

July 20, 2016
ECT No. 160299.0001/.0002

Mr. George Curtis
Director of Planning & Zoning
City of Live Oak
101 White Avenue, SE
Live Oak, FL 32064

**Re: Geophysical Survey Summary Report
The Palace Block Group
206 Haines Street N.E.
Live Oak, Florida 32064
City of Live Oak Brownfield Services
Cooperative Agreement No. BF-00D32015**

Dear Mr. Curtis:

Environmental Consulting & Technology, Inc. (ECT) is pleased to provide this Geophysical Survey Summary Report for the above referenced facility. Refer to **Figure 1** for a Site Location Map, **Figure 2** for a USGS Topographic Map, and **Figure 3** for an aerial photograph of the site circa 2013.

SCOPE OF WORK

These geophysical survey and support activities were conducted in accordance with Task Order 2016-07A issued on June 21, 2016.

Geophysical Survey

ECT utilized the services of GeoView to provide a geophysical surveying at the project Site. The purpose of the geophysical survey was to; 1) determine the possible presence and location of buried debris, objects, or structures at the project site; 2) locate any subsurface utilities prior to subsurface exploratory borings, and; 3) locate utilities proximate to proposed membrane-interface probe (MIP) borings. The geophysical investigation was conducted using time domain electromagnetics (TDEM) and ground penetrating radar (GPR) and an electronic pipe and cable locator. The geophysical survey was conducted between June 22 and June 24, 2016. A copy of the Geophysical Report is provided in **Attachment 1**. Refer to the attached report for a description of the geophysical survey and results.

3660 Maguire
Blvd., Suite 107
Orlando, FL
32803

(407) 903-0005

FAX
(407) 903-0030

Mr. George Curtis
City of Live Oak
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Representations

The geophysical results and findings are based upon the subjective evaluation of the collected data. They may not represent all conditions at the Site as they reflect the information gathered from specific locations. The geophysical survey was developed to provide the client with information regarding subsurface debris relating to the Site. It is limited to the conditions observed and to the information available at the time of the work.

Due to the limited nature of the work, there is a possibility that there may exist conditions which could not be identified within the scope of the survey. It is also possible that the testing methods employed at the time of the survey may later be superseded by other methods.

This report was prepared pursuant to the Professional Services Agreement between ECT and the City of Live Oak. Because of the importance of the communication between ECT and its client, reliance or any use of this report by anyone other than the City of Live Oak for whom it was prepared, is prohibited. Reliance or use by any such third party without explicit authorization in the report does not make said third party a third party beneficiary to ECT's agreement with the City of Live Oak. Any such unauthorized reliance on or use of this report, including any of its information or conclusions, will be at third party's risk. For the same reasons, no warranties or representations, expressed or implied in this report, are made to any such third party.

Closing

ECT appreciates the opportunity to continue working for the City of Live Oak and encourage you to contact the undersigned should you have any questions concerning the attached report.

Sincerely,

ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.



Jeffrey J. Peters, P.G.
Principal Scientist



Pamela J. McElroy
Senior Scientist

JP

FIGURES

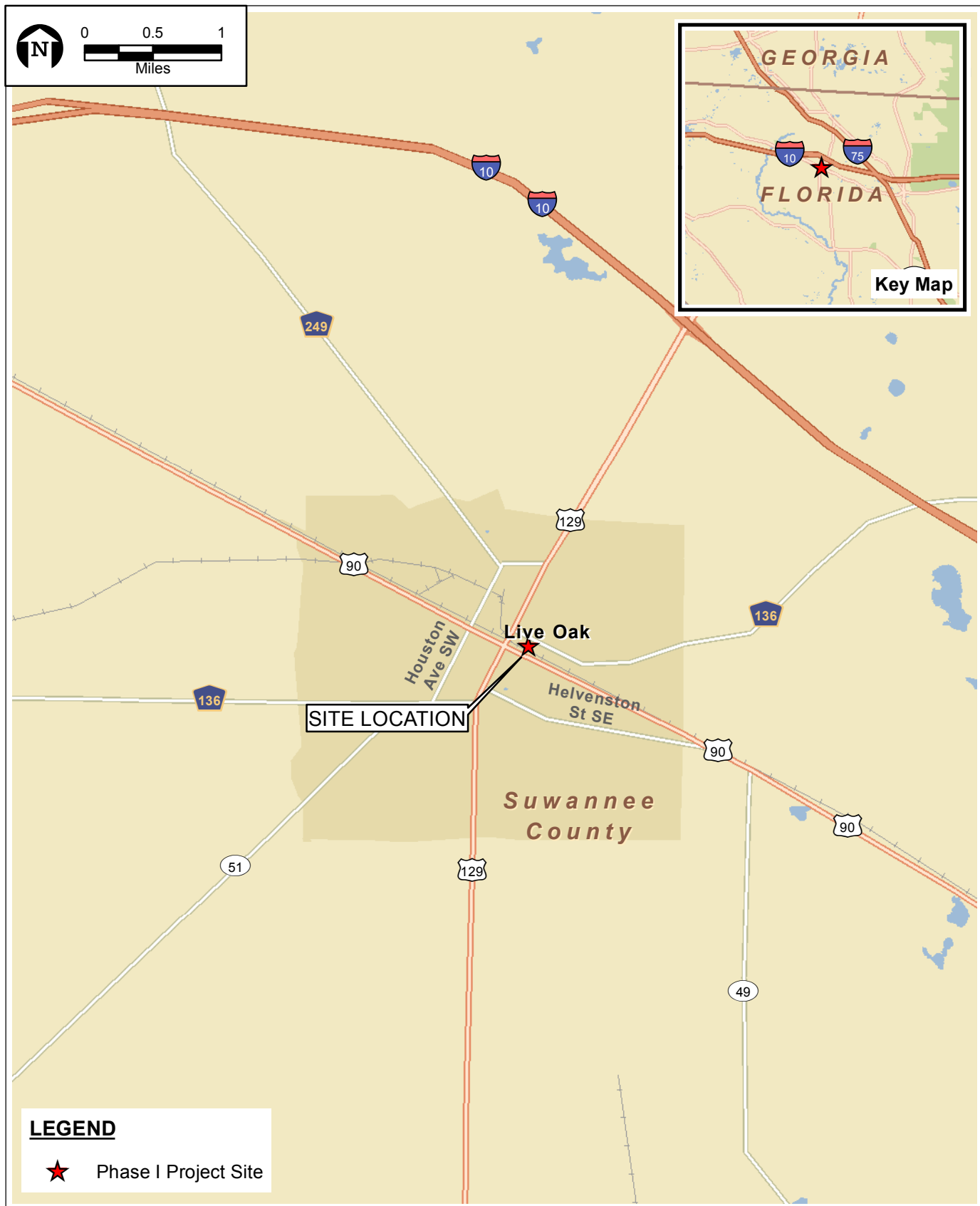


FIGURE 1.
LOCATION MAP
THE PALACE BLOCK GROUP
206 HAINES STREET NE, LIVE OAK, FLORIDA
Source: ESRI Street Map, 2016.



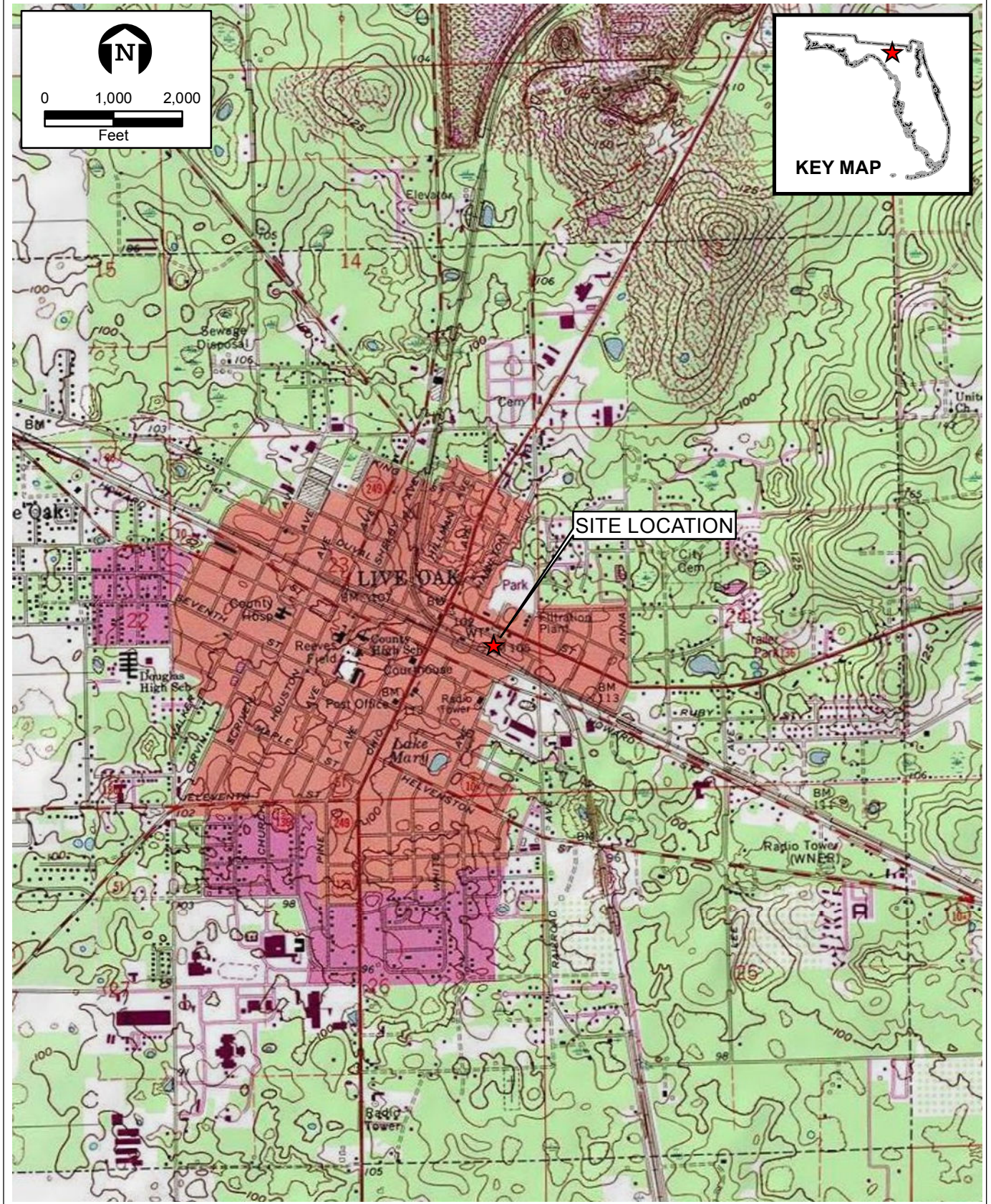


FIGURE 2.
USGS TOPOGRAPHIC MAP
THE PALACE BLOCK GROUP
206 HAINES STREET NE, LIVE OAK, FLORIDA

Source: USGS Quad: Live Oak East, 1993.





FIGURE 3.
 2013 AERIAL PHOTOGRAPH
 THE PALACE BLOCK GROUP
 206 HAINES STREET N.E., LIVE OAK, FLORIDA

Sources: USDA 2013 Imagery; ESRI StreetMap, 2015; ECT, 2016.



ATTACHMENT 1

**FINAL REPORT
GEOPHYSICAL INVESTIGATION
206 HAINES STREET NE SITE
LIVE OAK, FLORIDA**

Prepared for Environmental Consulting & Technology, Inc.
Orlando, Florida

Prepared by GeoView, Inc.
St. Petersburg, FL



June 30, 2016

Ms. Pamela J. McElroy
Environmental Consulting & Technology, Inc. (ECT)
3660 Maguire Blvd., Suite 107
Orlando, Florida 32803

**Subject: Transmittal of Final Report for Geophysical Investigation
206 Haines Street NE Site
Live Oak, Florida
GeoView Project Number 24022**

Dear Ms. McElroy,

GeoView, Inc. (GeoView) is pleased to submit the final report that summarizes and presents the results of the geophysical investigation performed at the above referenced site. Time domain electromagnetics and ground penetrating radar were used to help determine the presence of suspected underground storage tanks and buried debris that may be present within the project site. GeoView appreciates the opportunity to have assisted you on this project. If you have any questions or comments about the report, please contact us.

Sincerely,

GEOVIEW, INC.

Chris Taylor, P.G.
Vice President
Florida Professional Geologist Number 2256

A Geophysical Services Company

4610 Central Avenue
St. Petersburg, FL 33711

Tel.: (727) 209-2334
Fax: (727) 328-2477

1.0 Introduction

A geophysical investigation was conducted at 206 Haines Street NE in Live Oak, Florida. Of concern was the possible presence of suspected underground storage tanks (USTs) and buried debris that may be present within the survey areas. The geophysical investigation was conducted using time domain electromagnetics (TDEM) and ground penetrating radar (GPR). Mr. Merritt McLean and Mr. Wakefield Wade performed the investigation on June 22, 23 and 24, 2016.

2.0 Site Description

The site was approximately 1110 feet (ft) by 220 ft in plan size (Figure 1). The majority of this area was grass covered with some areas of dense vegetation. A former railyard was located near the northwest corner of the survey area. Objects of potential magnetic interference, which did influence the EM-61 instrument response, were located within the survey areas. These objects included bollards, metal plates, guy wires, surficial metallic debris, and reinforced concrete.

3.0 Description of Geophysical Investigation

The survey grids for the geophysical investigation were established along transect lines spaced 5 to 10 feet (ft) apart in both areas. A discussion of the limitations of the survey grid is provided in Appendix A2.1.

3.1 Time Domain Electromagnetic Survey

The TDEM survey was conducted using a Geonics EM61-MK2 Buried Metal Detector (EM-61). The EM-61 survey was conducted by towing the EM-61 throughout accessible areas of the project site. The EM-61 data was collected on transect lines spaced 5 ft apart and data readings were collected every 0.6 ft along each transect line. These readings were recorded using an Allegro hand held computer running Geonics DAT61 software. Recorded data is then contoured using Surfer Mapping software and presented in Figure 2.

The lateral sensitivity of the EM equipment to surficial metallic debris is usually 4 feet or less. In such areas, it is not possible to discriminate which portion of the instrument response is being caused by the surficial debris and which portion (if any) is being caused by buried metallic debris. Accordingly, it is usually not possible to determine if lesser quantities of buried metallic debris is present within 4 ft of areas where surficial metallic debris is present. A description of the EM-61 technique and the methods employed for buried debris studies is provided in Appendix A2.2.

3.2 Ground Penetrating Radar Survey

The GPR survey was conducted along perpendicular transects spaced 10 ft apart. The locations of the GPR transect lines are shown on Figure 1. The GPR data was collected using a Mala radar system with a 500-megahertz antenna. A time range setting of 70 nano-seconds was used. This time range setting provided information to an estimated depth of 4 to 7 ft below land surface (bls). A description of the GPR technique and the methods employed for buried debris studies is provided in Appendix A2.3.

4.0 Survey Results

A site map depicting GPR transect locations is shown in Figure 1. A color contour map of the EM-61 data is presented in Figures 2 and 3.

The geophysical investigation did not identify any suspected USTs. The survey did identify numerous areas of elevated EM response throughout the project site. While several of the areas were related to known above ground metallic features, the majority of the areas are suspected to be related to areas of suspected buried debris. These anomalies are highlighted with a blue dashed line on Figures 2 and 3. The elevated EM responses indicated that the possible debris was at least partially metallic in nature. GPR indicated that the majority of the suspected debris was at an approximate depth of 0 to 3 ft bls, with some areas extending to depths of 5 to 6 ft bls. The GPR did not identify any suspected basements or complete foundations within the possible debris. Several sections of suspected utilities were also identified within the survey area. The locations of these utilities are shown with magenta lines on Figure 1.

An example of the GPR data collected over an area of suspected debris is shown in Appendix 1. A discussion of the limitations of the geophysical methods used in this investigation is provided in Appendix 2.

APPENDIX 1
FIGURES AND EXAMPLE OF GPR ANOMALIES



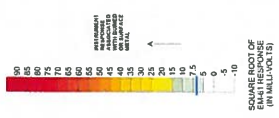
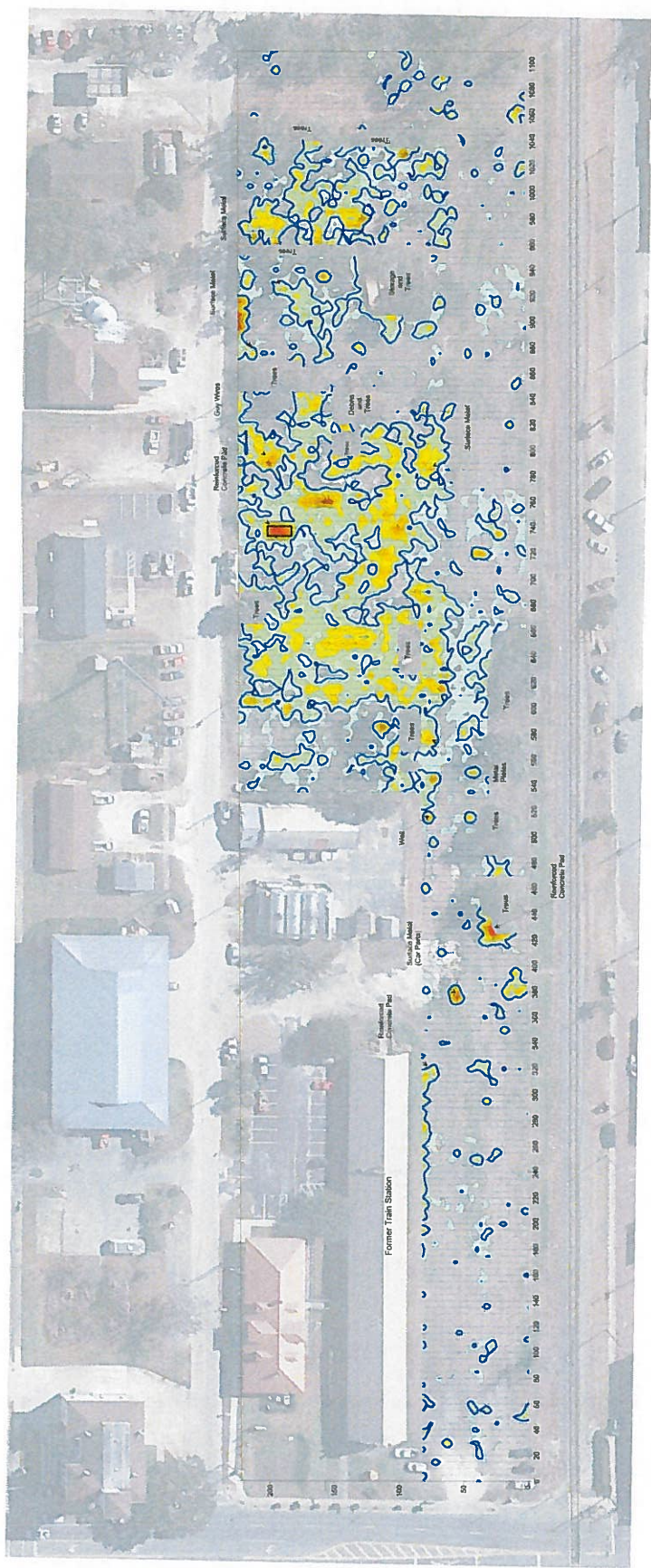
EXPLANATION
 ——— PATH OF GPR TRANSECT LINES
 - - - - - LOCATION OF SUSPECTED UNDERGROUND UTILITY



FIGURE 1
SITE MAP
 SHOWING LOCATION
 OF GEOPHYSICAL
 INVESTIGATION

206 HARNISH STREET NE
 LIVE OAK, FLORIDA
 ENVIRONMENTAL CONSULTING &
 TECHNOLOGY, INC.
 ORLANDO, FLORIDA

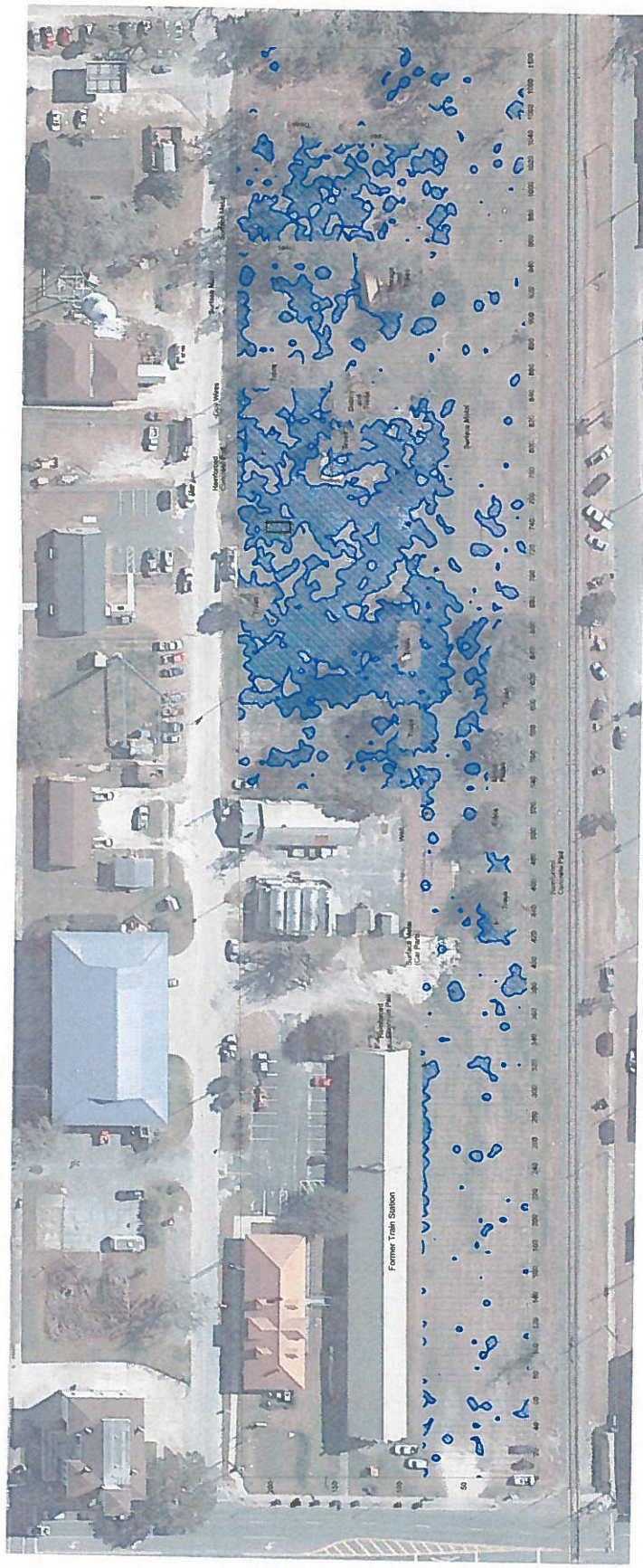
PROJECT:
 DATE:
 DRAWN BY:



EXPLANATION
 CONTOUR OF EM-41 RESPONSE
 (MVA/VOLTS)
 TRENCH STATIONS
 BOUNDARY OF AREA OF SUSPECTED BURIED METALLIC DEBRIS

NORTH
 SCALE: 1" = 40'
 0 20 40 60 80 100 120 140 160 180 200

	<p>FIGURE 2 COLOUR CONTOUR MAP OF EM-41 RESPONSE</p>	<p>208 HANNES STREET NE SITE LIVE OAK, FLORIDA ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC. ORLANDO, FLORIDA</p>
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EXPLANATION
CONTOUR OF EM481 RESPONSE
(IN MILLIGAUSS)
TERRAIN DATA STATIONS
AREA OF SUSPECTED BURIED AND SURFICIAL METALLIC DEBRIS



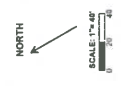
FIGURE 3

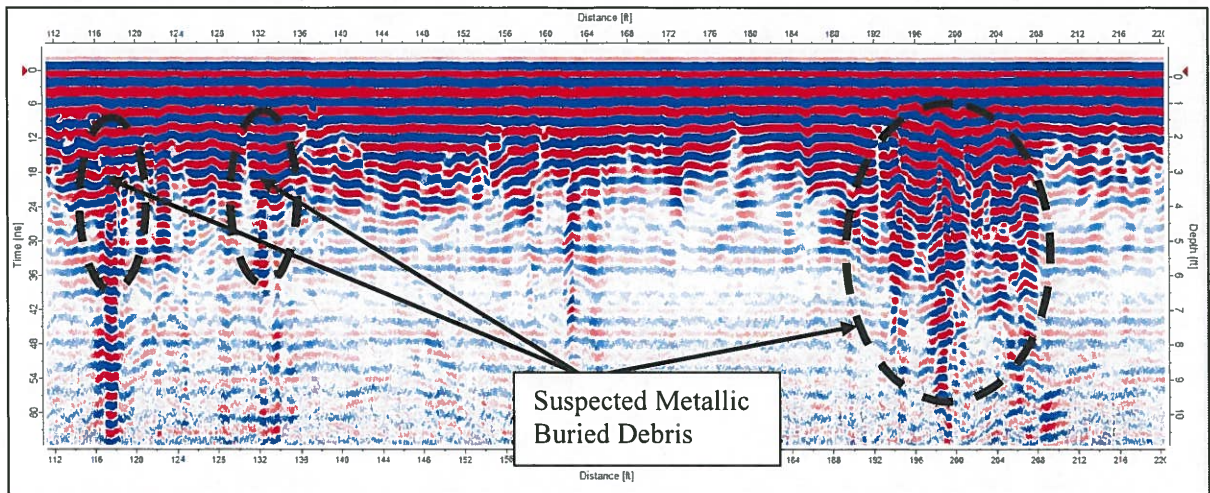
COLOR CONTOUR MAP OF
EM481 RESPONSE WITH AERIAL

286 HANES STREET NE SITE
LIVE OAK, FLORIDA

PROJECT:
DATE:
DATE:
DATE:

ENVIRONMENTAL CONSULTING
& TECHNOLOGY, INC.
ORLANDO, FLORIDA





GPR TRANSECT SHOWING AN AREA OF SUSPECTED METALLIC BURIED DEBRIS

APPENDIX 2

DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

A2.1 On Site Measurements

The measurements that were collected and used to create the site map were made using a fiberglass measuring tape. Right angles were estimated using the exterior walls of adjacent buildings or other features. The degree of accuracy of such an approach is typically +/- 5% for lengths and +/- 2.5 degrees for angles.

A2.2 Time Domain Electromagnetics

The TDEM (EM-61) method evaluates the magnitude of an induced (secondary) electromagnetic (EM) field caused by a primary EM field after that primary field is suddenly shut off.

During a TDEM (EM-61) sounding, an electrical current is caused to flow in a horizontal transmitter coil located near the ground. The current is maintained until a static magnetic field is established. The current in that coil is then rapidly terminated. This produces a strong electromotive force that induces eddy (secondary) currents in the ground. The eddy currents are caused by the presence of subsurface conductors. With increasing time, the strength of the eddy currents diminishes. The eddy currents, when they are still present induce a voltage in the receiver coil that is proportional to eddy current strength. The eddy current strength also depends on the amount of metal in the subsurface. The more metal present, the longer the eddy currents persist. Field measurement consists of reading the output voltage from the receiver coil registered at a particular time after field shut-off. If no metal is present near the coil, then there are no eddy currents at a late time and the reading is near zero. If metal is present near the coil, then the eddy currents persist for a longer time, and the reading is some positive number. By sensing only the response from the buried metal, the method is capable of detecting targets in highly conductive environments. For TDEM surveys the Geonics Ltd. Model EM-61 metal detection (EM-61) system is used. The EM-61 instrument response is recorded on field-portable computerized data logger (Juniper Allegro, Digital Data Logger) for subsequent data processing and contouring.

The EM-61 survey is performed along predetermined transect lines. The transect lines are typically uni-directional and oriented parallel to the long axis of the site. The spacing between transects ranges from 2 to 20 ft, depending upon the

desired size of the target to be identified. Approach is typically +/-5% for both lengths and angles in degrees.

A2.3 Ground Penetrating Radar

Ground Penetrating Radar (GPR) consists of a set of integrated electronic components, which transmits high frequency (200 to 1500 megahertz [MHz]) electromagnetic waves into the ground and records the energy reflected back to the ground surface. The GPR system consists of an antenna, which serves as both a transmitter and receiver, and a profiling recorder that both processes the incoming signal and provides a graphic display of the data. The GPR data can be reviewed as both printed hard copy output or recorded on the profiling recorder's hard drive for later review. GeoView uses a Mala GPR system.

A GPR survey provides a graphic cross-sectional view of subsurface conditions. This cross-sectional view is created from the reflections of repetitive short-duration electromagnetic (EM) waves that are generated as the antenna is pulled across the ground surface. The reflections occur at the subsurface contacts between materials with differing electrical properties. The electrical property contrast that causes the reflections is the dielectric permittivity that is directly related to conductivity of a material. The GPR method is commonly used to identify such targets as underground utilities, underground storage tanks or drums, buried debris, voids, rebar or geological features.

The greater the electrical contrast between the surrounding materials (earth or concrete) and target of interest, the greater the amplitude of the reflected return signal. Unless the buried object is metal, only part of the signal energy will be reflected back to the antenna with the remaining portion of the signal continuing to propagate downward to be reflected by deeper features. If there is little or no electrical contrast between the target interest and surrounding earth materials it will be very difficult if not impossible to identify the object using GPR.

A GPR survey is conducted along survey lines (transects) that are measured paths along which the GPR antenna is moved. An integrated survey wheel electronically records the distance of the GPR system along the transect lines.

Depth estimates to the top of the debris is determined by dividing the time of travel of the GPR signal from the land surface to the top of the GPR signal reflection associated with the debris by the velocity of the GPR signal. The velocity of the GPR signal is usually obtained from published tables of the GPR signal traveling through unsaturated soils (4 to 6 nano-seconds per foot two-way travel time). The accuracy of GPR-derived depths typically ranges from 20 to 40

percent of the total depth.

The analysis and collection of GPR data is both a technical and interpretative skill. The technical aspects of the work are learned from both training and experience. Interpretative skills for debris studies are developed by having the opportunity to compare GPR data collected in numerous settings to the results from confirmatory studies performed at the same locations.

The ability of GPR to collect interpretable information at a project site is limited by the attenuation (absorption) of the GPR signal within subsurface soil materials. Once the GPR signal has been attenuated at a particular depth, information regarding deeper features will not be obtained. GeoView can make no warranties or representations of geological conditions that may be present beyond the depth of investigation or resolving capability of the GPR equipment or in areas that were not accessible to the geophysical investigation.

GeoView can make no warranties or representations of the conditions that may be present beyond the depth of investigation or resolving capability of the TDEM or GPR equipment or in areas that were not accessible to the geophysical investigation.