GEO-TECH, INC.

ENGINEERING CONSULTANTS IN GEOTECHNICAL • ENVIRONMENTAL • CONSTRUCTION MATERIALS TESTING

October 10, 2023
Project No. 23-3006.206.1

Oscar E. Tovar, P.R.
City of Ocala Engineering Department
1805 NE 30th Avenue, Building 700
Ocala, Florida 34470

Reference: Proposed North Complex Project, Parcel No. 24264-000-00, NE 21st Street
Ocala, Florida
Geotechnical Site Evaluation

Dear Mr. Tovar:

Geo-Technologies, Inc. (Geo-Tech) completed a geotechnical site evaluation of the project site as requested by you. Services were conducted in accordance with our Proposal No. 13480 Revision A dated May 9, 2023.

Our findings, evaluations and recommendations are presented in the following report. Generally accepted soils and foundation engineering practices were employed in the preparation of this report.

Proposed finish floor elevations and loading conditions had not been established at the time of this report. Design of building foundation system was not included in Geo-Tech's scope of services for this project.

Geo-Tech appreciates the opportunity to provide our services for this project. Should you have any questions regarding the contents of this report or if we may be of further assistance, please do not hesitate to contact the undersigned.

Sincerely,

Gerald W. Green, Jr.
Soil & Water Scientist

Craig A. Hampy, P.E.
Florida Registration No. 83240

CRAIG AUSTIN HAMPY LICENSE No 83240 STATE OF FLORIDA PROFESSIONAL ENGINEER

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Purposes
Purposes of this evaluation were to characterize subsurface soils conditions in the proposed drainage retention, pavement and building areas and to provide geotechnical engineering site preparation recommendations to guide design and construction of the drainage retention area, pavement area and building foundation system.

Site Description
The site is located at Parcel No. 24264-000-00 on the north side of NE 21st Street in Ocala, Florida. The site was covered with native trees and grasses at the time of drilling.

Exploration Program
Field exploration services for this geotechnical site evaluation consisted of the following:

Drainage Retention Area
- Two (2) direct push borings (SB-1 and SB-2) to depths of approximately twenty (20) feet below existing site grade in the proposed drainage retention area (ASTM D-6282). Direct Push borings were performed on September 28, 2023.

- Two (2) field horizontal and two (2) field vertical permeability tests in the proposed drainage retention area. Permeability testing was performed on October 9, 2023.

Pavement Area
- One (1) direct push boring (R-1) to a depth of approximately ten (10) feet below existing site grade in the proposed pavement area (ASTM D-6282). Our direct push boring was performed on September 28, 2023.

Building Area
- One (1) Standard Penetration Test (SPT) boring (B-1) to a depth of approximately twenty (20) feet below existing site grade in the proposed building area (ASTM D-1586). Our SPT boring was performed on September 28, 2023.

Boring locations were determined in the field based on the site plan provided by Tillman & Associates Engineering, LLC.

Sampling & Testing Descriptions

Direct Push Sampling
Direct Push (DP) soil sampling method (ASTM D-6282) consists of advancing a sampling device into subsurface soils by applying static pressure, by applying impacts, or by applying vibration, or any combination thereof, to the above ground portion of the sampler extensions until sampler has been advanced to the desired sampling depth. The sampler is recovered from the borehole and the sample removed from the sampler. The sampler is cleaned and the procedure repeated for the next desired sampling interval.

Sampling can be continuous for full depth borehole logging or incremental for specific interval sampling. Samplers used can be protected type for controlled specimen gathering or unprotected for general soil specimen collection. Direct push methods of soil sampling are used for geologic investigation, soil chemical composition studies, and water quality investigations. Continuous sampling is used to provide a lithological detail of the subsurface strata and to gather samples for classification and index.

Samples recovered during performance of our direct push borings were visually classified in the field and were transported to our laboratory for further analysis.

Gradation (-200) Testing
A specimen of soil is washed over a seventy-five (75) µm (No. 200) sieve. Clay and other particles that are dispersed by the wash water, as well as water-soluble materials, are removed from the soil during the test. The loss in mass resulting from the wash treatment is calculated as mass percent of the original sample and is reported as the percentage of material finer than a seventy-five (75) µm (No. 200) sieve by washing.

Standard Penetration Testing
A Standard Penetration Test (SPT) boring (ASTM D-1586) is defined as a standard split-barrel sampler driven into the soil by a one hundred and forty (140) pound hammer falling thirty (30) inches. The number of blows required to drive the sampler one (1) foot, after seating six (6) inches, is designated resistance, or "N"-Value is an index to soil strength and consistency.

Samples recovered during performance of our SPT borings were visually classified in the field and representative portions of the samples were placed in containers and transported to our laboratory for further analysis.

Findings

Drainage Retention Area
General subsurface conditions found in borings SB-1 and SB-2 are graphically presented on the soil profiles in Appendix I. Horizontal lines designating the interface between differing materials found represent approximate boundaries. Transition between soil layers is typically gradual.

Soils found in boring SB-1 generally consisted of a surficial layer of construction debris (asphalt and limerock) approximately two (2) feet thick underlain by clayey sand, fine sand and slightly sandy clay to the depth drilled.

Soils found in boring SB-2 generally consisted of a surficial layer of slightly clayey sand approximately four (4) feet thick underlain by fine sand, clayey sand and slightly sandy clay to the depth drilled.

Groundwater was not found in our borings at the time of drilling.

Seasonal High Water Table Levels
Estimated seasonal high water table levels were found in our borings at depths ranging from approximately six and one-half (6 ½) to ten and one-half (10 ½) feet below existing site grade.

Estimated seasonal high water table levels are indicated on the soil profiles at the appropriate depths.

Confining Layers
Confining layers were found in our borings at depths ranging from approximately seven and one-half (7 ½) to eleven and one-half (11 ½) feet below existing site grade. Confining layers are indicated on the soil profiles at the appropriate depths.

Permeability
Two (2) field horizontal and two (2) field vertical permeability tests were performed adjacent to our boring locations at depths ranging from approximately three (3) to nine (9) feet below existing site grade.

Resulting coefficients of horizontal and vertical permeability are noted on the soil profiles and in Table 1 below.

Table 1 Permeability Testing Results

Boring No.	Depth of Test (feet)	K_H Rate (feet/day)	K_V Rate (feet/day)
SB-1	9.0	1.8	1.4
SB-2	3.0	28.6	-
SB-2	7.0	-	6.3

- = not tested

Geo-Tech utilizes the U.S. Department of the Navy, Naval Facilities Engineering Command (1974) Standard methods for performing variable head tests to determine and calculate hydraulic conductivities.

Measured permeability rates should not be used for design purposes without an appropriate safety factor. Actual pond exfiltration rates will depend on many factors such as ground water mounding, pond bottom siltation, construction technique, and the amount of soil compaction during construction.

Pavement Area
General subsurface conditions found in boring R-1 are graphically presented on the soil profile in Appendix I. Horizontal lines designating the interface between differing materials found represent approximate boundaries. Transition between soil layers is typically gradual.

Soils found in boring R-1 generally consisted of a surficial layer of fine sand approximately two and one-half (2 ½) feet thick underlain by clayey sand and slightly sandy clay to the depth drilled.

Groundwater was not found in our boring at the time of drilling.

Building Area
General subsurface conditions found in boring B-1 are graphically presented on the soil profile in Appendix I. Horizontal lines designating the interface between differing materials found represent approximate boundaries. Transition between soil layers is typically gradual.

Soils found in boring B-1 generally consisted of a surficial layer of loose clayey sand approximately two (2) feet thick underlain by medium dense fine sand, medium dense clayey sand and stiff slightly sandy clay to the depth drilled.

Groundwater was not found within ten (10) feet below existing site grade in our boring at the time of drilling.

Gradation (-200) Testing Results
Slightly clayey sand and clayey sand soils found in our borings yielded passing fines ranging from ten (10) to twenty-six (26) percent on the samples tested. We refer the reader to the attached soil profiles for the various soils found.

Evaluations and Recommendations

Pavement Area
Shallow fine sand soils found in our boring appear to be suitable material for pavement construction but will likely need to be stabilized prior to the addition of the limerock basecourse and asphalt pavement.

Clayey sand and slightly sandy clay soils found in our boring typically exhibit moderate to high shrink/swell behavior with moisture content changes. Generally, these clay soils will swell upon wetting and shrink upon drying thus causing movement of structures placed on them.

Geo-Tech recommends a minimum separation of two (2) feet be maintained from the base of the stabilized subgrade to the top of unsuitable clay soils.

General Pavement Construction Recommendations
The following are our recommendations for overall site preparation and mechanical densification work for the pavement construction portion of the project, based on the anticipated construction and our boring results. These recommendations should be used as a guideline for the project general specifications, which are prepared by the Design Engineer. Site preparation and filling should be in accordance with the latest edition of the Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction and Standard Index 505.

1. The pavement area plus a five (5) foot margin should be stripped and cleared of surface vegetation, organic or root laden topsoil, and grubbed of roots and stumps. Organic soil or near surface clays and silts found and any other soils with organic content in excess of five (5) percent should be overexcavated or hauled elsewhere for restricted use as permitted by FDOT Indexes 500 and 505. A representative of our firm should observe the stripped grade to document adequate depth of stripping prior to filling.

2. The stripped area should be leveled sufficiently to permit equipment traffic, cut to grade if necessary, and then compacted using a large diameter, self-propelled, or tractor drawn vibratory roller. The vibratory drum roller should have a static drum weight of about four (4) tons and should be capable of exerting a minimum impact force of fifteen (15) tons. Careful observations should be made during proof-rolling to help identify any areas of soft yielding soils that may require overexcavation and replacement. Care should be used when operating the compactor near existing structures to avoid transmissions of vibrations that could cause settlement damage or disturb occupants. Use of smaller vibratory or static compactor may be necessary in some instances. Construction operations that may be affected by vibration, such as pouring concrete, should be scheduled at times when nearby compaction operations are not taking place.

3. Prior to beginning compaction, soil moisture contents may need to be controlled in order to facilitate proper compaction. If additional moisture is necessary to achieve compaction objectives, then water should be applied in such a way that it will not cause erosion or removal of the subgrade soils. Moisture content within two (2) percentage points of the optimum indicated by the Modified Proctor test (ASTM D-1557) is recommended.

4. A minimum of ten (10) overlapping passes should be made by the vibratory drum roller across the stripped or cut ground surface. Compaction should continue to develop a minimum density requirement of ninety-eight (98) percent of the maximum Modified Proctor dry density established in accordance with ASTM D-1557, for a minimum depth of two (2) feet below the compacted surface, as determined by field density (compaction) test or in accordance with FDOT Index 505, whichever is higher.

5. Following satisfactory completion of the initial compaction on the existing grade, the pavement area may be brought up to finished subgrade levels if required. Fill should consist of fine sand with between three (3) to twelve (12) percent by dry weight passing a US Standard No. 200 sieve, free of rubble, organics, clay, debris, and other unsuitable material. **All structural fill should be pre-qualified prior to importing and placing.** Soils removed from the building cut areas can be used in this area also. Approved sand fill should be placed in loose lifts not exceeding twelve (12) inches in thickness and should be compacted to a minimum of ninety-eight (98) percent of the maximum Modified Proctor dry density. Density tests to confirm compaction should be performed in each fill lift before the next lift is placed.

6. Undercutting clayey soils should follow the recommendations in the previous section.

7. A representative from our firm should be retained to provide on-site observation of earthwork activities. The field technician would monitor the excavation of detrimental soil such as organics and plastic soils, placement of approved fills, proof-rolling and provide compaction testing. Density tests should be performed in surficial sands after proof rolling and in each fill lift thereafter. It is important that careful observation be made to confirm that the subsurface conditions are as we have discussed herein, and that foundation construction and fill placement is in accordance with our recommendations.

Flexible/Semi-Flexible Pavement Structure
Limerock could be considered as a base course for this site. Normal wet season groundwater levels should be controlled to at least eighteen (18) inches below a limerock base or associated stabilized subgrade (clean sand subgrade stabilized with a suitable imported cohesive soil), if one is used. Traffic loading conditions were not supplied to Geo-Tech at the time of this report writing, however, this design has been used as a general pavement section design and should be reviewed by Geo-Tech after loading conditions have been established.

As a guideline for pavement design, we recommended that the base course be a minimum of six (6) inches thick in standard parking areas and should be compacted to at least ninety-eight (98) percent of the Modified Proctor maximum dry density. A stabilized subgrade (LBR= forty [40]) should be used below the limerock base course. Stabilized subgrade soils should be a minimum of eight (8) inches (standard pavement section) to twelve (12) inches (heavy pavement section) thick and should be compacted to at least ninety-eight (98) percent of the Modified Proctor maximum dry density. Limerock should conform to FDOT specifications and should have a minimum LBR value of one-hundred (100), and should be compacted to at least ninety-eight (98) percent of the Modified maximum dry density (ASTM D-1557).

At a minimum, the asphaltic concrete wearing surface should consist of at least one and one-half (1½) inches of either Superpave 9.5 or Superpave 12.5 asphaltic concrete meeting current Florida Department of Transportation specifications and placement and compaction procedures. **Specific requirements for asphaltic concrete are outlined in sections 333 and 331 in FDOT Standard Specifications for Road and Bridge Construction – latest edition.** Superpave 9.5, although somewhat more expensive, offers increased stability. Superpave 12.5, which is more durable, should not be used unless the surface course is at least one and one-half (1½) inches thick because of the coarse aggregate. Superpave 9.5, which is somewhat finer aggregate, is also relatively durable and can be used in one (1) inch thickness. Superpave 9.5 or Superpave 12.5 is the preferred surface course. It is, however, important to point out that many combinations of asphaltic concrete, base course, and stabilized subgrade can be considered and that the above suggestions/guidelines are based only on our past experience with similar projects.

Rigid Pavement Structure
Experience has indicated that high quality concrete placed on compacted free draining clean natural or fill subgrade can provide satisfactory, long-term performance as a pavement wearing surface. Good performance and low maintenance is highly dependent on satisfactory subgrade drainage and closely spaced joints. A control pattern of fifteen (15) feet by fifteen (15) feet is highly recommended by the Florida Concrete Products Association. We suggest that there should be at least twenty-four (24) inches between the bottom of the surface course and the seasonal high groundwater table.

Pavement thickness and concrete design strength will depend on such variables as anticipated wheel loads, number of load applications, and the subgrade LBR value of the native soils. Based on our local experience, Geo-Tech recommends stabilizing the subgrade beneath all concrete pavements to a depth of twelve (12) inches and a minimum LBR of forty (40). Reinforcement should consist of 6"x 6" ten (10) gauge wire mesh.