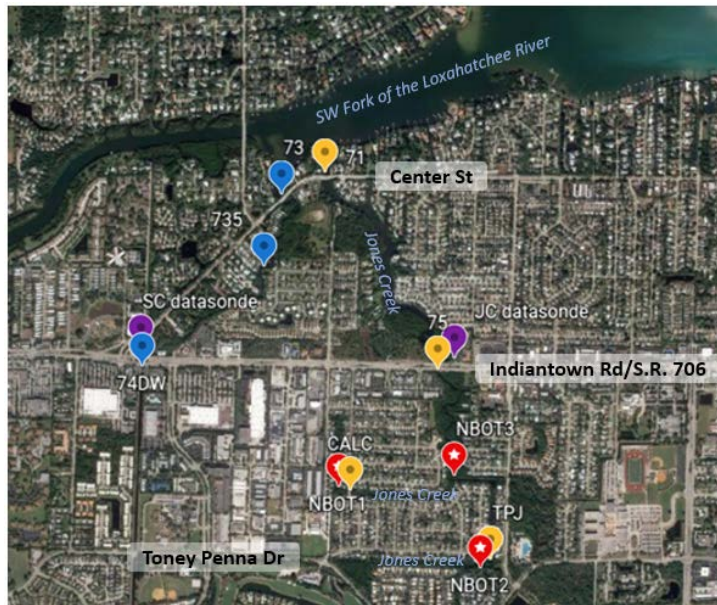




Nano Bubble Ozone Technology Project in Jones Creek



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.



Pre-Treatment – Aug 14 @ 5pm



Post-Treatment 12 08/15 7:00am



Post-Treatment – Aug 19 10am



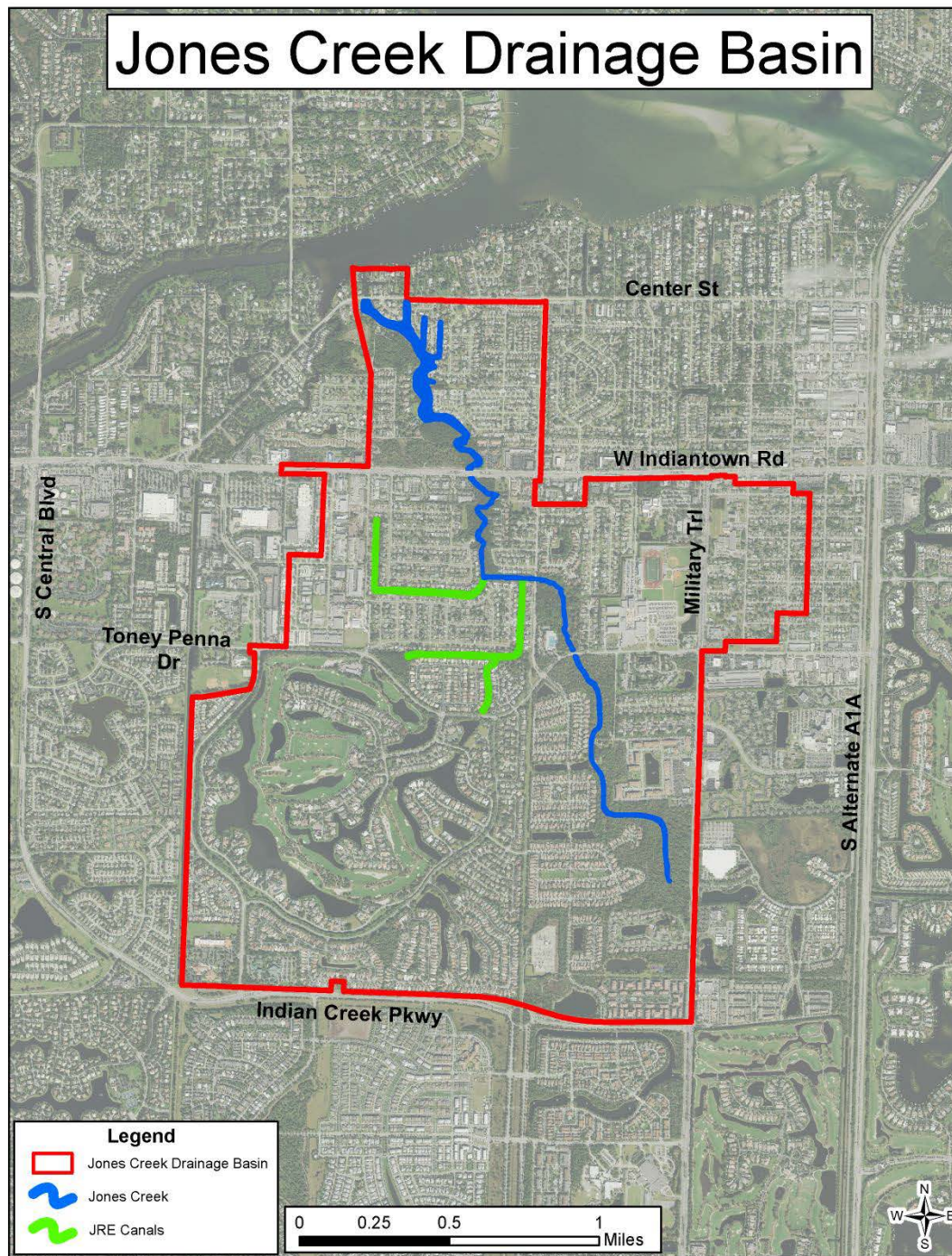
Overview

- ▶ Introductions
- ▶ Background - Water Quality Issues
- ▶ Nano Bubble Ozone Treatment (NBOT) Project
- ▶ What To Expect
- ▶ Schedule
- ▶ Questions & Answers

Introductions

- ▶ Loxahatchee River District
 - ▶ Project and Contract Manager
 - ▶ Bud Howard, Division Director
 - ▶ WildPine Laboratory
 - ▶ Sue Noel, Lab Manager
 - ▶ Rachel Harris, Ph.D., Sr. Scientist
- ▶ Green Water Solutions - NBOT System
 - ▶ Chas Antinone, President
 - ▶ Peter Moeller, Ph.D., NOAA
- ▶ Town of Jupiter
 - ▶ Rebecca Wilder & Staff
- ▶ Residents - Special thanks to the 3 property owners for equipment deployment locations

Jones Creek Drainage Basin



Condensed Background

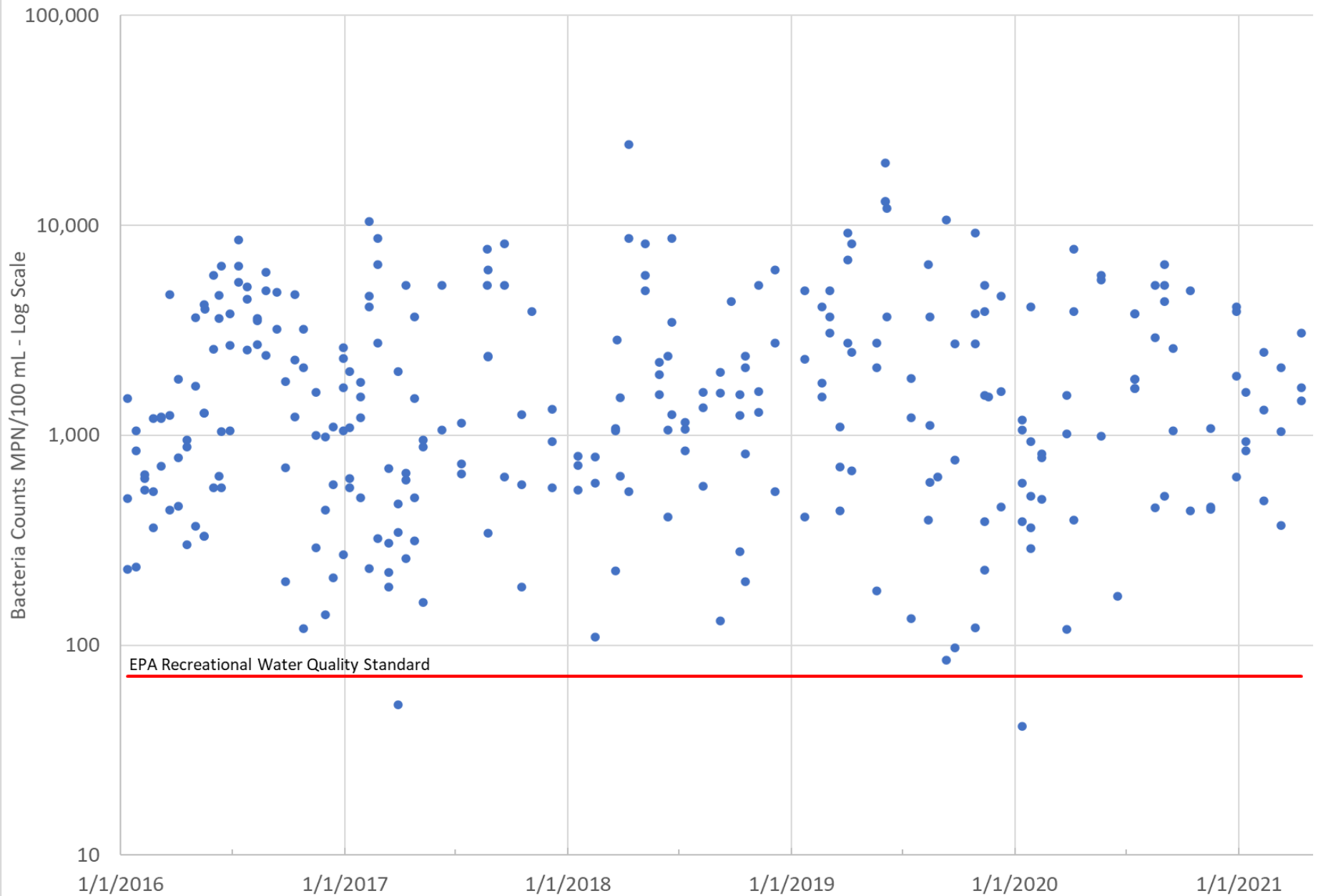
- ▶ Historically Poor Water Quality
- ▶ 1997 - LRD Septic to Sewer Conversion
- ▶ 2003 - TOJ and LRPI Muck Dredging & Exotic Removal
- ▶ 2009 - TOJ and LRPI Swale Reconstruction
- ▶ Expanded Water Quality Monitoring 2016-2019
 - ▶ Chronically High Bacteria & Turbidity
- ▶ 2017 LRD Sewer Overflow & Signage mandated by DOH
 - ▶ Jupiter River Estates Residents concerned & organize
- ▶ 2019 & 2020 - LRD & FDEP Molecular Bacteria Study
- ▶ 2020 - LRD, Green Water Solutions & partners seek DEP Innovative Technology Grant; awarded January 26, 2021



Enterococci Bacteria

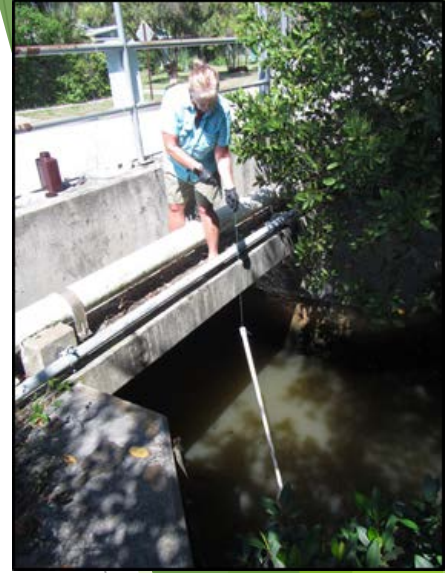
Jones Creek Stations 75, CALC, DEL, JCU, TPJ

2016 - April 2021; N=300



Monitoring Findings To Date

- ▶ Thoroughly evaluated all tributaries
- ▶ No “smoking gun”
- ▶ Bacteria experts - decaying vegetation likely a major factor
- ▶ Turbidity events - still a mystery; biochemical process?
- ▶ 2019/2020 FDEP Molecular Analysis
 - ▶ Live cells of human sewage
 - ▶ Small volume & small population
 - ▶ Not present in 2014
 - ▶ LRD conducting TV inspections
- ▶ Combination of Factors:
 - ▶ Limited flushing of waterway
 - ▶ Decaying vegetation
 - ▶ Sewage
 - ▶ Behavior - Dog waste, carcasses, grass clippings
 - ▶ Reduced sunlight/UV treatment
 - ▶ Possibly Others



Water Quality Improvement Opportunities

- ▶ NBOT Project - Short Term *Experiment*
- ▶ Find and resolve low volume sewage source - LRD
- ▶ Vegetation Trimming - Town of Jupiter & Residents
 - ▶ Provide access for cleanup projects
 - ▶ Reduce loading of vegetation
 - ▶ Increase sunlight and UV water treatment
- ▶ Cleanup projects to remove decaying vegetation
 - ▶ Residents, school groups, scouts, etc.
 - ▶ Grant for waders, long gloves, etc.



Nano Bubble Ozone Technology (NBOT) Project

► Research Opportunity

- Evaluate this Innovative Technology
- Highly effective in treating freshwater systems - Ohio, Port Mayaca
- How effective is this treatment in a highly impaired, tidal, brackish-water system?
- How long does treatment last?
- 60-day commitment of treatment equipment

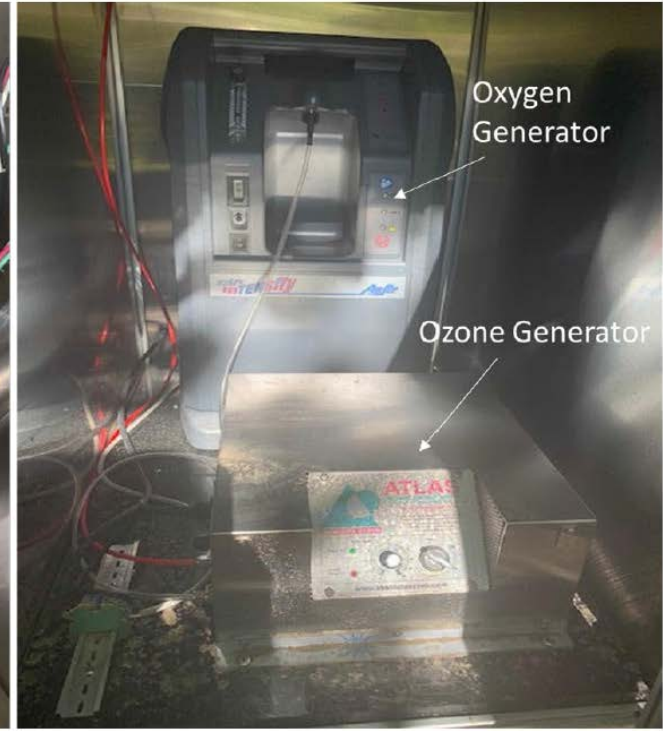
► FDEP Water Quality Improvement Grant - Innovative Technologies - \$350,000

- Local Government Sponsor - LRD
- Green Water Solutions, Dr. Peter Moeller - NOAA, Town of Jupiter
- Residents are engaged and supportive

► Heavy Emphasis on the Science

- Collaboration with Dr. Moeller; TOJ Assistance
- Rich Dataset; Publication in peer-reviewed scientific journal

NBOT System



Nano Bubble Ozone Technology

- Ozone (O_3)
 - Powerful oxidant
 - Used for decades in drinking and wastewater treatment
 - Used to treat water in fish farms and hatcheries
- Nano Bubble
 - Newer innovation
 - Higher surface area for gas exchange
 - Low buoyancy, longer bubble lifetime
- Combined
 - Ozone persists for a longer period of time, more slowly diffuse
 - Increase the production of hydroxyl radicals (OH)
 - Increased reaction times with contaminants (ex. bacteria)
- Treatment
 - Hydroxyl radicals attack essential cell components
 - Lethal to pathogenic viruses and bacteria
 - Humans, animals and plants have evolved to coexist
 - Don't enter blood stream or tissues



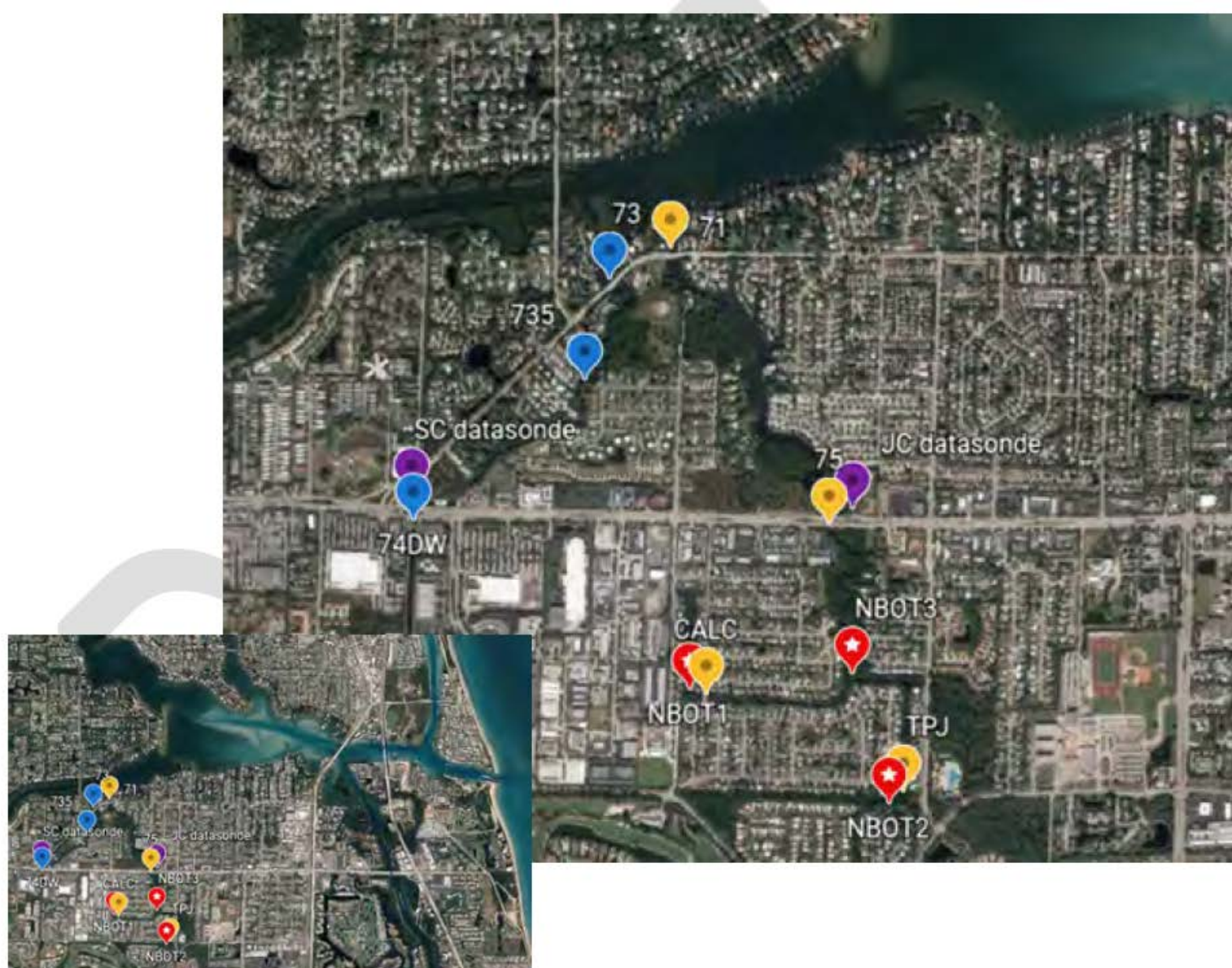
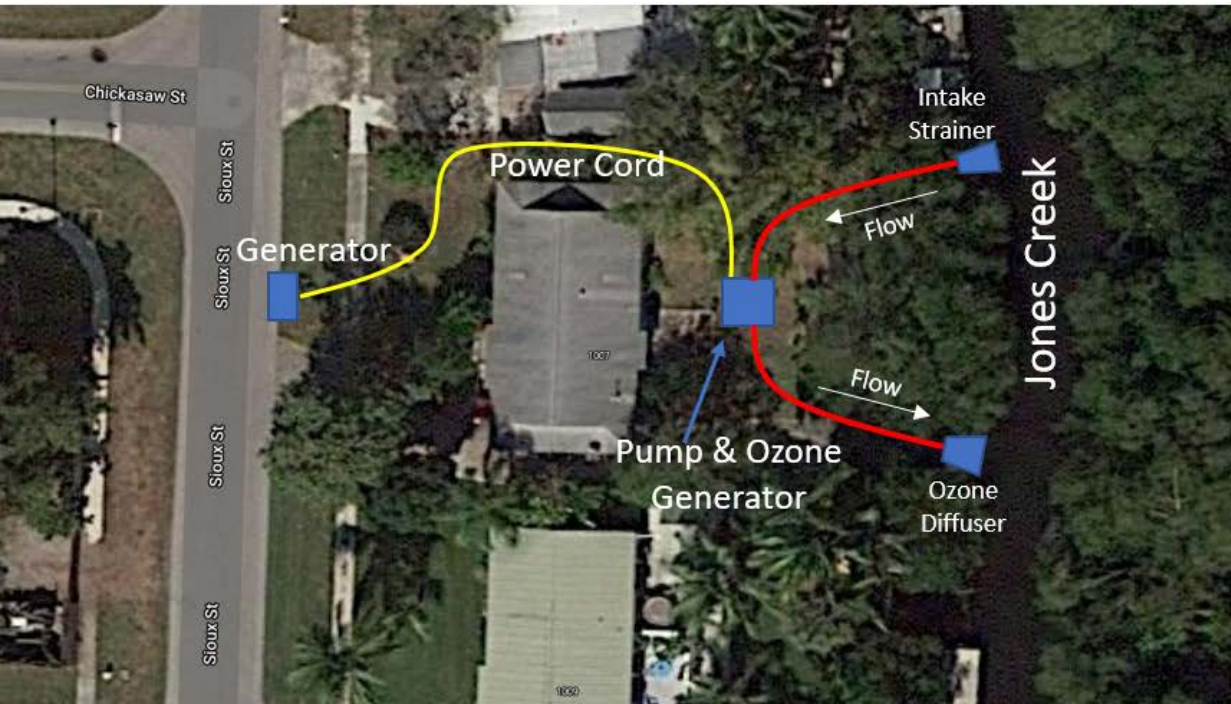


Figure 1. Map of Jones and Sims Creek monitoring sites, Jupiter, Florida. Loxahatchee River District (LRD) sample locations in Sims Creek in blue (74DW, 735 and 73) and Jones Creek in yellow (CALC, TPJ, 75 and 71). Red stars depict proposed NBOT deployment locations, purple points show continuous datasonde locations; site coordinates provided in Table 1.

Appendix A.1 List of Analytes with associated cost per sample in WATER

| | | | Sample Count | Sample Cost (\$) | | Total Cost (\$) | |
|--------------------------|---------------------------------|--------------------------|--------------|------------------|--------------|-----------------|--------------|
| Group | Analyte | Method | Total | LRD | Contract Lab | LRD | Contract Lab |
| Fecal Indicator Bacteria | Enterococci | Enterolert / Quanti-Tray | 112 | 18 | | 2,016 | 0 |
| Wet Chemistry - Water | Ammonia-N (un-ionized NH3) | DEP SOP 10/3/83 | 42 | | 8 | 0 | 336 |
| | Bromate | 300.1 | 42 | | 35 | 0 | 1,470 |
| | Color | SM2120B | 42 | 0 | | 0 | 0 |
| | Chlorophyll a (corr. & uncorr.) | SM10200H | 42 | 25 | | 1,050 | 0 |
| | Total Kjeldahl Nitrogen | 351.2 | 42 | | 15 | 0 | 630 |
| | Nitrate (as N) | 353.2 | 42 | | 7 | 0 | 294 |
| | Nitrite (as N) | 353.2 | 42 | | 7 | 0 | 294 |
| | Total Nitrogen | Calculation | 42 | | | 0 | 0 |
| | Total Phosphorus (as P) | 365.4 | 42 | | 15 | 0 | 630 |
| | Orthophosphate | 365.1 | 42 | | 25 | 0 | 1,050 |
| | Total Organic Carbon | SN5310B | 42 | | 12 | 0 | 504 |
| | Total Suspended Solids (TSS) | SM2540D | 42 | | 15 | 0 | 630 |
| | Turbidity | 180.1 | 42 | 0 | | 0 | 0 |
| Metals - Water | Aluminum | 200.7 | 42 | | 4 | 0 | 168 |
| | Antimony | 200.8 | 42 | | 4 | 0 | 168 |
| | Arsenic | 200.8 | 42 | | 4 | 0 | 168 |
| | Barium | 200.7 | 42 | | 4 | 0 | 168 |
| | Beryllium | 200.7 | 42 | | 4 | 0 | 168 |
| | Boron | 200.7 | 42 | | 4 | 0 | 168 |
| | Cadmium | 200.7 | 42 | | 4 | 0 | 168 |
| | Calcium | 200.7 | 42 | | 4 | 0 | 168 |
| | Chromium | 200.7 | 42 | | 4 | 0 | 168 |
| | Cobalt | 200.7 | 42 | | 4 | 0 | 168 |
| | Copper | 200.7 | 42 | | 4 | 0 | 168 |
| | Iron | 200.7 | 42 | | 4 | 0 | 168 |
| | Lead | 200.8 | 42 | | 4 | 0 | 168 |
| | Magnesium | 200.7 | 42 | | 4 | 0 | 168 |
| | Manganese | 200.7 | 42 | | 4 | 0 | 168 |
| | Molybdenum | 200.7 | 42 | | 4 | 0 | 168 |
| | Nickel | 200.7 | 42 | | 4 | 0 | 168 |
| | Potassium | 200.7 | 42 | | 4 | 0 | 168 |

Typical Schematic & Deployment Locations



Planned Deployment Locations:

1. 1007 Sioux St, Jupiter, FL 33458
2. 990 Mohican Blvd, Jupiter, FL 33458
3. 602 S. Caloosahatchee Ave, Jupiter, FL 33458



What To Expect

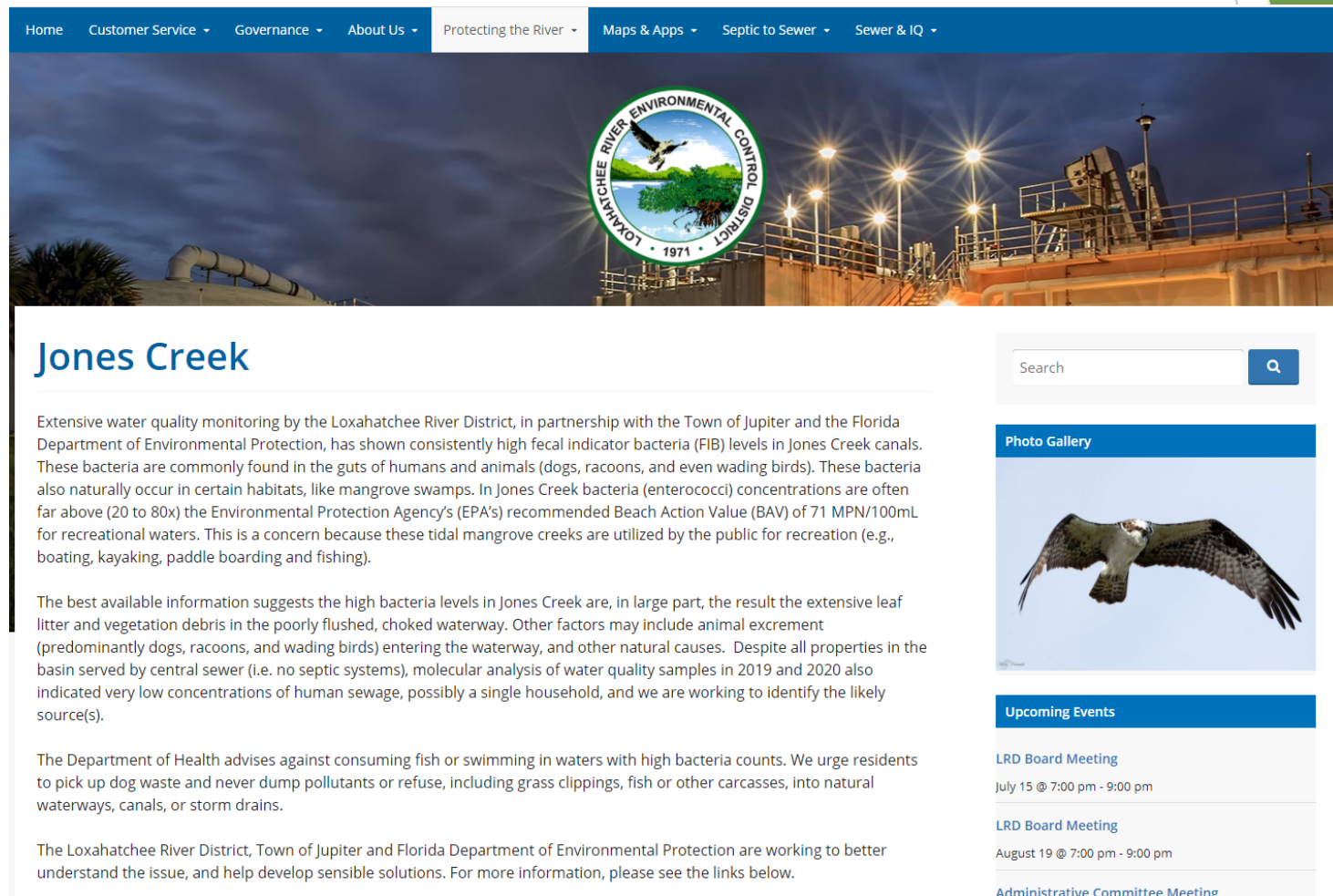
- ▶ NBOT System Powered by Generator
 - ▶ “Ultra-quiet” but still hum/reverberate
- ▶ Estimating a 5- to 10-day initial treatment???
- ▶ Retreatment based on bacteria concentrations
 - ▶ >500 MPN/100mL; presently 1,000 to 10,000+
 - ▶ State standard is 130; EPA Beach Action Value is 71
 - ▶ 24 hrs for bacteria results
- ▶ Ozone concentration testing to comply with EPA limits
- ▶ Results published to web page
- ▶ 60 days of treatment equipment availability
- ▶ 1 Month and 3 Month post treatment monitoring
- ▶ Final report to DEP; publication in scientific journal

Schedule

- ▶ Sat & Sun July 17 & 18 - Mobilize NBOT Equipment
- ▶ Tues July 20 - Pre-treatment water quality & sediment sampling
- ▶ Wed July 21 - NBOT Treatment begins between 1 and 2pm
- ▶ Thur July 22 - Day 1 water quality & sediment sampling
- ▶ Fri July 23 - Day 2 water quality sampling
- ▶ Mon July 26 - Day 5 water quality sediment sampling
- ▶ Ongoing bacteria testing and NBOT treatment based on bacteria results
- ▶ Sun Sept 19 - 60d commitment of NBOT equipment ends
- ▶ October - Month 1 post-treatment water quality sampling
- ▶ December - Month 3 post-treatment water quality and sediment sampling
- ▶ RiverKeeper Water Quality Monitoring Continues
- ▶ February - Final Report

Results

- ▶ We will present all results on the Jones Creek web page:
www.loxahatcheeriver.org/jonescreek
- ▶ Interactive data visualization tools & project blog



The screenshot shows the website for the Loxahatchee River Environmental Control District, specifically the Jones Creek page. The header is blue with navigation links: Home, Customer Service, Governance, About Us, Protecting the River, Maps & Apps, Septic to Sewer, and Sewer & IQ. Below the header is a large banner image of a wastewater treatment facility at night, with a circular logo for the Loxahatchee River Environmental Control District (founded 1971) overlaid. The main content area is titled "Jones Creek" and contains three paragraphs of text. To the right of the text is a search bar and a "Photo Gallery" section featuring a large image of an osprey in flight. Below the photo gallery is an "Upcoming Events" section listing two meetings: "LRD Board Meeting" on July 15 and "LRD Board Meeting" on August 19, both from 7:00 pm to 9:00 pm. At the bottom, there is a link for "Administrative Committee Meeting".

Jones Creek

Extensive water quality monitoring by the Loxahatchee River District, in partnership with the Town of Jupiter and the Florida Department of Environmental Protection, has shown consistently high fecal indicator bacteria (FIB) levels in Jones Creek canals. These bacteria are commonly found in the guts of humans and animals (dogs, racoons, and even wading birds). These bacteria also naturally occur in certain habitats, like mangrove swamps. 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).


The best available information suggests the high bacteria levels in Jones Creek are, in large part, the result the extensive leaf litter and vegetation debris in the poorly flushed, choked waterway. Other factors may include animal excrement (predominantly dogs, racoons, and wading birds) entering the waterway, and other natural causes. Despite all properties in the basin served by central sewer (i.e. no septic systems), molecular analysis of water quality samples in 2019 and 2020 also indicated very low concentrations of human sewage, possibly a single household, and we are working to identify the likely source(s).

The Department of Health advises against consuming fish or swimming in waters with high bacteria counts. We urge residents to pick up dog waste and never dump pollutants or refuse, including grass clippings, fish or other carcasses, into natural waterways, canals, or storm drains.

The Loxahatchee River District, Town of Jupiter and Florida Department of Environmental Protection are working to better understand the issue, and help develop sensible solutions. For more information, please see the links below.

Search

Photo Gallery



Upcoming Events

LRD Board Meeting
July 15 @ 7:00 pm - 9:00 pm

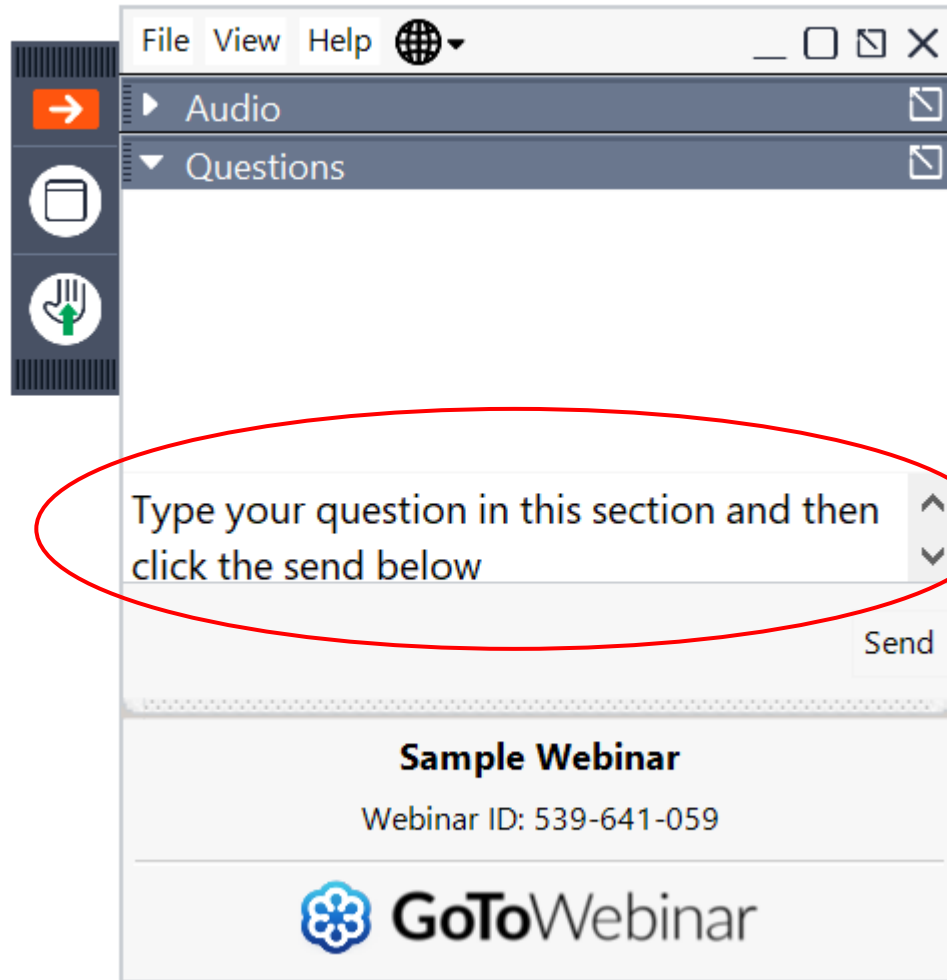
LRD Board Meeting
August 19 @ 7:00 pm - 9:00 pm

Administrative Committee Meeting

To ask a question:

You can expand the question box by clicking here

Option 1:
Type your question in the box above the send button, then click send



Option 2:
Raise Hand
Then I can
activate your
microphone

Contacts

▶ Loxahatchee River District

- ▶ Bud Howard - bud.howard@lrecd.org; (561) 401-4037
- ▶ Sue Noel, Lab Manager - susan.noel@lrecd.org; (561) 401-4058
- ▶ Rachel Harris, Sr. Scientist - Rachel.harris@lrecd.org (561) 401-4004

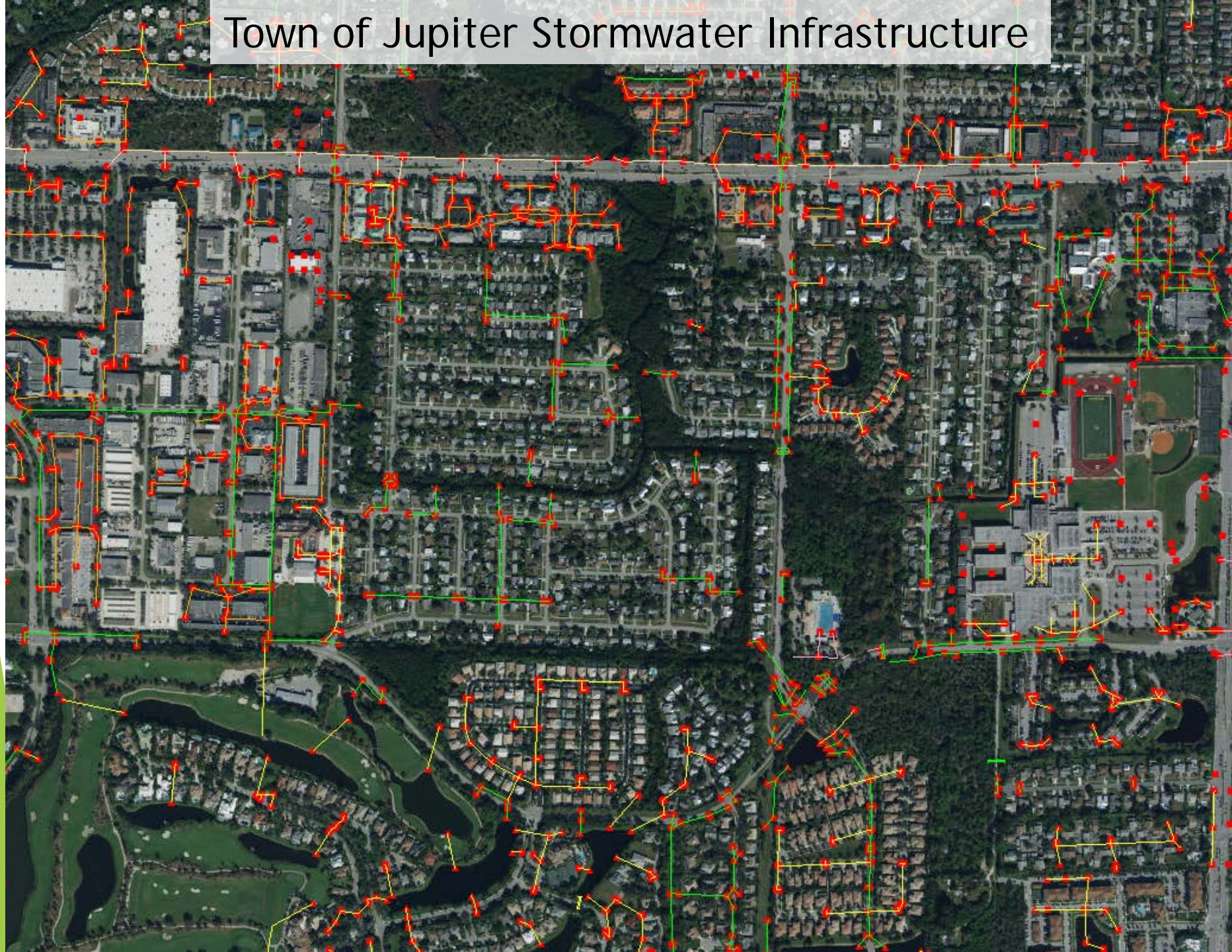
▶ Green Water Solutions

- ▶ Chas Antinone - cantinonejr@gmail.com

▶ Website - www.loxahatcheeriver.org/jonescreek



Town of Jupiter Stormwater Infrastructure



► Funding

► Environmental Study

| | |
|---|-------------|
| ► District Staff Time (estimated): | \$ 33,000 |
| ► In-House Lab Analysis: | \$ 3,570 |
| ► Contract Lab Analysis: | \$ 22,302 |
| ► District Contribution - Local Match for Grant | (\$36,444)* |
| ► Grant Reimbursement for Analysis | (\$22,428) |

► NBOT Treatment

| | |
|--|------------|
| ► 6 units * 2 month deployment * \$1,000/d | \$360,000 |
| ► Green Water Contribution - Local Match for Grant | (\$32,428) |

| | |
|-----------------------------|-------------|
| ► Total Project Cost | \$418,872 |
| ► Total Grant Reimbursement | (\$350,000) |

► Outcome

- Thorough Evaluation this Innovative Technology
 - Effectiveness & Longevity
- Catalyst for more improvements in the Jones Basin
 - Vegetation clearing & maintenance through the TOJ and Residents
 - Community cleanup efforts for debris removal

► Exciting Opportunity

Tasks

- ▶ DEP Contract Development ✓
- ▶ Green Water Solutions Contract ✓
- ▶ Temporary Access Easements for NBOT Systems ✓
- ▶ FDEP Permit/Authorization ✓
- ▶ ACOE Permit/Authorization ✓
- ▶ Quality Assurance Project Plan ✓
- ▶ Monitoring
 - ▶ BACI Design - Before, After, Control, Impact
 - ▶ Comprehensive Water Quality and Sediment Analysis
- ▶ NBOT Treatment
- ▶ Final Report & Manuscript Preparation