# Quality Assurance Audit Evaluation

# On

# Foster Wheeler Environmental Corporation Digital Geophysical Survey Results

# For The Ft. McClellan Eastern Bypass Area

**Jon Durham**

**Geologist**

**CEHNC-ED-CS-G**

**June 02, 2003**

**Table of Contents**

**1.0 Executive Summary**

**2.0 Introduction**

**3.0 Quality Assurance Audit Elements**

**3.1 Geophysical Prove-out Results**

**3.2 Survey Area Pre-Seeded Items**

**3.3 Government Field Oversight of Data Acquisition and Data Processing Operations**

**3.4 Government Review of Digital Geophysical Data**

**3.5 Comparison of Excavation Results with Geophysical Data Results**

**3.6 Government Re-survey of Select Areas of the M-2 Parcel**

**3.6.1 Digital Geophysical Re-mapping of Grids using EM-61, EM-61HH and USRADS Real-time DAqS**

**3.6.2 Digital Geophysical Re-mapping of Grids using Subcontractor operated GEM-3 and Fiducial Navigation**

**3.6.3 Re-mapping of Grids by CEHNC Safety Specialist**

**4.0 Quality Assurance Audit Summary and Recommendations**

**List of Figures**

**Figure 1. 60 mm practice mortar seeded in Grid E91. ID SV-EODT-25**

**Figure 2. Mark II practice grenade seeded in Grid E46. ID SV-EODT-29**

**Figure 3. Mark II practice grenade seeded in Grid G46. ID SV-EODT-26**

**Figure 4. 2.36" rocket-warhead casing seeded in Grid H08. ID SV-EODT-27**

**Figure 5. 2.36" rocket-motor casing seeded in Grid G33. ID SV-EODT-45**

**Figure 6. EM61 survey of Grid G46 and the Mark II grenade location.**

**Figure 7. Map of Grids N63, P05, and P11showing locations of grounding rods that are cut-off at the surface.**

**Figure 8. Grid N48r showing the location of the 1-inch cable wire.**

**Figure 9. Grid P15 showing the location of the utility valve and two pieces of cast iron pipe.**

**Figure 10. Grid P09 showing the location of the grounding rod.**

**Figure 11. Grid M39 showing the location of the wire.**

## 1.0 Executive Summary

The U.S. Army Corps of Engineers Huntsville Center (CEHNC) performed a Government Quality Assurance Audit on the UXO Geophysical Investigation Process performed on the Eastern Bypass 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 six (6) 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.) Government Field Oversight Inspection of Data Acquisition and Data Processing Operations

4.) Successfully passing a Government Review of Digital Geophysical Data

5.) Comparing Excavation Results with Geophysical Data Results

6.) Government Re-survey of Select Areas did not uncover any missed UXO or OE related items.

## 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-UXO 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, Processes and compliance of work-by-others.

## 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 six (6) major Quality Control Elements to verify acceptable contractor performance.

### 3.1 Geophysical Prove-out Results

The Contractor was selected for the Ft. McClellan Project in the spring of 1999 by performance based in part for their superior performance on the Demonstration Test Grid. This test grid was located adjacent to a target area within Range 16 and consisted of both existing ordnance and ordnance seeded on the grid by the Huntsville Corps of Engineers. Foster Wheeler Environmental Corporation finished first in this competition against three other Finalists (a total of 50 companies competed for this award). This Demonstration grid was used as the Geophysical Prove-out for the work performed by the Foster Wheeler Team in the Spring/Summer of 2000.

### 3.2 Survey Area Pre-Seeded Items

In October, 2001, CEHNC seeded the following items:

Eastern Bypass - Ft. McClellan - Government Blind Seed Test Items - Contractor: Foster Wheeler - Seed items placed on October 3, 2001

| Item# | Item Description | ID | Sector | Grid | Depth | Azimuth | Decl | Measurement from corner grid stakes (ft) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | SW | NW | NE | SE |
| 1 | 60 mm practice mortar (no fins) | SV-EODT-25 | E | E-91 | 16" | 0 | 0 | E-91 31' 10" | G-06 76' 1" | G-07 111' 6" | E-92 89' 10" |
| 2 | Mark II grenade | SV-EODT-26 | G | G-46 | 6" | 90 | 0 | G-46 71' 3" | G-54 72' 3" | G-55 74' 5" | G-47 69' 7" |
| 3 | 2.36" rocket warhead casing | SV-EODT-27 | H | H-08 | 6" | 315 | 0 | H-08 68' 0" | H-17 78' 0" | H-18 74' 6" | H-09 66' 2" |
| 4 | Mark II grenade | SV-EODT-29 | E | E-46 | 6" | 0 | 0 | E-46 54' | E-60 105' 2" | E-61 102' 5" | E-47 50' 9" |
| 5 | 2.36" rocket motor casing | SV-EODT-45 | G | G-33 | 6" | 270 | 0 | G-33 123' 7" | G-42 107' 0" | G-43 35' 2" | G-34 65' 9" |

Figures 1 through 5 show the items. (See **Section 3.5**)

**Figure 1. 60 mm practice mortar seeded in Grid E91. ID SV-EODT-25**

**Figure 2. Mark II practice grenade seeded in Grid E46. ID SV-EODT-29**

**Figure 3. Mark II practice grenade seeded in Grid G46. ID SV-EODT-26**

**Figure 4. 2.36" rocket-warhead casing seeded in Grid H08. ID SV-EODT-27**

**Figure 5. 2.36" rocket-motor casing seeded in Grid G33. ID SV-EODT-45**

## 3.3 Government Field Oversight of Data Acquisition and Data Processing Operations

A representative from the Huntsville Corps of Engineers participated in the initial digital Geophysical Mapping readiness review operations (Gamey 2000). A partial listing of the items checked for and optimized during this pre-operation check 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*
*-Wear boots with fiberglass rather than steel toe protection*
*Magnetics*
*-Establish diurnal base station (q.v.)*
*-Sensor head orientation*
*-Secure cable leads*
*-Sweep operator and assistant with Schonstedt*
*-Check battery levels*
*-Check cable and connector integrity*
*-Warm up sensors prior to recording*

*-Conduct heading error test for each operator*
*-Conduct stationary noise level test*
*-Calibrate amplitude gain with uniform test object*
*-Survey calibration line in both directions once each day (qv)*
*-Survey calibration line at each equipment change*
*-Maintain consistent ground clearance and coupling while surveying*

*EM*
*-Establish instrument nulling station (q.v.)*
*-Secure cable leads*
*-Sweep operator and assistant with Schonstedt*
*-Check battery levels*
*-Check cable and connector integrity*
*-Warm up sensors prior to recording*
*-Null instruments at nulling station*
*-Conduct stationary noise level test*
*-Calibrate amplitude gain with uniform test object*
*-Survey calibration line in both directions once each day (q.v.)*
*-Survey calibration line at each equipment change*
*-Maintain consistent ground clearance and coupling while surveying*

*Calibration Line*
*-Purpose: to ensure instrument is operating consistently over the life of the project, to ensure that any equipment or operator changes do not effect the results, to establish instrument repeatability baseline*
*-Establish permanent line convenient to grid (either GPO or Survey)*
*-Locate start and end points by land survey*
*-Survey line with all instruments prior to locating targets*
*-Include at least three targets of varying sizes on surface at 5m intervals*
*-Note type, orientation and position of targets in field log*
*-If targets are swapped, survey immediately before and after for control*

*Nulling Station*
*-Purpose: an electromagnetically quiet area to consistently null instruments prior to surveying*
*-Should be convenient to grid*
*-Sweep with all EM instruments to be used at the site before finalizing*
*-Mark location clearly*
*-Clearly mark desired instrument direction*
*-Can also be used to calibrate amplitude gain if mobile test source is used*

*SR locations*
*-Purpose: a base reference network to facilitate US measurements*

*Positioning – Ultra Sonic*
*-Establish SR locations (qv)*

*-Operational modes: data logging combined or separate from geophysics*
*-Obtain permission to use radio frequencies necessary for RT link*
*-Verify full radio link coverage over entire area*
*-Test geophysical signatures of positioning sensor with pull away test (power off)*
*-Test geophysical signature of positioning electronics with power up test*
*-Data synch with geophysics must be tested and will depend on collection rates and method*
*-Periodically test data synch at start and end of day to check for clock drift*
*-Calculate data lag on calibration line at various speeds*
*-Measure positional lag (separate from time lag) between US transmitter and instrument location*

*Survey grid*
*-Purpose: main survey grids to be cleared of target UXO*
*-Locate grid corners with land survey (to ensure the grid is square: choose corners digitally, then locate on the ground rather than the other way around)*
*-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 on an approximately weekly basis from FWEC to CEHNC for review. Digital data was checked for location accuracy, lag corrections, leveling corrections, proper filtering and thresholding. A random selection of grids was reprocessed and dig lists made and compared to FWEC dig lists.

## 3.5 Seeded Survey Results

All the seeded items (see **Section 3.2**) were detected and unearthed by the Contractor except the Mark II grenades in E46 and G46. Although detected, the Contractor decided not to unearth the

grenade in G46 because he felt the EM61 signature did not represent an OE item. CEHNC seeded grid E46 ***after*** the Contractor surveyed the grid (CEHNC was misinformed by the Contractor, being told E46 had not been surveyed at the time the seed was planted). Figure 6 shows the EM61 survey for grid G46 and the location/EM signature for the grenade.

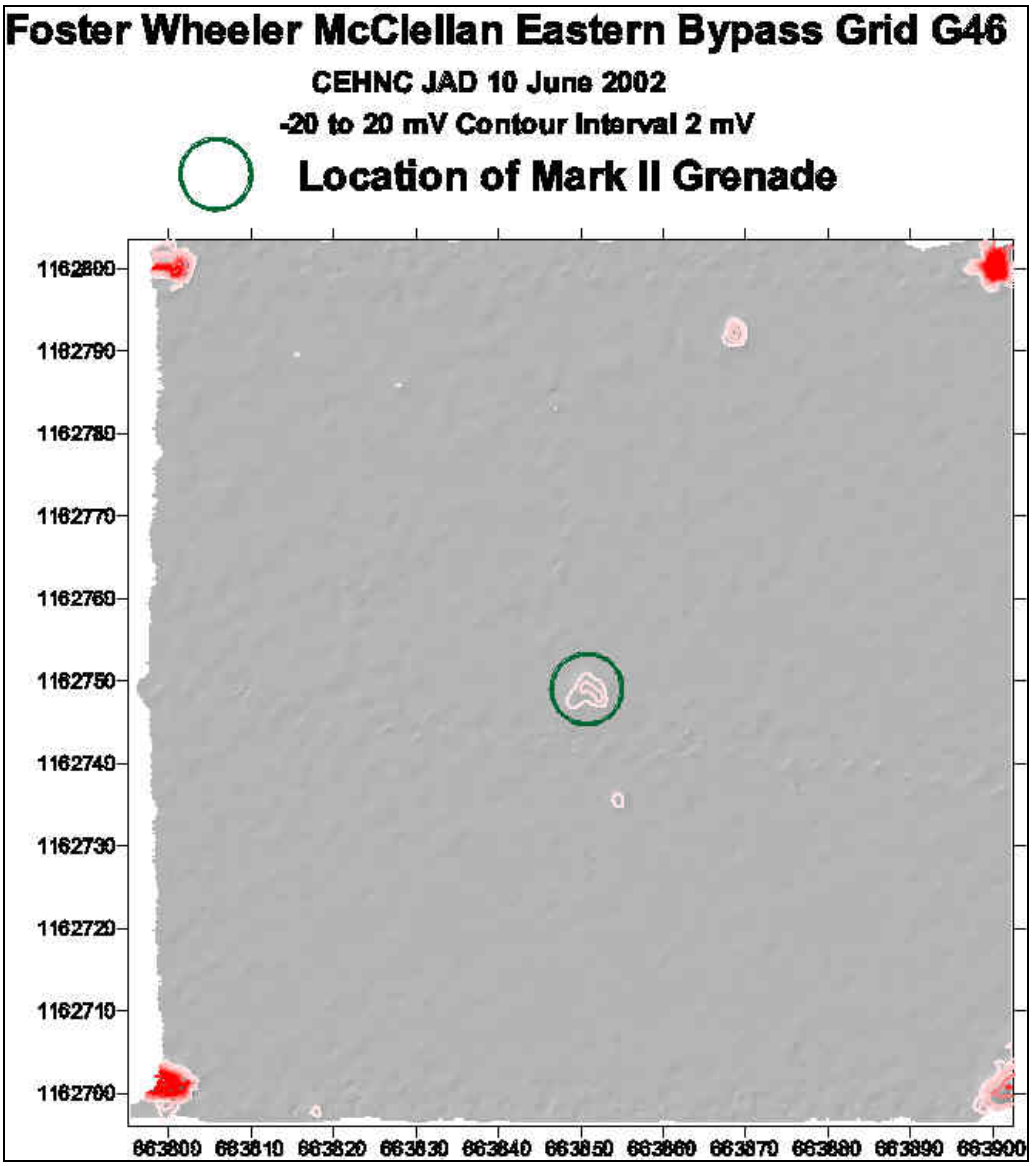


**Figure 6. EM61 survey of Grid G46 and the Mark II grenade location.**

## 3.6 Comparison of Excavation Results with Geophysical Data Results

CENHNC Safety performed QA checks on 10 percent of the grids and failed 9 grids because they detected magnetic anomalies that the Contractor failed to investigate. The grids are E63, P09, P15, N48r, PO5, N63, P11, and M39.

The Contractor has legitimate reasons for not digging anomalies on grids N63, P05, and P11. Grid E63 is located on construction debris containing ubiquitous metal and was removed from the failure list. Grids N63, P05, and P11 surround an old motor-pool facility and the failures are grounding rods that have been cut-off at the surface. The Contractor examined a few of the anomalies, noticed they were grounding rods, and then reasoned that the symmetry of layout of the remaining anomalies indicated that these anomalies are grounding rods too. Figure 7 shows the Grids N63, P05, and P11.

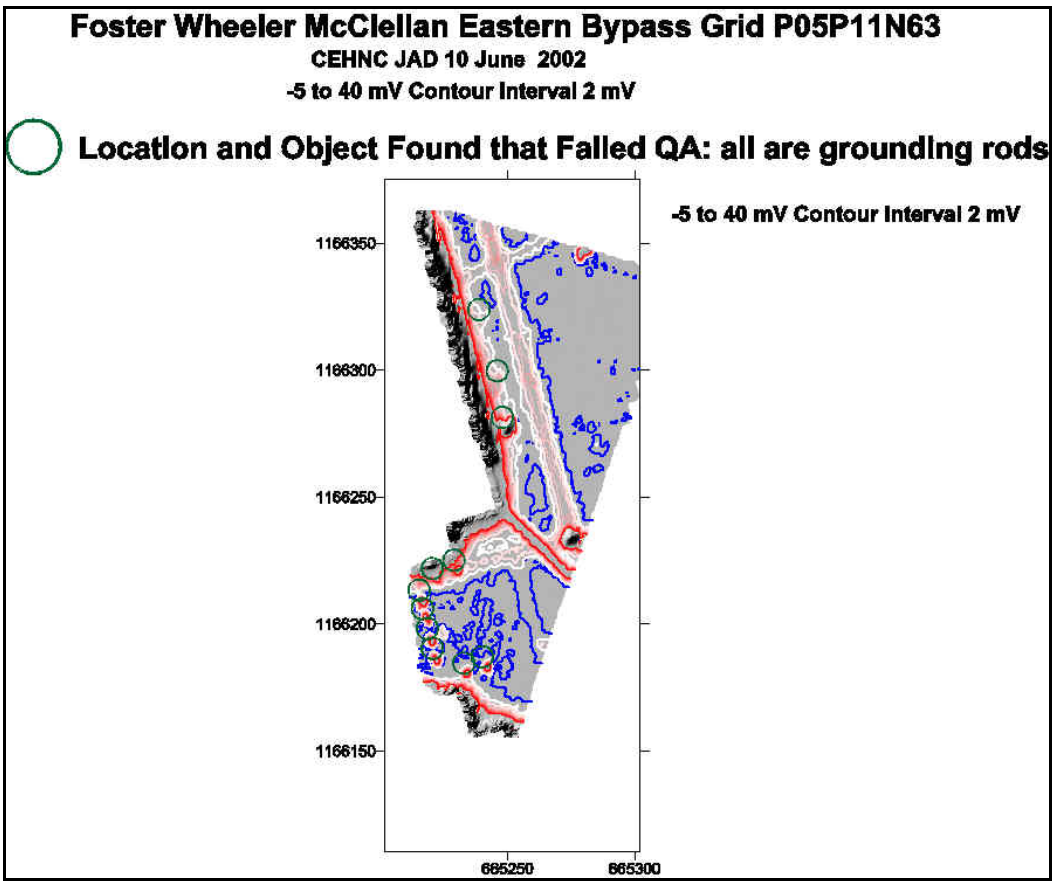

**Figure 7. Map of Grids N63, P05, and P11showing locations of grounding rods that are cut-off at the surface.**

Grid N48r failed QA because the contractor did not intrusively investigate an anomaly that turned out to be a fairly large section of 1-inch wire. Figure 8 shows the anomaly.

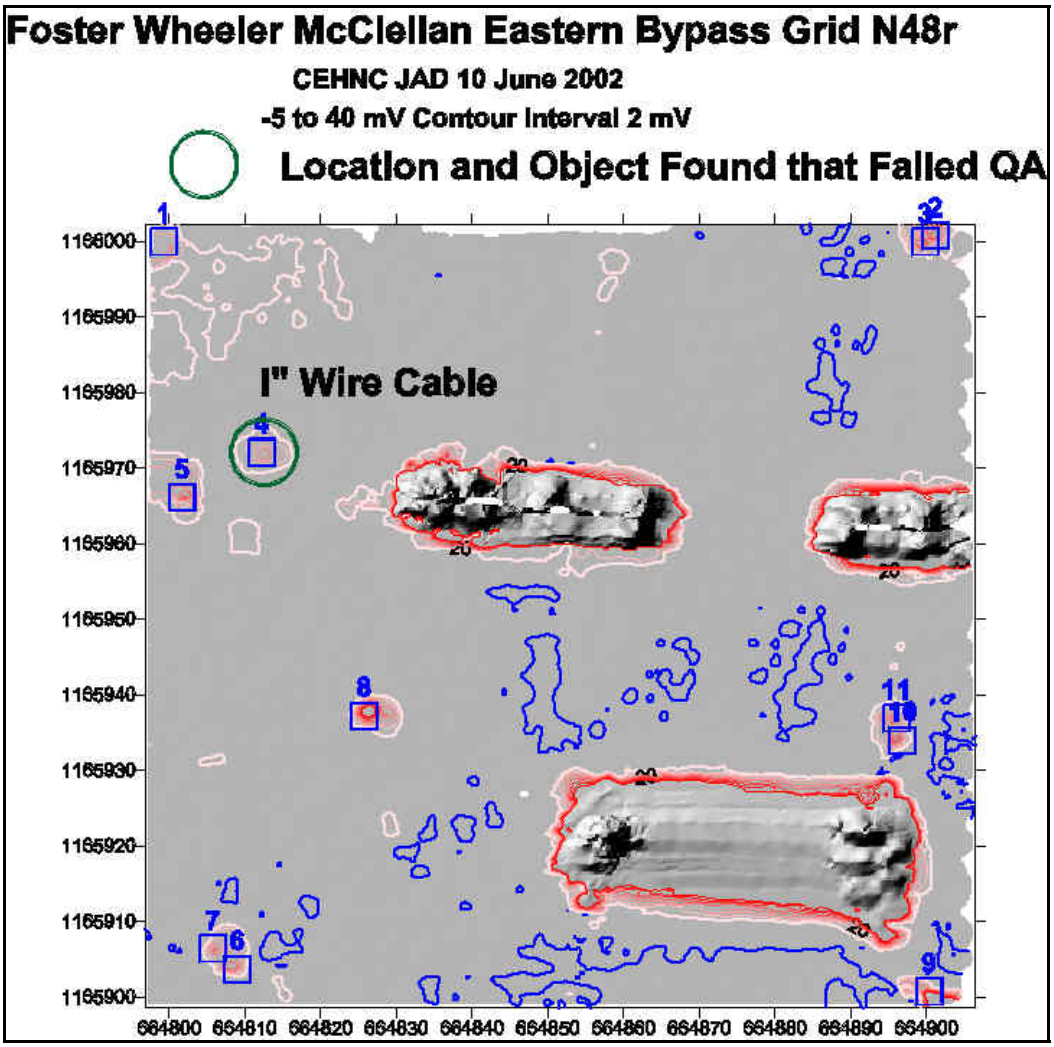


**Figure 8. Grid N48r showing the location of the 1-inch cable wire.**

Grid P15 failed because an anomaly that was not intrusive investigated turned out to be a utility valve and two cast iron pipes belonging to the utility (Figure 9). However, this anomaly was masked by an extremely large metal object.

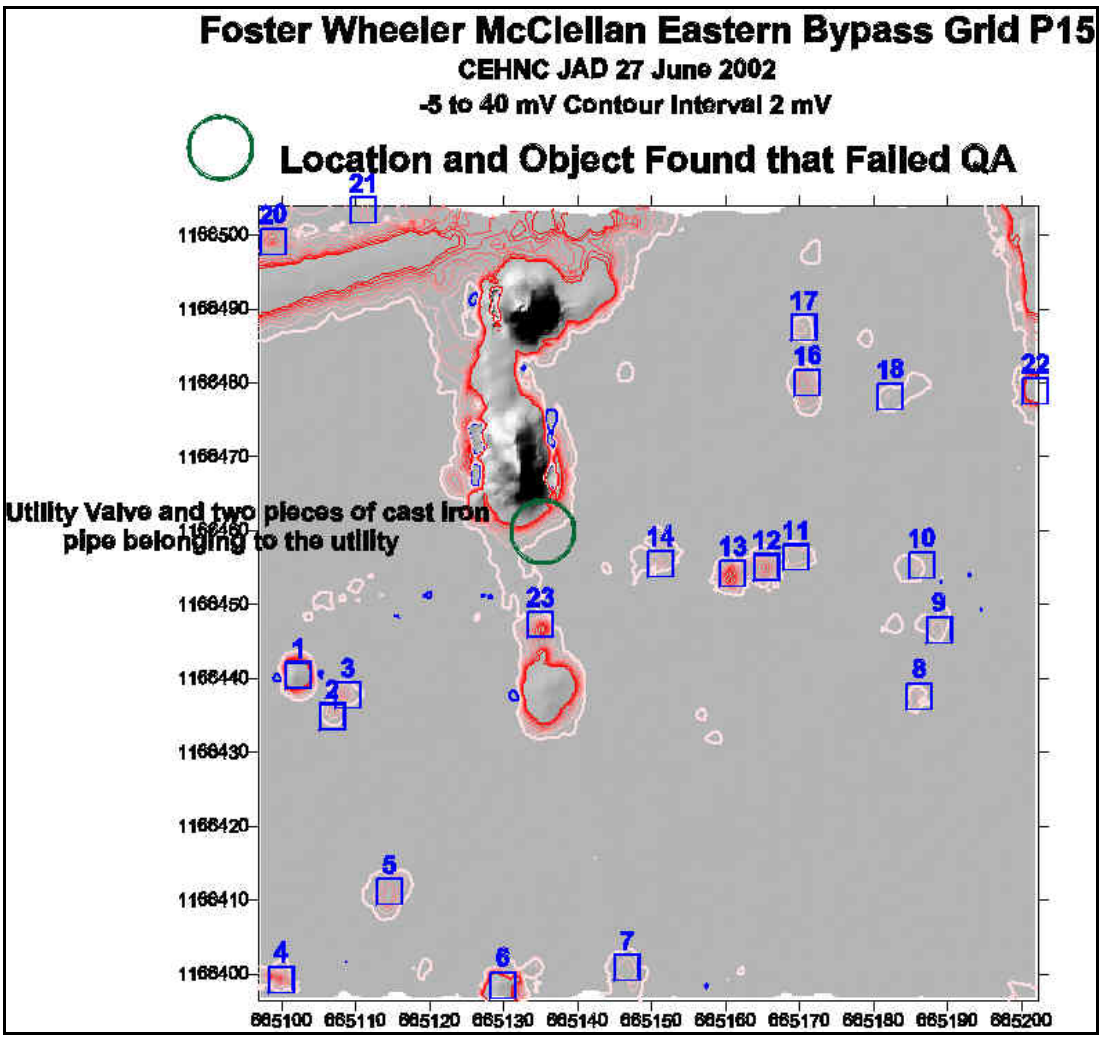


**Figure 9. Grid P15 showing the location of the utility valve and two pieces of cast iron pipe.**

Grid P09 failed because the Contractor failed to intrusively investigate a very large anomaly in the tens of mV that is a grounding rod (Figure 10).

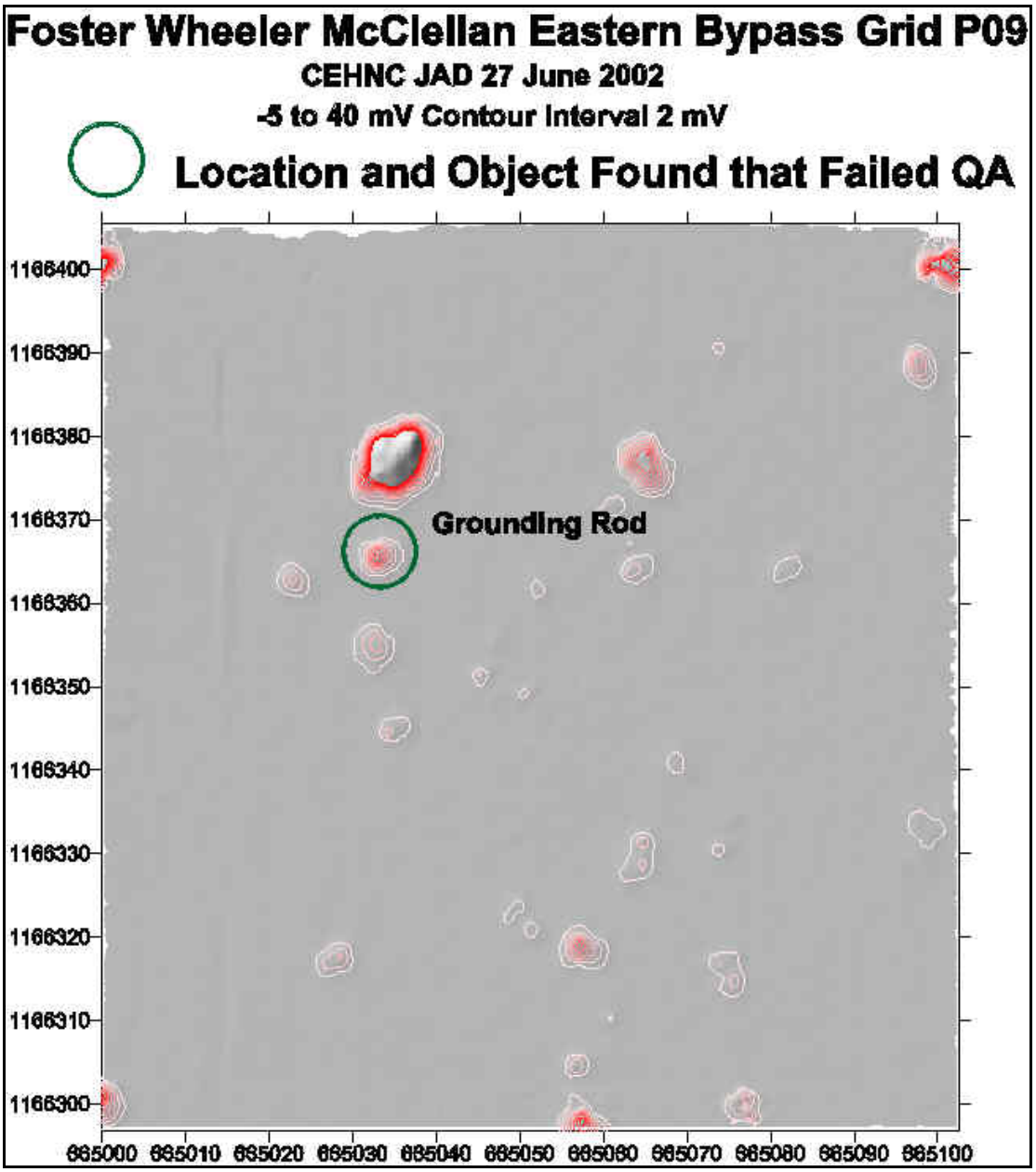


**Figure 10. Grid P09 showing the location of the grounding rod.**

Grid M39 failed because an anomaly that the Contractor did not investigate turned out to be a bail of wire (Figure11). The anomaly was acquired via a mag and dig operation and not an EM61 survey.

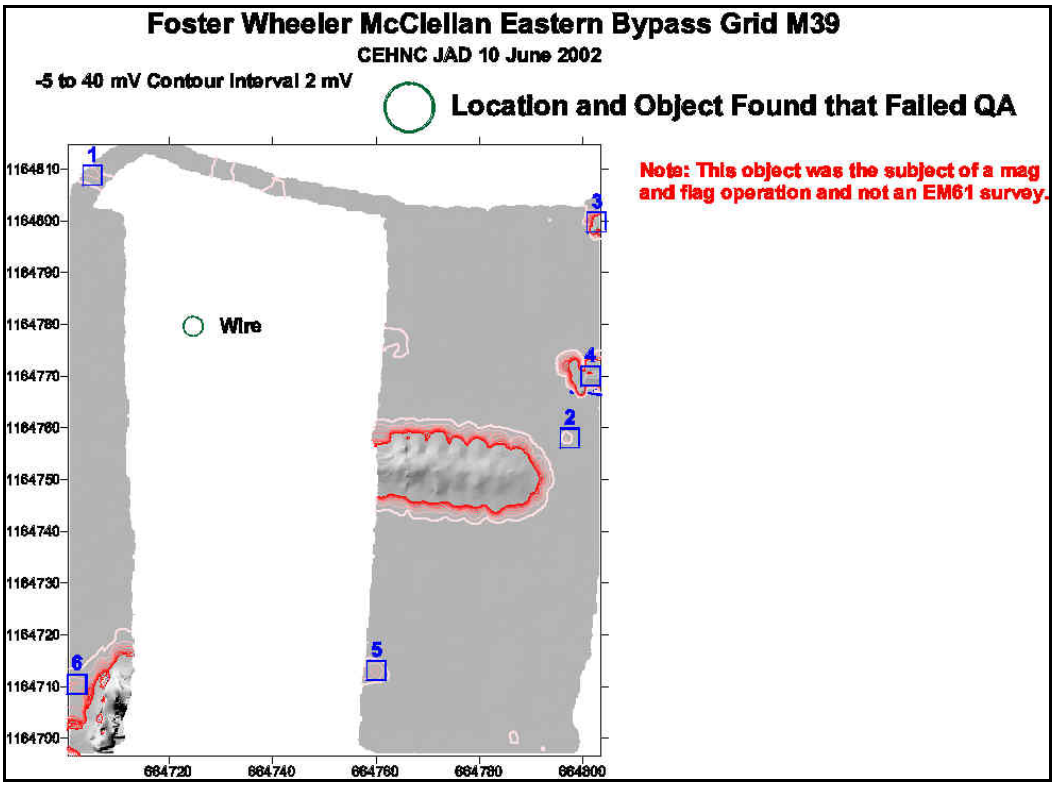


**Figure 11. Grid M39 showing the location of the wire.**

## 4.0 Quality Assurance Audit Summary and Recommendations

### 4.1

Outside of the Mechanical-Removal Area (AKA Rocket City), the contractor was unsuccessful in meeting all of the Quality Assurance elements by not intrusively investigating obvious EM61 and mag anomalies in Grids G46 (Mark II grenade), M39 (wire bail), P09 (grounding rod), and N48r (a bundle of 1-inch cable).

The EM61 data that the Contractor collects is good. The Contractor has the tools and procedures in place to find anomalies of interest but for some reason has chosen not to intrusively investigate those anomalies discussed above. The Contractor must refine his definition as to what constitutes a legitimate anomaly and also pay attention to obvious anomalies, even those that appear to be large cultural features.

**4.2** Mechanical-Removal Area. (AKA Rocket City)

Fig. 12 shows the Mechanical-Removal Area before OE debris was removed. This area was so cluttered with OE debris that it was necessary to use a mechanical device to safely and cost-effectively remove the OE.

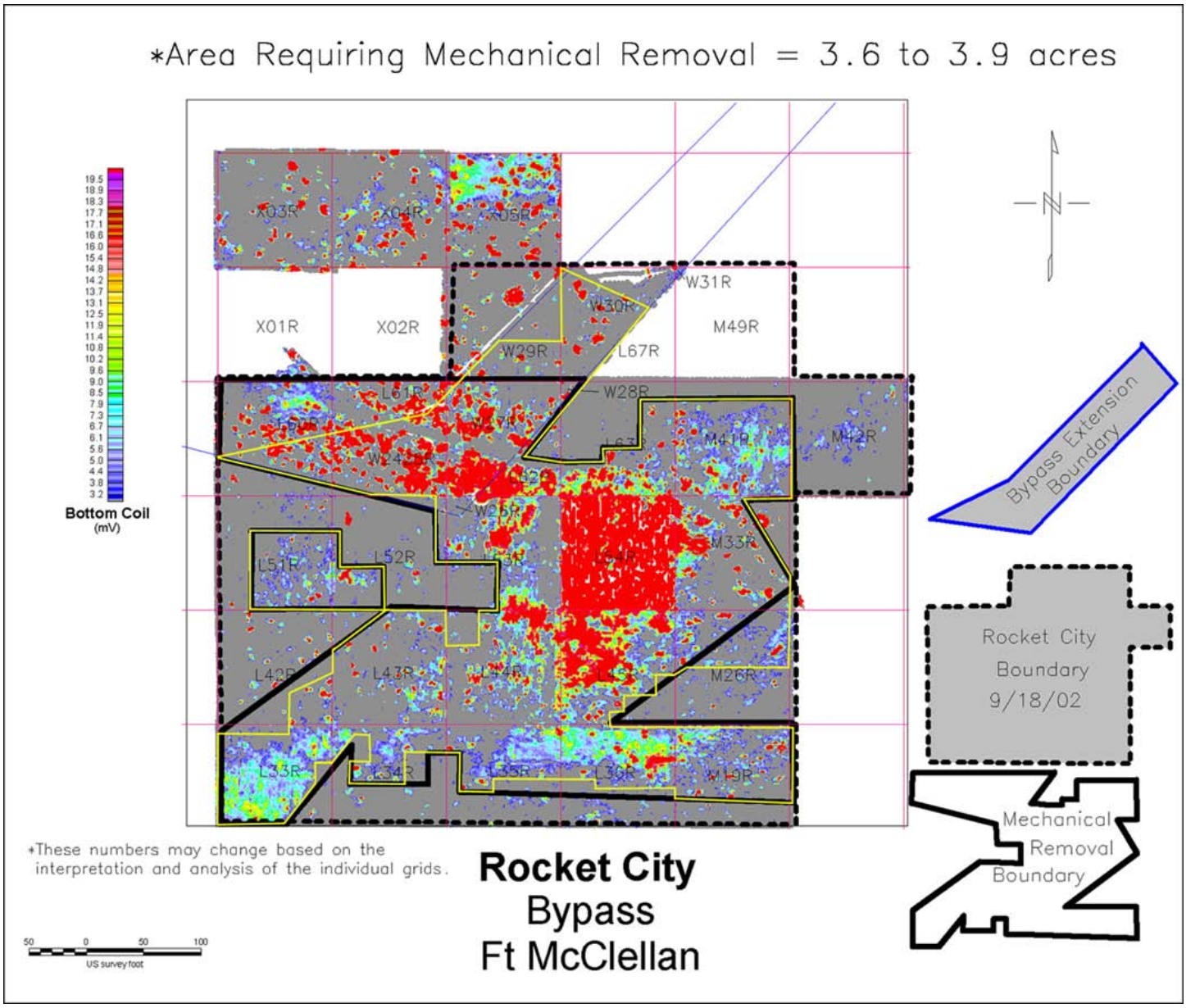


**Figure 12. Mechanical Removal Area before excavation.**

Once the Contractor removed the debris, as a QC effort, the contractor surveyed the area with the EM61 to check what OE items may have been left behind. From this data, the contractor reacquired and excavated most, but not all, anomalies. Fig. 13, 14, and 15 show grids in the area after excavation, but before the second removal effort, and what anomalies the contractor investigated.

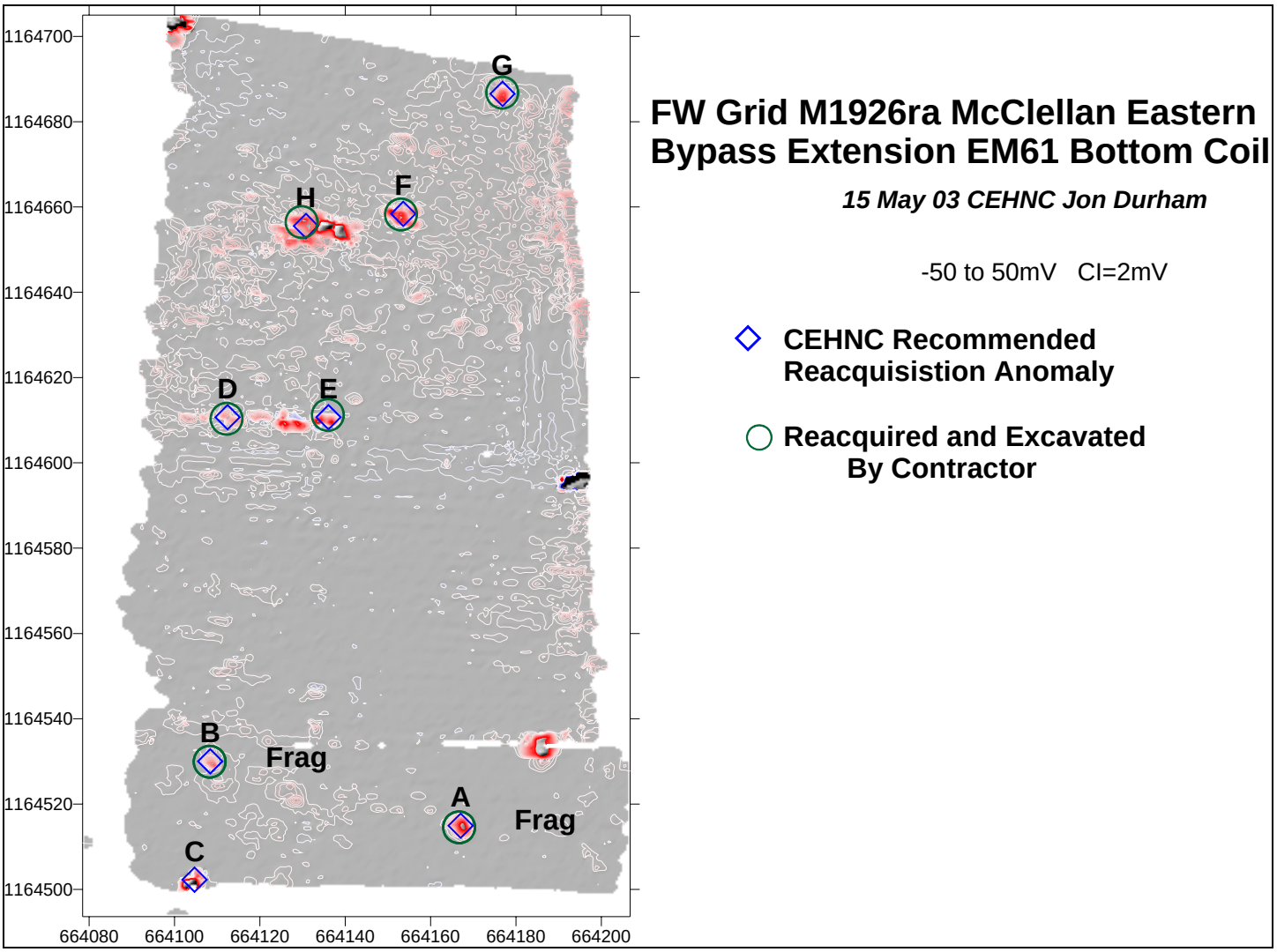


**Fig. 13**

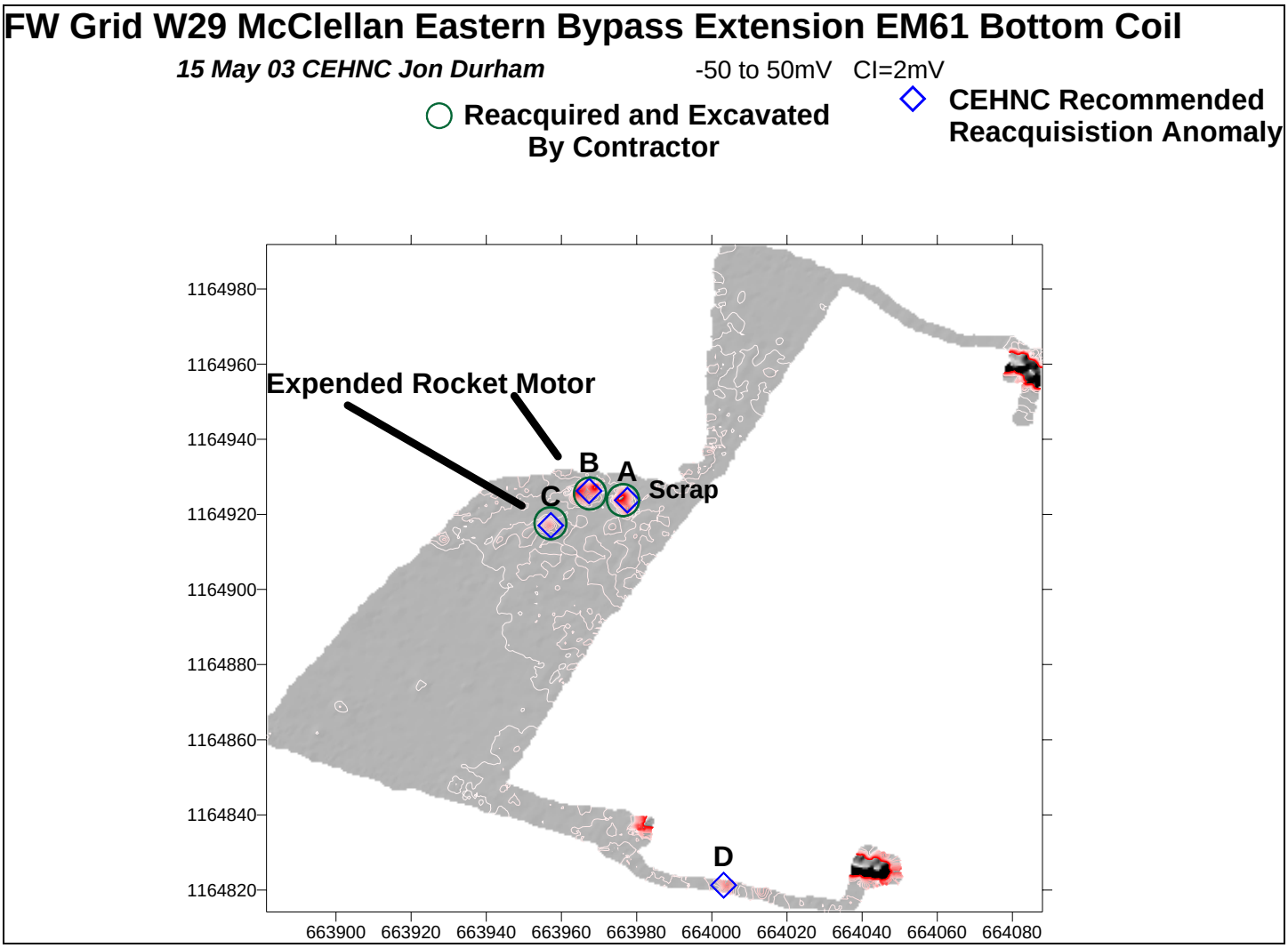
FW Grid W29 McClellan Eastern Bypass Extension EM61 Bottom Coil
15 May 03 CEHNC Jon Durham
-50 to 50mV CI=2mV
Reacquired and Excavated By Contractor
CEHNC Recommended Reacquisistion Anomaly
Expended Rocket Motor
A
B
C
D
Scrap
1164980
1164960
1164940
1164920
1164900
1164880
1164860
1164840
1164820
663900
663920
663940
663960
663980
664000
664020
664040
664060
664080

**Fig. 14.**

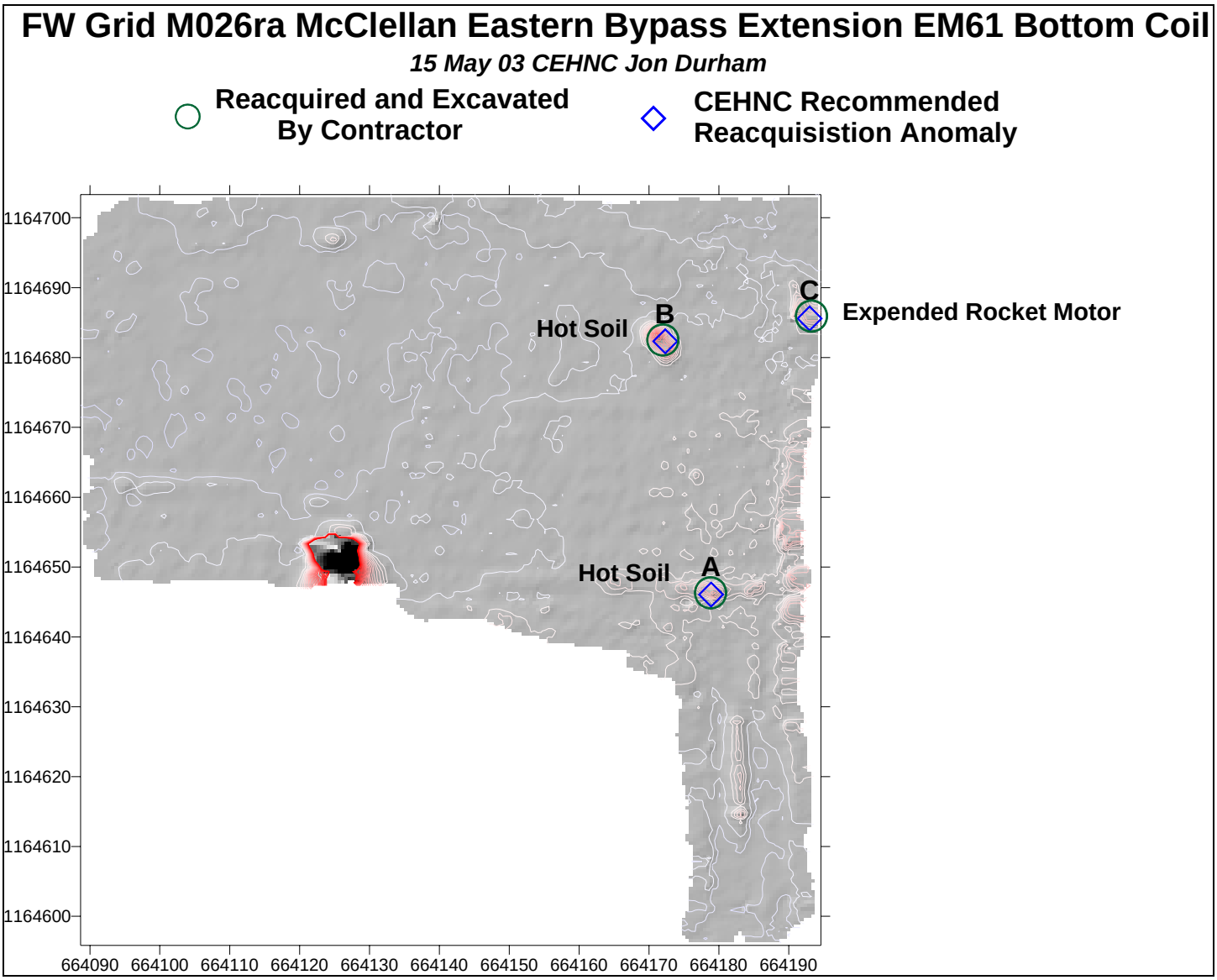


**Fig. 15**

A CEHNC Safety Specialist QQed 10 % of the grids in the Mechanical-Removal Area and found no OE.

Once again, the EM61 data that the Contractor collects is good. The Contractor has the tools and procedures in place to find anomalies of interest but for some reason has chosen not to intrusively investigate those anomalies

discussed above. The Contractor must refine his definition as to what constitutes a legitimate anomaly and also pay attention to obvious anomalies, even those that appear to be large cultural features.