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IFB NO. Y20-711-RC **ISSUED: September 17, 2019**

INVITATION FOR BIDS

FOR

ORANGE COUNTY LAKESIDE VILLAGE PARK PHASE II

****

PART G

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PART H
Volume II

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September 6, 2016

Orange County Public Works – Capital Projects Division
400 East South Street, 5th Floor
Orlando, Florida 32801

Attention: Mr. Roan Waterbury
roan.waterbury@ocfl.net

Reference: **Geotechnical Exploration**
Proposed Horizon West Park
Village Lake Road
Orlando, Orange County, Florida
UES Project No. 0130.1600231.0000
UES Report No. 1369685

Dear Mr. Waterbury:

Universal Engineering Sciences, Inc. (Universal) has completed a geotechnical exploration at the referenced site in Orlando, Orange County, Florida. The scope of our exploration was planned in conjunction with and authorized by you. This exploration was performed in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

This report contains the results of our exploration program, information on the presence or lack of unsuitable soils, potential subsurface constraints to development and recommendations for estimated seasonal high groundwater levels, foundation design for the proposed pavilions and fishing pier, pavement design for the proposed park trail, stormwater pond design and site preparation.

We appreciate the opportunity to have worked with you on this project and look forward to a continued association. Please do not hesitate to contact us if you should have any questions, or if we may further assist you as your plans proceed.

Respectfully Submitted,
UNIVERSAL ENGINEERING SCIENCES, INC.
Certificate of Authorization No. 549

Mohammed Muzammil, E.I.
Geotechnical Project Engineer

GUY H. RABENS LICENSE No 60917 STATE OF FLORIDA PROFESSIONAL ENGINEER 9/6/2016

Guy H. Rabens, M.S., P.E.
Geotechnical & Environmental Manager
Florida Registration No. 60917

3 – Client

UNIVERSAL ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION

PROPOSED HORIZON WEST PARK
VILLAGE LAKE ROAD
ORANGE COUNTY, FLORIDA

UES PROJECT NO. 0130.1600231.0000
UES REPORT NO. 1369685

PREPARED FOR:

Orange County Public Works – Capital Projects Division
400 East South Street, 5th Floor
Orlando, Florida 32801

PREPARED BY:

Universal Engineering Sciences
3532 Maggie Boulevard
Orlando, Florida 32811
(407) 423-0504

August 26, 2016

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1.0 PROJECT DESCRIPTION

We understand that Orange County proposes to construct a new park on the east side of Lake Spar on Village Lake Road near Silverlake Park Drive in the Horizons West development in Orange County, Florida. We were furnished with a plan from SK Consortium, the project civil engineer, which showed the park layout and recommended boring locations for the fishing pier, two (2) pavilions, storm water retention areas, as well as asphalt and concrete trails.

Universal was requested to evaluate the general subsurface soil and groundwater conditions across the site for the proposed site improvements. This information will be used to grade the site and design the stormwater management system, as well as finalize the designs for the fishing pier and pavilion structures.

The recommendations presented within this report are based upon the above information and assumptions. If any of this information or assumptions is incorrect, please contact Universal immediately so that we may review, and possibly amend the recommendations contained herein.

Universal must review the final site and grading plans, and structural design loads to validate all recommendations rendered herein. Without such a review, our recommendations may not be applicable, resulting in potentially unacceptable performance of site improvements for which Universal will not be responsible or liable.

No site or project facilities/improvements, other than those described herein, should be designed using the soil information presented in this report. Moreover, Universal will not be responsible for the performance of any site improvement so designed and constructed.

2.0 PURPOSE

The purposes of this exploration were:

- to explore and evaluate the subsurface conditions at the site with special attention to potential problems that may impact the proposed development,
- to provide our estimates of the groundwater level at the boring locations,
- to provide geotechnical engineering recommendations for site preparation, pavement design, stormwater design, and fishing pier/pavilion foundation design.

This report presents an evaluation of site conditions on the basis of geotechnical procedures for site characterization. The recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards.

3.0 SITE DESCRIPTION

The subject property is located within Section 36, Township 23 South, Range 27 East in Orange County, Florida. More specifically, the site is located west of Reams Road in Orange County, Florida. Please refer to the U.S.G.S Site Location Plan in **Appendix A**. The property consisted of vacant land with sparse vegetation at the time of our exploration.

3.1 SOIL SURVEY

Six (6) potential native soil types are mapped within the general area of the site according to the USDA NRCS Soil Survey of Orange County. A brief summary of the mapped surficial (native) soil type(s) is presented in Table I. **Please note that the soils types and their associated engineering properties may have been altered by past development activities on the subject site.**

TABLE I
SUMMARY OF PUBLISHED SOIL DATA

Soil Symbol	Soil Type	Hydrologic Group	Drainage Characteristics	Depth of Published Seasonal High GWT (feet)
3	Basinger fine sand, depressional, 0 to 1 percent slopes	A/D	Very poorly drained	+0
4	Candler fine sand, 0 to 5 percent slopes	A	Excessively drained	>6
43	Seffner fine sand, 0 to 2 percent slopes	A/D	Somewhat poorly drained	1½ to 3½
44	Smyrna, wet, fine sand, 0 to 2 percent slopes	A/D	Poorly drained	½ to 1½
54	Zolfo fine sand, 0 to 2 percent slopes	A	Somewhat poorly drained	2 to 3½
99	Water	--	--	--

3.2 TOPOGRAPHY

According to information obtained from the United States Geologic Survey (USGS) Windermere, FL quadrangle map, the ground surface elevation across the site area is approximately between 90 and 110 feet National Geodetic Vertical Datum (NGVD). A copy of a portion of the USGS Map is included in Appendix A.

4.0 SCOPE OF SERVICES

The services conducted by Universal during our geotechnical exploration are as follows:

- Drill eight (8) Standard Penetration Test (SPT) borings to depths of between 10 feet and 20 feet below existing grade within the subject property.
- Secure samples of representative soils encountered in the soil borings for review, laboratory analysis and classification by a Geotechnical Engineer.
- Measure the existing site groundwater levels and provide an estimate of the seasonal high groundwater level at the boring locations.

- Conduct laboratory testing on selected soil samples obtained in the field to determine their engineering properties.
- Assess the existing soil conditions with respect to the proposed construction.
- Prepare a report which documents the results of our exploration and analysis with geotechnical engineering recommendations.

5.0 FIELD EXPLORATION

The eight (8) SPT borings, labeled AB-1 through AB-7, and B-1, shown on the attached Boring Location Plan in Appendix B were performed in general accordance with the procedures of ASTM D 1586 "Standard Method for Penetration Test and Split-Barrel Sampling of Soils". SPT sampling was performed continuously within the top 10 feet to detect variations in the near surface soil profile and on approximate 5 feet centers thereafter.

6.0 LABORATORY TESTING

The soil samples recovered from the test borings were returned to our laboratory and visually classified in general accordance with ASTM D 2487 "Standard Classification of Soils for Engineering Purposes" (Unified Soil Classification System). We selected representative soil samples from the borings for laboratory testing to aid in classifying the soils and to help to evaluate the general engineering characteristics of the site soils. The results of these tests are shown on the boring logs in Appendix B. A summary of the tests performed is shown in Table II.

TABLE II
LABORATORY METHODOLOGIES

Test Performed	Number Performed	Reference
Grain Size Analysis (#200 wash only)	16	ASTM D 1140 "Amount of Material in Soils Finer than the No. 200 (75 - µm) sieve"
Moisture Content	16	ASTM D 2216 "Laboratory Determination of Water (Moisture) Content of Soil by Mass"
Permeability Tests	5	ASTM D 2434 "Standard Test Method for Permeability of Granular Soils (Constant Head)"

7.0 SUBSURFACE CONDITIONS

The results of our field exploration and laboratory analysis, together with pertinent information obtained from the SPT borings, such as soil profiles, penetration resistance and groundwater levels are shown on the boring logs included in Appendix B. The Key to Boring Logs, Soil Classification Chart is also included in Appendix B. The soil profiles were prepared from field logs after the recovered soil samples were examined by a Geotechnical Engineer. The stratification lines shown on the boring logs represent the approximate boundaries between soil types, and may not depict exact subsurface soil conditions. The actual soil boundaries may be more transitional than depicted. A generalized profile of the soils encountered at our boring locations is presented in Table III. For detailed soil profiles, please refer to the attached boring logs.

TABLE III
GENERALIZED SOIL PROFILE

Typical Depth (feet, bls)		Soil Description
From	To	
Surface	30	Very loose to Dense fine SAND [SP}. SPT "N" blow counts ranged from 2 to 34 blows per foot (bpf).
* denotes maximum termination depth of the borings		

8.0 GROUNDWATER CONDITIONS

8.1 EXISTING GROUNDWATER LEVEL

We measured the water levels at the boring locations on July 28, 2016 during drilling activities. Groundwater was encountered from about 1 to 4 feet below existing grade at the boring locations. The encountered groundwater level depths are shown on the attached boring logs. Fluctuations in groundwater levels should be anticipated throughout the year, primarily due to seasonal variations in rainfall, surface runoff, and other factors that may vary from the time the borings were conducted.

8.2 SEASONAL HIGH GROUNDWATER LEVEL

Based on historical data, the rainy season in Central Florida is between June and October of the year. In order to estimate the seasonal high water level at the boring locations, many factors are examined, including the following:

- Measured groundwater level
- Drainage characteristics of existing soil types
- Current & historical rainfall data
- Natural relief points (such as lakes, rivers, wetlands, etc.)
- Man-made drainage systems (ditches, canals, retention basins, etc.)
- On-site types of vegetation
- Review of available data (soil surveys, USGS maps, etc.)
- Redoximorphic features (mottling, stripping, etc.)

Based on the results of our field exploration and the factors listed above, we estimate that the seasonal high groundwater level at the boring locations will form from near the existing ground surface to about 2 ½ feet below existing grade for a normal rainfall distribution year. Please refer to the individual boring logs in **Appendix B** for further information.

It should be noted that the estimated seasonal high water levels do not provide any assurance that groundwater levels will not exceed these estimated levels during any given year in the future. Should the impediments to surface water drainage be present, or should rainfall intensity and duration, or total rainfall quantities, exceed the normally anticipated rainfall quantities, groundwater levels might exceed our seasonal high estimates. Further, it should be understood that changes in the surface hydrology and subsurface drainage from on-site and/or off-site improvements could have significant effects on the normal and seasonal high groundwater levels.

9.0 FOUNDATION DESIGN RECOMMENDATIONS

We understand that the proposed Horizons West Park will include two (2) pavilion areas. We have assumed that the maximum column loads will not exceed 10 kips for the proposed pavilion structures.

Provided the pavilion areas are properly prepared prior to construction, the proposed pavilions can be supported upon conventional, shallow footing foundations designed for a maximum allowable net soil bearing pressure of 2,000 pounds per square foot (psf) in order to keep total and differential settlements to tolerable levels (i.e. 1-inch or less total settlement and ½-inch or less of differential settlement). The allowable net soil bearing pressure is that pressure that may be transmitted to the soil in excess of the minimum surrounding overburden pressure. The allowable bearing pressure should include dead load plus sustained live load. Per Section 1805.4.1 of the Florida Building Code (FLBC), the foundations should be designed for the most unfavorable effects due to the combinations of loads specified in Section 1605.3 of the FLBC.

The foundations may bear on either the compacted suitable native soils or compacted structural fill. The bearing level soils should be densified to at least 95 percent of the maximum dry density as determined by ASTM D 1557 (Modified Proctor) to a depth of at least 1 foot below foundation level.

The minimum width recommended for an isolated column footing is 24 inches. For continuous wall or thickened edge monolithic slab footings, the minimum widths should comply with the current Florida Building Code, but under no circumstances should be less than 12 inches in width. The base of all footings should bear at least 12 inches below finished grade elevation as required under the current Florida Building Code.

10.0 PAVEMENT RECOMMENDATIONS

10.1 GENERAL

We understand that the proposed park trail will consist of a combination of flexible asphaltic and rigid concrete pavement sections with typical light pedestrian traffic and occasional maintenance vehicles. Our recommendations for both pavement types are listed in the following sections. The following recommendations are based on the pavement areas being prepared as recommended in this report.

10.2 ASPHALTIC PAVEMENTS

10.2.1 Layer Components

We recommend using a three layer pavement section for the proposed asphaltic parking/drive areas consisting of stabilized subgrade, base course, and surface course. Based on the results of our soil borings and our experience with similar projects, our minimum recommended pavement component thicknesses are presented in Table IV. Where applicable, the local municipality minimum standards should be followed when more stringent than the recommendations herein.

TABLE IV
MINIMUM ASPHALTIC PAVEMENT COMPONENT THICKNESSES

Service Level	Layer Component		
	Surface Course (inches)	Base Course (inches)	Stabilized Subgrade (inches)
Light Duty Pedestrian Trail	1	6	6

10.2.2 Subgrade

We recommend that the stabilized subgrade materials immediately beneath the base course exhibit a minimum Limerock Bearing Ratio (LBR) of 40 as specified by FDOT, or a minimum Florida Bearing Value (FBV) of 60 psi, compacted to at least 98 percent of the Modified Proctor maximum dry density (ASTM D 1557) value.

Stabilized subgrade can be imported materials or a blend of on-site and imported materials. If a blend is proposed, we recommend that the contractor perform a mix design to find the optimum mix proportions.

Compaction testing of the subgrade should be performed to full depth at a frequency of at least one (1) test per 10,000 square feet.

10.2.3 Base Course

Limerock, recycled crushed concrete and soil cement are all deemed suitable materials for the pavement base course at this project. However, local municipalities often limit the use of certain base course materials. We recommend the civil engineer consult with the local municipalities prior to selecting the base course material for this project.

For a limerock base, the base course should be compacted to a minimum density of 98 percent of the Modified Proctor maximum dry density and exhibit a minimum LBR of 100. The limerock material should comply with the latest edition of the Florida Department of Transportation (FDOT) Road and Bridge Construction specifications.

For a soil-cement base, we recommend the contractor perform a soil-cement design with a minimum seven (7)-day strength of 300 pounds per square inch (psi) on the materials he intends to use. Place soil-cement in maximum 6-inch lifts uniform and compact in place to a minimum density of 95 percent of the maximum dry density according to specifications in ASTM D-558,"Moisture Density Relations of Soil Cement Mixtures".

Place and finish the soil-cement according to Portland Cement Association requirements. Final review of the soil-cement base course should include manual "chaining" and/or "soundings" seven days after placement. Shrinkage cracks will form in the soil-cement mixture and you should expect reflection cracking on the surface course.

Recycled crushed concrete may provide a cost-effective alternative material in lieu of limerock or soil cement base courses. Local availability, along with municipality standards, typically governs the use of crushed concrete use as an alternative base course material. The advantages of using crushed concrete as a pavement base course include its high strength

(stronger than limerock), resistance to groundwater related distress, and lack of reflection cracking caused by thermal expansion and contraction.

If a crushed concrete base is used, the base course material should be sourced from an FDOT approved supplier. The base should be compacted to a minimum density of 98 percent of the Modified Proctor maximum dry density and exhibit a minimum LBR of 100. The base material should comply with the latest edition of the FDOT Road and Bridge Construction Specifications Section 204. We note that the Orange County may have more strict requirements for the use of recycled crushed concrete in which case the most strict criteria should be employed.

Compaction testing of the base course should be performed to full depth at a frequency of at least one (1) test per 10,000 square feet.

10.2.4 Surface Course

We recommend that the surfacing consist of FDOT SuperPave (SP) asphaltic concrete. The surface course should consist of FDOT SP-9.5 fine mix. The asphalt concrete should be placed within the allowable lift thicknesses for fine Type SP mixes per the latest edition of FDOT, Standard Specifications for Road and Bridge Construction, Section 334-1.4 Thickness.

The asphaltic concrete should be compacted to an average field density of 93 percent of the laboratory maximum density determined from specific gravity (G_{mm}) methods, with an individual test tolerance of **+2 percent and -1.2% of the design G_{mm}**. Specific requirements for the SuperPave asphaltic concrete structural course are outlined in the latest edition of FDOT, Standard Specifications for Road and Bridge Construction, Section 334-5.2.4.

Note: If the Designer (or Contract Documents) limits compaction to the static mode only or lifts are placed one-inch thick, then the average field density should be 92 percent, with an individual test tolerance of + 3 percent, and -1.2% of the design G_{mm}.

After placement and field compaction, the wearing surface should be cored to evaluate material thickness and density. Cores should be obtained at frequencies of at least one (1) core per 10,000 square feet of placed pavement, or a minimum of two (2) cores per day's production.

10.2.5 Effects of Groundwater

One of the most critical influences on the pavement performance in Central Florida is the relationship between the pavement base course and the seasonal high groundwater level. Sufficient separation will need to be maintained between the bottom of base course and the anticipated seasonal high groundwater level. We recommend that the seasonal high groundwater and the bottom of the base course be separated by at least 18 inches. Based on the results of the borings, the site may need to be raised in some areas to provide the necessary separation.

10.3 Concrete "Rigid" Pavements

We understand that concrete may be used for part of the pedestrian trail. Our recommended rigid pavement thickness is based upon the assumption that the trail will not be used by vehicular traffic. If vehicular traffic will also utilize the trail, a thicker rigid pavement section may be required.

We recommend using the existing surficial sands or approved structural fill densified to at least 98 percent of Modified Proctor test maximum dry density (ASTM D 1557) without additional stabilization under concrete pavement, with the following stipulations:

1. Prior to placement of concrete, the subgrade soils should be prepared as recommended in Section 11.4 of this report.

2. The surface of the subgrade soils must be smooth, and any disturbances or wheel rutting corrected prior to placement of concrete.

3. The subgrade soils must be moistened prior to placement of concrete.

4. Concrete pavement thickness should be uniform throughout, with exception to the thickened edges (curb or footing).

5. The bottom of the pavement should be separated from the seasonal high groundwater level by at least 12 inches.

Based on the results of our exploration and our experience with similar projects, our recommended minimum concrete pavement design is shown in Table V.

TABLE V
MINIMUM CONCRETE PAVEMENT THICKNESSES

Service Level	Minimum Pavement Thickness	Maximum Control Joint Spacing	Recommended Saw Cut Depth
Concrete Trail - Pedestrian Traffic	4 inches	10 feet x 10 feet	1⅓ inches

We recommend using concrete with a minimum 28-day compressive strength of at least 3,000 pounds per square inch. Layout of the saw cut control joints should form square panels, and the depth of saw cut joints should be ⅓ of the concrete slab thickness.

Specimens to verify the compressive strength of the pavement concrete should be obtained for at least every 50 cubic yards, or at least once for each day's placement, whichever is greater.

11.0 SITE PREPARATION

We recommend normal, good practice site preparation procedures for the new structures and pavement areas. These procedures include: stripping/clearing of the site to remove vegetation, surficial organics, roots, debris, etc. Following stripping, the exposed subgrade soils should be proof-rolled to detect soft or loose soils, and all subsequent fill soils should be properly densified. A more detailed description of this work is as follows:

1. Prior to construction, existing underground utility lines within the construction areas should be located (if applicable). It should be noted that if underground pipes are not properly removed or plugged, they may serve as conduits for subsurface erosion which may lead to excessive settlement of overlying structures.

2. Perform necessary remedial dewatering prior to any earthwork operations. Dewatering should be performed to a depth of at least 2 feet below the bottom of any excavations or compacted surface.

3. Strip the proposed construction limits of fences, pavements, surface vegetation, debris, and other deleterious materials within and 5 feet beyond the perimeter of the proposed building footprint. Expect clearing to depths up to 12 inches. We strongly recommend that the stripped/excavated surfaces be observed and probed by representatives of Universal.

4. Proof-roll the exposed subsurface soils under the observation of Universal, to locate any soft areas of unsuitable soils, and to increase the density of the shallow loose fine sand soils. If deemed necessary by Universal, in areas that continue to "yield", remove any deleterious materials and replace with a clean, compacted sand backfill [SP].

5. After approval of the stripped and proof-rolled surface, compact the exposed subgrade soils (including the 5 feet margin) to at least 95 percent of the Modified Proctor test maximum dry density (ASTM D 1557). Subgrade compaction should be achieved to a depth of at least 1 foot.

6. Place fill/backfill as necessary. Structural fill should consist of clean fine sands [SP] (less than 5 percent fines) placed in maximum 12 inch uniform loose lifts. Fill soils containing between 5 and 12 percent fines (SP-SM or SP-SC) may be also be used, however, strict moisture control may be required. Each lift of structural fill should be densified to at least 95 percent of the Modified Proctor test maximum dry density of the soil (ASTM D 1557) and tested for compaction and approved before the placement of subsequent lifts. The upper 12 inches of subgrade beneath the asphalt parking areas should be stabilized and compacted to at least 98 percent of the Modified Proctor maximum dry density.

7. Test the subgrade and each lift of fill for compaction at a frequency of not less than one test per 2,500 square feet in the building areas and one test per 5,000 square feet in the pavement areas, with a minimum of 4 tests in each area.

8. Prior to the placement of reinforcing steel and concrete, verify compaction within the footing trenches to a depth of **2 feet**. We recommend testing every column footing and at least one test every 100 feet of wall footing, with a minimum of 4 tests per building. Re-compaction of the foundation excavation bearing level soils, if loosened by the excavation process, can typically be achieved by making several passes with a walk-behind vibratory sled or jumping jack.

Stability of the compacted soils is essential and independent of compaction and density control. If the near surface soils or the structural fill experience "pumping" conditions, terminate all earthwork activities in that area. Pumping conditions occur when there is too much water present in the soil-water matrix. Earthwork activities are actually attempting to compact the water and not the soil. The disturbed soils should be dried in place by scarification and aeration prior to any additional earthwork activities.

Vibrations produced during vibratory compaction operations at the site may be significantly noticeable within 100 feet and may cause distress to adjacent structures if not properly

regulated. Provisions should be made to monitor these vibrations so that any necessary modifications in the compaction operations can be made in the field before potential damages occur. Universal Engineering Sciences can provide vibration monitoring services to help document and evaluate the effects of the surface compaction operation on existing structures. It is recommended that large vibratory rollers remain a minimum of 50 feet from existing structures. Within this zone, the use of a static roller or small hand guided plate compactors is recommended.

12.0 FISHING PIER FOUNDATION CONSIDERATIONS

We understand that the fishing pier will be supported on a series of 12" diameter (nominal) wood pilings. Loading conditions were assumed based on our previous experience with similar projects. Loading was assumed as 1 kip vertical compression, and 0.25 kip lateral, per pile.

We recommend that the piling should be installed to a depth of at least 8 feet below mudline in order to achieve the assumed loading capacity. If the pier piles are not cross braced, lateral movements on the order of 2 inches would be expected (based on pile stick-up of 5 feet above mudline). This movement will be permanent set. By cross bracing these piles, we estimated the movement can be reduced to about ½ inch or less under wind loading.

Based on our analysis, nominal 12" diameter treated timber piling bearing at a depth of at least 8 feet are suitable to restrain the lateral and vertical forces on the fishing pier if cross-braced. In order to minimize the horizontal movement under the maximum wind loading, we recommend that the walkway piling be cross braced at each span to stiffen the system and translate a portion the lateral force into vertical components and behave more as a couple.

13.0 DEWATERING AND EXCAVATION CONSIDERATIONS

Depending upon the time of year construction commences and the depth of excavation required, dewatering should be anticipated over portions of the site for the successful construction of this project, especially during the installation of underground utilities. Where excavations will extend only a few feet below the groundwater table, a sump pump may be sufficient to control the groundwater table. Deeper excavations may require well points and/or sock drains to control the groundwater table. Regardless of the method(s) used, we recommend drawing down the water level at least 2 feet below the bottom of the excavation. The actual method(s) of dewatering should be determined by the contractor. The design and discharge of the dewatering system must be performed in accordance with applicable regulatory criteria (i.e. water management district, etc.) and compliance with such criteria is the sole responsibility of the contractor.

Excavations should be sloped as necessary to prevent slope failure and to allow backfilling. As a minimum, temporary excavations below 4-foot depth should be sloped in accordance with OSHA regulations. Where lateral confinement will not permit slopes to be laid back, the excavation should be shored in accordance with OSHA requirements. During excavation, excavated material should not be stockpiled at the top of the slope within a horizontal distance equal to the excavation depth. Provisions for maintaining workman safety within excavations is the sole responsibility of the contractor.

14.0 CONSTRUCTION RELATED SERVICES

We recommend the owner retain Universal to provide inspection services during the site preparation procedures for confirmation of the adequacy of the earthwork operations. Field tests and observations include verification of foundation and pavement subgrades by monitoring earthwork operations and performing quality assurance tests of the placement of compacted structural fill courses.

The geotechnical engineering design does not end with the advertisement of the construction documents. The design is an on-going process throughout construction. Because of our familiarity with the site conditions and the intent of the engineering design, we are most qualified to address site problems or construction changes, which may arise during construction, in a timely and cost-effective manner.

15.0 LIMITATIONS

This report has been prepared for the exclusive use of **Orange County Capital Projects** and other designated members of their design/construction team associated with the proposed construction for the specific project discussed in this report. No other site or project facilities should be designed using the soil information contained in this report. As such, Universal will not be responsible for the performance of any other site improvement designed using the data in this report.

The recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated on the Boring Location Plan and from other information as referenced. This report does not reflect any variations which may occur between the boring locations. The nature and extent of such variations may not become evident until the course of construction or subsequent explorations. If variations become evident, it will then be necessary for a re-evaluation of the recommendations of this report after performing on-site observations during the construction period and noting the characteristics of the variations.

Borings for a typical geotechnical report are widely spaced and generally not sufficient for reliably detecting the presence of isolated, anomalous surface or subsurface conditions, or reliably estimating unsuitable or suitable material quantities. Accordingly, Universal does not recommend relying on our boring information for estimation of material quantities unless our contracted services ***specifically*** include sufficient exploration for such purpose(s) and within the report we so state that the level of exploration provided should be sufficient to detect anomalous conditions or estimate such quantities. Therefore, Universal will not be responsible for any extrapolation or use of our data by others beyond the purpose(s) for which it is applicable or intended.

All users of this report are cautioned that there was no requirement for Universal to attempt to locate any man-made buried objects or identify any other potentially hazardous conditions that may exist at the site during the course of this exploration. Therefore no attempt was made by Universal to locate or identify such concerns. Universal cannot be responsible for any buried man-made objects or environmental hazards which may be subsequently encountered during construction that are not discussed within the text of this report. We can provide this service if requested.

During the early stages of most construction projects, geotechnical issues not addressed in this

report may arise. Because of the natural limitations inherent in working with the subsurface, it is not possible for a geotechnical engineer to predict and address all possible problems A Geotechnical Business Council (GBC) publication, "Important Information About This Geotechnical Engineering Report" appears in Appendix C, and will help explain the nature of geotechnical issues.

Further, we present documents in Appendix C: Constraints and Restrictions, to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

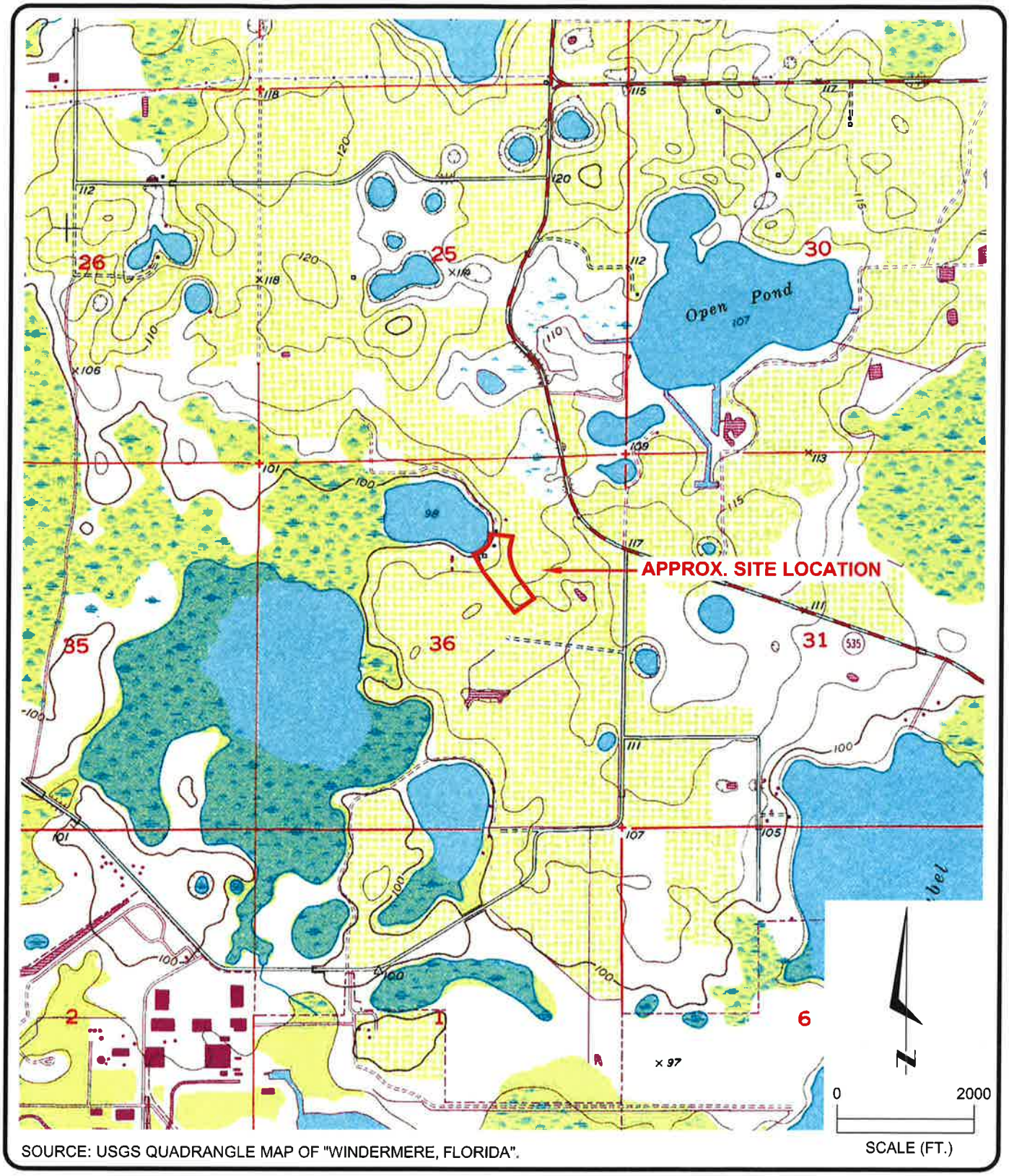
16.0 CLOSURE

We appreciate this opportunity to be of service as your geotechnical consultant on this phase of the project and look forward to providing follow up explorations and geotechnical engineering analyses as the project progresses through the design phase. If you have any questions concerning this report or when we may be of any further service, please contact us.

* * * * * * * * *

APPENDIX A

UNIVERSAL ENGINEERING SCIENCES



SOURCE: USGS QUADRANGLE MAP OF "WINDERMERE, FLORIDA".

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GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST PARK
VILLAGE LAKE ROAD
ORANGE COUNTY, FLORIDA

SITE LOCATION MAP

DRAWN BY: N.F.	DATE: 8 - 8 - 16	CHECKED BY: MM	DATE: 8-24-16
SCALE: AS SHOWN	PROJECT NO: 0130.1600231.0000	REPORT NO: 136965	PAGE NO: A-1

16-0316-01

APPENDIX B

UNIVERSAL
ENGINEERING SCIENCES

LEGEND

APPROX. STANDARD PENETRATION TEST BORING LOCATION (SPT)

BORINGS PERFORMED 7/28/16

0 200

SCALE (FT.)

N

THIS DRAWING CREATED USING PLAN PROVIDED BY CLIENT.

16-0316-01

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ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST PARK
VILLAGE LAKE ROAD
ORANGE COUNTY, FLORIDA

BORING LOCATION PLAN

DRAWN BY:	N.F.	DATE:	8 - 8 - 16	CHECKED BY:	MM	DATE:	8-24-16
SCALE:	AS SHOWN	PROJECT NO:	0130.1600231.0000	REPORT NO:	1369685	PAGE NO:	B-1

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0130.1600231.0000
REPORT NO.:	1369685
PAGE:	B-2.1

PROJECT: GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST VILLAGE
ORANGE COUNTY, FLORIDA

BORING I.D.: **AB-01** SHEET: **1 of 1**
SECTION: 36 TOWNSHIP: 23S RANGE: 27E

CLIENT: OCPW - CAPITAL PROJECTS

LOCATION: SEE BORING LOCATION PLAN

REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 110.2
WATER TABLE (ft): 4.0
DATE OF READING: 7/28/2016
EST. SHGWT (ft): 2.5

DATE STARTED: 7/28/16
DATE FINISHED: 7/28/16
DRILLED BY: ORL - JB/DD
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N BLOWS / FT	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0						Loose dark brown fine SAND [SP]						
		3-4-4	8	▽		-- brown -- very loose						
		3-2-2	4	▼		-- gray brown						
5		2-2-2	4									
		1-1-1	2			-- loose						
		3-4-5	9			-- dark gray brown						
10		3-4-5	9			BORING TERMINATED AT 10.0 FEET						
15												
20												
25												

W-09215.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0130.1600231.0000
REPORT NO.:	1369685
PAGE:	B-2.2

PROJECT: GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST VILLAGE
ORANGE COUNTY, FLORIDA

BORING I.D.: **AB-02** SHEET: **1 of 1**
SECTION: 36 TOWNSHIP: 23S RANGE: 27E

CLIENT: OCPW - CAPITAL PROJECTS

LOCATION: SEE BORING LOCATION PLAN

REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 105.3
WATER TABLE (ft): 3.5
DATE OF READING: 7/28/2016
EST. SHGWT (ft): 2

DATE STARTED: 7/28/16
DATE FINISHED: 7/28/16
DRILLED BY: ORL - JB/DD
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N BLOWS / FT	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0						Medium dense brown fine SAND [SP]						
		11-5-6	11	▽								
						-- shade lighter						
		6-6-5	11	▼			3	19			29	
						-- loose -- gray brown						
5		3-4-4	8									
						-- dark gray brown						
		2-2-4	6			-- medium dense -- dark brown						
		2-5-7	12									
10		5-7-7	14									
							3	24				
15		8-7-9	16			BORING TERMINATED AT 15.0 FEET						
20												
25												

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0130.1600231.0000
REPORT NO.:	1369685
PAGE:	B-2.3

PROJECT: GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST VILLAGE
ORANGE COUNTY, FLORIDA

BORING I.D.: **AB-03** SHEET: **1 of 1**
SECTION: 36 TOWNSHIP: 23S RANGE: 27E

CLIENT: OCPW - CAPITAL PROJECTS

LOCATION: SEE BORING LOCATION PLAN

REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 105.4
WATER TABLE (ft): 4.0
DATE OF READING: 7/28/2016
EST. SHGWT (ft): 2.5

DATE STARTED: 7/28/16
DATE FINISHED: 7/28/16
DRILLED BY: ORL - JB/DD
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N BLOWS / FT	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0						Medium dense dark gray brown fine SAND [SP]						
		5-6-9	15	▽								
		9-10-12	22	▼			4	18			16	
5						-- gray brown						
		7-7-7	14			-- loose, shade darker						
		6-5-4	9									
		1-2-3	5			-- brown -- medium dense						
		3-5-7	12				2	25				
10						BORING TERMINATED AT 10.0 FEET						
15												
20												
25												

W-09215.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0130.1600231.0000
REPORT NO.:	1369685
PAGE:	B-2.4

PROJECT: GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST VILLAGE
ORANGE COUNTY, FLORIDA

BORING I.D.: **AB-04** SHEET: **1 of 1**
SECTION: 36 TOWNSHIP: 23S RANGE: 27E

CLIENT: OCPW - CAPITAL PROJECTS

LOCATION: SEE BORING LOCATION PLAN

REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 100.5
WATER TABLE (ft): 2.5
DATE OF READING: 7/28/2016
EST. SHGWT (ft): 1

DATE STARTED: 7/28/16
DATE FINISHED: 7/28/16
DRILLED BY: ORL - JB/DD
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N BLOWS / FT	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0						Loose dark gray brown fine SAND [SP]						
		3-3-5	8									
		5-5-4	9			-- very loose						
5						-- gray brown	4	25				
		2-2-2	4				4	23				
		1-1-2	3			-- medium dense -- dark brown						
		5-8-15	23			-- dense -- dark reddish brown						
10		11-17-17	34			BORING TERMINATED AT 10.0 FEET						
15												
20												
25												

W-09215.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0130.1600231.0000
REPORT NO.:	1369685
PAGE:	B-2.5

PROJECT: GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST VILLAGE
ORANGE COUNTY, FLORIDA

BORING I.D.: **AB-05** SHEET: **1 of 1**
SECTION: 36 TOWNSHIP: 23S RANGE: 27E

CLIENT: OCPW - CAPITAL PROJECTS
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 104.3
WATER TABLE (ft): 3.5
DATE OF READING: 7/28/2016
EST. SHGWT (ft): 2

DATE STARTED: 7/28/16
DATE FINISHED: 7/28/16
DRILLED BY: ORL - JB/DD
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N BLOWS / FT	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0						Medium dense light brown fine SAND [SP]						
		5-7-8	15	▽								
		8-7-8	15	▼								
5		4-5-6	11			-- gray	2	18			18	
						-- loose						
		5-4-4	8									
		1-5-5	10									
10		3-3-3	6									
						-- medium dense, brown						
		6-7-6	13				3	21				
15						BORING TERMINATED AT 15.0 FEET						
20												
25												

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0130.1600231.0000
REPORT NO.:	1369685
PAGE:	B-2.6

PROJECT: GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST VILLAGE
ORANGE COUNTY, FLORIDA

BORING I.D.: **AB-06** SHEET: **1 of 1**
SECTION: 36 TOWNSHIP: 23S RANGE: 27E

CLIENT: OCPW - CAPITAL PROJECTS

LOCATION: SEE BORING LOCATION PLAN

REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 104.7
WATER TABLE (ft): 1.0
DATE OF READING: 7/28/2016
EST. SHGWT (ft): 0

DATE STARTED: 7/28/16
DATE FINISHED: 7/28/16
DRILLED BY: ORL - JB/DD
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N BLOWS / FT	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0				▽								
				▼		Medium dense light brown fine SAND [SP]						
							3	16			25	
		3-6-5	11			-- loose						
		5-5-5	10			-- shade darker						
5		3-5-5	10									
						-- brown						
		3-3-3	6			-- very loose						
						-- dark brown						
		2-2-2	4									
							3	25				
10		1-2-1	3									
						-- medium dense						
15		6-7-9	16									
						BORING TERMINATED AT 15.0 FEET						
20												
25												

W-09215.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0130.1600231.0000
REPORT NO.:	1369685
PAGE:	B-2.7

PROJECT: GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST VILLAGE
ORANGE COUNTY, FLORIDA

BORING I.D.: **AB-07** SHEET: **1 of 1**
SECTION: 36 TOWNSHIP: 23S RANGE: 27E

CLIENT: OCPW - CAPITAL PROJECTS

LOCATION: SEE BORING LOCATION PLAN

REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 104.5
WATER TABLE (ft): 1.2
DATE OF READING: 7/28/2016
EST. SHGWT (ft): 0

DATE STARTED: 7/28/16
DATE FINISHED: 7/28/16
DRILLED BY: ORL - JB/DD
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N BLOWS / FT	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0				▽		Medium dense light gray brown fine SAND [SP]						
				▼								
		4-6-6	12				2	20			22	
						-- loose						
		6-4-3	7				9	18				
5		1-3-3	6			-- very loose						
							2	21				
		3-1-2	3			-- brown -- loose						
		2-2-3	5			-- dark brown						
							2	23				
10		3-3-5	8			-- mixed brown						
						-- medium dense, light brown						
15		6-8-11	19			BORING TERMINATED AT 15.0 FEET						
20												
25												

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0130.1600231.0000
REPORT NO.:	1369685
PAGE:	B-2.8

PROJECT: GEOTECHNICAL EXPLORATION
PROPOSED HORIZON WEST VILLAGE
ORANGE COUNTY, FLORIDA

BORING I.D.: **B-01** SHEET: **1 of 1**
SECTION: 36 TOWNSHIP: 23S RANGE: 27E

CLIENT: OCPW - CAPITAL PROJECTS
G.S. ELEVATION (ft): 94.8 DATE STARTED: 7/28/16

LOCATION: SEE BORING LOCATION PLAN
WATER TABLE (ft): 2.5 DATE FINISHED: 7/28/16

REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED
DATE OF READING: 7/28/2016 DRILLED BY: ORL - JB/DD

EST. SHGWT (ft): 1 TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N BLOWS / FT	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0				▽		Very loose dark brown fine SAND with rocks & trace organics [SP]						
						-- without organics						
		2-2-2	4	▼								
		2-2-2	4			-- gray brown						
5		1-1-1	3			-- dark brown						
		1-1-2	2			-- loose, shade lighter						
		3-4-4	8									
10		3-4-4	8									
						-- medium dense, brown						
15		5-5-6	11									
							3	19				
20		7-8-8	16			BORING TERMINATED AT 20.0 FEET						
25												

W-09215.GPJ

UNIVERSAL ENGINEERING SCIENCES

KEY TO BORING LOGS

SYMBOLS AND ABBREVIATIONS

SYMBOL	DESCRIPTION
N-Value	No. of Blows of a 140-lb. Weight Falling 30 Inches Required to Drive a Standard Spoon 1 Foot
WOR	Weight of Drill Rods
WOH	Weight of Drill Rods and Hammer
	Sample from Auger Cuttings
	Standard Penetration Test Sample
	Thin-wall Shelby Tube Sample (Undisturbed Sampler Used)
RQD	Rock Quality Designation
	Stabilized Groundwater Level
	Seasonal High Groundwater Level (also referred to as the W.S.W.T.)
NE	Not Encountered
GNE	Groundwater Not Encountered
BT	Boring Terminated
-200 (%)	Fines Content or % Passing No. 200 Sieve
MC (%)	Moisture Content
LL	Liquid Limit (Atterberg Limits Test)
PI	Plasticity Index (Atterberg Limits Test)
NP	Non-Plastic (Atterberg Limits Test)
K	Coefficient of Permeability
Org. Cont.	Organic Content
G.S. Elevation	Ground Surface Elevation

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS More than 50% retained on the No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 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 and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS 5% or less passing No. 200 sieve	SW**	Well-graded sands and gravelly sands, little or no fines
			SP**	Poorly graded sands and gravelly sands, little or no fines
		SANDS with 12% or more passing No. 200 sieve	SM**	Silty sands, sand-silt mixtures
			SC**	Clayey sands, sand-clay mixtures
FINE-GRAINED SIOLS 50% or more passes the 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, 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 diamicaceous fine sands or silts, elastic silts
			CH	Inorganic clays or clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
			PT	Peat, muck and other highly organic soils

*Based on the material passing the 3-inch (75 mm) sieve
** Use dual symbol (such as SP-SM and SP-SC) for soils with more than 5% but less than 12% passing the No. 200 sieve

RELATIVE DENSITY
(Sands and Gravels)
Very loose – Less than 4 Blow/Foot
Loose – 4 to 10 Blows/Foot
Medium Dense – 11 to 30 Blows/Foot
Dense – 31 to 50 Blows/Foot
Very Dense – More than 50 Blows/Foot

CONSISTENCY
(Silts and Clays)
Very Soft – Less than 2 Blows/Foot
Soft – 2 to 4 Blows/Foot
Firm – 5 to 8 Blows/Foot
Stiff – 9 to 15 Blows/Foot
Very Stiff – 16 to 30 Blows/Foot
Hard – More than 30 Blows/Foot

RELATIVE HARDNESS
(Limestone)
Soft – 100 Blows for more than 2 Inches
Hard – 100 Blows for less than 2 Inches

MODIFIERS

These modifiers Provide Our Estimate of the Amount of Minor Constituents (Silt or Clay Size Particles) in the Soil Sample
Trace – 5% or less
With Silt or With Clay – 6% to 11%
Silty or Clayey – 12% to 30%
Very Silty or Very Clayey – 31% to 50%

These Modifiers Provide Our Estimate of the Amount of Organic Components In the Soil Sample
Trace – Less than 3%
Few – 3% to 4%
Some – 5% to 8%
Many – Greater than 8%

These Modifiers Provide Our Estimate of the Amount of Other Components (Shell, Gravel, Etc.) in the Soil Sample
Trace – 5% or less
Few – 6% to 12%
Some – 13% to 30%
Many – 31% to 50%

APPENDIX C

UNIVERSAL ENGINEERING SCIENCES

Important Information about This

Geotechnical-Engineering Report

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

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

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

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

Read the Full Report

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

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

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are Not Final

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

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

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

Do Not Redraw the Engineer's Logs

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Environmental Concerns Are Not Covered

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

Obtain Professional Assistance To Deal with Mold

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

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

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

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

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

CONSTRAINTS & RESTRICTIONS

The intent of this document is to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

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 on-site 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 exploration. 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.

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SECTION 02210 - EARTHWORK - UNDERGROUND UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, apply to work of this Section.

1.2 DESCRIPTION OF WORK

A. The work consists of excavating and backfilling all trenches and pits required for the installation of all underground utilities, pipelines, culverts, appurtenant structures and other items called for or reasonably implied in the Drawings to include sheeting and bracing, dewatering, supply and transport of fill materials, and disposal of waste materials. Appurtenant structures include headwalls, manholes, lift stations, box culverts, junction boxes, catch basins, inlets and other items related to underground systems.

PART 2 - MATERIALS

2.1 Bedding Material - CLASS I: ASTM D 2321, except that sizing shall be 1/4 inch to 3/4 inch. (Angular graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.)

2.2 Bedding Material - CLASS II: ASTM D 2321, except that upper size limit shall be 3/4 inch. (Coarse sands and gravels including variously graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Unified Soil Classification System (USCS) soil types GW, GP, SW, and SP are included.

2.3 Bedding Material - CLASS III: ASTM D 2321. (Fine sand and clay gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures, USCS soil types GM, GC, SM, and SC are included.)

2.4 Initial Lift Backfill: Clean earth fill composed of sand, clay and sand, sand and rock, crushed rock, or approved combination. Under no circumstances shall any muck, stumps, roots, brush, trash, rubbish or organic material be used in the backfill. Material may be selected from the excavation, or obtained, if necessary, from an approved borrow pit area. The fragment size listed below shall not be exceeded for the following pipe materials.

Fragment Size

A. Pipe Material	(Greatest Dimension - Inches)
Concrete	3
Steel	3
Cast Iron	3
Ductile Iron	3
Corrugated Metal	3
Vitrified Clay	1-1/2
Plastic	1
Asbestos Cement	1/2

2.5 Final Lift Backfill: As described in the above paragraph, Initial Lift Backfill, except that maximum dimension for any stone or pavement fragment shall be 6 inches.

2.6 Sheeting and Bracing: Wood sheeting to be left in place shall be treated with preservatives per FDOT 955.

PART 3 - EXECUTION

3.1 General: Trenches shall be excavated to the alignment and elevations required to install utilities with proper foundations and bedding. Open no more trench in advance of pipe laying than is necessary to expedite the work.

3.2 Sheeting and Bracing: To prevent damage to property, injury to erosion, cave-ins, of excessive trench widths, or as required by law, adequate sheeting and bracing shall be provided. Sheeting shall be removed when the trench has been backfilled to at least one-half its depth, or when removal would not endanger the construction of adjacent structures. When required, to eliminate excessive trench width or other damage, sheeting, bracing or shoring shall be left in place and the top cut off at an elevation 2.5' below finished grade, unless otherwise specified. Wood sheeting shall not be removed from the trench region below the crown of the pipe.

3.3 Trench Width: The minimum width of the trench shall be equal to the outside diameter of the pipe at the joint plus 8 inches for unsheeted trench, or 12 inches for sheeted trench. Trench walls shall be maintained as vertical as possible to the top of the pipes; the maximum width of trench measured at the top of the pipe shall not exceed the outside pipe diameter plus 2', unless otherwise called for in the Drawings.

3.4 Unstable Trench/Pit Bottom: Where muck or other deleterious materials are encountered at or below trench grade, they shall be removed and replaced with Bedding Material in layers not to exceed 6 inches in thickness, compacted to at least 95% of maximum (AASHTO T-180) density. The Engineer may elect, depending upon the severity of the unstable soil, to require special foundations.

3.5 Over-Excavation: Should the trench be inadvertently over-excavated below a point 6 inches below the bottom of the pipe, but not beyond a point 12 inches below the bottom of the pipe, fill that area of over-excavation with Bedding Material and compact to 95% of maximum (AASHTO T-180) density. Contractor shall fill any area of over-excavation beyond a point 12 inches below the bottom of the pipe with Class I Bedding material to form an impervious mat at his expense. Where the Engineer approves alternate material, compaction shall be not less than 95% of maximum (AASHTO T-180) density.

3.6 Noncushioned Trench Bottom: Where pipe is to be laid in a rock-cut or other noncushioned material, excavation shall allow for 6 inches of bedding beneath the pipe.

3.7 Excavated Materials: Ownership of all suitable excavated materials shall remain with the Owner until the final job requirement for fill or backfill materials have been fulfilled. Unless otherwise provided, any surplus materials then remaining and not needed for job requirements shall become the property of Contractor and are to be disposed of by him. Excavated material to be used for backfill shall be neatly and safely deposited at the sides of the trench/pit where space is available. All excavated material shall be stockpiled in a manner that will not endanger the work. Hydrants under pressure, water and gas valves, manhole covers, fire and police call boxes, or other utility controls shall be left unobstructed and accessible. Gutters shall be kept open or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed. Unless otherwise approved, stockpiles shall not obstruct adjacent streets, walks or driveways. Temporary store of apparent excess suitable materials in areas provided by Owner until such materials are needed in the job or are declared surplus. With the written approval of the Engineer, Contractor may dispose of such apparent excess material with the stipulation that he shall replace any portion of the disposed material required to fulfill the actual job requirements, with equally suitable material, at his own expense.

3.8 Dewatering: All utilities and structures shall be laid/placed, "in the dry". Dewatering shall be by well-point unless otherwise approved by the Engineer. Dewatering shall be in accordance with good standard practice and all applicable codes and regulations and must be efficient enough to lower the water level in advance of the excavation and maintain the trench or pit bottom and sides continuously firm and dry through inspection. Discharge from dewatering shall not interfere with the normal drainage of the area in which the work is being performed, create a public nuisance or form ponding.

3.9 Bedding: All pipe shall be bedded Class B except where Class A is called for by the Engineer. Bedding shall be in accordance with the Standard Detail Drawings and as described herein.

A. Class B: Raise trench to above pipe grade by placement and compaction of 4 inches to 6 inches of the bedding material specified for the particular system of installation. Provide bell holes to allow continuous support along the pipe barrel. Place and compact maximum (AASHTO T-180) density to the spring line of the pipe. Where coarse materials with voids have been used for bedding, the same coarse material shall also be used for the zone up to the spring line. Avoid vertical and lateral displacement of the pipe from proper alignment.

3.10 Backfill-Initial Lift: Initial Lift Backfill Material, as referenced in the "Initial Lift Backfill" paragraph above, shall be carefully placed and tamped over the upper half of the utility, and shall be carefully continued in layers not exceeding 6 inches in thickness for the full trench width, until the fill is 12 inches above the utility. Available material from the excavation shall be used if approved. The "Initial Lift" shall be thoroughly compacted and completed before the "Final Lift" is placed. Compact to 95% of maximum (AASHTO T-180) density.

3.11 Backfill-Final Lift: The remainder of the trench shall be backfilled with Final Lift Backfill material, as referenced in the "Final Lift Backfill" paragraph above, in layers not exceeding 12 inches. When trenches are cut in pavements or areas to be paved, compaction shall equal 98% of maximum (AASHTO T-180) density. Otherwise, compact to 95%.

3.12 Borrow: Should there be insufficient satisfactory material from the excavation to meet the requirements for fill material, and where borrow sites are not provided in the Contract Documents, borrow sites shall be secured by Contractor.

3.13 Compaction Method: The above specified compaction shall be accomplished using accepted standard methods (powered tampers, vibrators, etc.), with the exception that the first two feet of backfilling over the pipe shall be compacted by manual tamping devices. Flooding or puddling with water to consolidate backfill is not acceptable, except where sand is encountered.

3.14 Material Disposal: Excess, unsuitable, or cleared and grubbed material, resulting from the utility installation, shall be immediately removed from the work site and disposed of. Excess excavated material shall be spread on the disposal site and graded in a manner to drain properly and not disturb existing drainage conditions. Where disposal areas are not provided in the Contract Documents, Contractor shall furnish the disposal area without additional compensation.

3.15 Testing: Provide density testing by a qualified independent laboratory at intervals not to exceed 250 feet.

END OF SECTION

SECTION 02270 - EROSION AND SEDIMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. All erosion, sedimentation and water pollution control features shall be in place or relocated as designated on the plans prior to the start of any clearing, grubbing, grading or construction. Contractor shall be responsible for the installation and maintenance of all temporary erosion control features.

B. Location of the control features shall be in accordance with the Drawings or as required to facilitate drainage and control erosion and sedimentation within and adjacent to the site.

C. Control features are defined as, but not limited to, swales, berms, silt fences, silt barriers and temporary fences.

1.2 QUALITY ASSURANCE

A. The provision for prevention, control and abatement of erosion, sedimentation and water pollution shall be as stated in the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Section 104, latest edition.

1.3 SUBMITTALS

A. Product data: Manufacturers literature, application instructions and samples.

B. List of materials and their characteristics for other erosion control items.

1.4 CONTROL OF CONTRACTOR'S OPERATIONS WHICH MAY RESULT IN WATER POLLUTION

A. Take sufficient precautions to prevent pollution of streams, canals, lakes, reservoirs, wetlands and other sensitive areas with silt, sediment, fuels, oils, bitumens, calcium chloride, or other harmful materials. Conduct and schedule operations so as to avoid or otherwise minimize pollution or siltation of such streams, etc. and to avoid interference with movement of migratory fish. Do not dump the residue from dust collectors or washers into any water body.

B. Construction operations in rivers, streams, lakes, tidal waters, reservoirs, canals, and other impoundments shall be restricted to those areas where it is necessary to

perform filling or excavation to accomplish the work shown in the Contract Documents and to those areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, promptly clear rivers, streams, and impoundments of all obstructions placed therein or caused by construction operations.

C. Except as necessary for construction, do not deposit excavated material in rivers, streams, canals, or impoundments, or in a position close enough thereto, to be washed away by high water or run-off.

D. Where pumps are used to remove highly turbid waters from enclosed construction areas such as cofferdams or forms, treat the water prior to discharge into State waters. Pump the water into grassed swales, appropriately vegetated areas, or sediment basins, or confine it by an appropriate enclosure such as siltation curtains when other methods are not considered appropriate. Do not contaminate State waters. The background condition of all waters to be discharged from the site must be tested prior to discharge. All waters discharged from the site must be approved through Orange County Environmental Department by the Engineer.

E. Do not disturb lands or waters outside the limits of construction, unless approved in advance and in writing by the Owner. No operations within non-permitted wetlands or upland buffers are allowed.

1.5 START OF WORK

A. Do not start work until erosion control measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Silt Barriers:
1. Two types of silt barriers shall be installed in accordance with the plans: silt barriers installed on the ground and floating silt barriers.
2. Silt barriers (filter fabric) shall be synthetic and contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 to 120EF.
3. Filter fabric shall be a pervious sheet of propylene, nylon or polyester and shall be certified by the manufacturer or supplier to conform to the following specifications:
   - Filter efficiency (Test VTM-51): 75%.
   - Minimum tensile strength at 20% elongation (Test ASTM-D-1682): 120 lbs.
   - Tear strength (Test ASTM D2263): 50 lbs.
4. Contractor shall submit further filter fabric material specifications and installation configuration prior to start of construction.
5. Silt barriers shall be maintained in place.

6. Filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter fabric shall be spliced together only at a support post, with a 6 inch overlap, and securely sealed.
7. The following items shall be installed and maintained in accordance with the applicable sections of the FDOT Standard Specifications:
   a. Temporary silt fences and staked silt barriers
   b. Floating silt barrier

B. Temporary Fence
1. Brightly colored fence as manufactured by Mirafi, product Mirasafe, or approved equal.
2. Material shall be 4' high, attached to 6' metal posts at 12' centers. Posts shall be driven 18" into ground.

PART 3 - EXECUTION

3.1 GENERAL

A. Temporary erosion control features shall consist of, but not be limited to, temporary grassing, temporary sodding, temporary mulching, sandbagging, slope drains, sediment basins, artificial coverings, berms, baled hay or straw, floating silt barriers, staked silt barriers and staked silt fences. Design details for some of these items may be found in the Water Quality Section of the applicable edition of the FDOT Roadway and Traffic Design Standards. All of these items shall be constructed in accordance with applicable sections of the FDOT Standard Specifications.

B. Incorporate permanent erosion control features into the project at the earliest practical time. Correct conditions, using temporary measures, that develop during construction to control erosion prior to the time it is practical to construct permanent control features.

C. Construct temporary and permanent erosion and sediment control measures and maintain them to prevent the pollution of adjacent water ways in conformance with the laws, rules and regulations of Federal, State and local agencies.

D. Copies of approved permits will be provided to the Contractor for his review and use. Contractor shall be required to comply with all General and Special Conditions noted within the permit by the particular permitting agency. The Contractor shall maintain copies of these permits on the job site at all times.

3.2 INSTALLATION

The following items shall be installed in accordance with the FDOT Standard Specification. The procedures are only generally described herein.

A. Temporary Grassing: This work shall consist of furnishing and placing grass seed.

B. Temporary Sod: This work shall consist of furnishing and placing sod.

C. Temporary Mulching: This work shall consist of furnishing and applying a two-inch to four-inch thick blanket of straw or hay mulch and then mixing or forcing the mulch into the top two inches of the soil in order to temporarily control erosion. Only undecayed straw or hay, which can readily be cut into the soil, shall be used. Other measures for temporary erosion control such as hydro-mulching, chemical adhesive soils stabilizers, etc., may be substituted for mulching with straw or hay with the approval of the Owner. When permanent grassing operations begin, temporary mulch materials shall be plowed under in conjunction with preparation of the ground.

D. Sandbagging: This work shall consist of furnishing and placing sandbags in configurations, so as to control erosion and siltation.

E. Slope Drains: This work shall consist of constructing slope drains, utilizing pipe, fiber mats, rubble, cement concrete, asphaltic concrete plastic sheeting, or other acceptable materials, in accordance with the details shown in FDOT's Roadway and Traffic Design Standards or as may be approved as suitable to adequately perform the intended function.

F. Sediment Basins: Sediment basins shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards or as suitable to adequately perform the intended function. Sediment basins shall be cleaned out as necessary.

G. Artificial Coverings: This work shall consist of furnishing and applying fiber mats, netting, plastic sheeting, or other approved covering to the earth surfaces.

H. Berms: This work shall consist of construction of temporary earth berms to divert the flow of water from an erodible surface.

1. This work shall consist of construction of baled hay or straw dams or earth berms to protect against downstream accumulations of silt. The baled hay or straw dams shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards.
2. The berm or dam shall be placed so as to effectively control silt dispersion under conditions present on this project. Alternate solutions and usage of materials may be used if approved.

3.3 SILT BARRIERS

A. Silt barriers shall be installed and maintained at the locations shown on the plans. The Contractor is required to prevent the possibility of silting onto any adjacent parcel.

B. Silt barrier shall be of the staked type and stakes shall be installed as indicated in the drawings.

C. The height of the silt barrier fabric shall be a minimum of 42 inches.

D. The stakes shall be 2 inch x 4 inch wood, 5 feet long and shall be spaced a maximum of 10 feet apart at the barrier location and driven securely into the ground.

E. A trench shall be excavated approximately 4 inches wide by 4 inches deep along the line of stakes. The filter fabric shall be tied or stapled to the wooden stakes and 8 inches of fabric shall be extended into the trench. The staples shall be heavy duty wire and at least one-half (1/2) inch long. The trench shall then be backfilled and the soil compacted over the filter fabric.

3.4 FLOATING SILT BARRIERS

A. Floating silt barriers where required shall be in place prior to the start of any construction or grading.

B. Floating silt barriers shall meet or exceed the Florida Department of Transportation Roadway and Traffic Design Standards, Index No. 102, Floating Silt Barrier. Contractor shall submit fabric filter material specifications and installation configuration for approval prior to the start of construction.

3.5 TEMPORARY FENCE

A. Furnish, install and maintain on wetland lines, buffer lines, tree save lines and otherwise as shown on plans. Attach silt barrier to the temporary fence.

B. Follow manufacturer's installation recommendations.

3.6 MAINTENANCE

A. Silt barriers and temporary fences shall be inspected immediately after each rainfall and at least once a day during periods of prolonged rainfall. Any repairs shall be made immediately.

B. Should the fabric on a silt barrier or temporary fence decompose or become ineffective, the installation shall be repaired or replaced immediately at no additional

cost to the Owner. If the Contractor fails to repair or replace the items as above, the Owner shall have the right to stop work without additional cost to the Owner until such time as the repair or replacement has been made.

C. Sediment deposits shall be removed after each storm event. The Contractor will repair and restore the installations to a working and effective condition to the satisfaction of the Owner.

D. At the completion of all work, the silt barriers and the temporary fences will be removed if by the Owner.

E. Any sediment deposits in place after the silt fence or filter barrier is no longer required shall be dressed to conform to the existing grade and prepared for seeding or sodding.

3.7 PROTECTION DURING SUSPENSION OF CONTRACT TIME

A. In the event that it is necessary that the construction operations be suspended for any appreciable length of time, shape the top of the earthwork in such a manner as to permit run-off of rainwater and construct earth berms along the top edges of embankments to intercept run-off water. Provide temporary slope drains to carry run-off from cuts and embankments which are located in the vicinity of rivers, streams, canals, lakes and impoundments. Should such preventative measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation.

END OF SECTION

SECTION 02520 - PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract apply to work of this Section.

1.2 DESCRIPTION OF WORK

A. Extent of portland cement concrete paving is shown on drawings, including curbs, gutters, walkways and pavement.

B. Prepared subgrade is specified in "EARTHWORK" section.

C. Concrete and related materials are specified in Division-3.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with local governing regulations if more stringent than herein specified.

1.4 SUBMITTALS

A. Furnish samples, manufacturer's product data, test reports, and materials' certifications as required in referenced sections for concrete and joint fillers and sealers.

1.5 JOB CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.

1. Use flexible spring steel forms or laminated boards to form radius bends as required.

2. Coat forms with a non-staining form release agent that will not discolor or deface

surface of concrete.

B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185.

1. Furnish in rolls, unless otherwise acceptable to Architect.

C. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 40.

D. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 40. Cut bars true to length with ends square and free of burrs.

E. Metal Expansion Caps: Furnish for one end of each dowel bar in expansion joints. Design caps with one end closed and a minimum length of 3 inches to allow bars movement of not less than 1 inch, unless otherwise indicated.

F. Hook Bolts: ASTM A 307, Grade A bolts, internally and externally threaded. Design hook bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

G. Concrete Materials: Comply with requirements of applicable Division-3 sections for concrete materials, admixtures, bonding materials, curing materials, and others as required.

H. Expansion Joint Materials: Comply with requirements of applicable Division-7 sections for preformed expansion joint fillers and sealers.

I. Anti-Spalling Compound: 50% (by volume) boiled linseed oil and 50% (by volume) mineral spirits, complying with AASHTO M-233.

J. Liquid-Membrane Forming Curing Compound: Complying with ASTM C 309, Type I, Class A unless other type acceptable to Architect. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

"Masterseal"; Master Builders.
"A-H 3 Way Sealer"; Anti-Hydro Waterproofing Co.
"Ecocure"; Euclid Chemical Co.
"Clear Seal"; A.C. Horn.
"J-20 Acrylic Cure"; Dayton Superior.
"Sure Cure"; Kaufman Products Inc.
"Spartan-Cote"; The Burke Co.
"Sealkure"; Toch Div. - Carboline.
"Kure-N-Seal"; Sonneborn-Contech.
"Polyclear"; Upco Chemical/USM Corp.

"L&M Cure"; L & M Construction Chemicals.
"Klearseal"; Setcon Industries.
"LR-152"; Protex Industries.
"Hardtop"; Gifford - Hill.

K. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

"J-40 Bonding Agent"; Dayton Superior Corp.
"Weldcrete"; Larsen Products.
"Everbond"; L & M Construction Chemicals.
"EucoWeld"; Euclid Chemical Co.
"Hornweld"; A. C. Horn.
"Sonocrete"; Sonneborn-Contech.
"Acrylic Bondcrete"; The Burke Co.

L. Epoxy Adhesive: ASTM C 881, two component materials suitable for use on dry or damp surfaces. Provide material "Type," "Grade," and "Class" to suit project requirements.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

"Epoxtite"; A. C. Horn.
"Edoco 2118 Epoxy Adhesive"; Edoco Technical Prod.
"Sikadur Hi-Mod"; Sika Chemical Corp.
"Euco Epoxy 463 or 615"; Euclid Chemical Co.
"Patch and Bond Epoxy"; The Burke Co.
"Sure-Poxy"; Kaufman Products Inc.

2.2 CONCRETE MIX, DESIGN AND TESTING

A. Comply with requirements of applicable Division-3 sections for concrete mix design, sampling and testing, and quality control, and as herein specified.

Design mix to product normal-weight concrete consisting of portland cement, aggregate, water-reducing of high-range water-reducing admixture (super-plasticizer), air-entraining admixture and water to produce the following properties:

1. Compressive Strength: 3000 psi, minimum at 28 days, unless otherwise indicated.

2. Slump Range: 8 inches for concrete containing HRWR admixture (super-plasticizer); 3 inches for other concrete.

3. Air Content: 5% to 8%.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Remove loose material from compacted subgrade surface immediately before placing concrete.

Proof-roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.2 FORM CONSTRUCTION

A. Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 12 hours after concrete placement.

Check completed formwork for grade and alignment to following tolerances:

1. Top of forms not more than 1/8 inch in 10 feet.
2. Vertical face on longitudinal axis, not more than 1/4 inch in 10 feet.

Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

3.3 REINFORCEMENT

A. Locate, place and support reinforcement as specified in Division-3 sections, unless otherwise indicated.

3.4 CONCRETE PLACEMENT

A. General: Comply with requirements of Division-3 sections for mixing and placing concrete, and as herein specified.

1. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

2. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2-hour, place a construction joint.

3. Fabricated Bar Mats: Keep mats clean and free from excessive rust, and handle units to keep them flat and free of distortions. Straighten bends, kinks, or other irregularities or replace units as required before placement. Set mats for a minimum 2 inches overlap to adjacent mats.

Place concrete in 2 operations; strike-off initial pour for entire width of placement and to the required depth below finish surface. Lay fabricated bar mats immediately in final position. Place top layer of concrete, strike-off and screed.

a. Remove and replace portions of bottom layer of concrete which has been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Architect.

3.5 JOINTS

A. General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

1. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown on drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows:

a. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

2. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such placements terminate at expansion joints.

a. Construct joints as shown or, if not shown, use standard wood or metal keyway-section forms.
b. Where load transfer-slip dowel devices are used, install so that one end of each dowel bar is free to move.

3. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.

Locate expansion joints at spacings indicated.

Extend joint fillers full-width and depth of joint, and not less than 1/2 inch or more than 1 inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.

Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.

Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

3.6 CONCRETE FINISHING

A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand method only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2 inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

1. Broom finish, by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to Architect.

2. On inclined slab surfaces, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.

Do not remove forms for 12 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architect.

3.7 CURING

A. Protect and cure finished concrete paving, complying with applicable requirements of Division-3 sections. Use membrane- forming curing and sealing compound or

approved moist-curing methods.

3.8 REPAIRS AND PROTECTIONS

A. Repair or replace broken or defective concrete, as directed by Architect.

B. Drill test cores where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION

SECTION 02580 - CONCRETE CURBS AND WALKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract apply to work of this Section.

1.2 DESCRIPTION OF WORK

A. General: Furnish all labor and materials to construct concrete curbs and gutters, sidewalks including ramps, and driveways as called for in the Drawings and detailed in the Standard Detail Drawings to include excavation and backfill; foundation; and forming, placing, jointing, form removing, finishing and curing concrete.

PART 2 - MATERIALS

2.1 Concrete: FDOT 345-2 (except no pozzolan), 4, 6, 9, 10, 11, 12, 13. Class I concrete with minimum 28-day compressive strength of 3000 psi.

2.2 Reinforcement: ASTM A615 - Grade 60.

2.3 Joint Materials: FDOT 932-1.

2.4 Membrane Curing Compound: FDOT 925-2.

2.5 Forms: Forms shall be metal or wooden, straight, and free from warp or bends and of sufficient strength, when staked to resist the pressure of the concrete without deviation from line and grade. Flexible forms shall be used for all items constructed on a radius.

PART 3 - EXECUTION

3.1 Foundation (Subgrade Preparation): The subgrade shall be excavated or filled with suitable material to the required grades and lines. All soft, yielding, and otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted to a minimum of 95% of maximum (AASHTO T-180) density and extend to a minimum of 1 foot outside the form lines. The subgrade shall be dense, firm, trimmed to a uniform smooth surface, and in a moist condition when the concrete is placed.

3.2 Machine Laid Curb: The slipform/extrusion machine approved shall be so designed as to place a spread, consolidate, screed, and finish the concrete in one complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous concrete section. The machine shall shape, vibrate, and/or extrude the concrete for the full width and depth of the concrete section being placed. It shall

be operated with as nearly a continuous forward movement as possible. All operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the machine held to a minimum.

3.3 Forming: Depth of forms shall be equal to the Drawing dimensions for the concrete to be placed against them. Forms shall be staked to resist the pressure of the concrete without deviation from line and grade. They shall be cleaned each time used and shall be oiled or saturated with water prior to placing concrete.

3.4 Reinforcement: Reinforcement shall only be required where called for in the Drawings. Set reinforcement for sidewalks above the foundation so concrete will flow under it.

3.5 Placing: Place concrete in the forms and tamp and spade to prevent honeycomb until the top of the structure can be floated smooth. Round all edges to 1/2 inch radii unless otherwise shown on the Standard Detail Drawings.

3.6 Sidewalk Ramps: Ramps shall be provided at all road/street crossings each way as shown in the Standard Detail Drawings.

3.7 Contraction Joints: Unless otherwise shown or noted in the Drawings, weakened plane contraction joints shall be located as follows:

Curbs - 10 feet maximum intervals.

Sidewalks - To form squares of uniform size.

3.8 Contraction joints may be sawed, hand-formed, or made by 1/8 inch thick division plates in the framework. Sawing shall be done early after the concrete has set to prevent the formation of uncontrolled cracking. The joints may be hand-formed by using a narrow or triangular jointing tool or a thin metal blade to impress a plane of weakness into the plastic concrete. Where division plates are used, the plates shall be removed after the concrete has set and while the forms are still in place.

3.9 Expansion (Isolation) Joints: Provide isolation joints between all distinct structures such as between sidewalk and curbs, driveway and sidewalk or curbs, sidewalk or curbs and inlets, around concrete utility poles and at radius points along the curbs and at the end of a continuous pour.

3.10 Finishing: Strike off concrete sidewalks and driveways by means of a wood or metal screed, used perpendicular to the forms, to obtain required grade and remove surplus water laitance. Broom finish the surfaces and finish edges with an edging tool having a radius of 1/2 inch.

3.11 Remove all curb and gutter forms within 24 hours after concrete is in place, and fill minor defects with mortar composed of one part portland cement and two parts fine aggregate. Plastering is not permitted. Finish all curbs and gutter surfaces while the

cement is still green to a brush finish. For any surface areas that are too rough or where surface defects make additional finishing necessary, the curb shall be rubbed to a smooth surface with a soft brick or wood block, with water used liberally.

3.12 Surface Requirements: Test the gutters with a 20 foot straight edge laid parallel to the centerline of the roadway while the concrete is still plastic. Straight edging shall be done along the edge of the gutter adjacent to the pavement or along other lines on the gutter cross-section. Irregularities in excess of 1/4 inch shall be corrected immediately. Surface variations on sidewalks and driveways shall not exceed 1/4 inch under a 10 foot straight edge, nor more than 1/8 inch on a 5 foot traverse section.

3.13 Curing: Concrete shall be cured by the Membrane Curing Compound Method for a continuous period of 72 hours minimum, commencing after completing the finishing and as soon as the concrete has hardened sufficiently to permit application of the curing material without marring the surface. Immediately replace any curing material that may be removed or damaged during the 72-hour period.

This method requires the application of a clean membrane curing compound or white pigmented curing compound as in the Membrane Curing Compound paragraph above, by a hand sprayer in a single continuous film with uniform coverage of at least one gallon to each 200 square feet. Any cracks, check or other defects shall be recoated immediately. Agitate the curing compound thoroughly in the drum prior to application, and during application as necessary to prevent settlement of the pigment.

3.14 Backfilling and Compaction: After the concrete has set sufficiently, but no later than 3 days after the pouring, the spaces in front and back of the curb and other excavation generated from this work shall be refilled to the required elevation with suitable material, placed and thoroughly compacted in layers not to exceed 6 inches.

3.15 Protection: The Contractor shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper or plastic sheeting. For slipform construction, materials such as wood planks or forms to protect the edges shall also be required.

3.16 Testing: Provide not less than three 6 inches by 12 inches cylinder compressive strength tests (ASTM C 39) and one slump test (ASTM C 143) for each 75 cubic yards of part thereof poured.

END OF SECTION

SECTION 02666 - POTABLE WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract apply to work of this Section.

1.2 DESCRIPTION OF WORK

A. Extent of potable water systems work is indicated on drawings and schedules, and by requirements of this section.

B. Refer to Division-2 Section "EARTHWORK - UNDERGROUND UTILITIES" for excavation and backfill required for potable water systems; not work of this section.

C. Refer to Division-15 for interior building water systems including interior piping, fixtures, and equipment; not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of potable water systems materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with potable water piping work similar to that required for project.

C. Codes and Standards:

1. AWWA C-600 for Ductile Iron and install PVC as applicable.
2. AWWA C-900 for PVC pipe 4 inch to 12 inch.
3. Water Purveyor Compliance: Comply with requirements of Purveyor supplying water to project, obtain inspections from Purveyor as outlined in this section.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for potable water system materials and products.

B. Shop Drawings: Submit shop drawings for potable water systems, showing piping materials, size, locations, and elevations. Include details of underground structures, connections, thrust blocks, and anchors. Show interface and spatial relationship between piping and proximate structures.

C. Record Drawings: At project closeout, submit record drawings of installed potable water system piping and products, in accordance with requirements of Division-1.

D. Maintenance Data: Submit maintenance data and parts lists for potable water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division-1, if applicable.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

A. Underground-Type Plastic Line Markers: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW."

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering plastic line markers which may be incorporated in the work include, but are not limited to, the following:
   a. Allen Systems Inc.
   b. Seton Name Plate Corp.
   c. or approved equal

B. Nonmetallic Piping Label: If nonmetallic piping is used for water service, provide engraved plastic laminate, label permanently affixed to main electrical meter panel stating "This structure has a nonmetallic water service."

2.2 PIPES AND PIPE FITTINGS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems.

B. Piping: Provide pipes of one of the following materials, of weight/class indicated.

C. Iron Pipe & Fittings: Pipe shall be ductile iron (DI) with minimum thickness of Class 51 for 3 and 4 inch diameter pipe and Class 50 for larger pipe. Fittings may be ductile iron or gray iron (GI) with pressure rating equal to that of the pipe unless otherwise specified in the Drawings. The materials shall be as follows:

1. Pipe - ANSI A21.51 (AWWA C151)
2. Fittings - ANSI A21.10 (AWWA C110)
3. Joints - Mechanical & Push-on, ANSI A21.11 (AWWA C111)
4. Joints - Flanged ANSI A21.10 & A21.15 (AWWA C110 & C115) Class 125 and 1/8 inch full faced rubber gaskets.

5. Restrained joints - Ductile iron mechanical joint retainer glands approved equal to American Cast Iron Pipe Co.
6. Flexible joints - Boltless with 15 joint deflection per applicable portions of ANSI A21.10 (AWWA C110) approved equal to "Flex-Lok" by American Cast Iron Pipe Co.
7. Bolts & Nuts - Bolts, ANSI B18.21; Nuts, B18.2.1; low carbon steel per ASTM A307, Grade B.

D. Coatings, Linings & Encasement (Iron Pipe): All pipe and fittings shall be cement mortar lined per ANSI A21.4 (AWWA C104) and bituminous coated per above.
1. Where protective interior lining is called for, use 20 mil (minimum dry thickness) virgin polyethylene per ASTM D1248 compounded with an inert filler and with sufficient carbon black to resist ultraviolet rays during above ground storage, heat bonded to pipe and fittings, approved equal to "Polybond" by American Cast Iron Pipe Company.
2. Polyethylene Encasement, where required, shall be per ANSI A21.5 (AWWA C105).
3. Pipe fittings scheduled for field painting shall not receive an exterior bituminous coating. Instead, the pipe and fitting exterior shall be cleaned thoroughly and given one (1) shop coat of rust-inhibitive primer compatible with the field paint applied in accordance with the manufacturer's recommendations.
4. Machined surfaces shall be cleaned and coated with a suitable rust-preventative coating at the shop immediately after machining.

E. Polyvinyl Chloride Pipe (PVC): 4 inch to 12 inch AWWA C900, DR-18 National Sanitation Foundation (NSF) approved for potable water having integral wall-thickened bell ends without increase in DR and outside diameter equivalent to ductile iron pipe. Use iron fitting per above. Joints shall be elastomeric seals per ASTM D3139 and ASTM F477. Lubrication shall be non-toxic, NSF approved for potable water. Polyvinyl chloride pipe less than 4 inches shall be in accordance with ASTM 1785 for schedule 40, 80, 120 or ASTM 2241 for SDR21, minimum PC 200.

F. Check Valves: Iron body, bronze-mounted, stainless steel hinge pin, outside spring operated, swing non-slam type, and equipped with removable inspection covers. Units shall be rated for 150 psi minimum working pressure and shall permit full flow area equal to that of the connecting pipe. Approved equal to M & H.

Valves 2 inches and smaller - bronze body and disc, swing check type, with removable inspection covers, rated at 150 psi minimum working pressure, equal to Crane No. 37.

G. Valve Boxes: Cast iron, adjustable, with minimum interior diameter of 5 inches. The word "Water" shall be legibly cast into the cover. Boxes to conform to applicable surface loading and valve size approved equal to Clow.

H. Valves-General: The manufacturer shall clearly mark the valve type, size, rating and flow direction arrow. Valves shall open to the left (counter-clockwise) with an arrow cast in the metal of the operating handwheels and nuts indicating the direction of opening.

Above ground installations shall have flanged joints; below ground shall be mechanical joints.

I. Gate Valves: Iron body, bronze-mounted double disc, 0-ring seal, per AWWA C500. Valves for underground service shall be non-rising stem (NRS) type equipped with 2 inch square cast iron wrench nuts. Valves for above ground service shall be outside screw and yoke (OS & Y) rising stem type equipped with cast iron band wheels or chain operators with galvanized steel chains as noted in the Drawings.

1. Tapping valves - per the above, compatible with the connecting sleeve or saddle and specially designed for wet tapping installations.
2. Actuators - Equip all valves 16-inch and larger with approved gearing actuators, with sealed enclosures for buried or submerged service, and shall be furnished by the valve manufacturer. Position indicators as required.
3. Horizontal Installation - Valves 16-inches in diameter or larger, to be installed horizontally, shall be additionally equipped per the applicable Section of AWWA C500 and as follows:
   a. Installed in vertical pipe with horizontal stem-fitted with approved slides, tracks and shoes to assist the travel of the gate assembly.
   b. Installed in Horizontal pipe with horizontal stem - equipped with approved rollers, tracks and scrapers to assist the travel of the gate assembly and to clear the tract of obstructions.
4. Valves 3-inches and smaller - Bronze, wedge disc, non-rising stem type, 150 psi minimum working pressure, equipped with wrought steel or cast iron operating handwheels, approved equal to Crane No. 437.

J. Butterfly Valves: Cast iron body, allow cast or ductile iron disc, body mounted at seat, one-piece stainless steel shaft, short or long body type, AWWA C504, with the valve class, shaft size and other special requirements selected in accordance with the specific design, "Rubber-Seated Butterfly Valves". Valve operation by approved gear actuators, with sealed enclosures for buried or submerged service. Position indicators furnished as required. Equip units with actuating nuts, cast iron handwheels or chain operators, with galvanized steel chains for the given installation. All appurtenances furnished by valve manufacturer.

K. Backflow Prevention Device: Type and manufacturer shown in the Drawings, otherwise per AWWA C-506, however the device shall be acceptable to the local jurisdiction. Approved equal to Hersey (Beeco), CLa-Val, Febco, Grinnel.

L. Meter Box: Cast-iron or concrete standard types, appropriately sized for utilization and installation requirements.

M. Expansion Joints: Pipe expansion joints shall be minimum 150 psi working pressure equal to style N. 500, manufactured by Mercer Rubber Company.

N. Flanged Coupling Adapters: Equal to Smith Blair Type 912 for pipe size to 12 inches and Type 913 for larger sizes. Conformance with ANSI Standard B16.1 (125 lb flanges).

O. Cast Couplings: Equal to Smith Blair, Type 431 (connecting equal outside diameter pipes), Type 433 (connecting equal size pipes with variations in outside diameter), and Type 435 (reducing coupling).

P. Cast Iron Sleeves and Wall Pipes: Shall have integral annular ring water-stops, and conform to requirements for Cast Iron fittings noted herein. Sleeves and Wall Pipes to have laying length and ends required for proper installation.

Q. Tapping Saddles: Ductile Iron, suitable for either wet or dry installation double strapped as manufactured by the American Cast Iron Pipe Company. Provide an "O"-ring type sealing gasket. Provide tie straps and bolts of a corrosive resistant alloy steel.

R. Tapping Sleeves and Crosses: mechanical joint type, with outlet flange ANSI B16-1, 125 lb standard, approved equal to M & H.

S. Service Saddle: Double strap units with straps of corrosion resistant alloy steel and "O"-ring type sealing gasket. Ductile iron for ductile iron pipe, equal to Smith Blair Type 3.3. Type 342 or 352 for plastic pipe.

T. Service Line Materials: AWWA C800 and the Appendix thereto where applicable. The minimum pressure class for plastic piping/tubing shall be 200 psi.

U. Concrete: FDOT 345 - 2, 4, 6, 9, 10, 11, 12 and 23. Class II concrete, minimum 28 day compression strength of 3400 psi.

2.3 ACCESSORIES

A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
1. Clamps, Straps, and Washers: Steel, ASTM A 506.
2. Rods: Steel, ASTM A 575.
3. Rod Couplings: Malleable-iron, ASTM A 197.
4. Bolts: Steel, ASTM A 307.
5. Cast-Iron Washers: Gray-iron, ASTM A 126.
6. Thrust Blocks: Concrete, 3,000 psi, as indicated on drawings.

B. Yard Hydrants: Provide non-freeze yard hydrants, 3/4 inch inlet, 3/4 inch hose outlet, bronze casing, cast-iron or cast-aluminum casing guard, key-operated, and tapped drain port in valve housing.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering yard hydrants which may be incorporated in the work include, but are not limited to, the following:
   a. Josam Mfg. Co.
   b. Smith (Jay R.) Mfg. Co.
   c. Tyler Pipe.
   d. Zurn Industries, Inc.; Hydromechanics Div.

2.4 FIRE HYDRANTS

A. AWWA C502, and shall be equipped with a minimum of one pumper outlet nozzle 4-1/2 inches in diameter and two hose nozzles 2-1/2 inches in diameter. Paint hydrant with two coats of oil paint using the local color code based on fire flow tests. Threads, nozzle caps, operating nuts and color shall conform to requirements of the local jurisdiction. Units shall be traffic type with breakable safety clips, or flange, and stem, with safety coupling located below barrel break line to preclude valve opening. Hydrants shall be dry top, low profile design with a maximum height of 30 inches. Outlet nozzles shall be on the same plane, with minimum distance of 18 inches from center of nozzles to ground line. Valve shall be compression type with 5-1/2 inches minimum opening and shoe inlet connection to be 6 inches minimum.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which potable water system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF IDENTIFICATION

A. General: During back-filling/top-soiling of underground potable water piping, install continuous underground-type plastic line markers, located directly over buried lines at 24 inches below finish grade.

B. Insulation: Insulate all above ground piping for freeze protection.

C. Pipe Laying: Lay all pipe "in the dry" along straight lines and grades between fittings, manholes, or other defined points, unless definite alignments deflections or grade changes are noted in the Drawings. Maintain a 3 foot minimum depth of cover over the top of pipe, unless otherwise noted in the Drawings. Maintain all materials, clean and protect all coatings from damage. Maintain the interior of the pipe, clean and free of dirt and debris. When work is not in progress, plug all open ends. Underground piping shall not be driven to grade by striking it with an unyielding object. Provide bell holes in the bedding to allow uniform load bearing along the pipe barrel.

Subaqueous pipe laying may be permitted with prior approval of the Engineer where conditions make it impracticable to lay pipe "in the dry".

Provide proper provisions for pipe expansions or contraction by installing expansion joints or other suitable methods. Also provide flexible connections to expedite equipment or piping system removal.

D. Push-On Joints: The pipe bell and spigot shall be thoroughly cleaned immediately prior to inserting the gasket and jointing. Assure that the gasket is properly faced and positioned. Lubricate in accordance with manufacturer's recommendations. Protect pipe against damage from jointing equipment by using timber headers, etc.

E. Mechanical Joints: Wipe clean the socket and plain end. The plain end, socket, and gasket shall be washed with a soap solution immediately prior to jointing. Maintain the joint straight during assembly with the gasket pressed firmly and evenly into the recess. Bolts shall be tightened such that the gland remains reasonable parallel to the flange by alternating from bolt to bolt in cycles. The required bolt size (pipes 4 inch to 24 inch diameter) is 3/4 inch torqued to 75 - 90 ft-lbs.

F. Flange Joints: Make all flanged joints tight, without applying undue strain upon the joint or other appurtenances. Fit joints such that contact surfaces bear uniformly on the gasket with relatively uniform bolt stresses.

G. Pipe Cutting: Cutting pipe for the insertion of valves, fittings, or closure pieces shall be done in a neat workmanlike manner without damaging pipe, coatings or linings. Cut the pipe with an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw or milling wheel saw, and per manufacturer's recommendations. Cut ends and rough edges shall be ground smooth, and for push-on joint connections the cut end shall be beveled.

H. Pipe Restraint: All plugs, caps, tees, and bends, unless otherwise specified, shall be restrained by thrust block reaction backing and/or the use of tie rods, retainer glands and/or restrained joints as shown in the Drawings and Standard Detail Drawings. Thrust blocking shall be placed between solid ground and the fitting to be anchored. Where concrete is to be placed around bolted joints, provide a sheet of 3 mil (minimum) polyethylene between the fitting and the concrete. Where soil bearing is inadequate to provide proper thrust blocking, Contractor shall provide mechanical restraint as directed by the Engineer. Protect tie rods, clamps, or other components of dissimilar metal against corrosion by hand application of a bituminous coating. Backfilling over pipe restraints shall not proceed until inspected by the Engineer.

I. Polyethylene Encasement: When polyethylene encasement is specified for ductile iron pipe it shall be installed in accordance with ANSI A21.5 (AWWA C105).

J. Support of Exposed Pipework: Support exposed systems as necessary to hold the piping and appurtenances in a firm, substantial manner to the required line and grades indicated on the Drawings, with no undue piping stresses transmitted to equipment or other items. Support all piping in buildings from the floors, wall, ceiling and beams adequately. Supports from the floor shall be by suitable saddle stands or piers. Support piping along walls by wall brackets, saddles or by wall brackets with adjustable hanger rods. When piping is supported from the ceiling, use approved rod hanger of a type capable of screw adjustment after erection. Support all pipe above ground outside of buildings by concrete supports.

Where floor stands and extension stems are required for exposed valves, furnish adjustable wall bracket and extension stems. In general, brackets shall be not more than 6 feet apart, with floorstands and guides set firmly in concrete.

K. Tapping: Tapping shall be by tapping sleeve (or cross) and valve installed with a tapping device designed for the pipe material.

L. Service Connections: All connections less than 1 2-inches are considered service connections. New services shall be no less than 3/4-inches in diameter, unless noted otherwise on the drawings. Service lines serving a double connection shall be no less than 1-inch in diameter, unless noted on the drawings. Connection to main 4-inch and larger shall be by drilling the appropriate size hole and installation of service saddle with services to smaller mains by means of in-line fittings. Place a corporation stop at the saddle or fitting, extend service line to property line (perpendicular from the Main), and terminate with a plugged curb-stop pending meter installation. The contractor shall mark the location of each water service at its upper end by chiseling a letter "W" - 1 2-inches high on the top of the curb. If the curb does not exist, place a 4" x 4" x 3'-0" wood stake extending 2-inches above the ground at the end of the service.

M. Valves: Carefully inspect all valves, opened wide, and then tightly closed, and all the various nuts and bolts for tightness. Take special care to prevent joint materials, stones, and other substances from becoming lodged in the valve seat. Any valve that does not operate correctly shall be replaced. Install at the locations, to the sizes, and elevations called for in the Drawings. Install buried valves vertically centered over the pipe. Provide extension stems on all buried valves to place the operating nut not more than 3 feet below grade.

N. Valve Boxes: Center all valve boxes over the operating nut of underground valves to permit a valve wrench to be easily fitted to the nut. Set top of boxes to final grade. The valve box shall not transmit surface loads directly to either the pipe or valve. Use excessive care to prevent earth and other materials from entering the boxes. Any valve box that becomes out of alignment or is not to grade, shall be dug out and adjusted. A concrete collar shall be provided as shown in the Drawings.

3.3 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline 24- hrs prior to testing, and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than 150 psi for 2 hours.

This test shall be performed by the Contractor with his labor and equipment in the presence of the Engineer and Owner/Purveyor Representative. No testing will proceed until all thrust blocks are cured or restraining devices installed. Clean and flush all piping thoroughly prior to testing. During filling of water all air will be carefully permitted to escape through release cocks installed as required.

$$L = \frac{(N)\ (D)\ (P)^2}{3700} = \text{allowable leakage in gallons per 2 hour test.}$$

L = 0.00331 ND; for 150 psi test for 2 hours.

N = Number of joints in the section tested.

D = Nominal pipe diameter in inches.
P = Average test pressure maintained during the leakage test in psig (gauge).

During the two (2) hour period of the test, the Contractor shall maintain a continuous pressure of 150 psi, by means of a pump taking supply from a container suitable for the measurement of water loss. Should the test fail, the leak will be located and repaired and the test performed again until it meets the above specified limits.

C. Disinfection - Following the hydrostatic leakage test, Contractor shall provide all labor and materials to disinfect all sections of water systems, and receive approval from the appropriate agencies before placing the system in service. Disinfection shall be performed per AWWA C651 and Florida Department of Environmental Protection requirements.

D. Chlorination - Apply the chlorination agent at the beginning of the section adjacent to the feeder connection, by injecting it through a corporation cock, hydrant or other connection ensuring treatment of the entire system. The chlorination agent may be any compound specified in AWWA C651. Feed water slowly into the new line and induce chlorine to produce a dosage and a residual as a dosage of between 40-50 ppm and a residual of not less than 25 mg/1 in all parts of the line after a 24-hour time period. During the chlorination process operate all valves and accessories.

E. Flushing - Flush the system carefully until the chlorine concentration in the discharged water is equal to that generally prevailing or less than 1mg/1.

F. Bacteriological Testing - After disinfecting the system, Contractor shall have samples collected for bacteriological analysis and submit as directed by Florida Department of Environmental Protection or local governing authority.

G. Inspection of Work - All work is subject to inspection by the Water Purveyor, Owner's Representative and Engineer. The following phases of construction shall be inspected by the Owner's Representative and Engineer:

Placing of pipe, fittings and appurtenances.
Hydrostatic Test
Backfill
Sterilization
Placing in Service

END OF SECTION

SECTION 02938

SODDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Fertilizing.

D. Sod installation.

E. Maintenance.

1.2 RELATED SECTIONS

A. Section 02200 - Earthwork.

1.3 REFERENCES

A. ASPA (American Sod Producers Association) - Guideline Specifications to Sodding.

B. Fertilizers, Mixed, Commercial.

1.4 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.5 MAINTENANCE DATA

A. Operation Data: Submit for continuing Owner maintenance.

B. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer; and pesticides.

1.6 QUALITY ASSURANCE

A. Sod: Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.

B. Submit sod certification for grass species and location of sod source.

1.7 QUALIFICATIONS

A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of Florida

B. Installer: Company approved by the sod producer.

1.8 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Provide certificate of compliance from State Dept. of Agriculture and Consumer Services indicating approval of fertilizer and herbicide mixture.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Deliver sod on pallets. Protect exposed roots from dehydration by water as necessary.

C. Do not deliver more sod than can be laid within 24 hours of delivery.

1.10 COORDINATION

A. Coordinate work under provisions of Division 1.

B. Coordinate with installation of underground sprinkler system piping and watering heads.

1.11 MAINTENANCE SERVICE

A. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition or until final completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SOD GROWERS

A. To be submitted by Landscape Contractor.

2.2 MATERIALS

A. Sod: ASPA Certified cultivated grass sod; as indicated in plant schedule on Drawings with strong fibrous root system, free of stones, burned or bare spots; containing no more than 10 weeds per 1000 sq ft.
   1. Bahia Grass, as noted on the plant list.

B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from a well drained site; free of subsoil, clay, or impurities, plants, weeds and roots; pH value of minimum 6.0 and maximum 7.0.

C. Fertilizer: as recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil to the following proportions: nitrogen 6 percent, phosphoric acid 6 percent, soluble potash 6 percent.

D. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

2.3 ACCESSORIES

A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.

B. Edging: as noted per plan.

C. Herbicide: Submit manufacturer's data.

2.4 HARVESTING SOD

A. Machine cut sod and load on pallets in accordance with ASPA Guidelines.

B. Cut sod in area not exceeding 1 sq yd, with minimum 1/2 inch maximum 1 inch topsoil base.

2.5 TESTS

A. Provide analysis of topsoil fill under provisions of Division 1.

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, trace elements soluble salt content, organic matter content, and pH value.

C. Submit minimum 12 oz sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.2 PREPARATION OF SUBSOIL

A. Prepare sub-soil and eliminate uneven areas and low spots.

B. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

C. Remove foreign materials and undesirable plants and their roots. Do not bury foreign material beneath areas to be sodded.

D. Remove contaminated subsoil.

E. Scarify sub-soil to a depth of 4 inches where topsoil is to be placed.

F. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.3 PLACING TOPSOIL

A. Spread topsoil to a minimum depth of 4 inches over area to be sodded.

B. Place topsoil during dry weather and on dry subgrade.

C. Remove vegetative matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

E. Install edging as noted on plans at periphery of sodded areas in straight lines to consistent depth.

3.4 FERTILIZING

A. Apply fertilizer at a rate of 700 pounds per acre or 16 pounds per 1,000 square feet.

B. Apply after smooth raking of topsoil and prior to installation of sod.

C. Apply fertilizer no more than 48 hours before laying sod.

D. Mix thoroughly into upper 4 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.5 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod within 24 hours after harvesting to prevent deterioration.

C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

D. Lay smooth. Align with adjoining grass areas.

E. Place top elevation of sod 1/2 inch below adjoining paving.

F. On slopes 4 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 8 feet on center. Drive pegs flush with soil portion of sod.

G. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

H. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller not exceeding 150 lbs.

3.6 MAINTENANCE

A. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing. Maintain sod until final acceptance.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming.

D. Water to prevent grass and soil from drying out.

E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

F. Immediately replace sod to areas which show deterioration or bare spots.

END OF SECTION

SECTION 03300- CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 2 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Concrete paving and walks are specified in Division 2.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 2 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, curing compounds, and others as requested by Engineer.

C. Laboratory test reports for concrete materials and mix design test.

D. Materials certificates in lieu of materials laboratory test reports when permitted by Architect. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

E. Minutes of pre-construction conference.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 318, "Building Code Requirements for Reinforced Concrete."
2. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."

B. Concrete Testing Service: Orange County will employ a testing laboratory to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting at any time during

progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Use one brand of cement throughout project unless otherwise acceptable to Engineer.

B. Fly Ash: ASTM C 618, Type C or Type F.

C. Normal Weight Aggregates: ASTM C 33 and as herein specified. Provide aggregates from a single source for exposed concrete.

1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.

D. Lightweight Aggregates: ASTM C 330.

E. Water: Drinkable.

F. Admixtures, General: Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.

G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. "Air-Tite," Cormix.
    b. "Air-Mix" or "Perma-Air," Euclid Chemical Co.
    c. "Darex AEA" or "Daravair," W.R. Grace & Co.
    d. "MB-VR" or "Micro-Air," Master Builders, Inc.
    e. "Sealtight AEA," W.R. Meadows, Inc.
    f. "Sika AER," Sika Corp.

H. Water-Reducing Admixture: ASTM C 494, Type A.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. "Chemtard," ChemMasters Corp.
    b. "PSI N," Cormix.
    c. "Eucon WR-75," Euclid Chemical Co.
    d. "WRDA," W.R. Grace & Co.
    e. "Pozzolith Normal" or "Polyheed," Master Builders, Inc.
    f. "Prokrete-N," Prokrete Industries.
    g. "Plastocrete 161," Sika Corp.

I. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. "Super P," Anti-Hydro Co., Inc.
    b. "PSI Super," Cormix.
    c. "Eucon 37," Euclid Chemical Co.
    d. "WRDA 19" or "Daracem," W.R. Grace & Co.
    e. "Rheobuild," Master Builders, Inc.
    f. "PSP," Prokrete Industries.
    g. "Sikament 300," Sika Corp.

J. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. "Q-Set," Conspec Marketing & Manufacturing Co.
    b. "Gilco Accelerator," Cormix.
    c. "Accelguard 80," Euclid Chemical Co.
    d. "Daraset," W.R. Grace & Co.
    e. "Pozzutec 20," Master Builders, Inc.

K. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. "PSI-R Plus," Cormix.
b. "Eucon Retarder 75," Euclid Chemical Co.
c. "Daratard-17," W.R. Grace & Co.
d. "Pozzolith R," Master Builders, Inc.
e. "Protard," Prokrete Industries.
f. "Plastiment," Sika Corporation.

L. Fibrous Reinforcement: Engineered polypropylene fibers designed for secondary reinforcement of concrete slabs.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. "Fiberstrand 100," Euclid Chemical Co.
b. "Fibermesh," Fibermesh, Inc.
c. "Forta CR," Forta Corp.
d. "Grace Fibers," W.R. Grace & Co.

2.3 RELATED MATERIALS

A. Vapor Retarder: Provide vapor retarder cover over prepared base material where indicated below slabs on grade. Use only materials that are resistant to deterioration when tested in accordance with ASTM E 154, as follows:

1. Polyethylene sheet not less than 8 mils thick.

B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

C. Liquid Membrane-Forming Curing Compound: Liquid-type membrane- forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. "A-H 3 Way Sealer," Anti-Hydro Co., Inc.
b. "Spartan-Cote," The Burke Co.

c. "Conspec #1," Conspec Marketing & Mfg. Co.
d. "Hardtop," Cormix.
e. "Day-Chem Cure and Seal," Dayton Superior Corp.
f. "Eucocure," Euclid Chemical Co.
g. "Horn Clear Seal," A.C. Horn, Inc.
h. "L&M Cure," L & M Construction Chemicals, Inc.
i. "Masterkure," Master Builders, Inc.
j. "CS-309," W.R. Meadows, Inc.
k. "LR-151," Prokrete Industries.
l. "Kure-N-Seal," Sonneborn-Rexnord.
m. "Stontop CS2," Stonhard, Inc.

D. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. "Eucobar," Euclid Chemical Co.
b. "E-Con," L&M Construction Chemicals, Inc.
c. "Confilm," Master Builders, Inc.

E. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. Polyvinyl Acetate (Interior Only):

1) "Superior Concrete Bonder," Dayton Superior Corp.
2) "Euco Weld," Euclid Chemical Co.
3) "Weld-Crete," Larsen Products Corp.
4) "Everweld," L&M Construction Chemicals, Inc.

b. Acrylic or Styrene Butadiene:

1) "Acrylic Bondcrete," The Burke Co.
2) "Strongbond," Conspec Marketing and Mfg. Co.
3) "Day-Chem Ad Bond," Dayton Superior Corp.
4) "SBR Latex," Euclid Chemical Co.
5) "Daraweld C," W.R. Grace & Co.
6) "Hornweld," A.C. Horn, Inc.
7) "Everbond," L & M Construction Chemicals, Inc.
8) "Acryl-Set," Master Builders Inc.
9) "Intralok," W.R. Meadows, Inc.
10) "Sonocrete," Sonneborn-Rexnord.
11) "Stonlock LB2," Stonhard, Inc.

F. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material "Type," "Grade," and "Class" to suit project requirements.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. "Burke Epoxy M.V.," The Burke Co.
b. "Spec-Bond 100," Conspec Marketing and Mfg. Co.
c. "Euco Epoxy System #452 or #620," Euclid Chemical Co.
d. "Epoxtite Binder 2390," A.C. Horn, Inc.
e. "Epabond," L&M Construction Chemicals, Inc.
f. "Concresive 1001," Master Builders, Inc.
g. "Sikadur 32 Hi-Mod," Sika Corp.

2.4 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

1. Limit use of fly ash to not exceed 25 percent of cement content by weight.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until proposed mix designs have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

1. Slab-On-Grade: 4000-psi, 28-day compressive strength; W/C ratio, 0.44 maximum (non-air-entrained), 0.35 maximum (air-entrained).
2. Foundations: 3000-psi, 28-day compressive strength; W/C ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained).

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

2.5 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture

(Superplasticizer) in concrete as required for placement and workability.

B. Use nonchloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).

C. Use high-range water-reducing admixture (HRWR) in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.

D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within following limits:

1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:

a. 5.0 percent (moderate exposure); 6.0 percent (severe exposure) 3/4-inch max. aggregate.
b. 5.5 percent (moderate exposure); 7.0 percent (severe exposure) 1/2-inch max. aggregate.

2. Other concrete (not exposed to freezing, thawing, or hydraulic pressure) or to receive a surface hardener: 2 percent to 4 percent air.

E. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.

F. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:

1. Subjected to freezing and thawing; W/C 0.45.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
2. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches.
3. Concrete containing HRWR admixture (Superplasticizer): Not more than 8 inches after addition of HRWR to site-verified 2-inch to 3-inch slump concrete.
4. Other concrete: Not more than 4 inches.

2.6 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air

temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

3.2 VAPOR RETARDER/BARRIER INSTALLATION

A. General: Following leveling and tamping of granular base for slabs on grade, place vapor retarder/barrier sheeting with longest dimension parallel with direction of pour.

B. Lap joints 6 inches and seal vapor barrier joints with manufacturers' recommended mastic and pressure-sensitive tape.

C. After placement of vapor retarder/barrier, cover with sand cushion and compact to depth as shown on drawings.

3.3 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.

1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as accepted by Architect.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

A. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

B. Joint sealant material is specified in Division 2 Sections of these specifications.

3.5 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

B. Forms for Slabs: Set edge forms and bulkheads, for slabs to obtain required elevations and contours in finished surfaces.

3.6 PREPARATION OF FORM SURFACES

A. General: Coat contact surfaces of forms with an accepted, nonresidual, low-VOC, form-coating compound before reinforcement is placed.

B. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.7 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.

B. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete during placing operations so that concrete is thoroughly

worked around reinforcement and other embedded items and into corners.
2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position during concrete placement.

F. Cold-Weather Placing: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

G. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot-Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to Architect.

3.8 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or

other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

B. After placing slabs, plane surface to tolerances for floor flatness (Ff) of 15 and floor levelness (Fl) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of Ff 18 - Fl 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 20 - Fl 17. Grind smooth surface defects that would telegraph through applied floor covering system.

E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly

scarifying surface by fine brooming.

F. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

D. Provide moisture curing by following methods.

1. Keep concrete surface continuously wet by covering with water.
2. Use continuous water-fog spray.
3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

E. Provide moisture-cover curing as follows:

1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs as follows:

1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or

roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

H. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.

I. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

3.11 REMOVAL OF FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.12 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces except as acceptable to Architect.

3.13 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled.

E. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.14 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.

1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.
2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

C. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.

1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

D. Perform structural repairs with prior acceptance of Architect for method and procedure, using specified epoxy adhesive and mortar.

E. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.15 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General: Orange County will employ a testing laboratory to perform tests and to submit test reports.

B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Engineer.

C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

1. Slump: ASTM C 143; one test at point of discharge for each day's pour of each

type of concrete; additional tests when concrete consistency seems to have changed.

2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
3. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and each time a set of compression test specimens is made.
4. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cure test specimens are required.
5. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. more than the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
6. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
7. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

D. Test results will be reported in writing to Architect, Structural Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

F. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION