For the Love of Florida:
The North Fork of the St. Lucie River

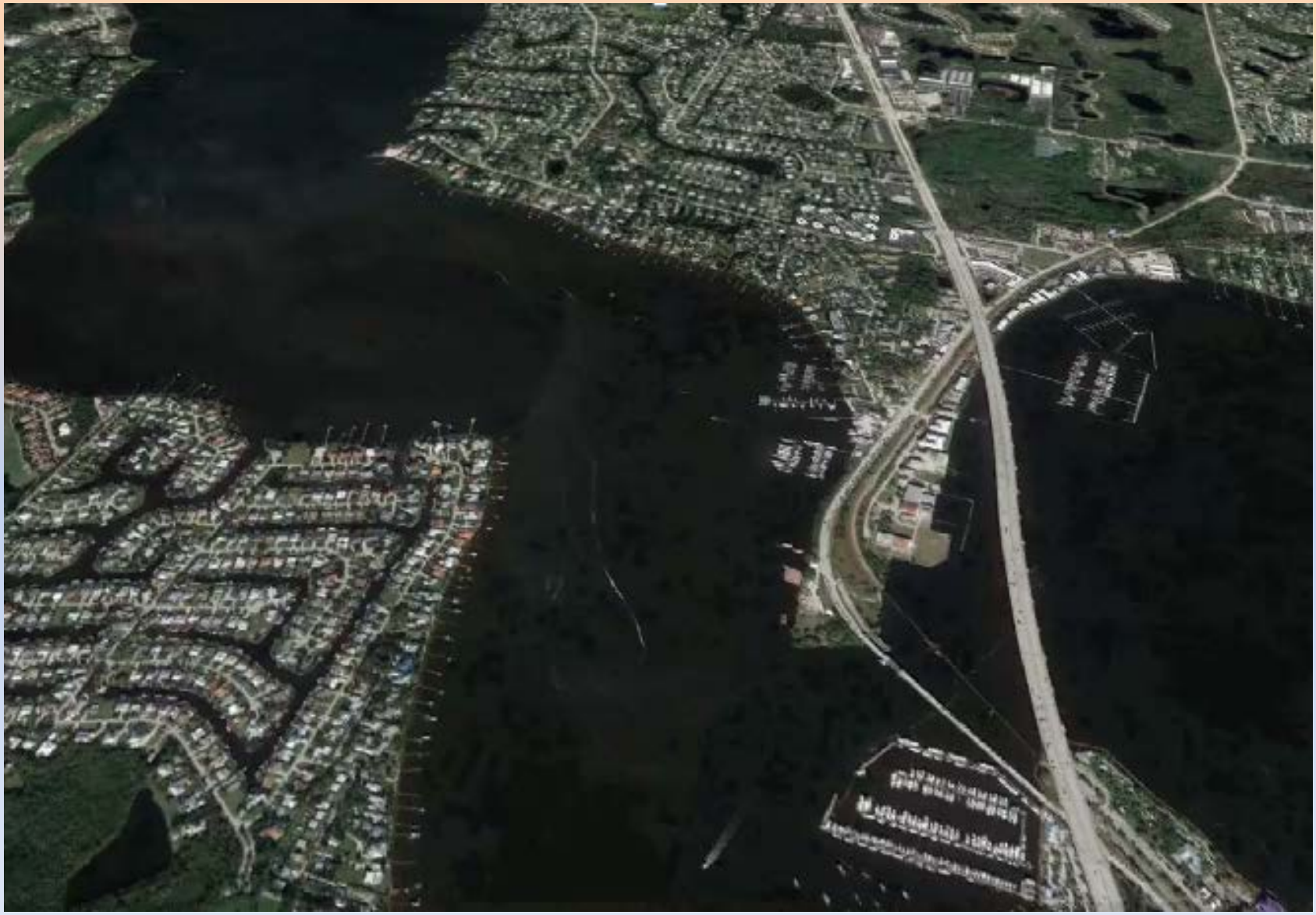
Gary Goforth, LLC

An Evening With Fellow River Warriors

- **A little history of our jungle river -** "sanctuaries for observation and contemplation" (E. Lyons, *My Florida*)
- **Alterations to the river**
- **Impacts of alterations**
  - Hydrology
  - Water quality
  - Vegetation
- **Moving forward, and areas of concern**

But first, …

… a little tour



Historical Timeline – Pre-20th Century

Pre-Spanish history - Numerous native peoples inhabited the area, including Ais tribe of Indians

1513 - Juan Ponce de Leon entered St. Lucie River (or Loxahatchee River at Jupiter). The Spanish called the river Rio de Santa Cruz (River of the Holy Cross) and Rio De Luz (River of Light).

1565 – A small garrison of Spanish soldiers established an outpost on Saint Lucea Day – December 13, possibly along Hutchinson Island or Jupiter Island.

1600s – 1700s: **Spanish charts referred to the southern Indian River Lagoon (IRL) as the "St. Lucia River"; north IRL was referred to as "River of Ais"**

1696 - Jonathan Dickinson shipwrecked, then as captive of natives on the way to St Augustine crosses the "St. Lucea River", likely a temporary inlet between IRL and ocean, e.g., Gilbert's Bar

1715 – The gold and silver-laden Spanish Plate Fleet wrecked – genesis of the name "Treasure Coast"

1821 – Florida became a US territory

1844 – St. Lucie County formed; name changed to Brevard County in 1855; re-established in 1905

1844 – St. Lucie inlet was dug by members of the Indian River Colony; inlet fills in shortly thereafter

1845 - Florida became a state

1885 – Attempt to re-open St. Lucie Inlet failed during storm as diggers attended Christmas party

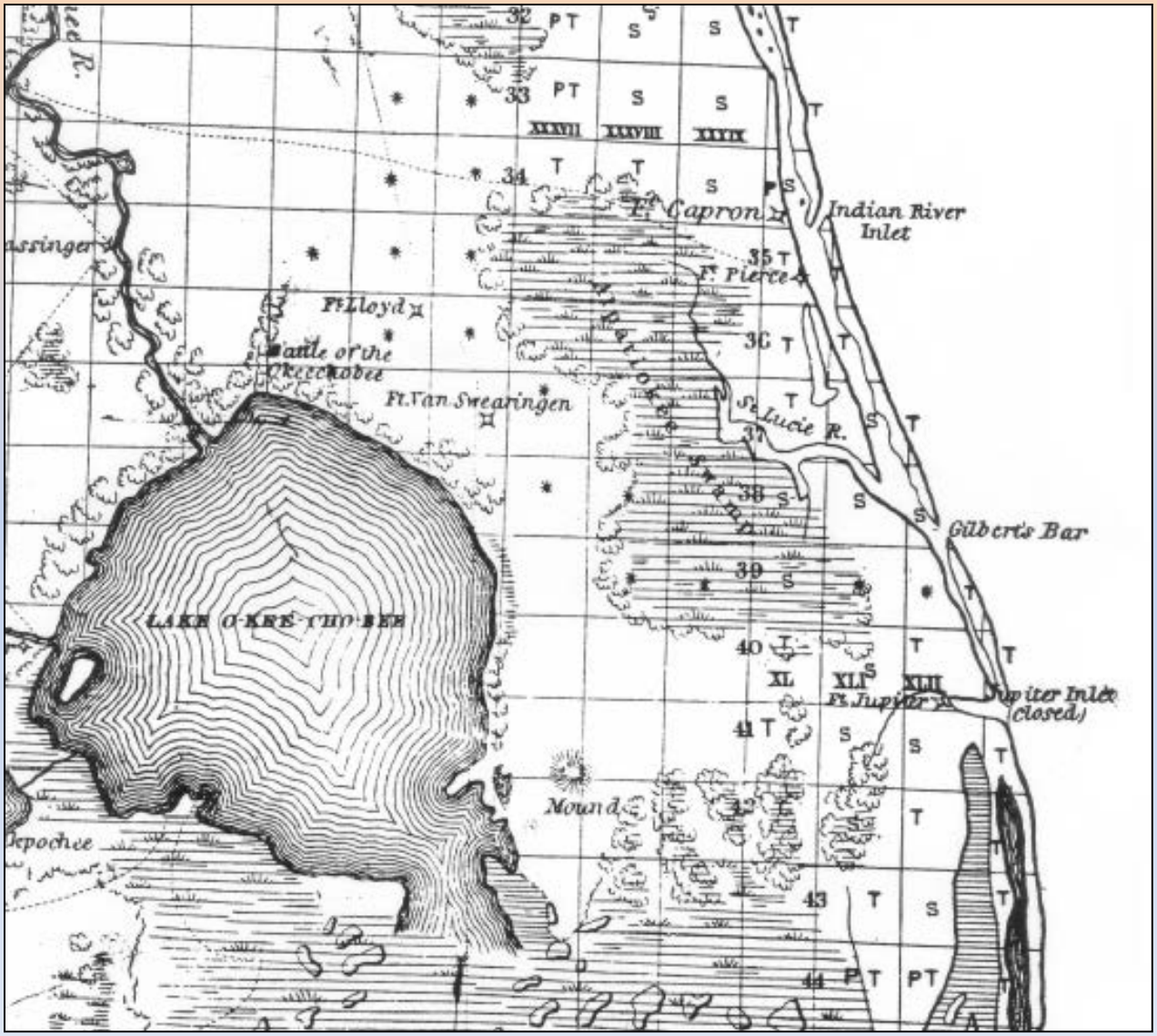
1892 – The St. Lucie Inlet is dug in 4 days by 100 people with picks and shovels, and when that filled in, the steam-powered dredge "Eric" was used, and has since been maintained, transforming the former freshwater system to an estuarine lagoon.

1894 – First railroad bridge across the St. Lucie River

1853 Map

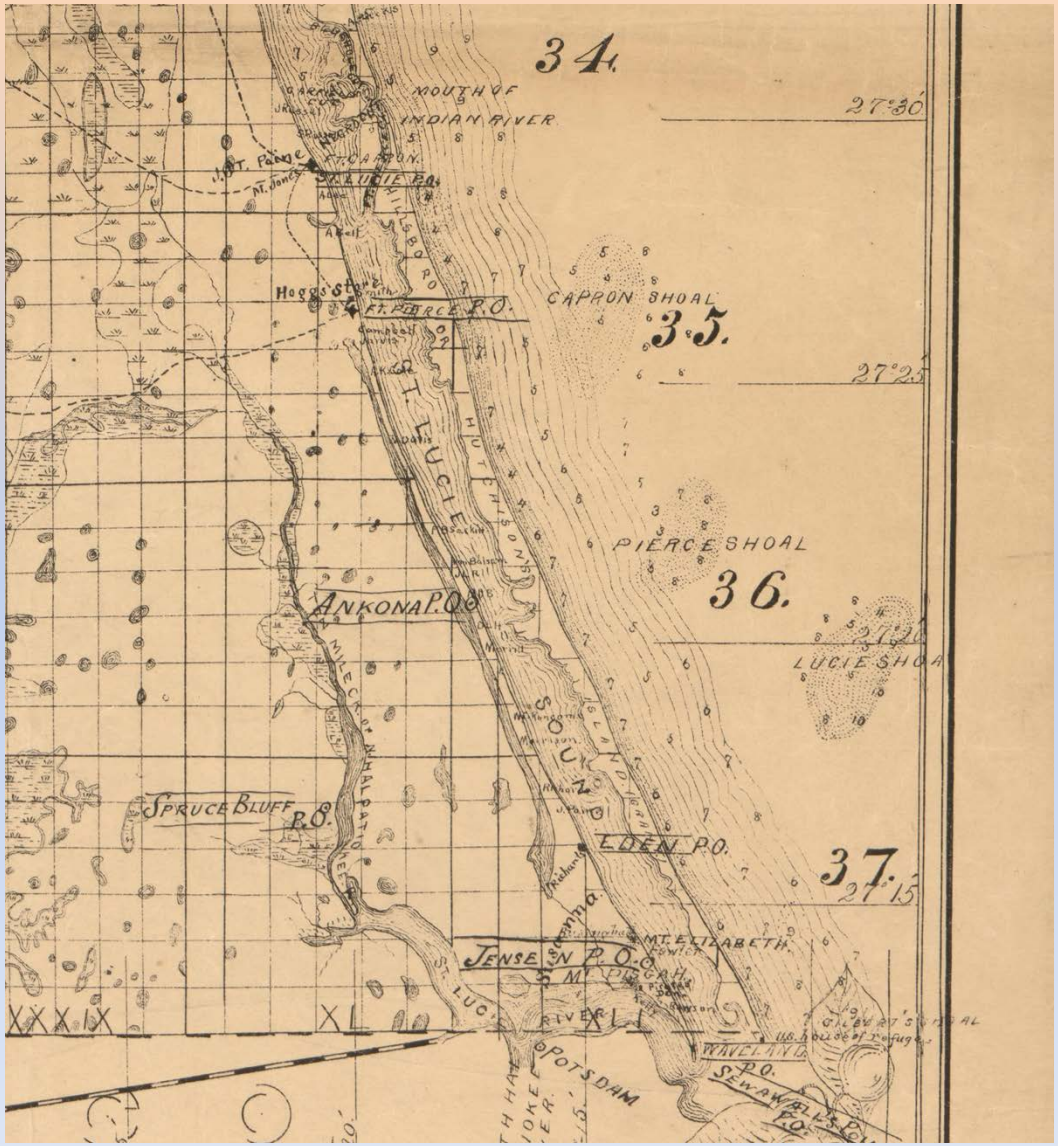
From US Bureau of Topographical Engineers Map of southern Florida showing:

- "Alpatiokee Swamp" as the headwaters of the North and South Fork of the St. Lucie River,
- Indian River Inlet, 2-3 miles north of present-day Ft. Pierce inlet, and
- Gilbert's Bar Inlet, a bit south of present-day St. Lucie Inlet



1885 Geodetic Survey Map

The North Fork is shown as “Ten Mile Creek of N. Halpatiokee River”



Historical Timeline – 20th Century

1918 – North St. Lucie River Water Control District formed; predecessor of C-24 constructed

1921 – Dredging began in North Fork of St. Lucie River; most of the floodplain canopy trees along the river were cut and removed for lumber

1923 – Discharges from Lake Okeechobee began to the St. Lucie Estuary via the South Fork

1924 – The North St. Lucie River Water Management District completed an extensive drainage system in the watershed of the North Fork

1958 – St. Lucie Indian Rivers Restoration League formed to protect St. Lucie River

1958 - General Development Corporation began to create the community of Port St. Lucie on 80 square miles of wetlands and pine forest land adjacent to the North Fork.

1961 - C-23 and C-24 canals enlarged; drainage area of North Fork increased to 4 times its natural watershed; however, much of historic watershed diverted around floodplain

1972 – Conservation Alliance of St. Lucie County formed

1972 – the North Fork was designated a Florida Aquatic Preserve with the goal of protecting its "aesthetic, biological, and scientific values." It's also a *wilderness preserve*, an Outstanding Florida Water and part of the State's "Save Our Rivers" Program.

1990s – Oxbow Eco-center begins operation

1991 – St Lucie River Initiative formed to protect the St. Lucie River

1996 – Ten Mile Creek Reservoir and treatment area near Ft. Pierce authorized by Congress

1998 – Massive discharges of polluted Lake Okeechobee water; Rivers Coalition formed

Historical Timeline – 21st Century

2002 – Restoration of old river meanders began in the North Fork

Mid-2000s - Lawsuit brought against federal government over releases from Lake Okeechobee. In 2007 the judge dismissed the case, citing "statute of limitations" had run out.

2002 – Minimum flow criteria set for North Fork St. Lucie River

2006 - Ten Mile Creek RSTA completed, but seepage issues delay operation until 2017

2008 – State of Florida established Total Maximum Daily Load (TMDL) for nitrogen, phosphorus and biological oxygen demand for North Fork and most of the St. Lucie Estuary watershed

2009 - SFWMD developed *St. Lucie River Watershed Protection Plan*

2009 – Water reservation rule was adopted by SFWMD for the North Fork to ensure healthy and sustainable native fish and wildlife communities

2013 - FDEP established a *Basin Management Action Plan* (BMAP) that established nitrogen and phosphorus load reduction goals for the North Fork

Unique Riverine Environment

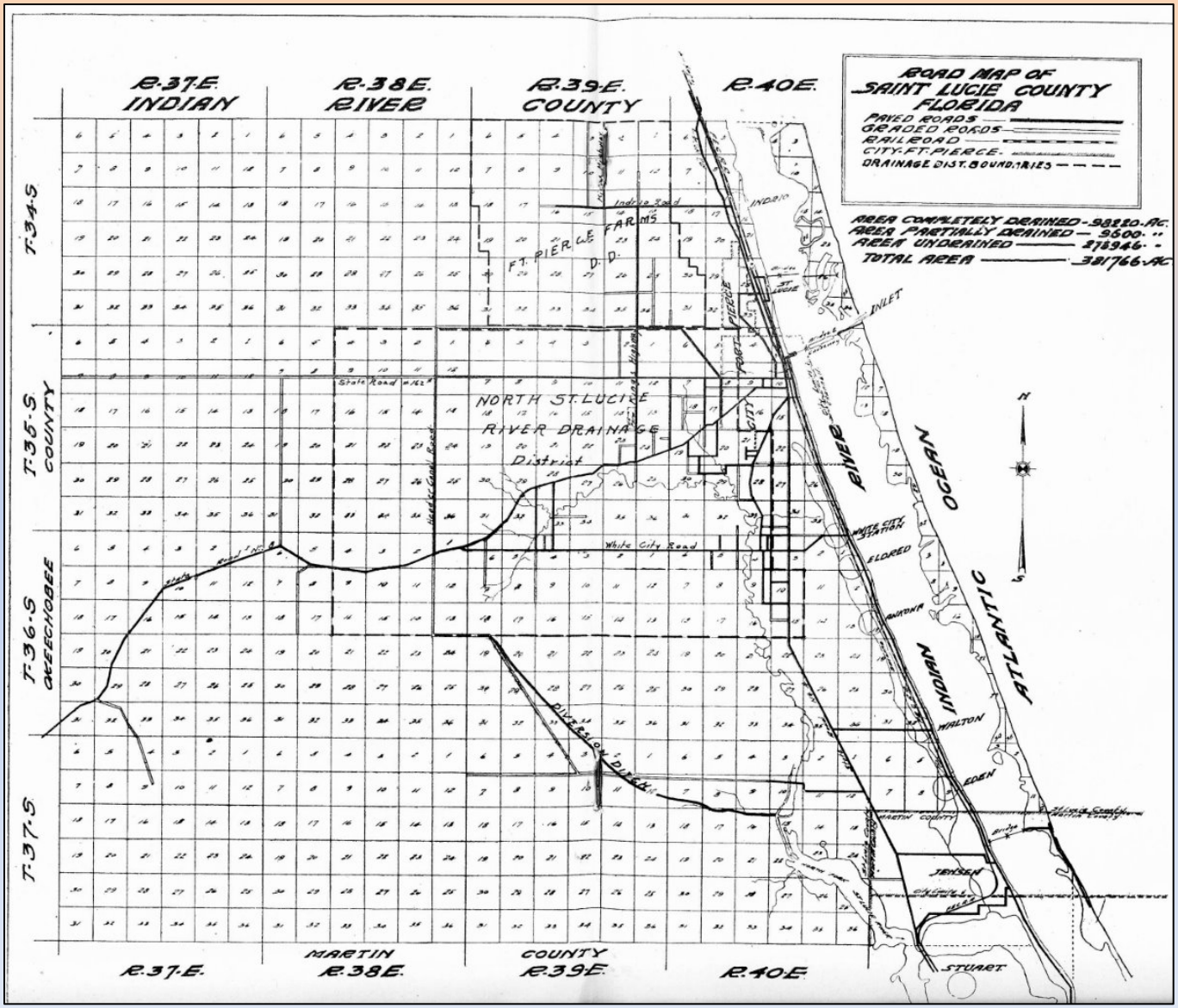
- Located at northern range of tropical climate – warm with lots of rain
- Receives a mix of freshwater and brackish water
- Has more species of fish than any other river in the state, providing critical habitat for important species, including juvenile snook, snapper, drum, blue crab and shrimp.
- Supports a variety of federally and state-protected species such as American alligators, manatees, nesting wood storks, little blue herons and opossum pipefishes.
- Rare tropical peripheral fish species, such as gobies, sleepers and pipefishes, are also found in the upper reaches of the North Fork and the two headwaters - Five Mile Creek and Ten Mile Creek.

Drainage, Lumber and Development

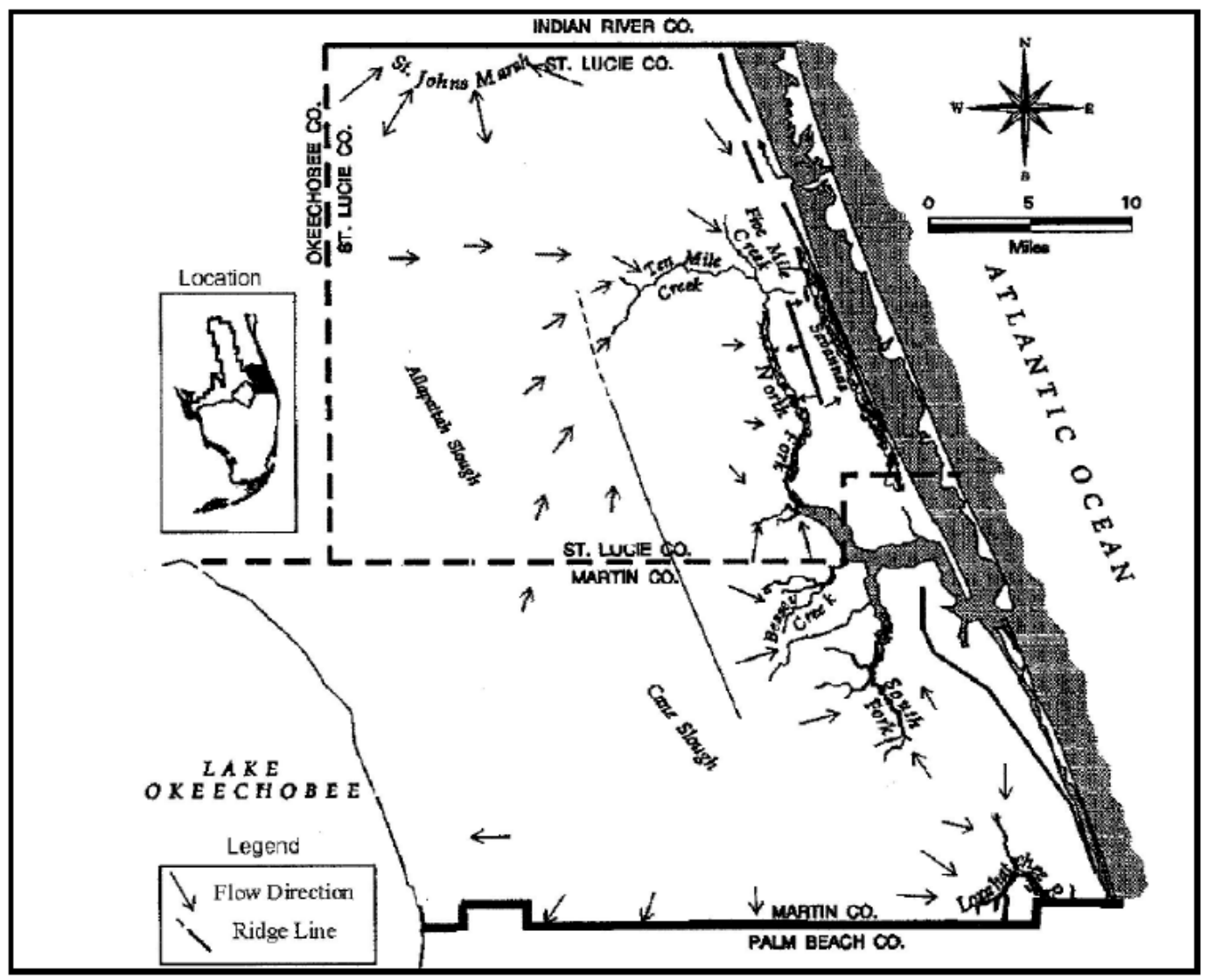
- 1918 – North St Lucie River WCD responsible for providing flood control to growing ag industry
  - Drainage canals
  - Dredging main channel of North Fork for navigation and flood control
  - Much of the old growth bald cypress and other large trees in floodplain harvested for timber
- Population and population density has increased

1936 Drainage Map of St Lucie County

- 287 miles of canals
- 60 miles of paved and graded roads

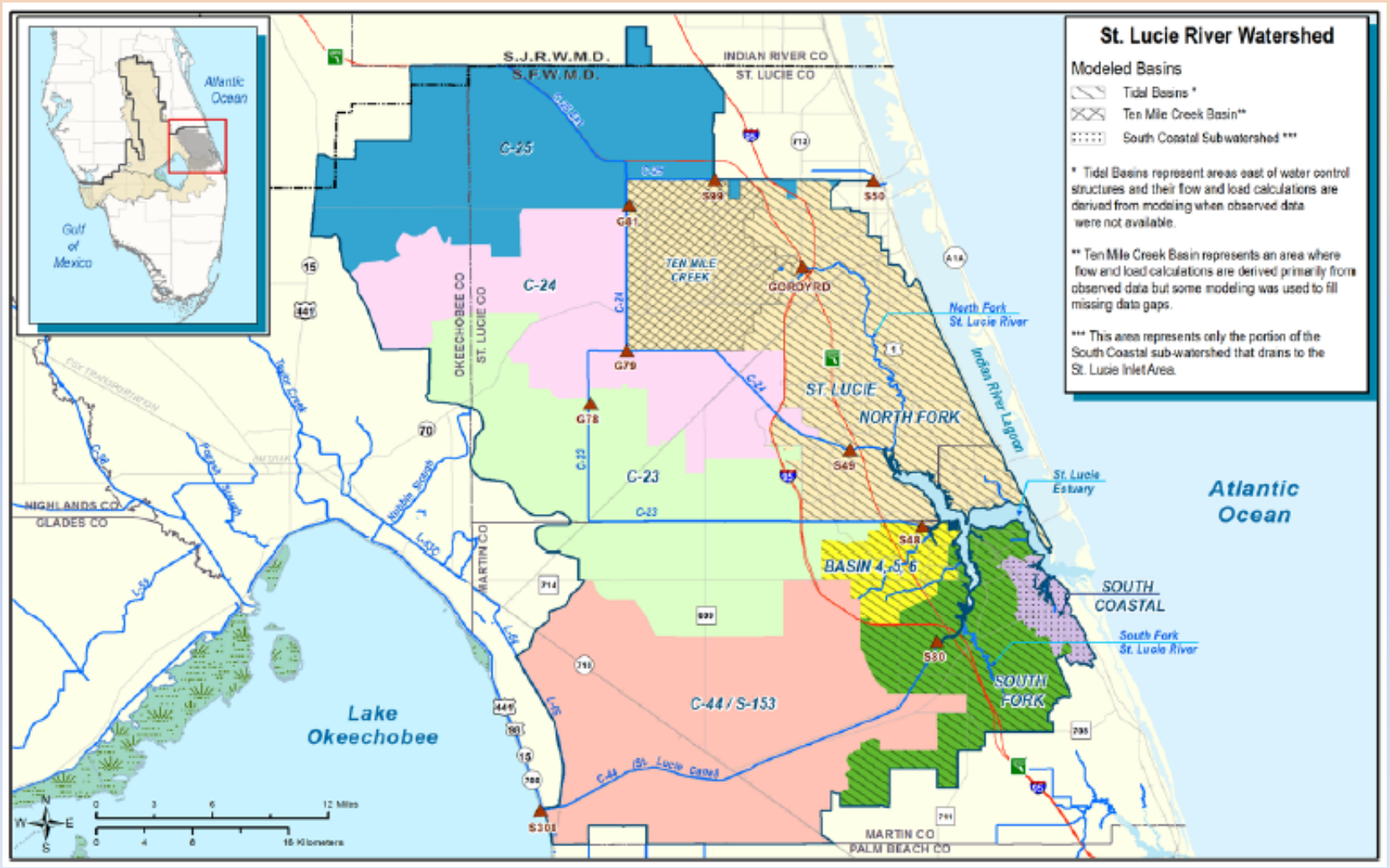


Historical Watershed



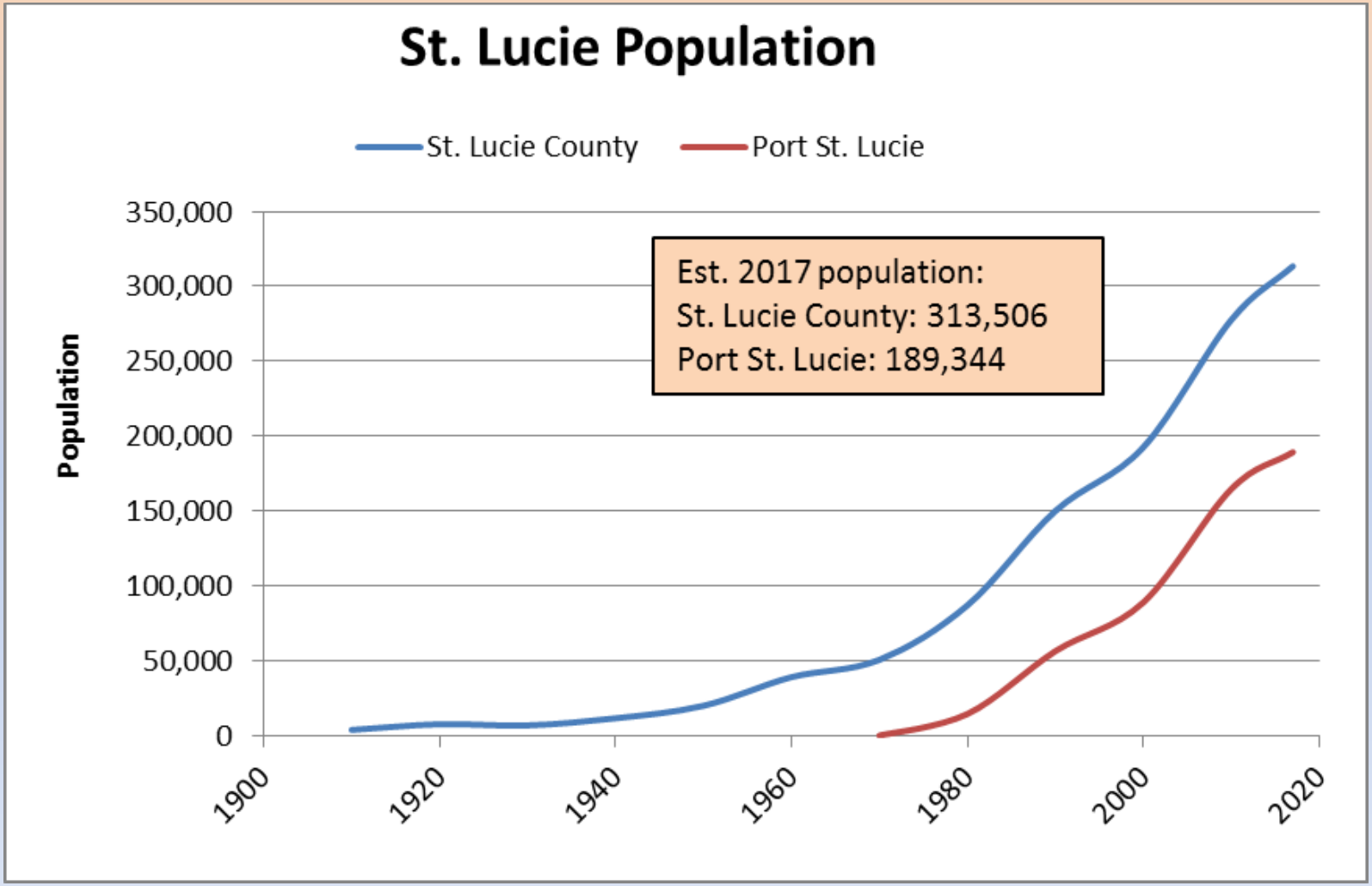
From SFWMD 2002

By 1961, Fourfold Increase in Drainage Area of North Fork



From SFWMD 2018

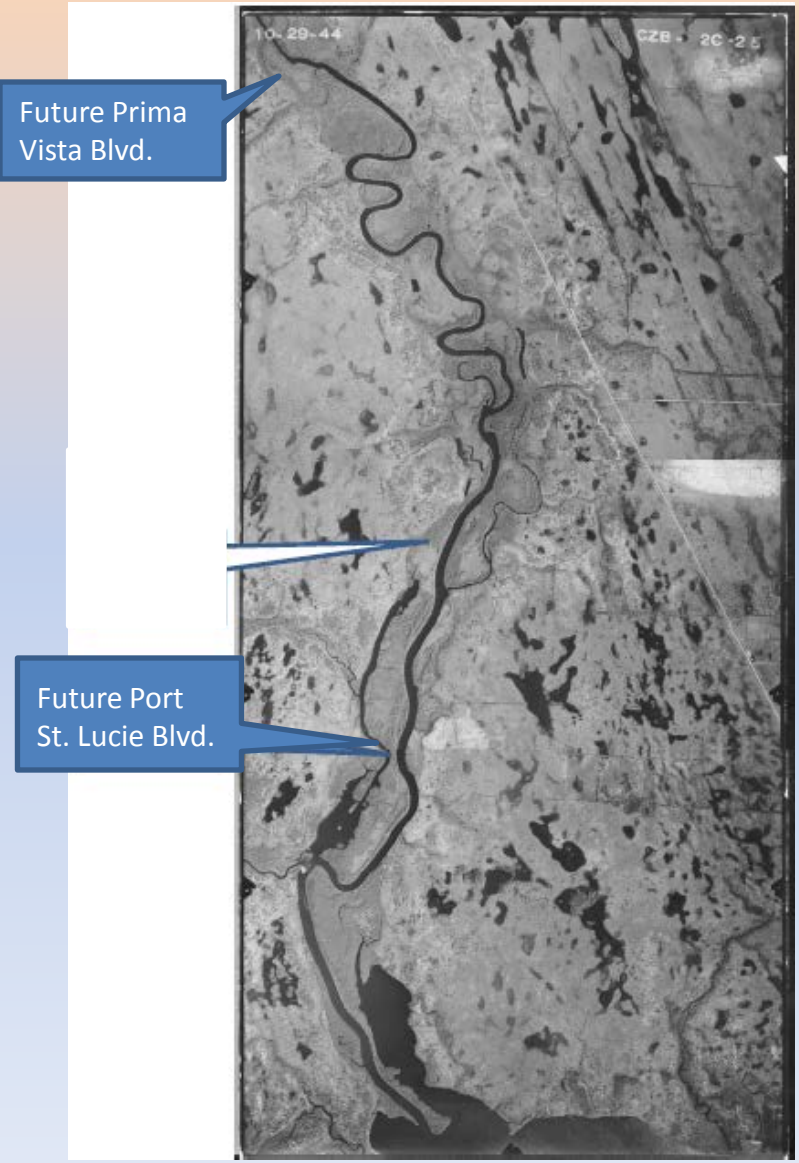
Population Growth



From US Census Bureau

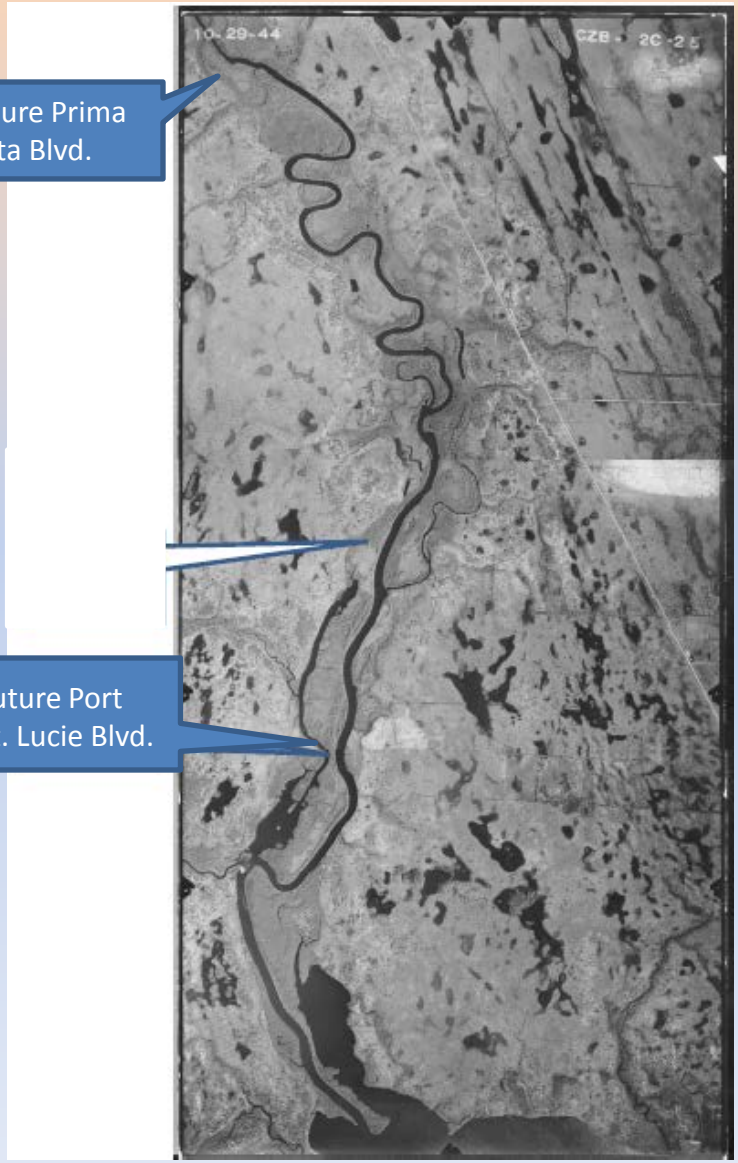
Alterations to the River

1944 aerial photo



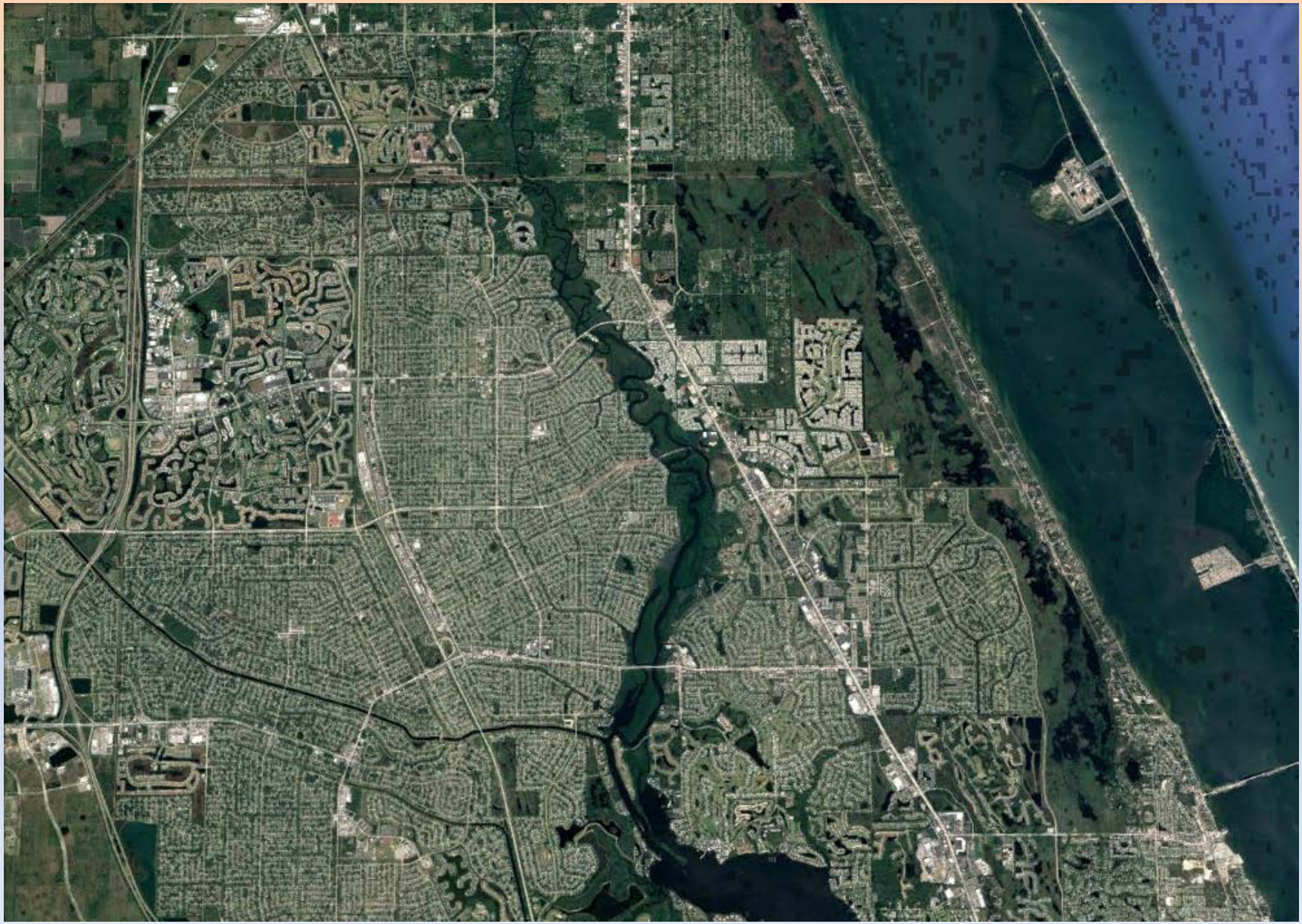
Alterations to the River

1944 aerial photo



2018 aerial photo

Today's North Fork Floodplain



Key Impacts

- Higher peak stormwater flows
- Less wetlands
  - Less water storage – water moves through system faster
  - Less water treatment
- C-24 resulted in diversion of flows around the North Fork floodplain to the south – net effect is 40% less water moving through floodplain
- Dredged spoil berms isolated floodplain wetlands, they don't receive overflow from channel
- Salt water intrusion, as evidenced by encroachment of white mangrove
- Shift in other vegetation species from riverine swamp to more upland species
- Deteriorating water quality: nutrients, pesticides/herbicides

Water Quality

Water quality in the North Fork is affected by

- flows and loads from the watershed,
- water quality of the South Fork, including discharges from Lake Okeechobee, and
- water quality in the estuary through tidal action.

Florida Oceanographic Society Weekly Snapshot of Water Quality

February 7:

Winding NF: Good

North Fork: Satisfactory

Floridaocean.org

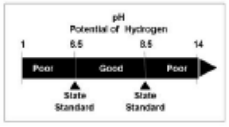
St. Lucie River Estuary Water Quality Report

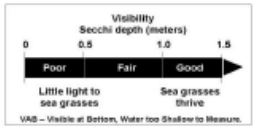
This information is provided by the Florida Oceanographic Society with support of the Marine Resources Council. It is collected by the Citizen Volunteer Water Quality Monitoring Network. For historical data go to our website at: http://www.floridaocean.org
For sample results related to bacteria levels go to: http://martin.floridahealth.gov/programs-and-services/ and click on the Environmental Health link

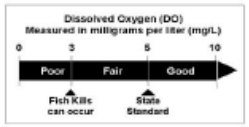
Posted: 02/07/19

Overall Grade:	89%	B+	GOOD

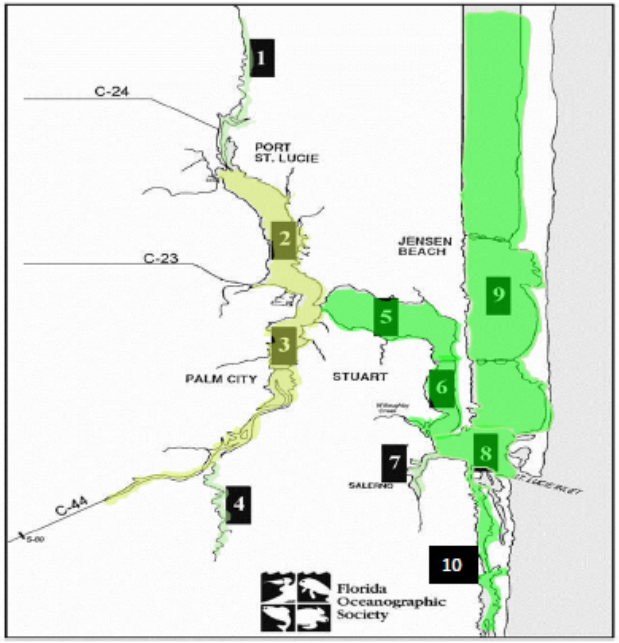
Zone/ Location	Water Temp. Deg. F	pH	Visibility (Secchi) Meters	Salinity ppt	Dissolved Oxygen mg/L	Location Score	Grade
1. Winding North Fork	67	7.4	0.9 Fair	3 Good	5.3 Good	87%	B Good
2. North Fork	68	8.2	0.9 Fair	15 Fair	6.8 Good	76%	C Satisfactory
3. South Fork	70	8.0	0.7 Fair	13 Fair	6.1 Good	76%	C Satisfactory
4. Winding South Fork	68	7.8	0.9 Fair	3 Good	5.0 Fair	81%	B Good
5. Wide Middle River	69	8.2	1.1 Good	24 Good	6.3 Good	97%	A Ideal
6. Narrow Middle River	72	8.2	2.0 Good	28 Good	7.6 Good	97%	A Ideal
7. Manatee Pocket	64	8.0	1.2 Good	23 Fair	7.5 Good	87%	B Good
8. Inlet Area	71	8.2	1.5 Good	34 Good	5.6 Good	97%	A Ideal
9. Indian River Lagoon	68	8.3	1.2 Good	35 Good	6.3 Good	97%	A Ideal
10. Intracoastal Waterway South	77	7.9	1.3 Good	30 Good	5.4 Good	97%	A Ideal







Comment: The data above may indicate areas of concern in the St. Lucie Estuary. Citizens should call the Florida Department of Environmental Protection (DEP) at 871-7662 or the South Florida Water Management District (SFWMD) 223-2600 to ask about the quality of a specific area and report observations of pollution.



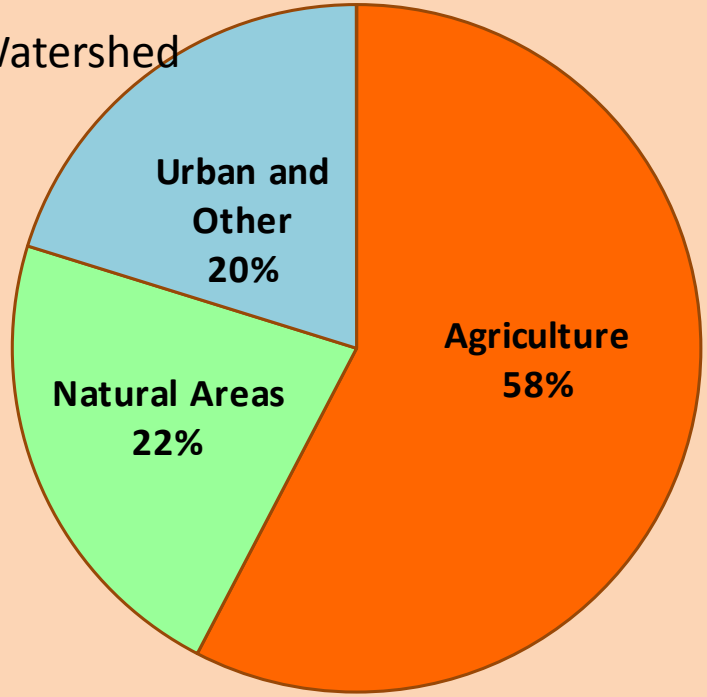
Overall Grading				
A	B	C	D	F
100-90	89-80	79-70	69-60	69-0
IDEAL	GOOD	SATISFACTORY	POOR	DESTRUCTIVE

Salinity (ppt) Grading				
Zones	description	GOOD	FAIR	POOR
1&4	upper north & south forks	2 - 8	1 - 2 or 8 - 15	< 1 or > 15
2 & 3	lower north & south forks	15 - 25	10 - 15 or > 25	< 10
5	wide middle river	> 20	15 - 20	< 15
6	narrow middle river	> 25	20 - 25	< 20
7	Manatee Pocket	> 27.5	20 - 27.5	< 20
8	inlet	> 30	25 - 30	< 25
6	IRL & Intracoastal W'wy	> 30	25 - 30	< 25

Annual Flows and Nutrient Loads from the North Fork Watershed

Land Use Within the North Fork Watershed

Basin	Area (acres)
C-23 Canal Basin	112,160
C-24 Canal Basin	83,373
Ten Mile Creek Basin	39,726
Tidal Areas (5 Mile Creek, etc.)	92,138
Total North Fork Watershed	***327,397***



From SFWMD 2016

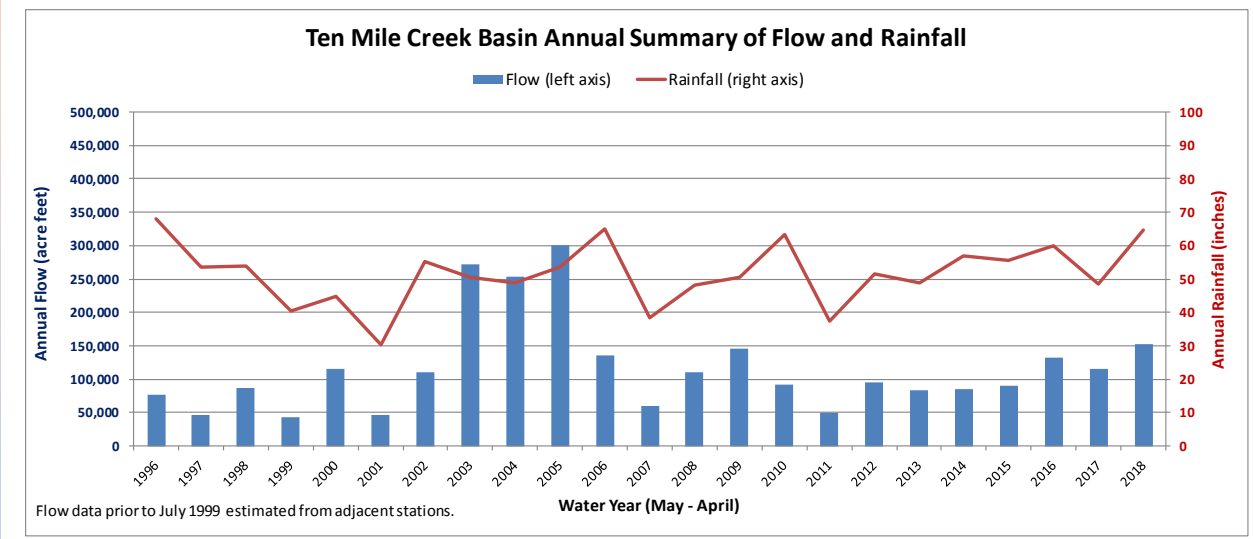
Agriculture is the dominant land use; communities comprise less than 20%.

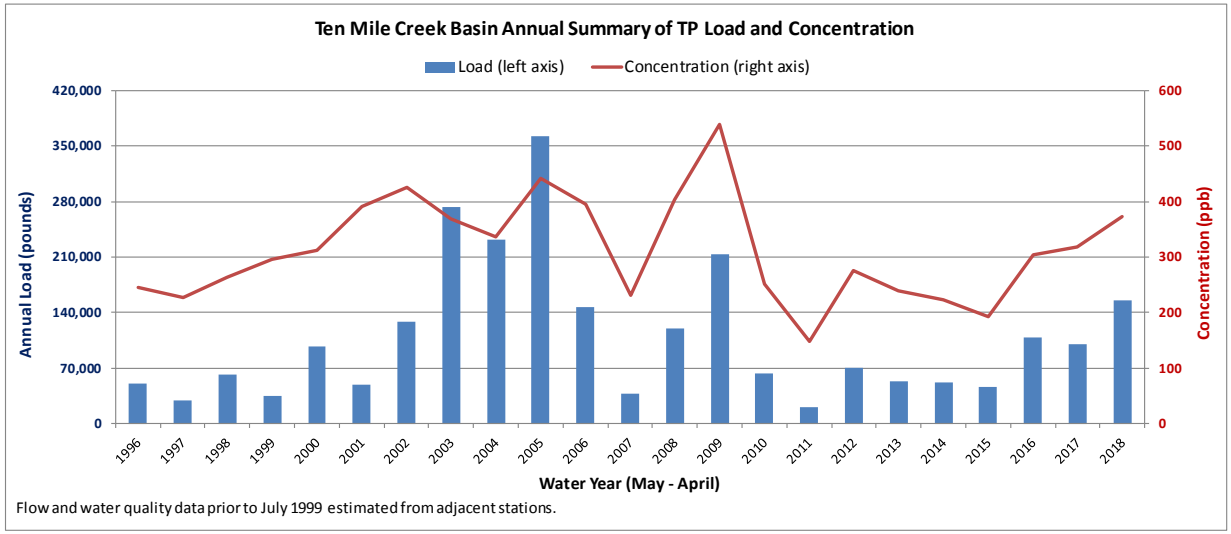
Less wetlands in floodplain now to filter/clean water before entering River.

Example of Data Analyses: Ten Mile Creek Flow and Phosphorus

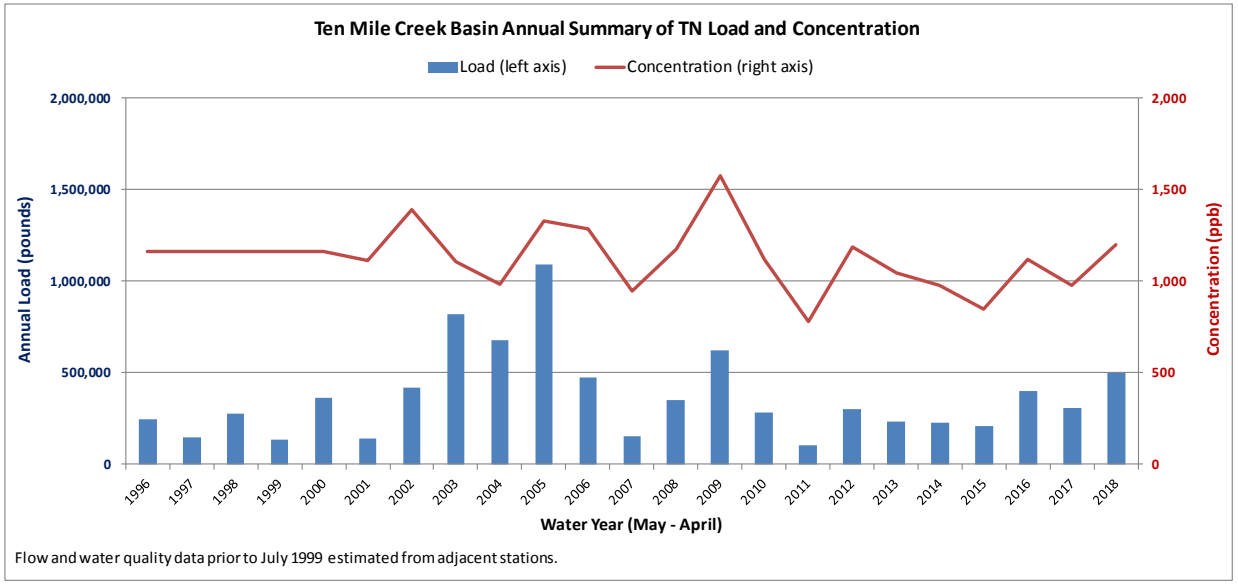
Each year I assess the water quality of the basins comprising the St. Lucie River and Estuary, including the basins within the North Fork –

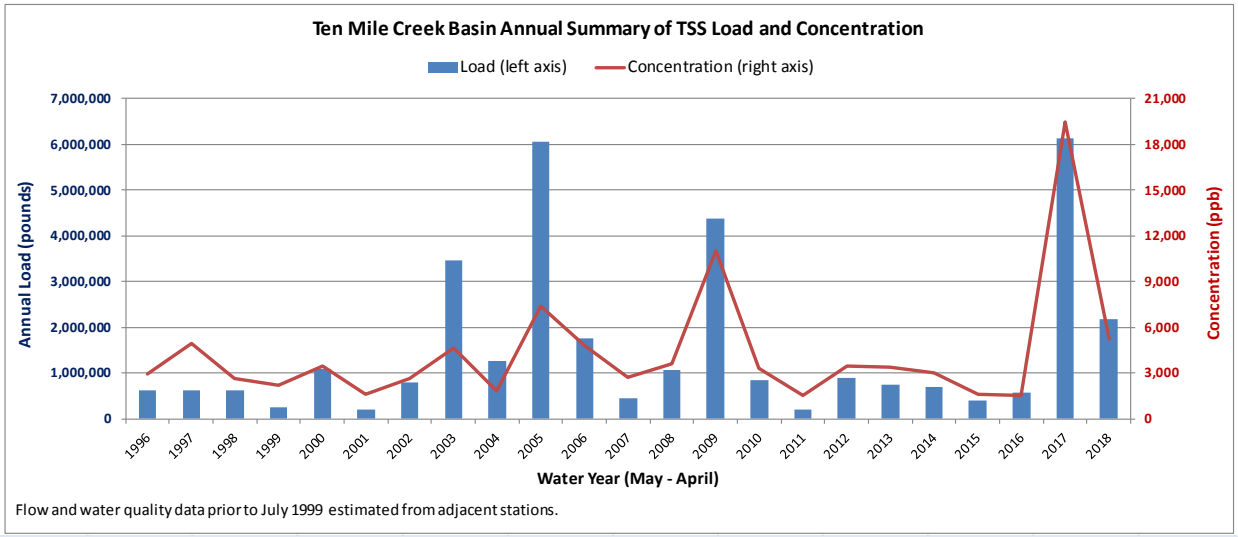
"Water Quality Assessment of the St. Lucie River Watershed – Water Year 2018"





Example of Data Analyses: Nitrogen and Suspended Sediment





2018 Water Quality Summary of North Fork Watershed

Basin	Flow Billion Gallons	Phosphorus pounds	Nitrogen pounds	Phosphorus Conc, ppb		Nitrogen Conc, ppb	
				Observed	TMDL	Observed	TMDL
C-23 Canal Basin	71.6	267,633	1,113,530	448	81	1,864	720
C-24 Canal Basin	70.7	221,548	959,763	376	81	1,627	720
Ten Mile Creek Basin	49.8	154,954	499,901	373	81	1,203	720
Tidal Areas (5 Mile Creek, etc.)	25.8	24,332	196,162	113	81	911	720
Total North Fork Watershed	217.9	668,467	2,769,356	368	81	1,523	720

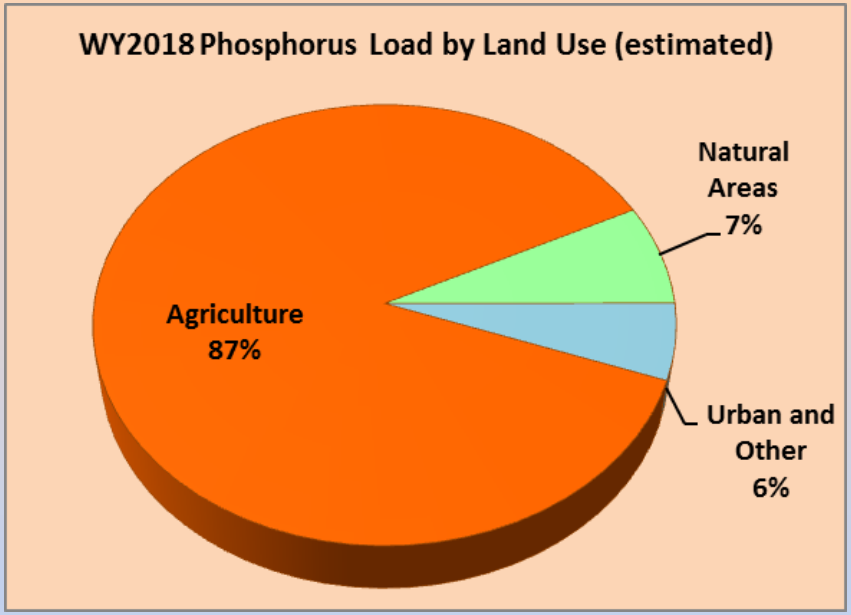
Flows and loads for tidal basins are estimated, not measured.

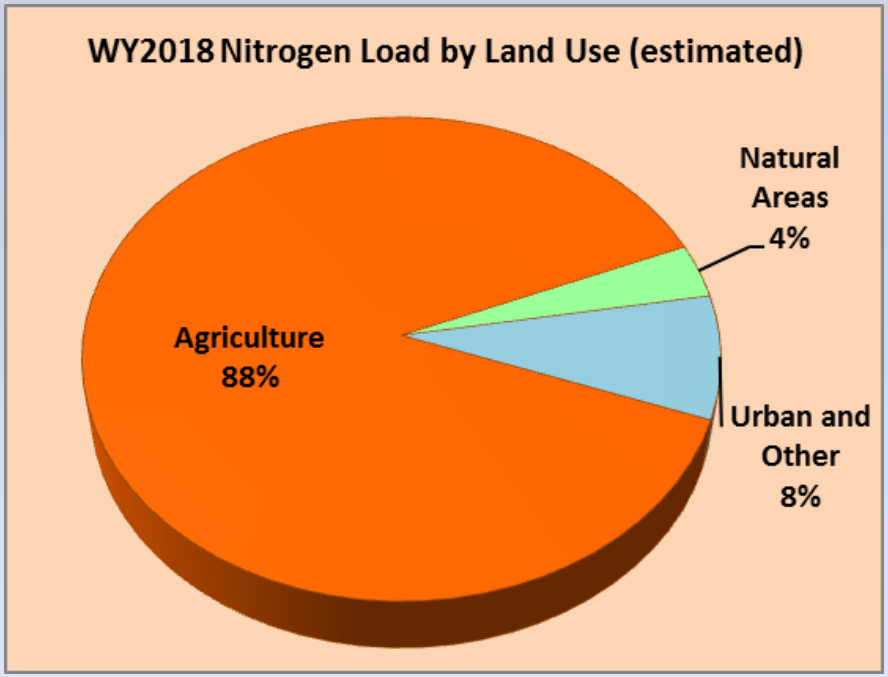
Water Year – May 1, 2017 – April 30, 2018

For 2018, the highly urbanized Tidal Areas demonstrated the best water quality, while the other basins were significantly worse.

Source of Flows and Loads – by Land Use

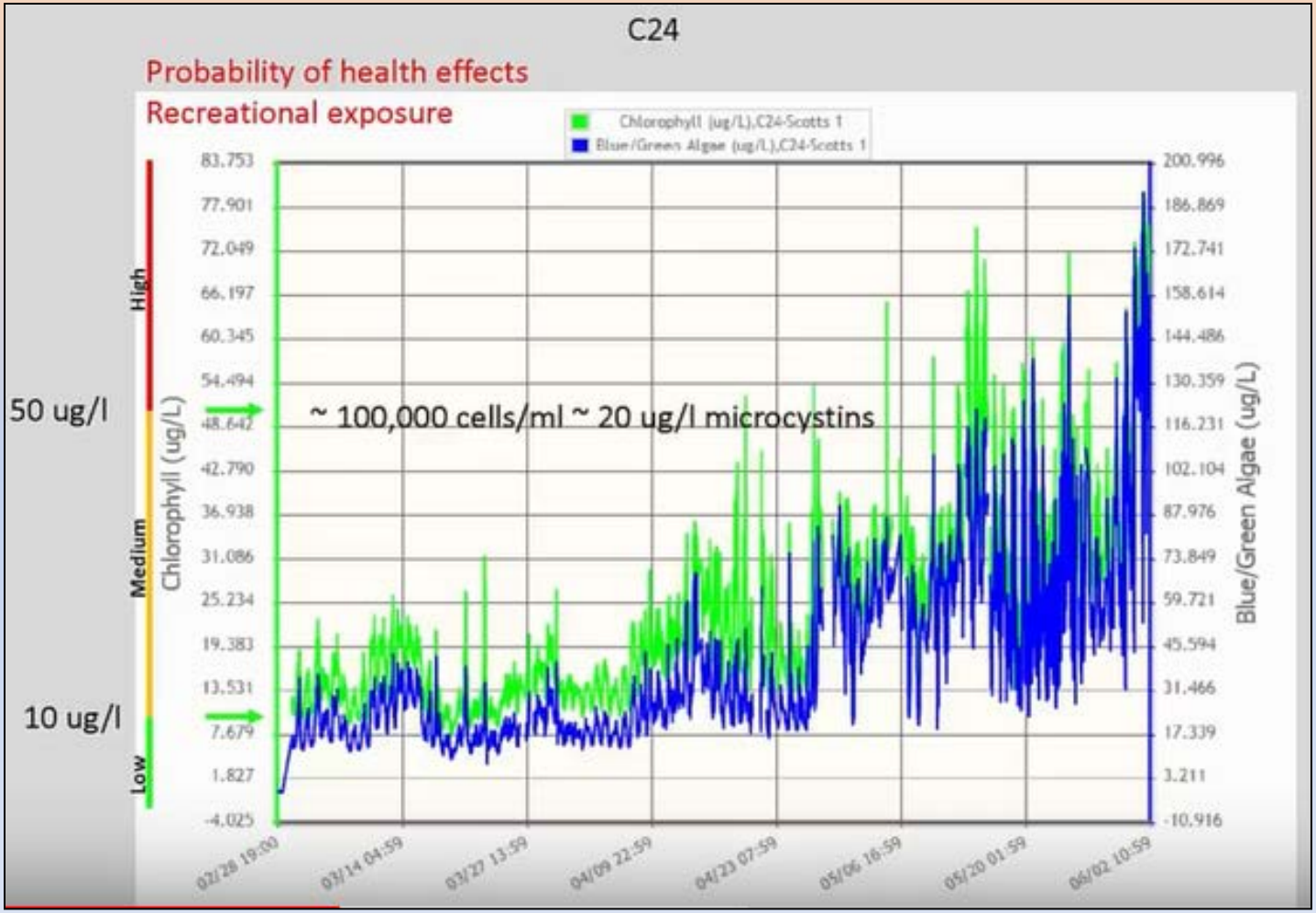
It is estimated that stormwater runoff from agricultural lands are the primary source of nutrient pollution to the North Fork.





Allocations based on BMAP land use (FDEP 2013); data are provisional and subject to revision

Blue-green algae also present in canals



Source: ORCA

Water Quality Status of North Fork Watershed

Source Basin	Total Nitogen		Total Phosphorus	
	WY2018 Status	10-yr Trend	WY2018 Status	10-yr Trend
C-23 Canal	Poor	Improving	Poor	Improving
C-24 Canal	Poor	Improving	Poor	Improving
Ten Mile Creek	Fair	Improving	Poor	Improving
Tidal Basins	Fair	Improving	Poor	Improving
Total North Fork Inflow	***Poor***	***Improving***	***Poor***	***Improving***

"Fair" indicates the water year exceeded the TMDL by less than 33%.
"Poor" indicates the water year exceeded the TMDL by more than 33%.
"Improving" indicates the 10-yr average nutrient level was below the base period value, adjusted for hydrologic variability;
"Worsening" indicates the 10-yr average nutrient level was above the base period value, adjusted for hydrologic variability.
The Tidal Basins assessment was based on observed concentrations; other source basin assessments were based on observed loads compared to hydrologically-adjusted base period loads.
The assessment of trend in each source basin was based on the most recent 10-yr average nutrient level compared to its base period. For the Tidal Basins, concentrations were assessed; for all other source basins loads were assessed.

Water Quality – Part 2

Flows and nutrient loads from the South Fork – predominantly the C-44 Canal Basin and discharges from Lake Okeechobee: both very poor water quality.

Lake discharges contain:

- *Toxic blue-green algae*
- *Excessive nutrients*
- *Extremely high suspended solids – "muck"*

St. Lucie Watershed: Poor Water Quality

Status of Inflows to St. Lucie Estuary

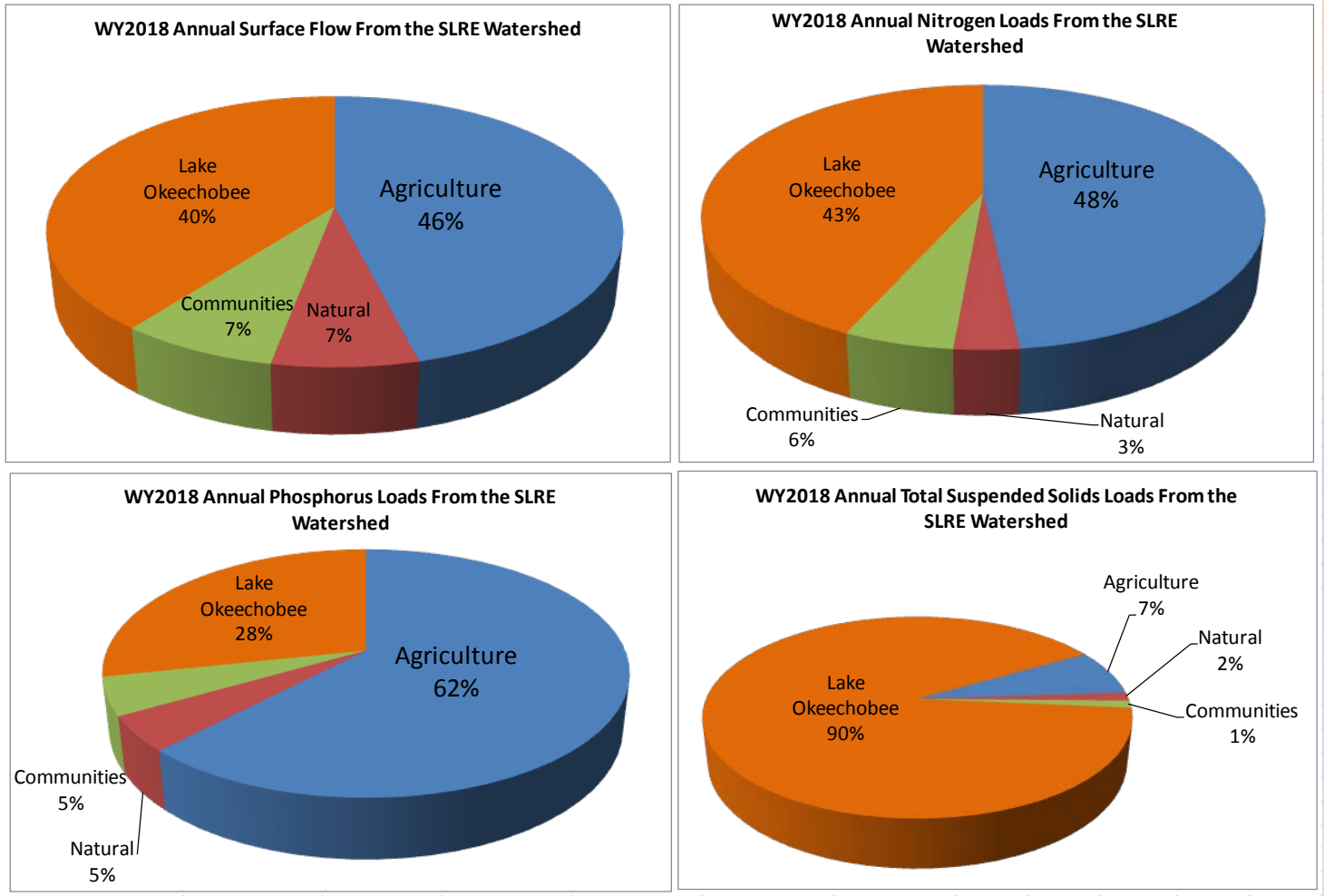
Source Basin	Total Nitogen		Total Phosphorus	
	WY2018 Status	10-yr Trend	WY2018 Status	10-yr Trend
C-23 Canal	Poor	Improving	Poor	Improving
C-24 Canal	Poor	Improving	Poor	Improving
C-44 Canal	Poor	Worsening	Poor	Worsening
Ten Mile Creek	Fair	Improving	Poor	Improving
Tidal Basins	Fair	Improving	Poor	Improving
Lake Okeechobee	Poor	Improving	Poor	Worsening
Total Inflow	***Poor***	***Worsening***	***Poor***	***Worsening***

"Fair" indicates the water year exceeded the TMDL by less than 33%.
"Poor" indicates the water year exceeded the TMDL by more than 33%.
"Improving" indicates the 10-yr average nutrient level was below the base period value, adjusted for hydrologic variability;
"Worsening" indicates the 10-yr average nutrient level was above the base period value, adjusted for hydrologic variability.
The Tidal Basins and Lake Okeechobee assessment were based on observed concentrations; other source basin assessments were based on observed loads compared to hydrologically-adjusted base period loads.
The assessment of trend in each source basin was based on the most recent 10-yr average nutrient level compared to its base period. For the Tidal Basins and Lake Okeechobee, concentrations were assessed; for all other source basins loads were assessed.

Source of Flows and Loads – by Land Use

Even with 117 days of discharges from the Lake, runoff from ag lands **represented the single largest source of flow and pollution loading.**

By contrast, runoff from ***the highly urbanized Tidal Basin*** contributed the smallest amount of pollution loading, ranging from 1-5 percent.



Allocations based on BMAP land use (FDEP 2013); Data are provisional and subject to revision

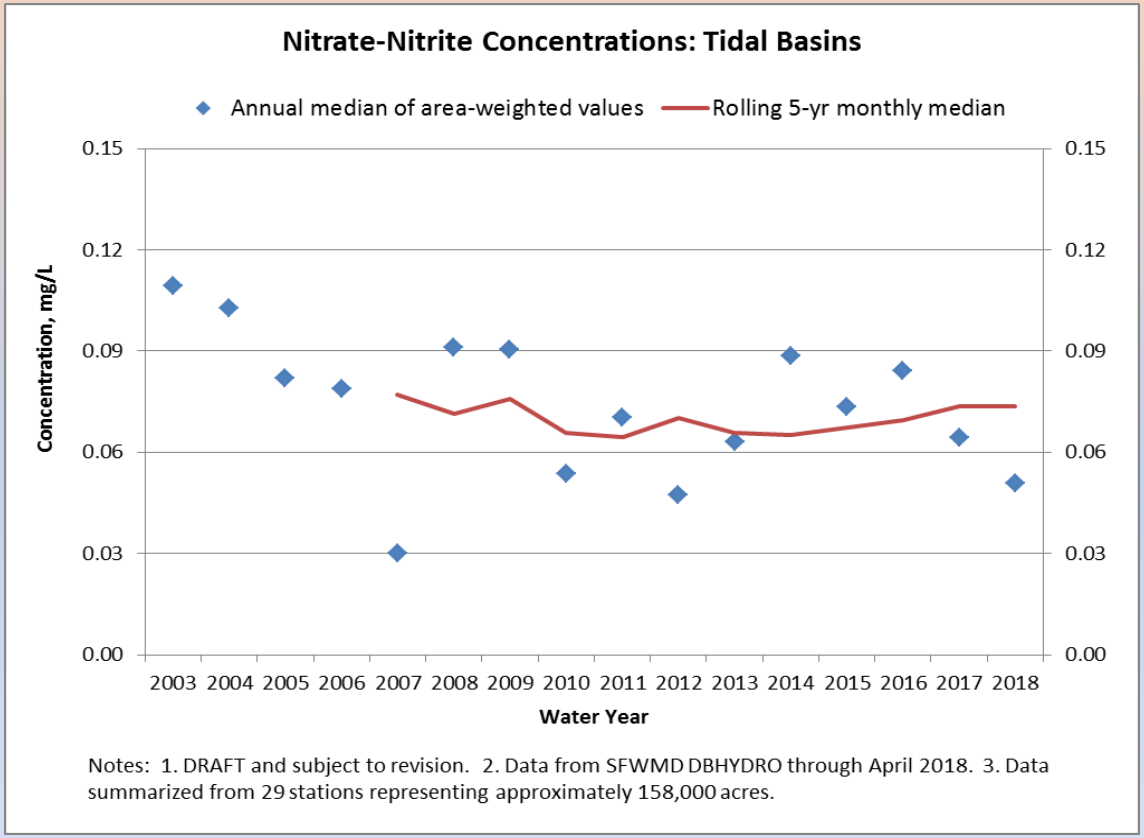
Septic Tanks – Contribution is Getting Smaller

Septic tanks are part of the loading problem

Estimated contribution remains below 10 percent of total nitrogen loading to estuary

Efforts by counties and municipalities are resulting in declining nitrogen levels

- Conversion of more than 8,000 septic tanks and 70 package treatment plants
- Active septic conversion program - $155 million

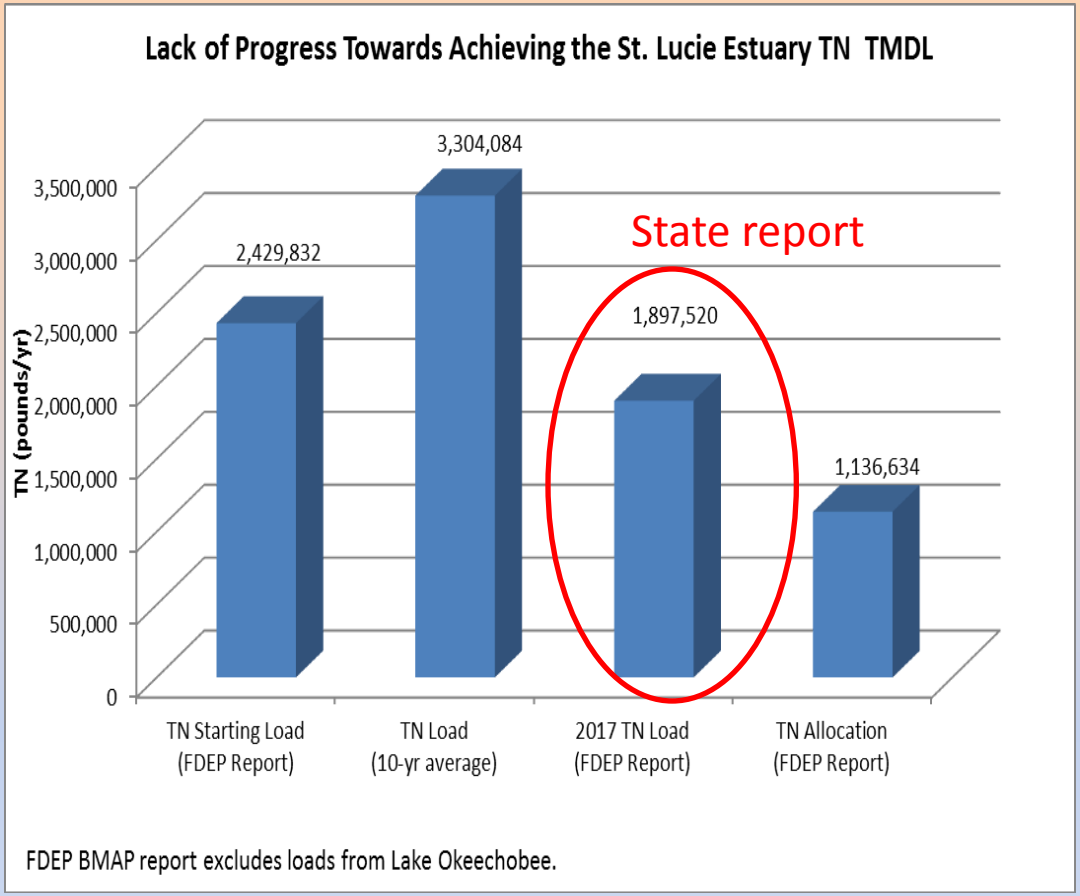


State of Florida Protection Plan: Doesn't Use the Data

Uses computer model to simulate best case scenario … as a result,

Significantly underestimated loading

- Claims phosphorus loading to the estuary has ***decreased***
- The estimated 5-yr average annual nitrogen load in 2017 was more than 74% higher than reported;
- Estimated phosphorus load was 33% more than reported by FDEP.



Other flaws in the Basin Management Action Plan (BMAP) process include:

- ignores loading from Lake Okeechobee discharges;
- fails to require field verification of Best Management Practices before assuming they are implemented;
- fails to use actual BMP performance data and instead relies on optimistic assumed load reductions;
- fails to account for the vast tonnage of nutrients being imported into the watershed from Class AA biosolids;
- fails to assess and report loads on a sub-watershed level that would allow remediation of hot spots; instead generates a single load;
- fails to evaluate loading trends – but rather, adopts a "wait and see" approach that can only begin to make necessary corrections every 5-10 years – way too late to be effective.

Recommendation: fix the flaws in the BMAP process!

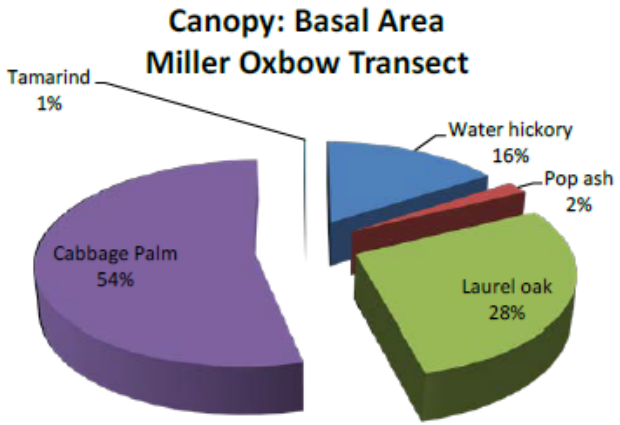
Water Quality Improvement Programs

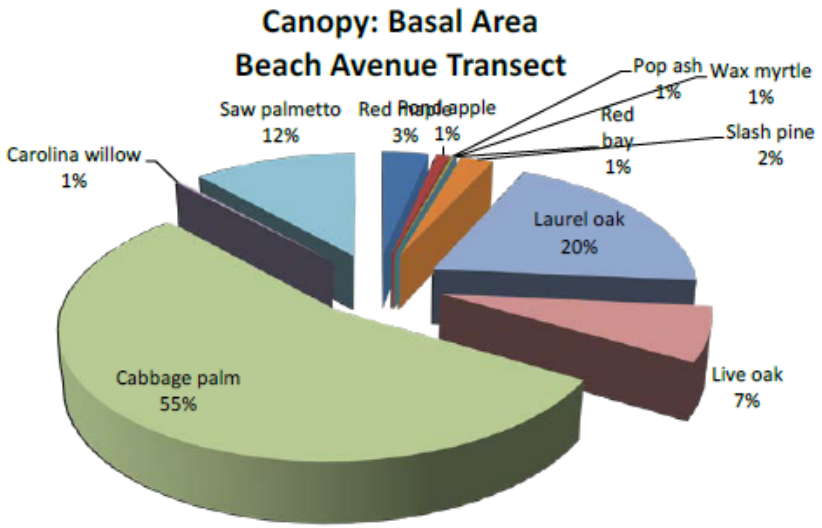
- Local governments and landowners have implemented numerous projects and activities to reduce pollutant loading
  - Fertilizer ordinances
  - Elimination of 70 wastewater treatment package plants
  - Conversion of more than 8,100 septic tanks to centralized sewers (2,150 more on-going)
  - Construction of numerous stormwater quality improvement projects
  - CERP: IRL South project: SFWMD/USACE Construction of C-44 Reservoir/STA
  - Many others too numerous to mention

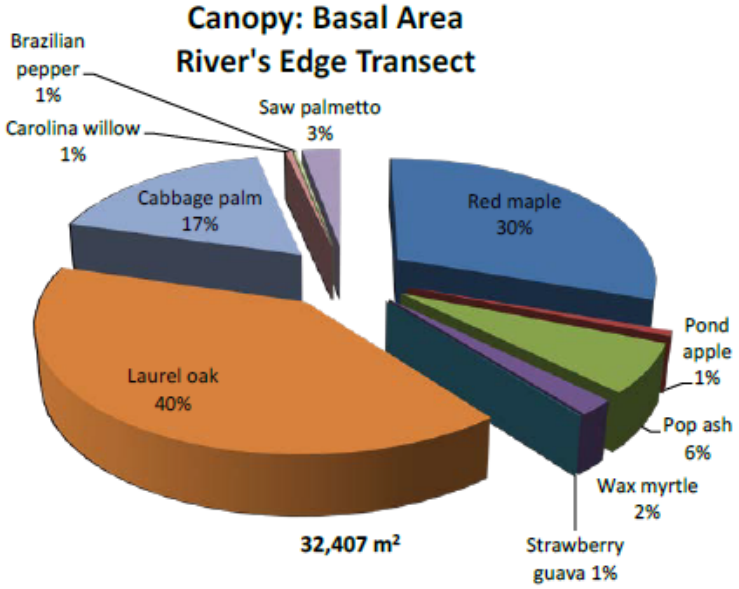
- Many recommendations have been developed and provided to FDEP staff to improve the BMAP program.

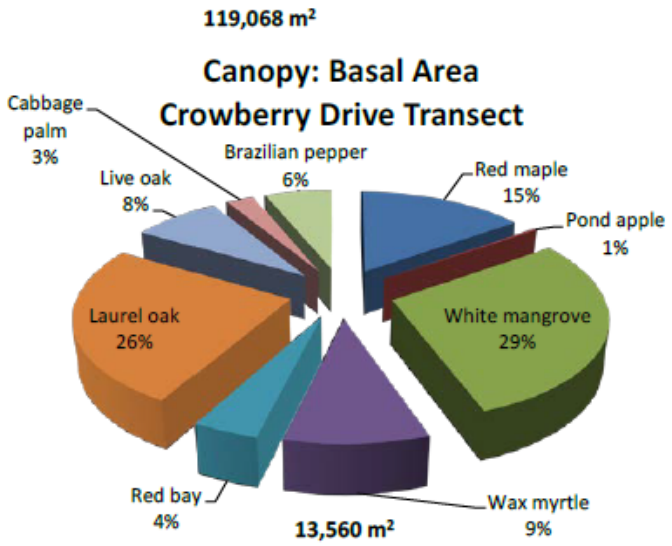
- However, due to a combination of legislative and policy constraints, and shortage of staff, it appears that significant improvements are not forthcoming.

Impacts to Vegetation









SFWMD 2015

Impacts to Vegetation

- Man-made impacts have greatly affected floodplain vegetation
- Most of the floodplain canopy trees, e.g., bald cypress, along the river were cut and removed for lumber in the 1920s
- Hydrologic conditions affect vegetation, primarily reduced inflows due to diversion from C-24
  - Swamp species like pond apple, pop ash and sawgrass are clearly struggling to survive the shorten hydroperiods on the isolated floodplains
  - Expansion of exotic species, e.g., Brazilian pepper
- The proliferation of mixed community and forest types are indicative of floodplains with altered hydrology and signs of saltwater intrusion.
- With sea level rise and the milder winters, mangroves, particularly white mangroves, may further intrude up into freshwater riverine areas and out compete freshwater plant species such as sawgrass and giant leather fern

- ***Reconnection of oxbows and isolated wetland habitats would reduce freshwater pulses, and provide greater retention time***

Moving Forward

- ***Many effective projects underway/completed***
  - Municipal and county stormwater detention/retention/treatment projects
    - Virginia Corridor water quality project – Comm. Dzadovsky
  - Septic to sewer conversion; met nitrogen reduction goals of BMAP program
  - $85 million spent on other nutrient reduction projects
  - Ten Mile Creek RSTA – reduce peak flows, improve water quality
  - North Fork floodplain restoration (FWC and FDEP)
  - Mitigation projects to improve tidal exchange with North Fork
  - Fertilizer ordinances and biosolids action
  - C-44 RSTA

- ***Future projects***
  - Comprehensive Everglades Restoration Plan (CERP) – IRL-South:
    - C-23/C-24 Reservoirs and Stormwater Treatment Areas; Muck removal
    - Allapattah Complex Natural Storage and Water Quality Area
  - HB2165 - $2M for NF floodplain restoration (FWC)

Some Areas of Concern

1. **State's water quality regulations need to be strengthened**. The 2016 Water Act significantly weakened the timeframes, plans and regulation required to achieve water quality standards. Legislative action is needed to reverse those actions. In addition, the prior administration severely cut the budgets and staff of the agencies responsible for monitoring and enforcing water quality regulations, and these need to be restored.

2. **Basin Management Action Plan (BMAP) needs to be strengthened**, including accelerating timeframes to achieve the TMDLs; establishing subwatershed-specific load allocations; annual assessments and reporting based on measured nutrient loads (or concentrations for tidal basins); increasing staffing to verify and monitor the implementation of Best Management Practices; and incorporating estimates of pollution loading from the application of biosolids.

3. **The state's biosolids program needs to be strengthened**, including reporting, monitoring and overall regulation of the application of Class AA and Class B biosolids.

Reasons to be Optimistic

- Waterkeepers Florida – a common voice to protect Florida waters
- Gov. DeSantis Executive Order
  - $2.5 billion over 4 years for Everglades restoration and protection of water resources
  - Blue Green Algae Task Force
  - Accelerate EAA Storage Reservoir (won't help water quality of Lake)
  - Office of Environmental Accountability and Transparency, Chief Science Officer
  - New board members of water management district
- In addition to long-standing general support, appears to be bipartisan support in the US House of Representatives
  - Rep. Brian Mast – his many efforts
  - Newly elected Rep. Debbie Mucarsel-Powell
- Corps to begin re-evaluation of LORS in 2019
- Grassroots activism – people are engaged

WE CAN DO THIS PEOPLE!

Any questions?

For further information:

www.garygoforth.net

Technical Support Documents for Lake Okeechobee, St. Lucie and Caloosahatchee Watersheds

"Brief Summary of Lake Okeechobee Pollution"

"Water Quality Assessment of the St. Lucie River Watershed – Water Year 2018"

Source of Flows and Loads – by Basin