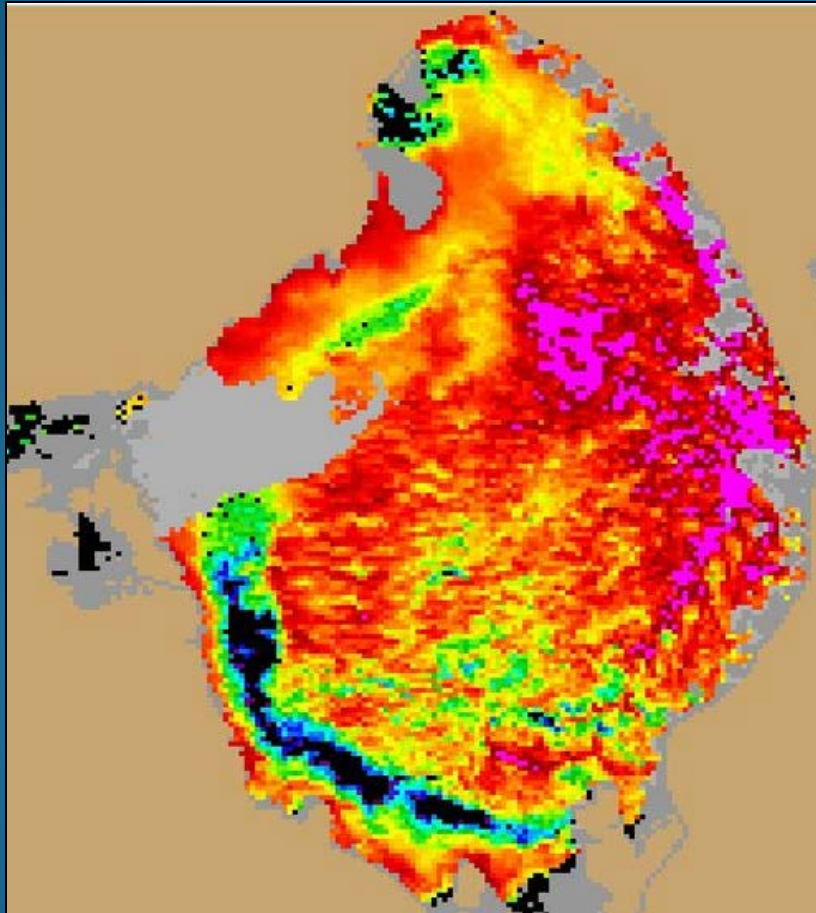
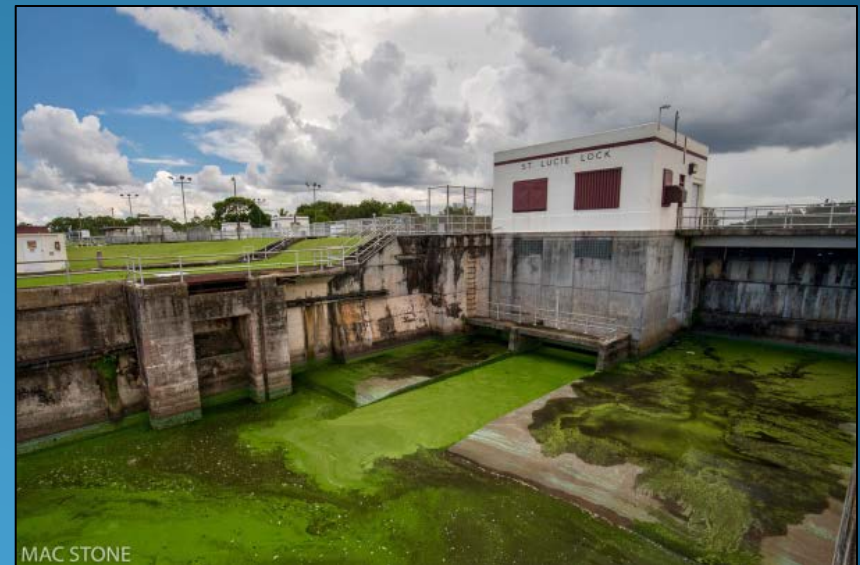


# Water Quality of Lake Okeechobee and St. Lucie Estuary Watersheds



Rivers Coalition  
October 25, 2018  
Gary Goforth, P.E., Ph.D.



Gary Goforth, LLC

Disclaimer: Opinions expressed are those of the author and not of Florida Oceanographic Society, RC or any other group.

# 2018 – Another Lost Summer With a Toxic Twist

127 days of destructive Lake discharges

- 87 billion gallons of polluted water
- Toxic blue-green algae
- 32 million pounds of suspended sediment
- 1.3 million pounds of nitrogen
- 147,000 pounds of phosphorus

Algae blooms sustained by high nutrient loading from ag-dominated local watershed

Rare red tide event

Human health impacts, fish kills, oyster mortality, economic impacts, etc.

*A review of prior year's pollution loading gives some insight to the reasons behind these conditions...*

# Lake Okeechobee

Watershed is almost 3.5 million acres

- 50% agriculture
- 38% natural lands and water
- 12% communities

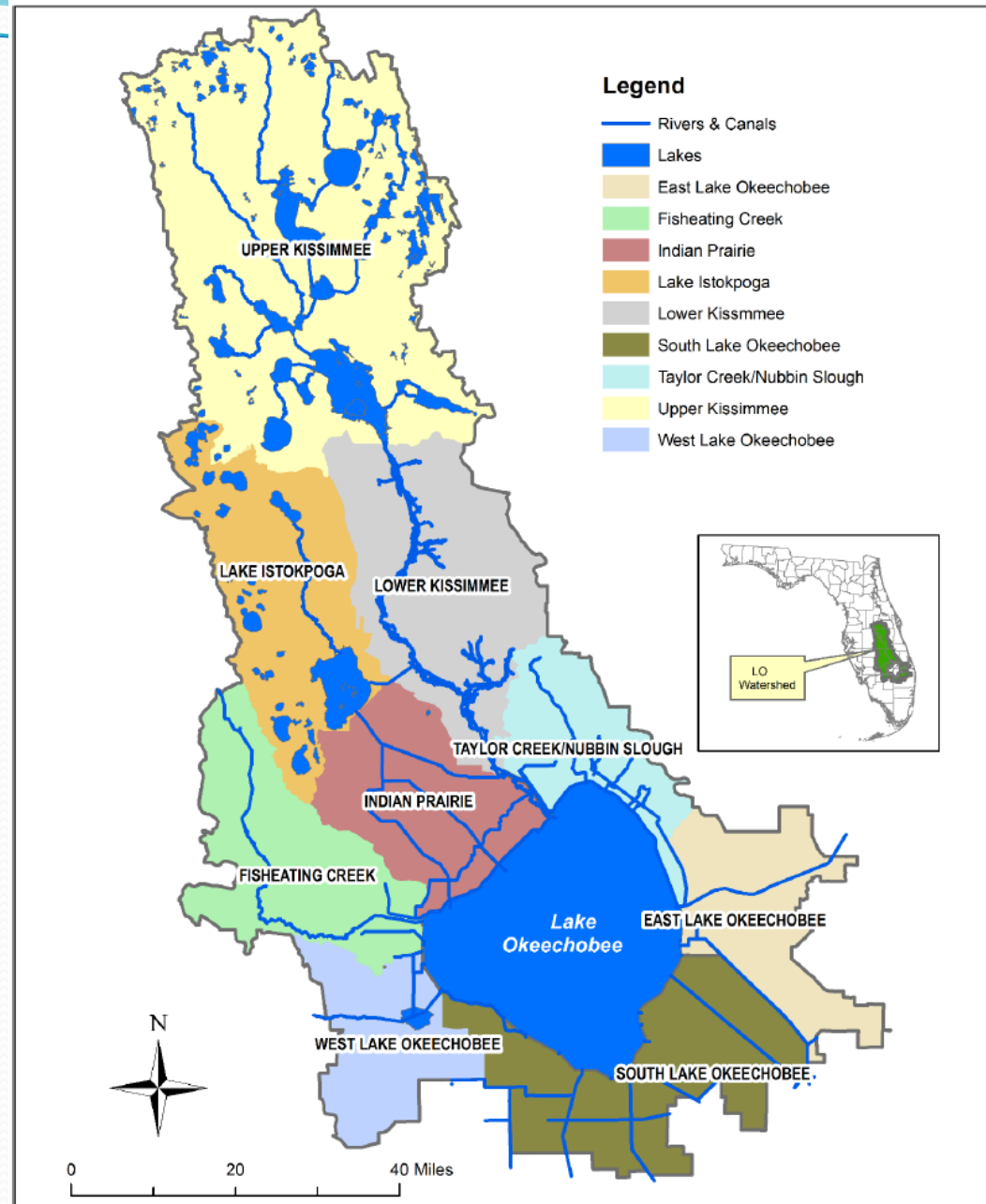
State has studied the causes of pollution for decades and identified solutions

Total Maximum Daily Load (TMDL)

- Set in 2001 at 231,483 pounds/yr of phosphorus from watershed
- Calculated as 5-yr average of calendar years' *measured* data

Original compliance date: January 2015

In 2016, Florida legislature deleted the 2015 deadline, and replaced it with an ambiguous process (BMAP) that does not hold landowners accountable for their pollution

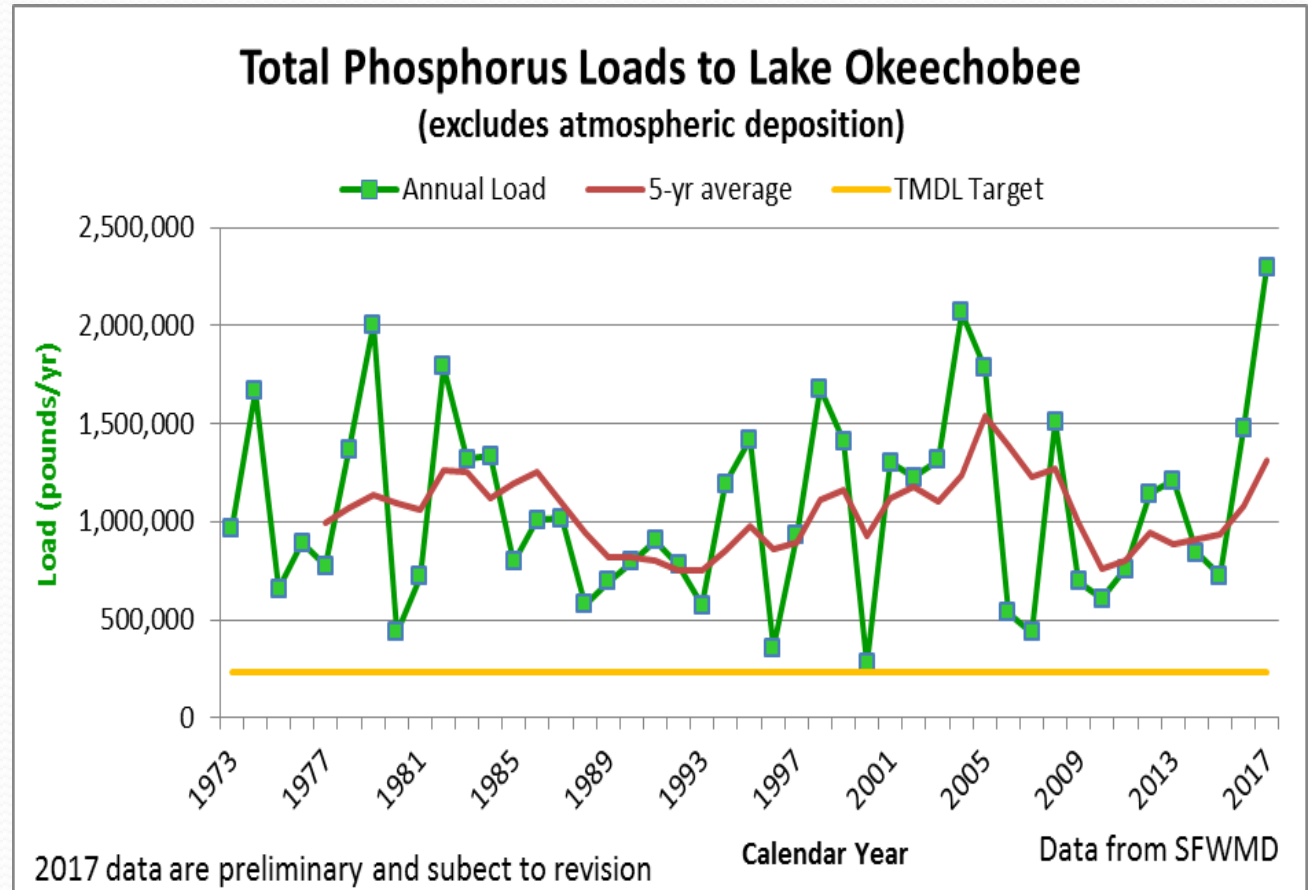


# Pollution to the Lake is Increasing

During 2017 - historic high phosphorus loads.

1. High flows from Hurricane Irma
2. **High concentrations from watershed**
  - 252 ppb concentration – 3<sup>rd</sup> highest in history

The average load was more than 5 times the target for the watershed, and getting worse, despite 2014 Plan.



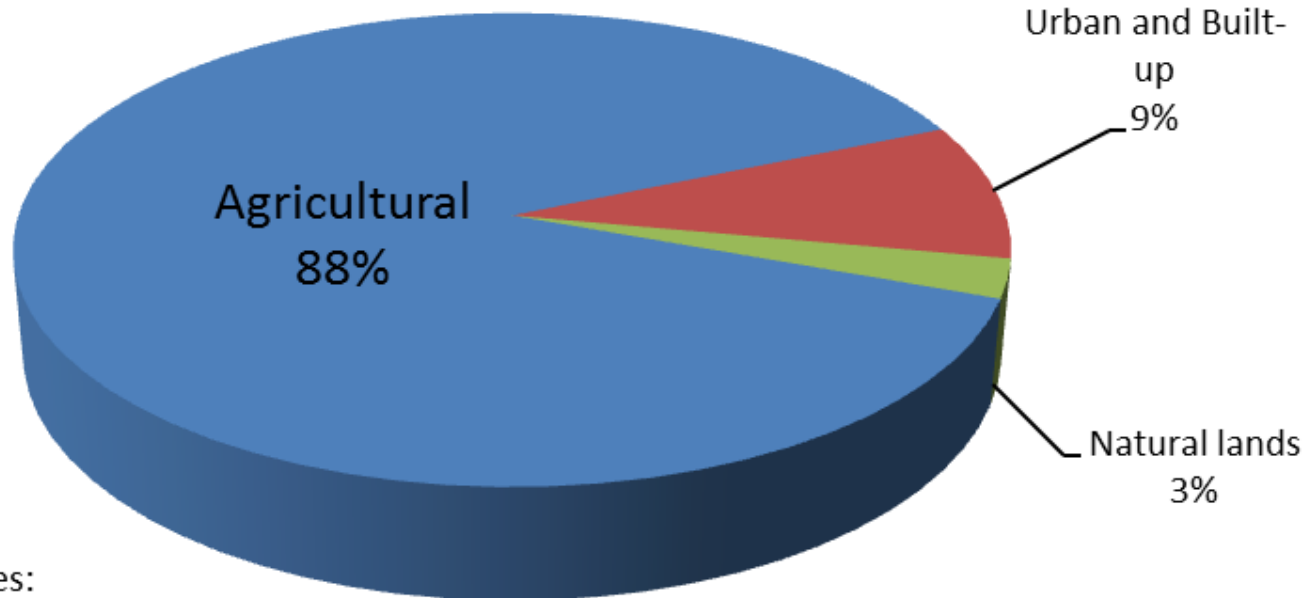


# Estimated Pollutant Loading by Land Use – 2017

## Total Phosphorus Loading to Lake Okeechobee (2017)

Annual load = 2,298,875 lbs/yr

*Draft*



### Notes:

Land use data from SFWMD (2018); unit area loads revised from Goforth et al. (2013).

"Agricultural" includes traditional agricultural activities.

"Urban and built-up" includes residential, transportation, communication and utilities.

"Natural lands" includes wetlands, waterbodies, upland forests, rangeland and barren land.

This is only an estimate – since no parcel-specific water quality data are available; this estimate assumes each land use has responded uniformly to load reduction measures since the 2001-2012 Starting Period.

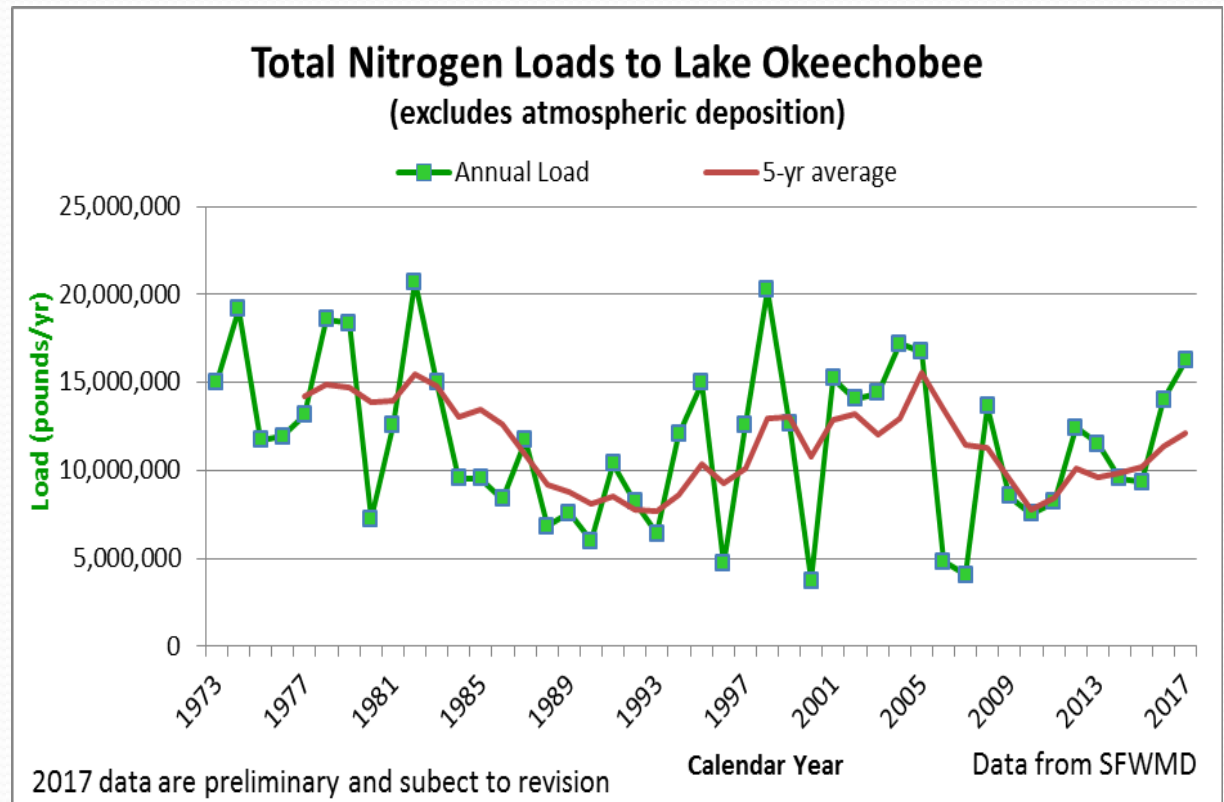
Experimental product for discussion only

# Similar Trend for Nitrogen Pollution

Average nitrogen loads have generally increased after achieving near-historic low in 2010

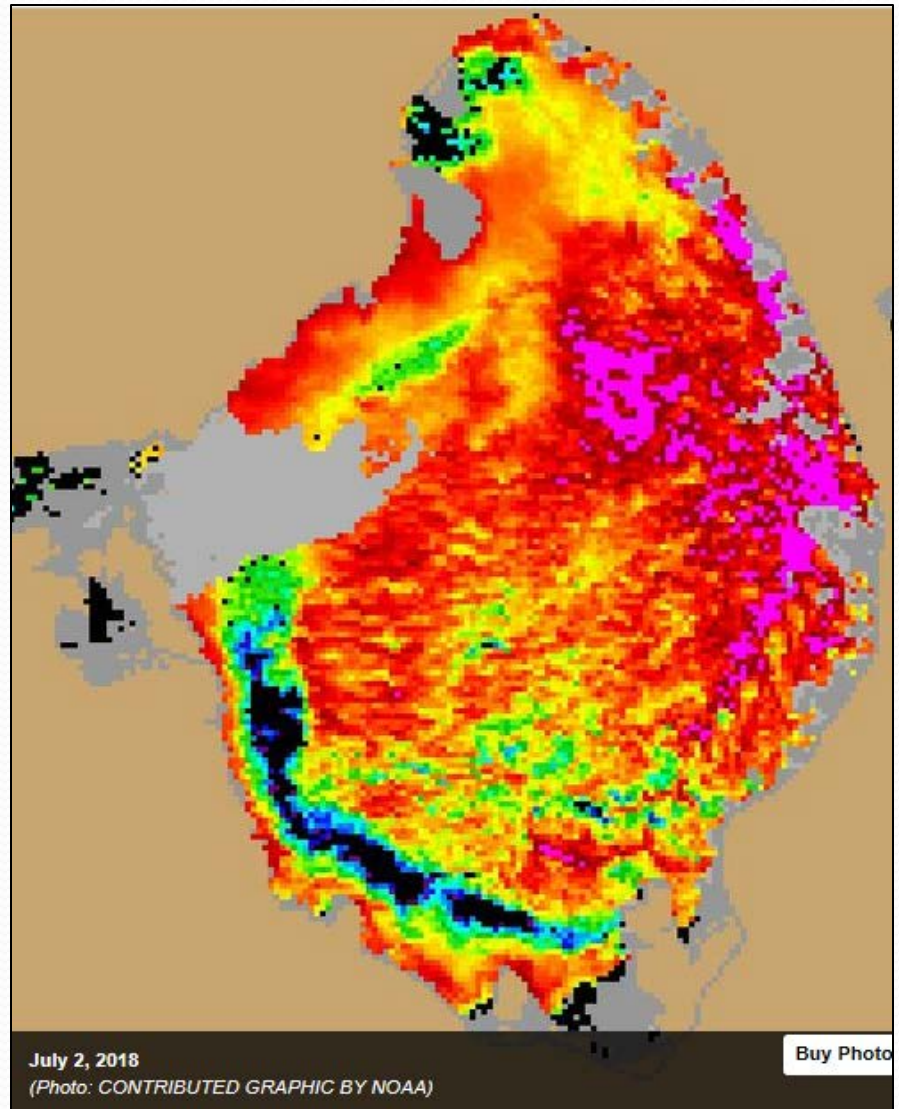
Total nitrogen is critical as toxic algae cannot obtain nitrogen from the air – feeds off of waterborne source

*Yet the state has not set a limit for inflows of nitrogen*



**Discharges of  
polluted water to St.  
Lucie Estuary began  
June 1.**

*On July 2, 2018, NOAA  
reported that 90  
percent of Lake's  
open water was  
covered by toxic blue  
green algae.*





**So ... in light of**

- **historic high pollution loads to Lake**
- **trend of increasing pollution loads**
- **toxic algae bloom on lake**
- **polluted discharges to estuaries**

**How did State of Florida address loads to Lake?**

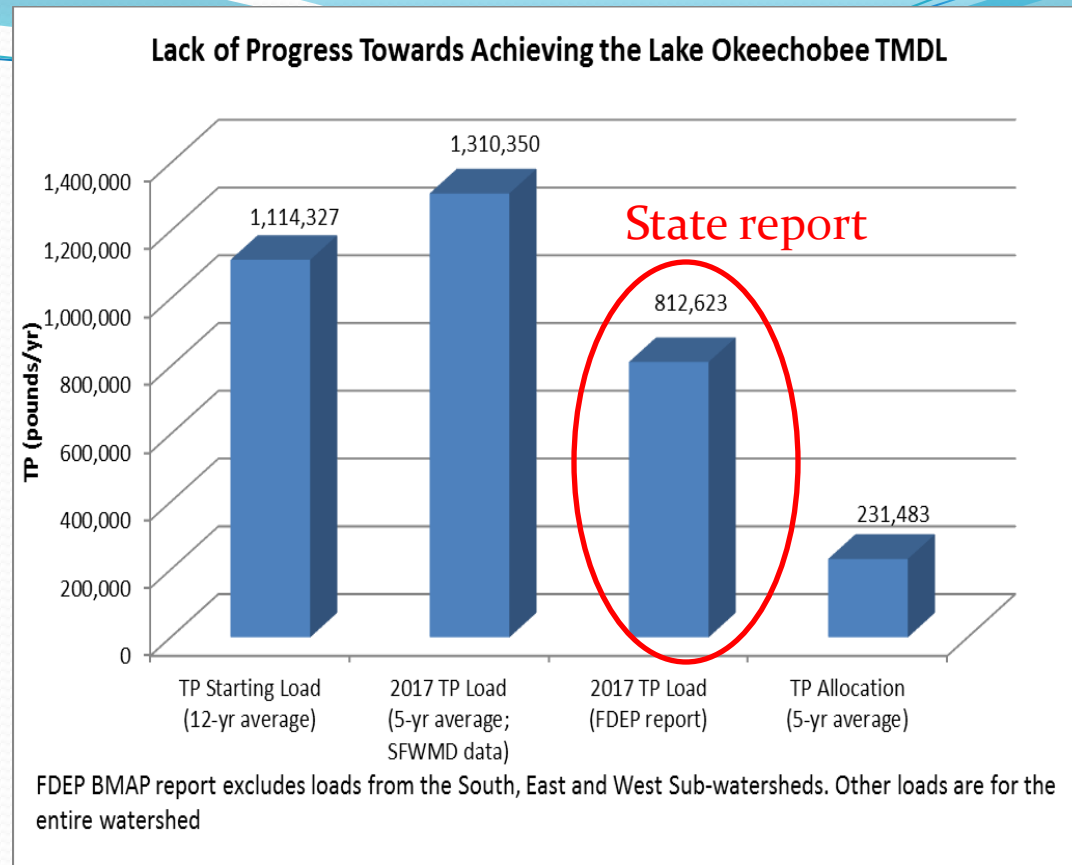


# State of Florida Protection Plan: Doesn't Use the Data

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

Significantly underestimated loading

- Claims phosphorus loading to the lake has decreased
- The measured 5-yr average annual load in 2017 was more than 60% higher than reported



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

- ignores loading from over 800,000 acres of the watershed;
- 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 identify measures that will collectively achieve the TMDL;
- 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!***

# Misinformation Continues ...

## ***“Orlando suburbs are the cause”***

- Loads come from all around Lake
- Lowest concentrations come from the Upper Kissimmee basin

## ***“High loads due to hurricane”***

- Less flow in 2017 than from 2004/5 hurricanes, but much worse concentrations

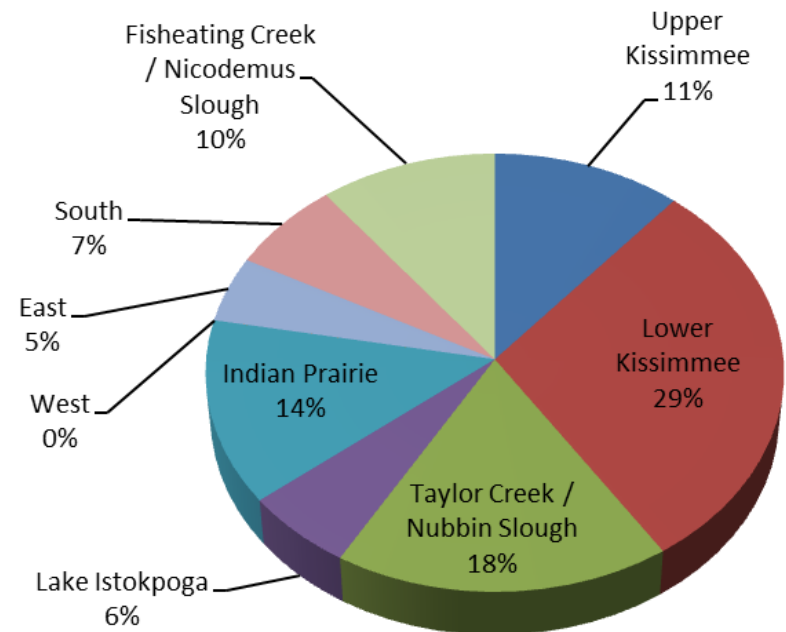
## ***“High loading due to rewetting of Kissimmee River Restoration project”***

- Most of the restoration has been complete and inundated for years
- Rehydrated wetlands make up less than 1% of watershed
- Majority of Lower Kissimmee basin is agriculture land use
- ***SFWMD has no data that would differentiate water quality of the restoration project from rest of basin***

## ***“Water quality is improving, the BMAP is working and BMPs are working”***

- Seriously?

**Total Phosphorus Loads to Lake (2017)**



2017 data are preliminary and subject to revision

Data from SFWMD

# Summary of Lake Okeechobee Watershed Water Quality

During calendar year 2017 the phosphorus loading was the highest ever recorded, and the average phosphorus loading to the lake was more than 5 times the target for the watershed set 17 years ago.

The water quality of the lake is at an all-time crisis level, and human health, the environment and the regional economy is suffering as polluted lake water is discharged to the estuaries.

The state's pollution control program for the lake is broken and needs to be fixed.

The EAA Reservoir will not fix the Lake Okeechobee pollution to the estuaries – the discharges that remain will continue to be toxically polluted.

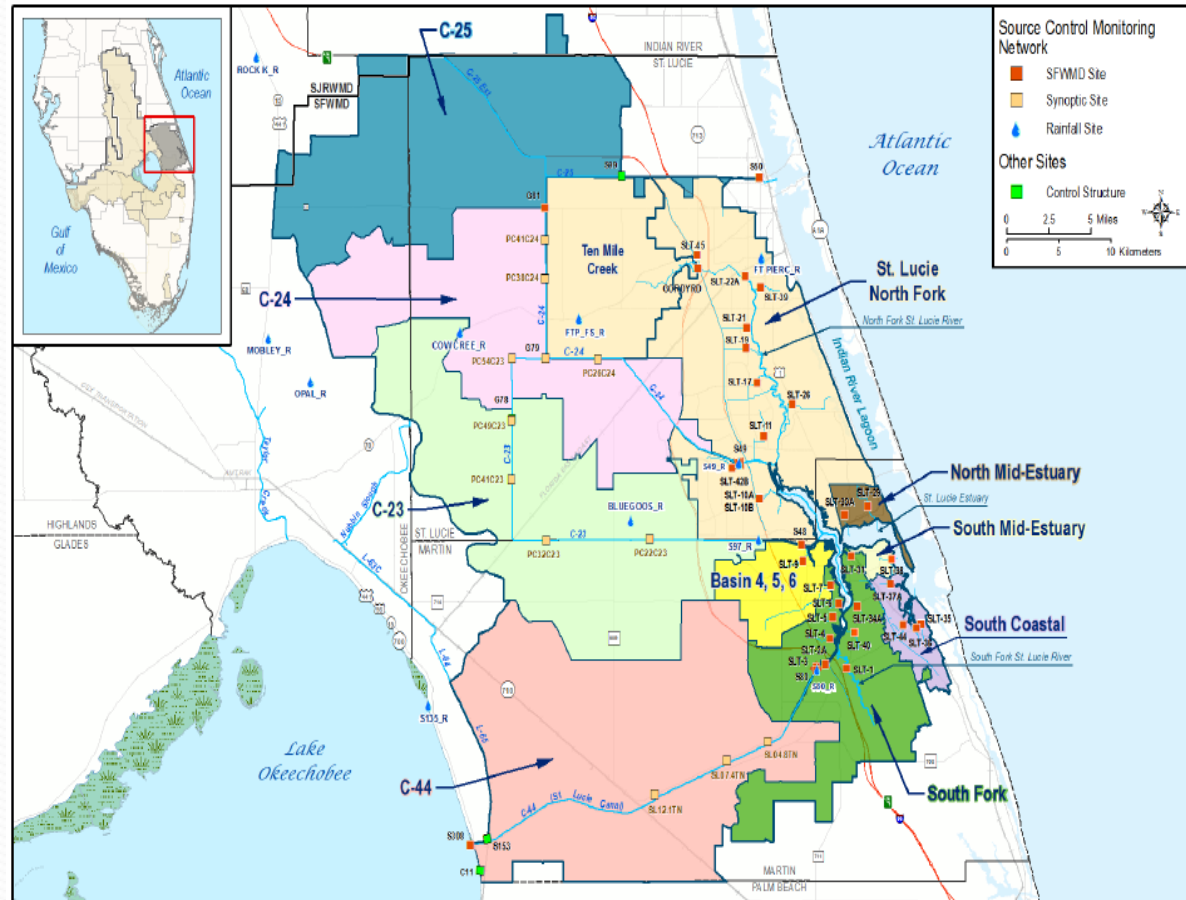
***The public needs to hold the state accountable,  
e.g., election of responsible candidates to  
strengthen environmental policies.***

# Water Quality of St. Lucie Estuary Watershed

My 3<sup>rd</sup> annual assessment using publically-available data

Major basins:

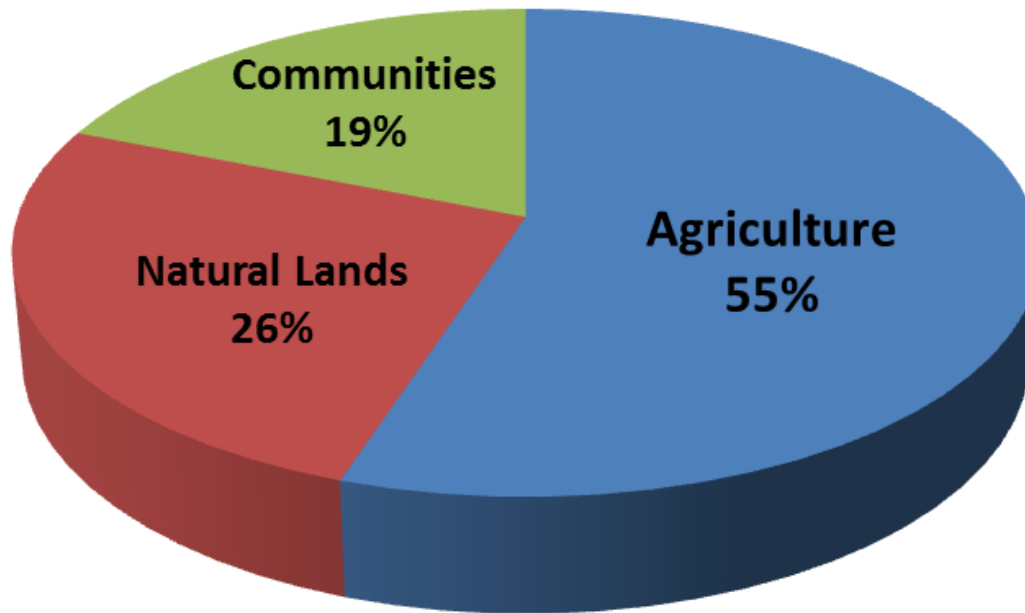
- C-23
- C-24
- C-44
- Ten Mile Creek
- Tidal Basins
  - 29 stations – concentrations
- Lake Okeechobee



FDEP chose a mid-year start, so conditions were analyzed for current Water Year (May 1, 2017 – April 30, 2018), and the most recent 10-yr period (WY2009-WY2018).



# Land Use of St. Lucie Estuary Watershed



Reference: FDEP 2014, SFWMD 2016

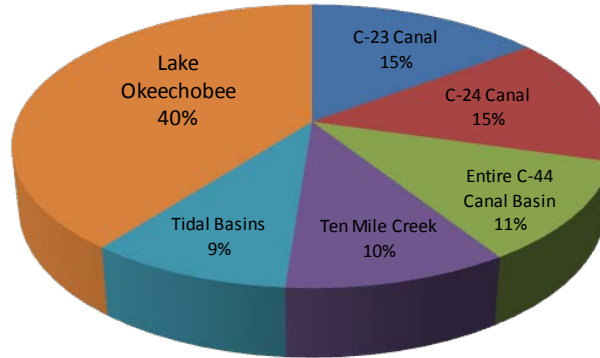
The “local watershed” has more than doubled in size over the last 100 years as large drainage canals were constructed (C-23, C-24, C-44).

# Loading to Estuary – Water Year 2018

117 days of discharges from the Lake **represented the single largest source of flow and pollution loading.**

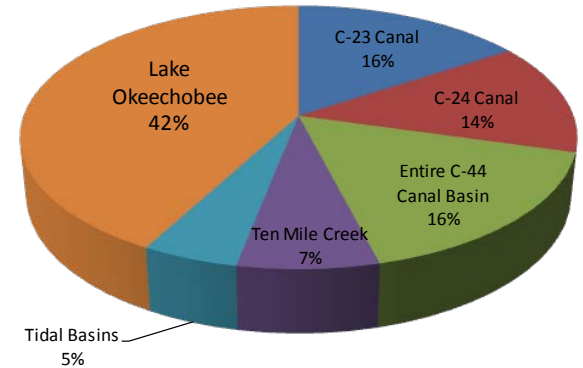
By contrast, runoff from **the highly urbanized Tidal Basin** contributed the smallest amount of pollution loading, ranging from 1-5 percent.

WY2018 Annual Surface Flow From the SLRE Watershed



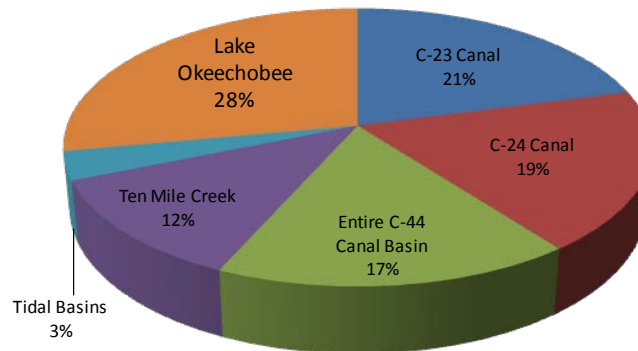
Flow data for Tidal Basins estimated from SFWMD calculations.

WY2018 Annual Nitrogen Loads From the SLRE Watershed



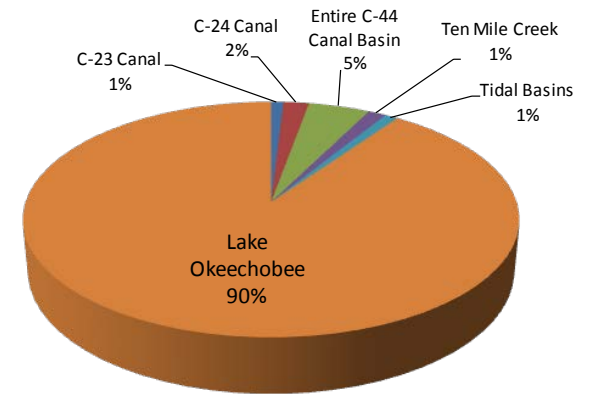
Flow data for Tidal Basins estimated from SFWMD calculations.

WY2018 Annual Phosphorus Loads From the SLRE Watershed



Flow data for Tidal Basins estimated from SFWMD calculations.

WY2018 Annual Total Suspended Solids Loads From the SLRE Watershed



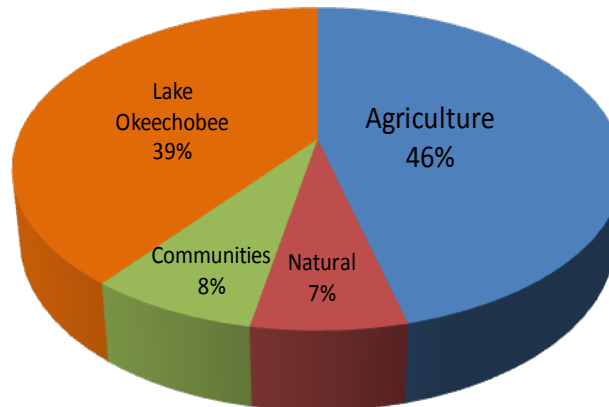
Flow data for Tidal Basins estimated from SFWMD calculations.

# Estimated Loading by Land Use – WY2018

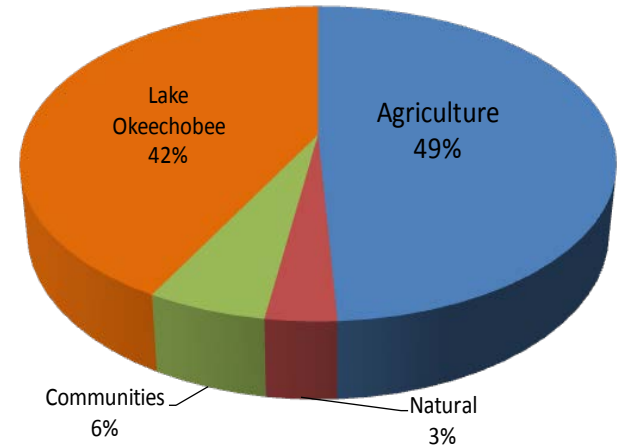
Despite the large discharges from the Lake during WY2018, stormwater runoff from agricultural lands represented the single largest source of flow and nutrient loading.

By contrast, runoff from urban areas contributed the smallest amount of pollution loading, ranging from 1-6 percent.

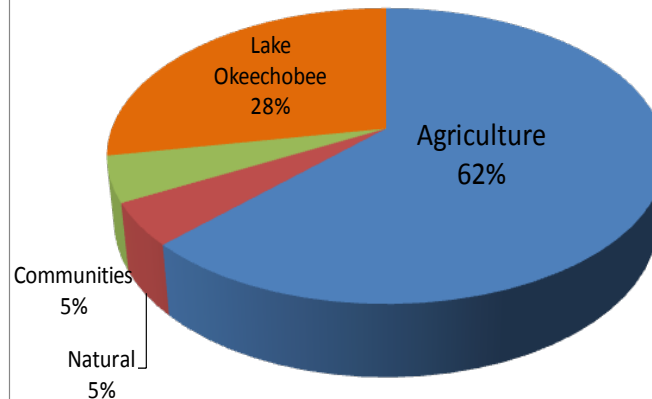
WY2018 Annual Surface Flow From the SLRE Watershed



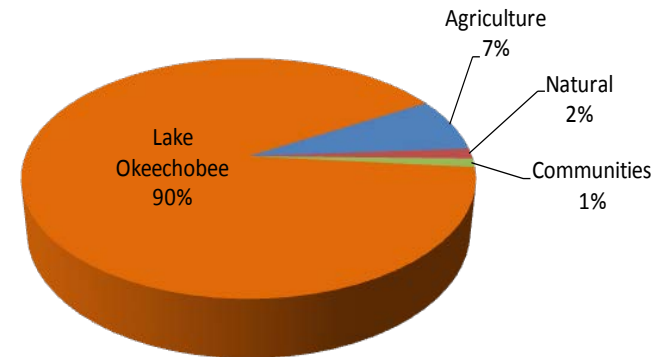
WY2018 Annual Nitrogen Loads From the SLRE Watershed



WY2018 Annual Phosphorus Loads From the SLRE Watershed



WY2018 Annual Total Suspended Solids Loads From the SLRE Watershed



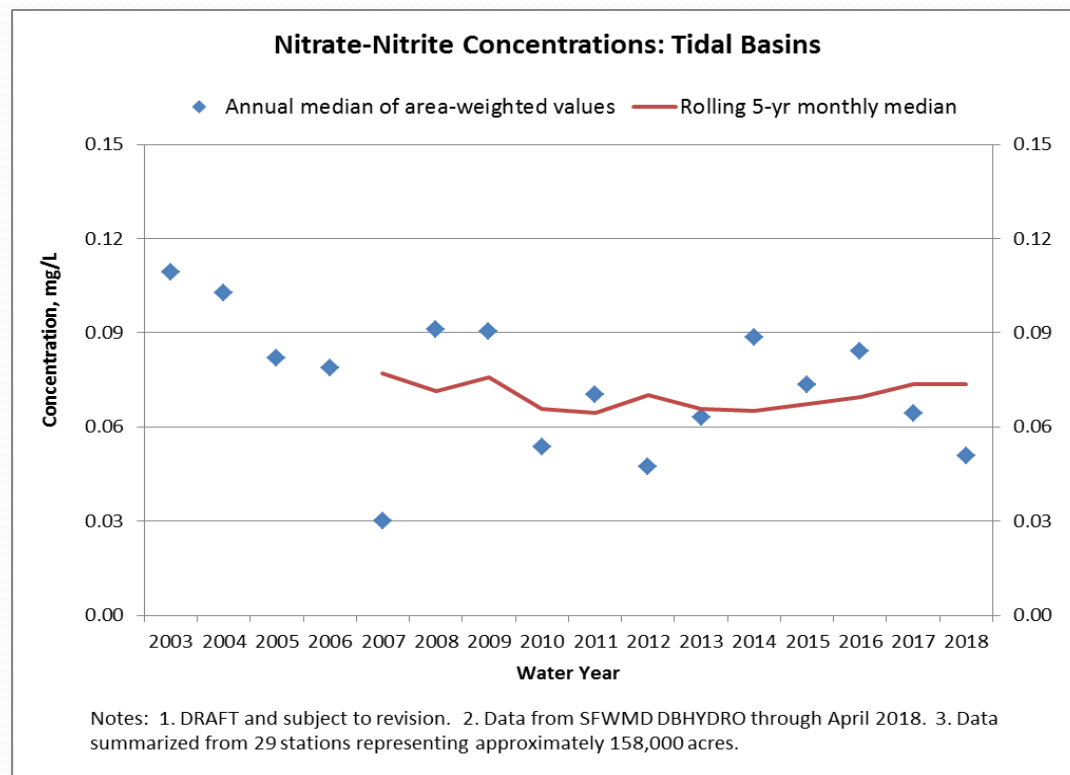
# Septic Tanks – Contribution is Getting Smaller

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 1,700 septic tanks and 70 package treatment plants
- Active septic conversion program - \$155 million
- \$72 million spent on other nutrient reduction projects





# St. Lucie Estuary Watershed Report Card

Source Basin	Total Nitrogen		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
<i>C-44 Canal</i>	<i>Poor</i>	<i>Worsening</i>	<i>Poor</i>	<i>Worsening</i>
Ten Mile Creek	Fair	Improving	Poor	Improving
Tidal Basins	Fair	Improving	Poor	Improving
Lake Okeechobee	Poor	Improving	Poor	Worsening
<b>Total Inflow</b>	<b>Poor</b>	<b>Worsening</b>	<b>Poor</b>	<b>Worsening</b>

“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.

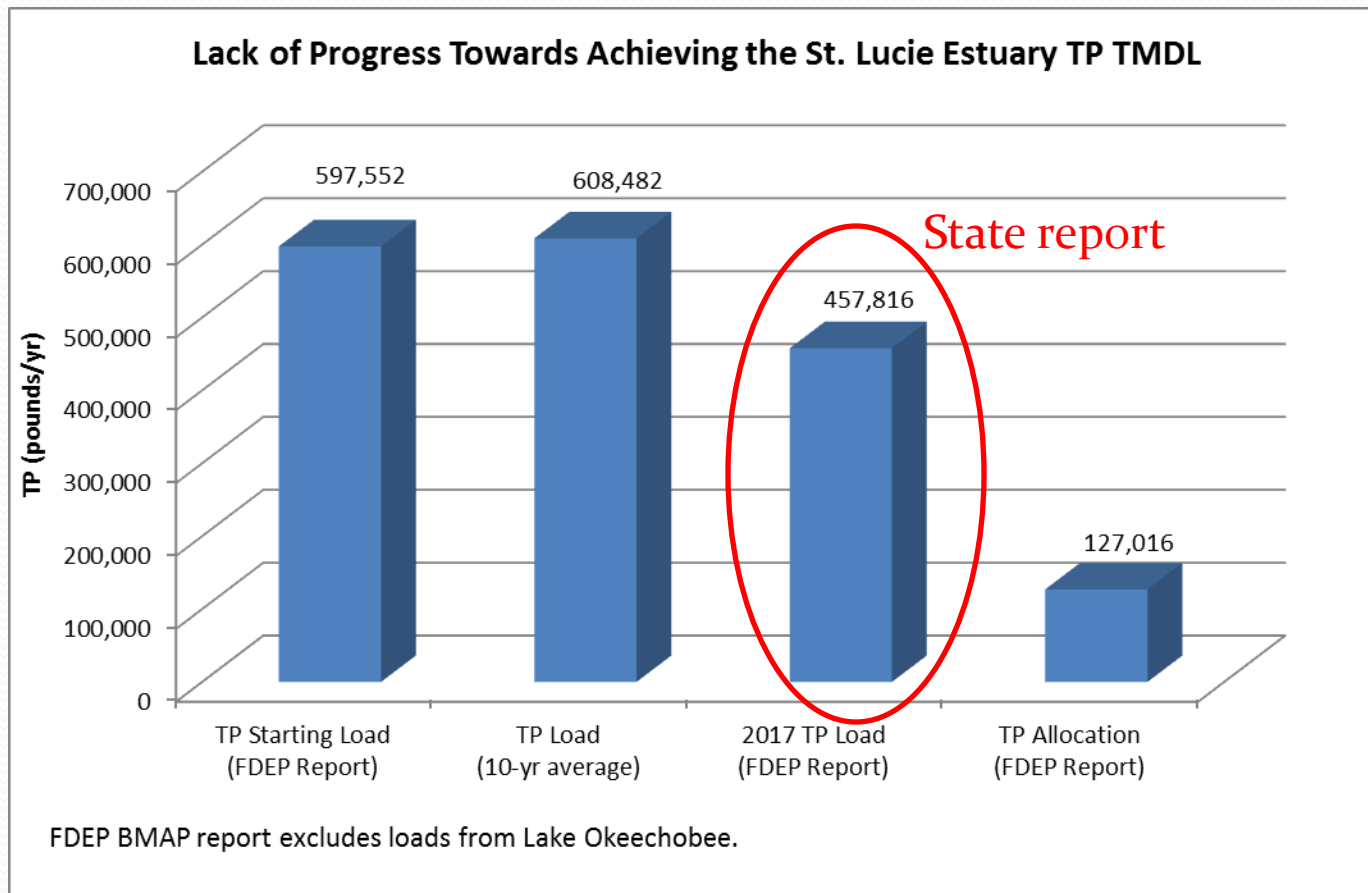
The assessment of trend in each source basin was based on the most recent 10-yr average nutrient level compared to its base period. For the Tidal Basins and Lake Okeechobee, concentrations were assessed; for all other source basins loads were assessed.



**So ... in light of poor water quality entering  
Estuary from watershed,**

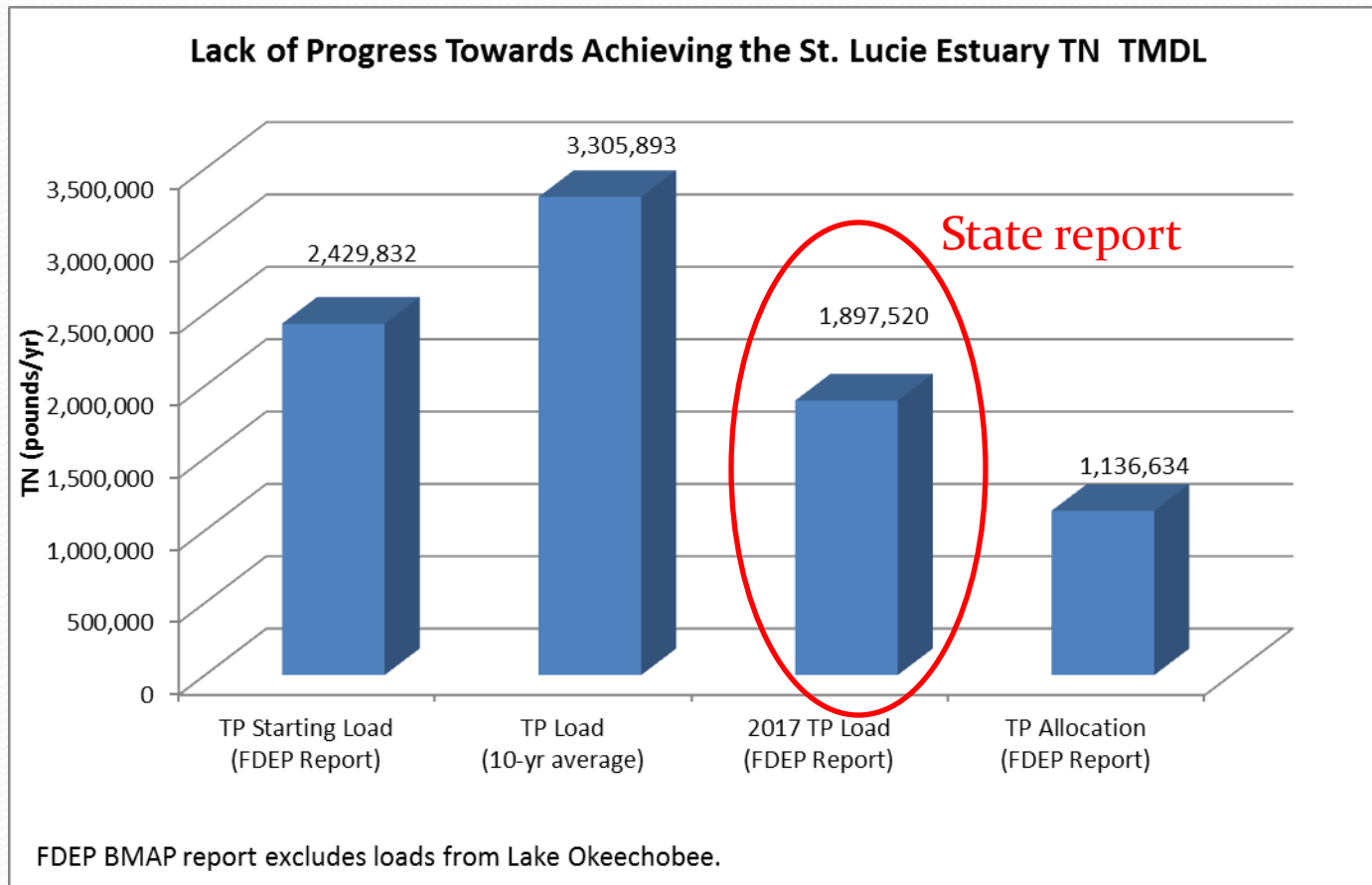
**How did State of Florida address issue?**

# State Assessment of Phosphorus Load



Estimated phosphorus load was 33% more than reported by FDEP.

# State Assessment of Nitrogen Load



Estimated nitrogen load was 74% more than reported by FDEP.



# Summary of St. Lucie Estuary Watershed Water Quality

Over the last water year, the surface water entering the St. Lucie Estuary in general was of *poor water quality*.

The best water quality entering the estuary was from the highly urbanized Tidal Basins.

The largest single source of phosphorus, nitrogen and sediment pollution was Lake Okeechobee discharges.

- The C-44 Canal Basin contributed poor water quality, and was the only basin demonstrating a worsening in both nitrogen and phosphorus over the last ten years.

The land use with the largest contribution of flow and nutrient loads was agriculture.

State's BMAP progress report is misleading; recommendations for improving BMAP process have been sent to FDEP.

*The public needs to hold the state accountable, e.g., election of responsible candidates to strengthen environmental policies.*


For further information:

*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”*

[www.garygoforth.net](http://www.garygoforth.net)



*Gary Goforth, P.E., Ph.D.*


Environmental Engineering and Water Resources Management

Services Contact Information Resume Technical Reports Publications Geo-hydrology

Presentations Everglades Stormwater Treatment Area Estuaries/Lake O Related Links Home

**ESTUARIES AND LAKE OKEECHOBEE**

*Lake Okeechobee, Caloosabatchee and St. Lucie River Watersheds Performance Measures*



Presentation: [Lake Okeechobee Watershed Protection Program Historical Data Analysis](#), August 2013

[Draft Technical Support Document: Lake Okeechobee Watershed Performance Measure Methodologies](#), February 2013

[Draft Technical Support Document: Caloosahatchee River Watershed Performance Measure Methodologies](#), September 2013

[Draft Technical Support Document: St. Lucie River Watershed Performance Measure Methodologies](#), December 2013

***St. Lucie River and Estuary & Caloosabatchee Estuary Protection***

September 2018 - [Flows to Estuaries](#)

August 2018 - [DRAFT - Water Quality Assessment of the St. Lucie River Watershed - 2018](#)

August 2018 - [Strengthening Environmental Policies in Tallahassee Required to Solve Algae Crisis](#)

Remember:

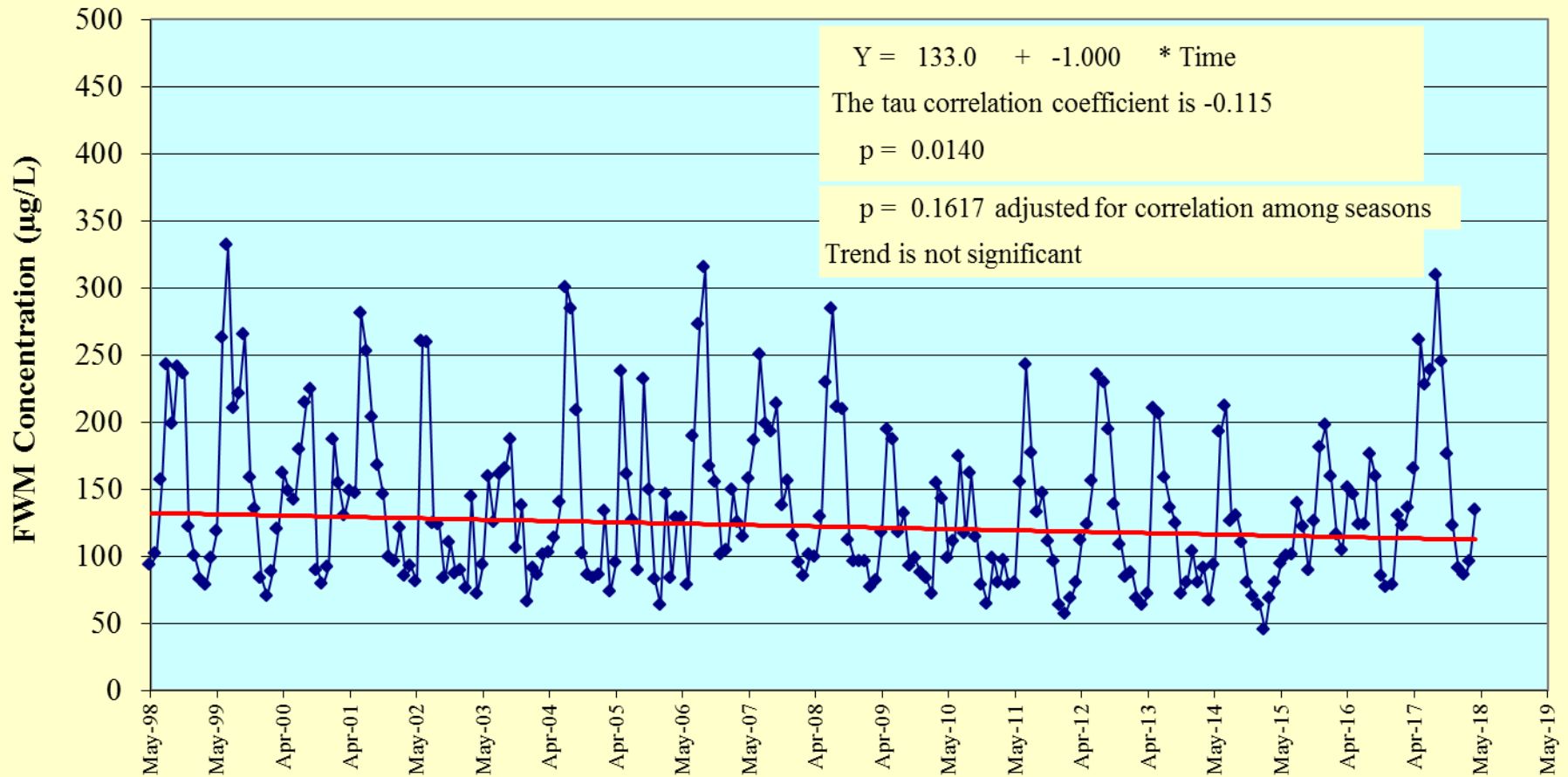
*Additional Storage,  
Treatment and Conveyance  
all around the Lake is  
necessary to stop these  
destructive discharges*

**Questions?**



Lake Inflow

### Seasonal Kendall Trend Test for Monthly FWM Concentration

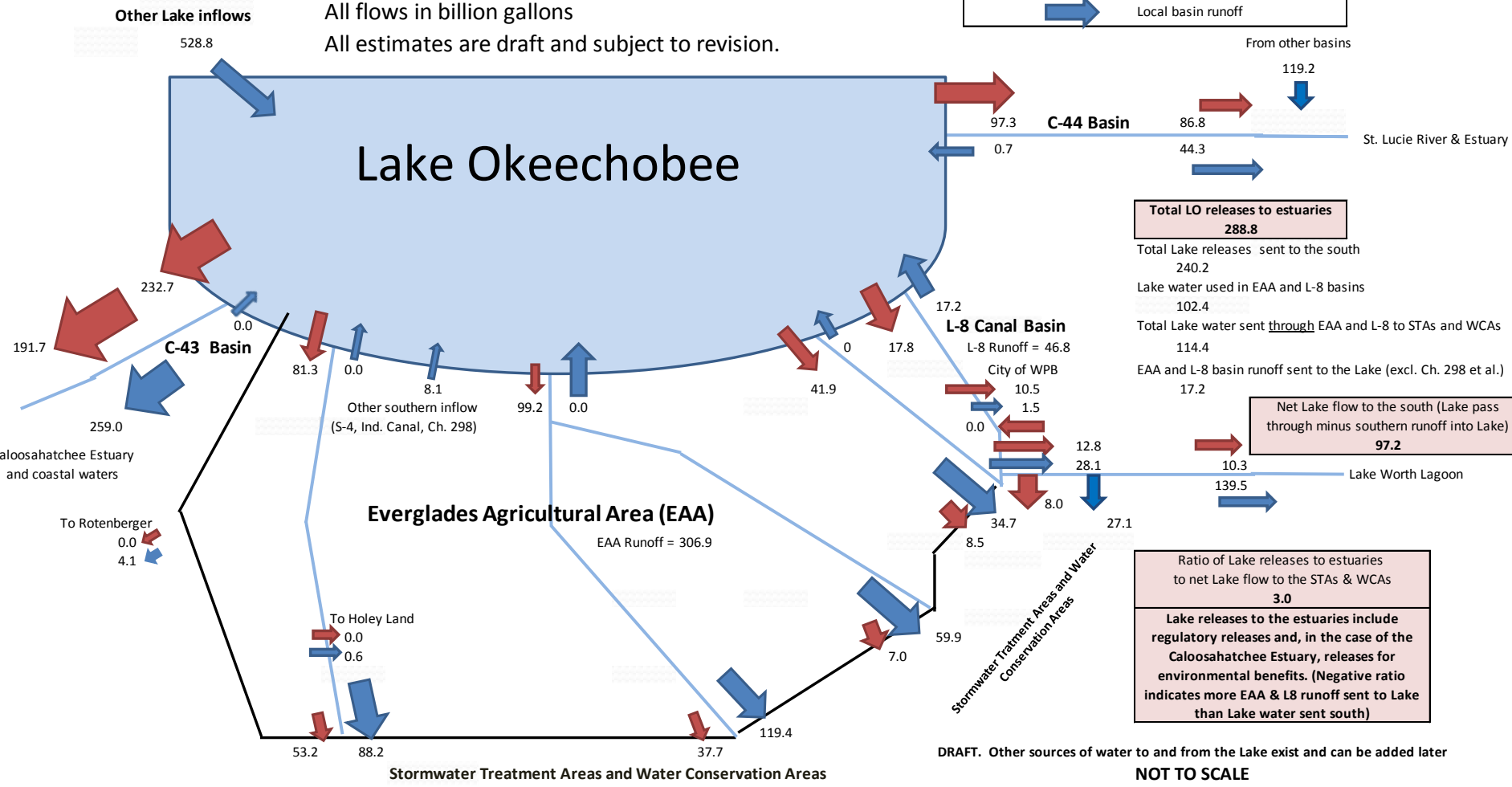
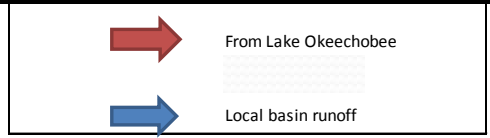




**Total Lake inflows 562.9**

**Flows between January 1, 2018 and October 5, 2018**

All flows in billion gallons  
All estimates are draft and subject to revision.



**Total LO releases to estuaries 288.8**

- Total Lake releases sent to the south 240.2
- Lake water used in EAA and L-8 basins 102.4
- Total Lake water sent through EAA and L-8 to STAs and WCAs 114.4
- EAA and L-8 basin runoff sent to the Lake (excl. Ch. 298 et al.) 17.2

**Net Lake flow to the south (Lake pass through minus southern runoff into Lake) 97.2**

**Ratio of Lake releases to estuaries to net Lake flow to the STAs & WCAs 3.0**

**Lake releases to the estuaries include regulatory releases and, in the case of the Caloosahatchee Estuary, releases for environmental benefits. (Negative ratio indicates more EAA & L8 runoff sent to Lake than Lake water sent south)**

DRAFT. Other sources of water to and from the Lake exist and can be added later

**NOT TO SCALE**

# Estimated Loading by Land Use WY2009-WY2018

Classified by land use, agricultural runoff was the largest source of flow and nutrient pollution.

By contrast, runoff from urban areas contributed the smallest amount of pollution loading, ranging from 3-9 percent.

