



The Threat of Harmful Algal Blooms to Tribes and Communities

University of California Center, Sacramento

April 10, 2023



Cal-WATCH

California Water: Assessment of
Toxins for Community Health



OEHHA
California Office of Environmental
Health Hazard Assessment



Presenters and Collaboration

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Big Valley Band of Pomo Indians



<https://www.bvrancheria.com/>

- Big Valley Tribal members are descendants of the Xa-Ben-Na-Po Band of Pomo Indians that have inhabited the Clear Lake area for over 11,800 years.
- For many generations, the various Pomo Bands enjoyed unfettered use of the lands and waters of Lake County, California and Xabatin, the Tribe's name for Clear Lake.
- Our Tribal Mission is to provide economic self-sufficiency, improve self-esteem, promote quality future development, provide for and maintain a government for the community, protect the environment and enrich tribal life by preserving, documenting and teaching the Pomo culture for future generations.

An aerial photograph showing a large body of water with a complex, swirling pattern of blue and green. The water appears to be covered in a dense layer of algae, creating a marbled or marbled effect. The colors range from deep blue to light green, with some darker patches. The overall appearance is that of a harmful algal bloom.

Background: Harmful Algal Blooms

What Causes a HAB?

- Increased nutrient loadings
 - Fertilizer
 - Septic systems, wastewater
 - Soil erosion
- Changes in the food web
- Changes in water flow/stagnation
- Drought or flooding
- Climate change



Photo: Elem Indian Colony

Impacts of Climate Change on the Occurrence of Harmful Algal Blooms

Climate Change and HABs

- Warmer water temperatures
- Changes in salinity
- Increases in atmospheric carbon dioxide concentrations
- Changes in rainfall patterns
- Intensifying of coastal upwelling (marine blooms)
- Sea level rise (estuarine blooms)

Summary

Climate change is predicted to change many environmental conditions that could affect the physical properties of fresh and marine waters both in the U.S. and worldwide. Changes in these factors could favor the growth of harmful algal blooms and other changes such that marine HABs can invade freshwater. An increase in the frequency and intensity of harmful algal blooms could negatively impact the environment, human

Background

Algae occur naturally in marine and fresh waters. Under favorable conditions that include adequate light availability, warm waters, and high nutrient levels, algae can rapidly grow and multiply causing “blooms.” Blooms of algae can cause damage to aquatic environments by blocking sunlight and depleting oxygen required by other aquatic organisms, restricting their growth and survival. Some species of algae, including golden and red



Photo credit: Big Valley Rancheria

Marine HAB Syndromes

- Amnestic Shellfish Poisoning
 - Domoic Acid
 - Pseudo-Nitzschia
- Paralytic Shellfish Poisoning
 - Dinoflagellates (“Red Tide”)
 - Saxitoxin
- Ciguatera poisoning
- Diarrhetic Shellfish Poisoning
- Others that cause dermatitis, respiratory symptoms

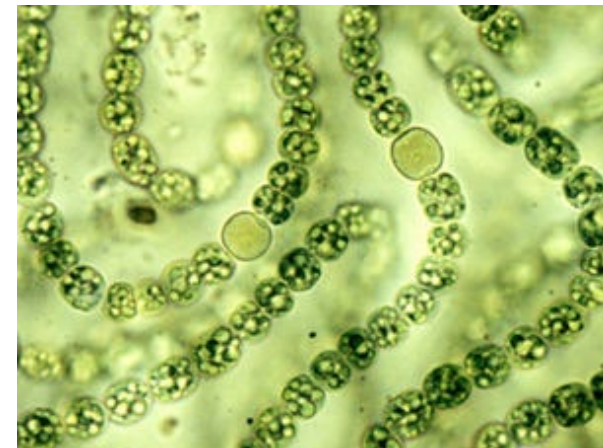


Freshwater HAB Toxins

- Mostly produced by cyanobacteria (“Blue-Green Algae”)
- Microcystin
 - Liver, kidney toxin; carcinogen
- Cylindrospermopsin
 - Liver, kidney, neuro toxins
- Anatoxin
 - Neurotoxin
- Saxitoxin
 - Neurotoxin
- Nodularin
 - Liver toxin, tumor promoter



Photo: USGS



Impacts of Freshwater HABs

- Humans
 - Respiratory symptoms, pneumonia
 - Headache, sore throat
 - Gastrointestinal distress
 - Skin rashes (dermatitis)
- Pets, livestock, wildlife
 - Severe illness or death
 - Sometimes massive die-offs
- Economic and social impacts
 - Decreased tourism and visitation
 - Decreased fishing
 - Odor complaints
 - Interference with cultural practices



HABs in and around Clear Lake

- Clear Lake was listed for nuisance algal blooms in 2007
- Since 2009:
 - More common
 - Lasting longer
 - Odors
 - Health impacts (human and animal)
 - Drinking water concerns



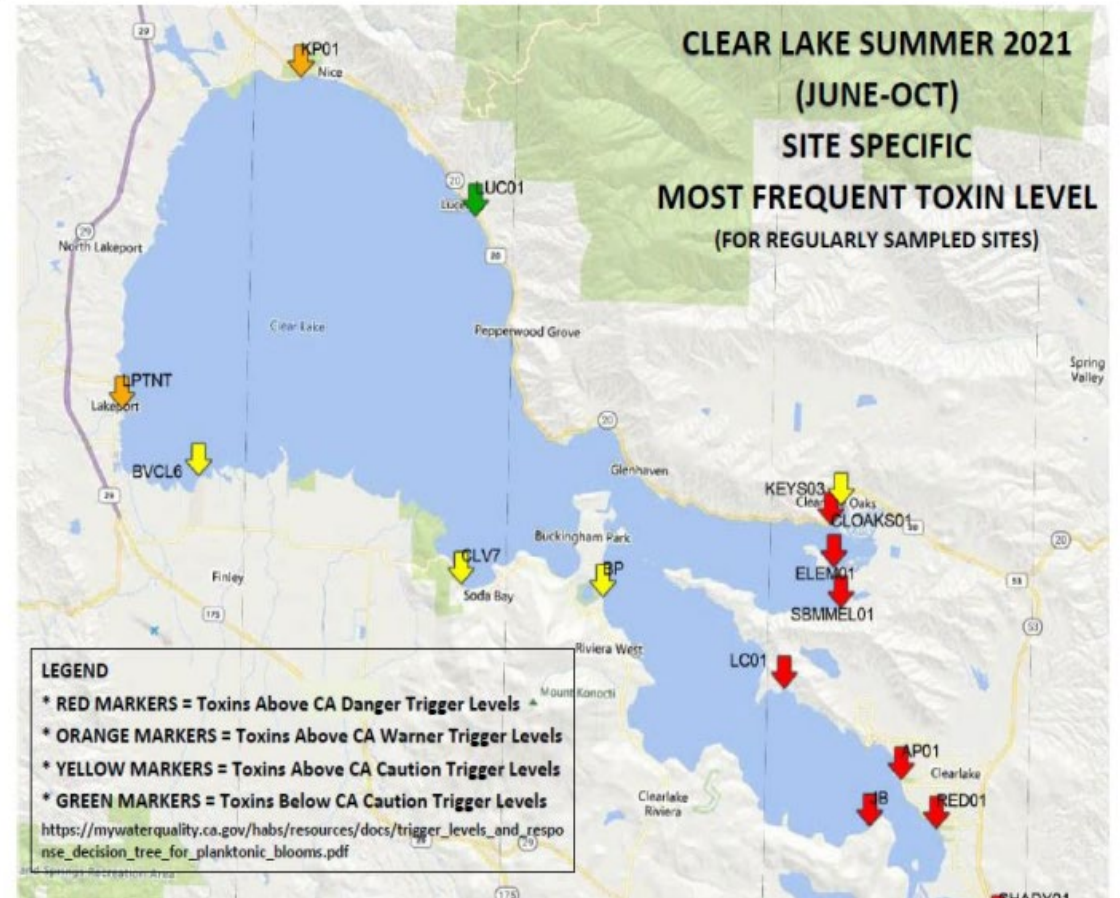
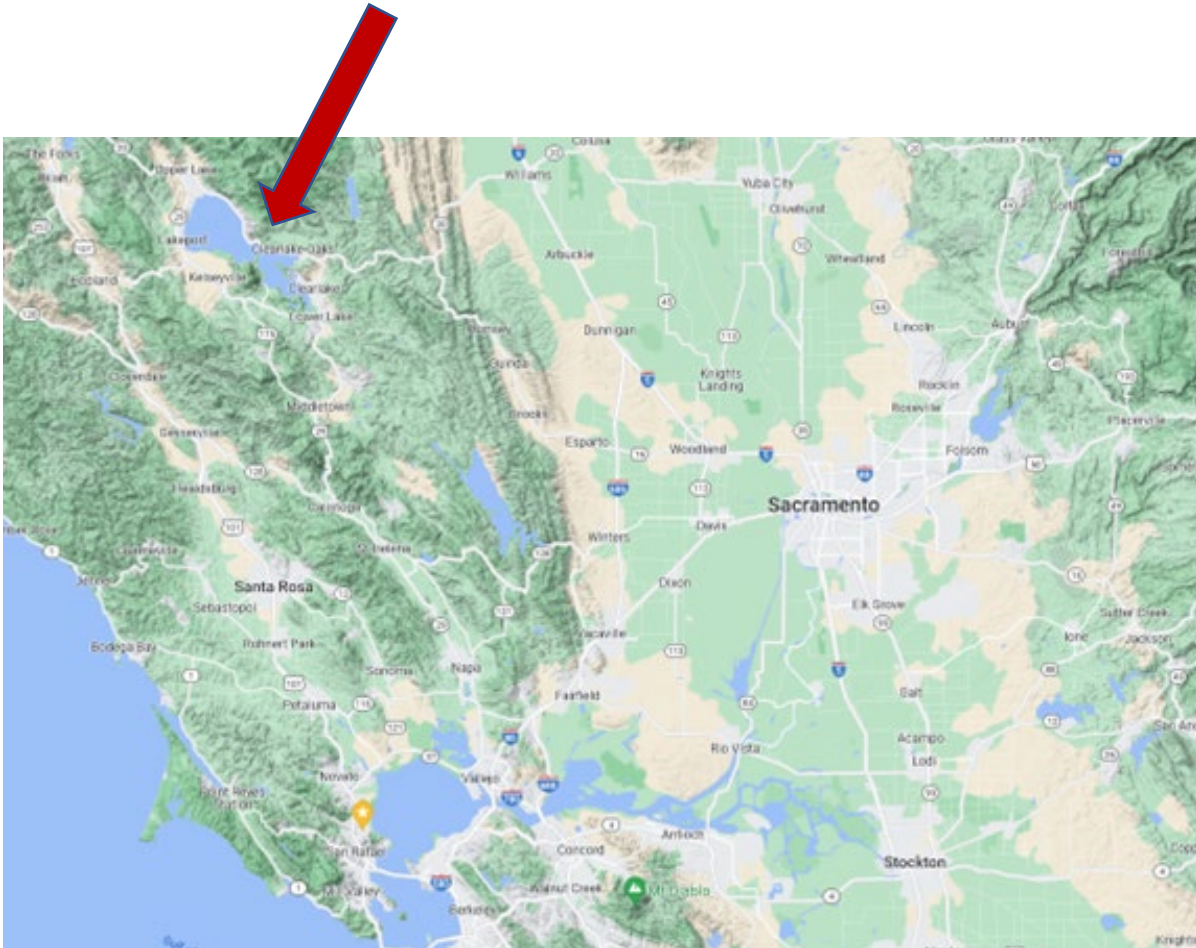


Traditional Uses of Lake, Tule

Photo (left and bottom): Tom Martin, BLM, <https://corinepearce.com/>, Marin Independent Journal, Nov 12, 2023.

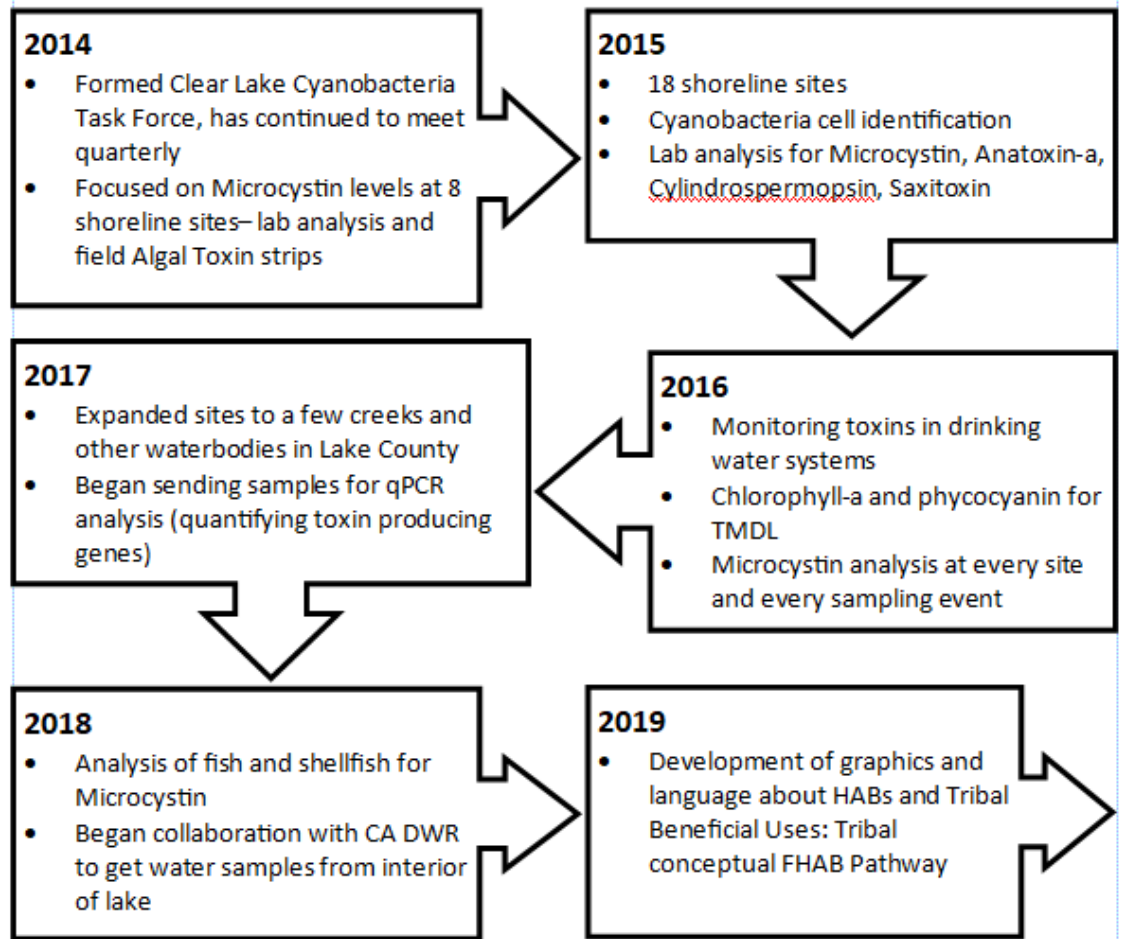
Photo (upper right): Big Valley Rancheria

Big Valley Cyanotoxin Water Testing Program Clear Lake, CA

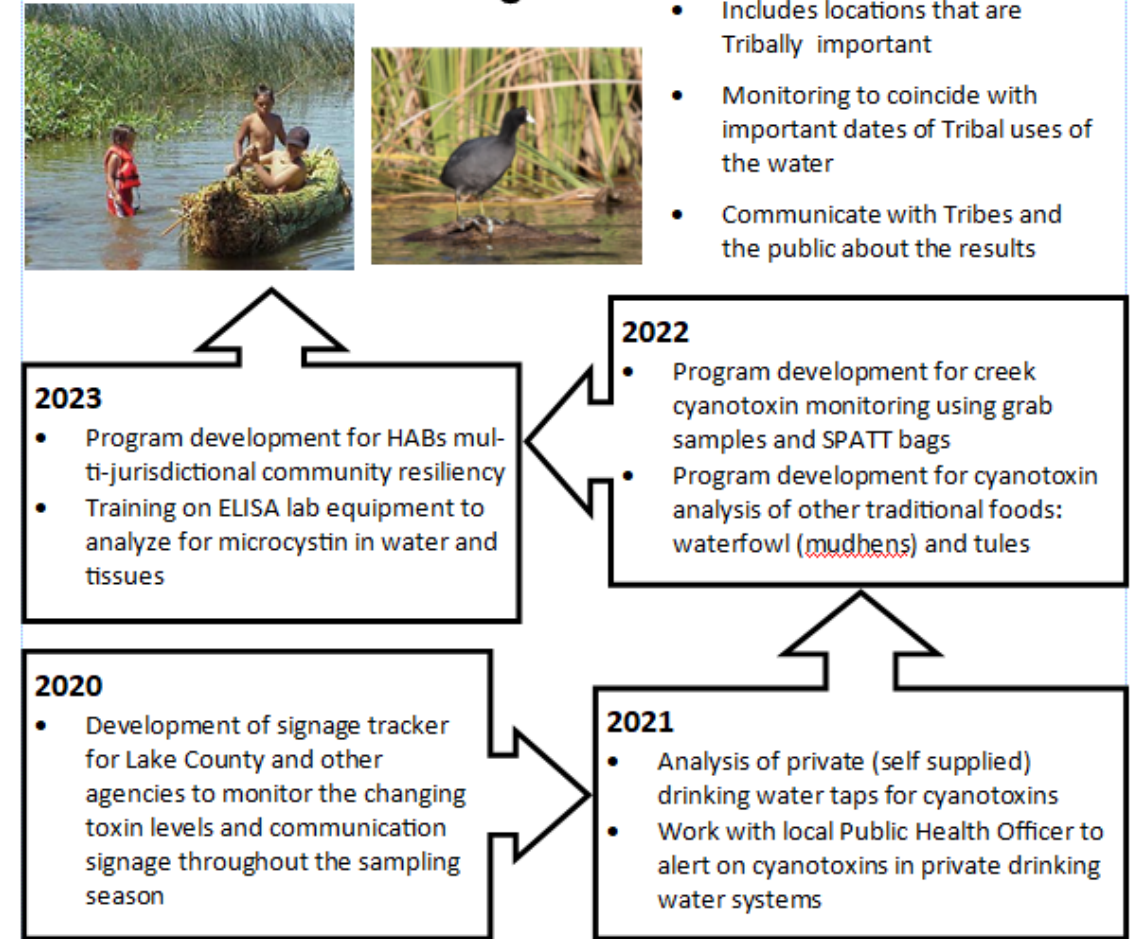


Shoreline Cyanotoxin Sampling on California's Largest Freshwater Lake since 2014

Tribal Cyanobacteria Monitoring Program



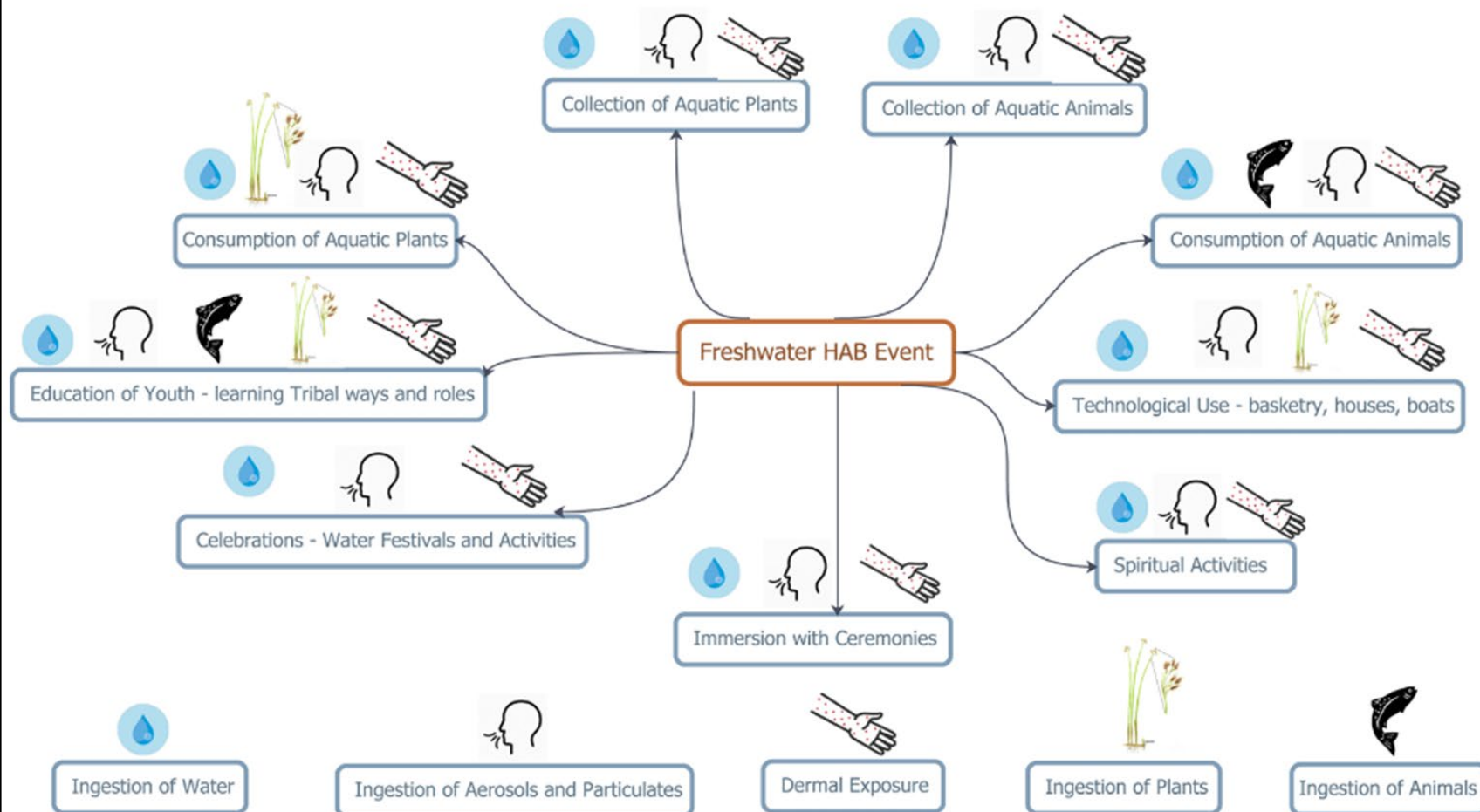
Tribal Centric Program



Using the Clean Water Act to Acknowledge and Protect Tribal Beneficial Uses

Tribal Cultural Use Conceptual Freshwater Harmful Algal Bloom (FHAB) Impact Pathway

Native peoples were given their land by Creator and honor Creator and their Ancestors by maintaining traditions and cultural landscapes. This is the connection between the land and the people. Uses can be repetitive, gender assigned and long term. Exposures can occur second hand through the use and trade of plants and animals that have been in contact with HABs.



Reviewing routes of exposure and calculating exposure scenarios to determine standards to protect Tribal cultural uses

Partnering on Recreational Advisories

Health Services Department
Public Health Division
922 Bevins Court
Lakeport, California 95453-9739
Telephone (707) 263-1090
FAX (707) 263-4395



COUNTY OF LAKE
HEALTH SERVICES
prevent.promote.protect.

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Public Health Nursing Director

Iyesha Miller
Public Health Program Manager

Guidance for Recreating Responsibly Prepared by the County of Lake Health Services and Water Resources Departments and Big Valley Band of Pomo Indians

Staying Safe While Cyanobacteria and Harmful Algal Blooms are Present
Officials offer guidance on recreating safely around lakes, reservoirs, and streams
Updated: April 22nd, 2022

As temperatures begin to rise, regional health and water resource officials are reminding residents and recreationists to be cautious if they are planning activities on local lakes and streams, now and throughout the summer. Cyanobacteria (also known as blue-green algae) are microscopic organisms that naturally occur in all freshwater and marine aquatic ecosystems. Usually, cyanobacteria concentrations are low and not harmful to humans and animals. But when conditions are favorable (high nutrients and warm weather), these organisms can rapidly grow, forming visible colonies or “harmful algal blooms.”

Welcome to Lake County

Be advised that Blue-Green Algae (Cyanobacteria) are in many lakes and streams, and some produce toxins that can harm humans and animals

BE ALERT and AVOID WATER THAT:

- Looks like spilled paint, has surface scum, mats or films
- Has green globs floating below the surface

BE ADVISED toxins may be present even if there are no visible signs

DO NOT DRINK water directly from the lake

DO NOT ALLOW children or pets to swim where Blue-Green Algae (Cyanobacteria) are present

RINSE OFF AFTER being in the water, shower with clean water, wash hands, and rinse off your pets thoroughly

Take appropriate precautions for people and pets while having fun on the water

Current Toxin Levels: <http://www.lakecounty.ca.gov/clearlake/cyanobacteria>
 Information or Report a Bloom: <http://www.waterquality.ca.gov/waba/>
 Call Local County Departments:
 Water Resources (707) 263-2344 or Environmental Health (707) 263-1164



Posted Signage



Photo credit: Big Valley Rancheria

Cal-WATCH Project Testing Drinking Water

-
- 5-Year grant from the CDC to:
 - Track illnesses that may be from exposure to harmful algal blooms (HABs)
 - Inform residents and visitors to avoid exposure to HABs
 - Identify homes that are not on public water systems
 - Test the water at these homes and inform residents of findings



Cal-WATCH



Background

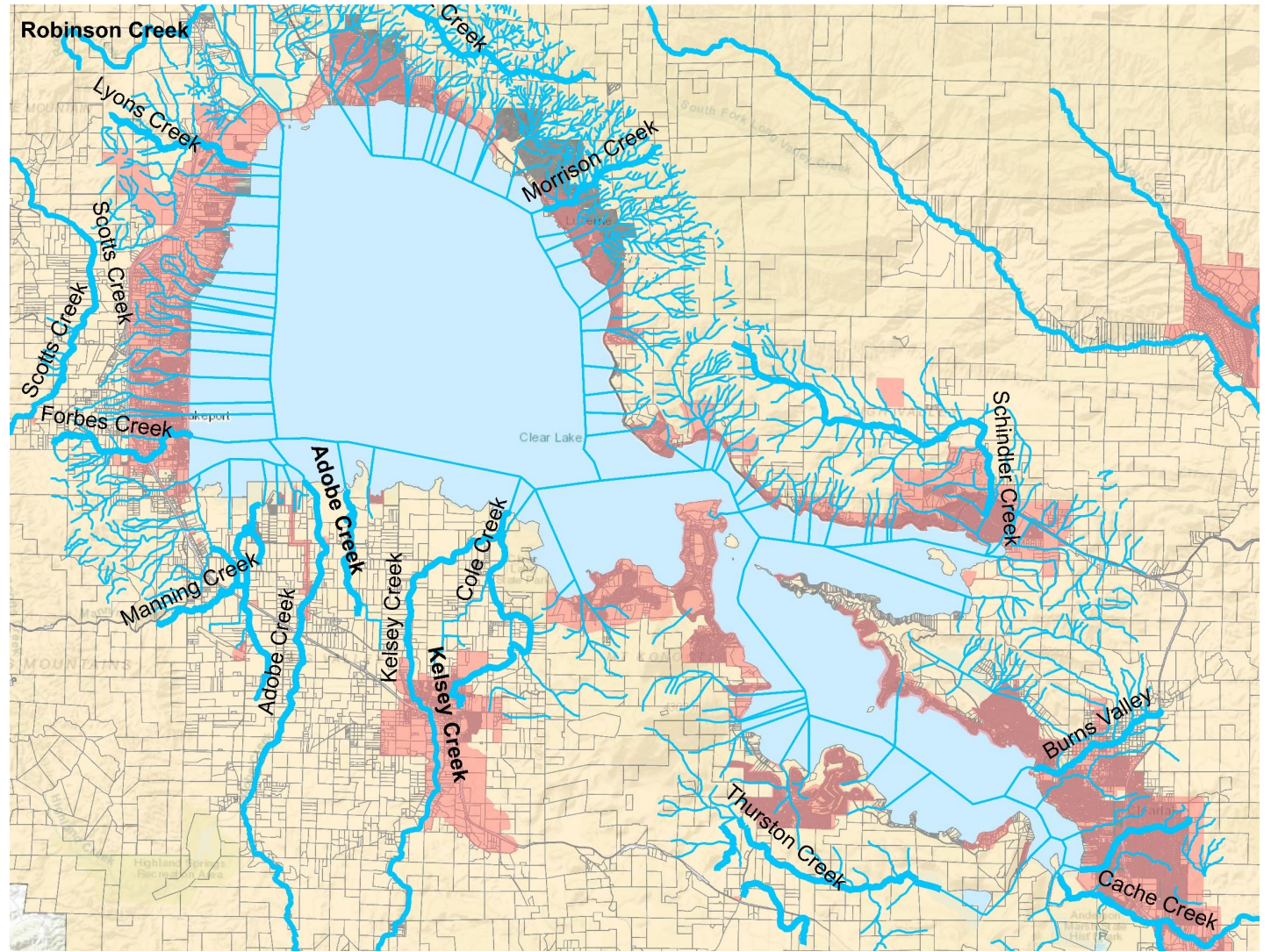
- Self-Supplied Systems – Private systems with <5 connections (unregulated)
- ~493 Clear Lake homes have drinking water from self-supplied systems
- Public Water Systems – Serve >24 people 60 days per year (regulated)
- 17 public water systems are around Clear Lake, serving ~44,000 people



Drinking Water Wells and Intakes Goals

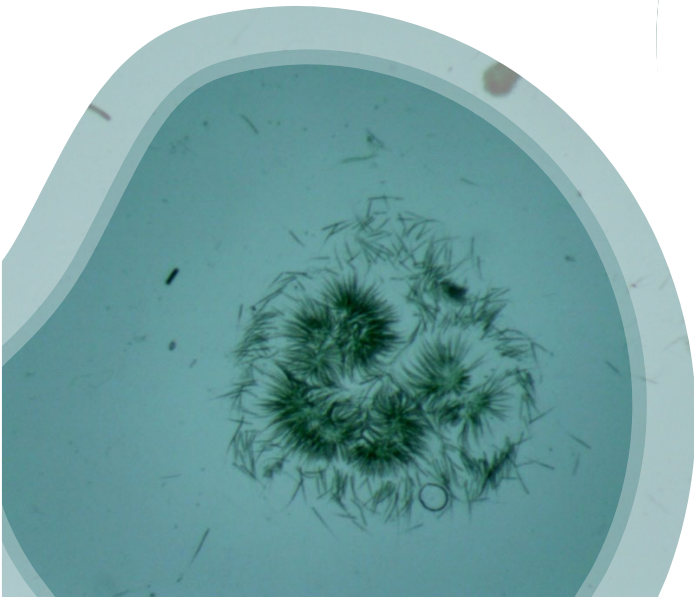
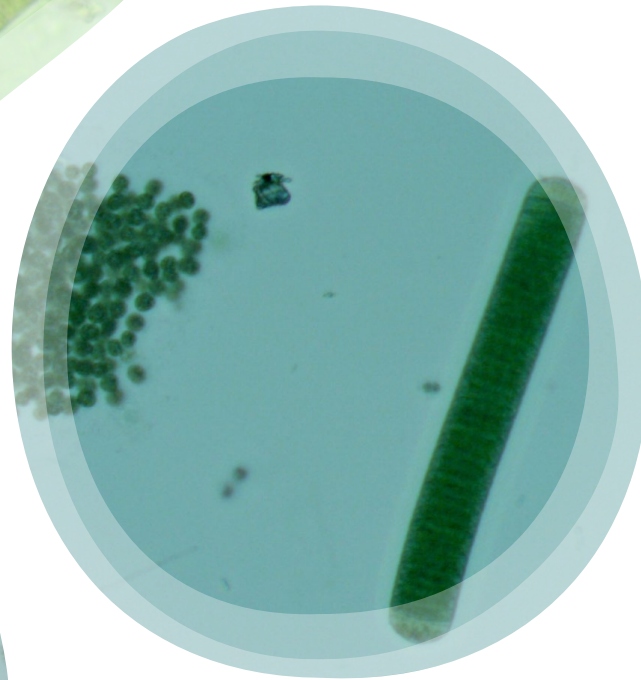
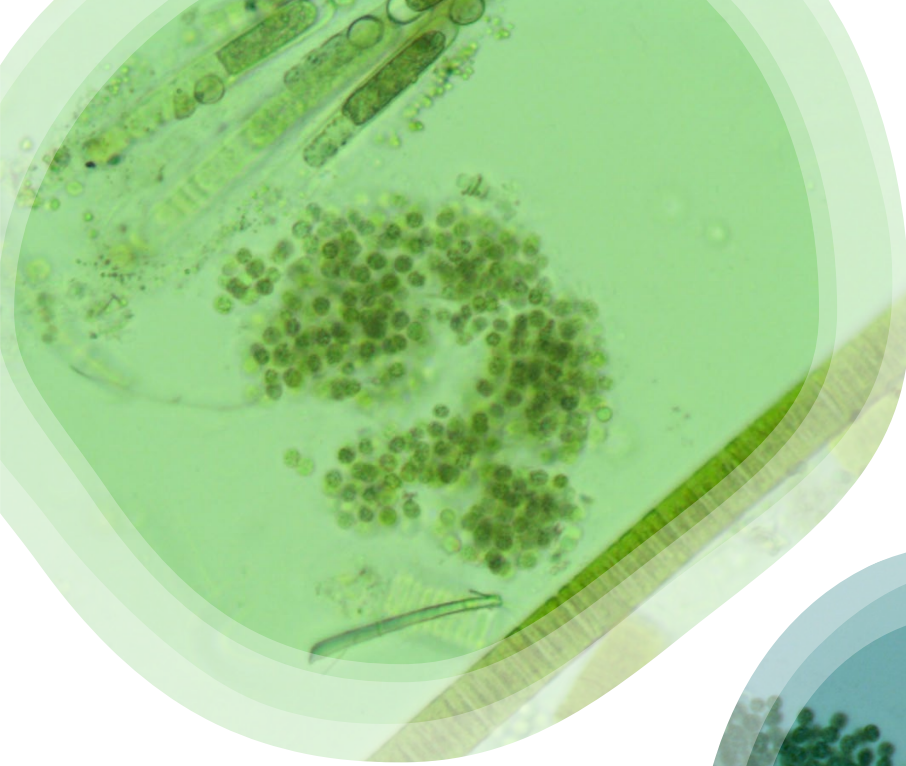
- Identify homes not served by a public water system
- Enroll residents:
 - Consent, questionnaire
 - No cost to residents
- Test water over a year for seasonal contaminants:
 - Nitrates
 - Coliform bacteria & *E. coli*
 - Herbicides
 - Cyanobacteria/cyanotoxins
- Return results with health education and resources
- Work with state and local agencies to address issues

Residential
Parcels Not on
Public Water
Systems (non
highlighted
areas)



Results of Testing for Cyanobacteria and Cyanotoxins

- June-October 2021, self supplied tap water from 46 homes analyzed:
 - 31 from lake water intakes
 - 15 from wells
- Microcystin was found in 22 homes with lake water intakes and 0 with wells.

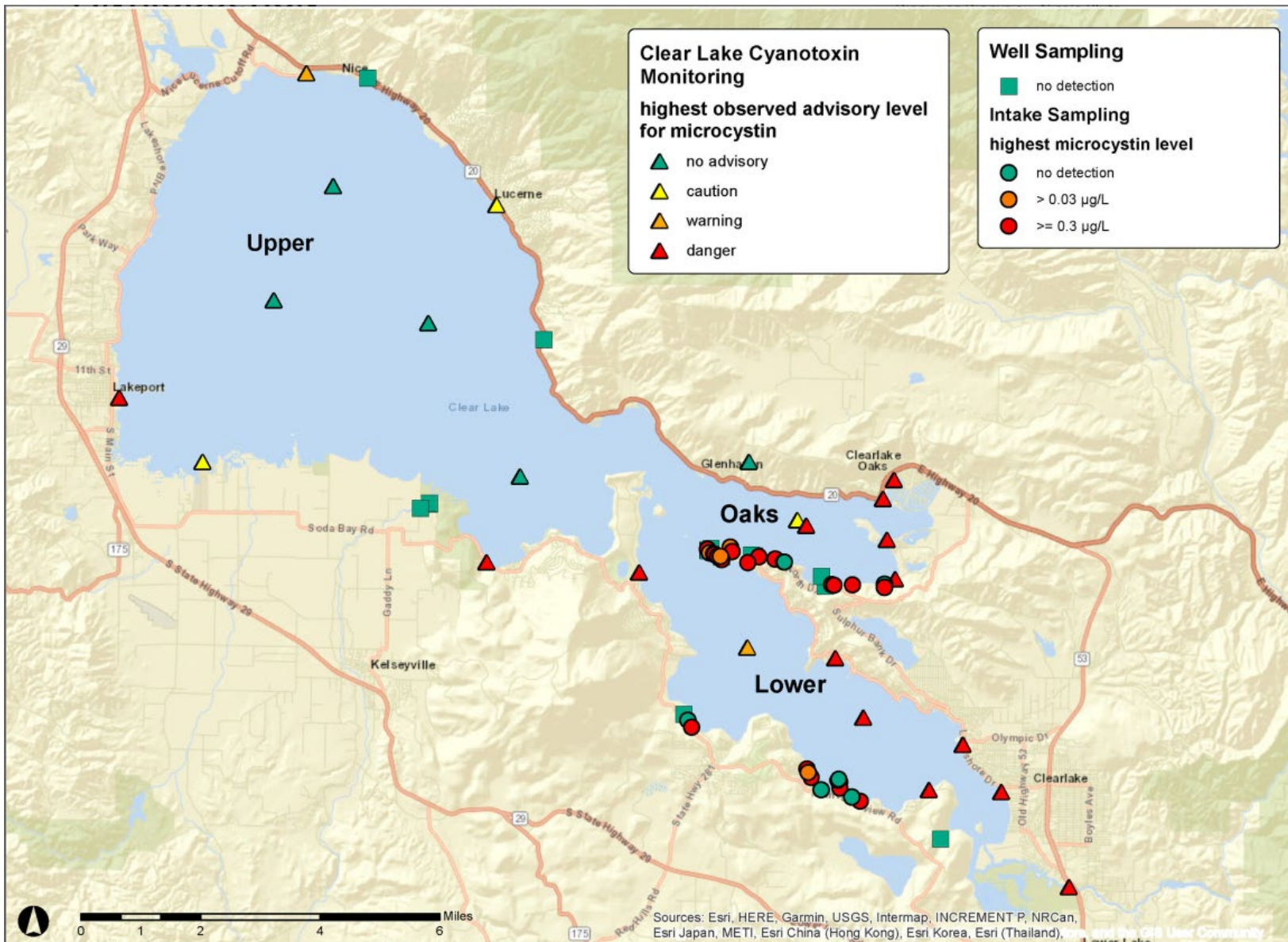


*Photos from tap water samples from private intakes, Clear Lake
Photo credit: Big Valley Rancheria*

Treatment Type and Microcystin

| Water Source | Treatment system | Total | Microcystin detects | Microcystin 0.3 µg/L or higher |
|---------------------------|-----------------------------|-------|---------------------|--------------------------------|
| Private lake water intake | Chlorine and filter | 21 | 13 | 10 |
| | Chlorine, filter, and UV | 2 | 2 | 1 |
| | Chlorine, filter, and ozone | 1 | 1 | 1 |
| | Filter only | 4 | 3 | 1 |
| | Filter and UV | 3 | 3 | 2 |
| | Total Intakes | | 31 | 22 |
| Private well | Chlorine and filter | 6 | 0 | 0 |
| | Filter and UV | 1 | 0 | 0 |
| | Filter, UV and ozone | 1 | 0 | 0 |
| | Filter | 1 | 0 | 0 |
| | None | 6 | 0 | 0 |
| | Total Wells | | 15 | 0 |

Limit of detection for most assays was 0.1 µg/L



Triangles – location of recreational cyanotoxin monitoring sites by Big Valley Band of Pomo Indians. **Color is the highest toxin level detected, summer 2021.**

Circles - tap water sampling Cal-WATCH **intake** participants (circles). **The color is the 2021 maximum concentration of microcystins in tap water samples.**

<https://doi.org/10.1002/aws2.1337>

Chlorine Residual

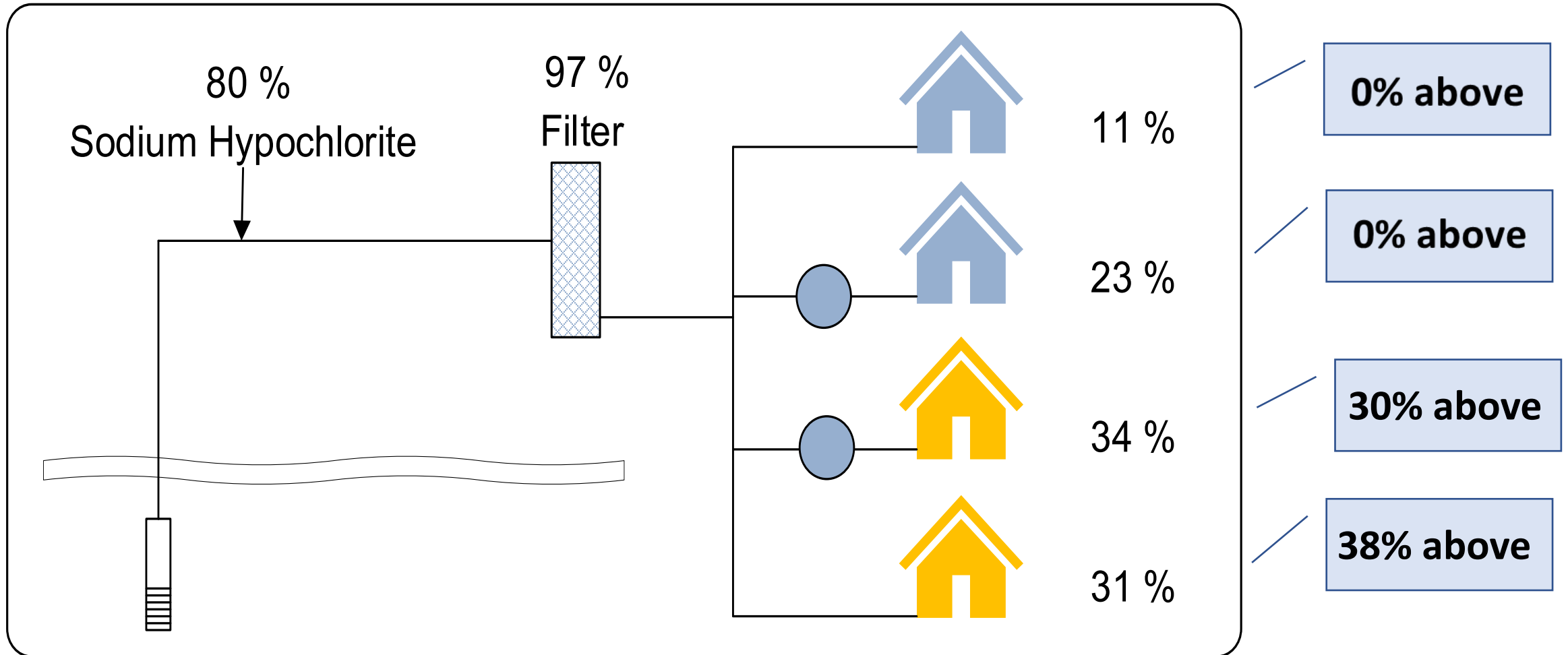
| | INTAKE participants (n=35) | WELL participants (n=18) |
|---|---|---|
| Percentage of systems with >0.1 mg/L chlorine residual | 7.7% (n=26) | 25% (n=4) |



Photo: Alfred Balleto

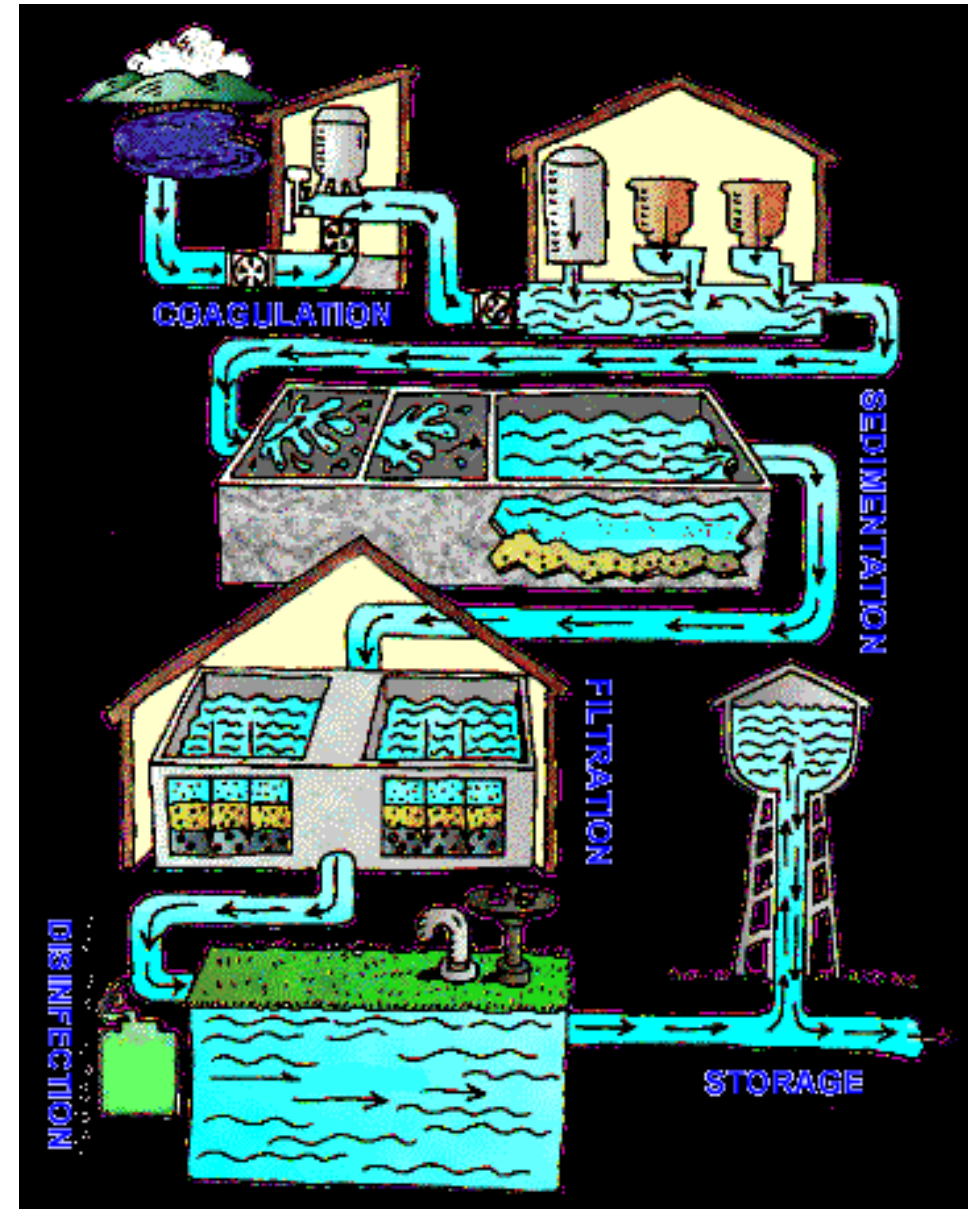
Chlorine Before Filtration: Potential Problem

Microcystin >0.3 ug/L



Public Water System Treatment

- Certified personnel operate these treatment systems
- Monitoring requirements to ensure disinfection and filtration systems are working properly
- Equipped with alarms to detect issues quickly
- Source water quality is monitored to anticipate treatment shifts
- Systems constantly adapt and optimize treatment



Public Health Advisory in Place for 2 months



COUNTY OF LAKE
Health Services Department
Public Health Division
922 Bevins Court
Lakeport, California 95453-9739
Telephone 707/263-1090
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*Environmental Director, Big Valley
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Joint Press Release from the County of Lake Health Services and Water Resources Departments and Big Valley Band of Pomo Indians

PRESS RELEASE FOR IMMEDIATE RELEASE

Tap Water Taken Directly from Clear Lake (not through a Public Treatment System or Groundwater Well) in the Oaks and Lower Arms Should Not Be Consumed Due to High Cyanotoxin Levels
Multifaceted Treatment Processes Utilized by Public Water Systems Can Effectively Treat Water

NOTE: a map demonstrating locations of concerning test results is included with this release, for your use.

Lake County, CA (September 16, 2021) – Clear Lake is a large natural, biologically diverse lake. As such, it is dynamic in water quality. Due to severe drought and heat, we are seeing unprecedented levels of cyanotoxins in some areas of Clear Lake. For Lake County residents with individual water systems that draw water directly from the lake using a private intake, drinking water may become unsafe when high levels of toxins are present.

Conclusions

Homes with private lake water intakes or shallow near-shore wells are relatively common in rural areas.

These homes generally have treatment systems inadequate to deal with HAB contamination.

Testing, alerts, and emergency supplies of safe drinking water are needed during a HAB event.

Longer term solutions include connecting with a nearby public water system, improved HAB monitoring, prevention of HAB conditions.



Harmful Algal BloomS Observing System

Zoom In Zoom Out Full Extent Prev Extent Next Extent Pan Stop Zoom Metadata Map Information HABSOS Main Page

Hide/Collapse

Search Add Layers Legend Tools

Select Harmful Algae Species:
Karenia brevis

Select Date Range:
From: 2023-06-05
To: 2023-12-28

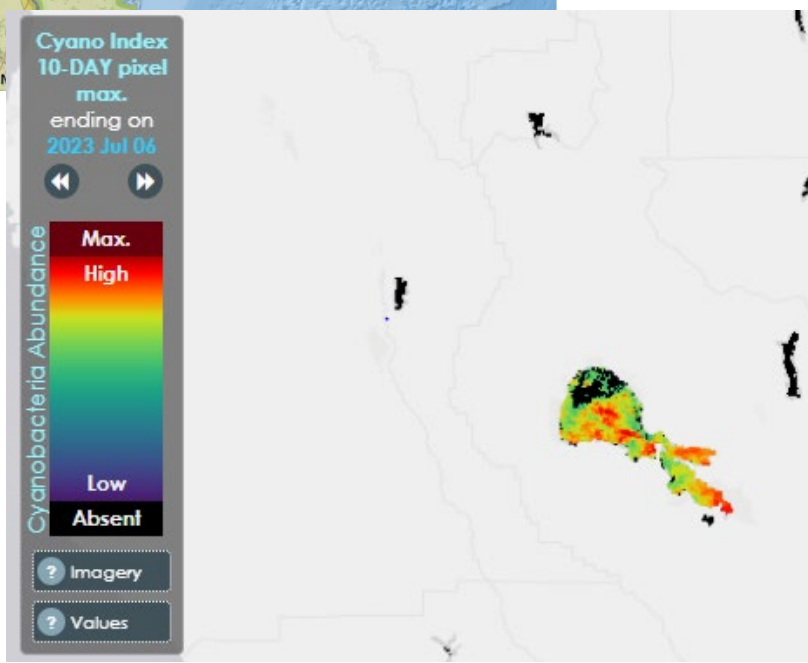
Select Predefined Condition:
Possible Remote Sensing Detection (>50,000)

Search Database

Exclude "Not Observed" Reports (X)

Click on any of the displayed analysis points to get additional information.

Classification of Report Values:
x Not Observed
○ Very Low (1 - 10,000 cells/L)
● Low (10,000 - 100,000 cells/L)
● Medium (100,000 - 1,000,000 cells/L)
● High (1,000,000+ cells/L)



Monitoring for HABs

- Satellite monitoring systems (NOAA, NASA, EPA, USGS collaboration)
- Sensor systems (e.g., Imaging Flow Cytobots)
- Citizen science (e.g., Phytoplankton Monitoring Network, HAB Watch)
- Manual sampling, microscopy and analysis for toxins



Resources:

- Cal-WATCH Page:
<https://trackingcalifornia.org/calwatch/cal-watch-resources>
- Big Valley Rancheria Cyanotoxins Page:
<https://www.bvrancheria.com/clearlakecyanotoxins>
- Bloom and Illness Reporting:
<https://mywaterquality.ca.gov/habs/index.html>

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Questions?