SOUTH FLORIDA WATER MANAGEMENT DISTRICT

INVESTIGATION OF STA-3/4 PERIPHYTON-BASED STORMWATER TREATMENT AREA (PSTA) PERFORMANCE, DESIGN, AND OPERATIONAL FACTORS

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Introduction

The concept of using periphyton to reduce phosphorus (P) in stormwater prior to entering the Everglades has been investigated by South Florida Water Management District (SFWMD) scientists and other researchers for over twenty years. Periphyton communities are complex assemblages of cyanobacteria, eubacteria, diatoms and eukaryotic algae found in lakes, streams and wetlands, including the marshes of the Everglades (McCormick and O'Dell, 1996).

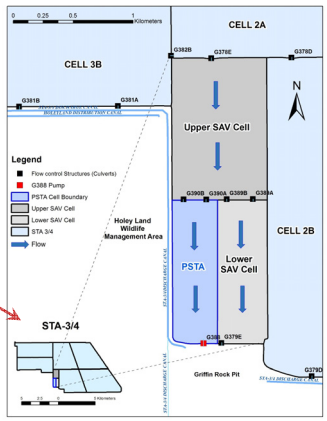
Periphyton typically has a high affinity for P and responds to P inputs more rapidly than other wetland components (macrophytes, soils) and thus is important in the uptake and storage of P (McCormick et al., 1996).

The field-scale Periphyton-based Stormwater Treatment Area (PSTA) was constructed in 2005 for the purpose of addressing uncertainties associated with large field scale implementation of the PSTA treatment technology.

Study Area

The PSTA Project is located in STA-3/4, and comprised of a 200-acre Upper Submerged Aquatic Vegetation (SAV) Cell, a 100-acre Lower SAV Cell and a 100-acre PSTA Cell.

Unlike adjacent cells, most of the soil from the PSTA Cell was removed down to the caprock to reduce potential source of P flux back to the water column. Several vegetation strips divide the PSTA Cell into smaller compartments.

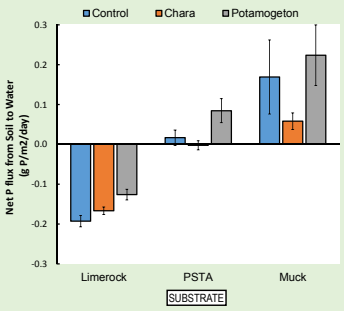


Study Objective

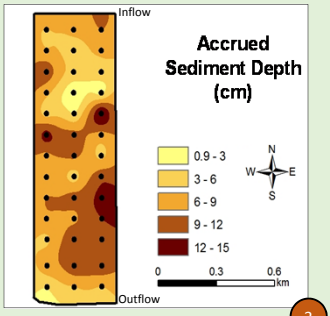
Primary objective is to address the following questions:

- What are the important design elements that enable the PSTA Cell to achieve ultra-low outflow TP levels?
- What are the key operational ranges that enable the PSTA Cell to achieve ultra-low outflow TP levels?
- What management practices are required to sustain the PSTA Cell's good performance?

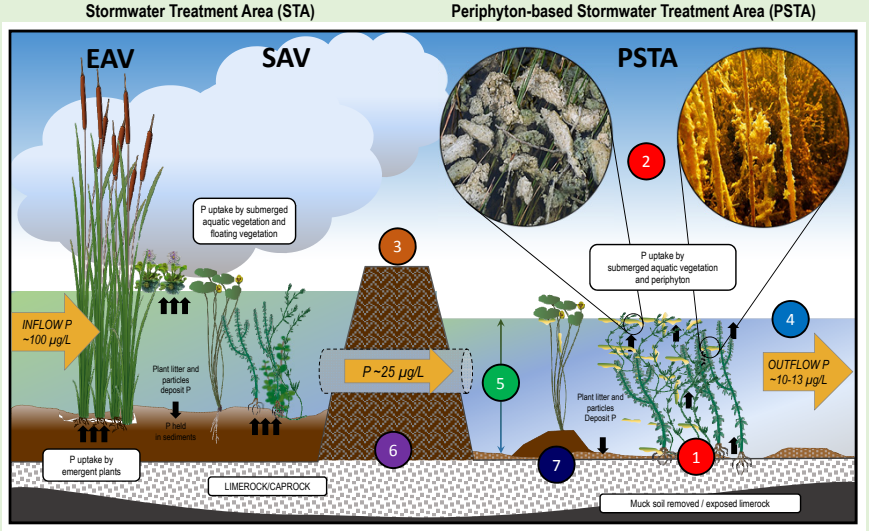
PSTA Findings

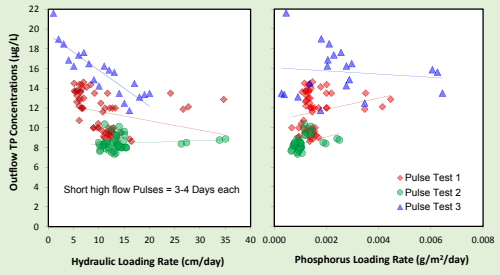


F1: Removal of high-P muck soil reduces or eliminates the flux of P from the soil to the water column.
F2: Removal of high-P muck soil decreases macrophyte tissue nutrient content.

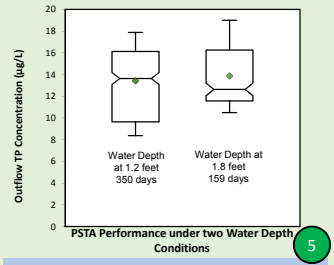


F3: Sediment data do not indicate the existence of strong internal gradients in sediment accumulation.

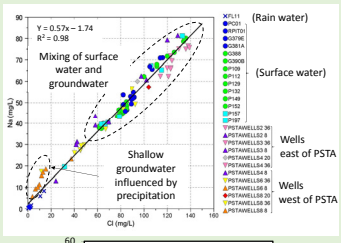


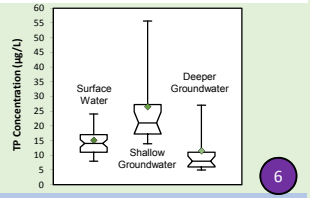


F4: No adverse impacts on treatment performance from short term high flow pulses or increased TP loading.

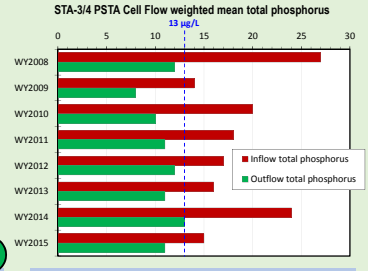


F5: Shallow depths did not contribute to superior treatment performance, increased water depth did not result in higher outflow TP concentrations.





F6: Data suggest that the ultra-low outflow TP concentrations achieved by the PSTA Cell did not result from dilution of inflow surface water with lower TP groundwater seepage.



F7: P flux from the sediment accrued in the PSTA Cell over time has not resulted in a degradation of the cell's treatment performance.

Summary

The STA-3/4 PSTA Cell is the only large-scale example to date where soil was removed down to the caprock and the ensuing average outflow TP concentrations over an extended period have been consistently less than or equal to 13 µg L^{-1}. To date there has been no indication that the PSTA Cell P removal performance is declining over time.

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References

McCormick, P.V., and M.B. O'Dell. 1996. Quantifying periphyton responses to phosphorus in the Florida Everglades: a synoptic-experimental approach. J. New Am. Benthol. Soc. 15:450-468.

McCormick, P. V., P. S. Rawlik, K. Lurding, E. P. Smith, F. H. Sklar. 1996. Periphyton-water quality relationships along a nutrient gradient in the northern Florida Everglades. J. North Am. Benthol. Soc. 15(4): 433-449.