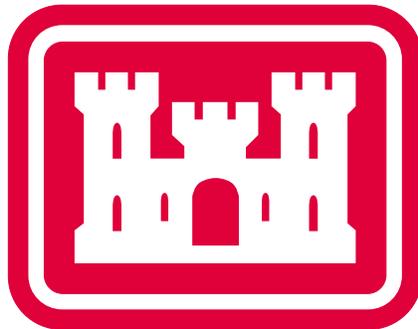


APPENDIX C

GEOPHYSICAL QUALITY ASSURANCE SUMMARY REPORT

Quality Assurance Audit Evaluation
on
Earth Tech Digital Geophysical Survey Results
Phase II Engineering Evaluation/Cost Analysis (EE/CA)
Former Waikoloa Maneuver Area and Nansay Sites
Island of Hawai'i, Hawai'i

19 September 2001



R.J. Selfridge
Chief Geophysical Engineer
CEHNC-ED-CS-G

TABLE OF CONTENTS

- 1.0 Executive Summary
- 2.0 Introduction
- 3.0 Quality Assurance Audit Elements
 - 3.1 Geophysical Prove-Out Results
 - 3.2 Government Field Oversight of Data Acquisition and Data Processing Operations
 - 3.3 Government Review of Digital Geophysical Data
 - 3.4 Survey Area Pre-Seeded Items
 - 3.5 Comparison of Excavation Results with Geophysical Data Results
- 4.0 Quality Assurance Audit Summary

PHOTOGRAPHS

- Photograph 1** Geophysical Prove-Out Site
- Photograph 2** EM-63 Background Survey
- Photograph 3** Government Pre-Seeded Inert Ordnance Items

APPENDICES

- A** Geophysical Maps of Select Government Processed Grids
- B** Government Blind Seed Items Recovered by Contractor

1.0 Executive Summary

A Government Quality Assurance (QA) Audit was performed on the Unexploded Ordnance (UXO) Geophysical Investigation Process for the Former Waikoloa Maneuver Area and Nansay Sites, Engineering Evaluation/Cost Analysis (EE/CA) Project. The project site is approximately 92,000 acres and is located on the northwestern portion of the Island of Hawai'i, Hawai'i. This report documents the specific processes used to ensure that the product delivered by the Contractor (Earth Tech, Inc.) meets the projects Data Quality Objectives as outlined in the Task Order. The Audit concentrated on the following five (5) major Quality Control Elements to verify acceptable contractor performance:

- 1) Acceptable geophysical prove-out results
- 2) Passed government field oversight inspection of data acquisition and data processing operations
- 3) Successfully passed government review of digital geophysical data
- 4) Successfully located all pre-seeded items within survey boundaries
- 5) Comparison of excavation results with geophysical data results was satisfactory

One initial problem identified in the reacquisition process for Sector 4 was remedied by utilizing data from the government blind-seeded items. Details on this error and corrective actions performed are summarized in Section 3.4. The QA blind seed items have been properly recovered in the grids approved for excavation for this project. The contractor was successful in meeting all of the government QA elements.

2.0 Introduction

The purpose of this Government QA Audit is to document the specific processes used and the results attained for the Waikoloa EE/CA 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 QA Inspection Audit provides a documentable process that effectively monitors the contractor's 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 contractors 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 five (5) major Quality Control Elements to verify acceptable contractor performance.

3.1 Geophysical Prove-Out Results

The test grid was located during the week of 15 November 2000 by the Huntsville Corps of Engineers and Earth Tech Senior Geophysicists. Background surveys were performed with several instruments including an EM-61, EM-63, and Gem-3 (Photograph 1 and Photograph 2).

Inert ordnance items were seeded at the site and data recollected. The data were evaluated and a decision reached that the EM-61 appeared to perform the best at this site for the expected target items. This demonstration grid was used as the Geophysical Prove-out for the work performed by the geophysical subcontractor (Zonge Engineering) to Earth Tech during the week of 24 January 2001. All seeded items were blind seeds to the Zonge Engineering Geophysical Team.

3.2 Government Field Oversight of Data Acquisition and Data Processing Operations

The Huntsville Corps of Engineers Chief Geophysical Engineer participated in the initial digital geophysical mapping readiness review and geophysical prove-out operations in November 2000. He was again present for field oversight during the initial field operations in January 2001. A partial listing of the items checked for and optimized during this oversight operation included:



Photograph 1 - Geophysical Prove-Out Site.



Photograph 2 - EM-63 Background Survey.

Safety

- Use buddy system
- Pre-sweep area for surface ordnance
- No stakes without safety inspection
- Obey exclusion and decontamination zone boundaries
- Use radios, but coordinate with geophysical data collection
- Wear boots with fiberglass rather than steel toe protection

EM

- Establish instrument nulling station (q.v.)
- Secure cable leads
- Sweep operator with detector to ensure surveyors are "metallic free"
- 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

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
- 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

Survey Grid

- Purpose: main survey grids to be cleared of target UXO
- 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

3.3 Government Review of Digital Geophysical Data

Geophysical data was regularly transmitted from the Earth Tech office to an FTP site that allowed convenient downloading by Corps of Engineers - Huntsville Center (CEHNC) personnel. 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 the contractors submitted dig lists. An example of the data reprocessed by the CEHNC geophysicists is located in Appendix A.

3.4 Survey Area Pre-Seeded Items

Several government blind seed items (Photograph 3) were buried in the proposed survey (Selfridge and Giffun, January 2001). Of the original grids seeded, not all were excavated at the time of this report. Several grids will be excavated during the future removal action.



Photograph 3 - Government Pre-Seeded Inert Ordnance Items (25 January 2001).

One initial problem was identified in the reacquisition process and remedied by utilizing data from the government blind-seeded items. A witness post was located within approximately ten (10) feet of the GPS base station monument in Sector 4. During the reacquisition process, the base station GPS was mistakenly placed on this witness post location instead of the monument. All reacquisition data was therefore offset by approximately 10 feet. When the dig locations were excavated, it was realized that no government seed items were recovered and review of the data and operations revealed the base station placement error. The GPS base station was set back up on the correct monument and the reacquisition process repeated for this sector. The QA blind seed items and other targets were then properly recovered. The four seeded items that were successfully recovered during this EE/CA are:

Waikoloa Seeded Test Items (Earth Tech/Zonge Engineering) 24 Jan 2001 - R.J. Selfridge/Mike Giffun

Seeded Item	ID	Sector	Grid	Location from corner (feet)				Depth (inches)	Located Yes/No
				SW	NE	SE	NW		
2.36-inch rocket motor & shrouded fin	ET_W01	12	12045	41	78.1	101.2	75.3	4	Yes
M73 dummy fuze	ET_W05	4	04006	103.6	37.8	80.9	76.2	4	Yes
3.5-inch rocket motor	ET_W08	4	04040	72.1	87.5	35.9	109	7.5 vertical	Yes
3-inch stokes mortar (no fuze)	ET_W09	12	12035	87.5	90.5	17.5	125	10	Yes

3.5 Comparison of Excavation Results with Geophysical Data Results

The first submittals of excavation results were met with skepticism by both the Earth Tech and CEHNC geophysicists. A high percentage of empty holes (false positives) and small excavated items when the data indicated much larger metallic items should have been discovered indicated a problem had developed in the Sector 4 area. Further investigation into this data discovered the GPS base station location error described in Section 3.4. After remediation of the positional error, the excavation results improved dramatically and within expectations. All government blind seeded items within the excavated grids have been recovered. Several government blind seed items have been left in the unexcavated grids as QA verification for the future removal action.

4.0 Quality Assurance Audit Summary

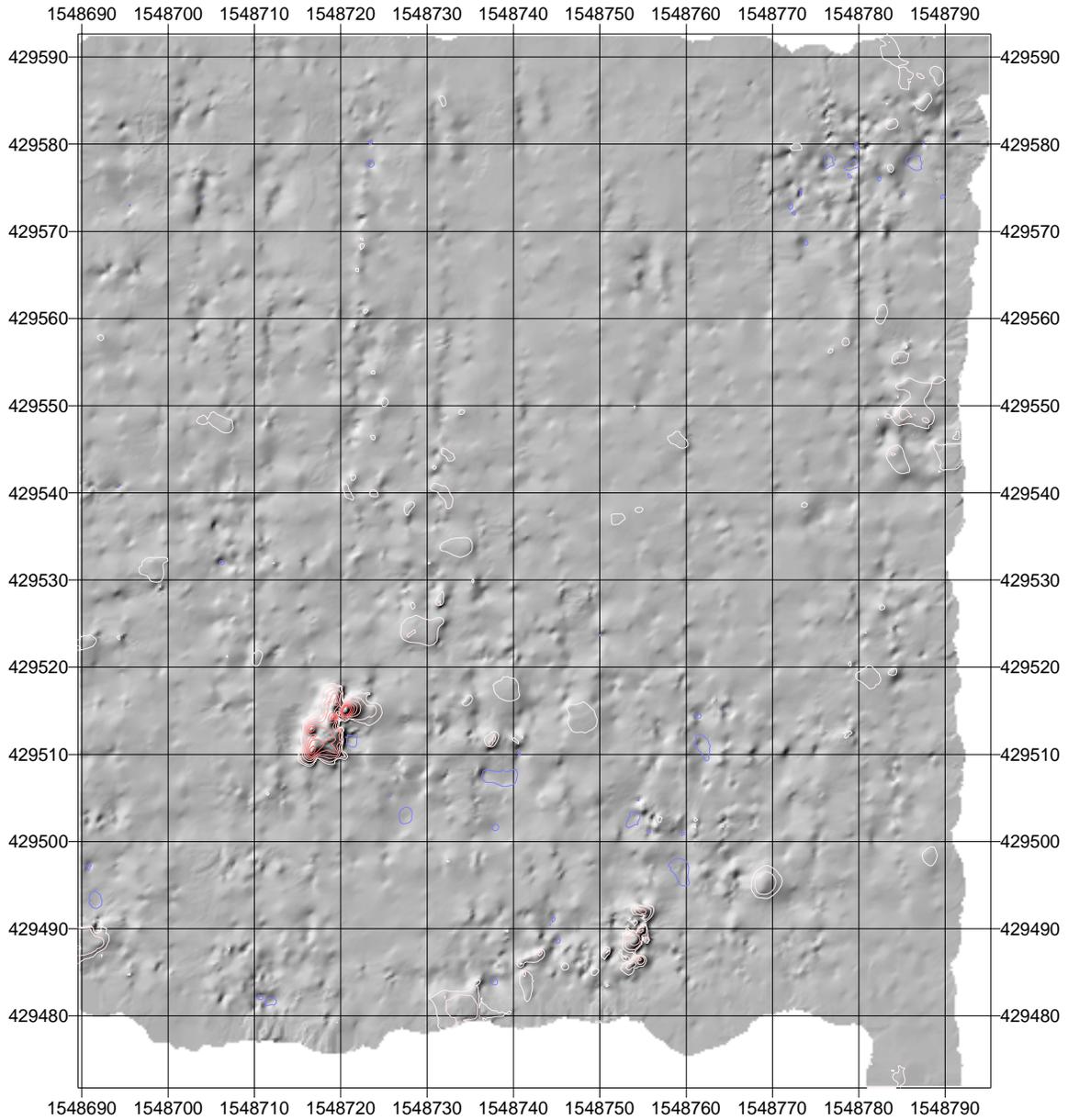
The contractor was successful in meeting all of the QA elements.

A lesson learned from this operation includes a simple navigation test before utilizing the DGPS system. Every day after completing setup of the GPS base station, positional measurements should be recorded with the rover GPS at two (2) locations within the survey area. The corrected survey coordinates should be compared with the established survey locations of these points and if not within position tolerances of the system (i.e., 20cm, 2cm, 1cm...dependant on equipment), identify and correct the problem before continuation of the survey. If an error occurs and is not immediately recognized, the data can be trans-rotated into the correct coordinate system utilizing the two known quality checkpoints in a post-processing operation.

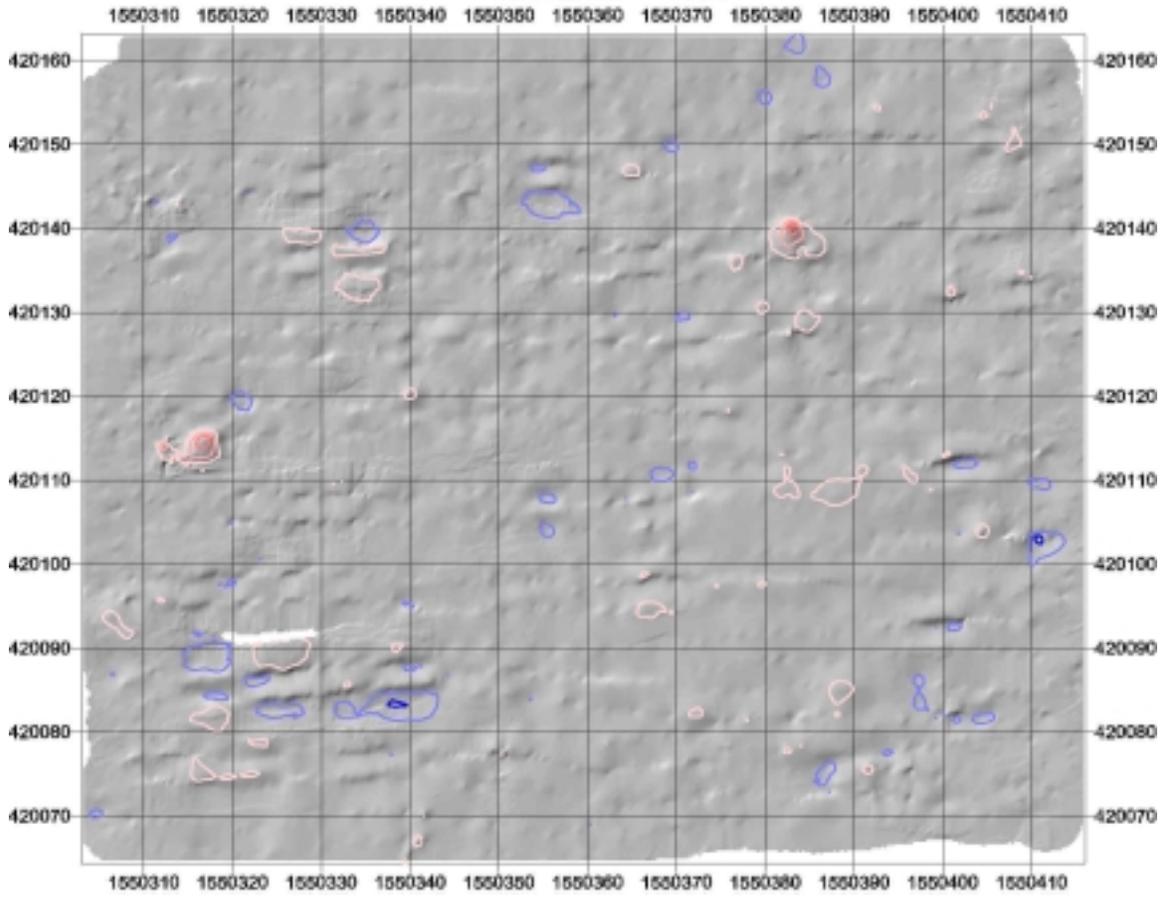
APPENDIX A

GEOPHYSICAL MAPS OF SELECT GOVERNMENT PROCESSED GRIDS

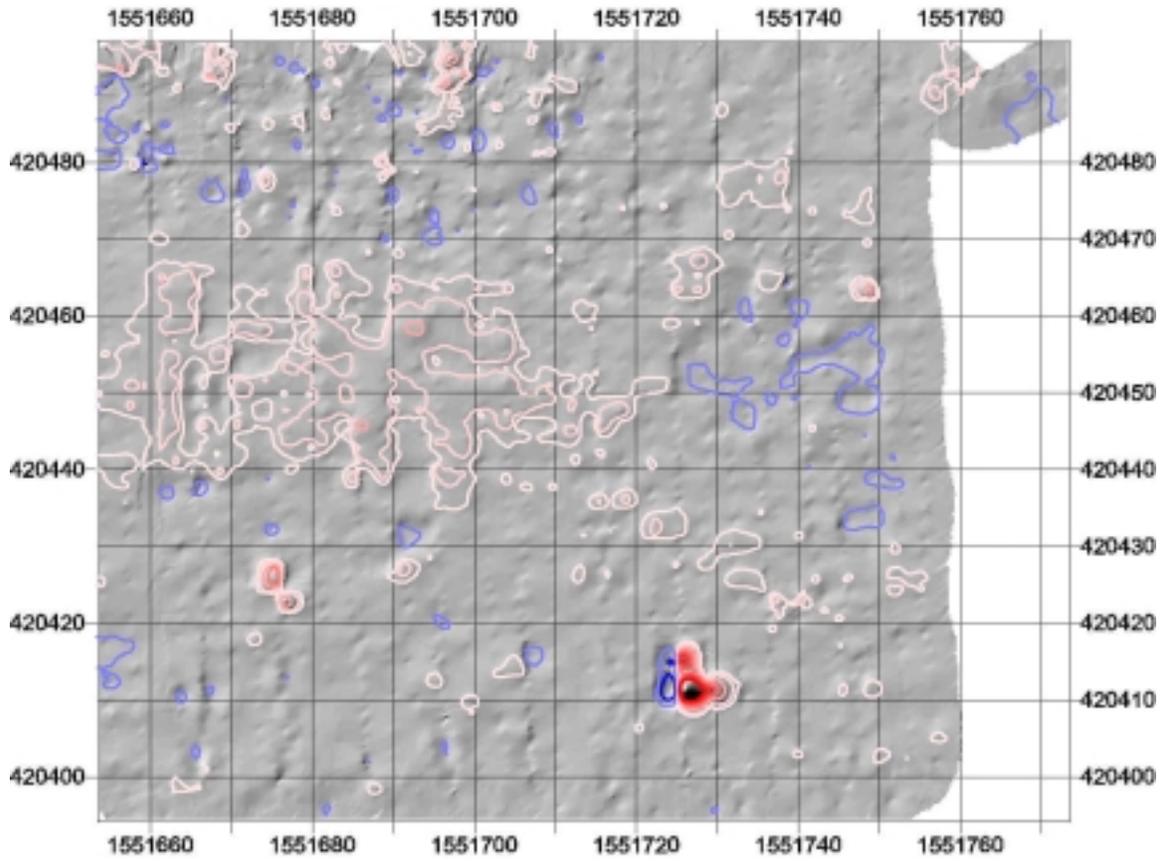
Sector 12 - Grid 12045



Sector 4 - Grid 04006



Sector 4 - Grid 04040



APPENDIX B

GOVERNMENT BLIND SEED ITEMS RECOVERED BY CONTRACTOR



U.S. Army Corps of Engineers
Engineering and Support Center
Huntsville, Alabama

Seed Item #: *ET_W09*

If found please contact: Bob Selfridge

Phone: (256) 895-1887

Fax: (256) 895-1602

Email: Bob.J.Selfridge@HND01.USACE.Army.Mil

This is an INERT piece of ordnance used for Contractor
Evaluation - No hazardous components!

*3.5" rocket motor
Sector 4 grid 04040*



U.S. Army Corps of Engineers
Engineering and Support Center
Huntsville, Alabama.

Seed Item #:

ET_W09

If found please contact: Bob Selfridge

Phone: (256) 895-1887

Fax: (256) 895-1602

Email: Bob.J.Selfridge@HND01.USACE.Army.Mil

This is an INERT piece of ordnance used for Contractor
Evaluation - No hazardous components!

*Stoke mortar
Sector 12 grid 12035*



U.S. Army Corps of Engineers
Engineering and Support Center
Huntsville, Alabama

Seed Item #: ET-W01

If found please contact: Bob Selfridge

Phone: (256) 895-1887

Fax: (256) 895-1602

Email: Bob.J.Selfridge@HND01.USACE.Army.Mil

This is an INERT piece of ordnance used for Contractor
Evaluation - No hazardous components!

*2.36" rocket motor
Sector 12 Grid 12045*



U.S. Army Corps of Engineers
Engineering and Support Center,
Huntsville, Alabama

Seed Item #: ET-W05

If found please contact: Bob Selfridge

Phone: (256) 895-1887

Fax: (256) 895-1602

Email: Bob.J.Selfridge@HND01.USACE.Army.Mil

This is an INERT piece of ordnance used for Contractor
Evaluation - No hazardous components!

*M73 fuse
Sector 4 Grid 04006*