

Nano Bubble Ozone Technology Project in Jones Creek, Jupiter, FL

The Problem

In Jones Creek bacteria (enterococci) concentrations are often far above (20 to 80x) the Environmental Protection Agency's (EPA's) recommended Beach Action Value (BAV) of 71 MPN/100mL for recreational waters. This is a concern because these tidal mangrove creeks are utilized by the public for recreation (e.g., boating, kayaking, paddle boarding and fishing).



Nano Bubble Ozone Technology

Green Water Solutions, LLC. is a provider of a water quality improvement treatment process utilizing Nano Bubble Ozone Technology (NBOT). Ozone is a powerful oxidant and has been used for decades in drinking water treatment, whereas nanobubble treatment is a newer innovation that provides much higher surface area for gas exchange and much longer bubble lifetime than traditional ozone technology. A benefit of the combined approach is the potential for

ozone to persist for longer periods of time in the water column, more slowly diffuse, increase the production of hydroxyl radicals, and provide increased reaction times with potential contaminants. Unlike other algae mitigation (biocidal), NBOT is "green" without legacy chemicals. A trial conducted at Port Mayaca Lock in Florida and lakes in Ohio using this approach demonstrated safe and substantial reductions in microcystis, microcystins, and nutrients post treatment.

Pre-Treatment – Aug 14 @ 5pm



Post-Treatment 12 08/15 7:00am



Post-Treatment – Aug 19 10am



The Study

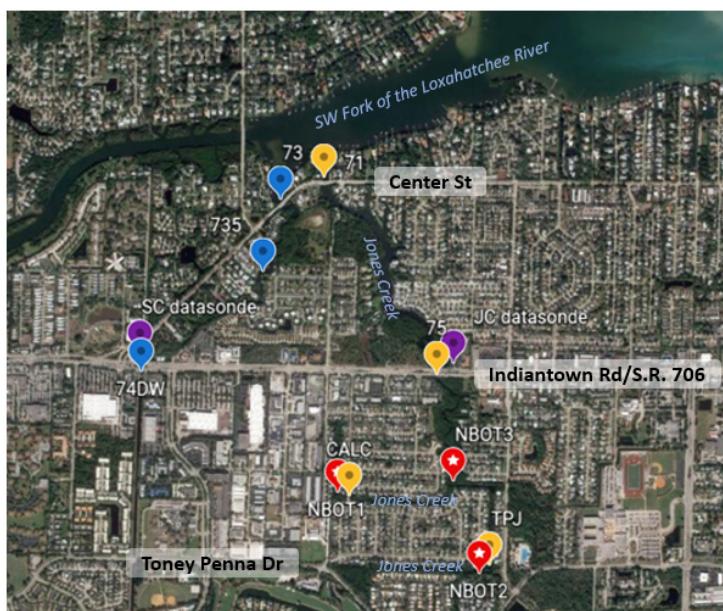
Although these trials have proven successful, it is unclear how changing environmental conditions (brackish, tidal) will affect the efficacy and longevity of the NBOT treatment on bacterial populations, water chemistry, nutrient cycling, and algal biomass in shallow tidal systems. Here, we will monitor water quality parameters before, during and after NBOT treatment to monitor the immediate and long-lasting (up to 3 months) effects of treatment. The objective of this comprehensive monitoring effort is to have a robust dataset to support the publication of the findings in a peer-reviewed scientific journal. This work would be carried out under a partnership between the Loxahatchee River District

(LRD), Green Water Solutions, Dr. Peter Moeller, Town of Jupiter, and Residents.

Green Water Solutions will provide a 60-day commitment of 6 NBOT systems (2 units at 3 locations) for 60 days as part of the overall test treatment project. NBOT Treatment will occur when enterococci bacteria concentrations exceed 500 MPN/L, and equipment will be available for retreatment within 24-hours when bacteria concentrations are below 500 MPN/L.

The deployment locations in Jones Creek in the vicinity of LRD's historical water quality monitoring stations CALC, TPJ, and a 3rd system between the two stations. These deployment locations capitalize on extensive historical water quality data collected under LRD's RiverKeeper monitoring program.

For each sample collection and site, we will analyze an extensive list of parameters from both water and sediments.



Map of Jones and Sims Creek monitoring sites, Jupiter, Florida. Loxahatchee River District (LRD) sample locations in Sims Creek in blue (74DW, 735 and 73) and Jones Creek in yellow (CALC, TPJ, 75 and 71). Red stars depict proposed NBOT deployment locations, purple points show continuous datasonde locations.

The Study - Continued

Surface water and sediment samples will be collected before, during and after NBOT treatment as follows:

- Before. LRD will collect one set of water samples and one set of sediment samples 1 week prior to NBOT deployment.
- During Initial Treatment. Week 1 Initial Treatment: LRD will sample all sites at days 1, 2 and 5, during NBOT deployment. Sediment samples and metals testing will be collected on days 1 and 5.
- Retreatment & After. Following the initial week-long NBOT treatment, LRD will collect weekly bacteria samples for 3 months post treatment, plus a full suite of water quality parameters at all sites at 1 month and 3 months, to evaluate any re-establishment of FIB and nutrients; sediments and metals will be sampled at 3 months post-NBOT deployment. After the project, LRD intends to continue their long-term monitoring of these sites under their ongoing RiverKeeper monitoring program with the regular monthly or quarterly sampling.

All data will be openly shared and made available to the public through LRD's Jones Creek website:

<https://loxahatcheeriver.org/jonescreek/>. A final report summarizing the treatment project and findings from the comprehensive environmental monitoring/study will be developed under this project and published on the website.

Cost & Funding

The \$415,000 project is largely funded by a \$350,000 Innovative Technologies Water Quality Improvement Grant from the Florida Department of Environmental Protection, with additional resources from LRD and a discount provided by Green Water Solutions.

Anticipated Schedule - Subject to Change

Task	Estimated Schedule & Duration (2021-2022)											
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb		
Grant Paperwork & Approvals												
Permitting / Authorization												
Quality Assurance Project Plan (QAAP)												
Resident & Deployment Site Coordination												
Pre-Treatment Monitoring												
NBOT Treatment & Monitoring												
Post-Treatment Monitoring												
Data Management & Analysis												
Report Preparation & Submittal*												

Partners & Roles

- **Loxahatchee River District.** LRD will serve as the local sponsor, contract administrator, and lead the environmental study effort. The study includes sample collection before, during and after the NBOT treatment, including all surface water and sediment sample collection, and the analysis and reporting/manuscript development. *For more information, please contact Bud Howard at bud.howard@lrecd.org or (561) 401-4037.*
- **Green Water Solutions, LLC.** Green Water is responsible for all aspects of the NBOT treatment including 6 NBOT systems, labor, generators, fuel, lodging, transportation, rentals, vehicles, site prep, cleanup, and coordination.
- **Peter Moeller, Ph.D.** Harmful Algal Bloom Monitoring and Reference Branch, National Ocean Service/NOAA, Hollings Marine Laboratory. Dr. Moeller is providing technical guidance in support of this project and will co-author the reporting of the findings.
- **Town of Jupiter.** TOJ Staff will assist LRD with water and sediment field sampling and data review.
- **Residents.** Many of the waterfront residents along Jones Creek are actively engaged in water quality improvement efforts. The members of the Restoration Group have been working with Green Water Solutions to identify deployment locations for the NBOT systems, secure temporary access easements, and facilitate neighborhood coordination.