APPENDIX B

APPENDIX B-1
GEOPHYSICAL PROVE-OUT DOCUMENTATION

Final
Geophysical Prove-Out Letter Report

for

Remedial Action in Charlie Area for Four Lead Removal Sites at Fort McClellan, Alabama

Delivery Order 0010

Contract Number: W912DY-04-D-0011

Prepared For:

U.S. Army Engineering and Support Center Huntsville, Alabama

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CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Arthur B. Holcomb P.E.

Program Manager

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1.0 INTRODUCTION

The United States Army Engineering and Support Center, Huntsville (USAESCH) has contracted Tetra Tech EC Inc. (TtEC) under Contract W912DY-04-D-0011, to perform a Geophysical Prove-Out (GPO) at Fort McClellan located in Anniston, Alabama. The GPO was performed between April 10th and April 16th, 2009 to demonstrate the geophysical equipment and procedures to be used for the geophysical survey during the Charlie Area Remedial Action. The Geophysical Prove-Out Work Plan provides the details of the approach, methods and operational procedures used at the GPO.

2.0 OBJECTIVE

The objective of the GPO is to demonstrate and document the performance of the data acquisition methodology and spatial sampling protocols, sensor(s) and positioning equipment, data analysis and management systems, data transfer procedures, and the geophysical Quality Control (QC) and Quality Assurance (QA) system. The following components of the geophysical system were evaluated during the GPO field program to ensure the program objectives will be met:

- Spatial sample density (i.e., line and station spacing)
- Navigation and positioning methodologies
- Sensor and positioning system platform (stability, noise characteristics and ergonomics)
- Data processing, analysis and interpretation
- Geophysical Quality Control (QC),
- The personnel that are going to perform the production geophysical survey also perform the GPO to ensure their ability to meet the data quality objectives.

3.0 LOCATION

The GPO area is located near the Bains Gap Range off of Bains Gap Road (Appendix A). The GPO area is representative of the wooded areas at Fort McClellan and contains a 100 foot (ft) by 100 ft test plot installed by USAESCH personnel. The GPO test plot will be more difficult to survey than the Charlie RA survey sites because the GPO site has not been brush cleared to the degree that is planned for the Charlie RA survey sites.

4.0 SEED ITEMS

The test plot contains known and unknown seed items. The known seed items buried at the existing GPO are presented in Appendix B, Table B-1. A background survey of the test plot was performed by USAESCH and several existing anomalies were identified. These anomalies are

also presented in Appendix B, Table B-1. In addition to the seed items emplaced by USAESCH, TtEC placed 10 kinematic seed items (6 inch nails with washers) for the purpose of determining the standard response for these items. The as-built drawings for the known seed items in the test plot can be found in Appendix B.

5.0 EQUIPMENT

Based on our previous experience at numerous UXO sites including Ft. McClellan, the EM61 MK2 TDEM geophysical sensor exhibits the greatest potential to meet the project objectives. Based on the physical features present at the area of interest, laser-based positioning methods (RTS and iGPS) have the highest probability of providing accurate coordinate locations for the geophysical measurements.

5.1 GEONICS EM61 MK2

The Geonics Limited EM61 MK2 is a high sensitivity high resolution time-domain metal detector which is used to detect both ferrous and non-ferrous metallic objects. It consists of a powerful transmitter that generates a pulsed primary magnetic field, which induces eddy currents in nearby metallic objects. The decay of these currents is measured by two receiver coils mounted on the coil assembly. The EM61 MK2 utilizes two coaxial receiver coils to measure the residual magnetic field generated by conductive and/or magnetic materials. The sensor electronics are designed to measure the residual magnetic field at a time when the response from conductive and/or magnetic objects is maximized, compared to the response from most earth materials. The use of two receiver coils also makes it possible to differentiate, in a simplistic fashion, shallow versus deep objects. An additional benefit of the specific design of the EM61 MK2 system is that it permits a more focused observation of the subsurface in areas of cultural interference, as well as in areas characterized by a high spatial density of subsurface metal objects. This is due to the mechanical design and operational parameters of the instrument, as well as the inherent nature of active electro-magnetic (EM) fields, which diminish in magnitude at a much higher rate than other sensor technologies such as magnetometry.

The EM61 MK2 utilizes multiple time-gates centered at 216, 366, 660, and 1,266 μs. The signal intensity for a given ferrous target recorded by the earlier time-gates is generally a factor of 2 to 4 times that recorded by the standard EM61 MK1 time-gate. This feature facilitates a more reliable and repeatable interpretation of smaller targets such as 37mm projectiles.

5.2 METRIS iGPS

The Metris iGPS (formerly known as the Arc Second Constellation system) is the positioning system that will be utilized in the medium to heavily wooded areas. The Metris iGPS is a laser-based positioning system that consists of four to six laser transmitters and a field computer for logging the position data. Four to six Trimble Spectra Precision LS920 Laser Transmitters are positioned in a square or rectangle geometry over 1/4 to 1 acre depending upon the density of obstacles present (e.g., trees). The transmitters are leveled, and an automatic routine calculates the relative x-y-z- plane between the transmitters to a tolerance of one inch or less. A laser detector “wand” (i.e., receiver) is centered over the EMII MK2 coils on a TtEC-designed fiberglass “doghouse” (or equivalent). The detector wand receives the laser pulses from the transmitters simultaneously, and computes a position based on the known position of the laser

transmitters. Only two of the laser transmitters are necessary to compute a reliable position to a relative accuracy of approximately one inch. The position data are updated at 2-5 Hz and recorded to the field computer for storage and display.

5.3 LEICA ROBOTIC TOTAL STATION

The RTS will be utilized as the positioning method, as needed, in areas that are open, or lightly wooded. The Leica Geosystems TPS1200 is a laser-based positioning system that utilizes line-of-site to accurately determine the position of a 360-degree prism that is mounted at a known offset from the geophysical sensor. The RTS continuously records the position of the prism at a rate of approximately 3-4 Hz as it is transported across the area of interest. Coordinate and time of measurement data are stored on a PCMCIA device on the RTS, and uploaded to the processing computer a minimum of once per day.

6.0 PROCEDURES

6.1 DATA ACQUISITION

The test plot was surveyed four times during the GPO; three (3) times using the RTS and once using the iGPS. For each of the surveys, data was acquired at a line spacing of 2.0 or 2.5 ft and at a sample rate of 12-15 times per second. The along line sampling is between 3.0 and 4.0 samples/ft depending on the operator's speed, which can vary slightly based on terrain. Prior to starting the acquisition session, the coil height was measured to 16 inches above ground level. Shake tests were performed to verify that all cables were secure in position. All four channels were electronically nulled to zero in a magnetically "quiet" area using the Geonics MKII acquisition software. Following these procedures, static and dynamic data were recorded to facilitate shift and drift corrections. The operators who will be acquiring data in the field collected the data in the GPO.

In addition to collecting geophysical data over the GPO test plot, data were also collected over two different seed items (37mm and 81mm) each buried at two different depths (6 inches and 1 foot for the 37mm and 1 foot and 2 feet for the 81mm). Data were collected with the coil directly over the seed item and at 6, 12, 18, 24, and 30 inches off to the side of the seed item. The purpose of this test was to help determine the maximum allowable line spacing.

6.2 DATA PROCESSING

Data were stored on PCMCIA cards and/or computers (Allegro and Sony Vaio) during data acquisition. After data acquisition was completed at each test grid, data was transferred to the site PC for processing. A TtEC geophysicist performed preliminary geophysical and navigation data processing and Quality Control (QC) checks. The final analysis and interpretation of the data was performed at the TtEC processing center at Lakewood, Colorado. Processing was performed with a combination of off the shelf software (Geonics' Dat61, Leica GeoOffice, iGPS's Workspace) and internally developed software that has been specifically produced to integrate and interpret digital geophysical data acquired with the RTS and Constellation Positioning Systems. Geosoft Oasis Montaj Mapping software was also used to graphically display data and select targets. Data transfer was fully tested during the GPO. This included the transfer of raw EM and positioning data. Corrected and leveled processed data were converted to

space delimited ASCII format and delivered to USAESCH via an FTP site. Due to the difficult terrain and vegetation at the GPO there were occasions where the RTS lost lock on the prism and EM data were interpolated between RTS positions over distances of several feet up to 15 feet. This caused minor variations between data sets in the positions of some targets depending on the interpolation process. Although these variations were not significant (less than 2 feet for most cases), special care will be needed during the processing stage to ensure data is interpolated correctly when data is collected in difficult conditions similar to the GPO test plot.

6.3 DATA INTERPRETATION

All anomalies detected during each of the test grid surveys were selected as potential targets for intrusive investigation. Anomalies were digitized and characteristics generated for each anomaly. These characteristics included the peak response on all four channels, estimated size and depth, and anomaly footprint.

6.4 REACQUISITION

The interpreted anomaly locations were uploaded to the RTS and the reacquisition team navigated to the locations. The UXOQC then used a Vallons VMX3 to pinpoint the anomaly location further. The pinpointed location was then measured using a tape measure.

7.0 QUALITY CONTROL

Instrument and functionality checks were performed at the beginning and/or end of every data acquisition session during the GPO. Independent QC tests performed included personnel and shake tests, static tests (position and response), kinematic tests (position and response).

7.1 PERSONNEL AND SHAKE TESTS

The coil operator was checked for metallic objects that may interfere with the EM signal. The cables were then shaken and the allegro monitored for noise. The coil operator also did some moving around while the data was monitored. Less than <1 mV noise was detected during these tests. It was determined during the analysis of the GPO data that Team 3's data was a little noisier than desirable (2 to 5 mV on 366us time gate). It was subsequently determined that the Team 3 member in the coil had shoes with large metal eyelets and corrective actions were taken (new shoes).

7.2 STATIC TESTS

The static test involved locating the instrument over a quiet area and recording data for 1 minute, then placing a standard item (4 inch copper pipe) on one of the EM61 stand-offs and recording an additional 1 minute of data. The figures located in Appendix C represent the static calibration and static response. The purpose is to inspect the consistency of the instrument response throughout the course of the project (<= 10% variation).

To test the positioning, the EM61 MK2 and navigation unit recorded data over at least one of the corners of the test grid. After data processing, the geophysical position data was compared to the survey data to ensure that the geophysical position data were accurate (<12 inches).

7.3 KINEMATIC TESTS

Kinematic tests were performed by collecting data over the kinematic seed items (nail with washer while moving in a normal data acquisition configuration. Ten (10) kinematic seed items were placed in the SE area of the test plot. The purpose of these seed items is to determine a standard response for the kinematic seed items that will placed in each grid (corners).

The kinematic positioning accuracy was evaluated by digitizing the anomalies from the kinematic seed items and comparing them to the surveyed locations of the seed items. The test item anomaly should be <= 12 inches +1/2 line spacing). The results from the kinematic tests are presented in Appendix C.

8.0 GPO RESULTS/RECOMMENDATIONS

8.1 PERFORMANCE GOALS

The performance goals for the DGM survey were evaluated during the GPO. The following section describes each of the performance goals, and the results from the testing performed during the GPO. All performance goal test results are documented in Appendix C and are summarized in the DGM Data Processing Sheet.

8.1.1 Static Sensor Repeatability

The static repeatability tests were performed and the sensor check values for each coil were determined during the GPO. Each of the response test items (4 inch copper pipe) are slightly different for each acquisition team, therefore, each team will have a different response. The measured responses (366us time gate) for each team are as follows:

Team 1 270 mV

Team 2 200 mV

Team 3 195 mV

Team 4 260 mV

The static repeatability goal for each team will be to record the same reading, +/- 10%, each day.

8.1.2 Static Position Repeatability

Each team stood over a GPO grid corner prior to collecting data and the recorded position was compared to the surveyed position. Each team's recorded position was less than 12 inches as presented in Appendix C. Twelve (12) inches will be the performance goal for Static Position Repeatability during data acquisition.

8.1.3 Sample Interval

The goal for along line sample interval is that 98% of the samples will be <=10 inches. The along line sample interval mean for each team during the GPO was < 4 inches and is presented in the DGM Data Processing Sheet section of Appendix C.

8.1.4 Coverage and Line Spacing

Based on the GPO test plot data, and the offset tests, it is apparent that a line spacing 2.5 feet will be sufficient to detect the items of interest at the site. The smallest item of interest (37mm projectile) was detected above background at distances of 1.5 feet from the item. Using twice this distance for maximum line spacing yields a spacing of 3.0 feet. A project line spacing of 2.25 feet to allow for normal deviations that typically occur during data acquisition in wooded and hilly terrain should be sufficient to detect the smallest items of interest. The offset data are presented in Appendix C.

The goal for coverage is that >=95% of the survey area will be covered at the maximum allowable line spacing (not including trees or other obstacles). Because the Geosoft footprint coverage calculations do not take into consideration the effect of trees (without a high level of effort to map each individual tree footprint), the percent area covered estimate usually underestimates the true coverage. Depending on the number of trees, the calculated footprint coverage may yield acreages that are less than 95% of the total area, and the effect of the trees should be incorporated in the coverage metric. A suggested footprint of approximately 10 square feet per tree is recommended for this effect, which is about 1% for every 10 trees in a ¼ acre grid. An additional goal will be that any line gaps with a line spacing greater than 3.5 feet and 15 feet in length will be filled in with DGM or analog methods.

A gap occurred during Team 2's data acquisition. Because the various teams had been through the test grid multiple times, there were numerous paint lines in the test grid that the teams use to keep their line spacing. Team 2 apparently lost track of the spray paint line they were walking and inadvertently skipped a line. Normally this would not be a problem as only one team would be collecting data in a grid. This line would normally be filled in using the gap goal as stated above.

Team 4 also had a coverage failure during their first attempt in the GPO. A cable between the EM61 backpack and the Allegro was not secured properly and came loose and the last half of the file was lost. The team subsequently went back and recollected the last half of the grid, but did not start at the correct location and had to go back a third time to fill in the remaining gap.

8.1.5 Dynamic Detection Repeatability

The EM61 MK2 responses for the dynamic seed items (grid corner nails) ranged from 19 mV to 74 mV and is presented in Appendix C. It is suspected that the variations are likely due to slight variations in the coil height, coil position relative to the seed item, and coil operator speed. The mean standard response for the seed items is 43 mV (366us time gate). The goal for dynamic detection repeatability is that the seed item response is no less than 75% of the standard response, which allows a range between 32 and 54 mV. However, because several of the readings for the seed items fell outside of this range during the GPO, it is likely that some of the

seed items in the survey area will also fall outside this range. It is not believed that the measurements that fall outside of the range necessarily indicate a malfunctioning instrument, but rather are indicative of variations in the seed item placement and site conditions. It is recommended that a minimum kinematic static response of 24mV be used. This value is 75% of typical responses recorded for seed items during field activities at the 81mm range and Range 20 (32mV).

8.1.6 Dynamic Position Repeatability

The EM61 MK2 dynamic seed positions were compared against the surveyed locations. The dynamic seed item accuracy for all teams was less than 0.75 feet and is presented in Appendix C. The goal for dynamic position repeatability is <= 2.13 feet (1 foot plus ½ line spacing).

8.2 INTERPRETATION

The Geosoft color-coded maps (366us time-gate) of the EM61 MK2 geophysical data are presented in Appendix E. A labeled symbol for each interpreted anomaly is plotted at the interpreted center of the anomaly. The known test item descriptions and depths are also labeled on the maps. Only the data set from Team 1 was interpreted and these interpreted targets are presented on each of the maps.

A modified dig sheet from Team 1 for the GPO is presented in Appendix D. For the known seed items, the interpretation accuracy is presented. The following discussion addresses only the known seed items.

The horizontal 37mm at 15 inches (Target 61) will be the smallest signature item to use for a lower threshold for “digs” at the Bains Gap Ranges, Range 20, and Range 24A. The 37mm had a response of 8.4 mV on the 216us time gate and 6.6 mV on the 366 us time gate, and is visible on 2 adjacent acquisition lines. Although it is not anticipated to encounter a 37mm at 15 inches based on previous investigations, TtEC will be conservative in the selection process. It is anticipated that the initial minimum dig selection criteria will be a 4 to 5 mV response on the 366 us time gate and/or 6 to 8 mV on the 216 us time gate, visible on 2 adjacent lines, and an upper coil response greater than or equal to the lower coil (660 us time gate), if the noise levels permit.

At the 81mm Range, the target of interest is the 81mm mortar. There was one 81mm “known” target in the GPO (Target 19 buried at 30.75 inches). TtEC will base it’s criteria on this item, the old GPO at Fort McClellan, on GPOs at other locations, and on previous experience. The 81mm buried in the USAESCH GPO test plot (deeper than expected at the site) was visible on 4 adjacent acquisition lines and had a response of 12.5 mV on the 366us time gate and 17.9 mV on the 216 time gate. There were four 81mm mortars buried at the old GPO at depths from 17 inches to 34 inches. One of the mortars was at 25 inches, which is about the maximum expected depth at the site. The responses ranged from 7.5 mV to 183 mV on the 366 us time gate (18mV for the mortar at 25 inches) and each of the 81mm mortars was visible on 4 adjacent acquisition lines. Based on TtEC’s previous experience these EM61 MK2 readings appear to be typical for 81mm mortars. Based on this data, the selection criteria for the 81mm Range will be any targets that appear on a minimum of 3 data acquisition lines with a response of at least 12 mV on the 366 us time gate and/or 20 mV on the 216us time gate, and the top coil greater than or equal to

the bottom coil 660 us time gate. Any targets that appear on 4 adjacent lines will also be included on the dig list.

8.3 REACQUISITION

Twenty three anomalies were reacquired in the GPO test plot at the interpreted locations and all but one of the anomalies were found to have an audible signal on the hand-held instrument within 8 inches of the reacquired location. One anomaly was located 18 inches from the reacquired location (#4). The work plan states a 2 foot radius will be searched around each flagged anomaly, therefore the reacquisition procedures will be sufficient to locate interpreted anomalies within this radius. A map of the reacquired targets is shown in Appendix E. The distance and direction from the reacquired anomalies to the audible anomalies is presented in Appendix D.

APPENDIX A

TEST GRID LOCATION

Figure A-1 GPO Test Plot Location (figure provided by USAESCH)

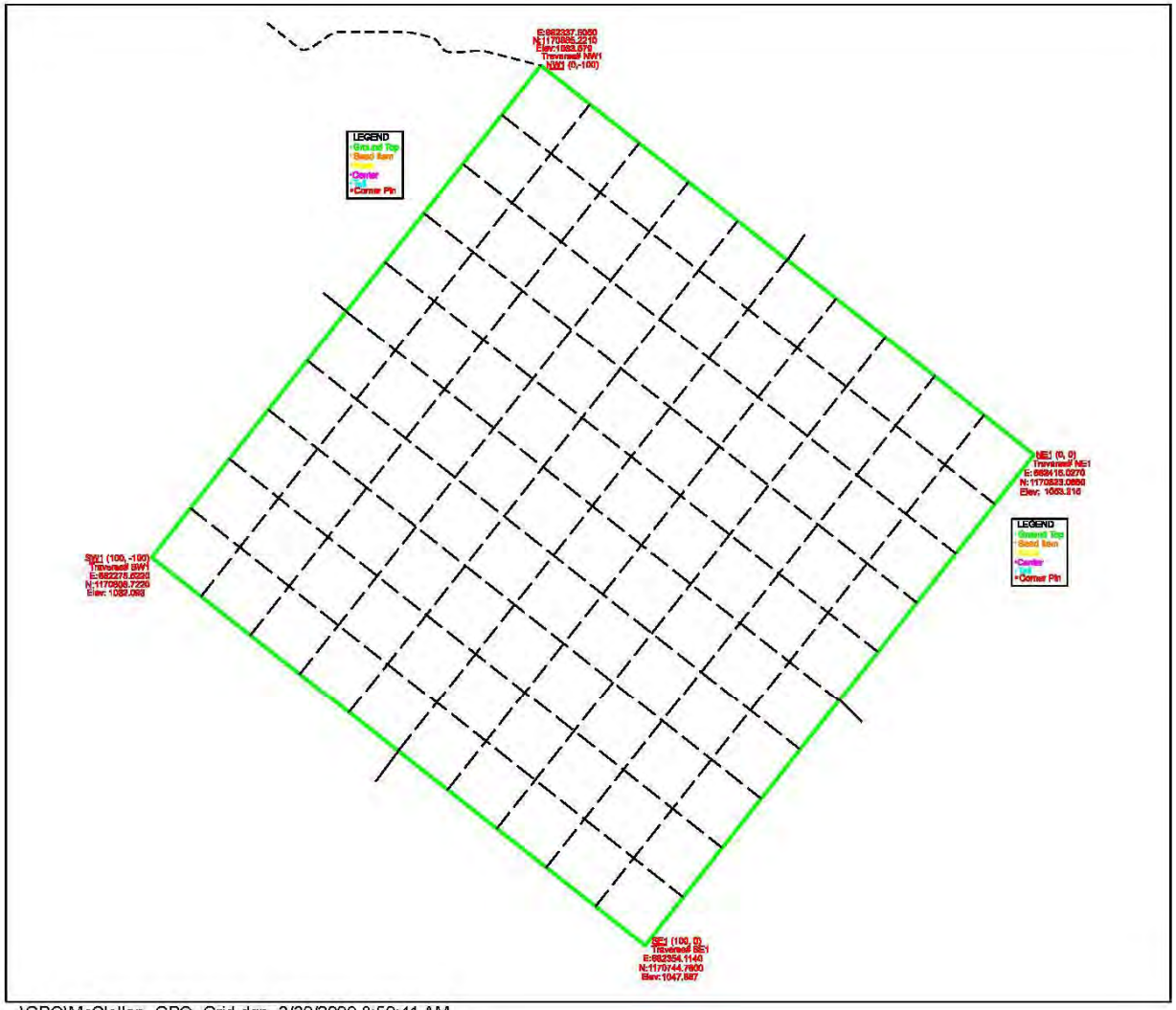


Figure A-2 Test Plot Layout (figure provided by USAESCH)

APPENDIX B

KNOWN SEED ITEMS

TABLE B-1 KNOWN SEED ITEMS

No.	Item Description	Tag No.	X (feet)	Y (feet)	Depth (BGS)
10	Hand Grenade	HG-011	682398.87	1170821.97	0.63
11	Hand Grenade	HG-012	682394.73	1170813.04	0.80
12	Hand Grenade	HG-013	682387.92	1170806.07	0.46
17	37mm Practice	37-032	682369.81	1170803.5	1.08
18	37mm Practice	37-031	682377.25	1170809.81	1.10
19	37mm Practice	37-030	682382.74	1170817.62	1.03
20	37mm Practice	37-029	682386.1	1170826.88	0.91
21	2.36 Rocket	2.36-037	682373.16	1170942.38	1.44
29	37mm Practice	G	682372.12	1170819.58	0.55
30	37mm Practice	F	682374.96	1170827.8	0.55
31	M69 Hand Grenade	E	682388.47	1170837.66	0.35
	81mm Mortar	81-019	682332.77	1170842.19	2.56
	pre-existing anomaly		682354.18	1170801.83	
	pre-existing anomaly		682365.67	1170779.47	
	pre-existing anomaly		682350.00	1170806.80	
	pre-existing anomaly		682355.42	1170811.07	
	pre-existing anomaly		682369.06	1170846.61	
	pre-existing anomaly		682354.21	1170849.98	
	pre-existing anomaly		682337.34	1170869.09	
	pre-existing anomaly		682320.89	1170860.41	
	pre-existing anomaly		682319.20	1170854.02	
	pre-existing anomaly		682301.02	1170826.87	
	pre-existing anomaly		682295.75	1170824.33	
	pre-existing anomaly		682302.32	1170812.36	
	pre-existing anomaly		682303.83	1170806.14	

Data Provided by USAESCH

Seed Item Pictures (pictures of all seed items not available)

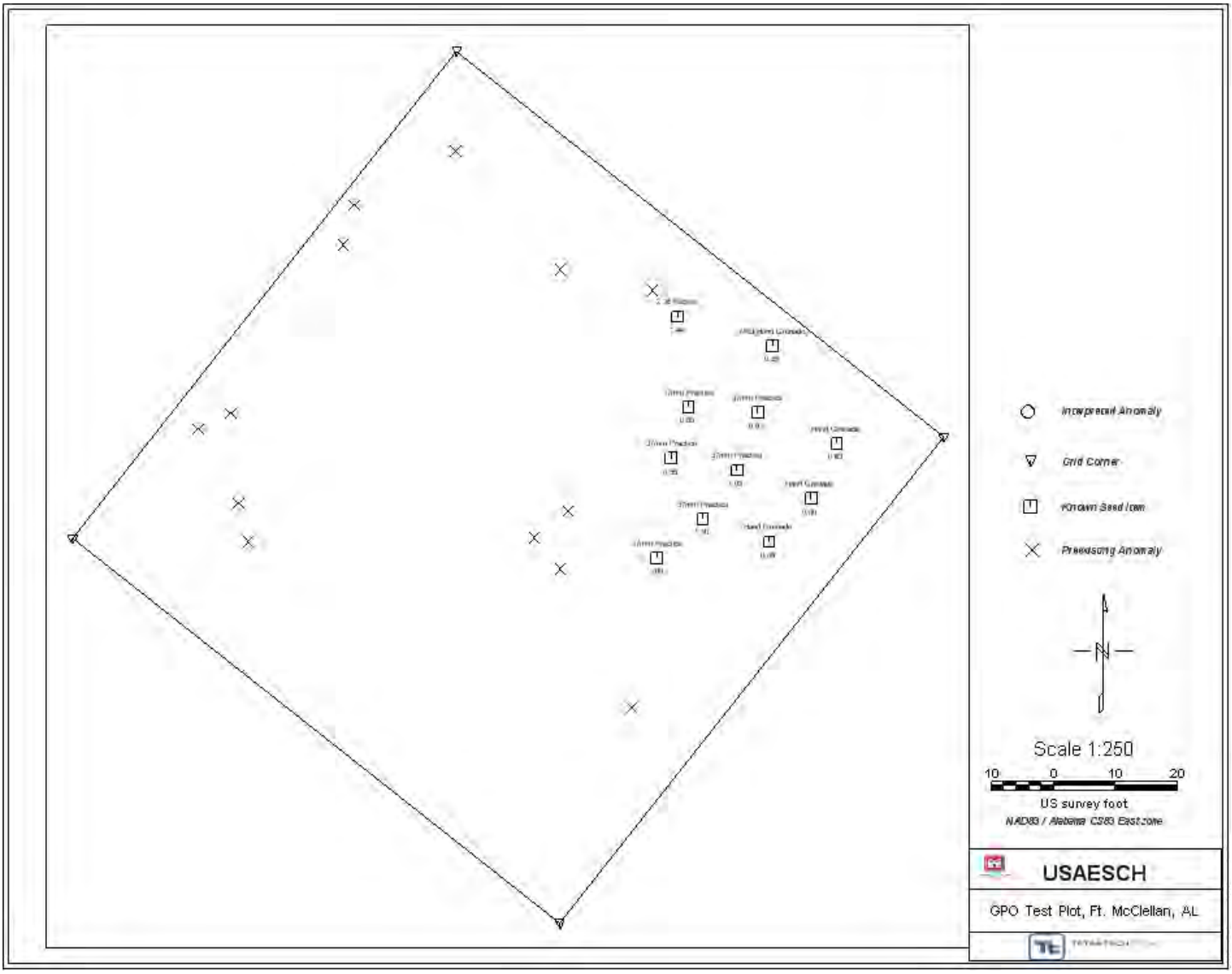
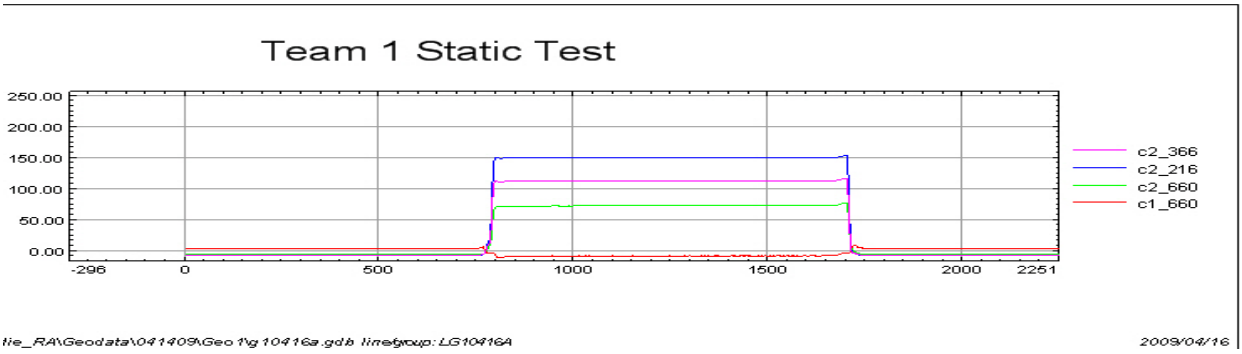
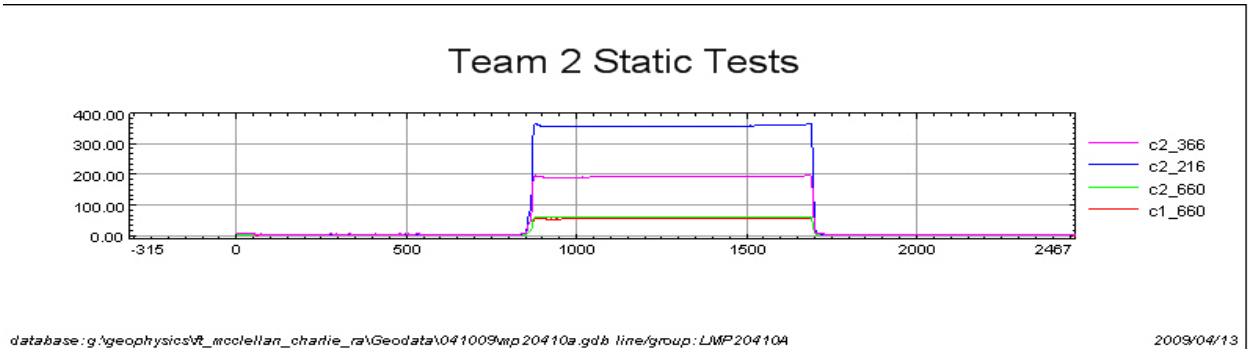


Figure B-1 Known Seed Item Locations (Locations Provided by USAESCH)

APPENDIX C

PERFORMANCE TESTS


Team 1 Static Test
250.00
200.00
150.00
100.00
50.00
0.00
-296
0
500
1000
1500
2000
2251
c2_366
c2_216
c2_660
c1_660
tie_RA\Geodata\041409\Geo 1\g10416a.gdb line/group: LG10416A
2009/04/16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200.00
100.00
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0
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1500
2000
2467
c2_366
c2_216
c2_660
c1_660
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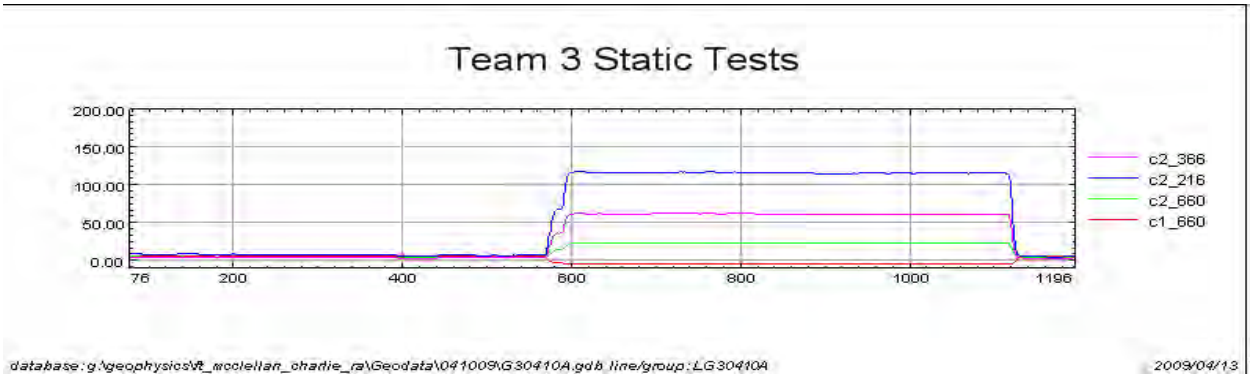
2009/04/13


Team 3 Static Tests
200.00
150.00
100.00
50.00
0.00
76
200
400
600
800
1000
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c2_366
c2_216
c2_660
c1_660
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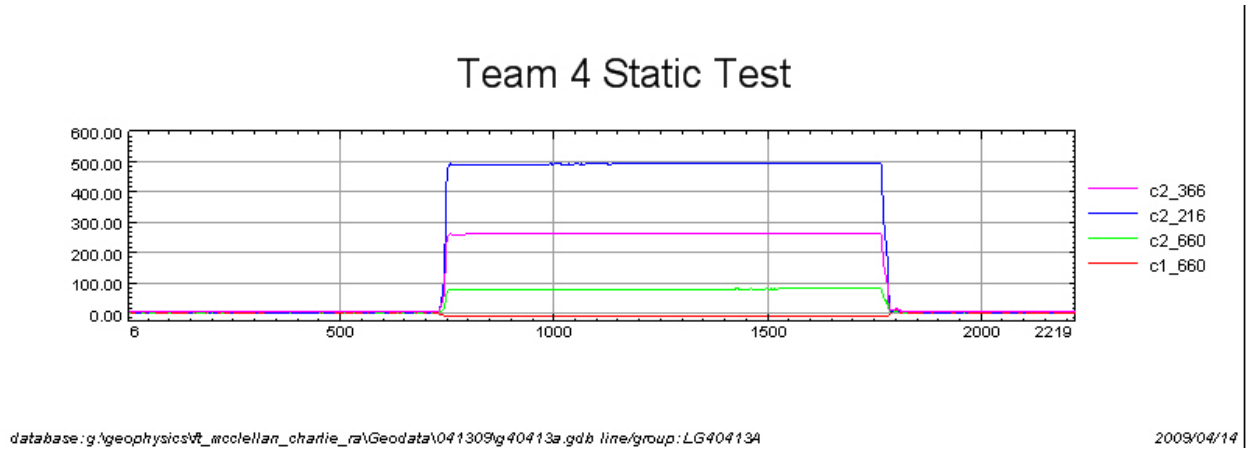
2009/04/13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600.00
500.00
400.00
300.00
200.00
100.00
0.00
6
500
1000
1500
2000
2219
c2_366
c2_216
c2_660
c1_660
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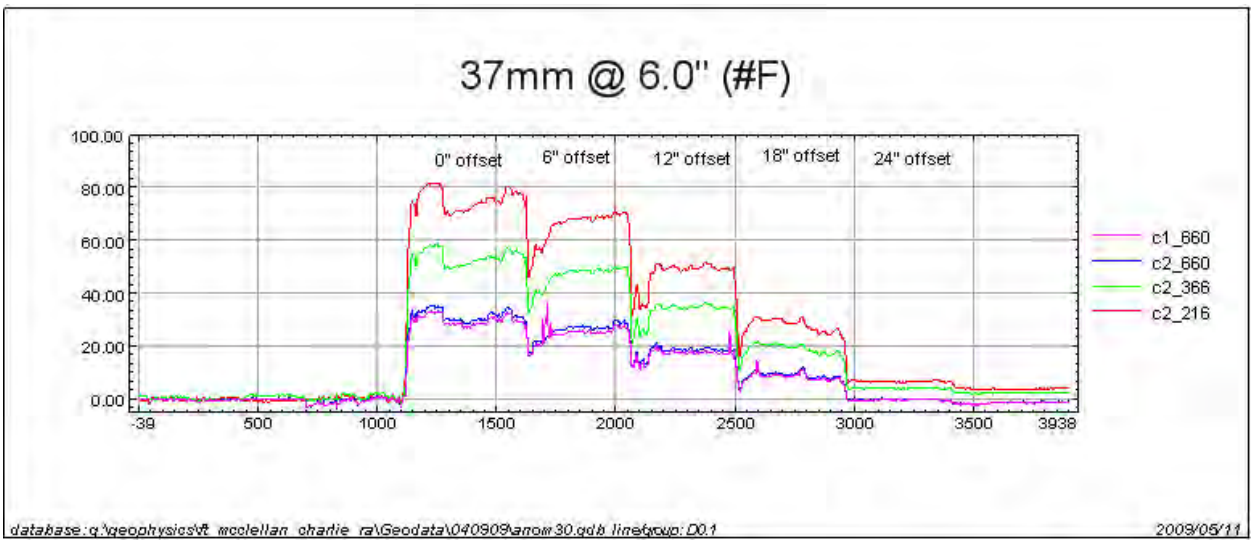
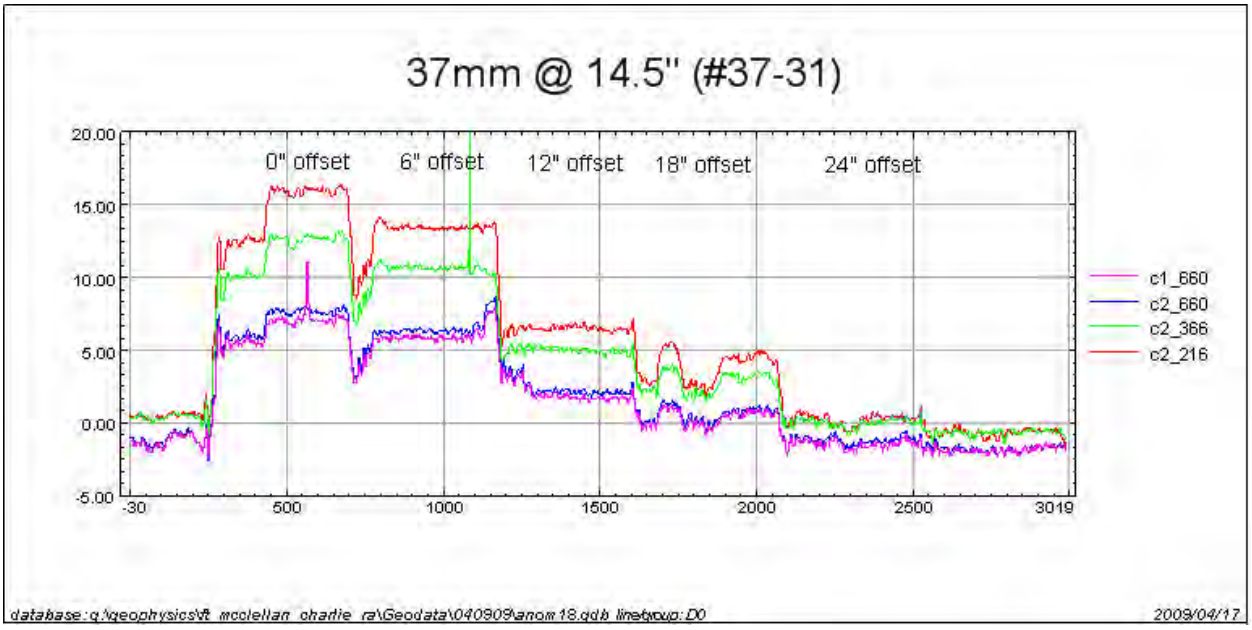
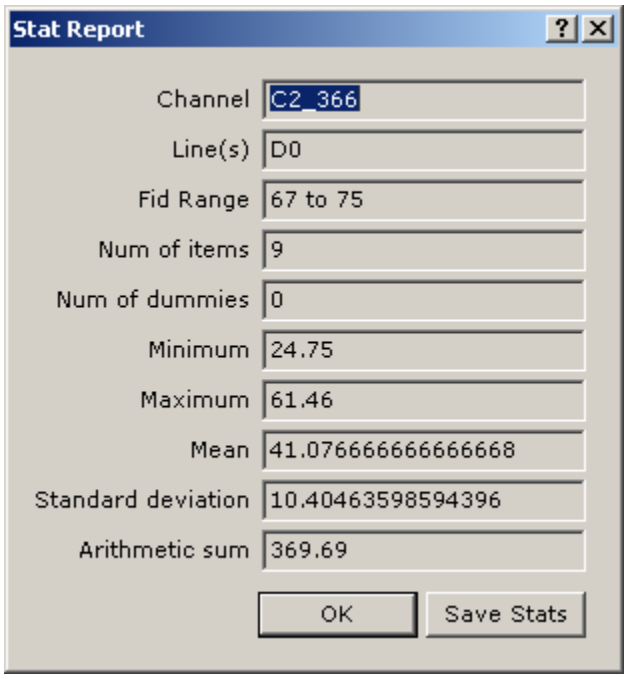
2009/04/14

Offset Tests





Kinematic Response Tests (Statistics on 10 seed nails)

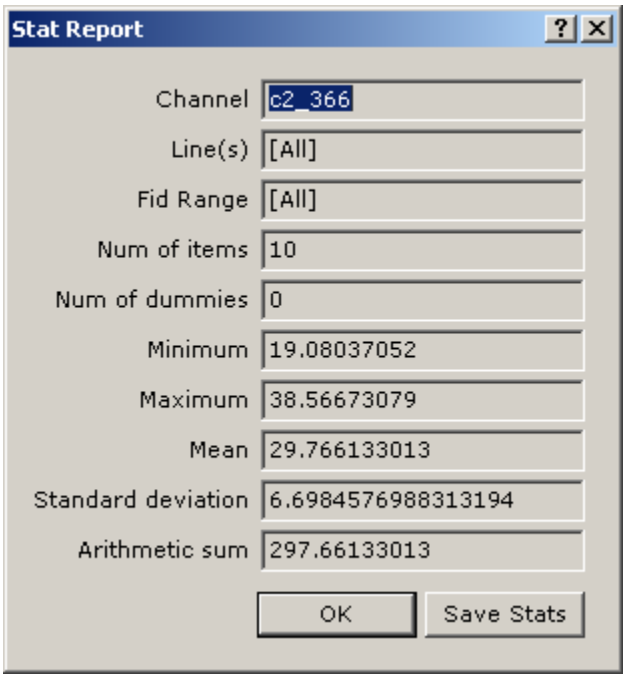


Stat Report

Channel	C2_366
Line(s)	D0
Fid Range	67 to 75
Num of items	9
Num of dummies	0
Minimum	24.75
Maximum	61.46
Mean	41.07666666666668
Standard deviation	10.40463598594396
Arithmetic sum	369.69

OK Save Stats

Team 1

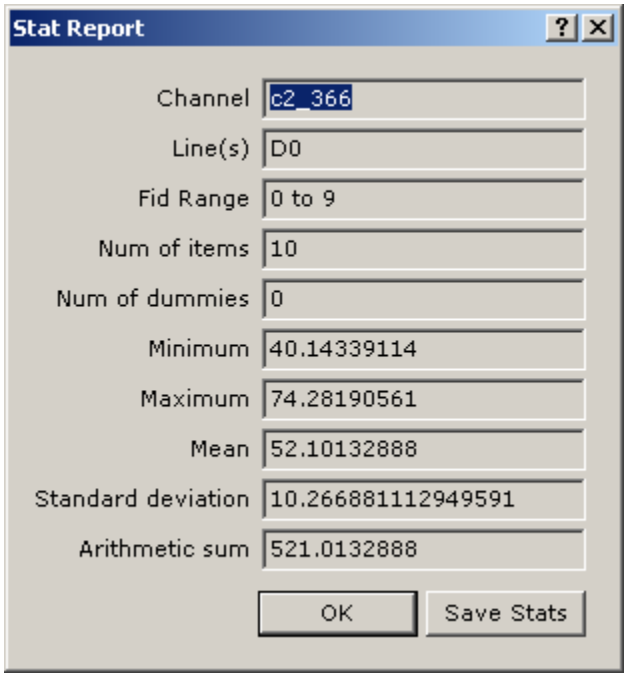


Stat Report

Channel	c2_366
Line(s)	[All]
Fid Range	[All]
Num of items	10
Num of dummies	0
Minimum	19.08037052
Maximum	38.56673079
Mean	29.766133013
Standard deviation	6.6984576988313194
Arithmetic sum	297.66133013

OK Save Stats

Team2

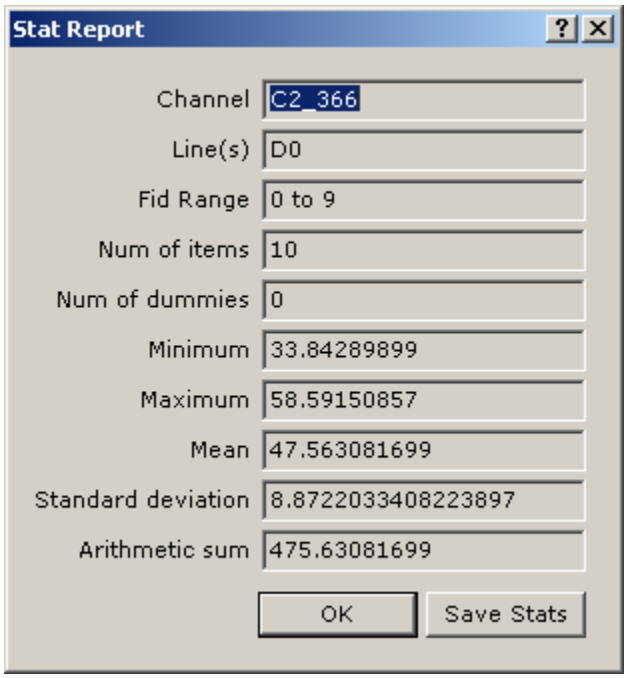


Stat Report

Channel	c2_366
Line(s)	D0
Fid Range	0 to 9
Num of items	10
Num of dummies	0
Minimum	40.14339114
Maximum	74.28190561
Mean	52.10132888
Standard deviation	10.266881112949591
Arithmetic sum	521.0132888

OK Save Stats

Team 3



Stat Report

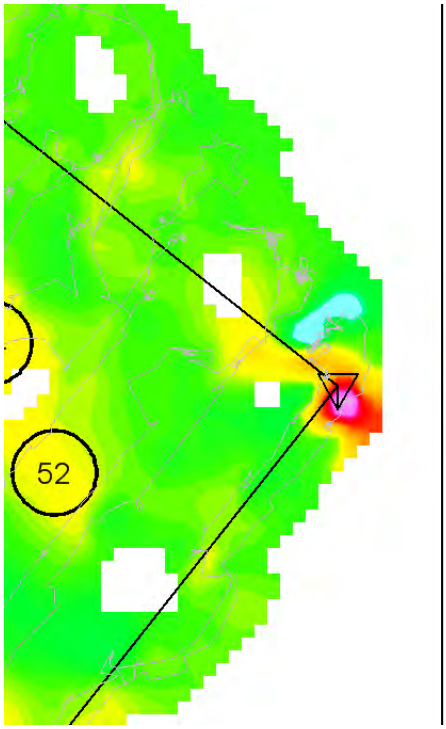
Channel	C2_366
Line(s)	D0
Fid Range	0 to 9
Num of items	10
Num of dummies	0
Minimum	33.84289899
Maximum	58.59150857
Mean	47.563081699
Standard deviation	8.8722033408223897
Arithmetic sum	475.63081699

OK Save Stats

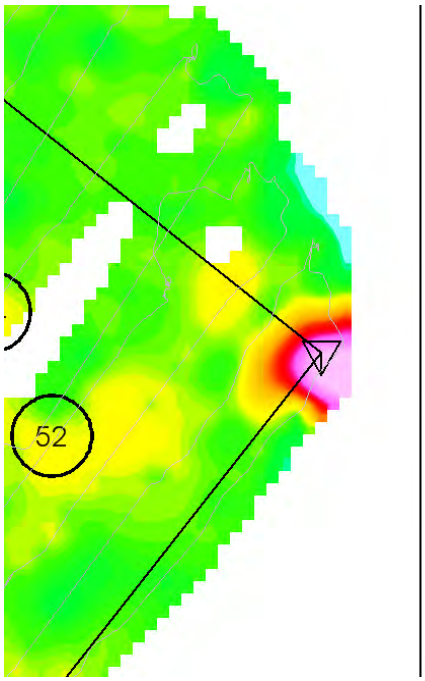
Team 4

Table C-1 Kinematic Responses										
			Team 1	Team 2	Team 3	Team 4				
Nail	Easting (ft)	Northing (ft)	C2_366 (mV)	C2_366 (mV)	C2_366 (mV)	C2_366 (mV)	Min	Max	Mean	Std Dev
5	682357.82	1170826.46	34.54	35.82	48.75	58.14	34.54	58.14	44.31	11.23
6	682366.12	1170818.42	38.31	37.62	49.48	41.19	37.62	49.48	41.65	5.44
7	682371.57	1170823.72	47.84	25.58	74.28	50.13	25.58	74.28	49.46	19.91
8	682372.33	1170836.41	39.64	19.08	40.88	33.84	19.08	40.88	33.36	10.00
9	682378.83	1170820.90	40.95	27.89	49.12	54.80	27.89	54.80	43.19	11.68
10	682381.62	1170828.93	38.00	33.44	51.34	53.67	33.44	53.67	44.11	9.91
11	682385.04	1170783.58	61.46	not present	59.51	46.77	46.77	61.46	55.91	7.98
12	682388.42	1170787.76	47.65	not present	46.69	36.90	36.90	47.65	43.75	5.95
13	682390.85	1170789.88	24.75	not present	40.14	41.60	24.75	41.60	35.50	9.33
14	682397.52	1170799.59	34.55	not present	60.82	58.59	34.55	60.82	51.32	14.57
1	682281.44	1170809.11	not present	25.09	not present	not present	25.09	25.09	25.09	#DIV/0!
2	682286.88	1170812.74	not present	38.57	not present	not present	38.57	38.57	38.57	#DIV/0!
3	682290.74	1170817.43	not present	32.03	not present	not present	32.03	32.03	32.03	#DIV/0!
4	682293.62	1170824.39	not present	22.54	not present	not present	22.54	22.54	22.54	#DIV/0!

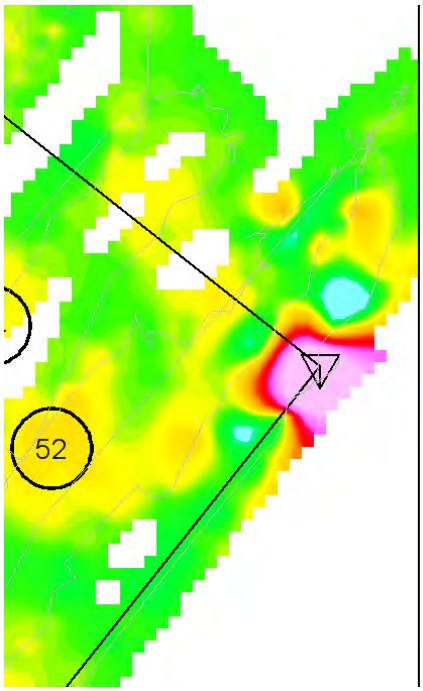
Kinematic Position Tests



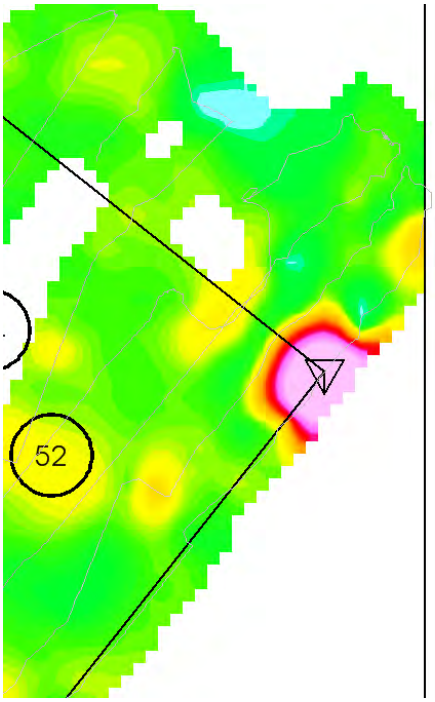
Team 1



Team 2



Team 3



Team 4

DGM Data Processing Sheet							
Date:	4/15/2009	4/16/2009	4/10/2009	4/10/2009	4/13/2009	4/13/2009	4/14/2009
Project:	Charlie Area Remedial Action						
Area:	GPO	GPO	GPO	GPO	GPO	GPO	GPO
Grid:	GPO	GPO	GPO	GPO	GPO	GPO	GPO
Filename:	g10415a	g10416a	mp20410a	g30410a	g40413a	g40413b	g40414a
Team:	1	1	2	3	4	4	4
Processor:	McGuire	McGuire	McGuire	McGuire	McGuire	McGuire	McGuire
Static Background (C2_366)							
min (mV)	4.87	3.57	4.14	2.42	6.14	na	6.63
max (mV)	5.45	4.14	6.68	4.43	7.14		7.97
mean (mV)	5.15	3.80	5.64	3.55	6.61		7.54
std dev (mV)	0.11	0.11	0.23	0.39	0.16		0.18
Static Response (C2_366)							
min (mV)	275.85	273.43	190.16	60.79	260	na	274.92
max (mV)	277.45	275.72	193.23	62	264.5		278.83
mean (mV)	276.70	274.64	191.90	61.29	262.5		277.11
std dev (mV)	0.41	0.67	0.78	0.32	1.2		0.54
Time (am/pm)	am	am	am	pm	pm	pm	pm
Static Difference (mean)	271.55	270.84	186.26	57.74	255.89	na	269.57
Expected Static Difference (+/-10%) (mV)	270	270	186	57	260	260	260
Expected - Calculated Static Difference (%)	-1%	0%	0%	-1%	0%	na	-4%
Static QC status (pass/fail)	Pass	Pass	Pass	Pass	Pass	na	Pass
Static Response Comment	initial reading	initial reading	initial reading	initial reading	initial reading	initial reading	initial reading
Kinematic Position							
Control Point ID (Stake ID)	gpo_w	gpo_s	gpo_s	gpo_s	gpo_s	gpo_n	gpo_n
Control Point Easting	682275.52	682354.11	682354.11	682354.11	682354.11	682337.51	682337.51
Control Point Northing	1170806.72	1170744.76	1170744.76	1170744.76	1170744.76	1170885.22	1170885.22
Interpreted Easting	682275.21	682353.37	682353.66	682353.93	682353.67	682337.43	682337.50
Interpreted Northing	1170806.51	1170744.77	1170745.10	1170744.81	1170744.91	1170884.95	1170884.96
Offset	0.38	0.74	0.57	0.20	0.46	0.28	0.26
Allowable offset (1 ft+1/2 line spacing)	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Position QC Status (pass/fail)	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Kinematic Position Comment							
Kinematic Response							
Control Point Response (mV)	25-61	25-61	19-39	40-74	34-59	34-59	34-59
Expected Control Point Response (mV)	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Control Point Response Difference (mV)	na	na	na	na	na	na	na
Allowable Control Point Difference (+/- 25%)(mV)	25%	25%	25%	25%	25%	25%	25%
Control Point QC Status (pass/fail)	na	na	na	na	na	na	na
Kinematic Response Comment	initial reading	initial reading	initial reading	initial reading	initial reading	initial reading	initial reading
Sample Separation							
min (ft)	0.00	0	0.00	0	0	0	0
max (ft)	2.11	1.49	1.05	4.93	3.31	0.45	0.34
mean (ft)	0.15	0.12	0.11	0.11	0.06	0.07	0.08
std dev (ft)	0.11	0.11	0.08	0.11	0.08	0.07	0.07
allowable separation (98%<10 inches)	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Separation QC Status (pass/fail)	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Separation Comment							
Coverage							
Polygon Area (square ft)	6990.00	3414.00	9989.00	9989	4847	3107	2308
Covered Area at line spacing (square ft)	6431.00	3233.00	9383.00	9335.00	4487	3058	2196
Percent Coverage	92%	95%	94%	93%	93%	98%	95%
Allowable Coverage (>95% covered at max allowable line spacing)	95%	95%	95%	95%	95%	95%	95%
Coverage QC Status (pass/fail)	Pass	Pass	Fail-line gap	Pass	Fail, incomplete	Pass	Pass
Coverage Comment	3% trees	1% trees	~4% trees	~4% trees	cable prob.	not complete	1% trees
Repeat Line	OK	OK	OK	OK	no-cable prob	OK	OK
Positioning System	iGPS	iGPS	RTS 1200	RTS 1200	RTS 1105	RTS 1105	RTS 1105

APPENDIX D

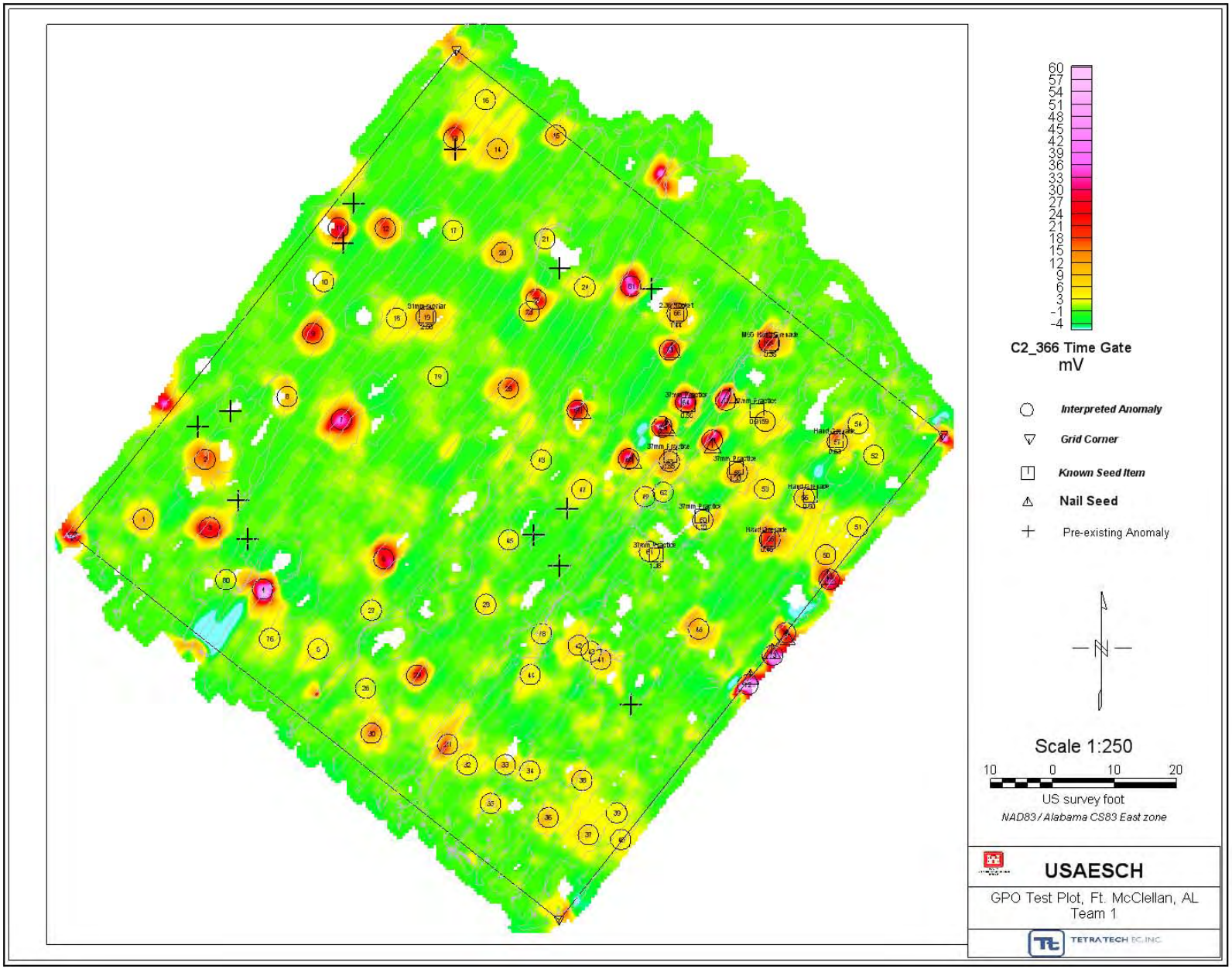
DIG SHEET

USAESCH GPO Target ID	Interpreted Easting (ft)	Interpreted Northing (ft)	Top Coil C1_660 mV	Bottom Coil C2_660 mV	Bottom Coil C2_216 mV	Bottom Coil C2_366 mV	Estimated Depth (ft)	Item Description	Known Depth (ft)	Known Easting (ft)	Known Northing (ft)	Interpreted Position Error (ft)	Reacquired Anomaly Distance (ft)	Reacquired Anomaly Direction
1	682287.02	1170809.3	7.06	6.08	16.25	10.84	2.27	Unknown						
2	682296.98	1170819	9.19	8.19	30.68	17.89	2.01	Unknown						
3	682297.74	1170808	15.4	14.82	44.55	29.32	1.49	Unknown					0.08	SW
4	682306.27	1170798	52.51	39.91	86.87	63.63	3.4	Unknown						
5	682315.22	1170788.4	2.29	2.13	7.52	4.9	1.71	Unknown						
6	682325.85	1170802.9	24.67	17.07	42.31	30.31	4.55	Unknown					0.33	W
7	682319.01	1170825.5	25.34	20.77	59.59	39.16	2.67	Unknown						
8	682310.23	1170829.2	-8.04	4.27	21.58	12.89	0	Unknown						
9	682314.37	1170839.4	22.14	17.31	44.2	30.75	3.11	Unknown					0.25	SW
10	682316.14	1170847.7	0.49	1.64	6.9	4.35	0	Unknown						
11	682318.51	1170856.4	-3.44	13.54	48.51	32.1	0	Unknown					0.67	SE
12	682326.1	1170856.3	18.2	13.13	32.4	22.89	4	Unknown						
13	682337.16	1170871	11.48	12.71	31.27	22.24	0.55	Unknown					0.33	E
14	682344.17	1170869.2	9.17	5.98	15.98	10.65	5.47	Unknown						
15	682353.62	1170871.4	2.94	3.44	37.23	16.78	0.14	Unknown						
16	682342.23	1170877.1	1.47	1.81	7.96	4.51	0	Unknown						
17	682336.99	1170856	2.13	1.88	5	3.36	2.08	Unknown						
18	682327.88	1170841.8	2.62	2.62	7.05	4.83	1.23	Unknown						
19	682332.69	1170842.1	11.45	7.45	17.91	12.51	5.51	81mm mortar	2.56	682332.8	1170842.2	0.15		
20	682344.93	1170852.5	12.76	8.92	20.36	14.63	4.41	Unknown					0.17	N
21	682351.85	1170854.7	-6.37	2.13	11.43	6.29	0	Unknown					0.17	NW
22	682350.41	1170844.4	15.51	19.03	40.92	31.28	0	Unknown					1.50	NE
23	682349.32	1170842.9	15.51	19.03	40.92	31.28	0	Unknown					0.00	
24	682358.27	1170846.9	2.94	2.46	7.11	5.15	2.5	Unknown						
25	682345.94	1170830.5	22.37	14.94	32.9	24.49	5.08	Unknown					0.58	W
26	682322.9	1170782.1	1.62	1.62	4.7	2.92	1.23	Unknown						
27	682323.83	1170794.6	1.8	1.39	3.43	2.61	3.23	Unknown						
28	682342.31	1170795.6	2.28	2.62	7.59	4.81	0.28	Unknown						
29	682331.17	1170784.2	19.78	15.24	37.68	26.83	3.26	Unknown						
30	682323.83	1170774.8	12.79	9.81	23.65	16.77	3.3	Unknown						
31	682336.15	1170773	11.92	10.6	34.76	21.93	2.03	Unknown					0.67	NW
32	682339.27	1170769.7	3.42	2.52	8.07	5.3	3.74	Unknown						
33	682345.43	1170769.7	-7.44	4.22	22.41	12.56	0	Unknown						
34	682349.4	1170768.7	3.3	2.8	8.08	5.19	2.38	Unknown						
35	682343.07	1170763.5	6.1	4.79	9.07	7.34	3.07	Unknown						
36	682352.36	1170761.2	5.91	5.01	16.83	10.75	2.39	Unknown						
37	682358.86	1170758.4	1.97	1.96	14.4	6.95	1.27	Unknown						
38	682357.84	1170767.2	3.44	3.2	10.92	6.81	1.71	Unknown						
39	682363.41	1170762	2.44	2.45	6.04	4.16	1.21	Unknown						
40	682364.09	1170757.7	2.76	2.6	6.98	4.63	1.63	Unknown						
41	682360.88	1170786.7	10.88	7.09	17.56	12.03	5.49	Unknown						
42	682357.25	1170789	7.44	4.55	10.93	7.45	6.73	Unknown						
43	682359.28	1170788	10.88	7.09	17.56	12.03	5.49	Unknown						
44	682349.49	1170784.3	2.16	1.9	8.7	5.8	2.11	Unknown						
45	682346.03	1170806	2.43	2.44	6	4.3	1.21	Unknown						
46	682376.67	1170791.6	6.73	6.73	24.54	14.85	1.23	Unknown						
47	682357.84	1170814.1	3.1	2.7	7.03	4.81	2.18	Unknown						
48	682351.26	1170819	2.44	2.35	6.75	4.39	1.48	Unknown						
49	682367.97	1170813	2.77	2.77	7.83	5.14	1.23	Unknown						
50	682397.18	1170803.6	3.91	3.43	10.11	6.76	2.13	Unknown						

USAESCH GPO Target ID	Interpreted Easting (ft)	Interpreted Northing (ft)	Top Coil C1_660 mV	Bottom Coil C2_660 mV	Bottom Coil C2_216 mV	Bottom Coil C2_366 mV	Estimated Depth (ft)	Item Description	Known Depth (ft)	Known Easting (ft)	Known Northing (ft)	Interpreted Position Error (ft)	Reacquired Anomaly Distance (ft)	Reacquired Anomaly Direction
51	682402.33	1170808.1	2.28	1.95	6.11	4.07	2.32	Unknown						
52	682404.94	1170819.7	2.13	1.97	5.08	3.52	1.75	Unknown						
53	682387.3	1170814.2	3.8	3.3	8.75	5.94	2.2	Unknown						
54	682402.41	1170824.8	2.13	1.97	5.66	3.94	1.75	Unknown						
55	682388.15	1170806.1	12.3	10.91	37.3	23.78	2.05	Hand Grenade	0.46	682387.92	1170806.07	0.24	0.08	N
56	682393.72	1170812.8	4.1	3.53	13.12	8.36	2.27	Hand Grenade	0.8	682394.73	1170813.04	1.04	0.25	S
57	682399.04	1170821.9	10.67	9.68	34.15	21.26	1.88	Hand Grenade	0.63	682398.87	1170821.97	0.18		
58	682382.91	1170816.9	12.9	10.42	20.18	15.3	2.8	37mm	1.03	682382.74	1170817.62	0.72	0.25	NW
59	682387.39	1170825.2	5.96	4.47	9.92	7.52	3.54	37mm	0.91	682386.1	1170826.88	2.13		
60	682377.34	1170809.2	9.23	7.5	13.19	10.8	2.75	37mm	1.1	682377.25	1170809.81	0.66	0.08	NE
61	682368.73	1170804.1	4.63	4.06	8.36	6.63	2.13	37mm	1.08	682369.81	1170803.5	1.23	0.25	NE
62	682370.93	1170813.7	2.77	3.02	7.67	5.06	0.66	Unknown						
63	682371.94	1170818.7	8.46	8.54	24.38	16.08	1.17	37mm	0.55	682372.12	1170819.58	0.91		
64	682374.56	1170828.2	34.95	32.26	80.34	57.15	1.76	37mm	0.55	682374.96	1170827.8	0.59	0.00	
65	682388.06	1170837.9	15.73	14.65	44.71	28.56	1.7	M69 Grenade	0.35	682388.47	1170837.66	0.45	0.17	S
66	682373.21	1170842.7	9.41	8.68	25.95	16.54	1.77	2.36" rocket	1.44	682373.16	1170842.38	0.28		
67	682357.08	1170827	23.51	22.7	45.48	34.54	1.46	seed nail						
68	682365.36	1170819.1	24.77	24.05	50.21	38.31	1.43	seed nail						
69	682370.76	1170824.3	30.05	30.7	61.49	47.84	1.1	seed nail						
70	682371.94	1170836.7	25.83	25.1	51.83	39.64	1.42	seed nail					0.25	SW
71	682378.86	1170822.2	26.97	25.81	53.2	40.95	1.52	seed nail					0.00	
72	682384.6	1170782.7	38.81	37.76	80.45	61.46	1.41	seed nail						
73	682388.57	1170787.4	30.52	29.63	61.45	47.65	1.43	seed nail						
74	682390.68	1170791	17.92	15.96	31.92	24.75	2.02	seed nail						
75	682397.77	1170799.6	23.03	22.3	45.18	34.55	1.44	seed nail						
76	682307.42	1170790.1	2.13	2.12	5.71	3.68	1.27	Unknown						
77	682381.04	1170828.6	24.66	23.84	49.33	38	1.46	Unknown					0.17	S
78	682351.31	1170790.8	2.82	3.4	9.35	6.21	0	Unknown						
79	682334.61	1170832.4	1.47	1.47	3.6	2.69	1.23	Unknown						
80	682300.33	1170799.6	0	1.88	7.13	4.17	0	Unknown					0.17	NW
81	682365.75	1170847	22.93	23.09	65.54	42.85	1.19	Unknown					0.08	SW

APPENDIX E

GEOPHYSICAL MAPS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C2_366 Time Gate
mV
Interpreted Anomaly
Grid Corner
Known Seed Item
Nail Seed
Pre-existing Anomaly
Scale 1:250
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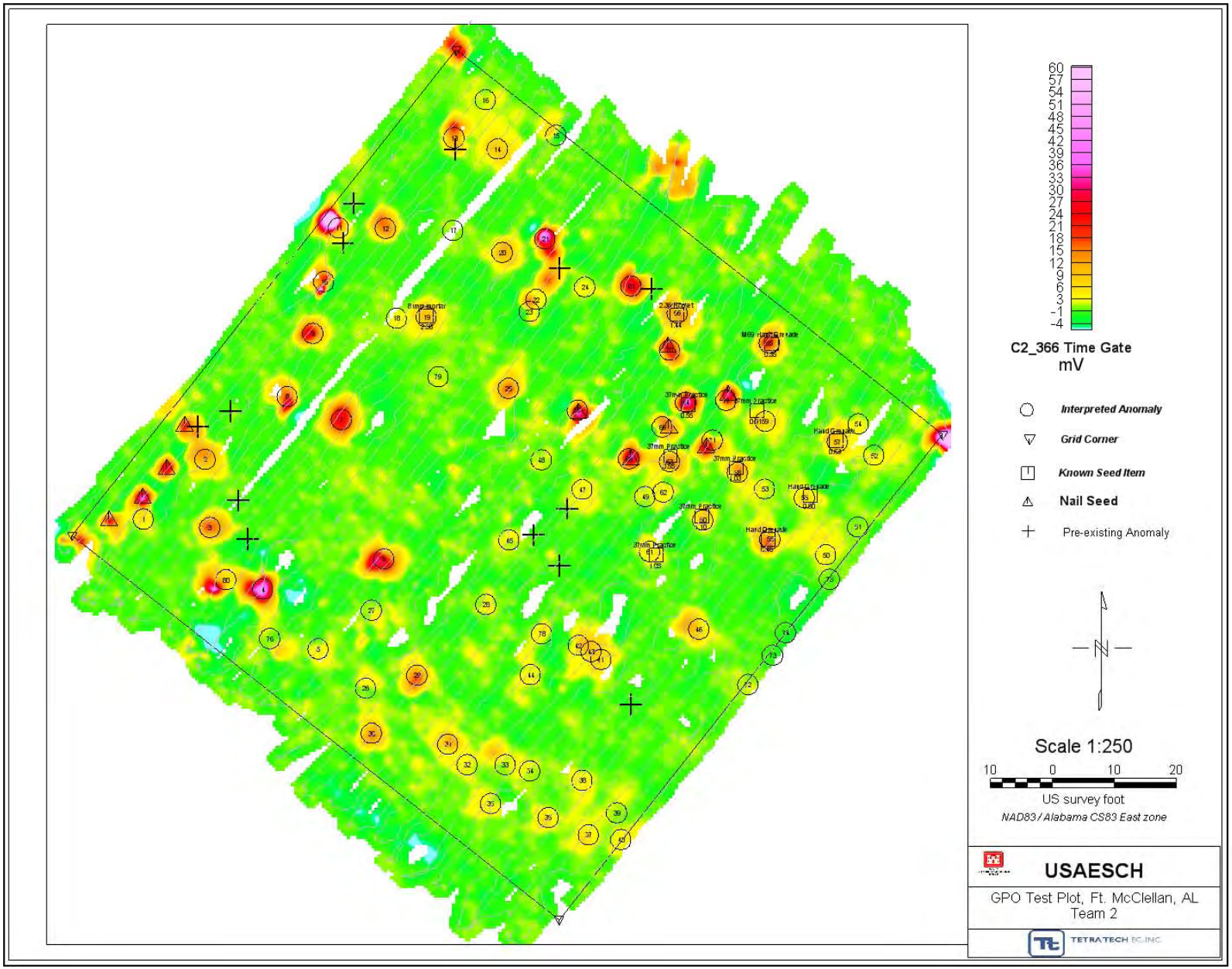
US survey foot
NAD83 / Alabama CS83 East zone
USAESCH
GPO Test Plot, Ft. McClellan, AL
Team 1
TETRA TECH EC, INC.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C2_366 Time Gate
mV
Interpreted Anomaly
Grid Corner
Known Seed Item
Nail Seed
Pre-existing Anomaly
Scale 1:250
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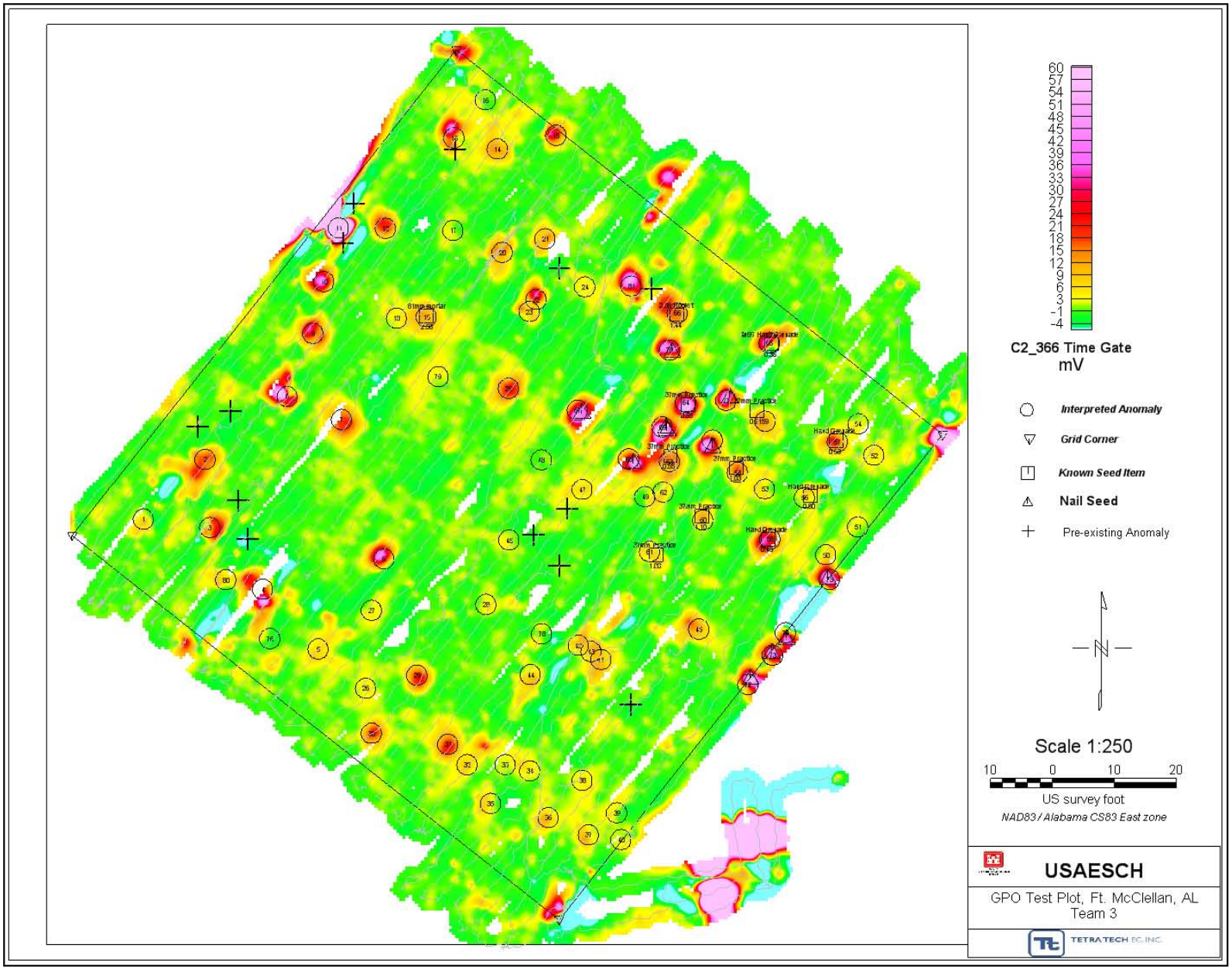
US survey foot
NAD83 / Alabama CS83 East zone
USAESCH
GPO Test Plot, Ft. McClellan, AL
Team 2
TETRA TECH EC, INC.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C2_366 Time Gate
mV
Interpreted Anomaly
Grid Corner
Known Seed Item
Nail Seed
Pre-existing Anomaly
N
Scale 1:250
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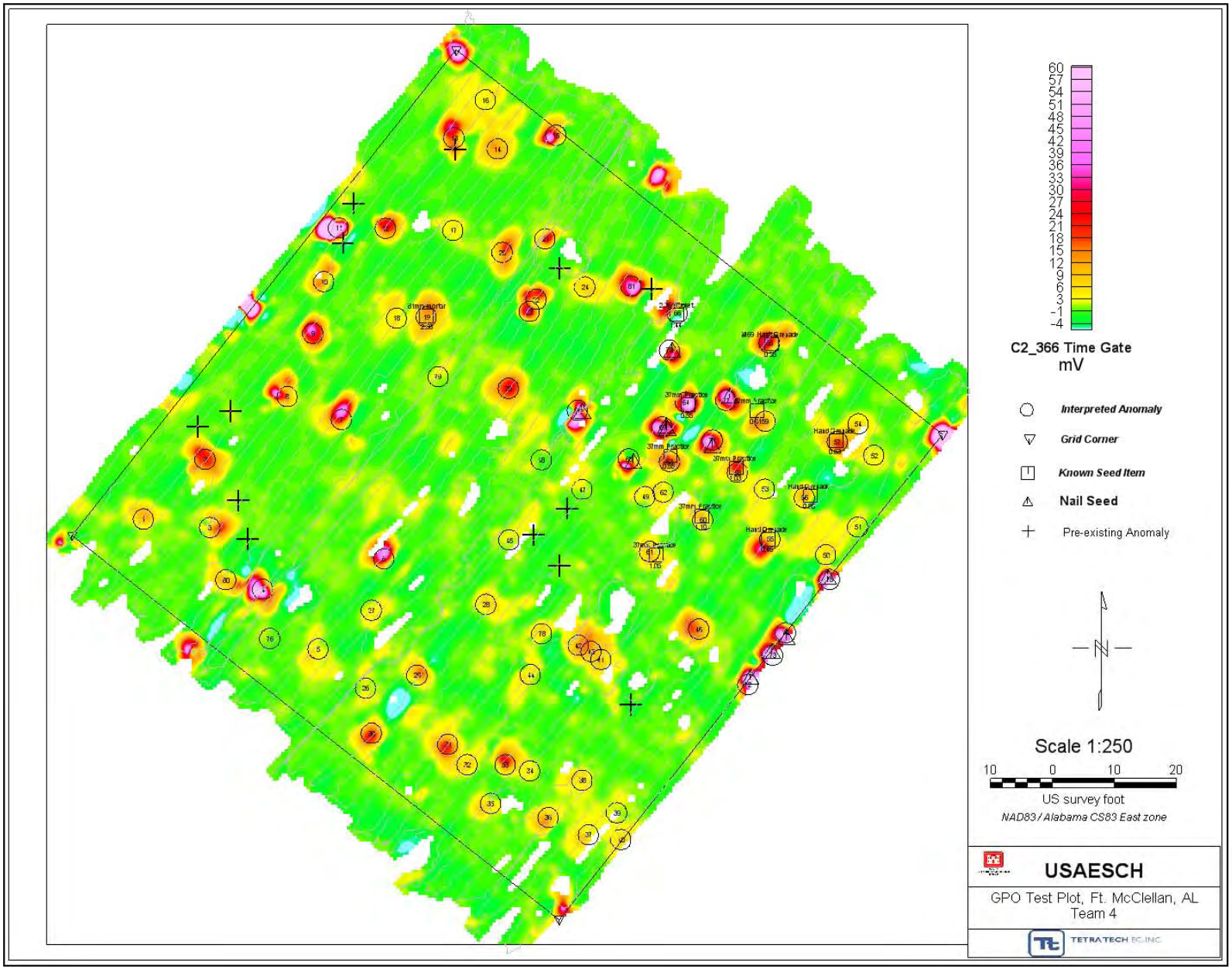
US survey foot
NAD83 / Alabama CS83 East zone
USAESCH
GPO Test Plot, Ft. McClellan, AL
Team 3
TETRA TECH EC, INC.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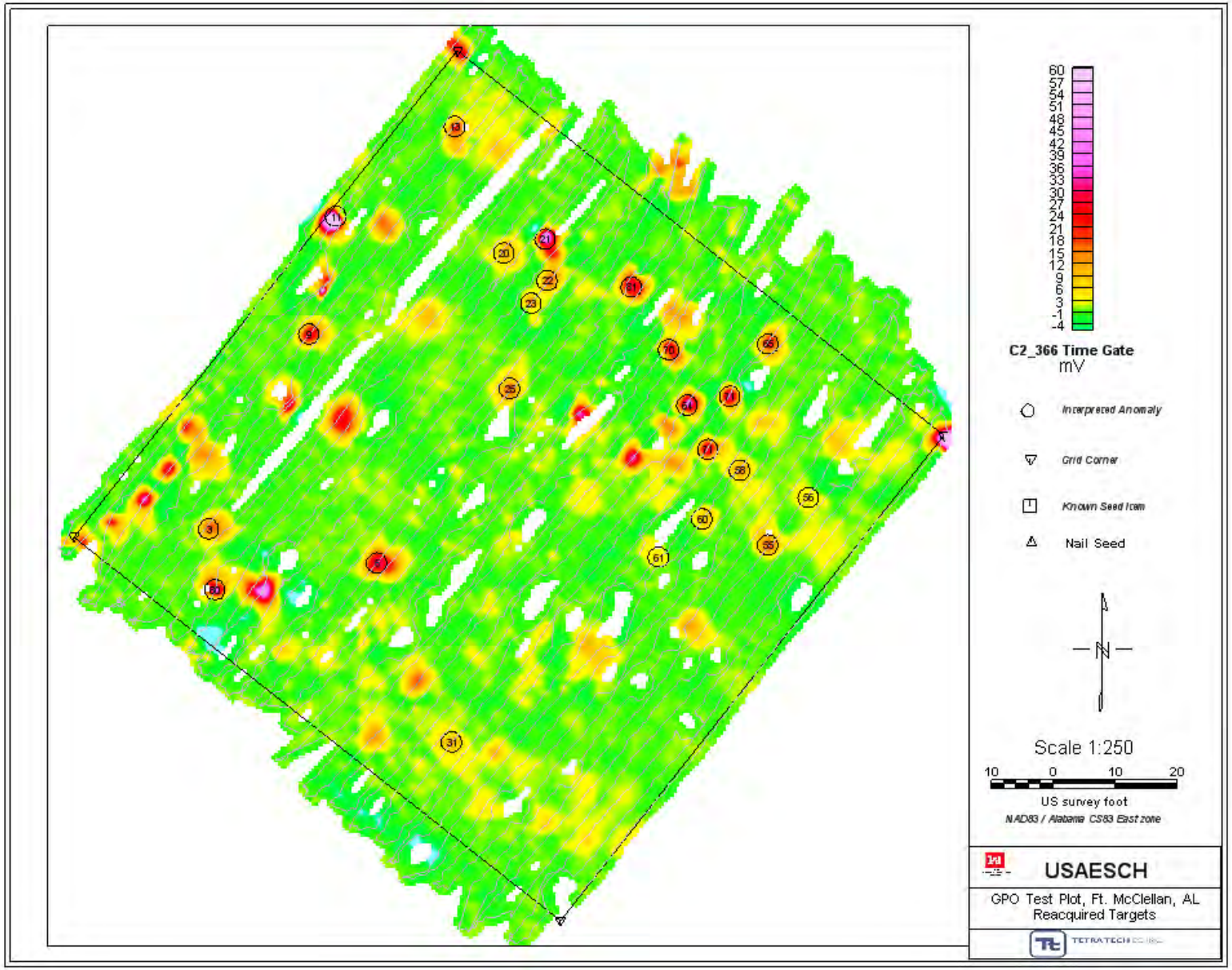
C2_366 Time Gate
mV
Interpreted Anomaly
Grid Corner
Known Seed Item
Nail Seed
Pre-existing Anomaly
Scale 1:250
10 0 10 20
US survey foot
NAD83 / Alabama CS83 East zone
USAESCH
GPO Test Plot, Ft. McClellan, AL
Team 4
TETRA TECH EC, INC.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C2_366 Time Gate
mV
Interpreted Anomaly
Grid Corner
Known Seed Item
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Scale 1:250
10 0 10 20
US survey foot
NAD83 / Alabama CS83 East zone
USAESCH
GPO Test Plot, Ft. McClellan, AL
Reacquired Targets
TETRA TECH