Preliminary Geotechnical Engineering Report

St. Anthony Coptic Orthodox Church
Stormwater and Civil Engineering Improvements
Maitland, Florida

August 15, 2014
Terracon Project No. H1145129

Prepared for:
St. Anthony Orthodox Church
Maitland, Florida

Prepared by:
Terracon Consultants, Inc.
Winter Park, Florida

August 15, 2014

St. Anthony Coptic Orthodox Church
1185 N. Wymore Road
Maitland, Florida 32751

Attn: Fr. Daoud Towadrous
P: [321] 422 0944

Re: Preliminary Geotechnical Engineering Report
St. Anthony Coptic Orthodox Church
Stormwater and Civil Engineering Improvements
Maitland, Orange County, Florida
Terracon Project Number: H1145129

Dear Fr. Towadrous:

Terracon Consultants, Inc. (Terracon) has completed the preliminary geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number PH1140531 dated July 10, 2014.

This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations concerning pavement and stormwater management system design for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
Certificate of Authorization Number 8830

Shenna McMaster, P.E. 8/18/14
Senior Geotechnical Engineer
Florida PE #57537

Bruce H. Woloshin, P.E.
Principal

Enclosures

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Preliminary geotechnical exploration has been performed for the proposed improvements to the St. Anthony Coptic Orthodox Church site located at North Wymore Road and Wymore Road in Maitland, Florida. Two (2) borings, designated as P-1 and P-2, have been performed to a depth of 20 feet below the existing ground surface in the proposed stormwater treatment areas. Structures were not included in this study.

Based on the information obtained from our geotechnical exploration, the following geotechnical considerations were identified:

- Soil conditions observed consisted of fine sand (SP) to depths of 8 to 13.5 feet underlain by fine sand with silt (SP-SM).
- Groundwater was not observed within the upper 10 feet of the borings. Seasonal high groundwater levels are anticipated to be approximately 8 to 10 feet below existing grade at the boring locations.
- Typical pavement sections are appropriate for use at this site.
- Use of dry stormwater ponds and underground stormwater systems appear feasible at this site. The depth to the seasonal high groundwater level should be considered in stormwater system design.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
ST. ANTHONY COPTIC ORTHODOX CHURCH
1185 NORTH WYMORE ROAD
MAITLAND, FLORIDA

Terracon Project No. H1145129
August 15, 2014

1.0 INTRODUCTION

Preliminary geotechnical exploration has been performed for the proposed improvements to the St. Anthony Coptic Orthodox Church site located at North Wymore Road and Wymore Road in Maitland,, Florida as shown on the Topographic Vicinity Map included as Exhibit A-1 in Appendix A. Two (2) borings, designated as P-1 and P-2, have been performed to a depth of 20 feet below the existing ground surface in the proposed stormwater treatment areas. Structures were not included in this study. Logs of the borings along with a Boring Location Diagram (Exhibit A-4) are included in Appendix A of this report. Laboratory testing procedures are included in Exhibit B-1 in Appendix B.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- stormwater management design parameters
- pavement design and construction

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site Layout	The proposed re-development of the site is anticipated to include three (3) one- to two-story structures in the center of the site. Paved parking and driveway areas are planned along the perimeter of the site. The general site layout is included on the Boring location Plan (Exhibit A-4).
Pavements	Preliminary only. Anticipated to include mostly passenger cars.
Stormwater Management System	A stormwater pond is planned on the southwestern portion of the site. An underground stormwater system may also be constructed in the northwestern portion of the site.

2.2 Site Location and Description

Item	Description
Location	North Wymore Road at I-4 (southeast) 28.639926° N 81.386993° W
Current Ground Cover	Various, existing building, parking and drive areas and sidewalks.
Existing Topography	The site currently appears to be sloping from northeast to southwest. Site specific topographic information provided indicates that ground surface elevations range from about +115 feet near the bottom of the embankment slope for Wymore Road on the northern portion of the site to +108 feet near the southwest corner of the site.
Surface Water	The USGS topographic quadrangle map "Forest City, Florida" depicts multiple lakes in the vicinity of the site with recorded water levels near +95 feet.

3.0 SUBSURFACE CONDITIONS

3.1 Soil Survey

The Soil Surveys of Orange and Seminole Counties, Florida as prepared by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS; later renamed the Natural Resource Conservation Service - NRCS), identifies the soil type at the subject site as *Urban land (34 in Seminole County and 50 in Orange County)*. It should be noted that the Soil Survey is not intended as a substitute for site-specific geotechnical exploration; rather it is a useful tool in planning a project scope in that it provides information on soil types likely to be encountered. Boundaries between adjacent soil types on the Soil Survey maps are approximate (included in Appendix as Exhibit A-2). Descriptions of the mapped soil units are included in Appendix A as Exhibit A-3.

3.2 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
Surface	1	Pavement or topsoil	N/A
1	8 to 13.5	Fine sand (SP)	Loose to Medium Dense
2	greater than 20[2]	Fine sand with silt (SP-SM)	Medium Dense

Conditions encountered at each boring location and results of laboratory testing are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report. Descriptions of our field exploration are included as Exhibit A-5 in Appendix A. Descriptions of our laboratory testing procedures are included as Exhibit B-1 in Appendix B. General notes for SPT borings can be found in Exhibit C-1. A more detailed description of the Unified Soil Classification System (USCS) is included as Exhibit C-2 in Appendix C.

3.3 Groundwater

The boreholes were observed during drilling for the presence and level of groundwater. Groundwater was not observed in the borings within a depth of 10 feet. Due to the use of driller's mud to stabilize boreholes, accurate groundwater levels could not be measured below a depth of 10 feet. Longer term monitoring in cased holes or piezometers, possibly installed to greater depths than explored under this project scope, would be required to better define groundwater conditions at the site.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the boring was performed. In addition, perched water can develop within higher permeability soils overlying less permeable soils. Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the boring logs.

We estimate that during the normal wet season (typically June through October) with rainfall and recharge at a maximum, groundwater levels will be about 8 to 10 feet below the existing grade at the boring locations, corresponding to approximate elevation +101 feet. Our estimates of the seasonal groundwater conditions are based on the USDA Soil Survey, available survey data, the encountered soil types, recent weather conditions, and the encountered water levels. The estimated normal seasonal high groundwater tables are included in the following table:

Boring No.	Approximate Ground Surface Elevation estimated from site plan (elev. feet)	Approximate depth to encountered water table (feet)	Approximate elevation to estimated normal seasonal high groundwater table (elev. feet)
P-1	+109	>10	+101
P-2	+111	>10	+101

These seasonal water table estimates do not represent the temporary rise in water table that occurs immediately following a storm event, including adjacent to other stormwater management facilities. This is different from static groundwater levels in wet ponds and/or drainage canals which can affect the design water levels of new, nearby ponds. The seasonal high water table may vary from normal when affected by extreme weather changes, localized or regional flooding, karst activity, future grading, drainage improvements, or other construction that may occur on our around the site following the date of this report.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Borings encountered sand to sand with silt with seasonal high groundwater levels expected to be at least 8 feet below existing grade. These conditions are generally suitable for construction of the dry bottom stormwater systems and normal pavement sections following the recommended Earthwork portions of this report.

Seasonal high groundwater levels should be considered in the civil engineering design for site grading, utility construction, and pavements.

We recommend that the exposed subgrade be thoroughly evaluated after stripping of any topsoil and creation of all cut areas, but prior to the start of structural fill operations (if any). We recommend that Terracon be retained to evaluate the satisfactory preparation of the bearing material for the pavements. Proposed structures are not included in this report.

Design and construction recommendations are outlined below.

4.2 Earthwork

4.2.1 Site Preparation

Prior to placing any fill, existing structures and pavements, all vegetation, topsoil, possible fill material and any otherwise unsuitable material should be removed from the construction areas. Wet or dry material should either be removed or moisture conditioned and re-compacted. After stripping and grubbing and achieving cut grades, the exposed surface should be proofrolled in proposed pavement areas to aid in locating loose or soft areas. Proofrolling should be avoided in stormwater treatment areas. Proof-rolling can be performed with appropriate heavy equipment to obtain a minimum compaction as defined in Section 4.2.3. Unstable soil (pumping) should be removed or moisture conditioned and compacted in place prior to placing fill.

Where fill is placed on existing slopes, we recommend that fill slopes be over filled and then cut back to develop an adequately compacted slope face. Slopes should be provided with appropriate erosion protection.

4.2.2 Material Requirements

Compacted structural fill within pavement areas should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement	Maximum Lift Thickness (in.)
General [1]	SP (fines content < 5%)	All locations and elevations	12[3]
	SP-SM (fines content between 5 and 12%)[2]	All locations and elevations outside of stormwater treatment areas, except strict moisture control will be required during placement, particularly during the rainy season.	8 to 12[3]

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris.
2. Loose thickness when heavy compaction equipment is used in vibratory mode. Lift thickness should be decreased if static compaction is being used, typically to no more than 8 inches, and the required compaction must still be achieved. Use 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is required. Over-compaction should be avoided in stormwater treatment areas.

4.2.3 Compaction Requirements-Pavement Areas

Item	Description
Minimum Compaction Requirements [1]	95 percent of the material's maximum modified Proctor dry density (ASTM D 1557).
Moisture Content [2]	Within ±2 percent of optimum moisture content as determined by the Modified Proctor test, at the time of placement and compaction.
Minimum Testing Frequency	One field density test per 10,000 square feet or fraction thereof per 1-foot lift.

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

4.2.4 Earthwork Construction Considerations

After initial proofrolling and compaction, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and re-compacted prior to pavement construction.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The Grading Contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of pavements.

4.3 Pavements

4.3.1 Subgrade Preparation

Site grading is typically accomplished relatively early in the construction phase. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy traffic from concrete trucks and other delivery vehicles disturbs the subgrade and many surface irregularities are filled in with loose soils to temporarily improve ride comfort. As a result, the pavement subgrades, initially prepared early in the project, should be carefully evaluated as the time for pavement construction approaches.

We recommend the moisture content and density of the top 12 inches of the subgrade be evaluated and the pavement subgrades be proofrolled and tested within two days prior to commencement of actual paving operations. Compaction tests should be performed at a frequency of 1 test per 10,000 square feet or fraction thereof. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and re-compacted. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are found should be repaired by removing and replacing the materials with properly compacted fills.

After proofrolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified and prepared as recommended in Section **4.2** of the **Earthwork** section this report to provide a uniform subgrade for pavement construction. Areas that appear severely desiccated following site stripping may require further undercutting and moisture conditioning. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

4.3.2 Design Considerations

Traffic patterns and anticipated loading conditions were not available at the time that this report was prepared. However, we anticipate that traffic loads will be produced primarily by automobile traffic and occasional delivery and trash removal trucks. The thickness of pavements subjected to heavy truck traffic should be determined using expected traffic volumes, vehicle types, and vehicle loads and should be in accordance with local, city or county ordinances.

Pavement thickness can be determined using AASHTO, Asphalt Institute, PCA, and/or other methods if specific wheel loads, axle configurations, frequencies, and desired pavement life are provided. Terracon can provide thickness recommendations for pavements subjected to loads other than personal vehicle and occasional delivery and trash removal truck traffic if this information is provided. However, absent that data, we recommend the following minimum typical sections.

4.3.3 Estimates of Minimum Pavement Thickness

Typical Pavement Section (inches)						
Traffic Area	**Alternative**	**Asphalt Concrete Surface Course**	**Limerock, Soil-Cement or Crushed Concrete Base Course**	**Stabilized Subbase Course[2,3,4]**	**Portland Cement Concrete**	**Free Draining Subgrade**
Car Parking	PCC	--	--		5.0	18.0
	AC	1.5	6.0	12.0	--	--
Truck and Drive Areas	PCC	--	--		6.0	18.0
	AC	2.5	8.0	12.0	--	--
Trash Container Pad [1]	PCC	--	--		6.0	18.0

1. The trash container pad should be large enough to support the container and the tipping axle of the collection truck.
2. Often referred to as Stabilized Subgrade.
3. Use coarse granular materials such as recycled crushed concrete, shell, or gravel.
4. Some municipalities do not require stabilized subbase beneath soil-cement base.

4.3.4 Asphalt Concrete Design Recommendations

The following items are applicable to asphalt concrete pavement sections.

- Terracon recommends a minimum separation of 12 inches between the bottom of the base course and the seasonal high water table.
- Natural or fill subgrade soils to a depth of 18 inches below the base should be clean, free draining sands with a fines content passing a No. 200 sieve of 7 percent or less.
- Stabilized subgrade soils (also identified as stabilized subbase) should be stabilized to a minimum Limerock Bearing Ratio (LBR; Florida Method of Test Designation FM 5-515) value of 40 if they do not already meet this criterion, or modified/replaced with new compacted fill that meets the minimum LBR value. Although LBR testing has not been performed, our experience with similar soils indicates that the near surficial sands encountered in the soil borings are unlikely to meet this requirement.
- The stabilized subgrade course should be compacted to at least 98 percent of the Modified Proctor maximum dry density (AASHTO T-180 or ASTM D-1557). Any underlying, newly-placed subgrade fill need only be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density. Compaction tests should be performed at a frequency of 1 test per 10,000 square feet or fraction thereof.

- Limerock base courses from an approved FDOT source should have a minimum LBR value of 100, and be compacted to a minimum of 98 percent of the maximum dry density as determined by the Modified Proctor test. Limerock should be placed in uniform lifts not to exceed 6 inches loose thickness. Recycled limerock is not a suitable substitute for virgin limerock for base courses but may be used as a granular stabilizing admixture.

- Soil cement base courses typically experience shrinkage cracking due to hydration curing of the cement. This shrinkage cracking typically propagates through the overlying asphalt course and reflects in the pavement surface. This reflective cracking is not necessarily indicative of a pavement structural failure, though it is sometimes considered to be aesthetically undesirable.

- Soil cement bases should have 7-day design strength of 300 psi. Soil cement base should be compacted to a minimum of 98 percent of the material's maximum dry density as determined by the Standard Proctor Test for Soil Cement (AASHTO T-134). Higher design strengths may result in increased cracking.

- Crushed (recycled) concrete base should meet the current FDOT Specification 204 for recycled materials.

- Asphalt should be compacted to a minimum of 95 percent of the design mix density. Asphalt surface courses should be Type SP, Type S, or other suitable mix design according to FDOT and local requirements.

- To verify thicknesses, after placement and compaction of the pavement courses, core the wearing surface to evaluate material thickness and composition at a minimum frequency of 5,000 square feet or two locations per day's production.

- Underdrains or strip drains should be considered along all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils. Underdrains will also be required below pavement if the separation between the bottom of the base course and the seasonal high groundwater table is less than 1 foot.

- All curbing should be full depth. Use of extruded curb sections which lie on top of asphalt surface courses can allow migration of water between the surface and base courses, leading to rippling and pavement deterioration.

4.3.5 Portland Cement Concrete Design Recommendations

The following items are applicable to rigid concrete pavement sections.

- At least 18 inches of free-draining material should be included directly beneath rigid concrete pavement. Fill meeting the requirements presented in Section 4.2 (Earthwork) of this report may be considered free-draining for this purpose. Limerock should not be considered free draining for this purpose.

- The PCC should be a minimum of 4,000 psi at 28 days. PCC pavements are recommended for trash container pads and in any other areas subjected to heavy wheel loads and/or turning traffic.

- The upper 1 foot of rigid pavement subgrade soils should be compacted to at least 98 percent of the Modified Proctor maximum dry density (AASHTO T-180 or ASTM D-1557). Compaction tests should be performed at a frequency of 1 test per 10,000 square feet or fraction thereof.

- Rigid PCC pavements will perform better than ACC in areas where short-radii turning and braking are expected (i.e. entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavement will perform better in areas subject to large or sustained loads. An adequate number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI and/or AASHTO requirements. Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.

- Adequate separation should be provided between the bottom of the concrete and the seasonal high water table. Terracon recommends that in no case should less than 1 foot of separation be provided. Based on the encountered conditions and anticipated development, we anticipate this requirement can be readily met.
- Sawcut patterns should generally be square or rectangular but nearly square, and extend to a depth equal to a quarter of the slab thickness. If the bottom of the concrete pavement is separated from the seasonal high water table by at least 1 foot, filter fabric will not be necessary beneath the expansion joints.

4.3.6 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. The subgrade and the pavement surface should have a minimum ¼ inch per foot slope to promote drainage. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the base layer.

4.3.7 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the first priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

4.4 Stormwater Management

Detailed design of the stormwater management system has not been completed yet, though we understand a dry retention system is planned in the southwest portion of the site and an underground exfiltration system may be constructed in the northwest portion of the site. Dry retention systems generally need to be at least 1 foot and sometimes as much as 3 feet (or more for large ponds) above the seasonal high water table to recover within the time required by SJRWMD.

Composite samples of anticipated stormwater system subgrade soils (3 to 5 feet below existing grade) obtained from each boring had measured permeability rates of 20 to 34 feet/day. We consider this permeability rate to be indicative of a saturated horizontal permeability. Experience with the observed soil types has shown that horizontal permeability may be on the order of 1.5 to 2 times the saturated vertical permeability in undisturbed materials.

It has been our experience that SJRWMD requires use of an appropriate factor of safety, generally reducing measured permeability rates or recovery time by a factor of safety of 2 for design of artificial recovery systems such and exfiltration trenches or underdrains, although this does not presently apply to ponds recovering by infiltration.

The top of the fine sand with silt (SP-SM) soils observed in the borings should be considered the base of the surficial aquifer in recovery analyses. Based upon our visual review of the sands, and our local project experience, we recommend that you consider the surficial aquifer (the site sands) to have a fillable porosity (η) of 25 percent. The table below summarizes our recommended stormwater management system design parameters.

Parameter	Boring Location P-1	Boring Location P-2[1]
Estimated Confining Layer Depth, B	8 feet	13.5 feet
Estimated Seasonal High Water Table Depth, WT	8 feet	10 feet
Unsaturated Vertical Infiltration Rate, k_V	10 feet/day	15 feet/day
Horizontal Saturated Hydraulic Conductivity, k_H	20 feet/day	30 feet/day
Fillable Porosity, η	25 percent	25 percent

1. It has been our experience that SJRWMD requires use of an appropriate factor of safety, generally reducing measured permeability rates or recovery time by a factor of safety of 2 for design of artificial recovery systems such and exfiltration trenches or underdrains, although this does not presently apply to ponds recovering by infiltration. This factor of safety was **not** applied to the permeability rates.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

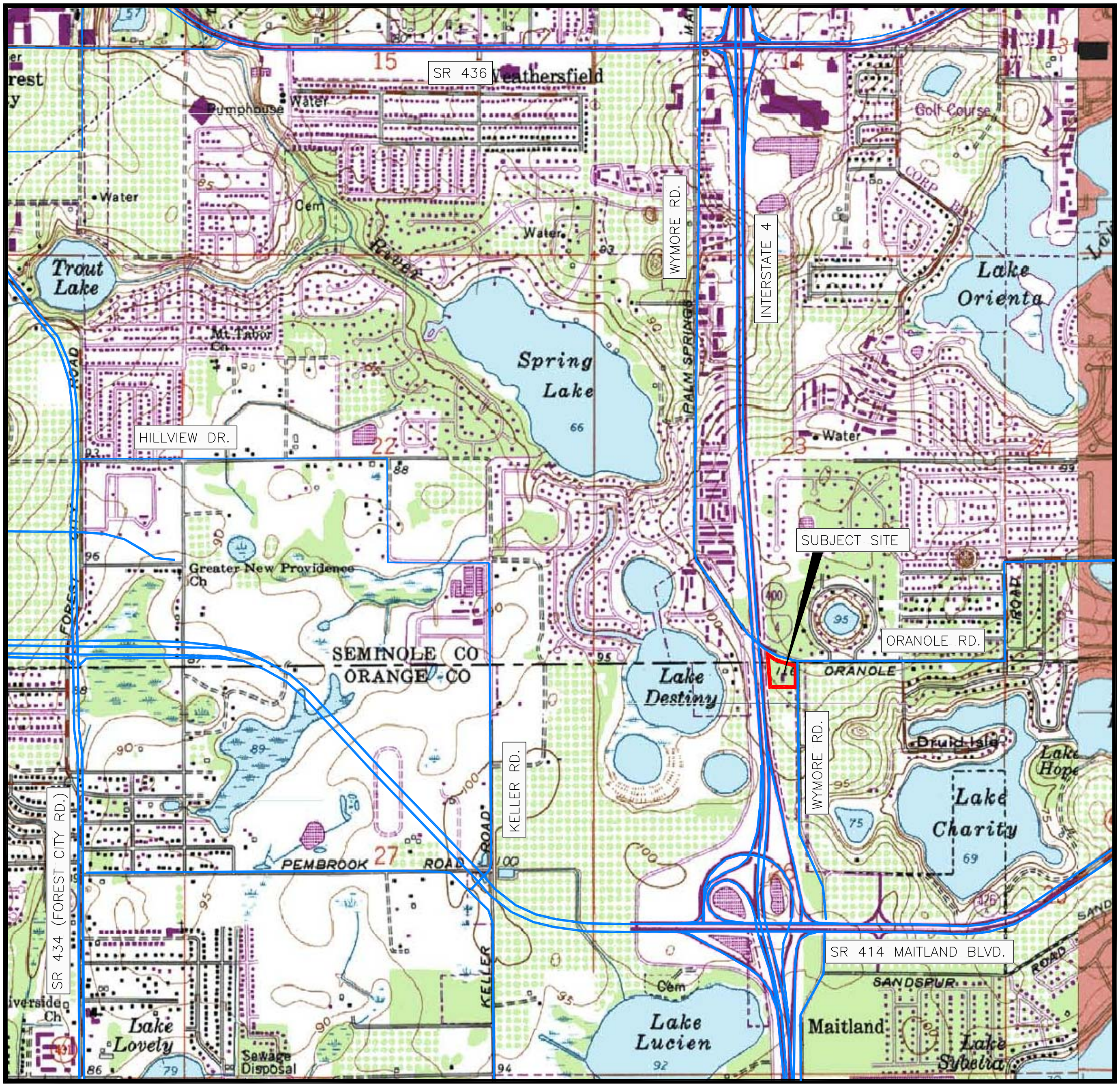
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION

UNITED STATES — DEPARTMENT OF THE INTERIOR — GEOLOGICAL SURVEY



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NATIONAL GEODETIC VERTICAL DATUM OF 1929

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SECTION: 23, 26
TOWNSHIP: 21 SOUTH
RANGE: 29 EAST

FOREST CITY, FLORIDA
ISSUED: 1959 REVISED: 1980
7.5 MINUTE SERIES (QUADRANGLE)

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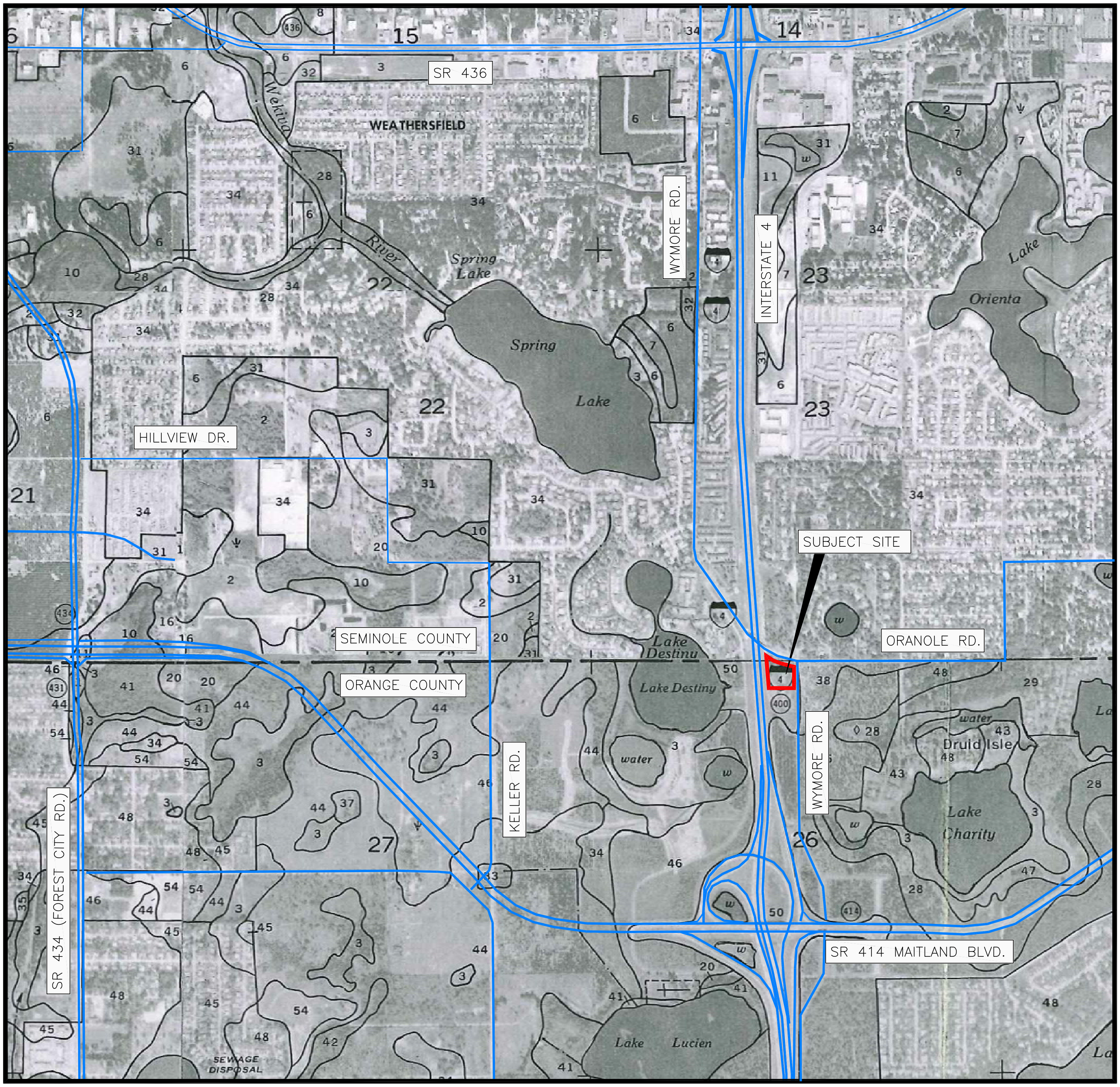
Project Mngr: SM	Project No. H1145129	Terracon Consulting Engineers and Scientists	TOPOGRAPHIC VICINITY MAP
Drawn By: SW	Scale: AS SHOWN	1675 LEE ROAD WINTER PARK, FLORIDA 32789	GEOTECHNICAL ENGINEERING EVALUATION ST. ANTHONY COPTIC ORTHODOX CHURCH NORTH WYMORE ROAD AND WYMORE ROAD MAITLAND, ORANGE COUNTY, FLORIDA
Checked By: SM	File No. H1145129-1	PH. (407) 740-6110 FAX. (407) 740-6112	EXHIBIT
Approved By: BHW	Date: 7-28-14		A-1



SCALE 1" = 2000'

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U.S.D.A. SOIL SURVEY FOR SEMINOLE COUNTY, FLORIDA ISSUED: 1990
U.S.D.A. SOIL SURVEY FOR ORANGE COUNTY, FLORIDA ISSUED: 1989

N

SECTION: 23, 26
TOWNSHIP: 21 SOUTH
RANGE: 29 EAST

SEMINOLE COUNTY SOILS MAP INDEX

34 URBAN LAND
0 TO 12 PERCENT SLOPES

ORANGE COUNTY SOILS MAP INDEX

50 URBAN LAND

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Project Mngr: SM	Project No. H1145129		
Drawn By: SW	Scale: AS SHOWN		
Checked By: SM	File No. H1145129-2		
Approved By: BHW	Date: 7-28-14		

Terracon
Consulting Engineers and Scientists
1675 LEE ROAD WINTER PARK, FLORIDA 32789
PH. (407) 740-6110 FAX. (407) 740-6112

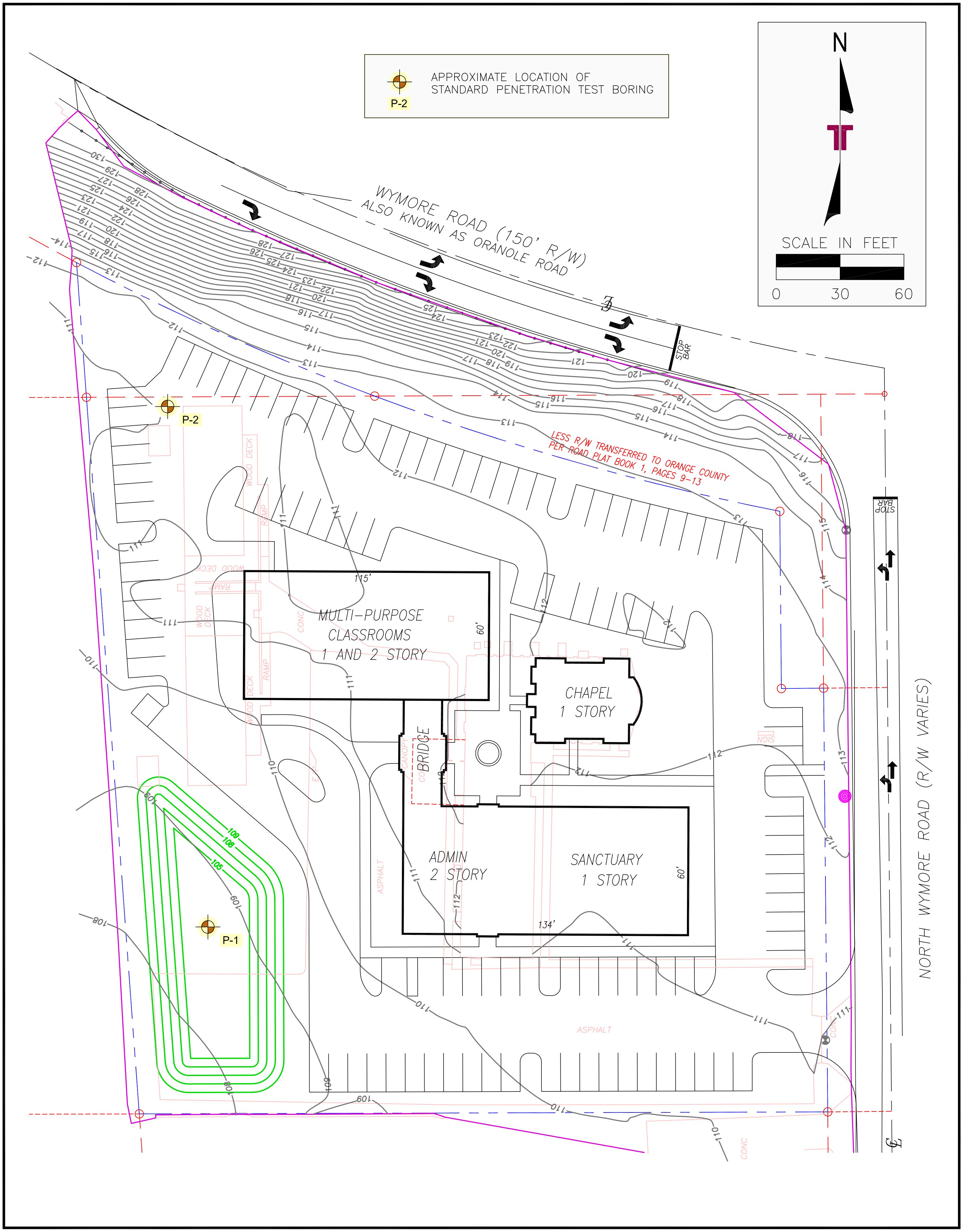
U.S.D.A. SOILS MAP
GEOTECHNICAL ENGINEERING EVALUATION
ST. ANTHONY COPTIC ORTHODOX CHURCH
NORTH WYMORE ROAD AND WYMORE ROAD
MAITLAND, ORANGE COUNTY, FLORIDA

EXHIBIT
A-2

Soil Survey Descriptions

Orange County: 50 – Urban land. This soil map unit has slopes of generally less than 2 percent, though some areas range in slope up to 5 percent. It is covered by shopping centers, parking lots, industrial buildings, houses, streets, sidewalks, airports, and other urban structures. The natural soil profile has been altered or obscured, including by the overlying structures, to such a point that the natural soil profile may not be observed. Drainage systems have been established in most areas of this soil map unit, thereby affecting the natural drainage. Seasonal high water table conditions have been altered by earthwork and/or development.

Seminole County: 34 – Urban land, 0 to 12 percent slopes. This soil map unit has slopes of generally less than 2 percent, though some areas range in slope up to 12 percent. It is covered by urban facilities such as shopping centers, parking lots, industrial buildings, houses, streets, sidewalks, airports, and related structures. The natural soil profile has been altered or obscured, including by the overlying structures, to such a point that the natural soil profile may not be observed. Drainage systems have been established in most areas of this soil map unit, thereby affecting the natural drainage. Seasonal high water table conditions are dependent upon the functioning of the drainage system.



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Project Mngr: SM	Drawn By: SW	Checked By: SM	Approved By: BHW
Project No. H1145129	Scale: AS SHOWN	File No. H1145129-4	Date: 7-28-14

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SOIL BORING LOCATION PLAN
GEOTECHNICAL ENGINEERING EVALUATION
ST. ANTHONY COPTIC ORTHODOX CHURCH
NORTH WYMORE ROAD AND WYMORE ROAD
MAITLAND, ORANGE COUNTY, FLORIDA

EXHIBIT
A-4

Field Exploration Description

The boring locations were laid out at the project site by Terracon personnel. The locations indicated on the attached diagram are approximate and were measured by pacing distances and estimating right angles, across the site. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The SPT soil borings were drilled with a mini-rig mounted, rotary drilling rig equipped with a rope and cathead-operated safety hammer. The boreholes were advanced with a cutting head and stabilized with the use of bentonite (drillers' mud). Soil samples were obtained by the split spoon sampling procedure in general accordance with the Standard Penetration Test (SPT) procedure. In the split spoon sampling procedure, the number of blows required to advance the sampling spoon the last 12 inches of an 18-inch penetration or the middle 12 inches of a 24-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (N). This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils. The sampling depths and penetration distance, plus the standard penetration resistance values, are shown on the boring logs.

Portions of the samples from the borings were sealed in glass jars to reduce moisture loss, and then the jars were taken to our laboratory for further observation and classification. Upon completion, the boreholes were backfilled with the site soil.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation of the samples.

BORING LOG NO. P-1

PROJECT: ST. ANTHONY COPTIC ORTHODOX CHURCH

CLIENT: St. Anthony Coptic Orthodox Church

SITE: North Wymore Road and Wymore Road, Maitland, Orange County, Florida

LOCATION See Exhibit A-4

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	VERTICAL PERMEABILITY (feet/day)	WATER CONTENT (%)	PERCENT FINES
	0.8	**2" Asphalt - 8" Road Base**							
	8.0	**SAND (SP)**, fine grained, light gray to light orange-brown, loose to medium dense	5			4-3-3-3 N=6	20	5	2
				▽ (approx. 8 ft)		4-5-5-5 N=10			
	20.0	**SAND WITH SILT (SP-SM)**, fine grained, reddish-brown to dark reddish-brown, medium dense	10			5-6-5-6 N=11			
			15			5-6-7 N=13			
			20			8-7-8 N=15			
		Boring Terminated at 20 Feet	25						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead

Advancement Method:
Mud Rotary

Abandonment Method:

See Exhibit A-5 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater Not Encountered To Depth Of 10'

▽ *Estimated Seasonal High Groundwater Level*

Terracon
1675 Lee Road
Winter Park, Florida

Boring Started: 7/21/2014	Boring Completed: 7/21/2014
Drill Rig: BR2500	Driller: Terracon
Project No.: H1 14 5129	Exhibit: A-6

BORING LOG NO. P-2

PROJECT: ST. ANTHONY COPTIC ORTHODOX CHURCH

CLIENT: St. Anthony Coptic Orthodox Church

SITE: North Wymore Road and Wymore Road Maitland, Orange County, Florida

LOCATION See Exhibit A-4

Depth (Ft.)	Material Description	Water Level Observations	Sample Type	Field Test Results	Vertical Permeability (feet/day)	Water Content (%)	Percent Fines
0 – 1.5	**SAND WITH SILT (SP-SM)**, trace roots (topsoil), fine grained, gray-brown						
1.5 – 13.5	**SAND (SP)**, fine grained, light brown to light gray, loose						
5					34	5	2
6–8			X	4-3-3-4 N=6			
8–10			X	5-4-5-6 N=9			
10		▽ (est. seasonal high)					
13.5 – 20.0	**SAND WITH SILT (SP-SM)**, fine grained, dark reddish-brown, medium dense						
13.5–15			X	6-8-6 N=14			
18.5–20			X	7-7-8 N=15			
20.0	***Boring Terminated at 20 Feet***						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead

Advancement Method:
Mud Rotary

Abandonment Method:

See Exhibit A-5 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater Not Encountered To Depth Of 10'

▽ *Estimated Seasonal High Groundwater Level*

Terracon
1675 Lee Road
Winter Park, Florida

Boring Started: 7/21/2014	Boring Completed: 7/21/2014
Drill Rig: BR2500	Driller: Terracon
Project No.: H1 14 5129	Exhibit: A-7

APPENDIX B
LABORATORY TESTING

Laboratory Testing

During the field exploration, a portion of each recovered sample was sealed in a glass jar and transported to our laboratory for further visual observation and laboratory testing. Selected samples retrieved from the borings were tested for moisture (water) content, fines content (soil passing a US standard #200 sieve), and laboratory permeability. Those results are included in this report and on the respective boring logs. The visual-manual classifications were modified as appropriate based upon the laboratory testing results.

The soil samples were classified in general accordance with the appended General Notes and the Unified Soil Classification System based on the material's texture and plasticity. The estimated group symbol for the Unified Soil Classification System is shown on the boring logs and a brief description of the Unified Soil Classification System is included in Appendix C. The results of our laboratory testing are presented in the Laboratory Test Results section of this report and on the corresponding borings logs.

Permeability testing was performed on bulk samples obtained from Boring P-1 and Boring P-2, from between depths of 3 and 5 feet below existing grade respectively, the presumed subgrade soils for the proposed stormwater management systems. The bulk samples were remolded in a permeameter to subjectively approximate in-place relative density of the sampled soil. Water was allowed to flow into the soil sample until the sample was apparently saturated. Once saturated, water flow was halted and incremental drops in the supply water level were timed.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

- Auger Cuttings
- Rock Core
- Grab Sample
- No Recovery
- Shelby Tube
- Standard Penetration Test

WATER LEVEL

- **Water Initially Encountered**
- **Water Level After a Specified Period of Time**
- **Water Level After a Specified Period of Time**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 500	0 - 1
Loose	4 - 9	Soft	500 to 1,000	2 - 4
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
		Hard	> 8,000	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

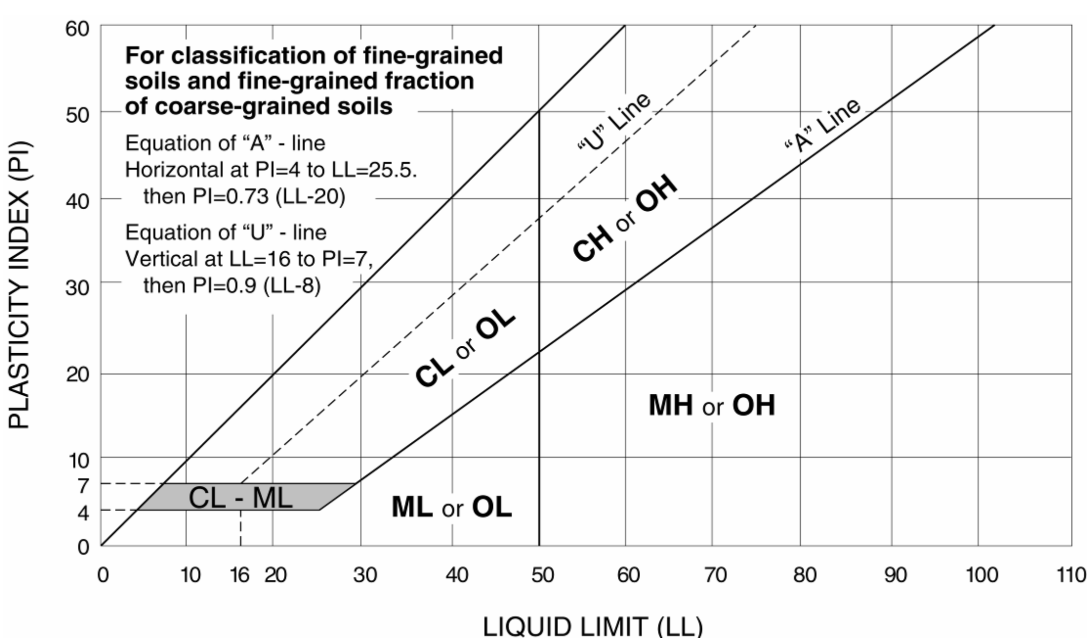
Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			$PI < 4$ or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay
[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains $\geq$ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] $PI \geq 4$ and plots on or above "A" line.
[O] $PI < 4$ or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



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