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THE GEORGE - DELRAY BEACH (JOB NO. 20011)

PRE-DEVELOPMENT ANALYSIS

PRE-DEVELOPMENT SITE INFORMATION:

LAND USE CATEGORY	IMPERVIOUS AREA	PERVIOUS AREA	TOTAL AREA	%
BUILDINGS	0.04		0.04	12.90
IMPERV	0.09		0.09	29.03
GREENSPACE		0.18	0.18	58.06
TOTAL ACREAGES:	0.13	0.18	0.31	
PERCENTAGES:	41.94	58.06	100.00	

RAINFALL DATA:

PER D.R.E. 291 - "FREQUENCY ANALYSIS OF ONE AND THREE DAY RAINFALL MAXIMA FOR CENTRAL AND SOUTHERN FLORIDA"

STORM EVENT FREQUENCY (YR)	STORM DURATION (DAYS)	RAINFALL AMOUNT(INCHES)	CONTROLS
3	1	5.0	
5	1	6.0	ROAD CROWN
10	1	7.5	
25	3	12.5	PERIMETER BERM
100	3	16.0	FINISHED FLOOR ELEV

FIGURE 8

FIGURE 9

FIGURE 10

FIGURE 14

FIGURE 15

PRE-DEVELOPMENT SOIL STORAGE: (COMPACTED SOILS)

AVERAGE FINISHED GRADE (FT) 13.50

WATER TABLE / CONTROL ELEV.(NGVD) 4.50

DEPTH TO WATER TABLE (FT) 9.00

COMPACTED SOIL STORAGE (IN) 8.18 NORMAL SANDY SOILS

WEIGHTED SOIL STORAGE (IN) = COMPACTED STORAGE x PERCENT PERVIOUS = 4.75

PRE-DEVELOPMENT SITE STORAGE:

- 0.31 AC SITE STORES LINEARLY FROM ELEV. 13.25 TO 14.25 NGVD
- NO PERIMETER BERM

SUMMARY OF PRE-DEVELOPMENT VERSUS POST-DEVELOPMENT DISCHARGE RATES:

STORM EVENT:	MAX. PRE-DEV. DISCHARGE RATE	MAX POST-DEVEL. DISCHARGE
5-YR, 1-DAY (ROAD)	0.3 CFS	0 CFS
10-YR, 1-DAY, (DELRAY BERM)	1.79 CFS	0 CFS
25-YR, 3-DAY, (SITE BERM)	2.35 CFS	0.03 CFS



PRE-DEVELOPMENT STAGE-STORAGE TABULATION:

[illegible]

Project Name: THE GEORGE

Reviewer: EDA

Project Number: 20011

Period Begin: Feb 28, 2019;0000 hr End: Mar 15, 2019;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: On-Site

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 3day

Design Frequency: 25 year

1 Day Rainfall: 12.5 inches

Area: 0.31 acres

Ground Storage: 2.11 inches

Time of Concentration: 0.167 hours

Initial Stage: 12.5 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
12.50	0.00
13.00	0.01
13.50	0.04
14.00	0.13
14.50	0.55
15.00	0.70
15.50	0.86
16.00	1.01
16.50	1.17

Offsite Receiving Body: Offsite1

Time (hr)	Stage (ft NGVD)
0.00	12.00
360.00	12.00

Structure: 1

From Basin: On-Site

To Basin: Offsite1

Structure Type: Gravity

Weir: Sharp Crested, Crest Elev = 13.2 ft NGVD, Length = 5 ft

Bleeder: None

Pipe: None

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
0.00	0.00	0.00	0.00	0.00	12.50	12.00
10.00	0.76	0.01	0.00	0.00	12.56	12.00
20.00	1.52	0.01	0.00	0.00	12.98	12.00
30.00	2.49	0.03	0.03	0.00	13.21	12.00
40.00	3.60	0.03	0.03	0.03	13.22	12.00
50.00	4.74	0.03	0.03	0.05	13.22	12.00
60.00	12.69	2.43	1.62	0.19	13.58	12.00
70.00	16.69	0.05	0.05	0.32	13.56	12.00
80.00	16.99	0.00	0.00	0.33	13.55	12.00
90.00	16.99	0.00	0.00	0.33	13.55	12.00
100.00	16.99	0.00	0.00	0.33	13.55	12.00
110.00	16.99	0.00	0.00	0.33	13.55	12.00
120.00	16.99	0.00	0.00	0.33	13.55	12.00
130.00	16.99	0.00	0.00	0.33	13.55	12.00
140.00	16.99	0.00	0.00	0.33	13.55	12.00
150.00	16.99	0.00	0.00	0.33	13.55	12.00
160.00	16.99	0.00	0.00	0.33	13.55	12.00
170.00	16.99	0.00	0.00	0.33	13.55	12.00
180.00	16.99	0.00	0.00	0.33	13.55	12.00

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
190.00	16.99	0.00	0.00	0.33	13.55	12.00
200.00	16.99	0.00	0.00	0.33	13.55	12.00
210.00	16.99	0.00	0.00	0.33	13.55	12.00
220.00	16.99	0.00	0.00	0.33	13.55	12.00
230.00	16.99	0.00	0.00	0.33	13.55	12.00
240.00	16.99	0.00	0.00	0.33	13.55	12.00
250.00	16.99	0.00	0.00	0.33	13.55	12.00
260.00	16.99	0.00	0.00	0.33	13.55	12.00
270.00	16.99	0.00	0.00	0.33	13.55	12.00
280.00	16.99	0.00	0.00	0.33	13.55	12.00
290.00	16.99	0.00	0.00	0.33	13.55	12.00
300.00	16.99	0.00	0.00	0.33	13.55	12.00
310.00	16.99	0.00	0.00	0.33	13.55	12.00
320.00	16.99	0.00	0.00	0.33	13.55	12.00
330.00	16.99	0.00	0.00	0.33	13.55	12.00
340.00	16.99	0.00	0.00	0.33	13.55	12.00
350.00	16.99	0.00	0.00	0.33	13.55	12.00
360.00	16.99	0.00	0.00	0.33	13.55	12.00

STRUCTURE MAXIMUM AND MINIMUM DISCHARGES

Struc	Max (cfs)	Time (hr)	Min (cfs)	Time (hr)
1	2.35	59.80	0.00	0.00

BASIN MAXIMUM AND MINIMUM STAGES

Basin	Max (ft)	Time (hr)	Min (ft)	Time (hr)
On-Site	13.58	60.60	12.50	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
On-Site	0.38	0.00	0.33	0.00	0.05	0.00

Project Name: THE GEORGE

Reviewer: EDA

Project Number: 20011

Period Begin: Feb 28, 2019;0000 hr End: Mar 15, 2019;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: On-Site

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 24 hr

Design Frequency: 10 year

1 Day Rainfall: 7.5 inches

Area: 0.31 acres

Ground Storage: 2.11 inches

Time of Concentration: 0.167 hours

Initial Stage: 12.5 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
12.50	0.00
13.00	0.01
13.50	0.04
14.00	0.13
14.50	0.55
15.00	0.70
15.50	0.86
16.00	1.01
16.50	1.17

Offsite Receiving Body: Offsite1

Time (hr)	Stage (ft NGVD)
0.00	12.00
360.00	12.00

Structure: 1

From Basin: On-Site

To Basin: Offsite1

Structure Type: Gravity

Weir: Sharp Crested, Crest Elev = 13.2 ft NGVD, Length = 5 ft

Bleeder: None

Pipe: None

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
0.00	0.00	0.00	0.00	0.00	12.50	12.00
10.00	1.60	0.06	0.00	0.00	13.00	12.00
20.00	7.14	0.04	0.04	0.08	13.56	12.00
30.00	7.50	0.00	0.00	0.09	13.55	12.00
40.00	7.50	0.00	0.00	0.09	13.55	12.00
50.00	7.50	0.00	0.00	0.09	13.55	12.00
60.00	7.50	0.00	0.00	0.09	13.55	12.00
70.00	7.50	0.00	0.00	0.09	13.55	12.00
80.00	7.50	0.00	0.00	0.09	13.55	12.00
90.00	7.50	0.00	0.00	0.09	13.55	12.00
100.00	7.50	0.00	0.00	0.09	13.55	12.00
110.00	7.50	0.00	0.00	0.09	13.55	12.00
120.00	7.50	0.00	0.00	0.09	13.55	12.00
130.00	7.50	0.00	0.00	0.09	13.55	12.00
140.00	7.50	0.00	0.00	0.09	13.55	12.00
150.00	7.50	0.00	0.00	0.09	13.55	12.00
160.00	7.50	0.00	0.00	0.09	13.55	12.00
170.00	7.50	0.00	0.00	0.09	13.55	12.00
180.00	7.50	0.00	0.00	0.09	13.55	12.00

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
190.00	7.50	0.00	0.00	0.09	13.55	12.00
200.00	7.50	0.00	0.00	0.09	13.55	12.00
210.00	7.50	0.00	0.00	0.09	13.55	12.00
220.00	7.50	0.00	0.00	0.09	13.55	12.00
230.00	7.50	0.00	0.00	0.09	13.55	12.00
240.00	7.50	0.00	0.00	0.09	13.55	12.00
250.00	7.50	0.00	0.00	0.09	13.55	12.00
260.00	7.50	0.00	0.00	0.09	13.55	12.00
270.00	7.50	0.00	0.00	0.09	13.55	12.00
280.00	7.50	0.00	0.00	0.09	13.55	12.00
290.00	7.50	0.00	0.00	0.09	13.55	12.00
300.00	7.50	0.00	0.00	0.09	13.55	12.00
310.00	7.50	0.00	0.00	0.09	13.55	12.00
320.00	7.50	0.00	0.00	0.09	13.55	12.00
330.00	7.50	0.00	0.00	0.09	13.55	12.00
340.00	7.50	0.00	0.00	0.09	13.55	12.00
350.00	7.50	0.00	0.00	0.09	13.55	12.00
360.00	7.50	0.00	0.00	0.09	13.55	12.00

STRUCTURE MAXIMUM AND MINIMUM DISCHARGES

Struc	Max (cfs)	Time (hr)	Min (cfs)	Time (hr)
1	1.79	12.20	0.00	0.00

BASIN MAXIMUM AND MINIMUM STAGES

Basin	Max (ft)	Time (hr)	Min (ft)	Time (hr)
On-Site	13.58	12.00	12.50	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
On-Site	0.14	0.00	0.09	0.00	0.05	0.00

Project Name: THE GEORGE

Reviewer: EDA

Project Number: 20011

Period Begin: Feb 28, 2019;0000 hr End: Mar 15, 2019;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: On-Site

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 24 hr

Design Frequency: 10 year

1 Day Rainfall: 6 inches

Area: 0.31 acres

Ground Storage: 2.11 inches

Time of Concentration: 0.167 hours

Initial Stage: 12.5 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
12.50	0.00
13.00	0.01
13.50	0.04
14.00	0.13
14.50	0.55
15.00	0.70
15.50	0.86
16.00	1.01
16.50	1.17

Offsite Receiving Body: Offsite1

Time (hr)	Stage (ft NGVD)
0.00	12.00
360.00	12.00

Structure: 1

From Basin: On-Site

To Basin: Offsite1

Structure Type: Gravity

Weir: Sharp Crested, Crest Elev = 13.2 ft NGVD, Length = 5 ft

Bleeder: None

Pipe: None

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
0.00	0.00	0.00	0.00	0.00	12.50	12.00
10.00	1.28	0.04	0.00	0.00	12.79	12.00
20.00	5.71	0.03	0.03	0.05	13.56	12.00
30.00	6.00	0.00	0.00	0.06	13.55	12.00
40.00	6.00	0.00	0.00	0.06	13.55	12.00
50.00	6.00	0.00	0.00	0.06	13.55	12.00
60.00	6.00	0.00	0.00	0.06	13.55	12.00
70.00	6.00	0.00	0.00	0.06	13.55	12.00
80.00	6.00	0.00	0.00	0.06	13.55	12.00
90.00	6.00	0.00	0.00	0.06	13.55	12.00
100.00	6.00	0.00	0.00	0.06	13.55	12.00
110.00	6.00	0.00	0.00	0.06	13.55	12.00
120.00	6.00	0.00	0.00	0.06	13.55	12.00
130.00	6.00	0.00	0.00	0.06	13.55	12.00
140.00	6.00	0.00	0.00	0.06	13.55	12.00
150.00	6.00	0.00	0.00	0.06	13.55	12.00
160.00	6.00	0.00	0.00	0.06	13.55	12.00
170.00	6.00	0.00	0.00	0.06	13.55	12.00
180.00	6.00	0.00	0.00	0.06	13.55	12.00

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
190.00	6.00	0.00	0.00	0.06	13.55	12.00
200.00	6.00	0.00	0.00	0.06	13.55	12.00
210.00	6.00	0.00	0.00	0.06	13.55	12.00
220.00	6.00	0.00	0.00	0.06	13.55	12.00
230.00	6.00	0.00	0.00	0.06	13.55	12.00
240.00	6.00	0.00	0.00	0.06	13.55	12.00
250.00	6.00	0.00	0.00	0.06	13.55	12.00
260.00	6.00	0.00	0.00	0.06	13.55	12.00
270.00	6.00	0.00	0.00	0.06	13.55	12.00
280.00	6.00	0.00	0.00	0.06	13.55	12.00
290.00	6.00	0.00	0.00	0.06	13.55	12.00
300.00	6.00	0.00	0.00	0.06	13.55	12.00
310.00	6.00	0.00	0.00	0.06	13.55	12.00
320.00	6.00	0.00	0.00	0.06	13.55	12.00
330.00	6.00	0.00	0.00	0.06	13.55	12.00
340.00	6.00	0.00	0.00	0.06	13.55	12.00
350.00	6.00	0.00	0.00	0.06	13.55	12.00
360.00	6.00	0.00	0.00	0.06	13.55	12.00

STRUCTURE MAXIMUM AND MINIMUM DISCHARGES

Struc	Max (cfs)	Time (hr)	Min (cfs)	Time (hr)
1	0.30	12.40	0.00	0.00

BASIN MAXIMUM AND MINIMUM STAGES

Basin	Max (ft)	Time (hr)	Min (ft)	Time (hr)
On-Site	13.58	12.40	12.50	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
On-Site	0.10	0.00	0.06	0.00	0.05	0.00



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THE GEORGE - DELRAY BCH. (JOB NO. 20011)

POST DEVELOPMENT SITE ANALYSIS

LAND USE CATEGORY	IMPERVIOUS AREA	PERVIOUS AREA	TOTAL AREA	%
FIRST FLOOR FOOTPRINT	0.02		0.02	6.45
IMPERVIOUS LOW	0.20		0.20	64.52
IMPERVIOUS HI	0.01		0.01	3.23
GREEN SPACE		0.08	0.08	25.81
TOTAL ACREAGES:	0.23	0.08	0.31	
PERCENTAGES:	74.19	25.81	100.00	

RAINFALL DATA:

PER D.R.E. 291 - "FREQUENCY ANALYSIS OF ONE AND THREE DAY RAINFALL MAXIMA FOR CENTRAL AND SOUTHERN FLORIDA"

STORM EVENT FREQUENCY (YR)	STORM DURATION (DAYS)	RAINFALL AMOUNT(INCHES)*	CONTROLS	ACTUAL RUNOFF (IN)	
3	1			0.11	FIG 8
5	1	6.0	ROAD CROWN	4.05	FIG 9
10	1	7.5		5.45	FIG 10
25	3	12.5	PERIMETER BERM	10.28	FIG 14
100	3	16.0	FINISHED FLOOR ELEV	13.72	FIG 15

* RAINFALL DATA FROM SFWMD PUBLICATION D.R.E. 291

DELRAY BEACH MINIMUM RETENTION REQUIREMENT: 5-YEAR, 1-HOUR STORM = 3.2 INCHES

ALLOWABLE DISCHARGE:

S.F.W.M.D. DRAINAGE BASIN:

ALLOWABLE RUNOFF (CSM):

DESIGN FREQUENCY (YR):

TOTAL SITE AREA (AC):

ALLOWABLE DISCHARGE (CFS):

C-15
70
25
0.31
0.03

SOIL STORAGE:

AVERAGE FINISHED GRADE (FT)

16.50

CONTROL ELEVATION (NGVD)

8.00

DEPTH TO WATER TABLE (FT)

8.50

SOIL STORAGE (IN)

8.18

NORMAL SANDY SOILS

WEIGHTED SOIL STORAGE (IN) = COMPACTED STORAGE x PERCENT PERVIOUS =

2.11

WATER QUALITY CALCULATIONS:

1" OVER ENTIRE SITE METHOD:

1 IN. x TOTAL SITE AREA = (1 x 0.31Ac.) / 12 =

0.03 Acre-Ft

2.5" OVER IMPERVIOUS METHOD:

BUILDING / ROOF AREA (AC): 0.02

WATER QUALITY SITE AREA = 0.31 - 0.02 = 0.29 Ac.

WATER QUAL. IMPERVIOUS AREA = 0.29 - 0.08 = 0.21 Ac.

WATER QUAL. % IMPERVIOUS = 0.21 / 0.29 = 72%

WATER QUAL. VOLUME = 2.5 IN. x 72% = 1.8" x 0.31 / 12 =

(Total Site - water surface + roofs)

(Site Area - Pervious)

(Impervious / Site Area)

0.05 Acre-Ft

(THIS METHOD CONTROLS)

THEREFORE, WATER QUALITY REQUIRED = 0.05 Acre-Ft

WHICH, AS SHOWN ON THE FOLLOWING STAGE-STORAGE TABLE, IS ACHIEVED AT EL. 9.27' NGVD



POST-DEVELOPMENT STAGE-STORAGE TABULATION:

[illegible]

Project Name: THE GEORGE

Reviewer: EDA

Project Number: 20011

Period Begin: Feb 28, 2019;0000 hr End: Mar 15, 2019;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: On-Site

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 3day

Design Frequency: 100 year

3 Day Rainfall: 16 inches

Area: 0.31 acres

Ground Storage: 2.11 inches

Time of Concentration: 0.167 hours

Initial Stage: 8 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
8.50	0.00
9.00	0.03
9.50	0.07
10.00	0.10
10.50	0.13
11.00	0.16
11.50	0.20
12.00	0.23
12.50	0.26
13.00	0.26
13.50	0.27
14.00	0.31
14.50	0.40
15.00	0.54
15.50	0.68
16.00	0.82
16.50	0.97

STRUCTURE MAXIMUM AND MINIMUM DISCHARGES

Struc	Max (cfs)	Time (hr)	Min (cfs)	Time (hr)
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BASIN MAXIMUM AND MINIMUM STAGES

Basin	Max (ft)	Time (hr)	Min (ft)	Time (hr)
On-Site	14.25	73.60	8.00	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
On-Site	0.35	0.00	0.00	0.00	0.35	0.00

Project Name: THE GEORGE

Reviewer: EDA

Project Number: 20011

Period Begin: Feb 28, 2019;0000 hr End: Mar 15, 2019;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: On-Site

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 3day

Design Frequency: 25 year

3 Day Rainfall: 12.5 inches

Area: 0.31 acres

Ground Storage: 2.11 inches

Time of Concentration: 0.167 hours

Initial Stage: 8 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
8.50	0.00
9.00	0.03
9.50	0.07
10.00	0.10
10.50	0.13
11.00	0.16
11.50	0.20
12.00	0.23
12.50	0.26
13.00	0.26
13.50	0.27
14.00	0.31
14.50	0.40
15.00	0.54
15.50	0.68
16.00	0.82
16.50	0.97

Offsite Receiving Body: Offsite1

Time (hr)	Stage (ft NGVD)
0.00	12.00
360.00	13.00

Structure: 1

From Basin: On-Site

To Basin: Offsite1

Structure Type: Gravity

Weir: Sharp Crested, Crest Elev = 13.2 ft NGVD, Length = 2 ft

Bleeder: None

Pipe: None

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
0.00	0.00	0.00	0.00	0.00	8.00	12.00
10.00	0.56	0.00	0.00	0.00	8.50	12.03
20.00	1.12	0.01	0.00	0.00	8.57	12.06
30.00	1.83	0.02	0.00	0.00	8.74	12.08
40.00	2.65	0.02	0.00	0.00	8.99	12.11
50.00	3.49	0.02	0.00	0.00	9.21	12.14
60.00	9.34	1.76	0.00	0.00	10.98	12.17
70.00	12.28	0.03	0.00	0.00	12.49	12.19
80.00	12.50	0.00	0.00	0.00	13.20	12.22
90.00	12.50	0.00	0.00	0.00	13.20	12.25
100.00	12.50	0.00	0.00	0.00	13.20	12.28

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
110.00	12.50	0.00	0.00	0.00	13.20	12.31
120.00	12.50	0.00	0.00	0.00	13.20	12.33
130.00	12.50	0.00	0.00	0.00	13.20	12.36
140.00	12.50	0.00	0.00	0.00	13.20	12.39
150.00	12.50	0.00	0.00	0.00	13.20	12.42
160.00	12.50	0.00	0.00	0.00	13.20	12.44
170.00	12.50	0.00	0.00	0.00	13.20	12.47
180.00	12.50	0.00	0.00	0.00	13.20	12.50
190.00	12.50	0.00	0.00	0.00	13.20	12.53
200.00	12.50	0.00	0.00	0.00	13.20	12.56
210.00	12.50	0.00	0.00	0.00	13.20	12.58
220.00	12.50	0.00	0.00	0.00	13.20	12.61
230.00	12.50	0.00	0.00	0.00	13.20	12.64
240.00	12.50	0.00	0.00	0.00	13.20	12.67
250.00	12.50	0.00	0.00	0.00	13.20	12.69
260.00	12.50	0.00	0.00	0.00	13.20	12.72
270.00	12.50	0.00	0.00	0.00	13.20	12.75
280.00	12.50	0.00	0.00	0.00	13.20	12.78
290.00	12.50	0.00	0.00	0.00	13.20	12.81
300.00	12.50	0.00	0.00	0.00	13.20	12.83
310.00	12.50	0.00	0.00	0.00	13.20	12.86
320.00	12.50	0.00	0.00	0.00	13.20	12.89
330.00	12.50	0.00	0.00	0.00	13.20	12.92
340.00	12.50	0.00	0.00	0.00	13.20	12.94
350.00	12.50	0.00	0.00	0.00	13.20	12.97
360.00	12.50	0.00	0.00	0.00	13.20	13.00

STRUCTURE MAXIMUM AND MINIMUM DISCHARGES

Struc	Max (cfs)	Time (hr)	Min (cfs)	Time (hr)
1	0.03	72.00	0.00	0.00

BASIN MAXIMUM AND MINIMUM STAGES

Basin	Max (ft)	Time (hr)	Min (ft)	Time (hr)
On-Site	13.23	72.00	8.00	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
On-Site	0.27	0.00	0.00	0.00	0.26	0.00

Project Name: THE GEORGE

Reviewer: EDA

Project Number: 20011

Period Begin: Feb 28, 2019;0000 hr End: Mar 15, 2019;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: On-Site

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 24 hr

Design Frequency: 10 year

1 Day Rainfall: 7.5 inches

Area: 0.31 acres

Ground Storage: 2.11 inches

Time of Concentration: 0.167 hours

Initial Stage: 8 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
8.50	0.00
9.00	0.03
9.50	0.07
10.00	0.10
10.50	0.13
11.00	0.16
11.50	0.20
12.00	0.23
12.50	0.26
13.00	0.26
13.50	0.27
14.00	0.31
14.50	0.40
15.00	0.54
15.50	0.68
16.00	0.82
16.50	0.97

Offsite Receiving Body: Offsite1

Time (hr)	Stage (ft NGVD)
0.00	12.00
360.00	13.00

Structure: 1

From Basin: On-Site

To Basin: Offsite1

Structure Type: Gravity

Weir: Sharp Crested, Crest Elev = 13.2 ft NGVD, Length = 2 ft

Bleeder: None

Pipe: None

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
0.00	0.00	0.00	0.00	0.00	8.00	12.00
10.00	1.60	0.06	0.00	0.00	8.67	12.03
20.00	7.14	0.04	0.00	0.00	10.52	12.06
30.00	7.50	0.00	0.00	0.00	10.68	12.08
40.00	7.50	0.00	0.00	0.00	10.68	12.11
50.00	7.50	0.00	0.00	0.00	10.68	12.14
60.00	7.50	0.00	0.00	0.00	10.68	12.17
70.00	7.50	0.00	0.00	0.00	10.68	12.19
80.00	7.50	0.00	0.00	0.00	10.68	12.22
90.00	7.50	0.00	0.00	0.00	10.68	12.25
100.00	7.50	0.00	0.00	0.00	10.68	12.28

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
110.00	7.50	0.00	0.00	0.00	10.68	12.31
120.00	7.50	0.00	0.00	0.00	10.68	12.33
130.00	7.50	0.00	0.00	0.00	10.68	12.36
140.00	7.50	0.00	0.00	0.00	10.68	12.39
150.00	7.50	0.00	0.00	0.00	10.68	12.42
160.00	7.50	0.00	0.00	0.00	10.68	12.44
170.00	7.50	0.00	0.00	0.00	10.68	12.47
180.00	7.50	0.00	0.00	0.00	10.68	12.50
190.00	7.50	0.00	0.00	0.00	10.68	12.53
200.00	7.50	0.00	0.00	0.00	10.68	12.56
210.00	7.50	0.00	0.00	0.00	10.68	12.58
220.00	7.50	0.00	0.00	0.00	10.68	12.61
230.00	7.50	0.00	0.00	0.00	10.68	12.64
240.00	7.50	0.00	0.00	0.00	10.68	12.67
250.00	7.50	0.00	0.00	0.00	10.68	12.69
260.00	7.50	0.00	0.00	0.00	10.68	12.72
270.00	7.50	0.00	0.00	0.00	10.68	12.75
280.00	7.50	0.00	0.00	0.00	10.68	12.78
290.00	7.50	0.00	0.00	0.00	10.68	12.81
300.00	7.50	0.00	0.00	0.00	10.68	12.83
310.00	7.50	0.00	0.00	0.00	10.68	12.86
320.00	7.50	0.00	0.00	0.00	10.68	12.89
330.00	7.50	0.00	0.00	0.00	10.68	12.92
340.00	7.50	0.00	0.00	0.00	10.68	12.94
350.00	7.50	0.00	0.00	0.00	10.68	12.97
360.00	7.50	0.00	0.00	0.00	10.68	13.00

STRUCTURE MAXIMUM AND MINIMUM DISCHARGES

Struc	Max (cfs)	Time (hr)	Min (cfs)	Time (hr)
1	0.00	0.00	0.00	0.00

BASIN MAXIMUM AND MINIMUM STAGES

Basin	Max (ft)	Time (hr)	Min (ft)	Time (hr)
On-Site	10.68	25.60	8.00	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
On-Site	0.14	0.00	0.00	0.00	0.14	0.00

Project Name: THE GEORGE

Reviewer: EDA

Project Number: 20011

Period Begin: Feb 28, 2019;0000 hr End: Mar 15, 2019;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: On-Site

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 24 hr

Design Frequency: 5 year

1 Day Rainfall: 6 inches

Area: 0.31 acres

Ground Storage: 2.11 inches

Time of Concentration: 0.167 hours

Initial Stage: 8 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
8.50	0.00
9.00	0.03
9.50	0.07
10.00	0.10
10.50	0.13
11.00	0.16
11.50	0.20
12.00	0.23
12.50	0.26
13.00	0.26
13.50	0.27
14.00	0.31
14.50	0.40
15.00	0.54
15.50	0.68
16.00	0.82
16.50	0.97

Offsite Receiving Body: Offsite1

Time (hr)	Stage (ft NGVD)
0.00	12.00
360.00	13.00

Structure: 1

From Basin: On-Site

To Basin: Offsite1

Structure Type: Gravity

Weir: Sharp Crested, Crest Elev = 13.2 ft NGVD, Length = 2 ft

Bleeder: None

Pipe: None

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
0.00	0.00	0.00	0.00	0.00	8.00	12.00
10.00	1.28	0.04	0.00	0.00	8.60	12.03
20.00	5.71	0.03	0.00	0.00	9.95	12.06
30.00	6.00	0.00	0.00	0.00	10.08	12.08
40.00	6.00	0.00	0.00	0.00	10.08	12.11
50.00	6.00	0.00	0.00	0.00	10.08	12.14
60.00	6.00	0.00	0.00	0.00	10.08	12.17
70.00	6.00	0.00	0.00	0.00	10.08	12.19
80.00	6.00	0.00	0.00	0.00	10.08	12.22
90.00	6.00	0.00	0.00	0.00	10.08	12.25
100.00	6.00	0.00	0.00	0.00	10.08	12.28

Time (hr)	Cumulative Rainfall (in)	Instant Runoff (cfs)	Current Discharge (cfs)	Cumulative Discharge (acre-ft)	Head Water Stage (ft NGVD)	Tail Water Stage (ft NGVD)
110.00	6.00	0.00	0.00	0.00	10.08	12.31
120.00	6.00	0.00	0.00	0.00	10.08	12.33
130.00	6.00	0.00	0.00	0.00	10.08	12.36
140.00	6.00	0.00	0.00	0.00	10.08	12.39
150.00	6.00	0.00	0.00	0.00	10.08	12.42
160.00	6.00	0.00	0.00	0.00	10.08	12.44
170.00	6.00	0.00	0.00	0.00	10.08	12.47
180.00	6.00	0.00	0.00	0.00	10.08	12.50
190.00	6.00	0.00	0.00	0.00	10.08	12.53
200.00	6.00	0.00	0.00	0.00	10.08	12.56
210.00	6.00	0.00	0.00	0.00	10.08	12.58
220.00	6.00	0.00	0.00	0.00	10.08	12.61
230.00	6.00	0.00	0.00	0.00	10.08	12.64
240.00	6.00	0.00	0.00	0.00	10.08	12.67
250.00	6.00	0.00	0.00	0.00	10.08	12.69
260.00	6.00	0.00	0.00	0.00	10.08	12.72
270.00	6.00	0.00	0.00	0.00	10.08	12.75
280.00	6.00	0.00	0.00	0.00	10.08	12.78
290.00	6.00	0.00	0.00	0.00	10.08	12.81
300.00	6.00	0.00	0.00	0.00	10.08	12.83
310.00	6.00	0.00	0.00	0.00	10.08	12.86
320.00	6.00	0.00	0.00	0.00	10.08	12.89
330.00	6.00	0.00	0.00	0.00	10.08	12.92
340.00	6.00	0.00	0.00	0.00	10.08	12.94
350.00	6.00	0.00	0.00	0.00	10.08	12.97
360.00	6.00	0.00	0.00	0.00	10.08	13.00

STRUCTURE MAXIMUM AND MINIMUM DISCHARGES

Struc	Max (cfs)	Time (hr)	Min (cfs)	Time (hr)
1	0.00	0.00	0.00	0.00

BASIN MAXIMUM AND MINIMUM STAGES

Basin	Max (ft)	Time (hr)	Min (ft)	Time (hr)
On-Site	10.08	25.60	8.00	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
On-Site	0.10	0.00	0.00	0.00	0.10	0.00



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THE GEORGE - DELRAY BCH. (JOB NO. 20011)

WATER MANAGEMENT SYSTEM SUMMARY AND RESULTS

SURFACE WATER MANAGEMENT ELEMENTS:

0.2 ACRES OF IMPERVIOUS LOW STORING LINEARLY FROM ELEV. 13.25' TO 14.8' NGVD

0.01 ACRES OF IMPERVIOUS HI STORING LINEARLY FROM ELEV. 14.8' TO 15.25' NGVD

0.08 ACRES OF GREEN SPACE STORING LINEARLY FROM ELEV. 13.25' TO 14.75' NGVD

45 LF OF 8' WIDE BY 4' DEEP EXFILTRATION TRENCH STORES FROM ELEV. 8.5' TO 12.5' NGVD

CONTROL STRUCTURE INFORMATION:

BUBBLE-UP TRENCH DRAIN ON EAST SIDE OF SITE TO DISCHARGE INTO NE 7TH AVE

DISCHARGE WEIR SET AT 13.25' NAVD

FLOOD ROUTING RESULTS:

REFER TO ATTACHED SANTA-BARBARA STORM RUNS

STORM EVENT	MAXIMUM STAGE (FT)	MAXIMUM DISCHARGE (CFS)	ZERO DISCHARGE STAGE (FT)	CONTROLS	MINIMUM DESIGN ELEVATIONS (FT)
3-YEAR, 1-DAY					
5-YEAR, 1-DAY		-0-	10.08	MIN ROAD ELEVATION	13.25
10-YEAR, 1-DAY		-0-	10.68	MIN DELRAY BEACH BERM	13.25
25-YEAR, 3-DAY	13.23	0.03		PERIMETER BERM	13.25
100-YEAR, 3-DAY	N/A	-0-	14.25	FINISHED FLOOR ELEV	15.50

COMMENTS:

NOTE: THE PRE- VS POST- DEVELOPMENT CALCULATIONS DEMONSTRATE A REDUCTION IN DISCHARGE FROM THE SITE. THE 25-YR, 3-DAY STORM REDUCES FROM 2.35cfs TO 0.03cfs. THE 5-YR, 1-DAY STORM REDUCES FROM 0.30cfs TO 0.0 cfs. WATER QUALITY VOLUME OF 0.05AC-FT IS PROVIDED IN THE ON-SITE EXFILTRATION TRENCH AT ELEVATION 9.20'.

EXFILTRATION TRENCH CALCULATIONS

THE GEORGE - DELRAY BEACH - Job #20011

L =	LENGTH OF TRENCH REQ'D (FT)	
V wq =	WTR QUALITY VOLUME TO BE TREATED (AC-IN)	= 0.56
V add =	ADD'L VOLUME TO BE TREATED (AC-IN)	= 2.66
W =	TRENCH WIDTH (FT)	= 8
H =	DEPTH TO WATER TABLE (FT)	= 6
Du =	NON-SATURATED TRENCH DEPTH (FT)	= 4
Ds =	SATURATED TRENCH DEPTH (FT)	= 0
FS=	SAFETY FACTOR NOT LESS THAN 2	= 2
%WQ=	PERCENT REDUCTION IN WATER QUALITY	= 50
K =	HYDRAULIC CONDUCTIVITY (CFS/FT ² -FT HEAD)	= 1.51 X 10 ⁻³
OR K =		= 0.00151

STANDARD FORMULA:

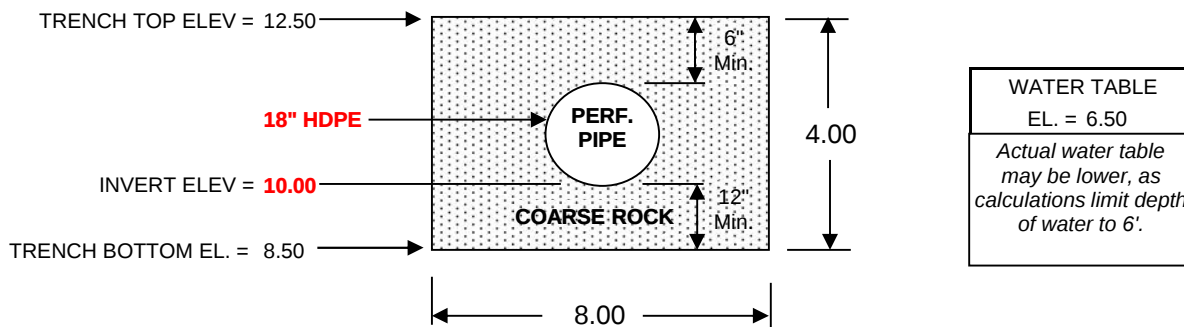
$$L = \frac{FS[(\%WQ)(V wq) + V add]}{K(HW+2HDu-Du^2 + 2HDS) + (1.39 \times 10^{-4}) wDu} = 46.93 \text{ FEET}$$

$$[L wq = \frac{4.46 \text{ FT}}{0.56} + L add = \frac{42.48 \text{ FT}}{3.10}]$$

CONSERVATIVE FORMULA: (NOT APPLICABLE - STANDARD FORMULA APPLIES)

$$L = \frac{V}{K(2HDu-Du^2 + 2HDS) + (1.39 \times 10^{-4}) wDu} = \text{N/A}$$

STANDARD TRENCH DETAIL - REFER TO ENGINEERING PLANS FOR ACTUAL SPECIFICATIONS



THEREFORE, MIN. TRENCH LENGTH REQUIRED	=	47 FEET
ACTUAL TRENCH LENGTH PROVIDED	=	45 FEET
ACTUAL TREATMENT VOLUME PROVIDED=		3.1 AC-IN OR 0.26 AC-FT
TRENCH DIMENSIONS:		8.00 FT. WIDE BY 4.00 FT. DEEP

*PERCENTAGE OF EXFILTRATION VOLUME CREDITED TOWARD STAGE-STORAGE: 100 %

O:\2020\20011-The George-GeorgeBush Blvd-Marc Julien Homes\CASCADE\20011-SFWM\20011-SFWM.xlsm]PRE-DEV



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May 11, 2020

Mr. Marc Julien
Marc Julien Homes
755 NW 17th Avenue, Suite 107
Delray Beach, FL 33445

Subject: Report of Exfiltration Test
Proposed Residence
655 George Bush Boulevard
Delray Beach, Florida

Dear Mr. Julien:

Nutting Engineers of Florida, Inc. has performed an exfiltration test for the proposed drainage improvements at the above referenced location. This report presents a brief description of the field procedures, and the results of the exfiltration test.

One exfiltration test was performed to a depth of six feet below existing grade in accordance with South Florida Water Management District (SFWMD) criteria for 'Usual Open-Hole' conditions.

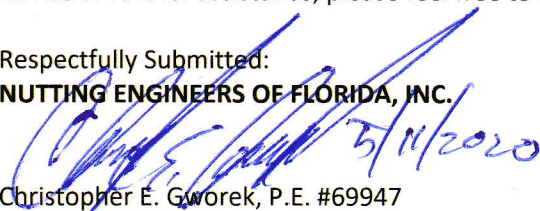
Prior to starting the test, a 6-inch diameter hole was augered to the test depth to determine the depth to groundwater and to examine subgrade soils. After establishing the above parameters, the hole was stabilized by a full-length perforated PVC pipe in accordance with South Florida Water Management District specifications. Water was then pumped into the hole maintaining a constant water level at the ground surface. The stabilized flow rates were recorded in one-minute intervals for a total of 10 minutes.

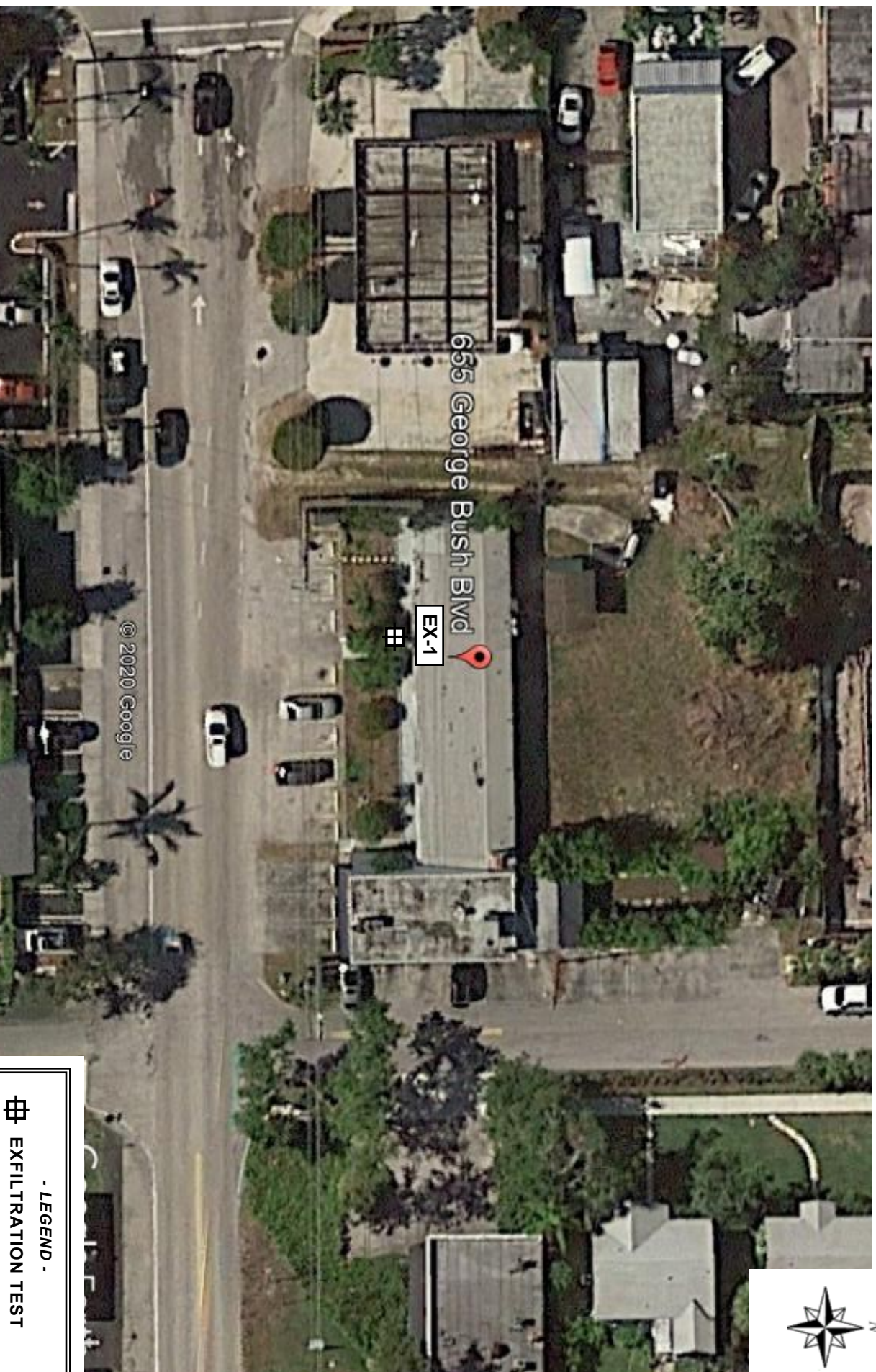
The exfiltration test revealed the hydraulic conductivity ('K'-value) of the soil was 1.51×10^{-3} cubic feet per second per square foot per foot of head. Soil descriptions and flow rates for the test are shown on the attached exfiltration summary sheet. We note that the water table was below a depth of 6 feet at the time of the test. This testing was performed to determine the hydraulic conductivity value only. Soil information shall not be used for other purposes.

We appreciate the opportunity to provide these services for you. Should you have any questions, or if we can be of further assistance, please feel free to contact us.

Respectfully Submitted:

NUTTING ENGINEERS OF FLORIDA, INC.


Christopher E. Gworek, P.E. #69947
Senior Engineer



- LEGEND -
EXFILTRATION TEST

Report of Exfiltration Test

Client:	<u>Marc Julien Homes</u>		Order No	<u>16570.2</u>
Project:	<u>Proposed Residence</u>		Report No	<u>1</u>
Location:	<u>655 George Bush Boulevard</u>		Date:	<u>5/6/20</u>
	<u>Delray Beach, Florida</u>			
Test:	<u>Usual Open Hole Exfiltration Test</u>			
Surface		Water table from ground		
Elevation:	<u>Approx. @ Road Crown</u>	surface:		<u>>6'</u>
Casing				
Diameter:	<u>6"</u>			
Tube Depth:	<u>6'</u>			

EXFIL NO. 1		One Minute Increme	Pump Rate in Gal/Min
Sample Location: <u>Approx. as located on site plan.</u>		1	20+
		2	20+
		3	20+
		4	20+
		5	20+
		6	20+
		7	20+
		8	20+
		9	20+
		10	20+
Material:	0-6' Gray fine SAND		

$$K = 1.51 \times 10^{-3} \text{ cfs/ft}^2\text{ft.head}$$

LIMITATIONS OF LIABILITY

WARRANTY

We warrant that the services performed by Nutting Engineers of Florida, Inc. are conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession in our area currently practicing under similar conditions at the time our services were performed. **No other warranties, expressed or implied, are made.** While the services of Nutting Engineers of Florida, Inc. are a valuable and integral part of the design and construction teams, we do not warrant, guarantee or insure the quality, completeness, or satisfactory performance of designs, construction plans, specifications we have not prepared, nor the ultimate performance of building site materials or assembly/construction.

SUBSURFACE EXPLORATION

Subsurface exploration is normally accomplished by test borings; test pits are sometimes employed. The method of determining the boring location and the surface elevation at the boring is noted in the report. This information is represented in the soil boring logs and/or a drawing. The location and elevation of the borings should be considered accurate only to the degree inherent with the method used and may be approximate.

The soil boring log includes sampling information, description of the materials recovered, approximate depths of boundaries between soil and rock strata as encountered and immediate depth to water data. The log represents conditions recorded specifically at the location where and when the boring was made. Site conditions may vary through time as will subsurface conditions. The boundaries between different soil strata as encountered are indicated at specific depths; however, these depths are in fact approximate and dependent upon the frequency of sampling, nature and consistency of the respective strata. Substantial variation between soil borings may commonly exist in subsurface conditions. Water level readings are made at the time and under conditions stated on the boring logs. Water levels change with time, precipitation, canal level, local well drawdown and other factors. Water level data provided on soil boring logs shall not be relied upon for groundwater based design or construction considerations.

LABORATORY AND FIELD TESTS

Tests are performed in *general* accordance with specific ASTM Standards unless otherwise indicated. All criteria included in a given ASTM Standard are not always required and performed. Each test boring report indicates the measurements and data developed at each specific test location.

ANALYSIS AND RECOMMENDATIONS

The geotechnical report is prepared primarily to aid in the design of site work and structural foundations. Although the information in the report is expected to be sufficient for these purposes, it shall not be utilized to determine the cost of construction nor to stand alone as a construction specification. Contractors shall verify subsurface conditions as may be appropriate prior to undertaking subsurface work.

Report recommendations are based primarily on data from test borings made at the locations shown on the test boring reports. Soil variations commonly exist between boring locations. Such variations may not become evident until construction. Test pits sometimes provide valuable supplemental information that derived from soil borings. If variations are then noted, the geotechnical engineer shall be contacted in writing immediately so that field conditions can be examined and recommendations revised if necessary.

The geotechnical report states our understanding as to the location, dimensions and structural features proposed for the site. **Any significant changes of the site improvements or site conditions must be communicated in writing to the geotechnical engineer immediately** so that the geotechnical analysis, conclusions, and recommendations can be reviewed and appropriately adjusted as necessary.

CONSTRUCTION OBSERVATION

Construction observation and testing is an important element of geotechnical services. The geotechnical engineer's field representative (G.E.F.R.) is the "owner's representative" observing the work of the contractor, performing tests and reporting data from such tests and observations. **The geotechnical engineer's field representative does not direct the contractor's construction means, methods, operations or personnel.** The G.E.F.R. does not interfere with the relationship between the owner and the contractor and, except as an observer, does not become a substitute owner on site. The G.E.F.R. is responsible for his/her safety, but has no responsibility for the safety of other personnel at the site. The G.E.F.R. is an important member of a team whose responsibility is to observe and test the work being done and report to the owner whether that work is being carried out in general conformance with the plans and specifications. The enclosed report may be relied upon solely by the named client.

SOIL AND ROCK CLASSIFICATION CRITERIA

SAND/SILT

N-VALUE (bpf)	RELATIVE DENSITY
0 – 4	Very Loose
5 – 10	Loose
11 – 29	Medium
30 – 49	Dense
>50	Very dense
100	Refusal

CLAY/SILTY CLAY

N-VALUE (bpf)	UNCONFINED COMP. STRENGTH (tsf)	CONSISTENCY
<2	<0.25	v. Soft
2 – 4	0.25 – 0.50	Soft
5 – 8	0.50 – 1.00	Medium
9 – 15	1.00 – 2.00	Stiff
16 – 30	2.00 – 4.00	v. Stiff
>30	>4.00	Hard

ROCK

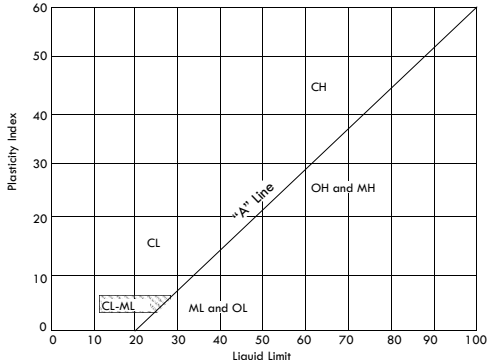
N-VALUE (bpf)	RELATIVE HARDNESS	ROCK CHARACTERISTICS
$N \geq 100$	Hard to v. hard	Local rock formations vary in hardness from soft to very hard within short vertical and horizontal distances and often contain vertical solution holes of 3 to 36 inch diameter to varying depths and horizontal solution features. Rock may be brittle to split spoon impact, but more resistant to excavation.
$25 \leq N \leq 100$	Medium hard to hard	
$5 \leq N \leq 25$	Soft to medium hard	

PARTICLE SIZE

Boulder	>12 in.
Cobble	3 to 12 in.
Gravel	4.76 mm to 3 in.
Sand	0.074 mm to 4.76 mm
Silt	0.005 mm to 0.074 mm
Clay	<0.005 mm

DESCRIPTION MODIFIERS

0 – 5%	Slight trace
6 – 10%	Trace
11 – 20%	Little
21 – 35%	Some
>35%	And

Major Divisions		Group Symbols	Typical names	Laboratory classification criteria	
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GW* d u	Atterberg limits below "A" line or P.I. less than 4	
			GC	Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM* d u	Atterberg limits below "A" line or P.I. less than 4	
			SC	Atterberg limits above "A" line with P.I. more than 7	
Fine-grained soils (More than half of material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	 Plasticity Index Liquid Limit Plasticity Chart	
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy, clays, silty clays, lean clays		
		OL	Organic silts and organic silty clays of low plasticity		
	Silts and clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
		CH	Inorganic clays or high plasticity, fat clays		
		OH	Organic clays of medium to high plasticity, organic silts		
	Highly organic soils	PT	Peat and other highly organic soils		