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SC DEPARTMENT of ENVIRONMENTAL SERVICES

BUREAU OF WATER

AQUATIC SCIENCE DIVISION

AQUATIC BIOLOGY SECTION

ALGAL BLOOM AND CYANOTOXIN FIELD COLLECTION STANDARD OPERATING PROCEDURES
ASDPROC 009

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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 or bottom (benthos) of the 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.

Cyanobacteria, or blue-green algae, are a type of algal species that have the potential to produce toxins, with blooms of cyanobacteria typically referred to as harmful algal blooms (HABs). These toxins can have a negative impact on the health of people, animals, and the environment. Cyanobacteria and algal blooms can also cause taste and odor issues in drinking water, decreases in water quality, and impact the aesthetic and recreational value of the waterbody. A person cannot tell by a bloom's visual appearance whether it is harmful, thus microscopy and analytical testing are needed for identification and toxin production. Please refer to Appendix A for common cyanobacteria species and their associated toxins found in SC.

Cyanobacteria distributions within a waterbody may be impacted by physical conditions such as winds, currents, rain, and lake turnover. These variables can exert controls on cyanobacteria growth and/or blooms and facilitate movement of the bloom within the waterbody.

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 all SCDES team members 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. Samplers should not ingest the bloom water or allow it to come into contact with skin. If contact is made with skin, the impacted area should be washed 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 water (tap or distilled) 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.

Table 1: Cyanobacteria toxin types and their health effects in humans.

<table>
<tr><th>Toxin Name</th><th>Type of Toxin</th><th>Health Effects in Humans</th><th>Onset of Symptoms</th></tr>
<tr><td>Anatoxin-a</td><td rowspan="2">Neurotoxins</td><td rowspan="2">Nervous System
Labored breathing, convulsions, numbness, paralysis and Dog deaths</td><td rowspan="2">Minutes to Hours</td></tr>
<tr><td>Saxitoxins</td></tr>
<tr><td>Microcystins</td><td rowspan="2">Hepatotoxin</td><td>Liver
GI symptoms, elevated liver enzymes in blood, death of cells, destruction of blood vessels</td><td rowspan="2">Hours to Days</td></tr>
<tr><td>Cylindrospermopsin</td><td>Liver and Kidneys
Symptoms like food poisoning/ possible kidney failure</td></tr>
</table>

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 Biology Section (ABS) provides the PETG bottles
- Paper towels
- Plastic bags (to place sample bottle in, if needed)
- Camera for field pictures
- Pencils/Pens and Sharpies
- Chain of Custody Form (DES 3271)
- 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

- Prior to conducting a field investigation, SCDES staff should obtain as much information about the potential HAB as possible. This includes:
    - 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. Consult with ABS about sampling if necessary. If the bloom should not be sampled by SCDES but rather referred to Clemson Extension or a private lab, refer to Appendix B for resources.
    - Extent of the bloom on the waterbody, description, photos, etc.
    - 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.
    - Any illnesses (human or animal) or associated animal deaths with the bloom.
- At the bloom site, identify and document characteristics of the bloom. This includes documenting the color and physical nature of the bloom (paint like vs stringy, etc.)
    - 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 additional descriptive or noteworthy features of the impacted area.
- To characterize the human health risk of potential bloom 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.

- A surface grab sample is the most common method of algal bloom collection. The purpose of a surface grab sample is to collect a water sample from a single point. This sample will capture material accumulated on the surface and in the underlying water column (i.e. scums, mats, algal material, etc.)
- If the impacted area is not easily accessible and access to a boat is not possible, other methods are acceptable (i.e. bottle on a stick, bucket, shoreline sampling) as long as a representative grab sample can be collected.
- To collect samples:
  - 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 recommended for sample collection. The use of plastic containers other than PETG is not recommended as some plastic will absorb or bind with the toxins.
  - Remove cap and submerge bottle 2-4 inches below the surface of the water. 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.
  - 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.
  - Place the algal bloom samples on ice and ship to the ABS within 24 to 36 hours. Cyanotoxins are sensitive to high temperatures so immediately store samples from 2-8 C.
  - Coolers can be addressed to:

    SCDES
    ATTN: Aquatic Biology Section
    2600 Bull Street
    Columbia, SC 29201
- Please notify personnel at the ABS when samples are being shipped and/or are in transit. Pictures taken of the bloom can be sent to the HAB email at: HAB@des.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 ASDPROC 008, Determination of Total Microcystins and Cylindrospermopsin in Ambient Water, for ELISA methodology.

7.0 Revision History

Revision	Date	Summary	Section
2.0	10/07/2026	Updated “SCDHEC” to “SCDES”	Where Applicable
2.0	10/07/2026	Inserted Figure 1	1.0
2.0	10/07/2026	Added new table	Appendix A
2.0	10/07/2026	Updated broken links and instructions	Appendix B
2.0	10/07/2026	Updated sampling flowchart	Appendix C

Appendices

Appendix A: Common cyanobacteria in SC and their associated algal Toxins

	Toxins			
Cyanobacteria Genera	**Hepatotoxins**		**Neurotoxins**	
	Cylindrospermopsin	Microcystins	Anatoxin	Saxitoxins
Anabaena	X	X	X	
Aphanizomenon	X		X	X
Calothrix		X		
Dolichospermum	X	X	X	X
Hapalosiphon		X		
Microcoleus		X	X	
Microcystis		X		
Microseira (Lyngbya)	X			X
Oscillatoria	X	X	X	
Phormidium		X	X	X
Planktothrix		X	X	X
Woronichinia		X		

Appendix B: Clemson Extension and Private Lab Resources

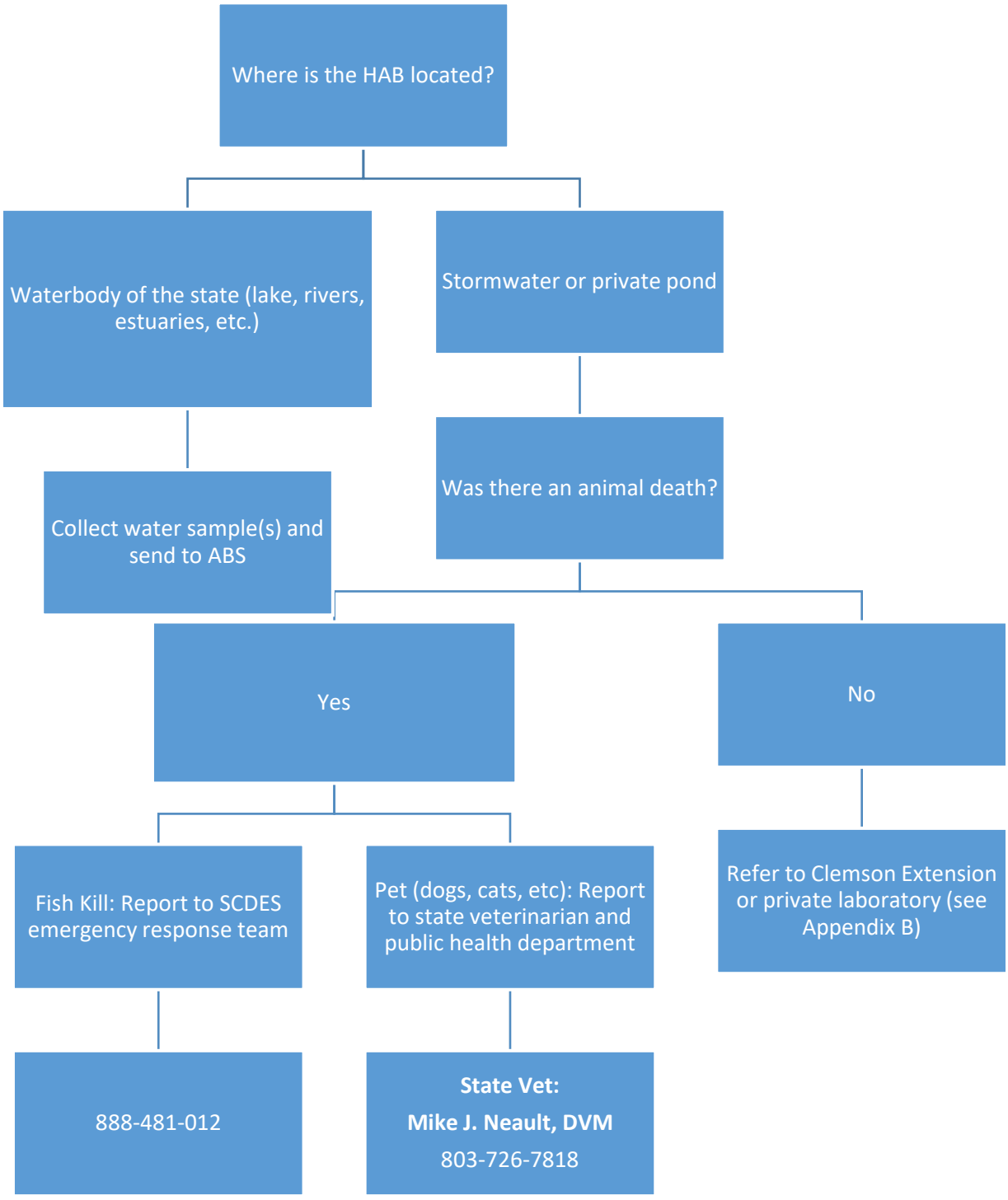
Samples can be submitted to Clemson extension for a cost where they can ID the algal bloom. They cannot test for toxin production.
Instructions on how to submit a sample can be found at:
https://hgic.clemson.edu/factsheet/submitting-an-algae-sample-for-identification/

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

Samples can also be submitted by shipping to the lab at:

Clemson University Plant and Pest Diagnostic Clinic
511 Westinghouse Rd., Pendleton, SC 29670

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

SC Pond Management Companies
For management and mitigation of HABs in private ponds, please refer to the list of pond and lake management companies provided by the SC Department of Natural Resources at:
https://www.dnr.sc.gov/wildlife/publications/pdf/LakeMgtConsultants.pdf

Appendix C: HAB Sampling Flowchart