SOUTH FLORIDA WATER MANAGEMENT DISTRICT

# Florida's Everglades Forever Act: Initial Steps Towards Restoration


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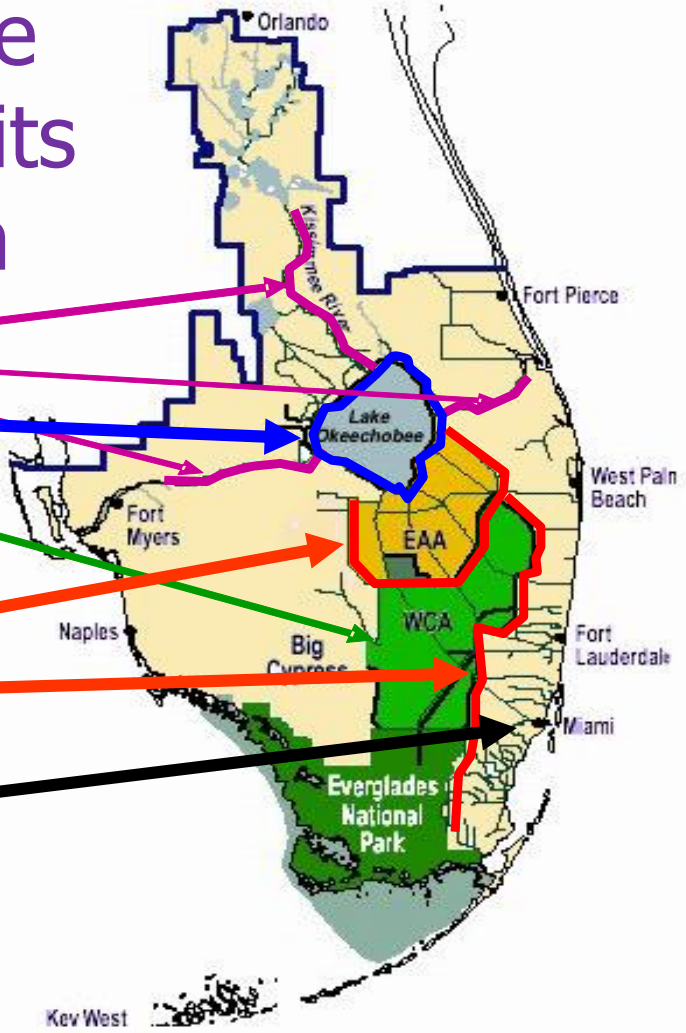
# Water Quality – A Regional Problem

## Water Quality is a challenge throughout the region with its highly modified ecosystem

- River Channelization
- Herbert Hoover Dike
- Water Conservation Areas
- Protective Levees
  - *Everglades Agricultural Area*
  - *Lower East Coast*
- Drainage Network
  - *Salinity Structures*



# Water Quality Restoration Strategies

## Everglades Forever Act

**Stormwater Projects**
**Sub-Regional and Regional**

**Source Controls**

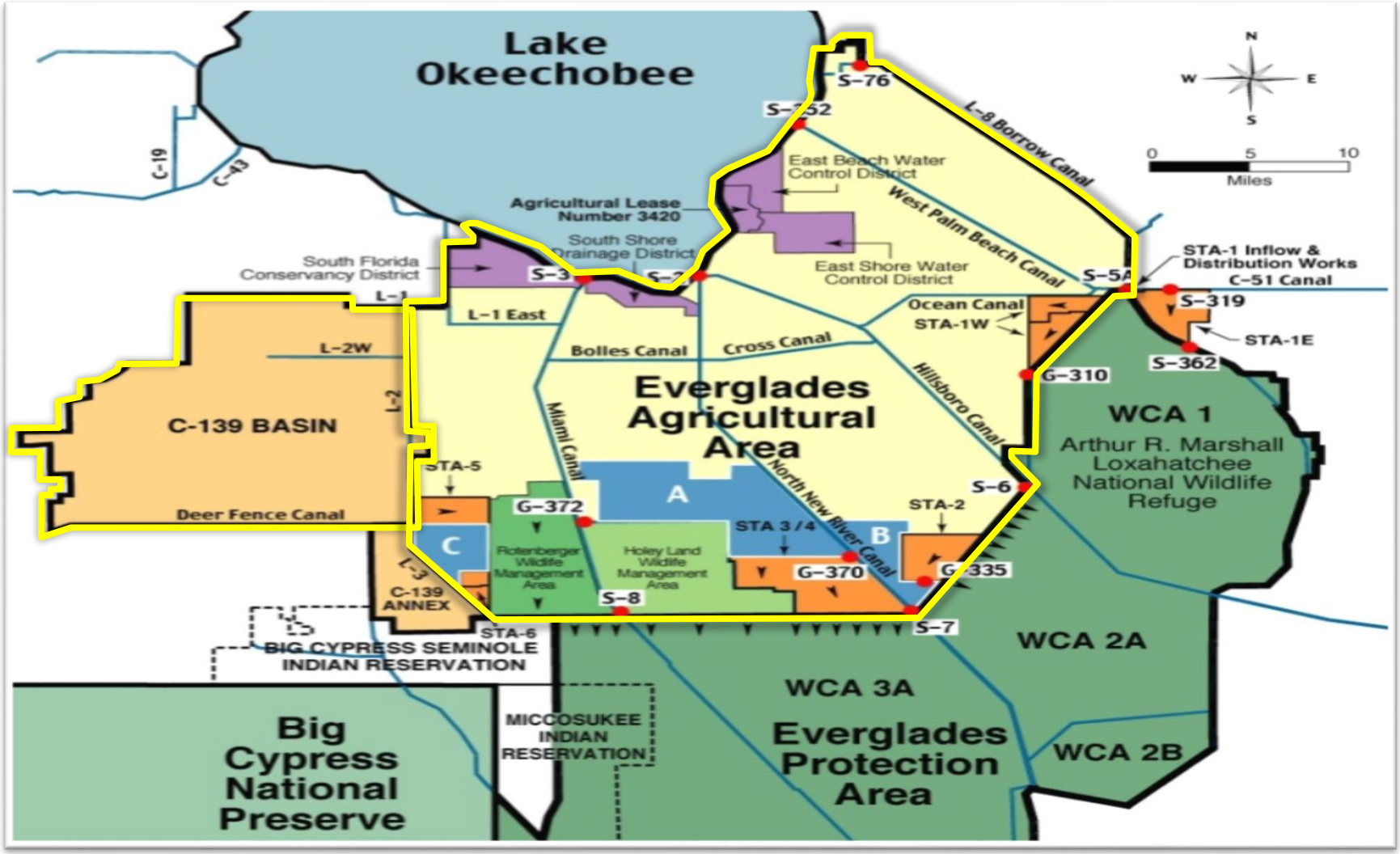
**Ecosystem Restoration**

# Everglades Forever Act

## Everglades Forever Act (EFA) 1994 – a framework for funding and regulation

- **Achieve: Water quality standards by 12/31/06**
- **Employ: Phosphorus Source Controls and Stormwater Treatment Areas**
- **Plan: Diversion and hydropattern restoration**
- **Conduct: Research for Water Quality Programs**
  - *Basin-specific feasibility studies*
  - *Phosphorus criterion research*
  - *Advanced treatment technology investigations*

# Everglades Agricultural Area (EAA)



# Everglades Regulatory Program
## - Source Controls -

- **Best Management Practices (BMPs) Ch.4 SFER**
  - *Fertilizer, water and pasture management practices*
  - *Sediment Controls and BMP research*
  - *BMP Program is now District-wide and linked to multiple mandates*
- **Everglades Agricultural Area BMP Regulatory Program – a good example of P source control**
  - *Goal: Reduce P load by 25% at the EAA basin level with BMPs on all farms in permitted areas*
  - *Achieved: 18 years of farm BMPs with an average 55% load reduction, farm BMPs and loads are tracked*
  - *Success: Great performance and example of a program structure that works well: performance relative to baseline period*

# Everglades Regulatory BMP Program

- **Comprehensive Best Management Practice (BMP) Plans**
- Fully implemented in1996,EAA: 2007, C-139
- **Field and records verification**
- **Research and demonstration projects**
- **Water quality monitoring**
- **Performance metrics**:
  - EAA: 25% TP load reduction
  - C-139: Maintain historic TP load

# Current versus Base Period Comparison

- **10-year pre-BMP base period used to assess performance – a good idea for source controls**
- **Data are adjusted for differences in rainfall timing and distribution**
  - **Rainfall adjustment allows for "apples to apples" comparison between years**
- **Basin compliance is determined by comparing a current year's actual P load with the load estimated from the rainfall adjusted base period**
  - **Empirical model predicts 'expected' load for a particular year based on rainfall, less 25% is the annual target**
  - **Compare actual load with predicted for % reduction**

# 2012 EAA Basin Phosphorus Results

## EAA Basin
## In Compliance

**Goal** → **25% reduction**

**Performance** → **71%**

Average 55% Load Reduction

Base Period discharge **217 mtons**

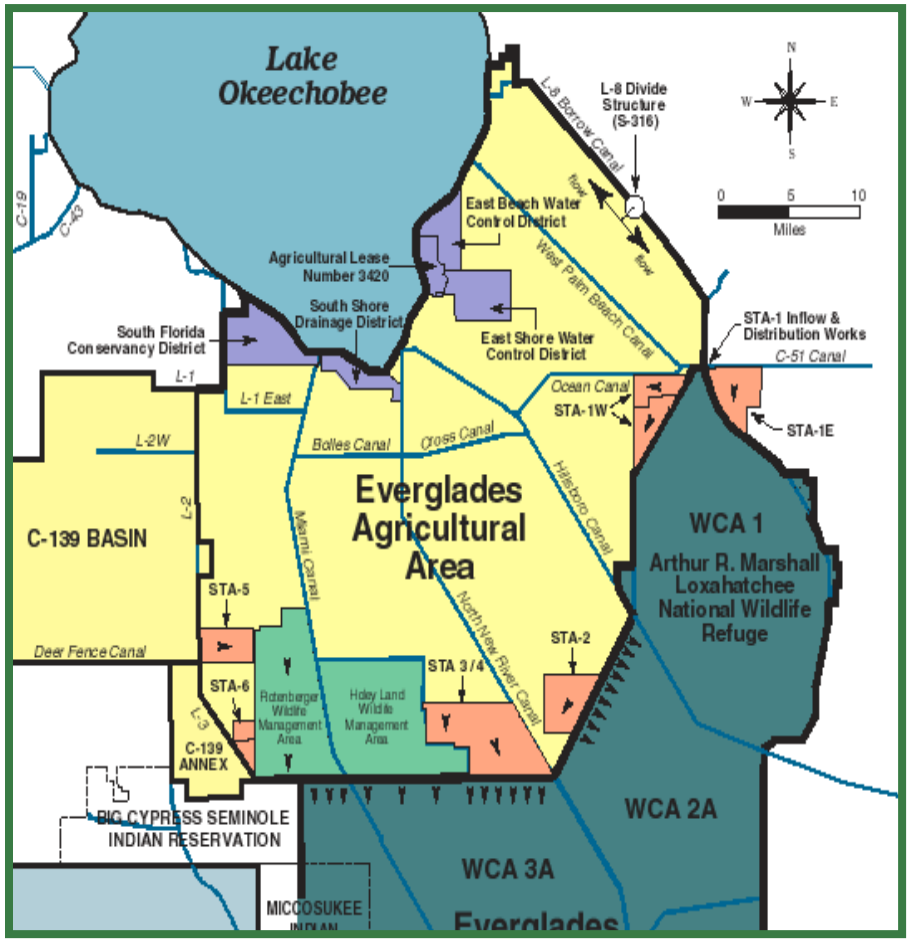
WY12 discharge **63 mtons**

BMPs have prevented 2,565 mtons of P from leaving the EAA

# Everglades Construction Project

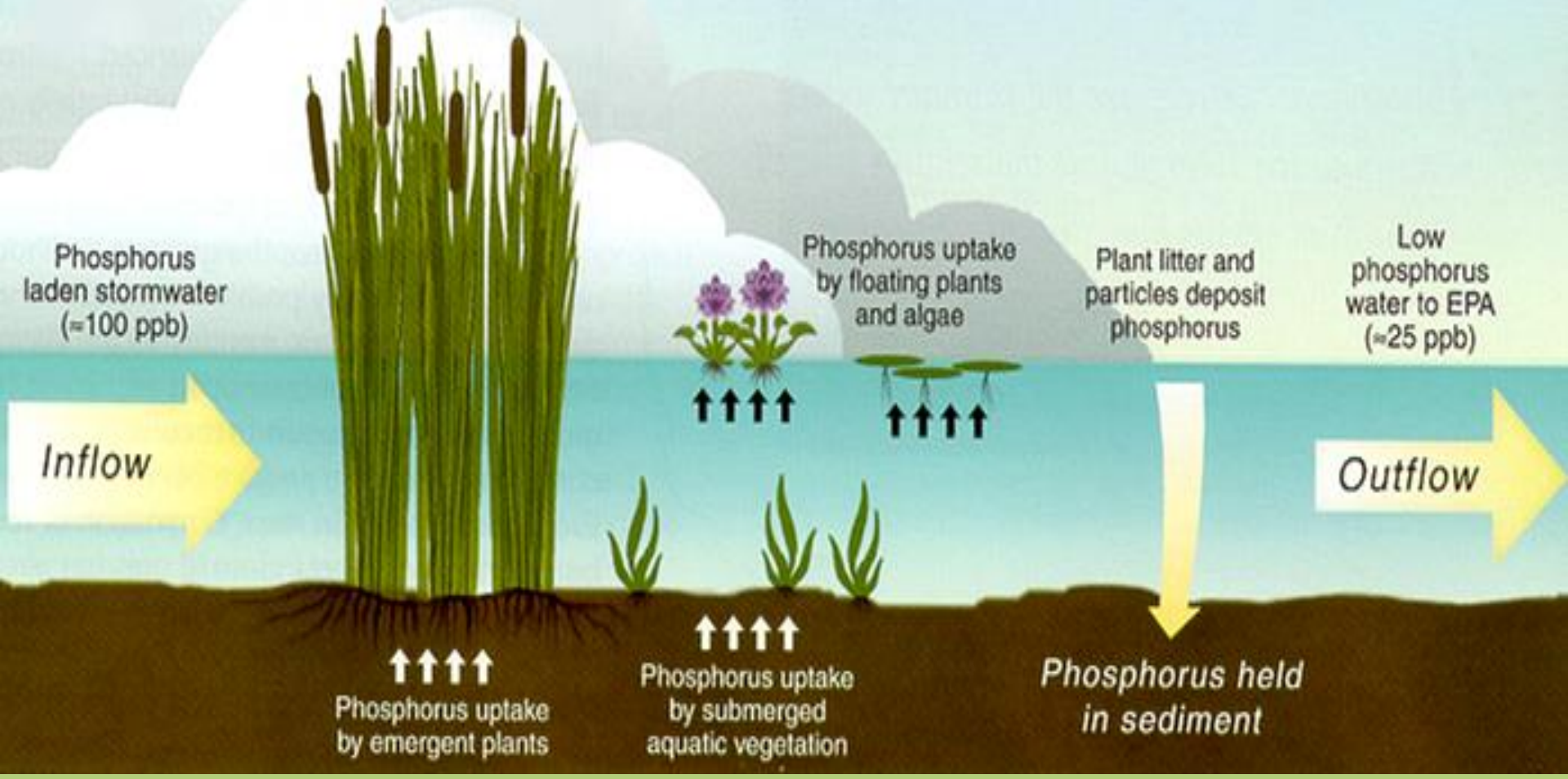
## Everglades Forever Act: Build Stormwater Treatment Areas

- **6 Stormwater Treatment Areas with multiple objectives**
- **Now, 21,000 hectares of constructed wetlands**
- **Treat 75% of the water entering the Everglades**
- **Chapter 5 of the South Florida Environmental Report provides information**



# Stormwater Treatment Areas

**STAs are constructed wetlands that remove and store nutrients through plant growth and the accumulation of dead plant material in a layer of peat.**



# STA Design Criteria

- **Open water constructed wetlands**
  - **40 cm water depth target**
- **Water control using treatment cells**
  - **Emergent Aquatic Vegetation (EAV)**
  - **Submerged Aquatic Vegetation (SAV)**
- **Hydraulic retention time: 10–20 days**
- **Expected P removal: 1.7 *g/m²/yr or >74%***
  - **Operate for 1 g or less for better treatment**

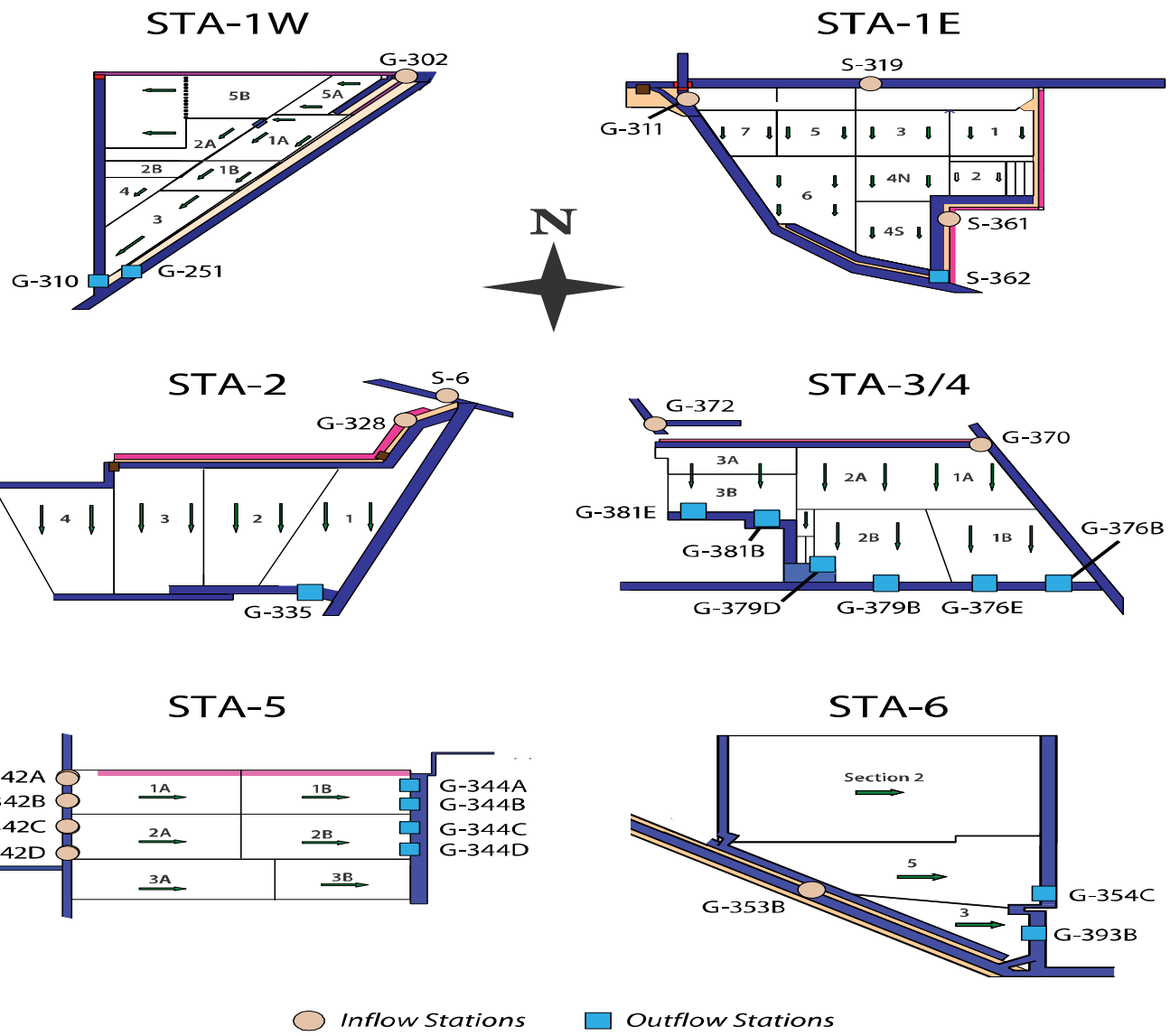
# Stormwater Treatment Areas

Emergent Vegetation

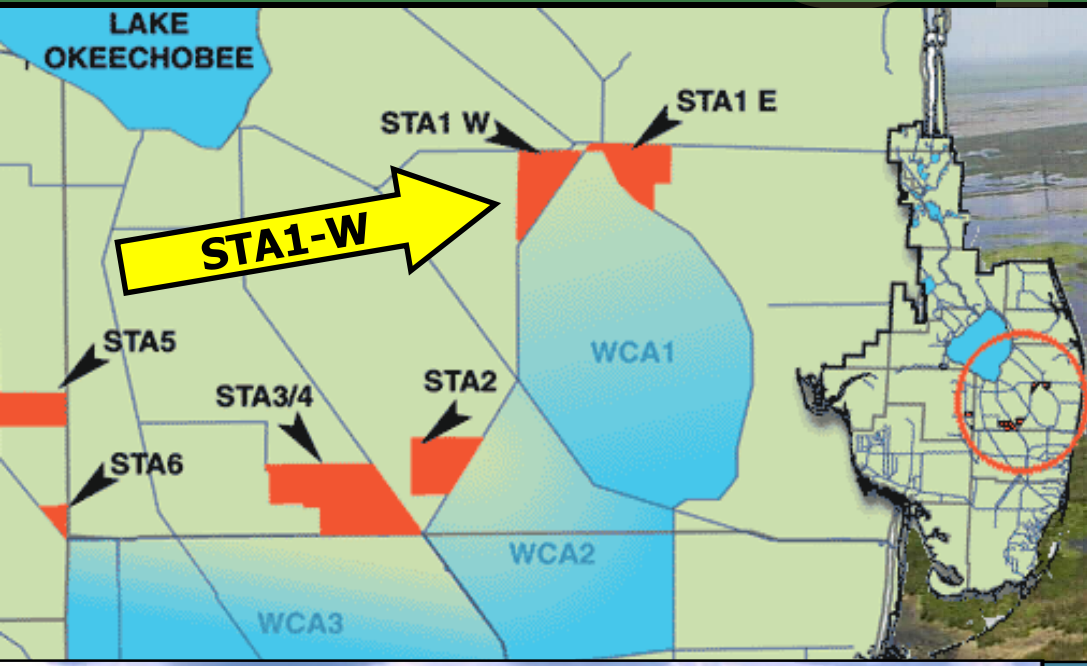
Submerged Aquatic Vegetation

Periphyton-based Stormwater Treatment Area (PSTA)

# Stormwater Treatment Areas



# Stormwater Treatment Areas




# Stormwater Treatment Area 1-W

# Stormwater Treatment Areas

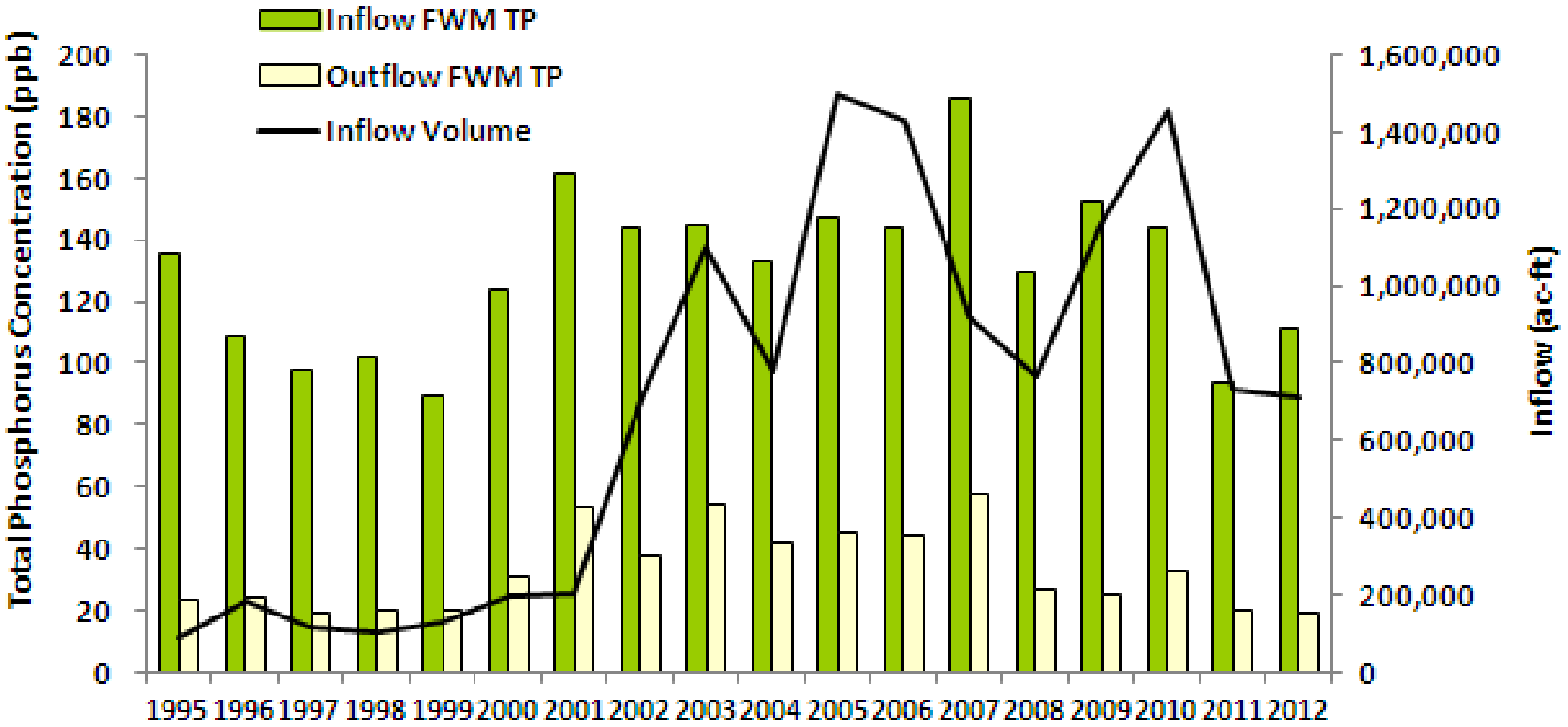
## Key Factors: Hydrology and Hydraulics

- Flow and velocity: Hydraulic loading rate
  - Routing must avoid short-circuiting and overloading
- Hydropattern: depth, period, frequency of inundation
  - Used to maintain biological assemblages (SAV, EAV)
- Phosphorus loading rate is also important
  - Overloading is possible and relation to outflow concentration is not linear at lower PLRs
- Data summaries on HLR and PLR in Chapter 5, SFER

# Stormwater Treatment Areas

## Period of Record

(Acre Foot = 1234 m3)



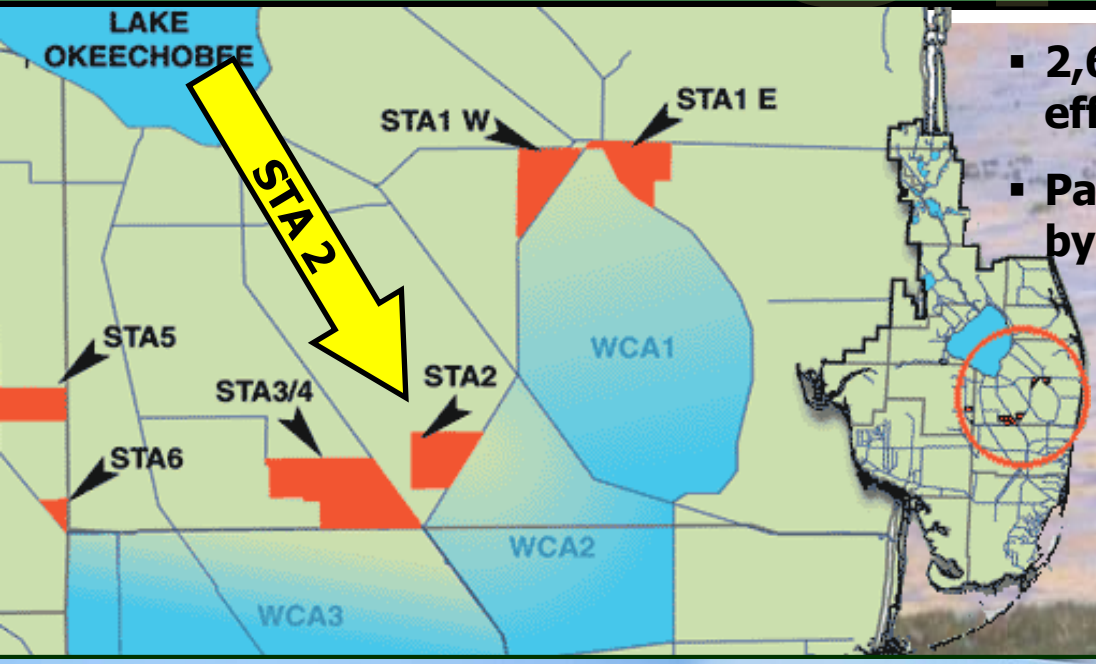
# Long-Term STA Performance

All STAs Combined, Period of Record 1994 – 2012

- Effective treatment area = 18,500 ha (45,000 ac)
- Inflow, flow-weighted mean TP = 111 ug/L
- Outflow, flow-weighted mean TP = 19 ug/L
- TP loading rate = 0.58 g /m2 / yr
- TP load reduction = 83 %
- TP load retained to date = 1,500 mt
- Average rainfall = 125 cm /yr

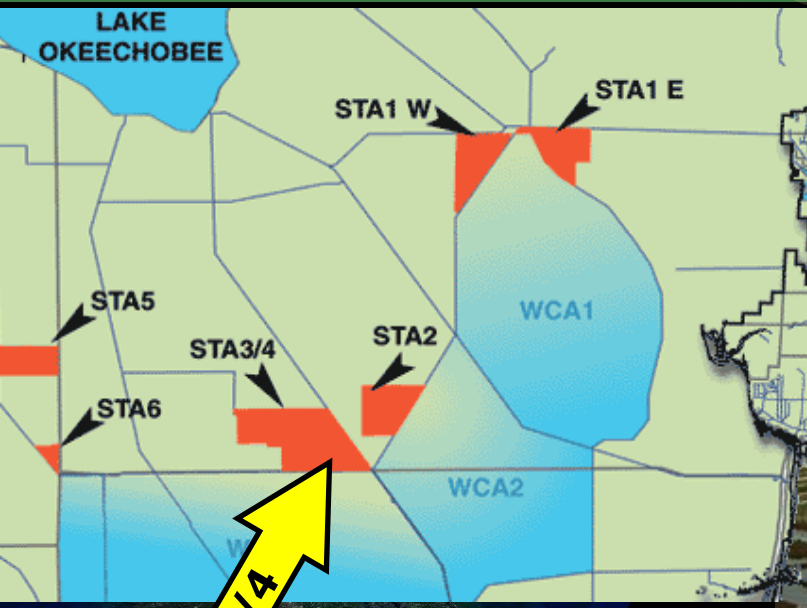
(2013 South Florida Environmental Report,
Vol III, Appendix 3-1)

# Stormwater Treatment Area 2




- 2,636 hectares (6,430 acres) of effective treatment area
- Parallel flow-ways: emergent followed by submerged aquatic vegetation

# Stormwater Treatment Area 3/4





- The world's largest constructed wetland
- 6,765 hectares (16,500 acres) of former agricultural land

# Stormwater Treatment Areas

**Treatment areas are susceptible to drought**

**Supplying water is a significant challenge and can compete with water supply for other uses**

# Stormwater Treatment Areas

Public Access – Bird Watching tours available in cooperation with multiple agencies.

- Over 200 species of birds have been recorded in the STAs.
- Bird densities are much higher than in natural marshes nearby.

Game hunting is permitted in some areas, including alligators and ducks.

Managing for migratory and endangered birds is a real operational challenge.

# Stormwater Treatment Areas

## Hurricane Impacts

**Submersed Aquatic Vegetation (SAV) uprooted and other biological components disturbed**

# Everglades Forever Act Programs

## Treatment Performance Has Exceeded Expectations

- The STAs have removed over 1,560 metric tons of phosphorus over the past decade
- Together, the Everglades Regulatory Program and the Stormwater Treatment Areas have prevented over 4,100 metric tons of phosphorus from entering the Everglades (1996 – 2012)
- Extensive cell by cell data has been used to develop a P cycling and retention model for the STAs, available at:
- http://www.wwwalker.net/dmsta1/
- Chapters 4 and 5 of the South Florida Environmental Report cover BMPs and STAs each year

# Stormwater Treatment Areas

**Despite success of BMPs and STAs, additional water quality improvements are being carried out to achieve compliance with phosphorus standard (10 ppb TP in the marsh).**

# The Long-Term Plan

## Goal: Achieve compliance with state water quality standards

- Plan works through adaptive implementation of new information and technologies
- Extensive peer review and public input
- Classic example of adaptive management

# Components of the Plan

Specific plans to improve each STA through continuous management actions and design modifications

Plans to conduct studies to improve all STAs with information from a new Restoration Strategies Science Plan

**Criticisms:** Implementation is too slow, concentrations are too high and too many uncertainties remain

**Counter Criticism:** There is no workable alternative to reach low phosphorus concentrations in huge quantities of stormwater using biological systems (1.4 million acre-feet, >100 billion cubic meters of water per year): adaptive management is critical

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## Questions for Mr. Bronson or Prof. Rizzardi?

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