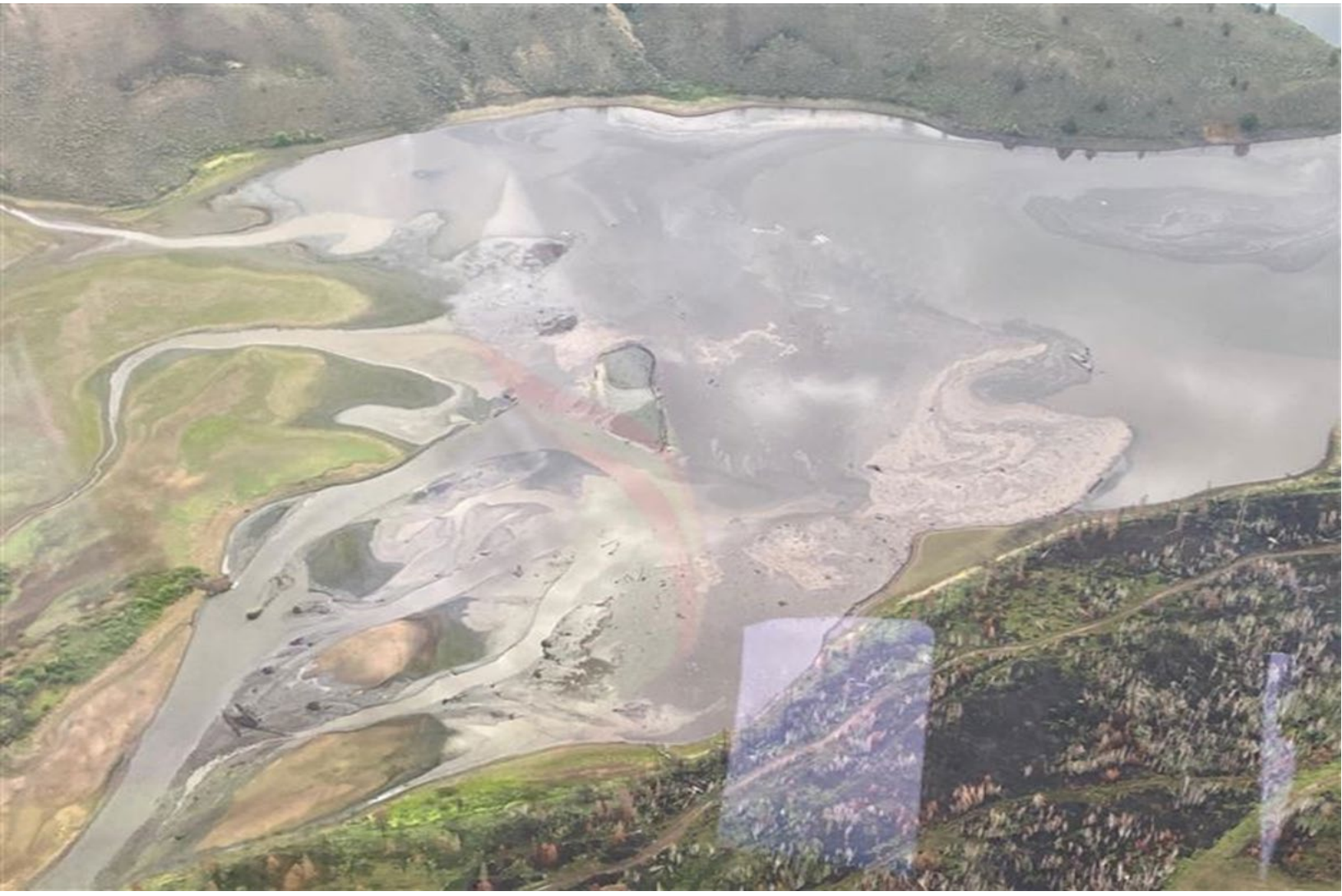

CYANOBACTERIA MONITORING RESPONSE AND COMMUNICATION PLAN

Grand Lake, Shadow Mountain Reservoir, Lake Granby and Willow Creek Reservoir

Prepared by: Grand County, Northern Water, Three Lakes Watershed Association, Town of Grand Lake, U.S. Forest Service, U.S. Bureau of Reclamation

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This plan describes cyanobacteria monitoring in Grand Lake, Shadow Mountain Reservoir, Lake Granby and Willow Creek Reservoir, and details the response and communication plan if cyanobacteria is visually present and/or cyanotoxins are detected. Exposure to cyanotoxins can be harmful to humans and animals; therefore, this monitoring program is focused on areas where there is contact recreation. This program was initiated in response to the East Troublesome Fire, which burned significant areas of the tributary watersheds (89% of Willow Creek, 90% of Stillwater Creek, 29% of the Colorado River, and 42% of the North Inlet). Runoff from the fire is resulting in an increase in nutrient loading and subsequently increasing the potential for Harmful Cyanobacteria Blooms (HCBs). This plan provides a framework for monitoring cyanobacteria that will equip water resource managers with the tools to protect human and animal health in the Three Lakes Region.

INTRODUCTION

Cyanobacteria (commonly referred to as blue-green algae) blooms can occur under certain environmental conditions that promote intense growth. These conditions include high temperatures, stagnant water, and excess nutrients. Cyanobacteria blooms have the potential to become toxic and cause harm to humans and animals if there is direct skin contact, ingestion of the water, or respiration of aerosols. Cyanobacteria blooms that contain toxins are commonly referred to as Harmful Algal Blooms (HABs). This protocol will use the term Harmful Cyanobacteria Blooms (HCBs), because the toxin producers are cyanobacteria and not an algae species. However, the terms Harmful Algae Bloom and Harmful Cyanobacteria Bloom are functionally interchangeable.

HCBs form when the dominant growth in a bloom is cyanobacteria. Cyanobacteria are normal and naturally occur in freshwater systems, including the water bodies monitored in this program. Cyanobacteria growth can become a nuisance, especially in drinking water supplies, as it can cause taste and odor issues, which are not typically harmful. Cyanobacteria blooms can also become a health hazard as they have the potential to produce toxic compounds, called cyanotoxins.

According to the Environmental Protection Agency (EPA), cyanotoxins are "... contained within the cyanobacterial cells (intracellular). The release of these toxins in an algal bloom into the surrounding water occurs mostly during cell death and lysis (i.e., cell rupture) as opposed to continuous excretion from the cyanobacterial cells. However, some cyanobacteria species are capable of releasing toxins (extracellular) into the water without cell rupture or death."

The most common toxin-producing cyanobacteria include Microcystis, Dolichospermum (previously known as Anabaena), and Planktothrix. These species produce four common types of cyanotoxins: microcystin, cylindrospermopsin, anatoxin and saxitoxin.

Toxin Advisory Levels for Recreation

Exposure to cyanotoxins can result in skin irritation, rashes, headaches, stomach cramps, diarrhea, nausea, and kidney and liver damage. Animals, especially dogs, are highly vulnerable to cyanotoxins since they drink the water and can lick cyanotoxins off their fur after swimming; exposure can result in death (CDPHE, 2020).

The Colorado Department of Public Health and Environment (CDPHE) has adopted toxin recreational advisory levels for the four primary cyanotoxins found in the U.S. (Table 1). The advisory levels for microcystin and cylindrospermopsin are consistent with EPA advisory levels, and the advisory levels for anatoxin-a and saxitoxin were established by the CDPHE Toxicology and Environmental Epidemiology department. If the threshold for

any one of the cyanotoxins is met or exceeded, the CDPHE recommends closure to contact recreation. Cyanotoxin results from previous years are available in Appendix F: Historical ELISA Cyanotoxin Data.

Table 1. CDPHE toxin advisory levels for recreation.

Cyanotoxin	Microcystin	Cylindrospermopsin	Anatoxin-a	Saxitoxin
No contact advisory value (ug/L)	8	15	15	9

The CDPHE provides guidance on steps to follow when there are potential or known cyanobacteria blooms in their Toxic Algae Risk Management Toolkit for Recreational Waters. The CDPHE Toolkit and staff guidance have been instrumental in this plan's development.

Geographic Area

The monitoring for this program is in four waterbodies located in the headwaters of the Colorado River Watershed: Grand Lake, Shadow Mountain Reservoir, Lake Granby (collectively referred to as the Three Lakes), and Willow Creek Reservoir. These water bodies are hydrologically connected, which can influence the timing and locations of cyanobacteria (Figure 1). The hydrology is strongly influenced by operations of the Colorado-Big Thompson (C-BT) Project, and flows can change directions seasonally. During snowmelt season, water flows from surrounding watersheds into the lakes and reservoirs. As the summer season progresses, operation of the C-BT project causes the flow direction to reverse as water is pumped from Willow Creek Reservoir to Lake Granby and from Lake Granby into Shadow Mountain and Grand Lake to deliver water to water users on Colorado's Northern Front Range through the Adams Tunnel. All four water bodies are open to the public for contact recreation. Grand Lake is managed by the Town of Grand Lake, and recreation on the other three reservoirs is managed by the U.S. Forest Service (Table 2).

Figure 1. Map showing the four water bodies included in this program: Grand Lake, Shadow Mountain Reservoir, Lake Granby (collectively referred to as the Three Lakes), and Willow Creek Reservoir.

Table 2. Managing agency by water body included in this program.

Water Body	Managing Agency
Grand Lake	Town of Grand Lake
Shadow Mountain Reservoir	USFS
Lake Granby	USFS
Willow Creek Reservoir	USFS

MONITORING PLAN

In this plan, monitoring for cyanobacteria consists of weekly or bi-weekly site visits and contingency sampling. The objectives of each are described below.

- Weekly and Bi-Weekly Site Visits Objective: To proactively and regularly monitor areas with high public use and contact recreation
- Contingency Sampling Objective: To investigate reports of potential cyanobacteria presence

There is more data collected in these four water bodies as part of other monitoring efforts, which can be used with the site visits to proactively monitor cyanobacteria activity within the geographic area. These additional data collection efforts are described in Appendix B: GCWIN Field Sheet.

Safety

Since cyanobacteria can produce toxins, field staff should always wear gloves when contacting sample water and should wash any areas of skin contact after sample handling. Any symptoms of exposure should be reported to both Poison Control: 800-222-1222 and Grand County Public Health: 970-725-3288 – option 8 and be treated immediately.

Weekly and Bi-Weekly Site Visits

There are five monitoring "zones" where recreational water contact is common and regular site visits will occur: one each in Grand Lake, Willow Creek Reservoir and Shadow Mountain Reservoir, and three in Lake Granby (Table 3). The zones are located along the shoreline in high-use, public access areas where there is contact recreation (Figure 2). The coordinates for the sites represent the general area that will be monitored; samples can be collected at any location along the shoreline within the routine monitoring zone where cyanobacteria are visible. If cyanobacteria are visibly present in multiple regions within a monitoring zone, the area that contains the highest apparent concentration will be sampled. Grand County Water Information Network (GCWIN) will perform the weekly site visits following the Monitoring Flowchart (Figure 3). Site visits will occur from mid-June through mid-October, depending on if conditions are conducive to cyanotoxin production. All sites other than GR-AB are monitored weekly, while GR-AB is monitored every other week because of the distance away from other monitoring locations.

Table 3. Locations for weekly site visits

Station	Description	Latitude	Longitude
GL-BEA	Grand Lake Public Beach to the fishing docks	40.250	-105.818
SM-PB	Shadow Mountain from Pine Beach to Green Ridge Campground	40.219	-105.854
GR-RBA	Lake Granby Rainbow Bay Recreation Area	40.152	-105.877
GR-ST	Lake Granby from Stillwater Recreation Area to Indian Peaks Marina	40.180	-105.885
WC-SS	Willow Creek Reservoir Boat Launch and Fishing Access	40.143	-105.948
GR-AB	Lake Granby around Arapaho Bay	40.126539	-105.767024

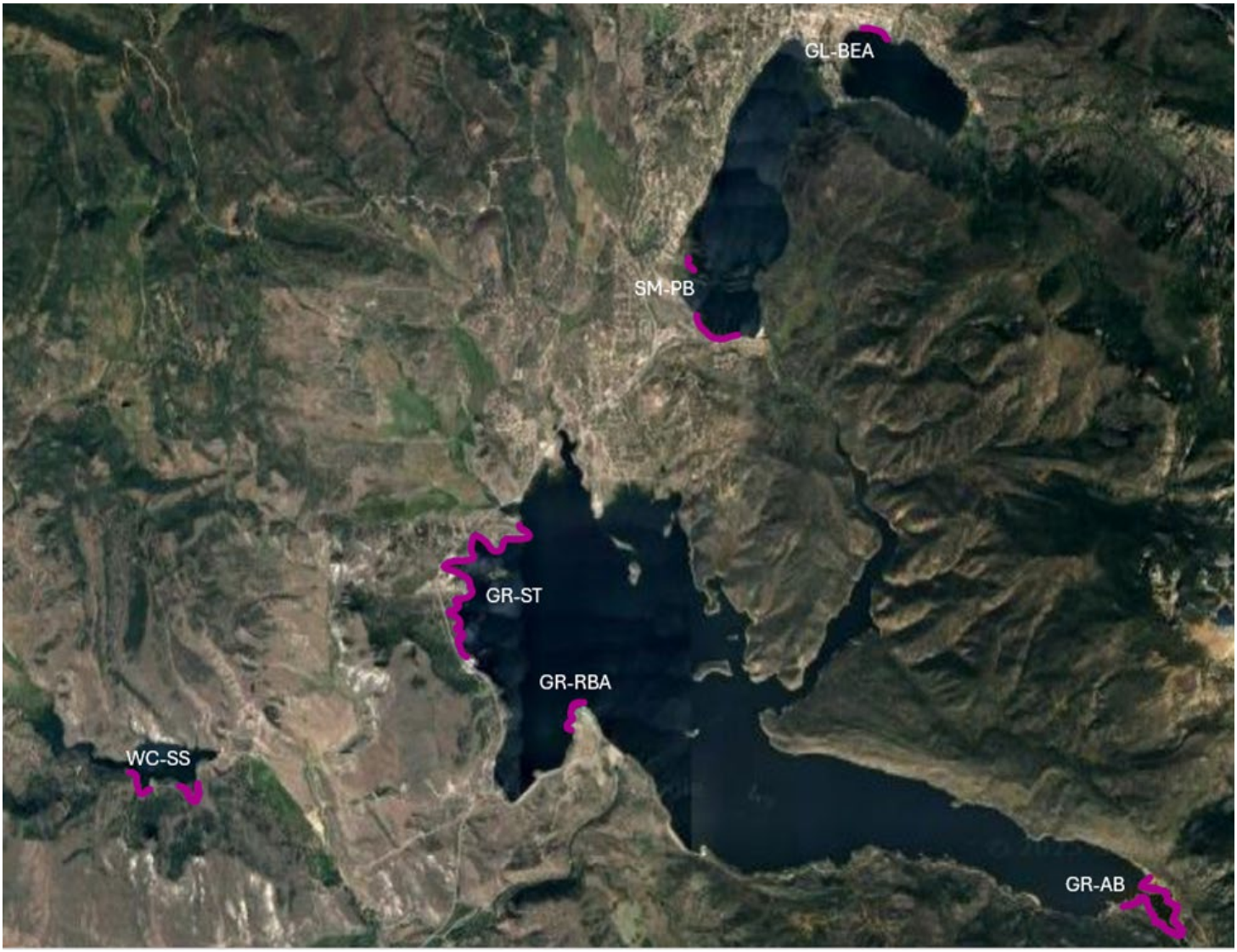

Figure 2. Map of weekly site visit zones.

Phytoplankton and Akinete Sampling

During the first week of August and the first week of October, GCWIN will collect samples from WC-SS, GR-RBA and GR-AB to be sent to BSA Labs for phytoplankton speciation and enumeration as well as akinete enumeration. These samples will help characterize benthic phytoplankton communities at these locations, variation between sampling locations and potential for future cyanobacteria blooms. These samples are independent from cyanotoxin samples but will be shipped to BSA with cyanotoxin samples when applicable.

Contingency Sampling

Since cyanobacteria blooms can form in still, warm locations other than those selected for routine monitoring, a limited number of contingency samples may be collected in the event of a verified report of visual presence of cyanobacteria in any of the four water bodies monitored. In addition to weekly site visits, while performing thrice-weekly Secchi monitoring (Appendix C: Supplemental Data Collection), GCWIN will observe conditions in other locations in Grand Lake and Shadow Mountain Reservoir, including but not limited to the Hilltop and Adams Tunnel boat ramps. If cyanobacteria are visible at locations other than the specified monitoring locations, caution signs will be posted. GCWIN will perform field tests and as-needed Abraxis test strips or sample collection for quantification on samples collected at the nearest area where recreation may be possible

relative to the visual presence of cyanobacteria. This focuses monitoring attention on the areas which are most likely to experience contact recreation.

Monitoring Flowchart

The monitoring steps required during either a weekly site visit or contingency site visit follow guidance from CDPHE (2020). The Monitoring Flowchart (Figure 3) outlines the steps that will be taken to determine the presence/absence of cyanobacteria and cyanotoxin. Either GCWIN or a partner agency can conduct the field observations to investigate and verify any reports of visual presence of cyanobacteria following the steps shown in the monitoring flowchart, up to the "stick" and/or "jar test" step (Monitoring Flowchart, Steps 1-4). If the stick and/or jar test indicate the presence of cyanobacteria, GCWIN will complete the remaining steps (Steps 5-7). The cyanotoxin test strips will be used to determine if a sample should be sent to the lab for further quantification. If there is no test line present for a cyanotoxin test strip, a sample should be sent to BSA Labs for quantification. Concentrations where the test line is present are below toxin advisory levels for recreation from CDPHE for each cyanotoxin and therefore a sample does not need to be sent to BSA Labs for quanitification. Each part of the flow chart is described below.

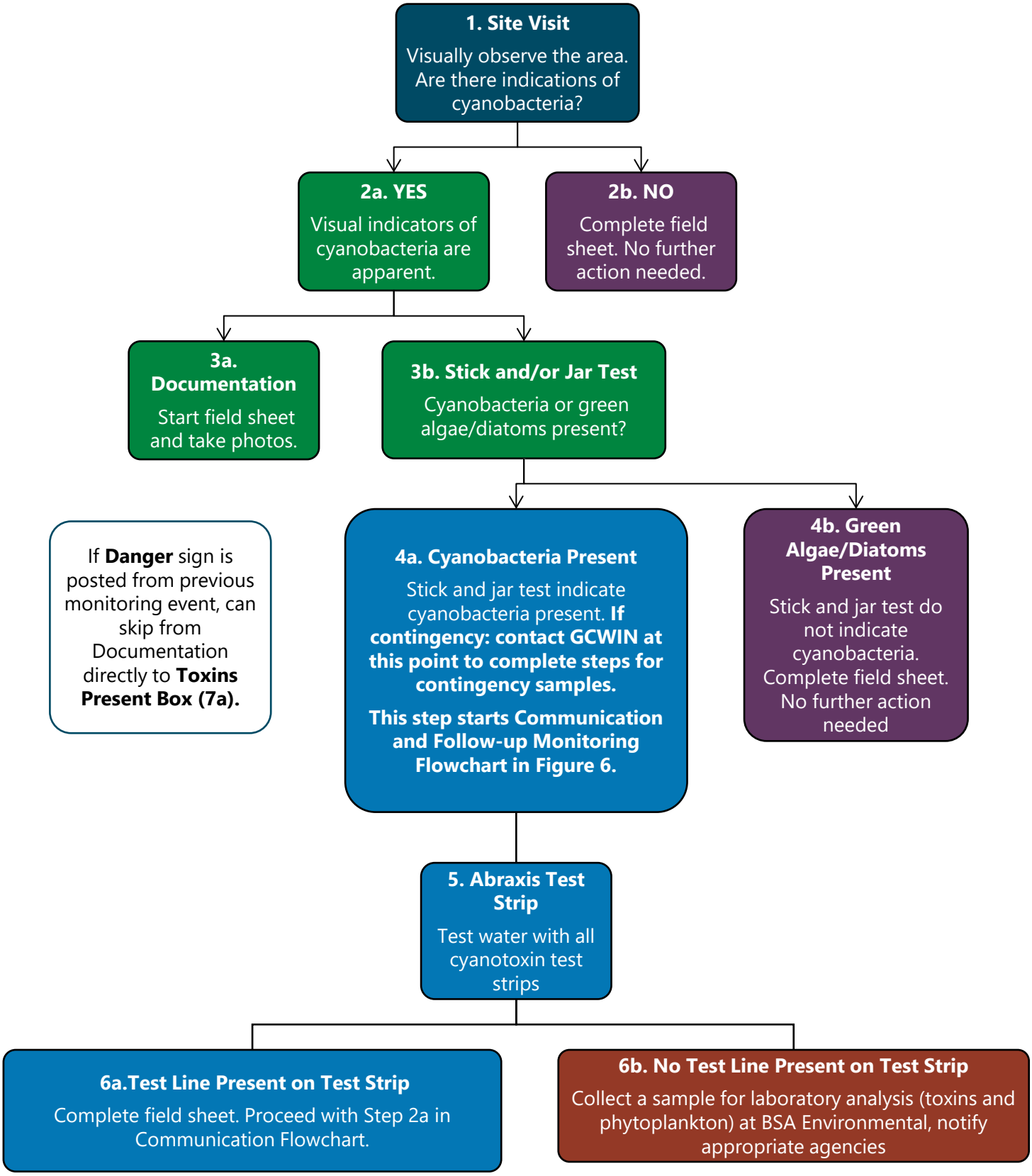

Figure 3. Monitoring Flowchart. Colors and steps convey the following: Purple (steps 2b and 4b) – all clear; Green (steps 2a, 3a, 3b) – caution; Light blue (steps 4a, 5, 6a) – concern.

Field Sheets

Field sheets must be filled out during each site visit. Any suspected identification of a cyanobacteria bloom should be accompanied by photographs. The field sheet is included in Appendix B: GCWIN Field Sheet.

Visual Indicators of a Cyanobacteria Bloom (Steps 1 & 2)

Site visits begin with a visual inspection of the water to assess whether cyanobacteria may be present. Visual signs of cyanobacteria in the water include:

- Surface water discoloration, which can be green, white, red, or turquoise.
- Cyanobacteria blooms can resemble thick pea soup or paint; there is reduced water transparency.
- Thick mats of algae and scum can form along the shoreline.
- Small specks of algae floating on or just below the surface.
- Cyanobacteria blooms are **NOT**: stringy, filamentous or mustard yellow in color.

Below are several examples of what cyanobacteria can look like (courtesy of GCWIN):

Figure 4. Image of potential cyanobacteria.

Figure 5. Image of potential cyanobacteria.

Stick and Jar Tests (Steps 3 & 4)

If there are visible signs of algae, a stick test and/or jar test will be performed which will help determine if the algae are cyanobacteria. Only one of these tests needs to be completed. If either of these tests indicate the presence of cyanobacteria, additional testing is needed. If there is uncertainty in the result of one test, the alternate test should be performed. If there is still uncertainty, additional testing is needed.

Stick Test

A stick test is a simple field test that requires a sturdy stick to be dipped into the algae bloom. After it is dipped, the residue on the stick is observed. If the stick has long, string like, filamentous algae attached to it, it is likely green algae. Green algae are not harmful as they do not produce cyanotoxins. If the stick has a thick coating of non-filamentous algae or looks like it has been painted, it is likely cyanobacteria and additional testing is needed (move to Monitoring Flowchart Step 5 "Abraxis Test Strip").

Figure 6. Example stick test showing likely presence of cyanobacteria.

Jar Test

Cyanobacteria have the unique ability to control their buoyancy in water. The jar test is a qualitative bench test that allows for visual determination of whether cyanobacteria are present in a water sample. After a resting period, cyanobacteria in a jar placed indoors will accumulate on the surface, where green algae will remain distributed throughout the water sample. The following method is used for the jar test, which is modified after City of Boulder Algae and Cyanotoxin Response Annex, May 2021 (References and Resources).

Materials

- A wide-mouthed clear mason jar with lid
- Extendable pole sampler
- Rubber or latex gloves

Method

1. Attach a jar to an extendable pole sampler.
2. While wearing rubber or latex gloves, collect a water sample from the suspected bloom by fully submerging the jar below the surface of the water and then carefully removing the filled jar. Pour off one quarter of the water sample so that the surface of the water can be clearly viewed below the lid of the jar. The water sample should be collected at roughly 0-6 inches depth.
3. Wipe off the outside of the jar and place a lid on the jar.

4. Keep the jar out of the wind (do not shake or agitate the jar in any way).
5. If cyanobacteria are present, they will tend to accumulate as a layer in the upper portion of the sample (note this could take 30 minutes or up to 8 hours or longer if blooms are small). Green algae (which are harmless) will not demonstrate this accumulation and will remain distributed throughout the water column or settle near the bottom. Figure 7 shows an example of cyanobacteria accumulation at the top of the jar (right).

Figure 7. Image of a jar that indicates likely presence of cyanobacteria.

Abraxis Test Strips (Steps 5 & 6)

Abraxis Test Strips are used to determine the presence or absence of cyanotoxins (Figure 8). The test strips used for this program are for drinking water source supplies and have a lower detection limit than the ones commonly used for recreation. This provides more certainty in the results if cyanotoxins are detected. The detection limits for each strip are shown in Table 4. The test strips will be used following the user's guide and instructions provided with the test strip kit.

Figure 8. Abraxis Test Strip Kit

Table 4. Abraxis Test Strip Detection Limits.

Abraxis Test Strip Detection Limit (ppb)	Microcystin	Cylindrospermopsin	Anatoxin-a	Saxitoxin
	5	10	2.5	3

When testing for toxins, the test strips for all four (or all available) cyanotoxins will be used simultaneously. If the test strip for any of the cyanotoxins shows a result with a test line present, no additional sample will be collected or sent to BSA Labs for quantification. If any of the test strips show a result with no test line present, a sample will be collected and sent to BSA Labs for quantification (Figure 9). If no test line is present on the test strips, the test indicates that the cyanotoxin concentrations are at or above the values displayed in Table 4. If the test line is present on the test strips, the test indicates that the cyanotoxin concentrations are below the values displayed in Table 4. Each of these values displayed in Table 4 are below the CDPHE Toxin Advisory Levels for Recreation displayed in Table 1. For example, language from the Microcystin test strip instructions reads: "Test strips with a test line which is lighter than the control line indicates a result which is < 5 ppb. Test strips with no test line visible (only the control line is visible) indicates a result which is ≥ 5 ppb." The same interpretation is consistent with the methods of interpretation for the other cyanotoxin test strips only with the values being different for each. The test strips provide qualitative results, and the laboratory analysis will provide quantification of toxin concentrations.

Figure 9. Example test strip instructions from a microcystin Abraxis Test Strip. If no test line is present, sample concentrations indicate potential concentrations of cyanotoxin above the detection limit, indicating that a sample should be sent to the lab.

Laboratory Analysis (Steps 6b & 7a)

If any test strip results show the absence of a test line indicating cyanobacteria presence at or above the values in Table 4, a sample is collected for laboratory analysis which will provide the concentration of toxins on the sample date. Samples are collected utilizing the recommended guidance from CDPHE 2020 (References and Resources). Note that the CDPHE guidance only applies to the procedures for sample collection and preservation; samples will be submitted to BSA Environmental Services, Inc, in Beachwood, OH, for toxin analysis. Samples will be shipped via FedEx by Wednesday when possible so that results will be available by Friday of the same week. BSA will analyze the samples using the Enzyme-Linked Immunosorbent Assay (ELISA) method. This method provides quantitative results for the four cyanotoxins of concern: microcystin, cylindrospermopsin, anatoxin-a, and saxitoxin.

RESPONSE AND COMMUNICATION PLAN

Communication and Follow-Up Monitoring

After each weekly site visit, GCWIN will distribute completed field sheets along with a summary of any signage change recommendations to Grand County, Northern Water, Three Lakes Watershed Association, the USFS, and the U.S. Bureau of Reclamation. Field sheets completed for contingency monitoring by partner agencies should be sent to GCWIN to redistribute to all partner agencies.

If the results from the laboratory confirm cyanotoxins are present, follow the Communication and Follow-up Monitoring Flowchart (Figure 3). First, the partners in will be contacted to coordinate a response. Partners will issue public notifications immediately (i.e., warnings, advisories, or closures) based on the cyanotoxin level and the risk it presents to human and animal health.

To promote quick placement of signage, Northern Water will notify the contacts from the Town of Grand Lake if cyanobacteria are identified in Grand Lake and will notify the USFS if cyanobacteria are identified in any of the water bodies. Each entity will be responsible for contacting additional people within their organization. Partners will monitor and sample the waterbody to confirm or modify the notification until lab tests show the cyanotoxins are below safe levels and visual signs of the bloom are gone.

Table 5. Primary contacts for each organization.

Organization	Title	Contact Name	Phone	Email
Grand County	Communications Director	Christine Travis	970-725-3136	ctravis@co.grand.co.us
	Water Quality Manager	Katherine Morris	970-531 8494	kmorris@co.grand.co.us
	Public Health	Abbie Baker	970-509-9309	abaker@co.grand.co.us
	Water Quality Specialist	Kayli Foulk	814-720-7353	kfoulk@co.grand.co.us
	Public Heath (General)	-	970-725-3288, option 8	
Northern Water	Water Quality Department Manager	Jen Stephenson	970-622-2334	jstephenson@northernwater.org
	Collections Department Manager	Craig Friar	970-627-7332	cfriar@northernwater.org
	Associate Water Quality Specialist	Becca Jonswold	970-786-4323	bjonswold@northernwater.org

Organization	Title	Contact Name	Phone	Email
USDA Forest Service	PAO	Reid Armstrong		Katherine.armstrong@usda.gov
	ARNA Manager	Paige Seibert	970-732-0093	Paige.seibert@usda.gov
	District Ranger	Eric Freels		Eric.k.freels@usda.gov
	Recreation Staff Officer	Andrew McElwee	970-281-0945	Andrew.McElwee@usda.gov
	Hydrologist	Tracy Weddle		Tracy.weddle@usda.gov
Colorado Department of Health and Environment	HAB Coordinator, Water Quality Control Division	Sarah Erickson	720-282-9168	Sarah.erickson@state.co.us
	State Toxicologist	Kristy Richardson	303-692-3287	Kristy.richardson@state.co.us
United States Bureau of Reclamation	Reclamation Public Affairs	Anna Perea	970-290-1185	aperea@usbr.gov
	Water Resources Group Leader	James Vanshaar	970-461-5424	jvanshaar@usbr.gov
Town of Grand Lake	Community Engagement Manager	Katie Hearsum	513-505-9553	khearsum@toglco.com
	Public Works Director	Matt Reed	970-531-9594	mreed-tolonen@toglco.com
	Town Manager	Steve Kudron		skudron@toglco.com
	Mayor	Christina Bergquist	970-627-3435	
Three Lakes Watershed Association	Director	Jeff Metzger	303-898-9190	Jmetzger36@gmail.com
Grand Lake Water Information Network (GCWIN)	Director	Kyle Masterson	970-596-3887	director@gcwin.org

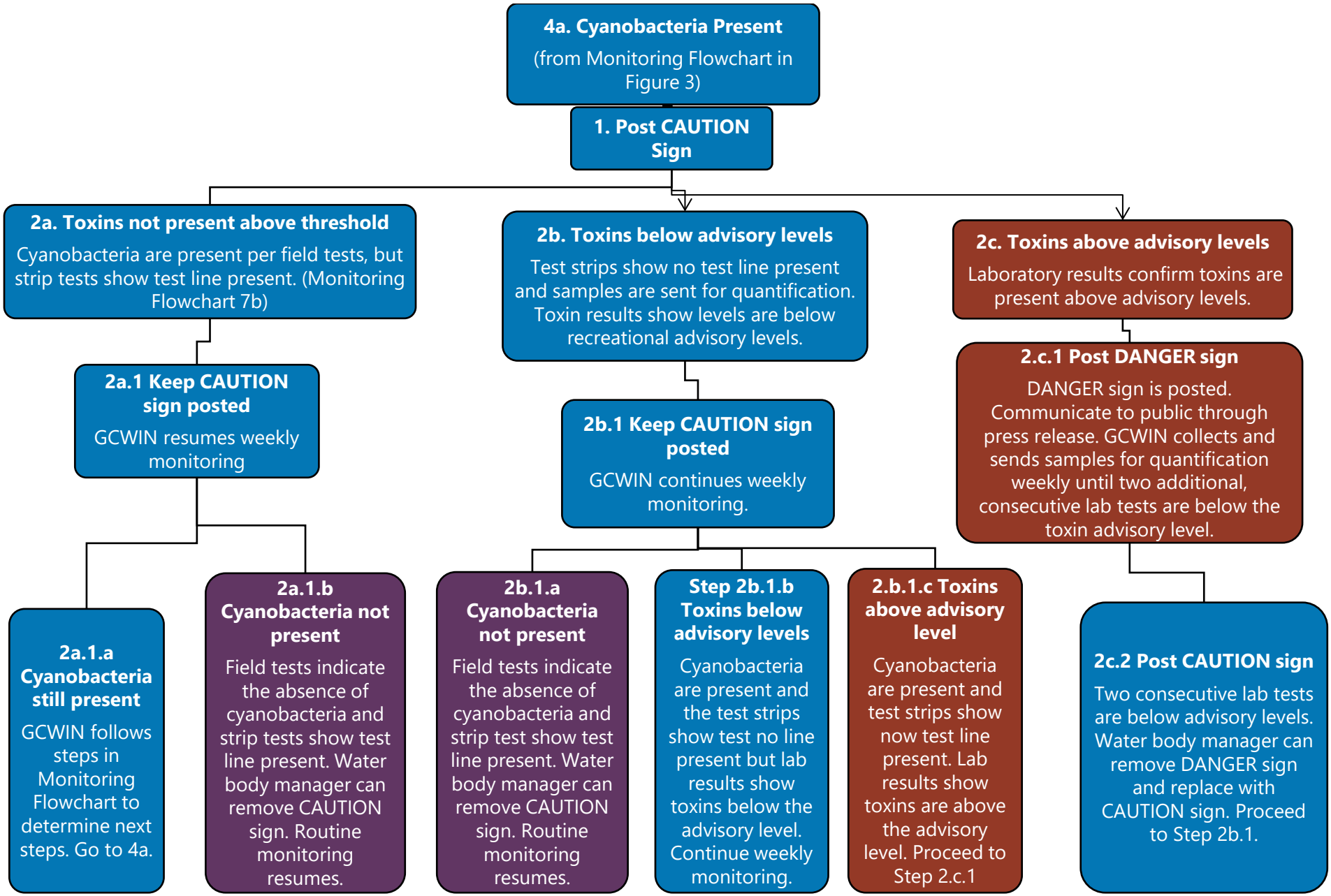

Figure 10. Communication Flowchart. Purple (steps 2a.1.b and 2b.1.a) – all clear; Light blue (steps 4a, 1, 2a, 2b, 2a.1, 2b.1, 2a.1.a, 2b.1.b, 2c.2) – concern; Red (steps 2c, 2.c.1, 2.b.1.c) – danger.

Signage

If the Communication and Follow-up Monitoring Flowchart determines that a CAUTION or DANGER sign needs to be posted to ensure public safety, signage should be posted in an area(s) high visibility location including, but not limited to, the following: swim beaches, access points for recreational activities including docks, boat launch areas, etc., and areas where children may wade.

Signage is currently available electronically (http://bit.ly/HABSigns) in English and Spanish and examples are shown in Appendix D: Signage. If printing from the electronic file, CDPHE recommends signage is at least 18 inches wide by 24 inches tall and printed in color so they are obvious to the public and easy to read. Metal signs may also be available, and details are also described below.

Two versions of the DANGER sign are available for posting: one for a specific area or one for an entire water body. If just a portion of a large water body is tested and results are above the toxin advisory levels, the DANGER sign stating "Area is Closed" should be posted. If test results are above the toxin advisory levels and visual monitoring indicates several areas of a water body are affected, the DANGER sign stating "Lake is Closed" should be posted. Recreation managers can choose if they will close a body of water based on monitoring results.

For Shadow Mountain Reservoir, Lake Granby, and Willow Creek Reservoir, USFS will post signage. Examples of the signs and the Arapaho National Recreation Area sign plan that details sign locations and protocols are in Appendix E: USFS Arapaho National Recreation Area Cyanotoxin Sign and Information Plan. The Town of Grand Lake will follow a similar protocol as the USFS but will only post signs if cyanobacteria are identified in Grand Lake.

SUMMARY

This Cyanobacteria Monitoring, Response, and Communication Plan encompasses Grand Lake, Shadow Mountain Reservoir, Lake Granby and Willow Creek Reservoir. Monitoring occurs seasonally from approximately mid-June through mid-October. Either through weekly site visits, contingency sampling, or supplemental monitoring, water bodies are examined for cyanobacteria and cyanotoxin presence following the Monitoring Flowchart (Figure 3). Depending on the presence or absence of cyanobacteria and cyanotoxins, signage and closures may or may not be needed as determined by the Communication and Follow-up Monitoring Flowchart (Figure 10). Communication among entities listed in Table 5 is essential throughout the monitoring season for rapid and coordinated response. This Plan is revisited on an as-needed basis between monitoring seasons to incorporate changes and lessons learned.

REFERENCES AND RESOURCES

CDPHE (2020). Toxic Algae (Harmful Algae Blooms) Risk Management Toolkit for Recreational Waters. Available on the CDPHE's Toxic Algae webpage: https://cdphe.colorado.gov/toxic-algae or here: https://drive.google.com/file/d/0B0tmPQ67k3NVczRwQkc3Q2dOXzA/view?resourcekey=0-BYj8JjMFDhUXMVnH9L-8zA

City of Boulder Algae and Cyanotoxin Response Annex, May 2021. https://northernwater.sharepoint.com/sites/CyanoMonitoring/Shared%20Documents/Forms/AllItems.aspx?id=%2Fsites%2FCyanoMonitoring%2FShared%20Documents%2FReference%20Documents%2FAnnex%5FAlgae%5FResponse%5FPlan%5Fboulder%2Epdf&viewid=b414ff5a%2Dd1d4%2D4361%2Daa32%2D53c8c2d53803&parent=%2Fsites%2FCyanoMonitoring%2FShared%20Documents%2FReference%20Documents

U.S. Environmental Protection Agency (EPA) Cyanobacterial Harmful Algal Booms (CyanoHABS) in Water Bodies website. https://www.epa.gov/cyanohabs

U.S. Environmental Protection Agency (EPA) Monitoring and Responding to Cyanobacteria and Cyanotoxins in Recreational Waters website. https://www.epa.gov/cyanohabs/monitoring-and-responding-cyanobacteria-and-cyanotoxins-recreational-waters

Kansas Department of Health and Environment. The Jar and Stick Tests. https://www.kdhe.ks.gov/DocumentCenter/View/6425/The-Jar-and-Stick-Tests-PDF?bidId=

APPENDIX A: SUMMARY OF PROGRAM CHANGES

Year	Description of Change
2024	The monitoring protocol is modified to send samples to BSA for toxin quantification only when one of the test strips has no test line present, indicating cyanotoxin concentrations at or above the detection threshold of one or more of the strip tests. This reduces any inconsistency or bias introduced from attempts to quantify cyanotoxin concentrations from the test strips below the detection threshold.
2025	GR-AB is added as a routine monitoring location. Site visits to GR-AB will be conducted every other week due to physical distance from other monitoring locations.
2025	Samples taken during the first week of August and the first week of October are added for phytoplankton speciation and enumeration as well as akinete enumeration. These samples are collected from the littoral zone at WC-SS, GR-RBA and GR-AB. These samples will help characterize benthic phytoplankton conditions and observe similarities and differences between monitoring locations.

APPENDIX B: GCWIN FIELD SHEET

Field Staff _____ Date _____

2024 Cyanobacteria Monitoring Program - Field Sheet							Field Tests			GCWIN LAB RESULTS | Complete ONLY if field tests come are "True" ABRAXIS Test | Test Line Present? (✓ if True)			
Time of Visit	Site	Surface Water Temp (°C)	Air Temp (°C)	Surface Water Color	Sky	Wind	Visible Signs of Cyanobacteria (✓ if True)	Stick Test Positive (✓ if True)	Jar Test Positive (✓ if True)	Microcystin	Anatoxin-a	Saxitoxin	Cylindro-spermopsin
	WC-SS												
	GR-RBA												
	GR-ST												
	SM-PB												
	GL-BEA												
	*GR-AB												

A present "Test Line" suggests the level of toxin present is below the threshold. If any test results in an "Absent" test line, GCWIN will follow protocols to send sample to BSA Environmental Services, Inc

Field Notes	
GL-BEA	
SM-PB	
GR-ST	
GR-RBA	
WC-SS	
*GR-AB	

APPENDIX C: SUPPLEMENTAL DATA COLLECTION

Northern Water Routine Data Collection

As part of Northern Water's Baseline Water Quality Monitoring Program, routine data collection is conducted by Northern Water, in partnership with the USGS, at all four of the water bodies. Some of these data collection efforts directly inform this Cyanobacteria Monitoring Plan and can be relied on as supplemental information. This includes:

Phytoplankton data are used to develop detailed data records of phytoplankton species composition and abundance. Sampling is completed monthly during May through October and during two additional winter sampling events typically in January and March. Phytoplankton samples are analyzed at BSA Environmental Services, Inc. Turnaround times vary between 10 and 45 days based on if the samples are expedited or not. This analysis takes some time as it requires identification of all species in the sample, but these data are valuable as they provide a baseline dataset to compare to as well as quantification of the phytoplankton species in the water body.

Depth-profile measurements of the water column measuring dissolved oxygen, temperature, turbidity, pH, specific conductivity, phycocyanin and chlorophyll a are taken at numerous sites (Table 6). The profile data are collected every 1 meter from depths of 0 to 25 meters and every 5 meters from a depth of 25 meters to the bottom. This data is typically available within a week of sampling and can be used throughout the summer to monitor trends of chlorophyll and phycocyanin. Profile measurements are taken at the same time as phytoplankton sample collection, monthly during May through October and during two winter sampling events typically in January and March.

Real-time monitoring is conducted to capture changes and at strategic locations to proactively assess whether a bloom might be forming, as well as to develop records for tracking long-term trends. Northern Water has two multiparameter sondes attached to buoys in Shadow Mountain Reservoir that collect a variety of water quality data, including both chlorophyll-a and phycocyanin (a combination of which provides information about algal activity). In addition, there are several monitoring locations in the interflows/outflows of the system that help monitor water quality conditions between the waterbodies.

Table 6. Locations for routine data collection.

Station	Description	Phyto	Depth-Profile	Real-Time	Latitude	Longitude
AT-WP	West Portal Adams Tunnel			X	40.2417	-105.8014
GL-ATW	Grand Lake West Portal of Adams Tunnel		X		40.2411	-105.8045
GL-MID[1]	Grand Lake Mid-Section	X	X		40.2433	-105.8133
GL-CHL	Shadow Mountain Connecting Channel to Grand Lake	X	X	X[2]	40.2445	-105.8247
SM-DAM	Shadow Mountain Reservoir Dam	X	X	X	40.2101	-105.8421
SM-MID[1]	Shadow Mountain Reservoir Mid-Section	X	X	X	40.2252	-105.8372
GR-PUMP	Granby Pump Canal	X		X	40.2068	-105.8495
GR-DAM[1]	Lake Granby near the Dam	X	X		40.1497	-105.8649
GR-WES	Lake Granby West Side		X		40.175	-105.8697
GR-EAS	Lake Granby East Side		X		40.1350	-105.7964
WC-DAM[1]	Willow Creek Reservoir at Dam	X	X		40.1497	-105.9435

Secchi Monitoring Program

Secchi Disk measurements are collected by GCWIN three times a week (Monday, Wednesday, Friday, typically) in Shadow Mountain Reservoir and Grand Lake as part of the Grand Lake Adaptive Management program. GCWIN boats from the south end of Shadow Mountain Reservoir to the northeast end of Grand Lake, allowing observations of algal/cyanobacteria conditions in both water bodies.

Table 7. Locations for Secchi Monitoring

Station ID	Description	Latitude	Longitude
GL-WES	Grand Lake south of Shadow Mountain Connecting Channel	40.2419	-105.8215
GL-MID	Grand Lake at mid-section	40.2434	-105.8138
GL-ATW	Grand Lake at Adams Tunnel West Portal	40.2411	-105.8050
SM-NOR2	Shadow Mountain Reservoir at the north end	40.2445	-105.8393
SM-MID	Shadow Mountain Reservoir at mid-section	40.2236	-105.8373
SM-DAM	Shadow Mountain Reservoir at the dam	40.2086	-105.8431
SM-NW1	Shadow Mountain Reservoir northwest of the center	40.2370	-105.8418

APPENDIX D: SIGNAGE

Figure 11. Example of a Danger sign that could be posted in the event cyanotoxin concentrations are at or above the state recreational threshold.

Figure 12. Example of a Danger sign that could be posted in the event cyanotoxin concentrations are at or above the state recreational threshold.

APPENDIX E: USFS ARAPAHO NATIONAL RECREATION AREA CYANOTOXIN SIGN AND INFORMATION PLAN

Locations (These sites are listed because they frequently have visitors accessing the water by wading and/or watercraft)

Time Frame
June 1 to Sept 30

Willow Creek Reservoir
Willow Creek Reservoir Access Road

Lake Granby
Sunset Point Boat Launch
Stillwater Boat Launch
Highland Marina
Indian Peaks Marina
Beacon Landing Marina
Quinette Point Picnic Area
Rainbow Bay Picnic Area
Willow Creek Canal Picnic Area
Sunset Point Campground
Stillwater Campground
Cutthroat Bay Group Campground
Arapaho Bay Campground Loops
Roaring Fork Boat Ramp

Shadow Mountain Reservoir
Green Ridge Boat Launch
Hilltop Boat Launch
Pine Beach Picnic Area
Shadow Mountain Picnic Area
Green Ridge Campground

Grand Lake
Point Park Picnic Area

Information Posting Strategy
The following information boards will be posted as needed depending on the safety concerns that arise from visual assessment or test results. This approach is desirable because it is easy to put together and maintain without ordering expensive aluminum signs and investing in the time to install permanent signs. The general information poster can be posted for the entire season, and the other

posters can be placed adjacent to the simple Toxic Algae in Colorado sign when needed with little effort.

Table 8. Town of Grand Lake sign posting locations if cyanobacteria are observed or cyanotoxins are detected in Grand Lake.

Site name	Latitude	Longitude
Hand Launch Boat Ramp	40.2509	-105.8209
Grand Lake Boat Dock	40.2505	-105.8191
Grand Lake Public Access	40.2498	-105.8248
Grand Lake Beach	40.2501	-105.8175
Tunnel Picnic Area	40.2507	-105.8018
East Inlet Picnic Area	40.2386	-105.8017
East Inlet Boat Launch	40.2390	-105.8015

Default Message (When the conditions do not warrant any other posting)
4'x4' Sandwich Board

Caution Message (When the conditions indicate a concern warrants a Caution)
4’x4’ Sandwich Board

Danger Message (When the conditions warrant a full-body contact prohibition with water)
4'x4' Sandwich Board

Toxic algae in Colorado

Algae is common and natural to our waters in Colorado. But some algae can multiply rapidly, form blooms or scums, and create toxins that can harm people, animals, and the local environment.

Toxic algae can

- Make the water look green, turquoise, gold, or red.
- Look like thick pea soup or spilled paint on the water's surface.
- Be made up of small specks or blobs floating at or just below the water's surface.

Toxic algae is typically not

- Stringy in appearance.
- Mustard yellow in color (this likely is pollen).

Learn more

- For questions about the health effects of toxic algae, call poison control at 1-800-222-1222.
- For more information about toxic algae, visit www.colorado.gov/cdphe/harmful-algae-blooms

When in doubt, stay out!

Don't go in the water if toxic algae is present.

- No swimming or wading in toxic algae.
- Keep kids and animals away from the water. Don't let them eat or play with toxic algae.
- Don't drink water that may contain toxic algae.
- Boating permitted: avoid areas with toxic algae.
- Clean fish well & discard guts appropriately.

Exposed?

Shower immediately. See a doctor or vet if symptoms occur.

Symptoms

Pets	People
• drooling	• skin irritation, rashes
• diarrhea	• nausea, vomiting
• vomiting	• diarrhea, stomach cramps
• low energy	• fever, headache, sore throat
• not eating	• liver damage
• stumbling	• allergic reactions
• tremors	• asthma flareups

COLORADO Department of Public Health & Environment

DANGER

LAKE IS CLOSED TO FULL-BODY CONTACT

Toxic algae is present!

Water contact can cause illness

- Keep kids out
- No pets in water (death may occur)
- Do not drink water
- No water recreation (swimming, skiing, paddle-boarding, wading, etc.)
- If exposed, shower immediately

Fishing permitted - rinse fish with clean water and properly dispose guts
Boating permitted - avoid algae

If you or your animals have nausea, vomiting, diarrhea, rash, irritated eyes, seizures or breathing problems, call Poison Control: 1-800-222-1222

PELIGRO

EL LAGO ESTÁ CERRADA A TODO CONTACTO CORPORAL

¡Presencia de algas tóxicas!

El contacto con el agua puede causar enfermedades

- Mantenga a los niños alejados
- No se permiten mascotas en el agua (puede provocar la muerte)
- No beba el agua
- No se permiten actividades acuáticas recreativas (nadar, caminar por el agua, practicar esquí o paddleboard, etc.)
- En caso de exposición, dúchese de inmediato

Se permite la pesca: enjuagar los pescados con agua limpiay desechar apropiadamente las vísceras
Se permite la navegación: evitar las algas

Si usted o sus mascotas presentan náuseas, vómitos, diarrea, sarpullido, irritación en los ojos, convulsiones o problemas para respirar, llame al control de intoxicación: 1-800-222-1222

Order # ARP-SRD-2021-01

USDA FOREST SERVICE
ARAPAHO NATIONAL FOREST
SULPHUR RANGER DISTRICT
FOREST ORDER
Willow Creek Reservoir Harmful Algae Bloom

Pursuant to 16 U.S.C. § 551 and 36 CFR 261.50(a) and (b), the following acts are prohibited on National Forest System (NFS) lands within the Sulphur Ranger District of the Arapaho National Forest, Grand County, Colorado described below and shown on the attached map incorporated into this Order as Exhibit A (the "Restricted Areas"). The purpose of this Order is to protect public health and safety on the areas affected by an observed harmful algae bloom by prohibiting full-body contact water recreation (swimming, skiing, paddle-boarding, wading, etc.).

RESTRICTED AREAS:

- The Willow Creek Reservoir.

PROHIBITIONS:

When provided by an order, the following are prohibited:

1. **Entering or being in a body of water. 36 CFR 261.58(i).**

EXEMPTIONS:

Pursuant to 36 CFR 261.50(e), the following persons are exempt from this Order:

1. Any federal, state or local officer, or member of an organized rescue or firefighting force in the performance of an official duty;
2. Persons with a special use authorization or other Forest Service authorization specifically exempting them from this Order.
3. Persons boating upon the water where full body contact water recreation (swimming, skiing, paddle boarding, wading, etc.) is avoided.

This Order becomes effective when signed and shall remain in effect until October 1, 2021 or until rescinded, whichever occurs first.

Executed in Fort Collins, Colorado this 30th day of July 2021.

MONTE WILLIAMS

MONTE WILLIAMS
Forest Supervisor
Arapaho and Roosevelt National Forests and Pawnee National Grassland

A violation of these prohibitions is punishable by a fine of not more than $5,000 for an individual or $10,000 for an organization, imprisonment for not more than 6 months, or both. (16 U.S.C. § 551 and 18 U.S.C. §§ 3559, 3571, 3581.)

APPENDIX F: PROGRAM HISTORY ELISA CYANOTOXIN DATA

Year	Site	Date	Microcystin (ug/L)	Anatoxin (ug/L)	Saxitoxin (ug/L)	Cylindrospermopsin (ug/L)
Recreational Advisory Level			8 ug/L	15 ug/L	15 ug/L	8 ug/L
2024	WC-SS	10/28/24	1.242	1.277	0.15514	<0.05
2023	WC-SS	9/26/23	<0.05	0.296	<0.02	<0.05
2023	WC-SS	10/3/23	<0.05	<0.15	<0.02	<0.05
2023	WC-SS	10/10/23	0.619	<0.15	<0.02	<0.05
2023	WC-SS	10/17/23	<0.05	<0.15	<0.02	<0.05
2023	WC-SS	10/27/23	<0.05	<0.15	<0.02	<0.05
2022	WC-SS	9/20/22	<0.05	<0.15	0.282	<0.05
2021	WC-BR	7/28/21	0.078	<0.15	<0.02	<0.05