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GEOTECHNICAL CONSULTING SERVICES

COAL COMBUSTION RESIDUALS (CCR)
ABUTMENT AND BASE SURFACE IMPOUNDMENT SYSTEM EVALUATION

DEERHAVEN GENERATING STATION (DGS)
10001 NW 13th STREET
GAINESVILLE, ALACHUA COUNTY, FLORIDA

PROJECT NO. 0230.1500077
REPORT NO. 1352022

Prepared For:

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October 12, 2016

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October 12, 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 Abutment and Base Impoundment Evaluation
10001 NW 13th Street
Gainesville, Alachua County, Florida
UES Project No. 0230.1500077
UES Report No. 1352022

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 residuals (CCR) abutment and base of the ash 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 257.60 and 40 CFR 257.73(d). The location restriction demonstration presented in this report with respect to the uppermost aquifer and structural stability analysis meets the requirements of 40 CFR 257.60 and 40 CFR 257.73(d), 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 I

EDUARDO SUAREZ P.E. LICENSE No. 60272 STATE OF FLORIDA PROFESSIONAL ENGINEER

Digitally signed by Eduardo Suarez
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Timothy Kwiatkowski, EI
Staff Geotechnical Engineer

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

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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 residuals (CCR) surface impoundment system (i.e., Ash Cell #1, Ash Cell #2), two pump back ponds (i.e., Pump Back Cell #1, Pump Back Cell #2), and two front-end treatment lime sludge ponds.

The structural stability of the surface impoundment system appears to be satisfactory and meets the requirements of 40 CFR 257.73(d), based on the following:

- A slope stability analysis showing satisfactory factors of safety as required by 40 CFR 257.73(e).

- Based on the recent geotechnical exploration, in-situ testing prepared by UES, and considering the adequate structural performance of the embankments over the last 35 years, we conclude that the foundation and dikes have been mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR impoundment system.

- The slopes are vegetated with grass along the exterior, and covered with rock/rip-rap along the interior slopes. No scarps, sloughs, major depressions, bulging, sags, tension cracks, or other signs of significant settlement or mass soil movement or slope instability were observed outside or inside the dike slopes.

    - Slope protection appears adequate to protect against surface erosion and wave action.

    - Vegetation on the exterior slope was less than 6 inches high.

    - The grades immediately surrounding the surface impoundment system are flat and there are no water bodies adjacent to the embankments encompassing the ash ponds and other vicinity process ponds that could affect the structural stability of the surface impoundment system.

The ash ponds were constructed primarily with compacted fine silty sands with a clay blanket within the interior slopes of each pond, to prevent seepage through the ash pond embankments. Below the clay blanket, each embankment has a clay slurry wall that connects to the top of a natural clay layer. This slurry wall prevents water from seeping below the embankments to the exterior slopes of the ash ponds.

Based on the History of Construction (IWCS, 2016) and subsurface information detailed by Burns & McDonnell (B&M, 1978), the CCR impoundment system was constructed to form an impervious surface that prevents intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuation in groundwater elevation, as required by 40 CFR 257.60.

We recommend that GRU continue the routine monitoring of the water levels in the impoundment piezometers and surrounding groundwater monitoring wells to keep verifying the absence of hydraulic connection between the base of the CCR unit and the uppermost aquifer.

1.0 INTRODUCTION

Universal Engineering Sciences, Inc. (UES) has completed this evaluation for the CCR surface impoundment system 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. 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 surface impoundment system is situated just northwest of the facility's main power generating infrastructure. The surface impoundment system is connected to the main plant by asphalt roads. The surface impoundment system studied in this analysis is approximately 5.2 acres and is located in close proximity to wooded areas. Moderately dense wooded areas surround much of DGS. There are some stormwater management areas/swales on the south side of the ash ponds. An aerial site location and USGS map are included in **Appendix A.**

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

The purposes of this evaluation were to:

1. Perform a structural stability assessment which meets the requirements of 40 CFR 257.73(d) to document whether the CCR surface impoundment system has been designed, constructed, operated, and maintained with:

    a. Stable foundations and abutments
    b. Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown
    c. Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR impoundments
    d. Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection
    e. Hydraulic structures passing through the dike of the CCR impoundments that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure
    f. For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.
    g. Identification of any structural stability deficiency associated with the CCR unit and provide recommendations for corrective measures.

2. Based on previous geotechnical explorations and the History of Construction, demonstrate that there will not be an intermittent, recurring or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuation in groundwater elevation, in accordance with the requirements of 40 CFR 257.60.

This evaluation included several site visits, a review of information submitted by Gainesville Regional Utilities (GRU) and Innovative Waste Consulting Services (IWCS) and any relevant publicly available information from state or federal agencies regarding the structural stability of the surface impoundment system and any hydraulic connection between the base of the CCR unit and the uppermost aquifer.

4.0 STRUCTURAL STABILITY ASSESSMENT

4.1 Background information - Document review

The following documents were available for the stability assessment;

- Report of Geotechnical Consulting Services – Slope Stability and Liquefaction Potential Analysis – Process Pond Impoundment Dikes (*UES, 2015*).

- History of Construction – Coal Combustion Residuals Surface Impoundment (*IWCS, 2016*).

As previously described, the ash ponds are impounded by an earthen embankment system consisting of a dike configuration. The top of the ponds are at or near elevation +195 feet, National Geodetic Vertical Datum of 1929 (NGVD 29), which is nearly 150 feet above the Floridan Aquifer potentiometric surface level. The slopes vary in steepness from 3H: 1V to 4H: 1V throughout the sides of the ash pond area. The slopes are vegetated with grass along the exterior, and covered with rock/rip-rap along the interior slopes.

The total perimeter of the embankment adjacent to the surface impoundment system is 1,070 feet with a crest width of 25 feet. The height of the embankments adjacent to the surface impoundment system varies from about 9 to 16 feet above the surrounding ground surface. An aerial photograph of the surface impoundment system and embankments is included in **Appendix B.**

4.1.1 Slope Stability Analysis

A slope stability analysis of the surface impoundment system embankments was performed using the data gathered from the laboratory analysis of the soil samples collected from the surface impoundment system embankments. The stability analysis was conducted for both the long-term maximum storage pool loading condition and maximum surcharge pool loading conditions. Maximum surcharge pool loading conditions were considered at the top of the embankment and long-term maximum storage pool loading conditions were considered at maximum operating levels. Slope stability analyses were conducted for the maximum water elevation corresponding to the top of the embankment (EL +195 ft, NGVD 29 for Ash Cells 1 and 2) and EL +188 ft, NGVD 29 for Pump Back Ponds 1 and 2) and for the maximum operating water levels (EL +193 ft, NGVD 29 for Ash Cells 1 and 2) and EL +186 ft, NGVD 29 for Pump Back Ponds 1 and 2). (*UES, 2015*)

The results of our previous evaluation indicated that factors of safety against shear failure of the existing slope areas exceeded the required values of 1.5 for the long-term maximum storage pool loading condition and 1.4 for the maximum surcharge pool loading condition. More details are presented in the UES (2015) report.

4.1.2 Liquefaction Potential Analysis

The potential for liquefaction was evaluated following the guidelines established by Environmental Protection Agency (EPA) in 40 CFR Part 257 and 261 – Hazards and Solid Waste management System; Disposal of Coal Combustion Residuals from Electric Utilities and more specifically Seismic Design Guidance for Municipal Solid Waste Landfill Facilities, US EPA Office of Research and Development, 1995.

Based on our previous liquefaction potential analysis (UES, 2015), the minimum liquefaction factor of safety exceeded the EPA minimum requirement of 1.2 for all critical strata considered. More details are presented in the UES report.

4.1.3 Slope Protection Inspection

The slopes vary in steepness from 3H: 1V to 4H: 1V throughout the sides of the ash ponds. The slopes are vegetated with grass along the exterior, and covered with rock/rip-rap along the interior slopes.

Exterior Slope: No scarps, sloughs, major depressions, bulging, sags, tension cracks, or other signs of significant settlement or mass soil movement or slope instability were observed inside or outside the embankment slope. The grass on the exterior slope was generally observed to be well maintained, as shown in **Photos 1 and 2**. Minor erosion was observed from mowing equipment, as shown in **Photos 3 and 4**. Some animal burrows were encountered on the northwestern exterior slope, as shown in **Photos 5 and 6**.

Wet/moist soils were observed along the toe of the dike at the northwest exterior embankment, slightly west of Ash Cell # 2, but no seepage or flowing water appeared to be associated with this wet area. No indication of seepage flow or erosion was observed on the outside surface of dikes.

Interior slope: The interior slopes of the ash ponds were observed to be lined with riprap with minor amounts of dormant vegetation, including algae and grass, as shown in **Photos 7 and 8**. The bottom slope of the embankment was observed to have a dormant cover of grass and weed with algae resting on some areas. See **Photos 9 and 10**.

The inside slope toe and much of the slope is covered with ash, particularly along the center of the northeastern slope of Ash Cell #1, and the center of the southwestern slope of Ash Cell #2. See **Photos 11 and 12** where ash is accumulated over the slope of the ash ponds. No slumps, slides or other signs of shear failure were observed in the visible part of the slope above the ash and water levels. No significant erosion was noted.

Minor ash sediment erosion was noted along the edge of crest on the north side of the embankment that wraps around the corners, as shown in **Photographs 13 and 14**. Former erosion at the discharge locations in Ash Cell #2 had been repaired with riprap, or stone, as shown in **Photos 15 and 16**.

Pavement cracking along the interior edge of the dikes was noted at the northwestern edges of each ash pond, as well as alligator cracking in the pavement atop the interior dike between both ash ponds. See **Photos 17 through 19** for the aforementioned pavement cracking. Previous pavement repair (patching) was apparent along the northwest edge of Ash Cell #2, as shown in **Photo 20**. The water level in the ash ponds was relatively low at the time of inspection. See **Photos 21 and 22** for the approximate ash pond water elevations.

Photographs taken during our field assessment are provided in **Appendix C.** Overall slope protection for interior and exterior slopes appears to be adequate to protect against surface erosion and wave action.

4.1.4 CCR Impoundment Compaction Tests

The crest of the ash pond dikes is accessible with vehicles. The crest had no signs of depression, tension cracking or other indications of settlement or shear failure.

The pavement surface was generally observed to be in fair condition. Some localized areas of distress were noted along the pavement surface. Asphalt surface cracks typically associated with shrinkage of the asphalt (longitudinal/transverse cracks) and weakened subgrade near the edge of pavement (edge cracking), were encountered along the service road at the top of the embankments in some areas. See **Photograph 18** for a typical view of the crest/pavement edge cracking.

Soil borings conducted during the most recent geotechnical exploration within the embankment crest encountered silty sand [SM] followed by clayey sand to sandy clay [SC/CH] to boring termination depths of 25 feet. Based on the SPT-N values and laboratory strength testing, the silty sands have relative densities of loose to medium dense to very dense and the clayey soils have relative densities of medium dense to very stiff.

UES representatives visited the site to collect near-surface soil samples along the exterior slope of Ash Cell #1 to obtain densities of the soil. Based on Drive Sleeve Density tests (ASTM D-2937) and Standard Proctor tests (AASSHTO T-99) the slope surfaces have been compacted to an average 90 percent of the standard maximum dry density.

Soil Boring logs and compaction test results are presented in **Appendix D**.

Based on the recent geotechnical exploration, in-situ testing, and considering the adequate structural performance of the embankments over the last 35 years, we conclude that the dikes and foundation have been mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR impoundment.

4.1.5 Vegetated Slopes Inspection

The interior slope of the ash ponds was observed to be lined with riprap, which serves as slope protection, with minor amounts of dormant vegetation (see **Photo 23**). The exterior slope has a grass cover and does not have signs of significant dips, sags or other visual evidence of distress (see **Photo 24**). See **Appendix C** for the aforementioned photos.

Riprap armor on the interior slopes serves as an adequate form of slope protection.

4.1.6 Hydraulic Structures Inspection

The outlets of Ash Cell #1 and Ash Cell #2 consist of concrete drop structures with stop logs that provide ash containment. The concrete drop structures hydraulically connect to Pump Back Cells #1 and #2. Water flows from the ash ponds to the pump pack ponds via a 12” butterfly valve located in the stop log structure in the ponds through a 12” filament-wound glass-fiber reinforced plastic culvert pipe to an outfall in the pump back pond. The elevation of the 12” butterfly valve is 177 feet, NGVD 29, and the outfall elevation is 175 feet, NGVD 29. Water from the Pump Back Cells gets pumped back to the plant for reuse in plant operations; the plant is a zero-discharge facility.

Because of the water level, a limited part of the structure that could be seen at the stop log structure platform and bridge structures was visible at the time of our assessment. Of the limited visible parts of the structure, the outlet structures appeared to be in generally sound and stable condition with no evidence of significant deterioration.

An attempt to inspect the connecting stop log pipes was made on August 4, 2016, by IWCS, UES and GRU. This study entailed inserting a PVC pipe into each stop log culvert pipe inlet just before the butterfly valve, and maneuvering a camera through the PVC pipe and into and through the culvert pipe to determine if there were any issues pertaining to the structural integrity of the pipe or sediment accumulation. However, the water was too turbid to make any conclusive assessments. In each case, the camera went approximately 65 feet into the pipe, which is believed to be the approximate midpoint of the service road along the embankment’s crest. It appeared that there were obstructions that prevented further camera insertion at those points, possibly consistent with a pipe flange, joint or another type of pipe fitting.

During the pipe inspections, we interviewed Gale Fillinger, the Process Plant Supervisor for DGS. He informed us that normal flow through the stop log pipes is approximately 250,000 gallons per day for each pipe. He also notified us that the water supply from the pump back ponds for plant operations has been adequate.

Based on the level of turbidity and the conclusion of the inspection, we recommend a dry/semi-dry inspection of the culverts be performed to assess the conditions of the culvert pipes connecting the ash ponds to the pump back cells.

We recommend including a periodic interior inspection of the connecting pipes between the impoundment ponds, as part of the periodic excavation of the accumulated ash within the ponds.

4.1.7 Downstream Slope Sudden Drawdown Evaluation

The ash ponds are impounded by an earthen embankment system. The site is wide and flat, and there are no downstream channels and no adjacent water bodies that could affect the CCR unit.

4.1.8 Structural Stability Deficiency

Based on groundwater measurements recorded from the piezometers installed at the top of the crest, it appears that potential seepage may be occurring from the ash ponds through the compacted clay cutoff surface.

The overall structural integrity of the slopes appears to be stable. However, minor signs of erosion were observed in the interior slope of the embankment at the time of our initial site visit. GRU repaired the erosion and stabilized the area with riprap. No signs of erosion were observed in subsequent site inspections If further erosion deepening occurs, additional rock (rip-rap) placement would be necessary for preventative maintenance.

4.2 Conclusion

The structural stability of the surface impoundment system appears to be satisfactory and meets the requirements of 40 CFR 257.73(d), based on the following:

- A slope stability analysis showing satisfactory factors of safety as required by 40 CFR 257.73(e).

- Based on the recent geotechnical exploration and in-situ testing prepared by UES, and considering the adequate structural performance of the embankments over the last 35 years, we conclude that the dikes and its foundation have been mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR impoundment system.

- The slopes are vegetated with grass along the exterior, and covered with rock/rip-rap along the interior slopes. No scarps, sloughs, major depressions, bulging, sags, tension cracks, or other signs of significant settlement or mass soil movement or slope instability were observed inside or outside the dike slopes.

    - The slope protection appears adequate to protect against surface erosion and wave action.

    - Vegetation on the exterior slope was less than 6 inches high.

    - The grades immediately surrounding the surface impoundment system are flat and there are no water bodies adjacent to the embankments encompassing the ash ponds and other vicinity process ponds that could affect the structural stability of the surface impoundment system.

Considering the adequate structural performance of the impoundments over the last 35 years, we conclude that the embankment and foundation had been adequately designed, constructed, operated and maintained.

5.0 CCR BASE UNIT AND UPPERMOST AQUIFER CONNECTION

5.1 Literature review

5.1.1 Alachua County Geology and Hydrogeology

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), the Hawthorne Formation, the Alachua Formation, and the Plio-Pleistocene Terrace Deposits (the youngest). The DGS surface impoundment system is located within the Plio-Pleistocene Terrace Deposits and the 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).

There are three aquifer systems in Alachua County: the water table aquifer, the secondary artesian aquifer, and the Floridan Aquifer. The water table aquifer is typically near the surface, and consists of thin layers of Pleistocene sands above the Hawthorne Formation. It is usually absent in western Alachua County, but occurs predominately between Gainesville and Waldo. The elevation of the water table aquifer is normally between 100 to 150 feet above sea level.

The secondary artestian aquifer is limited laterally and vertically in extent. It is normally within a few limestone layers and sands in the Hawthorne Formation. The secondary artesian aquifer may also be apparent within shell beds of the Choctowatchee Formation in north-central and northeastern Alachua County. Despite the fact that many wells draw from this formation, the yield tends to be low due to it recharging mostly from the overlying water table, or the underlying Floridan Aquifer, which is at higher pressures.

The Floridan Aquifer is under several hundred feet of limestone and is the most productive, because it transmits and stores water more easily. It ranges from an elevation of 35 feet above sea level in the northwestern section of the county to more than 80 feet in the eastern part of the county. This aquifer is confined when it is below the Hawthorne Formation, and therefore, under artesian conditions. It is unconfined where the Ocala Formation is near the surface (Thomas, 1985).

5.1.2 Previous Geotechnical Explorations

The following geotechnical studies have been performed within, or adjacent to the DGS surface impoundment system:

- Subsurface Information for the Deerhaven Generating Station Site Near Hague, Florida, prepared by Burns & McDonnell, Dated 1978. (B&M, 1978)
- Report of Geotechnical Consulting Services – Air Quality Control Retrofit, prepared by Universal Engineering Sciences, Inc., Dated 2006. (UES, 2006)
- Report of Geotechnical Consulting Services – Coal Yard Lighting Poles, prepared by Universal Engineering Sciences, Inc., Dated 2013. (UES, 2013)
- Report of Geotechnical Consulting Services – Slope Stability And Liquefaction Potential Analysis Process Pond Impoundment Dikes, prepared by Universal Engineering Sciences, Inc., Dated 2015. (UES, 2015)

The subsurface soil conditions generally consisted of 6 to 13 feet of sand with silt to silty sand [SP-SM/SM], followed by very clayey sand to sandy clay [SC/CH] with lenses of very stiff to hard cemented clay [CH] to the maximum boring termination depths 100 feet. The groundwater table was generally apparent between depths of 0 to 5 feet.

5.1.3 History of Construction

Based on a Site Certification Assessment, the subsurface soils within the impoundment system area generally consisted of near surface sands, followed by clayey sands to sandy clay with varying amounts of limestone, and limestone at depths of more than 100 feet below the existing ground surface.

Initial site preparation activities included clearing/stripping, unsuitable soil removal, stockpiling of excavated soils suitable for reuse as fill, and exposed areas were scarified and moistened as necessary before embankment construction. (IWCS, 2016)

Slurry Wall Construction: A bentonite clay slurry wall was constructed beneath the outermost embankment which surrounds the site's process water pond system. This system includes the surface impoundment system ash ponds, but also includes two pump back ponds and two front-end treatment lime sludge ponds. The top of the slurry wall was at an approximate elevation of +184 feet NGVD 29. Slurry material was a pulverized Wyoming sodium bentonite, with a maximum permeability of 1 x 10^{-7} cm/s for a minimum of 10 years. The minimum thickness of the slurry wall was 2.5 feet, and keyed a minimum depth of 3 feet into the existing natural clay layer that underlies the impoundment system.

Clay Blanket: The clay blanket was 2-feet thick and was constructed to act as a vertical extension of the slurry wall – please see a representative cross section of the ash ponds included in Appendix E. The clay blanket appears to have been constructed in two parts. The first part was constructed with a lateral orientation with its top elevation the same as that of the slurry wall. Above the lateral clay blanket, an additional 18-inch blanket was installed upward within the interior surface of the impoundment system. Clay blanket material was generally free of rock and calcareous material and conformed to AASHTO Classification Groups A-2-6, A-6, or A-2-7; Unified Classification Groups SC, CL, CH, or OH.

Embankment Grading: The embankments were constructed to an approximate elevation of +195 feet NGVD 29, which was approximately 15-16 feet above the existing grades. Each of the ash ponds of the surface impoundment system were constructed to be 365 feet by 365 feet wide between embankment crests. The exterior slopes were 4:1 (H:V), and the interior slopes were 3:1 (H:V). Embankment material generally consisted of sandy or silty clay that could have adequate compaction and be free of voids. Suitable clays that were stockpiled for reuse generally had sand mixed in to make the material workable and to allow it to meet the specified density and other performance requirements.

Filter Blanket and Riprap Placement: Filter blanket material generally consisted of a well-graded, crushed rock, and was placed on the interior slope of the impoundments. Riprap was placed over the filter blanket to protect the slopes from erosion.

Topsoil and Vegetation Placement: Slopes and areas that were not reinforced with riprap received suitable topsoil that was excavated from the site, or imported, if necessary. The topsoil was seeded and mulched to establish a vegetative cover.

A representative cross-section of the position and geometry of the slurry wall is shown in **Appendix E.**

5.2 Conclusion

The ash ponds were constructed primarily with compacted fine silty sands with a clay blanket within the interior slopes of each pond to prevent seepage from escaping through the surface impoundment system embankments. Below the clay blanket, each embankment has a clay slurry wall that connects to the top of a naturally-existing clay layer. This slurry wall prevents water from seeping below the embankments to the exterior slope of each ash pond.

Based on a previous geotechnical exploration and the History of Construction, the CCR surface impoundment system appears to be constructed with an impervious surface that prevents any intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuation in groundwater elevation (including the seasonal high water table), per 40 CFR 257.60.

We recommend that GRU continue the routine monitoring of the water levels in the impoundment piezometers and surrounding groundwater monitoring wells to keep verifying the absence of hydraulic connection between the base of the CCR unit and the uppermost aquifer.

6.0 LIMITATIONS

This report has been prepared for the exclusive use of IWCS and 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 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 F**, "Important Information About Your Geotechnical Engineering Report" prepared by Geoprofessional Business Association (GBA).

7.0 REFERENCES

IWCS, 2016 -Innovative Waste Consulting Services, LLC. (2016). *History of Construction - Coal Combustion Residual Surface Impoundment System*. Gainesville, FL.

B&M, 1978 -Subsurface Information for the Deerhaven Generating Station Site Near Hague, Florida, prepared by Burns & McDonnell, Dated 1978

Thomas, 1985- Thomas, B., & Cummings, E. (1985). *Soil survey of Alachua County, Florida* (pp. 6-7). Place of publication not identified, Florida: U.S. Dept. of Agriculture, Soil Conservation Service in cooperation with University of Florida, Institute of Food and Agricultural Sciences, Agricultural Experiment Stations and Soil Science Dept. ;.

UES, 2015- Universal Engineering Sciences. (2015). *Slope Stability And Liquefaction Potential Analysis Process Pond Impoundment Dikes,*. Deerhaven Generating Station, Gainesville, FL.

UES, 2016-Universal Engineering Sciences. (2016). CCR Landfill and Impoundment Evaluation. Deerhaven Generating Station,. Gainesville, FL.

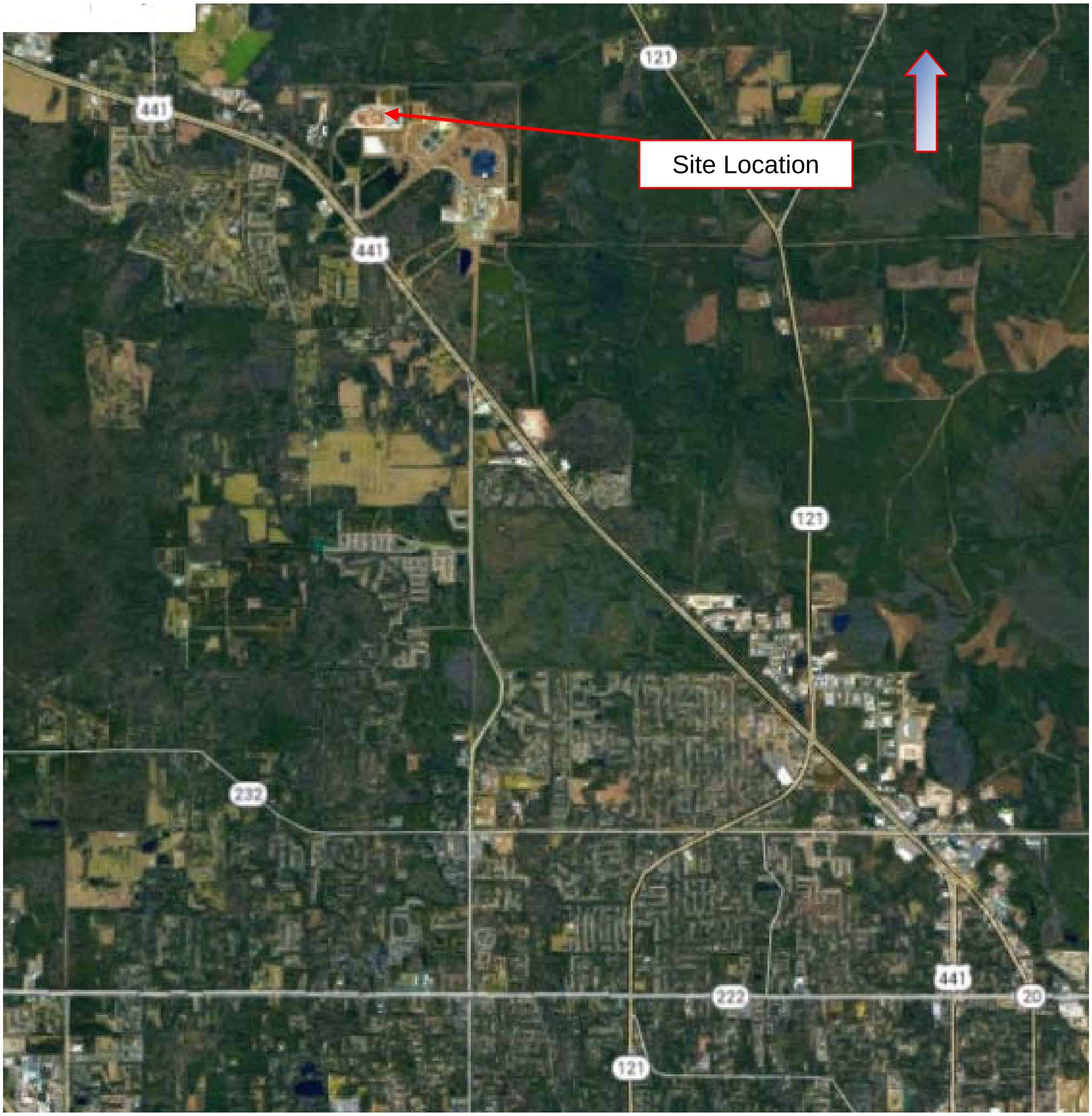
UES, 2006- Report of Geotechnical Consulting Services – Air Quality Control Retrofit, prepared by Universal Engineering Sciences, Inc., Dated 2006.

UES, 2013- Report of Geotechnical Consulting Services – Coal Yard Lighting Poles, prepared by Universal Engineering Sciences, Inc., Dated 2013.

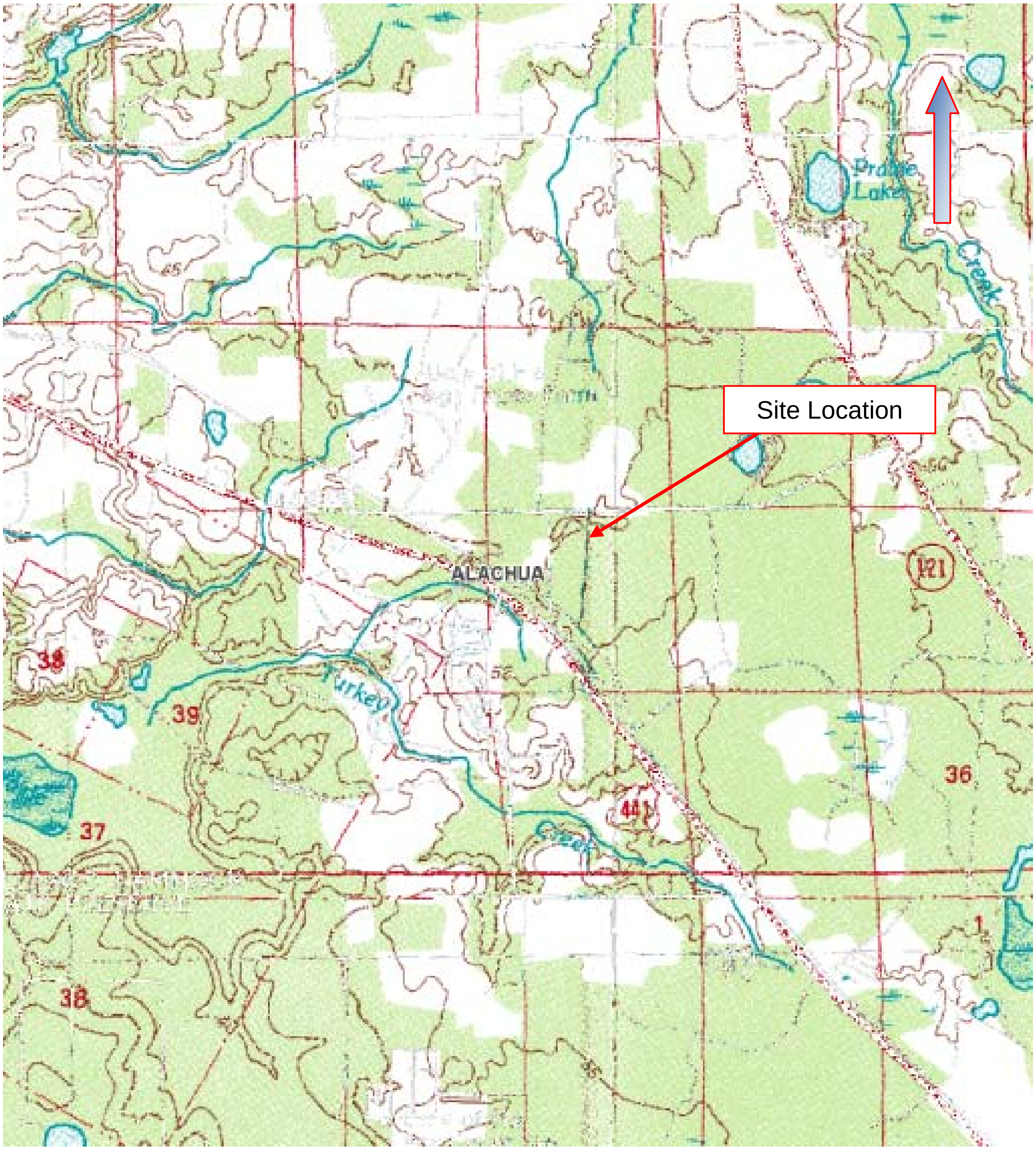
APPENDIX A

SITE AERIAL MAP

U.S.G.S. MAP



UNIVERSAL ENGINEERING SCIENCES	**GRU Deerhaven Generating Station Gainesville, Alachua County, Florida**		
	Site Location Map		
	DATE: 07-14-16	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: A
	SCALE: N.T.S.	REPORT NO.: 1352022	FIGURE NO.:A 1



UNIVERSAL ENGINEERING SCIENCES	**GRU Deerhaven Generating Station Gainesville, Alachua County, Florida**		
	U.S.G.S. Map		
	DATE: 07-14-16	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: A
	SCALE: N.T.S.	REPORT NO.: 1352022	FIGURE NO.:A 2

APPENDIX B

POND AND DIKES AERIAL MAP

	GRU – Deerhaven Generating Station **Embankment and Impoundment Pond Stability** **10001 NW U.S. Highway 441** **Gainesville, Alachua County, Florida**	
	Ponds and Dikes Aerial	
DATE: 07-14-16	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: B
SCALE: N.T.S.	REPORT NO.: 1352022	FIGURE NO.: B 1

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APPENDIX C

PHOTHOGRAPHS

Photograph 1

Photograph 2

Photograph 3

Photograph 4

Photograph 5

Photograph 6

UNIVERSAL ENGINEERING SCIENCES	**GRU – Deerhaven Generating Station Embankment and Impoundment Pond Stability 10001 NW U.S. Highway 441 Gainesville, Alachua County, Florida**		
	Site Photographs		
	DATE: 07-14-16	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: C
	SCALE: N.T.S.	REPORT NO.: 1352022	FIGURE NO.: C 1

 Photograph 7	 Photograph 8
 Photograph 9	 Photograph 10
 Photograph 11	 Photograph 12

UNIVERSAL ENGINEERING SCIENCES	GRU – Deerhaven Generating Station Embankment and Impoundment Pond Stability 10001 NW U.S. Highway 441 Gainesville, Alachua County, Florida		
	Site Photographs		
	DATE: 07-14-16	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: C
	SCALE: N.T.S.	REPORT NO.: 1352022	FIGURE NO.: C 2

Photograph 13

Photograph 14

Photograph 15

Photograph 16

Photograph 17

Photograph 18

UNIVERSAL ENGINEERING SCIENCES	GRU – Deerhaven Generating Station Embankment and Impoundment Pond Stability 10001 NW U.S. Highway 441 Gainesville, Alachua County, Florida		
	Site Photographs		
	DATE: 07-14-16	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: C
	SCALE: N.T.S.	REPORT NO.: 1352022	FIGURE NO.: C 3

Photograph 19

Photograph 20

Photograph 21

Photograph 22

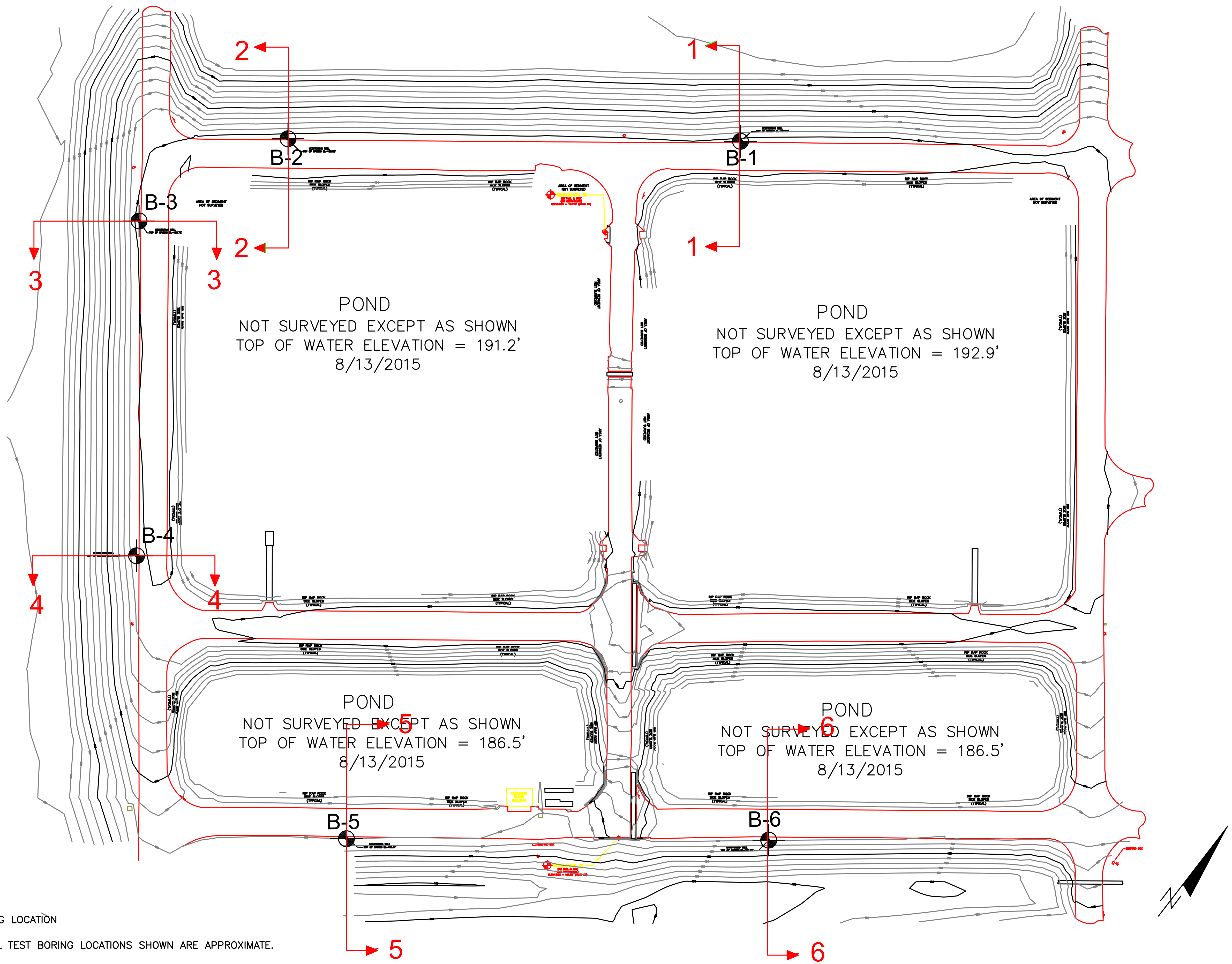
Photograph 23

Photograph 24

UNIVERSAL ENGINEERING SCIENCES	**GRU – Deerhaven Generating Station Embankment and Impoundment Pond Stability 10001 NW U.S. Highway 441 Gainesville, Alachua County, Florida**		
	Site Photographs		
	DATE: 07-14-16	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: C
	SCALE: N.T.S.	REPORT NO.: 1352022	FIGURE NO.: C 4

APPENDIX D

SOIL TEST BORING LOGS - COMPACTION TEST RESULTS



LEGEND

BORING LOCATION

NOTE: ALL SOIL TEST BORING LOCATIONS SHOWN ARE APPROXIMATE.

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES

DRAWN BY: KD DATE: 8/2/16

CHECKED BY: ES DATE: 8/2/16

SCALE: 1"=80' ACADFILE:0230.1500077-D

PROJECT NO: 0230.1500077.0000 REPORT NO:1352022

GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

CROSS SECTION FOR SLOPE STABILITY

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PAGE NO:
D - 1

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0230.1500077.0000
REPORT NO.:	1352022
PAGE:	D-2

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING NO: **B-1** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

GS ELEVATION(ft): 195
WATER TABLE (ft): 3.28
DATE OF READING: 7/17/15
EST. WSWT (ft):

DATE STARTED: 7/9/15
DATE FINISHED: 7/9/15
DRILLED BY: R. WOODARD
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	BLOWS PER 6" INCREMENT	N VALUE	W.T.	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT/ DAY)	ORG CONT. (%)
0				Medium dense brown silty SAND [SM]						
1–2.5	3-5-5	10								
2.5–4	6-5-5	10	▼	Medium dense brown and gray sand, with silt [SP-SM] (3–8 ft)						
4–5.5	5-6-5	11								
5.5–7	6-3-4	7			10	13				
7–8.5	4-2-2	4		Loose brown silty SAND [SM] (8–14 ft)						
8.5–10	2-3-3	6			14	17				
13.5–15	2-4-7	11		Medium dense gray-brown silty clayey SAND [SM-SC] (14–23 ft)						
18.5–20	6-7-7	14								
23.5–25	2-3-4	7		Loose brown SAND, with trace of silt [SP-SM] (23–25 ft)						
25				Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 0230.1500077.0000
REPORT NO.: 1352022
PAGE: D-3

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-2** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

GS ELEVATION(ft): 195
WATER TABLE (ft): 8.07
DATE OF READING: 7/17/15
EST. WSWT (ft):

DATE STARTED: 7/10/15
DATE FINISHED: 7/10/15
DRILLED BY: R. WOODARD
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/DAY)	ORG CONT. (%)
0						Medium dense brown, gray and tan silty SAND, with trace of clay [SM]						
1–2	X	3-4-7	11									
2–3	X	8-9-10	19									
4–5	X	9-10-11	21									
5–7	X	11-9-9	18									
7.5						Medium dense gray very clayey SAND [SC]						
7–8	X	8-8-6	14	▼ (8.07)								
9.3						Medium dense gray silty SAND [SM]						
8–10	X	10-6-6	12									
13.5–15	X	8-10-6	16									
17						Medium dense light gray SAND, with silt [SP-SM]						
18.5–20	X	5-8-10	18									
21						Medium dense brown silty SAND [SM]						
23.5–25	X	4-8-17	25									
25						Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0230.1500077.0000
REPORT NO.:	1352022
PAGE:	D-4

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-3** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHELBY TUBE SAMPLE TAKEN FROM 12' TO 14'

GS ELEVATION(ft): 195
WATER TABLE (ft): 9.4
DATE OF READING: 7/17/15
EST. WSWT (ft):

DATE STARTED: 7/10/15
DATE FINISHED: 7/10/15
DRILLED BY: R. WOODARD
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/DAY)	ORG CONT. (%)
0					Medium dense brown and gray silty SAND, with trace of clay [SM]						
1–2.5	X	4-6-10	16								
2.5–4	X	9-10-12	22								
4–5.5	X	11-14-15	29								
5.5–7	X	19-14-12	26			14	7				
7–8.5	X	14-14-9	23								
9				▼	Medium dense gray and orange clayey SAND [SC]						
8.5–10	X	7-4-6	10			32	20	40	22		
12–14	Shelby tube										
14–15	X	3-4-10	14								
19					Medium dense brown silty SAND [SM]						
18.5–20	X	10-11-17	28								
22					Medium dense white and light brown silty clayey SAND [SM-SC]						
23.5–25	X	2-3-7	10								
25					Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 0230.1500077.0000
REPORT NO.: 1352022
PAGE: D-5

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-4**

SHEET: 1 of 1

SECTION:

TOWNSHIP:

RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHELBY TUBE SAMPLE TAKEN FROM 10' TO 12'

GS ELEVATION(ft): 195
WATER TABLE (ft): 7.95
DATE OF READING: 7/17/15
EST. WSWT (ft):

DATE STARTED: 7/9/15
DATE FINISHED: 7/10/15
DRILLED BY: R. WOODARD
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG CONT. (%)
0						Loose to medium dense brown and tan silty SAND [SM]						
2		4-4-5	9				13	9				
4		8-9-10	19									
5		11-15-19	34									
7		17-14-12	26									
8		13-13-7	20	▼								
9						Loose gray and green clayey SAND [SC]						
10		5-4-4	8				27	21	25	10		
14						Loose to medium dense brown and light gray silty SAND [SM]						
15		1-2-4	6									
20		7-7-17	24									
25		3-5-7	12			Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 0230.1500077.0000
REPORT NO.: 1352022
PAGE: D-6

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-5**
SHEET: 1 of 1

SECTION:
TOWNSHIP:
RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHELBY TUBE SAMPLE TAKEN FROM 5' TO 7'

GS ELEVATION(ft): 188
WATER TABLE (ft): 3.14
DATE OF READING: 7/17/15
EST. WSWT (ft):

DATE STARTED: 7/9/15
DATE FINISHED: 7/9/15
DRILLED BY: R. WOODARD
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	BLOWS PER 6" INCREMENT	N VALUE	W.T.	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG CONT. (%)
0–3	2-3-2	5		Loose light brown SAND, with trace of silt [SP-SM]						
3–7	1-2-3	5	▼ (3.14)	Loose gray and orange clayey SAND [SC]						
	1-2-2	4			26	18	26	12		
	2-3-4	7								
7–12	10-14-13	27		Medium dense to dense brown and tan silty SAND [SM]						
	15-16-19	35								
12–16.5	5-7-11	18		Medium dense gray silty SAND [SM]						
16.5–21.5	3-2-2	4		Loose brown SAND, with silt [SP-SM]	6	18				
21.5–25	7-9-12	21		Medium dense white SAND [SP]						
25				Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0230.1500077.0000
REPORT NO.:	1352022
PAGE:	D-7

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-6**

SHEET: 1 of 1

SECTION:

TOWNSHIP:

RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES

LOCATION: SEE BORING LOCATION PLAN

REMARKS: SHELBY TUBE SAMPLE TAKEN FROM 4' TO 6'

GS ELEVATION(ft): 188

WATER TABLE (ft): 6

DATE OF READING: 7/17/15

EST. WSWT (ft):

DATE STARTED: 7/9/15

DATE FINISHED: 7/9/15

DRILLED BY: R. WOODARD

TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG CONT. (%)
0						Loose brown silty SAND, with trace of clay [SM]						
1												
2		3-4-5	9									
3						Loose dark gray clayey SAND [SC]						
4		4-3-3	6				24	13	23	9		
5												
6		4-3-5	8	▼								
7		6-4-5	9			Loose to dense brown and tan silty SAND, with trace of clay [SM]						
8		7-8-12	20									
9												
10		15-18-18	36									
11												
12												
13						Loose light brown SAND, with silt [SP-SM]						
14												
15		5-4-4	8				11	18				
16												
17												
18						Medium dense white SAND [SP]						
19												
20		4-9-9	18									
21												
22												
23												
24												
25		4-9-12	21			Boring Terminated at 25'						

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KEY TO BORING LOGS

SYMBOLS

22	Number of Blows of a 140-lb Weight Falling 30 in. Required to Drive Standard Spoon One Foot
WOR	Weight of Drill Rods
S	Thin-Wall Shelby Tube Undisturbed Sampler Used
90% Rec.	Percent Core Recovery from Rock Core-Drilling Operations
■	Sample Taken at this Level
□	Sample Not Taken at this Level
—	Change in Soil Strata
▼	Free Ground Water Level
▽	Seasonal High Ground Water Level

RELATIVE DENSITY
(sand-silt)

Very loose – Less Than 4 Blows/Ft.
Loose – 4 to 10 Blows/Ft.
Medium Dense – 10 to 30 Blows/Ft.
Dense – 30 to 50 Blows/Ft.
Very Dense – More Than 50 Blows/Ft.

CONSISTANCY
(clay)

Very Soft – Less Than 2 Blows/Ft.
Soft – 2 to 4 Blows/Ft.
Firm – 4 to 8 Blows/Ft.
Stiff – 8 to 15 Blows/Ft.
Very Stiff – 15 to 30 Blows/Ft.
Hard – More Than 30 Blows/Ft.

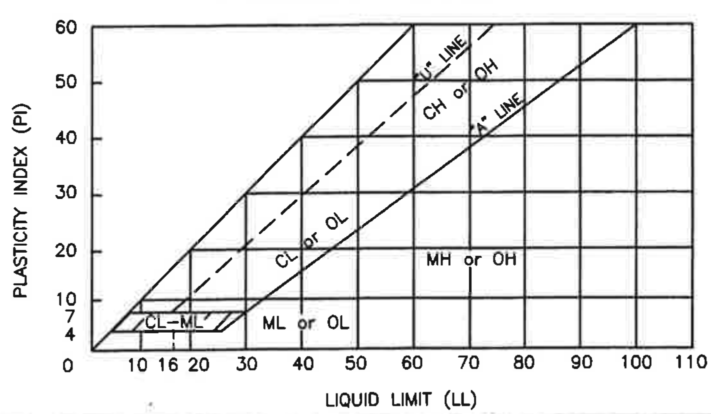
Based on Safety Hammer N-Values

UNIFIED CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	**GRAVELS** 50% or more of coarse fraction retained on No. 200 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	**SILTS AND CLAYS** Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomacaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly organic Soils			PT	Peat, muck and other highly organic soils

* Based on the material passing the 3-in. (75mm) sieve.

PLASTICITY CHART



STANDARD PROCTOR TEST RESULTS
(ASTM D 698)

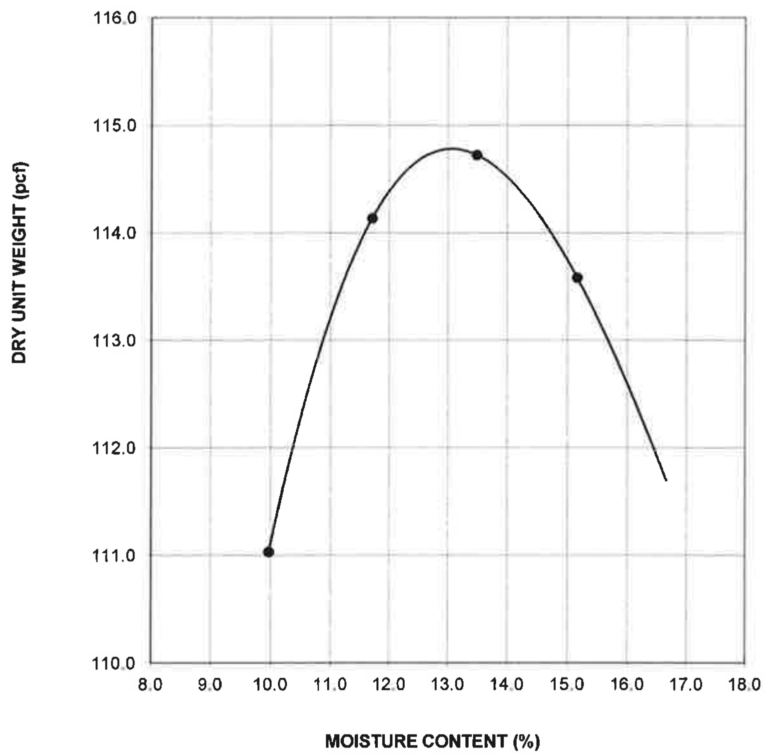
TESTED FOR: Innovative Waste Consulting Services, LLC
6628 NW 9th Blvd., Suite 3
Gainesville, FL 32608

PROJECT: Deerhaven Generating Station
10001 US 441
Gainesville, FL

DATE TESTED: June 30, 2016

REPORT NO: 1352022

SAMPLE LOCATION: P-1
SOIL DESCRIPTION: Dark Brown Silty Sand w/ trace of rock



OPT MOISTURE: **13.0** MAX DENSITY: **114.5**

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4475 S.W. 35TH TERRACE, GAINESVILLE, FL. 32608
(352)372-3392 (352)336-7914 (FAX)

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Construction Materials Testing, Threshold Inspections, Private Provider Inspection
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Certificate of Authorization No. 549

Project No: 230.1500077
Report No.: 1352022
Date: July 8, 2016

REPORT OF IN-PLACE DENSITY TESTS

Client: Innovative Waste Consultants, LLC **Project:** 34th Street HDPE

Area Tested
- [ ] Sanitary Pipe
- [ ] Sanitary Structure
- [ ] Storm Pipe
- [ ] Storm Structure
- [ ] Building Pad
- [ ] Footings
- [ ] Roadway
- [ ] Curb
- [x] Subgrade
- [ ] Other:

Material
- [ ] Fill
- [ ] Backfill
- [ ] Native
- [x] Embankment
- [ ] Limerock
- [ ] Stabilization
- [ ] Other:

Referenced From
- [x] Top
- [ ] Springline
- [ ] Bottom

"OF"
- [ ] Fill
- [ ] Native
- [ ] Footing
- [ ] Pipe
- [ ] Structure
- [ ] Berm
- [ ] Base Course
- [ ] Subgrade
- [x] Other: Slope surface

Field Test Performed
- [x] ASTM D-2937 Drive Cylinder Method
- [ ] ASTM D-6938 Nuclear Gauge Method
- [ ] ASTM D-1556 Sand Cone Method
- [ ] ASTM D-558 Soil Cement Field Proctor

Laboratory Testing
- [ ] ASTM D-1557 Modified Proctor
- [ ] ASTM D-698 Standard Proctor
- [ ] AASHTO T180 Modified Proctor
- [x] AASHTO T99 Standard Proctor
- [ ] FM 5-515 LBR
- [ ] ASTM D-1883 CBR

Report Left on Site?
- [ ] Yes (With Whom?) ____________
- [ ] No (Reason?) ____________

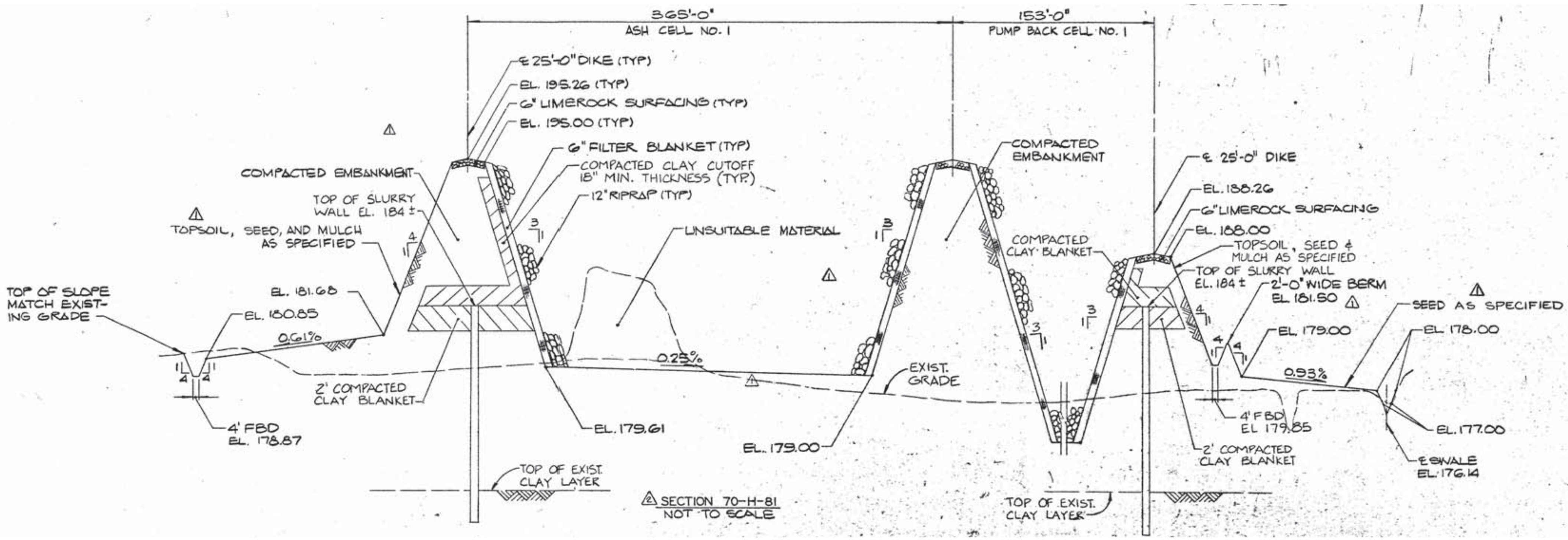
Compaction Requirement = 90%

Date Tested:

			Lab Test Results			Field Test Results				
Test No.	**Location of Test**	**Depth or Elevation**	**Sample Number**	**Maximum Density (pcf)**	**Optimum Moisture (%)**	**Wet Density (pcf)**	**Dry Density (pcf)**	**Field Moisture (%)**	**Compaction (%)**	**PASS FAIL**
B	Test #1	1 ft	-	114.5	13.0	106.0	101.9	4.0	89	
B	Test #2	1 ft	-	114.5	13.0	108.0	103.4	4.4	90	
C	Test #3	1 ft	-	114.5	13.0	111.0	102.7	8.1	90	

APPENDIX E

IMPOUNDMENT CROSS SECTIONS



365'-0"
ASH CELL NO. 1
153'-0"
PUMP BACK CELL NO. 1
℄ 25'-0" DIKE (TYP)
EL. 195.26 (TYP)
6" LIMEROCK SURFACING (TYP)
EL. 195.00 (TYP)
6" FILTER BLANKET (TYP)
COMPACTED CLAY CUTOFF 18" MIN. THICKNESS (TYP.)
12" RIPRAP (TYP)
COMPACTED EMBANKMENT
TOP OF SLURRY WALL EL. 184 ±
TOPSOIL, SEED, AND MULCH AS SPECIFIED
UNSUITABLE MATERIAL
TOP OF SLOPE MATCH EXISTING GRADE
EL. 181.68
EL. 180.85
0.61%
0.25%
2' COMPACTED CLAY BLANKET
4' FBD EL. 178.87
EL. 179.61
EL. 179.00
EXIST. GRADE
COMPACTED EMBANKMENT
COMPACTED CLAY BLANKET
℄ 25'-0" DIKE
EL. 188.26
6" LIMEROCK SURFACING
EL. 188.00
TOPSOIL, SEED & MULCH AS SPECIFIED
TOP OF SLURRY WALL EL. 184 ±
2'-0" WIDE BERM EL. 181.50
SEED AS SPECIFIED
EL. 179.00
EL. 178.00
0.93%
4' FBD EL 179.85
EL. 177.00
2' COMPACTED CLAY BLANKET
℄ SWALE EL. 176.14
TOP OF EXIST. CLAY LAYER
TOP OF EXIST. CLAY LAYER
SECTION 70-H-81
NOT TO SCALE

APPENDIX F

GBA 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.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in 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.

Geotechnical-Engineering 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 given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives 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 this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- 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. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include 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.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering 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 subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GBA GEOPROFESSIONAL BUSINESS ASSOCIATION

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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.