97642-1

97642-1

1720

(14)

Bound Reports 1720

Attached is a re-scanned document because of notations and/or highlights

STORMWATER MANAGEMENT ENGINEERING REPORT

Southgate Subdivision

Sections 30, Township 22S, Range 25E;
City of Groveland, Lake County, Florida

Please return plan & calculations booklet to Ruth Grady, when finished. thanks! ☺

Revised
January 2007

KNIGHT ENGINEERING & CONSULTING
Planning, Design, Permitting, Inspection
221-1 N. U.S. HWY. 27, CLERMONT, FL. 34711
PHONE: (352) 394-8514 FAX: (352) 394-8541
www.knighteng.com
Certificate of Authorization No. 00026360

LICENSE No 47614 STATE OF FLORIDA

THOMAS L. KNIGHT
 # 47614

1/17/07

STORMWATER MANAGEMENT ENGINEERING REPORT
FOR
SOUTHGATE SUBDIVISION

TABLE OF CONTENTS

LIST OF APPENDICES:

SECTION 1 - INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this engineering report is to provide stormwater management calculations and supporting documentation for the design of the proposed surface water management system at the Southgate single-family residential subdivision. The proposed development, as detailed on the accompanying construction plans, has been designed to meet the regulatory criteria of the St. Johns River Water Management District (SJRWMD) and City of Groveland. This report contains calculations and reference information that is the basis of the design for the development.

1.2 GENERAL PROJECT INFORMATION

The Southgate Subdivision project site is located in Section 30, Township 22 South, Range 25 East, City of Groveland, Lake County, Florida. The proposed project will consist of 70 single-family residential lots and the associated infrastructure and stormwater management system. The site is bordered by S.R.33 and a vacant parcel of land to the west, Lake Stewart to the east, vacant undeveloped land to the northwest, wetlands to the northeast, which flow into Lake Stewart, and vacant undeveloped land to the south. A location map of the proposed development is included in Appendix A. The 100year Flood Elevation for Lake Stewart is 100.0 ft NGVD (per FEMA & County Lake Index). The project site is outside of the 100 Year Flood Limits. A FEMA Flood Map for the proposed development is included in Appendix A. The project site ground cover consists of open rural lands with a variety of native grasses, weeds, and scattered small trees. The existing ground cover is in fair condition (50 -75% coverage). The total area of the property is 26.83 acres. The total uplands area is 20.14 acres. The project site and drainage basin area is 15.65 acres. The site ranges from an elevation of approximately 122 ft. NGVD near the southwest property corner to an elevation of approximately 101.5 ft. NGVD in the ditch, which joins the wetlands to Lake Stewart, located at the northeast corner of the site. The wetland area has a Normal High Water Elevation (NHWE) of 102.75 ft NGVD. The project site and wetland area are over a perched water table that overflows eastward through an existing ditch to Lake Stewart. The perched water table underlying the project site supplies a continuous flow of background seepage to the wetland area, which stages up to elevation 103.0ngvd and overflows into Lake Stewart. All surface runoff entering the wetland area from the design storm events shall likewise stage up to elevation +/-103.0 NGVD and overflow into Lake Stewart. The runoff from the majority of the site, Pre-Dev. Basin-A, flows northeasterly into the wetland area. The offsite upland area along the northwest portion of the site currently flows south across the site and shall be diverted by a proposed swale, east to the wetland area. The runoff from the offsite area adjacent to the west property line flows northeasterly across the site into the wetland area. This runoff shall be captured in a proposed ditch bottom inlet, located at the west property line, and shall be conveyed to the wetland area through a proposed 24" storm pipe. The runoff from the east portion of the project site, Pre-Dev. Basin-B, flows easterly into Lake Stewart. The runoff from the southwest portion of the project site, Pre-Dev. Basin-C, flows southerly into an exiting offsite depression, then easterly into Lake Stewart. Ultimately, all runoff from the site flows to Lake Stewart.

In the Post-Dev. condition, the dry pond, WRA-1, shall be over-excavated and backfilled with permeable clean sands and shall be designed with an underdrain system to draw down the artificial water table as well as meet volume recovery criteria. The wet pond, WRA-2, shall be excavated to 96.0 ft NGVD, to meet the Permanent Pool Volume and Mean Depth Criterion. The proposed orifice and control elevation for the wet pond, WRA-2, will be set at 103.2 ft. NGVD. Background seepage from the perched water table shall seep through the southerly pond side slopes. The proposed orifice diameter has been designed to pass the background seepage and keep the WRA #2 water level at the control elevation, 103.2 ft. NGVD. The orifice diameter has also been designed to recover one half the treatment volume within 24 to 30 hours and recover the attenuation volume within 14 days. The Orifice analysis is included in Section 2.7 of this report.

1.3 SCS SOILS INFORMATION PERMEABILITIES AND PROFILES

In July 2004, Universal Engineering Services, Inc. performed three soil borings and three falling head permeability tests at the proposed locations of the stormwater retention areas. Furthermore, Tri-County Laboratories, Inc. performed additional borings and determined the Normal High Water Elevation(NHWE) of the wetlands area to be 102.0 NGVD. **Recently, as an additional safety measure, Modica & Assoc. was contracted to analyze the wetland area and determine the NHWE. Modica & Assoc. has determined the NHWE in the wetland area to be between 102.5 and 102.75 NGVD. The more conservative value of 102.75 NGVD shall be utilized as the wetland's NHWE for design purposes.** The results of all tests, borings, and analyses are included in the Geotechnical Report, submitted under separate cover along with this report. The Lake County SCS Soil Survey, index sheet #58, indicates the onsite soils to be Astatula Tavares and MyAkka sands at 0-12% slopes, Astatula and Tavares sands are SCS Type "A" soils. MyAkka sands are SCS Type "B/D" soils respectfully. All soil borings to a depth of 15 feet encountered the water table.

1.4 STORMWATER MANAGEMENT CRITERIA

The primary objective of this report is to demonstrate that the water quality treatment volume requirements as outlined in Chapter 40C-42.026 F.A.C. will be met and to demonstrate that the proposed stormwater management system will function as designed. The City of Groveland water quality criteria for this project are the same as the SJRWMD requirements. Subparagraph 40C-42.026(1), F.A.C. Specific Design and Performance Criteria, lists a treatment option for dry retention systems for basins comprised of SCS Type "A" soils exclusively, and an impervious cover of less than 40%, as the "On-Line" retention of the runoff from a one inch rainfall over the basin or 1.25 inches of runoff from the basin's impervious area, whichever is greater. One treatment option for wet detention systems is the detention of the runoff from one inch of runoff from the basin or 2.5 inches of runoff from the basin's impervious area, whichever is greater. These are the water quality treatment volume requirements with which the proposed stormwater management system will comply. Lake Stewart Basin is a closed basin, and therefore the system has been designed so the post-dev. runoff volumes do not exceed the pre-dev. runoff volumes for the 100Y24H or the 25Y96H Storm Events. The dry pond, WRA-1, is designed with a 50' wide sodded overflow weir at elevation 110.0 and the pond retains and percolates both the water quality and attenuation volumes through an underdrain system. The water quality volume required for the wet pond, WRA-2, is met at 104.06 ft NGVD as indicated in the attached calculations, (Section 2.1). However, the overflow weir has been set at 104.88 ft. NGVD, in order to retain the pre-dev. vs. post-dev. runoff volumes for the 100year-24hour and 25year-96hour Storm Events. One normally dry retention pond and one wet detention pond will provide on-site stormwater management for the project in accordance with the requirements of the City of Groveland and SJRWMD. PONDS software program has been utilized to calculate Pre & Post Hydrographs, background seepage, under-drain and stage vs. discharge for WRA-1. AdIcpr software program has been utilized to calculate the stage vs. discharge of the wetpond, WRA-2, with simultaneous background seepage, orifice and weir flow rates. The retention volumes provided in the retention areas were calculated using the final grade contours indicated on the Grading and Drainage Plan. Surface areas at one-foot intervals were digitized from the CAD file. The following worksheets/calculations determine the water quality treatment volume requirements, the SCS Curve Numbers, Times of Concentrations, the Rational Runoff Coefficient, and Stage vs. Storage for the drainage basins and retention areas within the development.

SECTION – 2

STORMWATER MANAGEMENT CALCULATIONS

SECTION – 2.1

TREATMENT VOLUME & STAGE vs STORAGE CALCULATIONS

DRY RETENTION POND DESIGN - POND 1

Project: SOUTHGATE SUBDIVISION **Date:** 12/12/2006
Location: CITY OF GROVELAND
Basin: POST DEVELOPMENT BASIN-1 & OFF1

REQUIRED TREATMENT VOLUME:

Basin Area(acres)= 3.85 ac
Percent of impervious 39.68 %
Pre Dev Coef. 0.2
Post Dev Coef.
(%Imp. x .95) + (%Perv. x 0.2)= 0.50

The Greater of ;
RUNOFF FROM 1" RAINFALL OVER BASIN:
RATIONAL METHOD Q=CIA(Coef x 1"/12" x Basin Area) = 0.1596 ac-ft

OR

1.25" OF RUNOFF FROM IMPERVIOUS AREAS IN BASIN:
(1.25" x Imperv. area in acres)/12" = 0.1591 ac-ft

REQUIRED TREATMENT VOLUME = 0.1596 ac-ft

STAGE vs STORAGE:

Elevation	Depth	Area(sf)	Volume(cf)	Vol(ac-ft)
107	0	3,019	0	0
107.5	0.5	3,487	1,627	0.0373
108.5	1.5	4,515	5,628	0.1292
109.5	2.5	5,624	10,697	0.2456
110.5	3.5	6,790	16,904	0.3881

TREATMENT VOLUME AT ELEV. **108.80** nvgd

EQUIV. POND LENGTH/WIDTH
AT TOP OF T.V. ELEV: 108.80 nvgd
(2 x L) + (2 x W) = P
P (measured)= 296.00 ft
W (measured)= 50.00 ft
L=(P - 2W)/2= 98.00 ft

EQUIV. POND LENGTH/WIDTH
AT TOP OF POND ELEV: 110.50 nvgd
(2 x L) + (2 x W) = P
P (measured)= 346.00 ft
W (measured)= 60.00 ft
L=(P - 2W)/2= 113.00 ft

2.1 - WET POND

WATER QUALITY & STAGE/STORAGE PARAMETERS

WET DETENTION NON - LITORAL ZONE

Wet Pond Calcs (Revised) P.A.V. & P.P.V.

REQUIRED TREATMENT VOLUME:

Basin Area(acres)=	11.800	acres
Impervious Area(acres)=	4.389	acres (Exclusive of Pond Surface Area)
Pond Area @ Cntrl. El.(acres)=	1.030	acres
Percent of impervious=	37.195	% (Exclusive of Pond Surface Area)

One inch runoff from basin = (Basin Area) x 1/12"= 0.983333 ac-ft
2.5" runoff from imperv. = (Imperv. Area) X 2.5"/12 = 0.914375 ac-ft

T.V required for WRA-2 WetPond(TV-2)= 0.98 ac-ft Treatment Volume
Vol. Req'd to meet Pre.vs.Post disch(RV)= **2.09 ac-ft Retention Volume below weir**

Total 25y96h Pre-Dev. Runoff = 5.83ac-ft, Total 25y96h Post-Dev. Runoff =(1.95ac-ft+6.60ac-ft)=8.55ac-ft
Total 100y24h Pre-Dev. Runoff = 5.36ac-ft, Total 100y24hPost-Dev. Runoff =(1.81ac-ft+ 6.16ac-ft)=7.97ac-ft
Total Retention Volume Required = [8.55ac-ft - 5.36ac-ft) =2.72ac-ft
Volume Retained and Percolated in WRA-1 = 0.63ac-ft
Retention Volume Required in WRA-2 to meet Pre-Dev Runoff Volumes = (2.72ac-ft-0.63ac-ft)=2.09ac-

STAGE vs STORAGE:

Elevation	Depth	Area(sf)	Volume(cf)	Total Vol(ac-ft)	Above Cntrl Vol(ac-ft)	
96	0	8421	0	0	0	
97	1	9986	9203.5	0.211283	0	
98	2	11705	20049	0.460262	0	
99	3	15519	33661	0.77275	0	
100	4	18380	50610.5	1.161857	0	
100.5	4.5	20422	60311	1.38455	0	Pond Grade Break(6:1 to 3:1)
101	5	23751	71354.25	1.638068	0	
102	6	31989	99224.25	2.277875	0	
103	7	42475	136456.3	3.132604	0	
103.2	7.2	44678	145171.6	3.33268	0	**Proposed Control Elev.=103.2** ?
104	8	53492	184439.8	4.234154	0.901469	*T.V Met at Elev. 104.06*
105	9	64730	243550.8	5.591156	2.258471	plans indicate 102.50' (REG)
106	10	76195	314013.3	7.208752	3.876067	
106.5	10.5	85921	354542.3	8.13917	4.806485	

WEIR ELEVATION:

[(Et-Ec)*TV/(Vt-Vc)]+Ec = 104.8759 ft.**Set Weir at Elev.= 104.88 ngvd**

WHERE:

Et = Elev. Above RV in ft. =	105
Ec = Elev. Below RV in ft. =	104
RV - Vol @ Ec in ac-ft =	1.19
Vt = Vol. @ Et in ac-ft =	2.258471
Vc = Vol. @ Ec in ac-ft =	0.901469

2.1 CONTINUED:

PERMANENT POOL VOLUME:

[(Ba)(C)(Rw)(Rt)]/(Ws)(12")]= 1.872582 ac-ft. Required
3.33268 ac-ft. Provided

WHERE:

Ba = Basin Area in acres =	11.8	
C = Mannings runoff coef. =	0.447559	weighted
Rw = Normal wet season rainfall depth in inches =	31	
Rt = Minimum residence time in days =	21	
Ws = Length of wet season in days =	153	

TREATMENT VOLUME REVOVERY:

Orifice Shall be designed so that one-half the Treatment
Volume recovers within 24 to 30 Hours
(SEE APPENDIX "C" FOR TREATMENT VOLUME RECOVERY & ORIFICE SIZING)

PRE vs POST VOLUME DEPTH:

h = **1.68** ft = PRE vs POST VOL. DEPTH

WHERE:

h = Weir elevation - Control elevation = 1.68

REQUIRED DISCHARGE RATE: (For Pre vs Post Volume)

2.09ac-ft(RV) Must Recover within 14 Days or (14days x 24hours)= **336 hrs**
(2.09ac-ft * 43560FT^2)*(1/336hr)*(1/3600sec) = 0.075265 **cfs**
Background Seepage = 48.63gpm = 0.1083cfs= 0.10831 **cfs**
Required discharge rate = [0.0753cfs + 0.1083cfs] = **0.183575 cfs**
To meet 14 day Attenuation Volume Recovery

CIRCULAR ORIFICE SIZING: (For Pre vs Post Volume)

A=[(Discharge rate)/ (0.62((2*(32.2ft/sec^2))*RV Depth)^1/2)] = **0.028501 sf**

Min. Orifice Dia. = (4*Area/3.1446)^.5 = 0.190496 feet = **2.29** inches
Ortifice must be 2.29" or larger to meet 14 day recovery criteria
Use 2.75"Dia. Orifice to meet TV recovery criteria per Section 2.7

MEAN DEPTH:

Volume below control elev. in ac-ft 3.132604 = **3.041** ft
Area of Pond at control elevation in acres 1.03
Depth falls between the 2' minimum and 8' maximum requirement.

SECTION – 2.2

IMPERVIOUS AREA BREAKDOWN WORKSHEET

2.2
IMPERVIOUS AREA BREAKDOWN WORKSHEET

Project: SOUTHGATE SUBDIVISION **Date:** Dec. 12, 2006
Location: CITY OF GROVELAND, LAKE COUNTY

BASINS	BASIN AREA (ac)	No. of HOUSES	No. HOUSES x AREA No. x 2000(sf)	DRIVE/ PATIO No. x 500 (sf)	PVMT S/W AREA(sf)	WETPOND Area @ Cntrl AREA(sf)	TOTAL IMP AREA (sf)	TOTAL IMP AREA (ac)	% OF IMPERV	Rational COEF. "C"
PRE-DEV BASIN-A & OFF1	10.65	0.50	N/A	N/A	N/A	N/A	4792.00	0.11	1.03	0.21
PRE-DEV BASIN-B	3.90	N/A	N/A	N/A	N/A	N/A	1307.00	0.03	0.77	0.21
PRE-DEV BASIN-C	1.10	N/A	N/A	N/A	N/A	N/A	871.00	0.02	1.82	0.21
TOTALS	15.65	0.5	0.0	0.0	0.0	0.0	6970.00	0.16	1.02	0.21
POST-DEV BASIN-1 & OFF1	3.85	15.0	30,000.0	7,500.0	29,052.0	0.0	66,552.0	1.53	39.68	0.50
POST-DEV BASIN-2	11.80	55	110,000.0	27,500.0	46,263.0	44,678.0	228,441.0	5.24	44.44	0.43
TOTALS	15.65	70.0	140,000.0	35,000.0	75,315.0	44,678.0	294,993.0	6.77	43.27	0.52

SECTION – 2.3

PRE-DEVELOPMENT CURVE NUMBER WORKSHEET

2.3
PRE DEVELOPMENT
CURVE NUMBER WORKSHEET

Project: SOUTHGATE SUBDIVISION **Date: 12/12/2006**
Location: CITY OF GROVELAND, LAKE COUNTY,FL.

PRE-DEV. BASIN - A & OFF1
AREA= 10.65 acres

AREA (acres)	SCS SOIL TYPE	COVER TYPE AND CONDITION	CURVE NUMBER	AREA x CN
		Pasture, Grassland, or Range - Continuous forage for grazing		
10.54	A	Cover 50% to 75%	49	516.46
	C	Cover 50% to 75%	79	0
	D	Cover 50% to 75%	84	0
0.11	A,B,C,D,	Impervious (Pvmt, Conc., Roofs)	98	10.78
		[SUM: (AREA x CN)]/TOTAL AREA = **WEIGHTED CURVE NUMBER =**		**49.51**

PRE-DEV. BASIN - B
AREA= 3.90 acres

AREA (acres)	SCS SOIL TYPE	COVER TYPE AND CONDITION	CURVE NUMBER	AREA x CN
		Pasture, Grassland, or Range - Continuous forage for grazing		
3.02	A	Cover 50% to 75%	49	147.98
	C	Cover 50% to 75%	79	0
0.85	D	Cover 50% to 75%	84	71.4
0.03	A,B,C,D,	Impervious (Pvmt, Conc., Roofs)	98	2.94
		[SUM: (AREA x CN)]/TOTAL AREA = **WEIGHTED CURVE NUMBER =**		**57.01**

PRE-DEV. BASIN - C
AREA= 1.10 acres

AREA (acres)	SCS SOIL TYPE	COVER TYPE AND CONDITION	CURVE NUMBER	AREA x CN
		Pasture, Grassland, or Range - Continuous forage for grazing		
1.08	A	Cover 50% to 75%	49	52.92
	C	Cover 50% to 75%	79	0
	D	Cover 50% to 75%	84	0
0.02	A,B,C,D,	Impervious (Pvmt, Conc., Roofs)	98	1.96
		[SUM: (AREA x CN)]/TOTAL AREA = **WEIGHTED CURVE NUMBER =**		**49.89**

SECTION – 2.4

POST-DEVELOPMENT CURVE NUMBER WORKSHEET

2.4
POST DEVELOPMENT
CURVE NUMBER WORKSHEET

Post-Dev
CN
Calcs

Project: **SOUTHGATE SUBDIVISION** **Date:** **12/12/2006**
Location: **CITY OF GROVELAND, LAKE COUNTY, FL.**

POST-DEV. BASIN - 1 & OFF1

AREA= 3.85 acres

AREA (acres)	SCS SOIL TYPE	COVER TYPE AND CONDITION (Grass/Lawns)	CURVE NUMBER	AREA x CN
2.32	A	Cover > 75%	39	90.48
1.53	A,B,C,D,	Impervious (Pvmt, Conc., Roofs)	98	149.94
		[SUM: (AREA x CN)]/TOTAL AREA = **WEIGHTED CURVE NUMBER =**		**62.45**

Ponds not considered in CN calculations

POST-DEV. BASIN - 2

AREA= 11.80 acres

AREA (acres)	SCS SOIL TYPE	COVER TYPE AND CONDITION (Grass/Lawns)	CURVE NUMBER	AREA x CN
5.59	A	Cover > 75%	39	218.01
0.97	B	Cover > 75%	61	59.17
5.24	A,B,C,D,	Impervious (Pvmt, Conc., Roofs)	98	513.52
		[SUM: (AREA x CN)]/TOTAL AREA = **WEIGHTED CURVE NUMBER =**		**67.01**

SECTION – 2.5

PRE-DEVELOPMENT TIME OF CONCENTRATION WORKSHEET

2.5(a)

Pre-Development
Time of Concentration Worksheet

(Ref: Technical Release 55 Urban Hydrology for Small Watersheds)

Project: **SOUTHGATE SUBDIVISION** **Date: 12/12/2006**
Location: CITY OF GROVELAND, LAKE COUNTY
BASIN I.D. "A" & "OFF1"
Condition: PRE DEVELOPMENT

Sheet Flow

	A1		Segment ID
1. Surface Description (Table 3-1)	brush/weeds		
2. Manning's roughness coeff., n (Table 3-1)	0.2		
3. Flow Length, L (total <= 300 ft) (feet)	300		
4. 2-year 24-hour rainfall, P_2 (inches)	4.8		
5. Land slope, s (ft/ft)	0.0167		**Sub-total**
6. Tt =(0.007 * (nL)^0.8)/((P_2^0.5)*(s^0.4)) (hr)	0.43		0.43

Shallow Concentrated Flow

	Segment ID		
	A2		Segment ID
7. Surface description (paved or unpaved)	unpaved		
8. Flow length, L (feet)	460		
9. Watercourse slope, s (ft/ft)	0.0215		
10. Average velocity, V (figure 3-1) (ft/s)	2.37		**Sub-total**
11. Tt = (L/(3600*V) (hr)	0.05		0.05

Channel Flow

	Segment ID		
			Segment ID
12. Cross section flow area, a (ft^2)			
13. Wetted perimeter, Pw (ft)			
14. Hydraulic radius, r = a/Pw (ft)			
15. Channel slope, s (ft/ft)			
16. Manning/s roughness coeff., n			
17. V = (1.49*($r^{2/3}$)*($s^{1/2}$))/n (ft/s)			
18. Flow length, L (ft)			**Sub-total**
19. Tt = (L/3600*V) (hr)			0.000

Total

	Total	
20. Total Tc (hr)	0.49	hrs
21. Total Tc (min)	29.31	min

Notes:

2.5(b)

Pre-Development
Time of Concentration Worksheet

(Ref: Technical Release 55 Urban Hydrology for Small Watersheds)

Project: **SOUTHGATE SUBDIVISION** **Date: 12/12/2006**
Location: CITY OF GROVELAND, LAKE COUNTY
BASIN I.D. **"B"**
Condition: PRE DEVELOPMENT

Sheet Flow

	B1		Segment ID
1. Surface Description (Table 3-1)	brush/weeds		
2. Manning's roughness coeff., n (Table 3-1)	0.2		
3. Flow Length, L (total <= 300 ft) (feet)	300		
4. 2-year 24-hour rainfall, P_2 (inches)	4.8		
5. Land slope, s (ft/ft)	0.0167		**Sub-total**
6. Tt =(0.007 * (nL)^0.8)/((P_2^0.5)*(s^0.4)) (hr)	0.43		0.43

Shallow Concentrated Flow

	B2		Segment ID
7. Surface description (paved or unpaved)	unpaved		
8. Flow length, L (feet)	525		
9. Watercourse slope, s (ft/ft)	0.0229		
10. Average velocity, V (figure 3-1) (ft/s)	2.44		**Sub-total**
11. Tt = (L/(3600*V) (hr)	0.06		0.06

Channel Flow

			Segment ID
12. Cross section flow area, a (ft^2)			
13. Wetted perimeter, Pw (ft)			
14. Hydraulic radius, r = a/Pw (ft)			
15. Channel slope, s (ft/ft)			
16. Manning/s roughness coeff., n			
17. $V = (1.49*(r^{2/3})*(s^{1/2}))/n$ (ft/s)			
18. Flow length, L (ft)			**Sub-total**
19. Tt = (L/3600*V) (hr)			0.000

Total

	Total	
20. Total Tc (hr)	0.49	hrs
21. Total Tc (min)	29.65	min

Notes:

2.5(c)

Pre-Development
Time of Concentration Worksheet

(Ref: Technical Release 55 Urban Hydrology for Small Watersheds)

Project: **SOUTHGATE SUBDIVISION** **Date: 12/12/2006**
Location: CITY OF GROVELAND, LAKE COUNTY
BASIN I.D. **"C"**
Condition: PRE DEVELOPMENT

Sheet Flow

	C1		Segment ID
1. Surface Description (Table 3-1)	brush/weeds		
2. Manning's roughness coeff., n (Table 3-1)	0.2		
3. Flow Length, L (total <= 300 ft) (feet)	282		
4. 2-year 24-hour rainfall, P_2 (inches)	4.8		
5. Land slope, s (ft/ft)	0.0149		**Sub-total**
6. Tt =(0.007 * (nL)^0.8)/((P_2^0.5)*(s^0.4)) (hr)	0.43		0.43

Shallow Concentrated Flow

			Segment ID
7. Surface description (paved or unpaved)			
8. Flow length, L (feet)			
9. Watercourse slope, s (ft/ft)			
10. Average velocity, V (figure 3-1) (ft/s)			**Sub-total**
11. Tt = (L/(3600*V) (hr)			0.00

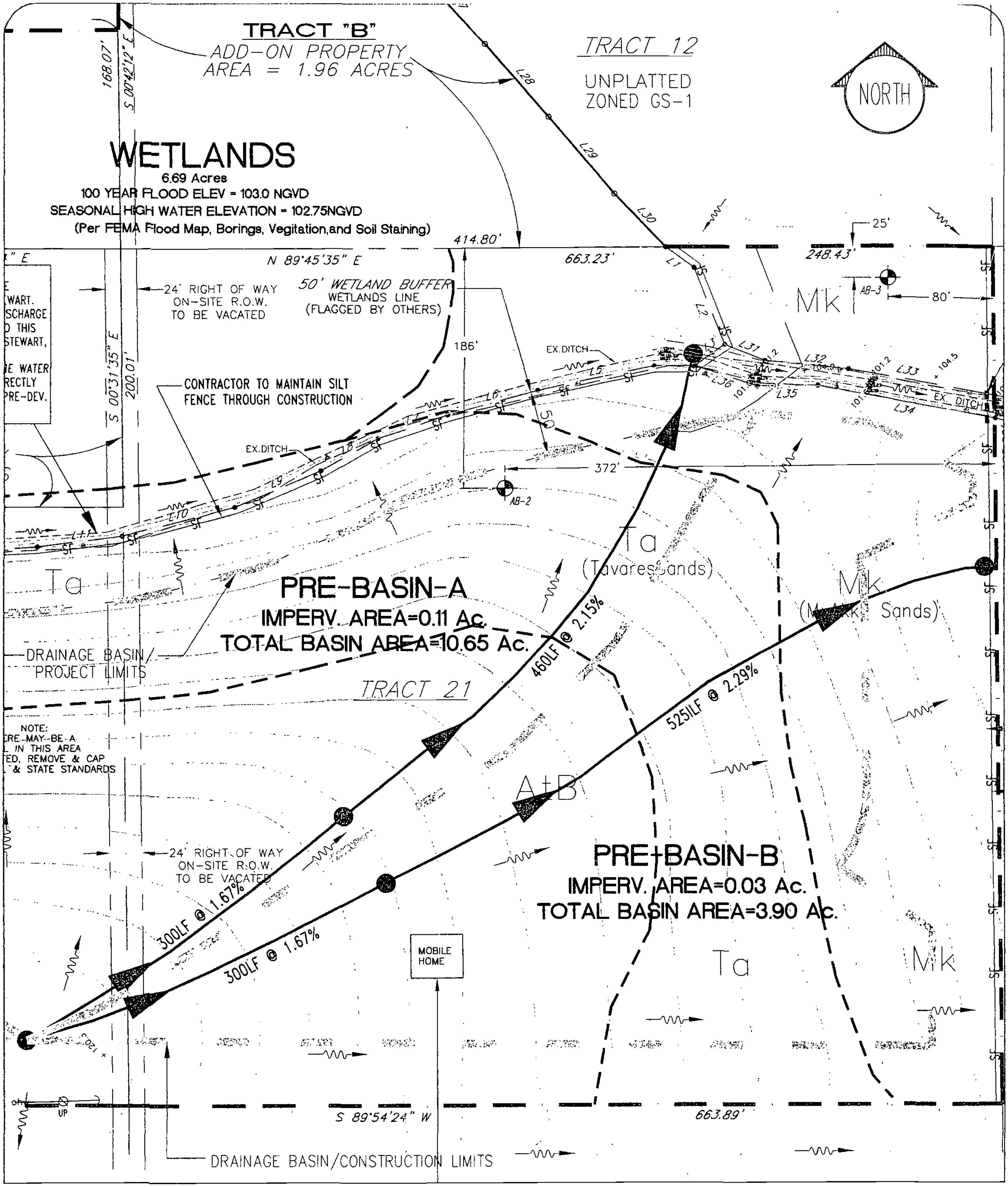
Channel Flow

			Segment ID
12. Cross section flow area, a (ft^2)			
13. Wetted perimeter, Pw (ft)			
14. Hydraulic radius, r = a/Pw (ft)			
15. Channel slope, s (ft/ft)			
16. Manning/s roughness coeff., n			
17. V = (1.49*($r^{2/3}$)*($s^{1/2}$))/n (ft/s)			
18. Flow length, L (ft)			**Sub-total**
19. Tt = (L/3600*V) (hr)			0.000

Total

	Total	
20. Total Tc (hr)	0.43	hrs
21. Total Tc (min)	25.96	min

Notes:

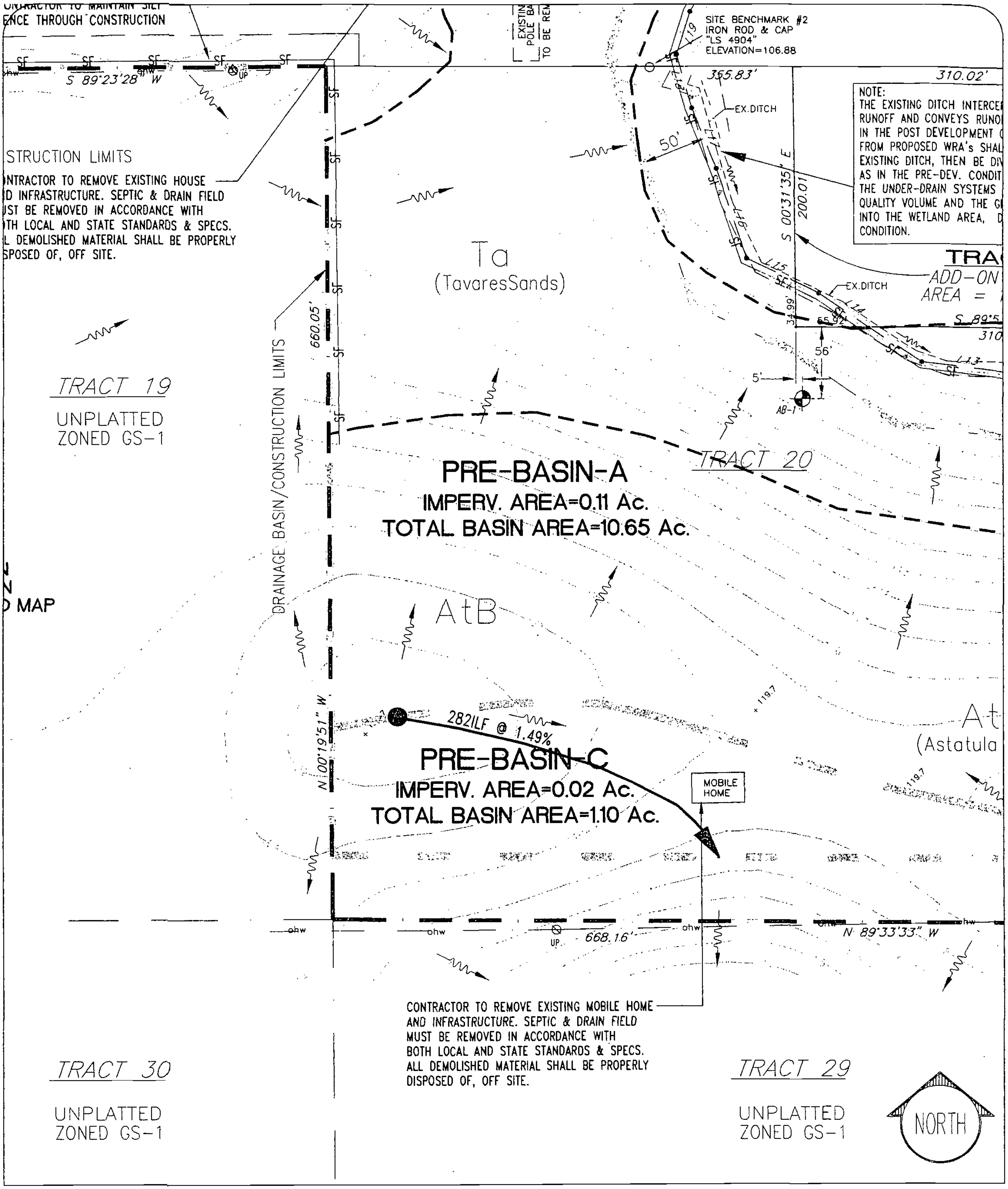


KNIGHT ENGINEERING, INC.
Planning, Design, Permitting, Inspection
221-1 N. U.S. HWY. 27, CLERMONT, FL. 34711
PHONE: (352) 394-8514 FAX: (352) 394-8541
www.knighteng.com
Certificate of Authorization No. 00007939

SOUTHGATE SUBDIVISION

PRE-DEV. Tc FLOW PATH

DATE: DEC. 2006
SCALE: 1" = 100'
FILE: BASE.DWG
SHEET: 1 of 2



KNIGHT ENGINEERING, INC.	SOUTHGATE SUBDIVISION	DATE: DEC. 2006
Planning, Design, Permitting, Inspection	PRE-DEV. Tc FLOW PATH	SCALE: 1" = 100'
221-1 N. U.S. HWY. 27, CLERMONT, FL. 34711 PHONE: (352) 394-8514 FAX: (352) 394-8541 www.knighteng.com Certificate of Authorization No. 00007939		FILE: BASE.DWG
		SHEET: 2 of 2

SECTION – 2.6

POST-DEVELOPMENT TIME OF CONCENTRATION WORKSHEET

2.6a

Post-Development
Time of Concentration Worksheet

Project: SOUTHGATE SUBDIVISION **Date:** 12/12/2006
Location: CITY OF GROVELAND, LAKE COUNTY
Basin: 1 & OFF1
Condition: POST-DEVELOPMENT

Sheet Flow

	1a		Segment ID
1. Surface Description (Table 3-1)	grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow Length, L (total <= 300 ft) (feet)	120		
4. 2-year 24-hour rainfall, P_2 (inches)	4.8		
5. Land slope, s (ft/ft)	0.01		**Sub-total**
6. Tt =(0.007 * (nL)^0.8)/((P_2^0.5)*(s^0.4)) (hr)	0.30		0.30

Shallow Concentrated Flow

	1b		Segment ID
7. Surface description (paved or unpaved)	grass		
8. Flow length, L (feet)	610		
9. Watercourse slope, s (ft/ft)	0.012		
10. Average velocity, V (figure 3-1) (ft/s)	2.19		**Sub-total**
11. Tt = (L/(3600*V) (hr)	0.08		0.08

Channel/Pipe Flow

	1c		Segment ID
12. Cross section flow area, a (ft^2)	1.77		
13. Wetted perimeter, Pw (ft)	4.71		
14. Hydraulic radius, r = a/Pw (ft)	0.38		
15. Channel slope, s (ft/ft) (average)	0.0208		
16. Manning/s roughness coeff., n	0.01		
17. V = (1.49*($r^{2/3}$)*($s^{1/2}$))/n (ft/s)	11.16		
18. Flow length, L (ft)	146		**Sub-total**
19. Tt = (L/3600*V) (hr)	0.004		0.004

Total

	Total
20. Total Tc (hr)	0.38
21. Total Tc (min)	22.65

Notes:

2.6b

Post-Development
Time of Concentration Worksheet

Project: **SOUTHGATE SUBDIVISION** **Date:** **12/12/2006**
Location: CITY OF GROVELAND, LAKE COUNTY
Basin: **2**
Condition: POST-DEVELOPMENT

Sheet Flow

	2a		Segment ID
1. Surface Description (Table 3-1)	grass		
2. Manning's roughness coeff., n (Table 3-1)	0.24		
3. Flow Length, L (total <= 300 ft) (feet)	185		
4. 2-year 24-hour rainfall, P_2 (inches)	4.8		
5. Land slope, s (ft/ft)	0.01		**Sub-total**
6. Tt =(0.007 * (nL)^0.8)/((P_2^0.5)*(s^0.4)) (hr)	0.42		0.42

Shallow Concentrated Flow

	2b		Segment ID
7. Surface description (paved or unpaved)	grass		
8. Flow length, L (feet)	255		
9. Watercourse slope, s (ft/ft)	0.011		
10. Average velocity, V (figure 3-1) (ft/s)	2.13		**Sub-total**
11. Tt = (L/(3600*V) (hr)	0.03		0.03

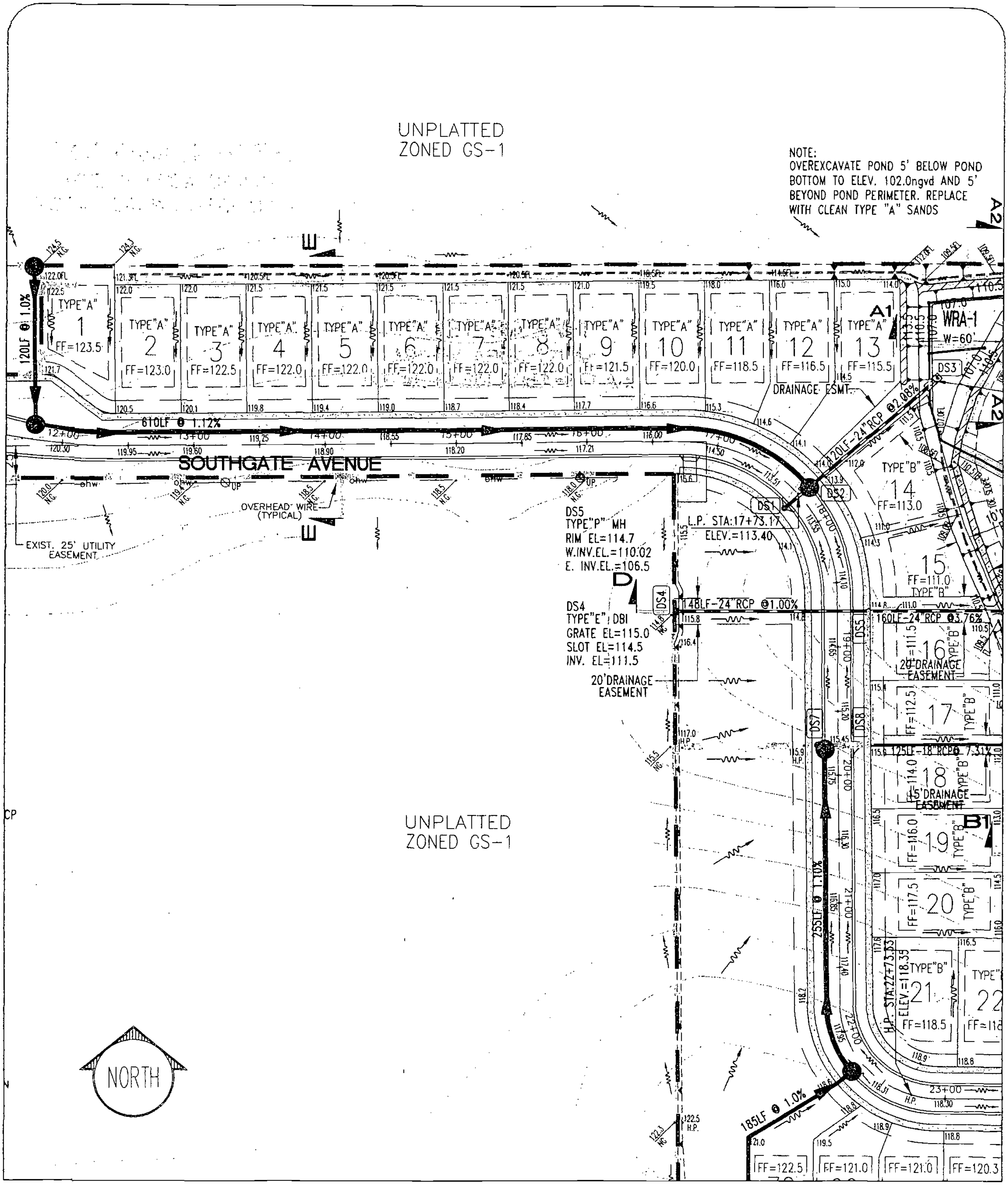
Channel Flow

	2c		Segment ID
12. Cross section flow area, a (ft^2)	1.77		
13. Wetted perimeter, Pw (ft)	4.71		
14. Hydraulic radius, r = a/Pw (ft)	0.38		
15. Channel slope, s (ft/ft) (average)	0.0372		
16. Manning/s roughness coeff., n	0.01		
17. $V = (1.49*(r^{2/3})*(s^{1/2}))/n$ (ft/s)	14.93		
18. Flow length, L (ft)	138		**Sub-total**
19. Tt = (L/3600*V) (hr)	0.003		0.003

Total

	Total
20. Total Tc (hr)	0.45
21. Total Tc (min)	27.30

Notes:



KNIGHT ENGINEERING, INC.

Planning, Design, Permitting, Inspection

221-I N. U.S. HWY. 27, CLERMONT, FL. 34711
PHONE: (352) 394-8514 FAX: (352) 394-8541
www.knighteng.com
Certificate of Authorization No. 00007939

SOUTHGATE SUBDIVISION

POST-DEV. Tc FLOW PATH

DATE: DEC. 2006
SCALE: 1" = 100'
FILE: BASE.DWG
SHEET: 1 of 1

SECTION – 2.7

ORIFICE – VOLUME RECOVERY CALCULATIONS

SOUTHGATE **Knight Engineering, Inc.**
SFR Subdivision ***Dec 2006***

ORIFICE

VOLUME RECOVERY CALCULATIONS

VOLUME BELOW WEIR= 2.09 ac.-ft. (Pre vs Post Vol.)
1/2 TREATMENT VOLUME = 0.49 ac.-ft. (T.V.=0.98 ac-ft)
WEIR ELEVATION = 104.88 ft., NGVD
NORMAL WATER ELEVATION = 103.20 ft., NGVD
ORIFICE DIAMETER = 2.750 inches
ORIFICE AREA = 0.041 sq. ft.
ORIFICE EQUATION: $Q = 4.8 * A * H^{0.5}$
ORIFICE INVERT ELEVATION = 103.20 ft., NGVD
CENTROID = 0.11 ft.
ORIFICE CENTROID ELEVATION = 103.31 ft., NGVD

STAGE (ft. NGVD)	H (ft.)	Q (cfs)	Qave. (cfs)	VOLUME INCRE. (ac-ft)	TIME INCRE. (hrs.)	VOLUME CUM. (ac-ft)	TIME CUM. (hrs.)
104.88	1.57	0.2477				0.00	0.00
			0.2437	0.1229	6.10		
104.78	1.47	0.2398				0.12	6.10
			0.2357	0.1229	6.31		
104.68	1.37	0.2315				0.25	12.42
			0.2273	0.1229	6.54		
104.58	1.27	0.2230				0.37	18.96
			0.2186	0.1229	6.81		
104.48	1.17	0.2142				0.49	25.77
			0.2095	0.1229	7.10		
104.39	1.07	0.2049				0.61	32.87
			0.2001	0.1229	7.43		
104.29	0.97	0.1952				0.74	40.30
			0.1901	0.1229	7.82		
104.19	0.87	0.1851				0.86	48.12
			0.1797	0.1229	8.28		
104.09	0.77	0.1743				0.98	56.40
			0.1685	0.1229	8.83		
103.99	0.68	0.1628				1.11	65.23
			0.1566	0.1229	9.50		
103.89	0.58	0.1504				1.23	74.73
			0.1437	0.1229	10.35		
103.79	0.48	0.1369				1.35	85.08
			0.1295	0.1229	11.49		
103.69	0.38	0.1220				1.48	96.57
			0.1134	0.1229	13.11		
103.60	0.28	0.1049				1.60	109.69
			0.0947	0.1229	15.71		
103.50	0.18	0.0844				1.72	125.40
			0.0707	0.1229	21.03		
103.40	0.08	0.0571				1.84	146.43
			0.0410	0.1229	36.32		
103.30	-0.02	0.0249				1.97	182.75
			0.0124	0.1229	119.70		

25y96h Pre.Dev. vs Post.Dev. Recovers in less than 14 days
One Half Treatment Volume Recovers within 24 to 30 hours

Ø Recovery Calcs

SECTION – 2.8

RESULTS SUMMARY TABLE

2.7 - RESULTS SUMMARY TABLE

Project: SOUTHGATE SUBDIVISION 12/12/2006
Location: CITY OF GROVELAND, LAKE COUNTY

BASINS	Basin Area Acres	10yr24hr Peak DISCH(cfs)	25yr24hr Peak DISCH(cfs)	25yr24h DHWE (ft)	100yr24h DHWE (ft)	TV-Recovery Time (as shown)	Attenuation Vol. Recovery (days)	100yr24hr Total Disch.Volume (ac-ft)	25yr96hr Total Disch.Volume (ac-ft)	Discharge Direction
PRE-DEV BASIN-A & OFF1	10.65	6.48	9.16	N/A	N/A	N/A	N/A	3.41	3.72	Wetlands Lk. Stewart
PRE-DEV BASIN-B	3.90	3.63	4.85	N/A	N/A	N/A	N/A	1.59	1.72	Lake Lk. Stewart
PRE-DEV BASIN-C	1.10	0.72	1.03	N/A	N/A	N/A	N/A	0.36	0.39	Depression/ Lk. Stewart
TOTAL	15.65	10.83	15.04					5.36	5.83	
POST-DEV BASIN-1 & OFF1	3.85	2.17	4.48	110.10	110.15	3 days	3 days	1.09	1.01	Wetlands/ Lk. Stewart
POST-DEV BASIN-2	11.80	3.00	4.15	105.25	105.63	1/2 TV within 24-30hrs	Less Than 14 days	4.14	5.63	Wetlands/ Lk. Stewart
TOTAL	15.65	5.17	8.63	N/A	N/A	N/A	N/A	5.23	6.64 *	

Total Post Dev. Discharge Rates & Volumes are less than in the Pre-Dev. Condition
Note: The WRA-2 Post-Dev. discharge volumes shown above include background seepage.

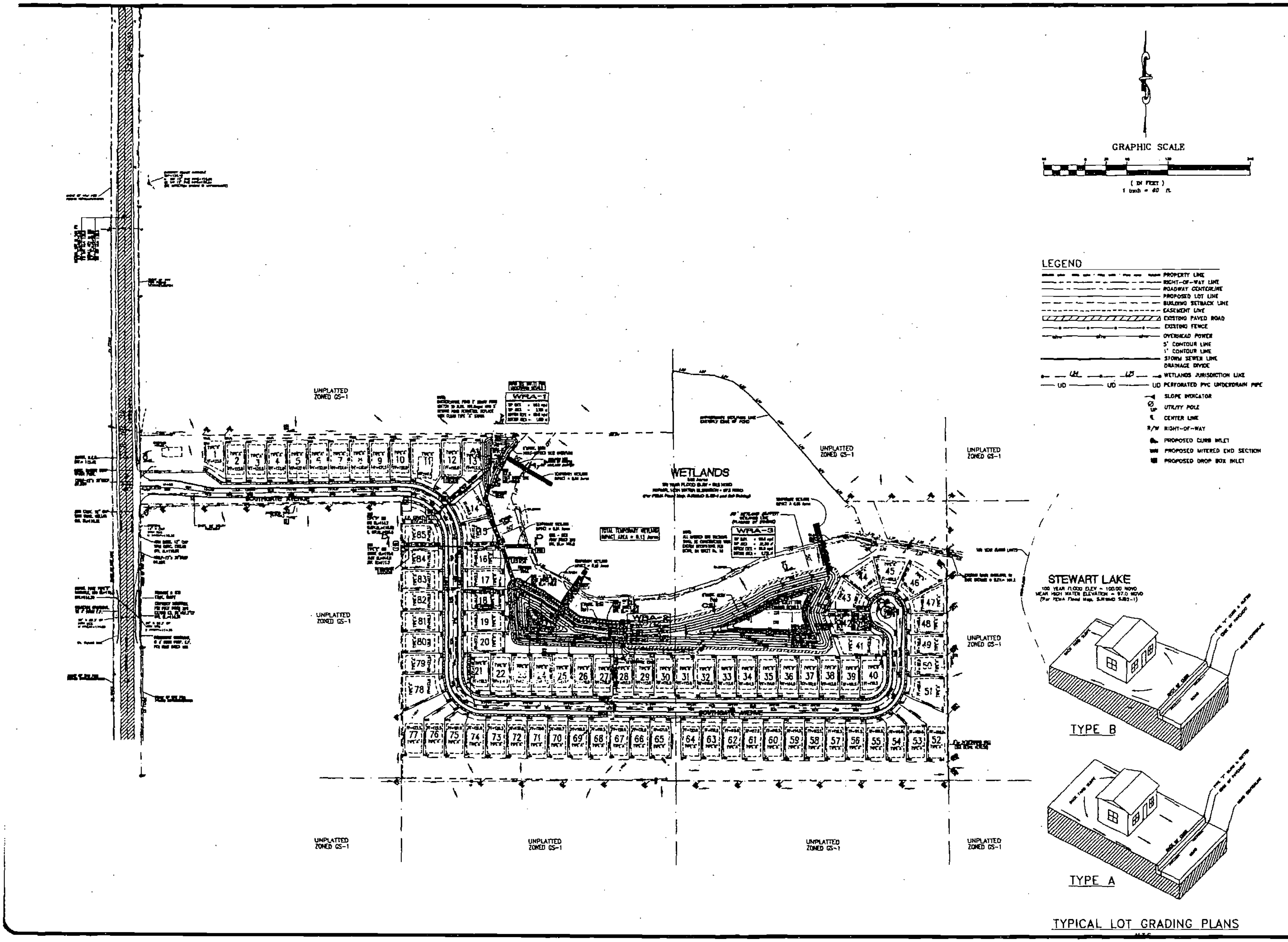
See Section 2.1, Page 3a, for Pre vs Post Development Volume calculation.Total Pre vs Post Discharge Volume from Site is 2.09ac-ft, which is the volume retained below the weir elev.=104.88. This Volume is slowly released through 2.75" orifice.

* SUBTRACT 0.83AC-FT FOR BACKGROUND SEEPAGE

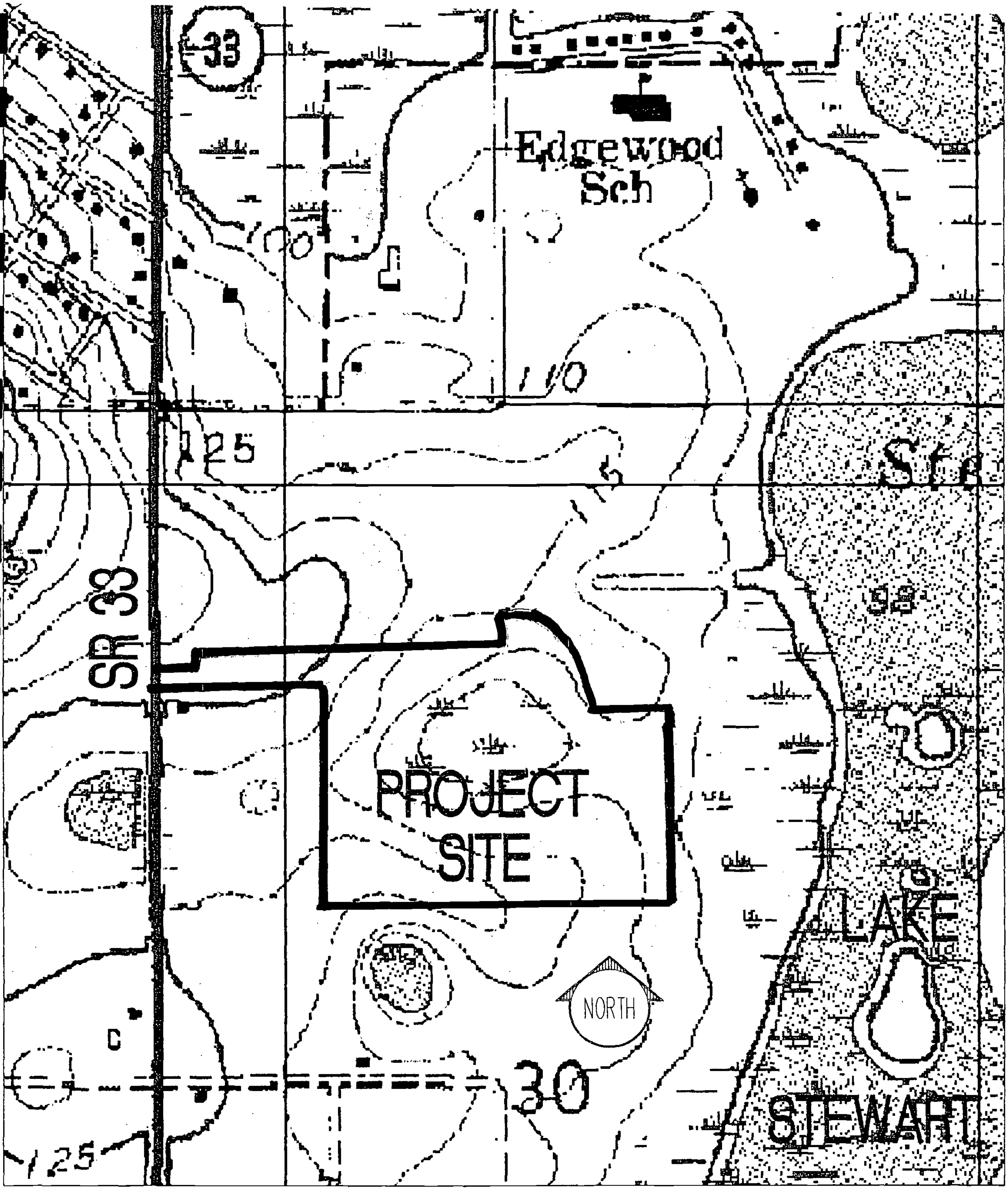
Results Summary

APPENDIX A

PROJECT REFERENCE MAPS



DEPICTION OF WORKS

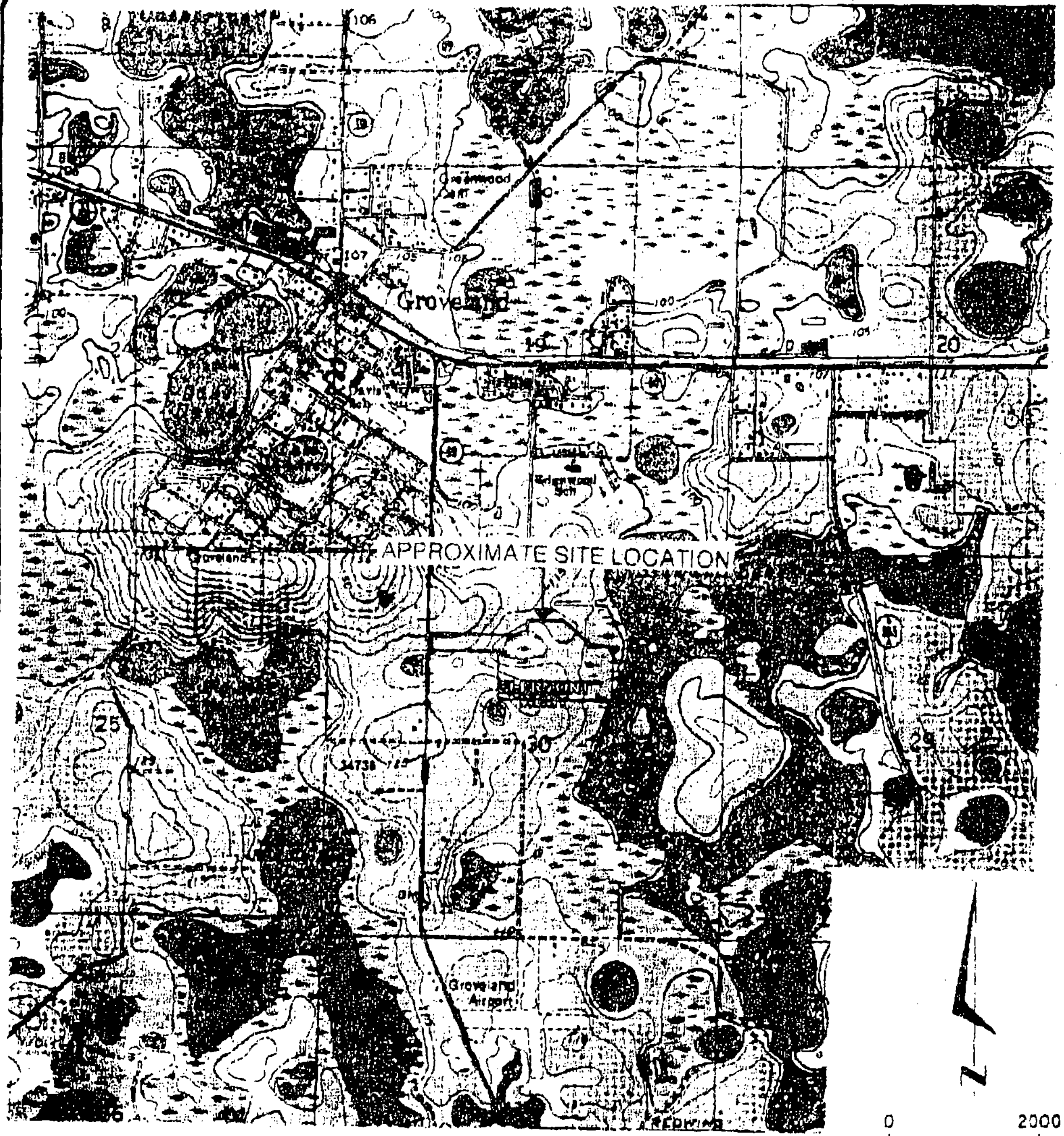


KNIGHT ENGINEERING, INC.
Planning, Design, Permitting, Inspection
221-I N. U.S. HWY. 27, CLERMONT, FL. 34711
PHONE: (352) 394-8514 FAX: (352) 394-8541
www.knighteng.com
Certificate of Authorization No. 00007939

SOUTHGATE SUBDIVISION

QUAD MAP

DATE: MAY 2005
SCALE: 1" = 500'
FILE: IMAGES.DWG
SHEET: 1 of 1



SOURCE: U.S.G.S. QUADRANGLE MAP OF CLERMONT, FLORIDA PHOTOREVISED 1980

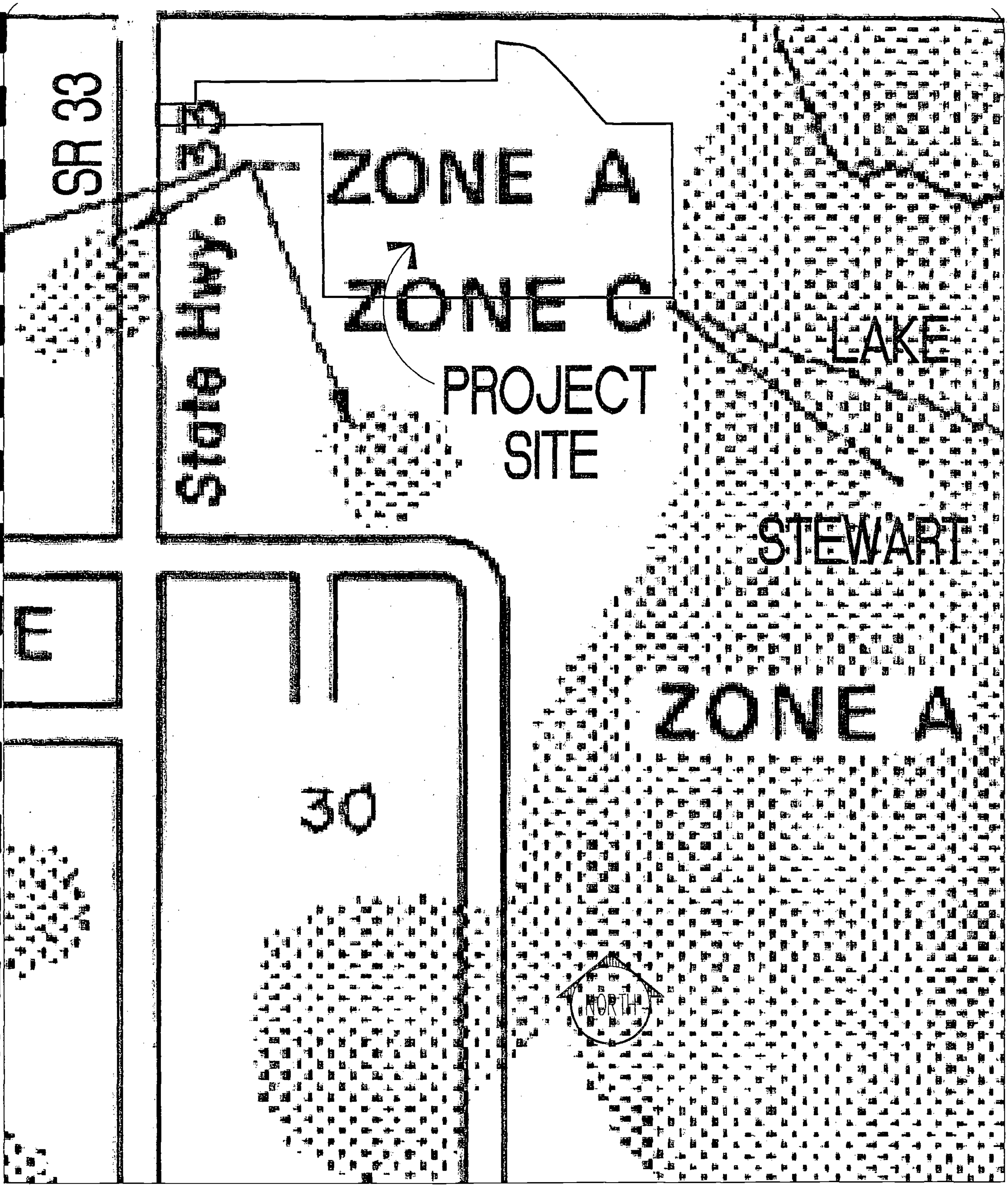
UNIVERSAL
ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION
SOUTHGATE SUBDIVISION-RETENTION PONDS
GROVELAND, LAKE COUNTY, FLORIDA

U.S.G.S. SITE LOCATION MAP

DRAWN BY: M.B.T	DATE: 07-15-04	CHECKED BY: MH	DATE: 7-21-04
SCALE: AS SHOWN	PROJECT NO: 13519-002-01	REPORT NO: 355633	PAGE: A-1

SCS SOILS SURVEY MAP, LAKE Co. Pg. 58



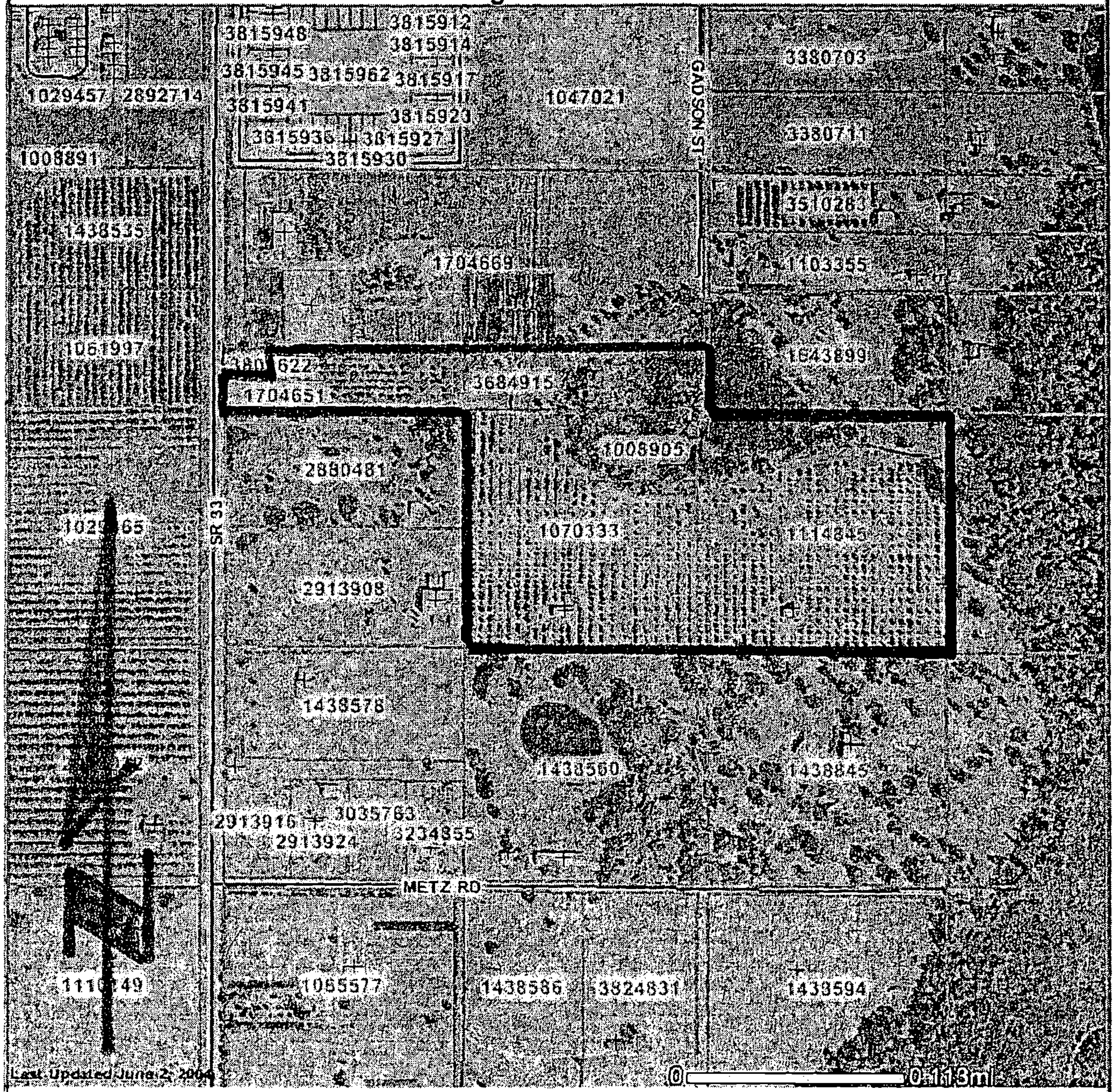
KNIGHT ENGINEERING, INC.
Planning, Design, Permitting, Inspection
221-I N. U.S. HWY. 27, CLERMONT, FL. 34711
PHONE: (352) 394-8514 FAX: (352) 394-8541
www.knighteng.com
Certificate of Authorization No. 00007939

SOUTHGATE SUBDIVISION

FEMA FLOOD MAP

DATE: MAY 2005
SCALE: 1" = 500'
FILE: IMAGES.DWG
SHEET: 1 of 1

Southgate Subdivision



LEGEND

PARCELS

STRUCTURE/ADDRESS

COUNTY PROPERTY

STREETS

2002 PHOTOGRAPHY

COUNTY BOUNDARY

APPENDIX B

PONDS ANALYSIS

PRE-DEVELOPMENT HYDROGRAPHS

```
*****************************************************************
*              BROOKSVILLE PERMITTING DEPARTMENT                *
*          SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT          *
* Sam J. Sebaali, P.E.                     David Z. Sua, P.E.   *
*                                                               *
*          Date:  12-18-2006        Time:  12:39:10             *
*                                                               *
*****************************************************************
```

PONDS - Version 2.25

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-A, 10y24h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:  10.65
Time of Concentration (Min.) ...............:  29.31
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  49.51
Rainfall Depth (In.) .......................:   7.50
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:   6.48
Time To Peak Discharge (Hour) ..............:  12.51
Calculated Total Runoff Volume (Inches) ....:   1.90
```

```
*****************************************************************
*                BROOKSVILLE PERMITTING DEPARTMENT              *
*           SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT         *
* Sam J. Sebaali, P.E.                      David Z. Sua, P.E.  *
*                                                               *
*          Date:  12-18-2006       Time:  12:40:46              *
*                                                               *
*****************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-B, 10y24h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.) ....:	3.90
Time of Concentration (Min.) ....:	29.65
Directly Connected Impervious Area (%) .....:	0.00
Curve Number (CN) ....:	57.01
Rainfall Depth (In.) ....:	7.50
Rainfall Duration (Hr.) ....:	24.00
Rainfall Distribution:	SCS Type II Florida-modified
Unit Hydrograph Shape Factor ....:	256.00

III. Results

Calculated Peak Discharge (cfs) ....:	3.63 ⇐
Time To Peak Discharge (Hour) ....:	12.26
Calculated Total Runoff Volume (Inches) ....:	2.65

```
**********************************************************************
*                BROOKSVILLE PERMITTING DEPARTMENT                   *
*          SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT               *
* Sam J. Sebaali, P.E.                         David Z. Sua, P.E.   *
*                                                                    *
*          Date:  12-18-2006       Time:  12:41:09                   *
*                                                                    *
**********************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-C, 10y24h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:   1.10
Time of Concentration (Min.) ...............:  25.96
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  49.89
Rainfall Depth (In.) .......................:   7.50
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:   0.72
Time To Peak Discharge (Hour) ..............:  12.35
Calculated Total Runoff Volume (Inches) ....:   1.94
```

```
*******************************************************************
*              BROOKSVILLE PERMITTING DEPARTMENT                  *
*         SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT             *
* Sam J. Sebaali, P.E.                         David Z. Sua, P.E. *
*                                                                 *
*          Date:  12-18-2006        Time:  12:40:06               *
*                                                                 *
*******************************************************************
```

PONDS - Version 2.25

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-A, 25y24h Storm
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) .............:  10.65
Time of Concentration (Min.) ...............:  29.31
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  49.51
Rainfall Depth (In.) .......................:   8.60
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:   9.16
Time To Peak Discharge (Hour) ..............:  12.31
Calculated Total Runoff Volume (Inches) ....:   2.57
```

```
*****************************************************************
*              BROOKSVILLE PERMITTING DEPARTMENT                *
*         SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT           *
* Sam J. Sebaali, P.E.                       David Z. Sua, P.E. *
*                                                               *
*          Date:  12-18-2006       Time:  12:41:34              *
*                                                               *
*****************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-B, 25y24h Storm
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:   3.90
Time of Concentration (Min.) ...............:  29.65
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  57.01
Rainfall Depth (In.) .......................:   8.60
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:   4.85
Time To Peak Discharge (Hour) ..............:  12.26
Calculated Total Runoff Volume (Inches) ....:   3.44
```

```
**********************************************************************
*               BROOKSVILLE PERMITTING DEPARTMENT                    *
*          SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT               *
* Sam J. Sebaali, P.E.                           David Z. Sua, P.E. *
*                                                                    *
*          Date:  12-18-2006       Time:  12:42:00                   *
*                                                                    *
**********************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-C, 25y24h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:   1.10
Time of Concentration (Min.) ...............:  25.96
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  49.89
Rainfall Depth (In.) .......................:   8.60
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:   1.03
Time To Peak Discharge (Hour) ..............:  12.29
Calculated Total Runoff Volume (Inches) ....:   2.61
```

```
**********************************************************************
*                 BROOKSVILLE PERMITTING DEPARTMENT                 *
*             SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT           *
* Sam J. Sebaali, P.E.                          David Z. Sua, P.E.  *
*                                                                    *
*           Date:  12-18-2006        Time:  12:42:25                 *
*                                                                    *
**********************************************************************
```

PONDS - Version 2.25

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-A, 100y24h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.)	10.65
Time of Concentration (Min.)	29.31
Directly Connected Impervious Area (%)	0.00
Curve Number (CN)	49.51
Rainfall Depth (In.)	10.50
Rainfall Duration (Hr.)	24.00
Rainfall Distribution: SCS Type II Florida-modified	
Unit Hydrograph Shape Factor	256.00

III. Results

Calculated Peak Discharge (cfs)	14.54
Time To Peak Discharge (Hour)	12.25
Calculated Total Runoff Volume (Inches)	3.84 ≃ ~~3.36~~ 3.41 ac-ft

```
***********************************************************************
*               BROOKSVILLE PERMITTING DEPARTMENT                     *
*          SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT                *
* Sam J. Sebaali, P.E.                          David Z. Sua, P.E.    *
*                                                                     *
*          Date:  12-18-2006       Time:  12:43:52                    *
*                                                                     *
***********************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-B, 100y24h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:   3.90
Time of Concentration (Min.) ...............:  29.65
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  57.01
Rainfall Depth (In.) .......................:  10.50
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:   7.13
Time To Peak Discharge (Hour) ..............:  12.26
Calculated Total Runoff Volume (Inches) ....:   4.89
```
≈ 1.59 ac-ft.

```
******************************************************************
*               BROOKSVILLE PERMITTING DEPARTMENT                *
*           SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT          *
* Sam J. Sebaali, P.E.                       David Z. Sua, P.E.  *
*                                                                *
*           Date:  12-18-2006       Time:  12:44:16              *
*                                                                *
******************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-C, 100y24h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.) ....:	1.10
Time of Concentration (Min.) ....:	25.96
Directly Connected Impervious Area (%) .....:	0.00
Curve Number (CN) ....:	49.89
Rainfall Depth (In.) ....:	10.50
Rainfall Duration (Hr.) ....:	24.00
Rainfall Distribution: SCS Type II Florida-modified	
Unit Hydrograph Shape Factor ....:	256.00

III. Results

Calculated Peak Discharge (cfs) ....:	1.64
Time To Peak Discharge (Hour) ....:	12.23
Calculated Total Runoff Volume (Inches) ....:	3.89 ≃0.36 ac-ft

```
*******************************************************************
*              BROOKSVILLE PERMITTING DEPARTMENT                  *
*         SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT             *
* Sam J. Sebaali, P.E.                        David Z. Sua, P.E. *
*                                                                 *
*          Date:  12-18-2006       Time:  12:44:40                *
*                                                                 *
*******************************************************************
```

PONDS - Version 2.25

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-A, 25y96h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.) ....:	10.65
Time of Concentration (Min.) ....:	29.31
Directly Connected Impervious Area (%) .....:	0.00
Curve Number (CN) ....:	49.51
Rainfall Depth (In.) ....:	11.00
Rainfall Duration (Hr.) ....:	96.00
Rainfall Distribution:	St. John's River WMD 96-Hour
Unit Hydrograph Shape Factor ....:	256.00

III. Results

Calculated Peak Discharge (cfs) ....:	15.84
Time To Peak Discharge (Hour) ....:	60.18
Calculated Total Runoff Volume (Inches) ....:	4.19 ≃ 3.72 ac-ft

```
**********************************************************************
*                BROOKSVILLE PERMITTING DEPARTMENT                   *
*          SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT               *
* Sam J. Sebaali, P.E.                          David Z. Sua, P.E.   *
*                                                                    *
*          Date:  12-18-2006        Time:  12:45:00                  *
*                                                                    *
**********************************************************************
```

PONDS - Version 2.25

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-B, 25y96h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.) ....:	3.90
Time of Concentration (Min.) ....:	29.65
Directly Connected Impervious Area (%) .....:	0.00
Curve Number (CN) ....:	57.01
Rainfall Depth (In.) ....:	11.00
Rainfall Duration (Hr.) ....:	96.00
Rainfall Distribution:	St. John's River WMD 96-Hour
Unit Hydrograph Shape Factor ....:	256.00

III. Results

Calculated Peak Discharge (cfs) ....:	7.30
Time To Peak Discharge (Hour) ....:	60.16
Calculated Total Runoff Volume (Inches) ....:	5.29 ~ 1.72 ac-ft

```
**********************************************************************
*                BROOKSVILLE PERMITTING DEPARTMENT                   *
*           SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT              *
* Sam J. Sebaali, P.E.                           David Z. Sua, P.E.  *
*                                                                    *
*           Date:  12-18-2006       Time:  12:45:23                  *
*                                                                    *
**********************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Pre-Dev. Basin-C, 25y96h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:   1.10
Time of Concentration (Min.) ...............:  25.96
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  49.89
Rainfall Depth (In.) .......................:  11.00
Rainfall Duration (Hr.) ....................:  96.00
Rainfall Distribution:  St. John's River WMD 96-Hour
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:   1.79
Time To Peak Discharge (Hour) ..............:  60.17
Calculated Total Runoff Volume (Inches) ....:   4.25 ≃ 0.39ac-ft
```

POST-DEVELOPMENT HYDROGRAPHS

```
***********************************************************************
*                 BROOKSVILLE PERMITTING DEPARTMENT                   *
*            SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT              *
* Sam J. Sebaali, P.E.                            David Z. Sua, P.E. *
*                                                                     *
*          Date:  12-18-2006        Time:  13:34:45                   *
*                                                                     *
***********************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Post-Dev. Basin-1 & OFF1, 10y24h Storm
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:   3.85
Time of Concentration (Min.) ...............:  22.65
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  62.45
Rainfall Depth (In.) .......................:   7.50
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:   5.28
Time To Peak Discharge (Hour) ..............:  12.18
Calculated Total Runoff Volume (Inches) ....:   3.22
```

```
********************************************************************
*                 BROOKSVILLE PERMITTING DEPARTMENT                *
*            SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT           *
* Sam J. Sebaali, P.E.                         David Z. Sua, P.E.  *
*                                                                  *
*            Date:  12-18-2006        Time:  13:35:19              *
*                                                                  *
********************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Post-Dev. Basin-2, 10yr-24hr Storm Event
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:  11.80
Time of Concentration (Min.) ...............:  27.30
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  67.01
Rainfall Depth (In.) .......................:   7.50
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:  17.32
Time To Peak Discharge (Hour) ..............:  12.19
Calculated Total Runoff Volume (Inches) ....:   3.71
```

```
*******************************************************************
*               BROOKSVILLE PERMITTING DEPARTMENT                 *
*          SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT            *
* Sam J. Sebaali, P.E.                        David Z. Sua, P.E.  *
*                                                                 *
*          Date:  12-18-2006       Time:  13:35:54                *
*                                                                 *
*******************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Post-Dev. Basin-1 & OFF1, 25y24h STORM
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.) ....:	3.85
Time of Concentration (Min.) ....:	22.65
Directly Connected Impervious Area (%) .....:	0.00
Curve Number (CN) ....:	62.45
Rainfall Depth (In.) ....:	8.60
Rainfall Duration (Hr.) ....:	24.00
Rainfall Distribution: SCS Type II Florida-modified	
Unit Hydrograph Shape Factor ....:	256.00

III. Results

Calculated Peak Discharge (cfs) ....:	6.80
Time To Peak Discharge (Hour) ....:	12.18
Calculated Total Runoff Volume (Inches) ....:	4.08

```
**************************************************************************
*              BROOKSVILLE PERMITTING DEPARTMENT                          *
*          SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT                   *
* Sam J. Sebaali, P.E.                          David Z. Sua, P.E. *
*                                                                          *
*          Date:  12-18-2006       Time:  13:36:25                       *
*                                                                          *
**************************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Post-Dev. Basin-2, 25yr-24hr Storm Event
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:  11.80
Time of Concentration (Min.) ...............:  27.30
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  67.01
Rainfall Depth (In.) .......................:   8.60
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ..............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ...........:  21.84
Time To Peak Discharge (Hour) .............:  12.19
Calculated Total Runoff Volume (Inches) ....:   4.63
```

```
*****************************************************************
*                BROOKSVILLE PERMITTING DEPARTMENT              *
*           SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT         *
* Sam J. Sebaali, P.E.                        David Z. Sua, P.E. *
*                                                               *
*           Date:  12-18-2006       Time:  13:36:50             *
*                                                               *
*****************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Post-Dev. Basin-1 & OFF1, 100y24h Storm
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.) ....: 3.85
Time of Concentration (Min.) ....: 22.65
Directly Connected Impervious Area (%) .....: 0.00
Curve Number (CN) ....: 62.45
Rainfall Depth (In.) ....: 10.50
Rainfall Duration (Hr.) ....: 24.00
Rainfall Distribution: SCS Type II Florida-modified
Unit Hydrograph Shape Factor ....: 256.00

III. Results

Calculated Peak Discharge (cfs) ....: 9.56
Time To Peak Discharge (Hour) ....: 12.13
Calculated Total Runoff Volume (Inches) ....: 5.65 ≃ 1.81 AC-FT

```
*******************************************************************
*              BROOKSVILLE PERMITTING DEPARTMENT                  *
*         SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT             *
* Sam J. Sebaali, P.E.                        David Z. Sua, P.E.  *
*                                                                 *
*           Date:  12-18-2006       Time:  13:37:15               *
*                                                                 *
*******************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Post-Dev. Basin-2, 100yr-24hr Storm Event
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

```
Contributing Basin Area (Ac.) ..............:  11.80
Time of Concentration (Min.) ...............:  27.30
Directly Connected Impervious Area (%) .....:   0.00
Curve Number (CN) ..........................:  67.01
Rainfall Depth (In.) .......................:  10.50
Rainfall Duration (Hr.) ....................:  24.00
Rainfall Distribution:  SCS Type II Florida-modified
Unit Hydrograph Shape Factor ...............: 256.00
```

III. Results

```
Calculated Peak Discharge (cfs) ............:  29.91
Time To Peak Discharge (Hour) ..............:  12.19
Calculated Total Runoff Volume (Inches) ....:   6.27 ≈ 6.16 AC-FT
```

```
**********************************************************************
*               BROOKSVILLE PERMITTING DEPARTMENT                    *
*          SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT               *
* Sam J. Sebaali, P.E.                          David Z. Sua, P.E.   *
*                                                                    *
*          Date:  12-18-2006       Time:  13:39:23                   *
*                                                                    *
**********************************************************************
```

PONDS - Version 2.25

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Post-Dev. Basin-1 & OFF1, 25y96h Storm
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.) ....:	3.85
Time of Concentration (Min.) ....:	22.65
Directly Connected Impervious Area (%) .....:	0.00
Curve Number (CN) ....:	62.45
Rainfall Depth (In.) ....:	11.00
Rainfall Duration (Hr.) ....:	96.00
Rainfall Distribution: St. John's River WMD 96-Hour	
Unit Hydrograph Shape Factor ....:	256.00

III. Results

Calculated Peak Discharge (cfs) ....:	9.65
Time To Peak Discharge (Hour) ....:	60.15
Calculated Total Runoff Volume (Inches) ....:	6.07 ≃ 1.95 AC-FT

```
**************************************************************************
*                 BROOKSVILLE PERMITTING DEPARTMENT                      *
*            SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT                 *
* Sam J. Sebaali, P.E.                              David Z. Sua, P.E.   *
*                                                                        *
*           Date:  12-18-2006       Time:  13:39:51                      *
*                                                                        *
**************************************************************************
```

PONDS - Version 2.25
Copyright 1995

Written By Devo Seereeram, Ph.D.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Hydrograph Generation

I. Job Information

Job Name: Southgate Subdv; Post-Dev. Basin-2, 25yr-96hr Storm Event
Engineer: Tom Knight, P.E.
Date : Dec. 2006

II. Input Data

Contributing Basin Area (Ac.)	11.80
Time of Concentration (Min.)	27.30
Directly Connected Impervious Area (%)	0.00
Curve Number (CN)	67.01
Rainfall Depth (In.)	11.00
Rainfall Duration (Hr.)	96.00
Rainfall Distribution:	St. John's River WMD 96-Hour
Unit Hydrograph Shape Factor	256.00

III. Results

Calculated Peak Discharge (cfs)	29.31
Time To Peak Discharge (Hour)	60.18
Calculated Total Runoff Volume (Inches)	6.71 ≃ 6.60 AC-FT

WRA #1 STAGE vs DISCHARGE

(10year-24hour Storm Event)

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Retention Pond Recovery Analysis - Inflow Hydrograph

I. Job Information

Job Name: Southgate Subdivision; Stage vs Discharge, WRA-1, 10y24h
Engineer: Tom Knight, P.E.
Date: Dec. 2006

II. Input Data

Equivalent Pond Length, [L] (ft):	113.00
Equivalent Pond Width, [W] (ft):	60.00
Base Of Aquifer Elevation, [B] (ft above datum):	100.00
Water Table Elevation, [WT] (ft above datum):	104.50
Horizontal Saturated Hydraulic Conductivity, [Kh] (ft/day)	21.60
Fillable Porosity of Aquifer, [n] (%):	25.00
Is there a ditch parallel to the pond length axis?:	No
Is there a ditch parallel to the pond width axis?:	No
Include unsaturated vertical infiltration?:	Yes
Unsaturated vertical infiltration rate, (ft/day):	14.40
Maximum area for unsaturated infiltration, (sq ft):	6790
Groundwater mound intersects pond bottom?:	Yes

Took credit for infiltration losses.

Project is 40C-42
N/A

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Is showing a 50' wide overflow weir @ 110.0' NOT shown on plans!

III. Input Data - Discharge Structures

Weir (or Orifice) #1 is Active

Discharge Elevation, [D] (ft above datum):	110.00
Discharge Coefficient, [C]:	2.86
Dimension, [WL] (ft or ft^2):	50.00
Exponent, [Wn]:	1.50

Weir (or Orifice) #2 is Inactive

Weir (or Orifice) #3 is Inactive

needs to stabilize & provide detail
Show location on plans.

Project is a 40C-42 ... 10/24, 25/24 & 25/96 water quality N/A

V. Input Data - Stage vs Area Data

Stage (ft datum)	Area (ft^2)
107.000	3019.0
107.500	3487.0
108.500	4515.0
109.500	5624.0
110.500	6790.0

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

VIII. Summary - Cumulative Volumes, Peaks Rates, and Peak Stage

Inflow

Peak Inflow Rate, (cfs):	5.28
Time, (hrs):	12.18
Cumulative Inflow Volume, (ft^3):	44933

Stage

Peak Stage, (ft datum):	110.06
Time, (hrs):	12.89

Overflow Discharge

Peak Discharge Rate, (cfs):	2.17
Time, (hrs):	12.94
Cumulative weir discharge volume, (ft^3):	14501

Infiltration Rate

Peak Infiltration Rate, (cfs):	2.0661
Time, (hrs):	13.19
Cumulative Infiltration Volume, (ft^3):	17420

WRA #1 STAGE vs DISCHARGE

(25year-24hour Storm Event)

PONDS - Version 2.26
Copyright 1995

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Retention Pond Recovery Analysis - Inflow Hydrograph

I. Job Information

Job Name: Southgate Subdivision; Stage vs Discharge, WRA-1, 25y24h
Engineer: Tom Knight, P.E.
Date: Dec. 2006

II. Input Data

Equivalent Pond Length, [L] (ft):	113.00
Equivalent Pond Width, [W] (ft):	60.00
Base Of Aquifer Elevation, [B] (ft above datum):	100.00
Water Table Elevation, [WT] (ft above datum):	104.50
Horizontal Saturated Hydraulic Conductivity, [Kh] (ft/day)	21.60
Fillable Porosity of Aquifer, [n] (%):	25.00
Is there a ditch parallel to the pond length axis?:	No
Is there a ditch parallel to the pond width axis?:	No
Include unsaturated vertical infiltration?:	Yes
Unsaturated vertical infiltration rate, (ft/day):	14.40
Maximum area for unsaturated infiltration, (sq ft):	6790
Groundwater mound intersects pond bottom?:	Yes

PONDS - Version 2.26
Copyright 1995

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

III. Input Data - Discharge Structures

Weir (or Orifice) #1 is Active

Discharge Elevation, [D] (ft above datum):	110.00
Discharge Coefficient, [C]:	2.86
Dimension, [WL] (ft or ft^2):	50.00
Exponent, [Wn]:	1.50

Weir (or Orifice) #2 is Inactive

Weir (or Orifice) #3 is Inactive

IV. Input Data - Stage vs Area Data

Stage (ft datum)	Area (ft^2)
107.000	3019.0
107.500	3487.0
108.500	4515.0
109.500	5624.0
110.500	6790.0

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

VIII. Summary - Cumulative Volumes, Peaks Rates, and Peak Stage

Inflow

Peak Inflow Rate, (cfs):	6.80
Time, (hrs):	12.18
Cumulative Inflow Volume, (ft^3):	56995

Stage

Peak Stage, (ft datum):	110.10
Time, (hrs):	12.58

Overflow Discharge

Peak Discharge Rate, (cfs):	4.48
Time, (hrs):	12.63
Cumulative weir discharge volume, (ft^3):	26375

Infiltration Rate

Peak Infiltration Rate, (cfs):	2.1971
Time, (hrs):	12.89
Cumulative Infiltration Volume, (ft^3):	17576

WRA #1 STAGE vs DISCHARGE

(100year-24hour Storm Event)

PONDS - Version 2.26
Copyright 1995

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Retention Pond Recovery Analysis - Inflow Hydrograph

I. Job Information

Job Name: Southgate Subdivision; Stage vs Discharge, WRA-1, 100y24h
Engineer: Tom Knight, P.E.
Date: Dec. 2006

II. Input Data

Equivalent Pond Length, [L] (ft):	113.00
Equivalent Pond Width, [W] (ft):	60.00
Base Of Aquifer Elevation, [B] (ft above datum):	100.00
Water Table Elevation, [WT] (ft above datum):	104.50
Horizontal Saturated Hydraulic Conductivity, [Kh] (ft/day)	21.60
Fillable Porosity of Aquifer, [n] (%):	25.00
Is there a ditch parallel to the pond length axis?:	No
Is there a ditch parallel to the pond width axis?:	No
Include unsaturated vertical infiltration?:	Yes
Unsaturated vertical infiltration rate, (ft/day):	14.40
Maximum area for unsaturated infiltration, (sq ft):	6790
Groundwater mound intersects pond bottom?:	Yes

PONDS - Version 2.26
Copyright 1993

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

Licensed Solely For Use By:
Jeff A. Ottaway

Underdrain Design Calculations

I. Job Information

Job Name: Southgate Subdivision; UnderDrain Analysis, WRA-1
Engineer: Tom Knight, P.E.
Date: Dec. 2006

II. Input Data

Area At Top Of Pond, [ATOP] (Sq Ft):	6790.0
Depth of Basin, [d] (Feet):	3.50
Aquifer Depth Below Pond Bottom, [B] (Feet):	7.00
Desired Depth To Water Table Below Pond Bottom, [R] (Feet):	0.50
Hydraulic Conductivity of Soil, [K] (Ft/Day):	21.60
Drain Diameter, [D] (Inches):	6.00
Thickness Of Gravel Envelope, [t] (in):	3.00
Thickness Of Soil Cover, [H] (Feet):	2.00
Treatment Volume, [PAV] (Cubic Feet):	13800.0
Recovery Time, [T] (Days):	3.00
Factor Of Safety, [FS]:	2.00
Background Seepage, [qb] (gpm):	7.83
Mannings n Value for Lateral Drain Pipe, [n1]:	0.01500
Mannings n Value for Main Drain Pipe, [n2]:	0.01000
Slope Of Lateral Drains, [s1] (%):	0.300
Slope of Main Drain, [s2] (%):	0.300
Maximum Length Of Single Lateral Drain, [l] (ft):	60.0
Max. % of Length of Laterals Connected To Main Drain, [P] (%):	100.00

III. Results

Computed Underdrain Spacing, [S] (ft):	34.72
Computed Total Length Of Laterals, [L] (ft):	195.57
Computed Flow Rate Through Outfall, [Q] (cfs):	1.23926E-01
Computed Flow Rate Per Foot Of Lateral, [ql] (cfs/ft):	6.33662E-04
Cumulative Flow Rate For The Longest Lateral, [qc] (cfs):	3.80197E-02
Minimum Theoretical Diameter for Longest Lateral, [Dl] (in):	2.90
Minimum Theoretical Diameter for Main Pipe, [Dm] (in):	3.87

Underdrain Design Calculations

IV. Notes:

1. Laterals should be no farther than S/2 from the top of the basin.
2. A gravel envelope at least 3 inches thick is recommended around the underdrain pipes. If a gravel envelope is used, a filter fabric will be required around this envelope.
3. The underdrain pipe should have a filter fabric sock to prevent fines from moving into and clogging the perforated pipe.
4. Ensure outfall elevation for system will allow gravity flow without tailwater backpressure to the underdrains.
5. Theory is applicable where ground water flow is largely in a horizontal direction (i.e., natural gradients less than 1%).
6. Capped and sealed inspection and cleanout ports which extend to the ground surface are recommended at the following locations for each drain pipe:
    a. the terminus
    b. at every 400 feet or every bend of 45 or more degress, whichever is shortest
7. Underdrain basin should be stabilized with permanent vegaetative cover.

V. Warnings:

None.

AdICPR ANALYSIS
WRA #2

WRA #2 – POST-DEVELOPMENT BASIN SUMMARY

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.20) [1]

SOUTHGATE SUBDIVISION
STAGE vs DISCHARGE ANALYSIS
WRA-2, POST-DEV. CONDITION

********** Basin Summary - 10Y24H **

***

Basin Name:	2
Group Name:	BASE
Node Name:	WRA2
Hydrograph Type:	SB
Spec Time Inc (min):	5.00
Comp Time Inc (min):	5.00
Rainfall File:	FLMOD
Rainfall Amount (in):	7.50
Storm Duration (hr):	24.00
Status:	ONSITE
Time of Conc. (min):	27.30
Lag Time (hr):	0.00
Area (acres):	11.80
Curve Number:	67.01
DCIA (%):	0.00
Time Max (hrs):	12.00
Flow Max (cfs):	22.09
Runoff Volume (in):	3.71
Runoff Volume (cf):	158745

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.20) [1]

SOUTHGATE SUBDIVISION
STAGE vs DISCHARGE ANALYSIS
WRA-2, POST-DEV. CONDITION

********** Basin Summary - 25Y24H ***

***

Basin Name:	2
Group Name:	BASE
Node Name:	WRA2
Hydrograph Type:	SB
Spec Time Inc (min):	5.00
Comp Time Inc (min):	5.00
Rainfall File:	FLMOD
Rainfall Amount (in):	8.60
Storm Duration (hr):	24.00
Status:	ONSITE
Time of Conc. (min):	27.30
Lag Time (hr):	0.00
Area (acres):	11.80
Curve Number:	67.01
DCIA (%):	0.00
Time Max (hrs):	12.00
Flow Max (cfs):	27.78
Runoff Volume (in):	4.62
Runoff Volume (cf):	197859

SOUTHGATE SUBDIVISION
STAGE vs DISCHARGE ANALYSIS
WRA-2, POST-DEV. CONDITION

********** Basin Summary - 100Y24H **

***

Basin Name:	2
Group Name:	BASE
Node Name:	WRA2
Hydrograph Type:	SB
Spec Time Inc (min):	5.00
Comp Time Inc (min):	5.00
Rainfall File:	FLMOD
Rainfall Amount (in):	10.50
Storm Duration (hr):	24.00
Status:	ONSITE
Time of Conc. (min):	27.30
Lag Time (hr):	0.00
Area (acres):	11.80
Curve Number:	67.01
DCIA (%):	0.00
Time Max (hrs):	12.00
Flow Max (cfs):	37.93
Runoff Volume (in):	6.26
Runoff Volume (cf):	268276

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

III. Input Data - Discharge Structures

Weir (or Orifice) #1 is Active

Discharge Elevation, [D] (ft above datum):	110.00
Discharge Coefficient, [C]:	2.86
Dimension, [WL] (ft or ft^2):	50.00
Exponent, [Wn]:	1.50

Weir (or Orifice) #2 is Inactive

Weir (or Orifice) #3 is Inactive

IV. Input Data - Stage vs Area Data

Stage (ft datum)	Area (ft^2)
107.000	3019.0
107.500	3487.0
108.500	4515.0
109.500	5624.0
110.500	6790.0

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

VIII. Summary - Cumulative Volumes, Peaks Rates, and Peak Stage

Inflow

Peak Inflow Rate, (cfs):	9.56
Time, (hrs):	12.13
Cumulative Inflow Volume, (ft^3):	78596

Stage

Peak Stage, (ft datum):	110.15 ←
Time, (hrs):	12.28

Overflow Discharge

Peak Discharge Rate, (cfs):	7.78
Time, (hrs):	12.33
Cumulative weir discharge volume, (ft^3):	47678 ≃ 1.09 AC-FT

Infiltration Rate

Peak Infiltration Rate, (cfs):	2.0610
Time, (hrs):	12.43
Cumulative Infiltration Volume, (ft^3):	17801

WRA #1 STAGE vs DISCHARGE

(25year-96hour Storm Event)

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

Retention Pond Recovery Analysis - Inflow Hydrograph

I. Job Information

Job Name: Southgate Subdivision; Stage vs Discharge, WRA-1, 25y96h
Engineer: Tom Knight, P.E.
Date: Dec. 2006

II. Input Data

Equivalent Pond Length, [L] (ft):	113.00
Equivalent Pond Width, [W] (ft):	60.00
Base Of Aquifer Elevation, [B] (ft above datum):	100.00
Water Table Elevation, [WT] (ft above datum):	104.50
Horizontal Saturated Hydraulic Conductivity, [Kh] (ft/day)	21.60
Fillable Porosity of Aquifer, [n] (%):	25.00
Is there a ditch parallel to the pond length axis?:	No
Is there a ditch parallel to the pond width axis?:	No
Include unsaturated vertical infiltration?:	Yes
Unsaturated vertical infiltration rate, (ft/day):	14.40
Maximum area for unsaturated infiltration, (sq ft):	6790
Groundwater mound intersects pond bottom?:	Yes

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

III. Input Data - Discharge Structures

Weir (or Orifice) #1 is Active

Discharge Elevation, [D] (ft above datum):	110.00
Discharge Coefficient, [C]:	2.86
Dimension, [WL] (ft or ft^2):	50.00
Exponent, [Wn]:	1.50

Weir (or Orifice) #2 is Inactive

Weir (or Orifice) #3 is Inactive

IV. Input Data - Stage vs Area Data

Stage (ft datum)	Area (ft^2)
107.000	3019.0
107.500	3487.0
108.500	4515.0
109.500	5624.0
110.500	6790.0

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

VIII. Summary - Cumulative Volumes, Peaks Rates, and Peak Stage

Inflow

Peak Inflow Rate, (cfs): 9.65
Time, (hrs): 60.10

Cumulative Inflow Volume, (ft^3): 84620

Stage

Peak Stage, (ft datum): 110.16
Time, (hrs): 60.25

Overflow Discharge

Peak Discharge Rate, (cfs): 8.18
Time, (hrs): 60.25

Cumulative weir discharge volume, (ft^3): 43783 ≈ 1.01 Ac. FT

Infiltration Rate

Peak Infiltration Rate, (cfs): 0.6195
Time, (hrs): 60.05

Cumulative Infiltration Volume, (ft^3): 27561

PONDS
WRA #1 – BACKGROUND SEEPAGE ANALYSIS

PONDS - Version 2.26
Copyright 1993

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

Licensed Solely For Use By:

Background Seepage Analysis

I. Job Information

Job Name: Southgate Subdivision; background Seepage Analysis, WRA-1
Engineer: Tom Knight, P.E.
Date: Dec. 2006

II. Input Data

Pond Control Elevation, [O] (ft above datum):	104.50
Bottom Of Aquifer Elevation, [B] (ft above datum):	100.00
Seasonal High Groundwater Elevation, [H] (ft above datum):	108.00
Seasonal Fluctuation Of Water Table, [F] (ft):	3.00
Hydraulic Conductivity Of Aquifer, [k] (ft/day) :	21.60
Specific Yield Of Aquifer, [S] (%):	25.00
Duration of Wet Season, [T] (days):	153.00
Length of Pond, [L] (ft):	113.00
Width of Pond, [W] (ft):	60.00

III. Results

Background Seepage Rate, [Q] (ft^3/day): 1507.86
Background Seepage Rate, [Q] (gpm): 7.83 ≃ 0.0174cfs

Groundwater Drawdown Profile:

Distance From Edge Of Pond (feet)	Water Table Drawdown (feet)
1380.0	0.00
1140.0	0.01
900.0	0.02
660.0	0.07
480.0	0.18
360.0	0.34
240.0	0.65
150.0	1.13
90.0	1.66
45.0	2.36
22.5	2.86
7.5	3.27
0.0	3.50

Background Seepage Analysis

PONDS
WRA #1 – UNDERDRAIN & VOLUME RECOVERY

SOUTHGATE SUBDIVISION
STAGE vs DISCHARGE ANALYSIS
WRA-2, POST-DEV. CONDITION

********** Basin Summary - 25Y96H **

***

Basin Name:	2
Group Name:	BASE
Node Name:	WRA2
Hydrograph Type:	SB
Spec Time Inc (min):	5.00
Comp Time Inc (min):	5.00
Rainfall File:	SJRWMD96
Rainfall Amount (in):	11.00
Storm Duration (hr):	96.00
Status:	ONSITE
Time of Conc. (min):	27.30
Lag Time (hr):	0.00
Area (acres):	11.80
Curve Number:	67.01
DCIA (%):	0.00
Time Max (hrs):	59.92
Flow Max (cfs):	34.49
Runoff Volume (in):	6.71
Runoff Volume (cf):	287466

WRA #2 – INPUT DATA

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.20) [1]

INPUT DATA

POST-DEVELOPMENT STAGE vs DISCHARGE ANALYSIS

********** **Input Report** **

--------Class: **Node**--

Name: WETLAND   Base Flow(cfs): 0   Init Stage(ft): 102.75
Group: BASE   Warn Stage(ft): 104
Comment: EXISTING WETLAND AREA

Time(hrs)	Stage(ft)
0	102.75
18	103.75
24	103.5
36	102.75

--------Class: **Node**--

Name: WRA2   Base Flow(cfs): 0.108   Init Stage(ft): 103.2
Group: BASE   Warn Stage(ft): 106.5
Comment: PROPOSED WETPOND "WRA #2"(Bckgrnd Seep=0.108cfs)

Bottom Area(ac): 1.03

Stage(ft)	Volume(af)
103.2	0
104	0.901
105	2.259
106	3.88
106.5	4.81

--------Class: **Basin**--

Basin: 2   Node: WRA2   Status: On Site   Type: Santa Barbara
Group: BASE

Rainfall File: FLMOD   Storm Duration(hrs): 24
Rainfall Amount(in): 8.6   Time Increment(min): 5
Area(ac): 11.8
Curve #: 67.01   Concentration Time(min): 27.3
DCIA(%): 0   Time Shift(hrs): 0

POST-DEV. BASIN-2

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.20) [2]

POST-DEVELOPMENT STAGE vs DISCHARGE ANALYSIS

```
********** Input Report ******************************************************
---------Class: Drop Structure------------------------------------------------
     Name: DS16           From Node: WRA2          Length(ft): 100
    Group: BASE             To Node: WETLAND            Count: 1

    Outlet Cntrl Spec: Use dn or tw     Inlet Cntrl Spec: Use dn
    Upstream Geometry: Circular      Downstream Geometry: Circular
                                UPSTREAM             DOWNSTREAM
               Span(in): 24                    24
               Rise(in): 24                    24
             Invert(ft): 100.5                 98
            Manning's N: 0.01                  0.01
            Top Clip(in): 0                    0
         Bottom Clip(in): 0                    0

     Entrance Loss Coef: 0.5                    Flow: Both
         Exit Loss Coef: 0.5                Equation: Aver Conveyance

      Upstream FHWA Inlet Edge Description:
      Circular Concrete: Square edge w/ headwall               1     1
      Downstream FHWA Inlet Edge Description:
      Circular Concrete: Square edge w/ headwall               1     1

              DISCHARGE FROM CONTROL STRUCTURE TO EX. WETLAND
 *** Weir 1 of 2 for Drop Structure DS16 ***                   [TABLE]
   Count: 1                     Bottom Clip(in): 0
    Type: Mavis                    Top Clip(in): 0
    Flow: Both              Weir Discharge Coef: 3.13
Geometry: Circular       Orifice Discharge Coef: 4.8

         Span(in): 2.75                        Invert(ft): 103.2
         Rise(in): 2.75                  Control Elev(ft): 103.2


 *** Weir 2 of 2 for Drop Structure DS16 ***                   [TABLE]
   Count: 1                     Bottom Clip(in): 0
    Type: Mavis                    Top Clip(in): 0
    Flow: Both              Weir Discharge Coef: 3.13
Geometry: Rectangular    Orifice Discharge Coef: 4.8

         Span(in): 36                          Invert(ft): 104.88
         Rise(in): 24                    Control Elev(ft): 104.88
```

```
    Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.20) [3]
    Copyright 1995, Streamline Technologies, Inc.

    POST-DEVELOPMENT STAGE vs DISCHARGE ANALYSIS


    ********** Input Report ****************************************************
    --------Class: Simulation-------------------------------------------------------
 C:\DWG\SOUTHG~1\ADICPR\POST\25Y24H
 Execution: Both
    Header: SOUTHGATE SUBDIVISION
            STAGE vs DISCHARGE ANALYSIS
            WRA-2, POST-DEV. CONDITION
---------HYDRAULICS-----------------------------HYDROLOGY--------------------
        Max Delta Z (ft): 1
          Delta Z Factor: 0.05          Override Defaults: Yes
     Time Step Optimizer: 10               Storm Dur(hrs): 24
Drop Structure Optimizer: 10              Rain Amount(in): 8.6
     Sim Start Time(hrs): 0                 Rainfall File: FLMOD
       Sim End Time(hrs): 24
      Min Calc Time(sec): 5
      Max Calc Time(sec): 15
        To Hour:   PInc(min):                 To Hour:   PInc(min):
        8          15                         8          15
        14         5                          14         5
        24         15                         24         15
---------GROUP SELECTIONS----------------------------------------------------
+ BASE     [01/02/07]
    --------Class: Simulation-------------------------------------------------------
 C:\DWG\SOUTHG~1\ADICPR\POST\10Y24H
 Execution: None
    Header: SOUTHGATE SUBDIVISION
            STAGE vs DISCHARGE ANALYSIS
            WRA-2, POST-DEV. CONDITION
---------HYDRAULICS-----------------------------HYDROLOGY--------------------
        Max Delta Z (ft): 1
          Delta Z Factor: 0.05          Override Defaults: Yes
     Time Step Optimizer: 10               Storm Dur(hrs): 24
Drop Structure Optimizer: 10              Rain Amount(in): 7.5
     Sim Start Time(hrs): 0                 Rainfall File: FLMOD
       Sim End Time(hrs): 24
      Min Calc Time(sec): 5
      Max Calc Time(sec): 15
        To Hour:   PInc(min):                 To Hour:   PInc(min):
        8          15                         8          15
        14         5                          14         5
        24         15                         24         15
---------GROUP SELECTIONS----------------------------------------------------
+ BASE     [01/02/07]
```

```
Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.20) [4]
Copyright 1995, Streamline Technologies, Inc.

POST-DEVELOPMENT STAGE vs DISCHARGE ANALYSIS


********** Input Report *****************************************************
--------Class: Simulation-------------------------------------------------------
C:\DWG\SOUTHG~1\ADICPR\POST\100Y24H
Execution: Both
   Header: SOUTHGATE SUBDIVISION
           STAGE vs DISCHARGE ANALYSIS
           WRA-2, POST-DEV. CONDITION
---------HYDRAULICS----------------------------HYDROLOGY--------------------
        Max Delta Z (ft): 1
          Delta Z Factor: 0.05          Override Defaults: Yes
     Time Step Optimizer: 10               Storm Dur(hrs): 24
Drop Structure Optimizer: 10             Rain Amount(in): 10.5
     Sim Start Time(hrs): 0                Rainfall File: FLMOD
       Sim End Time(hrs): 24
      Min Calc Time(sec): 5
      Max Calc Time(sec): 15
        To Hour:   PInc(min):                  To Hour:   PInc(min):
        8          15                          8          15
        14         5                           14         5
        24         15                          24         15
---------GROUP SELECTIONS--------------------------------------------------
+ BASE     [01/02/07]
    --------Class: Simulation-------------------------------------------------------
C:\DWG\SOUTHG~1\ADICPR\POST\25Y96H
Execution: Both
   Header: SOUTHGATE SUBDIVISION
           STAGE vs DISCHARGE ANALYSIS
           WRA-2, POST-DEV. CONDITION
---------HYDRAULICS----------------------------HYDROLOGY--------------------
        Max Delta Z (ft): 1
          Delta Z Factor: 0.05          Override Defaults: Yes
     Time Step Optimizer: 10               Storm Dur(hrs): 96
Drop Structure Optimizer: 10             Rain Amount(in): 11
     Sim Start Time(hrs): 0                Rainfall File: SJRWMD96
       Sim End Time(hrs): 96
      Min Calc Time(sec): 5
      Max Calc Time(sec): 15
        To Hour:   PInc(min):                  To Hour:   PInc(min):
        50         15                          50         15
        70         5                           70         5
        96         15                          96         15
---------GROUP SELECTIONS--------------------------------------------------
+ BASE     [01/02/07]
```

WRA #2 – MAX NODE CONDITIONS

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.20) [1]

SOUTHGATE SUBDIVISION
STAGE vs DISCHARGE ANALYSIS
WRA-2, POST-DEV. NODE MAX.CONDITIONS

********** ***Node Maximum Conditions - 10Y24H*** **********

(Time units - hours)

Node Name	Group Name	Max Time Conditions	Max Stage (ft)	Warning Stage (ft)	Max Delta Stage (ft)	Max Surface Area (sf)	Max Time Inflow	Max Inflow (cfs)	Max Time Outflow	Max Outflow (cfs)
WETLAND	BASE	15.00	103.75	104.00	0.0003	0.00	14.46	3.00	0.00	0.00
WRA2	BASE	14.51	**105.00**	106.50	0.0060	65014.87	12.00	22.18	14.46	**3.00**

********** ***Node Maximum Conditions - 25Y24H*** **********

(Time units - hours)

Node Name	Group Name	Max Time Conditions	Max Stage (ft)	Warning Stage (ft)	Max Delta Stage (ft)	Max Surface Area (sf)	Max Time Inflow	Max Inflow (cfs)	Max Time Outflow	Max Outflow (cfs)
WETLAND	BASE	18.00	103.75	104.00	0.0002	0.00	14.14	4.15	0.00	0.00
WRA2	BASE	14.16	**105.25**	106.50	0.0074	67860.83	12.00	27.87	14.14	**4.15**

********** ***Node Maximum Conditions - 100Y24H*** **********

(Time units - hours)

Node Name	Group Name	Max Time Conditions	Max Stage (ft)	Warning Stage (ft)	Max Delta Stage (ft)	Max Surface Area (sf)	Max Time Inflow	Max Inflow (cfs)	Max Time Outflow	Max Outflow (cfs)
WETLAND	BASE	18.00	103.75	104.00	0.0002	0.00	13.48	8.34	0.00	0.00
WRA2	BASE	13.49	**105.63**	106.50	0.0094	72106.86	12.00	38.01	13.48	**8.34**

********** ***Node Maximum Conditions - 25Y96H*** **********

(Time units - hours)

Node Name	Group Name	Max Time Conditions	Max Stage (ft)	Warning Stage (ft)	Max Delta Stage (ft)	Max Surface Area (sf)	Max Time Inflow	Max Inflow (cfs)	Max Time Outflow	Max Outflow (cfs)
WETLAND	BASE	65.00	104.00	104.00	-0.0001	0.00	61.11	8.42	0.00	0.00
WRA2	BASE	61.11	**105.69**	106.50	0.0079	72688.46	59.92	34.59	61.11	**8.42**

WRA #2 – NODE TIME SERIES

SOUTHGATE SUBDIVISION

STAGE vs DISCHARGE ANALYSIS

WRA-2, POST-DEV. CONDITION - NODE TIME SERIES

********** ***Node Time Series by Node - 10Y24H*** **********

*** Group: BASE **Node: WETLAND**

Time (hrs)	Stage (ft)	Surface Ar.(ac)	Inflow: Base Q (cfs)	Inflow: Onsite (cfs)	Inflow: Offsite (cfs)	Inflow: Bndry Q (cfs)	Inflow: Link Q (cfs)	Link Outflow (cfs)	Cumulative Volume In (ac.ft)	Cumulative Volume Out (ac.ft)
0.000	102.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000
10.002	103.42	0.00	0.00	0.00	0.00	0.00	-0.05	0.00	-0.0032	0.0000
12.002	103.55	0.00	0.00	0.00	0.00	0.00	0.98	0.00	-0.0156	0.0000
14.002	103.68	0.00	0.00	0.00	0.00	0.00	2.85	0.00	0.2877	0.0000
16.002	103.72	0.00	0.00	0.00	0.00	0.00	2.52	0.00	0.7550	0.0000
18.002	103.67	0.00	0.00	0.00	0.00	0.00	1.94	0.00	1.1183	0.0000
20.002	103.61	0.00	0.00	0.00	0.00	0.00	1.76	0.00	1.4172	0.0000
23.752	103.51	0.00	0.00	0.00	0.00	0.00	1.73	0.00	**1.9583**	0.0000

*** Group: BASE **Node: WRA2**

Time (hrs)	Stage (ft)	Surface Ar.(ac)	Inflow: Base Q (cfs)	Inflow: Onsite (cfs)	Inflow: Offsite (cfs)	Inflow: Bndry Q (cfs)	Inflow: Link Q (cfs)	Link Outflow (cfs)	Cumulative Volume In (ac.ft)	Cumulative Volume Out (ac.ft)
0.000	103.20	1.03	0.11	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000
10.002	103.32	1.06	0.11	0.52	0.00	0.00	0.00	-0.05	0.1222	-0.0032
12.002	103.94	1.21	0.11	22.07	0.00	0.00	0.00	0.98	0.8180	-0.0156
14.002	104.99	1.49	0.11	3.64	0.00	0.00	0.00	2.85	2.5254	0.2877
16.002	104.97	1.48	0.11	1.91	0.00	0.00	0.00	2.52	2.9627	0.7550
20.002	104.87	1.46	0.11	1.17	0.00	0.00	0.00	1.76	3.4788	1.4172
22.002	104.80	1.44	0.11	1.01	0.00	0.00	0.00	1.75	3.6689	1.7067
23.752	104.73	1.42	0.11	0.81	0.00	0.00	0.00	1.73	3.8197	**1.9583**

********** ***Node Time Series by Node - 25Y24H*** **********

*** Group: BASE **Node: WETLAND**

Time (hrs)	Stage (ft)	Surface Ar.(ac)	Inflow: Base Q (cfs)	Inflow: Onsite (cfs)	Inflow: Offsite (cfs)	Inflow: Bndry Q (cfs)	Inflow: Link Q (cfs)	Link Outflow (cfs)	Cumulative Volume In (ac.ft)	Cumulative Volume Out (ac.ft)
0.000	102.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000
10.002	103.31	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.0037	0.0000
12.002	103.42	0.00	0.00	0.00	0.00	0.00	1.28	0.00	0.0666	0.0000
14.002	103.53	0.00	0.00	0.00	0.00	0.00	4.14	0.00	0.5361	0.0000
16.002	103.64	0.00	0.00	0.00	0.00	0.00	3.43	0.00	1.1753	0.0000
20.002	103.67	0.00	0.00	0.00	0.00	0.00	2.16	0.00	2.0592	0.0000
23.752	103.51	0.00	0.00	0.00	0.00	0.00	1.82	0.00	**2.6574**	0.0000

*** Group: BASE **Node: WRA2**

Time (hrs)	Stage (ft)	Surface Ar.(ac)	Inflow: Base Q (cfs)	Inflow: Onsite (cfs)	Inflow: Offsite (cfs)	Inflow: Bndry Q (cfs)	Inflow: Link Q (cfs)	Link Outflow (cfs)	Cumulative Volume In (ac.ft)	Cumulative Volume Out (ac.ft)
0.000	103.20	1.03	0.11	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000
10.002	103.35	1.07	0.11	0.84	0.00	0.00	0.00	0.02	0.1585	0.0037
12.002	104.08	1.25	0.11	27.76	0.00	0.00	0.00	1.28	1.0712	0.0666
14.002	105.25	1.56	0.11	4.40	0.00	0.00	0.00	4.14	3.1768	0.5361
16.002	105.18	1.54	0.11	2.29	0.00	0.00	0.00	3.43	3.6999	1.1753
20.002	105.00	1.49	0.11	1.39	0.00	0.00	0.00	2.16	4.3106	2.0592
23.752	104.86	1.46	0.11	0.96	0.00	0.00	0.00	1.82	4.7107	**2.6574**

Advanced Interconnected Channel & Pond Routing (ICPR Ver 2.20) [1]
Copyright 1995, Streamline Technologies, Inc.

SOUTHGATE SUBDIVISION

STAGE vs DISCHARGE ANALYSIS
WRA-2, POST-DEV. CONDITION - NODE TIME SERIES

********** ***Node Time Series by Node - 100Y24H*** **********

Time (hrs)	Stage (ft)	Surface Ar.(ac)	Inflow: Base Q (cfs)	Inflow: Onsite (cfs)	Inflow: Offsite (cfs)	Inflow: Bndry Q (cfs)	Inflow: Link Q (cfs)	Link Outflow (cfs)	Cumulative Volume In (ac.ft)	Cumulative Volume Out (ac.ft)
*** Group: BASE		**Node: WETLAND**								
0.000	102.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000
10.002	103.31	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.0064	0.0000
12.002	103.42	0.00	0.00	0.00	0.00	0.00	1.56	0.00	0.1288	0.0000
14.002	103.53	0.00	0.00	0.00	0.00	0.00	7.92	0.00	1.1647	0.0000
16.002	103.64	0.00	0.00	0.00	0.00	0.00	5.10	0.00	2.2307	0.0000
18.002	103.75	0.00	0.00	0.00	0.00	0.00	3.47	0.00	2.9248	0.0000
20.002	103.67	0.00	0.00	0.00	0.00	0.00	2.71	0.00	3.4296	0.0000
22.002	103.58	0.00	0.00	0.00	0.00	0.00	2.25	0.00	3.8356	0.0000
23.752	103.51	0.00	0.00	0.00	0.00	0.00	2.02	0.00	**4.1435**	0.0000
*** Group: BASE		**Node: WRA2**								
0.000	103.20	1.03	0.11	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000
10.002	103.43	1.08	0.11	1.47	0.00	0.00	0.00	0.05	0.2480	0.0064
12.002	104.41	1.33	0.11	37.90	0.00	0.00	0.00	1.56	1.5595	0.1288
13.502	105.63	1.66	0.11	8.14	0.00	0.00	0.00	8.34	4.0836	0.8269
14.002	105.60	1.65	0.11	5.74	0.00	0.00	0.00	7.92	4.3671	1.1647
16.002	105.36	1.58	0.11	2.95	0.00	0.00	0.00	5.10	5.0391	2.2307
18.002	105.19	1.54	0.11	2.11	0.00	0.00	0.00	3.47	5.4708	2.9248
20.002	105.08	1.51	0.11	1.78	0.00	0.00	0.00	2.71	5.8132	3.4296
22.002	105.00	1.49	0.11	1.54	0.00	0.00	0.00	2.25	6.0941	3.8356
23.752	104.94	1.48	0.11	1.23	0.00	0.00	0.00	2.02	6.3153	**4.1435**

********** ***Node Time Series by Node - 25Y96H*** **********

Time (hrs)	Stage (ft)	Surface Ar.(ac)	Inflow: Base Q (cfs)	Inflow: Onsite (cfs)	Inflow: Offsite (cfs)	Inflow: Bndry Q (cfs)	Inflow: Link Q (cfs)	Link Outflow (cfs)	Cumulative Volume In (ac.ft)	Cumulative Volume Out (ac.ft)
*** Group: BASE		**Node: WETLAND**								
0.000	102.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000
10.002	102.94	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.0029	0.0000
20.002	103.13	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.0194	0.0000
30.002	103.33	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0495	0.0000
40.002	103.52	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.0918	0.0000
50.002	103.71	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.1497	0.0000
60.002	103.90	0.00	0.00	0.00	0.00	0.00	1.74	0.00	0.4934	0.0000
62.002	103.94	0.00	0.00	0.00	0.00	0.00	7.24	0.00	1.6563	0.0000
64.002	103.98	0.00	0.00	0.00	0.00	0.00	4.19	0.00	2.5679	0.0000
66.002	104.00	0.00	0.00	0.00	0.00	0.00	2.66	0.00	3.1178	0.0000
68.002	104.00	0.00	0.00	0.00	0.00	0.00	2.05	0.00	3.4992	0.0000
70.002	104.00	0.00	0.00	0.00	0.00	0.00	1.62	0.00	3.7998	0.0000
80.002	104.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00	4.8254	0.0000
90.002	104.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00	5.2333	0.0000
95.752	104.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	**5.6354**	0.0000
*** Group: BASE		**Node: WRA2**								
0.000	103.20	1.03	0.11	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000
10.002	103.28	1.05	0.11	0.00	0.00	0.00	0.00	0.01	0.0893	0.0029
20.002	103.35	1.07	0.11	0.00	0.00	0.00	0.00	0.03	0.1785	0.0194
30.002	103.41	1.08	0.11	0.01	0.00	0.00	0.00	0.04	0.2680	0.0495
40.002	103.52	1.11	0.11	0.17	0.00	0.00	0.00	0.01	0.4325	0.0918
50.002	103.73	1.16	0.11	0.39	0.00	0.00	0.00	0.15	0.7240	0.1497
60.002	105.00	1.49	0.11	34.16	0.00	0.00	0.00	1.74	2.7499	0.4934
62.002	105.59	1.64	0.11	4.21	0.00	0.00	0.00	7.24	4.8434	1.6563
64.002	105.32	1.57	0.11	2.27	0.00	0.00	0.00	4.19	5.3134	2.5679
66.002	105.15	1.53	0.11	1.42	0.00	0.00	0.00	2.66	5.5961	3.1178
68.002	105.06	1.51	0.11	1.38	0.00	0.00	0.00	2.05	5.8484	3.4992
70.002	104.99	1.49	0.11	0.96	0.00	0.00	0.00	1.62	6.0392	3.7998
80.002	104.69	1.41	0.11	0.50	0.00	0.00	0.00	1.08	6.6323	4.8254
90.002	104.57	1.35	0.11	0.51	0.00	0.00	0.00	0.89	7.3374	5.2333
95.752	104.49	1.33	0.11	0.51	0.00	0.00	0.00	0.81	7.4499	**5.6354**

PONDS
WRA #2 – BACKGROUND SEEPAGE ANALYSIS

PONDS - Version 2.26

Written By Devo Seereeram, Ph.D., P.E.
And Robert D. Casper

Licensed Solely For Use By:

Background Seepage Analysis

I. Job Information

Job Name: Southgate Subdivision; background Seepage Analysis, WRA-2
Engineer: Tom Knight, P.E.
Date: Dec. 2006

II. Input Data

Pond Control Elevation, [O] (ft above datum):	103.20
Bottom Of Aquifer Elevation, [B] (ft above datum):	96.00
Seasonal High Groundwater Elevation, [H] (ft above datum):	110.00
Seasonal Fluctuation Of Water Table, [F] (ft):	4.00
Hydraulic Conductivity Of Aquifer, [k] (ft/day) :	21.60
Specific Yield Of Aquifer, [S] (%):	25.00
Duration of Wet Season, [T] (days):	153.00
Length of Pond, [L] (ft):	751.00
Width of Pond, [W] (ft):	112.00

III. Results

Background Seepage Rate, [Q] (ft^3/day): 9360.75
Background Seepage Rate, [Q] (gpm): 48.63 ≃ 0.1083 cfs

Groundwater Drawdown Profile:

Distance From Edge Of Pond (feet)	Water Table Drawdown (feet)
1316.0	0.08
980.0	0.24
756.0	0.50
588.0	0.92
476.0	1.33
364.0	1.94
280.0	2.59
224.0	3.12
168.0	3.77
112.0	4.56
56.0	5.55
14.0	6.45
0.0	6.80

UNIVERSAL
ENGINEERING SCIENCES

UNIVERSAL
ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION

SOUTHGATE SUBDIVISION
RETENTION PONDS
GROVELAND, LAKE COUNTY, FLORIDA

PROJECT NO. 13519-002-01
REPORT NO. 355633

Prepared For:

Langley Development, Inc.
P.O. Box 120355
Clermont, Florida 34712

97642 1X-

Prepared By:

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

RECEIVED
FEB 2 2 2005
FDS
ALTAMONTE SVC. CTR.

July 21, 2004

Consultants in: Geotechnical Engineering • Environmental Sciences • Construction Materials Testing • Threshold Inspections
Offices in: Orlando • Gainesville • Riviera Beach • Rockledge • Daytona Beach • Punta Gorda • St. Augustine • Jacksonville • Ocala • Tampa

UNIVERSAL
ENGINEERING SCIENCES
Consultants in: Geotechnical Engineering • Environmental Sciences
Construction Materials Testing • Threshold Inspection

OFFICES IN:
- Daytona Beach
- DeBary
- Fort Myers
- Gainesville
- Jacksonville
- Ocala
- Orlando
- Rockledge
- Sarasota
- St. Augustine
- Tampa
- West Palm Beach

July 21, 2004

Langley Development, Inc.
P.O. Box 120355
Clermont, Florida 34712

Attention: Mr. Randy Langley

Reference: Geotechnical Exploration
Southgate Subdivision
Retention Ponds
Lake County, Florida
Project No. 13519-002-01
Report No. 355633

Dear Mr. Langley:

Universal Engineering Sciences, Inc. (UES) has completed the geotechnical exploration for the proposed ponds off of Thomas Bryant Highway, just north of Mertz Road in Groveland, Lake County, Florida. The scope of our exploration was planned in conjunction and authorized by you.

This report contains the results of our explorations, an engineering interpretation of these with respect to the project characteristics described to us, and recommendations for groundwater control, stormwater management design parameters and site preparation.

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

Respectfully submitted,
UNIVERSAL ENGINEERING SCIENCES, INC.

Melinda Hutchins, E.I.
Project Engineer

Shridhar S. Rao, M.S., P.E.
P.E. No. 56074
Geotechnical Department Manager

MH/SSR:as
Distributions: Client (6)

Project No. 13519-002-01
Report No. 355633

TABLE OF CONTENTS

LIST OF APPENDICES

Project No. 13519-002-01
Report No. 355633

1.0 EXECUTIVE SUMMARY

In summary, we understand that you propose to construct three ponds in Groveland, Lake County, Florida. We have performed field and laboratory explorations to provide geotechnical engineering recommendations for groundwater control, stormwater management design parameters and site preparation.

The soils encountered generally consist of 6 feet of very loose to loose, fine sand to fine sand with silt underlain by loose to medium dense silty clayey fine sand to the maximum depth explored of 15 feet. **This general soil profile was fairly consistent in all boring locations with the exception of boring AB-1 where a trace of organics was observed at existing grade to 1.0 foot below existing grade. This material is unsuitable to use as structural fill and should not be placed under buildings or roadways.**

We encountered the stabilized groundwater table at approximately at 3.1 to 3.3 feet below existing grade at our boring locations. We estimate the seasonal high groundwater table at about 1.0 foot below existing grade our boring locations.

The main criteria used for evaluating fill suitability was the percent of fines in the soils. The soils encountered in the proposed retention pond location boring has characteristics of soils as "Group A", "Group B", "Group C".

We recommend good practice site preparation procedures to prepare the subgrade to support the structures and pavements.

We hope this report meets your needs and discusses the problems associated with the proposed development. We would be pleased to meet with you and discuss any geotechnical engineering aspects of the project.

2.0 INTRODUCTION

2.1 GENERAL

In this report, we present the results of the geotechnical exploration of the site for the proposed ponds in Groveland, Polk County, Florida. We have divided this report into the following sections:

- SCOPE OF SERVICES - Defines what we did
- FINDINGS - Describes what we encountered
- RECOMMENDATIONS - Describes what we encourage you to do
- LIMITATIONS - Describes the restrictions inherent in this report
- APPENDICES - Presents support materials referenced in this report.

3.0 SCOPE OF SERVICES

3.1 PROJECT DESCRIPTION

The project consists of developing three ponds in a residential subdivision. The parcel is located off of Thomas Bryant Highway, just north of Mertz Road in Groveland, Lake County, Florida. We were asked to evaluate the soils and groundwater table conditions at the proposed retention ponds. The site is located in Section 30, Township 22 South, and Range 25 East. A general location map of the project area appears in Appendix A: Site Location Map.

Langley Development, Inc. provided us with the proposed site layout plan. We used these in preparing our field exploration and this report.

Our recommendations are based upon the above considerations. If any of this information is incorrect or if you anticipate any changes, inform Universal Engineering Sciences, Inc. so that we may review our recommendations.

3.2 PURPOSE

The purposes of this exploration were:

- to explore the general subsurface conditions at the site;
- to interpret and review the subsurface conditions with respect to the proposed construction; and
- to provide geotechnical engineering recommendations for stormwater management design parameters and site preparation.

This report presents an evaluation of site conditions on the basis of traditional geotechnical procedures for site characterization. The recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards. Universal Engineering Sciences would be pleased to perform these services, if you desire.

Our exploration was confined to the zone of soil likely to be stressed by the proposed construction. Our work did not address the potential for surface expression of deep geological conditions, such as sinkhole development related to karst activity. This evaluation requires a more extensive range of field services than performed in this study. We will be pleased to conduct an exploration to evaluate the probable effect of the regional geology upon the proposed construction, if you desire.

3.3 FIELD EXPLORATION

For our geotechnical exploration, we explored the subsurface conditions at the proposed pond locations with three (3) soil borings advanced to depths of 15 feet, while performing the Standard Penetration Test (SPT). The general location of the soil borings are indicated in Appendix B: Boring Location Plan.

We performed the Standard Penetration Test (SPT) in each of the borings in general accordance with the procedures of ASTM D-1586, with continuous sampling performed above a depth of 10 feet to detect slight variations in the soil profile at shallow depths and approximately every 5 feet thereafter. The basic procedure for the Standard Penetration Test is as follows: A standard split-barrel sampler is driven into the soil by a 140-pound hammer falling 30 inches. The number of blows needed to drive the sampler 1-foot, after seating 6 inches, is designated the penetration resistance, or N-value; this value is an index to soil strength and consistency.

It is important to note that no survey control was available for our soil boring locations. Therefore, you should consider our indicated locations to be a rough approximation.

Bag samples of the soils encountered will be held in our laboratory for your inspection for 60 days and then discarded, unless we are notified otherwise. The water levels were recorded immediately following the completion of each hole and later upon stabilized conditions.

3.4 LABORATORY EXPLORATION

The soil samples recovered from the soil borings were returned to our laboratory and then a geotechnical engineer visually examined and reviewed the field descriptions. We selected representative soil samples for laboratory testing consisting of three (3) soil fines content determinations (No. 200 sieve washes), three (3) moisture content determinations, and three (3) constant head permeability tests.

We performed these tests to aid in classifying the soils and to help to evaluate the general engineering characteristics of the site soils. See Appendix B: Boring Logs and Description of Testing Procedures, for further data and explanations.

4.0 FINDINGS

4.1 SURFACE CONDITIONS

We examined the USGS topographic quadrangle map for Clermont, Florida and the USDA SCS Soil Survey of Lake County, Florida for relevant information about the subject site. The site is currently undeveloped with scattered trees.

From the noted quadrangle map, it is apparent that the site is approximately at the +115-foot surface elevation contour.

The USDA SCS Soil Survey of Lake County identifies four (4) soil types on this site as defined in Table 1.

TABLE 1: USDA SCS Soil Classifications

Soil Number	Name	Drainage Characteristics	Hydrologic Group	Predicted Seasonal High Groundwater Table
57	Tavares fine sand	Well drained	A	GWT>6.0
47	Placid and Myakka fine sands	Poorly drained	B/D	+2.0>GWT>1.5
13	Candler fine sand	Well drained	A	GWT>6.0
35	Myakka fine sand	Poorly drained	B/D	0.5>GWT>1.5

4.2 SUBSURFACE CONDITIONS

The boring locations and detailed subsurface conditions are illustrated in Appendix B: Boring Location Plan and Boring Logs. The classifications and descriptions shown on the logs are based upon visual and manual characterizations of the recovered soil samples as well as the previously noted laboratory tests. Also, see Appendix B: Soils Classification Chart, for further explanation of the symbols and placement of data on the Boring Logs.

Table 2: General Soil Profile, summarizes the soil conditions encountered by the borings performed.

TABLE 2: General Soil Profile

Typical Depth (feet)	General Soil Profile
0 - 6	Very loose to loose gray brown fine SAND [SP]
6 - 15*	Loose to medium dense orange-brown silty clayey fine SAND [SM-SC]

*** Termination of Deepest Boring**
[ ] Bracketed Text Indicates: Unified Soil Classification

The above general soil profile was fairly consistent in all boring locations with the exception of boring AB-1 where a trace of organics was observed at existing grade to 1.0 foot below existing grade. This material is unsuitable to use as structural fill and should not be placed under buildings or roadways.. We encountered the groundwater table 3.1 to 3.3 feet below existing grade at our boring locations.

5.0 RECOMMENDATIONS

5.1 GENERAL

The following recommendations are made based upon a review of the attached soil test data, our understanding of the proposed construction, and our experience with similar projects and subsurface conditions. If the structural loadings, building locations or grading plans change from those discussed previously, we request the opportunity to review and possibly amend our recommendations with respect to those changes. Additionally, if subsurface conditions encountered during construction were not encountered in the borings, report those conditions immediately to us for observation and recommendations.

In this section of the report, we present our detailed recommendations for groundwater control, foundation design, pavements, stormwater management design parameters, site preparation and construction related services.

5.2 GROUNDWATER CONTROL

The groundwater table will fluctuate seasonally depending upon local rainfall. The rainy season in Central Florida is normally between June and September. Based upon our review of USGS data, Soils Survey of Polk County and regional hydrogeology, **we estimate the seasonal high perched groundwater table to approximately 1.0 foot below existing grade at our boring locations**. The existing water levels at each boring location appear in Appendix B: Boring Logs.

It should be noted that the estimated seasonal high water levels do not provide any assurance that groundwater levels will not exceed these estimated levels during any given year in the future. Should the impediments to surface water drainage be present, or should rainfall intensity and duration, or total rainfall quantities, exceed the normally anticipated rainfall quantities, groundwater levels may exceed our seasonal high and perched estimates. We recommend positive drainage be established and maintained on the site during construction. We further recommend permanent measures be constructed to maintain positive drainage from the site throughout the life of the project. We recommend all foundation designs, pavement designs and stormwater retention analyses incorporate the seasonal high groundwater conditions.

Based upon the estimated seasonal high water table and the necessary site preparation, we anticipate the need for temporary dewatering during construction. We recommend that the groundwater table be maintained at least 24 inches below all earthwork and compaction surfaces. We recommend that the groundwater level be verified immediately prior to construction.

5.3 STORMWATER MANAGEMENT DESIGN PARAMETERS

The preliminary plan provided to us indicates that you intend to manage stormwater by using three retention ponds. It is our understanding that your civil engineer will use our design parameters to design the proposed pond.

The general soil profile encountered in the proposed pond locations consisted of a surficial layer of clean sand [SP] to approximately 9 feet below existing grade underlain by silty clayey sand extending to 15 feet below existing grade at the west pond, and approximately 6 feet below existing grade underlain by silty clayey sand extending to 15 feet below existing grade at the middle pond. We did not encounter a confining layer at the eastern pond.

Based on our findings, we recommend that a seasonal high water table at the pond locations will be at an average depth of 1.0 foot below existing grade at all the pond locations.

We performed constant-head permeability tests on three representative samples obtained from the borings. These samples yielded permeability rates of 21.6 feet per day at the western pond, 4.6 feet per day at the middle pond, and 19.6 feet per day at the eastern pond. We recommend using these values as the horizontal saturated hydraulic conductivity and a vertical unsaturated infiltration rates of 14.4 feet per day, 3.1 feet per day, and 13.1 feet per day, respectively.

The results of the laboratory permeability tests performed on samples recovered from the boring locations in the proposed retention area are presented on the boring logs included in Appendix B. It should be noted that the coefficient of permeability indicated on the boring logs is not an infiltration rate. The actual infiltration rate is influenced by the coefficient of permeability as well as several factors, including the elevation of the pond bottom, water level in the pond, the elevation of the wet season water table, and confining layer. These factors must be accounted for in an appropriate groundwater model to determine the infiltration rate of a given soil stratum. We recommend that the designer use a commercial software program such as "Ponds" in order to evaluate this pond.

Based upon our visual-manual review of the site soils, the results of our laboratory testing and observation of the existing site conditions, we recommend that you consider the site soil above the confining layer to have a porosity of 25 percent. Table 3 below, summarizes our recommended stormwater retention design parameters.

Retention Pond Design Parameters

Project No. 13519-002-01
Report No. 355633

TABLE 3
Stormwater Retention Pond Design Parameters

Retention Pond Parameters	West Pond (WRA-1)	Middle Pond (WRA-2)	East Pond (WRA-3)
Estimated Depth of Confining Layer (feet)*	9.0	6.0	Greater than 15.0
Estimated Vertical Unsaturated Hydraulic Conductivity (ft/day)	21.6	4.6	19.6
Estimated Horizontal Saturated Hydraulic Conductivity (ft/day)	14.4	3.1	13.1
Estimated Fillable Porosity (percent)	25	25	25
Estimated Seasonal Low Groundwater Table Depth (feet)	4.0	4.0	4.0
Estimated Seasonal High Groundwater Table (feet) NWT	1.0 109.0'	1.0 111.0'	1.0 108.0'

* Depths refer to existing grade 110.0' 112.0' 109.0'
Pond Bottom 106.0' 105.0' 101.0'

5.4 STORMWATER MANAGEMENT DESIGN PARAMETERS

The main criteria tested for in our laboratory for fill suitability was fine contents. Based on the results of our laboratory testing program, it is our opinion that a majority of the soils encountered are suitable fill material that was used on the property. The soils encountered in on the property are from “Group A”, “Group B”, and “Group C”. Soils from “Group A” and “Group B” are ideal as fill, because of their drainage characteristics. Soils from “Group C” are more difficult to use because they are more moisture sensitive.

This section explains the applicability/purpose of fill reuse of the different soil types encountered. For your convenience, we have classified the various soil strata on the logs of the soil borings performed in the proposed pond areas according to the corresponding soil groups.

Group "A"

These soils consist of clean sands that have less than 5 percent soil fines (silt and/or clay). Group "A" soils are the most desirable for use as engineered fill because they drain freely when excavated from beneath the groundwater table, and are not as susceptible to moisture related instability. Soils with a USCS classification of [SP] would fall into Group “A.”

Group "B"

These soils consist of sand with silt and contain between 5 and 12 percent soil fines. Group "B" soils are moderate sources of engineered fill, but require some extra care during placement and compaction. The moisture content of these soils should not be higher than the optimum during placement and compaction in order to reduce the potential for moisture related instability. These soils drain fairly well, but may require dewatering prior to excavation or some stockpiling and aeration time when excavated from below the groundwater table. Soils designated with a USCS classification of [SP-SM] would fall into this category.

Group "C"

These soils consist of silty and clayey sands which contain 12 to 20 percent soil fines. Group "C" soils are more difficult to use because they are more moisture sensitive. The moisture content of these soils should be maintained below the optimum moisture content in order to help mitigate the potential for moisture-related instability during placement and compaction. If these materials are successfully placed and compacted, they should be graded to shed water from the site and prevent ponding, both during and after construction. If water ponds atop these soils, previously compacted soils can become overly wet and lose stability. Further, these soils will require complete dewatering prior to excavation and significant stockpiling and aeration periods in order to reduce the moisture content if the soils are excavated from below the groundwater table. Extreme caution should be used in order to prevent placing these soils during the rainy season.

Group "D"

These soils consist of silty and/or clayey sands, silts and clays that have greater than 20 percent soil fines. These soils are not recommended for use as structural fill, without special attention and procedures, because they will be too difficult to practically dry and work.

5.5 SITE PREPARATION

We recommend that normal, good practice site preparation techniques be employed during the excavation and construction of the proposed stormwater management areas. These procedures include: stripping the site of vegetation and removal of any remaining root and organic matter and the rough grading of the retention pond area. A more detailed synopsis of this work is as follows:

1. Strip the proposed pond limits of all grass, roots, topsoil or other deleterious organic matter, within and 10 feet beyond the perimeter of the proposed retention pond area. Expect clearing and grubbing to depths of 12-inches. Deeper clearing and grubbing depths may be encountered in more heavily vegetated areas, or where major root systems are present.

2. Excavate and rough grade the proposed basin by under-excavating the pond bottom and side slopes. Initial excavation should be performed to within approximately 12 inches of final side and bottom grade.

3. For dry ponds, if deposits of less permeable silty or clayey sands are encountered during pond excavation that were not indicated by the test borings, the full extent of these soils within the pond footprint and perimeter should be excavated and replaced with free-draining clean sands. We strongly recommend that any restrictive clayey sands to a depth of at least 5 feet below pond bottom and at a lateral distance at least 5 feet beyond the pond perimeter be over-excavated, removed **completely** and replaced with clean sands from the surficial sand layer, to enhance infiltration process.

4. We also recommend that excavation and replacement of any low permeability soils be performed under the full-time observation of a Universal Engineering Sciences engineer or his representative. Full-time observation of the excavation and replacement activities will allow us to confirm the positive removal of lower permeability soils and conformance with the design assumptions. The majority of the upper sands to be excavated during basin construction should be suitable for use as replacement for less permeable soils, however, we recommend that any replacement soils be tested to confirm that they will provide a permeability rate equal or greater than that used in the infiltration evaluation

5. **Provide siltation control measures throughout the contributing drainage area during basin construction and until the pond sides has been stabilized by final sodding and planting and until roadway paving has been completed.** Siltation control measures include, but are not limited to: usage of silt screens around the perimeter of the proposed pond, construction of temporary ditch blocks in roadway and utility construction areas and hay-bale barrier filtration blocks around stormwater catch basins.

6. Following stabilization of the contributing drainage area, perform final grading of the basins to dimensions and elevations specified in the project plans. During final excavation and grading, any excess soil or other undesirable materials should be removed. Undesirable materials include organic materials, silts, clays, or other accumulated soil fines which may prevent proper infiltration. Additionally, care should be exercised during final grading and excavation to prevent mixing of any accumulated soil fines with clean native soils and/or the replacement backfill.

7. During basin construction, care should be exercised to minimize compaction of near-surface and subsurface soils within the interior of the proposed stormwater management areas. Final grading within the pond should be performed using lighter weight construction equipment where possible.

8. Following final grading, the bottoms of the stormwater management areas should be deeply scarified using a root rake or other suitable device to assure maximum infiltration. For dry ponds, we do not recommend sodding the pond bottom.

9. The stormwater management area bottoms and side slopes should be stabilized according to applicable Water Management District and City guidelines.

5.6 CONSTRUCTION RELATED SERVICES

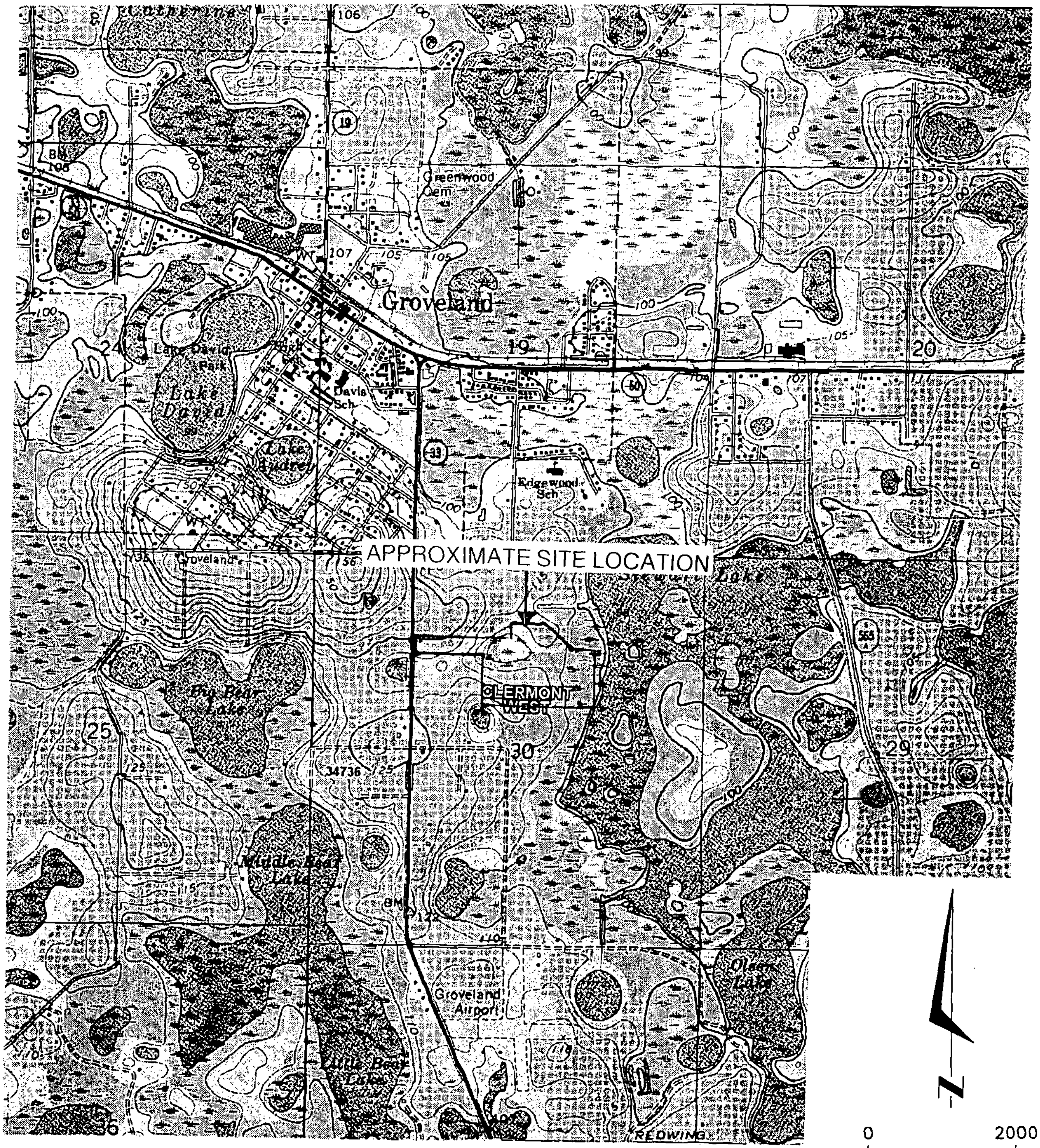
We recommend the owner retain Universal Engineering Sciences to perform construction materials tests and observations on this project. The geotechnical engineering design does not end with the advertisement of the construction documents. The design is an ongoing process throughout construction. Because of our familiarity with the site conditions and the intent of the engineering design, we are most qualified to address problems that might arise during construction in a timely and cost-effective manner. We have proposed on performing these services for you.

6.0 LIMITATIONS

During the early stages of most construction projects, geotechnical issues not addressed in this report may arise. Because of the natural limitations inherent in working with the subsurface, it is not possible for a geotechnical engineer to predict and address all possible problems. An Association of Engineering Firms Practicing in the Geosciences (ASFE) publication, "Important Information About Your Geotechnical Engineering Report" appears in Appendix C, and will help explain the nature of geotechnical issues.

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

APPENDIX A



0 2000
SCALE (FT.)

SOURCE: U.S.G.S. QUADRANGLE MAP OF CLERMONT, FLORIDA PHOTOREVISED 1980

UNIVERSAL
ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION
SOUTHGATE SUBDIVISION-RETENTION PONDS
GROVELAND, LAKE COUNTY, FLORIDA

U.S.G.S. SITE LOCATION MAP

DRAWN BY: M.E.J.	DATE: 07-15-04	CHECKED BY: MH	DATE: 7-21-04
SCALE: AS SHOWN	PROJECT NO: 13519-002-01	REPORT NO: 355633	PAGE: A-1

APPENDIX B

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	13519-002-01
REPORT NO.:	355633
PAGE:	B-2.1

PROJECT: GEOTECHNICAL EXPLORATION
SOUTHGATE SUBDIVISION-RETENTION PONDS
LAKE COUNTY, FLORIDA

BORING DESIGNATION: **AB-1** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: LANGLEY DEVELOPMENT
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): N.S. 110.0'
WATER TABLE (ft): 3.3
DATE OF READING: 7/9/2004
EST. SHGWT (ft): 1.0
DATE STARTED: 7/9/04
DATE FINISHED: 7/9/04
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/DAY)	ORG. CONT. (%)
0						Trace of organics						
				▽		Very loose, light gray mottled fine SAND; with silt [SP-SM]						
	X	2-2-2	4									
	X			▼								
	X	2-2-2	4			--loose						
5	X	3-3-3	6			--shade lighter						
						--light brown	6	15			21.6	
	X	3-4-5	9									
	X	4-4-4	8									
						Medium dense, mixed gray-brown, red and orange clayey silty SAND [SC-SM]						
10	X	6-7-9	16									
						Medium dense, light brown fine SAND [SP]						
15	X	10-13-15	28									
						BORING TERMINATED AT 15 FEET						
20												

W-04675.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	13519-002-01
REPORT NO.:	355633
PAGE:	B-2.2

PROJECT: GEOTECHNICAL EXPLORATION
SOUTHGATE SUBDIVISION-RETENTION PONDS
LAKE COUNTY, FLORIDA

BORING DESIGNATION: **AB-2** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: LANGLEY DEVELOPMENT
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): N.S. 108.5'
WATER TABLE (ft): 3.1
DATE OF READING: 7/9/2004
EST. SHGWT (ft): 1.0
DATE STARTED: 7/9/04
DATE FINISHED: 7/9/04
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT/ DAY)	ORG. CONT. (%)
0						Loose, gray-brown fine SAND; with silt [SP-SM]						
				▽								
	X	2-2-3	5									
				▼		--brown						
	X	2-2-3	5									
						--light brown	8	16			4.6	
5	X	2-2-3	5									
						Medium dense, mixed light gray-brown, with orange silty clayey SAND [SC-SM]						
	X	2-4-7	11									
	X	7-10-7	17			--with less clay						
10	X	7-8-8	16									
15	X	9-11-11	22			BORING TERMINATED AT 15 FEET						
20												

W-04675.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	13519-002-01
REPORT NO.:	355633
PAGE:	B-2.3

PROJECT: GEOTECHNICAL EXPLORATION
SOUTHGATE SUBDIVISION-RETENTION PONDS
LAKE COUNTY, FLORIDA

BORING DESIGNATION: **AB-3** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: LANGLEY DEVELOPMENT
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

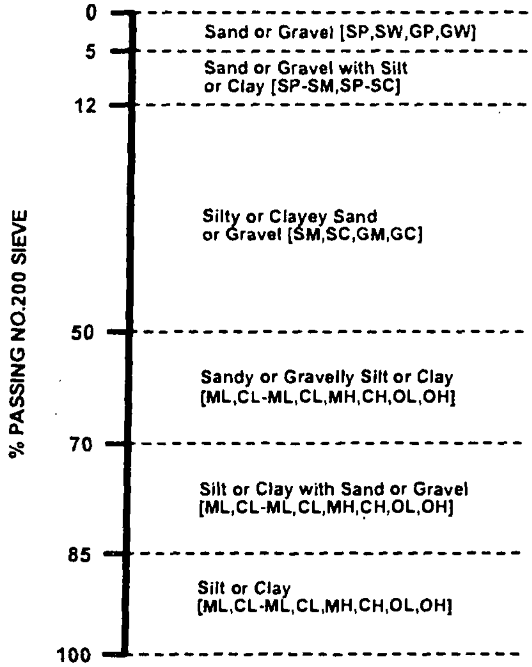
G.S. ELEVATION (ft): N.S. DATE STARTED: 7/9/04
WATER TABLE (ft): 3.3 DATE FINISHED: 7/9/04
DATE OF READING: 7/9/2004 DRILLED BY: UES - ORLANDO
EST. SHGWT (ft): 1.0 TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT/ DAY)	ORG. CONT. (%)
0						Loose, gray-brown mottled fine SAND [SP]						
				▽								
	X	3-3-3	6									
				▼		Very loose, dark brown fine SAND; with silt [SP-SM]						
	X	2-2-2	4			--loose, brown						
5	X	2-4-5	9									
						--shade lighter	6	15			19.6	
	X	2-4-6	10									
	X	3-4-5	9									
10	X	4-4-4	8									
						--medium dense						
15	X	3-6-10	16									
						BORING TERMINATED AT 15 FEET						
20												

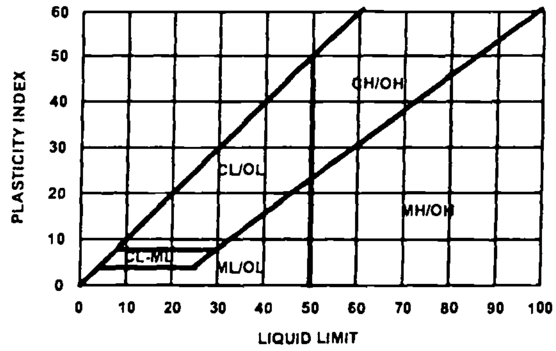
W-04675.GPJ

KEY TO BORING LOGS

SOIL CLASSIFICATION CHART*



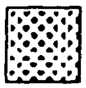
UNIVERSAL ENGINEERING SCIENCES, INC.

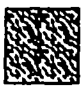


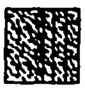
PLASTICITY CHART

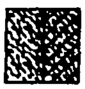
GROUP NAME AND SYMBOL

COARSE GRAINED SOILS

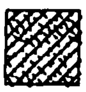
 WELL-GRADED SANDS [SW]

 POORLY-GRADED SANDS [SP]

 POORLY-GRADED SANDS WITH SILT [SP-SM]

 POORLY-GRADED SANDS WITH CLAY [SP-SC]

 SILTY SANDS [SM]

 CLAYEY SANDS [SC]

 SILTY CLAYEY SANDS [SC-SM]

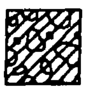
 WELL-GRADED GRAVELS [GW]

 POORLY-GRADED GRAVELS [GP]

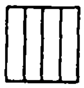
 POORLY-GRADED GRAVELS WITH SILT [GP-GM]

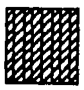
 POORLY-GRADED GRAVELS WITH CLAY [GP-GC]

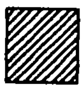
 SILTY GRAVELS [GM]

 CLAYEY GRAVELS [GC]

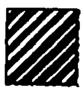
FINE GRAINED SOILS

 INORGANIC SILTS SLIGHT PLASTICITY [ML]

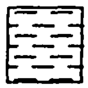
 INORGANIC SILTY CLAY LOW PLASTICITY [CL-ML]

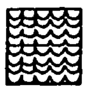
 INORGANIC CLAYS LOW TO MEDIUM PLASTICITY [CL]

 INORGANIC SILTS HIGH PLASTICITY [MH]

 INORGANIC CLAYS HIGH PLASTICITY [CH]

HIGHLY ORGANIC SOILS

 ORGANIC SILTS/CLAYS LOW PLASTICITY [OL]**

 ORGANIC SILTS/CLAYS MEDIUM TO HIGH PLASTICITY [OH]**

 PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS [PT]**

RELATIVE DENSITY

(SAND AND GRAVEL)

VERY LOOSE - 0 to 4 Blows/ft.
LOOSE - 5 to 10 Blows/ft.
MEDIUM DENSE - 11 to 30 Blows/ft.
DENSE - 31 to 50 Blows/ft.
VERY DENSE - more than 50 Blows/ft.

CONSISTENCY

(SILT AND CLAY)

VERY SOFT - 0 to 2 Blows/ft.
SOFT - 3 to 4 Blows/ft.
FIRM - 5 to 8 Blows/ft.
STIFF - 9 to 16 Blows/ft.
VERY STIFF - 17 to 30 Blows/ft.
HARD - more than 30 Blows/ft.

* IN ACCORDANCE WITH ASTM D 2487 - UNIFIED SOIL CLASSIFICATION SYSTEM.

** LOCALLY MAY BE KNOWN AS MUCK.

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

DESCRIPTION OF LABORATORY TESTING PROCEDURES

MOISTURE CONTENT DETERMINATION - ASTM D-2216

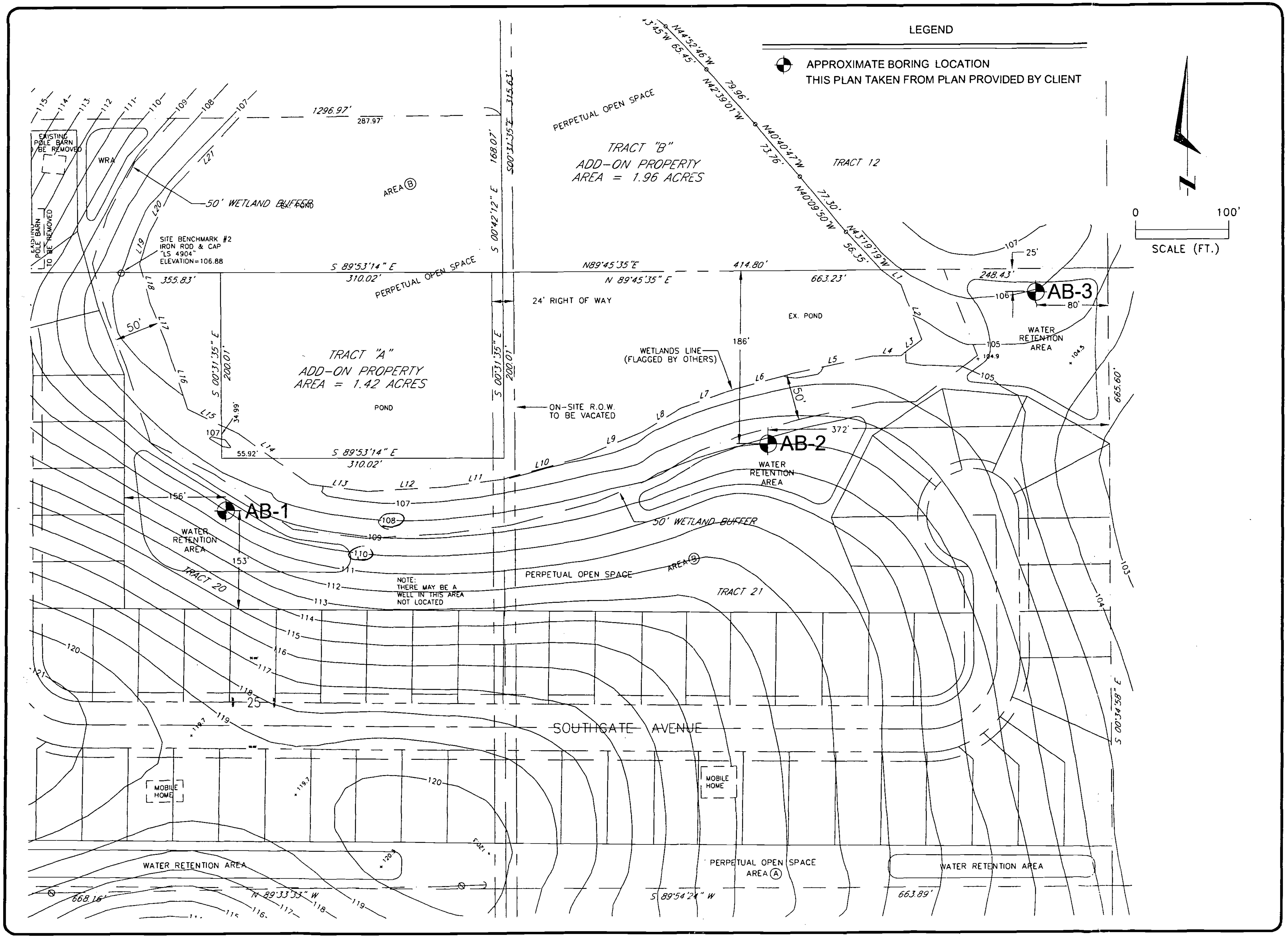
Moisture content is the ratio of the weight of water to the dry weight of soil. Moisture content is measured by drying a sample at 105 degrees Celsius. The moisture content is expressed as a percent of the oven dried soil mass.

WASH 200 TEST - ASTM D-1140

The Wash 200 test is performed by passing a representative soil sample over a No. 200 sieve and rinsing with water. The percentage of the soil grains passing this sieve is then calculated.

LABORATORY PERMEABILITY TEST, CONSTANT-HEAD - ASTM D-2434

The constant-head laboratory permeability test is performed by placing the soil sample in a tube and sealing the soil sample on both ends with a porous disk. The tube and soil sample are then sealed and the soil sample is saturated. Once the soil sample has been saturated, a constant-head water supply is run through the sealed soil sample. A pair of manometer tubes is used to measure the pressure head change through the soil. Once the manometer tubes indicate steady-state flow, test measurements of pressure head difference, quantity of flow and time of flow are made. The data recovered from this test are then used to calculate Darcy's Coefficient of Permeability (k) of the soil.



FOR:

LANGLEY DEVELOPMENT

DRAWN BY: M.E.J. DATE: 07-15-04

CHECKED BY: MH DATE: 7-21-04

REPORT NO: 355633 SCALE: AS SHOWN

PROJECT NO: 13519-002-01

GEOTECHNICAL EXPLORATION
SOUTHGATE SUBDIVISION-RETENTION PONDS
GROVELAND, LAKE COUNTY, FLORIDA

BORING LOCATION PLAN

UNIVERSAL
ENGINEERING SCIENCES

PAGE NO: B-1

04-0522-01

APPENDIX C

Important Information About Your
Geotechnical Engineering Report

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

The following information is provided to help you manage your risks.

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

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

A Geotechnical Engineering Report is Based on A Unique Set of Project Specific Factors

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are Not Final

Do not over rely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

A Geotechnical Engineering Report is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also, retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

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

Give Contractors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

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

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE PROFESSIONAL FIRMS PRACTICING IN THE GEOSCIENCES

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

IIGER06983.5M

Project No. 13519-002-01
Report No. 355633

CONSTRAINTS AND RESTRICTIONS

WARRANTY

Universal Engineering Sciences has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until excavation begins. If variations appear, we may have to re-evaluate our recommendations after performing on-site observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Universal Engineering Sciences, as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Universal Engineering Sciences of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Universal Engineering Sciences to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Universal Engineering Sciences is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Universal Engineering Sciences.

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Universal Engineering Sciences.

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations to determine those conditions that may affect construction operations. Universal Engineering Sciences cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

Project No. 13519-002-01
Report No. 355633

LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Universal Engineering Sciences to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Universal Engineering Sciences to locate any such buried objects. Universal Engineering Sciences cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of exploration. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.