

Restoration Strategies

Jeremy McBryan, P.E.
Principal Engineer

South Florida Water Management District

Phone: 561-682-6355

Email: jmcbryan@sfwmd.gov

July 28, 2015



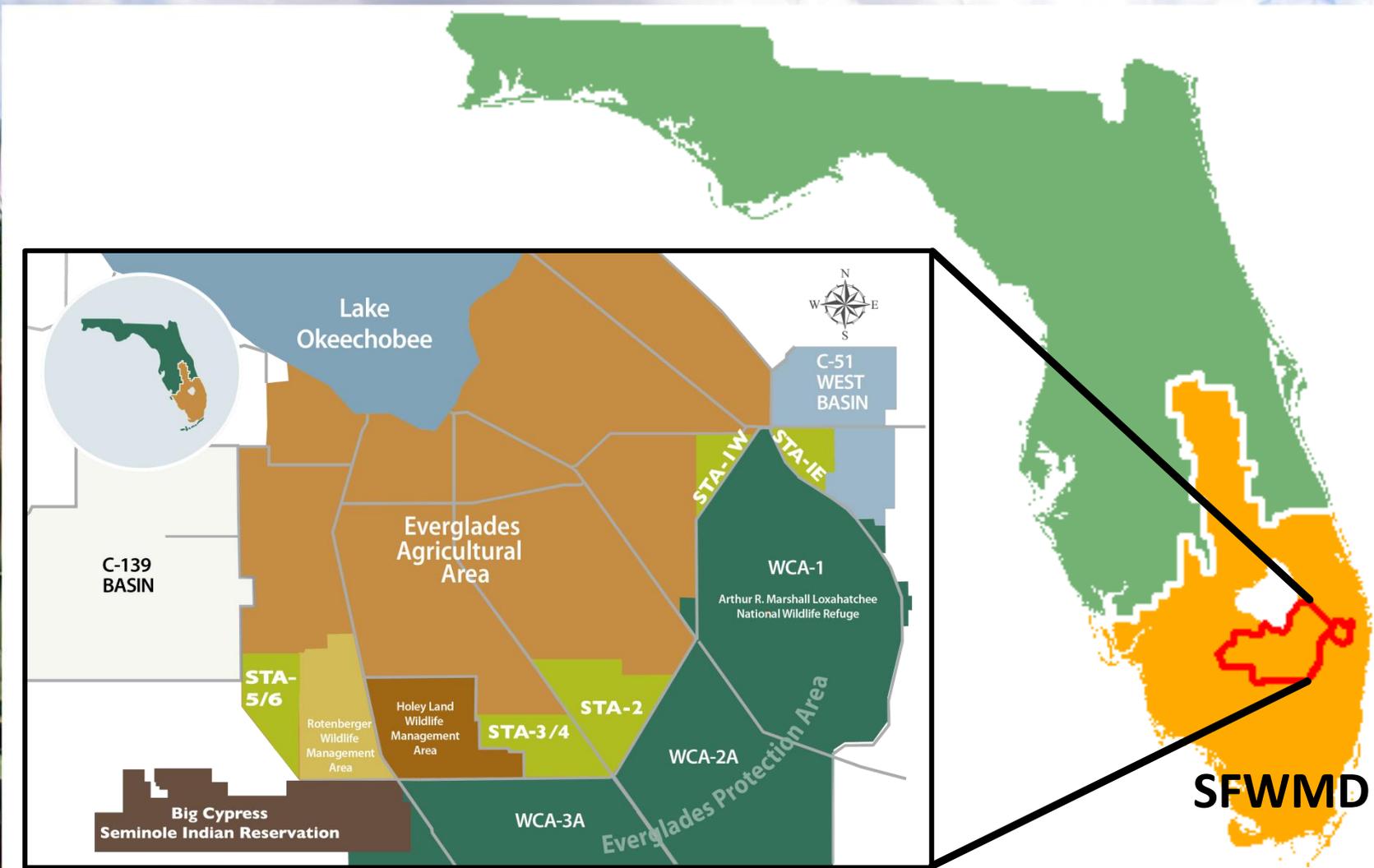
Agenda

- Stormwater Treatment Area Performance
- Restoration Strategies Design and Construction Update
- Restoration Strategies Science Plan
- Water Quality Requirements and Federal and State Laws intended to Protect Species

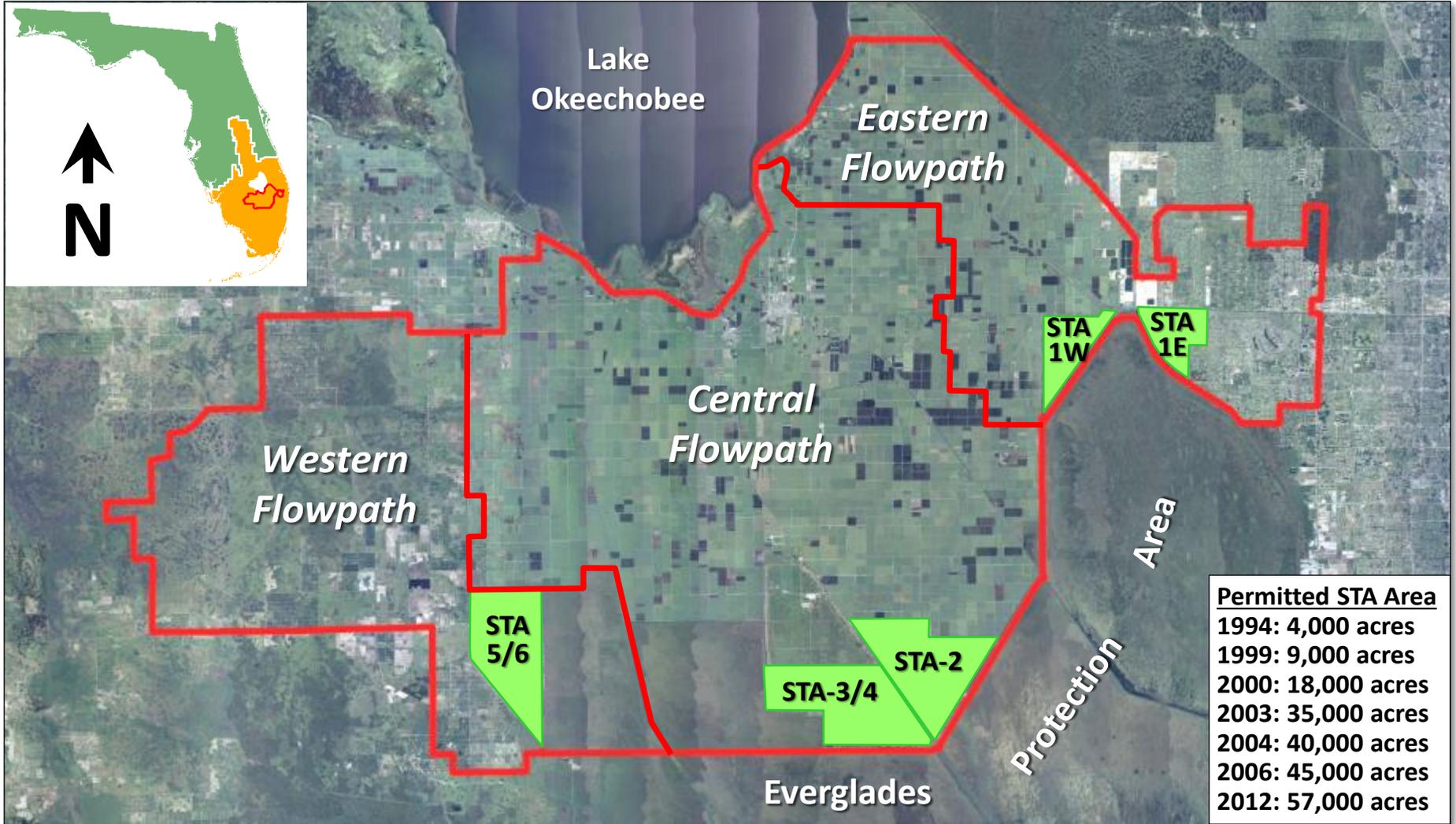
Stormwater Treatment Area Performance



Stormwater Treatment Areas (STAs)



Stormwater Treatment Areas (STAs)



Factors Affecting STA Operations and Performance

- Inflow total phosphorus (TP) concentrations
- Hydraulic and TP loading
- Vegetation composition/condition
- Antecedent land use
- Soil characteristics
- Topography
- Prolonged high water depths
- Hurricanes, floods, droughts
- Enhancement activities
- Regional operations
- Protected and Exotic Species, Migratory Birds



STAs: Ongoing Challenges

- Ultra-low limits on TP concentrations in STA discharges
- STAs are integral components of a complex water management system with multiple objectives and cannot be operated in isolation
- STAs require supplemental water during dry periods to sustain vegetation and maintain treatment performance
- Science is still being developed to understand factors affecting STA sustainability and long-term performance



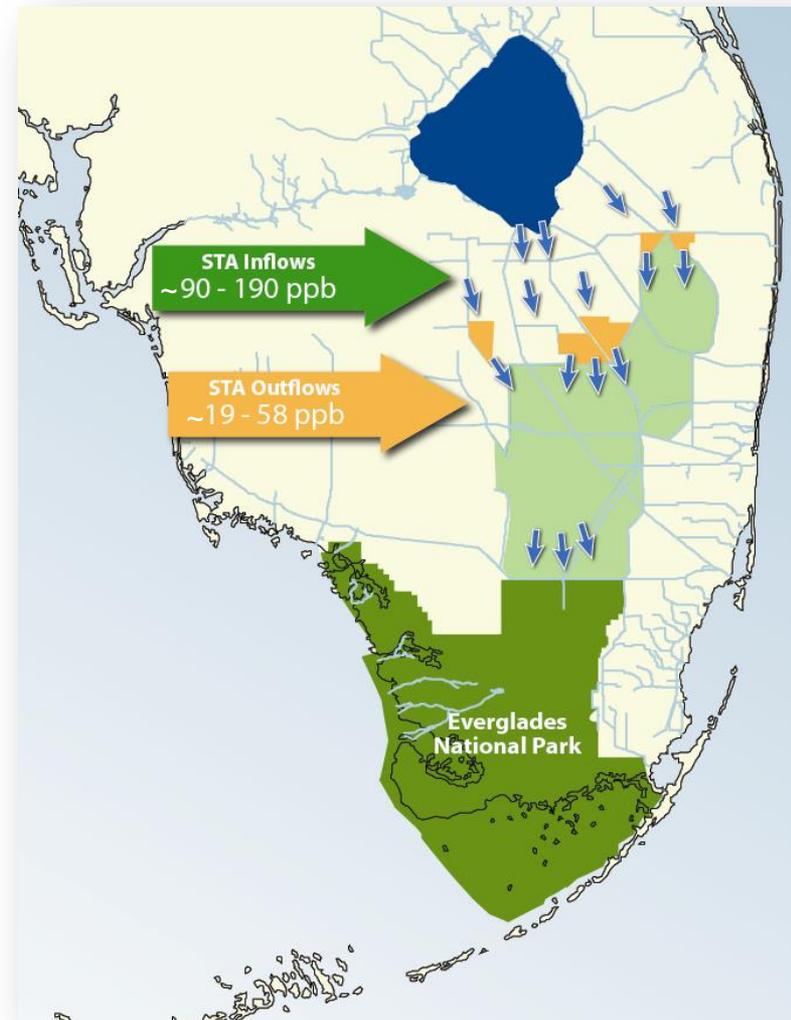
STAs: Ongoing Challenges (cont'd)

- South Florida's sub-tropical climate (hurricanes, floods, and droughts)
- Natural vegetation turnover and necessary off-line time for repairs, enhancements and stabilization
- Wildlife / Exotic Species use of the STAs / Impact on Operations and Treatment Performance
- Migratory Bird Treaty Act, Endangered Species Act, Bald Eagle Protection Act and others

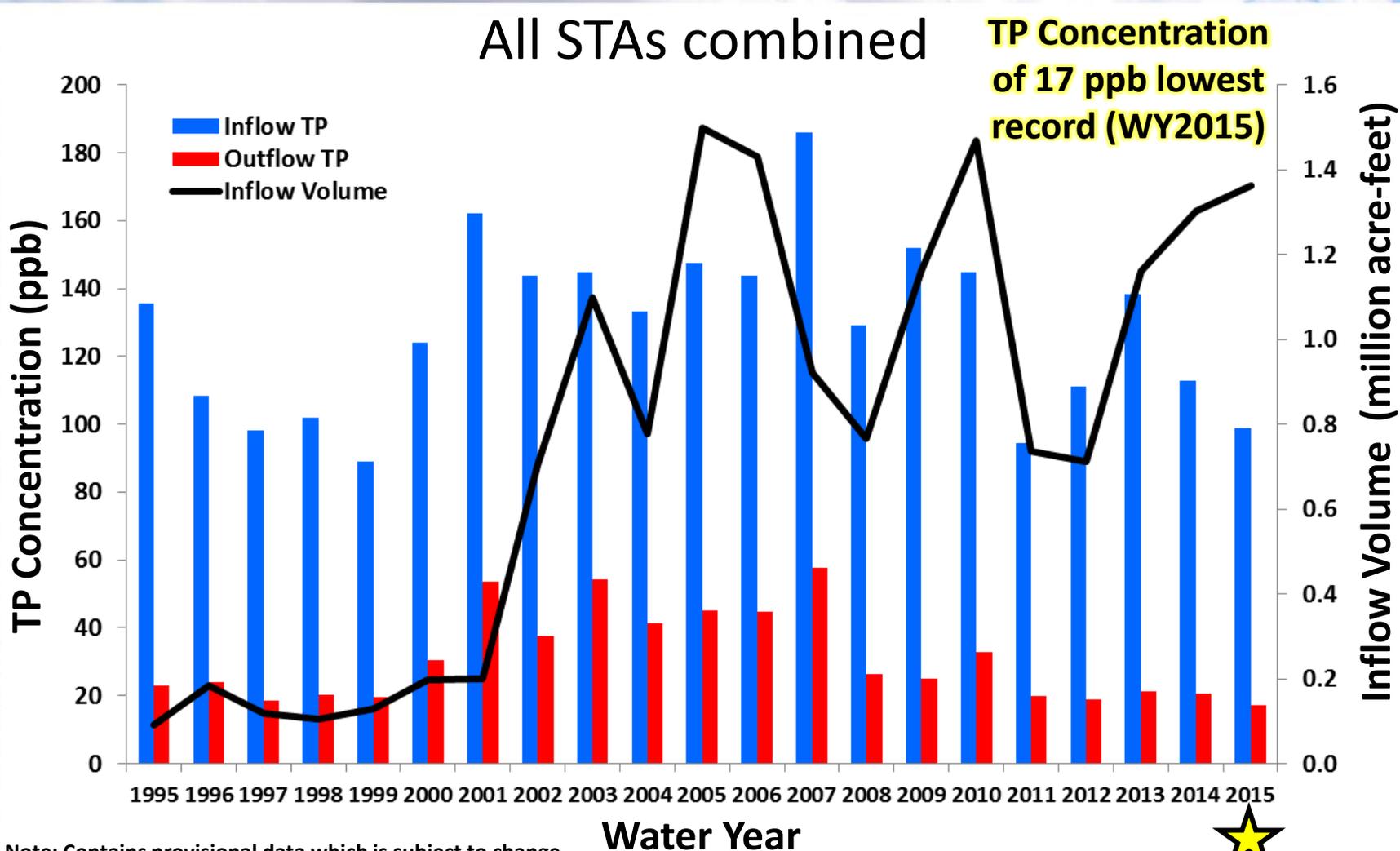


STA Performance: 1995-2015

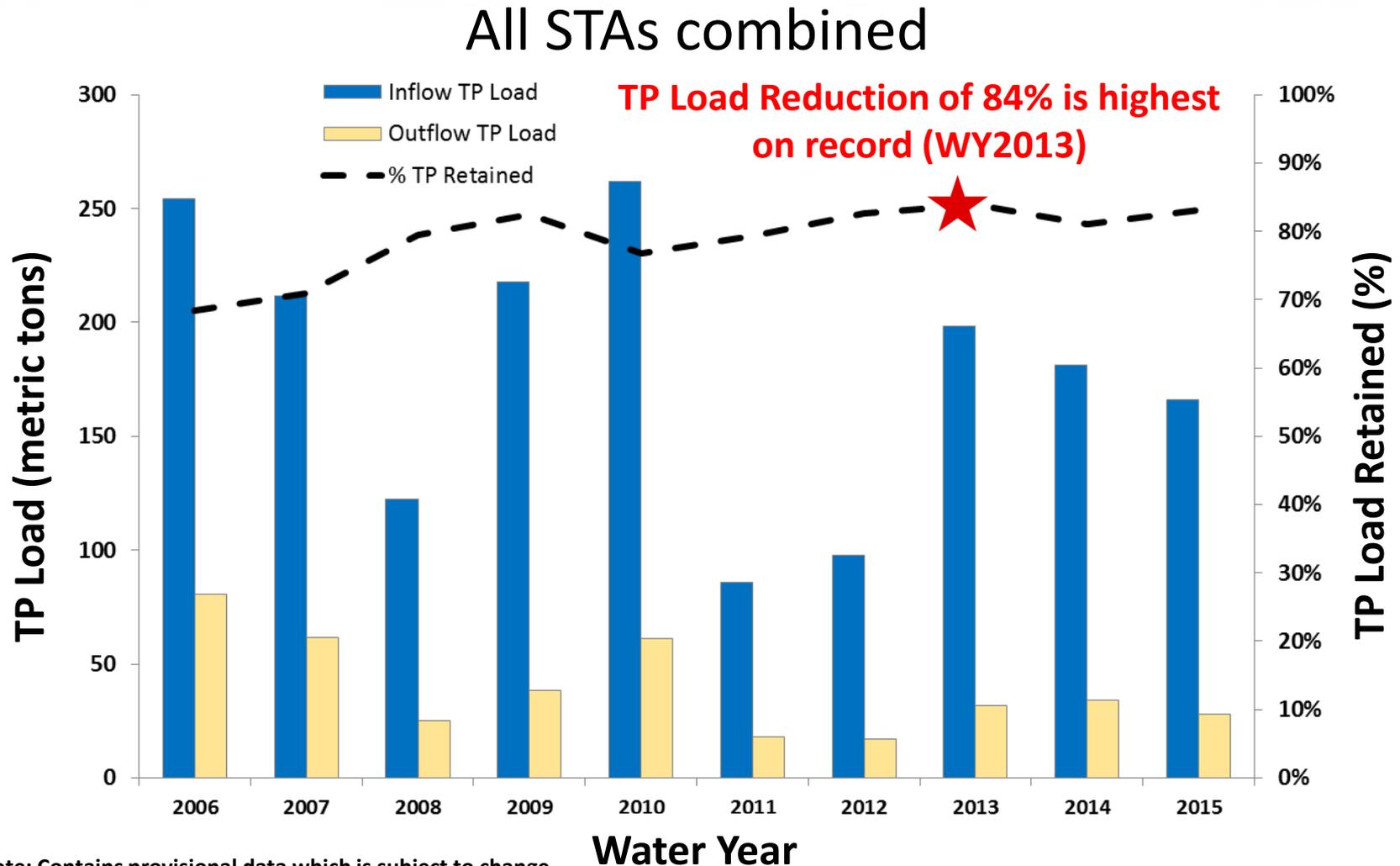
- **16.1 million acre-feet** (5.3 trillion gallons) of water treated
- **2,012 metric tons** of phosphorus removed
- Outflow TP concentration for STA-3/4 (best performing STA) averaging **17 parts per billion (ppb)** since it began operations in 2004
- At times, **STA-2** and **STA-3/4** have achieved annual average TP conc. of **12 ppb** and **13 ppb**



STA Performance: 1995-2015 (cont'd)



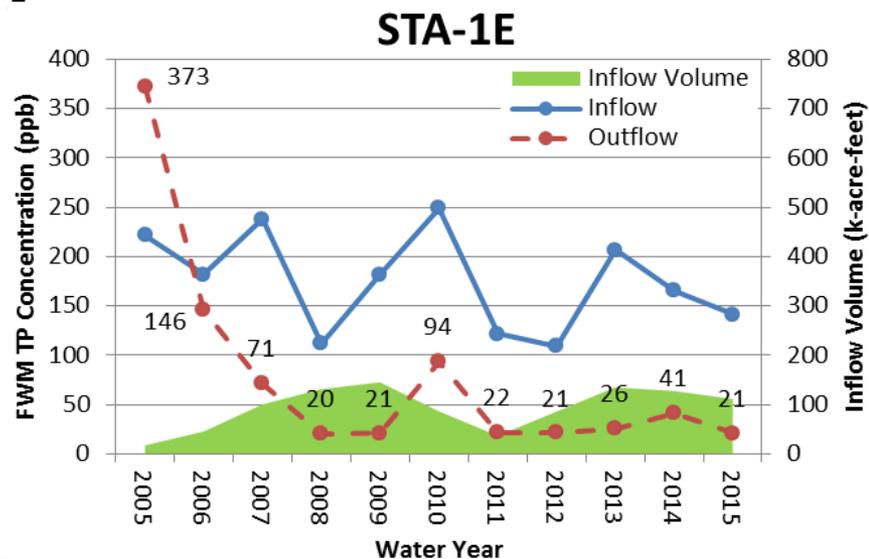
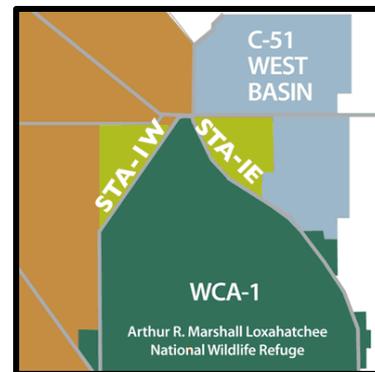
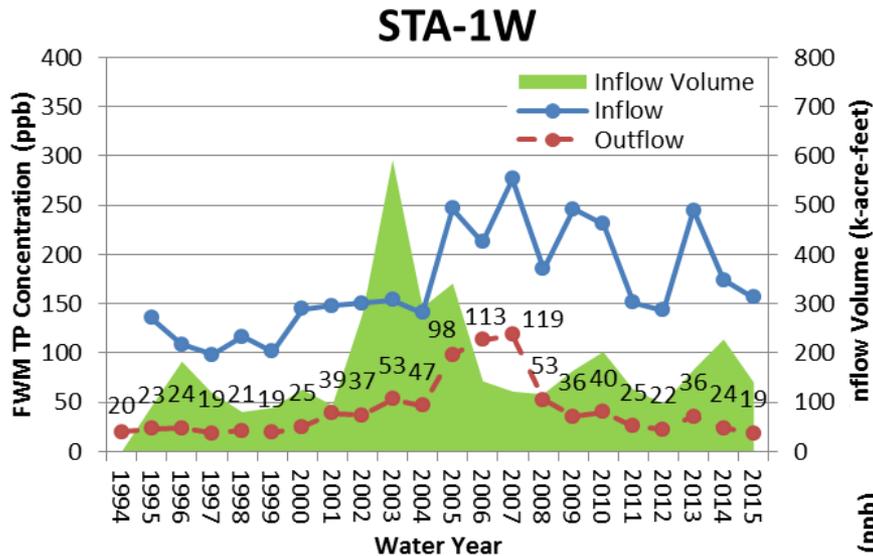
STA Performance: TP Load Reduction



Note: Contains provisional data which is subject to change

STA-1W and STA-1E Performance

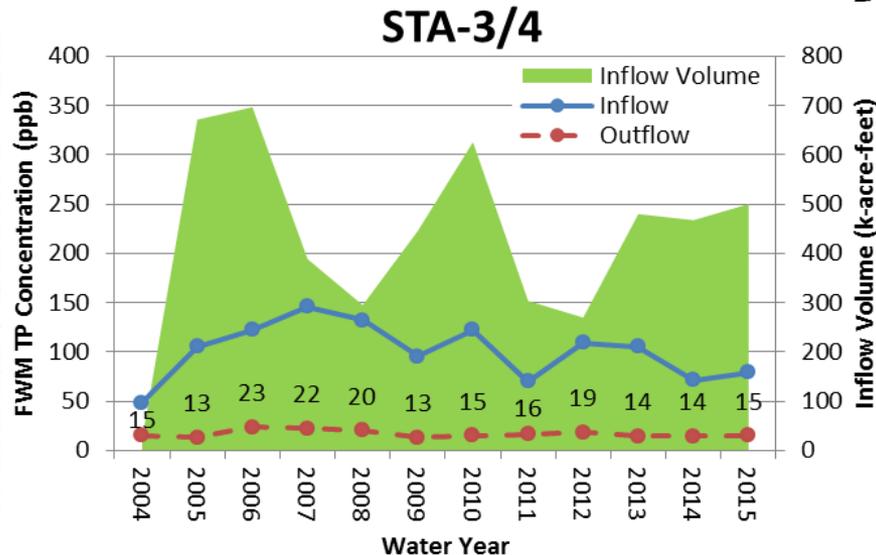
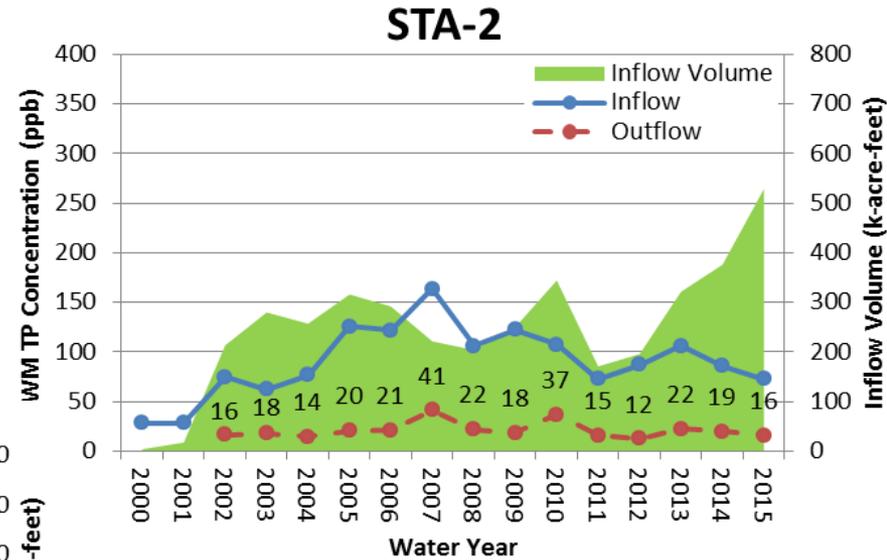
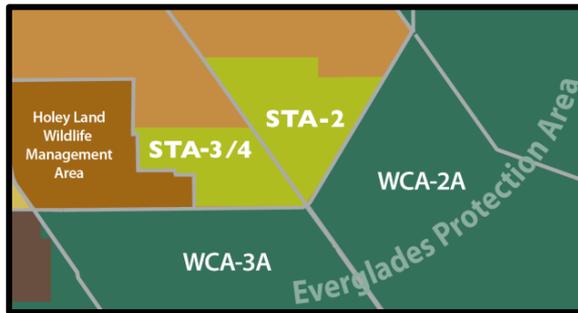
Total Phosphorus Concentration and Inflow Volume



Note: Contains provisional data which is subject to change

STA-2 and STA-3/4 Performance

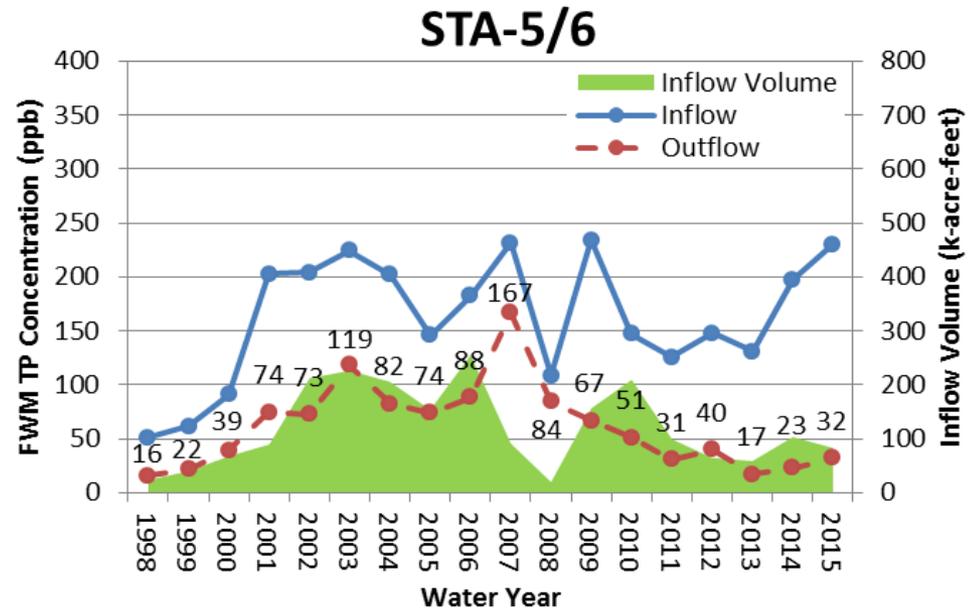
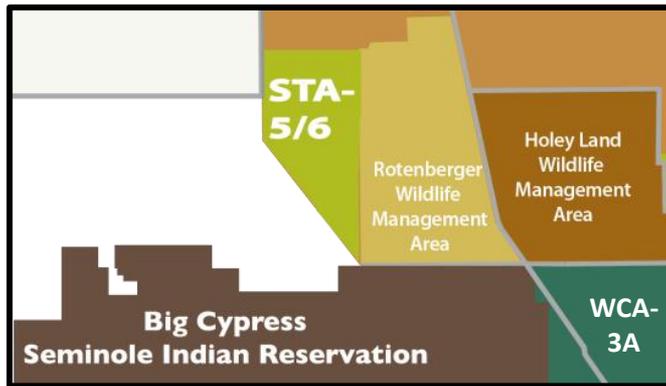
Total Phosphorus Concentration and Inflow Volume



Note: Contains provisional data which is subject to change

STA-5/6 Performance

Total Phosphorus Concentration and Inflow Volume



Note: Contains provisional data which is subject to change

Water Quality Based Effluent Limit

Developed to be protective of the Everglades and allow for the achievement of the Everglades phosphorus criterion (10 ppb)

WQBEL

Total Phosphorus concentrations in the discharge from each STA shall not exceed:

- 19 ppb as an annual flow-weighted mean in any water year; and
- 13 ppb as an annual flow-weighted mean in more than 3 out of 5 water years on a rolling basis

Restoration Strategies Design and Construction Update

Overview of Consent Orders

- Issued by FDEP to SFWMD in September 2012
- 74 corrective actions with deadlines ranging from April 1, 2012 to December 31, 2025
- Corrective actions include land acquisition, design, permitting, construction, and operational activities
- Require interim STA operations and performance reporting
- List key STA research areas to be studied and deadlines related to the Science Plan
- Require water quality, vegetation and sediment monitoring in Water Conservation Areas 1 and 2A

Design and Construction Schedule

2012

- 57,000 ac of STA

2012-2016

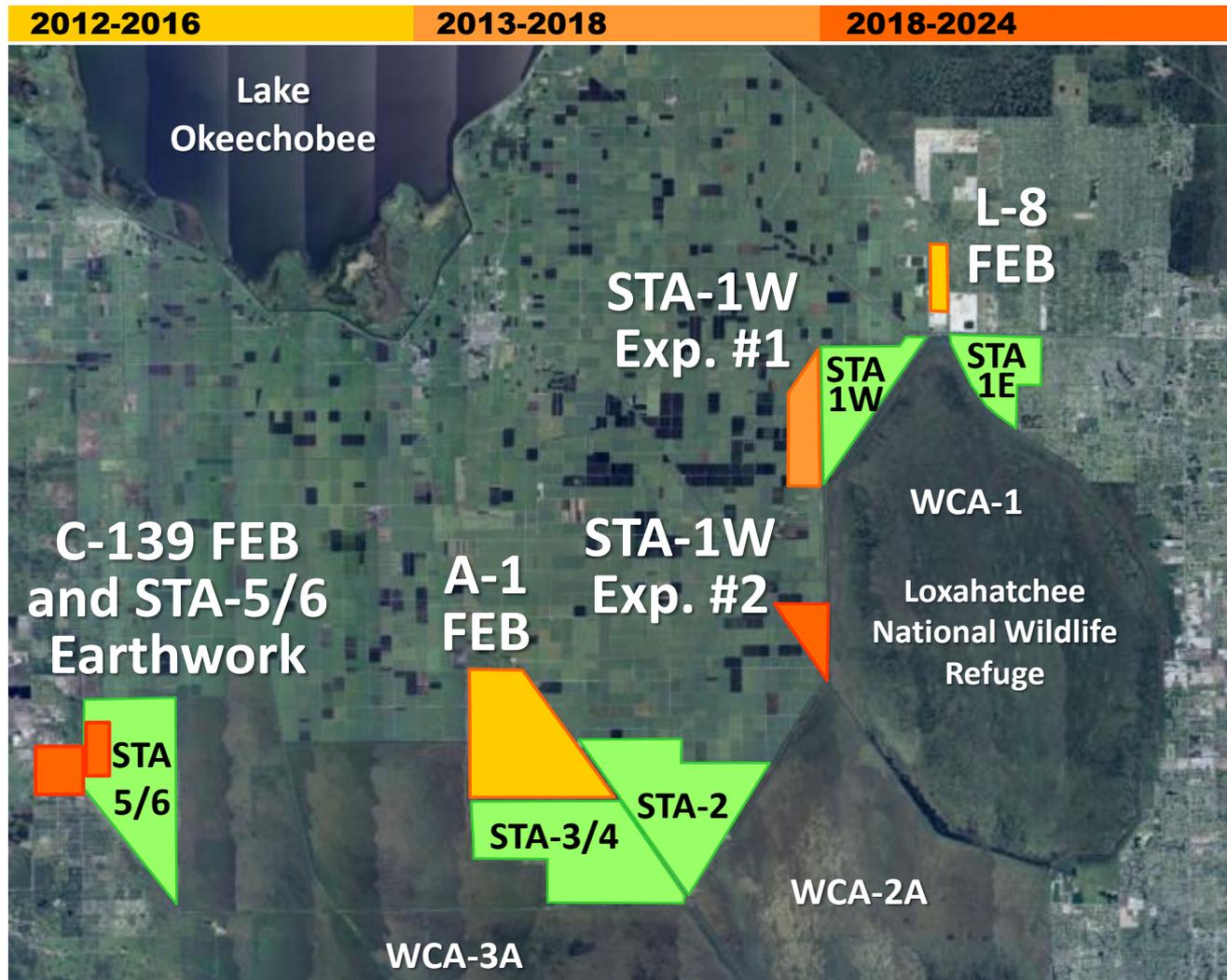
- L-8 FEB (45,000 ac-ft)
- A-1 FEB (60,000 ac-ft)

2013-2018

- STA (4,700 ac)

2018-2024

- STA (1,800 ac)
- C-139 FEB (11,000 ac-ft)
- STA Earthwork (800 ac)



Consent Order Milestones Achieved

 = Achieved Ahead of Deadline

Project	Milestone	Deadline	Date Completed
Eastern Flowpath			
L-8 Divide Structure	Initiate Design	10/1/2012	9/10/2012
	Complete Design	9/30/2014	3/5/2014
	Initiate Construction	10/1/2016	9/11/2014
S-5AS Modifications	Initiate Design	10/1/2012	9/10/2012
	Complete Design	9/30/2014	4/17/2014
	Initiate Construction	10/1/2014	9/11/2014
Flow Equalization Basin (L-8 FEB)	Submit State and Federal Permit Applications	1/31/2014	5/13/2013
	Construction Status Report	3/1/2014	2/25/2014
	Construction Status Report	3/1/2015	2/26/2015

Consent Order Milestones Achieved (cont'd)

 = Achieved Ahead of Deadline

Project	Milestone	Deadline	Date Completed
Eastern Flowpath (continued)			
S-375 Expansion	Initiate Design	9/30/2013	3/4/2013
	Complete Design	7/30/2015	7/22/2015
4,700-acre STA Expansion	Initiate Design	9/30/2013	9/17/2013
	Complete Land Acquisition	9/30/2013	4/23/2014
	Submit State and Federal Permit Applications	7/30/2014	7/22/2014
	Complete Design	7/30/2015	6/22/2015
Repairs and Modifications to STA-1E	PSTA Decommissioning Complete	Prior to long-term operations	8/21/2014

Consent Order Milestones Achieved (cont'd)

= Achieved Ahead of Deadline

Project	Milestone	Deadline	Date Completed
Central Flowpath			
Flow Equalization Basin (A-1 FEB)	Initiate Design	4/1/2012	12/16/2010
	Submit Permit Applications	12/1/2012	9/17/2012
	Design Status Report	3/1/2013	2/1/2013
	Complete Design	8/1/2013	7/24/2013
	Initiate Construction	6/30/2104	10/10/2013
	Construction Status Report	3/1/2015	2/26/2015
STA-2 Expansion: Compartment B	Initial flooding and optimization period complete	5/31/2014	5/30/2014
Western Flowpath			
STA-5/6 Expansion: Compartment C	Initial flooding and optimization period complete	5/31/2014	5/30/2014

Upcoming Consent Order Milestones

Project	Milestone	Deadline
Eastern Flowpath		
4,700-acre STA Expansion	Initiate Construction	1/31/2016
S-375 Expansion	Initiate Construction	1/31/2016
Central Flowpath		
Flow Equalization Basin (A-1 FEB)	Construction Status Report	3/1/2016
	Complete Construction	7/30/2016

All milestones with deadlines during the next 12 months are on track to be complete on or ahead of schedule.

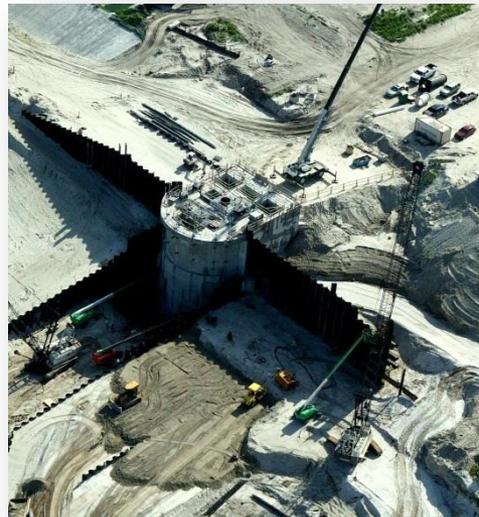
Project Status Update: L-8 FEB

- Revetment construction ~ 96% complete
- Outflow Pump Station ~90% complete
- Inflow Structure ~ 96% complete
- Cell Connection Improvements ~95% complete
- Construction completion expected by **October 2015** (more than 1 year ahead of deadline)

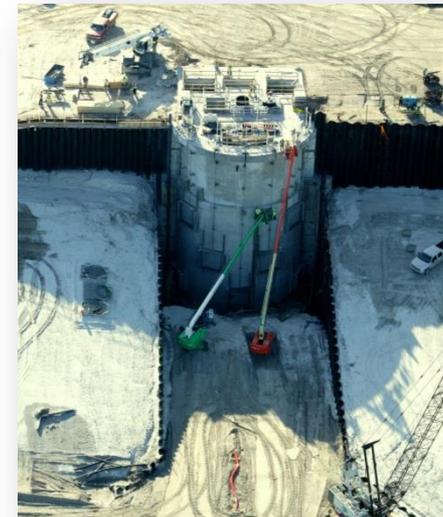
June 2014



May 2015



June 2015



Outflow Pump Station



Outflow Pump Station

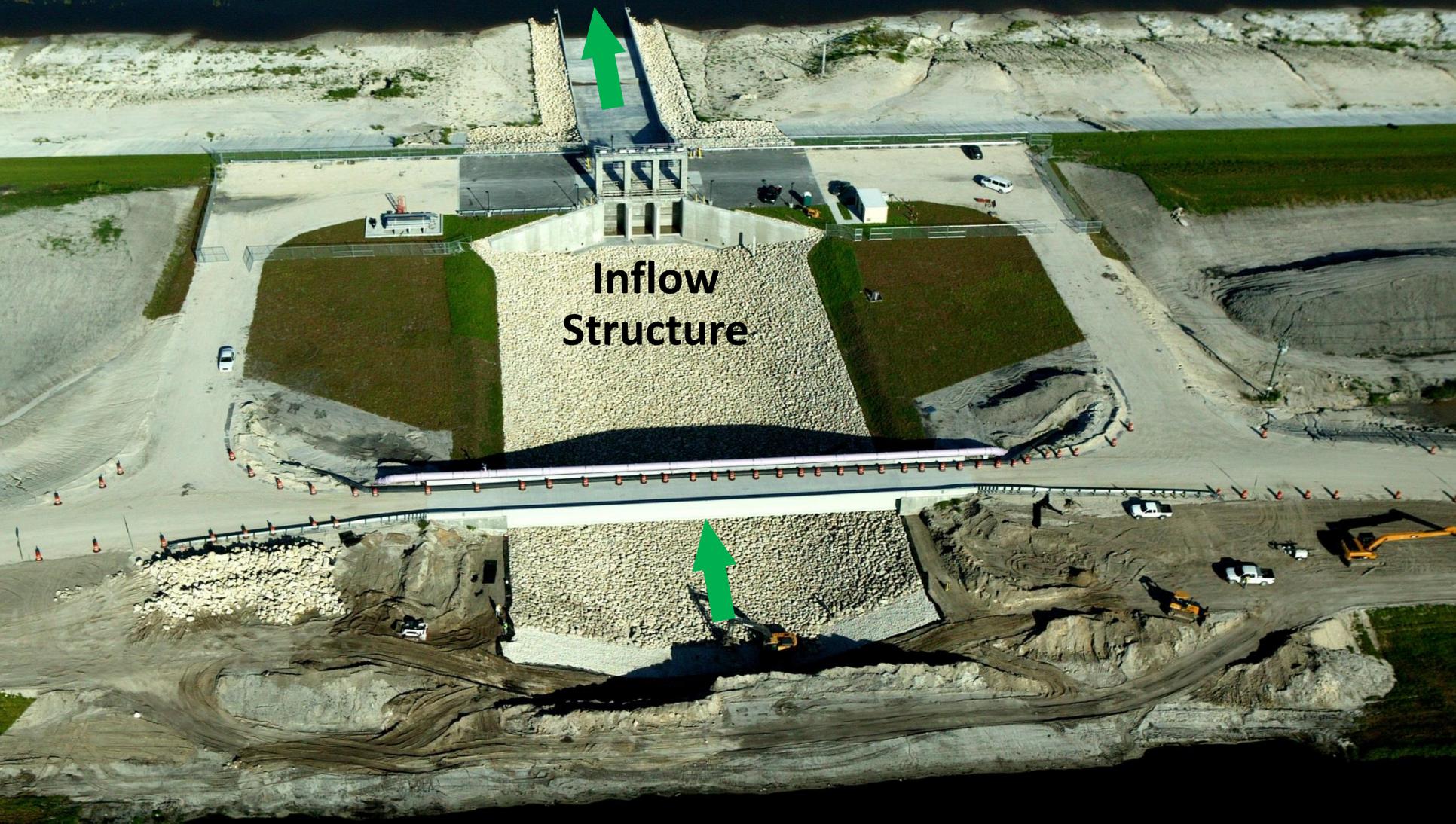
Inflow Structure

L-8 FEB



L-8 Canal

L-8 FEB



Inflow
Structure

June 2015

L-8 Canal



L-8 FEB Outflow
Pump Station

January 2015



L-8 FEB
Outflow
Pump
Station

June
2015

Project Status Update: A-1 FEB

- Construction completion expected **August 2015** (~1 year ahead of deadline)
- Operational Testing and Monitoring anticipated to begin by **September 2015**

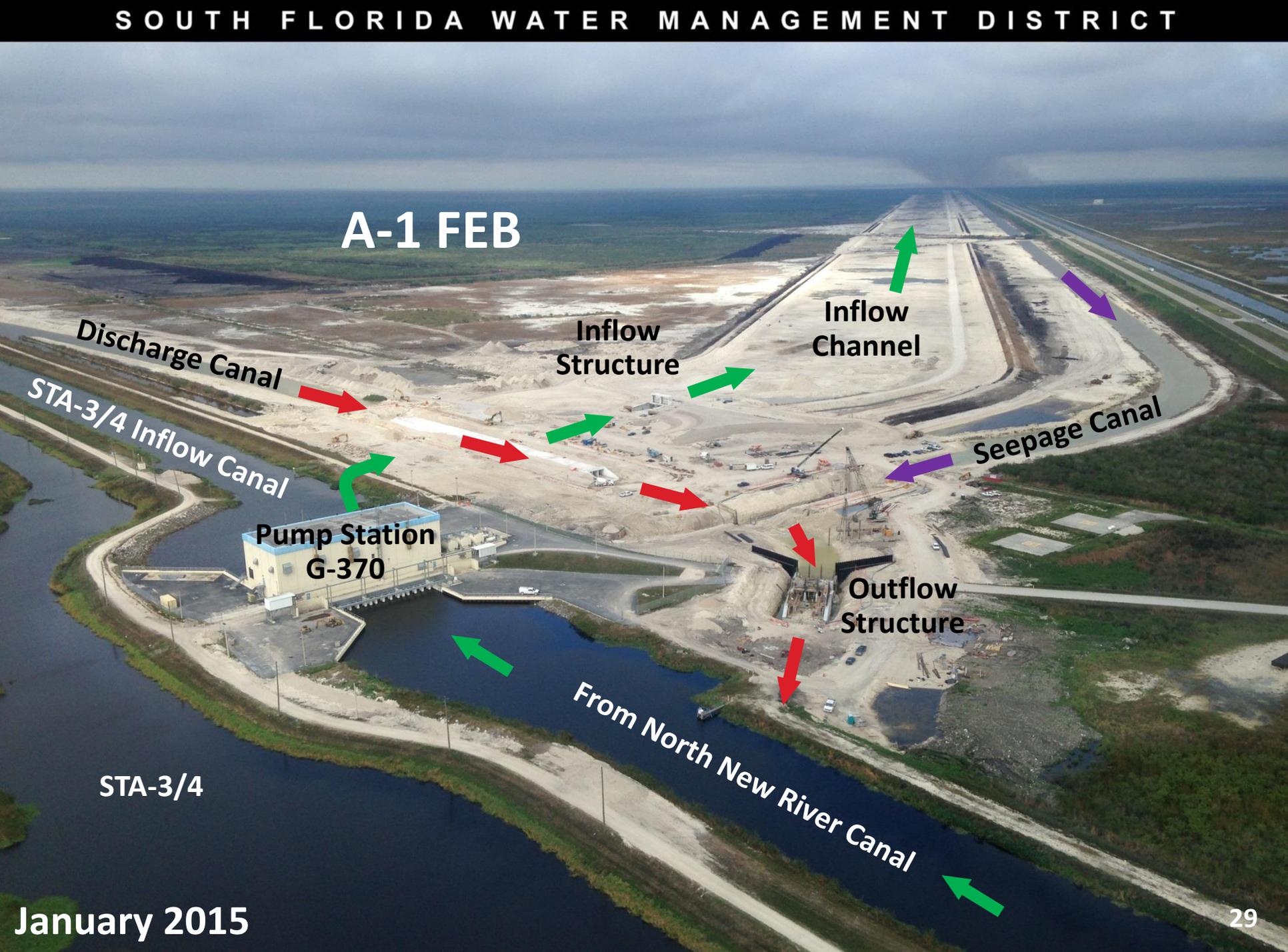
Solar-Powered Outflow Structure to STA-3/4



Inflow Structure G-720



A-1 FEB



Discharge Canal

STA-3/4 Inflow Canal

Pump Station G-370

STA-3/4

Inflow Structure

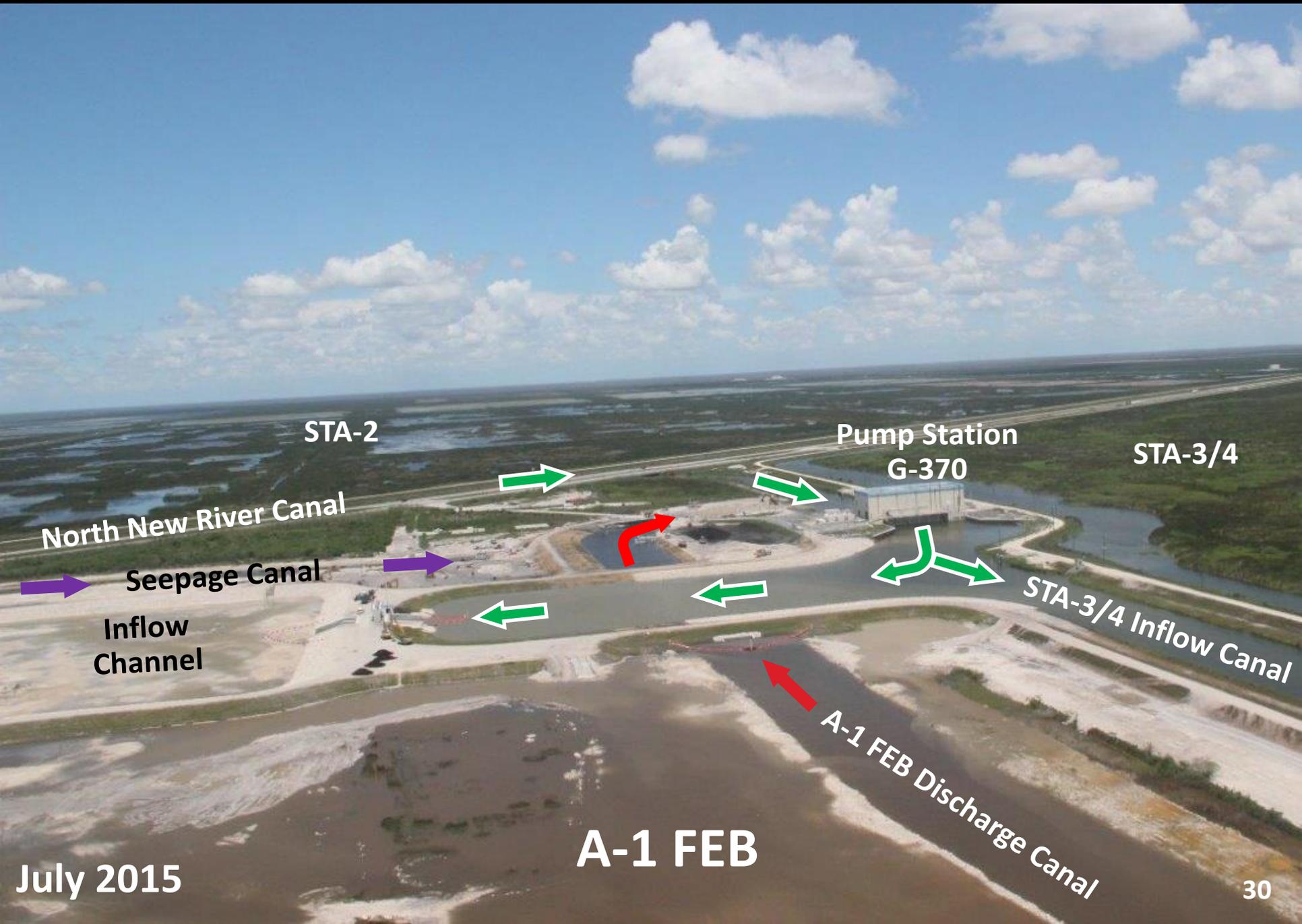
Inflow Channel

Seepage Canal

Outflow Structure

From North New River Canal

January 2015



STA-2

Pump Station
G-370

STA-3/4

North New River Canal

Seepage Canal

Inflow
Channel

STA-3/4 Inflow Canal

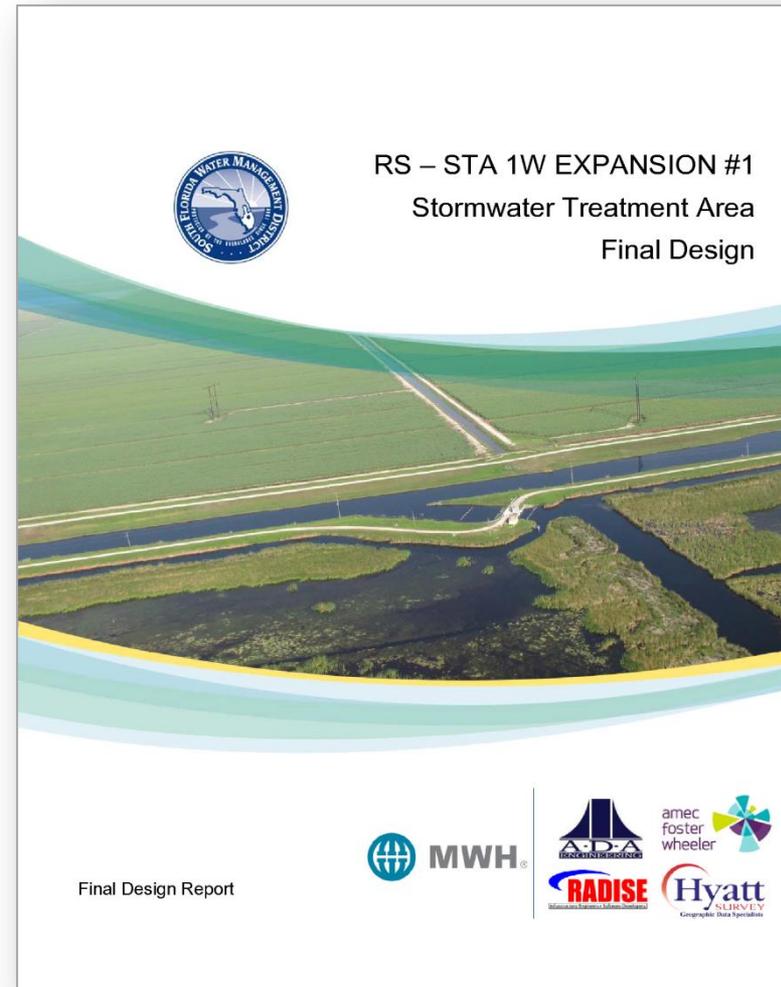
A-1 FEB Discharge Canal

A-1 FEB

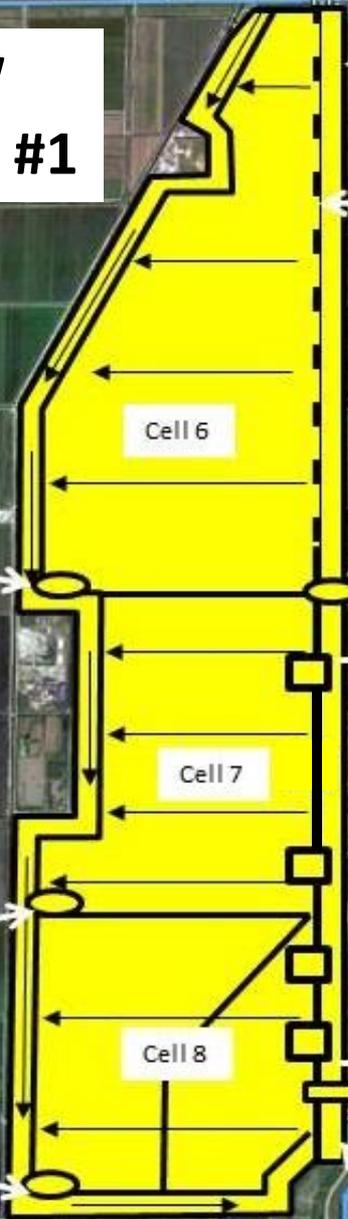
July 2015

Project Status Update: STA-1W Expansion No. 1

- Final Design completed **June 2015**
- Permits expected to be issued **September 2015**
- Construction will begin by **January 2016**
- Environmental remediation will be required prior to conversion of land to an STA
 - Pilot remediation project completed June 2015
 - Coordination with U.S. Fish and Wildlife Service ongoing



**STA-1W
Expansion #1**



Existing STA 1W Discharge Canal



Proposed Levee Degrade

**Existing
STA-1W**

Proposed Gated Spillway



Proposed Gated Box Culverts

Proposed Earthen Plug

Existing Outflow Pump Station G-251

Existing Outflow Pump Station G-310

**Arthur R.
Marshall
Loxahatchee
National
Wildlife Refuge
(WCA-1)**

Proposed Gated Spillway and Overflow Weir

Proposed Gated Spillway and Overflow Weir

Proposed Gated Spillway and Overflow Weir

Cell 6

Cell 7

Cell 8

G341

E-Canal SMS

S5AS

G311

G301

G302

G300

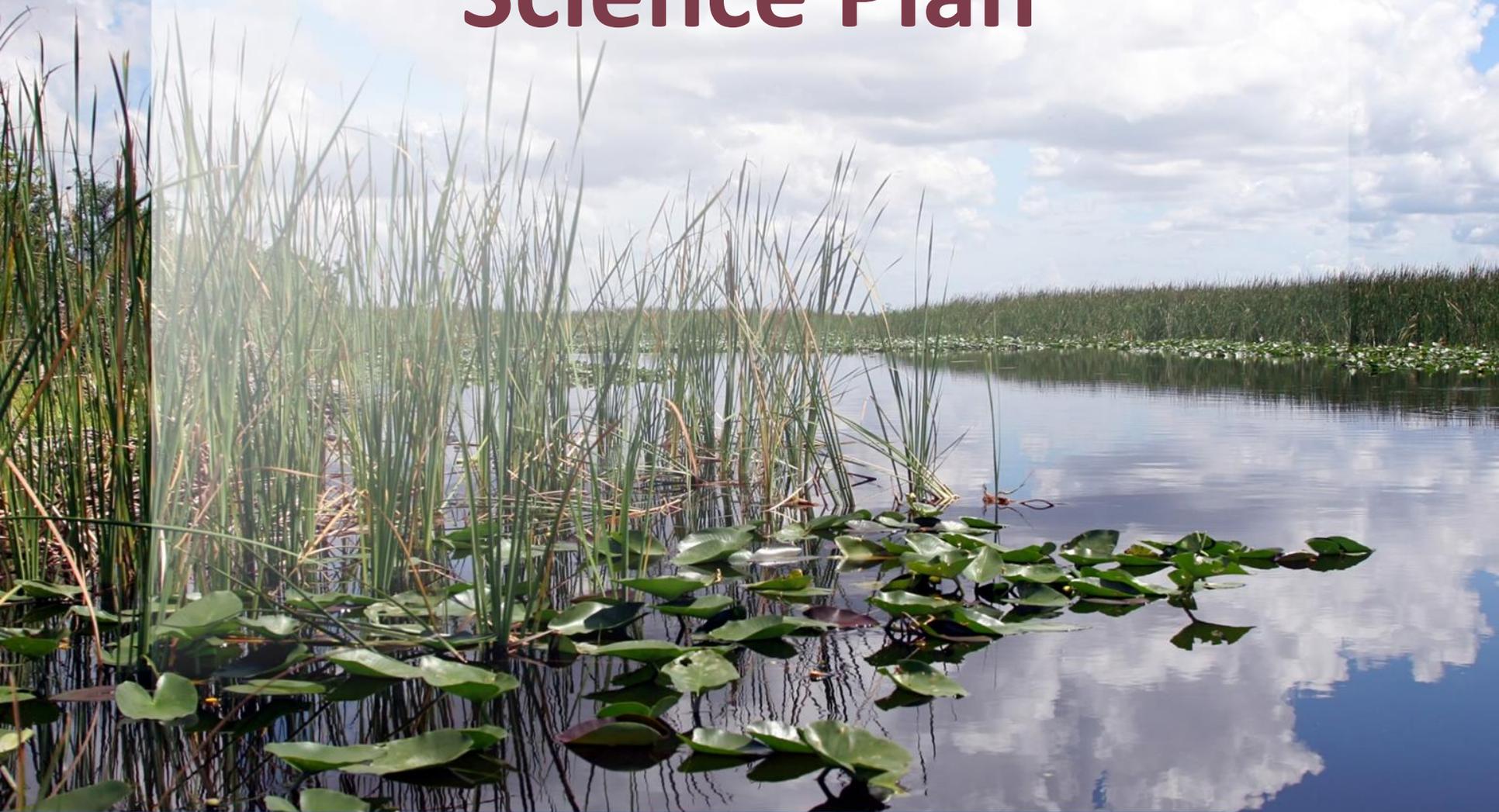
G310

Project Status Update: STA-1E

Repairs and Modifications of STA-1E (by USACE)

- Repairs complete at **36 of 44 culverts**; target completion **July 2016**
- **Outflow pump station trash rake repair** activities completed **April 2013**
- **Inflow pump station trash rake repair** activities started **November 2013**; target completion **July 2015**
- **Decommissioning of the PSTA project** in Cell 2 was completed in **August 2014**; normal operations began **October 2014**
- **Cell 5 and 7 Improvements**: continuing to coordinate with USACE regarding apparent topographic deficiencies to ensure optimum performance is achieved

Restoration Strategies Science Plan

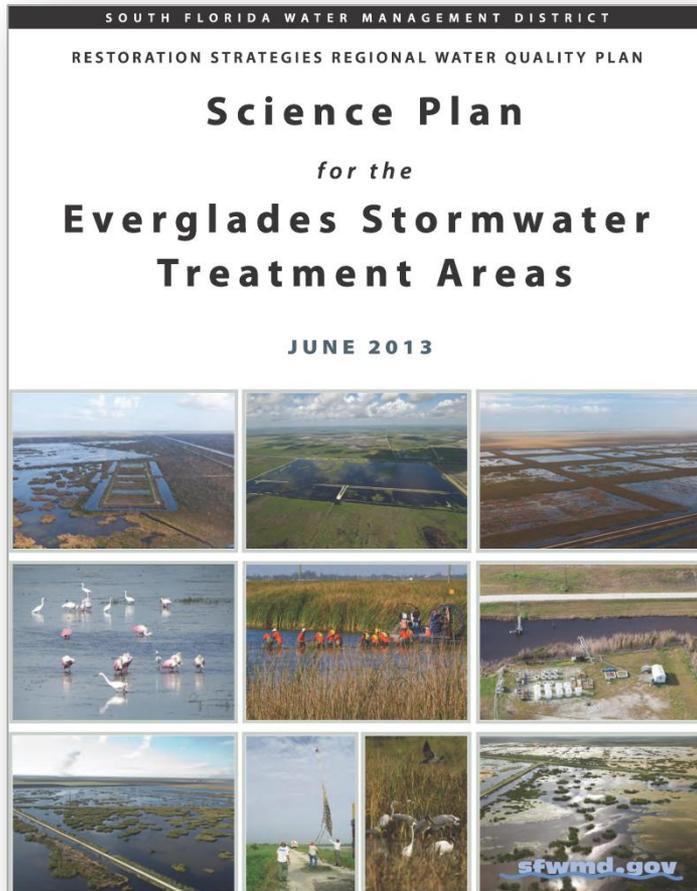


Science Plan

Purpose and Objectives

- Identify the key factors that collectively influence phosphorus reduction and treatment performance in order to meet the WQBEL at each STA
- Identify studies that investigate these key factors that influence phosphorus treatment performance
- Focus on better understanding design and operations that sustain low outflow phosphorus concentrations (<20 ppb)
- Obtain information that can be incorporated into modeling efforts/refinements
- Use information gathered to inform design and operations which will improve the ability of STAs to achieve the WQBEL

Science Plan (cont'd)



- Final Science Plan submitted to FDEP in **June 2013**
- Detailed Study Plans for 8 Science Plan studies updated in **September 2014**
- 17 Technical Representatives (Tech Reps) meetings/ workshops held (**Nov. 2012 – Mar. 2015**)
- Various **private firms and universities** under contract to provide technical support and specialized expertise
- 9 initial Studies in various stages of implementation

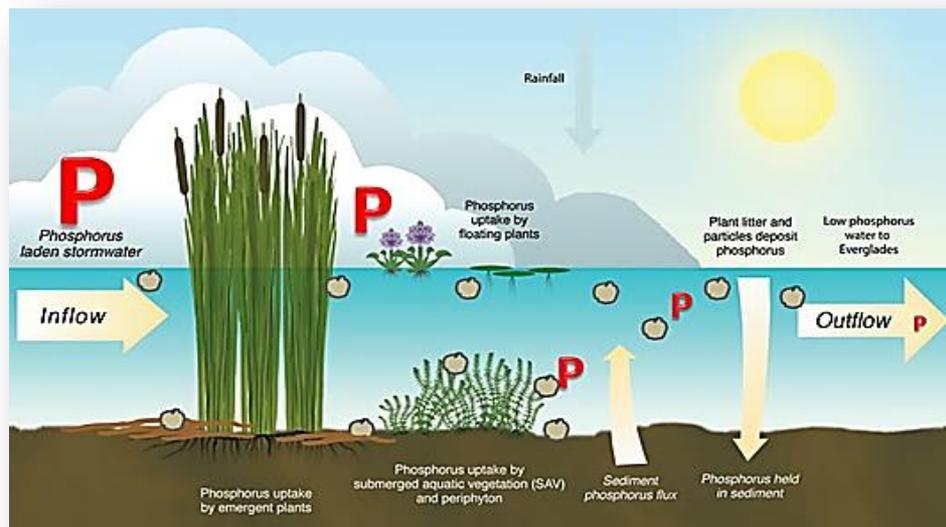
Phosphorus Sources, Forms, Flux, & Transformation Processes in the STAs

Study Objectives/Purpose

- Characterize P sources, speciation, cycling, and transport in STAs, and understand mechanisms and factors influencing P reduction in low P environment

Progress

- Vegetation surveys and data mining ongoing
- Onsite P flux chambers and water quality monitoring platforms have been installed at STA-2 Cell 1 and data collected has started
- Started initial soil and porewater characterization
- Waterfowl surveys are ongoing; additional fauna surveys to start soon



Use of Soil Amendments/Management to Control Phosphorus Flux

Study Objectives/Purpose

- Determine if soil P flux in STAs can be reduced with soil amendments or management techniques (e.g. soil inversion, limerock cap, etc.)

Progress

- Completed literature review of potential soil amendments and management techniques
- Summarized previous findings relevant to controlling P flux in wetlands
- Feasibility of experimental phase and full-scale implementation ongoing



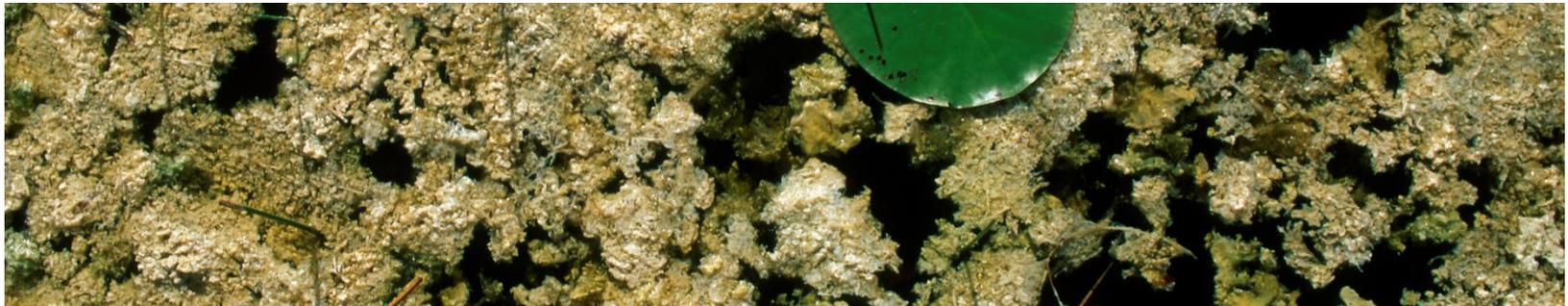
Periphyton-based Stormwater Treatment Area Performance, Design & Operational Factors

Study Objectives/Purpose

- Continue investigation of PSTA cell performance to determine design elements, operational factors, and biogeochemical characteristics that enable the PSTA cell to achieve ultra-low outflow TP levels

Progress

- Continued routine monitoring and analysis
- Completed preliminary analysis of PSTA cell water budget and water quality data; additional groundwater/seepage data being finalized
- Analyzing monitoring results from three pulse tests
- Preparing interim report summarizing results to date to assist in determining feasibility evaluation approach



Evaluate the Use of Alternative Vegetation Occurring in Low P Environments to Achieve Low P STA Discharge

Study Objectives/Purpose

- Evaluate nutrient removal efficacy of alternative vegetation and examine major processes and mechanisms underlying P cycling at very low P conditions in STAs

Progress

- Mesocosm results presented in 2015 South Florida Environmental Report (SFER)
- Compiling additional literature on vegetation in low P environments
- Experimental field study concept development ongoing



Impacts of Deep Water Inundation Pulses on Cattail Sustainability

Study Objectives/Purpose

- Evaluate the influence of deep water inundation pulsing on cattail and provide operational recommendations for STAs and FEBs

Progress

- Comprehensive literature review ongoing
- In-situ investigations at STA-1W and STA-3/4 ongoing
- Performed hydrologic data analysis and evaluated results from wave test in STA-1W Cell 2A to support experimental design
- Completed STA-1W test cell refurbishment



Development of Operational Guidance for FEB and STA Regional Operational Plans

Study Objectives/Purpose

- Develop modeling tools and operational protocols for FEBs/STAs to manage storage and flows and minimize STA outflow P concentrations

Progress

- Completed hydraulic field testing in STA-1W, STA-2 and STA-3/4 to assist in better understanding vegetation resistance in STAs/FEBs
- Refining inverse modeling optimization tool to assist in developing operations/water quality decision support framework
- Developed preliminary guidance for adaptive operational testing and monitoring of FEBs



Evaluation of the Influence of Canals on STA & FEB Inflow & Outflow TP Concentrations

Study Objectives/Purpose

- Develop modeling tools and operational protocols for FEBs/STAs to manage storage and flows and minimize STA outflow P concentrations

Progress

- Completed literature review, data analysis, and field inspections for 6 STA canals and prepared summary report
- Completed STA-1 inflow basin canal investigation and report
- STA-1W discharge canal investigation ongoing



Sampling Methods for Total Phosphorus

Study Objectives/Purpose

- To determine which sampling regime/method provides most accurate representation of TP (since historical grab samples and auto-samplers used for permit compliance have show significant differences)

Progress

- Completed data collection at STA-3/4 PSTA inflow structure and STA-1W outflow pump station G310
- Evaluating results to determine if modifications to sampling methods are needed



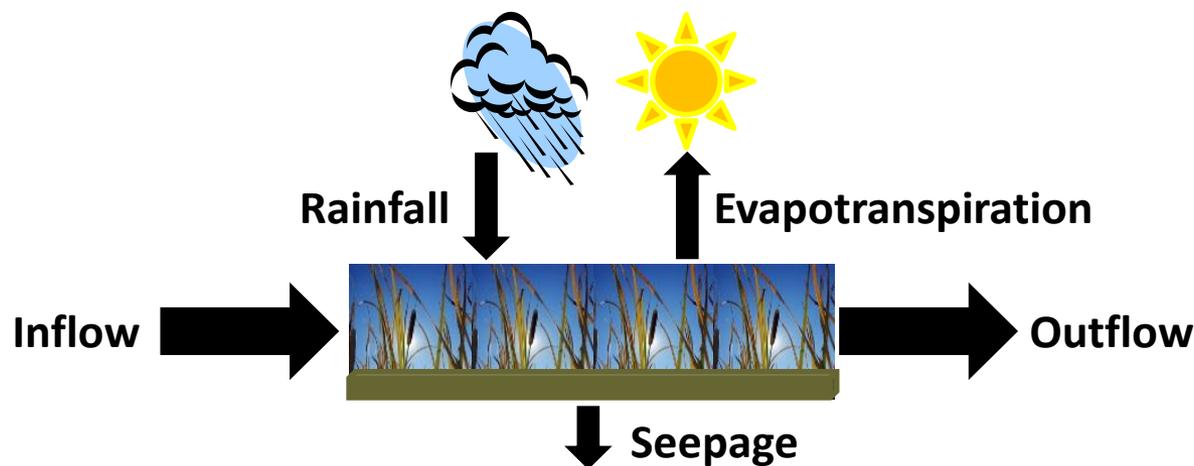
STA Water & Phosphorus Budget Improvements

Study Objectives/Purpose

- Evaluate methods to reduce errors in STA water budgets and develop improved STA water and phosphorus budgets to support Science Plan research

Progress

- Completed flow calculation improvements at STA-1E, STA-2 and STA-3/4
- Finalized test case report for STA-3/4 Cells 3A and 3B
- Water budget tool improvements ongoing



Science Plan: Path Forward

- Continue to implement Science Plan
 - Review relevant literature
 - Collect and analyze historical and new data
 - Document results via reports, technical publications, annual SFER, and peer-reviewed publications
 - Present preliminary findings at internal science forums, Tech Rep meetings, Long-Term Plan public meetings, etc.
 - Continue to have Tech Reps meetings every six (6) months in accordance with Consent Orders
 - Next meeting scheduled for **September 24, 2015**

www.sfwmd.gov/rs_scienceplan

www.sfwmd.gov/techpubs

www.sfwmd.gov/sfer

Water Quality Requirements and Federal and State Laws Intended to Protect Species

Water Quality Requirements and Federal and State Laws Intended to Protect Species

- The Endangered Species Act (ESA) and Migratory Bird Treaty Act (MBTA) currently affect how STAs are operated
- ESA and MBTA will continue to affect how STAs and FEBs are operated
- ESA and MBTA have the potential to impact achievement of Everglades STA water quality criteria (i.e. WQBEL)

Questions?

For more information go to:

www.sfwmd.gov/restorationstrategies

