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GEOTECHNICAL CONSULTING SERVICES – DESKTOP ASSESSMENT

COAL COMBUSTION RESIDUAL (CCR) LANDFILL AND IMPOUNDMENT EVALUATION
DEERHAVEN GENERATING STATION (DGS)
10001 NW 13th STREET
GAINESVILLE, ALACHUA COUNTY, FLORIDA

PROJECT NO. 0230.1500077
REPORT NO. 1302057v2

Prepared For:

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January 18, 2016
Revised: April 22, 2016

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January 18, 2016
Revised: April 22, 2016

Innovative Waste Consulting Services, LLC
6628 NW 9th Boulevard, Suite 3
Gainesville, FL 32608

Attention: Dr. Pradeep Jain, PhD., P.E.

Reference: **Report of Geotechnical Consulting Services – Desktop Assessment**
Deerhaven Generating Station
CCR Landfill and Impoundment Evaluation
10001 NW 13th Street
Gainesville, Alachua County, Florida
UES Project No. 0230.1500077
UES Report No. 1302057v2

Dear Dr. Jain:

Universal Engineering Sciences, Inc. (UES) has completed the geotechnical engineering services for the subject project in Gainesville, Alachua County, Florida. This geotechnical Report is submitted in satisfaction of the contracted scope of services as summarized in UES Proposal No. 1278053v2, dated December 16, 2015.

The following report presents the results of our Geotechnical and Geophysical Exploration, for the coal combustion residual (CCR) landfill and four process water ponds at the Deerhaven Generating Station. This plan was prepared under the supervision, direction and control of the undersigned registered professional engineer (PE). The undersigned PE is familiar with the requirements of 40 CFR 257.61, 40 CFR 257.62, 40 CFR 257.63, and 40 CFR 257.64. The location restriction demonstrations presented in this report with respect to wetlands, fault areas, and unstable areas meet the requirements of 40 CFR 257.61, 40 CFR 257.62, 40 CFR 257.63, and 40 CFR 257.64, respectively.

We appreciate the opportunity to have worked with you on this project and look forward to a continued association. Please contact us if you have any questions, or if we may further assist you as your plans proceed.

Sincerely,

UNIVERSAL ENGINEERING SCIENCES, INC.
Certificate of Authorization Number 549

Digitally signed by Eduardo Suarez
Date: 2016.05.05 09:55:18 -04'00'

Reviewed by:

FOR

Eduardo Suarez, P.E.
Senior Geotechnical Engineer
Florida P.E. No. 60272
Date:

Jeffrey S. Pruett, P.E.
Vice President
Florida P.E. No. 50775

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EXECUTIVE SUMMARY

We have prepared this executive summary as a general overview. Please refer to, and rely on, the full report for information about findings, recommendations, and other considerations.

The Deerhaven Generating Station is located in Gainesville, Alachua County, Florida. The Deerhaven process water ponds include a coal combustion residual (CCR) surface impoundment system (i.e., Ash Cell #1, Ash Cell #2) and two pump back ponds (i.e., Pump Back Cell #1, Pump Back Cell #2). Also of interest is the CCR landfill located west of the process ponds.

The purpose of these geotechnical consulting services was:

1. Determine the proximity of the CCR surface impoundment system to wetland areas, meeting the requirements of 40 CFR 257.61,
2. Based on previous geotechnical exploration, determine if the CCR surface impoundment system is located within 200 feet (60 meters) of the outermost damage zone of a fault that has had displacement in Holocene time. This analysis meets the requirements of 40 CFR 257.62,
3. Based on previous geotechnical exploration, determine if the CCR surface impoundment system is located within a Seismic Impact Zone. This analysis meets the requirements of 40 CFR 257.63,
4. Perform a geophysical survey to determine if the landfill and process ponds are located within unstable areas, including susceptibility to natural or manmade causes, karst activity, and other activities that could compromise the structural integrity. This analysis meets the requirements of 40 CFR 257.64,

Based on published information and our review of Florida's geologic history, the Alachua County Soil Survey geology subsection, and the USGS Quaternary Fault Map, there is not a fault damage zone located within 200 feet of the CCR surface impoundment system or the CCR landfill.

Based on the wetlands delineation reference material from Mapwise (2008) and the ERC report, the existing CCR landfill and CCR surface impoundment system are not located in a wetlands area and do not encroach upon existing wetlands.

Based on the karst analysis (review of published information), geophysical survey, and desktop assessment, it is our professional opinion that the existing CCR landfill and the CCR surface impoundment system are not located in unstable areas.

1.0 INTRODUCTION

Universal Engineering Sciences, Inc. (UES) has completed an evaluation, for the CCR landfill and process ponds at the Deerhaven Generating Station (DGS) in Gainesville, Alachua County, Florida.

2.0 PROJECT CONSIDERATIONS

The subject site is located within Sections 26 and 27, Township 8 South, Range 19 East in Gainesville, Alachua County, Florida. The Deerhaven Generating Station (DGS) is located approximately 1.25 miles north of NW 43rd Street along the north side of US HWY 441, in Gainesville, Alachua County, Florida. More specifically, the property is an approximately 930-acre parcel of land located at 10001 NW 13th Street in Gainesville, Alachua County, Florida.

The process ponds are situated just northwest of the generating facility. The process ponds are connected to the main plant by roadways that support asphalt/limerock base access roads. The area of the four process ponds studied in this analysis is approximately 8.5 acres and the ponds are located in close proximity to wooded areas. Moderately dense wooded areas surround much of the Deerhaven Generating Station (DGS). There are some stormwater management areas/swales on the south side of the process pond area.

The CCR landfill is located west of the process ponds, also connected by access roads. The landfill is approximately 22 acres in area and adjacent to wooded areas. The landfill also has stormwater drainage swales along the western and southern faces of the landfill.

If any of the above information is incorrect or changes, please contact UES immediately so that revisions to the recommendations contained in this report can be made, as necessary.

3.0 PURPOSE AND SCOPE OF SERVICES

3.1 Purpose

The purposes of this exploration were:

- Based on current information determine if the surface impoundment system is located in wetland areas, meeting the requirements of 40 CFR 257.61,

- Based on published geological information and previous geotechnical exploration, determine if the surface impoundment system is located within 200 feet (60 meters) of a fault that has had displacement in Holocene time, meeting the requirements of 40 CFR 257.62,

- Perform a geophysical survey to determine if the landfill or surface impoundment system are located within unstable areas, including susceptibility to natural or manmade causes, karst activity, and other activities that could compromise the structural integrity, meeting the requirements of 40 CFR 257.64,

3.2 Scope of Service

A compilation of the services conducted by UES to date for the CCR landfill and process ponds at the existing Deerhaven Generating Station (DGS) in Alachua County, Florida are as follows:

- Review research and prior documents/reports to determine the existence of fault damage zones within 200 feet of the existing surface impoundment system and landfill areas.

- Review research and prior reports to determine the existence of wetlands within the project site.

- Perform a geophysical survey to determine if the existing landfill and process ponds are located in unstable areas.

- Review the geophysical report and additional material to determine the susceptibility to karst activity.

4.0 FAULTS/GEOLOGY

4.1 Geologic Features

4.1.1 Geologic History

Florida's earliest geologic roots can be traced back to the Paleozoic Era (540 – 251 million years ago (mya)). Rocks from this age were extracted at depths of thousands of feet, and contain igneous and metamorphic rocks below sandstone and shale strata. As the Laurentian and Gondwanan landmasses converged to form Pangaea, carbonate (limestone) materials began to accumulate to create the Florida Platform. The limestone formed as a result of millions of dead marine organisms that sank to the ocean floor. This occurred during the Mesozoic Era (251 – 65.5 mya) as the supercontinent of Pangaea diverged and the continents of Africa, North America, and South America took shape.

Florida rests upon part of the African tectonic plate, and was submerged in a warm, shallow ocean before the limestone formation occurred. Florida slowly took its current shape during the Cenozoic Era (65.5 mya – present). The state was still covered by warm, tropical oceans until the Late Oligocene Epoch (28.4 – 23 mya). A combination of whales, small creatures called foraminifera, and small patch reefs created Florida's limestone strata during a marine current that scoured the sea floor and eroded some of the coastline adjacent to Florida.

As the Oligocene Epoch ended, sea levels dropped and Florida began to emerge. The first terrestrial fossils consist of bats, horses and carnivores. Following this event, some of Florida would remain above sea level, and the primary formation would result from land and ocean interactions. As the Oligocene paved way to the Miocene Epoch (23 – 5.3 mya), the Appalachian Mountain began to form, and erosion increased. This erosion transported siliclastic sediments, which contain a significant portion of phosphates, southward towards Florida to overlay its carbonate features.

Following the Miocene, the Pliocene Epoch (5.3 – 2.6 mya) connected North America to South America and sea levels fluctuated. This led to an event called the Great American Interchange, which allowed the exchange of plant and animal life between continents. As a result, southwest Florida accumulated additional deposits from mollusks. The Pleistocene Epoch (2.6 mya – 10,000 years ago) was a time of great climate and sea-level change. During warmer periods and higher sea levels, additional marine limestone accumulated along Florida. During the colder periods and lower sea levels, limestone dissolved and ice age mammals roamed Florida. At the end of the Pleistocene, these mammals became extinct from climate change, human hunting, or both, and their deposits led to additional formation of Florida.

Following the Pleistocene Epoch, the sea level began to reach its current elevation during the Holocene Epoch (10,000 years – present). During this period, human populations expanded, thick layers of muck were deposited in the Everglades, new coral reefs formed and the Keys became islands (Means).

4.1.2 Alachua County Geology

Alachua County is part of the Central Florida Ridge or Central Highlands of the Atlantic Coast Plains. It consists of four major geologic formations around the surface. These formations are: the Ocala Group (the oldest), Hawthorne Formation, Alachua Formation, and the Plio-Pleistocene Terrace Deposits (the youngest). The GRU Deerhaven Plant impoundments are located within Plio-Pleistocene Terrace Deposits and Hawthorne Formation areas. The Hawthorne Formation mainly consists of hills and valleys with a thin cover of quartz sands and Plio-Pleistocene Deposits. It also contains clays, carbonates, pebbles, and phosphate grains overlying an irregularly-shaped Ocala Group. Thickness of the Hawthorne Formation can range from a few feet near the surface overlying the Ocala Group, west of Gainesville, to over 200 feet in northeast Alachua County. Color may vary from green to yellow and gray to blue. The Plio-Pleistocene stratum consists of sand, silt and clay that were deposited during the sea level of that time. This formation consists mostly of sand and clay, and may vary by composition depending on location. The sand is usually light in color, and grades to a darker clayey sand at greater depths. These soils can vary in thickness from 20 to 45 feet, north of Gainesville. The clay within this formation is typically mottled, red, gray and yellow with a thickness range of 5 to 12 feet (Thomas, 1985).

4.1.3 Fault Zones

According to the USGS Quaternary Fault Map, there are not any faults or fault damage zones located within 200 feet of the impoundments. Further, the only fault located in Florida is the Gulf-margin normal fault, Alabama-Florida (Class B). This fault extends just east of Pensacola. This fault is listed as Class B because this zone consists of sediments in poorly-lithified rocks, and is not likely to be able to support the stresses required to cause considerable ground movement (Crone, 2000).

A USGS Quaternary map shows fault zone maps providing information on faults and associated folds within the continental US, the southeastern US and north Florida. Fault zone maps are included in **Appendix A**.

4.2 Conclusion

Based on published information and our review of Florida's geologic history, the Alachua County Soil Survey geology subsection, and the USGS Quaternary Fault Map, there are not fault or fault damage zones located within 200 feet of the surface impoundment system and landfill areas.

5.0 WETLANDS DISCUSSION

5.1 Wetland Delineation

5.1.1 Structural Descriptions

The landfill and surface impoundment system at the GRU Deerhaven Generating Station are both man-made structures that are raised above natural grades, and consist of selected structural fill. The CCR landfill is located west of the impoundment ponds, and receives bottom ash from CCR surface impoundment system pond dredging activities, flue gas desulfurization byproduct, and occasional loads of fly ash. The process ponds are divided into four hydraulically connected cells: Ash Cell #1, Ash Cell #2, and Pump Back Cells #1 and #2. Ash Cells #1 and #2 discharge decant water to Pump Back Cells #1 and #2, respectively, which then returns water back to the plant for onsite treatment or directly for reuse.

In Florida, wetlands are defined as areas that are inundated or saturated by surface water, and support vegetation that is capable of growing in saturated soils. They are typically considered hydric or alluvial, and may be associated with reducing soil conditions.

Both CCR units (i.e., the landfill and surface impoundment system) were designed to mitigate seepage and subsequent slope failure and are located within the developed area of the generating plant; therefore, neither the landfill nor the surface impoundment system are encroaching upon (nominated) wetlands.

A wetland map of the combined Deerhaven and annexation parcel is shown in Figure 31 of the Deerhaven ERC Report (ERC, 2014, pp. 44). A copy of this figure is included in Appendix B. Additional maps regarding wetlands can be found in ‘MapWise – Wetland Maps,’ and are included in **Appendix B**.

5.2 Conclusion

Based on the wetlands delineation reference material from Mapwise (2008) and the ERC report, the existing CCR landfill and surface impoundment system are not located in a wetlands area and do not encroach upon existing wetlands.

6.0 KARST ACTIVITY/UNSTABLE AREAS

6.1 Desktop Karst Analysis

Our “desktop” assessment of the presence of karst features included a review of available data from the United States Geological Survey (USGS) and Florida Geological Survey (FGS), and current topography survey. The FGS maintains an inventory of reported sinkholes as a continuation of the work originally performed by the Florida Sinkhole Research Institute. This sinkhole database is generally considered to be a record of more recent sinkholes, and does not incorporate older and more mature karst features such as large lakes. The FGS database is not a definitive or authoritative resource, and should only be used for a generalized overview of the locations/frequency of more recent sinkholes (FGS 2014). Our assessment included a search of the FGS database for sinkholes within a 3 mile radius of the subject site. There was one sinkhole reported within 3 miles northwest of the subject site, in the direction of La Crosse (Florida Geological Survey). We note that the FGS data base only contains more recently recorded sinkhole events. A Google map presenting the FGS recorded subsidence locations local to the subject property is presented in **Appendix C**. The USGS Quadrangle Map, Florida

Geological Survey, and current Topography Survey did not detect presence of surface karst features within the project site.

6.2 Geophysical Survey

The subsurface conditions around the impoundment and landfill areas were surveyed with geophysical methods in order to identify possible anomalies associated with karst conditions. The geophysical survey was performed by Geoview, Inc. Ground Penetration Radar (GPR) method was employed in an attempt to detect and identify subsurface anomalous features.

One GPR anomaly area was identified within the surveyed area. The anomaly was semi-elliptical in shape, with an approximate area of 3,960 square feet below land surface (bls). The anomaly encountered well-defined, relatively continuous sets of GPR reflectors at an approximate depth range of 2 to 5 feet bls and a partially imaged set of GPR reflectors at an approximate depth range of 12 to 18 feet bls. The GPR reflector sets are most likely associated with lithological changes at those depths. It is noted that no disruption of the sediments overlying the downwarped GPR reflectors was observed. This suggests that the GPR anomaly is likely associated with relic depositional or erosion activity, rather than possible karst activity. A more detailed description of the geophysical methods and findings is included in the Geophysical survey report. A copy of the geophysical survey report is included in **Appendix C**.

6.3 Conclusion

Based on the karst analysis (review of published information), geophysical survey, and desktop assessment, it is our professional opinion that the existing CCR landfill and the CCR surface impoundment system are not located in unstable areas.

7.0 SEISMIC IMPACT ZONES

UES previously performed a geotechnical exploration at this project site and presented our findings in our *Report of Geotechnical Consulting Services*, Report No. 1251804, dated November 20, 2015. As described in previous report "*Seismic Impact zones means an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years. Based on the USGS Hazards map included in the aforementioned report, the maximum expected horizontal acceleration in the impoundments is less than 0.02 g. Therefore the site is not considered to be located in a seismic impact zone*". This analysis meets the requirements of 40 CFR 257.63. Please refer to the above mentioned report for further information.

8.0 LIMITATIONS

This report has been prepared for the exclusive use of Innovative Waste Consulting Services, LLC, and Gainesville Regional Utilities (GRU). The scope is limited to the specific project and locations described herein. Our description of the project's design parameters represents our understanding of the significant aspects relevant to soil and foundation characteristics. In the event that any changes in the design or location of the CCR landfill or CCR surface impoundment system as outlined in this report are planned, we should be informed so the changes can be reviewed and the conclusions of this report modified, if required, and approved in writing by UES.

For a further description of the scope and limitations of this report please review the document attached within **Appendix D**, "Important Information About Your Geotechnical Engineering Report" prepared by GBC.

9.0 REFERENCES

Crone, A., & Wheeler, R. (2000). Data for Quaternary faults, liquefaction features, and possible tectonic features in the Central and Eastern United States, east of the Rocky Mountain front. *U.S. Geological Survey Open-File Report 00-0260,* 143-143.

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Interactive Fault Map. (n.d.). Retrieved January 4, 2016, from http://earthquake.usgs.gov/hazards/qfaults/map/

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Means, G. (n.d.). Florida's Geologic History. Retrieved January 4, 2016, from http://www.dep.state.fl.us/geology/geologictopics/geohist-2.htm

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APPENDIX A

USGS FAULT MAPS

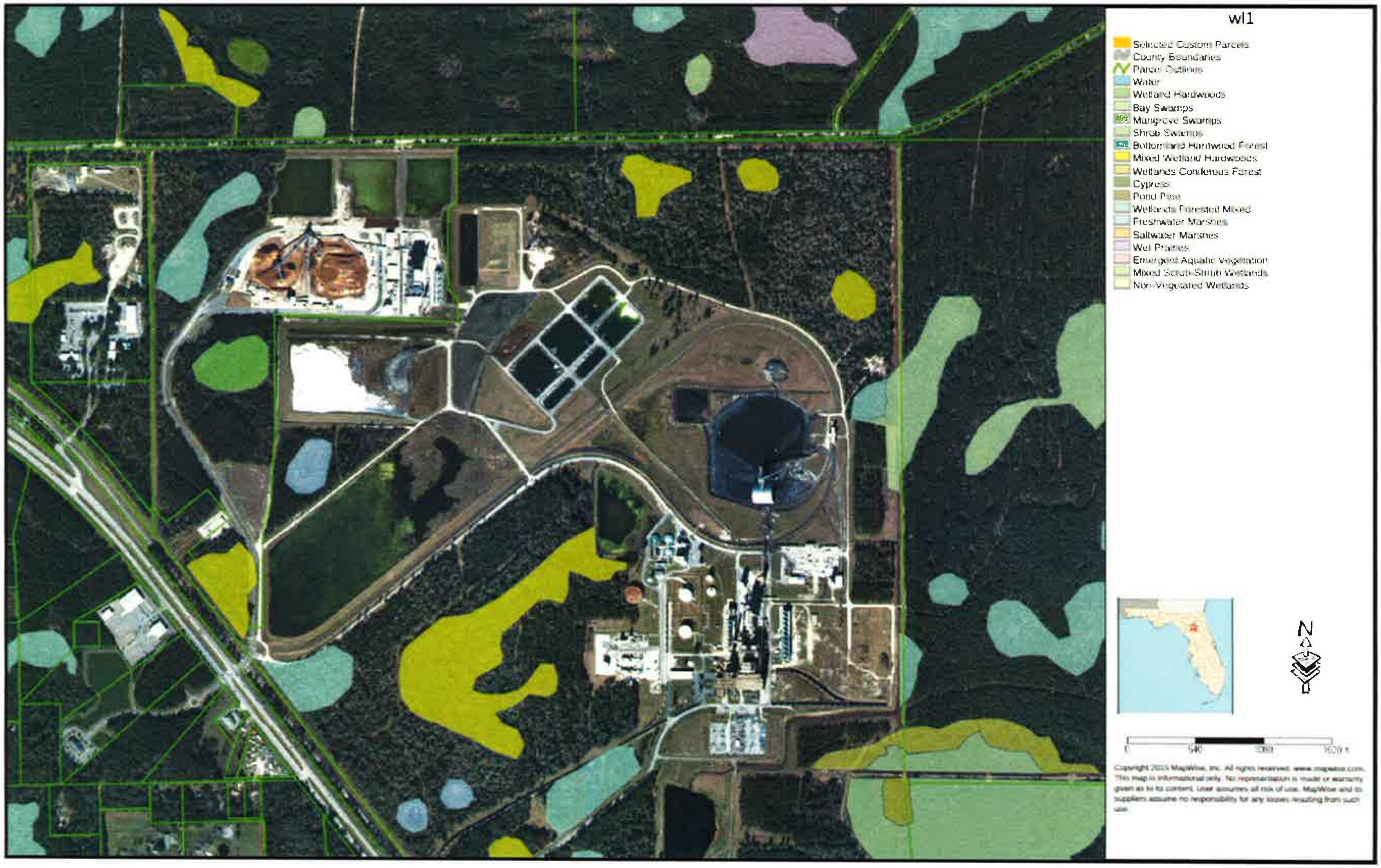

Quaternary Faults (Age)
< 150 years
< 15,000 years
< 130,000 years
< 750,000 years
< 1.6 million years
Class B
Location
Well Constrained
Moderately Constrained
Inferred
Paleosites
Download Shapefile
UNITED STATES
MEXICO
OCEAN
Gulf of Mexico
Gulf of St. Lawrence
ONTARIO
WASHINGTON
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
MINNESOTA
WISCONSIN
MICHIGAN
WYOMING
NEBRASKA
IOWA
ILLINOIS
INDIANA
OHIO
KANSAS
MISSOURI
KENTUCKY
OKLAHOMA
ARKANSAS
TENNESSEE
TEXAS
ALABAMA
GEORGIA
FLORIDA
PENNSYLVANIA
NEW YORK
NEW JERSEY
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
MAINE
NEW BRUNSWICK
NOVA SCOTIA
BERMUDA
BAHAMAS
CUBA
TURKS AND CAICOS ISLANDS
Calgary
Vancouver
Seattle
Winnipeg
Minneapolis
Chicago
Milwaukee
Detroit
Toronto
Ottawa
Montreal
Boston
New York
Philadelphia
Washington, D.C.
Pittsburgh
Cleveland
Columbus
Indianapolis
Cincinnati
Louisville
Kansas City
Saint Louis
Oklahoma City
Dallas
Austin
Houston
San Antonio
New Orleans
Memphis
Nashville
Knoxville
Birmingham
Atlanta
Charlotte
Greenville
Raleigh
Greensboro
Richmond
Norfolk
Jacksonville
Orlando
Tampa
Miami
Nassau
Halifax
Albany
Buffalo
Rochester
Providence
Phoenix
Tucson
Denver
Hermosillo
Chihuahua
Torreon
Monterrey
Brownsville
Culiacan
San Luis Potosi
Mexico Basin
Sohm Plain
300 km
200 mi
USGS
Leaflet | USGS


Quaternary Faults (Age)
< 150 years
< 15,000 years
< 130,000 years
< 750,000 years
< 1.6 million years
Class B
Location
Well Constrained
Moderately Constrained
Inferred
Paleosites
Download Shapefile
KANSAS
MISSOURI
INDIANA
KENTUCKY
WEST VIRGINIA
VIRGINIA
MARYLAND
DELAWARE
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
OKLAHOMA
ARKANSAS
MISSISSIPPI
ALABAMA
GEORGIA
LOUISIANA
TEXAS
FLORIDA
COAHUILA
DURANGO
TAMAULIPAS
COASTAL PLAIN
Topeka
Kansas City
Jefferson City
Saint Louis
Cincinnati
Frankfort
Louisville
Charleston
Washington, D.C.
Annapolis
Dover
Richmond
Norfolk
Wichita
Tulsa
Oklahoma City
Amarillo
Lubbock
Nashville
Knoxville
Greensboro
Raleigh
Charlotte
Greenville
Columbia
Memphis
Little Rock
Atlanta
Birmingham
Montgomery
Jackson
Dallas
Fort Worth
Midland
Odessa
Austin
San Antonio
Houston
Baton Rouge
New Orleans
Tallahassee
Jacksonville
Orlando
Tampa
Miami
Brownsville
Monterrey
Saltillo
Torreon
Nassau
BAHAMAS
La Habana (Havana)
Gulf of Mexico
Mexico Basin
Blake Plateau
Blake Ridge
Hatteras Plain
Sargasso
West Florida Escarpment
Straits of Florida
Florida Valley
Bahama Ridge
TROPIC OF CANCER
200 km
100 mi
USGS


Quaternary Faults (Age)
< 150 years
< 15,000 years
< 130,000 years
< 750,000 years
< 1.6 million years
Class B
Location
Well Constrained
Moderately Constrained
Inferred
Paleosites
Auburn
Warner Robins
Columbus
Montgomery
Statesboro
Vidalia
Savannah
Hinesville
Albany
Fitzgerald
Enterprise
Andalusia
Dothan
Waycross
Brunswick
Valdosta
Tallahassee
Pensacola
Jacksonville
Lynn Haven
Panama City
Apalachee Bay
Gainesville
Palm Coast
Blake Plateau
De Soto Valley
Ocala
FLORIDA
Daytona Beach
Port Orange
Deltona
Homosassa Springs
Titusville
Orlando
USGS

APPENDIX B

WETLAND MAPS


wl1
Selected Custom Parcels
County Boundaries
Parcel Outlines
Water
Wetland Hardwoods
Bay Swamps
Mangrove Swamps
Shrub Swamps
Bottomland Hardwood Forest
Mixed Wetland Hardwoods
Wetlands Coniferous Forest
Cypress
Pond Pine
Wetlands Forested Mixed
Freshwater Marshes
Saltwater Marshes
Wet Prairies
Emergent Aquatic Vegetation
Mixed Scrub-Shrub Wetlands
Non-Vegetated Wetlands
N
0
540
1080
1620 ft
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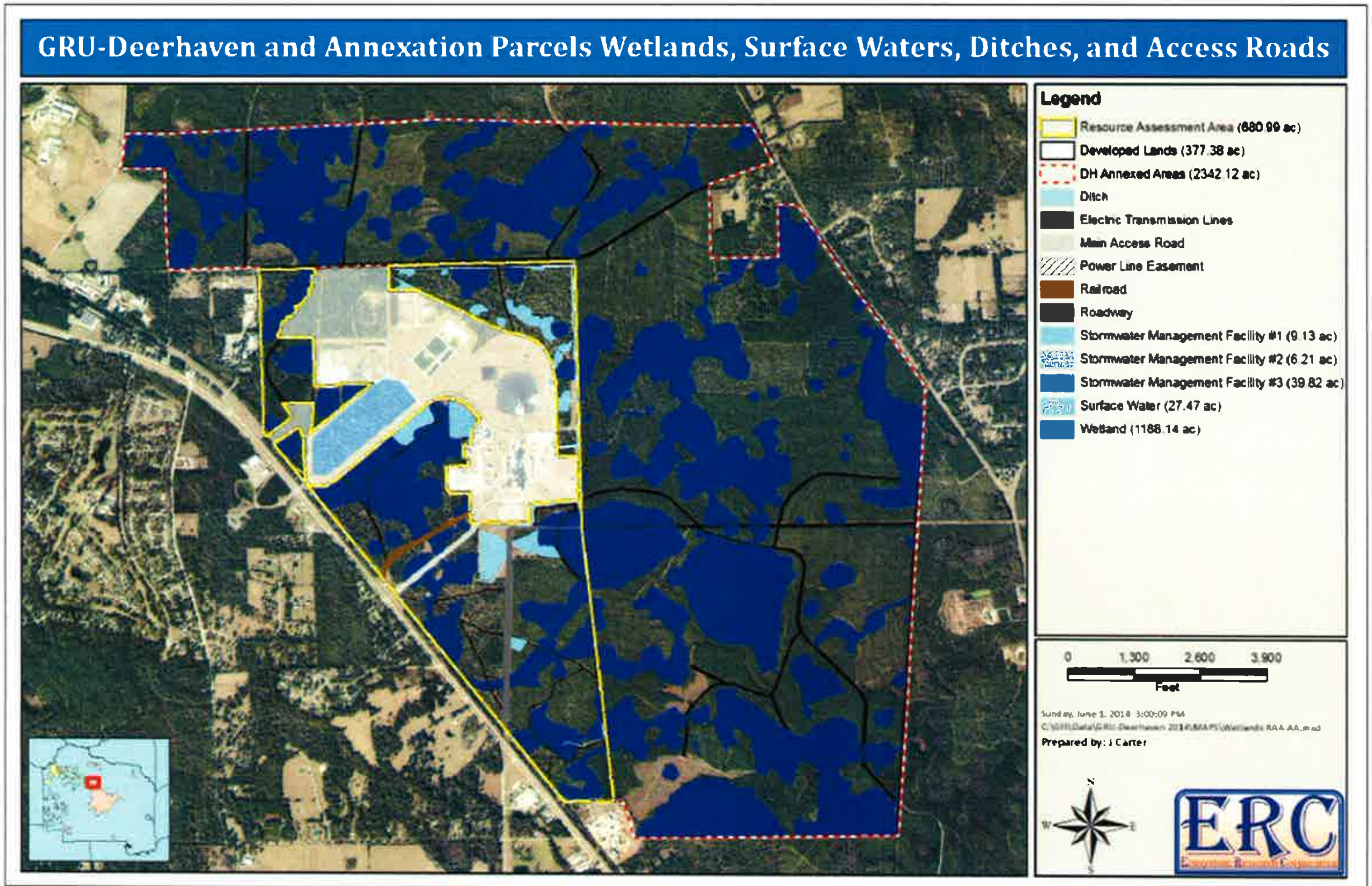

Figure 31. Wetlands, surface waters, ditches, and transportation networks map for the GRU-Deerhaven Power Generating Plant and Annexation Parcels.

APPENDIX C

FINAL REPORT FOR GEOPHYSICAL INVESTIGATION
REPORTED SUBSIDENCE MAPS

FINAL REPORT
GEOPHYSICAL INVESTIGATION
DEERHAVEN SITE
GAINESVILLE, FL

Prepared for Universal Engineering Sciences
Gainesville, FL

Prepared by GeoView, Inc.
St. Petersburg, FL

January 14, 2016

Mr. Eduardo Suarez, MCE, P.E.
Universal Engineering Sciences
4475 SW 35th Terrace
Gainesville, FL 32608

Subject: Transmittal of Final Report for Geophysical Investigation
Deerhaven Site - Gainesville, FL
GeoView Project Number 23248

Dear Mr. Suarez,

GeoView, Inc. (GeoView) is pleased to submit the final report which summarizes and presents the results of the geophysical investigation conducted at the Deerhaven Site in Gainesville, FL. 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.

Michael J. Wightman, P.G.
President
Florida Professional Geologist
Number 1423

Stephen Scruggs, P.G.
Senior Geophysicist
Florida Professional Geologist
Number 2470

4610 Central Avenue
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1.0 Introduction

A geophysical investigation was conducted at the Deerhaven Site located at 10001 NW 13th Street in Gainesville, Florida. The survey area consisted of the northern, southern, and western boundaries/roadways of a landfill and pond area at the site. The investigation was conducted on January 8, 2016.

The purpose of the investigation was to help characterize near-surface geological conditions and to identify subsurface features that may be associated with sinkhole activity within the two areas. The results of the investigation for the landfill area are shown on Figure 1 and the results for the pond area are shown on Figure 2.

2.0 Description of Geophysical Investigation

The GPR survey was conducted along a series of transects parallel with the surrounding roadways spaced approximately 15 to 20 ft apart (Figures 1 and 2). The GPR data was collected with a Mala radar system. The GPR settings used for the survey are presented in Table 1.

Table 1
GPR Equipment Settings Used for GPR Surveys

Antenna Frequency	Time Range (nano-seconds)	Estimated Depth of GPR Signal Penetration
250 MHz 1/	170	15 to 25 ft bls

1/ MHz means mega-Hertz and is the mid-range operating frequency of the GPR antenna.

A description of the GPR technique and the methods employed for geological characterization studies is provided in Appendix 2.

The positions of the geophysical transect lines were recorded using a Trimble GeoXH Global Positioning System (GPS). A Wide Area Augmentation System (WAAS) was used to augment GPS with additional signals for increasing the reliability, integrity, accuracy and availability of the GPS signal. By using WAAS, an accuracy of less than 3 feet in the horizontal dimension was achieved. In areas near dense tree canopy, the accuracy of the GPS signal was typically reduced.

3.0 Identification of Possible Sinkhole Features Using GPR

The features observed on GPR data that are most commonly associated with sinkhole activity are:

- A downwarping of GPR reflector sets, that are associated with suspected lithological contacts, towards a common center. Such features typically have a bowl or funnel shaped configuration and can be associated with a deflection of overlying sediment horizons caused by the migration of sediments into voids in the underlying limestone. If the GPR reflector sets are sharply downwarping and intersect, they can create a “bow-tie” shaped GPR reflection feature, which often designates the apparent center of the GPR anomaly.
- A localized significant increase in the depth of the penetration and/or amplitude of the GPR signal response. The increase in GPR signal penetration depth or amplitude is often associated with either a localized increase in sand content at depth or decrease in soil density.
- An apparent discontinuity in GPR reflector sets, that are associated with suspected lithological contacts. The apparent discontinuities and/or disruption of the GPR reflector sets may be associated with the downward migration of sediments.

The greater the severity of these features or a combination of these features the greater the likelihood that the identified feature is a sinkhole. It is not possible based on the GPR data alone to determine if an identified feature is a sinkhole or, more important, whether that feature is an active sinkhole.

4.0 Survey Results

Results of the GPR survey indicated the presence of a well-defined, relatively continuous set of GPR reflectors at an approximate depth range of 2 to 5 ft bls and a partially imaged set of GPR reflectors at an approximate depth range of 12 to 18 ft bls. These GPR reflector sets are most likely associated with some change in lithological conditions at those depth ranges.

<u>Description of GPR Anomaly</u>

One GPR anomaly area was identified northwest of the landfill (Figure 1). The anomaly is semi-elliptical in shape with a total area of approximately 3,960 square ft. The apparent vertical relief of the upper portion of the anomaly area was 4 to 6 ft as characterized by the observed downwarping of the lower GPR reflector set. A localized increase in the depth of penetration of the GPR signal was also observed within the anomaly area. The apparent center of the feature was characterized as the area of maximum downwarping of the previously referenced GPR reflectors. It is noted that no disruption to the sediments overlying the downwarped GPR reflectors was observed. This suggests that the GPR anomaly is likely associated with relic depositional or erosion activity, rather than possible karst activity. Table 2 provides the coordinates for the center for the anomaly. These coordinates were developed using a Trimble GEO-XH global positioning system (GPS) with sub-meter accuracy.

Table 2 – Anomaly Coordinates

Recommended SPT Location	Easting*	Northing*
B-1	529252.02	1975052.40

* US State Plane, Florida Central, NAD83 (Conus), Feet

An example of the GPR data collected across the anomaly area is provided in Appendix 1. In addition, a full GPR transect from the landfill area and the pond area are included in Appendix 1. A discussion of the limitations of the GPR technique in geological characterization studies is provided in Appendix 2.

APPENDIX 1
FIGURES AND EXAMPLES OF GPR DATA AND ANOMALY

SCALE: 1"=100' APPROXIMATE

EXPLANATION

S3 —— E3 PATH GPR LINES WITH START AND END POINTS

X LOCATION OF GPR ANOMALY WITH APPARENT CENTER

GeoView

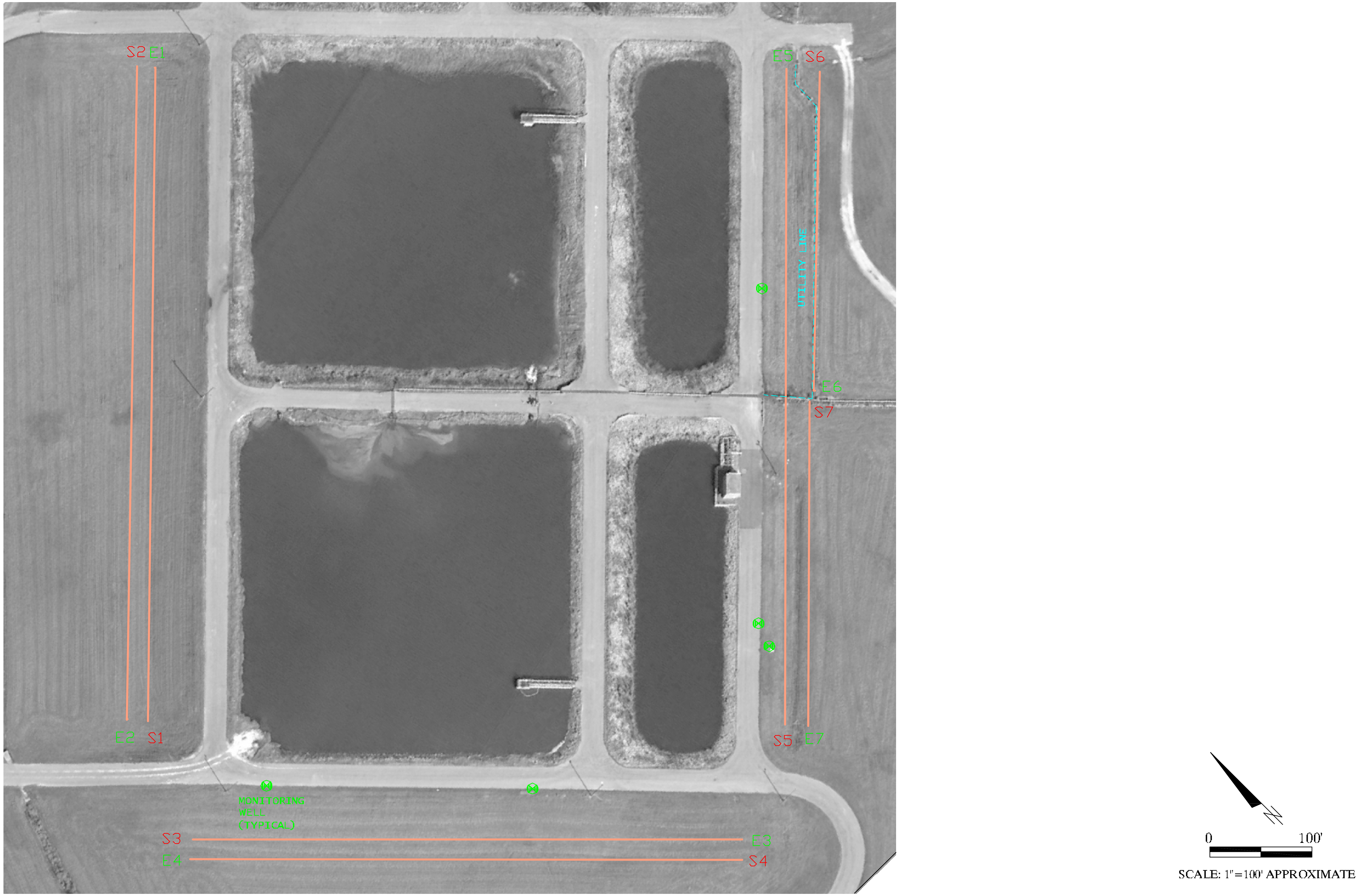
FIGURE 1 - LANDFILL

SITE MAP
SHOWING RESULTS
OF GEOPHYSICAL
INVESTIGATION

DEERHAVEN SITE
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

UNIVERSAL ENGINEERING
SCIENCES, INC.
GAINESVILLE, FLORIDA

PROJECT:
23248
DATE:
01/14/16



EXPLANATION

S3 ——— E3 PATH GPR LINES WITH START AND END POINTS

Geo View

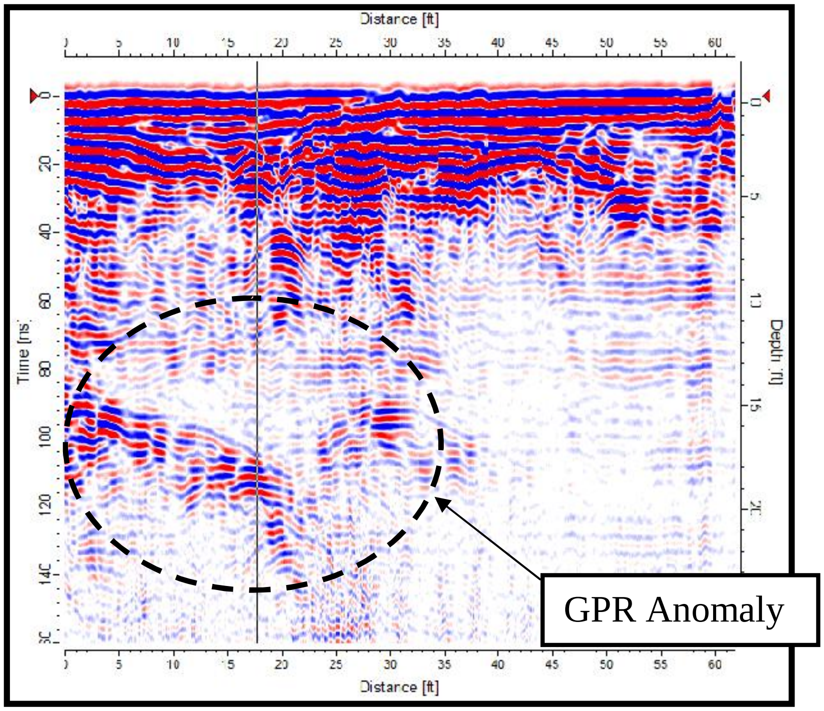
FIGURE 2 - POND

SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION

DEERHAVEN SITE
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

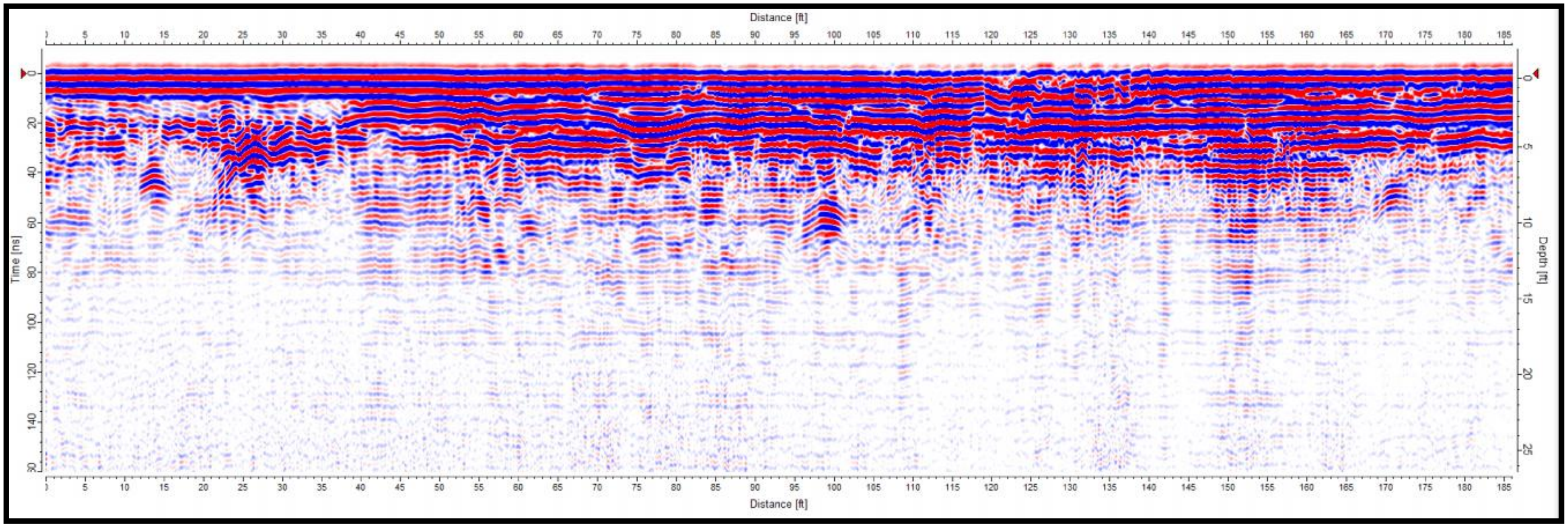
UNIVERSAL ENGINEERING SCIENCES, INC.
GAINESVILLE, FLORIDA

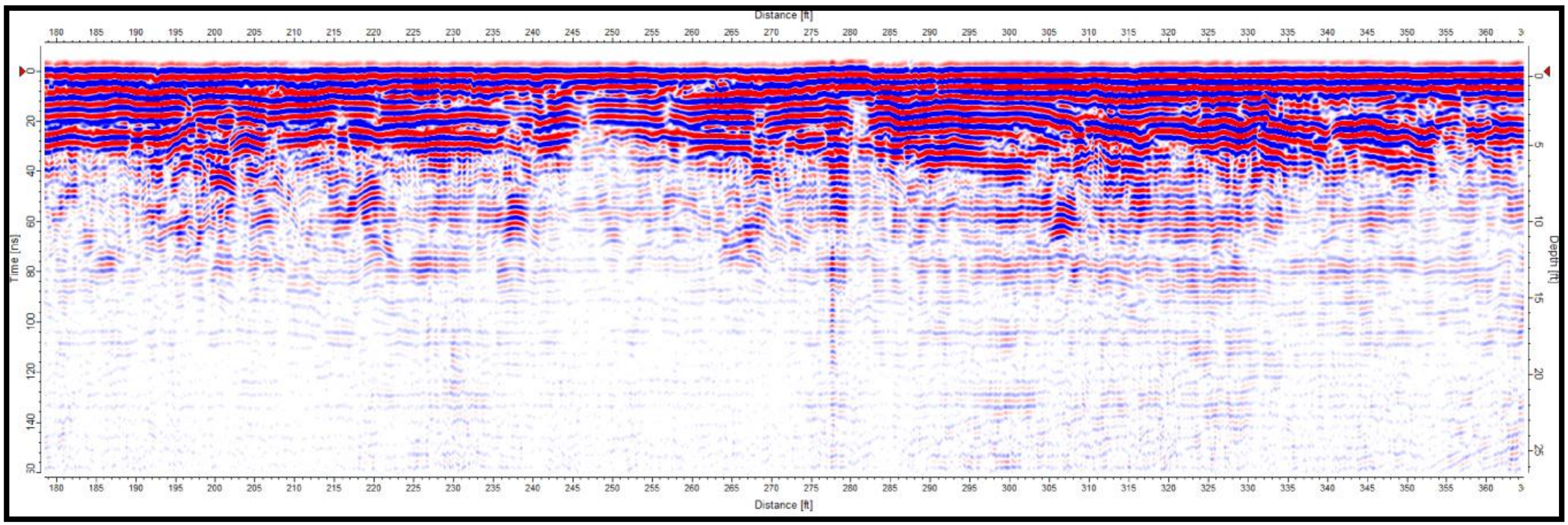
PROJECT: 23248
DATE: 01/14/16



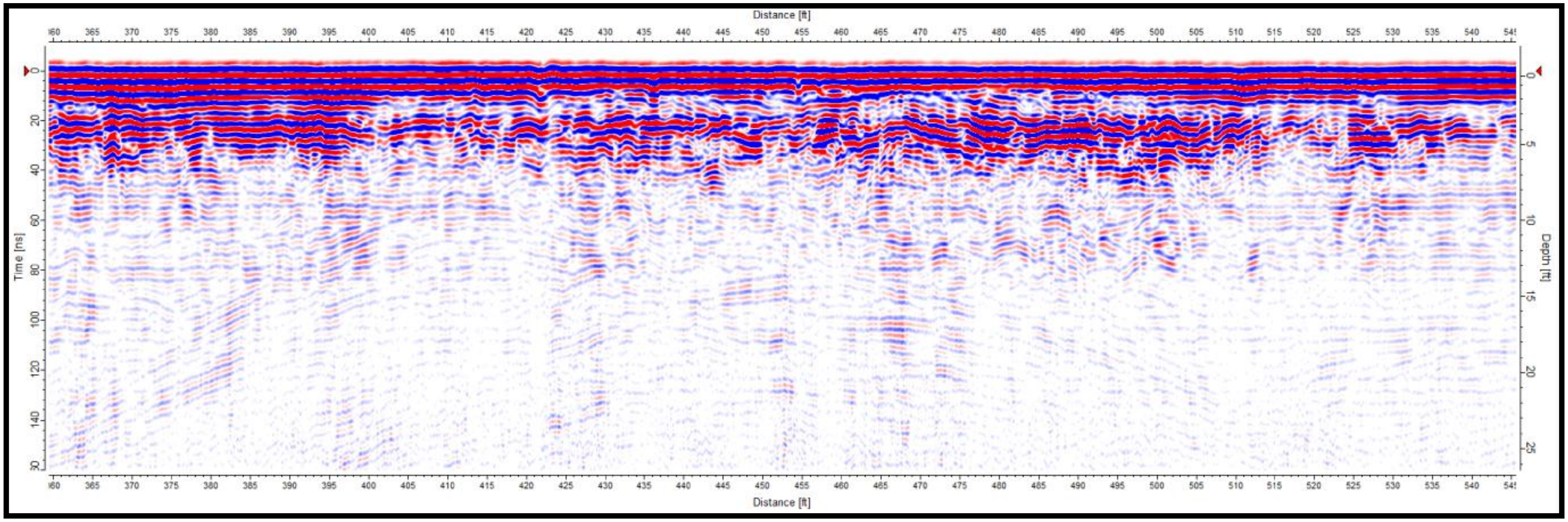
GPR Transect 7 Across Anomaly in Landfill Area

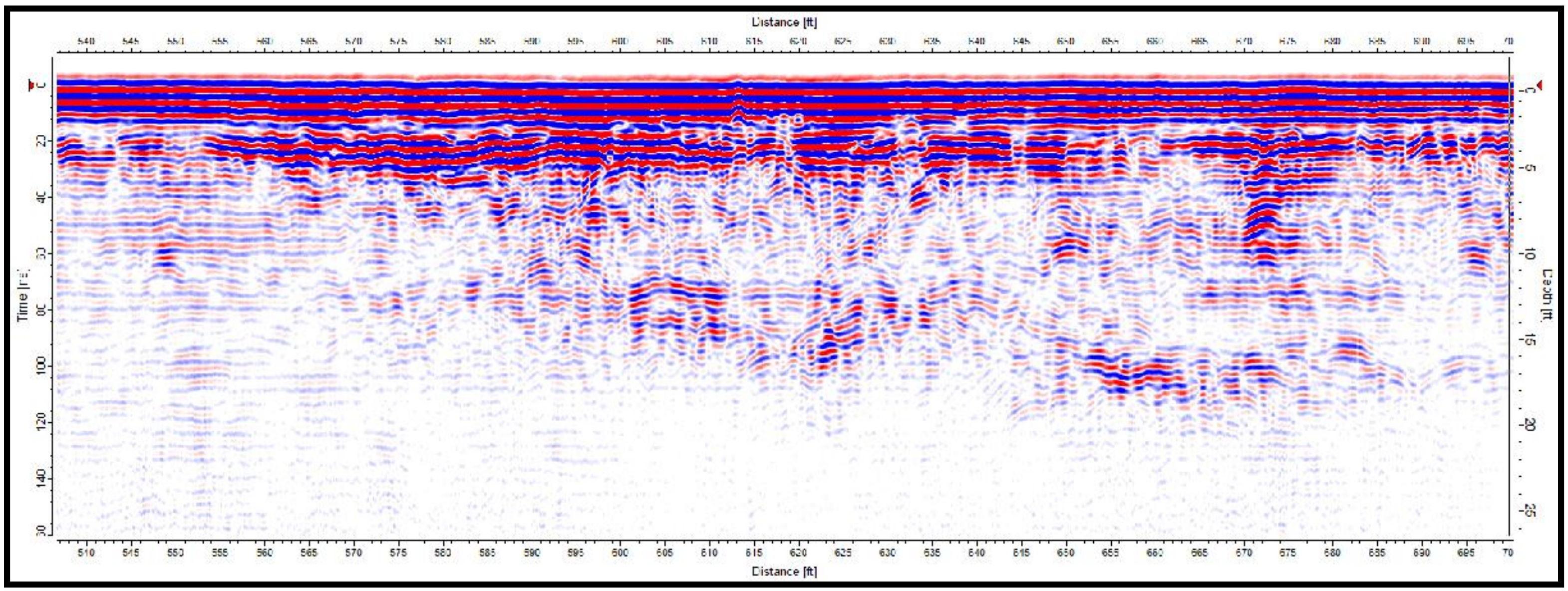
GPR Transect 6 – Landfill Area



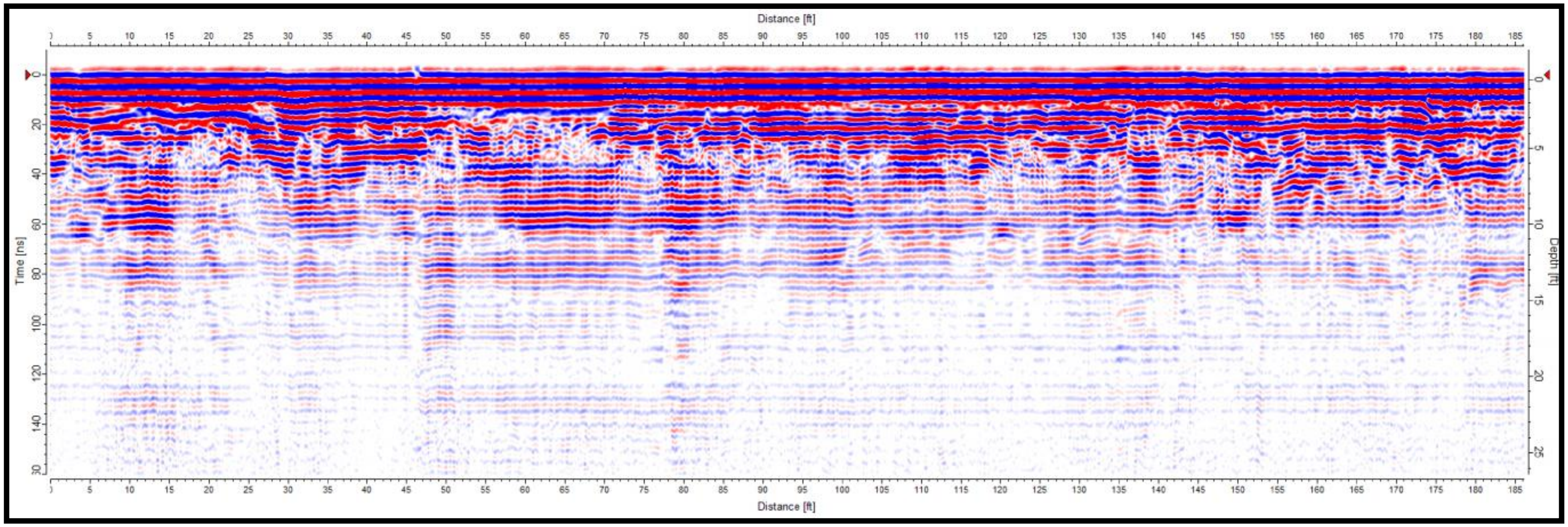


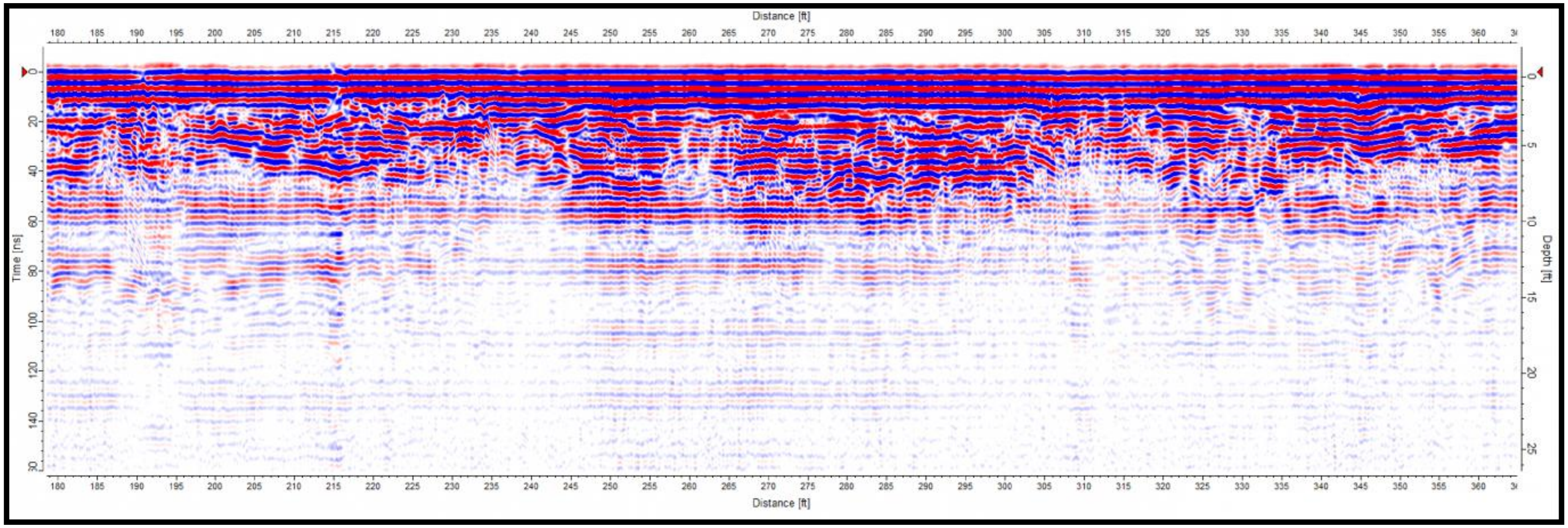
GPR Transect 6 – Landfill Area (continued)



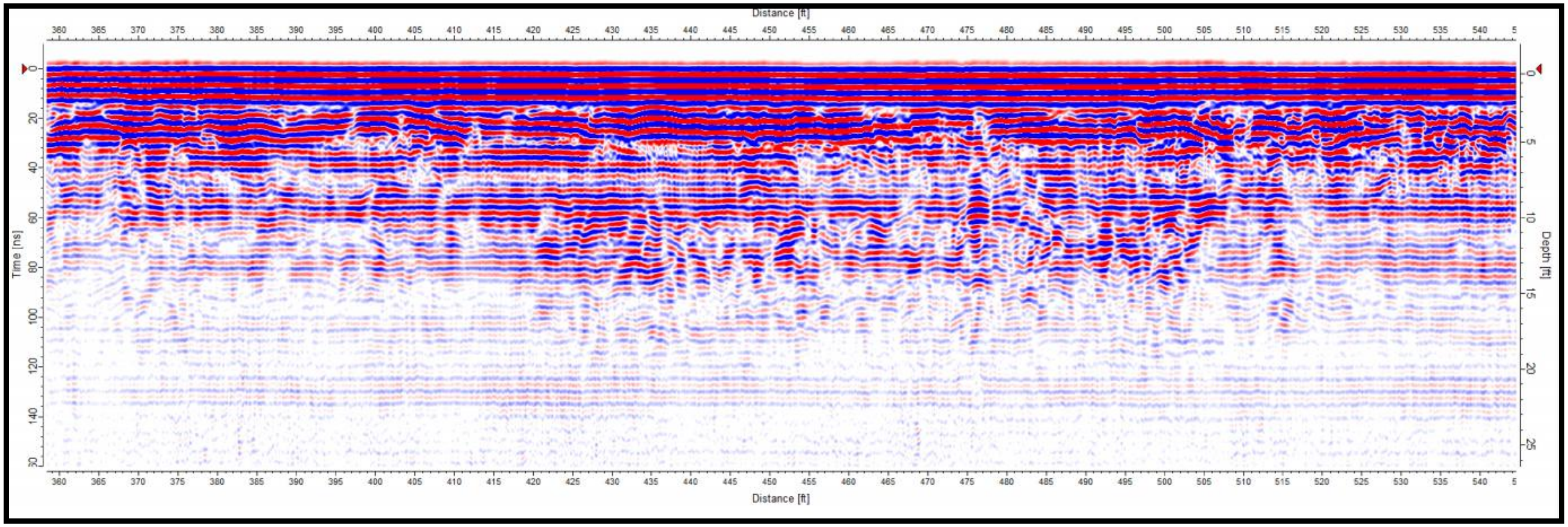


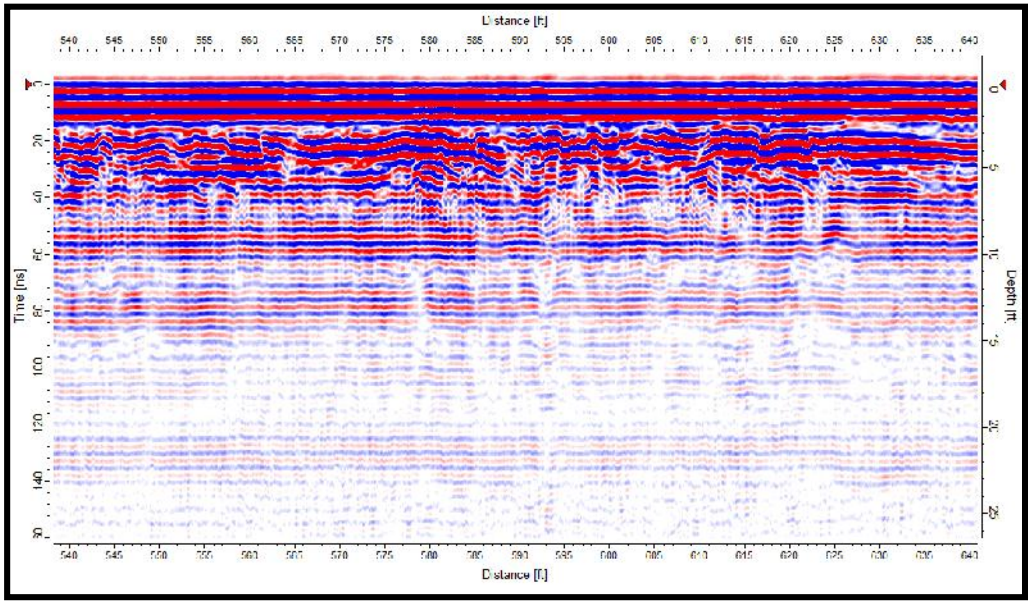
GPR Transect 1 – Pond Area





GPR Transect 1 – Pond Area (continued)





APPENDIX 2
DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

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. Geological characterization studies are typically conducted using a 250 MHz antenna.

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 which 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 which 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 or geological features.

The greater the electrical contrast between the surrounding earth materials 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.

The depth of penetration of the GPR signal is very site specific and is controlled by two primary factors: subsurface soil conditions and selected antenna frequency. The GPR signal is attenuated (absorbed) as is passes through earth materials. As the energy of the GPR signal is diminished due to attenuation, the energy of the reflected waves is reduced, eventually to the level that the reflections can no longer be detected. The more conductive the earth materials, the greater the GPR signal attenuation, hence a reduction in signal penetration depth. In Florida, the typical soil conditions which severely limit GPR signal penetration are near-surface clays and/or organic materials.

The depth of penetration of the GPR signal is also reduced as the antenna frequency is increased. However, as antenna frequency is increased the resolution of the GPR data is improved. Therefore, when designing a GPR survey a tradeoff is made between the required depth of penetration and desired resolution of the data. As a rule, the highest frequency antenna that will still provide the desired maximum depth of penetration should be used. For most sinkhole studies, a low-frequency (250 MHz) antenna is used. This allows for maximum signal penetration and thereby maximum depth from which information will be obtained.

A GPR survey is conducted along survey lines (transects) which are measured paths along which the GPR antenna is moved. Electronic marks are placed in the data by the operator at designated points along the GPR transects. These marks allow for a correlation between the GPR data and the position of the GPR antenna on the ground.

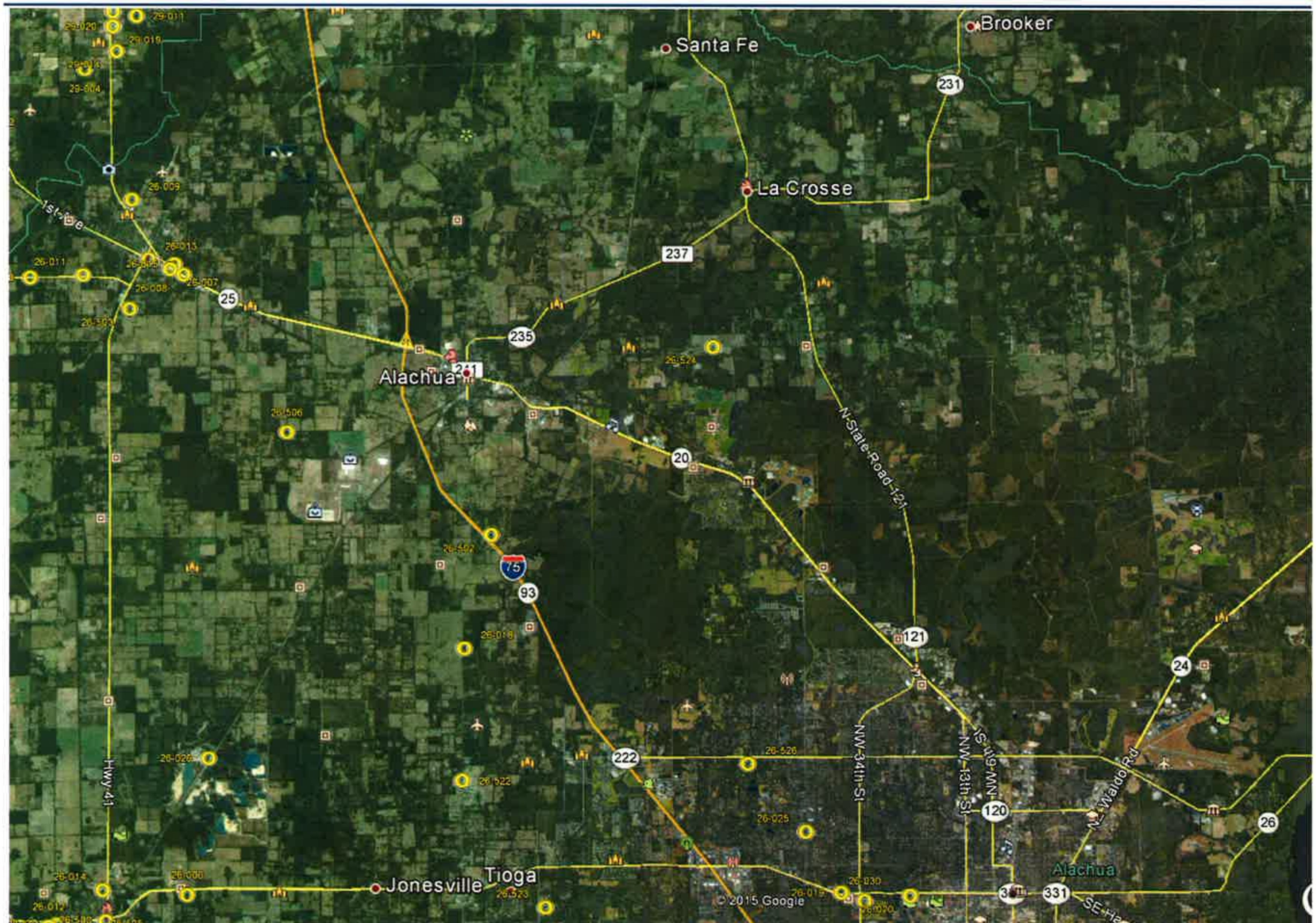
Depth estimates to the top of lithological contacts or sinkhole features are determined by dividing the time of travel of the GPR signal from the ground surface to the top of the feature by the velocity of the GPR signal. The velocity of the GPR signal is usually obtained from published tables of velocities for the type and condition (saturated vs. unsaturated) of soils underlying the site. The accuracy of GPR-derived depths typically ranges from 20 to 40 percent of the total depth.

Interpretation and Limitations of GPR data

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 geological characterization studies are developed by having the opportunity to compare GPR data collected in numerous settings to the results from geotechnical 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 by underlying soils. Once the GPR signal has been attenuated at a particular depth, information regarding deeper geological conditions will not be obtained. GPR data can only resolve subsurface features which have a sufficient electrical contrast between the feature in question and surrounding earth materials. If an insufficient contrast is present, the subsurface feature will not be identified.

GeoView can make no warranties or representations of geological conditions which 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.


Brooker
Santa Fe
La Crosse
Alachua
Jonesville
Tioga
N-State-Road-121
NW-34th-St
NW-13th-St
Hwy-41
NE Waldo Rd
231
237
235
25
241
20
75
93
121
24
222
120
26
331
© 2015 Google


239
235
22
NW 156th Ave
M L King Blvd
237
NW US Highway 441
231
N State Road 121
NW 13th St
NW 43rd St

APPENDIX D

GBC DOCUMENT
CONSTRAINTS AND RESTRICTIONS

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

CONSTRAINTS AND RESTRICTIONS

WARRANTY

Universal Engineering Sciences has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until excavation begins. If variations appear, we may have to re-evaluate our recommendations after performing native observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Universal Engineering Sciences, as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Universal Engineering Sciences of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Universal Engineering Sciences to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Universal Engineering Sciences is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Universal Engineering Sciences.

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Universal Engineering Sciences.

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations to determine those conditions that may affect construction operations. Universal Engineering Sciences cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Universal Engineering Sciences to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Universal Engineering Sciences to locate any such buried objects. Universal Engineering Sciences cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of investigation. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.