

# Lake Okeechobee Protection Plan and River Watershed Protection Plan Updates

Water Resources Advisory Commission Meeting  
July 8, 2010

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Everglades Restoration and Capital Projects, SFWMD*

# Presentation Outline



- Lake Okeechobee Protection Plan (LOPP)
  - Document Structure
  - Sections 1 (Introduction)
  - Section 2 (Overview of Lake Okeechobee Protection Programs)
  - Section 3 (Current Status of the Lake)
- River Watershed Protection Plans
  - Pollutant Control Program
  - Construction Project
  - Research and Water Quality (WQ) Monitoring Program

# Document Structure



- Section 1: Introduction
- Section 2: Overview of Lake Okeechobee Watershed Protection Programs
- Section 3: Current Status of the Lake
- Section 4: Watershed Challenges
- Section 5: Past and Current Activities
- Section 6: Strategies for Moving Forward

# Section 1: Introduction



- 1.1 Purpose of Document
- 1.2 Legislative Mandate
- 1.3 Description of the Watershed
- 1.4 Land Use
- 1.5 Lake Okeechobee Sub-Watersheds

## Section 2: Overview of Lake Okeechobee Protection Programs



- 2.1 Lake Okeechobee Protection Plan
- 2.2 Watershed Construction Plan (Phases I & II)
- 2.3 Overview of Lake Okeechobee Watershed Phosphorus (P) Control Programs
  - 2.3.1 FDACS Agricultural Program
  - 2.3.2 FDEP Agricultural Program
  - 2.3.3 FDEP Non-Agricultural Program
  - 2.3.4 SFWMD Source Control Programs
- 2.4 Research and Water Quality Monitoring Programs
- 2.5 Internal P Management Program
- 2.6 Exotic Species Control Program

## Section 3: Current Status of the Lake



### 3.1 Ecological Status

Water levels, littoral zone vegetation, benthic invertebrates, fish communities, control of exotic vegetation

### 3.2 Water Quality Trends

3.2.1 Lake Phosphorus Reduction goals

3.2.2 Tributary P Loading Trends

3.2.3 In-Lake P Loading Trends

3.2.4 Internal P Loading Trends

3.2.5 Lake Discharge Trends

### 3.3 Internal Phosphorus Management Program

## Section 4: Watershed Challenges



- 4.1 The Challenge of Legacy Phosphorus
- 4.2 Annual Phosphorus Imports
- 4.3 In-Lake Phosphorus Loading
- 4.4 Stormwater Treatment Areas in Northern Everglades
- 4.5 CERP Lake Okeechobee Watershed Projects
- 4.6 Funding Constraints

## Section 5: Past & Current Activities



### 5.1 Watershed Phosphorus Control Program

#### 5.1.1 Overview of Watershed P Source Programs

#### 5.1.2 Joint Phosphorus Source Control Programs

- Northern Everglades ERP Basins Rule
- FDEP State-wide Stormwater Rule

#### 5.1.3 SFWMD Source Control Programs

- Lake Okeechobee Watershed Regulatory P Source Control Program
- Ongoing P Control and Management Projects

## Section 5: Past & Current Activities (Cont.)



### 5.1.4 FDACS BMP Program

- Source Control Implementation
- Urban Turf Fertilization Rule

### 5.1.5 FDEP Source Control Programs

- FDEP Agricultural Regulatory Programs
  - Dairy Rule/Concentrated Animal Feeding Operations
  - Bio-solids/Domestic Wastewater Residuals Rule
- FDEP Non-Agricultural Programs

### 5.1.6 FDOH Source Control Programs

- FDOH Septage Applications

## Section 5: Past & Current Activities (Cont.)



### 5.2 Lake Okeechobee Construction Project – Phase II Technical Plan

#### 5.2.1 Status of Ongoing Project Features

- Stormwater Treatment Projects
- Dispersed Water Management & Treatment Projects
- Aquifer Storage and Recovery (ASR) Projects

#### 5.2.2 Development of Sub-watershed Plans

- Fisheating Creek Feasibility Study
- Taylor Creek Feasibility Study

## Section 5: Past & Current Activities (Cont.)



### **5.3 Research & Water Quality Monitoring Programs**

5.3.1 Watershed and In-Lake Monitoring

5.3.2 Modeling Refinements

### **5.4 Lake Okeechobee Exotic Species Control Program**

### **5.5 Lake Okeechobee Internal P Management Program**

### **5.6 Other Related Activities**

## Section 6: Strategies for Moving Forward



### **6.1 Action Plan for Control of P Imports, Legacy P and Reducing In-Lake P Loading**

6.1.1 Phosphorus Source Controls and Import Controls

6.1.2 Strategies to Minimize Mobilization of Legacy P

6.1.3 In-Lake P Management Study

### **6.2 Strategic Projects and Promising Technologies**

6.2.1 Regional Projects and Promising Technologies

6.2.2 Dispersed Water Management & Treatment Projects

6.2.3 Chemical Treatment & Hybrid Wetland Treatment Technologies

6.2.4 Sub-watershed Conceptual Plans

6.2.5 Research Projects

6.2.6 River of Grass Planning Initiatives

## Section 6: Strategies for Moving Forward (Cont.)



### **6.3 Action Plan Schedule & Funding**

6.3.1 Proposed Water Storage Projects

6.3.2 Proposed Water Quality Improvement Projects

6.3.3 Plan Schedule

6.3.4 Budget and Funding Requirements

# SECTION 1: INTRODUCTION

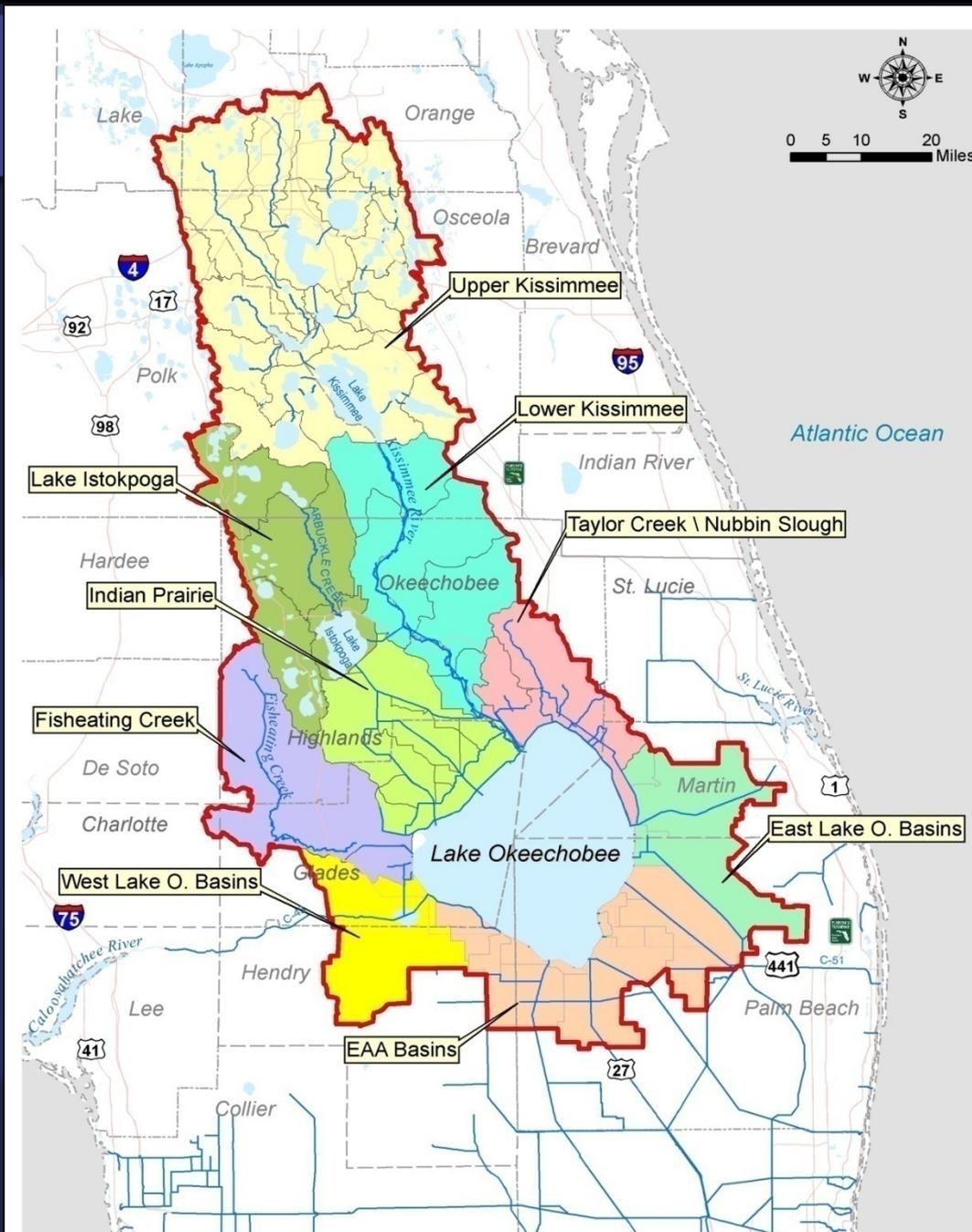
# Legislative Requirements



- In 2000, the Legislature passed the Lake Okeechobee Protection Act (LOPA) to reduce phosphorus inflows into the Lake through a comprehensive, phased program linked to meeting the TMDL target by 2015.
- The coordinating agencies submitted the initial **Lake Okeechobee Protection Plan (LOPP)** to the Legislature in 2004. **LOPA requires the plan to be updated every three years.**
- In 2007, the Legislature expanded LOPA to also include protection of the Caloosahatchee and St. Lucie watersheds and estuaries (Northern Everglades and Estuaries Protection Program).
- This update covers the three-year period since submission of the Lake Okeechobee Watershed Construction Project Phase II Technical Plan to the Legislature in 2008. **The LOPP Update will be submitted to the Legislature in early 2011.**

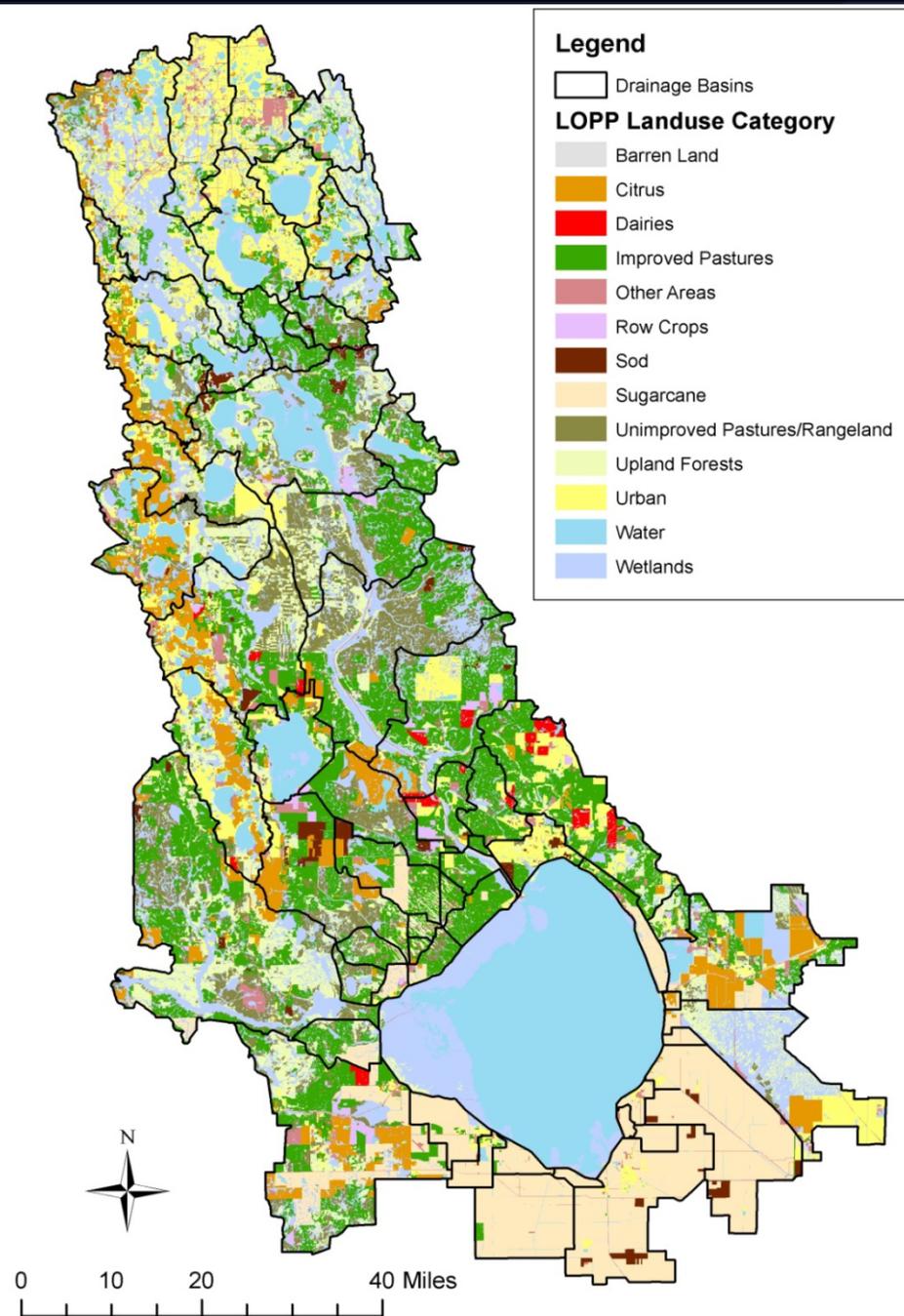
# Watershed Description

- The LOPP area, includes 61 drainage basins, spanning 10 Florida counties with a drainage area of over 5,400 square miles
- The LOPP includes nine sub-watersheds



## Land Use (2006)

- Land use dominated by agriculture
- Major land uses include:
  - Improved pasture: 19.7%
  - Wetlands: 17.9 %
  - Urban: 11.9%
  - Sugarcane: 11.6%
  - Upland Forests: 11.4%
  - Unimproved pasture/rangeland: 9.4%
  - Citrus: 7.1%
- Major land use in northern watershed is pasture, while sugarcane production dominates south of Lake Okeechobee



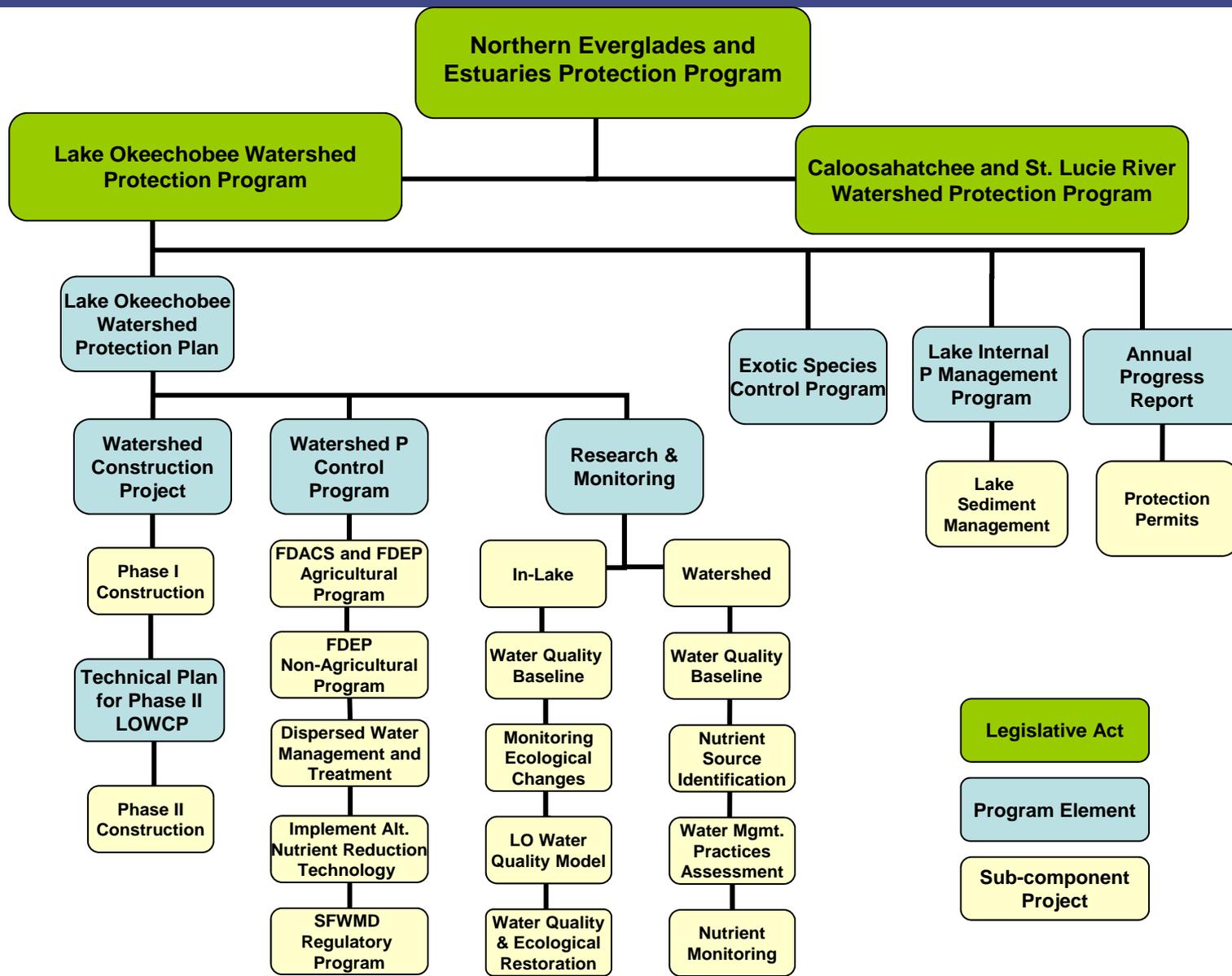
SECTION 2: OVERVIEW OF LAKE  
OKEECHOBEE PROTECTION  
PROGRAMS

## Section 2: Overview of Lake Okeechobee Protection Programs



- Program includes seven key elements:
  - Lake Okeechobee Protection Plan
  - Watershed Construction Project
  - Watershed Phosphorus Control Program
  - Research and Water Quality Monitoring Program
  - Exotic Species Control Program
  - Lake Internal Phosphorus Management Program
  - Progress Reports published annually in the South Florida Environmental Report

# Northern Everglades and Estuaries Protection Program



SECTION 3:  
CURRENT STATUS OF THE LAKE

# Current Status of Lake

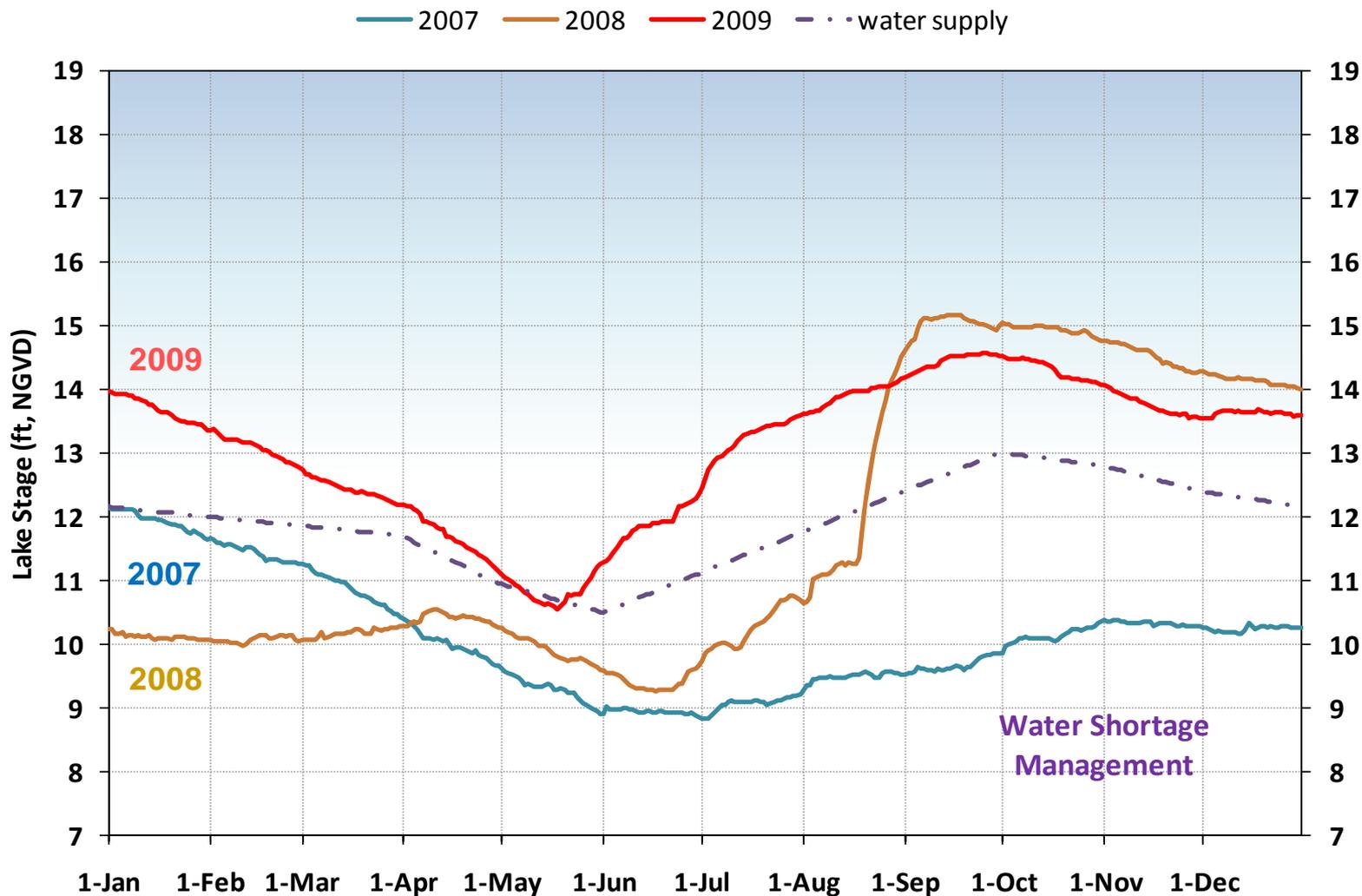


- Ecological conditions within Lake Okeechobee have improved since the 2007 update:
  - Lake levels are close to near average levels
  - Near-shore water clarity and P concentrations have improved relative to post-2004 hurricane conditions
  - No major algal bloom events reported; emergent and submerged vegetation have re-established and are comparable to pre-hurricane levels
  - Initial recovery of benthic invertebrates and forage fish populations
  - Current Lake levels and recovery of littoral zone vegetation have improved sport fish (Largemouth Bass) populations

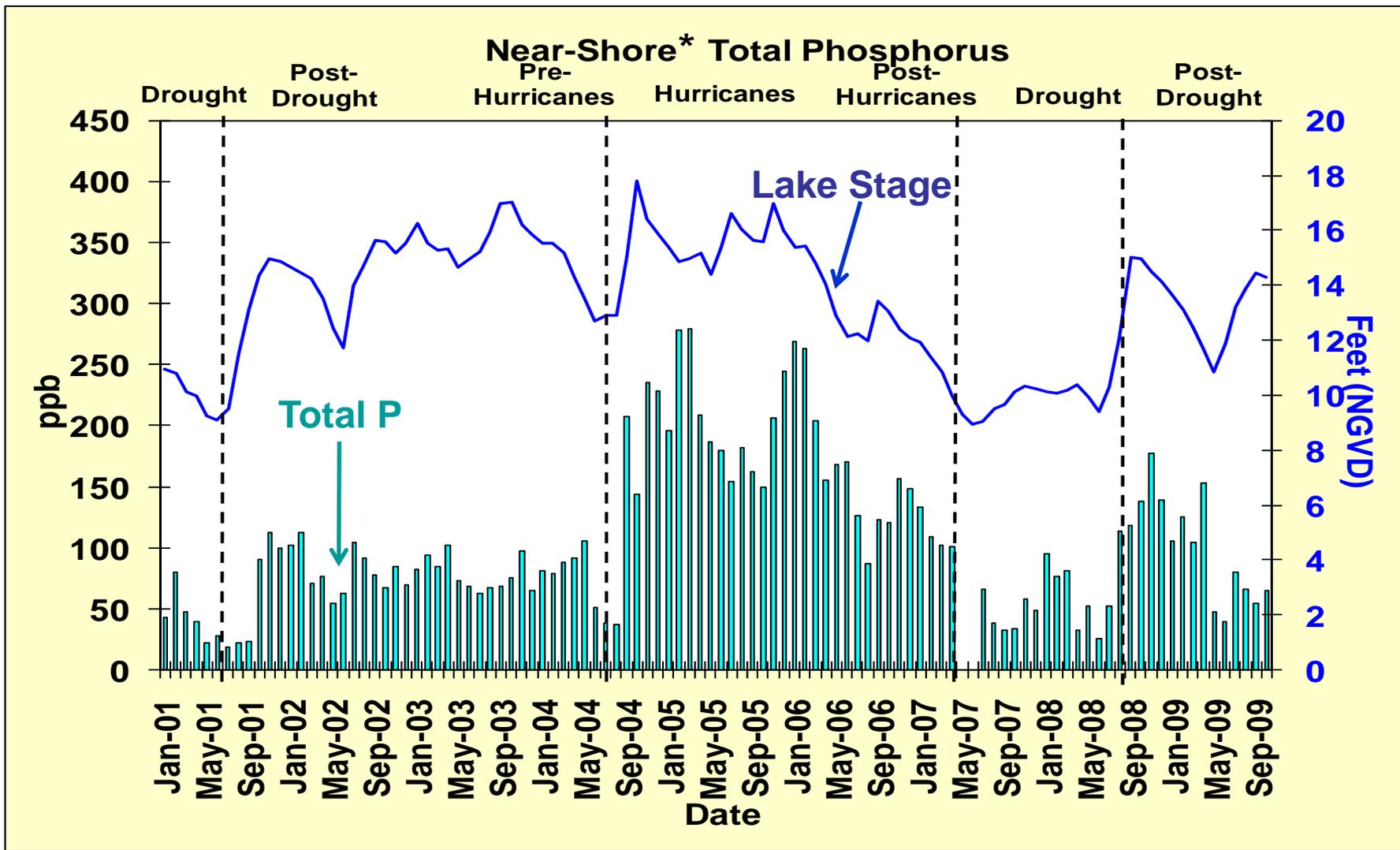
# Lake Water Levels



## Lake Okeechobee Stage



# Lake Stage vs. Near-Shore Total Phosphorus

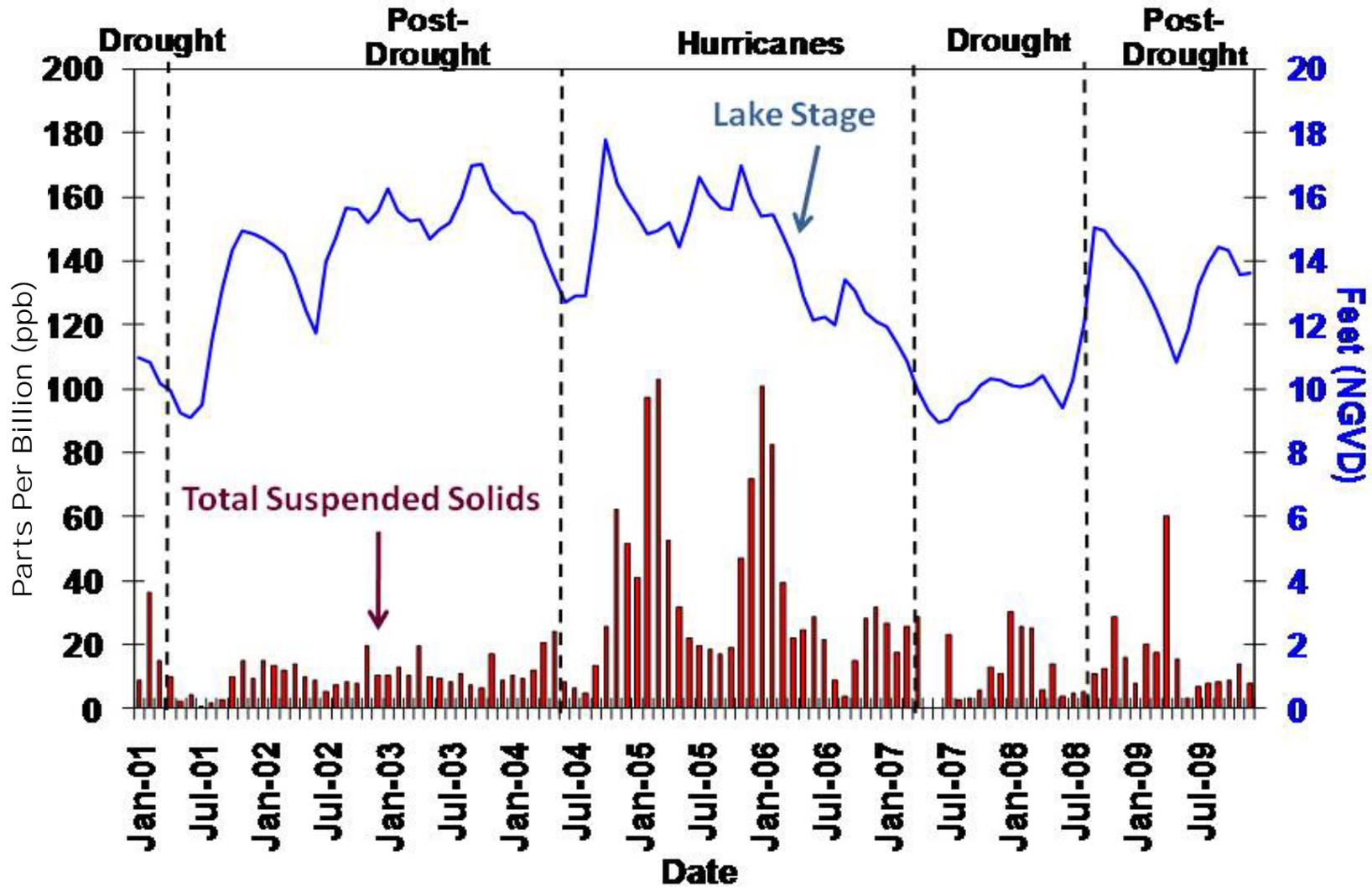


\* The Near-shore area is located between open water and the littoral marsh where SAV is dominant. The area is typically wet down to around 12 to 11 feet stage (NGVD)

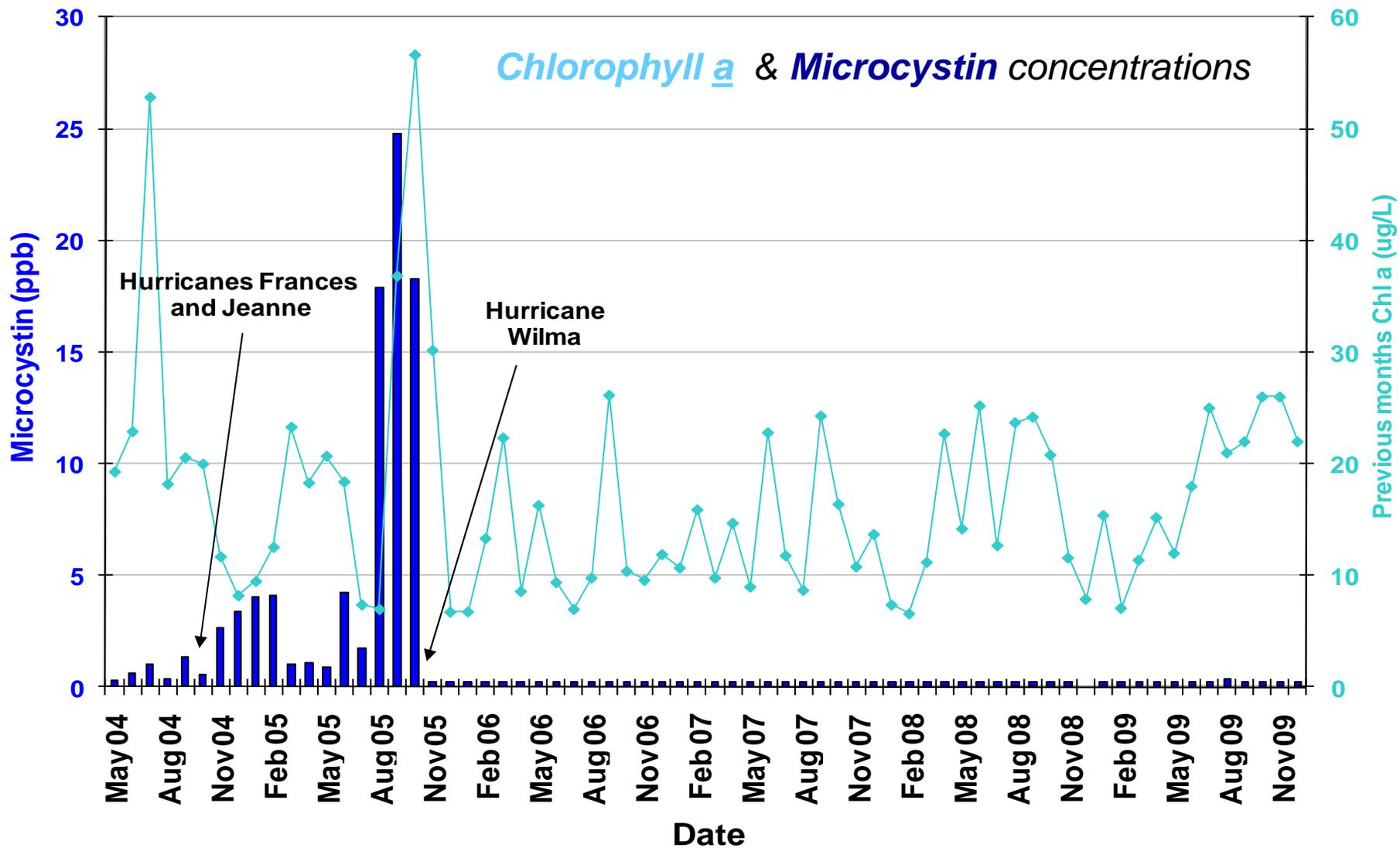
# Lake Stage vs. Near-Shore Total Suspended Solids



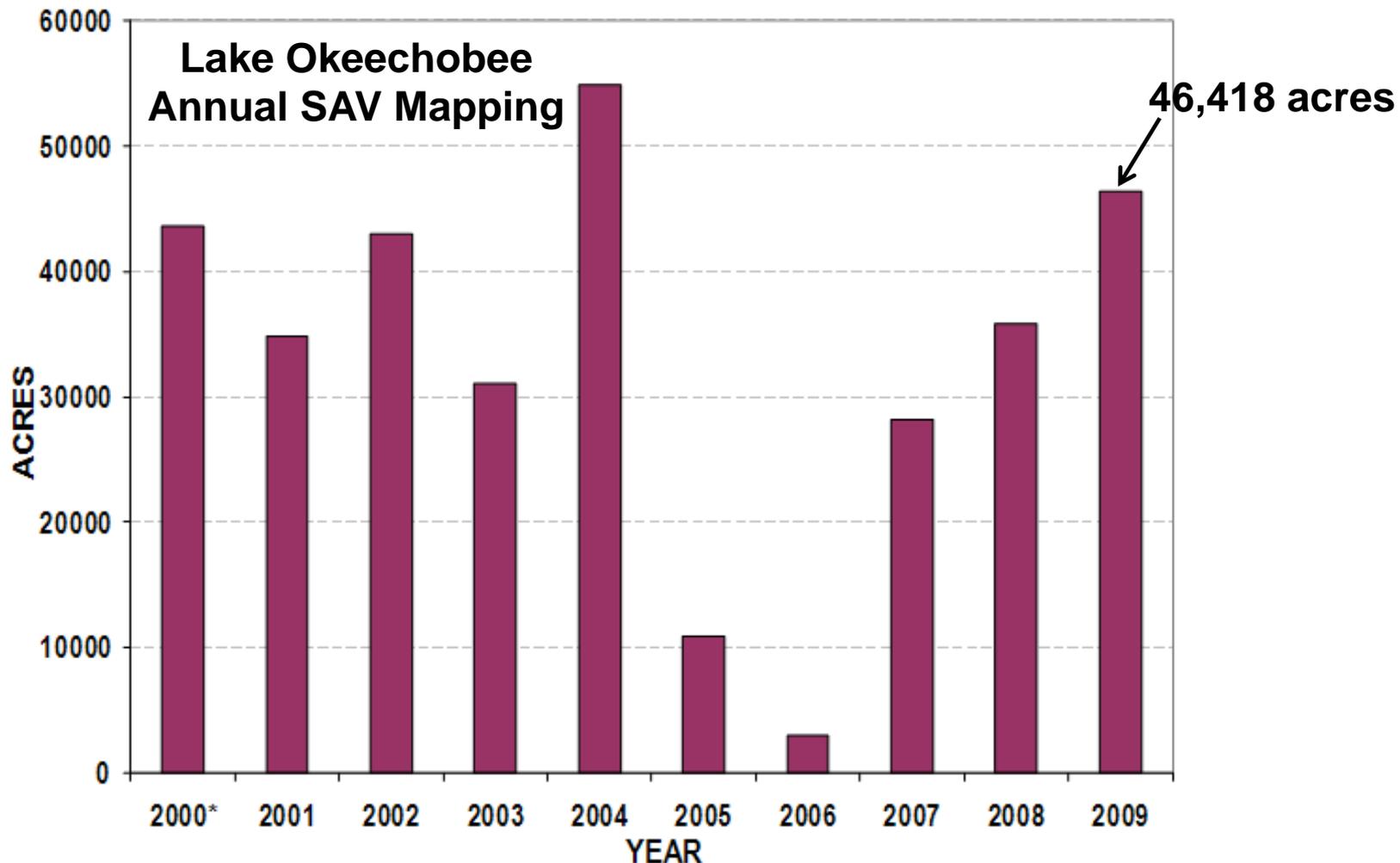
## Near-shore Total Suspended Solids



# Algal Bloom Monitoring



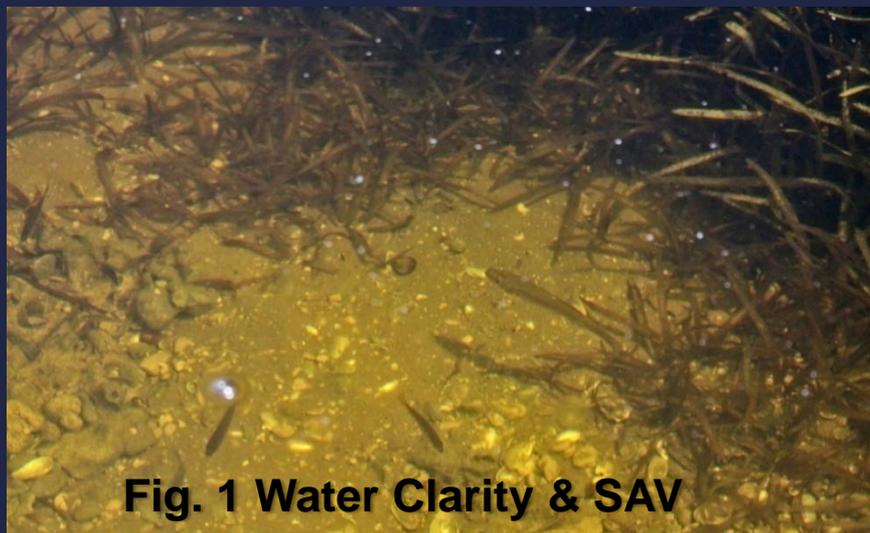
# Submerged Aquatic Vegetation (SAV)



Acres of Total of SAV (includes both vascular and non-vascular species)

# Current Ecological Conditions

# SFWMD



**Fig. 1 Water Clarity & SAV**



**Fig. 2 Emergent Vegetation (Bulrush)**



**Fig. 3 Apple Snail Recovery**



**Fig. 4 Wading bird foraging & nesting**

# Benthic Invertebrates



- Benthic invertebrate communities slowly recovered following recent hurricanes and drought, responding to reduced organic loading and transport of mud sediments from center of lake.
- Benthic species important to the lake's food web increased in terms of total number of taxa present, species diversity and density. Fastest recovery occurred in sand and peat sediments.

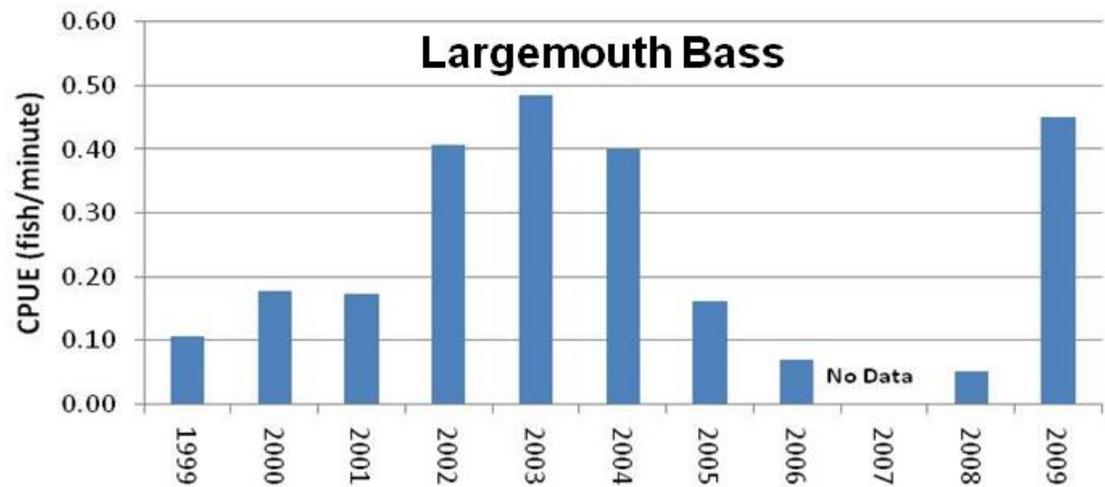
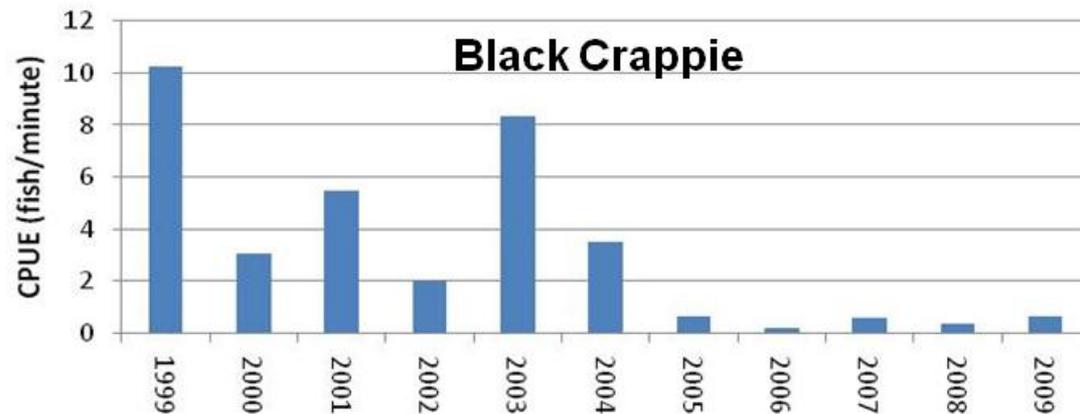
Descriptor	2005-2006	2006-2007	2007-2008
Total Taxa	48	68	94
Mean Species Richness	5.7	8.9	11.8
Mean Diversity	1.54	1.88	2.18
Mean Evenness	0.69	0.66	0.66
Mean Total Organisms/M <sup>2</sup>	3,338	7,591	12,678

Source: Warren, FFWCC, 2009

# Lake Okeechobee Fisheries



- The population, as depicted by catch per unit effort (CPUE) of Largemouth Bass and Black Crappie, declined following high water events in 2003
- Little recruitment of Black Crappie since hurricanes of 2004-05
- Concurrent with improvements in near-shore habitat and water quality, there was strong recruitment of Largemouth Bass young of the year in 2009



Largemouth Bass data collected Oct-Nov; Black Crappie data collected Jan-Feb of each year. Source: FFWCC

# Recovery of Littoral Zone Vegetation

# SFWMD



← Dry marsh conditions south of Indian Prairie canal (July 2008). Dog fennel and other terrestrial species became dominant across marsh landscape.

→ New bulrush growth along the lakeward edge of marsh near Indian Prairie Canal (August 2009)



# Control of Exotic Vegetation



- Drought conditions experienced over past three years have allowed for more aggressive treatment of torpedograss. About 10,000 acres of torpedograss were treated during 2004 - 2006 compared to 20,000 acres during 2007 - 2009.
- Wildfires that burned the marsh in 2007 and 2008 removed thousands of acres of dead torpedograss and other dead plant material. **Overall, torpedograss coverage on the lake has decreased dramatically.**
- Native plant communities have colonized some treated sites and wading bird surveys (2010) have documented thousands of birds foraging in shallow open water areas previously impacted by torpedograss

# Control of Exotic Vegetation (Cont.)

**SFWMD**

- South American watergrass has become a serious problem in the Lake
- Nearly 600 acres were treated in Fisheating Bay in 2009
- Floating exotic plants such as water hyacinth and water lettuce continue to pose significant ecological harm to the marsh
- The aerial coverage of these plants rapidly expanded during the summer and fall of 2009. During that time, more than 11,000 acres of water hyacinth and 4,000 acres of water lettuce were treated

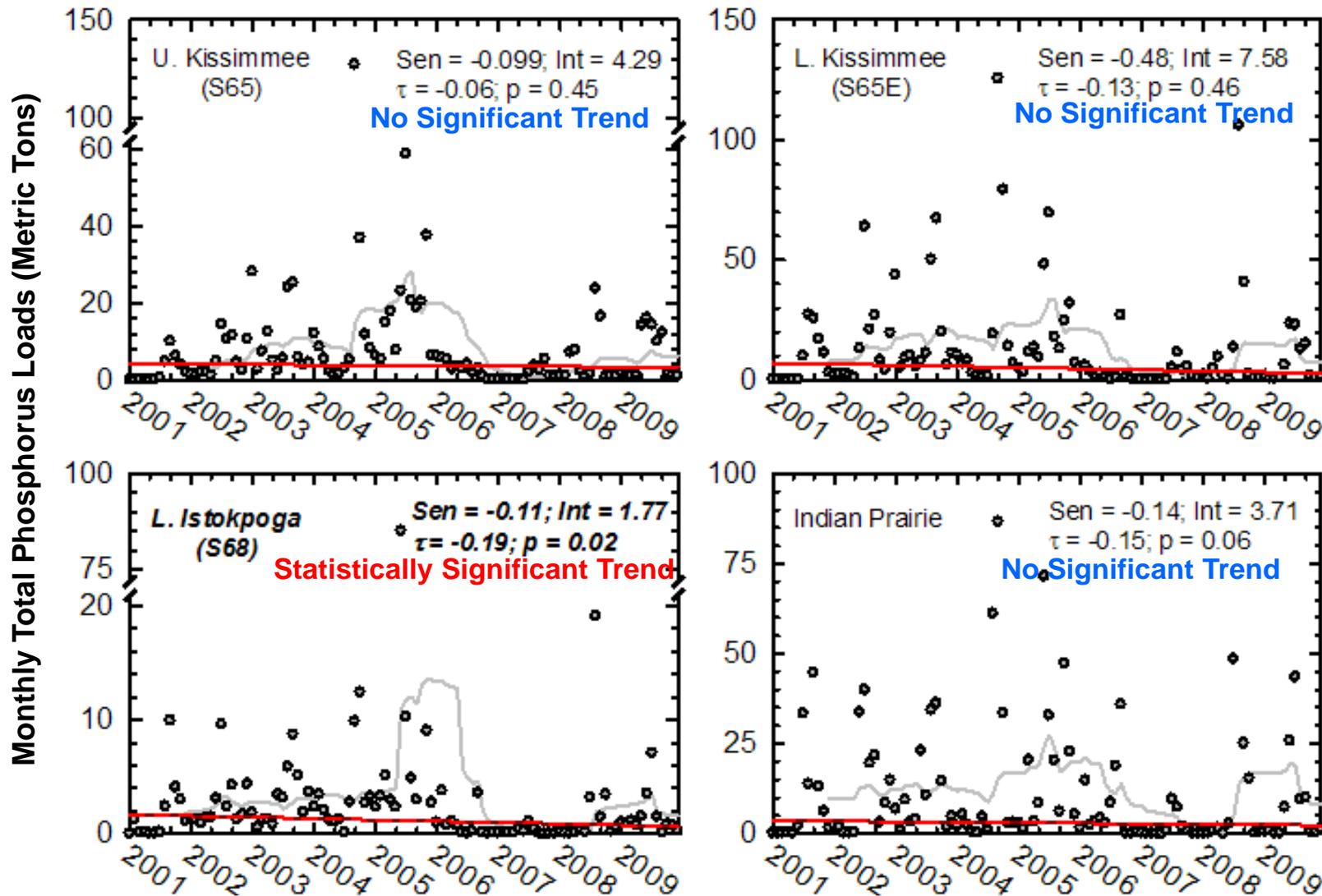


*Luziola* Treatment in Fisheating Bay  
(2008)

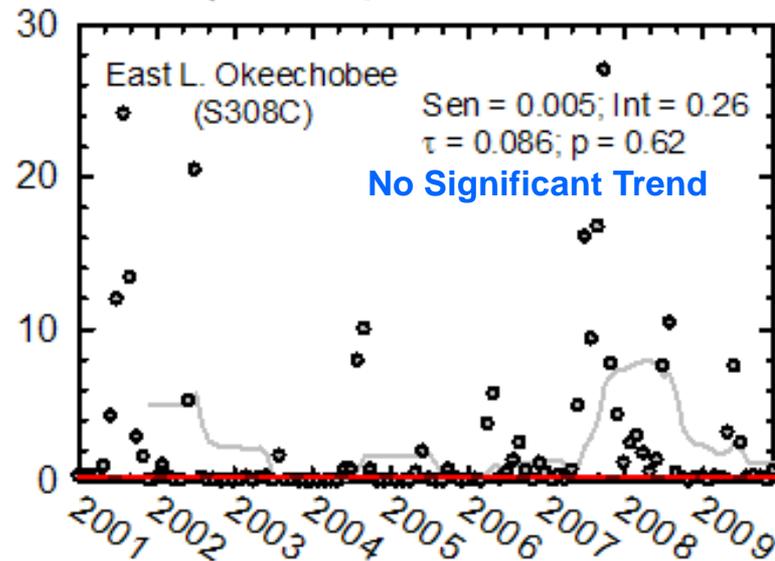
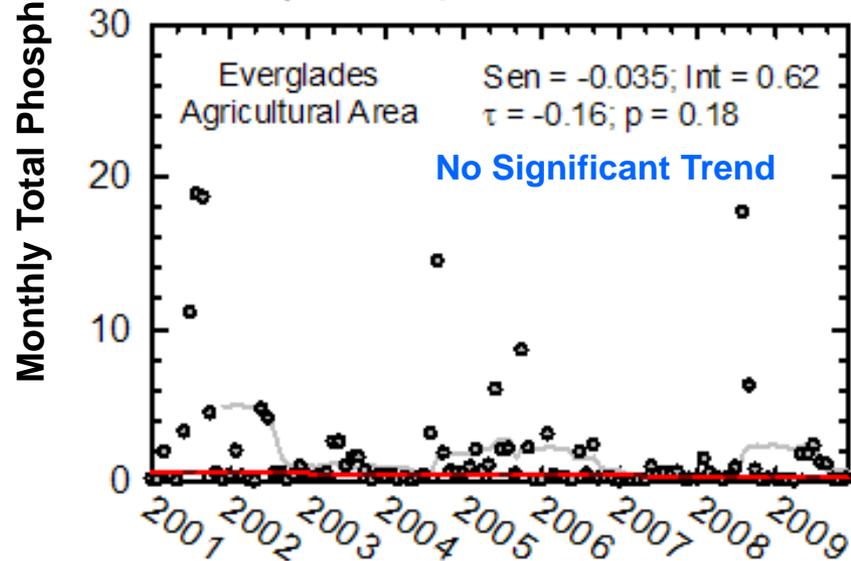
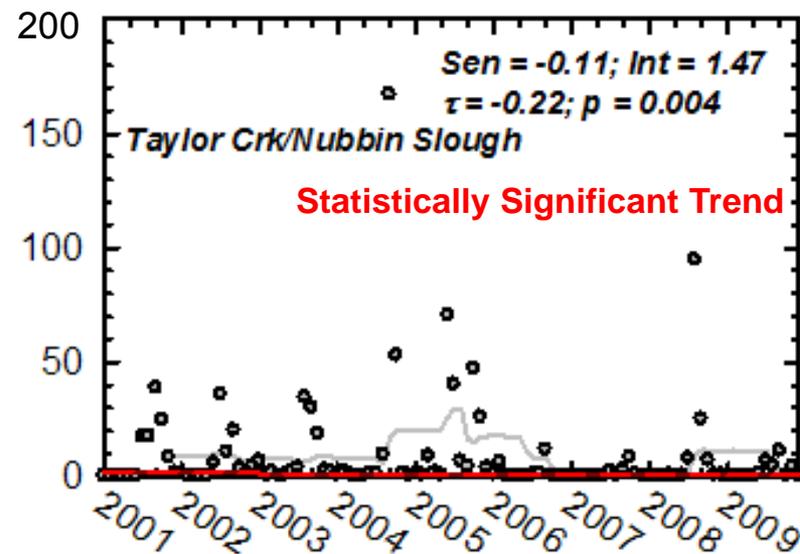
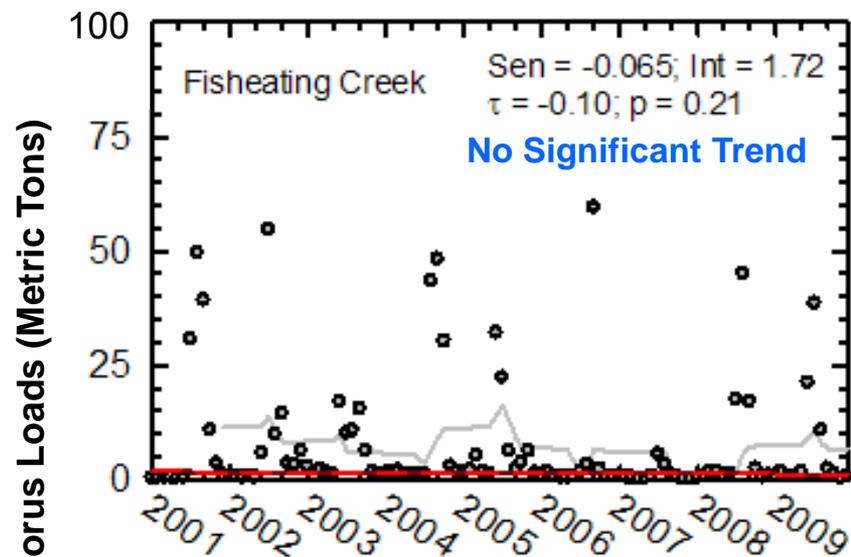


# Tributary P Loading Trends (2001-2009)

# SFWMD

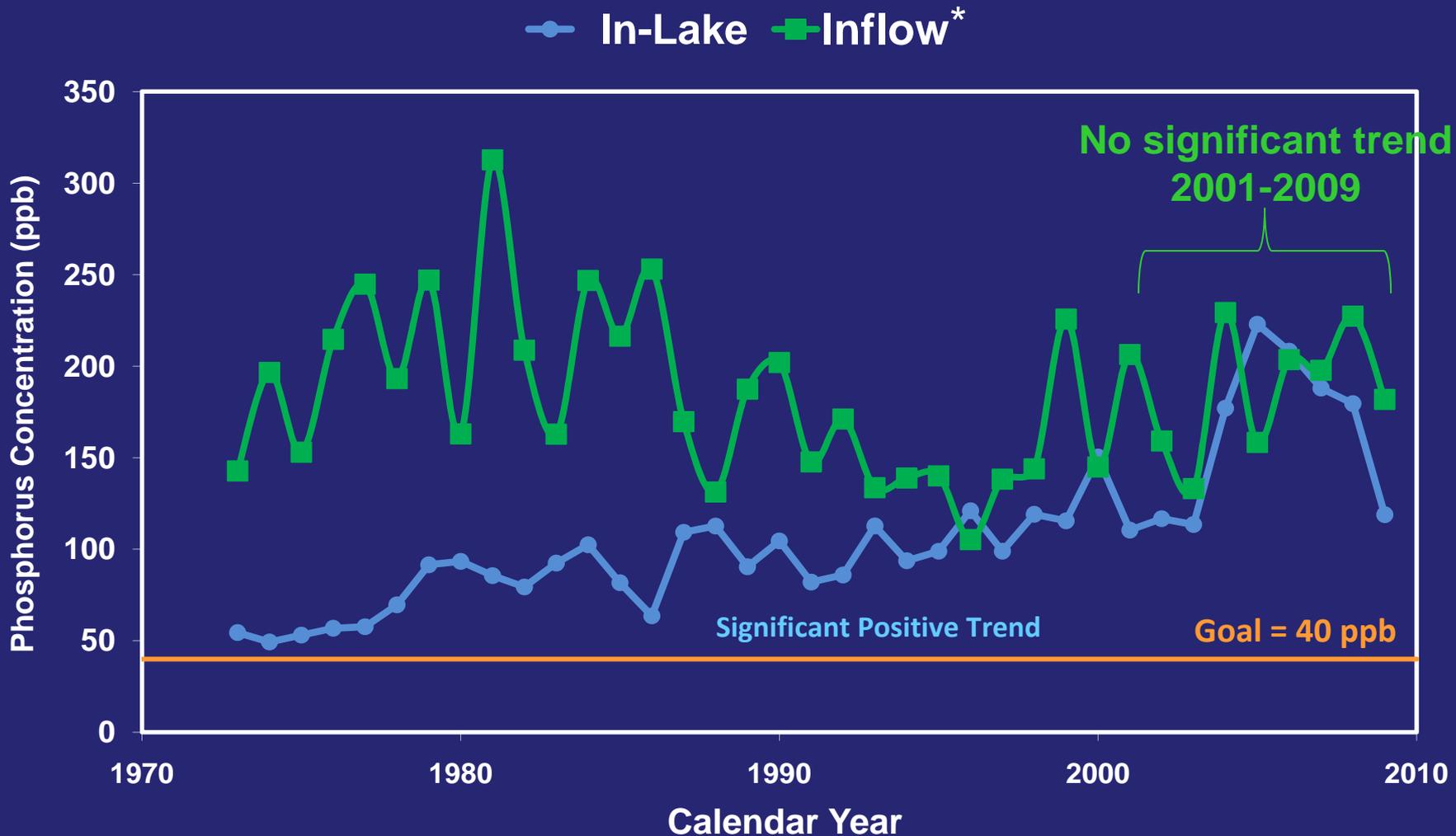


# Tributary P Loading Trends (2001-2009) Cont.



Monthly Total Phosphorus Loads (Metric Tons)

# Inflow vs. In-Lake Phosphorus Concentrations (1973-2009)

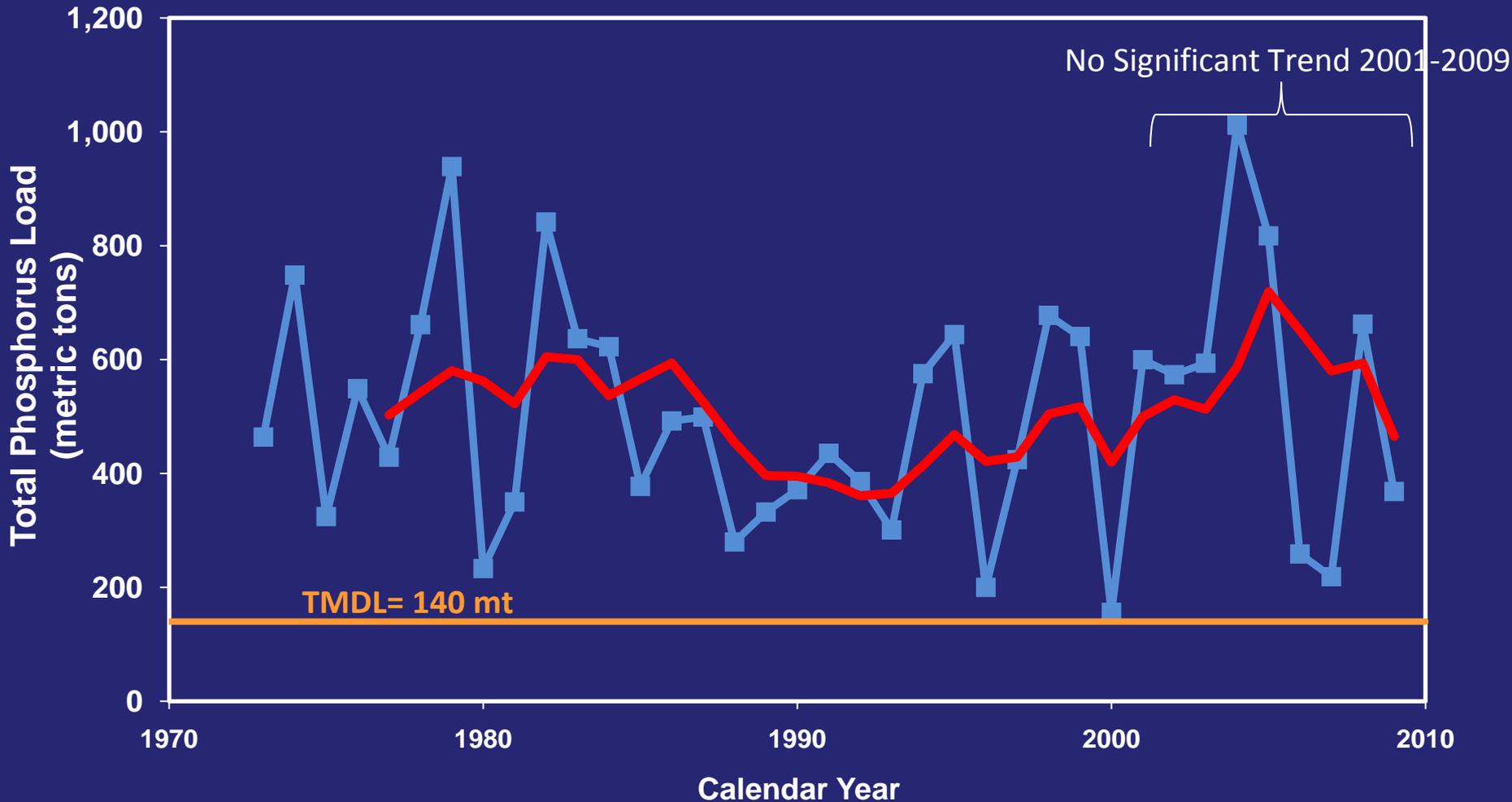


\* Inflow concentration = Yearly Sum of loads per year from all surface inflow points/Yearly sum of flow per year from all surface inflow points

# In-Lake Phosphorus Loads (1973-2009)



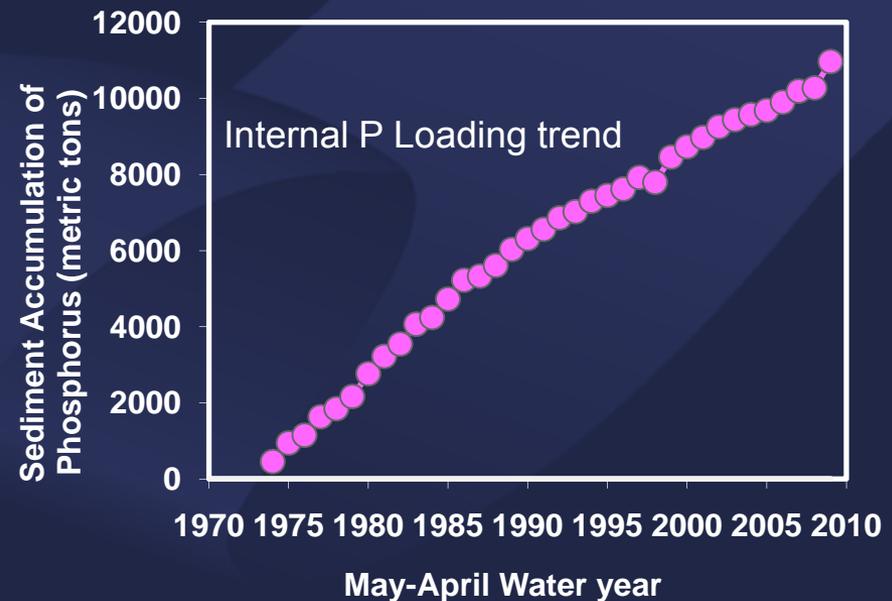
■ Load    — Goal    — Five-year moving average



# Internal P Loading Trends



- Decades of excessive P loads have accumulated in Lake sediments that are currently near saturation with P
- Sediment P moves into water column through diffusion and re-suspension
- Results from previous studies concluded that sediment removal (dredging) is not practical or cost-effective. However, the problem of internal P loading remains a significant challenge
- Previous studies recommend external P load reduction as most feasible, cost-effective alternative



# Internal Lake Phosphorus Management Program



- 80,000 hectares of lake bottom covered by 260 million cubic yards of P-enriched mud sediment
- If Internal P loading is not addressed, the lake may not fully respond to external P load reductions
- In 2003, the District conducted a study addressing the feasibility of removing or treating the Lake's P-enriched mud sediments

## *New Considerations*

- Public may be unwilling to wait decades to experience restored water quality conditions within the Lake
- Sediments also contribute to high turbidity that affects SAV and downstream receiving water bodies
- Everglades and estuary restoration more difficult to achieve without improving the quality of water discharged from the Lake
- Release of P from lake sediments will remain a large source of P for many decades regardless of how the upstream watershed is managed

# Internal Lake Phosphorus Management Program (Cont.)



## *New Technologies*

- Consideration of deep-well disposal of effluent water or the sediments themselves.
- Construction of in-lake islands or Littoral Zones near outlets

## *Proposed In-Lake P Management Study*

- Review the recommendations from the 2003 Feasibility study
- New concepts and technologies would be evaluated and then compared against those from the previous report.
- Finally, new recommendations would be made for implementation

# LOPP Update Schedule



- NE Interagency Meeting - LOPP Update 07/10
- NE Interagency Meeting - Draft LOPP 08/10
- Lake Okeechobee WRAC Meeting - Draft LOPP 08/10
- Draft LOPP Public Release - 09/10
- WRAC Meeting - Draft LOPP 09/10
- GB Meeting - Draft LOPP 09/10
- End Public Comment Review Period - 10/10
- L.O. WRAC/ WRAC/GB Meetings - Final LOPP 12/10
- Final LOPP to the Legislature - 3/11



# Caloosahatchee and St. Lucie River Watershed Protection Plans Update

- I. Pollutant Control Program**
- II. Construction Project**
- III. Research and Water Quality Monitoring Program**

# Pollutant Control Program



- Implementation of agricultural and urban Best Management Practices (BMP)
- Revisions to regulatory programs
  - Environmental Resource Permit (ERP) Program
    - The FDEP Statewide Stormwater Rule - Water Quality (FDEP)
      - FDEP and its collaborators will work on revisions to the Applicant's Handbook and the draft rule during July/ August 2010
      - Additional rule workshops may be held in October 2010 with comments due in mid to late November 2010
    - Northern Everglades ERP Basin Rule - Water Quantity (SFWMD)
      - The intent of the Basin Rule could be accomplished using existing rules
      - A guidance document will be prepared and reviewed with interested stakeholders prior to finalization and implementation

# Pollutant Control Program



- District's Regulatory Source Control Program
  - St. Lucie and Caloosahatchee:
    - Completed “work plan” and currently performing an inventory and evaluation of existing water quality data. Reports are expected to be finalized by early July
    - Rule development timeline is dependent on findings

# Construction Project – Caloosahatchee C-43 Water Quality Treatment and Testing Facility

SFWMD

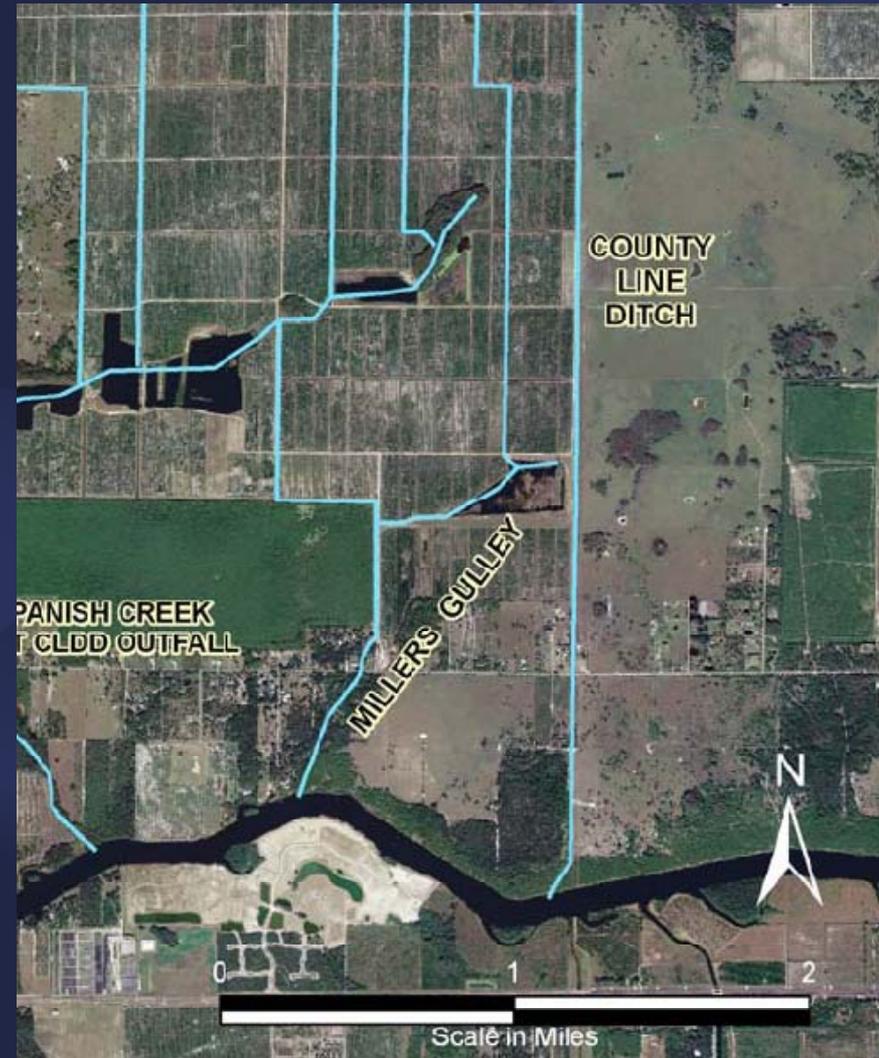
- Objective: Develop, design and build a testing facility to provide total nitrogen treatment
  - Site assessments and topographic surveys complete
  - Independent external review of consultant project deliverables
    - Two-day workshop for external review presentation of results and technology discussion in mid-July
    - Final report due by mid-September
  - Next steps – Planning and design team discuss path forward and present proposal to management



# Construction Project – Caloosahatchee County Line Ditch/Four Corners Phase I

**SFWMD**

- Completed efforts:
  - County Line Ditch (CLD) Cleared of vegetation south of CR-78
  - CR-78 culverts cleaned
- Ongoing efforts:
  - Gathering data from monitoring wells
  - Working with landowner for access on Lee County side
- Future efforts:
  - Monitoring will conclude in September 2010
  - Equipment will be removed and monitoring wells will be abandoned



# Construction Project – Caloosahatchee Powell Creek Algal Turf Scrubber (ATS)

# SFWMD

- Evaluate effectiveness of the ATS in treating both freshwater and estuarine waters
- Pilot Project was completed in December 10, 2009
- Fourth Quarter report (Dec 2008 – Dec 2009) provided cumulative results for Qtr 1-4
  - The average concentration reduction was approximately 19.28% for total phosphorous and 6.67% reduction for total nitrogen.
- Powell Creek ATS Pilot Final Report was revised, finalized and submitted May 26, 2010
- Meeting with Lee County to decide on future efforts is pending



# Construction Project – St. Lucie 5/5/5 projects with Martin County



- Manatee Pocket Dredging: Remove muck for water quality and habitat improvement
  - Dredge material maintenance site is expected to be constructed by the end of June, with dredging to begin immediately after.
- Manatee Creek Basin Water Quality Retrofit: Provides treatment of uncontrolled discharges to the Manatee Pocket from Manatee Creek
  - Construction began January 4, 2010
  - Delays were experienced with the erosion and sediment controls and the dewatering for Phase II and Phase III construction

# Construction Project – St. Lucie

## 5/5/5 projects with Martin County (Cont.)



- North River Shores Vacuum Sewer System - Enhances water quality in the North Fork of the St. Lucie River by eliminating nutrient loading from septic systems
  - Notice to proceed with construction issued on March 8, 2010
  - Construction is on target
- Old Palm City Phase III Water Quality Retrofit - Improves water quality by developing a neighborhood stormwater quality management system
  - Land acquisition is complete for all required lots
  - A hearing is being scheduled in Fall regarding the petition that filed against the SFWMD permit. This has stalled bidding and construction of the project

# C-44 Project

# SFWMD

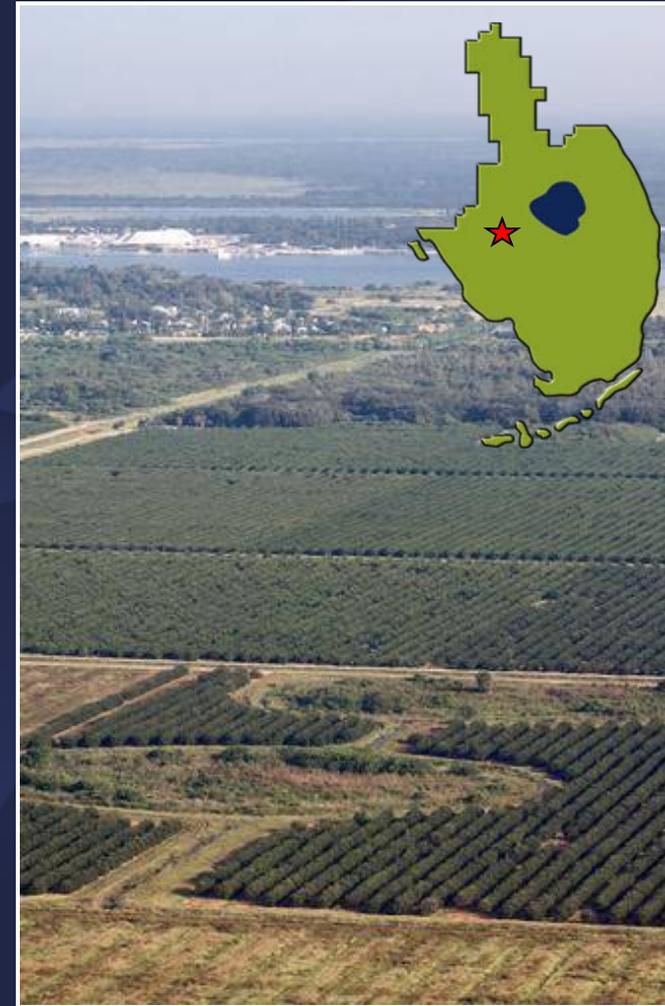
- Design completed; land acquired
- USACE intends to construct C-44 Project under three contracts
  - Contract 1: Intake Canal, main project access road, Citrus Boulevard related efforts, southern C-133 canal and spillway - Construction start Feb 2011
  - Contract 2: Reservoir and pump station - Construction start April 2012
  - Contract 3: Stormwater treatment areas - Construction start Oct 2014
- All construction to be complete by March 2017
- SFWMD initiated relocation construction efforts in April 2010



# C-43 West Basin Reservoir



- Final Project Design of Reservoir complete
- Pre-Partnership Credit Agreement was executed in August 2009
- Next Steps:
  - Chief of Engineers Report signed March 2010
  - Record of Decision signed September 2010
  - Submittal to Congress October 2010
  - Targeted for inclusion in WRDA 2010/2011
  - Tree clearing to remove approximately 6,000 acres of citrus substantially complete
  - Construction is currently on hold pending authorization and appropriation



# Research and Water Quality Monitoring Program



Research Topics	Project	CRE		SLE	
		FY2009	FY2010	FY2009	FY2010
Nutrient Budget	Measurements of Primary Production (Contract)	6 month sampling completed (2 yr contract)	Contract terminated due to lack of funds	Complete	
	Groundwater Seepage Studies (Contracts)	Complete		Complete	
	Dry Season Benthic Flux Data Analysis (In-House)		On-going		On-going
Dissolved Oxygen Dynamics	DO Data Collection (In-House)	Three sites continuous DO measurements from Feb. through Sep. 2008			
	DO Data Analyses (In-House)		On-going	Completed preliminary analysis	On-going
Low Salinity Zone	CRE Oligohaline Zone Study (Contract)	Two year contract - first year sampling and raw data completed	Final deliverable is due by September, 2010		
Light Attenuation in San Carlos Bay	CRE Measurements of Colored Organic Matter (In-House)	First year field sample completed	Second Year field sample on going		
Integrated Modeling	SLE Water Quality Model update (In-House)			Calibrated for 1999-2005	Further improvement on-going
	SLE Opti6 Model Reconfiguration (In-House)			Graphic User Interface completed	Further improvement on-going
	Tidal CRE Watershed Model		On-going		
	CRE SAV data Assessment and model development		On-going		

An aerial photograph of a rural landscape. The foreground is dominated by vibrant green agricultural fields, some of which are divided into smaller plots. A small, rectangular blue pond is visible on the right side. In the middle ground, there's a cluster of buildings and more fields. The background shows a vast, flat expanse that could be a plain or a large body of water, extending to a distant horizon. The sky is a deep blue, filled with large, fluffy white cumulus clouds. The overall scene is bright and clear.

Questions?

<https://my.sfwmd.gov/northerneverglades>