

Marco Island, Florida

Water Quality

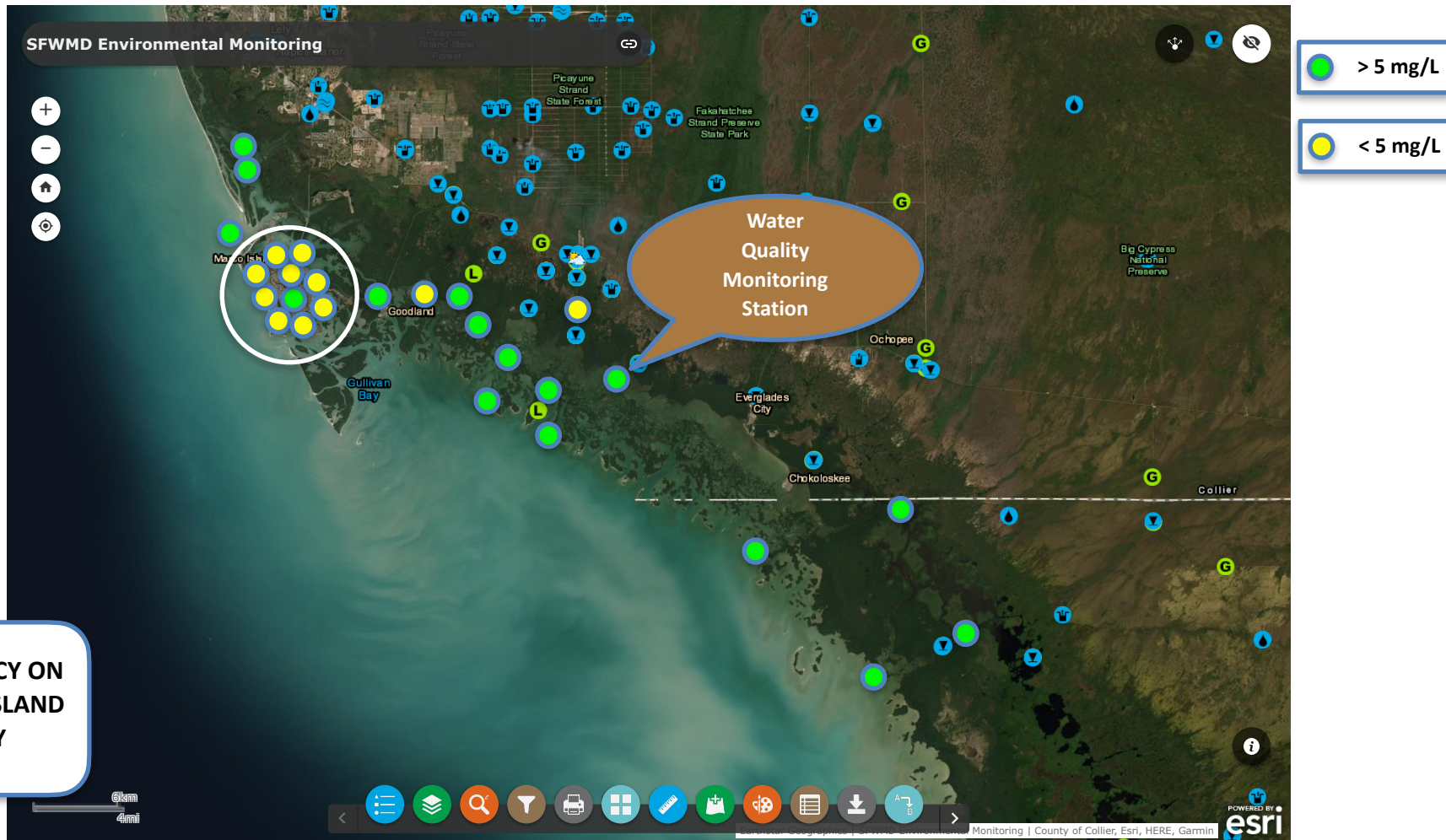
Reuse Water Causes Environmental Harm

6.14.24

Eugene Wordehoff
Marco Island, Florida

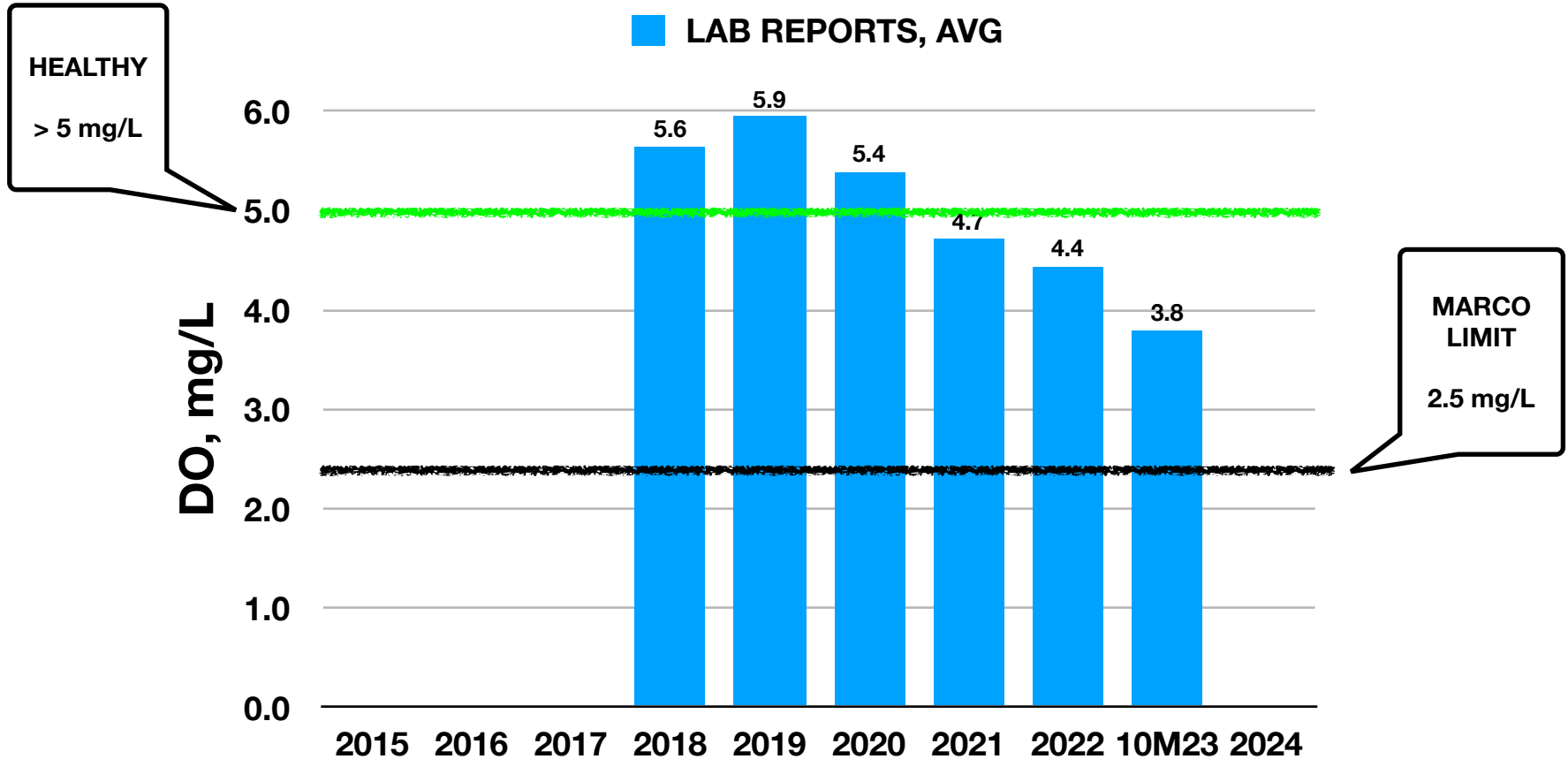
**WE NOTICED AN OXYGEN
PROBLEM ON MARCO**

Estuary Dissolved Oxygen (DO) MAY-21



Oxygen “pit” has formed only over Marco Island. Why?

Marco Dissolved Oxygen (DO) Trend



Marco oxygen decreasing. Why?

**WE DEVELOPED A DATABASE TO
EXPLORE ROOT CAUSES**

Marco Island 6-year Database (2017-2022)

MONTH	DO	REUSE-TP	REUSE-TN	FERTILIZER	RAIN	MONTH
	mg/L	mg/L	mg/L	DAYS	INCHES	
Dec-22	4.63	3.975	9.12	31	2.34	Dec-22
Nov-22	4.16	3.78	8.54	30	1.81	Nov-22
Oct-22	3.33	2.8225	13.2525	31	1.6	Oct-22
Sep-22	4.37	2.975	11.035	0	8.7	Sep-22
Aug-22	3.83	3.518	10.038	0	7.36	Aug-22
Jul-22	4.22	4.5925	7.1375	0	6.84	Jul-22
Jun-22	3.79	3.554	7.158	0	15.89	Jun-22
May-22	3.92	6.9	6.87	31	2.17	May-22
Apr-22	4.37	4.475	6.705	30	1.35	Apr-22
Mar-22	4.83	3.304	5.29	31	0.2	Mar-22
Feb-22	5.54	2.445	5.7325	28	0.67	Feb-22
Jan-22	6.28	3.9675	6.7925	31	0.88	Jan-22

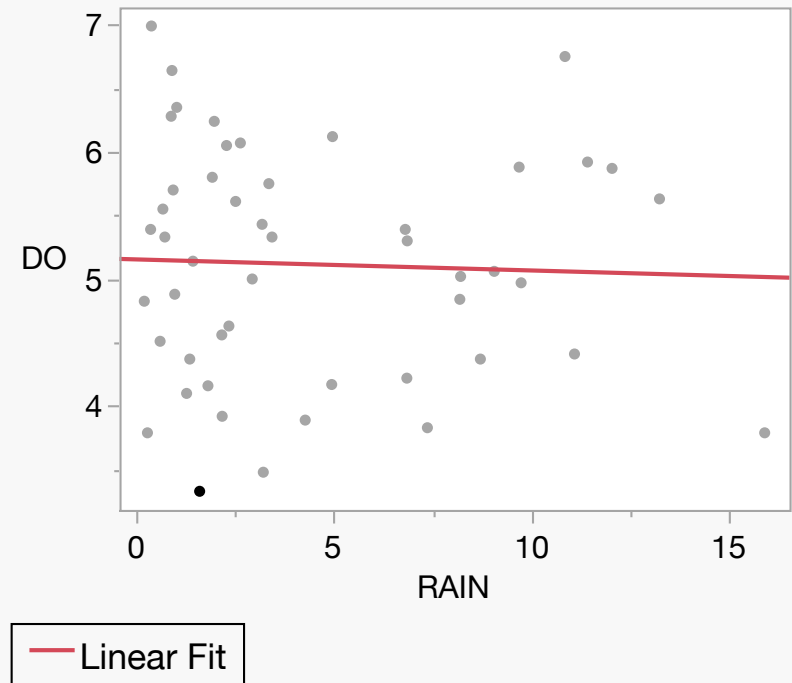
**WE FOUND THAT STORM WATER
AND FERTILIZER DID NOT
AFFECT WATERBODY OXYGEN**

Stormwater Impact on Oxygen

2017 - 2022

- Rain = Stormwater
- Rainy season has the same effect on oxygen as dry months
- Current swale operations appear to be effective

Bivariate Fit of DO By RAIN

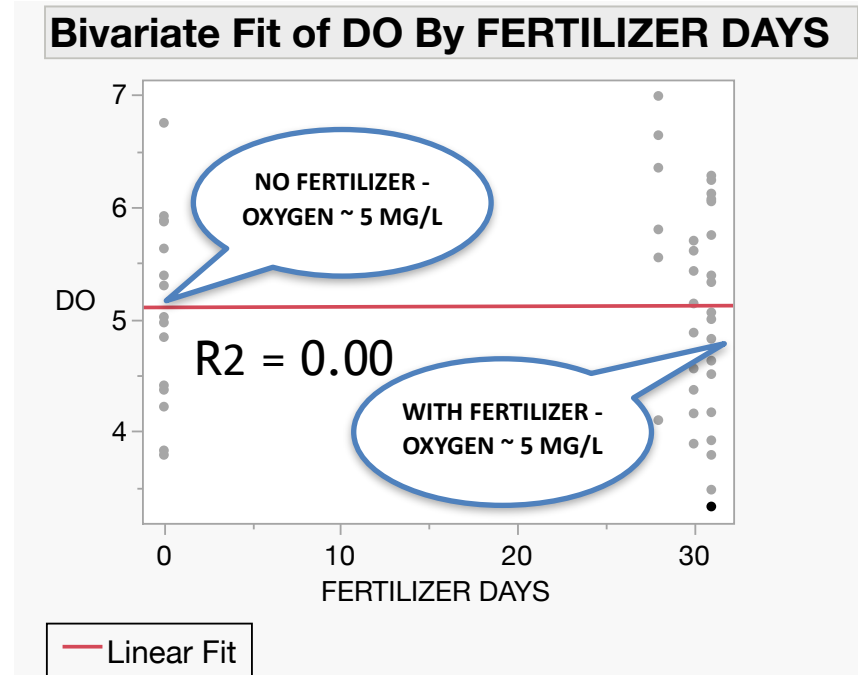


On Marco, Stormwater apparently has no effect on waterbody oxygen

Fertilizer Impact on Oxygen

2017 - 2022

- Ordinance bans all fertilizer in four summer months
- Oxygen levels in waterways do not change in summer vs winter



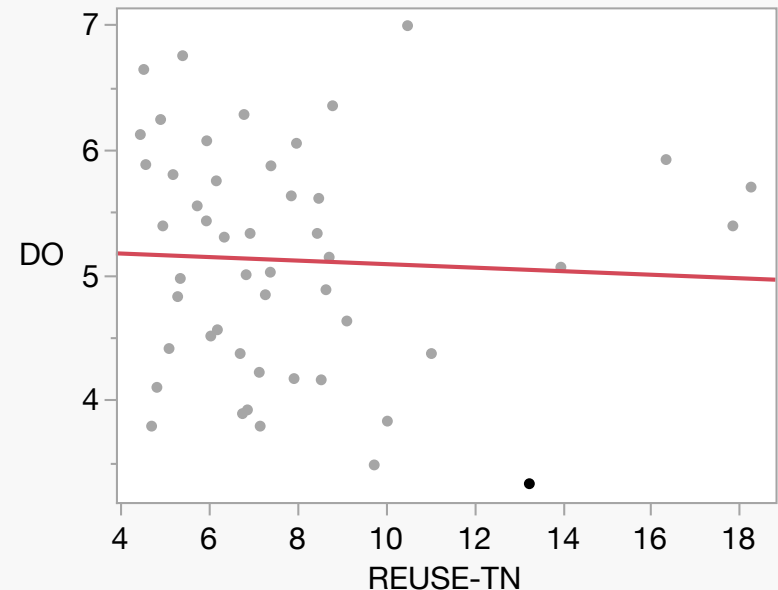
Data shows fertilizer has no effect on waterbody oxygen

**WE FOUND THAT REUSE WATER
PHOSPHORUS WAS THE ROOT
CAUSE OF WATERBODY OXYGEN
DEGRADATION**

Reuse Nitrogen Impact on Oxygen

2017 - 2022

Bivariate Fit of DO By REUSE-TN



— Linear Fit

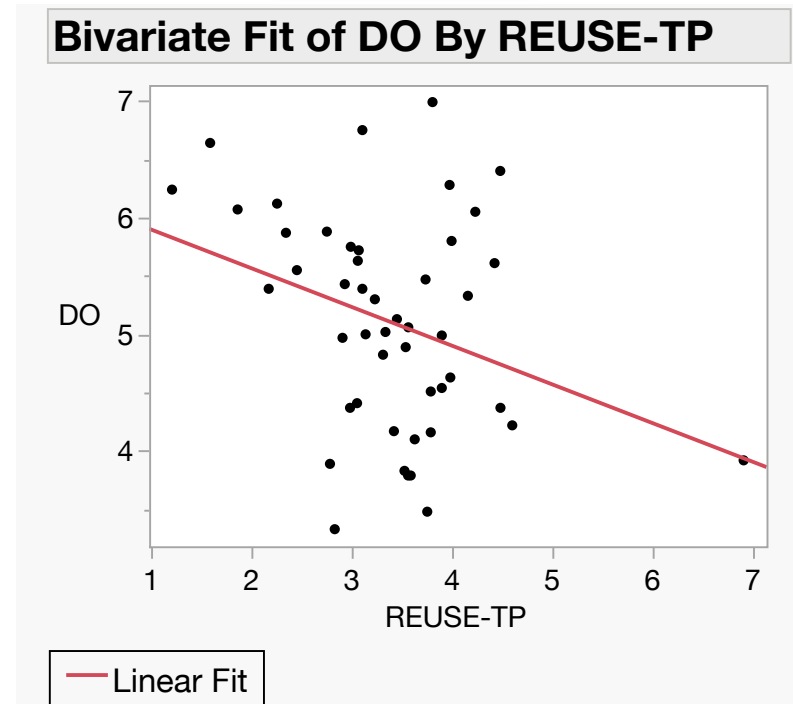
- High variation at low end of scale suggests other variables

Reuse nitrogen has minor effect on waterbody oxygen

Reuse Phosphorus Impact on Oxygen

2017 - 2022

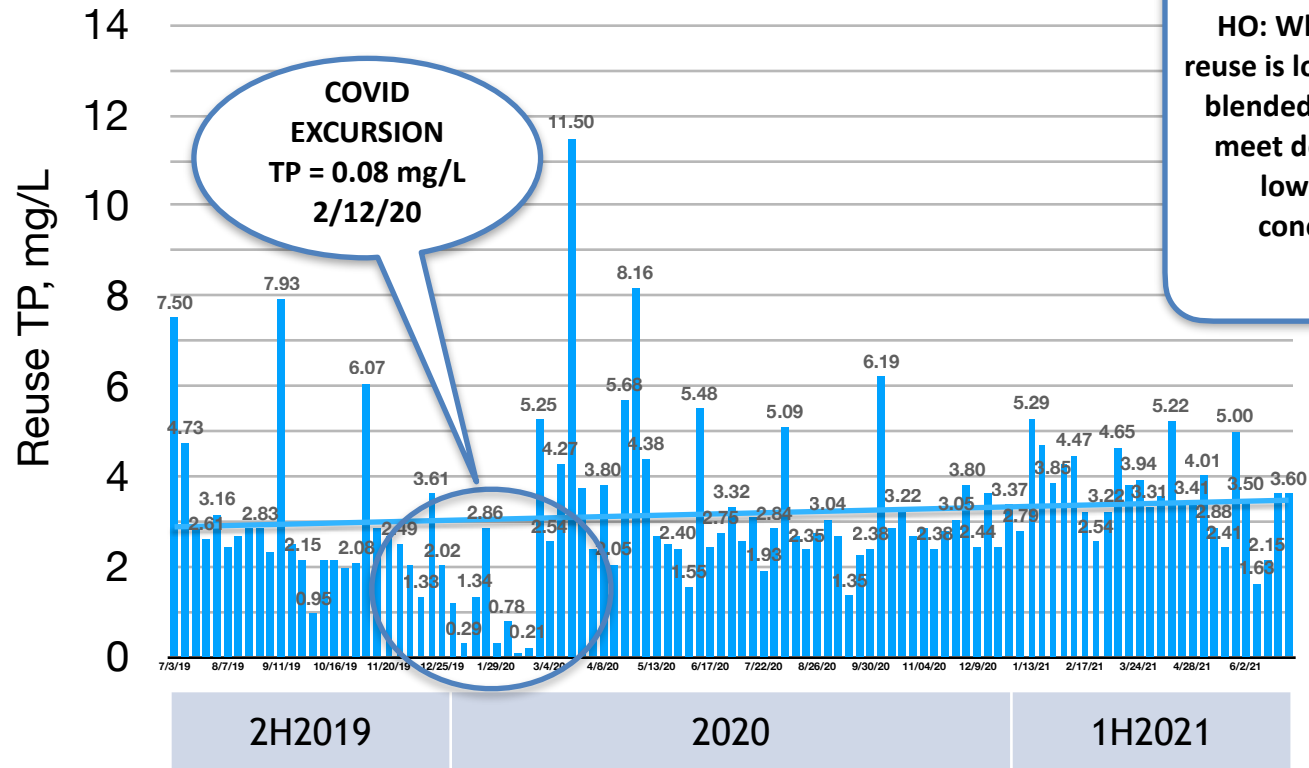
- Reuse phosphorus has strongest relationship with oxygen depletion
- Nutrients stimulate algal growth
- Algae decomposition consumes oxygen



**WE EXPLORED THE REUSE
PHOSPHORUS CONNECTION IN
MORE DETAIL**

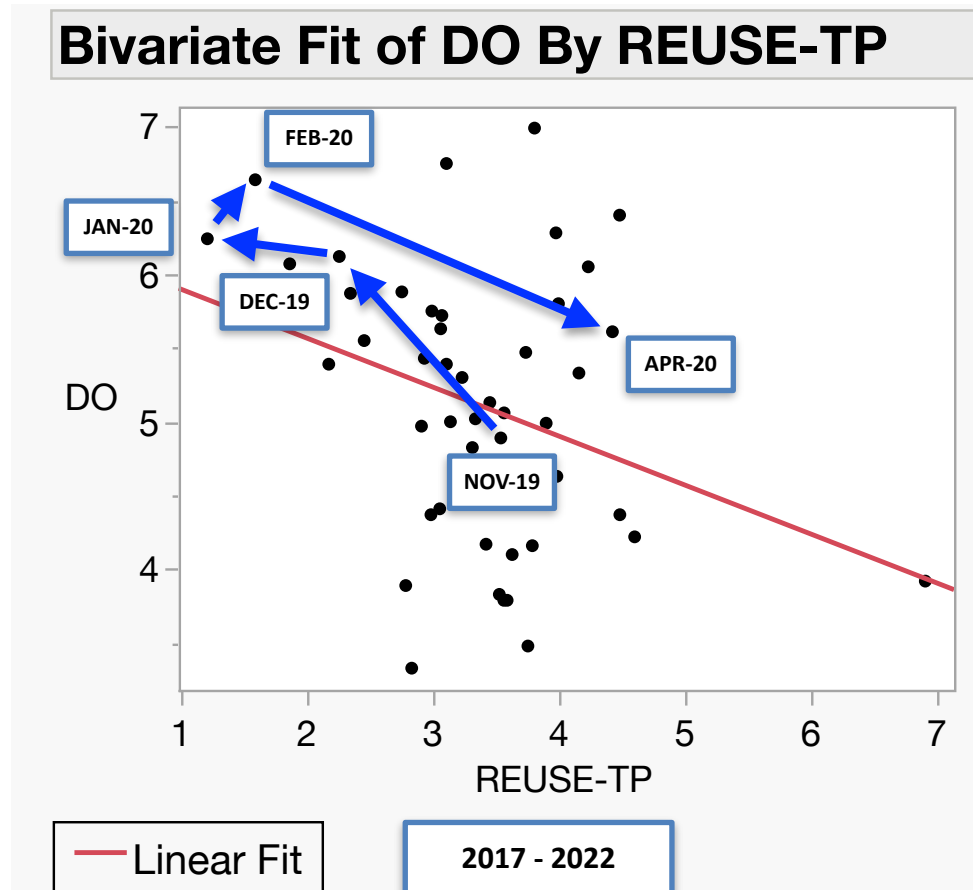
Marco Island WWTP - Reuse TP, mg/L

Source: WWTP, FOIA Request, JUL-19 - JUN-21 (n=105)



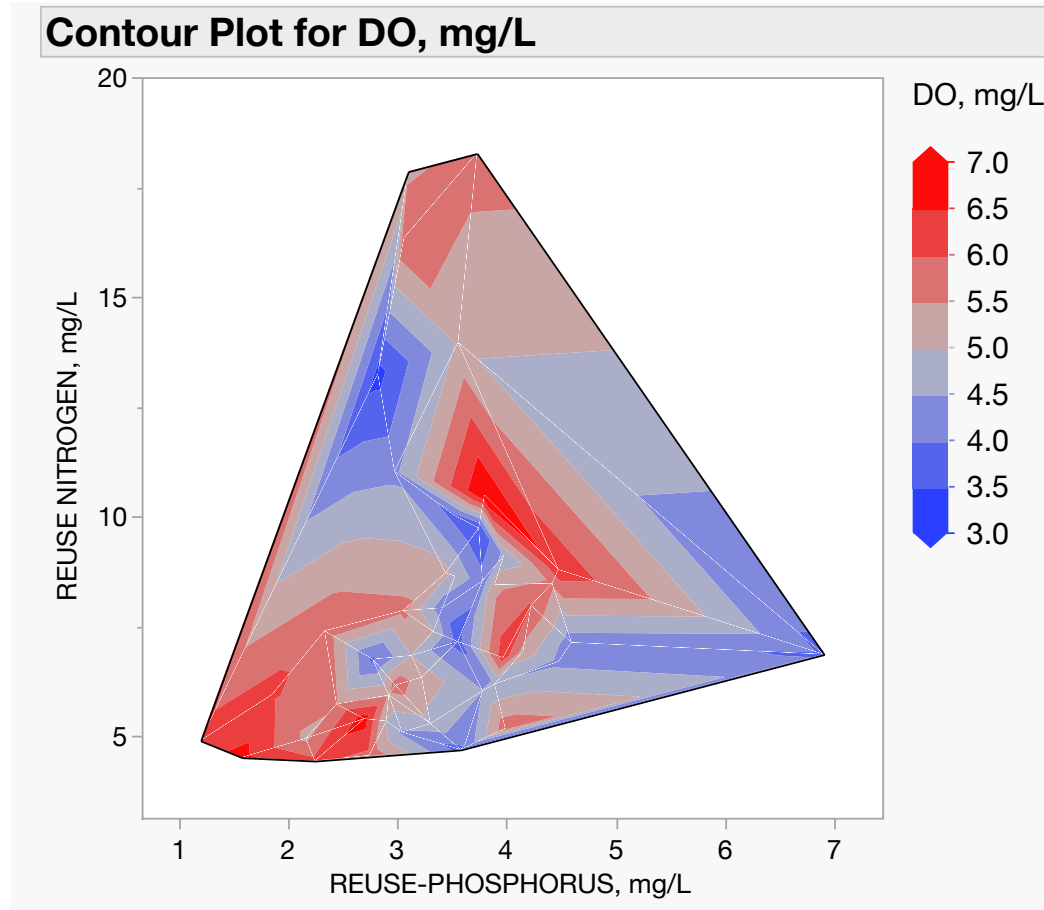
Phosphorus concentration periodically drops to lower levels

Reuse-TP - Covid Excursion



Less reuse phosphorus increases waterbody oxygen

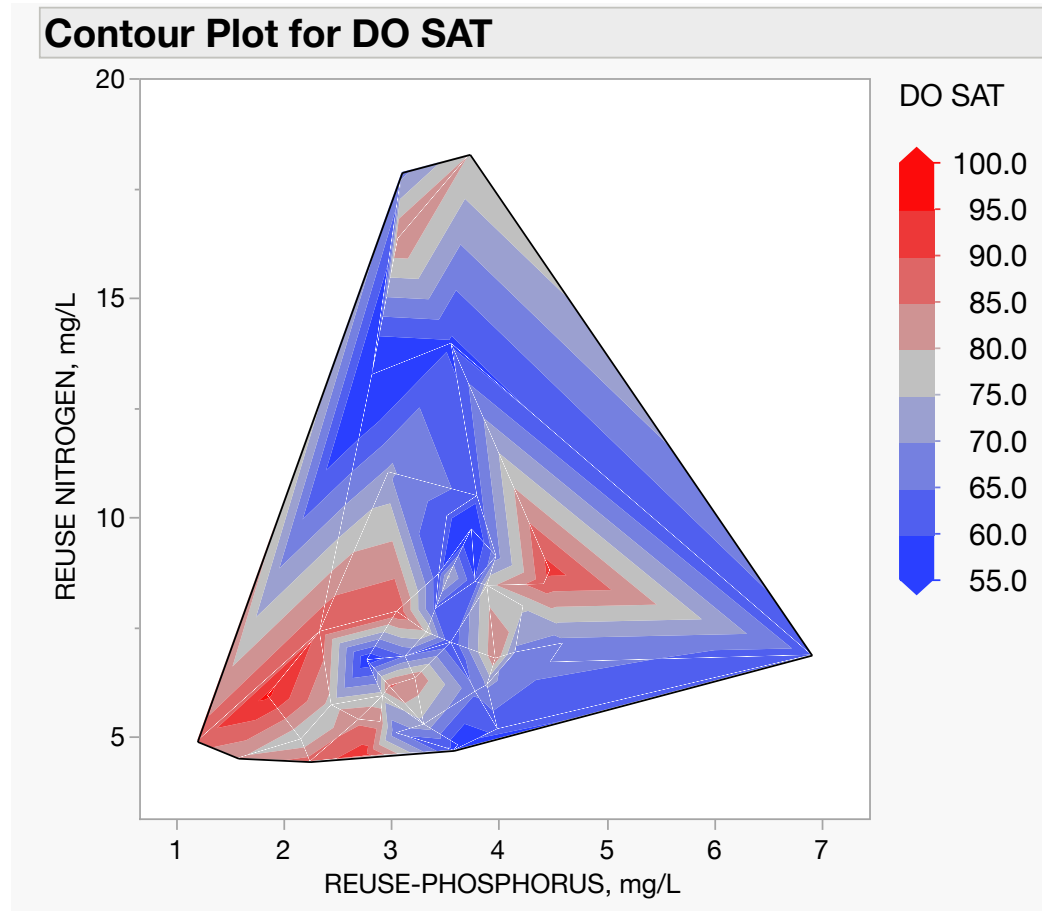
Contour Plot: DO by (R-TN by R-TP)



2017 - 2022

As both R-TN and R-TP decrease, DO increases

Contour Plot: DOSAT% by (R-TN by R-TP)



2017 - 2022

As both R-TN and R-TP decrease, DOSAT% increases

**WHY DOES REUSE PHOSPHORUS
DEplete WATERBODY OXYGEN?**

GOOGLE: “What is the cause of low oxygen in waterbodies in Florida?”

“Excess nutrients delivered to a waterbody can lead to both **overgrowth of algae** and **EUTROPHICATION**”

As dead algae decompose, oxygen is consumed in the process, resulting in **low levels of oxygen** in the water”

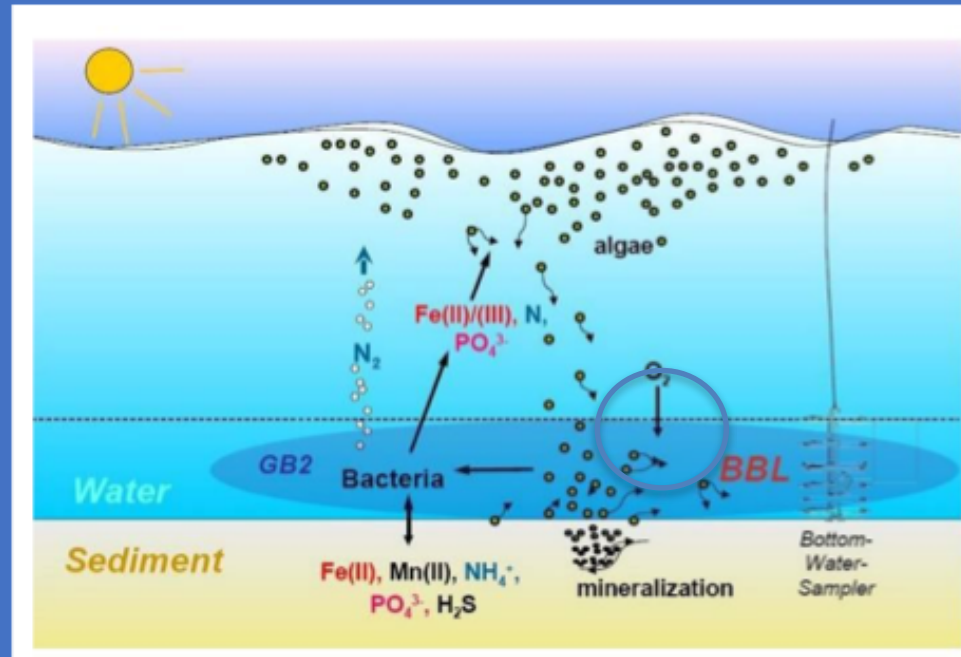
What is Eutrophication?



Eutrophication is a big word that describes a big problem in the nation's estuaries. Harmful algal blooms, dead zones, and fish kills are the results of a process called eutrophication – which occurs when the environment becomes enriched with nutrients, increasing the amount of plant and algae growth to estuaries and coastal waters.

<https://oceanservice.noaa.gov/facts/eutrophication.html>

Root-cause of Oxygen Loss



Nutrients (phosphorus and nitrogen) are food for algae ...
on algae death oxygen is depleted

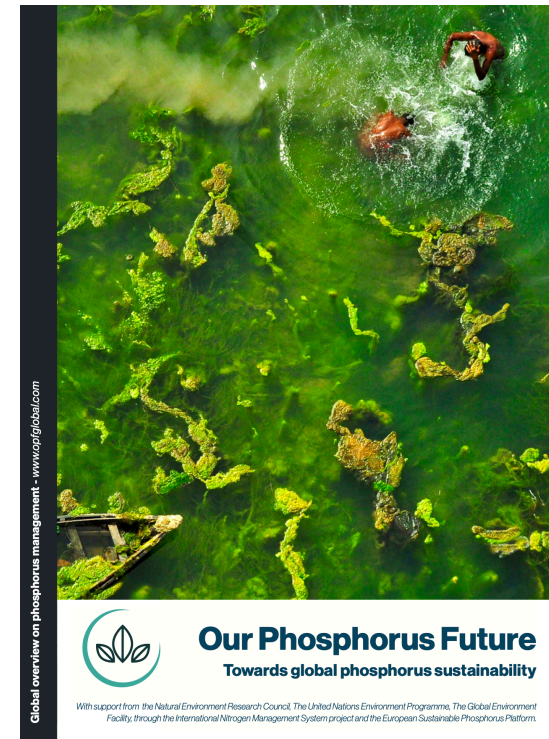
GOOGLE: “What is the source of excess nutrients in water bodies in Florida?”

“Because there are increasingly more people living in coastal areas, there are more nutrients entering our coastal waters from **wastewater treatment facilities**, runoff from land in urban areas during rains, and from farming”

A WELL KNOWN PROBLEM

Our Phosphorus Future, 2022

“Phosphorus
Pollution is
Destroying Our
Eco-systems”

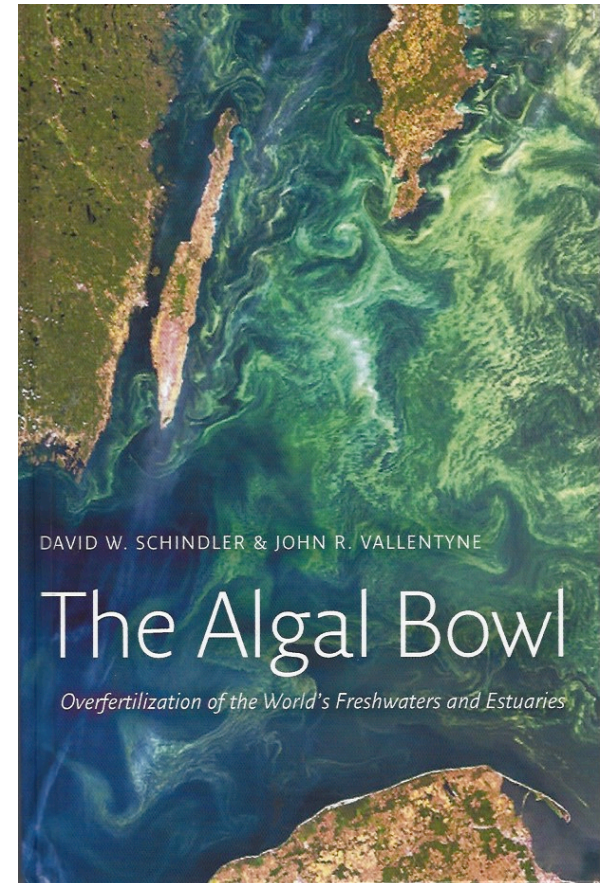


<https://www.opfglobal.com/lightboxvideo>

The Algal Bowl, 2008

“Over-fertilization of the World’s Freshwaters and Estuaries”

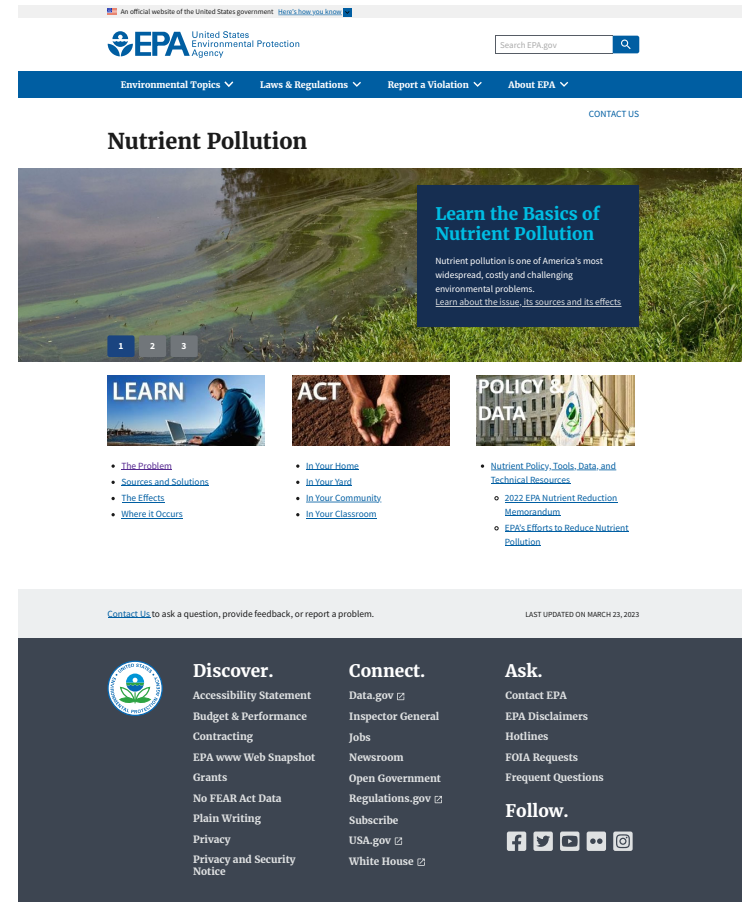
“... degradation of water comparable with the degradation of land during the great **American Dust Bowl** of the 1930s.”



This book describes what is happening on Marco Island

EPA - Nutrient Pollution

- Nutrient pollution is one of America's most widespread, costly and challenging environmental problems.
- Website: <https://www.epa.gov/nutrientpollution>



Video: <https://www.epa.gov/nutrientpollution/issue>

REUSE WATER SAVED THE FLORIDA AQUIFER

Reclaimed Water (purple pipes)

- Florida water table was dropping
- Reclaimed water introduced to maintain water supply
- Reclaimed water is treated sewage - disinfected
- **“Pollution (nitrogen, phosphorus) may occur if overused”** (UF/IFAS Blogs, Dr. Lusk)

The water table was saved



The WWTP is Responsible ...



ROLES IN RECLAIMED WATER & WATER REUSE



➤ **Florida Department of Environmental Protection (FDEP) permits:**

- ❖ Wastewater treatment facilities
- ❖ Water reuse
- ❖ Disposal options

North Ft. Myers

- FDEP does not restrict the use of reclaimed water
- The wastewater utility determines how and where the permitted reclaimed water will be reused

➤ **Water management districts** do not regulate the use of reclaimed water

➤ **Water management districts:**

- ❖ Promote and encourage the use of reclaimed water
- ❖ Require water users to consider the use of reclaimed water over traditional sources
- ❖ May incentivize water reuse through cooperative funding for construction and credits in water use permits

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"Harm" is not permitted

**MARCO WWTP IS IN VIOLATION
OF THEIR PERMIT AND STATE
STATUTE**

FDEP Permit: IX General Conditions

5. This permit does not relieve the permittee from liabilities for **harm or injury to human health or welfare, animal or plant life**, or property caused by the construction or operation of this permitted source; **nor does it allow the permittee to cause pollution** in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department. The permittee shall take all reasonable steps to minimize or prevent any discharge, reuse of reclaimed water, or residuals use or disposal in violation of this permit which has a reasonable likelihood of **adversely affecting human health or the environment**.

The Marco WWTP is in violation of its permit

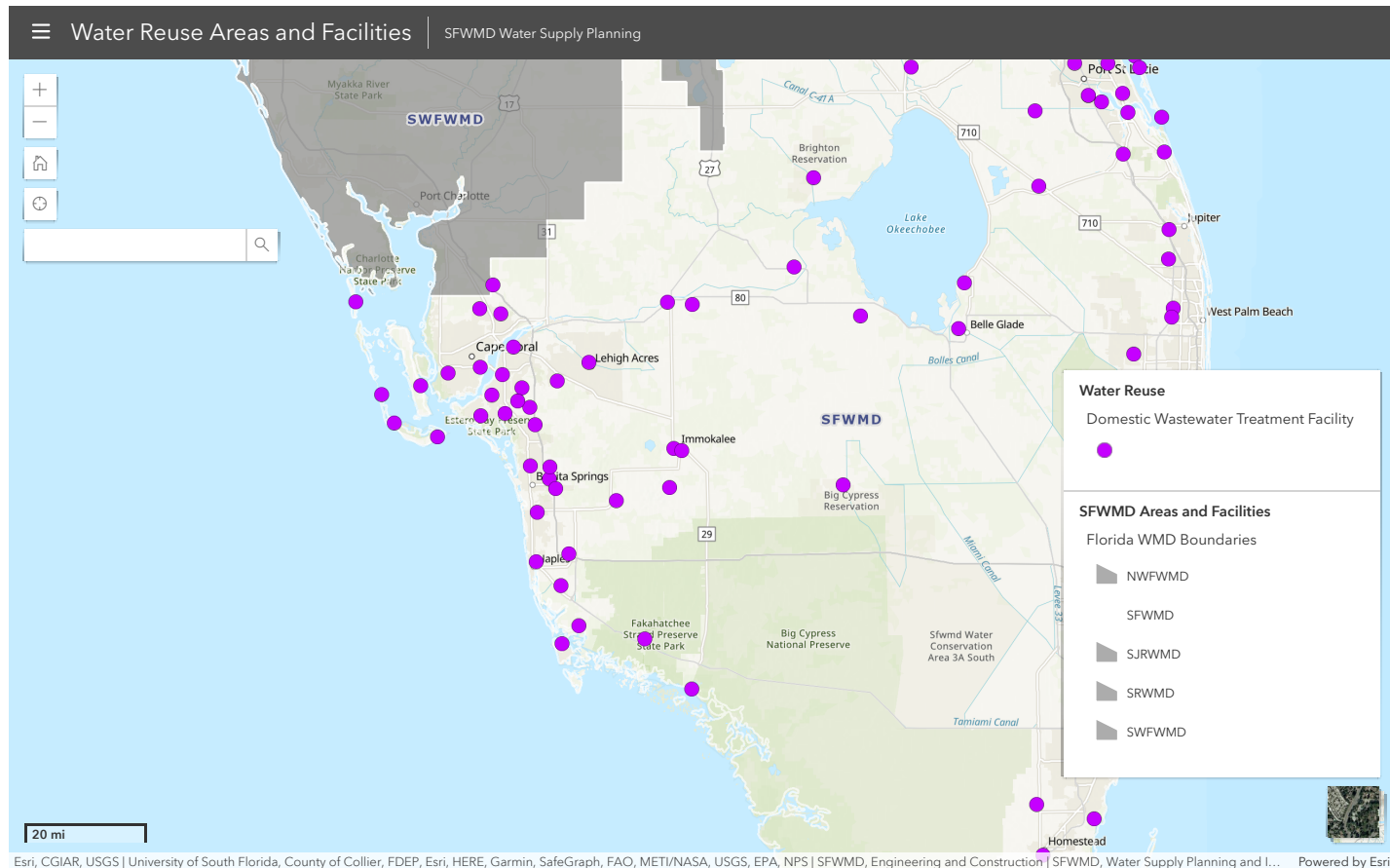
Florida Statute: 403.064 Reuse of reclaimed water

1) The encouragement and promotion of water conservation, and reuse of reclaimed water, as defined by the department, are state objectives and are considered to be in the public interest. The Legislature finds that the reuse of reclaimed water is a critical component of meeting the state's existing and future water supply needs while sustaining natural systems. The Legislature further finds that for those wastewater treatment plants permitted and operated under an approved reuse program by the department, the reclaimed water shall be considered environmentally acceptable and not a threat to public health and safety. The Legislature encourages the development of incentive-based programs for reuse implementation.

The Marco WWTP is in violation of the Florida statute

**THE SAME THIS SEEMS TO BE
HAPPENING ACROSS FLORIDA**

Reuse Water in SWFL



How extensive is the PHOSPHORUS pollution from reuse water?

Marco Island, Florida

Water Quality

Reuse Water Causes Environmental Harm