



Harmful Algal Bloom Remediation and Prevention in Willow Lake/Discovery Bay using BlueGreen Water Technologies' *Lake Guard*[®] Oxy Technology

Background:

Discovery Bay is a community located in eastern Contra Costa County, California, about 60 miles from San Francisco. The community was established in the early 1970's as a mostly weekend and summer resort community. Today, Discovery Bay has evolved into a thriving year-round home for over 14,000 residents. The community is connected to the Sacramento-San Joaquin Delta and has experienced numerous challenges with managing nuisance aquatic weeds and algae, including outbreaks of Harmful Algal Blooms (HABs), primarily caused by cyanobacteria (aka 'blue-green algae').

Project objective:

To handle and contain ongoing cyanobacterial blooms in Willow Lake within Discovery Bay (Fig. 1) and maintain the lake below advisory thresholds through preventive protocols over a period of approximately 4 months through the application of the *Lake Guard*[®] Oxy.

Impacts of cyanobacterial blooms

Cyanobacterial blooms disrupt the aquatic eco-system and reduce its bio-diversity to be dominated by a single species of cyanobacteria. They inhibit the growth of competing phytoplankton species by physical obstruction of direct access to sunlight, as well as by the secretion of an array of substances that can retard the growth of desirable algae. These molecules are detrimental to other competing phytoplankton. Some of these substances, known as cyanotoxins, are harmful to humans and animals. They may cause a range of health risks and the toxins can also become aerosolized and inhaled. Thus, the risk of exposure to toxins affects recreational activities in and around the water and depreciates home and business values around the lake.

About the technology:

The *Lake Guard*[®] Oxy technology, a targeted treatment against blue green algae, selectively eliminates and prevents toxic algae blooms. It is a proprietary formulation that allows the granular product to float and time-release the active ingredient on the water surface, while homing-in on cyanobacterial aggregates as they drift in the water. The *Lake Guard*[®] technology triggers a biological mechanism that results in a population-wide collapse of cyanobacteria.

The *Lake Guard*[®] Oxy is comprised of 98% (w/w) sodium percarbonate that releases hydrogen peroxide (H₂O₂) as its active ingredient, and 2% (w/w) of the food-grade biodegradable encapsulating agent. The reaction of hydrogen peroxide produces water and oxygen and does not contain heavy metals or pollutants that could degrade the natural environment. This eco-friendly product was specially formulated to act in surface waters where cyanobacteria accumulate, and none of the ingredients persist or accumulate in the environment.

The *Lake Guard*[®] Oxy is approved by the U.S. EPA, certified by the NSF/ANSI/CAN-60 for treatment in drinking water, and registered with the California Department of Pesticide Regulation. The ready-to-use *Lake Guard*[®] products can be broadcasted manually from the shore or a boat by a licensed applicator.

BlueGreen's approach is to use the *Lake Guard*[®] Oxy preventatively, during the early stages of an evolving cyanobacterial outbreak, therefore prescribing even lower doses of the active ingredient. Such early treatment should eliminate cyanobacteria blooms and the inevitable build-up of cyanotoxins during bloom episodes while preserving the beneficial uses of the waterbody. Using low doses also present a more cost-effective approach for combating blooms.

Figures:

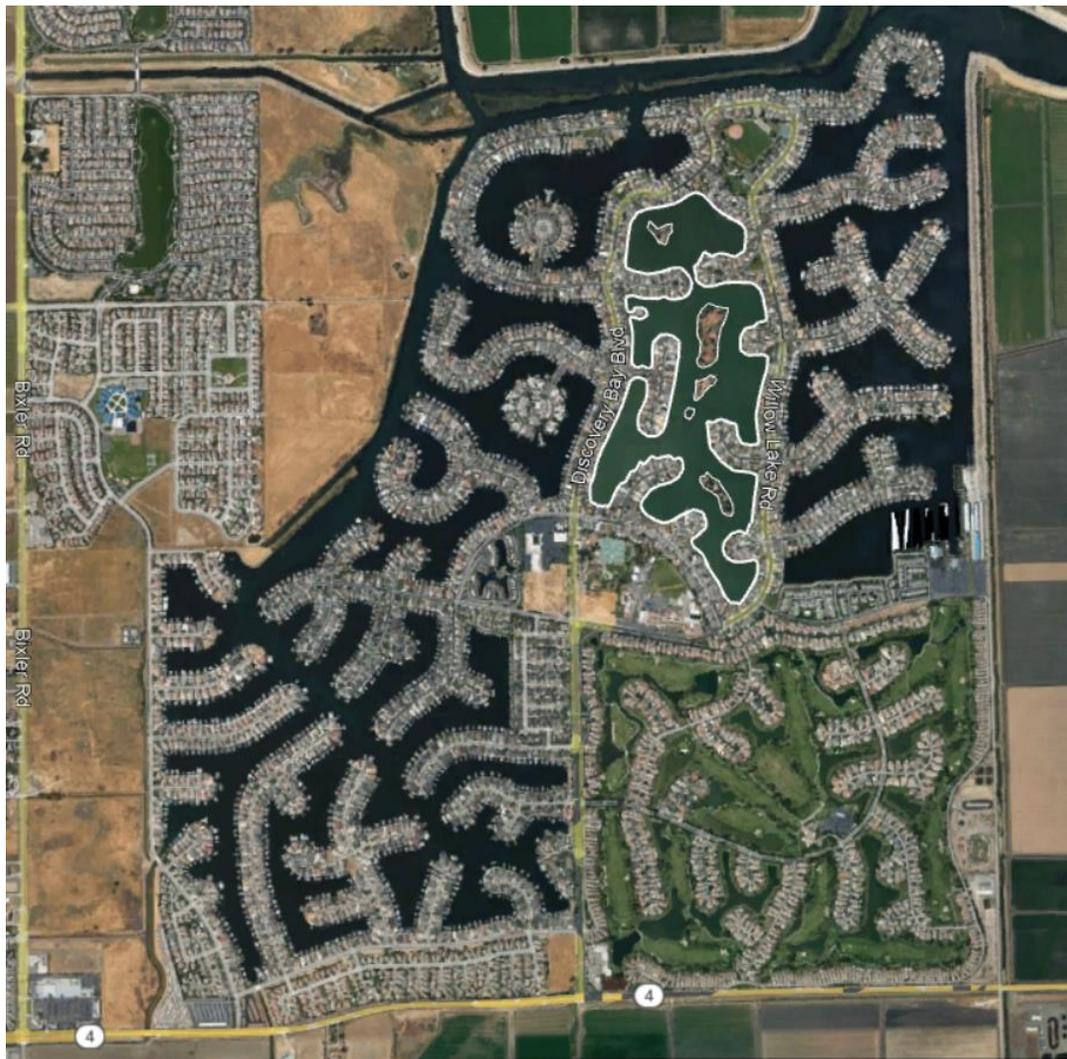


Fig. 1. Willow lake, outlined in white, is approximately 90 surface acres.

Frequently Asked Questions:

What are Algal Blooms and why do we need to treat them?

The term "Algal Blooms" describes a population explosion of phytoplankton in waterbodies. 'Algae' is, in fact, a generic and an inaccurate term associated with a diverse group of photosynthetic microorganisms, including 'desirable' species and also less desirable unicellular bacteria, better termed as '*Cyanobacteria*'.

Negative consequences of an "algal bloom" (i.e. a Harmful Algal Bloom) can occur when billions of cyanobacterial cells clump together to float on the water surface and eventually cover the entire water surface with a greenish, slimy film. This phenomenon results in strong odors, biodiversity loss, significant reduction in beneficial algal species in the water body, and occasionally the production of toxic compounds by the cyanobacteria. Extreme cases of algal blooms result in a 'dead aquatic zone' when the water becomes too dark and too toxic to the point it is almost uninhabitable to any other organism.

What are the chances we will experience an algal bloom this year?

Willow Lake and the surrounding areas had been suffering from algal bloom episodes for several years. Even with no visible scum, the cyanobacteria are still present at dangerous levels that may adversely impact the health of humans and animals. Without proper treatment, cyanobacteria will continue multiplying uninterrupted, increasing the frequency and severity of bloom episodes. This trend of increasing cyanobacterial levels is expected to continue with drought and the warming water temperature. *BlueGreen* aims to control cyanobacterial levels, rejuvenate healthy conditions, and prevent algal blooms from happening altogether throughout the duration of this project.

Why do we need to treat blooms to begin with?

Toxic cyanobacterial infections, if not treated properly, will continue to have devastating, often irreversible, effects on the surrounding environment. Cyanobacteria pose serious health risks to humans and animals. In that respect, risks to human health are not limited to contact with or consumption of contaminated waters, but extends to nearby communities, due to the airborne nature of the cyanotoxins ([Dominic et al., 2018](#); [Schaefer et al., 2000](#)).

Harmful algal blooms are expected to increase in frequency and in severity from year to year, consistent with worldwide trends thus far ([Ho et al., 2019](#)). These blooms have, in turn, a devastating impact on the local economy: undesirable and unhealthy living conditions, diminished recreational activities, and the devaluation of properties around the lake. The latter point was emphasized in a study about the effects of harmful algal blooms on the local economy around a small lake in Ohio. The study estimated an average of \$100 Million in property value depreciation over a 6-year period ([Wolf et al., 2017](#); [Wolf & Klaiber, 2017](#)).

Is the treatment safe to people and pets?

Yes, the treatment is safe to people and pets as well as local wildlife including ducks, fish, turtles, etc. Due to the unique formulation of the *Lake Guard*[®] products, all its ingredients will dissolve completely within a few hours of application. This eco-friendly product does not persist or accumulate in the environment, and the active ingredient decomposes quickly to water and oxygen.

The main concern for people and pets is the existence of cyanobacteria and cyanotoxins in the water, which present a major health risk to humans and animals. During bloom episodes, news stories about pets dying or



getting sick after a close contact with cyanobacteria-infested waters are a daily matter. Our main goal is to eliminate this health threat altogether, turning the water safe for all.

Is the treatment safe to the environment?

Yes, the treatment is safe to the environment.

The *Lake Guard*[®] Oxy selectively targets cyanobacteria, not beneficial green algae that are, by far, less sensitive to the active ingredient. The floating characteristic of the *Lake Guard*[®] products ensures that it will not be wasted away in the sediment or in areas with low cyanobacterial content. The product ‘mimics’ the cyanobacterial movement in the lake, that is dictated by the same natural forces in the water – making the *Lake Guard*[®] application a targeted treatment. As a result, the dose rates of the *Lake Guard*[®] products are extremely low. Moreover, the time-release mechanism, allows only a fraction of the total dose of hydrogen peroxide (H₂O₂) in the product to be released into the water over a few hours, thereby limiting the effective concentration of the H₂O₂, at any given moment, to extremely low levels.

For reference, the levels of hydrogen peroxide concentration in Willow Lake during the treatment application will be a tiny fraction of the concentration in a standard mouth wash. The H₂O₂ molecules that are released into the water surface interact immediately with the abundant organic material in the lake and decompose into water and oxygen. This subtle, prolonged oxidative stress is designed to induce a programmed cell death (PCD) signal within the cyanobacterial population, that results in its collapse. The *Lake Guard*[®] Oxy is certified by the NSF/ANSI/CAN-60 for treatment in drinking water. The standard allows for the use of as much as 33 parts per million in drinking water. The actual concentrations planned for Willow Lake during any treatment is far below 1 part per million.

Do recreational activities in the lake have to be suspended during the treatment application process?

No need to suspend recreational activities during treatments as there are no restrictions on recreational use of the waterbody before or during a treatment. However, due to the potentially high concentrations of cyanobacteria and cyanotoxins in the water, swimming or any water contact is not encouraged prior to the initial treatment. The *Lake Guard*[®] treatment aims at reducing the cyanobacteria and the cyanotoxins to below warning advisory levels. Only then will the water be safe for all recreational activities.

How long will the treatment application process take?

The initial interventional treatment application for a lake the size of Willow Lake (~90 acres), takes an hour or so to complete. The *Lake Guard*[®] Oxy will be broadcasted from a moving boat in predetermined, limited, areas. Once the initial treatment is complete with satisfactory results, follow-up treatments will be much more limited to specific areas, with lower doses. Such treatments will take less than an hour to complete.

When will the treatment results be apparent?

Treatment results will be apparent within 24-72 hours. The lake’s condition will continue to improve over time after treatment, and with subsequent low doses. The main goal of the treatment is to keep cyanotoxin levels in the lake below warning advisories for the State of California.

Aquatic EcoTechnologies, LLC along with *BlueGreen* will monitor the condition in the lake and in Discovery Bay proper (the latter for comparative purposes) throughout the summer, for cyanobacteria, cyanotoxins and a variety of environmental parameters.

How long does a single treatment last?

Treatment results will last for a few weeks. The treatment longevity depends on multiple factors, e.g. the source of the lake's water, geological factors, nearby vegetation, source of contamination, if any, initial diversity of fauna and flora, history of treatments (e.g. herbicides), and more. Our main goal is to establish the appropriate dosing and treatment schedule for controlling blooms in Discovery Bay thereby rehabilitating the aquatic ecosystem by eliminating the toxic cyanobacteria and rejuvenating the biodiversity of beneficial green algae that will serve as the lake's 'immune system' against cyanobacterial resurgence. A thriving green algae population ties-up important nutrients (e.g. Phosphorus and Nitrogen) away from cyanobacteria and prevents them from reestablishing themselves in high numbers in the water.

This delicate balance can be disturbed by a number of factors, e.g. a source of contamination, or water flowing into Willow Lake from outside sources. Our main focus will be to track any evolving cyanobacterial outbreaks and respond to them immediately, in order to maintain a healthy, biodiverse environment.

Will my over-the-counter hydrogen peroxide keep the algae away from my house?

While products such as hydrogen peroxide can be purchased over-the-counter, the use of these products for the treatment of algae is not encouraged/recommended as the products are not designed to effectively treat algae. Furthermore, the additions of any product may interfere with this study and will unlikely provide any visible or long-term benefit. Therefore, it is best to allow licensed and trained professionals to handle the dosing and treatment.

Official Press Releases, News and YouTube videos:

[Lake Guard treatment in the Caloosahatchee River- NBC2 news](#)

Florida has found a way to mitigate harmful BlueGreen Algae
https://www.youtube.com/watch?v=9OF_SrBh2rs

[Chippewa Lake, Ohio, Celebrates The First Summer in Years Free Of Toxic Cyanobacteria Following A Groundbreaking Treatment](#)

Roodeplaat Dam treatment, 1,100 acres, South Africa (*video*)
<https://www.youtube.com/watch?reload=9&v=eT5DoDOS2CM>

Aerial application, Setumo Dam, 1,000 acres, South Africa (*video*)
<https://www.youtube.com/watch?v=RxFiBSXRkcA>

Chippewa Lake, Ohio, testimonial from residents (*video*)
<https://www.youtube.com/watch?v=YW5QTecDPRA>

St Johns River Water Management District press release, Lake Minneola, June 8, 2021
<https://www.sjrwmd.com/2021/06/district-to-share-innovative-algal-bloom-treatment-contract-with-fellow-water-managers-fdep/>



Florida Gov. Press Release, C-43/Caloosahatchee River, 48-mile stretch, June 2021

<https://www.flgov.com/2021/06/03/governor-ron-desantis-visits-caloosahatchee-river-to-highlight-a-leading-israeli-company-working-with-the-state-to-combat-blue-green-algae/>

Florida Gov. Press Release, C-44/St. Lucie Canal, 21 miles, Oct. 2020

<https://content.govdelivery.com/accounts/FLDEP/bulletins/2a57376>

restriction on swimming.