November 18, 2024

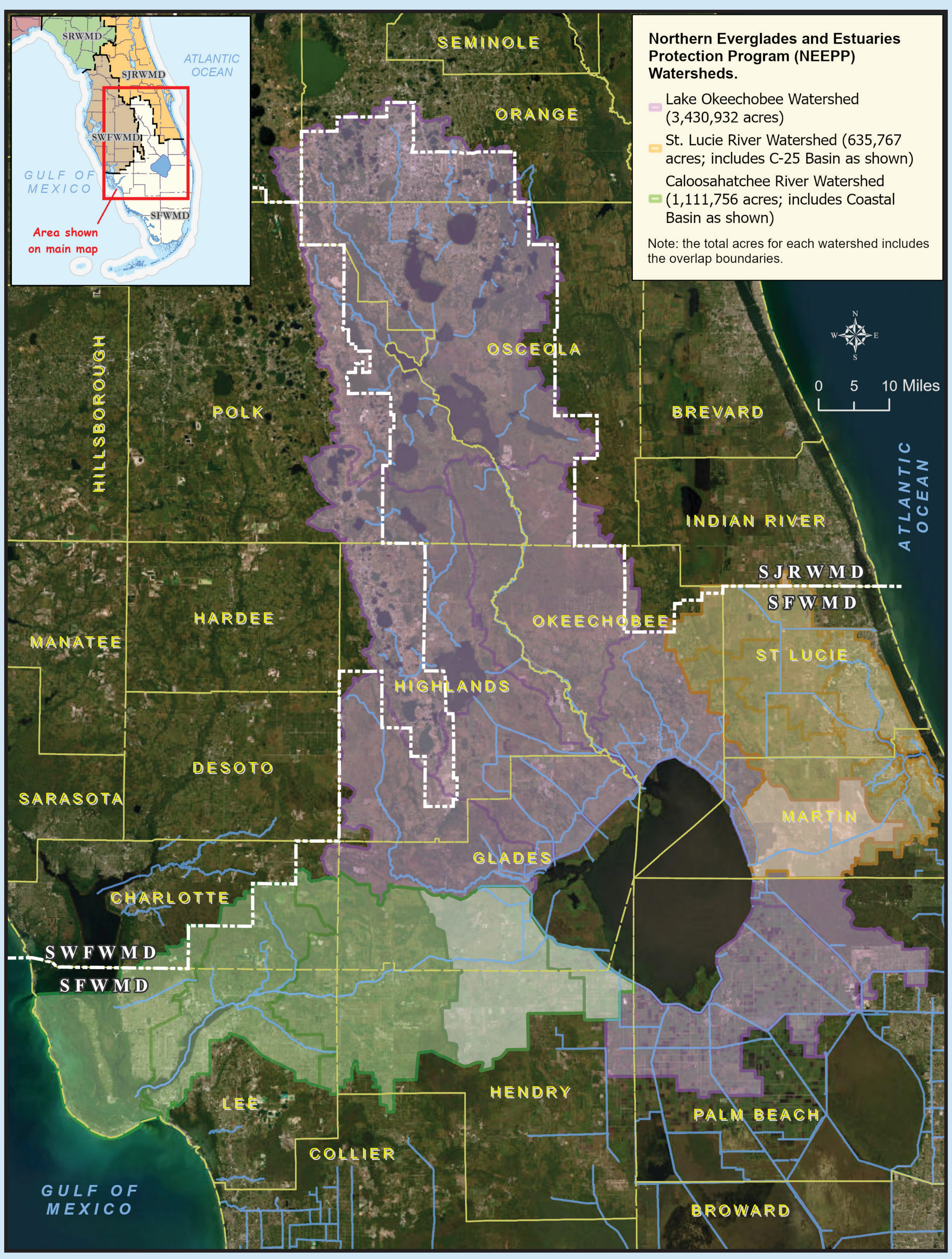
Northern Everglades and Estuaries Protection Program (NEEPP) Workshop and Open House

Encouraging Stakeholder and Public Engagement

The South Florida Water Management District (SFWMD), Florida Department of Environmental Protection (DEP) and Florida Department of Agriculture and Consumer Services (FDACS), "the Coordinating Agencies" welcome you to the second Joint NEEPP Workshop.

Boating in Lake Okeechobee

The purpose of NEEPP is to protect and restore surface water resources and achieve and maintain compliance with water quality standards in the Northern Everglades. The Northern Everglades watersheds include the Lake Okeechobee, Caloosahatchee and St. Lucie River watersheds.



NEEPP requires watershed protection programs (WPPs) to improve the quality, quantity, timing and distribution of water in the Northern Everglades ecosystem.

The programs are watershed specific and comprised of research and monitoring, development and implementation of best management practices (BMPs), refinement of existing regulations, and structural and nonstructural projects.

They are driven by DEP basin management action plans (BMAPs) and integrated with DEP and FDACS programs to control nutrient sources at the local, subregional, and regional levels.

Pelican sitting on a dock overlooking the St. Lucie River Estuary

Together, the Coordinating Agencies are jointly responsible for implementing NEEPP, each with specific areas of responsibility.

DEP is the lead on water quality protection measures through the BMAPs, SFWMD is the lead on hydrologic improvements pursuant to the WPPs, and FDACS is the lead on agricultural interim measures, BMPs, and other measures.

Oyster reefs in the Caloosahatchee River Estuary

Chapter 8B: Lake Okeechobee Watershed Protection Plan Annual Progress Report

Part III: Lake Okeechobee Watershed Construction Project

Anthony Betts

Planning and Project Management Section, Everglades and Estuaries Protection Bureau

The Northern Everglades and Estuaries Protection Program (NEEPP) promotes a comprehensive approach to the Lake Okeechobee Watershed. Using a combination of research, monitoring, source controls, and construction projects, the NEEPP works to restore and protect surface water resources by addressing water quality and storage within the natural system. This poster documents the key accomplishments and successes during the Water Year 2023 (WY2023; May 1, 2022 – April 30, 2023) reporting period.

Twenty (20) operational projects in WY2023 provided approximately:

- > **80,000 acre-feet** (ac-ft) of storage
- > **29.5 metric tons** (t) total phosphorus (TP) retention
- > **161 metric tons** (t) total nitrogen (TN) retention
- > **50,000 acres** of hydrated wetlands

Northern Everglades Request for Proposals:

In 2022, the South Florida Water Management District Governing Board authorized staff to negotiate up to **eight** projects in the Lake Okeechobee Watershed:

- **Four** 10-year contract extensions were executed for existing projects.
- **Two** new projects in the Lake Istokpoga & Upper Kissimmee subwatersheds were added.

Advancing Watershed Construction Projects

Partin Family Ranch

Basin: **Upper Kissimmee**
Project Area: **3,050 ac**
Est. Storage:
4,270 ac-ft/yr
Estimated TP: **0.4 t/yr**
Estimated TN: **5.2 t/yr**

Operations Extended until 2033

Basin: **Upper Kissimmee**
Project Area: **730 ac**
WY23 Storage: **758 ac-ft**
WY23 TP Retention: **0.1 t**
WY23 TN Retention: **1.2 t**


Eagle Haven Ranch

El Maximo Ranch

Basin: **Lower Kissimmee**
Project Area: **7,030 ac**
Est. Storage:
2,500 ac-ft/yr
Estimated TP: **2.4 t/yr**
Estimated TN: **7.0 t/yr**

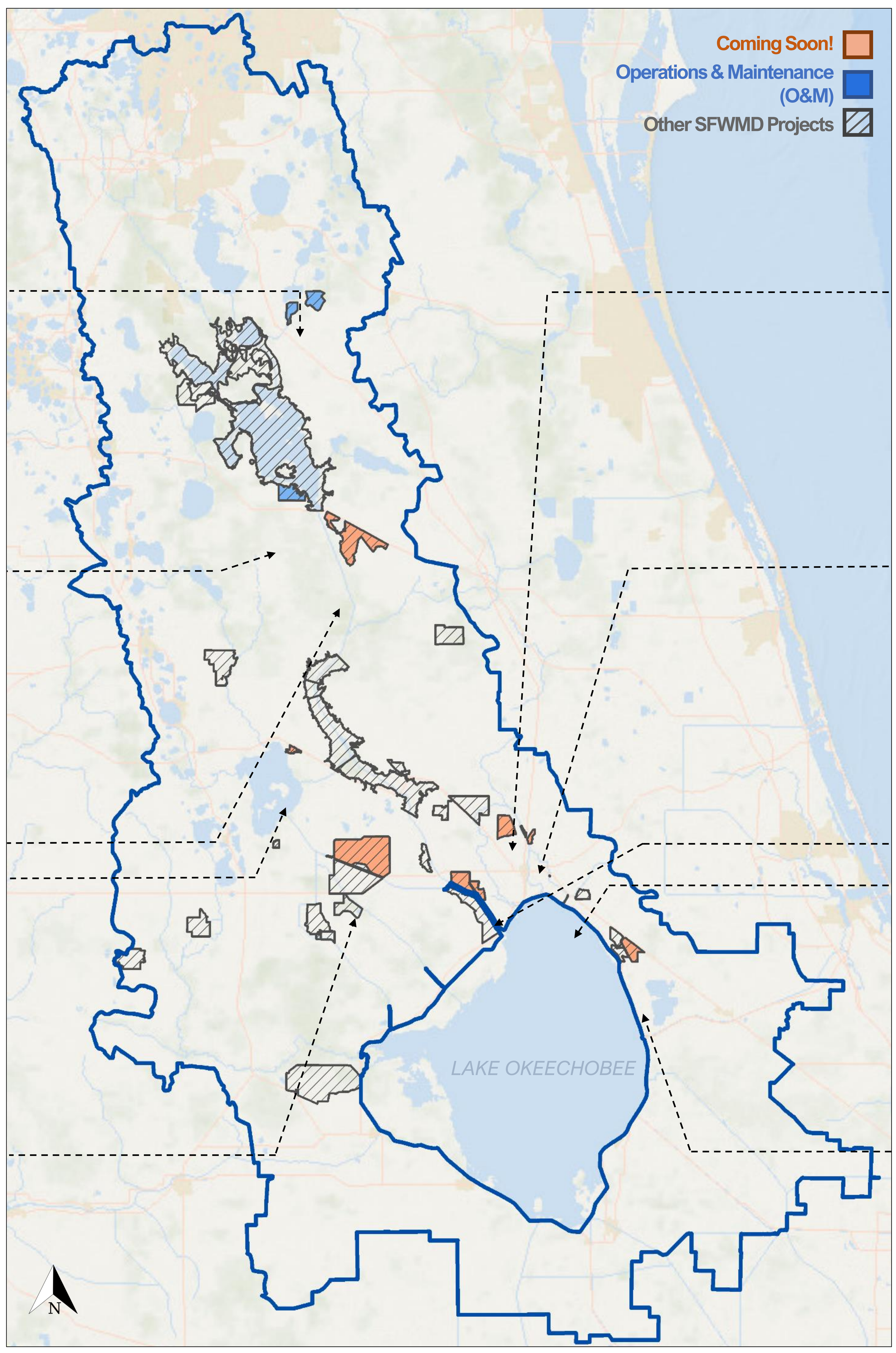
COMING SOON

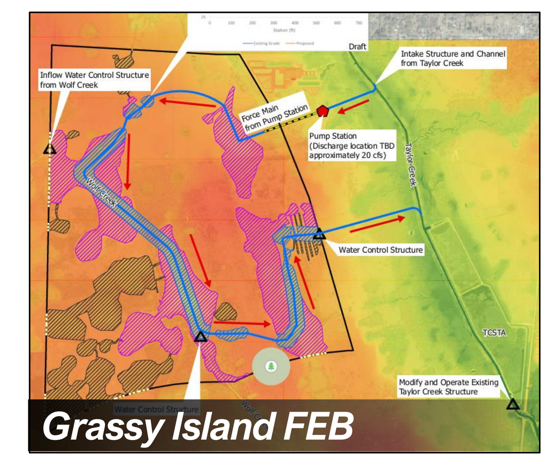
Basin: **Lake Istokpoga**
Project Area: **N/A**
Est. Storage: **N/A**
Estimated TP: **4.5 t/yr**
Estimated TN: **TBD**


Aguaculture - Lake Istokpoga

Lake Okeechobee Component A Reservoir

Basin: **C-41**
Project Area: **12,300 ac**
Est. Storage:
200,000 ac-ft
Estimated TP: **N/A**
Estimated TN: **N/A**



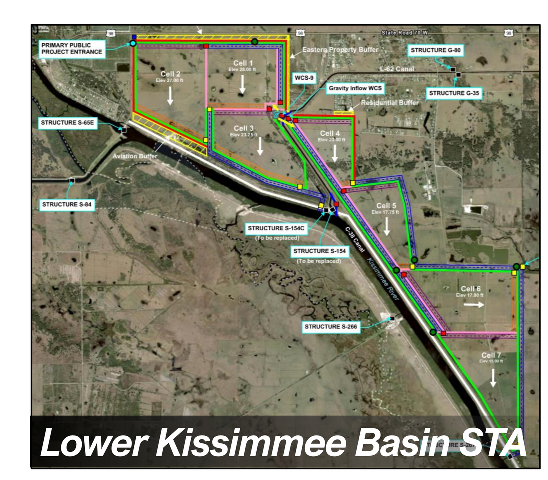

Grassy Island FEB

COMING SOON

Basin: **S-191**
Project Area: **2,400 ac**
Est. Storage:
3,200 ac-ft/yr
Estimated TP: **0.8 t/yr**
Estimated TN: **TBD**

Basin: **S-191**
Project Area: **410 ac**
Est. Storage:
312 ac-ft/yr
Estimated TP: **1.0 t/yr**
Estimated TN: **4.0 t/yr**

TCNS 214 Storage & Treatment

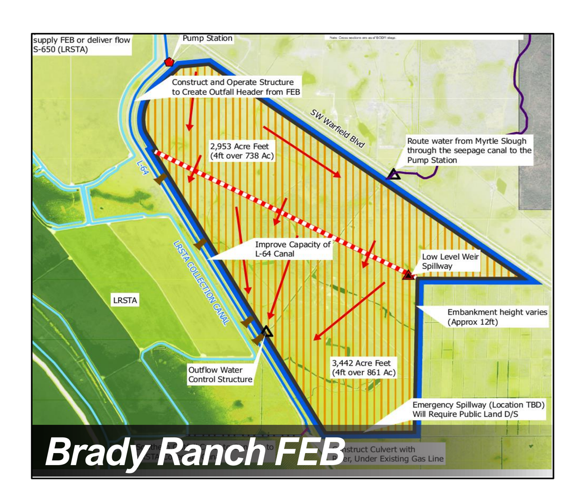

Lower Kissimmee Basin STA

COMING SOON

Basin: **S-154C**
Project Area: **3,350 ac**
Est. Storage:
5,900 ac-ft/yr
Estimated TP: **19.0 t/yr**
Estimated TN: **TBD**

Basin: **S-191**
Project Area: **N/A**
Est. Storage: **N/A**
Estimated TP: **2.9 t/yr**
Estimated TN: **N/A**

S191 Phosphorus Retention

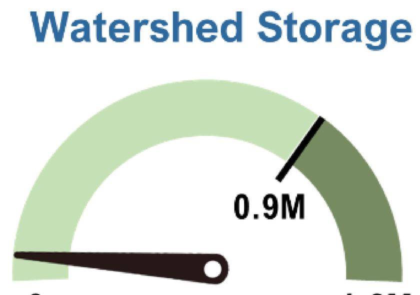

Brady Ranch FEB

COMING SOON

Basin: **S-191**
Project Area: **1,800 ac**
Est. Storage:
7,200 ac-ft/yr
Estimated TP: **4.0 t/yr**
Estimated TN: **TBD**

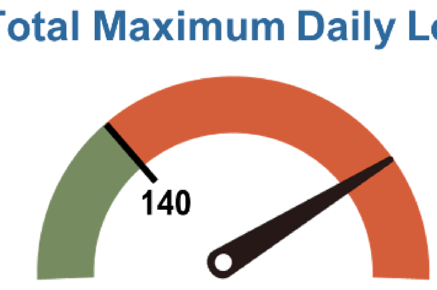
Progress Towards Water Quality and Storage Goals

Total Watershed Storage



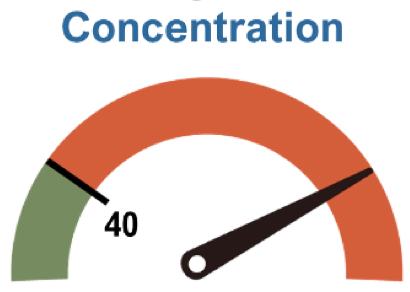
GOAL = 0.9 – 1.3 million
WY2023 = 80,627
Units = acre-feet

Total Phosphorus (TP) Total Maximum Daily Load



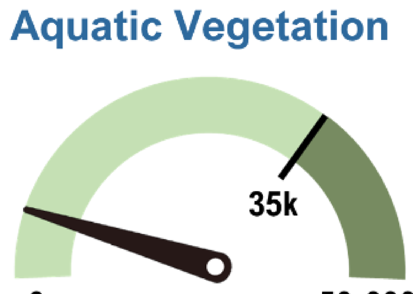
GOAL ≤ 140
5-Year Average = 402
Units = metric tons

Pelagic TP Concentration



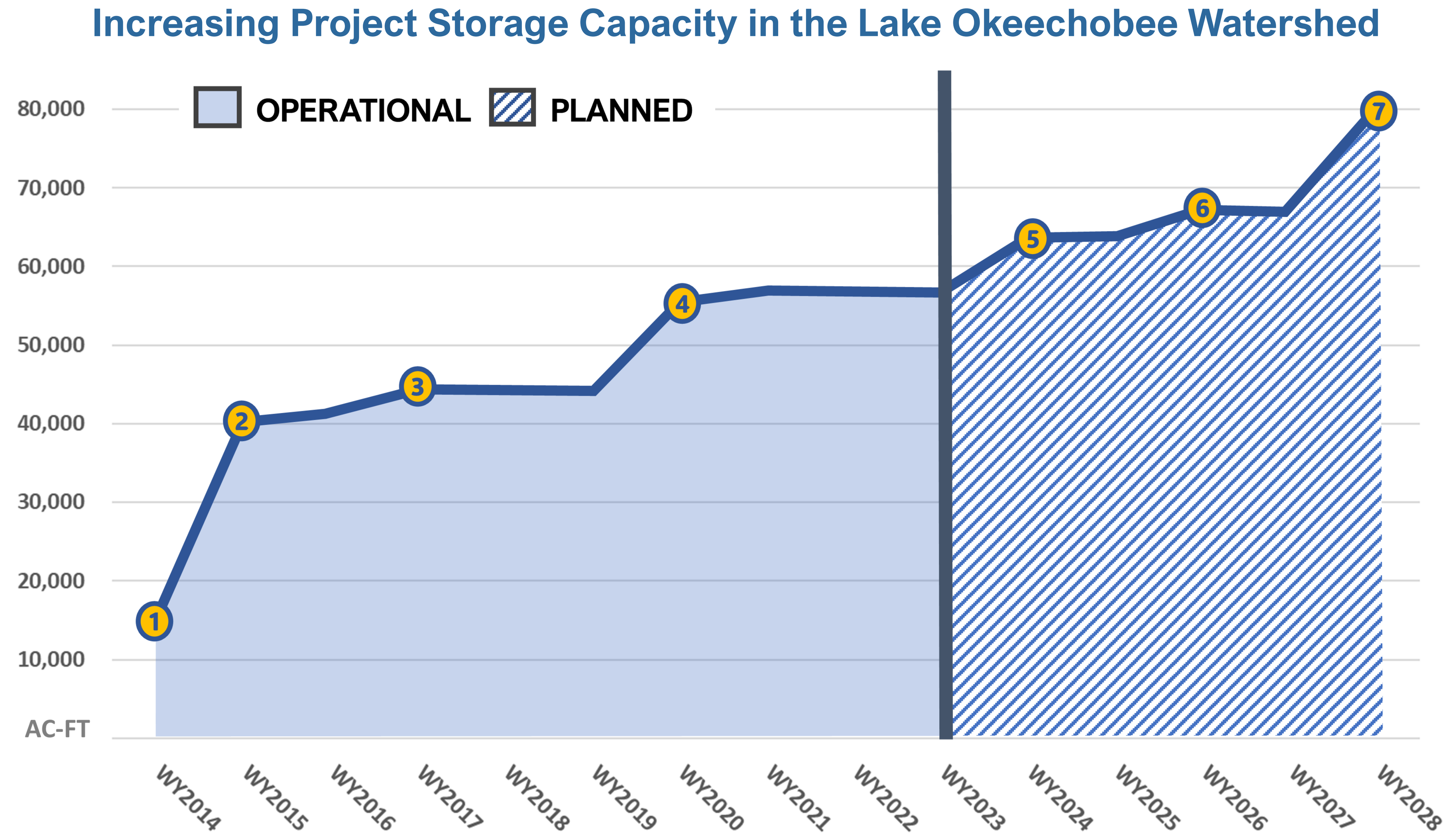
GOAL ≤ 40
WY2023 = 162
Units = micrograms per liter

Submerged Aquatic Vegetation



GOAL ≥ 35,000
WY2023 = 5,187
Units = acres

Increasing Project Storage Capacity in the Lake Okeechobee Watershed



1. BUCK ISLAND RANCH, DIXIE RANCH, WEST WATERHOLE
2. NICODEMUS SLOUGH, RAFTER T RANCH
3. LLANO RANCHES
4. BRIGHTON VALLEY
5. PARTIN FAMILY RANCH, EL MAXIMO RANCH
6. TCNS 214, GRASSY ISLAND FEB
7. BRADY RANCH FEB, LOWER KISSIMMEE STA

* Long-term storage estimates (shown here) may vary from actual water year storage.

For more information: SCAN ME

Chapter 8C: St. Lucie River Watershed Protection Plan Annual Progress Report

Part III: St. Lucie River Watershed Construction Project

Sara Ouly

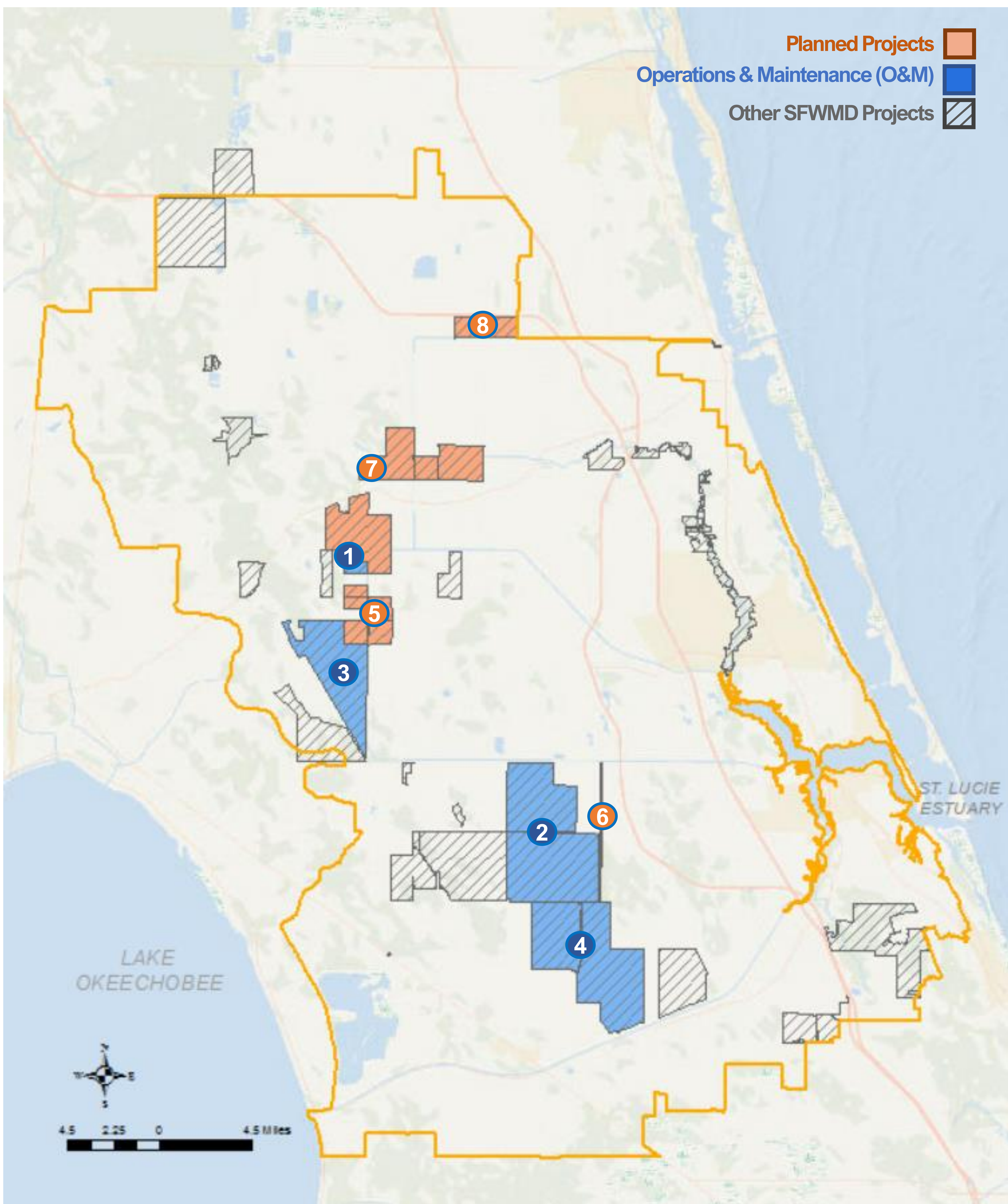
Planning and Project Management Section, Everglades and Estuaries Protection Bureau

Sixteen Operation Projects in WY2023, providing approximately:

- **128,011 acre-feet** (ac-ft) of storage
- **41 metric tons** (t) total phosphorus (TP) retention
- **266 metric tons** (t) total nitrogen (TN) retention

Highlighted Project: Scott Water Farm is a public-private partnership that retains stormwater on **7,549** acres, thus reducing overall loading to the C-25 Basin. During the first full year of operation (WY2023), the project removed **11.6 t/year (yr) of** TP and **69.8** t/yr of TN.

Advancing Watershed Construction Projects



Planned Projects


C-23/C-24 District Lands Hydrologic Enhancement

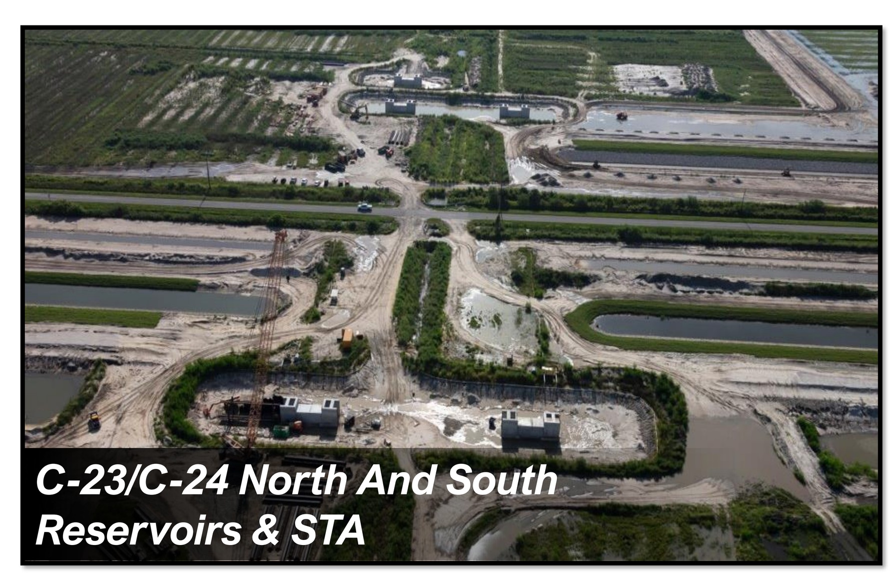
5. C-23/C-24 District Lands Hydrologic Enhancements

- Improve retention through hydrologic enhancements
- Status: Planning
- Estimated to store rainfall on 2,648 ac of District-owned land


C-23/C-44 Estuary Discharge Diversion Canal

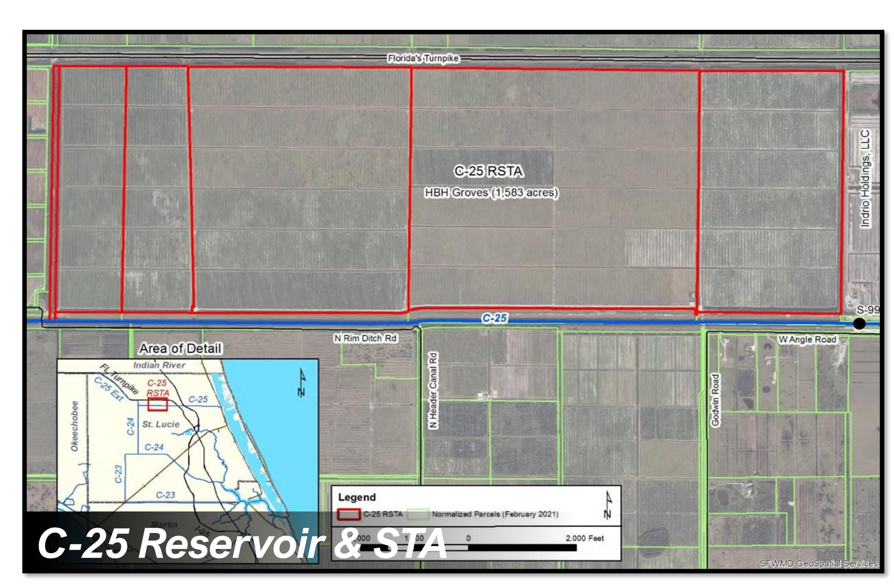
6. C-23/C-44 Estuary Discharge Diversion Canal

- Directs excess water from the C-23 Canal through the C-44 Reservoir & STA and into the C-44
- Status: Construction
- Expected to be operational by WY2026
- Estimated to divert 53,000 ac-ft/yr


C-23/C-24 North And South Reservoirs & STA

7. C-23/C-24 North and South Reservoirs & Stormwater Treatment Area (STA)

- Capture rainfall on 7,110-acre reservoirs and 2,568-acre STA
- Status: STA-Construction, Reservoirs-Design
- Expected to be operational by WY2030
- **Estimated storage: 95,242 ac-ft/yr**


C-25 Reservoir & STA

8. C-25 Reservoir & Stormwater Treatment Area (STA)

- Capture water from the C-25 Canal on 1,276 acres
- Status: Design
- Expected to be operational by WY2030
- **Estimated storage: 5,392 ac-ft/yr**

Operational Projects


C-23/C-24 Interim Storage Section C

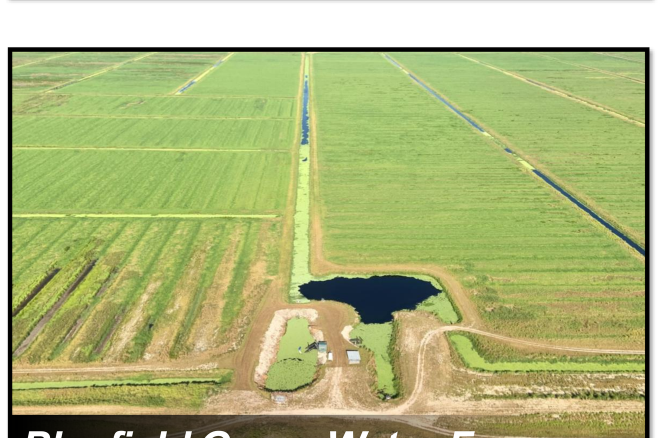
1. C-23/C-24 Interim Storage Section C

- Retains rainfall and excess water pumped from the C-23 Canal on 297 acres
- Operational since FY2019
- **WY2023 storage: 2,449 ac-ft**


Allapattah Flats Parcels A and B

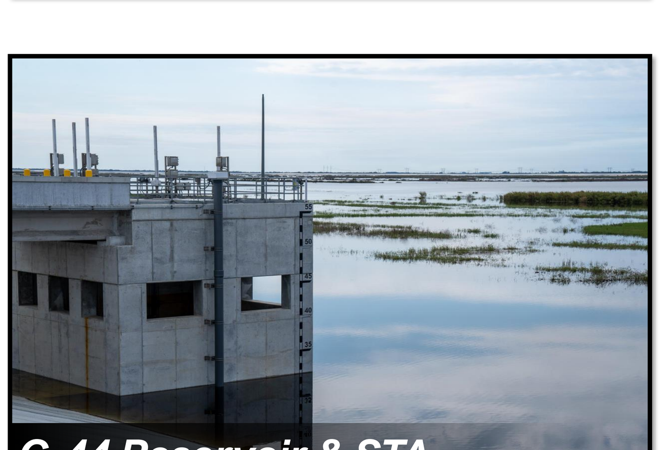
2. Allapattah Flats Parcels A and B

- Restored 6,621 acres of wetland habitat for storage retention
- Operational since FY2021
- **WY2023 storage: 5,350 ac-ft**


Bluefield Grove Water Farm

3. Bluefield Grove Water Farm

- 6,104-acre above ground impoundment (AGI)
- Operational since FY2022
- **WY2023 storage: 35,931 ac-ft**


C-44 Reservoir & STA

4. C-44 Reservoir & Stormwater Treatment Area (STA)

- Captures rainfall on 3,400-acre reservoir and 6,300-acre STA
- Operational Testing and Monitoring Period since FY2022
- **WY2023 storage: 9,370 ac-ft**

Progress Towards Water Quality and Storage Goals

*An additional 100,634 ac-ft/yr is expected to be added by WY2030

For more information: SCAN ME

Chapter 8D: Caloosahatchee River Watershed Protection Plan Annual Progress Report

Part III: Caloosahatchee River Watershed Construction Project

Jenna Bobsein

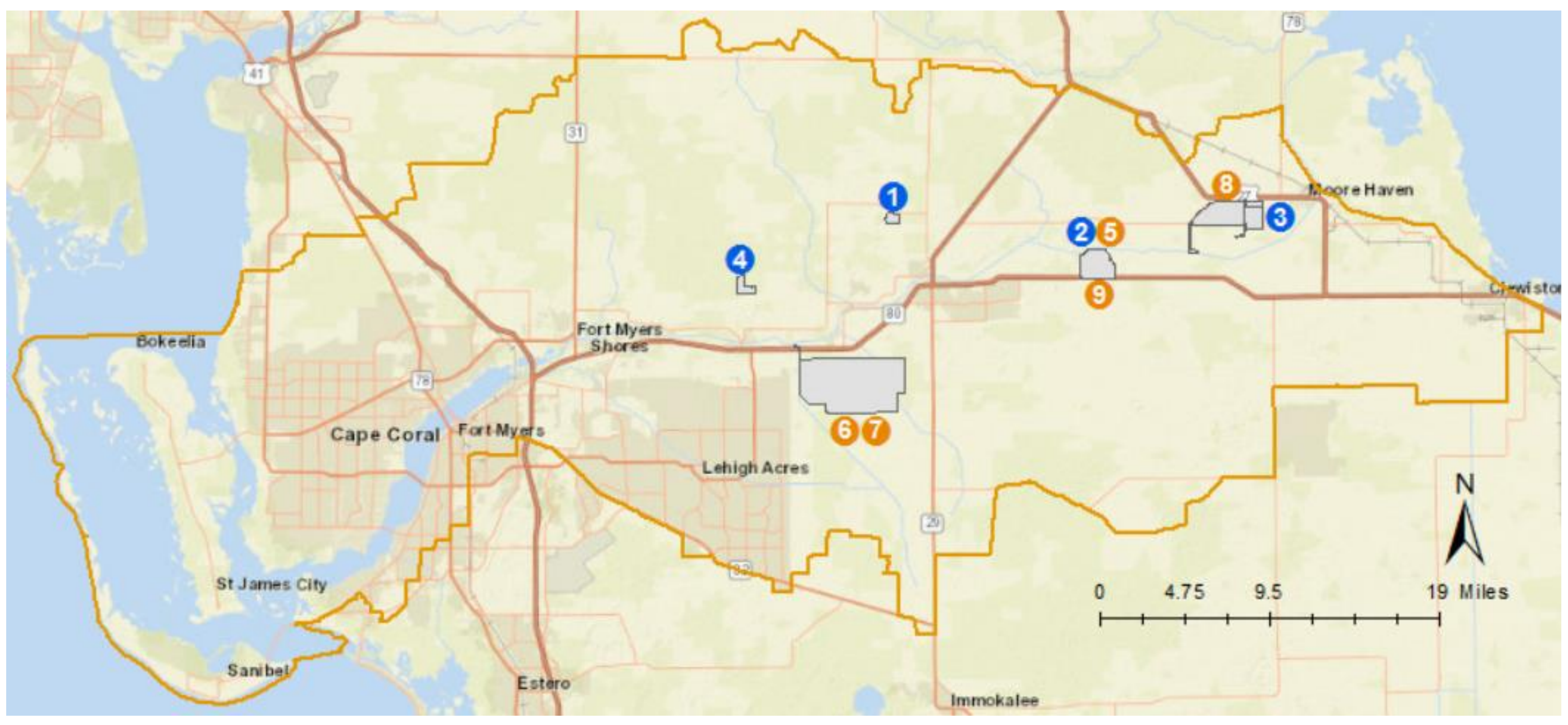
Planning and Project Management Section, Everglades and Estuaries Protection Bureau

Three operational projects in Water Year 2023 (WY2023) provided approximately:

- **5,000 acre-feet** (ac-ft) of storage
- **5.5 metric tons** (t) total phosphorus (TP) retention
- **29.3 metric tons** (t) total nitrogen (TN) retention

Four Corners Rapid Infiltration project completed construction and began operating in June 2023 (WY2024). This project will provide an additional estimated 20,000 ac-ft if storage and will retain 39.3 metric tons (t) of TN per year (t/yr).

Advancing Watershed Construction Projects



Operational Projects


Inspection at Mudge Ranch

1. Mudge Ranch

- Dispersed water management (DWM) public-private partnership
- Passive storage project
- Operational since WY2014
- **WY2023 storage: 362 ac-ft**


Pump at Boma Interim Storage

2. Boma Interim Storage

- Temporary storage until construction begins for the Boma Flow Equalization Basin (FEB)
- Operational since WY2019
- **WY2023 storage: 3,405 ac-ft**


Pump Station G-725 at LHHEP Phase I

3. Lake Hicpochee Hydrologic Enhancement Project (LHHEP) Phase I

- Enhances hydration of the historic Lake Hicpochee
- Phase I captures excess surface water from the C-19 canal
- Operational since WY2021
- **WY2023 storage: 1,222 ac-ft**


Ribbon cutting event at Four Corners Rapid Infiltration

4. Four Corners Rapid Infiltration

- DWM public-private partnership
- 366-acre above ground impoundment (AGI), including a 22-acre rapid infiltration area
- Operational since WY2024
- **Estimated storage: 20,000 ac-ft/yr**

Planned Projects


C-43 WQTT (Test Cells)

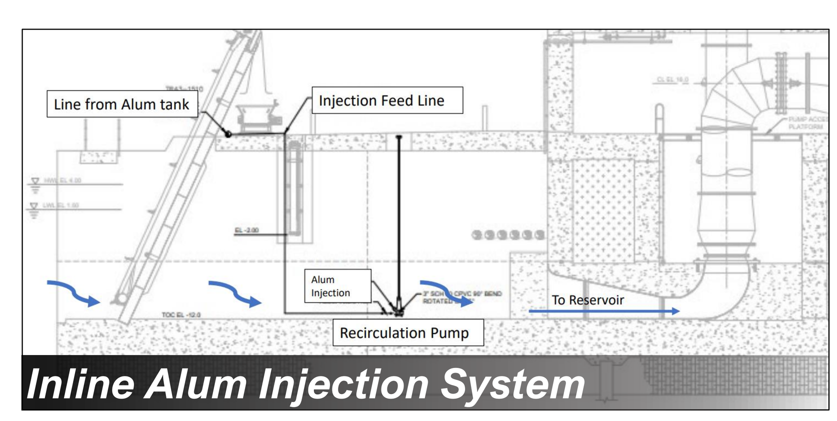
5. C-43 Water Quality Treatment and Testing (WQTT) Project – Phase II (Test Cells)

- Study evaluating the effectiveness of constructed wetland treatment systems in reducing TN at a test scale
- Status: Construction
- Expected to be operational by WY2025


Pump Station S-470 at C-43 WBSR

6. C-43 West Basin Storage Reservoir

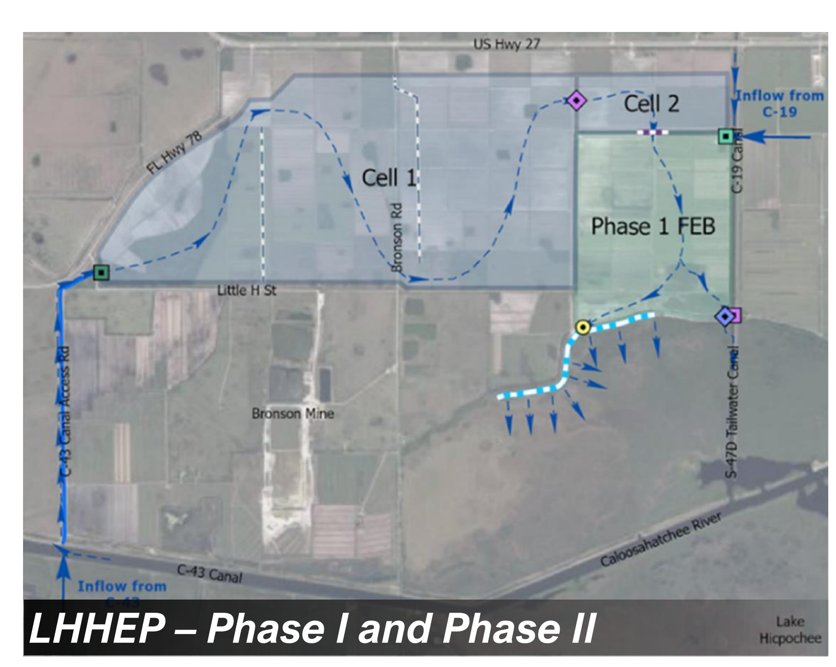
- Provides storage to reduce harmful discharges to the Caloosahatchee River Estuary during the wet season and provide freshwater flow during the dry season
- Status: Construction
- Expected to be operational by WY2026
- **Estimated static storage: 170,000 ac-ft**



Inline Alum Injection System

7. C-43 West Basin Storage Reservoir (WBSR) – Water Quality Component

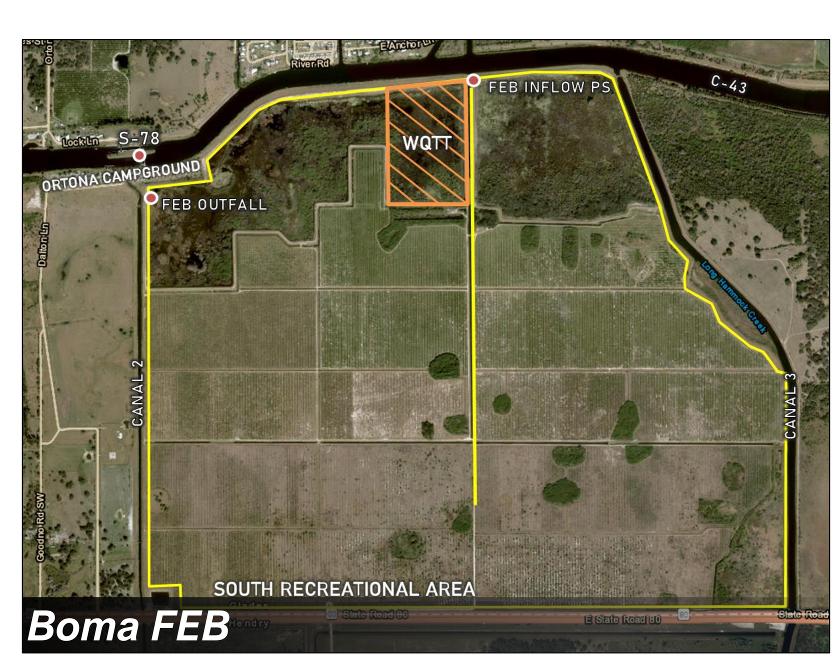
- Inline alum injection system at the C-43 WBSR project
- Status: Design
- Expected to be operational by WY2026



LHHEP – Phase I and Phase II

8. Lake Hicpochee Hydrologic Enhancement Project (LHHEP) Phase II

- Phase II includes a new 2,200-acre FEB and a pump station to withdraw water from the C-43 canal
- Status: Design
- Expected to be operational by WY2027
- **Estimated static storage: 8,058 ac-ft**

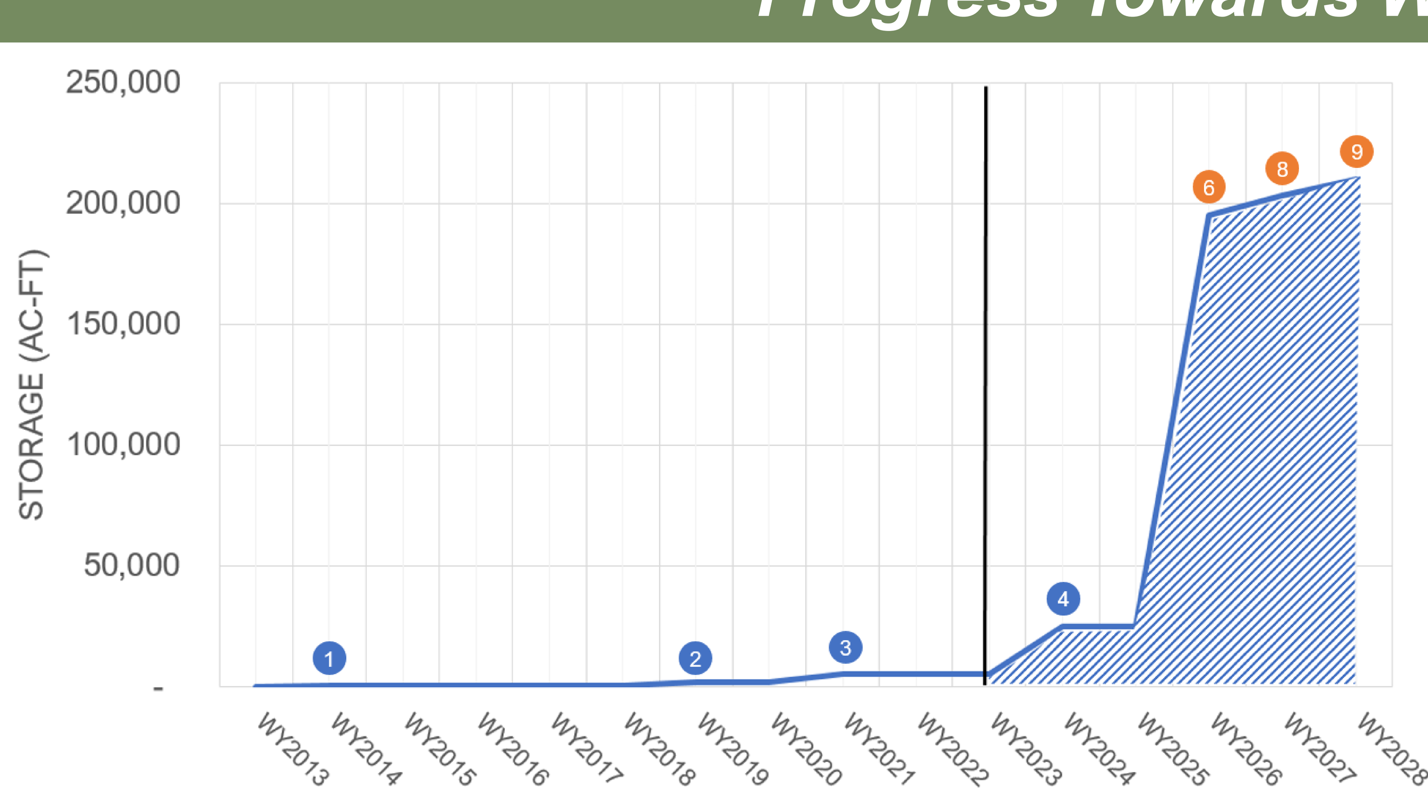


Boma FEB

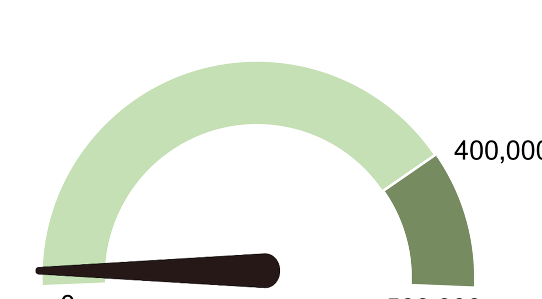
9. Boma Flow Equalization Basin (FEB)

- Provides storage to reduce harmful discharges to the Caloosahatchee River Estuary
- Status: Design
- Expected to be operational by WY2028
- **Estimated static storage: 7,200 ac-ft**

Progress Towards Water Quality and Storage Goals



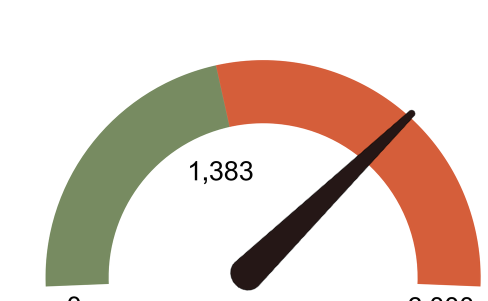
Total Storage



GOAL = 400,000 ac-ft

WY2023 = 4,989 ac-ft

TN Loading



GOAL = 1,383 t

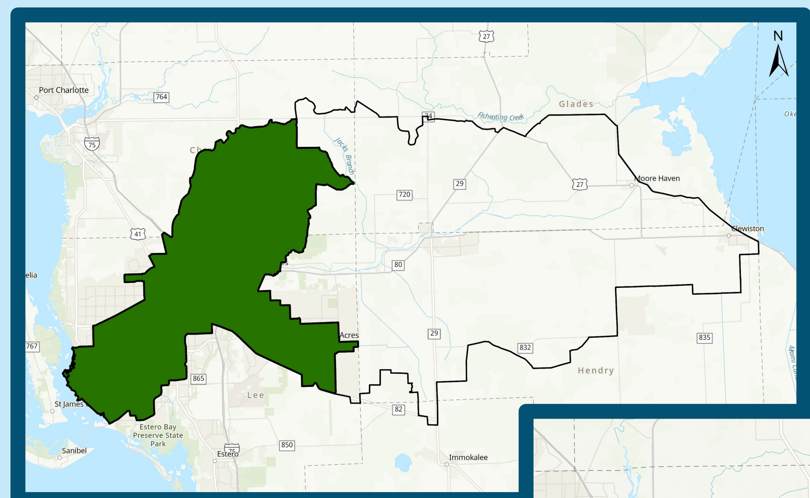
5-Year Average = 2,219 t

For more information: SCAN ME

CALOOSAHATCHEE RIVER AND ESTUARY BASIN MANAGEMENT ACTION PLAN (BMAP)

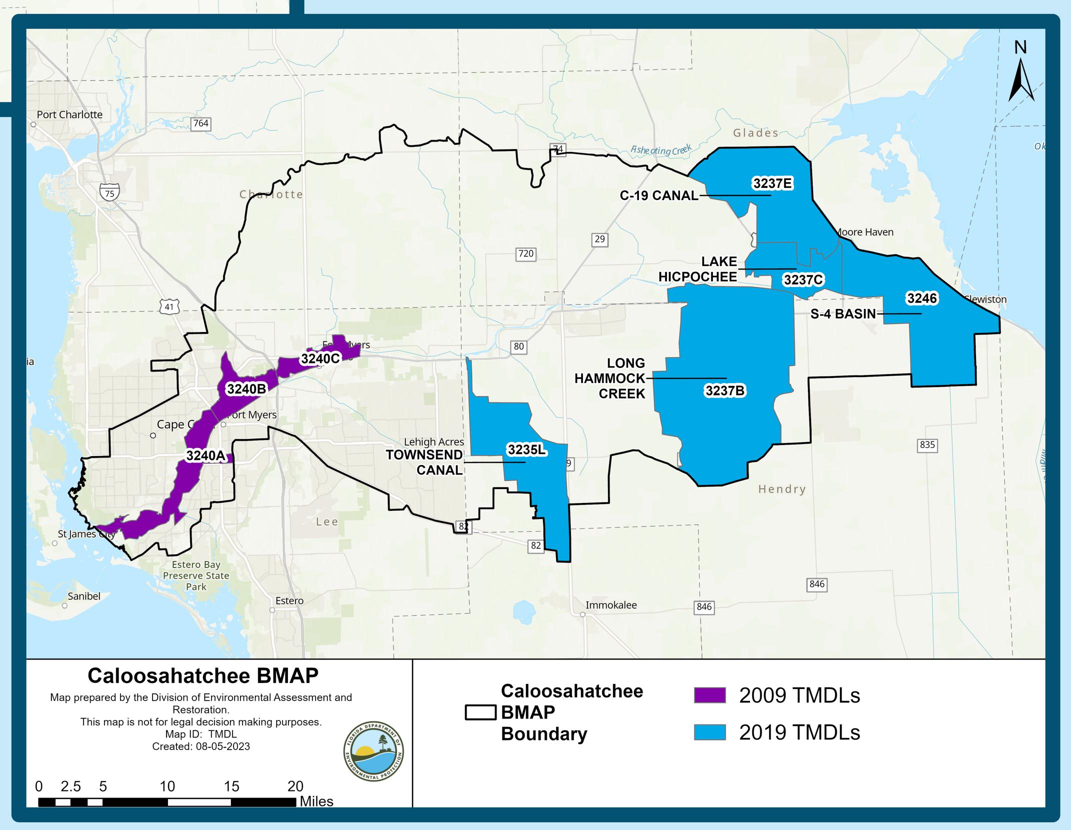
WATER QUALITY ANALYSES

BMAP Background



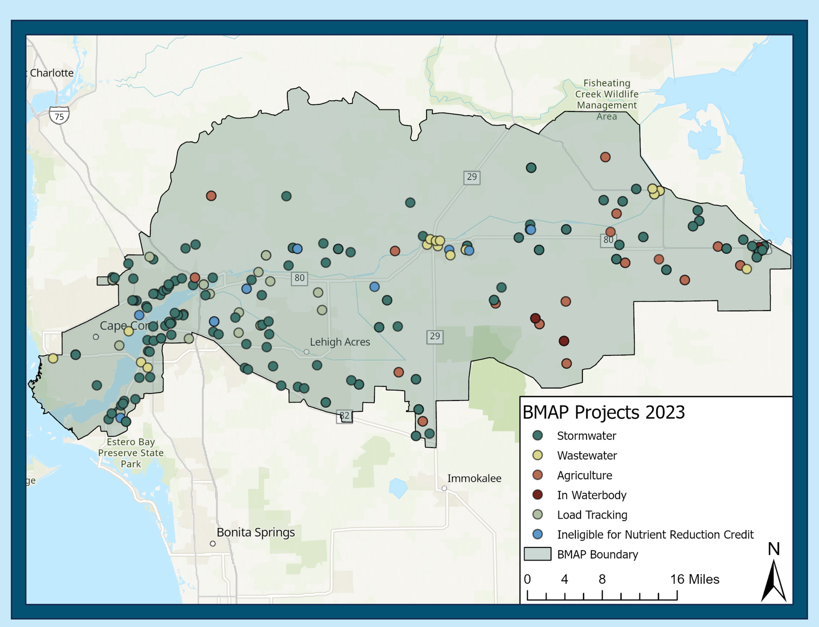
- Covers six total maximum daily loads (TMDLs).
- Estuary TMDL is for total nitrogen (TN).
- Tributaries have TN and total phosphorus (TP) TMDLs.

Original BMAP adopted in 2012 covered only the tidal subwatershed.

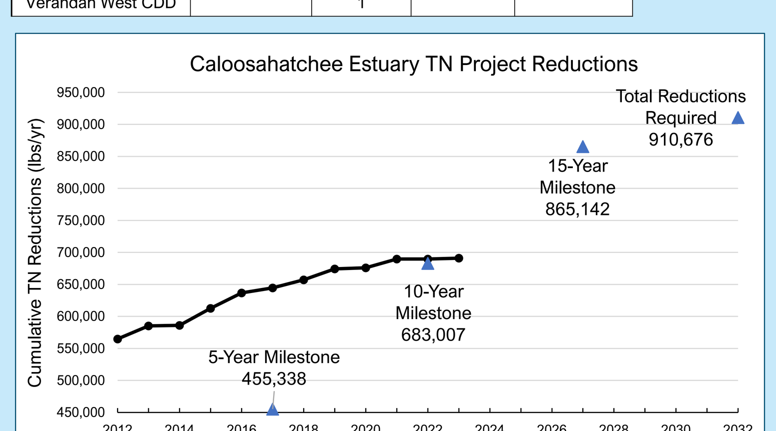


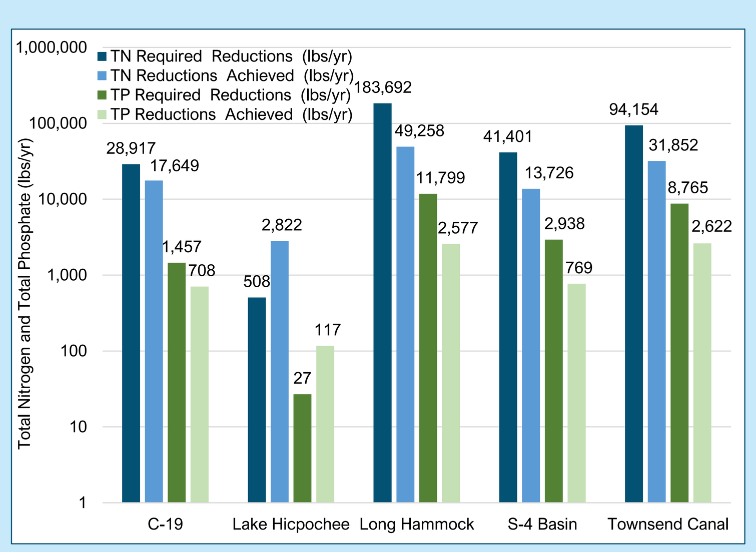
Statewide Annual Report (STAR) 2023

Lead Entity	Completed	Ongoing	Planned	Underway
Barron WCD	1	1	3	
Charlotte County		1		
City of Cape Coral	14	3	1	1
City of Clewiston	3	3		
City of Fort Myers	11	2	3	1
City of LaBelle				5
City of Moore Haven	1		1	
Clewiston Drainage District	1	1	3	
Collins Slough WCD	1	1	3	
County Line Drainage District	1	1		3
Cow Slough WCD	1	1	3	
Devil's Garden WCD	1	1	3	
Disston Island Conservancy District	1	1	3	
FDACS		6		
FDOT District 1	29	2		
Flaghole Drainage District	1	1	3	
Gerber Groves WCD	1	1	3	
Glades County	2			2
Hendry County	1		4	3
Hendry-Hilliard WCD	1	1	3	
LA-MSID (formerly ECWCD)	15	1	1	1
Lee County	44	2	4	1
Lucaya CDD		2		
Mirada CDD		2		
Port LaBelle CDD			1	
Portico CDD	3	1		
SFWMD - Coordinating Agency	3		3	2
Sugarland Drainage District	1	1	3	
Verandah East CDD		1		
Verandah West CDD		1		

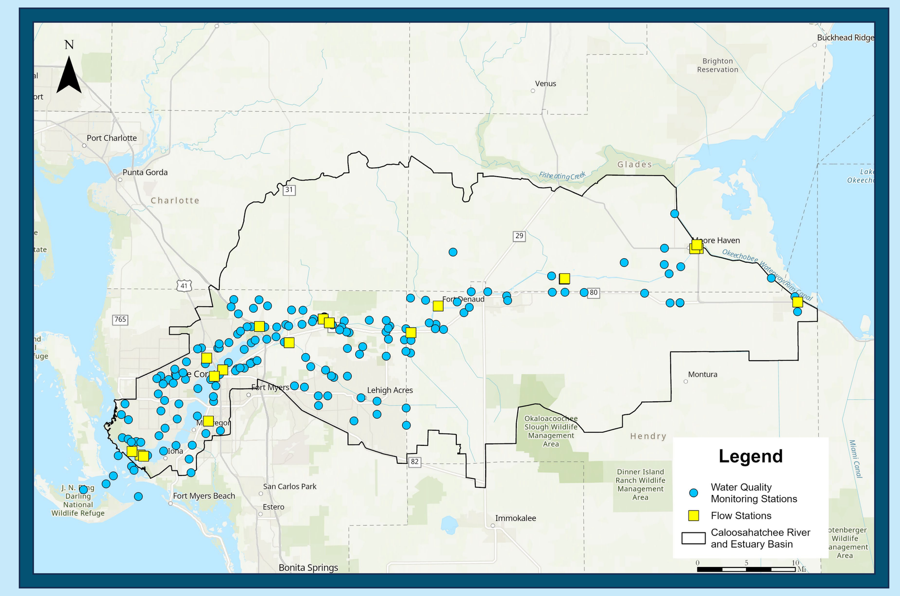


More recent tributary projects have begun to address TN and TP loading in the East and West Caloosahatchee subwatersheds.





Water Quality Monitoring Network



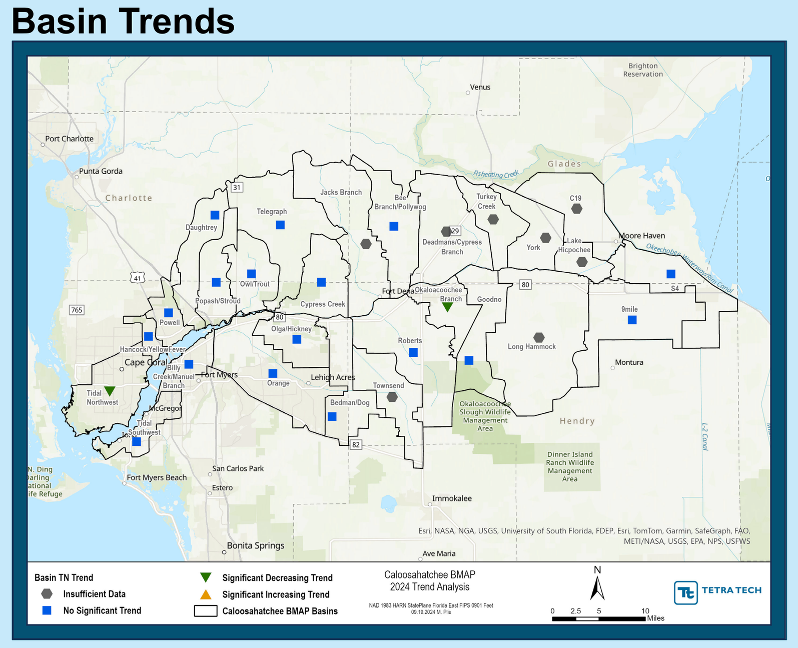
Water Quality Parameters Monitored	
Alkalinity	Nitrate-Nitrite (N)
Ammonia (N)	Total Kjeldahl Nitrogen (TKN)
Biological Oxygen Demand (BOD)	Total Nitrogen (TN)
Organic Carbon	Orthophosphate (P)
Total Carbon	pH
Chlorophyll-a	Total Phosphorus (TP)
Color	Specific Conductance/Salinity
Dissolved Oxygen	Temperature
Dissolved Oxygen (Saturation)	Total Suspended Solids
Flow	Turbidity

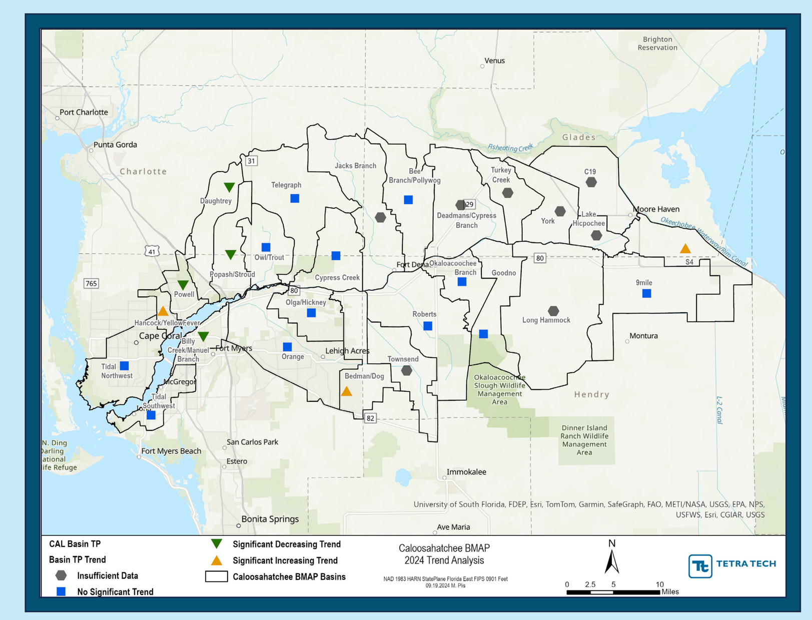
Water quality is monitored at 62 stations throughout the watershed.

Water Quality Trend Analyses

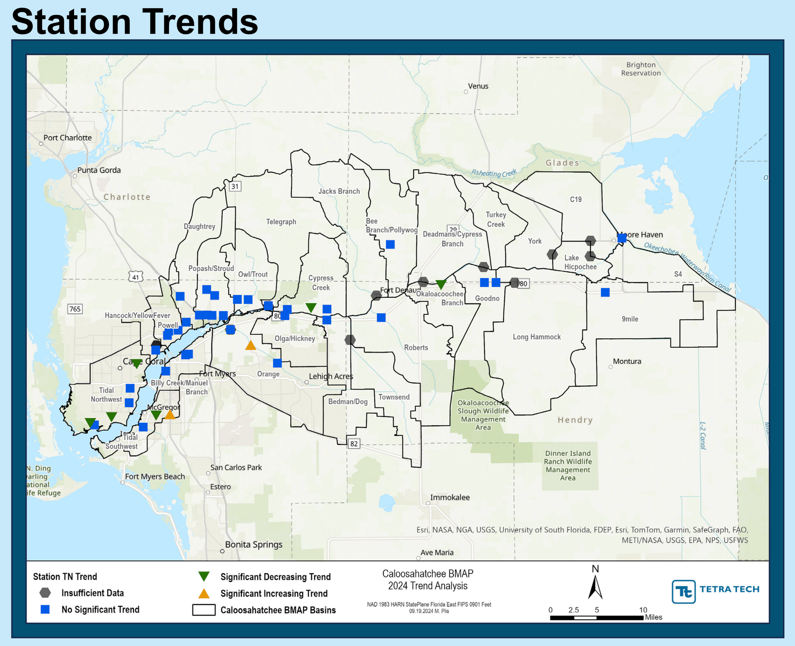
Seasonal Kendall trend analysis investigates trends in TN and TP concentrations for the basins and for the BMAP monitoring network stations.

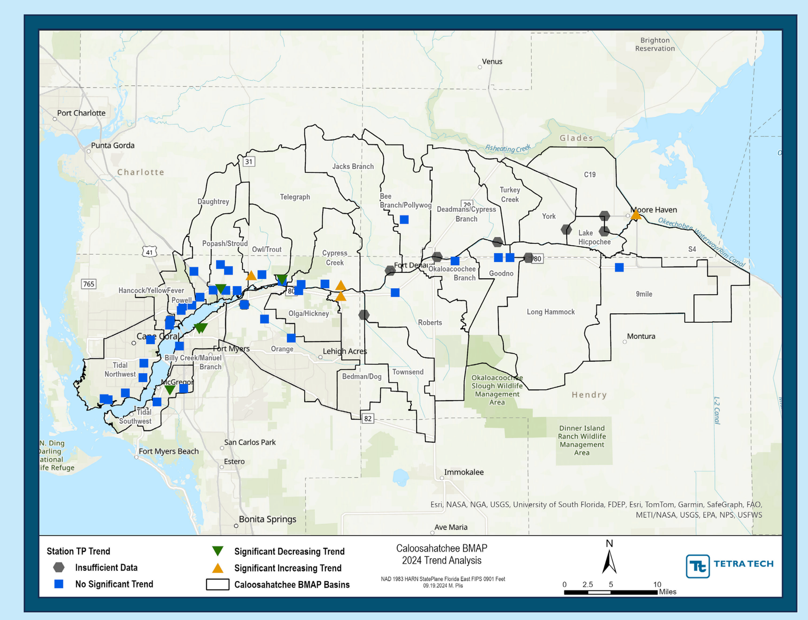
Basin Trends



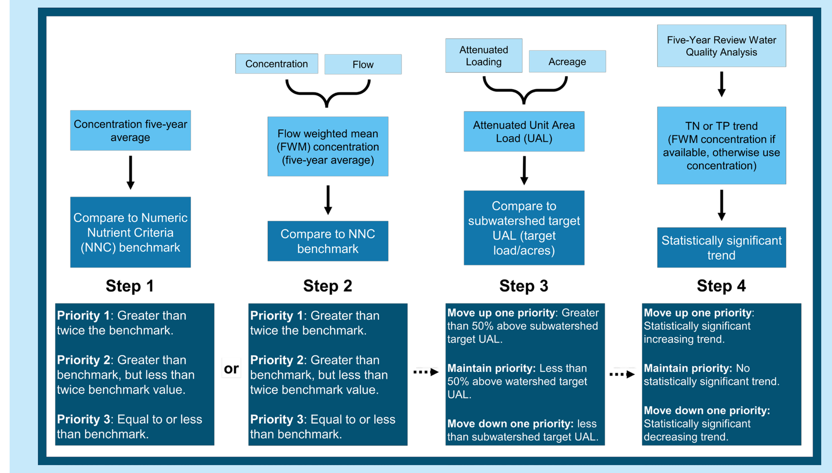


Station Trends

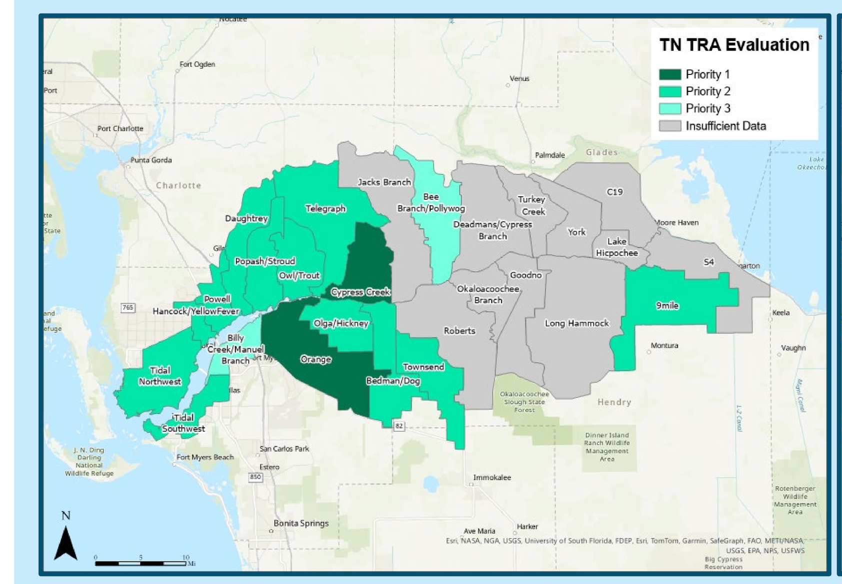


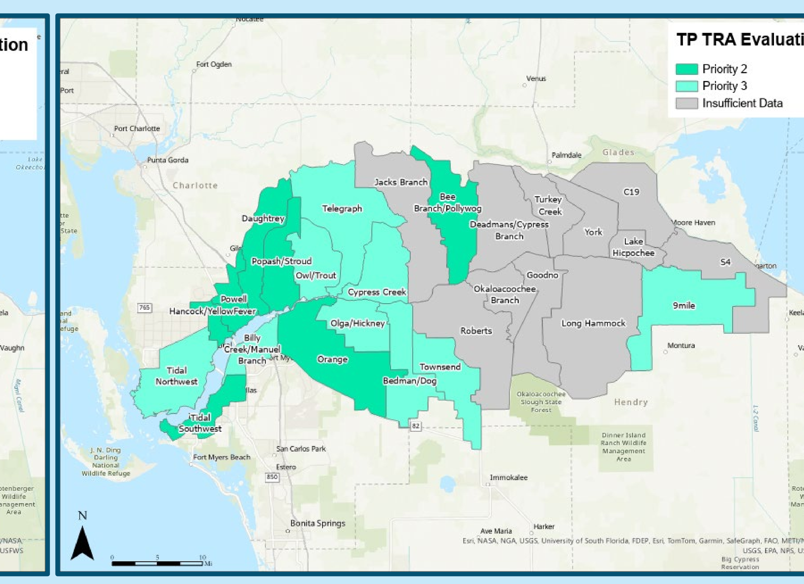


Targeted Restoration Area Evaluation



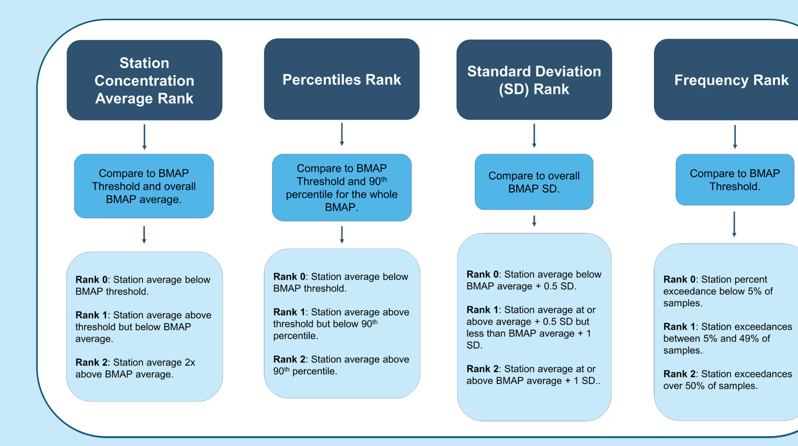
Targeted Restoration Areas (TRA) sequentially compare four parameters to determine priority basins for restoration projects.

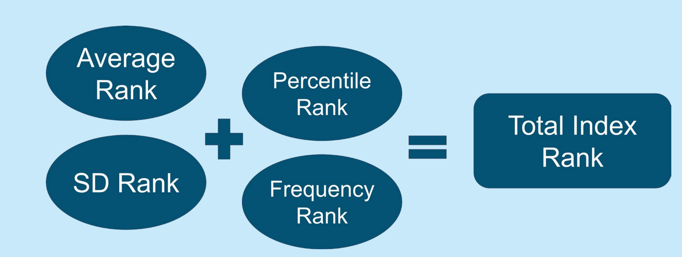




Hot Spot Analysis

Analysis method for prioritization at a more local scale than the TRA analysis.





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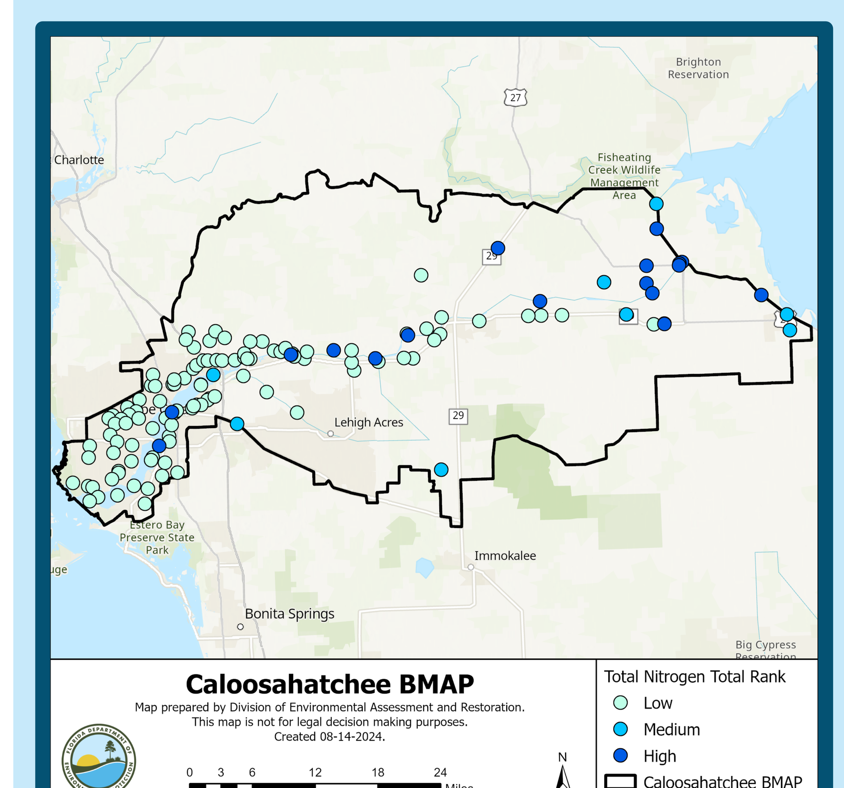

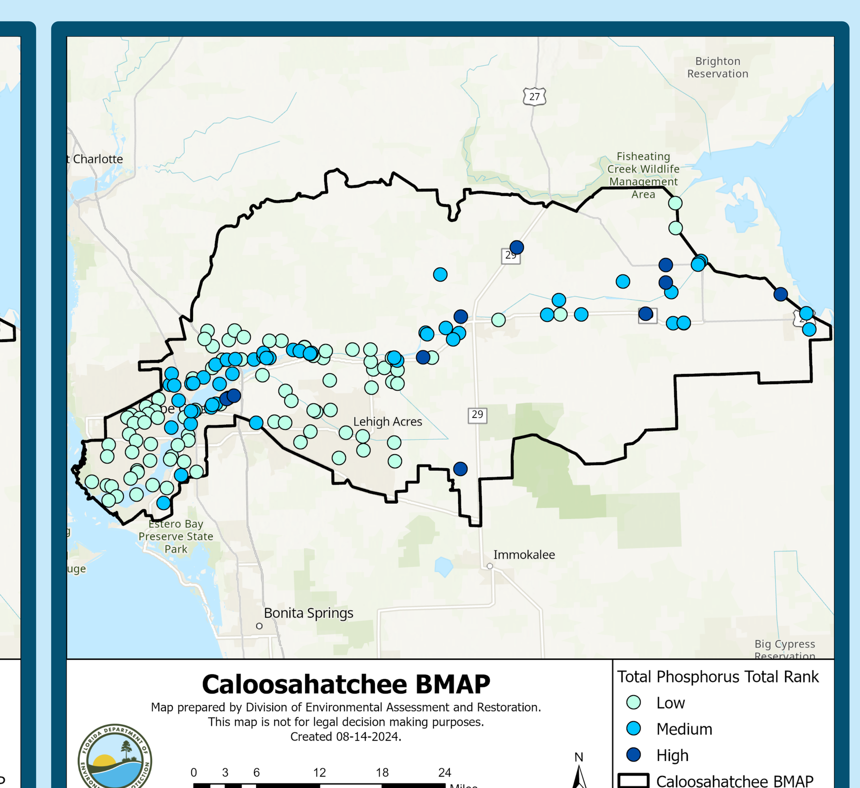

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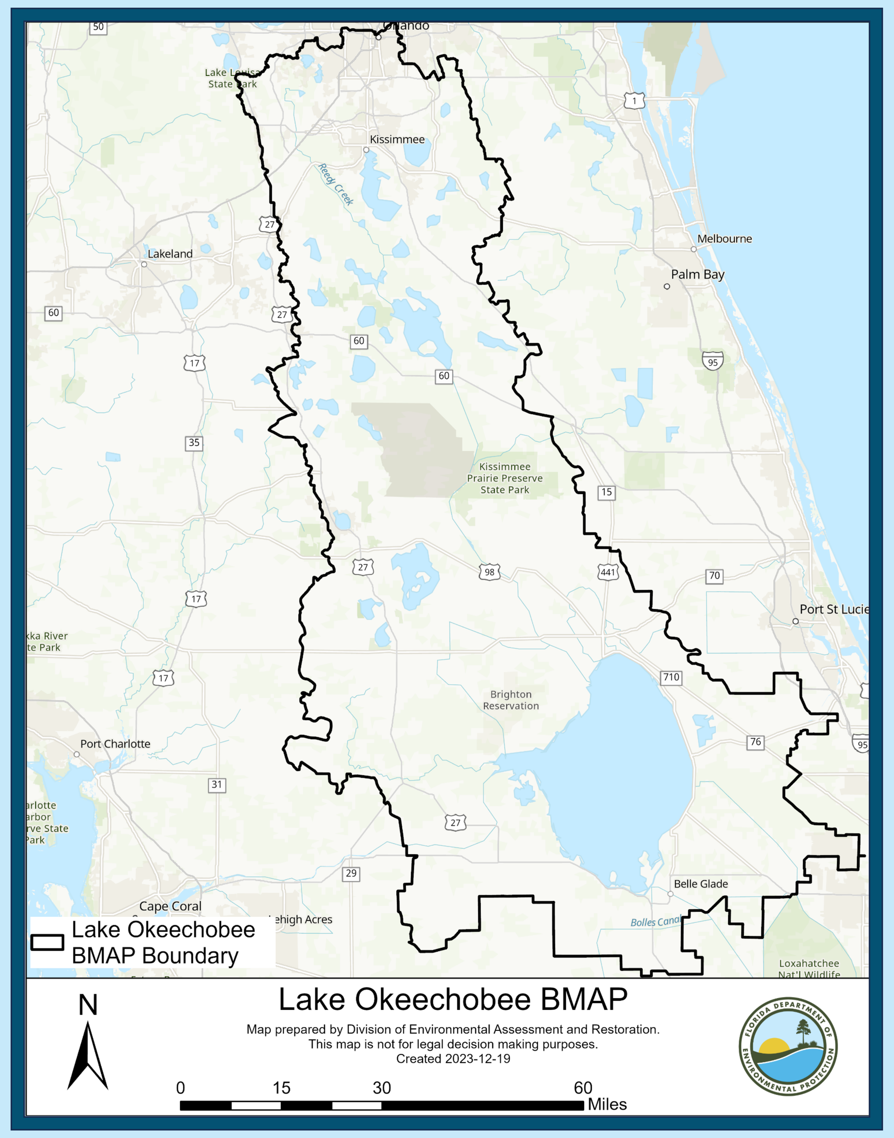
LAKE OKEECHOBEE BASIN MANAGEMENT ACTION PLAN (BMAP)

WATER QUALITY ANALYSES

BMAP Background



Lake Okeechobee Total Phosphorus (TP)Total Maximum Daily Load (TMDL) adopted in 2001.

TMDL set at a total load of 140 mt/yr TP.

35 mt/yr falls directly on the lake.

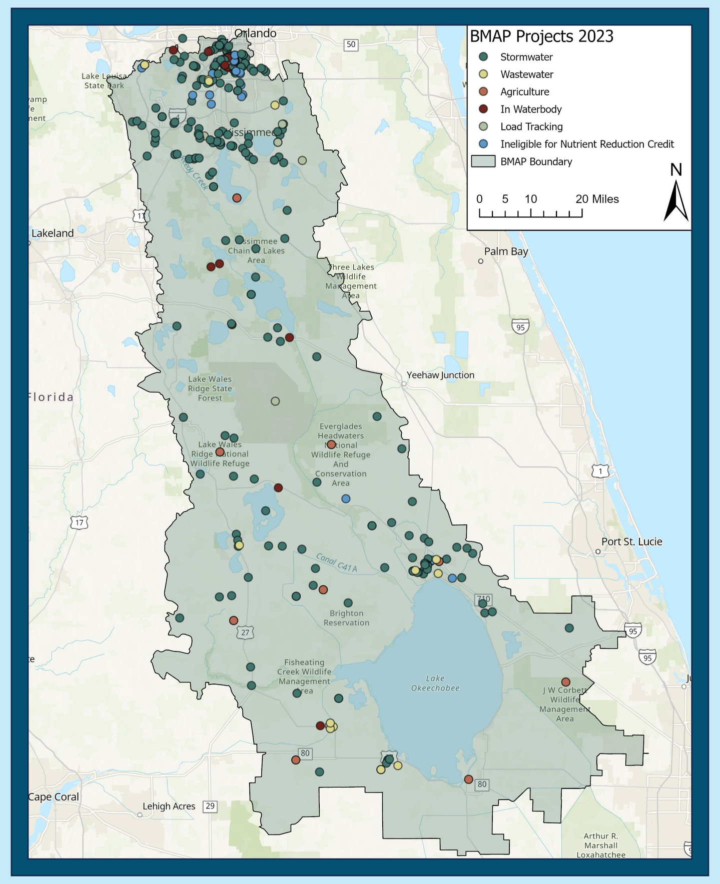
105 mt/yr allocated to the entire watershed.

mt/yr = metric tons/year.

The watershed is composed of nine subwatersheds and 65 basins.

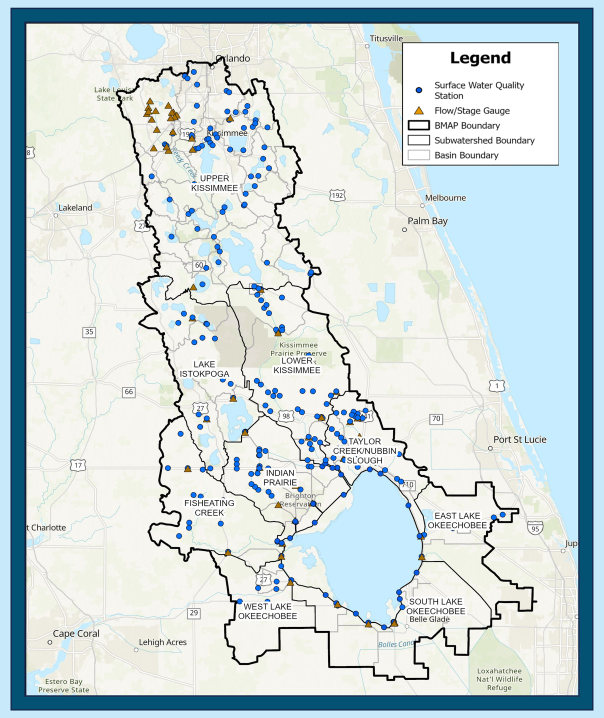
Statewide Annual Report (STAR) 2023

Subwatershed	TP Load Required Reduction (mt/yr)	TP Reduction Through Dec. 31, 2023 (mt/yr)	TP Reductions Achieved Through Dec. 31, 2023
Fisheating Creek	28.3	15.4	54%
Indian Prairie	22.7	22.7	66%
Lake Istokpoga	24.6	2.7	11%
Lower Kissimmee	57.1	13.5	21%
Taylor Creek/Nubbin Slough	41.6	32.3	78%
Upper Kissimmee	57.0	18.2	32%
East Lake Okeechobee	11.0	2.3	21%
South Lake Okeechobee	8.2	3.1	37%
West Lake Okeechobee	0.0	0.6	100%
Total	367.2	110.7	42%



Through Dec. 31, 2023, 343 projects in the BMAP address both stormwater and wastewater pollution sources.

Water Quality Monitoring Network



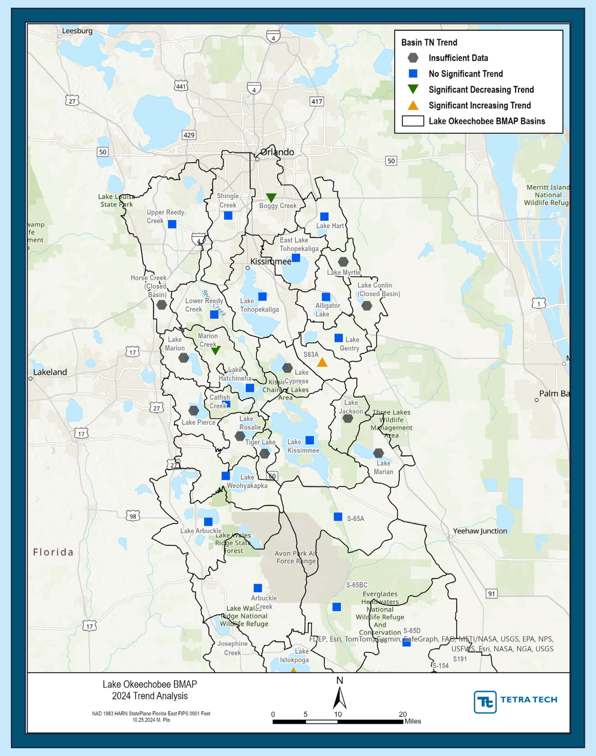
Water Quality Parameters Monitored	
Alkalinity	Nitrate-Nitrite (N)
Ammonia (N)	Total Kjeldahl Nitrogen (TKN)
Biological Oxygen Demand (BOD)	Total Nitrogen (TN)
Organic Carbon	Orthophosphate (P)
Total Carbon	pH
Chlorophyll-*a*	Total Phosphorus (TP)
Color	Specific Conductance/Salinity
Dissolved Oxygen	Temperature
Dissolved Oxygen (Saturation)	Total Suspended Solids
Flow	Turbidity

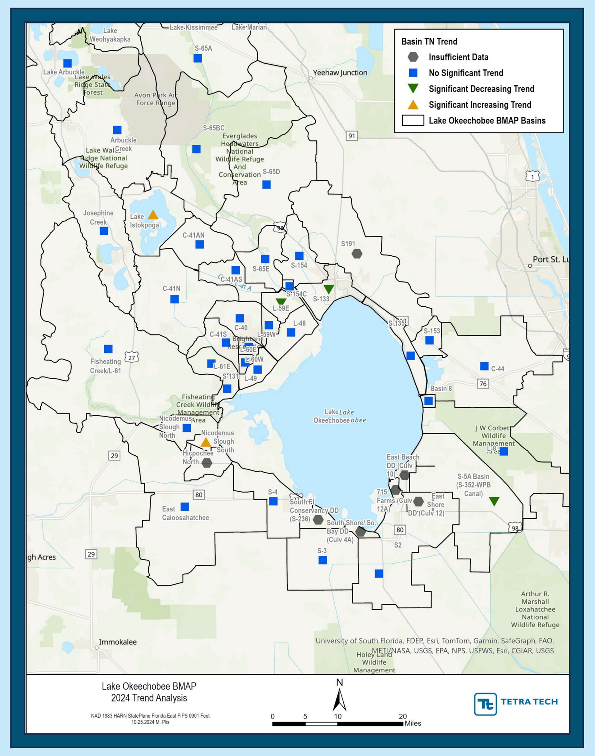
Water quality is monitored at 309 stations throughout the watershed.

Water Quality Trend Analyses

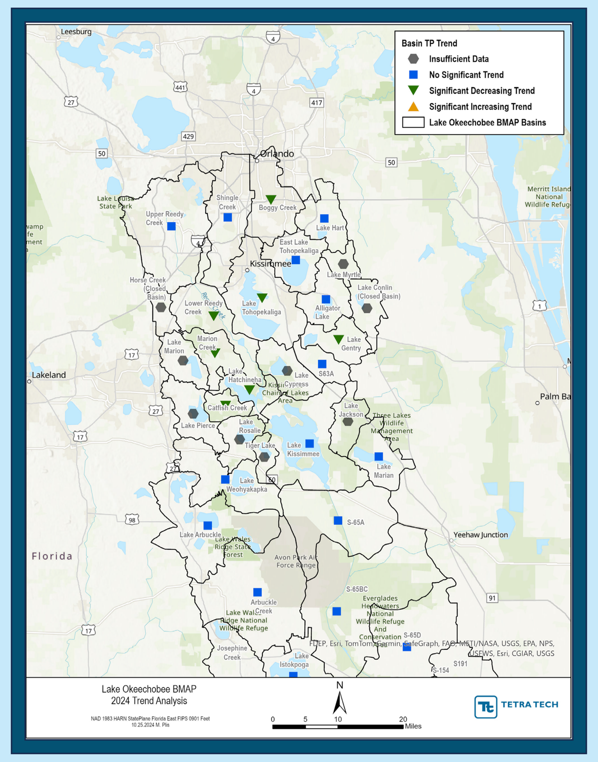
Seasonal Kendall trend analysis investigates trends in Total Nitrogen (TN) and TP concentrations for the basins.

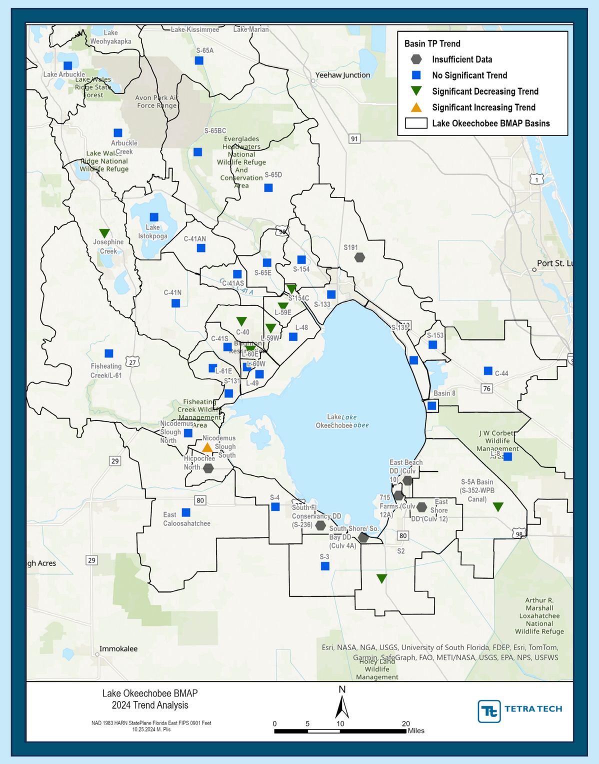
TN Trends



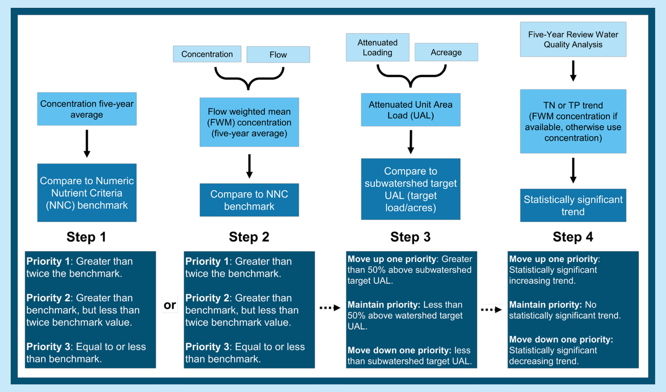


TP Trends

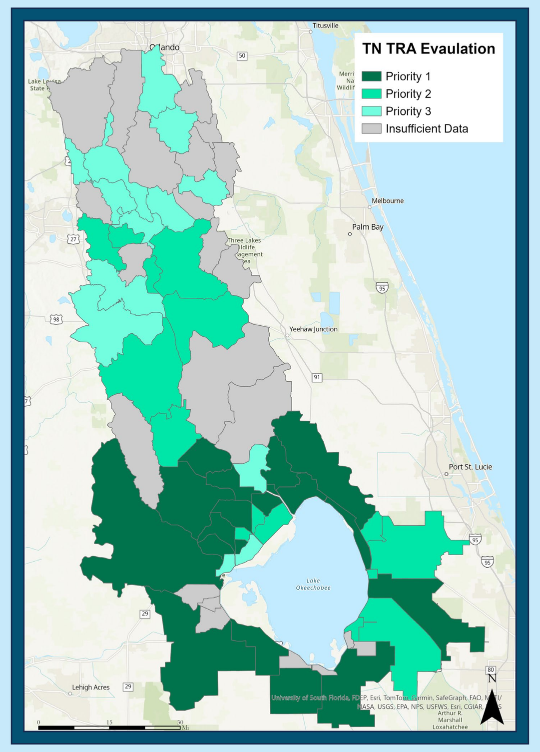


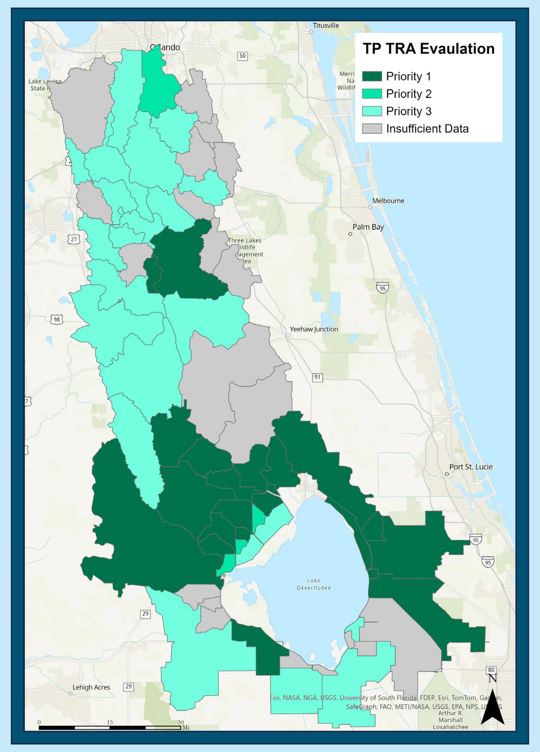


Targeted Restoration Area Evaluation



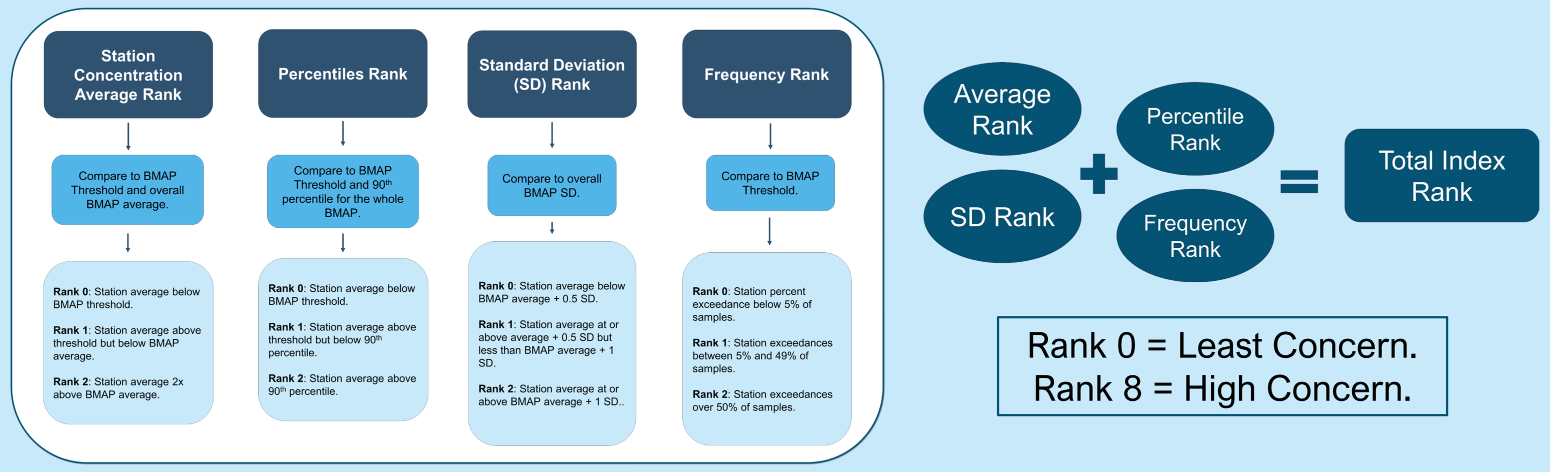
Targeted Restoration Areas (TRA) sequentially compare four parameters to determine priority basins for restoration projects.





Hot Spot Analysis

Analysis method for prioritization at a more local scale than the TRA analysis.



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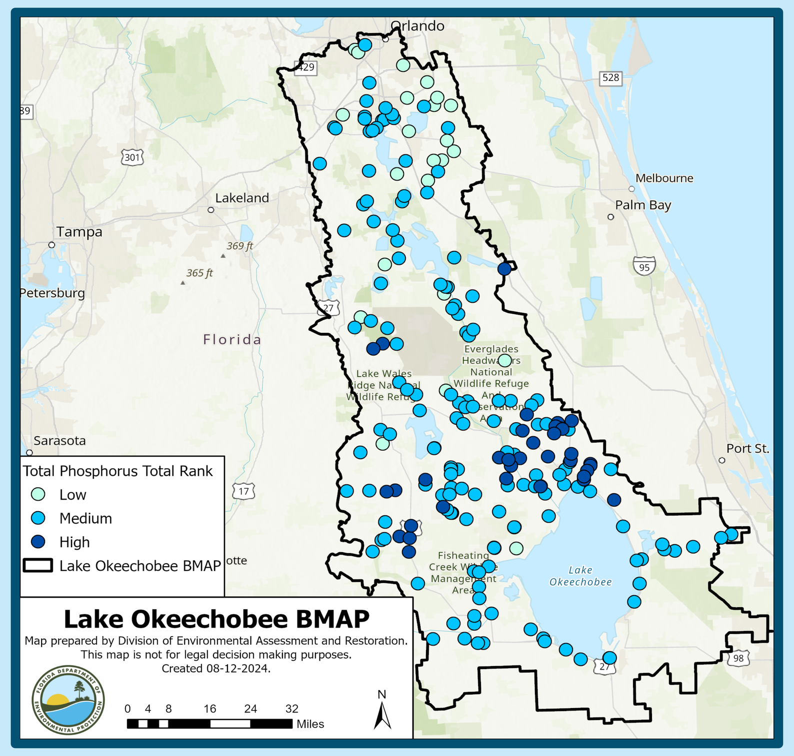

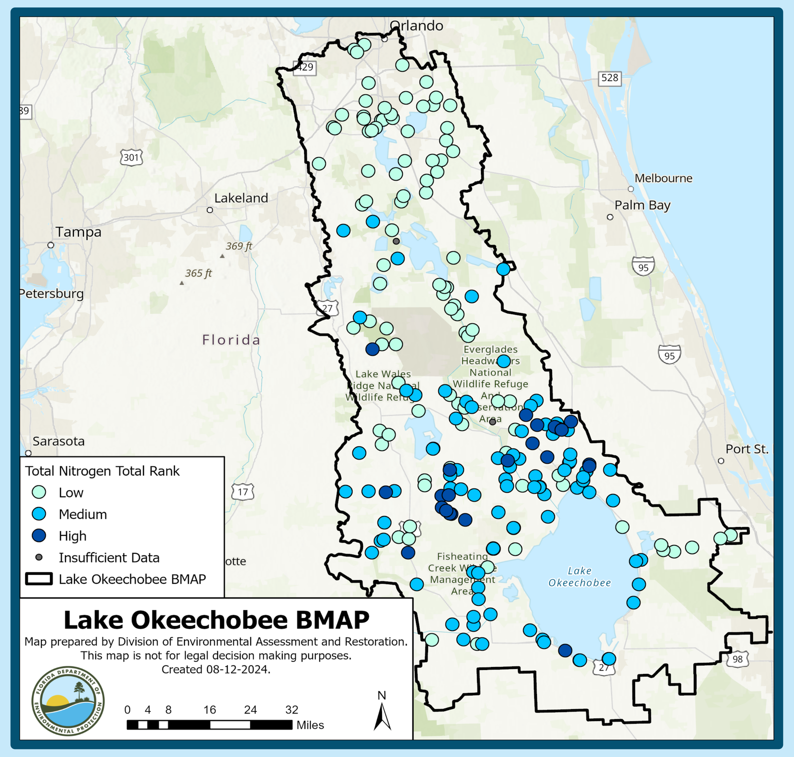

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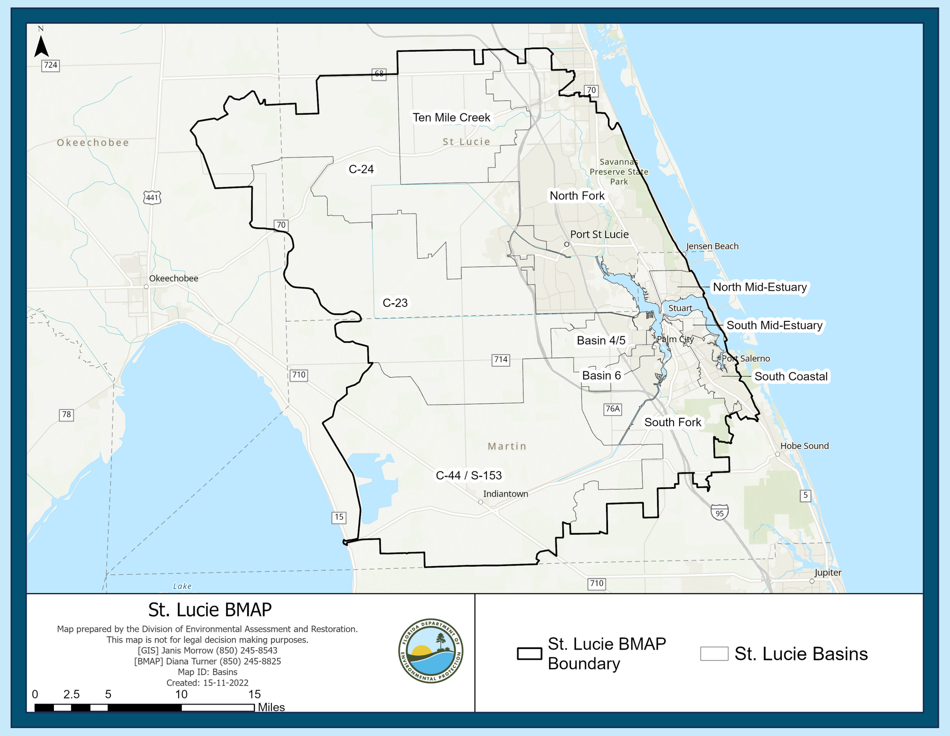
ST. LUCIE RIVER AND ESTUARY BASIN MANAGEMENT ACTION PLAN (BMAP)

WATER QUALITY ANALYSES

BMAP Background

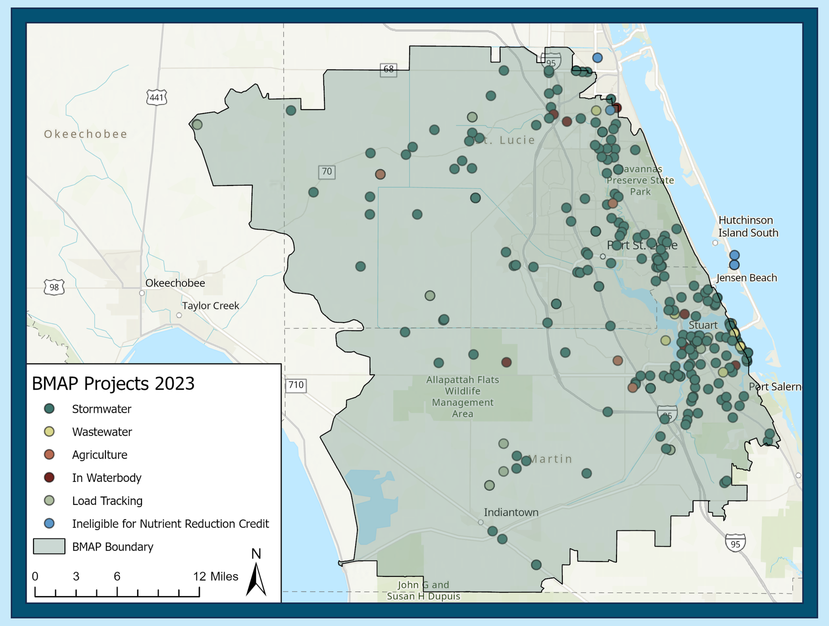


St. Lucie Total Nitrogen (TN) and Total Phosphorus (TP) Total Maximum Daily Loads (TMDLs) were established in 2009:

TP: 0.081 mg/L.
TN: 0.72 mg/L.
mg/L = milligrams per liter.

BMAP established in 2013, and the boundary was updated in 2020.

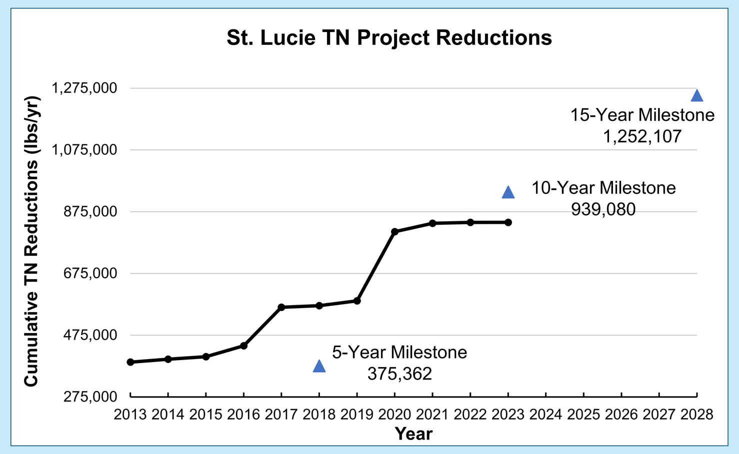
Statewide Annual Report (STAR) 2023

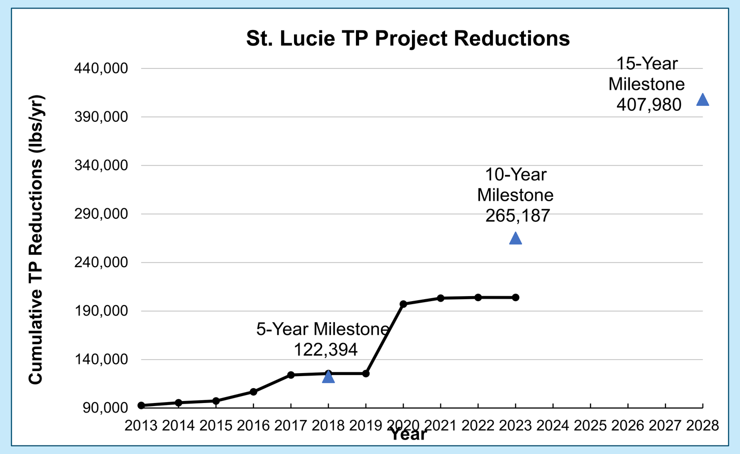


Entity	Completed	Ongoing	Planned	Underway	Total
City of Fort Pierce	9	4	0	0	13
City of Port St. Lucie	26	4	0	4	34
City of Stuart	21	3	0	1	25
FDACS/Agriculture	12	8	0	0	20
FDOT District 4	60	2	0	0	62
Fort Pierce Utilities Authority	0	0	1	5	6
Hobe St. Lucie Conservancy District	1	0	1	0	2
Martin County	40	3	1	3	47
North St. Lucie River WCD	11	0	0	0	11
SFWMD - Coordinating Agency	8	0	1	1	10
St. Lucie County	9	9	4	4	26
St. Lucie West Services District	2	3	0	0	5
Town of Sewall's Point	30	2	2	3	37
Troup-Indiantown WCD	2	0	0	2	4
Turnpike Enterprise	3	2	0	0	5
Tradition CDD	0	0	1	2	3
Total	**234**	**40**	**11**	**25**	**310**

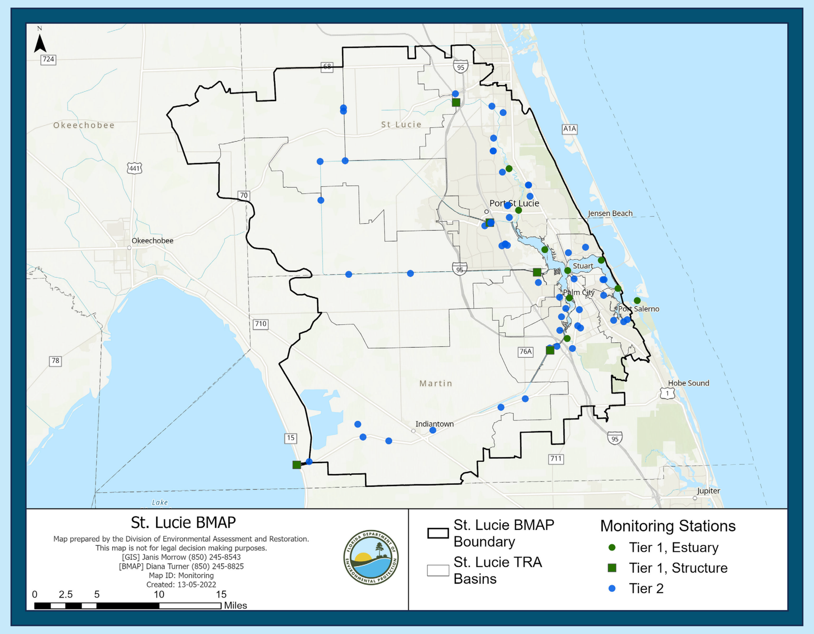
310 projects in the BMAP address both stormwater and wastewater sources of pollution.

Completed and ongoing projects have achieved 67% of the TN and 50 percent of the TP required reductions.





Water Quality Monitoring Network



Water Quality Parameters Monitored	
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Ammonia (N)	Total Kjeldahl Nitrogen (TKN)
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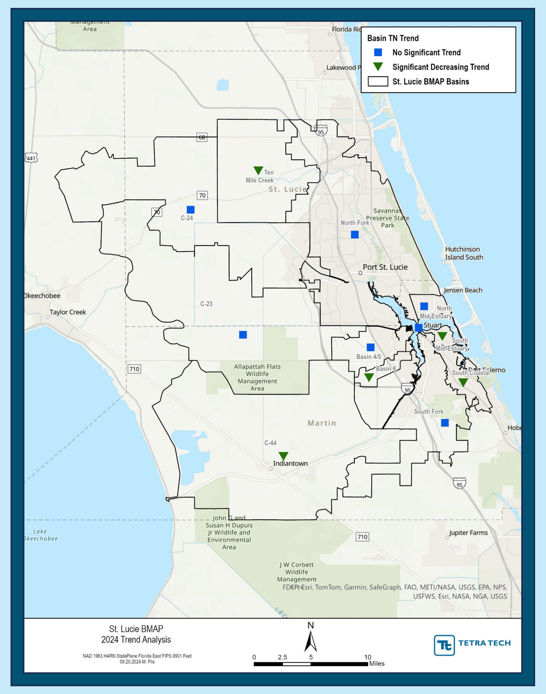
Total Carbon	pH
Chlorophyll-*a*	Total Phosphorus (TP)
Color	Specific Conductance/Salinity
Dissolved Oxygen	Temperature
Dissolved Oxygen (Saturation)	Total Suspended Solids
Flow	Turbidity

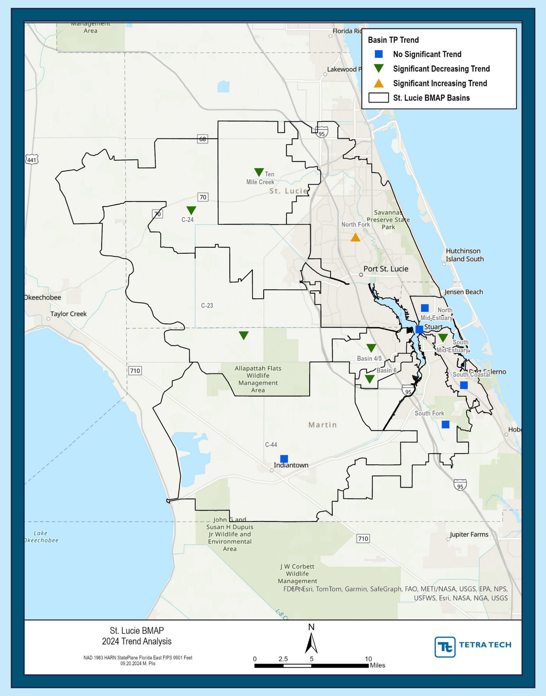
Water quality is monitored at 69 stations throughout the watershed.

Water Quality Trend Analyses

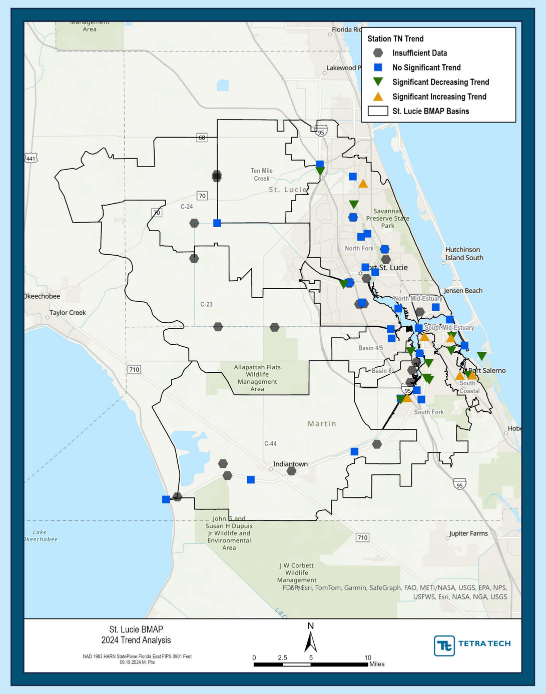
Seasonal Kendall trend analysis investigates trends in TN and TP concentrations for the basins and for the BMAP monitoring network stations.

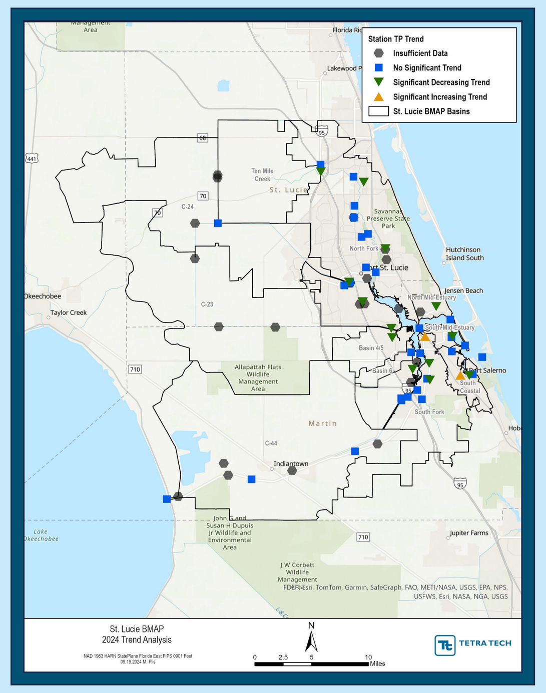
Basin Trends



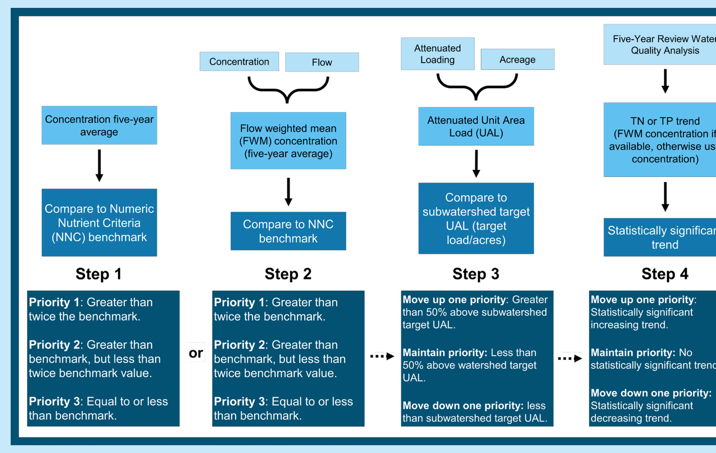


Station Trends





Targeted Restoration Area Evaluation



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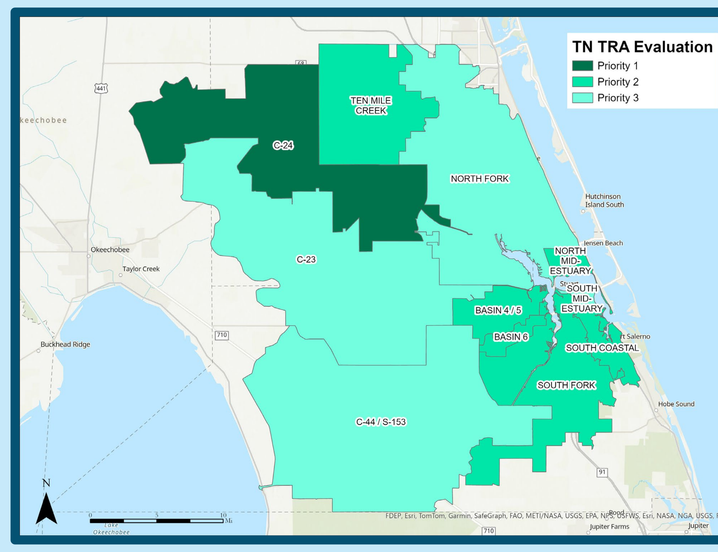

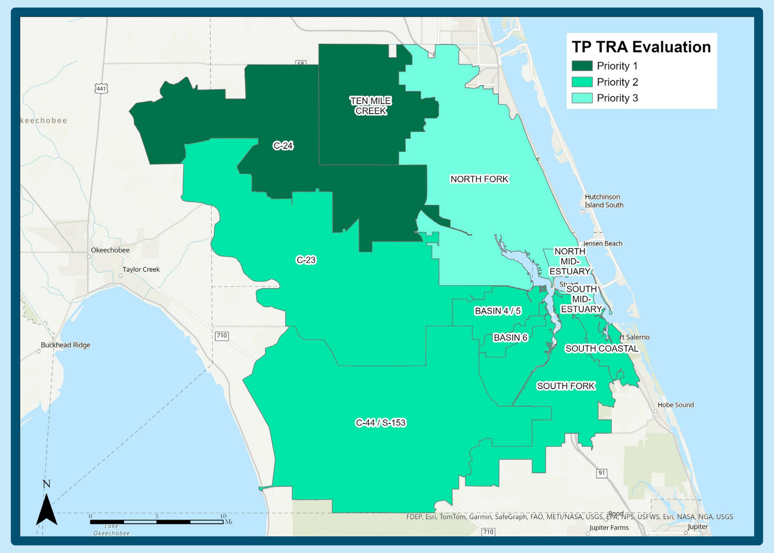

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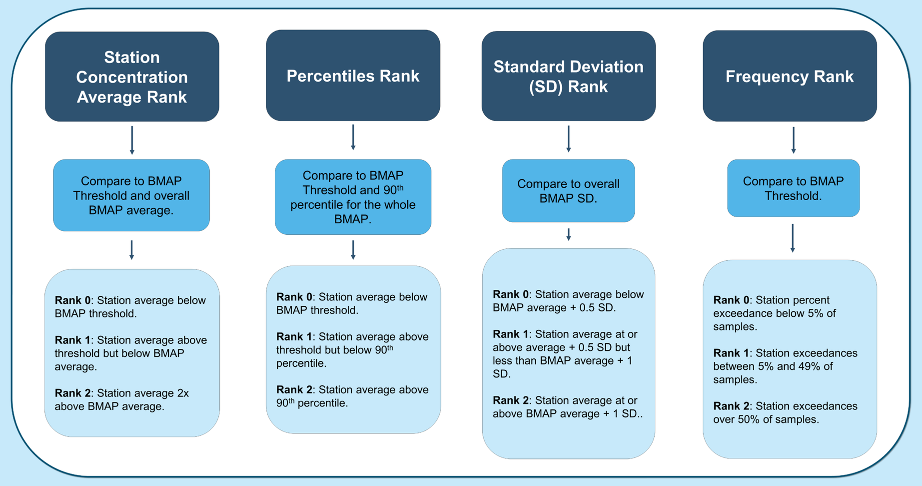

Average Rank + Percentile Rank + SD Rank + Frequency Rank = Total Index Rank

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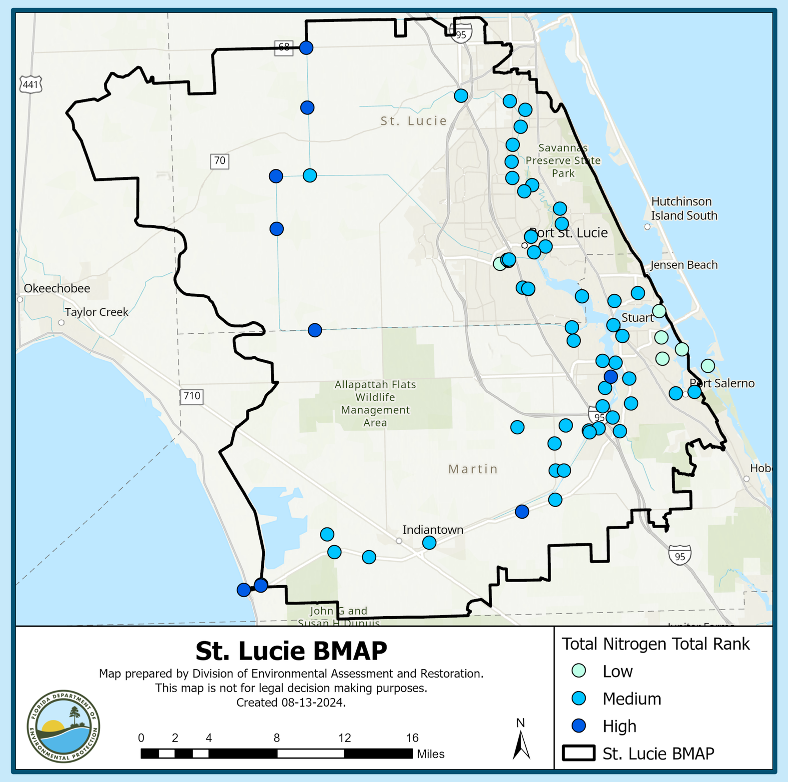

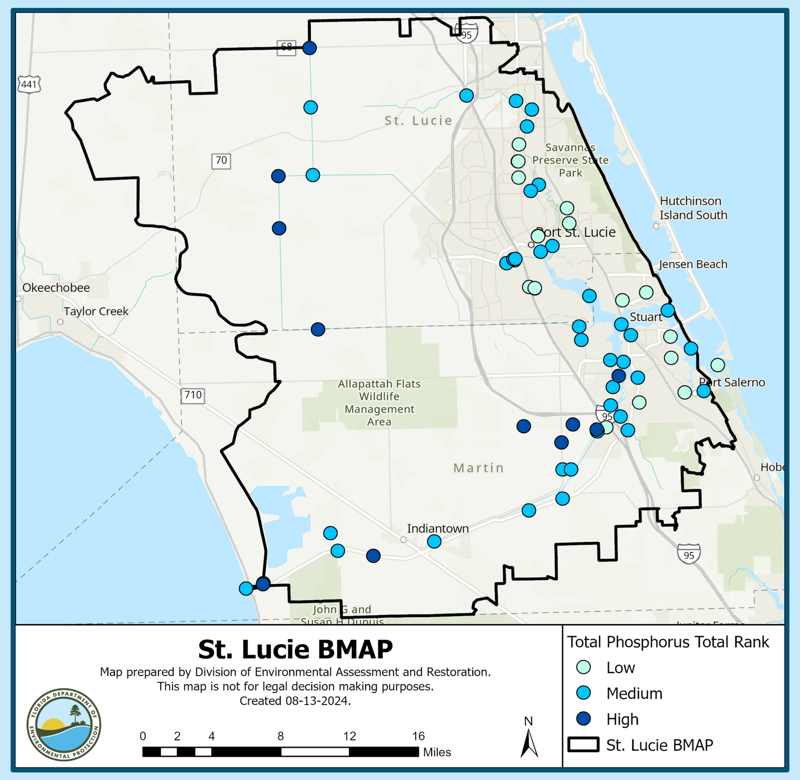

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BASIN MANAGEMENT ACTION PLANS (BMAPS)

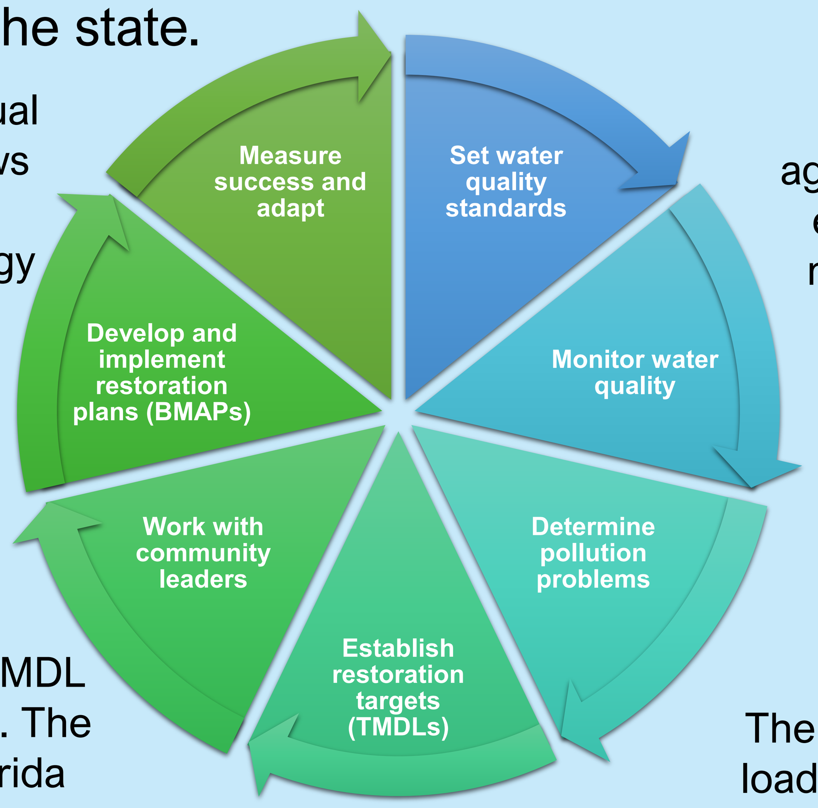
SOUTH FLORIDA BMAPS

Water Quality Restoration Cycle

The Florida Department of Environmental Protection's (DEP) Division of Environmental Assessment and Restoration (DEAR) monitors and assesses Florida's surface water and groundwater quality across the state.

The Statewide Annual Report (STAR) shows project and management strategy implementation progress made in BMAPs.

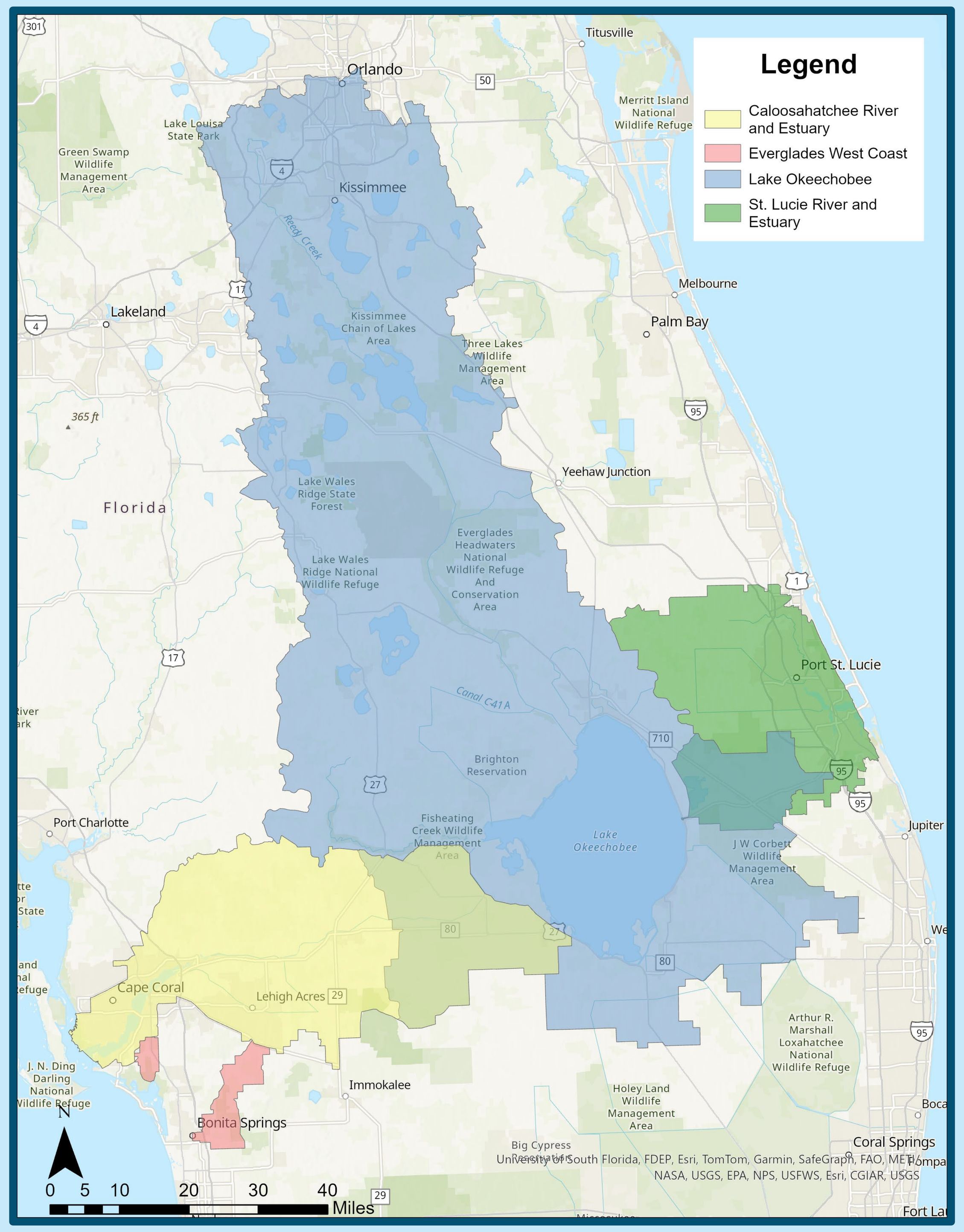
DEP and partner agencies maintain and expand water quality monitoring networks.



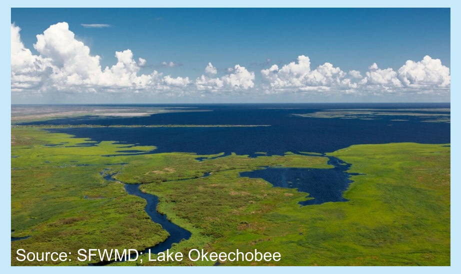
BMAPs address a TMDL for a given pollutant. The BMAPs in south Florida target nitrogen and phosphorus.

The total maximum daily load (TMDL) is the water quality target

South Florida BMAPs




Source: SFWMD; Caloosahatchee River


Source: SFWMD; Lake Okeechobee


Source: SFWMD; St. Lucie Estuary


Source: DEP; Hendry Creek

Statutory Requirements

Authority and responsibility comes from several Florida Statutes (F.S.), with some highlights described below:

Florida Watershed Restoration Act (Section 403.067, F.S)
- Cooperative implementation of plans to restore our waters, known as BMAPs.

Northern Everglades and Estuaries Protection Program (Section 373.4595, F.S.)
- Strengthens provisions for implementing the Lake Okeechobee, Caloosahatchee and St. Lucie BMAPs.
- Clarifies the roles and responsibilities, coordination, implementation and reporting efforts among DEP, Florida Department of Agriculture and Consumer Services (DACS) and South Florida Water Management District (SFWMD).
- Includes five-, 10- and 15-year measurable milestones and targets to achieve the TMDLs addressed by the BMAPs. If achieving the TMDL within 20 years is not practicable, the implementation plan must include an explanation of the constraints that prevent achievement, an estimate of the time needed to achieve the TMDL, and additional five-year measurable milestones.

Clean Waterways Act (2020)
- Promotes resilient wastewater infrastructure and utilities and looks at future growth.
- Requires local governments within a BMAP to develop wastewater treatment plans and/or onsite sewage treatment and disposal system (OSTDS) remediation plans to be incorporated into BMAP updates.

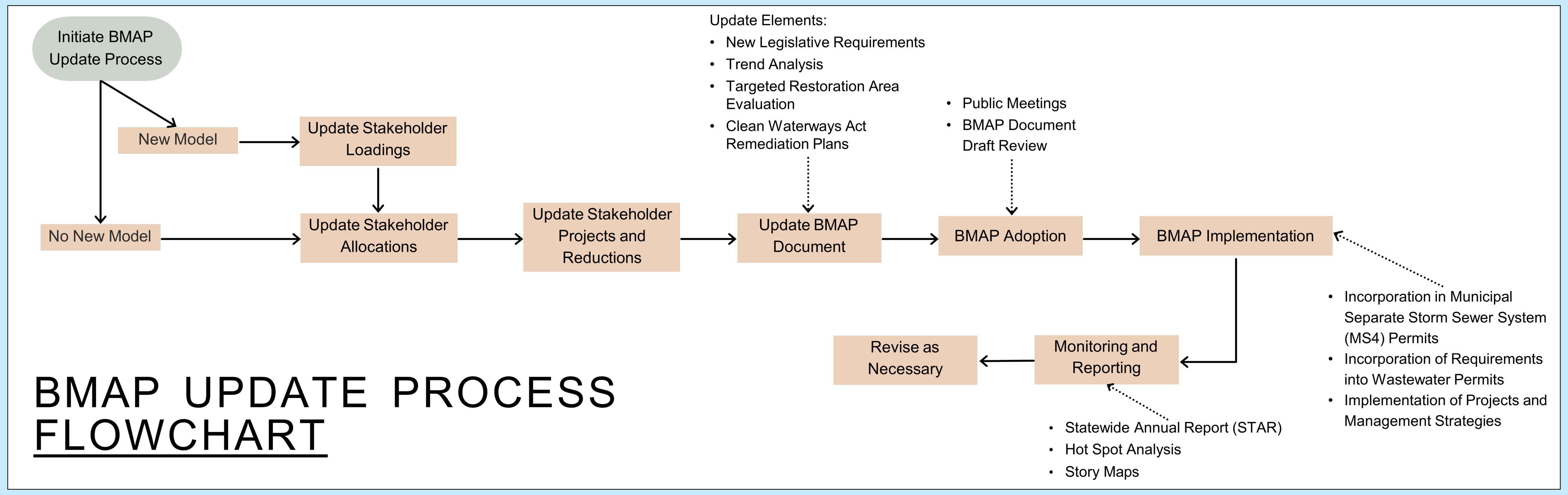
House Bill 1379 (2023)
- Requires BMAPs be assessed and updated every five years as needed to include implementation milestones and other requirements.
- Requires a list of projects and strategies that will achieve the five-year implementation milestones to meet TMDLs, as well as agricultural cooperative regional water quality improvement elements.
- Requires facilities discharging to a waterbody impaired for nutrients or subject to a BMAP or reasonable assurance plan (RAP) area to upgrade to advanced wastewater treatment (AWT) within 10 years.
- Requires applicants for new septic systems serving lots of 1 acre or less within BMAPs and RAPs must connect to central sewer if available, or if unavailable, to install an enhanced nutrient-reducing system or other wastewater system that achieves 65% reduction.
- Requires local governments to include BMAP projects in their comprehensive plans so these projects can be prioritized to achieve restoration benefits.
- Expands grant opportunities to accelerate project implementation.

House Bill 1557 (2024)
- Requires advanced treatment of reclaimed water within BMAPs.
- Requires facilities (including private) to provide information to local entities developing domestic wastewater treatment plans and OSTDS remediation plans within BMAP or other restoration areas.

BMAP Update Process

What is a Basin Management Action Plan?
- A BMAP is a framework for water quality restoration that contains a comprehensive set of solutions to achieve the pollutant reductions established by a TMDL.
- A BMAP is developed with local stakeholders and relies on local input and commitment for successful implementation.
- BMAPs are adopted by Secretarial Order and are legally enforceable.
- BMAPs use an adaptive management approach that allows for incremental load reductions through the implementation of projects and management strategies, while simultaneously monitoring and conducting studies to better understand the water quality and hydrologic dynamics.

Key Elements of a BMAP:
- TMDL(s) being addressed. These are the restoration targets.
- Physical description of the waterbody and contributing area.
- Description of the monitoring network and water quality.
- Identification of pollutant sources.
- Identification of responsible stakeholders.
- List of projects and strategies to reduce loading.
- Applicable legal requirements.



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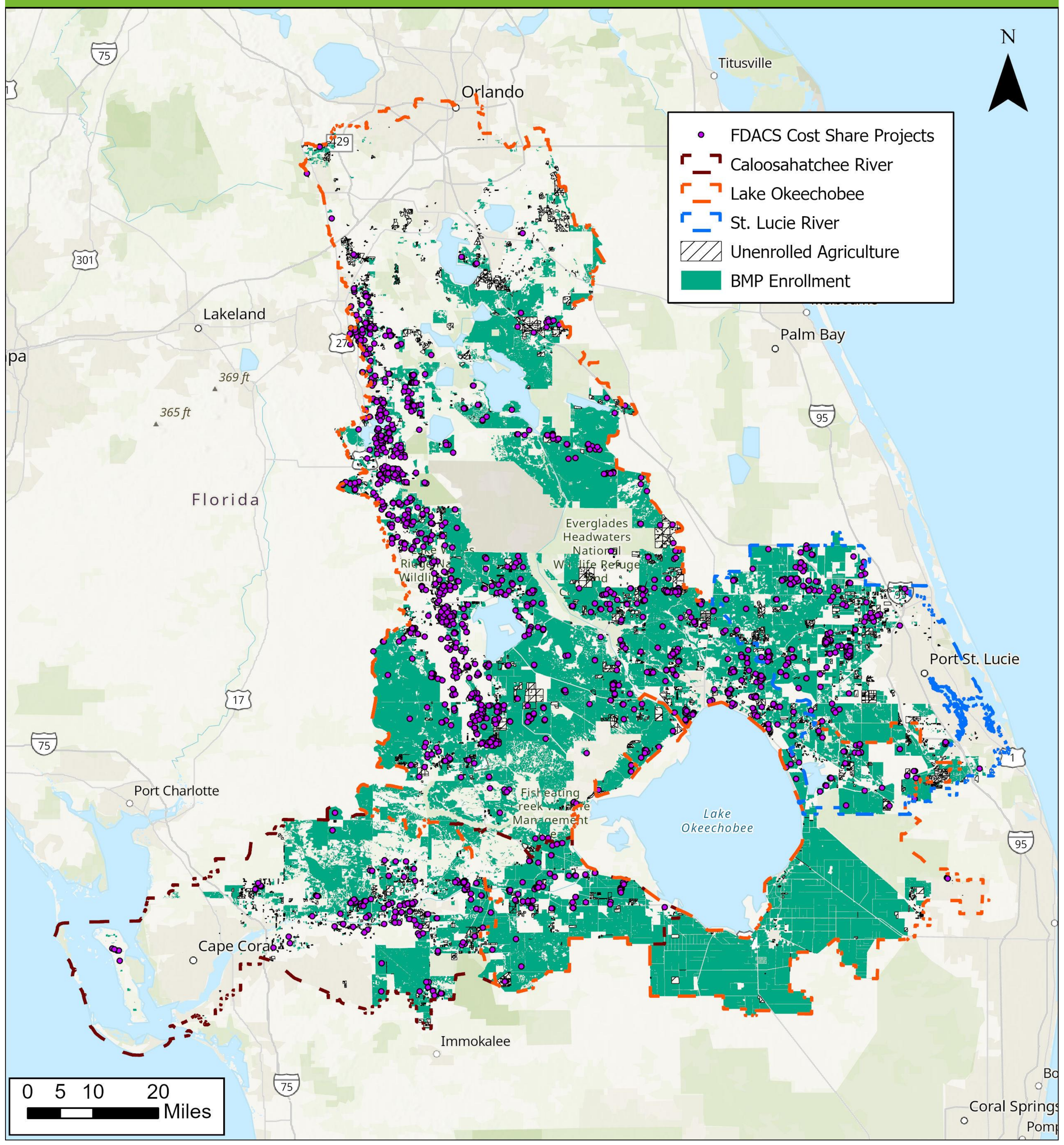
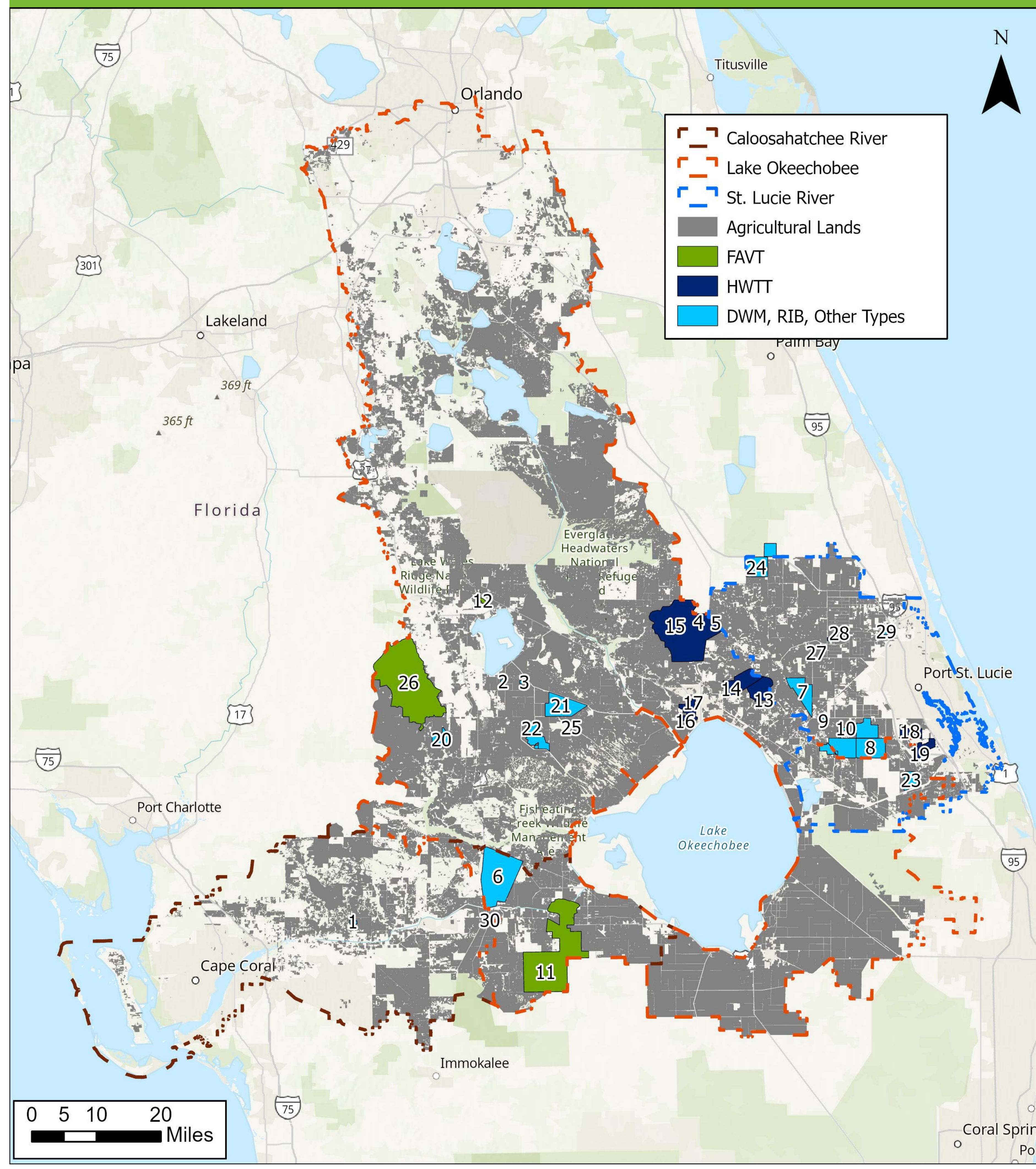
Agricultural Progress in the Northern Everglades Estuary Protection Program (NEEPP)

Enrolled Agriculture and Cost Share



Projects



Floating Aquatic Vegetative Tillage (FAVT)

- Arbuckle Creek (12)
- East Caloosahatchee (11)
- Fisheating Creek (26)

Hybrid Wetland Treatment Train (HWTT)

- Bessey Creek (18)
- Danforth Creek (19)
- Grassy Island (15)
- Ideal Holding (27)
- Lemkin Creek (16)/Wolff Ditch (17)
- Nubbin Slough (13)
- Mosquito Creek (14)

Other Projects

- McArthur Farms Barn 1 (5)
- McArthur Farms Barn 4 (4)
- Turkey Branch (6)
- American Forest Management (30)

Coordinating Agency Projects

- Allapattah Flats Parcels A and B (8)
- Bluefield Grove Water Farm (7)
- Brighton Valley DWM (21)
- Buck Island Ranch (22)
- Bull Hammock Ranch DWM (10)
- Caulkins Water Farm (23)
- Four Corners Rapid Infiltration Basin (1)
- IMWID Phase I (2)
- IMWID Phase II (3)
- Indian River Lagoon South (28)
- Lykes West Water Hold (25)
- Scott Water Farm (24)
- Spur Land and Cattle Water Farm (9)
- Ten Mile Creek (29)
- XL Ranch (20)

Agricultural Requirements in NEEPP BMAPs

- Enroll in and implement the applicable Best Management Practices (BMPs) identified for an operation

OR

- Perform water quality monitoring at the producer's own expense

- FDACS must perform an Implementation Verification (IV) site visit at least every 2 years
- IV site visit includes review and collection of certain records

Ag BMP Program Metrics

Enrollment Metrics

Ag Acres	Enrolled Ag Acres	Percent Enrolled
2,621,387	2,175,758	83%

Cost Share Project Counts by Type

Nutrient Management	Irrigation Management	Water Resource Protection
505	618	837

* Includes acreages addressed by other FDACS programs

FDACS NEEPP Contacts

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Matt Warren – Environmental Administrator
Field Services
Matt.Warren@fdacs.gov

Interested in learning more about the Office of Agricultural Water Policy?

Use the QR code to visit our website!

Agricultural Progress in the Lake Okeechobee BMAP

Agricultural Requirements in Adopted BMAPs

- Enroll in and implement the applicable Best Management Practices (BMPs) identified for an operation

OR

- Perform water quality monitoring at the producer's own expense

- FDACS must perform an Implementation Verification (IV) site visit at least every 2 years
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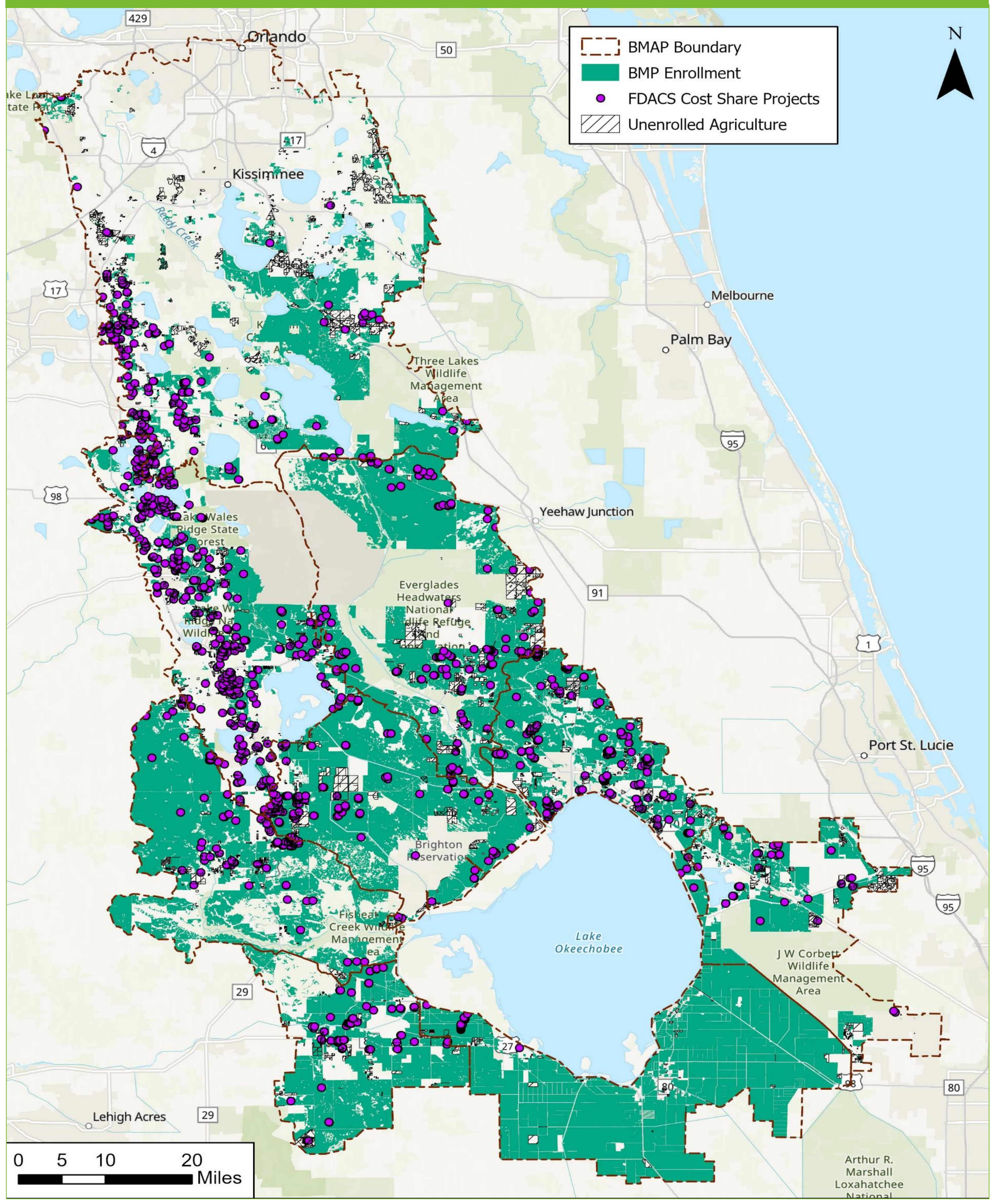
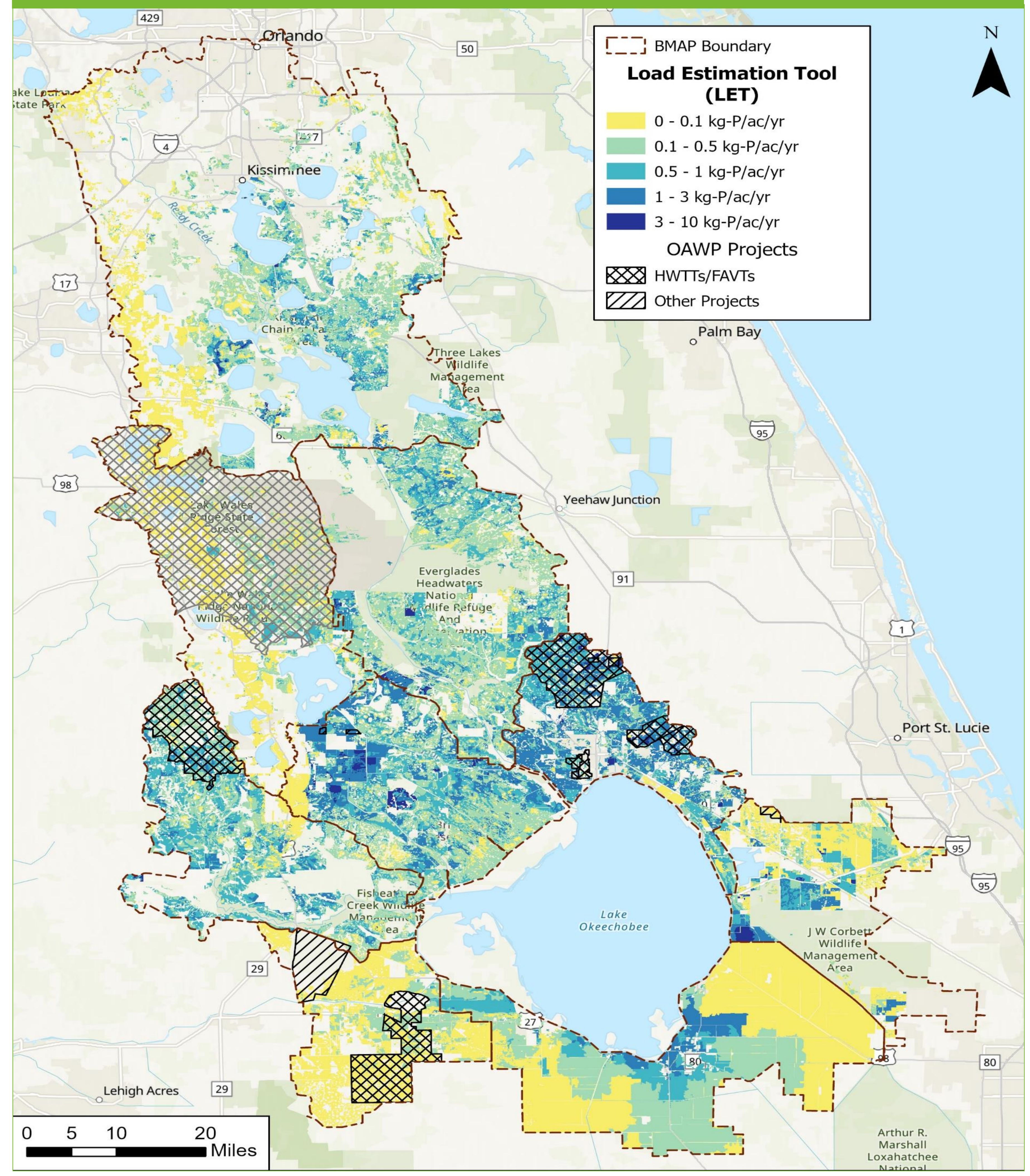
Enrolled Agriculture and Cost Share



Estimated TP Loading from Ag Lands



Progress Toward Milestones

Reductions Achieved (lbs-P/yr)

Enrollment	FDACS Cost Share	Other Projects
76,457	59,402	29,226

Milestone Progress

Next Milestone	Reductions Achieved (lbs-P/yr)	Progress Toward Milestone
TBD	165,085	TBD

Ag BMP Program Metrics

Enrollment Metrics

Ag Acres	Enrolled Ag Acres	Unlikely Enrollable Ag Acres*
1,822,331	1,519,525	91,250

Cost Share Project Counts by Type

Nutrient Management	Irrigation Management	Water Resource Protection
448	480	569

* Includes acreages addressed by other FDACS programs

FDACS BMAP Contacts

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BMAP / Water Supply
Jennifer.Thera@fdacs.gov

Matt Warren – Environmental Administrator
Field Services
Matt.Warren@fdacs.gov

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Agricultural Progress in the St. Lucie BMAP

Agricultural Requirements in Adopted BMAPs

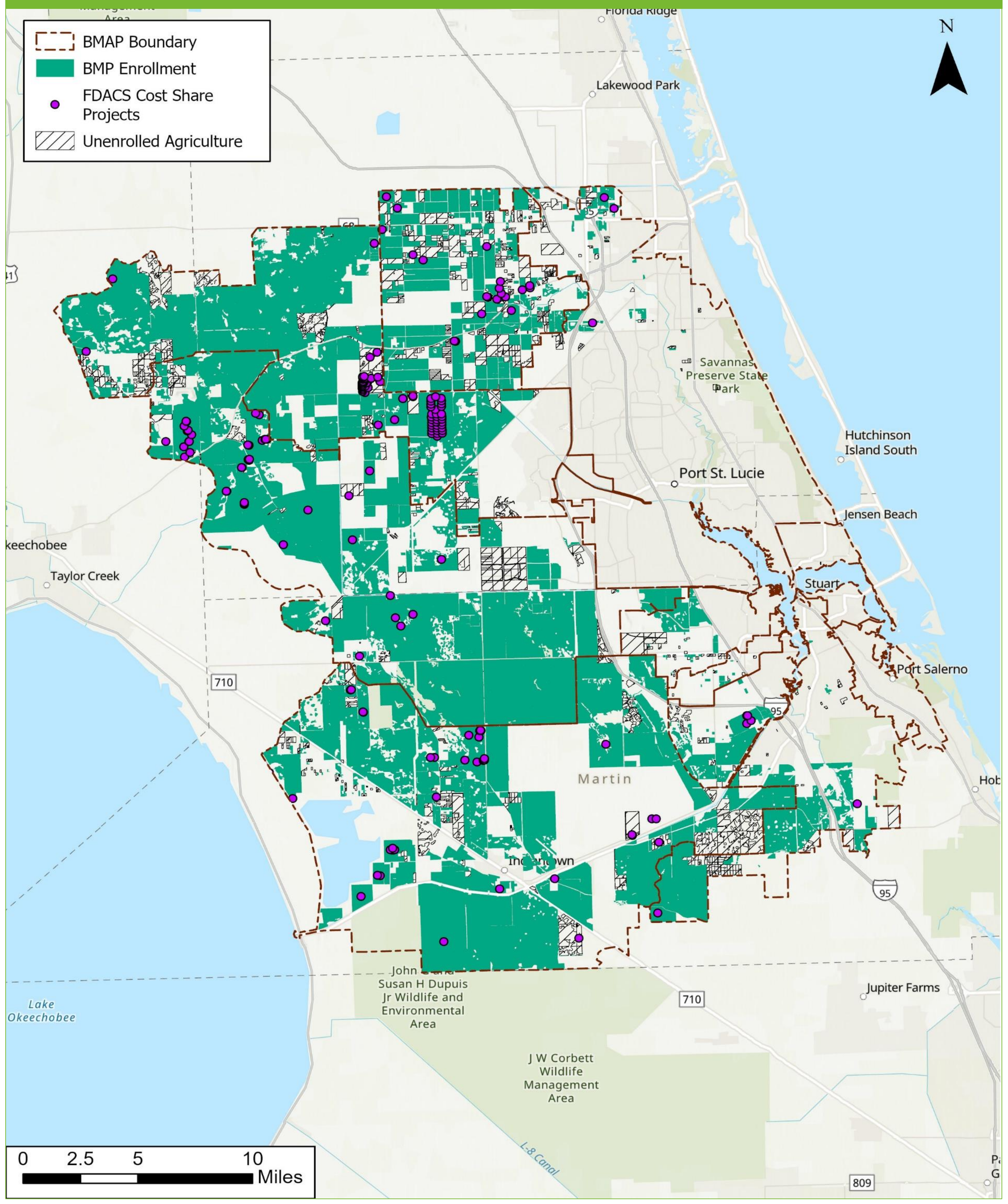
- Enroll in and implement the applicable Best Management Practices (BMPs) identified for an operation

OR

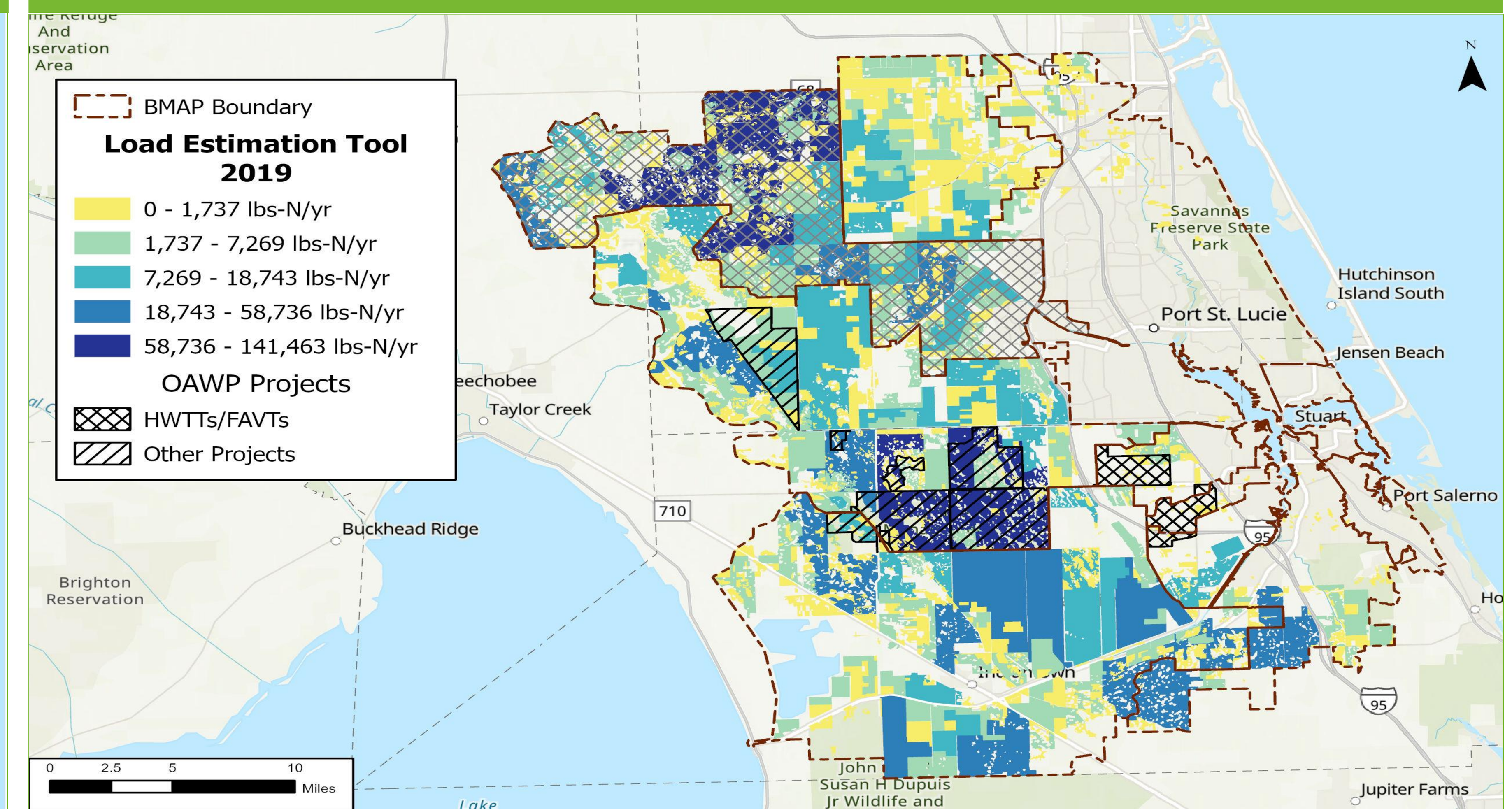
- Perform water quality monitoring at the producer's own expense

- FDACS must perform an Implementation Verification (IV) site visit at least every 2 years
- IV site visit includes review and collection of certain records

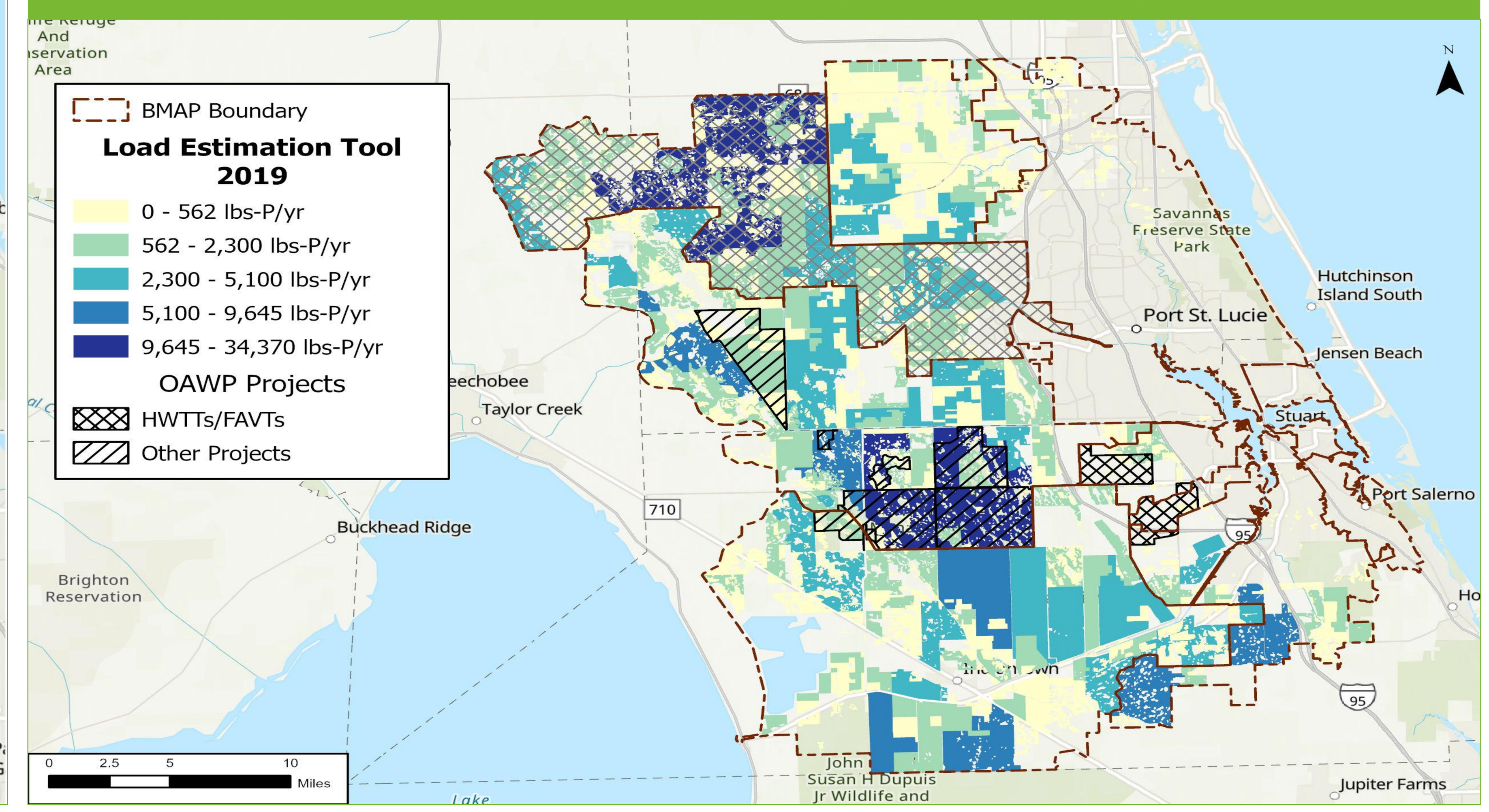
Enrolled Agriculture and Cost Share



Estimated TN Loading from Ag Lands



Estimated TP Loading from Ag Lands



Progress Toward Milestones

Reductions Achieved (lbs/yr)

	Enrollment	FDACS Cost Share	Other Projects
TN	224,508	126,992	15,795
TP	38,989	37,940	12,652

Milestone Progress

	2028 Milestone	Reductions Achieved (lbs/yr)	Progress Toward Milestone
TN	100%	367,295	41%
TP	100%	89,581	31%

Ag BMP Program Metrics

Enrollment Metrics

Ag Acres	Enrolled Ag Acres	Unlikely Enrollable Ag Acres*
281,480	215,955	27,317

Cost Share Project Counts by Type

Nutrient Management	Irrigation Management	Water Resource Protection
19	32	148

* Includes acreages addressed by other FDACS programs

FDACS BMAP Contacts

Jennifer Thera – Environmental Consultant
BMAP / Water Supply
Jennifer.Thera@fdacs.gov

Matt Warren – Environmental Administrator
Field Services
Matt.Warren@fdacs.gov

Interested in learning more about the Office of Agricultural Water Policy?

Use the QR code to visit our website!

Agricultural Progress in the Caloosahatchee BMAP

Agricultural Requirements in Adopted BMAPs

- Enroll in and implement the applicable Best Management Practices (BMPs) identified for an operation

OR

- Perform water quality monitoring at the producer's own expense

- FDACS must perform an Implementation Verification (IV) site visit at least every 2 years
- IV site visit includes review and collection of certain records

FDACS BMAP Contacts

Jennifer Thera – Environmental Consultant
BMAP / Water Supply
Jennifer.Thera@fdacs.gov

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Field Services
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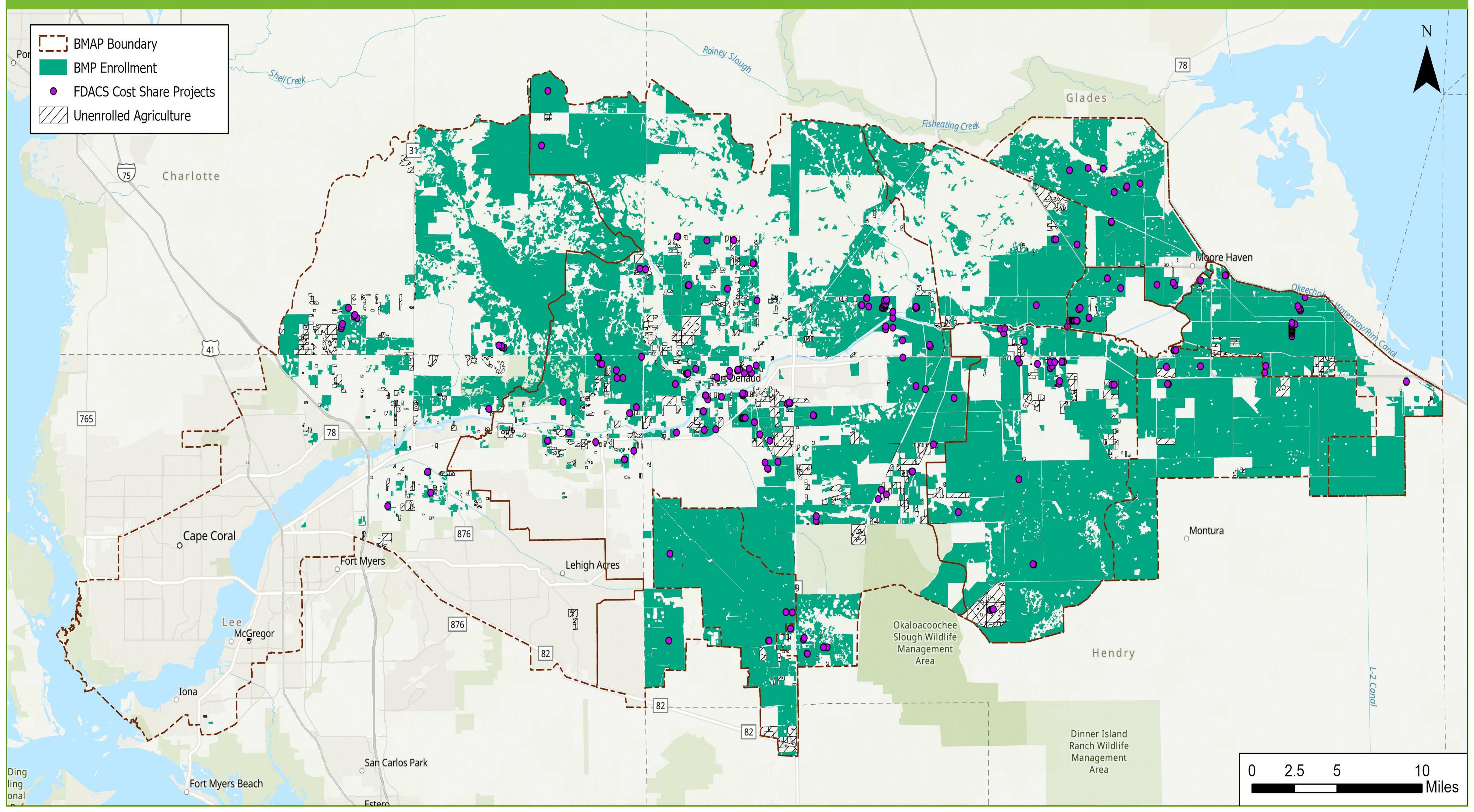
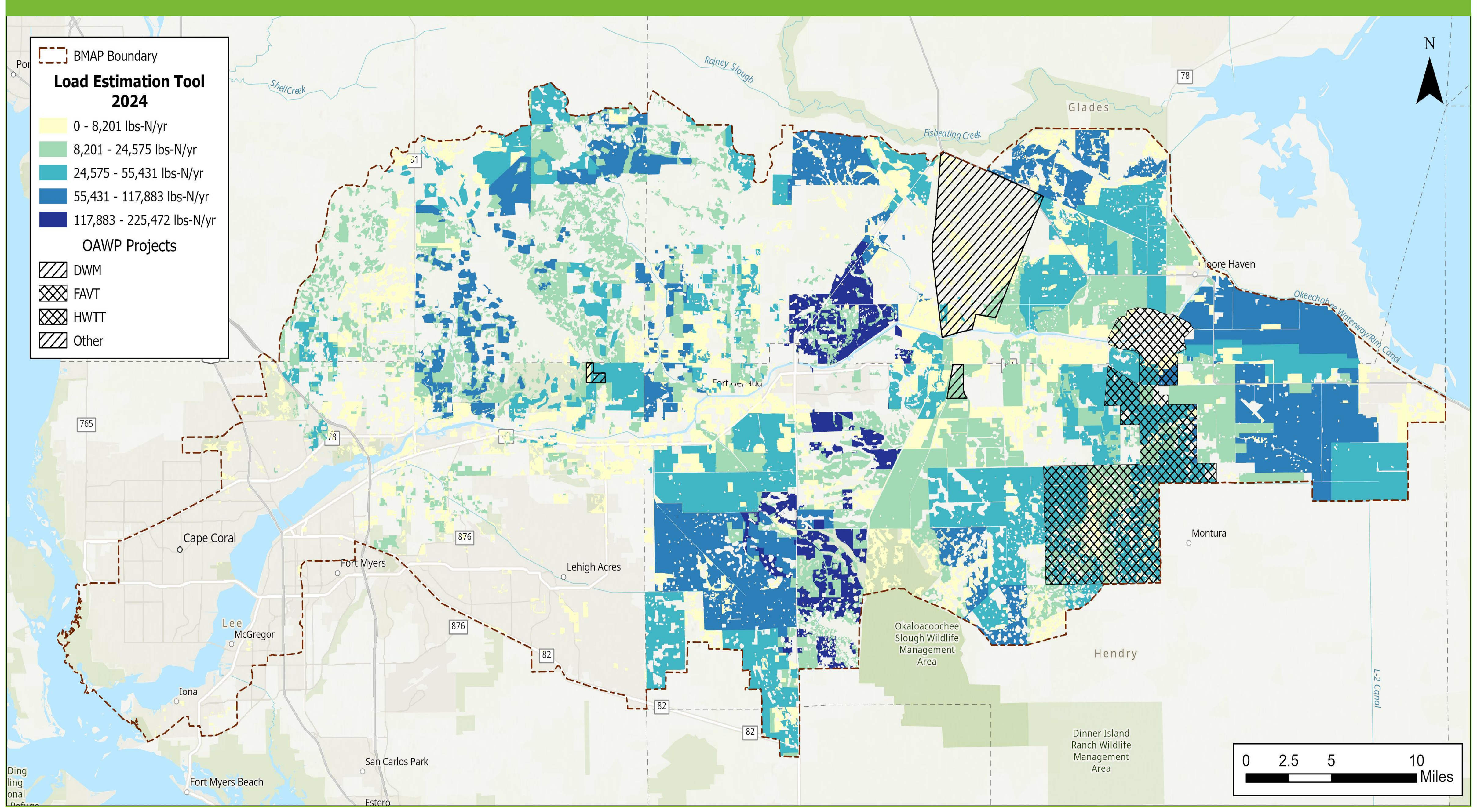
Enrolled Agriculture and Cost Share



Estimated TN Loading from Ag Lands



Ag BMP Program Metrics

Enrollment Metrics

Ag Acres	Enrolled Ag Acres	Unlikely Enrollable Ag Acres*
589,204	515,438	31,385

* Includes acreages addressed by other FDACS programs

Cost Share Project Counts by Type

Nutrient Management	Irrigation Management	Water Resource Protection
79	121	172

Progress Toward Milestones

Reductions Achieved- Tidal (lbs-N/yr)

Enrollment	FDACS Cost Share	Other Projects
54,817	17,746	TBD

Reductions Achieved – East & West (lbs-N/yr)

Enrollment	FDACS Cost Share	Other Projects
424,803	277,459	TBD

Milestone Progress - Tidal

2027 Milestone	Reductions Achieved (lbs-N/yr)	Progress Toward Milestone
198,236	72,563	37%

Milestone Progress – East & West

2030 Milestone	Reductions Achieved (lbs-N/yr)	Progress Toward Milestone
475,441	702,262	100%

Milestone Progress - Tributaries

2030 Milestone	Reductions Achieved (lbs-P/yr)	Progress Toward Milestone
7,984	13,019	100%

Agricultural Cooperative Regional Water Quality Elements (ACE)

What is an ACE?

- New BMAP requirement (2023)
  - Section 403.067(7)(e), F.S.
- Requires FDEP & FDACS to work cooperatively with agricultural producers to develop regional projects in certain BMAPs
- Next Steps:
  - Host basin-specific meetings with agricultural producers
  - Solicit potential project ideas

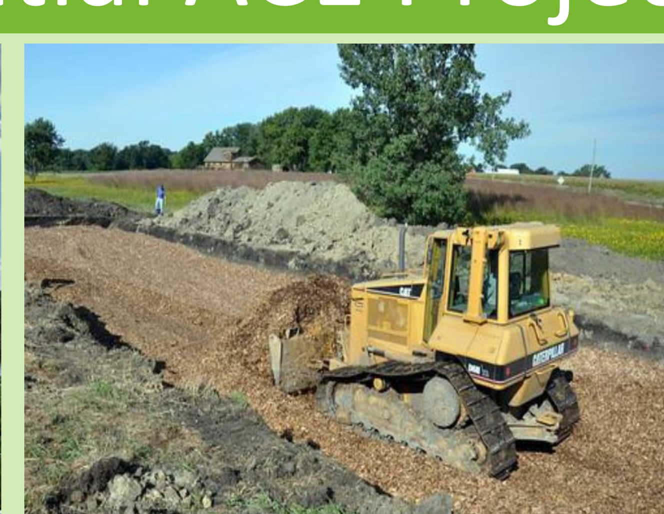
Proposed ACE Process

ACE Need Identified in BMAP → Assessment of Agriculture within BMAP → Meet with Stakeholders (producers, industry) → Identify Applicable Project Criteria (e.g., springs vs. surface waters)

→ Project Solicitation Based on Applicable Criteria → Determine Cost and Nutrient Reduction Estimates for Each Project → Cooperative Review of Submitted Projects and Estimated Impacts

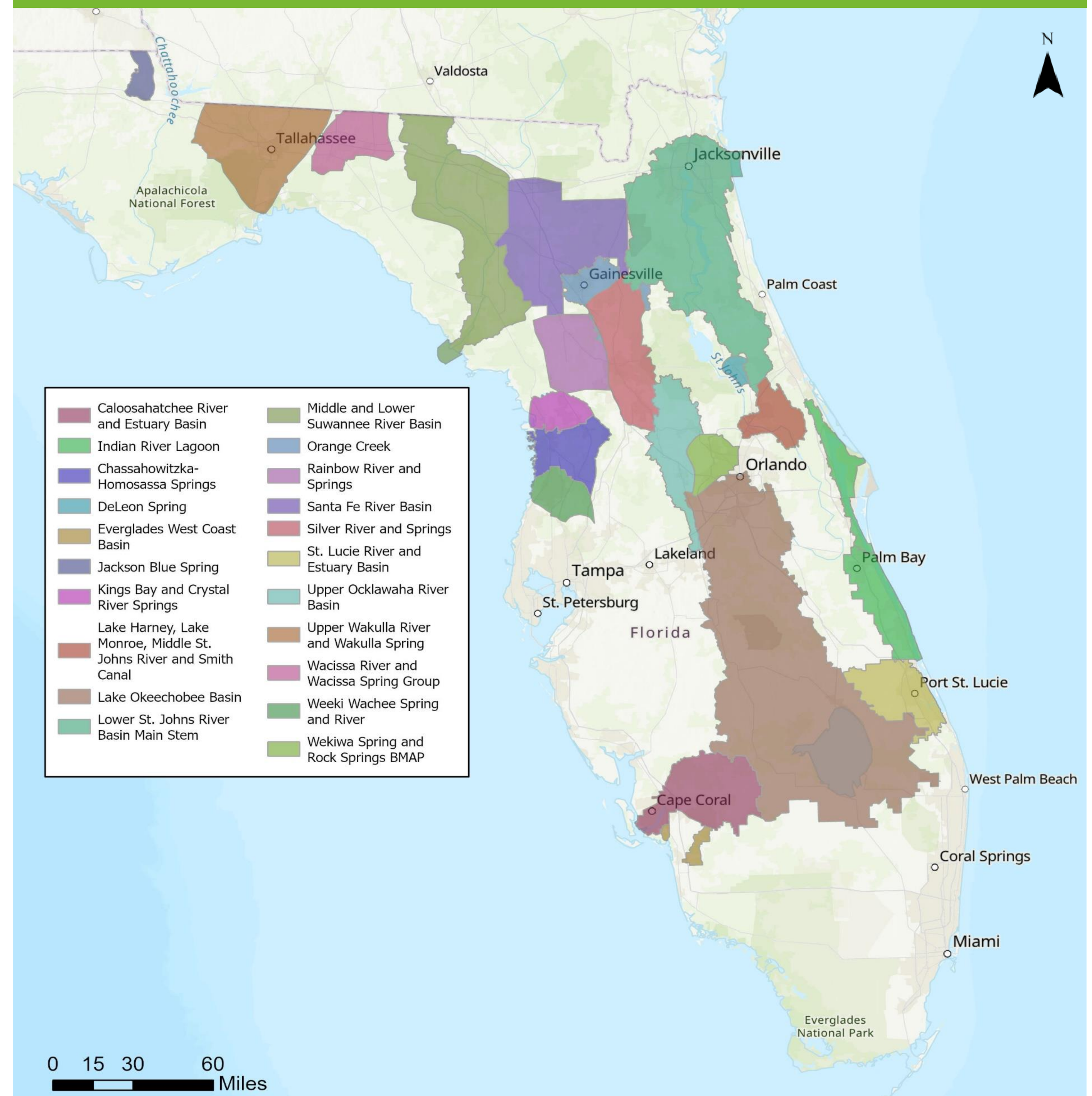
→ Project Implementation → Monitoring and Assessment → Project Modifications or Solicit Additional Projects (As Needed)

Examples of Potential ACE Projects


Regional Water Treatment – Nutrient Capture – Suites of BMPs

BMAPs Identified for ACE Development



Have a Project Idea?

FDACS Contact:

Madeline Hart

Madeline.Hart@fdacs.gov

(850) 617-1732

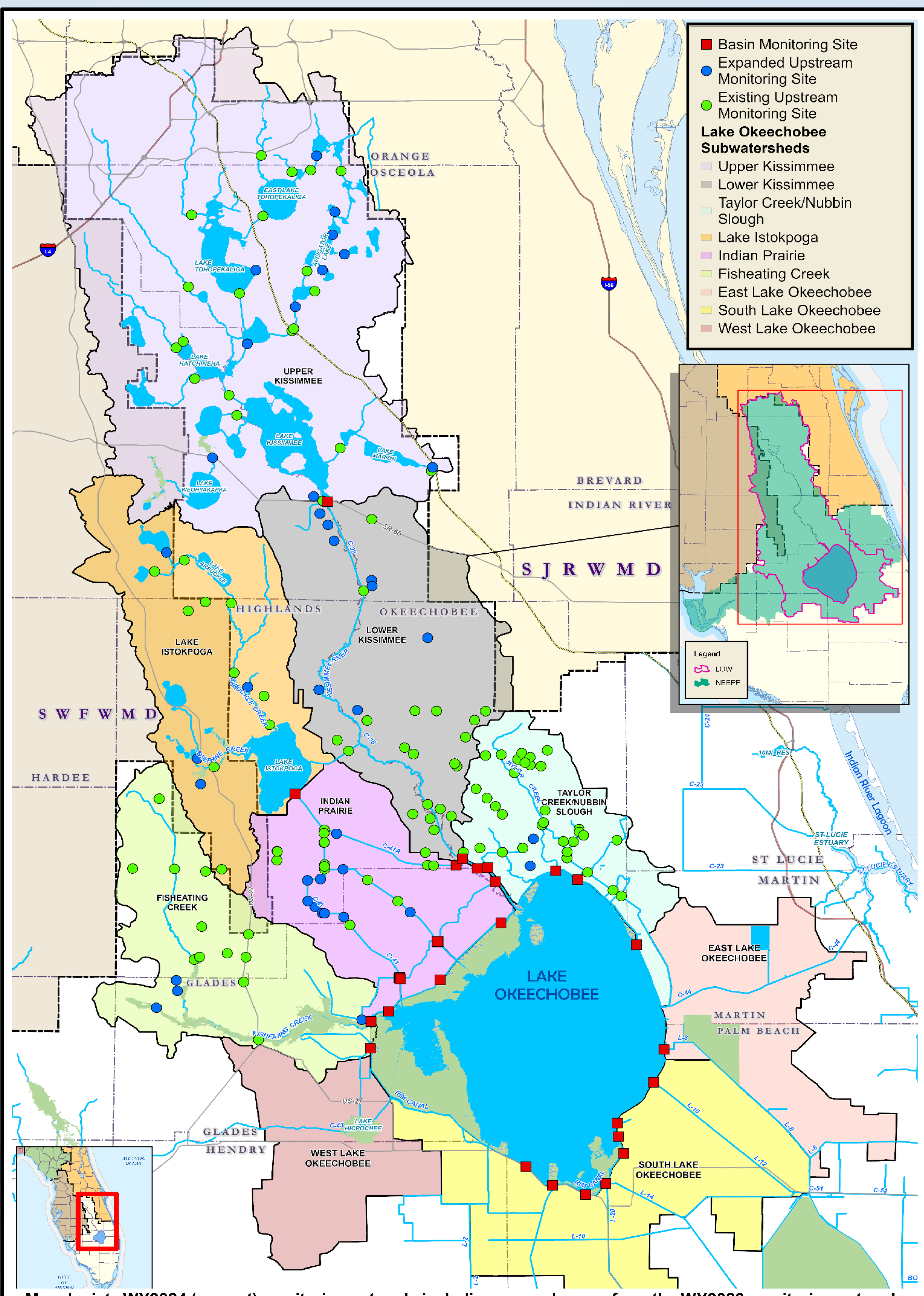
Scan the QR code to learn more about the Office of Agricultural Water Policy

Appendix 8B-1: Water Year 2023 Lake Okeechobee Watershed Upstream Monitoring

Steffany Olson, Alyssa O'Neill, Carolina Hernandez Burgos
Project Operations & Assessment Section, Everglades & Estuaries Protection Bureau

Purpose of Upstream Monitoring: ➢Highlight Areas of Concern ➢Prioritize Resources ➢Track Progress

Water Quality Monitoring Network



Map depicts WY2024 (current) monitoring network, including some changes from the WY2023 monitoring network.

Acknowledgements: Thank you to the staff from the Okeechobee Water Quality Office and Analytical Services Section. Without their efforts these data would not exist. Additionally, the maps were produced by Allison Lamb, Madelyn Rinka, and Edwin Rios of the Geospatial Services Section.

Governing Board Expansion of Upstream Network

➢Fully implemented in WY2021
➢Increased:
- Number of sites
- Collection frequency to biweekly
- Number of parameters collected

Parameters	Definitions
TP	total phosphorus
OPO_4-P	orthophosphate
TN	total nitrogen
NH_3-N	ammonial nitrogen
NO_x-N	nitrate + nitrate
pH	potential of hydrogen
Temp	temperature
DO	dissolved oxygen
Conductivity	Measures the ability of water to pass an electrical current.

Monitoring Level	Total Sites
Basin	37
Upstream	150

Upstream Monitoring Plan	
Frequency	Biweekly when flowing (some weekly)
Parameters	TP, OPO_4-P, TN, NH_3-N, NO_x-N, pH, Temp, DO, Conductivity

WY2023 Upstream Monitoring Network Results

Focus on S-191 Basin

- WY2023 average TP at every site was > 120 µg/L (Florida Department of Environmental Protection numeric nutrient criteria).
- Six sites with 5-year annual average TP concentrations > 1,000 µg/L.
- Three sites with 5-year annual average TN concentrations > 10 mg/L.
- Had slightly above average rainfall for basin.

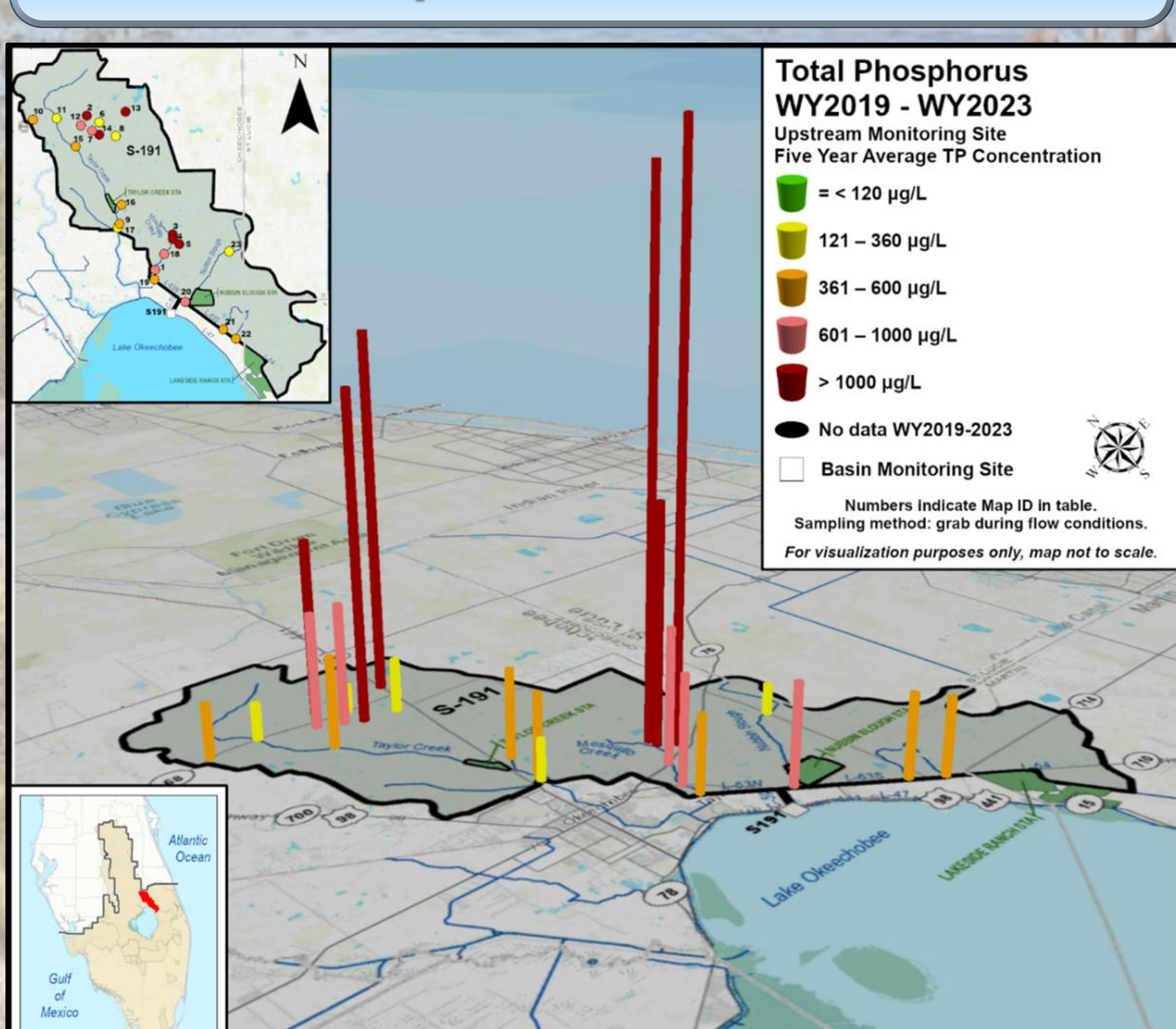
TCNS 207 Rapid Assessment

- There were four rapid assessment triggers when TN > 10 mg/L.
- Coordinating Agencies notified.
- SFWMD currently brainstorming projects.

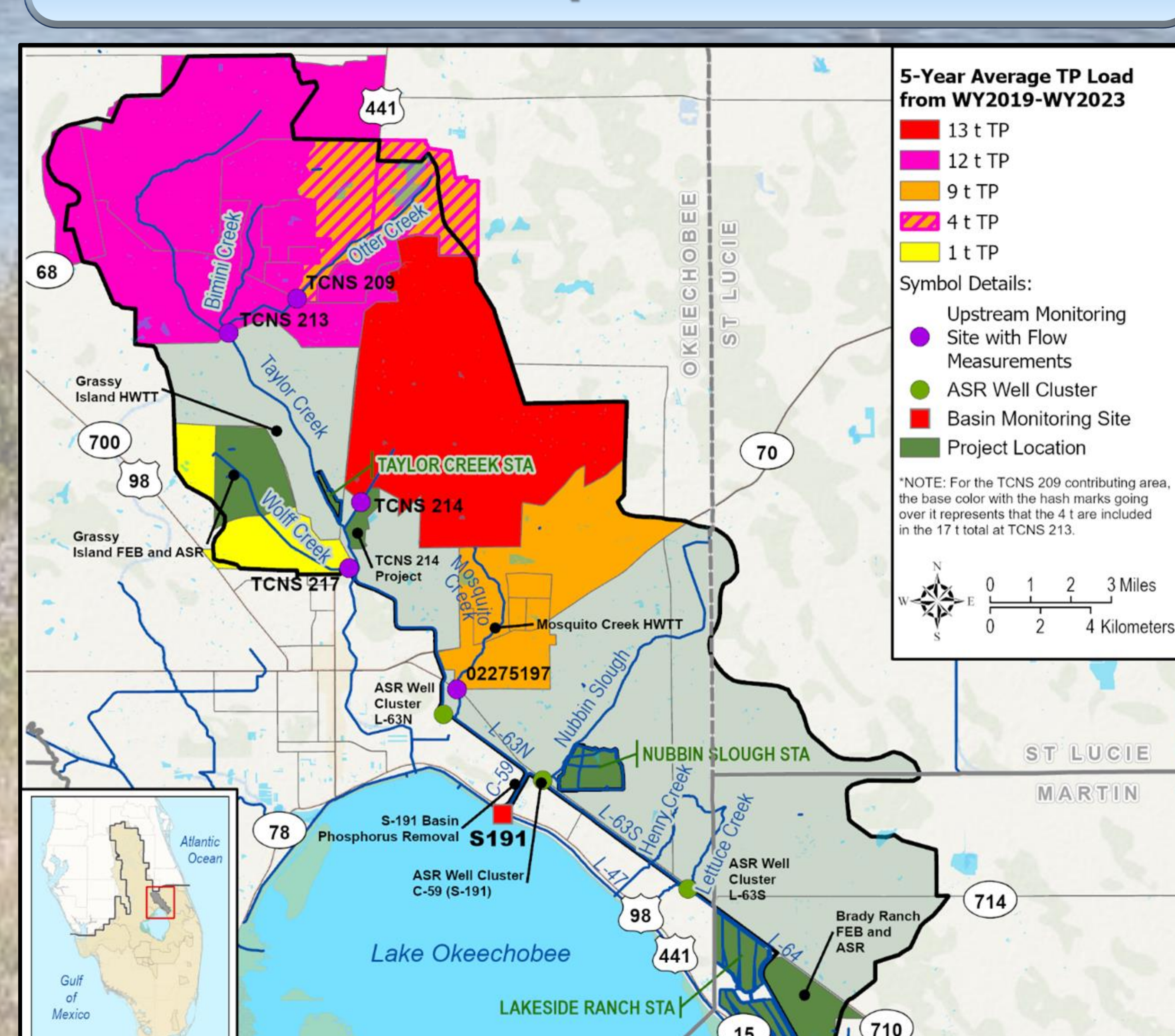
Nutrient Concentrations Water Years 2019–2023

TCNS S191		WY2019-WY2023									
		TP (µg/L)		OPO_4-P (µg/L)		TN (mg/L)		NH_3-N (mg/L)		NO_X-N (mg/L)	
Map ID	Site	No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.
1	02275197	50	694	41	477	50	3.39	36	0.49	41	0.46
2	LB29353513	31	1163	8	916	24	2.65	8	0.27	8	0.04
3	MS05373613	15	3417	4	2307	14	11.90	4	1.78	4	0.52
4	MS08373611	20	1539	5	2039	16	7.60	5	0.26	5	1.12
5	MS08373624	12	3655	11	2264	11	6.12	11	2.85	11	0.10
6	OT29353514	7	187	4	160	6	1.71	5	0.10	5	0.04
7	OT32353511	27	795	13	862	23	6.82	13	2.13	12	0.56
8	OT34353513	32	352	20	353	27	2.34	21	0.52	20	0.11
9	TC03373511	24	528	16	426	16	2.82	16	1.11	15	0.12
10	TC27353413	18	362	9	246	12	2.98	9	0.26	8	0.08
11	TCNS 201	42	246	31	187	42	1.66	32	0.11	31	0.15
12	TCNS 204	31	756	22	673	31	3.35	23	0.30	21	1.08
13	TCNS 207	34	2350	5	436	34	16.80	5	1.74	5	0.16
14	TCNS 209	32	2118	22	1643	32	14.22	22	7.15	20	1.40
15	TCNS 213	73	594	55	533	73	3.50	56	2.03	52	0.55
16	TCNS 214	74	575	60	479	74	1.79	60	0.34	59	0.15
17	TCNS 217	56	268	43	175	56	1.53	41	0.09	42	0.10
18	TCNS 220	45	864	35	605	45	3.78	35	0.89	33	0.19
19	TCNS 222	81	499	62	364	81	3.02	58	0.87	60	0.54
20	TCNS 228	11	658	9	590	11	2.38	9	0.17	8	0.17
21	TCNS 230	9	545	8	438	9	1.95	7	0.13	7	0.07
22	TCNS 233	28	505	24	442	28	1.86	22	0.14	23	0.09
23	TCNS 249	23	201	3	369	22	1.51	2	0.18	3	0.01

S-191 Basin Total Phosphorus Concentrations



S-191 Basin Total Phosphorus Loads



Meghan Anderson collecting a water sample in the Lake Okeechobee Watershed.

Unit of Measurement	Definitions
µg/L	microgram(s) per liter
mg/L	milligram(s) per liter

For more information:
SCAN ME

Appendix 8C-1: Water Year 2023 St. Lucie River Watershed Upstream Monitoring

Amanda McDonald, Steffany Olson, Jacob Landfield
Project Operations & Assessment Section, Everglades & Estuaries Protection Bureau

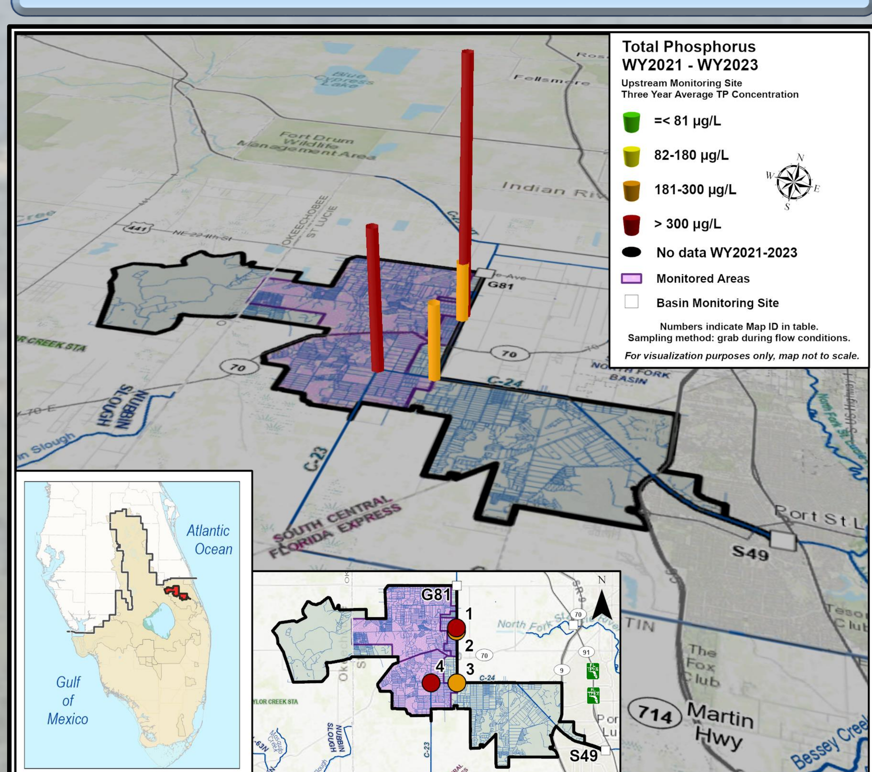
Purpose of Upstream Monitoring: ➤Highlight Areas of Concern ➤Prioritize Resources ➤Track Progress

Acknowledgements: Thank you to the staff from the Water Quality Monitoring Section and Analytical Services Section. Without their efforts these data would not exist. Additionally, the maps were produced by Allison Lamb, Madelyn Rinka, and Edwin Rios of the Geospatial Services Section.

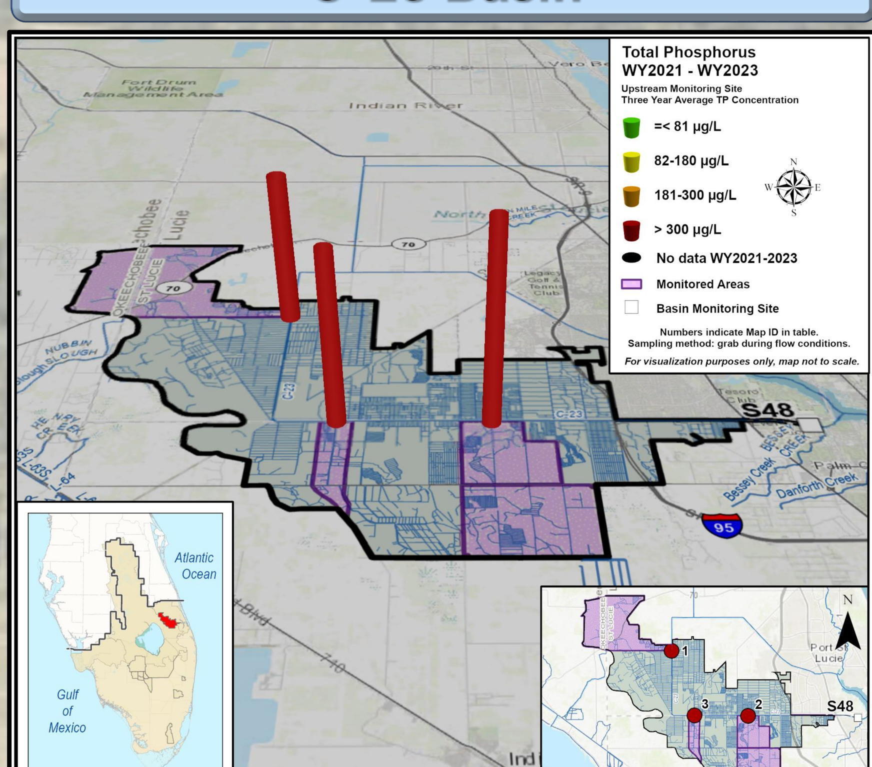
Nevada Wagoner collecting sonde data at station C44SC5.

WY2021 Expanded Network

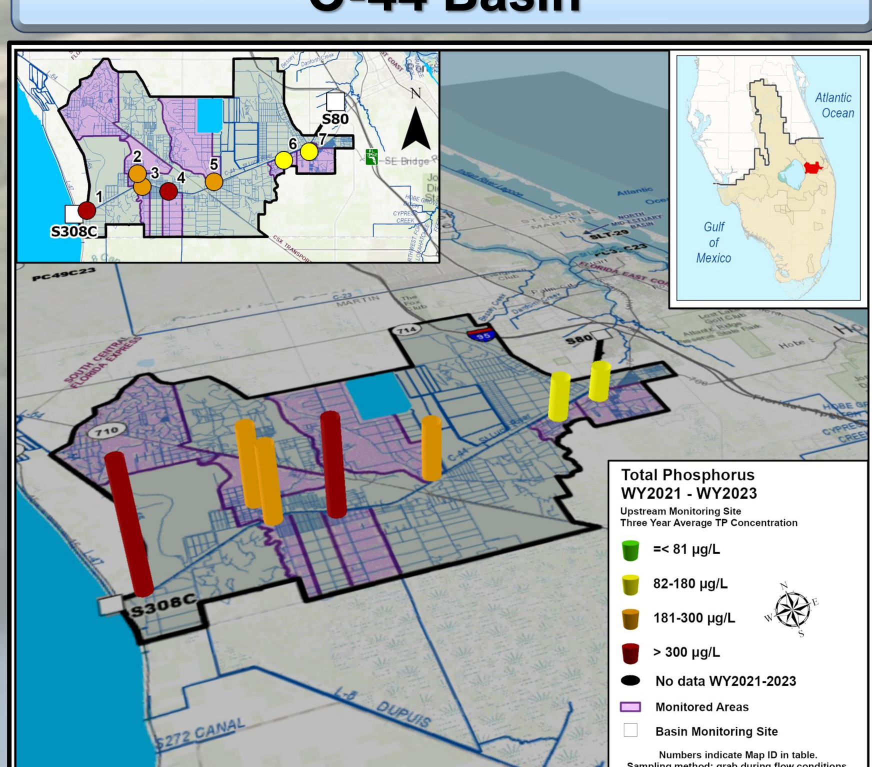
C-24 Basin



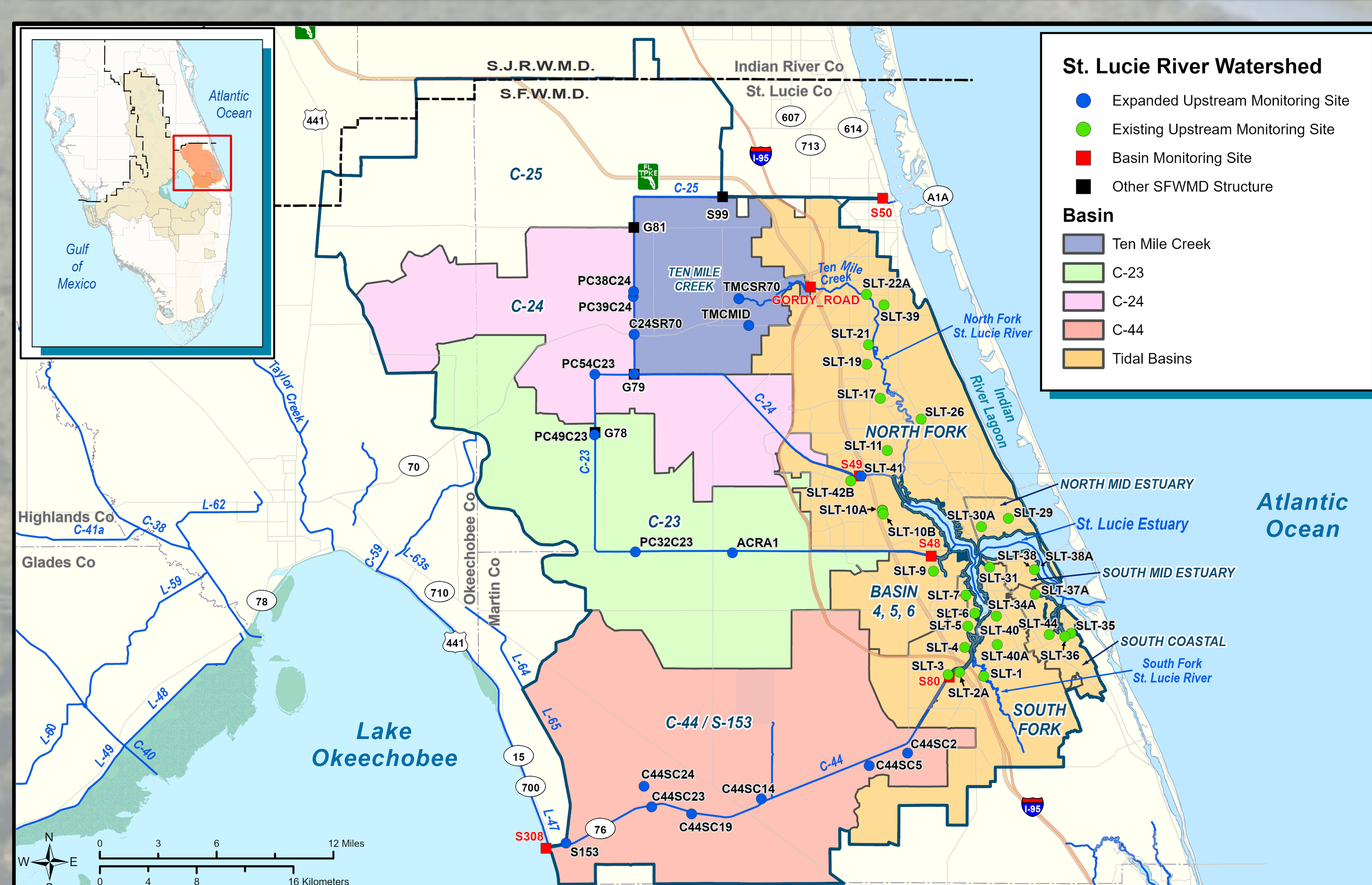
C-23 Basin



C-44 Basin



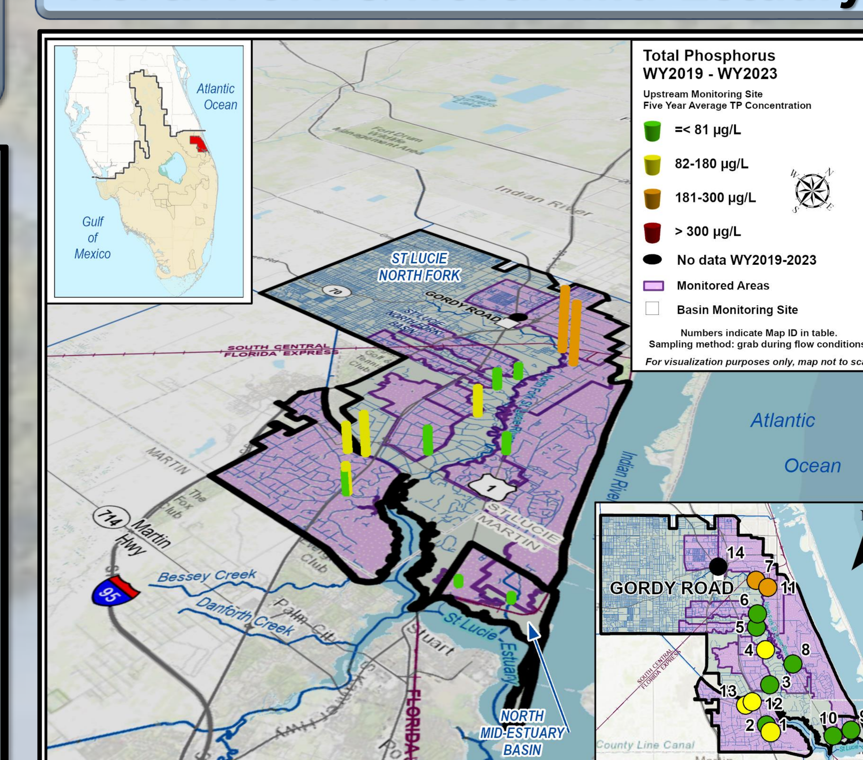
Water Quality Monitoring Network



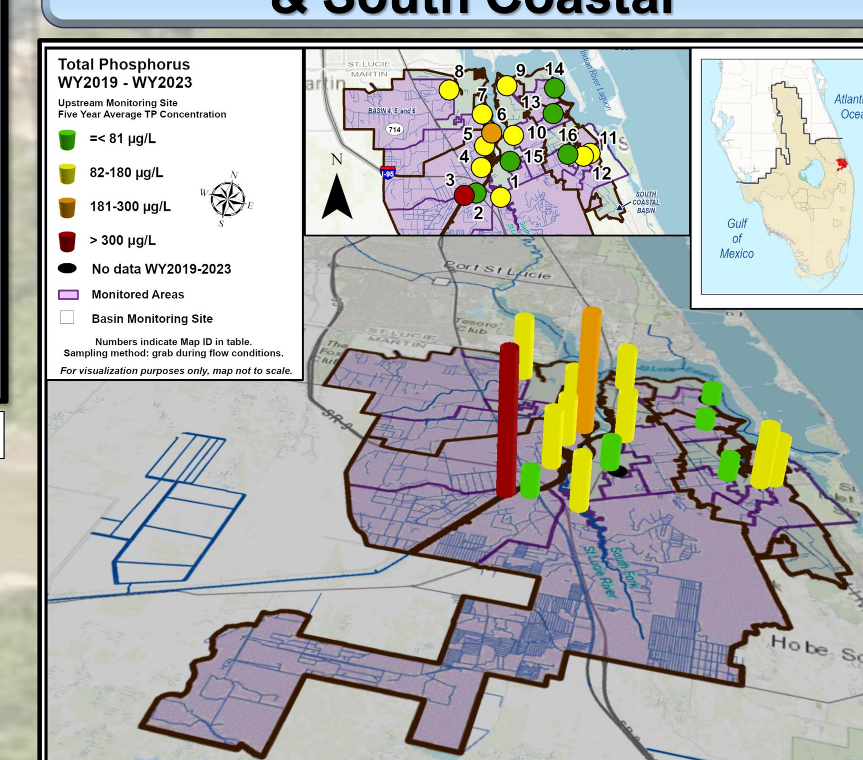
Map depicts WY2024 (current) monitoring network, including some changes from the WY2023 monitoring network.

Long-Term Network

North Fork & North Mid-Estuary



South Fork, South Mid-Estuary, & South Coastal



Madeleine Bitting clearing vegetation at C44SC23.

Chase Lausted collecting a water sample at PC54C23.

Nutrient Concentrations Water Years 2021–2023

Basin	Site	WY2021-WY2023									
		TP (µg/L)		OPO_4-P (µg/L)		TN (mg/L)		NH_3-N (mg/L)		NO_X-N (mg/L)	
		No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.
C-24	PC39C24	9	784	9	686	9	1.50	9	0.12	8	0.01
	PC38C24	17	189	17	126	17	1.66	15	0.12	15	0.04
	G79	68	237	66	154	68	1.45	65	0.08	68	0.02
	PC54C23	22	436	22	287	22	1.98	20	0.10	22	0.01
C-23	PC49C23	12	455	12	392	12	1.96	11	0.16	11	0.11
	ACRA1	17	605	16	511	17	1.66	14	0.07	16	0.01
	PC32C23	10	519	9	408	10	2.26	8	0.13	9	0.01
C-44	S153	21	412	21	370	21	1.60	21	0.13	21	0.07
	C44SC24	13	259	13	182	13	1.31	11	0.09	13	0.20
	C44SC23	21	253	21	200	21	1.26	21	0.18	21	0.13
	C44SC19	51	314	51	234	51	1.32	50	0.16	51	0.11
	C44SC14	27	186	27	127	27	1.26	27	0.11	27	0.09
	C44SC5	25	141	25	83	25	1.57	24	0.10	23	0.04
	C44SC2	16	111	17	43	16	1.25	17	0.09	15	0.01

Parameters	Definitions
TP	total phosphorus
OPO_4-P	orthophosphate
TN	total nitrogen
NH_3-N	ammonial nitrogen
NO_X-N	nitrate + nitrate

Unit of Measurement	Definitions
µg/L	microgram(s) per liter
mg/L	milligram(s) per liter

Nutrient Concentrations Water Years 2019–2023

Basin	Site	WY2019 - WY2023									
		TP (µg/L)		OPO_4-P (µg/L)		TN (mg/L)		NH_3-N (mg/L)		NO_X-N (mg/L)	
		No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.
North Fork & North Mid-Estuary	SLT-10A	109	84	103	29	110	0.96	107	0.12	107	0.05
	SLT-10B	87	68	79	22	88	0.88	87	0.09	86	0.07
	SLT-11	103	76	98	17	103	0.83	100	0.04	101	0.04
	SLT-17	115	87	107	17	115	0.81	113	0.10	112	0.11
	SLT-19	115	58	106	12	115	0.81	113	0.06	113	0.02
	SLT-21	96	44	87	8	96	0.75	93	0.02	93	0.02
	SLT-22A	53	201	52	112	53	0.85	51	0.07	52	0.09
	SLT-26	120	56	111	21	120	0.80	117	0.02	117	0.09
	SLT-29	108	21	103	3	110	0.90	108	0.04	107	0.04
	SLT-30A	20	23	19	2	20	0.89	20	0.04	19	0.01
	SLT-39	57	194	48	125	57	1.07	48	0.20	47	0.10
	SLT-41	77	121	72	33	77	0.95	75	0.10	75	0.08
	SLT-42B	76	83	72	19	76	0.70	75	0.06	74	0.04
	SLT-45	17	127	17	23	17	0.82	17	0.06	17	0.05
South Fork, South Mid-Estuary, & South Coastal	SLT-1	52	128	50	70	52	0.99	50	0.05	51	0.06
	SLT-2A	78	62	74	16	78	0.91	75	0.02	76	0.01
	SLT-3	108	333	106	260	108	1.08	107	0.07	106	0.22
	SLT-4	35	137	35	75	35	0.97	34	0.05	35	0.12
	SLT-5	47	113	14	69	47	1.37	13	0.04	14	0.19
	SLT-6	33	286	33	229	33	1.48	33	0.30	32	0.20
	SLT-7	53	102	47	46	52	0.89	50	0.08	51	0.12
	SLT-9	29	152	29	97	29	0.97	29	0.07	28	0.10
	SLT-31	95	97	86	7	95	0.89	92	0.01	95	0.01
	SLT-34A	119	116	91	29	118	1.04	94	0.13	93	0.11
	SLT-35	107	109	79	71	107	1.14	78	0.05	81	0.21
	SLT-36	11	142	10	100	11	1.00	11	0.05	11	0.09
	SLT-37A	93	33	87	5	92	0.72	91	0.10	91	0.06
	SLT-38	137	37	129	7	137	0.65	133	0.05	135	0.04
	SLT-40	81	68	69	15	81	0.95	68	0.03	70	0.01
	SLT-44	125	51	115	9	125	0.91	122	0.05	124	0.06

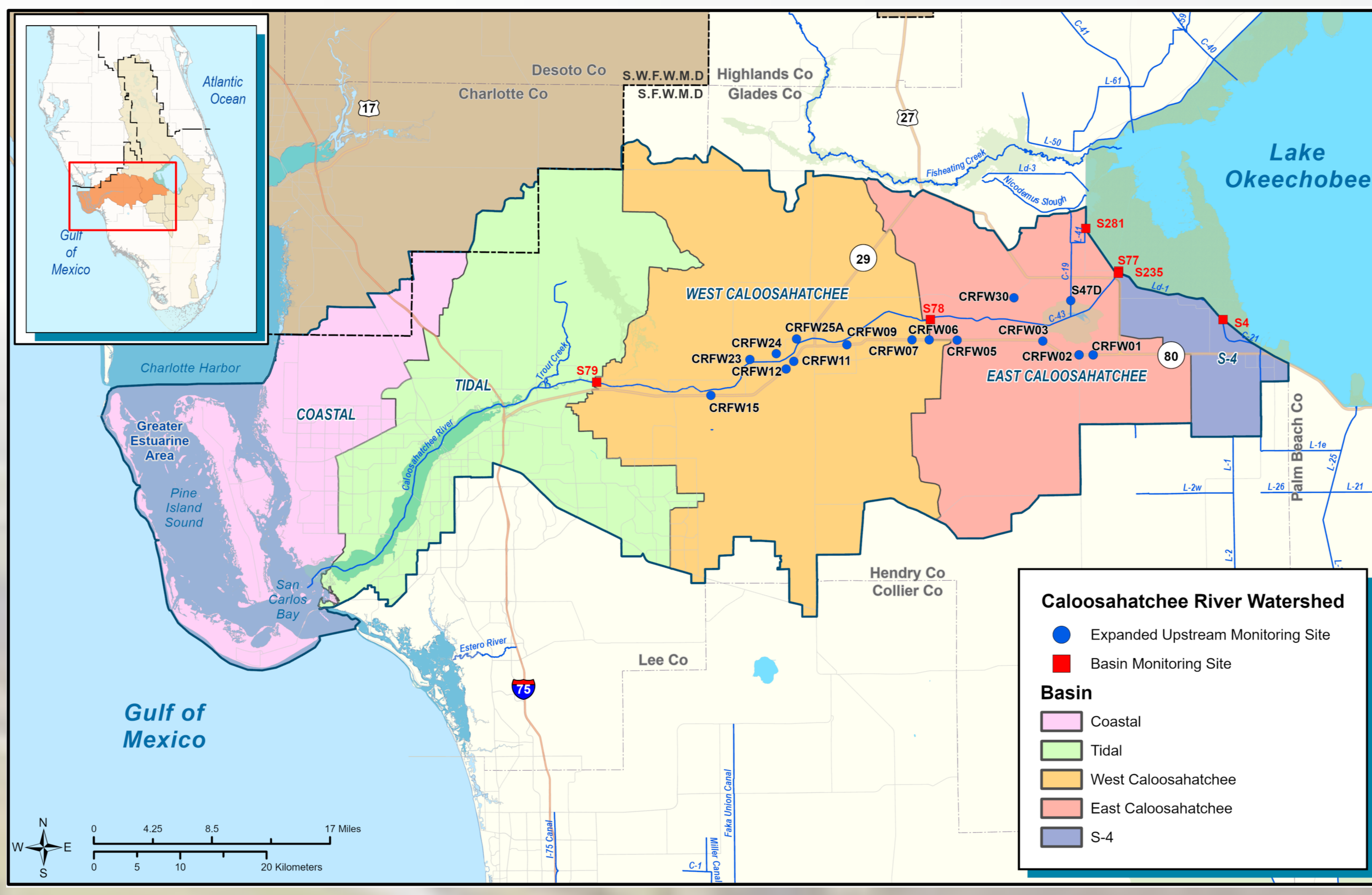
For more information: SCAN ME

Appendix 8D-1: Water Year 2023 Caloosahatchee River Watershed Upstream Monitoring

Jacob Landfield, Steffany Olson, Amanda McDonald
Project Operations & Assessment Section, Everglades & Estuaries Protection Bureau

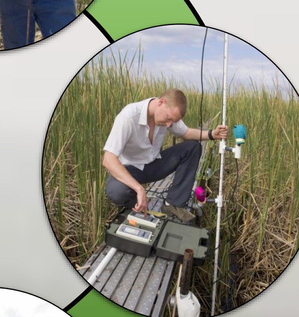
Purpose of Upstream Monitoring: ➢Highlight Areas of Concern ➢Prioritize Resources ➢Track Progress

Water Quality Monitoring Network



Acknowledgements: Thank you to the staff from the Water Quality Monitoring Section and Analytical Services Section. Without their efforts these data would not exist. Additionally, the maps were produced by Allison Lamb, Madelyn Rinka, and Edwin Rios of the Geospatial Services Section.

Interagency Coordination Effort



Rapid Assessment Process

Inform Projects

Nathan Moreo collecting data with YSI unit and sonde at S79

Governing Board Expansion of Upstream Network

➢Fully implemented in Water Year 2021 (WY2021)
➢Increased:
- Number of sites
- Collection frequency to bi-weekly
- Parameters collected

Monitoring Level	Total Number of Sites
Basin	6
Upstream	15

Parameters	Definitions
TP	total phosphorus
OPO_4-P	orthophosphate
TN	total nitrogen
NH_3-N	ammonial nitrogen
NO_x-N	nitrate + nitrate
pH	potential of hydrogen
Temp	temperature
DO	dissolved oxygen
Conductivity	Measures the ability of water to pass an electrical current.

Upstream Monitoring Plan	
Frequency	Biweekly when flowing (some weekly)
Parameters	TP, OPO_4-P, TN, NH_3-N, NO_x-N, pH, Temp, DO, Conductivity

Water Year 2023 Upstream Monitoring Network Results

Focus on East Basin

➢ Five of the six sites have 3-year average annual TN concentrations > 1.54 mg/L (Florida Department of Environmental Protection [FDEP] numeric nutrient criteria).

➢ All six sites have 3-year average annual TP concentrations > 120 µg/L (FDEP numeric nutrient criteria).

➢ There was above average rainfall across the watershed.

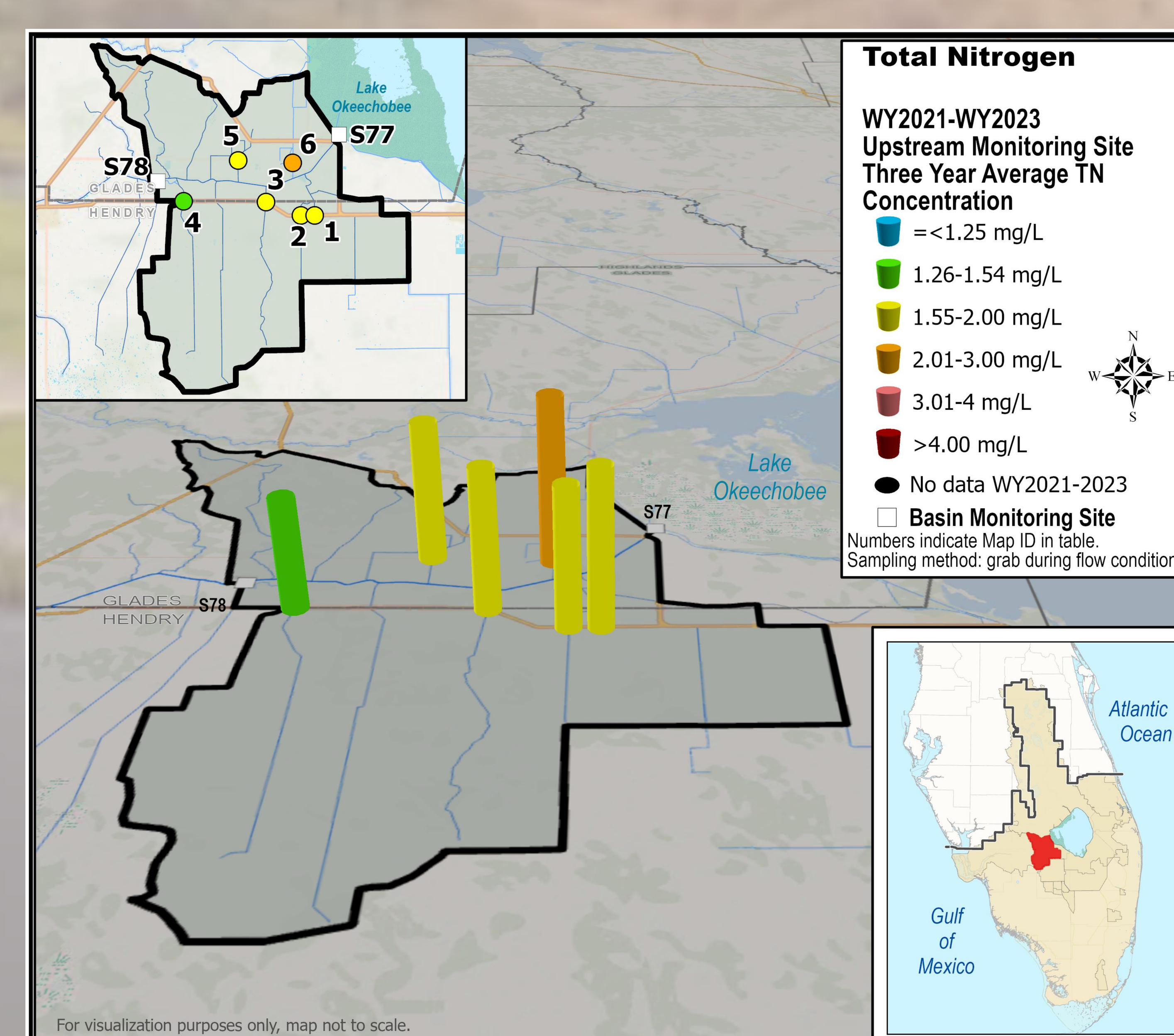
CRFW25A Rapid Assessment

➢ One trigger for TP > 1,000 µg/L.

➢ Coordinating Agencies notified.

➢ Continuing to monitor.

East Basin Total Nitrogen



Unit of Measurement	Definitions
µg/L	microgram(s) per liter
mg/L	milligram(s) per liter

Michael Ruccolo collecting water sample with Niskin bottle at S79

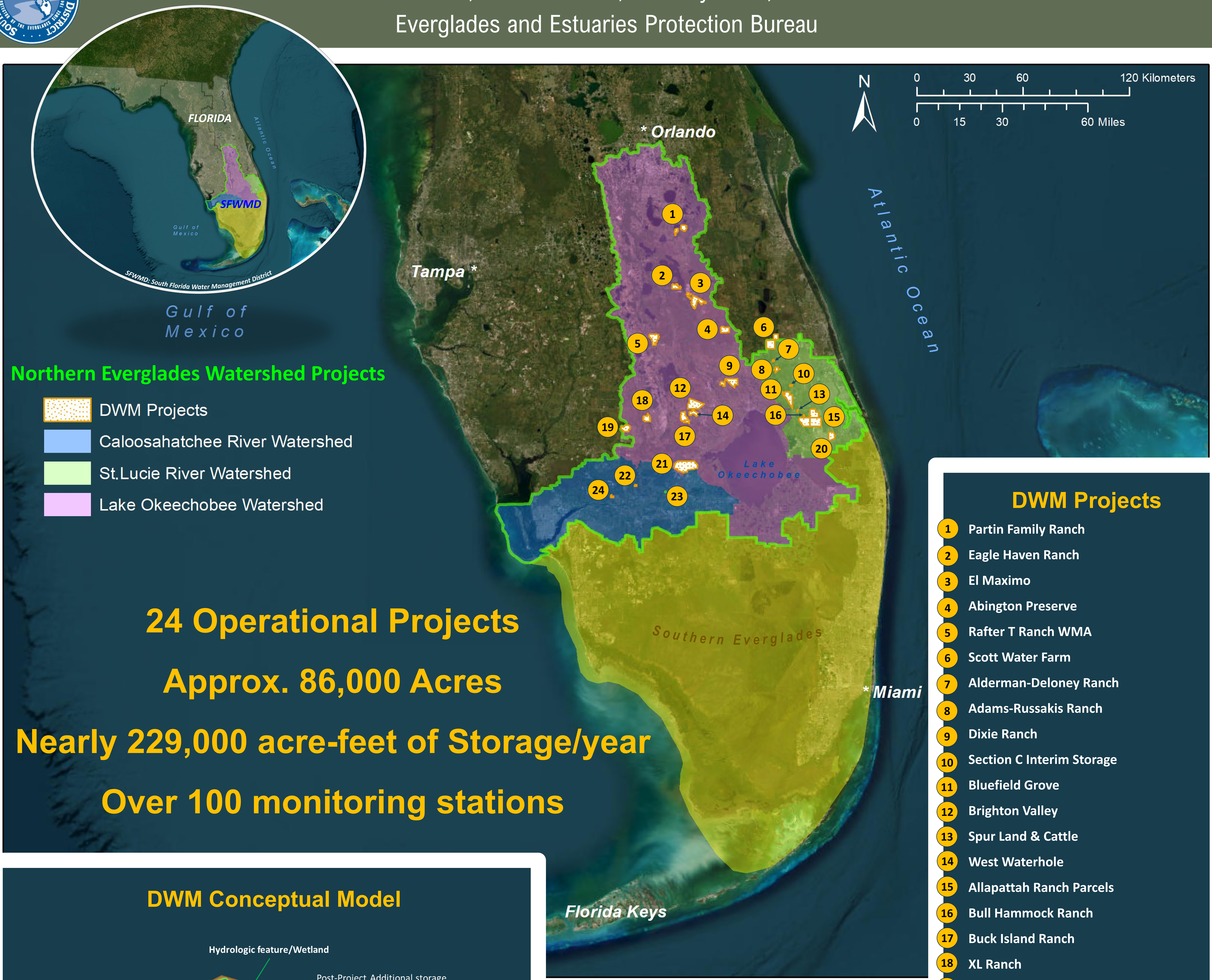
Nutrient Concentrations

East Caloosahatchee		WY2021-WY2023									
		TP (µg/L)		OPO_4-P (µg/L)		TN (mg/L)		NH_3-N (mg/L)		NO_x-N (mg/L)	
Map ID	Site	No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.
1	CRFW1	18	160	18	91	17	1.82	18	0.12	18	0.34
2	CRFW2	28	181	27	122	28	1.53	27	0.14	27	0.05
3	CRFW3	23	247	23	176	23	1.66	23	0.15	23	0.12
4	CRFW5	32	138	31	78	32	1.31	32	0.08	32	0.06
5	CRFW30	30	152	30	73	30	1.65	30	0.15	26	0.04
6	CRFW33 (S47D)	28	249	27	164	28	2.09	28	0.46	26	0.09

For more information: SCAN ME

Northern Everglades Dispersed Water Management (DWM)

Manuel F. Zamorano, Christian Avila, Anthony Betts, Cristina Gauthier
Everglades and Estuaries Protection Bureau



24 Operational Projects

Approx. 86,000 Acres

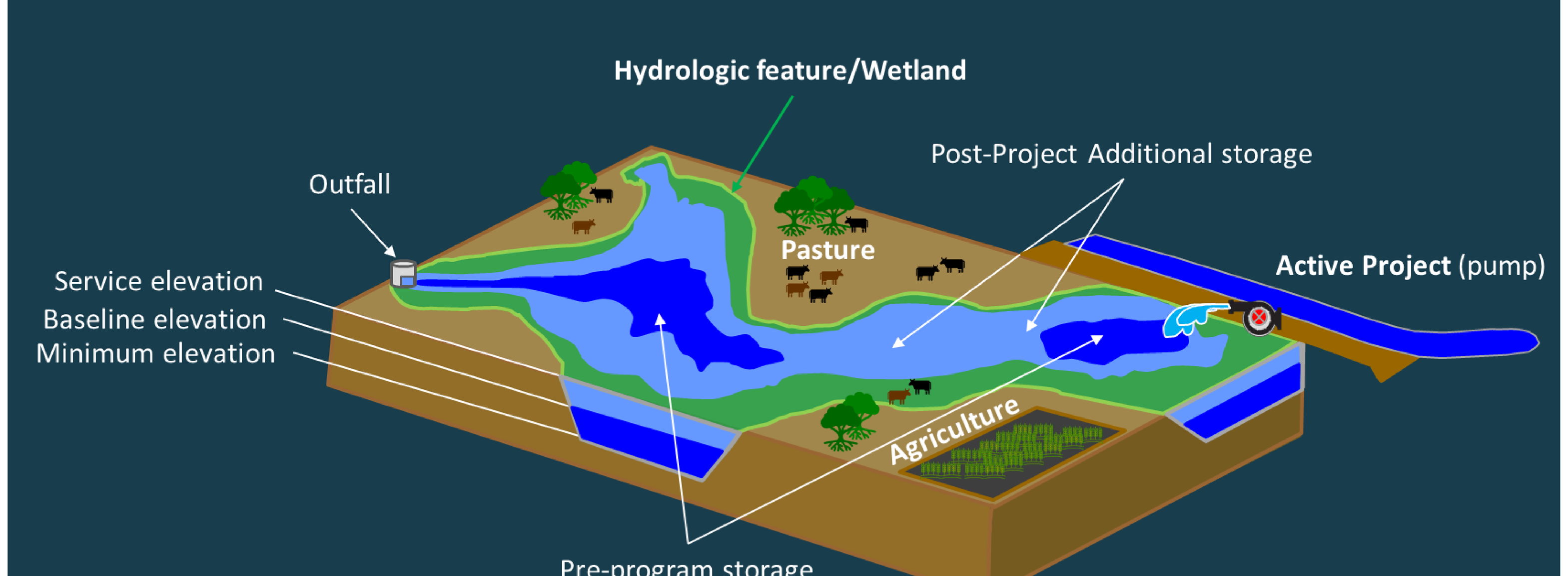
Nearly 229,000 acre-feet of Storage/year

Over 100 monitoring stations

DWM Projects

1. Partin Family Ranch
2. Eagle Haven Ranch
3. El Maximo
4. Abington Preserve
5. Rafter T Ranch WMA
6. Scott Water Farm
7. Alderman-Deloney Ranch
8. Adams-Russakis Ranch
9. Dixie Ranch
10. Section C Interim Storage
11. Bluefield Grove
12. Brighton Valley
13. Spur Land & Cattle
14. West Waterhole
15. Allapattah Ranch Parcels
16. Bull Hammock Ranch
17. Buck Island Ranch
18. XL Ranch
19. Llano Ranches
20. Caulkins Water Farm Expansion
21. Nicodemus Slough
22. Mudge Ranch
23. Boma Interim Storage
24. Four Corners Rapid Infiltration

DWM Conceptual Model



DWM Project Types

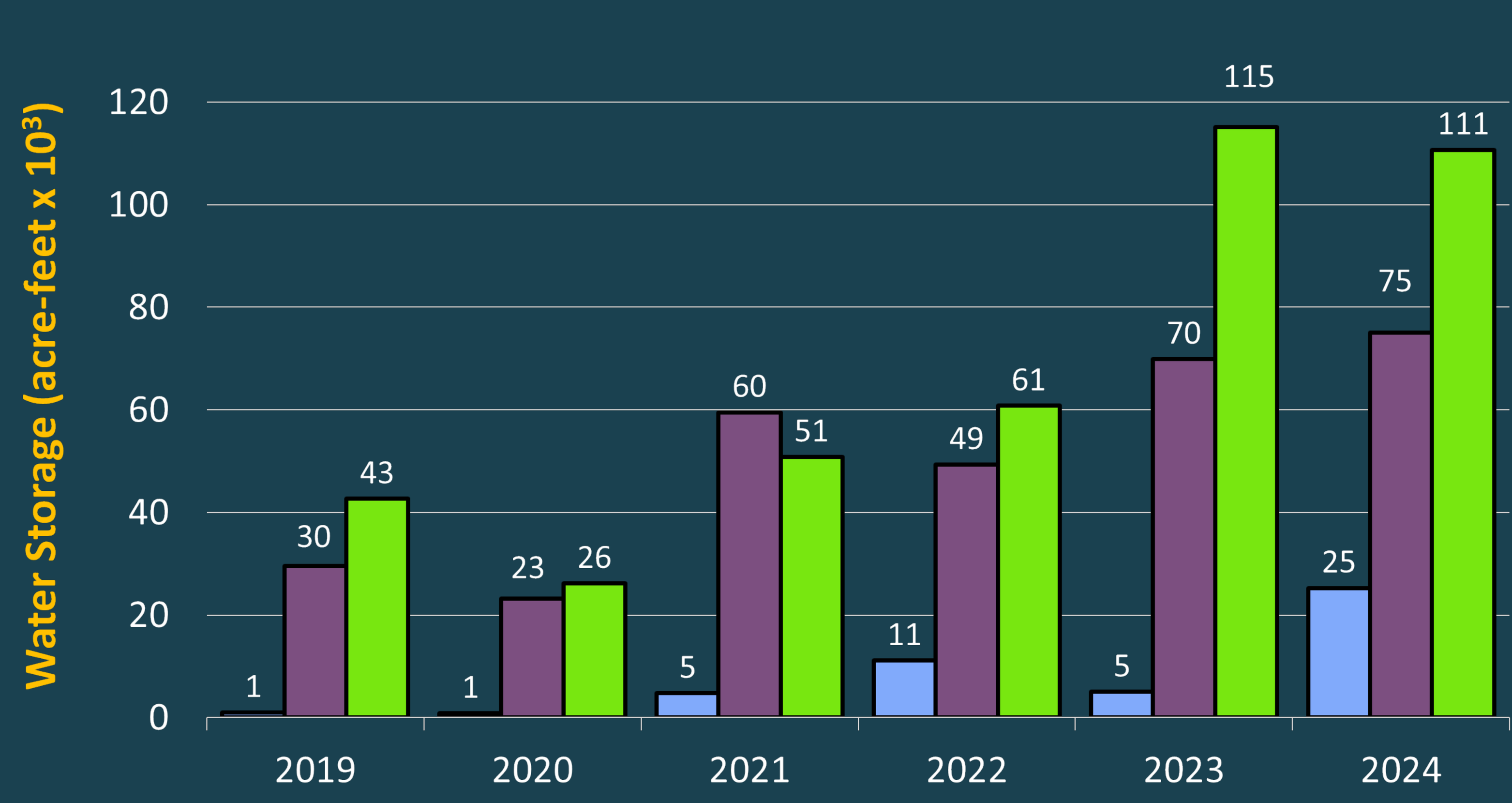
Active projects

Capture direct rainfall and have the capability to pump excess surface water from the regional system.

Passive projects

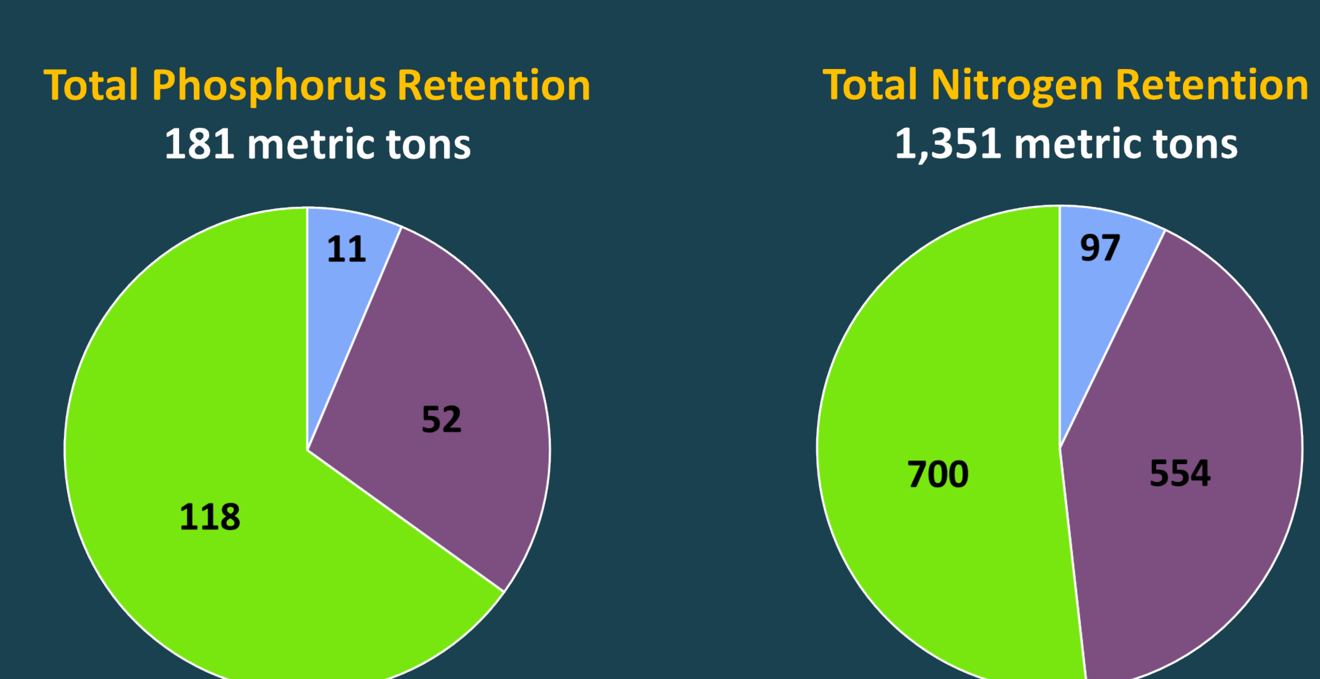
Store direct rainfall via modifications to the existing drainage infrastructure such as installation of ditch blocks, new culverts with risers, etc.

DWM 6-Year Project Performance



(District water year runs from May 1 through April 30 of the next calendar year)

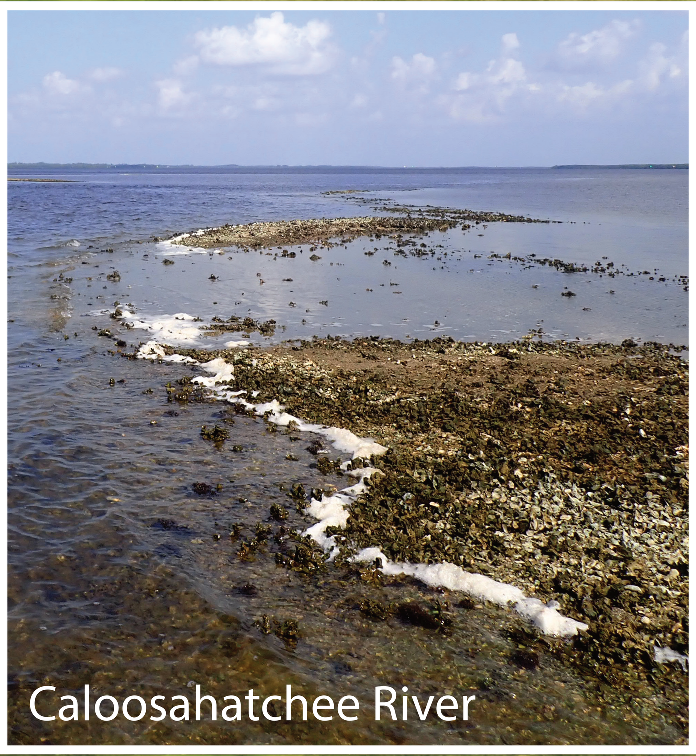
Nutrient Retention



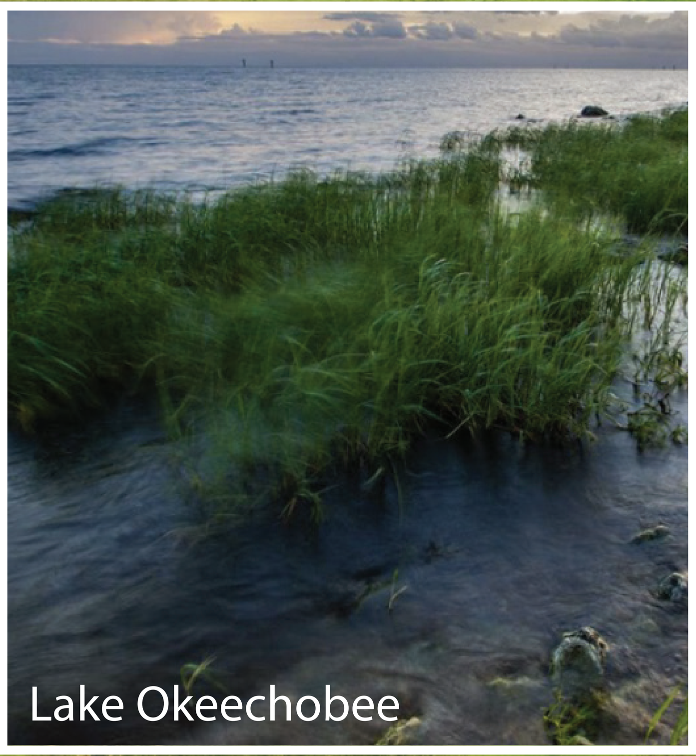
Total nutrient retention = sum of nutrient loads for previous six water years in metric tons

November 2024

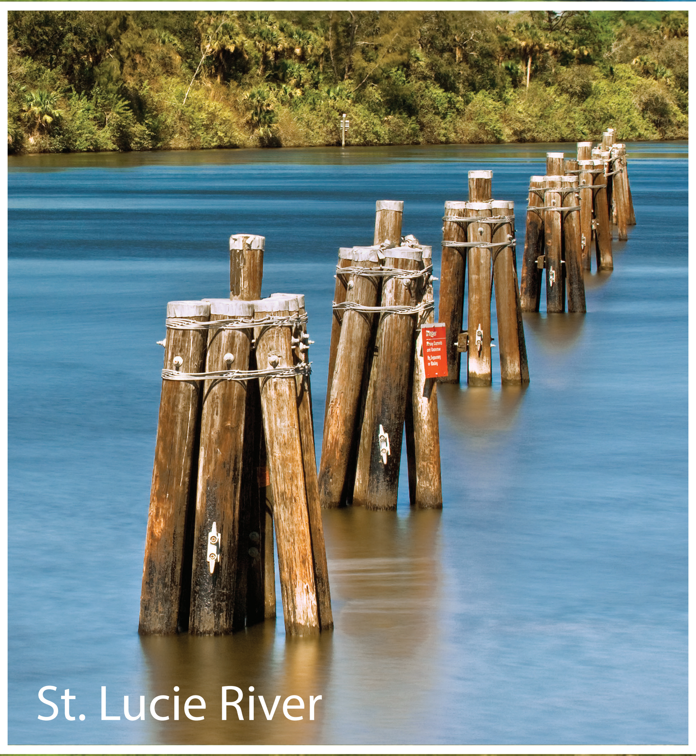
2025 Northern Everglades and Estuaries Protection Program (NEEPP) Regional Simulation Model Update



Caloosahatchee River



Lake Okeechobee



St. Lucie River

Key Findings

Lake Stage: All model simulations reduced potentially high stage impacts; improving conditions during drier periods was heavily dependent on additional storage.

Estuary Salinity: Updated performance metrics show equal or improved performance in St. Lucie and Caloosahatchee Estuaries Minimum Flows and Levels (MFL) compliance and reduced high and damaging flows compared to the original plan metrics.

Water Supply: Performance improved with additional storage.

Background

The Northern Everglades and Estuaries Protection Program

- Statute stipulates that the South Florida Water Management District (District) shall take the lead on hydrologic improvements consistent with the Lake Okeechobee Basin Management Action Plans.
- Directs the District to develop the appropriate water quantity storage goals to achieve the desired Lake Okeechobee range of lake levels and inflow volumes to the Caloosahatchee and St. Lucie estuaries while meeting the other water-related needs of the region, including water supply and flood protection.

Original modeling: The Lake Okeechobee Watershed Phase II Technical Plan published in Feb. 2008 and the St. Lucie and Caloosahatchee River Watershed Protection Plans in Jan. 2009

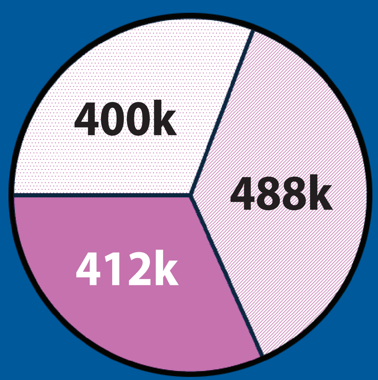
- Lake Okeechobee Watershed storage target: 900,000 – 1,300,000 acre-feet
- Caloosahatchee River Watershed storage target: 400,000 acre-feet
- St. Lucie River Watershed storage target: 200,000 acre-feet

In the 15 years since the initial modeling effort was completed

- Several major hydrologic projects have been constructed and are operational.
- Progress has been made in locating and sizing additional future planned storage projects.
- Other regulatory/operational guidelines have been revised.

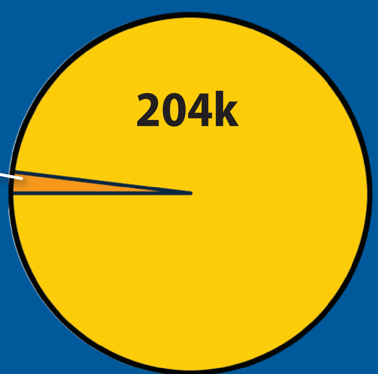
Recommendation

Original storage targets (shown in acre-feet) were confirmed to meet Northern Everglades and Estuaries Protection Program legislative goals.



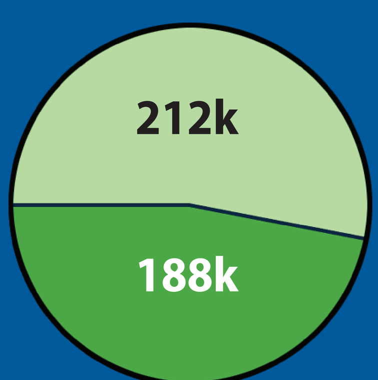
Lake Okeechobee Watershed

- Current & future project storage
- Storage needed for 900k acre-feet
- Storage needed for 1,300k acre-feet



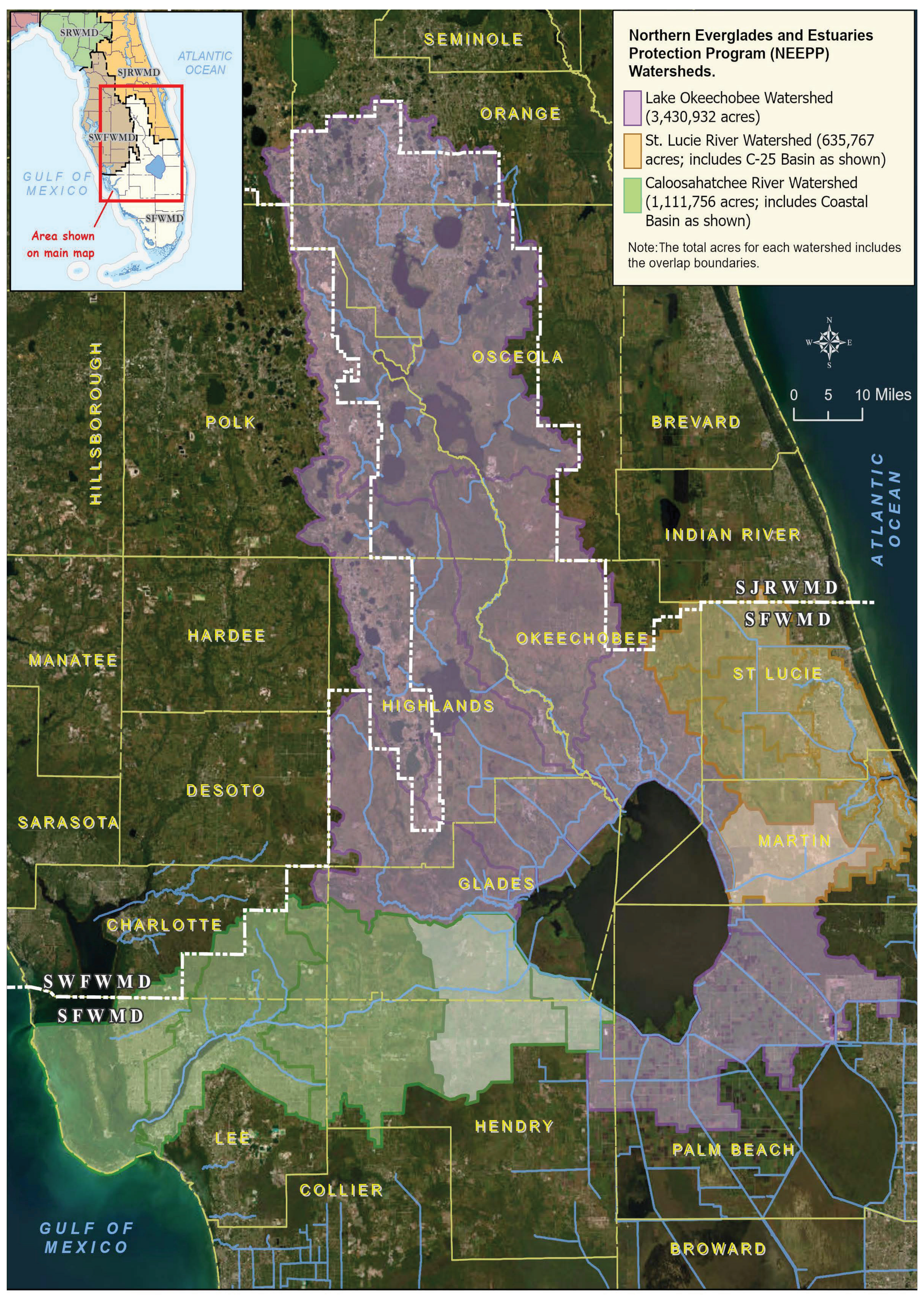
St. Lucie River Watershed

- Current & future project storage
- Storage exceeded



Caloosahatchee River Watershed

- Current & future project storage
- Storage needed



Making Progress

The District is making significant progress towards meeting the NEEPP storage goals. Dispersed Water Management Projects along with the restoration of natural lands are playing a part in achieving these goals.

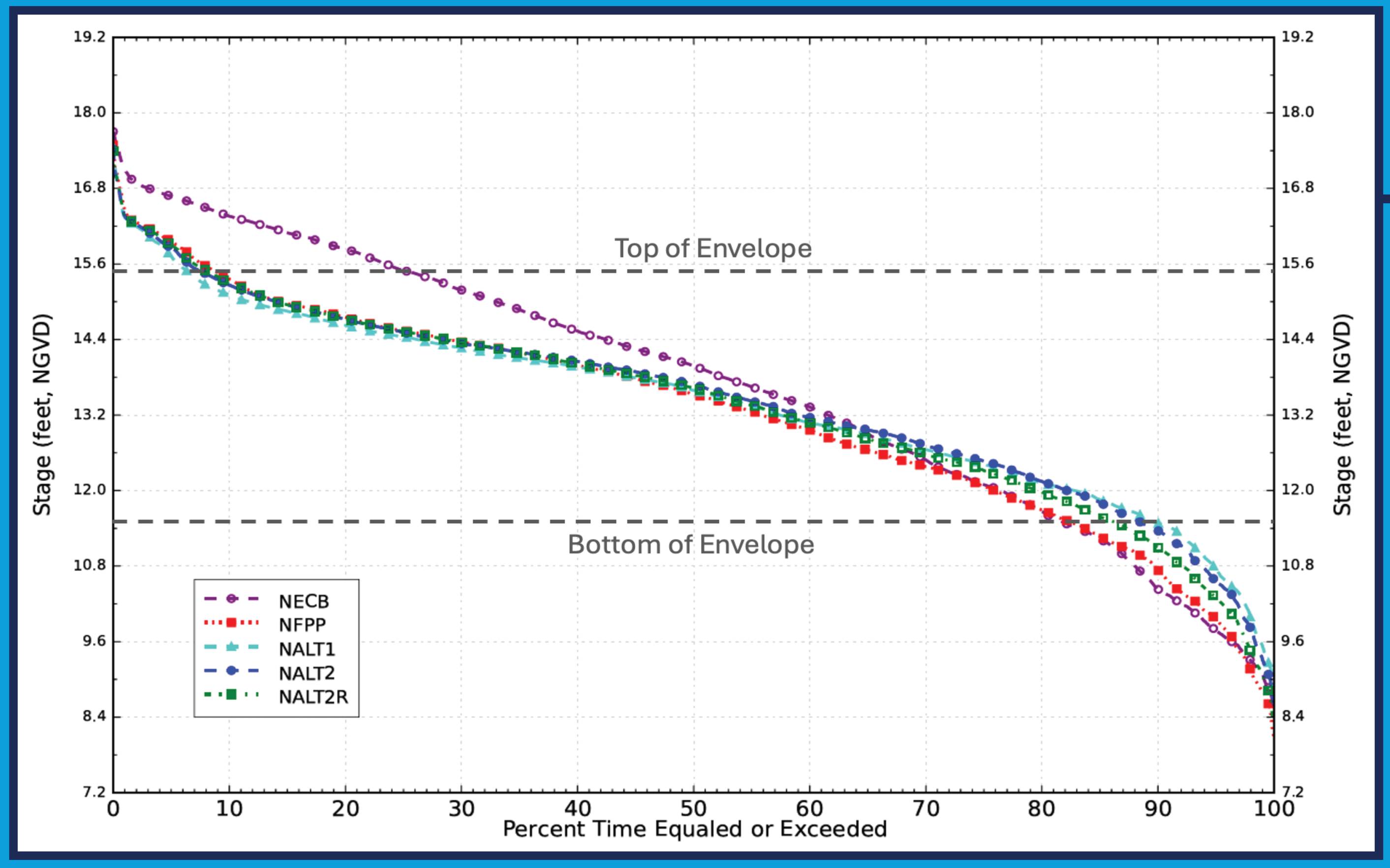
Modeled Scenarios

NECB Existing	=	LOSOM	+	LOW Storage 50k ac-ft	+	SLRW Storage 108k ac-ft	+	CRW Storage 2k ac-ft
NFPP Future Projects	=	NECB	+	LOW Storage 412k ac-ft	+	SLRW Storage 204k ac-ft	+	CRW Storage 188k ac-ft
NALT 1 Maximize Storage	=	NFPP	+	LOW Storage 1,300k ac-ft	+	SLRW Storage 204k ac-ft	+	CRW Storage 400k ac-ft
NALT 2 Optimize	=	NFPP	+	LOW Storage 900k ac-ft	+	SLRW Storage 204k ac-ft	+	CRW Storage 400k ac-ft
NALT 2R Reduce Storage	=	NFPP	+	LOW Storage 682k ac-ft	+	SLRW Storage 204k ac-ft	+	CRW Storage 294k ac-ft

NECB = NEEPP Existing Conditions Baseline NFPP = NEEPP Future Planned Projects NALT = NEEPP Alternative
LOW = Lake Okeechobee Watershed CRW = Caloosahatchee River Watershed SLRW = St. Lucie River Watershed
LOSOM = Lake Okeechobee System Operating Manual

Updated Modeling Tools and Hydrologic Analysis

- Updated performance metrics incorporate the latest science on lake ecology, estuarine salinity, and water supply.
- NEEPP existing conditions baseline was updated to include the Lake Okeechobee System Operating Manual (LOSOM) Dispersed Water Management Projects, various restoration features and the C-44 Reservoir.
- Major NEEPP future planned projects include the Caloosahatchee (C-43) Reservoir, LOCAR and the EAA Reservoir.
- Conceptual storage and treatment projects.



LAKE STAGE DURATION CURVE

The Lake Stage Duration Curve suggests that all model simulations were able to substantially improve potential high stage impacts.

Improving conditions during drier periods was heavily dependent on storage capacity.

For more information contact Aubrey Frye at afrye@sfwmd.gov.

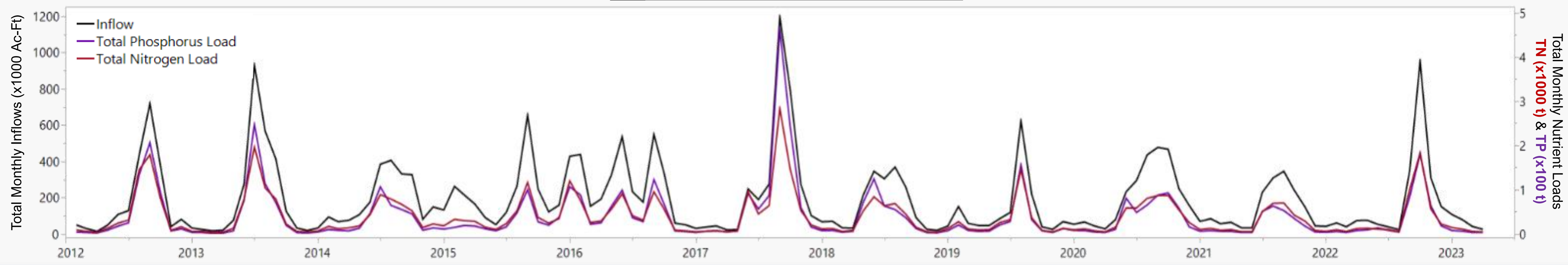
Chapter 8B: Lake Okeechobee Watershed Protection Plan Annual Progress Report

Lake Okeechobee Hydrology, Water Quality and the Ecological Envelope

Paul Jones, Ph.D., Lake and River Ecosystem Section, Applied Sciences Bureau

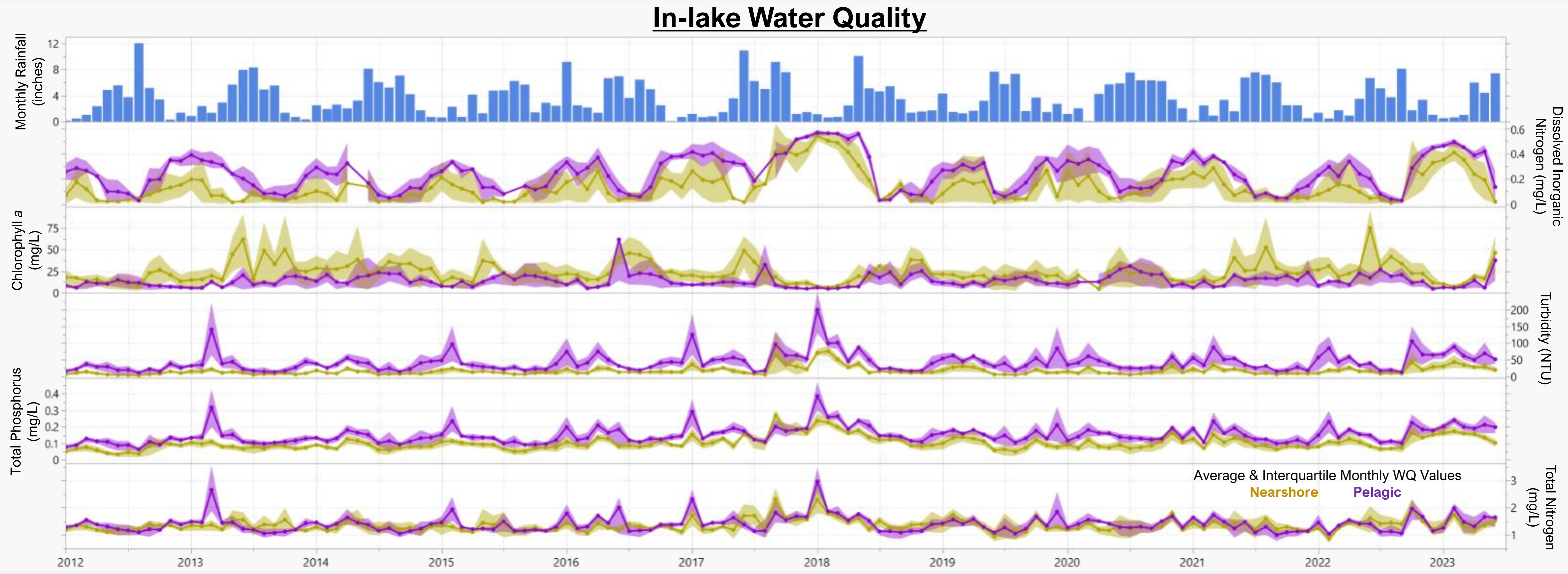
Inflows and Nutrient Loads

- Nutrient loads to Lake Okeechobee are determined primarily by surface water inflow volumes.
- Elevated inflows are the main driver of rapid rises in lake stage.
- H. Ian (2022) caused the highest inflows since H. Irma (2017), but TP loads were considerably lower.



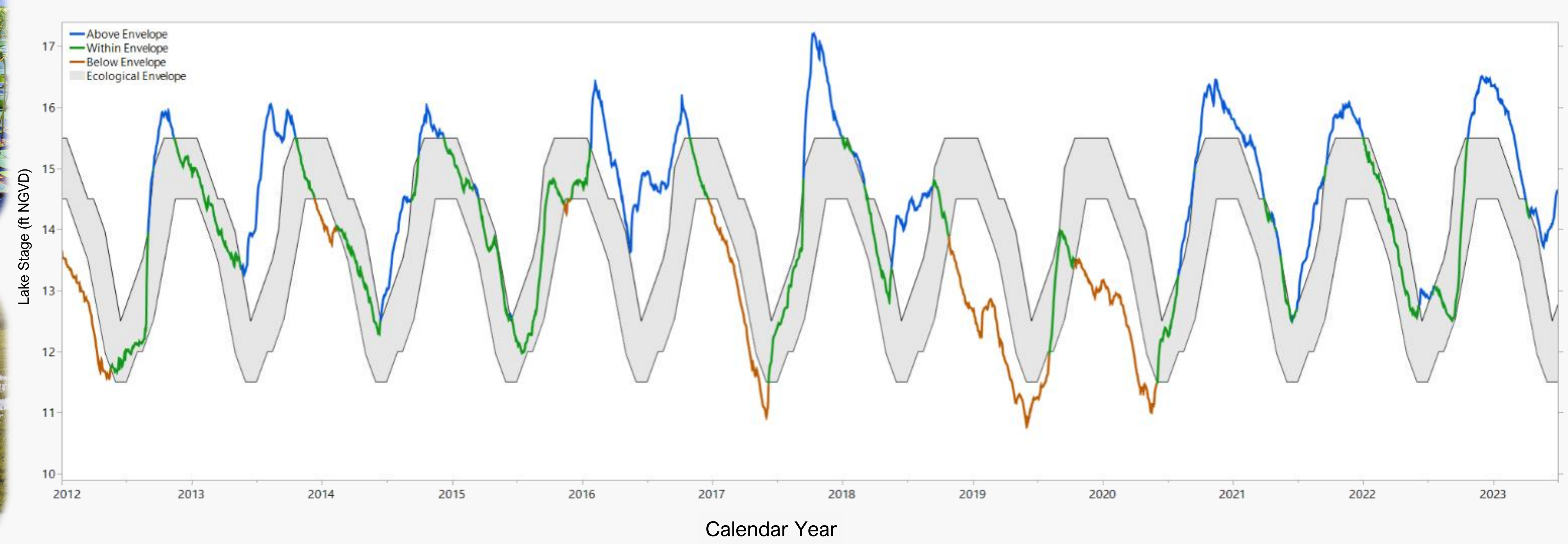
In-lake Water Quality

- TN and TP levels in the **Pelagic** (central) region follow a similar pattern to turbidity, suggesting they are associated with particulates.
- With large surface area and shallow water, particulate levels are highly influenced by strong winds.



- Changes in concentrations of dissolved inorganic nitrogen (DIN) and chlorophyll *a* are indicators of biological activity.
- High inflows often increase DIN, which is rapidly consumed by algae and cyanobacteria and intensifies the risk of phytoplankton blooms (higher chlorophyll *a*).
- Poor water clarity after strong storms, such as H. Irma in Sept 2017, may cause prolonged periods of low light and elevated DIN, until conditions for biological uptake improve.

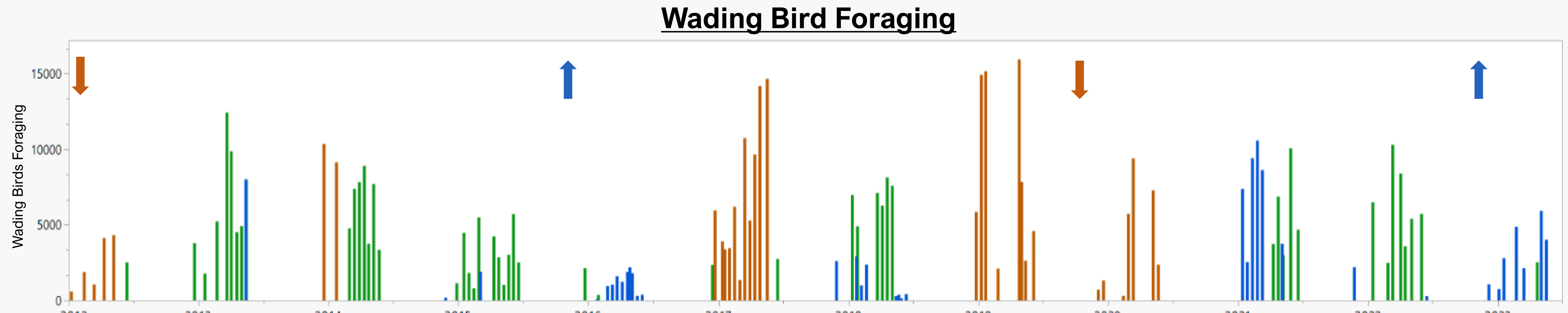
Lake Stage Ecological Envelope



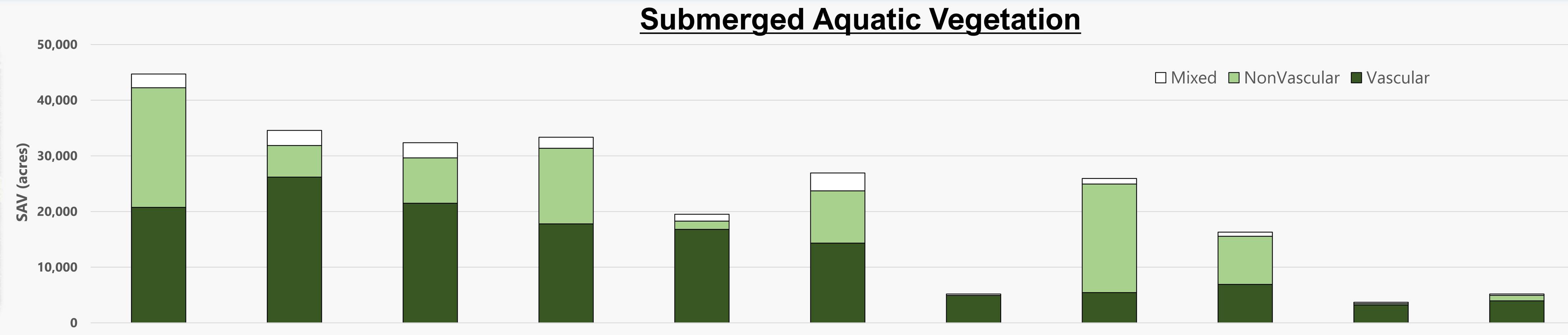
- Lake Okeechobee stages (line) fluctuate in response to changes in inflows, outflows, rainfall, and evaporation.
- Ecological envelope (gray band) defines the range of water levels that represent a compromise of optimal conditions across seasons, habitats, flora, and fauna.
- Short periods **above** or **below** the envelope are not necessarily ecologically harmful, but slow rates of change are desirable.
- Rapid and extreme variations in water levels are unnatural and a function of the highly channelized watershed.

Wading Bird Foraging

- Higher wet season lake levels promote prey production in the upper marshes.
- As lake levels recede and marshes dry, prey becomes concentrated and easier to catch.
- If lake is too low prior to nesting season (e.g.⬇), or too high during it (e.g.⬆), foraging is usually lower.

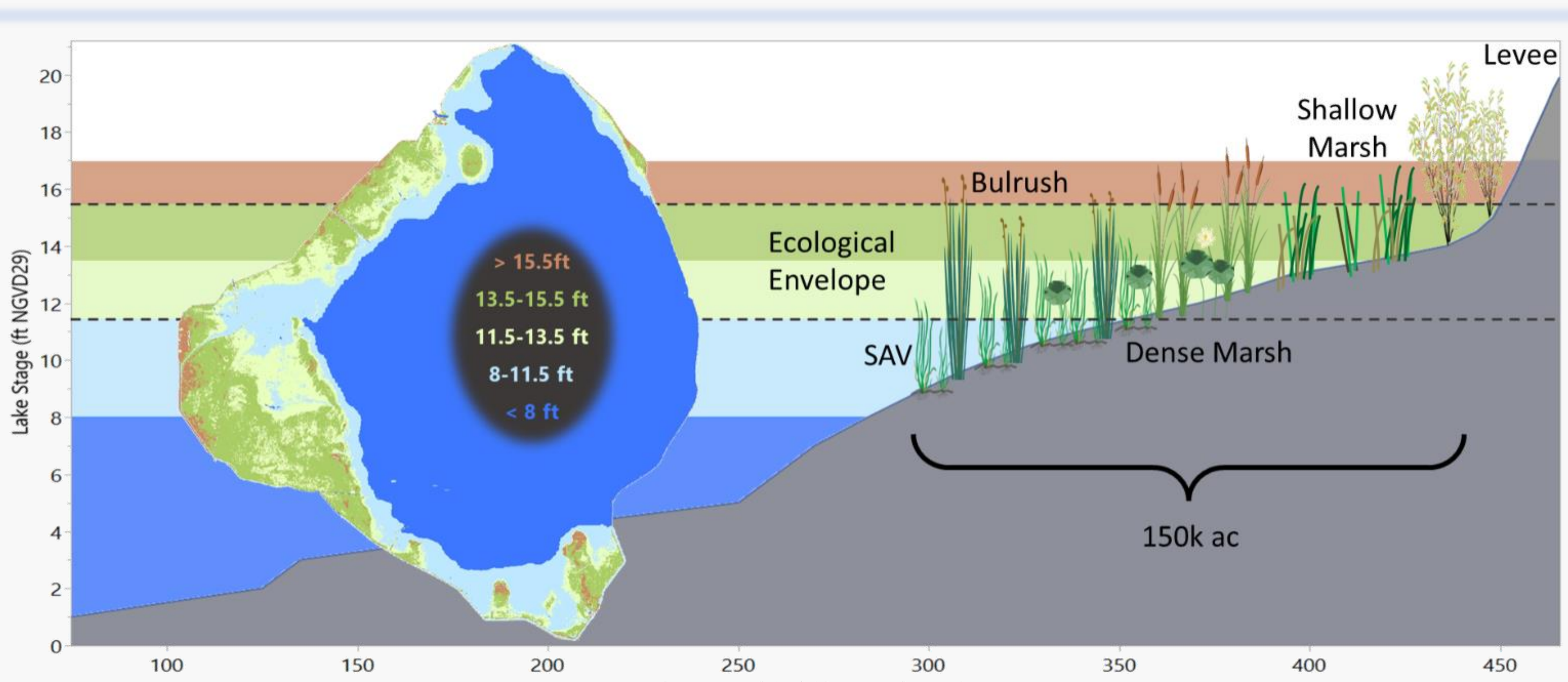


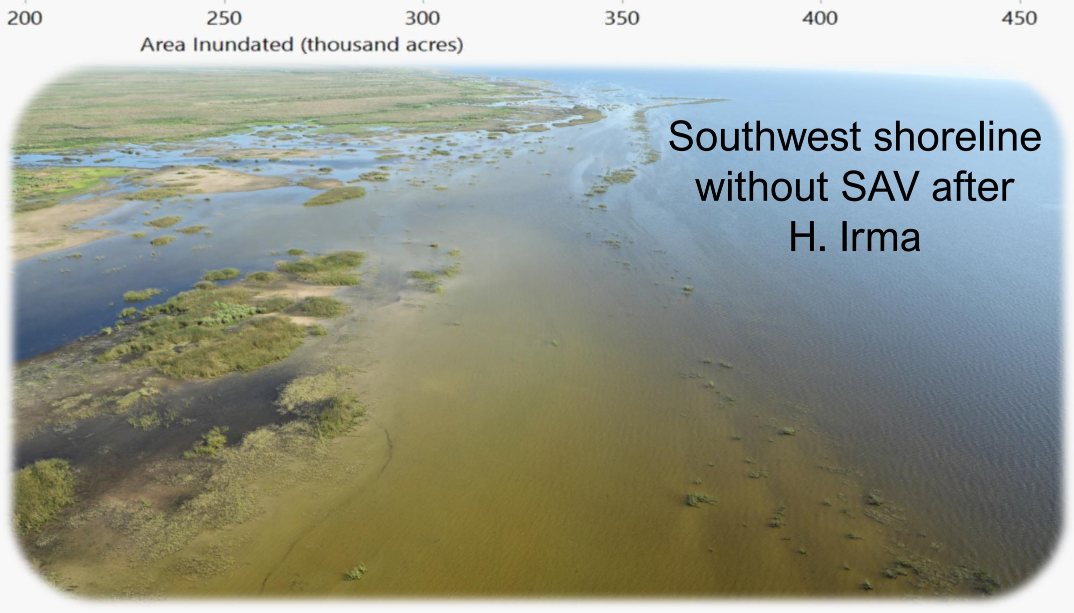
Submerged Aquatic Vegetation



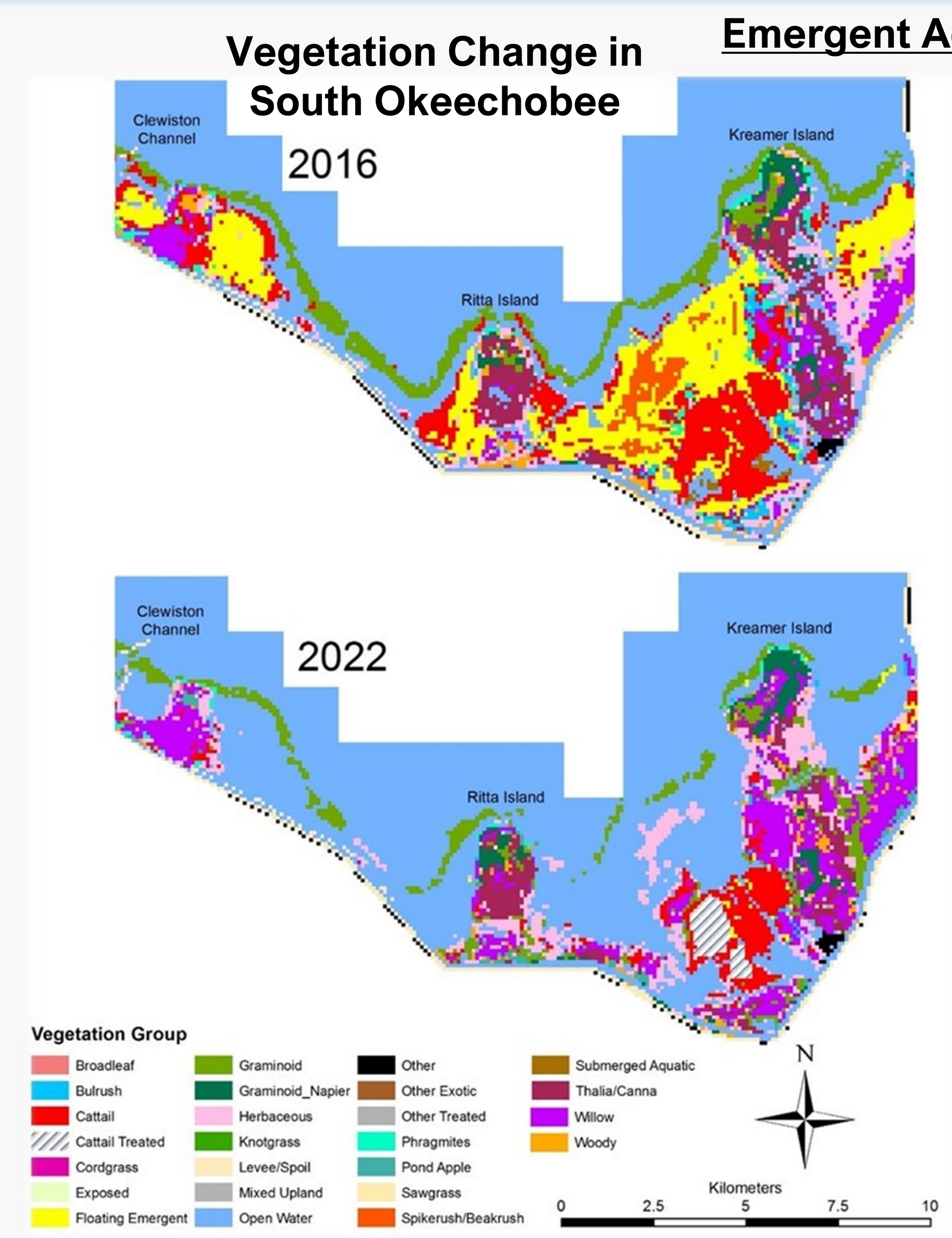
- Lower lake stages increase the light reaching young/seedling submerged aquatic vegetation SAV and promote growth.
- If stages stay too low, SAV beds may dry out and become dominated by emergent plants.
- If lake stages stay too high, even tall and well established SAV can die out.

SAV sampled in Aug, prior to H. Ian (Sept. 2022) and H. Nicole (Nov. 2022)





Emergent Aquatic Vegetation



For more information:

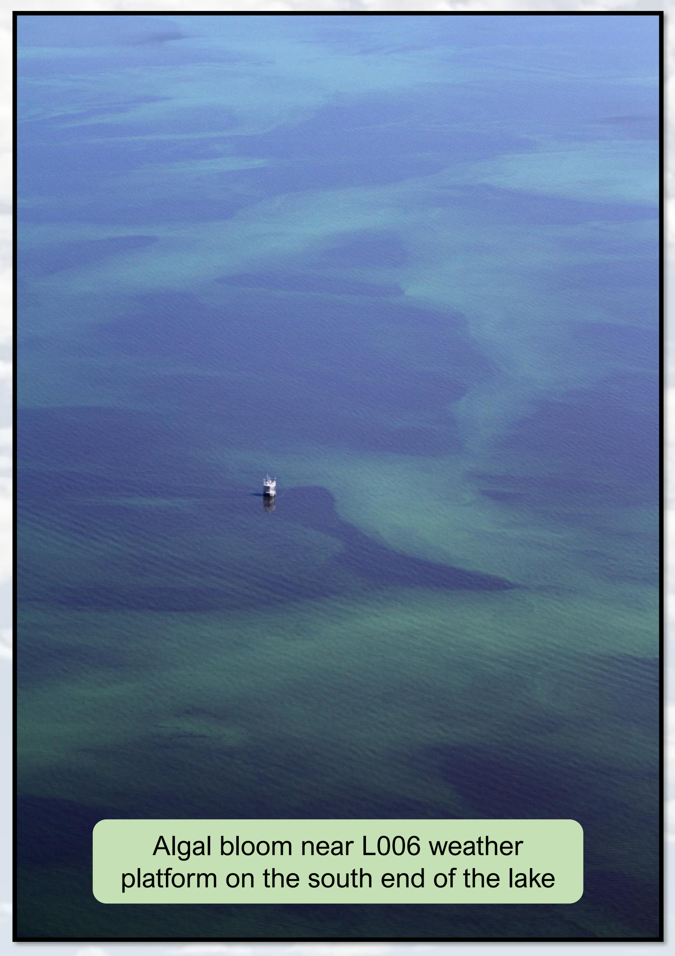
Chapter 8B: Lake Okeechobee Phytoplankton Monitoring in Water Year 2023

Anna Swigris

Lake and River Ecosystems Section, Applied Sciences Bureau

Sampling Florida's Inland Sea

For decades, the South Florida Water Management District (SFWMD) has monitored the presence and distribution of phytoplankton blooms and their associated toxins on Lake Okeechobee. To maintain this long-term dataset, SFWMD monitors six historic sampling stations on the lake for a multitude of phytoplankton-related parameters. Here is a look at that sampling effort in Water Year 2023 (WY2023) and how it compares to the last decade.



Algal bloom near L006 weather platform on the south end of the lake

Setting the Stage

- WY2023 = May 2022 – April 2023
- Dry Season = November – April
- Wet Season = May – October
- Monthly monitoring at 6 stations (**Figure 1**)
- Measured parameters:
  - Chlorophyll *a* (chl-*a*), as a proxy for phytoplankton biomass
    - Algal Bloom = chl-*a* concentrations > 40 micrograms per liter (µg/L)
  - Microcystin toxin concentrations
    - Most microcystins monitored are detectable at 0.25 µg/L
  - Algal identification
  - Surface water quality parameters

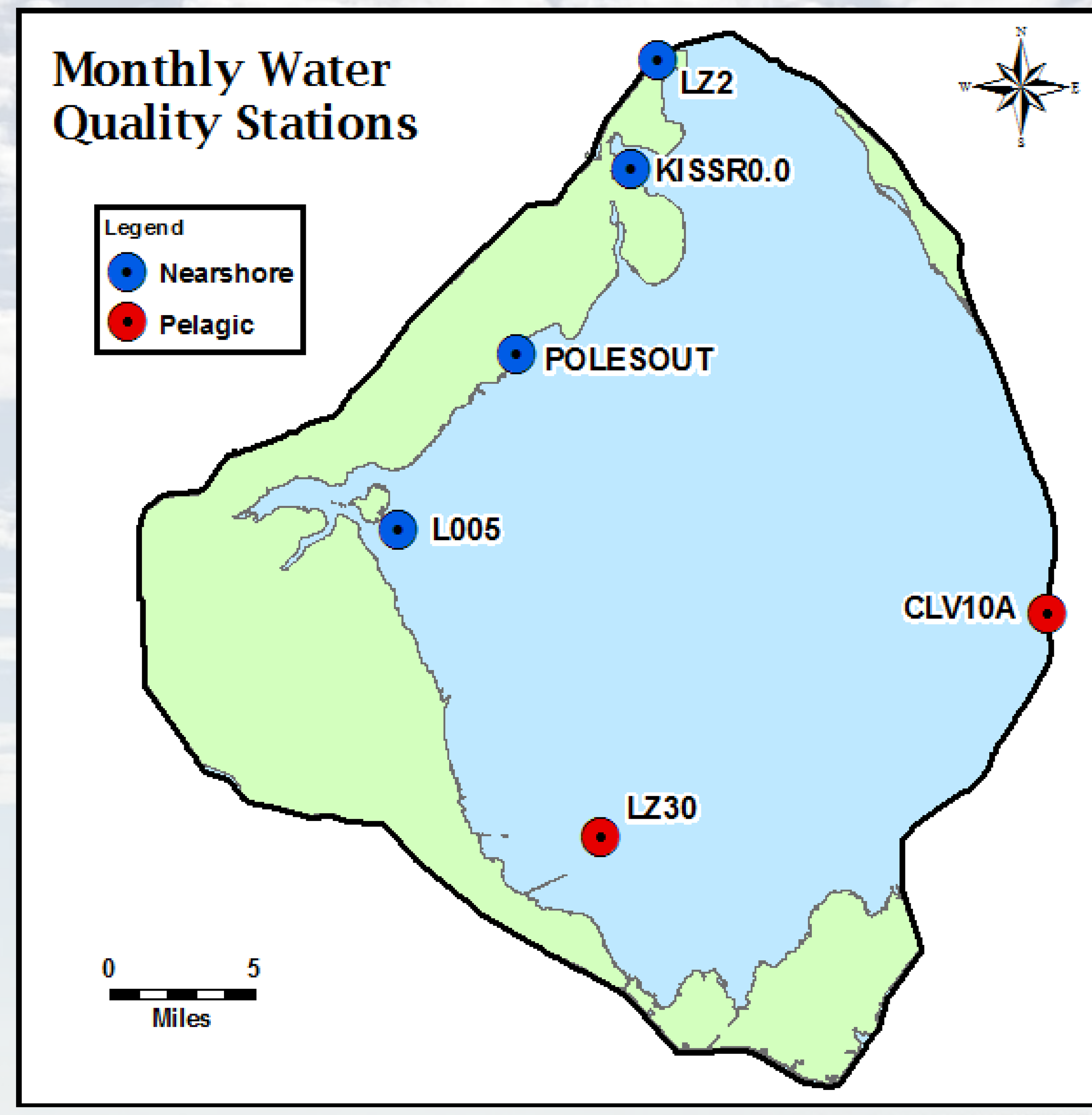


Figure 1. Long-term monitoring stations for chlorophyll *a*, microcystin toxins, and algal identification. Pelagic stations are outlined in red, while nearshore stations are outlined in blue.

Bloom Detections

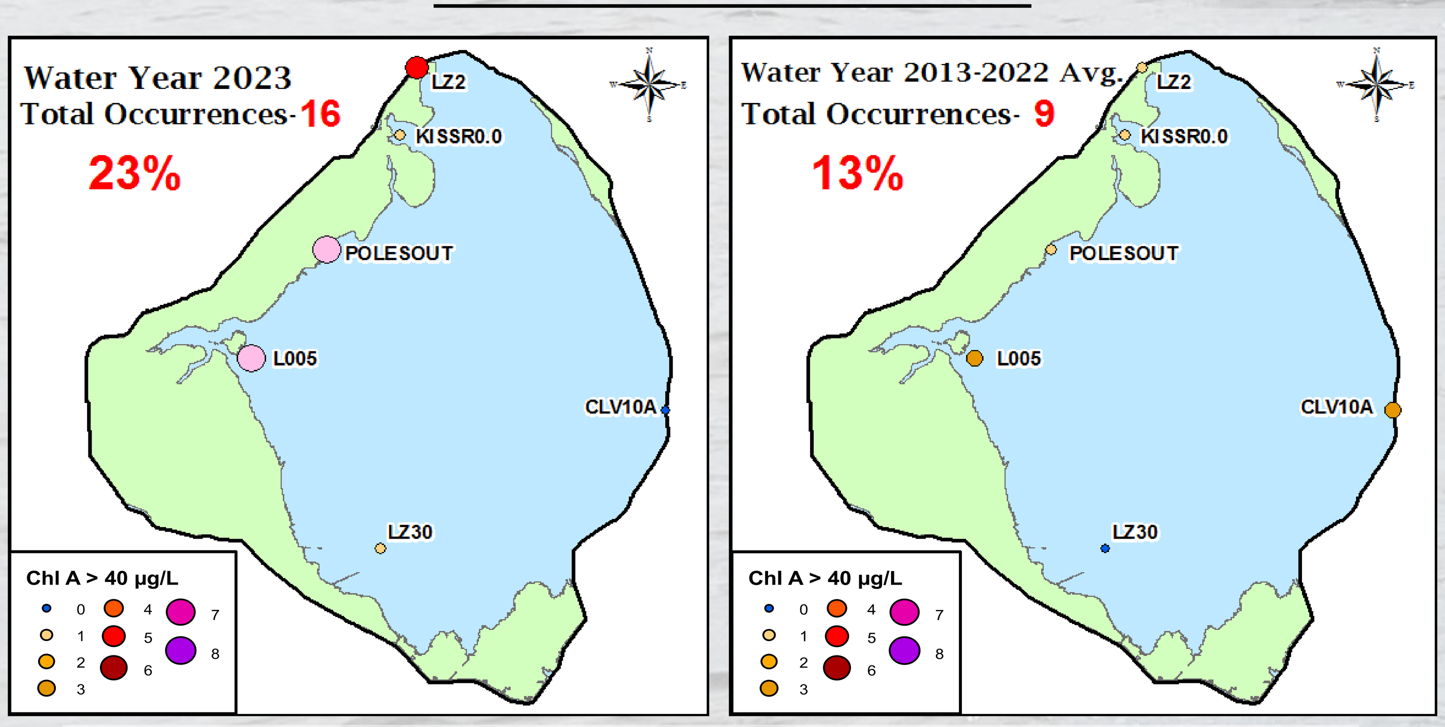


Figure 2. Algal bloom occurrences in WY2023 (left) compared to the last ten water years (right).

Toxin Detections

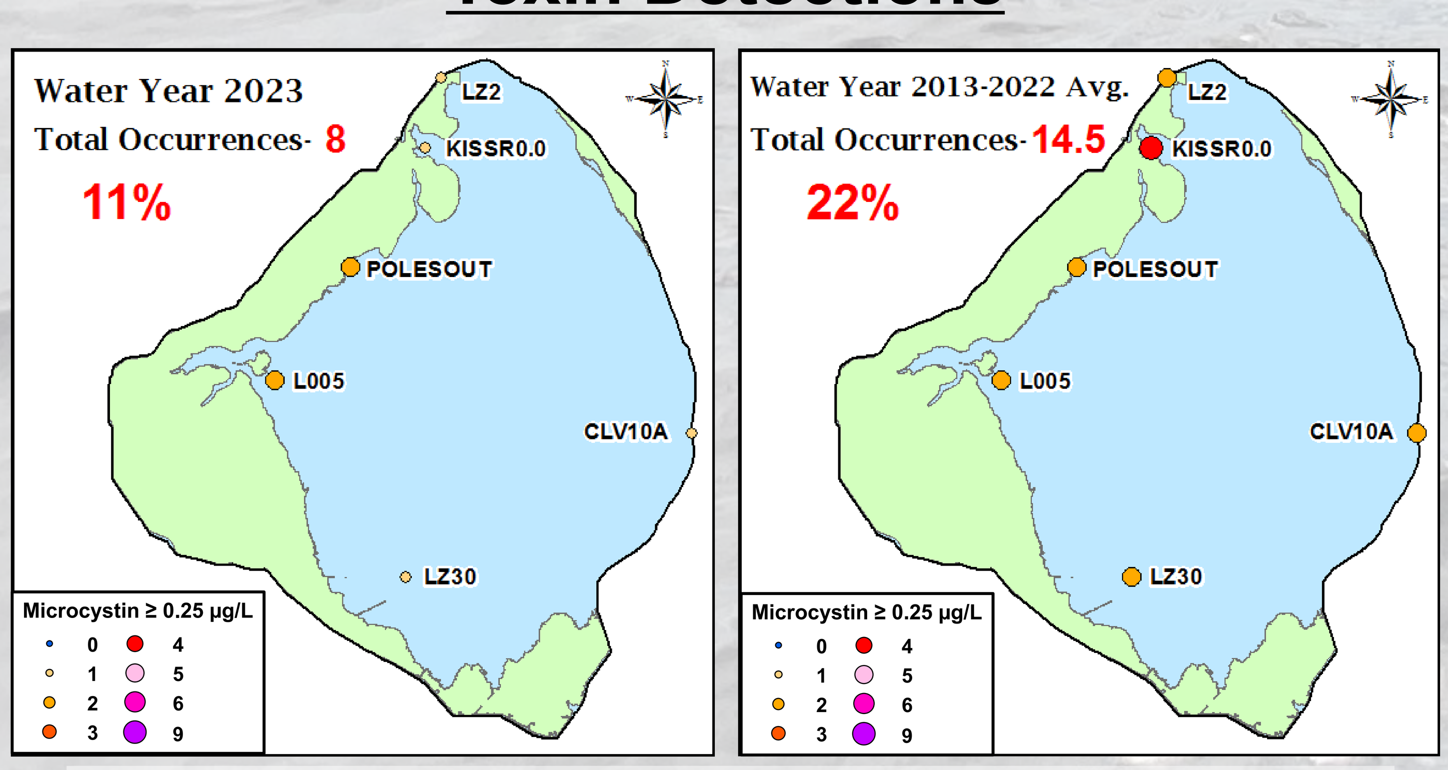


Figure 3. Detectable microcystin levels in WY2023 (left) compared to the last ten water years (right).

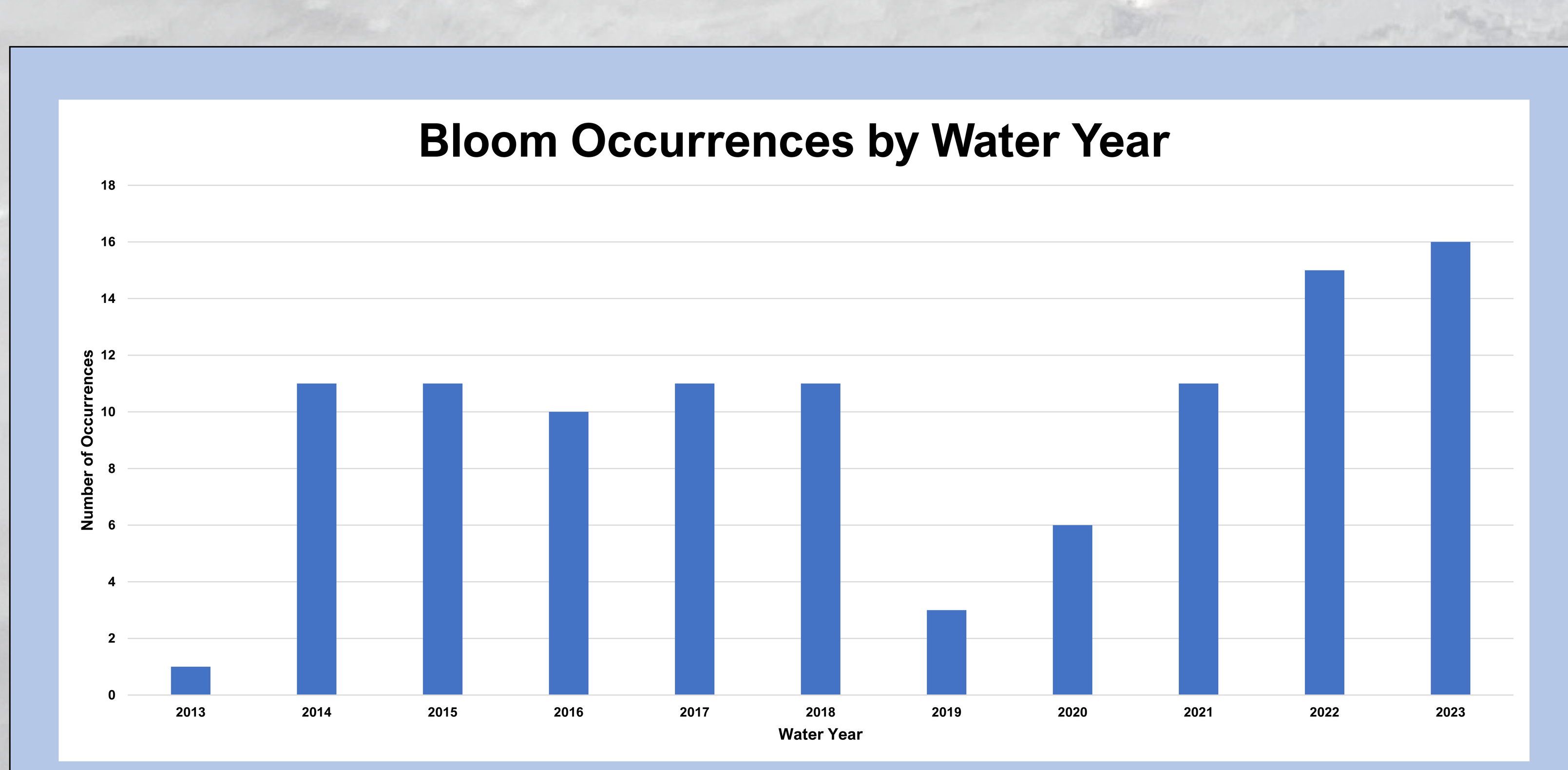


Figure 5. Frequency of algal blooms represented in the historic dataset from WY2013 through WY2023.

Wet versus Dry

Algal blooms and detectable toxin levels occur more in the wet season than in the dry season on Lake Okeechobee. Here are some of those differences over the last eleven water years.

Wet Season
May – October

- 82% of total bloom occurrences
- 77% of detectible microcystin toxins
- Average chl-*a* concentration of 29.6 µg/L
- Average microcystin concentration of 0.9 µg/L

Dry Season
November – April

- 18% of total bloom occurrences
- 23% of detectible microcystin toxins
- Average chl-*a* concentration of 15.7 µg/L
- Average microcystin concentration of 0.04 µg/L

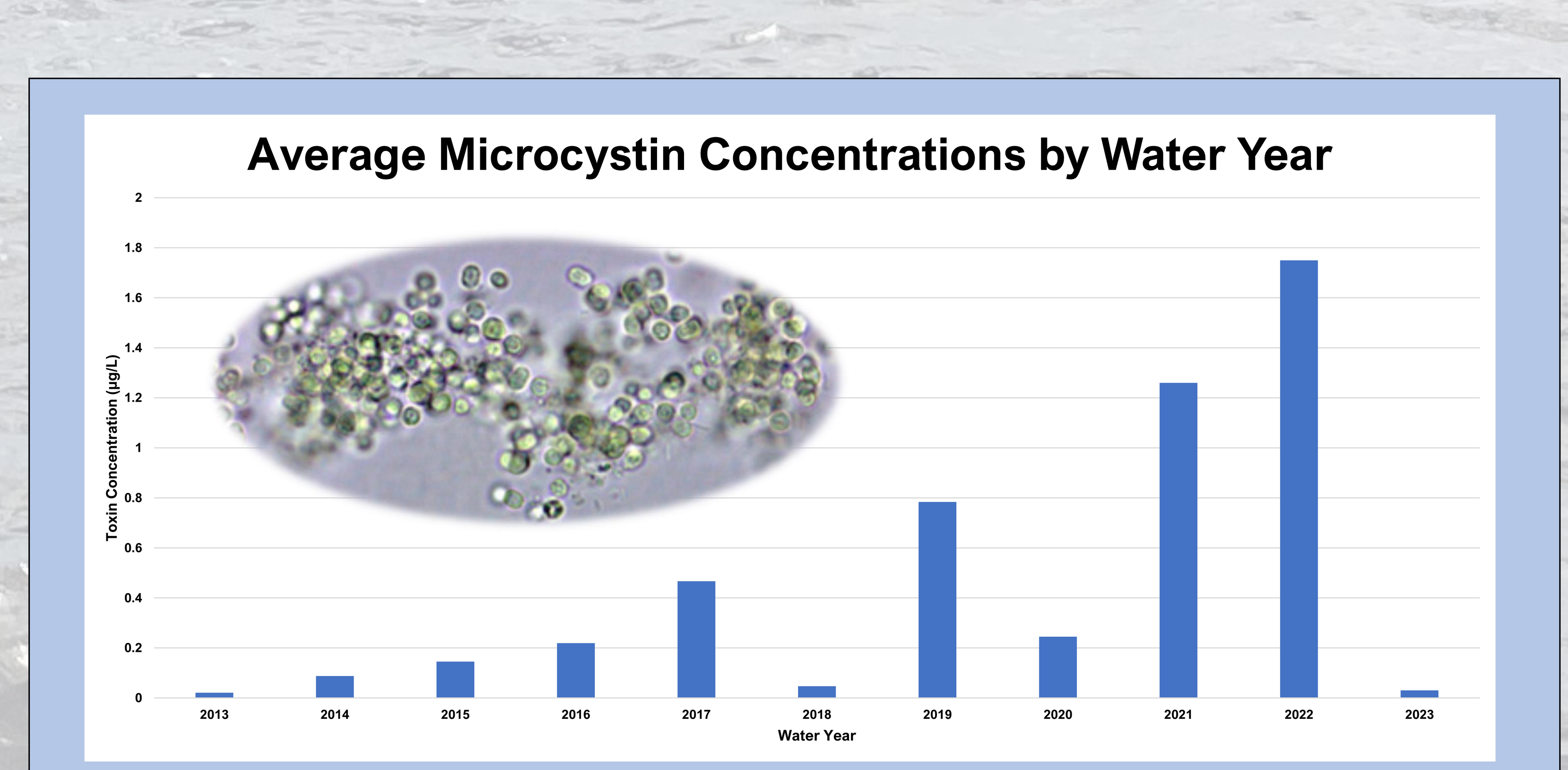


Figure 4. Average microcystin toxin concentrations represented in the historic dataset from WY2013 through WY2023.

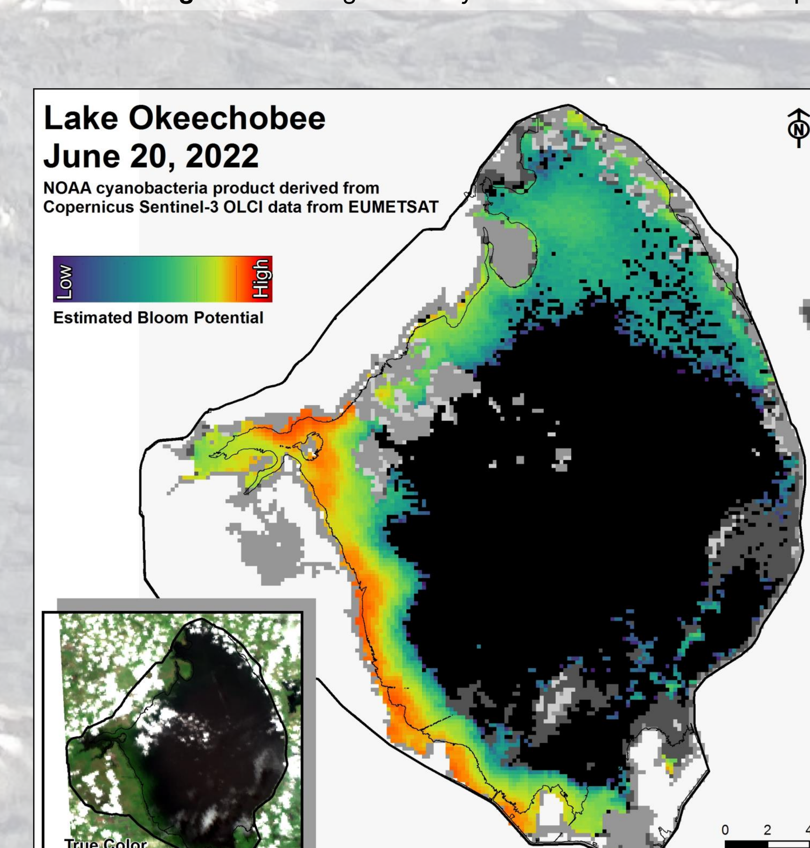


Figure 6. Satellite imagery showing bloom potential on Lake Okeechobee one day during WY2023's wet season.

Space and Time

Algal blooms occur more often in nearshore areas than offshore areas in Lake Okeechobee. In the eleven-year dataset, nearshore areas experienced blooms 18% of the time, and offshore areas experienced blooms 4% of the time. This trend can be seen in greater detail in Appendix 8B-2 of the South Florida Environmental Report, which, due to an expansion of phytoplankton monitoring in March of 2020, elucidates finer-scale trends in toxins and chlorophyll *a*.

For more information:

Chapter 8B: Lake Okeechobee Submerged Aquatic Vegetation Update

Daniel Marchio

Lake and River Ecosystems, Applied Sciences Bureau

Submerged Aquatic Vegetation (SAV) is a key indicator of overall ecological health and benefits the lake ecosystem in a multitude of ways:

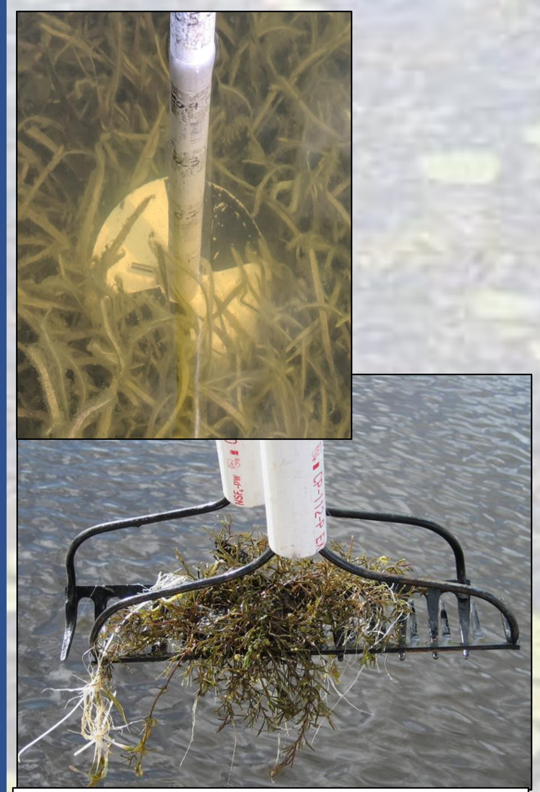
- Increased water clarity
- Improved water quality
- Stabilization of sediments
- Increased mammalian and Invertebrate species richness

SAV distribution and abundance is principally governed by light availability and water depth in Lake Okeechobee.

SAV coverage has varied dramatically over the period of record, coinciding with hydrology:

- SAV coverage generally peaks 1-2 years after low lake stage and increased underwater light availability.
- SAV coverage generally decreases after major hurricanes.

SAV is monitored by two methods to track responses to environmental conditions at different scales in time and space using a combination of methods. Each fall (August to September) the entire nearshore region of the lake is mapped to determine the total area of each SAV species using a systematic grid while biomass of SAV species is measured twice a year on transects.

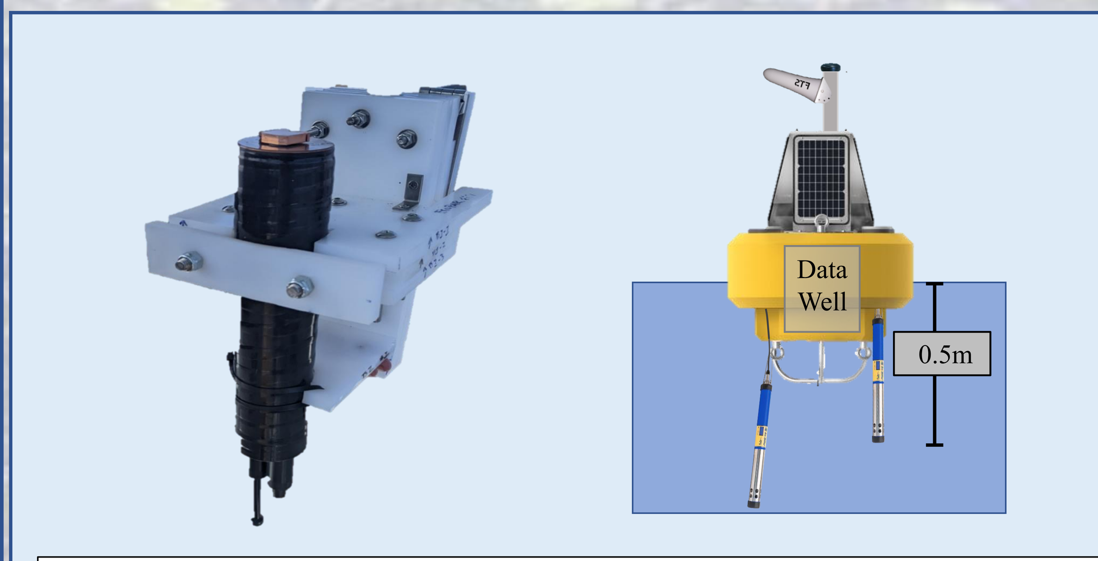


Secchi disk (upper left) and modified-rake SAV sampler.

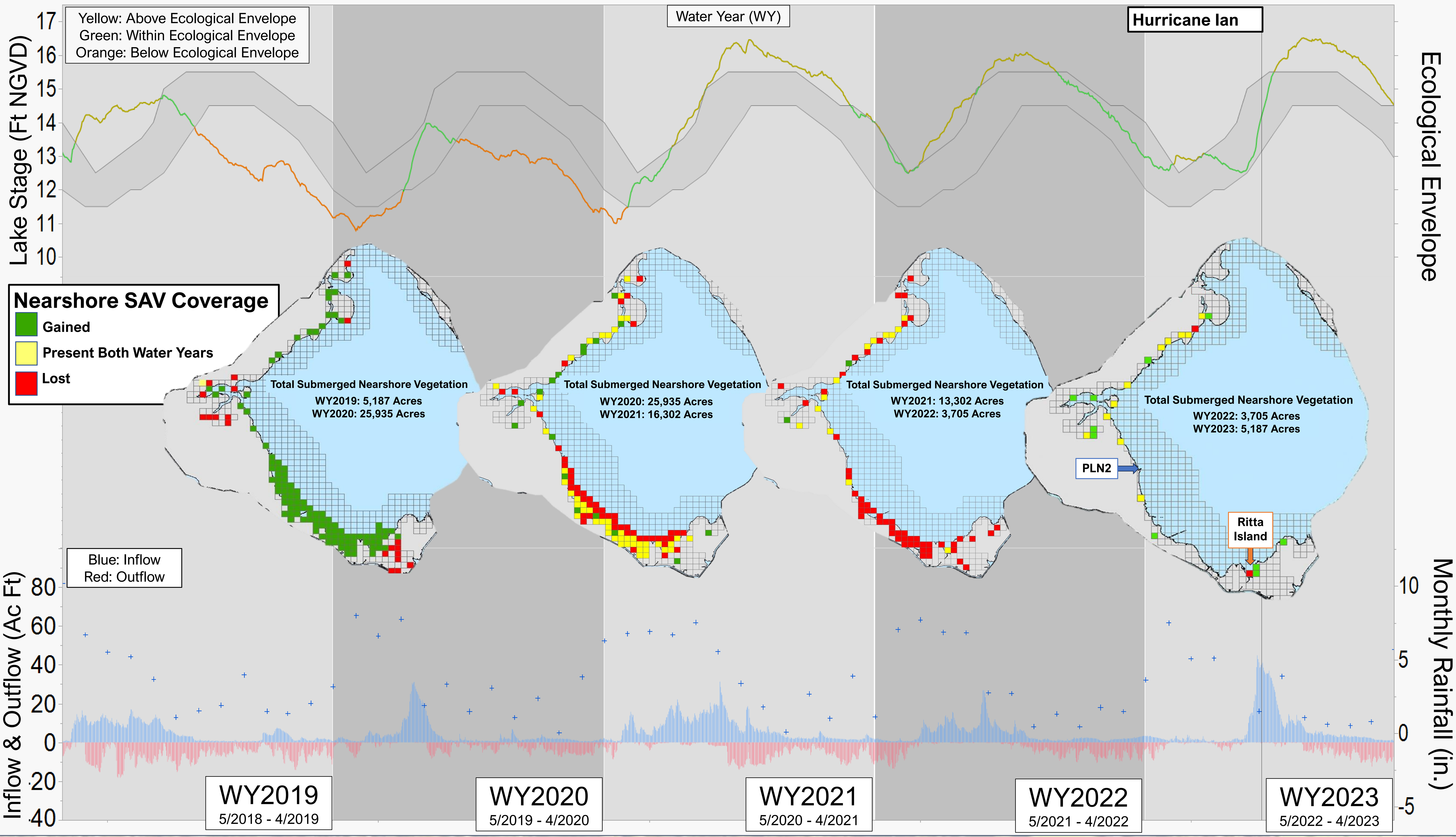
Combined SAV grid (blue boxes) projection and transects (orange dots) on Lake Okeechobee.

Ongoing research dealing with SAV may allow identification of an optimal range of water levels, and in turn could be used to maximize ecological benefits from regional hydrologic restoration programs (i.e., the Comprehensive Everglades Restoration Plan).

Current research is investigating underwater light availability, seedbank dynamics and near real-time water quality, to gain a better understanding of environmental stresses imposed on SAV.

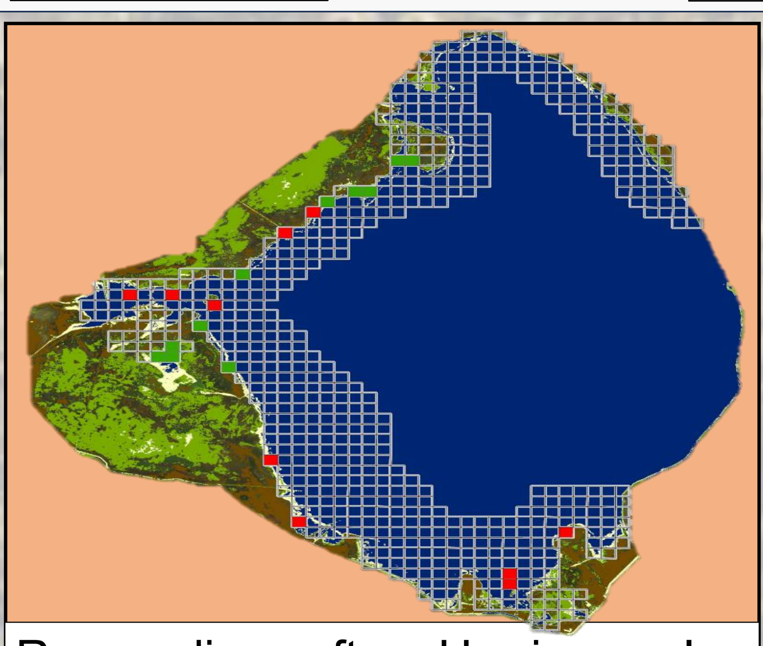


Photosynthetic Active Radiation sensor* (left) and water quality buoy (right). *not to scale

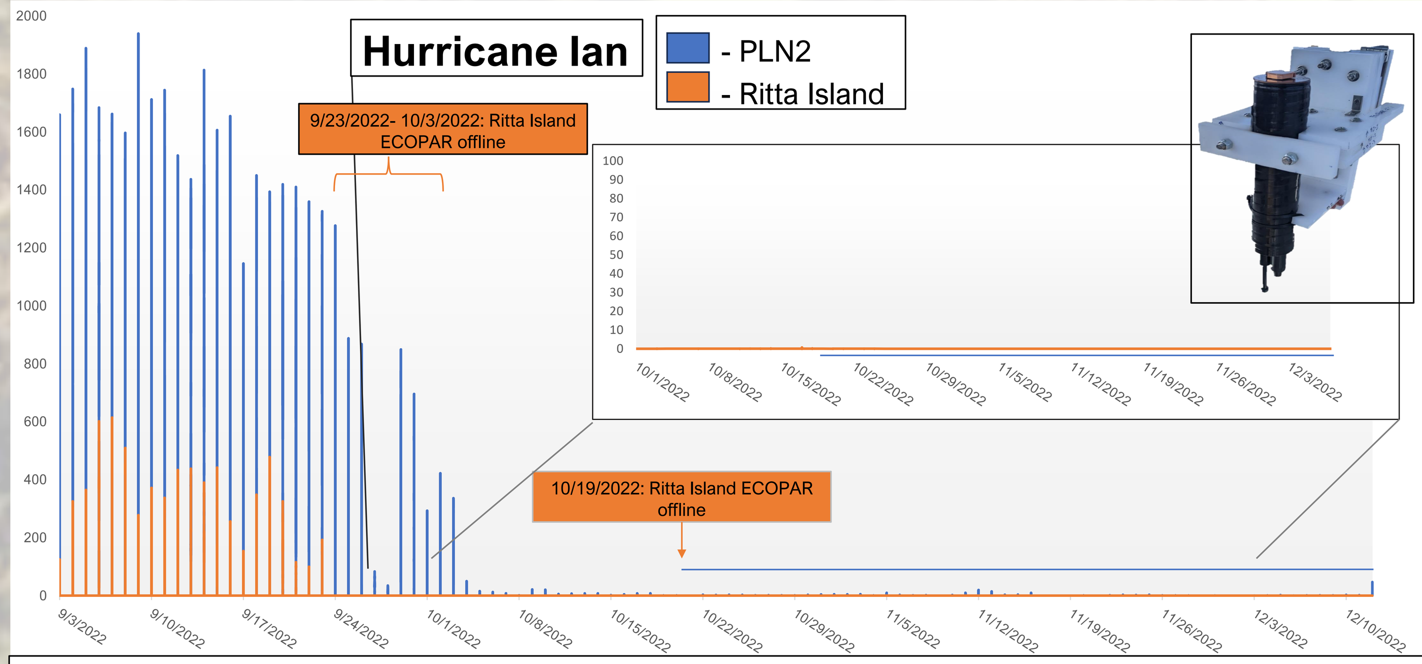


Low lake stages in WY2020 assisted the SAV recovery from lingering impacts of Hurricane Irma. Coverage of SAV increased from 5,187 ac (acre) to 25,935 ac, the vast majority was from, *Chara*, the non-vascular species (macroalgae).

SW Shore Lake Okeechobee, 2020



Resampling after Hurricane Ian showed 2,470 ac of lost SAV (red grids) and 2,717 ac persisted (green).



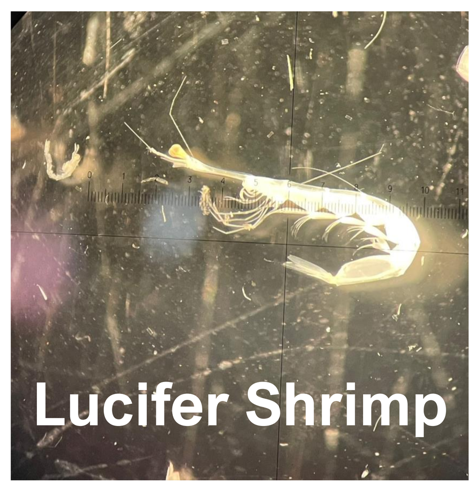
Measured underwater light availability at PLN2 and Ritta Island from before and after Hurricane Ian.

For more information: SCAN ME

Chapter 8C: St. Lucie River Watershed Protection Plan Annual Progress Report

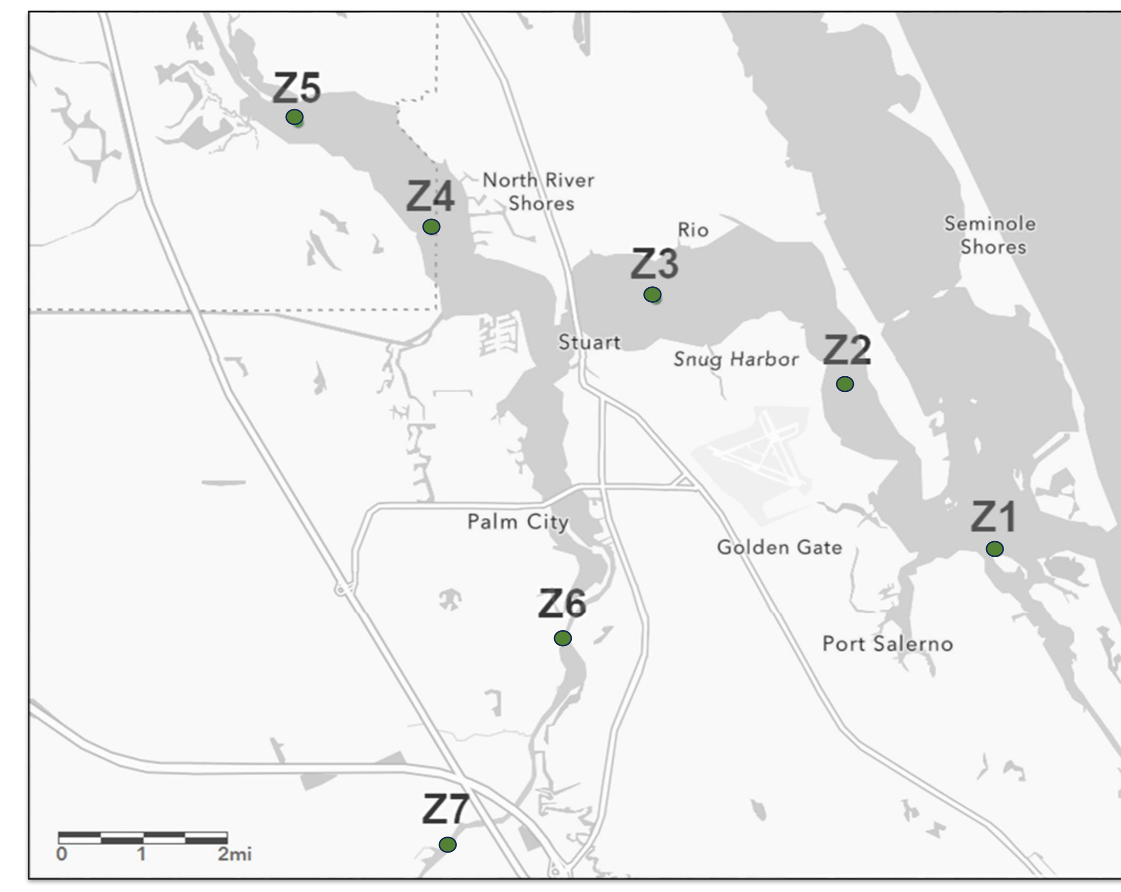
Zooplankton Monitoring in the St. Lucie River Estuary

Elizabeth Pudlak
Coastal Ecosystems Section, Applied Sciences Bureau



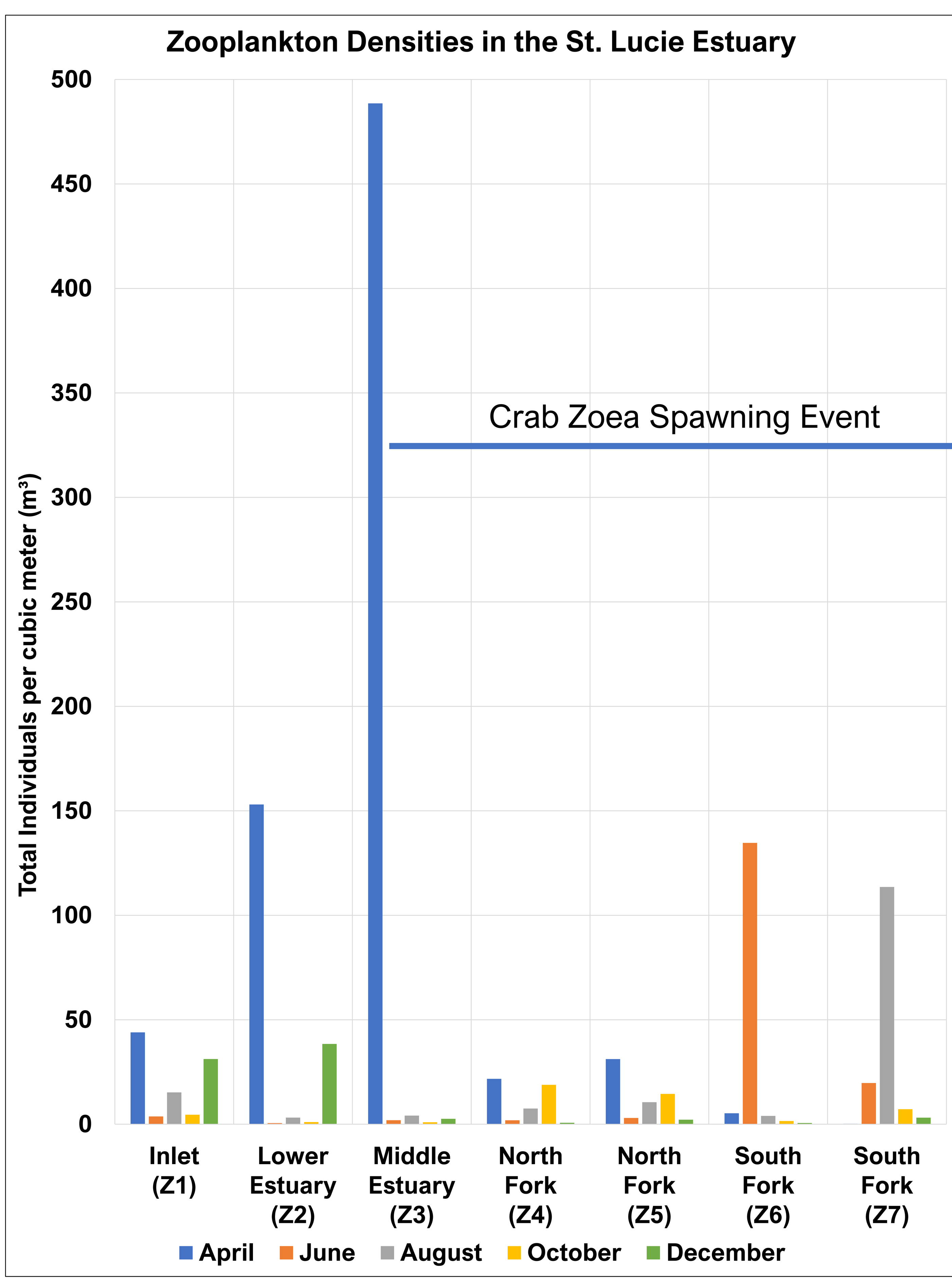
Purpose of Zooplankton Monitoring

- Zooplankton are the base of the food chain and are relied on by many animals like fish and crustaceans.
- Many of our estuarine fauna begin as zooplankton.
- Zooplankton are sensitive to temperature and salinity changes, so they can be an indicator of changes in water quality.
- Zooplankton spawning is often triggered by salinity or temperature changes.

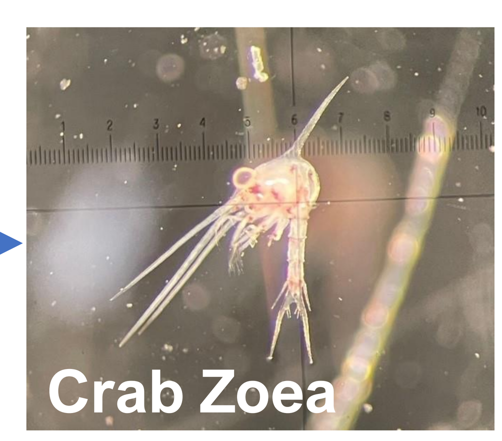


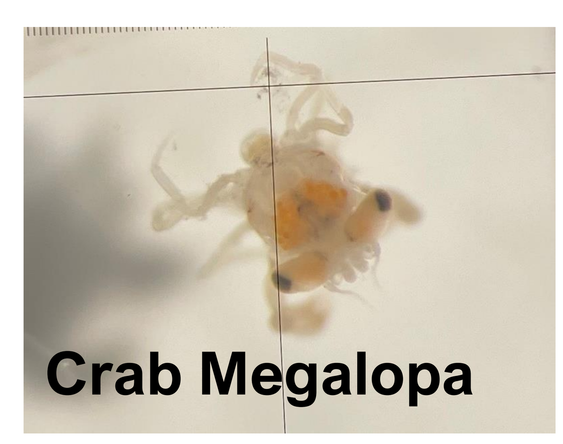
Zooplankton Communities

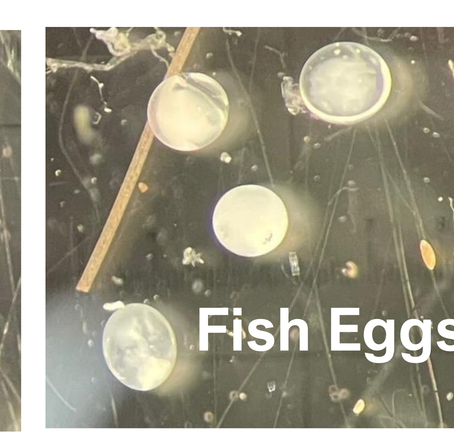
- The highest zooplankton densities were at different sites each sampling month.
- Peaks in zooplankton densities were usually a result of a spawning event triggered by temperature or salinity changes.



Taxonomic Group	Percent Present
Crab Zoea	100.0 %
Shrimp Zoea	91.4 %
Fish Larvae	94.3 %
Calanoid Copepods	85.7 %
Chaetognaths	77.1 %
Crab Megalopa	77.1 %
Shrimp Mysis	65.7 %
Barnacle Nauplii	62.8 %
Amphipods	62.8 %

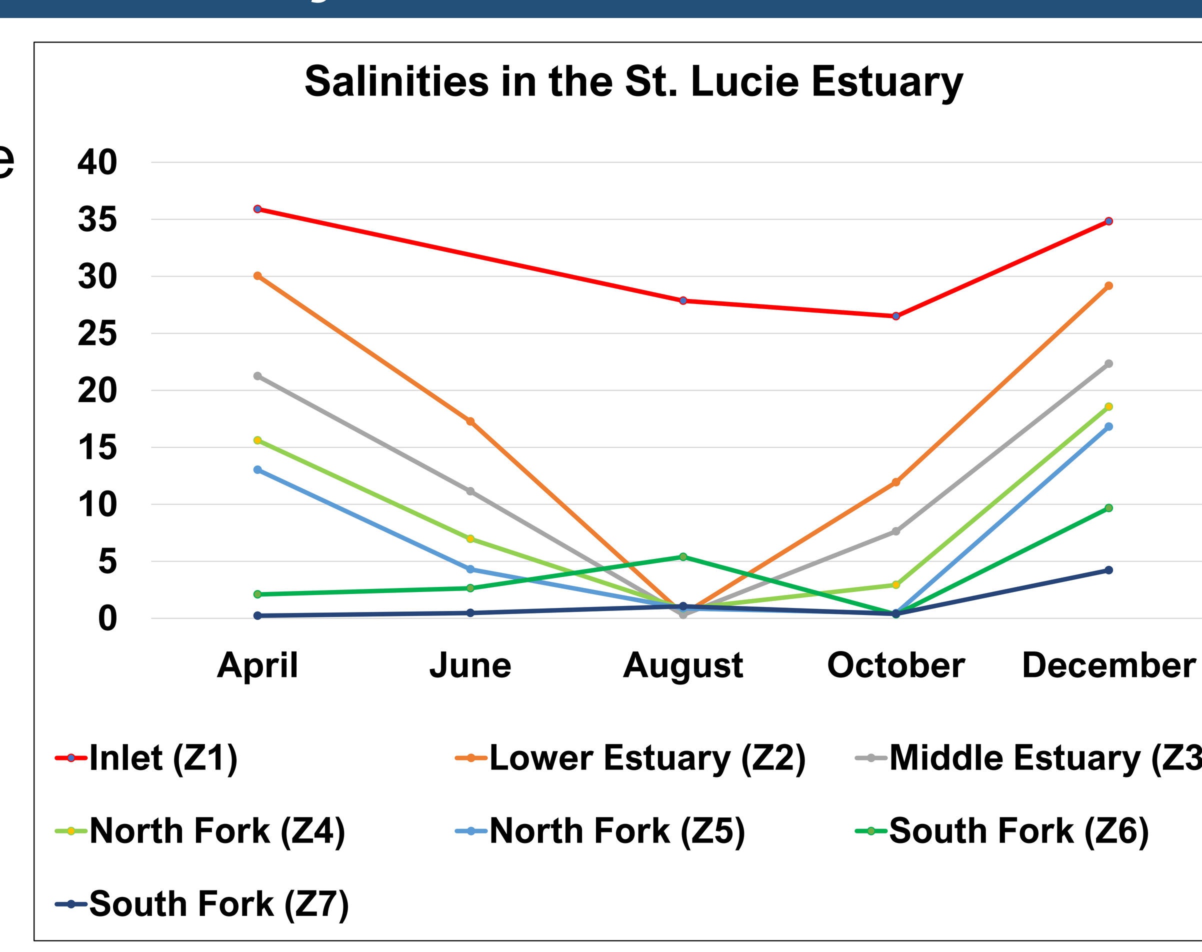




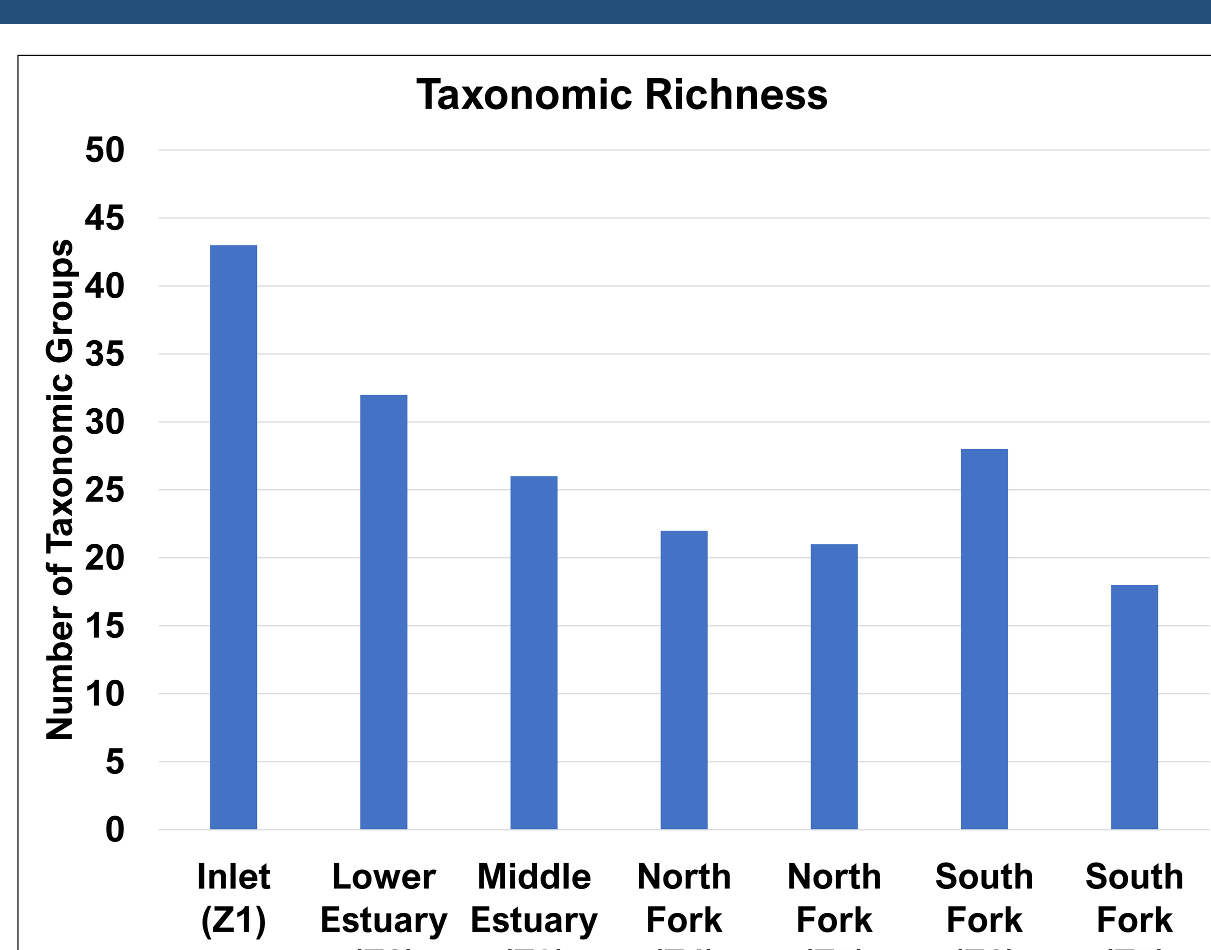


Water Quality

- Salinities differ between sites.
- Dry months (April, December) have higher salinities.
- Wet months (June, August, October) have lower salinities.
- High freshwater inflows can cause changes to diversity and abundance by flushing of zooplankton out of the system, triggering spawning events, and altering the salinity gradients throughout the system.



Taxonomic Richness



- Understanding zooplankton communities and their spatial and temporal changes can help better understand how they are impacted by freshwater inflows.
- Using zooplankton as an indicator can determine the health of the system and future decisions in water management.

For more information: SCAN ME

Chapter 8C: St. Lucie River Watershed Protection Plan Annual Progress Report

Fishes in the Northern Estuaries Monitoring (FNEMO)

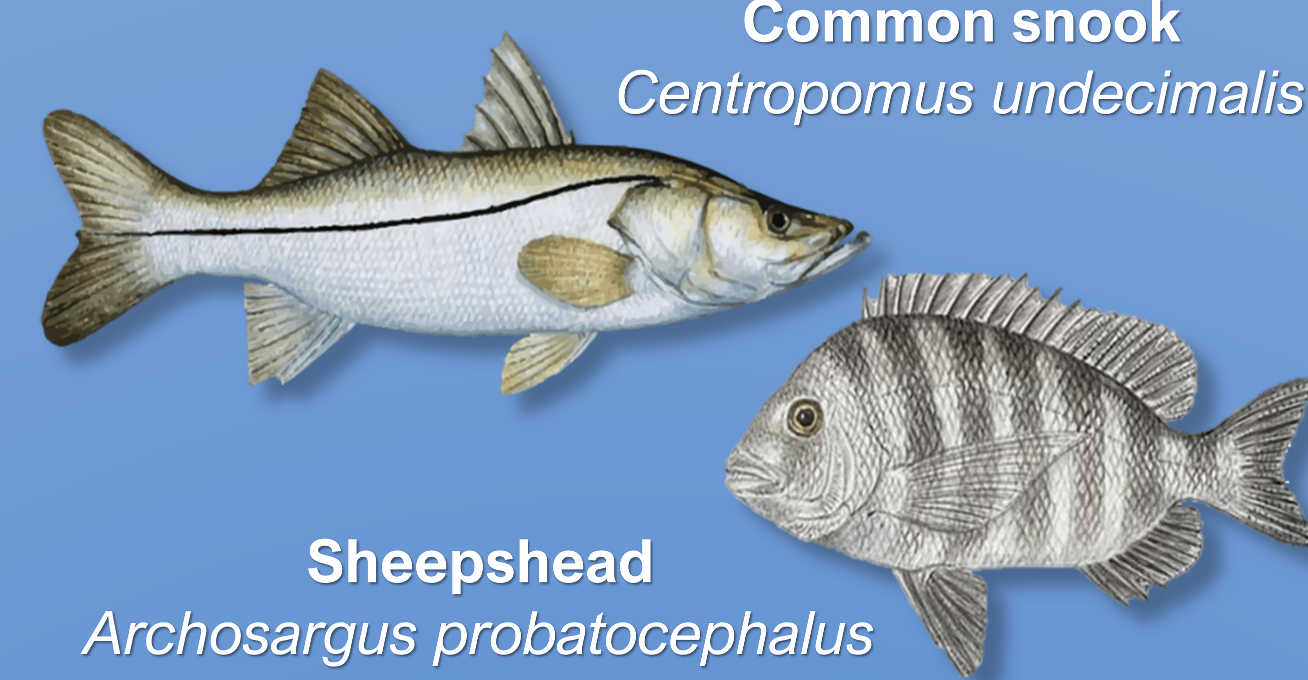
Sarah Webb, Juliane Caughron, Mark Barton
Coastal Ecosystems Section, Applied Sciences Bureau

Introduction and Background

Comprehensive Everglades Restoration Plan (CERP)
Restoration Coordination and Verification (RECOVER)

- Will fish be affected by flow restoration?
- Are fish moving out of the system?
- Are fish subjected to stressful conditions?
- Do prey base and diet patterns change?

Target Species



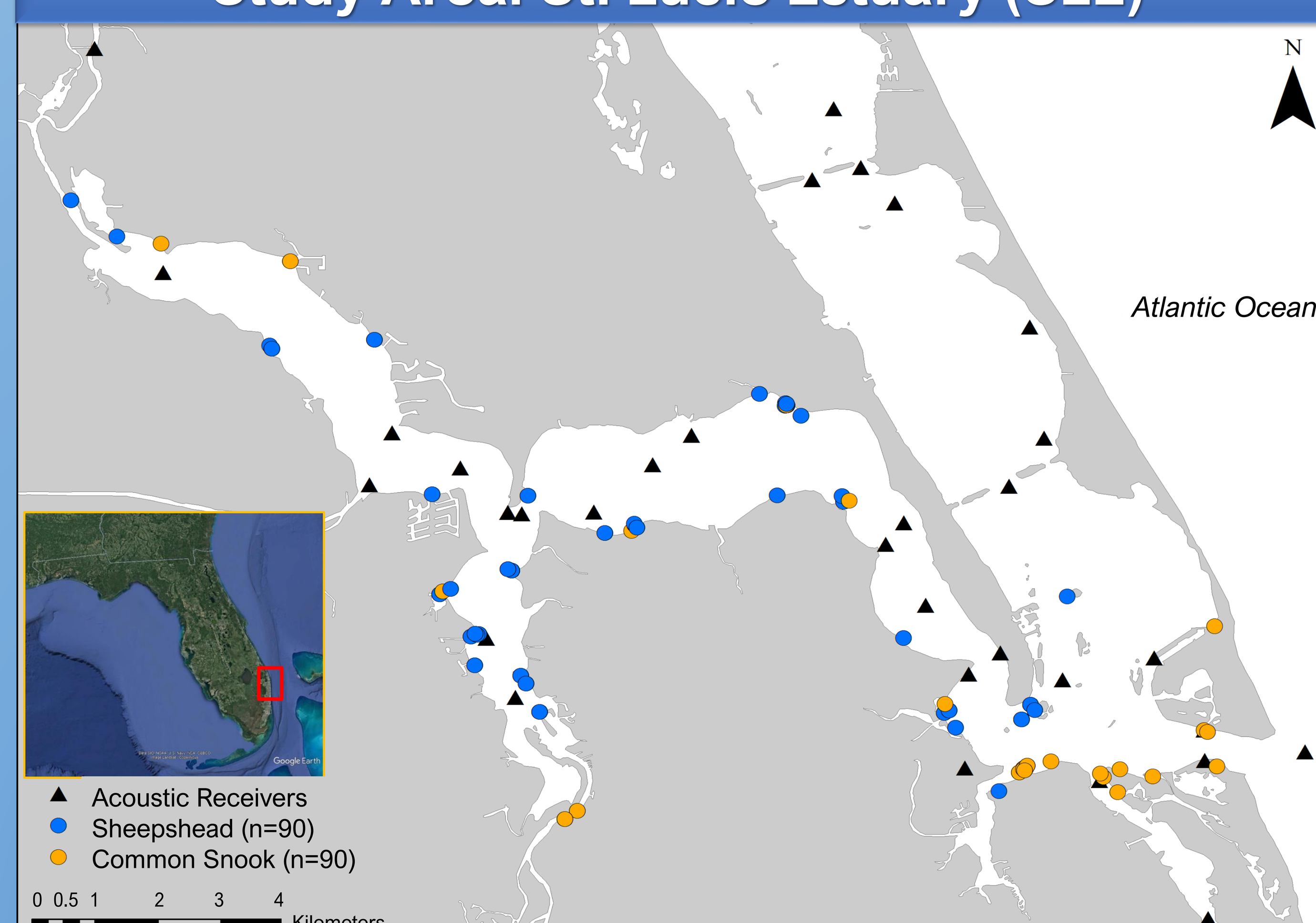
Collection Methods

Fish were caught via seine net or fishing in collaboration with the Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute.

Objective 1: Correlate Fish Movement

180 fish were surgically implanted with acoustic telemetry tags to identify distribution in relation to changing environmental conditions. External dart tags were used for recapture information.

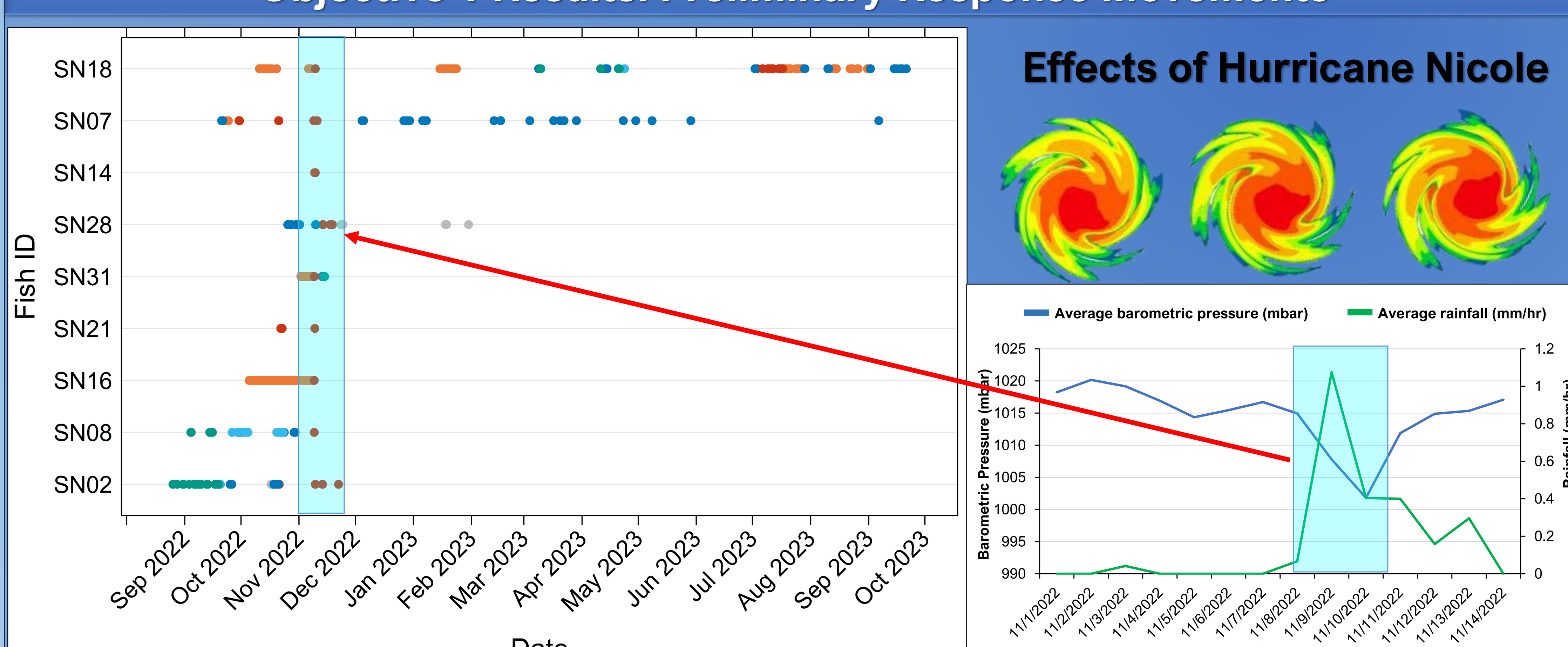
Study Area: St. Lucie Estuary (SLE)



Objective 2: Identify Baseline Health

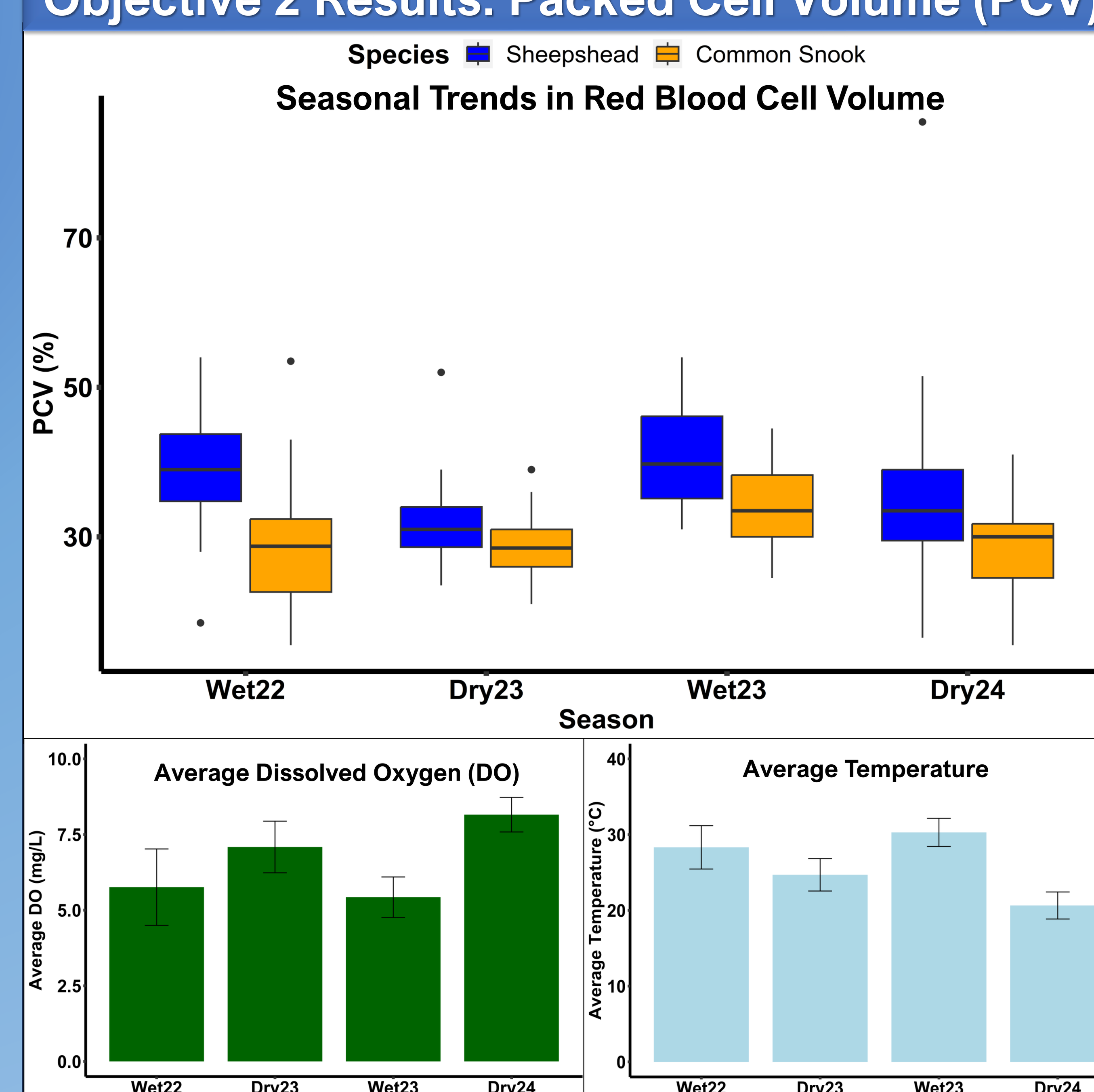
Blood draws and muscle biopsies were taken from snook and sheepshead to identify health parameters and food usage.

Objective 1 Results: Preliminary Response Movements



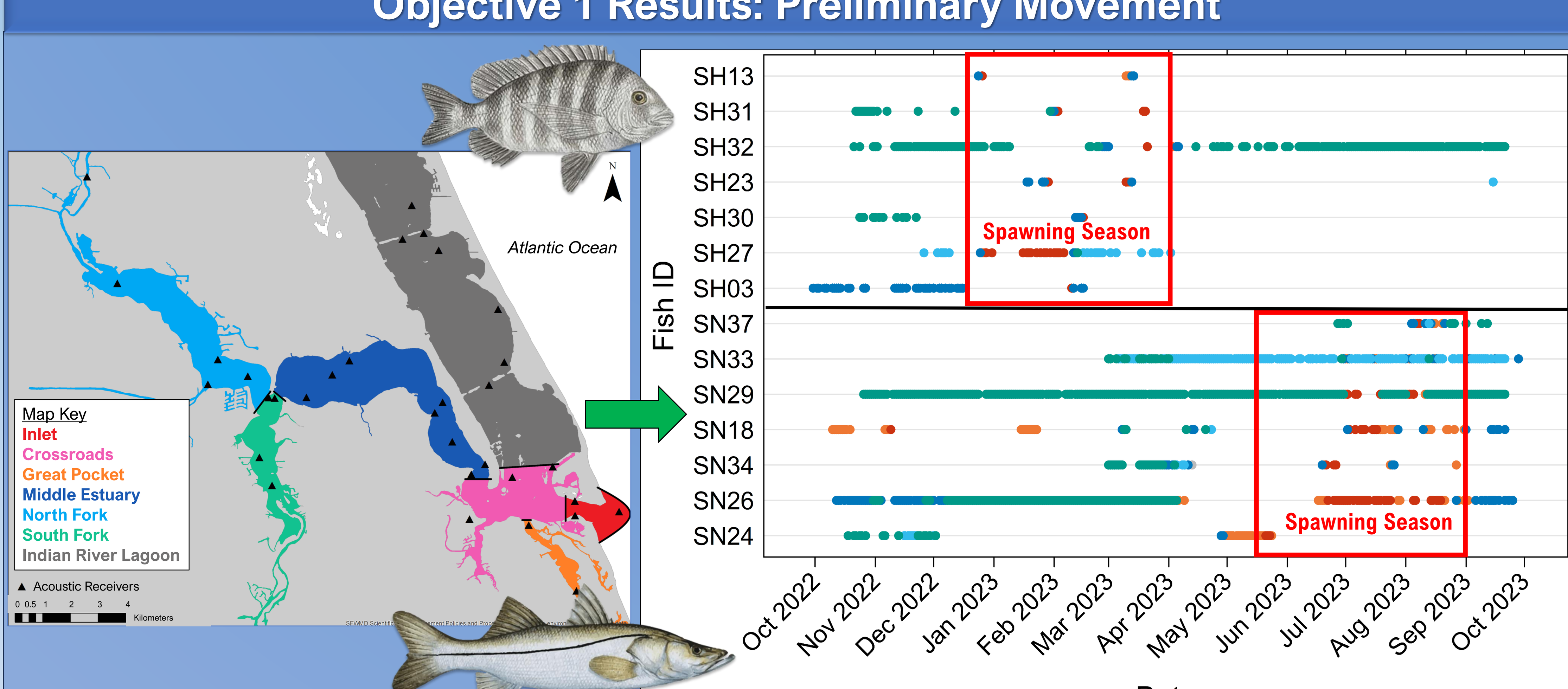
9 snook left the SLE in response to Hurricane Nicole on 11/10/23 and were detected in partner arrays south of the SLE from Jupiter to Elliot Key.

Objective 2 Results: Packed Cell Volume (PCV)



Red blood cell volume can be used as a proxy for oxidative stress. Cell volume typically increases with low dissolved oxygen (DO). Dissolved oxygen decreases with higher temperatures. Higher packed cell volume (PCV) allows for retention of oxygen in low DO (stressful) environments.

Objective 1 Results: Preliminary Movement



Sheepshead were detected at less receivers and had less detections on average than snook. Both species were detected at stations near the inlet during documented spawning seasons.

Summary

- Fish detected south of SLE after Hurricane Nicole.
- Implications for guidance of water releases from Lake Okeechobee in relation to spawning & larval settlement.
- Sheepshead PCV > Snook PCV:
  - Snook may be leaving unfavorable environments.
  - Sheepshead may remain in unfavorable conditions.

For more information: SCAN ME

Chapter 8D: Caloosahatchee River Watershed Protection Plan Annual Progress Report

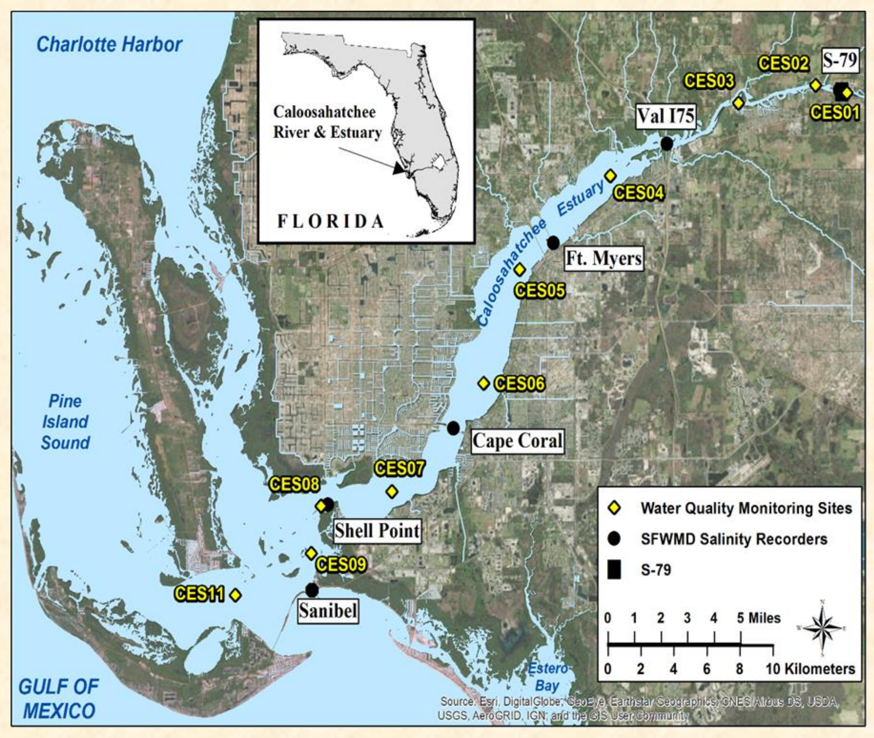
Synthesizing Monitoring Data With a 1D Model for Water Quality Conditions

Detong Sun, Tom Behlmer

Coastal Ecosystems Section, Applied Sciences Bureau

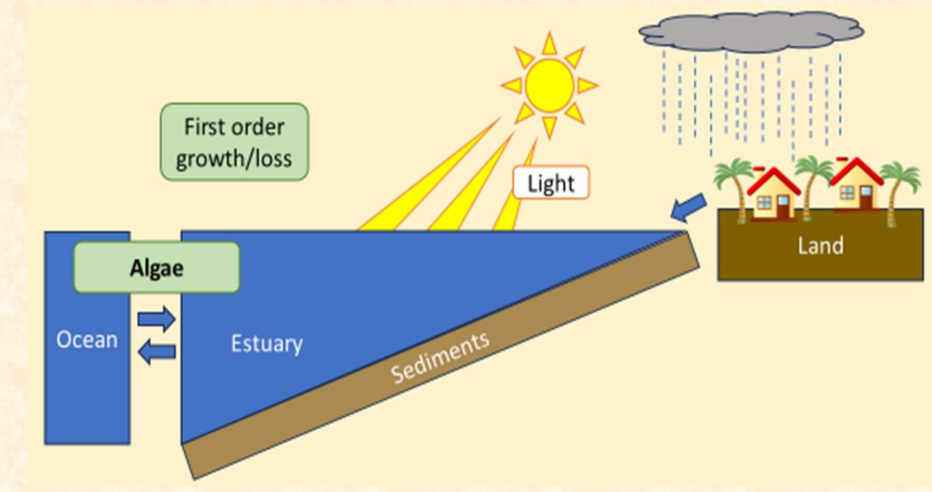
Background and Objective

- The Lake (Okeechobee)-Canal-Estuary systems in Florida are heavily altered and managed.
- More frequent and more intensified harmful algal blooms (HABs) have occurred in recent years.
- Water quality monitoring and modeling are important for the assessment of conditions.
- Kinetic rates are critical for the assessment.
- Quantification of the rates are difficult as direct measurement are not feasible and empirical relationships are often inadequate.
- A mathematical model can be helpful to synthesize survey data to estimate the rates and assessment of water quality conditions.



Approach

- One-dimensional (1D) salt-balanced tidally-averaged advection-diffusion-reaction model as basis.
- Analytical and semi-analytical solutions to the 1D model.
- Calibrate the 1D model with survey data.
- Calibrated rates are the estimated net rates.
- The estimated rates can be important water quality condition indicators that will be helpful for the assessment of algal bloom risk.



Monitoring

- Regular monthly survey.
- Surveying Estuary Responses to Freshwater Inflows (SERFIS) events.
- Nutrients, chlorophyll *a*, salinity, temperature, light, color, turbidity, etc.

1D Model and Solutions

$$\frac{\partial Ac}{\partial t} + \frac{\partial Qc}{\partial x} = \frac{\partial}{\partial x}\left(AE\frac{\partial c}{\partial x}\right) + \mu Ac$$

$$\mu = P_M f(I) f(T) - M$$

where: x is coordinate
C is estuary concentration
μ is net growth rate
E is mixing coefficient
Q is river discharge
A is cross-section area
t is time

Application to the Caloosahatchee River Estuary

- Discharge at S-79.
- Salinity from a hydrodynamic model.
- Boundary conditions from survey at S-79 and station CES09.
- A modified BZI model used to compute phytoplankton growth rate as a function of temperature, light, color, and turbidity.
- Empirical parameters determined through calibration for each survey.
- Model was applied to monthly surveys from 1999 to 2015.

Analytical Solution for Idealized Conditions

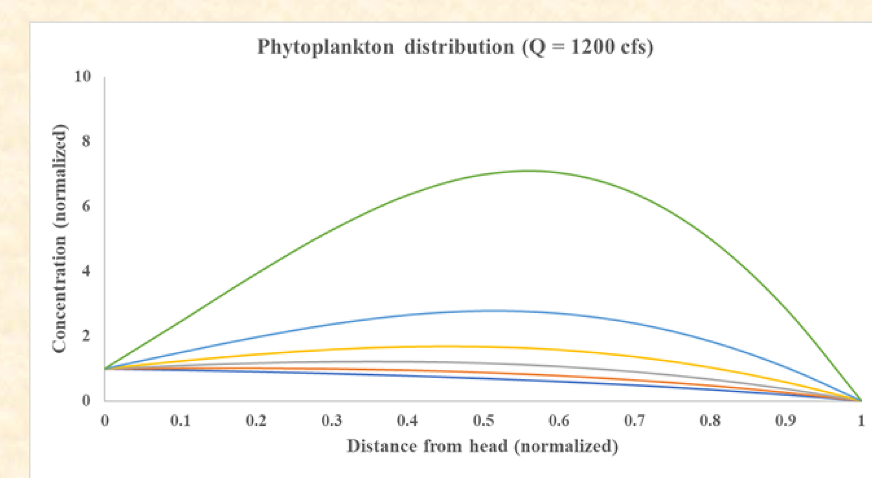
- From Sun et al. 2022.
- Upstream boundary conditions have a controlling effect on downstream estuary for both nutrients and phytoplankton.
- Residence time is critical for algal bloom: when μ is greater than flushing rate, potential algal bloom may develop.
- Higher μ leads to higher chlorophyll maximum, the location of which moves downstream with increasing discharge.

Sun, D., Barton, M., Parker M. and Sheng, Y. P., 2022. Estuarine water quality: One-dimensional model theory and its application to a riverine subtropical estuary in Florida. Estuarine, Coastal and Shelf Sciences 277 (2022) 108058

$$C = C_s(x) + C_t(x, t)$$

$$C_s = C_r \frac{e^{\frac{ux}{2E}} \sinh\left(\beta\left(1 - \frac{x}{L}\right)\right)}{\sinh(\beta)}$$

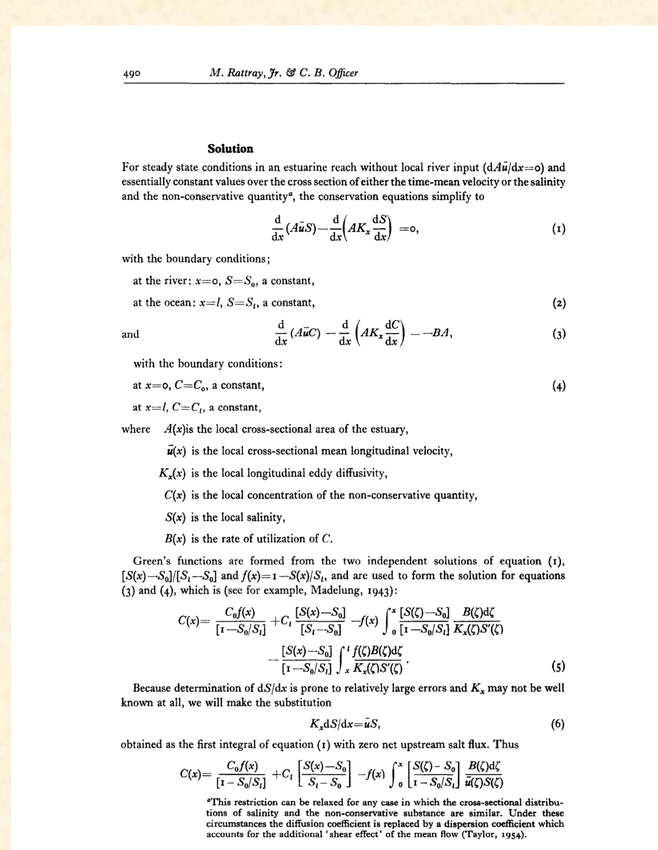
$$C_t = e^{\frac{ux}{2E}} \sum_{m=1}^{\infty} B_m\, e^{-\left[\frac{u^2}{4E} + E\left(\frac{m\pi}{L}\right)^2 - \mu_{net}\right]t} \sin\frac{m\pi x}{L}$$



Semi-analytical Solution

- Sun et al. 2023 (manuscript in preparation).
- Steady state semi-analytical solutions for a real estuary.
- Salt-balance approach.
- Salinity from monitoring or a hydrodynamic model.
- Green function constructed to compute nutrient and phytoplankton concentrations (Rattray and Officer 1979).
- Iterations are needed.

Sun, D., T. Behlmer and M. Barton, 2024. Estuarine water quality: Semi-analytical one-dimensional model and its application to a riverine subtropical estuary in Florida. (manuscript in preparation)



490 *M. Rattray, Jr. & C. B. Officer*

Solution

For steady state conditions in an estuarine reach without local river input ($dA\bar{u}/dx=0$) and essentially constant values over the cross section of either the time-mean velocity or the salinity and the non-conservative quantity[a], the conservation equations simplify to

$$\frac{d}{dx}(A\bar{u}S) - \frac{d}{dx}\left(AK_x\frac{dS}{dx}\right) = 0, \quad (1)$$

with the boundary conditions;

at the river: $x=0$, $S=S_0$, a constant,

at the ocean: $x=l$, $S=S_l$, a constant, (2)

and

$$\frac{d}{dx}(A\bar{u}C) - \frac{d}{dx}\left(AK_x\frac{dC}{dx}\right) = -BA, \quad (3)$$

with the boundary conditions:

at $x=0$, $C=C_0$, a constant, (4)

at $x=l$, $C=C_l$, a constant,

where $A(x)$ is the local cross-sectional area of the estuary,
$\bar{u}(x)$ is the local cross-sectional mean longitudinal velocity,
$K_x(x)$ is the local longitudinal eddy diffusivity,
$C(x)$ is the local concentration of the non-conservative quantity,
$S(x)$ is the local salinity,
$B(x)$ is the rate of utilization of C.

Green's functions are formed from the two independent solutions of equation (1), $[S(x)-S_0]/[S_l-S_0]$ and $f(x)=1-S(x)/S_l$, and are used to form the solution for equations (3) and (4), which is (see for example, Madelung, 1943):

$$C(x) = \frac{C_0 f(x)}{[1-S_0/S_l]} + C_l\frac{[S(x)-S_0]}{[S_l-S_0]} - f(x)\int_0^x \frac{[S(\zeta)-S_0]}{[1-S_0/S_l]}\frac{B(\zeta)d\zeta}{K_x(\zeta)S'(\zeta)} - \frac{[S(x)-S_0]}{[1-S_0/S_l]}\int_x^l \frac{f(\zeta)B(\zeta)d\zeta}{K_x(\zeta)S'(\zeta)}. \quad (5)$$

Because determination of dS/dx is prone to relatively large errors and K_x may not be well known at all, we will make the substitution

$$K_x dS/dx = \bar{u}S, \quad (6)$$

obtained as the first integral of equation (1) with zero net upstream salt flux. Thus

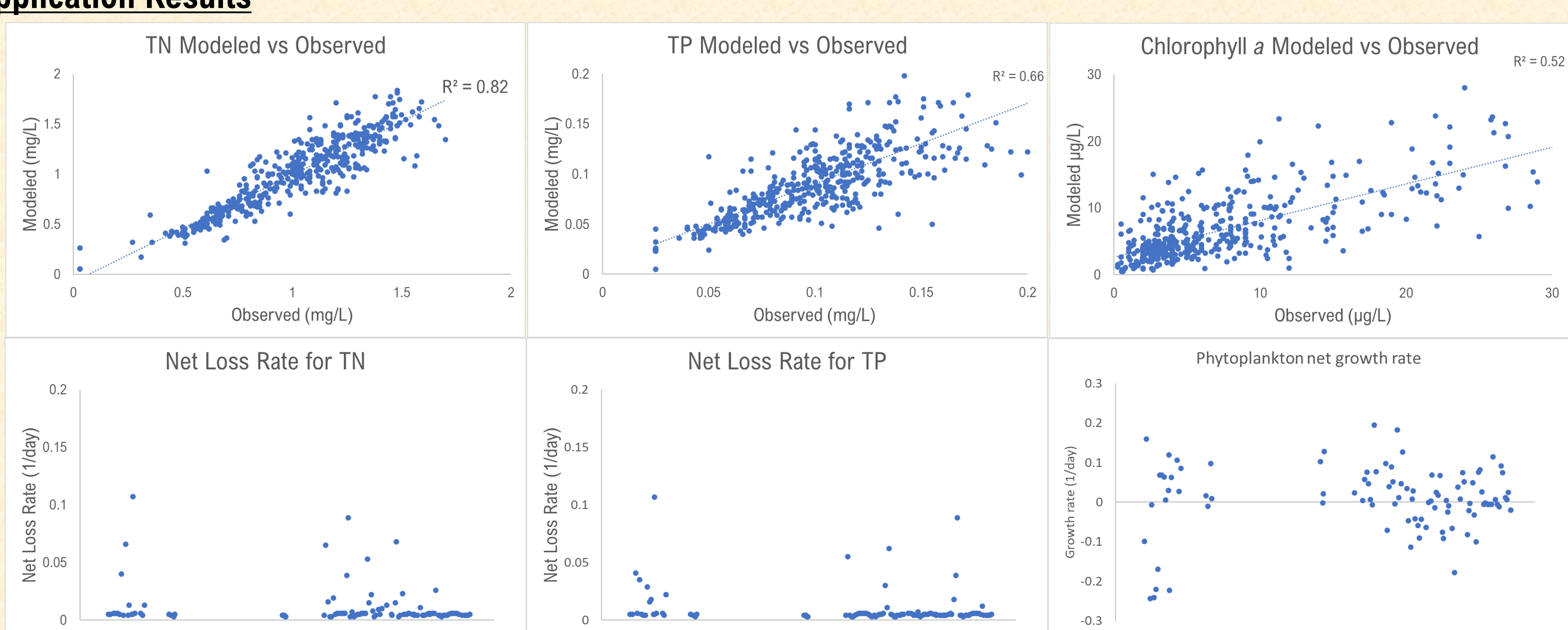
$$C(x) = \frac{C_0 f(x)}{[1-S_0/S_l]} + C_l\left[\frac{S(x)-S_0}{S_l-S_0}\right] - f(x)\int_0^x \left[\frac{S(\zeta)-S_0}{1-S_0/S_l}\right]\frac{B(\zeta)d\zeta}{\bar{u}(\zeta)S(\zeta)}$$

[a]This restriction can be relaxed for any case in which the cross-sectional distributions of salinity and the non-conservative substance are similar. Under these circumstances the diffusion coefficient is replaced by a dispersion coefficient which accounts for the additional 'shear effect' of the mean flow (Taylor, 1954).

Summary of calibrated net rates for nutrients and chlorophyll *a*.

Constituent	Number of Surveys	R^2	Net Loss/Growth Rate (1/day)		
			Maximum	Minimum	Average
Total Nitrogen	100	0.82	0.107	0.003	0.011
Total Phosphorus	103	0.66	0.110	0.004	0.012
Dissolved Inorganic Nitrogen	90	0.74	0.119	0.003	0.030
Dissolved Inorganic Phosphorus	98	0.71	0.120	0.003	0.015
Chlorophyll *a*	97	0.52	0.195	-0.24	0.008

Model Application Results



Upper panel: Modeled total nitrogen (TN), total phosphorus (TP), and chlorophyll *a* versus (vs) observation. Lower panel: Calibrated loss rates for TN and TP, and net growth rate for chlorophyll *a*.

Discussion and Summary

- Analytical solution suggests the higher the net growth rate, the higher the maximum phytoplankton concentration, a rationale for the estimates of net growth rates using observed profile.
- The calibrated net loss rate for nutrients are low compared with few literature available, e.g., Dettmann 2001 for TN.
- The calibrated net growth rates are an order of magnitude lower than reported gross primary production rates for phytoplankton, which is likely true as most of these surveys are taken during normal conditions. Net growth rates in the same order as gross growth rate would mean algal bloom in the estuary.
- Study is experimental. A more vigorous inverse method is under development using more detailed survey data such as SERFIS.

Dettmann, E.H., 2001. Effect of water residence time on annual export and denitrification of nitrogen in estuaries: A model analysis. Estuaries 24: 481-490

For more information: SCAN ME

Chapter 8D: Caloosahatchee River Watershed Protection Plan Annual Progress Report

Modeling Oyster Recruitment to Optimize Yields Through Enhanced Restoration

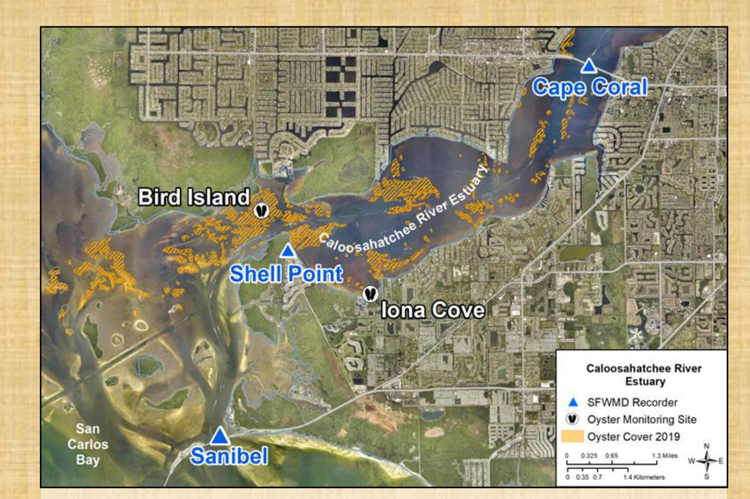
Detong Sun, Cassondra Armstrong, Melanie Parker, Mark Barton, Phyllis Klarmann, Juliane Caughron
Coastal Ecosystems Section, Applied Sciences Bureau

Background & Objectives

- Oyster reefs are essential habitats in estuaries.
- Altered hydrology and severe drought/wet conditions are stressors for eastern oysters in the Caloosahatchee River Estuary.
- Freshwater water management is critical for oyster restoration.
- Objectives: a) develop model tools to quantify oyster population/density and habitat area; b) test management strategy under different hydrological and hydrodynamic conditions; and c) pilot restoration and monitoring with assist from modeling.

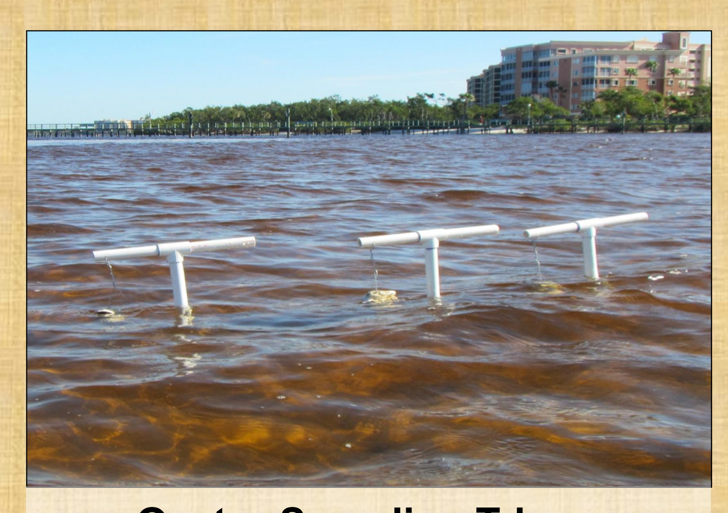
Methods & Approaches

1. Machine learning (ML) to explore possible patterns between oyster population/density physical drivers.
2. Particle tracking model to predict oyster larvae transport and settlement.
3. Spatial oyster habitat model to predict the evolution of oyster habitat.
4. A pilot restoration with model support and feedback to improve and validate the models.
5. Benthic mapping to collect more oyster habitat data to support modeling efforts and to help the pilot restoration.



Study Site

Oyster Reef



Oyster Sampling T-bars

Research Questions

	Research Questions	Data/Model Needs
Q1	How changes in climate, inflow and management affect oyster population and larval transport?	Historical data, machine learning, hydrodynamic and larval transport model
Q2	How changes in climate, inflow and management affect available estuarine oyster habitat?	Oyster habitat model, oyster mapping
Q3	How changes in climate, inflow and management affect available estuarine oyster productivity?	Oyster ecological model, hydrodynamic and water quality model
Q4	Where and when does oyster spat settle?	Field survey, YSI data sonde, and larval transport model
Q5	What are the site characteristics for ideal oyster habitat conditions?	Larval transport model and ecological model combined with field data
Q6	How do the model and empirical outputs inform oyster restoration?	Field survey data and model outputs

Project Organization

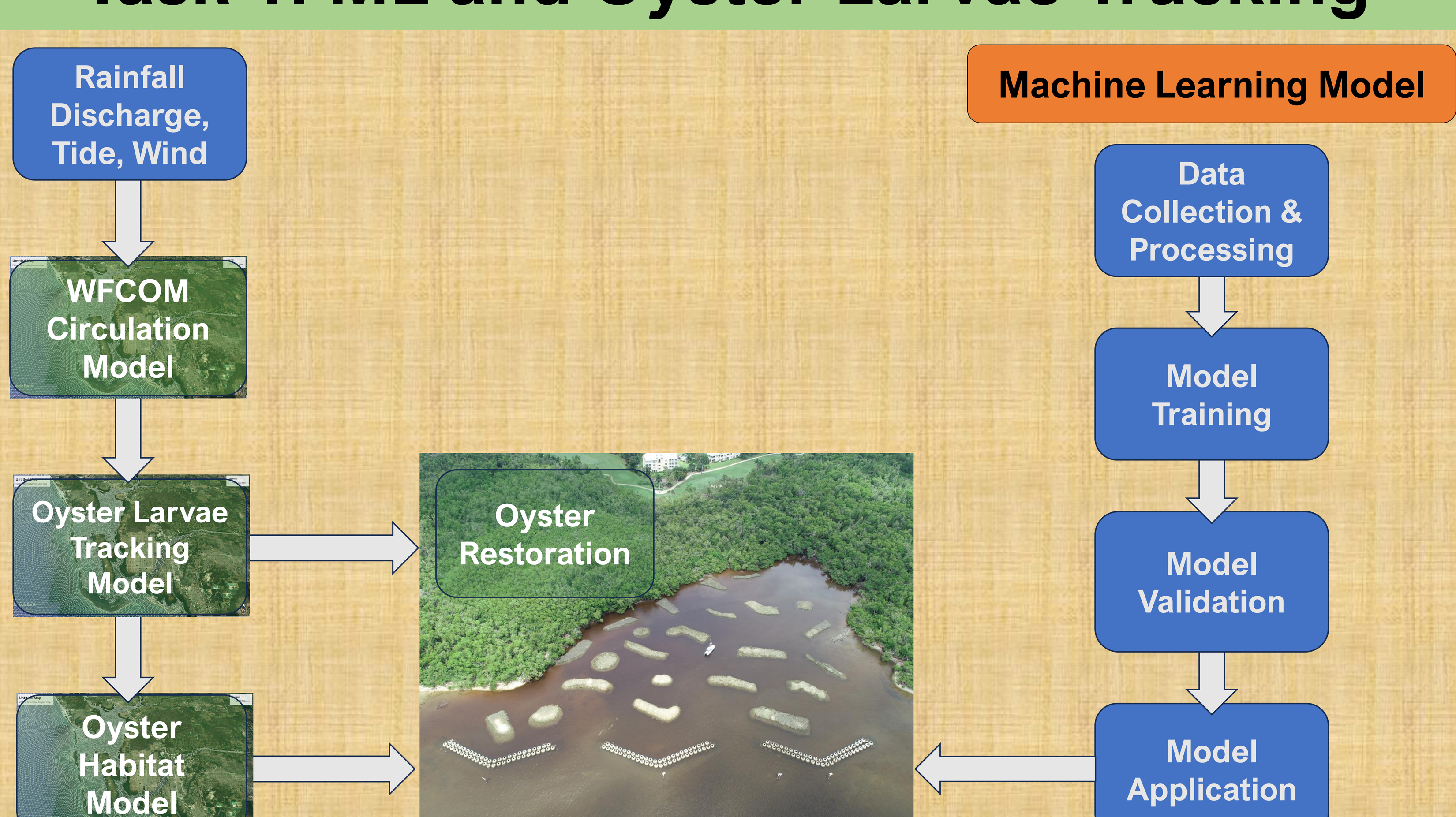
- Principal Investigator (PI)/Project Manager — Detong Sun, SFWMD
- EPA Program Officer — Ade Adesiji
- EPA Technical Officer — Steven Blackburn
- Quality Assurance/Quality Control Manager — Juliane Caughron, SFWMD
- CO-PI — Phyllis Klarmann, SFWMD
- CO-PI, ML, and Larvae Transport — Yonggang Liu, USF
- CO-PI, Ecological Modeling — Chris Buzzelli, CELLC, SFWMD Consultant
- CO-PI, Oyster Restoration — Eric Milbrandt, SCCF

Collaborators

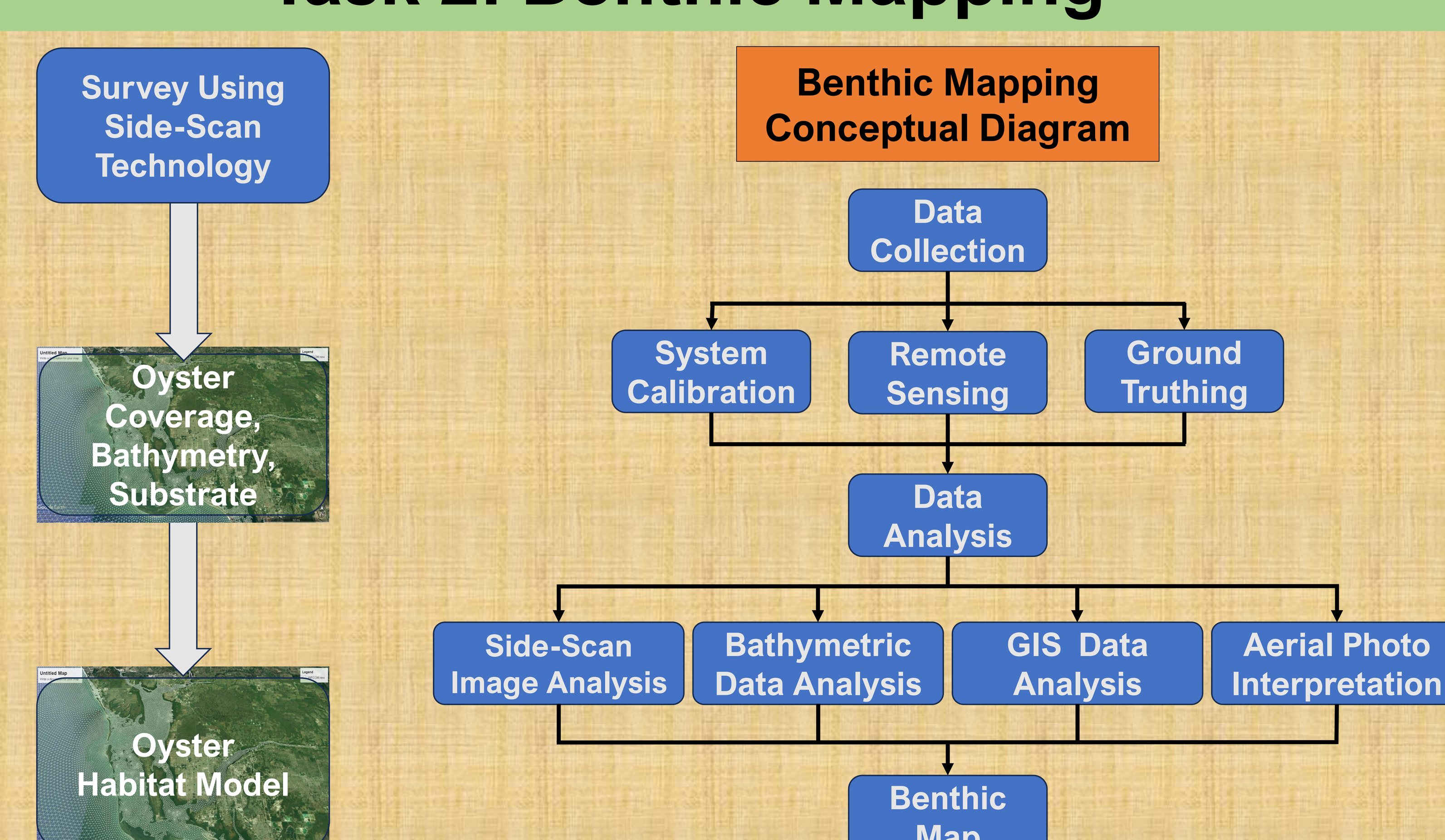
Project Schedule

- The entire project will span the next five years.
- The first half of the project focuses on model development (Tasks 1 and 3), while the later half focuses on model applications and integration.
- Benthic mapping (Task 2) is expected to be completed within the first two years.
- Oyster reef restoration (Task 4) starts later with assistance from model applications for site selection and operation. Pre- and post-construction monitoring will feed into models.
- Monthly spat settlement monitoring (Task 5) will be performed throughout the project period.

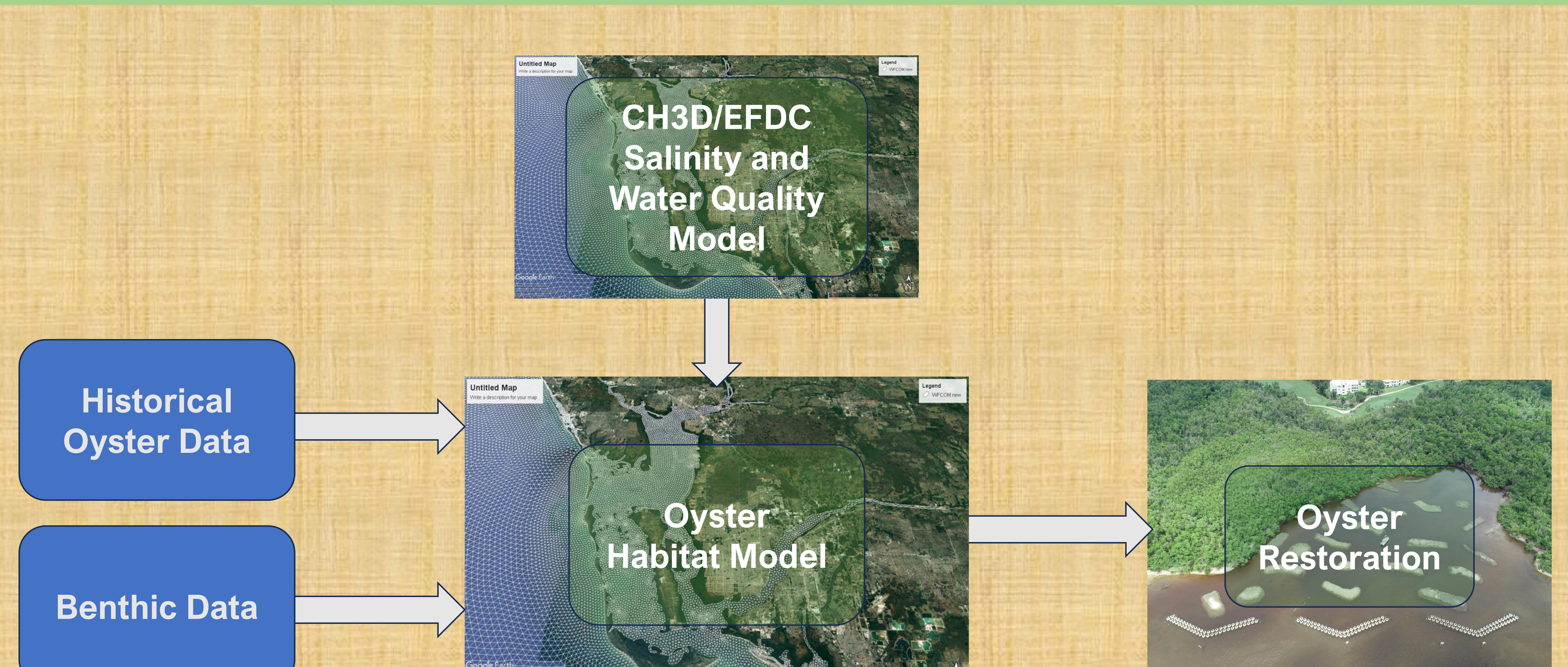
Task 1: ML and Oyster Larvae Tracking



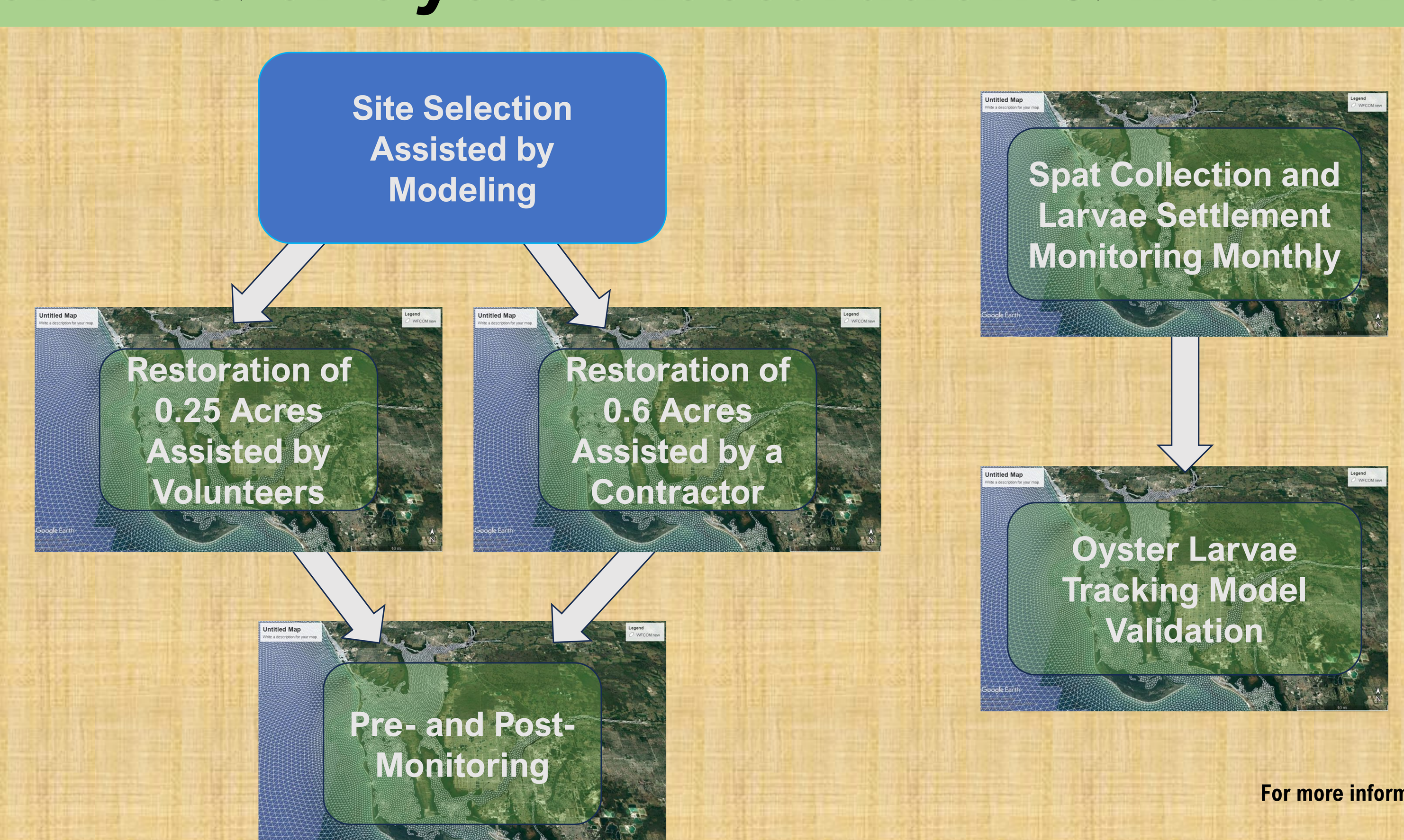
Task 2: Benthic Mapping



Task 3: Oyster Habitat Model



Tasks 4 & 5: Oyster Restoration & Monitoring



For more information:
SCAN ME