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MUNITIONS RESPONSE PROGRAM EXPANDED SITE INSPECTION REPORT FOR THE FLEMING KEY DREDGE SPOIL AREA NAS KEY WEST FL

3/1/2014

RESOLUTION CONSULTANTS

Prepared for:
Department of the Navy
Naval Facilities Engineering
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Munitions Response Program

Expanded Site Inspection Report

for the Fleming Key Dredge Spoil Area

Naval Air Station Key West

Key West, Florida

March 2014

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Contract Number N62470-11-D-8013
CTO JM20

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3-D	Three-Dimensional
AGM	Analog Geophysical Mapping
ASTM	American Society for Standards and Materials
bgs	Below Ground Surface
BSP	Blind Seeding Program
CD	Compact Disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CH2	(EM61-MK2) Channel 2
CI	Cued-Interrogation
CLEAN	Comprehensive Long-Term Environmental Action Navy
cm	Centimeter
CTO	Contract Task Order
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DFW	Definable Feature of Work
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DoD	Department of Defense
DVD	Digital Versatile Disc
EP	Engineering Pamphlet
EE/CA	Engineering Evaluation / Cost Analysis
EMI	Electromagnetic Induction
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ESI	Expanded Site Inspection
ESO	Explosives Safety Officer
ESS	Explosives Safety Submission
ESS-DR	Explosives Safety Submission - Determination Request
ESTCP	Environmental Security Technology Certification Program
FDEP	Florida Department of Environmental Protection
FI	Field Investigation
FKDSA	Fleming Key Dredge Spoil Area
FS	Feasibility Study
ft	foot or feet in length
GIS	Geographic Information System
GPS	Global Positioning System

HASP	Health & Safety Plan
HE	High Explosive
HEAT	High Explosive Anti-Tank
HSM	Health & Safety Manager
IAVS	Instrument-Aided Visual-Survey
in	inches in length
IRA	Interim Removal Action
ISO	Industry Standard Object
IVS	Instrument Verification Strip
m	meters
MC	Munitions Constituent
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as Explosive Hazard
MEC	Munitions and Explosives of Concern
mm	millimeters
MM	MetalMapper
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRP	(U.S. Navy's) Munitions Response Program
MRS	Munitions Response Site
NA	Not Applicable
NASKW	Naval Air Station Key West
NAVFAC	Naval Facilities Engineering Command
NFA	No Further Action
NOSSA	Naval Ordnance Safety and Security Activity
NPL	National Priorities List
NRL	Naval Research Laboratory
Ops	Operations
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PA/SI	Preliminary Assessment/Site Inspection
PDF	Portable Document Format
PM	Project Manager
POC	Point of Contact
PP	Project Planning
PPE	Personal Protective Equipment
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control

RA	Removal Action
RI	Remedial Investigation
RLS	Registered Land Surveyor
RPM	Remedial Project Manager
RTK-DGPS	Real-Time-Kinematic Differential Global Positioning System
RTS	Robotic Total Station
SAP	Sampling and Analysis Plan
SE	South East
SERDP	Strategic Environmental Research & Development Program
SI	Site Inspection, limited Site Inspection
SOP	Standard Operating Procedure
SOW	Scope of Work, Statement of Work
SUXOS	Senior Unexploded Ordnance Supervisor
TAV	Technical Assistance Visit
TBD	To Be Determined
TDEM	Time-Domain Electromagnetics
TEMTADS-2x2	Time Domain Electromagnetic Towed Array Detection System Two-by-Two Coil Array
TP-18	Technical Publication – 18
TTNUS	Tetra Tech NUS, Inc.
UFP	Uniform Federal Policy
UFP-QAPP	Uniform Federal Policy – Quality Assurance (Project) Plans
UXO	Unexploded Ordnance
UXOSO	Unexploded Ordnance Safety Officer
UXOQCS	Unexploded Ordnance Quality Control Specialist
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WS	Worksheet

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EXECUTIVE SUMMARY

Resolution Consultants was retained by Naval Facilities Engineering Command Southeast to conduct an Expanded Site Inspection (ESI) under the Navy's Munitions Response Program at the Fleming Key Dredge Spoil Area (FKDSA) located at Naval Air Station Key West, Florida. The work was performed under Comprehensive Long-Term Environmental Action Navy contract N62470-11-D-8013, Contract Task Order JM20.

Fleming Key was originally created as a dredge spoil island prior to World War II and was used as a munitions storage area as early as 1942. Between 2003 and 2004, dredge spoils from the Federal Channel, Truman Harbor, and an adjacent turning basin were placed on the northern 27-acre portion of the site (known as the "upland placement" area) that was the primary focus of this ESI. The dredge material was transported to the island via trucks then spread with heavy equipment to dry. During the dredging, two munitions items were reported: a 7.2-inch Hedgehog rocket and a 76-millimeter (mm) artillery projectile ceremonial round. The dredge spoils pile is estimated at 10–12 feet thick above the original island grade, equating to approximately 0.5 million cubic yards of material. During a 2009 Technical Assistance Visit conducted by the Naval Ordnance Safety and Security Activity to inspect the FKDSA, munitions items were observed on the ground surface including 20-mm and .50-caliber expended cartridge casings {***February 2009, NOSSA***}.

Two phases of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 process have been completed thus far, a Preliminary Assessment (PA) {***December 2010, Malcolm Pirnie Inc. and Osage of Virginia Inc.***} and a limited Site Inspection (SI) {***April 2012, Tetra Tech NUS***}. During a limited visual survey conducted as part of the PA, 20-mm, .30-caliber, .50-caliber, and .762-caliber expended cartridge casings were observed on the ground surface of the dredge spoil area. The SI field activities were limited to a UXO detector-aided surface survey to locate and identify potential munitions and explosives of concern (MEC) and/or material potentially presenting and explosive hazard (MPPEH) present on the ground surface along accessible portions of planned transects, and detector-aided subsurface surveys to qualitatively characterize the amount of shallow subsurface anomalies along select transects. The surface survey findings of the limited SI investigations were similar to the PA findings (i.e., expended 20-mm and small arms munitions casings) and subsurface anomalies were found across the site potentially representing MEC/MPPEH.

The primary objective, and ultimate goal, of the ESI was to determine through the collection of supplemental investigation data, whether further response actions such as an interim removal action (IRA) or follow-on investigation, are appropriate for the dredge spoil area (or portions thereof) or if a No Further Action (NFA) determination is appropriate. To accomplish this goal, ESI investigation activities included instrument-aided visual surveys to inspect the ground surface for MEC and non-invasive geophysical techniques to assess the subsurface for MPPEH.

Based on the ESI investigation results concerning the presence or absence of MEC/MPPEH, a recommendation for an IRA or NFA for an area or portion of the site would be based on the following:

- If surface MEC is encountered or if subsurface anomalies indicate MPPEH presence in subsurface, then the site (or portion thereof) is a possible candidate for an IRA.
- If no surface MEC are present, and no subsurface anomalies indicate MPPEH presence in the subsurface, then a recommendation for NFA at the site (or portion thereof) is possible.

However, if uncertainties concerning the presence or absence of MEC/MPPEH exist following ESI investigations, further investigation would be recommended to validate the findings.

Surface Assessment Results

After the surface assessment of the site was completed, one newly-encountered 37-mm High Explosive (HE) projectile and one previously-encountered (but misidentified) 105-mm high explosive anti-tank (HEAT) round were confirmed as surface hazards. Four other partially exposed surface-visible items were initially identified as MPPEH as they could not be confirmed as material documented as safe (MDAS) without disturbing the item or surrounding soil. As part of the subsurface assessments, Resolution Consultants used the *Naval Research Laboratory (NRL)* Time Domain Electromagnetic Towed Array Detection System two-by-two coil array (TEMTADS-2x2) to catalogue each of the six surface-visible MPPEH items in the library. After evaluation of the six items, a suspect 20-mm was determined to be not ordnance related, a 75-mm round was reclassified as the aforementioned 105-mm HEAT round, two unknown items were modeled as spherical and did not correspond to any library items, and the newly-encountered 37-mm HE projectile was confirmed.

Subsurface Assessment Results

General patterns in soil conditions and metal content were assessed by two sets of transect Digital Geophysical Mapping (DGM) surveys: **1)** *Geonics EM31-MK2 ground conductivity meter* surveys, which responds to changes in soil moisture and metal content to a depth of approximately 15 feet; and **2)** *Geonics EM61-MK2 all metals detector* surveys, which responds to subsurface metal (ferrous and nonferrous) up to a depth of 6 feet dependent on size. The EM31-MK2 transect-DGM data indicated high conductivities along the western and eastern portions of the dredge spoils, suggesting higher subsurface soil moisture in material bounding the berm. The EM61-MK2 transect-DGM data indicated metal throughout the spoils, but with more intensely concentrated patterns in the south-central portion of the site.

Fourteen 100-foot x 100-foot grids were selected based on tracking unique anomaly density fluctuations in the transect data crossing the site. Each grid was surveyed to collect high-density

EM61-MK2 data to distinguish closely spaced targets, enabling the interpreter to pinpoint each anomaly peak with high accuracy in preparation for the advanced classification effort. The anomaly densities in the grids ranged from greater than 1000 anomalies per acre at the south end of the site then trending downward to less than 400 anomalies per acre at the northwest end of the site.

Following the pinpointing of select anomalies from the grid surveys, the *TEMTADS-2x2* three-dimensional (3-D) cued-interrogation (CI) system was used to perform the advanced classification of 548 anomalies. These represented a continuum of responses, from weak to strong and small to large, running the gamut of responses, to evaluate the data for signatures from MPPEH of all shapes and sizes. The 3-D CI data collected were compared to "library" responses compiled from other sites and the current site, inclusive of items seeded in the test pit and surface MPPEH items. Advanced classification methods were applied to fully model, analyze, and compare results to a library suite of items with representative response curves. Upon completion, 123 of the 548 anomalies analyzed (22%) were considered to have either Priority-1 or Priority-2 'dig category' characteristic response signatures representing high confidence of MPPEH (i.e., ordnance items) while the remaining anomalies (78%) were labeled as Priority-3 or 'no dig category' low confidence of MPPEH (i.e., scrap metal). The dig category included large-sized (e.g., 105-mm, 5-inch projectile, 76-mm w/ casing), medium-sized (e.g., 60-mm, 81-mm), and small-sized (e.g., 20-mm, 37-mm) ordnance items of interest through signature fingerprint identification. The distribution of potential MEC/MPPEH is site wide, with the highest concentrations consistent with anomaly density patterns (e.g., highest concentrations in the south central portion of the site). Based on the ranking of size to depth, large-sized MPPEH appear more prevalent than small-sized MPPEH within the first few feet below ground surface (bgs).

Conclusions and Recommendations

The non-invasive sample data collected during the ESI at the dredge spoils area were used to draw four major conclusions:

- The only confirmed surface MPPEHs were a 37-mm HE projectile and a 105-mm HEAT round;
- The transect-pattern and grid-pattern DGM data demonstrate that subsurface anomaly densities generally trend downward spatially from higher densities in the south-end (density > 1000 anomalies per acre) to lower but still significant densities in the northwest portion (density < 400 anomalies per acre) of the site;
- Advanced classification library matching efforts indicate MPPEH distribution is site-wide; and
- Advanced classification ranking efforts determined that large-sized MPPEH appears more prevalent than small-sized MPPEH within the first few feet bgs.

Given that no areas within the site were assessed to be free from MPPEH in the subsurface, a NFA recommendation cannot currently be supported for any portion of the site. Additionally, due to the widespread distribution of the MPPEH anomalies, an IRA is not recommended at this time due to the significant cost of implementing a removal action across the entire site. Instead, invasive confirmation sampling is recommended as a follow-on to the current ESI to verify the nature of the anomalies identified during non-invasive advanced classification. Confirmation sampling will help resolve the uncertainties associated with the limited library of ordnance signatures, as compared to the unique ordnance hazards on site, and be used to support accurate interpretations of the nature of MEC/MPPEH items. The confirmations will also help define whether an IRA or another course of action is appropriate for the site.

1.0 INTRODUCTION

Resolution Consultants was retained by Naval Facilities Engineering Command Southeast (NAVFAC SE) to conduct an Expanded Site Inspection (ESI) under the Navy's Munitions Response Program (MRP) at the Fleming Key Dredge Spoil Area (FKDSA), located at Naval Air Station Key West (NASKW), Key West, Florida. The work was performed under Comprehensive Long-Term Environmental Action Navy (CLEAN) contract N62470-11-D-8013, Contract Task Order (CTO) JM20.

This ESI Report summarizes the completed investigation and contains summaries of the site background, objectives, approach including personnel and equipment utilized, and the results including conclusions and recommendations. ESI investigation activities were conducted in accordance with the final approved Sampling and Analysis Plan (SAP) {**March 2013, Resolution Consultants**}.

1.1 Site History

Fleming Key was originally created as a dredge spoil island prior to World War II and was used as a munitions storage area as early as 1942. Between 2003 and 2004, dredge spoils from the Federal Channel, Truman Harbor, and adjacent turning basin were placed on the northern 27-acre portion of the site (known as the "upland placement" area) that was the primary focus of this ESI. A turtle screen was reportedly used during dredging to limit the size of items transported through the dredging equipment. Prior to placement of the material at the site, all nine munitions storage magazines were inspected, verified empty, and closed. The dredge material was transported to the island via trucks then spread with heavy equipment to dry. During the dredging, two munitions items were reported: a 7.2-inch Hedgehog rocket and a 76-millimeter (mm) artillery projectile ceremonial round. Both items were destroyed in place by Explosive Ordnance Disposal (EOD) personnel {***August 2004, EOD 8027 via EODMU Six DET Mayport***}. Information obtained during discussions with NASKW personnel indicated that the two items were removed from the dredge barge and transported separately to the site for demolition.

The dredge spoils pile is estimated at 10-12 feet thick above the original island grade, equating to approximately 0.5 million cubic yards of material at the FKDSA site. During a 2009 Technical Assistance Visit (TAV) conducted by the Naval Ordnance Safety and Security Activity (NOSSA) to inspect the FKDSA site, munitions items were observed on the ground surface including 20-mm and .50-caliber expended cartridge casings {***February 2009, NOSSA***}. As a result of these discoveries, concerns were raised that the dredge spoils may contain material potentially presenting an explosive hazard (MPPEH) and NOSSA indicated that munitions response under the Navy MRP was required.

Navy MRP guidance states that munitions response will be conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National

Oil and Hazardous Substances Pollution Contingency Plan. Two phases of the CERCLA process have been completed thus far, a Preliminary Assessment (PA) {***December 2010, Malcolm Pirnie Inc. and Osage of Virginia Inc.***} and a limited Site Inspection (SI) {***April 2012, Tetra Tech NUS***}. During a limited visual survey conducted as part of the PA, 20-mm, .30-caliber, .50-caliber, and .762-caliber expended cartridge casings were observed on the ground surface of the dredge spoil area. The SI field activities were limited to a UXO detector-aided surface survey to locate and identify potential munitions and explosives of concern (MEC) and/or MPPEH present on the ground surface along accessible portions of planned transects, and detector-aided subsurface surveys to qualitatively characterize the amount of shallow subsurface anomalies along select transects. The surface survey findings of the limited SI investigations were similar to the PA findings (i.e., expended 20-mm and small arms munitions casings) and subsurface anomalies were found across the site potentially representing MEC/MPPEH. Additional details pertaining to site history, physical setting, and historical findings at the dredge spoil area are presented in the referenced PA and SI reports.

1.2 ESI Purpose

The primary objective, and ultimate goal, of the ESI was to determine whether further response actions, interim removal action (IRA) or follow-on investigation, are appropriate for the dredge spoil area (or portions thereof) based on the collection of supplemental investigation data, or if a No Further Action (NFA) determination is appropriate. To accomplish this goal, the ESI field activities included instrument-aided visual surveys (IAVS) to inspect the ground surface for MEC/MPPEH and non-invasive geophysical techniques to assess the subsurface for MEC/MPPEH.

Based on the ESI investigation results concerning the presence or absence of MEC/MPPEH, a recommendation for an IRA or NFA for the entire site, or portion thereof would be based on the following:

- If surface MEC is encountered or if subsurface anomalies indicate MPPEH presence in subsurface, then the site (or portion thereof) is a possible candidate for an IRA.

- If no surface MEC are present, and no subsurface anomalies indicate MPPEH presence in the subsurface, then a recommendation for NFA at the site (or portion thereof) is possible.

However, if uncertainties concerning the presence or absence of MEC/MPPEH exist following ESI investigations, further investigation would be recommended to validate the findings.

1.3 Report Organization

The report is organized into the following chapters / appendices:

- **Chapter 1.0 Introduction** reviews site history and purpose of the ESI;

- **Chapter 2.0 Summary of ESI Field Activities** reviews pertinent ESI tasks and field activities for surface and subsurface assessment;
- **Chapter 3.0 Results from ESI Field Activities** details pertinent ESI results for field activities for surface and subsurface assessment;
- **Chapter 4.0 QC Performance of ESI Field Activities** details pertinent ESI Quality Control (QC), as compared to the performance metric requirements tabulated within Worksheet #12 of the Uniform Federal Policy (UFP)-QAPP, for field activities for surface and subsurface assessment;
- **Chapter 5.0 Conclusions and Recommendations** identifies conclusions based on ESI investigation results and recommended future site actions;
- **Chapter 6.0 References** lists relevant documents referenced within this ESI report;
- **Figures** Large full-page graphics hyperlinked from body to end of report;
- **Appendix A** MEC Management Field Forms / Logbooks on Digital Versatile Disc (DVD);
- **Appendix B** MPPEH Discovery/Accountability Log and MPPEH Photo-Log;
- **Appendix C** Transect- Digital Geophysical Mapping (DGM), Grid-DGM, and Surface MPPEH Three Dimensional (3-D) Cued Interrogation (CI) Maps;
- **Appendix D** Final Ranked Anomaly List of 3-D CI Data with Subsurface 3-D CI Maps on DVD;
- **Appendix E** Geophysical Data and Deliverables on DVD;
- **Appendix F** Geophysics Investigation Summary Report on DVD; and
- **Appendix G** Independent Evaluation Figures of QC Performance Metrics along Project Timeline.

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2.0 SUMMARY OF ESI FIELD ACTIVITIES

This chapter summarizes the approaches, methods, and procedures utilized to complete ESI tasks and field activities. Additional details concerning these investigations are presented in the SAP {**March 2013, Resolution Consultants**}.

A total of seven primary definable features of work (DFWs) were identified as well as measurement performance requirements and the tasks required to complete each DFW. These DFWs included:

- Project Startup [includes: Mobilization, Security, Equipment Verification, Instrument Verification Strip (IVS) Construction, Blind Seeding];
- Anomaly Avoidance;
- Vegetation Management;
- Survey Management;
- MEC Management [includes: Inspection and Disposal of MPPEH, MEC Demolition/Disposal Operations (Ops)];
- Geophysics Management (includes: DGM Transect Surveys, DGM Grid Surveys, Anomaly Pinpointing, 3-D CI with Advance Classification]; and
- Project Closeout [includes: field investigation (FI) data deliverables check relative to ESI reporting, demobilization].

Additionally, the proposed investigation techniques in each DFW were further categorized into two groups based on assessment depth:

- Surface Assessments: Included initial safety escorting during pre-DGM site preparation activities (i.e., Vegetation Management, Survey Management) in conjunction with Anomaly Avoidance duties conducted by UXO Techs to locate, mark, and document locations for surface anomaly avoidance and assess the surface MEC/MPPEH; and
- Subsurface Assessments: Included standard DGM techniques (e.g., EM61, EM31, etc.) to capture anomaly distributions along transects and within grids down to detection depth followed by recently developed 3-D CI advanced sensors to assess the subsurface for MEC/MPPEH.

Table 2-1 below presents a modified version of the original DFW table, originally introduced in Worksheet #17 of the SAP, to include the surface versus subsurface assessment distinction for each DFW listed.

Table 2-1
Modified DFW Listing Appended to Include Two Distinct Assessment Types

Definable Feature of Work	Assessment Type	Standard Operating Procedure (SOP)	Supporting Document(s)
Project Startup [includes: Mobilization, Security, Equipment Verification, IVS construction, Blind Seeding]	SURFACE and SUBSURFACE	Not Applicable (NA)	SAP, Health and Safety Plan (HASP), Explosives Safety Submission-Determination Request (ESS-DR)
Anomaly Avoidance	Primarily SURFACE; SUBSURFACE for safety precautions only	MRP SOP 01	SAP & ESS-DR
Vegetation Management	SURFACE	MRP SOP 04	SAP & ESS-DR
Survey Management		MRP SOP 05	SAP & ESS-DR
MEC Management [includes: Inspection and Disposal of MPPEH, MEC Demolition/Disposal Ops]	SURFACE	MRP SOP 02, MRP SOP 03	SAP & ESS-DR
Geophysics Management (includes: DGM Transect Surveys, DGM Grid Surveys, Anomaly Pinpointing, 3-D CI with Advance Classification]	SUBSURFACE	MRP SOP 06, MRP SOP 07, MRP SOP 08, and MRP SOP 09	SAP & ESS-DR
Project Closeout [includes: FI data deliverables check relative to ESI reporting, demobilization]	SURFACE and SUBSURFACE	NA	SAP & ESS-DR

The following sections summarize the ESI field activities conducted on a DFW basis. Additional details concerning these investigations are presented in the SAP {**March 2013, Resolution Consultants**}.

2.1 Project Startup

The following summarizes the project startup activities as presented in Worksheet #17 of the SAP.

2.1.1 Prepare and Review Project Plans

The following planning documents were submitted and approved by the corresponding oversight entities (e.g., NOSSA, NAVFAC SE, NASKW, Florida Department of Environmental Protection [FDEP]):

- SAP {***March 2013, Resolution Consultants***};
- HASP {***February 2013, Resolution Consultants***}; and
- ESS-DR Letter {***December 2012, NOSSA***}.

These documents were maintained onsite for reference and signoff by each of the Resolution Consultants personnel and subcontract employees.

2.1.2 Site Mobilization, Set-up, and Preliminary Activities

Resolution Consultants mobilized all personnel on a staggered schedule (depending on the exact timing of their field activity) starting on May 8th, 2013. As per the SAP requirements, the following activities commenced starting on day 1 for all personnel arriving on site:

- Occupational Safety and Health Administration (OSHA) medical surveillance monitoring;
- Reviewing of planning documents (Section 2.1.1) and signing acknowledgment forms;
- Briefing personnel (daily) on site-specific technical requirements and safety protocols; and
- Discussing and monitoring of safety protocols (e.g., heat stress, communications, Personal Protective Equipment [PPE], tree felling) emphasized by NASKW and NAVFAC SE personnel.

Given the emphasis on heat stress, communications, and PPE from NASKW, NAVFAC SE, and Resolutions Consultants health and safety officers, the on-site UXO field management set-up a shade tent, with coolers filled with water bottles and tubes of sun block readily available, as a rest area during break times for the field crews. Additionally, lines of communication were confirmed via contact information exchange of cellular telephone numbers between on-site personnel, off-site personnel, and base emergency contacts. *Motorola* Talk-About MD200 "Walkie-Talkie" radios were handed to each field team leader for regimented radio checks and supplement communication backup between field crews, Senior Unexploded Ordnance Supervisor (SUXOS), and Unexploded Ordnance Quality Control Specialist (UXOQCS) / Unexploded Ordnance Safety Officer (UXOSO), as an extra safety precautionary measure in the field. Lastly, proper PPE, inclusive of high-vis yellow vests, safety toe shoes, and safety glasses, were worn by all employees during fieldwork activities (**See Photo 2-1**).

Photo 2-1. Safety Precaution Equipment Supplied for Employees at FKDSA. Gear included: (a) Shade-tent setup outside for breaks, (b) "walkie-talkie" radios as backup communication, and (c) proper PPE.

2.1.3 Site Accessibility and Traffic Control

FKDSA is a locked-in fenced area with **Restricted Area** signage (**See Photo 2-2**) that is also within the confines of a controlled area accessible only through guarded access gates at NAS Key West Trumbo Point Entrance, just north of the corner of Palm Avenue and Ely Street.

Photo 2-2. Access Controls Applied to FKDSA Gate Entrance. Supplies included orange chain and keyed lock.

Once on site, safety regulations normally require active exclusion zones for MEC sites. However, since the entire project was non-invasive with no MEC investigation activities, no exclusion zones were established outside of the locked gate, which prevented entry by any unauthorized personnel.

2.1.4 Site Security

Site security was maintained via the locked gate entrance to ensure that any non-essential personnel did not access the site during any on-site activity.

2.1.5 Governing Regulations/Guidance and Explosive Safety Submission Determination

Following the guidelines of the aforementioned NOSSA approved ESS-DR letter, safety escort and anomaly avoidance measures were practiced during the non-invasive investigations and under no circumstances was any MEC or MPPEH moved or disturbed during the current project phase.

2.1.6 Equipment Verification

The following equipment verification steps were conducted as a part of a checklist (as part of MEC Management Field Forms introduced/referenced in Section 2.2.4**,** with scanned versions catalogued within **Appendix A**) prior to the commencement of daily ESI field activities:

- Inspecting all equipment to be used during that day’s activities to confirm that all components are present and in good condition;

- Assembling, powering up, and monitoring the equipment functionality after warm-up; and
- Conducting daily QC tests as prescribed in SAP Worksheet #12.

QC tests required completion, monitoring, and tracking on a daily basis, along with final documentation of each QC test (i.e., figure, table, etc.), to confirm successful individual performance against Worksheet #12 standards before demobilizing from site.

2.1.7 IVS Construction

The IVS was located in an area within the property fence-line (**blue-line**) due west of locked gate entrance (**grey-box**) yet outside of both the dredge spoils pile boundary (**green line**) and MRP boundary (**red line**) using anomaly avoidance techniques. (**See Figure 2-1**). The IVS was constructed within representative site conditions using well-characterized Industry Standard Objects (ISOs) seeded in an in-line manner (within the confines of an **orange box**) along the worst-case orientation (i.e., horizontal and perpendicular to line-path traversal). The ISOs consisted of Schedule 40 welded steel pipe nipples, threaded on both ends and painted **orange** prior to seeding in the ground. Additionally, the objects were buried at depths between three and seven times the diameter of the ISO and were placed sufficiently far apart such that the sensor signal returns to the background noise level between objects. The positions of each seed location and start-end point of the IVS were recorded by the Registered Land Surveyor (RLS). Additionally, seed specifications and depths were marked on an ink-board that was photographed with the seed (**See Photo 2-3**). Finally, **orange** plastic tent stakes were impounded at each location along with rope tied between in order to provide a visual cue of controlling the walk-path and limiting controllable sources of errors while providing regimented consistency between passes. The final dimensions of the IVS are provided in **Table 2-2**, below.

Photo 2-3. Four ISO Seed Items Captured from FKDSA IVS Test Line. Images captured before Global Positioning System (GPS) coordinates of each item were recorded and the location covered with dirt. The above images correspond to GPS Point-ID's IVS_001, IVS_002, IVS_003, and IVS_005, respectively, in Table 2-2, as listed below.

Table 2-2
IVS Seed Item Specs for FKDSA: Positions, Depths, Descriptions, Orientations, and Inclinations

SurveyID	Point-ID	X_US-ft	Y_US-ft	Item_Desc	Depth-to-Top_in	Orientation	Inclination
ivs0	IVS_start	391590.076	91025.616	Start Point	-------NA------	-------NA------	----NA----
ivs1	IVS_001	391569.911	91027.217	Medium ISO	10.25	perpendicular to linepath	horizontal
ivs3	IVS_002	391563.486	91027.060	Small ISO	6.750	perpendicular to linepath	horizontal
ivs4	IVS_003	391552.148	91028.590	Medium ISO	13.250	perpendicular to linepath	horizontal
ivsblank	IVS_004	391543.842	91029.388	No Seed	-------NA------	-------NA------	----NA----
ivs5	IVS_005	391500.669	91034.924	Small ISO	6.000	perpendicular to linepath	horizontal
ivs6	IVS_end	391494.108	91035.213	End Point	-------NA------	-------NA------	----NA----

In addition to constructing the IVS, a 4.5-foot (ft) wide by 6.0-ft long area was assessed as "clean" using anomaly avoidance techniques adjacent (just east and slightly south) of the IVS for use as a test pit. Subsequently, an internal area of 1.5-ft wide by 3.0-ft long by 2.0-ft deep test pit hole was edged out using hand tools (e.g., pick axes, shovels) with edges smoothed. (**See Photo 2-4.**) Once installation of the test pit was completed, the area was roped-off and covered with plywood to clearly mark the location and prevent anyone from accidentally stepping directly into the pit.

Photo 2-4. South-Faced and Overhead View of FKDSA Test Pit. Images taken from: (a) north-side view looking south showing anomaly avoided 4.5-ft wide by 6.0-ft long "roped-off" area, and (b) above plan-view showing extent of 2.0-ft depth of the 1.5-ft wide by 3.0-ft long hand-excavated hole to seed items of interest.

The pit was constructed in preparation for advanced sensors application for a number of relevant inert ordnance items (e.g. 20-mm, 57-mm, 76-mm) to be seeded within a controlled setting of soil type, depth, orientation, inclination, and position relative to center of the 3-D CI sensors centroid. Due to potential tip-hazard concerns and schedule unavailability, the *Geometrics* tractor-towed MetalMapper (MM) was not utilized at the site. Instead, the preferable *Naval Research Lab (NRL)* man-portable 2x2 coil Time Domain Electromagnetic Towed Array Detection System (TEMTADS-2x2) which is a more portable and stable system along slopes was utilized. **Photo 2-5** shows example images of both 3-D CI sensors.

Photo 2-5. Commercially Available Marketing Images of 3-D CI Sensors. Example Photos of: (a) *Geometrics* MM (as extracted from www.geometrics.com), and (b) *NRL* TEMTADS (as extracted from www.serdp.org).

2.1.8 Initial IVS Passes with Letter Report

The initial IVS pass using the *Geonics EM61-MK2* Time-Domain Electromagnetics (TDEM) all-metals detection DGM sensor digitally recorded data over the line of seed of items. Immediately after the initial pass, an additional pass was made and the responses were compared to ensure consistency.

As a practical supplement to the process, EM61-MK2 data streams were recorded while small ISOs were centrally mounted statically above the coil. Thus, the recorded data were compared to the NRL curves as a part of the daily static test evaluation process. Ultimately, data were collected both statically and kinematically over well-defined ISO objects at the beginning and the end of each workday, and after any modifications to the system (e.g., replacement of coils, changing of coil height). For the *NRL TEMTADS 2x2 Electromagnetic Induction (EMI) array* all-metals detection DGM sensor; however, only static readings over the IVS seed locations were required for comparison to catalogued library readings/curves as per the planning documents. The first passes for the DGM sensors--EM61 and TEMTADS--occurred on May 28th and June 10th, respectively.

The initial IVS pass using the hand-held Analog Geophysical Mapping (AGM) sensor required each UXO Tech operator (e.g., SUXOS, UXOQCS / UXOSO, UXO Tech II) to sweep the line of seed of items. The first pass down the IVS with the *Schonstedt* GA-52cx magnetic locator occurred on May 8th with subsequent IVS passes documented in field sheets / logbook entries of **Appendix A**. A few days after the first pass with the *Schonstedt*, a *White's Instruments* Spectrum XLT EM detector was tested as a backup in case non-ferrous MEC items were encountered on the surface. Since non-ferrous items were never encountered, the Spectrum XLT was not used and the GA-52cx was used exclusively to adequately screen for and prevent physical contact with MPPEH during anomaly avoidance per the ESS-DR. See **Photo 2-6** for IVS examples.

Photo 2-6. AGM and DGM Operating Methods Captured from FKDSA IVS Test Line. Images captured included the following techniques applied at the IVS Test Line: (a) *Schonstedt GA-52cx* magnetic ferrous-metal content locator, (b) *White's Instrument Spectrum XLT* EM all-metals detector, (c) *Geonics EM61-MK2* TDEM all-metals detector, (d) *NRL TEMTADS 2x2* electromagnetic induction (EMI) array all-metals detector.

The results from day 1 passes along the IVS, for both full-size DGM sensors and hand-held AGM sensors, were considered the truth for comparison against each day thereafter and as long as each future pass was representative of the previous, and other twice-daily QC tests were successful, the equipment-operator system was considered to be functioning properly as a cohesive unit. Lastly, IVS reporting results and discussions are within CHAPTER 3.0 – PRODUCTION RESULTS.

2.1.9 Blind Seeding Program

The Blind Seeding Program (BSP) involved the seeding of the dredge spoils area with ISO targets at known locations that were "blind" with respect to the each field team. The general criteria for placing blind seeds are that the items should be numerous enough to be encountered on a daily basis, selected as potential targets, and identified / recovered. The BSP ISOs were used to monitor the quality of the operations during the surface assessments (e.g., anomaly avoidance, vegetation management, survey management) and the subsurface assessments (e.g., geophysics management), as introduced in **Table 2-1** and procedurally detailed further in Sections 2.2 and 2.3. As with the IVS seeded items, the ISOs for the BSP were painted **orange** as a visual cue as "safe to handle" as opposed to the **light blue** tinged MPPEH items on site. Finally, anomaly avoidance procedures were strictly adhered to when placing BSP ISOs on the surface and in the subsurface, not only to limit the potential of masking an item but also to remove the potential of physically contacting MPPEH with a hand tool (e.g., pick axe, shovel).

2.2 Surface Assessments

The surface assessment category was comprised of the following four field activities: **1)** Anomaly Avoidance, **2)** Survey Management, **3)** Vegetation Management, and **4)** MEC Management.

2.2.1 Anomaly Avoidance

The following four precautionary measures were implemented prior to the start of each field activity to which the measure applied:

- Notifying NASKW Explosives Safety Officer (ESO) regarding the commencement of field work;
- Providing adequate UXO-qualified personnel to escort all field teams, site visitors, and non-essential personnel;
- Providing adequate UXO-qualified personnel to conduct anomaly avoidance techniques that prevent physical contact with potential MEC/MPPEH located on the surface; and
- Conducting no intrusive activities or intentional physical contact with MEC/MPPEH.

The two key UXO Tech escort duties required included: 1) completion of anomaly avoidance procedures and 2) communicate any findings (e.g., MEC/MPPEH, blind seed) to the SUXOS or UXOQCS/UXOSO for further inspection, documentation (e.g., logs, field forms, photos), and signage (e.g., flags, tape). Furthermore, anomaly avoidance efforts required three main phases, each completed at a different stage in the project time-line. The three phases are:

- Re-occupation and re-inspection of the surface or partially exposed to surface MPPEH items reported within the limited SI by Tetra Tech NUS, Inc. (TTNUS);

- Anomaly avoidance assessment for circumventing physical contact with surface and subsurface MPPEH items during blind seed emplacement; and
- IAVSs to avoid surface-visible MPPEH items.

An example set of photographs of visual cues (e.g., stakes, caution tape) for avoiding surface MPPEH are provided within **Photo 2-7**. Final documentation from anomaly avoidance results is discussed further in the MEC Management (Section 2.2.4).

Photo 2-7. Example Anomaly Avoidance Markings for Surface-Visible MPPEH Items Encountered at FKDSA. Images clearly show the visual cues from afar, closer, and close-up, with no vegetation piled to mask views.

2.2.2 Survey Management

Resolution Consultants completed survey management oversight of the RLS subcontractor, *Island Surveying, Inc.*, for the following field activities conducted over three work days:

- **DAY 1 – May 8th:** Safety / site-specific training, benchmark establishment, MRP boundary delineation, IVS seed emplacement, and re-occupy surface MPPEH locations.
- **DAY 2 & DAY 3 – May 24th & May 30th:** Internal grid system layout and newly discovered surface MPPEH location identification. The RLS provided survey deliverables within 2 days of completing field activities.

Following the SAP requirements, the planned network of benchmarks were established with horizontal and vertical control of Class I, Third Order or better, while the remaining surveys were within standard industry metrics for GPS quality under the guidance and within the metrics of MRP SOP 02 and Worksheet #12, respectively. The reoccupation of surface MPPEH items allowed the SUXOS to re-inspect items identified during the limited SI. After thorough inspection, the SUXOS determined whether each surface-visible MPPEH item was intact MEC or munitions debris (MD). If deemed MD, the SUXOS was required to further characterize the item into the hazard class of either Material Documented as Safe (MDAS) or Material Documented as Explosive Hazard (MDEH). Any characterization except 100% confirmed MDAS would mean the item would remain MPPEH (if uncertain) or MEC (if explosive material observed) and, as such, would require the location to be marked with the anomaly avoidance visual cues introduced in Section 2.2.1. Since only surface items could be inspected without physical contact, all partially exposed items remained as MPPEH while all surface items were labeled as MEC, MDEH, or MDAS. The RLS completed all DAY 1 activities with SUXOS support prior to vegetation removal.

After vegetation removal activities, the RLS returned to site to layout an internal grid system, within the confines of the vegetation removal boundaries, utilizing a series of pre-established coordinates at 100-ft intervals provided to them by the Resolution Consultants Field QC Scientist. Following the SAP, the grid corners were oriented N-S-E-W cardinal directions, in order to provide transect guidance and grid corner boundaries for geophysics surveys. As a field variance from the SAP document, 4-ft tall metal tubes were used as grid corner markings to replace the wooden laths previously planned for use due to the ground hardness causing wooden laths to either split or not penetrate deep enough to maintain permanence. Other procedures (e.g., indelible ink marking of grid identifiers [grid-ID], anomaly avoidance, proximity to magazine stand-off distance, etc.) were strictly adhered to for safety precautions and procedural efficiency purposes. In addition to the MPPEH locations revisited during the RLS activities, any newly encountered items had their GPS locations recorded by the RLS for all future documentation forms / reports, such as the MPPEH Photo-Logs.

Both the UXO Tech escort and UXOQCS/UXOSO conducted safety audits regularly while the Field QC Scientist conducted quality inspections relative to the Worksheet #12 metrics. Lastly, the RLS used the same methods and metrics (without exception) as the GPS check as further detailed in Geophysics Management section of CHAPTER 4 – QC PERFORMANCE.

2.2.3 Vegetation Management

Following the SAP requirements, the vegetation removal subcontractor, *OPS Contracting, Inc.*, provided a suite of services (e.g., cutting, trimming, felling, mowing, chipping, etc.) to reduce the overall vegetation height in the dredge spoils area to 6-in above ground surface (ags) following the guidelines of ESS-DR approval letter **{NOSSA, December 2012}**. Vegetation removal was required prior to performing site survey activities as the vegetation (e.g., brush, grass, trees) presented physical impediment challenges (e.g. mobility, balance, tripping) and line-of-sight impairments (e.g., visual, communication relays, electronic signals), all of which hinders both production and quality. The field effort followed the guidance protocols and metrics detailed within MRP SOP 01 and MRP SOP 04, Anomaly Avoidance and Vegetation Management SOPs, respectively. In summary, vegetation removal personnel worked with UXO management during the following 22 days of Vegetation Management field activities:

- **DAY 1 & 2 – May 9th & 10th:** Safety / site-specific training, tree felling training, UXO Tech II surface assessments, and hand-held equipment (e.g., chainsaws, weed-whackers) operation for cutting trees, thick shrubs, and tall grasses.
- **DAY 3 thru DAY 13 – May 13th thru May 24th**: UXO Tech II surface assessments, initial mob of heavy equipment (e.g., mower, chipper, skid-steer) arrival.
- **DAY 14 thru DAY 17 – May 28th thru May 31st:** No more surface assessments (i.e., completed), SUXOS and UXOQCS/UXOSO monitoring of field personnel, second mob of additional heavy equipment (e.g., mower, chipper, skid-steer), additional personnel arrival, and hand-held equipment operation for trees, thick shrubs, and tall grasses.
- **DAY 18 thru DAY 22 – June 3rd thru June 7th:** All hand-held tree felling operations ceased (i.e., completed), SUXOS and UXOQCS/UXOSO monitoring of field personnel, third mob of additional heavy equipment (i.e., chipper & skid-steer only), and mowing operations using brush-hog attachment. Crews demobilized the afternoon of June 7th.

The vegetation removal team was escorted by the UXO Tech escort at all times for ensuring anomaly avoidance procedures were strictly adhered to for their safety. The UXOQCS/UXOSO conducted safety audits (e.g., PPE, blade height) and quality inspections (i.e. 6-in ags metric) regularly. The four-step VR process (i.e. felling, bundling, chipping, and mowing) is depicted in **Photo 2-8**.

Photo 2-8. Four-step Vegetation Removal Process Conducted at FKDSA. Steps included: (1) first, tree felling, then (2+3) second + third of bundling w/ chipping, and (4) fourth, grass mowing prior to field activities.

2.2.4 MEC Management

MEC Management duties and responsibilities included the following: (1) first, UXO Tech escort implementation of anomaly avoidance requirements and (2) second, UXO Tech management completion of logbook entries of surface-visible MPPEH after closer inspections. The MEC Management duties and responsibilities were required to not only prevent hazardous physical contact with MPPEH but also to document any MEC findings deemed to have a residual explosive hazard (i.e., UXO, Discarded Military Munitions, MDEH, etc.) as compared to inert items (e.g., MDAS, Cultural Debris, etc.). All materials that could not be 100% certified as inert were considered MPPEH. The final nomenclature of each surface-visible MPPEH was documented in the appropriate project files (e.g., field forms, logbook entries). Resolution Consultants conducted the following during the 22 days of overarching MEC Management discovery documentations during other field activities:

- **DAY 1 – May 8th:** Conducted anomaly avoidance as a precursor to constructing IVS / impounding RLS benchmarks; re-inspected for nomenclature / hazard classification (e.g., UXO, MDAS, MDEH) all re-occupied surface MPPEH items via visual inspections.
- **DAY 2 thru DAY 18 – May 9th thru May 31st:** Conducted anomaly avoidance as a precursor to vegetation removal activities; visually inspected for nomenclature and associated hazard classification any newly discovered surface items encountered deemed to be MPPEH.
- **DAY 15 & DAY 17 – May 24th & May 30th**: Conducted anomaly avoidance as a precursor to installation of internal grid stakes.
- **DAY 19 thru DAY 23 – June 3rd thru June 7th:** Escorted and monitored vegetation removal field crews for safe practices.

In addition to documentation requirements, any new findings deemed potentially hazardous were communicated to the NASKW ESO for knowledge and communications to NOSSA as deemed necessary.

2.3 Subsurface Assessments

The subsurface assessment category was comprised of the following two field activities: **1)** Geophysics Management Phase-I: DGM Survey Field Activities and **2)** Geophysics Management Phase-II: Anomaly Resolution Field Activities.

2.3.1 Geophysics Management Phase-I: DGM Survey Field Activities

Geophysics Management Phase-I focused on aspects pertaining to transect-pattern and grid-pattern DGM field activities completed by the geophysics subcontractor. Resolution Consultants monitored the production progress, safe practices, and quality control metrics via means of daily inspections by the UXOQCS/UXOSO and by further examinations by the Field QC Scientist as needed. The DGM crew was escorted by the UXOQCS/UXOSO at all times for ensuring anomaly avoidance procedures were continually invoked for their safety while QC metrics were tracked through checklist documentation of their twice-daily QC tests (weather permitting, with production surveying activities sandwiched in-between the two sets of times). The QC tests were processed off-site by subcontractor personnel and subsequently independently evaluated by the Field QC Scientist in order to confirm the demonstrated evaluation that both the positional accuracy and geophysical sensor quality were maintain through the project lifecycle. Any data of suspect quality identified by the subcontractor or Resolution Consultants', without probable cause documented and two acceptable tests sandwiched between, such as a suspect test due to isolated uncontrolled ambient noise sources (e.g., EM storms, excessive rain), was recollected. The scheduled seven workdays of DGM Survey Field Activities included:

- **DAY 1 & DAY 2 – May 28th & May 29th:** Safety / site-specific training, assembly of equipment, powering up and evaluating equipment operation, standard twice-daily QC tests, including IVS. Inclement weather washed-out approximately half of each day.
- **DAY 3 thru DAY 5 – May 30th thru June 3rd:** Twice-daily QC tests, including IVS with transect DGM data acquisition sandwiched between. Portion of data from 30th was noticed to contain line path sampling deviations and, as such, immediately reworked on the morning of June 3rd with no other occurrences of QC aberrations.
- **DAY 5 thru DAY 7 – June 3rd thru June 5th:** Twice-daily QC tests, including IVS with gird DGM data acquisition sandwiched between. All data passed QC analysis by the DGM subcontractor and independent evaluation by Resolution Consultants' Field QC Scientist.

Following the SAP requirements, the geophysics subcontractor, *NAEVA Geophysics, Inc*., completed the site-wide 50-ft centered transects and the equivalence to 14 (13 full / 2 half) 100-ft x 100-ft grid surveys, which met the sampling requirements of approximately 4.5 miles of transects (with turn-arounds) and at least 3.0 acres of grids. The twice-daily QC tests and IVS passes, with DGM survey data sandwiched between, were acquired and evaluated to be within standard industry metrics for both (*Trimble* Real-Time-Kinematic Differential Global Positioning System [RTK-DGPS]) position accuracy and (*Geonics* EM61/EM31) TDEM quality standards under the guidance and within the metrics of MRP SOP 06, MRP SOP 07, and Worksheet #12, respectively. In addition to the SAP requirements, the DGM staff worked with site management to prepare daily progress update maps for Resolution Consultants' Field QC Scientist to evaluate anomaly density and lead the process of selecting grids for full coverage DGM (based on the transect-pattern DGM results) and anomalies to pinpoint (based on the grid-pattern DGM results). In summary, the DGM team worked with the SUXOS, UXOQCS/UXOSO, and Field QC Scientist to conform to the following protocols:

- <u>Avoided</u> surveying within the same proximity of the vegetation removal crews;

- Followed the directives from the UXO Tech escort, along with safety precautions and field procedures, all in accordance with MRP SOP 01 (Anomaly Avoidance), MRP SOP 06 (EM31-MK2 Procedures / Management), MRP SOP 07 (EM61-MK2 Procedures / Management), and SAP attachments to which the work followed; and

- Documented QC checks and tabulated against metric standards, as listed in Worksheet #12.

Both the UXO Tech escort and UXOQCS/UXOSO conducted safety audits regularly while the Field QC Scientist conducted quality inspections relative to the Worksheet #12 metrics. Additionally, the geophysics subcontractor used the same methods and metrics (without exception) as detailed for geophysical survey operations. Furthermore, the associated results of the QC inspections and independent QC evaluations of data are discussed as part of CHAPTER 4 – QC PERFORMANCE. Finally, an example pair of photographs of the different types of Geophysics Phase I survey activities across the site while avoiding surface MMPEH are provided in **Photo 2-9**.

Photo 2-9. Geophysics Phase-I Field Activities Conducted at FKDSA. Images include example representations of: (1) *Geonics* EM31 transects and (2) *Geonics* EM61 transects/grids.

2.3.2 Geophysics Management Phase-II: Anomaly Resolution Field Activities

Geophysics Management Phase-II focused on aspects pertaining to Anomaly Resolution Field Activities completed by the geophysics subcontractor. For non-invasive sampling projects, Anomaly Resolution is limited to Pinpointing for and Advanced Classification of DGM Anomalies identified during Phase-I activities using the *NRL* TEMTADS-2x2 3-D CI sensor system. Resolution Consultants monitored the production progress, safe practices, and quality control metrics via means of daily inspections by the UXOQCS/UXOSO and by further examinations by the Field QC Scientist as needed. The 3-D CI crew was escorted by the UXOQCS/UXOSO at all times for ensuring anomaly avoidance procedures were continually invoked for their safety while QC metrics were tracked through checklist documentation of their twice-daily QC tests (weather permitting, with production surveying activities sandwiched in-between two sets of times). The QC tests were processed off-site by subcontractor personnel and subsequently independently evaluated by the Field QC Scientist in order to confirm the demonstrated evaluation that both the positional accuracy and geophysical sensor quality were maintained through the project lifecycle. Any data of suspect quality identified by the subcontractor or Resolution Consultants', without probable cause documented and two acceptable tests sandwiched between, such as acceptable suspect readings due to isolated uncontrolled ambient noise sources (e.g., EM storms, excessive rain), were recollected. The scheduled seven workdays of Anomaly Resolution Field Activities included:

- **DAY 1 – June 10th:** Safety / site-specific training, assembly of equipment, powering up and evaluating equipment operation, standard twice-daily QC tests, including IVS, and capturing of TEMTADS readings over certified inert ordnance items in the Test Pit or MPPEH items exposed to the surface of the FKDSA to add to the library catalogue.

- **DAY 2 thru DAY 4 – June 11th thru June 13th:** Twice-daily QC tests, including IVS, with Anomaly Pinpointing and TEMTADS 3-D CI of DGM anomalies sandwiched between the morning and afternoon session of QC tests. Preliminary inversions of TEMTADS data to solve for anomaly position were completed in the field in order to verify that each anomaly center was within a conservatively set 30-centimeter (cm) offset (i.e., less than the 40-cm requirement with a Safety Factor added for comfort) from the centroid of the TEMTADS system. All Anomaly Pin-Pointing (with associated flagging) was completed by COB of DAY 4. Data were evaluated each evening to ensure adequate quality prior to the next workday.

- **DAY 5 thru DAY 7 – June 14th thru June 17th:** Continuation of DAY 2 thru DAY 4 activities with exception of Anomaly Pin-Pointing and Flagging which was completed. Any suspect readings for key anomalies after QC analysis were re-visited prior to the last day to ensure evaluation was complete prior to demobilization. Lastly, any MPPEH items exposed to the surface of the FKDSA not previously evaluated were done so at this time.

Following the SAP requirements, the 3-D CI subcontractor, *NAEVA Geophysics, Inc*., completed the pinpointing of 825 DGM anomalies and the advanced classification of 548 of the 825-flagged DGM anomalies, which met the minimum sampling plan to achieve advanced classification of over 500 anomalies within a seven-day period. The field effort was also supported by research scientists from *NRL / NOVA Research* who were well versed with the design, operation, and repair of the TEMTADS as the entity responsible for housing the instrumentation, in order to ensure the project started correctly with any instrument repairs readily completed on-site at project outset. The twice-daily QC tests and IVS passes, with 3-D CI data sandwiched between, were acquired and evaluated to be within standard industry metrics for both (*Trimble* RTK-DGPS) position accuracy and (*NRL* TEMTADS) TDEM quality standards under the guidance and within the metrics of MRP SOP 08, MRP SOP 09, and Worksheet #12, respectively. In addition to the SAP requirements, the 3-D CI staff worked with site management to prepare anomaly maps for Resolution Consultants' Field QC Scientist to not only evaluate preliminary results but also lead the process of down-selecting DGM anomalies for advanced classification analyses. The Resolution Consultants' down-selection process was two-fold: 1) eliminated difficult-to-resolve anomalies (e.g., grid edge, very weak, or very large anomalies without a solid discernible peak); 2) maintained a sample percentage cap from each grid. Then intent of the down-selection was to preserve a representative sample from each category (e.g., 1, 2, 3) within each grid to prevent skewing the results via biased sampling within a large dynamic range.

In summary, the 3-D CI team with support from *NRL* reps worked with the SUXOS, UXOQCS/UXOSO, and Field QC Scientist to conform to the following protocols:

- Avoided surveying within the same proximity of the vegetation removal crews;
- Followed the directives from the UXO Tech escort, along with safety precautions and field procedures, all in accordance with MRP SOP 01 (Anomaly Avoidance), MRP SOP 08 (Anomaly Reacquire Procedures / Management), and MRP SOP 09 (Advance Classification Procedures / Management);
- Documented QC checks and tabulated against Worksheet #12 metric standards; and
- Leveraged the library catalogued TEMTADS-2x2 responses from surface or exposed to surface MPPEH items to search for duplicates in the production area even if they cannot be clearly identified**.**

In addition to the SAP requirements, the Resolution Consultants site management coordinated with the 3-D CI team to revisit each surface (i.e., fully visible) or exposed to surface (i.e., only crown visible) MPPEH item to record TEMTADS-2x2 data directly over each location. Subsequently, the recorded readings were catalogued in the library to compare to other locations captured as part of the advanced classification assessment of subsurface DGM anomalies. As a corollary to this process, the analysis of each of the MPPEH items provided enough information to confirm or deny the presence of ordnance-shaped materials, which supplemented the SUXOS visual re-inspection process to determine whether each re-assessed item identity remained as MPPEH or relabeled as benign pieces of scrap metal. Any unidentifiable items via visual and/or 3-D CI means, particularly those of a spherical nature (e.g., underwater mine, crude boat anchor), were conservatively classified as MPPEH. The results of the evaluation are summarized in CHAPTER 3 – PRODUCTION RESULTS.

Concurrent to the pinpointing and interrogation of DGM anomalies, both the UXO Tech escort and UXOQCS/UXOSO conducted safety audits regularly while the Field QC Scientist conducted quality inspections relative to the Worksheet #12 metrics. Furthermore, the 3-D CI subcontractor used the same static GPS position checks and modified static version of IVS to validate the adequacy of the data fidelity. In turn, the data fidelity were evaluated during Internal QC Monitoring Assessments (Section 4.1) and confirmed during Independent QC Inspections (Section 4.2), as summarized within CHAPTER 4 – QC PERFORMANCE. During the Geophysics Phase-II portion of the project, all QC tests were recorded statically to simulate quality aspects during standard stationary instrument operation of both Pinpointing and Advanced Classification of DGM Anomalies. Finally, example photographs of each Geophysics Phase-II activity are provided in **Photo 2-10**.

Photo 2-10. Geophysics Phase-II Field Activities Conducted at FKDSA. Photo Collage shown includes example images of: (1) *Trimble* RTK-DGPS anomaly pinpoint flagging, then (2) *NRL* TEMTADS-2x2 advanced classification of surface MPPEH, followed by (3) *NRL* TEMTADS-2x2 advanced classification of subsurface DGM anomalies.

2.4 Project Closeout Activities

Following the minimum requirements for Project Closeout as specified within the SAP, Resolution Consultants' completed the following tasks prior to demobilizing from site:

- <u>Ensured</u> thoroughness of all field sheets, checklists, and digital records which summarize QC inspections (tabulated in Worksheets #34, #35, and #36 of SAP document) and data deliverable requirements (listed in Worksheets #12, #14, #22 of the SAP document);

- <u>Evaluated</u> each task to determine whether the project deliverables provided from the field met the Data Usability criteria (listed within Worksheet #37 of the SAP document);

- <u>Scanned</u> field forms / logbooks for nightly preservation on digital recording devices (e.g., computers, File Transfer Protocol, Compact Disk [CD], DVD);

- Shipped all original logbooks and field record hard copies for corporate office storage; and
- Prepared the IVS, the Test Pit, the blind seeds, the tubular metal RLS stakes, and the metal rebar surface anomaly avoidance stakes to reside on site for future field activities**.**

Upon completion, the associated field crews from each task were demobilized from the site. Specifically, the last days on-site for personnel associated with the RLS crew, vegetation removal crew, DGM team, and UXO site management were May 30th, June 7th, June 17th, and June 18th, respectively. Of all activities, only the vegetation removal crew and RLS exceeded their allotted calendar schedule. However, as shown in the schedule (**Table 2-3**), the overall start-to-finish schedule of the project as a whole was held in tact.

Table 2-3
Projected vs. Actual Schedule for Field Activities for FKDSA ESI Non-Invasive Assessment

Task #	Name	WBS	# Days	*Projected* Start	*Projected* Finish	*Actual* Start	*Actual* Finish	# Days
2.1	Registered Land Surveyor	FI.SU	1	8-May-13	8-May-13	8-May-13	8-May-13	1
2.2 / 2.3	Vegetation Removal / UXO Anomaly Avoidance	FI.MS / FI.XO	10	9-May-13	22-May-13	9-May-13	7-Jun-13	22
2.1	Registered Land Surveyor	FI.SU	2	22-May-13	24-May-13	24-May-13	30-May-13	2
2.?	Holiday (Memorial Day)	NA	1	27-May-13	27-May-13	27-May-13	27-May-13	1
2.4 / 2.5	Geophysical Surveys / Anomaly Pin-Pointing	FI.GE	10	28-May-13	10-Jun-13	28-May-13	7-Jun-13	9
2.5	Cued Interrogation	FI.GE	5	11-Jun-13	17-Jun-13	10-Jun-13	17-Jun-13	7

The final project closeout activity is the preparation of this ESI Report summarizing the investigation.

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3.0 PRODUCTION RESULTS FROM ESI FIELD ACTIVITIES

This chapter presents the production results for the ESI Field Activity DFWs. The results of the project startup and project closeout DFWs are considered QC in nature and therefore are covered in CHAPTER 4.0 - QC PERFORMANCE. The other DFWs have production results that are data related and are presented in this chapter. These distinctions are clarified through a modified version of **Table 2-1**, provided as **Table 3-1**.

Table 3-1
Modified DFW Listing Appended to Include Two Distinct Assessment and Data Types

Definable Feature of Work [Field Activity]	Assessment Type	Chapter # (Data Type)	SOP	Supporting Doc(s)
Project Startup [includes: Mobilization, Security, Equipment Verification, IVS construction, BSP]	SURFACE and SUBSURFACE	CHAPTER 4.0 (QUALITY)	NA	SAP, HASP, & ESS-DR
Anomaly Avoidance	Primarily SURFACE; SUBSURFACE for safety precautions only	CHAPTER 3.0 (PRODUCTION)	MRP SOP 01	SAP & ESS-DR
Vegetation Management	SURFACE	CHAPTER 3.0 (PRODUCTION)	MRP SOP 04	SAP & ESS-DR
Survey Management		CHAPTER 3.0 (PRODUCTION)	MRP SOP 05	SAP & ESS-DR
MEC Management [includes: Inspection and Disposal of MPPEH, MEC Demolition & Disposal Operations]	SURFACE	CHAPTER 3.0 (PRODUCTION)	MRP SOP 02, and MRP SOP 03	SAP & ESS-DR
Geophysics Management (includes: DGM Transect Surveys, DGM Grid Surveys, Anomaly Pin-Pointing, Three-Dimensional (3-D) Cued-Interrogation (CI) with Advance Classification]	SUBSURFACE	CHAPTER 3.0 (PRODUCTION)	MRP SOP 06, MRP SOP 07, MRP SOP 08, and MRP SOP 09	SAP & ESS-DR
Project Closeout [includes: FI data deliverables check relative to ESI reporting, demobilization]	SURFACE and SUBSURFACE	CHAPTER 4.0 (QUALITY)	NA	SAP & ESS-DR

The following sections summarize the production results for the surface and subsurface assessments associated with the anomaly avoidance, vegetation management, survey management, MEC management, and geophysics management DFWs.

3.1 Surface Assessments

Resolution Consultants completed the following three key efforts as part of the surface assessments:

- first, re-inspected the twenty-two (22) items identified in the limited SI and resolved the list down to four (4) MPPEH items prior to conducting vegetation removal activities;
- second, encountered two (2) new MPPEH items during surface anomaly avoidance assessments as a part of site preparation for vegetation removal activities; and
- third, tracked progress and suggested methods for improvement while safety escorting and QC inspecting each team during implementation of field activities.

The daily surface assessment activities were documented within MEC Management Field Forms / Logbooks (**Appendix A**) while the six (6) MPPEH items are listed in the MPPEH Discovery/Accountability Log and MPPEH Photo-Log (**Appendix B**). The forms are primarily checklists verifying SAP required activities were completed while logbook entries are documentation of hourly timeline events. As a footnote regarding the MPPEH Photo-Log, the document includes relevant **red text** comments added after the TEMTADS-2x2 3-D CI advanced classification assessment of the six surface MPPEH items as feedback to confirm or deny each item as originally identified. As a result, the only surface visible MPPEH item that did not match characteristic responses was the 20-mm and after careful re-examination arising from the feedback loop process, the UXO staff deemed the item unlikely to be as originally labeled.

A time-lapse visual representation of the surface assessment results are detailed in series of Geographic Information System (GIS) images as follows:

- The first GIS image (**Figure 3-1**) presents the multiple site-specific boundaries and surface features extracted from the historically relevant reports from both the Malcolm-Pirnie PA and TTTNUS limited SI which preceded this ESI. The re-occupation and re-inspection of the limited SI 22 surface finds (**green dots**) by the RLS crew working in conjunction with UXO-qualified staff during the ESI culminated in the surface assessment distributions detailed within second and third GIS images discussed below.
- The second GIS image (**Figure 3-2**) presents the estimated size and hazard class of each surface item re-occupied/re-inspected during the ESI. Sizes were grouped into three simple qualitative categories (i.e., small, medium, large) relative to ordnance size, defined by diameter. Small is less than or equal 40-mm, medium is greater than 40-mm but less than or equal to 81-mm, and large is greater than 81-mm. Hazard classes were also grouped into three categories (i.e., MPPEH, MDAS, Cultural Debris), whereby MPPEH is inclusive of all confirmed or suspect hazardous items, MDAS is material deemed ordnance-related but non-

hazardous (i.e., fully expended), and cultural debris is deemed all non-ordnance related material such as scrap metal or concrete structures related to the empty magazines. As shown in **Figure 3-2**, the circles have varying sizes and color-codes (i.e., **magenta**, **light blue**, and **grey)**. Additionally, for this figure only, the two **yellow circles** are indicative of the 2 newly encountered surface items during the ESI. These two items, one on the surface and one partially exposed to the surface, were initially identified as MPPEH by the SUXOS. Lastly, as can be seen by the size and color-code symbols on **Figure 3-2**, of the 24 total surface-visible items identified (i.e., 22 residual from limited SI and 2 new from ESI), 8 locations are large-cultural debris, 10 are small MDAS, and the remaining 6 are small/medium MPPEH.

- The third GIS image (**Figure 3-3**) presents the following: 1) first, the six (6) MPPEH items in **magenta** and 2) second, adds five (5) medium-sized **orange** circles representing the locations the inert-certified ISO seeds planted in the subsurface as part of the BSP verification of DGM coverage. As introduced in Section 2.3.1, the ISOs were required for detection/interpretation during the DGM Survey Field Activities. Additionally, as introduced in Section 2.3.2, both MPPEH and ISO items were selected for proper identification during the Anomaly Resolution Field Activities implementation of the *NRL* TEMTADS-2x2 3-D CI surveys with Advanced Classification. The actual ISO seed locations were compared to both the interpretation position accuracies from DGM data along with the modeled position accuracies from 3-D CI data as detailed in CHAPTER 4 – QC PERFORMANCE.

- The fourth GIS image (**Figure 3-4**) expands on **Figure 3-3** to include the actual RLS grid corner locations and vegetation removal boundaries as indicated by **dark red pluses** and **dark green outline**, respectively. Both the internal grid layout and vegetation boundary primarily fall within the planned **green line** spoils pile boundary The vegetation removal boundary was not extended completely to the W, N, and E borders since the physical features present along these borders (e.g., sloped terrain, metal debris, bunkers) would have severely impaired the effectiveness of achieving Anomaly Resolution at these locations.

3.2 Subsurface Assessments

Resolution Consultants completed the following two field activities as part of the subsurface assessments: **1)** DGM Survey Field Activities and **2)** Anomaly Resolution Field Activities.

3.2.1 DGM Survey Field Activities

Resolution Consultants supported the field performance and inspected quality for two DGM Survey Field Activities: 1) acquiring 4.5-miles of DGM transect data and 2) acquiring 3.0 acres of DGM grid data selected based on the transect results. In addition, Resolution Consultants UXO staff tracked progress and suggested methods for improvement while personnel escorting, safety auditing, and QC inspecting the teams' field conduct. The daily activities were documented within the MEC Management Field Forms / Logbooks (**Appendix A**). The results from both the *Geonics* EM61 all metals detector and *Geonics* EM31 terrain conductivity meter transect surveys are displayed in **Figure 3-5**, **Figure 3-6,** and **Figure 3-7,** respectively. The EM61 map displays channel 2 (CH2) while the EM31 displays in-phase and quadrature channels. The data gridding for these maps is over-exaggerated for providing an aesthetically pleasing presentation to simplify the demonstration of the grid selection process. The transect DGM maps are useful for qualitative interpretation of large-scale high metal content features (shown as hot or warm colors) indicative of high anomaly count areas for further assessment with grid DGM surveys followed by advanced classification.

Resolution Consultants' grid selection process surrounded the cluttered areas while maintaining a proximity to surface MPPEH items, avoiding closeness to installation infrastructure (e.g., storage bunkers, manhole covers), and preserving geographic distribution across the site. The results from the grid-pattern DGM surveys are shown in **Figure 3-8** with the anomaly densities provided in **Table 3-2**. As shown in the table column headers, the anomaly categories replicated the definitions in the SAP Worksheet #17 based on the minimum response thresholds from a 7.2-in Hedgehog (**> 13mV**), 76-mm Projectile (**> 5.6mV**), and 20-mm projectile (**> 3.5mV**) at the worst case orientation (i.e. horizontal), as groups 1, 2 and 3, respectively, from high to low EM response.

Table 3-2
Anomaly Density Results from FKDSA Full Coverage DGM Sample Grids

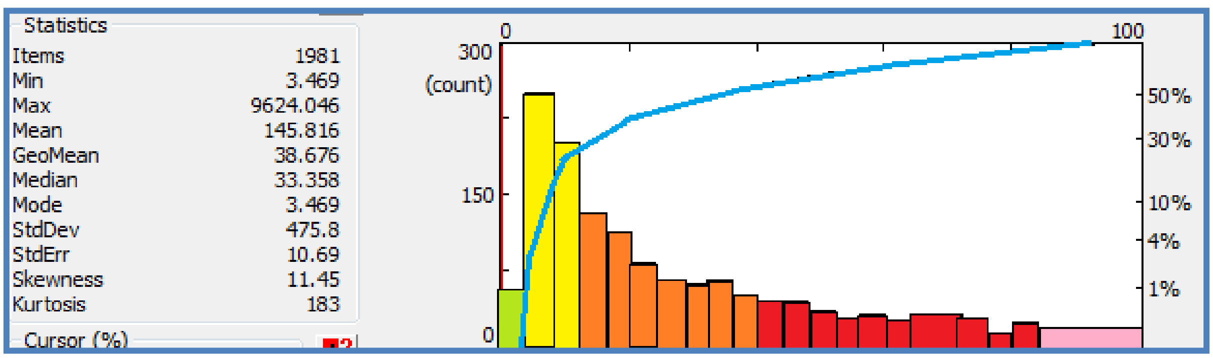
GRID ID	Category 1 (> 13mV)	Category 2 (>5.6mV)	Category 3 (>3.5mV)	# Targets Total	Grid Size	Target Density
F06	111	8	2	121	0.12	1052
D07	198	19	5	222	0.23	965
C09	103	35	15	153	0.23	665
C14	125	29	8	162	0.23	704
C17	33	31	24	88	0.23	383
C19	29	15	5	49	0.12	426
E20	92	23	11	126	0.23	548
F10	101	31	21	153	0.23	665
E13	98	44	17	159	0.23	691
F14	100	24	1	125	0.23	543
F18	95	18	16	129	0.23	561
H08	79	20	17	116	0.23	504
H11	71	27	6	104	0.23	452
D11	111	24	4	139	0.23	604
G16	90	33	12	135	0.23	587
TOTAL				1981		

The following three trends were observed from the color-coded display map and tabulated anomaly list for the dredge spoils area:

- first, the interpreted anomaly density is relatively high (i.e. density > 400 targets per acre);
- second, the anomaly densities follow the same trend as the surface MPPEH, with highest concentrations in the south tapering down slightly towards the north end of the site; and
- third, the majority of items appear to be stronger category-1 responses usually indicating the source is larger, closer to the surface, or both.

Transect-Pattern DGM and Grid-Pattern DGM maps (i.e., without GIS overlays) are provided in the first set of images of **Appendix C** for reference. Furthermore, a histogram distribution summarizing peak anomaly responses was generated below in **Table 3-3**, while a complementary depth distribution histogram is provided in the next section for comparison.

Table 3-3
Histogram of CH2 Peak Target Responses from ESI Sample Data at FKDSA



The color-coded bars in **Table 3-3** represent statistical bins, which correspond to the column headers in **Table 3-2**, such that green is **category-3**, yellow is **category-2**, and the remaining responses are incremental variants within **category-1**. Furthermore, the statistically-binned dynamic-range category whereby the majority of responses reside, as indicated by the cumulative total blue line, registers that less than 30% of all responses are in **category-2** and **category-3**, which leaves 70% within **category-1**. Since almost 2000 anomalies were identified in the 14 grids, not all of the anomalies could be evaluated with TEMTADS-2x2 3-D CI with Advanced Classification as that would extend well-beyond the planned field investigation schedule to assess at least 500 anomalies. As such, Resolution Consultants Field QC Scientist guided NAEVA Geophysics on reprioritizing the anomaly count in preparation for the Anomaly Resolution Field Activities portion of subsurface assessments from the original interpreted total of 1981 peak locations down to 825 prioritized locations distributed across the 14 grids, while maintaining the approximate histogram distribution introduced in **Table 3-3** as best possible.

3.2.2 Anomaly Resolution Field Activities

Resolution Consultants supported the field performance and inspected the quality for three Anomaly Resolution Field Activities: 1) TEMTADS-2x2 recording and library cataloguing of the six surface MPPEH items; 2) Anomaly Pinpoint flagging of the 825 prioritized locations from the DGM Survey Activities; and 3) TEMTADS-2x2 3-D CI with Advanced Classification of the flagged anomalies. In addition, Resolution Consultants UXO staff tracked progress and suggested methods for improvement while safety escorting and QC inspecting the teams' field conduct. The daily activities were documented within the MEC Management Field Forms / Logbooks (**Appendix A**) and MPPEH Discovery/Accountability/Photo Logs (**Appendix B**). The relevance of the Logs are that the results from the first step, discussed next, provided vital feedback to the UXO staff for those items that, as shown from the images captured in the Photo Log, could not be fully inspected due to visibility impairments.

According to the MPPEH Logs, each of the six (6) items were sequentially labeled as: 1) partially buried 0.50 caliber casing; 2) predominately buried unknown item; 3) partially exposed 75-mm unknown item; 4) partially exposed small round characterized as a 20-mm, conservatively labeled unconfirmed HE; 5) partially exposed unknown projectile; and 6) 37-mm fully exposed on surface. The first four MPPEH items were originally characterized by TTNUS during the limited SI while the last two MPPEH items were newly encountered and identified by Resolution Consultants during the ESI. After acquiring the suite of 3-D CI readings with the TEMTADS-2x2 stationary over each of the six (6) MPPEH items, each data set was inverted for modeling parameters which, in turn, portray certain physical features (e.g., shape, material properties, size) of the metal objects in comparison to ordnance related items already in the library. The preliminary results of the surface-visible MPPEH assessment portion of Anomaly Resolution are displayed in a series of six images in the second set of maps after DGM Survey maps within **Appendix C** for reference. **Table 3-4**, below, summarizes the results from the Advanced Classification assessment of the six (6) surface-visible MPPEH items.

Table 3-4
Feedback from 3-D CI with Advanced Classification of Six Surface-Visible MPPEH Items

MPPEH PHOTOLOG		ADVANCED CLASSIFICATION ASSESSMENT			
ID#	Original Identification	Relative Size, Geometric Shape	Confidence Metric	Library Match?	In-Line with Expectations?
1	0.50 caliber SAA	extremely small symetric	Too Small	Yes, to shape	Yes, 0.50 caliber SAA
2	unknown projectile	large fully-symmetric, spherical	Not in Library	No	No, unknown spherical object
3	75-mm unknown	large axial-symmetric, projectile	93%	Yes, to all	Yes, but larger 105-mm HEAT
4	20-mm projectile	small non-symmetric, junk	<< 50%	No	No, not ordnance related
5	unknown projectile	large fully-symmetric, spherical	Not in Library	No	No, unknown spherical object
6	37-mm projectile	small axial-symmetric, projectile	87%	Yes, to all	Yes, 37-mm projectile

Both the 37-mm High Explosive (HE) projectile and 105-mm High Explosive Anti-Tank (HEAT) round were added to supplement the pre-fabricated industry-sponsored ordnance library. Due to the inadequate match percentage (< 50%) for the 20-mm projectile, the result triggered feedback loop communication to the UXO staff which, in-turn, lead to a re-inspection referenced in Section 3.1 and the conclusion that the item was not a 20-mm projectile as initially thought. Therefore, the prospective 20-mm MPPEH item was no longer an item of interest. The two unknown items were not added to the project-specific search library because there were no close identifiers; however, the two unknown items garnered attention of the Field QC Scientist to ensure that careful attention was paid towards significant-sized, fully-symmetric anomalies (inferred to be spherical items), as observed during the Advanced Classification reviews. Although fully-symmetric items are not commonplace as opposed to axial-symmetric shapes of most ordnance items, the (rare) potential of underwater mines or other spherical-shaped munitions still exists and, as such, repeated occurrences were flagged (i.e., manually moved up the priority list) for future intrusive investigations. Ultimately, this manual override not only demonstrates that the library is incomplete (i.e., not a fully stocked mature library yet) but also conveys the importance of upgrading the library after confirmation sampling is completed for the benefit of future projects.

After the 825 anomalies were Anomaly Pin-Point flagged and the TEMTADS-2x2 3-D CI process commenced (**see Photo 3-1**), it was readily apparent that evaluating all 825 anomalies within the planned schedule (which was based on the upper echelon of production rates listed in published reports) was not feasible. Therefore, the Resolution Consultants Field QC Scientist prioritized the anomaly lists from the EM61 grid data maps so the field crew could navigate to an achievable goal of at least 550 anomalies, which also met the minimum planned assessment of 500 anomalies.

Photo 3-1. Anomaly Resolution Field Activities. Image represents conducting 3-D CI with the TEMTADS-2x2 system.

Anomaly prioritizations were completed by Resolution Consultants Field QC Scientist primarily based on properties of anomalies which were observed in the field to be consistently difficult to resolve due to positional offsets or signal intensities, or combination thereof, which required chasing multiple reoccupations and resulted in less confident modeling results with Advanced Classification. For explicit reference, the three most common anomaly types downgraded were:

- first, anomalies near (with peak response inferred outside of) grid edges;
- second, 2nd or 3rd peak locations selected on edge of large anomaly; and
- third, extremely small responses regarding both size and amplitude.

After all anomalies recorded with the TEMTADS-2x2 3-D CI system were evaluated for quality, the number of fully resolvable anomalies after careful evaluation by NAEVA Geophysics was determined to be 548 anomalies across the 14 grids (equating to approximately 3.2-acres, or 16% of the 20-acre spoils pile). The results from the numerical percentage analysis of the down-selection process are summarized within **Table 3-5**. By completing advanced classification on the 548 anomalies, Resolution Consultants exceeded the minimum planned assessment of 500 anomalies by approximately 10%.

Table 3-5
Transparent Breakdown (Relative to % of Original Total) of the Anomaly Down-Selection

Flag'd Category 1 (> 13mV)	Flag'd Category 2 (>5.6mV)	Flag'd Category 3 (>3.5mV)	# targets flagged	% targets flagged	TEM'd Category 1 (> 13mV)	TEM'd Category 2 (>5.6mV)	TEM'd Category 3 (>3.5mV)	# targets TEM'd	% targets TEM'd	GRID ID
24	1	0	25	21%	23	1	0	24	20%	F06
44	4	2	50	23%	44	4	1	49	22%	D07
28	13	9	50	33%	28	12	9	49	32%	C09
55	12	8	75	46%	32	3	0	35	22%	C14
28	16	6	50	57%	22	10	2	34	39%	C17
19	4	2	25	51%	15	3	2	20	41%	C19
31	9	10	50	40%	23	6	5	34	27%	E20
37	21	17	75	49%	34	14	4	52	34%	F10
55	17	3	75	47%	27	6	1	34	21%	E13
35	14	1	50	40%	22	8	0	30	24%	F14
43	16	16	75	58%	32	5	5	42	33%	F18
26	12	12	50	43%	23	9	7	39	34%	H08
34	11	5	50	48%	27	7	1	35	34%	H11
38	10	2	50	36%	31	1	1	33	24%	D11
58	13	4	75	56%	32	4	2	38	28%	G16
			825	42%				548	28%	TOTAL

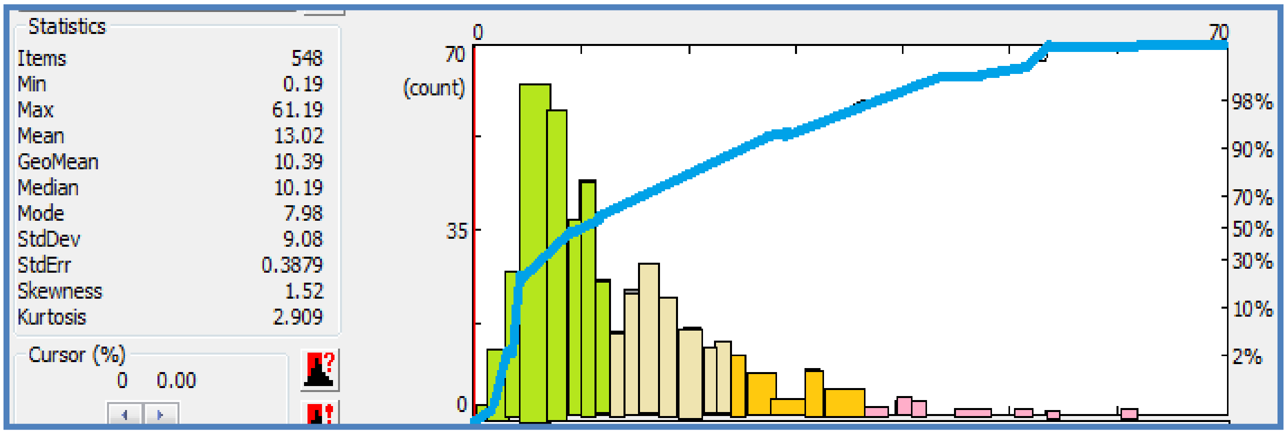
Each of the 548 anomalies above were then inverted for the three polarizability curves and associated modeling parameters which, in turn, paints a picture of physical properties (e.g. size, shape, composition, aspect ratio, depth, wall thickness) of each anomaly. For example, there is dual polarizability overlap for most ordnance due to elongated axial-symmetric "bullet" shape (e.g., 76-mm projectile, 7.2-in Hedgehog) or triple polarizability overlap for isolated cases of fully-symmetric "spherical" shaped items, while non-symmetric shapes (e.g., anchor) are not targets of interest (TOIs). Thus, each modeled property correlates to the physical properties of the ordnance items including shape and physical characteristics inherent to their structural design.

Example polarizability curves are shown in the lower left corner, as part of the library match plot, from the surface MPPEH assessment portion of Anomaly Resolution in **Appendix C**. These polarizability curves and associated parameters of the 548 anomaly locations were compared to the Fleming Key specific library items. The library consisted of the industry-sponsored library concatenated with the responses catalogued from the aforementioned MPPEH items and simulated inert items (e.g., 20-mm, 57-mm, 76-mm) emplaced in the test pit as introduced in Section 2.3, to determine the best match to a library item. Once completed, the anomalies were reviewed, sorted, and preliminarily ranked into three priorities primarily based on a combined confidence metric. At this stage, a confidence metric less than 0.7 immediately places the item in priority 3, a 'no dig' category, while anomalies with a confidence metric match greater than this were placed in either priority-2 or priority-1, both ordnance related dig categories. The terms 'dig' and 'no dig' categories are standard advanced classification terms which simplified the recommendation that these anomalies have a high and low confidence level, respectively, to be ordnance related and are ranked according to their similarity to ordnance TOIs.

Subsequent to the preliminary ranking of all 548 anomalies, the Resolution Consultants' Field QC Scientist reviewed the ranked results with NAEVA Geophysics in order to modify the list based on practical information from the site history (e.g., spherical shaped MPPEH). Ultimately, the step required manually moving anomalies with unique polarizability curves into the dig priority TOIs to rectify anomalies perceived to have poor confidence metrics only because the items currently do not exist in the library, not because the anomalies don't have a high probability as MPPEH. Even with incorporating a conservative approach of including unique items, only 123 of the anomalies assessed, or 22%, were deemed to have ordnance related signatures which leaves a residual 78% of anomalies were classified as non-TOIs and thus not ordnance related.

The last step invoked by the Field QC Scientist was to incorporate both depth estimates and the qualitative measure of size (e.g., small, medium, large), defined by diameter, to convey the distribution of items both vertically and spatially. A CH2 histogram with a complementary depth histogram was generated below as **Table 3-6** for direct comparison.

Table 3-6
Histogram of Depth Estimations from ESI Advanced Classification Data at FKDSA



The color-coded bars in **Table 3-6** represent statistical bins, which correspond depth ranges at 1-ft increments. Green is **0-ft to 1-ft**, tan is **1-ft to 2-ft**, gold is **2-ft to 3-ft**, and the remaining pink outcrops are **3-ft up to 5-ft**, the deepest items registered through both the detection and classification schemes. Reverting back to the discussion regarding **Table 3-3**, the skewing of the CH2 peak anomaly responses towards the upper echelon appears to be because the majority of the anomalies detected are expected to be shallower than 1-ft with greater than 90% of the anomalies at less than 2-ft below ground surface (bgs). Resolution Consultants completed spatial distribution displays through incorporation of qualitative measure of size (e.g., small, medium, or large) onto a series of GIS maps (**Figure 3-9**, **Figure 3-10**, and **Figure 3-11**) for Priority-1 **red circles** and Priority-2 suspected MPPEH items as **yellow circles**, whereby symbol size changes for the qualitative measure of size. The previously defined medium-sized **orange** circles remained at the locations the inert-certified ISO seeds for reference, as each of these seeds were successfully placed in Priority-1 during the advanced classification process (as further elaborated in CHAPTER 4.0).

From the Advance Classification High Correlation Library Match (i.e., Priority-1) GIS Map (**Figure 3-9**), the trend appears to follow the same as the surface MPPEH finds that the further north or towards the far east, there appears there may be a point (which would require further delineation) where the amount of ordnance related material tapers off. From the Advance Classification Medium Correlation Library Match (i.e., Priority-2) GIS Map (**Figure 3-10**), the trend appears to follow the same as the surface MPPEH finds that the further north the amount of ordnance related material tapers off. Lastly, the perceived presence of subsurface MPPEH for the concatenated dig priority (of priority-1 and priority-2), is summarized in **Figure 3-11**. The breakdown of classification priority, dig priority, and size distributions were analyzed in a series of pie charts in **Figure 3-12**. The short synopsis is that dig priority anomalies are conservatively less than 25% of all anomalies evaluated and the dig priority is heavily weighted towards ordnance items of a larger size than smaller size. This is consistent with the symbiotic relationship demonstrated between the DGM CH2 peak response histogram (**Table 3-3**) and complementary estimate depth histogram (**Table 3-6**), culminating in the conclusion that the majority of the metallic items appear to be large and primarily within the first few feet of the ground surface. However, given the general detection to depth limitation of standard EM61-MK2 sensors of 11 times diameter, we cannot say anything definitive about whether smaller ordnance items are below 1 or 2 feet (depending on the size of the item) at this time due to inherent depth of detection limitations from the DGM surveys. For example, the two most common small ordnance items of interest expected at the FKDSA site, the 20-mm projectile and 37-mm projectile, are only reliably detected to within 9–12 inches and 16–20 inches, respectively, depending on orientation.

The Final Ranked Anomaly List (**Appendix D**) also provides some specifics of what types of ordnance related items are the most common within the Priority-1 and Priority-2 lists. The most common matches within the Priority-1 list large-sized portion are exclusively 105-mm projectiles (inclusive of a match to surface MPPEH item #3 as 105-mm HEAT) and 5-inch projectiles, both of which are between 4-5-inches in diameter and 20-25 inches long metal bodies. The medium and small sized primarily line-up with 60/81-mm mortars and 20/37-mm projectiles, respectively. The most common matches within the Priority-2 list large-sized items almost exclusively mirrors the Priority-1 list with exception of the introduction of the 76-mm projectile, a newly catalogued item with full shell casing seeded within the Test Pit. The Priority-2 matching may simply be the case of discrepancies between museum-like condition of the seeded item in the test pit versus condition of the perspective item in the ground. As elaborated in the next chapter, all BSP ISO seeds made the top of the Priority-1 lists. For additional details regarding data sets or graphic summary images associated with each transect, grid, or anomaly, associated with the DGM Survey Field Activities or Anomaly Resolution Field Activities, refer to **Appendix E** and **Appendix D**, respectively.

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4.0 QC PERFORMANCE OF ESI FIELD ACTIVITIES

This chapter presents the QC performance results for the ESI Field Activity DFWs. QC Performance encompasses all DFWs listed in **Table 2-1** and **Table 3-1** for complete validation of the ESI Field Activities. The activities were grouped into either Internal QC Monitoring Assessments or Independent QC Inspections, dependent on whether the QC steps were conducted daily by the contractor as part of or evaluated regularly by Resolution Consultants UXOQCS and Field QC Scientist, respectively. Internal QC Monitoring requirements were listed within Worksheets #12, #14, #22, while QC Inspections were listed within Worksheets #34, #35, #36, with some overlap of Worksheet #12 pertaining to performance metrics. Ultimately, final validation of the ESI Field Activities was conducted in accordance with the Data Usability Checklist (Worksheet #37).

4.1 Internal QC Monitoring Assessments

Internal QC Monitoring Assessments were field measurements made on (at least) a daily basis by an individual contractor, vendor, or task lead to validate their individual performance on a DFW basis.

4.1.1 Project Startup

The project startup DFW was comprised of **nine** activities: **1)** Prepare/Review Project Plans; **2)** Site Mobilization, Setup, and Preliminary Activities; **3)** Site Access / Traffic Control; **4)** Site Security, **5)** Governing Regulation Guidance/Governing Explosive Safety Determination; **6)** Equipment Verification; **7)** IVS Construction; **8)** Initial IVS Passes with Letter Report; and **9)** Blind Seed Program.

4.1.1.1 Prepare and Review Project Plans

All project plans (e.g. SAP, HASP, ESS-DR) were reviewed with adequate pre-project startup signoff completed, therefore the prepare/review project plan bulleted line-items within the Project Startup DFW lines of the Measurement Performance Criteria Table (SAP Worksheet #12) and the first few line-items related to review project plans within the Data Usability Checklist Table (SAP Worksheet #37) have been completed.

4.1.1.2 Site Mobilization, Set-up, and Preliminary Activities

After setup and MRP SOP review, specifically focused on Anomaly Avoidance, the key safety measure, the mobilization set of items within the Project Startup DFW lines of the Measurement Performance Criteria Table (SAP Worksheet #12) and from the Pre-Survey elements of the Data Usability Checklist Table (SAP Worksheet #37) were considered completed.

4.1.1.3 Site Accessibility and Traffic Control

Accessibility has no QC metric, except note that site access was controlled during ESI Field Activities.

4.1.1.4 Site Security

Security has no QC metric, except note that site security was controlled during ESI Field Activities.

4.1.1.5 Governing Regulations/Guidance and ESS-DR

Governing Regulations have no QC metric, except note that all guidance requirements from the ESS-DR were in-place during all ESI Field Activities to maintain safe operations on site.

4.1.1.6 Equipment Verification

Equipment Verification steps were either completed by the UXO Tech II and SUXOS (for Analog instrument verification) or by a subcontractor (for RLS, vegetation removal, or Geophysics instrument verifications) on Day 1 prior to commencement of ESI Field Activities. The Day 1 set of Analog Instruments verification activities were detailed in Logbook Entries and Checklists within **Appendix A**, while the Day 1 set of DGM Instrument verification data is within **Appendix E** and summary reporting within **Appendix F**.

4.1.1.7 IVS Construction

IVS Construction has no QC metric, except to note that passes were completed, as detailed in the next section, prior to commencement of ESI Field Activities which followed.

4.1.1.8 Initial IVS Passes with Letter Report

As with Equipment Verification (Section 4.1.1.6), the Tech II / SUXOS completed and documented all IVS Passes, inclusive of the Day 1 in their **Appendix A** documentation. All IVS runs met the QC metrics of detecting all items as on Day 1. The IVS Passes with reporting for DGM activities were detailed in NAEVA's Geophysical Investigation Report provided within **Appendix F**.

4.1.1.9 Blind Seeding Program

The BSP has no subcontractor involvement for monitoring as BSP's are for independent QC inspection by the prime contractor's UXOQCS and Field QC Scientist of both the UXO Tech II's IAVS and the Geophysics subcontractor's DGM Subsurface Assessment detection rate(s).

4.1.2 Project Closeout Activities

Documentation of the collection of acceptable data is presented in **Figures 4-1 thru 4-5**. As noted below each figure caption, these figures were extracted from NAEVA's Geophysical Investigation Report provided within **Appendix F**. The figures provide acceptance proof for the geophysics contractor's static position, static response, dynamic positioning, dynamic responses, and confidence metric percentages. Figure displays for the blind seed results and incorporating other non-geophysics contractors are introduced in the Section 4.2, Independent QC Inspection Assessments.

As evidence for completion for each of the DFW task line items, the documentation for itemized DFW tasks as excerpted from Worksheet #14 are summarized in **Table 4-1** with the locations of documentation referenced.

Table 4-1
Reference Location(s) for Data Documentation of Individual DFW tasks from Worksheet #14 at FKDSA

Definable Feature of Work	Tasks	ESI Report Location(s)
Site Preparation [includes: Mobilization, Security, Equipment Verification, IVS construction]	• Prepare Project Plan (SAP review, geographic information system (GIS) setup, review documentation and data management procedures, approve SAP and subcontractors, and schedule confirmed) • Verify Personnel (gather personnel records, vet personal qualifications, obtain & maintain safety training certifications, and collect I-9 & other base access forms)	• Section 2.1.1, Section 4.1.1.2, Appendix A
	• Coordinate with local authorities (hospital, environmental director, explosive safety officer, etc.) and establish lines of communication after informal introductions	• Section 2.1.2, Section 4.1.1.2
	• Equipment set-up and checkout to ensure all parts were shipped, arrived, and are working to specification	• Section 2.1.6, Section 4.1.1.6
	• Remove non-munitions surface related debris; identify, mark (i.e., paint, cones, flagging), and position suspect munitions related items for anomaly avoidance	• Section 2.2.1, Section 3.1.1
	• Initial site orientation and safety training (including HASP / SAP review w/ signoff, emergency response discussion w/ handout of hospital map, contact number list)	• Section 2.1.1, Section 4.1.1.2, Appendix A
	• Install IVS (anomaly avoidance techniques, place seeds, leave holes open for Site Survey and/or DGM subcontractor, close holes, conduct initial survey)	• Section 2.1.8, Section 4.1.1.8
Anomaly Avoidance – transects, grids, and pathways for all field crews {**MRP SOP 01, 02, 03**}	• Detector-aided survey to locate metallic items, indicative of potential MEC/MPPEH, on the ground surface	• Section 2.2.1, Section 3.1.1
	• Metallic items clearly identified as recyclable material (i.e., cultural debris, MDAS), from the surface, without initially moving or prying from subsurface, will be placed into scrap buckets for subsequent proper disposal in locked storage bin by COB	• Section 2.2.1, Section 3.1.1
	• Metallic items clearly identified as an explosives hazard (i.e., UXO, MDEH) or suspected to have energetic material (i.e., MEC, MPPEH) from the surface will be documented (e.g., GPS, photograph, logbook), Left-In-Place (LIP), and flagged for anomaly avoidance while awaiting EODMU6 demolition	• Section 2.2.4, Section 3.1.4, Appendix A
	• UXO escort and anomaly avoidance duties, as needed, for all visitors and all other field tasks using non-essential personnel	• Section 2.2.1, Section 3.1.1

Table 4-1 (Continued)
Reference Location(s) for Data Documentation of Individual DFW tasks from Worksheet #14 at FKDSA

Definable Feature of Work	Tasks	ESI Report Location(s)
Vegetation Management {**MRP SOP 04**}	• Check Equipment for proper height • UXO Escort and MEC avoidance • Cut vegetation to proper height • Avoid cutting in close proximity (i.e., 5-10 ft) to large metal or concrete features (e.g., magazines, fences, etc.) which could damage equipment and would interfere with DGM instruments to a level of producing an indiscernible product • Requires full-time UXO Tech for escort and anomaly avoidance	• Section 2.2.3, Section 3.1.3, Figure 3-4, Appendix A • Section 2.2.1, Section 3.1.1
(Land) Survey Management {**MRP SOP 05**}	• Survey benchmarks and establish control points for all future coordinate checks on-site • Survey site boundaries with Theodolite, RTS, GPS, or conventional • Survey internal grid system (at **100 ft** square grid increments, aligned N-S-E-W) using Theodolite, RTS, GPS, or conventional means • Avoid surveying in close proximity (i.e., 5-10 ft) to large metal or concrete features (e.g., magazines, fences, etc.) which could damage equipment and would interfere with DGM instruments • Survey IVS (end points and location of items down-hole) • Requires full-time UXO Tech for escort and anomaly avoidance	• Section 2.2.3, Section 3.1.3, Figure 3-4, Appendix A • Section 2.1.9, Table 2-2 • Section 2.2.1, Section 3.1.1
Geophysics Management Phase I [*includes: DGM Transect & Grid Surveys* {**MRP SOP 06 & MRP SOP 07**}	• DGM transect-pattern surveys to locate metallic items, indicative of potential MEC/MPPEH densities, in the subsurface • DGM grid-pattern surveys to be conducted at areas of interest as identified by either groups of surface MEC/MPPEH finds (as documented in the PA / SI / ESI surface assessments) or elevated densities of MEC/MPPEH (as documented by the elevated anomaly count in the ESI DGM transect surveys) • Data will be downloaded from digital logger each evening and sent (i.e., email, ftp, etc.) to the home office for processing and Field Scientist for record keeping; the data will be maintained on the digital logger for 1 week, or until hard drive is full, for a redundant source of backup for site personnel	• Section 2.3.1 Section 3.2.1 Figure 3-5 thru Figure 3-8, Appendix C • Appendix E

Table 4-1 (Continued)
Reference Location(s) for Data Documentation of Individual DFW tasks from Worksheet #14 at FKDSA

Definable Feature of Work	Tasks	ESI Report Location(s)
Geophysics Management Phase I (cont'd) [*includes: DGM Transect & Grid Surveys* {**MRP SOP 06 & MRP SOP 07**}	• All Raw data, QC test (i.e., static, IVS) results, and preliminary processed production data, inclusive of fidelity evaluations (i.e., sample separation, footprint coverage, seed detection, etc.), will be tracked in the appropriate database table with both data and tracking uploaded to the ftp site within 24 hrs • Processed data with preliminary results (i.e., color-coded map showing currently identified areas of interest and historically relevant GIS data) will be uploaded within 48 hours • End-product deliverables with final processed data, *Geosoft* template color-coded map with discrete targets, and target database tabulations will be uploaded within 96 hours	• Appendix E, Appendix F • Appendix C, Appendix E • Appendix F
Geophysics Management Phase II [*includes: Anomaly Pin-Pointing, 3-D CI with Advanced Classification*] { **MRP SOP 08 & MRP SOP 09**}	• Anomaly pin-pointing to flag the peak location, record the peak response, and record the offsets from the original interpretation location • Cued-Interrogation to record the static response over nearest location, within 40cm, that infers a peak response from the previously pin-pointed peak anomaly location • All Raw data, QC test (i.e., static for anomaly pin-pointing or IVS for cued interrogation) results, and preliminary processed interrogation data will be tracked in the appropriate database table and uploaded to the ftp site within 24 hrs • End-product deliverables with final processed data, database tabulations, visual representations, and decision-making summaries, inclusive of confidence metrics, completed within 48 hours and uploaded to ftp site within 72 hours	• Section 2.3.2, Section 3.2.2, Figure 3-9 thru Figure 3-11, Appendix C • Appendix D, Appendix E, Appendix F • Appendix E • Appendix F
Project Closeout Phase I [*includes: FI data deliverables check relative to ESI reporting*]	• Gather and QC all field documentation, inclusive of logbooks • Conduct final QC inspections / audits to ensure all FI data reporting deliverables required to complete each DFW, as referenced in **Worksheets 12 and 22**, are completed before demobilizing personnel and equipment	• Appendix A • Section 4.1 (Assessment), Section 4.2 (Inspection)

Table 4-1 (Continued)
Reference Location(s) for Data Documentation of Individual DFW tasks from Worksheet #14 at FKDSA

Definable Feature of Work	Tasks	ESI Report Location(s)
Project Closeout Phase II [*includes: Demobilization*]	• Discuss with client whether IVS should be removed or remain for future field operations (as ESI results may drive decision) • Return rental pool of vehicles and other field equipment to home office or owners/operators of said equipment	• Section 2.4.1, Section 2.4.2

4.2 Independent QC Inspections

Resolution Consultants conducted independent QC Inspections (audits) of individual contractors on (at least) a daily basis to validate the individual performance on a DFW basis.

4.2.1 Project Startup

The project startup DFW was comprised of **nine** activities: **1)** Prepare/Review Project Plans; **2)** Site Mobilization, Setup, and Preliminary Activities; **3)** Site Access / Traffic Control; **4)** Site Security, **5)** Governing Regulation Guidance/Governing Explosive Safety Determination; **6)** Equipment Verification; **7)** IVS Construction; **8)** Initial IVS Passes with Letter Report; and **9)** Blind Seed Program.

4.2.1.1 Prepare and Review Project Plans

Plans were prepared and subsequently reviewed by all required field staff as referenced in Section 4.1.1.1.

4.2.1.2 Site Mobilization, Set-up, and Preliminary Activities

Mobilization, set-up, and preliminary activities were completed as referenced in Section 4.1.1.2.

4.2.1.3 Site Accessibility and Traffic Control

Accessibility has no QC metric, except note that site access was controlled during ESI Field Activities.

4.2.1.4 Site Security

Security has no QC metric, except note that site security was controlled during ESI Field Activities.

4.2.1.5 Governing Regulations/Guidance and ESS-DR

Governing Regulations have no QC metric, except note that all guidance requirements from the ESS-DR were in-place during all ESI Field Activities to maintain safe operations on site.

4.2.1.6 Equipment Verification

Equipment Verification QC audit inspections were either completed by the UXOQCS/UXOSO (for Analog instrument verification) or combination of UXOQCS/UXOSO and Field QC Scientist (for RLS, vegetation removal, or Geophysics instrument verifications) on Day 1 prior to commencement of ESI Field Activities. The daily set of inspections are detailed in UXOQCS / Field QC Scientist Checklists within **Appendix A**, while the daily recorded DGM data sets for QC inspection data is within **Appendix E** and figure summaries within **Appendix G**.

4.2.1.7 IVS Construction

IVS Construction activities were completed as referenced in Section 4.1.1.7 and **Table 4-1**.

4.2.1.8 Initial IVS Passes with Letter Report

Initial IVS Passes with summary reporting activities were completed as referenced in Section 4.1.1.8.

4.2.1.9 Blind Seeding Program

As mentioned in Section 4.1.1.9, the BSP has no subcontractor involvement for monitoring as BSP's are for independent QC inspection by the prime contractor's UXOQCS/UXOSO and Field QC Scientist of both the UXO Tech II's IAVS and the Geophysics subcontractor's DGM Subsurface Assessment detection rate(s). The project time-line figure representation of the tallied results demonstrating 100% recovery, detection, pin-pointing, and identification, for all blind seeds placed for testing the respective IAVS surface assessments, DGM subsurface detections, reacquisition of subsurface DGM anomalies, and 3-D CI subsurface classifications is provided as **Figure 4-6**. A key distinction is that not only were all blind seeds located within the Worksheet #12 QC metric tolerances (as indicated by the **red --- line** in the figure), the blind seed ISOs were explicitly labeled correctly in the Priority-1 portion of the Final Ranked Anomaly List (**Appendix D**). The importance of understanding the upper echelon ranking of the blind seeds is the fact that the quality of data and modeling results are validated by the high fit coherence and confidence metrics as reported for each of the ISOs in **Table 4-2**.

Table 4-2
Documentation of Proper ID, High Fit Coherence, and High Confidence Metric for BSP at FKDSA

FKDSA Grid ID	TEMTADS 3-D CI ID	Adv. Class. Priority-1 Ranked ID	Adv. Class. Labeled ID	Modeled Data Fit Coherence	Modeled Data Conf. Metric
D07	100171	#1	Small ISO	0.9993	0.9817
C09	170034	#8	Medium ISO	0.9969	0.9608
F14	150040	#7	Medium ISO	0.9993	0.9624
C14	210045	#5	Medium ISO	0.9999	0.9697
D11	220035	#3	Medium ISO	0.9986	0.9728

For frame of reference, the closer the number is to 1 (considered representative of 100%, or perfect) for fit coherence and confidence metric is best, as fit coherence and confidence metric values are a representation of how well multiple data readings consistently overlap and how well the modeled data matched a catalogued signature from a known library item, respectively.

4.2.2 Project Closeout Activities

Documentation of the collection of acceptable data is presented in nine consecutive figures in **Appendix G**. The Resolution Consultants Field QC Scientist generated all figures for documenting the results of independent QC inspections of each key aspect of QC detailed in the SAP. The few deviations in quality from the SAP requirements lead to either (a) rework of failures or (b) annotation of failures due to an isolated storm event. Afternoon electrical storm events temporarily caused ambient noise but did not affect data before or after the isolated weather events as demonstrated by the bookending of acceptable QC inspection results. The single rework event of recollection of transects is further documented in **Appendix F**, while both rework and annotation events have symbol overlays which reflect the basic QC nature as referenced in the legends on the **Appendix G** figures. Modified Worksheet #12 and Worksheet #22 are provided below as **Table 4-3** and **Table 4-4**, respectively, to document the individual reference locations for each Internal QC Assessment (Section 4.1) or Independent QC Inspection (current section) portion of the Project Closeout Phase-I.

Modified versions of verification and validation Worksheets #34, #35, and #36 from the SAP revised to include reference locations for each line of evidence, are provided below as **Table 4-5**, **Table 4-6**, and **Table 4-7**, respectively. With full documentation provided, the ESI Field Activities have final validation through the Data Usability Checklist (Worksheet #37) provided below as **Table 4-8** and revised to include verification comments.

Since each contractor completed all Internal QC Assessment results and Resolution Consultants completed all Independent QC Inspection audits, full demobilization occurred.

Table 4-3
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #12 at FKDSA

Definable Feature of Work	ESI Report Reference Location(s)	QC Sample and/or Activity to Assess Performance	Measurement Performance Criteria	Frequency
Site Preparation [*includes: Mobilization, Security, Equipment Verification, IVS construction*]	Table 4-1	Verify that approved project plans are reviewed and signed Verify that equipment needed is on site Verify that communications needed are on site and working Verify emergency services Verify site-specific training	Approved project plans reviewed and signed Equipment is on site. Communications verified to work across the site. Emergency services checked Site-Specified training given to personnel and signed	Once
Anomaly Avoidance – transects, grids, and pathways for all field crews {**MRP SOP 01, 02, 03**}	Appendix A (Logbooks / Checklists) Appendix A (Logbooks / Checklists), 2nd Figure of Appendix G (Δ symbol) Appendix A (Logbook Entries and Checklists)	UXOQCS to independently resurvey transect or grid lanes Surface Seed detection, placed by UXOQCS in grid near no known response using anomaly avoidance IVS Strip	UXO Team must have same performance of marking surface items as UXOQCS Discover and Record all on the surface seeds in grids Audibly detect items verified detectable on day 1	UXOQCS to repeat 25% day 1, 10% days after, failure = rework Daily, failure = rework effected grid Day 1 once, twice daily or equip. change thereafter
Vegetation Management {**MRP SOP 04**}	Appendix A (Logbooks / Checklists)	Full-time UXO Tech to conduct escort and anomaly avoidance ahead of brush cutters; verify vegetation removed.	All vegetation and trees less 4” diameter cut to within 2-4” of ground surface, no closer	As needed
(Land) Survey Management {**MRP SOP 05**}	Appendix A (Logbooks / Checklists) Appendix A (Logbooks / Checklists), 1st Figure of Appendix G (Δ symbol)	Verify that site benchmarks, boundaries, survey transects, and survey grids established Surveyor has met accuracy guidelines; safety escort and anomaly avoidance by UXO tech.	Site boundaries, survey transects, and survey grids have been established by RLS. Static Position Repeatability for re-occupy of points < 10-cm (4-in)	Once Twice Daily (beginning and end of each day)

Table 4-3 (Continued)
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #12 at FKDSA

Definable Feature of Work	ESI Report Reference Location(s)	QC Sample and/or Activity to Assess Performance	Measurement Performance Criteria	Frequency
Geophysics Management Phase I [*includes: DGM Transect & Grid Surveys*] {**MRP SOP 06 & MRP SOP 07**}	Appendix A (Logbooks / Checklists), Appendix F (GIR)	Null followed by personnel, cable shake, static background & spike response tests over "anomaly-free electronically-quiet" area for EM61	Personnel, cable shake, & static background tests exhibit no spikes > +/- threshold w/out documented external noise source	Twice Daily (beginning & end of each day)
	Figure 4-2, Appendix F (GIR), 3rd Figure of Appendix G	Null followed by background over "anomaly-free electronically-quiet" area and spike near structure (e.g. fence, culvert, magazine) for EM31	EM61 Static Response compared to ISO curve on day 1, compared +/- 10% to day 1 thereafter; EM31 reviewed for qualitative response on both channels	Twice daily (beginning and end of day) or equipment changes
	Figure 4-3 / Figure 4-4, Appendix F (GIR), 4th / 5th Figure of Appendix G	Instrument Verification Strip dynamic testing for EM61	Digital record shows peak response within 25% or 1mV (whichever is larger) / position within 50-cm along-line direction using fiducial positioning methods, 30-cm along-line RTK-DGPS positioning methods as compared to day 1 results	Day 1 once, twice daily or equip. change thereafter
	Text in Appendix F (GIR), 6th, 7th, and 8th Figures of Appendix G	Sample Separation & Footprint Coverage for EM61	Sample Separation within 25-cm > 98% of time, no gaps > 60-cm; Footprint coverage within 80-cm > 90% of time	Ultimately per dataset submittal, but must be monitored daily
	Text in Section 4.2.1.9, Table 4-2, 2nd Figure of Appendix G (⊕symbol)	Subsurface "blind" seed detection for EM61, placed by UXOQCS in grid near no known response using anomaly avoidance	Peak detected within 90-cm fiducial positioning methods and within 70-cm using RTK-DGPS positioning methods	Ultimately per dataset submittal, but must be monitored daily

Table 4-3 (Continued)
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #12 at FKDSA

Definable Feature of Work	ESI Report Reference Location(s)	QC Sample and/or Activity to Assess Performance	Measurement Performance Criteria	Frequency
Geophysics Management Phase II [*includes: Anomaly Pin-Pointing, 3-D CI with Advanced Classification*] { **MRP SOP 08 & MRP SOP 09**}	Text in Section 4.2.1.9, Table 4-2, 2nd Figure of Appendix G (Osymbol)	Anomaly Peak offset evaluations between interpreted to pin-pointed locations and between pin-pointed to cued interrogation model locations	Pin-Pointed peak < 100-cm offset from interpreted peak location cued interrogation model position < 40-cm offset from pin-pointed peak location	Each Anomaly
	Figure 4-5, Appendix F (GIR), 9th Figure of Appendix G	Instrument Verification Strip static cued testing for 3-D CI	Cued interrogation model results demonstrate > 0.95 (~ 95%) confidence metric as compared to library saved item	
Project Closeout Phase I [*includes: FI data deliverables check relative to ESI reporting*]	Appendix A, Appendix B	**QC of MEC:** Tracking Log and Daily Field Reports	Quantitative tabulation, including photo log, of MEC items discovered during ESI surface assessments	Prior to key UXO Personnel or hand-held instrument (e.g., GPS, Schonstedt, White) Demobilization
	Appendix C, D, E, F, G	**QC of DGM**: Equipment Test Results & Preliminary Target Interpretation Maps Generated	Quantitative tabulation or figure representation subsurface metallic item response assessment	Prior to key DGM personnel or equipment (e.g. EM31, EM61) Demobilization
	Appendix C, D, E, F, G	**QC of 3-D CI:** Equipment Test Results, Anomaly noise-level assessment, & preliminary results	Semi-quantitative tabulation of MEC items discovered based on subsurface assessment using non-invasive techniques	Prior to key 3-D CI personnel or equipment (e.g. 2x2Temtads, MetalMapper) Demobilization
Project Closeout Phase II [*includes: Demobilization*]	CHAPTER 4	Verify that sites have been restored and all equipment is inspected, packaged, and shipped to appropriate location	All equipment is off-site and arrived at destination. Discuss with client whether IVS should be removed or remain intact for future project.	Once at the end of field operations

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Table 4-4
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #22 at FKDSA

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference[2]	ESI Report Location(s)
Schonstedt Instruments Magnetic Metals Locator; *White Instruments* All Metals Locator	Operation & Maintenance	Start & End of day; after repairs, replacements, or extended time w/out use	Audible response to metallic item waved visibly in front of coil head	Turn up volume, adjust sensitivity settings, replace batteries, replace unit with spare	UXO Team w/ trouble-shooting support from UXOQCS & SUXO	**MRP SOP 01** – Anomaly Avoidance SOP	Appendix A (Logbooks / Checklists)
Schonstedt Instruments Magnetic Metals Locator; *White Instruments* All Metals Locator	Testing & Verification	Start & End of day; after repairs, replacements, or extended time w/out use	Audible response to buried ISO item when instrument waved over flag	Turn up volume, adjust sensitivity settings, replace batteries, replace unit with spare	UXO Team w/ trouble-shooting support from UXOQCS & SUXO	**MRP SOP 01** – Anomaly Avoidance SOP	Appendix A (Logbooks / Checklists)
Global Position System (GPS), Theodolite, etc.	Operation & Maintenance	Start & End of day; after repairs, replacements, or extended time w/out use	Digital indicators for battery life, satellites and base station (or beacon) signals w/in tolerances	Replace or charge batteries, check cable connections, adjust radio frequency signals if stepped on	RLS Team w/ trouble-shooting support from Field Scientist	**MRP SOP 04** – RLS Management SOP	Appendix A (Logbooks / Checklists)
Global Position System (GPS), Theodolite, etc.	Testing & Verification	Start & End of day; after repairs, replacements, or extended time w/out use	Recorded Position w/in **Worksheet #12** tolerances.	Repeat Test to ensure human error not part of equation and then replace faulty part.	RLS Team w/ trouble-shooting support from Field Scientist	**MRP SOP 04** – RLS Management SOP	Appendix A, Appendix F, Appendix G, Table 4-3
Geonics Limited EM31-MK2 TDEM Terrain Conductivity Meter	Operation & Maintenance	Start & End of day; after repairs, replacements, or extended time w/out use	Observe stability and qualitative response values over EM quiet / or near large metal structures	Check connections, replace power source, move sensor to different area to ensure equipment related and not localized noise	GEO Team w/ trouble-shooting support from Field Scientist	**MRP SOP 06** – EM31-MK2 SOP	Appendix F, Table 4-3

Table 4-4 (Continued)
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #22 at FKDSA

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference[2]	ESI Report Location(s)
Geonics Limited EM31-MK2 TDEM Terrain Conductivity Meter	Calibration & Verification	Start & End of day; after repairs, replacements, or extended time w/out use	Recorded Responses w/in **Worksheet #12** tolerances.	Repeat Test to ensure human error not part of equation and then replace faulty part.	GEO Team w/ trouble-shooting support from Field Scientist	**MRP SOP 06** – EM31-MK2 SOP	Appendix A, Appendix F, Appendix G, Table 4-3
Geonics Limited EM61-MK2 TDEM All Metals Detector	Operation & Maintenance	Start & End of day; after repairs, replacements, or extended time w/out use	Observe stability and qualitative response values over EM quiet / or over ISO at fixed offset	Check connections, replace power source, move sensor to different area to ensure equipment related and not localized noise	GEO Team w/ trouble-shooting support from Field Scientist	**MRP SOP 07** – EM61-MK2 SOP	Appendix F, Table 4-3
Geonics Limited EM61-MK2 TDEM All Metals Detector	Testing & Verification	Start & End of day; after repairs, replacements, or extended time w/out use	Recorded Responses w/in **Worksheet #12** tolerances.	Repeat Test to ensure human error not part of equation and then replace faulty part.	GEO Team w/ trouble-shooting support from Field Scientist	**MRP SOP 07** – EM61-MK2 SOP	Appendix A, Appendix F, Appendix G, Table 4-3
Advanced Classification Sensors (e.g., Temtads 2x2, Metal Mapper, etc.)	Operation & Maintenance	Start & End of day; after repairs, replacements, or extended time w/out use	Observe stability and qualitative response values over EM quiet / or over ISO at fixed offset	Check connections, replace power source, move sensor to different area to ensure equipment related and not localized noise	GEO Team w/ trouble-shooting support from Field Scientist, Manufacturer, and/or Vendor Representative	**MRP SOP 09** – Advanced Classification Sensors SOP	Appendix F, Table 4-3

Table 4-4 (Continued)
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #22 at FKDSA

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference[2]	ESI Report Location(s)
Advanced Classification Sensors (e.g., Temtads 2x2, Metal Mapper, etc.)	Testing & Verification	Start & End of day; after repairs, replacements, or extended time w/out use	Recorded Responses w/in **Worksheet #12** tolerances.	Repeat Test to ensure human error not part of equation and then replace faulty part.	GEO Team w/ trouble-shooting support from Field Scientist, Manufacturer, and/or Vendor Representative	**MRP SOP 09** – Advanced Classification Sensors SOP	Appendix A, Appendix F, Appendix G, Table 4-3

[1] Activities may include: calibration, verification, testing, and maintenance.
[2] Specify the appropriate reference letter or number from the Project Sampling SOP References table (**Worksheet #21**).

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Table 4-5
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #34 at FKDSA

Definable Feature of Work	Supporting Documentation/Description	Responsible for Verification	ESI Report Location(s)
Project Startup [*incl.: Project Readiness and Field Plan Reviews; Personnel Qualifications and Security Access Vetting; Equipment Verification and Mobilization Preparedness Planning; and Mobilization (w/ IVS construction activities)*]	*Project readiness review* to be performed by Resolution Consultants PM and Navy RPM, including UFP-SAP, HASP, and ESS-DR reviews. Attendees via conference call include all technical leads identified in **Worksheet #7**. *Field Plan reviews* to be performed by Resolution Consultants PM, including reviews of the UFP-SAP, HASP, DFW details (i.e. **Worksheet #14**), mobilization preparation activities (e.g., equipment lists, and IVS installation procedures), and field procedures (i.e. **Worksheet # 22**, **Worksheet #12**). Attendees via conference call include all technical leads and key subcontractor personnel during discussions of their roles, responsibilities, and requirements of their services in the project.	Todd Haverkost, PM, Resolution Consultants Brian Syme, NAVY RPM, NAVFAC SE Todd Haverkost, PM, Resolution Consultants Mike Ervine, QAM, Resolution Consultants	Section 2.1.1, Section 4.1.1.2, Appendix A Table 4-1, Table 4-3, Table 4-4
	Personnel Qualifications to be assessed by the Resolution Consultants PM, inclusive of reviewing resumes and training records, including those for UXO field personnel, to ensure that all required safety training (e.g., EOD certifications, OSHA training, medical surveillance, etc.) and experience requirements identified in **Worksheet #7** have been completed for each crew member, inclusive of subcontractors. *Security Access Vetting* to be completed after receiving required forms (e.g. I-9 Form, base pass entrance form, supplemental documentation, etc.) from all Resolution Consultants or subcontract personnel planned for utilization during field efforts. Substitution of personnel is required if requirements are not met.	Todd Haverkost, PM, Resolution Consultants Rick Swahn, UXO Manager, Resolution Consultants Sean Liddy, HSM, Resolution Consultants	Section 2.1.1, Section 4.1.1.2, Appendix A
	Equipment Verification to be delegated by Resolution Consultants PM to each technical lead to verify their personnel or subcontract personnel have either gathered or determined the location of functional equipment for use in field surveys. The equipment should be prepped for shipment, inclusive of packing spares for commonly damaged parts and an inventory of each box. *Mobilization Preparedness Planning* to be completed after equipment verification in order to confirm schedules for transit of all personnel and equipment to the site. Mobilization will be staggered, on a task-by-task basis.	Todd Haverkost, PM, Resolution Consultants Rick Swahn, UXO Manager, Resolution Consultants Brian Brunette, Geophysics Manager, Resolution Consultants Mike Ervine, QAM, Resolution Consultants	Table 4-1

Table 4-5 (Continued)
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #34 at FKDSA

Definable Feature of Work	Supporting Documentation/Description	Responsible for Verification	ESI Report Location(s)
Project Startup (cont'd) [*incl.: <u>Project Readiness and Field Plan Reviews</u>; <u>Personnel Qualifications and Security Access Vetting</u>; <u>Equipment Verification and Mobilization Preparedness Planning</u>; and <u>Mobilization (w/ IVS construction activities)</u>*]	*<u>Initial Mobilization</u>* to be completed after equipment verification and mobilization preparedness planning and, upon arrival on site, the equipment shipment boxes will be opened with each unit tested for general operational functionality along with determining whether full parts list, inclusive of spare, safely made the transition to site or whether addition parts are required. Additionally, site-specific orientation, safety training, and equipment operation training (if required) will be completed and signed-off as such at this time. *<u>IVS Construction</u>* to be completed following guidelines provided in the UFP-SAP, inclusive of communicating exclusion zones to NAS Key West and following anomaly avoidance techniques, discussed next, prior to conducting intrusive activities in order to seed ISO items in the IVS. Lastly, the terms of the ESS-DR approval letter (**see attachment 2**) must be fully implemented.	Rick Swahn, UXO Manager, Resolution Consultants TBD, SUXOS, Resolution Consultants TBD, UXOQCS/UXOSO, Resolution Consultants Brian Brunette, Geophysics Manager, Resolution Consultants Mike Ervine, QAM, Resolution Consultants	Table 4-1 Section 2.1.8, Section 4.1.1.8
Anomaly Avoidance [*includes: <u>Inspection and Disposal of MPPEH</u>, <u>MEC Demolition & Disposal Operations</u>*]	**Anomaly Avoidance** to be reviewed and completed following guidelines provided in the UFP-SAP and SOP guidance documents (i.e. **MRP SOP 01, MRP SOP 02, MRP SOP 03)** provided for Anomaly Avoidance*, <u>Inspection and Disposal of MPPEH</u>*, and *<u>MEC Demolition and Disposal</u>*, respectively. The documents are to be followed during all aspects of the project, starting with the IVS construction activities. Furthermore, the SUXOS and UXOQCS / UXOSO will verify first hand that the first lot of **Survey** field activities are being conducted properly, safely, and technically correct, inclusive of reviewing the deliverables to ensure that the data not only meets reporting requirements but also exceeds quality requirements of **Worksheet #12**	**Initial Daily Inspections:** TBD, SUXOS, Resolution Consultants TBD, UXOQCS/UXOSO, Resolution Consultants **Final Product Inspection:** Rick Swahn, UXO Manager, Resolution Consultants	Table 4-1, Table 4-3, Table 4-4, Appendix A, Appendix B
Vegetation Management	**Vegetation Management**, inclusive of brush clearing, tall grass mowing, and tree removal will be conducted in accordance with **MRP SOP 04,** inclusive of anomaly avoidance techniques to be implemented as a part of **MRP SOP 01**.	**Initial Daily Inspections:** TBD, SUXOS, Resolution Consultants TBD, UXOQCS / UXOSO, Resolution Consultants **Final Product Inspection:** Eric Celebrezze, Field QC Scientist, Resolution Consultants	Table 4-1, Table 4-3, Table 4-4, Appendix A

Table 4-5 (Continued)
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #34 at FKDSA

Definable Feature of Work	Supporting Documentation/Description	Responsible for Verification	ESI Report Location(s)
Survey Management	**Survey Management** will be conducted in accordance with **MRP SOP 05**, inclusive of anomaly avoidance techniques implemented as part of **MRP SOP 01**. Prior to the start of field work, the boundaries and benchmarks will be established for the entire site while grid layouts await vegetation removal, just prior to the start of the DGM surveys. Furthermore, the Field QC Scientist and UXOQCS / UXOSO will verify first hand that the first lot of **Survey** field activities are being conducted properly, safely, and technically correct, inclusive of reviewing the deliverables to ensure that the data not only meets reporting requirements but also exceeds quality requirements of **Worksheet #12.**	**Initial Daily Inspections:** TBD, UXOQCS / UXOSO, Resolution Consultants **Final Product Inspection:** Eric Celebrezze, Field QC Scientist, Resolution Consultants	Table 4-1, Table 4-3, Table 4-4, Appendix A
Geophysics Management [*includes: EM31-MK2 DGM Transect Surveys, EM61-MK2 DGM Transect and Grid Surveys, Anomaly Pin-Pointing, 3-D CI with Advanced Classification*]	**Geophysics Management** to be reviewed and completed following guidelines provided in the UFP-SAP and SOP guidance documents (i.e. **MRP SOP 06, MRP SOP 07, MRP SOP 08, MRP SOP 09)** provided for *EM31-MK2 DGM Surveys*, *EM61-MK2 DGM Surveys*, *Anomaly Pin-Pointing*, and *MEC 3-D CI with Advanced Classification*, respectively. The documents are to be followed during all DGM aspects of the project, beginning with the start of project QC / IVS testing activities. Furthermore, the Field QC Scientist and UXOQCS / UXOSO will verify first hand that the first lot of **Geophysics** field activities are being conducted properly, safely, and technically correct, inclusive of reviewing the deliverables to ensure that the data not only meets the reporting requirements but also exceeds the quality requirements of **Worksheet #12**.	**Initial Daily Inspections:** TBD, UXOQCS / UXOSO, Resolution Consultants Eric Celebrezze, Field QC Scientist, Resolution Consultants **Final Product Inspection:** Brian Brunette, Geophysics Manager, Resolution Consultants	Table 4-1, Table 4-3, Table 4-4, Figure 4-1, Figure 4-2, Figure 4-3, Figure 4-4, Figure 4-5, Appendix A, Appendix F, Appendix G
Project Closeout [*includes: FI data deliverables check,, Demobilization*]	*FI Data Deliverables Check* to be delegated by Resolution Consultants PM to each technical lead to verify their personnel or subcontract personnel have either gathered or determined that the field investigation data is of sufficient quantity, quality, and format to be easily detailed in the final ESI report. As with mobilization, Demobilization will be staggered, on a task-by-task basis. The equipment should be prepped for shipment, inclusive of re-packing spares for commonly damaged parts and an inventory of each box. Upon equipment leaving the site, the transit of personnel can commence.	Todd Haverkost, PM, Resolution Consultants Rick Swahn, UXO Manager, Resolution Consultants Brian Brunette, Geophysics Manager, Resolution Consultants Mike Ervine, QAM, Resolution Consultants	Table 4-1, Table 4-3, Table 4-4, Figure 4-1, Figure 4-2, Figure 4-3, Figure 4-4, Figure 4-5, Appendix A, Appendix F, Appendix G

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Table 4-6
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #35 at FKDSA

Definable Feature of Work	Frequency of Inspection	Supporting QC Documents/Description	Responsible for Validation (name, organization)	ESI Report Location(s)
Project Startup	After each mobilization event is completed for individual tasks	No follow-up required. Verify that UFP-SAP was implemented as written, with any deviations clearly and transparently documented with sufficient detail in order to summarize as a part of ESI report.	Todd Haverkost, PM, Resolution Consultants Rick Swahn, UXO Manager, Resolution Consultants	Appendix A, Appendix B, Table 4-8
Anomaly Avoidance	Daily	Checklist and field logbooks that document equipment utilization, production progress, and quality control or safety annotations are scanned.	TBD, SUXOS, Resolution Consultants TBD, UXOQCS / UXOSO, Resolution Consultants	Appendix A, Appendix B
Vegetation Management	Daily	Checklist and field logbooks that document equipment utilization, production progress, and quality control or safety annotations are scanned.	TBD, SUXOS, Resolution Consultants TBD, UXOQCS / UXOSO, Resolution Consultants	Appendix A
Survey Management	Daily	Checklist and field logbooks that document equipment utilization, production progress, and quality control or safety annotations are scanned. Interpretation results and final deliverables review are completed upon submittal, a few days after start.	TBD, SUXOS, Resolution Consultants TBD, UXOQCS / UXOSO, Resolution Consultants Eric Celebrezze, Field QC Scientist, Resolution Consultants	Appendix A, Appendix G
Geophysics Management	Daily	Checklist and field logbooks that document equipment utilization, production progress, and quality control or safety annotations are scanned. Includes review of IVS and all other QC tests results. Interpretation results and final deliverables review are completed upon submittal, which is daily starting one week after the first day of field work.	TBD, UXOQCS / UXOSO, Resolution Consultants Eric Celebrezze, Field QC Scientist, Resolution Consultants Brian Brunette, Geophysics Manager, Resolution Consultants	Appendix A, Appendix F, Appendix G Appendices C, D, E, F, & G

Table 4-6 (Continued)
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #35 at FKDSA

Definable Feature of Work	Frequency of Inspection	Supporting QC Documents/Description	Responsible for Validation (name, organization)	ESI Report Location(s)
Project Closeout	After each demobilization event is completed for individual tasks.	Demobilization is preceded by the FI Data Deliveries Check for Site-Specific ESI Final Report(s) and followed by a check for demobilization adequacy and fidelity.	Todd Haverkost, PM, Resolution Consultants Rick Swahn, UXO Manager, Resolution Consultants Brian Brunette, Geophysics Manager, Resolution Consultants Mike Ervine, QAM, Resolution Consultants	Appendix A

Table 4-7
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #36 at FKDSA

Step IIa / IIb [1]	Matrix	Analytical Group	Validation Criteria	Data Validator (title, organizational)	ESI Report Location(s)
IIa	Surface Soils	Anomaly Avoidance	a) 10% Daily inspections conducted by SUXOS and UXOQCS / UXOSO do not find additional items on surface not previously marked or clearly circumvented by field crews b) Seed items placed on surface by UXOQCS are located, marked and recorded in logbook entries	TBD, UXOQCS / UXOSO, Resolution Consultants TBD, SUXOS, Resolution Consultants	Appendix A
IIa	Near Surface (or Shallow Subsurface) Soils	Anomaly Avoidance	a) 10% Daily inspections conducted by UXOQCS / UXOSO do not observe puncturing of subsurface without first observing anomaly avoidance assessment of subsurface b) The same ISO's seeded in IVS are detected each day of equipment use as were detected on day 1	TBD, UXOQCS / UXOSO, Resolution Consultants TBD, SUXOS, Resolution Consultants	Appendix A
IIa	Surface Soils & Near Surface (or Shallow Subsurface) Soils	EM61-MK2 Grid Surveys	a) Random daily Inspections conducted by Field QC Scientist and UXOQCS / UXOSO observe field crews circumventing or stepping over pre-marked avoidance items, as opposed to stepping on them b) Seed items placed in subsurface by UXOQCS are located, marked and recorded so response is evident to Field QC Scientist during the daily review of the EM61-MK2 data	TBD, UXOQCS / UXOSO, Resolution Consultants Eric Celebrezze, Field QC Scientist, Resolution Consultants	Appendix A Section 4.2.1.9, Table 4-2
IIa	Near Surface (or Shallow Subsurface) Soils	EM61-MK2 Surveys	a) Inspections conducted by Field QC Scientist do not determine faulty standardized QC test results or noise-filled data w/out clearly identified noise source or planned rework b) The same ISO's seeded in IVS are detected each day of equipment use as were detected on day 1	TBD, UXOQCS / UXOSO, Resolution Consultants Eric Celebrezze, Field QC Scientist, Resolution Consultants	Section 4.2, Appendix A, Appendix G

Table 4-7 (Continued)
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #36 at FKDSA

Step IIa / IIb [1]	Matrix	Analytical Group	Validation Criteria	Data Validator (title, organizational)	ESI Report Location(s)
IIa	Near Surface (or Shallow Subsurface) Soils	3-D CI Surveys	a) Inspections conducted by Field QC Scientist do not determine faulty standardized QC test results or noise-filled data w/out clearly identified noise source or planned rework b) The same ISO's seeded in IVS are detected each day of equipment use were detected within the same confidence metric guidelines as recorded and observed on day 1	TBD, UXOQCS / UXOSO, Resolution Consultants Eric Celebrezze, Field QC Scientist, Resolution Consultants	Section 4.2, Appendix A, Appendix G

[1] IIa = compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.], **APPLICABLE to MEC investigation**.

IIb = comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005], **NOT APPLICABLE to MEC Investigation**

Table 4-8
Reference Location(s) for Data Documentation of Individual DFW Tasks from Worksheet #37 at FKDSA

Phase of Work	Items to be Checked/Verified	Verified (Yes or No)	Comments or Deviations
Pre-Survey(s)	Personnel Reviewed and Signed-Off on Relevant UFP-SAP sections, inclusive of SOP's	**YES**	
	Personnel Reviewed & Signed off on HASP	**YES**	
	Personnel Received Site Orientation, inclusive of reminder of Anomaly Avoidance procedures and protocols to be implemented for all FI tasks.	**YES**	
Survey	QC evaluation of equipment tests, following **Worksheet #22** guidance relative to **Worksheet #12** metrics	**YES**	Blind seeds were painted **orange** to clearly indicate "inert" safe to pickup to prevent confusion compared **light blue** tinged MPPEH items on site.
	Conformance to SAP requirements and procedures for all survey work and rework (including documentation requirements), and all deficiencies documented	**YES**	All deviations documented as isolated ambient storm events or reworked. Documentation is in Appendices F, G.
	Coverage of areas to be investigated fulfilled and located within accuracy levels required for the ESI in order to be adequate for the final report.	**YES**	

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5.0 CONCLUSIONS AND RECOMMENDATIONS

Since all production / quality thresholds were met for the data acquired, as summarized in CHAPTER 3 / CHAPTER 4, the non-invasive sample data collected during the ESI at the dredge spoils area were used to draw four major conclusions:

- first, only confirmed surface MPPEHs were a 37-mm HE projectile and a 105-mm HEAT round;
- second, the transect-pattern and grid-pattern DGM data demonstrate that subsurface anomaly densities generally trend downward spatially from higher densities in the south-end (density > 1000 anomalies per acre) to lower but still significant densities in the northwest portion (density < 400 anomalies per acre) of the site;
- third, advanced classification library matching indicates MPPEH distribution is site-wide; and
- fourth, advanced classification ranking efforts determined that large-sized MPPEH appears more prevalent than small-sized MPPEH within the first few feet bgs.

Given that no areas within the site were assessed to be free from MPPEH in the subsurface, a NFA recommendation cannot currently be supported for any portion of the site based on the criteria listed in Section 1.2. Additionally, due to the widespread distribution of the MPPEH anomalies, an IRA is not recommended at this time due to the significant cost of implementing a removal action across the entire site. Instead, intrusive investigation activities are recommended to append the current ESI to verify the nature of the anomalies identified during non-invasive advanced classification. As such, the following is recommended:

⇒ Prepare an ESI SAP addendum, APP/SSHP, and ESS documentation for MEC/MPPEH confirmation sampling using the current information as guidance for the planning documents;

⇒ Conduct MEC/MPPEH confirmation sampling based on the Final Ranked Anomaly List (Appendix D) associated with the 14 grids, starting with the Priority-1 anomalies first then move down the list until MEC/MPPEH is no longer evident;

⇒ Determine technologically viable and economically feasible cleanup strategies for confirmed MEC contaminated areas within the confines of depth ranges MEC items were recovered; and

⇒ Summarize findings and justify recommendations within an ESI addendum report.

Confirmation sampling will help resolve the uncertainties and verify the certainties associated with the limited library of ordnance signatures, as compared to the unique ordnance hazards on site. The confirmations will also be used to support accurate interpretations of the nature of MPPEH items and help define whether an IRA or another course of action is appropriate for the site.

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6.0 REFERENCES

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FIGURES

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Fleming Key Dredge Spoil Area Expanded Site Inspection Report

FIGURE 2-1

Boundaries and features within FKDSA, inclusive of planned grid boundaries yet to be physically marked and coordinates recorded by RLS

CONTRACT NO N62470-11-D-8013	TASK NO JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 300'	SHEET 1 of 1
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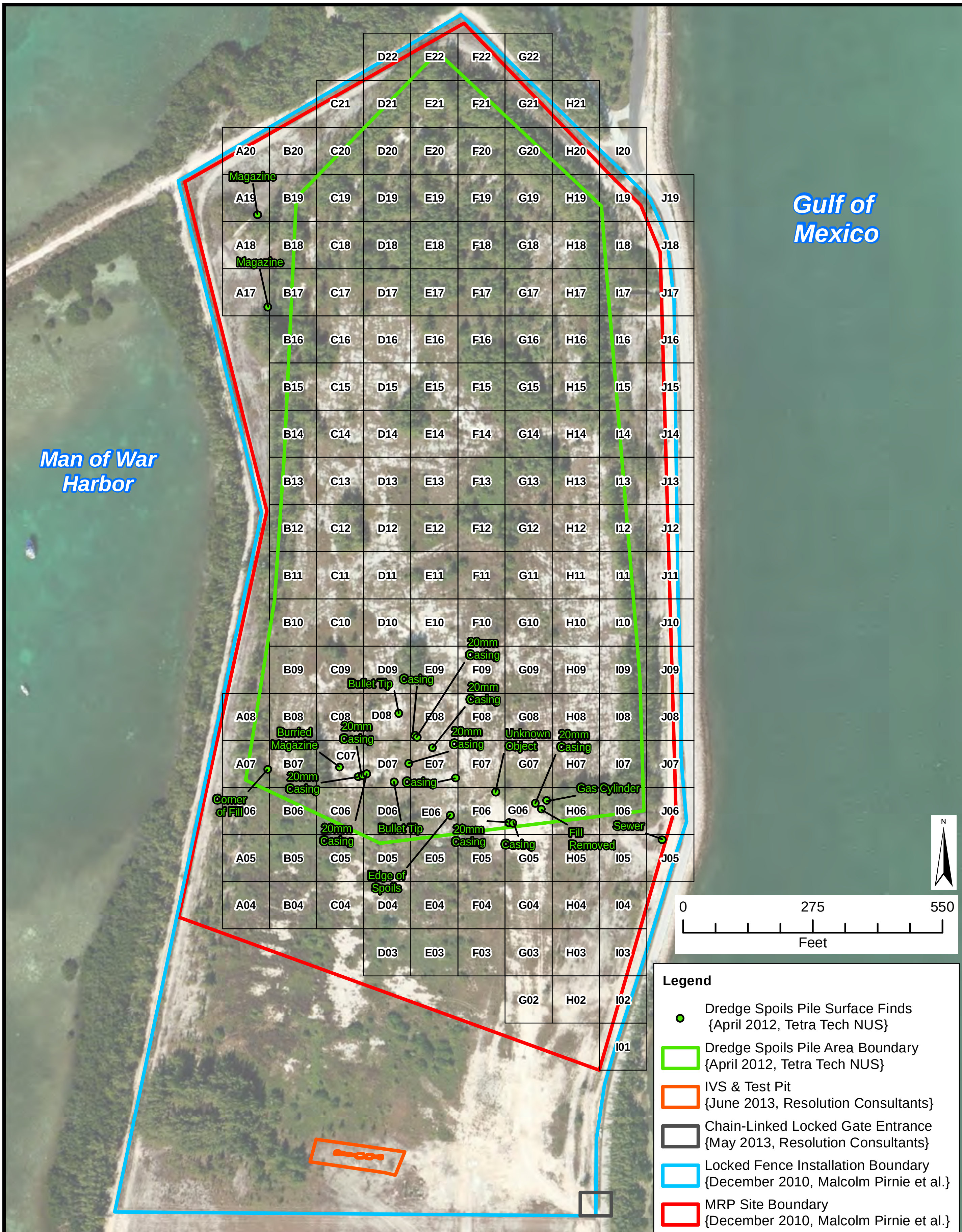

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FIGURE 3-1

FKDSA Anomaly Avoidance Assessment Progress #1:
All Surface items, including cultural debris and installation infrastructure documented from previously-completed limited SI

CONTRACT NO N62470-11-D-8013	TASK NO JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1

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FIGURE 3-2

FKDSA Anomaly Avoidance Assessment Progress #2: Surface Items documented from limited SI reduced to MPPEH items after re-inspection by Resolution Consultants SUXOS / UXOQCS

CONTRACT NO N62470-11-D-8013	TASK NO JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1
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FIGURE 3-3

FKDSA Anomaly Avoidance Assessment Progress #3: Additional Surface MPPEH items encountered and Subsurface ISO items seeded by Resolution Consultants SUXOS / UXOQCS

CONTRACT NO N62470-11-D-8013	TASK NO JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1

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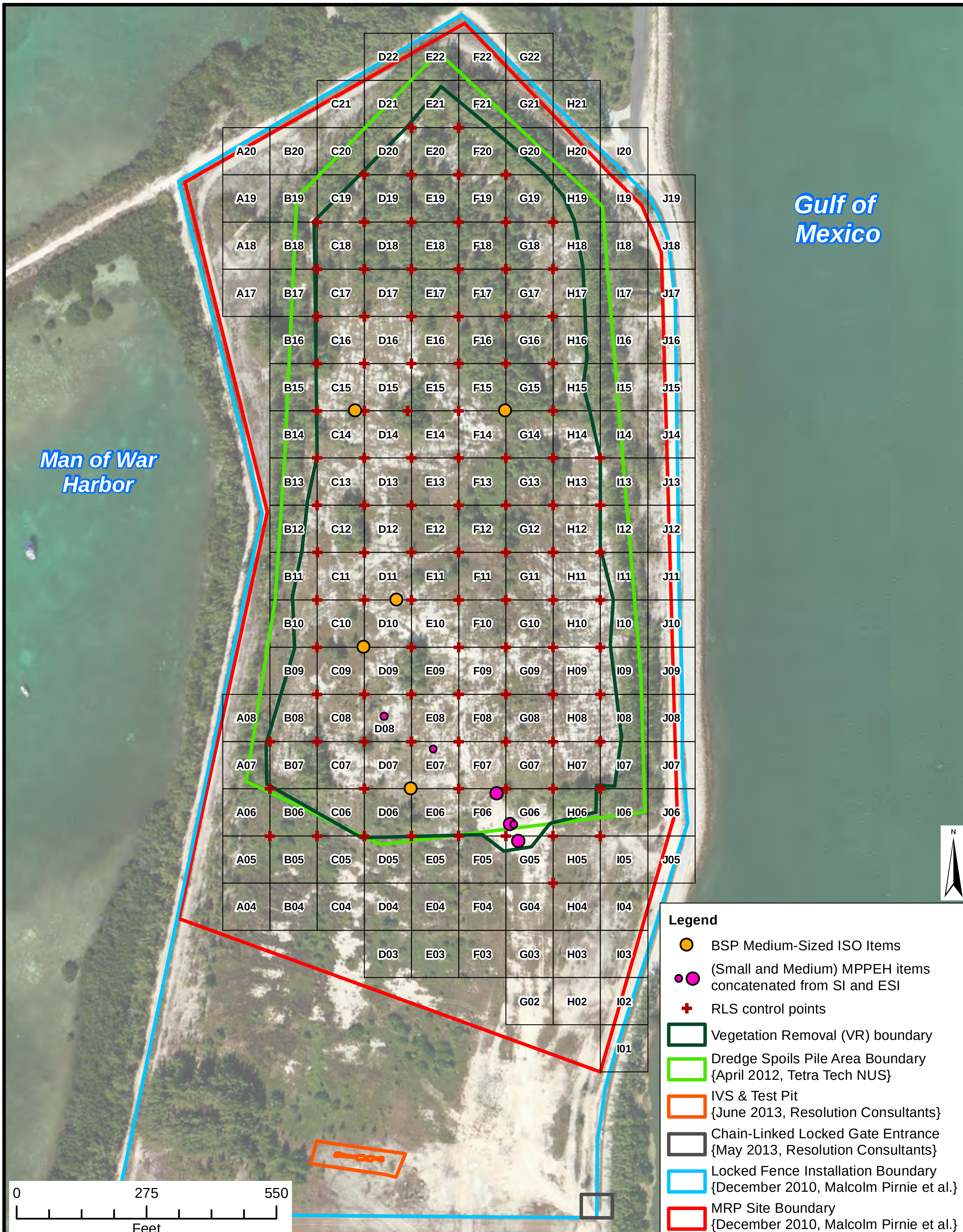

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FIGURE 3-4

FKDSA Surface Anomaly Avoidance Assessment Results with VR boundary and RLS control points overlay

CONTRACT NO N62470-11-D-8013	TASK NO JM20
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CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1

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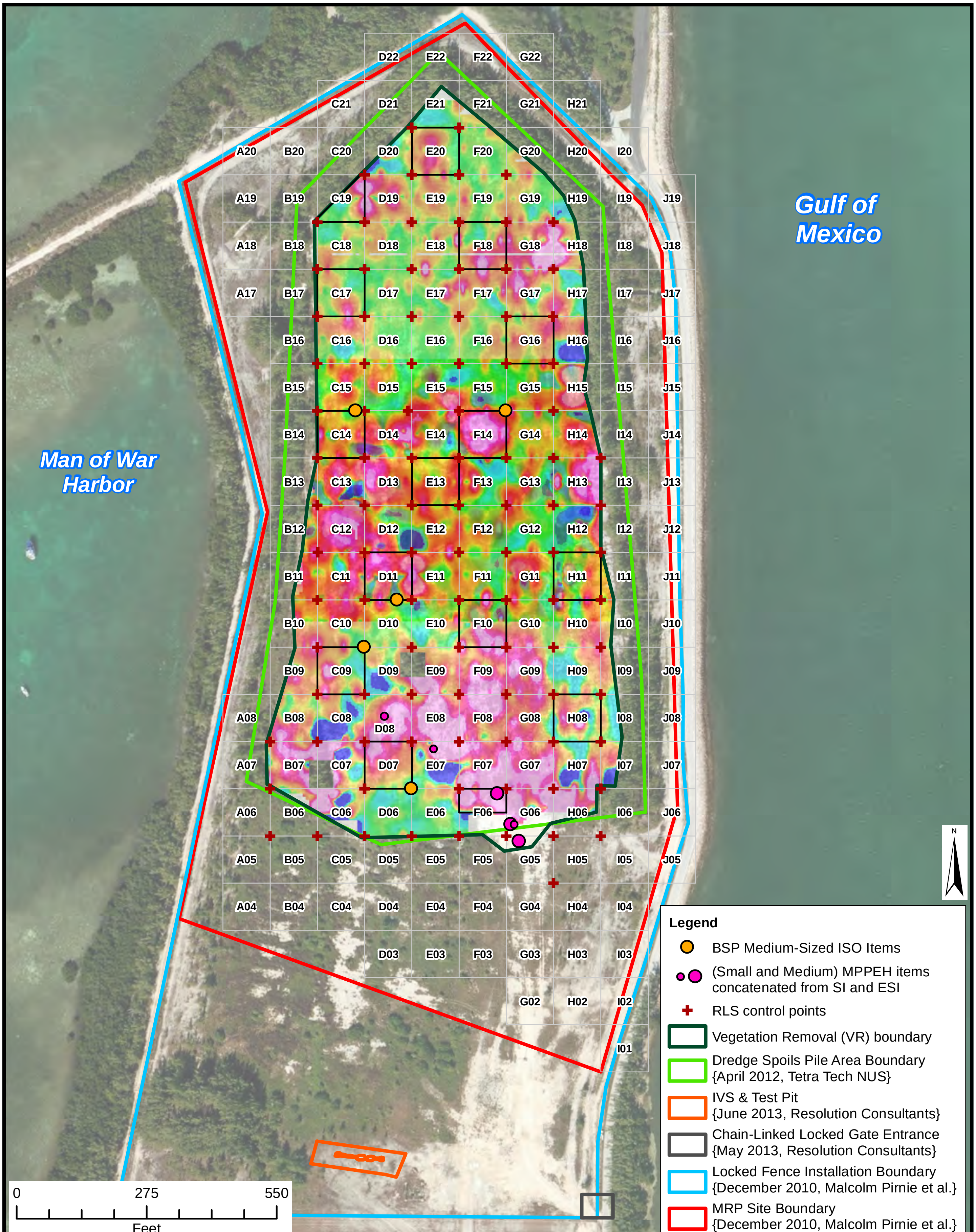

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FIGURE 3-5

FKDSA Transect-Pattern EM61 Subsurface Assessment Survey, CH2 displayed.

CONTRACT NO	TASK NO
N62470-11-D-8013	JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1
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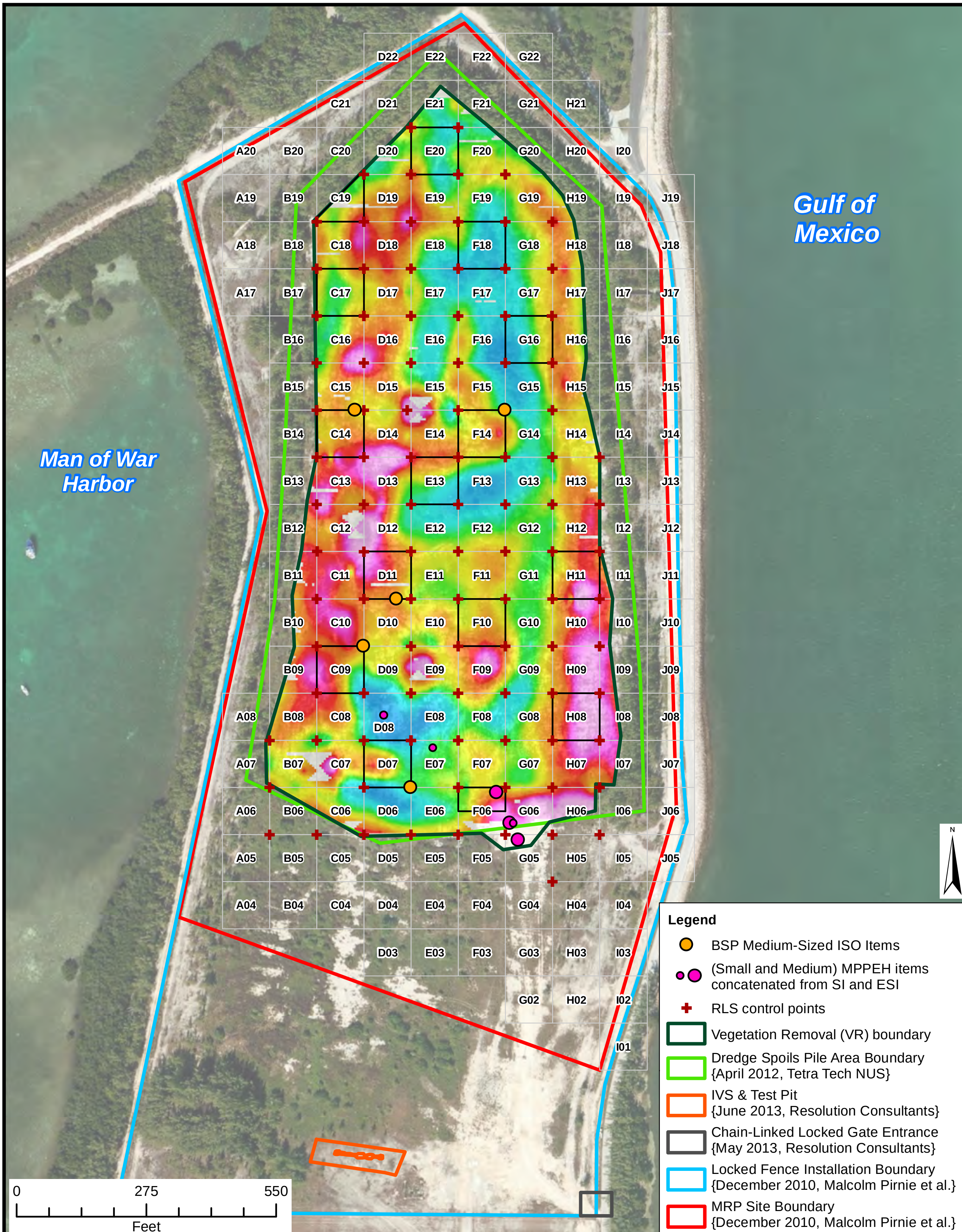

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FIGURE 3-6

FKDSA Transect-Pattern EM31 Subsurface Assessment Survey, IN-PHASE displayed

CONTRACT NO N62470-11-D-8013	TASK NO JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1
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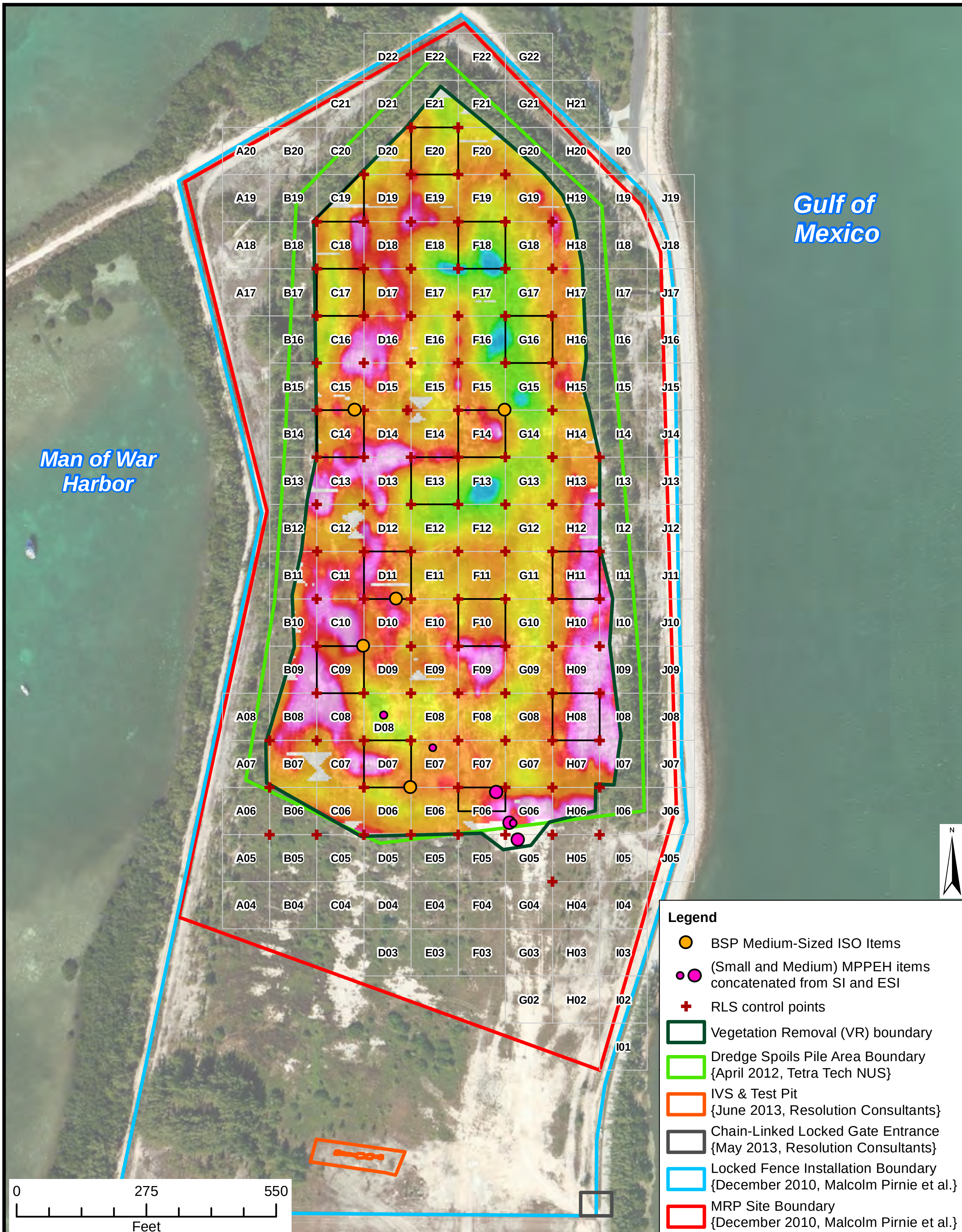

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FIGURE 3-7

FKDSA Transect-Pattern EM31 Subsurface Assessment Survey, OUT-PHASE displayed

CONTRACT NO N62470-11-D-8013	TASK NO JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1
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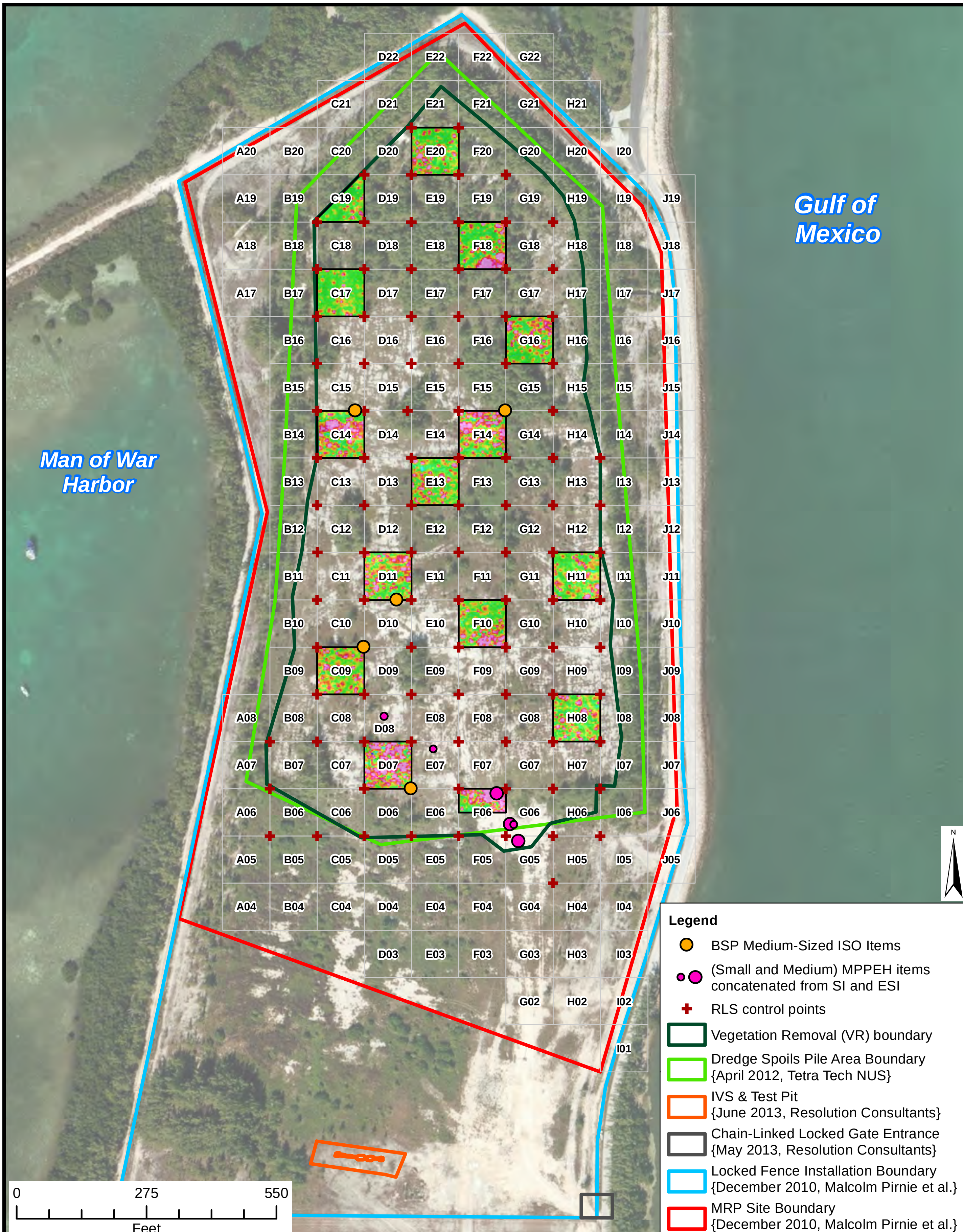

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FIGURE 3-8

FKDSA Grid-Pattern EM61 Subsurface Assessment Surveys, CH2 displayed

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DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1

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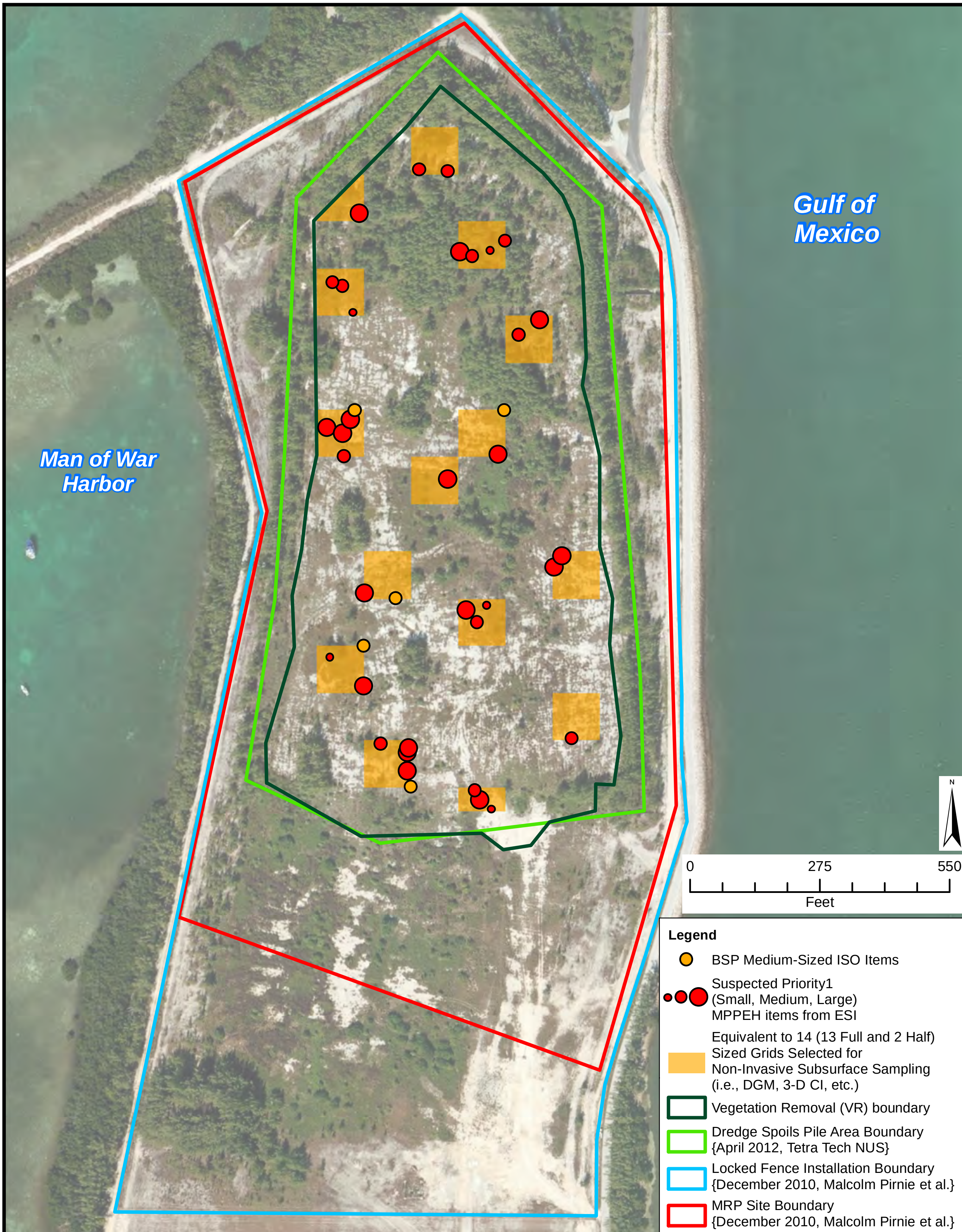

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Fleming Key Dredge Spoil Area Expanded Site Inspection Report

FIGURE 3-9

FKDSA TEMTADS-2x2 system 3-D CI Subsurface Assessment Results: Advanced Classification High Correlation Match to Library Item(s)

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DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1
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Fleming Key Dredge Spoil Area Expanded Site Inspection Report

FIGURE 3-10

FKDSA TEMTADS-2x2 system 3-D CI Subsurface Assessment Results: Advanced Classification Medium Correlation Match to Library Item(s)

CONTRACT NO N62470-11-D-8013	TASK NO JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1
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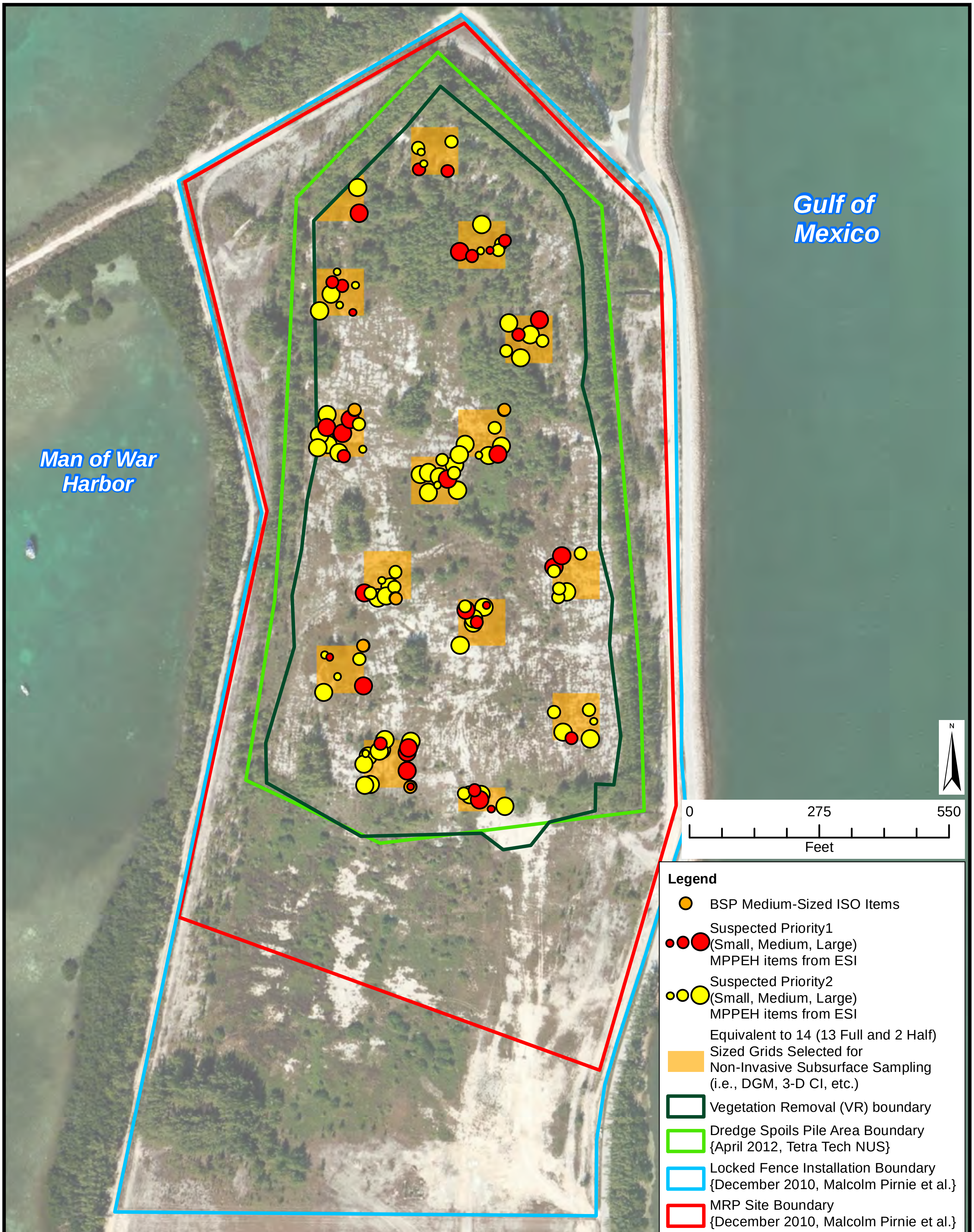

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FIGURE 3-11

FKDSA TEMTADS-2x2 system 3-D CI Subsurface Assessment Results: Concatenated Dig Priority Targets for Confirmation Sampling

CONTRACT NO	TASK NO
N62470-11-D-8013	JM20
DESIGNED BY K. Weber	DRAWN BY K. Weber
CHECKED BY B. Brunette	DATE August 2013
SCALE 1" = 275'	SHEET 1 of 1

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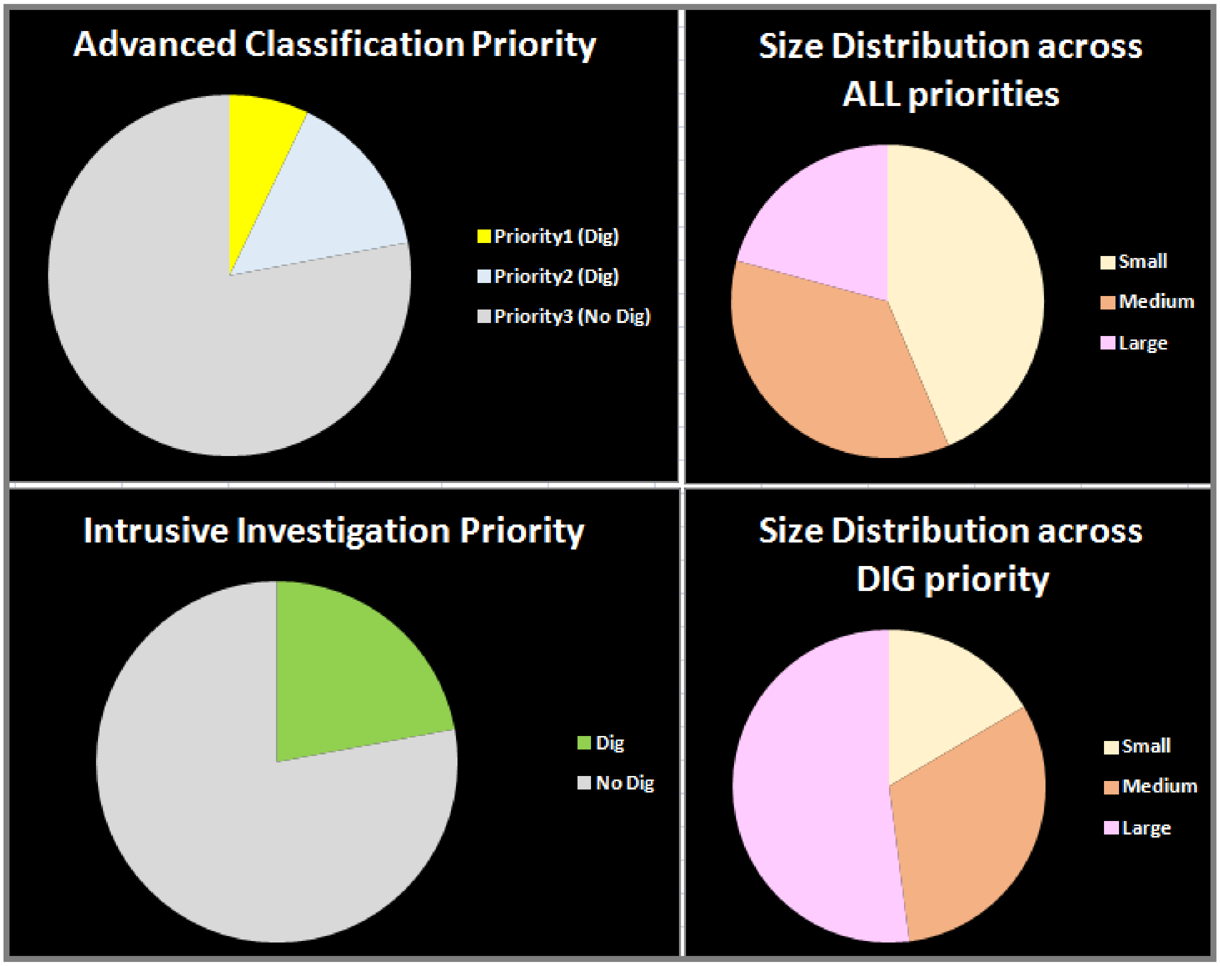

Figure 3-12
Breakdowns of Classification Priority, Dig Priority, and Size Distribution

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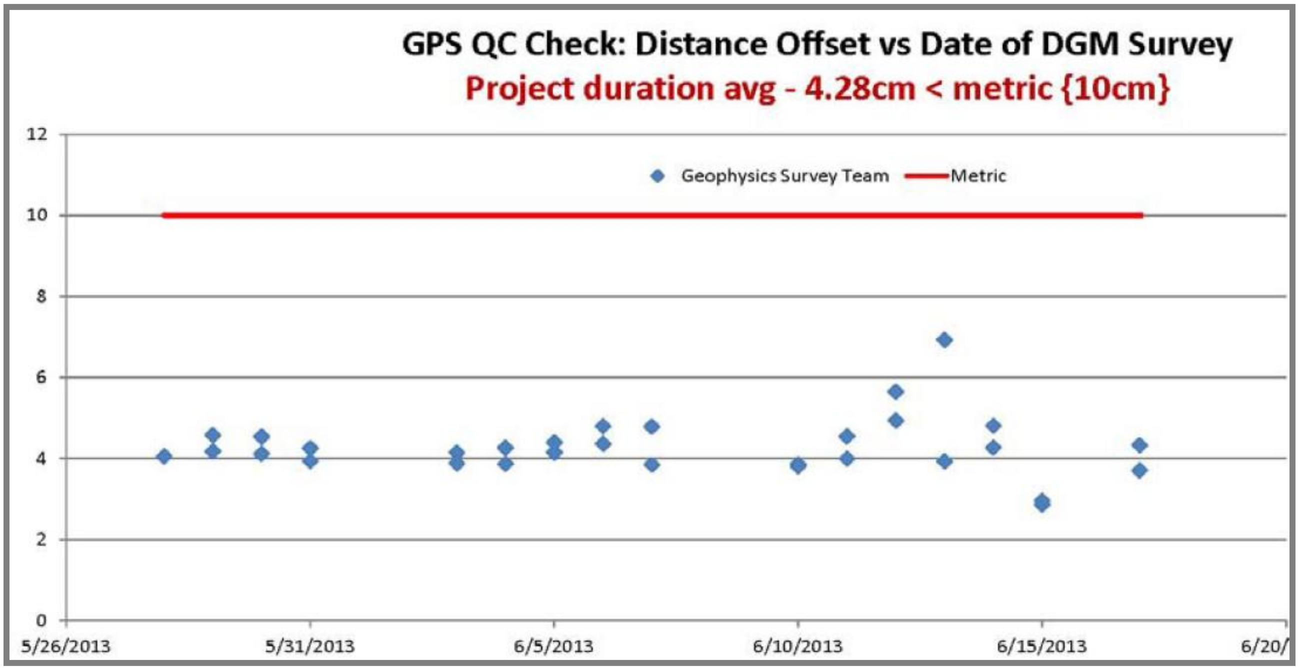

Figure 4-1
Geophysics Operator GPS Position Check
(as extracted Figure 13 from NAEVA's GIR, Appendix F)

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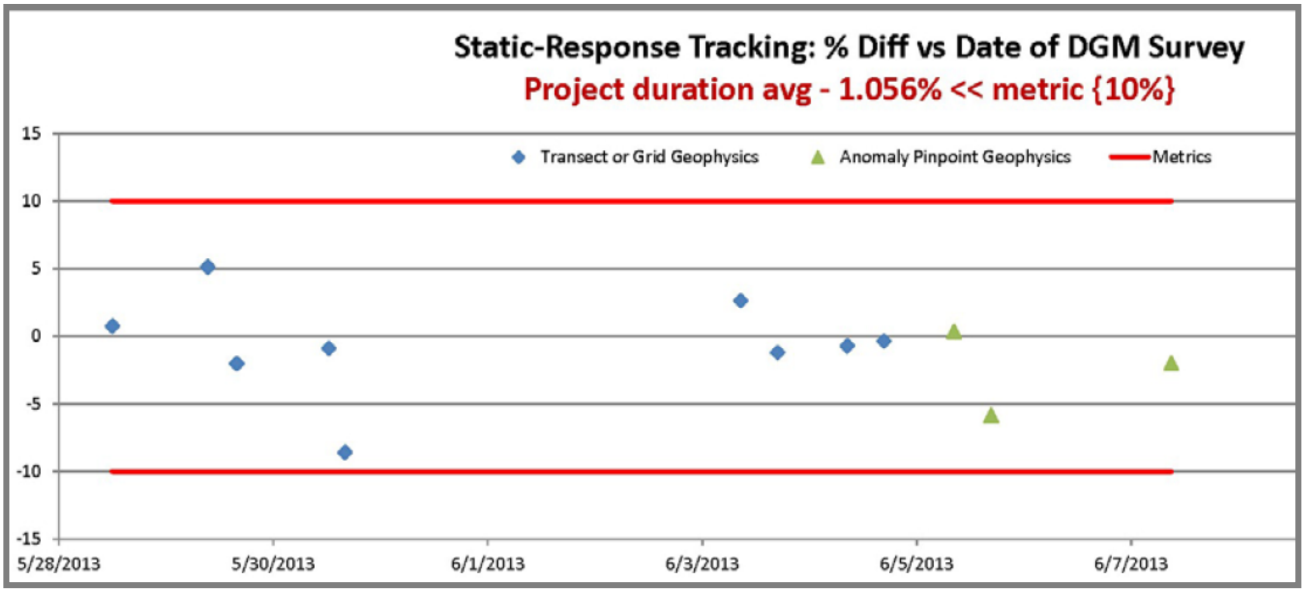

Figure 4-2
Geophysics Operator Static EM61 Response Test
(as extracted Figure 11 from NAEVA's GIR, Appendix F)

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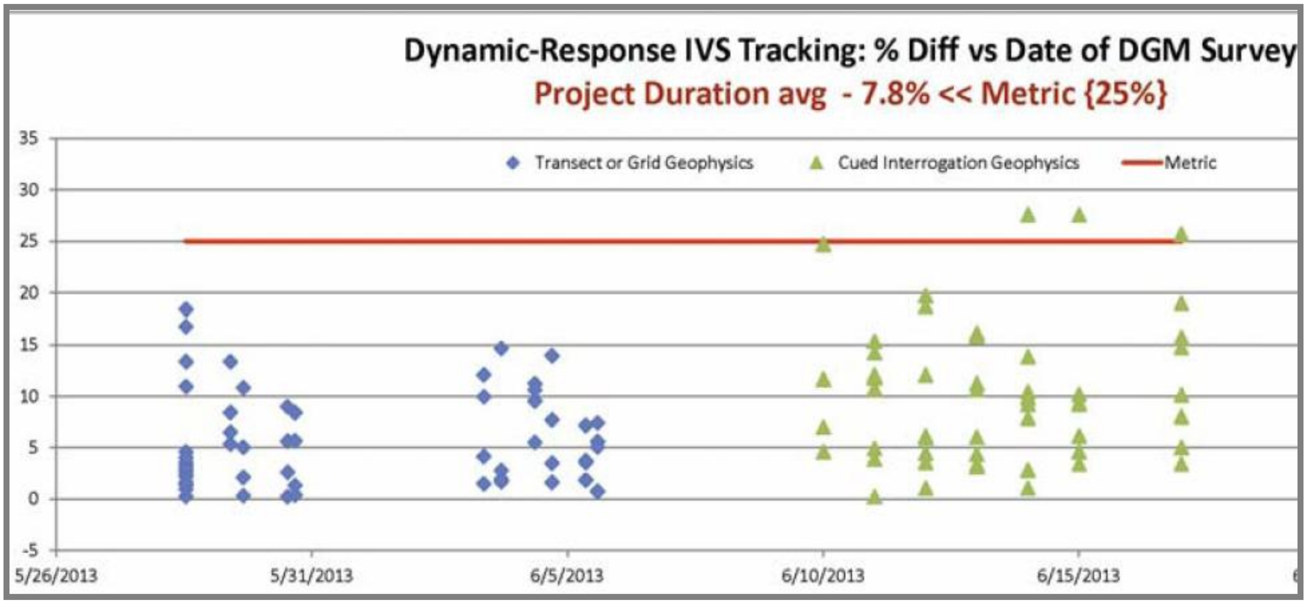

Figure 4-3
Geophysics Operator Dynamic EM61 & Static TEMTADS IVS Response Tests
(as extracted Figure 08 from NAEVA's GIR, Appendix F)

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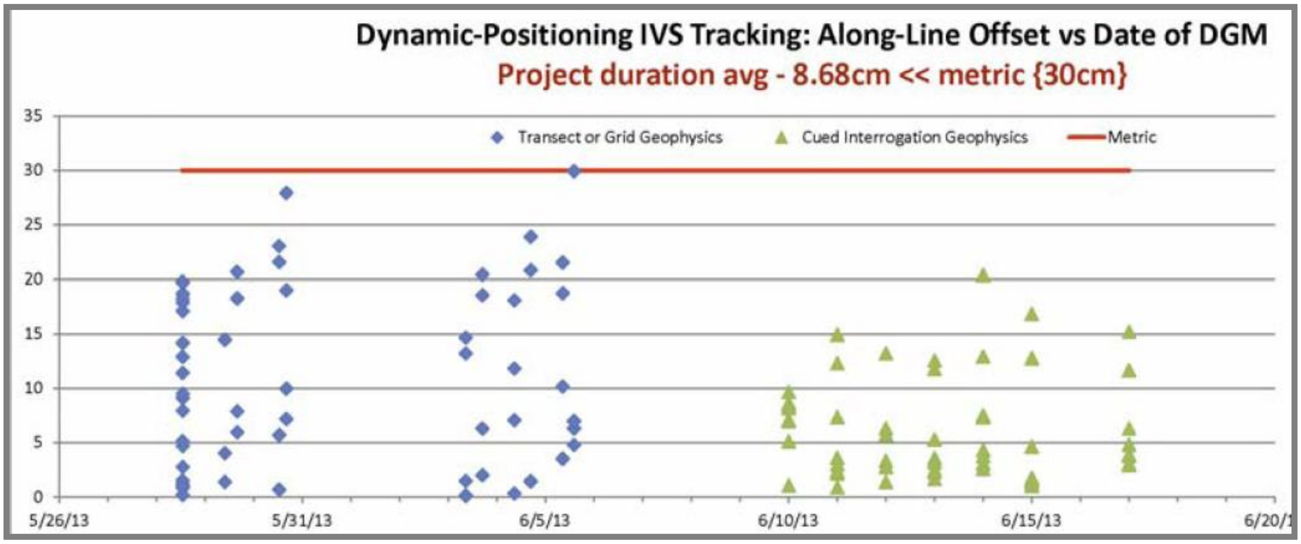

Figure 4-4
Geophysics Operator Dynamic EM61 & Static TEMTADS IVS Positioning Tests
(as extracted Figure 09 from NAEVA's GIR, Appendix F)

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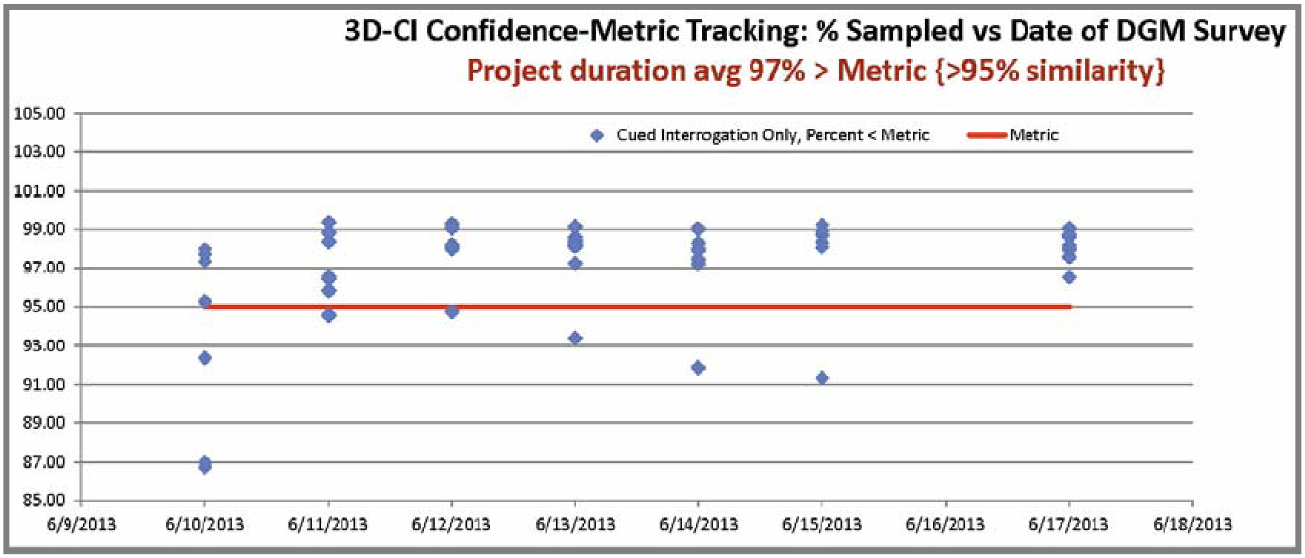

Figure 4-5
Geophysics Operator Static TEMTADS IVS Confidence Metric Matching Tests
(as extracted Figure 12 from NAEVA's GIR, Appendix F)

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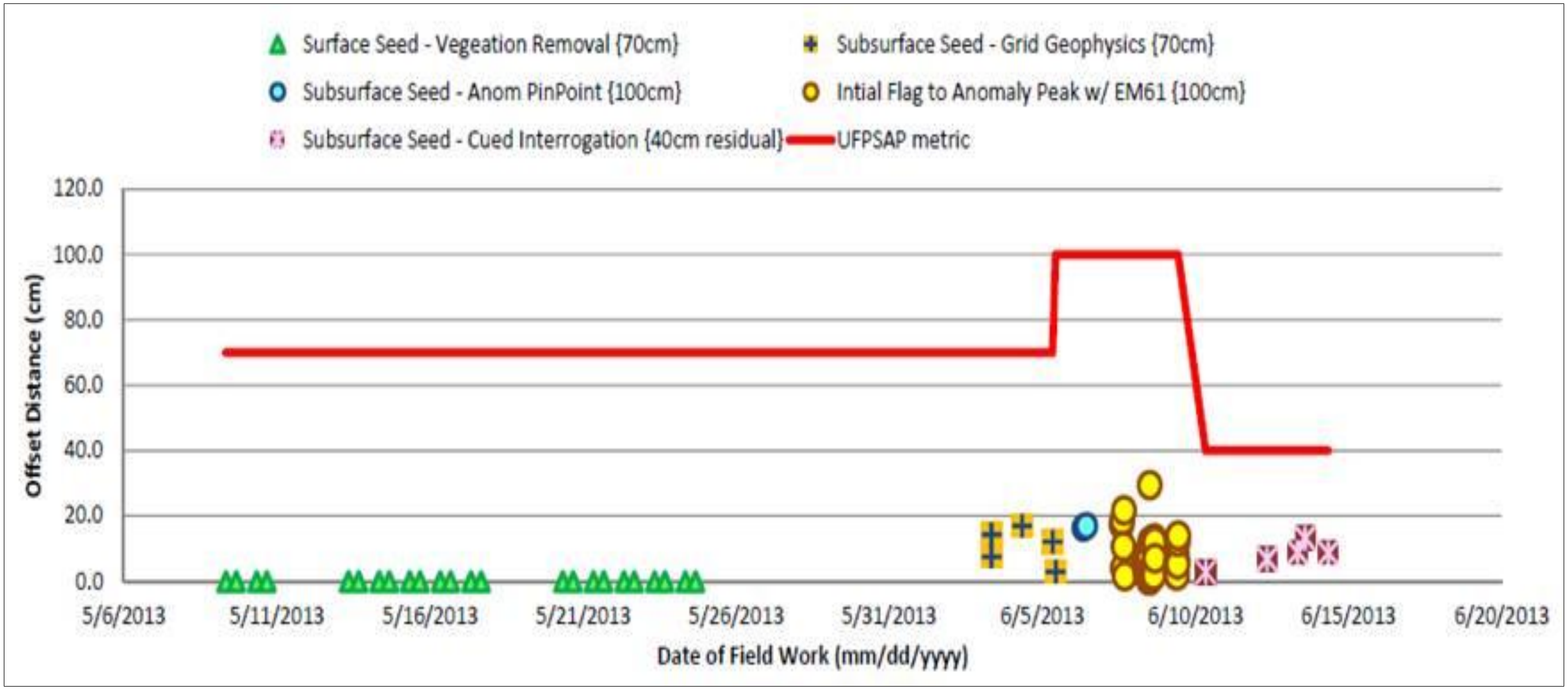

Figure 4-6
Project Time-line Representation of Blind Seed Recovery Efforts
(as extracted Figure 2 from Appendix G)

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APPENDIX A

MEC MANAGEMENT FIELD FORMS/LOGBOOKS
(Refer to DVD)

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APPENDIX B

MPPEH DISCOVERY/ACCOUNTABILITY LOG AND MPPEH PHOTO-LOG

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APPENDIX B.1

MPPEH DISCOVERY/ACCOUNTABILITY LOG

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RESOLUTION CONSULTANTS

MEC/MPPEH Discovery plus Accountability Log

Project Location: _Fleming Key Dredge Spoils Pile, NAS Key West, FL

SUXOS: CHRIS BROOME

ID#	Date	Type	Hazard Class (e.g., UXO, DMM, MPPEH, MEC, MDEH, MDAS, etc.)	SUXO & UXOQCS Concurrence?	Photo Log #	Coordinates	Estimated Depth/ Orientation	EODMU Notified?	Final Disposition (e.g. LIP, BIP, off-site, etc.)
#1	5/10/13	SAA .50 CAL	DMM	Y	1	391870.43 91734.98	SURF	N	LEFT IN PLACE FOR FURTHER DISP.
#2	5/10/13	UKNOWN	MPPEH	Y	2	391862.49 91735.86	PARTIALLY BURIED	N	LEFT IN PLACE FOR FURTHER DISP.
#3	5/10/13	~~UNKNOWN~~ PROJECTILE	MPPEH	Y	3	391834.25 91801.00	PARTIALLY BURIED	N	LEFT IN PLACE FOR FURTHER DISP
#4	5/10/13	PROJECTILE 20 MM	MPPEH	Y	4	391700.23 91893.91	SURF	N	LEFT IN PLACE FOR FURTHER DISP.
#5	5/10/13	UNKNOWN	MPPEH	Y	5	391880.05 91699.63	PARTIALLY BURIED	N	LEFT IN PLACE FOR FURTHER DISP
#6	5/10/13	37 MM PROJO	UXO	Y	6	391595.55 91964.16	SURF	N	LEFT IN PLACE
#7									
#8									
#9									
#10									
#11									
#12									

ID # 1 → 4 PREVIOUSLY DISCOVERED BY TTEC ON 5/1.

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APPENDIX B.2

MPPEH PHOTO-LOG

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MPPEH Photo Log

	**Photo No.:** 1 **Site:** Fleming Key Dredge **Position/Location:** 391870.43 91734.98 **Date:** 05/10/13 **Photographed by:** Broome **Description:** .50 Cal Casing Original SN SF_01 discovered on previous SI by Tetra Tech Addendum note on 6/15/13: TEMTADS-2x2 data capturing and advance classification confirms item as 50 cal casing. SUXO and UXOQCS 100% agreement.
	**Photo No.:** 2 **Site:** Fleming Key Dredge **Position/Location:** 391862.49 91735.86 **Date:** 05/10/13 **Photographed by:** Broome **Description:** Unknown Original SN SF_02 discovered on previous SI by Tetra Tech Addendum note on 6/15/13: TEMTADS-2x2 data capturing and advance classification models item has spherical shape and does not match known library items. SUXO cannot confirm or deny as only "crown" is visible and cannot pry from subsurface without breaking ESS-DR.

Photo No.: 3

Site: Fleming Key Dredge

Position/Location: 391834.25 91801.00

Date: 05/10/13

Photographed by: Broome

Description: Unknown

Original SN SF_05 discovered on previous SI by Tetra Tech

Addendum note on 6/15/13: TEMTADS-2x2 data capturing and advance classification indicates item is greater than 75-mm (and more likely a 105-mm HEAT). SUXO cannot confirm as only "crown" is visible and cannot pry from subsurface without breaking ESS-DR. SUXO did confirm from measurements, item is definitely > 75-mm.

Photo No.: 4

Site: Fleming Key Dredge

Position/Location: 391700.23 91893.91

Date: 05/10/13

Photographed by: Broome

Description: 20MM HE

Original SN SF_12 discovered on previous SI by Tetra Tech

Addendum note on 6/15/13: TEMTADS-2x2 data capturing and advance classification indicates item does not have characteristics of 20mm. Further inspection by SUXO infers item is unlikely to be 20mm, but cannot pry from dirt without breaking ESS-DR rules.

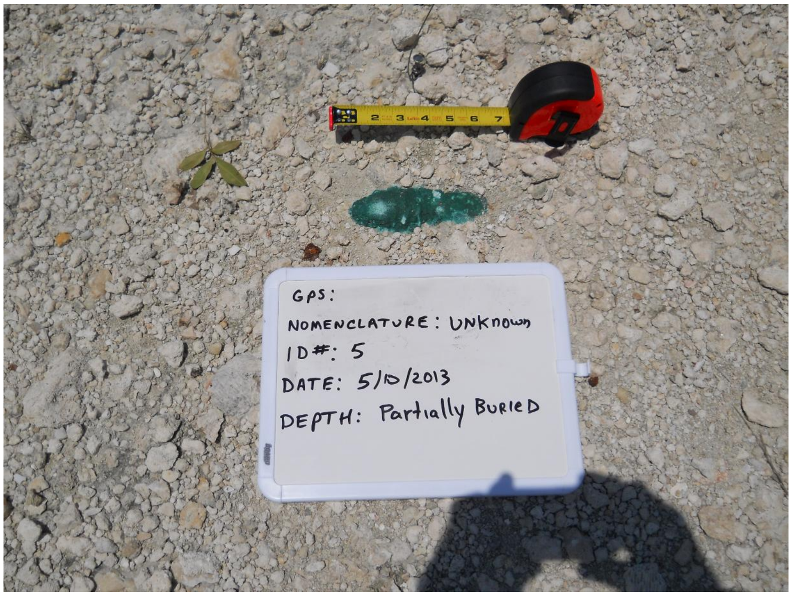

Photo No.: 5

Site: Fleming Key Dredge

Position/Location: 391880.05 91699.63

Date: 05/10/13

Photographed by: Broome

Description: Unknown, newly discovered by Resolution Consultants visible and partially exposed to surface.

Addendum note on 6/15/13: TEMTADS-2x2 data capturing and advance classification models item as another spherical shaped object and does not match library item. SUXO cannot confirm as only "crown" is visible / cannot pry from subsurface under ESS-DR.

Photo No.: 6

Site: Fleming Key Dredge

Position/Location: 391595.55 91964.16

Date: 05/13/13

Photographed by: Broome

Description: Projectile, US 37mm HE MKII, newly discovered by Resolution Consultants on surface.

Addendum note on 6/15/13: TEMTADS-2x2 data capturing and advance classification confirms item as 37-mm. SUXO and UXOQCS 100% agreement on 37-mm HE identification.

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APPENDIX C

TRANSECT-DGM, GRID-DGM, AND SURFACE MPPEH 3-D CI MAPS

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APPENDIX C.1

SITE-WIDE TRANSECT-DGM AND GRID-DGM MAP

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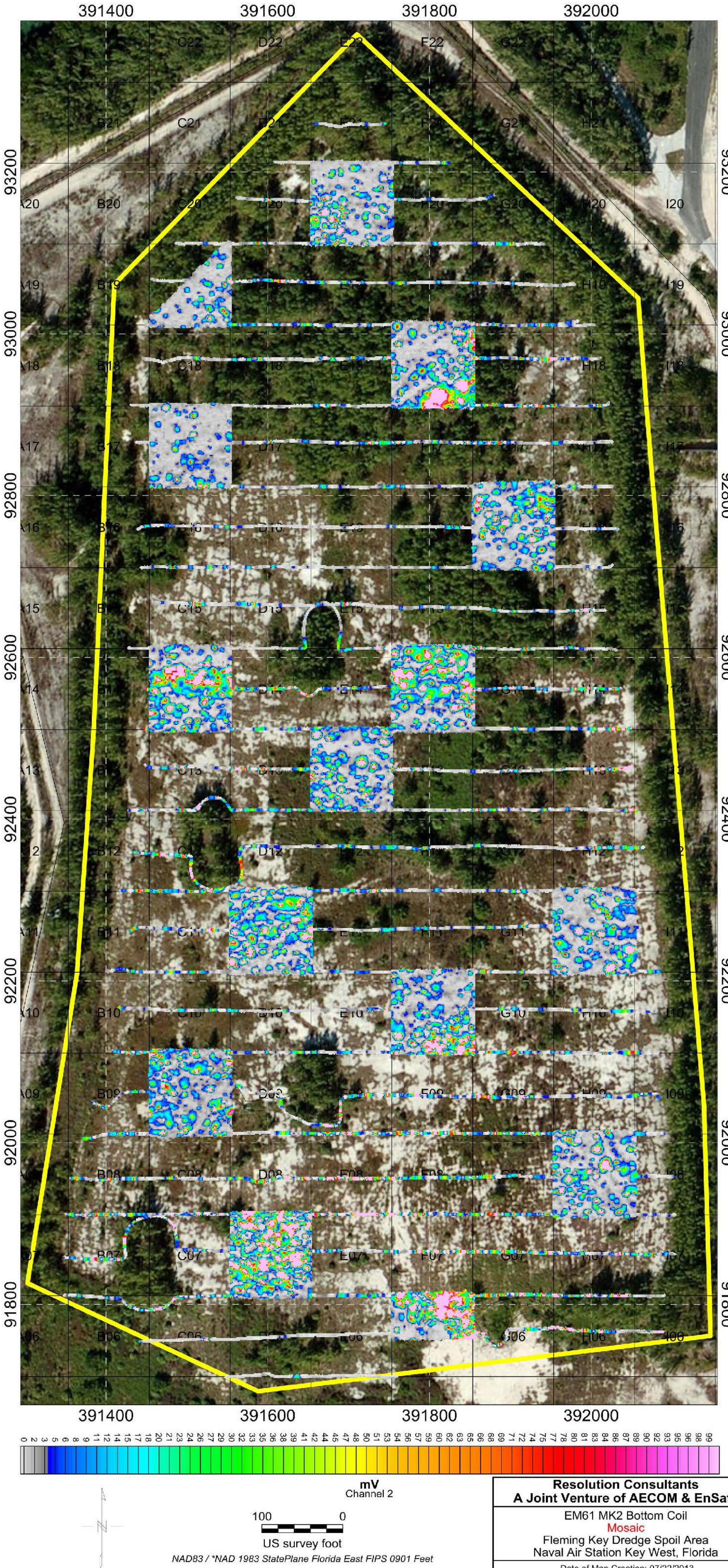

Resolution Consultants
A Joint Venture of AECOM & EnSafe

EM61 MK2 Bottom Coil
Mosaic
Fleming Key Dredge Spoil Area
Naval Air Station Key West, Florida

Date of Map Creation: 07/22/2013
Date of Survey: 05/29/2013 - 06/05/2013

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APPENDIX C.2

SURFACE MPPEH 3-D CI MAPS

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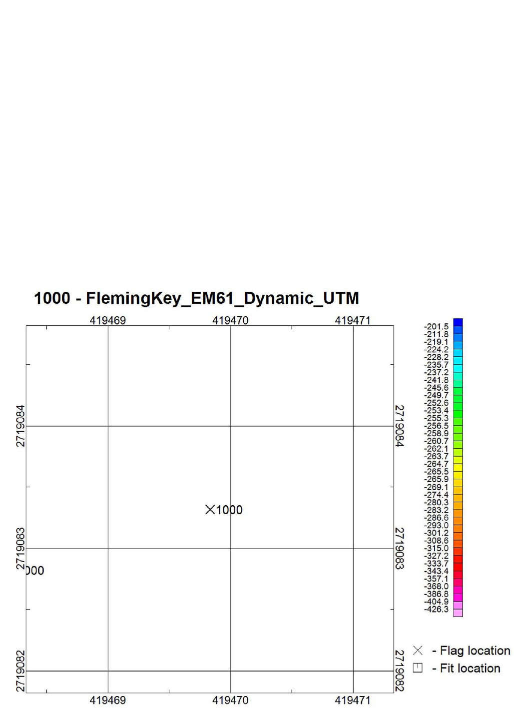
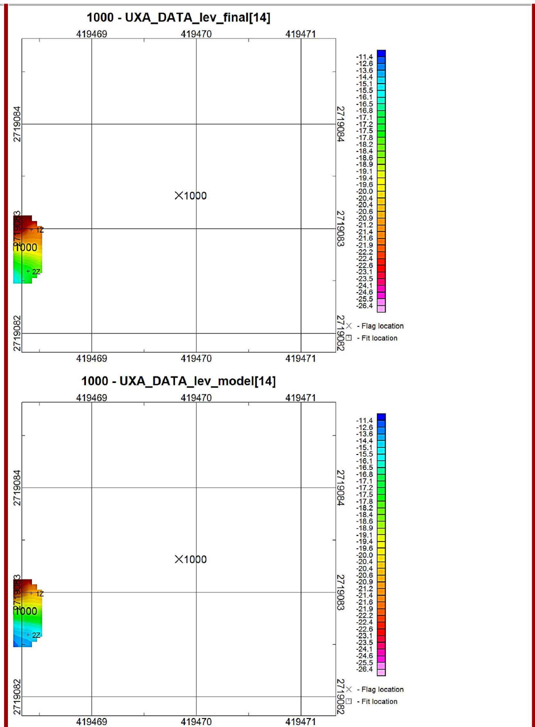
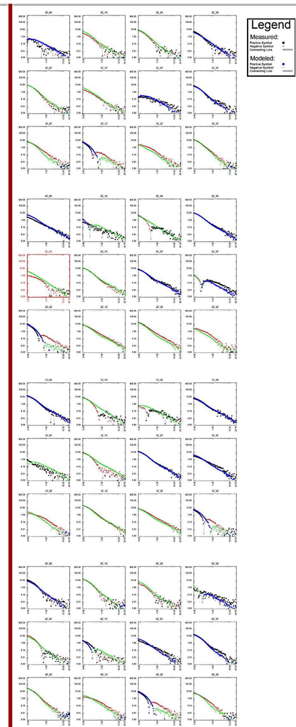
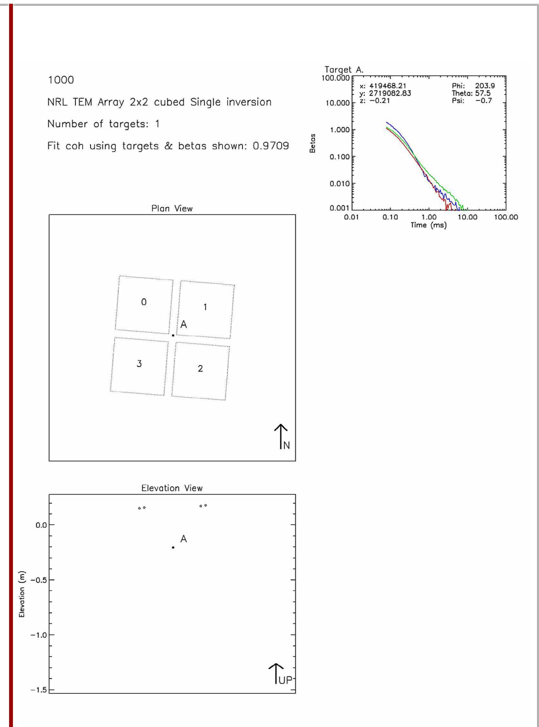
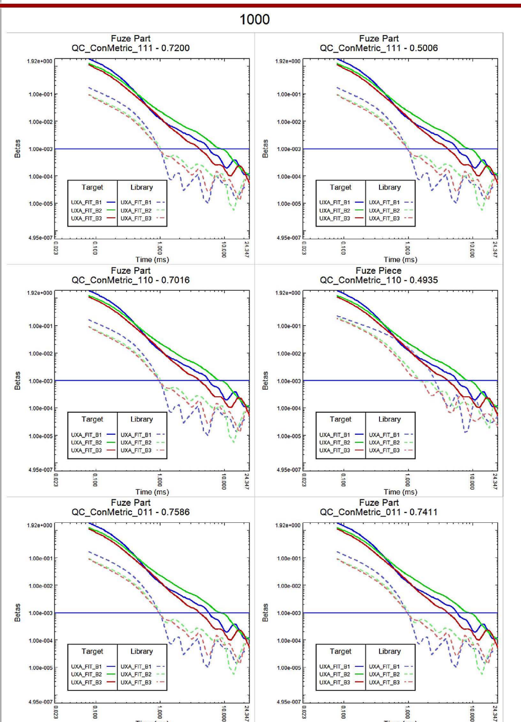








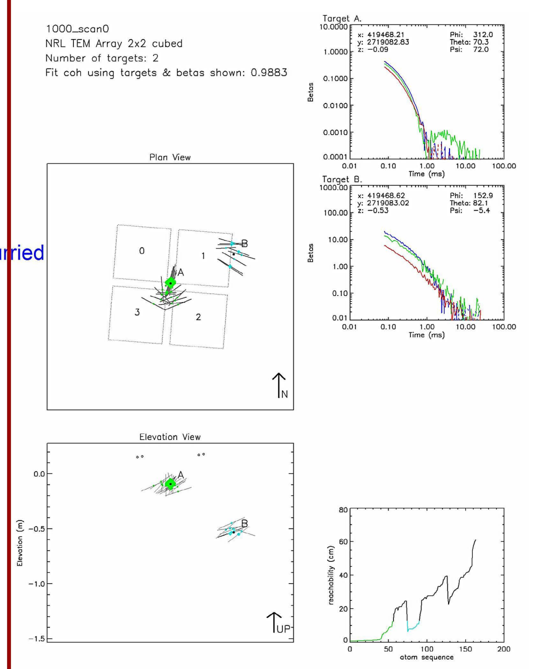


1000

Flag_ID: 1000.00
Redo_Type: *
UXA_COMMENTS: Fit location Too Far From Flag Location
UXA_FIT_X[14]: 419468.21
UXA_FIT_Y[14]: 2719082.83
UXA_FIT_Z[14]: -0.21
UXA_Diff_Array_Fit: 0.019
UXA_Diff_Flag_Array: 1.703
UXA_Diff_Flag_Fit: 1.693
UXA_FIT_COH[14]: 0.9709
UXA_BETANOISE_PTS: 68.00
UXA_BETANOISE_VAL: 0.02

1000

QC_ConMetric_Combined: 0.7149
QC_ConMetric_111_best: 0.7200
QC_ConMatch_111_best: Fuze Part
UXA_COMMENTS_2:
UXA_Size: 0.411
UXA_Decay71: 0.0041
UXA_B1sum: 22.53
UXA_B2sum: 16.56
UXA_B3sum: 13.61
UXA_SIG_AMPLITUDE: 25.86
Dynamic_Comments: .50 Cal Casing - Partially Burried



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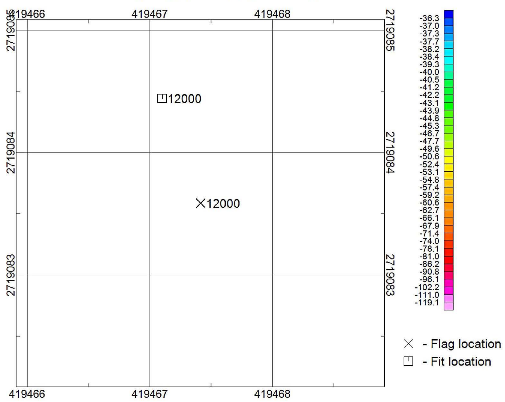

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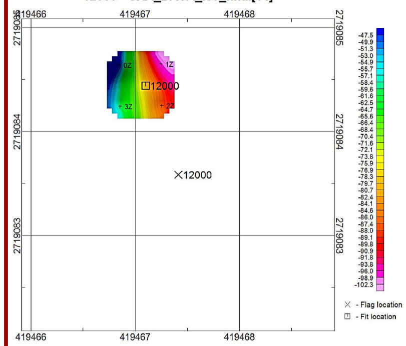

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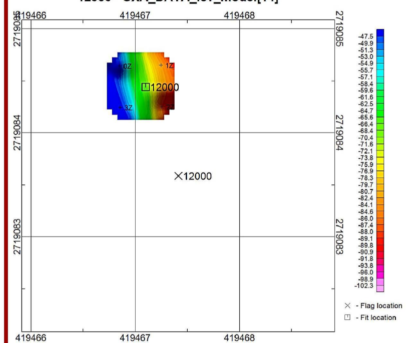

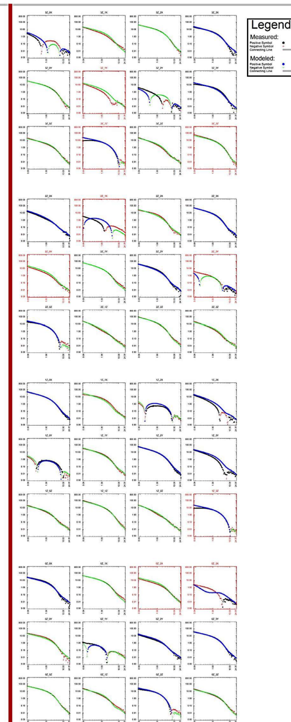

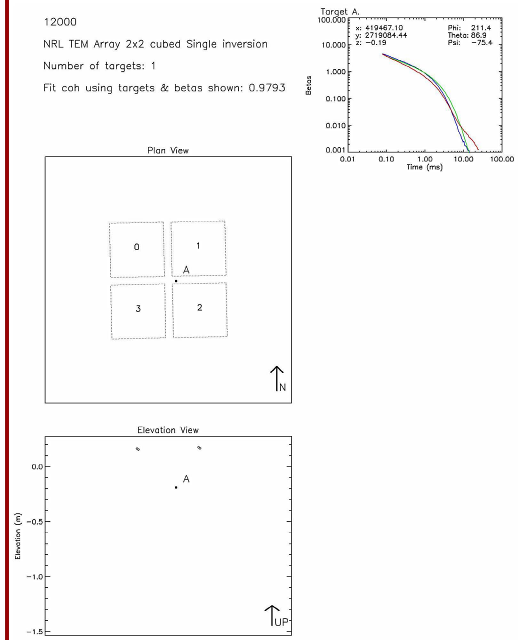

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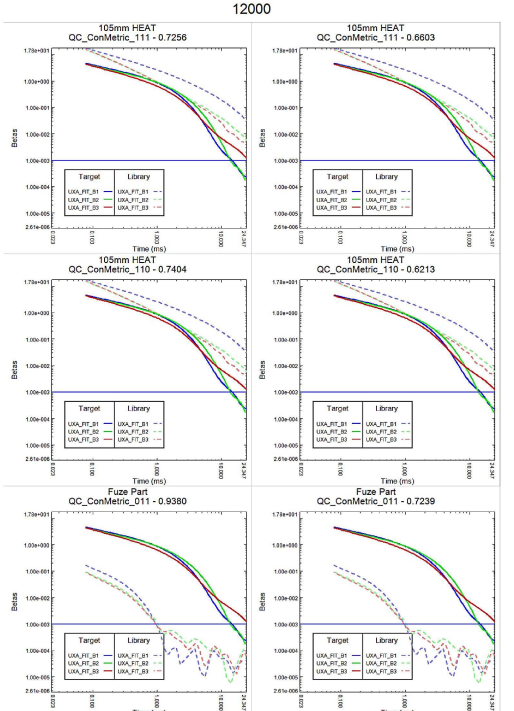
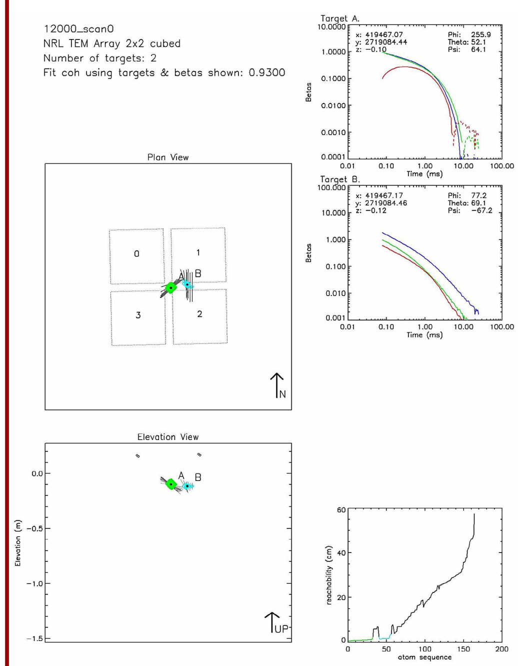


12000

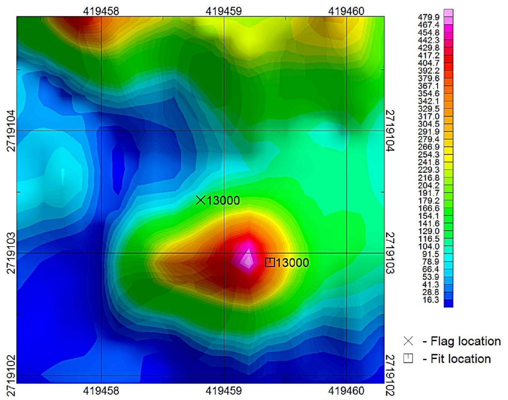
Flag_ID: 2000.00
Redo_Type: *
UXA_COMMENTS: Fit location Too Far From Flag Location
UXA_FIT_X[14]: 419467.10
UXA_FIT_Y[14]: 2719084.44
UXA_FIT_Z[14]: -0.19
UXA_Diff_Array_Fit: 0.049
UXA_Diff_Flag_Array: 0.933
UXA_Diff_Flag_Fit: 0.910
UXA_FIT_COH[14]: 0.9793
UXA_BETANOISE_PTS: 6.00
UXA_BETANOISE_VAL: 0.00

12000

QC_ConMetric_Combined: 0.8394
QC_ConMetric_111_best: 0.7256
QC_ConMatch_111_best: 105mm HEAT
UXA_COMMENTS_2:
UXA_Size: 0.897
UXA_Decay71: 0.0769
UXA_B1sum: 116.72
UXA_B2sum: 110.68
UXA_B3sum: 97.41
UXA_SIG_AMPLITUDE: 97.98
Dynamic_Comments: Unknown - Partially Burried



13000 - FlemingKey_EM61_Dynamic_UTM



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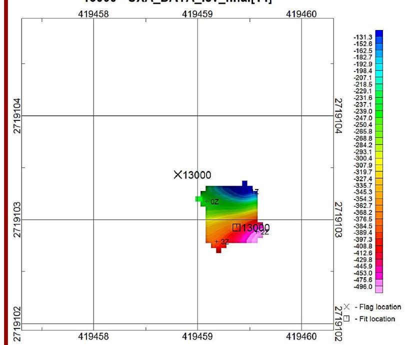

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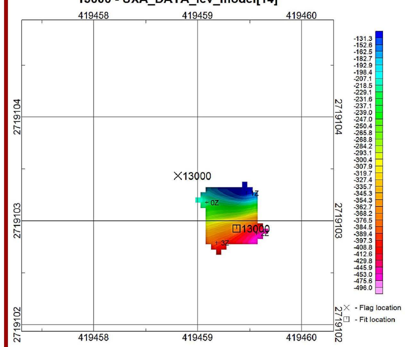
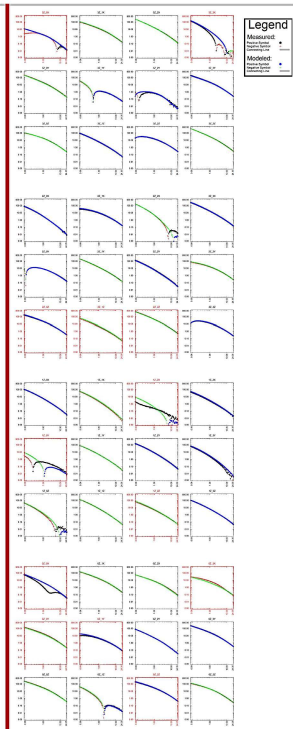
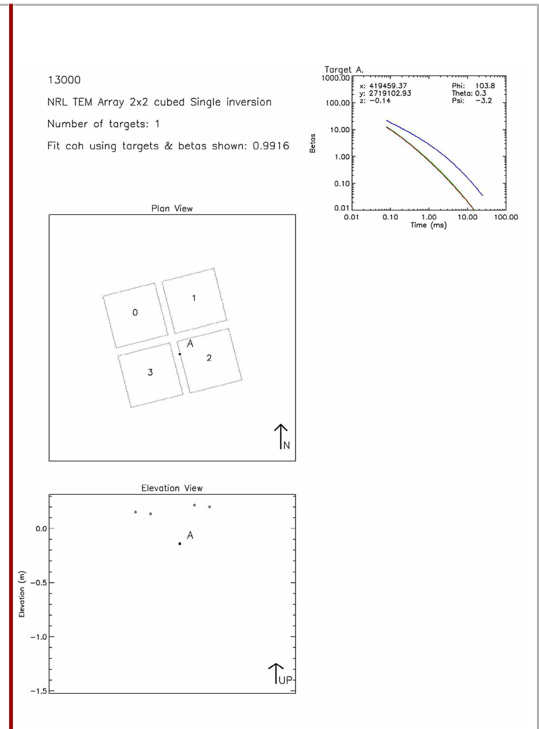
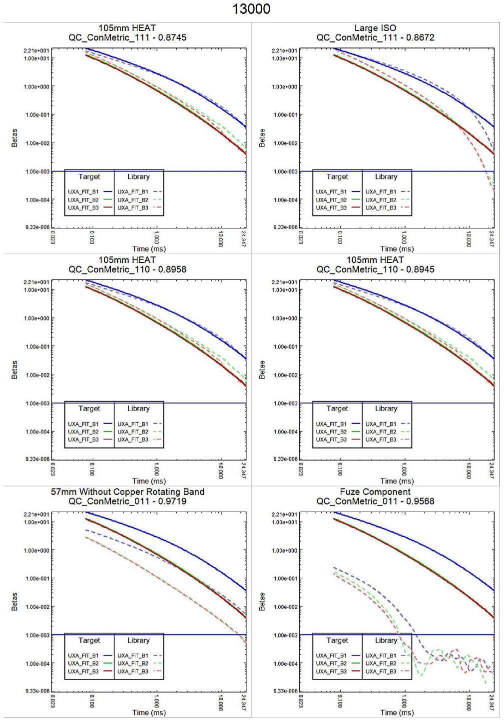






13000

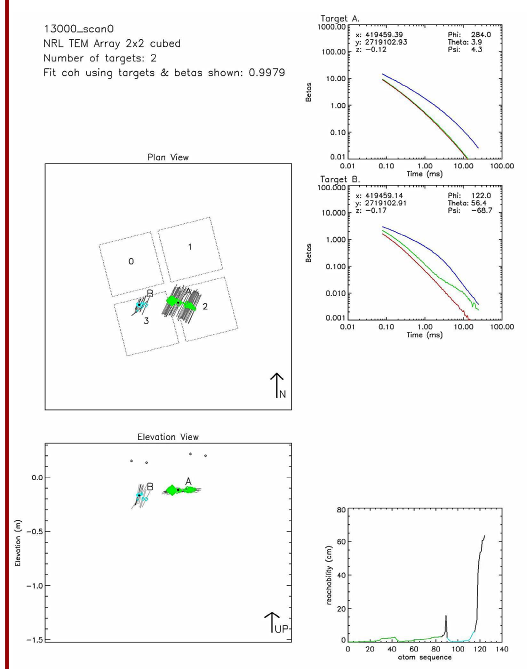


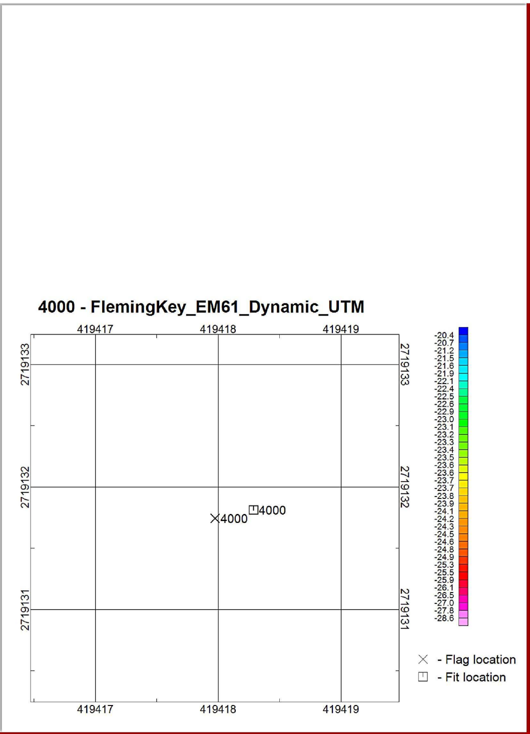
13000

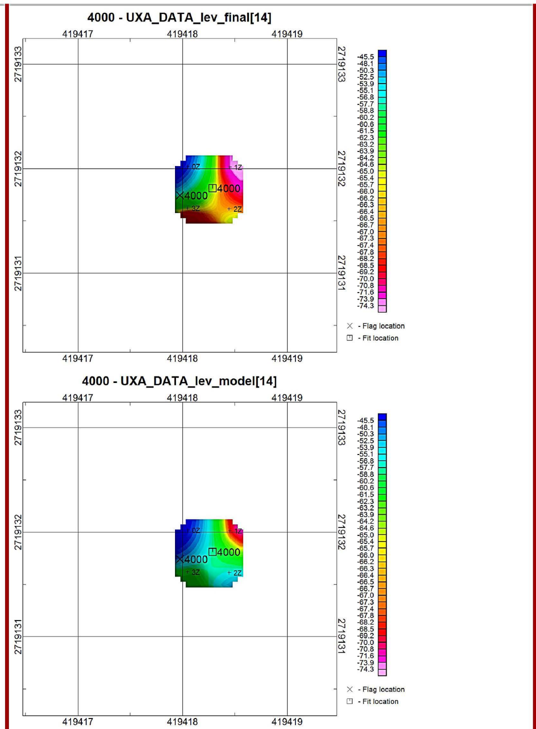
Flag_ID: 3000.00
Redo_Type: *
UXA_COMMENTS: Fit location Too Far From Flag Location
UXA_FIT_X[14]: 419459.37
UXA_FIT_Y[14]: 2719102.93
UXA_FIT_Z[14]: -0.14
UXA_Diff_Array_Fit: 0.115
UXA_Diff_Flag_Array: 0.657
UXA_Diff_Flag_Fit: 0.761
UXA_FIT_COH[14]: 0.9916
UXA_BETANOISE_PTS: 0.00
UXA_BETANOISE_VAL: 0.00

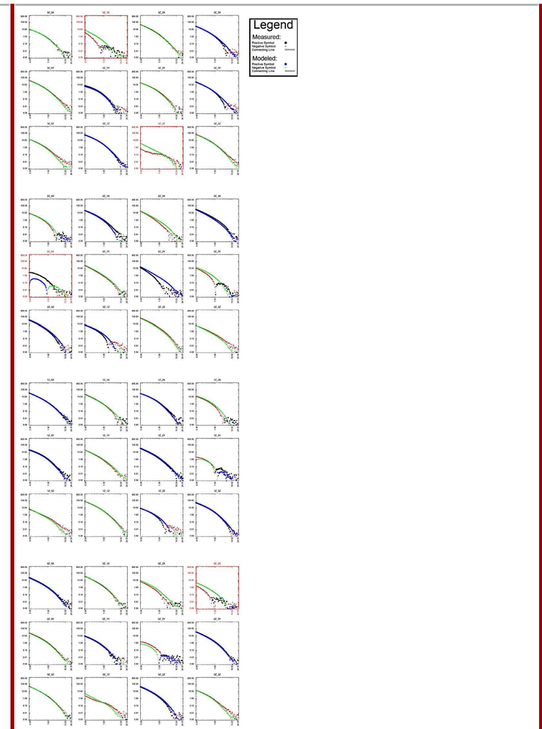
13000

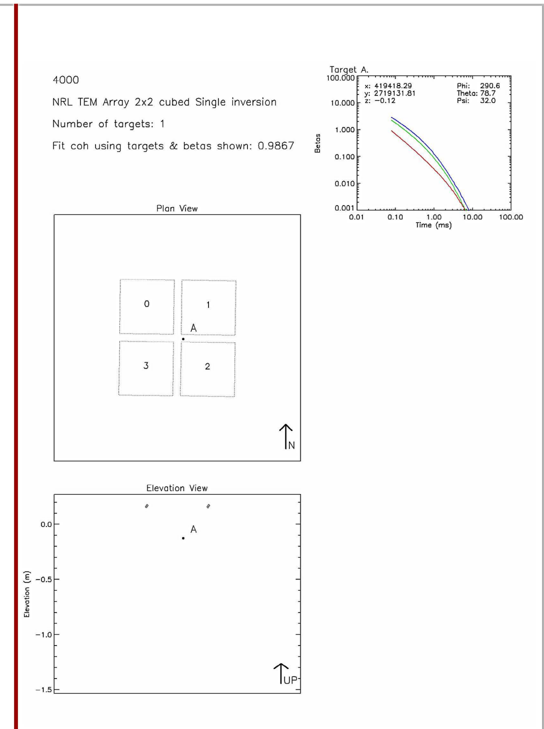
QC_ConMetric_Combined: 0.9337
QC_ConMetric_111_best: 0.8745
QC_ConMatch_111_best: 105mm HEAT
UXA_COMMENTS_2:
UXA_Size: 1.457
UXA_Decay71: 0.0510
UXA_B1sum: 460.71
UXA_B2sum: 205.26
UXA_B3sum: 195.69
UXA_SIG_AMPLITUDE: 491.08
Dynamic_Comments: Unknown - Partially Burried

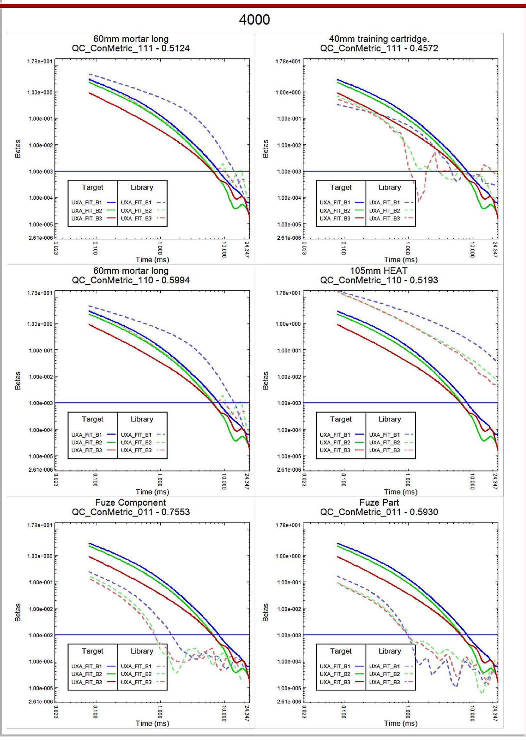










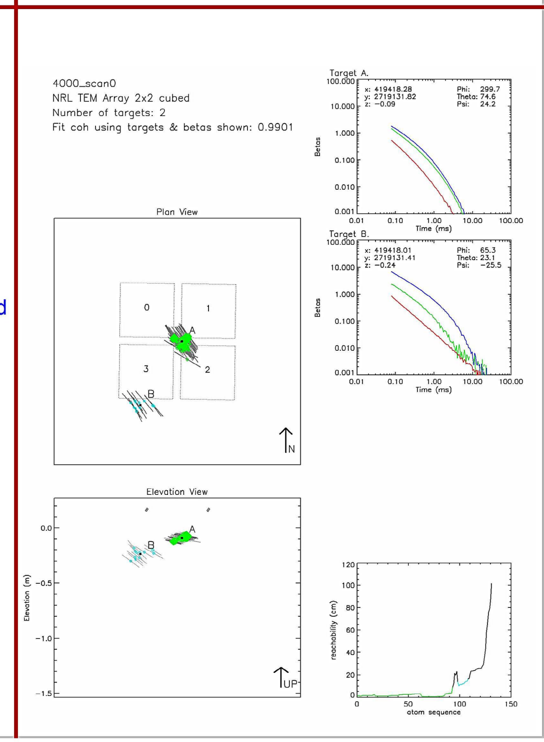


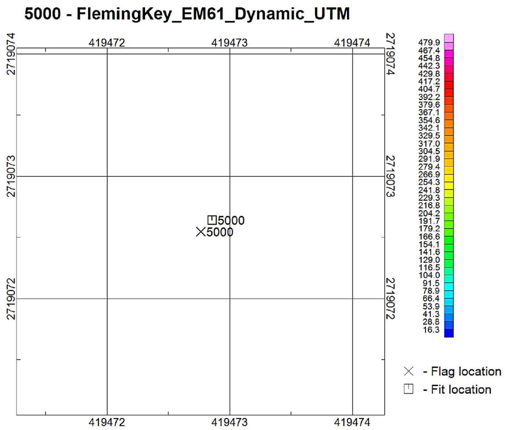
4000

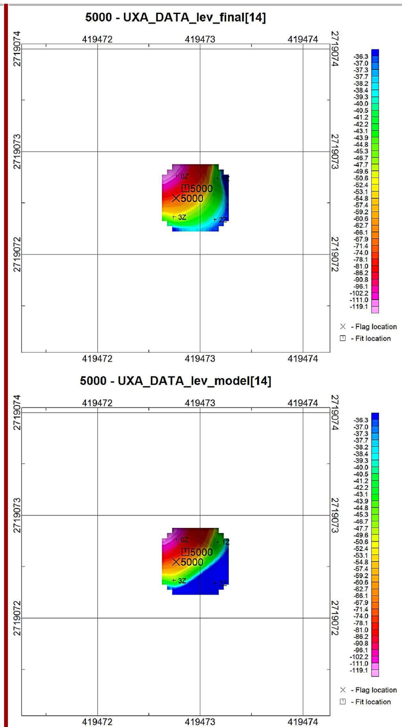
Flag_ID: 4000.00
Redo_Type: *
UXA_COMMENTS:
UXA_FIT_X[14]: 419418.29
UXA_FIT_Y[14]: 2719131.81
UXA_FIT_Z[14]: -0.12
UXA_Diff_Array_Fit: 0.038
UXA_Diff_Flag_Array: 0.285
UXA_Diff_Flag_Fit: 0.320
UXA_FIT_COH[14]: 0.9867
UXA_BETANOISE_PTS: 26.00
UXA_BETANOISE_VAL: 0.00

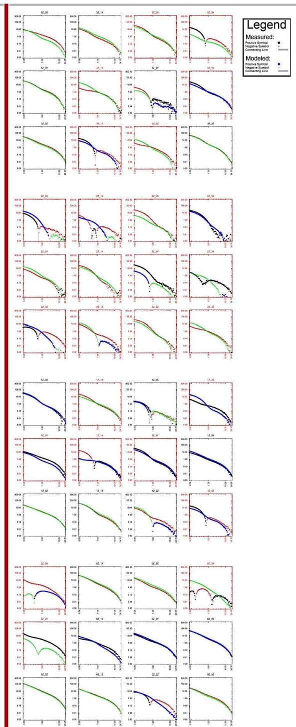
4000

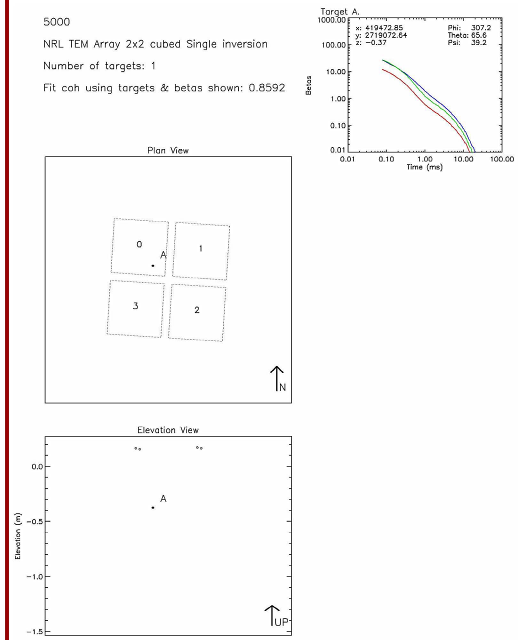
QC_ConMetric_Combined: 0.7004
QC_ConMetric_111_best: 0.5124
QC_ConMatch_111_best: 60mm mortar long
UXA_COMMENTS_2:
UXA_Size: 0.587
UXA_Decay71: 0.0112
UXA_B1sum: 45.27
UXA_B2sum: 33.39
UXA_B3sum: 12.45
UXA_SIG_AMPLITUDE: 74.26
Dynamic_Comments: 20MM HE - Partially Burried

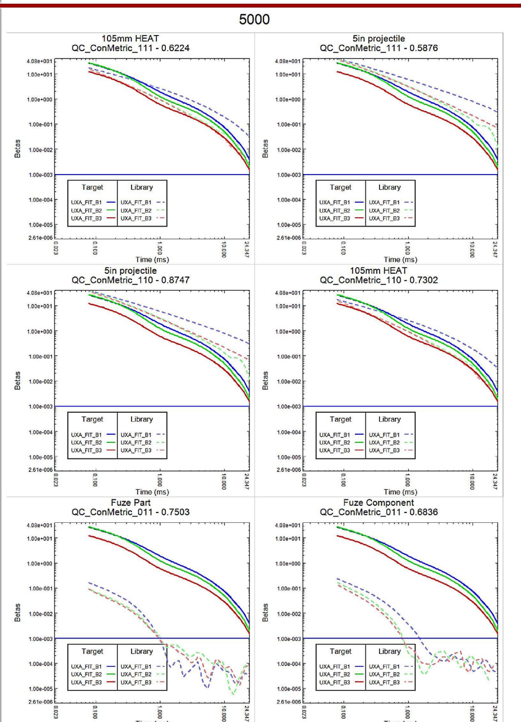












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Flag_ID: 5000.00
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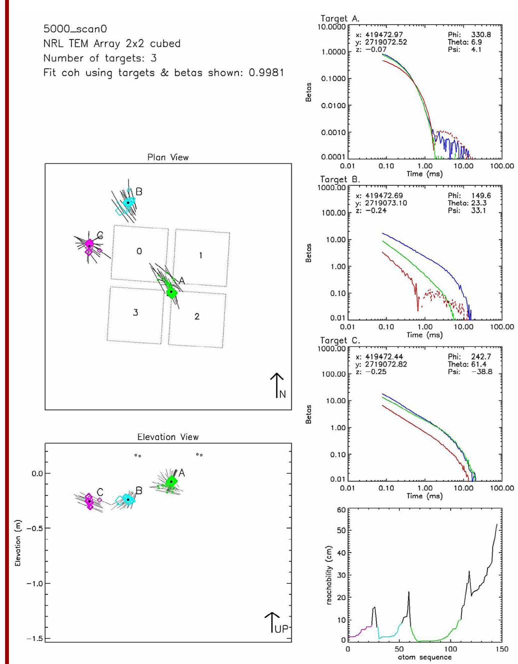
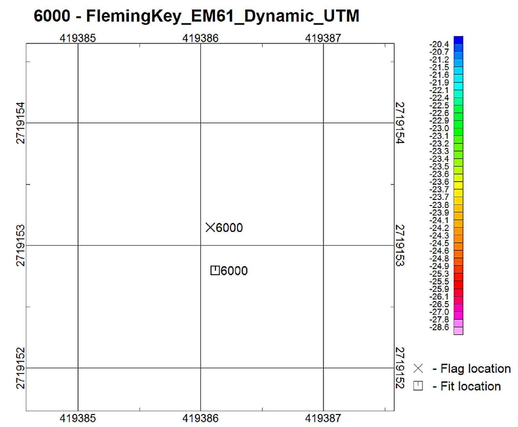
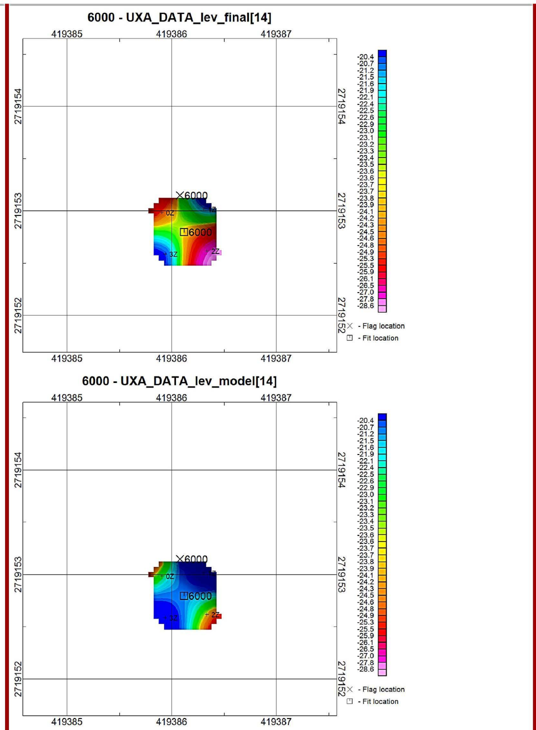
UXA_FIT_Y[14]: 2719072.64
UXA_FIT_Z[14]: -0.37
UXA_Diff_Array_Fit: 0.137
UXA_Diff_Flag_Array: 0.193
UXA_Diff_Flag_Fit: 0.133
UXA_FIT_COH[14]: 0.8592
UXA_BETANOISE_PTS: 3.00
UXA_BETANOISE_VAL: 0.00

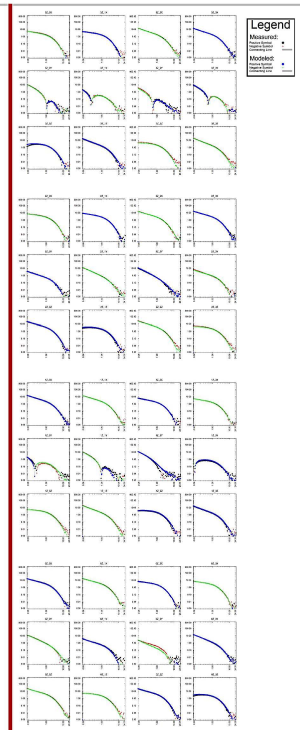
5000

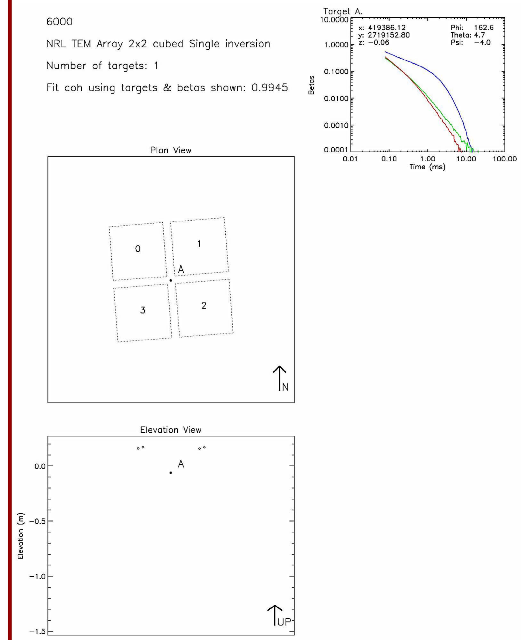
QC_ConMetric_Combined: 0.7950
QC_ConMetric_111_best: 0.6224
QC_ConMatch_111_best: 105mm HEAT
UXA_COMMENTS_2:
UXA_Size: 1.617
UXA_Decay71: 0.0264
UXA_B1sum: 502.65
UXA_B2sum: 480.80
UXA_B3sum: 213.27
UXA_SIG_AMPLITUDE: 111.35
Dynamic_Comments: Unknown - Partially Burried

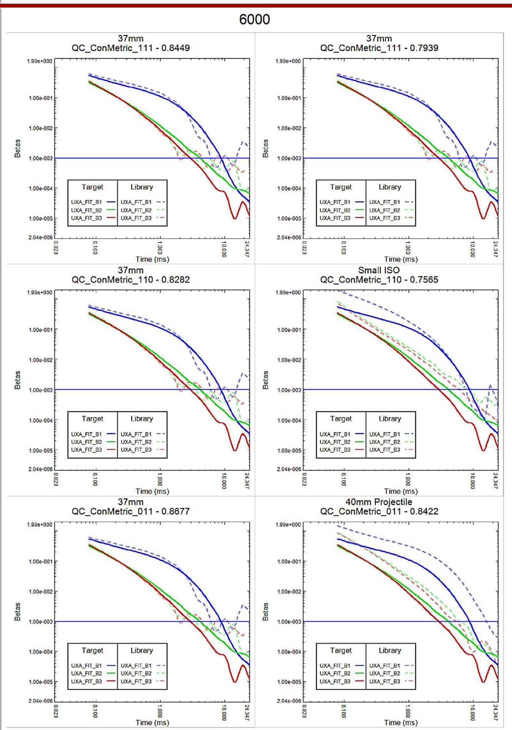










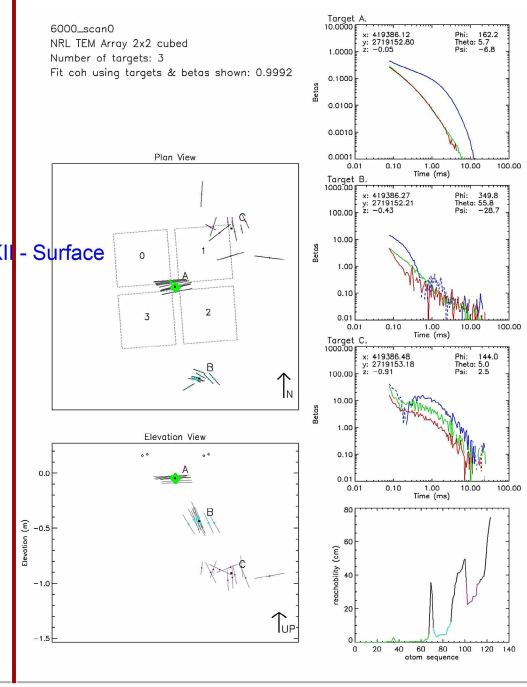


6000

Flag_ID: 6000.00
Redo_Type: *
UXA_COMMENTS:
UXA_FIT_X[14]: 419386.12
UXA_FIT_Y[14]: 2719152.80
UXA_FIT_Z[14]: -0.06
UXA_Diff_Array_Fit: 0.005
UXA_Diff_Flag_Array: 0.351
UXA_Diff_Flag_Fit: 0.353
UXA_FIT_COH[14]: 0.9945
UXA_BETANOISE_PTS: 34.00
UXA_BETANOISE_VAL: 0.00

6000

QC_ConMetric_Combined: 0.8785
QC_ConMetric_111_best: 0.8449
QC_ConMatch_111_best: 37mm
UXA_COMMENTS_2:
UXA_Size: -0.135
UXA_Decay71: 0.0685
UXA_B1sum: 13.48
UXA_B2sum: 4.51
UXA_B3sum: 4.57
UXA_SIG_AMPLITUDE: 27.61
Dynamic_Comments: Projectile US 37mm HE MKII - Surface



APPENDIX D

FINAL RANKED ANOMALY LIST OF 3-D CI DATA WITH SUBSURFACE 3-D CI MAPS
(Refer to DVD)

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APPENDIX E

GEOPHYSICAL DATA AND DELIVERABLES
(Refer to DVD)

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APPENDIX F

IVS LETTER-SIZED REPORT & GEOPHYSICS INVESTIGATION SUMMARY REPORT (Refer to DVD)

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APPENDIX G

INDEPENDENT EVALUATION FIGURES OF QC PERFORMANCE METRICS ALONG PROJECT TIMELINE

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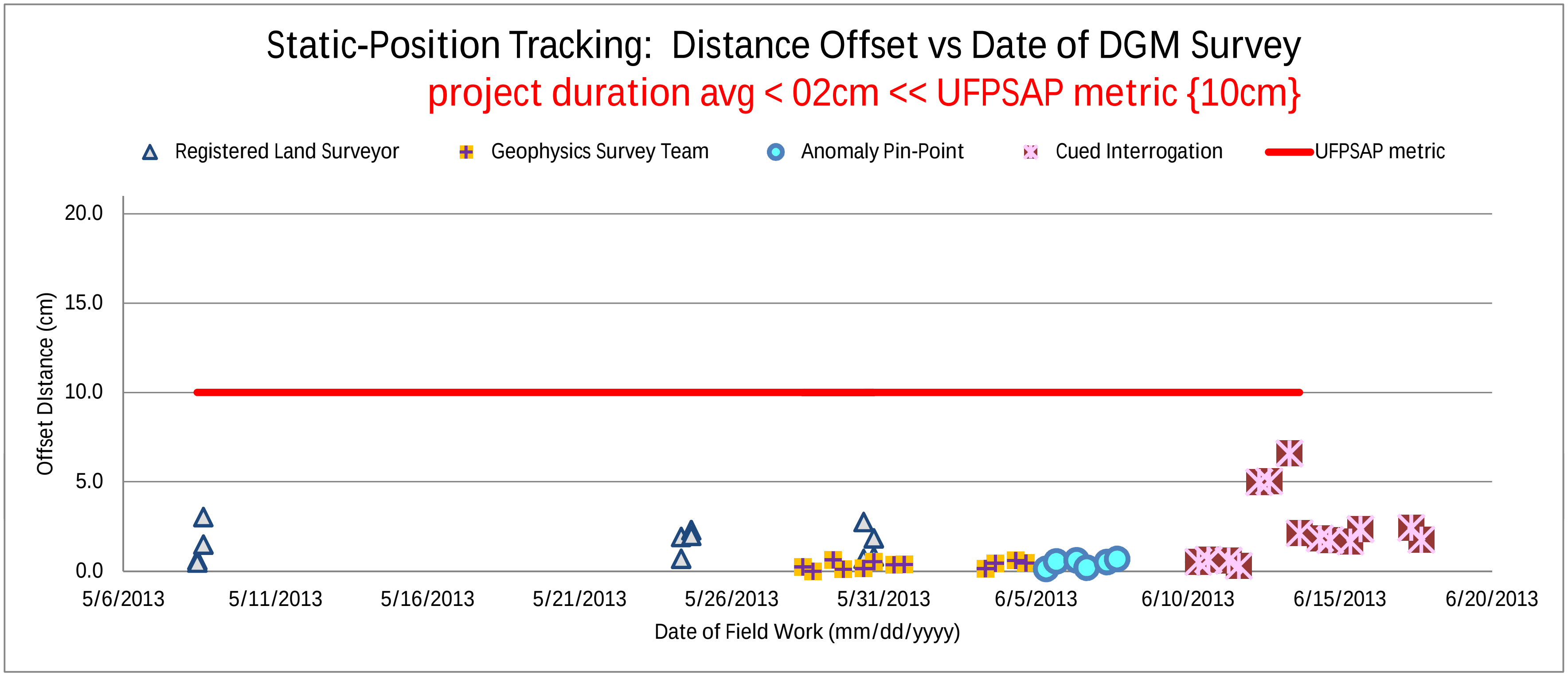
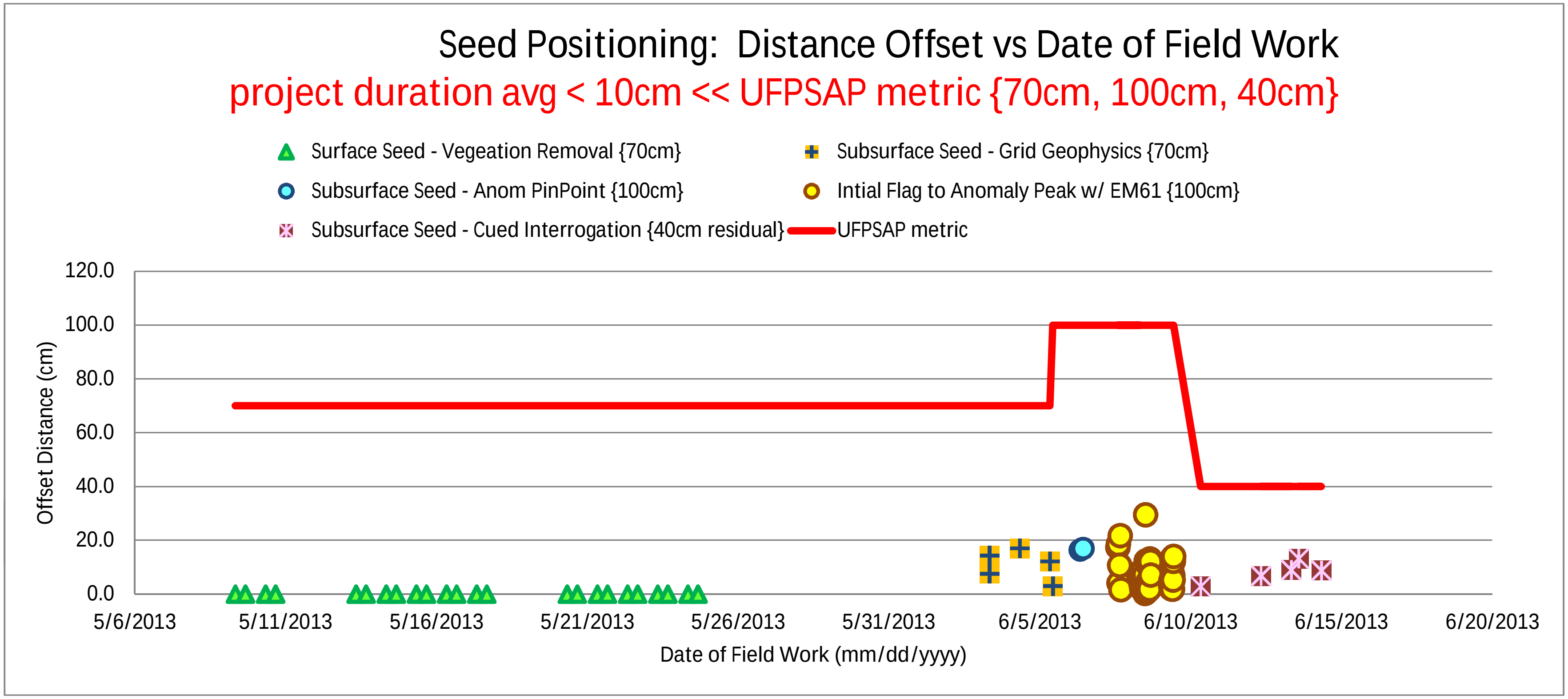
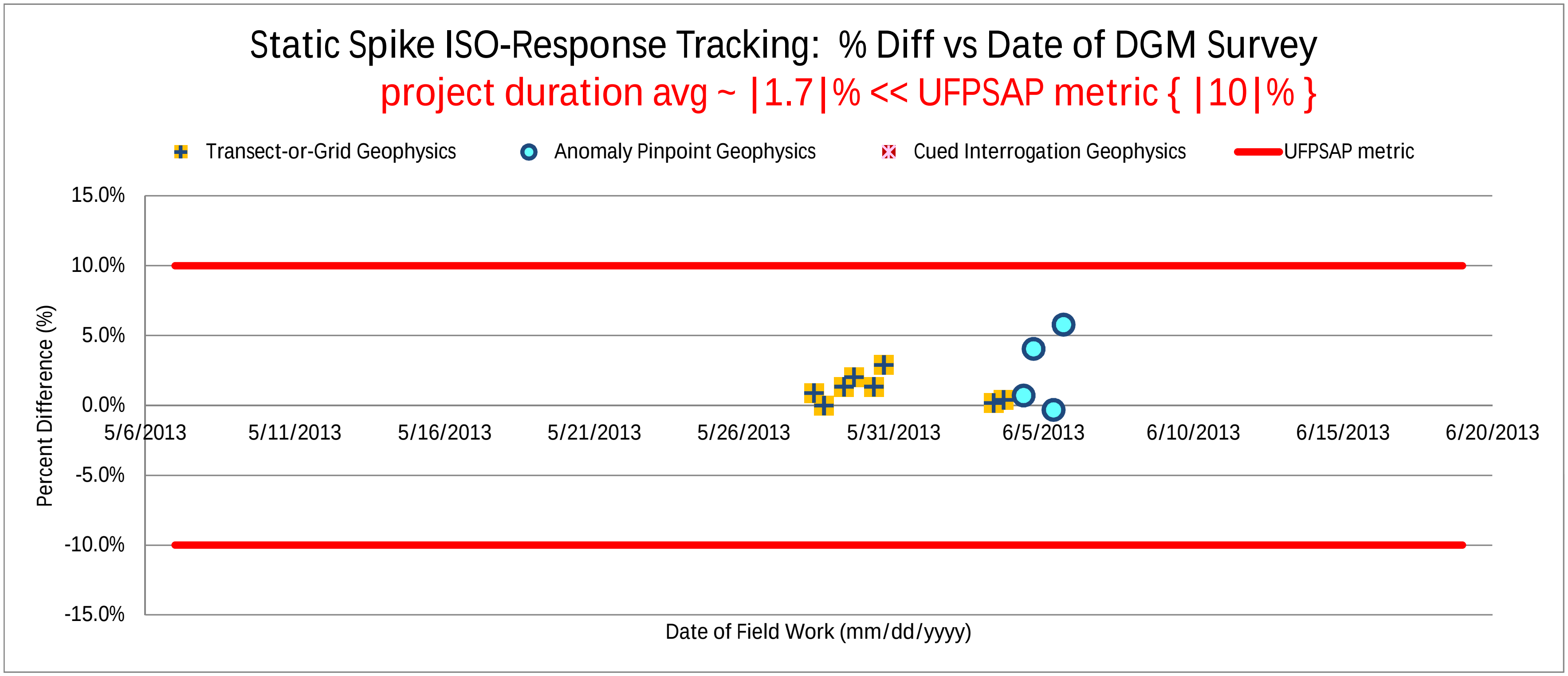
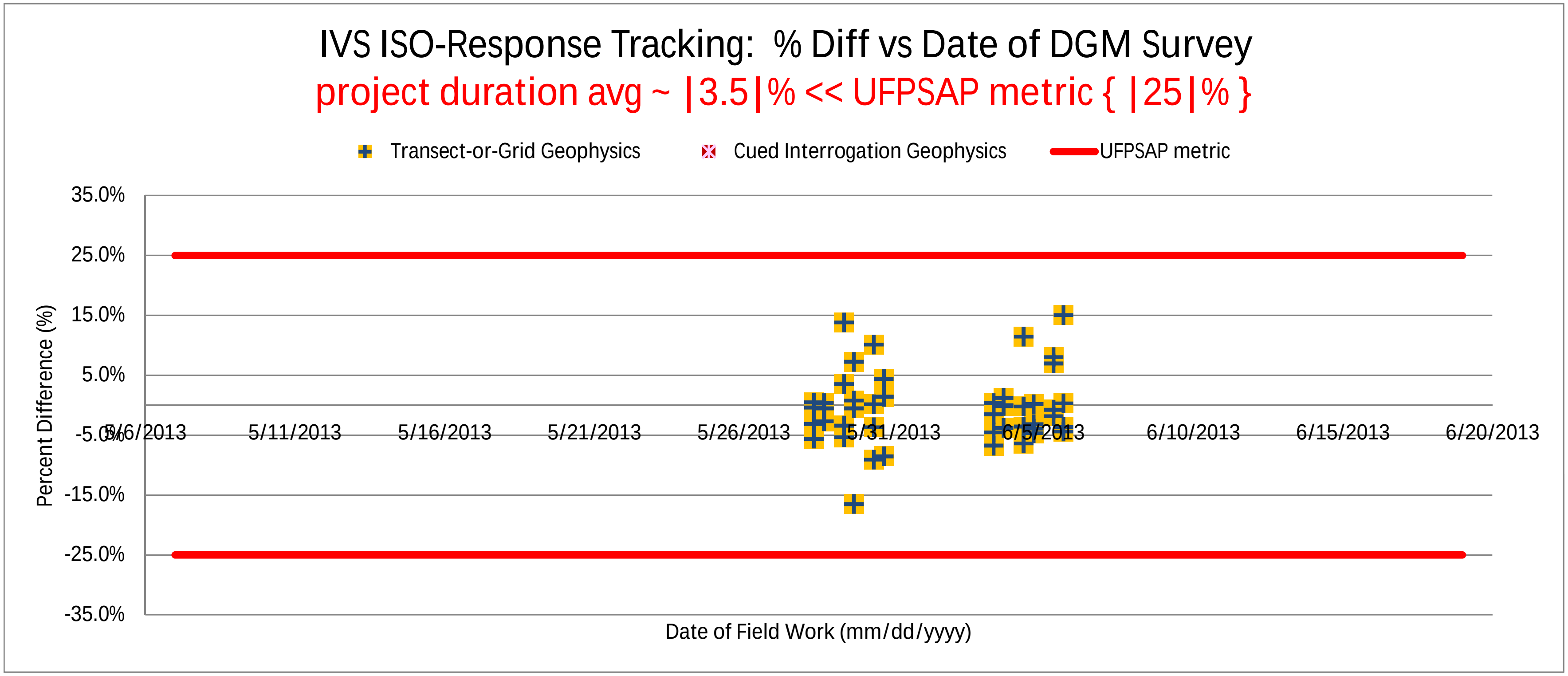
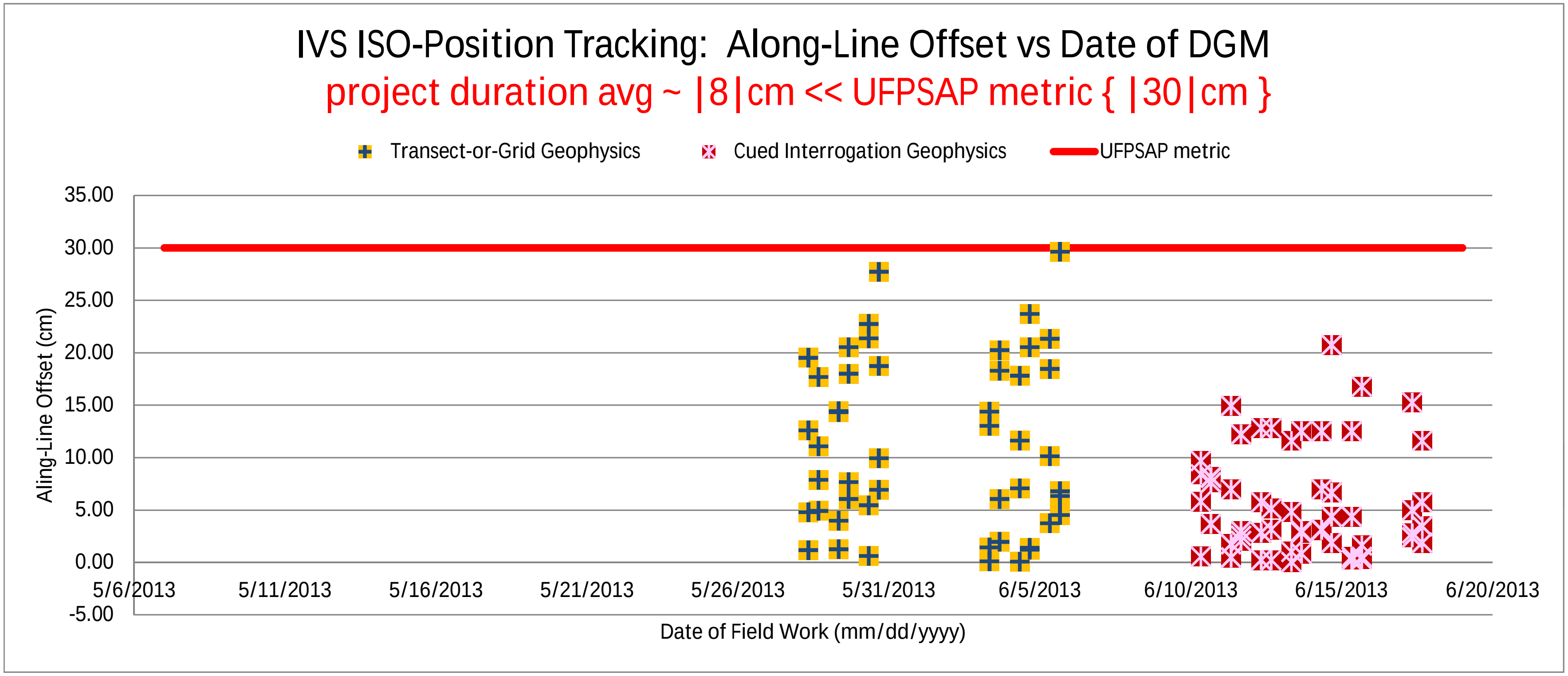

Static-Position Tracking: Distance Offset vs Date of DGM Survey
project duration avg < 02cm << UFPSAP metric {10cm}
Registered Land Surveyor
Geophysics Survey Team
Anomaly Pin-Point
Cued Interrogation
UFPSAP metric
Offset Distance (cm)
20.0
15.0
10.0
5.0
0.0
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of Field Work (mm/dd/yyyy)

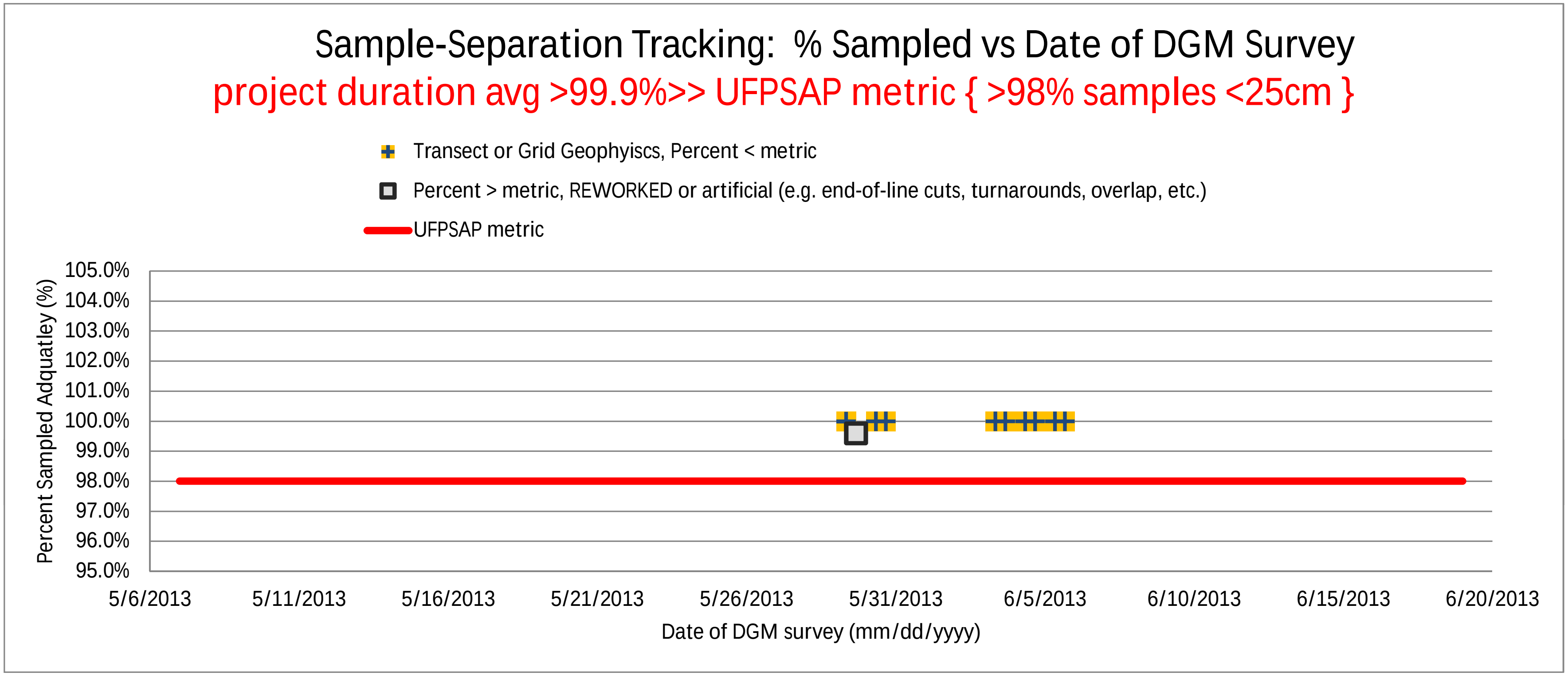

Seed Positioning: Distance Offset vs Date of Field Work
project duration avg < 10cm << UFPSAP metric {70cm, 100cm, 40cm}
Surface Seed - Vegeation Removal {70cm}
Subsurface Seed - Grid Geophysics {70cm}
Subsurface Seed - Anom PinPoint {100cm}
Intial Flag to Anomaly Peak w/ EM61 {100cm}
Subsurface Seed - Cued Interrogation {40cm residual}
UFPSAP metric
Offset Distance (cm)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of Field Work (mm/dd/yyyy)


Static Spike ISO-Response Tracking: % Diff vs Date of DGM Survey
project duration avg ~ |1.7|% << UFPSAP metric { |10|% }
Transect-or-Grid Geophysics
Anomaly Pinpoint Geophysics
Cued Interrogation Geophysics
UFPSAP metric
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
-15.0%
Percent Difference (%)
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of Field Work (mm/dd/yyyy)

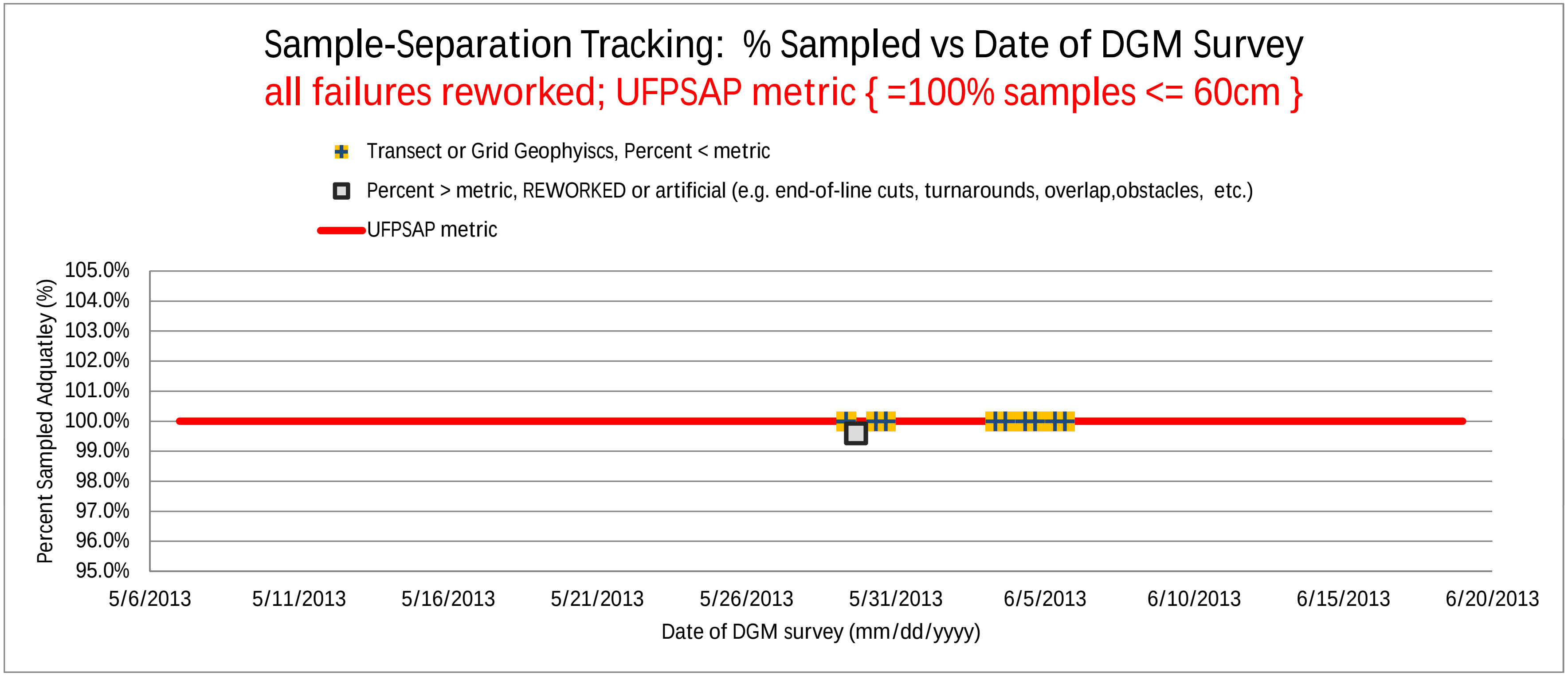

IVS ISO-Response Tracking: % Diff vs Date of DGM Survey
project duration avg ~ |3.5|% << UFPSAP metric { |25|% }
Transect-or-Grid Geophysics
Cued Interrogation Geophysics
UFPSAP metric
35.0%
25.0%
15.0%
5.0%
-5.0%
-15.0%
-25.0%
-35.0%
Percent Difference (%)
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of Field Work (mm/dd/yyyy)

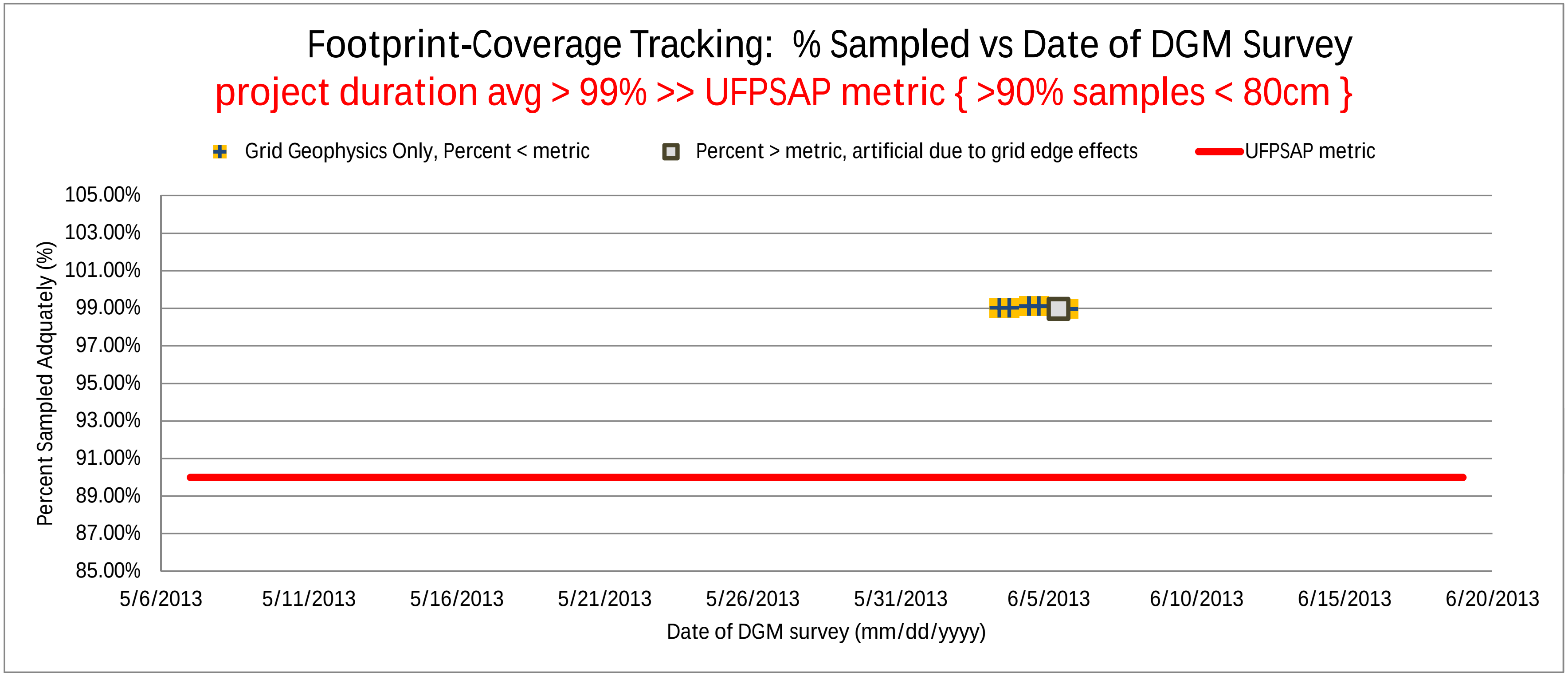


IVS ISO-Position Tracking: Along-Line Offset vs Date of DGM
project duration avg ~ |8|cm << UFPSAP metric { |30|cm }
Transect-or-Grid Geophysics
Cued Interrogation Geophysics
UFPSAP metric
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
Aling-Line Offset (cm)
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of Field Work (mm/dd/yyyy)

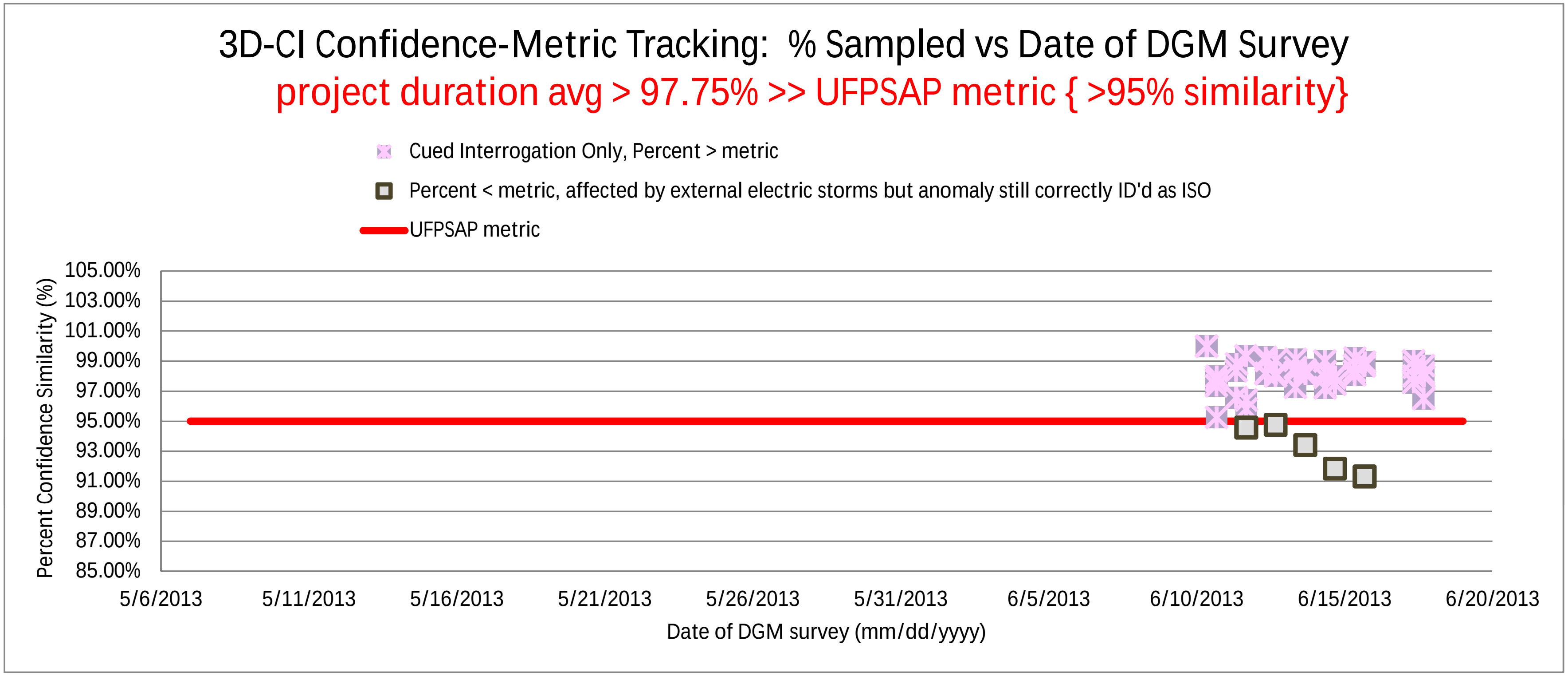


Sample-Separation Tracking: % Sampled vs Date of DGM Survey
project duration avg >99.9%>> UFPSAP metric { >98% samples <25cm }
Transect or Grid Geophyiscs, Percent < metric
Percent > metric, REWORKED or artificial (e.g. end-of-line cuts, turnarounds, overlap, etc.)
UFPSAP metric
Percent Sampled Adquatley (%)
105.0%
104.0%
103.0%
102.0%
101.0%
100.0%
99.0%
98.0%
97.0%
96.0%
95.0%
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of DGM survey (mm/dd/yyyy)


Sample-Separation Tracking: % Sampled vs Date of DGM Survey
all failures reworked; UFPSAP metric { =100% samples <= 60cm }
Transect or Grid Geophyiscs, Percent < metric
Percent > metric, REWORKED or artificial (e.g. end-of-line cuts, turnarounds, overlap,obstacles, etc.)
UFPSAP metric
Percent Sampled Adquatley (%)
105.0%
104.0%
103.0%
102.0%
101.0%
100.0%
99.0%
98.0%
97.0%
96.0%
95.0%
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of DGM survey (mm/dd/yyyy)



Footprint-Coverage Tracking: % Sampled vs Date of DGM Survey
project duration avg > 99% >> UFPSAP metric { >90% samples < 80cm }
Grid Geophysics Only, Percent < metric
Percent > metric, artificial due to grid edge effects
UFPSAP metric
105.00%
103.00%
101.00%
99.00%
97.00%
95.00%
93.00%
91.00%
89.00%
87.00%
85.00%
Percent Sampled Adquately (%)
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of DGM survey (mm/dd/yyyy)


3D-CI Confidence-Metric Tracking: % Sampled vs Date of DGM Survey
project duration avg > 97.75% >> UFPSAP metric { >95% similarity}
Cued Interrogation Only, Percent > metric
Percent < metric, affected by external electric storms but anomaly still correctly ID'd as ISO
UFPSAP metric
Percent Confidence Similarity (%)
105.00%
103.00%
101.00%
99.00%
97.00%
95.00%
93.00%
91.00%
89.00%
87.00%
85.00%
5/6/2013
5/11/2013
5/16/2013
5/21/2013
5/26/2013
5/31/2013
6/5/2013
6/10/2013
6/15/2013
6/20/2013
Date of DGM survey (mm/dd/yyyy)

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