Retention Pond Treatment Analysis

Springs Chapel
Proposed Drainage Area

Detention/Retention Basin

Site Area (acres)	0.95	
Drainage Area 1 (acres)	0.95	
% Impervious (excluding ponds)	93%	
Impervious Area	0.88	
Run off Coefficient	0.7	
On-line treatment		
f Prorosity=	0.25	
Kvs= see soils test results	25.9	ft/day
*Kh=	24.4	ft/day
F.S.=	2	
Basin Bottom	15.00	ft
Estimated Seasonal High GWT	9.90	ft
Impervious Layer Elevation	-3.00	ft
Rectangular retention basin		
Area at bottom (acres)	0.017	ac
Height of Basin above GWT, hb	5.10	ft

Stage	Depth of Water	Area (sq.ft)	Area (acre)	Vol. (ac.ft.)	Vol. (cu.ft.)	Storage(ac.ft.)
15.00	0.00	744.0	0.02	0.00	0.00	0.00
15.50	0.50	1872.0	0.04	0.02	654.00	0.02
16.00	1.00	3064.0	0.07	0.03	1234.00	0.04
16.50	1.50	4320.0	0.10	0.04	1846.00	0.09
17.00	2.00	5640.0	0.13	0.06	2490.00	0.14

Calculate time to recover Treatment Volume

Treatment volume required

0.5" of run off	1724.25	cu.ft.	0.04	ac. ft.
1.25" x impervious area excluding pond area	4007.29	cu.ft.	0.09	ac. ft.
Greatest + additional 0.5"	5731.54	cu.ft.	0.13	ac. ft.
Treatment volume / drainage area	1.66	in.		

Calculate height of treatment volume

Treatment Volume Elevation 16.84 ft.

Determine if saturated lateral (Stage Two) flow will occur

Treatment Volume Depth (hv) 1.84 ft

Height of water to saturate the soil (hu)
hu=f(hb) 1.275 ft

Retention Pond Treatment Analysis

Since hv > hu Saturated Lateral Flow will occur

Calculate the volume of water infiltrated in unsaturated vertical (Stage One) flow and the time to infiltrate this volume.

Area of basin bottom(sq.ft)	744.00	sq. ft.		
Volume Infiltrated during Stage One (Vu) Vu=Ab*hb*f	948.60	cu. ft.		
Unsaturated Vertical Hydraulic Conductivity (Kvu) Kvu= 2/3*Kvs	17.27	ft/day		
Design Infiltration Rate Id Id=Kvu/FS	8.63	ft/day		
Time to saturate soil beneath the basin t_{sat} tsat=f*hb/Id	0.15	days		

Saturated Lateral Flow Analysis

Calculated the remaining treatment volume to be recovered under saturated lateral flow (Stage 2) conditions.

Remaining volume to be infiltrated	4782.94	cu. ft.		0.11 ac.ft
Elevation of treatment volume at start of	16.71	ft	Interpolate	
saturated lateral flow.	16.71			

Calculate Fx and Fy

hc=hb (at t=t Total)			
Height of water in basin at saturated lateral flow			
h2= HT-hb	1.71	ft	
HT=hb+h2	6.81	ft	
Fy = hb/HT	0.75		
When water level is at the basin bottom			
the basin length L	268	ft	
the basin width W	2	ft	
Basin Width to Length ratio (L/W)	134.00		ft/ft
Determine Fx			
Fx (f=0.2)	1.00		
Fx (f=0.3)	1.50		
Fx=((W^2)/4KH*D*t)^.5	1.25		

Calculate time to recover treatment volume under saturated lateral flow.

H=seasonal high GWT-impervious layer	12.9	ft
Average Saturated Thickness (D) D=H+(hc/2)	15.45	ft
Time to recover remaining treatment volume under lateral saturated flow conditions t=W^2/ 4*Kh*D*Fx^2	0.00	days
Total Recovery Time T=Tsat+T lateral sat.	0.149	days
	3.59	hours

Design meets 72 hour recovery time criteria

Kh value is based on Double Ring Infiltromiter

Node Max Conditions [Scenario1]

Node Name	Sim Name	Warning Stage [ft]	Max Stage [ft]	Min/Max Delta Stage [ft]	Max Total Inflow [cfs]	Max Total Outflow [cfs]	Max Surface Area [ft2]
FDOT INLET	100Y-24H	17.75	14.75	0.0010	0.92	0.00	0
GWR	100Y-24H	10.00	9.90	0.0000	1.39	0.00	0
P1	100Y-24H	17.00	16.91	-0.0010	2.80	1.47	2304
P2	100Y-24H	17.00	16.95	-0.0010	2.58	0.88	3128
P3	100Y-24H	17.00	16.96	0.0010	2.38	0.69	3144
P4	100Y-24H	17.00	16.97	-0.0010	2.11	0.51	3158
P5	100Y-24H	17.00	16.97	0.0010	1.92	0.34	3162
FDOT INLET	10Y-24H	17.75	14.75	0.0010	0.00	0.00	0
GWR	10Y-24H	10.00	9.90	0.0000	1.14	0.00	0
P1	10Y-24H	17.00	16.48	-0.0010	1.87	1.13	1834
P2	10Y-24H	17.00	16.48	0.0010	1.83	0.74	2403
P3	10Y-24H	17.00	16.48	0.0010	1.73	0.58	2407
P4	10Y-24H	17.00	16.49	-0.0010	1.52	0.34	2410
P5	10Y-24H	17.00	16.49	-0.0010	1.33	0.21	2411
FDOT INLET	25Y-24H	17.75	14.75	0.0010	0.00	0.00	0
GWR	25Y-24H	10.00	9.90	0.0000	1.21	0.00	0
P1	25Y-24H	17.00	16.63	-0.0010	2.12	1.23	2001
P2	25Y-24H	17.00	16.64	-0.0010	2.04	0.78	2643
P3	25Y-24H	17.00	16.64	0.0010	1.92	0.61	2647
P4	25Y-24H	17.00	16.64	-0.0010	1.69	0.35	2650
P5	25Y-24H	17.00	16.64	-0.0010	1.50	0.22	2652
FDOT INLET	MA-24H	17.75	14.75	0.0010	0.00	0.00	0
GWR	MA-24H	10.00	9.90	0.0000	0.93	0.00	0
P1	MA-24H	17.00	16.00	-0.0010	1.18	0.85	1366
P2	MA-24H	17.00	16.01	-0.0010	1.17	0.54	1764
P3	MA-24H	17.00	16.01	0.0010	1.02	0.42	1755
P4	MA-24H	17.00	16.01	-0.0010	0.83	0.26	1769
P5	MA-24H	17.00	16.01	-0.0010	0.74	0.20	1744

Manual Basin: B1

Scenario:	Scenario1
Node:	P1
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	10.0000 min
Max Allowable Q:	99999.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH484
Peaking Factor:	484.0
Area:	0.3490 ac

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name
0.3490	B1	B1	

Comment:

Manual Basin: B2

Scenario:	Scenario1
Node:	P2
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	10.0000 min
Max Allowable Q:	99999.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH484
Peaking Factor:	484.0
Area:	0.2157 ac

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name
0.2157	B2	B2	

Comment:

Manual Basin: B3

Scenario:	Scenario1
Node:	P3
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	10.0000 min
Max Allowable Q:	99999.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH484
Peaking Factor:	484.0
Area:	0.2148 ac

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name
0.2148	B3	B3	

Comment:

Manual Basin: B4

Scenario:	Scenario1
Node:	P4
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	10.0000 min
Max Allowable Q:	99999.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH484
Peaking Factor:	484.0
Area:	0.2062 ac

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name
0.2062	B4	B4	

Comment:

Manual Basin: B5

Scenario:	Scenario1
Node:	P5
Hydrograph Method:	NRCS Unit Hydrograph
Infiltration Method:	Curve Number
Time of Concentration:	10.0000 min
Max Allowable Q:	99999.00 cfs
Time Shift:	0.0000 hr
Unit Hydrograph:	UH484
Peaking Factor:	484.0
Area:	0.2166 ac

Area [ac]	Land Cover Zone	Soil Zone	Rainfall Name
0.2166	B5	B5	

Comment:

Node: FDOT INLET

Scenario:	Scenario1
Type:	Time/Stage
Base Flow:	0.00 cfs
Initial Stage:	13.24 ft
Warning Stage:	17.75 ft
Boundary Stage:	

Year	Month	Day	Hour	Stage [ft]
0	0	0	0.0000	13.24
0	0	0	12.0000	14.75
0	0	0	24.0000	14.75

Comment:

Node: GWR

Scenario: Scenario1
Type: Time/Stage
Base Flow: 0.00 cfs
Initial Stage: 9.90 ft
Warning Stage: 10.00 ft
Boundary Stage:

Comment:

Node: P1

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: 15.00 ft
Warning Stage: 17.00 ft

Stage [ft]	Area [ac]	Area [ft2]
15.00	0.0096	416
15.50	0.0198	864
16.00	0.0309	1344
16.50	0.0426	1856
17.00	0.0551	2400

Comment:

Node: P2

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: 15.00 ft
Warning Stage: 17.00 ft

Stage [ft]	Area [ac]	Area [ft2]
15.00	0.0109	474
15.50	0.0244	1062
16.00	0.0393	1714
16.50	0.0558	2430
17.00	0.0737	3210

Comment:

Node: P3

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: 15.00 ft
Warning Stage: 17.00 ft

Stage [ft]	Area [ac]	Area [ft2]
15.00	0.0109	474
15.50	0.0244	1062
16.00	0.0393	1714
16.50	0.0558	2430
17.00	0.0737	3210

Comment:

Node: P4

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: 15.00 ft
Warning Stage: 17.00 ft

Stage [ft]	Area [ac]	Area [ft2]
15.00	0.0109	474
15.50	0.0244	1062
16.00	0.0393	1714
16.50	0.0558	2430
17.00	0.0737	3210

Comment:

Node: P5

Scenario: Scenario1
Type: Stage/Area
Base Flow: 0.00 cfs
Initial Stage: 15.00 ft
Warning Stage: 17.00 ft

Stage [ft]	Area [ac]	Area [ft2]
15.00	0.0109	474
15.50	0.0244	1062
16.00	0.0393	1714
16.50	0.0558	2430
17.00	0.0737	3210

Comment:

Pipe Link: L-0020P		Upstream		Downstream	
Scenario:	Scenario1	Invert:	15.50 ft	Invert:	15.00 ft
From Node:	P2	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	P1	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.00 ft	Max Depth:	1.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	75.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	1.00	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 dec	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: L-0030P		Upstream		Downstream	
Scenario:	Scenario1	Invert:	15.50 ft	Invert:	15.00 ft
From Node:	P3	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	P2	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.00 ft	Max Depth:	1.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	20.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	1.00	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 dec	Op Table:		Op Table:	

Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: L-0040P		Upstream		Downstream	
Scenario:	Scenario1	Invert:	15.50 ft	Invert:	15.00 ft
From Node:	P4	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	P3	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.00 ft	Max Depth:	1.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	70.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	1.00	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 dec	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Pipe Link: L-0050P		Upstream		Downstream	
Scenario:	Scenario1	Invert:	15.50 ft	Invert:	15.00 ft
From Node:	P5	Manning's N:	0.0120	Manning's N:	0.0120
To Node:	P4	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.00 ft	Max Depth:	1.00 ft
Flow Direction:	Both	Bottom Clip			
Damping:	0.0000 ft	Default:	0.00 ft	Default:	0.00 ft
Length:	20.00 ft	Op Table:		Op Table:	
FHWA Code:	1	Ref Node:		Ref Node:	
Entr Loss Coef:	1.00	Manning's N:	0.0000	Manning's N:	0.0000
Exit Loss Coef:	0.00	Top Clip			
Bend Loss Coef:	0.00	Default:	0.00 ft	Default:	0.00 ft
Bend Location:	0.00 dec	Op Table:		Op Table:	
Energy Switch:	Energy	Ref Node:		Ref Node:	
		Manning's N:	0.0000	Manning's N:	0.0000

Comment:

Percolation Link: L-0060PERC			
Scenario:	Scenario1	Surface Area Option:	Vary Based on Stage/Area Table
From Node:	P1		
To Node:	GWR	Vertical Flow Termination:	Horizontal Flow Algorithm

Link Count:	1		
Flow Direction:	Both	Perimeter 1:	216.00 ft
Aquifer Base Elevation:	-3.00 ft	Perimeter 2:	404.00 ft
Water Table Elevation:	9.90 ft	Perimeter 3:	530.00 ft
Annual Recharge Rate:	50 ipy	Distance P1 to P2:	30.00 ft
Horizontal Conductivity:	24.400 fpd	Distance P2 to P3:	50.00 ft
Vertical Conductivity:	25.900 fpd	# of Cells P1 to P2:	10
Fillable Porosity:	0.250	# of Cells P2 to P3:	20
Layer Thickness:	0.00 ft		

Comment:

Percolation Link: L-0070PERC

Scenario:	Scenario1	Surface Area Option:	Vary Based on Stage/Area Table
From Node:	P2		
To Node:	GWR	Vertical Flow Termination:	Horizontal Flow Algorithm
Link Count:	1	Perimeter 1:	62.00 ft
Flow Direction:	Both	Perimeter 2:	250.00 ft
Aquifer Base Elevation:	-3.00 ft	Perimeter 3:	376.00 ft
Water Table Elevation:	9.90 ft	Distance P1 to P2:	30.00 ft
Annual Recharge Rate:	50 ipy	Distance P2 to P3:	50.00 ft
Horizontal Conductivity:	24.400 fpd	# of Cells P1 to P2:	10
Vertical Conductivity:	25.900 fpd	# of Cells P2 to P3:	20
Fillable Porosity:	0.250		
Layer Thickness:	0.00 ft		

Comment:

Percolation Link: L-0080PERC

Scenario:	Scenario1	Surface Area Option:	Vary Based on Stage/Area Table
From Node:	P3		
To Node:	GWR	Vertical Flow Termination:	Horizontal Flow Algorithm
Link Count:	1	Perimeter 1:	62.00 ft
Flow Direction:	Both	Perimeter 2:	250.00 ft
Aquifer Base Elevation:	-3.00 ft	Perimeter 3:	376.00 ft
Water Table Elevation:	9.90 ft	Distance P1 to P2:	30.00 ft
Annual Recharge Rate:	50 ipy	Distance P2 to P3:	50.00 ft
Horizontal Conductivity:	24.400 fpd	# of Cells P1 to P2:	10
Vertical Conductivity:	25.900 fpd	# of Cells P2 to P3:	20
Fillable Porosity:	0.250		
Layer Thickness:	0.00 ft		

Comment:

Percolation Link: L-0090PERC

Scenario:	Scenario1		
From Node:	P4	Surface Area Option:	Vary Based on Stage/Area Table
To Node:	GWR		
Link Count:	1	Vertical Flow Termination:	Horizontal Flow Algorithm
Flow Direction:	Both	Perimeter 1:	62.00 ft
Aquifer Base Elevation:	-3.00 ft	Perimeter 2:	250.00 ft
Water Table Elevation:	9.90 ft	Perimeter 3:	376.00 ft
Annual Recharge Rate:	50 ipy	Distance P1 to P2:	30.00 ft
Horizontal Conductivity:	24.400 fpd	Distance P2 to P3:	50.00 ft
Vertical Conductivity:	25.900 fpd	# of Cells P1 to P2:	10
Fillable Porosity:	0.250	# of Cells P2 to P3:	20
Layer Thickness:	0.00 ft		

Comment:

Percolation Link: L-0100PERC

Scenario:	Scenario1	Surface Area Option:	Vary Based on Stage/Area Table
From Node:	P5		
To Node:	GWR	Vertical Flow Termination:	Horizontal Flow Algorithm
Link Count:	1	Perimeter 1:	62.00 ft
Flow Direction:	Both	Perimeter 2:	250.00 ft
Aquifer Base Elevation:	-3.00 ft	Perimeter 3:	376.00 ft
Water Table Elevation:	9.90 ft	Distance P1 to P2:	30.00 ft
Annual Recharge Rate:	50 ipy	Distance P2 to P3:	50.00 ft
Horizontal Conductivity:	24.400 fpd	# of Cells P1 to P2:	10
Vertical Conductivity:	25.900 fpd	# of Cells P2 to P3:	20
Fillable Porosity:	0.250		
Layer Thickness:	0.00 ft		

Comment:

Drop Structure Link: OUTFALL

		Upstream Pipe		Downstream Pipe	
Scenario:	Scenario1	Invert:	14.50 ft	Invert:	14.00 ft
From Node:	P1	Manning's N:	0.0150	Manning's N:	0.0150
To Node:	FDOT INLET	Geometry: Circular		Geometry: Circular	
Link Count:	1	Max Depth:	1.50 ft	Max Depth:	1.50 ft
Flow Direction:	Both	Bottom Clip			
Solution:	Combine	Default:	0.00 ft	Default:	0.00 ft
Increments:	0	Op Table:		Op Table:	
Pipe Count:	1	Ref Node:		Ref Node:	
Damping:	0.0000 ft	Manning's N:	0.0000	Manning's N:	0.0000
Length:	75.00 ft	Top Clip			
FHWA Code:	1	Default:	0.00 ft	Default:	0.00 ft
Entr Loss Coef:	0.00	Op Table:		Op Table:	
Exit Loss Coef:	0.00	Ref Node:		Ref Node:	
Bend Loss Coef:	0.00	Manning's N:	0.0000	Manning's N:	0.0000
Bend Location:	0.00 dec				

Energy Switch: Energy

Pipe Comment:

Weir Component

Weir:	1	**Bottom Clip**	
Weir Count:	1	Default:	0.00 ft
Weir Flow Direction:	Both	Op Table:	
Damping:	0.0000 ft	Ref Node:	
Weir Type:	Horizontal	**Top Clip**	
Geometry Type:	Rectangular	Default:	0.00 ft
Invert:	16.84 ft	Op Table:	
Control Elevation:	16.84 ft	Ref Node:	
Max Depth:	3.00 ft	**Discharge Coefficients**	
Max Width:	4.50 ft	Weir Default:	3.200
Fillet:	0.00 ft	Weir Table:	
		Orifice Default:	0.600
		Orifice Table:	

Weir Comment:

Drop Structure Comment:

Simulation: 100Y-24H

Scenario: Scenario1
Run Date/Time: 6/19/2024 4:43:12 PM
Program Version: ICPR4 4.07.08

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000
End Time:	0	0	0	30.0000

	Hydrology [sec]	Surface Hydraulics [sec]
Min Calculation Time:	60.0000	0.1000
Max Calculation Time:		30.0000

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	15.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	15.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources

Rainfall Folder:

Unit Hydrograph Folder:

Lookup Tables

Boundary Stage Set:
Extern Hydrograph Set:
Curve Number Set: 1
Green-Ampt Set:
Vertical Layers Set:
Impervious Set: 1

Tolerances & Options

Time Marching: SAOR
Max Iterations: 6
Over-Relax Weight Fact: 0.5 dec
dZ Tolerance: 0.0010 ft
Max dZ: 1.0000 ft
Link Optimizer Tol: 0.0001 ft
Edge Length Option: Automatic

IA Recovery Time: 24.0000 hr
Smp/Man Basin Rain Opt: Global
Rainfall Name: ~FLMOD
Rainfall Amount: 11.04 in
Storm Duration: 24.0000 hr
Dflt Damping (1D): 0.0050 ft
Min Node Srf Area (1D): 100 ft2
Energy Switch (1D): Energy

Comment:

Simulation: 25Y-24H

Scenario: Scenario1
Run Date/Time: 6/19/2024 4:43:17 PM
Program Version: ICPR4 4.07.08

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000

End Time:	0	0	0	30.0000

	Hydrology [sec]	Surface Hydraulics [sec]
Min Calculation Time:	60.0000	0.1000
Max Calculation Time:		30.0000

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	15.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	15.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources

Rainfall Folder:

Unit Hydrograph Folder:

Lookup Tables

Boundary Stage Set:
Extern Hydrograph Set:
Curve Number Set: 1

Green-Ampt Set:
Vertical Layers Set:
Impervious Set: 1

Tolerances & Options

Time Marching: SAOR
Max Iterations: 6
Over-Relax Weight Fact: 0.5 dec
dZ Tolerance: 0.0010 ft

Max dZ: 1.0000 ft
Link Optimizer Tol: 0.0001 ft

Edge Length Option: Automatic

IA Recovery Time: 24.0000 hr

Smp/Man Basin Rain Opt: Global

Rainfall Name: ~FLMOD
Rainfall Amount: 8.40 in
Storm Duration: 24.0000 hr

Dflt Damping (1D): 0.0050 ft
Min Node Srf Area (1D): 100 ft2
Energy Switch (1D): Energy

Comment:

Simulation: MA-24H

Scenario: Scenario1
Run Date/Time: 6/19/2024 4:43:27 PM
Program Version: ICPR4 4.07.08

General

Run Mode: Normal

	Year	Month	Day	Hour [hr]
Start Time:	0	0	0	0.0000
End Time:	0	0	0	30.0000

	Hydrology [sec]	Surface Hydraulics [sec]
Min Calculation Time:	60.0000	0.1000
Max Calculation Time:		30.0000

Output Time Increments

Hydrology

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	15.0000

Surface Hydraulics

Year	Month	Day	Hour [hr]	Time Increment [min]
0	0	0	0.0000	15.0000

Restart File

Save Restart: False

Resources & Lookup Tables

Resources

Rainfall Folder:

Unit Hydrograph Folder:

Lookup Tables

Boundary Stage Set:
Extern Hydrograph Set:
Curve Number Set: 1

Green-Ampt Set:
Vertical Layers Set:
Impervious Set: 1

Tolerances & Options

Time Marching:	SAOR	IA Recovery Time:	24.0000 hr
Max Iterations:	6		
Over-Relax Weight Fact:	0.5 dec		
dZ Tolerance:	0.0010 ft	Smp/Man Basin Rain Opt:	Global
Max dZ:	1.0000 ft		
Link Optimizer Tol:	0.0001 ft	Rainfall Name:	~FLMOD
		Rainfall Amount:	4.80 in
Edge Length Option:	Automatic	Storm Duration:	24.0000 hr
		Dflt Damping (1D):	0.0050 ft
		Min Node Srf Area (1D):	100 ft2
		Energy Switch (1D):	Energy

Comment:

Curve Number: 1 [Set]

Land Cover Zone	Soil Zone	Curve Number [dec]
B1	B1	94.0
B2	B2	94.0
B3	B3	94.0
B4	B4	94.0
B5	B5	94.0

JACKSON GEOTECHNICAL ENGINEERING, LLC

Consulting Geotechnical Engineers

REPORT OF GEOTECHNICAL EXPLORATION
1106 NORTH ORANGE AVENUE
GREEN COVE SPRINGS, FLORIDA
JGE PROJECT NO. 24-516.1

Prepared for:

Tocoi Engineering
714 N. Orange Avenue
Green Cove Springs, FL 32043

Prepared by:

Jackson Geotechnical Engineering
164 Plaza Del Rio Drive
St. Augustine, Florida 32084
Phone: 904-252-2292

May 13, 2024

May 13, 2024

Mr. Charley Sohm, P.E.
Tocoi Engineering
714 N. Orange Avenue
Green Cove Springs, FL 32043

Report of Geotechnical Exploration and Engineering Services
1106 North Orange Avenue
Green Cove Springs, Florida
JGE Project No. 24-516.1

Dear Mr. Sohm:

As requested, Jackson Geotechnical Engineering has completed a geotechnical exploration for the subject project. The exploration was performed to evaluate the general subsurface conditions within the area of the proposed construction, and to provide guidelines to facilitate pavement support, earthwork preparation, and drainage design.

We appreciate this opportunity to be of service as your geotechnical consultant on this phase of the project. Please contact us if you have any questions, or if we may be of any further service.

Sincerely:
Jackson Geotechnical Engineering, LLC.

Jeff S. Jackson, P.E.
Licensed, Florida 51979

Table of Contents

1.0 PROJECT INFORMATION

1.1 Site Location and Description

The site of the proposed project is located in the northwest quadrant of the intersection of Orange Avenue and Grove Street in Green Cove Springs, Florida. The site is cleared with a few scattered oak trees. Asphaltic pavement is present within the southern portion of the site. An existing church facility is located directly to the west, and St. Johns Avenue bounds the site to the north.

1.2 Project Description

Project information was provided to us during correspondence with you. We were provided with a Boundary Survey of the subject site prepared by Compass Surveying, last dated January 21, 2022. The provided survey shows the property boundaries, limits of existing asphalt, and adjacent roadways.

We understand a parking lot will be constructed at the site to expand the Church's parking capacity. The proposed pavement section will consist of flexible asphaltic concrete underlain by base course and stabilized subgrade. A dry retention pond will be excavated to treat and attenuate stormwater runoff.

2.0 FIELD EXPLORATION

2.1 Soil Borings

To explore the subsurface conditions within the area of the proposed pond, 1 Standard Penetration Test (SPT) boring (PB-1) was conducted to a depth of 20 feet below existing grade. To explore the subsurface conditions within the proposed pavement areas, 3 auger borings (A-1 through A-3) were conducted to a depth of 6 feet each below existing grade. The borings were performed at pre-selected areas within the site. The SPT and auger borings were conducted in accordance with ASTM D1586 and ASTM D1452, respectively. The locations of the borings, and the subsurface conditions encountered at each boring location, are presented in Appendix A on the Boring Location Plan and Subsurface Profiles, respectively.

2.2 Relatively Undisturbed Soil Samples

Two relatively undisturbed soil samples (one horizontal and one vertical) were obtained at the location of Boring PB-1 for the purposes of permeability (hydraulic conductivity) testing. The soil samples were obtained using thin-walled tube sampling techniques (Shelby tube). The Shelby tubes were transported to our laboratory for permeability testing.

3.0 LABORATORY TESTING

3.1 Index Testing

Soil samples recovered during the field exploration were visually classified in accordance with ASTM D2488. The results of the classification testing are presented on the Subsurface Profiles in Appendix A.

3.2 Permeability Testing

Permeability (hydraulic conductivity) tests were conducted on the undisturbed soil samples to estimate the coefficients of permeability of the appropriate soil layers. The coefficient of permeability is a measure of a soil's ability to transmit water under hydraulic loading conditions. It typically is a required input parameter for groundwater modeling, such as dry pond recoveries, background seepage, etc. The laboratory permeability test is typically conducted by placing the undisturbed soil sample in a permeameter, and while in the permeameter, the soil sample is subjected to differential hydraulic loading over a period of time. The volume of water that is transmitted through the soil sample is recorded, and along with the known hydraulic loading conditions, Darcy's law is utilized to calculate the coefficient of permeability. The coefficients of permeability are shown on the Subsurface Profiles at the depths of which the soil samples were obtained.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General Soil Profile

The boring locations and general subsurface conditions that were encountered are presented on the Boring Location Plan and Subsurface Profiles. When reviewing these records, it should be understood the soil conditions may change significantly between the boring locations. The following discussion summarizes the soil conditions encountered.

The SPT boring (PB-1), performed within the area of the proposed pond, encountered loose to medium dense fine sand (SP) throughout its 20-foot exploration depth. As an exception, the sandy soils encountered below a depth of approximately 15 feet exhibited a dense compactness.

The auger borings (A-1 through A-3) were performed within the proposed pavement areas. Borings A-1 through A-3 encountered fine sand (SP) throughout their 6-foot exploration depths.

4.2 Groundwater Level

The groundwater level was only encountered at the location of Boring PB-1. At this location, the groundwater level was encountered at a depth of approximately 10.6 feet below existing grade. The depth of the groundwater level encountered at the boring location is presented on the Subsurface Profiles.

The groundwater table will fluctuate depending on seasonal variations, adjacent construction, surface water runoff, etc. Our estimate of the normal seasonal high groundwater level at each applicable boring location is also presented on the Subsurface Profiles in Appendix A. Our estimates are based on the results of the soil borings, review of available published literature, and information provided for this study. Should rainfall intensity exceed normal quantities, or should other variables that affect the seasonal high groundwater level be altered, the groundwater profile at the site could change significantly.

5.0 PAVEMENT RECOMMENDATIONS

5.1 General

We understand the subject project will utilize flexible asphaltic concrete pavement. In the following sections, we have presented our recommendations to guide pavement design and site preparation.

5.2 Pavement Section Recommendations

Our recommendations for pavement sections are presented below. Detailed traffic loading conditions were not available; therefore, we have provided pavement sections which can accommodate loading conditions typical of the subject construction over a design life of 20 years. The light duty pavement sections are based on 500,000 Equivalent Single Axle Loads (ESALs) of 18 kips. The heavy-duty pavement sections are based on 1,500,000 ESALs. Pavement sections supporting significant truck loads would require different component thicknesses than presented below. If provided with detailed traffic loading, Jackson Geotechnical Engineering can perform a detailed pavement design.

Pavement Section	Asphalt[1] Thickness (in)	Base Course[2] Thickness (in)	Stabilized[3] Subgrade (in)
Light Duty Asphalt	1.5	6.0	12
Heavy Duty Asphalt	2.0	8.0	12

1) Flexible pavement should consist of SP 9.5 and/or SP 12.5. Heavy-duty pavement sections should include the use of SP 12.5.
2) Base course should consist of limerock exhibiting an LBR of at least 100, or crushed concrete exhibiting an LBR of at least 130. Limerock and crushed concrete base course materials and gradations should conform to FDOT Standard Specifications for Road and Bridge Construction Sections 911 and 204, respectively.
3) Subgrade should exhibit an LBR of at least 40.

5.3 Site Preparation for Pavements

We recommend the following site preparation guidelines for pavement construction:

1. Strip the proposed construction limits of all grass, roots, topsoil, existing asphalt, and other potentially deleterious materials from within, and extending at least 3 feet beyond, the proposed pavement limits. Expect initial clearing and grubbing to average depths of approximately 6 to 12 inches. During stripping operations, roots with a diameter greater than 0.5 inches, stumps, and roots in a concentrated state, should be completely removed.

2. Compact the exposed surface with a vibratory drum roller until densities of at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557) are achieved within the upper one foot below the exposed surface with the exception that densities of at least 98 percent should be obtained in the upper 12 inches below base course. We recommend the compacted soils exhibit moisture contents within 2 percent of the optimum moisture content as determined by the Modified Proctor Test (ASTM D 1557).

   Should the soils experience pumping and soil strength loss during the compaction operations, compaction work should be immediately terminated and (1) the disturbed soils removed and backfilled with dry structural fill soils which are then compacted, or (2) the excess moisture content within the disturbed soils allowed to dissipate before recompacting.

3. Test the compacted surface for density at a frequency of not less than one test per 10,000 square feet of pavement area (minimum four locations).

4. Place structural fill in loose lifts not exceeding 12 inches and compact until finished subgrade is achieved. Structural fill and backfill is typically defined as non-plastic, inorganic, granular soil having less than 12 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. Typically, the material should

exhibit moisture contents within 2 percent of the Modified Proctor optimum moisture content (ASTM D 1557) during the compaction operations. Compaction should continue until densities of at least 95 percent of the Modified Proctor maximum dry density (ASTM D 1557) have been achieved within each foot of the compacted structural fill, with the exception that densities of at least 98 percent should be obtained in the upper 12 inches below base course.

Care should be exercised to avoid damaging any nearby structures while the compaction operation is underway. Prior to commencing compaction, occupants of adjacent structures should be notified and the existing conditions of the structures be documented with photographs and survey (if deemed necessary). Compaction should cease if deemed detrimental to adjacent structures and Jackson Geotechnical Engineering should be contacted immediately. It is recommended the vibratory roller remain a minimum of 75 feet from existing structures. Within this zone, use of a vibratory roller operating in the static mode (vibration turned off) is recommended.

5. Perform density tests within each lift of fill at a frequency of not less than one test per 10,000 square feet of pavement area (minimum of four locations).

6. Place and compact base course until densities of at least 100 percent of the modified Proctor maximum dry density are achieved.

7. Perform density tests within the base course at a frequency of not less than one test per 10,000 square feet of pavement area (minimum of four locations).

5.4 Additional Pavement Considerations

5.4.1 Asphaltic Concrete Pavement

Asphaltic concrete mixes should be a current FDOT approved design of the materials actually used. Samples of the materials delivered to the project should be tested to verify that the aggregate gradation and asphalt content satisfies the mix design requirements.

After placement and field compaction, core the wearing surface to evaluate material thickness and to perform laboratory densities. Obtain cores at frequencies of at least one core per 3,000 square feet of placed pavement, or a minimum of two cores per day of production.

5.4.2 Groundwater Separation

Groundwater, if not maintained below the base course an adequate distance, can result in weakened subgrade and base course soils, and therefore a greatly reduced pavement life. The groundwater level at the location of the pond boring (PB-1) was encountered at a depth of approximately 10.5 feet. The groundwater level was not encountered within the

6-foot vertical reaches of the auger borings. At these depths, it is anticipated that groundwater will not adversely affect the pavement base course.

6.0 DRY RETENTION RECOVERY PARAMETERS

The drainage system will include a dry retention pond. Retention systems retain the necessary minimum amount of stormwater runoff (treatment volume) during the storm event. The volume retained is treated by infiltration into the ground. Infiltration into the ground is primarily affected by permeability of the soil, vertical height of stormwater stored in the pond (hydraulic loading), depth of the aquifer, soil porosity, and vertical distance between the pond bottom and the water table.

Based on State regulations, the retention system must recover the Pollution Abatement Volume (PAV) within a specified period of time, typically 72 hours after the storm event. Additionally, it is required the total volume located below the weir be recovered in a specified period of time. The table below summarizes the tested and estimated parameters for stormwater recovery modeling. A factor of safety of 2.0 should be utilized in the recovery analysis.

Location	Horizontal Permeability (ft/day)	Vertical Permeability (ft/day)	Effective Porosity	Bottom of Aquifer(1,2) (feet)	Estimated Seasonal High Groundwater Level(2) (feet)
PB-1	24.4	25.9	25%	20	7.6

(1) Aquifer depth limited to depth of boring, in accordance with SJRWMD guidelines.
(2) Depth references existing ground surface.

Note: Presented permeability values represent in-situ permeability rates of soil layer tested. It is recommended the drainage engineer specify on his plans the permeability of the backfill required, based on his calculations. The contractor should verify the permeability of the backfill soils prior to placement, and prior to import to the site.

7.0 LIMITATIONS

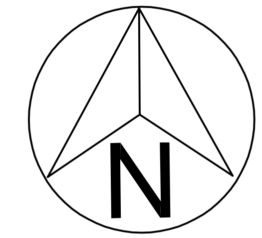
We have conducted the geotechnical engineering in accordance with principles and practices normally accepted in the geotechnical engineering profession. Our analysis and recommendations are dependent on the information provided to us. Jackson Geotechnical Engineering is not responsible for independent conclusions or interpretations based on the information presented in this report.

The recommendations provided in this report are specific to the proposed construction, and construction locations, as shown on the provided plans. Significant changes to the site design and construction, as described in this report, would nullify the provided recommendations.

APPENDIX A

BORING LOCATION PLAN

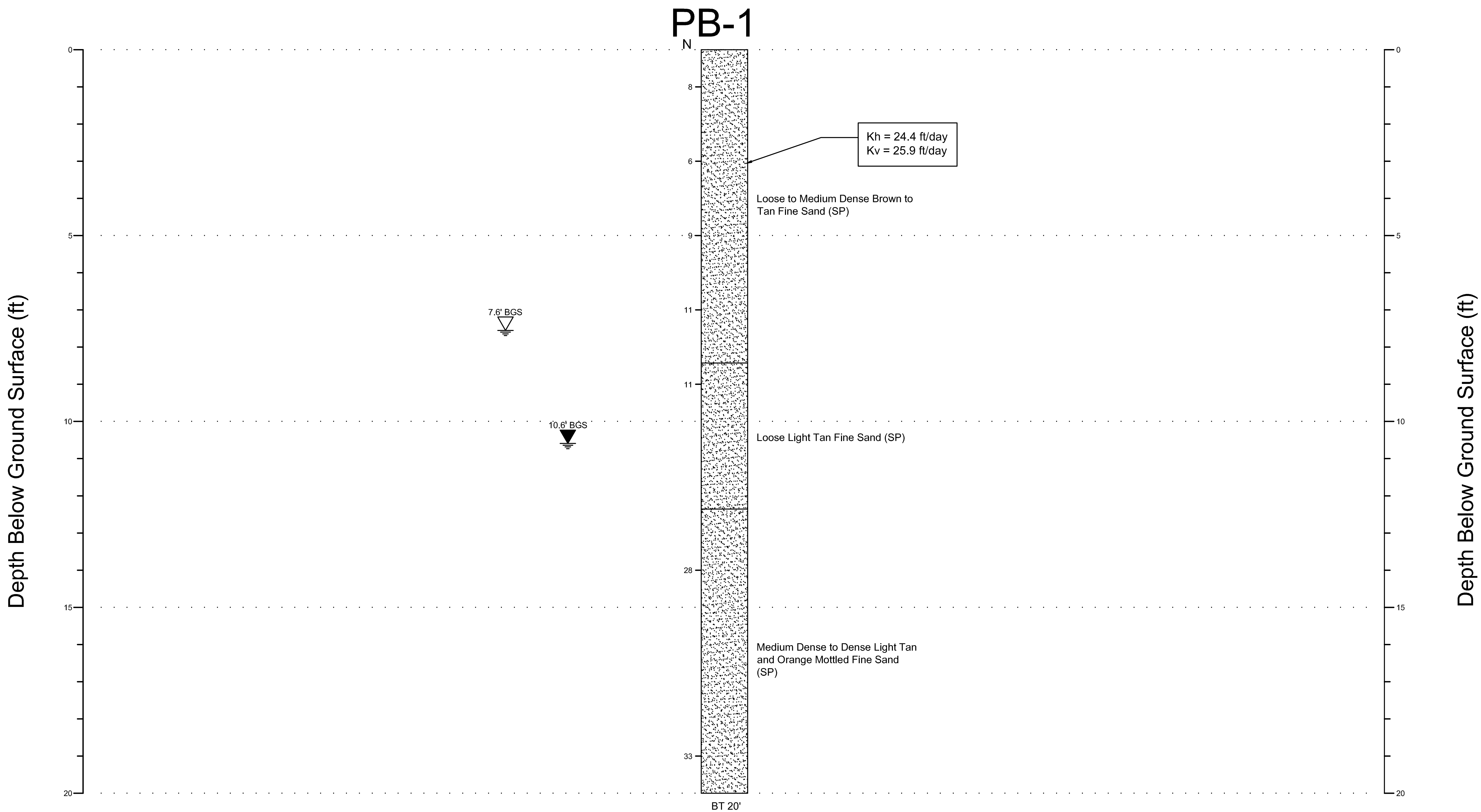
SUBSURFACE PROFILES



SPT Boring Location

Auger Boring Location

Jackson Geotechnical Engineering	
Subsurface Profiles	
1106 North Orange Avenue	
May 9, 2024	Drawn by: MJ
Project No. 24-516	Figure 1



Fine Sand (SP)

Kh Coefficient of Horizontal Permeability

Kv Coefficient of Vertical Permeability

Seasonal High Groundwater Table Estimated Below Existing Surface

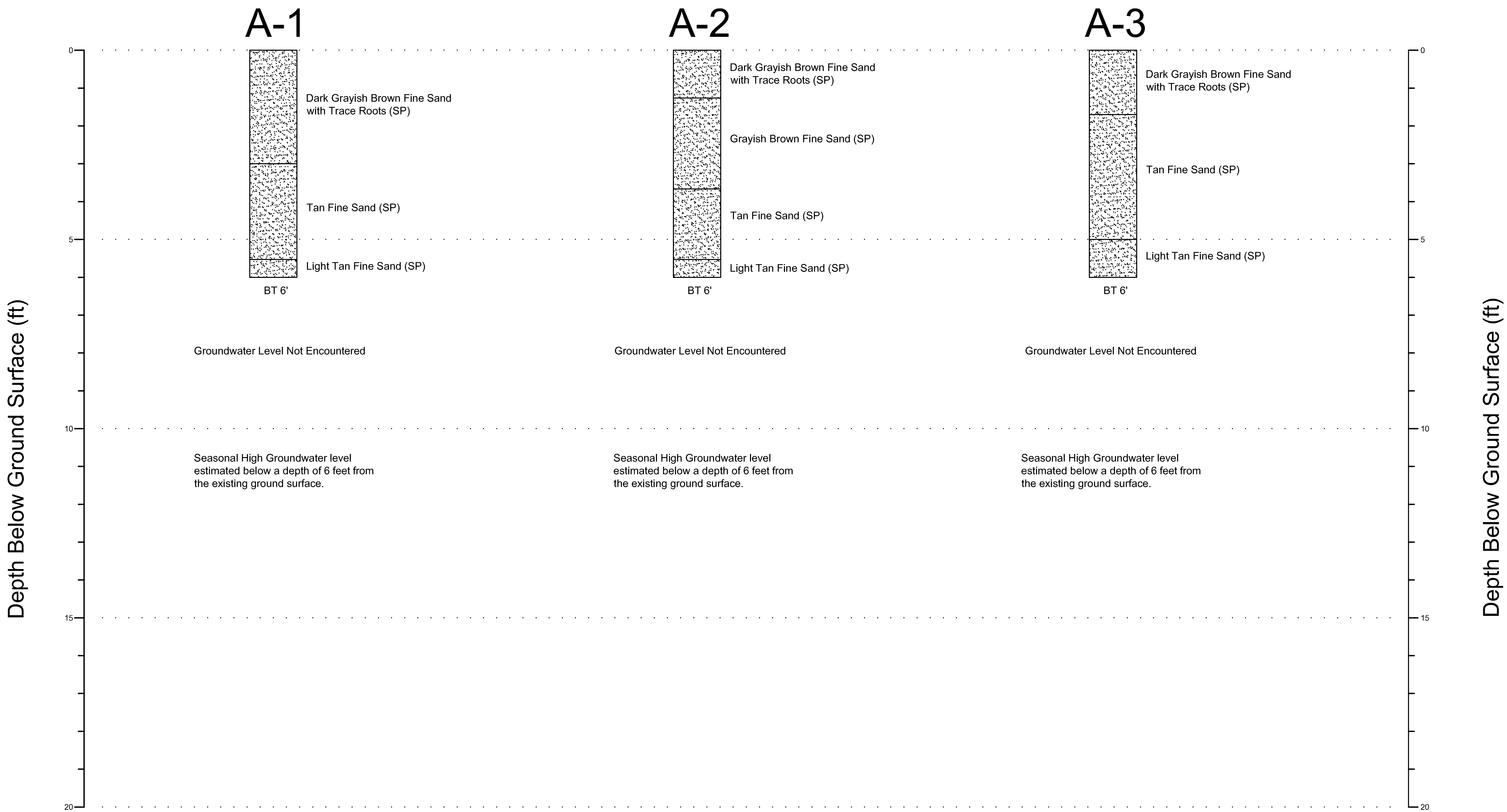
Groundwater Table Measured Below Surface

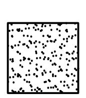
BT Boring Terminated

BGS Below Ground Surface

N SPT - N Blow Count

Jackson Geotechnical Engineering	
Subsurface Profiles	
1106 North Orange Avenue	
May 9, 2024	Drawn by: MJ
Project No. 24-516	Figure 2





BT Boring Terminated

BGS Below Ground Surface

Jackson Geotechnical Engineering	
Subsurface Profiles	
1106 North Orange Avenue	
May 9, 2024	Drawn by: MJ
Project No. 24-516	Figure 3

APPENDIX B

KEY TO SOIL CLASSIFICATION

FIELD AND LABORATORY TEST PROCEDURES

JACKSON GEOTECHNICAL ENGINEERING

Consulting Geotechnical Engineers

KEY TO SOIL CLASSIFICATION

CORRELATION OF PENETRATION WITH RELATIVE DENSITY & CONSISTENCY

SANDS AND GRAVEL	
BLOW COUNT	RELATIVE DENSITY
0-3	VERY LOOSE
4-10	LOOSE
11-30	MEDIUM DENSE
31-50	DENSE
OVER 50	VERY DENSE

SILTS AND CLAYS	
BLOW COUNT	CONSISTENCY
0-2	VERY SOFT
3-4	SOFT
5-8	FIRM
16-30	VERY STIFF
31-50	HARD
OVER 50	VERY HARD

PARTICLE SIZE IDENTIFICATION
(UNIFIED CLASSIFICATION SYSTEM)

CATEGORY	*DIMENSIONS*
Boulders	Diameter exceeds 12 inches
Cobbles	3 to 12 inches
Gravel	Coarse – 0.75 to 3 inches in diameter Fine – 4.76 mm to 0.75 inch diameter
Sand	Coarse – 2.0 mm to 4.76 mm diameter Medium – 0.42 mm to 2.0 mm diameter Fine – 0.074 mm to 0.42 mm diameter
Silt and Clay	Less than 0.074 mm (invisible to the naked eye)

MODIFIERS

These modifiers provide our estimate of the amount of minor constituent
(sand, silt, or clay size particles) in the soil sample

PERCENTAGE OF MINOR CONSTITUENT	*MODIFIERS*
0% to 5%	No Modifier
5 % to 12 %	With Silt, With Clay
12% to 30%	Silty, Clayey, Sandy
30% to 50%	Very Silty, Very Clayey, Very Sandy

APPROXIMATE CONTENT OF OTHER COMPONENTS (SHELL, GRAVEL, ETC.)	*MODIFIERS*	*APPROXIMATE CONTENT OF ORGANIC COMPONENTS*
0% to 5%	TRACE	1 to 2%
5% to 12%	FEW	2% to 4%
12% to 30%	SOME	4% to 8%
30% to 50%	MANY	>8%

FIELD AND LABORATORY TEST PROCEDURES

Penetration Borings

The penetration borings were made in general accordance with ASTM D 1586-67, "Penetration Test and Split-Barrel Sampling of Soils". Each boring was advanced to the water table by augering and, after encountering the groundwater table, further advanced with a rotary drilling technique that uses a circulating bentonite fluid for borehole flushing and stability. At two-foot intervals within the upper 10 feet and at five-foot intervals thereafter, the drilling tools were removed from the borehole and a split-barrel sampler inserted to the borehole bottom. The sampler was then driven 18 inches into the material using a 140-pound SPT hammer falling, on the average, 30 inches per hammer blow. The number of hammer blows for the final 12 inches of penetration is termed the "penetration resistance, blow count, or N-value". This value is an index to several in-place geotechnical properties of the material tested, such as relative density and Young's Modulus.

After driving the sampler 18 inches (or less, if in hard rock or rock-like material) at each test interval, the sampler was retrieved from the borehole and a representative sample of the material within the split-barrel was placed in a watertight container and sealed. After completing the drilling operations, the samples for each boring were transported to our laboratory where our Geotechnical Engineer examined them in order to verify the driller's field classifications. The samples will be kept in our laboratory for a period of two months after submittal of formal written report, unless otherwise directed by the Client.

Auger Borings

The auger borings were performed using a continuous flight auger attached to a rotary drill rig or manually using a post-hole auger; and thus in general accordance with ASTM D 1452-80, "Soil Investigation and Sampling by Auger Borings". Representative samples of the soils brought to the ground surface by the augering process were placed in watertight containers and sealed. After completing the drilling operations, the samples for each boring were transported to the laboratory where the Geotechnical Engineer examined them in order to verify the driller's field classifications. The samples will be kept in our laboratory for a period of two months after submittal of formal written report, unless otherwise directed by the Client.

Soil Classification

Soil samples obtained from the performance of the borings were transported to our laboratory for observation and review. An engineer, registered in the State of Florida and familiar with local geological conditions, conducted the review and classified the soils in accordance with ASTM 2488. The results of the soil classification are presented on the boring records.

Constant Head Permeability Test

The coefficient of permeability for the laminar flow of water through granular soils was determined in general accordance with the latest revision of ASTM D 2434. The constant head permeability test is a measure of the quantity of water that flows through a sample contained in a cylinder of known height and diameter in a measured time while maintaining a constant head of water on the sample. The coefficient of permeability is determined by application of the Darcy's Law shown below:

$$k = \frac{Q\,L}{hAt}$$

k = Coefficient of permeability

Q = Quantity of water discharge

L = Length of specimen

h = Constant head of water

A = Cross-sectional area of specimen

t = Total time of discharge

Undisturbed Sampling

Relatively undisturbed samples were obtained in general accordance with the latest revision of ASTM A 1587, "Thin-Walled Tube Sampling of Soils". Manual methods were used to advance the 3-inch O.D. – 16 gauge stainless steel sampler tubes into the soils at the selected depths. After retrieving the samples, the ends were capped and then transported to our laboratory.