# Alternative Treatment Technologies

*South Florida Water Management District, Applied Sciences Bureau, Water Quality Treatment Technologies*

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## Introduction

The South Florida Water Management District (SFWMD) is continuing to seek ways to reduce nutrients from stormwater runoff in an effort to improve regional water quality in Lake Okeechobee, the Caloosahatchee and St. Lucie estuaries, and water moving south via the Everglades Stormwater Treatment Areas. To address a number of inquiries from vendors about the suitability of their products for water quality treatment, the SFWMD created a structured process to evaluate these technologies- the New Alternative Technology Assessment (NATA) Program. The NATA Program provided interested vendors the opportunity to demonstrate the efficacy of potential treatment technologies, aside from vegetative treatment, for reducing phosphorus (P) and/or nitrogen (N) concentrations in waters discharged from farms and urban tributaries.

## Methods

Selected technologies were evaluated, using either SFWMD facilities or farm lands, and using the SFWMD's laboratory facility for analytical testing. All other direct and indirect costs associated with conducting NATA projects were borne by each vendor. In addition, the SFWMD evaluated a number of other technologies brought to its attention through other avenues.

## Criteria

- Products must remove nutrients from water, and may focus on any source subject to agency interest/regulation; estuaries, canals, Lake Okeechobee discharges and soil inactivation
- Products/processes are vetted with a pre-determined set of evaluation criteria by a team of internal scientific staff
- Test sites could be District-owned or cooperating landowner properties
- Evolved into product screening: not a Research & Development process for the vendors

## Types

### Mineral-based product applications:

- Phoslock™
- WP1™
- STI
- ViroPhos™
- Phosphorus Flux Study

### Flow- through processes:

- Ferrate
- AquaFiber
- Electrocoagulation



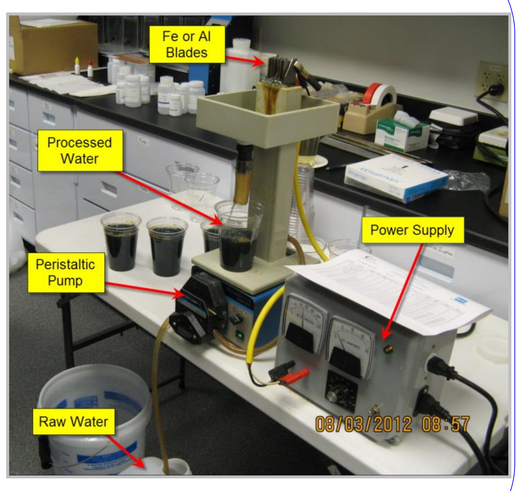
National Conference on Ecosystem Restoration (NCER 2016), Coral Springs FL

## Flow - Through Processes Testing

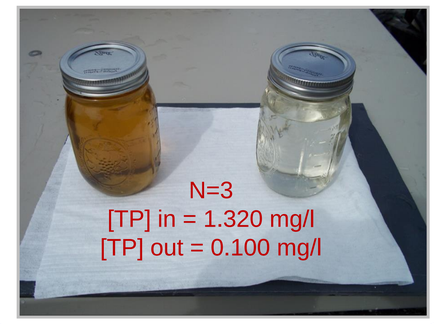
### AquaLutions™ (AquaFiber)


**Two sites along the Caloosahatchee River**

### Electrocoagulation - EC

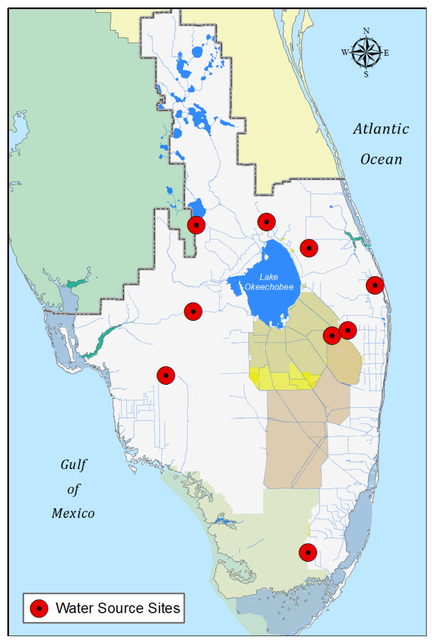



### Ferrate


## Results and Discussion

The table below summarizes the results of different alternative treatment technologies evaluated during the study period (September 2011 to June 2013). The water sources are identified by red dots on the District map.




| Technology | Study Type | Water Source | TP | TDP | SRP | DOP | PP | TN | TON | DON | NOX | NH4 | AL | CA | FE | SO4 | PH | COND | TURB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AquaLutions™ | Field | C-43 Canal | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | – | ↓ | na | na | na | ↑ | ↓ | ↑ | ↓ |
| Aragonite | Jar test | Taylor Creek | ↓ | ↓ | ↓ | ↓ | ↑ | ↓ | ↓ | na | ↑ | ↓ | na | ↑ | na | ↑ | ↑ | ↑ | ↑ |
| Electrocoagulation | Bench-top | C-51 Canal | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | na | ↓ | ↑ | ↑ | na | ↓ | ↓ | ↑ | ↓ | na |
| Electrocoagulation | Bench-top | C-51 Canal | ↓ | ↓ | ↑ | ↓ | ↓ | ↓ | ↓ | na | ↓ | ↑ | ↓ | na | ↑ | ↓ | ↑ | ↓ | na |
| Ferrate | Field | Istokpoga Marsh | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | na | ↑ | ↓ | na | na | ↑ | ↓ | ↓ | ↑ | ↓ |
| Nclear® | Jar test | MacArthur Lake | ↓ | ↓ | ↓ | ↓ | ↑ | ↓ | ↓ | ↓ | ↑ | ↑ | na | ↑ | na | ↓ | ↑ | ↑ | ↓ |
| Phoslock® | jar test | C-51 Canal | ↓ | ↓ | ↓ | ↓ | – | ↑ | ↓ | na | ↑ | ↑ | ↑ | na | ↑ | – | – | – | ↑ |
| Phoslock® | Field | MacArthur Lake | ↓ | ↓ | ↓ | ↓ | ↑ | ↓ | ↓ | na | – | ↓ | na | na | na | na | – | – | ↑ |
| STI | Jar test | C-51 Canal | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | na | ↑ | ↑ | ↓ | na | ↓ | ↓ | ↑ | ↑ | ↑ |
| STI | Jar test | Lake Trafford | ↓ | ↓ | ↓ | – | ↓ | – | – | na | * | ↓ | – | na | ↓ | na | – | – | ↓ |
| ViroPhos™ | Jar test | STA Test Cells | ↓ | ↓ | * | ↓ | ↓ | na | na | na | na | na | ↑ | ↑ | ↑ | ↑ | – | ↑ | – |
| ViroPhos™ | Jar test | C-51 Canal | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | na | ↑ | ↓ | ↑ | na | ↑ | ↑ | – | ↑ | ↑ |
| ViroPhos™ | Field | Dairy pond | ↓ | ↓ | ↓ | na | ↑ | – | – | na | ↑ | ↓ | ↑ | ↑ | ↑ | ↑ | – | ↑ | ↑ |
| WP-1™ | Field | STA Test Cells | ↓ | ↓ | * | ↓ | ↓ | ↓ | na | na | ↑ | ↓ | ↑ | ↓ | ↓ | ↓ | – | – | na |
| WP-1™ | Jar test | C-51 Canal | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | na | ↑ | – | ↓ | na | ↑ | ↑ | ↑ | – | ↑ |
| WP-1™ | Field | Blue Heron Pond | ↓ | ↓ | ↓ | ↓ | ↑ | na | na | na | na | na | ↑ | ↓ | ↓ | na | na | na | na |

**Water Quality Parameter Key:** TP= total phosphorus; TDP= total dissolved phosphorus; SRP= soluble reactive phosphorus; DOP = dissolved organic phosphorus; PP = particulate phosphorus; TN = total nitrogen; TKN= total Kjeldahl nitrogen; TDKN = total dissolved Kjeldahl nitrogen; TON = total organic nitrogen; DON= dissolved organic nitrogen; NOX = nitrite + nitrate - N; NH4= ammonia-N; AL= total aluminum; CA= dissolved calcium; FE= total iron; K= dissolved potassium; MG= dissolved magnesium; NA= dissolved sodium; CL= chloride; SO4= sulfate; ALKA= alkalinity; PH= pH; COND= conductivity; TURB = turbidity.

**Test Result Key:** ↑ = constituent level increased (> 5% increase): ↓= constituent level decreased (< 5% decrease): – = little appreciable change in constituent level (≤ 5% increase or decrease): na = constituent not evaluated: *= initial constituent level at MDL - could not evaluate performance of technology

- All the technologies evaluated in this effort demonstrated the potential to reduce TP concentrations in surface waters to some degree and many of them reduced TN levels as well.
- These assessments represent screening level studies - not Research & Development. There are scale-up challenges and site specific product and processes which makes direct comparisons difficult among technologies. Other potential (unintended) impacts (no acute toxicity risk) would also need to be addressed for any full-scale implementation.
- Although there are no current plans to conduct additional laboratory or field tests, the SFWMD remains interested in potential water treatment technologies.

### Reference

**Chimney, M., O. Diaz, O. Villapando, K. O'Dell. SFWMD Technical Publication WR-2013-03. December 2013. West Palm Beach Fl.**