Total Phosphorous Levels in Surface Water Discharges to Shark River Slough, Everglades National Park

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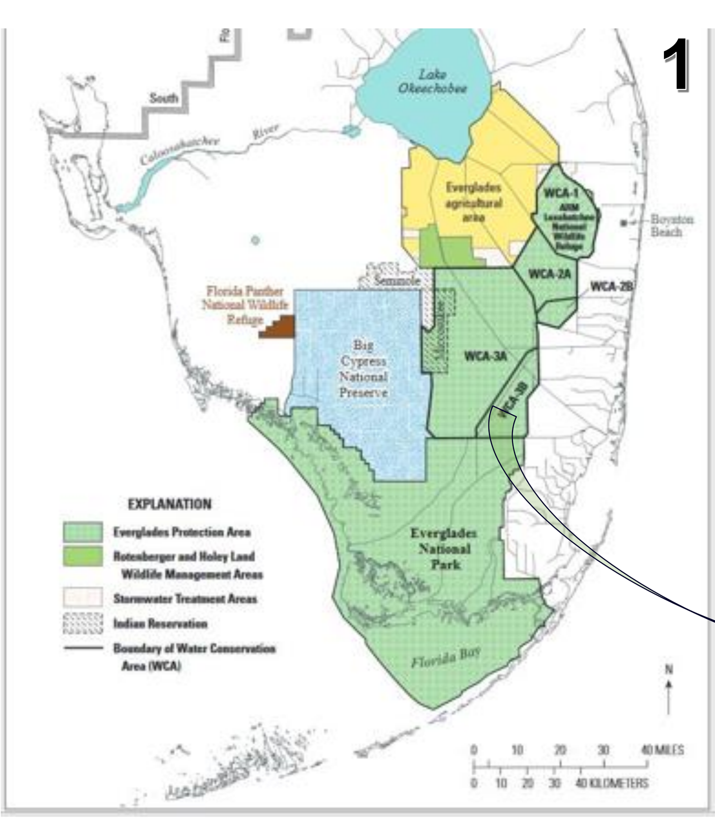
GEER 2017 Greater Everglades Ecosystem Restoration — Advancing Science, Restoring the Everglades — April 17 - 21, 2017 | Coral Springs, Florida

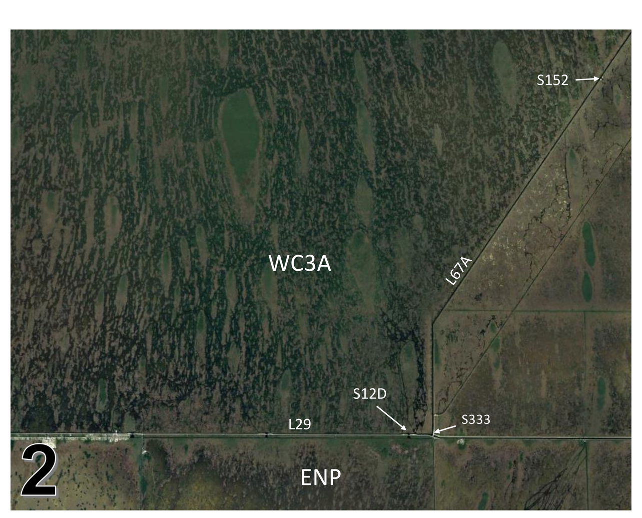
Abstract

Monitoring and current studies have identified a strong correlation between Total Phosphorous (TP) at structure S333 (inflow structure to ENP) and canal stage. Waters from upstream S333 (along the L67A and L29 canal) are mostly the results of managed deliveries by the SFWMD and the exchange with freshwater marshes and groundwater. The conditions and mechanisms that cause elevated TP are unknown. Some may result from changes in natural conditions but others may be the direct result of anthropogenic actions. Water levels in Everglades marshes and canals are closely tied to management and climate variability. The purpose of this study is to identify the sources of the elevated TP at S333 and, if possible, characterize them as to be from either local effects and conditions at S333 or upstream of S333 within the L67A Canal, L29 Canal or the WCA-3A marsh.

Background

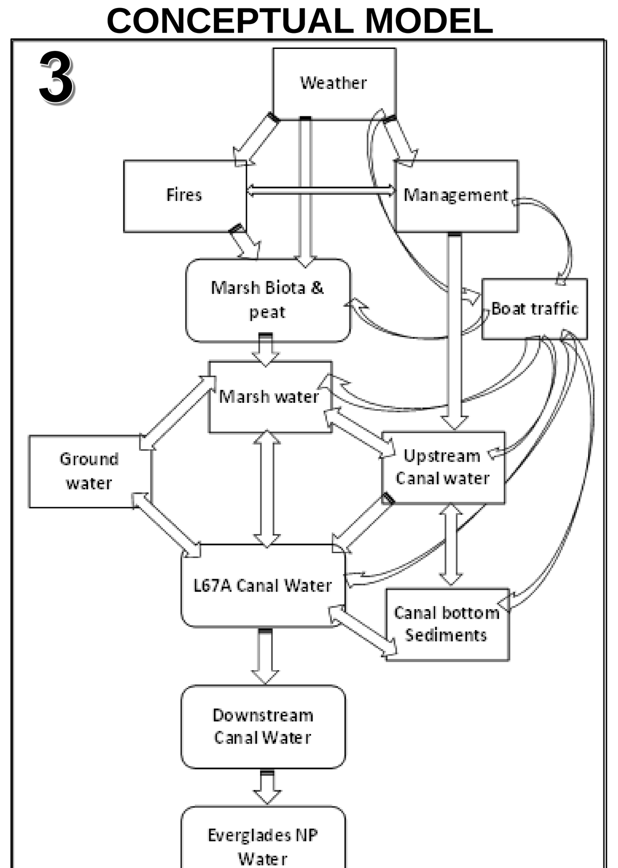
As stages in the Water Conservation Area 3A (WCA-3A; Fig 1,2) decline the L67A canal rather than the marshes conveys the majority of the flow into the Everglades National Park (ENP). Canal water is typically of poorer quality than marsh water because canal water has not benefitted from the marsh filtering removal quality of nutrients. Low stages are associated with high TP levels at S333. Canal flows, especially at low stage, have the potential of re-suspending and remobilizing nutrient-rich sediments that accumulate at the bottom of canals. These phosphorus-rich sediments can be rapidly transported downstream while contributing part of their P load to canal waters to finally reach the park (Fig 3). Another potential contributing factor to high phosphorus levels is varying environmental conditions such as wet and dry seasons, peat oxidation, weather events, and wildfires.

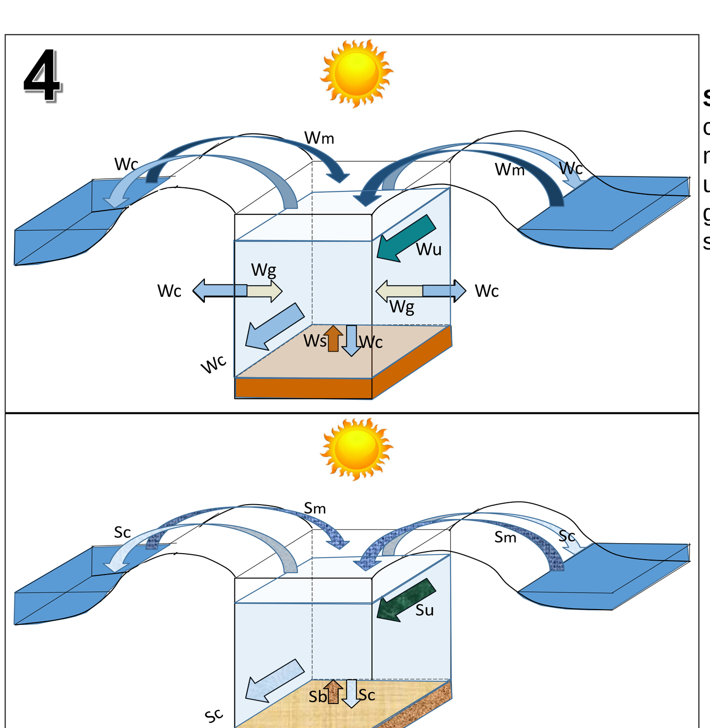




Study Area

CONCEPTUAL MODEL





SOURCE:
c= canal
m= marsh
u= upstream
g= ground
s=sediment

COMPONENT:
W= water
S= Sediment

Research Question

What are the mechanisms responsible for increases in TP concentration in Everglades canal waters when water level declines?

Objectives

The Objectives of this work are:

1- Determine the sources of the elevated TP at S333

2- Establish the most relevant mechanisms driving TP dynamics at S333

Field Collection

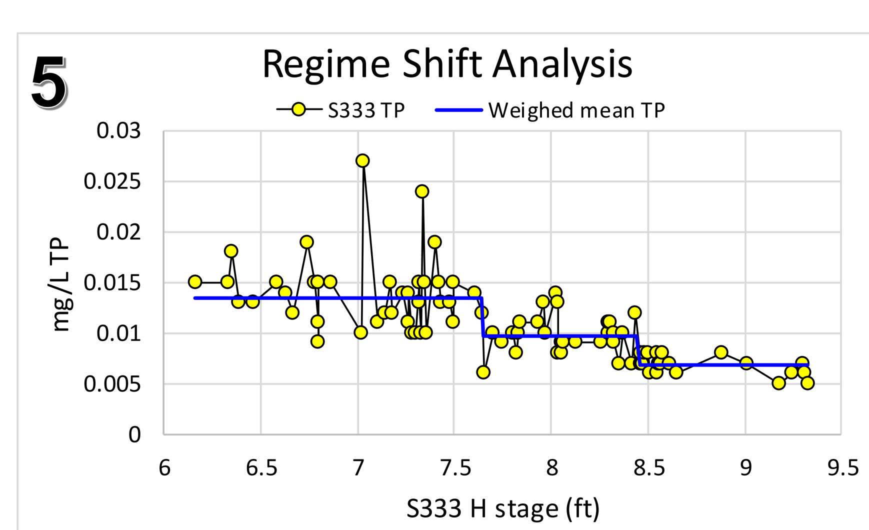
- **Profile** measurements (YSI cast): Temp, DO, depth, Cond, Sal, pH, Turbidity
- **Surface** and bottom waters sampling
- **Bottom** sediment and floc sampling
- Canal water flow profiles

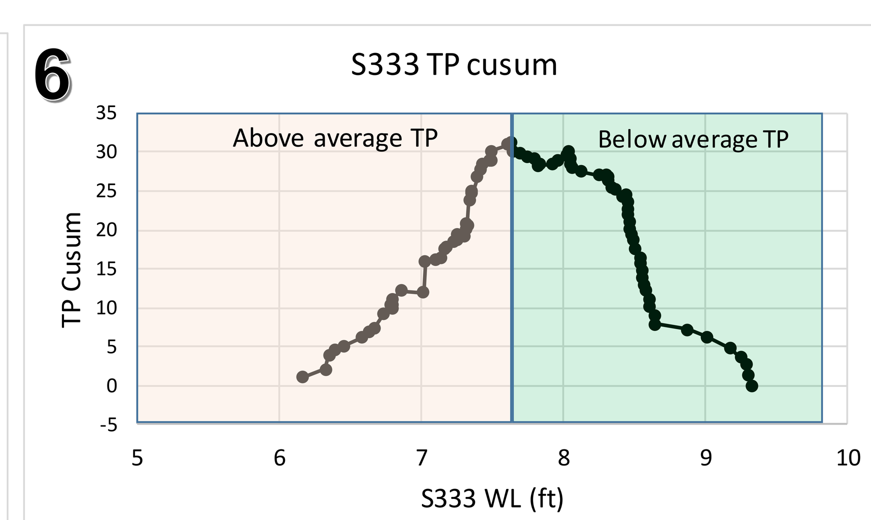
Materials and Methods

- **Water** samples are analyzed for ammonium (NH4+), nitrate+nitrite (N+N), nitrite (NO2-), total nitrogen (TN), soluble reactive phosphorus (SRP), total phosphorus (TP), total organic carbon (TOC), silicate (SiO2), chlorophyll a (CHLA), and turbidity using standard laboratory methods.
- **Floc** and bottom Sediments collected by pumping and dredging respectively are subjected to fractionation in i) 30ml deionized water (plant available and water extractable P; TP-H2O), (ii) 0.5M NaHCO3 (pH ¼ 8.2) (weakly sorbed-bioavailable organic and inorganic P; TP-HCO3), (iii) 0.1M NaOH (strongly bound chemisorbed P-potentially bioavailable; TP-NaOH) and (iv) 1M HCl (apatite or Ca-bound P non bioavailable;TP-HCl)

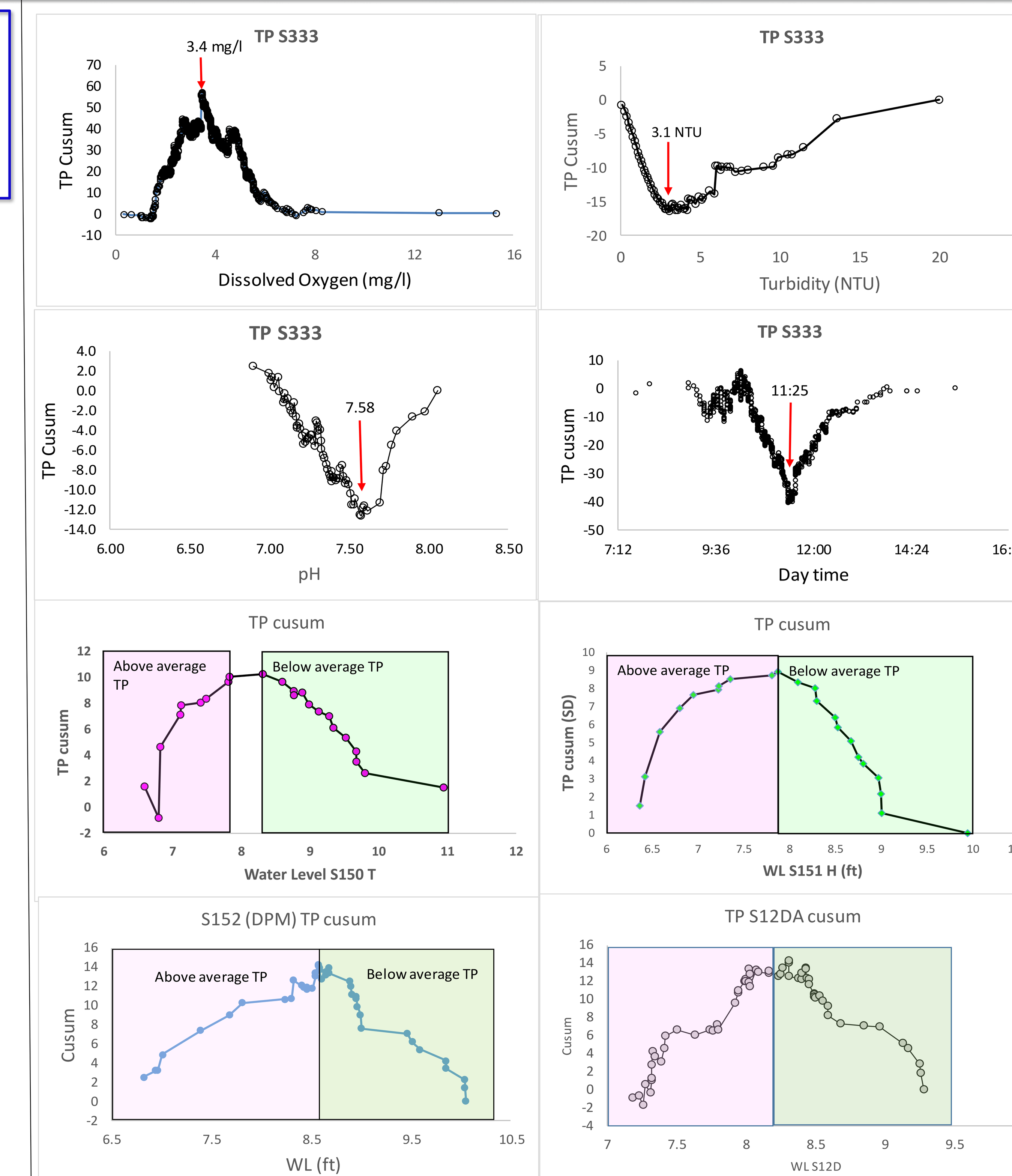
Preliminary Results

- **Exploration** of existing datasets (SFWMD, EDEN, USGS) confirms significant correlations between TP concentrations and WL, pH, Turbidity, Dissolved oxygen and even sampling time of the day (Fig 4 to XX)

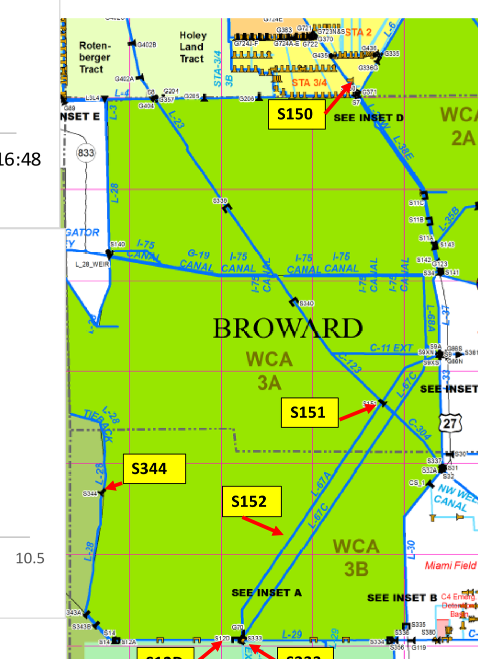




- **We confirmed** the inverse WL:TP relationship for stations connected to WCA3-A (S151, S152, S12D, S344 and even S150 located in the Everglades Agricultural Area (EAA) . In all of them there is a significant WL threshold (system shift) separating above from below average TP (Fig 5, 6). Main thresholds are between 7 and 8 ft WL.



7 Cumulative Sum charts for TP, plotted along the DO, Turbidity, pH and sampling time gradients highlight the thresholds (red arrow) where TP changes from below to above average concentration.



8 Similar relationships TP:WL occurring region wide suggest commonalities among sites in WCA-3A and perhaps EAA

Preliminary Conclusions

- There are clear relationships of TP with WL, DO, Turbidity, pH and sampling time (diel cycle) with thresholds separating hi from low TP waters.
- Although some increase in TP may be due to changing proportions of contribution from marsh vs upstream canal, a local source from deposited sediments and floc seems an interesting alternative.
- Changes in the hydraulic geometry of the canal due to declining WL may stir and erode TP-rich bottom sediments and floc, increasing TP concentration in the water column.
- We are testing this initial hypothesis by collecting and analyzing waters, sediments and floc during different WL conditions, and especially during critical stages, when approaching and when reaching the WL threshold

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Acknowledgements

This study is part of the NPS funded project “Mechanisms and Conditions Responsible for Elevated TP Levels in Surface Water Discharges to Shark River Slough within Everglades National Park”, and the NSF funded “Florida Coastal Everglades Long=Term Ecological Research Project”