Water Management During High Water Conditions
Recent Experience

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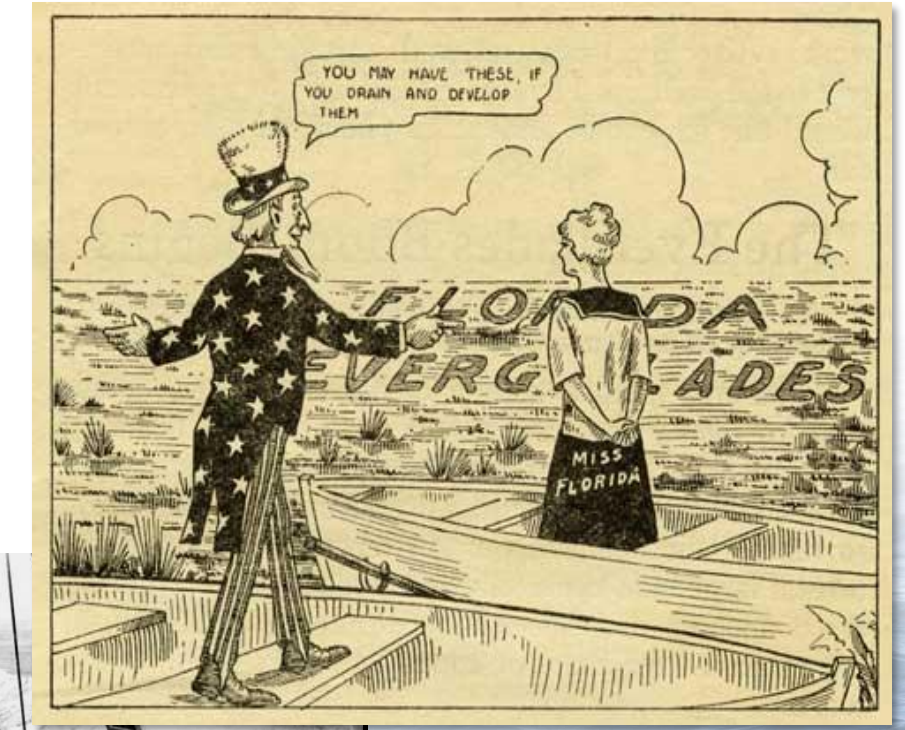
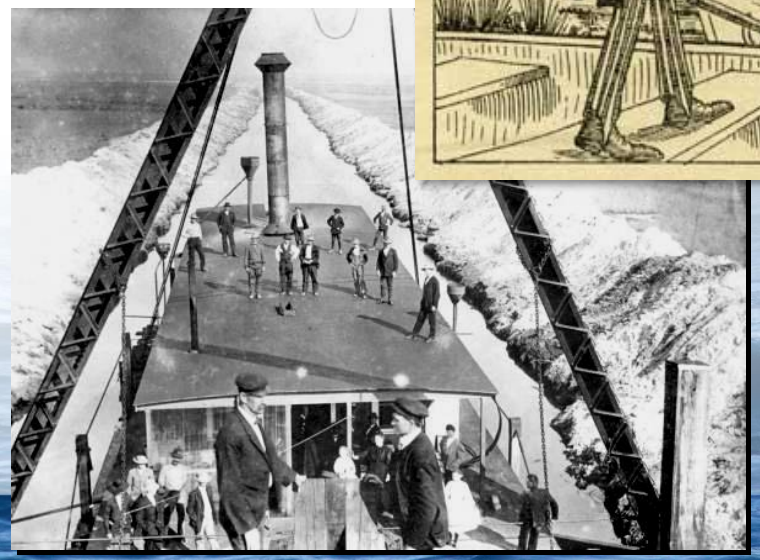
Air & Waste Management Association
54th Annual Conference and Expo
October 23, 2018

A Brief History of Water Management in South Florida

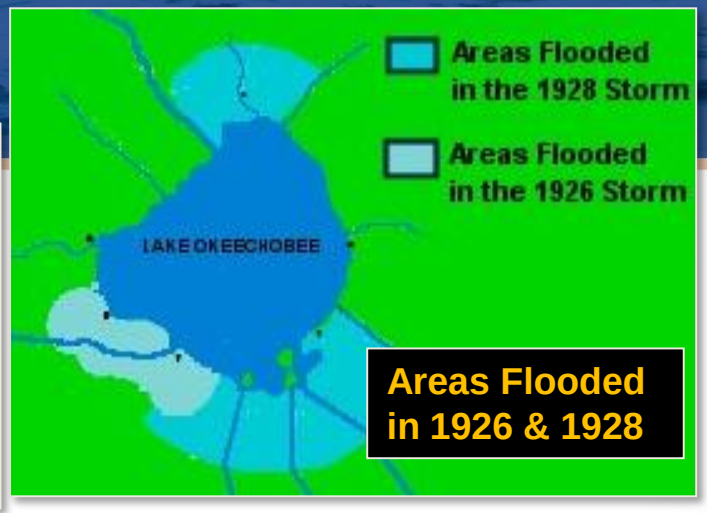
- Early explorers in south Florida recognized its value and challenges
  - Unique sub-tropical climate in North America offered a prime agricultural opportunity
  - Vast extent of flooded lands precluded settlement
- As development progressed in the early 20th century, pressure increased to drain the region
- The early efforts to reclaim these flooded areas were largely ineffective
  - Flooding and droughts persisted
  - Soil subsidence increased

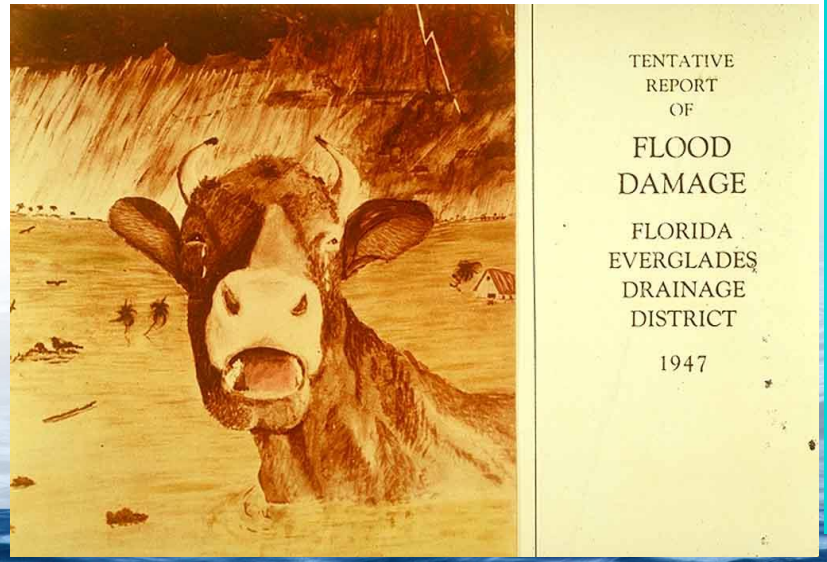


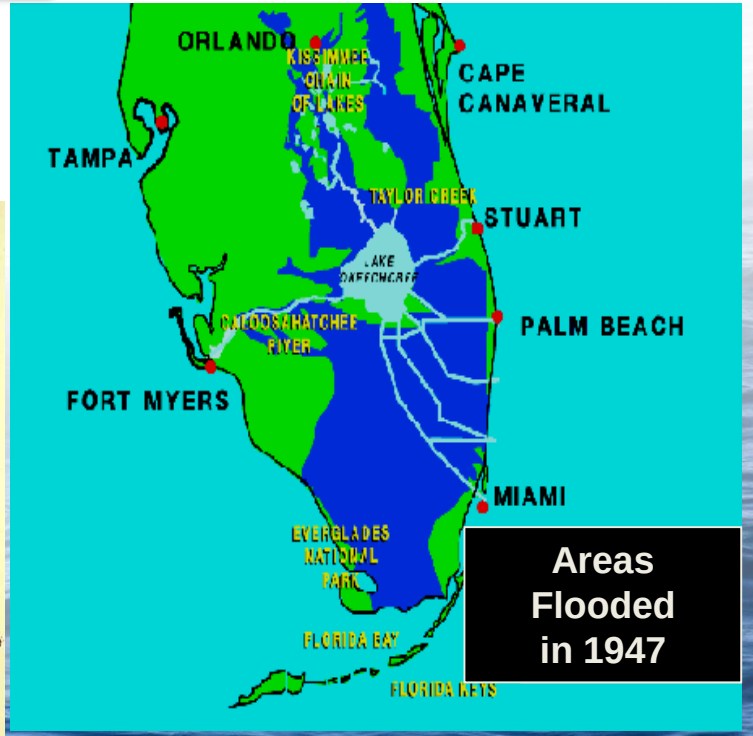


Historic Water Resource Problems

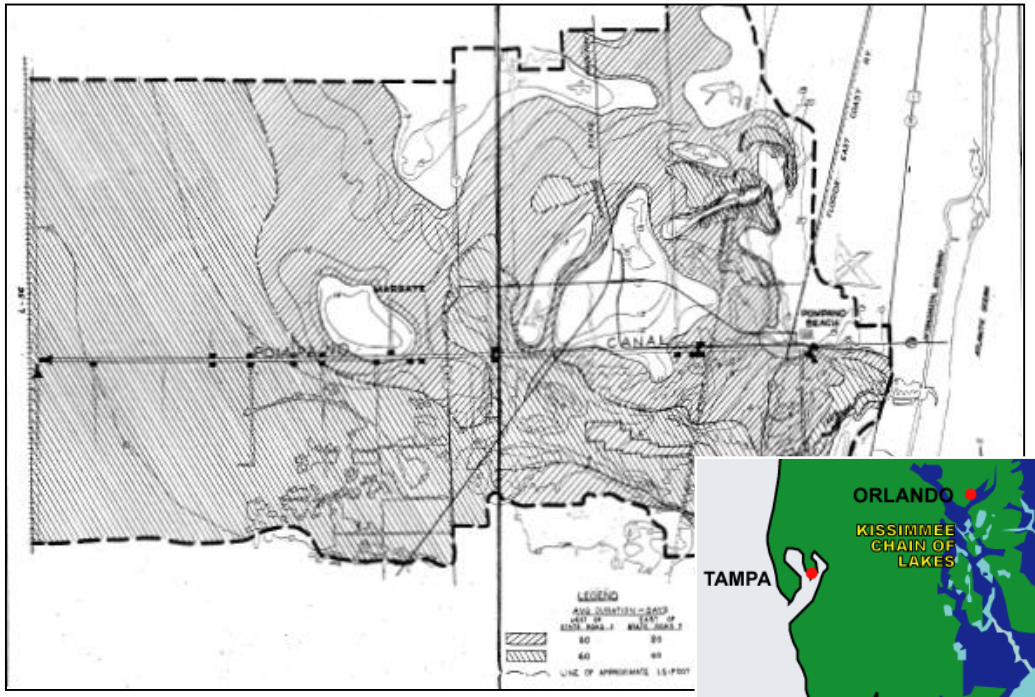
- Flood Control
  - 1926/1928: Lake Okeechobee Levee Failure
  - 1947: Hurricane Flooding
- Water Supply
  - 1931 - 1945: Lower East Coast saltwater intrusion threat identified
- State of Florida requested federal assistance

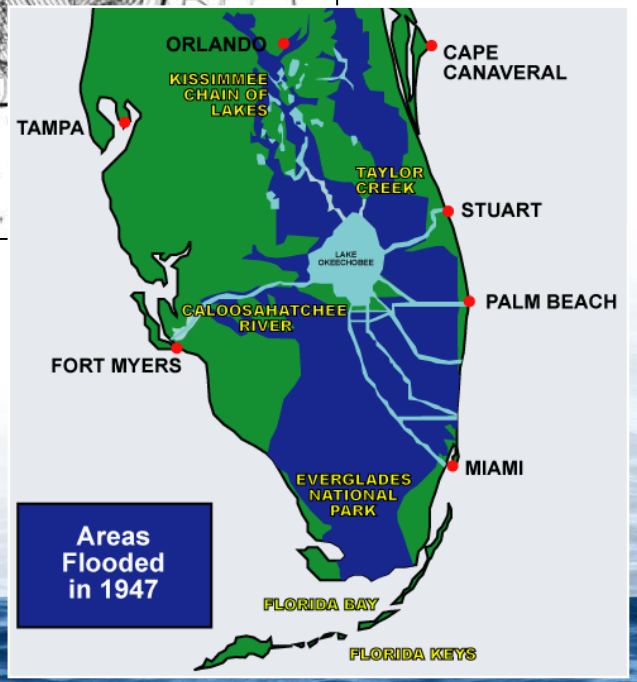


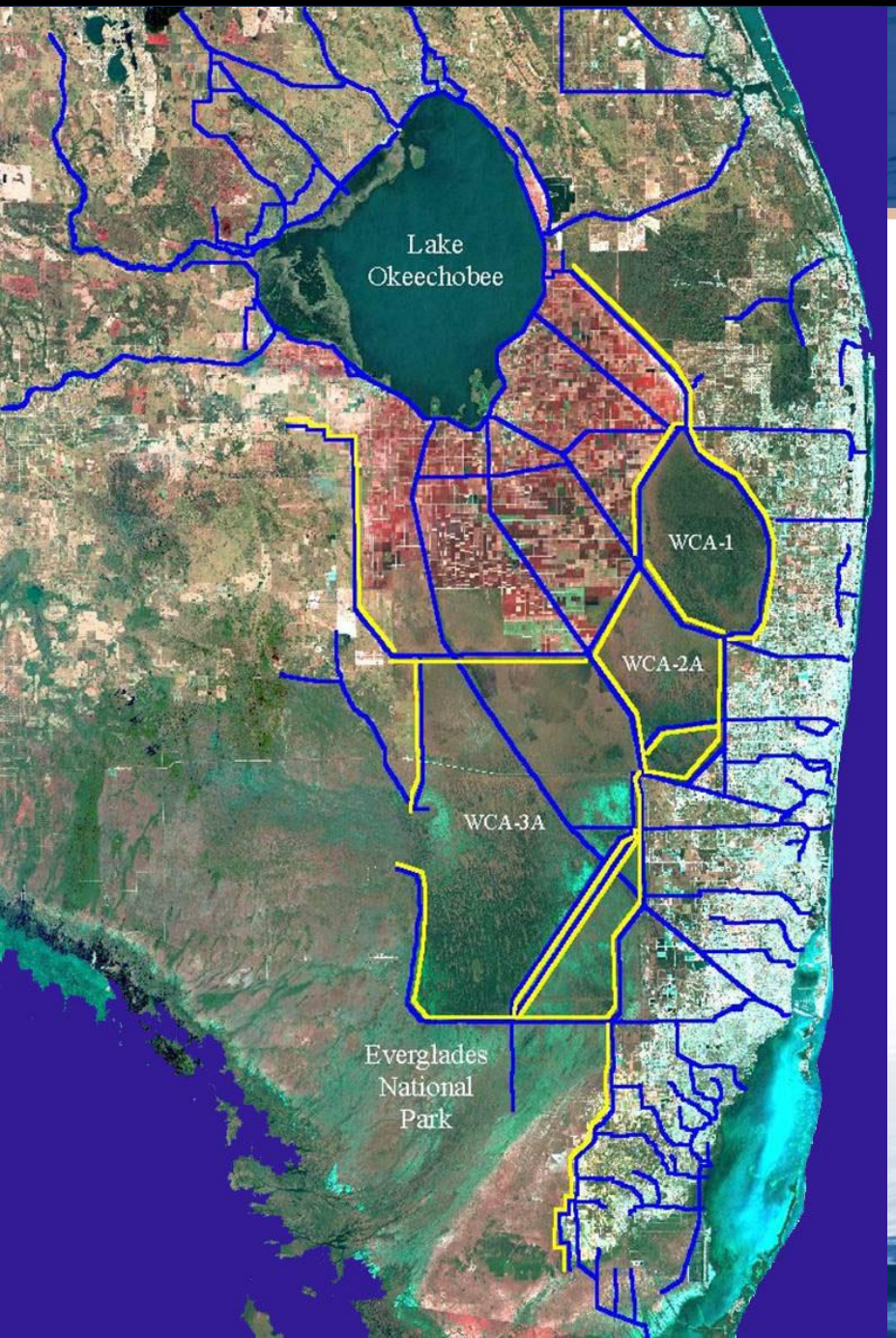




The Entire Region Flooded in 1947, 1950 & 1951





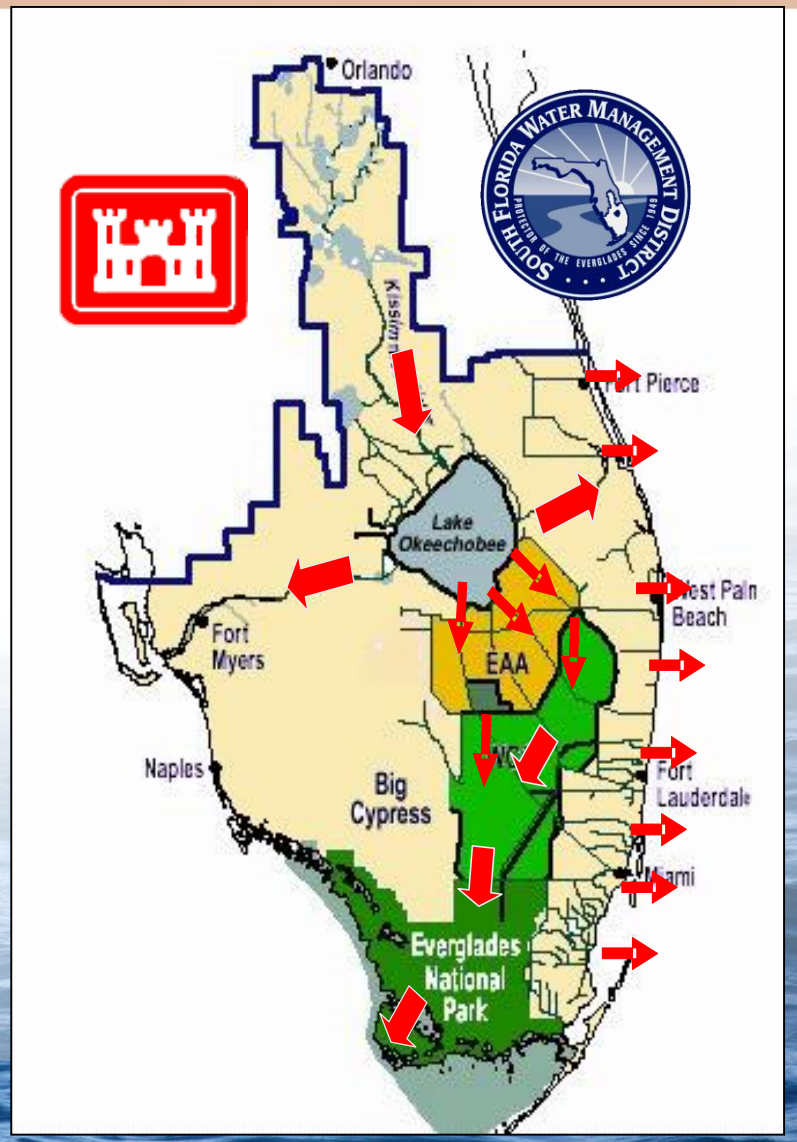


Plan to Reduce Flooding

- Wall off the Everglades
  - East Coast Protective Levee
  - EAA Levees
- Drain to the Ocean
  - Cheap
  - Effective
  - Minimal footprint on high priced lands
  - Water lost, but we had too much

Central and Southern Florida Project

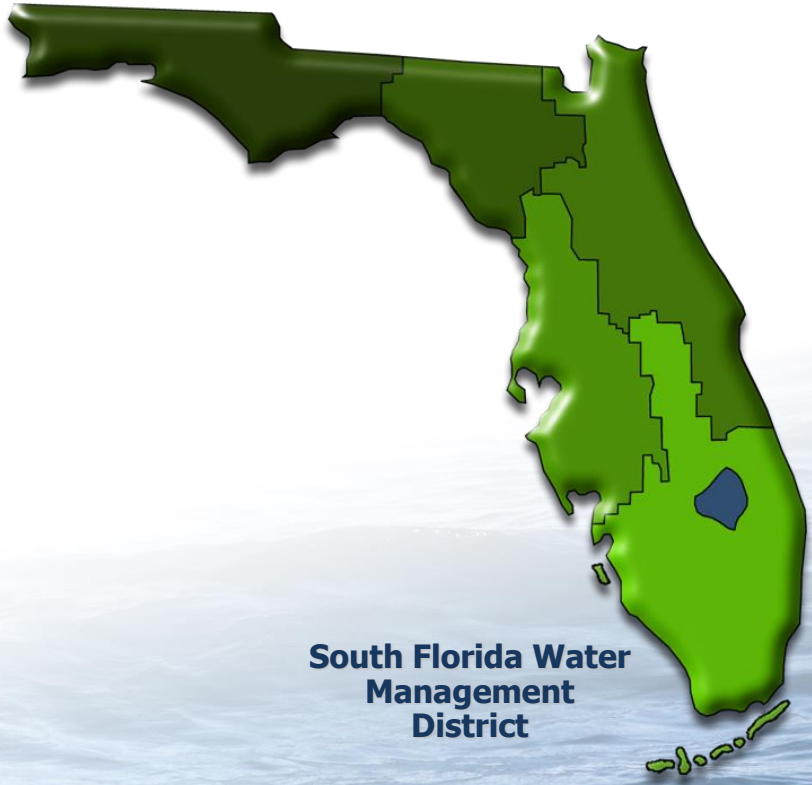
- Designed for multiple purposes
  - Flood Control
  - Water Supply
  - Navigation
  - Prevention of Saltwater Intrusion
  - Protection of Fish & Wildlife
- Constructed by the U.S. Army Corps of Engineers between 1949 and 1970
- Operated and maintained by the South Florida Water Management District
- Recent improvements include regional storage (FEBs) and stormwater treatment projects to improve water quality entering the Everglades



Who we are and what we do

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

- Oldest and largest of the state's five regional water management districts
- Protecting water resources in the southern half of the state since 1949



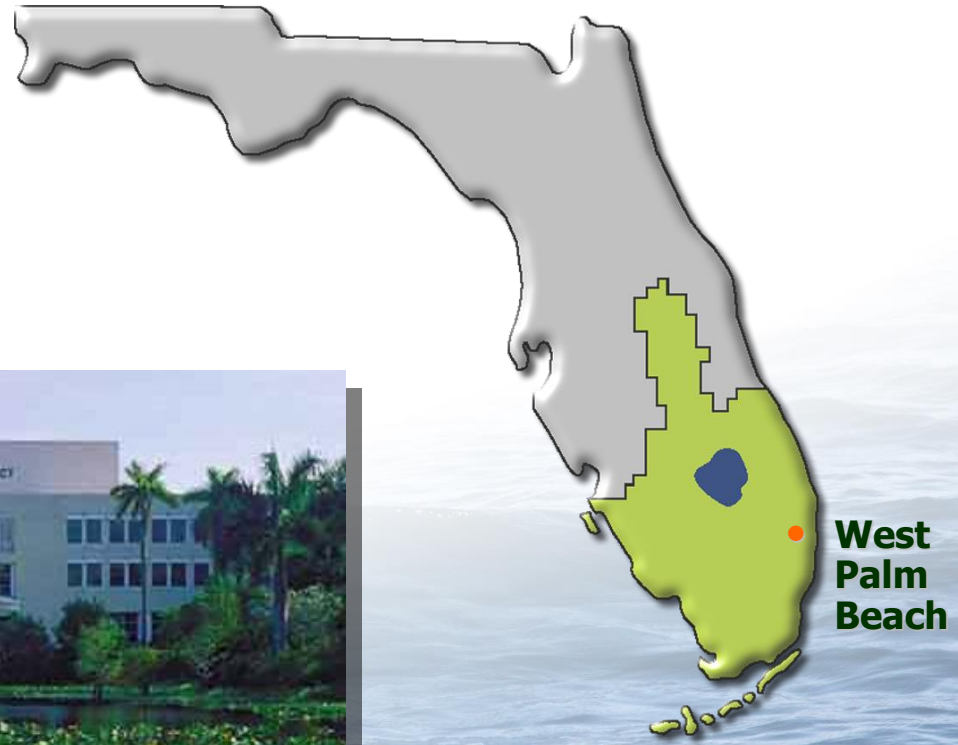
Who we are and what we do

Covers an 18,000 square-mile region:

16 counties; 8.1 million residents

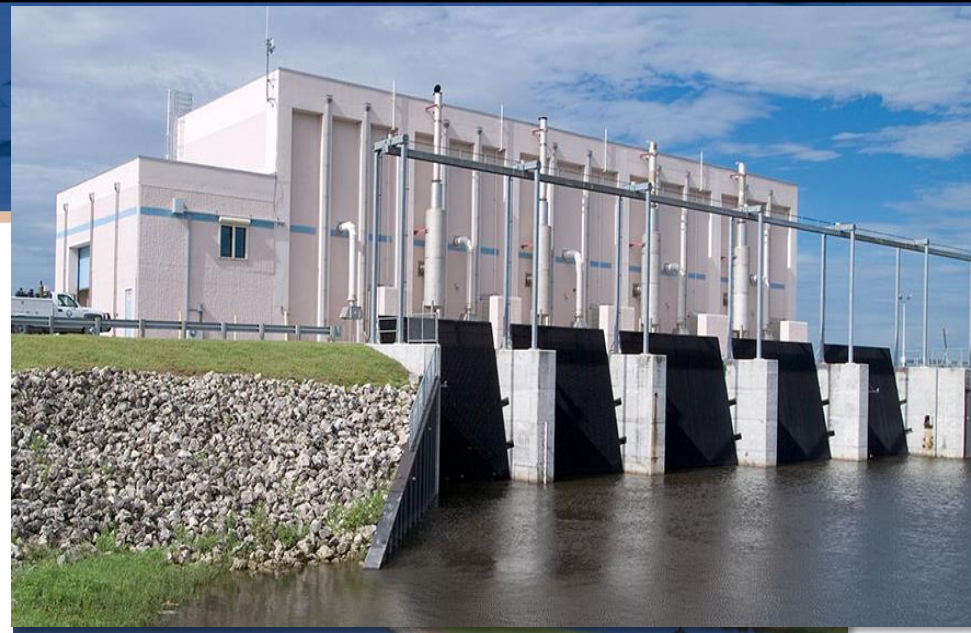
Mission Elements:

- Water Quality
- **Flood Control**
- Natural Systems
- Water Supply



Water Management System

- 2,060 miles of canals
- 2,028 miles of levees
- 160 major drainage basins
- 1,413 water control structures
- 71 pumping stations
- 60,000 acres of regional wetland Stormwater Treatment Areas
- Lake Okeechobee
  - 450,000 acre water storage area
- Water Conservation Areas
  - 959,000 acre water storage

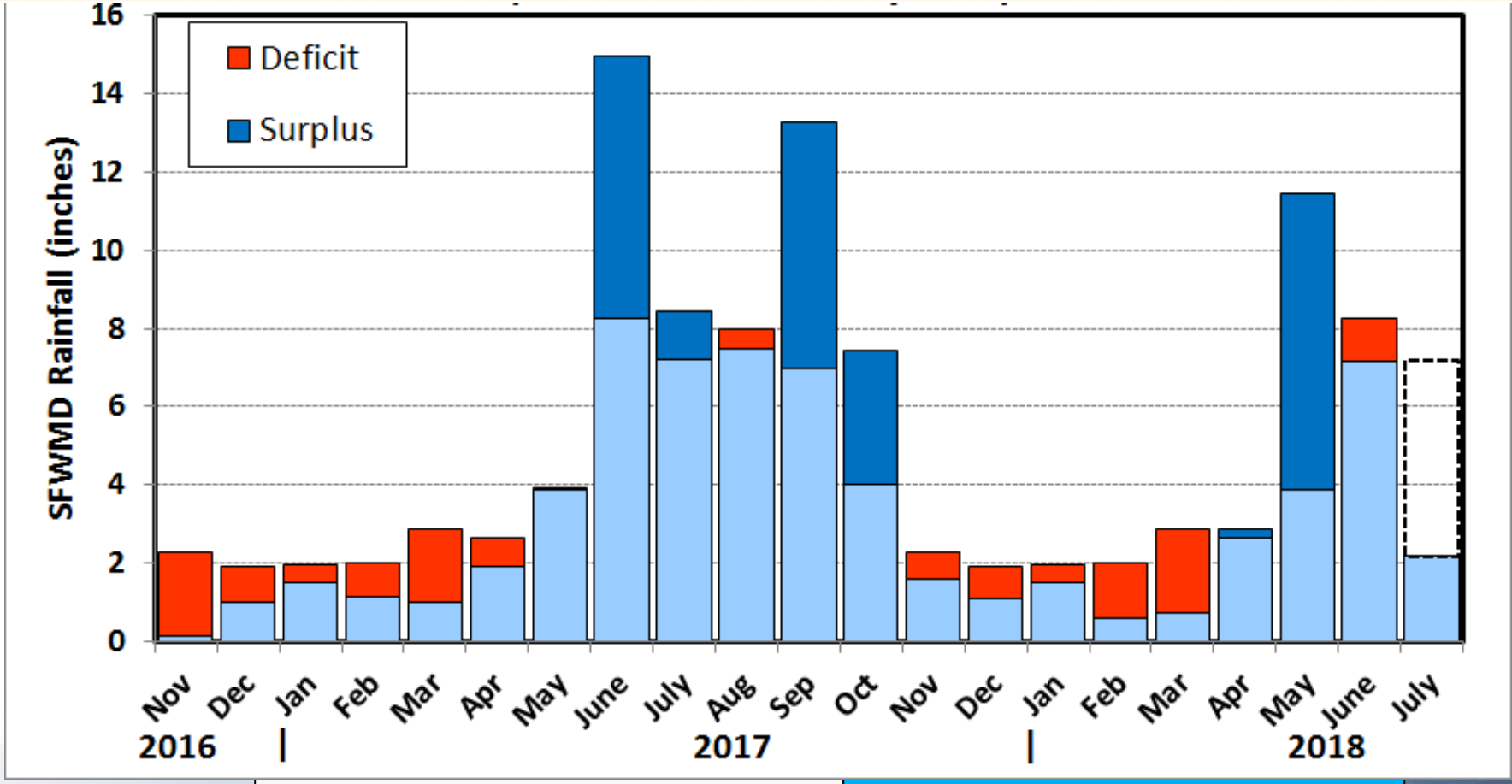


Why and Where is High Water A Concern

- Areas of south Florida lie any where from 1 to 6 feet above sea level
- Adjacent to huge water management features separated by levees
- Water management features serve dual purposes – storage and environmental
- Environmental objectives not compatible with excessively high water
- Necessary to manage water levels to ensure levee integrity for life and safety reasons

Highwater Drivers - Rain

- Rain - accumulation
- Rain - distribution
- Rain - intensity
- …..
- Transitioned from drought response to flood response in less than a month
- Compounded by a hurricane



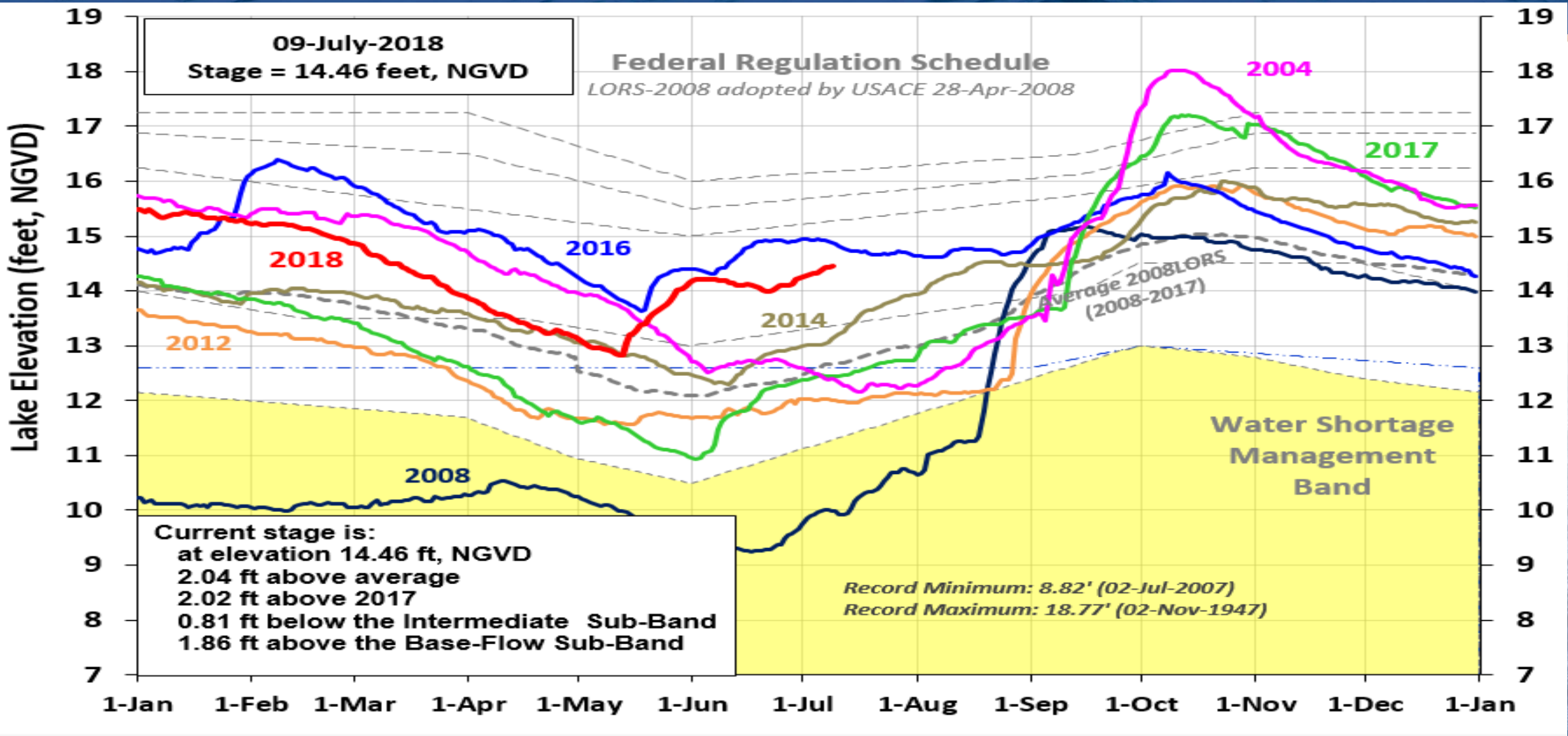
2017-2018 WET SEASON:

- June, September and October 2017 were ~ 190% average
- Hurricane Irma Impact ~ 8.5”
- TS Philippe ~ 2.4”

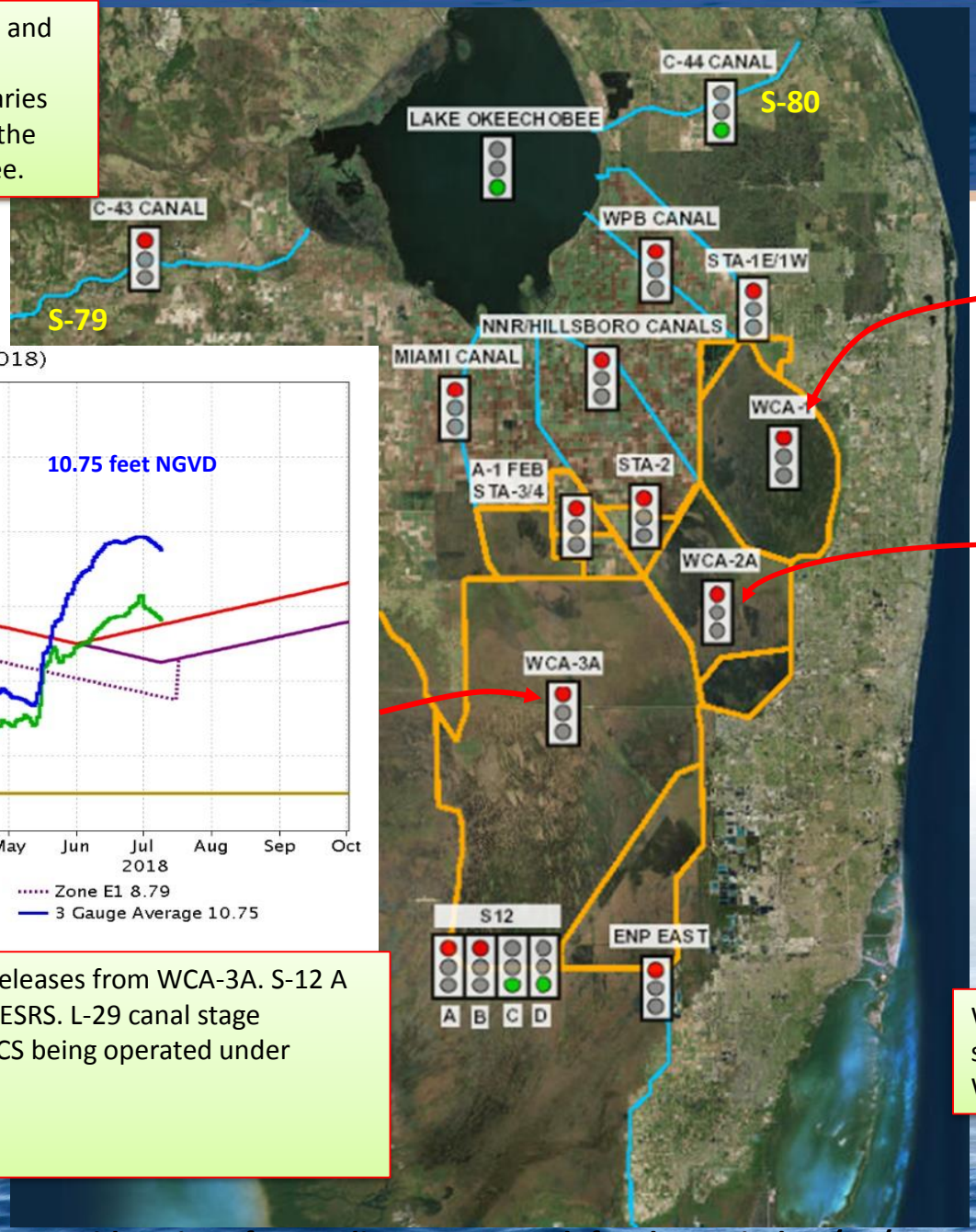
2018 DRY SEASON:

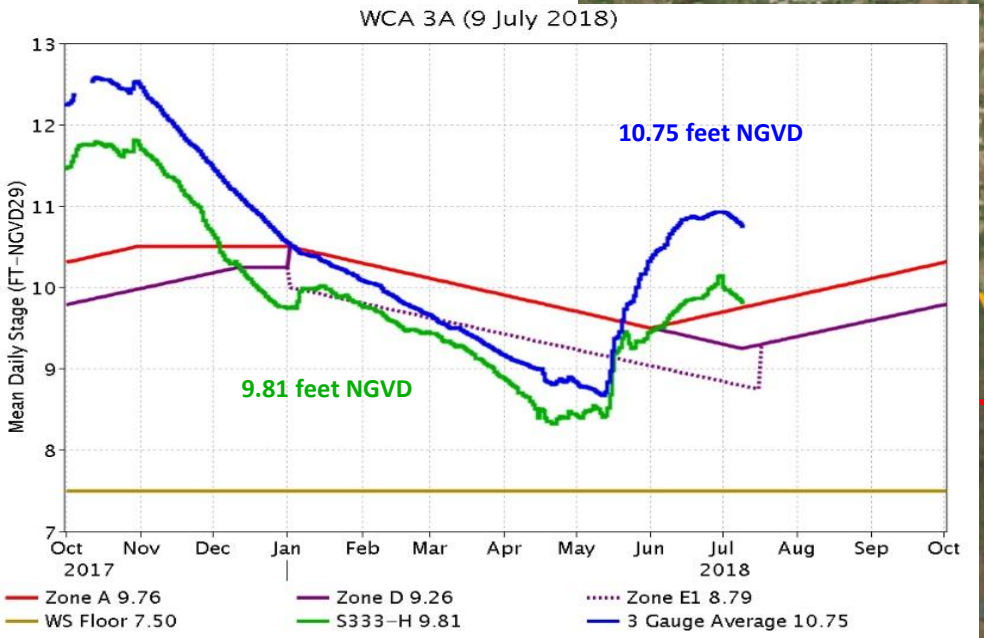
- Below average
- April was first month above average after 5 dry months
- Wettest May in the POR

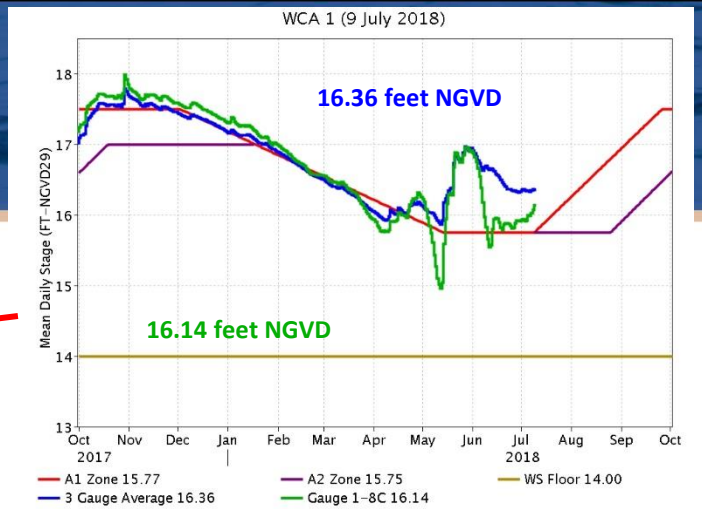
Effect on Water Levels in Lake Okeechobee

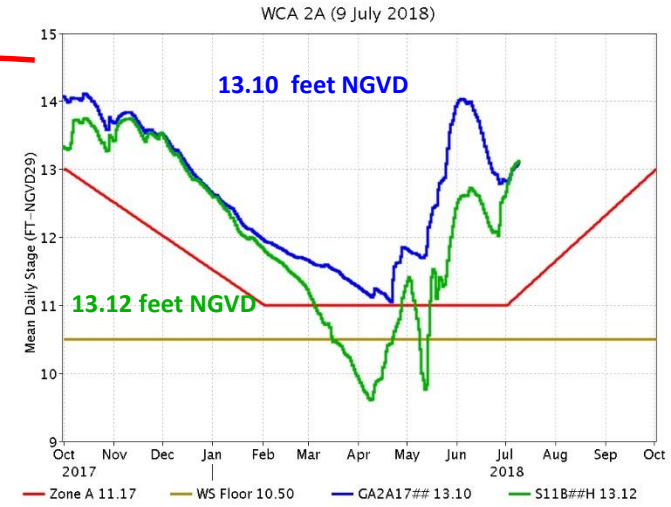


Lake Okeechobee stage is in the Low Sub-Band and less than 1 ft from the Intermediate Sub-band. Releases to St. Lucie and Caloosahatchee Estuaries are on hold. Maximum practicable releases to the south through the WCAs from Lake Okeechobee.





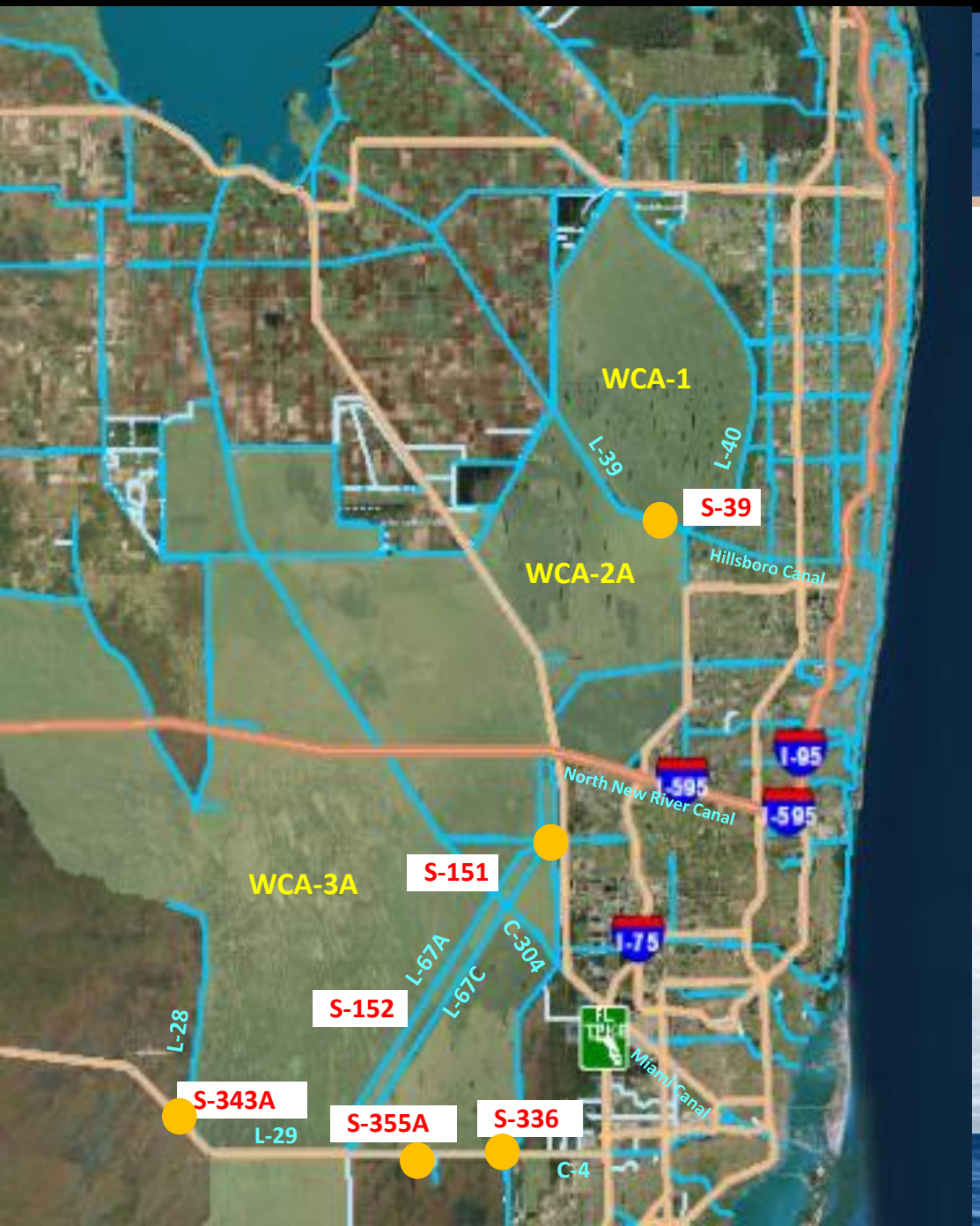




Rainfall Plan calls for maximum flood control releases from WCA-3A. S-12 A and B are closed. S-333 passing ~ 995 cfs to NESRS. L-29 canal stage constraint is at 8.0 feet NGVD. WCA3A and SDCS being operated under transition plan from Increment 1.1/1.2 to 2.0.

WCA-1 is above schedule (Canal gauge 1-8C); WCA-2A is above schedule; WCA-3A is above schedule. Flood control releases from WCA-3A to ENP are occurring now. S-10s and S-11s are closed.

System considerations for sending water south for the period 07/03/2018 to 07/09/2018



Emergency Measures to Manage High Water Levels

- Reducing inflows to Lake Okeechobee or WCA where possible
- Use gravity structures to move water to tide
- Use Pump Station to manage water
- Store water in regional storage, the A-1 Flow Equalization Basin and L-8 Flow Equalization Basin
- Store water on public lands through the Dispersed Water Management program.
- Work with private landowners to store water on their properties
- Install temporary pumps where possible to add discharge capacity

Temporary Pump Operation Near Structure S-39

Fig 1: 2- 42” pumps at L-39 moving water through L-39 levee from WCA 2 into WCA 1 near WCA 1 spillway structure

Fig 2: Pumps releasing water from WCA 2 to WCA 1

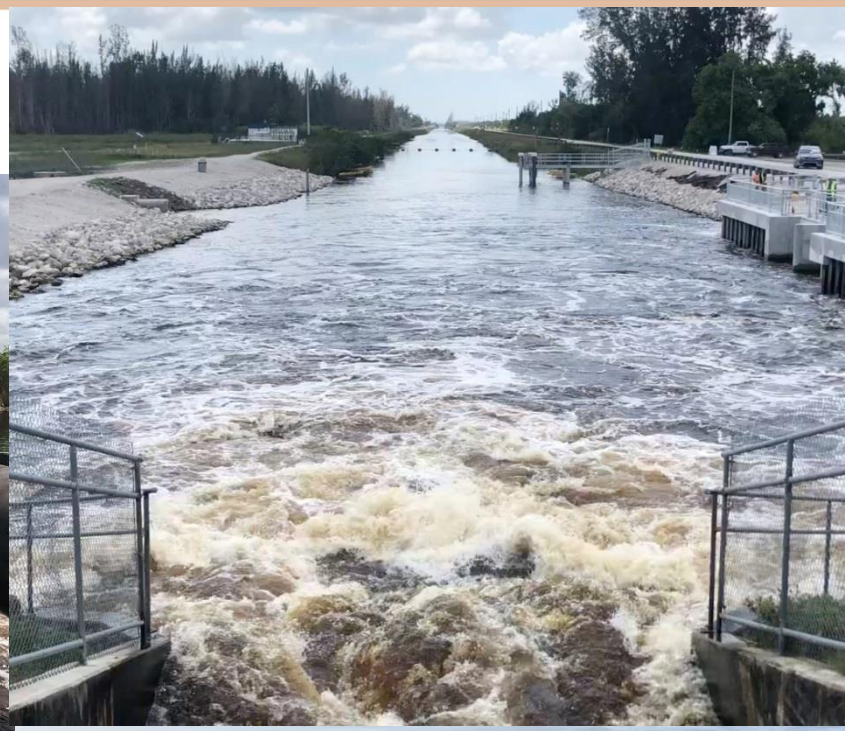
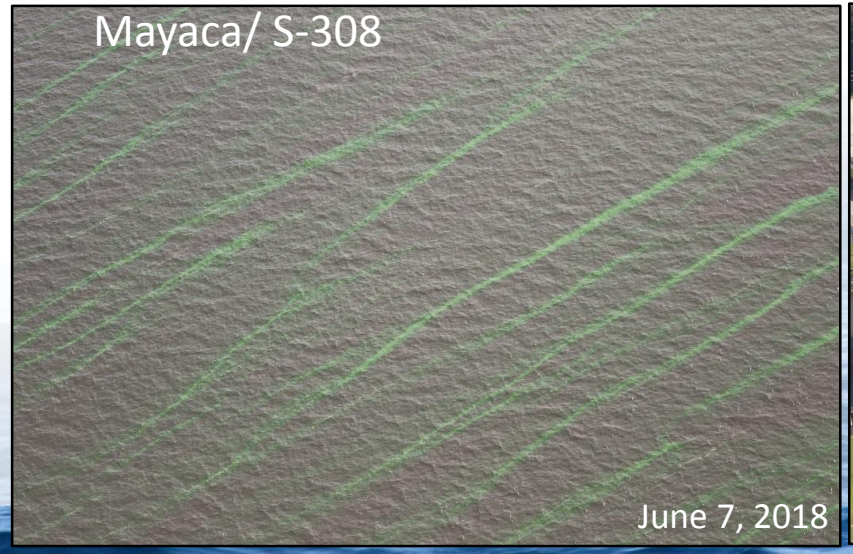
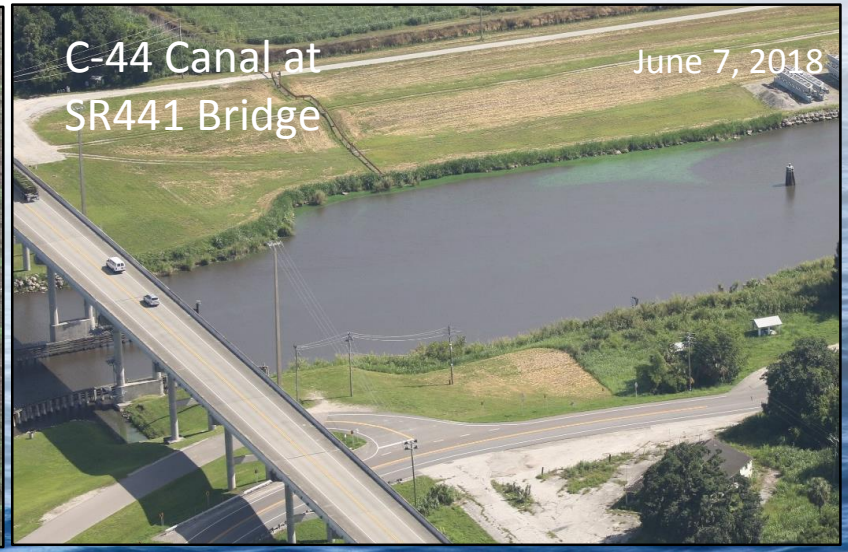


Fig 3: Releasing water from WCA 1 to Hillsboro Canal (looking downstream)

Some Limitations and Challenges

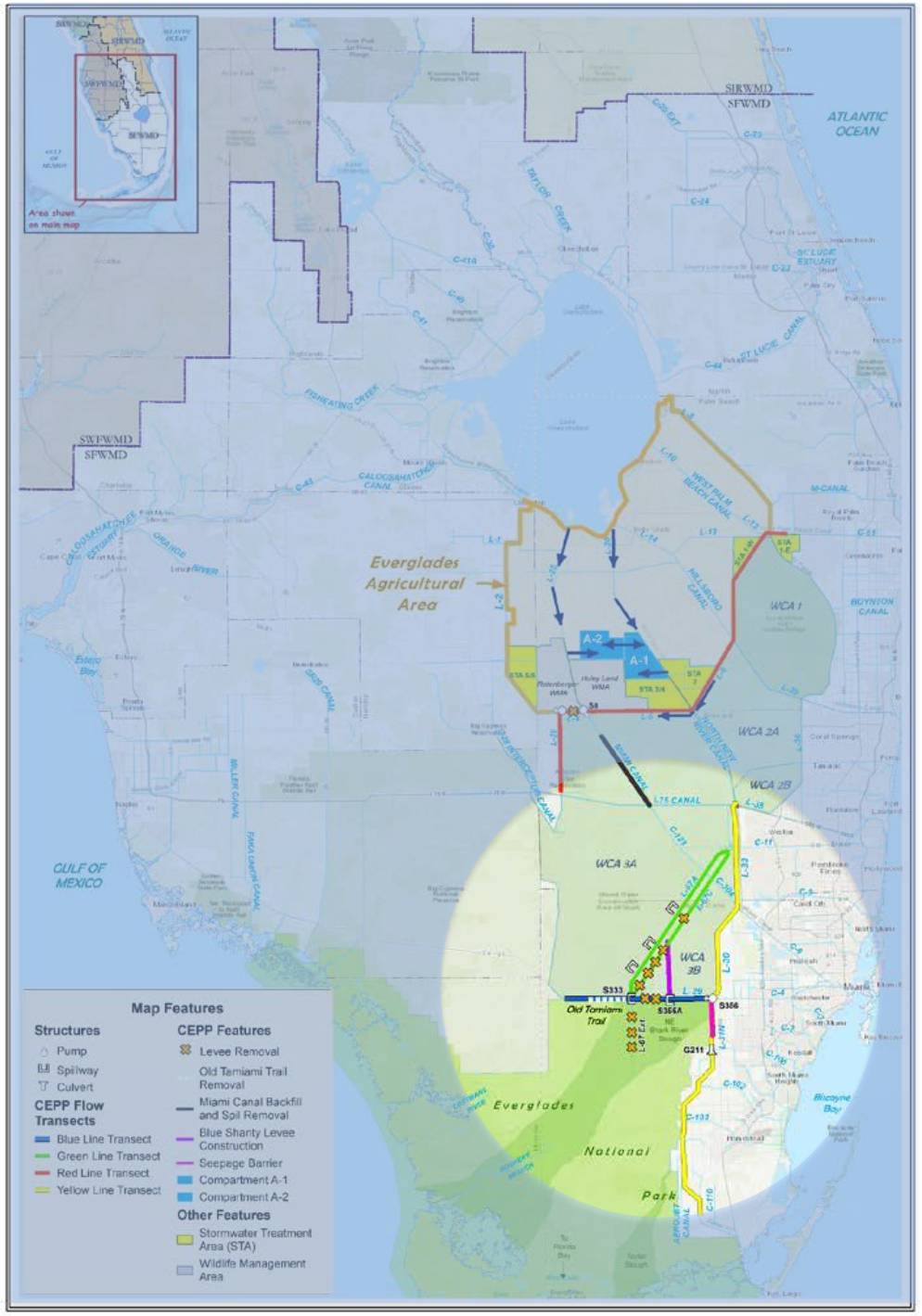
- Algae bloom in northern estuaries attributed to high discharges from Lake Okeechobee
- STA treatment capacity limits flows south
- Need to prioritize local runoff limits ability to rapidly lower lake and WCAs





Future Assets and Strategies

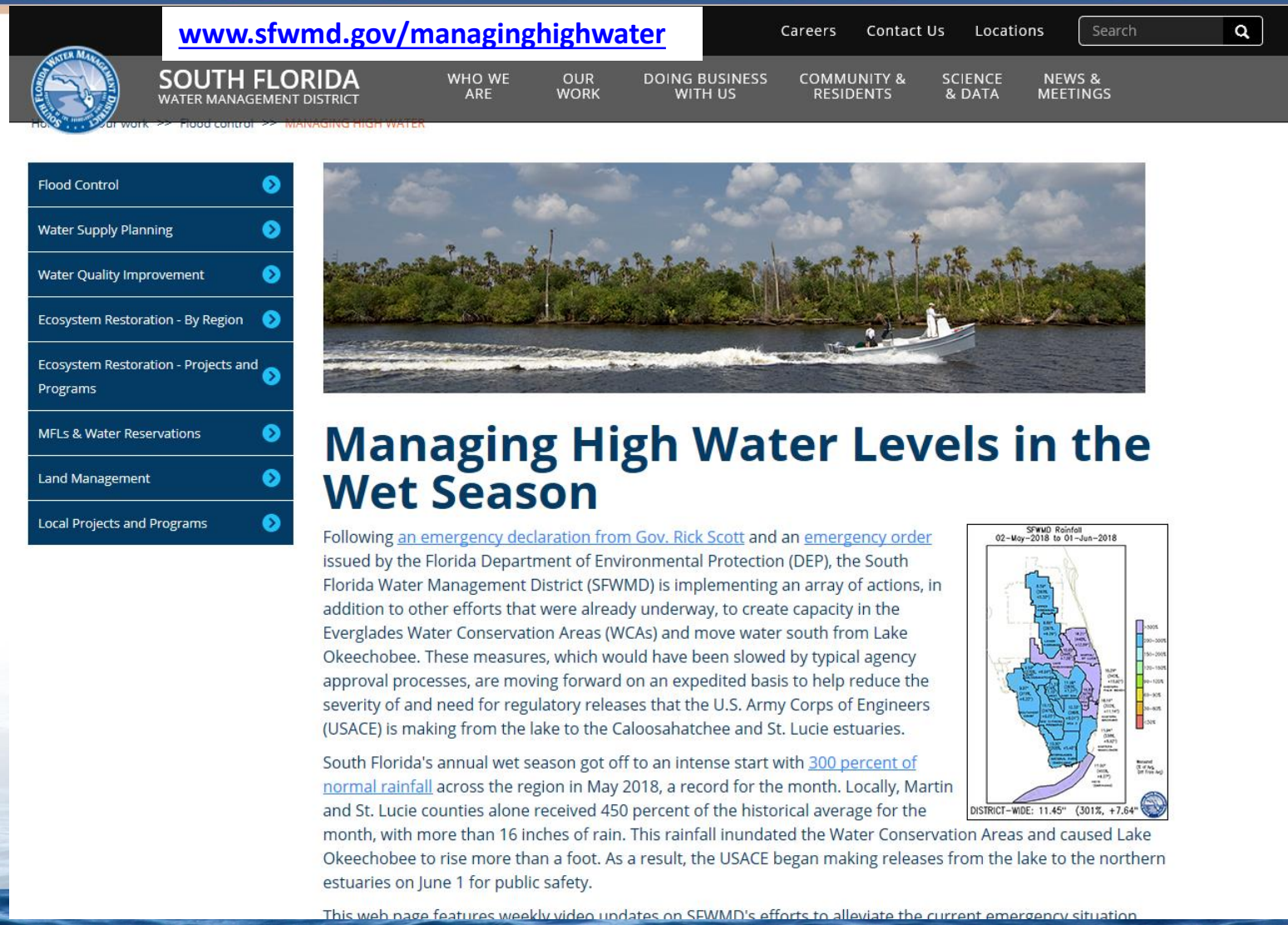
- Storage, including ASR associated with Everglades Restoration is part of the long term solution
- Enhancement of getaway capacity in the lower half of the everglades envisioned as part of CEPP will help
- Emergency Estuary Protection Wells, deep injection wells into the Boulder Zone



Dedicated Managing High Water Website

Social Media Communication

www.sfwmd.gov/managinghighwater



Questions?

Miami Herald, Nov 03, 2017

https://vimeo.com/223345347

SFWMD, June 27, 2017

Miami Herald, Nov 03, 2017

The Water-Energy Nexus

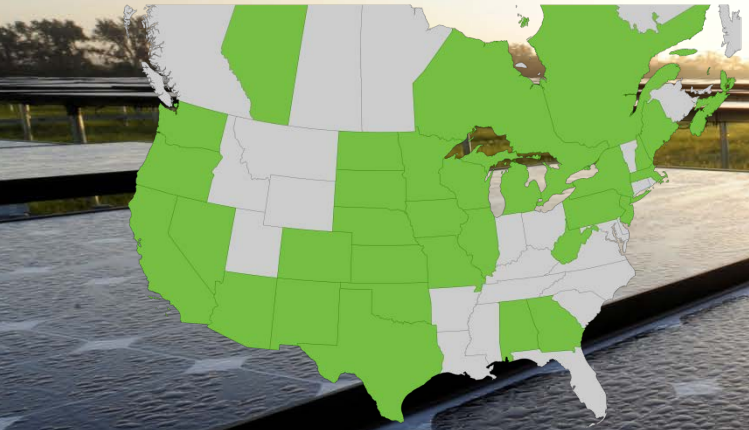
Air & Waste Management Association Conference

October 23, 2018

Agenda

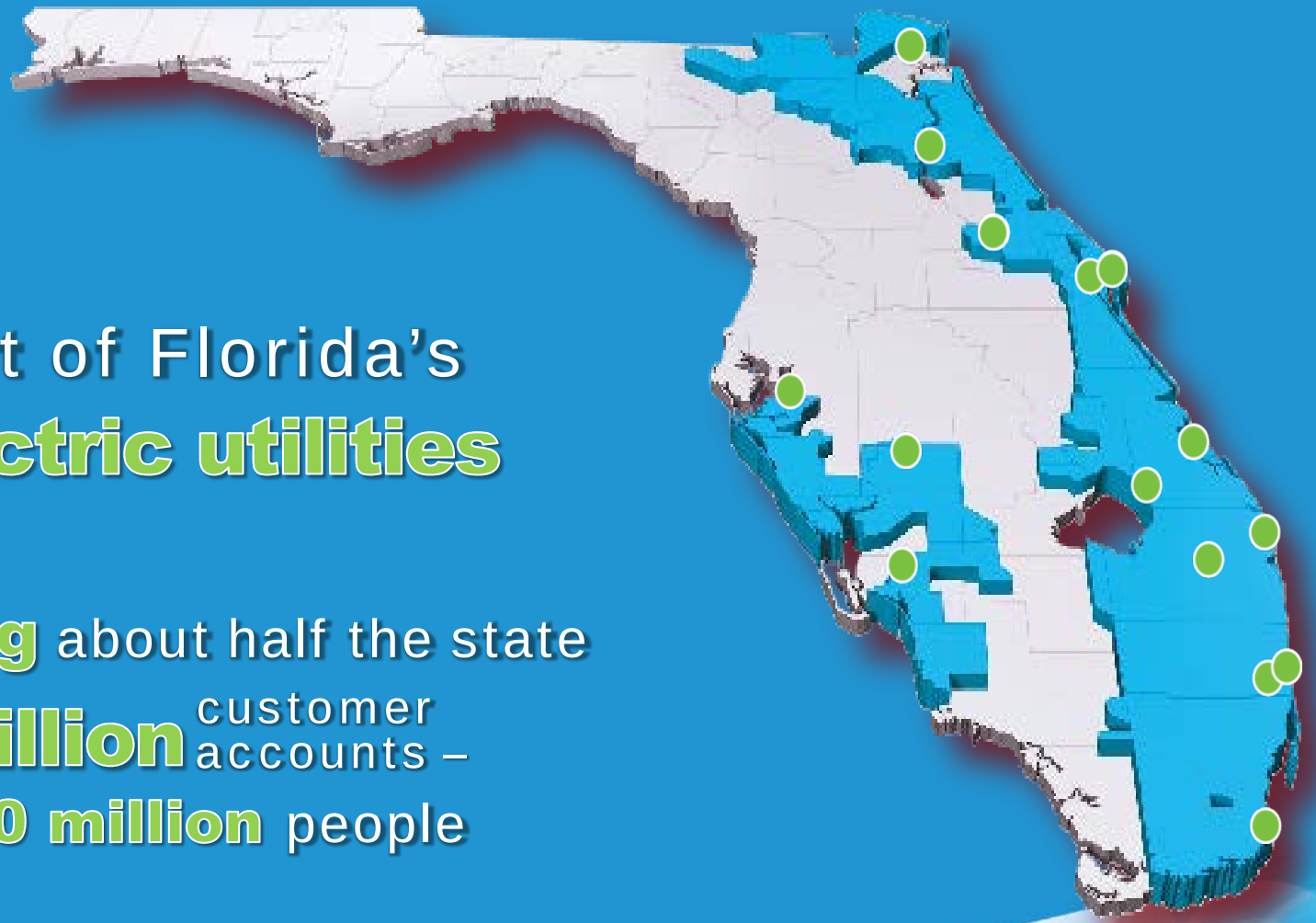
- Water use in power generation
- FPL's innovative use of water
- Future opportunities for reclaimed water use

NEXTera ENERGY



- World's #1 producer of renewable energy from the wind and sun
- Operating in 30 U.S. states & Canada, but Florida is our home
- Consistently ranks among Fortune's World's Most Admired Companies

Introduction

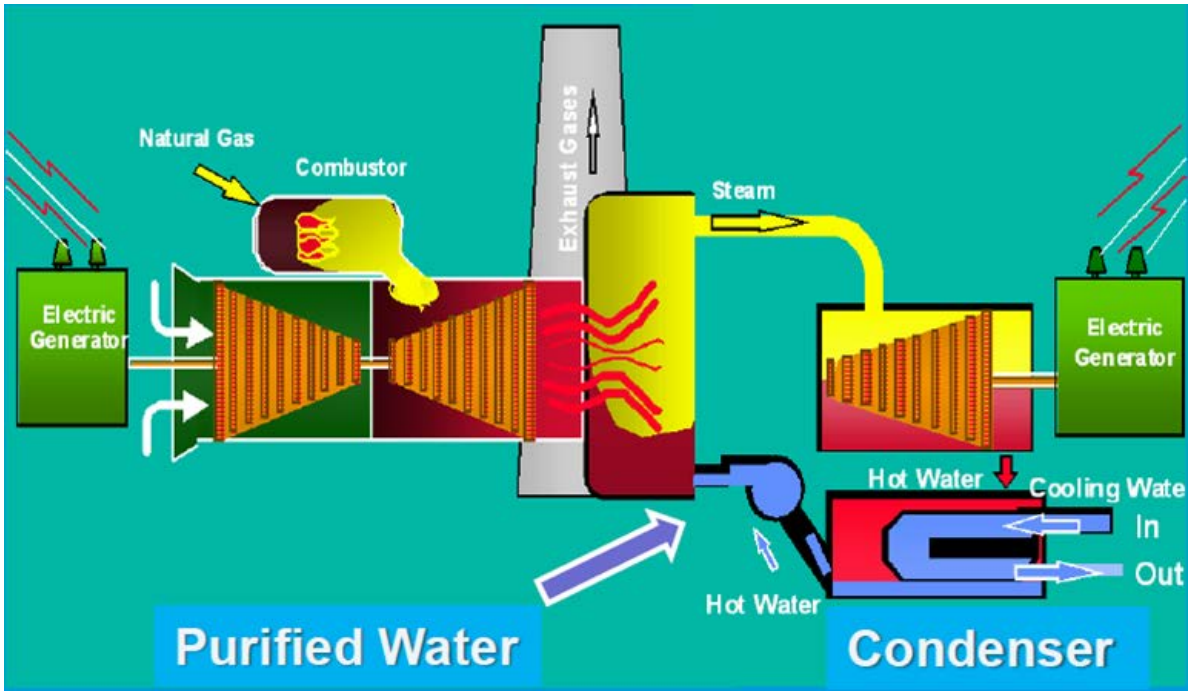


Largest of Florida's
55 electric utilities

Powering about half the state
4.9 million customer accounts –
nearly **10 million** people

Water is a critical resource for steam powered electric generating facilities

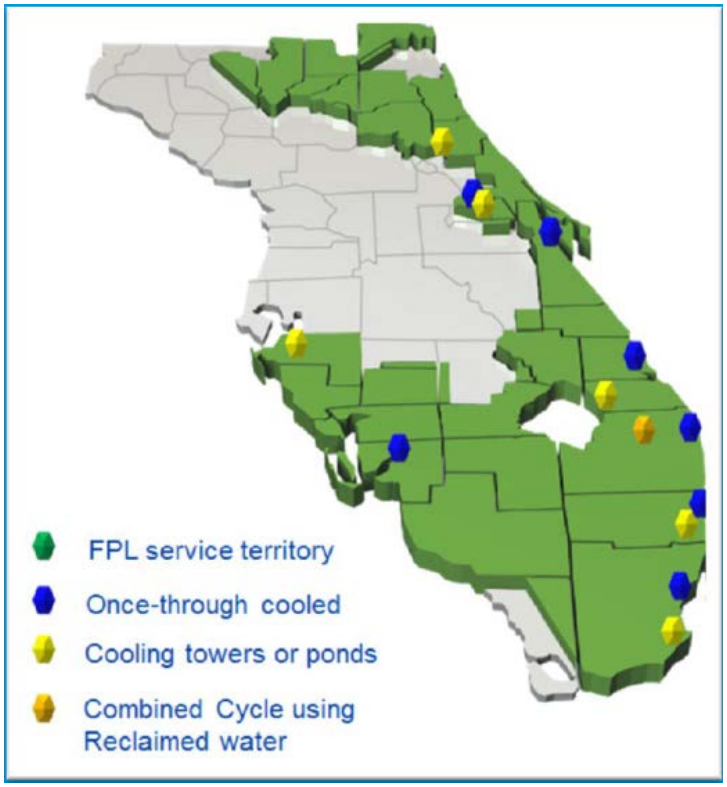
Combined Cycle Steam Electric Generating Plant



Combined-cycle technology reduces water use as ~60% of generation is produced by combustion turbines, which don't use water for cooling

Cooling technology has evolved from once-through systems reliant on large waterbodies to closed-cycle systems

Power Plant Water Usage



Recent water conservation focus has been exploration and utilization of different water sources

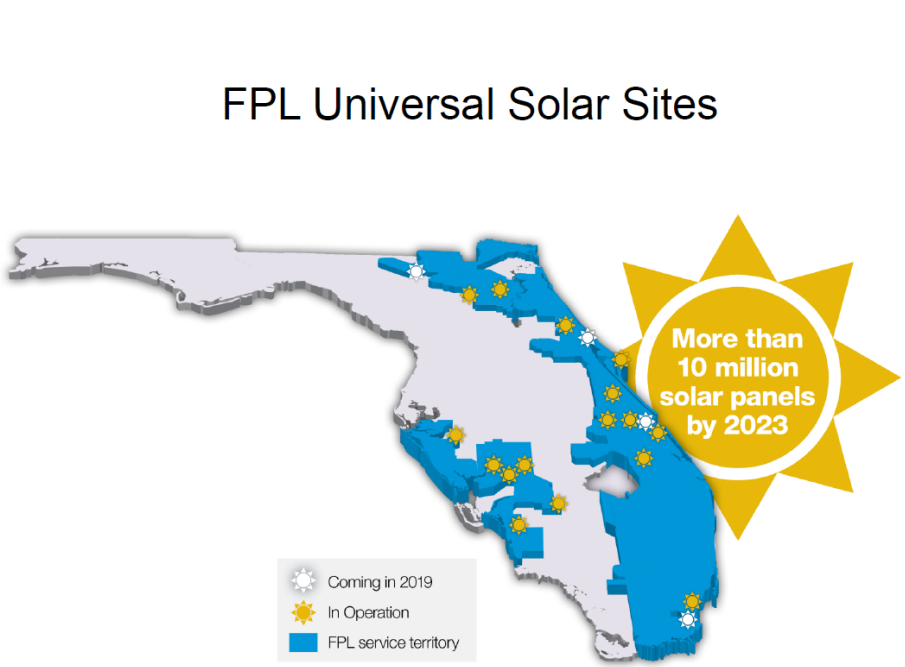
Water conservation in power generation is accomplished through improved fleet efficiency, use of renewable resources, and innovative use of water

FPL's Water Conservation Efforts

- **Modernization of FPL fleet to high efficiency combined-cycle facilities that use clean, U.S. produced natural gas**
- **Expansion of renewable energy generation technology with no required water use**
- **Enhanced utilization of degraded water resources**
  - Policy, economics, technology and environmental considerations affect the options for users and suppliers of reclaimed water

FPL has embarked on an unprecedented expansion of solar energy centers that require no water to operate

FPL Solar Energy Centers



FPL solar centers avoided the use of 44.4 million gallons of water in 2017

West County Energy Center, a 3,750 MW combined-cycle facility that uses 22 mgd of reclaimed water, is a example of innovative water reuse

FPL's West County Energy Center

- Originally designed to use Floridan water
- Converted to use Palm Beach County's treated wastewater in 2011
- Water pumped from reclaimed treatment facility 17 miles east of West County
- Plant retains original Floridan well system as restricted backup

Extensive coordination and commitment between reclaimed water supplier and user is required for success

FPL and Miami-Dade County are collaborating to explore use of reclaimed water to address water challenges

Reclaimed Opportunities in Miami-Dade

- **Ocean Outfall Legislation will require two key changes in how Miami-Dade handles wastewater**
  - Up to 60% of treated wastewater goes to ocean outfalls currently; this will not be an option after 2025
  - A target to reuse 117 mgd of treated wastewater has been set
- **Miami-Dade and FPL have executed a Joint Participation Agreement to explore opportunities to reuse wastewater at FPL's Turkey Point**

An advanced reclaimed water facility is proposed to enable the sustainable reuse of up to 60 mgd of wastewater at Turkey Point

Turkey Point cooling canals are a 168 linear mile system that presents a unique opportunity for reclaimed water use

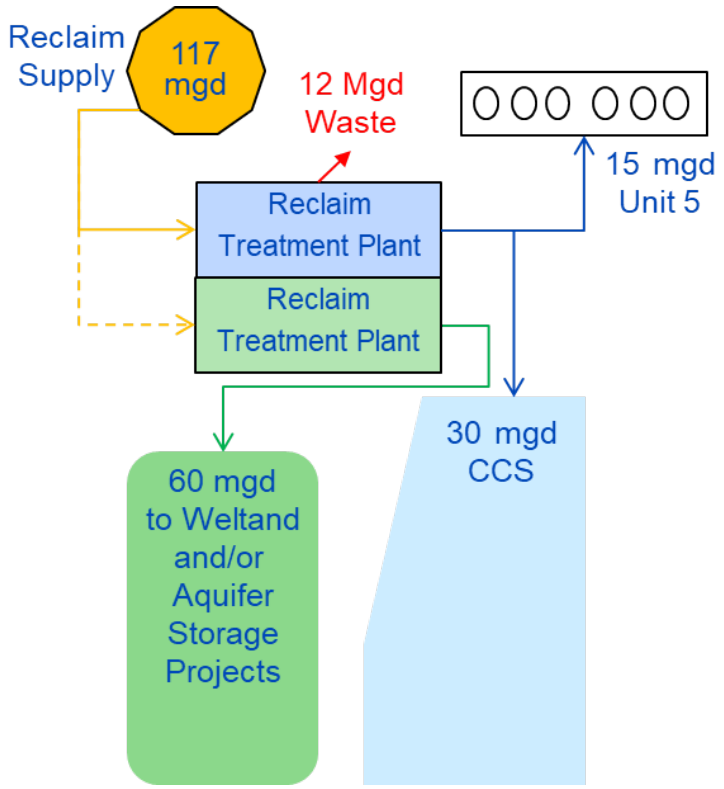
Turkey Point Overview

- **Turkey Point Site includes:**
  - One fossil unit with cooling towers (Floridan wells)
  - Two nuclear units with cooling canal system
- **Cooling canals are an Industrial Waste Water Facility permitted to interact with Biscayne Aquifer**
- **Evaporation and rainfall deficits increase salinity in the cooling canals**
- **Floridan aquifer water is used to manage salinity**

Using innovative technology, reclaimed water would be treated and delivered to site via a large dedicated pipeline

Reclaimed Opportunities at Turkey Point

- Joint Participation Agreement envisions up to 60 mgd for use as makeup water and freshening water
- Existing Floridan wells would be converted to a backup system
- Additional treatment of another 60 mgd could support wetland hydration projects



Reclaimed water used by Turkey Point does not compete with reclaimed water reserved for Everglades restoration

Questions

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Florida Power & Light Company
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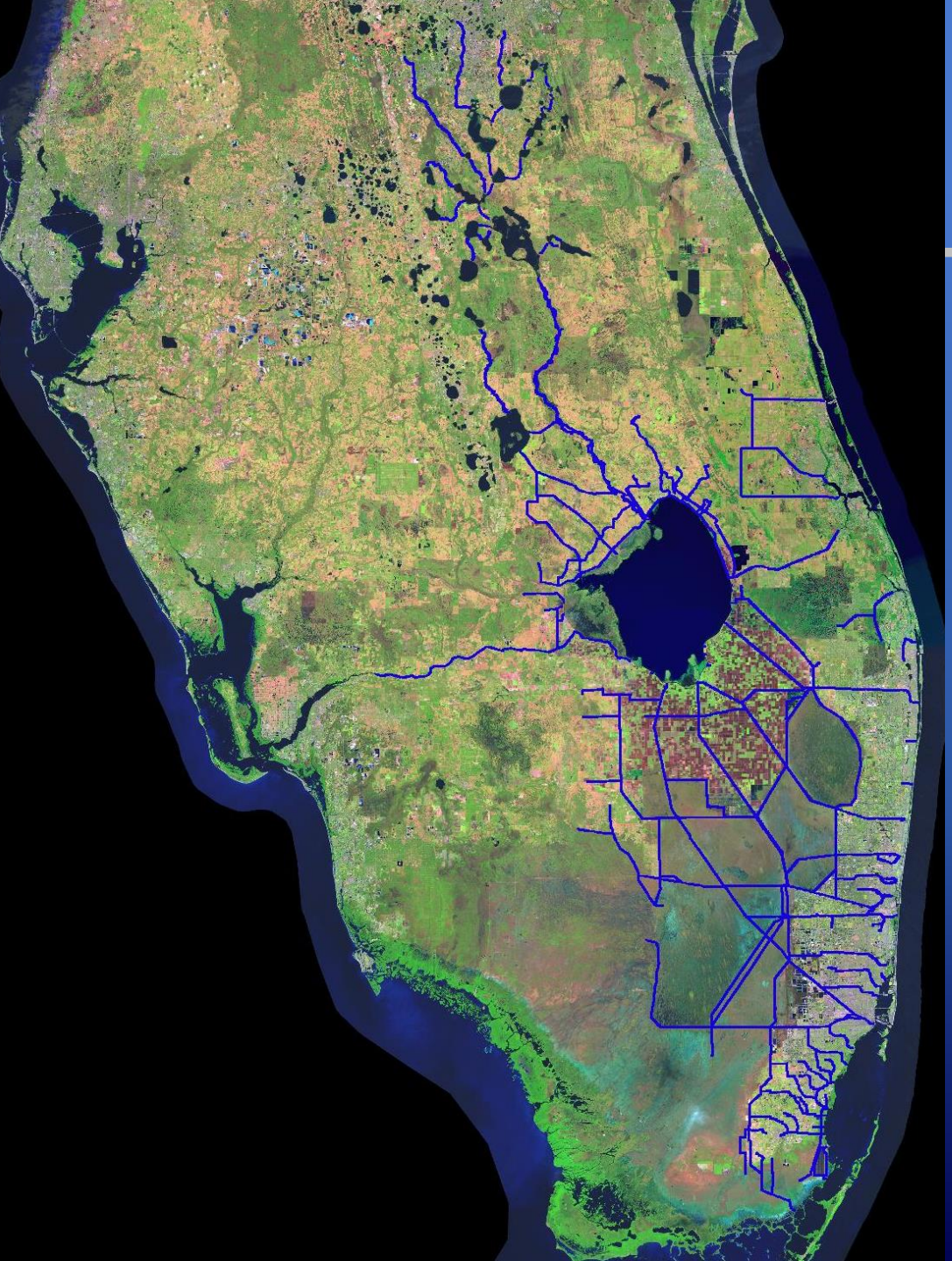


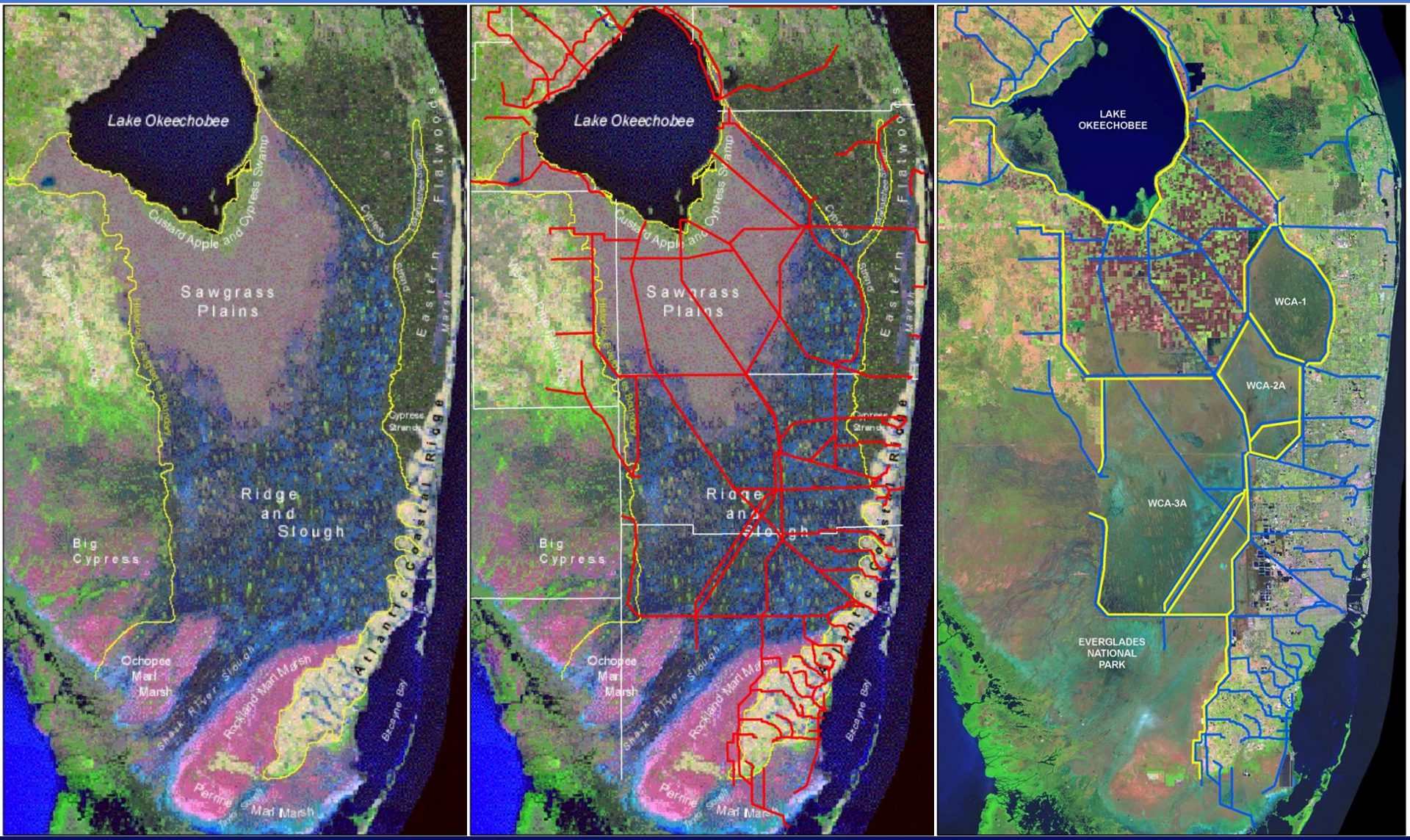
Lake Okeechobee Management

The Perspective from the Agricultural Sector

Florida Section of A&WMA
Conference & Exposition
October 2018

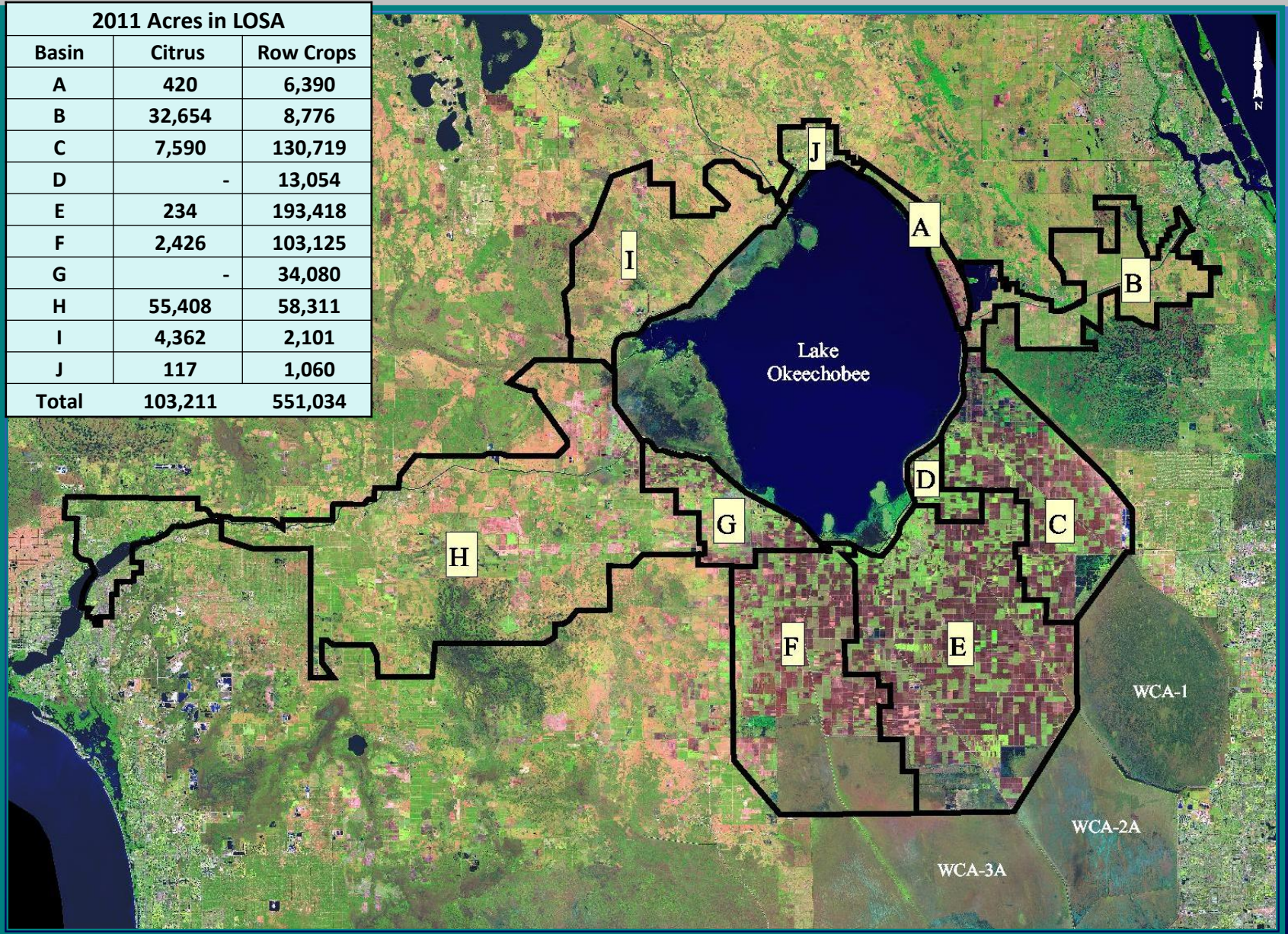
MacVicar Consulting, Inc.
South Florida Water Resource Specialists

Changes in the System Over Time



Lake Okeechobee Service Area (LOSA)

2011 Acres in LOSA		
Basin	Citrus	Row Crops
A	420	6,390
B	32,654	8,776
C	7,590	130,719
D	-	13,054
E	234	193,418
F	2,426	103,125
G	-	34,080
H	55,408	58,311
I	4,362	2,101
J	117	1,060
Total	103,211	551,034



Agriculture in the Lake Okeechobee Service Area

Winter Vegetable Capital of the US

- Largest producer of sweet corn
- Salad Bowl for the eastern US
- Major rice production

$500 million per year

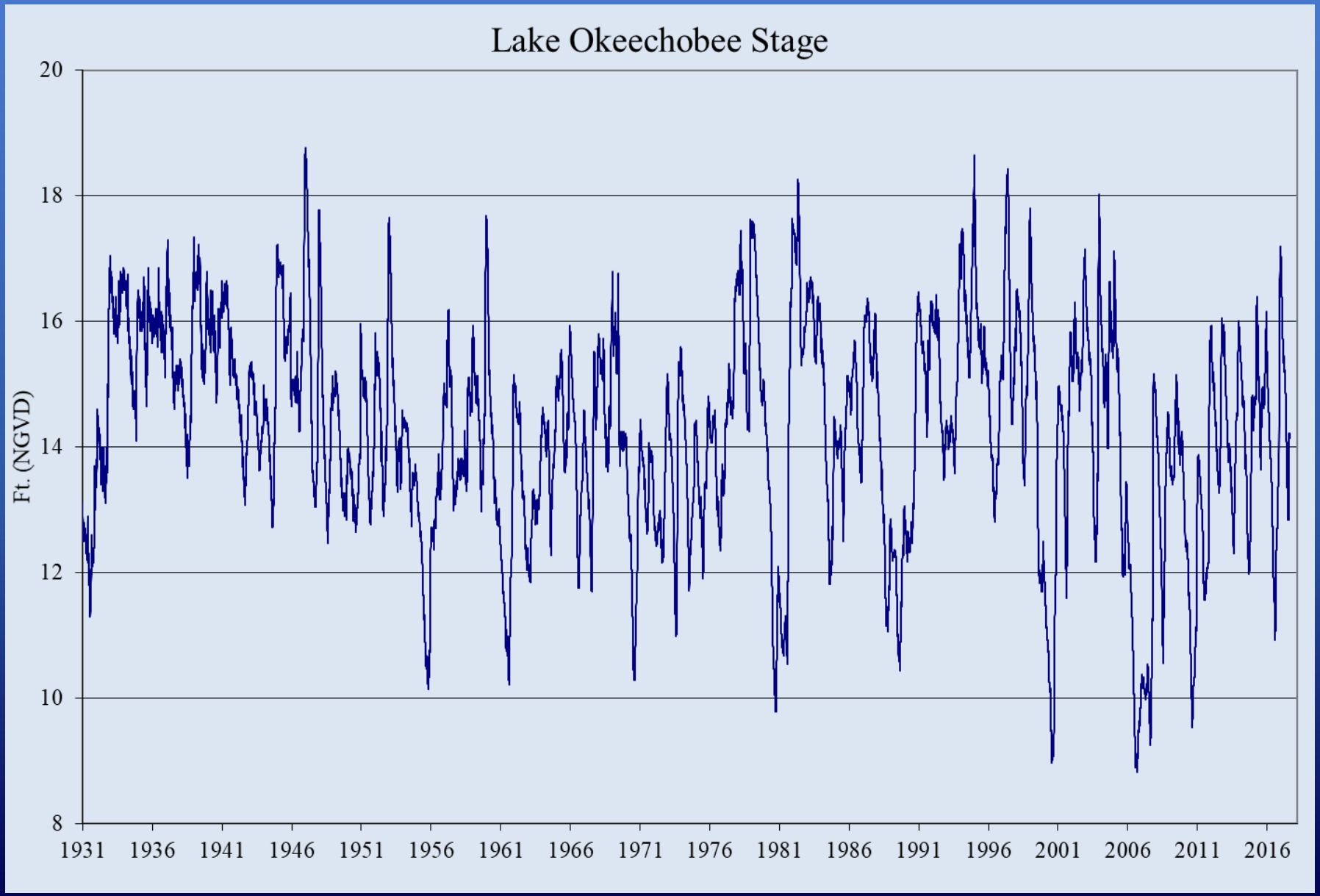
Largest Cane Sugar Production in US

- Over 400,000 acres in LOSA
- Reduced phosphorus off farm by 55% (paid for by farmers)
- Paid $200 million for government water quality projects
  - Farmers pay an agricultural privilege tax as established in the Everglades Forever Act

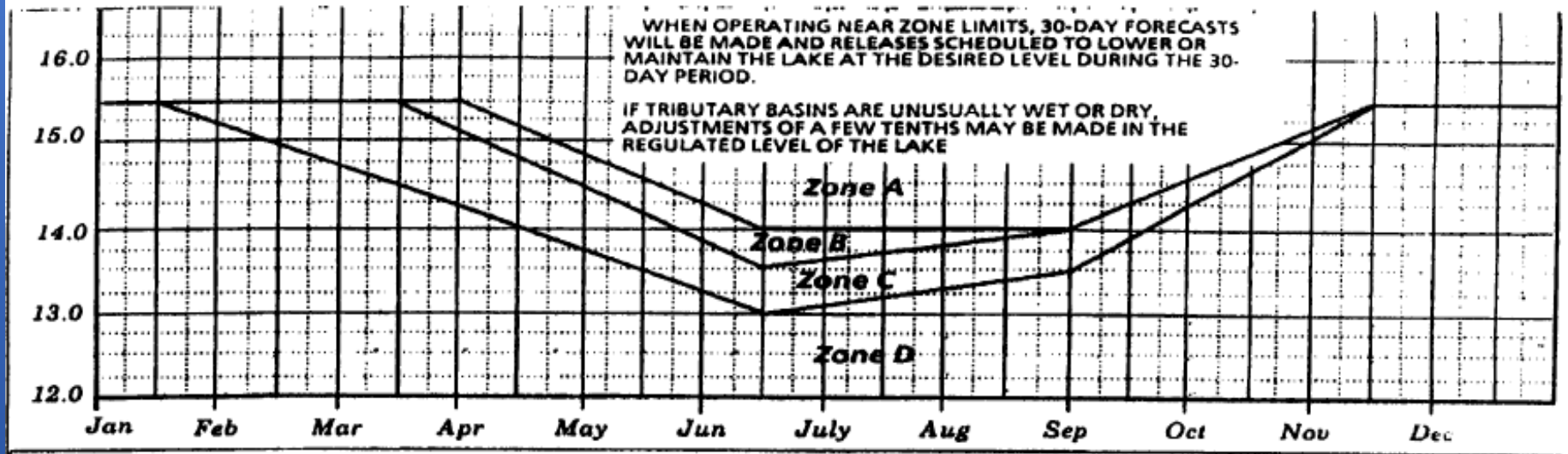
An Essential Part of the Florida Economy

- 23,000 sugar industry jobs in Florida
- Four sugar factories (Clewiston, South Bay, Pahokee and Belle Glade)
- Two refineries (South Bay and Clewiston)
- Largest Biomass-to-Electricity plant in the US (New Hope Power Plant - 140 MW)
- Modern product distribution center
- $3 Billion annual economic impact

There is no place in the world with south Florida's combination of climate and regional water management infrastructure, and Lake Okeechobee is the key



The Corps has created a process, and rules to manage releases from the Lake based on water level and the time of year. Check Zone D



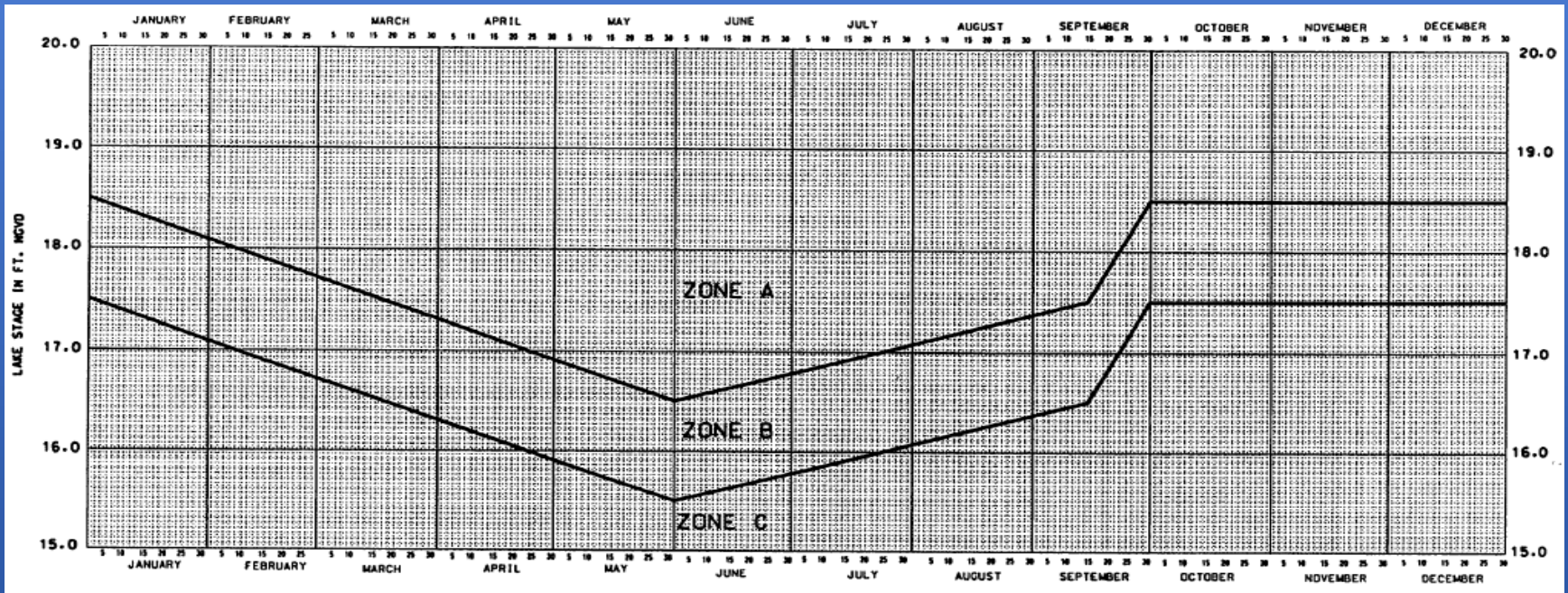
RELEASE THROUGH OUTLETS AS INDICATED			
Zone	Agricultural Canals	Caloosahatchee River	St. Lucie Canal
A	MAXIMUM DISCHARGE AFTER REMOVAL OF LOCAL INFLOW	MAXIMUM DISCHARGE WITHOUT LOCAL FLOODING	MAXIMUM DISCHARGE
B	MAXIMUM GRAVITY RELEASES AFTER REMOVAL OF LOCAL INFLOW		MAXIMUM DISCHARGE WITH AVERAGE VELOCITY LIMITED TO 2 5 FT/SEC
C	MAXIMUM GRAVITY RELEASES AFTER REMOVAL OF LOCAL INFLOW	MAXIMUM CAPACITY	0 TO 3500 CFS
D	FOR AG DEMAND ONLY	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE

PRIORITY FOR USE OF OUTLETS

1. GRAVITYRELEASES THROUGH THE AGRICULTURAL CANALS
2. ST LUCIE CANAL AND/OR CALOOSAHATCHEE RIVER DEPENDING ON LOCAL CONDITIONS. WHEN THERE IS AN UNUSUAL RED-TIDE HAZARD, RELEASES THROUGH THE CALOOSAHATCHEE MAY BE CURTAILED
3. PUMPED RELEASES THROUGH THE AGRICULTURAL CANALS

Central and Southern Florida
ALTERNATE REGULATION SCHEDULE--LAKE OKEECHOBEE
Department of the Army, Jacksonville District
Corps of Engineers, Jacksonville, Florida
Summer and Fall, 1965

Water Supply was a big deal from the beginning and in the 1970s the Corps approved a new operational schedule to hold more water in the Lake.



RELEASE THROUGH OUTLETS AS INDICATED

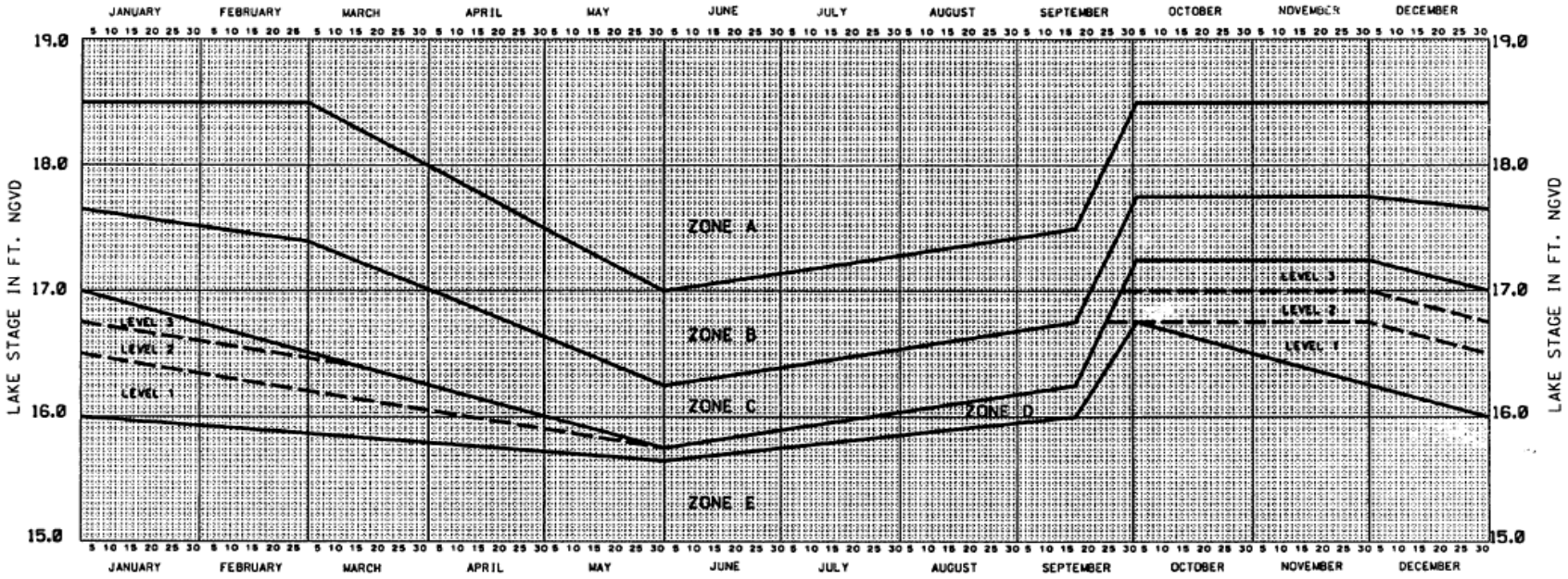
ZONE	AGRICULTURAL CANALS	CALOOSAHATCHEE RIVER	ST. LUCIE CANAL
A	PUMP MAXIMUM PRACTICABLE TO WCA'S FOR REGULATION AFTER REMOVAL OF LOCAL RUNOFF.	UP TO MAXIMUM CAPACITY (9,300 CFS AT S-77) WITHOUT LOCAL FLOODING	UP TO MAXIMUM CAPACITY AT S-308C
B(1)		UP TO 4500 CFS AT S-77	UP TO 2500 CFS AT S-80 (2)
C	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE
	FIRST PRIORITY	SECOND PRIORITY	THIRD PRIORITY

NOTES: (1) RELEASES THROUGH VARIOUS OUTLETS MAY BE MODIFIED TO MINIMIZE DAMAGES OR OBTAIN ADDITIONAL BENEFITS.
(2) EXCEPT WHEN EXCEEDED BY LOCAL INFLOW.

CENTRAL AND SOUTHERN FLORIDA
INTERIM REGULATION SCHEDULE
LAKE OKEECHOBEE
DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT
CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA
DATED: 10 MAY 1978
78 SCHEDULE

Figure 3-7

The big challenge was always how to release water with the least harm possible. This schedule, adopted in 1994, added more flexibility to deal with the releases



RELEASE THROUGH OUTLETS AS INDICATED

ZONE	AGRICULTURAL CANALS (2)	CALOOSAHATCHEE RIVER (2)	ST. LUCIE CANAL
A	PUMP MAXIMUM PRACTICABLE TO WCA'S	UP TO MAXIMUM CAPACITY AT S-77	UP TO MAXIMUM CAPACITY AT S-80
B (1)	MAXIMUM PRACTICABLE TO WCA'S	6500 CFS AT S-77	3500 CFS AT S-80 (3)
C (1)	MAXIMUM PRACTICABLE TO WCA'S	UP TO 4500 CFS AT S-77	UP TO 2500 CFS AT S-80 (3)
D	MAXIMUM PRACTICABLE TO WCA'S	MAXIMUM NON-HARMFUL DISCHARGES TO ESTUARY WHEN STAGE RISING	MAXIMUM NON-HARMFUL DISCHARGES TO ESTUARY WHEN STAGE RISING (3)
E	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE	NO REGULATORY DISCHARGE

NOTES: (1) RELEASES THROUGH VARIOUS OUTLETS MAY BE MODIFIED TO MINIMIZE DAMAGES OR OBTAIN ADDITIONAL BENEFITS.

(2) SUBJECT TO FIRST REMOVAL OF LOCAL RUNOFF.

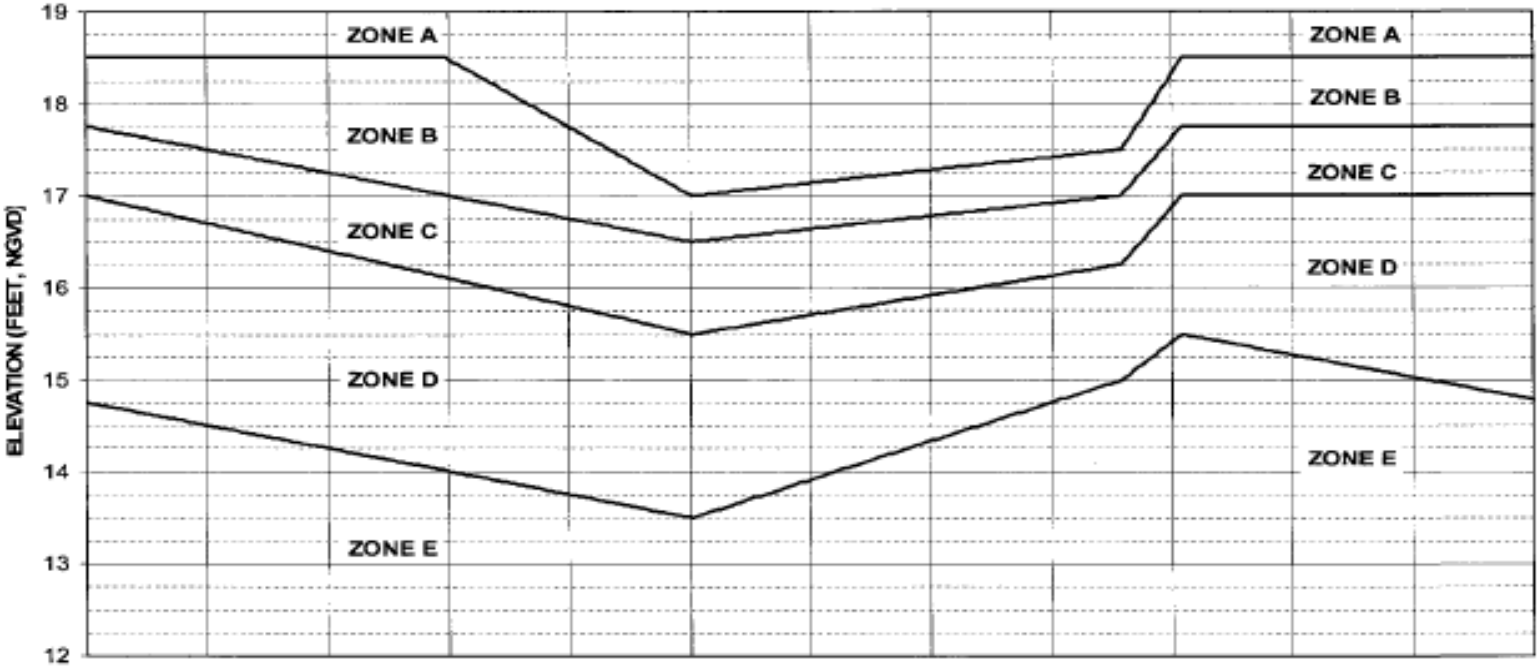
(3) EXCEPT WHEN EXCEEDED BY LOCAL INFLOW.

CENTRAL AND SOUTHERN FLORIDA
INTERIM REGULATION SCHEDULE
LAKE OKEECHOBEE
DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT
CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA
DATED: 27 DEC 1994

RUN 25

Figure 3-8

In 1999 the WSE schedule was adopted with even more flexibility, and for the first time introduced factors based on climate forecasts and regional hydrology



WSE

Zone	Agricultural canals to WCA's (1,2)	Caloosahatchee River at S-77 (1,2,4)	St. Lucie Canal at S-80 (1,2,4)
A	Pump maximum practicable	Up to maximum capacity	Up to maximum capacity
B (3)	Maximum practicable releases	Normal to wet: Up to 6500 cfs. Dry: Up to maximum pulse release.	Normal to wet: Up to 3500 cfs. Dry: Up to maximum pulse release.
C (3)	Maximum practicable releases	Wet: Up to 4500 cfs. Normal: Up to maximum pluse release. Dry: None.	Wet: Up to 2500 cfs. Normal: Up to maximum pluse release. Dry: None.
D (3,5)	As need to minimize adverse impacts to the littoral zone while not adversely impacting the everglades (see Note 5)	Very wet: Up to maximum pulse release. Otherwise: None	Very wet: Up to maximum pulse release. Otherwise: None
E	No regulatory discharge	No regulatory discharge	No regulatory discharge

Notes

1 Subject to first removal of runoff from downstream basins

2 Guidelines for wet, dry and normal conditions are based on: 1) Selected climatic indices and tropical forecasts and 2) Projected inflow conditions. Releases are subject to the guidelines in the WSE Operation Decision Tree. Parts 1 and 2

3 Releases through various outlets may be modified to minimize damages or obtain additional benefits. Consultation with Everglades and estuarine biologists is encouraged to minimize adverse effects to downstream ecosystems

4 Pulse releases are made to minimize adverse impacts to the estuaries

5 Only when the WCA's are below their respective schedules

DRAFT

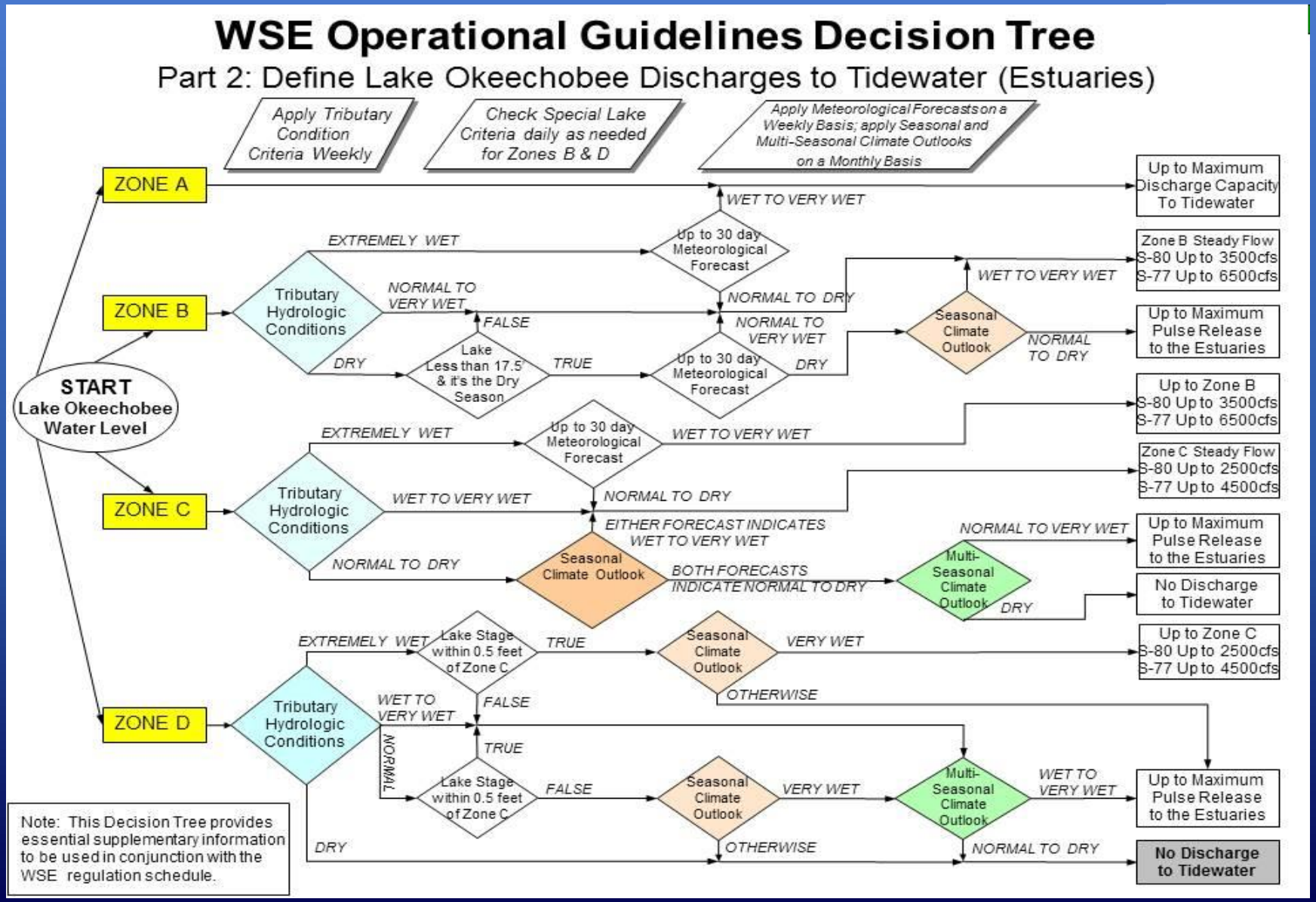
CENTRAL AND SOUTHERN FLORIDA

REGULATION SCHEDULE
LAKE OKEECHOBEE

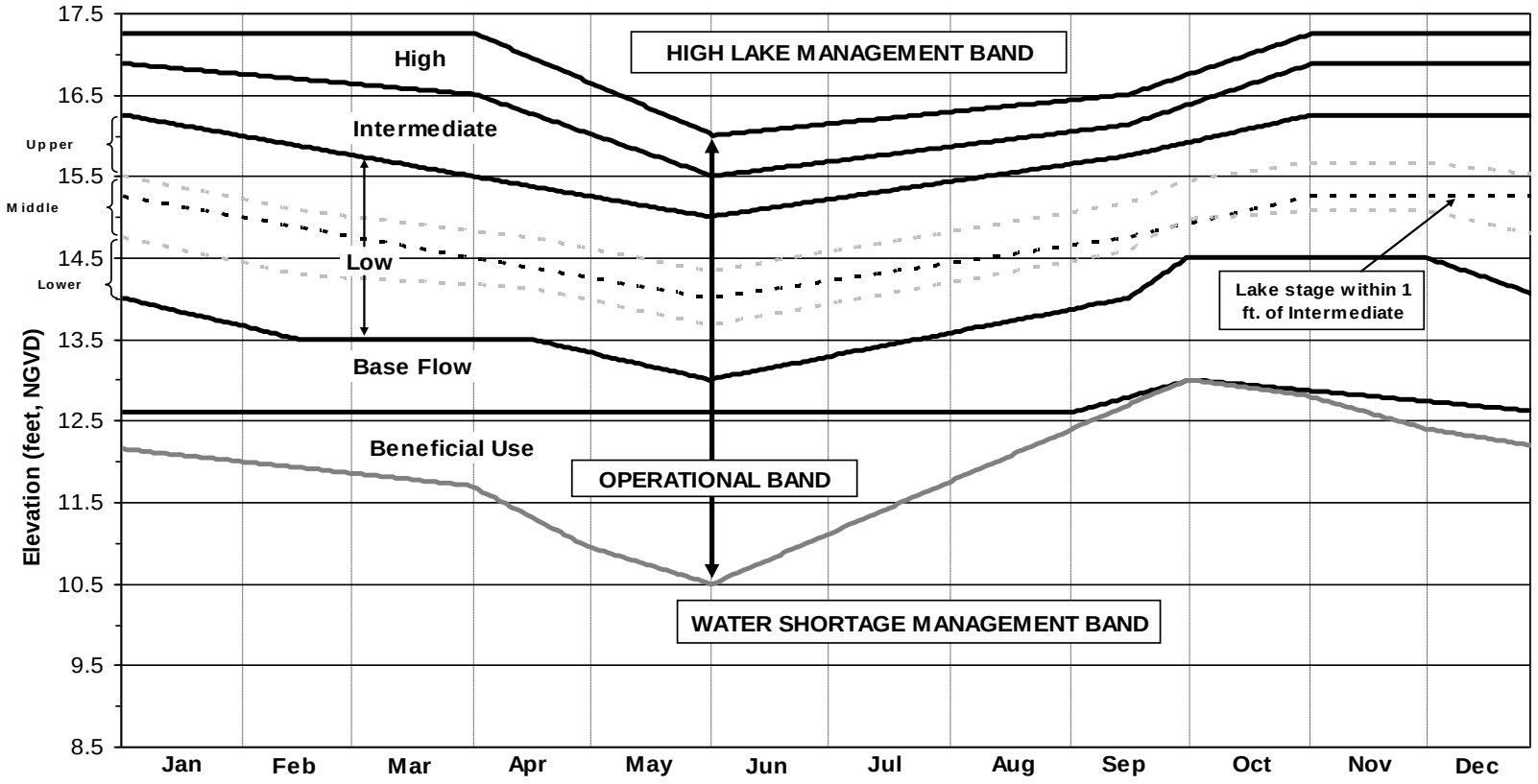
US ARMY ENGINEER DISTRICT
JACKSONVILLE, FLORIDA

05 November 1999

The WSE incorporated a Decision Tree to formally add climate and hydrologic conditions to the determine the releases from the Lake



A dramatic new schedule was adopted in 2008 because of concern for the structural integrity of the Herbert Hoover Dike. It lowers the Lake levels and adds a new Base Flow Zone for environmental releases to the estuary



NOTES:

High Lake Management Band: Outlet canals may be maintained above their optimum water management elevations.

Operational Band: Outlet canals should be maintained within their optimum water management elevations.

Water Shortage Management Band: Outlet canals may be maintained below optimum water management elevations.

CENTRAL AND SOUTHERN FLORIDA PROJECT

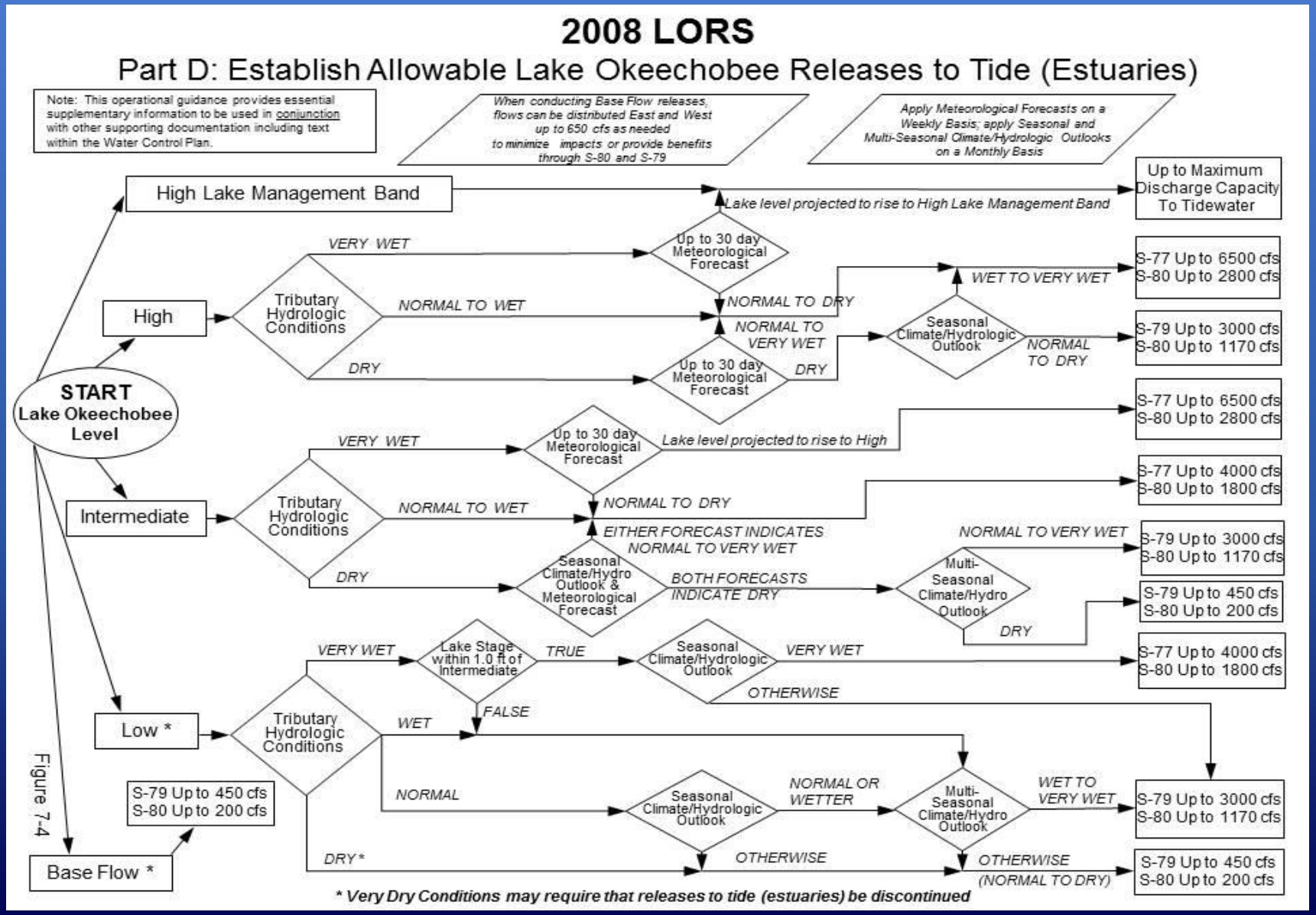
2008 LAKE OKEECHOBEE
INTERIM REGULATION SCHEDULE

PART B

DATED: March 2008
DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT
CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA

Figure 7-2

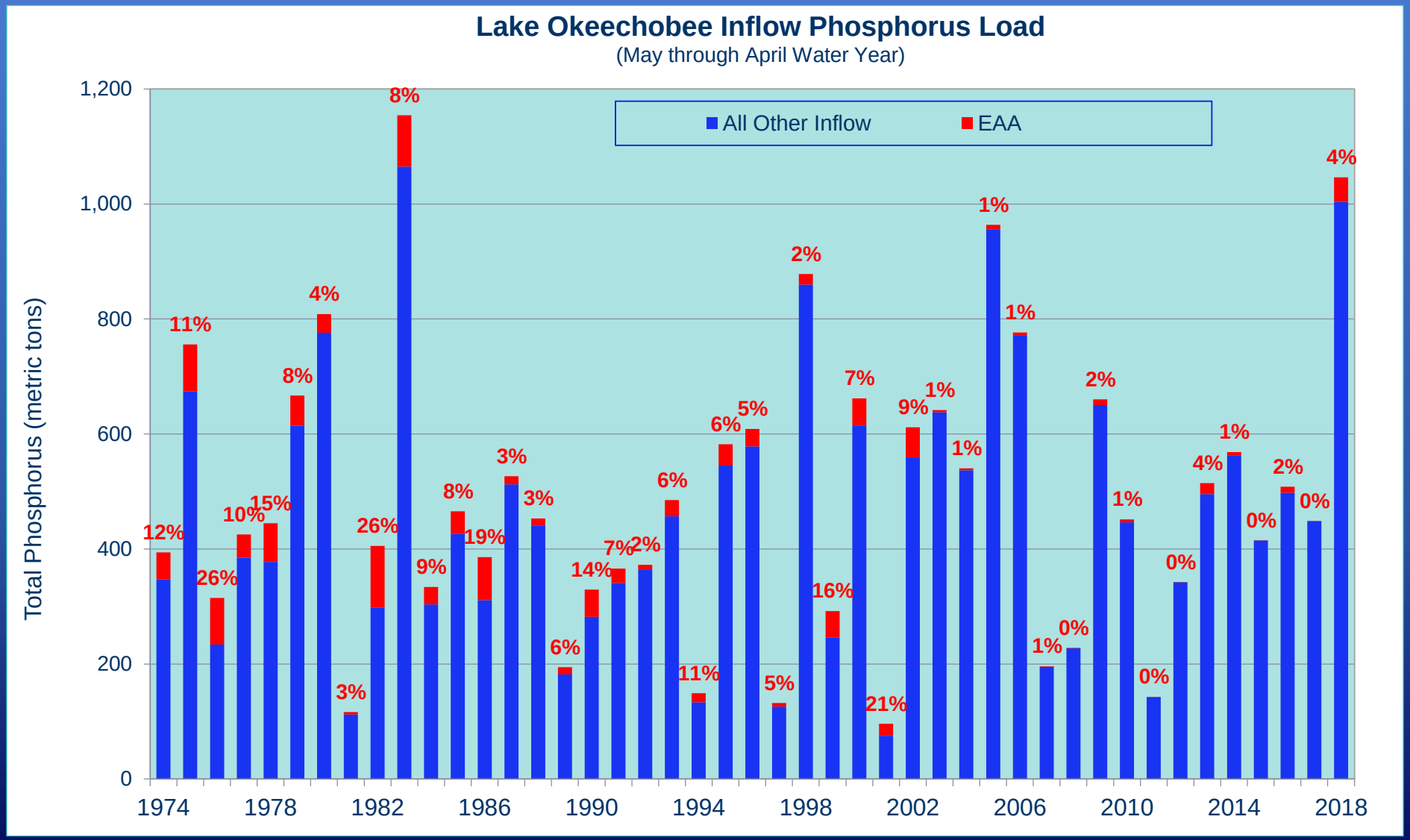
The 2008 schedule employs a similar Decision Tree logic as WSE



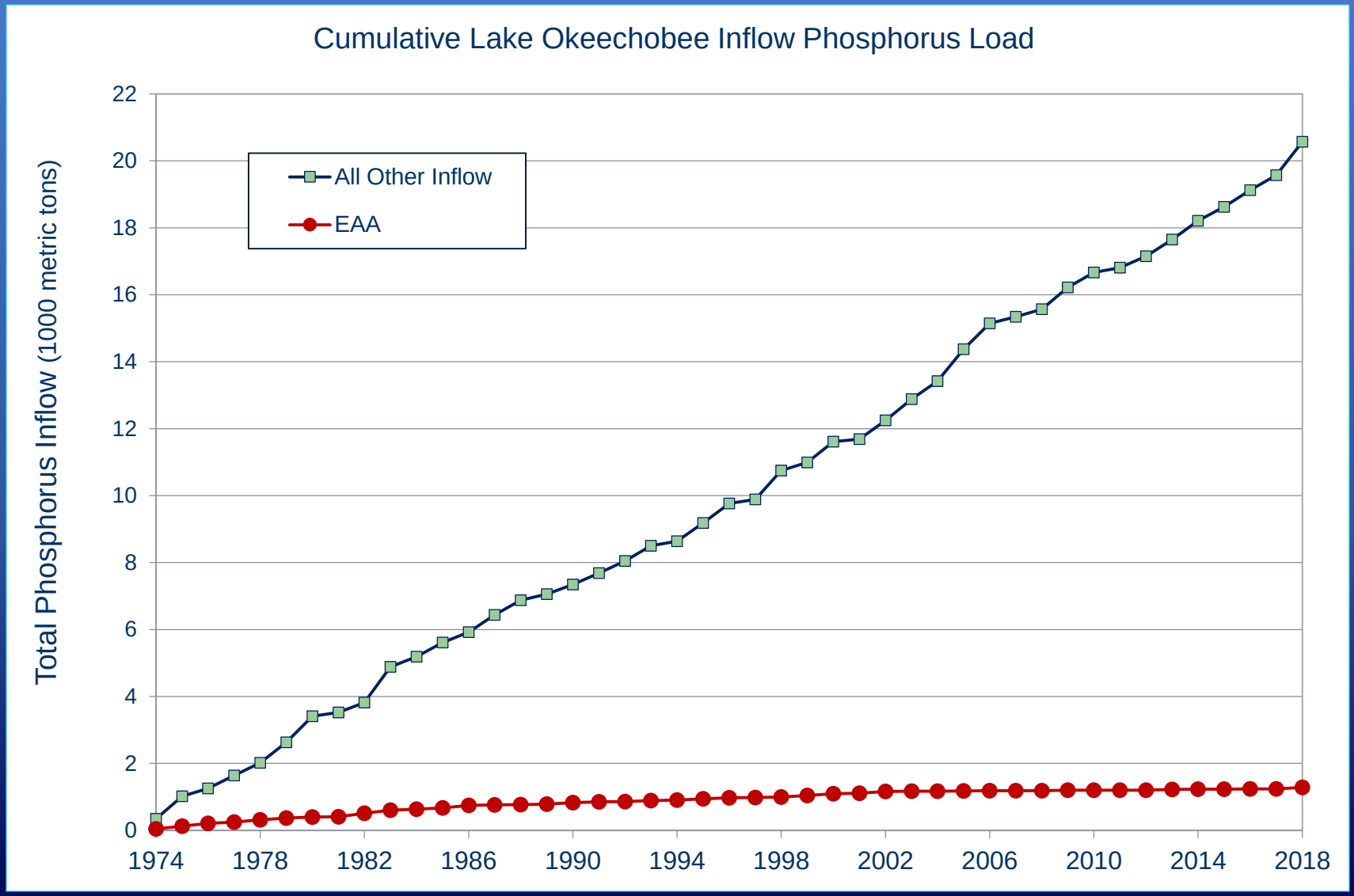
Temporary Forward Pumps

- Lake Outlets designed for gravity flow into primary canals
- Most farm inflow is through simple culverts from primary canals
- At Lake stages below 10.0 gravity is not sufficient

The EAA is a Minor Factor in Phosphorus Inflow to Lake Okeechobee

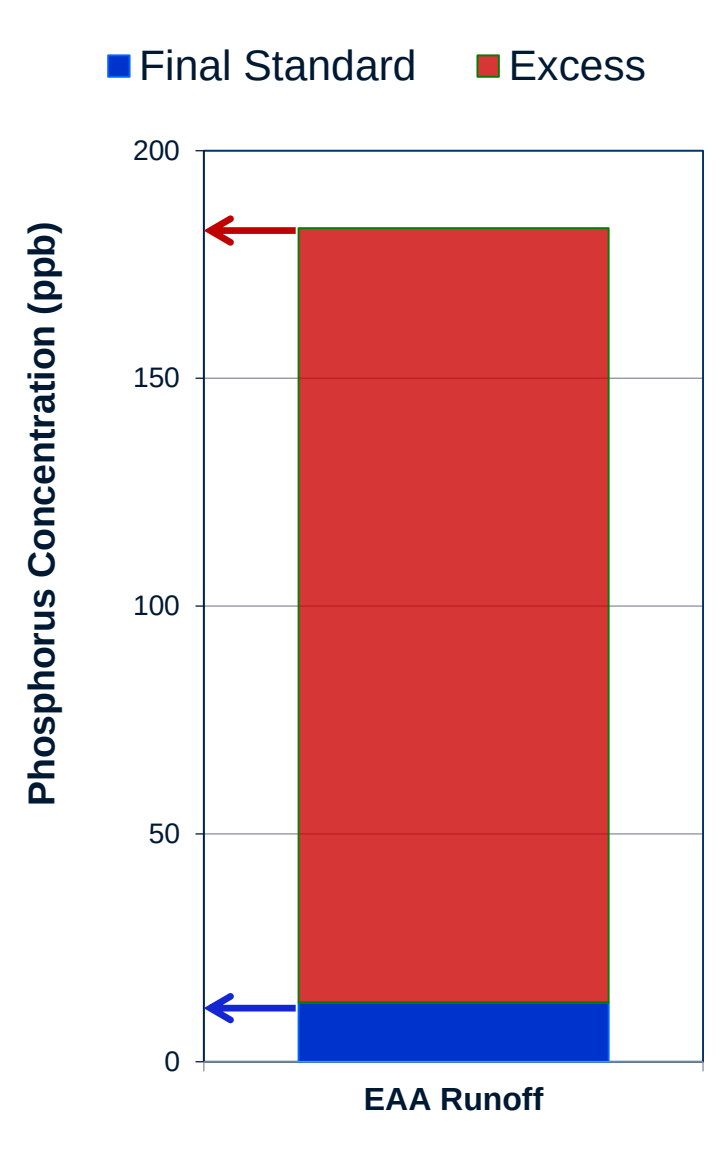


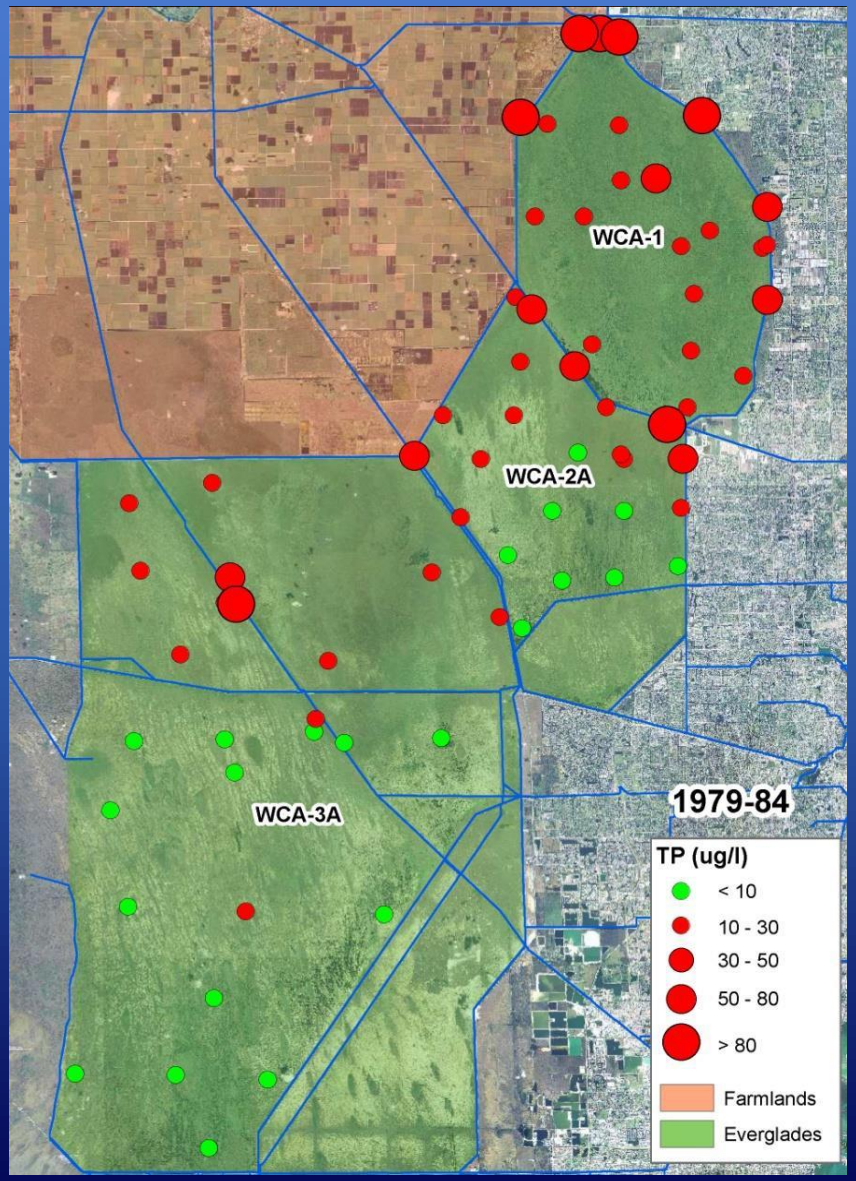
The EAA has Contributed 6% of the Phosphorus Inflow to the Lake Since 1974



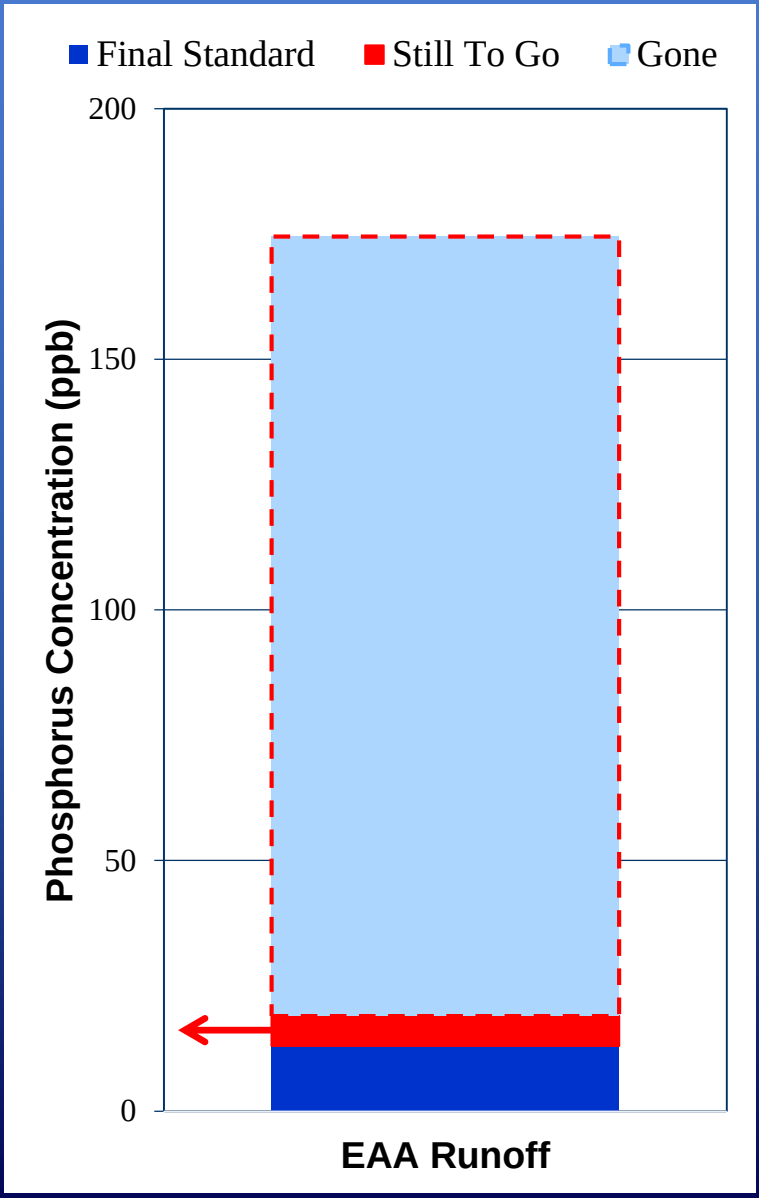
The Phosphorus Standard Must Be Met (1988 Litigation)

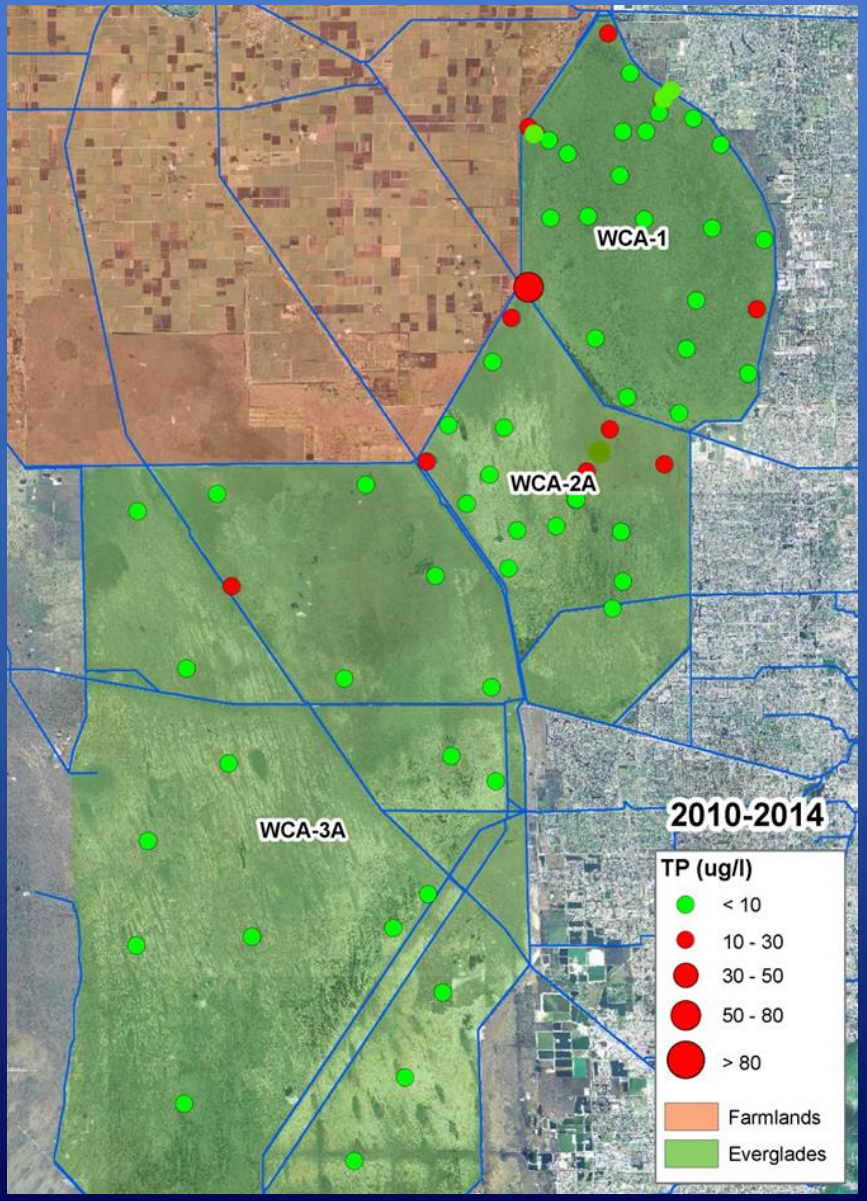
The situation before the Everglades Forever Act (1994)



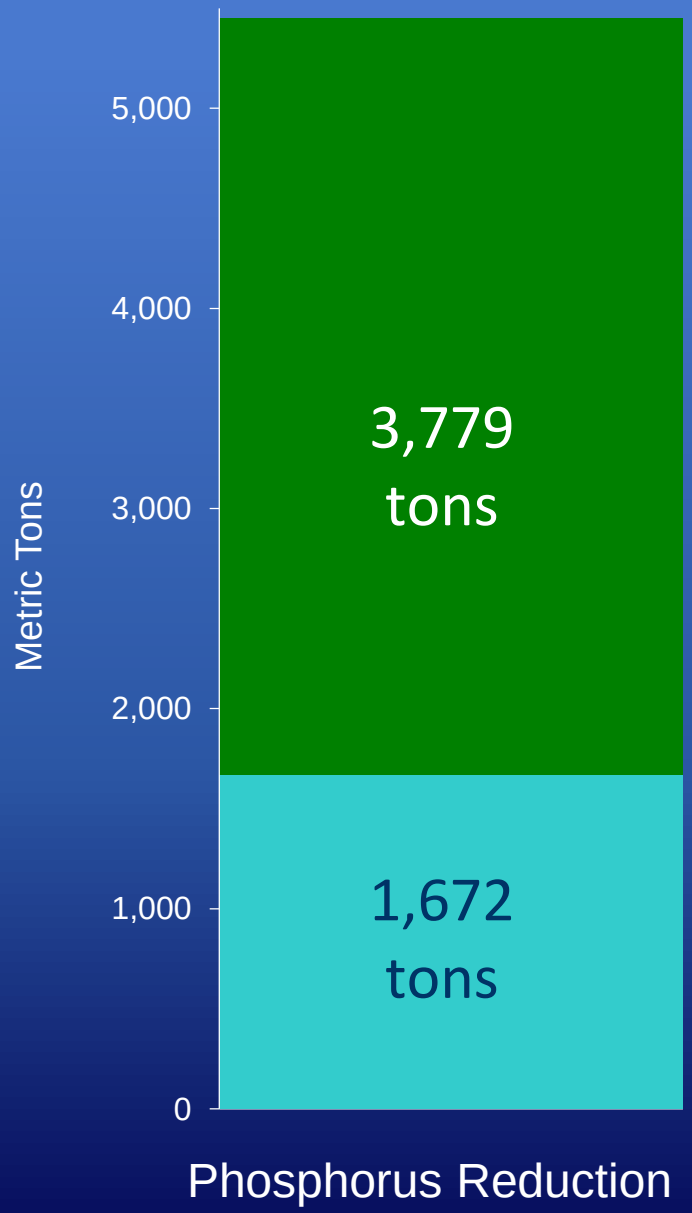


Where Are We Now?





Phosphorus Prevented from Entering the Everglades Since the Everglades Forever Act in 1996



Amount removed by Agricultural Best Management Program, Paid for and Implemented 100% by Farmers

Amount Removed to Achieve Restoration Water Quality Targets through Stormwater Treatment Areas, paid for jointly by Farmers and SFWMD

Note: All data from South Florida Water Management District

The Farmer's Perspective

- We want a healthy Lake
- We want clean water for the Everglades… and we pay for it
- We hate it when Lake flood releases hurt the estuaries
- We are a significant part of the social and economic fabric of south Florida, and have been for generations
- We love what we do!!

Thank you