Riviera Bella East

City of DeBary, Florida

STORMWATER MANAGEMENT REPORT

Prepared for

HENIN GROUP

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1 Introduction

This report is to demonstrate that the proposed project complies with the drainage requirements of the permitting agencies having jurisdiction over the development of this site located within the City of DeBary and St. Johns River Water Management District (SJRWMD). The Riviera Bella project is divided into two areas, Riviera Bella East and Riviera Bella West. The Riviera Bella West has been completely permitted for construction by the City of DeBary and SJRWMD. The below table provides a summary of the Riviera Bella West permitting and construction history.

Table 1A
Riviera Bella West Permit and Construction History

Unit	City Permit	SJRWMD Permit	Construction Activity
1	Permitted	40-127-64289-1	Constructed
2A	Permitted	40-127-64289-1	Constructed
2B	Permitted	40-127-64289-2 and 7	Constructed
3	Permitted	40-127-64289-9	Constructed
4	Permitted	40-127-64289-11 and 15	Under Construction 2015
5	Permitted	40-127-64289-11 and 15	To Be Constructed
6	Permitted	40-127-64289-11 and 15	To Be Constructed
7	Permitted	40-127-64289-11 and 15	To Be Constructed

Riviera Bella East will consist of two units (Units 8 and 9) and have not be permitted for construction. This Stormwater Management Report will provide calculations to demonstrate compliance with the drainage requirements to permit Riviera Bella East - Units 8 and 9 for construction.

1.1 Project Location

The Riviera Bella East project is located within the city limits of the City of DeBary, which is within Volusia County, Florida. The project is bounded on the west and south by Fort Florida Road, the north side by 6th Street right-of-way, and the east side by the power company property which is used for cooling reservoir (Konomac Lake). Refer to Exhibit 1, Location Map.

1.2 Project Ownership

The Riviera Bella (East and West) is under the ownership of Traderscove Corporation, which Mr. Jerome L. Henin, 2300 Lee Road, Fl 32789 is the President and Agent. See Appendix A, Print out of Sunbiz for Traderscove Corporation information.

The development company for the project is Henin Group, which Mr. Jerome L. Henin, 2300 Lee Road, Fl 32789 is the President and Agent.

2 Site Conditions

2.1 Existing Site Conditions

The Riviera Bella East consists of 66.31 acres of un-developed land. Generally the site slopes from northeast (elevation 20.0'+/-) to southwest (elevation 15.0'+/-). The project survey, soils reports, construction plans, and this drainage report are based on the National Geodetic Vertical Datum of 1929 (NGVD 29). The existing vegetation conditions consists of woods and wetlands areas. Refer to Exhibit 2, Aerial Map. The existing site in the pre-development condition is divided into 6 on-site basins, in which 3 of the on-site basins have wetland areas with in them. Under existing conditions, stormwater runoff from the property primarily sheet flows to Fort Florida Road right-of-way by way of sheet flow directly or through an existing swale on the power company property. Refer to Exhibit 3, Pre-Development Drainage Basin Map and Exhibit 4, Pre-Development surface Flow Map.

Approximately 1,500 linear feet of Fort Florida Road right-of-way will be included in the pre-development analysis. This right-of-way area will be improved with new pavement and a closed secondary drainage system which will extend the existing updated roadway system from the south entrance to Riviera Bella West to the proposed south entrance of Riviera Bella East. In its current state, Fort Florida Road drains southward from the south entrance of Riviera Bella West, consists of a paved road with road side swales.

2.2 Existing Site Soils

Existing soil types with in the project boundary as delineated by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) are described in Table 2 below. See Appendix B for the USDA NRCS Custom Soil Resource Report.

Table 2A
Existing Soil Types

Map No.	Soil Name	Hydrologic Soil Group
23	Farmton Fine Sand	B/D
29	Lmmokalee Sand	B/D

For the purposes of runoff calculations, pervious areas within the project will be assigned curve numbers corresponding to Hydrologic Soil Group "D" for existing and proposed conditions.

On-site subsurface investigations were performed by Andreyev Engineering, Inc. for the proposed project. See Appendix C for Report of Geotechnical Engineering Services.

2.3 Existing Off-Site Conditions

There are no adjacent properties that have runoff discharging through the Riviera Bella East. See Exhibit 3, Pre-Development Drainage Basin Map and Exhibit 4, Pre-Development Surface Flow Map, for offsite and onsite flow patterns. Fort Florida Road is adjacent to the project on the west and south side boundaries. For the west and south boundaries, Fort Florida Road drainage system consists of road side swales which discharges to the southwest over land to the St. Johns River. The off-site area to the north of the project sheet flows to the northwest to a portion of Fort Florida Road that has been improved. The north part of Fort Florida Road improvements included a by-pass outfall storm sewer system that drains the runoff to the St. Johns River. The property to the east of the project is known as Konomac Lake, in which is the Duke Energy DeBary Plant cooling water reservoir system. Between the reservoir and the east boundary of Riviera Bella East, on the reservoir property, is a drainage swale which collects the surface runoff from the reservoir berm and the land area to the east of Riviera Bella East property. This swale discharges to Ft.

Florida Road east of Riviera Bella East.

2.4 Proposed Site Conditions

The Riviera Bella East will be constructed as a single family subdivision as approved by the City of DeBary PUD and ODP process. The Riviera Bella East will consists of 293 single family lots. The lot minimum dimensions are 50 foot wide by 110 feet deep. The proposed impervious area per lot is 45% of the lot area. The developed project will include a 50 foot wide right-of-way, in which will include a 20 foot wide paved road, 2 foot wide curb (each side of road), and 5 foot sidewalks (each side of right-of-way). There will be a three new parks developed within Riviera Bella East. These parks have been estimated to include 45% impervious area over the park area. All drainage runoff from the lots, parks, and right-of-ways will be collected in a closed drainage system with in the proposed right-of-way and discharged to 4 dry ponds. The proposed dry ponds will treat the post development pollutants. Then the dry ponds will discharge to 2 wet ponds for continuation of water quality treatment and detention storage prior to discharging to the St. Johns River via an outfall system through Riviera Bella West. See Exhibit 5, Post Development Basin Map and Exhibit 7, Riviera Bella West – Units 4-7, Approved Const. Plan Sheet 14, Plan and Profile (Outfall).

The proposed outfall pipe system from Riviera Bella East Project will run through Riviera Bella West Project and have a manifold connection with the outfall pipe system from Riviera Bella West Pond 4. The proposed Post-Development Flood Routings will demonstrate that this manifold connection will not adversely affect the hydraulic function of the Riviera Bella West Pond 4 outfall. See Exhibit 8, Riviera Bella West – Units 4-7, Approved Const. Plan Sheet 23, Pond 4 Improvement Plan.

The proposed Riviera Bella East stormwater systems (secondary collection, stormwater ponds, and stormwater outfall system) shall be maintained by the City of DeBary.

The off-site Fort Florida Road improvement area that will be built with Riviera Bella East will be routed through Riviera Bella East public dedicated drainage system. This public dedicated system will be owned and maintained by the City of DeBary which consists of the on-site collection system, stormwater ponds, and stormwater outfall system that collects, treats, detain, and discharges the stormwater runoff from Fort Florida Road.

A drainage easement over the portion of the outfall pipe system that runs through Riviera Bella West shall be dedicated to the City of DeBary. See Exhibit 7, Riviera Bella West – Units 4-7, Approved Const. Plan Sheet 14, Plan and Profile (Outfall).

2.5 Environmental Assessment

All wetlands that were permitted to be removed have been removed within the project limits of Riviera Bella West (Units 1-7). Conservation tracts or easements have been platted over the wetlands that were permitted to remain.

There are three existing wetlands located within the Riviera Bella East Project boundary. These wetlands are requested to be removed. Permitting of the wetland removal and mitigation will be permitted with SJRWMD, ACOE and the City of DeBary. For discussion pertaining to existing land use, wetlands, and proposed wetland mitigation, refer to the attached environmental support documentation, prepared by Ecological Consulting Solutions, Inc. . See Appendix D, for the Environmental Report.

2.6 Flood Plain

As represented by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) in the vicinity of the proposed Riviera Bella East, there are no 100 year flood plain limits shown with in the project area. Therefore, no encroachment is proposed. See Exhibit 9, Flood Map.

3 Design and Performance Criteria

3.1 Applicable Design Criteria

Detailed calculations related to the Pre-Development and Post-Development stormwater runoff characteristics, the proposed stormwater management pond storage capacity, water quality treatment storage volumes, recovery times, design event flood routing analysis, basin parameters and permanent pool volumes are included in the Pre-Development Analysis and Post-Development Analysis Section of this report. The applicable City of DeBary and SJRWMD drainage design parameters are summarized in Table 3A.

TABLE 3A
APPLICABLE DESIGN CRITERIA

Primary Stormwater Management System	City of DeBary	SJRWMD
1. General		
a. Peak Discharge Rate	See Note 1	mean-annual & 25-yr. / 24-hr. pre-development rate (PIM 3.2.1)
b. Pond Slopes (Not Fenced)	See Note 1	4:1 out to a depth of 2' below CWL (PIM 2.6.1 and 8.12)
c. Maintenance/Access	See Note 1	Easement, Deed Restrictions, or other instrument for rights to manage system (PIM 2.4)
d. Base Flow	See Note 1	Consideration/adverse impact for additional flow if: more than an average 3' lower over the project area than average dry season low water table; or at any location more than 5' lower than the average dry season low water table, or to a level that would decrease the flows or level of surface water bodies below any minimum level or flow established by the Governing Board pursuant to section 373.042, FS (PIM 3.5.2 and 8.10)
e. Freeboard	See Note 1	Not specified
f. Embankment Stabilization	See Note 1	Permanent vegetative plantings (PIM 2.6.2)
g. Building minimum finish floor elevation	Not specified	Not specified
2. Wet Detention (On Line System)		
a. Out Flow Pollutant Loading	See Note 1	Less than Pre-Development Rate (use PIM 13.7)
b. Water Quality Treatment Volume	See Note 1	1" of runoff OR 2.5" of runoff from the impervious area whichever is greater, OFW WQT Additional 50% of normal water quality treatment volume (PIM 8.2, 8.11, and 8.13)
c. Water Quality Treatment Volume Recovery Time (Drawdown Time)	See Note 1	One half of the treatment volume in 24 to 30 hours but no more than half in the first 24 hours (PIM 8.3)
d. Underdrain Recovery Time	See Note 1	72 hours (PIM 6.3)
e. Permanent Pool Volume	See Note 1	Enough to provide residence time of at least 14 days, OFW additional 50% of normal volume.(PIM 8.5)
f. Pond Shape	See Note 1	2:1 length to width flow path (PIM 8.9)
g. Pond Bottom Elevation	See Note 1	Max. 12' below CWL (PIM 8.8)
h. Mean Depth below CWL	See Note 1	2-8 Feet (Vol / CWL area) (PIM 8.8)
i. Bleed Down Device	See Note 1	6 sq.in. and 2 inches wide minimum (PIM 8.4)

Abbreviation Legend: SHGWT = seasonal high groundwater table CWL = control water level
CN = curve number PIM = SJRWMD Permit Informational Manual

Note: 1. Rules established by the St. Johns River Water Management District are recognized as valid stormwater criteria by the City of DeBary.

3.2 Computer Modeling

The enclosed flood routing calculations for pre-development and post-development conditions were accomplished using a computer program entitled "Advanced Interconnected Channel and Pond Routing Model (adICPR, Version 2.11)" developed by Peter J. Singhofen, P.E., of Streamline Technologies, Inc. located in Winter Park, Florida. The hydrograph generation module within this program utilizes the SCS Unit Hydrograph Method to compare the runoff hydrographs. AdICPR was also utilized to perform flood routing analyses of the proposed stormwater management system.

3.3 Time of Concentration

The time of concentration was determined by the use of the TR-55 for Pre and Post Development flow paths.

3.4 Runoff Curve Numbers

For Pre-Development, the Runoff Curve Numbers are calculated by the use of the TR-55. Based on the USDA NRCS Custom Soil Resource Report (Appendix B), the hydrologic soil group for the Pre-Development condition pervious surface is "D".

For Post-Development, the Runoff Curve Numbers are calculated by the use of the TR-55. Based on the USDA NRCS Custom Soil Resource Report (Appendix B), the hydrologic soil group for the Post-Development condition pervious surface is "B". However, for the purposes of runoff calculations, pervious areas within the delineation of soil type 23 and 29 will be assigned curve numbers corresponding to Hydrologic Soil Group "D".

3.5 Tailwater Conditions

The proposed project will discharge to the St. Johns River. The flood stages for the 10, 25, 50, 100, and 500 year storm events were previously determined in the Flood Insurance Study for Seminole County, dated January 1987. The following table provides a summary of the flood stages corresponding to the flood frequency in years for the St. Johns River.

Table 3B
Summary of St. Johns River Flood Stages

	Flood Stages (ft), NGVD				
Flood Source	10 Year	25 Year	50 Year	100 Year	500 Year
St Johns River	6.25	7.2	8.0	9.0	9.9

4 Conclusions and Results

4.1 General

A. Peak Discharge Rates Results

Below is a Table that summarizes the results of the Pre-Development Hydrograph Discharge Rates versus the Post-Development Flood Routing Discharge Rates.

Table 4A
Pre-Development Hydrograph Discharge Rates vs the Post-Development Flood Routing Discharge Rates

Overall Basin ID	Mean Annual/24 hour	25 year/24 hour
Pre-Dev	65.74 cfs	153.69 cfs
Post-Dev	12.71 cfs	69.37 cfs

The ICPR Node "Outfall Conn 1" was used for the Post-Development discharge rates evaluation. The Post-Development discharge rates are less than the required Pre-Development discharge rates for both the Mean Annual/24 hour and the 25 year/24 hour storm event.

Pond 4 Discharge Rates and Stage Results

Since the outfall system for the Riviera Bella East will manifold with the outfall system from Riviera Bella West Pond 4, verification will be necessary to confirm that the flood routing stages and flow rates do not adversely affect the previous permitted Pond 4. The table below summaries the SJRWMD permitted stages and discharge flow rates versus the new flood routings.

Table 4B
Summary of Discharge Rates and Stages for Pond 4

	Wet Pond 4	Dry Pond 4
SJRWMD Permit 40-127-64289-11		
Qp 25y/24h	27.4 cfs	n/a
DHW, 25y/24h	14.74 elev.	16.54 elev.
DHW, 100y/24h	15.39 elev.	16.72 elev.
Top of Pond	16.0 elev.	17.0 elev.
New Routings		
Qp 25y/24h	23.23 cfs	n/a
DHW, 25y/24h	14.86 elev.	16.54 elev.
DHW, 100y/24h	15.73 elev.	16.73 elev.
Top of Pond	16.0 elev.	17.0 elev.

There are no adveris impacts on Pond 4 system with the proposed manifold outfall connection. The Wet Pond 4 did increase in stage elevation for the 25 year / 24 hour and 100 year / 24 hour storm events, however, the stage elevations are still within the pond embankment.

B. Pond Slopes Results

All Stormwater Ponds (wet and dry) shall not be fenced. All pond embankment slopes on Dry Ponds shall be 5' horizontal to 1' vertical (5:1) from berm to pond bottom. All wet ponds shall have embankment slopes of 5' horizontal to 1' vertical to 2' below the control water level. From the lower level of the 5:1 embankment slope, the pond will slope 2' horizontal to 1' vertical (2:1) to the pond bottom elevation.

C. Maintenance/Access Results

The Stormwater System, which includes the Stormwater Sewer and Stormwater Pond System will be owned and maintained by the City of DeBary. Stormwater Tracts will be provided over the Stormwater Ponds which will be dedicated to the City of DeBary. The Stormwater Sewer System will be within the street right-of-ways and will be dedicated to the City of DeBary as public street right-of-ways.

D. Base Flow Results

Since the water level in the ponds are controlled at an elevation below or at the seasonal low water level (SLWL), groundwater baseflow seepage is expected to occur in the stormwater management ponds. The estimated groundwater baseflow rate for each pond was established using the software program PONDS - Version 2.26 developed by Devo Seereeram, Ph.D., P.E. and Robert Casper. For detailed results of the background seepage analysis, refer to the attached Additional Appendix D, Geotechnical Report, by GEO Engineering & Science, Inc.

An analysis was performed using adICPR, Version 3.10, to determine the peak stages of the proposed stormwater ponds influenced by the additional background seepage rates (refer to Section 6). The water quality elevations were adjusted in order to compensate for the Base Flow Volume in the proposed orifices. **(Please note: The Base Flow will be included in the Final Stormwater Management Report during final construction plan review.)**

E. Freeboard Results

Below is a table of the Stormwater Pond Freeboard results based on the flood routing of the 25 year – 24 hour storm event with the proposed stormwater system improvement.

Table 4C
Summary of Freeboard Obtained

Pond ID	25Yr/24Hr Stage Elev.	Top Of Pond Elev.	Freeboard Obtained (FT)
5 North	20.90	22.00	1.10
5 Wet	18.64	22.00	3.36
5 South	20.62	22.00	1.38
6 North	18.54	20.00	1.46
6 Wet	16.97	20.00	3.03
6 South	19.03	20.00	0.97
4 Dry	16.54	17.00	0.46
4 Wet	14.86	16.00	1.14

F. Embankment Stabilization Results

Dry Ponds

The Construction Plans specify that the berms and embankments on the Dry Ponds will be sodded. The Pond bottom will be grassed with seed and mulch.

Wet Ponds

The berms and embankments, down to the CWL, will be sodded.

G. Building Minimum Finish Floor Elevation Results

The building minimum finish floor elevation for Riviera Bella East will be set at a minimum of 1' above the 100 year – 24 hour Flood Stage Elevation as calculated by the flood routings.

Table 4D
Summary of the Minimum Finish Floor Elevation

Pond ID	100Yr/24Hr Stage Elev.	Min. Set Finish Floor Elev.
5 North	21.37	22.37
5 South	20.73	21.73
5 Wet	19.36	20.36
6 North	18.65	19.65
6 South	19.44	20.44
6 Wet	17.84	18.84
4 Wet	15.73	16.73
4 Dry	16.73	17.73

4.2 Wet Detention (On-Line System)

A. Out Flow Pollutant Loading Results

The Pre-Development Outflow Mass Loading was calculated to be 6.35 kg/yr.

The Post-Development Inflow Mass Loading will equal 43.68 kg/yr, based on a pollutant loading rate of 0.696 kg/ac-yr. Which was interpolated between the values from 40% to 65% impervious single family P Loading Rate. By providing a minimum retention volume of 0.5" over the basin area, the Post-Development Outflow Mass Loading can be reduced by 93%. Therefore, the Outflow Mass Loading will equal 3.06 kg/yr, which is below the Pre-Development Mass Loading value.

B. Water Quality Treatment Volume Results

According to the St. Johns River Water Management District's Permit Information Manual, Section 8.0, wet detention stormwater management systems shall provide a treatment volume of the greater of the following:

(a) first one (1) inch of runoff; or

(b) 2.5 inches of runoff from the impervious area (excluding water bodies), whichever is greater.

Additionally, due to the project discharges to an OFW (St. Johns River), an additional 50% of the required treatment volume is required. Below table summarizes the required volume. See Table 4E for Required Water Quality Treatment Volumes.

C. Water Quality Treatment Volume Recovery Time Results

A drawdown analysis was performed in order to demonstrate that the proposed bleed-down devices (e.g., circular orifices, etc.) will evacuate one-half (1/2) of the water quality volume within 24- to 30-hours after a storm event, in accordance with the SJRWMD. This was accomplished by deactivating the inflow hydrographs to the proposed stormwater ponds and setting the initial stage in the ponds to the water quality level. The flood routing was then performed to allow the bleed-down devices to drawdown the required water quality volume in 24- to 30-hours. The required volume to be released within the 24- to 30-hour period for the proposed stormwater ponds are summarized in the following table. **(Please note: The Recovery Time Analysis will be adjusted in the Final Stormwater Management Report during final construction plan review to include Base Flow.)**

Table 4E
Water Quality Required Treatment Volume

Basin ID	Required Treatment Volume	Provided Treatment Volume	Wet Pond Required Volume to be Released in 24-30 hours	Time to Drawdown Treatment Volume
5	4.12 ac-ft	4.12 ac-ft	0.57 ac-ft	29.5
6	4.52 ac-ft	4.52 ac-ft	0.77 ac-ft	29.8

Note: The additional treatment volume is provided in the Dry Ponds.

D. Underdrain Recovery Results

The Dry Retention Ponds for Riviera Bella East will need to recover within 72 hours after the storm event. See Appendix D, Geotechnical Report prepared by GEO Engineering & Sciences, Inc., Dated 12/18/15, PN. for Underdrain Analysis. Below table summarizes the recovery time for each dry pond. **(Please note: The a updated Geotechnical Report with Underdrain Analysis will be included in the Final Stormwater Management Report during final construction plan review.)**

Table 4D
Dry Retention Pond Recovery Results

Pond ID	Volume Recovery	Required Underdrain Length	Recovery Time
5 North	0.72 ac-ft		
5 South	0.52 ac-ft		
6 North	0.44 ac-ft		
6 South	1.05 ac-ft		

E. Permanent Pool Volume Results

The permanent pool is the volume of a pond which is designed to hold water at all times (i.e., below the control elevation). Typically, the permanent pool is sized to provide at least a 21-day residence time during the wet season (June through October). Table 4F summarizes the Permanent Pool Time for each wet pond. **(Please note: An updated Permanent Pool Volume Analysis will be included in the Final Stormwater Management Report during final construction plan review which will include Base Flow.)**

Table 4F
Permanent Pool Volume Results

Pond ID	Required Permanent Pool Volume	Provided Permanent Pool Volume	Residence Time
5 Wet	10.08 ac-ft	22.35 ac-ft	70
6 Wet	10.90 ac-ft	21.00 ac-ft	61

F. Pond Shape Results

SJRWMD requires that the shape of the pond allows for a 2:1 length to width flow path ratio. At the CWL elevations the Wet Ponds have the following overall widths and lengths:

Table 4G
Wet Pond Overall Dimensions at CWL

Pond ID	Length (ft)	Width (ft)
5 Wet	720	158
6 Wet	738	158

The point of the stormwater influent on the wet ponds are at the north and south ends of the ponds. Therefore, the Outfall Structures needs to be located 2 times the pond width away from the influent lines. The provided distance from the end of the Pond (at CWL) to the Outfall Structure location is 320 LF.

G. Pond Bottom Results

SJRWMD requires that the maximum depth of the wet ponds can be 12' below the CWL. Table 4H summarizes the maximum required and provide pond depths.

Table 4H
Wet Pond Depth Summary

Pond ID	CWL (ft)	Required Pond Bottom (ft)	Provided Pond Bottom (ft)
5 Wet	16.00	4.00	6.00
6 Wet	14.00	2.00	4.00

H. Mean Depth Below CWL Results

SJRWMD requires that the mean depth of the wet ponds be determine so that the pond will be established with a minimum depth to keep aquatic plant growth from becoming excessive if the pond is too shallow. Table 4 I summarizes the Mean Depth required and provide pond depths.

Table 4 I
Wet Pond Depth Summary

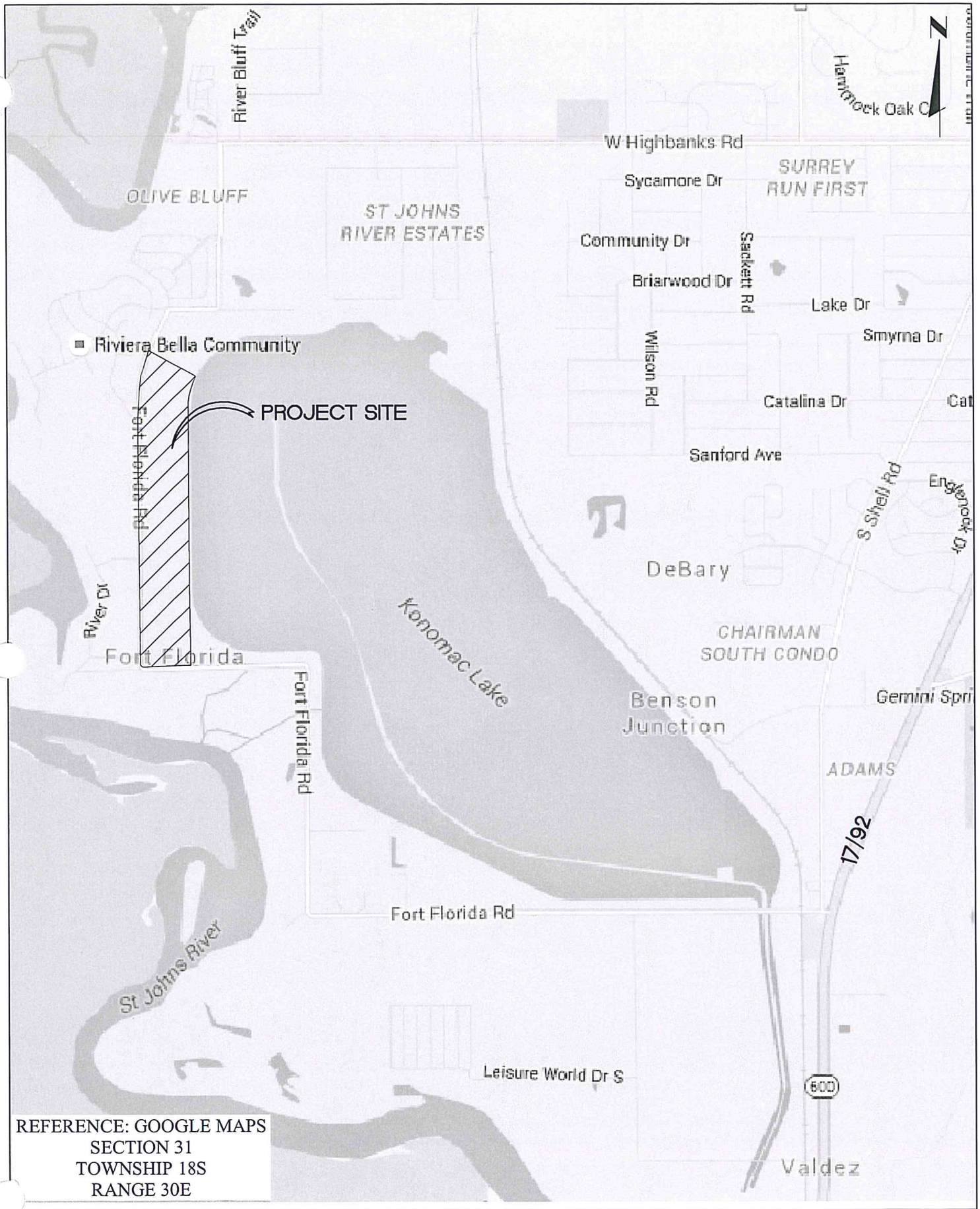
Pond ID	CWL (ft)	Volume Below CWL(ac-ft)	CWL Area (ac)	Required Mean Depth (ft)	Provided Pond Depth (ft)
5 Wet	16.00	22.35	2.83	7.90	10.0
6 Wet	14.00	21.00	2.70	7.80	10.0

I. Bleed Down Device Results

The Bleed Down Device on the Outfall Structure is proposed to be a 3.35 inch dia. orifice. This size orifice will have a 8.81 sq. in. surface area and is wider than 2 inches. The proposed orifice exceeds the minimum requirements set by SJRWMD. **(Please note: The Bleed Down Device will be adjusted to include Base Flow Analysis, in the Final Stormwater Management Report during final construction plan review.)**

SECTION 5

EXHIBITS



REFERENCE: GOOGLE MAPS
SECTION 31
TOWNSHIP 18S
RANGE 30E

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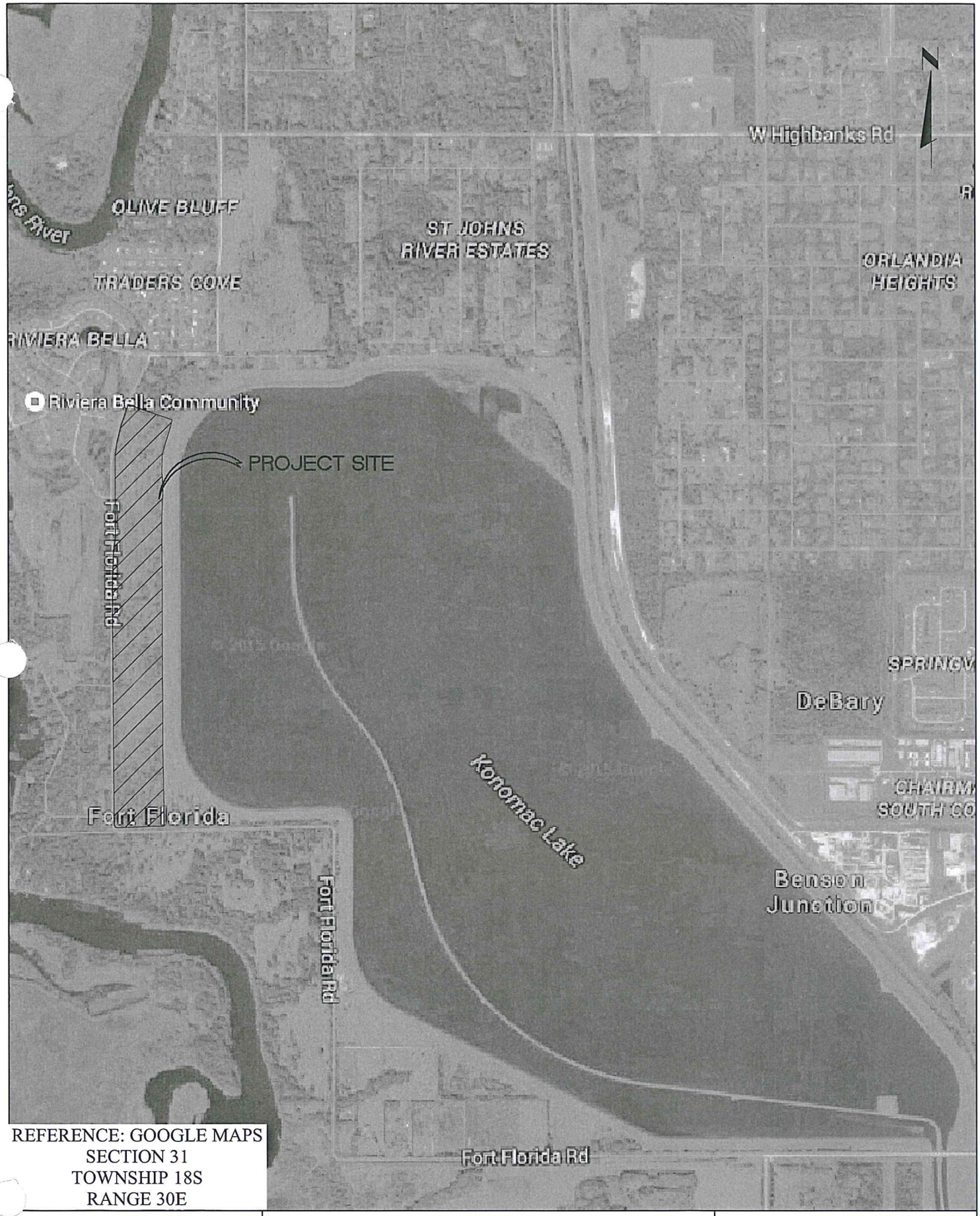
RIVIERA BELLA EAST
DEBARY, FL

LOCATION MAP
EXHIBIT 1
1"=2000'



REFERENCE: GOOGLE MAPS
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TOWNSHIP 18S
RANGE 30E

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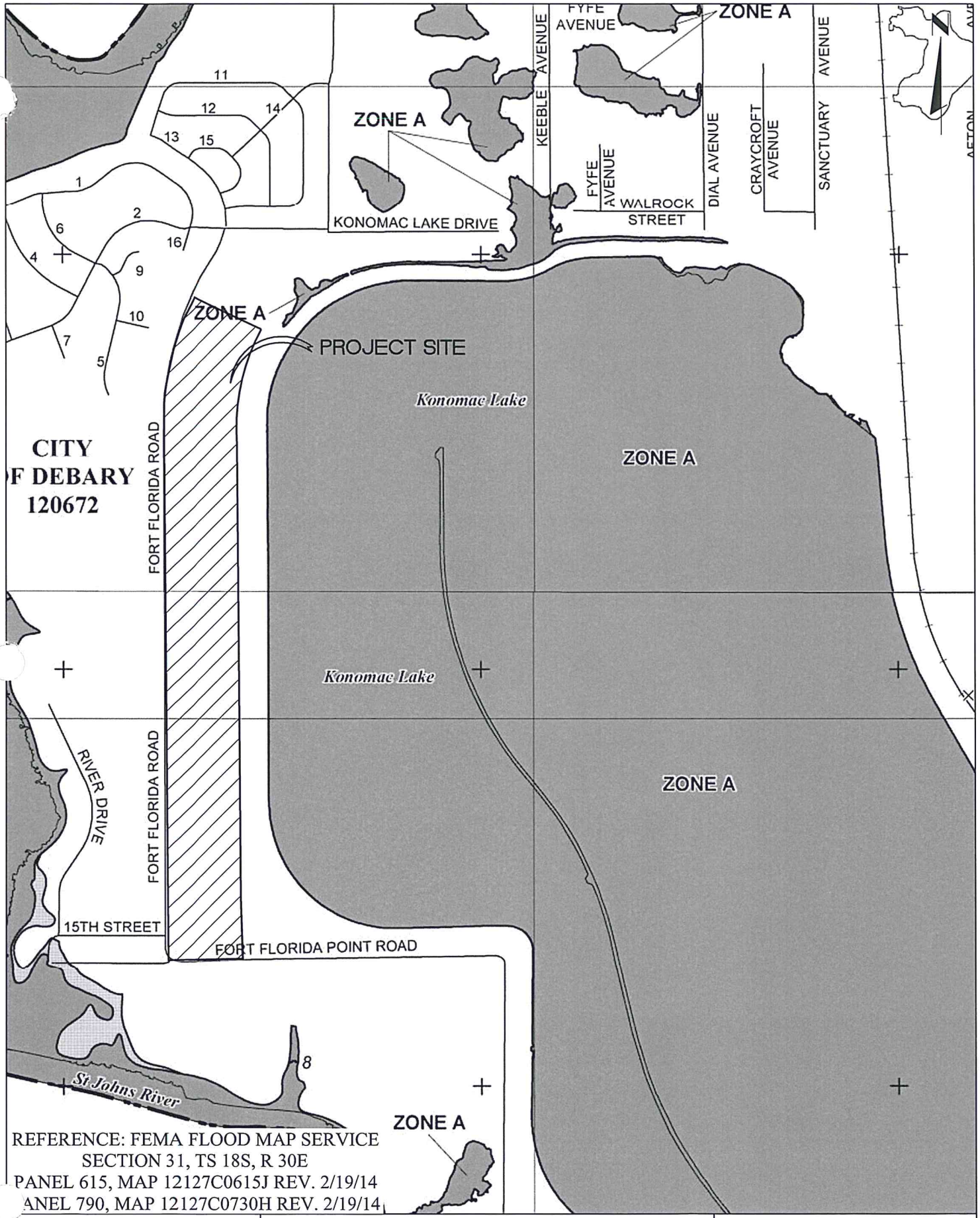
RIVIERA BELLA EAST
DEBARY, FL

AERIAL MAP
EXHIBIT 2
1"=2000'



REFERENCE: FEMA FLOOD MAP SERVICE
SECTION 31, TS 18S, R 30E
PANEL 615, MAP 12127C0615J REV. 2/19/14
ANEL 790, MAP 12127C0730H REV. 2/19/14

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RIVIERA BELLA EAST
DEBARY, FL

FLOOD MAP
EXHIBIT 9
1"=1000'

SECTION 6

STORMWATER ANALYSIS

6.1 Pre-Development Analysis

A. Pre-Development Basin Area Summary

PRE-DEVELOPMENT BASIN AREA SUMMARY

Pre-Development				
Drainage Area Description	Drainage Area *(ac)*	Impervious Area *(ac)*	Pervious Area *(ac)*	Percent Impervious
Pre Dev 1	0.84	0.00	0.84	0.0%
Pre Dev 2	14.88	0.00	14.88	0.0%
Pre Dev 3	6.67	0.00	6.67	0.0%
Pre Dev 4	1.05	0.00	1.05	0.0%
Pre Dev 5	7.79	0.00	7.79	0.0%
Pre Dev 6	35.08	0.00	35.08	0.0%
Sub-Total	66.31	0.00	66.31	0.0%
Ft. Florida Road	1.96	0.64	1.32	32.7%
Total	68.27	0.64	67.63	0.9%

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 7/27/2015	AREA BASINS

B. Pre-Development Runoff Curve Numbers

Pre-Development Runoff Curve Number

Pre Dev Basin 1

HSG	Cover Description	CN	Area (acres)	Product
D	Pervious Area (Woods)	83	0.84	69.72
				0.00
		Totals =	0.84	69.72
		CN =	**83**	

Pre Dev Basin 2

HSG	Cover Description	CN	Area (acres)	Product
D	Pervious Area (Woods)	83	13.03	1081.49
N/A	Wetland (Wet Condition)	100	1.85	185.00
		Totals =	14.88	1266.49
		CN =	**85**	

Pre Dev Basin 3

HSG	Cover Description	CN	Area (acres)	Product
D	Pervious Area (Woods)	83	5.73	475.59
N/A	Wetland (Wet Condition)	100	0.94	94.00
		Totals =	6.67	569.59
		CN =	**85**	

Pre Dev Basin 4

HSG	Cover Description	CN	Area (acres)	Product
D	Pervious Area (Woods)	83	1.05	87.15
				0.00
		Totals =	1.05	87.15
		CN =	**83**	

Pre Dev Basin 5

HSG	Cover Description	CN	Area (acres)	Product
D	Pervious Area (Woods)	83	6.60	547.80
N/A	Wetland (Wet Condition)	100	1.19	119.00
		Totals =	7.79	666.80
		CN =	**86**	

Pre Dev Basin 6

HSG	Cover Description	CN	Area (acres)	Product
D	Pervious Area (Woods)	83	35.08	2911.64
				0.00
		Totals =	35.08	2911.64
		CN =	**83**	

Existing Fort Florida Road Conditions

HSG	Cover Description	CN	Area (acres)	Product
N/A	Paved Road	98	0.64	62.72
D	Pervious Area	80	1.32	105.60
		Totals =	1.96	168.32
		CN =	**86**	

Reference: Technical Release 55 (TR 55)
Soil Conservation Service, June 1986

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	CN Pre-Dev

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

FOR PRE DEV. BASINS

1 Average runoff condition, and $I_a = 0.2S$.

2 ***Poor:*** <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 ***Poor:*** <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 ***Poor:*** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

C. Pre-Development Time of Concentration

TR55 Tc Worksheet

Hyd. No. 1

Pre Dev 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.80		0.00		0.00		
Land slope (%)	= 0.14		0.00		0.00		
Travel Time (min)	**= 50.80**	**+**	**0.00**	**+**	**0.00**	**=**	**50.80**
Shallow Concentrated Flow							
Flow length (ft)	= 35.00		0.00		0.00		
Watercourse slope (%)	= 0.17		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.67		0.00		0.00		
Travel Time (min)	**= 0.88**	**+**	**0.00**	**+**	**0.00**	**=**	**0.88**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 51.67 min

TR55 Tc Worksheet

Hyd. No. 2

Pre Dev 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.80		0.00		0.00		
Land slope (%)	= 0.30		0.00		0.00		
Travel Time (min)	**= 37.45**	**+**	**0.00**	**+**	**0.00**	**=**	**37.45**
Shallow Concentrated Flow							
Flow length (ft)	= 560.00		525.00		50.00		
Watercourse slope (%)	= 0.27		0.02		0.20		
Surface description	= Unpaved		Paved		Unpaved		
Average velocity (ft/s)	=0.84		0.29		0.72		
Travel Time (min)	**= 11.13**	**+**	**30.44**	**+**	**1.15**	**=**	**42.72**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 80.17 min

TR55 Tc Worksheet

Hyd. No. 3

Pre Dev 3

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.80		0.00		0.00		
Land slope (%)	= 0.40		0.00		0.00		
Travel Time (min)	**= 33.38**	**+**	**0.00**	**+**	**0.00**	**=**	**33.38**
Shallow Concentrated Flow							
Flow length (ft)	= 395.00		171.00		0.00		
Watercourse slope (%)	= 0.46		0.06		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.09		0.50		0.00		
Travel Time (min)	**= 6.02**	**+**	**5.72**	**+**	**0.00**	**=**	**11.74**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 45.12 min

TR55 Tc Worksheet

Hyd. No. 4

Pre Dev 4

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.80		0.00		0.00		
Land slope (%)	= 0.20		0.00		0.00		
Travel Time (min)	**= 44.04**	**+**	**0.00**	**+**	**0.00**	**=**	**44.04**
Shallow Concentrated Flow							
Flow length (ft)	= 145.00		0.00		0.00		
Watercourse slope (%)	= 0.28		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.85		0.00		0.00		
Travel Time (min)	**= 2.83**	**+**	**0.00**	**+**	**0.00**	**=**	**2.83**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 46.87 min

TR55 Tc Worksheet

Hyd. No. 5

Pre Dev 5

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.80		0.00		0.00		
Land slope (%)	= 0.40		0.00		0.00		
Travel Time (min)	**= 33.38**	**+**	**0.00**	**+**	**0.00**	**=**	**33.38**
Shallow Concentrated Flow							
Flow length (ft)	= 655.00		0.00		0.00		
Watercourse slope (%)	= 0.35		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.95		0.00		0.00		
Travel Time (min)	**= 11.44**	**+**	**0.00**	**+**	**0.00**	**=**	**11.44**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 44.81 min

TR55 Tc Worksheet

Hyd. No. 6

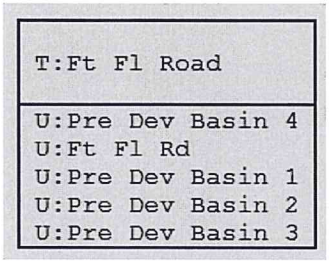
Pre Dev 6

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.80		0.00		0.00		
Land slope (%)	= 0.50		0.00		0.00		
Travel Time (min)	**= 30.53**	**+**	**0.00**	**+**	**0.00**	**=**	**30.53**
Shallow Concentrated Flow							
Flow length (ft)	= 1085.00		0.00		0.00		
Watercourse slope (%)	= 0.34		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.94		0.00		0.00		
Travel Time (min)	**= 19.22**	**+**	**0.00**	**+**	**0.00**	**=**	**19.22**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 49.75 min

D. Pre-Development ICPR Analysis

Pre Development Node

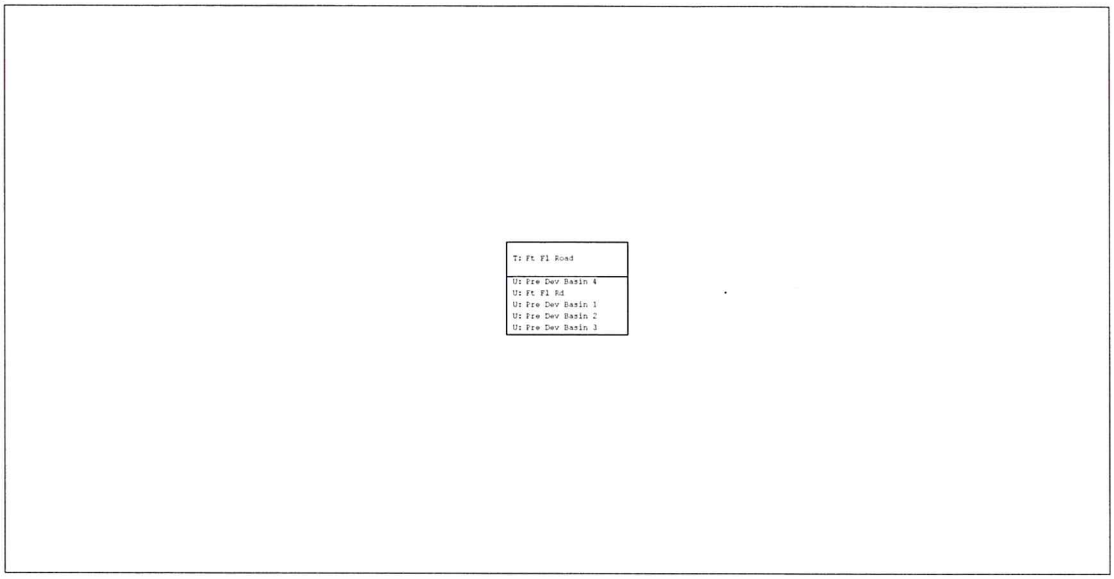


Pre Dev System Node

Nodes
A Stage/Area
V Stage/Volume
T Time/Stage
M Manhole

Basins
O Overland Flow
U SCS Unit CN
S SBUH CN
Y SCS Unit GA
Z SBUH GA

Links
P Pipe
W Weir
C Channel
D Drop Structure
B Bridge
R Rating Curve
H Breach
E Percolation
F Filter
X Exfil Trench



Pre Dev System Node

Name	Simulation	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Inflow cfs	Max Outflow cfs
Ft Fl Road	25-24	18.000	18.000	0.0000	0	153.689	0.000
Ft Fl Road	Mean	18.000	18.000	0.0000	0	65.737	0.000

==========
==== Basins ====
==========

Name: Ft Fl Rd
Group: BASE
Node: Ft Fl Road
Type: SCS Unit Hydrograph CN
Status: Onsite

Unit Hydrograph: Uh323
Rainfall File: Flmod
Rainfall Amount(in): 8.600
Area(ac): 1.960
Curve Number: 86.00
DCIA(%): 0.00
Peaking Factor: 323.0
Storm Duration(hrs): 24.00
Time of Conc(min): 10.00
Time Shift(hrs): 0.00
Max Allowable Q(cfs): 999999.000

Name: Pre Dev Basin 1
Group: BASE
Node: Ft Fl Road
Type: SCS Unit Hydrograph CN
Status: Onsite

Unit Hydrograph: Uh323
Rainfall File: Flmod
Rainfall Amount(in): 8.600
Area(ac): 0.840
Curve Number: 83.00
DCIA(%): 0.00
Peaking Factor: 323.0
Storm Duration(hrs): 24.00
Time of Conc(min): 51.67
Time Shift(hrs): 0.00
Max Allowable Q(cfs): 999999.000

Name: Pre Dev Basin 2
Group: BASE
Node: Ft Fl Road
Type: SCS Unit Hydrograph CN
Status: Onsite

Unit Hydrograph: Uh323
Rainfall File: Flmod
Rainfall Amount(in): 8.600
Area(ac): 14.880
Curve Number: 85.00
DCIA(%): 0.00
Peaking Factor: 323.0
Storm Duration(hrs): 24.00
Time of Conc(min): 80.17
Time Shift(hrs): 0.00
Max Allowable Q(cfs): 999999.000

Name: Pre Dev Basin 3
Group: BASE
Node: Ft Fl Road
Type: SCS Unit Hydrograph CN
Status: Onsite

Unit Hydrograph: Uh323
Rainfall File: Flmod
Rainfall Amount(in): 8.600
Area(ac): 6.670
Curve Number: 85.00
DCIA(%): 0.00
Peaking Factor: 323.0
Storm Duration(hrs): 24.00
Time of Conc(min): 45.12
Time Shift(hrs): 0.00
Max Allowable Q(cfs): 999999.000

Name: Pre Dev Basin 4
Group: BASE
Node: Ft Fl Road
Type: SCS Unit Hydrograph CN
Status: Onsite

Unit Hydrograph: Uh323
Rainfall File: Flmod
Rainfall Amount(in): 8.600
Area(ac): 1.050
Curve Number: 83.00
DCIA(%): 0.00
Peaking Factor: 323.0
Storm Duration(hrs): 24.00
Time of Conc(min): 46.87
Time Shift(hrs): 0.00
Max Allowable Q(cfs): 999999.000

```
--------------------------------------------------------------------------------------------
         Name: Pre Dev Basin 5          Node: Ft Fl Road             Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh323                   Peaking Factor: 323.0
          Rainfall File: Flmod                Storm Duration(hrs): 24.00
    Rainfall Amount(in): 8.600                  Time of Conc(min): 44.81
               Area(ac): 7.790                    Time Shift(hrs): 0.00
          Curve Number: 86.00                Max Allowable Q(cfs): 999999.000
               DCIA(%): 0.00


--------------------------------------------------------------------------------------------
         Name: Pre Dev Basin 6          Node: Ft Fl Road             Status: Onsite
        Group: BASE                     Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh323                   Peaking Factor: 323.0
          Rainfall File: Flmod                Storm Duration(hrs): 24.00
    Rainfall Amount(in): 8.600                  Time of Conc(min): 49.75
               Area(ac): 35.080                   Time Shift(hrs): 0.00
          Curve Number: 83.00                Max Allowable Q(cfs): 999999.000
               DCIA(%): 0.00


============================================================================================
==== Nodes =================================================================================
============================================================================================

      Name: Ft Fl Road          Base Flow(cfs): 0.000          Init Stage(ft): 18.000
     Group: BASE                                              Warn Stage(ft): 18.000
      Type: Time/Stage


      Time(hrs)       Stage(ft)
--------------- ---------------
           0.00          18.000
        9999.00          18.000

============================================================================================
==== Cross Sections ========================================================================
============================================================================================

              Name:                              Group: BASE
      Encroachment: No


    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------

============================================================================================
==== Operating Tables ======================================================================
============================================================================================

      Name:                      Group: BASE
      Type: Bottom Clip
  Function: Time vs. Depth of Clip
```

Time(hrs)	Clip Depth(in)

==========
==== Hydrology Simulations ====
==========

Name: 100-24
Filename: P:_PROJECT DRAWINGS\HG-001 Riviera Bella\MLS Drainage\100-24.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: Flmod
Rainfall Amount(in): 10.60

Time(hrs)	Print Inc(min)
24.000	15.00

Name: 25-24
Filename: P:_PROJECT DRAWINGS\HG-001 Riviera Bella\East\Drainage\GB Drainage\25-24.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: Flmod
Rainfall Amount(in): 8.60

Time(hrs)	Print Inc(min)
30.000	5.00

Name: Mean
Filename: P:_PROJECT DRAWINGS\HG-001 Riviera Bella\MLS Drainage\MEAN.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: Flmod
Rainfall Amount(in): 4.50

Time(hrs)	Print Inc(min)
30.000	5.00

==========
==== Routing Simulations ====
==========

Name: 100-24 Hydrology Sim: 100-24
Filename: P:_PROJECT DRAWINGS\HG-001 Riviera Bella\MLS Drainage\100-24.I32

Execute: No Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 24.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: Boundary Flows:

Time(hrs)	Print Inc(min)
24.000	5.000

Group	Run
BASE	Yes

Name: 25-24 Hydrology Sim: 25-24
Filename: P:_PROJECT DRAWINGS\HG-001 Riviera Bella\East\Drainage\GB Drainage\25-24.I32

Execute: Yes Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 24.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: Boundary Flows:

Time(hrs)	Print Inc(min)
24.000	5.000

Group	Run
BASE	Yes

Name: Mean Hydrology Sim: Mean
Filename: P:_PROJECT DRAWINGS\HG-001 Riviera Bella\MLS Drainage\MEAN.I32

Execute: Yes Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 24.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: Boundary Flows:

Time(hrs)	Print Inc(min)
24.000	5.000

Group	Run
BASE	Yes

6.2 Post-Development Analysis

A. Post-Development Basin 5 Work Sheets

POST-DEVELOPMENT BASIN AREA SUMMARY

Drainage Basin 5				
Drainage Area Description	Drainage Area *(ac)*	Impervious Area *(ac)*	Pervious Area *(ac)*	Percent Impervious
North				
Basin 5B (no pond areas)	8.82	4.55	4.27	51.6%
Basin 5D (no pond areas)	8.29	4.02	4.27	48.5%
Pond 5 North (dry pond)	0.85	0.00	0.85	0.0%
Sub-Total	17.96	8.57	9.39	47.7%
South				
Basin 5A (no pond areas)	4.84	2.31	2.53	47.7%
Basin 5C (no pond areas)	4.73	2.31	2.42	48.8%
Pond 5 South (dry pond)	0.83	0.00	0.83	0.0%
Sub-Total	10.40	4.62	5.78	44.4%
Pond 5 (wet pond)	4.10	2.83	1.27	69.0%
Total	32.46	16.02	16.44	49.4%

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	AREA BASINS

Sub-Basin Area Calculations - System 5

Sub Basin	Sub Basin Area	Lot Area	Lot Imperious Area (1)	R/W Impervious Area	Total Impervious Area	Total Pervious Area
5A.1	1.29	0.85	0.38	0.22	0.60	0.69
5A.2	1.25	0.95	0.43	0.19	0.62	0.63
5A.3 (MH)	0	0	0.00	0	0.00	0.00
5A.4	1.63	1.24	0.56	0.18	0.74	0.89
5A.5	0.67	0.39	0.18	0.18	0.36	0.31
5A.6 (MES)	0	0	0.00	0	0.00	0.00
Subtotal	**4.84**	**3.43**	**1.54**	**0.77**	**2.31**	**2.53**
5B.1	1.73	1.2	0.54	0.24	0.78	0.95
5B.2	0.29	0	0.00	0.18	0.18	0.11
5B.3 (MH)	0	0	0.00	0	0.00	0.00
5B.4	2.75	2.12	0.95	0.47	1.42	1.33
5B.5	1.68	1.27	0.57	0.47	1.04	0.64
5B.6 (MH)	0	0	0.00	0	0.00	0.00
5B.7	1.54	1.07	0.48	0.22	0.70	0.84
5B.8	0.83	0.56	0.25	0.17	0.42	0.41
5B.9 (MES)	0	0	0.00	0	0.00	0.00
Subtotal	**8.82**	**6.22**	**2.80**	**1.75**	**4.55**	**4.27**
5C.1	1.22	0.98	0.44	0.13	0.57	0.65
5C.2	1.25	0.95	0.43	0.19	0.62	0.63
5C.3 (MH)	0	0	0.00	0	0.00	0.00
5C.4	1.59	1.3	0.59	0.18	0.77	0.83
5C.5	0.67	0.39	0.18	0.18	0.36	0.31
5C.6	0	0	0.00	0	0.00	0.00
Subtotal	**4.73**	**3.62**	**1.629**	**0.68**	**2.31**	**2.421**
5D.1	1.59	1.3	0.46	0.18	0.64	0.96
5D.2	0.28	0	0.00	0.18	0.18	0.10
5D.3 (MH)	0	0	0.00	0	0.00	0.00
5D.4	2.67	2.2	0.77	0.56	1.33	1.34
5D.5	1.81	1.45	0.51	0.56	1.07	0.74
5D.6 (MH)	0	0	0.00	0	0.00	0.00
5D.7	1.3	1.08	0.38	0.14	0.52	0.78
5D.8	0.64	0.42	0.15	0.14	0.29	0.35
5D.9	0	0	0.00	0	0.00	0.00
Subtotal	**8.29**	**6.45**	**2.26**	**1.76**	**4.02**	**4.27**
Total	**26.68**	**19.72**	**8.23**	**4.96**	**13.19**	**13.49**

Notes:

1. Patio lots is estimated to have 45% impervious area. All lots are Patio Lots.
2. The Lot Area also includes Park Areas. It is assumed the Park Areas to have 45% impervious area.

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	AREA Sub-Basins

RUNOFF CURVE NUMBER

Proposed Conditions
Basin 5 North Drainage Area

HSG	*Cover Description*	*CN*	*Area (acres)*	*Product*
D	Open Space (good condition)	80	8.54	683.20
N/A	Impervious	98	8.57	839.86
D	Pond (Dry)	80	0.85	68.00
		Totals =	17.96	1591.06
		AMC II *CN =*	**89**	

Reference: Technical Release 55 (TR 55)
Soil Conservation Service, June 1986

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	CN Basin 5 North

RUNOFF CURVE NUMBER

Proposed Conditions
Basin 5 South Drainage Area

HSG	*Cover Description*	*CN*	*Area (acres)*	*Product*
D	Open Space (good condition)	80	4.95	396.00
N/A	Impervious	98	4.62	452.76
D	Pond	80	0.83	66.40
		Totals =	10.40	915.16
		AMC II *CN =*	**88**	

Reference: Technical Release 55 (TR 55)
Soil Conservation Service, June 1986

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	CN Basin 5 South

RUNOFF CURVE NUMBER

Proposed Conditions
Pond 5 Wet Drainage Area

HSG	*Cover Description*	*CN*	*Area (acres)*	*Product*
N/A	Wet Pond @ CWL	100	2.83	283.00
D	Wet Pond pervious area	80	1.27	101.60
		Totals =	4.10	384.60
		AMC II *CN =*	**94**	

Reference: Technical Release 55 (TR 55)
Soil Conservation Service, June 1986

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	CN Pond 5 Wet

TIME OF CONCENTRATION

Basin 5

The Time of Concentration (TC) is based on the TC calculations as generated in the Secondary Stormwater Sewer Analysis. Summary of the systems are as follows:

Secondary Stormwater Sewer Analysis will be provided during final construction plan review.

Basin 5 North

Sub-Basin	TC (Min.)	Use TC (Min.)
5B	24.03	24.00
5D	23.78	

Basin 5 South

Sub-Basin	TC (Min.)	Use TC (Min.)
5A	22.52	22.00
5C	22.47	

Note: Assume Time of Concentration of 5 min. for Basin 5 Wet.

STORMWATER POND STAGE STORAGE CALCULATIONS

Drainage Basin 5 - Wet Pond

STAGE-STORAGE RELATIONSHIP						
Stage (feet)	Depth (feet)	Surface Area (sq. ft.)	Surface Area (acres)	Average Area (acres)	Incremental Volume (ac-ft)	Total Volume (ac-ft)
6.00	0.00	80,018	1.84	0.00	0.00	0.00
7.00	1.00	83,210	1.91	1.87	1.87	1.87
8.00	2.00	86,423	1.98	1.95	1.95	3.82
9.00	3.00	89,666	2.06	2.02	2.02	5.84
10.00	4.00	92,932	2.13	2.10	2.10	7.94
11.00	5.00	96,221	2.21	2.17	2.17	10.11
12.00	6.00	99,532	2.28	2.25	2.25	12.36
13.00	7.00	102,869	2.36	2.32	2.32	14.68
14.00	8.00	106,238	2.44	2.40	2.40	17.08
15.00	9.00	114,766	2.63	2.54	2.54	19.62
16.00	10.00	123,442	2.83	2.73	2.73	22.35
16.0 CWL						
16.00	0.00	123,442	2.83	0.00	0.00	0.00
17.00	1.00	132,271	3.04	2.94	2.94	2.94
18.00	2.00	141,273	3.24	3.14	3.14	6.08
19.00	3.00	150,428	3.45	3.35	3.35	9.42
20.00	4.00	159,733	3.67	3.56	3.56	12.98
21.00	5.00	164,461	3.78	3.72	3.72	16.70
22.00	6.00	169,185	3.88	3.83	3.83	20.53

Drainage Basin 5 - North Dry Pond

STAGE-STORAGE RELATIONSHIP						
Stage (feet)	Depth (feet)	Surface Area (sq. ft.)	Surface Area (acres)	Average Area (acres)	Incremental Volume (ac-ft)	Total Volume (ac-ft)
17.00	0.00	17,739	0.41	0.00	0.00	0.00
18.00	1.00	20,545	0.47	0.44	0.44	0.44
19.00	2.00	23,508	0.54	0.51	0.51	0.95
20.00	3.00	26,620	0.61	0.58	0.58	1.52
21.00	4.00	29,901	0.69	0.65	0.65	2.17
22.00	5.00	33,330	0.77	0.73	0.73	2.90

Drainage Basin 5 - South Dry Pond

STAGE-STORAGE RELATIONSHIP						
Stage (feet)	Depth (feet)	Surface Area (sq. ft.)	Surface Area (acres)	Average Area (acres)	Incremental Volume (ac-ft)	Total Volume (ac-ft)
17.00	0.00	17,000	0.39	0.00	0.00	0.00
18.00	1.00	19,762	0.45	0.42	0.42	0.42
19.00	2.00	22,681	0.52	0.49	0.49	0.91
20.00	3.00	25,749	0.59	0.56	0.56	1.47
21.00	4.00	28,986	0.67	0.63	0.63	2.09
22.00	5.00	32,371	0.74	0.70	0.70	2.80

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	STAGE STORAGE Basin 5

WATER QUALITY TREATMENT VOLUME ANALYSIS

Treatment Requirement:

For Wet Detention, the greater of following:

a) Runoff from the drainage area as required for an Wet Detention which is 1" of runoff from the drainage area.

b) Runoff from the impervoius area as required for an Wet Detention which is 2.5" of runoff from the impervious area.

c) Additional 50% of the above runoff volumes will be required for OFW requirements.

Drainage Basin 5						
Drainage Area Description	Drainage Area *(ac)*	Impervious Area (w/out wet pond) *(ac)*	Pervious Area *(ac)*	Percent Impervious	1 Inch of Runoff *(ac-ft)*	2.5 Inches X Imp Area *(ac-ft)*
Total	32.46	13.19	16.44	40.6%	2.71	2.75
				Plus 50% for OFW	1.35	1.37
				Total Treatment Volume Required =	4.06	4.12

TREATMENT VOLUME REQUIRED = **4.12** *(ac-ft)*

Phosphorus Loading Retention Requirement
(Dry Retention)

To obtain the Phosphorus Loading Retention Requirement runoff from the 1st 0.5" of rainfall over the drainage area shall be stored and treated in online dry retention ponds located north and south of the wet pond.

Drainage Basin North	Area (Ac)	Retention Volume (Ac-ft)
Basin 5B	8.82	n/a
Basin 5D	8.29	n/a
Pond 5 North	0.85	n/a
1/2 of Pond 5 Wet	2.05	n/a
Total	20.01	0.83

Drainage Basin South	Area (Ac)	Retention Volume (Ac-ft)
Basin 5A	4.84	n/a
Basin 5C	4.73	n/a
Pond 5 South	0.83	n/a
1/2 of Pond 5 Wet	2.05	n/a
Total	12.45	0.52

Total = 1.35 Ac-ft

Wet Retention = Total Treatment - Dry Retention = 2.77 (ac-ft)

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/18/2015	WQTR POND 5

WATER QUALITY TREATMENT VOLUME DESIGN

The Dry Ponds can provide more of the Water Quality Treatment Volume than just the required volume of the Phosphorus Loading.

Pond ID	Required Phosphorus Loading Vol (Ac-ft)	Provided Volume (Ac-ft)	Pond Stage for Treatment (ft)
Pond 5 North	0.83	1.52	20
Pond 5 South	0.52	1.47	20
Total	1.35	2.99	n/a

The outfall wier for the dry ponds will be set at elevation 20.0.

The total treatment volume required 4.12 ac-ft
Provided treatment from dry ponds - 2.99 ac-ft
1.14 ac-ft Remaining Treatment Volume to be obtained in the Wet Pond

Based on the Stage/Storage Calculations the remaining treatment volume will be obtained in the Wet Pond at:

1.14 ac-ft Remaining Treatment Volume to be obtained in the Wet Pond
16.39 Elevation based on the Stage/Storage relationship of the Wet Pond

Stage (ft)	Storage (ac-ft)
17	2.94
16	0

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/18/2015	WQTD **POND 5**

DRAWDOWN TIME CALCULATION

No more than half the treatement volume (for the wet pond) should be discharged in the first 24 to 30 hours after the storm event.

Provided Treatment Volume =	1.14	ac-ft
Drawdown Volume (1/2 Treatment Volume) =	**0.57**	ac-ft
Corrresponding Stage for 1/2 Treatment Volume =	**16.19**	ft (see below)
Remaining Treatment Volume =	0.57	ac-ft
Depth of Remaining Treatment Volume =	0.19	ft

Based on the Stage/Storage Calculations:

0.57	ac-ft
16.19	Elevation based on the Stage/Storage relationship of the Wet Pond

Stage (ft)	Storage (ac-ft)
17	2.94
16	0

GROUNDWATER SEEPAGE AND UNDERDRAIN INFLOW

Approximate Groundwater Seepage Rate * =	0	gpd/ lf
Pond Perimeter @ Normal Water Line =	114,840	ft
Groundwater Inflow =	0	gpd
Groundwater Inflow =	**0.00000**	ac-ft/day
Approximate Underdrain Flow Rate =	0	gpd
Approximate Underdrain Flow rate =	**0.000**	ac-ft/day

FALLING HEAD DRAWDOWN CALCULATION

$$t = \{ TV * 43560\} / \{C * Ao * 3600 * (2*g)^{0.5} * ((h1 + h2)/2)^{0.5}\}$$

where: t = *drawdown time (hrs.)*; TV = *Pond volume to be drawn down (ac-ft)*; Ao = *Orifice area (sf.)*; $h1$ = *Initial height above orifice centerline (ft)*; C = *Orifice coefficient*; $h2$ = *Final height above orifice centerline (ft)*

Assumed Orifice Diameter =	**3.35**	***in***
h1 Based on Assumed Dia=	0.25	*ft*
h2 Based on Assumed Dia=	0.05	*ft*
h average height between h1 and h2=	0.15	*ft*
Ao Based on Assumed Dia=	0.06	*sf*
Q Based on Assumed "h" and Dia=	0.12	*cfs*
Initial Elevation =	**16.39**	ft
Final Elevation =	**16.19**	ft
Orifice Invert =	**16.00**	ft
Total Drawdown Volume TV =	**0.57**	ac-ft
Orifice Coefficient =	**0.61**	
Drawdown Time =	**29.5**	***hrs***

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/18/2015	DRAWDOWN **POND 5**

PERMANENT POOL VOLUME / RESIDENCE TIME / MEAN POND DEPTH

RUNOFF INFLOW

Drainage Area =	32.46	*(ac)*
Impervious Drainage Area =	13.19	*(ac)*
Runoff Coefficient for Impervious Areas =	0.95	
Pervious Drainage Area =	16.44	*(ac)*
Runoff Coefficient for Pervious Areas =	0.20	
Water Area =	2.83	*(ac)*
Runoff Coefficient of Water =	1.00	
Weighted Runoff Coefficient =	0.57	
Wet Season Rainfall =	31.50	*(in)*
Wet Season Duration =	153	*(days)*
Average Daily Inflow =	**0.320**	***(ac-ft/day)***

GROUNDWATER SEEPAGE AND UNDERDRAIN INFLOW

Approximate Groundwater Seepage Rate * =	0	*(gpm/lf)*
Pond Perimeter @ Normal Water Line =	114,840	*(ft)*
Groundwater Inflow =	0.00	*(gpm)*
Groundwater Inflow =	**0.000**	***(ac-ft/day)***
Approximate Underdrain Flow rate =	0	*(gpd)*
Approximate Underdrain Flow rate =	**0.000**	***(ac-ft/day)***

PERMANENT POOL EVALUATION

Minimum Residence Time =	21.00	*(days)*
Minimum Permanent Pool Volume + 50% of Volume for OFW =	10.08	*(ac-ft)*
Permanent Pool Volume Provided =	**22.35**	***(ac-ft)***
Residence Time =	**70**	***(days)***

MEAN POND DEPTH

Mean Pond Depth Criteria =	2.0 - 8.0	(feet)
Mean Pond Depth =	**7.9**	**(feet)**

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	PPV **POND 5**

B. Post-Development
Basin 6 Work Sheets

POST-DEVELOPMENT BASIN AREA SUMMARY

Drainage Basin 6				
Drainage Area Description	Drainage Area *(ac)*	Impervious Area *(ac)*	Pervious Area *(ac)*	Percent Impervious
North				
Basin 6B (no pond areas)	4.73	2.64	2.09	55.8%
Basin 6D (no pond areas)	2.91	1.24	1.67	42.6%
Pond 6 North (dry pond)	0.83	0.00	0.83	0.0%
Sub-Total	8.47	3.88	4.59	45.8%
South				
Basin 6A (no pond areas)	11.21	5.28	5.93	47.1%
Basin 6C (no pond areas)	10.95	5.29	5.66	48.3%
Pond 6 South (dry pond)	0.85	0.00	0.85	0.0%
Sub-Total	23.01	10.57	12.44	45.9%
Pond 6 (wet pond)	4.33	2.70	1.63	62.4%
Total	35.81	17.15	18.66	47.9%

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 9/10/2015	AREA **BASINS**

Sub-Basin Area Calculations - System 6

Sub Basin	Sub Basin Area	Lot Area	Lot Imperious Area (1)	R/W Impervious Area	Total Impervious Area	Total Pervious Area
6A.1	2.28	1.83	0.82	0.19	1.01	1.27
6A.2	1.25	0.95	0.43	0.18	0.61	0.64
6A.3 (MH)	0	0	0.00	0	0.00	0.00
6A.4	1.66	1.3	0.59	0.18	0.77	0.90
6A.5	1.6	1.3	0.59	0.18	0.77	0.84
6A.6 (MH)	0	0	0.00	0	0.00	0.00
6A.7	1.66	1.3	0.59	0.18	0.77	0.90
6A.8	1.66	1.3	0.59	0.18	0.77	0.90
6A.9	0.28	0	0.00	0.18	0.18	0.10
6A.10 (MH)	0	0	0.00	0	0.00	0.00
6A.11	0.82	0.52	0.23	0.18	0.41	0.41
6A.12 (MES)	0	0	0.00	0	0.00	0.00
Subtotal	**11.21**	**8.5**	**3.83**	**1.45**	**5.28**	**5.94**
6B.1	0.48	0	0.00	0.31	0.31	0.17
6B.2	0.48	0	0.00	0.31	0.31	0.17
6B.3 (MH)	0	0	0.00	0	0.00	0.00
6B.4	0.48	0	0.00	0.31	0.31	0.17
6B.5	0.48	0	0.00	0.31	0.31	0.17
6B.6 (MH)	0	0	0.00	0	0.00	0.00
6B.7 (MH)	0	0	0.00	0	0.00	0.00
6B.8	1.85	1.33	0.60	0.29	0.89	0.96
6B.9	0.96	0.56	0.25	0.26	0.51	0.45
6B.10 (MES)	0	0	0.00	0	0.00	0.00
Subtotal	**4.73**	**1.89**	**0.85**	**1.79**	**2.64**	**2.09**
6C.1	2.21	1.84	0.83	0.2	1.03	1.18
6C.2	1.25	0.95	0.43	0.18	0.61	0.64
6C.3 (MH)	0	0	0.00	0	0.00	0.00
6C.4	1.6	1.3	0.59	0.18	0.77	0.84
6C.5	1.6	1.3	0.59	0.18	0.77	0.84
6C.6 (MH)	0	0	0.00	0	0.00	0.00
6C.7	1.6	1.3	0.59	0.18	0.77	0.84
6C.8	1.6	1.3	0.59	0.18	0.77	0.84
6C.9	0.28	0	0.00	0.18	0.18	0.10
6C.10 (MH)	0	0	0.00	0	0.00	0.00
6C.11	0.81	0.52	0.23	0.18	0.41	0.40
6C.12 (MES)	0	0	0.00	0	0.00	0.00
Subtotal	**10.95**	**8.51**	**3.83**	**1.46**	**5.29**	**5.66**
6D.1	1.95	1.64	0.57	0.21	0.78	1.17
6D.2	0.96	0.56	0.20	0.26	0.46	0.50
6D.3 (MES)	0	0	0.00	0	0.00	0.00
Subtotal	**2.91**	**2.2**	**0.77**	**0.47**	**1.24**	**1.67**
Total	**29.8**	**21.10**	**9.28**	**5.17**	**14.45**	**15.36**

Notes:

1. Patio lots is estimated to have 45% impervious area. All lots are Patio Lots.
2. The Lot Area also includes Park Areas. It is assumed the Park Areas to have 45% impervious area.

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 9/10/2015	AREA Sub-Basins

RUNOFF CURVE NUMBER

Proposed Conditions
Basin 6 North Drainage Area

HSG	*Cover Description*	*CN*	*Area (acres)*	*Product*
D	Open Space (good condition)	80	3.76	300.80
N/A	Impervious	98	3.88	380.24
D	Pond	80	0.83	66.40
		Totals =	8.47	747.44
		AMC II *CN =*	**88**	

Reference: Technical Release 55 (TR 55)
Soil Conservation Service, June 1986

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 9/10/2015	CN Basin 6 North

RUNOFF CURVE NUMBER

Proposed Conditions
Basin 6 South Drainage Area

HSG	*Cover Description*	*CN*	*Area (acres)*	*Product*
D	Open Space (good condition)	80	11.59	927.20
N/A	Impervious	98	10.57	1035.86
D	Pond	80	0.85	68.00
		Totals =	23.01	2031.06
		AMC II *CN =*	**88**	

Reference: Technical Release 55 (TR 55)
Soil Conservation Service, June 1986

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 9/10/2015	CN Basin 6 South

RUNOFF CURVE NUMBER

Proposed Conditions
Pond 6 Wet Drainage Area

HSG	*Cover Description*	*CN*	*Area (acres)*	*Product*
N/A	Wet Pond @ CWL	100	2.70	270.00
D	Wet Pond pervious area	80	1.63	130.40
		Totals =	4.33	400.40
		AMC II *CN =*	**92**	

Reference: Technical Release 55 (TR 55)
Soil Conservation Service, June 1986

B&S Engineering Consultants, LLC	RIVIERA BELLA EAST UNITS 8 AND 9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 9/10/2015	CN Pond 6 Wet

TIME OF CONCENTRATION

Basin 6

The Time of Concentration (TC) is based on the TC calculations as generated in the Secondary Stormwater Sewer Analysis. Summary of the systems are as follows:

Secondary Stormwater Sewer Analysis will be provided during final construction plan review.

Basin 6 North

Sub-Basin	TC (Min.)	Use TC (Min.)
6B	20.23	20.00
6D	18.94	

Basin 6 South

Sub-Basin	TC (Min.)	Use TC (Min.)
6A	27.14	27.00
6C	27.09	

Note: Assume Time of Concentration of 5 min. for Basin 6 Wet.

STORMWATER POND STAGE STORAGE CALCULATIONS

Drainage Basin 6 - Wet Pond

STAGE-STORAGE RELATIONSHIP						
Stage (feet)	Depth (feet)	Surface Area (sq. ft.)	Surface Area (acres)	Average Area (acres)	Incremental Volume (ac-ft)	Total Volume (ac-ft)
4.00	0.00	74,110	1.70	0.00	0.00	0.00
5.00	1.00	77,294	1.77	1.74	1.74	1.74
6.00	2.00	80,510	1.85	1.81	1.81	3.55
7.00	3.00	83,755	1.92	1.89	1.89	5.43
8.00	4.00	87,021	2.00	1.96	1.96	7.39
9.00	5.00	90,312	2.07	2.04	2.04	9.43
10.00	6.00	93,630	2.15	2.11	2.11	11.54
11.00	7.00	96,973	2.23	2.19	2.19	13.73
12.00	8.00	100,339	2.30	2.26	2.26	15.99
13.00	9.00	108,874	2.50	2.40	2.40	18.40
14.00	10.00	117,582	2.70	2.60	2.60	21.00
14.0 CWL						
14.00	0.00	117,582	2.70	0.00	0.00	0.00
15.00	1.00	126,448	2.90	2.80	2.80	2.80
16.00	2.00	135,476	3.11	3.01	3.01	5.81
17.00	3.00	144,690	3.32	3.22	3.22	9.02
18.00	4.00	154,077	3.54	3.43	3.43	12.45
19.00	5.00	163,619	3.76	3.65	3.65	16.10
20.00	6.00	173,308	3.98	3.87	3.87	19.97

Drainage Basin 6 - North Dry Pond

STAGE-STORAGE RELATIONSHIP						
Stage (feet)	Depth (feet)	Surface Area (sq. ft.)	Surface Area (acres)	Average Area (acres)	Incremental Volume (ac-ft)	Total Volume (ac-ft)
15.00	0.00	16,678	0.38	0.00	0.00	0.00
16.00	1.00	19,397	0.45	0.41	0.41	0.41
17.00	2.00	22,288	0.51	0.48	0.48	0.89
18.00	3.00	25,349	0.58	0.55	0.55	1.44
19.00	4.00	28,575	0.66	0.62	0.62	2.06
20.00	5.00	31,953	0.73	0.69	0.69	2.75

Drainage Basin 6 - South Dry Pond

STAGE-STORAGE RELATIONSHIP						
Stage (feet)	Depth (feet)	Surface Area (sq. ft.)	Surface Area (acres)	Average Area (acres)	Incremental Volume (ac-ft)	Total Volume (ac-ft)
15.00	0.00	17,867	0.41	0.00	0.00	0.00
16.00	1.00	20,680	0.47	0.44	0.44	0.44
17.00	2.00	23,650	0.54	0.51	0.51	0.95
18.00	3.00	26,769	0.61	0.58	0.58	1.53
19.00	4.00	30,057	0.69	0.65	0.65	2.18
20.00	5.00	33,493	0.77	0.73	0.73	2.91

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 9/10/2015	STAGE STORAGE Basin 6

WATER QUALITY TREATMENT VOLUME REQUIREMENTS

Treatment Requirement:

For Wet Detention, the greater of following:

a) Runoff from the drainage area as required for an Wet Detention which is 1" of runoff from the drainage area.

b) Runoff from the impervoius area as required for an Wet Detention which is 2.5" of runoff from the impervious area.

c) Additional 50% of the above runoff volumes will be required for OFW requirements.

Drainage Basin 5						
Drainage Area Description	Drainage Area *(ac)*	Impervious Area (w/out wet pond) *(ac)*	Pervious Area *(ac)*	Percent Impervious	1 Inch of Runoff *(ac-ft)*	2.5 Inches X Imp Area *(ac-ft)*
Total	35.81	14.45	18.66	40.4%	2.98	3.01
				Plus 50% for OFW	1.49	1.51
				Total Treatment Volume Required =	4.48	4.52

TREATMENT VOLUME REQUIRED = **4.52** *(ac-ft)*

Phosphorus Loading Retention Requirement
(Dry Retention)

To obtain the Phosphorus Loading Retention Requirement runoff from the 1st 0.5" of rainfall over the drainage area shall be stored and treated in online dry retention ponds located north and south of the wet pond.

Drainage Basin North	Area (Ac)	Retention Volume (Ac-ft)
Basin 6B	4.73	N/A
Basin 6D	2.91	N/A
Pond 6 North	0.83	N/A
1/2 of Pond 6 Wet	2.17	N/A
Total	10.64	0.44

Drainage Basin South	Area (Ac)	Retention Volume (Ac-ft)
Basin 6A	11.21	N/A
Basin 6C	10.95	N/A
Pond 6 South	0.85	N/A
1/2 of Pond 6 Wet	2.17	N/A
Total	25.18	1.05

Total = 1.49 Ac-ft

Wet Retention = Total Treatment - Dry Retention = 3.02 (ac-ft)

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	WQTR POND 6

WATER QUALITY TREATMENT VOLUME DESIGN

The Dry Ponds can provide more of the Water Quality Treatment Volume than just the required volume of the Phosphorus Loading.

Pond ID	Required Phosphorus Loading Vol (Ac-ft)	Provided Volume (Ac-ft)	Pond Stage for Treatment (ft)
Pond 6 North	0.44	1.44	18
Pond 6 South	1.05	1.53	18
Total	1.49	2.97	n/a

The outfall wier for the dry ponds will be set at elevation 18.0.

The total treatment volume required 4.52 ac-ft
Provided treatment from dry ponds - 2.97 ac-ft
1.55 ac-ft Remaining Treatment Volume to be obtained in the Wet Pond

Based on the Stage/Storage Calculations the remaining treatment volume will be obtained at:

1.55 ac-ft Remaining Treatment Volume to be obtained in the Wet Pond
14.55 Elevation based on the Stage/Storage relationship of the Wet Pond

Stage (ft)	Storage (ac-ft)
15	2.80
14	0

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 9/10/2015	WQTD **POND 6**

DRAWDOWN TIME CALCULATION

No more than half the treatement volume (for the wet pond) should be discharged in the first 24 to 30 hours after the storm event.

Provided Treatment Volume =	1.55	ac-ft
Drawdown Volume (1/2 Treatment Volume) =	**0.77**	ac-ft
Corrresponding Stage for 1/2 Treatment Volume =	**14.28**	ft (see below)
Remaining Treatment Volume =	0.77	ac-ft
Depth of Remaining Treatment Volume =	0.28	ft

Based on the Stage/Storage Calculations:

0.77	ac-ft
14.28	Elevation based on the Stage/Storage relationship of the Wet Pond

Stage (ft)	Storage (ac-ft)
15	2.80
14	0

GROUNDWATER SEEPAGE AND UNDERDRAIN INFLOW

Approximate Groundwater Seepage Rate * =	0	gpd/ lf
Pond Perimeter @ Normal Water Line =	114,840	ft
Groundwater Inflow =	0	gpd
Groundwater Inflow =	**0.00000**	ac-ft/day
Approximate Underdrain Flow Rate =	0	gpd
Approximate Underdrain Flow rate =	**0.000**	ac-ft/day

FALLING HEAD DRAWDOWN CALCULATION

$$t = \{ TV * 43560\} / \{C * Ao * 3600 * (2*g)^{0.5} * ((h1 + h2)/2)^{0.5}\}$$

where: t = drawdown time (hrs.), Ao = Orifice area (sf.), C = Orifice coefficient, TV = Pond volume to be drawn down (ac-ft), $h1$ = Initial height above orifice centerline (ft), $h2$ = Final height above orifice centerline (ft)

Assumed Orifice Diameter =	**3.35**	***in***
h1 Based on Assumed Dia=	0.41	*ft*
h2 Based on Assumed Dia=	0.14	*ft*
h average height between h1 and h2=	0.27	*ft*
Ao Based on Assumed Dia=	0.06	*sf*
Q Based on Assumed "h" and Dia=	0.16	*cfs*
Initial Elevation =	**14.55**	ft
Final Elevation =	**14.28**	ft
Orifice Invert =	**14.00**	ft
Total Drawdown Volume TV =	**0.77**	ac-ft
Orifice Coefficient =	**0.61**	
Drawdown Time =	**29.8**	***hrs***

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	DRAWDOWN **POND 6**

PERMANENT POOL VOLUME / RESIDENCE TIME / MEAN POND DEPTH

RUNOFF INFLOW

Drainage Area =	35.81	*(ac)*
Impervious Drainage Area =	14.45	*(ac)*
Runoff Coefficient for Impervious Areas =	0.95	
Pervious Drainage Area =	18.66	*(ac)*
Runoff Coefficient for Pervious Areas =	0.20	
Water Area =	2.70	*(ac)*
Runoff Coefficient of Water =	1.00	
Weighted Runoff Coefficient =	0.56	
Wet Season Rainfall =	31.50	*(in)*
Wet Season Duration =	153	*(days)*
Average Daily Inflow =	**0.346**	***(ac-ft/day)***

GROUNDWATER SEEPAGE AND UNDERDRAIN INFLOW

Approximate Groundwater Seepage Rate * =	0	*(gpm/lf)*
Pond Perimeter @ Normal Water Line =	114,840	*(ft)*
Groundwater Inflow =	0.00	*(gpm)*
Groundwater Inflow =	**0.000**	***(ac-ft/day)***
Approximate Underdrain Flow rate =	0	*(gpd)*
Approximate Underdrain Flow rate =	**0.000**	***(ac-ft/day)***

PERMANENT POOL EVALUATION

Minimum Residence Time =	21.00	*(days)*
Minimum Permanent Pool Volume + 50% of Volume for OFW =	10.90	*(ac-ft)*
Permanent Pool Volume Provided =	**21.00**	***(ac-ft)***
Residence Time =	**61**	***(days)***

MEAN POND DEPTH

Mean Pond Depth Criteria =	2.0 - 8.0	(feet)
Mean Pond Depth =	**7.8**	**(feet)**

B&S Engineering Consultants, LLC	RIVIERA BELLA UNITS 8-9 DeBary, Florida	PN: HG-002 BY: GB CHK: MS DATE: 12/17/2015	PPV **POND 5**

C. Post-Development Pollutant Loading Analysis

Riviera Bella East - Units 8 and 9
Site Specific Pre/Post Pollutant Loading Analysis

Existing Condition

Basin ID	Land Use	Soil Type	Total P Loading (kg/ac-yr)		Basin Acreage (Acres)		Inflow Mass Loading (kg/yr)	Treatment System	Inches of Retention Over Basin Area (Inches)	Pollutant Removal Efficiency (%)	Outflow Mass Loading (kg/yr)
Improvement Area	Forest	HSG D	0.07	x	66.31	=	4.64				4.64
Ft Fl Road	Highway max 50% impervious	HSG D	0.871	x	1.96	=	1.71				1.71
		Total			68.27		6.35				6.35

Proposed Condition

Basin ID	Land Use	Soil Type	Total P Loading (kg/ac-yr)		Basin Acreage (Acres)		Inflow Mass Loading (kg/yr)	Treatment System	Inches of Retention Over Basin Area (Inches)	Pollutant Removal Efficiency (%)	Outflow Mass Loading (kg/yr)
Pond 5 North	SRF 45%	HSG D	0.696	x	18.60	=	12.95	Retention/21 day Detention	0.5	93	0.91
Pond 5 South	SRF 45%	HSG D	0.696	x	11.04	=	7.68	Retention/21 day Detention	0.5	93	0.54
Pond 6 North	SRF 45%	HSG D	0.696	x	9.29	=	6.47	Retention/21 day Detention	0.5	93	0.45
Pond 6 South	SRF 45%	HSG D	0.696	x	23.83	=	16.59	Retention/21 day Detention	0.5	93	1.16
		Total			62.76		43.68				3.06

Notes:

1. For Proposed Condition the Soil Type is HSG B. However, to be conservative a Soil Type of HSG D is used.
2. Total P Loading rate is based on a interpolation between values for a single family max 40% and 65% impervious
3. Based on guidance from SJRWMD, the drainage area for each Proposed Condition does not include the CWL area for each wet pond.

TABLE 13.7-3

MEAN ANNUAL LOADINGS OF TOTAL PHOSPHORUS FOR LAND USE TYPES IN THE LAKE APOPKA HYDROLOGIC BASIN

LAND USE CATEGORY	MEAN ANNUAL TOTAL PHOSPHORUS LOAD (kg/ac-yr)			
	HSG A	HSG B	HSG C	HSG D
Low-Density Residential (max. 15% impervious)	0.069	0.135	0.215	0.284
Single-Family Residential (max. 25% impervious)	0.227	0.286	0.383	0.465
Single-Family Residential (max. 40% impervious)	0.250	0.333	0.446	0.536
Multi-Family Residential (max. 65% impervious)	1.082	1.156	1.257	1.336
Commercial (max. 80% impervious)	0.899	0.916	0.943	0.964
Highway – max. 50% impervious	0.710	0.756	0.817	0.871
Highway – max. 75% impervious	1.053	1.076	1.106	1.133
Agriculture – Pasture	0.026	0.118	0.239	0.347
Agriculture – Crops, Ornamentals, Nurseries	0.040	0.180	0.366	0.531
Agriculture – Groves	0.007	0.036	0.079	0.123
Open Land/Recreational/Fallow Groves and Cropland	0.004	0.017	0.035	0.051
Forests/Abandoned Tree Crops	0.004	0.021	0.045	0.070

HSG = Hydrologic Soil Group

Table 13.7-17

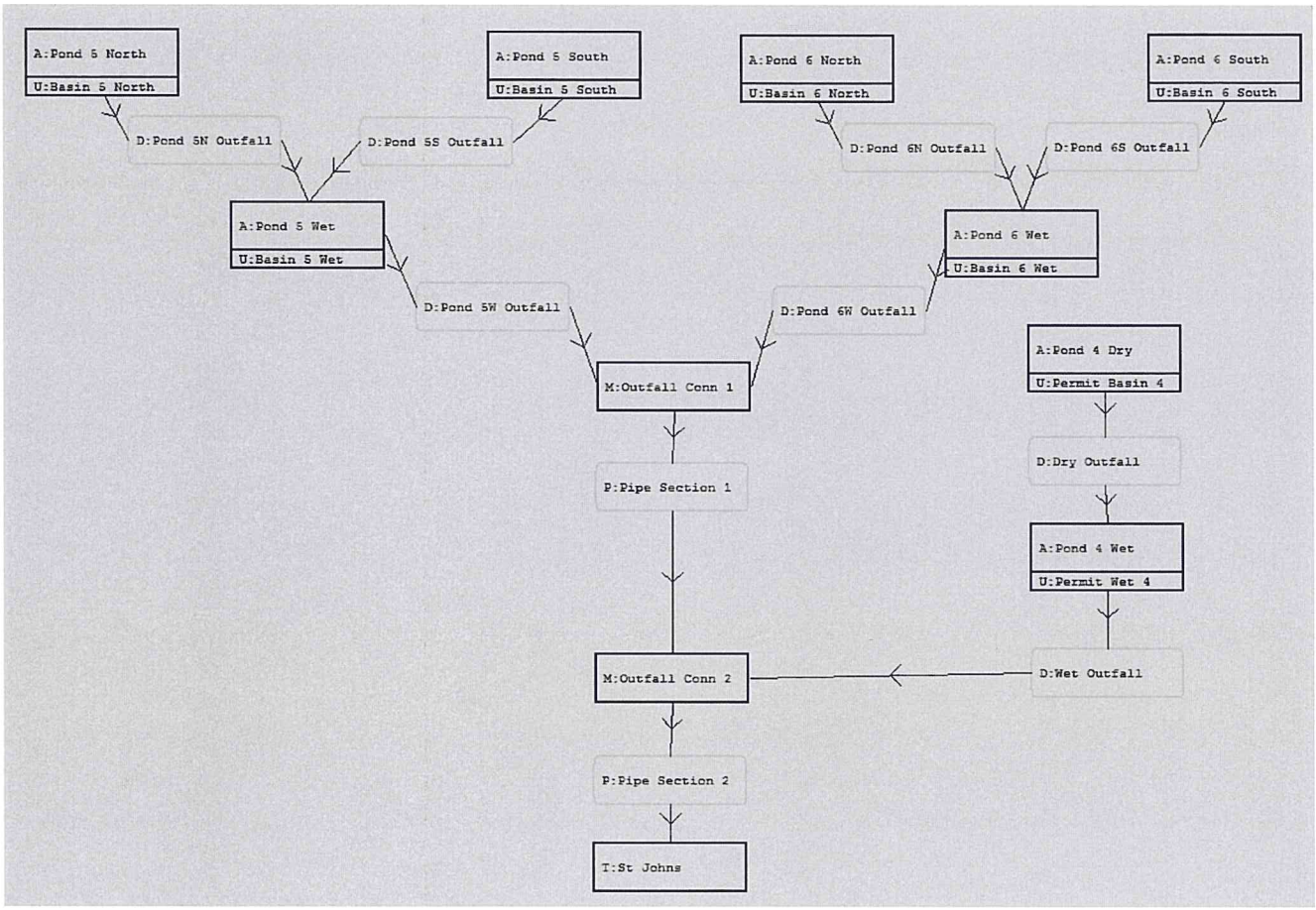
Removal Efficiencies for Total Phosphorus Using Various Treatment Options in Single-Family Residential (max. 40% impervious) for Hydrologic Soil Group D

Retention Depth (inches)	Annual Total P Removal (%)			
	Dry Retention[1]	Retention / Wet Detention[2]		
		t_d=7 days	t_d=14 days	t_d=21 days
0.25	48	82	87	90
0.50	65	88	91	93
0.75	75	91	94	95
1.00	81	93	95	96
1.25	85	95	96	97
1.50	88	96	97	98
1.75	90	96	97	98
2.00	92	97	98	98
2.25	93	97	98	99
2.50	94	98	98	99
2.75	94	98	99	99
3.00	95	98	99	99
3.25	96	98	99	99
3.50	96	99	99	99
3.75	97	99	99	99
4.00	97	99	99	99

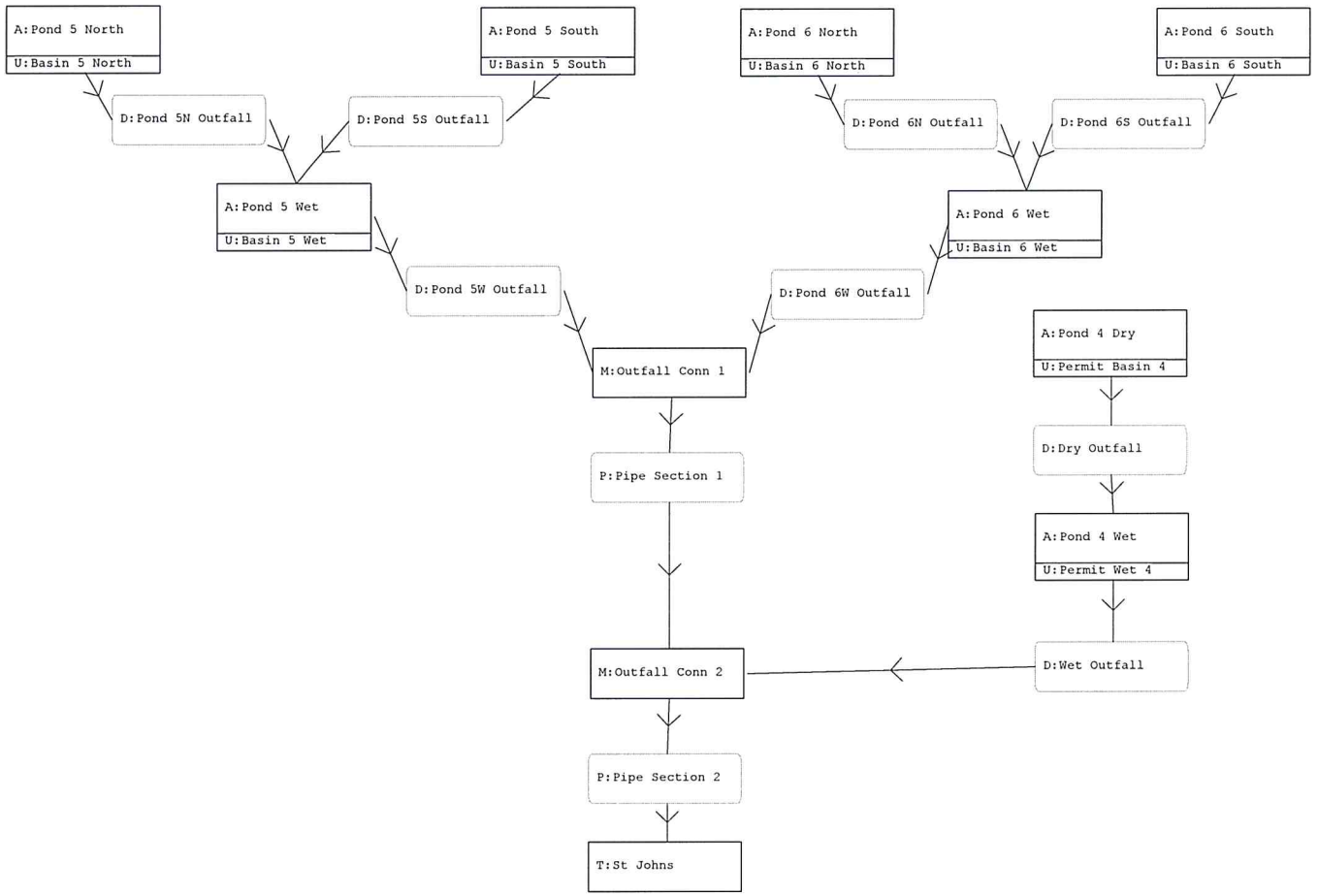
1. Dry retention alone.
2. Dry retention followed by wet detention with various residence times.

D. Post-Development ICPR Analysis

Post Development Node



Post Dev System Node



Nodes
A Stage/Area
V Stage/Volume
T Time/Stage
M Manhole

Basins
O Overland Flow
U SCS Unit Hydro CN
S Santa Barbara CNZ
Y SCS Unit Hydro GA
Z Santa Barbara GA

Links
P Pipe
W Weir
C Channel
D Drop Structure
B Bridge
R Rating Curve
H Breach
E Percolation Link
F Filter
X Exfiltration Trench

Post Dev System Node

Name	Simulation	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Inflow cfs	Max Outflow cfs
Outfall Conn 1	100-24	13.561	20.500	0.0125	218	84.211	84.227
Outfall Conn 2	100-24	11.123	16.530	0.0151	420	107.787	107.786
Pond 4 Dry	100-24	16.734	17.000	0.0050	14870	54.634	53.642
Pond 4 Wet	100-24	15.725	16.000	0.0044	52566	64.160	26.762
Pond 5 North	100-24	21.368	22.000	0.0045	31339	82.053	67.359
Pond 5 South	100-24	20.732	22.000	0.0045	28252	47.825	46.439
Pond 5 Wet	100-24	19.367	22.000	0.0024	153799	132.879	41.939
Pond 6 North	100-24	18.647	20.000	0.0050	27519	39.216	38.569
Pond 6 South	100-24	19.441	20.000	0.0050	31595	101.511	86.465
Pond 6 Wet	100-24	17.837	20.000	0.0025	152639	143.873	42.386
St Johns	100-24	7.200	7.200	0.0070	728	107.786	0.000
Outfall Conn 1	25-24	12.046	20.500	-0.0050	218	69.345	69.366
Outfall Conn 2	25-24	10.383	16.530	0.0144	427	91.355	91.352
Pond 4 Dry	25-24	16.543	17.000	0.0050	14287	43.462	43.288
Pond 4 Wet	25-24	14.859	16.000	0.0046	44687	50.752	23.230
Pond 5 North	25-24	20.898	22.000	0.0043	29700	65.396	63.007
Pond 5 South	25-24	20.623	22.000	0.0050	27870	38.026	36.408
Pond 5 Wet	25-24	18.637	22.000	0.0019	146964	110.439	32.808
Pond 6 North	25-24	18.540	20.000	0.0047	27148	31.197	29.433
Pond 6 South	25-24	19.027	20.000	0.0050	30150	80.618	77.124
Pond 6 Wet	25-24	16.968	20.000	0.0022	144324	117.747	36.542
St Johns	25-24	7.200	7.200	0.0070	727	91.352	0.000
Outfall Conn 1	Mean	8.345	20.500	0.0050	1954	12.719	12.706
Outfall Conn 2	Mean	7.299	16.530	-0.0048	2768	16.327	16.322
Pond 4 Dry	Mean	16.247	17.000	0.0050	13386	21.963	21.499
Pond 4 Wet	Mean	13.308	16.000	0.0028	38234	24.223	4.411
Pond 5 North	Mean	20.488	22.000	0.0046	28274	32.093	25.301
Pond 5 South	Mean	20.202	22.000	0.0032	26406	18.687	6.746
Pond 5 Wet	Mean	17.108	22.000	0.0011	133362	28.295	6.129
Pond 6 North	Mean	18.109	20.000	0.0029	25645	15.765	2.670
Pond 6 South	Mean	18.585	20.000	0.0050	28609	37.553	33.136
Pond 6 Wet	Mean	15.303	20.000	0.0015	129097	36.689	6.592
St Johns	Mean	7.200	7.200	0.0070	726	16.322	0.000

==========
==== Basins ====
==========

Name: Basin 5 North | Node: Pond 5 North | Status: Onsite
Group: BASE | Type: SCS Unit Hydrograph CN

Unit Hydrograph: Uh323 | Peaking Factor: 323.0
Rainfall File: Flmod | Storm Duration(hrs): 24.00
Rainfall Amount(in): 8.600 | Time of Conc(min): 24.00
Area(ac): 17.960 | Time Shift(hrs): 0.00
Curve Number: 89.00 | Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00

Name: Basin 5 South | Node: Pond 5 South | Status: Onsite
Group: BASE | Type: SCS Unit Hydrograph CN

Unit Hydrograph: Uh323 | Peaking Factor: 323.0
Rainfall File: Flmod | Storm Duration(hrs): 24.00
Rainfall Amount(in): 8.600 | Time of Conc(min): 22.00
Area(ac): 10.400 | Time Shift(hrs): 0.00
Curve Number: 88.00 | Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00

Name: Basin 5 Wet | Node: Pond 5 Wet | Status: Onsite
Group: BASE | Type: SCS Unit Hydrograph CN

Unit Hydrograph: Uh323 | Peaking Factor: 323.0
Rainfall File: Flmod | Storm Duration(hrs): 24.00
Rainfall Amount(in): 8.600 | Time of Conc(min): 5.00
Area(ac): 4.100 | Time Shift(hrs): 0.00
Curve Number: 94.00 | Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00

Name: Basin 6 North | Node: Pond 6 North | Status: Onsite
Group: BASE | Type: SCS Unit Hydrograph CN

Unit Hydrograph: Uh323 | Peaking Factor: 323.0
Rainfall File: Flmod | Storm Duration(hrs): 24.00
Rainfall Amount(in): 8.600 | Time of Conc(min): 20.00
Area(ac): 8.470 | Time Shift(hrs): 0.00
Curve Number: 88.00 | Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00

Name: Basin 6 South | Node: Pond 6 South | Status: Onsite
Group: BASE | Type: SCS Unit Hydrograph CN

Unit Hydrograph: Uh323 | Peaking Factor: 323.0
Rainfall File: Flmod | Storm Duration(hrs): 24.00
Rainfall Amount(in): 8.600 | Time of Conc(min): 27.00
Area(ac): 23.010 | Time Shift(hrs): 0.00
Curve Number: 88.00 | Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00

Name: Basin 6 Wet | Node: Pond 6 Wet | Status: Onsite
Group: BASE | Type: SCS Unit Hydrograph CN

Unit Hydrograph:	Uh323	Peaking Factor:	323.0
Rainfall File:	Flmod	Storm Duration(hrs):	24.00
Rainfall Amount(in):	8.600	Time of Conc(min):	5.00
Area(ac):	4.330	Time Shift(hrs):	0.00
Curve Number:	92.00	Max Allowable Q(cfs):	999999.000
DCIA(%):	0.00		

Name: Permit Basin 4 | Node: Pond 4 Dry | Status: Onsite
Group: BASE | Type: SCS Unit Hydrograph CN

Unit Hydrograph:	Uh323	Peaking Factor:	323.0
Rainfall File:	Flmod	Storm Duration(hrs):	24.00
Rainfall Amount(in):	8.600	Time of Conc(min):	20.00
Area(ac):	11.800	Time Shift(hrs):	0.00
Curve Number:	88.00	Max Allowable Q(cfs):	999999.000
DCIA(%):	0.00		

Name: Permit Wet 4 | Node: Pond 4 Wet | Status: Onsite
Group: BASE | Type: SCS Unit Hydrograph CN

Unit Hydrograph:	Uh323	Peaking Factor:	323.0
Rainfall File:	Flmod	Storm Duration(hrs):	24.00
Rainfall Amount(in):	8.600	Time of Conc(min):	5.00
Area(ac):	1.760	Time Shift(hrs):	0.00
Curve Number:	90.00	Max Allowable Q(cfs):	999999.000
DCIA(%):	0.00		

==========

Nodes

==========

Name: Outfall Conn 1 | Base Flow(cfs): 0.000 | Init Stage(ft): 7.280
Group: BASE | Plunge Factor: 1.00 | Warn Stage(ft): 20.500
Type: Manhole, Flat Floor

Stage(ft)	Area(ac)
7.280	0.0000
20.500	0.0000

Name: Outfall Conn 2 | Base Flow(cfs): 0.000 | Init Stage(ft): 5.680
Group: BASE | Plunge Factor: 1.00 | Warn Stage(ft): 16.530
Type: Manhole, Flat Floor

Stage(ft)	Area(ac)

5.680	0.0000
16.530	0.0000

Name: Pond 4 Dry Base Flow(cfs): 0.000 Init Stage(ft): 13.600
Group: BASE Warn Stage(ft): 17.000
Type: Stage/Area

Stage(ft)	Area(ac)
13.500	0.1500
14.000	0.1700
15.000	0.2300
16.000	0.2900
17.000	0.3600

Name: Pond 4 Wet Base Flow(cfs): 0.000 Init Stage(ft): 11.100
Group: BASE Warn Stage(ft): 16.000
Type: Stage/Area

Stage(ft)	Area(ac)
11.000	0.6800
12.000	0.7600
13.000	0.8500
14.000	0.9400
15.000	1.0400
16.000	1.2700

Name: Pond 5 North Base Flow(cfs): 0.000 Init Stage(ft): 17.100
Group: BASE Warn Stage(ft): 22.000
Type: Stage/Area

Stage(ft)	Area(ac)
17.000	0.4100
18.000	0.4700
19.000	0.5400
20.000	0.6100
21.000	0.6900
22.000	0.7700

Name: Pond 5 South Base Flow(cfs): 0.000 Init Stage(ft): 17.100
Group: BASE Warn Stage(ft): 22.000
Type: Stage/Area

Stage(ft)	Area(ac)
17.000	0.3900
18.000	0.4500
19.000	0.5200
20.000	0.5900
21.000	0.6700
22.000	0.7400

Name: Pond 5 Wet Base Flow(cfs): 0.000 Init Stage(ft): 16.100
Group: BASE Warn Stage(ft): 22.000
Type: Stage/Area

Stage(ft)	Area(ac)
16.000	2.8300
17.000	3.0400
18.000	3.2400
19.000	3.4500
20.000	3.6700
21.000	3.7800
22.000	3.8800

Name: Pond 6 North Base Flow(cfs): 0.000 Init Stage(ft): 15.100
Group: BASE Warn Stage(ft): 20.000
Type: Stage/Area

Stage(ft)	Area(ac)
15.000	0.3800
16.000	0.4500
17.000	0.5100
18.000	0.5800
19.000	0.6600
20.000	0.7300

Name: Pond 6 South Base Flow(cfs): 0.000 Init Stage(ft): 15.100
Group: BASE Warn Stage(ft): 20.000
Type: Stage/Area

Stage(ft)	Area(ac)
15.000	0.4100
16.000	0.4700
17.000	0.5400
18.000	0.6100
19.000	0.6900
20.000	0.7700

Name: Pond 6 Wet Base Flow(cfs): 0.000 Init Stage(ft): 14.100
Group: BASE Warn Stage(ft): 20.000
Type: Stage/Area

Stage(ft)	Area(ac)
14.000	2.7000
15.000	2.9000
16.000	3.1100
17.000	3.3200
18.000	3.5400
19.000	3.7600
20.000	3.9800

Name: St Johns Base Flow(cfs): 0.000 Init Stage(ft): 3.000
Group: BASE Warn Stage(ft): 7.200
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	3.000
14.00	3.000
24.00	7.200
36.00	7.200
48.00	5.000
60.00	3.000

Cross Sections

Name: Group: BASE
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N

Operating Tables

Name: Group: BASE
Type: Bottom Clip
Function: Time vs. Depth of Clip

Time(hrs)	Clip Depth(in)

Pipes

Name: Pipe Section 1 From Node: Outfall Conn 1 Length(ft): 933.00
Group: BASE To Node: Outfall Conn 2 Count: 1
Friction Equation: Average Conveyance
Solution Algorithm: Automatic
Flow: Both
Entrance Loss Coef: 0.50
Exit Loss Coef: 1.00
Bend Loss Coef: 0.00
Outlet Ctrl Spec: Use dc or tw
Inlet Ctrl Spec: Use dn
Stabilizer Option: None

	UPSTREAM	DOWNSTREAM
Geometry:	Circular	Circular
Span(in):	54.00	54.00
Rise(in):	54.00	54.00
Invert(ft):	7.280	5.680
Manning's N:	0.013000	0.013000
Top Clip(in):	0.000	0.000
Bot Clip(in):	0.000	0.000

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name:	Pipe Section 2	From Node:	Outfall Conn 2	Length(ft):	332.00
Group:	BASE	To Node:	St Johns	Count:	1
				Friction Equation:	Average Conveyance
	UPSTREAM	DOWNSTREAM		Solution Algorithm:	Automatic
Geometry:	Circular	Circular		Flow:	Both
Span(in):	54.00	54.00		Entrance Loss Coef:	0.50
Rise(in):	54.00	54.00		Exit Loss Coef:	1.00
Invert(ft):	5.680	4.500		Bend Loss Coef:	0.00
Manning's N:	0.013000	0.013000		Outlet Ctrl Spec:	Use dc or tw
Top Clip(in):	0.000	0.000		Inlet Ctrl Spec:	Use dn
Bot Clip(in):	0.000	0.000		Stabilizer Option:	None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

==========
==== Drop Structures ==========
==========

Name:	Dry Outfall	From Node:	Pond 4 Dry	Length(ft):	50.00
Group:	BASE	To Node:	Pond 4 Wet	Count:	1
				Friction Equation:	Average Conveyance
	UPSTREAM	DOWNSTREAM		Solution Algorithm:	Automatic
Geometry:	Circular	Circular		Flow:	Both
Span(in):	36.00	36.00		Entrance Loss Coef:	0.000
Rise(in):	36.00	36.00		Exit Loss Coef:	0.000
Invert(ft):	10.000	9.000		Outlet Ctrl Spec:	Use dc or tw
Manning's N:	0.013000	0.013000		Inlet Ctrl Spec:	Use dn
Top Clip(in):	0.000	0.000		Solution Incs:	10
Bot Clip(in):	0.000	0.000			

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

*** Weir 1 of 1 for Drop Structure Dry Outfall ***

TABLE

Count:	1	Bottom Clip(in):	0.000
Type:	Horizontal	Top Clip(in):	0.000
Flow:	Both	Weir Disc Coef:	3.200
Geometry:	Rectangular	Orifice Disc Coef:	0.600
Span(in):	79.00	Invert(ft):	15.750
Rise(in):	36.00	Control Elev(ft):	15.750

Name:	Pond 5N Outfall	From Node:	Pond 5 North	Length(ft):	55.00
Group:	BASE	To Node:	Pond 5 Wet	Count:	1
				Friction Equation:	Average Conveyance
	UPSTREAM	DOWNSTREAM		Solution Algorithm:	Automatic
Geometry:	Circular	Circular		Flow:	Both
Span(in):	36.00	36.00			

Rise(in):	36.00	36.00	Entrance Loss Coef:	0.500
Invert(ft):	12.550	12.000	Exit Loss Coef:	1.000
Manning's N:	0.013000	0.013000	Outlet Ctrl Spec:	Use dc or tw
Top Clip(in):	0.000	0.000	Inlet Ctrl Spec:	Use dn
Bot Clip(in):	0.000	0.000	Solution Incs:	10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

*** Weir 1 of 1 for Drop Structure Pond 5N Outfall ***

TABLE

Count:	1	Bottom Clip(in):	0.000
Type:	Horizontal	Top Clip(in):	0.000
Flow:	Both	Weir Disc Coef:	3.200
Geometry:	Rectangular	Orifice Disc Coef:	0.600
Span(in):	90.96	Invert(ft):	20.000
Rise(in):	48.00	Control Elev(ft):	20.000

Name:	Pond 5S Outfall	From Node:	Pond 5 South	Length(ft):	55.00
Group:	BASE	To Node:	Pond 5 Wet	Count:	1

	UPSTREAM	DOWNSTREAM		
Geometry:	Circular	Circular	Friction Equation:	Average Conveyance
Span(in):	36.00	36.00	Solution Algorithm:	Automatic
Rise(in):	36.00	36.00	Flow:	Both
Invert(ft):	12.550	12.000	Entrance Loss Coef:	0.500
Manning's N:	0.013000	0.013000	Exit Loss Coef:	1.000
Top Clip(in):	0.000	0.000	Outlet Ctrl Spec:	Use dc or tw
Bot Clip(in):	0.000	0.000	Inlet Ctrl Spec:	Use dn
			Solution Incs:	10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

*** Weir 1 of 1 for Drop Structure Pond 5S Outfall ***

TABLE

Count:	1	Bottom Clip(in):	0.000
Type:	Horizontal	Top Clip(in):	0.000
Flow:	Both	Weir Disc Coef:	3.200
Geometry:	Rectangular	Orifice Disc Coef:	0.600
Span(in):	90.96	Invert(ft):	20.000
Rise(in):	48.00	Control Elev(ft):	20.000

Name:	Pond 5W Outfall	From Node:	Pond 5 Wet	Length(ft):	870.00
Group:	BASE	To Node:	Outfall Conn 1	Count:	1

	UPSTREAM	DOWNSTREAM		
Geometry:	Circular	Circular	Friction Equation:	Average Conveyance
Span(in):	36.00	36.00	Solution Algorithm:	Automatic
Rise(in):	36.00	36.00	Flow:	Both
Invert(ft):	9.280	7.540	Entrance Loss Coef:	0.500
			Exit Loss Coef:	1.000

Manning's N:	0.013000	0.013000	Outlet Ctrl Spec: Use dc or tw
Top Clip(in):	0.000	0.000	Inlet Ctrl Spec: Use dn
Bot Clip(in):	0.000	0.000	Solution Incs: 10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

*** Weir 1 of 3 for Drop Structure Pond 5W Outfall ***

TABLE

Count:	1	Bottom Clip(in):	0.000
Type:	Horizontal	Top Clip(in):	0.000
Flow:	Both	Weir Disc Coef:	3.200
Geometry:	Rectangular	Orifice Disc Coef:	0.600
Span(in):	49.00	Invert(ft):	21.000
Rise(in):	37.00	Control Elev(ft):	21.000

*** Weir 2 of 3 for Drop Structure Pond 5W Outfall ***

TABLE

Count:	1	Bottom Clip(in):	0.000
Type:	Vertical: Mavis	Top Clip(in):	0.000
Flow:	Both	Weir Disc Coef:	3.200
Geometry:	Circular	Orifice Disc Coef:	0.600
Span(in):	3.35	Invert(ft):	16.000
Rise(in):	3.35	Control Elev(ft):	16.000

*** Weir 3 of 3 for Drop Structure Pond 5W Outfall ***

TABLE

Count:	1	Bottom Clip(in):	0.000
Type:	Vertical: Mavis	Top Clip(in):	0.000
Flow:	Both	Weir Disc Coef:	3.200
Geometry:	Rectangular	Orifice Disc Coef:	0.600
Span(in):	36.00	Invert(ft):	16.390
Rise(in):	55.56	Control Elev(ft):	16.390

Name:	Pond 6N Outfall	From Node:	Pond 6 North	Length(ft):	55.00
Group:	BASE	To Node:	Pond 6 Wet	Count:	1

	UPSTREAM	DOWNSTREAM		
Geometry:	Circular	Circular	Friction Equation:	Average Conveyance
Span(in):	36.00	36.00	Solution Algorithm:	Automatic
Rise(in):	36.00	36.00	Flow:	Both
Invert(ft):	10.550	10.000	Entrance Loss Coef:	0.000
Manning's N:	0.013000	0.013000	Exit Loss Coef:	1.000
Top Clip(in):	0.000	0.000	Outlet Ctrl Spec:	Use dc or tw
Bot Clip(in):	0.000	0.000	Inlet Ctrl Spec:	Use dc
			Solution Incs:	10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

*** Weir 1 of 1 for Drop Structure Pond 6N Outfall ***

TABLE

```
                Count: 1                      Bottom Clip(in): 0.000
                 Type: Horizontal               Top Clip(in): 0.000
                 Flow: Both                   Weir Disc Coef: 3.200
             Geometry: Rectangular          Orifice Disc Coef: 0.600

             Span(in): 90.96                       Invert(ft): 18.000
             Rise(in): 48.00                Control Elev(ft): 18.000
```

```
         Name: Pond 6S Outfall     From Node: Pond 6 South       Length(ft): 55.00
        Group: BASE                  To Node: Pond 6 Wet             Count: 1

               UPSTREAM       DOWNSTREAM              Friction Equation: Average Conveyance
     Geometry: Circular       Circular           Solution Algorithm: Automatic
     Span(in): 42.00          42.00                           Flow: Both
     Rise(in): 42.00          42.00              Entrance Loss Coef: 0.500
   Invert(ft): 10.550         10.000                 Exit Loss Coef: 1.000
  Manning's N: 0.013000       0.013000             Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                 Inlet Ctrl Spec: Use dn
 Bot Clip(in): 0.000          0.000                   Solution Incs: 10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall


*** Weir 1 of 1 for Drop Structure Pond 6S Outfall ***
                                                                          TABLE
                Count: 1                      Bottom Clip(in): 0.000
                 Type: Horizontal               Top Clip(in): 0.000
                 Flow: Both                   Weir Disc Coef: 3.200
             Geometry: Rectangular          Orifice Disc Coef: 0.600

             Span(in): 90.96                       Invert(ft): 18.000
             Rise(in): 48.00                Control Elev(ft): 18.000
```

```
         Name: Pond 6W Outfall     From Node: Pond 6 Wet         Length(ft): 578.00
        Group: BASE                  To Node: Outfall Conn 1         Count: 1

               UPSTREAM       DOWNSTREAM              Friction Equation: Average Conveyance
     Geometry: Circular       Circular           Solution Algorithm: Automatic
     Span(in): 36.00          36.00                           Flow: Both
     Rise(in): 36.00          36.00              Entrance Loss Coef: 0.500
   Invert(ft): 8.700          7.540                  Exit Loss Coef: 1.000
  Manning's N: 0.013000       0.013000             Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                 Inlet Ctrl Spec: Use dn
 Bot Clip(in): 0.000          0.000                   Solution Incs: 10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall


*** Weir 1 of 3 for Drop Structure Pond 6W Outfall ***
                                                                          TABLE
                Count: 1                      Bottom Clip(in): 0.000
                 Type: Horizontal               Top Clip(in): 0.000
```

```
                Flow: Both                    Weir Disc Coef: 3.200
            Geometry: Rectangular          Orifice Disc Coef: 0.600

            Span(in): 49.00                      Invert(ft): 19.000
            Rise(in): 37.00                Control Elev(ft): 19.000

*** Weir 2 of 3 for Drop Structure Pond 6W Outfall ***
                                                                TABLE
               Count: 1                     Bottom Clip(in): 0.000
                Type: Vertical: Mavis          Top Clip(in): 0.000
                Flow: Both                   Weir Disc Coef: 3.200
            Geometry: Circular             Orifice Disc Coef: 0.600

            Span(in): 3.35                       Invert(ft): 14.000
            Rise(in): 3.35                 Control Elev(ft): 14.000

*** Weir 3 of 3 for Drop Structure Pond 6W Outfall ***
                                                                TABLE
               Count: 1                     Bottom Clip(in): 0.000
                Type: Vertical: Mavis          Top Clip(in): 0.000
                Flow: Both                   Weir Disc Coef: 3.200
            Geometry: Rectangular          Orifice Disc Coef: 0.600

            Span(in): 36.00                      Invert(ft): 14.550
            Rise(in): 53.40                Control Elev(ft): 14.550


-------------------------------------------------------------------------------------------
        Name: Wet Outfall         From Node: Pond 4 Wet         Length(ft): 266.00
       Group: BASE                  To Node: Outfall Conn 2          Count: 1

             UPSTREAM       DOWNSTREAM              Friction Equation: Average Conveyance
    Geometry: Circular       Circular              Solution Algorithm: Automatic
    Span(in): 24.00          24.00                             Flow: Both
    Rise(in): 24.00          24.00                 Entrance Loss Coef: 0.500
  Invert(ft): 9.000          8.460                     Exit Loss Coef: 0.500
 Manning's N: 0.013000       0.013000                Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000          0.000                    Inlet Ctrl Spec: Use dn
Bot Clip(in): 0.000          0.000                      Solution Incs: 10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall


*** Weir 1 of 3 for Drop Structure Wet Outfall ***
                                                                TABLE
               Count: 1                     Bottom Clip(in): 0.000
                Type: Horizontal               Top Clip(in): 0.000
                Flow: Both                   Weir Disc Coef: 3.200
            Geometry: Rectangular          Orifice Disc Coef: 0.600

            Span(in): 49.00                      Invert(ft): 15.000
            Rise(in): 37.00                Control Elev(ft): 15.000

*** Weir 2 of 3 for Drop Structure Wet Outfall ***
                                                                TABLE
               Count: 1                     Bottom Clip(in): 0.000
                Type: Vertical: Mavis          Top Clip(in): 0.000
                Flow: Both                   Weir Disc Coef: 3.200
            Geometry: Circular             Orifice Disc Coef: 0.600

            Span(in): 3.25                       Invert(ft): 11.000
```

```
              Rise(in): 3.25                  Control Elev(ft): 11.000

*** Weir 3 of 3 for Drop Structure Wet Outfall ***
                                                                      TABLE
                 Count: 1                     Bottom Clip(in): 0.000
                  Type: Vertical: Mavis          Top Clip(in): 0.000
                  Flow: Both                  Weir Disc Coef: 3.200
              Geometry: Rectangular          Orifice Disc Coef: 0.600

              Span(in): 36.00                       Invert(ft): 12.750
              Rise(in): 27.00                Control Elev(ft): 12.750


================================================================================
==== Weirs =====================================================================
================================================================================

         Name:                      From Node:
        Group: BASE                   To Node:
         Flow: Both                      Count: 1
         Type: Horizontal           Geometry: Circular

                    Span(in): 0.00
                    Rise(in): 0.00
                  Invert(ft): 0.000
       Control Elevation(ft): 0.000
                                          TABLE
            Bottom Clip(in): 0.000
               Top Clip(in): 0.000
          Weir Discharge Coef: 3.200
      Orifice Discharge Coef: 0.600



================================================================================
==== Rating Curves =============================================================
================================================================================

         Name:                      From Node:                      Count: 1
        Group: BASE                   To Node:                       Flow: Both

              TABLE           ELEV ON(ft)     ELEV OFF(ft)
           #1:                0.000           0.000
           #2:                0.000           0.000
           #3:                0.000           0.000
           #4:                0.000           0.000



================================================================================
==== Hydrology Simulations =====================================================
================================================================================

          Name: 100-24
      Filename: P:\_PROJECT DRAWINGS\HG-001 Riviera Bella\MLS Drainage\100-24.R32

       Override Defaults: Yes
     Storm Duration(hrs): 24.00
           Rainfall File: Flmod
     Rainfall Amount(in): 10.60

Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          15.00

--------------------------------------------------------------------------------
```

```
         Name: 25-24
     Filename: P:\_PROJECT DRAWINGS\HG-001 Riviera Bella\East\Drainage\GB Drainage\25-24.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Flmod
    Rainfall Amount(in): 8.60

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          15.00

-------------------------------------------------------------------------------------------------
         Name: Mean
     Filename: P:\_PROJECT DRAWINGS\HG-001 Riviera Bella\MLS Drainage\MEAN.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Flmod
    Rainfall Amount(in): 4.50

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

=================================================================================================
==== Routing Simulations ========================================================================
=================================================================================================

         Name: 100-24              Hydrology Sim: 100-24
     Filename: P:\_PROJECT DRAWINGS\HG-001 Riviera Bella\MLS Drainage\100-24.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

       Max Delta Z(ft): 1.00                     Delta Z Factor: 0.00500
   Time Step Optimizer: 10.000
       Start Time(hrs): 0.000                     End Time(hrs): 24.00
    Min Calc Time(sec): 0.5000                Max Calc Time(sec): 60.0000
       Boundary Stages:                           Boundary Flows:


Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          5.000

Group           Run
--------------- -----
BASE            Yes


-------------------------------------------------------------------------------------------------
         Name: 25-24               Hydrology Sim: 25-24
     Filename: P:\_PROJECT DRAWINGS\HG-001 Riviera Bella\East\Drainage\GB Drainage\25-24.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

       Max Delta Z(ft): 1.00                     Delta Z Factor: 0.00500
   Time Step Optimizer: 10.000
       Start Time(hrs): 0.000                     End Time(hrs): 24.00
    Min Calc Time(sec): 0.5000                Max Calc Time(sec): 60.0000
       Boundary Stages:                           Boundary Flows:
```

Time(hrs)	Print Inc(min)
24.000	5.000

Group	Run
BASE	Yes

Name: Mean Hydrology Sim: Mean
Filename: P:_PROJECT DRAWINGS\HG-001 Riviera Bella\MLS Drainage\MEAN.I32

Execute: Yes Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 24.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: Boundary Flows:

Time(hrs)	Print Inc(min)
24.000	5.000

Group	Run
BASE	Yes

6.3 Secondary Conveyance Facilities Hydraulic Design Analysis

The Secondary Conveyance Facilities Hydraulic Design Analysis will be provided during Construction Plan review.

Appendices

Appendix A

FLORIDA DEPARTMENT OF STATE
DIVISION OF CORPORATIONS
www.sunbiz.org

Detail by Entity Name

Foreign Profit Corporation

TRADERSCOVE CORPORATION

Filing Information

Document Number	F94000005842
FEI/EIN Number	52-1546037
Date Filed	11/10/1994
State	DE
Status	ACTIVE

Principal Address

2300 Lee road
winter park, FL 32789

Changed: 01/10/2015

Mailing Address

PO BOX 940
WINTER PARK, FL 32790

Changed: 04/26/2011

Registered Agent Name & Address

HENIN, JEROME L
2300 Lee road
WINTER PARK, FL 32789

Address Changed: 04/24/2013

Officer/Director Detail

Name & Address

Title P

HENIN, JEROME
PO BOX 940
WINTER PARK, FL 32790

Title director

kalin, mike
2300 lee road
winter park, FL 32789

Annual Reports

Report Year	Filed Date
2013	04/24/2013

Appendix B

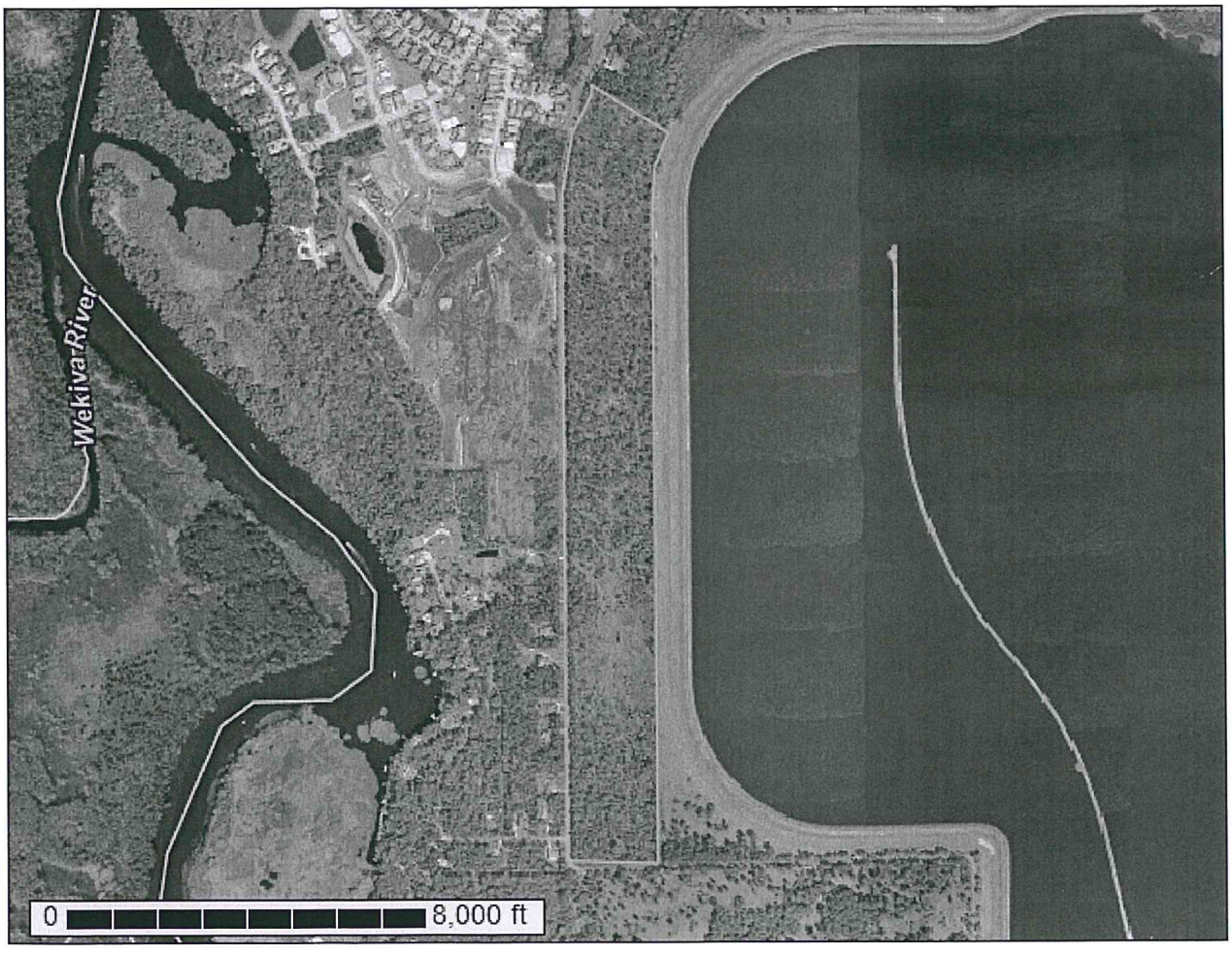
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Volusia County, Florida



September 1, 2015

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Volusia County, Florida
Survey Area Data: Version 12, Sep 18, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 8, 2015—Mar 18, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Volusia County, Florida (FL127)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
23	Farmton fine sand	66.5	99.2%
29	Immokalee sand	0.5	0.8%
Totals for Area of Interest		**67.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Volusia County, Florida

23—Farmton fine sand

Map Unit Setting

National map unit symbol: 1ntsg
Elevation: 20 to 120 feet
Mean annual precipitation: 53 to 61 inches
Mean annual air temperature: 66 to 73 degrees F
Frost-free period: 285 to 315 days
Farmland classification: Not prime farmland

Map Unit Composition

Farmton, non-hydric, and similar soils: 70 percent
Farmton, hydric, and similar soils: 10 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Farmton, Non-hydric

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Interfluve, talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 7 inches: fine sand
E - 7 to 34 inches: fine sand
Bh - 34 to 50 inches: fine sand
Btg - 50 to 80 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Description of Farmton, Hydric

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Interfluve, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 7 inches: fine sand
E - 7 to 34 inches: fine sand
Bh - 34 to 50 inches: fine sand
Btg - 50 to 80 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Minor Components

Eaugallie, non-hydric

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Basinger, depressional

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL)

Pomona, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Wauchula, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)

Immokalee, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Myakka, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

29—Immokalee sand

Map Unit Setting

National map unit symbol: 1ntsn
Elevation: 10 to 150 feet
Mean annual precipitation: 53 to 61 inches
Mean annual air temperature: 66 to 73 degrees F
Frost-free period: 285 to 315 days
Farmland classification: Not prime farmland

Map Unit Composition

Immokalee, non-hydric, and similar soils: 65 percent
Immokalee, hydric, and similar soils: 10 percent

Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Immokalee, Non-hydric

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 10 inches: sand
E - 10 to 34 inches: sand
Bh - 34 to 43 inches: sand
C - 43 to 85 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Description of Immokalee, Hydric

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 10 inches: sand
E - 10 to 34 inches: sand
Bh - 34 to 43 inches: sand
C - 43 to 85 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained

Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Minor Components

Placid

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL)

Myakka, non-hydric

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Basinger, depressional

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL)

Daytona

Percent of map unit: 4 percent
Landform: Knolls on marine terraces, rises on marine terraces
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on rises, knolls, and ridges of mesic uplands (G155XB121FL)

Smyrna, non-hydric

Percent of map unit: 3 percent

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Satellite

Percent of map unit: 3 percent
Landform: Rises on marine terraces, flats on marine terraces
Landform position (three-dimensional): Rise, talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on rises and knolls of mesic uplands (G155XB131FL)

St. johns, hydric

Percent of map unit: 3 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

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Appendix C

Andreyev Engineering, Inc.

CLERMONT OFFICE
1170 W. Minneola Avenue
Clermont, Florida 34711
352-241-0508
Fax: 352-241-0977

▼ Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

July 30, 2015
Revised December 16, 2015
Project No. CPGT-15-0095

To: Traderscove Corp d/b/a HENIN Group
2300 Lee Road
Winter Park, Florida 32789

Attention: Mr. Jerome Henin, President

Subject: Report of Geotechnical Engineering Services
Riviera Bella East Subdivision
DeBary, Volusia County, Florida

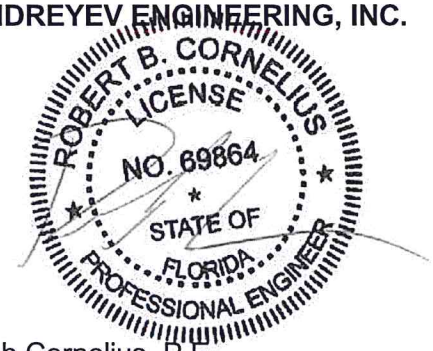
Dear Mr. Henin:

Pursuant to your request and authorization, Andreyev Engineering, Inc. (AEI) has completed a geotechnical engineering study in connection with the proposed Riviera Bella East Subdivision located in DeBary, Volusia County, Florida.

This report includes the results of exploratory borings drilled within the proposed roadways and stormwater retention pond areas, engineering evaluations, and recommendations for pavement design, stormwater management design, and proper site preparation prior to construction.

We appreciate the opportunity to provide our services on this project and trust that the information presented in this report is sufficient for design purposes. Should you have any questions concerning this report please feel free to contact the undersigned at 352-241-0508

Sincerely,
ANDREYEV ENGINEERING, INC.



Rob Cornelius, P.E.
Branch Manager
Florida Registration No.: 69864

Cc: Mr. Gary Beverly; B & S Engineering Consultants, LLC

1.0 PURPOSE AND SCOPE

This study was performed to obtain information about the general subsurface conditions within the subject site in order to form an opinion of the soil stratigraphy and develop estimates of geotechnical properties. Based on the data obtained, recommendations for each of the following were formulated:

1. Soil stratigraphy at the boring locations.

2. Provide recommendations for pavement section design.

3. Provide recommendations for stormwater management design.

4. Suitability of the on-site soils for use as fill material for grading of the planned development.

5. Provide structural fill, placement, compaction and construction quality control recommendations. Provide engineering criteria for the placement and compaction of approved fill materials.

Our work for this study involved coordination of field activities, drilling soil borings, visual classification of collected soil samples, measuring groundwater levels, performing laboratory tests, geotechnical engineering evaluations, and report preparation. Specifically, the work included the following:

1. Carried out a subsurface exploration program consisting of thirty-four (34) auger borings drilled to depths ranging from 6 to 20 feet below existing grades within the proposed roadway and stormwater retention pond areas. These borings are designated as RB-1 through RB-25 (roadway borings) and PB-1 through PB-9 (pond borings).

2. Performed a series of shallow hand auger borings within the four designated wetland areas to determine the approximate depth of surficial organic soil deposits.

3. Collected and packaged representative soil samples and returned them to our laboratory facility for evaluation and testing. We also collected four (4) relatively undisturbed tube samples of the shallow soils within the proposed pond areas. Laboratory falling head permeability tests were performed on these samples.

4. Measured the depth to groundwater at each of the roadway and pond boring locations.

5. Visually classified the collected soil samples in the laboratory according to the Unified Soil Classification System (USCS). The laboratory testing program

consisted of performing forty-six (46) Pass No. 200 sieve tests and four (4) falling head permeability tests. The permeability tests were performed on the tube samples collected at auger boring locations PB-1, PB-4, PB-5 and PB-8

6. Performed geotechnical engineering evaluations and analyses to develop recommendations as previously described.

7. Prepared this engineering report describing the results of our findings together with our geotechnical engineering evaluations and recommendations in each of the above areas.

2.0 SITE LOCATION AND PROJECT DESCRIPTION

The subject site is located on the east side of Fort Florida Road in DeBary, Volusia County, Florida (Sections 6 and 31, Township 18 South, and Range 29 East). The USGS Topographic Map depicting the site location is presented as **Figure 1**.

According to the information provided to us, it is our understanding that the site encompasses an area of 64 acres and will be developed into a single-family home residential community. The proposed development will include roadways, stormwater retention ponds, and associated underground utilities. The project will also include widening/reconstructing Fort Florida Road along an approximate 1,500 lineal feet length.

The site consists of undeveloped land. The surface conditions consist primarily of wooded land with associated underbrush. The property contains four (4) wetland areas. An earthen dam exists to the east side of the property. This dam is associated with the man-made Komomac Lake. Details of the lake/dam such as design high water, geometry, seepage barrier etc. are not known.

3.0 REVIEW OF PUBLISHED LITERATURE

3.1 U.S.G.S. Topographic Map

Referencing the data presented on the U.S.G.S. Topographic Map (**refer to Figure 1)**, the natural ground surface elevation of the site ranges from approximately 15 to 20 feet NGVD. In general, the ground surface is relatively flat with no significant topographical relief. There are several closed topographic features mapped in the central and northern portions of the site. These features are the previously indicated wetland areas.

3.2 N.R.C.S. Soil Survey Map

Details of the near surface soil groups present at the site and vicinity are summarized in the N.R.C.S. Soil Survey of Volusia County, Florida. This map is presented as **Figure 2** in the Appendix. There are two (2) soil map units identified within the subject site. General information regarding the mapped soil units for the project site is provided in the following table.

Soil Unit #	Name	High Water Table Depth (feet)	General Soil Profile
23	Farmton Fine Sand	0 to -1.0	0-50" Sand, Fine Sand 50-80" Fine Sandy Loam, Sandy Loam, Sandy Clay Loam
29	Immokalee Sand	0 to -1.0	0-85" Sand, Fine Sand

The vast majority of the site is mapped as #23 Farmton Fine Sand.

4.0 SUBSURFACE EXPLORATION PROGRAM

The subsurface exploration program included drilling twenty-five (25) auger borings within the proposed roadway areas. These borings are designated as RB-1 through RB-25. Nine (9) auger borings (PB-1 through PB-9) were drilled within the proposed stormwater retention ponds. Additionally, we drilled a series of shallow hand auger borings within the wetland areas to determine the approximate thickness of surficial organic soil deposits. The roadway and retention pond borings were drilled to depths ranging from 6 to 20 feet below grade.

The locations where the roadway and retention pond borings were drilled are shown on the attached **Figure 3**. The roadway and retention pond borings were surveyed by representatives of PEC Surveying and Mapping, LLC. The locations where the shallow hand auger borings were drilled in the wetland areas are illustrated on the attached **Figures 6 through 8**. Survey control was not provided for these locations. The locations were determined in the field using a hand held GPS unit.

The recovered soil samples were visually classified in the field with representative portions of the samples placed in jars and transported to our office for review and classification by the geotechnical engineer.

5.0 SUBSURFACE CONDITIONS

5.1 Generalized Soil Conditions

The results of our subsurface exploration program including the stratification profiles and groundwater levels are graphically presented on the attached **Figures 4 and 5.** Soil stratification is based on review of recovered soil samples and interpretation of field boring logs by a geotechnical engineer. The stratification lines represent the approximate boundaries between soil types. The actual transition may be gradual. Minor variations not considered important to our engineering evaluations may have been abbreviated or omitted for clarity.

The soils encountered consist of slightly silty fine sand, silty fine sand, slightly clayey fine sand and clayey fine sand. At several boring locations, we encountered shallow surficial deposits of muck and sand with organics/roots. Please refer to the attached **Figures 4 and 5** (soil profiles) for specific boring data.

The shallow hand auger borings performed within the four (4) wetland areas encountered surficial deposits of organic soil ranging from 0.3 to 1.5 feet thick. The results of these findings are illustrated on the attached **Figures 6 through 8**.

5.2 Groundwater Levels

At the time of our field investigation (June/July 2015), the groundwater table was encountered at depths ranging from approximately 0.5 to 4.1 feet below the existing grades. Fluctuation of the groundwater table should be anticipated throughout the year due to variations in seasonal rainfall. Based on the time of year, the encountered groundwater levels, the amount of rainfall received to date, and review of the Soil Survey data, we estimate that the normal wet season high groundwater table will range from ground surface to a depth of about 1.5 feet below existing grade at the roadway/pond boring locations. Standing water is expected to occur in the wetland areas during the rainy season.

The following table summarizes the measured groundwater levels together with our estimated normal wet season high groundwater elevations.

Boring No.	Ground Surface Elevation (feet, NGVD29)	Encountered Depth to Groundwater (feet)	Encountered Groundwater Elevation (feet, NGVD29)	Estimated Normal Wet Season High Groundwater Elevation (feet, NGVD29)
RB-1	19.7	1.9	17.8	19.2
RB-2	18.8	1.8	17.0	18.3
RB-3	17.6	2.3	15.3	17.1
RB-4	16.3	2.3	14.0	15.8
RB-5	16.3	2.8	13.5	15.3
RB-6	14.6	2.1	12.5	14.6
RB-7	16.0	3.3	12.7	15.0
RB-8	15.9	2.2	13.7	15.9
RB-9	17.0	2.9	14.1	16.0
RB-10	18.1	2.3	15.8	17.6
RB-11	19.6	2.0	17.6	19.1
RB-12	20.5	2.9	17.6	19.5
RB-13	18.7	4.1	14.6	17.7
RB-14	18.5	2.0	16.5	18.5
RB-15	20.7	3.0	17.7	19.7
RB-16	17.8	1.0	16.8	17.8
RB-17	19.8	2.5	17.3	18.8

RB-18	19.7	2.6	17.1	18.7
RB-19	20.4	2.5	17.9	19.4
RB-20	20.5	2.5	18.0	20.0
RB-21	20.7	3.1	17.6	19.7
RB-22	20.3	3.4	16.9	18.8
RB-23	20.6	3.3	17.3	19.1
RB-24	20.7	3.4	17.3	19.2
RB-25	20.4	2.0	18.4	19.9
PB-1	20.3	3.0	17.3	19.3
PB-2	20.6	3.0	17.6	19.6
PB-3	20.0	3.0	17.0	19.5
PB-4	21.0	3.3	17.7	20.0
PB-5	20.1	2.9	17.2	19.1
PB-6	19.5	2.6	16.9	19.0
PB-7	17.6	2.0	15.6	17.6
PB-8	17.1	1.4	15.7	17.1
PB-9	Not Surveyed	0.5	---	Ground Surface

5.3 Laboratory Testing

The recovered soil samples were visually classified and stratified in the laboratory by a geotechnical engineer using the Unified Soil Classification System (USCS). The soil classifications are presented on the attached **Figures 4 and 5**.

The laboratory testing program consisted of performing forty-six (46) Pass No. 200 sieve analysis and four (4) falling head permeability tests. The results of the tests are shown next to the soil profiles on **Figures 4 and 5**.

6.0 ENGINEERING EVALUATIONS AND RECOMMENDATIONS

6.1 General

Based on the results of our field investigations and laboratory testing programs, the main constraints for the planned development from a geotechnical perspective are the high groundwater table conditions and poor drainage characteristics of some of the soil types that were encountered (silty/clayey sands). The organic soil deposits in the wetland areas are relatively shallow and are not expected to pose a major constraint for the site development.

Design and planning of the proposed development will need to take into account the estimated normal wet season high groundwater table conditions. The bottom of building floor slabs and pavement base material (limerock/crushed concrete base) should be set a minimum of 2 feet above the seasonal high groundwater table. For a soil cement pavement base material, the minimum separation should not be less than 1 foot.

The majority of the near surface soils encountered consist of slightly silty fine sand (Strata 1 and 9 soils). These soils were encountered within the upper 2 to 6 feet of the soil column. The percent passing the No. 200 sieve for these soil types ranged from 6.1 to 12.0 percent. These soil types that are excavated during earthwork activities will be suitable for structural fill provided that the fines content does not exceed 12 percent. Any soils excavated from below the groundwater table will require air drying prior to placement/compaction. The deeper soils consist primarily of silty and clayey fine sand. These soils are difficult to work with as they are susceptible to moisture related instability due to their high fines content. Accordingly, these type soils are not considered a good fill source. If the contractor elects to use these type soils as fill, we recommend that they not be used in the upper 2 feet of fill areas. Any highly plastic clayey soils shall not be used as fill. We recommend that on site and imported materials be tested prior to placement to verify that they are suitable for use during earthwork operations and meet the project specifications. All organic soils and root laden soils shall be removed and not used as fill. Organic soils may be suitable for surface cover in landscape areas. Highly organic soils may need to be blended with sand for this application. The suitability of the organic soils for use in landscape areas should be verified by the landscape architect.

Wet bottom retention pond design will be suitable for the planned retention ponds. Dry bottom retention ponds will require site filling and possibly the use of underdrains to artificially recover stormwater.

Temporary dewatering should be anticipated during excavation activities at this site. The groundwater table should be controlled at least 2 feet below excavation and compaction surfaces.

The following sections of this report provide our recommendations for pavement design, stormwater retention pond design, and site preparation.

6.2 Pavement Design Considerations

The results of the auger borings performed within the proposed roadways revealed subsurface conditions that are suitable for support of either flexible (limerock) or semi-flexible (soil-cement) pavement structures.

For a flexible pavement section, we recommend that the limerock base thickness be a minimum of 6 inches within parking areas and at least 8 inches where there will be heavy traffic. The limerock base materials should have a minimum Limerock Bearing Ratio (LBR) of 100 and be compacted to at least 98 percent of the Modified proctor maximum dry density per ASTM D-1557. The base course should be underlain by at least 12 inches of stabilized sub-base for both light and heavy duty pavement sections having an LBR of at least 40 and compacted to a minimum of 98 percent of the Modified proctor.

In lieu of using a limerock base material for flexible pavement structure, consideration can be given to using a crushed concrete base material. The crushed concrete base material should have a minimum Limerock Bearing Ratio (LBR) of 120 and be compacted to at least 98 percent

of the Modified proctor maximum dry density per ASTM D-1557. The crushed concrete material should meet FDOT specifications. The base course should be underlain by at least 12 inches of stabilized sub-base for both light and heavy duty pavement sections having an LBR of at least 40 and compacted to a minimum of 98 percent of the Modified proctor. The thickness for light and heavy duty areas shall be the same as the limerock base thicknesses provided above.

If a soil-cement base material is used, the thickness for light and heavy duty areas shall be the same as the limerock base thicknesses provided above. For this type of pavement section, a stabilized sub-base is not recommended. The sub-grade soils to a depth of at least 12 inches below the bottom of the base should consist of well draining fine sand with less than 7 percent passing the No. 200 sieve and should be compacted to a minimum of 98 percent of the Modified proctor maximum dry density to a depth of at least 12 inches below the base course. The soil-cement base course should be compacted to a minimum of 98 percent of the Standard proctor density per AASHTO T-134. Please note that soil-cement pavements are susceptible to cracking as a result of shrinkage and are typically used only when there are high groundwater table conditions. Soil cement is the least desirable type of pavement structure from an aesthetic and performance point of view.

The asphaltic concrete wearing surface should be Type S and should have a minimum thickness of 1.5 inches in light duty areas and 2 inches in heavy duty areas. The asphaltic concrete should be rolled to achieve a minimum density of 93 percent of the laboratory density as determined by the Marshall Stability test method.

The recommended pavement thicknesses presented herein are minimum thicknesses typical of local construction practices. Actual pavement section thicknesses should be designed by the project civil engineer based on traffic loads, volumes and the selected design life. All pavement materials should conform to the requirements of FDOT, American Concrete Institute (ACI) and county requirements.

6.3 Fill Placement and Subgrade Preparation

The following are our recommendations for overall site preparation and mechanical densification work, based on the anticipated construction and our test boring results. These recommendations should be incorporated into the project general specifications prepared by the Design Engineer.

1. The proposed construction areas should be stripped and cleared of trees, surface vegetation, topsoil, root laden soils, debris, and any deleterious materials. All organic soils shall be excavated from the proposed construction areas. A representative from our firm should observe the exposed subgrade to verify an adequate depth of stripping and that all organic soils are removed in their entirety.

2. The exposed subgrade should be leveled sufficiently to permit equipment traffic, and then proof-rolled. Careful observations should be made during proof-rolling of the subgrade soils to identify any areas of soft yielding soils that may require over-excavation and replacement. The groundwater table should be controlled at least 2 feet below excavation and compaction surfaces.

3. Compaction should continue until a minimum density requirement of 95% of the maximum modified Proctor dry density established in accordance with ASTM D-1557, is achieved for a minimum depth of 1 foot below the exposed subgrade as determined by field density (compaction) tests.

4. Following satisfactory completion of the initial compaction of the exposed subgrade soils at the specified minimum depth, the areas may be brought up to finished subgrade levels. Fill should consist of fine sand with less than 12% passing the No. 200 sieve, free of rubble, organics, clay, debris and other unsuitable materials. Fill materials should be tested and approved prior to acquisition. Approved sand fill should be placed in loose lifts not exceeding 12 inches in thickness and should be compacted to a minimum of 95% of the maximum modified Proctor dry density (ASTM D-1557). Density tests to confirm compaction should be performed in each fill lift before the next lift is placed.

5. In-place density tests should be performed at a minimum frequency of one test per 5,000 square feet for a depth of 1 foot below exposed subgrade and for each 1-foot lift of placed fill.

6. Earthwork operations should take place under the full-time observation of a representative from Andreyev Engineering, Inc.

6.4 Stormwater Management System Recommendations

The following table summarizes our recommended parameters for design of the proposed stormwater retention ponds.

Dry Ponds (Borings PB-1, PB-4, PB-5, PB-8)

Boring No.	Bottom of Aquifer Elevation (feet)	Unsaturated Vertical Hydraulic Conductivity (ft./day)	Horizontal Hydraulic Conductivity (ft./day)	Normal Wet Season High Groundwater Table Elevation (feet)	Soil Storage Coefficient
PB-1	14.3	6	13	19.3	0.10
PB-4	15.0	7	16	20.0	0.10
PB-5	14.1	5	12	19.1	0.10
PB-8	9.1	7	16	17.1	0.10

Wet Ponds (Borings PB-2, PB-3, PB-6, PB-7, PB-9)

Boring No.	Normal Dry Season Low Groundwater Table Elevation (feet)	Normal Wet Season High Groundwater Table Elevation (feet)
PB-2	16.1	19.6
PB-3	15.5	19.5
PB-6	15.5	19.0
PB-7	14.1	17.6
PB-9	3.5 feet below existing grade	Ground Surface

6.5 Fill Suitability

The results of our borings indicate that the Strata 1 and 9 soils (slightly silty fine sand) are suitable for structural fill and general backfill provided that they are free of roots, organic matter, deleterious materials, and have a maximum fines (Pass No. 200 sieve) content of 12 percent. The silty and clayey soils (SM and SC materials) are not considered a good source of fill as they are inherently susceptible to moisture related compaction problems and have poor drainage characteristics. If the contractor elects to use these type soils as fill, we recommend that they not be used in the upper 2 feet of fill areas. Any highly plastic clayey soils shall not be used as fill. The clayey soils may be suitable for use as a stabilizing material for pavement subbase (flexible pavement section) or for pond berm design provided that they are properly compacted. The Strata 11 and 13 soils are not a suitable fill source due to their high organic content. However, those soils may be suitable for use in green areas.

6.6 Pipe Bedding

Trench excavation bottoms should be graded to provide a positive contact with the contour of the utility pipe to ensure uniform bedding for the full length of all pipes. Soft materials found in the trench excavation bottom should be removed and replaced with granular fill.

If required for stabilization purposes in localized areas, the bedding material should consist of crushed stone or No. 57 stone with not less than 95 percent passing the ½ inch sieve and not less than 95 percent retained on a U.S. Standard No. 4 sieve. It should be placed in 6-inch layers and compacted with hand held equipment.

6.7 Excavations

All excavations should be constructed in accordance with applicable local, state and federal regulations including those outlined by the Occupational Safety and Health Administration (OSHA). It is the contractor's sole responsibility for designing and constructing safe and stable excavations. Excavations should be sloped, benched or braced as required to maintain stability of the excavation sides and bottoms. Excavations should take into account loads resulting from equipment, fill stockpiles and existing construction. Any shoring needed to maintain a safe excavation should be designed by a professional engineer registered in the State of Florida in accordance with local, state and federal guidelines.

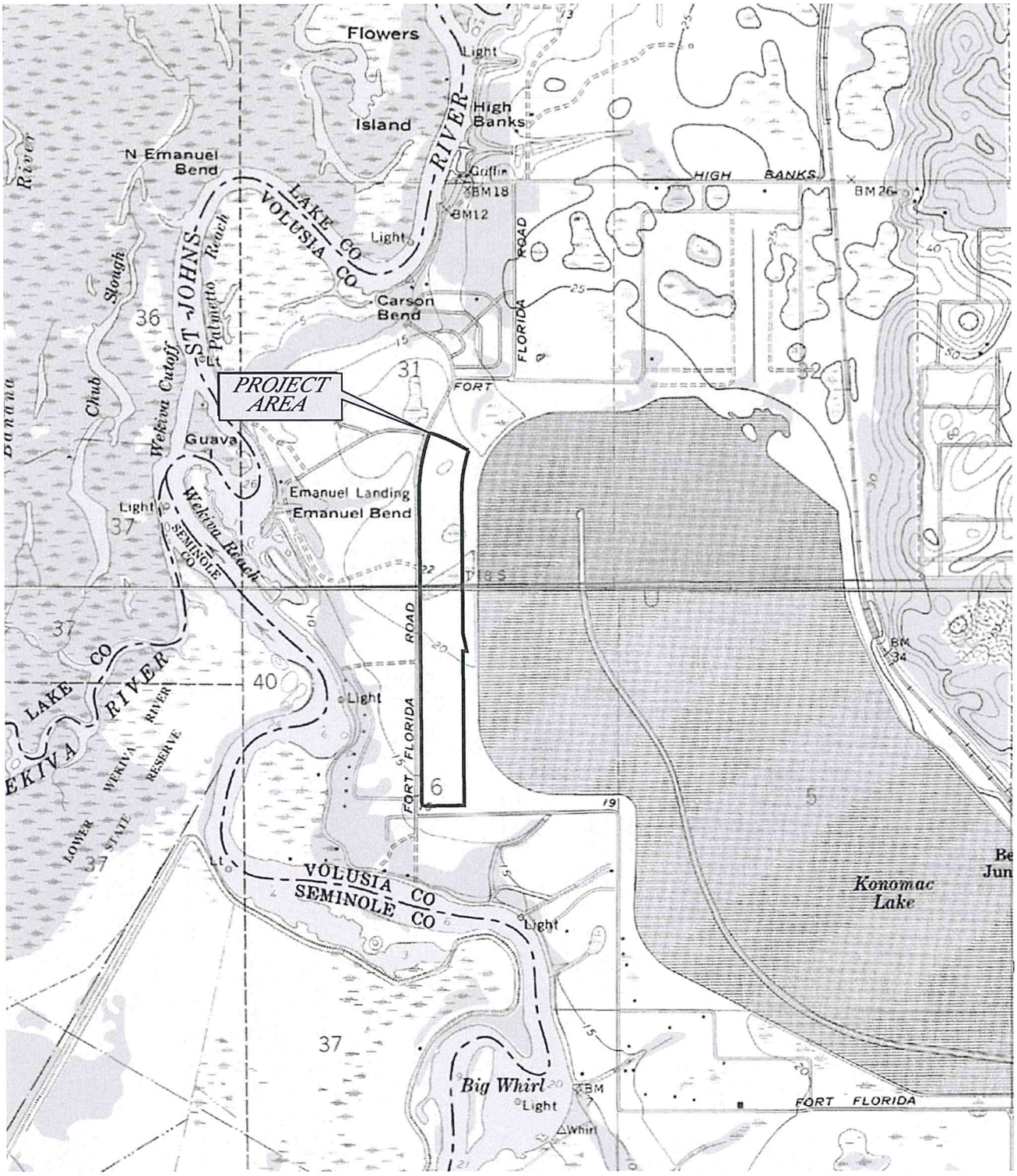
7.0 GENERAL CONDITIONS

This report has been prepared for the exclusive use of HENIN Group and its designers, based on our understanding of the project as stated in the section entitled "Site Location and Project Description". The recommendations presented in this report have been prepared in accordance with generally accepted geotechnical engineering practice. No other warranty, expressed or implied, is made as to the professional advice presented herein.

8.0 LIMITATIONS OF REPORT

The analyses and recommendations submitted in this report are based upon the anticipated location and type of construction discussed herein and the data obtained from the soil borings performed at the locations indicated, and does not reflect any variations which may occur beyond these borings. If any variations become evident during the course of construction, or if the site development plans change, a re-evaluation of the recommendations contained in this report will be necessary after we have had an opportunity to observe and evaluate the characteristics of the conditions encountered. When final design plans and specifications are available, a general review by our office is strongly recommended as a means to check that the assumptions made in preparation of this report are correct, and that earthwork recommendations are properly interpreted and implemented.

FIGURES



REFERENCE:
U.S.G.S. ORANGE CITY, FLA.
QUADRANGLE MAP
DATED 1964
PHOTOREVISED 1980
AND
U.S.G.S. ORANGE CITY, FLA.
QUADRANGLE MAP
DATED 1965
PHOTOREVISED 1988

SECTIONS 6 & 31
TOWNSHIP 18 SOUTH
RANGE 29 EAST

Andreyev Engineering, Inc.

APPROXIMATE SCALE:	DATE: 06/22/15	ENGINEER: EM
1"=2000'	PN: CPGT-15-0095	DRAWN BY: DLS

GEOTECHNICAL ENGINEERING SERVICES

RIVIERA BELLA EAST SUBDIVISION

FORT FLORIDA ROAD
DEBARY, VOLUSIA COUNTY, FL

U.S.G.S. TOPOGRAPHIC MAP

FIGURE 1

REFERENCE:
N.R.C.S. WEB SOIL SURVEY
DATA OBTAINED 6/22/2015

LEGEND:

23 FARMTON FINE SAND
29 IMMOKALEE SAND

Andreyev Engineering, Inc.

APPROXIMATE SCALE:	DATE: 06/22/15	ENGINEER: EM
1"=800'	PN: CPGT-15-0095	DRAWN BY: DLS

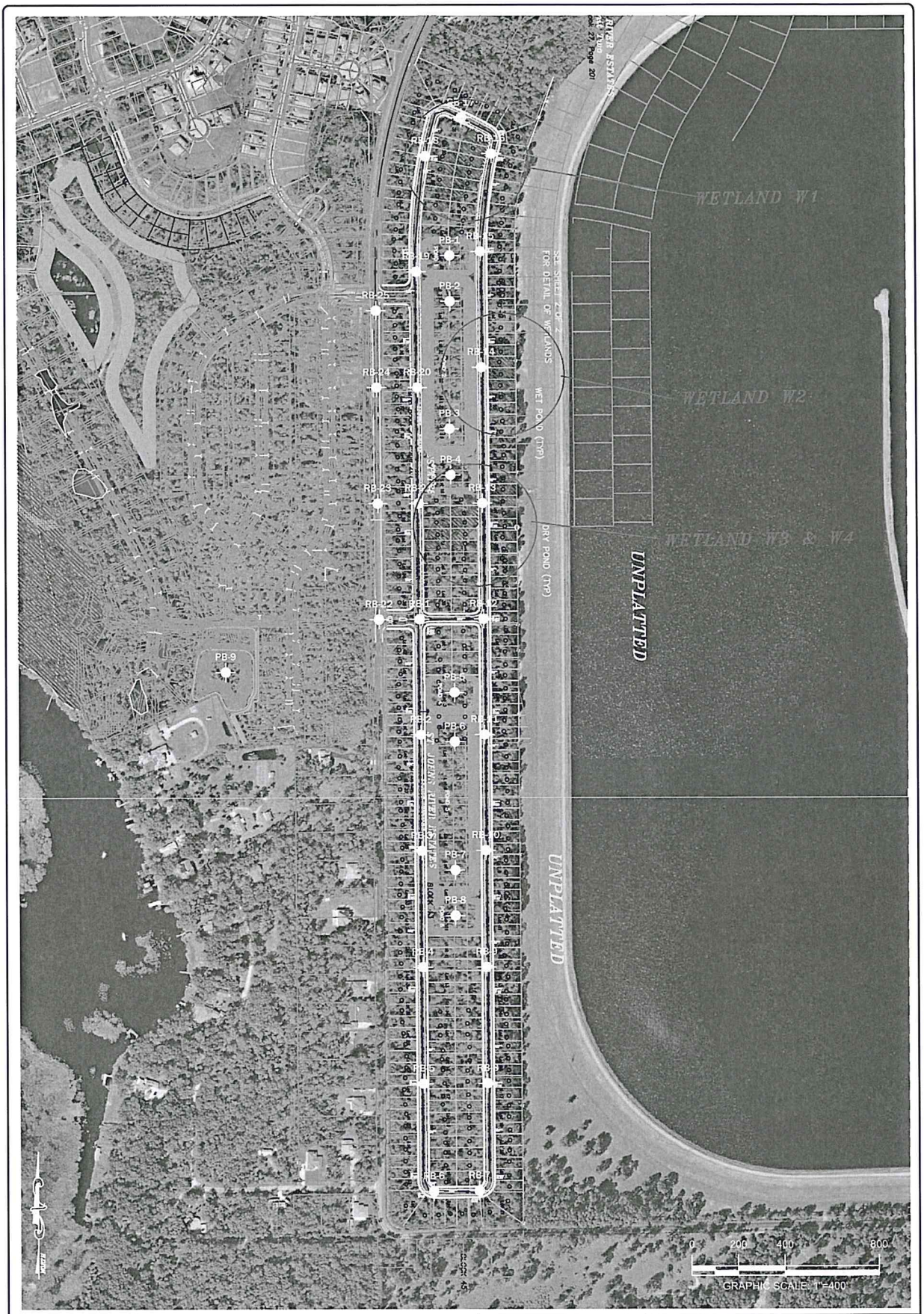
GEOTECHNICAL ENGINEERING SERVICES

RIVIERA BELLA EAST SUBDIVISION

FORT FLORIDA ROAD
DEBARY, VOLUSIA COUNTY, FL

N.R.C.S. SOIL SURVEY MAP

FIGURE 2



LEGEND:

- APPROXIMATE POND BORING LOCATION (PB–1 THROUGH PB–9)
- APPROXIMATE ROAD BORING LOCATION (RB–1 THROUGH RB–25)

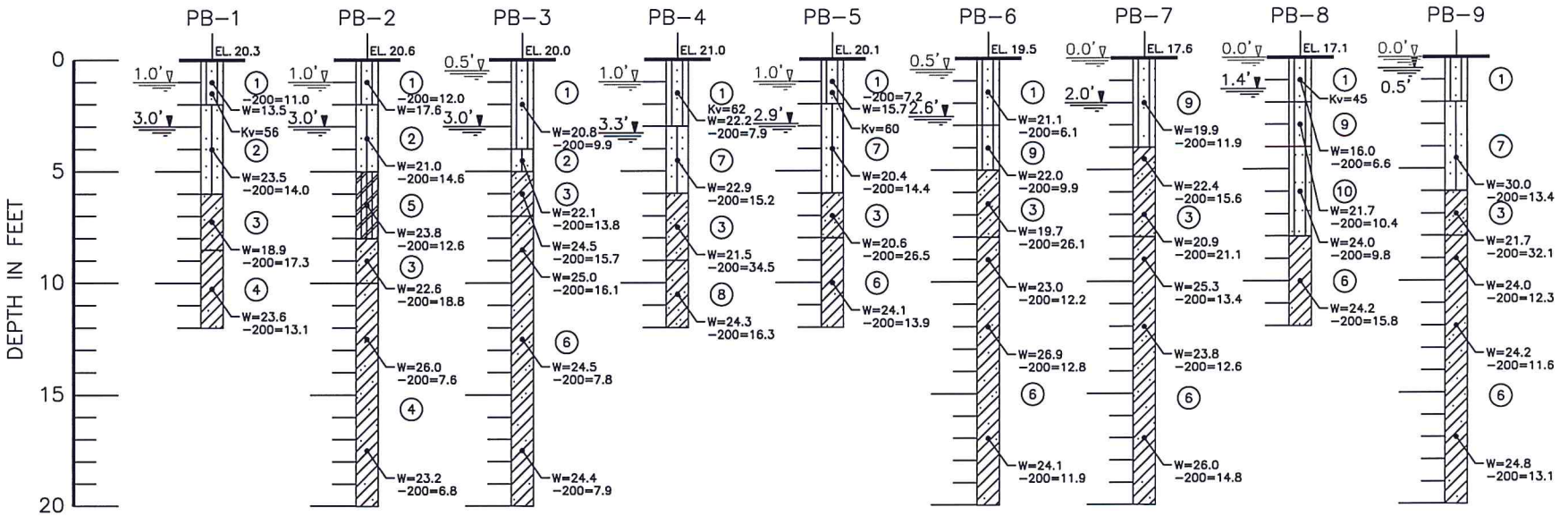
Andreyev Engineering, Inc.

APPROXIMATE SCALE:	DATE: 07/03/15	ENGINEER: EM
1"=400'	PN: CPGT–15–0095	DRAWN BY: DLS

GEOTECHNICAL ENGINEERING SERVICES
RIVIERA BELLA EAST SUBDIVISION
FORT FLORIDA ROAD
DEBARY, VOLUSIA COUNTY, FL

BORING LOCATION PLAN

FIGURE 3



LEGEND:

- (1) LIGHT GRAYISH BROWN TO GRAYISH BROWN SLIGHTLY SILTY FINE SAND (SP–SM)
- (2) DARK BROWN SILTY FINE SAND WITH CLAY (SM)
- (3) GRAYISH BROWN TO BROWN CLAYEY FINE SAND (SC)
- (4) GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND (SP–SC)(SC)
- (5) TAN SILTY TO CLAYEY FINE SAND (SM)(SC)
- (6) LIGHT GRAYISH BROWN TO GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND WITH SHELL (SP–SC)(SC)
- (7) DARK BROWN SILTY FINE SAND (SM)
- (8) GRAY CLAYEY FINE SAND (SC)
- (9) DARK BROWN SLIGHTLY SILTY FINE SAND (SP–SM)
- (10) BROWN SLIGHTLY SILTY TO SILTY FINE SAND (SP–SM)(SM)
- (11) DARK GRAYISH BROWN SLIGHTLY SILTY FINE SAND WITH ORGANICS & ROOTS (SP–SM)
- (12) GRAYISH BROWN SLIGHTLY SILTY FINE SAND WITH SHELL (SP–SM)
- (13) DARK BROWN MUCK WITH ROOTS (PT)

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

1.0▽ DEPTH TO GROUNDWATER, JUNE/JULY, 2015

1.0▽ ESTIMATED NORMAL WET SEASON GROUNDWATER DEPTH

W MOISTURE CONTENT, IN PERCENT

-200 PERCENT OF FINES PASSING THE U.S. No. 200 SIEVE

Kv VERTICAL COEFFICIENT OF PERMEABILITY, IN FEET PER DAY

EL GROUND ELEVATION AT BORING LOCATION (FT)

Andreyev Engineering, Inc.

GEOTECHNICAL ENGINEERING SERVICES

RIVIERA BELLA EAST SUBDIVISION

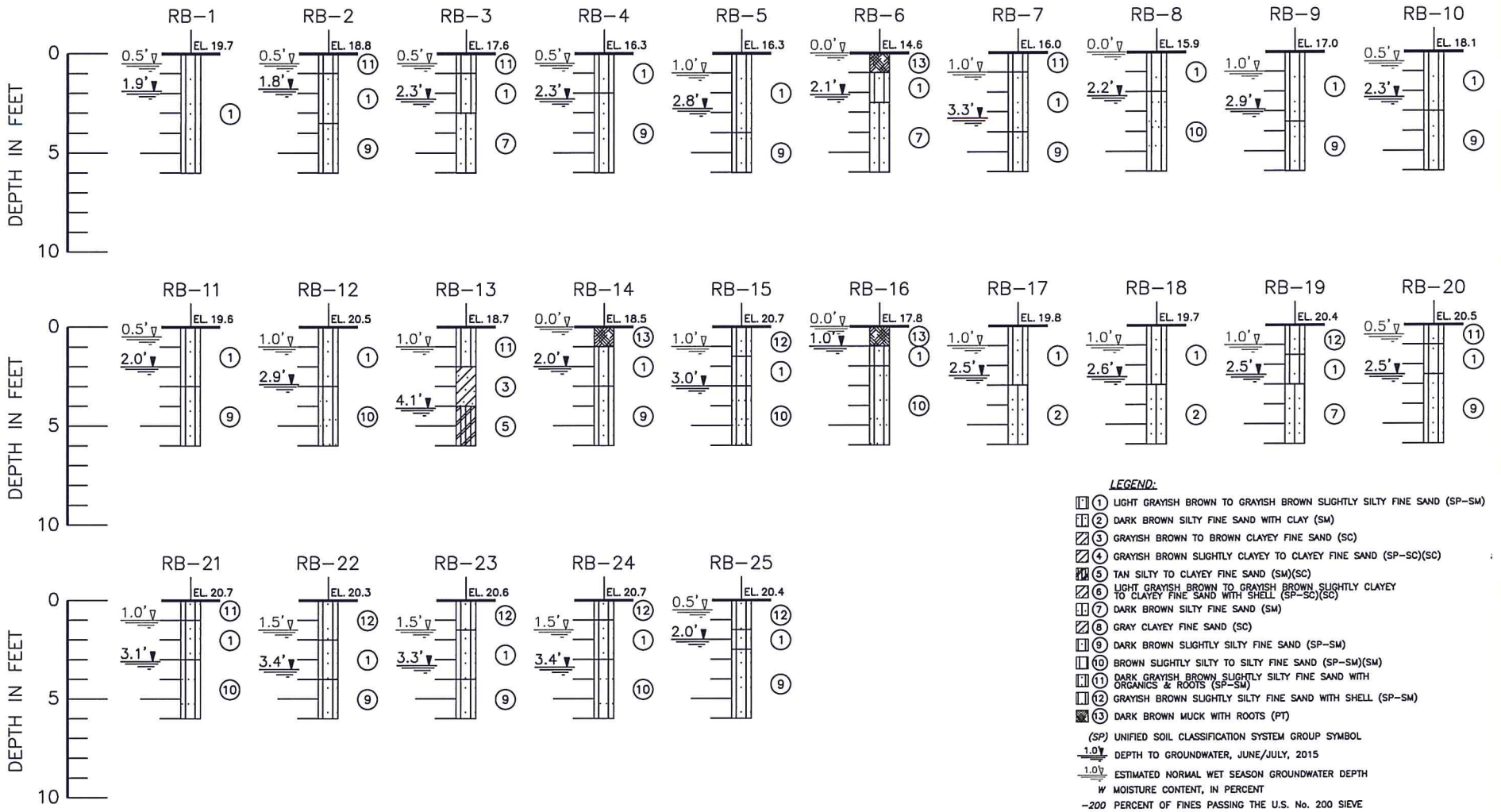
FORT FLORIDA ROAD

DEBARY, VOLUSIA COUNTY, FL

SOIL PROFILES

APPROXIMATE SCALE:	DATE: 07/30/15	ENGINEER: EM
1"=5'	PN: CPGT-15-0095	DRAWN BY: DLS

FIGURE 4



LEGEND:

1. LIGHT GRAYISH BROWN TO GRAYISH BROWN SLIGHTLY SILTY FINE SAND (SP-SM)
2. DARK BROWN SILTY FINE SAND WITH CLAY (SM)
3. GRAYISH BROWN TO BROWN CLAYEY FINE SAND (SC)
4. GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND (SP-SC)(SC)
5. TAN SILTY TO CLAYEY FINE SAND (SM)(SC)
6. LIGHT GRAYISH BROWN TO GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND WITH SHELL (SP-SC)(SC)
7. DARK BROWN SILTY FINE SAND (SM)
8. GRAY CLAYEY FINE SAND (SC)
9. DARK BROWN SLIGHTLY SILTY FINE SAND (SP-SM)
10. BROWN SLIGHTLY SILTY TO SILTY FINE SAND (SP-SM)(SM)
11. DARK GRAYISH BROWN SLIGHTLY SILTY FINE SAND WITH ORGANICS & ROOTS (SP-SM)
12. GRAYISH BROWN SLIGHTLY SILTY FINE SAND WITH SHELL (SP-SM)
13. DARK BROWN MUCK WITH ROOTS (PT)

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

1.0' DEPTH TO GROUNDWATER, JUNE/JULY, 2015

1.0' ESTIMATED NORMAL WET SEASON GROUNDWATER DEPTH

W MOISTURE CONTENT, IN PERCENT

-200 PERCENT OF FINES PASSING THE U.S. No. 200 SIEVE

EL GROUND ELEVATION AT BORING LOCATION (FT)

Andreyev Engineering, Inc.

GEOTECHNICAL ENGINEERING SERVICES

RIVIERA BELLA EAST SUBDIVISION

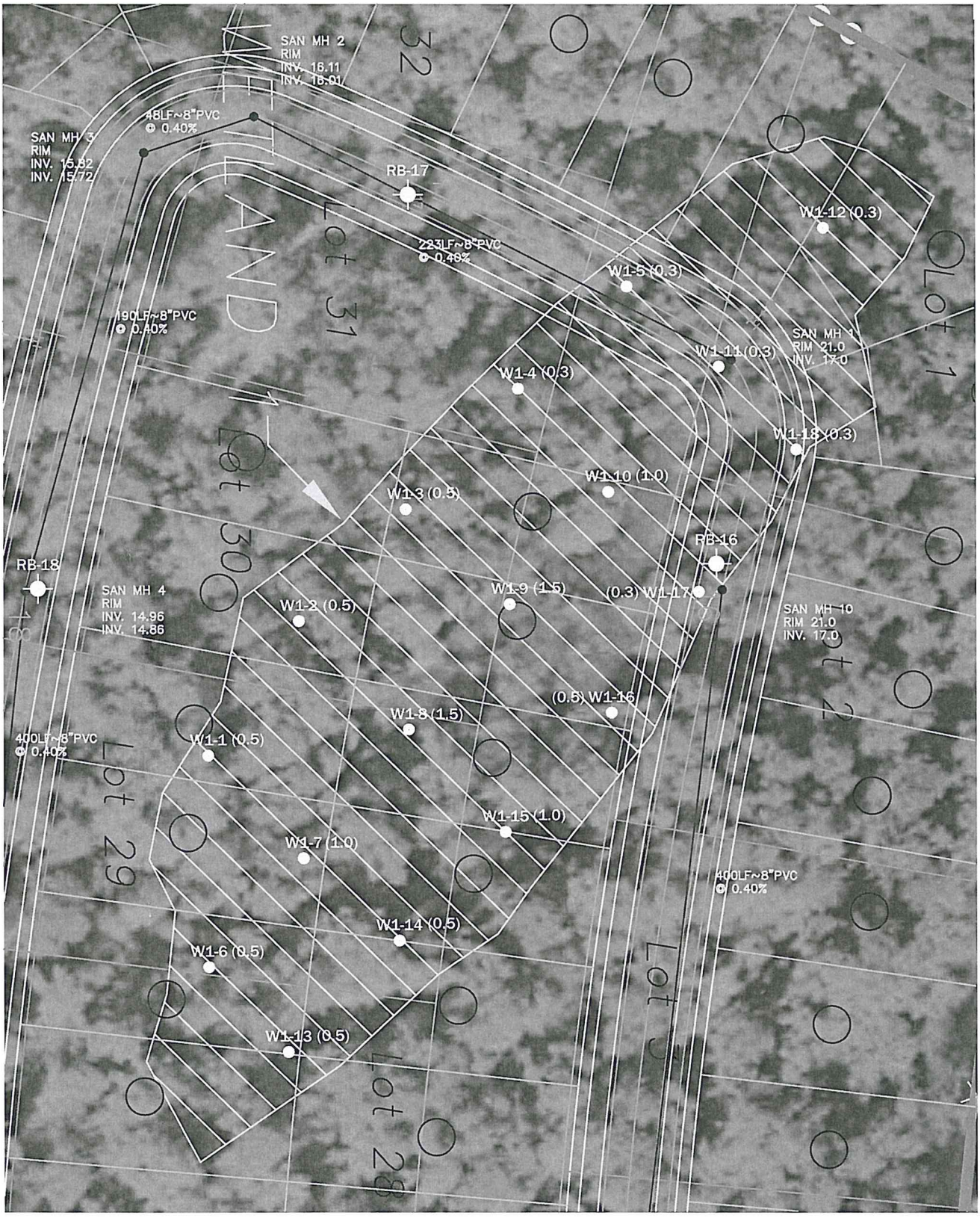
FORT FLORIDA ROAD

DEBARY, VOLUSIA COUNTY, FL

APPROXIMATE SCALE:	DATE: 07/30/15	ENGINEER: EM
1"=5'	PN: CPGT-15-0095	DRAWN BY: DLS

SOIL PROFILES

FIGURE 5



LEGEND:

- ● APPROXIMATE LOCATION OF MUCK PROBE
- (0.3) MUCK/ORGANIC SAND THICKNESS (IN FEET)

Andreyev Engineering, Inc.

GEOTECHNICAL ENGINEERING SERVICES

RIVIERA BELLA EAST SUBDIVISION

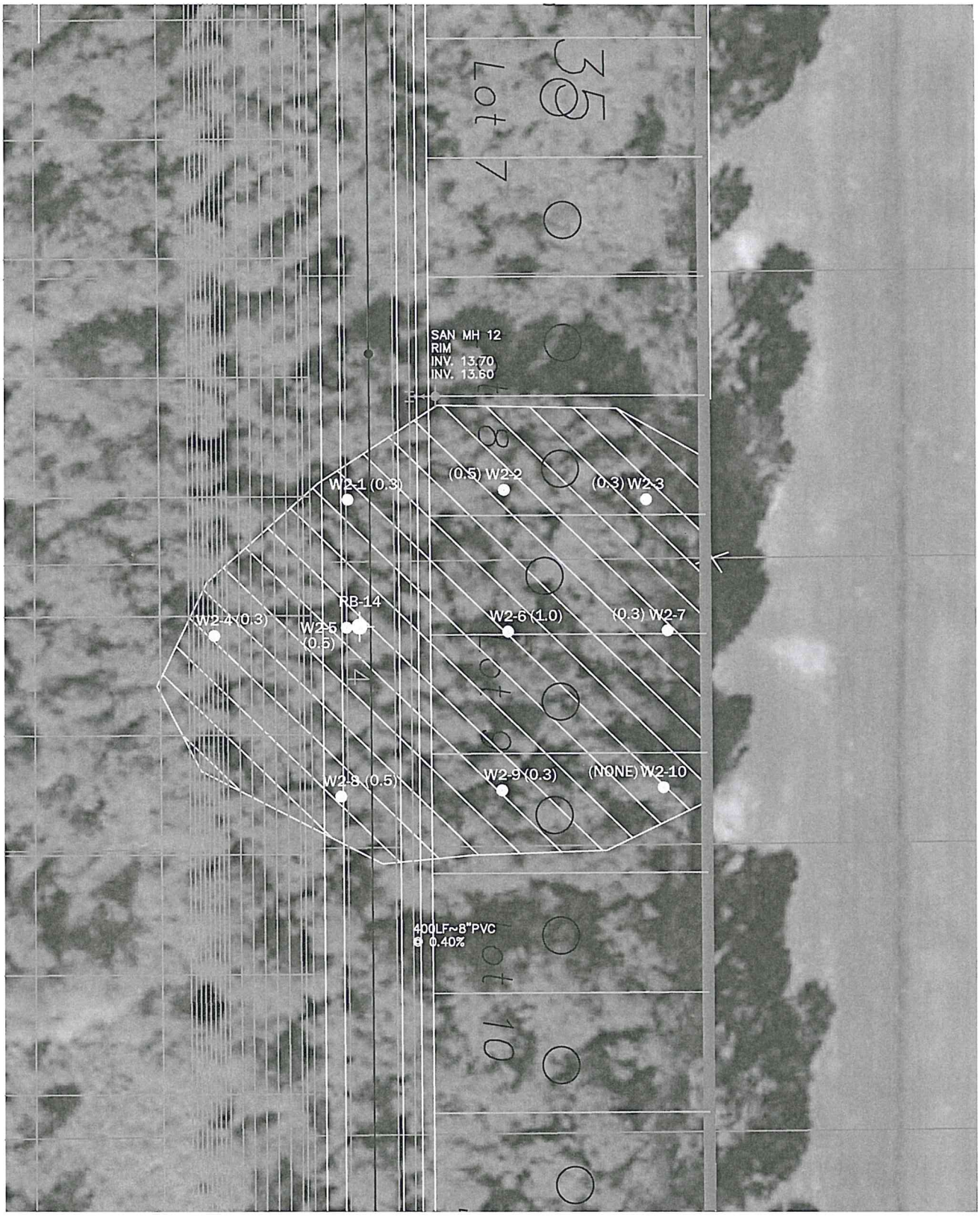
FORT FLORIDA ROAD

DEBARY, VOLUSIA COUNTY, FL

MUCK PROBE LOCATION PLAN
WETLAND W1

APPROXIMATE SCALE:	DATE: 07/27/15	ENGINEER: EM
1"=60'	PN: CPGT-15-0095	DRAWN BY: DLS

FIGURE 6



LEGEND:

- ● APPROXIMATE LOCATION OF MUCK PROBE
- (0.3) MUCK/ORGANIC SAND THICKNESS (IN FEET)

Andreyev Engineering, Inc.

GEOTECHNICAL ENGINEERING SERVICES

RIVIERA BELLA EAST SUBDIVISION

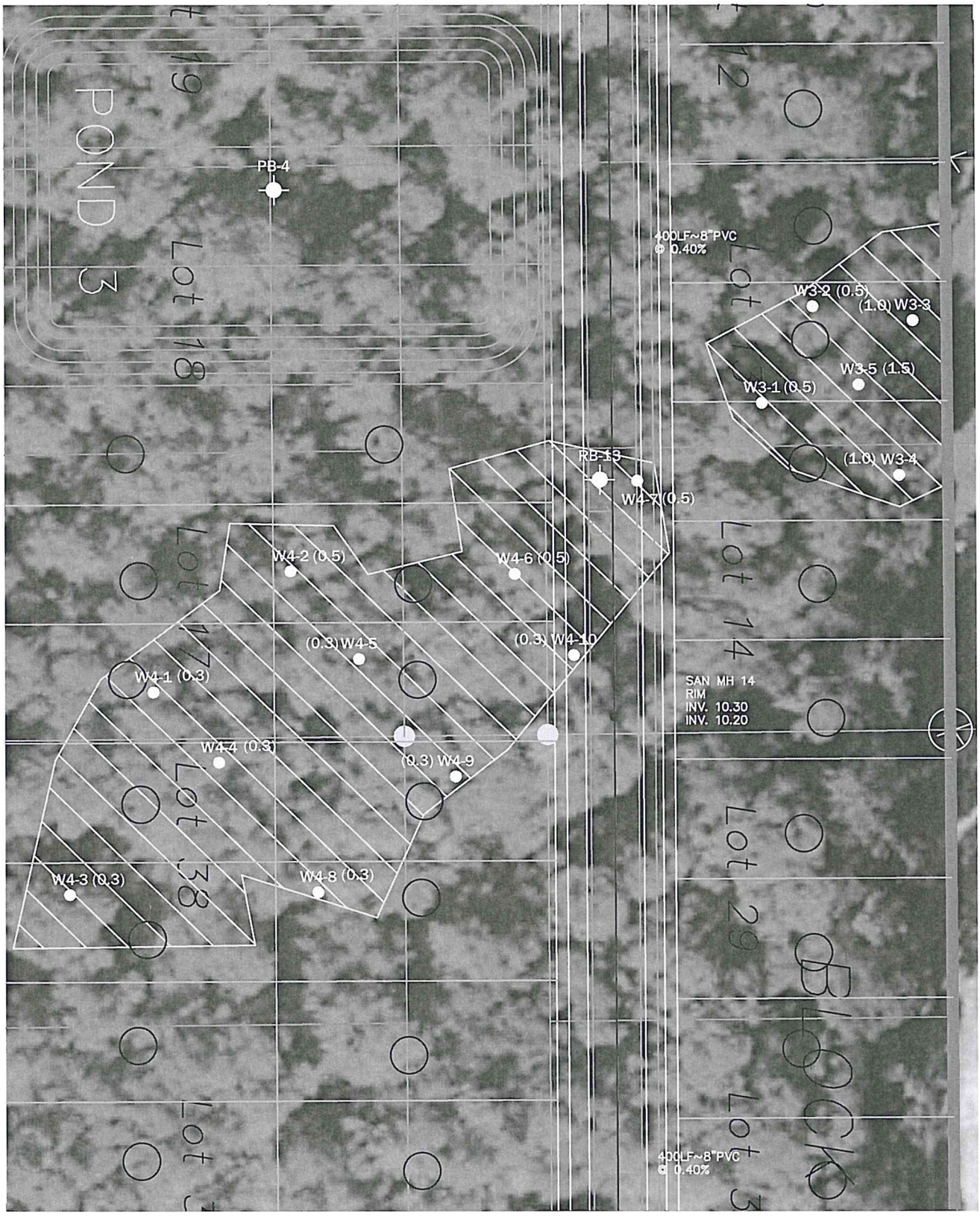
FORT FLORIDA ROAD

DEBARY, VOLUSIA COUNTY, FL

MUCK PROBE LOCATION PLAN
WETLAND W2

APPROXIMATE SCALE:	DATE: 07/27/15	ENGINEER: EM
1"=60'	PN: CPGT-15-0095	DRAWN BY: DLS

FIGURE 7



LEGEND:

- ● APPROXIMATE LOCATION OF MUCK PROBE
- (0.3) MUCK/ORGANIC SAND THICKNESS (IN FEET)

Andreyev Engineering, Inc.

APPROXIMATE SCALE:	DATE: 07/27/15	ENGINEER: EM
1"=60'	PN: CPGT-15-0095	DRAWN BY: DLS

GEOTECHNICAL ENGINEERING SERVICES

RIVIERA BELLA EAST SUBDIVISION

FORT FLORIDA ROAD

DEBARY, VOLUSIA COUNTY, FL

MUCK PROBE LOCATION PLAN
WETLAND W3 & W4

FIGURE 8

Appendix D

The Geotechnical Report from GEO, which will address Base Flow, Underdrain Design and additional recovery analysis will be submitted with final construction plans.

Appendix E

Ecological Consulting Solutions, Inc.

April 27th, 2015

Mr. Jerome Henin
President
HENIN Group
2300 Lee Road
Winter Park, FL 32789

Re: Fort Florida Road Property
Volusia County, FL
ECS Project No. 010.04.15

Dear Jerome:

On February 15th and 17th, 2006 and April 24th and 27th, 2015, a listed species survey was conducted on the above referenced project site. The project site is located adjacent to Fort Florida Road on the southern and western boundaries and south of Konomac Lake Drive. The site borders Lake Konomac on the eastern boundary. More specifically the project site is located at Section 31, Township 18 South and Range 30 East in Volusia County, Florida.

Historically this land has been an undeveloped forest. Currently, the majority of the property is densely forested without any access roads or trails. A deep roadside ditch prevents vehicular access to the property along the west side. The eastern boundary is fenced. Along the northern end of the project site there is a medium-quality forested wetland. There are also two more medium-quality forested wetlands in the center of the property.

A survey of the project boundaries was conducted to assess the potential occurrence of flora and fauna listed as threatened or endangered by the United States Fish and Wildlife Service (USFWS), Florida Fish and Wildlife Conservation Commission (FWC), and the Florida Department of Agriculture (FDA). Tables 1 and 2 provide a listing of the species known to occur within Volusia County and their expected occurrence of the project site. The findings and conclusions of the survey are reported in this letter.

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235 Hunt Club Blvd., Suite 202
Longwood, FL 32779
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Tampa Office
419 W. Platt St., Suite 103
Tampa, FL 33606
Phone: (813) 254-5959

The survey was conducted by Ecological Consulting Solutions Inc (ECS) for the purpose of evaluating the site for the presence or absence of wetland habitat and protected flora and fauna or their habitat. The survey was conducted by means of pedestrian transects in the early morning to assure the potential of observing listed fauna as recommended by the FWC and the USFWS.

The following resources were used for supporting information during the site assessment and letter preparation:

- Color aerial photographs (1" = 300), 2015, Google Earth, Volusia County, Florida.
- United States Geological Survey (USGS) 7.5 minute quadrangle map, Volusia County, Florida, (ArcGIS).
- Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida (USFWS and FWC).

Pedestrian and vehicular surveys of the project site were conducted in order to qualitatively document the existing vegetation and to assess the present land use patterns according to the Florida Land Use, Cover and Forms Classification System, Department of Transportation (FLUCFCS; DOT 1999). Two land use types are present. A brief description of each FLUCFCS community is provided below.

414 – Pine Mesic Oak

This upland habitat dominates the entire subject site. This land type is usually found on moister sites where slash, longleaf, and loblolly pine grow in strong association with a wide variety of mesic oaks and other mesic hardwood species. Tree vegetation was dominated by slash pine (*Pinus elliottii*), loblolly pine (*Pinus echinata*), water oak (*Quercus nigra*), laurel oak (*Quercus hemisphaerica*), and dahoon holly (*Ilex cassine*). Understory vegetation was dominated by dense saw palmetto (*Serona repens*) with gallberry (*Ilex galbra*), wax myrtle (*Myrica cerifera*) and cat brier (*Smilax spp.*). The groundcover is sparse due to the thick pine needle and oak duff.

6201 – Wetland Coniferous Forest, canopy less than 30% crown

This wetland coniferous forest is a wetland which meets the crown closure requirements of less than 30% closure. These communities are usually found as interior wetlands in river flood plains with little to no standing water. The three onsite wetlands have a dominant canopy of slash pine, forming a cover of about 15%. Other tree species associated with the canopy vegetation include pond pine (*Pinus serotina*), dahoon holly, red bay (*Persea borbonia*), loblolly bay (*Gordonia lasianthus*), red maple (*Acer rubrum*), water oak, cabbage palm (*Sabal palmetto*), and scattered examples of sweetgum (*Liquidambar styraciflua*) and American elm (*Ulmus americana*). Understory vegetation is dominated by cordgrass (*Spartina alterniflora*) and sawgrass (*Cladium jamaicense).* Other understory vegetation includes soft rush (*Juncus spp.),* chain fern (*Woodwardia virginica*), gallberry, cat brier, and sphagnum moss (*Sphagnum cymbifolium*). These wetlands had a distinct saw palmetto edge.

Listed Species Survey

A survey was conducted using pedestrian transects throughout the site to assess the occurrence, or potential for occurrence, of flora and fauna listed as threatened, endangered, or as species of special concern (SSC) by the Florida Fish and Wildlife Conservation Commission (FWC), United States Fish and Wildlife Service (USFWS), and Florida Department of Agriculture (FDA).

Birds

Approximately 35 species (and sub-species) of birds found in Florida are protected by the FWC and/or the USFWS. For Volusia County, the USFWS federally lists 5 bird species. Overall, about fifteen (15) are expected to occur in central Florida. No listed birds were observed at this site (Table 1).

Florida scrub jays (*Aphelocoma c. coerulescens)* were not observed on the project site. This species is listed as threatened at the state and federal levels. The property does not contain scrub habitat. Surveys were conducted for this species per the guidelines outlined in the *Ecology & Development-Related Habitat Requirements of the Florida Scrub Jay (April 1991).* No scrub jays were observed or vocalizations heard.

Red-cockaded woodpeckers (*Picoides borealis*) are endangered (USFWS) and endangered (FWC). No red-cockaded woodpeckers were observed and the upland habitat type is not suitable. There were no open pine flatwoods with old-growth pines that characterize RCW nesting and foraging habitat.

Listed wading birds such as limpkin (*Aramus guarauna),* snowy egret (*Egretta thula),* tricolored heron (*Egretta tricolor)* white ibis (*Eudocimus albus)* and the wood stork *(Mycteria americana)* were not observed. The lack of open water habitat within the onsite wetlands greatly reduces the possibility of any of these listed birds utilizing the project site. No listed wading birds were observed onsite.

Bald eagles (*Haliaeetus leucocephalus*) or their nests were not observed on the site. Bald eagles are protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The USFWS has established a 660 foot protection zone around a bald eagle nest.

ECS searched the FWC website to determine if any documented bald eagle nests are within 660 feet of the project site. There are no bald eagle nests in close proximity to the project site. The closest bald eagle nest is VO124 which is located over 2,000 feet to the south of the subject site. Therefore the project site is well outside of the 660 foot eagle nest protection zone and the development will not affect any bald eagle nests.

No other listed raptors such as Southeastern American kestrels (*Falco sparverius paulus*) or Arctic peregrine falcons (*Falco peregrinus tundrius*) were observed on or around the site. There is little foraging habitat for kestrels. No birds were observed on or offsite at the time of the survey.

Amphibians and Reptiles

About thirty (30) species of Florida's amphibians and reptiles are protected. For Volusia County, the USFWS federally lists 7 reptile species. Only a few could occur on this site.

The property does not contain open sandy ridge habitat for the presence of sand skinks (*Neoseps reynoldsi).* The known range of this species is west of the project site.

A cursory survey was conducted throughout the property for gopher tortoises (*Gopherus polyphemus)*, a species listed by the FWC as a Threatened. No gopher tortoise burrows were observed. The upland portion of the property is overgrown and does not provide suitable habitat for gopher tortoises.

Several commensal species associated with gopher tortoise burrows, including the gopher frog (*Rana areolata aesopus)* and eastern indigo snake (*Drymarchon corais couperi)* also receive protection, but were notobserved.

Eastern Indigo Snake

Concerning the eastern indigo snake, ECS conducted survey transects to identify potential above-ground and underground refugia which eastern indigo snakes may inhabit. Underground refugia includes active or inactive gopher tortoise burrows, mammal burrows, hollows at the base of trees and other similar formations. Above ground refugia includes thick shrub formations, stumps, the base of thick palmetto, ground litter, brush piles, trash piles, and abandoned structures, and crevices of rock-lined ditch walls and other similar refugia. Surveys for eastern indigo snakes are recommended by the USFWS during the time period of October 01st through April 30th. There were little suitable refugia for the eastern indigo snake onsite. No eastern indigo snakes were observed.

The USFWS requires the developer to notify the local field office via email at least **30 days prior** to any clearing/land alteration activities.

Mammals

Thirty-three (33) mammals are currently protected in Florida. For Volusia County, the USFWS federally lists one mammal species. About four could occur in the region of this project site. None were observed on this site. We focused our search on fox squirrels (*Sciurus niger shermani*) and the Florida mouse (*Podomys floridanus)* and their possible den or nest sites. We did not observe any listed mammals or their potential den sites.

Listed Plants

There were no protected plant species found on the project site (Table 2). Protected plants are not expected to occur on the property since the uplands are pine flatwoods that are periodically timbered. Currently, there are no technical reports available by the state or federal agencies mentioned in this letter report for the survey of the nearly 400 protected plant species. None of the agencies require relocation or mitigation for protected plant species.

The Department of Agriculture and Consumer Services (DACS) designates and regulates plants listed as "endangered", "commercially exploited" and "threatened". There is no statutory prohibition against a landowner from harvesting an endangered or threatened plant from his property.

However, it is unlawful for an individual to harvest an endangered or threatened species from the private land of another or any public land without first obtaining written permission of that landowner and a permit from DACS. Additionally, harvesting three or more commercially exploited plants from the private land of another or any public land will also require a DACS permit.

Summary

In summary, no listed animal or plant species were observed within the Fort Florida property.

During the listed species surveys, ECS did conduct visual observation for historic trees and these observations were consistent with the City of DeBary LDC tree preservation and protected species requirements.

Ecological Consulting Solutions Inc. appreciates the opportunity to provide you with our services. Should you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

ECOLOGICAL CONSULTING SOLUTIONS INC

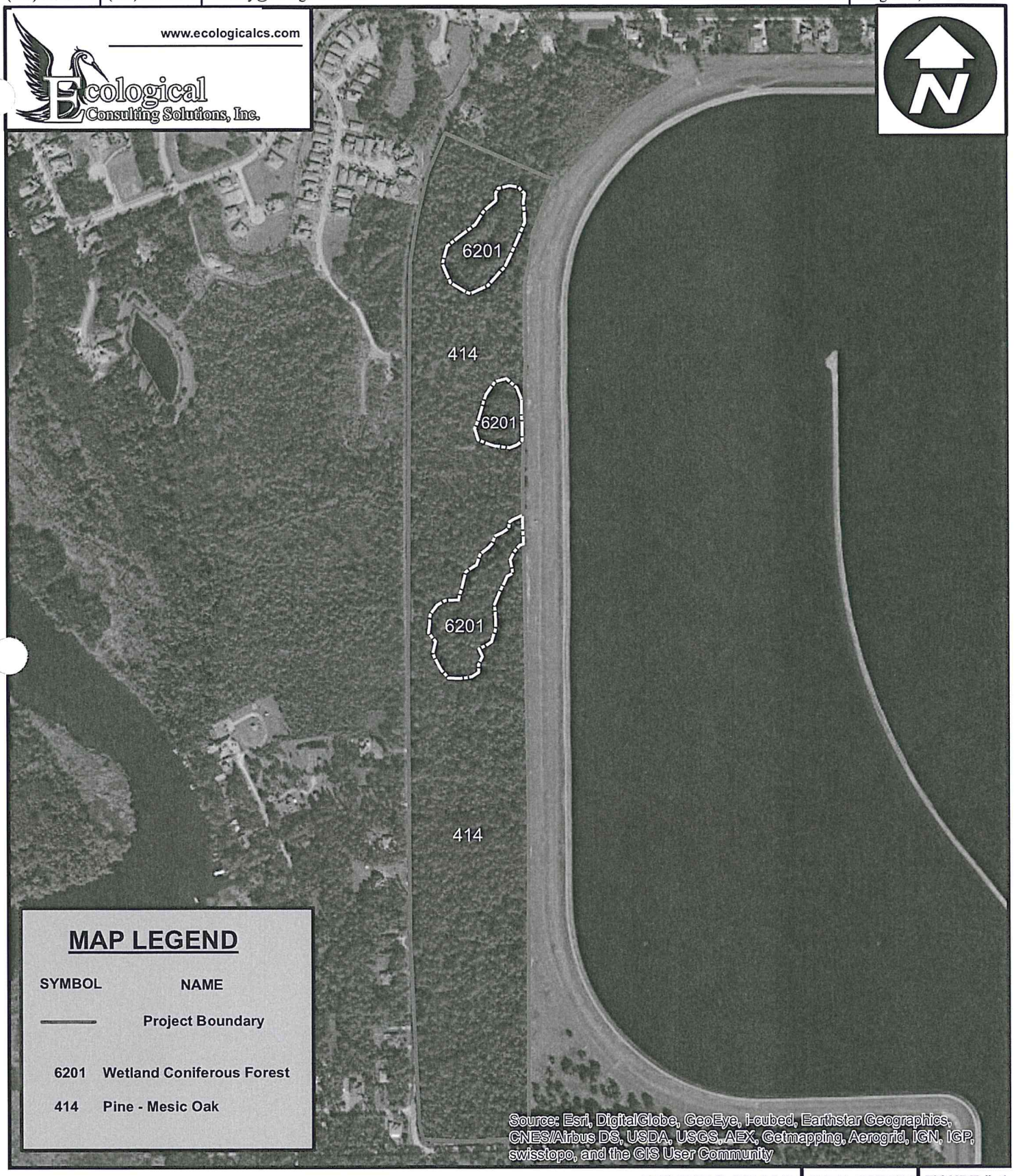
Bill Griffy

Attachments

Office #: (407) 869-9434 | Fax #: (407) 869-9436 | Email: BGriffy@ecologicalcs.com
235 Hunt Club Blvd. Suite 202 | Longwood, Florida 32779

www.ecologicalcs.com

Ecological Consulting Solutions, Inc.



PROJECT #: 010.04.15 | DATE: 04/27/15 | FIGURE #: 1

0 310 620 1,240 1,860 2,480 Feet

FORT FLORIDA PROPERTY
VOLUSIA COUNTY, FLORIDA
FLUCFCS MAP

TABLE 1: PROTECTED FAUNA FOUND IN VOLUSIA COUNTY, FLORIDA AND THEIR EXPECTED OCCURRENCE ON THE FORT FLORIDA ROAD PROPERTY.

SPECIES	FWC STATUS (1)	USFWS STATUS (2)	PREFERRED HABITAT (3)	PROBABILITY OF OCCURRENCE (4)
REPTILES				
Drymarchon corais couperi Eastern indigo snake	T	T	Dry habitats bordered by water; often occupy *G. polyphemus* burrows	Low: some habitat available, gopher tortoise burrows not observed
Gopherus polyphemus Gopher tortoise	SSC	_	Well drained soil; xeric pine-oak hammocks and scrub; pine flatwoods	Low: little habitat available, no burrows observed
Neoseps reynoldsii Sand Skink	T	T	Well drained sandy soil, open areas, sand pine-rosemary scrub	Low: habitat not available, none sighted, outside of known range
Pituophis melanoleucus mugitus Florida pine snake	SSC	_	Dry, sandy barrens in xeric oak and pine-wooded sandhills	Low: habitat not present, none observed
Stilosoma extenuatum Short-tailed snake	T	_	Sandy upland ridges; xeric oak pine woods; xeric oak hammocks	Low: habitat not present, none sighted
AMPHIBIANS				
Rana areolata aesopus Florida gopher frog	SSC	-	Dry, xeric habitats with wetlands such as isolated permanent ponds and cypress domes	Low: no habitat available, gopher tortoise burrows not observed
BIRDS				
Aphelocoma coerulescens Florida scrub jay	T	T	Level, sterile, white sand with low, xeric oak scrub	Low: scrub not available on site, none sighted
Aramus guarauna Limpkin	SSC	_	Densely vegetated swamps, lakeshores and slow streams	Low: open water habitat not available on site, none sighted
Egretta caerulea Little blue heron	SSC	_	Lake littorus; shallow ponds and marshes	Low: foraging habitat not available, no birds sighted
Egretta thula Snowy egret	SSC	_	Lake littorus; shallow ponds and marshes	Low: foraging habitat not available, no birds sighted

TABLE 1: PROTECTED FAUNA FOUND IN VOLUSIA COUNTY, FLORIDA AND THEIR EXPECTED OCCURRENCE ON THE FORT FLORIDA ROAD PROPERTY.

SPECIES	FWC STATUS (1)	USFWS STATUS (2)	PREFERRED HABITAT (3)	PROBABILITY OF OCCURRENCE (4)
BIRDS (cont..)				
Egretta tricolor Tricolored heron	SSC	_	Lake littorus; shallow ponds and marshes	Low: foraging habitat not available, none sighted
Eudocimus albus White ibis	SSC	-	Beaches, mudflats, wet fields and prairies, forested wetlands and marshes	Low: foraging habitat not available, none sighted
Falco peregrinus tundrius Peregrine falcon	E	_	Coastal beaches, prairies, and marshes	Low: no habitat available, none sighted.
Falco sparverius paulus Southeastern American kestrel	T	_	Forest edges, and clearings; nests in mature pines	Low: no habitat available, none sighted
Grus canadensis pratensis Florida sandhill crane	T	_	Marshes, wet prairies, pastures, and open herbaceous rangeland	Low: no habitat available, no birds sighted
Haliaeetus leucocephalus Bald eagle	T	T	Open (<60% canopy cover), mature pine forests < 2 km from expansive open waters	Low: habitat not available, no nests or birds sighted
Mycteria americana Wood stork	E	E	Nests is cypress swamps; forage sites range from shallow marshes to roadway borrow pits	Low: foraging habitat not available, none sighted
Picoides borealis Red-cockaded Woodpecker	E	E	Old-growth pine flatwoods with regular fire occurrence are required for nesting	Low: habitat not available, none sighted
MAMMALS				
Podomys floridanus Florida mouse	SSC	_	Sand pine scrub; xeric oak-pine flatwoods; often associated with *G. polyphemus* burrows	Low: habitat not present, none sighted
Sciurus niger shermani Sherman's fox squirrel	SSC	_	Mature flatwoods of sandhills; occasional in tall cypress-bay forests	Low: little habitat available, none sighted
Ursus americanus floridanus Florida black bear	T	_	Nearly-impenetrable wooded thickets and swamps	Low: habitat available, none sighted

Footnotes to Table 1

1 FWC - Florida Fish and Wildlife Conservation Commission, formerly the Florida Game and Fresh Water Fish Commission; Official Lists of Florida's Endangered Species, Threatened Species and Species of Special Concern, published August 1997.

2 USFWS – United States Fish and Wildlife Service; List obtained from FWC's Florida's Endangered Species, Threatened Species and Species of Special Concern, published August 1997.

(E-endangered, T-threatened, SSC-species of special concern, CE-commercially exploited). C1 (candidate for federal listing, with enough substantial information on biological vulnerability and threats to support proposals for listing) and C2 (candidate for listing, with some evidence of vulnerability, but for which not enough data exists to support listing) are no longer official categories.

3 Habitats described by:

Ashton, R.E. and P.S. Ashton. 1985 Handbook of Reptiles and Amphibians of Florida (3 vols.). Windward Publ. Inc. Miami.
Conant, R. 1975 A Field Guide to Reptiles and Amphibians of Eastern/Central North America (2nd ed.). Houghton Mifflin Co. Boston 430 pp.
Kale, H.W. 1978. Volume Two; Birds. In P.C.H. Pritchard (ed.), Rare and Endangered Biota of Florida. University Presses of Florida. Gainesville. 121 pp.
Kale, H.W. and D.S. Maehr. 1990. Florida's Birds: A Handbook and Reference. Pineapple Press. Sarasota. 288 pp.
Layne, L.N. 1978 Volume One: Mammals. In P.C.H. Pritchard (ed.), Rare and Endangered Biota of Florida. University Presses of Florida. Gainesville, 52 pp.
McLane, W.M. 1985. The Fishes of the St. Johns River, Florida. Ph.D. diss. University of Florida, Gainesville. 361 pp.
Peterson, R.T. 1980. A Field Guide to the Birds of East of the Rockies (4th ed.). Houghton Mifflin Co. Boston. 384 pp.

4 Likelihood of occurrence: Low, Moderate or High, based on the best available data and selective field observations.

TABLE 2: PROTECTED FLORA FOUND IN VOLUSIA COUNTY, FLORIDA AND THEIR EXPECTED OCCURRENCE ON THE FORT FLORIDA ROAD PROPERTY.

SPECIES	FDA STATUS (1)	USFWS STATUS (2)	PREFERRED HABITAT (3)	PROBABILITY OF OCCURRENCE (4)
Calopogon barbatus Bearded grass pink	T	_	Damp pinelands	Low: habitat not available, none found
Calopogon multiflorus Many-flowed grass pink	E	_	Open, damp, occasionally recently burned pinelands and meadows	Low: habitat not available, none found
Deerinfothamnus rugelii Rugel's pawpaw	E	E	Mesic flatwoods	Low: habitat not available, none found
Encyclia tampensis Butterfly orchid	CE	_	Cypress swamps, hardwood swamps and hammocks	Low: habitat available, none found
Epidendrum conopseum Greenfly orchid	CE	_	Cypress swamps, hardwood swamps and hammocks	Low: habitat available, none found
Hartwrightia floridiana Florida Hartwrightia	T	_	Wet, open areas, moist grasslands, and sphagnum bogs	Low: no habitat available, none found
Lilium catesbaei Southern red lily	T	_	Mesic flatwoods, wet prairies, usually in graminoid systems	Low: no habitat available, none found
Listera australis Southern tway blade	T	_	Hammocks, low moist woods in deep humus, ravines, shady stream banks, sphagnum	Low: habitat not available, none found
Nemastylis floridana Fall-flowering ixia	E	_	Marshes; grassy openings of wet hammocks moist flatwoods	Low: no habitat available, none found
Platanthera blephariglottis Large white fringed orchid	T	_	Inhabits sphagnum bogs, meadows, damp fields and woods	Low: no habitat available, none found
Platanthera cristata Golden fringed orchid	T	_	Low moist meadows and damp pine woods	Low: habitat available, none found
Platanthera flava Southern tubercled orchid	T	_	Very wet habitats such as swamps, bogs and wet forests with thick, black mud	Low: habitat available, none found

TABLE 2: PROTECTED FLORA FOUND IN VOLUSIA COUNTY, FLORIDA AND THEIR EXPECTED OCCURRENCE ON THE FORT FLORIDA ROAD PROPERTY.

SPECIES	FDA STATUS (1)	USFWS STATUS (2)	PREFERRED HABITAT (3)	PROBABILITY OF OCCURRENCE (4)
Platanthera integra Southern yellow fringeless orchid	E		Marshes and wet pine flatwoods	Low: no habitat available, none found
Platanthera nivea Snowy orchid	T	_	Open bogs and sunny, wet meadows	Low: habitat not available, none found
Pogonia ophioglossoides Rose pogonia	T	_	Open, wet meadows and sphagnum bogs, poorly drained roadside ditches	Low: habitat not available, none found
Polygala lewtonii Scrub (Lewton's) milkwort	E	E	Dry oak woodlands and scrub	Low: no habitat available, none found.
Rhapidophyluum hystrix Needle palm	CE	_	Wet to mesic woods and hammocks; spring fed stream bottoms	Low: habitat not available, none found
Spiranthes brevilabris floridana Florida Ladies' tresses	E	_	Open meadows and damp pinelands, road shoulders, ditches	Low: no habitat available, none found
Spiranthes laciniata Lace-tip ladies' tresses	T	_	Marshes and cypress swamps; road banks and ditches	Low: habitat available, none found
Spiranthes longilabris Long-tip ladies' tresses	T	_	Marshes and wet prairies	Low: habitat not available, none found
Stenorrhynchos lanceolatus var. lanceolatus Leafless beaked orchid	T	_	Vacant lots, open pastures, pine flatwoods and mowed roadsides	Low: habitat not available, none found
Tillandsia fasciculata Common wild pine	E	_	Cypress swamps and hammocks	Low: habitat available, none found
Tillandsia utriculata Giant wild pine	E	_	Hammocks and cypress swamps	Low: habitat available, none found
Zephyranthes simpsonii Simpson zephyr lily	T	_	Dome swamps, wet flatwoods, ditches, wet pastures, often burned-over areas	Low: habitat available, none found

Table 2 Footnotes

1 FDA – Florida Department of Agriculture and Consumer Services; List obtained from FWC's Florida's Endangered Species, Threatened Species and Species of Special Concern, published August 1997. Supporting information from FNAI - Florida Natural Inventory; Matrix of habitats and distribution by county of rare/endangered fauna and flora in Florida, published April 1990.

2 USFWS – United States Fish and Wildlife Service; List obtained from FWC's Florida's Endangered Species, Threatened Species and Species of Special Concern, published August 1997.

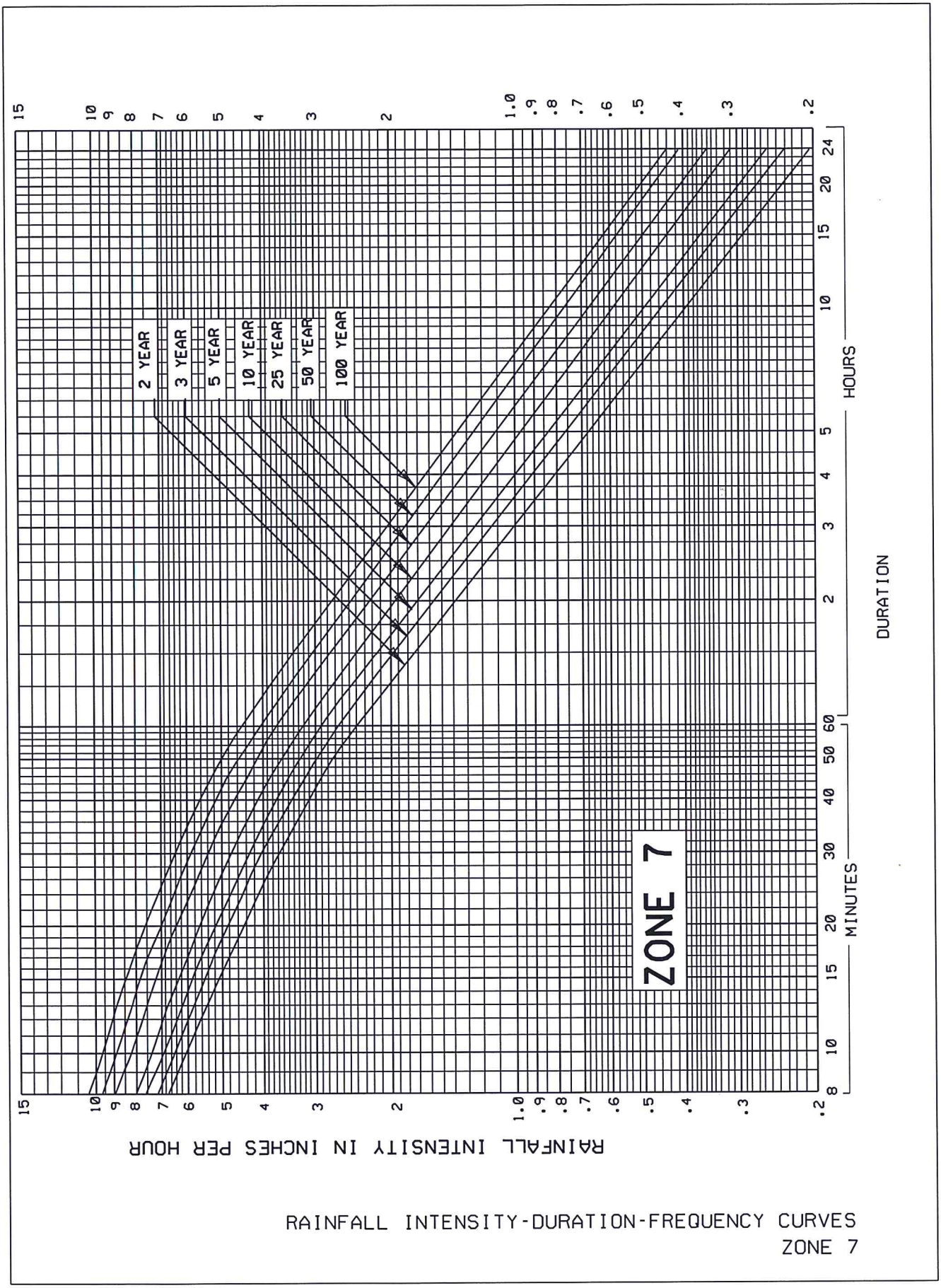
[E-endangered, T-threatened, SSC- species of special concern, CE-commercially exploited.] C1 (candidate for federal listing, with enough substantial information on biological vulnerability and threats to support for listing) and C2 (candidate for listing with some evidence of vulnerability, but for which not enough data exist to support listing) are no longer official categories.

3 Habitats described by:

Bell, C.R. and B.J. Taylor. 1982. Florida Wild Flowers and Roadside Plants. Laurel Hill Press, Chapel Hill, NC 308pp.
FNAI - Florida Natural Inventory; Matrix of Habitats and Distribution by County of Rare/Endangered Species in Florida, published April 1990.
Godfrey, R.K. 1988. Trees, Shrubs, and Woody Vines of Northern Florida, and Adjacent Georgia and Alabama. University Georgia Press. Athens, GA 734 pp.
Ward, D.B. (publ. date not listed). Volume Five,. Plants, in P.C.H. Pritchard (ed.), Rare and Endangered Biota of Florida. University Presses of Florida, Gainesville. 175 pp.
Wunderlin, R.P. 1982. Guide to Vascular Plants of Florida. University Presses of Florida, Gainesville, FL. 472 pp.

4 Likelihood of occurrence: Low, Moderate, or High, based on the best available data and selective field observations.

Appendix F

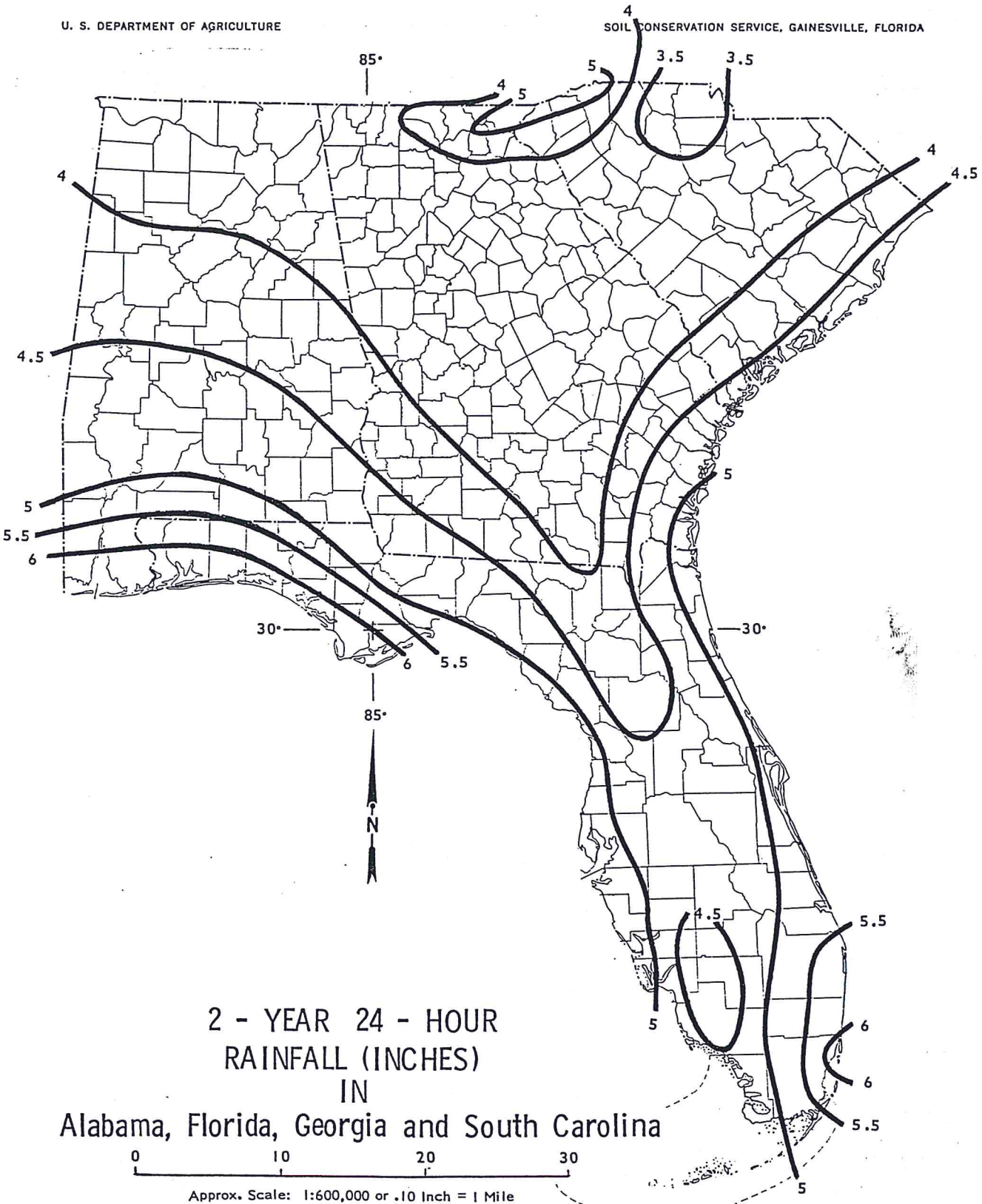


RAINFALL INTENSITY-DURATION-FREQUENCY CURVES
ZONE 7

Appendix G

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE, GAINESVILLE, FLORIDA



2 - YEAR 24 - HOUR RAINFALL (INCHES) IN Alabama, Florida, Georgia and South Carolina

0 10 20 30

Approx. Scale: 1:600,000 or .10 Inch = 1 Mile

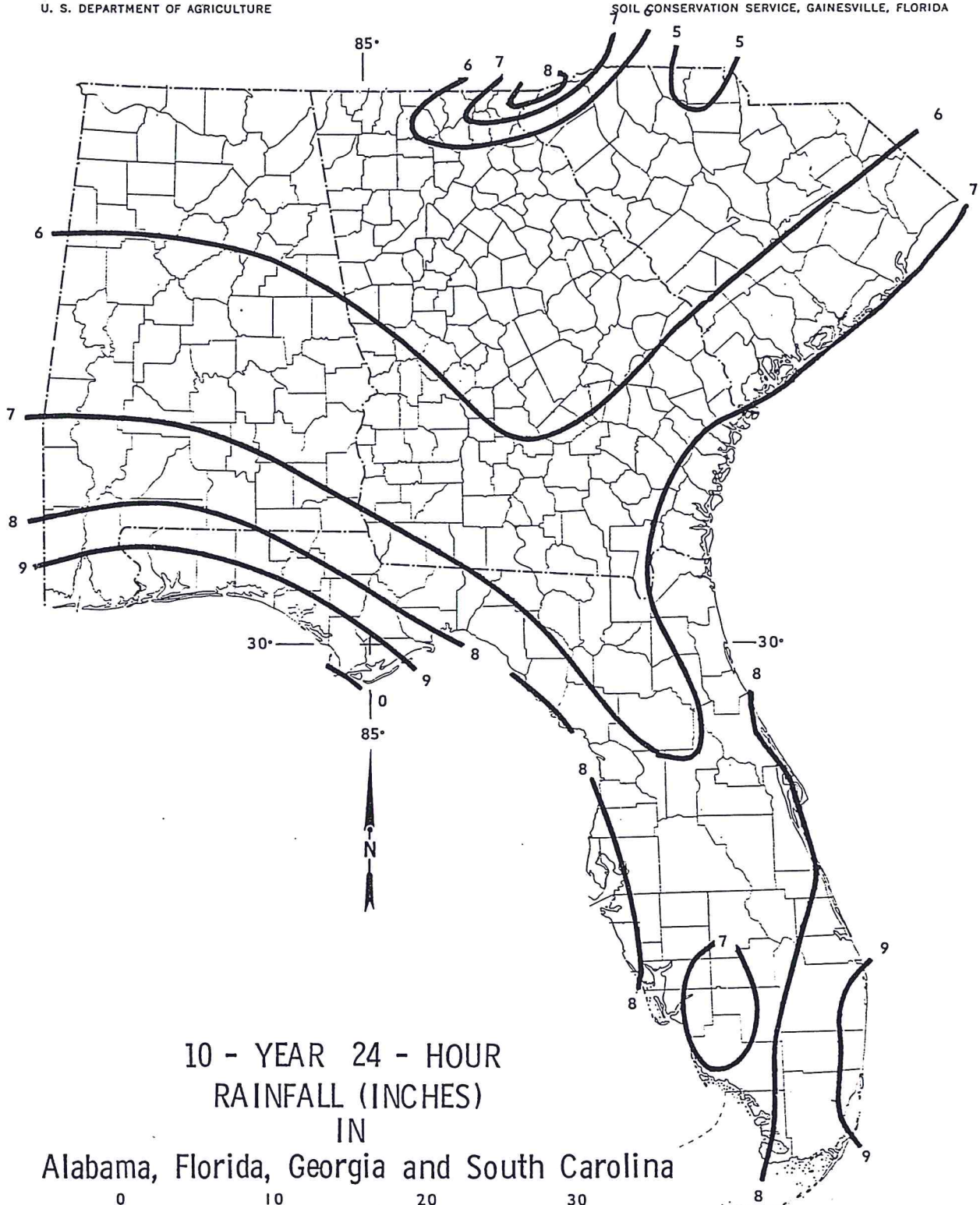
Ref: Technical Paper No. 40, Weather Bureau

USDA-SCS-FORT WORTH, TEX. 1973

6-73 4-L-33137 44 of 49

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE, GAINESVILLE, FLORIDA



10 - YEAR 24 - HOUR RAINFALL (INCHES) IN Alabama, Florida, Georgia and South Carolina

0 10 20 30

Approx. Scale: 1:600,000 or .10 Inch = 1 Mile

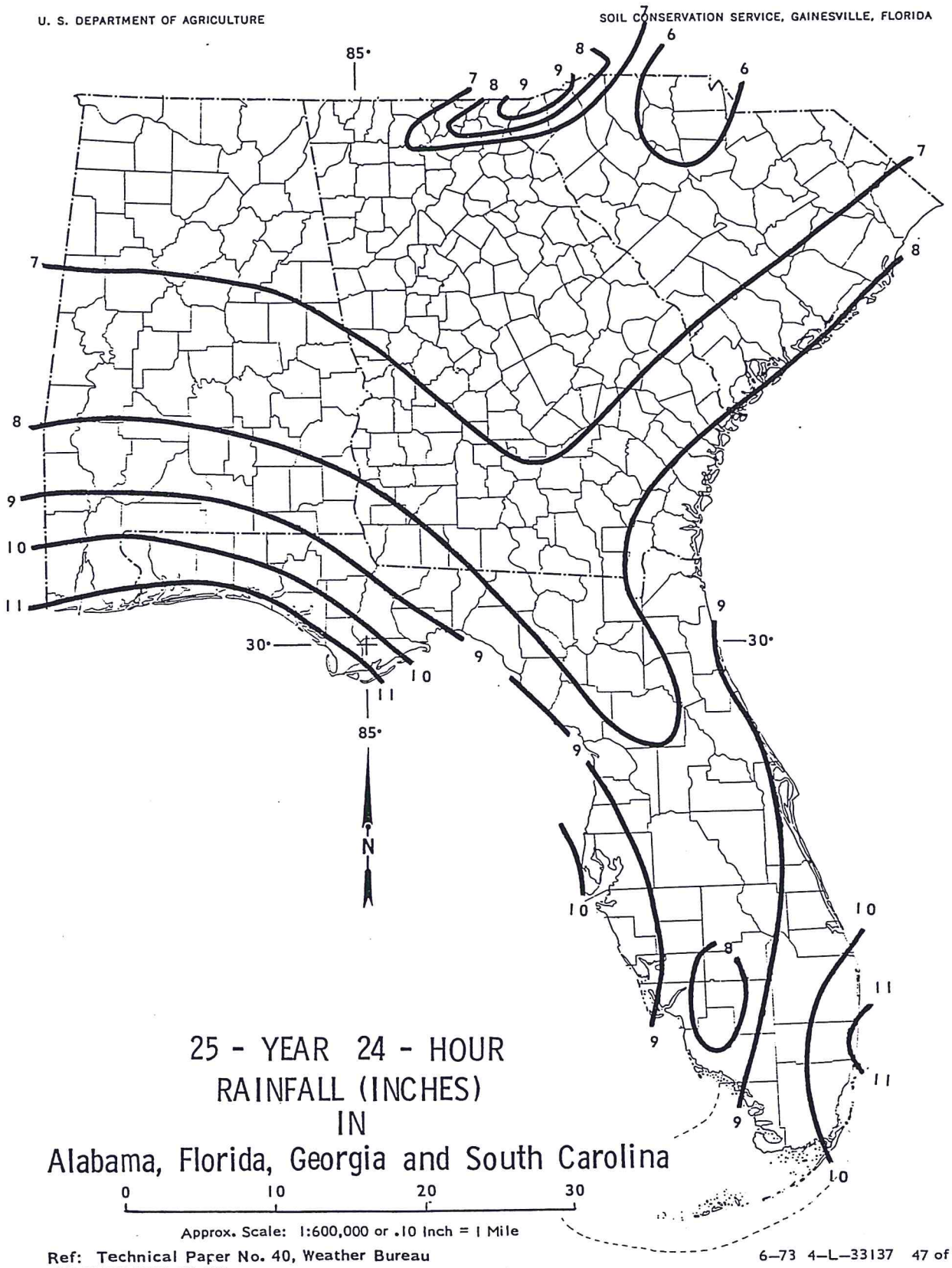
Ref: Technical Paper No. 40, Weather Bureau

USDA-SCS-FORT WORTH, TEX. 1973

6–73 4–L–33137 46 of 49

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE, GAINESVILLE, FLORIDA



25 - YEAR 24 - HOUR RAINFALL (INCHES) IN Alabama, Florida, Georgia and South Carolina

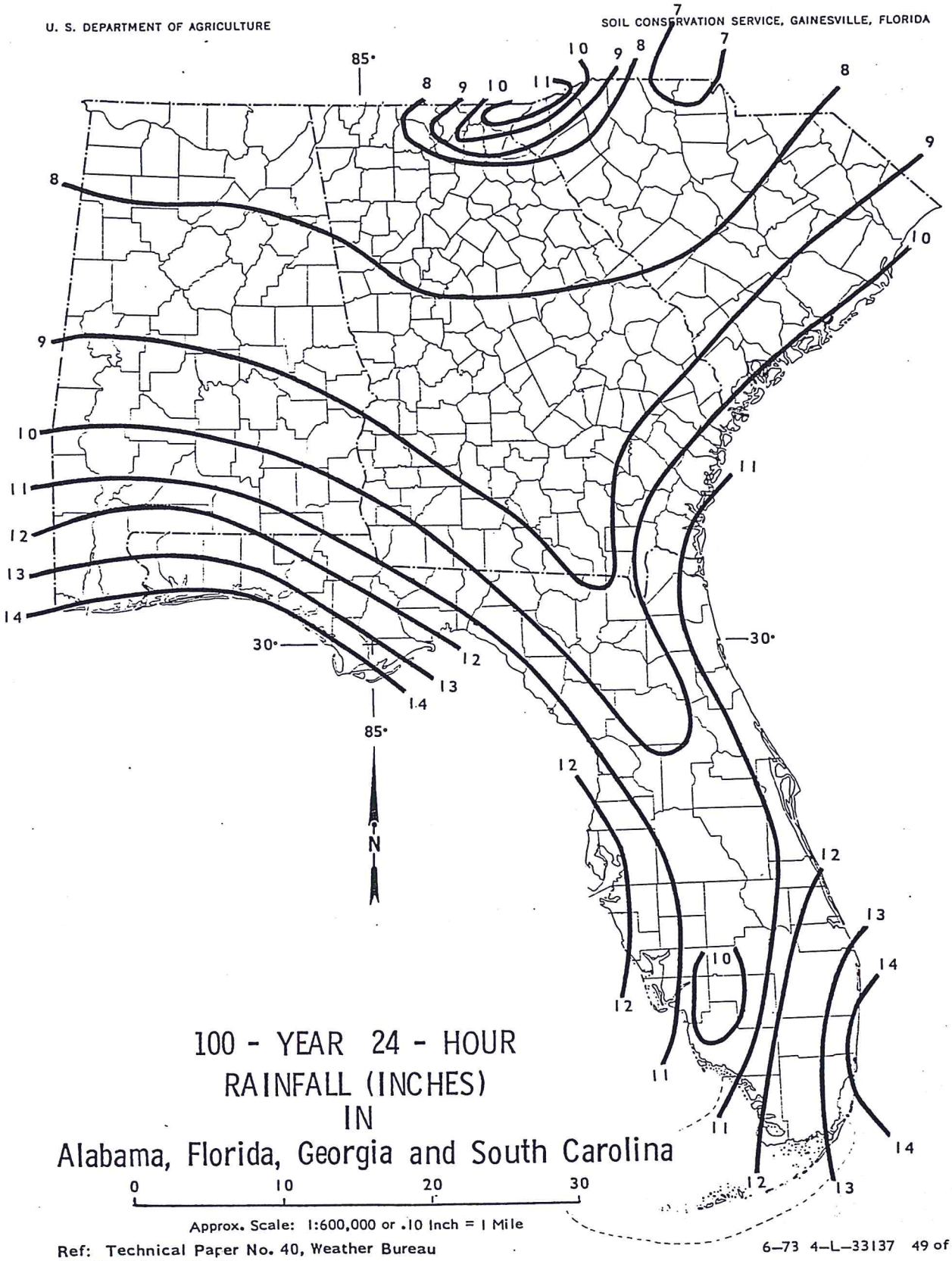
Approx. Scale: 1:600,000 or .10 Inch = 1 Mile

Ref: Technical Paper No. 40, Weather Bureau

USDA-SCS-FORT WORTH, TEX. 1973

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE, GAINESVILLE, FLORIDA



100 - YEAR 24 - HOUR RAINFALL (INCHES) IN Alabama, Florida, Georgia and South Carolina

Approx. Scale: 1:600,000 or .10 Inch = 1 Mile

Ref: Technical Paper No. 40, Weather Bureau

USDA-SCS-FORT WORTH, TEX. 1973

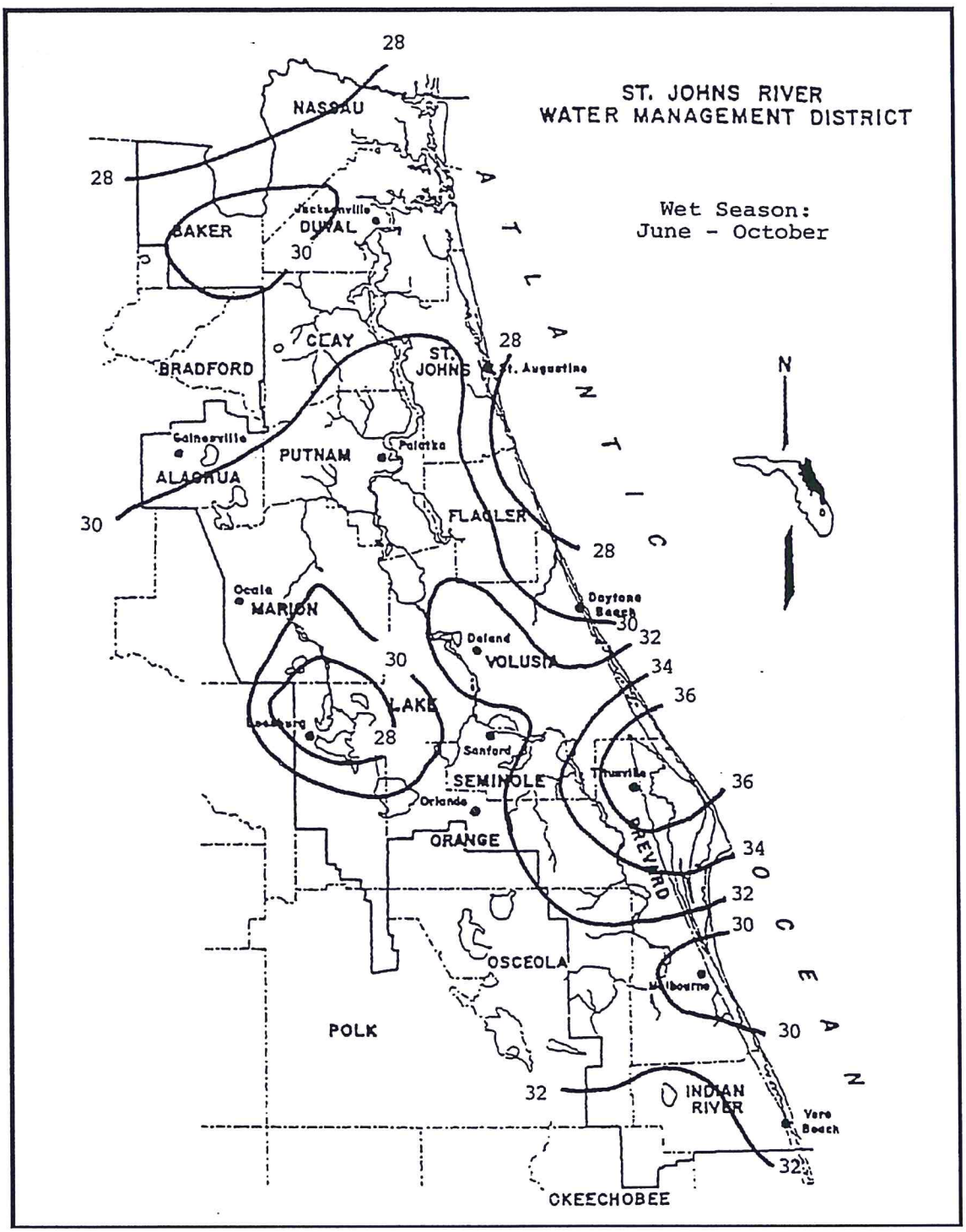


Figure 26-1. Wet Season Normal Rainfall, inches (Source: Rao, et al., 1990)

Appendix H

RIVIERA BELLA – UNITS 4-7

Drainage Summary

May 15, 2008

POND 4	WET POND	DRY POND	SWALE
Drainage Area	1.27	11.8	0.49
Impervious Area	0	4.97	0.24
WQT Volume (ac-ft)	1.21	0.47	0.02
Baseflow (gpm)	3.65	2.35	n/a
Initial Stage (ft)	11.1	13.5	18
Orifice Diameter (in)	3.25	n/a	n/a
Underdrain Length (ft)	n/a	760	n/a
Recovery Time (days)	(1/2) 26 hr	3	1
Weir Elevation (ft)	12.75	15.75	19
Weir Length (ft)	3	19.2	n/a
Residence Time (days)	35	n/a	n/a
Qp, 25yr/24hr (cfs)	27.4	n/a	n/a
DHW, 25yr/24hr (ft)	14.7	16.5	19

DRAINAGE SUMMARY AS PERMITTED
SWFWMD 40-127-64289-11
BY HEI (10-23-2008)

RIVIERA BELLA - UNITS 4-7
POND 4 WET
PEAK DISCHARGE / DESIGN HIGH WATER
MAY 15, 2008

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
DRY POND	BASE	025-024	12.25	16.543	17.000	0.0050	14287	12.25	43.461	12.25	43.288
ST JOHNS	BASE	025-024	24.00	7.198	7.200	0.0070	0	12.67	27.389	0.00	0.000
WET POND	BASE	025-024	12.67	14.738	16.000	0.0050	44162	12.07	50.768	12.67	27.389
DRY POND	BASE	100-024	12.29	16.721	17.000	0.0050	14832	12.25	54.635	12.11	53.672
ST JOHNS	BASE	100-024	24.00	7.199	7.200	0.0070	0	12.69	33.769	0.00	0.000
WET POND	BASE	100-024	12.69	15.388	16.000	0.0050	49192	12.07	64.178	12.69	33.769
DRY POND	BASE	MEAN	12.26	16.224	17.000	0.0050	13316	12.25	20.261	12.26	20.023
ST JOHNS	BASE	MEAN	23.99	7.197	7.200	0.0070	0	13.46	4.396	0.00	0.000
WET POND	BASE	MEAN	13.46	13.307	16.000	0.0045	38228	12.11	23.037	13.46	4.396

Drainage Summary
#3 Permitted By SJRWMD
40-127-64289-1
By HEI (10-23-2008)