Appendix B-3

Quality Assurance Documentation

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CEHNC Form 948

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U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE
ORDNANCE AND EXPLOSIVE GROUP
MEMO

TO:	DATE:	TIME:
Foster Wheeler Environmental Corp.	8-17-05	1530

CONTRACT NUMBER:	PROJECT LOCATION:
DACA87-99-D-0010	Ft McClellan, AL
DO #: 0010	E. By-Pass

SUBJECT ITEM(S) (Check all that apply):

- ☐ Work Plan
- ☐ Safety Violation
- ☐ Safety Comments
- ☒ Quality Control
- ☐ Other

DESCRIPTION: The following grids have passed a quality assurance check: D-07, D-08, D-14, D-15, D-22, D-23, D-30, R-01, R-02, R-03, R-05, R-06 and R-09. /Last Item/

☐ Prompt correction or compliance with contract specifications is requested.

Robert S. Thompson
USACE Site Representative

RECEIPT ACKNOWLEDGED: Gladys Bentl
Contractor's Representative

ACTION TAKEN:

CEHNC FORM 948 (Revised) 1 APR 96 — **COPY 1 - Contractor's Representative**

U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE
ORDNANCE AND EXPLOSIVE GROUP
MEMO

TO: Foster Wheeler Environmental Corp.	DATE: 8-19-05	TIME: 1400
CONTRACT NUMBER: DACA87-99-D-0010	**PROJECT LOCATION:** Ft. McClellan E. By-Pass	
DO #: 0010		

SUBJECT ITEM(S) (Check all that apply):

- ☐ Work Plan
- ☐ Safety Violation
- ☐ Safety Comments
- ☒ Quality Control
- ☐ Other

DESCRIPTION: The following grids have passed a quality assurance check: C-67, D-34, D-47, D-75, D-76, D82, D-83, S-02, S-03, S-04, S-05, R-18.

Last Item

☐ Prompt correction or compliance with contract specifications is requested.

USACE Site Representative

RECEIPT ACKNOWLEDGED: Grady Burchfield

Contractor's Representative

ACTION TAKEN:

CEHNC FORM 948 (Revised) 1 APR 96

COPY 1 - Contractor's Representative

Government QA Report

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Quality Assurance Audit Evaluation

On

Tetra Tech Environmental Corporation

Digital Geophysical Survey Results

for

The Ft. McClellan Eastern Bypass Construction Debris Area

Debra Edwards

Geotechnical Branch

USAESCH-ED-CS-G

November 10, 2005

Table of Contents

1.0 Executive Summary

The U.S. Army Engineering and Support Center at Huntsville (USAESCH) performed a Government Quality Assurance Audit on the UXO Geophysical Investigation Process performed on the Eastern Bypass Construction Debris Area at Ft. McClellan in Anniston, Alabama. This report documents the specific processes used to evaluate the Data Quality Objectives delivered by the contractor. The Audit concentrated on the following three (3) major Quality Control Elements to verify acceptable contractor performance:

1) Acceptable Geophysical Prove-out Results
2) Successfully locating all Pre-Seeded Items within survey boundaries
3) Successfully passing a Government Review of Digital Geophysical Data

2.0 Introduction

The purpose of this Government Quality Assurance Audit is to document the specific processes used and the results attained for the Ft. McClellan Alabama Eastern-Bypass-Construction Debris-Area Geophysical Investigation. The general objective of the geophysical investigations was to efficiently locate buried UXO for removal and proper disposal while complying with applicable laws, regulations, and sound technical practices. The audit evaluates the effectiveness of the Contractors Quality Control Program and Processes.

3.0 Quality Assurance Audit Elements

The Government Geophysical Quality Assurance Inspection Audit provides a documentable process that effectively monitors the contractors Performance in the areas of;

a.) Initial data acquisition, processing and interpretation,

b.) Target anomaly reacquisition and excavation.

The Inspection Audit is a multi-layered approach that verifies whether the contractor's team is performing the UXO Detection and Clearance operations to an acceptable standard. Any failure

resulting from this audit by the contractor will result in a detailed review of the affected Data Quality Control Elements followed by immediate remediation of the identified failures. This Audit concentrated on three (3) major Quality Control Elements to verify acceptable contractor performance.

3.1 Geophysical Prove-out Results

Tetra Tech Enivironmental Corporation, Inc. (TtEC) satisfactorily performed a geophysical prove-out (GPO) for this project under task order 0010 during August 2005. Details are included in the final report "Final Geophysical Prove-Out Letter Report, Fort McClellan, Alabama, August 2005". The TtEC team utilized the Geophysical Prove Out grid during project execution to maintain efficiency and performance levels as well as to test innovative navigation technologies that may be applicable to the Ft. McClellan clean up effort. The data were collected using the EM61-MK2 as the geophysical instrument with two methods of navigation: (1) Differential Global Positioning System (DGPS) and (2) Robotic Total Station (RTS). The DGPS can only be successfully operated in open areas and the RTS can be used in areas with tree canopy. Figures 1 and 2 are the line paths for the DGPS and RTS, respectively. Problems were identified with both navigation systems. DGPS faired well in the open areas, however, satellite visibility was limited up to 25 feet off of the tree line of the GPO, as can be seen by the apparent erratic lines and line spacing near the trees. The RTS system presented problems when the operator paused the survey, as spikes were created in the positioning data. Processing methods allowed for much of the positioning data to be corrected, however, the result were holidays or missing navigation points in the data as seen in Figure 2. Due to the problems with the RTS system during the GPO, the TtEC site geophysicist did not use the RTS on any of the grids until the problem was resolved and the GPO was resurveyed. Therefore, areas where the DGPS could not be used or where the terrain was too difficult for the EM61-MK coils, were cleared using the mag-and-dig method with the Vallon handheld all-metal detector. After a successful GPO using the RTS, grid R18 was collected with the RTS system.

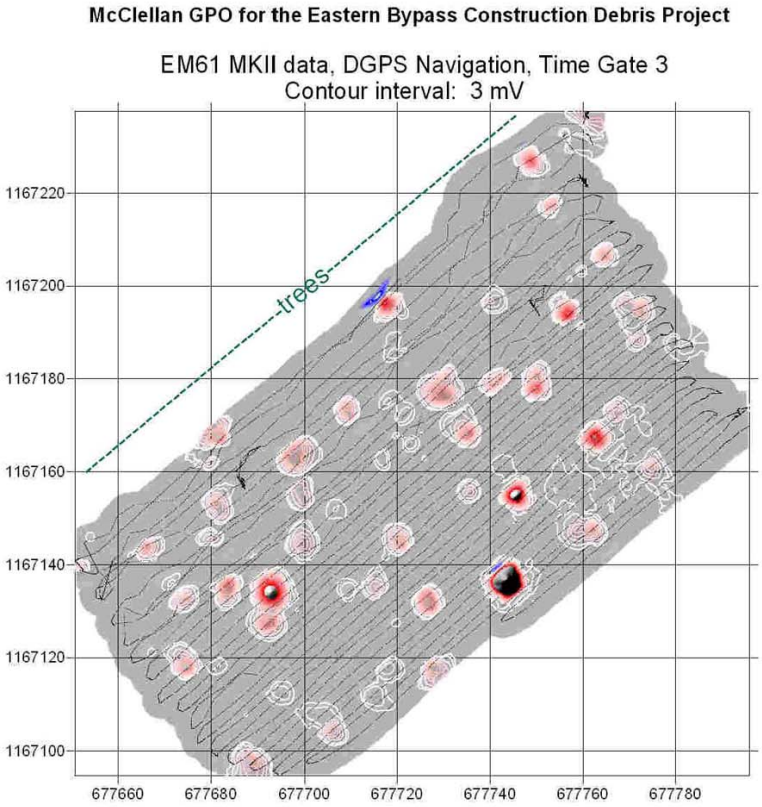


Figure 1. Navigation tracks for GPO collected using DGPS superimposed on resulting geophysical survey map. Note the apparent uneven line spacing a glitches along the paths of the tracks closest to the trees.

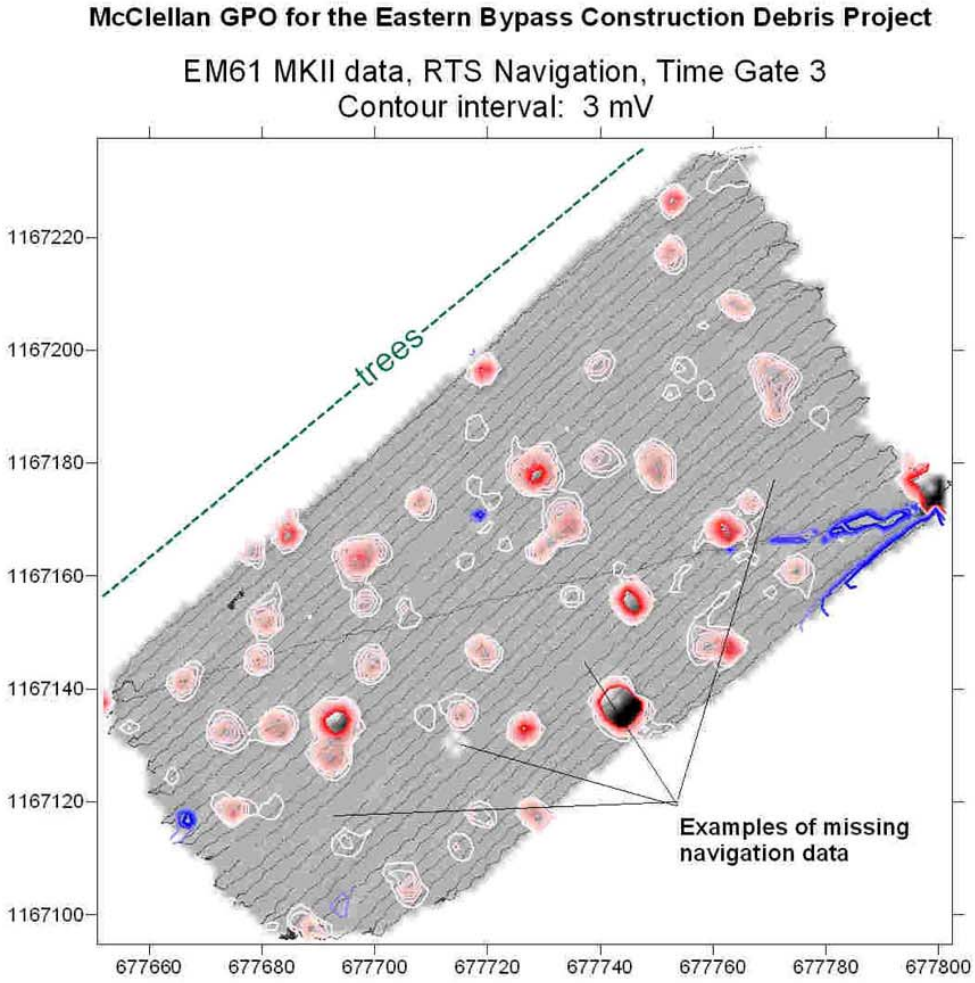
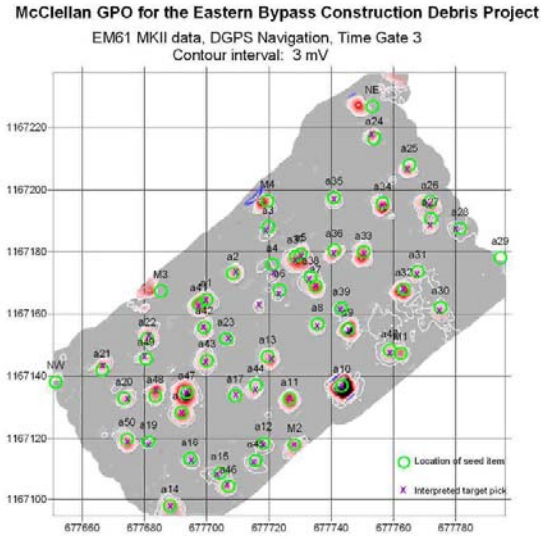


Figure 2. Navigation tracks for GPO collected using RTS superimposed on resulting geophysical survey map. Note the missing data along tracks.



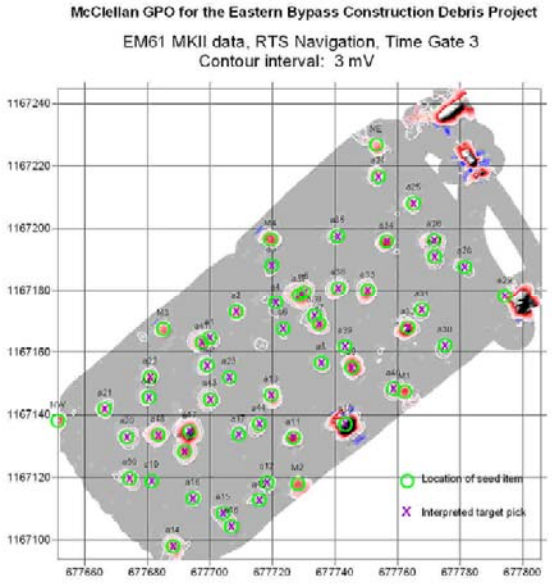


Figure 3. Results of geophysical survey using the DGPS and RTS navigation systems showing seed Items and TtEC target picks.

Figure 3 contains maps of the GPO using both the DGPS and RTS systems with the locations of the seed items and interpreted target picks. Table 1 lists the results of the target picks compared to the actual location of each seed item, referred to as the offset from the true value. The accuracy requirement according to DID MR-005-05 is 1 meter (3.3 feet). For both the DGPS and RTS navigation systems the one-meter accuracy was achieved. DID MR-005-05 requires an accuracy of 35 cm (1.1 feet) after the target location has been refined through the reacquisition process. The results are presented in Table 2. The reacquisition tests were performed by relocating the target pick using the RTS, and then refining the location within the 1-meter radius using the EM61-MK2 instrument. The process would be identical with the DGPS as all DGPS target picks were within the1-meter radius of the actual locations of the seed items. The accuracy requirement for reacquisition was met for all items with the exception of Item a4, a 2.36-inch rocket. The seed item coordinates listed in Table 2 are located over the center of the item. However, in the case of the rocket, the largest anomaly may be on the end of the item. Therefore, allowing for the size of the rocket, the reacquisition test passes.

X	Y	ID	Item	DGPS offset (ft)	RTS offset (ft)
677699.94	1167164.58	a1	37mm	0.27	0.16
677708.37	1167173.14	a2	37mm	1.10	0.36
677719.73	1167188.12	a3	81mm	1.35	1.12
677721.1	1167175.99	a4	2.36" rocket	2.68	1.50
677730.1	1167179.32	a5	rocket motor	0.81	0.16
677723.37	1167167.69	a6	37mm	1.19	0.92
677735	1167169.03	a7	60mm	0.05	0.14
677735.62	1167156.66	a8	MKII HG	0.62	0.21
677745.3	1167155.03	a9	2.36" rocket	0.29	0.02
677743.41	1167136.92	a10	Anti Tank Mine	0.36	0.20
677726.67	1167132.67	a11	60mm	0.13	0.07
677718.25	1167118.37	a12	MKII HG	0.42	0.46
677719.58	1167146.36	a13	37mm	1.39	0.58
677688.23	1167097.99	a14	3 "stokes	0.18	0.27
677704.27	1167108.58	a15	3 "stokes	1.13	0.31
677694.61	1167113.24	a16	75mm	0.67	0.37
677709.18	1167133.61	a17	60mm	0.41	0.79
677691.87	1167128.25	a18	75mm	0.16	0.29
677681.35	1167118.85	a19	MKII HG	1.04	0.41
677673.49	1167132.86	a20	75mm	1.08	0.50
677666.45	1167141.88	a21	37mm	1.50	0.07
677680.9	1167152.03	a22	slap flare	1.31	0.16
677706.2	1167151.98	a23	105mm	0.81	0.10
677753.84	1167216.57	a24	37mm	1.60	0.68
677765.13	1167208.06	a25	37mm	1.55	0.68
677771.7	1167196.19	a26	81mm	1.09	0.55
677771.95	1167190.79	a27	2.36" rocket	2.18	0.27
677781.41	1167187.6	a28	rocket motor	1.52	0.42
677794.28	1167178.14	a29	37mm	na	na
677775.16	1167162.11	a30	60mm	1.10	0.81
677767.82	1167173.71	a31	MKII HG	0.98	0.26
677763.33	1167167.94	a32	2.36" rocket	0.33	0.13
677750.42	1167179.97	a33	60mm	0.48	0.17
677756.51	1167195.77	a34	60mm	0.71	0.27
677740.94	1167197.48	a35	MKII HG	0.47	0.28
677741.04	1167180.67	a36	37mm	1.04	0.17
677728.58	1167178.52	a37	3 "stokes	1.09	0.06
677733.4	1167171.79	a38	3 "stokes	0.75	0.11
677743.27	1167161.79	a39	75mm	0.55	0.15
677758.76	1167148.27	a40	81mm	0.88	0.05
677697.46	1167163.21	a41	75mm	0.58	0.11
677699.23	1167155.7	a42	MKII HG	0.33	0.19
677700.11	1167144.91	A43	75mm	0.58	0.11
677715.77	1167137.08	a44	37mm	1.50	0.31
677715.85	1167112.69	a45	slap flare	0.97	0.55
677706.94	1167104.36	a46	105mm	0.71	0.32
677693.62	1167134.69	a47	81mm	0.39	0.34
677683.47	1167133.54	a48	rocket motor	1.90	0.11
677680.56	1167145.54	a49	3 "stokes	1.15	0.44
677674.37	1167119.69	a50	37mm	0.86	0.08

Table 1. Accuracy of target selections using both DGPS and RTS systems computed as the offset from the true seed location.

X	Y	ID	Item	Depth(in)	Orientation	Reacq_X	Reacq_Y	Total_offset (ft)
677699.94	1167164.6	a1	37mm	4	Horizontal	677700.1	1167164.6	0.16
677708.37	1167173.1	a2	37mm	4	Vertical	677708.73	1167173.1	0.36
677719.73	1167188.1	a3	81mm	34	Horizontal	677719.52	1167187	1.12
677721.1	1167176	a4	2.36" rocket	26	Horizontal	677721.55	1167174.6	1.50
677730.1	1167179.3	a5	rocket motor	12	Horizontal	677729.94	1167179.4	0.16
677723.37	1167167.7	a6	37mm	16	Horizontal	677723.35	1167166.8	0.92
677735	1167169	a7	60mm	12	Vertical	677735.09	1167168.9	0.14
677735.62	1167156.7	a8	MKII HG	8	Vertical	677735.69	1167156.5	0.21
677745.3	1167155	a9	2.36" rocket	6	Vertical	677745.28	1167155	0.02
677743.41	1167136.9	a10	Anti Tank Mine	6	Horizontal	677743.25	1167136.8	0.20
677726.67	1167132.7	a11	60mm	6	Vertical	677726.71	1167132.7	0.07
677718.25	1167118.4	a12	MKII HG	4	Horizontal	677717.97	1167118	0.46
677719.58	1167146.4	a13	37mm	0	Horizontal	677720.12	1167146.2	0.58
677688.23	1167098	a14	3 "stokes	20	Horizontal	677688.5	1167098	0.27
677704.27	1167108.6	a15	3 "stokes	32	Horizontal	677703.96	1167108.5	0.31
677694.61	1167113.2	a16	75mm	30	Horizontal	677694.97	1167113.3	0.37
677709.18	1167133.6	a17	60mm	25	45 degrees	677709.22	1167134.4	0.79
677691.87	1167128.3	a18	75mm	12	Vertical	677691.97	1167128.5	0.29
677681.35	1167118.9	a19	MKII HG	14	Horizontal	677681.42	1167118.5	0.41
677673.49	1167132.9	a20	75mm	18	45 degrees	677673.99	1167132.8	0.50
677666.45	1167141.9	a21	37mm	4	45 degrees	677666.44	1167142	0.07
677680.9	1167152	a22	slap flare	4	45 degrees	677681.06	1167152	0.16
677706.2	1167152	a23	105mm	45	45 degrees	677706.11	1167152	0.10
677753.84	1167216.6	a24	37mm	4	Horizontal	677753.54	1167217.2	0.68
677765.13	1167208.1	a25	37mm	4	Vertical	677764.45	1167208.1	0.68
677771.7	1167196.2	a26	81mm	17	Horizontal	677772.24	1167196.1	0.55
677771.95	1167190.8	a27	2.36" rocket	26	Horizontal	677771.88	1167191.1	0.27
677781.41	1167187.6	a28	rocket motor	12	Horizontal	677781.58	1167187.2	0.42
677794.28	1167178.1	a29	37mm	16	Horizontal	na	na	na
677775.16	1167162.1	a30	60mm	12	Vertical	677774.89	1167161.4	0.81
677767.82	1167173.7	a31	MKII HG	8	Vertical	677767.58	1167173.8	0.26
677763.33	1167167.9	a32	2.36" rocket	6	Vertical	677763.38	1167167.8	0.13
677750.42	1167180	a33	60mm	6	Horizontal	677750.44	1167179.8	0.17
677756.51	1167195.8	a34	60mm	6	Vertical	677756.43	1167195.5	0.27
677740.94	1167197.5	a35	MKII HG	4	Horizontal	677740.73	1167197.7	0.28
677741.04	1167180.7	a36	37mm	0	Horizontal	677741.21	1167180.7	0.17
677728.58	1167178.5	a37	3 "stokes	20	Horizontal	677728.63	1167178.5	0.06
677733.4	1167171.8	a38	3 "stokes	32	Horizontal	677733.42	1167171.9	0.11
677743.27	1167161.8	a39	75mm	30	Horizontal	677743.13	1167161.8	0.15
677758.76	1167148.3	a40	81mm	25	45 degrees	677758.71	1167148.3	0.05
677697.46	1167163.2	a41	75mm	12	Vertical	677697.36	1167163.3	0.11
677699.23	1167155.7	a42	MKII HG	0	Horizontal	677699.04	1167155.7	0.19
677700.11	1167144.9	A43	75mm	18	45 degrees	677700.11	1167144.8	0.11
677715.77	1167137.1	a44	37mm	4	45 degrees	677715.71	1167136.8	0.31
677715.85	1167112.7	a45	slap flare	4	Vertical	677715.36	1167112.9	0.55
677706.94	1167104.4	a46	105mm	10	Vertical	677706.85	1167104.7	0.32
677693.62	1167134.7	a47	81mm	34	Vertical	677693.78	1167134.4	0.34
677683.47	1167133.5	a48	rocket motor	12	Vertical	677683.48	1167133.4	0.11
677680.56	1167145.5	a49	3 "stokes	20	Vertical	677680.12	1167145.5	0.44
677674.37	1167119.7	a50	37mm	2	Horizontal	677674.37	1167119.8	0.08

Table 2. Results of reacquisition tests.

3.2 Survey Area Pre-Seeded Items

In August 2005, USAESCH seeded the following items:

ID	Item	Depth (inches)	Grid/Area	Easting	Northing	Detection method	Recovered
H20-01	MKII Grenade	11	R18	665081.5	1160712.8	geophysics	yes
H20-02	2.36" rocket	7	R18	665069.8	1160766.2	geophysics	yes
H20-04	60mm mortar	7	D22	664804.0	1160432.0	mag and dig	yes
H20-06	37mm projectile	8	D75	664403.0	1161205.0	mag and dig	yes
H20-08	MKII Grenade	6	PPR	664268.0	1161092.9	geophysics	yes
H20-20	37mm projectile	6	PPR	664310.4	1161039.4	geophysics	no

Table 3. Blind seed items and results.

Table 3 indicates the locations of the items, whether or not they were recovered and the method of detection that was used to clear the areas where the blind seeds were buried. The two detection methods were digital geophysics or handheld detection with the Vallon (indicated by mag and dig) when the terrain or tree canopy prevented the use of digital geophysics. Figures 4 through 9 are the photographs of the seed items taken during burial. The location of these seed items are kept as government close hold information and not revealed to the contractor until the grid has been turned over to the government for QA and deliverable acceptance. Figure 10 shows the anomalies and target picks associated with seed items H20-01 and H20-02 in grid R18.

Figure 4. Item H20-01

Figure 5. Item H20-02

Figure 6. Item H20-04

Figure 7. Item H20-06

Figure 8. Item H20-08

Figure 9. Item H20-20

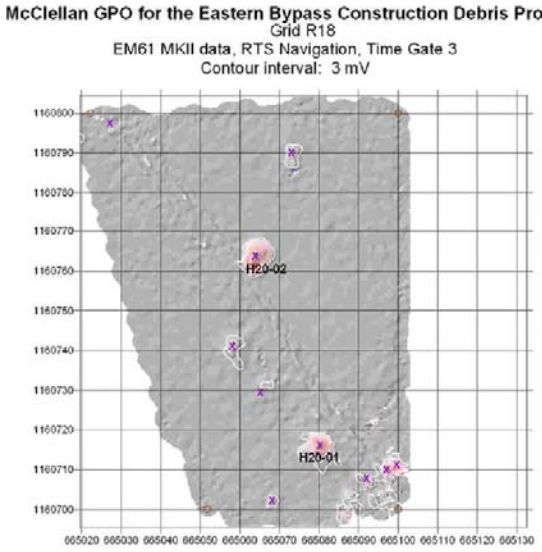


Figure 10. Grid R18 with blind seed items.

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All the seeded items were detected and unearthed by the Contractor with the exception of H20-20, which was planted on a slope. The USACE Onsite Safety Representative attempted to relocate the item, but it was no longer in the seeded location. After the seeded items were buried and prior to geophysical surveying, rainstorms occurred that creating wash-outs. The most plausible explanation for the non-detect is that the item was washed out during a rainstorm.

3.3 Government Field Oversight of Data Acquisition and Data Processing Operations

Representatives from the Huntsville Corps of Engineers monitored fieldwork performed during the GPO by the contractor and as a result of observations, seeded inert items in the field to test potential weaknesses in the operations. USAESCH and TtEC geophysicists also reviewed data processing operations and discussed data issues. A partial listing of the items monitored by USAESCH representatives included:

Safety
-Use buddy system
-Pre-sweep area for surface ordnance
-No stakes w/o safety inspection
-Obey exclusion and decontamination zone boundaries
-Use radios, but coordinated with geophysical data collection

EM

-Secure cable leads
-Sweep operator and assistant to be" metal free"
-Check battery levels
-Check cable and connector integrity
-Warm up sensors prior to recording
-Conduct stationary noise level test
-Record amplitude response with uniform test object
-Survey standardization line in both directions once each day (q.v.)
-Survey standardization line at each equipment change
-Maintain consistent ground clearance and coupling while surveying

Standardization Line
-Purpose: to ensure instrument is operating consistently over the life of the project, to ensure that any equipment or operator changes do not affect the results, to establish instrument repeatability baseline

Survey grid

-Purpose: main survey grids to be cleared of target UXO
-Locate grid corners with land survey
-Measure corner positions with whatever digital data positioning system is being used
-Maintain logical and consistent file naming conventions
-Document naming convention and data structures in field log book
-Document instrument changes including operator and battery changes in field log

Data processing
-Make duplicate copies of all raw data as soon as possible
-Maintain logical and consistent file naming conventions
-Document naming convention and data structures in field log book
-Pick thresholds (from GPO) and pick targets for dig list

3.4 Government Review of Digital Geophysical Data

Geophysical data was transmitted from TtEC to USAESCH for review. Digital data was checked for location accuracy, lag corrections, leveling corrections, proper filtering and threshold levels. Random selections of grids were reprocessed and compared to TtEC results. All results are comparible. Figures 11 and 12 show TtEC's map and USAESCH's reprocessed map of the data for grid C67, respectively.

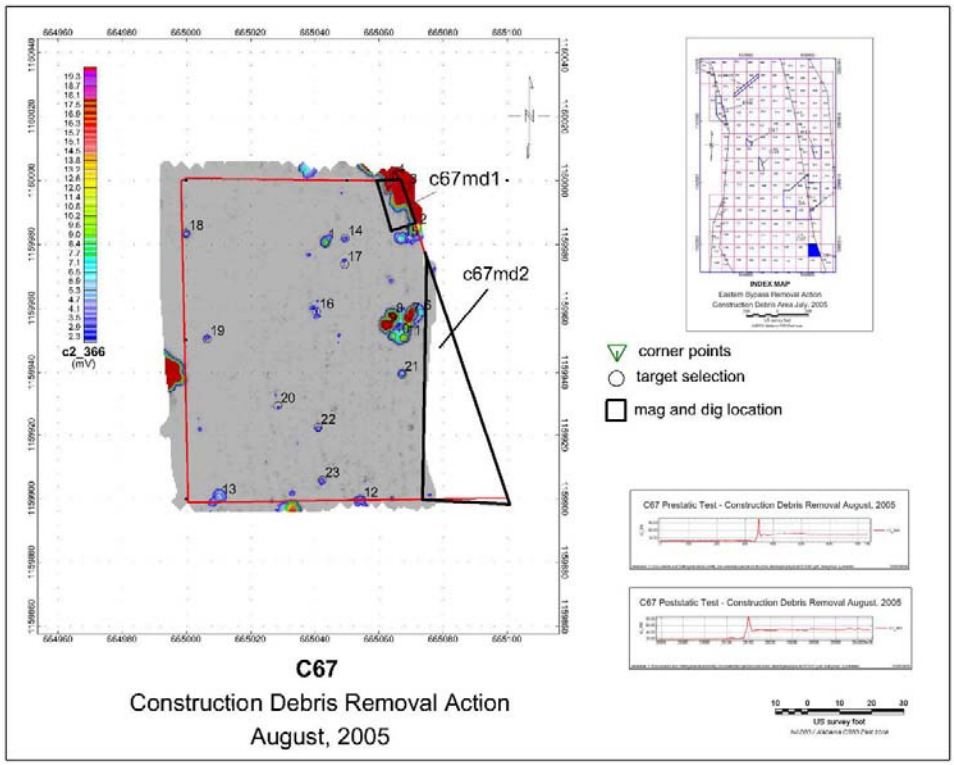

Figure 11. Geophysical map of grid C67 showing target picks and area of mag-and-dig clearance.

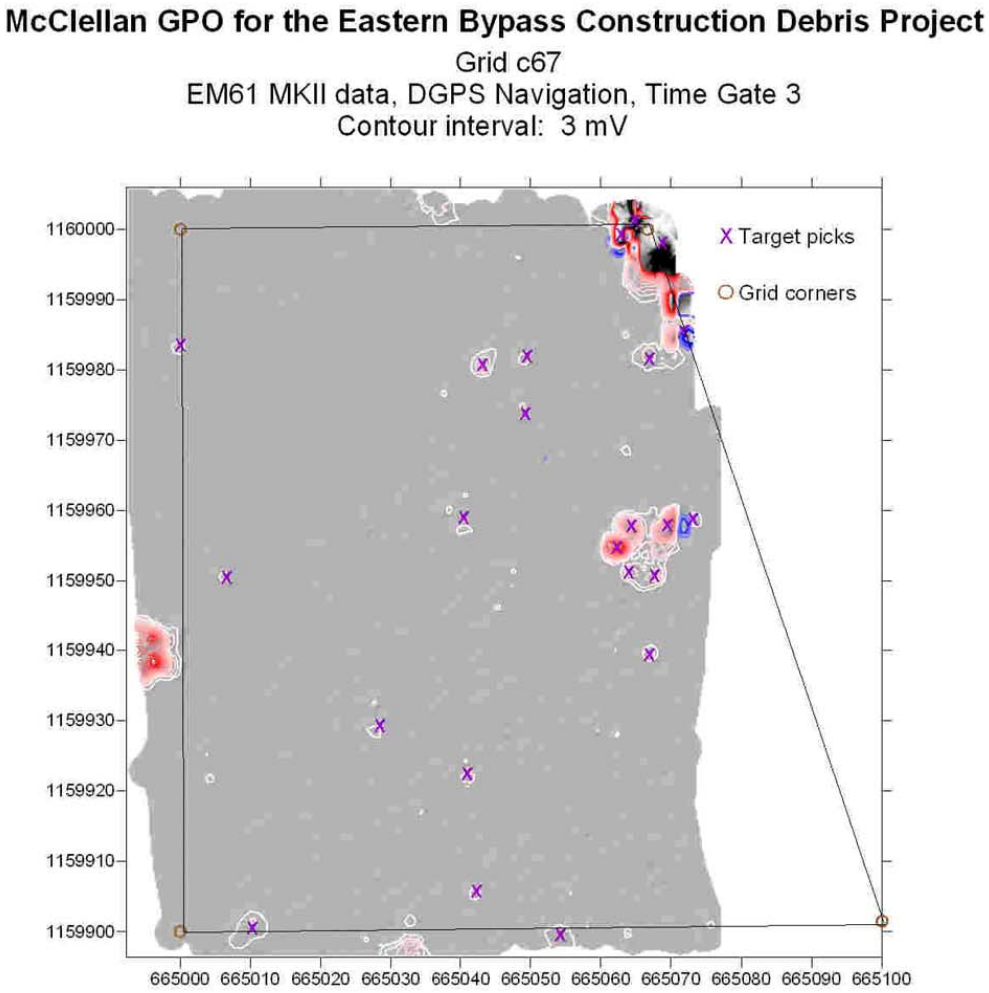

Figure 12. Reprocessed data on grid C67 showing target picks within the grid boundary.

3.5 Government QA field survey results

The criterion for accepting grids that have completed surface and subsurface clearance for this project is stated in paragraph 3.0 of "Site-Specific Work plan for Removal Action, Eastern Bypass Rev 3" as: All UXO and OE scrap larger than 1.25" x 2.0" (Rocket, M6 HEAT) is to be collected, removed, and disposed of from the site. USAESCH Safety personnel performed QA

checks on a minimum of 10 percent of the grids. No UXO items were located during the Government QA checks on the project.

4.0 Quality Assurance Audit Summary and Recommendations

The contractor was successful in satisfactorily meeting all of the Quality Assurance elements. Concerns about the navigation that could potentially affect the clearance activities were discovered during the GPO. The contractor has satisfactorily addressed all concerns. The Contractor successfully performed the appropriate root cause analysis and took actions to address the identified weaknesses. The Contractors EM61 raw and processed data and data interpretations are recognized to be of a high quality in a challenging geologic environment. The Contractor has the tools and procedures in place to find the target objectives identified for this project.