Manager	George DeMetropolis/SDO Telephone (Office): (619) 687 – 0120, Ext. 37239 Telephone (Cellular): (619) 564 – 9627
Safety Plan, Accident Prevention Plan and Activity Hazard Analysis	(s) All field personnel require reading, compliance, and acknowledging they understand and comprehend the safety information contained within these plans, SOP and AHA; attesting through signature and date
Visitors access to work location	(s) All visitors (contract/transient/witness) require a safety briefing, wearing of PPE IAW site specific safety plan, and conformance to UXO Technician instructions**.**
Safety Meeting:	(s) Each morning – Project Personnel shall participate in a tailgate safety briefing, discussing the operational activities (plan of the day), MEC/HTRW hazards/risks, safety controls, and emergency procedures; daily weather forecast, work activity OSHA PPE

	level, insect/poisonous plant avoidance, and heat/cold stress prevention. Personnel shall sign and date, the safety briefing acknowledgment form; confirming individual participation, understanding, and comprehension prior to operations. Personnel who do not participate in the safety briefing or, understand, or comprehend the safety briefing may not access work areas.
Safety Pre-field operations check list	(s) ( ) First Aid Kit (serviceable and supplies within shelf life) (s) ( ) Fire Extinguisher 10BC (or greater) (charged/indicator green) (s) ( ) Water (minimum 1 liter per person) (s) ( ) Cell phone/identified alternate land line location/or two/way Radio (s) ( ) Identification of wind direction, and rally points (s) ( ) PPE IAW Activity Hazard Analysis (s) ( ) Vehicles unlocked; keys in announced location (s) ( ) Insect repellant/sun screen (available)
Equipment Check-out: 1) Schonstedt – GA52CX magnetometer or equivalent 2) White's (E series) Spectrum model XLT Metal Detector or equivalent 3) Schonstedt gradiometer MG 230 for Down-hole or underwater search or equivalent 4) Forster Ferex 4.021 models K,L, & W or MK 26 MOD 0 magnetometer for down-hole or underwater search or equivalent	(o) Assemble/inspect, IAW manufacture instructions (o) Test geophysical instruments against a known source (ferrous or non-ferrous) for instrument response. (o) Source (ferrous) Schedule 40, 2-inch x 5-inch steel pipe or equivalent (q) Pass/Fail - instrument shall detect source on surface at 12-inches above item/fail non-detect - replace instrument (o) Source on surface (non-ferrous) ¾-inch x 6-inch Brass Pipe nipple (aka) couple fitting or equivalent (q) Pass/Fail - instrument shall detect source on surface at 6-inches above item/fail non-detect - replace instrument

	(q) Name of individual recording geophysical instrument source test results by instrument manufacturer with: type, model, serial number, by the date of daily equipment check. Record results for pass/fail source test with remarks. Reject and replace geophysical instrument that does not pass quality control source test.
14.0 SITE ACCESS	
WARNING: UXO Technician(s) shall not make physical contact with MEC, or commercial explosives. UXO Technicians assigned to implement this SOP shall not intentionally move MEC or explosives, incendiaries, smokes, propellants, or commercial explosives. **NOTE:** If MEC, to include Unexploded Ordnance (UXO), Discarded Military Munitions, (DMM) or Material Potentially Presenting an Explosive Hazard (MPPEH) are encountered, the UXO Technician shall respond IAW 3R training, avoid such items, and notify Project Manger IAW site-specific project instructions.	(o) Implement 3R (R, R, R) process, and procedures. (o) Recognize MEC, UXO, DMM, and or MPPEH; offset mark anomaly location with flag, ribbon, paint, stakes, other location identifier (o) Retreat from MEC location and avoid MEC location (o) Report & record MEC location in logbook and contact Project Manager IAW project instructions to request additional guidance. **Note:** MR Safety may instruct UXO Qualified Technician to perform a zero contact Explosive Ordnance Reconnaissance of the item requesting information for type by function, condition, filler, and nomenclature (if visually possible), supported by photographs of the item.
15.0 EXPLOSIVE ORDNANCE RECONNAISSANCE (EOR)	
EXPLOSIVE ORDNANCE RECONNAISSANCE Reconnaissance involving the investigation, detection, location, marking, initial identification, and reporting of suspected MPPEH in order to determine future action	
EOR Method UXO Qualified Technician is required prior to performing an Explosive Ordnance Reconnaissance to review Department of the Army, Field Manual (FM) 21-16, Unexploded Ordnance (UXO) Procedures, August 1994 – A copy can be obtained from:	(o) Use general Explosive Ordnance Disposal (EOD) safety precautions until munition type, fuzing , condition, and filler are identified (o) Upon identification, of type by function, fuzing, and condition use general EOD safety precautions for the category of munition (e.g.

WWW.UXOINFO.COM or from CH2M HILL MR Operations, Kevin Lombardo/WDC	Rocket; avoid approach to the front and rear of item, etc). (s) Approach Unexploded Ordnance (UXO) 45^0 to the rear (s) Do not cast shadows over UXO fuze (s) Remain cognizant to avoid dispensed wires, filaments, or other items that could initiate movement (s) Remain cognizant of Electromagnetic Hazardous Radiation, to Ordnance (HERO) precautions.
Information Recovery	(o) Photograph item from each vantage point. Identify each photograph with item name, view (side, front, rear, etc.), and distance from camera to item, (f-stop & shutter speed and film speed if applicable). It is required that a photograph log be kept for each item. Use a ruler in photo to demonstrate perspective of the item. (o) Close-up photograph fuze, markings, nose, tail, and or markings
16.0 PERSONNEL ESCORT	
Personnel Escort A minimum of one UXO qualified Technician(II) shall escort non-UXO qualified site personnel conducting access to a Munitions Response Area or Site The UXO qualified person shall visually search the surface of walking paths, roads, and parking areas to locate, mark, and avoid MEC during walking, driving, or setting-up equipment.	(o) Establish a wind streamer of tape/ribbon (flag) within/near the project site to observe wind direction. (o) A UXO Technician shall visually search the surface area, for MEC/HTRW to avoid such items. The UXO Technician may augment the visual search with the application of a geophysical instrument to detect surface/subsurface ferrous and or non-ferrous anomaly sources for the purpose of anomaly avoidance (o/s) When escorting non-qualified UXO personnel, a UXO Technician shall lead, and non-UXO qualified personnel shall follow along a path identified by the UXO Technician. (o) The UXO Technician shall identify surface hazards (MPPEH) and avoid such hazards. The location of a hazard requires, the UXO Technician to communicate the location to non-UXO qualified persons for avoidance around the item. (s) Communication can be by hand signals (pointing), or marking with flags, tape, ribbon, paint, stakes, or other means identified during a safety briefing.

	(s) Essential Personnel Limits - MR Escorts are a minimum of one UXO qualified Technician II or above, to no more than six (6) non-qualified persons. (s) Non UXO qualified personnel shall not approach and avoid a marked MPPEH or HTRW hazard.
17.0 MEC AVOIDANCE SUPPORT **LAND SURVEY, SEDIMENT SAMPLING, GROUNDWATER COLLECTION, ENDANGERED SPECIES SAMPLING/MONITORING**	
Applicable to Visitors, Land Survey, Sediment Sampling, Groundwater Collection, Endangered Species Sampling/Monitoring	
WARNING: Subsurface intrusive acts could initiate MEC, through physical contact, movement, or shock.	(o) A UXO Technician shall search each intrusive point from the surface with a magnetometer and or all metals detector in accordance with the instruments manufactures instructions, to locate ferrous and/or non-ferrous subsurface anomalies. Location of such subsurface anomalies requires the placement of an offset marker (pin flag a minimum of 12-inches) to the north of the greatest signal strength for the anomaly. (s) For land survey and sampling activities where detection of an anomaly occurs, an alternative location free of ferrous and non-ferrous anomalies is required to proceed with intrusive activities. (q) The UXO Technician shall note within the daily logbook the rejection of the primary location and selection of the alternative location, with a written description of direction and feet/inches for the offset location from the primary point.
NOTE: Personnel performing subsurface intrusive activities for the purpose of land survey and environmental sampling require a UXO Technician to search the subsurface with either or both (dependent on MEC site-specific history) a magnetometer and/or all metals detector to confirm the subsurface is free of ferrous and or non-ferrous anomalies. A UXO Technician shall mark the boundaries /limits for ingress/egress access from a safe area (i.e.: road) to the work activity location or provide escort to and from the work activity location.	
18.0 VEGETATION REDUCTION MEC AVOIDANCE (MANUAL/MECHANICAL)	
WARNING: DO not apply vegetation cutting	(o) A UXO Technician shall escort vegetation reduction personnel, perform a visual and/or magnetometer and/or all metals detection instrument search of surface

closer than six-inches to ground surface. Vegetation reduction actions that occur less than six-inches above ground surface, may result in movement, or shock to MEC, resulting in an unintentional detonation or functioning as designed of the item.	access routes, walking paths, and vegetation reduction locations for MEC/HTRW and or obstruction hazards. (o) The UXO Technician shall operate a magnetometer and or all metals detection instrument to locate surface anomalies with potential to be a hazard to vegetation reduction crews. (o) The UXO Technician shall perform a visual surveillance of the surface to locate surface hazards (MEC, HTRW) or obstructions to equipment, mark the location and instruct vegetation reduction crews to avoid the location. (s) The UXO Technician shall remain away from the immediate operating radius of powered equipment and remain alert for flying debris (s) The UXO Technician shall wear high visibility outerwear, use hearing, and eye protection, and avoid swing radius of powered equipment.
Warning : Personnel performing vegetation reduction activities shall not operate equipment closer than 6-inches to the ground thus, all brush cutting equipment (chain saws, weed whackers, string trimmers, brush cutters, bush hogs, hydro-ax, or debarking equipment) shall operate six-inches or greater above ground.	
19.0 MEC AVOIDANCE (DOWN HOLE)	
WARNING: When applying MEC avoidance procedures for drilling or the use of direct push technology, the steel mass of drill rigs and direct push technology DPT power plants will influence gradiometers, and magnetometer reporting instruments. Thus, drill rigs and DPT equipment shall be withdrawn a minimum of ten feet from intrusive points while performing down-hole avoidance search.	(o) Prior to drilling, the UXO Technician will conduct a visual reconnaissance of access paths and drilling area. The reconnaissance will include locating the designated sampling or drilling location(s) ensuring that the locations do not have surface MEC, or MPPEH, and magnetometers or all metal detection search do not indicate the presence of subsurface anomalies. If detection of subsurface anomalies occurs, at the sampling point, the sampling point is abandoned. Once the designated sampling point has been determined free of anomalies, an access route for the sampling crew's vehicles is searched. The access path requires twice the width of the widest vehicle and marking along the sides with flags, ribbon, engineer tape, stakes, or equivalent to define limits. (s) If an observation of MEC or MPPEH should occur, the UXO Technician shall mark the item, avoid it, and notify the PM for either military EOD or UXO Contractor

	support. (o) A UXO Technician will clear each work site for drilling/DPT and clearly mark the safe to walk, and drill or DPT, boundaries. Each drill/DPT safe area will be large enough to accommodate the drilling equipment and provide a work area for the crews. As a minimum, the safe area will be a rectangle, with a side dimension equal to twice the length of the largest vehicle or piece of equipment for use on site.
NOTE: (p) Drilling and application of DPT may require an ingress route and pad turning radius, twice the width, and length of the mechanical equipment.	
NOTE: MEC may exist within the subsurface up to 30 feet below ground surface, dependent on site-specific history. Refer to project instruction to determine maximum depth for down-hole MEC avoidance support.	
The UXO Technician is required to escort personnel and remain with personnel when sampling/drilling at an MRP or MEC/MPPEH suspect site.	(o) Soil bore holing may be by hand auger, power-auger, drilling, DPT. A UXO Technician will examine, prior to sampling/drilling, the borehole location with a down-hole gradiometer or magnetometer, a minimum of every one (1) foot, to the deepest sampling depth or a maximum of 30 feet below ground surface to ensure avoidance of anomalies, or to depth identified within the project instruction.
WARNING: Drilling equipment may produce injury from snapping cables, pinch points, chain failures or falling booms, derricks, and drill piping. Avoid the immediate operational radius of drillers when supporting efforts.	(o) Drilling down–hole monitoring requires at a minimum of one (1) foot increments of search, during the actual well drilling operation. This will require the withdrawal of the drill rod or augers from the hole and moving the drill rig a minimum of 10 feet or enough feet away from the drill-hole location to prevent the metal in the rig from influencing the magnetometer/gradiometer. (o) The UXO Technician shall perform down-hole monitoring for anomalies at each location identified within the project instruction.
20.0 QUALITY CONTROL	

The QC Manager will be responsible for ensuring this SOP is effectively implemented. Surveillances and/or inspections will be conducted to ensure SOP compliance.	(q) UXOQC personnel shall document nonconforming materials, items or activities in a NCR based on surveillances and/or inspections
21.0 ACTIVITY COMPLETION	
Completion of documentation:	( ) Project site logs to Project Manager ( ) Tail gate safety meeting log to Project Manager ( ) Equipment check-out report to Project Manager ( ) Quality control reports to Project Manager

21.0 EQUIPMENT

ITEM	QUANTITY
Cellular telephone	1
Dow-hole (only) Magnetometer/Gradiometer capable of down-hole operations to 30 feet	1 or (as required by Project instruction)
Magnetometer capable of monitoring to a depth of two-feet below ground surface for ferrous items	1 or (as required by Project instruction)
All metals detector capable of monitoring to a depth of 6-inches below ground surface for non-ferrous items	Optional
Multi colors of marking flags, ribbon, and tape	As determined by SUXOS
Batteries	Two day supply for instruments
First –aid Kit (25 person)	1 within the work area
Water	Minimum 1 liter per person in work area
Camera/Tape Measure/Ruler/Calipers/Paper Pencil	As determined by SUXOS
Hand tools, (hammer, general purpose tools, etc.)	Assorted as determined by SUXOS

MINIMUM PERSONAL PROTECTIVE EQUIPMENT: IAW with Safety Plan and AHA or a minimum of OSHA LEVEL "D"

Coveralls (or long pants, sleeved shirt)

Boots (level "D") Cover (cap, floppy, skull) Gloves (leather) Safety Eye protection (as required by AHA) Hard hats (when working in an area with a potential for head injury or heavy equipment e.g. drill rig) Because this is a possible HTRW operation, the MR Supervisor will direct the required explosive safety site PPE conditions.
SPECIAL TRAINING AND REFRESHER REQUIREMENTS: UXO Technicians will be qualified at a minimum Level II designation and be graduates of the U.S. Naval School of Explosive Ordnance Disposal or other DOD DEDSB TP 18 approved course or school/course of instruction, Hazard Waste Operations IAW 29CFR 1910.120 (e) & (f) and medical clearance physical authorization to perform work.
WAIVERS, EXEMPTIONS, SPECIFIC AUTHORIZATIONS, OR APPROVED DEVIATIONS THAT APPLY TO THIS OPERATION: None
ACTIVITY HAZARD ANLAYSIS

Safe Work Method Statement/ Job Hazard Analysis

Company Name: **CH2M HILL**	Project Name/#: SOP MRP 0001- MEC Anomaly Avoidance
Work Activity/Task: MEC Anomaly Avoidance	Principal Contractor: **CH2M HILL**
Date: December 09, 2009	Note: Sign off to be provided at Tool Box talk
Prepared by: George DeMetropolis	Supervisor: TBD by project location
Signature:	Safety Coordinator (SC): TBD by project location
All metals detection equipment, metal detection instruments, magnetometry equipment, gradiometers, and military ordnance detection equipment, plant & equipment required: - machinery: maintenance checks provided and recorded by subcontractor or operator: suitably qualified and competent, with health, safety, and environment (HS&E) training	Training Requirements 29 CFR 1910.120 (e) & (f); DDESB TP 18 minimum qualifications for Unexploded Ordnance Technicians; OPNAVINST 8020.14/MCO P8020.11 (series) and are certified to perform the job assigned and certification is current. NAVSEA OP5, paragraph 2-3 involving ammunition and explosives shall comply with NAVMED P117 Article 15-107. Prior to site operations, CH2M HILL will verify training, medical qualification statements by physicians, and conformance to substance abuse testing and reporting programs. CH2M HILL has an active explosive certification program and monitors these personnel for conformance to the Bureau of Alcohol, Tobacco, Firearms, and Explosives, Safe Explosives Act 2003 Certification requirements for "Employee Possessor," and or "Responsible Person." 3R training for non-UXO qualified Personnel. (in addition to those in project's written safety plan: - OHS Construction Induction - Waste Management for waste streams and materials

Job Step	Potential Hazard	Controls
Forms/Permits	Unknown client-specific hazards. MEC Surface/Subsurface	UXO qualified personnel, SOP MR 0001, 3Rs Training for Non-UXO qualified personnel, Metal (ferrous/nonferrous) detection equipment, DA EP 75-1-2. Well driller license, drill rig permit •Well installation or abandonment notification •Dig/drill permit obtained, where required by client facility •Water withdrawal permit obtained, where required
Site Setup	Striking underground utilities, impact with MEC	•Location of underground utilities and installations identified •Daily briefing Avoid Surface and Subsurface MEC through the use of MR SOP 0001 – MEC Anomaly Avoidance
	Striking overhead utilities	•Locate and take appropriate precautions with required distances from power lines •Lower mast and secure during travel

	Physical environmental hazards	•Use of appropriate personal protective equipment (PPE) where required. Safety boots, hard hats, safety glasses and hearing protection are mandatory. Respirators when chemical hazards exist. No loose-fitting clothing, rings, watches, etc.; long hair to be restrained close to the head.
	Dermal or inhalation exposure to contaminants	•Investigate history of area; determine nature and degree of contaminants that could be present •Conduct air monitoring for potential hazardous atmospheres as described in the project's written safety plan. •Use respirators and other PPE as prescribed in the project's written safety plan

Job Step	Potential Hazard	Controls
Site Setup (Continued)	Fire /Explosion	• No smoking around the drill rig – MR SOP-0001 MEC Anomaly Avoidance
	Struck by vehicles	•Follow traffic control plan •Wear high-visibility warning vests
	Drill rig travel	•Ensure stable ground and adequate footing for machinery. Adequate ground preparation to support loads and accommodate waste materials. •Drill rig travel will be conducted with mast secured in its lowered position •Tools and equipment secured prior to rig movement •Only personnel seated in cab are to ride on the rig vehicle •Ensure clearance of overhead power lines •Use alarm or spotter when reversing rig
	Illegal offsite impacts	• Excavation area checked for wetlands, endangered species, cultural/historic resources
	Spread of contamination from contaminated drill cuttings	•Manage cuttings in accordance with all project plans

Drilling Activities	Rotating machinery parts of drill rig MEC- surface/Subsurface – physical contact	•Daily inspection of drill rig & equipment •Ensure appropriate guards are installed or suitable barriers to forewarn personnel of dangers •Personnel clear during set up, clear of rotating parts •Loose clothing, long hair, and jewelry to be safely secured •Hands or feet should not be used to move cuttings away from auger •Rig in neutral and augers stopped rotating before cleaning •Kill switch installed, clearly identified and operational •Rig placed in neutral when operator not at controls •Pressurized lines and hoses secured from whipping hazards Advance Drill/bore hole/DPT in one foot increments applying MR SOP 0001-MEC Anomaly Avoidance Procedures
	Hoisting operations	•Ensure all personnel are clear of operation to a suitable safe distance
	Overturning of drill rig	•Establish drill pad if necessary •Drill rig level and stabilized
	Securing ropes and cables	•Ensure security to stable fixture. Do not wrap around any part of the body. •Drill rig ropes in clean, sound condition

22.0 PROCESS SUPERVISOR'S STATEMENT

I have read and understand this SOP. To the best of my knowledge, the processes described within this SOP can be done in a safe, healthful, and environmentally sound manner. I have made sure that all persons assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the workers statement for this process. I will ensure the SOP is the most recent revision. If a major change to the SOP is necessary, I will ensure that the processes are stopped until the SOP is revised and approved. If unexpected safety, health, or environmental hazards arise, I will stop activities, until hazards have been controlled, reduced, or eliminated to an acceptable risk level.

SOP MRP 0001 PROCEDURE SUPERVISOR ACKNOWLEDGEMENT

UXO Supervisor's Name (print):	Supervisor's Signature	Organization	Date

23.0 PERSONNEL STATEMENT

I have read this SOP and I have received adequate demonstration of the procedure, training to perform the process and procedure according to requirements, procedure, and guidance identified below. I agree to follow this SOP, unless I identify a hazard, work condition, or compliance issue not addressed within this SOP or encounter a situation, condition, or issue that, I cannot perform according to the SOP. If such a stoppage occurs, I will immediately notify the SUXOS, UXO Technician III, or II. Should the situation, condition, or compliance remain unresolved for greater than 24-hours, I shall contact the Munitions Response Safety Manager (619) 564-9627.

SOP MRP – 0001 - PERSONNEL STATEMENT ACKNOWLEDGEMENT

Personnel Name (print):	Personnel Signature	Organization	Date

STANDARD OPERATING PROCEDURE
OPS-03 – DEMOLITION/DISPOSAL OPERATIONS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the minimum procedures and safety and health requirements applicable to the conduct of demolition/disposal operations on sites contaminated with unexploded ordnance (UXO) or munitions and explosives of concern (MEC).

2.0 SCOPE

This SOP applies to all USA Environmental, Inc. (USA) site personnel, including contractor and subcontractor personnel, involved in the conduct of UXO/MEC demolition/disposal operations on a UXO/MEC contaminated site. This SOP is not intended to contain all of the requirements needed to ensure complete compliance, and should be used in conjunction with approved project plans and applicable referenced regulations. Consult the documents listed in Section 12.0 of this SOP for additional compliance issues.

3.0 RESPONSIBILITIES

3.1 PROJECT MANAGER

The Project Manager (PM) will be responsible for ensuring the availability of the resources needed to implement this SOP, and will also ensure that this SOP is incorporated into plans, procedures, and training for sites where this SOP is to be implemented.

3.2 SENIOR UXO SUPERVISOR

The Senior UXO Supervisor (SUXOS) will be responsible for assuring that adequate safety measures and housekeeping are performed during all phases of site operations, to include demolition activities, and will visit site demolition locations, as deemed necessary, to ensure that demolition operations are carried out in a safe, clean, efficient, and economic manner. The demolition activities will then be conducted under the direct control of the SUXOS, who will have the responsibility of supervising all demolition operations within the area.

The SUXOS will be responsible for training all on-site UXO personnel regarding the nature of the materials handled, the hazards involved, and the precautions necessary. The SUXOS will also ensure that the Daily Operational Log, Ordnance Accountability Log, USA Demolition Shot Records, and inventory records are properly filled out and accurately depict the demolition events and demolition material consumption for each day's operations. The SUXOS will be present during all demolition operations or designate a competent, qualified person to be in charge during any absences.

3.3 UXO SAFETY OFFICER

The UXO Safety Officer (UXOSO) for the site is responsible for ensuring that all demolition operations are being conducted in a safe and healthful manner, and is required to be present during all MEC demolition operations. The UXOSO will ensure the compliance of the demolition team with the above referenced documents that are applicable to the particular task being performed.

3.4 UXO QUALITY CONTROL SPECIALIST

The UXO Quality Control Specialist (UXOQCS) is responsible for ensuring the completeness of demolition operations records and for weekly inspection of the Ordnance Accountability Log, the Daily Operational Log, the USA Demolition Shot Record, and the inventory of MEC and demolition material. The UXOQCS,

assisted by demolition team personnel, will inspect each demolition pit and an area of appropriate radius after each demolition shot, in accordance with the approved explosive siting plan, to ensure that there are no kick-outs, hazardous UXO/MEC components, or other hazardous items. In addition, the pit may be checked with a magnetometer and large metal fragments, and any hazardous debris, will be removed on a per use basis in accordance with the SOW. Any UXO/MEC discovered during the QC check will be properly disposed of using the demolition procedures in the WP. Extreme caution must be exercised when handling UXO/MEC, which has been exposed to the forces of detonation. Personnel must adhere to acceptable safe practices and procedures when determining the condition of munitions and fuzes that have not been consumed in the disposal process.

4.0 GENERAL OPERATIONAL AND SAFETY PROCEDURE

All personnel, including contractor and subcontractor personnel, involved in operations on UXO/MEC-contaminated sites will be familiar with the potential safety and health hazards associated with the conduct of demolition/disposal operations, and with the work practices and control techniques used to reduce or eliminate these hazards. During demolition operations, the general safety provisions listed below will be followed by all demolition personnel, at all times. Noncompliance with the general safety provisions listed below will result in disciplinary action, which may include termination of employment.

All safety regulations applicable to demolition range activities and demolition and MEC materials involved will be complied with.

- Demolition of any kind is prohibited without an approved siting plan.
- The quantity of MEC to be destroyed will be determined by the range limit, fragmentation and K-Factor distance calculations.
- In the event of an electrical storm, dust storm, or other hazardous meteorological conditions, immediate action will be taken to cease all demolition range operations and evacuate the area.
- In the event of a fire, which does not include explosives or energetic material, put out the fire using the firefighting equipment located at the site; if unable to do so, notify the fire department and evacuate the area. If injuries are involved, remove the victims from danger, administer first aid, and seek medical attention.
- The UXOSO is responsible for reporting all injuries and accidents that occur.
- Personnel will not tamper with any safety devices or protective equipment.
- Any defect or unusual condition noted that is not covered by this SOP will be reported immediately to the SUXOS or UXOSO for evaluation and/or correction.
- Methods of demolition will be conducted in accordance with this SOP and approved changes or revisions thereafter.
- Adequate fire protection and first aid equipment will be provided at all times.
- All personnel engaged in the destruction of MEC will wear clothing made of natural fiber, close-weave clothes, such as cotton. Synthetic material such as nylon is not authorized unless treated with anti-static material.
- Care will be taken to minimize exposure to the smallest number of personnel, for the shortest time, to the least amount of hazard, consistent with safe and efficient operations.
- Work locations will be maintained in a neat and orderly condition.
- All hand tools will be maintained in a good state of repair.
- Each heavy equipment and/or vehicle operator will have a valid operator's permit or license for the equipment being operated.

- Equipment and other lifting devices designed and used for lifting will have the load rating and date of next inspection marked on them. The load rating will not be exceeded and the equipment will not be used without a current inspection date.
- Leather or leather-palmed gloves will be worn when handling wooden boxes, munitions, or UXO/MEC.
- Lifting and carrying require care. Improper methods cause unnecessary strains. Observe the following preliminaries before attempting to lift or carry:
  - When lifting, keep your arms and back as straight as possible, bend your knees and lift with your leg muscles.
  - Be sure you have good footing and hold, and lift with a smooth, even motion.
- The demolition range will be provided with two forms of communication, capable of contacting appropriate personnel or agencies (i.e., medical response, Quick Response Force (QRF).
- Motor vehicles and material handling equipment (MHE) used for transporting MEC or demolition materials must meet the following requirements:
  - Exhaust systems will be kept in good mechanical repair at all times.
  - Lighting systems will be an integral part of the vehicle.
  - One Class 10B:C rated, portable fire extinguisher will, if possible, be mounted on the vehicle outside of the cab on the driver's side, and one Class 10B:C fire extinguisher will be mounted inside the cab.
  - Wheels of carriers must be chocked and brakes set during loading and unloading.
  - No demolition material or MEC will be loaded into or unloaded from motor vehicles while their motors are running.
- Motor vehicles and MHE used to transport demolition material and MEC will be inspected prior to use to determine that:
  - Fire extinguishers are filled and in good working order.
  - Electrical wiring is in good condition and properly attached.
  - Fuel tank and piping are secure and not leaking.
  - Brakes, steering, and safety equipment are in good condition.
  - The exhaust system is not exposed to accumulations of grease, oil, gasoline, or other fuels, and has ample clearance from fuel lines and other combustible materials.
- Employees are required to wear leather, or rubber, gloves when handling demolition materials. The type of glove worn is dependent on the type of demolition material.
- A red warning flag, such as an “Active Range Flag” or a wind sock, will be displayed at the entrance to the demolition range during demolition operations when required by local authority. If applicable, the entrance gate will be locked when demolition work is in process.
- Unless otherwise directed or authorized by the explosives siting plan, all demolition shots will be tamped with an appropriate amount of earth/dirt.
- An observer will be stationed at a location where there is a good view of the air and surface approaches to the demolition range, before material is detonated. It will be the responsibility of the observer to order the SUXOS to suspend firing if any aircraft, vehicles, or personnel are sighted approaching the general demolition area.

- Two-way radios will not be operated in close proximity of the demolition range while the pit is primed or during the priming process. Radio transmissions and explosives will be separated by a minimum of 50 ft.
- No demolition operation will be left unattended during the active portion of the operation (i.e., during the burn or once any explosives or UXO/MEC are brought to the range).
- A minimum radius (approximately 50 feet) around the demolition pit will be cleared of dry grass, leaves, and other extraneous combustible materials around the demolition pit area.
- No demolition activities will be conducted if there is less than a 2,000-ft ceiling or if wind velocity is in excess of 20 mph.
- Demolition shots must be fired during daylight hours (minimum time for sunrise and sunset is determined by the firing procedure used (i.e., electric, non-electric, shock tube 30/60/60).
- Notification of the local authorities will be made in accordance with the site requirements.
- No more than two persons will ride in a truck transporting demolition material or MEC, and no person will be allowed to ride in the trailer/bed.
- Vehicles will not be refueled when carrying demolition material or MEC, and must be 100 ft from magazines or trailers containing such items before refueling.
- All explosive vehicles will be cleaned of visible explosive and other contamination, before releasing the vehicles for other tasks.
- Prior to conducting any other task, personnel will wash their faces and hands after handling demolition material or MEC.
- Demolition pits will be spaced a safe distance apart, with no more than 10 pits prepared for a series of shots at any one time.

5.0 SPECIAL REQUIREMENTS FOR DEMOLITION ACTIVITIES

The following safety and operational requirements will be met during demolition range operations. Any deviations from this procedure will be allowed only after receipt of written approval from the PM and the client. Failure to adhere to the requirements and procedures listed in the paragraphs below could result in serious injury or death; therefore, complete compliance with these requirements and procedures will be strictly enforced.

5.1 GENERAL REQUIREMENTS

The general demolition range requirements listed below will be followed at all times:

- The CEHNC "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Munitions and Explosives of Concern (MEC) Sites," will be followed when destroying multiple munitions by detonation on site. This document will be present on site during site operations.
- White Phosphorus and propellant will be disposed of only in an approved manner and following the guidance for maximum temperature exposure (90 degrees Fahrenheit).
- Material awaiting destruction will be stored at not less than intra-line distance, based on the largest quantity involved, from adjacent explosive materials and from explosives being destroyed. The material will be protected against accidental ignition or explosion from fragments, grass fires, burning embers, or detonating impulses originating in materials being destroyed.
- UXO/MEC or bulk explosives to be destroyed by detonation should be detonated in a pit not less than 3 ft deep and covered with earth which protrudes not less than 2 ft above existing ground level. Requirements may be found in the explosives siting plan. The components should be placed on their sides or in a position to expose the largest area to the influence of the demolition

material. The demolition material should be placed in direct contact with the item to be detonated and held in place by tape or earth packed over the demolition materials. The total quantity to be destroyed below ground at one time will not exceed the range limit.

- Detonations will be counted to ensure detonation of all pits. After each series of detonations, a search will be made of the surrounding area for UXO/MEC. Items such as lumps of explosives or unfuzed ammunition may be picked up and prepared for the next shot. Fuzed ammunition, or items that may have internally damaged components, will be detonated in place, if possible.
- Prevailing weather condition information can be obtained from the local weather service, or other acceptable source and the data logged in the Demolition Shot Log before each shot or round of shots.
- All shots will be dual primed.
- Whenever possible, during excavation of the demolition pits contour the ground so that runoff water is channeled away from the pits. If demolition operations are discontinued for more than two weeks, the pits should be backfilled until operations resume.
- Upon completion of the project, all disturbed demolition areas will be thoroughly inspected for UXO/MEC. Depending upon contract requirements, the site may have to be backfilled and leveled. If necessary, this will be coordinated with the contractor representative.
- Prior to and after each shot, the USA Demolition Shot Record is to be filled out by the SUXOS with all applicable information. This record will be kept with the Ordnance Accountability Log and reflect each shot.

5.2 ELECTRIC DETONATOR USE

The following requirements are necessary when using electric detonators and blasting circuits:

- Electric detonators and electric blasting circuits may be energized to dangerous levels from outside sources such as static electricity, induced electric currents, and radio communication equipment. Safety precautions will be taken to reduce the possibility of a premature detonation of the electric detonator and explosive charges of which they form a part. Radios will not be operated while the pit is primed or during the priming process.
- The shunt will not be removed from the leg wires of the detonator until the continuity check of the detonator is to be performed.
- When uncoiling, or straightening, the detonator leg wires, keep the explosive end of the detonator pointing away from the body and away from other personnel. When straightening the leg wires, do not hold the detonator itself; rather, hold the detonator leg wires approximately 1 in. from the detonator body. Straighten the leg wires by hand; do not throw or wave the wires through the air to loosen them.
- Prior to use, the detonators will be tested for continuity. To conduct the test, place the detonators in a pre-bored hole in the ground or place them in a sand bag, and walk facing away from the detonators and stretch the wires to their full length, being sure to not pull the detonators from the hole or sand bag. With the leg wires stretched to their fullest length, test the continuity of the detonators one at a time by un-shunting the leg wires and attaching them to the galvanometer and checking for continuity. After the test, re-shunt the wires by twisting the two ends together. Repeat this process for each detonator until all detonators have been tested. This process will be accomplished at least 50 ft from and downwind of any MEC or demolition materials and out of the demolition range personnel and vehicle traffic flow pattern. In addition, all personnel on the demolition range will be alerted prior to the test being conducted.

  NOTE: When testing the detonator, prior to connecting the detonator to the firing circuit, the leg wires of the detonator must be shunted by twisting the bare ends of the wires together

immediately after testing. The wires will remain short circuited until time to connect them to the firing line or Remote Firing Device (RFD) Receiver.

- At the power source end of the blasting circuit, the ends of the wires will be shorted or twisted together (shunted) at all times, except when actually testing the circuit or firing the charge. The connection between the detonator and the circuit firing wires must not be made, unless the power ends of the firing wires are shorted and grounded or the firing panel is off and locked.
- The firing line will be checked using pre-arranged hand signals or through the use of two-way radios, if the demolition pit is not visible from the firing point. If radios are used, communication will be accomplished a minimum of 50 ft from the demolition pit and detonators. The firing line will be checked for electrical continuity in both the open and closed positions, and will be closed/shunted after the check is completed.
- UXO/MEC to be detonated will be placed in the demolition pit and the demolition material placed/attached in such a manner as to ensure the total detonation of the UXO/MEC. Once the UXO/MEC and demolition material are in place and the shot has been tamped, the detonators will be connected to the det cord. Prior to handling any detonators that are connected to the firing line or RDF, personnel will ensure that they are grounded. The detonators will then be carried to the demolition pit with the end of the detonators pointed away from the individual. The detonators are then connected to the detonation cord, Non-El, etc., ensuring that the detonator is not covered with tamping material to allow for ease of recovery/investigation in the event of a misfire.
- Prior to making connections to the blasting machine or RFD Transmitter, the entire firing circuit will be tested for electrical continuity and ohms resistance, or transmitting power (as applicable), to ensure the blasting machine or RFD Transmitter (distance) has the capacity to initiate the shot.
- The individual assigned to make the connections at the blasting machine or panel will not complete the circuit at the blasting machine or panel, and will not give the signal for detonation, until satisfied that all personnel in the vicinity have been evacuated to a safe distance. When in use, the blasting machine, or its actuating device, will be in the blaster's possession at all times. When using the panel, the switch must be locked in the open position until ready to fire, and the single key must be in the blaster's possession.
- Prior to initiating a demolition shot(s), a warning will be given; the type and duration of such warning will be determined by the prevailing conditions at the demolition range. At a minimum, this should be an audible signal using a siren, air horn, or megaphone, which is sounded for a duration of one minute, five minutes prior to the shot and again one minute prior to the shot.

5.3 NON-EL USE (SHOCK TUBE)

The following requirements are necessary when using NON-EL (Shock Tube) systems:

- After cutting a piece of shock tube, either immediately tie a tight overhand knot in one or both cut ends or splice one exposed end and tie of the other.
- Always use a sharp knife or razor blade to cut shock tube so as to prevent the tube from being pinched or otherwise obstructed.
- Always cut shock tube squarely across and make sure the cut is clean.
- Use only the splicing tubes provided by the manufacturer to make splices.
- Every splice in the shock tube reduces the reliability of the priming system; therefore keep the number of splices to a minimum.
- Always dispose of all short, cut-off pieces in accordance with local laws as they relate to flammable material.

The shock tube system is a thin plastic tube of extruded polymer with a layer of Pentaerythritol Tetranitrate (PETN) coated on its interior surface. The PETN propagates a shock wave, which is normally contained within the plastic tubing. The shock tube offers the controlled instantaneous action of electric initiation without the risk of premature initiation of the detonator by radio transmissions, high-tension power lines, or static electricity discharge. The NON-EL system uses detonators in the bunch blocks and in the detonator assembly, which are to be handled in accordance with approved procedures.

The high reliability of the shock tube initiating system is due to the fact that all of the components are sealed and, unlike standard non-electric priming components, cannot be easily degraded by moisture. Cutting the shock tube makes the open end vulnerable to moisture and foreign contamination; therefore, care must be taken to prevent moisture and foreign matter from getting in the exposed ends of the shock tubes.

5.3.1 Shock Tube Demolition Procedures

WARNING
Although the detonation along the shock tube is normally contained within the plastic tubing, burns may occur if the shock tube is held.

5.3.2 Shock Tube Assembly

- Spool out the desired length of shock tube from firing point to demolition site and cut it off with a sharp knife or razor blade. Weight down the loose end of trunk line.
- Immediately seal off the shock tube remaining on the spool by tying a tight overhand knot in the cut-off end or use a push-over sealer.
- Using a sharp knife or razor, cut the sealed end off the detonator assembly.
- Push one of the shock tube ends to be spliced firmly into one of the pre-cut splicing tubes provided by the manufacturer at least ¼ inch. Push the other shock tube end firmly into the other end of the splicing tube at least ¼ inch. Secure splice with tape if needed.

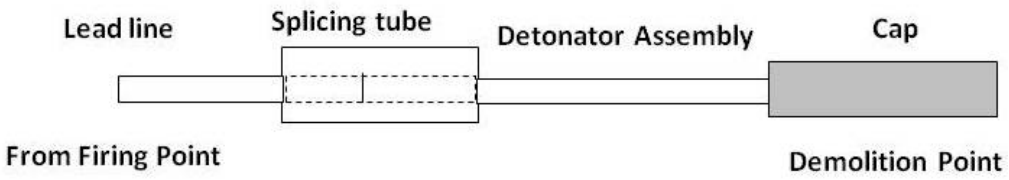


Figure 1

5.3.3 Firing Assembly Setup

1) If there are multiple items to be destroyed using bunch block(s) supplied by the manufacturer, lay out lead lines at demo site to the shot(s) and secure the bunch block with a sandbag, or some other item which will keep it from moving.

NOTE: No more than six leads may be used from any one bunch block.

2) If the detonator assembly has not been attached yet, then, using the splicing tube, splice the detonator assembly to the shock tube branch line as explained in the splicing instructions above.
3) If this is a non-tamped shot, place the detonator assembly into the demolition material. If the shot is to be tamped, then prepare the demolition material with a detonating cord lead long enough to stick out of the tamping at least 1 ft.

4) Tape the detonator assembly with cap to the detonating cord lead as shown in Figure 2.

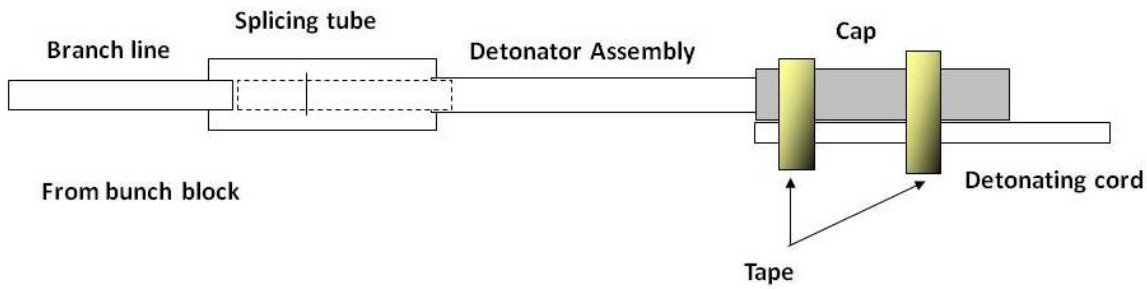


Figure 2

5) Return to the firing position.
6) Cut off the sealed end of shock tube, proceed to the directions listed in Step 7. If you are using a previously cut piece of shock tube, using a sharp knife or razor blade cut approximately 18 inches from the previously cut end, whether or not it was knotted in accordance with the above guidance.
7) Insert a primer into the firing device and connect the shock tube lead line to the firing device ensuring that the shock tube is properly seated in the firing device.
8) Take cover.
9) Signal **"Fire in the hole"** three times and initiate charge.
10) Observe a 5-minute wait time after the detonation.
11) Remain in designated safe area until Demolition Supervisor announces **"All Clear."**

5.4 DETONATING CORD USE

The following procedures are required when using detonating cord (det cord):

- Det cord should be cut using approved crimpers, and only the amount required should be removed from inventory.
- When cutting det cord, the task should be performed outside the magazine.
- For ease of inventory control, remove det cord only in 1-ft increments.
- Det cord should not be placed in clothing pockets or around the neck, arm, or waist, and should be transported to the demolition location in either an approved “day box”, original container, or a cloth satchel, depending upon the magazine location and proximity to the demolition area.
- Det cord should be placed at least 50 ft away from detonators and demolition materials until ready for use. To ensure consistent safe handling, each classification of demolition material will be separated by at least 25 ft until ready for use.
- When ready to “tie in” either the det cord to demolition materials, or det cord to detonator, the det cord will be connected to the demolition material and secured to the UXO/MEC. The cord is then strung out of the hole and secured in place with soil, or filled sandbags, being sure to leave a minimum of 6 ft of det cord exposed outside the hole.
- Once the hole is filled, make a loop in the det cord large enough to accommodate the detonator, place the detonator in the loop, and secure it with tape. The detonator’s explosive end will face down the det cord toward the demolition material or parallel to the main line.

- In all cases, ensure that there is a minimum of 6 ft of det cord extending out of the hole to allow for ease of detonator attachment and detonator inspection/replacement should a misfire occur.
- If the det cord detonators are electric, they will be checked, tied in to the firing line, and shunted prior to being taped to the loop. If the det cord detonators are non-electric, the time/safety fuse will be prepared with the igniter in place prior to taping the detonators to the det cord loop. If the det cord detonators are Non-EI, simply tape the detonators into the loop as described above.
- In the event that a time/safety fuse is used, an igniter is not available, and a field expedient initiation system is used (i.e., matches), do not split the safety fuse until the detonator is taped into the det cord loop.

5.5 TIME/SAFETY FUSE USE

The following procedures are required when using a time/safety fuse:

- Prior to each daily use, the burn rate for the time/safety fuse must be tested to ensure the accurate determination of the length of time/safety fuse needed to achieve the minimum burn time of five minutes needed to conduct demolition operations.
- To ensure both ends of the time/safety fuse are moisture free, use approved crimpers to cut 6 inches off the end of the time/safety fuse roll, and place the 6 inch piece in the time/safety fuse container.
- If quantity allows, accurately measure and cut off a 6-ft-long piece of the time/safety fuse from the roll.
- Take the 6 ft section out of the magazine, and attach a fuse igniter.
- In a safe location, removed from demolition materials and UXO/MEC, ignite the time/safety fuse, measure the burn time from the point of initiation to the "spit" at the end, and record the burn time in the SUXOS's Log.
- To measure the burn time, use a watch with a second hand or chronograph.
- To calculate the burn rate in seconds per foot, divide the total burn time (in seconds) by the length (in feet) of the test fuse.
- When using time/safety fuse for demolition operations, the minimum amount of fuse to be used for each shot will be the amount needed to permit a minimum burn time of five minutes.

5.6 DEMOLITION RANGE INSPECTION SCHEDULE

The schedule for the demolition range inspection will be followed when demolition operations are being conducted. This inspection will be conducted by the UXOSO or UXOQCS and will be documented in the Site Safety or QC Log. If any deficiencies are noted, demolition operations will be suspended and the deficiency reported to the SUXOS. Once the deficiencies are corrected, demolition operations may be resumed.

6.0 METEOROLOGICAL CONDITIONS

In order to control the effects of demolition operations and to ensure the safety of site personnel, the following meteorological limitations and requirements will apply to demolition operations:

- Demolition operations will not be conducted during electrical storms or thunderstorms.
- No demolition operations will be conducted if the surface wind speed is greater than 20 miles per hour.

- Demolition operations will not be conducted during periods of visibility of less than one mile caused by, but not limited to, dense fog, blowing snow, rain, sand storms, or dust storms.
- Demolition will not be carried out on extremely cloudy days, defined as overcast (more than 80% cloud cover) with a ceiling of less than 2,000 ft.
- Demolition operations will not be initiated until an appropriate time after sunrise, and will be secured at an appropriate time prior to sunset (see Section 4.0).

7.0 PRE-DEMOLITION/DISPOSAL PROCEDURES

7.1 PRE-DEMO/DISPOSAL OPERATIONAL BRIEFING

It is the belief of USA that the success of any operation is dependent upon a thorough brief, covering all phases of the task, which is presented to all affected personnel. The SUXOS will brief all personnel involved in range operations in the following areas:

- Type of UXO/MEC being destroyed
- Type, placement, and quantity of demolition material being used
- Method of initiation (electric, non-electric, or NON-EL)
- Means of transporting and packaging MEC
- Route to the disposal site
- Equipment being used (i.e., galvanometer, blasting machine, firing wire, etc.)
- Misfire procedures
- Post-shot clean-up of range.

7.2 PRE-DEMO/DISPOSAL SAFETY BRIEFING

The USA SUXOS, Team Leader, or UXOSO will conduct a safety brief for all personnel involved in range operations in the following areas:

- Care and handling of explosive materials
- Personal hygiene
- Two man rule, and approved exceptions
- Personnel roles and responsibilities
- Potential trip/fall hazards
- Horseplay on the range
- Stay alert for any explosive hazards on the range
- Calling a safety stop for hazardous conditions
- Location of emergency shelter (if available)
- Parking area for vehicles (vehicles must be positioned for immediate departure, with the keys in the ignition
- Location of range emergency vehicle
- Location of the assigned paramedic
- Wind direction (to assess potential toxic fumes)

- Locations of first aid kit and fire extinguisher
- Route to nearest hospital or emergency aid station
- Type of communications in event of an emergency
- Storage location of demolition materials and MEC awaiting disposal
- Demolition schedule.

7.3 TASK ASSIGNMENTS

Individuals with assigned tasks will report the completion of the task to the SUXOS. The types of tasks that may be required are:

- Contact local military authorities and fire response personnel, and get air clearance, as required.
- Contact hospital/emergency response/medevac personnel, if applicable.
- Secure all access roads to the range area.
- Visually check range for any unauthorized personnel.
- Check firing wire for continuity and shunt.
- Prepare designated pits as required.
- Check continuity of detonators.
- Check time/safety fuse and its burn rate.
- Designate a custodian of the blasting machine, fuse igniters, or Non-El initiator.
- Secure detonators in a safe location.
- Place UXO/MEC in pit, and place charge in desired location.

7.4 PREPARING EXPLOSIVE CHARGE FOR INITIATION

To prepare the explosive charge for initiation, the procedures listed below will be followed:

- Ensure firing wire is shunted.
- Connect detonator to the firing wire.
- Isolate or insulate all connections.
- Prime the demolition charge.
- Place demolition charge on UXO/MEC.
- Depart to firing point (if using non-electric firing system, obtain head count, pull igniters, and depart to designated safe area).
- Obtain a head count.
- Give one minute warning signal, using a bullhorn or siren, five minutes prior to detonation, and again at one minute prior to detonation.
- Check the firing circuit.
- Signal **“fire in the hole”** three times (or an equivalent warning), and take cover.
- If using electric firing system, connect firing wires to blasting machine, and initiate charge.
- Remove firing wires from blasting machine and shunt or turn off RFD Transmitter.

- Remain in designated safe area until SUXOS announces **"All Clear."** This will occur after a post-shot waiting period of 5 minutes and the SUXOS has inspected the pit(s).

8.0 POST DEMOLITION/DISPOSAL PROCEDURES

Do not approach a smoking hole or allow personnel out of the designated safe area until cleared to do so, and follow the procedures listed below:

- After the **"All Clear"** signal, check pit for low orders or kick outs.
- Examine pit, and remove any large fragmentation, as needed.
- Back fill hole, as necessary.
- Police all equipment.
- Notify military authorities, fire department, etc., that the operation is complete.

9.0 MISFIRE PROCEDURES

A thorough check of all equipment, firing wire, and detonators will prevent most misfires. However, if a misfire does occur, the procedures outlined below will be followed.

9.1 ELECTRIC MISFIRES

To prevent electric misfires, one technician will be responsible for all electrical wiring in the circuit. If a misfire does occur, it must be cleared with extreme caution, and the responsible technician will investigate and correct the situation, using the steps outlined below:

- Check firing line and blasting machine connections, and make a second initiation attempt.
- If unsuccessful, disconnect and connect to another blasting machine (if available), and attempt to initiate a charge.
- If unsuccessful, commence a 30-minute wait period.
- After the maximum delay predicted for any part of the shot has passed, the designated technician will proceed down range to inspect the firing system, and a safety observer must watch from a protected area.
- Disconnect and shunt the detonator wires, connect a new detonator to the firing circuit, check the replacement detonator for continuity, and prime the charge without disturbing the original detonator.
- Follow normal procedures for effecting initiation of the charge.

9.2 NON-ELECTRIC MISFIRES

Working on a non-electric misfire is the most hazardous of all operations. Occasionally, despite all painstaking efforts, a misfire will occur. Investigation and corrective action should be undertaken only by the technician who placed the charge, using the following procedure:

- If charge fails to detonate at the determined time, initiate a 60-minute wait period plus the time of the safety fuse, i.e., 5-minute safety fuse plus 60 minutes for a total of 65 minutes.
- After the wait period has expired, a designated technician will proceed down range to inspect the firing system. A safety observer must watch from a protected area.
- Prime the shot with a new non-electric firing system, and install a new fuse igniter.
- Follow normal procedures for initiation of the charge.

9.3 NON-EL MISFIRE

The use of a shock tube for blast initiation can present misfires, which require the following actions:

- If charge fails to detonate, it could be the result of the shock tube not firing. Visually inspect the shock tube; if it is not discolored (i.e., slightly black), it has not fired.
- If it has not fired, cut a 1 ft piece off the end of the tube, re-insert the tube into the firing device, and attempt to fire again.
- If the device still does not fire, wait 60 minutes and proceed down range to replace the shock tube per the instructions outlined below.
- If the tube is slightly black, then a "Black Tube" misfire has occurred, and the shock tube will have to be replaced, after observing a 60-minute wait time. When replacing the shock tube, be sure to remove the tube with the detonator in place. Without removing the detonator from the end of the tube, dispose of by demolition.

9.4 DETONATING CORD MISFIRE

USA uses det cord to tie in multiple demolition shots, and to ensure that electric detonators are not buried. Since det cord initiation will be either electrical or non-electrical, the procedures presented in Paragraphs9.1, 9.2, or 9.3, as appropriate to the type of detonator used, will be used to clear a det cord misfire. In addition, the following will be conducted:

- If there is no problem with the initiating system, wait the prescribed amount of time, and inspect the initiator to the cord connection to ensure it is properly connected. If it was a bad connection, simply attach a new initiator, and follow the appropriate procedures in Paragraph 9.0.
- If the initiator detonated and the cord did not, inspect the cord to ensure that it is det cord and not time fuze. Also, check to ensure that there is PETN in the cord at the connection to the initiator.
- It may be necessary to uncover the det cord and replace it. This must be accomplished carefully, to ensure that the demolition charge and the MEC item are not disturbed.

10.0 RECORD KEEPING REQUIREMENT

To document the demolition operations procedures and the completeness of the demolition of MEC, the following record keeping requirements will be met:

- USA (as directed) will obtain and maintain all required permits.
- The SUXOS will ensure the accurate completion of the logs, and the SUXOS and UXOQCS will monitor the entries in the log for completeness, accuracy, and compliance with meteorological conditions.
- The SUXOS will enter the appropriate data on the Ordnance Accountability Log and the Demolition Shot Record, to reflect the MEC destroyed, and will complete the appropriate information on the Explosives Accountability Log (a.k.a. the Magazine Data Card) which indicates the demolition materials used to destroy the MEC.
- The quantities of MEC recovered must also be the quantities of MEC destroyed or disposed.
- USA will retain a permanent file of all demolition records, including permits; magazine data cards; training and inspection records; waste manifests, if applicable; and operating logs.
- Copies of ATF License and any required permits must be on hand.

11.0 SAFETY AND PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

The following safety measures and personal protective equipment (PPE) will be used in preventing or reducing exposure to the hazards associated with UXO/MEC demolition/disposal operations. These requirements will be implemented unless superseded by site-specific requirements stated in the SSHP.

- Hard hats are required only when working around heavy equipment or when an overhead or head impact hazard exists.
- Steel toe/shank boots are not required during surface/subsurface location of anomalies, unless a serious toe hazard exists, whereupon a fiber safety toe will be used.
- Safety glasses will be required whenever an eye hazard exists, for example, when working around flying dirt/debris, using hand tools, etc. Safety glasses will provide protection from impact hazards and, if necessary, ultraviolet radiation (i.e., sunlight).
- Positive means will be required to secure the PPE and prevent it from falling and causing an accidental detonation.

12.0 REGULATORY REFERENCES

Applicable sections and paragraphs in the documents listed below will be used as references for the conduct of UXO demolition/disposal operations:

- USA Corporate Safety and Health Program
- OSHA General Industry Standards, 29 CFR 1910
- OSHA Construction Standards, 29 CFR 1926
- DDESB TP-16, Methodology for Calculation of Fragmentation Characteristics
- DoD 4160.21-M, Defense Reutilization and Marketing Manual
- DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards
- AR 385-64, U.S. Army Explosives Safety Program
- AR 385-10, Army Safety Program
- DA PAM 385-64, U.S. Army Explosives Safety Program
- TM 9-1300-200, Ammunition General
- TM 9-1300-214, Military Explosives
- Applicable TM 60 Series Publications
- AR 190-11, Physical Security of Arms, Ammunition, and Explosives
- ATF 5400.7, Alcohol, Tobacco, and Firearms Explosives Laws and Regulations
- DOT, 49 CFR, Parts 100 to 199, Transportation (applicable sections)
- EPA, 40 CFR Parts 260 to 299, Protection of Environment (applicable sections).
- AR 385-40 w/ USACE Supplement 1, Accident Reporting & Records
- Basic Safety Concepts and Considerations for Ordnance and Explosives Operations, EP 385-1-95a
- USACE EM 385-1-1, Safety and Health Requirements Manual

STANDARD OPERATING PROCEDURE – OPS-04
DGM ANOMALY INVESTIGATIONS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide USA Environmental, Inc. (USAE) employees and subcontractors with the minimum procedures and safety and health requirements applicable to the conduct of digital geophysical mapping (DGM) anomaly investigation operations on sites contaminated with unexploded ordnance (UXO) or munitions and explosives of concern (MEC).

2.0 SCOPE

This SOP applies to all USAE site personnel, including contractor and subcontractor personnel, involved in the conduct of DGM operations on a UXO/MEC contaminated site. The following USAE policies and procedures are not all inclusive nor are they applicable in all situations. This SOP is not a stand-alone document and is to be used together with Work Plans, other USAE SOPs, the USAE Site Safety and Health Plan (SSHP), applicable Federal, State, and local regulations, and contract restrictions and guidance. Consult the documents listed in Section 5.0 of this SOP for additional compliance issues.

3.0 INTRUSIVE INVESTIGATION OPERATIONS

All intrusive operations at MEC sites will be under the supervision of UXO qualified personnel. Non-UXO qualified personnel will not be allowed in the exclusion zone (EZ) during intrusive operations. The EZ will encompass an area large enough to protect personnel from fragmentation by an unplanned detonation. In addition, if non-UXO qualified personnel require access to the EZ, all work will stop while they are in the EZ. During operations, USAE personnel will strictly adhere to the SSHP and the following general safety practices:

- Operations will be conducted during daylight hours only.
- Access to operating areas will be limited to only those personnel necessary to accomplish the specific operation.
- UXO will only be handled by qualified UXO Technicians.
- During UXO operations the minimum separation distance (MSD) between UXO and non-UXO operations is the munition with the greatest fragmentation distance (MGFD), as stated in the Work Plan.
- During demolition operations personnel remaining on site will be limited to those personnel needed to safely and efficiently prepare the item/s for destruction.
- All personnel will attend the daily safety briefing (tailgate safety briefing) prior to entering the operating area.
- Anyone can stop operations for an unsafe act or situation.
- Safety violations and/or unsafe acts will be immediately reported to the UXO Safety Officer (UXOSO).
- Failure to comply with safety rules/procedures may result in termination of employment.

3.1 DETECTION AND REMOVAL PROCEDURES

3.1.1 GRID LAYOUT

A registered Land Surveyor will survey each of the clearance areas, accompanied by a UXO escort. Surveying activities will consist of locating clearance area boundaries, establishing permanent survey monuments, and establishing grids for geophysical investigation activities within the clearance areas.

Grids will be laid out by the survey team in the approximate size of 100 feet (ft) x 100 ft or 200 ft x 200 ft, depending on the terrain. These grids will be geophysical surveyed and the data gathered and evaluated to determine which anomalies will be selected for intrusive investigation. Dig sheets will be developed that prioritize the anomalies. These prioritized anomalies will be re-acquired to an exact location using the highly accurate Real Time Kinematic-Differential Global Positioning System (RTK-DGPS) and a Schonstedt GA-52CX magnetometer.

3.1.2 INTRUSIVE INVESTIGATION OF ANOMALIES

3.1.2.1 Intrusive Teams

Intrusive investigation teams usually consist of a Team Leader (UXO Technician III) and at least one UXO Technician II or I. During Intrusive operations UXO Technicians I will operate under the supervision of UXO Technicians II or III. Only qualified UXO technicians will perform UXO operations, which are defined as:

- MEC identification
- Access procedures such as excavation, either by hand or using heavy equipment
- Handling of MEC, explosives or explosive items
- Disposal, including movement, transportation, and final disposal of MEC

The UXO Team will be assigned a set of anomalies. Using the Dig Sheets provided, the dig team(s) will excavate each of the selected target anomalies. Site-specific conditions (e.g., a larger ordnance item found than was anticipated) may warrant modification of the EZ/MSD and removal procedures described herein. As necessary, any changes will be prepared and submitted separately for approval prior to initiation of further activities on site.

3.1.2.2 Manual Excavations

Excavations for individual anomalies will be conducted using Schonstedt GA-52CX (ferrous metal) and/or White's XLT or Minelab's Explorer II (all metals) detector to assist the team in determining the location and orientation of the target item. The personnel excavating an anomaly shall initially remove no more than a 6-inch layer of soil at the location of the anomaly. A visual and electronic search of the excavation shall then be made. This process shall be repeated until the audible signal from the magnetometer indicates the object is close to the surface. Once this determination has been made, soil will be removed by hand until the source of the anomaly is located. Excavations on individual anomalies greater than 4 ft below the ground surface (bgs) will not be made without prior approval of the U.S. Army Corps of Engineers (USACE) OE Safety Specialist.

3.1.2.3 Mechanical Handling Equipment

Mechanical handling equipment (MHE) may be used to excavate large anomalies (e.g., pits) or those deeper than 4 ft bgs if required (e.g., to confirm the anomaly is not a MEC). Any decision to use mechanized equipment to excavate these anomalies will be made by the Senior UXO Supervisor

(SUXOS) and the USACE OE Safety Specialist. Excavations will proceed slowly to ensure the MHE does not broach the item. If the excavated material is considered to be an MEC, it shall be uncovered sufficiently by hand to obtain a positive identification of the item. If the item is identified as UXO/MEC, a determination will subsequently be made as to whether it is fuzed or not.

While excavating with MHE, a UXO technician will be stationed in a position that is out of the reach of the excavation equipment but affords a view of the excavation site. This observer will ensure that the next lift is visually free of UXO. The excavated material will be placed onto the ground within a screening area that has been surface swept and the boundaries recorded. The soil spoils will be spread across the screening area using the excavator bucket. The excavated material will be screened for range related debris, material potentially presenting an explosive hazard (MPPEH), munitions debris (MD), and UXO/MEC items. UXO technicians will recover all pieces of munitions debris or range related debris and any ordnance items. After screening, the soil spoils will be stockpiled to the side of the screening area.

3.1.2.4 Disposal Pits

Excavations for disposal pits using MHE will be performed in a similar manner as specified in Section 3.1.3.2. However, because individual anomalies cannot be discerned within the disposal pits, material from the disposal pit will be excavated carefully in 2-foot lifts.

3.2 ANOMALY EXCAVATION REPORTING

The MEC Subcontractor will excavate and identify the sources of the reacquired anomalies in the field. Data to be recorded for each item discovered during anomaly excavation will include the following (as applicable):

- Type (e.g., MD, MPPEH, MEC, and UXO)
- Description (e.g., “20mm projectile, MK105 practice bomb, 40mm hand grenade” and “base, coupling, firing device”)
- Initial Condition (e.g., expended, inert, live, and to be determined [TBD])
- Approximate length
- Approximate width
- Depth
- Approximate weight
- Approximate inclination (per Figure 1-1)
- Approximate orientation (Azimuth per Figure 1-1)
- Approximate distance from flag
- Approximate orientation from flag
- Found in a pit?
- Piece of fragmentation?
    - Initial disposition (e.g., left in place or removed to scrap pile)

- Requires demolition?

All data will be turned into the Site Geophysicist at the end of the day.

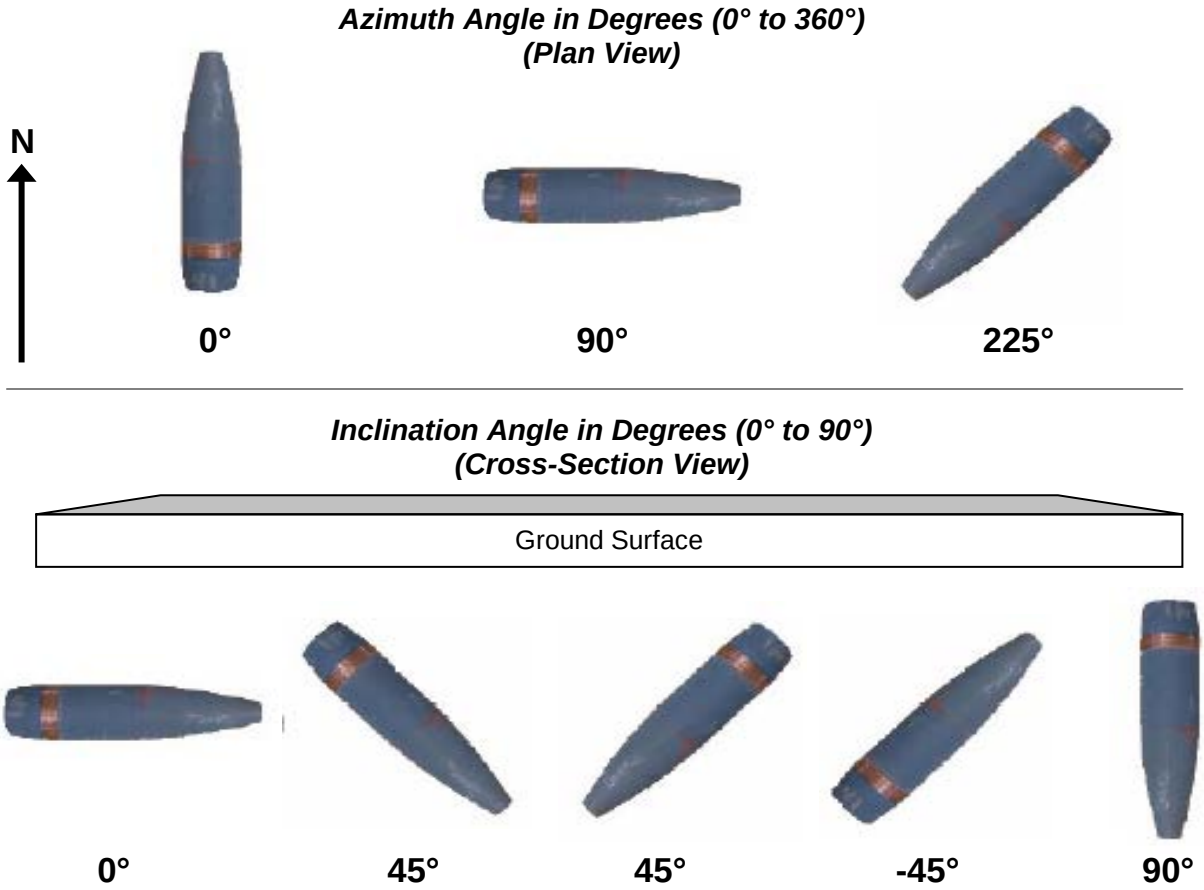


Figure 1-1: Azimuth and Inclination Examples

4.0 DISPOSAL OPERATIONS

Fuzed UXO/MEC items will be blown in place (BIP), and un-fuzed UXO/MEC items will be consolidated whenever possible in accordance with USACE Engineer Pamphlet (EP) 1110-1-17, *Establishing a Temporary Open Burn and Open Detonation Site for Conventional Ordnance and Explosives Projects*, dated 16 July 1999, Appendix D. In no case shall the SUXOS authorize or undertake destruction of UXO/MEC when there is sufficient reason to believe that the disposal action will result in personnel casualties or property damage. The USACE OE Safety Specialist will be consulted for guidance in the event that there is sufficient reason to believe that the disposal action will result in personnel casualties or property damage.

5.0 REFERENCES

- USACE Safety Considerations for UXO/MEC
- USAE Corporate Safety and Health Program (CSHP)
- OSHA, 29 CFR 1910, Occupational Safety and Health Standards

- OSHA, 29 CFR 1926, Construction Standards
- Applicable sections of EPA, 40 CFR Parts 260 to 299, Protection of Environment
- Applicable sections of DOT, 49 CFR Parts 100 to 199, Transportation
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous Waste Remedial Actions
- DOD 4145.26-M, Contractors' Safety Manual for Ammunition and Explosives
- DOD 6055.9-STD, DOD Ammunition and Explosives Safety Standards
- DOD 4160.21-M, Defense Reutilization and Marketing Manual
- DA PAM 385-64, Ammunition and Explosives Safety Standards
- AR 385-64, Ammunition and Explosives Safety Standards
- AR 200-1, Environmental Protection and Enhancement
- AR 385-10, The Army Safety Program
- AR 385-16, System Safety Engineering and Management
- AR 385-40 w/USACE supplement, Accident Reporting and Records
- TM 9-1300-200, Ammunition General
- TM 9-1300-214, Military Explosives
- TM 60 Series Publications

STANDARD OPERATING PROCEDURE AND CHECKLISTS – OPS-05
DIGITAL GEOPHYSICAL MAPPING

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1.0 CHECKLIST FOR GEOPHYSICAL TEST STRIP LOCATION AND DESIGN

Project Name: _____

Project Location: _____

USACE POC: _____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	N/A
Objectives			
a. Have survey objectives been determined, clarified, and documented?	____	____	____
b. Has EM-1110-1-4009 been consulted to ensure that all objectives mentioned therein will be met?	____	____	____
c. Will the prove-out be available during the project for the evaluation of suspected instrument malfunctions?	____	____	____
d. Will the prove-out be available during the project for the evaluation of new equipment and operators?	____	____	____
e. Is the contractor prepared to demonstrate target reacquisition techniques in the prove-out area?	____	____	____
Site Selection			
1. Has the proposed prove-out site been evaluated for the following criteria:			
• Easy access for project personnel?	____	____	____
• Restricted access for non-project personnel?	____	____	____
2. Is the prove-out located in close proximity to the survey area?	____	____	____
3. Does the prove-out have geophysical noise conditions similar to those expected in the survey area?	____	____	____
4. Does the prove-out have terrain and vegetation conditions similar to those of the survey area?	____	____	____
5. Has a backup prove-out site been identified?	____	____	____
Site Preparation			
6. Has surface clearance been performed?	____	____	____
7. Have the following steps been executed in preparing three areas within the prove-out:			

Site Preparation (continued)	Y	N	N/A
• Geophysically map entire area prior to burial?	____	____	____
• Remove non geologic sources of anomalous response from two-thirds of the area? (optimal situation)	____	____	____

Seeding Test Strip

8. Have all available sources been consulted to determine appropriate seeded items and orientations?	____	____	____
9. Have DQO's been established and documented?	____	____	____
10. Have appropriate burial depths been determined for the seeded items?	____	____	____
11. Have the DQO's been consulted to determine the number of seeded items?	____	____	____
12. Have the seeded items been spaced a minimum of 3 meters apart?	____	____	____
13. Has a list been made to document the range of burial depths for different MEC items?	____	____	____
14. Have the following steps been taken to ensure accurate locations for the seeded items:	____	____	____
• Specify location requirements in x,y,z?	____	____	____
• Measure depth to top and center of mass of each object?	____	____	____
• Have thorough notes been taken on each item's burial?	____	____	____
• GPS or a land surveyor employed to record the position of each item?	____	____	____

Seeding Survey Areas

15. Have items been seeded near the boundaries of the survey areas?	____	____	____
16. Has a list been made of number and type of items buried, the range burial depths for different MEC items, and percentage of area seeded?	____	____	____
17. Will target threshold be reevaluated based on results of seeded items in the survey areas?	____	____	____
18. Have the positional accuracy standards used during the prove-out been applied to seeded items in the survey areas?	____	____	____

2.0 CHECKLIST FOR OUT OF BOX EQUIPMENT TESTS

Project Name: _____

Project Location: _____

USACE POC: _____

Equipment Source: _____

Equipment Serial Numbers: _____

_____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	N/A
1. Has the equipment been inventoried and inspected for damage or wear?			
2. Has the cable shake test been performed? (Replace any faulty components if necessary)	____	____	____
3. Has the instrument (EM only) been nulled?	____	____	____
4. Has a nearby, noise-free site been selected for static background and static response tests?	____	____	____
5. Have the following instrument function tests been successfully performed:	____	____	____
• Static background test demonstrating <20% deviation in response for at least 3 minutes?	____	____	____

Background values: TG1_____, TG2_____, TG3_____, TG4_____

• Instrument response test demonstrating <20% deviation in response from test to test?	____	____	____

Response values: TG1_____, TG2_____, TG3_____, TG4_____

3.0 CHECKLIST FOR INITIAL INSTRUMENT TESTS

Project Name: _____

Project Location: _____

USACE POC: _____

Equipment Source: _____

Equipment Serial Numbers: _____

_____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	N/A
6. Has the six-line test been utilized to evaluate the following factors:			
• Heading effects?	____	____	____
• Repeatability of the response amplitude?	____	____	____
• Positional accuracy?	____	____	____
• Latency?	____	____	____
7. If magnetics data are to be collected, have the following steps been taken in the performance of the azimuthal test:	____	____	____
• Selected an area free of geophysical noise?	____	____	____
• Fixed sensor head position?	____	____	____
• Marked four cardinal directions on ground?	____	____	____
• Collected data using a variety of sensor head orientations?	____	____	____
8. If magnetics data is to be collected, has the octant test been performed and documented?	____	____	____
9. Has the optimum sensor height for each instrument been determined?	____	____	____
10. Has the pull-away test been performed and successfully demonstrated no influence for navigational or towing equipment?	____	____	____

4.0 CHECKLIST FOR DAILY INSTRUMENT QC CHECKS

Project Name: _____

Project Location: _____

USACE POC: _____

Equipment Source: _____

Equipment Serial Numbers: _____

_____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	N/A
1. Has the cable shake test been performed? (Replace faulty components if necessary)	____	____	____
2. Has instrument (EM only) been nulled?	____	____	____
3. Has a static background test been performed and demonstrated <20% deviation in response over at least 3 minutes:			
• Start of day?	____	____	____
Background values: TG1_____, TG2_____, TG3_____, TG4_____			
• End of day?	____	____	____
Background values: TG1_____, TG2_____, TG3_____, TG4_____			
4. Has instrument response test been performed and demonstrated <20% deviation in response from test to test:			
• Start of day?	____	____	____
Response values: TG1_____, TG2_____, TG3_____, TG4_____			
• End of day?	____	____	____
Response values: TG1_____, TG2_____, TG3_____, TG4_____			
5. Has the operator been thoroughly examined with the geophysical instrument for any sources of response that may not be readily apparent?	____	____	____
6. Has the repeat data or "clover-leaf" tests been utilized to evaluate the following factors:			
• Repeatability of response amplitude?	____	____	____
• Proper Lag Correction Applied?	____	____	____
• Positional accuracy?	____	____	____

Has there been an equipment or DQO metric failure?

Document any failure:

Document any corrective action (repair/retest)

Has corrective action solved failure?

5.0 SURVEY AREA REPORT FORM

☐ QC checked by _____ Date: _____

☐ QA checked by _____ Date: _____

Project Name: _____

Project Location: _____

Geophysical Contractor: _____

Design Center POC: _____

Project Geophysicist: _____

Site Geophysicist: _____

Prove-out Area ID: _____ **Date:** _____

Field Team: _____

Survey Type: ☐Grid ☐Meandering Path ☐Transect ☐Other _____

Coordinate System: ☐UTM ☐State Plane NAD _____ ☐Local ☐Other _____ **Unit of Measure:** ☐ meters☐ feet

Sketch of Survey Area: **Approx. Scale:** _____ **North Arrow:** _____

Terrain:

☐Level ☐Moderate Slope ☐Steep ☐Rolling ☐Ruts ☐Gullies ☐Rocky ☐Swampy ☐Dangerous

Tree Cover: **Tree Height:** ____☐None ☐Light ☐Medium ☐Thick

Brush: ☐None ☐Light ☐Medium ☐Thick

Weather: ☐Sunny ☐Cloudy ☐Drizzle ☐Rain ☐Thunderstorms ☐Hail ☐Fog ☐Humid ☐Snow

Grid Corner Coordinates: Start End File Name UTM/State Plane Local

Battery Voltage: _____ _____

SW _____, _____ _____, _____ **Static Background Value:** _____ _____ _____, _____

NW _____, _____ _____, _____

Static Response Value: _____ _____ _____, _____

NE _____, _____ _____, _____

SE _____, _____ _____, _____

Instrument Clock Drift: _____

Raw Data File Name: _____

Repeat Data File Name: _____

Geophysical Instrumentation: _____

Serial Number: _____

Sensor Separation (if applicable)**:** _____

Source (rental agency, contractor, etc.)**:** _____

Base Station: _____ **Source:** _____ **Serial Number:** _____

Navigation Method: _____ **Source:** _____ **Serial Number:** _____

Additional Comments:

_____

_____

_____

6.0 CHECKLIST FOR DATA STORAGE AND TRANSFER

Project Name: _____

Project Location: _____

USACE POC: _____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	N/A
a. Has the transfer medium been approved by USACE?	____	____	____
b. Are all files in USACE approved formats?	____	____	____
c. Have all of the following been included in the transfer packet:			
• "Readme" file detailing contents?	____	____	____
• Raw data files?	____	____	____
• Edited data files?	____	____	____
• GPS positioning files (if separate)?	____	____	____
• Completed geophysical maps?	____	____	____
• Prioritized target lists?	____	____	____
• Data File Log / Spreadsheet of Delivered Data Files with Dates Sent?	____	____	____
d. Have the required number of copies, per USACE, been included in the transfer packet?	____	____	____

7.0 CHECKLIST FOR FIELD EDITING

Project Name: _____

Project Location: _____

USACE POC: _____

Reviewer's Name and Title: _____

Date of Review: _____

	Y	N	N/A
1. Have the following items been evaluated for correctness and edited if necessary:			
• Line numbers?	____	____	____
• Start and end points?	____	____	____
• Line direction?	____	____	____
• Fiducial locations?	____	____	____
2. Has the data been examined in profile and evaluated for geophysical noise? Enter background noise value and compare with Test Strip background:_____ vs. _____	____	____	____
3. Has the data been examined for the presence of drop-outs and spikes?	____	____	____
4. Has the presence of metal on the operator been eliminated as a possible source of geophysical noise?	____	____	____
5. Has the edited data been converted to the appropriate .xyz format?	____	____	____
6. If using magnetics, have the following steps been taken:			
• Examined base station data for any problems?	____	____	____
• Performed diurnal correction to field magnetometer data?	____	____	____
7. Has the positional data been evaluated for accuracy and completeness?	____	____	____

8.0 CHECKLIST FOR DATA PROCESSING

			FILENAMES:
Site:	_____	Raw:	_____
Location:	_____	Edited:	_____
Contractor:	_____	Processed:	_____
Sector:	_____	Contour Map:	_____
Grid:	_____	Target List:	_____
Processor(s):	_____	Target Map:	_____

	Y	N	N/A
Preprocessing			
1. Coordinate Conversion			
PROJECTED COORDINATE SYSTEM _____	____	____	____
2. Removal of Drift and Leveling	____	____	____
Record Corrections:			
3. Removal of Heading	____	____	____
Record Corrections:			
4. Lag and Offset	____	____	____
Record Corrections:			
Processing			
5. Initial Gridding	____	____	____
Record Parameters:			
6. Calculation of 3D Analytic Signal	____	____	____
7. Digital Filtering and Enhancement			
❑ Low Pass			
❑ High Pass			
❑ Non Linear	____	____	____
❑ 3x3 Convolution			
❑ Difference			
❑ Other _____			
8. Threshold Selection			
Threshold value _____	____	____	____
9. Anomaly Selection			
Number of targets _____	____	____	____

DGPS AND EM61-MK2 SOP

NMEA GGA and GSA strings are used as inputs to the Geonics EM61-MK2 data logger to position sensor data in DGM operations. For applications in wooded areas or wherever RTK DGPS does not provide sufficient coverage AND the acceptable sensor positioning accuracy is less than normal (e.g. to support reconnaissance operations), Trimble's GeoExplorer 2005 (GeoXH or equivalent) can be configured to output the required NMEA position strings. The ability to tailor the output strings in necessary, because the default output of all NMEA strings clogs up the EM61-MK2 data logger too severely.

1. Attach GeoXH, or equivalent to EM61-MK2 handle,
2. Mount external antenna over EM61-MK2 coil center,
3. Attach the serial clip to get access to the GeoXH, or equivalent, COM1 port;
4. Turn ON the GPS and once it boots, Tap START, SETTINGS, and then the CONNECTIONS tab;
5. Open *GPS CONNECT*;
6. COM2 NMEA (GPS CONNECT) should be routed to COM1 and COM3 & COM4 should be (Available). Note the very bottom message "NMEA output on COM1 at 9600-8-1-N." You're good to go;
    a. If this is not the case, tap Setup;
        i. Set NMEA Output to External – COM1:
        ii. Using the tool wrench next to the NMEA Output:
        iii. Set Port Configuration to Custom (top menu option);
        iv. Set Baud Rate to 9600;
        v. Set Data Bits to 8;
        vi. Set Stop Bits to 1; and
        vii. Set Parity to None;
        viii. Tap OK.
    b. Check that TSIP is set to Internal – COM3; and
    c. Real-Time is set to None;
    d. Tap OK;
    e. The bottom message should read "NMEA output on COM1 at 9600-8-1-N";

NOTE: GPS Connector needs to stay running, so *DO NOT tap OK*, simply tap the Windows Flag, Programs, and open GPS Controller.

7. For Surveys in wooded areas, set the precision slide all the way *left* for maximum productivity;
8. Tap the wrench to open GPS Settings;
    a. GPS Receiver Port should be set to COM3: TSIP Serial Port;
    b. The precision slider should be all the way left;
    c. Max PDOP: should be 20;
    d. Min SNR: should be 33.0 (scroll down);
    e. Min Elevation: should be 5 degrees;
    f. Velocity Filter: should be Auto;
    g. NMEA Output: Should be On;
    h. Tap the wrench next to NMEA Output:
        i. Output Interval: should be 1s;
        ii. Baud Rate: should be 9600;
        iii. Data Bits: should be 8;
        iv. Stop Bits: should be 1;
        v. Parity: should be None;

vi. Only the GGA box needs to be checked. Adding additional NMEA stings will only slow the EM61-MK2 data logger down. Scroll down to verify;
vii. Tap OK.

i. Tap OK.

9. In the upper left hand corner of the frame, open the menu and select “Real-time.” On the next bar down, click on the menu and select “Summary.”

   a. If everything is working correctly you should notice the following categories and their respective status:
      i. Integrated SBAS: In Use;
      ii. System: ;
      iii. Satellite ID: ;
      iv. SNR: _._ dB;
      v. Last correction: .
10. **If under “Summary” the categories above do not appear,** the settings are incorrect. Go back to the upper left hand menu (in GPS Correct) and select “Setup”. Click on “Real-Time Settings” and choose:
    a. Choice 1: Integrated SBAS;
    b. Choice 2: Use uncorrected GPS;
    c. Real Time Age Limit: 4 min.
11. Verify the NMEA GGA output is being accepted by the EM61-MK2 data logger and periodically check DGPS status and number of satellites.
12. Periodically monitor GPS Controller for position accuracy, including number of satellites, PDOP, and Differential status.

Rover DGPS Equipment

1. Rover DGPS receiver with integrated and external antenna box
2. Rover Antenna telescoping range pole – in tripod box
3. Rover charger – in yellow box Rover serial cable – in yellow box (DB9 to DB9)
4. Rover Range Pole Bracket – in yellow box

Support Equipment

1. Battery chargers and data transfer link to PC – in yellow boxes
2. VAC power cable for chargers – in yellow box
3. Serial data transfer cable – in yellow box
4. Laptop PC with Trimble Geomatics Office software

Rover DGPS set up for Reacquisition:

1. Charge rover DGPS
2. Setup Telescoping Range Pole and attach Rover external antenna
3. Attach Rover bracket to range pole and Rover DGPS to bracket
4. Power ON the receiver and start TerraSync
5. Select Stakeout for Reacquisition
6. Select points from list or from map
7. Add all points, if necessary
8. Select anomaly point [e.g. A1-12842]
9. Follow rover guidance to anomaly location.
10. Extend range pole above tree canopy, if necessary
11. When delta values fall below 2m, mark location with flag labeled with the point name. Verify point reacquired with flag label
12. Measure location and accept to mark anomaly as reacquired
13. Select next point … etc.
14. When done, exit TerraSync and power down the rover DGPS
15. Remove DGPS from Range Pole
16. Store Rover
17. Store Range Pole
18. Charge Rover batteries overnight

Rover DGPS Position Reoccupation QC Test:

1. Position rover DGPS antenna over a known location
2. Verify rover position Differential
3. Record Easting (X), and Northing (Y) location
4. Compare measured location to known location
5. If location offset exceeds 2m, combined,
    a. Check satellite planning software

EM61-MK2 Setup:

1. Assemble coil assemblies
2. Attach wheels and handle (or stretcher)
3. Attach rover GPS antenna mount and mount rover GPS
4. connect upper coil to lower coil connector or attach shorting plug for bottom coil only
5. Attach battery to backpack
6. Connect coil cable to backpack
7. Connect data cable to backpack and Data Logger COM1
8. Connect GPS to EM Data Logger COM2
9. Move to an electromagnetically clean area
    a. Set the EM61-MK2 Mode Switch to:
        i. 4 – for logging four (4) bottom coil time gates
    b. Set the Master/Slave Switch to M for single sensor operation
    c. Push In the Circuit Breaker on the EM61-MK2 backpack and warm up for at least 5 minutes.
    d. Turn on Rover GPS
    e. Push the ON/OFF button to turn on the Data Logger
        i. Set Antenna Coil Size (e.g. Standard 1 x .5 m)
        ii. Set Up Logger
            1. Date
            2. Time
            3. Units (e.g. feet)
            4. COM port (e.g. COM1)
            5. Audio
            6. Pause Key: (e.g. Alt F1 or any key)
            7. Display (e.g. Text or Graphic)
        iii. Set GPS Port
            1. GPS Input: (Enabled)
            2. COM Port (COM2)
            3. Baud Rate: (9600)
            4. Parity: (No)
            5. Data Bits: 8
            6. Stop Bits: 1
            7. Can monitor GPS data in terminal mode (F3)
        iv. Set Output Port – Not used unless logging data to external PC
    f. Monitor/Null Coils – After 5 minute warm-up, null EM61-MK2 – all channels should be close to 0 +/- 1
    g. Acquire Data:
        i. Create File (F1 for default name, F3, Enter, F1 for other file name)
        ii. Survey Setup
            1. Mode: Auto
            2. Wheel Inc: N/A
            3. Reading/s: 10.00 or 16
            4. Surv Line: (e.g. 0)
            5. Line Incr: (e.g. 1 for instrument checks or 2.5 for survey)
            6. Sequence: (e.g. Alternate)
            7. Direction: (e.g. North
            8. Start Stn: (e.g. 0)
            9. Stn Incr: (e.g. Positive)
        iii. LOG DATA
            1. Wait for data display (0 to 100% internal calibration)
            2. Observe time gate values

3. Observe DGPS input (observe toggle bar and correction status for letter D, letter A is unusable GPS)
4. Enter to log data– System is ready to log data. Move to start of survey line.

h. When coil is centered over start point, press ENTER again. Display will show "logging" on the top display line. Observe coil readings. Observe Station Number (STN). Note any unusual recordings on Field Survey Sheet.

i. Walk along survey line slowly (about 2 to 3.5 miles per hour). Periodically observe Data Logger display. Note any unusual recordings, any deviations from the survey line, or any observed metal objects. Escort should log these observations and marks the outer coil edge with marking paint or plastic pin flags to insure sensor overlap on a return transect.

(If fiducial marks are available, press thumb button when coil is centered over mark for 1 second)

j. Press Pause Key (e.g. Any Key) when coil is centered over the line end to stop logging EM61-MK2 data.

(If in the Auto mode, simply continue to next line and keep moving until survey session is complete or manually set new lines with the F1 key)

k. When survey is complete, press F5 then the letter Y to exit logging. Enter a new file name to continue surveying, or return to main menu to transfer data.

l. Data Transfer using a cable:
   i. Turn OFF the Data Logger by holding the ON/OFF key
   ii. Disconnect Data Logger from EM61-MK2 backpack.
   iii. Change EM61-MK2 Backpack battery, if required
   iv. Connect Data Logger to Field Lap Top PC
   v. Power PC
   vi. Run DAT61MK2
   vii. Select "Data Transfer"
   viii. Verify serial port settings (COM1, Baud Rate: Auto)
   ix. Run the Data Logger program File Manager
      1. Upload Files.
   x. Select "List Files" and select the file names. (Check the Field Survey Form).
   xi. Select "Download" and observe PC and Data Logger to monitor data transfer status. Log any transfer problems on Field Survey Sheet.
   xii. Data Transfer using Memory Card:
      1. Exit DAT61 program to DOS c: prompt
      2. Use up arrow to find (or type) copy *.r61 d:
      3. Hit enter (files get copied from c: to Memory Card)
      4. Turn data logger OFF and eject Memory Card
      5. Insert Memory Card into PC and copy files to appropriate folder
      6. In DAT61 for Windows, convert all files from raw to ASCII (from *.r61 to *.m61)

m. Combine EM and GPS data in EM61MK2 using the "GPS Positioning" tool (or position with line and marker data).
   i. Select input file name
   ii. Enter output file name and location, enter file name on Survey Sheet.
   iii. Select the channels to position (e.g. STD D or STD 4 (all 4 bottom coil time gates))
   iv. Set the GPS Time Gap (e.g. 3 seconds)
   v. Select file format (e.g. Geosoft)
   vi. Set the GPS System (e.g. Geodetic or UTM)
   vii. Set Units to meters
   viii. Set GPS corrections to Raw GPS or Differential RTK

ix. Click “Apply” to export GPS integrated ASCII data file

n. From the File tool, select “Open XYZ File” and select the one just created. Display should show the survey tracks.

o. Data is ready for Processing and Analysis.

10. Data Management in Data Logger

a. Once data transfer is complete and data has been positioned, exported (*.xyz file), and processed successfully, clear the data logger memory

i. From the Main Menu, select “File Manager”

ii. Select “Delete File”

1. Scroll to select a file to be deleted
2. Hit F1 key to delete
3. Hit the “Y” key to confirm delete

File should have been removed from list

Daily EM61 Static Check

1. Setup as above
2. In a quiet area, log static EM61 background data for 1 minute (observe meter readings near 0, +/- 2-3 mV)
3. Press Enter to Pause and increment line (F1)
4. Place a “know object (e.g. a Standard Static Test Bar with steel bolt)” on the coil and log data (Enter) for 1 minute (observe meter readings #> 0, +/- 2-3 mV)
5. Press Enter to Pause, remove target, and increment line (F1)
6. Log static background data (Enter) for 1 more minute (observe meter readings near 0 +/- 2-3 mV)
7. Press Enter to Pause, and increment line
8. Log static data for 30 seconds while all system cables are shaken (observe meter readings near 0 +/- 2-3 mV – no jumps or spikes),
9. Press Enter to Pause, and increment line
10. Log static data for 30 seconds while operator kicks towards coil, twists left/right, and bends up/down (observe meter readings near 0 +/- 2-3 mV).
11. QC checks:
    a. Look for near zero readings during lines 0, 2, 3, and 4 – re-null coil or replace battery as necessary
    b. Check for consistent target readings +/-20% on line 1 from previous readings. Replace battery as necessary

Daily Latency Check

1. Setup as above
2. Find a quiet area at least 50 feet long
3. Place a known object in the center of this line (e.g. 2” Tow Ball)
4. Acquire line 0 from start (0,0) to end (0,50) directly over the object (0,25)
5. Increment the line number and acquire line 1 from end (0,50) to start (0,0) directly over the object (0,25)
6. Use this data to help determine data processing latency parameter needed to get the peak to line up in both directions.

EM Reacquisition

1. Setup as above
2. Position coil (push and pull) over flagged location in several directions while monitoring the display (e.g. SUM Channel).
3. Try to match or exceed the reported mV value on the Dig Sheet within 5 to 7m of each flag along cleared and marked transect
4. Move the flag to coil center over refined peak location
5. Log reacquired mV peak on Dig Sheet. If necessary, log refined location offset distance and direction on Dig List
6. Move to next flag

PC – Pathfinder Office, or equivalent

1. New Project
2. Enter new project name (e.g. Luis Pena)
3. Make sure Template: is using project coordinate system and units
4. Set Coordinate System correctly (e.g. US State Plane 1983, Colorado Central 0502, NAD 1983, Geoid (none) … click Finish … click Apply … click OK
5. Import points, select Custom [format] … select Name, East, North, Elevation … OK
6. Find *.csv file to load (e.g. My Documents/DRI/DRI_Sector_D.csv). Points should load and be displayed. Verify!

GPS Data Transfer from PC to Rover DGPS

1. Run Trimble Pathfinder Office, or equivalent, software on PC
2. Open Project and verify project coordinate system and units (e.g. Luis Pena, UTM, 19N, meters)
3. Import or verify target waypoints are shown
4. Connect Rover DGPS to PC (USB or Serial) a power ON Rover (machines should connect thru ActiveSync)
5. Export target waypoints to rover DGPS
6. Verify on rover DGPS:
7. Select the job
8. Select Review current job and verify points and point order. You can also map the points for the job

1. Charge all GPS and EM61-MK2 batteries overnight.

9.0 WEEKLY DGM QC REPORT:

Project Name: _____

Report Week: _____

9.1 INSTRUMENT LATENCY TEST

Metric is no zig-zag or chevron effects visible.

Describe latency correction performed _____

Document critical latency correction parameter(s) _____

Attach a representative data image map for each survey day documenting proper latency correction.

9.2 INSTRUMENT NOISE

Metric based on approved GPO results (e.g. < +/- 1.3 mV on time gate 1).

Report the weekly summary of all static background noise levels from each static test.

Report the dynamic noise levels for each survey file.

9.3 INSTRUMENT RESPONSE TEST RESULTS

Metric +/- 20 % from day to day.

Report the weekly summary of all static instrument response tests.

9.4 MAGNETOMETER HEADING CORRECTION

If used, magnetometer data will be corrected for heading errors such that there is no visible heading affects in the data displayed at the amplitude range used for detection and analysis.

Describe magnetometer heading correction performed _____

Document specific heading correction values _____

Attach a representative data image map for each survey day documenting proper heading correction.

9.5 DATA LEVELING AND/OR FILTERING

Metric is leveling and/or filtering utilities do not adversely alter the nature of the original measured response by more than 5%.

Describe data leveling and/or filtering used _____

Document critical leveling and/or filtering parameters used _____

Attach example of data profile before and after leveling and/or filtering

9.6 REOCCUPATION ACCURACY

Metric is not to exceed +/- 2m from a known location.

Describe the reoccupation point _____

Record the known location X = _____, Y = _____

Summarize the location offsets from each reoccupation test.

9.7 DATA SAMPLING DENSITY

Metric is along-track density will not exceed 0.5 feet.

Use Oasis QC tools to assess data sampling density.

Check if all data sets pass metric _____.

Attach QC maps to document any failures.

9.8 ACROSS-TRACK LINE SPACING FOR GRIDS

Metric is 90% of line spacing will not exceed 2.5 feet.

Use Oasis QC tools to assess the across-track line spacing for each grid survey.

Check if all data sets pass metric _____.

Attach QC maps to document any failures.

9.9 DYNAMIC REPEATABILITY

Dynamic DGM detection metric for grids is: Test item characteristics (peak response and size) repeatable with allowable variation of +/-25%.

Dynamic DGM detection metric for transects is: Test item in test strip anomaly characteristics (peak response and size) repeatable with allowable variation +/-25%.

Dynamic DGM positioning metric for grids is: Position offset of test item target <=35cm + ½ line spacing (e.g. <=2.4 ft for 2.5 ft line spacing) or <=50cm + ½ line spacing (e.g. <=2.9 ft for 2.5 ft line spacing) for fiducially positioned data.

Dynamic DGM positioning metric for transects is: Test item position offset <=2m.

Dynamic Analog detection repeatability metric is: Repeat a segment transect and show extra flags not greater than the greater of 20% or 8 flags, or within range of adjacent segment.

9.10 REACQUISITION ACCURACY

Metric is not to exceed 2 meters from to refined location.

Document all refined location offsets on dig list

Include updated dig list with this report

9.11 REFINED LOCATION ACCURACY

Metric is not to exceed 30 cm from refined location.

Document all discovered location offsets from refined location on Dig List

Include updated dig list with this report.

9.12 DGM FALSE NEGATIVES

Metric is no false negatives.

Document all false negative discoveries

Provide failure ID and photograph (attached to this report)

Provide failure location X = _____, Y = _____

Document corrective action taken _____

9.13 INTRUSIVE ANOMALY RESOLUTION

Metric is for all intrusive results resolved with DGM data.

UXOQCS and Project Geophysicist will initial all dig results

Each discrepancy and final resolution will be documented

Final weekly dig list is attached to this report

Site Geophysicist Signature and Date _____

UXOSO/UXOQCS Signature and Date _____

OPS 13- MPPEH MANAGEMENT

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide procedures that ensure that interior and exterior of all recovered MPPEH is inspected to determine what explosive hazard, if any exist, requiring further treatment before shipping off site for final treatment. These procedures are general in nature and may be refined with the concurrence of the Senior UXO Supervisor (SUXOS) to adapt to specific site conditions and circumstances.

2.0 SCOPE

These procedures will be conducted in accordance with the Work Plan, the Site Health and Safety Plan (SHSP) and the Explosives Safety Submission (ESS). This SOP provides the MPPEH management process that describes the inspection, storage, certification/verification procedures, and the chain of custody requirements for materials documented as safe (MDAS) slated for shipment to an authorized recycler. Specific requirements for personnel, training, equipment/material, surface search, and documentation are found in the Work Plan (WP).

3.0 INSPECTION PROCESS

All recovered MPPEH items will undergo a 100% inspection and an independent 100% re-inspection to determine and document whether it is safe (MDAS) or whether it is known to have or is suspected of having an explosive hazard [material documented as an explosive hazard (MDEH)]. The sequence of events in the inspection process is summarized in Figure 1. A Material Inspection and Release Form (Attachment 2) will be completed to document the two 100% inspections performed on all recovered materials.

A UXOTII (a UXOTI can tentatively identify items, however, a UXOTII or UXOTIII must confirm the identification) will perform a 100% inspection of each item as it is recovered and determine:

- If the item is MDAS, requiring no additional treatment prior to containerizing for off-site shipment
- If the item is MDEH that requires additional treatment (demilitarization, i.e. detonation or venting to expose a dangerous filler)
- If item is range related debris that may require draining fluids or removal of visible liquid hazardous, toxic or radiological waste (HTRW) materials.

A UXOTIII will:

- Conduct a 100% re-inspection of all recovered items to determine the proper classification as MDAS, MDEH or an item containing other dangerous fillers or HTRW constituents.
- Supervise the segregation of items by category to ensure no co-mingling of MDAS and MDEH or HTRW items.

The UXOQCS will:

- Conduct daily audits of UXO Teams performing the MPPEH inspection process and will conduct and document random sampling of all processed MDAS, MDEH and HTRW items to ensure no co-mingling occurs.

The UXOSO will:

- Ensure specific procedures and responsibilities for processing MPPEH for certification as MDAS MDEH or range-related debris outlined in the WP and this SOP are being followed
- Ensure all procedures for processing are being performed safely and consistent with applicable regulations.

The SUXOS will:

- Perform random checks to determine that the munitions debris and range-related debris are free from explosive hazards necessary to complete the appropriate Requisition and Turn-in Document, DD Form 1348-1A (see Attachment 1)
- Ensure that a DD Form 1348-1A is completed for all MDAS and range-related debris to be transferred for final disposition
- Ensure the WP, QC Plan and this SOP outline the procedures and responsibilities for processing MPPEH for final disposition as MDAS or range-related debris
- Certify all MDAS and range-related debris with one of the following statements as applicable –

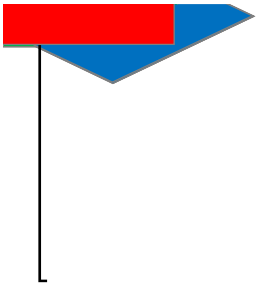
  > "This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluid, illuminating dials and other visible liquid HTRW materials."[1]
  >
  > "This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials."[2]

- Ensure that inspected debris is secured in sealed and labeled containers.

This space is intentionally left blank.

[1] This statement will be used on any ranges where range-related debris is being processed along with munitions debris

[2] This statement will be used for properties where only munitions debris is being processed



4.0 MDAS CONTAINERIZATION

MDAS is placed in closed containers that will be sequentially number and:

- Closed in such a manner that the applied seal will be broken if the container is opened
- Clearly labeled with USA Environmental, Inc., the installation/project name, the sequence number (e.g. 0001), and the container's unique seal identification, see Attachment 3 for detailed requirements for completing the label

5.0 MDAS CERTIFICATION AND VERIFICATION

The SUXOS will certify the MDAS by preparing and signing the DD Form 1348-1A for all shipments of recovered materials as discussed in Section 3 above. The designated government representative will verify the shipments if available, otherwise the shipment verification is delegated to the UXOQCS.

The 1348-1A will contain the appropriate statement as mentioned in Section 3 and prepared to provide the required information as shown in Attachment 1.

6.0 MAINTAINING THE CHAIN OF CUSTODY

The chain of custody must remain intact until the MDAS is released from DOD control that is received and signed for by the qualified receiver to further manage and process the material in accordance with DOD Instruction 4140.62. The qualified receiver will:

- Receive the unopened labeled containers
- Review and concur with the supporting documents
- Sign the 1348-1A and provide on company letterhead stating the contents of the sealed containers will not be sold, traded or otherwise given to another party prior to smelting and are only identifiable by their basic contents
- Send the supporting documentation and notification to USA that the MDAS in the sealed containers has been smelted and is only identifiable by its basic content.

If the chain of custody is broken at any time during shipment, the contents of the affected container will revert to MPPEH and will require a second 100% inspection and a 100% re-inspection, be documented as certified and verified as MDAS by qualified USA personnel.

ATTACHMENT 1.
DD FORM 1348-1A EXAMPLES

DD FORM 1348-1A, JUL 91 (EG) ISSUE RELEASE/RECEIPT DOCUMENT

1 2 3 4 5 6 7 23 24 25 26 27 28 29 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

DOCUMENT | RI FROM | M&S | UNIT | QUANTITY | SER | SUPPLEMENTARY ADDRESS | SIG | FUND | DISTRIBUTION | PROJECT | PRI | REQD | DEAD DATE | ADV | RI | O/P | COND | MGT

1. TOTAL PRICE | UNIT PRICE | DOLLARS | CTS | DOLLARS | CTS

2. SHIP FROM | 3. SHIP TO | 4. MARK FOR

5. DOC DATE | 6. NMFC | 7. FRT RATE | 8. TYPE CARGO | 9. PS

10. QTY. REC'D | 11. UP | 12. UNIT WEIGHT | 13. UNIT CUBE | 14. UFC | 15. SL

16. FREIGHT CLASSIFICATION NOMENCLATURE

17. ITEM NOMENCLATURE

18. TY CONT | 19. NO CONT | 20. TOTAL WEIGHT | 21. TOTAL CUBE

22. RECEIVED BY | 23. DATE RECEIVED

24. DOCUMENT NUMBER & SUFFIX (30-44)

Basic Material Content: _____

Estimate Weight (lbs): _____

Container ID No.: _____ Seal ID No.: _____

25. NATIONAL STOCK NO. & ADD (8-22)

Site Address: _____

_____

Site Telephone No.: _____

26. RIC (4-6) UI (23-24) QTY (25-29) CON CODE (71) DIST (55-56) UP (74-80)

This certifies and verifies that the material listed has been100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials.

27. ADDITIONAL DATA

Certify By:

_____ Date: _____
Senior UXO Supervisor / Team Leader

Verify By:

_____ Date: _____
USACE OE Safety Specialist

USA Environmental, Inc., 720 Brooker Creek Boulevard, Suite 204, Oldsmar, Florida 34677, Telephone: 813.343.6336, Fax: 813.343.637

PREVIOUS EDITION MAY BE USED

PerFORM (DLA)

Reset

DD Form 1348-1A: FOR USE FOR PROPERTIES WHERE ONLY MUNITIONS DEBRIS IS BEING PROCESSED

DD FORM 1348-1A, JUL 91 (EG) ISSUE RELEASE/RECEIPT DOCUMENT

1 2 3 4 5 6 7 23 24 25 26 27 28 29 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

DOCUMENT | RI FROM | M&S | UNIT | QUANTITY | SER | SUPPLEMENTARY ADDRESS | SIG | FUND | DISTRIBUTION | PROJECT | PRI | REQD | DDATE | ADV | RI | O/P | COND | MGT

1. TOTAL PRICE | 2. SHIP FROM | 3. SHIP TO

UNIT PRICE: DOLLARS | CTS | DOLLARS | CTS

4. MARK FOR

5. DOC DATE | 6. NMFC | 7. FRT RATE | 8. TYPE CARGO | 9. PS

10. QTY. REC'D | 11.UP | 12. UNIT WEIGHT | 13. UNIT CUBE | 14. UFC | 15. SL

16. FREIGHT CLASSIFICATION NOMENCLATURE

17. ITEM NOMENCLATURE

18. TY CONT | 19. NO CONT | 20. TOTAL WEIGHT | 21. TOTAL CUBE

22. RECEIVED BY | 23. DATE RECEIVED

24. DOCUMENT NUMBER & SUFFIX (30-44)

25. NATIONAL STOCK NO. & ADD (8-22)

26. RIC (4-6) UI (23-24) QTY (25-29) CON CODE (71) DIST (55-58) UP (74-80)

27. ADDITIONAL DATA

Basic Material Content: _____

Estimate Weight (lbs): _____

Container ID No.: _____ Seal ID No.: _____

Site Address: _____

_____

Site Telephone No.: _____

This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluids, illuminating dials and other visible liquid HTWR materials.

Certify By: Verify By:

_____ Date: _____ _____ Date: _____

Senior UXO Supervisor / Team Leader USACE OE Safety Specialist

USA Environmental, Inc., 720 Brooker Creek Boulevard, Suite 204, Oldsmar, Florida 34677, Telephone: 813.343.6336, Fax: 813.343.637

PREVIOUS EDITION MAY BE USED

PerFORM (DLA)

Reset

DD Form 1348-1A: FOR USE WHERE RANGE-RELATED DEBRIS IS PROCESSED WITH MUNITIONS DEBRIS

ATTACHMENT 2.
MATERIAL INSPECTION AND RELEASE FORM

USA 100% MATERIAL INSPECTION AND RELEASE FORM

Project:							Document Date:
Location:							Document Number:
Container Number:	Seal #:	Initials 1st:	Initials 2nd:	Reseal #:	Initials 1st:	Initials 2nd:	Comments:

The above listed containers have received two separate 100% inspections to ensure proper classification of material.
A copy of this form is to accompany the listed containers to final disposition and be retained for a period of 3 years.
This form is used to document the inspections performed by two UXO qualified personnel, one of whom must be a Technician III or higher.
This form is not to be used in place of other required documents for the transportation and/or accountibilty of material.

Name of First 100% Inspector:	Title:	Date:
Name of Second 100% Re-Inspector:	Title:	Date:

ATTACHMENT 3.
NON-HAZARDOUS WASTE (CONTAINER LABEL)

NON-HAZARDOUS WASTE

Solid Waste Excluded From Regulation Under 40 CFR 261.4 (b)

SHIPPER: USA Environmental, Inc.

PROJECT ADDRESS / LOCATION:

CITY, STATE, ZIP:

PROJECT CONTACT AND TELEPHONE NUMBER:

USACE IDENTIFIER / INSTALLATION NAME OR CONTRACT #:

UNIQUE CONTAINER # (i.e., 0001 of 0001): of

UNIQUE SEAL IDENTIFICATION #:

Date:	Seal Number:	1st Initials:	2nd Initials:	Comments:

☐ **DD Form 1348-1A** ☐ **100% Material Inspection and Release Form**

NOTE: See DD Form 1348-1A For Additional Information.
Check box(s) if DD Form 1348-1A and/or the 100% Inspection Form will accompany this shipment.

CONTACT INFORMATION: **USA Environmental, Inc.**
720 Brooker Creek Blvd., Suite 204
Oldsmar, FL. 34677
(813) 343-6336

CONTAINER LABEL

STANDARD OPERATING PROCEDURE – OPS-14
MEC ANALOG DETECTION AND REMOVAL ACTIONS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide all USA Environmental, Inc. (USAE) employees and subcontractors with the minimum procedures and safety and health requirements applicable to the conduct of analog detection and removal actions (mag and dig) at sites potentially containing unexploded ordnance (UXO) and/or munitions and explosives of concern (MEC).

2.0 SCOPE

This SOP applies to all USAE site personnel, including contractor and subcontractor personnel, involved in the conduct of analog detection and removal actions (mag and dig) on a UXO/MEC contaminated site. The following USAE policies and procedures are not all inclusive nor are they applicable in all situations. This SOP is not a stand-alone document and is to be used together with Work Plans, other USAE SOPs, the USAE Site Safety and Health Plan (SSHP), applicable Federal, State, and local regulations, and contract restrictions and guidance. Consult the documents listed in Section 7.0 of this SOP for additional compliance issues.

3.0 RESPONSIBILITIES

3.1 PROJECT MANAGER

The Project Manager is responsible for ensuring availability of resources to safely and effectively implement this SOP.

3.2 SITE MANAGER

The Site Manager is responsible for incorporating this SOP in plans, procedures, and training. In addition, he is responsible for oversight and supervision of field personnel, and ensuring compliance with this SOP.

3.3 UXO SAFETY OFFICER

The UXO Safety Officer (UXOSO) ensures that all mag and dig activities are conducted in a safe manner, in accordance with the approved Work Plan, the SSHP, this SOP, and all applicable regulatory guidance. The UXOSO's duties shall include, but are not limited to: analyzing UXO explosives operational risk, hazards, and safety requirements; establishing and ensuring compliance with all site-specific safety requirements for UXO and explosives operations; enforcing personnel limits and safety exclusion zones (EZ) for UXO clearance operations; and all activities associated with UXO and explosives transportation, storage, and destruction.

3.4 UXO QUALITY CONTROL SPECIALIST

The UXO Quality Control Specialist (UXOQCS) ensures compliance with the project Quality Control (QC) Plan and performs analog QC checks of completed grids in accordance with the Work Plan.

4.0 OPERATIONS

4.1 ANALOG DETECTION AND REMOVAL ACTIONS

All analog detection and removal (mag and dig) activities at MEC sites will be under the supervision of UXO qualified personnel. Non-UXO qualified personnel will not be allowed in the EZ during intrusive operations. If access is required by non-UXO qualified personnel, all work will stop while they are in the EZ. During operations, USAE personnel will strictly adhere to the SSHP and the following general safety practices:

- Operations will be conducted during daylight hours only.
- Access to operating areas will be limited to only those personnel necessary to accomplish the specific operation.
- UXO will only be handled by qualified UXO Technicians.
- During UXO operations the minimum separation distance (MSD) between UXO and non-UXO operations is fragmentation distance of the munition with the greatest fragmentation distance (MGFD), as stated in the Work Plan.
- During demolition operations personnel remaining on site will be limited to those personnel needed to safely and efficiently prepare the item/s for destruction.).
- All personnel will attend the daily safety briefing (tailgate safety briefing) prior to entering the operating area.
- Anyone can stop operations for an unsafe act or situation.
- Safety violations and/or unsafe acts will be immediately reported to the UXOSO.
- Failure to comply with safety rules/procedures may result in termination of employment.

4.2 GRID LAYOUT

A registered land surveyor will survey each of the clearance areas, accompanied by a UXO escort. Surveying activities will consist of locating clearance area boundaries, establishing permanent survey monuments, and establishing grids for geophysical investigation activities within the clearance areas.

Depending on the method selected and approved by the customer, the site layout and search grids will be established using a Global Positioning System (GPS), licensed surveyor, or compass and measuring tape. Survey crews will be escorted in the field by a UXO Technician II or above who will provide UXO avoidance including checking the intended survey stake locations with a magnetometer prior to driving stakes into the ground. This will prevent driving stakes into buried MEC.

4.3 ANALOG SWEEP PROCEDURES

Intrusive investigation team(s) will consist of a Team Leader (UXO Technician III) and UXO Technicians II/I. During intrusive operations UXO Technicians I will operate under the supervision of UXO Technicians II or III. UXO operations will only be performed by qualified UXO Technicians, which are defined as:

- MEC identification
- Access procedures such as excavation, either by hand or using heavy equipment
- Handling of MEC/UXO, explosives, or explosive items
- Disposal, including movement, transportation, and final disposal of MEC

Analog detector sweeps (i.e., mag and dig) are particularly effective in areas where vegetation and terrain limit the use of larger digital systems. Also, mag and dig approaches should be used when there is insufficient difference between UXO at the site and other metallic fragments and debris, such that digital discrimination is ineffective or cost prohibitive.

Initially, individual search lanes will be established approximately 5 feet (ft) wide. Each lane will be surveyed using a Schonstedt GA-52CX and/or White's XLT magnetometer. The operation will begin at one end of each lane and move in a forward direction toward the opposing baseline. During the forward movement the technician moves the magnetometer back and forth from one side of the lane to the other. Both forward movement and the swing of the magnetometer are performed at a pace that ensures the entire lane is searched and that the instrument is able to appropriately respond to subsurface anomalies. When a subsurface anomaly or metallic surface object is encountered, the UXO Technician halts and investigates the anomaly at that time. Throughout this operation the team leader closely monitors the team's individual performance to ensure these procedures are being performed correctly.

4.4 SURFACE UXO

Upon encountering a surface MEC it will be identified by two UXO Technicians and marked in accordance with the approved Work Plan for future disposition. If detonation cannot be arranged the same day as the MEC is identified, a guard will be posted during the non-working hours to ensure the item is not disturbed.

4.5 SUBSURFACE ANOMALIES

4.5.1 MANUAL EXCAVATIONS

Subsurface anomalies will be investigated by UXO-qualified personnel as they are identified during the sweep. All identified anomalies within the grid will be intrusively investigated. Excavations for individual anomalies will be conducted using the Schonstedt GA-52CX and/or White's XLT magnetometers to assist the team in determining the location and orientation of the target item. The UXO Technicians excavating anomalies shall initially remove no more than a 6-inch layer of soil along side the location of the anomaly, being careful not to impact the anomalous feature. The UXO Technician will conduct a visual and electronic search of the excavation to further pin point the anomaly source as needed. This process shall be repeated until the audible signal from the magnetometer indicates the object is close to the surface. Once this determination has been made, soil will be removed by hand until the source of the anomaly is located. Excavations on individual anomalies greater than 4 ft below the ground surface (bgs) will not be made without prior approval of the U.S. Army Corps of Engineers (USACE) OE Safety Specialist.

4.5.2 MECHANICAL HANDLING EQUIPMENT

Mechanical Handling Equipment (MHE) may be used to excavate large anomalies (e.g., pits) or those deeper than 4 ft bgs if required (e.g., to confirm the anomaly is not a MEC). Any decision to use MHE to excavate these anomalies will be made by the SUXOS and the USACE OE Safety Specialist (see SOP OPS-06, Excavation and Trenching for detailed MHE procedures). The excavation will proceed slowly to ensure the item is not broached by the MHE. If the excavated material is considered to be a MEC, it shall be uncovered sufficiently by hand to obtain a positive identification of the item. If the item is identified as UXO/MEC, a determination will subsequently be made as to whether it is fuzed or not.

While excavating with MHE, a UXO Technician will be stationed in a position that is out of the reach of the excavation equipment but affords a view of the excavation site. This observer will ensure that the next lift is visually free of UXO. The excavated material will be placed onto the ground within a screening area that has been surface swept and the boundaries recorded. The soil spoils will be spread across the screening area using the excavator bucket. The excavated material will be screened for range related debris, munitions debris, and UXO/MEC items. UXO technicians will recover all pieces of munitions debris or range related debris and any ordnance items. After screening, the soil spoils will be stockpiled to the side of the screening area.

5.0 RECORD KEEPING

The team leader will maintain a field logbook, which at a minimum will contain a record of the following:

- Weather
- Instrument details and serial number
- Team Personnel
- Grids worked
- Start and stop times
- MEC/UXO items encountered

The data to be recorded for each item discovered during anomaly excavation will include the following (as applicable):

- Type (e.g., MD, MPPEH, UXO, and non-MEC Scrap)
- Description (e.g., “projo, 20-mm, practice, MK105” and “base, coupling, firing device”)
- Initial Condition (e.g., expended, inert, live, and to be determined [TBD])
- Approximate length
- Approximate width
- Depth
- Approximate weight
- Found in a pit?
- Piece of frag?
- Initial disposition (e.g., left in place and removed to scrap pile)
- Requires demolition?

All data will be turned into the Site Geophysicist at the end of the day.

6.0 DISPOSAL OPERATIONS

Fuzed UXO/MEC items will be blown in place (BIP), and un-fuzed UXO/MEC items will be consolidated whenever possible in accordance with USACE Engineer Pamphlet 1110-1-17, Establishing a Temporary Open Burn and Open Detonation Site for Conventional Ordnance and Explosives Projects, dated 16 July 1999, Appendix D. In no case shall the SUXOS authorize or undertake destruction of UXO/MEC when there is sufficient reason to believe that the disposal action will result in personnel casualties or property damage. The USACE OE Safety Specialist will be consulted for guidance in the event that there is sufficient reason to believe that the disposal action will result in personnel casualties or property damage.

7.0 REFERENCES

- USACE Safety Considerations for UXO

- USAE Corporate Safety and Health Program (CSHP)
- OSHA, 29 CFR 1910, Occupational Safety and Health Standards
- OSHA, 29 CFR 1926, Construction Standards
- Applicable sections of EPA, 40 CFR Parts 260 to 299, Protection of Environment
- Applicable sections of DOT, 49 CFR Parts 100 to 199, Transportation
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous Waste Remedial Actions
- DOD 4145.26-M, Contractors' Safety Manual for Ammunition and Explosives
- DOD 6055.9-STD, DOD Ammunition and Explosives Safety Standards
- DOD 4160.21-M, Defense Reutilization and Marketing Manual
- DA PAM 385-64, Ammunition and Explosives Safety Standards
- AR 385-64, Ammunition and Explosives Safety Standards
- AR 200-1, Environmental Protection and Enhancement
- AR 385-10, The Army Safety Program
- AR 385-16, System Safety Engineering and Management
- AR 385-40 w/USACE supplement, Accident Reporting and Records
- TM 9-1300-200, Ammunition General
- TM 9-1300-214, Military Explosives
- TM 60 Series Publications

STANDARD OPERATING PROCEDURE
EM61-MK2 SET UP AND USE FOR REACQUIRE AND POST INTRUSIVE CHECKS

1.0 Equipment

- 1.1 EM61 Coil Assembly
- 1.2 EM61 Wheel Assemblies
- 1.3 EM61-MK2 Handle Assembly
- 1.4 GPS Tripod (if needed)
- 1.5 Custom Lower Coil GPS Tripod Mounts (if needed)
- 1.6 EM61-MK2 Back Pack
- 1.7 EM61-MK2 Cables
  - 1.7.1 Lower coil to Upper coil cable And Shorting Plug
  - 1.7.2 Lower coil to Back Pack cable
  - 1.7.3 Back Pack to Data Logger cable
  - 1.7.4 Data Logger to PC cable and PCMCIA Memory Card
  - 1.7.5 Battery Chargers & cables
    - 1.7.5.1 Back Pack Battery Charger & cable
    - 1.7.5.2 Data Logger Battery Charger & cable
    - 1.7.5.3 Power Inverter to charge from vehicle
- 1.8 EM61-MK2 Static Check Bar with Spike Target
- 1.9 EM61-MK2 Operating Manuals
  - 1.9.1 EM61-MK2 Operating Manual
  - 1.9.2 DAT61MK2 Computer Program Manual
  - 1.9.3 EM61-MK2 Software
    - 1.9.3.1 Data Logger Software
      - 1.9.3.1.1 EM61MK2A V1.37
    - 1.9.3.2 PC Software
      - 1.9.3.2.1 DAT61MK2 for Windows V1.35
      - 1.9.3.2.2 Backup Data Logger software
- 1.10 Tape Measures & Line Markers (line, flags, spray paint, or cones)
- 1.11 Log Book or PDA

2.0 Charge all batteries

- 2.1 EM61-MK2 Back Pack Batteries – up to 14 hours for fully discharged battery
- 2.2 EM61-MK2 Data Logger Batteries – up to 14 hours for fully discharged battery
- 2.3 PDA Batteries

3.0 Set Up EM61-MK2

- 3.1 Assemble coil, wheel, and handle assemblies
- 3.2 Connect wheel encoder cable to lower coil – tape it in place with electrical tape (do not use duct tape)
- 3.3 Connect lower to upper coil or install shorting plug to bottom coil (usually use bottom coil only with shorting plug)
- 3.4 Connect lower coil to backpack
- 3.5 Set a freshly charged battery into the backpack
- 3.6 Connect backpack to Data Logger COM1 port
- 3.7 Adjust backpack shoulder and waist straps for good fit
- 3.8 Tape cables to handle, leaving enough slack for turning

4.0 EM61-MK2 Operation

4.1 Set the EM61-MK2 Mode Switch to:
- 4.1.1 4 – for logging four (4) bottom coil time gates
- 4.1.2 D – for logging three (3) bottom coil time gates and one (1) top coil time gate – typically not used

4.2 Set the Master/Slave Switch to M for single sensor operation

4.3 Push In the Circuit Breaker on the EM61-MK2 backpack and warm up for at least 5 minutes – backpack sensor noise should start and LED should be on.

4.4 Push the ON/OFF button to turn on the Data Logger
- 4.4.1 Set Antenna Coil Size (e.g. Standard 1 x .5 m)
- 4.4.2 Set Up Logger
  - 4.4.2.1 Date
  - 4.4.2.2 Time
  - 4.4.2.3 Units (e.g. feet)
  - 4.4.2.4 COM port (e.g. COM1)
  - 4.4.2.5 Audio
  - 4.4.2.6 Pause Key: (e.g. Alt F1 or any key)
  - 4.4.2.7 Display (e.g. Text or Graphic)

4.5 Monitor/Null Coil – After 5 minute warm-up, null EM61-MK2 – all channels should be close to 0 +/- 1

4.6 Static Check:
- 4.6.1 Look for a “quiet area” where the EM61-MK2 data doesn’t change more than 3mV on channel 1
- 4.6.2 Null coil = all channels should be 0 +/-1mV
- 4.6.3 Observe all 4 channels for about 1 minute. Values should not change by more than +/- 2.5 mV
- 4.6.4 Place Static Check Bar with Spike Target (screw or bolt) on coil. Mark location so you can put it in the same place, same orientation each morning. Write the spike responses for all 4 channels in the log book and observe that they stay constant for about 1 minute.
- 4.6.5 Remove static check bar and observe that all 4 channels return to 0 +/- 2.5mV for about 1 minute.
- 4.6.6 Sensor is ready for reacq. Note that you may need to null the coil periodically. Write spike response values for all 4 channels on the static check bar to compare to next day’s check. Daily responses for each channel should not vary by more than +/- 20%. If they do, check the location and orientation of the Static Check Bar.

4.7 If refining, move to first marked flag and push/pull the EM61-MK2 over the flag in at least 2 different directions while observing the displayed values. Center the coil over the peak response and log peak response and any location offset (e.g. 6” NE) in logbook or PDA. Move flag to center of coil for intrusive team. Continue to next flag.

4.8 To check intrusive holes or spoils piles, push/pull the EM61-MK2 over the hole or spoils pile in at least 2 different directions while observing the displayed values. Insure that the EM61-MK2 values confirm that the project background value (e.g. <2.5mV on the EM61-MK2 channel, or channels, used to select anomalies) is not exceeded. Log peak response in logbook or PDA. Holes or spoils piles with signatures above the project background requirements will need to be reinvestigated.

5.0 EM61-MK2 Training/Certification

5.1 All personnel using the EM61-MK2 for confirming anomaly resolution will demonstrate that they can follow this SOP at a local test strip with at least one inert seed item buried horizontal at a depth 11 times its diameter. The UXOQC and team leaders will document each operator’s performance at this test strip located in a clean (metal free) area that is convenient to the work site in their log books to insure each operator is fully trained and certified.