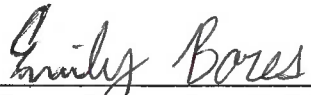
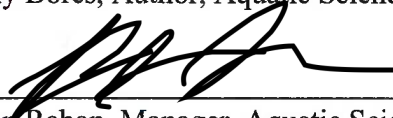
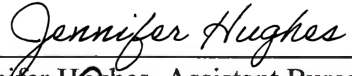
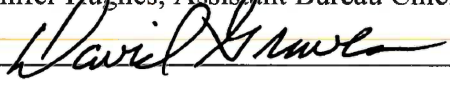




S.C. Department of Health and  
Environmental Control

**Algal Bloom and Cyanotoxin Field  
Collection Standard Operating  
Procedures**  
**Bureau of Water- Aquatic Science Programs**

**February 23, 2021**

 _____ Emily Bores, Author, Aquatic Science Programs	<u>02/23/2021</u> Date
 _____ Bryan Rabon, Manager, Aquatic Science Programs	<u>2021-02-23</u> Date
 _____ Jennifer Hughes, Assistant Bureau Chief- BOW	<u>2/24/2021</u> Date
 _____ David Graves, Quality Assurance Manager, EA	<u>2/24/2021</u> Date

## 1.0 Background

Algae and cyanobacteria are a large, diverse group of single and multi-celled organisms that can possess characteristics of both plants and animals. Under the right environmental conditions, algae can proliferate and become a nuisance in any body of water. This rapid growth is called an algal bloom and can be associated with foam, scum, or thick layers of algae on the surface of water. Algal blooms can look and smell bad and may cause the water to appear green, red, brown, or blue in color; however, algal blooms cannot always be seen and are not always harmful. Refer to Appendix A for examples of cyanobacteria blooms.

Cyanobacteria can be found at the water surface (scums, mats), at specific depths, or throughout the water column. Cyanobacteria location can also be impacted by weather such as winds, currents, rain, and lake turnover while other species can regulate their buoyancy and move throughout the water column. It is important to note these different variables to understand that cyanobacteria and cyanobacteria blooms may not 'stay' in one place on the waterbody and an absence of an obvious scum or mat does not necessarily indicate the death/decay or absence of a bloom.

Cyanobacteria, or blue-green algae, are a type of species that has the potential to produce toxins. When they contain toxins that affect the health of people, animals, and the environment, they are known as harmful algal blooms (HABs). Cyanobacteria and algal blooms can also cause taste and odor issues in drinking water, decrease water quality, and impact the aesthetic and recreational value of the waterbody. You cannot tell by looking at a bloom whether it is harmful, and additional microscopy and analytical testing will be needed for species identification and toxin quantification.

## 2.0 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures and safety precautions that should be followed when assessing a HAB and the proper collection and handling techniques. This SOP applies to any DHEC employee that is performing algal bloom sampling in lakes, reservoirs, rivers, streams, estuaries, and if applicable, ponds.

## 3.0 Health and Safety

Algal blooms may cause exposure to respiratory, dermal, and ingestible toxins. All algal blooms should be treated as potentially harmful until verified otherwise. Samplers should wear gloves (elbow/shoulder length if possible) and waders/boots during sampling. Do not ingest the water or allow it to come in contact with the skin. If water comes into contact with the skin, wash the impacted area immediately. If attempting to avoid spray caused by boats or winds, wearing a mask is recommended. Hands and equipment (boots, waders) should be washed thoroughly with clean tap or distilled water after sampling. It is also important for staff who have sampled HABs to report any symptoms from exposure to cyanotoxins, which can occur immediately to several days after exposure to the toxins. Refer to Table 1 for common cyanobacteria toxins and their associated symptoms.

Toxins Produced	Type of Toxin	Health Effects in Humans	Onset of Symptoms
Anatoxin- a	Neurotoxins	Nervous System Labored breathing, convulsions, numbness,	Minutes to Hours

Saxitoxins		paralysis, and Dog deaths caused by Anatoxin-a	
Microcystins	Hepatotoxin	<b>Liver</b> GI symptoms, elevated liver enzymes in blood, death of cells, destruction of blood vessels	Hours to Days
Cylindrospermopsin	Hepatotoxin	<b>Liver and Kidneys</b> Symptoms like food poisoning/ possible kidney failure	Hours to Days

Table 1: Cyanobacteria toxins produced and their health effects in humans. Table adapted from presentation by Jen Maucher Fuquay, coordinator of the Phytoplankton Monitoring Network (PMN).

#### 4.0 Equipment and Supplies

- \_\_\_ Protective Equipment: elbow length gloves, safety goggles/glasses, mask, boots, waders
- \_\_\_ PETG or Glass 500mL (clear or amber) sample bottles. The Aquatic Science Programs (ASPs) provide the PETG bottles
- \_\_\_ Paper towels and Plastic bags (to place sample bottle in, if needed)
- \_\_\_ Camera for field pictures
- \_\_\_ GPS
- \_\_\_ Pencils/Pens and Sharpies
- \_\_\_ Algal Bloom Report Form (D-4110)
- \_\_\_ Cooler with ice or ice pack
- \_\_\_ In-situ meter if site parameters (such as D.O., temp) are being taken

#### 5.0 Algal Bloom Site Evaluation and Sampling

5.1 Prior to conducting a field investigation, DHEC staff should obtain as much information about the potential HAB as possible. This includes:

5.1.1. Location of the bloom and type of waterbody. Use Appendix C to determine whether the complaint bloom should be sampled based on waterbody type and/or location. If the bloom is to not be sampled, but rather referred to Clemson Extension or a private lab, refer to Appendix B for resources.

5.1.2. Extent of the bloom on the waterbody, description, photos, etc.

5.1.3. History of the bloom- when did it form, how long has it been on the waterbody, has it gotten bigger/smaller, has there been blooms there in previous years, etc.

5.2. Consult with the ASPs if necessary, to determine whether the bloom should be sampled. See Appendix C for the Flowchart for HAB response sampling. Private Pond/ Stormwater ponds are a case by case situation.

5.3 At the bloom site, identify characteristics of the bloom using the Algal Bloom Report Form (Appendix D). This includes documenting the color and physical nature of the bloom.

5.3.1. Take photos of the bloom both close up and of the spatial extent of the bloom, if possible. Other photos can be taken to capture anything else that is deemed noteworthy.

5.3.2. All observations should be recorded on the Algal Bloom Report Form.

5.3.3. Refer to Appendix E on whether an algal bloom/fish kill should be sampled for in situ measurements.

5.4 A surface grab sample is the most common method of algal bloom collection when the bloom forms a concentrated algal mat or scum on the surface of the water. The purpose of a surface grab sample is to collect a whole water sample from a single point. This sample will capture material accumulated on the surface AND in the water column (i.e. scums, mats, algal material, etc.)

5.4.1. If the impacted area is not easily accessible and access to a boat is not possible, another dip method is acceptable (i.e. bottle on a stick, bottle on a string, bucket) as long as a representative grab sample is still collected.

5.5 To characterize risk of exposure by water contact, samples are collected from sites where the most visible indicators of a bloom are present. This will help determine the maximum concentration of cyanobacteria and potential toxins in that specific area.

5.5.1. Put on gloves and obtain a clean bottle labeled with the site location, date, and time. A 500mL disposable bottle that is PETG or glass is the recommended bottle for sample collection. The use of plastic containers other than PETG is not recommended as some plastic will absorb or bind with the toxins, resulting in inaccurate results.

5.5.2. Remove cap and submerge bottle into the surface of the water, submerging 2-4 inches below the surface, but not so low that water goes into the glove. If possible, attempt to sample in the middle of the bloom. The bottle should contain a mixture of both water and algal sample (scum, mat, clump, etc.) DO NOT collect the sample by only skimming the top of the water.

5.5.3. Try to avoid overfilling the bottle, leaving about 1 inch of headspace; immediately cap the bottle and wipe off the exterior to remove any spilled content from the exterior of the container.

5.5.4. Place the algal bloom samples on ice and ship to the ASPs within 24 to 36 hours. Cyanotoxins are sensitive to high temperatures so immediately store samples from 2-8 C on wet ice.

5.5.5. Coolers can be addressed to: Aquatic Science Programs

2600 Bull Street

Columbia, SC 29201

5.5.6. Please notify personnel at the ASPs when samples are being shipped and/or are in transit. Pictures taken of the bloom can be sent to Emily Bores at [WTR\\_ASP\\_HAB@dhec.sc.gov](mailto:WTR_ASP_HAB@dhec.sc.gov)

## 6.0 Laboratory Analytical Methods

Samples will be analyzed via microscopy when received by the lab to determine dominant algal species. If potential toxin-producing algal species are identified, toxin analysis via ELISA (if possible) should be conducted to determine the toxicity of the bloom. Refer to the SOP, Determination of Total Microcystins and Cylindrospermopsin in Ambient Water, for ELISA methodology. Recreational advisories will be issued (if necessary) based on the EPA’s recreational values for microcystins and cylindrospermopsins, shown in Table 2. Recreational advisories will be issued by the ASPs and will be listed online and through a media press release. If there are drinking water intakes on the waterbody, drinking water facilities will be notified if quantifiable amount of toxins are found that could affect their finished drinking water (See Table 3 for EPA drinking water health advisory guidelines). Drinking water facilities will be notified via phone and/or email about drinking water concerns by the ASPs. ASPs will coordinate all efforts with the Division of Drinking Water & Recreational Water Protection when a drinking water intake or a permitted natural recreational area is being impacted by a HAB. Additional sampling may be conducted until toxin levels are no longer measurable or they are below the EPA recreational guidelines.

Total Microcystins (ug/L)	Cylindrospermopsin (ug/L)	Duration
8	15	1 in 10-day assessment period across a recreational season

Table 2: EPA recreational Health Advisories

Cyanotoxin	Drinking Water Health Advisory (10-day)	
	Infants and pre-school children	School-age children and Adults
Microcystins	0.3 ug/L	1.6 ug/L
Cylindrospermopsin	0.7 ug/L	3.0 ug/L

Table 3: EPA drinking water health advisories for finished drinking water

## 7.0 References

Florida DEP. Sampling for Cyanobacteria Blooms. Available at:

[http://publicfiles.dep.state.fl.us/dear/labs/biology/hab/cyanobacteria\\_sop.pdf](http://publicfiles.dep.state.fl.us/dear/labs/biology/hab/cyanobacteria_sop.pdf)

State of Ohio, Environmental Protection Agency; Department of Natural Resources. Harmful Algal Bloom Response Strategy for Recreational Waters. 2016. Available at <https://epa.ohio.gov/portals/35/hab/HABResponseStrategy.pdf>

State of Utah, Department of Environmental Quality; Division of Water Quality. Recommended Standard Procedures for Phytoplankton Collection to Detect Harmful Algal Blooms. Available at <https://deq.utah.gov/legacy/divisions/water-quality/health-advisory/harmful-algal-blooms/docs/SOP-HAB-Phytoplankton-Samples-2016.pdf>

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## Appendix A: Examples of Cyanobacteria Blooms



*Planktothrix sp.* Bloom



*Microcystis sp.* bloom



*Aphanizomenon sp.* Bloom



*Dolichospermum sp.* and *Microcystis sp.* bloom

## Appendix B: Clemson Extension and Private Lab Resources

### Clemson Extension:

Samples can be submitted to Clemson extension for a cost of \$20 as of 07/01/2020 where they can ID the algal bloom. They cannot test for toxin production.

The form to fill out to submit a sample is located at:

<https://www.clemson.edu/public/regulatory/plant-problem/pdfs/form-weed-id-2018-pdf.pdf>

Under suspected ID and/or comments: Can add language about concerns for algal bloom

Fill out Section for “If from a pond”: Responses here will be used to inform management resources provided

Fill out “pond” under “location of planting”

Samples can be dropped off at a county Extension office. There is an office in every county. Contact information can be found at:

<https://www.clemson.edu/extension/co/index.html>

If the extension offices are still closed due to Covid-19, samples can be submitted by shipping to the lab at:

Clemson University Plant and Pest Diagnostic Clinic

511 Westinghouse Rd., Pendleton, SC 29670

Mail a check along with the sample made out to “Clemson University” and placed in a plastic bag. It would be helpful to have an ice pack shipped with the sample to keep it cool. Ship the sample on a Monday so it can reach the lab by Thursday.

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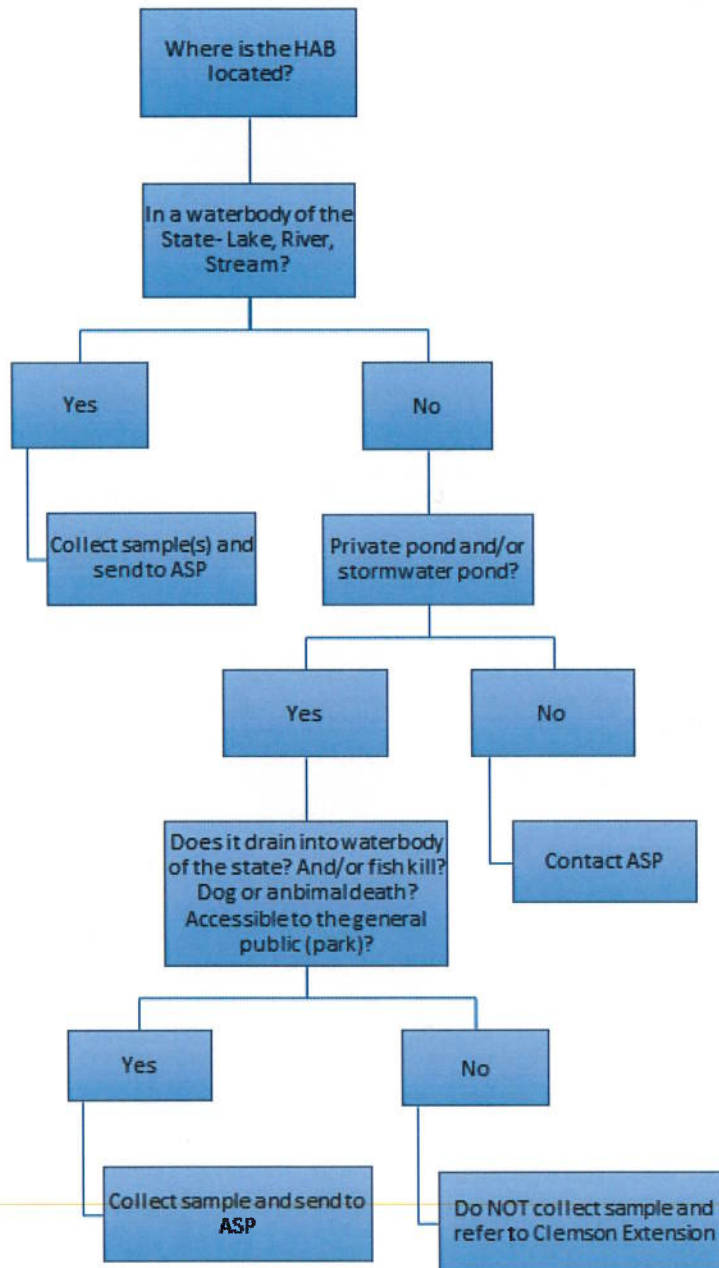
### Private Lab Resources:

If a citizen wants to have their pond/lake tested for algal toxins, refer them to the link of possible private labs below, provided by the EPA

<https://www.epa.gov/cyanohabs/laboratories-analyze-cyanobacteria-and-cyanotoxins>



## Appendix C: HAB sampling flow chart



## Appendix D: Algal Bloom Report Form (RIMS #D-4110)

Access the most Current Form from RIMS.

### ALGAL BLOOM REPORT FORM

This form should be completed and sent with a representative algal sample to the **Aquatic Science Programs, 2600 Bull Street, Columbia, S. C. 29201**. The fresh sample should be placed on ice or ice packs and should be shipped the same day as collection. Fill the sample bottles provided to the top. If you do not have a provided sample bottle, a glass jar can be used instead. Please call the **Aquatic Science Programs at (803)898-8374** if there are any questions.

Collector's Name \_\_\_\_\_ Date \_\_\_\_\_ Time \_\_\_\_\_

EA Office \_\_\_\_\_ Phone \_\_\_\_\_

Waterbody Name \_\_\_\_\_ County \_\_\_\_\_

If Pond/Lake - Tributary:

Inflowing \_\_\_\_\_ Outflowing \_\_\_\_\_

Basin \_\_\_\_\_

#### **REASON FOR SAMPLING (Check):**

Fish Kill  Discoloration in Water  Taste/Odor Problem  Scum or mat on surface

Other(Specify) \_\_\_\_\_  
\_\_\_\_\_

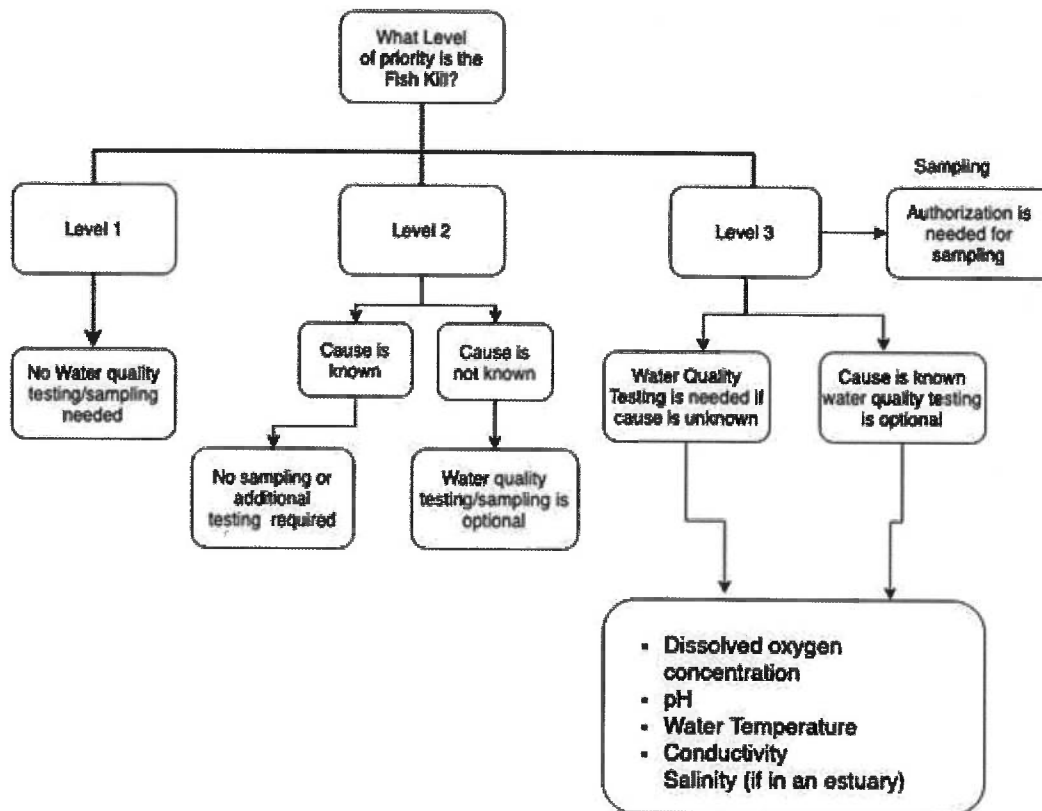
#### **Description of Bloom:**

Include a map or GPS coordinates to indicate the exact location of the water body affected by the algal bloom. Also include qualitative observations of the bloom (i.e., color, floating mats or clumps, % of surface covered by bloom, etc.) in the space below. Please describe the current weather conditions and the weather conditions prior to bloom (if known).

Color				
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## Appendix E: Field Assessment Priorities for Fish Kills



When to respond is based on the following priorities:

Field Assessment:

For calls received after normal business hours, the Environmental Response Section telephone duty officer and the ROSC will confer to share information and to determine the proper Level classification of each notification. The regional office will classify calls received during normal business hours. As a courtesy to the public and agencies SC DHEC works with (i.e. SC DNR, USF&W and Riverkeepers), all fish kill calls are followed up by DHEC. The Field Assessment will help delineate the appropriate response DHEC investigators will take upon determining a level of priority.

- Level 1 A notification/concern raised by the public; the incident is handled as a complaint based on the available information obtained in the initial assessment. Examples would include situations where the event is documented to have occurred in a storm water retention pond; where only a few dead fish are observed in a remote area with no wastewater discharge immediately upstream; or where the initial report is made to the Department several days after the event was observed by the caller and only small numbers of fish are involved. These would be calls where there are reports of dead fish within a body of water not intended to support aquatic life.
- Level 2 A field investigation is needed but can be delayed until the next calendar day when: The person doing the initial assessment is reasonably sure of the cause of the kill and the water body is not waters of the State (i.e. a private pond) or impacting State waters. For safety reasons, notifications of fish kills needing a field investigation received at night can be delayed until daylight.
- Level 3 If the initial assessment will not allow for a Level 1 or 2 classification, then an immediate field investigation is required. This would be a report of a fish kill in public waters (i.e. SC lakes, streams, and rivers).