



# The Eelgrass Project

“We can’t solve problems with the same kind of thinking we used when we created them.”

-Albert Einstein

Presented by

Nicholas Muzia, P.E.



# The Eelgrass Project

## Background:

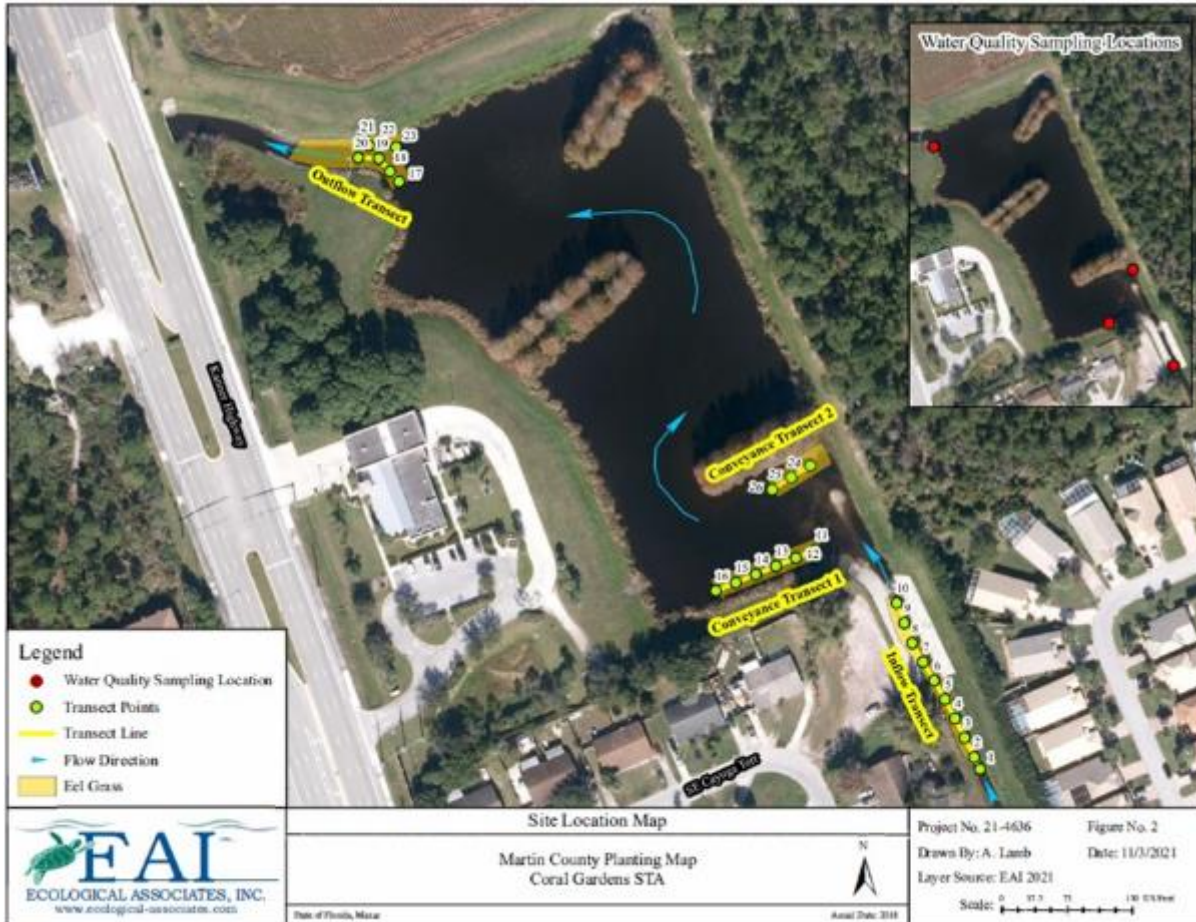
Martin County Board of County Commissioners provided a funding mechanism for the purpose of retrofitting out existing stormwater infrastructure.

In 2020 we initiated the Eelgrass Pilot Project to retrofit and improve water quality from our existing Stormwater Treatment Area STA.

# The Eelgrass Project

## Purpose:

- Out-compete nuisance vegetation (hydrilla, hygrophila)
- Stabilize the bottom to reduce sediment transport
- Improve water quality
- Restore a natural ecosystem
- Provide coastal resilience
- Investigate a nature based solution



# What is Nature-Based Solution ?

## Green/Grey Infrastructure



Public works structures consisting of man-made materials with an element of green habitat.

## Bioengineering



Approach that uses natural materials and systems to mimic natural processes with the goal of reducing hazards.

## Engineering with Nature

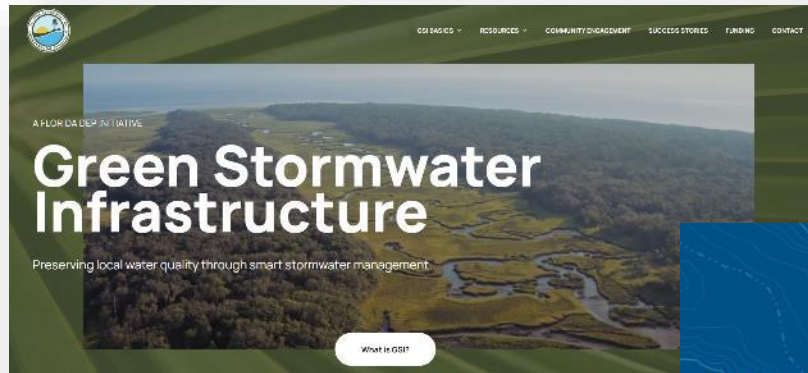


Water resources projects using natural and engineering processes to create multifunctional infrastructure.

*According to FEMA:*

“Nature-based solutions are sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience.”

# What is Nature-Based Solution ?



## Florida Rules

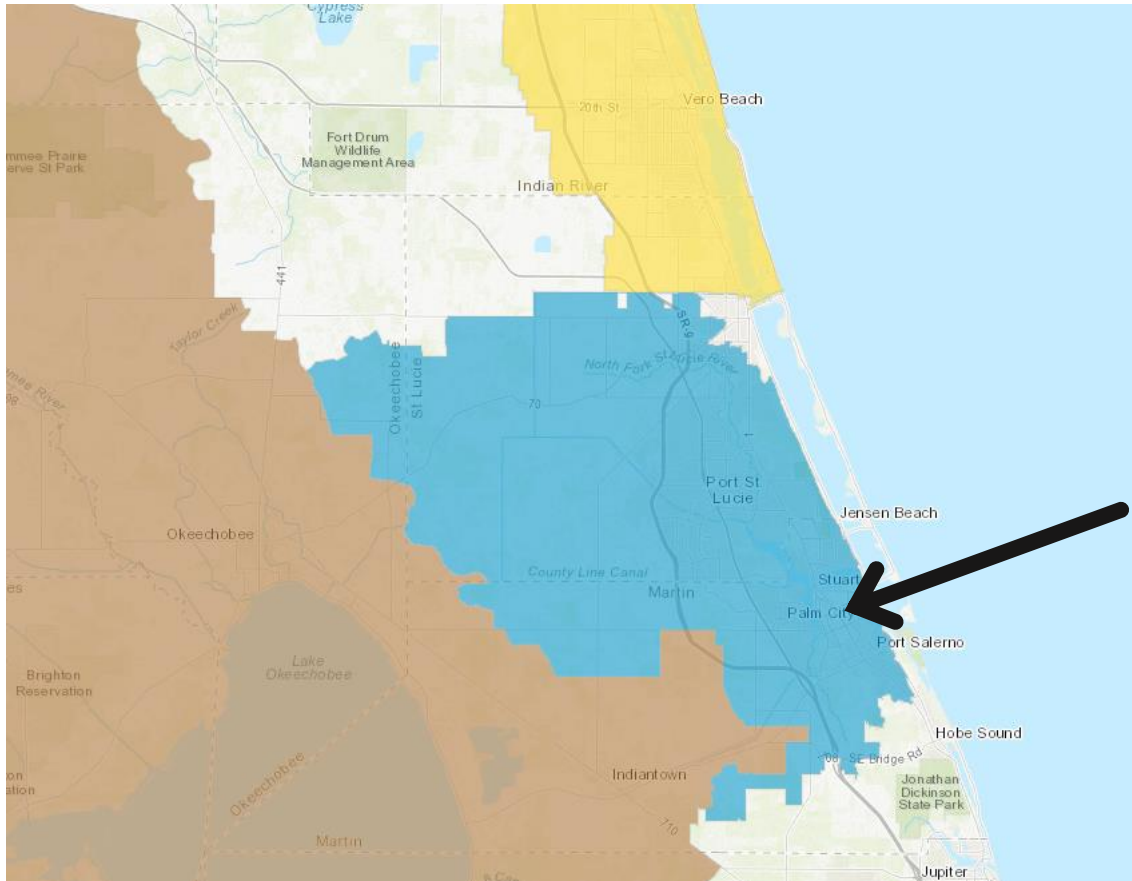
Chapter 62-302 State Water Quality Standards  
Chapter 62-304 Total Maximum Daily Loads

FL Department of Environmental Protection  
Green Infrastructure initiative

## FEMA BRIC Technical Evaluation Criteria

Priority goal to Incorporate nature-based solutions  
10% of application score for nature-based solutions

## [FDEP Impaired Waters, TMDLs, and BMAP Interactive Map](#)



# The Eelgrass Project

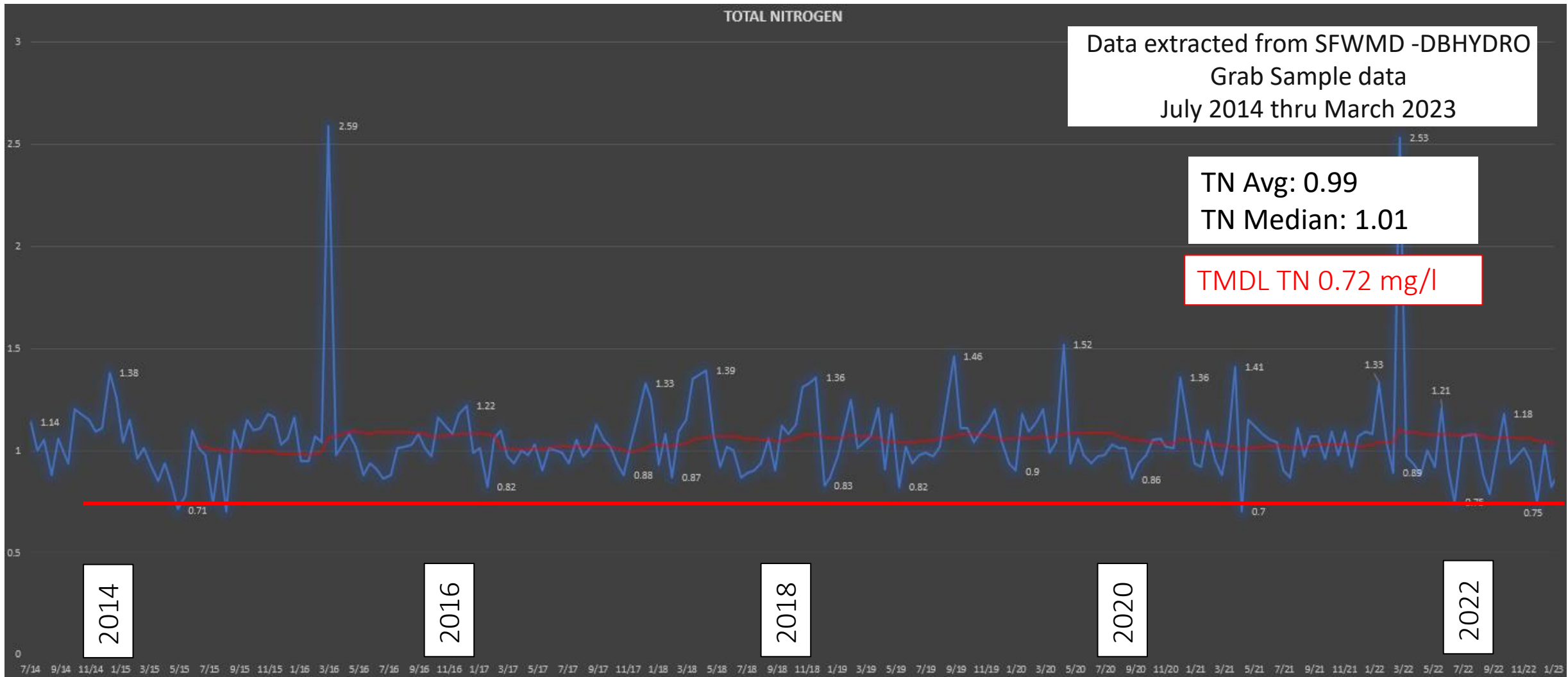
## Site Evaluation:

This site is located within the St. Lucie River and Estuary Basin Management Action Plan (BMAP). Adopted Total maximum daily loads (TMDLs) for Nitrogen (TN) and Phosphorus (TP).

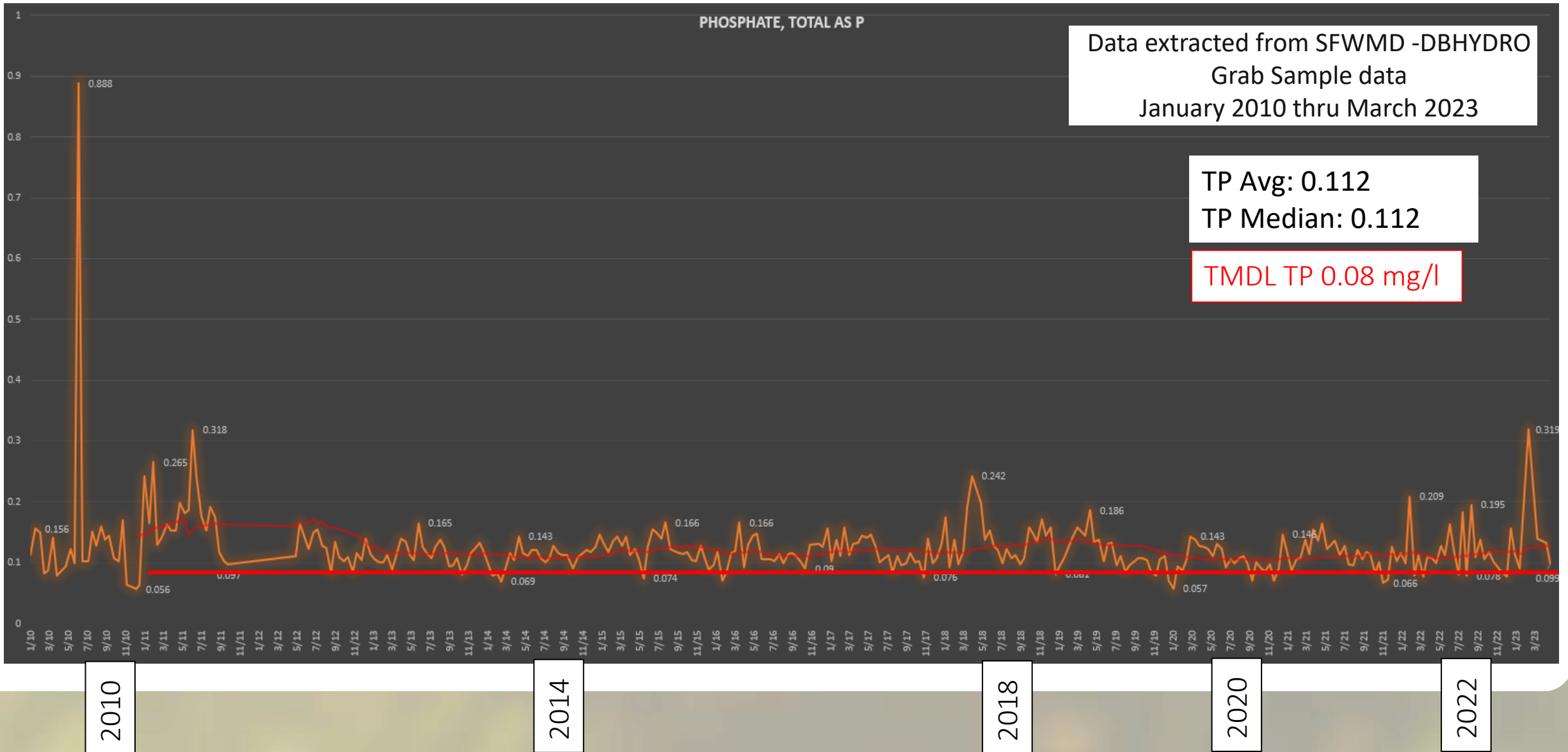
Coral Gardens Drainage Basin 3000 acres for urban development part of Martin County MS4.

It was not meeting TMDL goals. ☹️

# Coral Gardens Basin Outfall (SLT-34A)



# Coral Gardens Basin Outfall (SLT-34A)





# How does it work ?



## Planting Plugs

Individual plants are grown in plugs. Over 5000 plugs were planted.

## Site Selection

The hydraulics were considered in locations - all outfalls to SLE & IRL



## Monitor

We changed our stormwater maintenance practices to support establishment of the grass & Monitored the project.

# 2021 Quarterly Monitoring Summary

- Seasonality with growth period Typically highest in the growing season (late summer)
- Competition from increased presence of Hydrilla and Ludwigia impacted eelgrass coverage due to competition for sunlight and space (*University of Florida, IFAS 2022*).
- The ability of eelgrass to tolerate a wide range of environmental conditions is partially responsible for its frequent inclusion in restoration projects. (*Gettys and Haller 2013*)
- Flow rates may impact level of predation, muck deposition, and nutrient absorption.  
The Eelgrass established first and most dense at the inflow where velocity was highest.

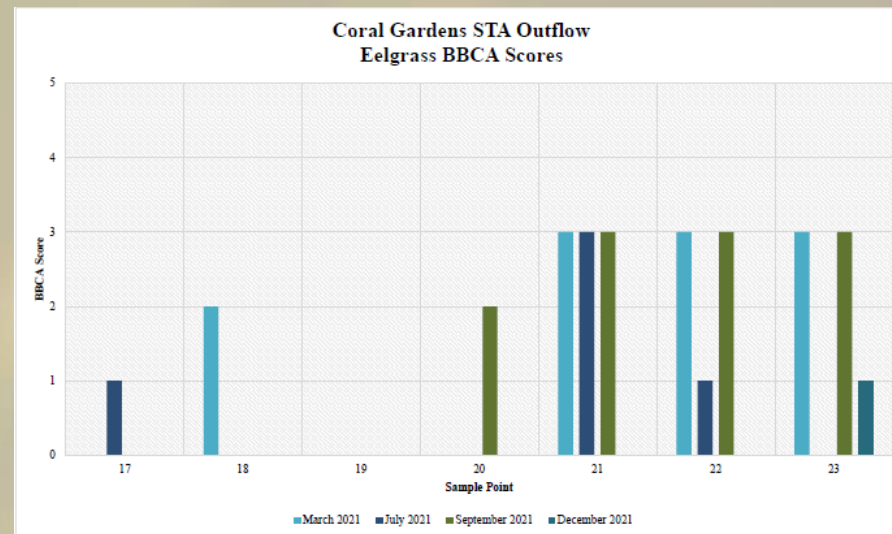
What to  
expect ?

# 2022 Quarterly Monitoring Summary

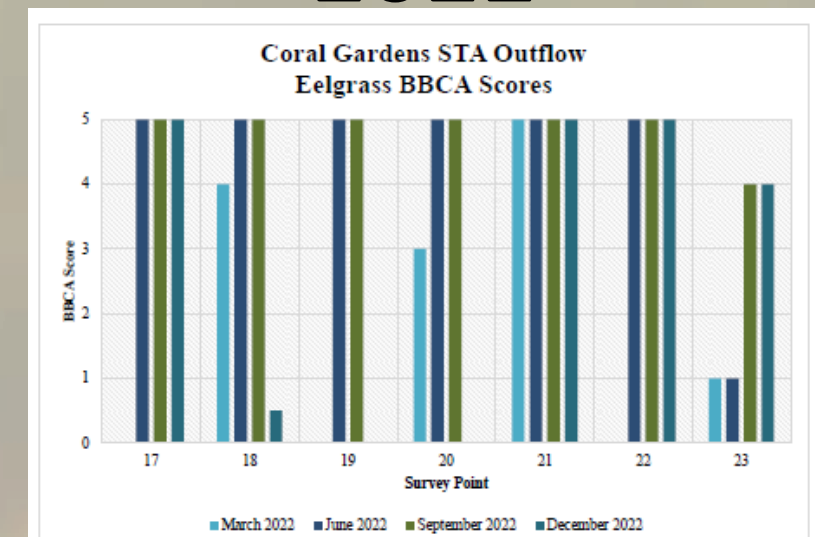
- Significant increases in coverage over time
- Project timeline should expect 2 years for establishment with maintenance for invasive veg.
- Ability to withstand predation from fish, turtles, & birds.
- Plants were limited in depth of approximately 2 ft. Likely based on available light & clarity.

What to expect ?

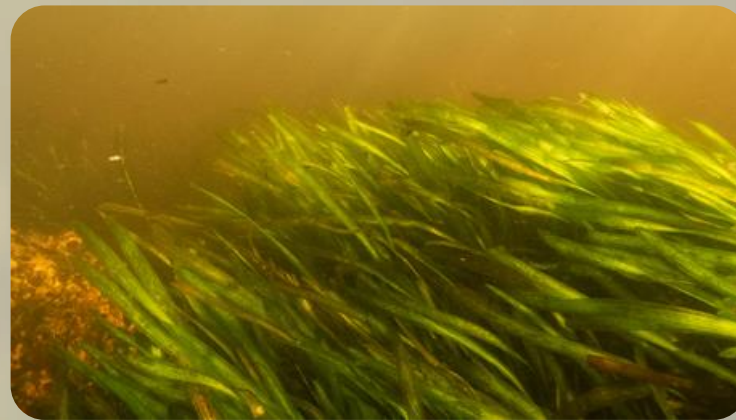
## 2021



## 2022

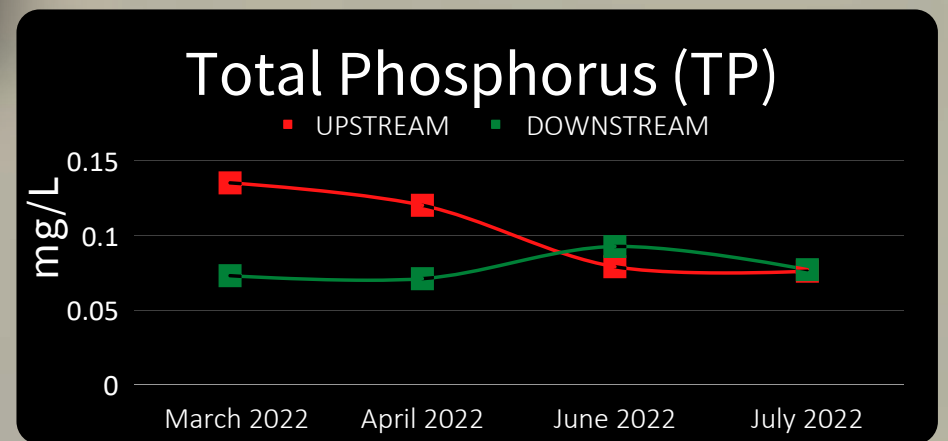
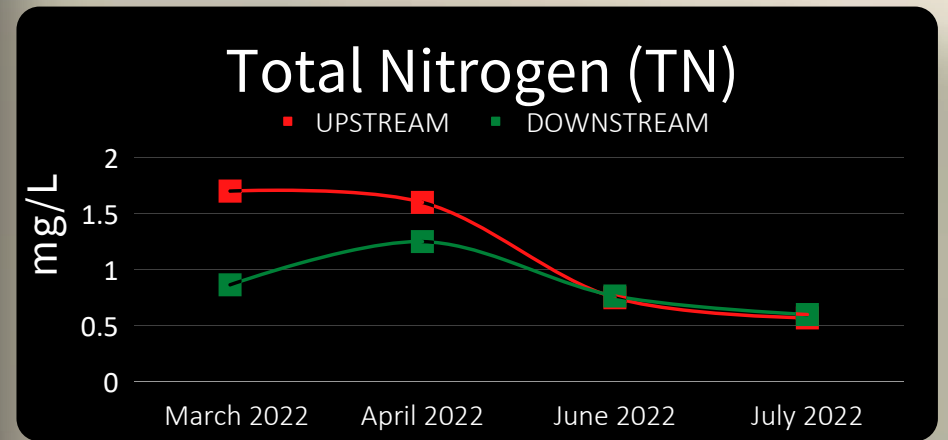
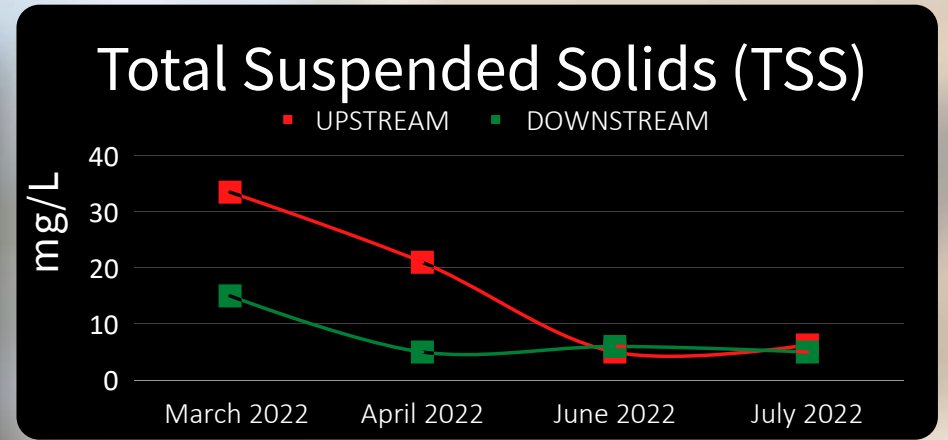
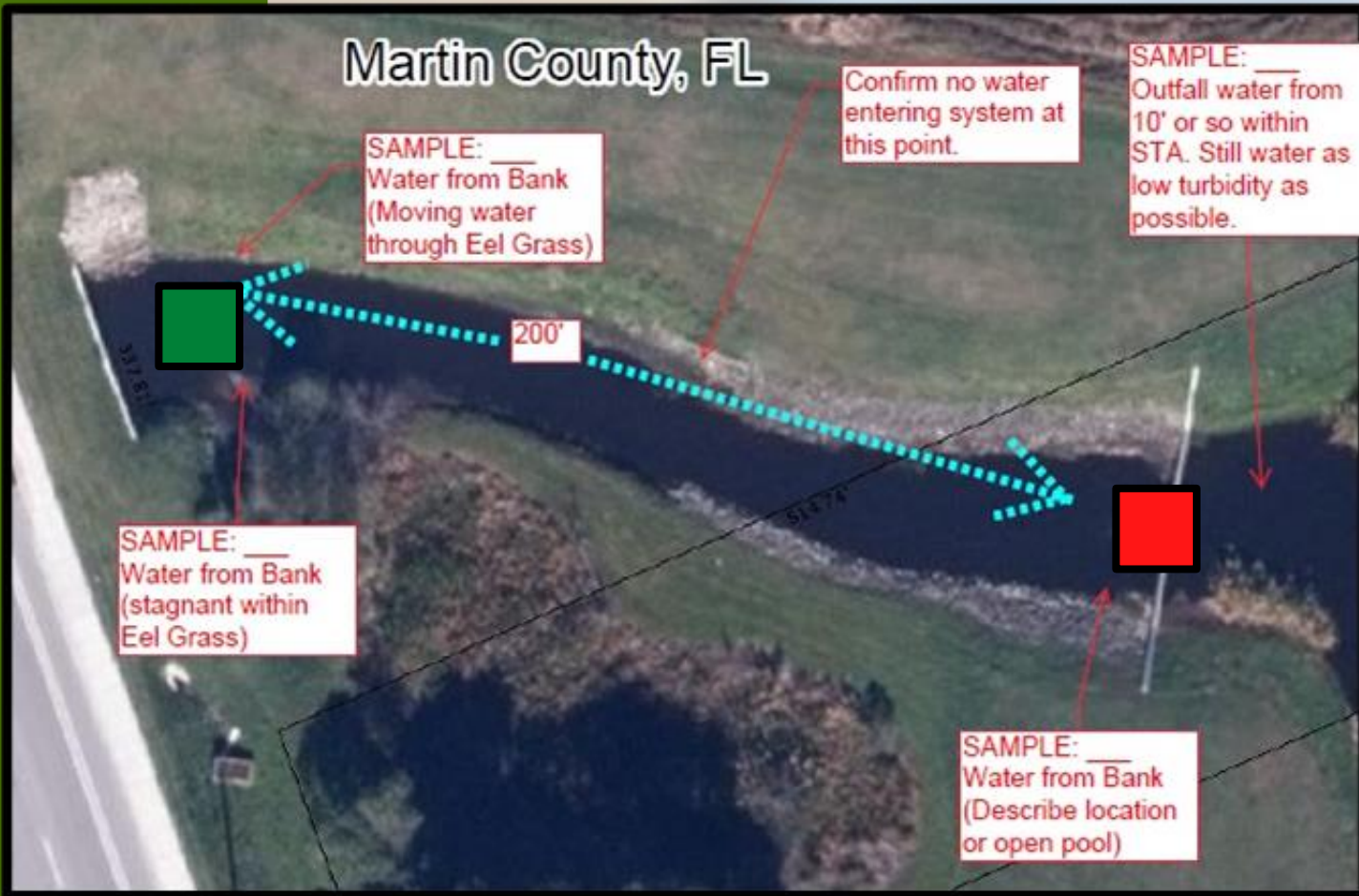


# After 2 years



Hey that looks tasty!





Preliminary Controlled

Testing 2022

TMDL TN 0.72 mg/l

TMDL TP 0.08 mg/l

# 2023 Water Quality Monitoring

- Nutrient and water quality parameters were collected with purpose to evaluate nutrient reductions with respect to water velocity.

- 24 samples collected
- 12 events over 24 weeks  
April through September.

- Small sample set intended to try and identify if trends could be found and evaluate test methods.



# 2023 Water Quality Monitoring

## Observations over the 200' section of vegetated ditch

- This should still be considered preliminary due to limited data set.
- Samples broken into three flow ranges based on spread during test period.
- Water lettuce impacted testing for several events due to maintenance issues on the lake and a failed floating vegetation containment boom. Assumed to decrease the SAV density in the lake and test area.
- During test period
  - TN: Average 0.70 mg/L < TMDL 0.72mg/L
  - TP: Average 0.045 mg/L < TMDL 0.08 mg/L

	TN	TP
No Flow (1 event)	Significantly Below TMDL	53% Reduction TP
Average (6 events)	12% Reduction TN	1% Increase TP
High (5 events)	16% Increase TN	5% increase TP

# 2023 Water Quality Monitoring

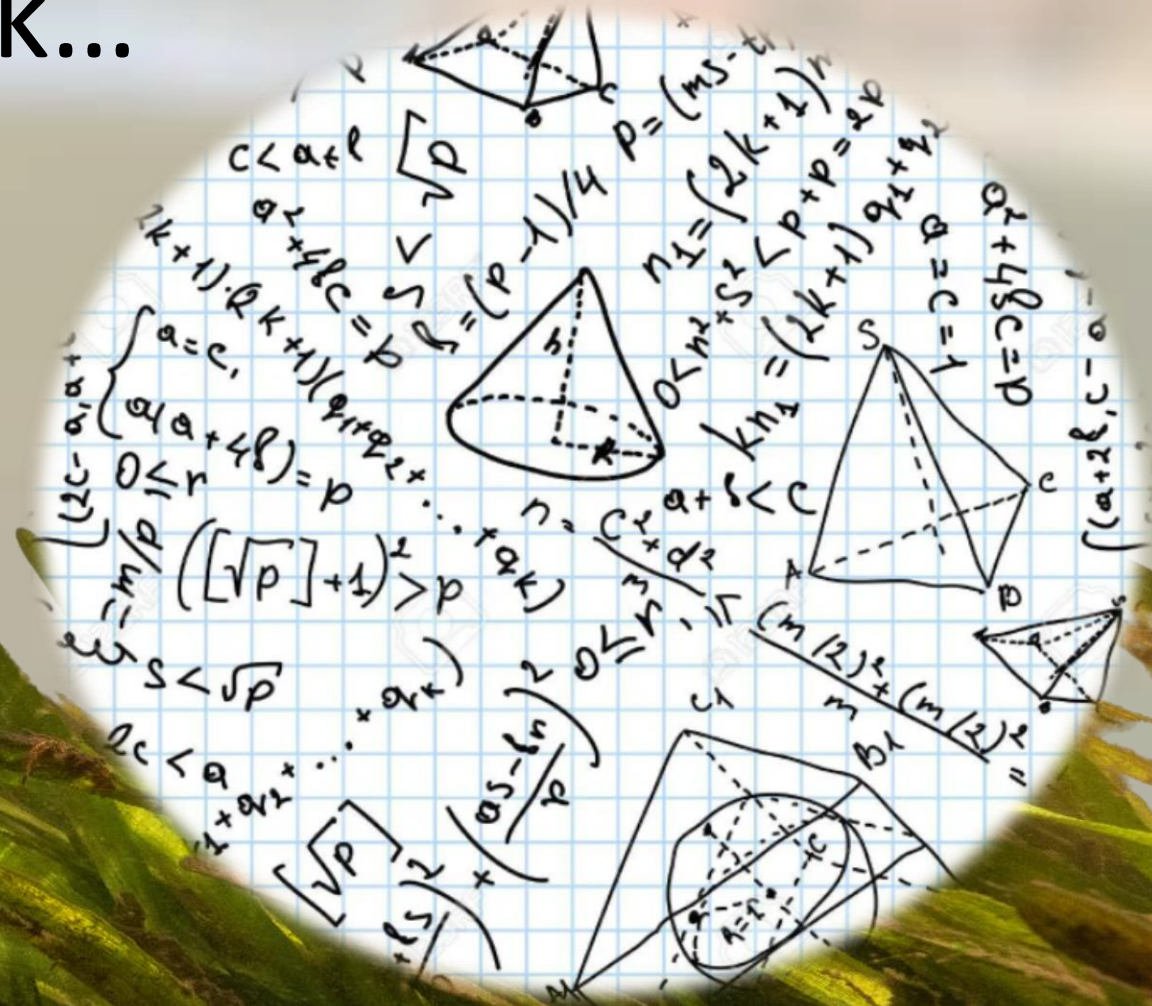
## Observations over the 200' section of vegetated ditch

- Turbidity was generally linked jointly with nutrient increase or decrease.
- Future Testing Assumption: Increasing the length or density of vegetation would increase removal efficiency
- Future Testing Assumption: Nutrient test results that are significantly below the TMDL may be considered outside the range of interest and may be excluded. Statistical data trimming for values outside the purpose of the evaluation.

	TN	TP
No Flow (1 event)	Significantly Below TMDL	53% Reduction TP
Average (6 events)	12% Reduction TN	1% Increase TP
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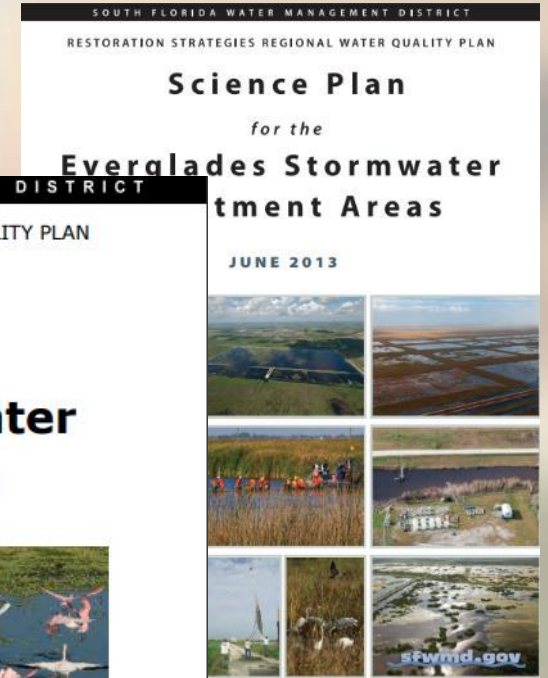
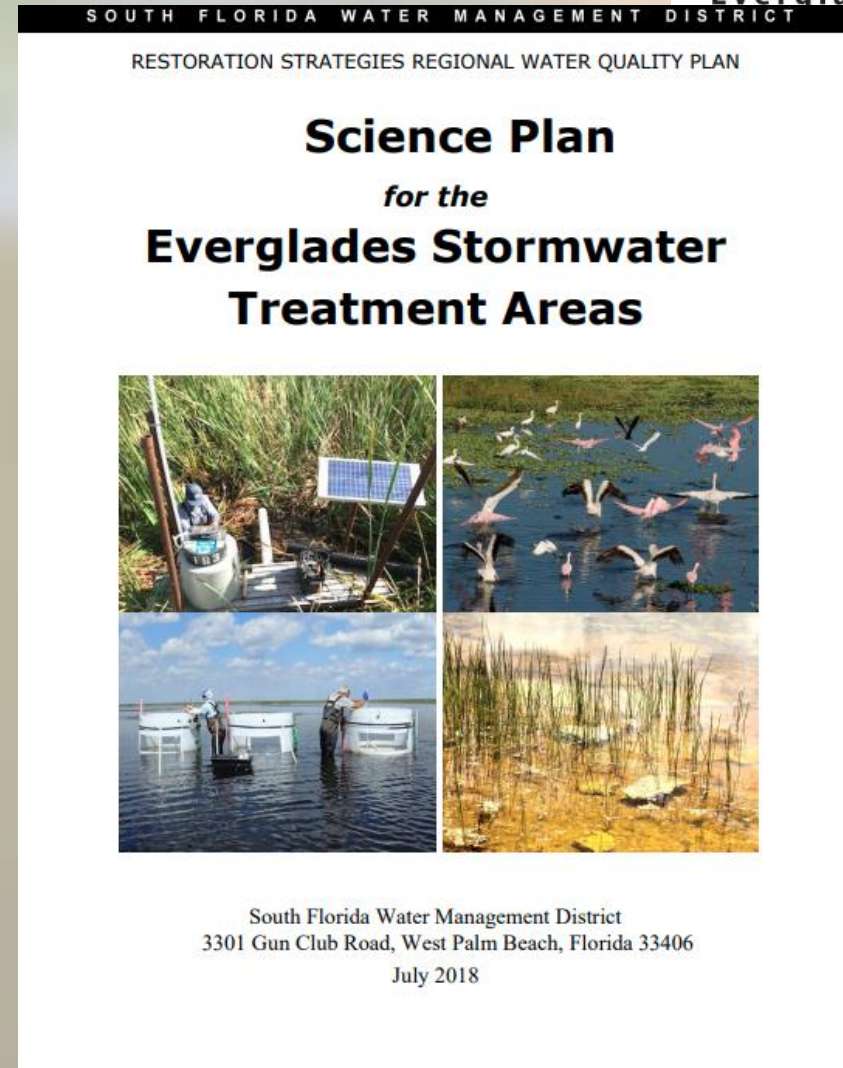
How does this really work...



## Benefits of SAV for water quality

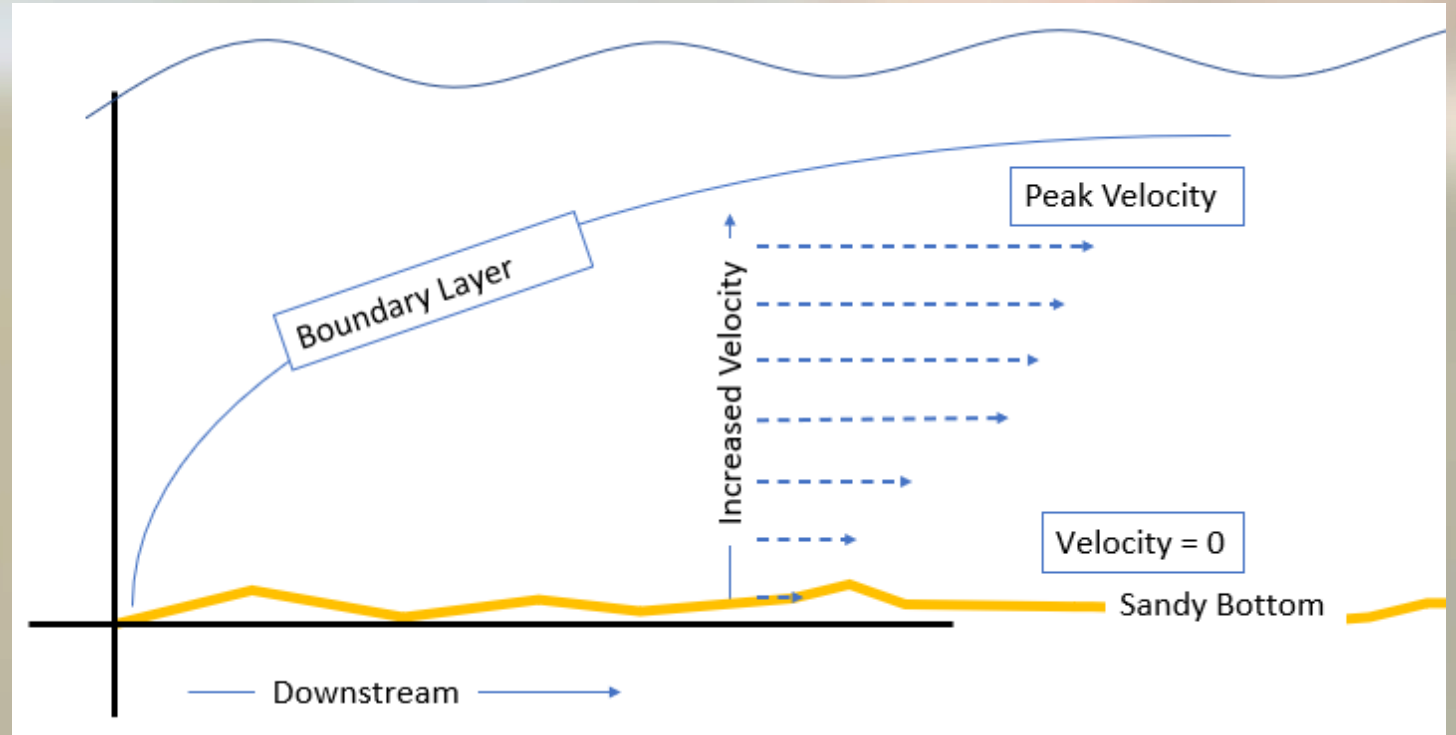
"Photosynthesis within dense beds of SAV elevates the water column pH, which facilitates co-precipitation of P with cationic minerals such as Ca (Brix, 1997; Reddy and DeLaune 2008; Kadlec and Wallace, 2009). Macrophytes also provide contact surface for microbes and periphyton, which can reduce soluble reactive phosphorus (SRP) from the water column by storing it as cellular organic P and/or through extracellular processes of metal-phosphate deposition, co-precipitation with Ca and magnesium (Mg), and adsorption to inorganic compounds like calcium carbonate (CaCO<sub>3</sub>; Hagerthey et al., 2011). "

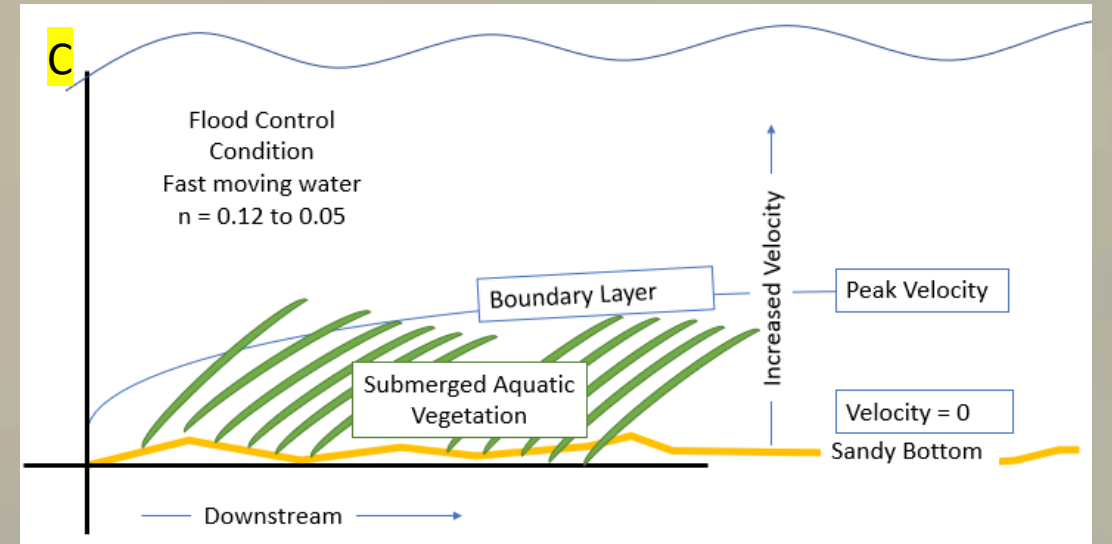
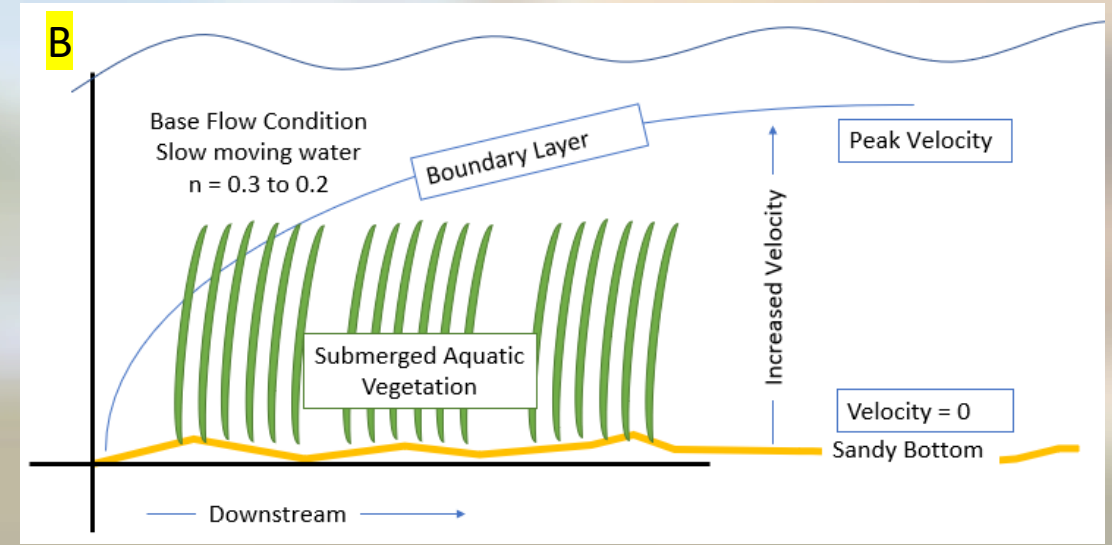
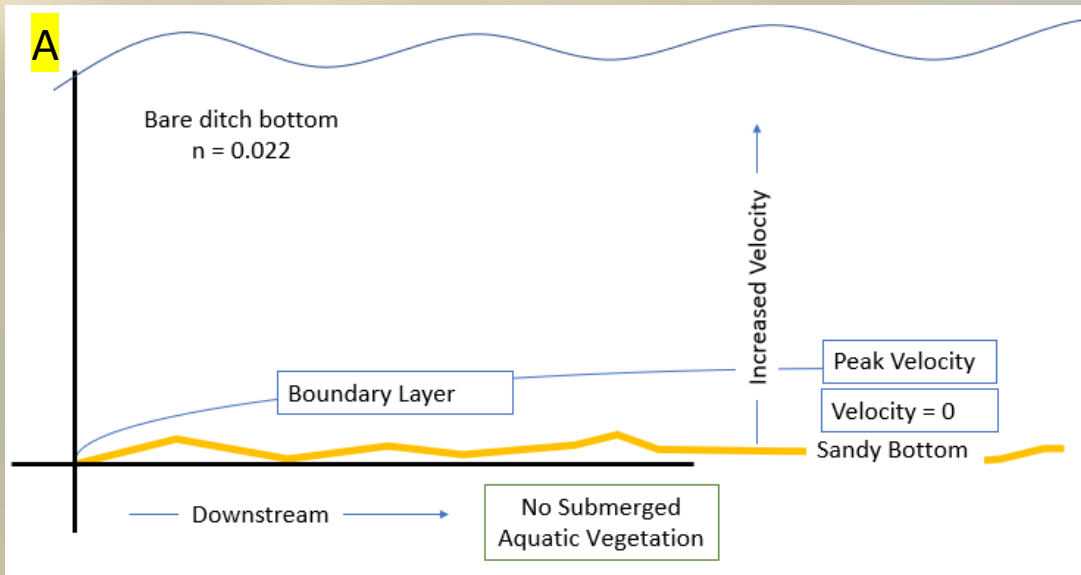
"Beyond their role as attachment surfaces for periphyton and microbes, vegetation communities in wetlands can also lower P concentrations in the water column by pervasive changes they cause in the physical environment. **Macrophytes reduce current velocities greatly near the sediment-water interface and thereby stabilize the sediment surface and minimize the movement of superficial sediments and floc. The underwater plant canopy forms a fiber bed that reduces water movement; decreases sediment and floc resuspension and transport; and provides a large surface area for particle impaction, interception, and settling** (Kadlec and Wallace, 2009, Ch. 10)."



## Stabilizing the Boundary Layer (*Sediment-water interface*)

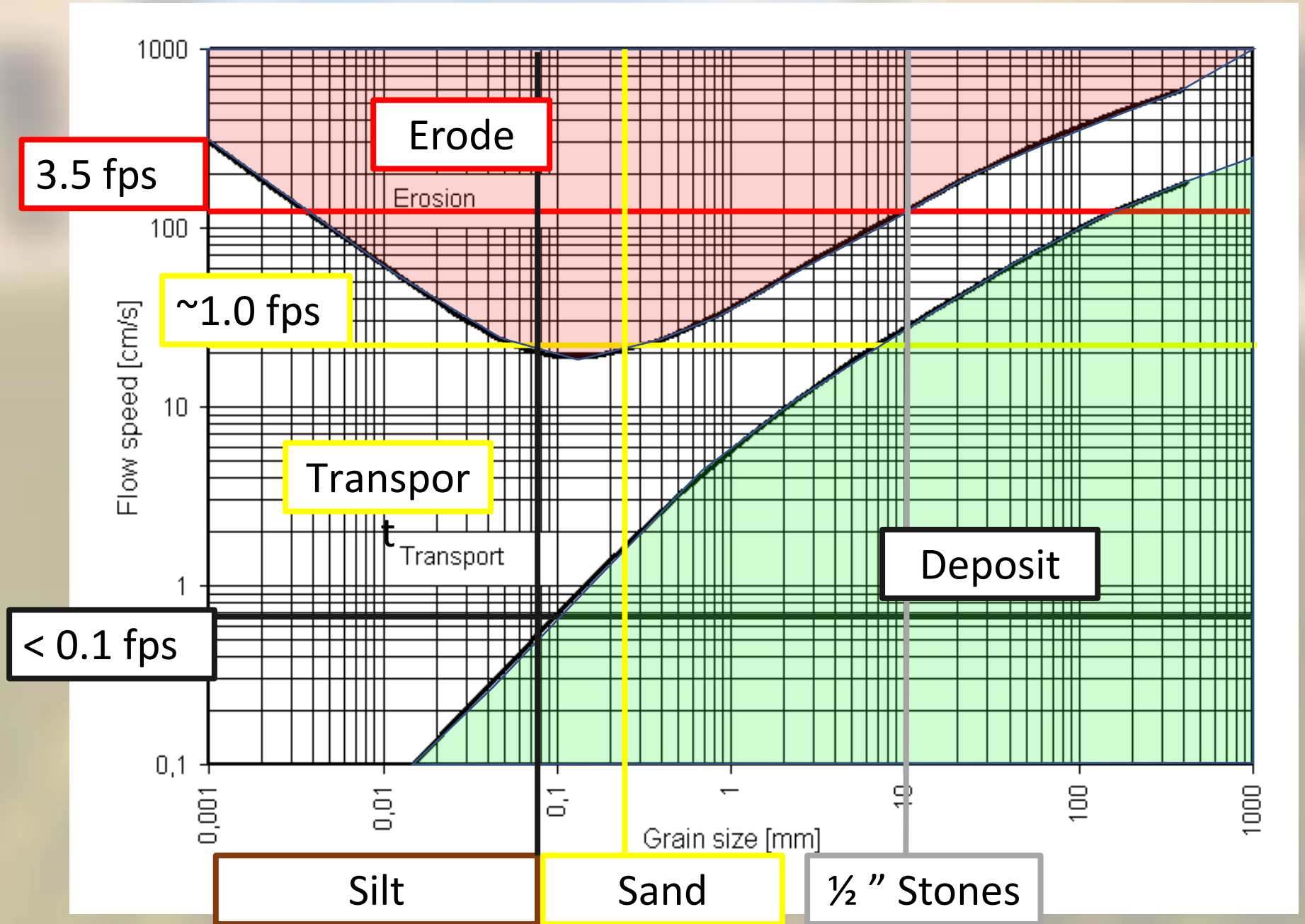
- Reduces sediment transport
- Reduces erosion
- Improves water quality
- limits nuisance SAV (e.g., hydrilla)





Schügerl, R. et al.: Effect of aquatic vegetation on Manning's roughness coefficient value – Acta Hydrologica Slovaca, Volume 21, No. 1, 2020, 123–129

# How does it work ?



## Increased Residence Time

- Significantly increases residence time during base flow condition
- Improves water quality
- Most important factor for water quality performance (Harper, 2007)

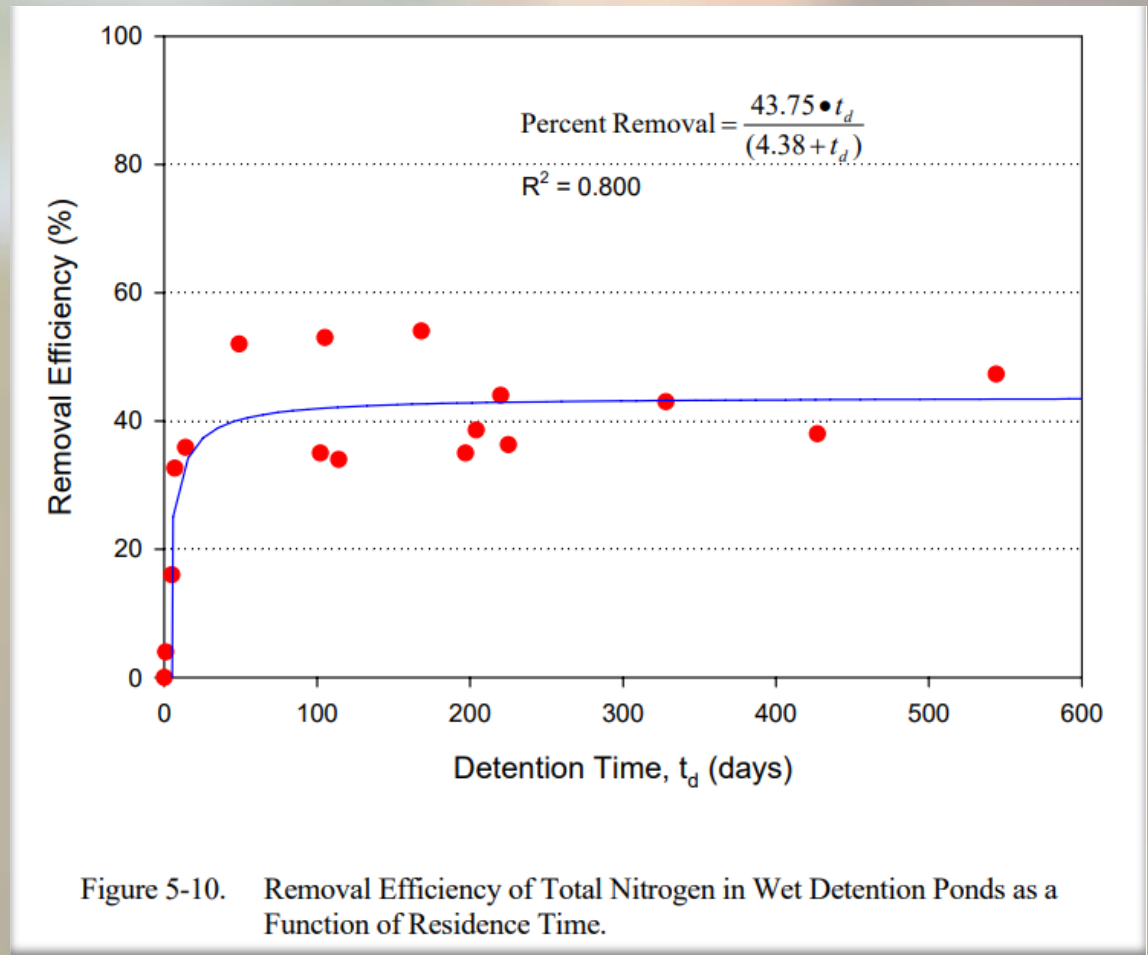


Figure 5-10. Removal Efficiency of Total Nitrogen in Wet Detention Ponds as a Function of Residence Time.

# Public Outreach

This is not common knowledge

- This project also involved the community and I think that is one of the most important aspects of our work.
- Felix A. Williams Elementary hosted us for a presentation and got their 3 thru 5<sup>th</sup> graders involved in the project.
- Mr. Mike tells me they loved petting the grass



# Site & Design Considerations

## What to know

- Predation was significant when planted in still water.
- Floating vegetation (water lettuce/water fern) can be an issue that must be controlled. Use of booms to control have been beneficial, but removal or treatment is still required if that is an issue on the site.
- Maintenance of the nuisance SAV (Hydrilla/Hygrophila) still must be done. Hand removal quarterly is sufficient. Our test site was cleaned in about 3 hours.



# The Eelgrass Project

Submerged Aquatic Vegetation (SAV) is good for your stormwater system

- It's an adaptable and inexpensive retrofit that improves water quality and clarity.
- Select the right location and the right plants!
- Change your maintenance practice to support the project.
- It's currently listed as lacking data for credit on BMP efficiencies table for nutrient removal. Based on our preliminary data and cited research; It absolutely has an effect and should be considered as a nature based solution

# Thank You

The eelgrass project  
is a great idea and  
this information is digestible.  
mmm.... tasty

# Questions ?

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