

**City of Margate
Fire Station 58
Stormwater Calculations**

PROJECT DATA

Site	Total Area (ac)	Pavement Area (ac)	Building Area (ac)	Pervious Area (ac)
Existing Conditions	1.660	0.56	0.12	0.98
Proposed Conditions	1.660	0.65	0.20	0.81

Wet Season Water Table 5.5 NAVD 88 (Per Broward County Wet Season Water Table Map)

WATER QUALITY RETENTION REQUIRED

First Inch of Runoff

$$1.0 \text{ IN} \quad \times \quad 1.66 \text{ AC} \times (1 \text{ FT} / 12 \text{ IN}) \quad = \quad 0.14 \text{ Acre-Feet}$$

2.5 Times Impervious

Site Area for Water Quality:

$$1.66 \text{ Acres} \quad - \quad 0.20 \text{ Acres (Bldg)} \quad = \quad 1.459 \text{ Acres}$$

Impervious Area for Water Quality:

$$1.459 \text{ Acres} \quad - \quad 0.81 \text{ Acres} \quad = \quad 0.65 \text{ Acres}$$

Percentage of Imperviousness for Water Quality:

$$0.65 \text{ Acres} \quad / \quad 1.66 \text{ Acres} \times 100 \quad = \quad 39.0\%$$

Amount of Runoff to be Treated:

$$2.5 \text{ Inches} \quad \times \quad 0.39 \quad = \quad 0.97 \text{ Inches}$$

Volume Required for Quality Retention:

$$0.97 \text{ Inches} \quad \times \quad 1.66 \text{ AC} \times (1 \text{ FT} / 12 \text{ IN}) \quad = \quad 0.13 \text{ Acre-Feet}$$

Retention Required:

0.14 Acre-Feet

WATER QUALITY RETENTION PROVIDED

EXFILTRATION TRENCH

The equation used is:

$$V = L \times (K (H_2 W + 2 H_2 D_u - D_u^2 + 2 H_2 D_s) + (1.39 e^{-4}) W D_u)$$

V = Trench Volume (ac-in)

L = Trench Length (ft)

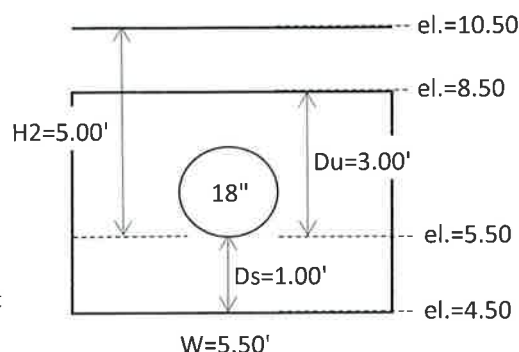
W = Trench Width (ft)

K = 2.500E-04 CFS/SF*FT Head; Per Geotechnical Report

H₂ = Depth to water table or depth to bottom of trench (ft)

D_u = Unsaturated Trench Depth (ft)

D_s = Saturated Trench Depth (ft)



see table below for values for each variable

Basin	Pipe Diameter (IN)	L	W	H ₂	D _s	D _u	V
Overall Site	18	116	5.5	5	1	3.00	0.164
TOTAL							0.16

Proposed exfiltration volume provided = 0.16 ac-ft



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DRY RETENTION

Proposed Land Use	Area (ac)	Storage Type	Elevation Range
Dry Retention Bottom	0.17	Vertical	7
Dry Retention Banks	0.07	Lateral	7 to 9

Dry Retention Volume Calculation (ac-ft)

retention area x (elevation range) + retention bank area x (elevation range/2)

Proposed dry retention volume provided = 0.24 ac-ft

TOTAL WATER QUALITY VOLUME PROVIDED

Proposed dry detention volume provided = 0.24 ac-ft

Proposed exfiltration volume provided = 0.16 ac-ft

Total water quality volume provided = 0.40 ac-ft

0.40 ac-ft > 0.14 ac-ft

Volume of water quality provided is greater than volume of water quality required

WATER QUANTITY CALCULATIONS

Proposed Trench was modeled in Cascade through the reduction of the rainfall amount.

Exfiltration Volume	0.16	ac-ft
Site Area	1.660	acres
Rainfall Reduction Utilitized in Model	1.18	inches
Rainfall Reduction Allowed	3.20	inches (per ERP Manual)

Storm Event	Existing Conditions		Proposed Conditions	
	Rainfall (inches)		Rainfall (inches)	
100 year, 3 day storm event	18.00	in	16.82	in
25 year, 3 day storm event	14.00	in	12.82	in
10 year, 1 day storm event	8.50	in	7.32	in
5 year, 1 day storm event	7.50	in	6.32	in

Cascade Modeling

Existing and Proposed Peak Flood Stage Elevation Results

Storm Event	Existing Conditions Peak Stage (ft, NAVD)	Proposed Conditions Peak Stage (ft, NAVD)
100 year, 3 day storm event	11.27	11.20
25 year, 3 day storm event	-	-
10 year, 1 day storm event	10.33	10.00
5 year, 1 day storm event	-	-

100 year - 3 day storm event: Existing Peak Stage ≤ Proposed Peak Stage

**City of Margate
Fire Station 58
Stormwater Calculations**

DRY RETENTION BLEED DOWN CALCULATIONS

Required Retention Volume, V (Ac-in) =

Dry Retention Area (Ac) = Area at Bottom of Retention Area (conservative).

Dry Retention Perimeter, L (ft) = Length at bottom of bank (conservative).

Design Volume Head, H_2 (ft) = Distance from top of bank to bottom of retention pond.

Saturated depth, D_s (ft) = Depth to water table as measured from pond bottom.

Hydraulic Conductivity, K (cfs/ft²-ft) = From geotechnical report.

Volume of Water Treated in one hour (Ac-in) = when the retention area is full.

Average V (Ac-in) =

Time to drain retention volume (hrs) = < 72 hrs; therefore, the design meets the 72-hour bleed down criterion.

Fire Station 58
City of Margate
Appendix B-1 Existing Conditions - Soil Storage & Stage Storage Calculations

Wet Season Water Table 5.50 NAVD 88 (Per Broward County Wet Season Water Table Map)

		Area		Elevation			Depth To Water Table	Soil Storage
		SF	Acres	Low	High	Average		
1	Buildings, Tanks, Canopies	5,360	0.123	11.61	11.61	11.61	6.11	0.00
2	Asphalt Pavement	17,733	0.407	10.30	11.50	10.90	5.40	0.00
3	Concrete Area - North	4,636	0.106	9.50	11.00	10.25	4.75	0.00
4	Concrete Area - South	1,935	0.044	10.80	11.50	11.15	5.65	0.00
5	Green Area (High)	15,748	0.362	10.50	11.00	10.75	5.25	12.22
6	Green Area (Low)	26,890	0.617	8.50	10.50	9.50	4.00	4.74
	TOTAL	72,302	1.660					

Total Site soil storage **4.42** inches

Notes:

Highlighted Area = Pervious Area with Soil Storage

Table is used in Cascade to generate the stage storage values for the proposed site conditions

Depth	Soil Storage
1	0.45
2	1.88
3	4.95
4	8.18

Impervious % 41.0%
Pervious % 59.0%

Fire Station 58
City of Margate
Appendix B-1 Proposed Conditions - Soil Storage & Stage Storage Calculations

Wet Season Water Table 5.50 NAVD 88 (Per Broward County Wet Season Water Table Map)

		Area		Elevation			Depth To Water Table	Soil Storage
		SF	Acres	Low	High	Average		
1	Buildings, Tanks, Canopies	8,757	0.201	12.00	12.00	12.00	6.50	0.00
2	Asphalt Pavement	14,353	0.329	10.50	11.00	10.75	5.25	0.00
3	Concrete Area - North	10,873	0.250	11.00	11.90	11.45	5.95	0.00
4	Concrete Area - South	2,977	0.068	10.90	11.90	11.40	5.90	0.00
5	Green Area (High)	7,666	0.176	10.50	11.75	11.13	5.63	13.43
6	Proposed Retention Slopes	3,089	0.071	7.00	9.00	8.00	2.50	3.34
7	Proposed Retention Bottom	7,310	0.168	7.00	7.00	7.00	1.50	0.11
8	Green Area (Low)	17,277	0.397	8.50	10.50	9.50	4.00	4.74
TOTAL		72,302	1.660					

Total Site soil storage **2.56** inches

Notes:

Highlighted Area = Pervious Area with Soil Storage

Table is used in Cascade to generate the stage storage values for the proposed site conditions

Depth	Soil Storage
1	0.45
2	1.88
3	4.95
4	8.18

Impervious % 51.1%
Pervious % 48.9%

Project Name: Fire Station 58

Reviewer: DD

Project Number: 178.011

Period Begin: Jan 01, 2000;0000 hr End: Jan 16, 2000;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: EXISTING

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 24 hr

Design Frequency: 10 year

1 Day Rainfall: 8.5 inches

Area: 1.66 acres

Ground Storage: 4.42 inches

Time of Concentration: 0.1 hours

Initial Stage: 8 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
6.00	0.00
6.50	0.00
7.00	0.00
7.50	0.00
8.00	0.00
8.50	0.00
9.00	0.04
9.50	0.15
10.00	0.40
10.50	0.80
11.00	1.47
11.50	2.24
12.00	3.05
12.50	3.88
13.00	4.71
14.00	6.37
15.00	8.03
16.00	9.69
17.00	11.35
18.00	13.01

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)
EXISTING	10.33	24.80	6.00	0.20

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
EXISTING	0.67	0.00	0.00	0.00	0.67	0.00

Project Name: Fire Station 58

Reviewer: DD

Project Number: 178.011

Period Begin: Jan 01, 2000;0000 hr End: Jan 16, 2000;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: PROPOSED

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 24 hr

Design Frequency: 10 year

1 Day Rainfall: 7.32 inches

Area: 1.66 acres

Ground Storage: 2.56 inches

Time of Concentration: 0.1 hours

Initial Stage: 8 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
6.00	0.00
6.50	0.00
7.00	0.00
7.50	0.09
8.00	0.19
8.50	0.29
9.00	0.43
9.50	0.63
10.00	0.87
10.50	1.16
11.00	1.67
11.50	2.36
12.00	3.09
12.50	3.92
13.00	4.75
14.00	6.41
15.00	8.07
16.00	9.73
17.00	11.39
18.00	13.05

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)
PROPOSED	10.00	25.00	8.00	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
PROPOSED	0.68	0.00	0.00	0.19	0.87	0.00

Project Name: Fire Station 58

Reviewer: DD

Project Number: 178.011

Period Begin: Jan 01, 2000;0000 hr End: Jan 16, 2000;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: EXISTING

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 3day

Design Frequency: 100 year

3 Day Rainfall: 18 inches

Area: 1.66 acres

Ground Storage: 4.42 inches

Time of Concentration: 0.1 hours

Initial Stage: 6 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
6.00	0.00
6.50	0.00
7.00	0.00
7.50	0.00
8.00	0.00
8.50	0.00
9.00	0.04
9.50	0.15
10.00	0.40
10.50	0.80
11.00	1.47
11.50	2.24
12.00	3.05
12.50	3.88
13.00	4.71
14.00	6.37
15.00	8.03
16.00	9.69
17.00	11.35
18.00	13.01

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)
EXISTING	11.27	73.00	6.00	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
EXISTING	1.88	0.00	0.00	0.00	1.88	0.00

Project Name: Fire Station 58

Reviewer: DD

Project Number: 178.011

Period Begin: Jan 01, 2000;0000 hr End: Jan 16, 2000;0000 hr Duration: 360 hr

Time Step: 0.2 hr, Iterations: 10

Basin 1: PROPOSED

Method: Santa Barbara Unit Hydrograph

Rainfall Distribution: SFWMD - 3day

Design Frequency: 100 year

3 Day Rainfall: 16.82 inches

Area: 1.66 acres

Ground Storage: 2.56 inches

Time of Concentration: 0.1 hours

Initial Stage: 6 ft NGVD

Stage (ft NGVD)	Storage (acre-ft)
6.00	0.00
6.50	0.00
7.00	0.00
7.50	0.09
8.00	0.19
8.50	0.29
9.00	0.43
9.50	0.63
10.00	0.87
10.50	1.16
11.00	1.67
11.50	2.36
12.00	3.09
12.50	3.92
13.00	4.75
14.00	6.41
15.00	8.07
16.00	9.73
17.00	11.39
18.00	13.05

STRUCTURE MAXIMUM AND MINIMUM DISCHARGES

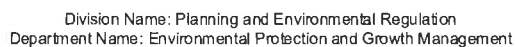
Struc	Max (cfs)	Time (hr)	Min (cfs)	Time (hr)
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BASIN MAXIMUM AND MINIMUM STAGES

Basin	Max (ft)	Time (hr)	Min (ft)	Time (hr)
PROPOSED	11.20	73.00	6.00	0.00

BASIN WATER BUDGETS (all units in acre-ft)

Basin	Total Runoff	Structure Inflow	Structure Outflow	Initial Storage	Final Storage	Residual
PROPOSED	1.95	0.00	0.00	0.00	1.95	0.00



This map is for conceptual purposes only and should not be used for legal boundary determinations.
Elevation converted from NGDV to NAVD using the FEMA approved conversion factor for Broward County of (-) 1.5

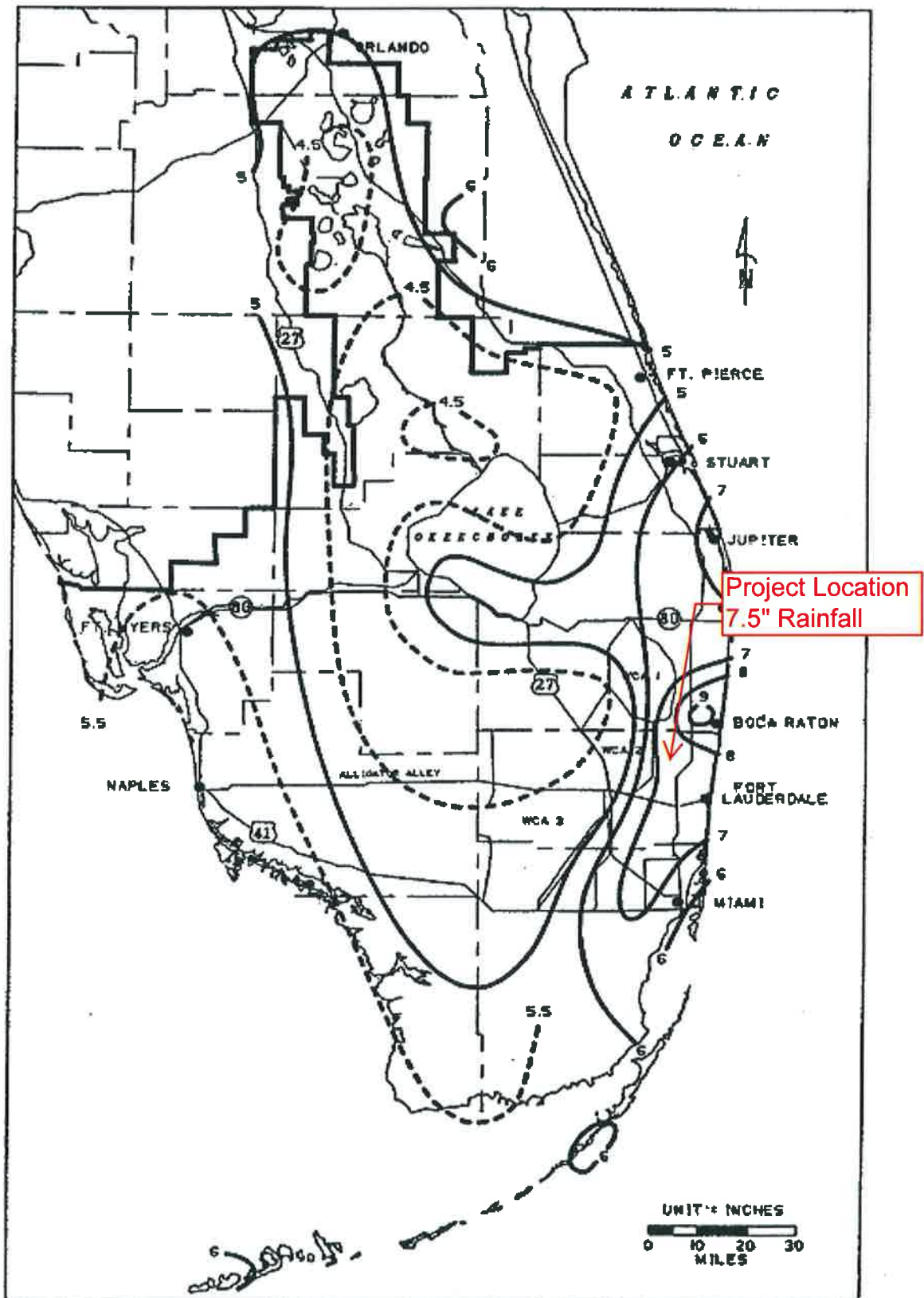


FIGURE C-3. 1-DAY RAINFALL: 5-YEAR RETURN PERIOD

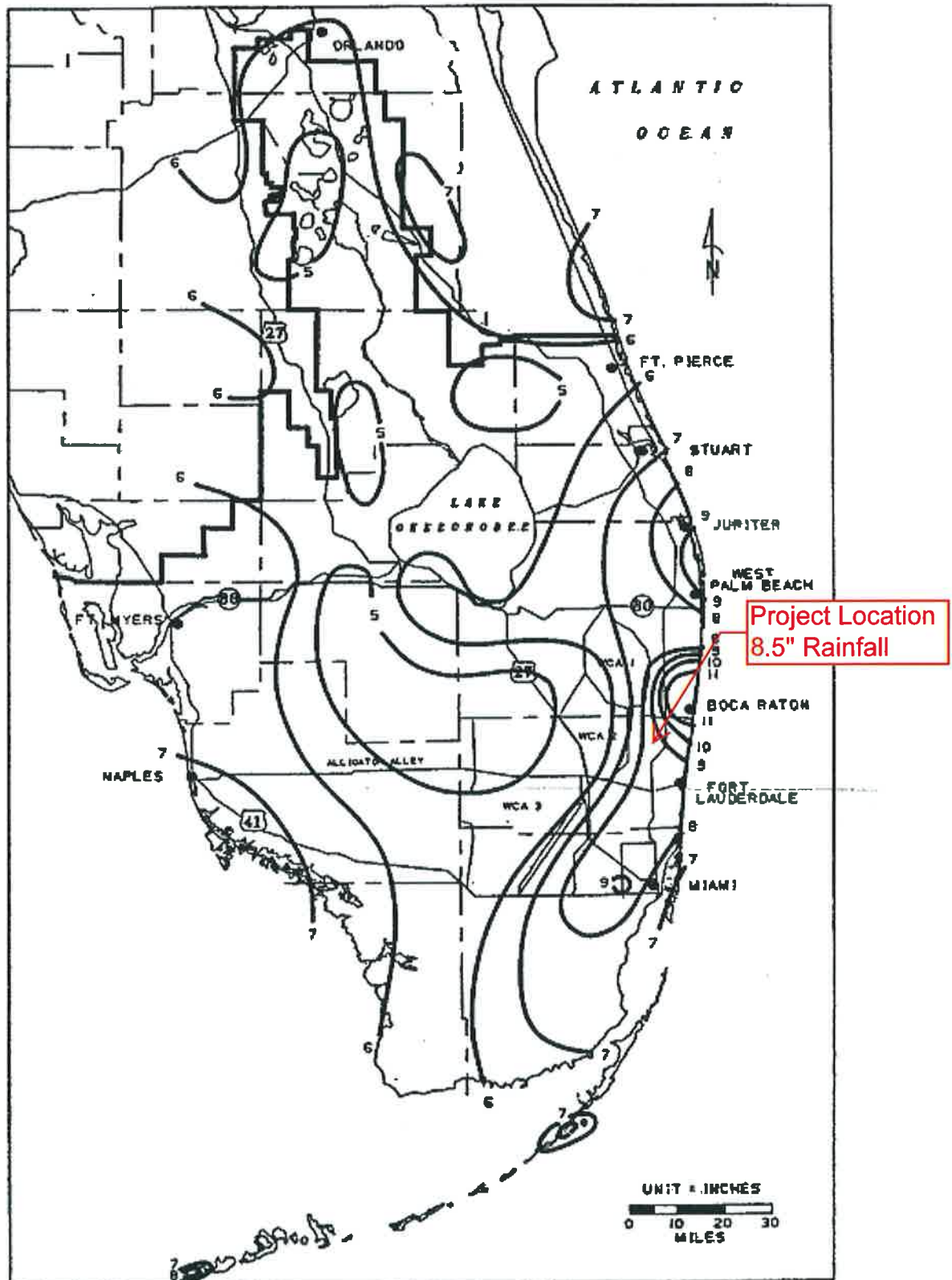


FIGURE C-4. 1-DAY RAINFALL: 10-YEAR RETURN PERIOD

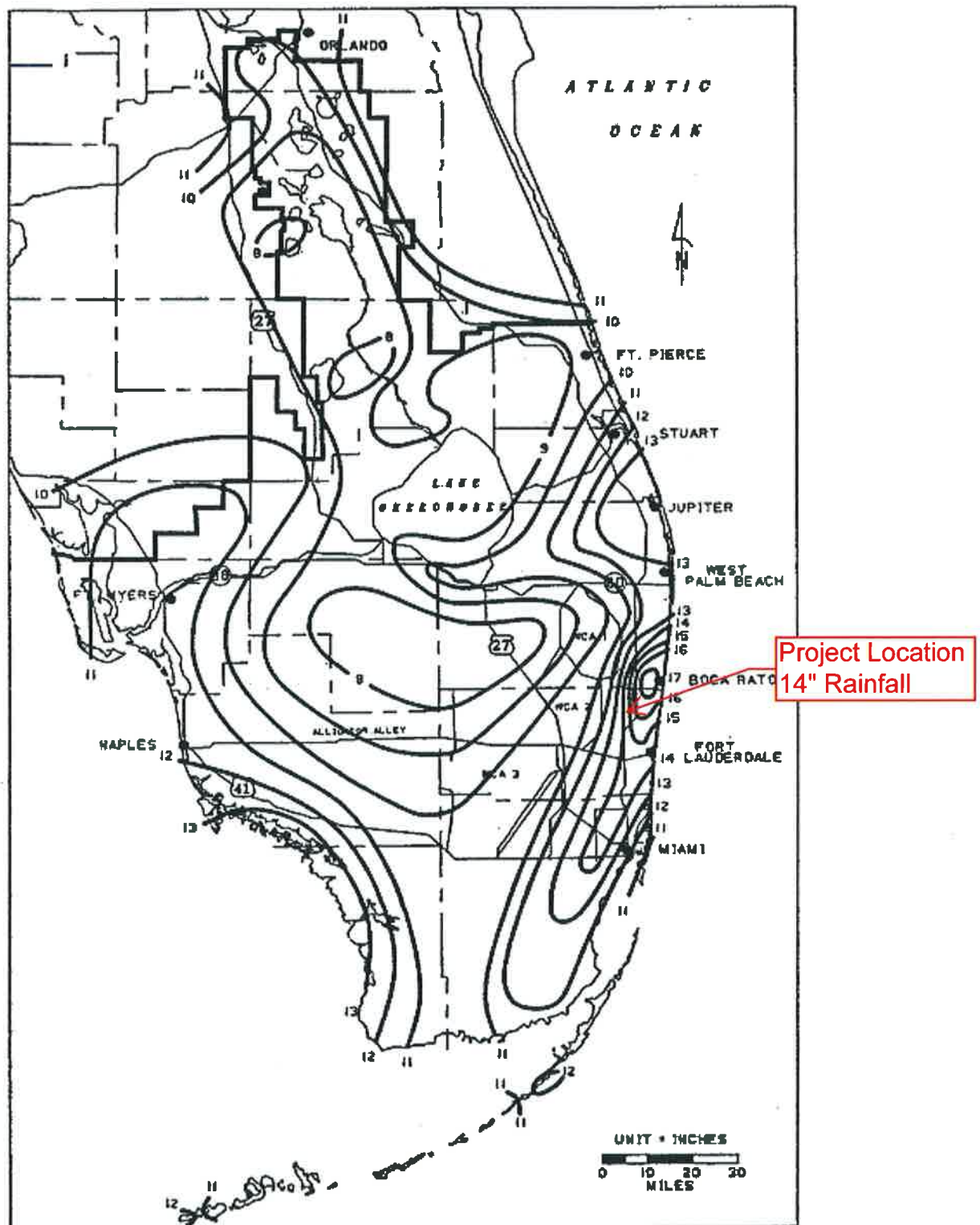


FIGURE C-8. 3-DAY RAINFALL: 25-YEAR RETURN PERIOD

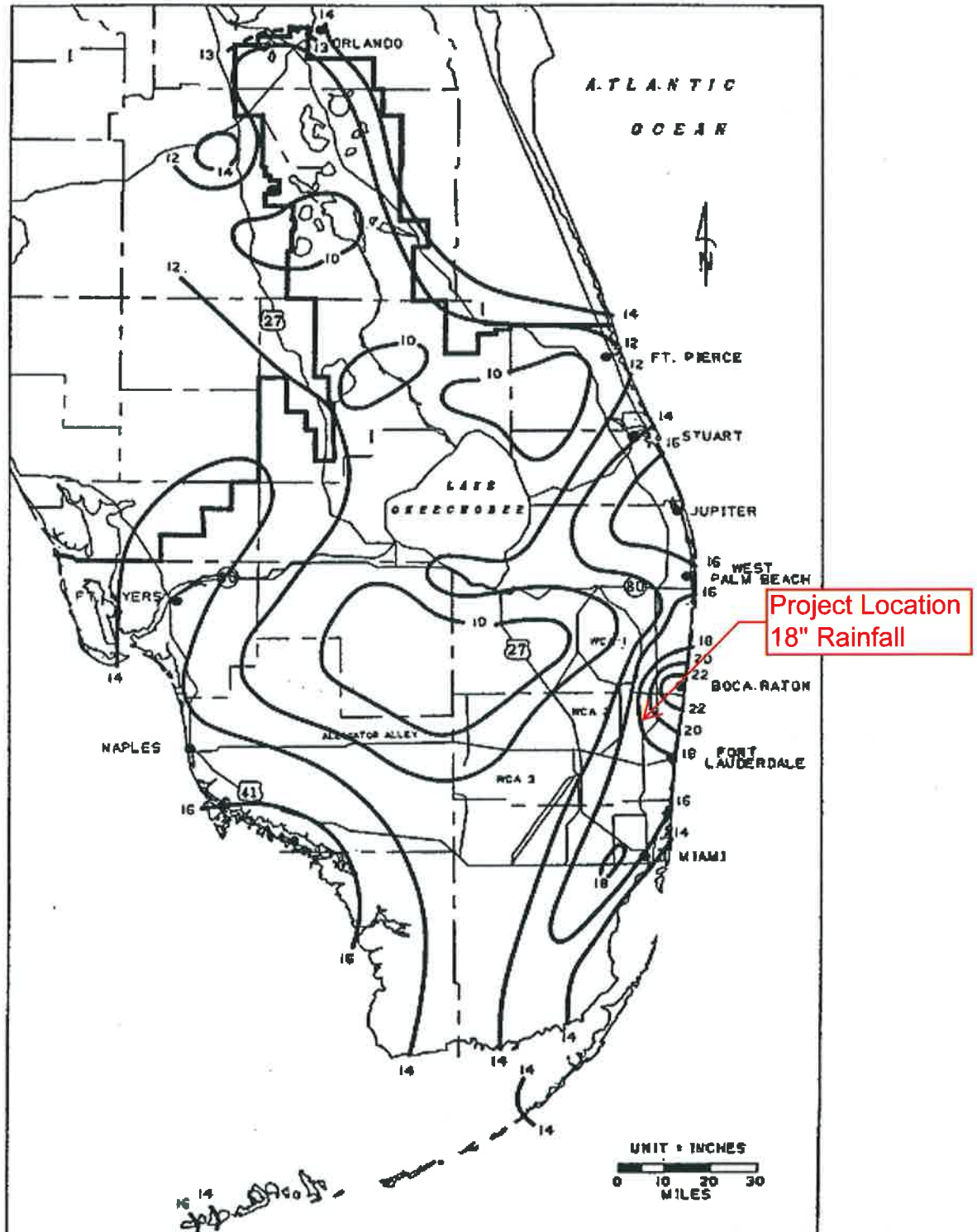


FIGURE C-9. 3-DAY RAINFALL: 100-YEAR RETURN PERIOD