NORTH Dakota | Environmental Quality
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QUALITY CONTROL/QUALITY ASSURANCE DOCUMENTATION

Title: Collecting a Water Sample for Algal Toxin Analysis
Type: Standard Operation Procedure #7.24
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Author: Brian Houle

REVISION HISTORY

Revision	Change Description	Date	Authorization
1.0	Creation	04/13/2020	Joe Nett
1.1	Department address updated, SOP number assigned, new lab custody form	01/24/2023	Joe Nett
2.0	Document Updated	03/28/2024	Brian Houle
2.1	Updated lab custody form, HAB Guidance Document included	01/27/2025	Brian Houle

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1.0 SCOPE AND APPLICABILITY

This document presents the North Dakota Department of Environmental Quality (NDDEQ), Division of Water Quality's (DWQ) Standard Operating Procedure (SOP) for collecting a water sample for algal toxin analysis. This SOP applies to all DWQ field staff, non-DWQ cooperators, and citizen volunteers. Cyanobacteria, also known as blue-green algae, are efficient at utilizing nutrients and light and often outcompete other species of algae during the summer months. Dense growth of these cyanobacteria, also referred to as a bloom, can affect dissolved oxygen cycles, shade-out other algal species, cause skin irritation and produce harmful toxins.

These toxins (referred to as cyanotoxins) can affect wildlife, livestock, pets, and humans. These toxins are produced intra-cellularly and then release toxins when the cell lyses (or breaks). Different species of cyanobacteria can produce different types of cyanotoxins, and different cyanotoxins effects an organism's body in a different way (e.g., neurotoxins affecting the brain, hepatotoxins affecting the liver). Understanding the type of bloom that is present can help a sampler in determining what to sample for.

2.0 SUMMARY OF METHOD

When responding to a report the sampler shall take a sample from the densest part of the bloom, with public safety, livestock, and wildlife health in mind. If the sample is taken as part of a monitoring project, please refer to associated Quality Assurance Project Plan (QAPP) or the Sampling and Analysis Plan (SAP) for sample location information. Samples shall be collected by partially submerging the bottle in the bloom and filling the bottle to the shoulder (125mL mark). Samples should be immediately put on ice. When all sampling is completed, samples should either be frozen or shipped immediately.

3.0 HEALTH AND SAFETY WARNING

Field personnel should take appropriate precautions when operating watercraft and working on, in, or around water. All boats should be equipped with safety equipment such as personal flotation devices (PFD's), oars, air horn, etc. North Dakota Boating Safety Guide and rules shall be followed by all field personnel.

Field personnel should be aware that hazardous conditions potentially exist at every waterbody. If unfavorable conditions are present at the time of sampling, the sample visit is recommended to be rescheduled. If hazardous weather conditions arise during sampling, such as lightning or high winds, personnel should cease sampling and move to a safe location.

Cyanotoxins are harmful to humans. Skin contact can cause irritation and ingestion can cause illness. The sampler should take care to always wear gloves when collecting a sample and clean hands after sampling.

4.0 INTERFERENCES

Time of day can affect the quality of sample. Cyanobacteria can alter their buoyancy (vertically) depending on light intensity or time of day, so being mindful of environmental conditions is necessary. Cyanobacteria movement horizontally is common depending on wind speed and direction. Understanding present wind condition as well as that of the leading days is necessary to determining bloom condition.

5.0 PERSONNEL QUALIFICATIONS/RESPONSIBILITIES

All personnel taking water samples for algal toxin analysis must read this SOP annually and acknowledge they have done so via a signature page (see Appendix B). New field personnel must also demonstrate successful performance of the method. The signature page will be signed by both trainee and trainer to confirm that training was successfully completed and that the new monitor is competent in carrying out this SOP. The signature page will be kept on-file at DWQ along with the official hard copy of this SOP.

6.0 EQUIPMENT AND SUPPLIES

_____Copy of this SOP #7.24
_____ Field Observation Form (Appendix B)
_____ PETG bottle(s)*
_____ Nitrile gloves
_____ Camera
_____ GPS
_____ Batteries
_____ Sample Label(s) (Appendix C)
_____ Clear Packing Tape
_____ Pens (non-gel), pencils, and sharpies
_____ HAB sign
_____ Hardware kit for sign installation
_____ Zip ties
_____ Cooler with ice

*Care should be taken to use correct sampling bottles (sterile, PETG,125mL). Some bottles (e.g., Nalgene) have been documented as causing invalid results.

7.0 PROCEDURE

Sites to be sampled for potential algal toxins are reported to the NDDEQ from the public or other government agencies, or part of monitoring projects associated with specific waterbodies. These sites are sampled with public safety and the health of livestock and wildlife in mind.

1. Once the sampler has arrived at the reported waterbody, the sampler should locate the reported area of the bloom.
    a. Note: for monitoring projects the scheduled sample collection shall be at the location designated in the project QAPP or SAP.

2. The sampler should not only assess the reported location of the bloom, but also investigate and record information on the bloom at other public access points (e.g., boat ramps, swimming beaches, fishing piers).

3. As bloom conditions can change rapidly in terms of location and severity, the sampler should take care to collect their sample from the densest part of the bloom.

4. The sampler should use the Field Observation Form (Appendix A) to record conditions at sampled sites and access points.

5. Complete sample label for the site with waterbody name, site description, date collected, time collected, and sampler name (Appendix B). Affix the label to the sample bottle and secure the label to the bottle with clear packing tape.

6. Since cyanobacteria blooms tend to proliferate at the surface, partially submerge the mouth of the sample bottle in the water, filling the bottle to the shoulder (125mL). Sample should be taken at the worst part of bloom, or in the location designated in the project SAP.

    a. **Note: Filling beyond the shoulder (125mL) will increase the possibility that the bottle may break during freezing.**

7. Take pictures of the bloom area. At least one overview photo of sample location and one of the blooms up close.

8. Place sample bottle on ice and proceed to next site (other public access areas) at the waterbody as needed.

9. Repeat steps 2 - 7 as needed.

10. Post HAB sign(s) at public access point(s) and note on Field Observation Form.

11. Following all sampling, samples should either be shipped immediately with laboratory custody form, or frozen for batch shipping.

8.0 DATA AND RECORDS MANAGEMENT

Observations will be recorded on the Field Observation Form (Appendix B). Completed Field Observation Forms should be routed to designated office staff for listing determination (Advisory / Warning), website updates, data entry, and reporter follow-up. Field Observation Forms must be turned in ***IMMEDIATELY*** upon returning from the field so that staff can notify the public on water body conditions. Field staff should upload site visit photos and label as noted on the Field Observation Form.

9.0 QUALITY ASSURANCE AND QUALITY CONTROL

There are limited Quality Assurance and Quality Control (QA/QC) procedures for collecting water samples for algal toxin analysis. Following the procedures outlined above should ensure quality control.

10.0 RESOURCES

Report a HAB:
www.tinyurl.com/HABs-Report

United States Geological Survey:
http://pubs.usgs.gov/sir/2008/5038/

National Center for Disease Control (CDC) HABs:
https://www.cdc.gov/habs/index.html

EPA Cyanobacterial HABs:
https://www.epa.gov/nutrient-policy-data/cyanobacterial-harmful-algal- blooms-water

World Health Organization Guidelines for Drinking Water Quality:
http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf

World Health Organization Guidelines for Safe Recreational Waters, V. 1 – Coastal and Fresh Waters:http://apps.who.int/iris/bitstream/10665/42591/1/9241545801.pdf

World Health Organization's "Toxic cyanobacteria in water: A guide to their public healthconsequences, monitoring and management":
http://www.who.int/water_sanitation_health/publications/toxicyanobact/en/

Cyanobacteria Image Galleries:
http://www-cyanosite.bio.purdue.edu/images/images.html

11.0 REFERENCES

EPA 2019, Recommended Human Health Recreational Ambient Water Quality Criteria or SwimmingAdvisories for Microcystins and Cylindrospermopsin, Office of Water, United States of Environmental Protection Agency, EPA 822-R-19-001

NDDEQ. (2024) Harmful Algal Bloom Sampling and Analysis Plan. North Dakota Department of Environmental Quality, Bismarck, North Dakota.

NDDEQ. (2024) Quality Assurance and Quality Control Plan. North Dakota Department of Environmental Quality, Bismarck, North Dakota.

NDGF. 2023. Boating Safety Guide. North Dakota Game and Fish. Bismarck, ND. https://gf.nd.gov/boating/safety-regulations

WHO, 2003: Algae and cyanobacteria in fresh water. Guidelines for Safe Recreational Water Environments World Health Organization, Geneva. https://www.who.int/publications/i/item/9241545801

APPENDIX A
FIELD OBSERVATION FORM

Please write neatly for efficient processing [Version date: 10/04//2024] [Office Use: _____ Entered in HABTracker]

Name : _____ **Visit Date:** _____ **Lake Name:** _____

Visit Reason: Online Report Phone Report Email Report Office Report Revisit Random Staff Visit Project

Weather: Sunny Overcast Partly Cloudy **Wind Speed (mph)**: No Wind (0-5) Slight (6-15) Breezy (16-25) Stormy (25+

Dark Clouds Raining Smoky/Hazy **Wind Direction:** N S E W NW NE SW

LOCATIONS VISITED

Sample bottle label MUST match information on form *(Example Location Description: "N boat ramp")*

SITE 1

Visit Time (24hr): _____

Type: Boat Ramp Main Lake Shoreline Swim Beach **Location Description:** _____

Latitude: _____ **Longitude:** _____ **Sample Collected?** Yes No

Bloom Color(s): No color/Clear Green Turquoise Reddish Yellow Other: _____

Appearance: Scum/Film Present Green Cottage Cheese Small Leaves Dots
Crust/Puff Balls Spilled Green Paint Grass Clippings NA

Sign Present? Yes No

Additional Description *(odor, dead fish, etc.):*

SITE 2

Visit Time (24hr): _____

Type: Boat Ramp Main Lake Shoreline Swim Beach **Location Description:** _____

Latitude: _____ **Longitude:** _____ **Sample Collected?** Yes No

Bloom Color(s): No color/Clear Green Turquoise Reddish Yellow Other: _____

Appearance: Scum/Film Present Green Cottage Cheese Small Leaves Dots
Crust/Puff Balls Spilled Green Paint Grass Clippings NA

Sign Present? Yes No

Additional Description *(odor, dead fish, etc.):*

SITE 3

Visit Time (24hr): _____

Type: Boat Ramp Main Lake Shoreline Swim Beach **Location Description:** _____

Latitude: _____ **Longitude:** _____ **Sample Collected?** Yes No

Bloom Color(s): No color/Clear Green Turquoise Reddish Yellow Other: _____

Appearance: Scum/Film Present Green Cottage Cheese Small Leaves Dots
Crust/Puff Balls Spilled Green Paint Grass Clippings NA

Sign Present? Yes No

Additional Description *(odor, dead fish, etc.):*

BLOOM EXTENT (lake coverage): No bloom observed < 25% 25-49 % 50-75 % > 75 %

PHOTOS UPLOADED? Yes No Will Be

**Turn in ASAP with or without uploaded photos*

Photo File Location:
Y:\WATER\SURFACE\11_HarmfulAlgalBlooms\Year\LakeName\Date

Name photos as LakeName_SiteName_YYYYMMDD (e.g., MoonLake_BoatRamp_20230804)

APPENDIX B
SAMPLE LABELS

Lake Name: Example Lake
Lat / Long: 46.71536116, -100.1092716
Site Description: Boat Ramp
Analysis Requested: Microcystin
Date: 08/15/2030 Time (24hr): 15:45
Sampler: John Smith

Lake Name:
Lat / Long:
Site Description:
Analysis Requested: Microcystin
Date: Time:
Sampler:

Lake Name:
Lat / Long:
Site Description:
Analysis Requested: Microcystin
Date: Time:
Sampler:

Lake Name:
Lat / Long:
Site Description:
Analysis Requested: Microcystin
Date: Time:
Sampler:

Lake Name:
Lat / Long:
Site Description:
Analysis Requested: Microcystin
Date: Time:
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Lake Name:
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Site Description:
Analysis Requested: Microcystin
Date: Time:
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Lake Name:
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Site Description:
Analysis Requested: Microcystin
Date: Time:
Sampler:

Lake Name:
Lat / Long:
Site Description:
Analysis Requested: Microcystin
Date: Time:
Sampler:

Lake Name:
Lat / Long:
Site Description:
Analysis Requested: Microcystin
Date: Time:
Sampler:

Lake Name:
Lat / Long:
Site Description:
Analysis Requested: Microcystin
Date: Time:
Sampler:

APPENDIX C

ENVIROMENTAL CHAIN OF CUSTODY FORM

GreenWater Laboratories

GreenWater laboratories — aquatic analysis ... research ... consultation

Chain of Custody (COC) / Analysis Request Form

Client Information

Name: Emily Brazil
Organization: North Dakota Department of Environmental Quality
Street Address: 4201 Normandy St
City/State/Zip: Bismarck, ND 58503
Phone: 701-328-5296
Email (results): DEQ-HAB@nd.gov

■ Billing Information (check if same as Client)

Name:
Organization:
Street Address:
City/State/Zip:
Phone:
Email (invoice): DEQ-HAB@nd.gov

Services Requested (check appropriate option(s))

Phycological Services ***Do not freeze sample(s)***

- ☐ PTOX Cyanobacteria Screen
- ☐ Qualitative Algal Identification
- ☐ Cyanobacteria ID/E
- ☐ Total Algae ID/E
- ☐ Total Algae ID/E with Biovolume

Outsourced Services

☐ Phycocyanin ☐ MIB/Geosmin ☐ Chlorophyll

Analytical Services

Microcystins/Nodularins (MCs/NODs)
- ☑ ELISA - Adda MCs/NODS
- ☐ LC-MS/MS - Microcystin Suite
- ☐ LC-MS/MS - Total MCs/NODs (MMPB Method)

Anatoxin-a (ATX)
- ☐ LC-MS/MS -ATX
- ☐ LC-MS/MS - ATX Suite

Cylindrospermopsin (CYN)
- ☐ LC-MS/MS - CYN
- ☐ LC-MS/MS - CYN Suite

Saxitoxins (STX; paralytic shellfish poisons)
- ☐ ELISA - STX
- ☐ LC-MS/MS - STX Suite

Other services
- ☐ LC-MS/MS - Dermatoxins
- ☐ LC-MS/MS - BMAA
- ☐ LC-MS/MS - Domoic Acid (amnesic shellfish poison)
- ☐ LC-MS/MS - Okadaic Acid (diarrhetic shellfish poison)
- ☐ ELISA - Brevetoxins (neurotoxic shellfish poison)
- ☐ Other: _____

Notes/Comments:	
Number of Samples:	
Relinquished by:	
Signature:	
Date:	
Relinquished by:	
Signature:	
Date:	

INTERNAL USE ONLY			
Received by:		*Temp. Check (°C):*	
Signature:		*Chlorine Chk. (P/F/NA):*	
Date:		*Notes:*	
Arrival Time:		*Sample Kit Charge:*	

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Green Water laboratories aquatic analysis ... research ... consultation

	Sample ID	Site	Collection Date	Time	Matrix / Notes *(e.g. drinking water, raw water, tissue)*	**Preservation *(e.g. Sodium Thiosl1/fate, Lugo/'s)*
1					Raw Water	Frozen
2					Raw Water	Frozen
3					Raw Water	Frozen
4					Raw Water	Frozen
5					Raw Water	Frozen
6					Raw Water	Frozen
7					Raw Water	Frozen
8					Raw Water	Frozen
9					Raw Water	Frozen
10					Raw Water	Frozen
11					Raw Water	Frozen
12					Raw Water	Frozen
13					Raw Water	Frozen
14					Raw Water	Frozen
15					Raw Water	Frozen
16					Raw Water	Frozen
17					Raw Water	Frozen
18					Raw Water	Frozen
19					Raw Water	Frozen
20					Raw Water	Frozen
21					Raw Water	Frozen
22					Raw Water	Frozen
23					Raw Water	Frozen
24					Raw Water	Frozen
25					Raw Water	Frozen
26					Raw Water	Frozen
27					Raw Water	Frozen
28					Raw Water	Frozen
29					Raw Water	Frozen
30					Raw Water	Frozen

***Do not freeze sample(s) if requesting algal identification*

APPENDIX D

SOP ACKNOWLEDGMENT AND TRAINING FORM

SOP Acknowledgement and Training Form

This SOP must be read, and this form signed annually. This form must be kept with the latest version of the SOP.

Document Title:	
Document Revision Number:	
Document Revision Date:	

Please sign below in accordance with the following statement:
“I have read and understand the above referenced document. I agree to perform the procedures described in this SOP in accordance with the document until such time that it is superseded by a more recent approved revision.”

Printed Name	Signature	Date

SOP Acknowledgement and Training Form (cont.)

Trainee: Sign below to acknowledge that training on this SOP was received, understood, and all questions/concerns were addressed by the trainer.

Trainer: Sign below to acknowledge that training on this SOP was completed for the individual listed and that training is competent to perform the procedures described within.

Date of Training	Trainee Printed Name	Trainee Signature	Trainer Printed Name	Trainer Signature

APPENDIX E

HABs Guidance Document

NORTH Dakota | Environmental Quality

Be Legendary.™

Harmful Algal Bloom (HAB) Guidance Document for North Dakota

January 2025

Table of Contents

1 INTRODUCTION

The purpose of this document is to provide guidance to local, state, federal, and private landowners to protect people, pets, and livestock from the effects of Harmful Algal Blooms (HABs) in North Dakota. This guide discusses the general process, factors to consider, and suggestions and recommendations when a waterbody is experiencing a potential HAB. The document provides helpful hyperlinks within the text for more information as well as HAB contacts (**Table 3, Appendix A**) and resources.

This guidance document is NOT a state policy and only serves as recommendation. The guide is a compilation of information from states and federal agencies that have established HAB guidelines.

1.0 BACKGROUND

Algae exist naturally in all types of water. Although algae are individually very small, under certain conditions a group (or colony) of algae can grow rapidly and create an algal bloom. Blooms often occur in summer in standing water (lakes, reservoirs, stock ponds) as a result of excess nutrients (such as nitrogen and phosphorus) entering the water from fertilizer, livestock, and septic systems. Harmful Algal Blooms (HABs) develop when blooms present health risks for people and wildlife or become damaging to the environment.

HABs can cover large areas of water, blocking sunlight from reaching other aquatic life, lowering oxygen levels in the water and clogging fish gills. In North Dakota, HABs typically consist of blue-green algae, also known as cyanobacteria. Cyanobacteria are distinct from other algae based on their microscopic structure (prokaryotes having no membrane-bound organelles). Cyanobacteria, or blue-green algae, can produce toxins that present serious health risks for humans and animals. Skin contact with toxic algae can cause irritation such as rashes, blisters, swelling and itching. Swallowing or drinking water with toxic algae can severely damage internal organs and ais known to have caused pet and livestock death.

When dense algae populations develop, especially cyanobacteria, water can turn a greenish or blue-greenish color referred to as a “bloom.” Dense blooms near the surface may resemble a layer of green paint or spilled pea soup (**Figure 1)**. HABs can occur in a variety of colors, including (but not limited to) bright blue, green, white, brown, and red. HABs can form visible water discoloration, scums, and/or mats. They may also give off a foul odor. They can occur year-round but are most common in the summer when abundant sunlight and warm, stagnant water combine with high nutrient levels (e.g., phosphorous, nitrogen, etc.)

There is no way to determine if an algal bloom is toxic just by visual observation. The presence of a bloom does not mean that toxins are present or being released into the water. On the other hand, toxins can be present even when no bloom is visible. Because algae blooms take many forms, non-toxic blooms are easy to mistake for cyanobacteria (potentially toxic) blooms. Filamentous algae, for example, form stringy mats on the water surface. While filamentous algae can be a nuisance and impact aquatic life (for example, depleting oxygen levels in the water), they do not produce toxins

and are not the target of Harmful Algal Bloom sampling in North Dakota. Visual examples of different algae blooms are presented in **Figure 1**.

Figure 1. Potentially Toxic Cyanobacteria and Filamentous Algae Examples

a. Green Filamentous Algae (Photo: Healthy Ponds)

b. Green Filamentous Algae (photo: Snohomish County, WA)

c. Blue-Green Algae (Cyanobacteria)

d. Blue-Green Algae (Cyanobacteria)

1.1 CYANOTOXINS

Not all cyanobacteria produce toxins, and those that do produce toxins do not produce them at all times. Toxins produced by cyanobacteria are known as cyanotoxins. The most common cyanotoxin is microcystin, a potent liver toxin and potential carcinogen. Other cyanotoxins identified in North Dakota surface waters include anatoxin-a and cylindrospermopsin. Cyanotoxins can be harmful to human health, animal health, and the environment through different routes of exposure such as direct skin contact, inhalation, and ingestion (drinking contaminated water and/or eating contaminated fish). No human deaths have been confirmed in the United States from direct contact cyanotoxins; however, pet and livestock deaths have been confirmed in North Dakota (and other states). Direct skin contact typically results in less serious health effects such as a rash. Ingestion of cyanotoxins can cause gastrointestinal illness. Limited cyanotoxin data exists for North Dakota, dating back to 2016 when the

NDDEQ began monitoring for HABs. Common cyanobacteria species that have the ability to produce toxins are shown in **Figure 2**.

Microcystin are a group of at least 80 toxin variants, microcystin-LR is the most toxic. They are produced by *Microcystis*, *Anabaena*, *Planktothrix*, *Nostoc*, *Hapalosiphon*, A*nabaenopsis*, and *Snowella Lacustris*.

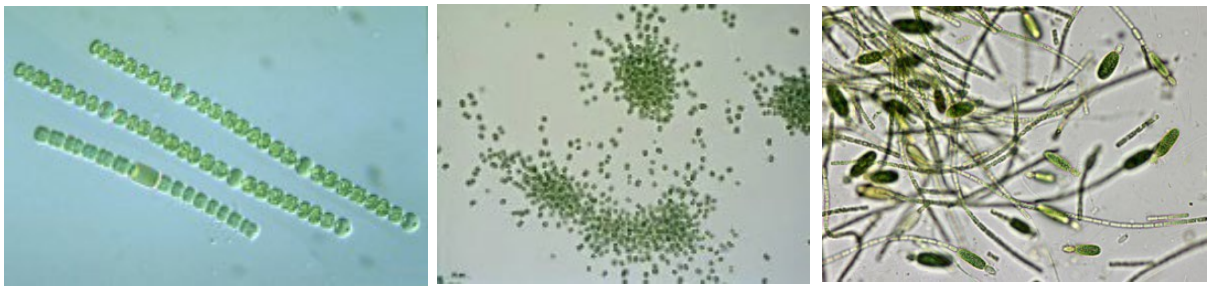
Microcystin is a hepatotoxin, affecting the liver, causing serious acute symptoms and slower chronic symptoms. Symptoms can occur hours or days after being exposed to the cyanotoxin. Signs include abdominal pain, loss of appetite, jaundice, dark or reduced urine, diarrhea, vomiting, liver damage, and hemorrhages.

Anatoxin is a neurotoxin produced by several cyanobacterial genera including *Anabaena*, *Aphanizomenon*, and *Planktothrix*. Neurotoxins affect the nervous system and can occur very quickly. Signs can appear within 15 -20 minutes after ingestion. Signs include numbness of the lips, tingling in fingers and toes, stumbling, seizures, paralysis, disorientation, headaches, inactivity, elevated heart rate,dizziness, and respiratory failure.

Cylindrospermopsin is another liver toxin that can be found in *Cylindrospermopsis*, *Aphanizomenon*, *Anabaena*, *Umezakia*, and *Raphidiopsis*. The toxin can also damage other major organs (kidney, lung,spleen, thymus, and heart).

Dermatoxins affect the skin and can be produced by various cyanobacteria species with or without other toxins. Symptoms can occur quickly if the skin is not rinsed after contact with cyanotoxins. Signs include rashes, hives, swelling, itching, and excessive drooling and seizures. Dermatoxins are not specifically part of toxin testing, although high cyanobacteria cell counts usually indicate the presence ofdermatoxins and the increased likelihood of associated illnesses.

Figure 2. Common Cyanobacteria Species Under a Microscope



a. Anabaena *b. Microcystis* *c. Cylindrospermopsis*

1.2 EXPOSURE PATHWAYS

If cyanobacteria are producing toxins, cyanotoxins can be released into the water as cyanobacteria grow and die. Toxin concentrations can become elevated, particularly during a bloom event, concentrate along shorelines, and can persist in the environment after a visible bloom is over.

The primary exposure pathway for cyanotoxins is through ingestion of water. Ingestion of water can occur through both incidental and intentional pathways. The risk of incidental ingestion is particularly high for children playing in near-shoreareas since these areas are also where blooms tend to accumulate.

Dermal irritant, or allergic effects, are possible from skin contact with cyanobacteria; however, the cyanotoxins are not likely to cross the skin barrier and enter the bloodstream. Inhalation and aspirationof toxin is possible, especially through activities where the toxin is aerosolized, such as water skiing, splashing, or in high wind events.

A possible scenario for the intentional ingestion of recreational water is the use of lake water for drinking or cooking purposes by campers, hikers, and backpackers. Camping filters, tablets, and boiling ***will not remove cyanotoxins***. There is insufficient information to determine the risk of consuming fish caught in waters with toxigenic cyanobacteria. At a minimum, the fish should be rinsed with potable water and the organs should be removed and discarded prior to cooking fillets.

North Dakota Public Water Systems (PWS) are ***not federally mandated*** to monitor or treat for cyanotoxins. Thus, there is potential risk to consumers whose drinking water is sourced from a lake or reservoir during HAB season. Landowners with private drinking water sources from lakes or reservoirs should be cautious during HAB season. Do not drink water sourced from a HAB identifiedwater body.

1.3 ANIMAL EXPOSURE

Pets and livestock may be at higher risk for cyanotoxin poisoning since they are more likely to drink contaminated water.

Late summer, times of drought, or wind blowing a bloom toward the animal access points are the times of greatest concern for livestock poisoning due to cyanotoxins. Immediate symptoms may include vomiting, diarrhea, dark urine, excessive thirst, shaking, itching, rash, respiratory paralysis, and death. Chronic exposure may include symptoms of anorexia, mental derangement, dehydration, hypoglycemia,and death.

If you suspect the presence of a HAB, do not let your pet or livestock drink the water. In the case of no other water source, the waterbody in question should be tested for cyanotoxins immediately. **Section 3** discusses testing methodologies.

If your pet or livestock has ingested a water source that is potentially or verifiably contaminated withcyanotoxins, call your veterinarian immediately and report the incident on www.tinyurl.com/HABs-Report. If your veterinarian is unfamiliar with cyanotoxin poisoning, please have them contact the State Veterinarian (**Section 4, Table 3**). Additional information on animal cyanotoxin poisoning is available on the Centers for Disease Control and Prevention (CDC) website.

In the case of a livestock death, the U.S. Department of Agriculture (USDA) Farm Service Agency (FSA) may be able to provide financial assistance through the Livestock Indemnity Program (LIP). To be eligible for livestock reimbursement through LIP, a water test is required to confirm the presence of cyanotoxins, and a veterinarian must provide proof of loss. Livestock producers can contact their FSA Office for assistance.

There are funding opportunities available for livestock producers looking to provide livestock a new water source, such as off-stream water or other grazing best management practices, that can reduce the risk of HAB exposure. These include but are not limited to the USDA Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) and NDDEQ's Nonpoint Source Pollution 319 Funding. Interested landowners can contact their local NRCS field office or the Nonpoint Source Program for more information.

2.0 GUIDELINES AND ADVISORIES

2.1 FINISHED DRINKING WATER

Finished drinking water is the transformation of raw water from surface water or groundwater sources into drinking water that is compliant with the Safe Drinking Water Act using an appropriate treatment technology. EPA has issued Drinking Water Health Advisories for the cyanobacterial toxins, microcystins, and cylindrospermopsin. Recommended health advisory levels are outlined in **Table 1**. It is important to remember that these concentrations apply to finished drinking water. Young children are more susceptible than older children and adults as they consume more water relative to their body weight. Health advisories are non-regulatory values, rather they serve as informal technical guidance to assist federal, state, and local officials, and managers of public or community water systems to protect public health from contaminants. EPA has also published health effects support documents for the cyanobacterial toxins microcystins and cylindrospermopsin.

Table 1. EPA Drinking Water Health Advisory for Cyanotoxins

Cyanotoxin	Bottle-fed infants and pre-school children[1]	School-age children and adults[1]
Microcystins	0.3 µg/L	1.6 µg/L
Cylindrospermopsin	0.7 µg/L	3 µg/L

[1]10 Day Exposure (EPA, 2015a,b)

Should any lake, river, or stream utilized by public water systems in the state of North Dakota test positive for any of the cyanobacterial toxins, microcystin or cylindrospermopsin, the North Dakota Department of Environmental Quality Drinking Water Program will sample the system's finished water to determine if the cyanotoxins have bypassed the treatment processes operated by the system. If sampling shows that public notice is needed, the NDDEQ along with the water supply system will issue a Drinking Water Advisory to all consumers at such a time. The Drinking Water Advisory will contain the following information:

- Type of toxin present in the water system and date notice was issued,
- What the water system is doing to correct the problem,
- Dates samples were collected, types of toxins, and at what levels they were detected.

Other information contained in the notice will explain what you as a consumer should do or not do and will include who the water system is working with such as public health unit and emergency response agencies. The water system will post updated advisories when the levels are less than or equal to the national drinking water Health Advisories, the do not drink advisory is lifted, or any change to the adversity. System contact information will also be included for follow-up questions and concerns from consumers that need to be addressed.

For more information on drinking water guidelines, contact the NDDEQ's Drinking Water Program (**Section 4, Table 4**).

2.2 Recreational Water

North Dakota has developed a three tier approach to public health advisories incorporating both World Health Organization (WHO) and EPA guidelines as shown in **Table 2.** The elevated cyanotoxin levels detected under Tier 2 pose more health risks than levels detected under Tier 1; however, it is difficult to test cyanotoxins frequently enough to determine when conditions change. Therefore, the NDDEQ recommends individuals observe waterbodies before recreating and report suspected blooms immediately. *"When in doubt, stay out!"*

Table 2. North Dakota HAB Public Health Advisory Tiers for Recreational Waters

	Tier 1: Low	Tier 2: Advisory	Tier 3: Warning
Relative Probability of Acute Health Effects[1]	Low	Moderate	High
Microcystins (µg/L)[1,2]	≤ 8	> 8 - ≤ 20	> 20 (i) OR > 2000 (ii)
Additional Factors	Minimal presence, No reported illness	Reports of animal illness or death, reports of human health impact	(i) Bloom covers > 50% of water body OR (ii) Sample exceeds 2000 µg/L (any size bloom)
Health Risks[1]	Negligible	Short-term effects such as skin irritation nausea, vomiting, diarrhea. Potential for long-term effects.	Short-term effects such as skin irritation nausea,vomiting, diarrhea. Potential for long-term effects and acute poisoning.
Recommended Actions	Monitoring and informational sign posted at waterbody	ND HABs StoryMap updated, notify local agencies, and media with advisory status	ND HABs StoryMap updated, notify local agencies and media with warning status

[1]WHO, 2003, [2]EPA, 2019

Table 3. North Dakota Water Quality Standards for Cyanotoxins

Cyanotoxin	Maximum Limit
Cylindrospermopsin	15 µ/l For Clean Water Act water quality criterion, no more than 3 excursions (10-day assessment periods) within a single recreational season in a single year
Microcystins	8 µ/l For Clean Water Act water quality criterion, no more than 3 excursions (10-day assessment periods) within a single recreational season in a single year.

North Dakota Century Code 33.1-16-02.1

2.3 ADVISORIES AND WARNINGS

Figure 3. Decision Flow Chat for HABs Reporting and Monitoring in Recreational Waters

Recommended advisories and/or warnings should be based on the guidelines and recommendations in **Table 2** following the decision flow chart shown in **Figure 3**.

A waterbody will be listed under an **Advisory** if:

- Total microcystin concentration is between 9 µg/L and 20 µg/L,
- The waterbody is suspected of human, wildlife, pet, or livestock illness, contact, or accidental consumption of recreational water.
- The total microcystin concentration is > 20 µg/L and ≤ 2,000 µg/L, AND the bloom does not appear to extend beyond the immediate area (covering < 50% of the water body)

A waterbody will be listed under a **Warning** if:

- The local measured microcystin concentration exceeds 20 µg/L and goes beyond the area being sampled (i.e., is covering at least 50% of the lake by the sampler's best professional judgement). More than one sample and/or visit will be required around the lake to confirm a widespread bloom.
- The local concentration exceeds 2,000 µg/L.
- If a pet or livestock death is reported.

Waterbodies that have active HABs monitoring projects will be sampled every two weeks or according to a specific project Sampling and Analysis Plan (SAP). This will take place from April to October of each year.

Laboratory results will better determine what level of advisory is needed (**Figure 3, Table 2**). After an Advisory or Warning has been issued, it is recommended that field and/or laboratory testing continues at a minimum of every two weeks. At least two consecutive sample results showing low toxin levels is recommended before removing or downgrading any Advisory or Warning.

2.4 NOTIFICATIONS

NDDEQ recommends notifying the public and local jurisdictions (i.e., water resource boards, county parks and recreation departments,state, and federal agencies) when a Tier 2: **Advisory** or Tier 3: **Warning** is issued (**Figure 3**). This may include notifying the localpaper and television news station.

The authority to notify the media rests with the NDDEQ. In the case of an extensive bloom that has the potential to affect multiple jurisdictions, the NDDEQ will work to issue a unified message to the public.

3.0 MONITORING AND TESTING

Monitoring and testing is ***not mandated by the state of North Dakota.*** NDDEQ encourages all managing jurisdictions visually monitor for HABs and report any occurrences. NDDEQ staff will conduct follow-up monitoring activities as shown in **Figure 3**.

NDDEQ recommends at a minimum, visual monitoring, or an "eyes on the ground" approach to identifying HABs. If a local jurisdiction is interested in conducting monitoring activities, sample bottles and laboratory assistance is available at no cost through the NDDEQ on a limited basis. Contact DEQ-HAB@nd.gov or 701-328-5210 for more information.

3.1 FIELD TESTS

All assessments and photos should be reported through the state reporting system at www.tinyurl.com/HABs-Report.

If a potential bloom is reported, an initial visual assessment is recommended. A visual assessment includes documenting the color and physical nature of the bloom (e.g., floating scum/mats) using a

digital camera (photos should include a close-up and view of the extent of the bloom). In addition, the locations and extent of the bloom should be noted, especially if it is present near any public access.

All site visits by the NDDEQ include a water collection sample for further analysis.

Water samples should target areas with the highest likelihood or risk of animal or human-cyanotoxin interaction and exposure. These areas may include public access areas such as beaches and shorelines, drinking water intakes, etc. The GPS location and general description of sample location should be recorded in field notes and on the sample bottle label. Laboratory analysis will be performed for verification of toxicity, speciation, and cell count.

3.2 LABORATORY ANALYSIS

Samples shall be collected for analysis by an accredited laboratory. Turnaround time for sample results varies by laboratory. In 2024, HAB sample results were typically received within 7-14 days of sample receipt.

The NDDEQ (**Section 4, Table 4**) is available to assist in the interpretation of laboratoryresults.

Toxin analyses may include microcystins, anatoxin-a, cylindrospermopsin, and more depending on the laboratory. The analysis techniques include but are not limited to enzyme-linked immunosorbent assay(ELISA) and/or liquid chromatography-tandem mass spectrometry (LC-MS/MS).

Some labs perform a preliminary qualitative analysis of samples. These methods will examine the presence or absence of cyanobacteria, the dominance of cyanobacteria, the identification of dominant cyanobacteria genera, and their relative abundance in the sample. From these results, toxicity testing and or further taxonomic analysis can be recommended.

Additional analysis may involve the direct observation and enumeration of the phytoplankton, and any cyanobacteria present in the water column sampled. Depending upon the level of analysis, phytoplankton are identified to the lowest possible taxonomic category (generally species) and counted; cell densities for all identified cyanobacteria species are calculated.

If taxonomic analysis is conducted to the resolution of genera or cells/mL, the results will be quantitative, but for the contents of the sample volume alone. These methods will not quantify the composition of cyanobacteria in the waterbody, the water surrounding the bloom, or even the entirety of the bloom itself. For more intensive studies of cyanobacteria, protocols for quantitative phytoplankton collection methods are available.

3.4. SAMPLING PROCEDURES

Samples will be collected from surface waters following the NDDEQ's Standard Operating Procedure (SOP) #7.24 *Collecting a Water Sample for Algal Toxin Analysis* .

3.5 REPORTING

Public reporting of HABs may be done by email (DEQ-HAB@nd.gov), by phone (701-328-5210), or via the online portal (www.tinyurl.com/HABs-Report).

All Field Observation Forms (see SOP #7.24), photos, and analytical results should be submitted and entered into the NDDEQ HABTracker database.

4 CONTACTS AND RESOURCES

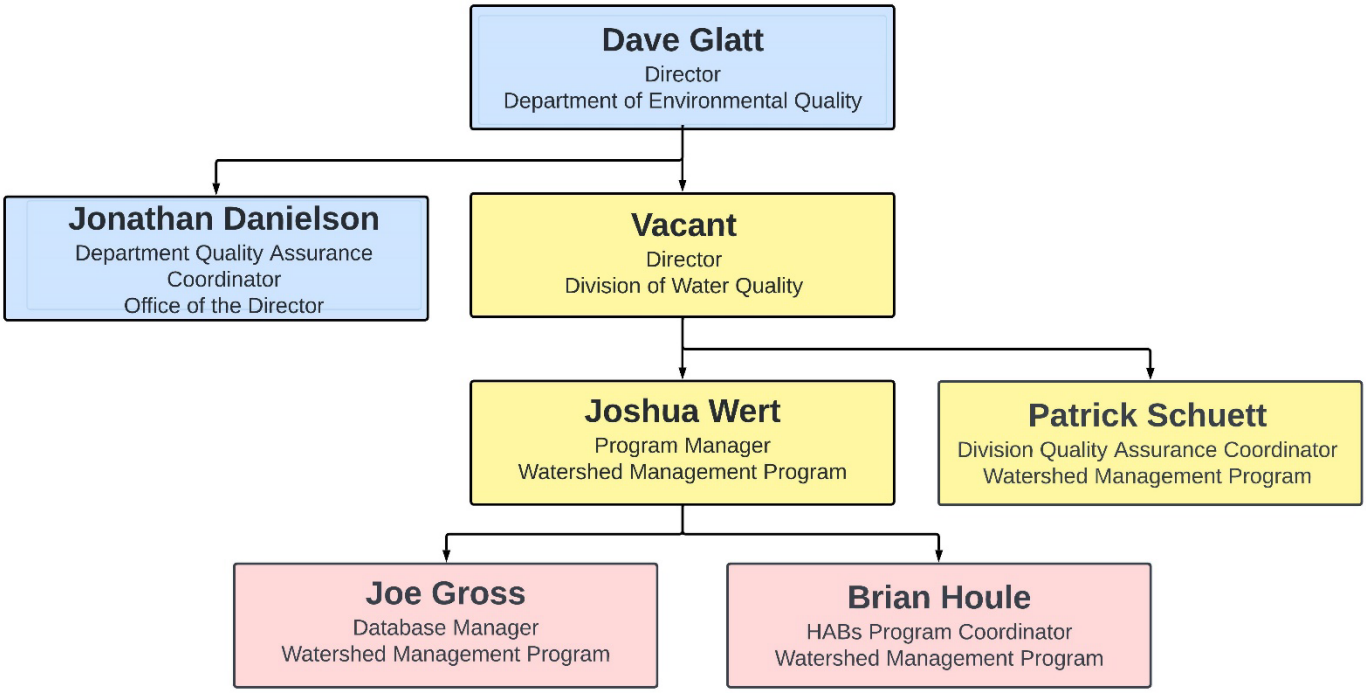
4.1 NORTH DAKOTA HAB TEAM

NDDEQ canbe reached at 701-328-5210 or email DEQ-HAB@nd.gov.

Table 4. Table 4 NDDEQ HABs Contacts

Name	Agency	Email	Phone
Joshua Wert	NDDEQ	jewert@nd.gov	701-328-5014
Brian Houle	NDDEQ	bhoule@nd.gov	701-328-5193
Joe Gross	NDDEQ	jgross@nd.gov	701-328-5292
Drinking Water Program	NDDEQ	gwavra@nd.gov	701-328-5224
State Veterinarian Office	ND Department of Agriculture	doa-bah@nd.gov	701-328-4567

Figure 4. ND DEQ Organization Flow Chart



4.3 RESOURCES

Report a HAB:
www.tinyurl.com/HABs-Report

United States Geological Survey:
http://pubs.usgs.gov/sir/2008/5038/

National Center for Disease Control (CDC) HABs:
https://www.cdc.gov/habs/index.html

EPA Cyanobacterial HABs:
https://www.epa.gov/nutrient-policy-data/cyanobacterial-harmful-algal- blooms-water

World Health Organization Guidelines for Drinking Water Quality:
http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf

World Health Organization Guidelines for Safe Recreational Waters, V. 1 – Coastal and Fresh Waters:http://apps.who.int/iris/bitstream/10665/42591/1/9241545801.pdf

World Health Organization's "Toxic cyanobacteria in water: A guide to their public healthconsequences, monitoring and management":
http://www.who.int/water_sanitation_health/publications/toxicyanobact/en/

Cyanobacteria Image Galleries:
http://www-cyanosite.bio.purdue.edu/images/images.html

5.0 REFERENCES

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EPA 2019, Recommended Human Health Recreational Ambient Water Quality Criteria or SwimmingAdvisories for Microcystins and Cylindrospermopsin, Office of Water, United States of Environmental Protection Agency, EPA 822-R-19-001

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Snohomish County Surface Water Management. Algae and Other Scums Identification Guide. Snohomish County, Washington.

WHO, 2003: Algae and cyanobacteria in fresh water. Guidelines for Safe Recreational Water Environments World Health Organization, Geneva. https://www.who.int/publications/i/item/9241545801

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