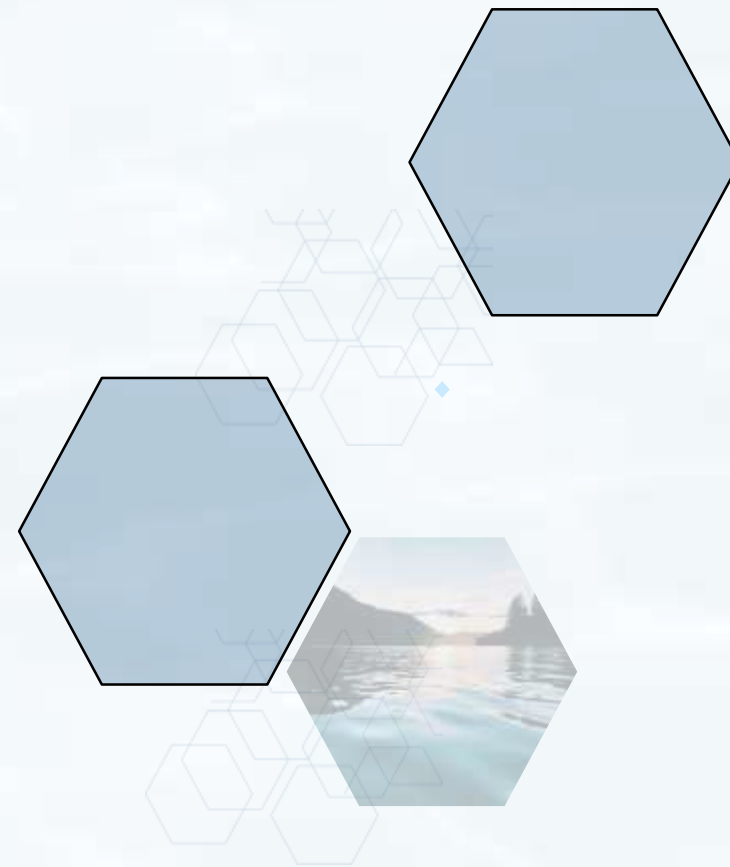




Case Studies



CASE STUDY

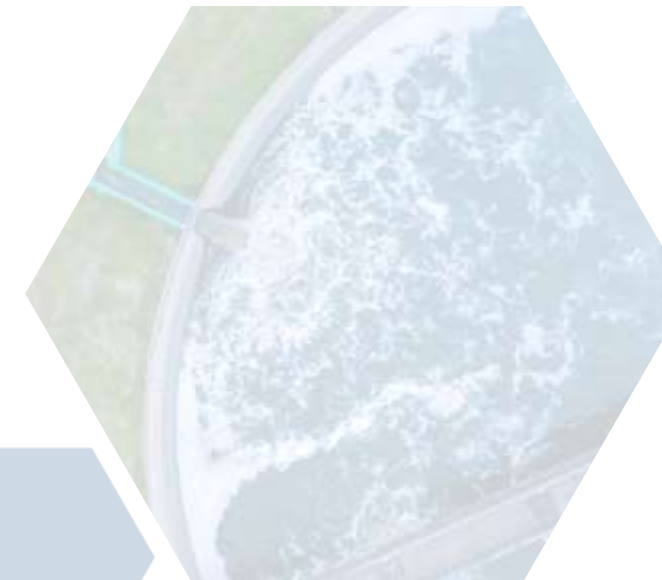
AQUARION WATER COMPANY
MONROE, CT

Introduction

Aquarion Water Company is the public water supply company for approximately 236,000 customer accounts or more than 750,000 people in 72 cities and towns in Connecticut, Massachusetts and New Hampshire.

The Challenge

Aquarion Water Company was facing a potential Microcystis bloom in their drinking water system. Microcystis is a genus of freshwater cyanobacteria that includes the harmful algal bloom-forming Microcystis aeruginosa. Many members of a Microcystis community can produce neurotoxins and hepatotoxins, such as microcystin and cyanopeptolin, which could lead to public health risks. There was also a need to reduce copper sulphate usage. The EPA has set a copper sulfate limit of 1ppm in any drinking water, staying below this level is imperative.



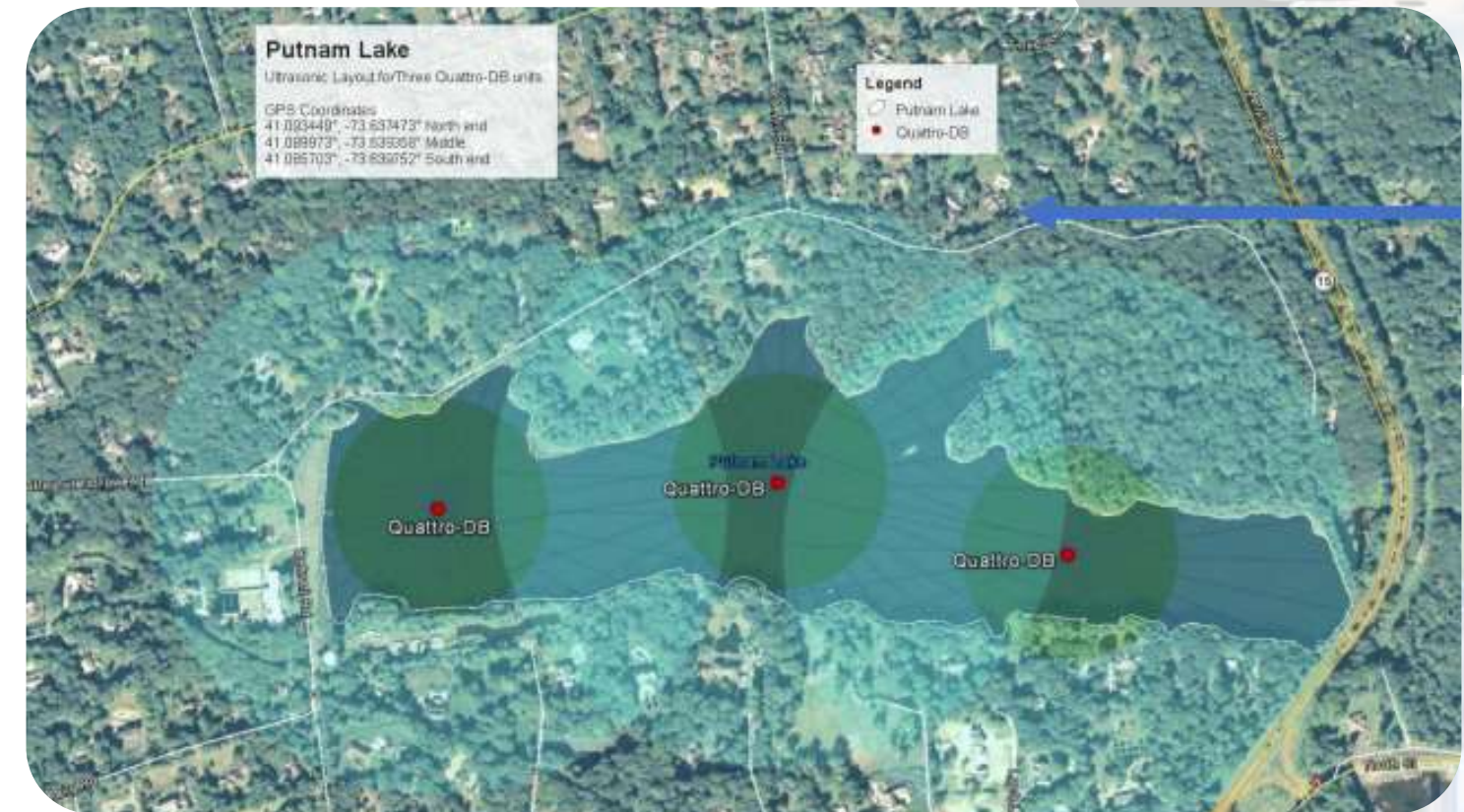
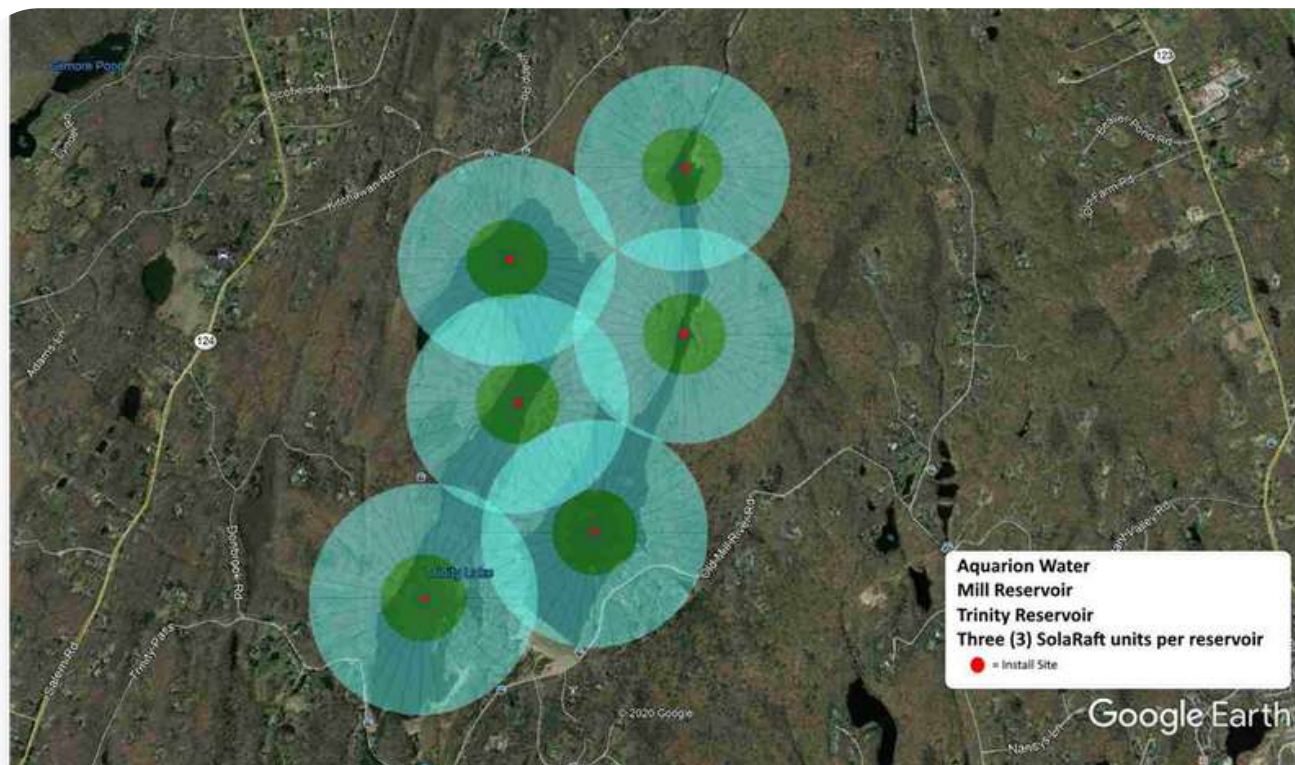
CASE STUDY

AQUARION WATER COMPANY

MONROE, CT

The Solution

It was determined that 9 SolaRaft Quattro-DB units, deployed across three reservoirs would provide optimal results for the community's drinking water. With our ultrasonic technology emitting thousands of frequencies that break down the cellular make up of algae. And the use of eco-friendly, chemical free processes to mitigate algae.



The Results

After successful deployment and operation of our transducers, Aquarion Water Company reported reduced Anabaena, Amphanizominon, Oscillatoria, Plantothrix and chemical usage, within 14 days.

CASE STUDY

BURTONVILLE RESERVOIRS

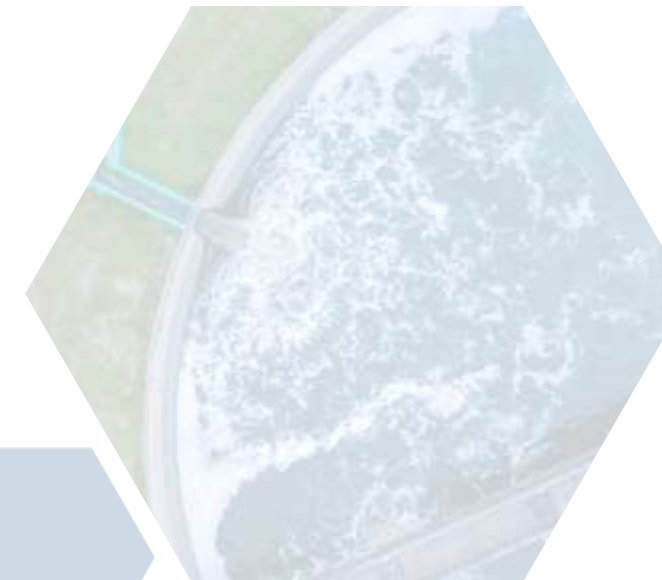
WILMINGTON, OH

Introduction

Each day, the City of Wilmington's Water Treatment Plant produces around 2 million gallons of water for some 12,500 people in the city and immediate area. To keep up with demand two reservoirs were constructed with a capacity of 450 million gallons.

The Challenge

Both reservoirs, historically, had Green and Blue Green algae. *Cylindrospermopsis* & *Microcystis* were main Blue-Green algae of concern, both may be toxic if left untreated. Previously, the City of Wilmington had attempted to remediate the algae through a series of copper sulphate treatments, both costly and labor intensive.



CASE STUDY

BURTONVILLE RESERVOIRS

WILMINGTON, OH

The Solution

It was determined that a ultrasonic transducer would have positive change on the current challenges they faced. In May 2018, the installation of a SolaRaft Quattro-DB unit in reservoir one and the city continued the use of copper sulfate on reservoir 2 as a control.

The Results

“The reservoir with the ultrasonic unit is certainly clearer than it has been historically, and it has an overall lower cyanobacteria count. It could be that it’s just less effective on the benthic species. Last year’s cylindrospermopsin level peaked at 1.0 ug/l in September, about seven times higher than the result found last week. At this point, I’m hopeful that the unit keeps it from getting that high.” - Rick Schaefer



CASE STUDY

WOODLAND RESERVOIR

SYRACUSE, NY

Introduction

Woodland Reservoir is a 126 million gallon man-made reservoir serving as a drinking water supply for the City of Syracuse in New York. The reservoir's water surface area is approximately 14 acres with a maximum depth of 35 feet. The city has a population of 145,170

The Challenge

Records dating back to 1975 showed copper sulfate was applied for 44 consecutive years to control phytoplankton growth in the reservoir, averaging over 8,700lbs per year for the last 10+ years. Elevated Chroococcus Type II cell counts continued to be problematic for the city.



CASE STUDY

WOODLAND RESERVOIR

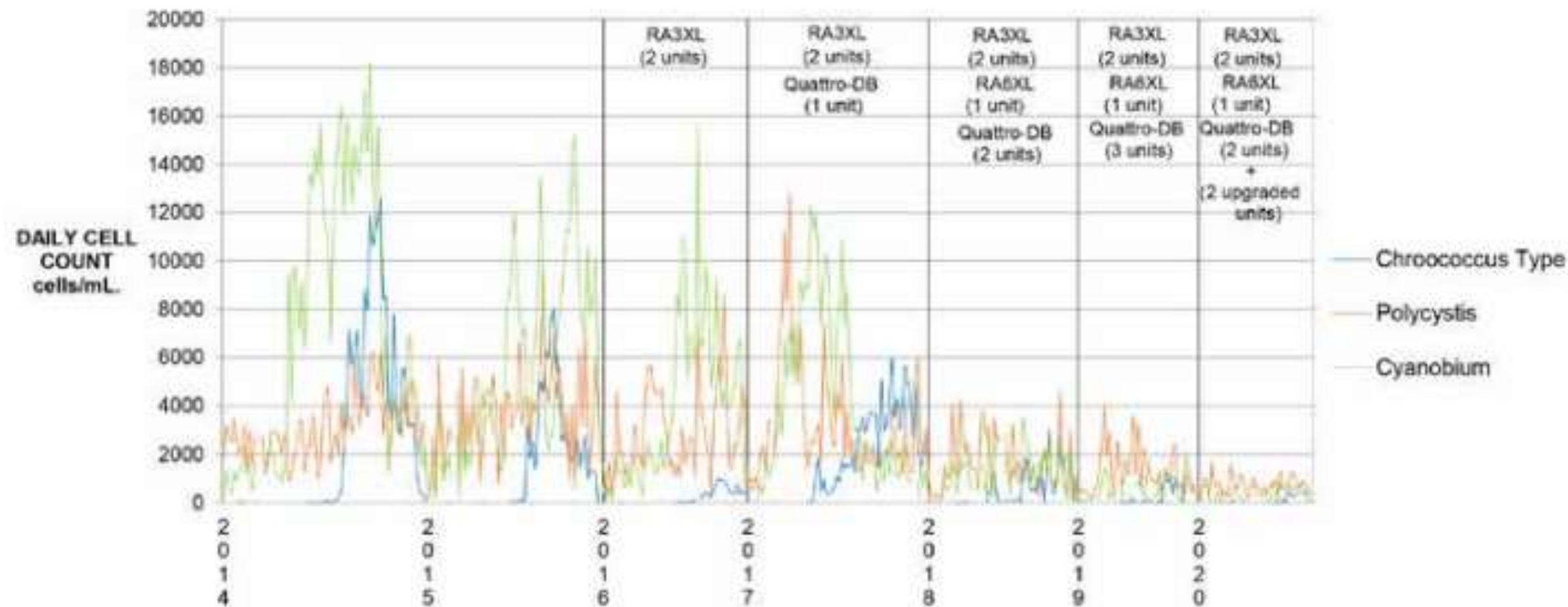
SYRACUSE, NY

The Solution

In July 2017 a Quattro-DB ultrasonic algae control unit was installed in the reservoir's north basin. The coverage includes up to 17 acres for green algae and diatoms and 120 acres for cyanobacteria. In 2018, an additional Quattro-DB was installed in the south basin, followed by a third unit in 2019.

The Results

Woodland Reservoir showed an exponential decline in algal cell counts. Prior to installation maximum cell counts exceeded 30,000 cells/mL, averaging 13,752 cell/mL. In 2020, the algal cell count was 2,127 cells/mL. HBS technology saved Syracuse \$100,000 and eliminated a 44 yr reliance on chemical applications.



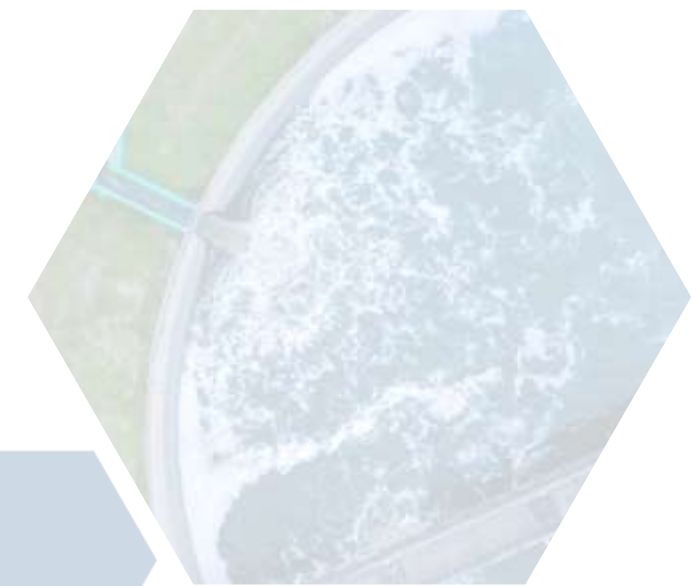
PEER REVIEWED STUDY

EFFECTS OF ULTRASONIC ALGAL CONTROL DEVICES ON FISH | CORNELL UNIVERSITY

Getchell RG, George E, Rice AN, Malatos JM, Chambers BM, Griefen A, Nieder C, Rudstam LG. 2022. Effects of ultrasonic control devices on fish. Lake Reserv Manage. 38:240–255.

Harmful algal blooms (HABs) can have serious impacts on both ecosystem services and human health, and several mitigation techniques have been developed to control them. Ultrasonic sound sources can disrupt developing algal mats, causing concern that the acoustic energy emitted from these devices may have deleterious health or behavioral effects on nearby fishes. We conducted field and laboratory studies on the effects of ultrasonic control devices on resident fishes. Field observations in Oneida Lake, New York, of the behavioral response of fish to the ultrasonic sound were conducted in shallow water using line transects, and in deeper water using hydro acoustics.

No avoidance behavior was detected in either shallow or deep water while the ultrasonic devices were operating. Under controlled laboratory conditions, 7 recreationally or ecologically important fish species and local wild tadpoles were exposed to sound produced by the ultrasonic control devices for a 2 week period. No behavioral effects were noted while fish and tadpoles were monitored during the exposure interval. Finally, no significant or harmful histological or morphological alterations to the skin, fins, gills, or internal organs were observed on either fish or tadpoles when specimens were examined after the 2 week exposure period.



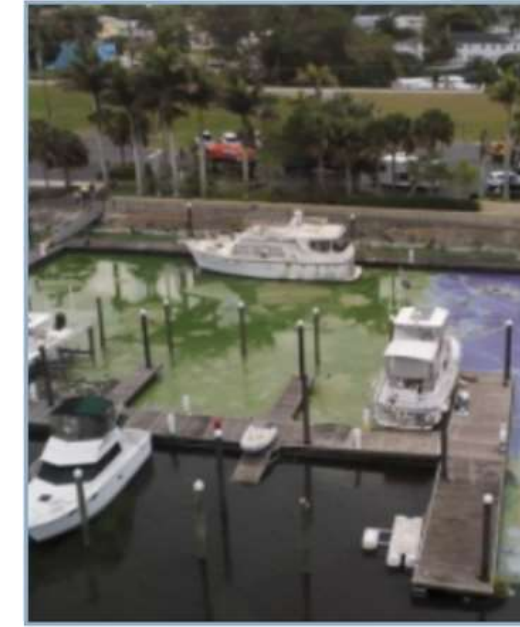
OUR PRODUCTS ARE PROVEN



EMAAR PROPERTIES LAGOON
EQYPT



SAN ROQUE DAM
CORDOBA, ARGENTINA



PAHOKEE MARINA
FLORIDA, USA



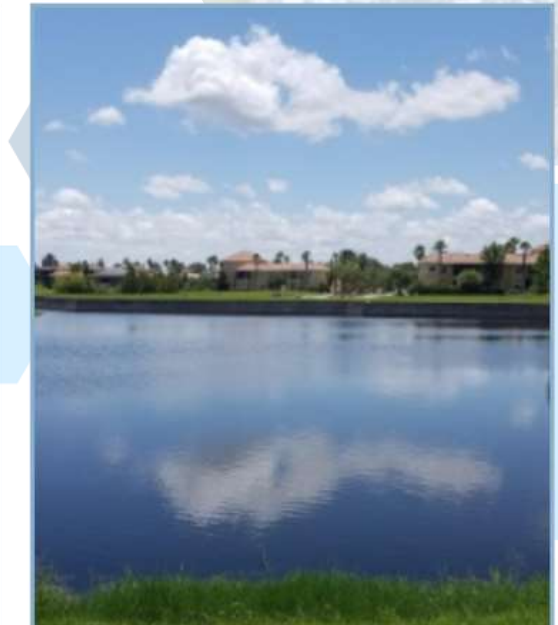
BASS PRO SHOPS HEADQUARTERS
SPRINGFIELD, MO



COASTAL WATER SOLUTIONS
OXNARD, CA



PALENCIA COUNTRY CLUB
ST. AUGUSTINE, FL



CASE STUDY

PAHOKEE MARINA

PAHOKEE, FL

Introduction

Pahokee Marina is a 125 site marina and campground in Pahokee, FL. Pahokee is the only city that has direct access to Lake Okeechobee. This is a recreational marina for fishing, camping, boating etc.

The Challenge

City of Pahokee has had a history of toxic algae blooms, resulting in closures over public health concerns. The city had spent over a million dollars combatting the issue with over 6 tons of a hydrogen peroxide- based algaecide.



CASE STUDY

PAHOKEE MARINA

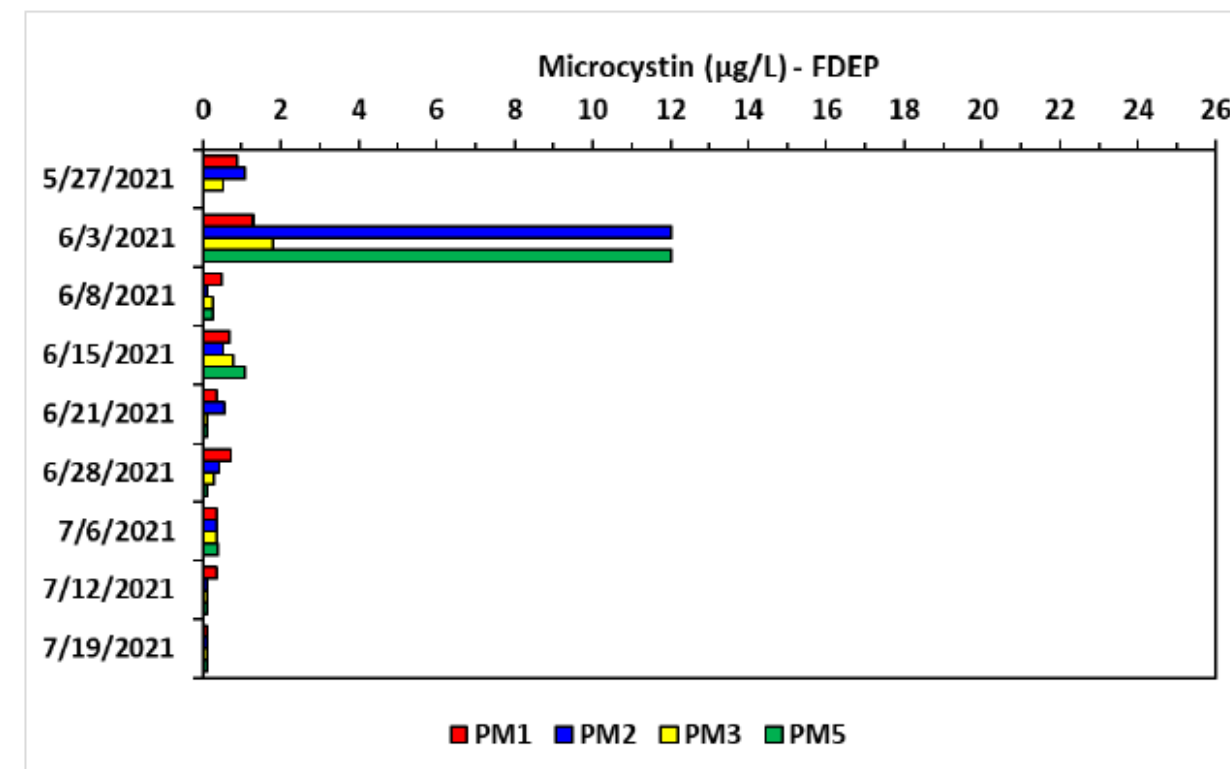
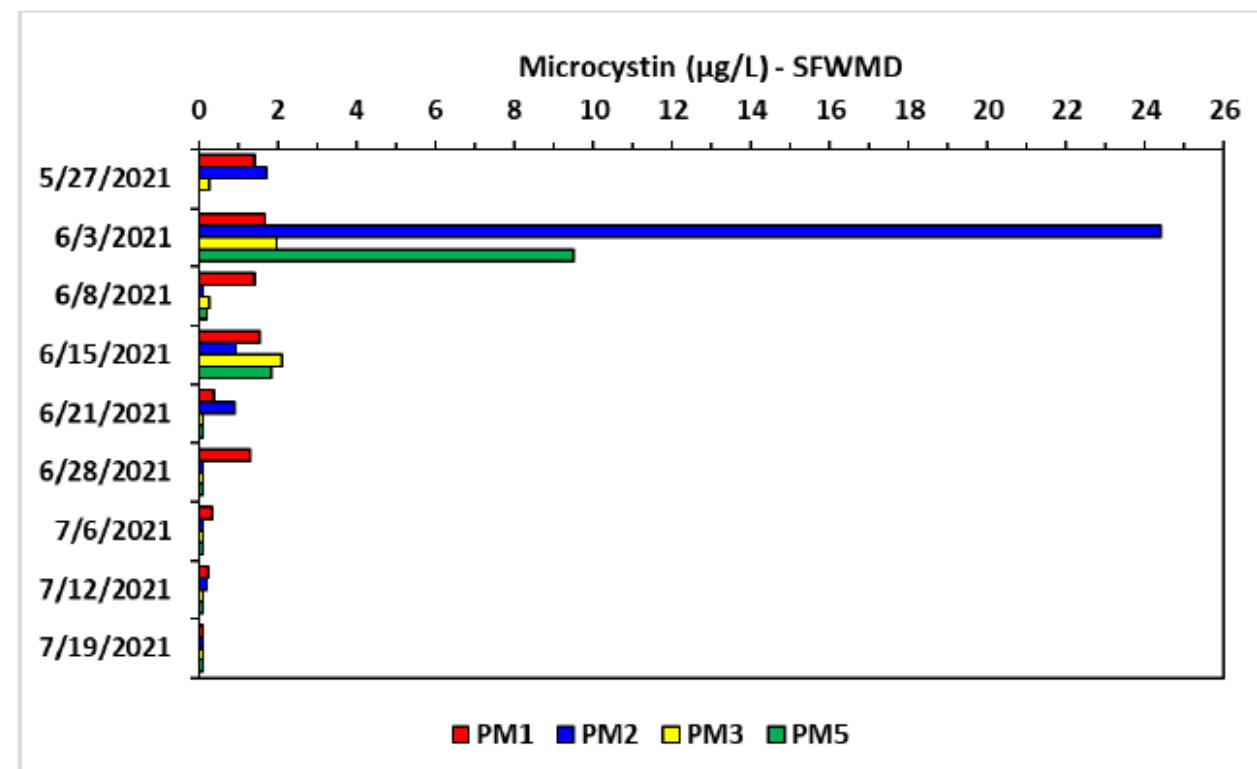
PAHOKEE, FL

The Solution

In June 2021, 4 transducer heads were installed with water quality monitoring to optimize results and provide the South Florida Water Management District a clear understanding of the marinas position relating to nutrient loads and cyanobacteria.

The Results

The marina experienced decreased Microcystin, below detection levels. Nutrient concentrations decreased, overall toxin concentration decreased since late June.



CASE STUDY

Emaar

Soul Beach Resort Lagoon North Coast Egypt

Introduction

The Soul Beach Resort features a wide array of services and facilities such as retail stores, smart technology, green areas, luxury hotel, beach and lagoon cabanas. As well as a pier infinity pool, waterfall gate, beach boardwalk, kid's activities and fine dining experiences.

The project includes about 300,000 m² swimmable lagoons, EMAAR tendered the first phase of lagoons on November 2022, consequently, Kharafi National Company (as main contractor) and Puroxi and EMAC lagoons

Aim of Experiment

The aim of this experiment is to measure the efficiency of the technology proposed by *Puroxi and EMAC Lagoons* for use in the design and operation of the swimmable artificial lagoons in the Seoul project, North Coast. On Wednesday, February 8, 2023, a meeting was held at the headquarter of Emaar (the owner of the project) in *Marassi* North Coast.

The attendees agreed to choose one of the existing lagoons in *Marassi* to test the Puroxi Ultrasonic Algae Treatment and EMAC Lagoons technology. This report describes the experiment setting, the results and the conclusions.



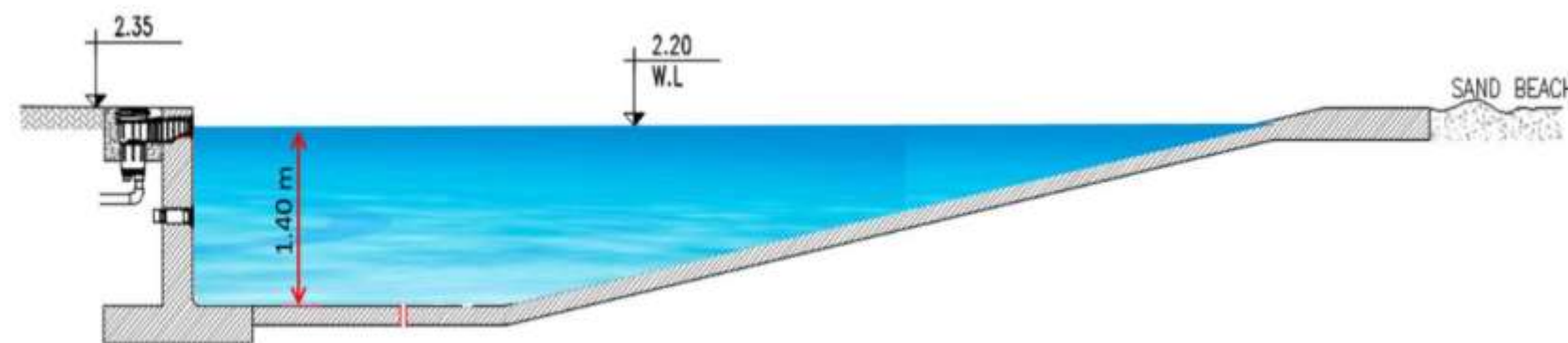
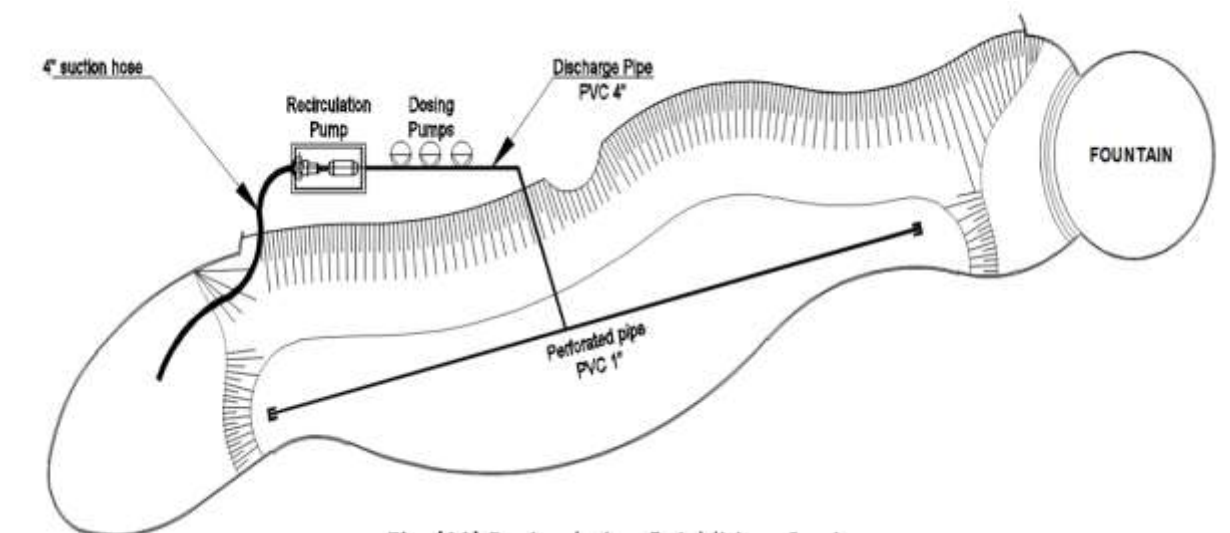
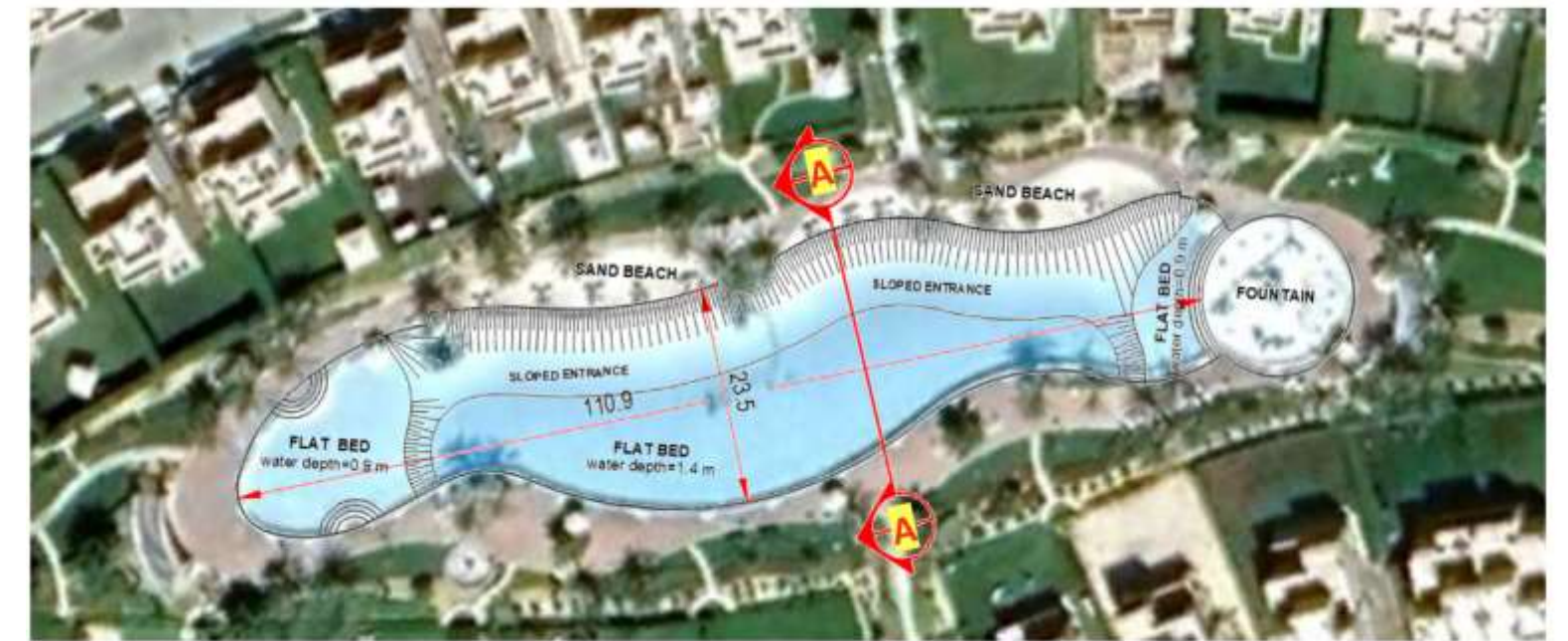
CASE STUDY

Emaar

Sould Beach Resort Lagoon North Coast Egypt

Description of the Experiment

The chosen lagoon is a swimmable lagoon of about 2,142 m² area with water volume 2140 m³, the water depth varying from 0 to 1.4 m, and utilize small pump and filter systems around the perimeter of the lagoon. Each of these systems are located in vaults behind the lagoon vertical edge. The pump suction is connected directly to a single skimmer with an integrated small cartridge filter. Each individual system is capable of a flow rate of approximately 30 m³/hr. Due to the very small size and capacity of each system, the lagoon will require multiple units to achieve the necessary treatment flow rate (exist 23 units). It is presumed that chemicals such as chlorine and acid are added manually as there is no practical way to introduce automatic chemical injection into these small units. From the data of the lagoon operation, all pumps working 4 hours daily, and the rest of the day they work in turns half the pumps number for one hour and then stop and run the other half and so on, with recirculation rate about 8970 m³/day, which means that the turn over time for the system is 5.3 hours. The chlorine rate is 12 kg/day.



Experiment Protocol 1

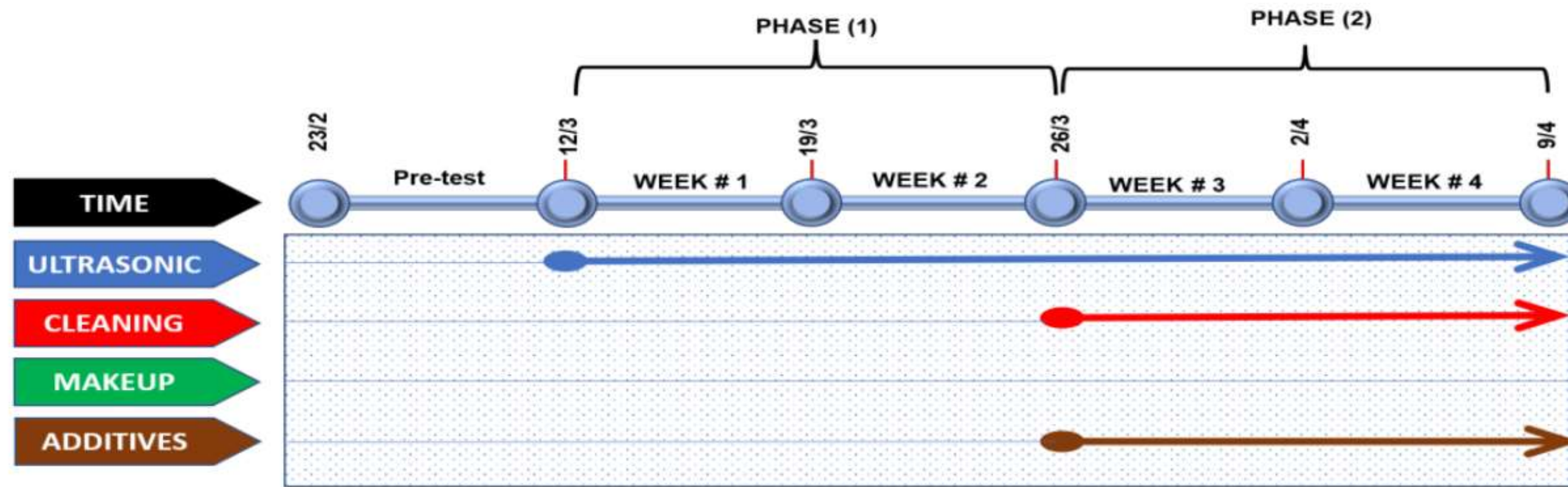
The objective of this experiment is to test the efficiency and quality of the proposed patented system (*EMAC Lagoons Technology*) to be used in the *SOUL* project, and this test will be related to the following:

- 1- Verifying the efficiency of the proposed technology on the quality of the lagoon water, which includes:
 - a. Efficiency of ultrasound technology in algae control.
 - b. Coagulation additives efficiency as a turbidity remover.
- 2- Ensure that the proposed system is economical in constructing and operating the lagoon.

Experiment Protocol 2

Before starting the experiment, the lagoon will be left untreated, allowing algae to thrive in its water.

- 2- When algae blooms, and before operating the ultrasonic control system, a water sample is taken and algae count test is performed.
- 3- After that, the ultrasonic algae control system is operated to deal with what appeared in the lagoon water.
- 4- The experiment duration is 4 weeks, divided into two phases:
- 5- The first phase is the first two weeks, and the purpose of this phase is to test the effect of the ultrasonic system alone on aquatic organisms, and it includes:
 - a. The lagoon will be left without adding any chemicals.
 - b. The lagoon will be left without replenishment (water makeup).
 - c. The ultrasonic algae control system will be turned on.
 - d. No cleaning will be done during these 2 weeks.
 - e. Every week, a water sample is taken and algae count test is performed.
- 6- The second phase is the other two weeks, in which:
 - a. The ultrasonic algae control system will continue turned on.
 - b. Start the cleaning of the lagoon bed.
 - c. Start adding the additives through the recirculation system.
 - d. By the end of this phase, a water sample is taken and algae count test is performed.



Before starting the experiment, the lagoon was left untreated for 19 days, allowing algae to appear in its water. The experiment began on March 12, when a sample of the lagoon water was taken by the testing laboratory, and the ultrasonic device was turned on, placed in the correct location and tested to ensure that it works efficiently. For two weeks, from March 12 to 26, the lagoon was left without any treatment, without any bed cleaning, and without any water losses makeup, the ultrasonic device was left work inside the lagoon water. During these two weeks, another two water samples were collected, one by the end of each week.

By the end of the two weeks (phase one completed), a layer of killed algae and bacteria had settled to the bottom of the lagoon, and the water had turned green due to the high level of the chlorophyll. The shape of the lagoon became very bad due to the lack of cleaning operations for the bottom according to the experimental protocol.

At the second phase of the experiment, the level of chlorophyll in the water had to be reduced in order for it to return to its normal shape. This took intensive doses of chlorine were added to the lagoon water. 18 kg of chlorine were added over a period of 3 days (from 27 to 29), in this phase, the following activities were carried out:

- The ultrasonic system continues working 24/7
- The daily cleaning of the lagoon bottom and water surface (cleaning process takes 4 hours daily).
- The recirculation of water for 2 hours daily.
- Adding the additives during the recirculation process (The daily chemicals doses are 2 kg of polymers + 1 kg of powder chlorine).
- No water losses replenishment or make-up is done.

Experiment Results

We do have a full report if you would like to see it. The following were the results.

To test the effect of EMAC lagoons technology on the water quality, in addition to the wonderful shape of the lagoon, a Control sample was taken from the lagoon before starting the experiment, and a weekly test sample was taken, the following table includes the samples and the date they were taken.

Sample No.	(1) Control Sample	Sample # (2)	Sample # (3)	Sample # (4)
Date of Taken	12/3/2023	19/3/2023	26/3/2023	9/4/2023

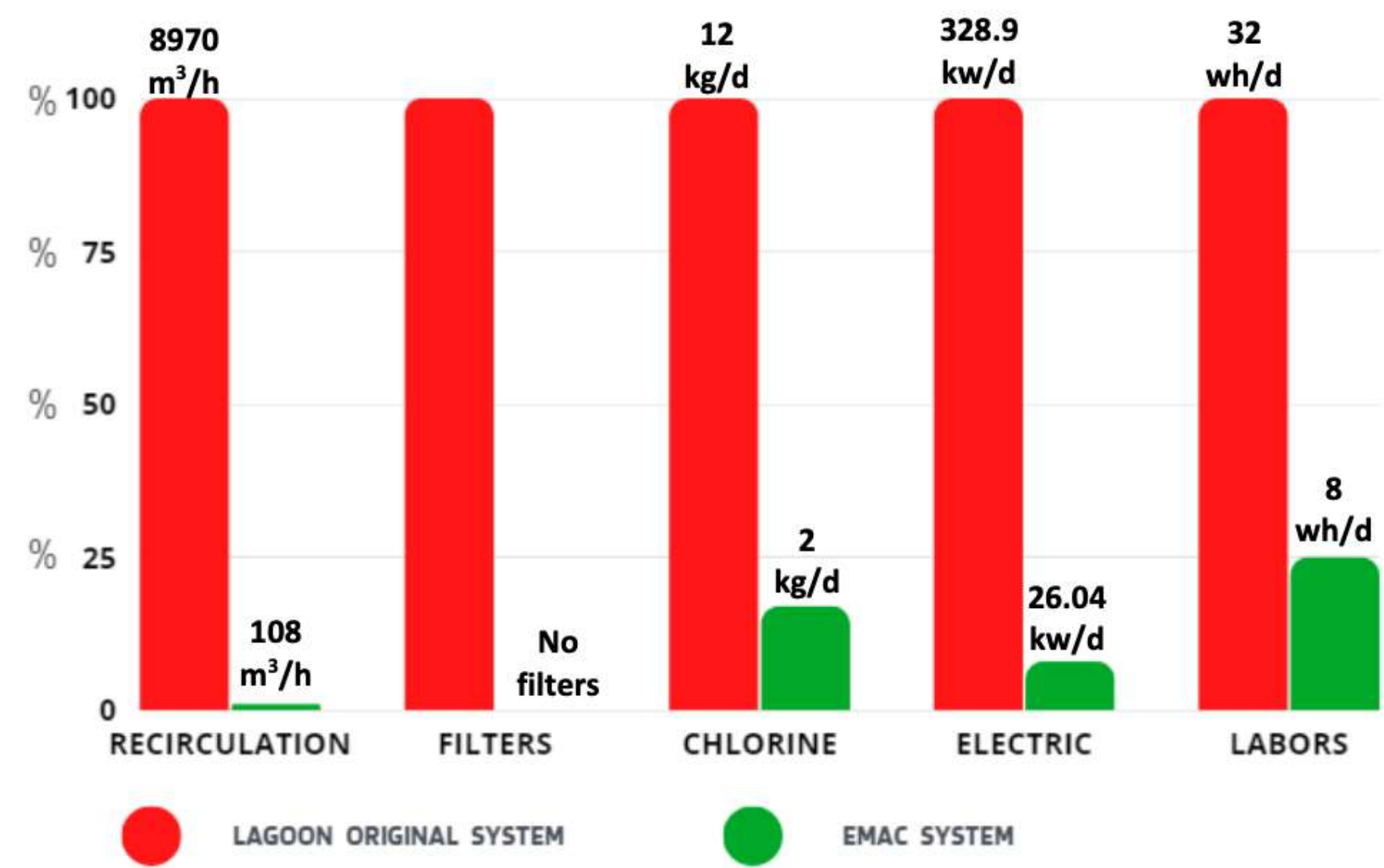
Test Description	Units	The Results			
		Control Sample # (1)	Sample # (2)	Sample # (3)	Sample # (4)
Total Bacterial Count At 37 ° C	CFU/100 ml	10,000	5	4	300
Total Bacterial Count At 22 ° C	CFU/100 ml	12,000	9	5	0
Algae Count	Cell/ml	15	0	0	0
pH	N.A.	7.73	8.84	10.12	8.33
Chlorophyll (A)	Mg/l	0.012695	0.06124	0.13460	0.01

Experiment Results Impact on Operational Cost

No.	Comparison items	EMAC Lagoons system	Lagoon Original System	Saving %
1	Recirculation Pumps	One Pump 54 m ³ /h and Head = 15 m, works 2 hours/day (Q=108 m ³ /day)	23 Pumps 30 m ³ /h, head 13 m, work for 13 hours/day (Q=8970 m ³ /day)	99%
2	Turnover Time	18.5 Day	5.3 Hours	---
3	Filtration	One Cartridge Filter 75 cm for cleaning	23 Cartridge Filter 75 cm	100%
4	Chlorination	2 kg/day (0.65 ppm)	12* kg/day (3 ppm)	83%
5	Ultrasonic	One device	N. A.	---
6	Polymers	2 kg /day	N. A.	---
7	Electrical Consumption	26.04 kw/day	Recirculation = 23 x 1.1 x 13= 328.9 kw/day	92%
8	Labors	2 labors, working hours = 8	4 labors, working hours = 32	75%

* 8 buckets are used monthly; each bucket contains 45 kg of chlorine = 12 kg daily

Experiment Results Impact on Operational Cost



The Final Conclusion:

The visible results, the daily consumption of chemicals and electricity, and the water analysis proved a great savings (average of 90%) was achieved.

Industry Leading Technology



START



DAY 14



DAY 21



DAY 28

Time lapse results using Quattro-DB in a private pond in Iowa, US.
Filamentous algae take about 3-4 weeks to fully die from ultrasonic treatment.

Ultrasound vs Algaecide Cost Benefit

MOORINGS BAY | NAPLES, FL | 50 ACRES

BUDGET

	Capital Costs	Annual Operating Cost/Acre	Total Cost Per Acre 5Years
Ultrasonic Algae Technology with Water Quality Monitoring	\$50,000	\$5,000	\$1,500
Typical Alum or Copper Algaecide	\$105,000	\$525,000	\$10,500
Alternative Offerings with Water Quality Monitoring	\$250,000	\$25,000	\$7,500

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