



Advanced Phosphorus Effluent Removal

Fleming Island Regional Wastewater Treatment Facility, Clay County

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Prepared by
Sustainable Water Infrastructure Group, LLC (SWIG)



Company Background

- Founded in 2018
- SWIG is water quality developer using innovative vertical filtering media systems for phosphorus and nitrogen removal
- Operating nutrient removal systems in Florida, Virginia, and Louisiana
- Technology targets both point and non-point source applications



Company Overview

- Established in 2017
- Four partners with extensive experience in point and non-point source nutrient removal
- Core technology is patented media-based Phosphorus (P) and Nitrogen (N) removal system
- Design, build, finance and operate innovative nutrient removal systems
- Four active nutrient removal systems
- Unique features of system
 - Flexible deployment (point and non-point)
 - Speed of project delivery (<1 year)
 - Passive, easy to operate systems, no chemicals
 - Reliably remove P and N
 - Monitored systems, verified removal results
 - Alternative delivery, “pay for performance” contracts



Point Source Case Study

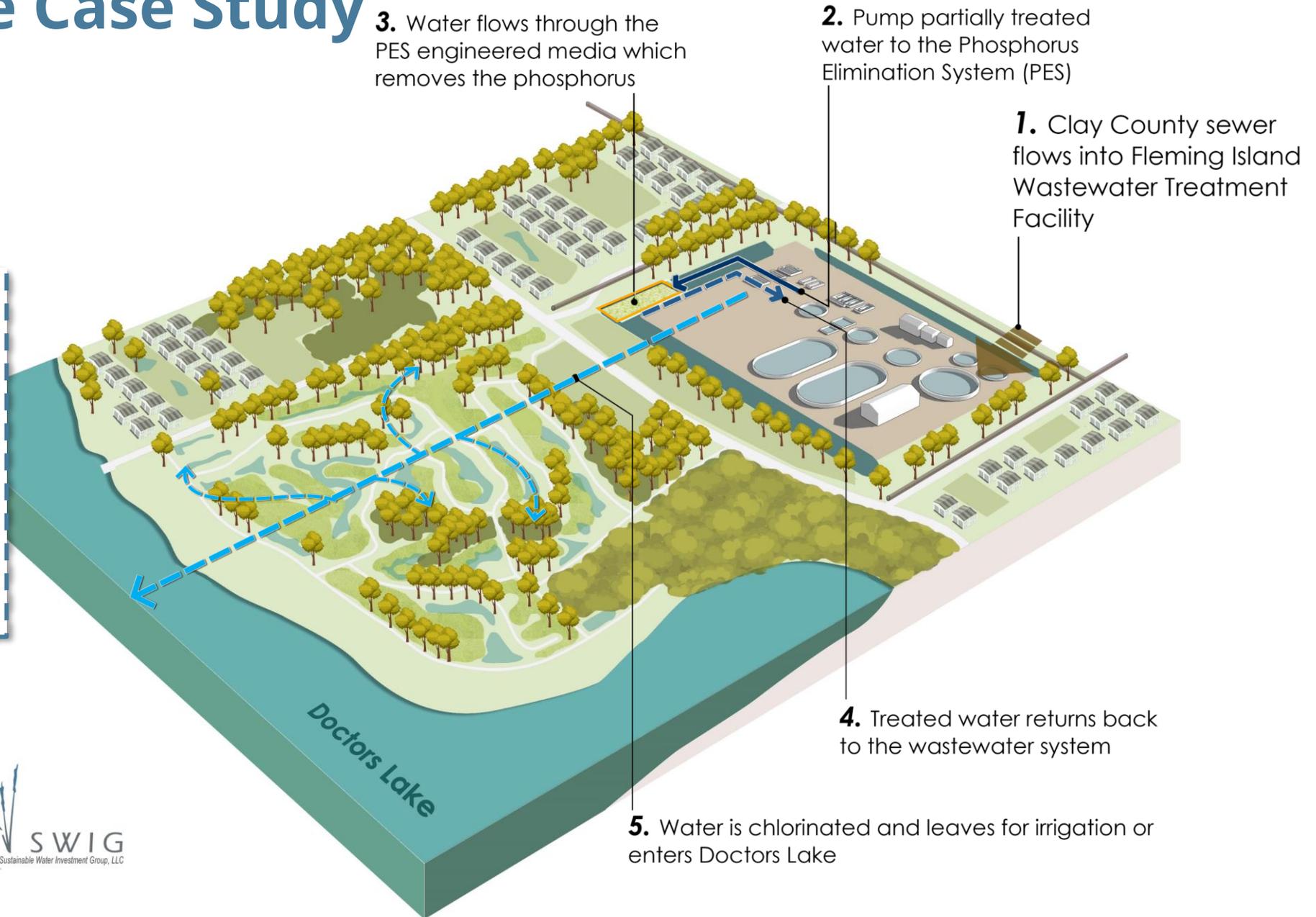
Doctors Lake Advanced Phosphorus Removal

Location: **Clay County, FL**
Client: **St. Johns River WMD**

"Pay for Performance"
Contract

Daily composite sampling

System is designed to remove at least 4,000 lb/y, or 24,000 lb of TP over 6-year projected lifespan.





Doctors Lake Schematic Flow Routing

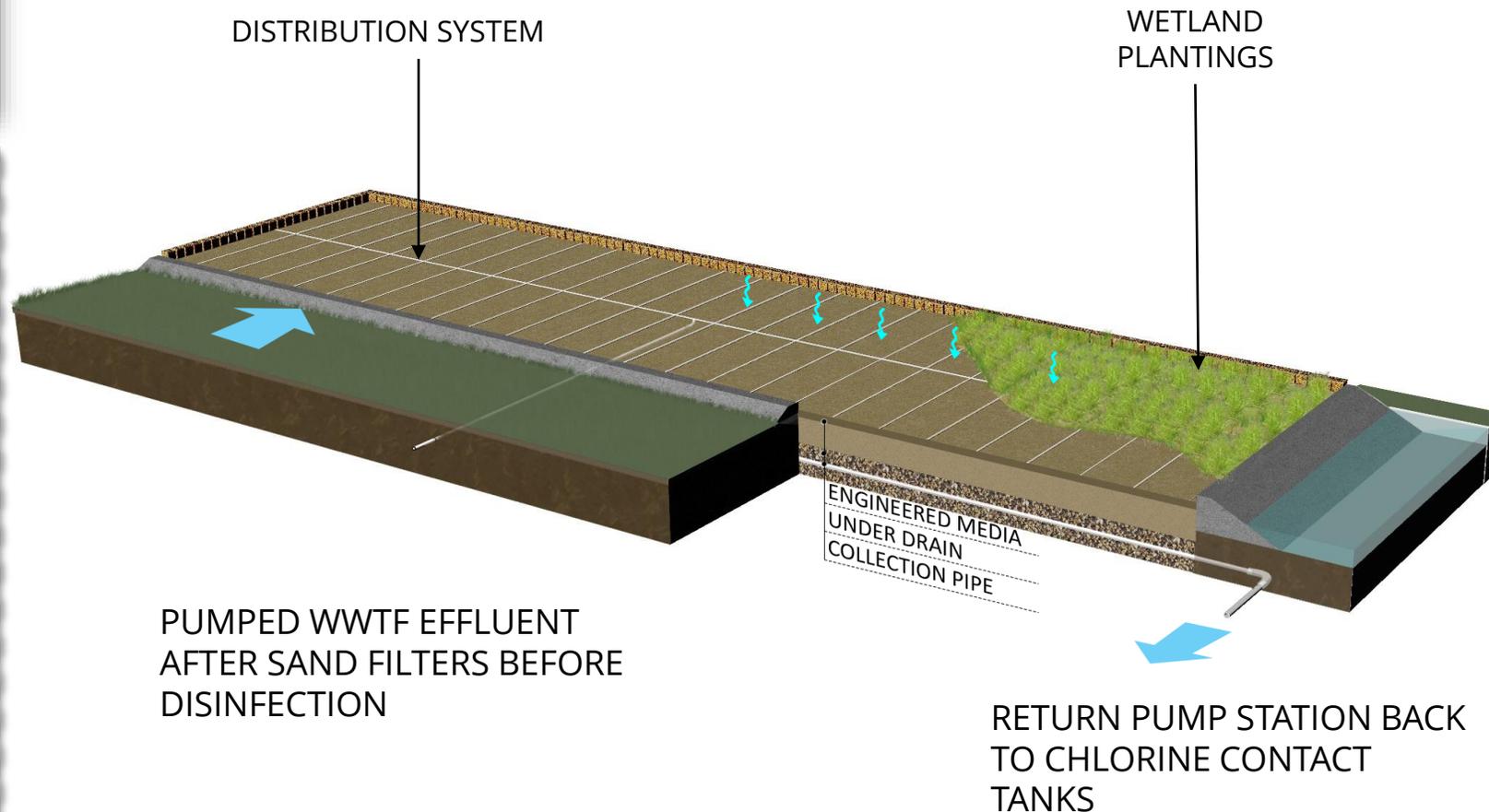
Phosphorus Elimination System (PES)

Filtered effluent from the WWTF is pumped onto the 46,500 sq. ft. media bed.

Effluent applied at 6 feet/day (1.7 mgd). Cells are dosed in sequence, allowing flow regime to cycle between saturated and drained.

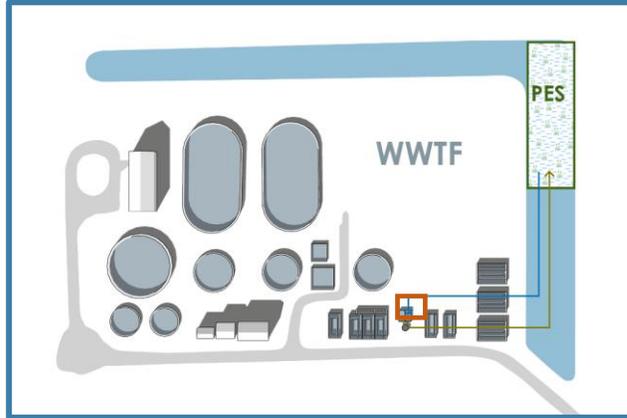
Wetland plantings facilitate TP removal and improve media infiltration rates.

Treated effluent collected in under drain is then pumped back into WWTF.





Site Plan



Diversion Box



Flow Sampling and Reporting

Inflows and Outflows continually monitored with flow paced ISCO 6712 samplers.

Samplers placed in converted chest freezer to maintain 4° C over the week.

Sample bottles advance every day, so we can analyze each day's TP load, and calculate the daily reduction.

Samples analyzed for TP every day. On occasion, turbidity, TSS, TKN and NOx are also measured.



Pump controls, valve controls, and auto-samplers (influent and effluent)

Real-time operations and remote monitoring

Flows are measured with magnetic flow meters.

Flow meters control sample flow pacing as well as the valves that control cell inflows.

Each cell has two valves that open simultaneously, moving to the next cell after a preset dose volume.



Return wet well viewed with Remote camera (using Reolink software)



Magnetic flow meters



Automated valves to each cell

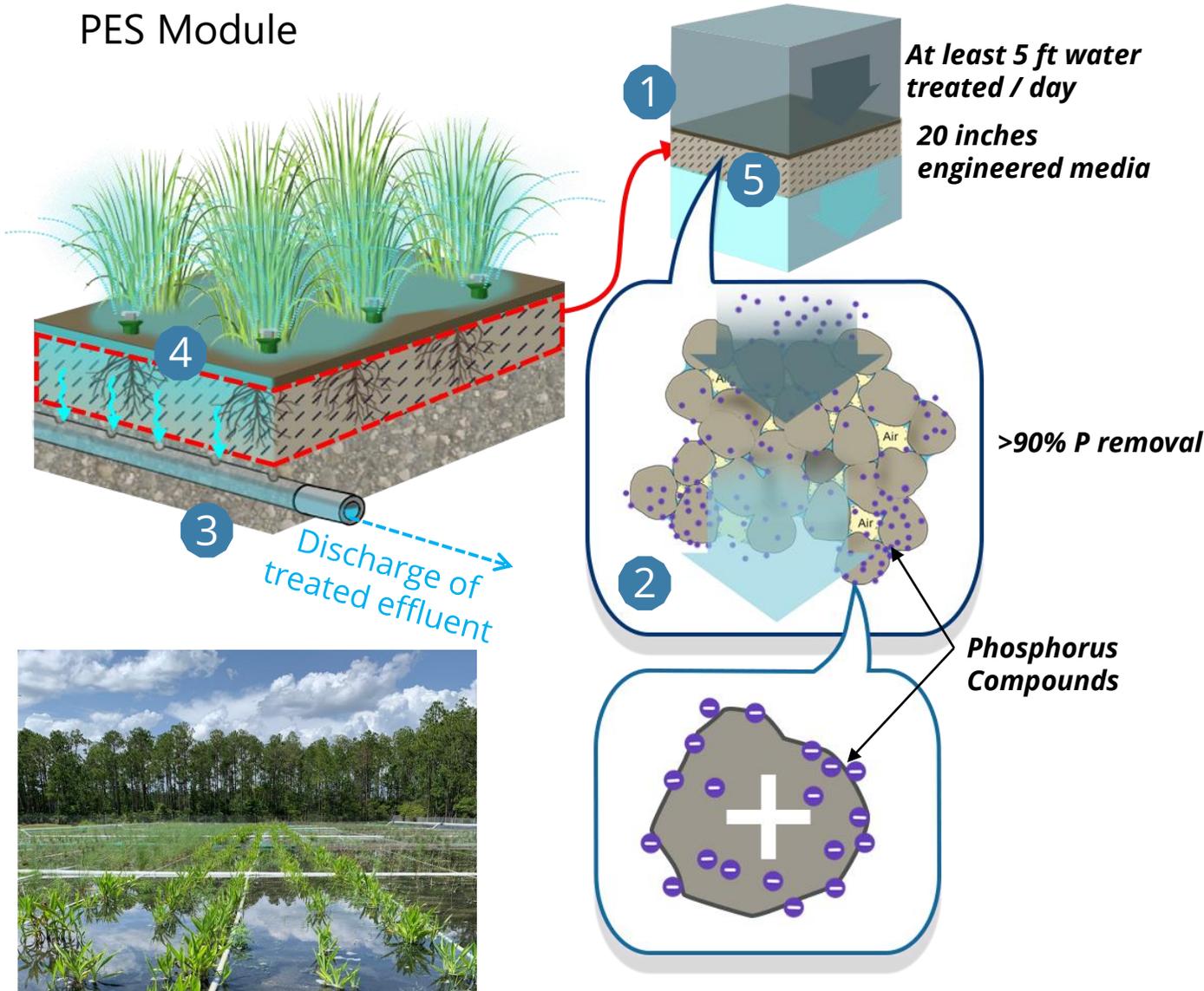


Valve control panel has SCADA system to monitor and adjust operations remotely



Technology – Phosphorus Elimination System (PES) - Overview

PES Module



- 1 Water is distributed onto and passes vertically through a layer of patented media (think "Brita" filter)
- 2 Patented media has an exceptionally high capacity to adsorb and irreversibly bind phosphorus (P)
- 3 Treated effluent is collected via underdrain pipe(s) and discharged into receiving waters
- 4 Robust plant growth with deep roots maintains media porosity and creates dense wildlife habitat
- 5 The media is designed for a specific lifetime (5 to 20 years) and can be replaced to extend project lifetime. Spent media is an excellent soil amendment

Media Evaluation and Lifetime Performance

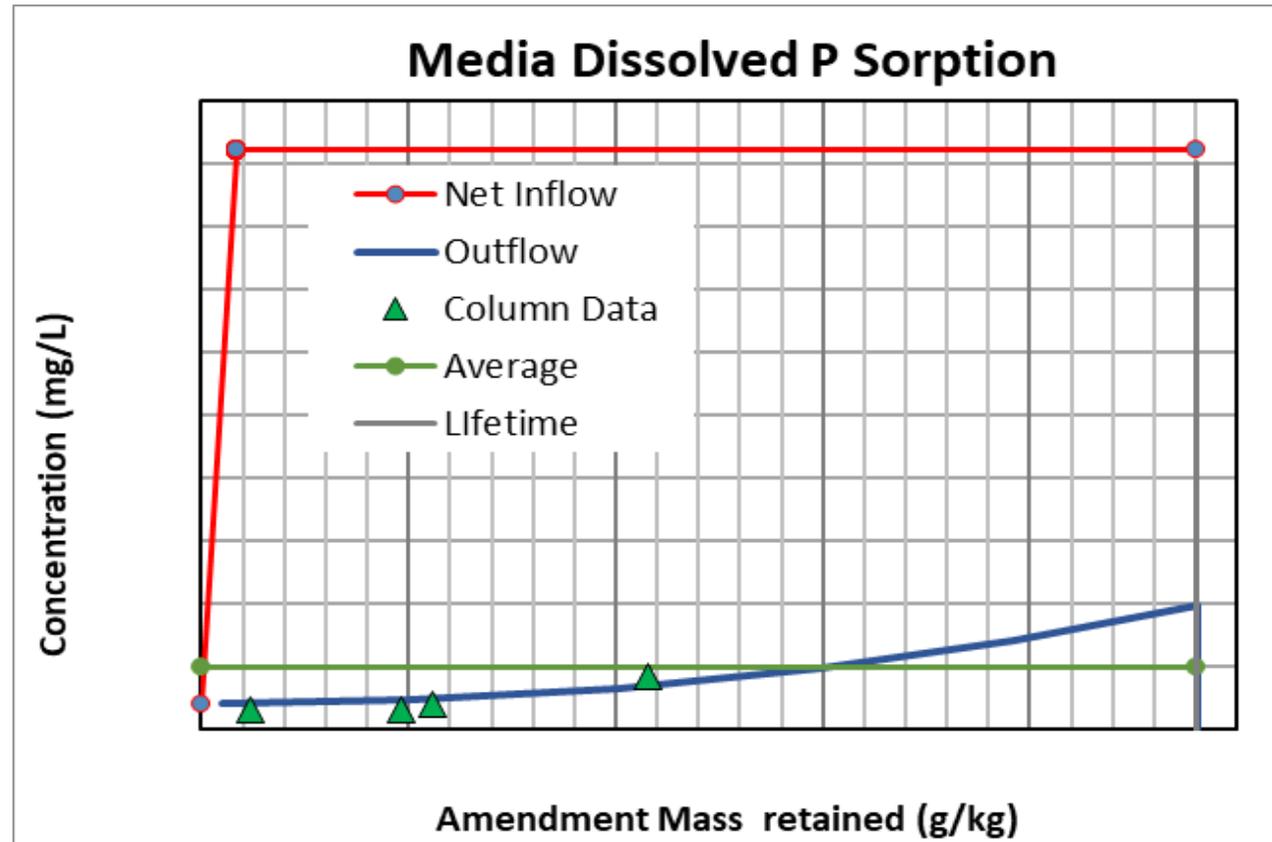
Media are evaluated by how low they keep concentrations after high amounts of TP have been retained.

This calculation is specific to the its percentage of the media, what other amendments you add, and total media thickness.

All of this determines media capacity to retain TP. That can then be plotted against its projected TP load.

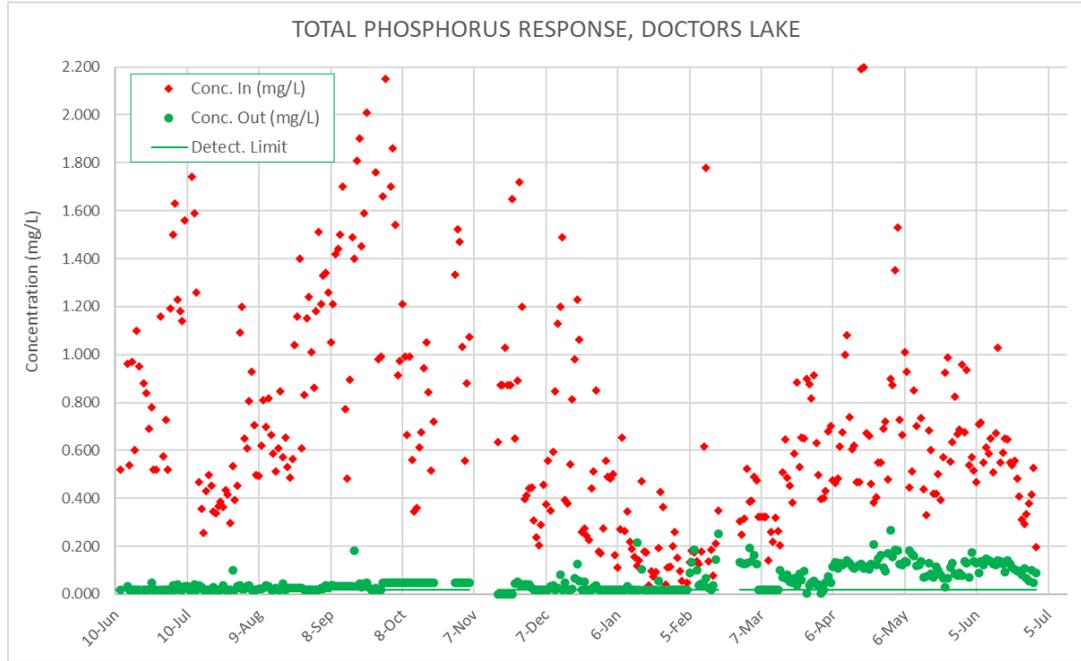
Figure shows column observations used to project TP removals for typical project.

(Figure is based on rearranged Freundlich isotherm for those interested.)



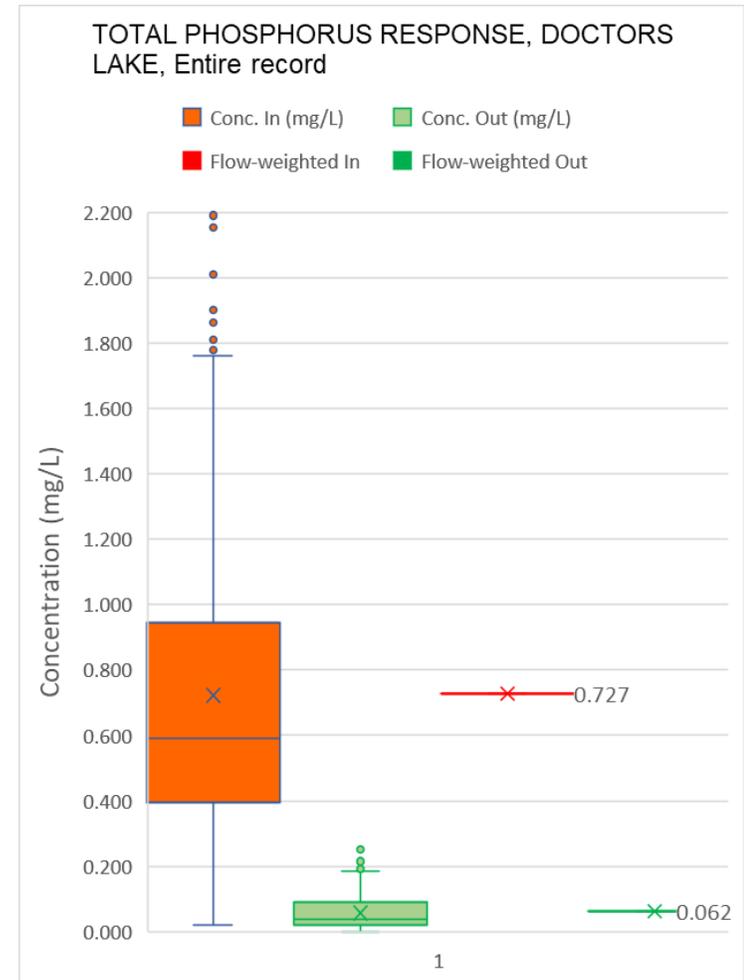
Media Discharge as function of accumulated TP mass loads.

Annual Results



- Majority of outflows were below detection limit over the past year.
- As the media accumulates the loads applied, start to see breakthrough.
- Outflows exceeding 0.100 mg/L were due to fouling of collection lines. Once the collection line issue resolved, outflows currently averaging <math><0.060</math> mg/L, with occasional outflows still below detection limit.

Cumulative flow weighted inflow is 0.727 mg/L, outflow is 0.060. This is a **92%** flow weighted removal after 3,000 lb TP has been removed.



PES Plants and Media Reuse

The plants help in terms of long-term TP removal performance. As the plants grow, the PES becomes an increasingly natural ecosystem.

Bi-annual plant stalk removal to prevent an organic mat from forming. Roots remain intact.



The spent media provides further sustainable reuse. It has so much P in it that it can be blended with topsoil as an amendment that will provide all P required for decades, but without using P fertilizer.

So in effect, the P removed is again reused. By both reducing P fertilizer demand, as well as reducing P losses from fertilized properties such as golf courses.

Key System Highlights

- **Consistently treat P to non-detect level (< 0.04 mg/l TP)**
- **Flexible influent parameters**
 - Influent P can range from 0.10 to 25.0 mg/L
 - Neutral pH system not affected by influent pH
- **Rapid project implementation (operational in <1 year)**
 - Easy permitting due to ability to minimize impacts.
 - Rapid construction time due to simplicity



- **Flexible design considerations**
 - Easy “bolt-on” to infrastructure (e.g. WWTP, STA, etc.)
 - Deployable in distributed systems of virtually any size
 - Can be either pumped or gravity fed
 - Easily located to intercept nutrient loads at optimal sites
 - Is specifically optimized for project influent nutrient loads
 - Is precisely designed for project-specific longevity specs
- **“Marsh Ready”**
 - No chemicals or structures needed
 - System at/below grade, so hurricane proof
 - Simple passive system has no moving parts
 - Remote monitoring/operation used to control system
- **Verifiable results**
 - Influent and effluent continuously monitored
 - Nutrient removal verified, no guessing or estimates

Thank You

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