

Surficial Aquifer

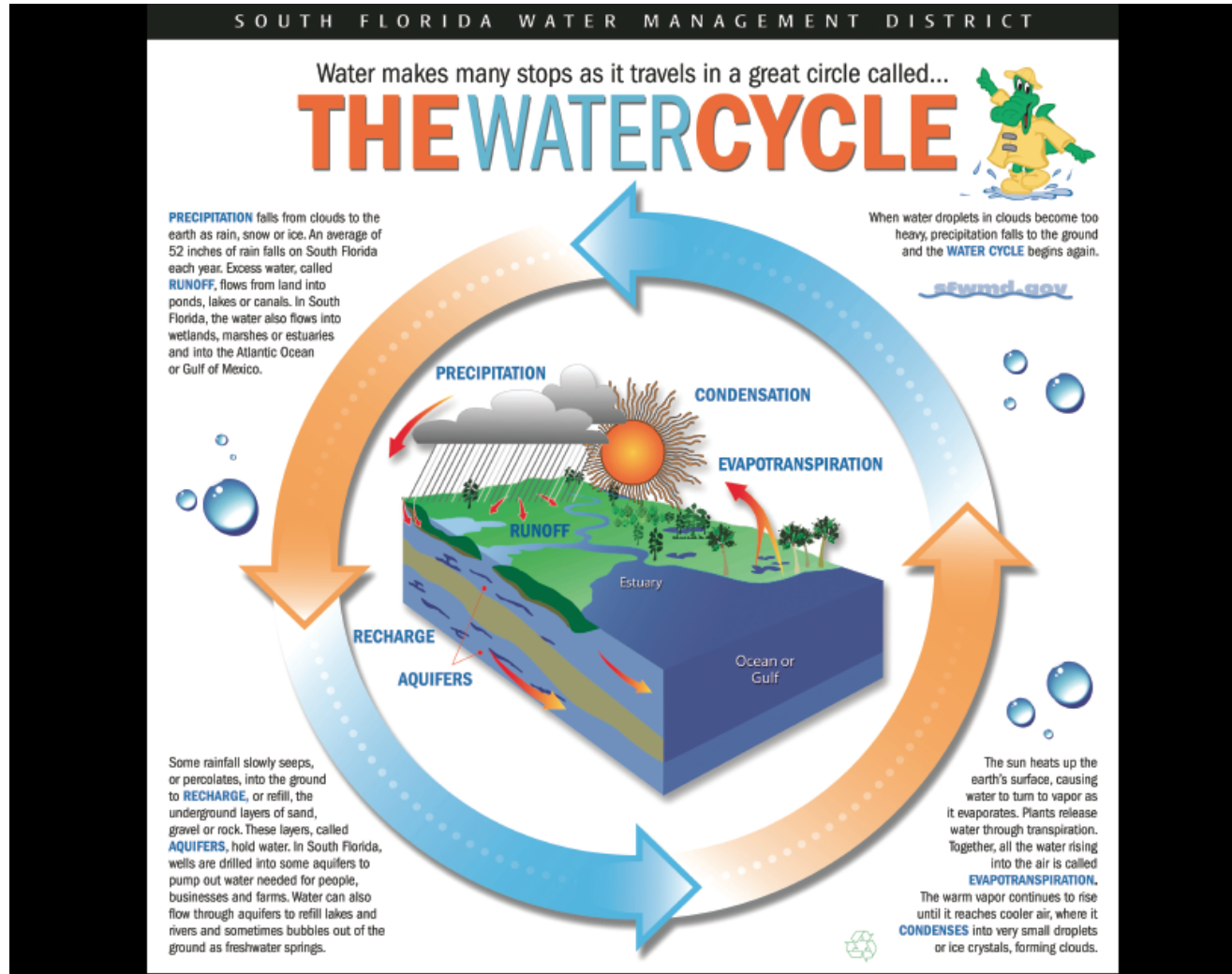
Steve Lamb P.G.

Federico Lamb & Associates

Water Management

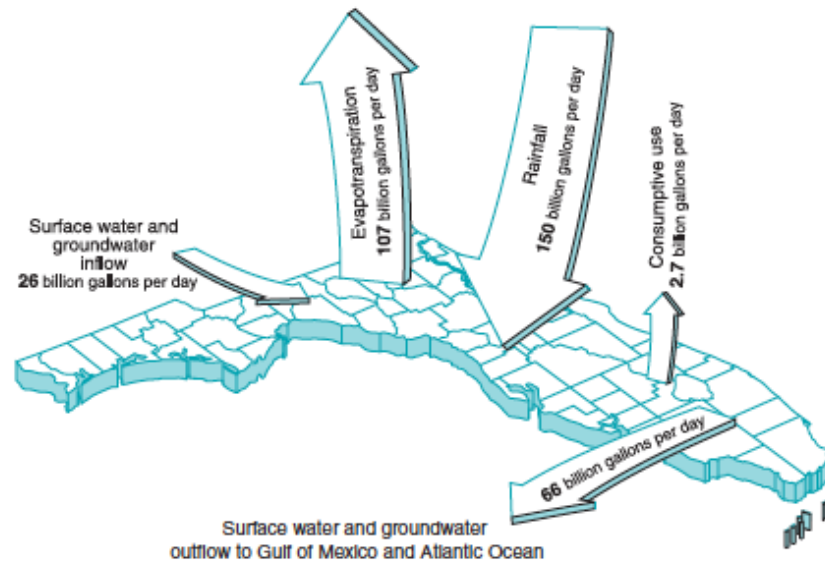
- Hydrologic Cycle
- Rainfall
- Hydrogeology
- Permitting

Florida's Hydrologic Cycle



Water Budget

Florida's Water Cycle



Source: Fernald and Purdum 1998

An average of 150 billion gallons of rain falls each day in Florida. Another 26 billion gallons flows into the state, mostly from rivers originating in Georgia and Alabama. Nearly 70 percent of the rain (107 billion gallons) returns to the atmosphere through evaporation and plant transpiration (evapotranspiration). The remainder flows to rivers or streams or seeps into the ground and recharges aquifers. Each day in Florida, 2.7 billion gallons are incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate environment (consumptive use).

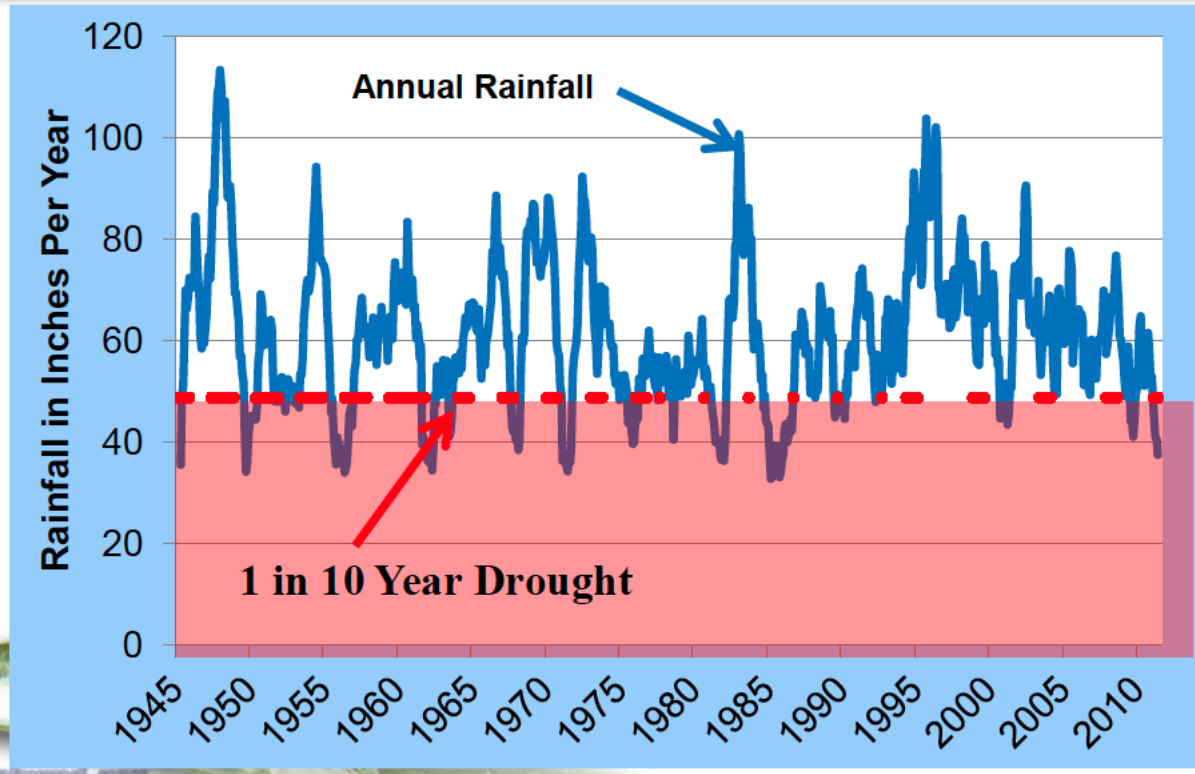
South Florida Average Rainfall

- Average annual precipitation
- **Days** **Place** **Inches**
- 91 Arcadia 52.2
- 106 Avon Park 50.8
- 108 Bradenton 56.2
- 145 Ft. Lauderdale 66.5
- 111 Ft. Myers 55.9
- 124 Ft. Pierce 53.8
- 138 Hialeah 70.4
- 106 Key West 39.8
- 135 Miami 61.9
- 120 Miami Beach 51.7
- 129 Naples 55.6
- – Pompano Beach 60.0
- 97 Tavernier (Key Largo) 46.0
- 102 Venice 50.5
- 130 Vero Beach 56.9
- **136 West Palm Beach 62.3**

Average is Only a Number

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Variable over years



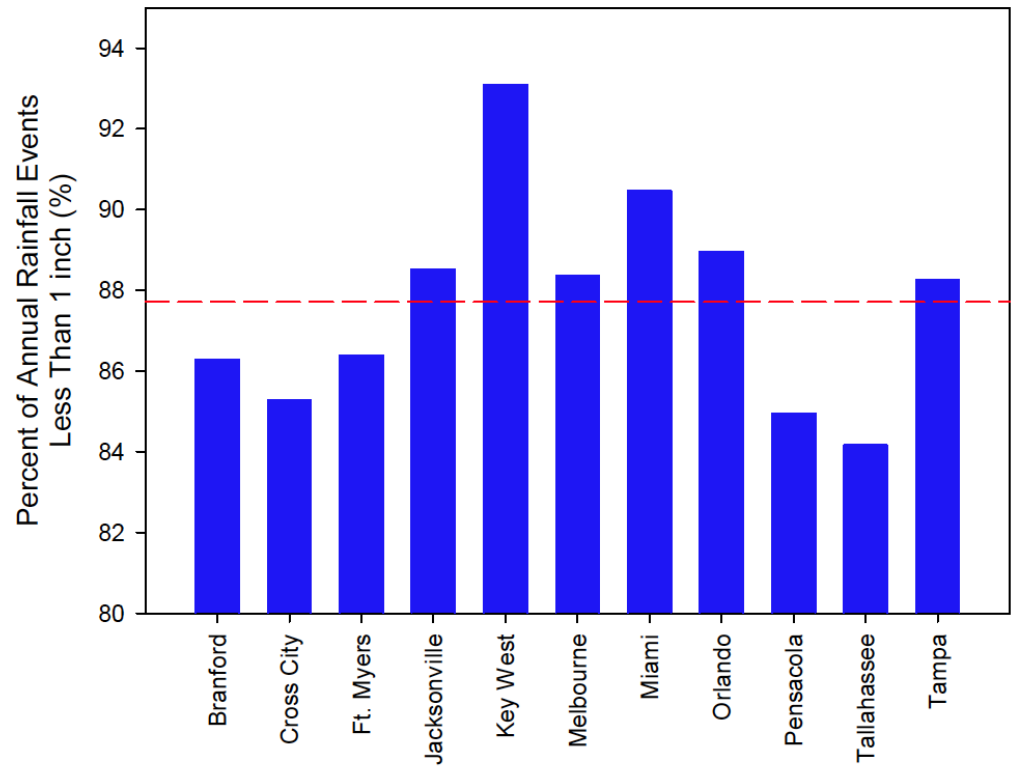
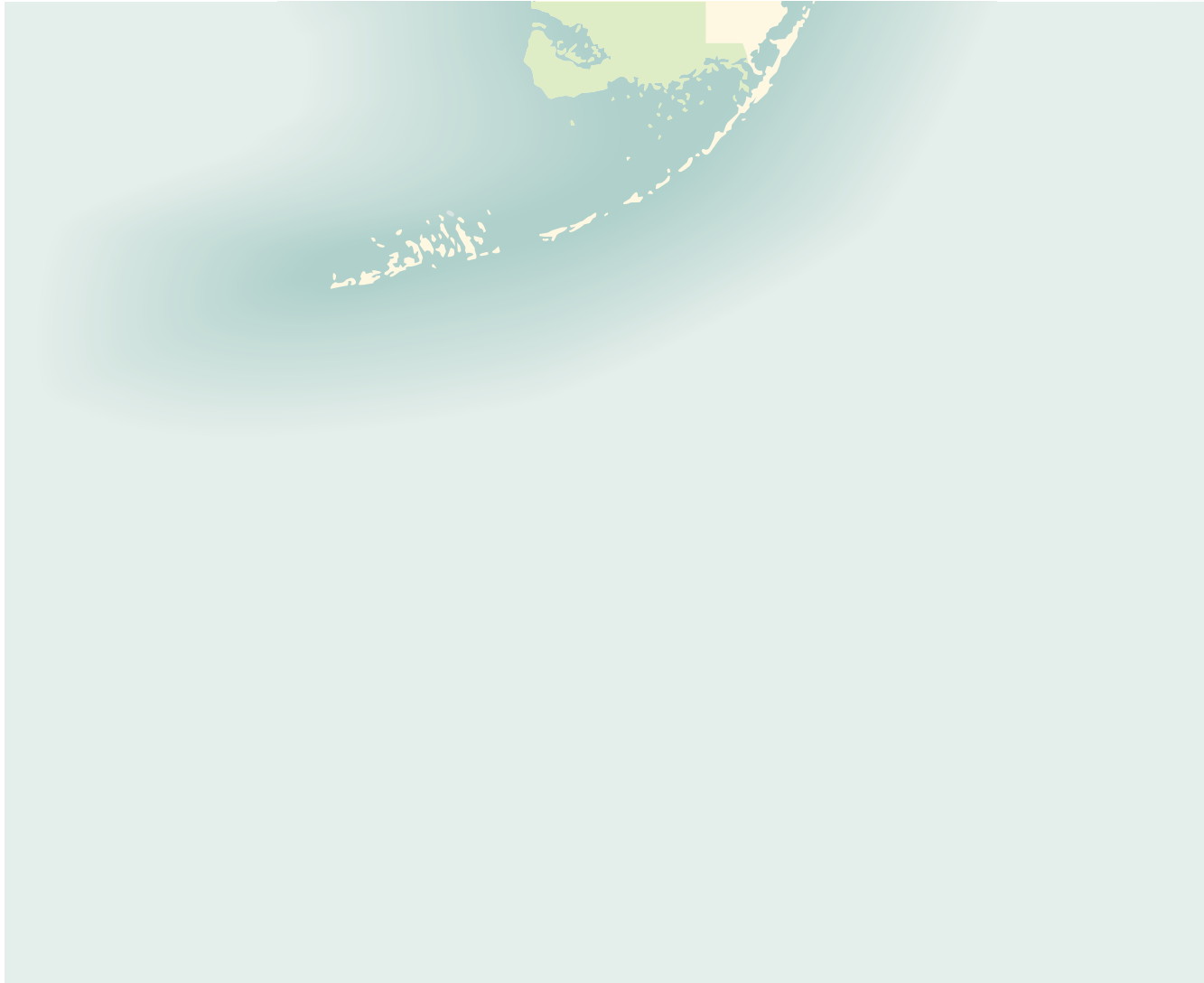


Figure 3-4. Percentage of Annual Rain Events Less than 1 inch at the Selected Regional Sites.

Water Management



PALM BEACH COUNTY HYDROGEOLOGY

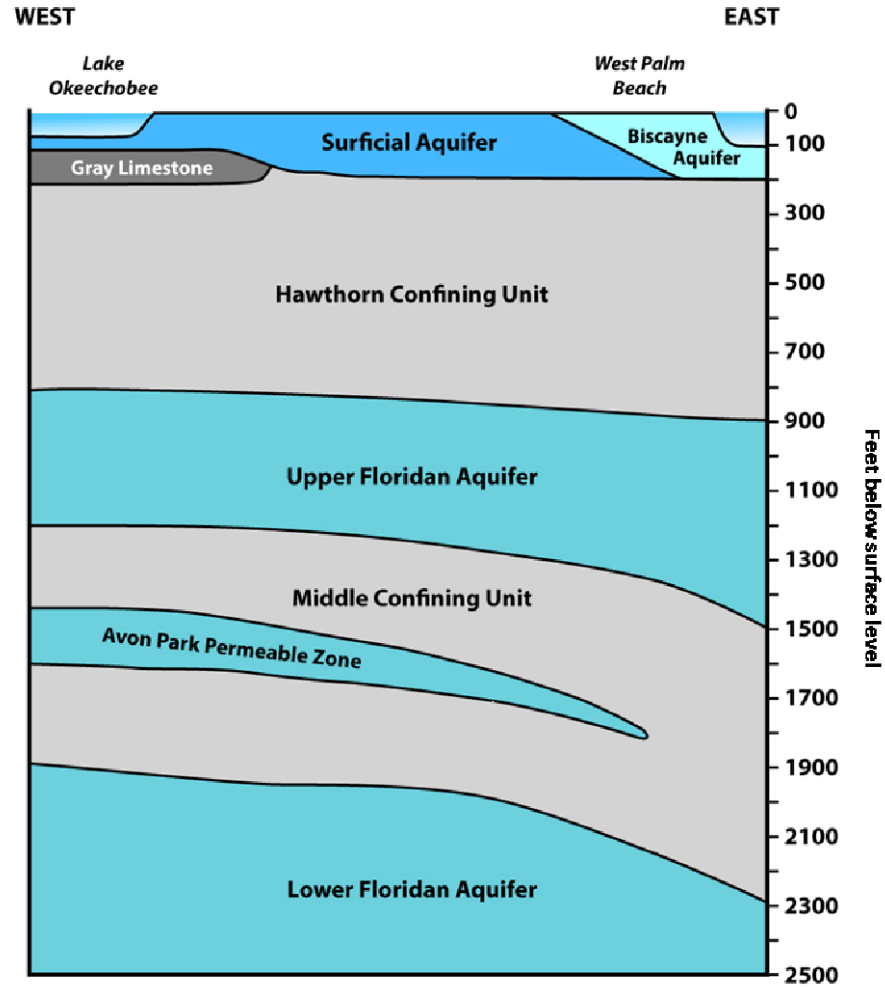


Figure 3. Generalized hydrogeologic cross-section of South Florida.

Surficial Aquifer System - LECsR

Series	Lithostratigraphic units			Approximate thickness (feet)	Lithology		Hydrologic unit	Approximate thickness (feet)
HOLOCENE	Lake Flirt Marl, Undifferentiated Soil and Sand	H	UNDIFFERENTIATED	0-5	Marl, peat, organic soil, quartz sand	SURFICIAL AQUIFER SYSTEM	Water Table Aquifer	0-120
PLEISTOCENE	Pamlico Sand	Q5		0-50	Quartz sand			
	Miami Limestone	Q4		0-30	Oolitic and bryozoan limestone			
	Fort Thompson Formation	Q3		0-100	Marine limestone and minor gastropod-rich freshwater limestone			
	Anastasia Formation	Q2		0-140	Coquina, quartz sand and sandy limestone			
	Key Largo Limestone	Q1		0-20	Coralline reef rock			
PLIOCENE	Pinecrest Sand Member	T2	Tamiami Formation	0-90	Quartz sand, pelecypod-rich quartz sandstone, terrigenous mudstone	Upper Semiconfining to Confining Unit	0-130	
	Ochopee Limestone Member	T1		0-130	Pelecypod lime rudstone and floatstone, pelecypod-rich quartz sand, moldic quartz sandstone	Gray Limestone or Lower Tamiami Aquifer	0-130	
MIOCENE	Peace River Formation		Upper Hawthorn Group	0-300	Clay-rich quartz sand, terrigenous mudstone, diatomaceous mudstone, local abundant phosphate grains	Intermediate Confining Unit or Intermediate Aquifer System	300 ±	

Figure 24. Lithostratigraphic and Geohydrologic Units of the Surficial Aquifer System in Southeast Florida. Source: Adapted from Reese and Cunningham 2000; Perkins 1977.

Biscayne Aquifer

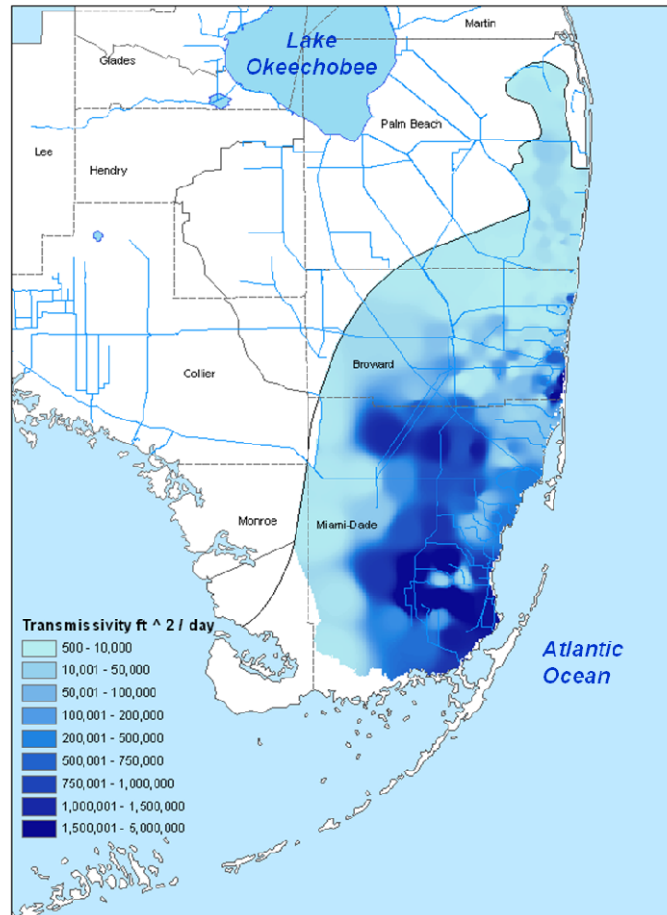
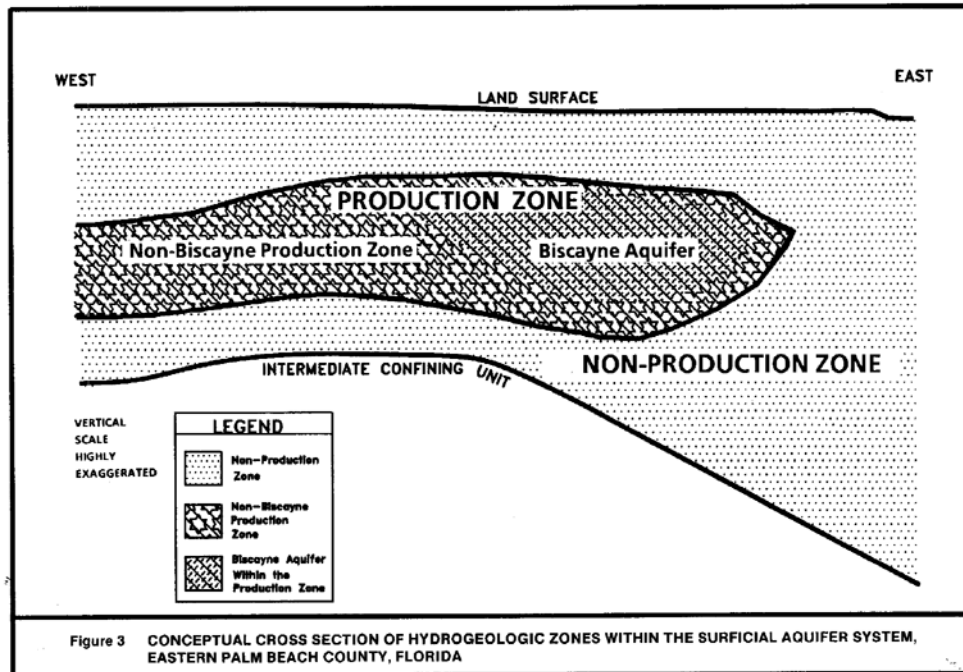
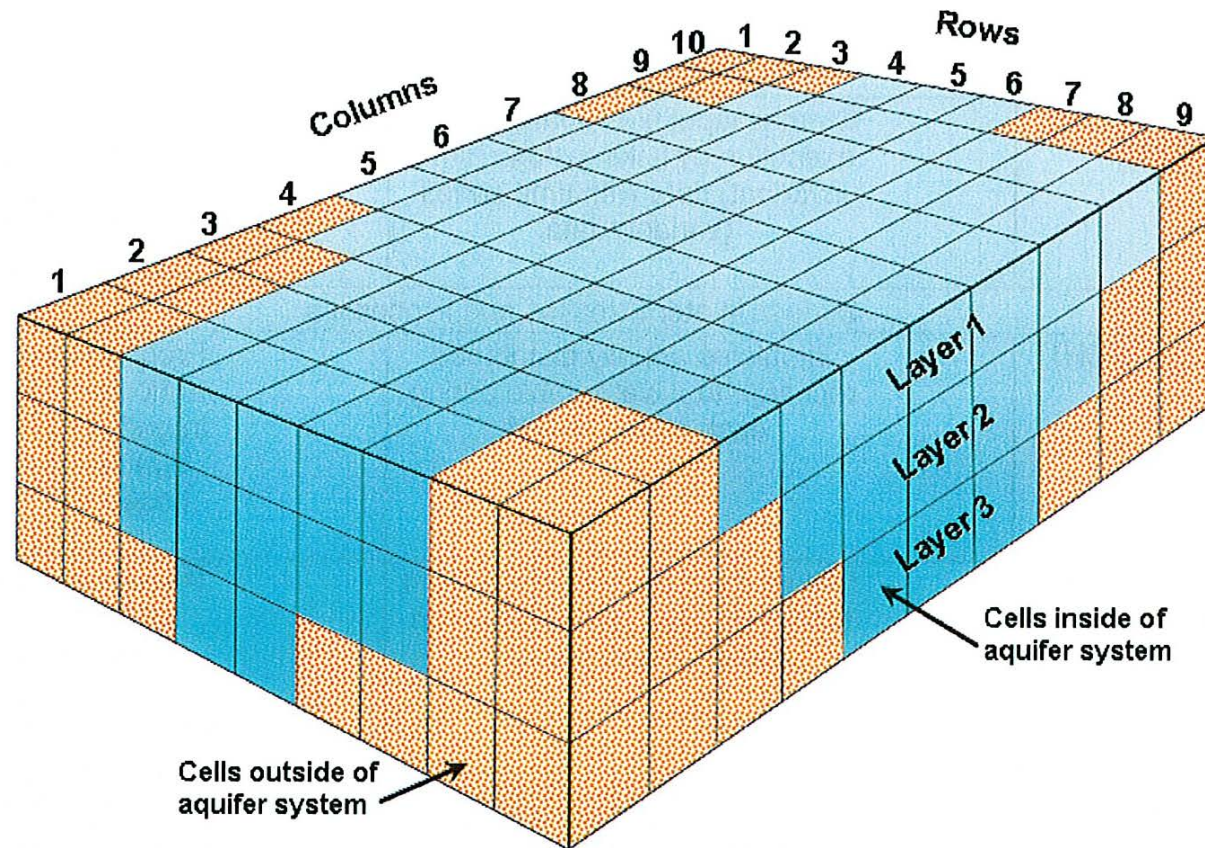


Figure 24. Map of the spatial extent and transmissivity of the Biscayne aquifer. (Note: in units of square feet per day.)

Production Zone



Surficial Aquifer - LECsR



Control Levels

- LECsR Model

DRAFT

LEC subRegional MODFLOW Model Documentation

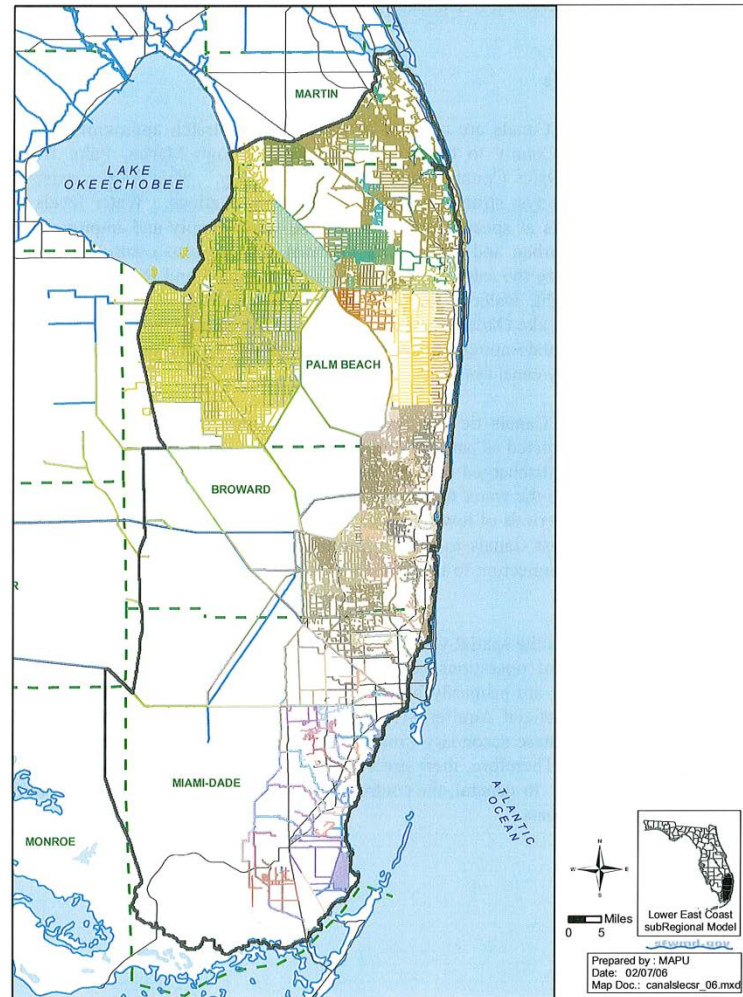
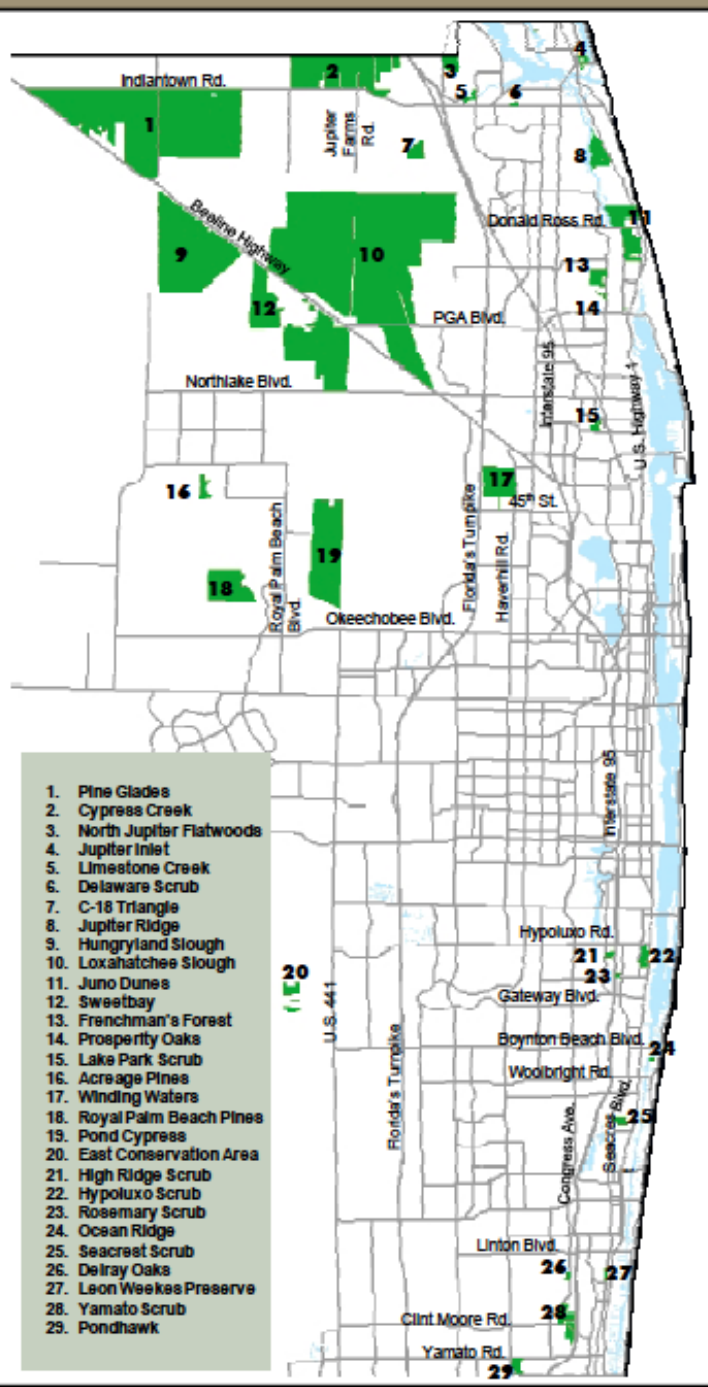


Figure 12. Spatial Variation of Control Levels in Primary, Secondary, and Certain Tertiary Canal Systems. Each Color is Associated with an Operational Rule and/or a Structure.

PALM BEACH COUNTY NATURAL AREAS LOCATOR MAP and AMENITIES GRID



LWDD – Provides Storage, Recharge and Flood Protection

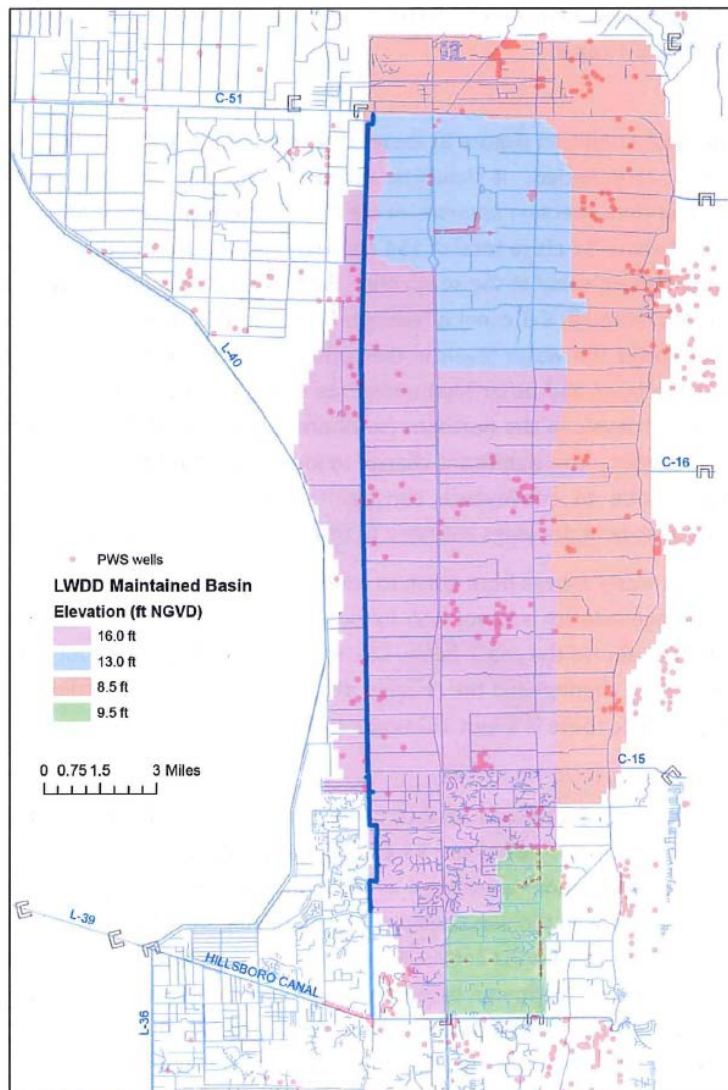
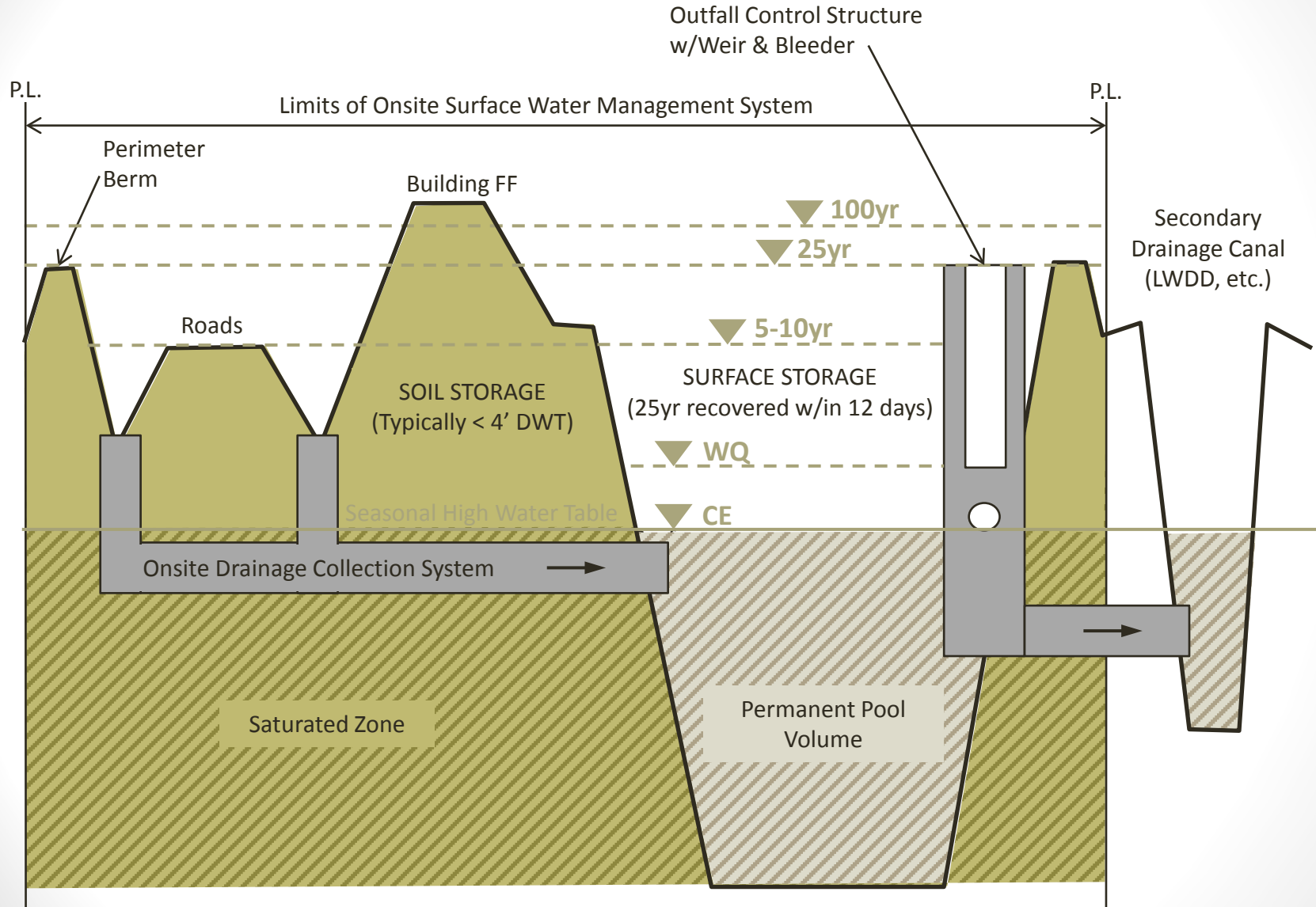
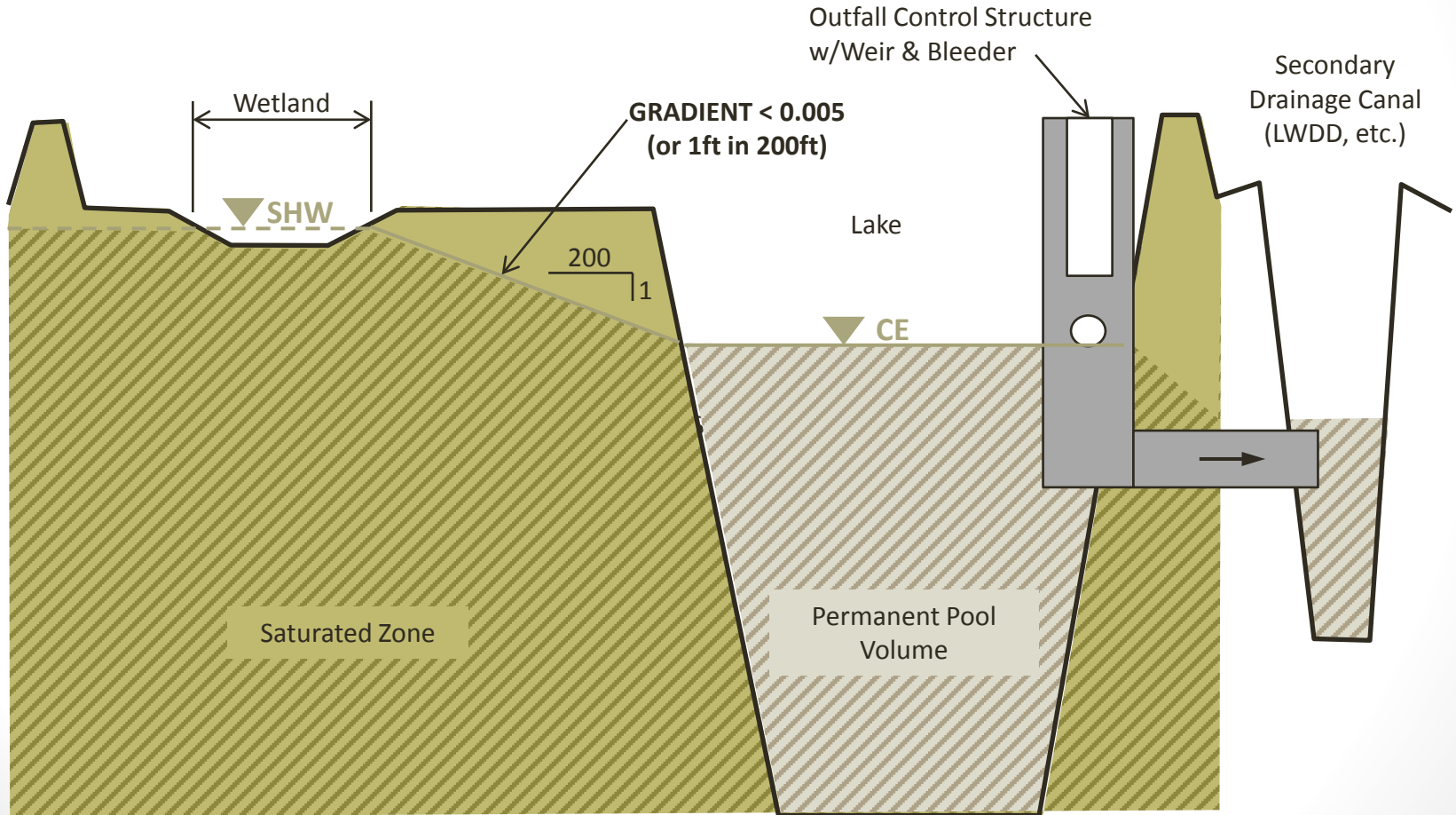


Figure 9. Maintenance elevations of canals within the LWDD

Typical Onsite Surface Water Management System Design

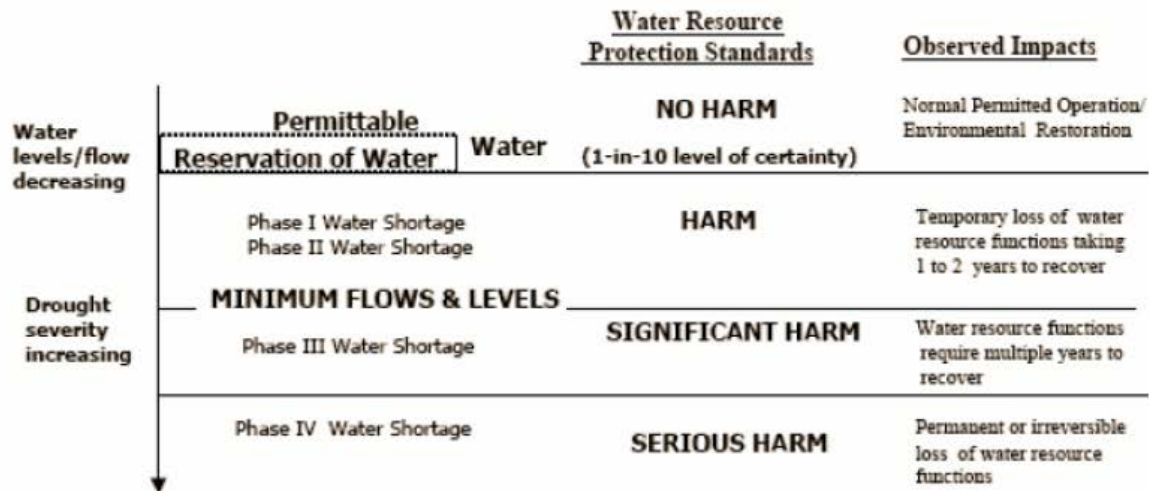


Lake-Wetland Separation Design Criteria



SFWMD - Water Management

Figure 1: Conceptual Relationship Among the Harm, Serious Harm and Significant Harm Standards



CUP Permitting

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Major Principles & "Tools" of Florida Water Law - **Water Use Permits**

"The 3 Prong Test" for permit issuance

The proposed use:

1. Is a **reasonable-beneficial use** as defined in §373.019(4);
 - Reasonable - Eastern U.S.
 - Beneficial - Western U.S.
2. Will not interfere with any **presently existing legal use** of water; and
 - Prior appropriation concept
 - "First in time is first in right" - Western U.S.
3. Is consistent with the **public interest**



1% Breakdown

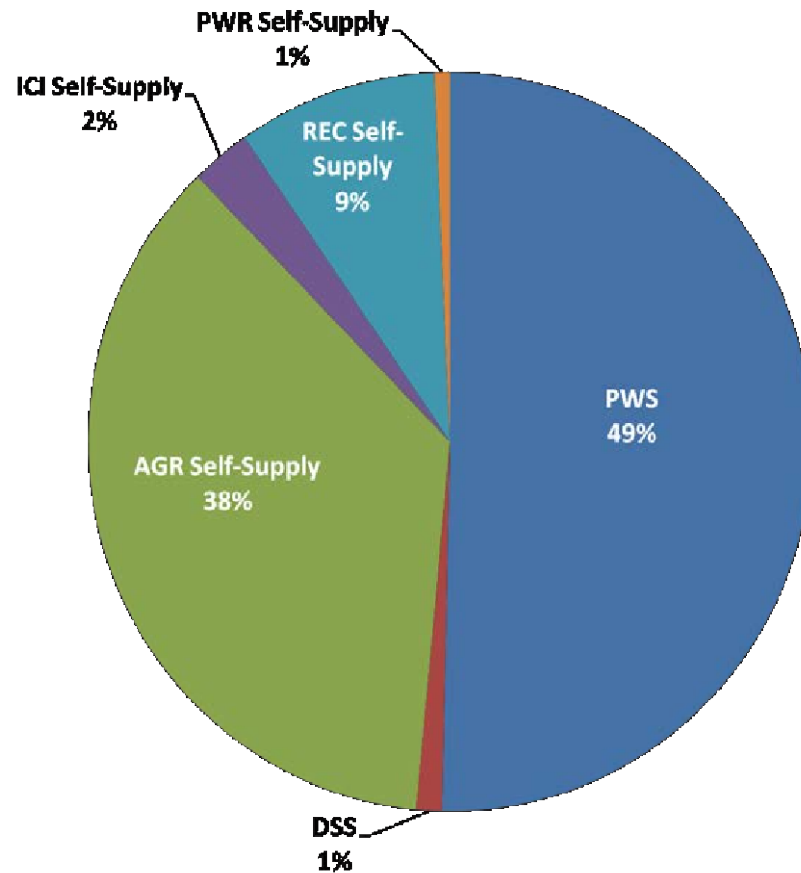


Figure 4. Percentage of estimated demand of each major water use category in 2010.

Need

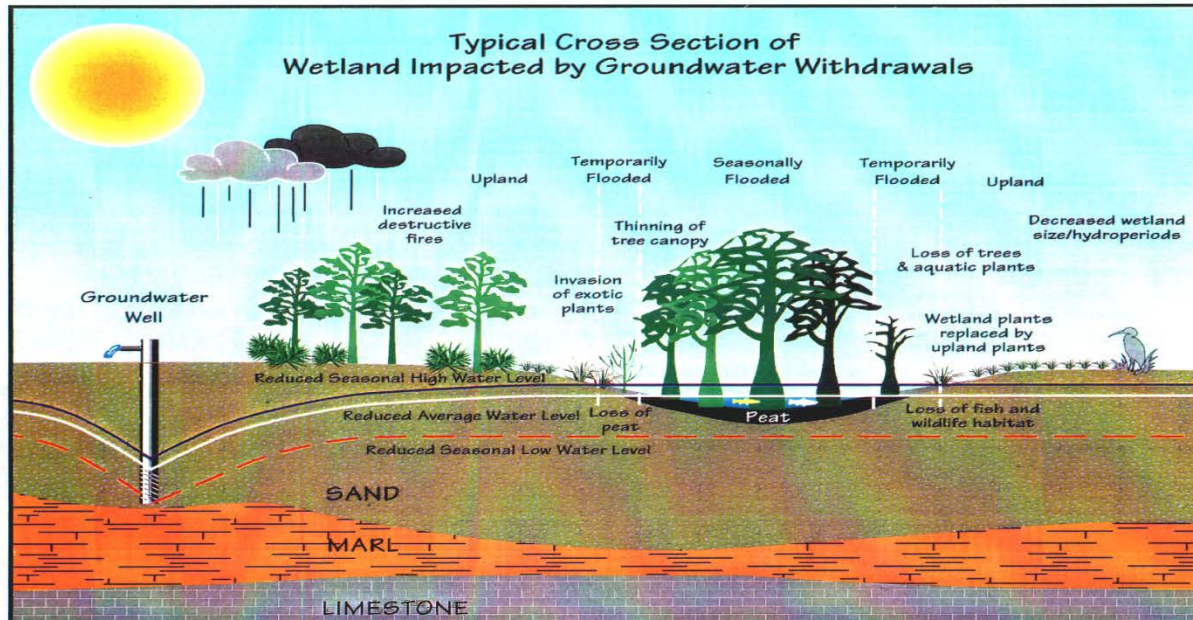
Table 15. Per capita use rates in gallons in the LEC Planning Area for PWS finished water.

County	Per Capita Use Rates (gallons)		
	2000	2005	2010
Palm Beach	219	203	166
Broward	153	139	123
Miami-Dade	168	157	140
Monroe	216	211	109
LEC Planning Area Weighted Average	176	163	142^a

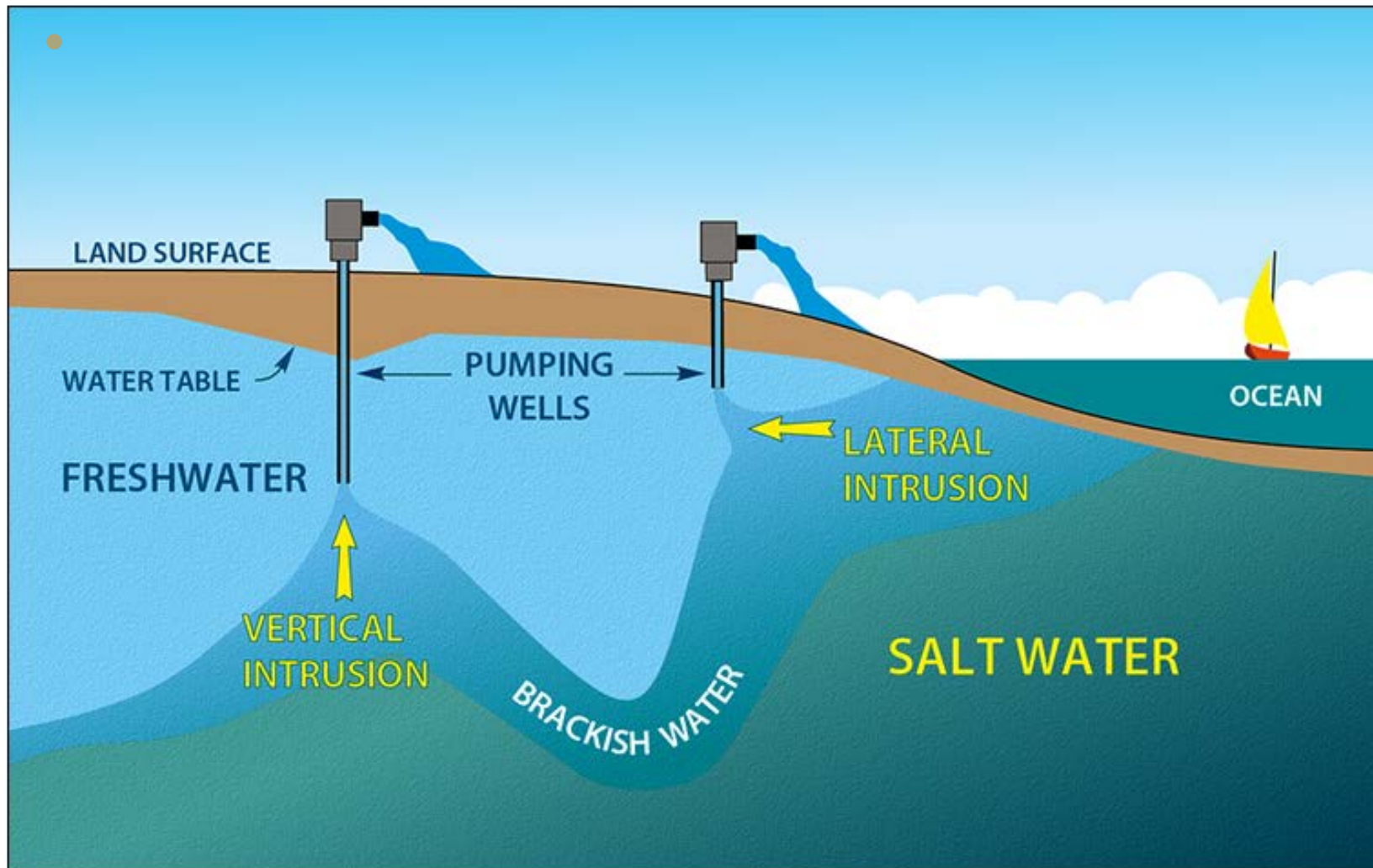
a. Reflects variations in demand by permanent and seasonal populations.

Wetland Protection

Figure 1b. Effects of Groundwater Withdrawals (Wells) on a Wetland.

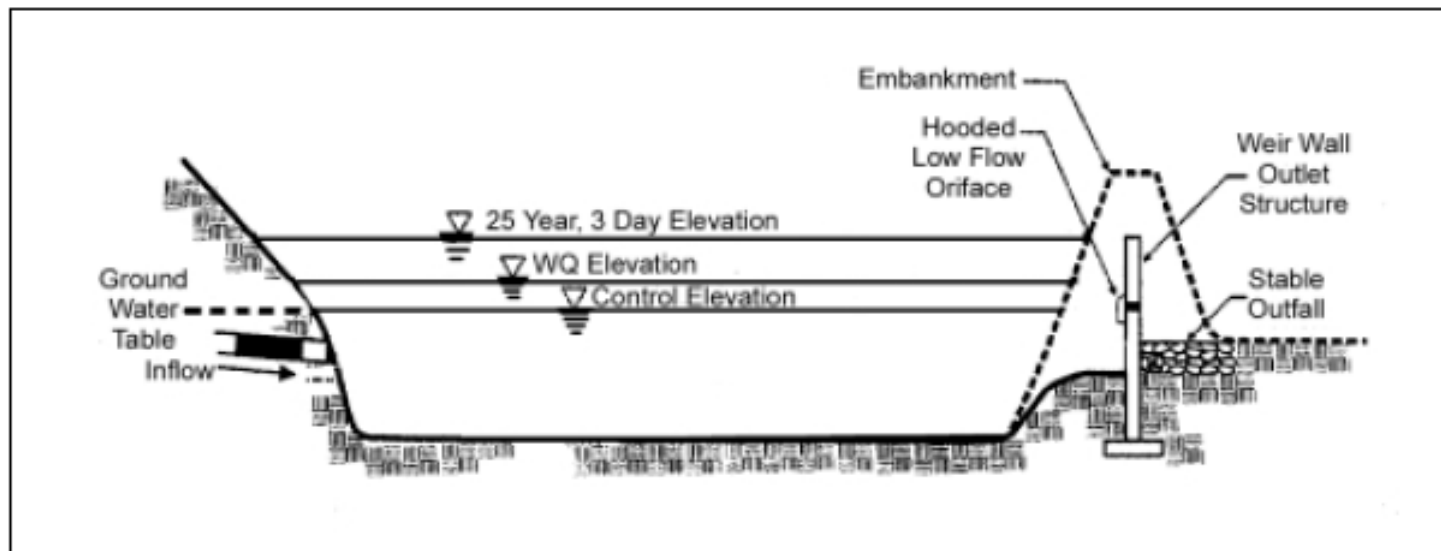


Saline Intrusion



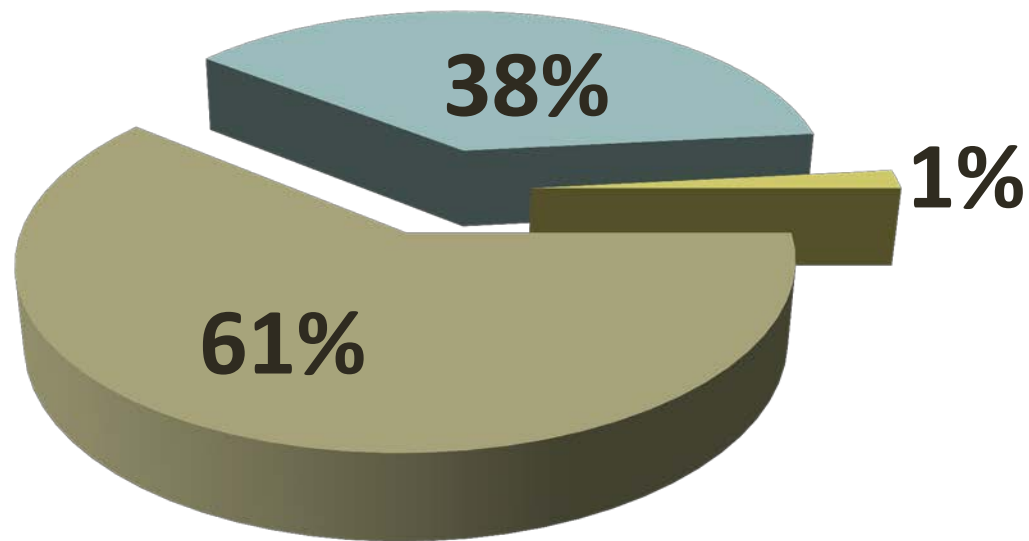
Structural BMP Fact Sheet

SFWMD-BMP-DS-2 - Detention Systems - Wet Detention Ponds



Florida Water Budget

Surface & Groundwater



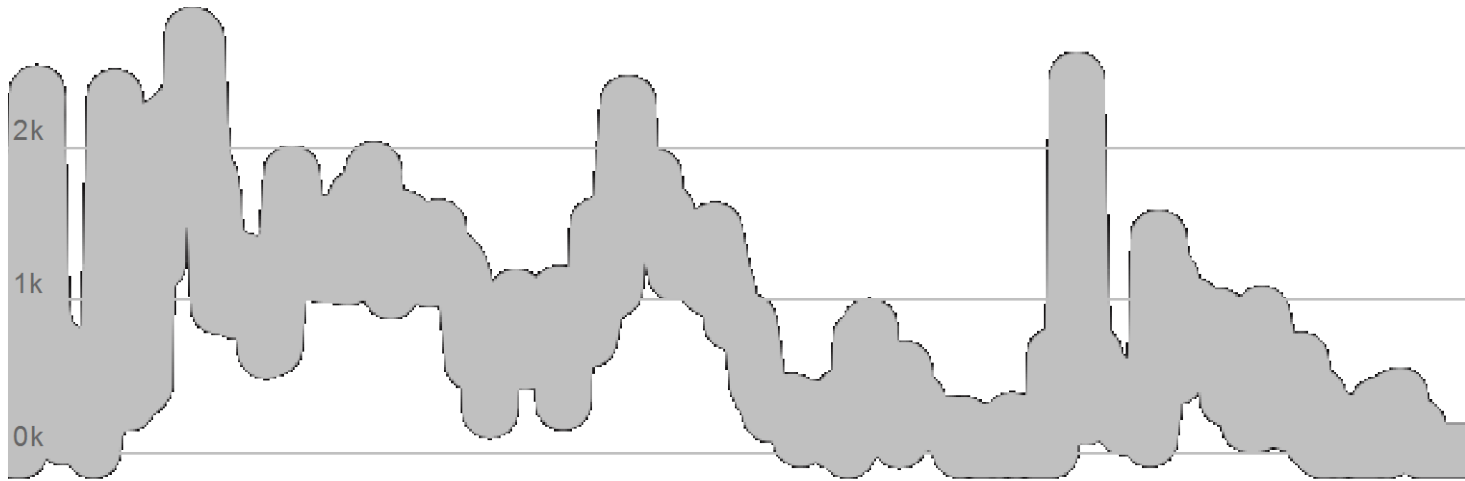
■ Evapotranspiration ■ Lost to Tide ■ Consumptive Use

S-155 Discharge, cfs

2013 discharge = 59,283,400,000 gallons

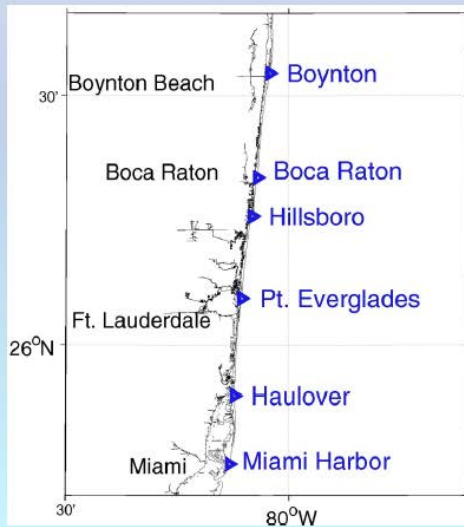
S155 - Sdischarge

Zoom From To



Ocean inlet characterization studies

NAME	Lat	Lon	Distance to next inlet (km)	Width m	Depth m
Lake Worth Inlet (mm)	26.77	-80.03	25.2	122	10.7
Boynton Beach Inlet	26.55	-80.04	23.5		
Boca Raton Inlet	26.34	-80.07	8.7		
Hillsboro Inlet	26.26	-80.08	18.4		3.0
Port Everglades Inlet	26.09	-80.10	21.7	137	12.8
Bakers Haulover Inlet	25.90	-80.12	13.0	61	3.4
Miami Harbor Inlet	25.76	-80.13	122.		11.0



Boynton Inlet

What is their effect on the coastal ocean?



C-51 Canal Muck Dredging

PALM BEACH COUNTY SEDIMENT MANAGEMENT PROJECT

Lake Worth Lagoon

- 20 miles long, stretching from North Palm Beach to Ocean Ridge.
- Separated from the ocean by Singer Island and Palm Beach Island.
- Two permanent, man-made inlets.

Project Location

- West Palm Beach Canal (C-51 Canal)

The Problem

- Stormwater discharges through the C-51 Canal carry suspended sediments that settle out as muck in the Lake Worth Lagoon.



Muck sediments



Sediment Processing Site



Dredge Outflow

- “ ~ There is no such thing as bad storage ”

- Tommy Strowd

