Environmental Protection Agency

Public Water System Harmful Algal Bloom Response Strategy

Division of Drinking and Ground Waters
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List of Definitions

Action level— Concentration of cyanotoxin which, if exceeded, will require additional monitoring, and potentially other actions as described in OAC Chapter 3745-90.

Anatoxin-a — A nerve toxin produced by a number of cyanobacteria.

Biovolume — The volume of cells in a unit volume of water. Biovolume is calculated to determine the relative abundance of co-occurring phytoplankton of varying shapes and sizes.

Blue-green algae — Common name for cyanobacteria, see definition below.

Consecutive samples — Successive samples that are collected on separate calendar days.

Cyanobacteria — Photosynthesizing bacteria, also called blue-green algae, which naturally occur in marine and freshwater ecosystems and may produce cyanotoxins which at sufficiently high concentrations can pose a risk to public health.

Cyanobacteria screening — Quantitative polymerase chain reaction (qPCR) for the detection of genes unique to cyanobacteria and genes associated with the production of cyanotoxins, a method for phytoplankton identification, or a semiquantitative method of cyanotoxin analysis acceptable to the director.

Cyanotoxin — Toxin (such as microcystins) produced by cyanobacteria, which include liver toxins, nerve toxins, and skin toxins.

Cylindrospermopsin — A liver toxin produced by a number of cyanobacteria.

cyrA- cylindrospermopsin production gene.

Detection or **detected** — An analytical result that is equal to or greater than the reporting limit for the analytical method being used.

Distribution sampling points — Representative points in the distribution system.

ELISA (Enzyme-Linked Immunosorbent Assay) — A rapid assessment method commonly used to detect microcystins, cylindrospermopsin, anatoxin-a, and saxitoxin.

Finished drinking water — Treated water ready for human consumption.

Finished water sampling point — Each entry point to the distribution system which is representative of the water intended for the distribution and consumption without further treatment, except as necessary to maintain water quality in the distribution system (e.g., booster disinfection, addition of corrosion control chemicals).

Extracellular — Located or occurring outside of a cell or cells.

HAB (harmful algal bloom) — A concentration of cyanobacteria that discolors the water, or a cell count greater than 4,000 cells/mL of cyanobacteria genera capable of cyanotoxin production (Shambaugh and Brines, 2003). Accumulations of cyanobacteria cells may be present at the water surface, at a defined depth, or throughout the water column.

Harmful algal bloom season — Period beginning the first full week of June until the beginning of off-season (first full week of December) of the same calendar year.

Harmful algal bloom off-season — Period beginning the first full week of December until the beginning of harmful algal bloom season (first full week of June) of the following calendar year.

Intracellular — Located or occurring within a cell or cells.

***mycE* -** Microcystins production gene.

Microcystins —Total microcystins: the combination of all the variants of the cyanotoxin microcystin, which is produced by a number of cyanobacteria.

Paired samples – A sample set of one raw water sample (LT001) and one finished water sample (EP001) taken at the same time.

Photic zone — The uppermost layer in a body of water into which light penetrates in sufficient amounts to influence living organisms, especially by permitting photosynthesis.

Phytoplankton — Free-floating photosynthesizing microscopic organisms that inhabit almost all bodies of water, and include cyanobacteria, diatoms, green algae, and dinoflagellates.

Raw water sampling point — Each plant intake in use prior to any treatment, or another raw water sampling point acceptable to the director.

Resample — The first sample required after a microcystins action level exceedance in a sample collected at the finished water sampling point.

Repeat sample — The second sample required after a microcystins action level exceedance in a sample collected at the finished water sampling point.

Saxitoxin— Nerve toxin produced by a number of cyanobacteria.

Scum — A cyanobacterial bloom that has a dense surface accumulation of cyanobacteria cells.

Source water — Water used as a source for public drinking water.

sxtA- Saxitoxin production gene.

Treatment Optimization Protocol (TOP)—Document that is required in accordance with Ohio Administrative Code (OAC) Rule 3745-90-05 for all public water systems (PWS) receiving water from a surface water source. It must provide details on how a PWS will optimize existing treatment for microcystins removal.

Week — Period of seven days beginning with Sunday and ending with Saturday.

Weekly — Once during the period of seven days beginning with Sunday and ending with Saturday.

16S - rRNA gene of Cyanobacteria.

Executive Summary

The public water system (PWS) harmful algal bloom (HAB) response strategy provides guidelines on HAB monitoring and sampling protocols, identifies acceptable analytical methods, and identifies cyanotoxin levels that will be used to make advisory decisions. PWS' with a surface water source(s) must comply with the updated HAB monitoring and reporting rule requirements, OAC 3745-90. The most updated version of this rule can be found on the Ohio EPA Division of Drinking and Groundwater's regulations webpage, ***DDAGW Effective Rules | Ohio Environmental Protection Agency***. The strategy is regularly reviewed and includes updates based on the agency's experience and knowledge with HABs.

Numerical Cyanotoxin Thresholds for Drinking Water

The thresholds will be used to determine when a public health advisory will be issued for a detection of cyanotoxins in finished drinking water as detailed in section 4.3.1. The child and adult drinking water thresholds for all cyanotoxins remain unchanged from the 2022 PWS HAB Response Strategy and are as follows:

Table 1. Ohio Numerical Cyanotoxin Thresholds for Drinking Water

Drinking Water Thresholds*	Microcystins (µg/L)	Anatoxin-a (µg/L)	Cylindrospermopsin (µg/L)	Saxitoxins (µg/L)
Do Not Drink – children under 6, including bottle-fed infants and sensitive populations	0.3	0.3	0.7	0.3
Do Not Drink – children 6 and older and adults	1.6	1.6	3.0	1.6

**The microcystins and saxitoxins thresholds are intended to be applied to total concentrations of all reported congeners/variants. Ohio EPA will also consider established saxitoxin toxicity equivalency factors when determining if a threshold has been exceeded (see Appendix B).*

For sensitive populations, Ohio includes pregnant women, nursing mothers, and those receiving dialysis treatment in the do not drink category with children under six years old for all cyanotoxins. Ohio has also added those with pre-existing liver conditions to the do not drink category for sensitive populations for the microcystins and cylindrospermopsin advisories only because they are hepatotoxins. Ohio concurs with the U.S. EPA recommendation that elderly and immunocompromised individuals may want to consider following the recommendations for children under six years old.

The numerical cyanotoxin thresholds for recreational waters are identified in the current ***Ohio HAB Response Strategy for Recreational Waters***.

HAB Monitoring and Analytical Methods

All surface water PWSs must conduct routine microcystins monitoring and cyanobacteria screening in accordance with OAC Rule 3745-90-03. The 2025 PWS HAB Response Strategy details monitoring requirements for microcystins, as well as saxitoxins, cylindrospermopsin, and anatoxin-a. Detections in the cyanobacteria screening sample will trigger follow-up cyanotoxin testing and additional sampling by Ohio EPA. Cyanotoxin data collected from this monitoring can be found at: ***Public Water System HAB Data and Map***. The analytical methods and reporting requirements for cyanobacteria screening and microcystins were refined in 2022 and are consistent with OAC Rule 3745-90-04. See Section 3.1.1 for more details on specific methods.

Response to Finished Water Threshold Exceedance and Issuing Drinking Water Use Advisories

Ohio EPA should be notified of any finished water cyanotoxin detections as soon as possible, but no later than 24 hours. Please call the spill hotline at 1-866-372-1800 if the finished water exceedance comes

through after hours. The PWS should also follow response procedures detailed in their contingency plan as applicable (OAC Rule 3745-85-01). The response to microcystins threshold exceedances is detailed in OAC Rules 3745-90-03, 3745-90-05, and 3745-90-06. The response to saxitoxin, cylindrospermopsin and anatoxin-a is detailed in Section 4.2.

A drinking water use advisory will be issued based on finished water detections of a cyanotoxin above the applicable threshold. Public notification for total microcystins threshold exceedances will be conducted in accordance with OAC Rule 3745-90-06.

If thresholds for saxitoxins, cylindrospermopsin, or anatoxin-a are exceeded in resample and repeat sample results, Ohio EPA recommends PWSs issue a public notification as soon as possible, but no later than 24 hours. The public notice should include health effects language and use restrictions. Ohio EPA will evaluate the sample results and work with the PWS to determine if a public notice should be issued.

If the PWS does not issue public notification as recommended, Ohio EPA may issue a drinking water use advisory in accordance with Ohio Revised Code (ORC) section 6109.06 or may require the PWS to issue public notification under the authority of OAC Rule 3745-81-32.

Proactive Measures

Ohio EPA encourages PWSs to be proactive by developing and implementing source water protection strategies that are best for their water system and source water concerns. These could include additional source water HAB monitoring, reservoir management practices, contingency planning, and general source water protection strategies. Section 5 covers these in more detail.

Additionally, Ohio EPA's Source Water Assessment & Protection Program (SWAP) works with PWSs to help protect their source water by providing source water assessment reports and assistance with protection planning. This includes delineation of areas in the watershed that supply a PWS's source water as well as identifying potential contaminant sources within these areas. The PWS can use this information to develop a source water protection plan which details the actionable protective strategies that will be implemented.

1 — Introduction

1.1 Purpose of the PWS HAB Response Strategy

The purpose of the public water system (PWS) harmful algal bloom (HAB) response strategy is to protect the public from cyanotoxins produced by cyanobacteria that may be present in sources of drinking water at concentrations that can affect human health.

Ohio's PWS HAB Response Strategy identifies cyanotoxin levels that will be used to make water use advisory decisions. It also provides monitoring guidelines and sampling protocols, identifies acceptable analytical methods, and recommends treatment optimization protocols. The PWS HAB response strategy complements the HAB rules included in OAC Chapter 3745-90 and in OAC Chapter 3745-89 (laboratory certification).

The State of Ohio continues to refine its PWS HAB response strategy to provide a consistent and timely response to HABs in PWS source waters and ensure treatment technologies are effective at cyanotoxin removal. The state of the science of HABs and their related cyanotoxins is evolving, and Ohio EPA will continue to update these guidelines as appropriate. A separate procedure for responding to HABs at beaches and recreational waters, ***Ohio HAB Response Strategy for Recreational Waters***, is available online at ***ohioalgaeinfo.com***.

1.2 Cyanobacteria Causes of Concern

Cyanobacteria can produce a variety of harmful toxins called cyanotoxins that can cause illness and death in humans and animals. These cyanotoxins can affect the liver, nerves, and skin. Some of the more common cyanotoxins detected in Ohio waters include microcystins and saxitoxins. Cylindrospermopsin and anatoxin-a have also been detected, but much less frequently. Symptoms of cyanotoxin exposure include nausea, rashes, gastrointestinal distress, disorientation, numbness, and fatigue, and can easily be mistaken for other illnesses.

Since there is no known antidote for these cyanotoxins, health agencies are cautious, limiting human exposure. The Ohio Department of Health and Ohio Department of Agriculture have received reports of probable human illness and dog deaths associated with exposure to cyanotoxins in Ohio. The Center for Disease Control and Prevention launched a reporting system, One Health Harmful Algal Bloom System (OHHABS, ***cdc.gov/habs/ohhabs***) to track cases nationwide.

In addition to cyanotoxin production, cyanobacteria can cause other problems for PWSs by increasing organic material in the source water, leading to the production of disinfection byproducts (DBPs), including total trihalomethanes (TTHMs) and haloacetic acids (HAAs), which are carcinogens. Many cyanobacteria also produce the taste and odor compounds Geosmin and 2-Methylisoborneol (MIB) that affect drinking water palatability. Appendix A summarizes common cyanobacteria genera and associated cyanotoxins and taste and odor compounds.

1.3 Cyanobacterial Blooms

Cyanobacteria are naturally occurring microorganisms found in most bodies of water. Under favorable conditions, including nutrient availability, sufficient light, and sometimes warmer temperatures, cyanobacteria can multiply and form a bloom that may or may not be visible to the naked eye. Cyanobacterial blooms generally occur in eutrophic or hypereutrophic water bodies which are water bodies that receive excess nutrients, particularly nitrogen and phosphorus, causing excessive plant growth.

Cyanobacterial blooms may vary in species composition and cyanotoxin production over time as well as throughout a water body. The distributions of cyanobacteria populations are affected by weather, hydrology, and morphology. They may be distributed evenly throughout a water body or may be irregularly distributed because of currents and/or prevailing winds. Hydrologic changes resulting from heavy rains or the discharge from a stream resulting in localized currents can significantly affect cyanobacteria population distributions. Areas like shallow bays, coves, sites directly affected by nutrient-rich inflows, or structures that affect flow (for example, dikes, piers, or intake towers) can affect population growth rates and cyanobacteria distribution.

Cyanobacteria can be found at various depths of water, like the surface (scums), at a particular depth (i.e., *Planktothrix rubescens*), or spread throughout the water column (i.e., *Planktothrix*, *Raphidiopsis*). Wind, rain, currents, and lake turnover can mix surface blooms into the water or push them to calmer areas like bays or inlets. Some cyanobacteria can control their buoyancy, and during calm conditions they can move vertically through the water column depending on light and nutrient availability. These factors are important to understand because even if an algal bloom isn't visually present on the surface, it doesn't mean it's not there. The visual absence of an algal bloom does not necessarily indicate presence/absence. If a surface algal bloom has dissipated, it may not have senesced (died) but could have moved to another area of the lake or mixed below the lake surface within the water column. In addition, some cyanobacteria do not form surface scums, so surface accumulations should not be relied on as the only indicator that an algal bloom is present.

It is important for PWSs to be familiar with their source waters and recognize changes that may be associated with a cyanobacterial bloom. Color is not necessarily a good way to distinguish cyanobacteria from green algae or suspended sediment. Cyanobacteria can appear in many colors including brown, green, blue, and red. *Raphidiopsis* (formerly *Cylindrospermopsis*) blooms are generally brown and appear like suspended sediment. Other blooms are green and are mistaken for green algae. The best way to confirm whether cyanobacteria are present is through sampling.

Many cyanobacteria can produce one or several different types of cyanotoxins (see Appendix A for a list of cyanobacteria genera and their associated cyanotoxins). Cyanotoxin production is cyanobacteria strain-specific, and not all cyanobacteria may be genetically capable of or actively producing cyanotoxins. Some cyanotoxins are comprised of multiple structural variants or congeners. The potential health effects are not known for all variants or cyanotoxins. Cyanotoxins can be found within cyanobacteria cells (intracellular) or free or dissolved (extracellular) in the water. Cyanotoxins are colorless and may persist in the water after a cyanobacterial bloom is gone. Cyanotoxins may degrade over time in the environment due to bacterial action and sunlight.

1.4 Cyanotoxin History and Occurrence in Ohio

1.4.1 History

Ohio became aware of HAB development in Ohio's lakes when the Ohio EPA participated in the U.S. EPA National Lakes Assessment which included sampling for the cyanotoxin microcystins. In April 2009, the results of the 2007 National Lakes Assessment were released, showing that more than 36% of the 19 randomly selected Ohio lakes sampled had detectable levels of microcystins. The following cycle, the 2012 National Lakes Assessment found that 43% of lakes in U.S. EPA Region 5 had detectable levels of microcystins.

Since Ohio EPA began more frequent sampling in 2010, microcystins are regularly detected in many of the water bodies used as sources of drinking water. Microcystins concentrations typically peak in August and

September, although maximum microcystins concentrations at some PWSs have occurred as early as May and as late as December. In addition, some source waters experience microcystins year-round. The six-month period with the highest frequency of microcystin detections at PWSs is June through November. These data are what led to the timeframes for Ohio's HAB season and off-season periods as defined in OAC 3745-90.

In 2015, the Ohio legislature passed Senate Bill 1, which directed Ohio EPA to protect against cyanobacteria in the western basin of Lake Erie and in public water supplies. This prompted the development of HAB monitoring, reporting, and treatment technique rules which became effective on June 1, 2016. A five-year rule review was conducted in 2022, and revised rules were effective November 1, 2022.

1.4.2 Cyanotoxin Frequency and Occurrence

During strategy and rule development, Ohio EPA reviewed the historical occurrence data for cylindrospermopsin and saxitoxins at PWSs to inform response sampling. Cylindrospermopsin production genes were rarely detected in raw water at PWS. Similarly to cylindrospermopsin, anatoxin-a is rarely detected in PWS source water. While saxitoxin production genes are more commonly detected in raw water at Ohio PWSs, follow-up response sampling for saxitoxins resulted in detections at half the sites and typically only at low concentrations (below drinking water thresholds). The concentration of saxitoxins detected in finished water were all less than 0.15 µg/L, which is 50% of the drinking water threshold for children under six (0.3 µg/L), and approximately 88% of saxitoxin detections in raw water had concentrations less than 0.15 µg/L from 2020-2024. Based on this information, Ohio EPA revised the response sampling guidelines for saxitoxin production gene in 2025 (see Section 3.2)

Since the rules went into effect, microcystins have been detected in the raw water at approximately 74% of the PWS' monitoring for HABs. Saxitoxins have been detected in the raw water at approximately 30% of those PWS and cylindrospermopsin has only been detected at one PWS. In 2025, Ohio EPA updated the ***PWS HAB Data and Map Dashboard*** for statewide HAB PWS compliance data. The dashboard includes a map showing the most recent microcystins data and has historic microcystins and saxitoxin results available for download.

2 — Cyanotoxin Toxicity Thresholds

2.1 Introduction

In 2011, representatives from Ohio EPA, Ohio Department of Health (ODH), and Ohio Department of Natural Resources (ODNR) cooperatively developed cyanotoxin thresholds for microcystins, cylindrospermopsin, saxitoxins, and anatoxin-a that were adopted by the respective state agency directors (Table 1). In May 2015, U.S. EPA released tiered health advisory levels for microcystins and cylindrospermopsin. These new levels were established after review of available toxicological information and were subjected to independent peer review. Ohio adopted the recommended U.S. EPA health advisory concentrations for microcystins and cylindrospermopsin and revised the saxitoxins threshold to be consistent with U.S. EPA's tiered approach. In June 2016, the microcystins drinking water thresholds were formally adopted into OAC 3745-90-02 as action levels.

Thresholds were revised in the 2020 PWS HAB Response Strategy specifically for anatoxin-a and to remove the 'Do Not Use' tier. The drinking water thresholds for anatoxin-a were lowered based on a review of toxicity reference information and using the same tier structure and exposure assumptions consistent with all other cyanotoxins (see Section 2.3 and Appendix B).

2.2 Determining Numerical Cyanotoxin Thresholds for Drinking Waters

Ohio EPA adopted the thresholds for microcystins as action levels due to the high occurrence of microcystins in Ohio's sources of drinking water, microcystins ability to "break through" during the drinking water treatment process, and the establishment of national health advisories for microcystins. Action levels for cylindrospermopsin were not established in rule due to the low historic occurrence of cylindrospermopsin in Ohio. Action levels for saxitoxins or anatoxin-a were not established in rule due in part to a lack of an established national health advisory for those two cyanotoxins.

However, Ohio EPA established drinking water thresholds for anatoxin-a and saxitoxins based on a review of available toxicological studies and guidance documents, and in consultations with other states. The toxicity value for saxitoxins was based on documented acute intoxications in humans following ingestion of seafood containing saxitoxins (EFSA 2009). The toxicity value for anatoxin-a was based on a subchronic exposure study, and threshold values were updated in the 2020 PWS HAB Response Strategy to reflect current information.

To be consistent with the tiered health advisories established by U.S. EPA for microcystins and cylindrospermopsin, tiered thresholds were established for both child and adult exposure for anatoxin-a and saxitoxins. The thresholds were calculated based on the same exposure assumptions used to calculate the microcystins and cylindrospermopsin health advisory concentrations.

More details on reference values, exposure assumptions, and calculations for cyanotoxin thresholds are provided in Appendix B.

2.3 Additional Information

In 2020, World Health Organization (WHO) published guideline or health-based reference values for all four groups of cyanotoxins: microcystins, cylindrospermopsin, saxitoxins, and anatoxins. Specific guideline values for microcystins and cylindrospermopsin were issued based on chronic (lifetime) and short-term (approximately two weeks) exposure through drinking water, whereas values for saxitoxins and anatoxin-a are for acute exposure. Full details on the derivation and supporting documentation are provided in background documents for each cyanotoxin group (WHO 2020) and summarized in Chorus and Welker (2021).

U.S. EPA's national health advisories for microcystins and cylindrospermopsin were established in June 2015 for a short-term (10-day) exposure. While based on a 10-day exposure, U.S. EPA guidance recommends that PWSs act as soon as possible if a threshold is exceeded. This means, based on specific circumstances, a PWS may have some limited time to adjust treatment or take other actions to prevent exposures prior to issuing an advisory. More information on the basis for the health advisories is available at ***https://www.epa.gov/habs/epa-drinking-water-health-advisories-cyanotoxins***.

3 — Monitoring Strategy

3.1 Microcystins Monitoring and Cyanobacteria Screening

All surface water PWSs must conduct routine microcystins monitoring and cyanobacteria screening in accordance with OAC Rule 3745-90-03.

The monitoring schedules for each PWS will be posted here: ***https://epa.ohio.gov/divisions-and-offices/drinking-and-ground-waters/public-water-systems/seasonal-hab-monitoring-schedule***.

HAB Season

During the HAB season, the HAB rule specifies that for routine monitoring:

- Raw water cyanobacteria screening (qPCR) monitoring is required once every two weeks (biweekly monitoring).
- Raw water total microcystins monitoring is also required every two weeks but on the alternate week of the cyanobacteria screening samples.

Consecutive water systems receiving water from an out-of-state surface water source must monitor for finished water microcystins weekly. PWSs with sources considered ground water under the direct influence of surface water (ground water sources; GWUDI) with no historic microcystins or saxitoxins detections, no *sxtA* or *mcyE* detections, and low *16S* results are eligible for **monthly** (raw water) cyanobacteria screening monitoring.

If microcystins are detected in the raw water, the PWS will trigger into increased weekly monitoring at **both** raw and finished water sampling points beginning no later than 24 hours following the notification of the detection. Increased monitoring includes weekly paired water total microcystins sampling with the alternating biweekly raw water cyanobacteria screening sampling. The PWS can return to routine microcystins monitoring once every two weeks (raw water sampling point) when microcystins are not detected in at least two consecutive weekly samples (raw and finished water sampling points).

When cyanobacteria screening results for the *mcyE* exceed five gene copies per microliter without microcystin data, it triggers follow-up microcystins monitoring (raw and finished water sampling points) within 24 hours. If microcystins are not detected in the raw or finished water samples after *mcyE* detection follow-up, the PWS can resume the routine biweekly monitoring schedule.

Off-Season

Surface water PWSs, including consecutive water systems receiving water from an out-of-state surface water system, shall sample **finished water** once every two weeks for microcystins analysis during off-season. GWDUI shall sample finished water microcystins monthly during the off-season.

Note: If a PWS is on increased monitoring during the transition from HAB season to off-season monitoring the PWS should remain on weekly paired microcystins monitoring until two weeks non-detect.

Seasonal Systems

Seasonal surface water systems shall notify their district office coordinators of their start up and closing/offline dates. PWS should collect the required samples **prior to or on the start date** that water is being produced for use and must sample in accordance with the applicable schedule based on the date water is produced for use. If the start-up date occurs during the defined HAB off-season (first full week of December until first full week of June), the PWS must monitor for finished microcystins samples regardless of the monitoring schedule week and follow the schedule thereafter. If the start-up date occurs during the HAB season, the PWS must follow the weekly sampling schedule.

Additional Information

Sampling triggers and HAB monitoring implementation notes for all systems during the HAB and off-season are included on Table 2.

Table 2. Monitoring requirements based on revised HAB Rule

Microcystins and Cyanobacteria Screening Monitoring Requirements HAB Season (begins first full week of June) -- Off-season (begins first full week of December)	
Monitoring Requirements	**Additional Sampling Triggers**
Routine HAB Monitoring for all PWS with a surface water source HAB SEASON Biweekly raw water cyanobacteria screening AND Biweekly **raw** water microcystins (alternate week of cyanobacteria screening) OFF-SEASON Biweekly **FINISHED** water microcystins	**If microcystins are detected in the raw water:** • PWS must collect raw and finished water samples within 24 hours of receiving the result and complete analysis within five days. If PWS voluntarily collected a paired raw and finished water sample with their initial raw water sample, an additional set of raw and finished samples is not required until the following week unless a finished water detection triggers more immediate sampling (see "All PWS" below). • **PWS will continue with weekly paired raw and finished water microcystins monitoring and the biweekly raw water cyanobacteria screening until non-detect for at least two consecutive weeks**. **If *mcyE* are detected in raw water greater than 5 gene copies/µL:** • PWS must collect raw and finished water microcystins sample within 24 hours of receiving the result and complete analysis within five days. • If microcystins are not detected, the PWS will resume biweekly monitoring. • If microcystins are detected in either the raw or finished water, the PWS continues with weekly raw and finished microcystins monitoring and biweekly cyanobacteria screening until microcystins are non-detect for at least two consecutive weeks.
Reduced Monitoring for all PWS with a groundwater under the influence (GWUI) source HAB SEASON: Monthly cyanobacteria screening OFF-SEASON: Monthly FINISHED water microcystins	If sampling detects the presence of microcystins or *mcyE*, the PWS will transition to routine HAB monitoring (detailed above) and must collect paired microcystin samples within 24 hours of receiving the result and complete analysis within five days.
Ohio PWS with an out-of-state surface water source* HAB SEASON: Weekly finished water microcystins OFF-SEASON Biweekly finished water microcystins	Increased monitoring would be triggered by finished water microcystins detections (see "All PWS" below).

Microcystins and Cyanobacteria Screening Monitoring Requirements HAB Season (begins first full week of June) -- Off-season (begins first full week of December)	
Monitoring Requirements	**Additional Sampling Triggers**
All PWSs	**If cyanobacteria screening indicates the presence of saxitoxins, cylindrospermopsin or genes (*sxtA* or *cyrA*):** • PWS must notify Ohio EPA no later than the end of the next business day per OAC Rule 3745-89-08. Ohio EPA also recommends written or verbal results be communicated as soon as possible to ensure a timely response by Ohio EPA. **If microcystins are detected in finished water greater than 0.3 µg/L (reported value ≥0.35 µg/L):** • PWS must collect one **resample** of raw and finished water within 24 hours of action level exceedance and collect an additional **repeat** sample of raw and finished water within 24 hours of resample. Analysis must be completed within 24 hours in each case. • If microcystins are greater than 0.3 µg/L in either resample or repeat, PWS must notify all consecutive systems within three hours of receiving results. • PWS and consecutive systems ***may*** collect samples from representative distribution points established in the contingency plan. • PWS will sample raw water once per week and increase sampling to three times per week at the finished water sampling point. • PWS can resume routine monitoring when microcystins are non-detect in finished water for two consecutive samples.

**Ohio PWS with an out-of-state surface water source will monitor in accordance with OAC 3745-90 due to varying drinking water HAB compliance rule requirements between states.*

3.1.1 Analytical Methods for Microcystins and Cyanobacteria Screening

The analytical methods and reporting requirements for total microcystins and cyanobacteria screening are described in OAC Rule 3745-90-04. The HAB rule references version 2.4 of Ohio EPA Method 701.0 – Total (Extracellular and Intracellular) Microcystins – ADDA by ELISA that has a lower reporting limit of 0.24 µg/L. All results at or above the reporting limit are considered a detection of total microcystins (OAC Rule 3745-90-04).

The analytical method for cyanobacteria screening in OAC Rule 3745-90-04 was updated to reference version 1.0 of Ohio EPA method 705.0 – Ohio EPA quantitative Polymerase Chain Reaction (qPCR) Multi-Plex Molecular Assay for Determination of Cyanobacteria and Cyanotoxin-Producing Genes Analytical Method. Molecular screening methods can distinguish between strains of cyanobacteria (*16S*) that are capable of toxin production (*mcyE*, *cyrA*, *sxtA*) from those that are not. However, the molecular screening method used by Ohio EPA cannot distinguish between live and dead cells. Additionally, the presence of a cyanotoxin gene does not mean the cyanotoxin is present in water.

A list of on-demand labs certified by Ohio EPA to conduct microcystins analysis and/or cyanobacteria screening is available at ***Laboratory Certification | Ohio Environmental Protection Agency***.

3.2 Cylindrospermopsin and Saxitoxins Sampling

Ohio EPA reviews all cyanobacteria screening data and conducts follow-up sampling for cylindrospermopsin or saxitoxins as described in this section. Ohio EPA can provide additional sampling and technical assistance at the request of a PWS in response to cyanotoxin gene and cyanotoxin detections.

The response sampling for detections in raw or finished water at concentrations below drinking water thresholds are based on concentration and percentage of the drinking water threshold (Table 3)

Table 3. Select Concentrations for Cylindrospermopsin and Saxitoxins Response Sampling

	Cylindrospermopsin (µg/L)	Saxitoxins*(µg/L)
Method Reporting Limit	0.05	0.02
15% of Threshold	0.11	0.05
50% of Threshold	0.35	0.15
Do Not Drink Threshold, Children under 6 and sensitive population	0.7	0.3

**Saxitoxins thresholds are intended to be applied to total concentrations of all reported congeners/variants. Ohio EPA will also consider established saxitoxin toxicity equivalency factors when determining if a threshold has been exceeded (see Appendix B)*

3.2.1 Cylindrospermopsin Sampling

For cyanobacteria screening results, the response is as follows:

If cyanobacteria screening samples detect *cyrA*, Ohio EPA will conduct follow-up paired cylindrospermopsin monitoring within five business days following notification as described below. Details on sample handling, including safety considerations, containers, preservatives, labeling, and paperwork are included in Section 6.

Paired cylindrospermopsin follow-up monitoring will be conducted after the first initial gene detection of the HAB season. However, the decision to continue follow-up monitoring is at the discretion of Ohio EPA. This decision will be made after the initial cylindrospermopsin sampling follow-up and based upon future cyanobacteria screening and cylindrospermopsin results. The general guidelines are outlined below.

If cylindrospermopsin is not detected in the initial follow-up sample, Ohio EPA will review the cyanobacteria screening results from the next sampling event and use that information to decide if ongoing sampling is necessary. As a preliminary guide, if *cyrA* concentrations remain less than 0.5 gene copies/µL since the prior sampling event, additional response sampling may not be necessary. If the number of *cyrA* copies in the next routine cyanobacteria screening sample is greater than or equal to 0.5 gene copies/µL or shows a substantial increase, Ohio EPA will continue to collect paired samples for cylindrospermopsin analysis.

For cylindrospermopsin detected in raw water only, the response is as follows:
If cylindrospermopsin is detected at concentrations greater than or equal to 15% of the threshold, paired cylindrospermopsin sampling water will continue weekly until cylindrospermopsin is less than 50% of the cylindrospermopsin threshold in two consecutive weekly sampling events in raw water. If treatment has been proven to be consistently effective at cyanotoxin removal, Ohio EPA may consider decreasing sampling and/or analysis frequency.

For cylindrospermopsin detected in finished water, the response is as follows:
If cylindrospermopsin is detected in the finished water at concentrations between 15% and 50% of the threshold, a paired samples will be collected for cylindrospermopsin analysis within 24 hours of receiving the results. If the follow-up sample remains less than 50% of the threshold in finished water, paired cylindrospermopsin sampling will continue weekly until cylindrospermopsin is less than 50% of the threshold in raw water in two consecutive weekly sampling events and are below 15% in the finished water. Ohio EPA may conduct additional cylindrospermopsin sampling including weekly sampling when finished water concentrations are between 15% and 50% of threshold based on additional information.

If cylindrospermopsin is detected in the finished water at greater than 50% of the threshold (but less than the Do Not Drink threshold of 0.7 ug/L), paired samples will be collected for cylindrospermopsin analysis within 24 hours of receiving the results and paired cylindrospermopsin sampling will increase to three days per week. In addition, an extra set of paired samples will be collected and submitted to an independent lab for LC-MS/MS analysis (See 4.2.1). Increased monitoring (three days per week) will continue until finished water concentrations decrease to less than 50% of the threshold in two consecutive sampling events. At that point, sampling can decrease according to the tiered response outlined above.

The response protocol for responding to finished water detections at concentrations above the thresholds is presented in Section 4.

3.2.2 Saxitoxins Sampling

Ohio EPA utilizes the ELISA method for the detection of saxitoxins. Saxitoxin is comprised of multiple variants, but unlike microcystins, the ELISA method used to detect it is not capable of detecting total saxitoxins. This ELISA method is not based on the detection of a structure common to all saxitoxin variants and may underreport total saxitoxins. Therefore, Ohio EPA will conduct additional analysis using an alternate LC-MS/MS method for detection of saxitoxin variants following an initial ELISA finished water saxitoxins detection that is greater than 50% of the saxitoxins threshold.

<u>For cyanobacteria screening results, the response is as follows:</u>

If cyanobacteria screening samples detect *sxtA*, Ohio EPA will conduct follow-up paired saxitoxin monitoring within five business days following notification as described below. Details on sample handling, including safety considerations, containers, preservatives, labeling, and paperwork are included in Section 6.

Paired saxitoxin follow-up monitoring will be conducted after the first initial gene detection of the HAB season. However, the decision to continue follow-up monitoring is at the discretion of Ohio EPA. This decision will be made after the initial saxitoxin sampling follow-up and based upon future cyanobacteria screening and saxitoxin results. The general guidelines are outlined below.

For any saxitoxin gene detections following the **initial** saxitoxin gene detection:

- Saxitoxin gene detections below 1.0 gene copies/microliter (gc/µL) after the initial detection will not require additional follow-up.
- Any saxitoxin genes increasing above or equal to the 1.0 gc/µL threshold will result in additional saxitoxin follow-up.
- If saxitoxin genes are decreasing, but remain above or equal to 4.0 gc/µL, saxitoxin sampling will continue.
- If saxitoxin genes are decreasing and fall below 4.0 gc/µL, additional saxitoxin sampling may not be required.

Ohio EPA reserves the right to conduct additional sampling as needed at the Director's discretion.

<u>For saxitoxin detected in raw water only, the response is as follows:</u>

If saxitoxin is detected at concentrations greater than or equal to 15% (0.05 µg/L) of the threshold, saxitoxin sampling in the raw and finished water will continue weekly until saxitoxin is less than 50% of the saxitoxins threshold in two consecutive weekly sampling events in raw water. If treatment has been proven to be consistently effective at cyanotoxin removal, Ohio EPA may consider decreasing sampling and/or analysis frequency.

For saxitoxin detected in finished water, the response is as follows:

- If saxitoxin is detected in the finished water at concentrations less than 15% of the threshold, paired saxitoxin sampling will continue weekly until saxitoxin are less than 50% of the saxitoxins threshold in raw water and less than 15% of the saxitoxins threshold in the finished water in two consecutive weekly sampling events.

- If saxitoxin is detected in the finished water at concentrations between 15-50% of the threshold (0.05-0.15 µg/L), paired samples will be collected for saxitoxin analysis within 24 hours of receiving the results. If the follow-up sample remains less than 50% of the threshold in finished water, paired sampling and analysis will continue in the raw and finished water weekly until saxitoxin is less than 50% of the threshold in raw water in two consecutive weekly sampling events and are below 15% in the finished water. Ohio EPA may conduct additional saxitoxin sampling including weekly sampling when finished water concentrations are between 15% and 50% of threshold based on additional information.

- If saxitoxin is detected in the finished water greater than 50% of the threshold (but less than the threshold of 0.3 ug/L), sampling frequency will increase to three days per week. In addition, an extra set of paired saxitoxins samples may be collected and submitted to an independent lab for LC-MS/MS analysis (See 4.2.1).
    - Increased monitoring (three days per week) will continue until finished concentrations decrease to less than 50% of the threshold in two consecutive sampling events. At that point, sampling can decrease according to the tiered response outlined above.

The response protocol for responding to finished water detections at concentrations above thresholds is presented in Section 4.

3.2.3 Analytical Methods for Cylindrospermopsin and Saxitoxins

This section describes the analytical methods Ohio EPA utilizes for cylindrospermopsin and saxitoxin. Ohio EPA will continue to evaluate new analytical methods and refine this strategy based on the best information available. In any instance that LC-MS/MS analysis is required, Ohio EPA will work the PWS is selecting the appropriate analysis methodology.

As stated above, Ohio EPA uses the results of the cyanobacteria screening data to help target response sampling for cylindrospermopsin and saxitoxin with the methods listed below. In addition, Ohio EPA's Division of Environmental Services (DES) developed semiquantitative (presence/absence) methods for saxitoxin and cylindrospermopsin using ELISA (Ohio EPA Method 702.0 Version 2.3 and 703.0 Version 2.1, respectively) which will provide direct detection of cyanotoxins in finished water. Any PWS using a semi-quantitative method that has a detection in the finished water shall follow the tiered responses found earlier in section 3.2.

Cylindrospermopsin

Ohio EPA utilizes the ELISA method for the detection of cylindrospermopsin. Ohio EPA's DES developed an SOP that outlines sample collection and handling procedures and quality assurance measures for the ELISA cylindrospermopsin method (DES Method 703.0, Version 2.1 March 2024). Ohio EPA will conduct additional analysis using a LC- MS/MS method following any ELISA finished water cylindrospermopsin detections that are greater than 50% of the cylindrospermopsin threshold.

Saxitoxins

Ohio EPA utilizes the ELISA method for the detection of saxitoxin. Ohio EPA's DES also developed an SOP that outlines sample collection and handling procedures and quality assurance measures for the ELISA saxitoxins method (DES Method 702.0, Version 2.3 April 2024).

3.3 Anatoxin-a Sampling and Analytical Method

Ohio EPA will limit anatoxin-a sampling to the following circumstances:

1) At the request of a PWS in response to a HAB on a source water that is capable of producing anatoxin-a.
1) At the request of the Ohio Department of Health or a local health district in response to a potential animal death or human illness that could be linked to anatoxin-a.
2) As needed, based on sampling information from the Division of Surface Water (DSW).

Ohio EPA is utilizing LC-MS/MS method for detection of anatoxin-a. U.S. EPA Method 545 has been developed for the quantitation of anatoxin-a in finished water. Additional LC-MS/MS methods can detect anatoxin-a and at least six of the anatoxin-a variants in both finished and source water samples.

3.4 Ohio EPA Coordination with PWSs

Ohio EPA staff in the Central Office provide oversight of the compliance program, coordinate follow-up response sampling, and provide technical assistance, as needed. District Office HAB coordinators and other DDAGW staff are primary points of contact for communication with PWSs to provide technical assistance, obtain status updates, review screening or sampling results, and collect samples as needed. Central Office, District Offices, and DES staff work collaboratively to provide results of Ohio EPA sampling to the PWS.

4 — Response to Finished Water Threshold Exceedances

4.1 Microcystins

The responses to microcystins threshold exceedances are detailed in OAC Rules 3745-90-03, 3745-90-05, and 3745-90-06. In some circumstances Ohio EPA may conduct additional sampling as needed. Including, but not limited to, if there is a finished water detection above the reporting limit but below the threshold.

4.2 Cylindrospermopsin, Saxitoxins, and Anatoxin-a

This section outlines the steps that will be taken in response to a finished water saxitoxins, cylindrospermopsin or anatoxin-a detection above an Ohio threshold. It is written assuming Ohio EPA DES will conduct all cyanotoxin analyses for these toxins. Ohio EPA should still be notified of any finished water detections as soon as possible, but must be reported by the end of the next business after analysis is completed.

4.2.1 Sampling

If cylindrospermopsin, saxitoxins, or anatoxin-a are detected in the finished water above the thresholds (Section 2.2), the following steps will be taken:

1) **Resample.** Two sets of paired samples will be collected by Ohio EPA within 24 hours of being informed of the initial sample results. One set will be transported to Ohio EPA DES (or an Ohio EPA designated laboratory) for ELISA analysis and the other set will be shipped to a commercial lab for LC-MS/MS analysis. If the result of the resample is above the threshold in finished water, the PWS

should notify all consecutive water systems as soon as practical but at least within three hours of receiving the resample sample result.

- Treatment Train Sampling - Treatment train samples may also be collected to provide additional information on how to best optimize for cyanotoxin destruction/removal. Specific locations for treatment train samples are unique to each system and will be determined by the PWS and Ohio EPA district staff based on the design of the plant.
- Raw Water Analysis - The raw water resample will be analyzed for both intracellular and extracellular cyanotoxins, to help guide treatment optimization.

2) **Repeat.** Two additional sets of paired samples will be collected within 24 hours of collecting the resample. One set will be delivered to Ohio EPA DES (or an Ohio EPA designated laboratory) for ELISA analysis and the second set will be shipped to a commercial lab for LC-MS/MS analysis (the second set will be collected and shipped to a commercial lab for LC-MS/MS analysis only if the finished water detection in the resample was greater than 50% of the threshold).

3) **Distribution Sampling.** If cyanotoxins are detected above the threshold in either the resample or repeat finished water sample, the PWS should immediately coordinate with Ohio EPA concerning collection and analysis of samples within the distribution system and at any consecutive systems. If cyanotoxins do not exceed Ohio EPA thresholds within all the portions of the distribution system or at consecutive system locations, the water system may be able to isolate impacted areas of the distribution system and limit the extent of a drinking water advisory. Distribution mapping and sampling locations should be addressed in a PWS's contingency plan.

Ongoing sampling by Ohio EPA depends on the results of the finished water samples, as follows:

- If cylindrospermopsin or saxitoxins are detected in the finished water at concentrations less than 50% of the thresholds, sampling frequency will decrease to weekly.
- If cylindrospermopsin or saxitoxins are detected in the finished water at greater than 50% of the thresholds, sampling will continue three times per week until concentrations decrease to less than 50% of the threshold in two consecutive sampling events. At that point, sampling can decrease to weekly.
- If cyanotoxins are detected in the finished water samples at concentrations above Ohio EPA thresholds, sampling and analysis will continue three times per week until cyanotoxins are no longer detected at concentrations greater than 50% of the threshold in the finished water in two consecutive sampling events. Distribution sampling may also be conducted as outlined under Step 2. Sampling frequency may decrease, depending on results of distribution samples, cyanotoxin concentrations in the raw water, status of treatment, and other factors.

4.3 Drinking Water Use Advisories and Public Notification

The decision to issue a drinking water use advisory will be based on detections of a cyanotoxin above thresholds in finished water (Table 1). PWSs need to take actions to protect the public from exposures as soon as practicable. The PWS should also follow response procedures detailed in their contingency plan as applicable (OAC Rule 3745-85-01). The PWS should issue a public notification, including health effects language and use restrictions, if thresholds continue to be exceeded in the repeat sample results. Public notice templates are included in Appendix C.

Ohio EPA will evaluate a variety of site-specific factors to determine if a public notice should be issued earlier, after the resample results indicate a threshold exceedance, or if conditions are such that the issuance can be delayed until additional actions can be taken and additional repeat sample results are

available. The following factors will be considered by Ohio EPA when deciding the timing of public notification:

- What type of cyanotoxin is present?
- When was the last finished water sample collected that was non-detect for cyanotoxins?
- How high are the cyanotoxin concentrations detected?
- Does the PWS have enhanced cyanotoxin treatment capability or an alternative source of water?
- What are the current raw water cyanotoxin concentrations? Are there indications raw water conditions are improving?

In limited circumstances, based on the factors described above, the recommendation to issue an advisory may be delayed until additional daily sampling results are available. The delay would provide additional time for the water system to optimize treatment yet still be protective of public health given the 10-day health advisory for cylindrospermopsin and subchronic exposure assumptions for anatoxin-a. Informing the public of current conditions and efforts underway would still be conducted.

In the event of an exceedance of a drinking water threshold, community PWS shall implement their contingency plan and follow protocol outlined in the PWS' Treatment Optimization Protocol (TOP) as applicable. If a PWS needs to use alternative water sources, they should discuss this plan with Ohio EPA. For more information regarding contingency plan requirements and public notification please refer to OAC Rules 3745-85-01 and 3745-81-32, respectively.

4.3.1 Public Notice Procedure

Public notification for total microcystins will be conducted in accordance with the provisions contained in OAC Rule 3745-90-06. Public notification for all other cyanotoxins should be conducted in accordance with the provisions contained in OAC Rule 3745-81-32. Any public notification that needs to be modified from the guidelines and templates presented in Appendix C will be coordinated with ODH.

If public notification is to be issued, Ohio EPA will call the PWS to discuss issuing an immediate Tier 1 public notice informing all customers of the situation. A public notice template will be provided containing the appropriate health effects language and use restrictions.

If the PWS does not issue public notification as recommended, Ohio EPA may issue a drinking water use advisory in accordance with ORC section 6109.06, or may require the PWS to issue public notification under the authority of OAC Rule 3745-81-32.

The use of drinking water restrictions may be modified, based on sampling results and other factors, after consultation with the director. For example, a decrease in finished water cyanotoxin concentrations could warrant transitioning from an advisory for the entire population to a more limited advisory for children pre-school age and younger. This change will require additional public notification.

4.3.2 Limiting Extent of Public Notice

The geographic area under public notification may be limited based on distribution sample results and provisions described in the system's written contingency plan, after consultation with the director. Distribution sampling results may also be a consideration when modifying use restrictions or lifting the advisory.

4.3.2 Public Notice Templates

Eight public notice templates are included in Appendix C:

- **Drinking water advisories** for exceeding the microcystins, saxitoxins and cylindrospermopsin preschool age children and younger exposure thresholds.

- **Do not drink** advisories for exceeding the microcystins, saxitoxins, and cylindrospermopsin school age children and adult thresholds.

4.3.3 Lifting the Advisory

The PWS may end issuance of public notification when the finished water cyanotoxin levels are below the drinking water threshold(s) in two consecutive sampling events collected a minimum of 24 hours apart and after consultation with the director on distribution monitoring, raw water quality, treatment optimization, and other extenuating factors.

4.3.4 Consumer Confidence Report (CCR)

If microcystins are detected in a sample collected at finished water or distribution sampling point(s), the range of levels detected and highest single microcystins concentration measured must be included in the community's consumer confidence report (CCR). The CCR must also include the microcystins action level, information regarding the major source of the contaminant, and standard health effects language (when exceedance of action level). Community water systems are also encouraged to include finished water saxitoxins, cylindrospermopsin, and anatoxin-a threshold detections and exceedances in their CCR. Drinking water use advisory language (Appendix C) can be used for CCR health advisory language.

5 — Source Water Surveillance and Reservoir Management

As a part of source water management and protection, waters used as a source of public drinking water can be monitored in different ways. This can include increased observation for HABs through direct surveillance by PWS personnel, HAB bloom reports submitted via Ohio EPA's website, National Oceanic and Atmospheric Administration (NOAA) satellite imagery and analysis, and water quality surveys conducted by Ohio EPA and other state or local organizations. Water systems are encouraged to conduct routine phytoplankton identification on their source waters and collect other raw water screening information to help manage their source water for HABs, provide an early warning for HAB impacts, and know when to optimize treatment for cyanotoxin removal. Ohio EPA is available to provide guidance on reservoir management and treatment optimization in response to a new or expanding HAB.

5.1 PWS Surveillance

PWSs should be aware that some raw water quality and operational changes can indicate a potential HAB impact. Potential indicators include pH increases, phycocyanin or chlorophyll a increases, elevated turbidity not associated with a rain event, shortened filter run times, increased chlorine demand, taste and odor (Geosmin or MIB) events, a shift in phytoplankton community (increase in cyanobacteria or cyanobacteria dominance), presence of cyanotoxin production genes, or cyanotoxin detections.

It is beyond the scope of this document to provide guidance on the collection of screening data or establishing a source water monitoring program. More information is available in the ***USGS Lake Monitoring Field Manual***, Lakes and Reservoirs: Guidelines for Study Design and Sampling at: ***pubs.er.usgs.gov/publication/tm9A10***.

5.2 Bloom Reporting via Ohio EPA Website

PWSs are requested to notify the district office HAB coordinator or central office HAB staff of a bloom occurring on a drinking water source. Individuals that observe HABs are encouraged to complete an algal bloom web form that can be found at ***Ohio EPA Harmful Algal Bloom Reporter***. All algal bloom reports and HAB data (cyanotoxin and phytoplankton data, and photographs) will be entered into a repository maintained by Ohio EPA. Algal bloom observers are encouraged to submit pictures with the algal bloom report for bloom evaluation.

Bloom reports at state park beaches will be forwarded to the state park beach manager for response. In response to reports of potential HABs on non-state park beaches, Ohio EPA will evaluate the report and share with local water managers and ODH, who will notify local health districts. Ohio EPA will provide sampling guidance to managers of private water bodies and share all third-party reports of blooms on public water supply source waters with the affected PWS.

More information on bloom reports, recreational guidance, and contact information can be found in the ***Ohio HAB Response Strategy for Recreational Waters*** and at ***ohioalgaeinfo.com***.

5.3 Remote Sensing Surveillance

Ohio EPA will review NOAA HAB reports, MODIS/OCLI satellite, and NASA hyperspectral overflight data. Ohio EPA will share reports of moderate to severe blooms with the affected public water supply.

The Cyanobacteria Assessment Network (CyAN) is a multi-agency project to detect algal blooms in inland lakes throughout the U.S. A web application (CyANWeb) provides direct access to cyanobacterial bloom satellite data for over 2000 of the nation's largest lakes and reservoirs. Find more information and access these data and tools at ***epa.gov/water-research/cyanobacteria-assessment-network-application-cyan-app***.

5.4 Ohio EPA Water Quality Surveys and Integrated Report

Ohio EPA collects water quality data as part of its inland lakes program and other monitoring programs. These data may be useful to water systems interested in starting a reservoir monitoring program or developing reservoir management strategies. On a biannual basis, Ohio EPA completes an integrated water quality monitoring and assessment report, also referred to as the integrated report. The integrated report indicates the general condition of Ohio's waters and identifies waters that are not meeting water quality goals. The report satisfies the Clean Water Act requirements for both Section 305(b) for biennial reports on the condition of the State's waters and Section 303(d) for a prioritized list of impaired waters. For each impaired water, Ohio EPA typically prepares a total maximum daily load (TMDL) analysis. More details on water quality programs are available at ***epa.ohio.gov/divisions-and-offices/surface-water/dsw-programs/water-quality-programs***.

5.5 Assessing Bloom Severity

Ohio EPA recommends that PWSs conduct routine phytoplankton/algae analysis (community composition and dominance) of their source waters. This information can help water systems to better assess the potential threat of cyanotoxins and provide the information needed to help optimize their treatment to address cyanotoxins and other potential algae-related issues (taste and odor concerns, disinfection byproduct formation, filter clogging, etc.). The information can also be used to guide source water management practices, including algaecide application. Phycocyanin and other sensors positioned in the source water (intake structure, wet well, etc.) can also provide extremely valuable real-time information that can be used to trigger treatment optimization for HABs.

PWSs can use the available screening data to help characterize a bloom as severe, moderate, or minor. It may be necessary to make an initial assessment based on visual evidence, which can then be refined as additional information is collected. Guidance on the visual appearance of cyanobacterial blooms versus other green algae blooms, including a picture gallery of blooms, is available: ***epa.ohio.gov/divisions-and-offices/drinking-and-ground-waters/public-water-systems/harmful-algal-blooms***. Since a severe cyanobacterial bloom may not form a surface scum, in the absence of any additional data, a visible bloom

should be regarded as severe until additional data is collected. Please note, cyanobacteria cells can vary substantially in size and bloom size does not necessarily correlate with toxicity.

The following guidelines will help water systems characterize the severity of a bloom:

- Severe bloom (meets any of the following):
  - cyanobacteria cell count (or phycocyanin equivalents*) > 100,000 cells/mL
  - qPCR *16S* results > 100,000 gene copies/mL
  - biovolume > 10 mm^3/L
  - chlorophyll a** > 50 µg/L
  - scum or surface accumulation is present and/or significant concentration of cells are visible throughout the water column
  - presence of cyanotoxins, as indicated by test kit or laboratory analyses
  - presence of cyanotoxin production genes
- Moderate bloom (meets any of the following):
  - cyanobacteria cell count (or phycocyanin equivalents*) 10,000-100,000 cells/mL
  - qPCR *16S* results 10,000-100,000 gene copies/mL
  - biovolume 1-10 mm^3/L
  - chlorophyll a** 5-50 µg/L
  - bloom is visible throughout the water column
- Minor bloom (meets any of the following):
  - cyanobacteria cell count (or phycocyanin equivalents*) 4,000-10,000 cells/mL
  - biovolume 0.4-1 mm^3/L
  - chlorophyll a** 2-5 µg/L
  - some visual evidence of a bloom (note: blooms may not be visually apparent at the lake surface)

**Phycocyanin is a pigment unique to cyanobacteria. Sensors are available which measure the presence of this pigment and report in either relative fluorescence units (RFUs) or cyanobacteria concentrations in cells/mL. The cell concentration data, however, should be used with caution because sensors are typically calibrated to a pure Microcystis culture, and Microcystis may not be the dominant cyanobacteria in the water source. Also, other factors such as turbidity and overall light availability can impact the amount of phycocyanin that is produced per cyanobacterial cell. It is often best for a water system to review the general changes in RFUs over time as an indication of an increase in bloom severity instead of a particular cell/mL reading.*

***Chlorophyll a values are based on quantitative in vitro analysis. Semi-quantitative in vivo chlorophyll a readings can be used if they have been corrected for turbidity effects. Real-time in vivo chlorophyll a analysis is also helpful if a water system is primarily interested in relative changes in chlorophyll concentrations over time, but not as concerned with the precise chlorophyll a concentration.*

In some situations, a severe bloom may be present but not visually evident. This can be the case with cyanotoxin-producing *Planktothrix rubescens* blooms that can occur at significant depth in the water column and not be visible at the water surface and with *Raphidiopsis* blooms that can resemble turbid brownish-green water. These blooms do not appear like the more typical blue or green colored scum-forming cyanobacterial blooms and can pose a monitoring challenge.

5.6 Reservoir Management

Source water monitoring is an essential component of reservoir management. It helps assess the source water conditions for problems such as excessive nutrient loading and HABs. Monitoring data is needed to establish baseline conditions and triggers for source water control strategies, as well as to determine the effectiveness of control strategies (for example, algaecide treatment). Control and treatment strategies to minimize HABs focus on controlling nutrients (primarily phosphorus) and algae. An example of direct

control on algae is use of algaecides. Some actions, such as phosphorus precipitation, aim to control both nutrients and algal populations.

U.S. EPA developed a list of control and treatment strategies and provided benefits and limitations associated with each strategy. The guidance is available at ***epa.gov/cyanohabs/control-measures-cyanobacterial-habs-surface-water***.

The Interstate Technology Regulatory Council reviewed studies on strategies to manage cyanobacterial blooms and compiled factsheets for each strategy/technology (ITRC 2020). The factsheets summarize the technology, supporting field data and case studies, provide an estimated cost per season, and applicability to water bodies. The project includes an interactive management selection tool along with other guidance documents (e.g., monitoring, communication, nutrient reduction, and visual guide to identify cyanobacteria). All information and training resources are available at ***hcb-1.itrcweb.org***.

The reservoir management techniques commonly used in Ohio inland reservoirs to control HABs are summarized in Table 4 with information on recommendations from Osgood and Gibbons (2017).

Table 4. Common HAB reservoir management techniques.

Technique	Control Type	Recommendation	Benefits	Limitations
Algaecides	Algae	Recommended, but does not address ongoing nutrient loading	High applicability and reliability	Short duration; Frequent or repeat applications needed throughout year
Artificial Circulation	Algae; Internal phosphorus	Recommended only with critical implementation*	Critically implemented examples have shown success	Typically requires continuous operation with ongoing operation and maintenance expenses; Uncritical examples show poor reliability and even unintended negative effects
Phosphorus stripping (primarily alum, lower doses)	Algae; Phosphorus in water column	Recommended, but does not address ongoing nutrient loading	High applicability and reliability	Limited duration; may require repeat (yearly) applications
Phosphorus inactivation (primarily alum, higher doses)	Algae; Phosphorus in water column and internal phosphorus in sediments	Recommended, addresses internal -but not external- nutrient loads	High applicability and reliability (especially if internal phosphorus loads are driver for HABs)	May require repeat (yearly) applications if external phosphorus loads are not addressed

**Critical implementation means reservoir management strategy is only employed after careful source water evaluation, including collecting site specific data to help ensure strategy is adequately designed and implemented.*

It is beyond the scope of this guidance to discuss all relevant reservoir management strategies, but algaecides are so commonly used they warrant additional discussion. Algaecides (including copper sulfate and peroxide formulations), when applied to a drinking water source under controlled conditions, may control the growth of algae and cyanobacteria. Water systems are required to submit a notice of intent (NOI) to Ohio EPA's Division of Surface Water and obtain coverage under the pesticide general permit prior to applying algaecide to a source of drinking water. Information and forms associated with the pesticide application discharge general permit are available at ***epa.ohio.gov/divisions-and-offices/surface-water/permitting/pesticide-application-discharges--general-permit.***

Before applying an algaecide, it is important to closely read the pesticide label and be fully aware of both the environmental impact and practical problems with its use. Water systems must also follow the conditions outlined in the pesticide general permit. Treatment should be applied at the early stages of a bloom prior to raw water cyanotoxin detections when cyanobacteria abundance is low (<10,000 cells/mL, or cyanotoxin production genes are not detected) because:

4) the potential for cyanotoxin release is not probable or low;
5) if the treatment is applied at the early stages of a bloom, then low concentrations of cyanotoxins released into the water can be removed effectively during the treatment processes; and
6) it helps eliminate or reduce the future severity of the bloom. To keep the algae under control for extended periods of time, the algaecide applications should be performed at specific intervals based upon the pesticide label.

The pesticide general permit prohibits algaecide application to drinking water source waters if cyanotoxin concentrations at the water supply intake exceed Ohio EPA drinking water thresholds or if there is a severe bloom (>100,000 cells/mL) or any scums that are within 500 yards of the intake or cover greater than 20% of the reservoir. In some instances, algaecide application is permissible if information is provided to Ohio EPA prior to application. This should confirm that the bloom is not currently producing cyanotoxins, or the surface water will not be used as a source of drinking water until monitoring can confirm cyanotoxins are

below levels of concern, or the water system has demonstrated that treatment is capable of removing high concentrations of cyanotoxins. Please contact your district or central office HAB coordinator prior to applying algaecide to a source water currently in use that has a severe bloom or a visible bloom of unknown severity or if raw water cyanotoxins concentrations exceed Ohio EPA thresholds. More information is available in the Ohio EPA algaecide application fact sheet: ***dam.assets.ohio.gov/image/upload/epa.ohio.gov/Portals/28/documents/habs/Algaecide-Application-FS.pdf***.

6 — HAB Sampling Protocol

This sampling protocol outlines how to collect HAB samples at PWS source waters, finished waters, and treatment train sampling locations.

Generally, cyanobacteria screening, phytoplankton, and cyanotoxin samples will be collected by PWSs or Ohio EPA. It is requested that other sample collectors, such as lake managers, ODNR, ODH, local health districts, Army Corps of Engineers, universities, and volunteers also use this guidance to ensure consistent collection methods.

6.1 Safety Precautions

Safety must come first when sampling for cyanotoxins. Gloves should be worn when sampling HABs (shoulder length if collecting source water samples at depth). Chest waders should also be worn if collecting a cyanotoxin sample when wading off the shore. A personal floatation device (PFD) should be worn if sampling from a boat or wading into swift water. Avoid inhaling spray or getting spray in eyes from boats, wind, or irrigation water from areas with harmful algal blooms. Consider wearing eye protection and a mask if conditions exist that promote aerosolization of cyanotoxins.

Do not ingest or allow the water to come in contact with the skin. Always wash hands with clean, fresh water after sampling. Do not touch hands to mouth, eyes, open cuts, or other exposed areas of the body before washing. All equipment, gloves, and waders should be washed with Alconox and rinsed with clean (tap or bottled) water (not lake water) after a sampling event.

Ohio EPA staff should follow all applicable guidelines outlined in agency standard operating procedures.

For molecular screening, phytoplankton sampling and cyanotoxin sampling at PWSs, the recommended supplies include:

- Plastic disposable gloves
- For microcystins or cylindrospermopsin sampling: 125 mL PETG or 100 mL glass containers
- For qPCR: 250 mL PETG (Polyethylene Terephthalate Glycol) container
- For phytoplankton sampling: lab-approved containers and Lugol's iodine or preservative specified by the laboratory processing samples
- For saxitoxins sampling: 60 mL glass vials from Ohio EPA DES, pre-dosed with preservative for saxitoxins collection
- For anatoxin-a sampling: 60 mL **amber** glass vials from Ohio EPA DES, pre-dosed with preservative for anatoxin-a collection
- Cooler with wet ice
- Waterproof permanent marker (for writing on sample containers, pre-printed labels are also acceptable)
- Large trash bags and twist ties (to contain ice in cooler)
- Chain of Custody Report and Sample Submission Forms

- Shipping labels (if shipping)
- Digital camera to record appearance of bloom, if available
- If collecting raw water or scum samples directly from a water source these additional supplies may be necessary:
  - Elbow- or shoulder-length gloves (to protect skin from dermal toxin irritation if sampling at depth)
  - Goggles (if wind is aerosolizing water droplets)
  - Respirator (if wind is aerosolizing water droplets)
  - Plastic knee boots, hip waders, or chest waders (if collecting samples requires wading offshore)
- Personal flotation device (PFD) (if collecting samples requires wading offshore). If appropriate protective sampling gear is not available, the sampler should avoid contact with the source water and only collect samples from the raw and finished water plant taps.

6.2 Sample Collection

6.2.1 Label Information

Label the collection containers with a waterproof marker or attach a label to the outside of the container and mark with a waterproof marker. Include the following information:

- Sampling Site Location
- Date
- Preservative (if applicable)
- PWS Name and/or PWSID
- Time (military time)

If using Ohio EPA pre-printed labels, you must still write the date and time sample was collected on the label using a waterproof marker. If using glass containers with paper labels, fill out the label and then cover it with clear plastic tape. This will prevent the label from coming off once the container is placed on ice.

6.2.2 Cyanotoxin Samples

For microcystins compliance sampling, collect one sample from the raw water tap or designated raw water sampling point and one sample from finished water at the entry point to the distribution system. Collect finished water, or "clean" samples first. Raw water samples must be collected prior to chemical addition or samples treated with chlorine or any other oxidizer (e.g. KMnO4) must be quenched immediately after collection. 10.0 mg sodium thiosulfate added per 100 mL of sample is sufficient. PWSs should work with their Ohio EPA HAB coordinator if they would like to request an alternate sampling location that is after chemical addition. Additional special purposes samples may be collected at alternate raw water sampling points (individual reservoir intake structures, etc.), within the treatment train, and within the distribution system.

Microcystins and cylindrospermopsin samples must be collected in clean 125 mL PETG or 100 mL glass containers. Saxitoxins samples must be collected in 60 mL pre-preserved glass vials provided by Ohio EPA. Finished water samples and any treatment train samples that have already been subjected to an oxidant MUST be quenched with sodium thiosulfate immediately upon collection (sodium thiosulfate tablets may also be placed in vial prior to collecting samples). The 60 mL, 100 mL, and 125 mL containers should be preserved with one 10 mg sodium thiosulfate tablet. Immediately put all cyanotoxin samples in a dark cooler on wet ice or ice packs. It recommended to double bag any loose ice and to bag sample bottles separately from the ice to avoid breakage.

Drinking water samples must be analyzed as soon as practical but no later than 5 days from the time of collection. If a sample will not arrive for processing at the laboratory within five days, the sample must be frozen in a standard freezer until it is processed. If freezing saxitoxins samples, the sample should first be

mixed by repeatedly inverting the sample vial and then half the sample volume should be decanted and disposed of prior to freezing to avoid breaking the glass vial. Saxitoxins vials should be placed horizontally in the freezer, not vertically.

If collecting samples for LC-MS/MS analysis, verify with the receiving lab the sample volume necessary and required container type. Triple rinse both containers using the water you are sampling, prior to collecting sample that will be submitted to lab (fill and discard water, fill and discard water, fill and discard water, fill and cap container). Include a chain of custody with all samples shipped to the laboratory.

6.2.3 Cyanobacteria Screening Samples

Use the sample container specified in the method (Ohio EPA DES 705.0, section 4.0) for qPCR or semiquantitative cyanotoxin analysis. For qPCR, use a clean 250 mL PETG container to collect one sample from the raw water tap. Raw water samples should be collected prior to chemical addition. Water systems should work with their Ohio EPA district office HAB coordinator if they would like to request an alternate sampling location, post chemical addition.

6.2.4 Phytoplankton Samples

PWSs are encouraged to collect routine phytoplankton samples within their source waters. If a bloom is observed, the water system should consider collecting samples from the scum or biomass in the areas where the bloom is concentrated using a clean lab-approved container. The densest bloom may be near the surface or at a different depth. If the bloom is not at a distinct location, but diffused throughout the water column, consider using a composite sampler that includes collection from a range of depths. If collecting a scum, collect a sample from the scum-water surface interface, which is typically just below the surface of the water. The goal is to collect live cells that have not been lysed (the top of scum –often colored blue or white- is usually dead cells that may be difficult to identify).

Phytoplankton samples should be collected in a clean glass, plastic, or other laboratory-approved container. The sampler should contact the lab that will be analyzing the samples for further instruction on containers, sample volume, and preservation guidance. Ideally, samples should be preserved at the time of collection with Lugol's iodine solution at a ratio of 1:100. To achieve a 1:100 ratio, add approximately 1 mL of Lugol's solution per 100 mL of sample. Final preserved sample color should be similar to that of weak tea. Samples should be kept on wet ice and in the dark during transport. Ship for overnight delivery to the laboratory. If samples are shipped immediately after collection on wet ice, sample preservation with Lugol's iodine may not be necessary (consult lab conducting analysis). Do not freeze the phytoplankton sample - doing so will make identification difficult.

6.2.5 QA/QC

Ohio EPA will use quality assurance/quality control procedures that meet quality objectives for HAB sampling. As part of these procedures, Ohio EPA recommends collecting and analyzing one field duplicate sample for every 20 samples collected.

6.3 Cyanotoxin Processing (Lysing) Instructions

At the laboratory, total cyanotoxins (free extracellular cyanotoxins and intracellular cyanotoxins stored within cyanobacteria cells) shall be determined for PWS sample analysis. Samples should be processed to ensure all algal cells are lysed. The Ohio EPA DES total cyanotoxin analysis methods (Method 701, 702, and 703) all require samples be subjected to at least three freeze/thaw cycles prior to analysis.

6.4 Sample Documentation

6.4.1 Samples Submitted to Ohio EPA for Analysis

Entities submitting samples to Ohio EPA must first contact the DES Sample Coordinator to arrange delivery. Samples submitted to Ohio EPA must include a chain of custody report and one sample submission form. Place the paperwork in zip top bags and seal each bag. Place the paperwork on top of the samples and ice in the cooler.

6.4.2 Samples Submitted to Alternate Labs

Please follow the instructions provided by the lab conducting the analysis. At a minimum, Ohio EPA recommends that a chain of custody be included with all samples shipped to a lab for analysis. A list of laboratories currently accepted for Total Microcystin Testing by the Ohio EPA is available at ***https://dam.assets.ohio.gov/image/upload/epa.ohio.gov/Portals/28/documents/labcert/Combined-Lab-List.pdf***.

6.5 Shipping

Wet ice sealed in plastic bags (recommended to double bag) should be used to ensure samples arrive at the lab at the proper temperature (<10.0º C). Ice packs are often not sufficient to maintain temperature, especially during warmer months. The sample container should be sealed with three continuous circles of tape to help avoid melting ice leaking out of the container during shipment. It is also recommended to place sample vials in bubble wrap and place them in individual Ziplock bags.

6.5.1 Response Sampling Kits

When practical and in agreement with PWS staff, HAB sampling kits may be shipped directly to a PWS for collection and samples shipped to Ohio EPA's DES lab. Sample kit preparation and shipping will be coordinated by Ohio EPA staff and communication will include district office, central office, and DES staff. Kits are typically shipped via FedEx overnight ground. The sampling kit will include sample containers for raw and finished water sampling points (and extra glass vial, if breakage occurs), sodium thiosulfate tablets (to quench samples), cooler, and pre-paid return label to lab. Sample submission forms and sampling instructions may be included as printed copies or provided electronically. Please follow collection procedures in Section 6.

Samples should be packed in a cooler with adequate ice and shipped overnight to Ohio EPA's DES lab. Samples must be received by noon on the day following sample collection and when should only be shipped Monday through Thursday (unless otherwise directed by Ohio EPA staff) to ensure that samples are received at temperature and can be analyzed within holding time.

6.5.2 Samples Collected by Ohio EPA

Ohio EPA staff should plan sampling early in the week and ship overnight for next day delivery by 14:00 hrs. so samples can be properly processed, and results will be ready by the weekend. Samples can be received by DES Monday through Thursday. If Friday delivery is required, DES may not be able to analyze the sample until the following week. Contact the DES sample coordinator at 614.644.4243 and indicate how many samples will be collected and when they will be delivered to DES prior to sampling.

If samples will not arrive at DES within that timeframe, samples may need to be frozen to preserve the cyanotoxin until they are shipped to DES the following week (depending on holding time). The exception is for resample or repeat sampling following cyanotoxin detections in finished water or source water conditions that warrant rush sampling. The central office staff will coordinate with DES following any

finished water cyanotoxin detections to ensure the laboratory has capacity to analyze samples over the weekend or holiday, if necessary.

6.5.3 Shipping to Alternate Labs

Contact the appropriate laboratory prior to shipping samples. Include any paperwork required by the receiving laboratory. Make sure that all compliance sampling data is submitted to Ohio EPA via eDWR. Voluntary PWSs sampling data can also be reported to eDWR using the special purpose code.

7 — Treatment Optimization Protocols and General Plan Requirements

All public water systems (PWS) receiving water from a surface water source (excluding consecutive systems) are required to submit a harmful algal bloom (HAB) treatment optimization protocol (TOP). The protocols must be in an acceptable form and include detailed information on the PWS, water sources, existing treatment processes with schematic, and describe treatment adjustments that will be made under various raw and finished water quality conditions. While HABs can produce many different cyanotoxins, the TOP must focus on optimization of existing treatment for microcystins removal. However, if the PWSs has detected other toxins, it is recommended the TOP address optimization strategies to address these as well.

In addition to TOPs, 3745-90 also requires the PWS to submit an approvable cyanotoxin general plan under specific conditions. A general plan is required when microcystins concentrations exceed 1.6 micrograms per liter in a sample collected at the raw water sampling point more than once within a consecutive twelve-month period, or when microcystins are detected in a sample collected at a finished water sampling point or a distribution sampling point. The cyanotoxin general plan shall include both short-term and long-term strategies to prevent exceedances of the microcystins action levels.

Ohio EPA developed guidance documents on how to develop treatment optimization protocols (TOPs) for HABs and cyanotoxin general plans. All PWS with surface water source are required to review these documents annually. Guidance resources, including a template form for HAB TOPs, are available at ***epa.ohio.gov/divisions-and-offices/drinking-and-ground-waters/public-water-systems/harmful-algal-blooms.***

There are a variety of resources available to help PWSs understand which treatment processes are effective at cyanotoxin destruction or removal and how to optimize a treatment plant to deal with cyanotoxins. Ohio EPA partnered with the Ohio Section of AWWA to develop a white paper on cyanotoxin treatment. The white paper covers microcystins, saxitoxins, cylindrospermopsin, and anatoxin-a treatment and found at: ***dam.assets.ohio.gov/image/upload/epa.ohio.gov/Portals/28/documents/hab/Algal%20Toxin%20Treatment%20White%20Paper%20FINAL%20November%202016.pdf***

APPENDIX A: CYANOBACTERIA AND THEIR ASSOCIATED CYANOTOXINS AND TASTE AND ODOR COMPOUNDS

Cyanobacterial Genera	Hepatotoxins		Neurotoxins		Tastes and Odors	
	CYLINDRO-SPERMOPSIN	MICROCYSTINS	ANATOXIN	SAXITOXINS	GEOSMIN	MIB
Anabaena (Dolichospermum)	x	x	x	x	x	
Anabaenopsis		x				
Aphanizomenon (Cuspidothrix)	x	x	x	x	x	
Aphanocapsa		x				
Arthrospira		x	x			
Chrysosporum	x					
Cylindrospermum	x		x	x		
Fischerella		x			x	
Gloeotrichia		x				
Hapalosiphon		x				
Hyella					x	x
Leptolyngbya (Plectonema)		x			x	x
Limnothirix		x				
Lyngbya (Microseira)	x	x		x	x	x
Merismopedia		x				
Microcystis		x				
Nostoc		x		x	x	x
Oscillatoria (Planktothrix)	x	x	x	x	x	x
Phormidium (Anagnostidinema, Geitlerinema, Microcoleus)		x	x	x	x	x
Pseudanabaena		x				x
Raphidiopsis (Cylindrospermop-sis)	x	x	x	x		
Scytonema		x				
Snowella		x				
Synechococcus		x			x	x
Synechocystis		x				
Umezakia	x	x				
Woronichinia		x	x			

Information adapted from Jennifer Graham (USGS) with cyanotoxin production documented by Bernard et al., 2017; Chapman and Foss, 2019; Huang and Zimba, 2019.

APPENDIX B: BASIS FOR CYANOTOXIN THRESHOLDS

Toxicity Review and Calculations

Toxicity values for microcystins and cylindrospermopsin are consistent with U.S. EPA national health advisories for these cyanotoxins. Toxicity values for anatoxin-a and saxitoxins are detailed below. The toxicity values for the specific cyanotoxins are referred to as reference doses (RfDs), which are intended to represent a "safe" dose for humans, below which no toxic effect is to be expected. The values are expressed in micrograms per kilogram body weight per day (µg/kg-day). Uncertainty factors are included between 10 and 1000, depending on the number, variety, and quality of the available studies. The child and adult advisory values use the same toxicity data (RfD) and represent differences in drinking water intake and body weight for different human life stages. The child advisory value is based on the summation of the time-weighted drinking water intake/body weight ratios for birth to less than 12 months of age (U.S. EPA 2011). The adult advisory value is based on the mean body weight and the 90th percentile drinking water consumption rate for adults aged 21 and over (U.S. EPA 2011), which is similar to that of school-aged children.

The basic calculation and other exposure factors used to calculate cyanotoxin thresholds in drinking water are consistent with U.E. EPA's national health advisories for microcystins and cylindrospermopsin:

$$\text{Threshold} = \frac{\text{NOAEL or LOAEL}}{\text{UF} \times \text{DWI/BW}}$$

Where:

NOAEL or **LOAEL** = No- or Lowest-Observed-Adverse-Effect Level (µg/kg BW-day) from a study of an appropriate duration.

UF = Uncertainty factors account for: intraspecies variability (variation in susceptibility across individuals); interspecies variability (uncertainty in extrapolating animal data to humans); uncertainty in extrapolating from a LOAEL to a NOAEL; and uncertainty associated with extrapolation when the database is incomplete.

DWI/BWI = Normalized ratio of drinking water ingestions to body weight (L/kg-day). For children under the age of six, this value is 0.15 L/kg-day and based on the 90th percentile of drinking water consumption and mean body weight. For adults and children aged six and older, the value is 0.03 L/kg-day based on adult default values of 2.5 L/day and 80 kg.

Threshold unit is µg/L.

The toxicity review with supporting references is described for each cyanotoxin, and the values used in the threshold calculation are provided in the table below.

Table B1. Toxicity values used to calculate cyanotoxin thresholds in drinking water.

	Microcystins	Cylindrospermopsin	Anatoxin-a	Saxitoxins
RfD (µg/kg-day)	0.05	0.1	0.05	0.05
NOAEL (µg/kg-day)	NA	30	50	0.5
LOAEL (µg/kg-day)	50	NA	NA	NA
UF	1000	300	1000	10
DWI/BW, children under 6 (L/kg-day)	0.15	0.15	0.15	0.15
DWI/BW, children 6 and older and adults (L/kg-day)	0.03	0.03	0.03	0.03

Microcystins

U.S. EPA identified a study by Heinze (1999) conducted on rats as the critical study used in the derivation of the RfD for microcystins. The critical effects identified in the study are increased liver weight, slight to moderate liver lesions with hemorrhages, and increased enzyme levels as a result of exposure to microcystin-LR. The LOAEL was determined to be 50 µg/kg-day, based on these effects. The drinking water route of exposure matches potential drinking water exposure scenarios in humans. The total UF applied to the LOAEL was 1000. This was based on a UF of 10 for intraspecies variability, a UF of 10 for interspecies variability, a UF of 3 ($10^{0.5}$) for extrapolation from a LOAEL to NOAEL, and a UF of 3 ($10^{0.5}$) to account for deficiencies in the database. U.S. EPA is using microcystin-LR as a surrogate for other microcystin congeners. Therefore, the threshold value applies to total microcystins. U.S. EPA issued a ten-day health advisory for microcystins based on the duration of the supporting health effects study and human exposure scenario for microcystins in drinking water.

Cylindrospermopsin

U.S. EPA identified a study by Humpage and Falconer (2002, 2003) conducted on mice as the critical study used in the derivation of the RfD for cylindrospermopsin. The critical effects identified in the study are increased kidney weight and decreased urinary protein. The NOAEL was determined to be 30 µg/kg-day, based on kidney toxicity. The total UF applied to the NOAEL was 300. This was based on a UF of 10 for intraspecies variability, a UF of 10 for interspecies variability, and a UF of 3 ($10^{0.5}$) to account for deficiencies in the database. U.S. EPA issued a ten-day health advisory for cylindrospermopsin based on the duration of the supporting health effects study and human exposure scenario for cylindrospermopsin in drinking water.

Anatoxin-a

U.S. EPA's *Health Effects Support Document for the Cyanobacteria Toxin Anatoxin-A* from 2015 was used as the basis for the anatoxin-a thresholds presented here. U.S. EPA determined that data were inadequate to develop acute, short term, or chronic RfDs for anatoxin-a. Additionally, this document noted a change from U.S. EPA's 2006 draft toxicological review of anatoxin-a in the interpretation of the NOAEL and LOAEL values from a seven-week drinking water study in rats that supports the subchronic oral toxicity of anatoxin-a (Astrachan and Archer 1981, Astrachan et al. 1980). The same study served as the basis for the subchronic RfD and threshold calculations for anatoxin-a in the 2019 PWS HAB Response Strategy. The threshold values for anatoxin-a are recalculated herein with the NOAEL of 50 µg/kg**-**day to determine subchronic RfD and to incorporate the exposure assumptions (i.e., body weight and ingestion rates) used for other cyanotoxins. The total UF applied to the NOAEL was 1000. The UF includes a factor of 10 for rat to human variability, 10 for variability among humans, and 10 for database deficiencies, including limitations within the study used as the basis for the RfD, lack of reproductive studies, and lack of toxicity testing in a second species. To be consistent with the tiered health advisories established by U.S. EPA for microcystins and cylindrospermopsin, tiered thresholds were established for both child and adult exposure. The thresholds were calculated based on the same assumptions used to calculate the microcystins and cylindrospermopsin health advisory concentrations.

Saxitoxins

Neither U.S. EPA nor World Health Organization (WHO) have issued an RfD for saxitoxins; though WHO recently published ***Cyanobacterial Toxins: Saxitoxins. Background Document for Development of WHO Guidelines for Drinking-Water Quality and Guidelines for Safe Recreational Water Environments*** (2020). To develop a saxitoxins guideline, the committee reviewed information in the Report of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs from 2004, as well as a peer-

reviewed paper by Galváo et al. (2009). The joint FAO/IOC/WHO report recommends an acute reference dose for saxitoxins (STX)of 0.7 µg/kg-day but does not establish an RfD. The report does not describe the toxicological basis for the recommended value.

Galváo (2009) states:

From available reports on exposure in humans, a lowest-observed-adverse-effect-level (LOAEL) in the region of 1.5 µg STXs/kg body weight (b.w.) could be set, and an estimated no-observed-adverse-effect-level (NOAEL) of 0.5 µg STXs/kg b.w. was established. Thus, the CONTAM panel has defined an acute reference dose (ARfD) of 0.5 µg STXs/kg b.w.

The Galváo paper refers to a report in the European Food Safety Authority (EFSA), 2009, Marine Biotoxins in Shellfish – Saxitoxin Group Scientific Opinion of the Panel on Contaminants in the Food Chain.

Using the WHO and U.S. EPA method of applying an uncertainty factor to the NOAEL to derive an RfD, a total UF of 100 was applied to the NOAEL-based ARfD. The UF includes a factor of 10 for human variability and 10 for a lack of chronic, developmental, and reproductive studies. In 2016 Ohio EPA consulted with the State of Oregon and reviewed the EFSA data and determined that the application of an uncertainty factor of 10 for human variability was not appropriate. This is because "No additional factor for variation among humans was deemed necessary because the data covered a large number of affected consumers, including sensitive individuals" (EFSA 2009). The factor of 10 for human variability was removed, and the total UF of 10 is used in the current threshold calculations. To be consistent with the tiered health advisories established by U.S. EPA for microcystins and cylindrospermopsin and the saxitoxin thresholds established by the State of Oregon, tiered thresholds were established for both child and adult exposure. The thresholds were calculated based on the same assumptions used to calculate the microcystins and cylindrospermopsin health advisory concentrations.

Toxicity Equivalency Factors (TEFs) for Saxitoxins

The Food and Drug Administration (FDA), U.S. EPA, and the European Food Safety Authority utilize TEFs when calculating saxitoxins exposure in seafood. The TEFs are based on research on the acute toxicity of saxitoxin analogues following intraperitoneal administration in mice. The established TEFs are in the Table B2.

Table B2. List of saxitoxin analogues and corresponding TEF.

Saxitoxin Analogue	Toxicity Equivalency Factor
STX	1
NeoSTX	1
GTX1	1
GTX2	0.4
GTX3	0.6
GTX4	0.7
GTX5	0.1
GTX6	0.1
C2	0.1
C4	0.1
dc-STX	1
dc-NeoSTX	0.4
dc-GTX2	0.2
dc-GTX3	0.4
11-hydroxy-STX	0.3

Ohio EPA may utilize the established TEFs to help determine if a saxitoxins threshold has been exceeded. If a saxitoxin variant is detected that does not have an established TEF, it will be assigned a TEF of 1. ELISA analysis for total saxitoxins may be utilized for ongoing sampling after an initial finished water threshold exceedance.

APPENDIX C: EARLY MESSAGING AND PUBLIC NOTICE TEMPLATES

DRINKING WATER ADVISORY

Microcystins are present in [name] water system

ESTE INFORME CONTIENE INFORMACION IMPORTANTE ACERCA DE SU AGUA POTABLE. HAGA QUE ALGUIEN LO TRADUZCA PARA USTED, O HABLE CON ALQUIEN QUE LO ENTIENDA.

Microcystins, compounds produced by blue-green algae, have been detected in the finished drinking water from [name] water system. A sample[s] collected on [date] shows microcystins at [level] micrograms/liter (µg/L). U.S. EPA has established a national health advisory level for bottle-fed infants and children younger than school age based on drinking water for 10 days. The Ohio Environmental Protection Agency recommends that bottle-fed infants and children younger than school age do not drink the water at microcystins levels above 0.3 µg/L.

Consuming water containing concentrations of microcystins over the action level may result in abnormal liver function, diarrhea, vomiting, nausea, numbness or dizziness. Children younger than school age, pregnant women, nursing mothers, the elderly, immune-compromised individuals, those with pre-existing liver conditions and those receiving dialysis treatment may be more susceptible than the general population to the health effects of microcystins. Seek medical attention if your child is experiencing any of these symptoms.

What should I do?

- **THE FOLLOWING INDIVIDUALS SHOULD NOT DRINK THE WATER: Bottle-fed infants and children younger than school age, pregnant women, nursing mothers, those with pre-existing liver conditions and those receiving dialysis treatment. These individuals may be more susceptible than the general population to the health effects of microcystins. Alternative water should be used for drinking, making infant formula, making ice, brushing teeth, and preparing food.**
- **As a precautionary measure, the elderly and immune-compromised individuals may want to consider using an alternate water source for drinking, making ice, brushing teeth and preparing food.**
- **School-age children and adults not in the categories listed above may drink the water.** Healthy school age children and adults may use the water for all uses including bathing, washing hands, washing dishes and doing laundry. The water may be used for flushing toilets.
- Infants and children younger than school age must be supervised while bathing to prevent accidental ingestion of water. Providing a final rinse of skin with uncontaminated water is recommended for people with open wounds or skin conditions such as eczema. Recommend rinsing with uncontaminated water items that go into the mouths of infants and children under the age of six years (i.e., teething rings, nipples, bottles, toys, silverware).
- **DO NOT BOIL THE WATER.** Boiling the water will not destroy microcystins and it may become more concentrated as a result of boiling.
- Contact a veterinarian immediately if pets or livestock show signs of illness.

What happened? What is being done?

[Lake/name of water source], which is a source of drinking water for the [drinking water system] is experiencing a harmful algal bloom (HAB). XXX water system is making adjustments to its treatment processes (this may need to be modified based on water system capability) to help reduce microcystins levels. We are working closely with local and state public health and emergency response agencies to address and resolve the situation. We will keep you informed as the situation is resolved.

For more information, please contact _____at_____. More information about harmful algal blooms can be found at ***ohioalgaeinfo.com***.

Please share this information anyone who drinks this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#:		STUID#:		Date distributed:	

DRINKING WATER ADVISORY

Microcystins are present in [name] water system

ESTE INFORME CONTIENE INFORMACION IMPORTANTE ACERCA DE SU AGUA POTABLE. HAGA QUE ALGUIEN LO TRADUZCA PARA USTED, O HABLE CON ALQUIEN QUE LO ENTIENDA.

DO NOT DRINK THE WATER NO BEBA EL AQUA

Microcystins, compounds produced by blue-green algae, have been detected in the finished drinking water from [name] water system. A sample[s] collected on [date] shows microcystins at [level] micrograms/liter (µg/L). U.S. EPA has established a national health advisory level based on drinking water for 10 days. The Ohio Environmental Protection Agency recommends that you do not drink the water at microcystins levels above 1.6 µg/L.

Consuming water containing concentrations of microcystins over the action level may result in abnormal liver function, diarrhea, vomiting, nausea, numbness or dizziness. Children younger than school age, pregnant women, nursing mothers, the elderly, immune-compromised individuals, those with pre-existing liver conditions and those receiving dialysis treatment may be more susceptible than the general population to the health effects of microcystins. Seek medical attention if your child is experiencing any of these symptoms.

What should I do?

- **DO NOT DRINK THE WATER. Alternative water should be used for drinking, making infant formula, making ice, brushing teeth, and preparing food.**
- Healthy adults may use the water for bathing, washing hands, washing dishes and doing laundry. The water may be used for flushing toilets.
- Infants and children must be supervised while bathing to prevent accidental ingestion of water. Providing a final rinse of skin with uncontaminated water is recommended for people with open wounds or skin conditions such as eczema. Recommend rinsing with uncontaminated water items that go into the mouths of infants and children (i.e., teething rings, nipples, bottles, toys, silverware).
- **DO NOT BOIL THE WATER.** Boiling the water will not destroy microcystins and it may become more concentrated as a result of boiling.
- Pets should not drink the water. Contact a veterinarian immediately if pets or livestock show signs of illness.

What happened? What is being done?

[Lake/name of water source], which is a source of drinking water for the [drinking water system] is experiencing a harmful algal bloom (HAB).

XXX water system is making adjustments to its treatment processes (this may need to be modified based on water system capability) to help reduce microcystins levels. We are working closely with local and state public health and emergency response agencies to address and resolve the situation. We will keep you informed as the situation is resolved.

For more information, please contact _____at_____. More information about harmful algal blooms can be found at ***ohioalgaeinfo.com***.

Please share this information anyone who drinks this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#:		STUID#:		Date distributed:	

DRINKING WATER ADVISORY

Saxitoxins are present in [name] water system

ESTE INFORME CONTIENE INFORMACION IMPORTANTE ACERCA DE SU AGUA POTABLE. HAGA QUE ALGUIEN LO TRADUZCA PARA USTED, O HABLE CON ALQUIEN QUE LO ENTIENDA.

Saxitoxins, compounds produced by blue-green algae, have been detected in the finished drinking water from [name] water system. A sample[s] collected on [date] shows saxitoxins at [level] micrograms/liter (µg/L). The Ohio Environmental Protection Agency recommends that children under six, including bottle fed infants, and sensitive populations do not drink the water at saxitoxins levels above 0.3 µg/L.

Consuming water containing saxitoxins may result in numbness or tingling around the mouth, numbness spreading to arms and hands, headache, dizziness, a floating sensation, muscle soreness, muscle weakness, difficulty breathing, paralysis, nausea or vomiting. Seek medical attention if your child is experiencing any of these symptoms.

What should I do?

- **THE FOLLOWING INDIVIDUALS SHOULD NOT DRINK THE WATER: Bottle-fed infants and children younger than school age, pregnant women, nursing mothers and those receiving dialysis treatments. These individuals may be more susceptible than the general population to the health effects of saxitoxins. Alternative water should be used for drinking, making infant formula, making ice, brushing teeth, and preparing food.**
- **As a precautionary measure, the elderly and immune-compromised individuals may want to consider using an alternate water source for drinking, making ice, brushing teeth and preparing food.**
- **School-age children and adults not in the categories listed above may drink the water.** Healthy school age children and adults may use the water for all uses including bathing, washing hands, washing dishes and doing laundry. The water may be used for flushing toilets.
- Infants and children younger than school age must be supervised while bathing to prevent accidental ingestion of water. Providing a final rinse of skin with uncontaminated water is recommended for people with open wounds or skin conditions such as eczema. Recommend rinsing with uncontaminated water items that go into the mouths of infants and children under the age of six years (i.e., teething rings, nipples, bottles, toys, silverware).
- **DO NOT BOIL THE WATER.** Boiling the water will not destroy saxitoxins and it may become more concentrated as a result of boiling.
- Contact a veterinarian immediately if pets or livestock show signs of illness.

What happened? What is being done?

[Lake/name of water source], which is a source of drinking water for the [drinking water system] is experiencing a harmful algal bloom (HAB). XXX water system is making adjustments to its treatment processes (this may need to be modified based on water system capability) to help reduce saxitoxin levels. We are working closely with local and state public health and emergency response agencies to address and resolve the situation. We will keep you informed as the situation is resolved.

For more information, please contact _____at_____. More information about harmful algal blooms can be found at ***ohioalgaeinfo.com***.

Please share this information anyone who drinks this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#:		STUID#:		Date distributed:	

DRINKING WATER ADVISORY

Saxitoxins are present in [name] water system

ESTE INFORME CONTIENE INFORMACION IMPORTANTE ACERCA DE SU AGUA POTABLE. HAGA QUE ALGUIEN LO TRADUZCA PARA USTED, O HABLE CON ALQUIEN QUE LO ENTIENDA.

DO NOT DRINK THE WATER NO BEBA EL AGUA

Saxitoxins, compounds produced by blue-green algae, has been detected in the finished drinking water from [name] water system. A sample[s] collected on [date] shows saxitoxins at [level] micrograms/liter (µg/L). The Ohio Environmental Protection Agency recommends that you do not drink the water at saxitoxins levels above 1.6 µg/L.

Consuming water containing saxitoxins may result in numbness or tingling around the mouth, numbness spreading to arms and hands, headache, dizziness, a floating sensation, muscle soreness, muscle weakness, difficulty breathing, paralysis, nausea or vomiting. Seek medical attention if you are experiencing any of these symptoms.

What should I do?

- **DO NOT DRINK THE WATER. Alternative water should be used for drinking, making infant formula, making ice, brushing teeth, and preparing food.**
- Healthy adults may use the water for bathing, washing hands, washing dishes and doing laundry. The water may be used for flushing toilets.
- Infants and children must be supervised while bathing to prevent accidental ingestion of water. Providing a final rinse of skin with uncontaminated water is recommended for people with open wounds or skin conditions such as eczema. Recommend rinsing with uncontaminated water items that go into the mouths of infants and children (i.e., teething rings, nipples, bottles, toys, silverware).
- **DO NOT BOIL THE WATER.** Boiling the water will not destroy saxitoxins and it may become more concentrated as a result of boiling.
- Pets should not drink the water. Contact a veterinarian immediately if pets or livestock show signs of illness.

What happened? What is being done?

[Lake/name of water source], which is a source of drinking water for the [drinking water system] is experiencing a harmful algal bloom (HAB). XXX water system is making adjustments to its treatment processes (this may need to be modified based on water system capability) to help reduce saxitoxin levels. We are working closely with local and state public health and emergency response agencies to address and resolve the situation. We will keep you informed as the situation is resolved.

For more information, please contact _____at_____. More information about harmful algal blooms can be found at ***ohioalgaeinfo.com***.

Please share this information anyone who drinks this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#:		STUID#:		Date distributed:	

DRINKING WATER ADVISORY

Cylindrospermopsin is present in [name] water system

ESTE INFORME CONTIENE INFORMACION IMPORTANTE ACERCA DE SU AGUA POTABLE. HAGA QUE ALGUIEN LO TRADUZCA PARA USTED, O HABLE CON ALQUIEN QUE LO ENTIENDA.

Cylindrospermopsin, a compound produced by blue-green algae, has been detected in the finished drinking water from [name] water system. A sample[s] collected on [date] shows cylindrospermopsin at [level] micrograms/liter (µg/L). U.S. EPA has established a national health advisory level for bottle-fed infants and children younger than school age based on drinking water for 10 days. The Ohio Environmental Protection Agency recommends that bottle-fed infants and children younger than school age do not drink the water at cylindrospermopsin levels above 0.7 µg/L.

Consuming water containing cylindrospermopsin at the detected level may result in abdominal pain, fever, vomiting, diarrhea or impaired liver or kidney function in this population. Seek medical attention if your child is experiencing any of these symptoms.

What should I do?

- **THE FOLLOWING INDIVIDUALS SHOULD NOT DRINK THE WATER: Bottle-fed infants and children younger than school age, pregnant women, nursing mothers, those with pre-existing liver or kidney conditions and those receiving dialysis treatment. These individuals may be more susceptible than the general population to the health effects of cylindrospermopsin. Alternative water should be used for drinking, making infant formula, making ice, brushing teeth, and preparing food.**
- **As a precautionary measure, the elderly and immune-compromised individuals may want to consider using an alternate water source for drinking, making ice, brushing teeth and preparing food.**
- **School-age children and adults not in the categories listed above may drink the water.** Healthy school age children and adults may use the water for all uses including bathing, washing hands, washing dishes and doing laundry. The water may be used for flushing toilets.
- Infants and children younger than school age must be supervised while bathing to prevent accidental ingestion of water. Providing a final rinse of skin with uncontaminated water is recommended for people with open wounds or skin conditions such as eczema. Recommend rinsing with uncontaminated water items that go into the mouths of infants and children under the age of six years (i.e., teething rings, nipples, bottles, toys, silverware).
- **DO NOT BOIL THE WATER.** Boiling the water will not remove cylindrospermopsin and it may become more concentrated as a result of boiling.
- Contact a veterinarian immediately if pets or livestock show signs of illness.

What happened? What is being done?

[Lake/name of water source], which is a source of drinking water for the [drinking water system] is experiencing a harmful algal bloom (HAB). XXX water system is making adjustments to its treatment processes (this may need to be modified based on water system capability) to help reduce cylindrospermopsin levels. We are working closely with local and state public health and emergency response agencies to address and resolve the situation. We will keep you informed as the situation is resolved.

For more information, please contact _____at_____. More information about harmful algal blooms can be found at ***ohioalgaeinfo.com***.

Please share this information anyone who drinks this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#:		STUID#:		Date distributed:	

DRINKING WATER ADVISORY

Cylindrospermopsin is present in [name] water system

ESTE INFORME CONTIENE INFORMACION IMPORTANTE ACERCA DE SU AGUA POTABLE. HAGA QUE ALGUIEN LO TRADUZCA PARA USTED, O HABLE CON ALQUIEN QUE LO ENTIENDA.

DO NOT DRINK THE WATER NO BEBA EL AGUA

Cylindrospermopsin, a compound produced by blue-green algae, has been detected in the finished drinking water from [name] water system. A sample[s] collected on [date] shows cylindrospermopsin at [level] micrograms/liter (µg/L). U.S. EPA has established a national health advisory level based on drinking water for 10 days. The Ohio Environmental Protection Agency recommends that you do not drink the water at cylindrospermopsin levels above 3.0 µg/L.

Consuming water containing cylindrospermopsin at the detected level may result in abdominal pain, fever, vomiting, diarrhea, or impaired liver or kidney function. Seek medical attention if your child is experiencing any of these symptoms.

What should I do?

- **DO NOT DRINK THE WATER. Alternative water should be used for drinking, making infant formula, making ice, brushing teeth, and preparing food.**
- Healthy adults may use the water for bathing, washing hands, washing dishes and doing laundry. The water may be used for flushing toilets.
- Infants and children must be supervised while bathing to prevent accidental ingestion of water. Providing a final rinse of skin with uncontaminated water is recommended for people with open wounds or skin conditions such as eczema. Recommend rinsing with uncontaminated water items that go into the mouths of infants and children (i.e., teething rings, nipples, bottles, toys, silverware).
- **DO NOT BOIL THE WATER.** Boiling the water will not remove cylindrospermopsin and it may become more concentrated as a result of boiling.
- Pets should not drink the water. Contact a veterinarian immediately if pets or livestock show signs of illness.

What happened? What is being done?

[Lake/name of water source], which is a source of drinking water for the [drinking water system] is experiencing a harmful algal bloom (HAB).

XXX water system is making adjustments to its treatment processes (this may need to be modified based on water system capability) to help reduce cylindrospermopsin levels. We are working closely with local and state public health and emergency response agencies to address and resolve the situation. We will keep you informed as the situation is resolved.

For more information, please contact _____at_____. More information about harmful algal blooms can be found at ***ohioalgaeinfo.com***.

Please share this information anyone who drinks this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#:		STUID#:		Date distributed:	

DRINKING WATER ADVISORY

Anatoxin-a is present in [name] water system

ESTE INFORME CONTIENE INFORMACION IMPORTANTE ACERCA DE SU AGUA POTABLE. HAGA QUE ALGUIEN LO TRADUZCA PARA USTED, O HABLE CON ALQUIEN QUE LO ENTIENDA.

Anatoxin-a, a compound produced by blue-green algae, has been detected in the finished drinking water from [name] water system. A sample[s] collected on [date] shows anatoxin-a at [level] micrograms/liter (µg/L). The Ohio Environmental Protection Agency recommends that children under six, including bottle fed infants, and sensitive populations do not drink the water at anatoxin-a levels above 0.3 µg/L.

Consuming water containing anatoxin-a may result in loss of coordination, muscular twitching, convulsions, difficulty breathing, and potentially other neurotoxicity symptoms: headache, dizziness, a floating sensation, muscle soreness, muscle weakness, nausea or vomiting, and paralysis. Seek medical attention if you are experiencing any of these symptoms.

What should I do?

- **THE FOLLOWING INDIVIDUALS SHOULD NOT DRINK THE WATER: Bottle-fed infants and children younger than school age, pregnant women, nursing mothers and those receiving dialysis treatments. These individuals may be more susceptible than the general population to the health effects of anatoxin-a. Alternative water should be used for drinking, making infant formula, making ice, brushing teeth, and preparing food.**
- **As a precautionary measure, the elderly and immune-compromised individuals may want to consider using an alternate water source for drinking, making ice, brushing teeth and preparing food.**
- **School-age children and adults not in the categories listed above may drink the water.** Healthy school age children and adults may use the water for all uses including bathing, washing hands, washing dishes and doing laundry. The water may be used for flushing toilets.
- Infants and children younger than school age must be supervised while bathing to prevent accidental ingestion of water. Providing a final rinse of skin with uncontaminated water is recommended for people with open wounds or skin conditions such as eczema. Recommend rinsing with uncontaminated water items that go into the mouths of infants and children under the age of six years (i.e., teething rings, nipples, bottles, toys, silverware).
- **DO NOT BOIL THE WATER.** Boiling the water will not destroy anatoxin-a and it may become more concentrated as a result of boiling.
- Contact a veterinarian immediately if pets or livestock show signs of illness.

What happened? What is being done?

[Lake/name of water source], which is a source of drinking water for the [drinking water system] is experiencing a harmful algal bloom (HAB). XXX water system is making adjustments to its treatment processes (this may need to be modified based on water system capability) to help reduce anatoxin-a levels. We are working closely with local and state public health and emergency response agencies to address and resolve the situation. We will keep you informed as the situation is resolved.

For more information, please contact _____at_____. More information about harmful algal blooms can be found at ***ohioalgaeinfo.com***.

Please share this information anyone who drinks this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

PWSID#:		STUID#:		Date distributed:	

DRINKING WATER ADVISORY

Anatoxin-a is present in [name] water system

ESTE INFORME CONTIENE INFORMACION IMPORTANTE ACERCA DE SU AGUA POTABLE. HAGA QUE ALGUIEN LO TRADUZCA PARA USTED, O HABLE CON ALQUIEN QUE LO ENTIENDA.

DO NOT DRINK THE WATER NO BEBA EL AGUA

Anatoxin-a, a compound produced by blue-green algae, has been detected in the finished drinking water from [name] water system. A sample[s] collected on [date] shows anatoxin-a at [level] micrograms/liter (µg/L). The Ohio Environmental Protection Agency recommends that you do not drink the water at anatoxin-a levels above 1.6 µg/L.

Consuming water containing anatoxin-a may result in loss of coordination, muscular twitching, convulsions, difficulty breathing, and potentially other neurotoxicity symptoms: headache, dizziness, a floating sensation, muscle soreness, muscle weakness, nausea or vomiting, and paralysis. Seek medical attention if you are experiencing any of these symptoms.

What should I do?

- **DO NOT DRINK THE WATER. Alternative water should be used for drinking, making infant formula, making ice, brushing teeth, and preparing food.**
- Healthy adults may use the water for bathing, washing hands, washing dishes and doing laundry. The water may be used for flushing toilets.
- Infants and children must be supervised while bathing to prevent accidental ingestion of water. Providing a final rinse of skin with uncontaminated water is recommended for people with open wounds or skin conditions such as eczema. Recommend rinsing with uncontaminated water items that go into the mouths of infants and children (i.e., teething rings, nipples, bottles, toys, silverware).
- **DO NOT BOIL THE WATER.** Boiling the water will not destroy anatoxin-a and it may become more concentrated as a result of boiling.
- Pets should not drink the water. Contact a veterinarian immediately if pets or livestock show signs of illness.

What happened? What is being done?

[Lake/name of water source], which is a source of drinking water for the [drinking water system] is experiencing a harmful algal bloom (HAB). XXX water system is making adjustments to its treatment processes (this may need to be modified based on water system capability) to help reduce anatoxin-a levels. We are working closely with local and state public health and emergency response agencies to address and resolve the situation. We will keep you informed as the situation is resolved.

For more information, please contact _____at_____. More information about harmful algal blooms can be found at ***ohioalgaeinfo.com***.

Please share this information anyone who drinks this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

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APPENDIX D: 2025 HAB CONTACTS

Ohio EPA Division of Drinking and Ground Waters

If it is after normal business hours and an Ohio EPA staff person cannot be reached (*primary contact), call: **1.800.282.9378**

PWS HAB Webpage

epa.ohio.gov/divisions-and-offices/drinking-and-ground-waters/public-water-systems/harmful-algal-blooms

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Rebecca Werner, Engineering and Treatment
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Central District Office

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Phone: 614.644.4247; Fax: 614.644.4272

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Nik Dzamov, Chief
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Communications & Outreach (Media Calls)

614.644.2160

Legislative Liaisons (Legislative Inquiries)

614.644.303

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