

Stormwater Treatment & Nutrient Removal to Mitigate Harmful Algae Blooms

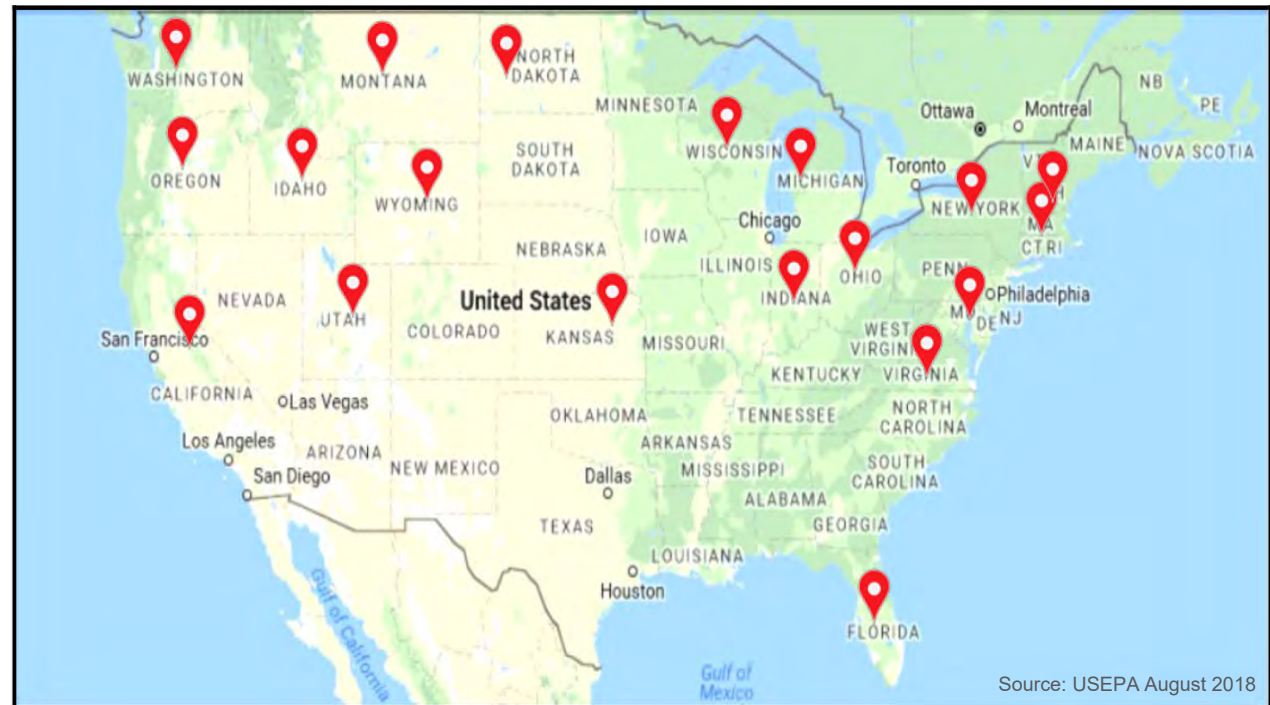
June 20, 2019

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Delivered.



US Algae Issue - States with Blooms, Advisories and/or Beach Closures

- State's threshold
 - Blooms
 - Cautions
 - Warnings
 - Public Health Advisories
 - Closings and Detections



USEPA - June 2018

Recent US Events

Toxic Algae Bloom Leaves 500,000 Without Drinking Water in Toledo, Ohio.

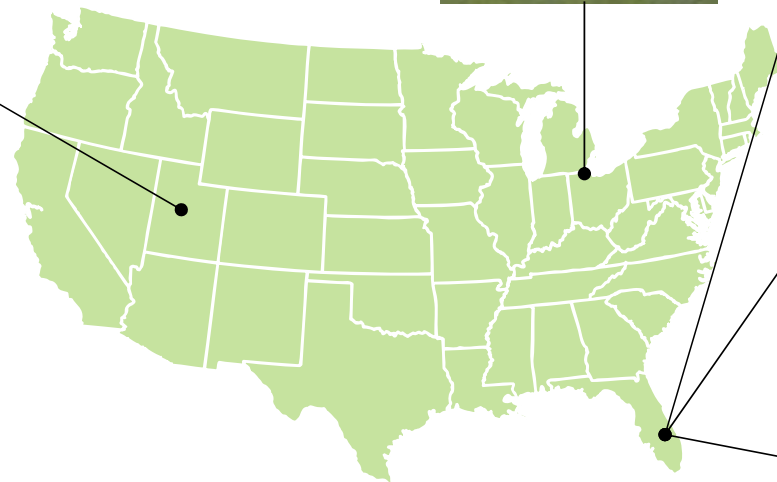
A mass of bright green cyanobacteria surrounds Toledo's water intake crib in Lake Erie, August 3, 2014



"Lost Summer" Jupiter Inlet - 2013



Toxic algae bloom closes Utah lake, sickens more than 100 people



Toxic algae bloom blankets Florida beaches, prompts state of emergency EO 16-155 June 2016
By Mayra Cuevas
Fri July 1, 2016



Gov. Scott declares state of emergency over algae bloom EO 18-191- July 2018

2019 Florida HABs

- Data maintained by FDEP
- Samples collected beginning January 1, 2019



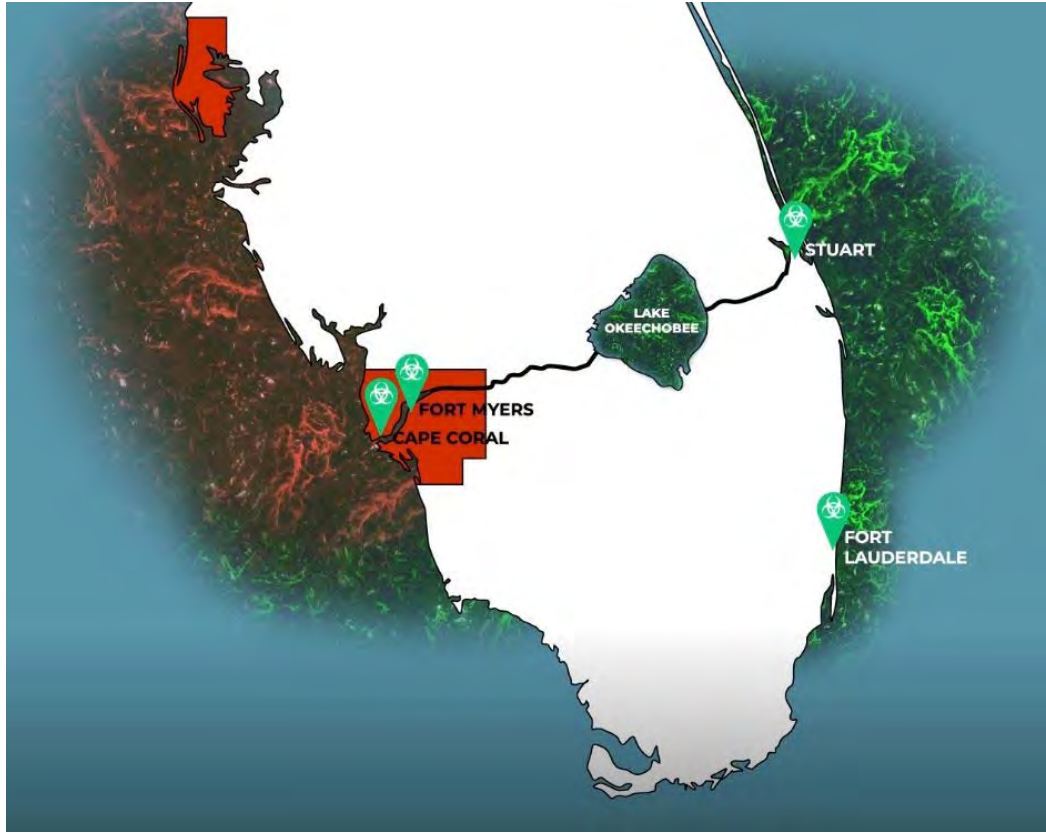
The Problem



Anthropogenic Sources of Nutrients

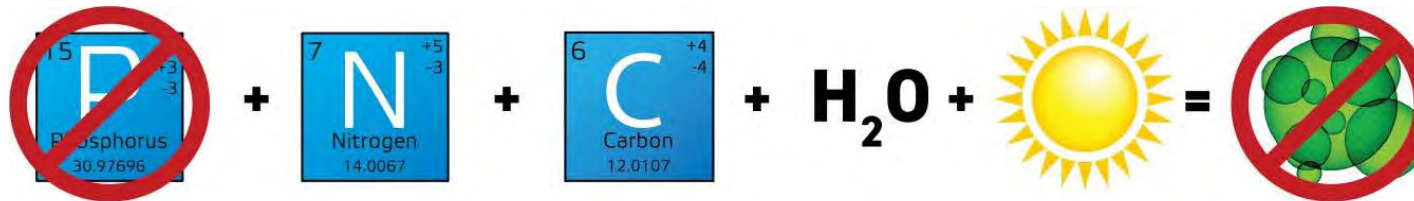
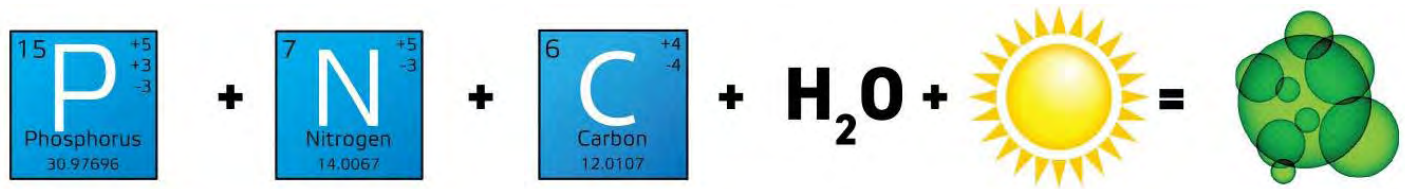
Cause	Response
DW/IW Discharges, Septic Tanks	WWTP Plant Upgrades, Connect to Municipal WWTP
“Traditional” Urban Landscapes	“Florida Friendly” landscapes using indigenous plants, fertilizer ordinances
Agriculture, Livestock and Dairy Operations	FDACS and IFAS Best Management Practices (BMPs)
The Built Environment and Non-point Stormwater Discharges	Basin Management Action Plans (BMAPs) and Total Maximum Daily Load (TMDL) Programs
Releases from Lake Okeechobee by ACOE	Funding for repairs to the Herbert Hoover Dike & Water Diversion South of Lake Okeechobee

USACE Requirement to Control Lake Level



Break the Cycle

Mitigation of Algal Blooms Through Nutrient Export



Remove phosphorus from the equation, prevent algae formation

2018 Emergency Response Algae Removal & Treatment Lee County, Florida



Clipper Bay Condominium – Cape Coral, Florida



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August 10, 2018

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Temporary Recovered Algae Treatment System - North Lee County RO WTP



August 12, 2018

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Dissolved Air Flotation – Solid/Liquid Separation



Dissolved Air Flotation – Solid/Liquid Separation



Belt Filter Press



Belt Filter Press Slurry Dewatering



Belt Filter Press - Filter Cake



5-Million Gallon RO Brine Pond



The New Normal ? We Say No !



DAF Approach Developed to Support Aquaculture in SE United States



Best (Appropriate) Technology - BAT

Dissolved Air Flotation (DAF)

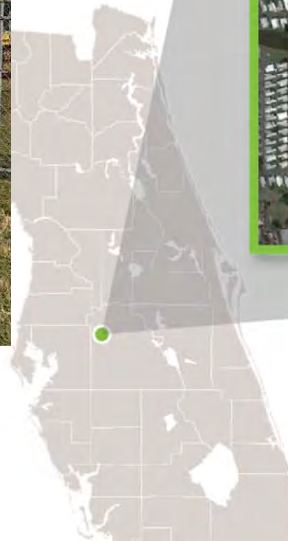
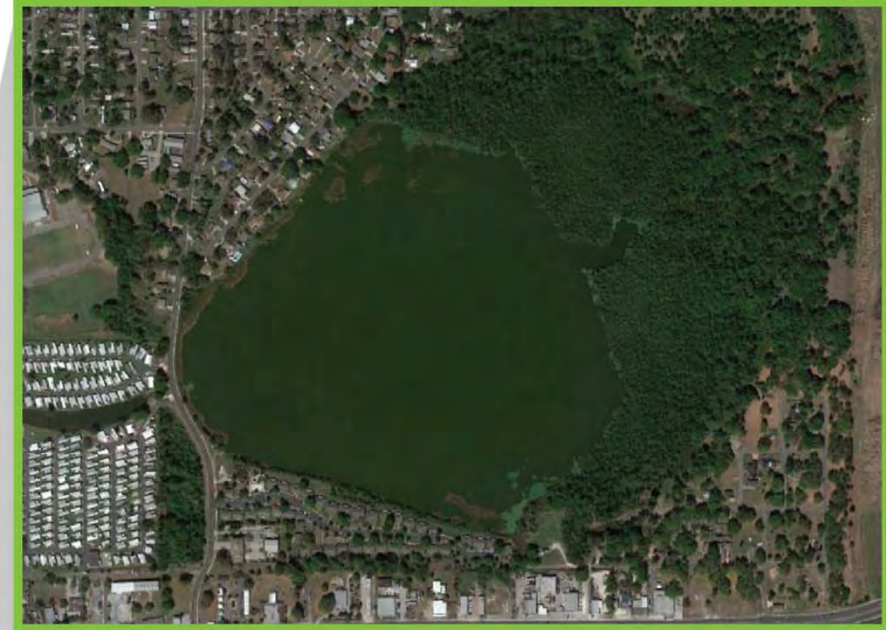
Liquid/solid separation process in which microscopic air bubbles are attached to solids particles suspended in water, imparting buoyancy and causing the solids to float to the water's surface where they can be removed.



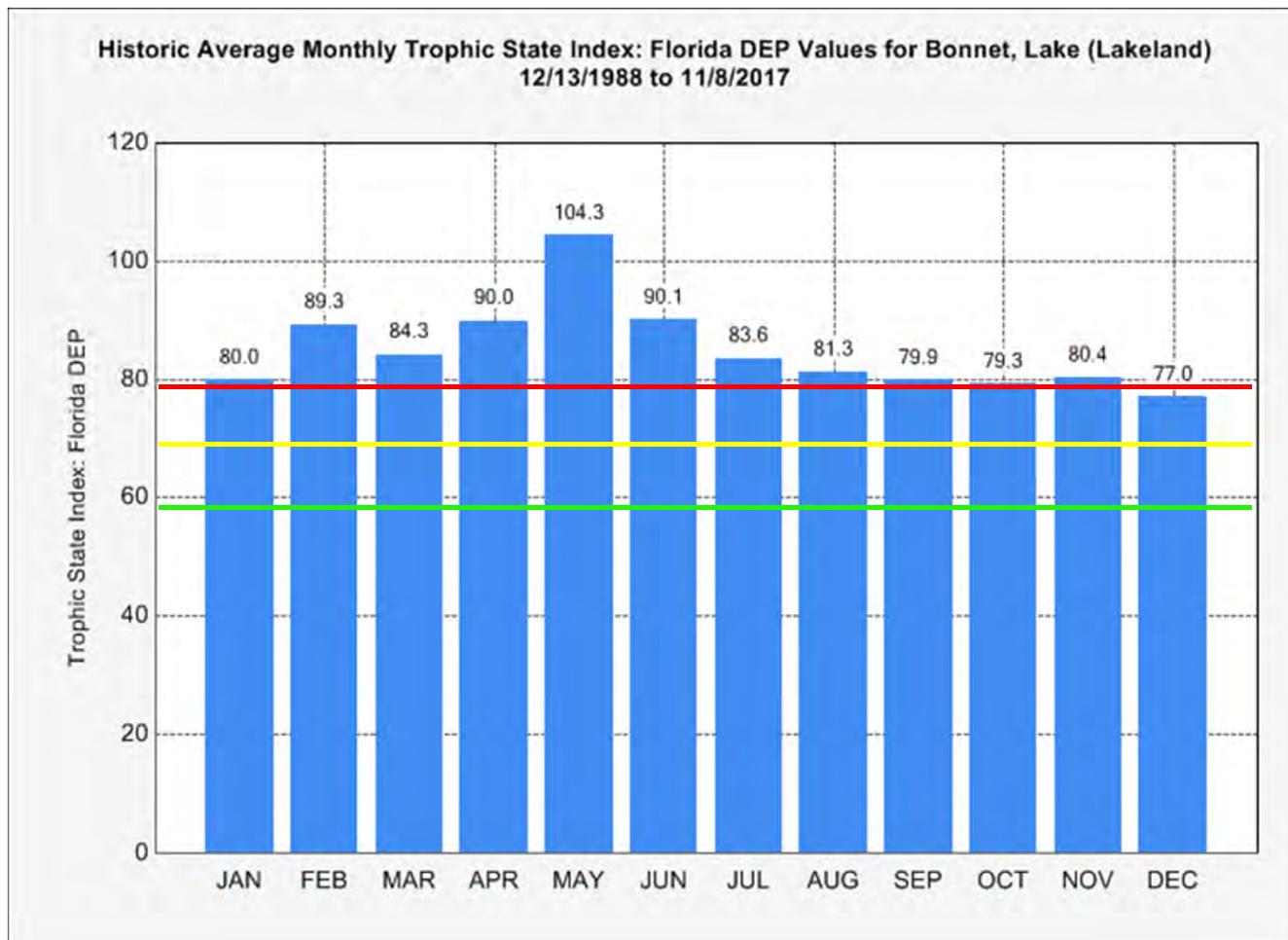
Advantages Offered by DAF

- Proven “Shovel Ready” Technology
- High Hydraulic Loading - Highest Throughput in Smallest Space
- Algae Naturally Floats when Agglomerated
- Scale-able to Meet Flow Requirements
- Very Efficient Liquid/Solid Separation
- Recovered Algae Compacted into a Heavy Slurry
- Recovered Biomass Beneficial Use Potential
- Exports Nutrients via Removal of Intact Algae Cells

2017 Lake Bonnet Pilot Test - Lakeland, Florida



Historic Average Monthly Trophic State Index



- Oligotrophic to Mid-Eutrophic
- Mid-Eutrophic to Eutrophic
- Eutrophic to Hypereutrophic

Bench-scale Treatability Testing

3-Day Average
Influent Water

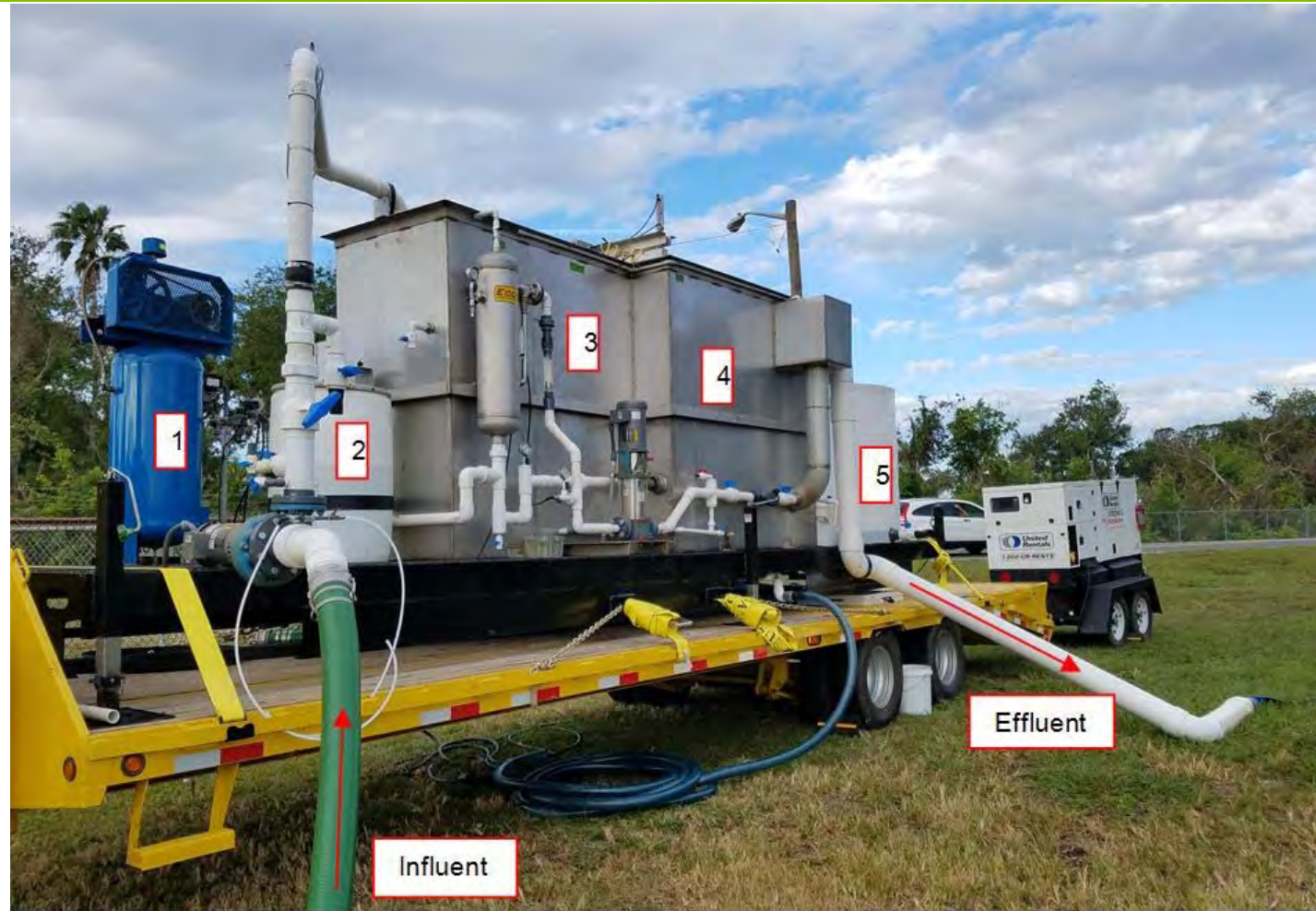
- Chl-*a* 76 µg/L
- NTU 28 units



Lake Bonnet Raw Water and Clarified Test Samples using Aluminum Chlorohydrate (ACH) 

Pilot Algae Harvester

- 1 Air Compressor
- 2 Coagulant Tank
- 3 Contact Tank
- 4 Flotation Tank
- 5 Algae Slurry Collection Tank



Contact Tank



Flotation Tank with Float Blanket



Performance Objective: Green Water In – Sparkling Water Out



Total N & P Removal Efficiency: 75% to 95%
Chlorophyll-a Removal Efficiency: 85% to 95%

Bioassay

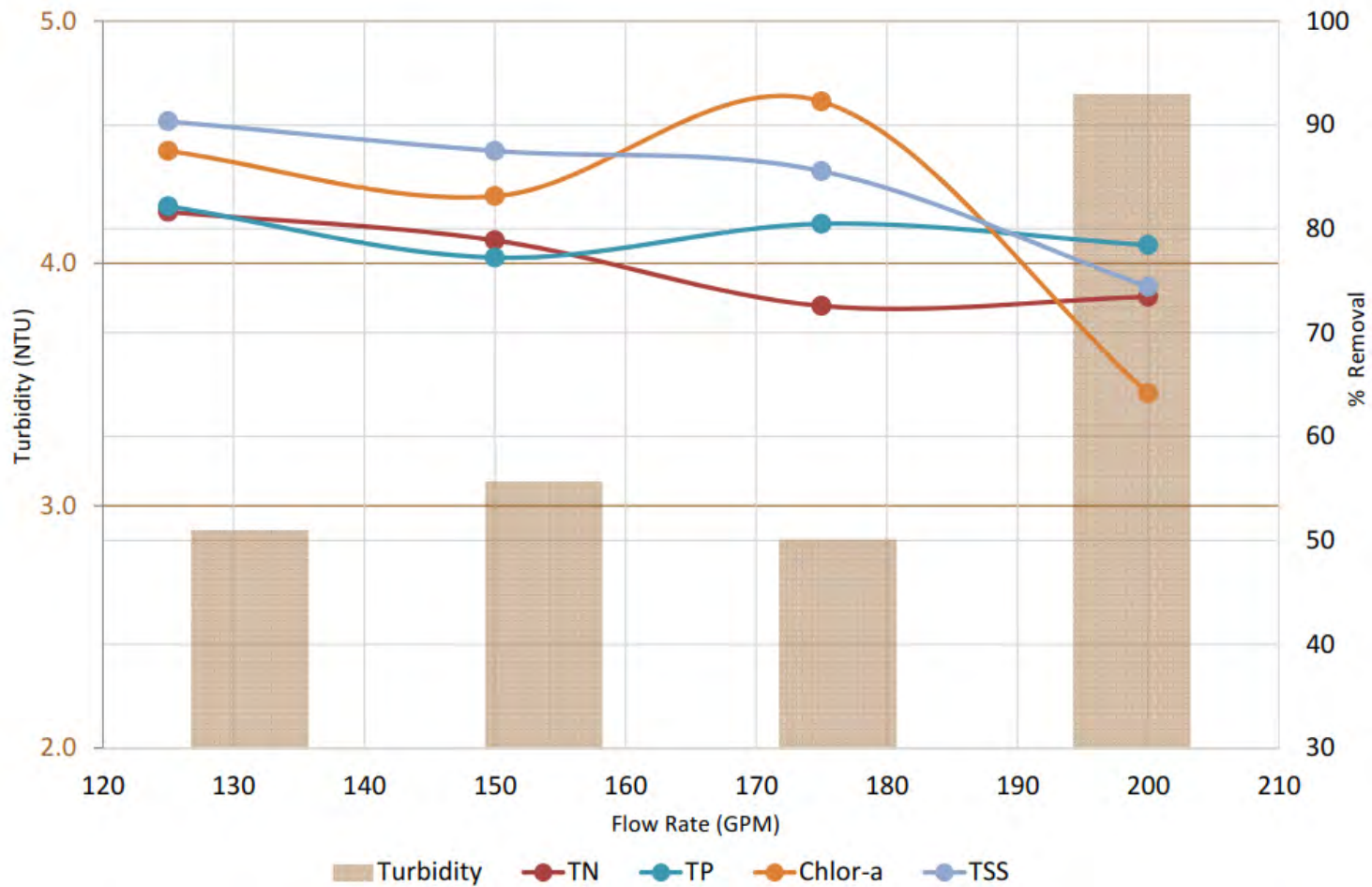
Summary of Acute Toxicity Results for *C. dubia* and *P. promelas*

Sample Concentration (%)	Percent Survival (at Test Termination)	
	<i>C. dubia</i>	<i>P. promelas</i>
Control	100	92.5
100	95	95.0

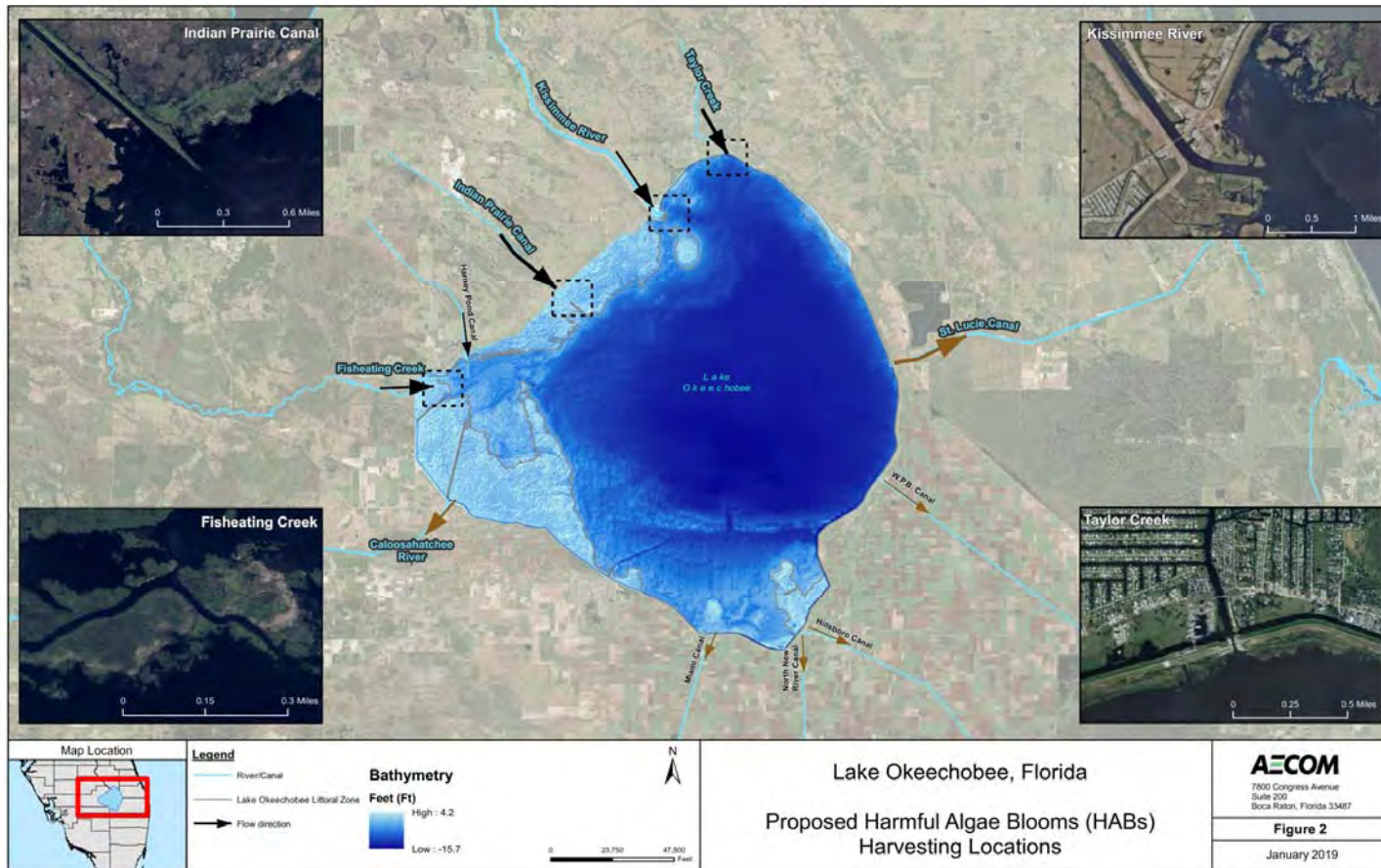
Summary of Chronic Toxicity Results for *C. dubia* and *P. promelas*

Sample Concentration (%)	Percent Survival		Mean No. Young/Adult	Mean Dry Weight/Organism Added (mg)
	<i>C. dubia</i>	<i>P. promelas</i>	<i>C. dubia</i>	<i>P. promelas</i>
Control	100	87.5	28.3	0.748
100	100	90.0	23	0.776

Percent Removal vs GPM – Lake Bonnet November 2017



A Part of the Solution – NIRS



Nutrient Interceptor Removal System (NIRS) TP Removal Capability

Water Body	Flow Type	Annual Discharge	Total Annual TP (metric tons)	Total Annual TP Removal from STA	Total Annual TP Removal from NIRS	
					10 MGD	100 MGD
Taylor Creek/ Nubbin Slough	Inflow	196,062	92	2	5.4	54
Kissimmee River	Inflow	1,397,234	158	0	1.5	15
Indian Prairie	Inflow	832,401	147	0	2.9	29
Fisheating Creek	Inflow	466,189	71	0	1.7	17
Total		2,891,886	468	2	11.5	115

A 100 MGD NIRS Plant for Taylor Creek/Nubbin Slough would be 2,700% more effective than the existing 146 acre STA in removing TP and will remove as much TP by 2020 as the STA would by 2050

Harmful Algal Bloom Interceptor Treatment and Transformation System (HABITATS)

2018 Water Resources Development Act (WRDA) Requires ERDC to Demonstrate Scalable Technologies to Help Mitigate HABs (SEC. 140. HAB Technology Demonstration)

IN GENERAL –USACE/ERDC shall implement a 5-year HAB technology development demonstration under the Aquatic Nuisance Research Program. USACE shall support research that will identify and develop improved strategies for early detection, prevention, and management techniques and procedures to reduce the occurrence and effects of harmful algal blooms in the Nation’s water resources.

SCALABILITY REQUIREMENT - The Secretary shall ensure that technologies identified, tested, and deployed have the ability to scale up to meet the needs of harmful-algal-bloom-related events.



Nutrient Interceptor Removal System (NIRS) Plant Rendering (10-MGD)



Next Steps



What is algae?

- Most algae is harmless and a natural part of our environment.
- Some types of algae can be harmful to people and pets.
- Toxic algae is a general term for the dangerous types of algae, such as "Red Tide" or "Blue-Green Algae (cyanobacteria)."
- Blooms can occur rapidly, especially in a warm environment and where water does not move fast. Algae can be found in both fresh and salt water.
- Algae containing microcystin is **TOXIC**.

What are the health effects of toxic algae?

- Contact with the skin, inhalation and swallowing impacted water are the exposure pathways
- Toxic algae can affect the nervous system and the respiratory system, and can cause serious damage to the liver
- Children are at greater risk than adults because of their comparative lower body weight





What is it costing us?

- Over 145 miles of coastline were affected by toxic algae in Florida in 2018.
- During 2018, Florida businesses lost over \$90 million in tourism dollars.
- Over \$17 million in state funding was used as part of the public health emergency declared in Florida in 2018.

This guide is provided by AECOM and Brizaga for informational purposes only. Not all algae is alike, information contained herein should not be considered specific advice on how to handle a specific toxic algae outbreak. Please heed the advice of local officials.

What should I do if I see algae?

Algae blooms can be toxic. If you come across algae that is thick, discolored, looks "scummy," or smells bad.

-  Use caution. Do not touch the water.
-  Do not consume the water. Keep pets and children away.
-  Report the bloom to local environmental agency.
-  Leave the area. Toxic algae can affect your health.

What can we do?

- Algae can be treated and removed, but the root of the problem, the pollution that fuels the algae, requires a long-term solution.
- Toxic algae must be removed and treated by a trained professional. Improper removal or treatment of toxic algae can cause serious health effects.
- Local communities can create a preparedness plan before a bloom occurs. A plan roadmap is provided on the reverse side of the flyer.



Creating a **TOXIC ALGAE PREPAREDNESS PLAN** before an Algae outbreak occurs can greatly reduce the impact on the community and the response time needed to address the outbreak.

Creating a plan will prepare your community for an outbreak by (1) having a clear roadmap on how to respond to the algae, (2) reduce the response time, (3) reduce economic losses, and (4) having the community on the same page on how to move forward.

- 1 Identify and evaluate community assets that could be utilized in response to a toxic algae emergency.
- 2 Identify high algae-prone areas and access routes to these areas.
- 3 Pre-position emergency response equipment that can prevent and reduce toxic algae from accumulating in these high algae-prone areas.
- 4 Develop an outreach and engagement campaign to educate the public on the health effects of coming in contact with toxic algae.
- 5 Implement a continuous air quality monitoring program during an outbreak.
- 6 Pre-position approved toxic algae recovery and treatment equipment.
- 7 Train staff on how to safely respond to toxic algae.
- 8 Secure the area, post warning signs, and safely remove the toxic algae ASAP.

For more information, please contact:

Dan Levy, PG
E: dan.levy@aecom.com
P: 305.519.1194

Dr. Alec Bogdanoff
E: alec@brizaga.com
P: 954.609.3854

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AECOM Algae Response Team



August 9, 2018 Before Clean-up



August 10, 2018 After Clean-up





David Pinelli

828-301-3962

david.pinelli@aecom.com

Bill Colona

850.402.6422

william.colona@aecom.com

Dan Levy

305.519.1194

dan.levy@aecom.com

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