WELCOME

Robert Shuford
Lead Scientist
Ecosystem Restoration and Capital Projects

20th Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins
February 27, 2023

AGENDA

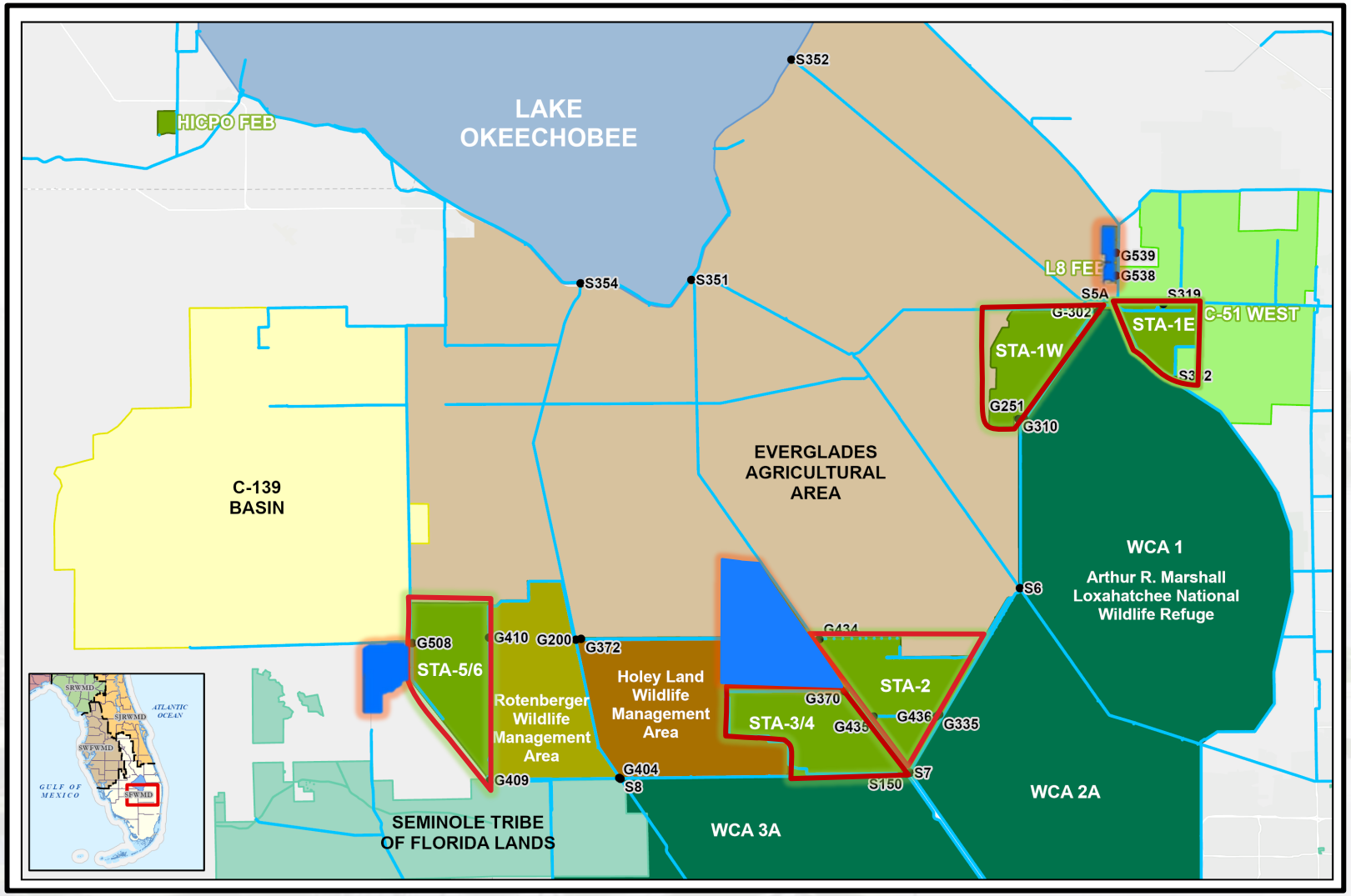
1. Welcome and Introduction Robert Shuford, Ecosystem Restoration and Capital Projects Bureau	**9:00**
2. System Conditions Robert Shuford, Ecosystem Restoration and Capital Projects Bureau	**9:05**
3. Everglades Stormwater Treatment Areas (STA) Performance Update Jake Dombrowski, Applied Sciences Bureau	**9:25**
4. STA Vegetation Management and Enhancement Eric Crawford, Land Resources Bureau	**9:45**
5. Restoration Strategies: Stormwater Treatment Area (STA) Science Plan Update & Highlights Tom James, Applied Sciences Bureau	**10:05**
6. Restoration Strategies: Design and Construction Update Lucine Dadrian, Engineering and Construction Bureau	**10:25**
7. Southern Everglades Nutrient Source Control Program Update Youchao Wang, Ecosystem and Capital Projects Division & Steve Sarley, Regulation Division	**10:45**
8. Public Use on SFWMD Stormwater Treatment Areas James Harbaugh, Land Resources Bureau	**11:05**
9. Public Comment	**11:25**

System Conditions

Robert Shuford
Lead Scientist
Ecosystem Restoration and Capital Projects

20th Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins
February 27, 2023

Restoration Strategies Projects



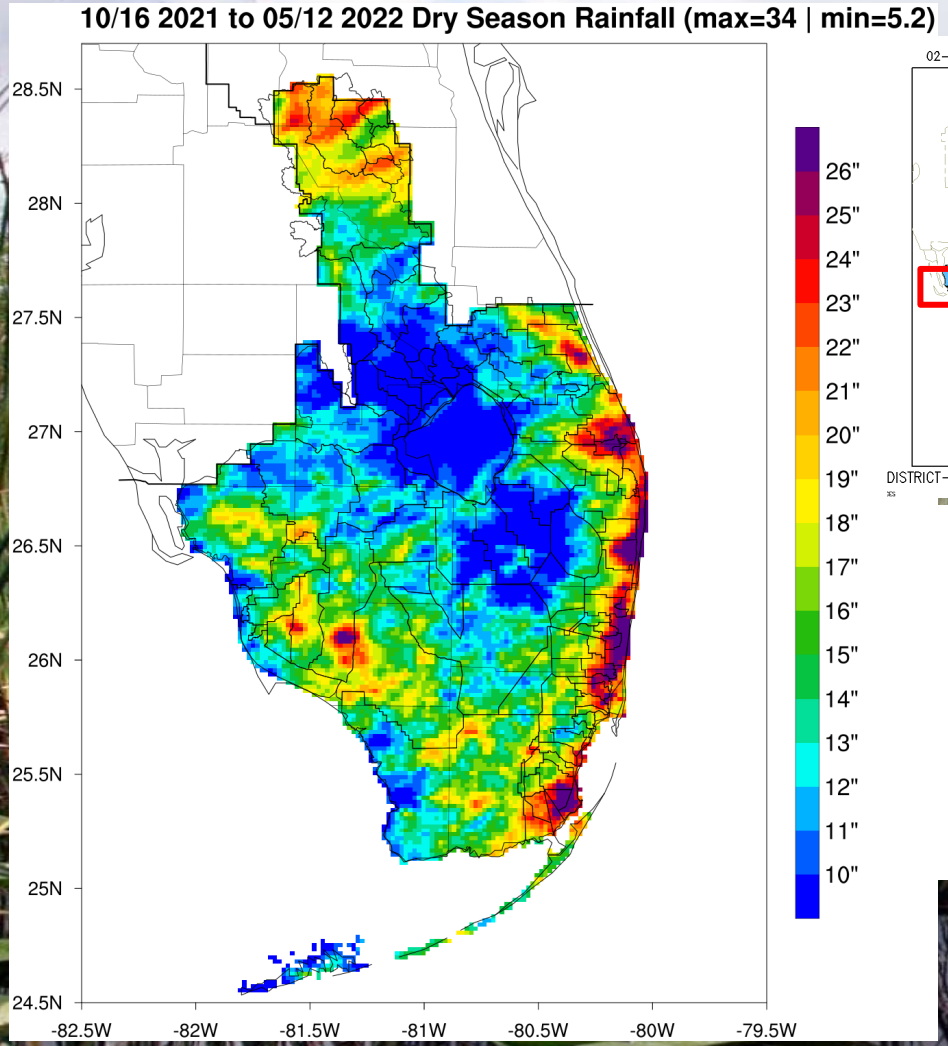
Presenter: Robert Shuford

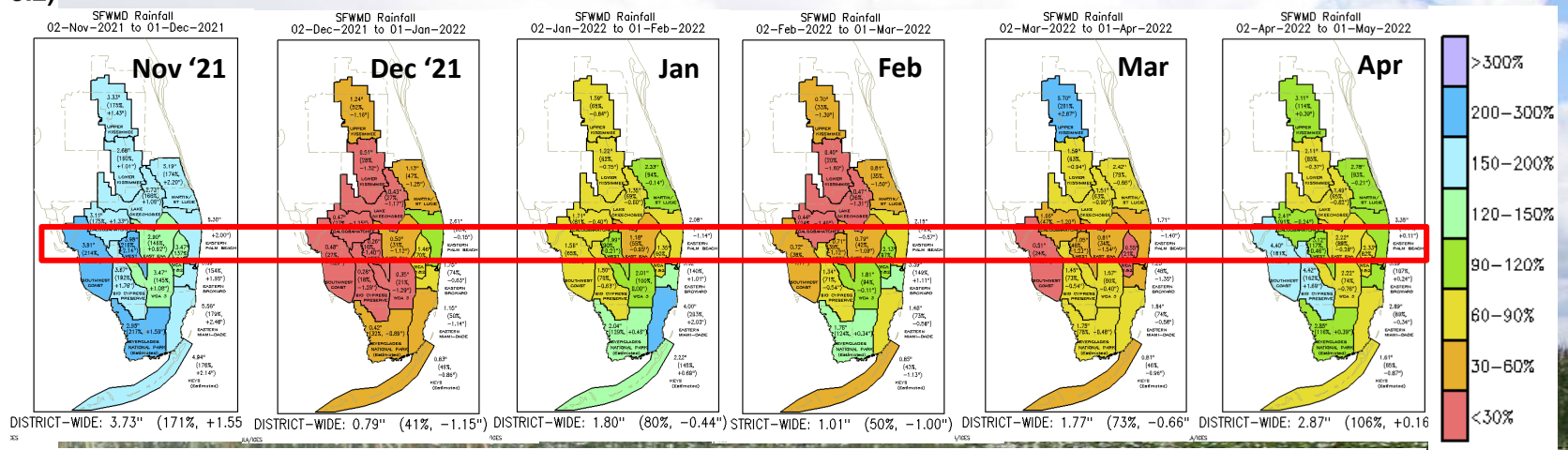
Water Year 2023
(May 1, 2022 – Apr 30, 2023)

May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
WET SEASON						DRY SEASON					

Presenter: Robert Shuford

Dry Season Rainfall
Water Year 2022

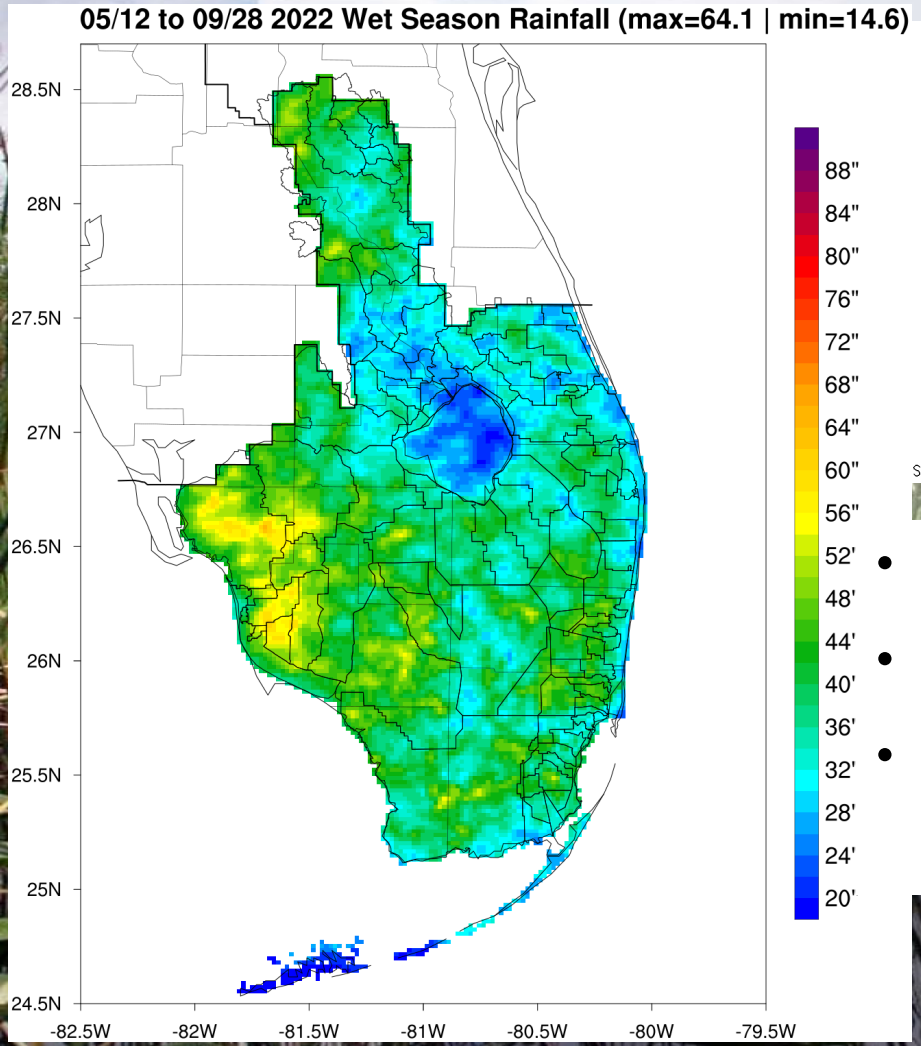


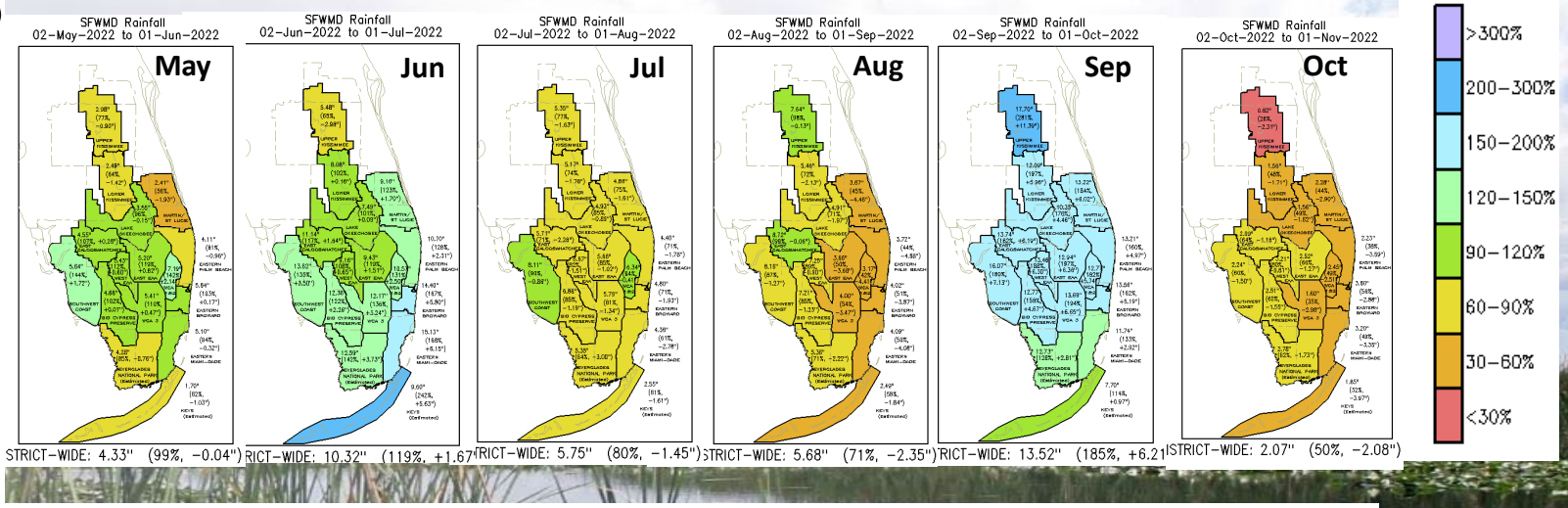


- Dry Season near normal District-wide
- Nov 2021 extremely wet in C-139, EAA, C51W
- Dec 2021 and Mar 2022 extremely dry everywhere
- Especially dry in areas of interest

Presenter: Robert Shuford

Wet Season Rainfall
Water Year 2023

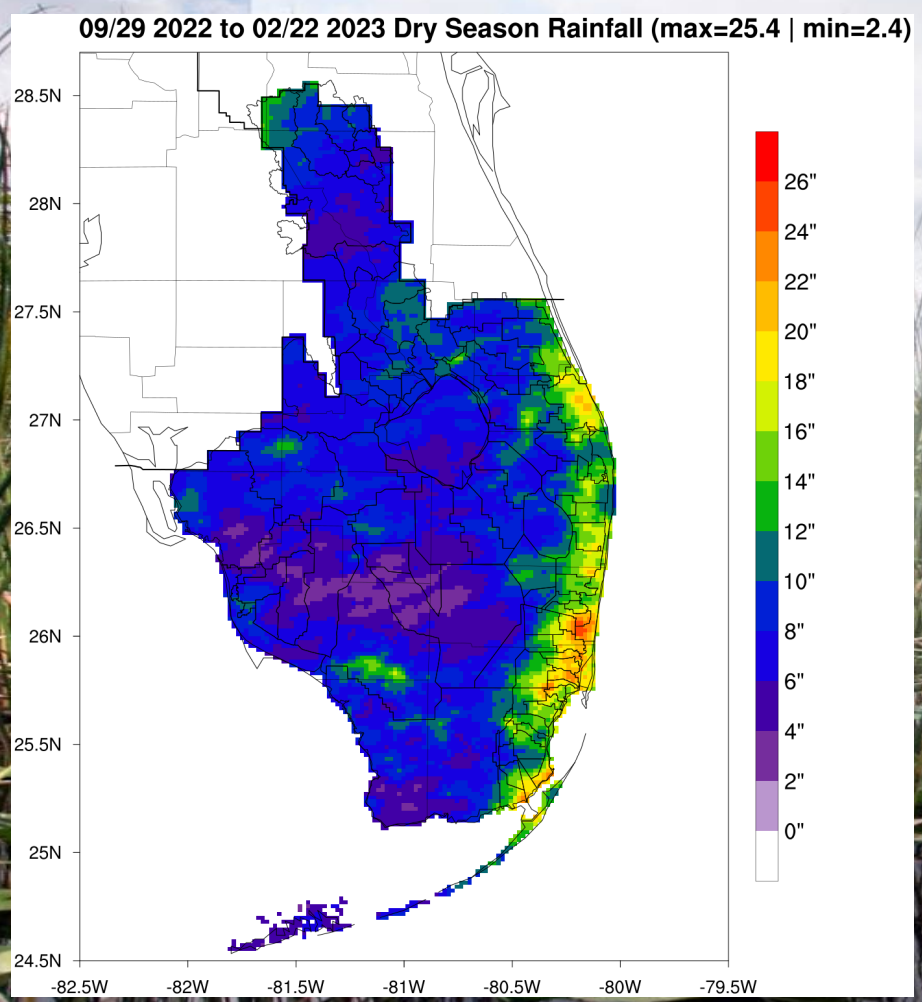


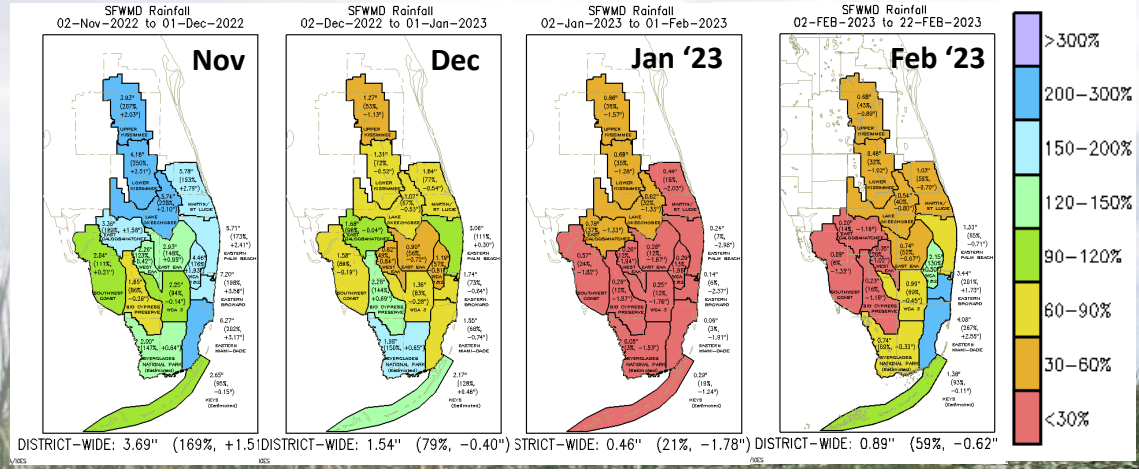


- Wet Season normal in the southern region of the District
- Jul, Aug, and Oct dry District-wide
- Sept. very wet every (Hurricane Ian)

Presenter: Robert Shuford

Dry Season Rainfall
Water Year 2023

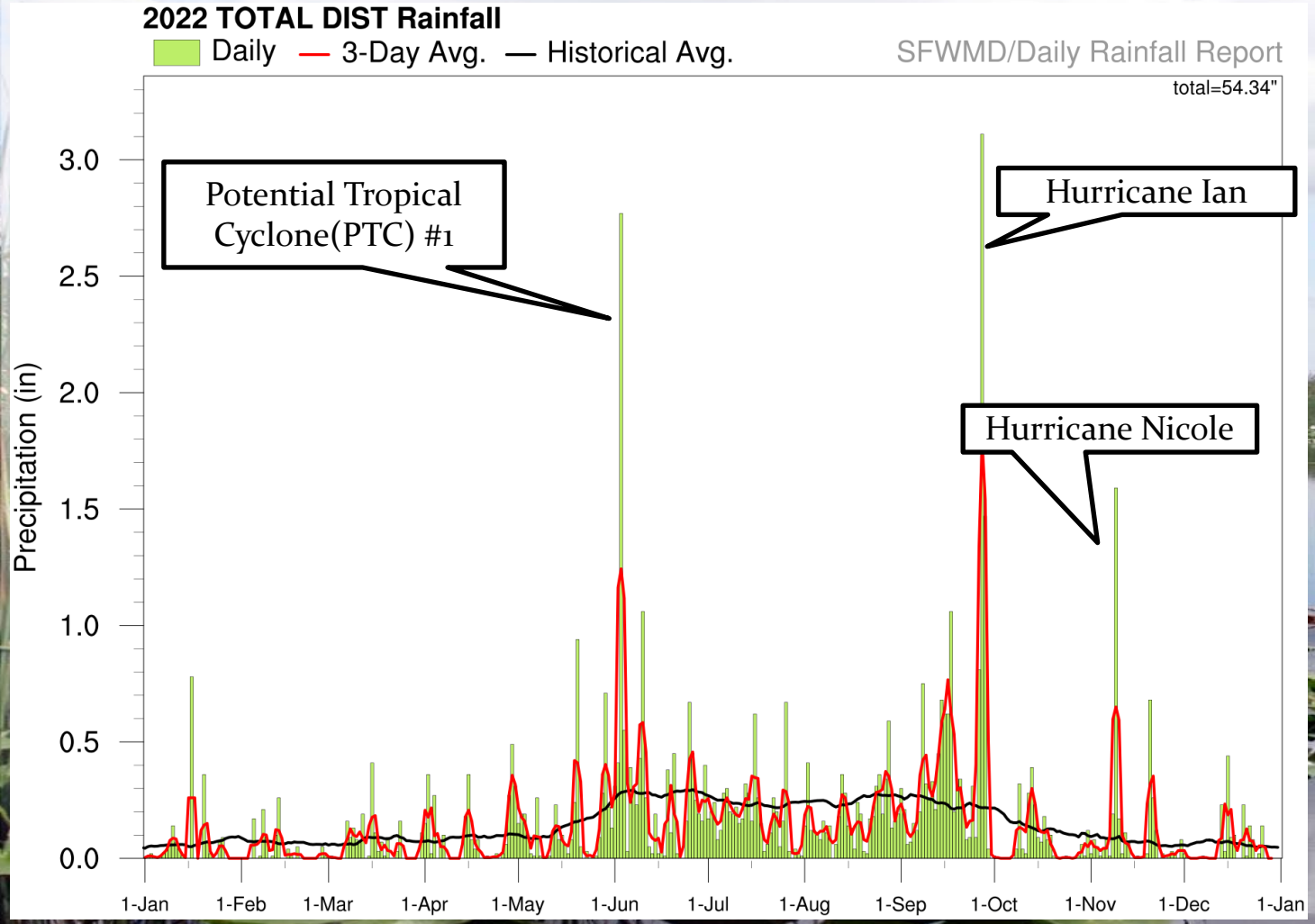




- Dry Season near normal District-wide
- Nov 2022 wet in Kissimmee Valley and East Coast (Hurricane Nicole)
- Jan 2023 and Feb 2023 extremely dry

Presenter: Robert Shuford

Water Year 2023 Rainfall

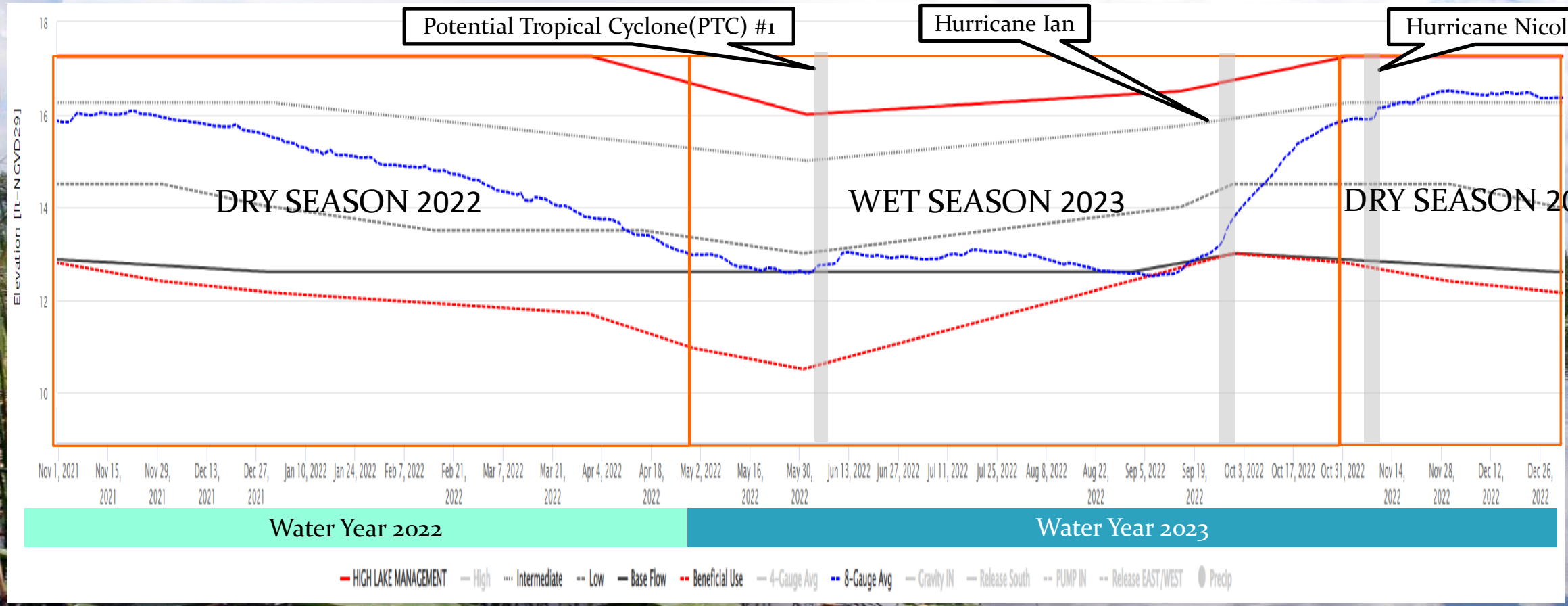


Major Rain Events of WY2023

- PTC1 – June 4
- Hurricane Ian – September 28
- Hurricane Nicole – November 10

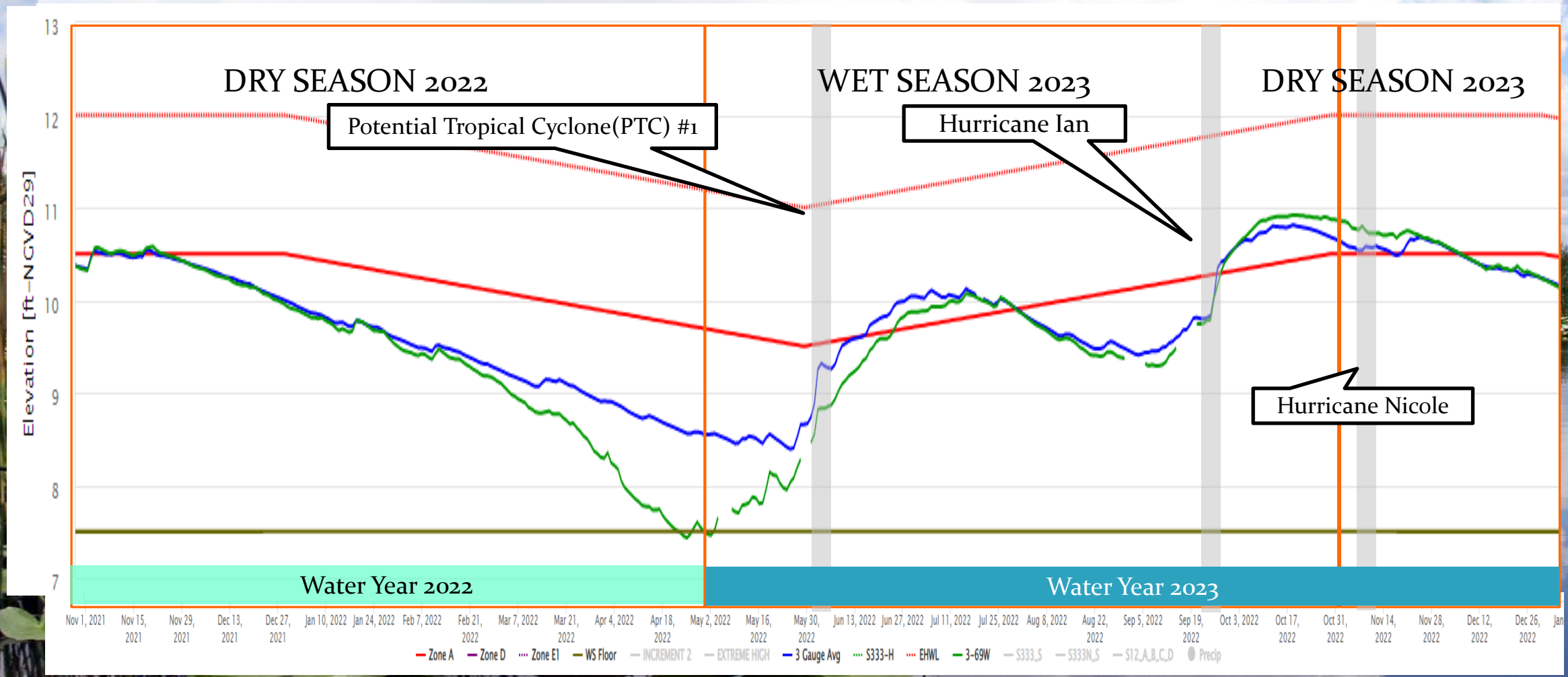
Presenter: Robert Shuford

Lake Okeechobee



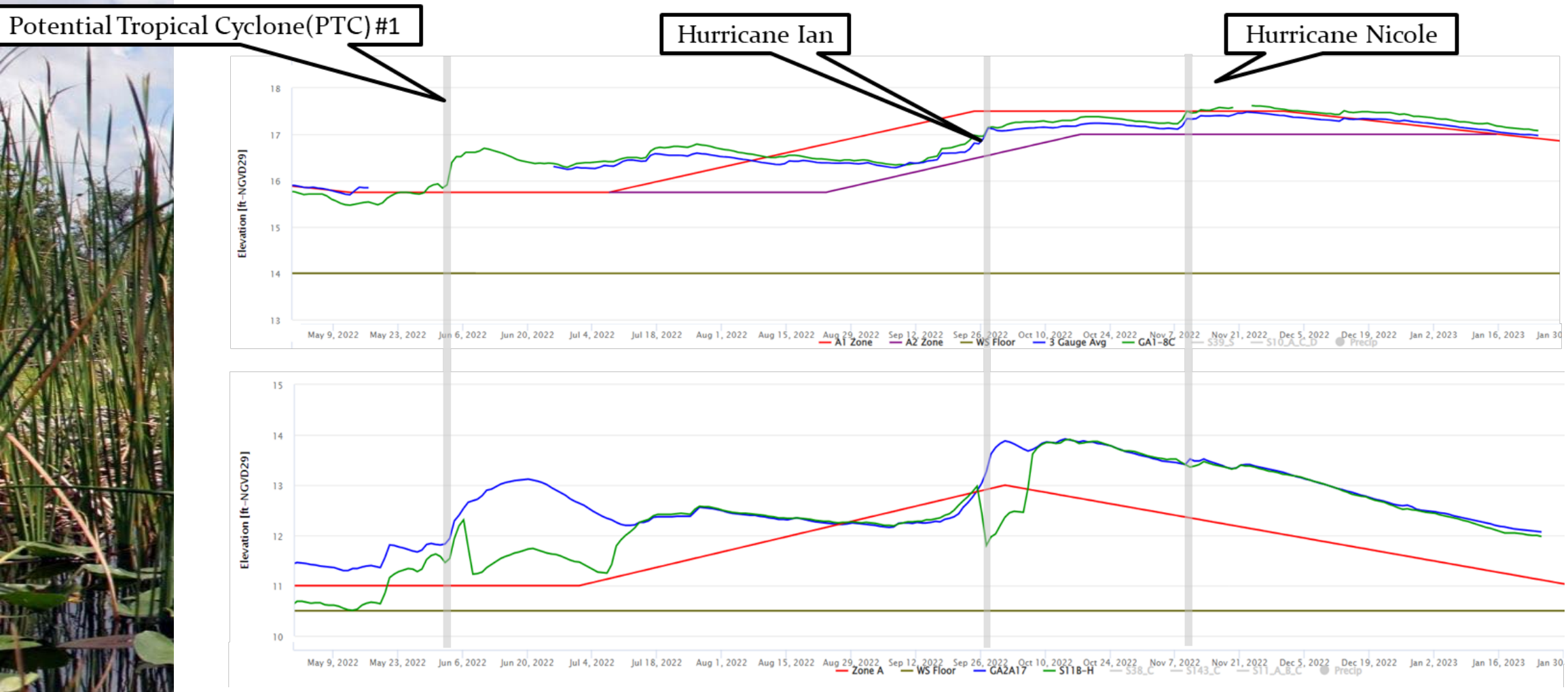
Presenter: Robert Shuford

WCA 3A



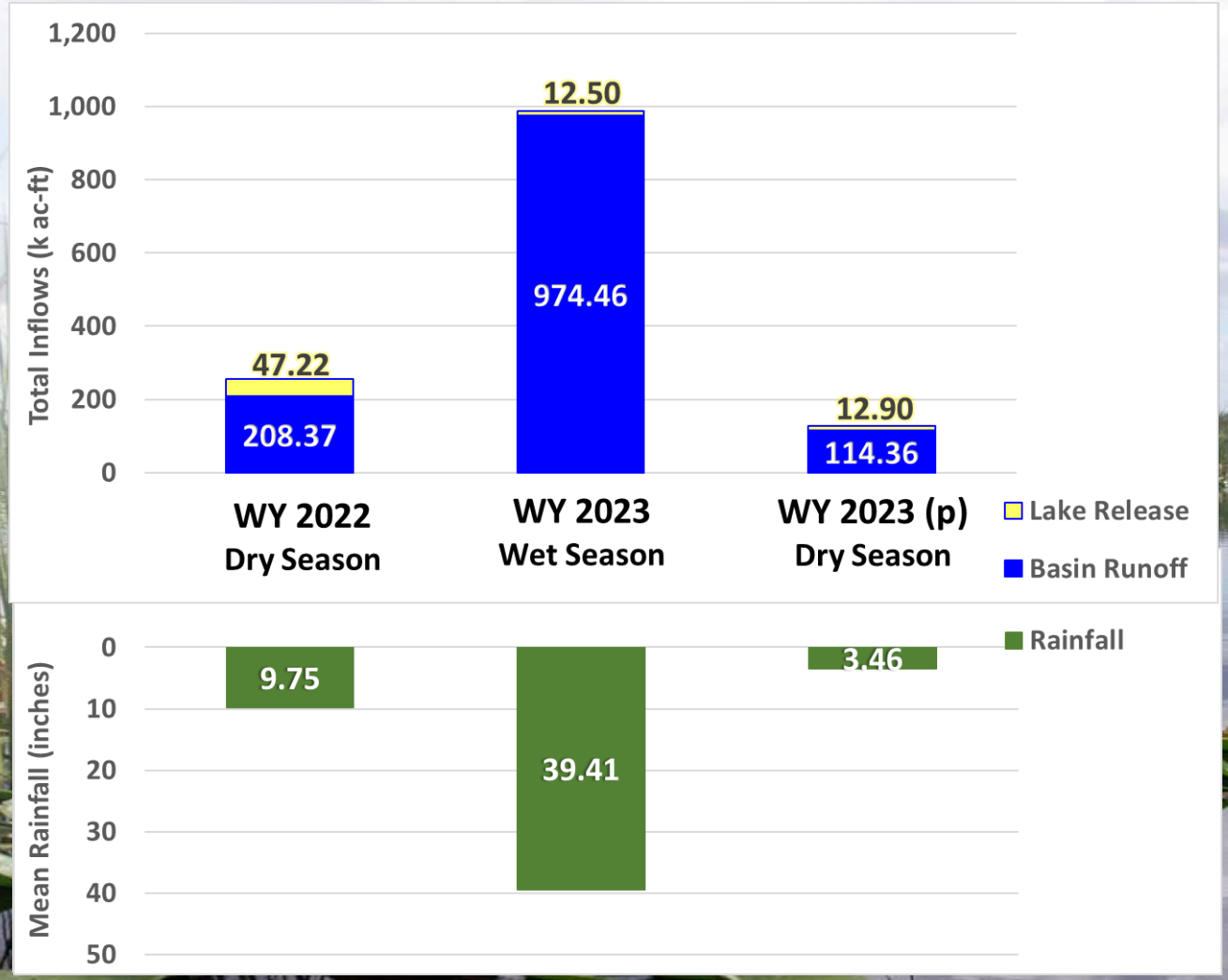
Presenter: Robert Shuford

WCA 1 & 2



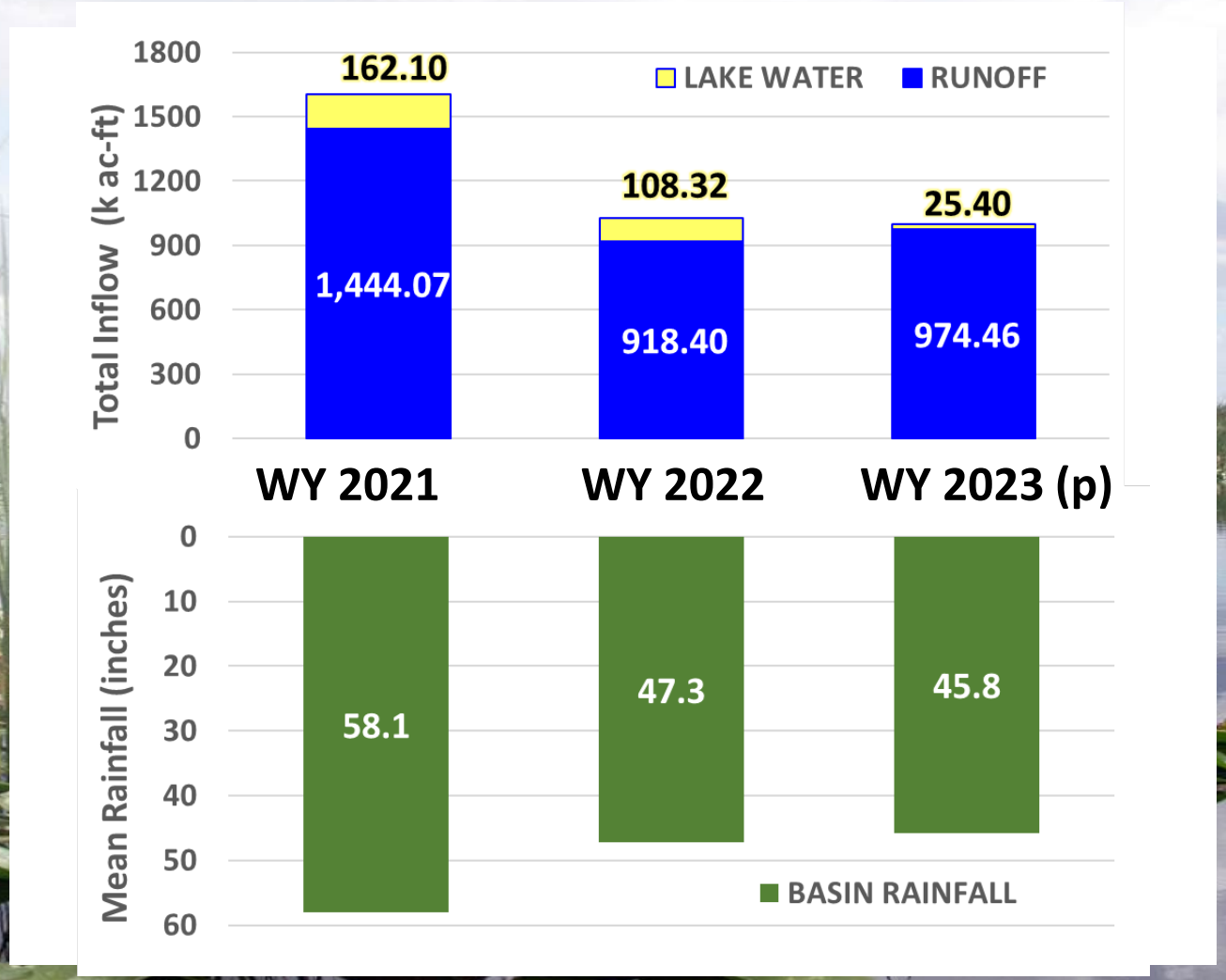
Presenter: Robert Shuford

Seasonal Inflows and Rainfall



Presenter: Robert Shuford

Water Year Inflows and Rainfall



Presenter: Robert Shuford

Contact Information

Robert Shuford
rshufor@sfwmd.gov

Everglades National Park

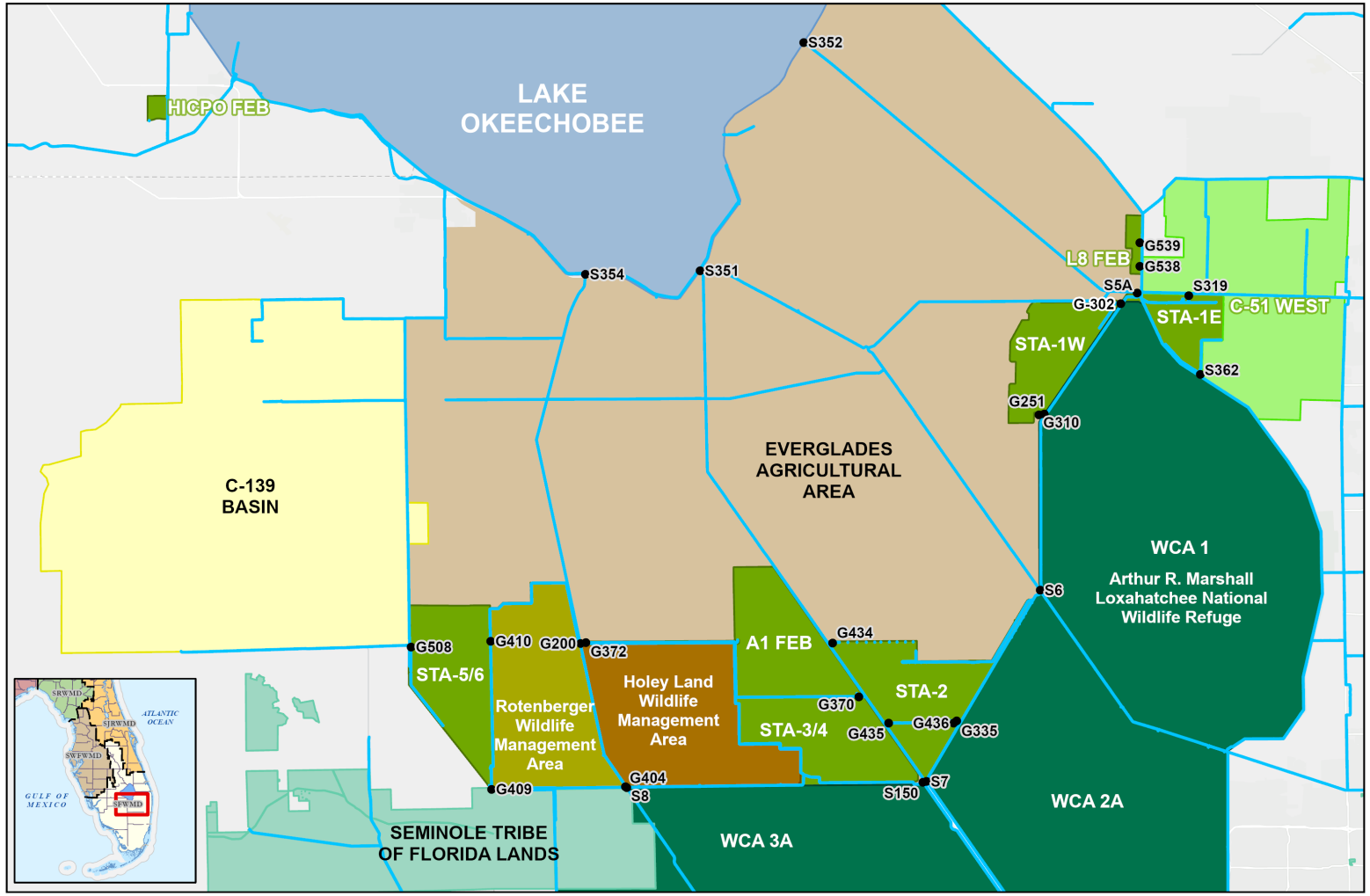
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Everglades Stormwater Treatment Areas Performance Update

Jake Dombrowski
Senior Scientist
Applied Sciences Bureau

20th Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins
February 27, 2023

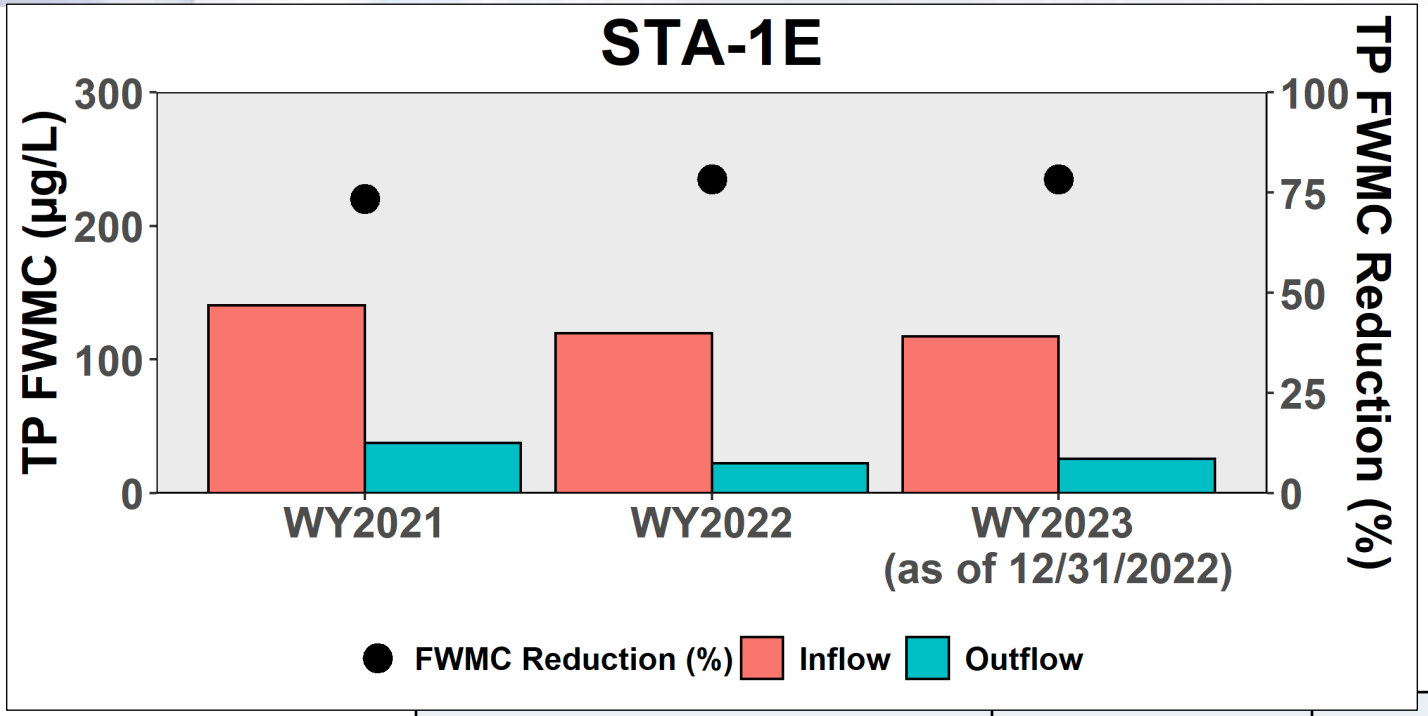
Introduction



- STA Performance
  - Flow volumes
  - TP loads
  - Flow-Weighted Mean Concentration (FWMC)
- Yearly and monthly variation
- Construction and operational restrictions

Presenter: Jake Dombrowski

STA-1E Performance Comparison by Water Year



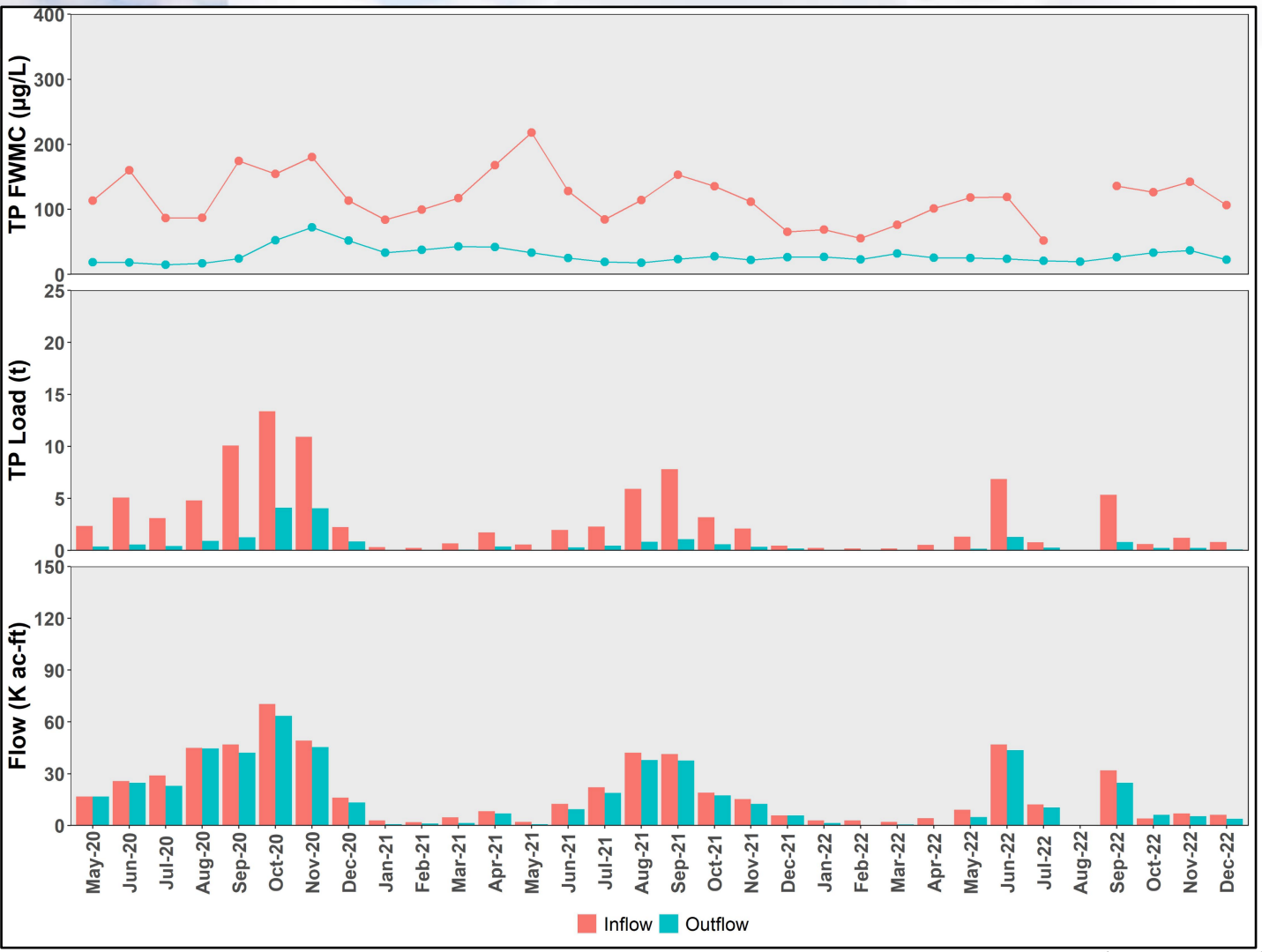

Cell 4S Submerged Vegetation (T. Adeagbo)

	WY2021	WY2022	Partial WY2023 (05/01/2022 - 12/31/2022)
Total inflow (k acre-feet)	316	172	117
Lake releases (k acre-feet)	25	4	1
TP FWMC inflow / outflow (µg/L)	141 / 37	120 / 22	117 / 25
TP load inflow / outflow (tons)	55 / 13	25 / 4	17 / 3
Reduction in TP FWMC / load	73% / 76%	78% / 82%	78% / 82%

Includes preliminary data

Presenter: Jake Dombrowski

STA-1E Monthly Inflows and Outflows



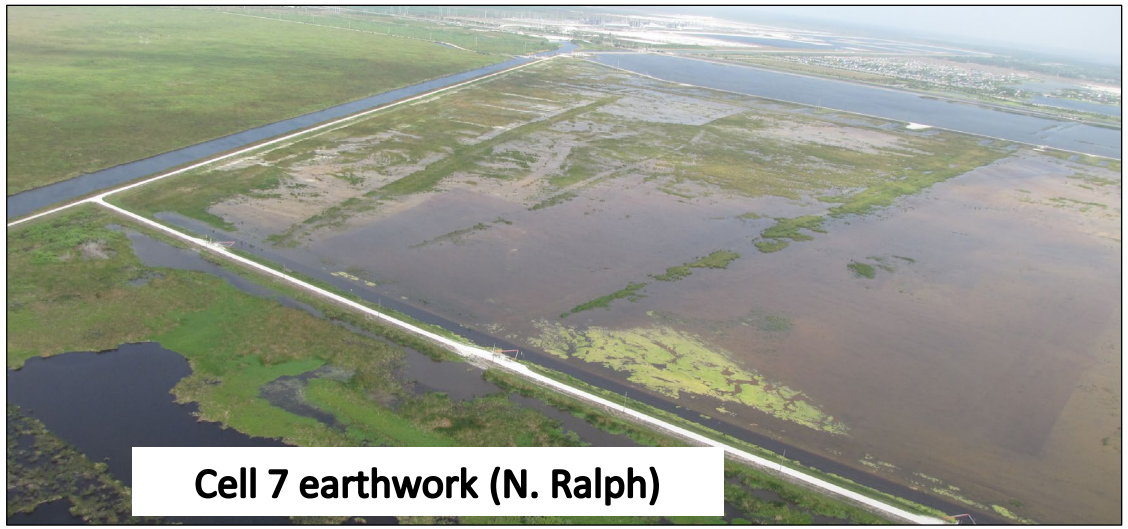
- Lower inflows in WY23 relative to previous years
  - L8-FEB captured high flows during Hurricane Ian
  - Ongoing construction
- Generally stable outflow TP FWMC
  - Minimal impact from Hurricanes Ian and Nicole

Includes preliminary data

Presenter: Jake Dombrowski

STA-1E Operational Restrictions (Jan. 1, 2022 – Dec. 31, 2022)

- Western Flow-way offline
  - Project complete, offline for vegetation grow-in
- Eastern Flow-way offline for rip-rap repairs related to Tropical Storm Eta
- Periodic restrictions in Central Flow-way for vegetation management and Black-necked stilt nesting

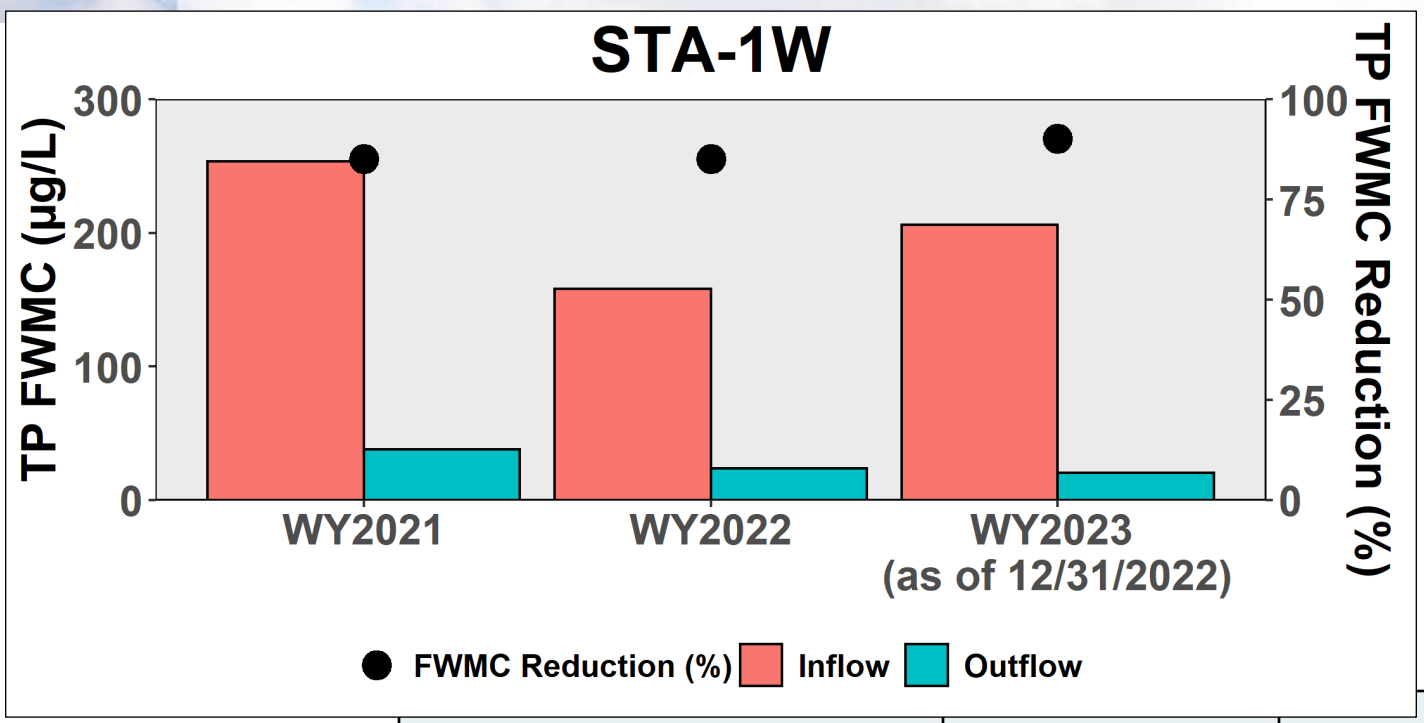


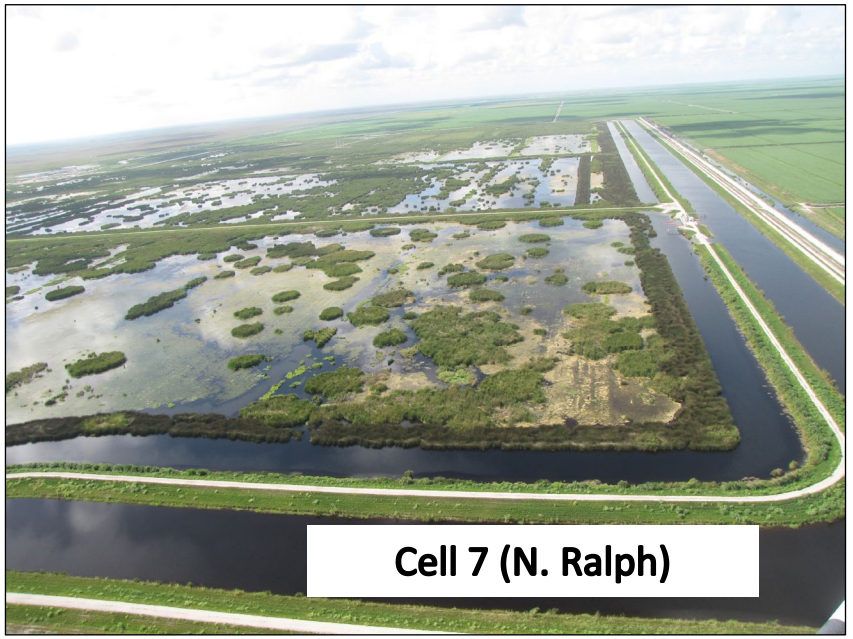
Cell 7 earthwork (N. Ralph)

Black-necked stilts (B. Garrett)

Presenter: Jake Dombrowski

STA-1W Performance Comparison by Water Year



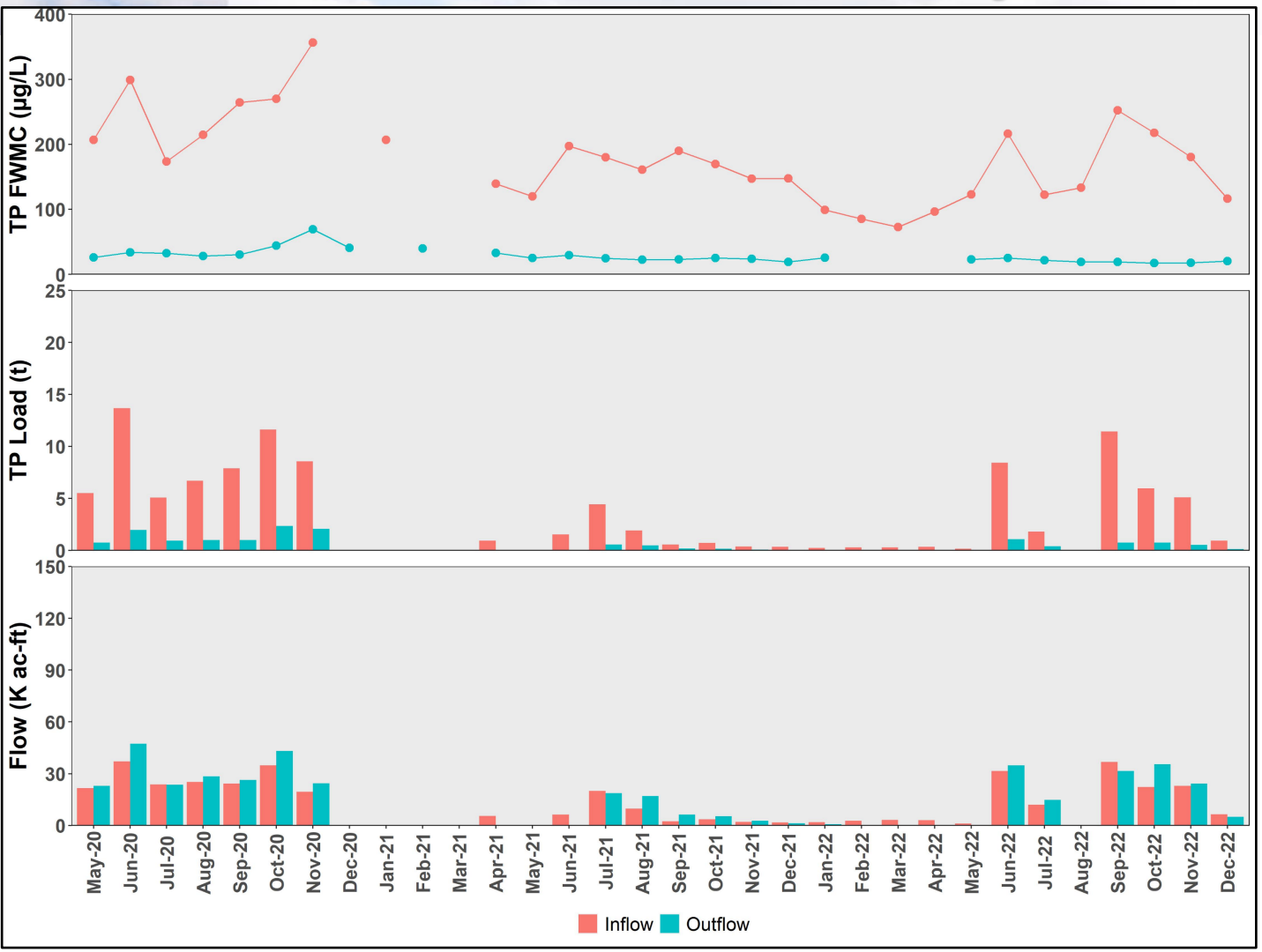


	WY2021	WY2022	Partial WY2023 (05/01/2022 - 12/31/2022)
Total inflow (k acre-feet)	192	57	133
Lake releases (k acre-feet)	8	3	0
TP FWMC inflow / outflow (µg/L)	254 / 38	158 / 24	206 / 20
TP load inflow / outflow (tons)	60 / 10	11 / 2	34 / 4
Reduction in TP FWMC / load	85% / 83%	85% / 86%	90% / 89%

Includes preliminary data

Presenter: Jake Dombrowski

STA-1W Monthly Inflows and Outflows



- Higher inflows in WY23 relative to recent years
  - Refurbishments projects complete
  - Ongoing construction in STA-1E
- Outflow TP FWMC remains low and stable
  - No impact from Hurricanes

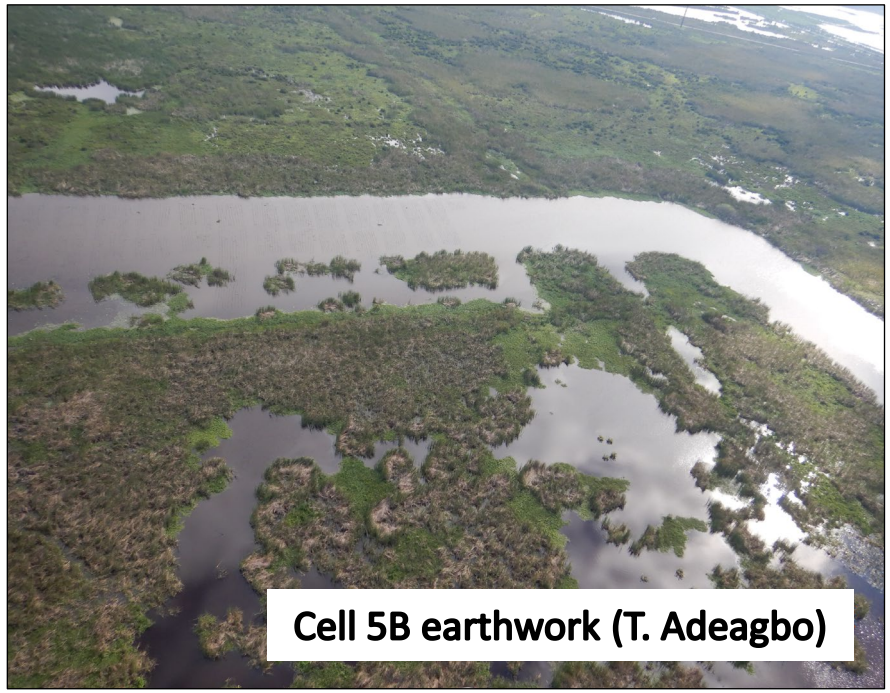
Includes preliminary data

Presenter: Jake Dombrowski

STA-1W Operational Restrictions (Jan. 1, 2022 – Dec. 31, 2022)

- Periodic restrictions in all flow-ways
  - Refurbishment earthwork projects in Northern, Western, and Eastern Flow-ways
  - Construction related to STA-1W Expansion #2 in Cell 8
  - Black-necked stilts nested in the Northern and Eastern Flow-ways

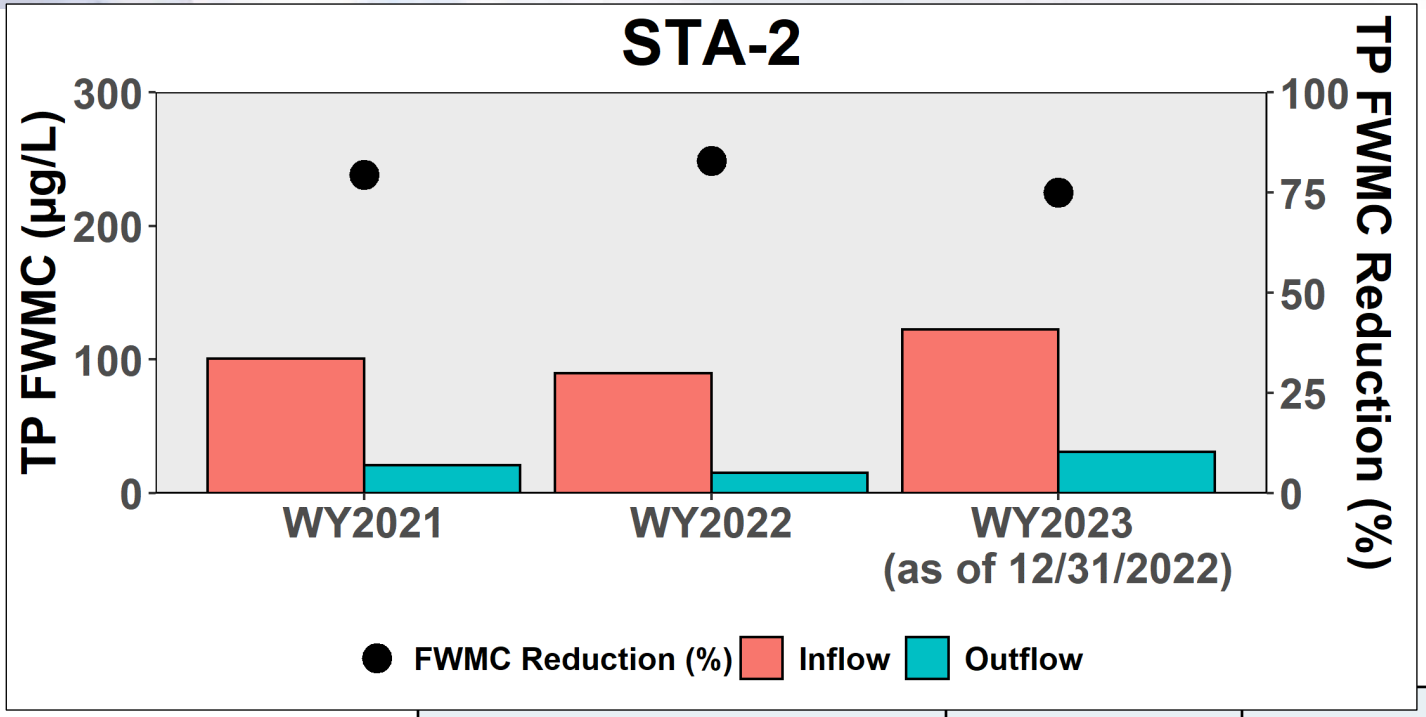
Black-necked stilt nesting (B. Garrett)

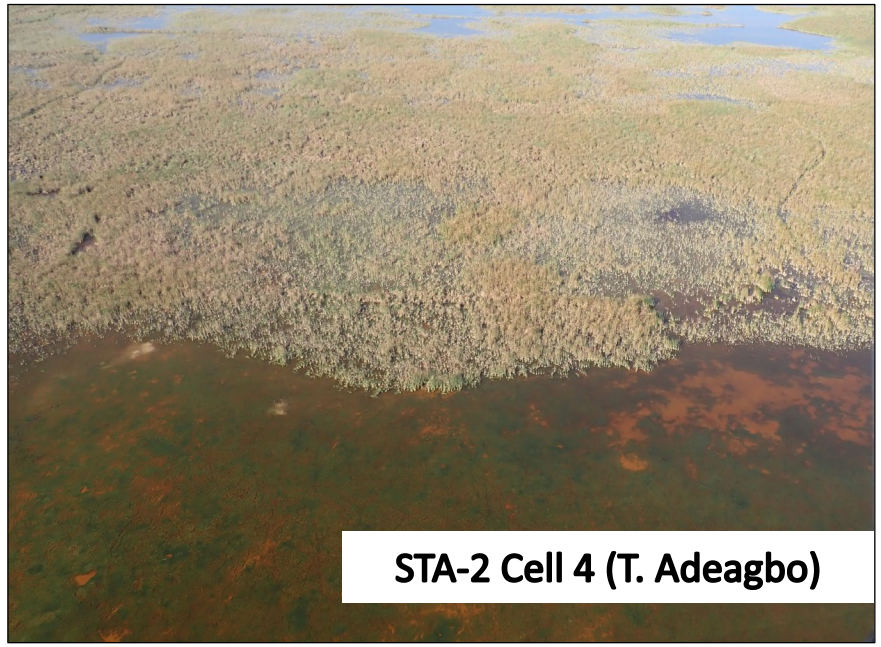


Cell 5B earthwork (T. Adeagbo)

Presenter: Jake Dombrowski

STA-2 Performance Comparison by WY



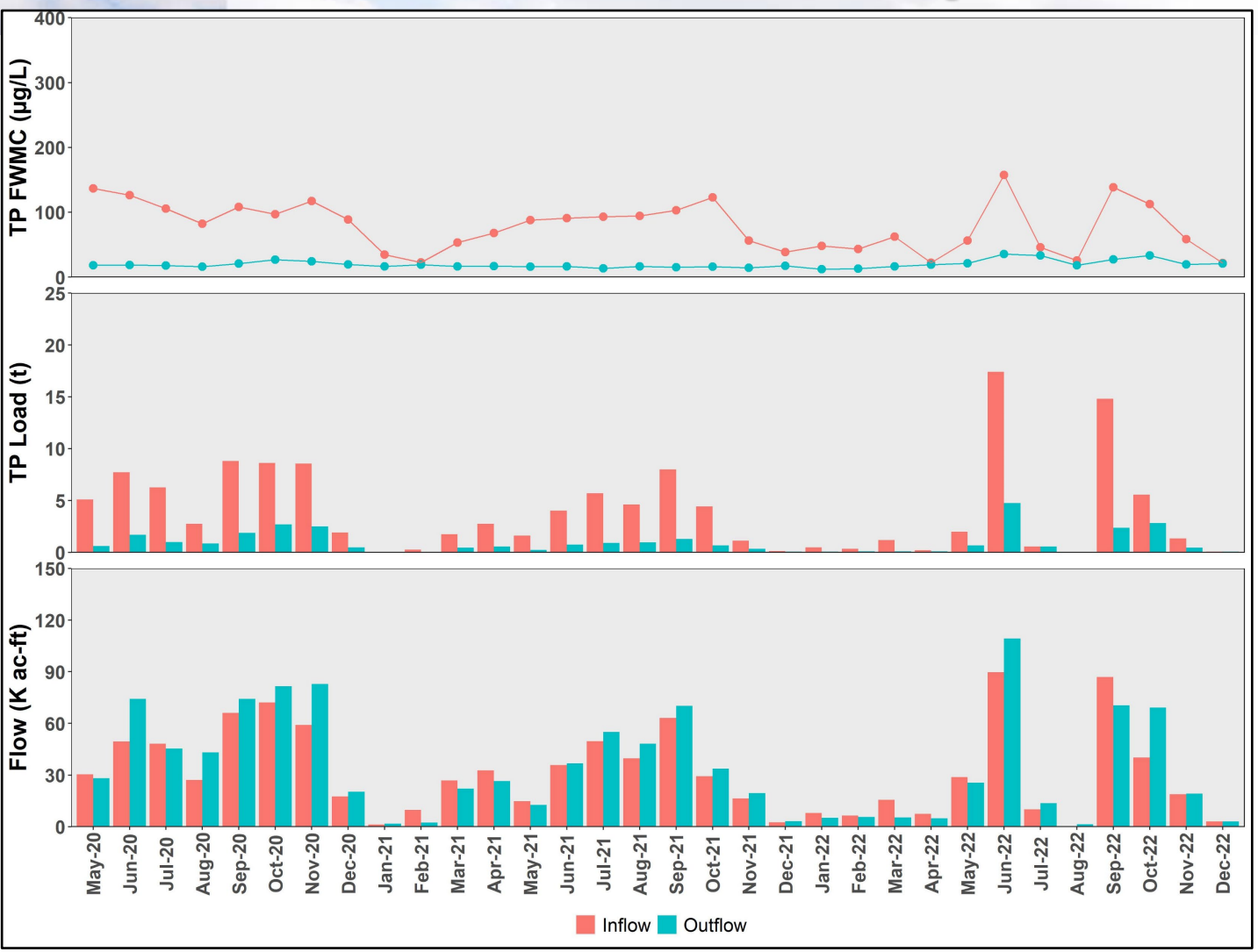


	WY2021	WY2022	Partial WY2023 (05/01/2022 - 12/31/2022)
Total inflow (k acre-feet)	441	289	276
Lake releases (k acre-feet)	72	38	9
TP FWMC inflow / outflow (µg/L)	100 / 21	89 / 15	123 / 31
TP load inflow / outflow (tons)	55 / 13	32 / 6	42 / 12
Reduction in TP FWMC / load	79% / 76%	83% / 82%	75% / 72%

Includes preliminary data

Presenter: Jake Dombrowski

STA-2 Monthly Inflows and Outflows



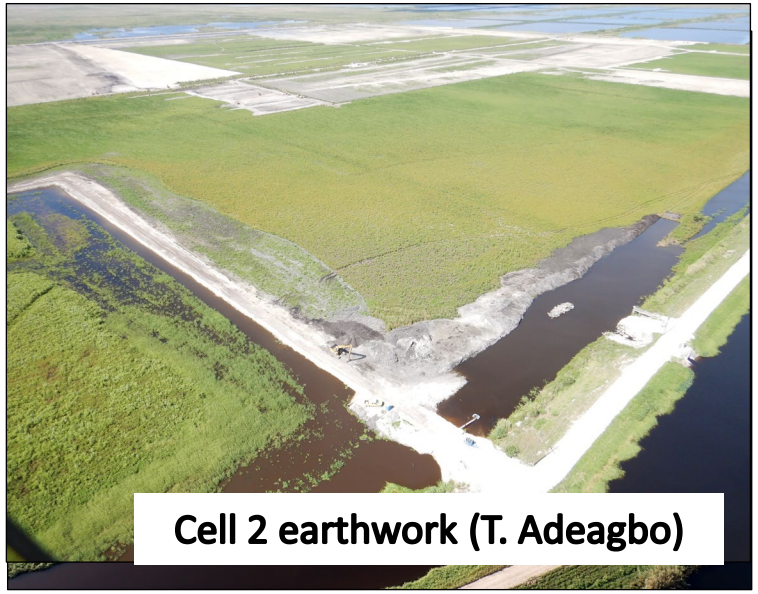
- Elevated flows and TP loads in WY23
  - Large rain event in June 2022
  - Hurricane Ian
  - A-1 FEB captured large portion of flows
- Slightly elevated outflow TP FWMC
  - Flow-way 2 – ongoing construction
  - Flow-way 1 – dryout

Includes preliminary data

Presenter: Jake Dombrowski

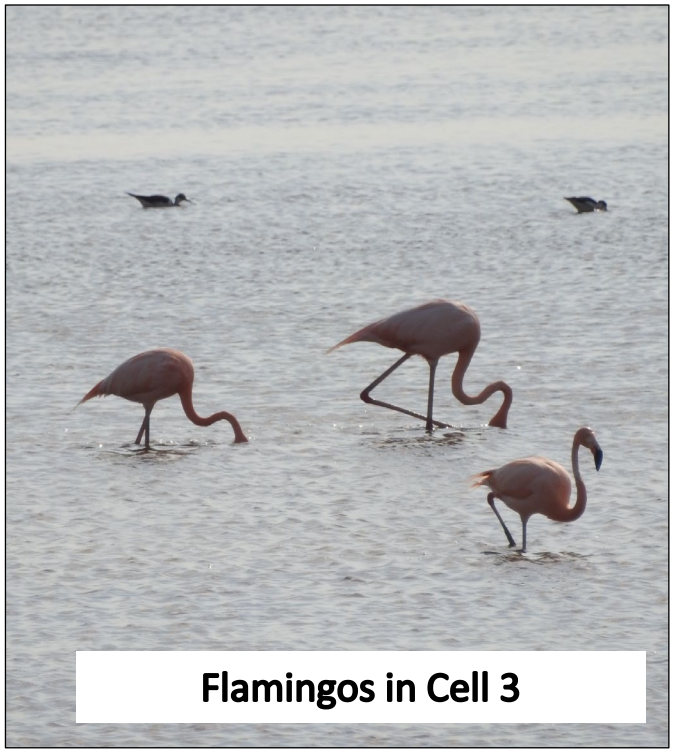
STA-2 Operational Restrictions (Jan. 1, 2022 – Dec. 31, 2022)

- Flow-way 2 offline for earthwork project
- Periodic restrictions in Flow-ways 1, 3, and 4
  - Dryout in Flow-way 1 related to Flow-way 2 refurbishments project
  - Vegetation management activities
  - Black-necked stilt nesting in Flow-ways 2 and 3



Cell 2 earthwork (T. Adeagbo)

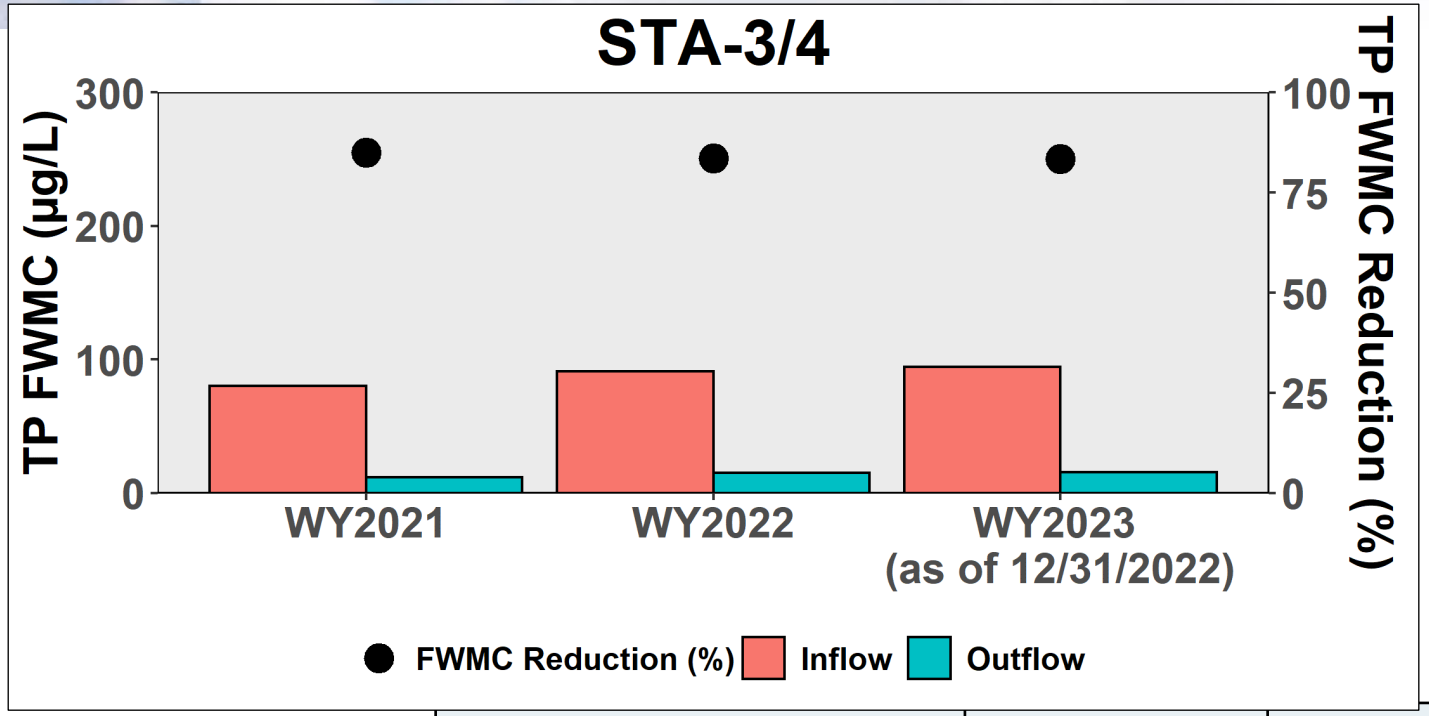
Cell 4 Mixed Marsh (T. Adeagbo)



Flamingos in Cell 3

Presenter: Jake Dombrowski

STA-3/4 Performance Comparison by WY



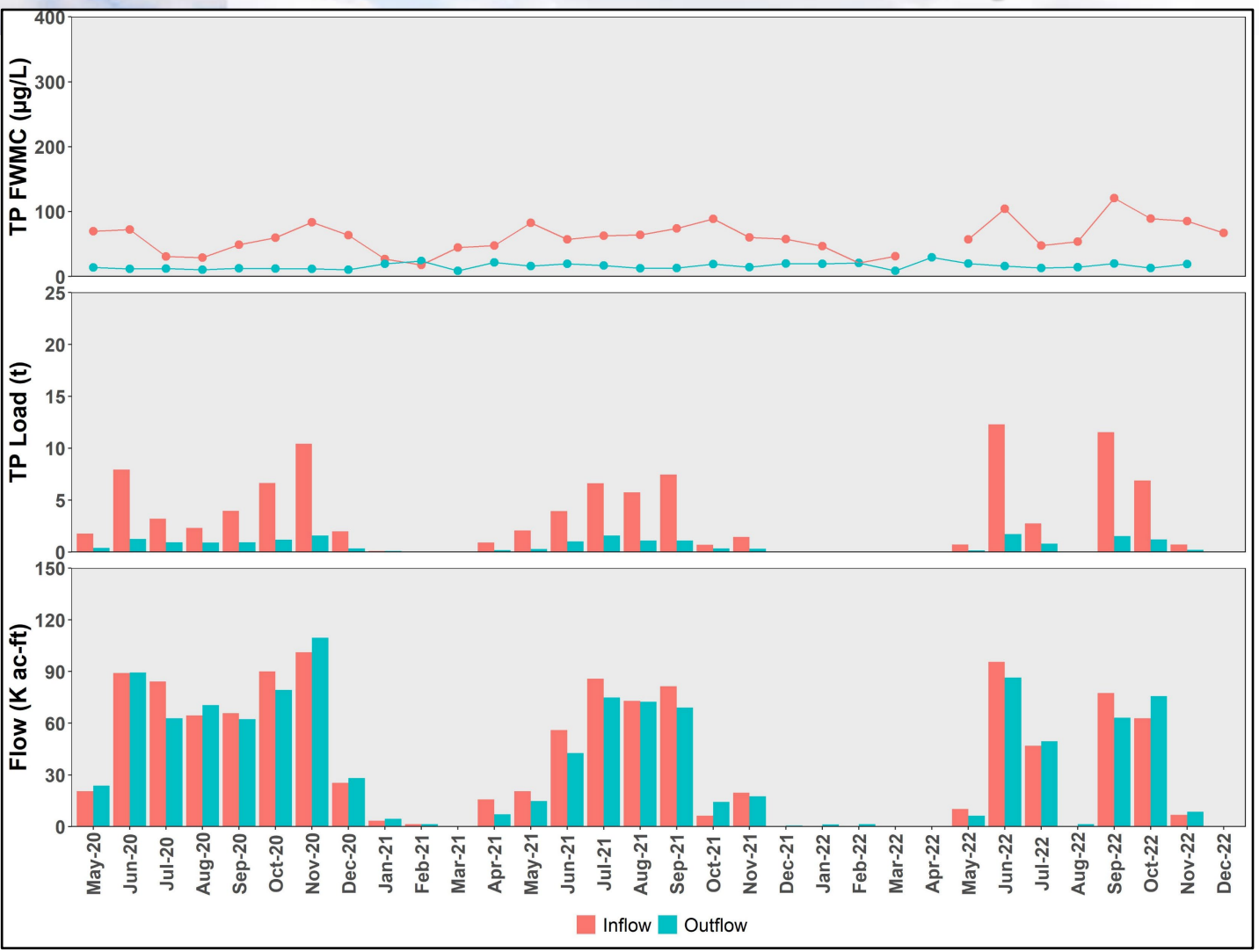

STA-3/4 Mixed Marsh (T. Adeagbo)

	WY2021	WY2022	Partial WY2023 (05/01/2022 - 12/31/2022)
Total inflow (k acre-feet)	521	330	300
Lake releases (k acre-feet)	42	31	3
TP FWMC inflow / outflow (µg/L)	80 / 12	91 / 15	94 / 16
TP load inflow / outflow (tons)	51 / 8	37 / 6	35 / 6
Reduction in TP FWMC / load	85% / 84%	84% / 84%	83% / 84%

Includes preliminary data

Presenter: Jake Dombrowski

STA-3/4 Monthly Inflows and Outflows



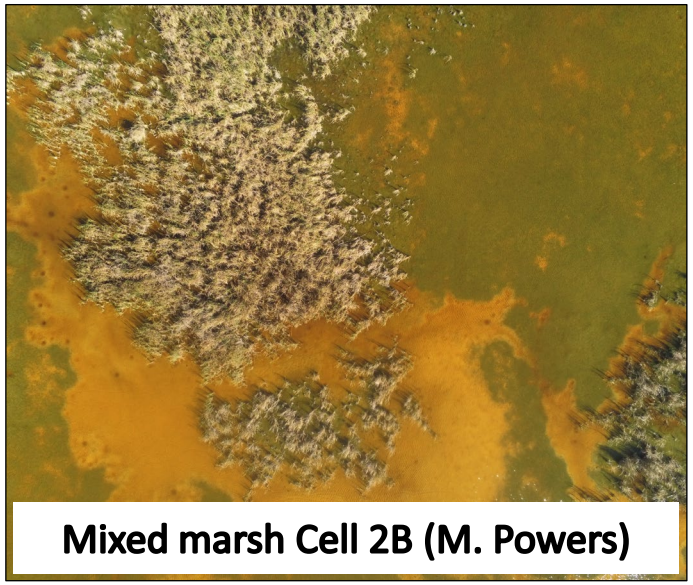
- Compared to other STAs, less variability in inflow TP loads due to A-1 FEB
- Elevated flows and TP loads in WY2023
  - Large rain event in June 2022
  - Hurricane Ian
  - A-1 FEB captured large portion of flows
- Outflow TP FWMC remains low and stable

Includes preliminary data

Presenter: Jake Dombrowski

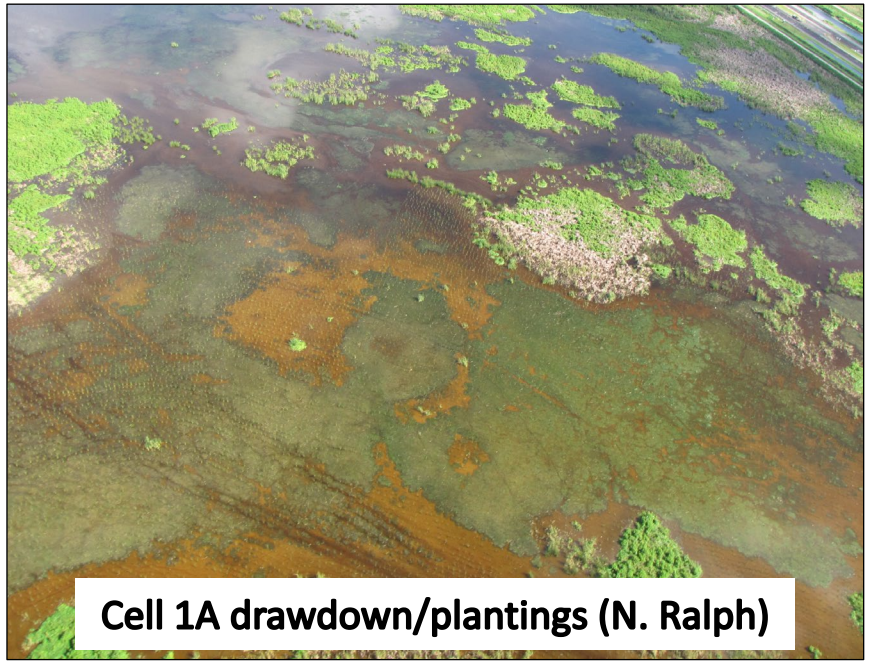
STA-3/4 Operational Restrictions
(Jan. 1, 2022 – Dec. 31, 2022)

- Eastern Flow-way offline for vegetation rehabilitation/drawdown
- Black-necked stilt nesting in Central Flow-way



Mixed marsh Cell 2B (M. Powers)

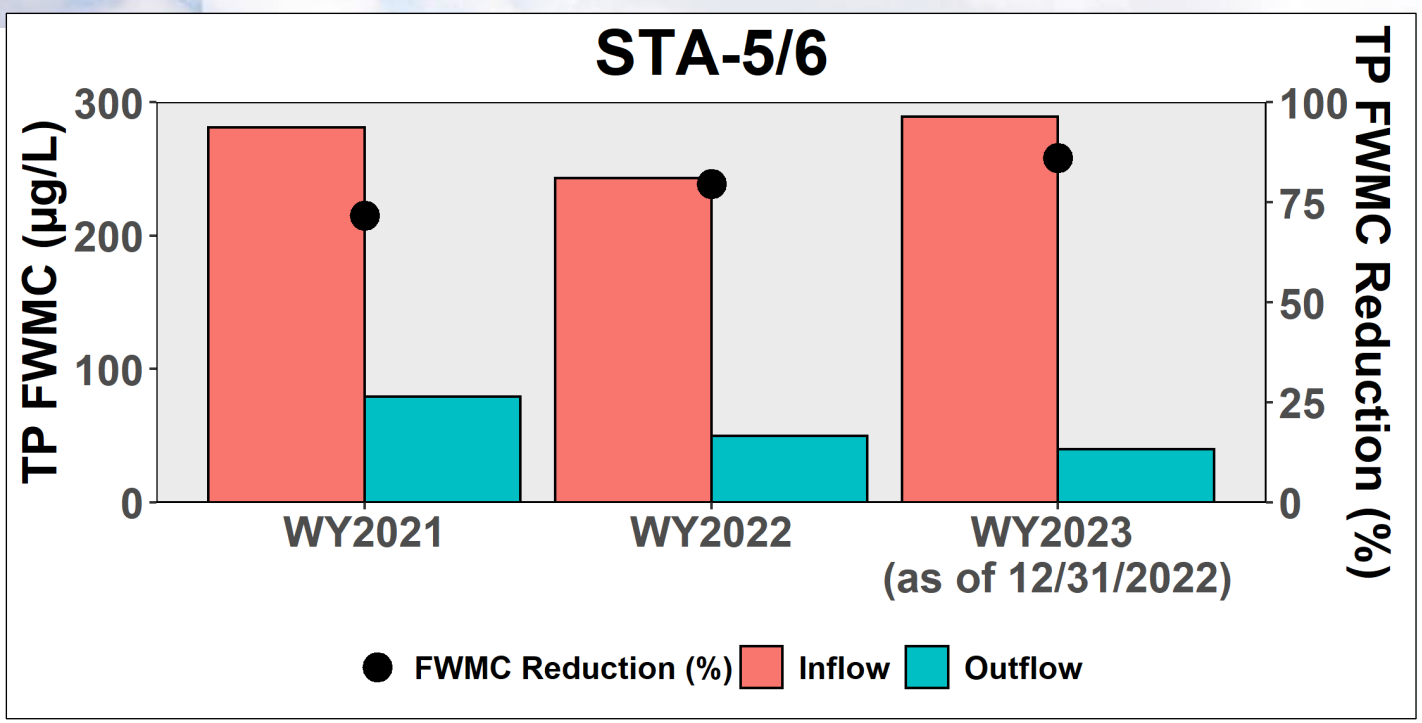
Black-necked stilt Cell 2B
(E. Ashford)

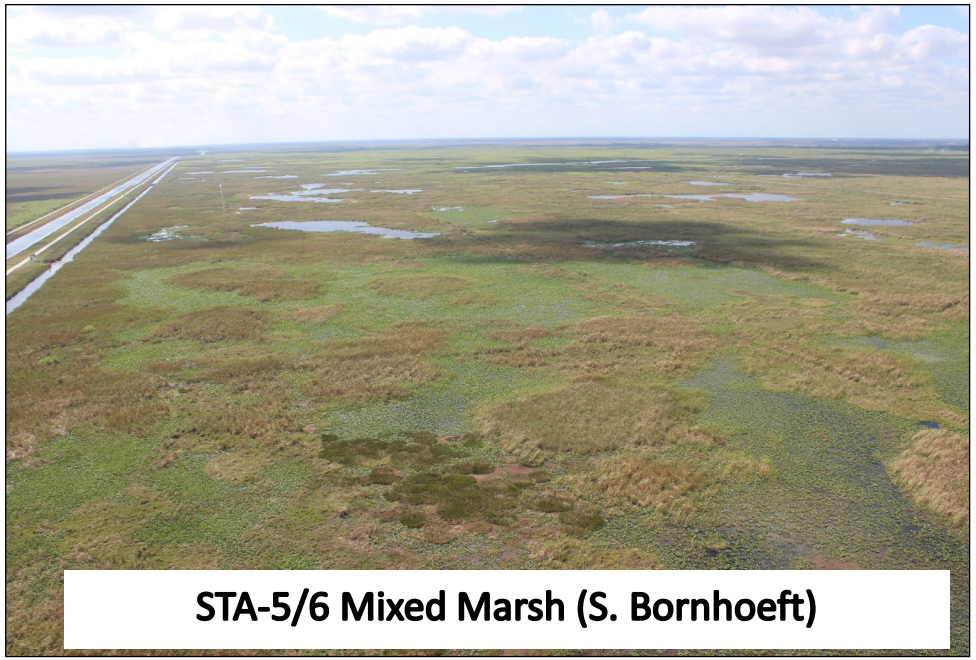


Cell 1A drawdown/plantings (N. Ralph)

Presenter: Jake Dombrowski

STA-5/6 Performance Comparison by WY



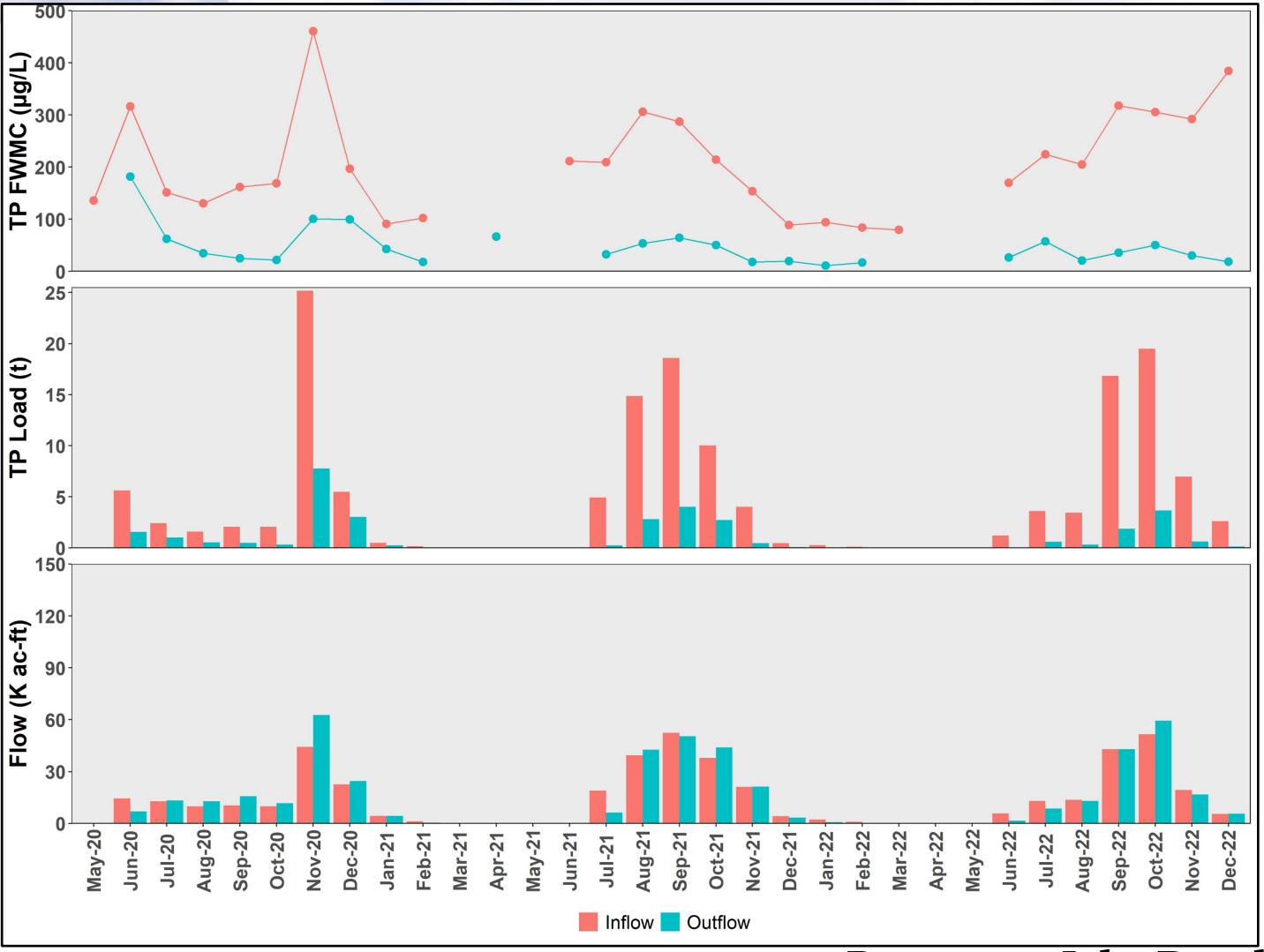

STA-5/6 Mixed Marsh (S. Bornhoeft)

	WY2021	WY2022	Partial WY2023 (05/01/2022 - 12/31/2022)
Total inflow (k acre-feet)	130	178	152
TP FWMC inflow / outflow (µg/L)	281 / 79	243 / 50	289 / 40
TP load inflow / outflow (tons)	45 / 15	53 / 10	54 / 7
Reduction in TP FWMC / load	72% / 67%	80% / 81%	86% / 87%

Includes preliminary data

Presenter: Jake Dombrowski

STA-5/6 Monthly Inflows and Outflows



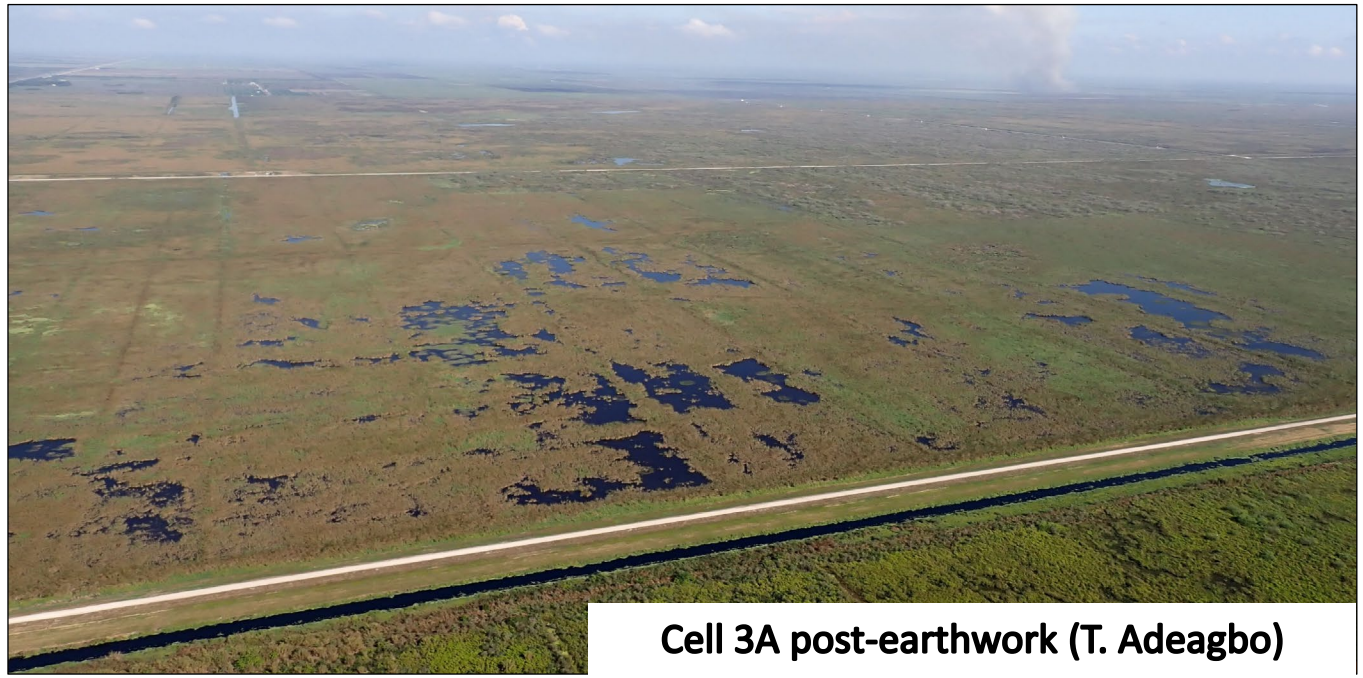
- Inflow TP load and FWMC spikes
  - Hurricanes Ian and Nicole
- Frequent dry-out conditions during the dry seasons
- Elevated inflow/outflow TP FWMC following dry-out
  - Reduced impact in WY23
  - Outflow TP FWMC lower following storm events

Includes preliminary data

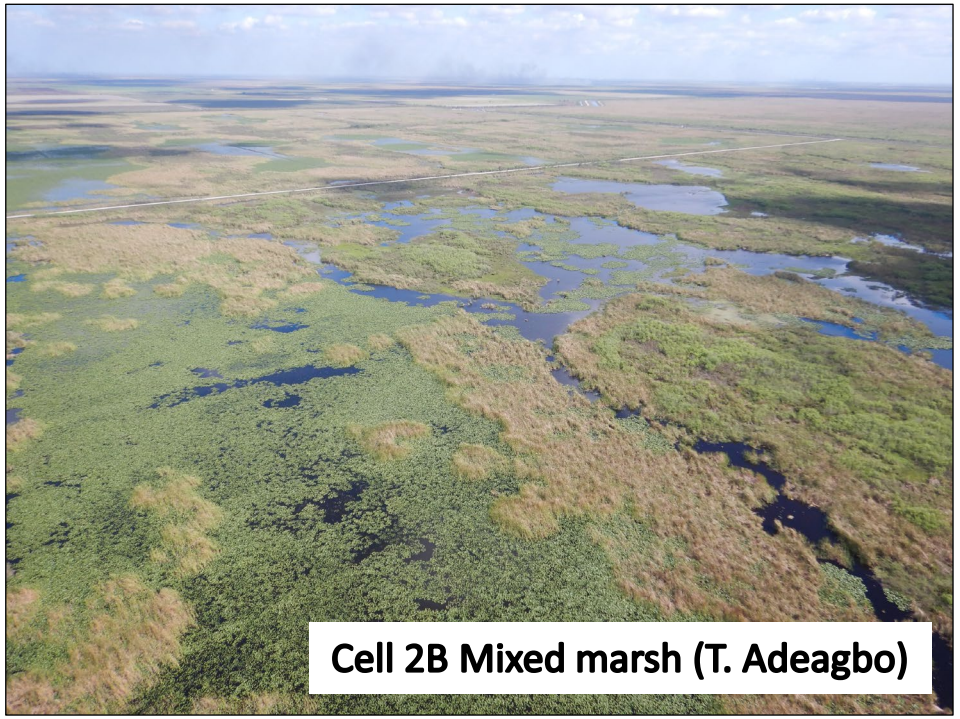
Presenter: Jake Dombrowski

STA-5/6 Operational Restrictions
(Jan. 1, 2022 – Dec. 31, 2022)

- Flow-way 4 offline for vegetation management activities



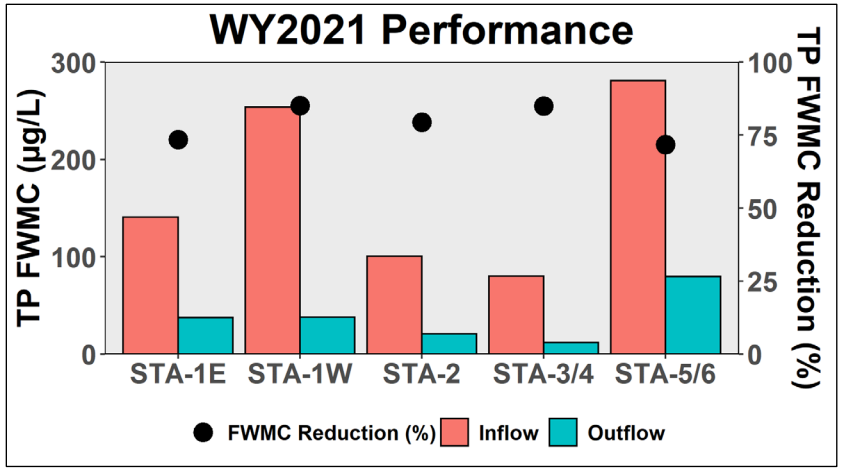
Cell 3A post-earthwork (T. Adeagbo)

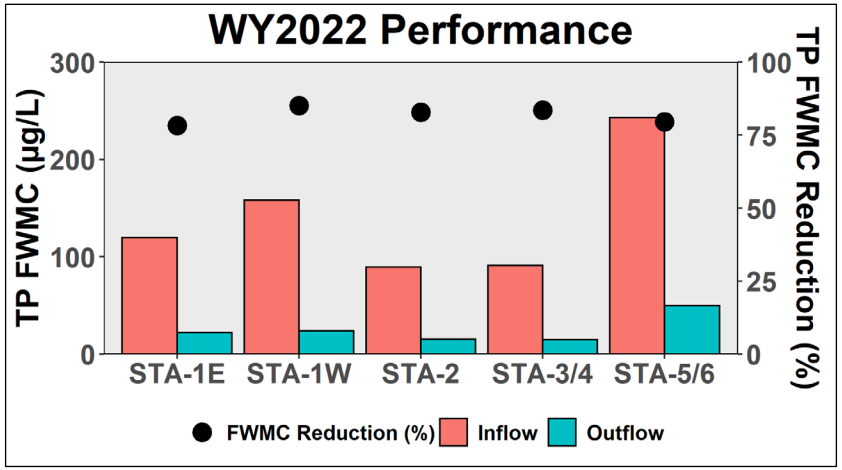


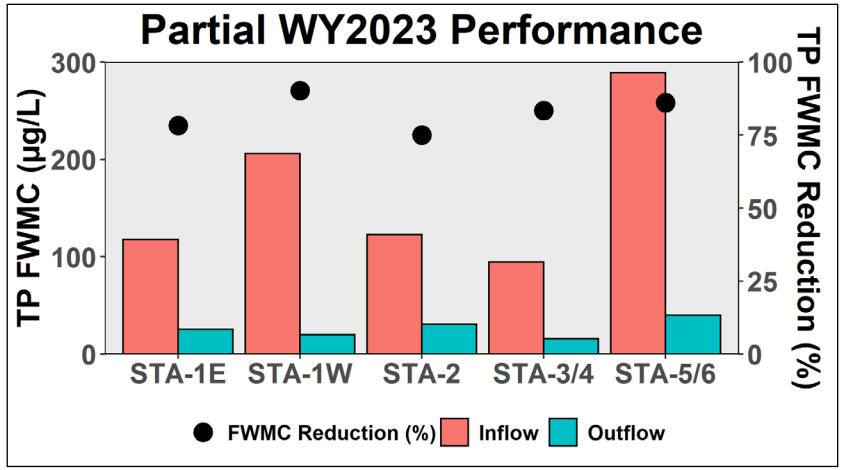
Cell 2B Mixed marsh (T. Adeagbo)

Presenter: Jake Dombrowski

All STAs Performance Comparison by WY







	WY2021	WY2022	Partial WY2023 (05/01/2022 - 12/31/2022)
Total inflow (k acre-feet)	1606	1027	953
Lake releases (k acre-feet)	162	108	12.6
TP FWMC inflow / outflow (µg/L)	134 / 28	125 / 23	155 / 27
TP load inflow / outflow (tons)	266 / 59	159 / 27	182 / 31
Reduction in TP FWMC / load	79% / 78%	82% / 83%	83% / 83%

Presenter: Jake Dombrowski

Includes preliminary data

CONTACT INFORMATION

Jake Dombrowski
jdombrow@sfwmd.gov

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Vegetation Management

Eric Crawford
Senior Scientist
Land Resources Bureau

20th Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins
February 27, 2023

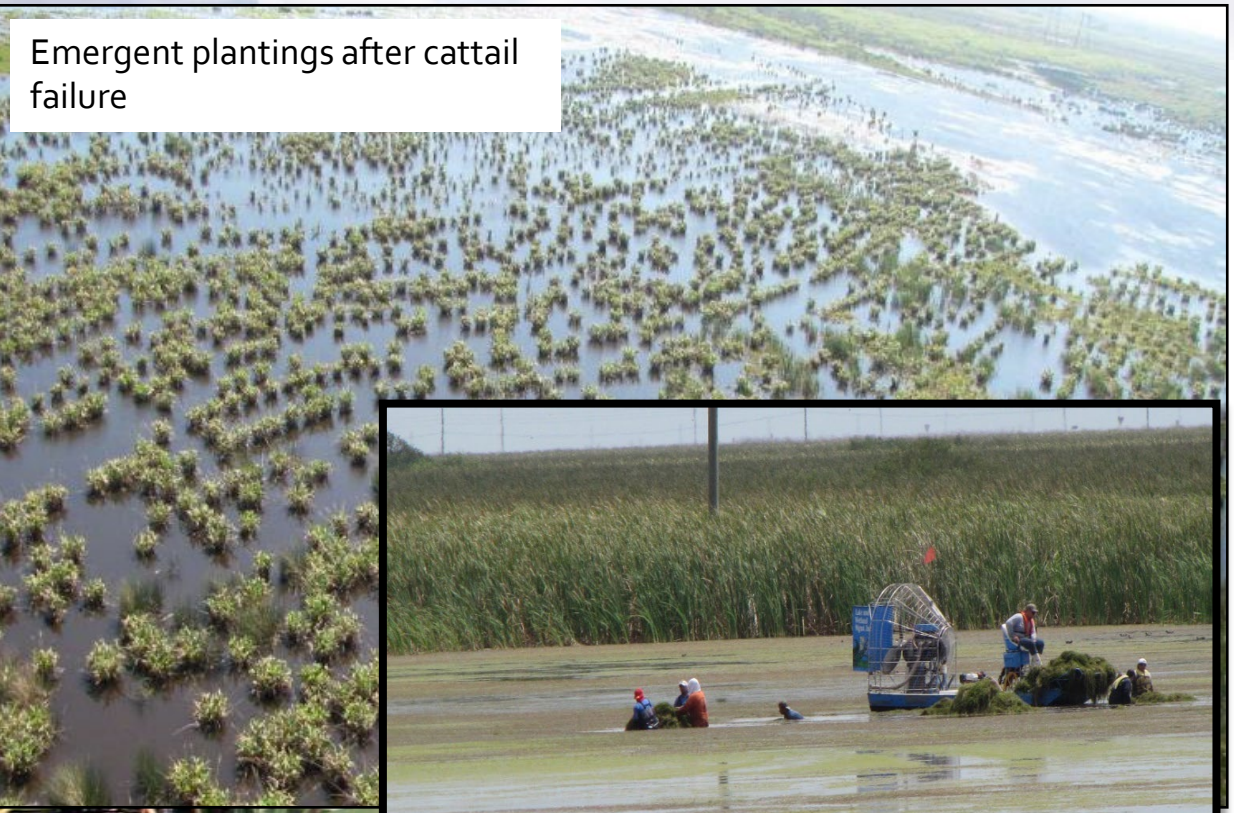
Objective

Maintain sustainable vegetation-based phosphorus uptake processes

- Vegetation Enhancement
  - Establish/maintain appropriate vegetation communities
  - Improve stability and functional redundancy
- Selective Management
  - Increase desirable species
  - Control invasive/undesirable species

Presenter: Eric Crawford

STA Vegetation Function



Emergent plantings after cattail failure

SAV harvest and transport

Emergent Aquatic Vegetation (EAV)

- Stabilize soils
- Maximize sedimentation
- Decrease turbidity
- Create litter

Submerged Aquatic Vegetation (SAV)

- Water column nutrient uptake
- Provide periphyton substrate

Presenter: Eric Crawford

Healthy EAV

Presenter: Eric Crawford

Highly Stressed EAV

Presenter: Eric Crawford

STA Vegetation

Desirable Plants

A healthy mix of emergent vegetation, dominated by cattail and bulrush, and a mix of submerged vegetation dominated by southern naiad, spiny naiad and Chara

Undesirable Plants

Undesirable vegetation dominated by floating mats of cattail and primrose willow, plants growing on floating delaminated soils

Presenter: Eric Crawford

Invasive Species Control

- Herbicide application and mechanical removal measures
- Dense plantings of desirable species limit the spread of invasive and undesirable vegetation
- District staff have identified several native species to use in varying conditions to maximize resiliency and performance

Presenter: Eric Crawford

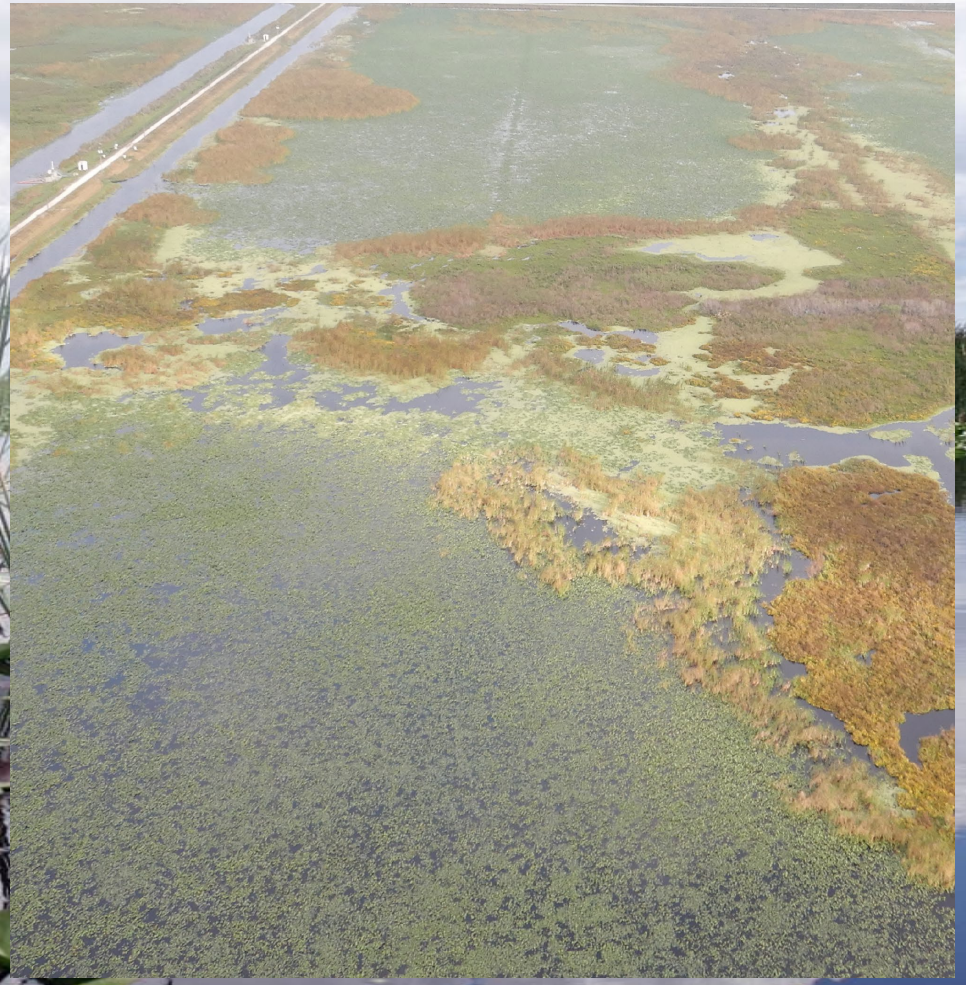
Floating Aquatic Vegetation Control

FAV control is needed to protect desirable vegetation

Dense emergent vegetation strips can reduce FAV penetration

Emergent strips at inflows can trap and concentrate FAV decreasing herbicide use

Emergent strip repair reduces FAV penetration into the cells



Presenter: Eric Crawford

Vegetation Management Process

- **Monitor Vegetation Health**
  - Coordinate with water management to optimize stage, flow rates (cfs), and redirecting flow when necessary
- **Proactively Manage Vegetation**
  - Increase cover and health of desired species where needed to adjust flows or stabilize soils
  - Control undesirable vegetation
- **Repair and Restore**
  - Emergent vegetation enhancements where vegetation is damaged or undesirable and SAV plantings where appropriate

Presenter: Eric Crawford

Rehabilitation: Emergent Plants

Presenter: Eric Crawford

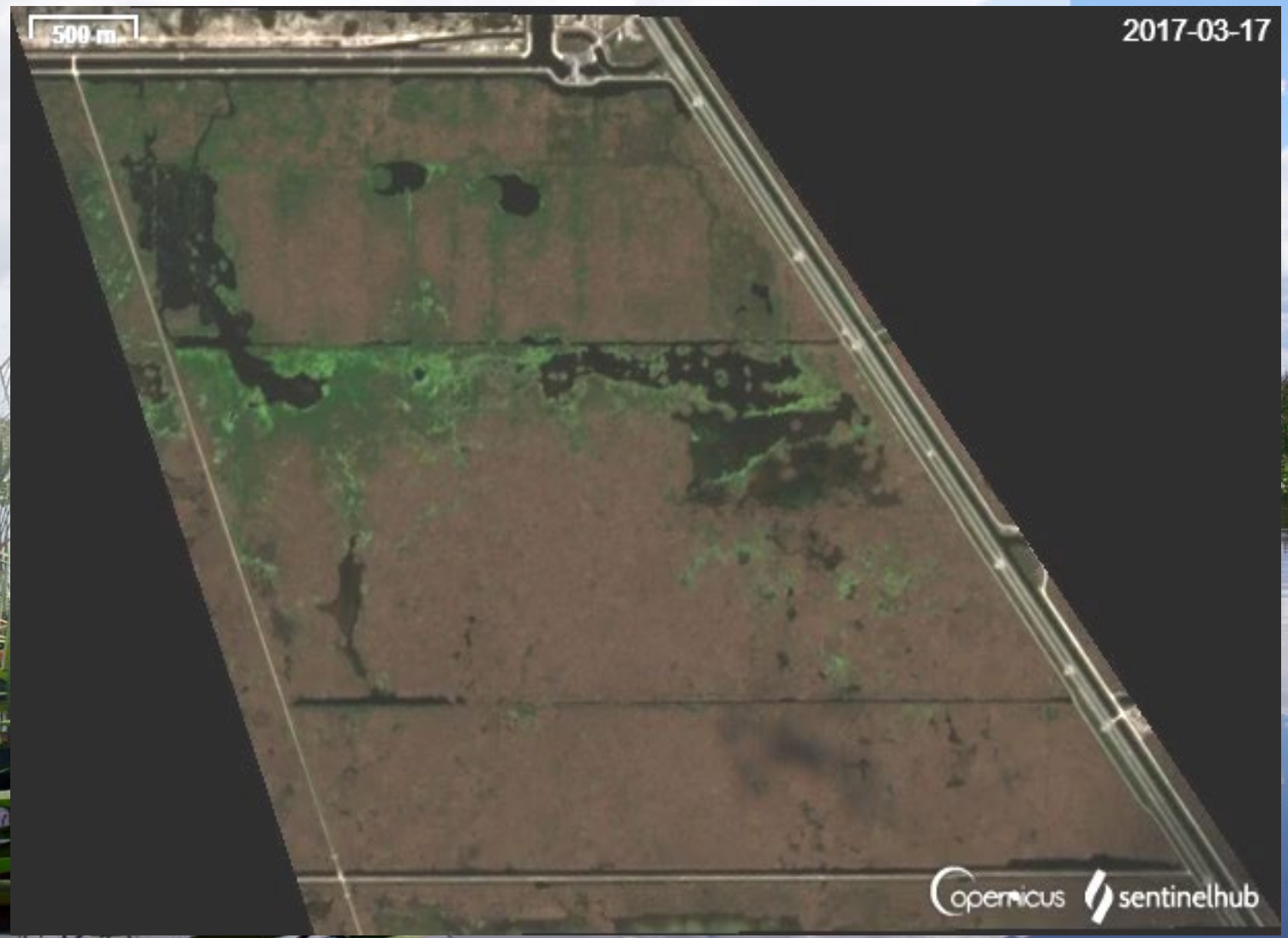
Rehabilitation: Extreme Measures to mitigate extensive soil delamination and vegetation loss, STA 3-4 Cells 1A and 2A

Floating excavator grinding floating vegetation and delaminated soils

Presenter: Eric Crawford

STA 3/4 Cell 1A

Excessive dry season flows/ stages and short circuits allowed FAV to penetrate the cell, which accelerated soil delamination and floating wetlands formation.
This time-lapse illustrates the process, and the rehabilitation work under way



Presenter: Eric Crawford

Rehabilitation: SAV Inoculation

SAV harvest and transport

Presenter: Eric Crawford

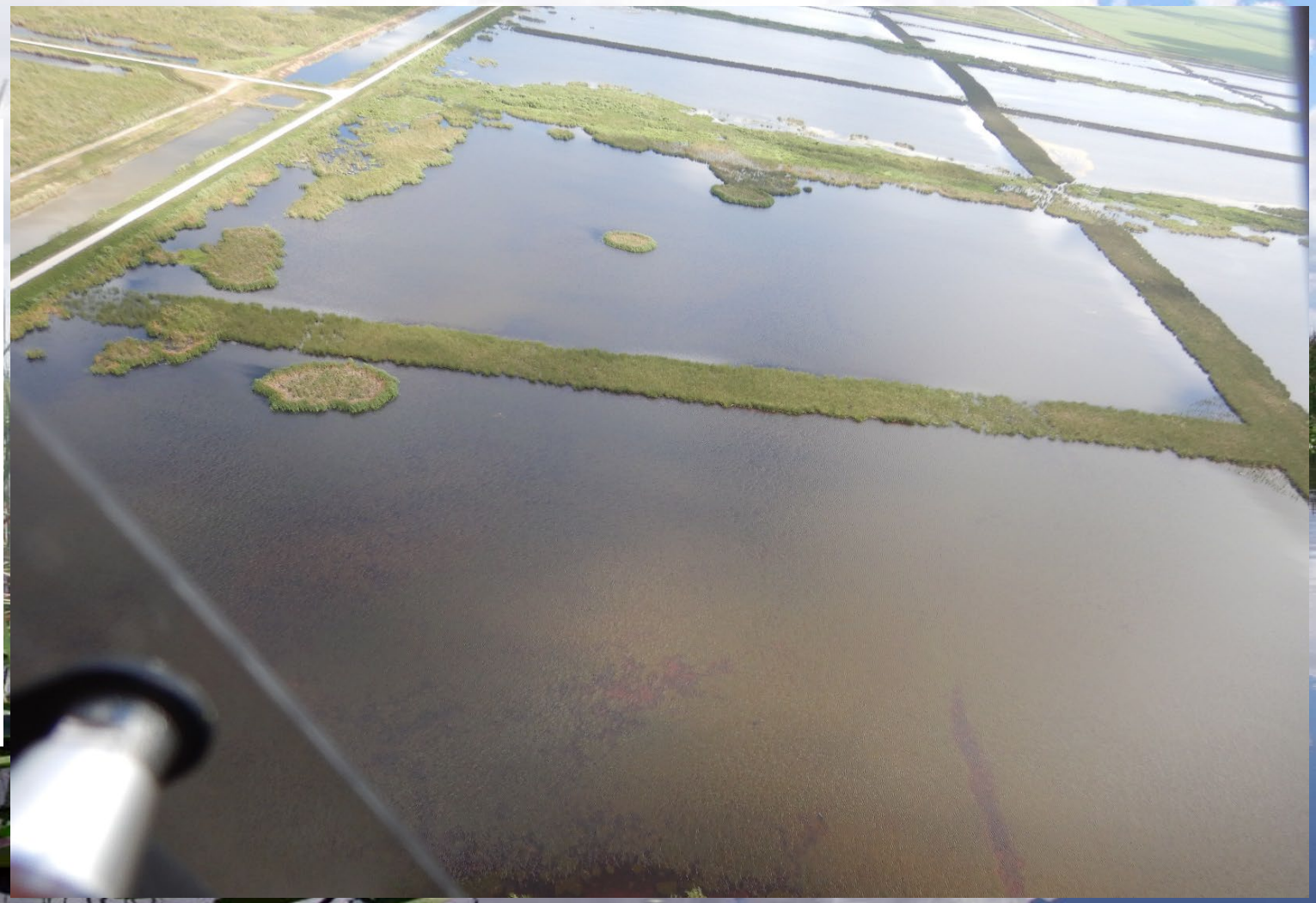
SAV Management

- Compartmentalizing the SAV cells with vegetation strips can help protect and stabilize SAV populations
- EAV provides structure, protection, and litter to assist with nutrient uptake
- Smaller, more diverse and compartmentalized SAV beds are more resistant to short circuiting, disturbance, storm events and encroachment by exotic species.

Presenter: Eric Crawford

Repair and Restoration of STA 2 Cell 3

- Over ten miles of emergent vegetation strips planted since 2017 to protect and compartmentalize the Cell prior to SAV restoration
- Multiple short circuits and scoured out boat trails filled and planted
- SAV was planted and enhancements continue throughout the cell.

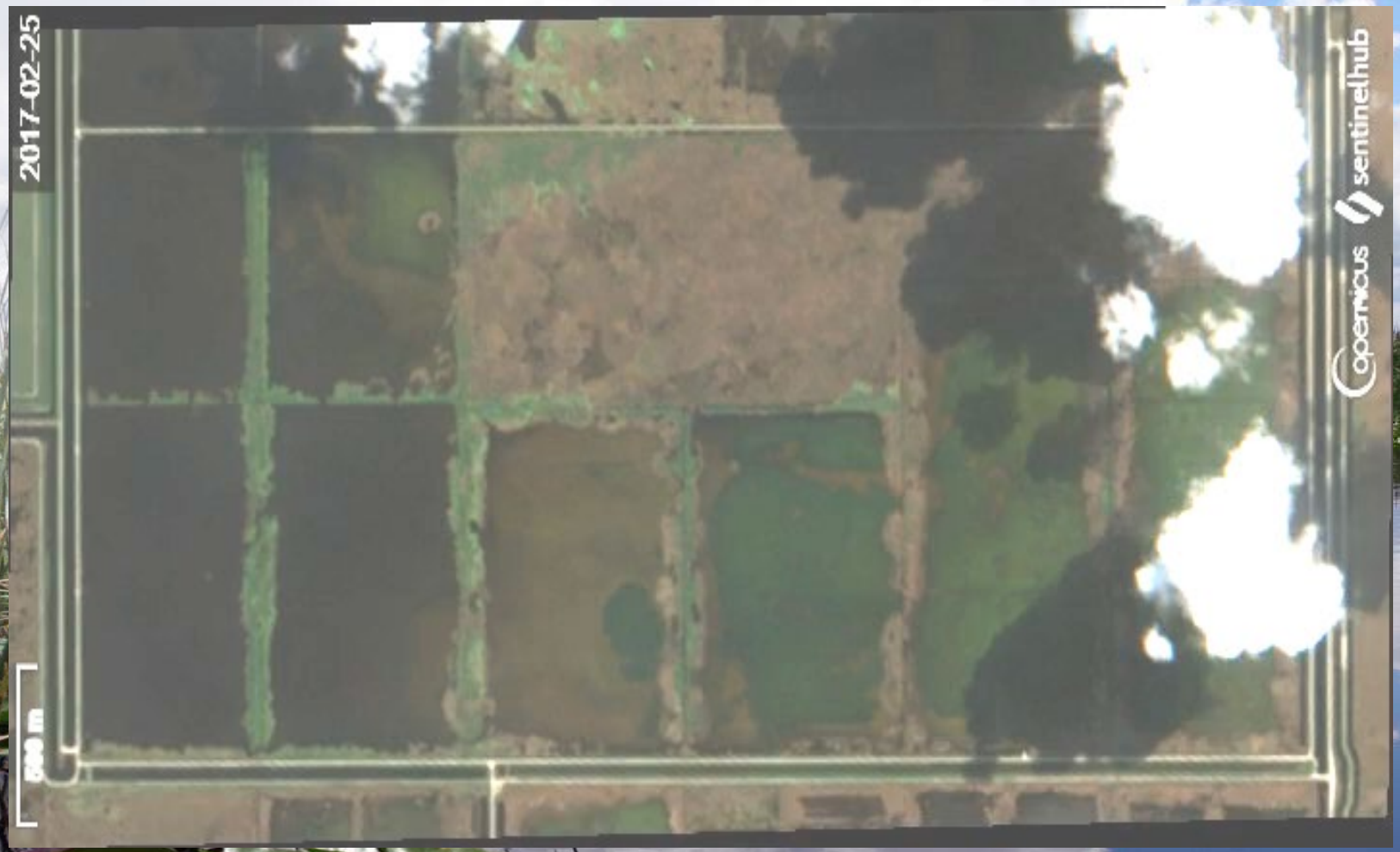


Presenter: Eric Crawford

STA2 Cell 3

Timeline, Jan 2017-Dec 2022

This graphic illustrates the short circuiting, wave action, and turbidity that we believe contributed to the collapse of the SAV. The addition of new vegetation strips further compartmentalizing the cell can be seen, as well as the return of the SAV



Presenter: Eric Crawford

Contact Information

Eric Crawford
ecrawfor@sfwmd.gov

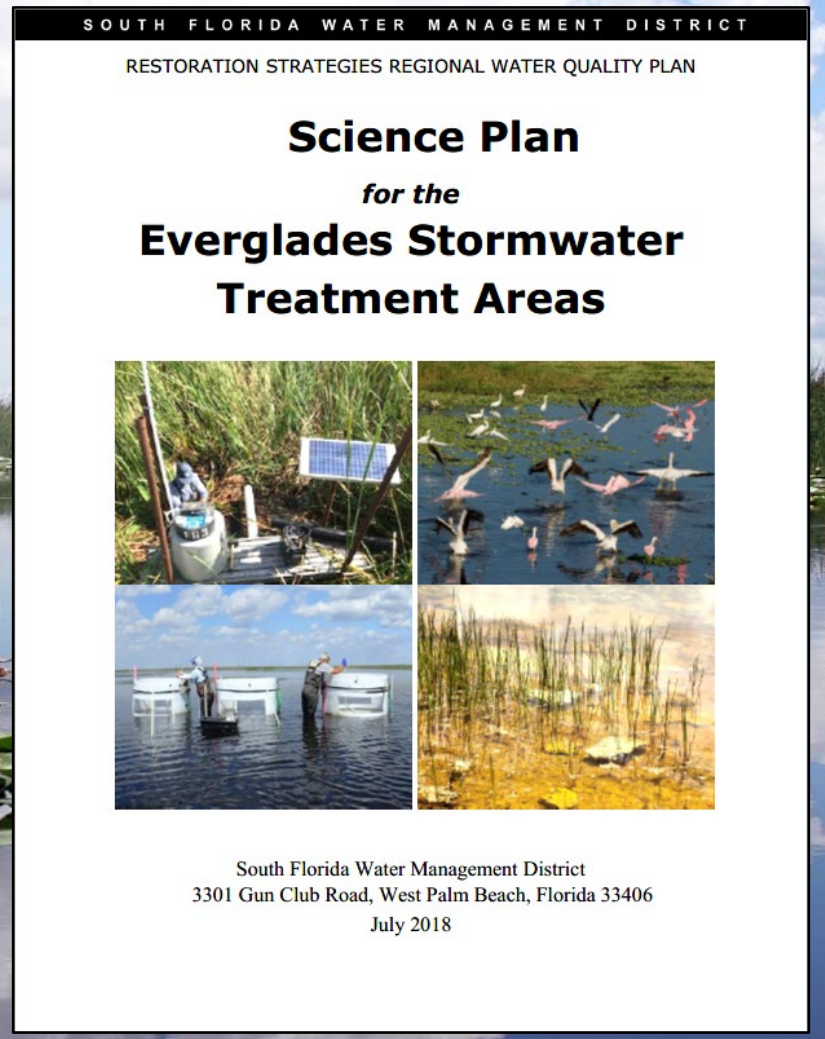
Status of Restoration Strategies Science Plan Studies

R. Thomas James
Principal Scientist
Applied Sciences Bureau

20th Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins
February 27, 2023

THE SCIENCE PLAN

- Developed in 2013 and updated in 2018
- Specified in Restoration Strategies and required by STA permit related consent orders
- Framework for studies
  - Evaluate key factors and processes that affect phosphorus removal in the STAs
  - Support design, operation, & management of STAs to achieve Water Quality-Based Effluent Limits (WQBEL)

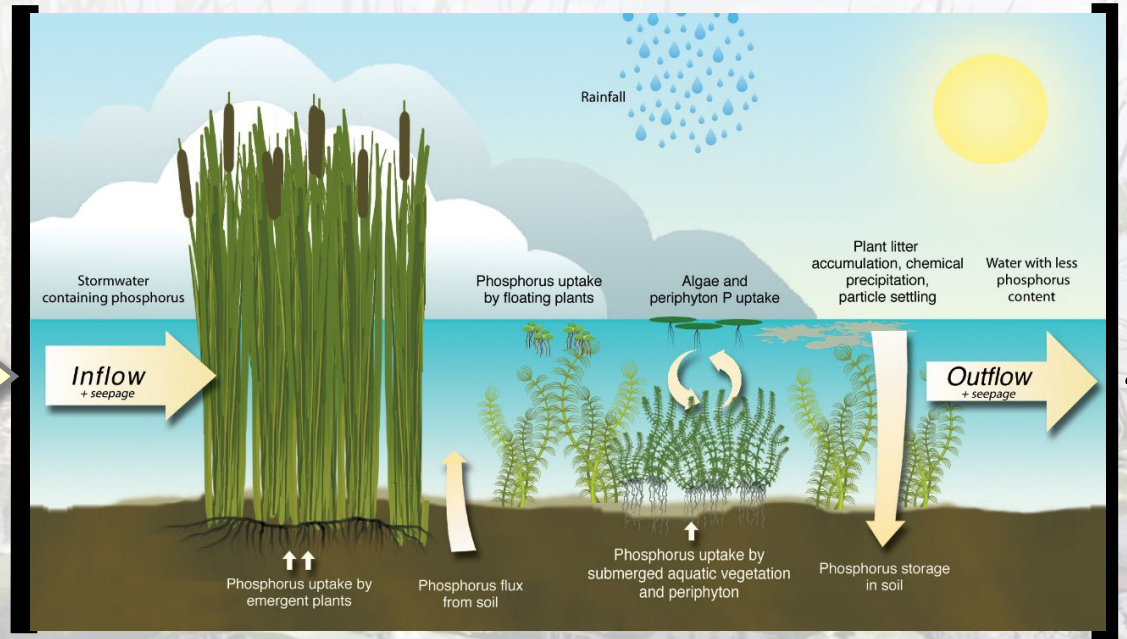


Presenter: Tom James

Areas of Investigation

6 Key questions and 18 sub-questions on these topics

FEB



1. Design and operation of FEBs
2. Design and operation of STAs
3. Vegetation improvement
4. Internal loading of phosphorus
5. Biogeochemical and physical mechanisms
6. Role of fauna

Presenter: Tom James

Studies Completed

Study Title	Major Findings
Development of Operational Guidance for Flow Equalization Basin (FEB) and STA Regional Operation (Operation Study)	▪ Improved measurements of flow through vegetated STAs • Supports the hydrologic planning model (RSM) and STA design ▪ Developed computer applications • used in real-time operations to achieve flow targets through automatic gate opening to achieve desired flow ▪ Model showed FEB operations can be optimized to meet the WQBEL
Influence of Canal Conveyance Features on STA and FEB Inflow and Outflow P Concentrations (Canal Study)	▪ TP Export related to high flow events and increase of particulate P ▪ Use of FEBs to reduced peak flow should reduce TP export
Investigation of STA-3/4 Periphyton-based Stormwater Treatment Area (PSTA) Technology Performance, Design, and Operational Factors (PSTA Study)	▪ Muck removal and low inflow TP concentrations/loads resulted in annual flow weighted mean discharge of TP ≤ 13 ppb for last 15 years ▪ Continue monitoring to evaluate performance
Evaluation of Sampling Methods for TP (Sampling Study)	▪ Grab and time-base auto samples are more reliable for low flow gated structures than auto composite samples which capture backflow ▪ Autosamplers vulnerable to plant and animal contamination
Evaluation of the Role of Rooted Floating Aquatic Vegetation (rFAV) in STAs (rFAV Study)	▪ rFAV does not enhance P reduction in outflow region compared to submerged aquatic vegetation

Presenter: Tom James

Studies Completed

Study Title	Major Findings
Evaluation of P Sources, Forms, Flux and Transformation Processes in the STAs (P Flux Study)	▪ P removal is primarily organic in EAV and primarily mineral in SAV areas ▪ P Gradients decrease from inflow to outflow ▪ No-flow conditions result in increased water column TP in SAV regions, especially after high load events ▪ Internal loading affects STA performance
STA Water and P Budget Improvements (Water and P Budget Study)	▪ Improved Period of Record flow data at all structures of STA-2 Flow-ways 1, 2, 3 and STA-3/4 all flow-ways • Improved accuracy of water budgets (reduced residuals) • Rainfall, ET, change in storage, and seepage are minor contributors • Improved accuracy of TP budgets
Evaluation of Inundation Depth and Duration Threshold for Cattail Sustainability (Cattail Study)	▪ Water depths > 91 cm for more than 100 days result in observable stress ▪ Test cell treatments with water levels > 84 cm in first 8 weeks • Increased leaf elongation • Decline in density of adult cattail and juvenile cattail growth • Elongation due to high water level results in lodging (falling over of plants) when water levels are lowered substantially

Presenter: Tom James

Studies Completed in the past year

Study Title	Major Findings
Use of Soil Amendments and/or Management to Control P Flux (Soil Management Study)	▪ Soil amendments are expensive and may adversely affect the downstream ecology ▪ Deep tilling (flipping) of soils high in P with deeper soils lower in P and high in calcium reduced flux of P into the overlying water column in a laboratory study ▪ Results from field trials of soil inversion were inconclusive due to: • Different plant species and densities • Difference in flow operations
Improving Resilience of SAV in the STAs (SAV Resilience Study)	▪ Accumulation of marl not inhibitory to SAV growth ▪ High loads (internal and/or external) result in dense SAV communities within mesocosms • Hypoxic conditions, potentially reduced P removal capacity • Stress to SAV, reduced P removal following low water levels ▪ Increased SAV germination following managed drawdown ▪ Reduced SAV growth and biomass from fish grazing

Presenter: Tom James

Studies Completed in the past year

Study Title	Major Findings
Evaluation of Factors Contributing to the Formation of Floating Tussocks in the STAs (Tussock Study)	▪ Predictors of historical tussock formation • High-water levels • Past land use (agriculture) • TP content of soils ▪ Unmanned aerial vehicle (UAV) used to survey for tussocks • Found tussocks not seen in satellite imagery • Optimized methodology can be used for future surveys ▪ Buoyancy model • Root connectivity, soil depth, and water levels are factors that result in net positive buoyancy and thus tussock formation
The Effect of Vertical Advective Transport on TP Concentrations in the STAs [Advection Study]	▪ Vertical advection (positive seepage from groundwater) • Could not be identified statistically in water and P budgets ▪ A simple tank-in-series model of an STA flow-way indicated that P loads from groundwater were very small ▪ Other soil/water interactions affect P retention in STAs to a greater degree

Presenter: Tom James

Current Studies

Study Title	Year Initiated	Expected completion
Investigation of the Effects of Abundant Faunal Species on P Cycling in the STAs (Faunal Study)	2018	2023
Periphyton and Phytoplankton P Uptake and Release (Periphyton Study)	2019	2023
L-8 FEB Operational Guidance (L-8 FEBOG Study)	2019	2023
Quantifying the Recalcitrance and Lability of Phosphorus (P) to Optimize P Retention Within STAs (Biomarker Study)	2020	2023
Phosphorus Dynamics in the Everglades Stormwater Treatment Areas (P Dynamics Study)	2020	2023
Phosphorus Removal Performance of Ecotopes In the STAs (Ecotope Study)	2021	2023
Sustainable Landscape and Treatment in a Stormwater Treatment Area [Landscape Study]	2022	2023
Data Integration and Analyses (Data Integration Study)	2020	2024
Assess Feasibility and Benefits of Consolidating Accrued Marl in the Submerged Aquatic Vegetation Cells/Flow-ways of the Stormwater Treatment Areas (Marl Study)	2021	2024

Presenter: Tom James

Fauna Study

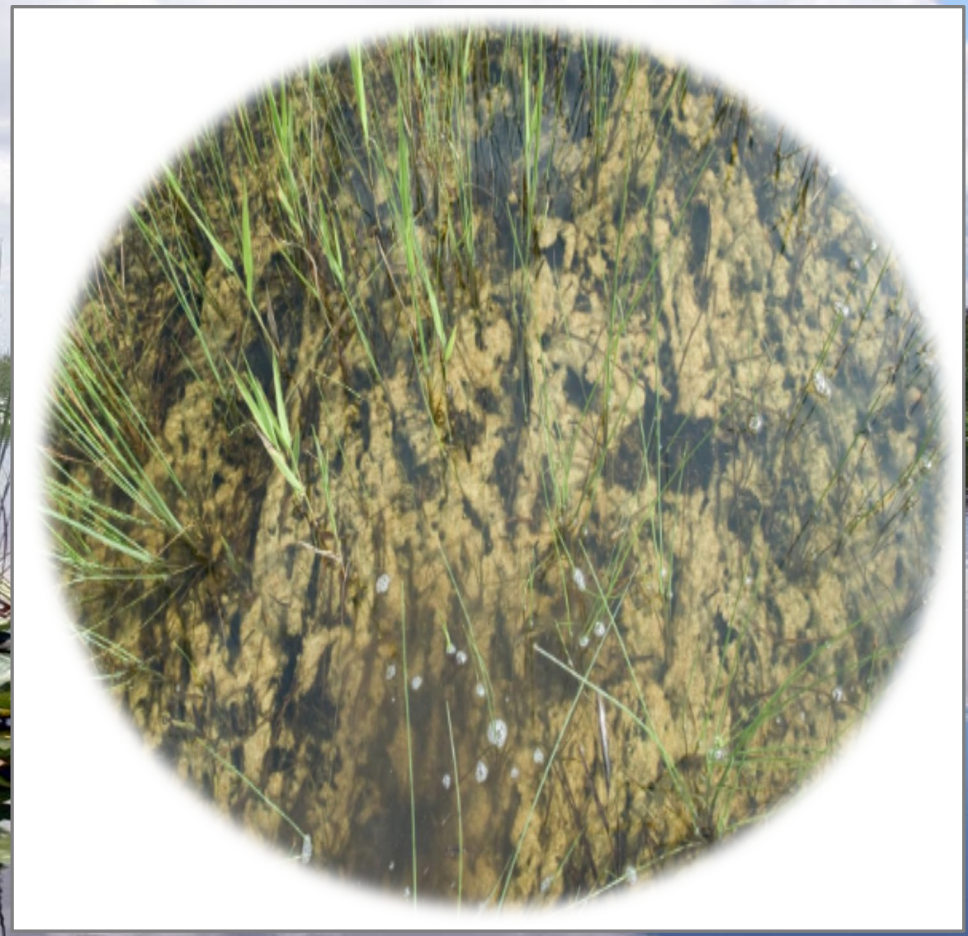
- **Objective**
  - Quantify abundant fauna and effects on outflow STA cell P-cycling and loading
  - Evaluate their effect on P outflow
- **Results**
  - Bioturbation by large fish dependent on species
    - Sailfin catfish (high)
  - Excretion
    - Greater effect than bioturbation
    - Dominated by small fish
- **Status**
  - Fish biomass sampling complete
  - Bioturbation experiments complete
  - Excretion rate studies complete
  - Electrofishing calibration complete
  - Final report ongoing

Presenter: Tom James

Periphyton Study

- **Objective**
  - Estimate growth, senescence, P uptake and release rates from periphyton and phytoplankton in downstream STA treatment flow ways under various flow conditions

- **Results**
  - Pilot Metagenomics Study
    - SAV areas greater expression of P metabolism genes
    - EAV exhibited genes related to P limitation
    - Representative communities did not grow on artificial substrates (periphytometers)
    - Water column, floc, soil, and periphyton on plant material were different in expression of metabolism genes
- **Status**
  - Metagenomics study
    - Bimonthly sampling underway
    - Small flume study to evaluate community shear stress
    - Laboratory nutrient addition incubations



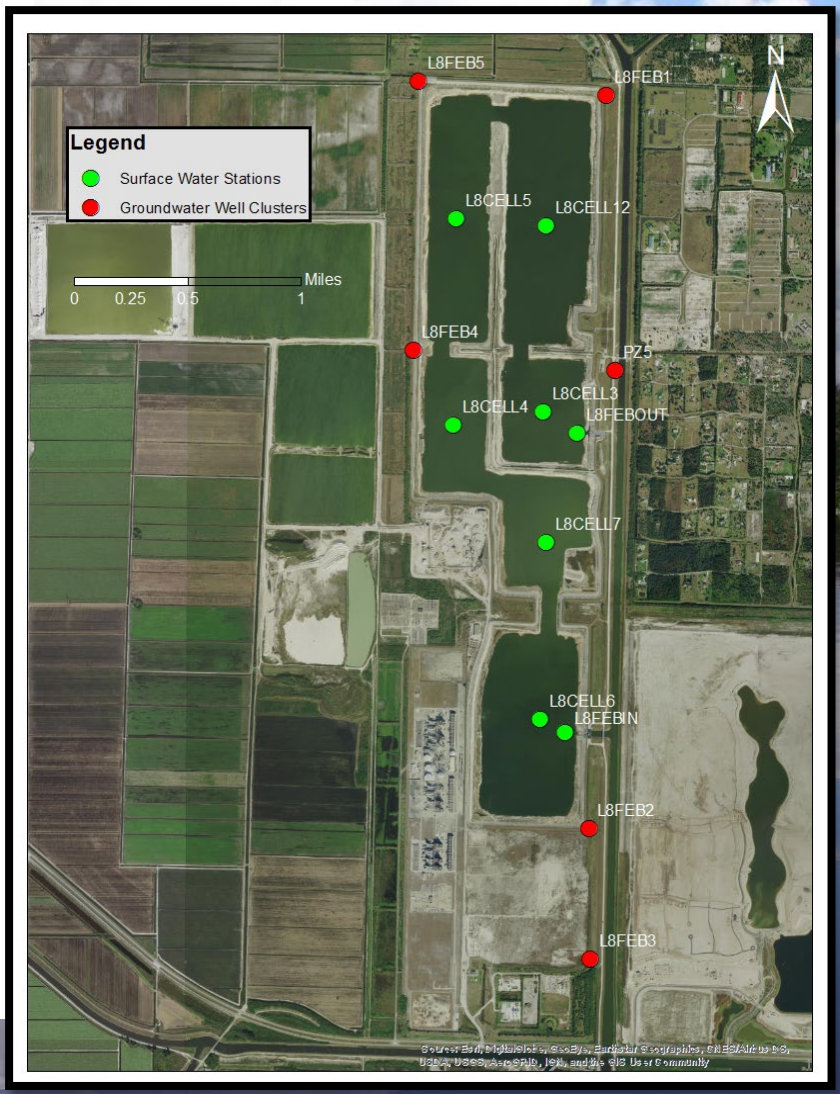
Presenter: Tom James

L-8 FEB Study

- **Objective**
  - Evaluate relationships among L-8 FEB water quality, stage, flow and groundwater to provide guidance for support of FEB operations to enhance STA performance

- **Results**
  - Potential sources of elevated P in surface water
    - Large inflows
      - Contribute significant loads of nutrients and suspended materials
      - TP resuspended from benthic sediments
    - Groundwater is not a factor
    - Runoff from embankments is not a factor

- **Status**
  - Monitoring response of L-8 FEB to inflow events
  - Alum Injection feasibility study ongoing



Presenter: Tom James

Biomarker Study

- **Objective**
  - Evaluate relationships between organic matter (OM) and P and to evaluate sources and potential turnover of P within STAs

- **Results**
  - STA inflow waters and Lake Okeechobee outflow water have varying DOM quality
    - Indicates different sources and turnover
  - Photodegradation in open water and SAV-regions of STAs can affect dissolved OM which can be processed microbially
  - Decomposition and leaching experiments
    - EAV release more Dissolved P than SAV

- **Status**
  - Final Analysis and Reports underway
    - Field and lab measurements of litter and floc decomposition
    - Photochemistry experiments and spectroscopy of STA waters
    - Transect sampling

Presenter: Tom James

P Dynamics Study

- **Objective**
  - Evaluate mechanisms and factors influencing P reduction in underperforming flow-ways (FW)s

- **Results**
  - Historical analysis found underperformance related to dry out/reflood events, loss/damaged veg, construction activities and high phosphorus loading rate
  - No flow conditions
    - Water column is dominated by PP
    - Higher water column TP than during flow
  - Flowing conditions
    - TP patterns primarily dictated by SRP concentrations
    - Water column TP is often lower compared to low flow conditions except for extreme loading events

- **Status**
  - Wet Season sampling completed
    - STA-2 FWs 3 and 4
  - Dry season sampling underway
    - STA-2 FW 3; STA-1E CFW and EFW

Presenter: Tom James

Marl Study

- **Objective**
  - Evaluate drying and/or addition of organic materials to marl soils to improve physical and chemical stability, reduce internal P loading and reduce water column P concentrations in the lower reaches of the STAs

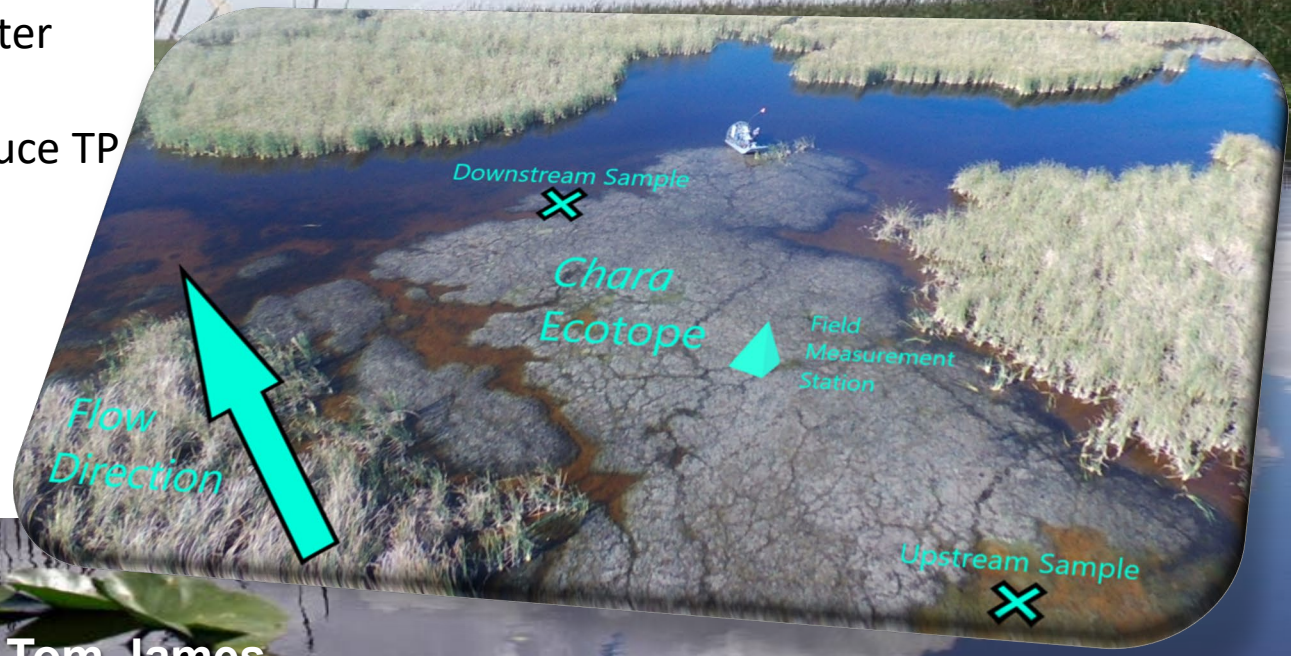
- **Results**
  - Muck soils more susceptible to resuspension than Marl soils
  - Marl soils have a wide range of resuspension
  - Consolidation of soils by dewatering most effective at improving short term physical stability
  - Organic amendments were relatively ineffective

- **Status**
  - Soil P flux potential before and after consolidation is being evaluated

Presenter: Tom James

Ecotope Study

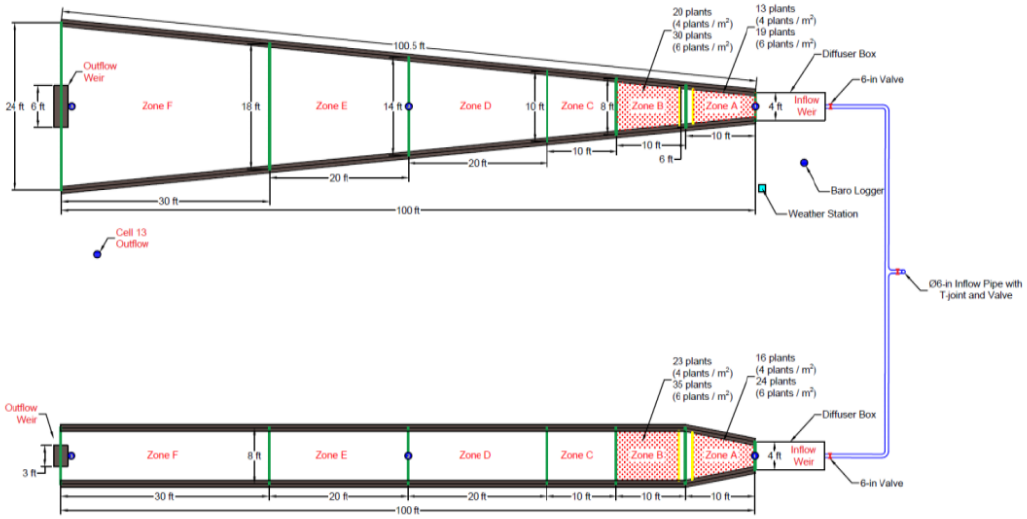
- **Objective**
  - Estimate the phosphorus treatment performance of ecotopes commonly found in the STAs
- **Results**
  - Rank of TP concentration by Ecotope
    - Chara < Mixed ≈Naiad < Typha < Bare
  - DOP is largest P fraction during high flows
  - Seasonal changes in TP concentration greater than ecotope differences
  - Increased outflow and/or water depth reduce TP concentration
- **Status**
  - Sampling continues
    - STA-3/4 Cell 2B
    - STA-1W Cell 5B



Presenter: Tom James

Landscape Study

- **Objective**
  - Quantify flow effects on hydraulic mixing given different plant densities and water depths
- **Results**
  - Ongoing
- **Status**
  - Flumes built
  - Leaks being repaired



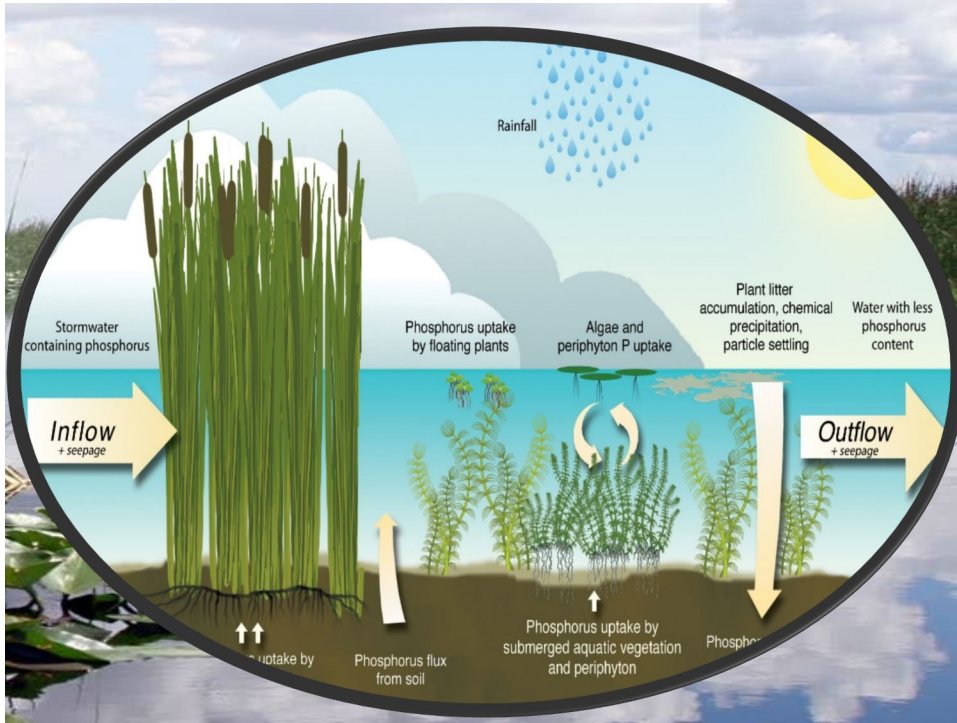
Presenter: Tom James

Data Integration Study

- **Objective**
  - Develop a comprehensive description of P dynamics and factors affecting Everglades STA performance through document review, data review and analyses, and modeling

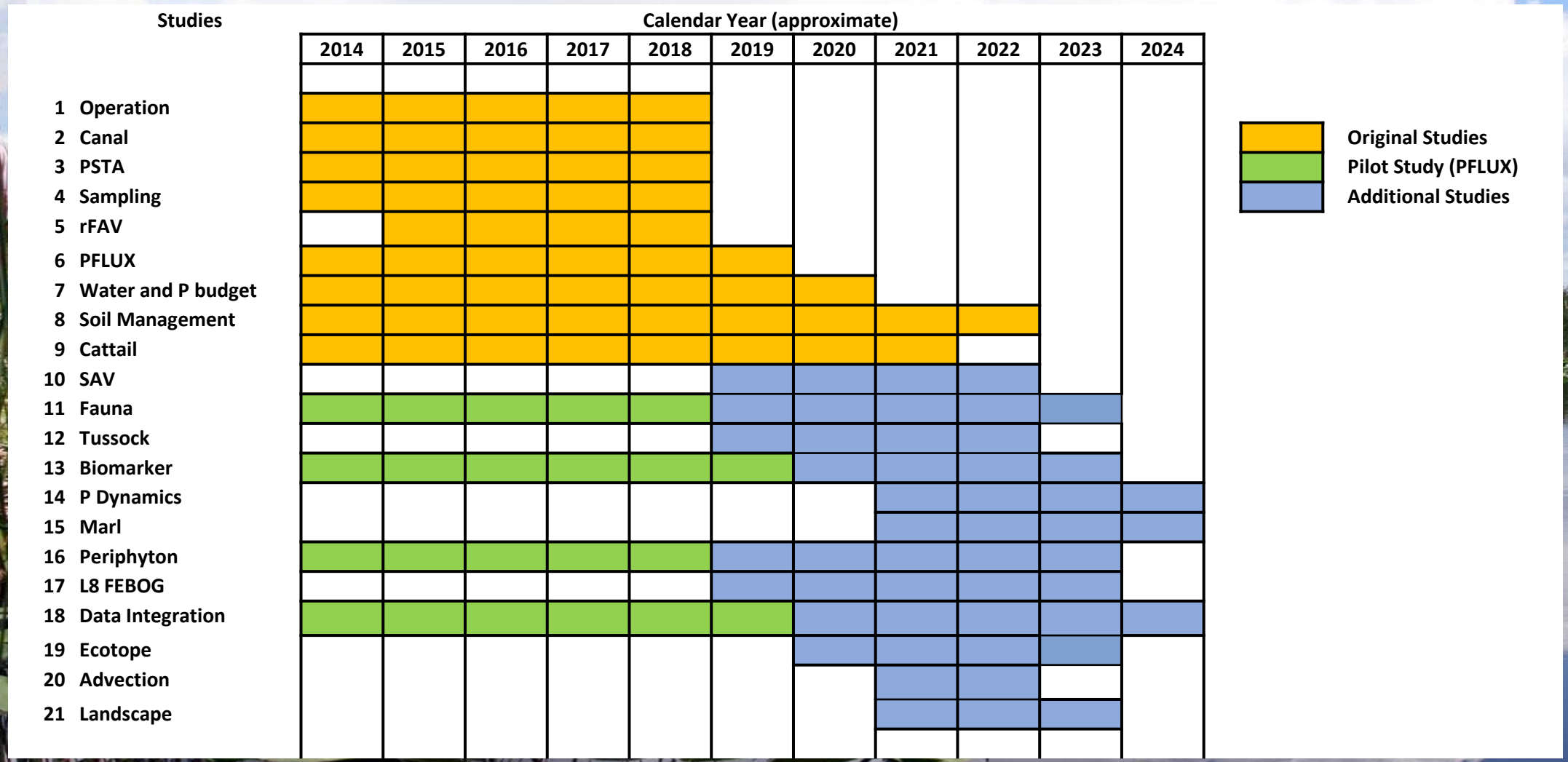
- **Results**
  - Microbial literature review
    - Reduced mineralization in soils and enhanced enzyme activity in water column promote lower TP outflow concentrations
  - Analyses of outflow soil, water, plants
    - Dense SAV results in low TP outflow
    - Soil management to reduce internal P load can result in lower TP outflow
  - Biogeochemical EAV model of STA-2 FW1 has been developed and calibration is ongoing

- **Status**
  - Biogeochemical model development continues
  - Food web model being developed



Presenter: Tom James

Science Plan Study Timelines



Presenter: Tom James

Contact Information

Tom James
tjames@sfwmd.gov

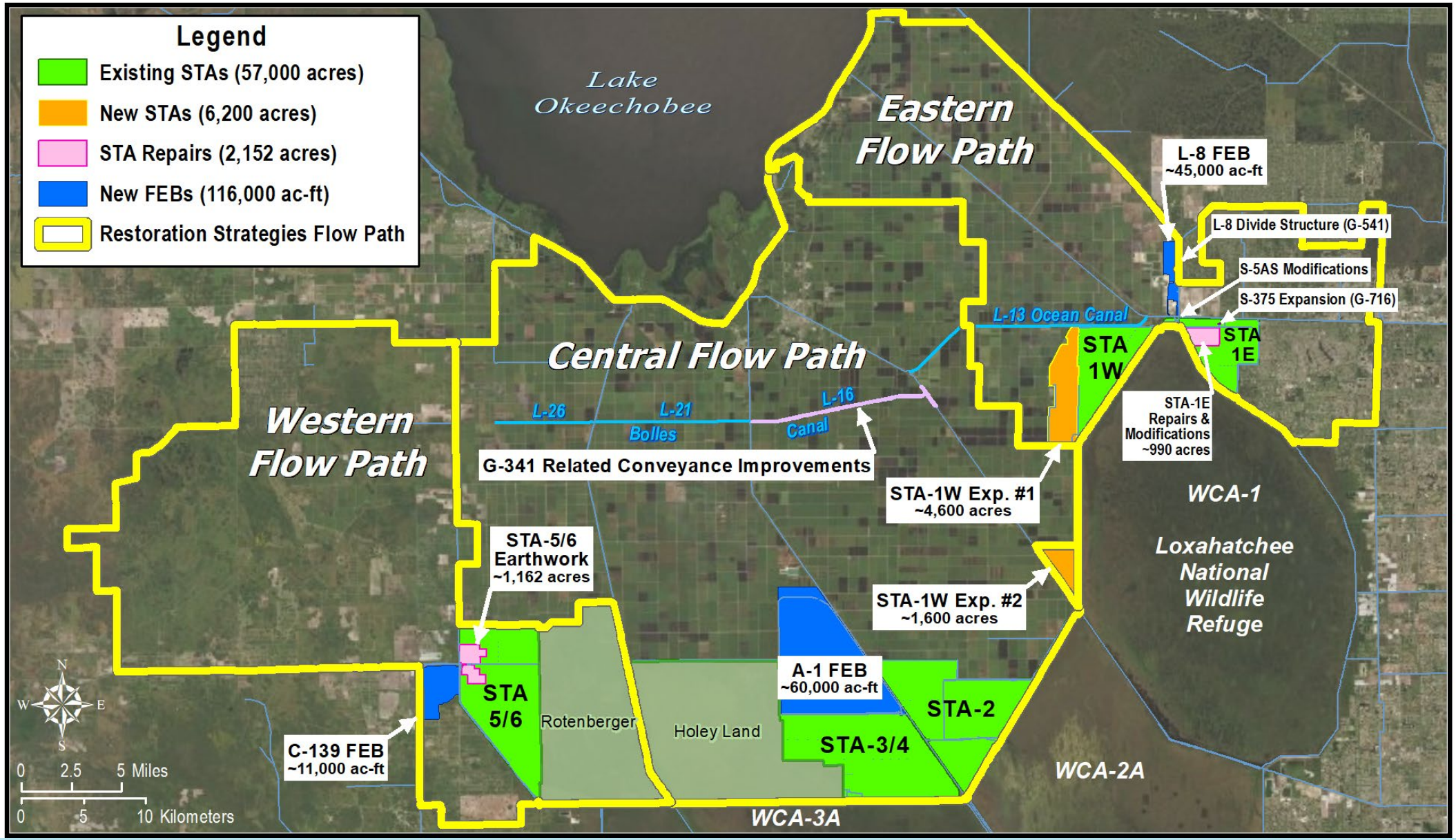
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Restoration Strategies

Engineering & Construction Update

Lucine Dadrian, P.E.
Project Management Section Administrator
Engineering and Construction Bureau

20th Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins
February 27, 2023



Presenter: Lucine Dadrian

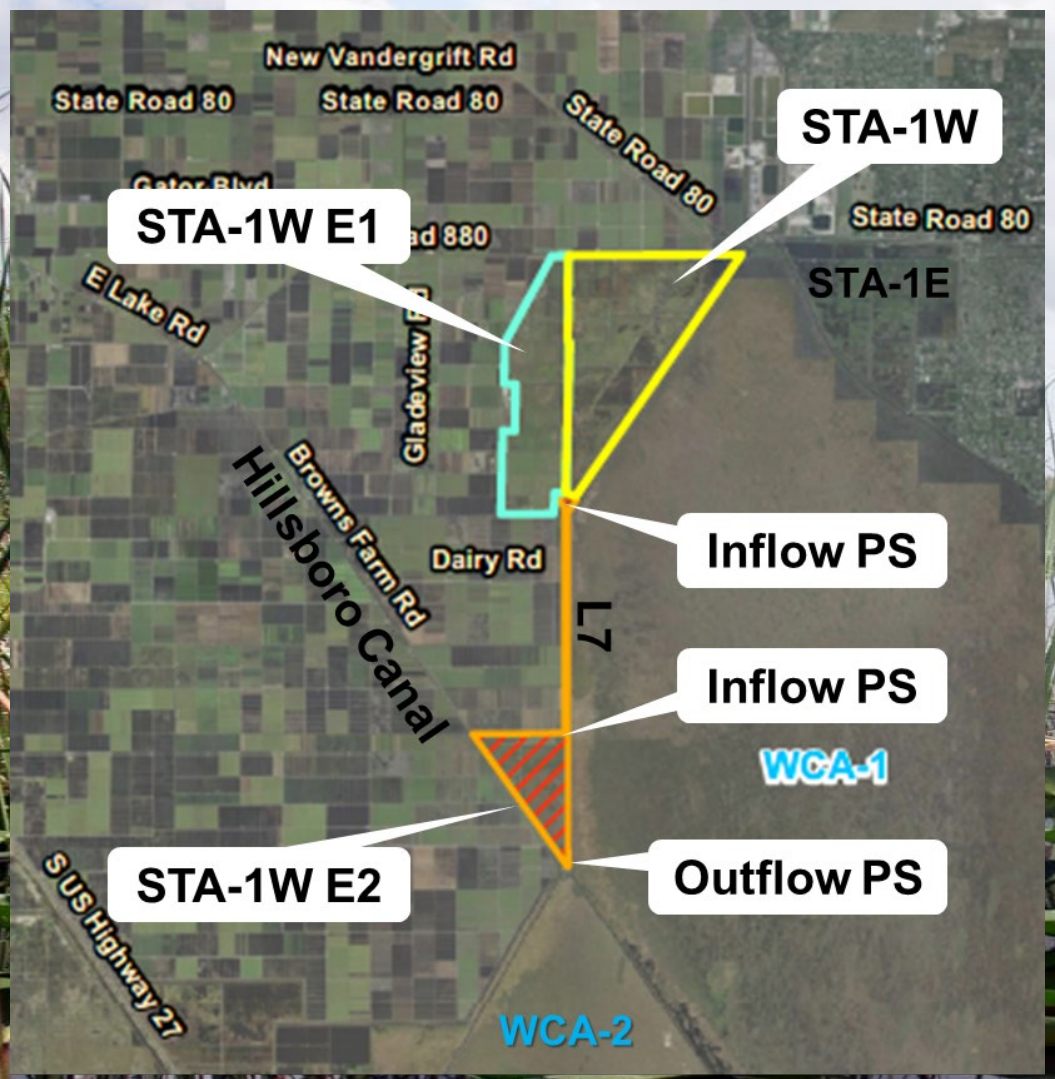
Restoration Strategies Project Status

- **Completed Construction:**
  - STA2 Expansion Compartment B
  - STA 5/6 Expansion Compartment C
  - S-5AS Modifications
  - L-8 FEB *Multi-Use Operation*
  - A-1 FEB
  - L-8 Divide Structure (G-541)
  - S-375 Expansion (G-716)
  - STA 5/6 Earthwork *Optimization*
  - STA-1W Expansion #1
  - G-341 Segments 1 – 4
- STA-1E Repair

- **Ongoing:**
  - STA-1W Expansion #2 *Construction*
  - G-341 Segment 5 *Construction*
  - C-139 FEB *Construction*

Presenter: Lucine Dadrian

STA-1W Expansion No. 2

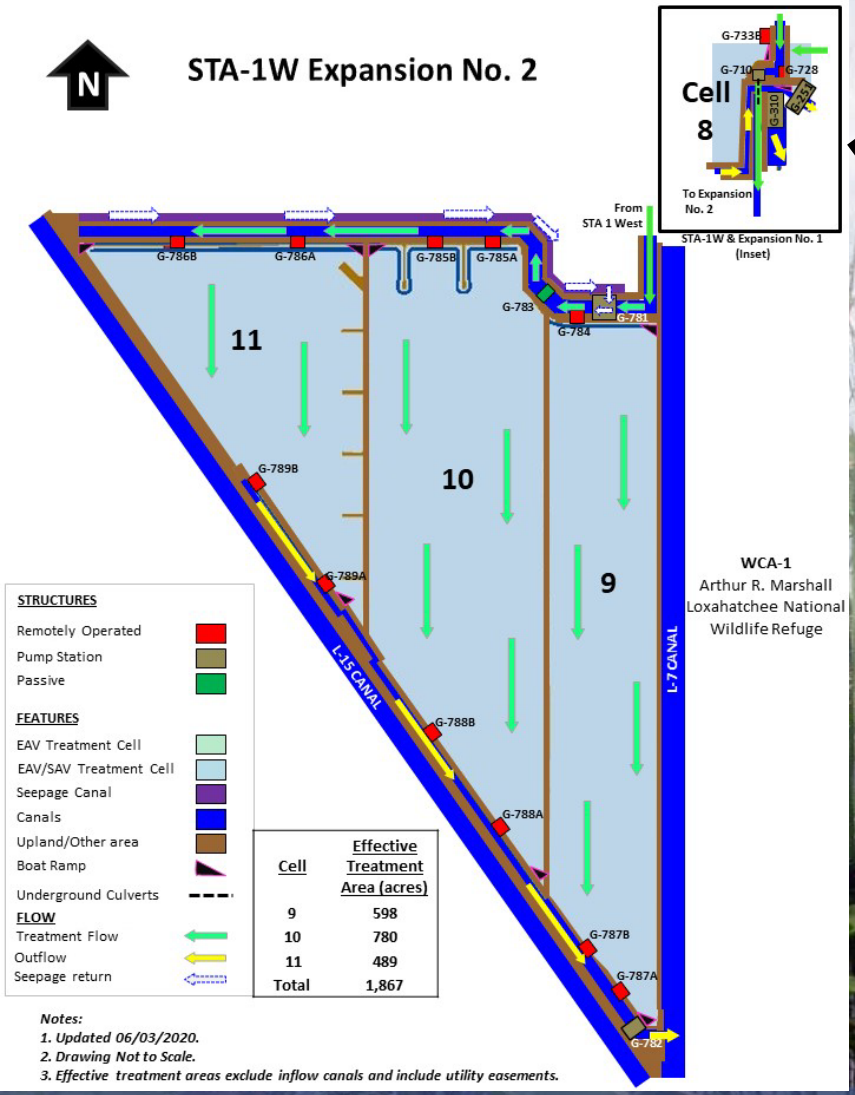


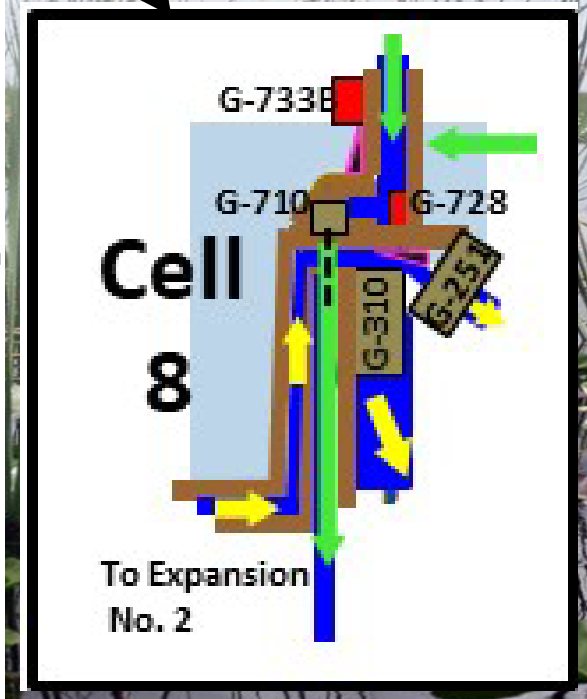
- Purpose is to extend treatment flow-ways for STA-1W
- Overall Construction Cost $214M
- Features 1,600 acres of additional treatment area
- Inflows from S-5A and C-51 West Basins via STA-1W
- Outflow to Water Conservation Area 1

Presenter: Lucine Dadrian

STA-1W Expansion No. 2

Schedule of Construction





- Underground Piping Complete
  - Construction Complete - December 2020
- STA and Connector Canal
  - Start Construction - September 2020
  - 90% Complete
- Inflow Pump Stations (G780 & G781)
- Start Construction – December 2020
  - 60% Complete
- Outflow Pump Station (G782)
  - Start Construction – December 2020
  - 60% Complete

Presenter: Lucine Dadrian

STA-1W Expansion No. 2

STA Civil Works

Northern Section of Concrete Conveyance Canal

North Inflow Canal and Levee

Presenter: Lucine Dadrian

STA-1W Expansion No. 2

Inflow Pump Stations

G-780, Dissipator & Lined Discharge Channel

G-781 & STA Intake Channel

Presenter: Lucine Dadrian

STA-1W Expansion No. 2

Outflow Pump Station

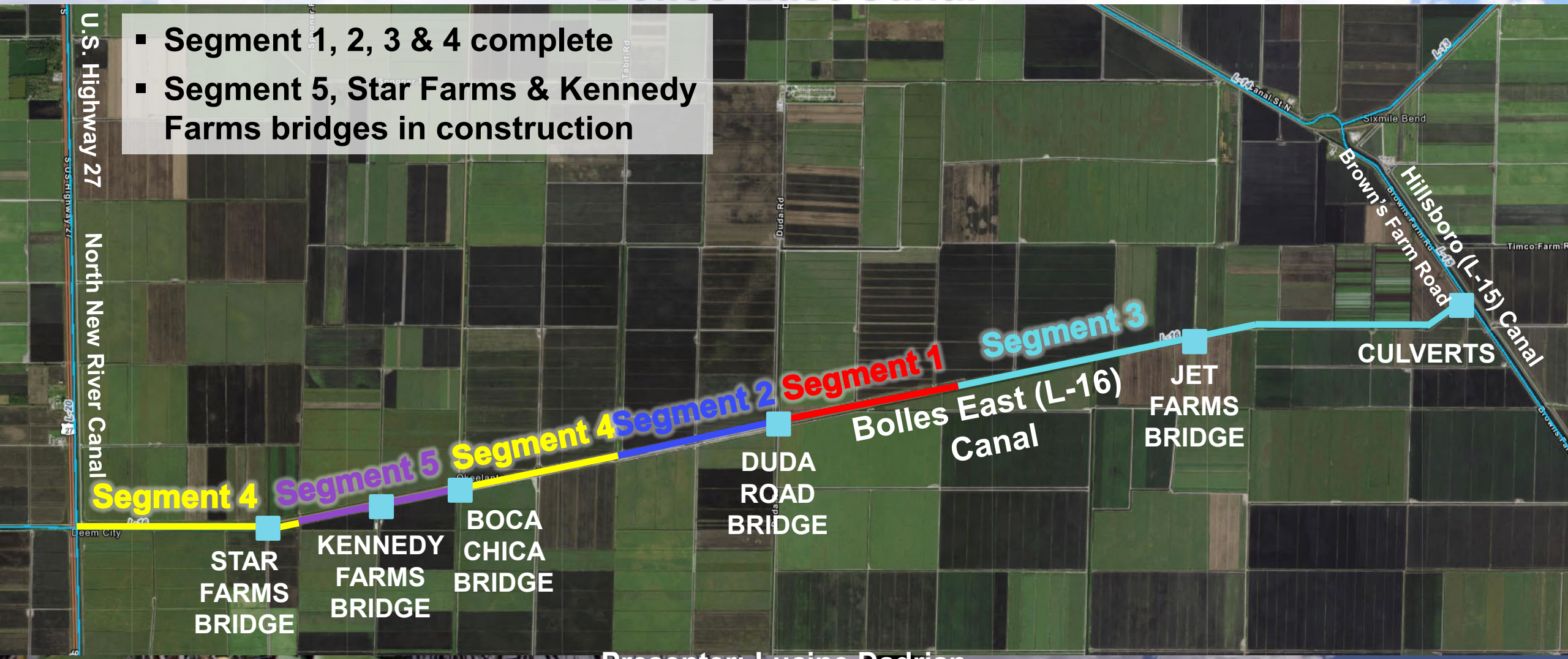
G-782 Pipe Gallery

G-782 & STA

Presenter: Lucine Dadrian

G-341 Related Conveyance Improvements

Bolles East Canal



- Segment 1, 2, 3 & 4 complete
- Segment 5, Star Farms & Kennedy Farms bridges in construction

Presenter: Lucine Dadrian

G-341 Related Conveyance Improvements

Bolles East Canal – Segment 5

Pile Placement Star Farm Bridge

FDOT Beam Slab Placement

Presenter: Lucine Dadrian

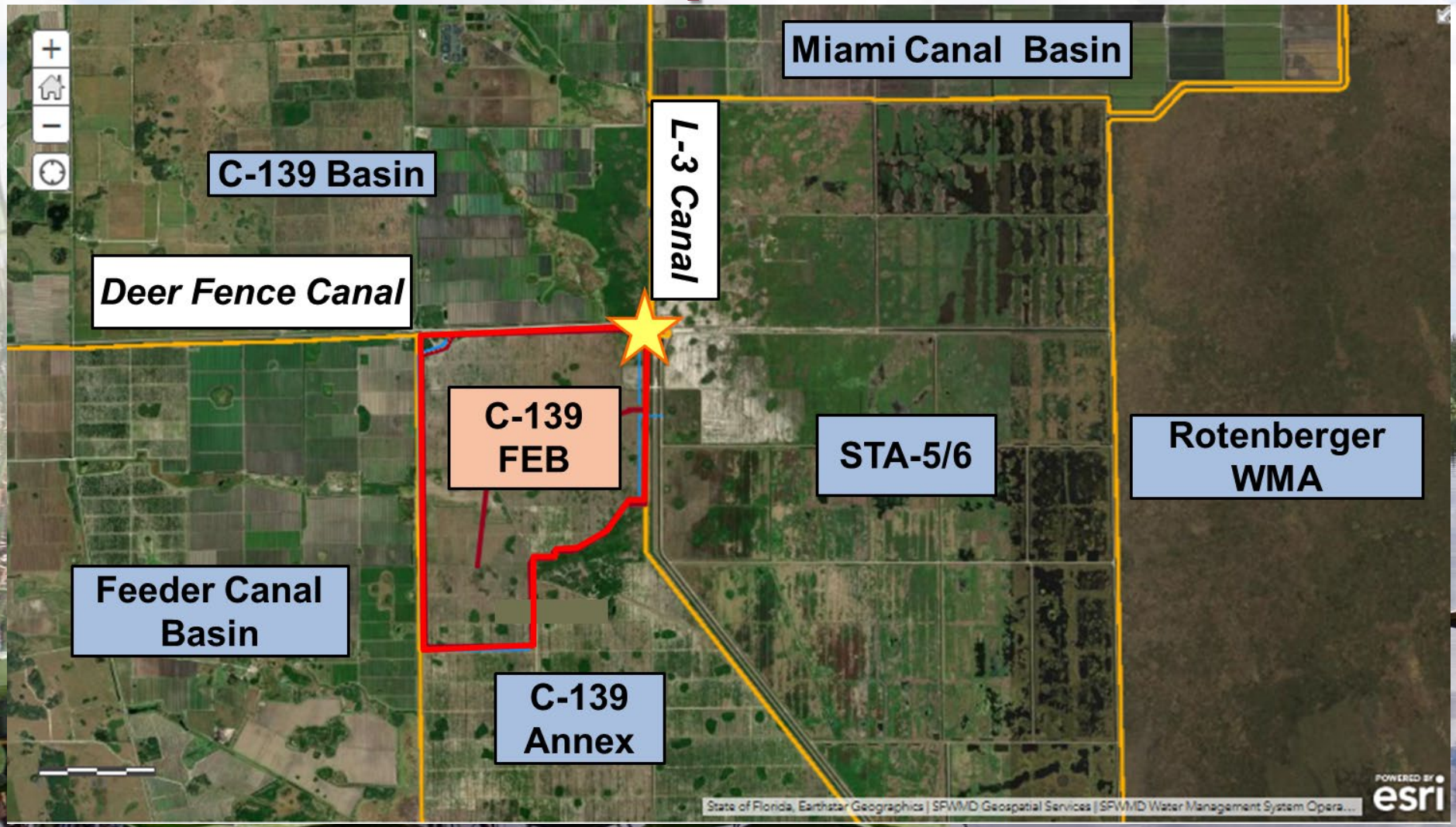
G-341 Related Conveyance Improvements

Bolles East Canal – Segment 5

Bolles Canal Widening Improvements

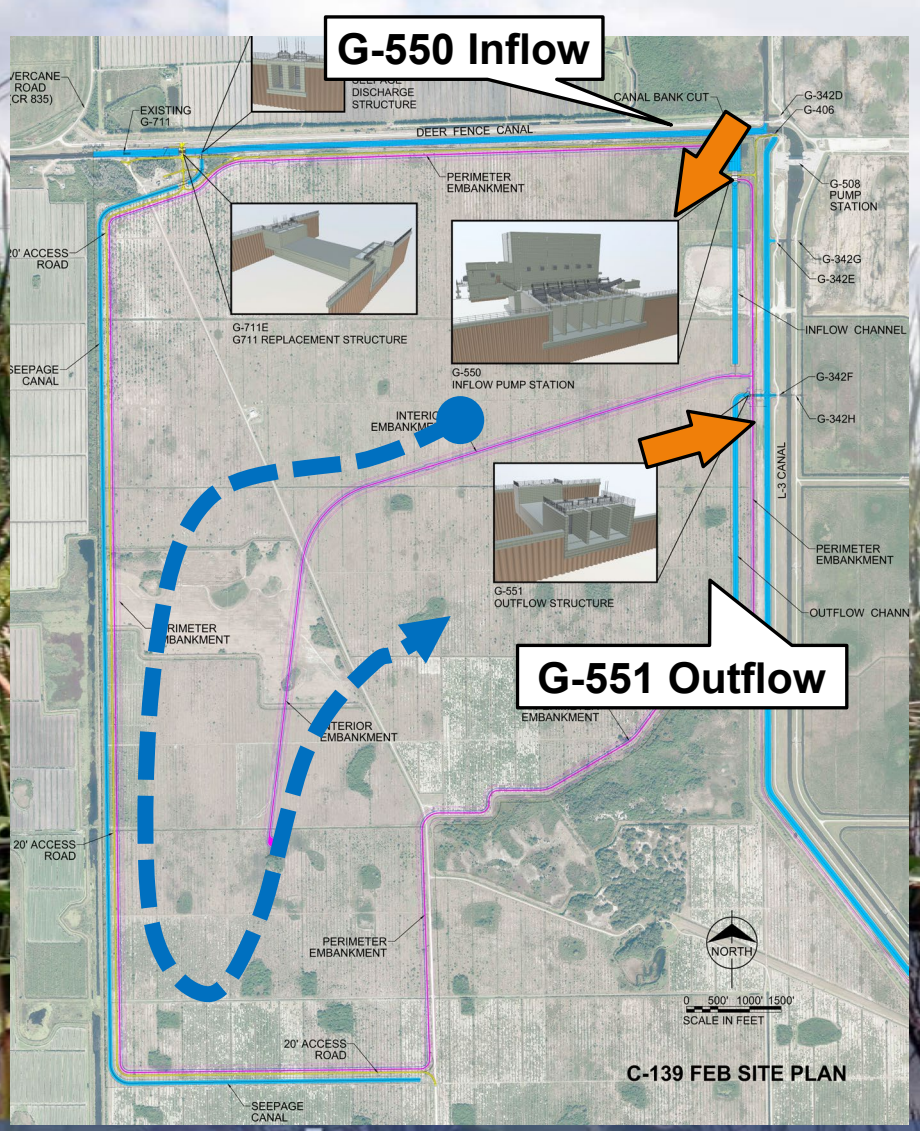
Presenter: Lucine Dadrian

C-139 Flow Equalization Basin



Presenter: Lucine Dadrian

C-139 Flow Equalization Basin



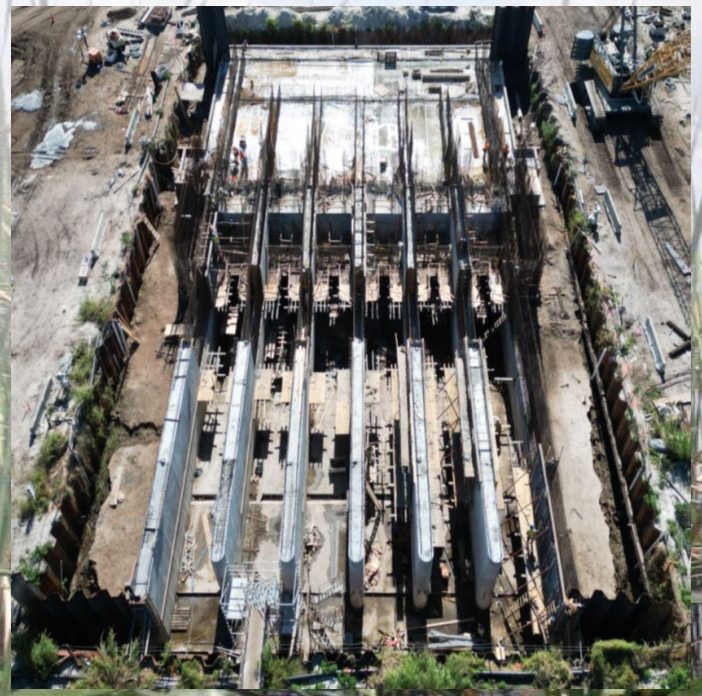
- Overall Project - 73% Complete
- G550 PS - Concrete 49% Complete
- G551 - Concrete 100% Complete
- Flow Equalization Basin
  - Land Levelling 86% Complete
  - Levee 74% Complete
  - Canal 90% Complete

Presenter: Lucine Dadrian

C-139 Flow Equalization Basin

Presenter: Lucine Dadrian

C-139 Flow Equalization Basin



G-550 Pump Station
Concrete & Reinforcement

Pump Housing Placement

Presenter: Lucine Dadrian

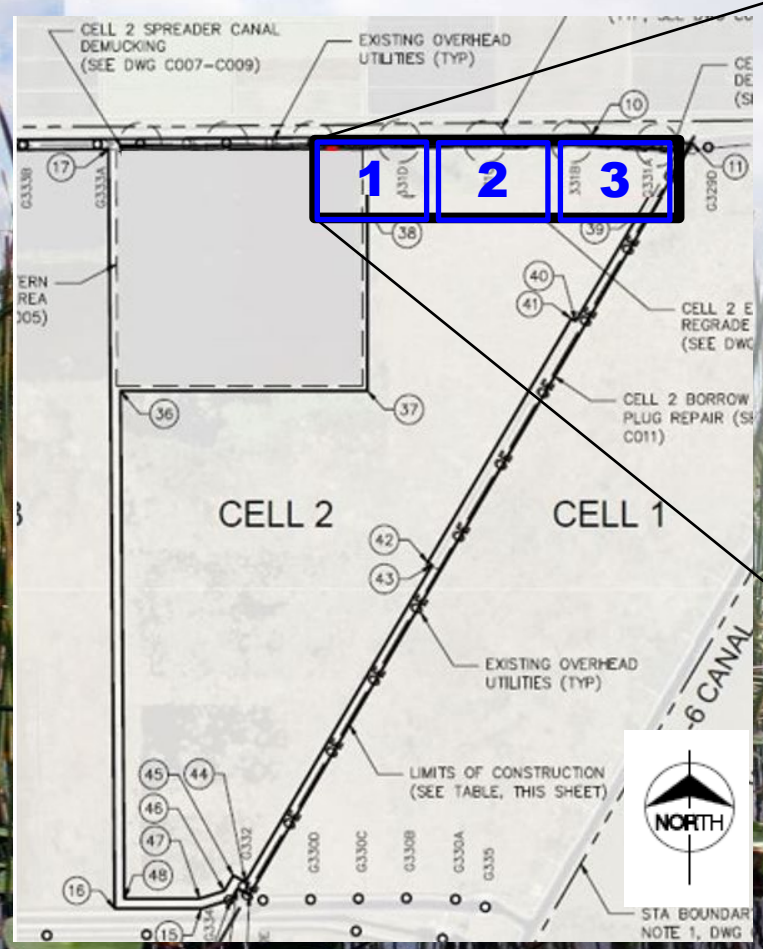
C-139 Flow Equalization Basin

G-551 Outflow Structure 100% Concrete Completed

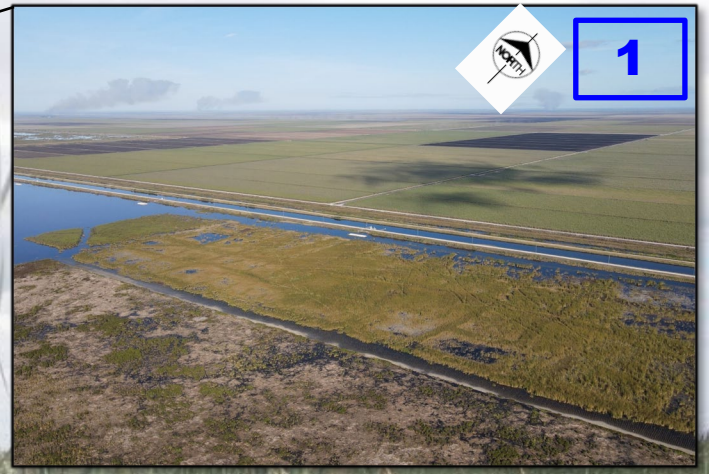
Eastern Levee construction over the G-551 Outflow Structure nearing completion

Presenter: Lucine Dadrian

STA Refurbishments – STA-2 Cell 2



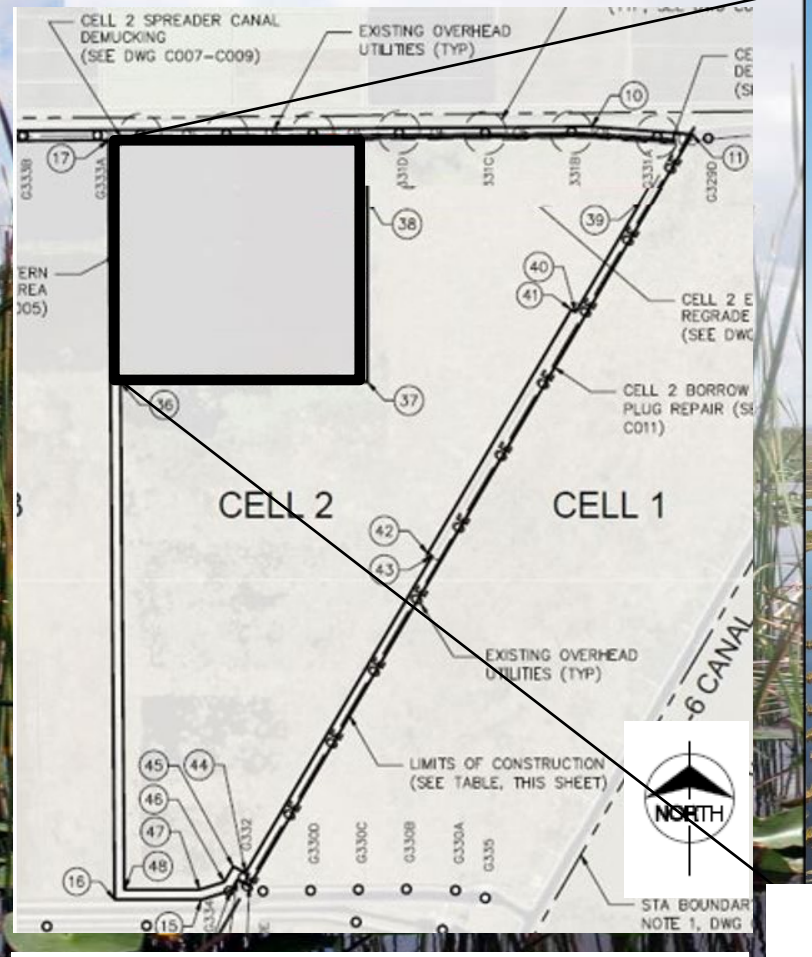
STA-2 Schematic



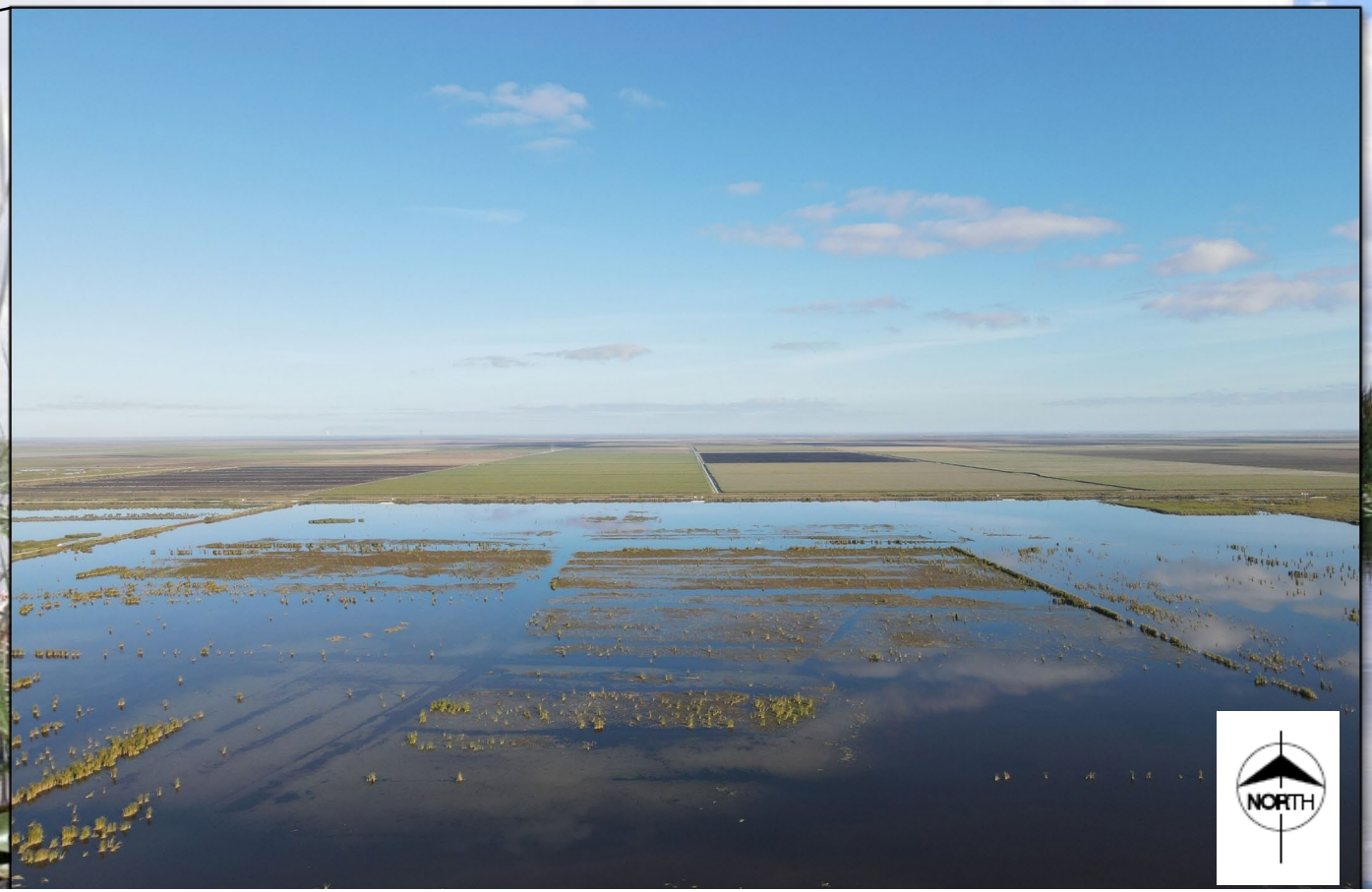
STA-2 Cell 2 Eastern Regrade Area
Regrading Complete and Planting Underway (70% complete)

Presenter: Lucine Dadrian

STA Refurbishments – STA-2 Cell 2



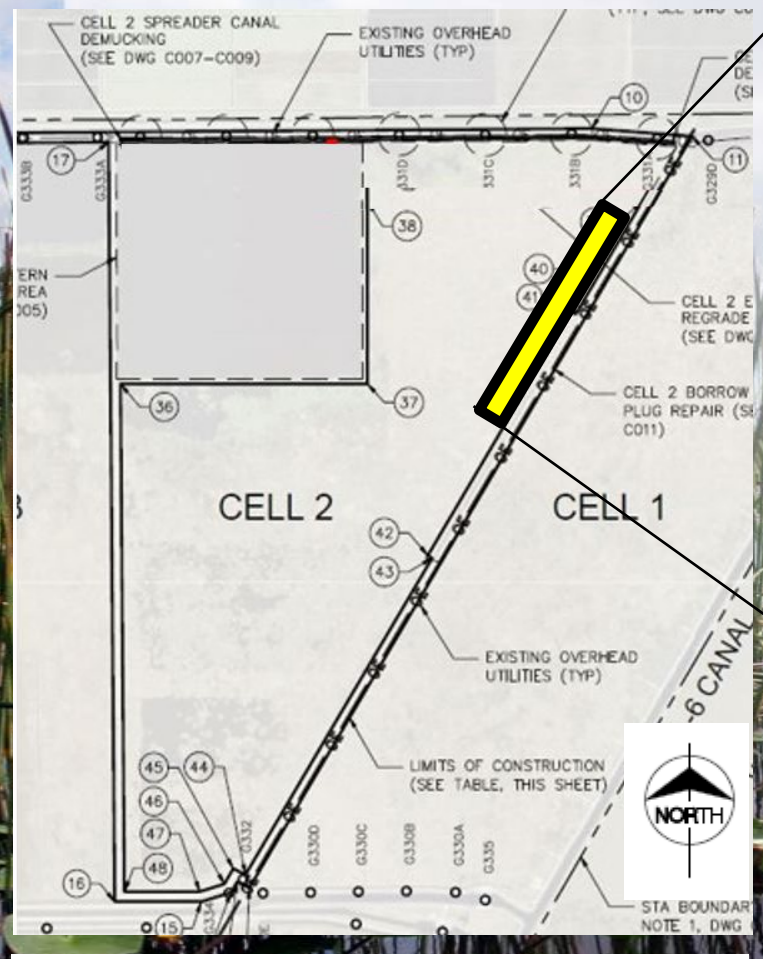
STA-2 Schematic



STA-2 Cell 2 Western Regrade Area
Regrading Complete and Planting Underway (10% complete)

Presenter: Lucine Dadrian

STA Refurbishments – STA-2 Cell 2

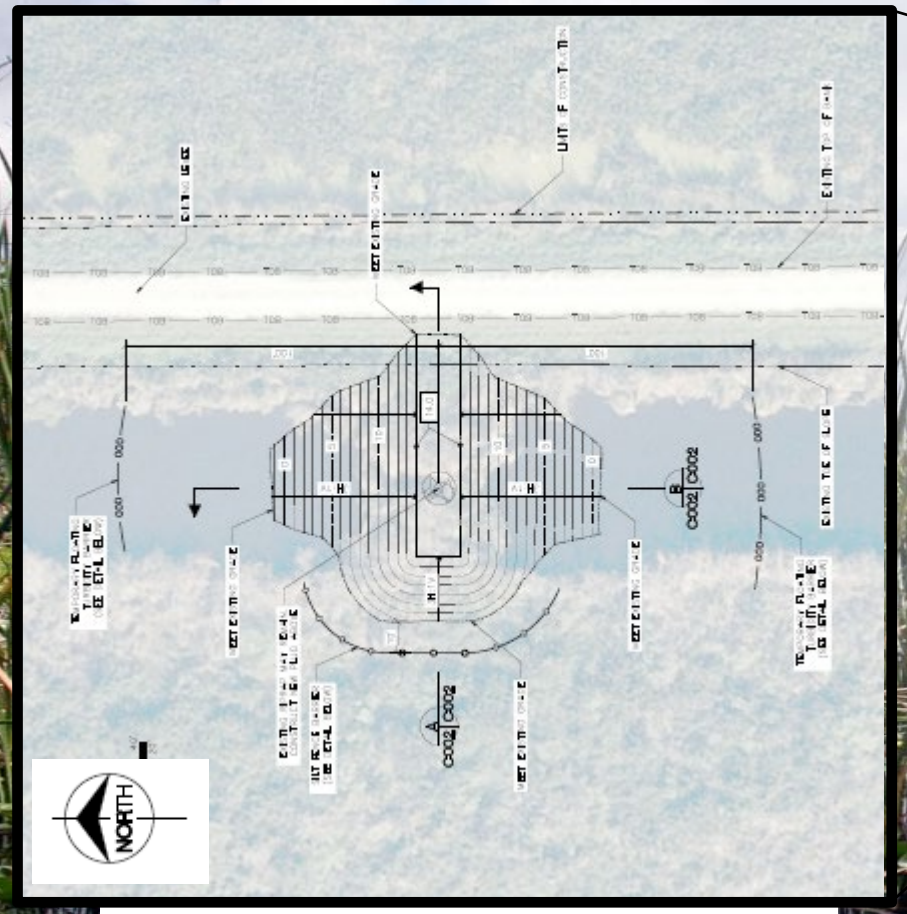


STA-2 Schematic

STA-2 Cell 2 East Borrow Canal
Restoration of 37 Canal Plugs – 15 Complete

Presenter: Lucine Dadrian

STA Refurbishments – STA-2 Cell 3



Typical Canal Plug Plan View

STA-2 Cell 3 East Borrow Canal
Restoration 49 of Canal Plugs – April – July 2023

Presenter: Lucine Dadrian

EASTERN FLOW PATH

STA-1W Expansion #2 (100864)

Activity	Deadline	
Complete land acquisition	3/31/2018	✓
Initiate design	10/1/2018	✓
Submit state and federal permit applications	8/1/2019	✓
Complete design	7/31/2020	✓
Initiate construction	11/30/2020	✓
Construction status report	3/1/2021	✓
Construction status report	3/1/2022	✓
Complete construction	**12/31/2022**	
Initial flooding and optimization period complete	12/31/2024	

STA-1W Expansion #1 (100818)

COMPLETE

Activity	Deadline	
Complete land acquisition	9/30/2013	✓
Initiate design	9/30/2013	✓
Submit state and federal permit applications	7/30/2014	✓
Complete design	7/30/2015	✓
Initiate construction	1/31/2016	✓
Construction status report	3/1/2017	✓
Construction status report	3/1/2018	✓
Complete construction	12/31/2018	✓
Initial flooding and optimization period complete	12/31/2020	✓

STA-1E Repairs and Modifications

COMPLETE

Activity	Deadline	
PSTA Decommissioning complete	12/31/2022	✓
Culvert repairs complete	12/31/2022	✓
Cell 5 and 7 improvements complete	12/31/2022	✓

L-8 FEB (100813)

COMPLETE

Activity	Deadline	
Submit state and federal permit applications	1/31/2014	✓
Construction status report	3/1/2014	✓
Construction status report	3/1/2015	✓
Complete construction (begin multi-purpose ops)	12/31/2016	✓
Long term operations commence	12/31/2022	✓

G-341 Related Conveyance Improvements (100802)

Activity	Deadline	
Initiate design	10/1/2020	✓
Submit state and federal permit applications	8/1/2021	✓
Complete land acquisition (if required)	9/30/2021	✓
Complete design	7/31/2022	✓
Initiate construction	11/30/2022	✓
Construction status report	3/1/2023	✓
Construction status report	**3/1/2024**	
Complete construction	12/31/2024	

L-8 Divide Structure (100817)

COMPLETE

Activity	Deadline	
Initiate design	10/1/2012	✓
Complete design	9/30/2014	✓
Initiate construction	10/1/2016	✓
Complete construction	9/30/2018	✓

S-5AS Modifications (100822)

COMPLETE

Activity	Deadline	
Initiate design	10/1/2012	✓
Complete design	9/30/2014	✓
Initiate construction	10/1/2014	✓
Complete construction	9/30/2016	✓

S-375 Expansion (100819)

COMPLETE

Activity	Deadline	
Initiate design	9/30/2013	✓
Complete design	7/30/2015	✓
Initiate construction	1/31/2016	✓
Complete construction	12/31/2018	✓

LEGEND

- Flow Equalization Basin
- Stormwater Treatment Area
- Conveyance Improvement
- ✓ Complete

Projects Complete = 9 of 13
Activities Complete = 66 of 74
% Activities Complete = 89 %
% Time Complete = 78 %

CENTRAL FLOW PATH

STA-2 Expansion: Compartment B

COMPLETE

Activity	Deadline	
Initial flooding and optimization period complete	5/31/2014	✓

A-1 FEB (100706)

COMPLETE

Activity	Deadline	
Initiate design	4/1/2012	✓
Submit state and federal permit applications	12/1/2012	✓
Design status report	3/1/2013	✓
Complete design	8/1/2013	✓
Initiate construction	6/30/2014	✓
Construction status report	3/1/2015	✓
Construction status report	3/1/2016	✓
Complete construction	7/30/2016	✓
Operational monitoring and testing period complete	7/29/2018	✓

WESTERN FLOW PATH

STA-5/6 Internal Improvements (100868)

Activity	Deadline	
Initiate design	10/31/2019	✓
Submit state and federal permit applications	8/30/2020	✓
Complete design	10/31/2021	✓
Initiate construction	1/31/2022	✓
Construction status report	3/1/2023	✓
Construction status report	3/1/2024	✓
Complete construction	12/31/2024	✓
Initial flooding and optimization period complete	**12/31/2025**	

STA-5/6 Expansion: Compartment C

COMPLETE

Activity	Deadline	
Initial flooding and optimization period complete	5/31/2014	✓

C-139 FEB (100867)

Activity	Deadline	
Initiate design	10/31/2018	✓
Submit state and federal permit applications	8/30/2019	✓
Complete design	10/31/2020	✓
Initiate construction	1/31/2021	✓
Construction status report	3/1/2021	✓
Construction status report	3/1/2022	✓
Construction status report	**3/1/2023**	
Complete construction	12/31/2023	
Operational monitoring and testing period complete	12/31/2024	

Presenter: Lucine Dadrian

Contact Information

Lucine Dadrian
ldadrian@sfwmd.gov

Everglades National Park

SFWMD Southern Everglades Nutrient Source Control Program Update

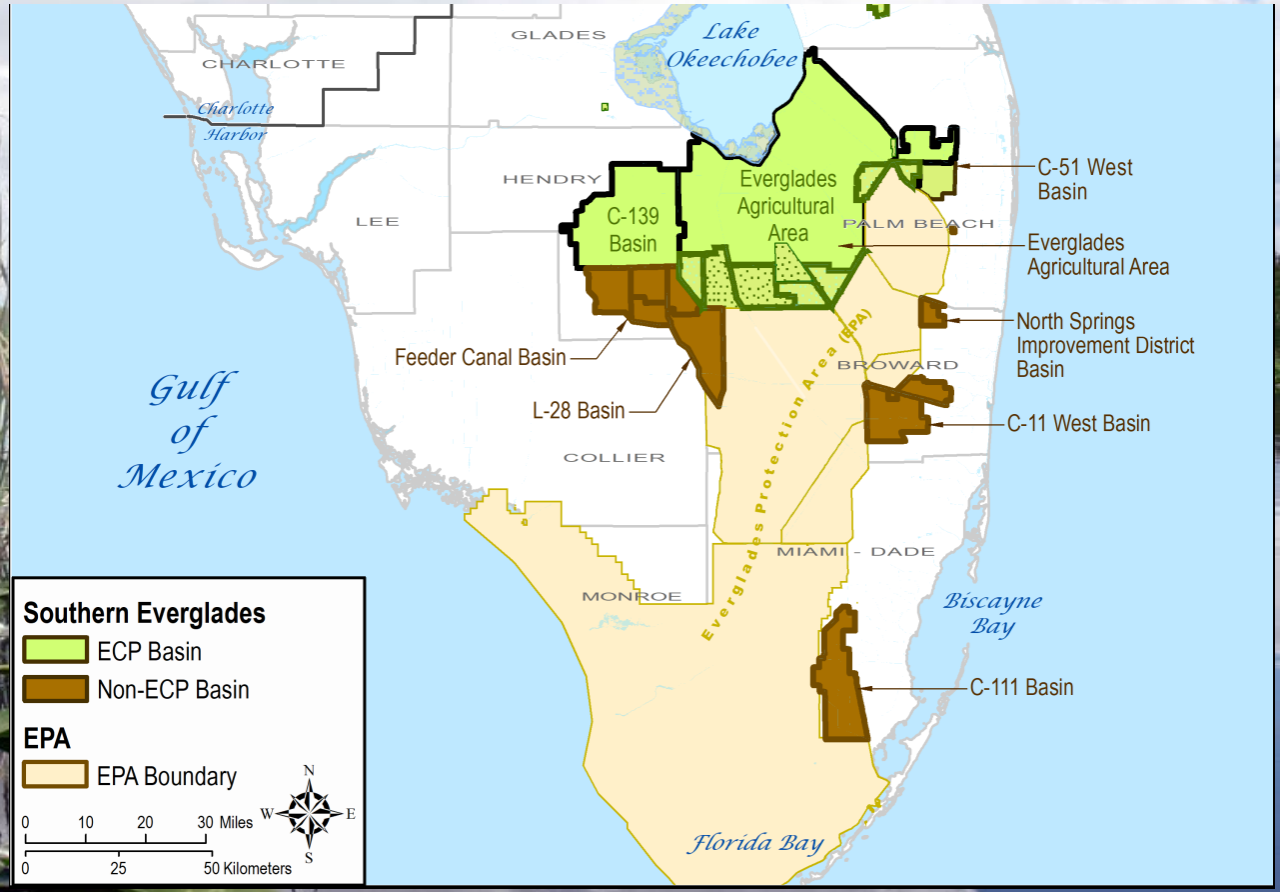
Youchao Wang, P.E., Ecosystem and Capital Projects Division

Steve Sarley, P.E., Regulation Division

20th Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

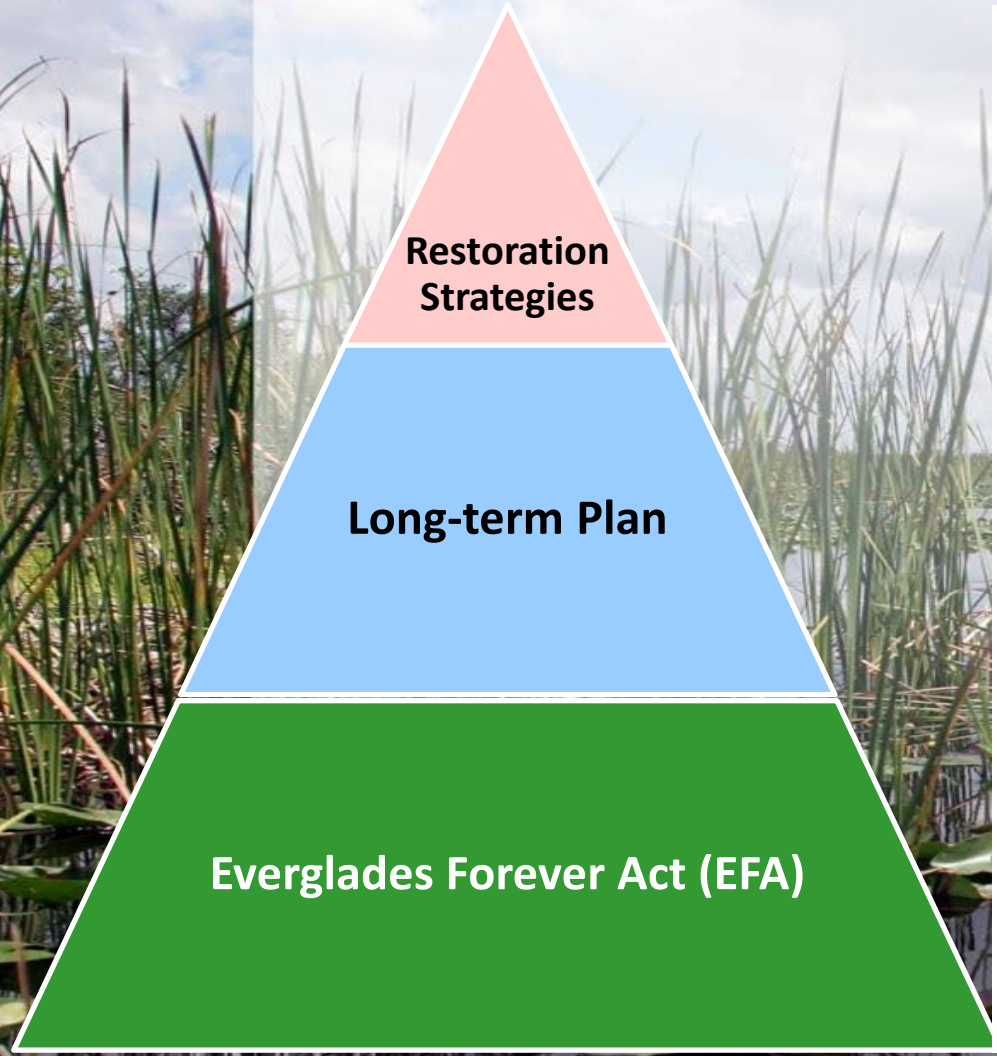
February 27, 2023

Basins Tributary to the Everglades Protection Area



Presenter: Youchao Wang

Long Term Plan Project Objectives

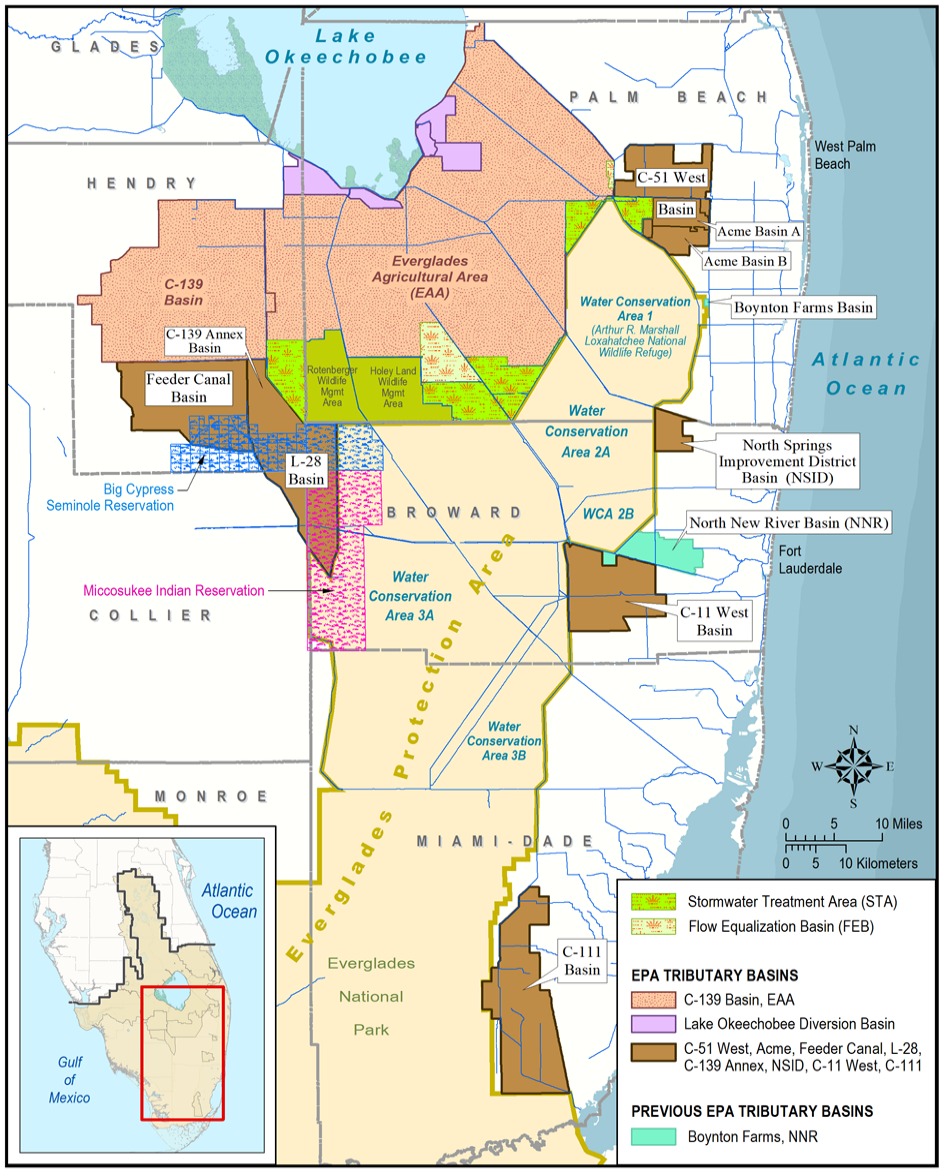


The Long-Term Plan recommends activities designed to:
"***Maintain and improve*** *upon the contribution of source controls to overall water quality improvement goals.*"

Specifically:

- **Identify** discharges that are candidates for implementation of **cost-effective** source controls
- Characterize management practices on lands or processes tributary to those discharges
- Implement these source controls **in concert with** landowners or municipalities

Presenter: Youchao Wang



Contents

- EAA and C-139 Basins
  - Regulatory compliance and activities
  - Research and demonstration projects
  - Sub-regional source control projects
- Other Tributary Basins
  - Regulatory and cooperative activities
  - Environmental Resource Permit (ERP) integration

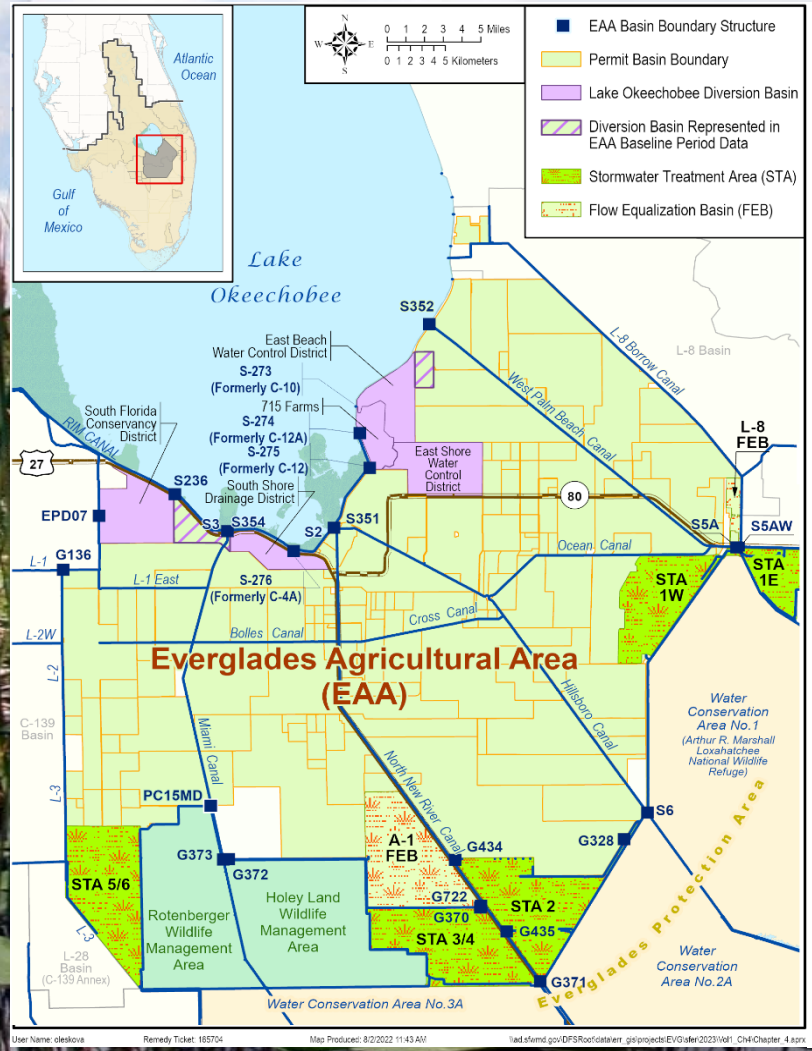
Presenter: Youchao Wang

WY2022 Total Phosphorus Data by Basin

Basin	Receiving Water Body	WY2022 TP Load (metric tons)	WY2022 TP FWMC (µg/L)
Everglades Agricultural Area (EAA)	STAs and Lake Okeechobee	75	85
C-139	STA 5/6 and EAA	57	226
C-51 West (incl. Acme Improvement District)	STA-1E, C-51 East Basin, and WCA-1	15	111
Feeder Canal	WCA-3A	11	125
L-28	WCA-3A	5	67
C-11 West	WCA-3A	4	14
C-111 ✖	ENP	2	6
North Springs Improvement District (NSID)	WCA-2A	0	-

Presenter: Youchao Wang

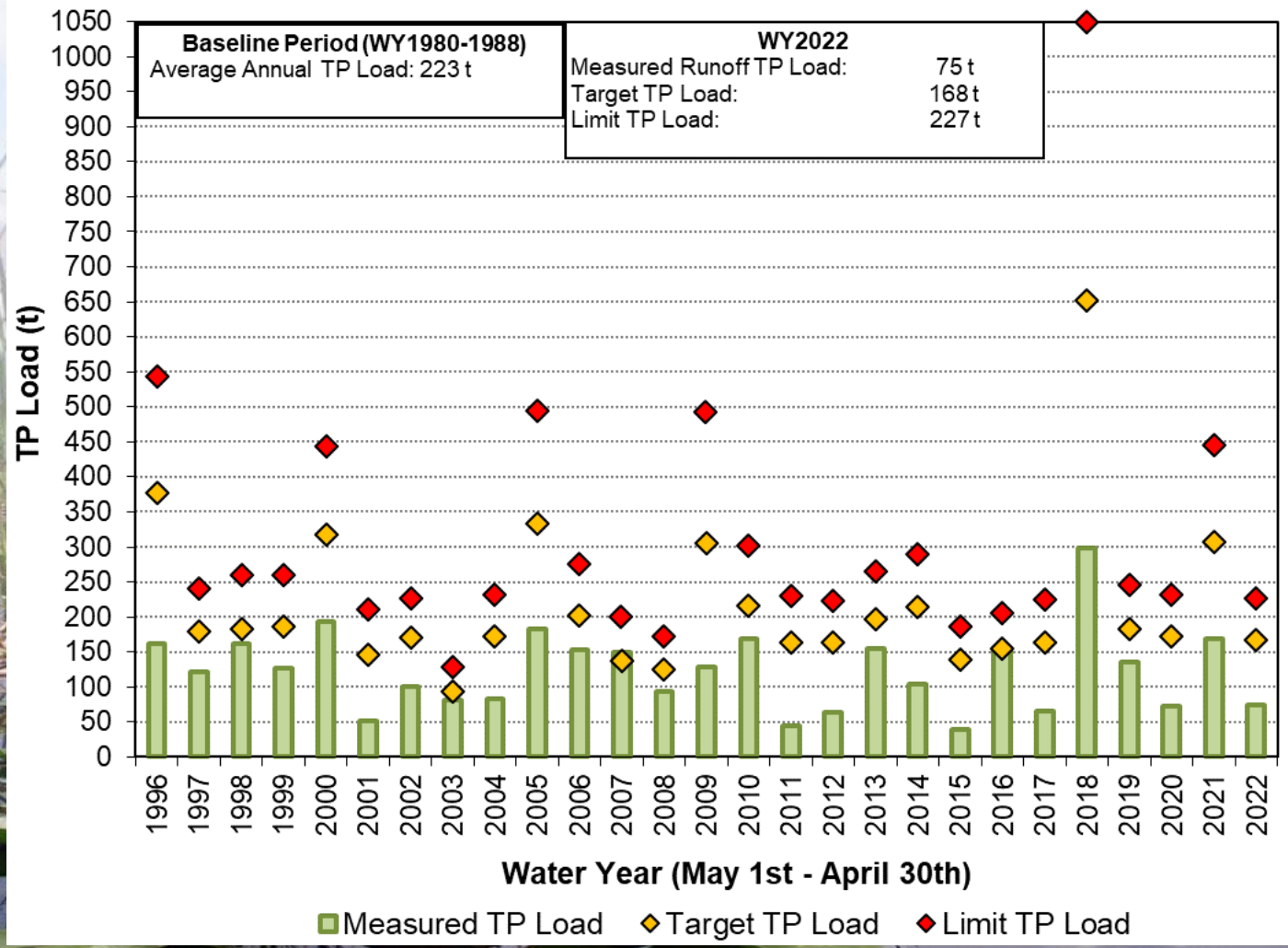
EAA Basin Source Control Programs



- EAA Basin level water quality compliance
- Permit level compliance
- Research and demonstration projects
  - EAA Everglades Protection District (EAAEPD) Research Master Permit
- Sub-regional source control projects (S-5A Sub-basin)

Presenter: Youchao Wang

EAA Basin Level Compliance



Presenter: Youchao Wang

EAA Permit Level Compliance

- Works of the District (WOD) permit renewed 2022
- Regulate phosphorus in discharges to WOD canals through
  - Comprehensive best management practices (BMP) plan
  - Permittee water quality monitoring plan
  - Post-permit compliance activities

Nutrient Management

Controlled application

Water Management

Rainfall Detention

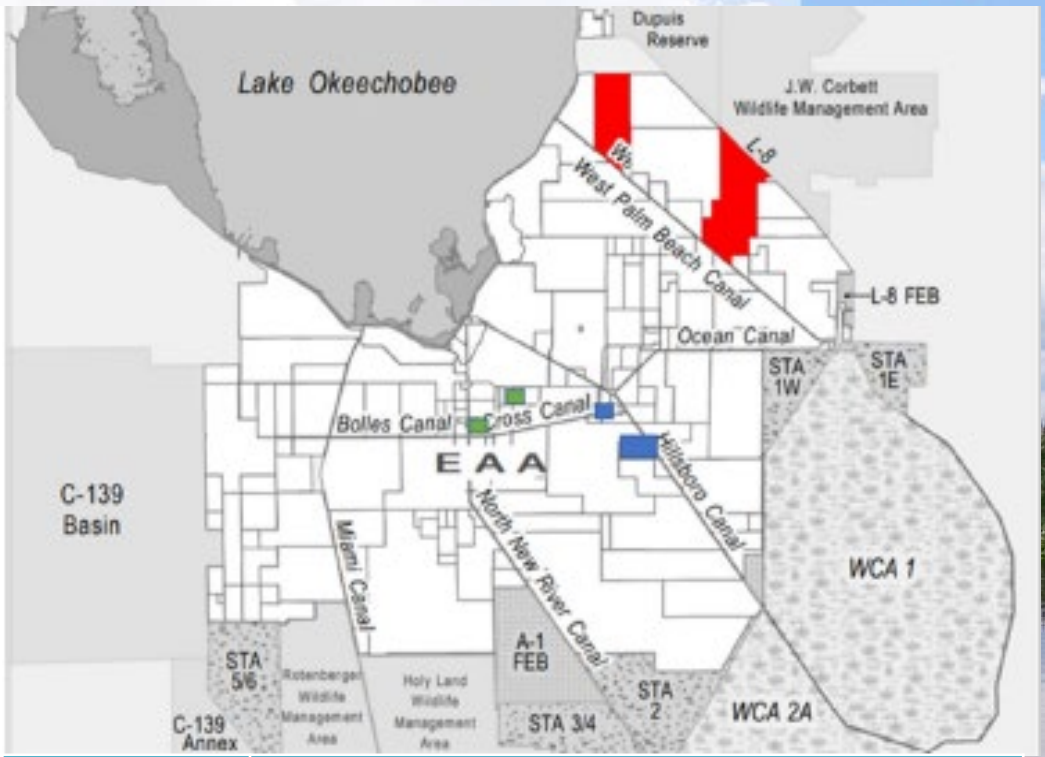
Particulate Matter and Sediment Controls

Canal cleaning, sumps and vegetated banks

Presenter: Youchao Wang

EAA BMP Master Research Permit

- The Everglades Forever Act (EFA) requires a comprehensive program of research, field testing and implementation of BMPs.
- A 5-year EAA-EPD Master Research Permit was issued in September 2020.
- This research evaluates performance differences between EAA farm basins with similar BMPs.
- Six farms were selected for this research project that started in October 2020.
- Second interim annual report completed in July 2022.

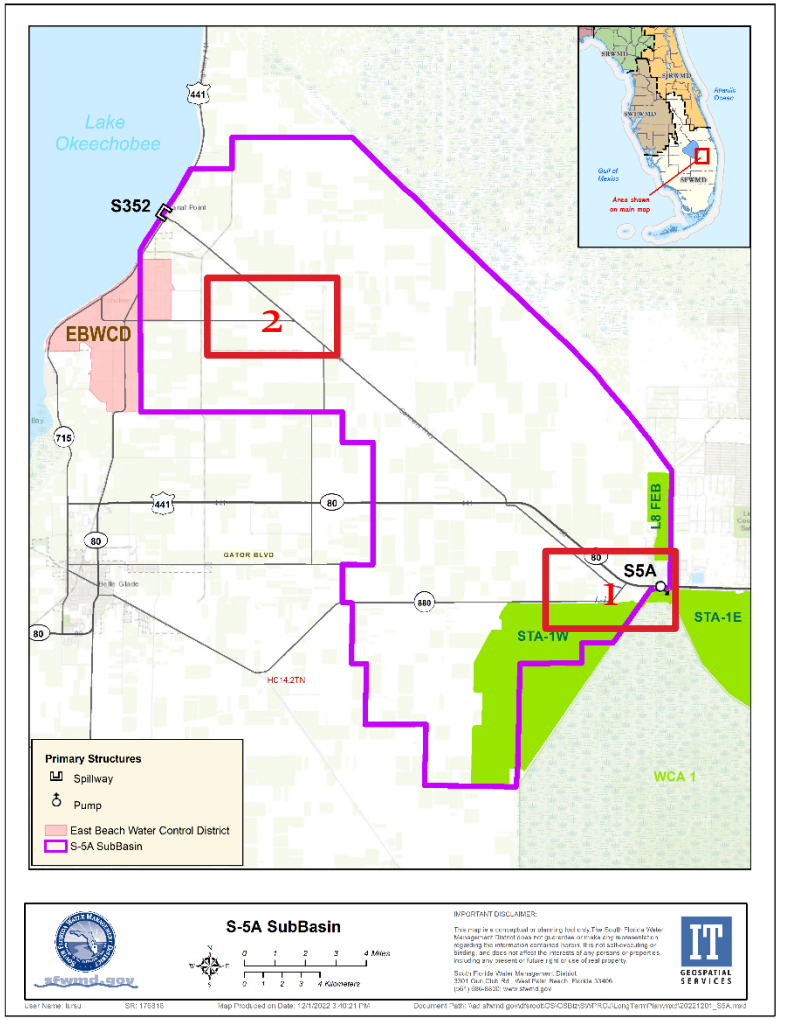


Legend	Farm Basin ID
	50-018-01 and 50-018-03
	50-028-01 and 50-048-01
	50-061-07 and 50-061-12

Presenter: Youchao Wang

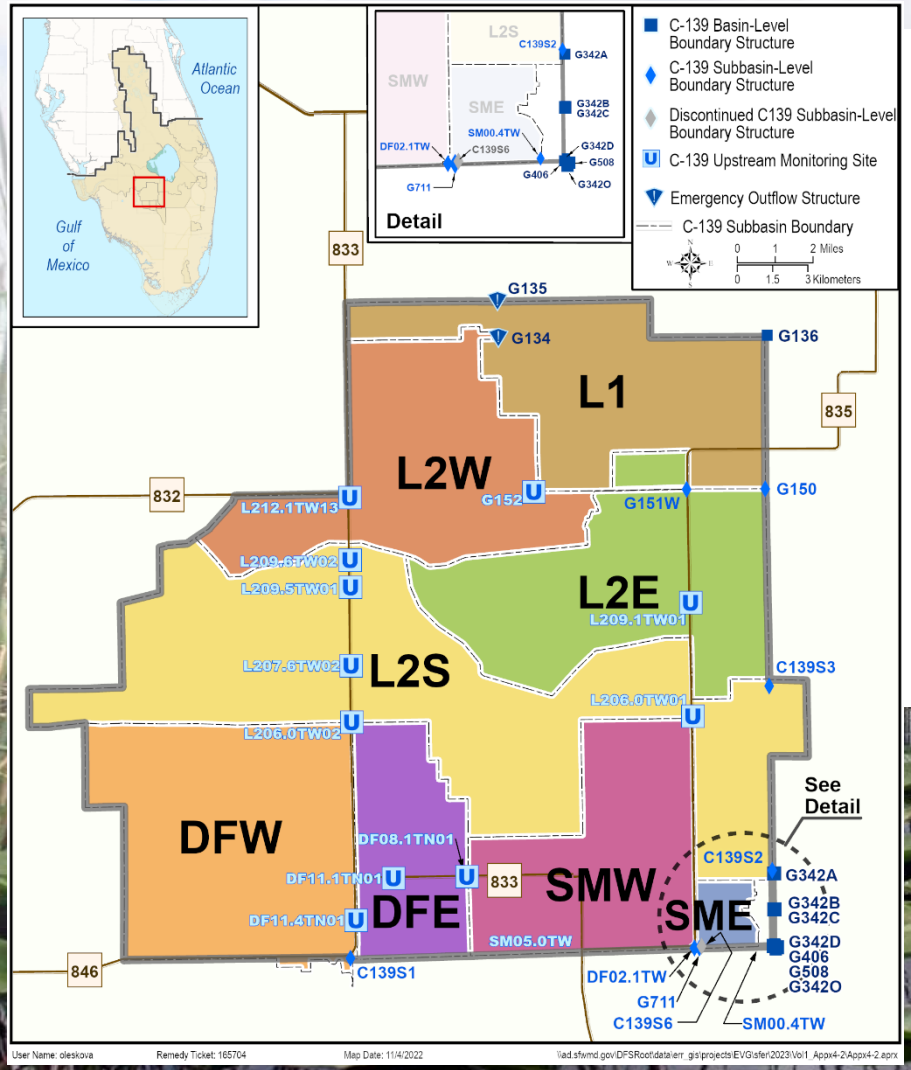
Sub-regional Source Control Projects

- "Supplement" existing regulatory BMP program
- Control phosphorus discharges upstream of STA-1E and STA-1W (Eastern Flowpath)
- Currently, two sub-regional source control projects are under consideration
  1. Investigation of West Palm Beach Canal (L-10/L-12) upstream of STA-1W and STA-1E to reduce TP concentrations
  2. East Beach Water Control District Flow Improvements - assessing hydraulic feasibility of innovative technology measures to improve water quality of discharges

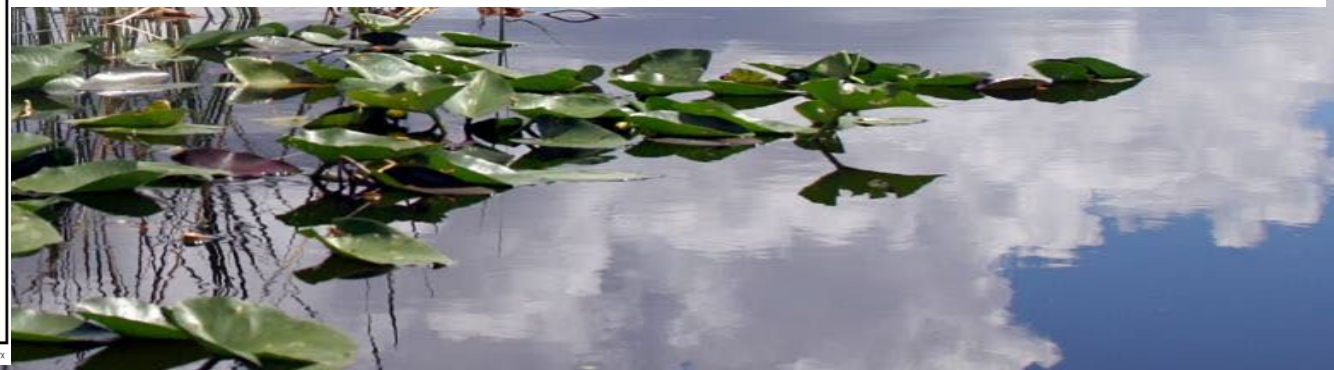


Presenter: Youchao Wang

C-139 Basin Source Control Programs

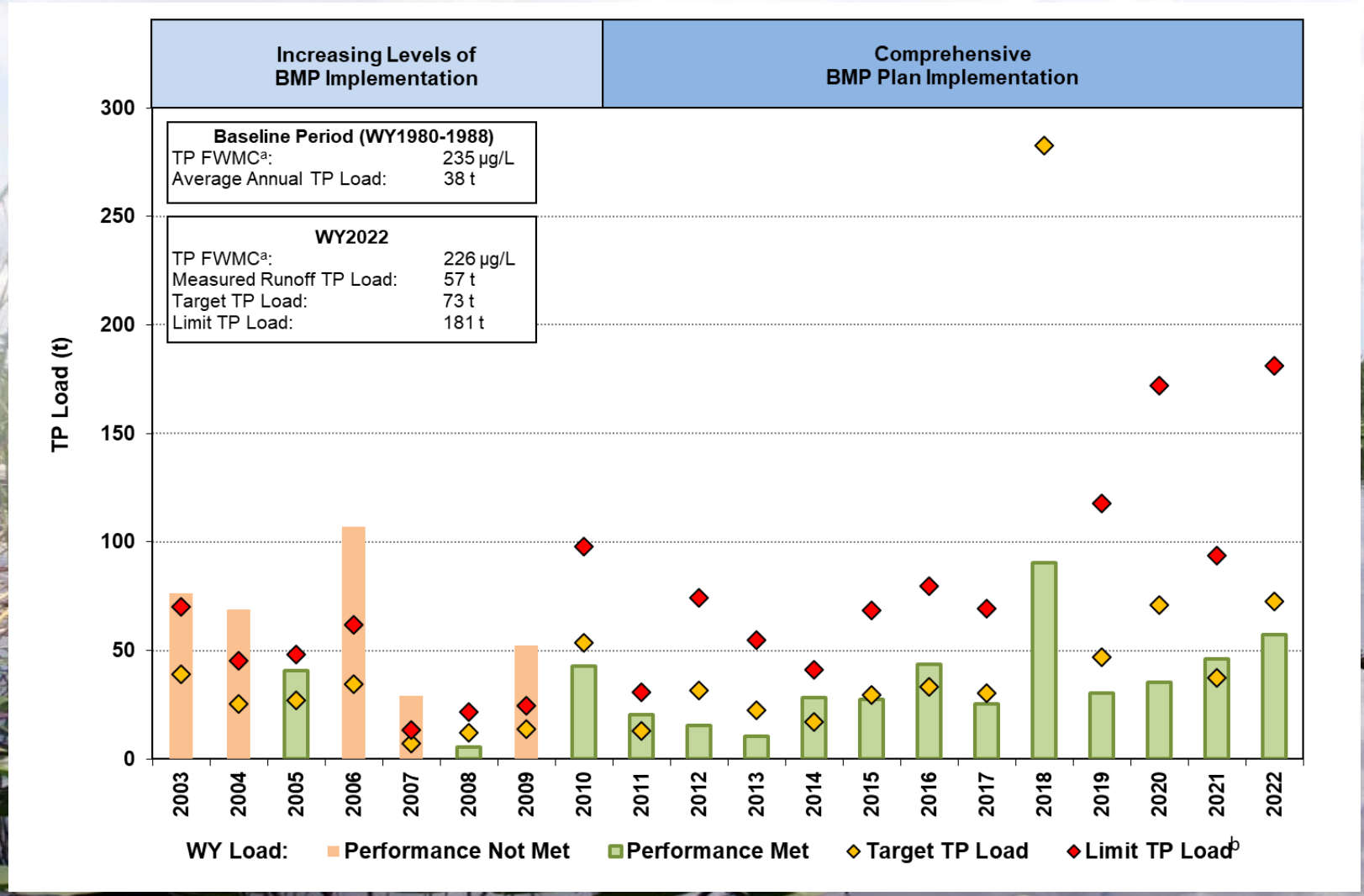


- Basin-level water quality compliance
- Sub-basin water quality monitoring
  - Upstream water quality monitoring
  - Post-permit compliance activities



Presenter: Youchao Wang

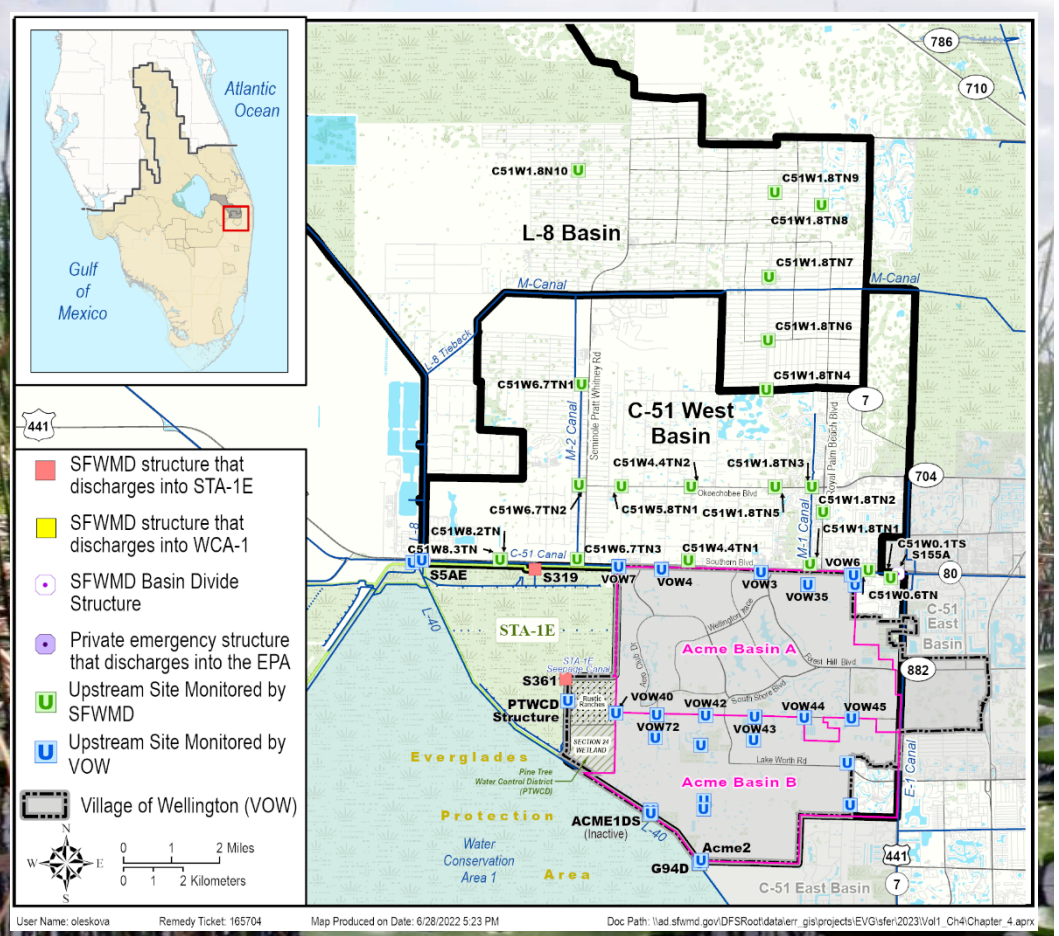
C-139 Basin Level Compliance



Presenter: Youchao Wang

Other Tributary Basins

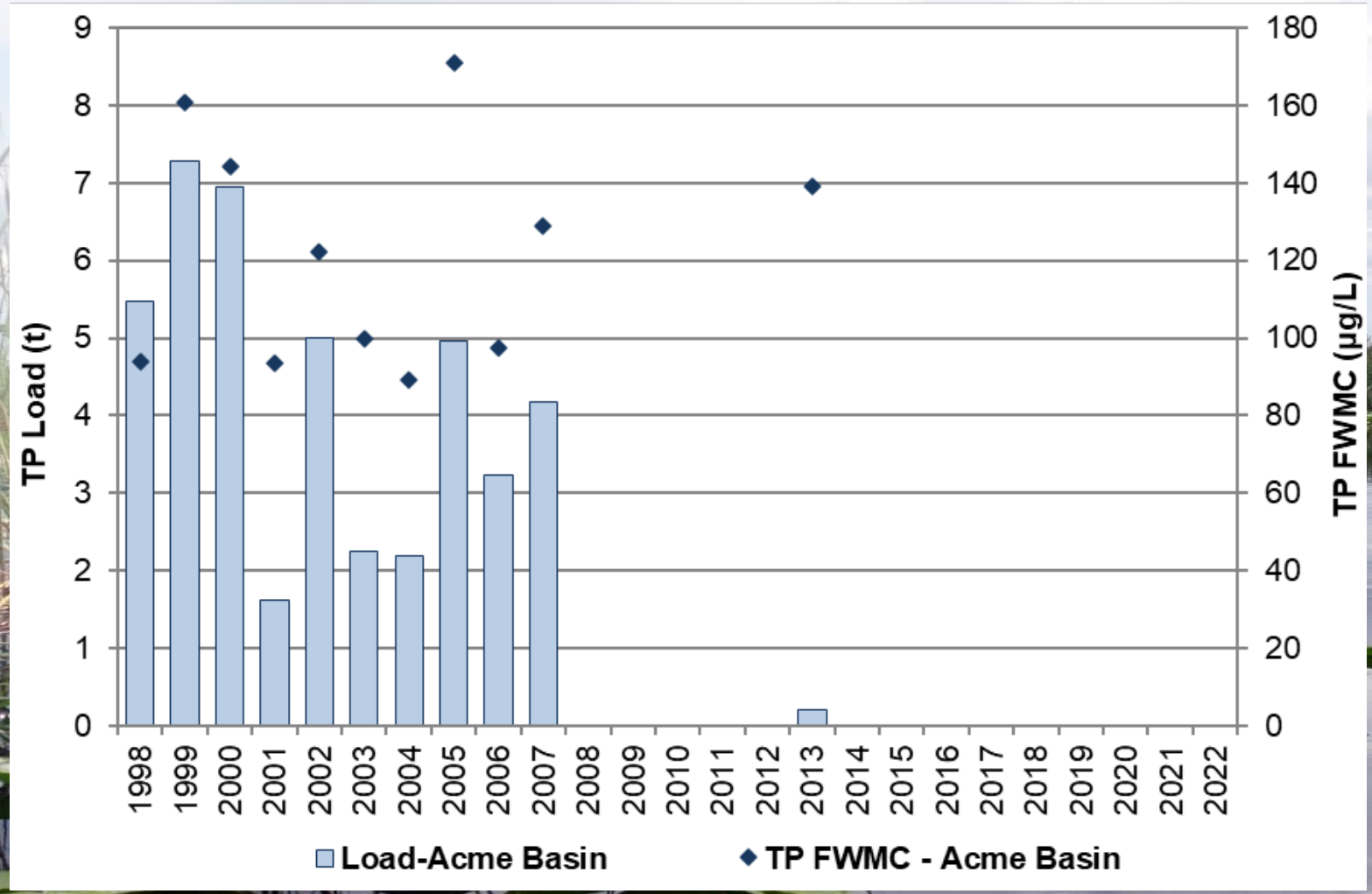
C-51 West and Acme Basin



- ERPs and ordinances in Village of Wellington include conditions that require
  - BMPs and livestock waste storage and disposal requirements in coordination with FDACS
  - Water quality monitoring program throughout the Acme basin (U markers)
- Additional sampling has been implemented by SFWMD in areas north of the C-51 West Canal (U markers)

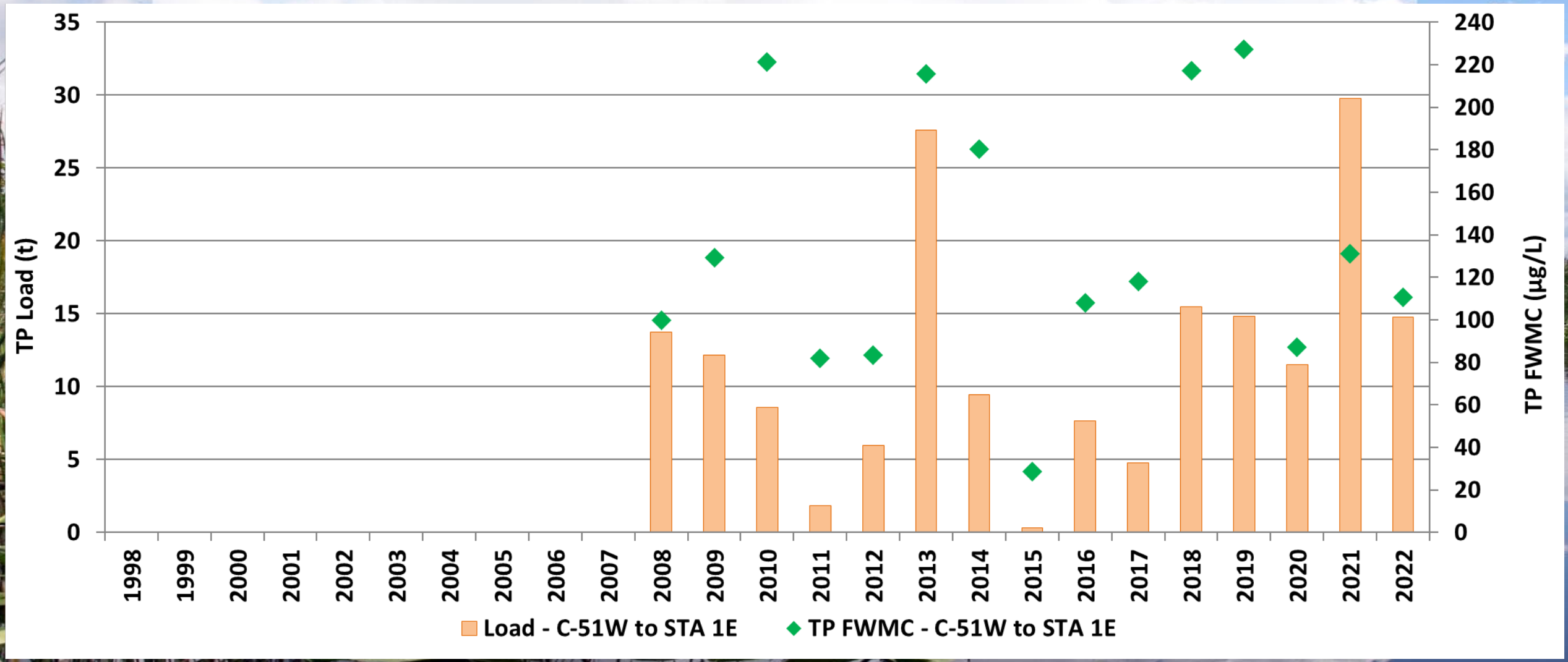
Presenter: Steve Sarley

C-51 West and Acme Basin to Refuge



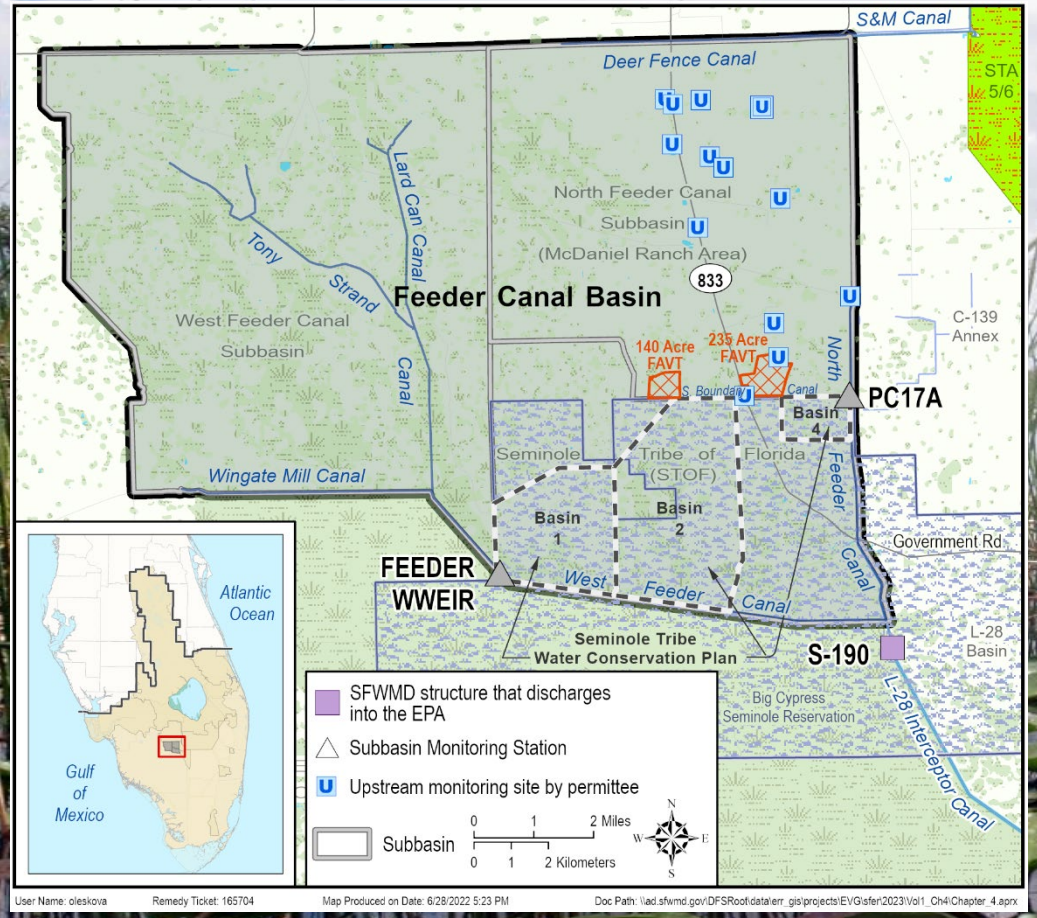
Presenter: Steve Sarley

C-51 West and Acme Basin to STA 1E



Presenter: Steve Sarley

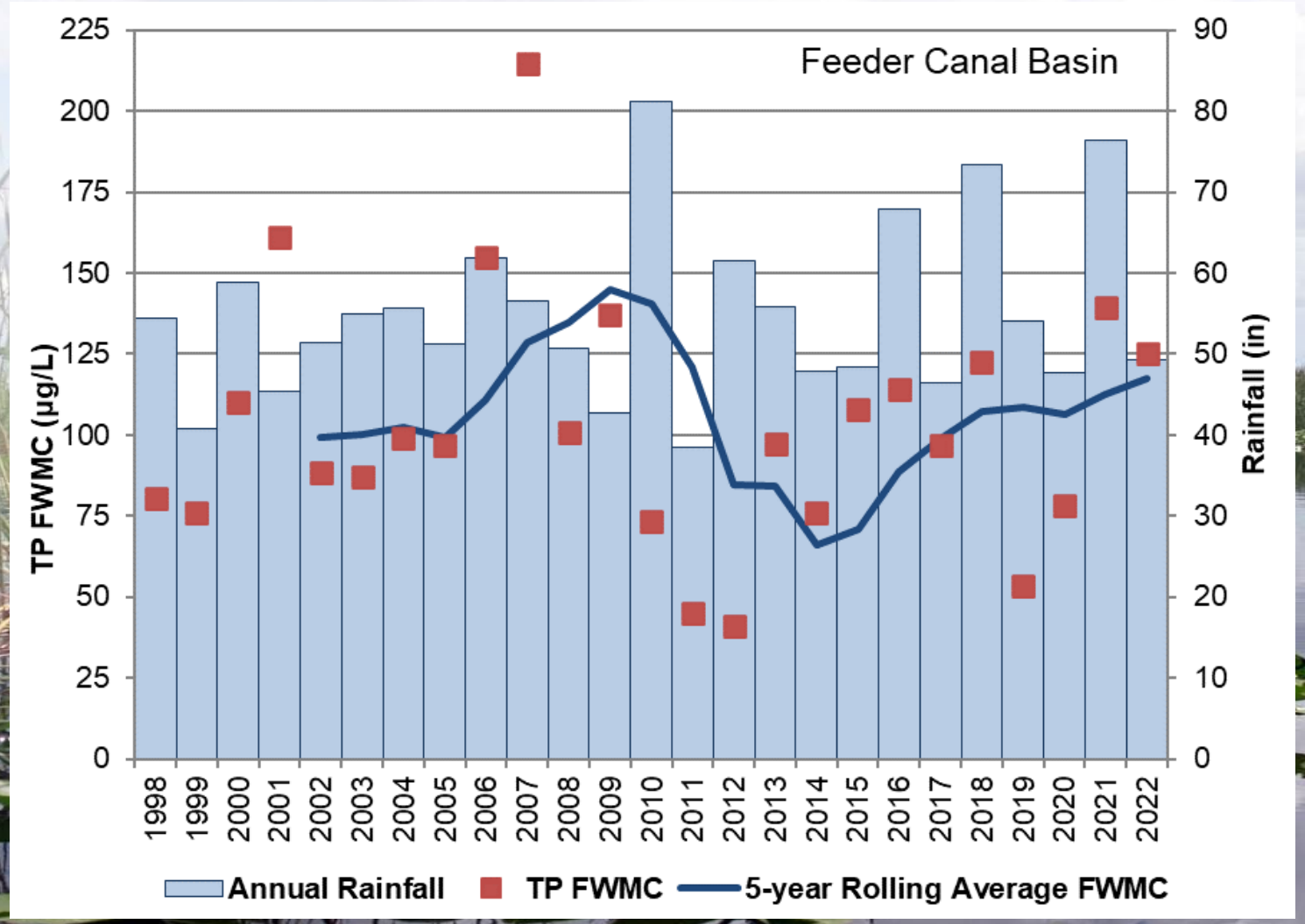
Feeder Canal Basin



- North Feeder Subbasin:
  - Landowner ERPs require BMPs and water quality monitoring
  - Voluntary FAV tilling projects
- West Feeder Subbasin:
  - Landowners can enroll in the FDACS BMP program.
- CERP Big Cypress/L-28 Interceptor Modification (WERP)

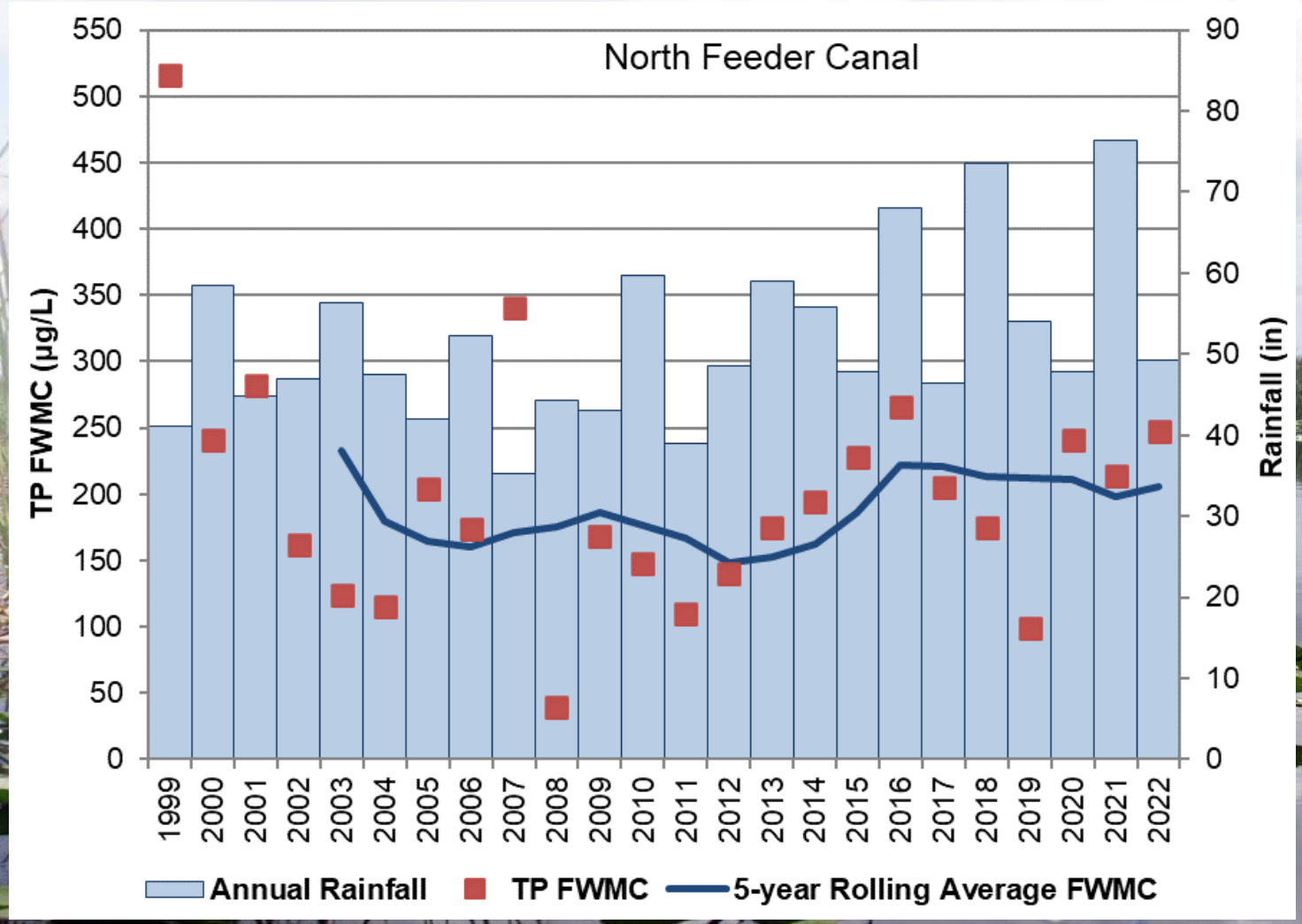
Presenter: Steve Sarley

Feeder Canal Basin



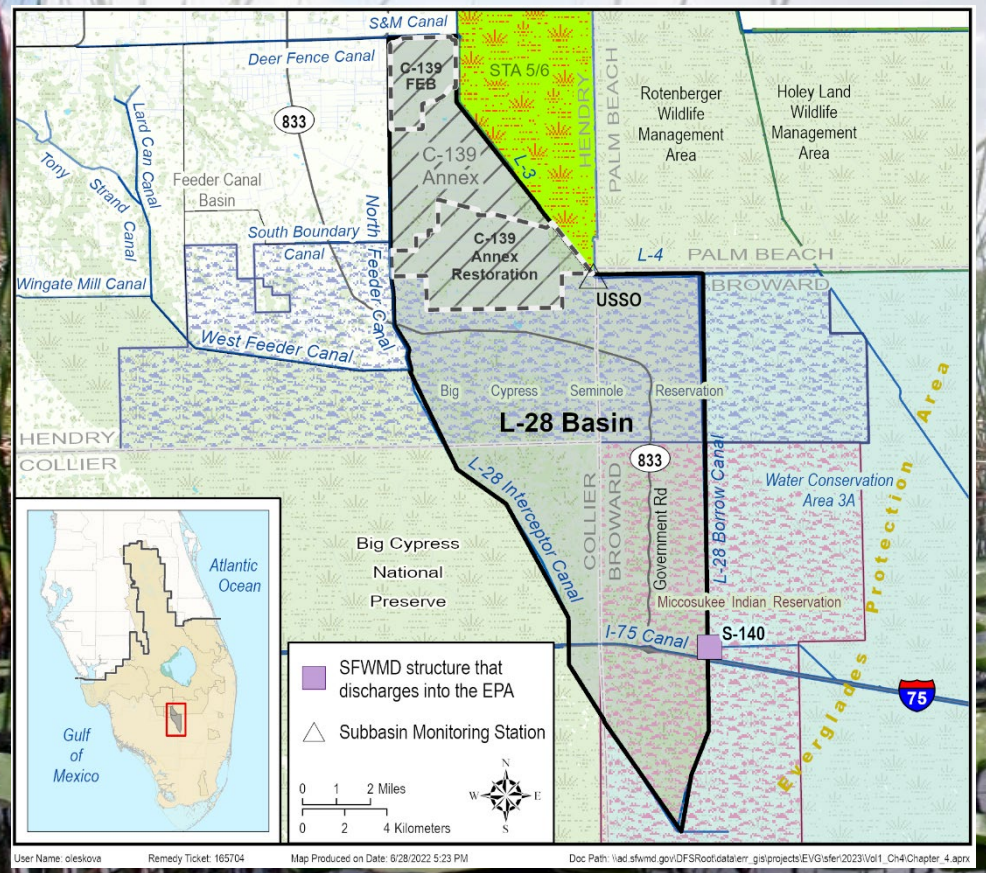
Presenter: Steve Sarley

Feeder Canal Basin
North Feeder Canal Sub-basin



Presenter: Steve Sarley

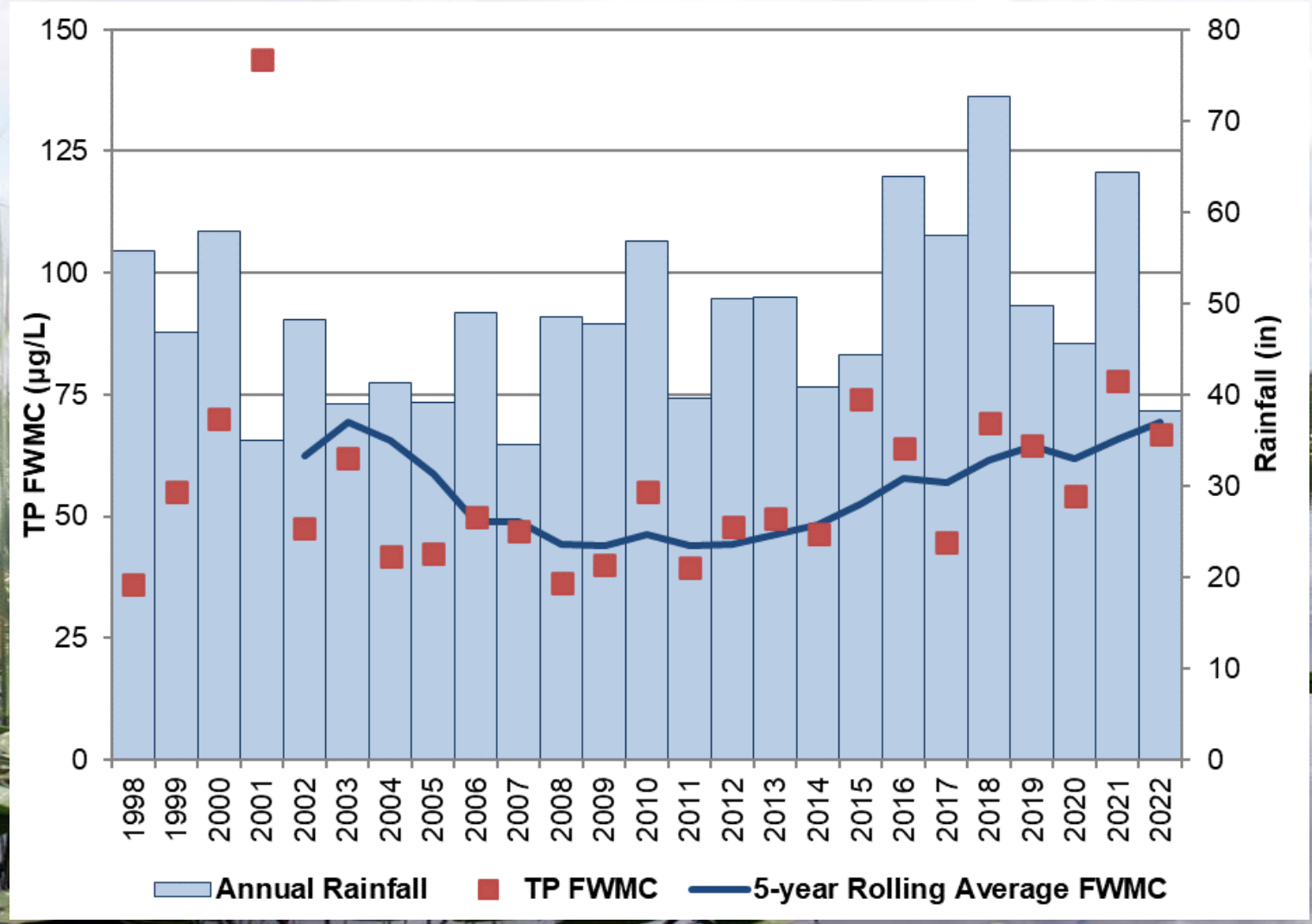
L-28 Basin



- ERP Southern Gardens Groves in the C-139 Annex includes conditions for BMPs
- LTP projects:
  - CERP Big Cypress/L-28 Interceptor Modification (WERP)
- Other basin projects:
  - C-139 Flow Equalization Basin treats runoff from the C-139 Basin
  - Sam Jones Abiaki Prairie Restoration

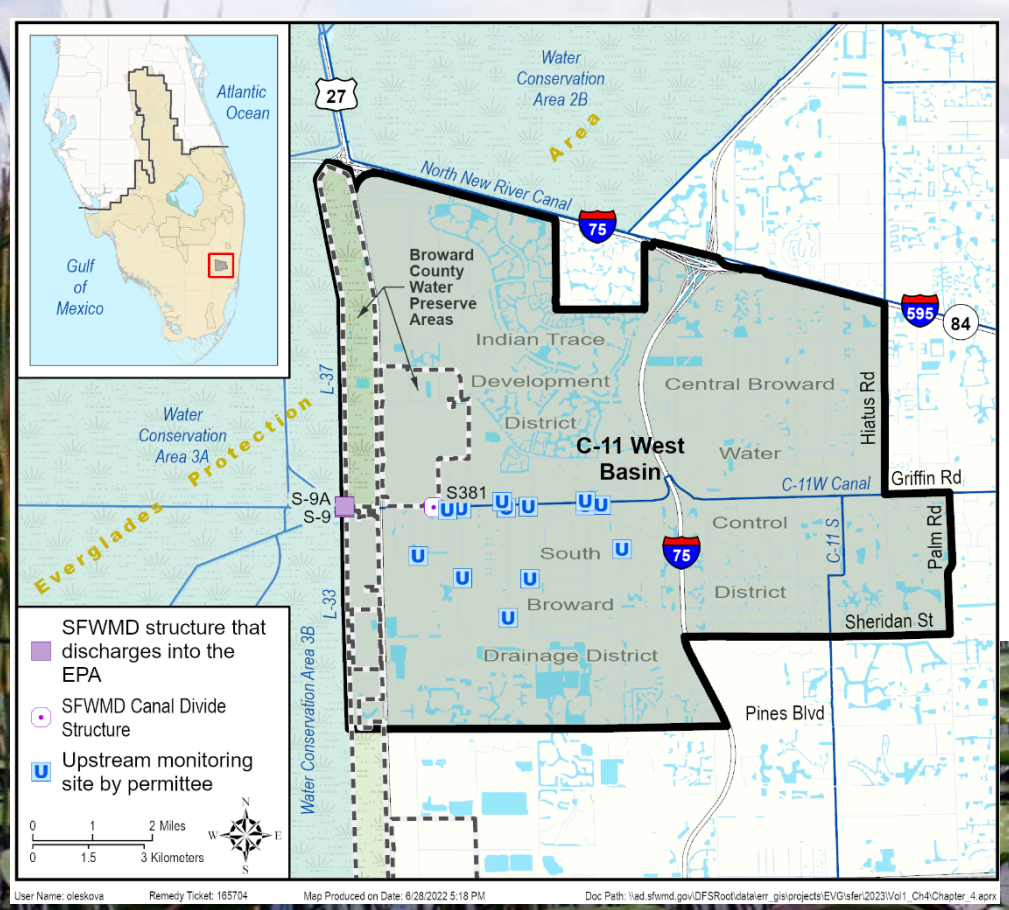
Presenter: Steve Sarley

L-28 Basin



Presenter: Steve Sarley

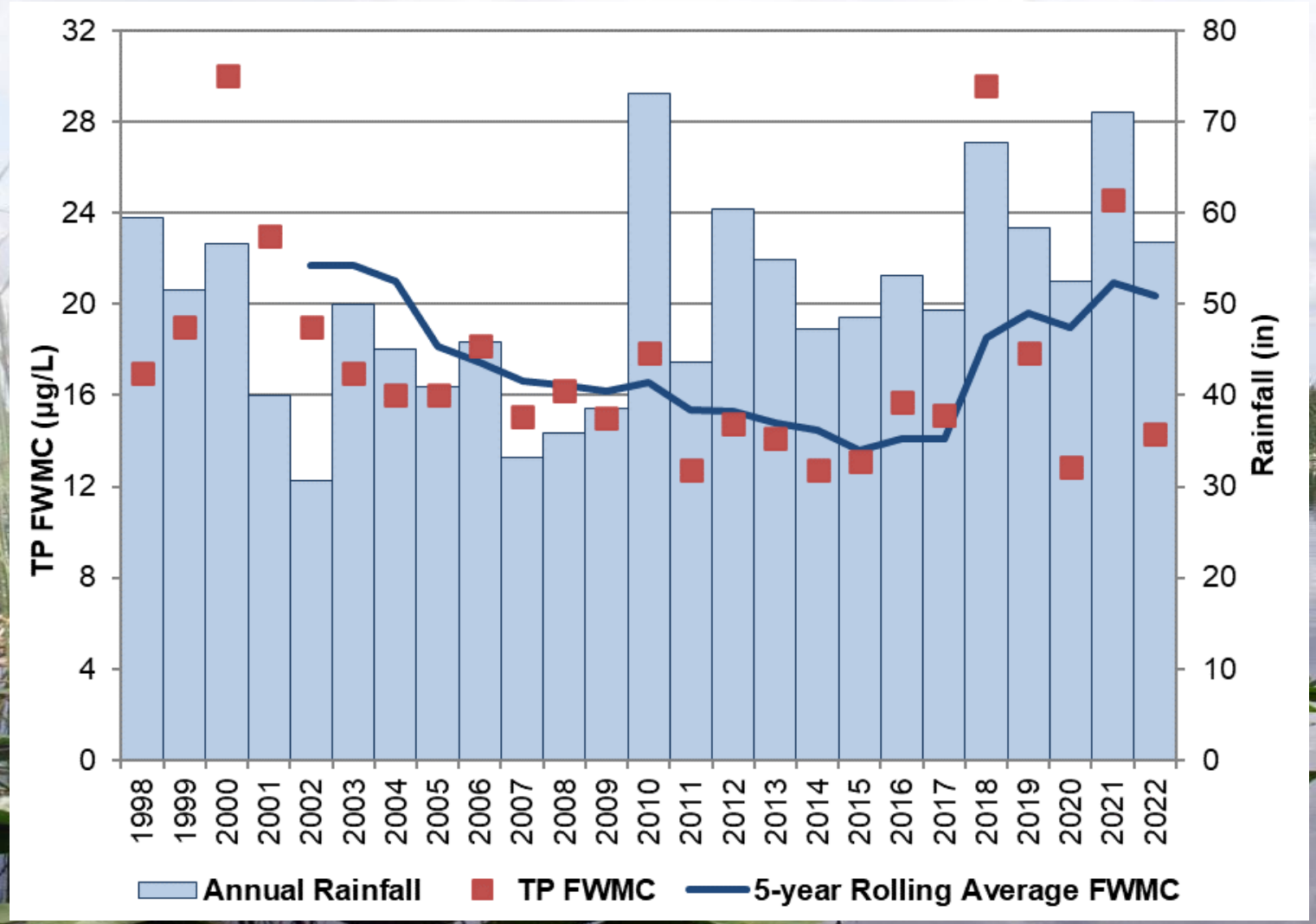
C-11W Basin



- ERPs issued to water control districts include conditions for BMPs including optimized detention of runoff and water quality monitoring
- Basin project:
  - CERP Broward County Water Preserve Area

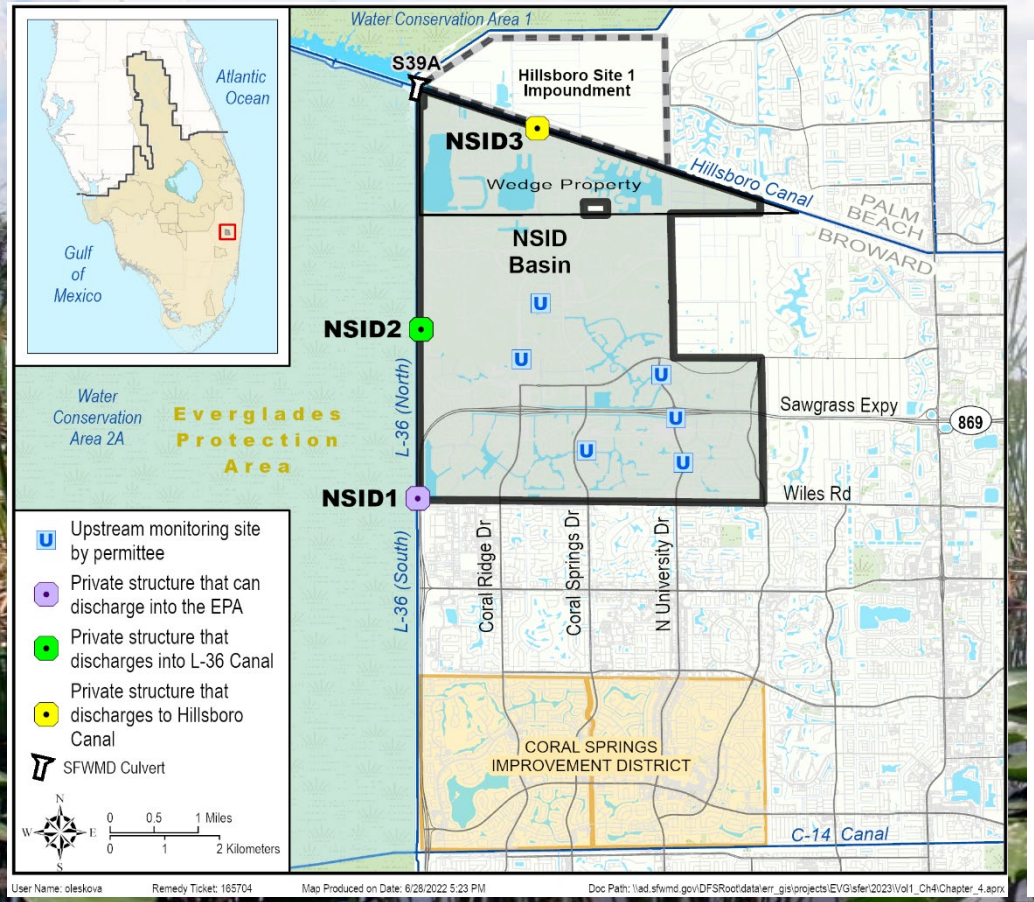
Presenter: Steve Sarley

C-11W Basin



Presenter: Steve Sarley

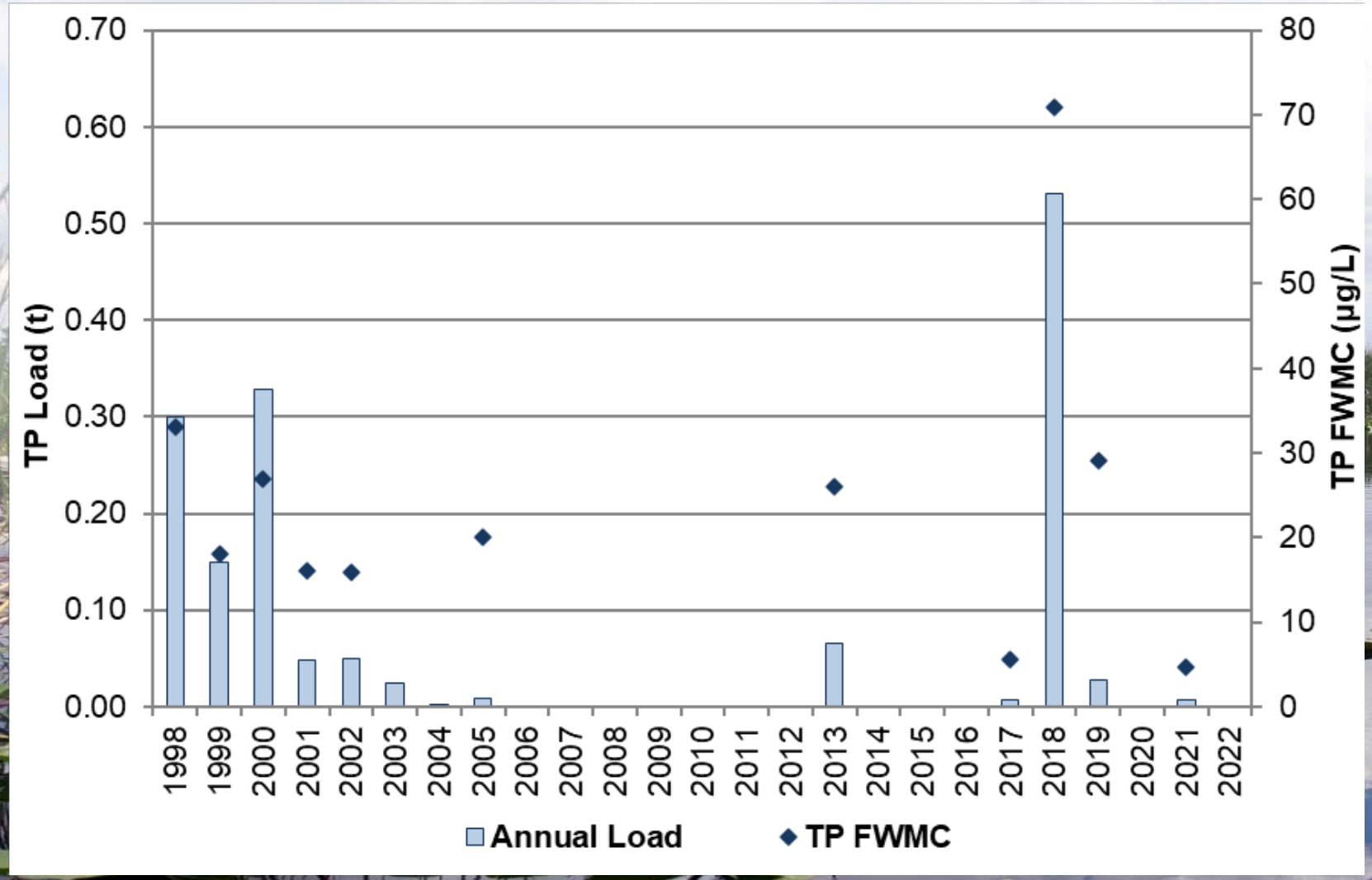
NSID Basin



- ERPs issued to NSID include conditions requiring BMPs implementation, water quality reporting, and phosphorus load limits for discharges to WCA-2A.
- LTP project:
  - CERP Hillsboro Site 1 Impoundment Phase 2 needs congressional authorization before moving forward

Presenter: Steve Sarley

NSID Basin



Presenter: Steve Sarley

Summary

- For the EAA basin, WY2022 TP load reduction is 66%. With the WY2022 results, the 27-year average annual TP load reduction for the program is 57%.
- For the C 139 basin WY 2022 remained in compliance, the measured runoff TP load is below the target phosphorus load.
- For the other tributary basins during WY2022, voluntary BMP implementation and progress toward the completion of CERP projects continued.
- The continued success of and ongoing improvements to the Southern Everglades source control program rely on verifying BMP implementation, continuing meaningful research and tracking program performance based on WQ data and basin-specific metrics.

Presenter: Steve Sarley

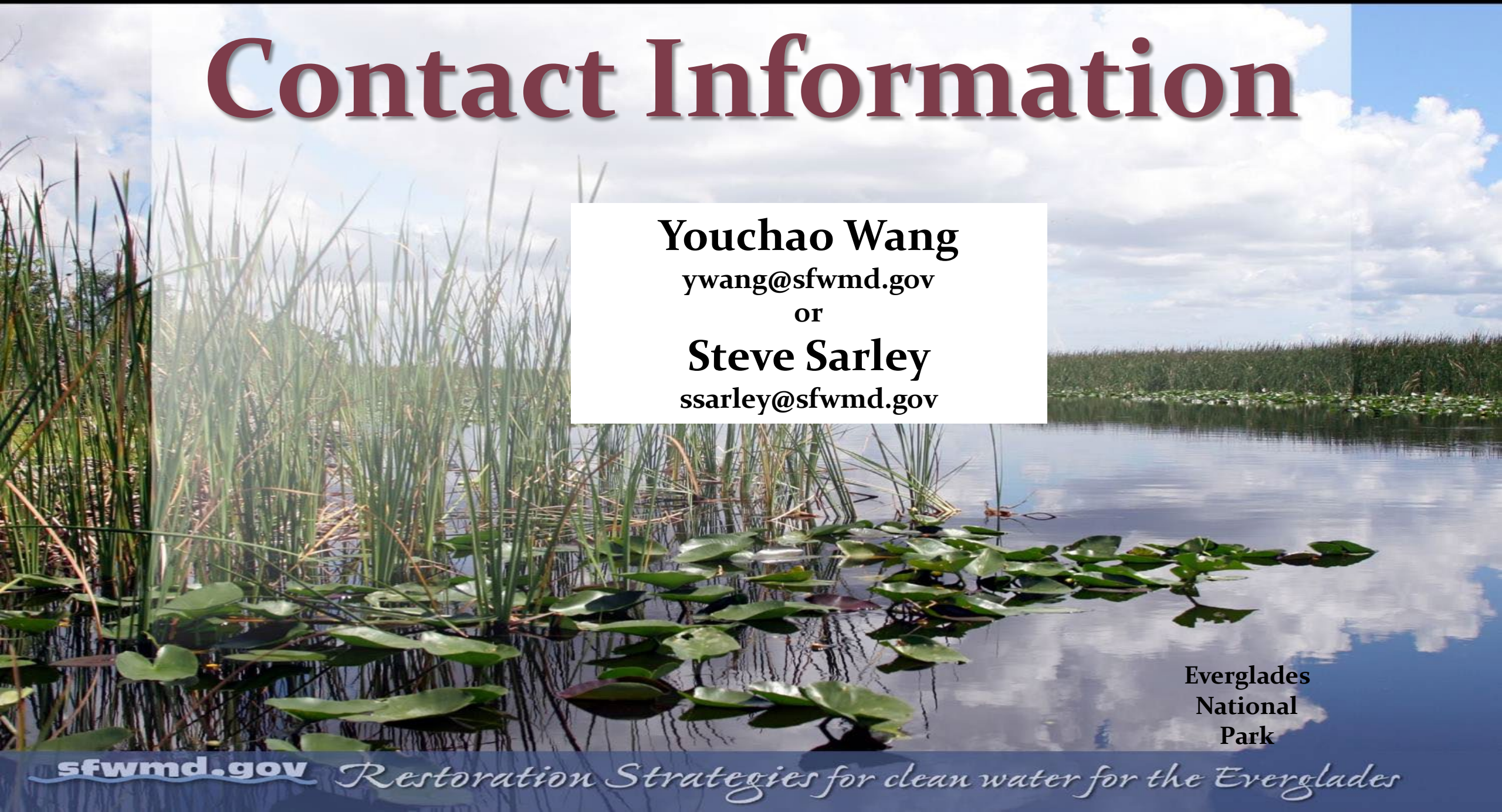
Additional Information

Chapter 4:
Nutrient Source Control Programs
in the Southern Everglades

www.sfwmd.gov/sfer

Contact Information

Youchao Wang
ywang@sfwmd.gov
or
Steve Sarley
ssarley@sfwmd.gov



Everglades National Park

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Public Use on SFWMD Stormwater Treatment Areas

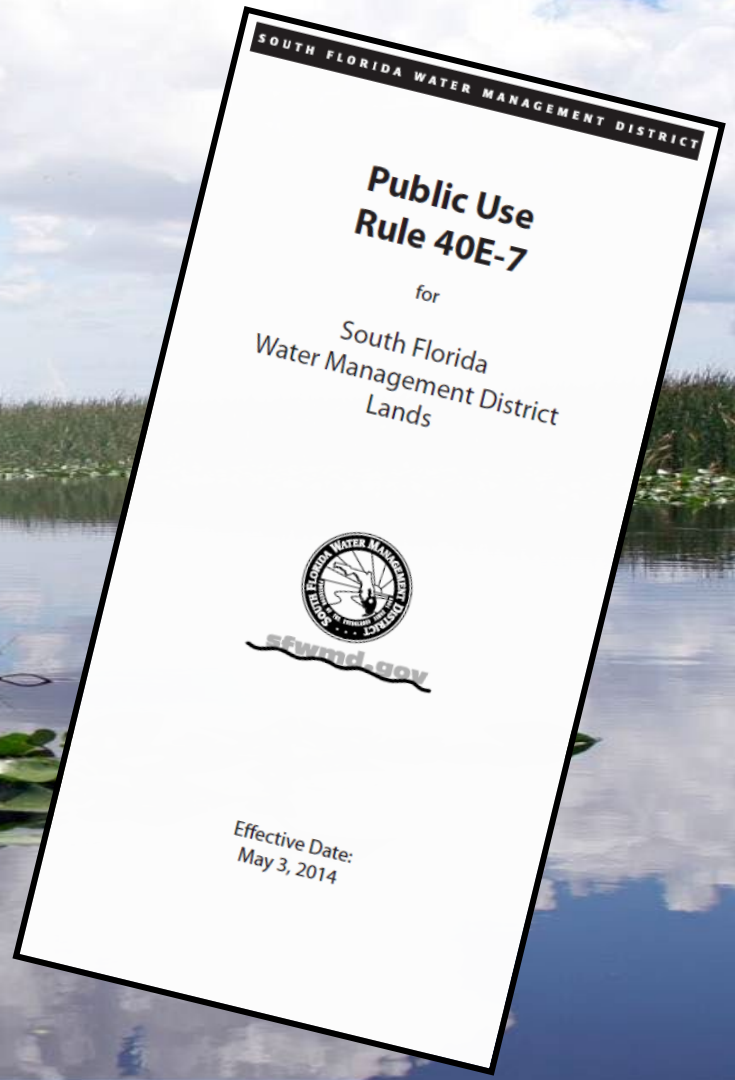
James R. Harbaugh
Recreation Planner
Land Resources Bureau

20th Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins
February 27, 2023

Mission

- **Why have Public Use?**
- **Florida Statutes 373.4592 - Everglades improvement and management …** These lands shall be made available for recreational use unless … such uses are incompatible with the restoration goals of the Everglades Construction Project or the water quality and hydrological purposes of the STAs or would otherwise adversely impact the implementation of the project.

- **Florida Administrative Code: 40E - 7**



Presenter: James Harbaugh

Nature Based Recreation Types

- **Nature based recreation from levees**
  - Hiking
  - Wildlife Viewing
  - Biking
  - Day use picnic
  - Fishing
- **Recreation within cells**
  - Hunting

Presenter: James Harbaugh

Partnerships

- **SFWMD**
  - Responsibility to provide recreation opportunities
- **Stakeholders/Partners**
  - Florida Fish and Wildlife Conservation Commission -FWC
  - Florida National Scenic Trail - FNST
  - Audubon Society
  - Conservation/Recreation Clubs
    - i.e.- United Waterfowlers of Florida
    - South Florida Amateur Astronomer Assoc
    - Many others

Presenter: James Harbaugh

Nature Based Recreation

- **Guided Wildlife Viewing**
  - STA 5/6
    - Hendry Glades Audubon
  - STA 1E
    - Everglades Audubon
  - Lakeside Ranch
    - Martin Co. Audubon
- **Hiking/Biking**
  - All STA's
    - Fri - Mon
  - STA 5/6
    - FNST – L3 rerouted


STA 5/6 – L1


STA-2 Flamingos

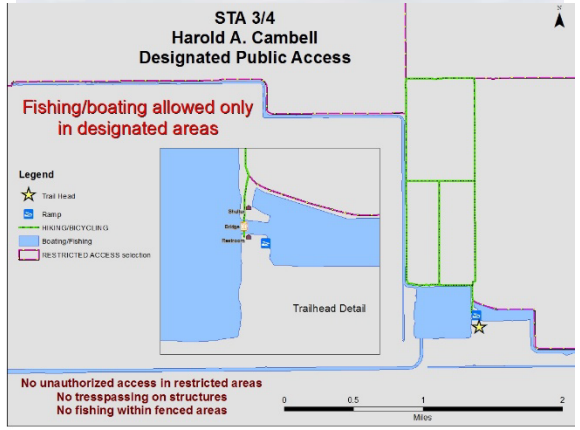

STA5/6


Cycling STA's

Presenter: James Harbaugh

Nature Based Recreation

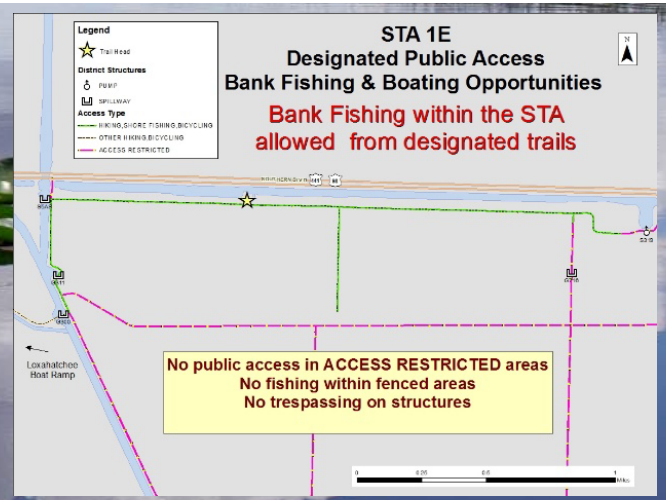
- **FWC quota hunt**
  - Waterfowl & Alligator
    - Access into cells limited
      - Designated access points
- **FWC Youth Hunt Program**
- **Other specialty hunts**
  - Wounded Warrior Hunts
  - Federal Youth Waterfowl Hunt



- **Fishing outside project area**
  - i.e. Discharge canals
  - STA - 1E & 1W
    - Bank fishing
  - STA - 3/4, Harold Campbell
    - Motorboat access
    - Non impacting


STA 1E -Youth Hunt Program

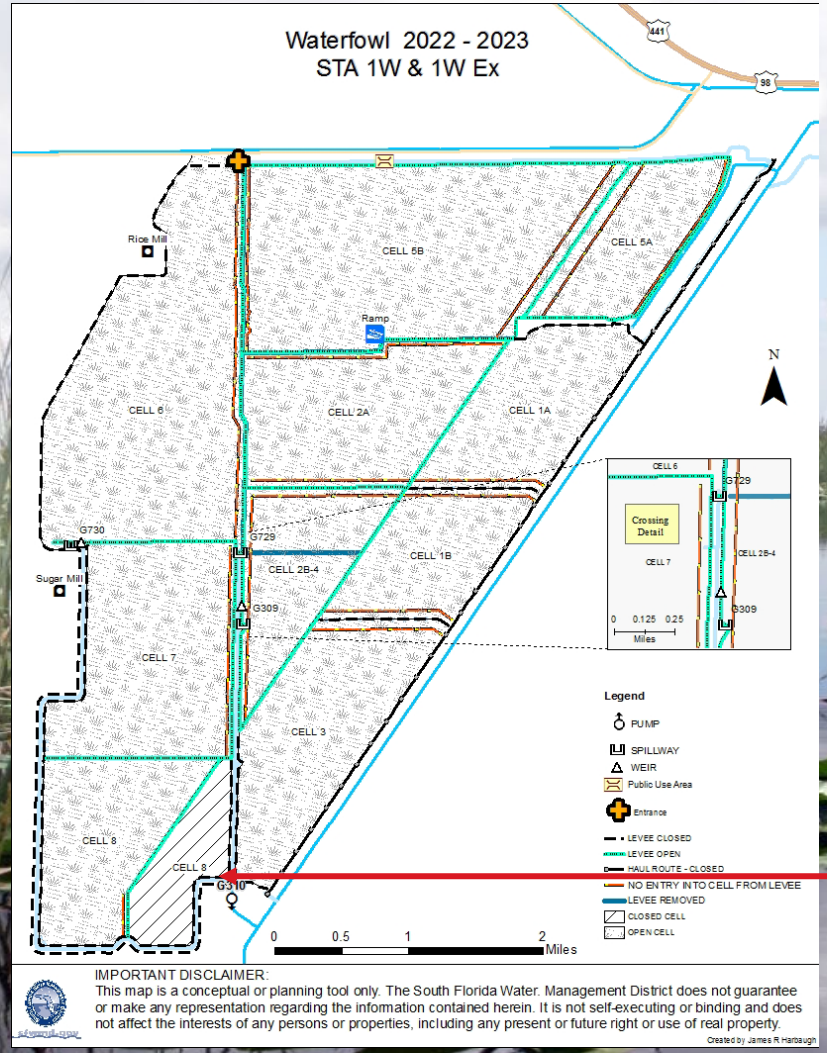

STA-3/4



Presenter: James Harbaugh

STA Function vs Public Use

- **A working property**
  - Engineered Restoration
    - Aquatic vegetation management to improve water quality
  - **Internal consultation for access**
    - Veg Management Team
    - Construction - Project Manager
    - Field Operations
      - Public access hours
      - Fri - Mon
    - Land Stewardship
      - T/E Wildlife



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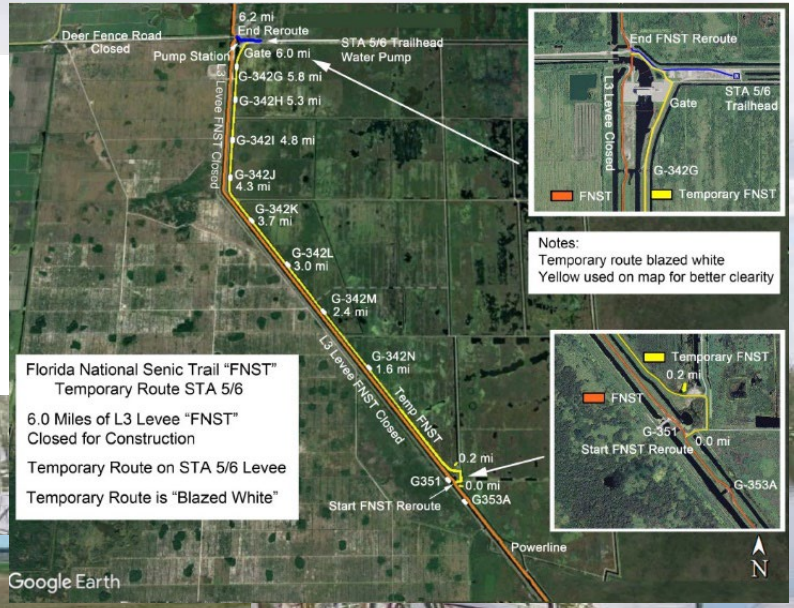
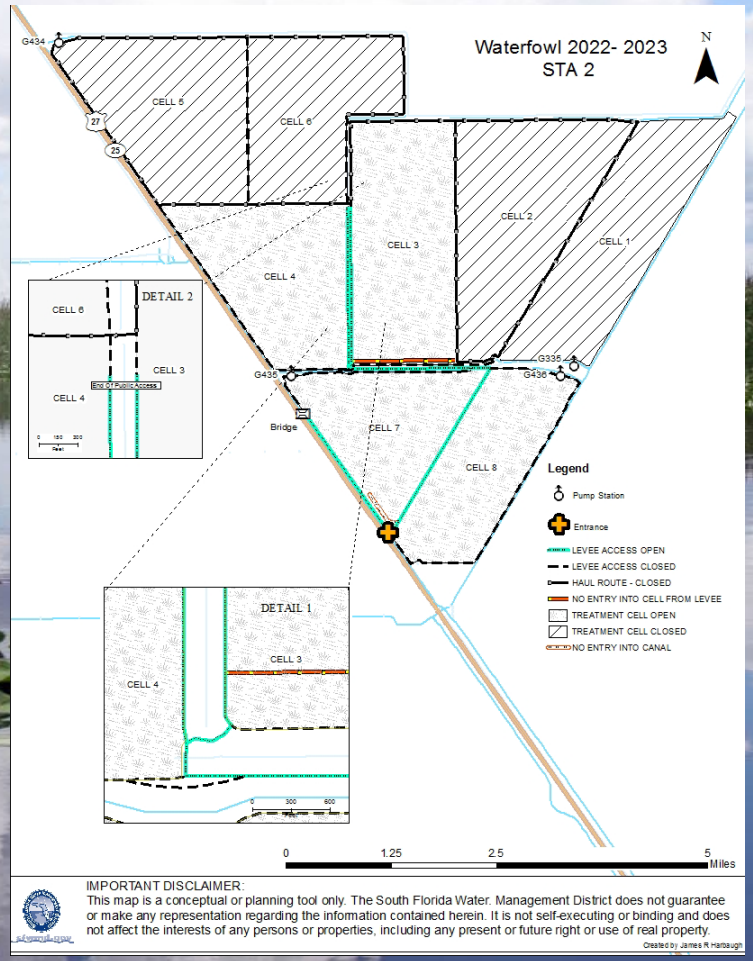
Construction & Maintenance

- **Necessary Closures**
  - Construction zone
    - Safety/Deadlines





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Moving forward – phase involvement

- Rec Infrastructure Standards incorporated in design phase
- Implement construction
- Construction completion
- Testing phase/finalizing rec infrastructure
  - ADA considerations, facilities, access points, barriers, etc.
- Consulting with internal staff
- Public Input
  - Recreation considerations
    - Hunting
    - Birding tours
    - Etc.
- Testing completion
- Governing Board approval

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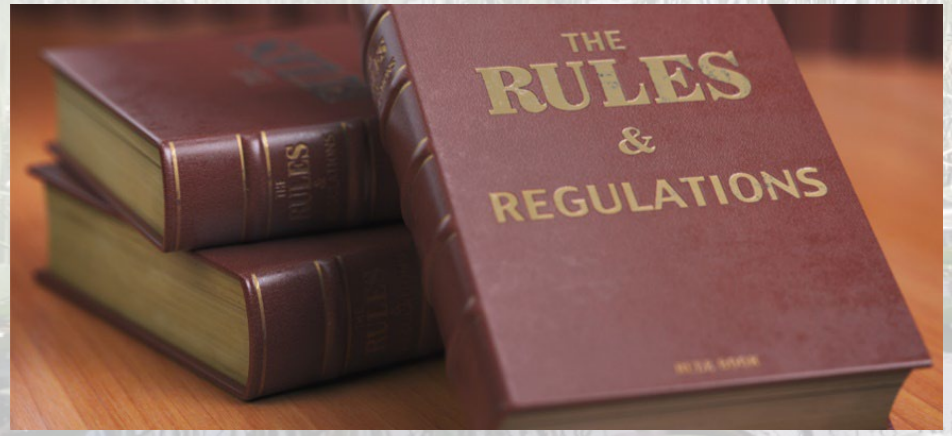
Public Participation

- Public Meetings - SFWMD
  - Public Meetings and Forums | South Florida Water Management District (sfwmd.gov)
  - Rec Forum – Quarterly
- Proposed Rule Changes - FWC
  - Proposed Rule Changes | FWC (myfwc.com)



Presenter: James Harbaugh

Contact Information

James Harbaugh
jharbaug@sfwmd.gov

Everglades National Park

Public Comment

If you're participating in person – please fill out a comment card and give to a meeting attendant

If you're participating via Zoom – use the Raise Hand feature

If you're participating via Phone –
*9 Raises Hand
*6 Mutes/Unmutes

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