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Successes and Challenges in Operating the Everglades Stormwater Treatment Areas

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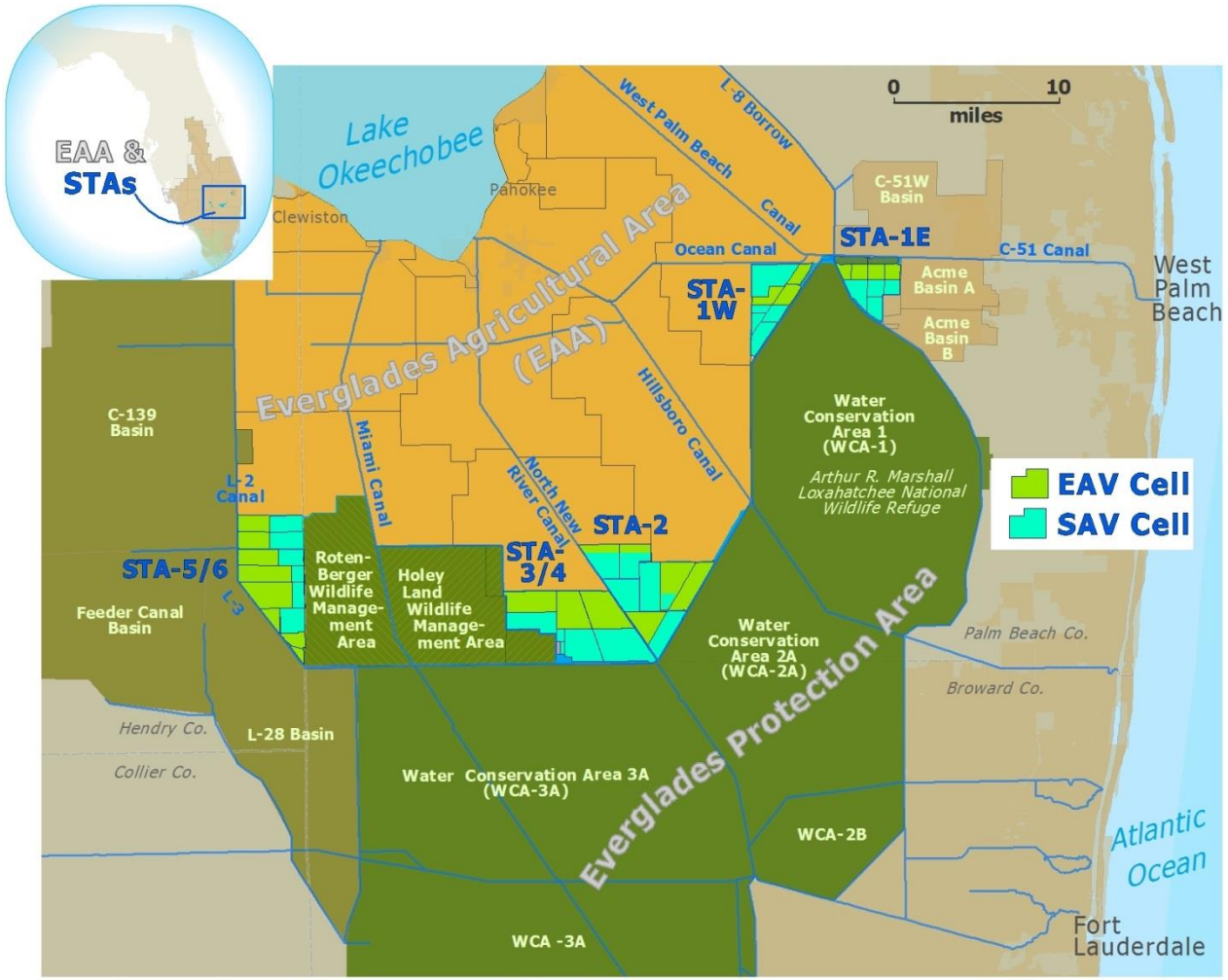
Location of the Five STAs



STA	Treatment Area, acres
1E	4,994
1W	6,544
2	15,495
3/4	16,327
5/6	13,685
Total	57,045

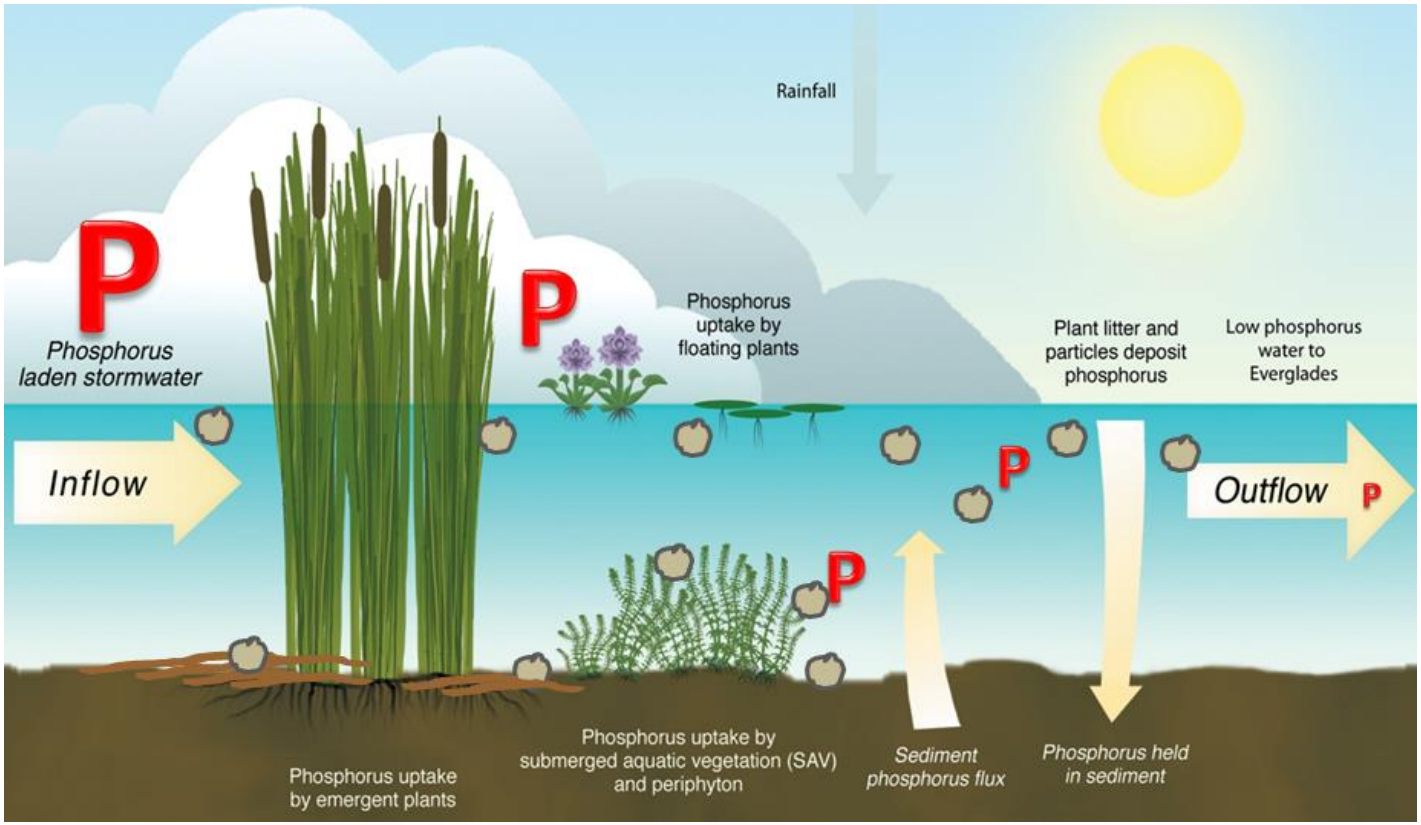
Purpose and Mandates

- Reduce phosphorus in runoff water prior to discharging to the Everglades Protection Area.
- Mandates:
  - Everglades Forever Act
  - NPDES and EFA permits
  - Consent orders
- Current Water-quality based effluent limit (WQBEL) for TP
  - Maximum of 19 ppb Annual Flow-weighted Mean
  - Not to exceed 13 ppb long-term flow-weighted mean in more than three (3) out of five (5) years.

STA Design

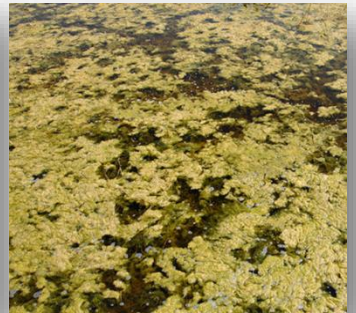
- Shallow constructed wetlands
  - ~ 40 cm water depth target
- Water delivery through gravity and pump flow structures
- Vegetation types
  - Emergent Aquatic Vegetation (EAV)
  - Submerged Aquatic Vegetation (SAV)
- Target Hydraulic Retention Time:
  - 10–20 days
- Target P loading rate: <1 $g/m^2/yr$
- Original expected P load removal: >74%

Phosphorus Removal Process



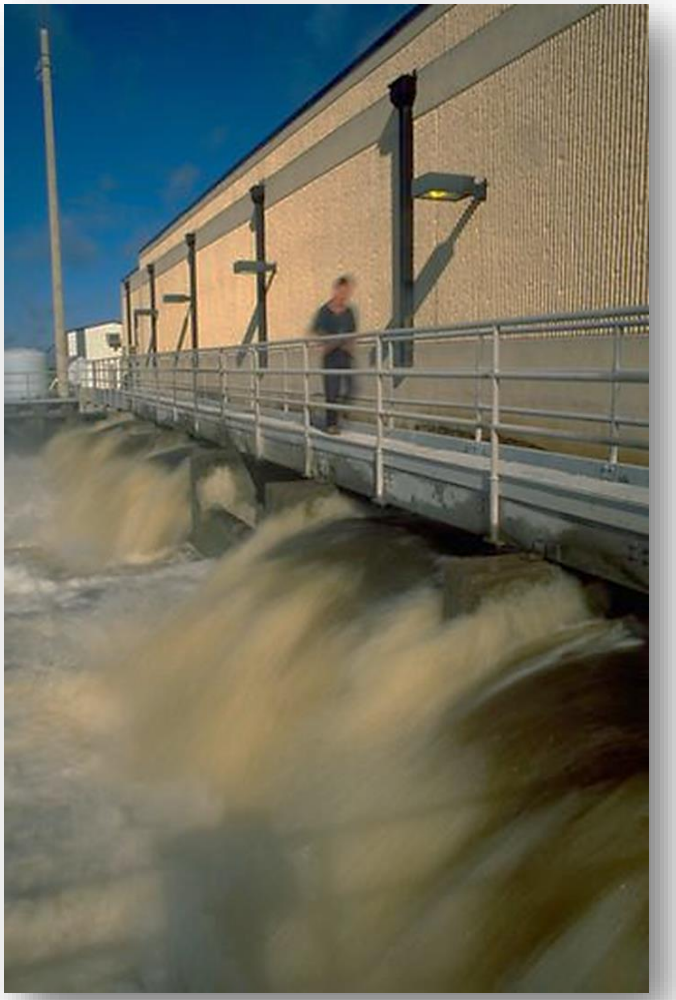
- Particulate settling
- Plant uptake
- Microbial uptake
- Binding with cations, e.g. Ca
- Phosphorus cycling
- Burial




STA Operational Strategies

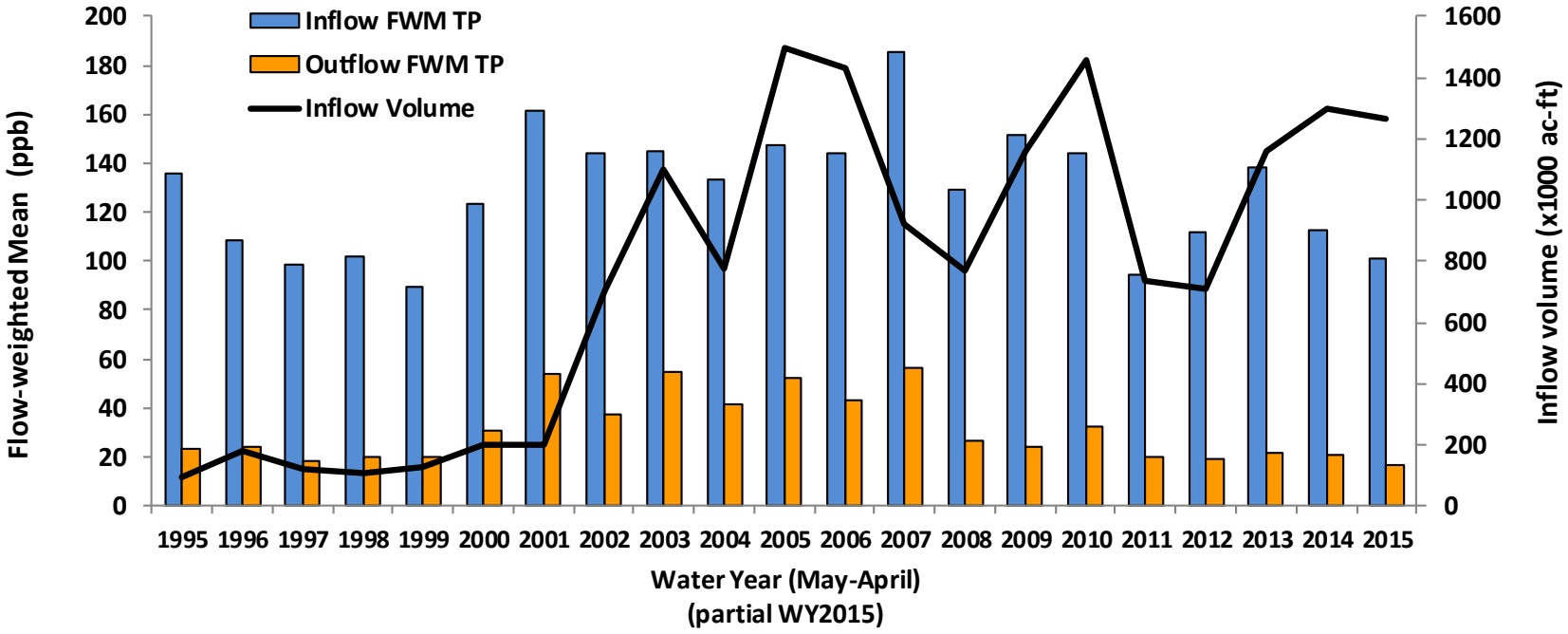
- Overall: Treat all runoff water within STA capacity and considering desired STA treatment performance and flow-way restrictions
- Maintain optimal hydraulic and phosphorus loading
- Maintain optimal water depth for vegetation (~40 cm)
  - Avoid too deep for too long
  - Avoid dryout
- Adaptive management for performance optimization
- Use weekly data and information in prioritizing flows

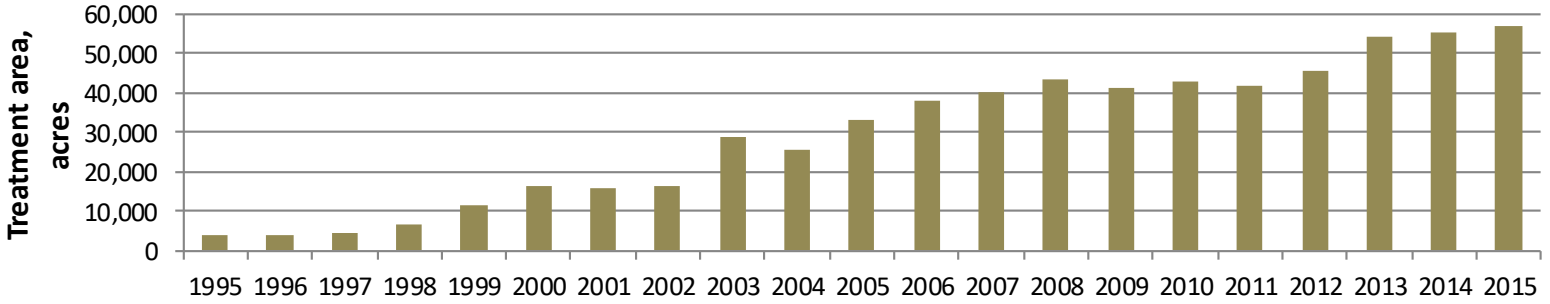


Long-Term STA Performance

Parameter	Period of Record	WY2015
Total volume treated (ac-ft)	16.1 million	1.4 million
HLR (cm/d)	1.0-5.7	2.0 (0.6-2.9)
PLR ($g/m^2/yr$)	0.5-3.0	0.8 (0.5-1.8)
TP load retained (mt)	1,874	147
% of load retained	75	81
Inflow concentration, µg/L	137 (101-180)	113 (71-198)
Outflow concentration, µg/L	34 (17-71)	21 (14-41)

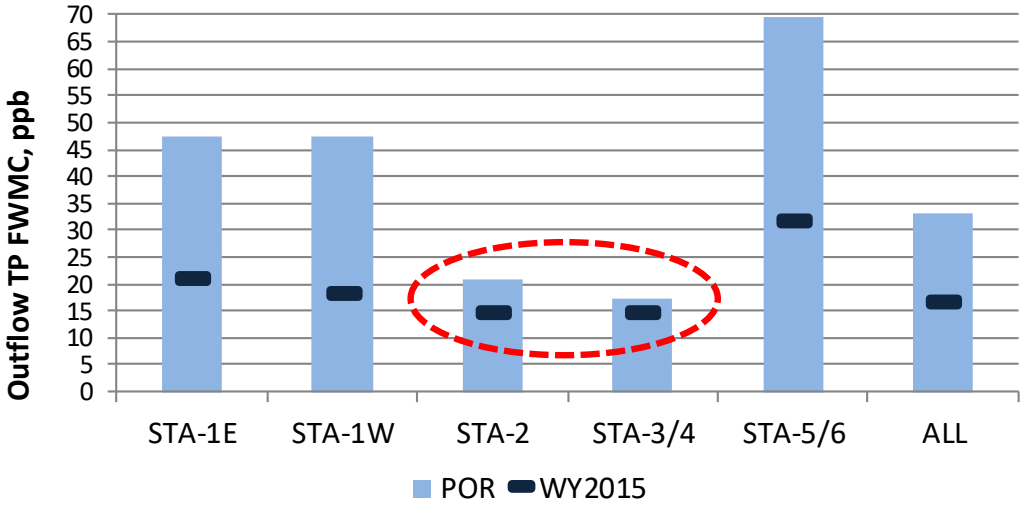
Annual Flows and TP Concentrations

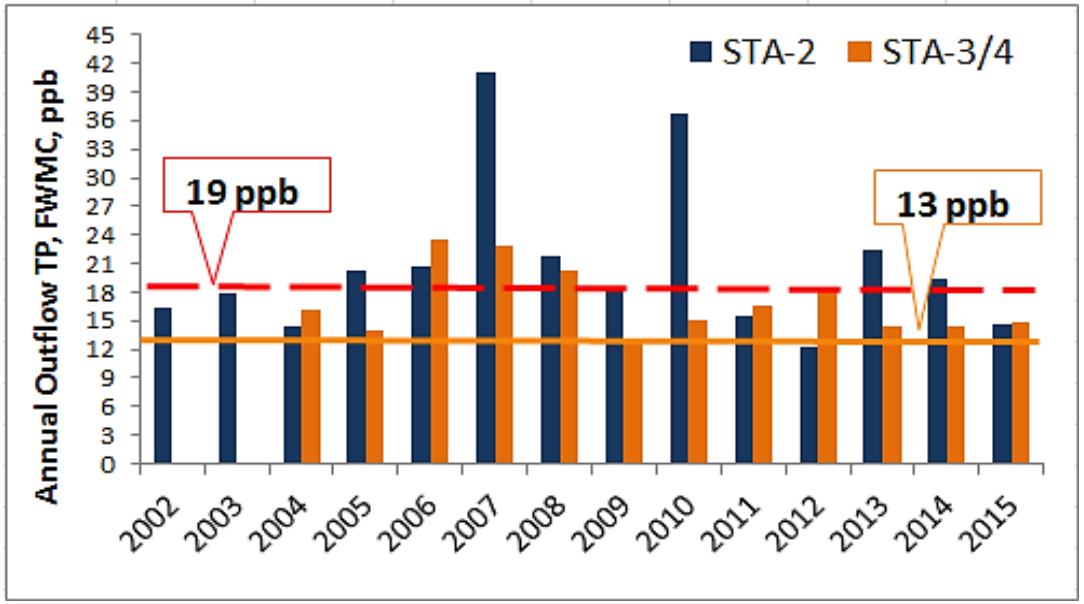




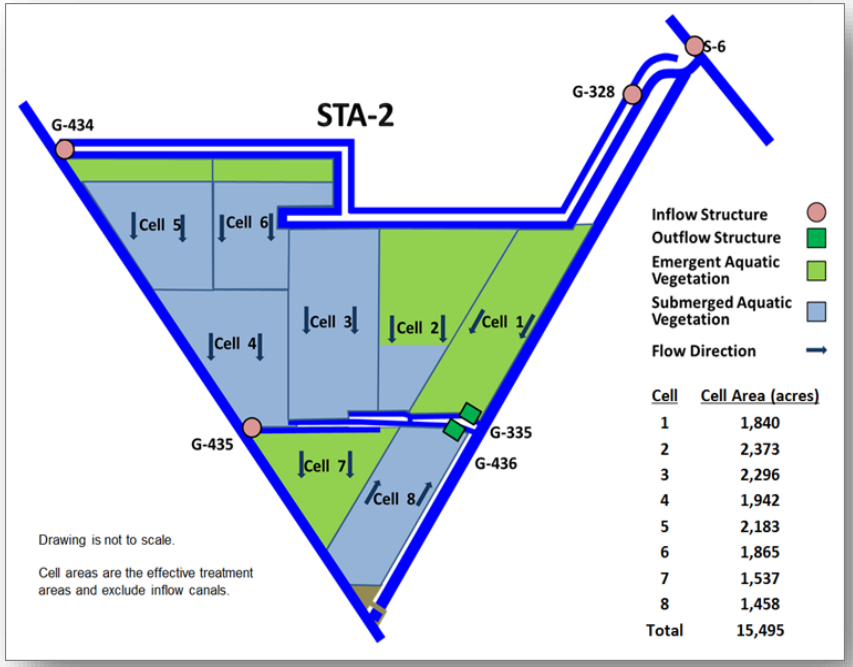
Annual Outflow TP Concentration

- **POR outflow FWMC**: 17 (STA-3/4) to 70 ppb (STA-5/6)
- **WY 2015 outflows**: 15 (STA-2 & STA-3/4) to 32 ppb (STA-5/6)
- STA-2 & 3/4 frequently achieved ≤19 ppb; each achieved≤ 13 ppb once

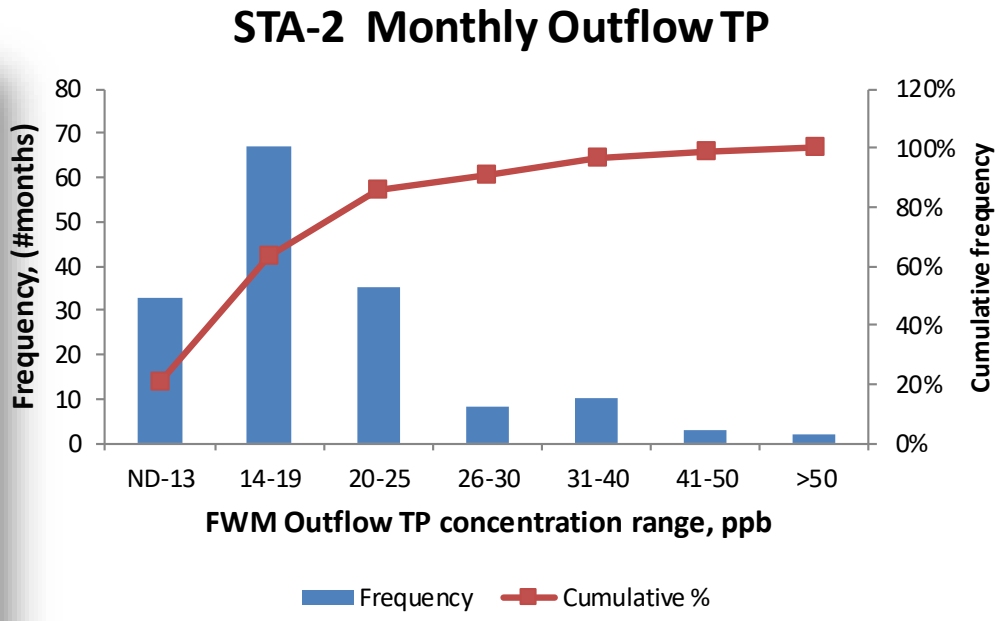




STA-2 Monthly & Seasonal Outflow TP Distribution

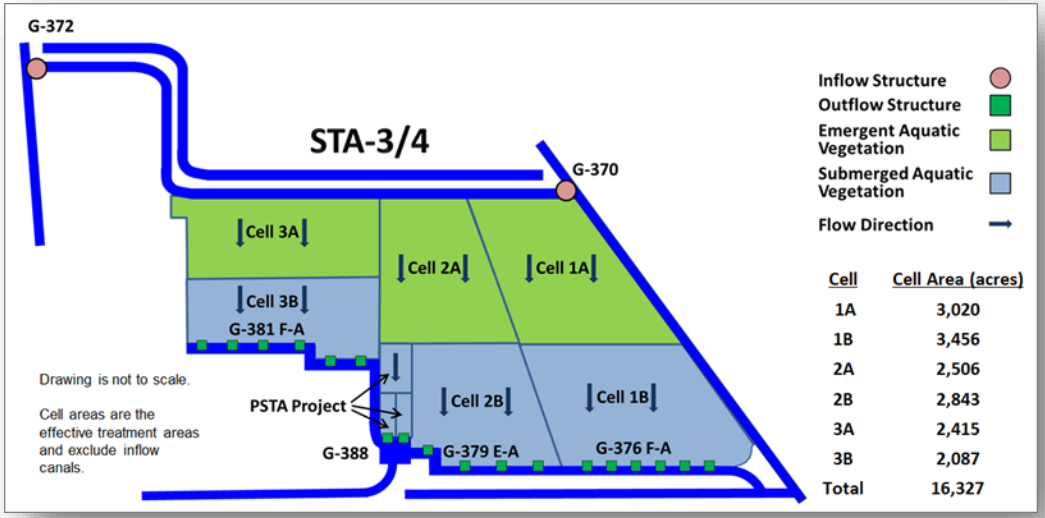


Cell	Cell Area (acres)
1	1,840
2	2,373
3	2,296
4	1,942
5	2,183
6	1,865
7	1,537
8	1,458
Total	15,495

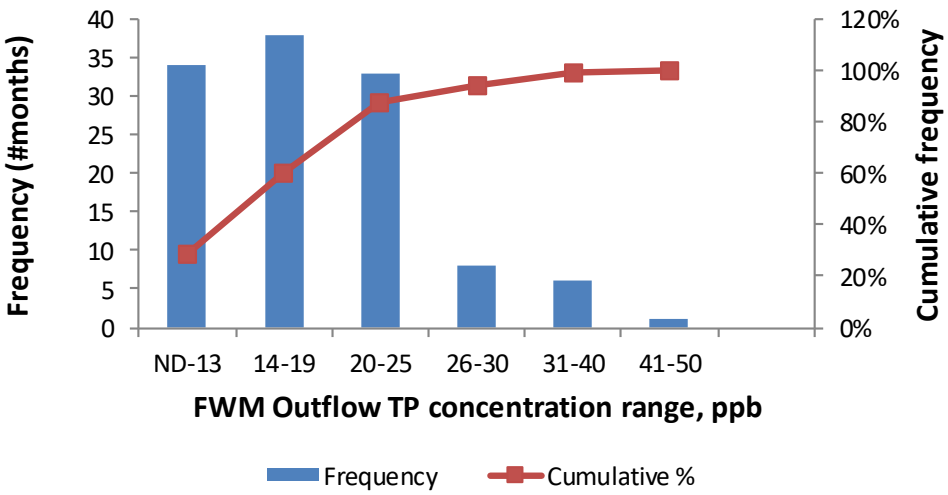


- 13 ppb or less – 21% of the time
- 19 ppb or less - 63% of the time

STA-3/4 Monthly & Seasonal Outflow TP Distribution



Monthly Outflow TP Frequency Distribution



- 13 ppb or less - 28% of the time
- 19 ppb or less – 60% of the time

Operational Constraints and Challenges

- Performance of biologically-based treatment systems like the STAs is naturally variable
- Integral components of a complex water management system with multiple objectives
- Receives variable inflows, which affects the amount of phosphorus in the outflows
- Highly managed systems
  - routine operations and maintenance
  - controlling flows and stages
  - monitoring and optimization are necessary
  - Enhancements and repairs

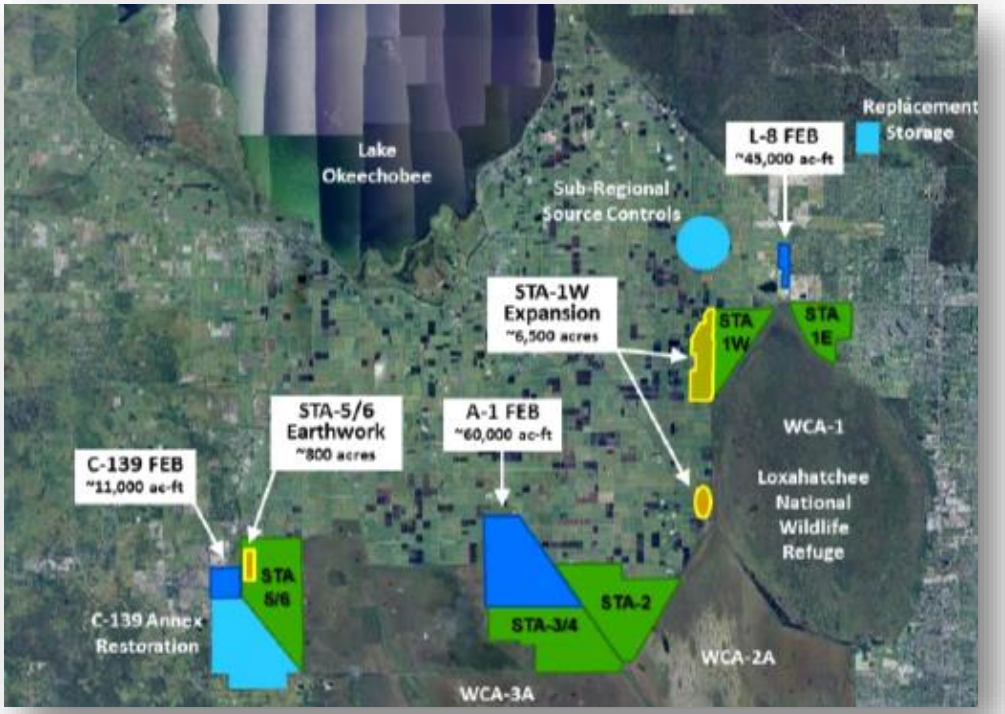
Operational Constraints and Challenges (continued)

- Wildlife use of the STAs can impact operations
  - Migratory Bird Treaty Act, Endangered Species Act, Bald Eagle Protection Act
  - Shared use of the STAs, which includes recreational (bird-watching and hunting)




Long-Term Plan

- Adaptive management implementation
- Specific plans to improve each STA through structural and operational improvements and scientific research
- Added Restoration Strategies (2013)
  - Additional areas, including Flow Equalization Basins
  - Restoration Strategies Science Plan



RS Science Plan

- Objective: Investigate the key factors and mechanisms that collectively influence TP reduction and treatment in the STAs.
- Use results to enhance the design and operations, as well as to develop new or enhance existing management strategies.
- Initial studies include investigation of biogeochemical characteristics and transformations of phosphorus in low P environment, influence of canal systems, cattail sustainability, periphyton-based treatment, and alternative vegetation.