HARMFUL ALGAL BLOOMS (HABS)

PROGRAM GUIDE

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Abbreviations and Acronyms

Acronym	Definition
µg/L	Micrograms per liter (parts per million)
BG	Blue green
CALM	Consolidated Assessment and Listing Methodology
CSLAP	Citizen Statewide Lake Assessment Program
CWA	Clean Water Act
DEC	Department of Environmental Conservation
DOW	Division of Water
EMB	Environmental Management Bureau
ESF	SUNY College of Environmental Science and Forestry
HA	Health Advisory
HAB	Harmful Algal Bloom
LCBP	Lake Champlain Basin Program
LCC	Lake Champlain Committee
LCI	Lake Classification and Inventory Program
LHD	Local Health Department
LMAS	Lake Management and Assessment Section
NOAA	National Oceanic and Atmospheric Administration
NYC	New York City
NYCDEP	New York City Department of Environmental Protection
NYSDOH	New York State Department of Health
OPRHP	Office of Parks, Recreation and Historic Preservation
PWS	Public Water Supply
RIBS	Rotating Integrated Basin Sampling
SDWA	Safe Drinking Water Act
SSC	State Sanitary Code
SUNY	State University of New York
TMDL	Total Maximum Daily Load
TOGS	Technical & Operational Guidance Series
USACE	United States Army Core of Engineers
USEPA	United States Environmental Protection Agency
VDH	Vermont Department of Health
WHO	World Health Organization
WI/PWL	Waterbody Inventory/Priority Waterbodies List

1 Executive Summary

Harmful Algal Blooms (HABs) in freshwater generally consist of cyanobacteria (also referred to as blue-green algae). Cyanobacteria are naturally present in low numbers in most marine and freshwater systems but under certain conditions, particularly high nutrients and warm temperatures, the organisms can begin to multiply rapidly and form blooms. Similar to algae, cyanobacteria possess chlorophyll and are capable of photosynthesis. Several types have the potential to produce toxins and other harmful compounds that can pose a public health risk to people and animals through ingestion, skin contact, or inhalation. DEC suggests avoiding contact with any water that is discolored or has algal scums on the surface

The purpose of this guide is to describe how the New York State DEC identifies and documents cyanobacteria HABs throughout the state, communicates health risks to the public, provides guidance on bloom management, and conducts research. The primary audience for this guide is New York State agency staff, but the guide may be useful to others, particularly the wide range of partners involved in addressing HABs in New York. Efforts are currently underway to produce a joint multi-agency New York HABs plan that will replace this guide in the future.

The DEC HABs Program uses a combination of visual surveillance, chlorophyll concentration (specifically, the portion of total chlorophyll that can be fluoroscopically attributed to cyanobacteria, also known as blue-green chlorophyll) and microcystin concentration (a toxin produced by cyanobacteria) to determine a bloom status for a waterbody (Suspicious, Confirmed, or Confirmed with High Toxins Blooms). The status system provides a uniform way to rapidly communicate information about blooms throughout the state.

HABs surveillance and/or sampling reports are generated and sent to the DEC HABs Program from state agency staff, the public, and several collaborating partners. DEC staff work to support structured monitoring on waterbodies prone to HABs through existing monitoring programs and site-specific partnerships.

Rapid and effective outreach is a critical component of the DEC HABs Program. Communication of information about HABs and the results from surveillance and sampling programs serve to inform the public’s recreational choices. DEC maintains a regularly updated HABs website of current and archived bloom locations and sends emails to county-based agency staff lists with rapid communication of bloom occurrences and sampling results. The DEC HABs Program publishes annual and cumulative summaries of bloom reports.

This guide includes a discussion of HAB prevention and control approaches. Watershed nutrient input reduction, water treatment strategies, and in-lake control methods are summarized.

2 Introduction

2.1 Purpose of this Document

The purpose of the DEC HABs Program Guide is to describe how DEC identifies and documents freshwater cyanobacteria HABs throughout the state, communicates health risks to the public, provides guidance on bloom management, interacts with other agencies, and conducts research.

2.2 Scope, Jurisdiction and Audience

This guide follows the scope of the DEC HABs Program. The DEC HABs Program serves all surface waters in New York, although HABs are most likely to be observed and reported in lakes, reservoirs, or ponds. Because of an increased likelihood of public exposure, the program has a particular focus on waterbodies that have public access, serve as drinking water supplies or have regulated bathing beaches. The jurisdictional framework in New York, and therefore the DEC HABs Program, does not distinguish between public and private waters since all of the waters of the state may be used by the public (see the New York State Clean Lakes Assessment).

What is the DEC HABs Program?

The program consists of DEC staff within the DOW Lake Monitoring and Assessment Section who work to identify bloom status, oversee HAB monitoring and surveillance activities, communicate public health risks, and conduct outreach, education, and research.

This guide does not address marine blooms that occur in coastal and estuarine environments in New York. Many of the concepts discussed here could be used in the future to address blooms in these waters. Marine blooms are currently tracked and reported through the DEC Marine Biotoxin Monitoring Program.

This guide outlines the DEC HABs Program elements that are under the explicit or assumed authority of DEC, but includes references to those elements assumed by the NYSDOH and/or the New York OPRHP.

The primary intended audience for this guide are the state agency staff who are directly involved in implementing or work with the DEC HABs Program; the surveillance and monitoring partners described in this document; and those members of the public interested in background information about the development and implications of the HABs program.

2.3 Background

New York State has an abundance of water resources, both flowing and ponded. HABs are most commonly observed in ponded waters, although blooms have been documented in several streams and rivers. There is no formal legal definition of a lake, but by most common measures, there are between 7,500 and 16,000 ponded

waters in New York. Lakes are heavily used and enjoyed by New Yorkers for a wide variety of purposes including recreation and as surface drinking water supplies.

What do HABs look like?

Cyanobacteria HABs can have a variety of appearances such as scattered green dots in the water, long, linear green streaks, pea soup or spilled green paint appearance, or blue-green or white coloration.

DOW is tasked with protecting and conserving the water resources of New York. This mission is achieved through a variety of programs and activities. The primary function of the DOW's Bureau of Water Assessment and Management is to monitor and assess waterbodies of the state to determine whether they are supporting their best intended uses such as potable water, public bathing, recreation, and support of aquatic life. The bureau's programs address the mission of the DOW and identify impairments in New York waterbodies

One such impairment that has become increasingly prevalent throughout New York are HABs. HABs in freshwater generally consist of cyanobacteria (also referred to as blue-green algae). Cyanobacteria are naturally present in low numbers in most marine and freshwater systems, but under certain conditions (particularly high nutrients and warm temperatures) these organisms can begin to multiply rapidly and form blooms. Similar to algae, cyanobacteria possess chlorophyll and are capable of photosynthesis. Several taxa have the potential to produce toxins. Whether toxins are present or not, exposure to any cyanobacterial blooms can cause health effects in people and animals when water with blooms is touched, swallowed, or when airborne droplets are inhaled.

What if you see a bloom?

People, pets and livestock should avoid contact with water that is discolored or has algal scums on the surface. If a bloom is present, do not use the water and inform the DEC HABs Program at: HABsInfo@dec.ny.gov.

Although HABs have been observed for many decades, recent high profile blooms throughout the world and in New York have increased the need for enhanced education, documentation, and reporting of blooms. Since 2012, HABs have been documented in several hundred waterbodies in New York, and it is likely the true extent of bloom occurrence is substantially greater. It is not yet known if recent increases in bloom frequency and duration reflect changing environmental conditions or are a result of improved reporting and monitoring of their occurrence.

Many New York waterbodies are regularly monitored through formal monitoring programs. About 200 lakes are sampled each year through two DEC ambient lake monitoring programs: The Citizens Statewide Lake Assessment Program (CSLAP) and the DEC Lake Classification and Inventory Program (LCI). In recent years, both programs expanded to include significant HABs monitoring components. Most other HABs surveillance and sampling is done on individual waterbodies by agency staff,

researchers, consultants, lake residents or as part of special studies. As described below, several monitoring partnerships have been established by DEC in recent years in response to increased public concern about HABs.

HABs exposure in New York has resulted in several dog deaths, public swimming beach closures, and have compromised drinking and recreational water uses. In response to these impairments, a HABs program within DOW has been developed to address blooms in New York. A primary objective of the DEC HABs Program is to protect human and animal health. Program staff facilitate bloom surveillance, sampling, and timely communication between state agencies and the public. Further objectives of the DEC HABs Program include education, documentation of blooms, and research that can link algal blooms to nutrient concentrations or other causes

2.4 Agency Responsibilities

The DEC HABs Program consists of DEC staff within DOW's Lake Monitoring and Assessment Section. The current structure of the DEC HABs Program relies on partnerships with state agencies and a wide range of stakeholders, and seeks to provide a unified approach to HABs identification and communication in New York.

Many of the responsibilities of the DEC HABs Program described in this guide fall within the authority of DEC under the Federal Clean Water Act. NYSDOH and OPRHP have separate statutory responsibility for protecting public health. For example, NYSDOH regulates swimming beaches under the authority of the SSC and regulates drinking water supplies under the federal SDWA and the SSC. DEC defers authority for regulatory decisions regarding HABs in regulated swimming areas and impacts on drinking water to NYSDOH and OPRHP, where relevant.

The DEC HABs Program coordinates HABs surveillance, monitoring and outreach with additional agencies and partners (Table 2.2, Figure 2.2). This guide can and should be used to support those agencies and their efforts. Several large waterbodies in New York (notably Lake Erie, Lake Ontario, Lake Champlain, New York City drinking water reservoirs, and the Alleghany Reservoir) already have HAB management plans in place that are overseen by a jurisdiction other than DEC. Below is a summary of the roles of the major government entities that manage inland waterbodies and HABs in New York.

DEC

DEC programmatic functions and activities support the agency mission in compliance with the CWA and state Environmental Conservation Law and are structured to provide environmental and health protection throughout the state. Several DEC roles that relate to the HABs Program include:

- DEC HABs Program:
    - Coordinating HABs surveillance and sampling statewide. Tracking and recording bloom reports received from DEC regional and field staff, NYSDOH, OPRHP, federal agencies, the public, CSLAP, LCI and

other HABs sampling programs. The program assigns bloom status, receives and interprets lab results, supports development of HABs surveillance and/or sampling programs and provides general information about blooms through education and outreach.
    - Maintaining MOUs with the SUNY ESF and Stony Brook University labs for HABs sample analysis and coordinate drinking water sampling with NYSDOH.
    - Preparing and issuing weekly updates on bloom status from May to October on the DEC HABs website. Maintains an online list and map of bloom notifications from May-October and sends email notifications regarding HABs to regional agency stakeholders.
    - Maintaining a drop box for HABs inquiries: HABsInfo@dec.ny.gov.
    - Publishing results of findings in DEC reports, individual lake reports, and in other formats.
- Conducting the two primary state lake monitoring programs (LCI and CSLAP) and managing most lake-related public outreach (Lake Monitoring and Assessment Section staff).
- Reporting blooms to the HABs Program as they are encountered in the field (DEC field staff).

A HABs coordinator is assigned in each DEC regional office. Some coordinators serve primarily as conduits to the DEC HABs Program by forwarding bloom reports, press inquiries, and other programmatic requests. Other coordinators and regional staff take a more active role, such as sample collection and follow up evaluation of publicly reported blooms.

NYSDOH

NYSDOH programs and activities support their mission to comply with the SDWA and Public Health Law to oversee public health protection at regulated sites. Several NYSDOH roles that relate to the DEC HABs Program include:

- Overseeing HABs monitoring at PWS through their statutory responsibility as part of the 1974 SDWA and SSC within the source water protection program.
- Responsibility for the development and distribution of beach protocols at all regulated bathing beaches, including many children's camps. Staff communicate HAB occurrences and regulated bathing beach closures and reopenings to DEC and OPRHP.
- Supporting the DEC HABs Program in the form of surveillance or sampling assistance, often conducted by staff at LHDs.
- Supporting PWS sampling and regulated swimming area monitoring at the Wadsworth Laboratory in Albany. They possess analytical capabilities to analyze toxins, perform microscopic analyses, and conduct quantitative polymerase chain reaction analysis.
- Maintaining an email for HABs inquiries: harmfulalgae@health.ny.gov
- Producing HABs public outreach materials, including a blue-green algae website and brochures.

- Investigating reports of human illnesses that may be related to HABs. Analyzing human health data related to epidemiological issues and providing technical advice on public health aspects of HABs.
- Coordinating interagency communication with LHDs, the NYC Department of Health and Mental Hygiene and NYSDOH Regional and District Offices.

County NYSDOH offices are established in most New York counties; LHD offices provide additional oversight and/or serve the functions of a county NYSDOH if no such office exists. These offices implement PWS and beach outreach and monitoring programs, including the deployment of beach protocols and making final determinations about beach closures. Some county or regional DOH staff may post closure or advisory signs, issue press releases, and dedicate staff to investigate blooms reported by the public.

OPRHP

- Managing regulated swimming areas and other lake or river access points at state parks.
- Providing training on HABs identification and response protocols to parks' staff.
- Conducting visual surveillance of beach conditions in support of beach closure decisions. HABs occurrences and bathing beach closures and reopenings are communicated to NYSDOH and DEC.
- Providing outreach and education to park patrons through a HABs brochure.
- Conducting periodic water quality monitoring and wastewater system surveys to evaluate causes of HABs in state parks' lakes and ponds.

Federal and Other State Agencies

- *USEPA*: conducting research, organizing educational webinars and meetings, and creating federal regulations and advisory guidelines regarding HABs.
- *NOAA*: Overseeing sampling and response to HABs in Lake Erie and Lake Ontario.
- *USACE*: Monitoring HABs and providing regular updates to the DEC HABs Program regarding Alleghany Reservoir.
- *Vermont DEC and VDH*: Overseeing a public-private monitoring partnership in Lake Champlain, including phytoplankton enumeration and toxin analysis; providing regular updates to the DEC HABs Program.
- *NYCDEP*: Overseeing water quality monitoring in NYC reservoirs; providing DEC HABs Program with updates on bloom conditions, if present.

Table 2.1 Summary of state agency and programmatic responsibilities

	DEC				NYSDOH & LHDs	OPRHP	SUNY ESF & Stony Brook
	HABs Program	LCI	CSLAP	Other DEC Staff			
HABs Surveillance & Sampling							
Surveillance	✓	✓	✓	✓	✓	✓	
Sampling	✓	✓	✓	✓	✓	✓	✓
Analysis	✓ *				✓		✓
Outreach							
Public health					✓		
Beach closures					✓	✓	
Email dropbox	✓				✓		
HABs website	✓				✓		
Annual reports	✓	✓	✓				
Respond to public inquiries	✓			✓	✓	✓	

*microscopy only

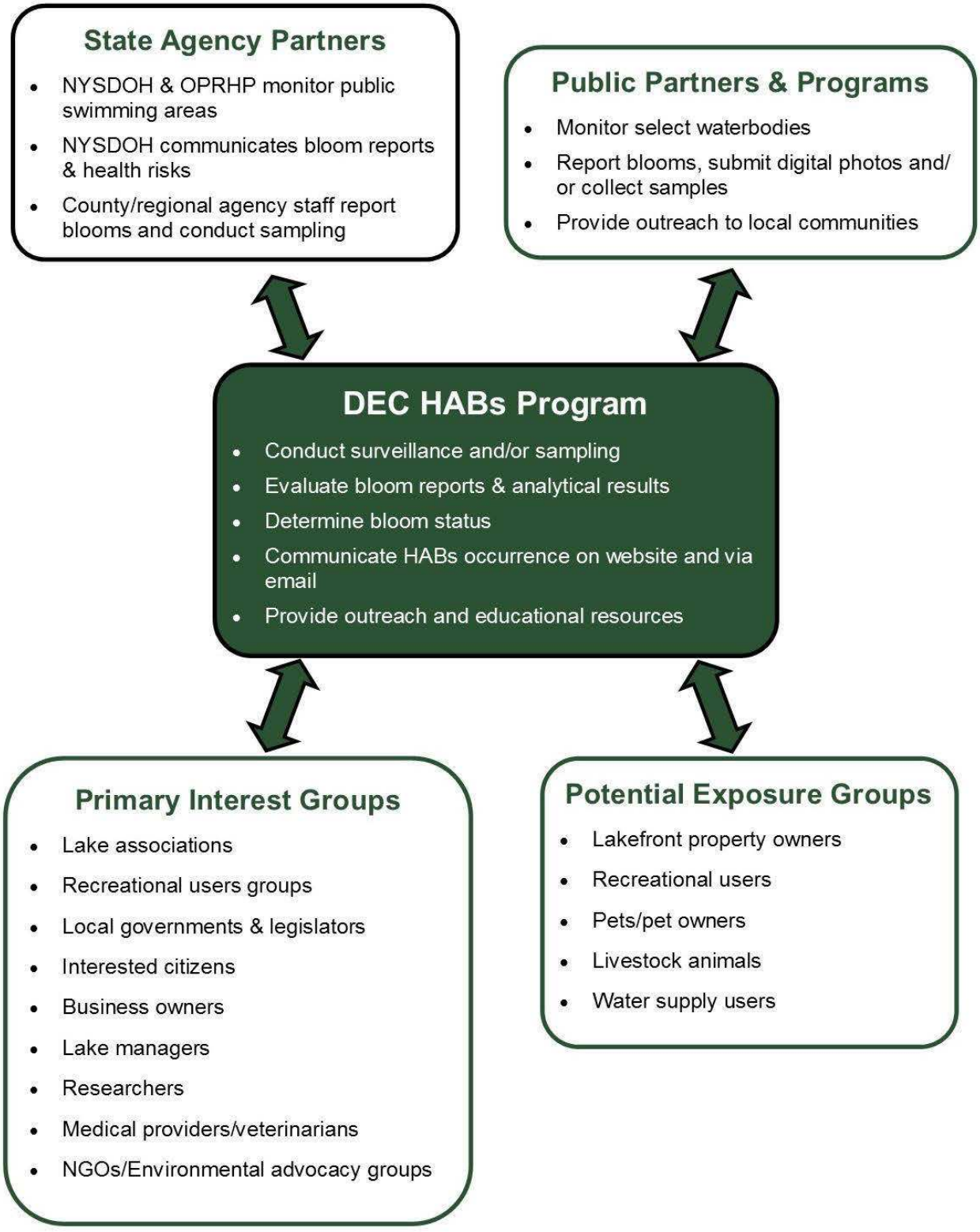


Figure 2.1 Summary of organization roles, interests groups, and exposure groups that are served by the DEC HABs Program.

3 DEC Bloom Status Designation in New York

3.1 Bloom Status Criteria

Bloom reports and lab data from a wide variety of sources (Table 3.1) are received and interpreted by DEC HABs Program staff who then designate a bloom status for each waterbody. The DEC HABs Program has adopted a combination of visual surveillance and a surrogate measure for cyanobacteria density (specifically, the portion of total chlorophyll that can be fluoroscopically attributed to cyanobacteria, also known as blue-green chlorophyll or BG Chl.a), and toxin concentration to determine bloom status. A decision tree process can be followed to determine bloom status (Figure 3.1).

There were several factors that led the DEC HABs Program to adopt the current bloom status criteria: (a) the need for rapid analysis and reporting turnaround time, (b) a suitable way to evaluate a high volume of samples from a large number of waterbodies, (c) limited analytical capabilities associated with microscopic enumeration or taxonomic evaluations, (d) lags in completion of toxin analysis, and (e) a need to distinguish cyanobacteria HABs from non-toxin producing algal blooms.

The DEC HABs Program has working relationships through MOUs with two research labs that are capable of analyzing water samples for cyanotoxins, quantifying algal pigment concentrations, and documenting algal community composition via microscopy. Most DEC HABs Program samples are sent to one of the following laboratories for analysis:

- The Gobler Laboratory Group run by Dr. Christopher J. Gobler of SUNY Stony Brook University (Only samples from New York City and Long Island)
- The research laboratory of Dr. Gregory L. Boyer at SUNY ESF (Samples from the rest of New York State)

The DEC HABs Program has established four levels of bloom status:

No Bloom: A report has been evaluated by DEC HABs Program or NYSDOH staff, and there is a low likelihood that a cyanobacteria bloom is present. At least one of the following criteria must be met: (1) in the absence of a sample, visual evidence is not consistent with a cyanobacteria bloom; (2) BG chlorophyll levels ≤ 25 µg/L; (3) microscopic confirmation sample is not dominated by cyanobacteria and not present in bloom-like density; or (4) only in absence of the previous criteria being met: microcystin ≤ 4 µg/L.

Suspicious Bloom: DEC HABs Program or NYSDOH staff have determined that a report of a bloom is likely to be cyanobacteria; digital photographs, a descriptive field report from professional staff or trained volunteer or closure of a regulated swimming area all may constitute reports that can be considered Suspicious Blooms. For surveillance reports received from the public, lay monitors, etc., DEC HABs Program staff will determine if a bloom is Suspicious and whether collection of a sample is feasible or warranted.

Confirmed Bloom: The DEC HABs Program receives laboratory analytical results from a sampled bloom that fulfills at least one of the following criteria: (1) BG chlorophyll levels ≥ 25 µg/L; (2) microscopic confirmation that majority of sample is cyanobacteria and present in bloom-like densities; (3) only in absence of the previous criteria being met: microcystin ≥ 4 µg/L but less than high toxin thresholds and accompanied by ancillary evidence of the presence or recent history of a bloom.

Confirmed with High Toxins Bloom: The DEC HABs Program receives laboratory analytical results from a waterbody with a Confirmed Bloom that meets either of the following criteria: (1) microcystin ≥ 20 µg/L (shoreline samples only); (2) microcystin ≥ 10 µg/L (open water samples only); (3) known risk of exposure to anatoxin or another cyanotoxin, based on consult between DEC HABs Program and NYSDOH staff.

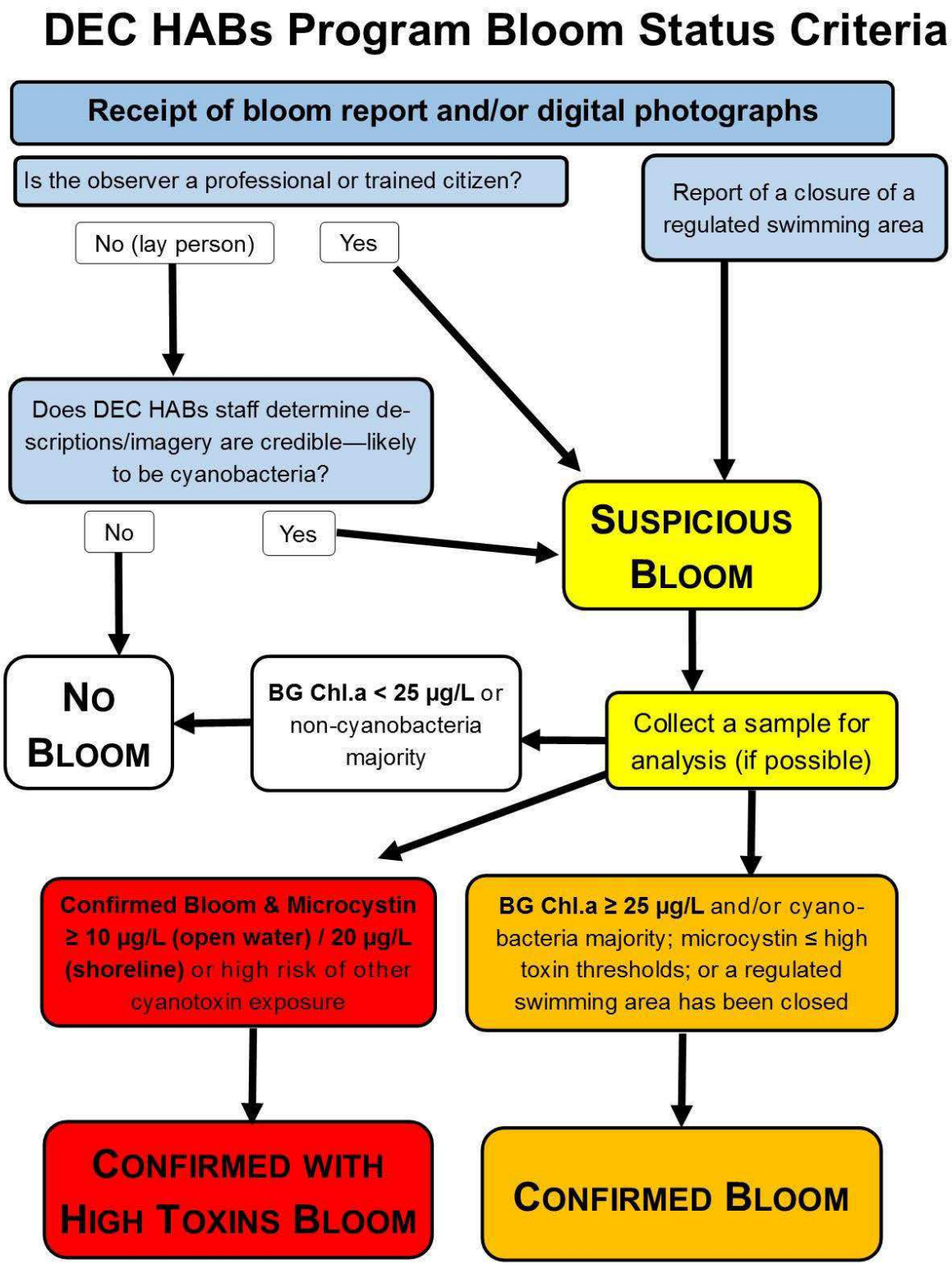


Figure 3.1 Decision tree that indicates the process by which DEC HABs Program staff determine the status of a potential bloom

Table 3.1 Summary of the types of information regarding HABs that are received by the DEC HABs Program and descriptions of how this information is used to determine bloom status

Type of Information	Explanation	Format	Sources	Connection to Bloom Status Criteria
Visual/Field Reports (Lay person)	Description of a suspected algal bloom	Suspicious Algae Report Form, email to DEC or NYSDOH dropbox, phone calls	Public	Can be used to designate a Suspicious Bloom
Visual/Field Report (Trained personnel such as DEC or NYSDOH professional or trained volunteer)	Description of an algal bloom, sometimes with location, extent, etc.	Reports sent via email, direct communication, or completed field forms	DEC or NYSDOH staff, CSLAP volunteers, other HABs program partners	Can be used to designate a Suspicious Bloom
Digital Photograph	Digital photographs of an algal bloom	Digital photographs files often received via email	Public, DEC or NYSDOH staff, CSLAP volunteers, other HABs program partners	Can be used to designate a Suspicious Bloom
Quantitative Phytoplankton Count	Quantitative enumeration of algal abundance present in samples	Quantitative data sent from external HABs programs to DEC HABs Program	Only received for Alleghany Reservoir (USACE), Lake Champlain (VT DEC), NYC reservoirs (NYCDEP)	Can be used to designate a Confirmed Bloom*
Qualitative Microscopy	Narrative indicating qualitative phytoplankton community composition present in water samples	Qualitative data sent from labs to DEC HABs Program or as analyzed by DEC staff	Partner labs (primarily SUNY ESF and Stony Brook) or DEC HABs Program staff	Can be used to designate a Confirmed Bloom (if accompanied with visual evidence of a bloom)
Pigment/chlorophyll Concentration	Extracted Chlorophyll a or Fluoroprobe chlorophyll concentrations (µg/L) present in water samples	Quantitative data sent from labs to DEC HABs Program	Partner labs (primarily SUNY ESF and Stony Brook)	Primary tool used to potentially designate a Confirmed Bloom
Toxin Concentration	Concentrations of cyanotoxins (µg/L) present in water samples	Quantitative data sent from labs to DEC HABs Program	Partner labs (primarily SUNY ESF and Stony Brook)	Primary tool used to designate a Confirmed with High Toxins Bloom

*Cell counts are interpolated using the WHO recreation guidelines (Table 3.2)

If an algal bloom report does not include enough information to determine a bloom status (for example, a written description from a member of the public and/or digital photographs that are of insufficient quality to determine if a bloom is a HAB), a place-holding status (Possible Bloom) is used internally. DEC HABs Program staff work to acquire additional information to inform bloom designation. However, in the absence of additional information, there may not be resolution. Possible blooms are not assigned any other bloom categories in the absence of corroborating information.

Recommended action for any bloom

- Avoid exposure. Keep children and pets away from scums or discolored water
- Seek immediate medical assistance for symptoms consistent with exposure
- Report any symptoms to local or state NYS Department of Health
- Report blooms to DEC through HABsInfo@dec.ny.gov

A bloom remains categorized as a Suspicious Bloom until lab results are received or in the case of a lack of sampling, when a report indicates that bloom has disappeared. When results are received, they are evaluated following the criteria described above. If the results indicate that a cyanobacteria HAB is not present, the bloom is designated as Not a Bloom. If the sample meets the BG Chl.a threshold, it may be designated as a Confirmed Bloom. A Confirmed Bloom can later be changed to a Confirmed with High Toxins Bloom if the toxin threshold is met.

The spatial and temporal heterogeneity of cyanobacteria blooms means that a sample reflects conditions at a single space and time and cannot be assumed with any certainty to reflect lasting conditions in an entire section of shoreline, much less a whole lake. An individual sample may or may not reflect the highest densities of cyanobacteria or cyanotoxins present in a waterbody. The results therefore indicate the potential for such conditions to exist in the area sampled, and potentially in the whole waterbody.

3.2 Threshold Development

The DEC HABs Program bloom status criteria relies on a combination of visual assessment, pigment concentration (BG Chl.a), toxin concentrations and professional judgment (Figure 3.1). In the absence of accepted federal guidelines on exposure to cyanotoxins in recreational waters, the DEC HABs Program bloom status criteria are based on an adaptation of the WHO guidance values for moderate risk of acute health effects from recreational exposure to harmful algal blooms (Table 3.2). WHO recommends the use of cyanobacteria cell counts to trigger alert and advisory systems and cites chlorophyll a or toxins as suitable alternative alert or advisory triggers. The DEC HABs Program interprets the chlorophyll a guidance values in the context of the capability of fluoroprobes to rapidly detect cyanobacteria-

specific pigments (BG Chl.a). A benchtop FluoroProbe (bbe moldaenke©) can be used to rapidly quantify relative quantities of algal pigments using fluorescence spectroscopy.

Table 3.2 WHO guidance values for the relative probability of health effects resulting from exposure to cyanobacteria blooms and microcystin

Relative Probability of Acute Health Effects	Cyanobacteria (cells/mL)	Microcystin-LR (µg/L)	Chlorophyll-a (µg/L)
Low	<20,000	<10	<10
Moderate	20,000-100,000	10-20	10-50
High	100,000-10,000,000	20-2,000	50-5,000
Very High	>10,000,000	>2,000	>5,000

For the first few years of the DEC HABs Program, the WHO guideline (10-50 µg/L of chlorophyll-a and a description of cyanobacteria “dominance”) was interpreted by DEC to be ≥ 25 to 30 µg/L BG Chl.a and ≥ 50% of the algal community comprised of cyanobacteria. As a result of practical application, a narrower BG chlorophyll threshold of 25 µg/L BG Chl.a and qualitative verification the presence of bloom quantities of cyanobacteria via microscopy was adopted.

The DEC HABs Program does not use toxins as a primary determinant in bloom status designation. Pigment analyses and visual assessments can be completed more quickly than toxin analyses, so turnaround time to determine bloom status and communicate risk to the public can be conducted quickly. The designation of a bloom as Suspicious or Confirmed does not ensure that toxins are not present, but merely that they were not above the High Toxins threshold. Additionally, cyanobacteria HABs produce other harmful compounds such as dermal irritants and other uncharacterized or unmeasured toxins, so contact with all blooms should be avoided. Outreach is comparable for all waterbodies, regardless of bloom status.

3.3 Cyanotoxins and Other Harmful Compounds

The potential routes of exposure for humans and animals to cyanotoxins and other harmful compounds created by cyanobacteria can be broadly classified into three categories: dermal, ingestion, or inhalation of aerosolized toxins.

Exposure can occur during:

- recreation
- fishing

- household use of untreated or in-home treated surface waters when there is a bloom
- consumption of water that contains cyanobacteria or cyanotoxins

Exposure to high levels of HABs and cyanotoxins can cause:

- diarrhea
- nausea or vomiting
- skin, eye or throat irritation
- allergic reactions
- breathing difficulties

Cyanotoxin production mechanisms and triggers are not well understood and the relationship between algal biomass and toxin concentration is not clear. Presently, the analytical methods available for detection of the wide range of cyanotoxins are expensive and require a high level of laboratory equipment and trained analysts. There are several types of techniques used for detecting cyanotoxins or the potential for cyanotoxin production in environmental samples including biological assays, chromatographic methods, or genetic methods.

Of the cyanotoxins that are routinely tested for by the DEC HABs Program, the most commonly detected are microcystin and anatoxin-a, with the former detected substantially more frequently. Each has been listed on the USEPA's fourth Contaminant Candidate List. Additional cyanotoxins and other bloom-related compounds are of concern for public health risks. The USEPA has issued 10-Day Drinking Water HA for microcystin and cylindrospermopsin, which provide information on the chemical and physical properties, health effects, toxicological effects, and analytical methods for quantification of those cyanotoxins.

Microcystin

The most commonly detected cyanotoxin is microcystin. It is produced by several genera of cyanobacteria. Microcystin-LR is the most commonly detected of the more than 100 congeners (forms) of microcystin and has been found to be the most toxic.

For drinking water, the WHO provisional guideline for lifetime consumption is 1.0 µg/L of microcystin-LR. In 2015, the USEPA issued a 10-day drinking water HA of 0.3 µg/L for children (less than six years old), and 1.6 µg/L for older children (>6 years of age). New York will continue to evaluate how to implement this guidance regarding PWS; this is the responsibility of NYSDOH.

The DEC HABs Program bloom status criteria are based on a Confirmed with High Toxin Bloom threshold for microcystin of 10 µg/L (open water) and 20 µg/L (shoreline). These values were derived from the WHO criteria moderate risk thresholds (Table 3.2).

USEPA has developed draft human health recreational ambient water quality criteria for microcystin released in 2016. The guidelines suggest a swimming advisory threshold of 4 µg/L, not to be exceeded on any day or more than 10% of days per

recreation season, up to one calendar year to designate waterbody impairment. New York will continue to evaluate how to reconcile these values with the DEC bloom status criteria in a way that is protective for recreational use of waterbodies.

Anatoxin-a

Anatoxin-a is one of several alkaloid neurotoxins produced by some types of cyanobacteria. Several incidents of pet and livestock poisonings have been reported after exposure to cyanobacterial blooms. Symptoms of exposure from animal case reports include staggering, paralysis, muscle twitching, gasping, convulsions, and death. Dogs are at particular risk of exposure to cyanobacteria and cyanotoxins through grooming of their fur and dose response effect related to their relative body mass.

Given the lack of federal guidance and wide variations in individual state advisory values, the DEC HABs Program has not adopted a specific Confirmed with High Toxin threshold for anatoxin-a. This toxin is not often detected in water samples in New York State, in part because the rapid photo-degradation rate thwarts detection. Detection of anatoxin-a presents a monitoring and analytical challenge. The USEPA has not released a HA or any guidance values for anatoxin-a in recreational or drinking waters, citing a lack of research and current data available to generate such guidance.

Cylindrospermopsin

Cylindrospermopsin is produced by several kinds of cyanobacteria, including genera commonly encountered in New York, however, this toxin is rarely detected in water samples analyzed by the DEC HABs Program.

The DEC HABs Program does not have a Confirmed with High Toxins Bloom threshold for cylindrospermopsin. In 2015, the USEPA released a 10-day drinking water health advisory for cylindrospermopsin (0.7 µg/L for children <6 years of age, 3.0 µg/L for older children and adults). Draft human health recreational ambient water quality criteria for cylindrospermopsin released by USEPA in 2016 suggest a swimming advisory threshold of 8 µg/L not to be exceeded on any day, or not more than 10 percent of days per recreation season up to one calendar year to designate waterbody impairment.

Other Cyanotoxins and Harmful Compounds

Cyanobacteria have been shown to produce a wide range of additional compounds that have not been thoroughly identified or studied. The rapidly changing landscape of the research regarding cyanotoxins and cyanobacterial blooms supports an overall policy of caution and avoidance of blooms by the public. At this time, a lack of substantial published data, no federal guidelines, and low rates of occurrence in New York warrants that the DEC HABs Program should not include bloom status thresholds for any cyanotoxins other than microcystin.

Additional information regarding HABs and health can be found on the DOH Blue-green Algae and Health webpage.

4 Bloom Reporting: HABs Documentation by DEC

4.1 Surveillance & Sampling: Two approaches

The process by which reports of HABs are generated and sent to the DEC HABs Program has many potential routes and collaborating partners. There are two general categories of bloom reports:

Surveillance

Bloom surveillance relies on a visual evaluation of lake conditions and may or may not eventually lead to water sample collection or analysis. Reports can include a single observation reported to DEC via a phone call from the public, an email to HABsinfo@dec.ny.gov, and/or the submission of a Suspicious Algal Bloom Report Form (see Appendix D), or other communication which may or may not include digital photographs. DEC, NYSDOH, LHDs and OPRHP staff send in reports either as a result of their own surveillance or after receiving reports from the public. Surveillance is also conducted by programs that commit to routine surveillance at specific waterbodies. Surveyors that work within programs will often complete a customized data sheet provided by the DEC HABs Program that includes information about field conditions and a map of a survey area (see Appendix B for an example). Surveillance reports can be used to designate a bloom as Suspicious.

NYSDOH has established a regulated beach closure protocol based on visual surveillance, as described in greater detail in Section 4.2. If a beach manager believes that conditions within the swimming beach fit the description of a HAB, the manager will close the beach and post signs indicating that the beach has been closed. If these conditions are not apparent on the beach but are observed or reported on the waterbody near the beach, the manager may post advisory signs. This protocol has been adopted for regulated swimming beaches by NYSDOH and OPRHP. Beach closures are considered by DEC to be Confirmed Blooms.

Sampling

Bloom sampling may be conducted as a consequence of a bloom report or following a pre-determined sampling program protocol. HABs sampling, particularly when paired with water quality testing, can provide valuable data that can be used to better understand long-term patterns in geographic extent, toxicity, duration, and other characteristics of blooms in a particular waterbody. Analytical results from sampling can be used to designate a Confirmed Bloom or Confirmed with High Toxins Bloom.

The DEC HABs Program works with several partners to conduct structured surveillance and/or sampling programs throughout the state; these programs are described in more detail below. Sampling supports and supplements overall statewide surveillance efforts and increases the likelihood of rapid observation and

public notification of bloom occurrence. Although monitoring plan details (number, frequency, and types of samples analyzed) differ among partners, they generally consist of the following:

- Observations of waterbody condition are conducted by a trained member or affiliate of the partner organization (volunteer, employee, or agency worker). Surveys are usually conducted by a person familiar with the waterbody. Training helps improve the likelihood that algal blooms are correctly identified in the field and that reports of non-cyanobacteria blooms are minimized.
- Samples are usually collected from the densest portion of the bloom (the "worst case scenario") to be as protective as possible regarding exposure risk.
- Samples are collected and sent to a partner laboratory to be analyzed for phytoplankton community composition via microscopy, pigment concentration, and toxins (See Chapter 3 for more detail).
- Some programs survey and/or sample only when visible scums or blooms occur (**episodic**). Others programs perform these tasks on a regular basis, regardless of the visual state of the waterbody (**routine**). Some programs follow a combination of these protocols (**hybrid**).

4.2 HABs Programs in New York

The Lake Classification and Inventory Program (LCI)

The DEC DOW Lake Management and Assessment Section conducts lake water quality sampling through the LCI Program to support lake assessment and management activities. Data collected as part of LCI are used to update the New York WI/PWL and to identify waterbodies that do not attain their designated uses. LCI data supports DEC outreach, education and waterbody assessment programs. Waterbodies that are selected for sampling are grouped by drainage basin and follow the five-year RIBS schedule. The waterbodies selected each year generally have a paucity of historical data or evidence of a current water quality problem. A full suite of field data and laboratory water quality parameters (profiles, water chemistry, Secchi depth, etc.) are collected at each sampling event. This program was developed to characterize overall water quality conditions, not necessarily HAB occurrences. Digital photographs and water samples are collected when blooms are encountered.

The Citizens Statewide Lake Assessment Program (CSLAP)

CSLAP is a volunteer lake sampling and education program that is jointly managed by DEC and NYSFOLA. Over 240 lake associations and 1,500 volunteers have participated in CSLAP since its inception. The program has delivered high quality data to many DEC programs for over 30 years. Annually, about 120 lakes throughout the state participate in the program. CSLAP supports sampling by shorefront resident members of lake associations that apply to participate in CSLAP

through their affiliation with NYSFOLA. A full suite of water quality parameters is measured throughout the summer months (8x/ season) from each lake. Samples are collected from a single open water site (the deepest part of the lake); HABs surveys are conducted periodically at all lakes and on each sampling date for lakes prone to HABs. Shoreline HABs surveys can lead to episodic HABs reports and sampling if a shoreline scum is observed between scheduled sampling events.

Lake-specific Professional and Semi-professional Programs

Several lake communities have developed structured surveillance and sampling programs in response to annually recurring HABs. These programs have been developed in cooperation with DEC and other partners. The programs vary in structure but most involve leveraging existing analytical partnerships and sampling frameworks. Most programs only collect HABs samples while a few also monitor further water quality parameters through separate programs.

NYC and Long Island Enhanced HABs Monitoring

The NYC Department of Parks and Recreation and researchers at SUNY Stony Brook oversee a hybrid sampling, surveillance and research partnership in New York City parks and in Suffolk County, Long Island. Routine surveillance and/or sampling is conducted on lakes with persistent blooms and episodic surveys are conducted on other lakes with potential HABs as they are observed. Sampling occurs weekly in lakes with persistent cyanobacteria blooms.

New York State OPRHP EMB

EMB staff work closely with DEC and NYSDOH to provide outreach to State Park managers and staff on how to recognize and respond to HABs. A formal reporting protocol has been defined by EMB through consultation with DEC and NYSDOH. Routine surveillance is conducted by individual beach or State Park managers at parks with waterbodies that are prone to HABs. That information is reported to central EMB staff, who then communicate information to DEC and NYSDOH. Digital photographs are provided in support of this surveillance and reporting. When the bloom is at a bathing beach, State Park managers, in consultation with EMB, can make the decision whether to close or reopen a beach, in compliance with NYSDOH beach closure protocols.

NYSDOH Regulated Swimming Beaches

Bathing beaches are regulated by NYSDOH District Offices, County Health Departments and the New York City Department of Health and Mental Hygiene in accordance with the SSC. The SSC contains qualitative water quality requirements for protection from HABs. NYSDOH developed an interactive intranet tool that provides guidance to County, City and State District DOH staff to standardize the process for identifying blooms, closing beaches, sampling, reopening beaches and reporting activities. The protocol uses a visual assessment to initiate beach closures

as it affords a more rapid response than sampling and analysis. Beaches are reopened when a bloom dissipates (visually) and samples collected the following day confirm the bloom has dissipated and show toxin levels are below a guidance value (< 10 µg/L microcystin). Sample analysis is through the use of Abraxis test kits, the Wadsworth Laboratory in Albany or academic institutions.

Lake Champlain

HABs surveillance and sampling in Lake Champlain is coordinated by joint efforts among the VT DEC, VDH, LCBP, and LCC. Over 50 trained citizen monitors conduct shoreline surveys at locations throughout the lake in both Vermont and New York. Additionally, VT DEC staff conduct sampling at 15 fixed sites (both shoreline and open water). Samples are evaluated following a tiered alert protocol. Results are posted online in the VDH Blue Green Algae Tracker interactive map and not the on the DEC HABs website. DEC provides a link to the tracker on the HABs notifications page.

Great Lakes (Lake Erie and Lake Ontario)

There is not basin-wide defined HABs response or management plan for the Great Lakes. NOAA and DEC respond to concerns and issues related to HABs on Lake Erie or Lake Ontario on an episodic basis, including reports of blooms from embayments to the lakes.

Episodic HABs Surveillance and Sampling by DEC and LHD Staff

DEC and LHD staff occasionally conduct site visits in response to bloom reports from the public. While at the waterbody, they assess if a bloom is likely to be cyanobacteria and determine whether sample collection is warranted. Site visits are often triggered by phone calls, emails or suspicious algal bloom report forms submitted by the public to DEC and/or NYSDOH. A shortage of staff to conduct this on-demand sampling has led to the development of the programs described above.

Episodic HABs Surveillance by the Public

The public often encounter algal blooms and report their findings to the DEC HABs Program. These reports include phone calls, emails, or completion of a Suspicious Algal Bloom Report Form (See Section 5.2). Occasionally, DEC HABs Program staff will request that members of the public conduct follow up surveillance as deemed appropriate; this facilitates tracking the duration and size of the bloom.

5 Outreach

A critical component of the DEC HABs program is outreach: communication of information about HABs and the results of surveillance and sampling programs to inform public decisions about recreational choices. The bloom statuses are based in part on

the need to provide information to lakefront residents, visitors and their families as quickly as possible.

5.1 Email Communication to Regional Stakeholders

Emails regarding bloom status are sent within 1-2 days of receipt of a bloom report or results from a laboratory, usually within the same workday. For any given waterbody and county there are a suite of regional stakeholders who receive email notifications about bloom reports and results provided through the program: regional DEC and/or NYSDOH staff, LHDs, lake associations, local government officials, or lake managers, and others who receive email notifications about bloom reports and results provided through the program. Contact lists are maintained by the DEC HABs Program on primarily a county basis. The response actions taken by the recipients of the notification emails varies substantially by county. If a member of the public reports a bloom directly to DEC, he or she will be sent an email regarding the bloom status designation and any planned follow up actions.

The communication process begins when a report of a potential bloom is sent to DEC HABs Program staff. This report can include digital photographs, a written description of the bloom and/or a sample collection. These reports take the form of phone calls or emails sent directly to DEC, NYSDOH or LHDs. On occasion, the initial report of a bloom may come as analytical results reported by one of the SUNY laboratories following sample analysis, for those blooms not initially reported directly to DEC.

After the sample is analyzed, results are submitted to the DEC HABs Program, and staff determine a bloom status (see Chapter 3). Notification of the status is sent to county stakeholders by several mechanisms. Because of the public health risks related to HABs exposure, DEC HABs Program staff work to transmit relevant information as quickly as possible. Rapid and broad-reaching responses rely on email and the DEC HABs website. Specific blooms may involve multiple email notifications spread over multiple days, since these may represent a visual report and sampling results for both screening pigment and microscopy analysis, and later for toxins.

Every year, the DEC HABs Program staff sends out several hundred notifications to report bloom status or provide updates on ongoing blooms. The content of the emails is tailored for each waterbody and recipient group; overall messaging remains consistent, but there are variations in the details included in each message, as explained below.

Subject Lines

Descriptive email subject lines are used to immediately provide the most important and useful information to the reader. This allows the recipient to quickly determine if the report requires action and/or is relevant to his or her professional responsibilities. Subjects of notification emails generally include: bloom status (No Bloom, Suspicious, Confirmed or Confirmed with High Toxins Bloom), lake name, county,

date bloom was observed and/or sampled, and indication of waterbody uses (presence of PWS or public swimming beaches).

Attachments

If digital photographs were received with a bloom report, they are attached to regional stakeholder emails. Photos help agency staff determine if or where to conduct any follow up investigations. If a bloom report originated with a submission of a Suspicious Algal Report Form (Appendix D), a copy of the form may be attached to the regional stakeholder email. If field sample sheets are available, they are occasionally attached to the emails as well.

Content

When possible, the contents of emails to regional stakeholders include analytical results, such as chlorophyll and toxins concentrations. Raw data are included to provide support for the bloom status designation and are disseminated with the recognition that state agency staff or trained sample collectors are able to properly interpret the information. These data are not included in the public notification summary table updated weekly on the DEC HABs website (See Section 5.2). The extent of the bloom is indicated (when available).

Messages sent to lake associations or the public include reminders to avoid exposure, report symptoms consistent with HABs exposure to LHDs or NYSDOH, and seek medical advice or assistance as needed.

The Extent of a Bloom

Extent is a rough estimate of the size of the bloom within the waterbody.

Small Localized: Bloom affects a small area of the waterbody, limited from one to several neighboring properties.

Large Localized: Bloom affects many properties within an entire cove, along a large segment of the shoreline, or in a specific region of the waterbody.

Widespread/Lakewide: Bloom affects the entire waterbody, a large portion of the lake, or most to all of the shoreline.

Open Water: Sample was collected near the center of the lake and may indicate that the bloom is widespread and conditions may be worse along shorelines or within recreational areas. Special precautions should be taken in situations when a Confirmed with High Toxins Bloom is reported with an Open Water extent because toxins are likely to be even higher in shoreline areas.

5.2 DEC HABs Webpages

DEC's website has several informative HABs webpages: a landing page, a notifications page, an archive page, a photo gallery of HABs and non-HABs algal blooms, an FAQs page, and additional information about HABs. The content of these pages is updated periodically. The notifications page and archive page are updated every Friday from May through the end of October. The notifications page includes a map and a sortable summary table of current blooms. On the archive

page, there is information about blooms that have ended and historical data from previous years. Further detail about these two pages is provided below.

The DEC HABs Program established a public notification system in 2012, as part of an on-going agency effort to improve public reporting and outreach regarding environmental hazards. The HABs notification program is intended to improve public awareness about this pressing environmental issue, improve transparency regarding information collected by DEC monitoring and reporting programs, and assist the public in making informed decisions about recreation and other water uses. The structure of some features of the pages reflects DEC rules, requirements and limitations associated with current web page formats.

Notifications Page

The page includes a statewide map of waterbodies with current HABs reports and additional sampling locations without HABs from the preceding three weeks. The map has numbered locations for each waterbody with a current Suspicious, Confirmed, or Confirmed with High Toxin Bloom (Figure 5.1). The label is placed on or near the center of a waterbody, not necessarily on the specific reported bloom location. Support for reporting only a general location includes: the likelihood of bloom movement, the potential for multiple concurrent bloom locations within a waterbody, and a degree of uncertainty about the precise location of each bloom. The notification page includes a note that for large lakes or flowing water systems, reported blooms may not be apparent in all portions of the waterbody.

Updates to Bloom Status

The DEC HABs Program and its partners consistently seek current information to provide the most up-to-date bloom notifications. Attempts are made to update the status of blooms with more recent reports. Information gathering is done by email requests for updates and/or site visits by DEC and NYSDOH staff. CSLAP samplers and other DEC surveillance partners usually conduct surveillance in 1-3 week intervals, allowing for routine updates. However, the frequency of bloom reporting can be sporadic and decreases after the routine water sampling season ends, even if some blooms persist into the fall.

Below the map is a sortable summary table that provides detailed information on waterbodies with current HABs reports (Table 5.1). The table includes: county, bloom status, extent of the bloom (*Small localized*, *Large localized*, *Widespread/lakewide*, or *Open water*), sample date, type of report (*Lab sample* or *Visual report*) and change in status (*New*, *No Change*, or *Updated Listing*). The table does not include laboratory analytical results. Bloom status designations are intended to be sufficient for public health protection without requiring interpretation of analytical data. The exclusion of the data is particularly important for those situations in which multiple sample results from a single waterbody are not internally consistent

(i.e. could be categorized in multiple ways) and require DEC HABs Program staff professional judgment.

Archive Page

The archive page includes a sortable table that is updated weekly with the following information about non-current blooms: county, most recent bloom status date, and details on why the bloom has been archived (*Bloom reported to have ended* or *No additional information*). A bloom is moved from the notifications page to the archive Page when: a report of visual surveillance indicates that the bloom has dissipated, follow up analytical results have BG chlorophyll values below the threshold for a Confirmed Bloom, or no additional reports have been received for three weeks. The waterbody is listed on the Archive page for the rest of the season; however, if the bloom returns at a later date the waterbody may reappear on the notifications page with a change in status listed as *New*.

Below the table, the page includes links to downloadable PDFs of tables with bloom information from previous years. Each table includes all waterbodies for which a bloom was documented in a particular year. Waterbodies that were cited as having a Suspicious Bloom that was later determined not to be a bloom are not included. For each cited waterbody, the first and last report dates and the cumulative duration of the blooms are included. A cumulative archive showing all waterbodies with reported blooms since 2012 is also available for download.

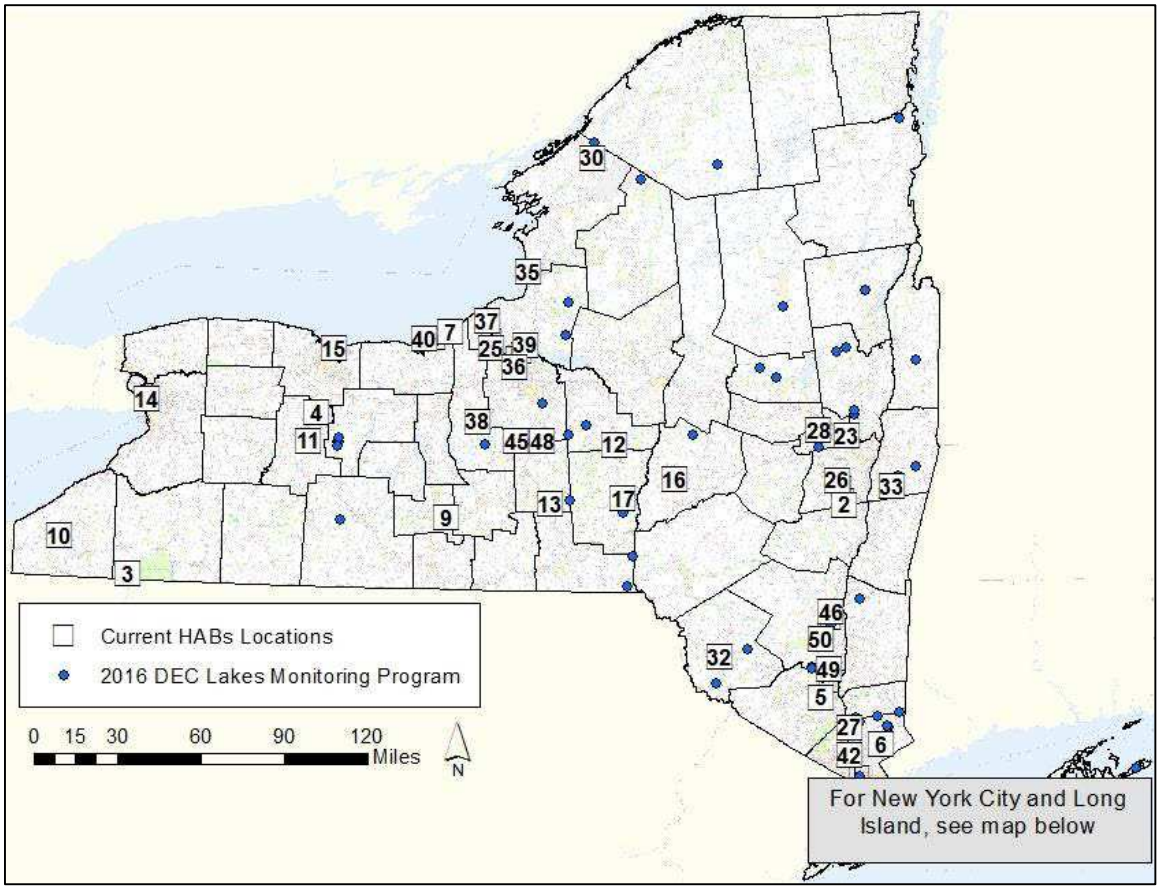


Figure 5.1 Example of the statewide map of HABs locations throughout the state that is updated weekly on the DEC HABs notifications page

Table 5.1 Example of the format of the sortable summary table posted weekly on the DEC HABs notifications page

Map Number	Waterbody Name	County	Bloom Status	Extent of Bloom	Date	Type of Report	Change in Status
1	Agawam Lake	Suffolk	Confirmed with High Toxins	Widespread/ lakewide	10/4/15	Lab sample	Updated listing
2	Alcove Reservoir	Albany	Confirmed	Small localized	9/29/15	Lab sample	No change
3	Allegheny Reservoir	Chautauqua	Confirmed	Large localized	10/7/15	Lab sample	Updated listing
4	Conesus Lake Outlet	Livingston	Suspicious	Small localized	10/7/15	Visual Report	New

5.3. Additional Outreach Efforts

Pamphlets, flyers, and other published informative documents play an important role in educating the public about HABs in New York. Outreach materials provide precautionary information that instructs readers to be aware of HABs and may include additional instructions about exposure risk, likely symptoms, how to report blooms and appropriate steps to take if exposed to HABs. In outreach materials, care is taken to provide precautionary advice without triggering public alarm about risks, particularly in large waterbodies with blooms found only at limited locations. The DEC HABs Program supports several outreach strategies:

Signs

- The DEC HABs Program has developed templates for advisory signs for use by lake associations at public access points outside of NYSDOH regulated facilities (See Appendix B). If a regional agency staff member (DEC or NYSDOH), lake manager, or local resident expresses interested in posting (and removing) signage, the DEC HABs Program will provide them with printable PDF template files that can be customized to a limited extent
- Signs have been developed by NYSDOH for use at regulated swimming beaches when LHD personnel or beach operators close beaches. Sign templates are used or modified by regional staff and LHDs to post at beaches or to notify users at locations within a waterbody other than a beach.
- Limitations in personnel, resources, and logistics prevent DEC from being able to post advisory notices at public access points on the large number of waterbodies in New York that have documented HABs. The DEC HABs Program and NYSDOH provide general guidance that instructs lake residents and visitors to be on the lookout for blooms at any time once they have been documented for a particular waterbody. This is based on the expectation that even vigilant surveillance might not catch all blooms and that all lakes with previously confirmed blooms are highly susceptible to future blooms.

Brochures and Pamphlets

- DEC developed a brochure specially focused on HABs in 2017.
- Some individual lake associations have developed HABs brochures for their communities. The DEC HABs program often supports these initiatives with feedback on content and by providing photographs that can be used.
- NYSDOH released a HABs brochure in 2016, which supplements a public FAQ document that has been available since 2003.

Online

- During the summer notification period, a weekly update on the number of HABs locations in New York is included in *MakingWaves*, DEC's weekly email newsletter regarding water issues in New York State. The update includes a link to the Notifications page and additional information about blooms.

- During the summer notification period, weekly updates on the number of blooms with a link to the Notifications page and additional information about blooms are posted on DEC's Facebook page and Twitter account.
- There are several locations on the DEC HABs website where members of the public can download a Suspicious Algal Bloom Report Form. Users are instructed to complete the form and email it, along with digital photographs, to the DEC HABs drop box email (HABsInfo@dec.ny.gov).
- NYSDOH has maintained a HABs webpage since 2003. Several LHD website have specific HABs pages, some of which include real-time information on local bloom status and beach closures.

Other

- Several state or regional agencies issue press releases to inform communities about the potential risks associated with HABs. Some releases are issued proactively in early summer in advance of the upcoming recreational season, usually before any blooms are observed. Other press releases are issued in the midst of bloom season or in response to a high profile bloom. DEC HABs Program staff write or contribute to these press releases on an as needed basis, usually at the request of regional agency staff.
- DEC HABs Program staff regularly give presentations regarding HABs issues to a variety of audiences including: agency staff, individual lake associations, local government, the public, training workshops and lake-related conferences.
- DEC HABs Program staff periodically provide articles or other education materials for publication in lake association newsletters, DEC's *Conservationist* magazine, and other outreach methods.
- DEC HABs Program staff regularly participate in regional and national HABs working groups and share data and program development strategies with all interested parties.

5.4 Challenges & Limitations to Current Outreach Strategies

Communication about HABs in New York requires consistent messaging across several state agencies. The DEC HABs Program strives to be a central location for information and outreach regarding HABs statewide. The program has the potential to include all HABs reports and beach closure information from NYSDOH, LHDs, and OPRHP on the DEC HABs website. The current outreach system, as described above, sometimes makes achieving this objective a challenge. The following examples illustrate some of these challenges:

- It is not possible to know whether all recipients have read emails sent by the DEC HABs Program. Further, staff can't be sure whether all relevant parties have been included in the recipient list. List memberships require annual overhauls and constant in-season revisions.
- Many lake communities maintain their own listserv or internal communication framework. Bloom status emails that have been communicated by the DEC

HABs Program to local lake contacts are frequently forwarded to the larger lake community; DEC does not assume this responsibility or maintain contact lists and therefore cannot control additional or potentially contradictory messaging included in the transmissions.

- The practice of updating the Notifications and Archive pages on the DEC HABs website once per week means that posted listings cited as “new” or “updated” may be up to six days old. Even if additional analytical results are received about a bloom from the previous week, the Notifications page is not updated until the following Friday. More frequent web-based notifications are not achievable, at least at this time.

5.5 Publication and Use of DEC HABs Data

DEC HABs Program staff evaluate HABs data and contribute to several different publication outlets.

CSLAP Reports

Annual reports are issued to participating lake associations for every CSLAP lake. All CSLAP lake reports completed since 1996 are posted on the NYSFOLA website and the most recent year’s reports are posted on DEC's website. These reports include annual and cumulative summaries of all CSLAP program information, with a focus on physical and chemical water quality indicators. The analysis and reporting of HABs-related information include the following:

- For each year of HABs sampling, graphs show seasonal distribution of algae communities (as measured by total and component chlorophyll a) and microcystin in open water and shoreline bloom samples
- Tabular summaries of total and component chlorophyll a and major toxins (microcystin and anatoxin-a), including minimum, long term average, present year average, and maximum values during the current year
- Narrative summaries of sampling results and a summary of microscopic analyses
- A comparison of fluoroprobe and toxin results to the DEC HABs thresholds for Confirmed and Confirmed with High Toxins Blooms

LCI Reports

Summary reports are issued for select LCI lakes. The reports include annual and cumulative summaries of all LCI program information, with a focus on physical and chemical limnological indicators. The analysis and reporting of HABs-related information include the following:

- Narrative summaries of sampling results and a summary of microscopic analyses
- A comparison of fluoroprobe and toxin results to the DEC HABs thresholds for Confirmed and Confirmed with High Toxins Blooms

The Waterbody Inventory/Priority Waterbodies List (WI/PWL)

All of the DEC HABs Program data is used to support the assessment of waterbodies through the WI/PWL, the DEC inventory of water quality information.

- Each waterbody is assessed against criteria defined in the state CALM to evaluate whether a waterbody is attaining its best intended uses (drinking water, recreation, support of aquatic life, etc.). DEC bloom status thresholds and frequency of DEC HABs notifications are used to assess recreational uses through the CALM process.
- For waterbodies cited on the WI/PWL, individual waterbody *Fact Sheets*, outline the most recent assessment of use support, identify water quality problems and sources, and summarize current activities underway to restore and protect each waterbody. Documentation of HABs impacts is included in the *Fact Sheets.*

Impaired Waters List

Waterbodies that do not meet their best designated uses, mostly due to violations of state water quality standards or CALM criteria, are cited on the federal Impaired Waters list, as dictated by Section 303(d) of the federal CWA.

- DEC has established CALM criteria for designated waterbodies with documented persistent and widespread HABs occurrences as candidates for the Section 303(d) list. Currently the threshold is defined in the Assessment Methodology as *occurring on multiple days and verified over more than a 2 week period, at multiple locations covering significant spatial extent, with likelihood of annual recurrence*. In some instances HABs occurrences may trigger other impairment criteria related to administrative use restrictions on water supply, public bathing or recreational use. In other cases, waterbodies with recently documented HABs have previously been cited on the list as impaired due to excessive nutrients or other water quality problems.
- Starting in 2016, DEC HABs Program data have been used to support New York State 303(d) listings.
- HABs Program data is used to prioritize impaired waterbodies for the development of a clean water plan such as a TMDL or Nine Element Plan.

6 Methods for Bloom Prevention and Control

6.1 Bloom Prevention

Most research indicates that the primary cause of HABs is excessive nutrients (phosphorus and nitrogen) so watershed management efforts should be targeted at measures to reduce the input of phosphorus and nitrogen to waterbodies. Nutrient reduction through watershed management strategies is the most effective method of preventing eutrophication and potentially preventing blooms from occurring.

Numeric nutrient thresholds refer to an ambient phosphorus or nitrogen concentration above which designated use impairments are documented or likely occurring. The establishment of these nutrient thresholds continues to be an active subject of research and data evaluation, as required by USEPA as part of the numeric nutrient criteria development process.

The process by which numeric thresholds are established and promulgated to protected designated uses in most waterbodies, including ponded and flowing waters, is discussed in the DEC Nutrient Plan. Currently, New York has a narrative standard for nutrients: *none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages* (6 NYSCRR Part 703.2). An ambient water guidance value of 20 µg/L (0.020 mg/L) total phosphorus has been developed for ponded waters (TOGS 1.1.1), in order to be protect aesthetics. Additional research and data evaluation is on-going to identify appropriate thresholds to protect primary and secondary contact recreation best uses. Site-specific criteria may be needed for waterbodies with nutrient levels below the thresholds and that have recurrent HABs. A timeline has not been established for promulgation of the thresholds, which will most likely be in the form of a state guidance value. However, it is likely that future criteria will be based on numeric thresholds derived from ecological response variables such as open water chlorophyll *a* or documentation of shoreline HABs.

Waterbodies exceeding these thresholds are identified by the DEC and USEPA as impaired, and are cited on the federal 303(d) list. For these waterbodies, monitoring and/or modeling analysis are required to determine the primary source(s) of nutrients. Then, a Clean Water Plan (a TMDL or a Nine Element Watershed Plan) that identifies pollutant sources and strategies for reducing the nutrient loading from these sources is developed for the waterbody.

In some waterbodies, the primary source of nutrients is discharge from a wastewater treatment plant, referred to as a point source. In New York, most point source discharges to lakes are associated with long-standing outfalls from small municipal treatment plants to big lakes. Discharges to rivers are more common and HABs have been documented on some large river systems.

DEC has been delegated authority by USEPA to regulate point source pollutant discharges under the SPDES Permit Program. SPDES permits may authorize phosphorus or nitrogen permit limits through a process that establishes nutrient permit limits according to up-to-date wastewater treatment technologies and practices (TOGS 1.3.6). This guidance considers both receiving and downstream waters. Discharge limits are established to meet the point source pollutant reductions necessary to bring ambient nutrient levels in the receiving waterbody below the numeric nutrient thresholds described above.

In most impaired waterbodies in New York, nonpoint source pollution is the primary source of nutrient inputs. The fundamental goal of the DEC Nonpoint Source Management Program is to encourage comprehensive management of nonpoint pollutant sources in order to protect and conserve all waters of New York State for beneficial uses. The NPS Program offers guidance and technical support through the process of writing watershed plans, identifying best management practices, and implementing planned actions that can control impacts from nonpoint sources. Common preventative measures include targeted management of septic systems, advanced wastewater treatment, reduced or eliminated use of lawn and agricultural fertilizers, and stormwater management.

A detailed discussion of nutrient management activities is beyond the scope of this document, but given limited resources and agencies' regulatory reach, nutrient management is largely conducted by a coalition of agencies, local officials, and lake communities. Watershed management techniques for lake communities and lake residents are discussed in Chapter 9 of the 2009 DEC publication Diet for a Small Lake: the expanded guide to New York State lake and watershed management, collaboratively written by DEC and NYSFOLA.

6.2 Bloom Management at Drinking Water Treatment Plants

Municipalities are responsible for providing high quality water for a variety of domestic purposes, including drinking. In New York, there are nearly 1,500 surface water supplies. DOH and LHDs provide guidance and technical assistance to public water suppliers to respond to HABs in water supplies that use surface waters. For more information, see www.health.ny.gov/harmfulalgae or contact the NYSDOH Bureau of Water Supply Protection at bpwsp@health.ny.gov.

6.3 In-Lake Bloom Control Options

Efforts to minimize or eliminate the frequency of HABs should focus on prevention, specifically the reduction of ambient waterbody nutrient concentrations. However, the timeline for implementation and success of most preventative measures will exceed a single bloom season. For many lake residents or lake communities, bloom control must include causal management. Concurrent to the implementation of prevention and nutrient management measures, there are some steps to take to reduce the intensity or occurrence of blooms.

Algal blooms can be controlled using a variety of physical, chemical, or biological strategies. A short summary of algae control measures that have been used or could be considered for use in New York is provided in Table 6.1. Readers are encouraged to learn more about in-lake control techniques on the USEPA control and treatment website. The control measures discussed below are covered in much greater detail in Chapter 7 of Diet for a Small Lake, *Algae and Other Undesirables: Getting Rid of Yuck*. Many algal control measures require permits from DEC

Regional Environmental Permit Administrators, who should be consulted before any algal control measure is implemented.

Table 6.1 Summary of various water management techniques used for algal blooms, their effectiveness, DEC permitting requirements and relative cost.

Method	Principle	Pros	Cons	Limitations	DEC Permits	Cost
BIOLOGICAL CONTROL METHODS						
Biomanipulation	Manipulate trophic interactions by stocking piscivorous fish to eat planktivorous fish	Once stocked, fish are inconspicuous, may improve sports fishery, method is regarded as "natural," inexpensive	Risk of disrupting fish community or other unexpected consequences, highly variable success rate, assumes planktivorous fish dominate lake food web	Need to evaluate fisheries data on existing food web & probable changes as a result of manipulation	Article 11 stocking permit	Highly variable; $100-$2k/acre
Floating islands	Artificial wetlands outcompete algae for suspended nutrients; islands act as nutrient sinks	Natural appearance, some evidence of success in small ponds, other potential beneficial uses (such as acting as a nursery for terrestrial plantings), a long-term control strategy	Limited history of use in NYS, may be unsightly or impact active recreation, limited to small ponds or isolated portions of larger waterbodies, need to harvest islands to prevent nutrients from migrating back to water	Not known	Not known	Not known
CHEMICAL CONTROL METHODS						
Algaecides	Kill algal cells through cellular toxicity (copper-based) or oxidation (hydrogen peroxide)	Immediate response, long history of copper usage in NYS, scalable	May have limited duration, potential non-target impacts, controversial in some settings, cell lysing can spill toxins into water, spot treatment may be difficult	Some water quality restrictions	Article 15/Part 327, Article 17/SPDES General Permit needed, Article 24 wetlands permit may be needed	Highly variable, $5-25 per acre-foot
Nutrient Precipitation and Inactivation	Precipitate nutrients in water and/or seal nutrients in the sediment, primarily with use of alum (aluminum sulfate), PhosLock (lanthanum-based), or iron	Can have immediate response & long-term duration, may address significant internal nutrient sources, non-pesticidal, may minimize spillage of toxins from HABs	Permitting issues, fish toxicity in low pH lakes, public perception of chemical use, floc/sludge removal if nutrients intercepted, may have limited effectiveness in waterbodies that are not strongly stratified, high cost	Presently illegal in NYS, but a permitting approval method may be developed in the future; a detailed project proposal and plan will be required	Not presently allowed	$100 - >$500/acre

Method	Principle	Pros	Cons	Limitations	DEC Permits	Cost
PHYSICAL CONTROL METHODS						
Surface aeration, including oxygenation & circulation	Inject oxygen or air to keep water moving, prevent nutrient release from anaerobic sediments	Reduces taste & odor, reduce nutrient release in deep lakes, reduces surface scums, fast	Breaks down thermal layer, may move nutrients to surface, high cost for aerators/operation	Need access to power source, need expert to size & install except in small ponds	Article 15 Protection of Waters may be required	Variable; $150-$2500/acre, DEC funds might support projects
Hypolimnetic aeration or oxygenation (not circulation)	Inject oxygen or air to prevent nutrient release from anaerobic sediments in deep lake areas	Reduce taste & odor problems for potable water, might enhance deepwater fisheries, may improve quality of downstream water	Break down of thermal layer can be detrimental to coldwater fish, nutrient diffusion to the surface, high cost for aerators and their operation, takes time to be effective	Needs access to power source/batteries for compressors, large hypolimnion, & an expert to size & install except in small ponds	Article 15 Protection of Waters may be required	>$2,500/acre, DEC funds might support projects in some limited cases
Drawdown	Reduce water level in autumn to expose sediments to winter freezing/desiccation and to consolidate sediments	Inexpensive & easy for some waterbodies, can be combined with dock repair or macrophyte control, potential exposure impact to overwintering cyanobacteria cysts	Impacts non-target plants, invertebrates or fish, refill rates unpredictable, deep drawdown is needed to expose anoxic sediments & cyanobacteria cysts, variable success at best, takes time	A dam or control structure is needed, deep drawdown permitting is unlikely	Article 15 Protection of Waters and Article 24 wetland permits may be required	Essentially no cost if a dam control structure is present
Hypolimnetic Withdrawal	Selectively remove water from hypolimnion, slowly replenish deepwater oxygen, and reduce nutrient release from sediments	Inexpensive if a siphon/deep outfall exists, removes nutrient source, inconspicuous, downstream cold water refugia are created	Potential impacts to aquatic life, potability, aesthetics (odor & color), significant withdrawal rate needed for highly anoxic hypolimnia, risk of destratification, takes time	Need a deepwater siphon or deep outfall	Article 15 Protection of Waters permit may be required	Mostly valve operational costs if a deep outfall exists, up to $10,000 annual operating costs for siphons
Ultrasonic waves	Apply 20kHz- 1MHz sound waves to disrupt cyanobacteria cell walls & gas vacuoles	Inconspicuous, works immediately	Multiple units needed, potential effects on non-target organisms, need to find correct frequency to target cyanobacteria, requires persistent use	Need local power source (or batteries), ultrasonic structure may be considered a regulated fill by permit offices	Need to consult with regional offices, may be considered to be pesticidal	$5000/unit + operating costs
Barley straw	Limit algae through contact with straw via rotifer predation, released hydrogen peroxide, adsorption, or other unknown mechanisms	Often deemed as a “natural” control method, can be done by non-professionals, inexpensive, can be removed if not working	Little empirical evidence of effectiveness, removal of spent bales can be difficult, may be unsightly	None	Need to consult with regional offices, may be considered to be pesticidal	$20-50/acre

7 Glossary

Algal toxin: A toxin produced by cyanobacteria, also called a cyanotoxin.

Beach: A public swimming area regulated by trained NYSDOH or OPRHP staff and routinely monitored for public safety.

Bloom: High concentrations of algal cells that may form surface scums, mats, or other dense accumulations of algal material.

Blue-green algae: An outdated, but still commonly used term for the class of bacteria now known as cyanobacteria.

Cyanobacteria: Also known as blue-green algae. Photosynthesizing bacteria that are capable of producing toxins and other substances that pose a health risk to exposed humans or animals. Cyanobacteria may be unicellular, colonial, or filamentous. Some genera are capable of fixing nitrogen.

Cyanotoxin: A toxin produced by cyanobacteria. Most are classified as hepatotoxins, neurotoxins, or other.

Episodic surveillance/sampling: Conducted outside of programs, or between routine surveillance/sampling, on an as-observed basis, in reply to bloom reports.

Extent: The geographic span of a bloom along the shoreline; during surveys, extent is recorded as *Small Localized*, *Large Localized*, *Widespread/Lakewide*, or present in open water.

Hybrid: A combination of event-based and routine programs. Includes adapting sampling locations to account for sampling conducted at bloom locations that may occur in addition to routine survey times or sampling sites.

Report: Any information regarding a potential bloom including visual surveillance, suspicious algal bloom report forms, emails, digital photographs, or bloom samples.

Routine surveillance/sampling: Conducted on a pre-determined schedule in pre-determined locations (particularly open water sites and locations known to be prone to blooms/scum accumulation). This type of program is most often conducted on lakes that have a documented history of HABs.

Sampling: Collecting representative water from suspected blooms as a means for detection and report generation regarding potential blooms.

Scum: An algal bloom that has a dense surface accumulation of cells or filamentous material.

Stakeholder: A person, business, or other organized entity that has an interest in a particular issue. Their interest may be financial, personal, or academic.

Status: Bloom designation assigned according to DEC criteria as *No Bloom*, *Suspicious*, *Confirmed*, or *Confirmed with High Toxins*.

Surveillance: A report on the visual evaluation of lake conditions as a means for detecting potential blooms.

Zone: Geographic span along shoreline subject to HAB surveillance.

8 Appendices

Appendix A. Generalized DEC HABs Sampling

For use and adaptation by programs that may be training volunteers on how to collect HABs samples for the DEC HABs Program. Additional training materials are available from the DEC HABs Program upon request.

Instructions

- **Prepare**: Bring DEC-provided sample form, digital camera, HAB gallery sheet (if available), sample bottles, and gloves. Only collect samples if visual evidence of bloom is apparent. When in doubt, a sample should be collected, and DEC can advise (via email or phone) if samples should be submitted. If conducting surveillance by boat, make sure that personal floatation devices and other safety equipment are deployed as appropriate.

Do not allow cyanobacteria to come in contact with skin

- **Digital photographs**: If a suspected bloom is observed, take a close up photograph (within 10-20 feet if possible) of the water surface at the most intense part(s) of the bloom. This will help to characterize the bloom. For small lakes that can be completely surveyed from a single site, photograph a wide view of the entire lake to demonstrate the extent of the bloom. For lakes with public and/or surveyor access limited to discrete locations, photograph a wide view of this accessible site that shows as much of the bloom area as possible. Go to next accessible site and repeat these procedures until as much of the lakeshore has been surveyed as possible. For all photos, label the image files with the waterbody name, location/site name or description, and date.

- **Bloom visual description**: If a lake-specific HAB Bloom Sample Data Sheet has been provided, consult the thumbnail images or another visual HAB photo gallery (if available) to categorize the bloom conditions visible on the lake.

Collect a HABs Sample	Do Not Collect a HABs sample
Spilled paint appearance on surface	Bubbling scum on surface
Pea soup	Slight greenish or brownish tint
Streaks	Duckweed or watermeal (floating plants)
Green dots or clumps	Other

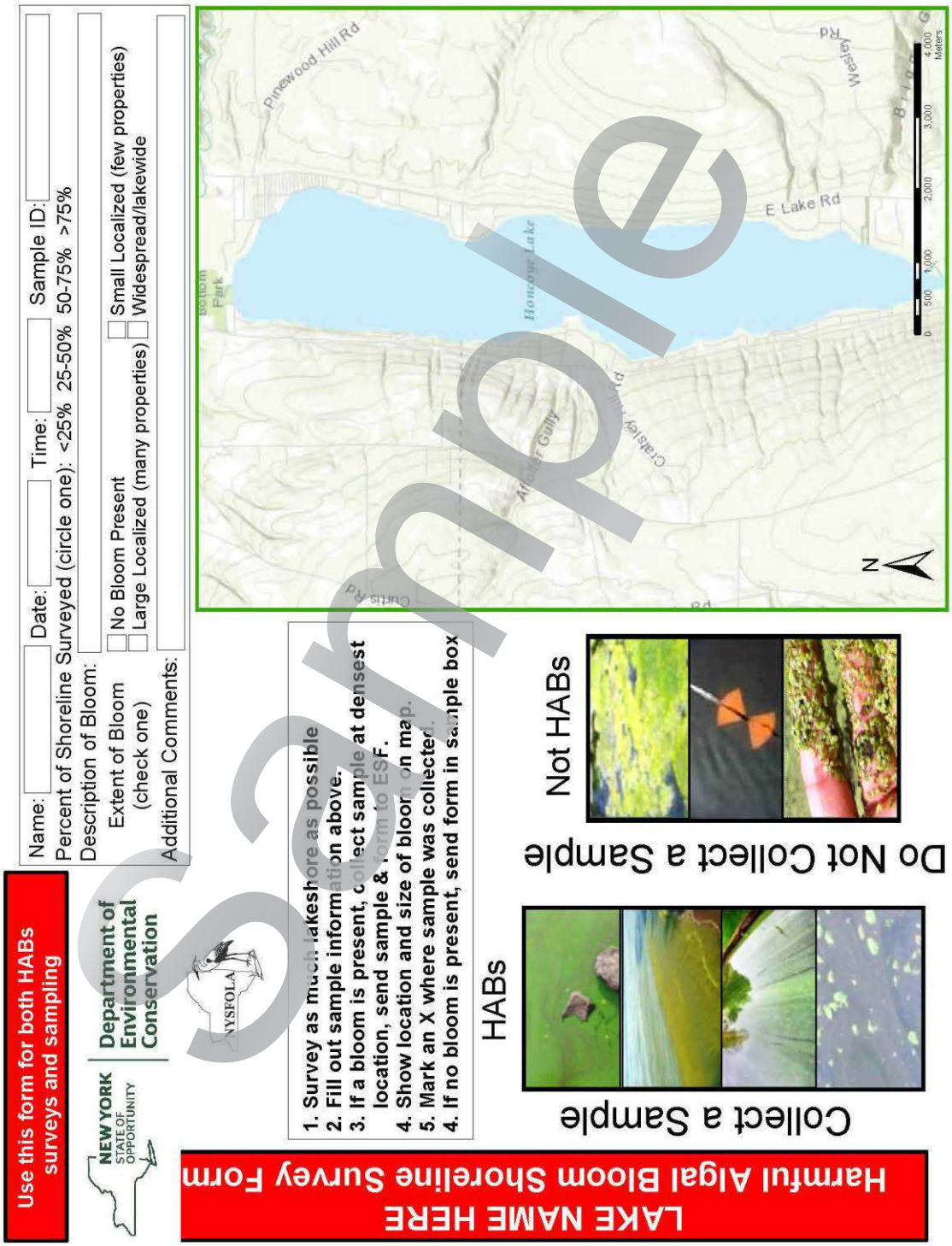
- **Bloom extent**: If no blooms are observed, check the box on the field form stating *no bloom present*. If blooms are observed, describe the extent of the overall bloom conditions on the lake as *small localized* (covering < 100 feet, affects a small area of the waterbody, limited from one to several neighboring properties), *large localized*

(covering many properties within an entire cove, along a large segment of the shoreline, or in a specific region of the waterbody), or *widespread/lakewide* (covering the entire waterbody, a large portion of the lake, or most to all of the shoreline). Describe the extent of the shoreline surveyed (provide locations and sizes of sections surveyed if the entire lake was not surveyed). Use the lake map to sketch the extent of visible surface or immediate subsurface algal bloom coverage (scums, streaks, dots, etc.). Use the map scale or landmarks to guide the drawing.

- **Sample collection:** If a bloom is not apparent, there is no need to collect a sample. If any suspected blooms are observed, identify the most intense (thickest or most discolored scum, streaks, or concentration of dots or surface material) part of the bloom. *Sample from a boat if possible rather than entering the water. Protect yourself with disposable gloves. Limit any exposure to scums.* Skim the surface to collect a sample with the densest amount of scum possible. Collect a sample in the sample bottle by slowly plunging the inverted bottle beneath the surface the water, avoiding bloom exposure to the skin. Tip the bottle slightly upward to allow air to exit and the bottle to fill up to the neck, then cap the bottle. *If possible, rinse the side of the closed bottle with clean water from the lake to minimize exposure to the bloom. Wash any areas of the skin that contact scums with clean water. Monitor yourself for any exposure symptoms.*

Appendix B. DEC HABs Shoreline Survey Form

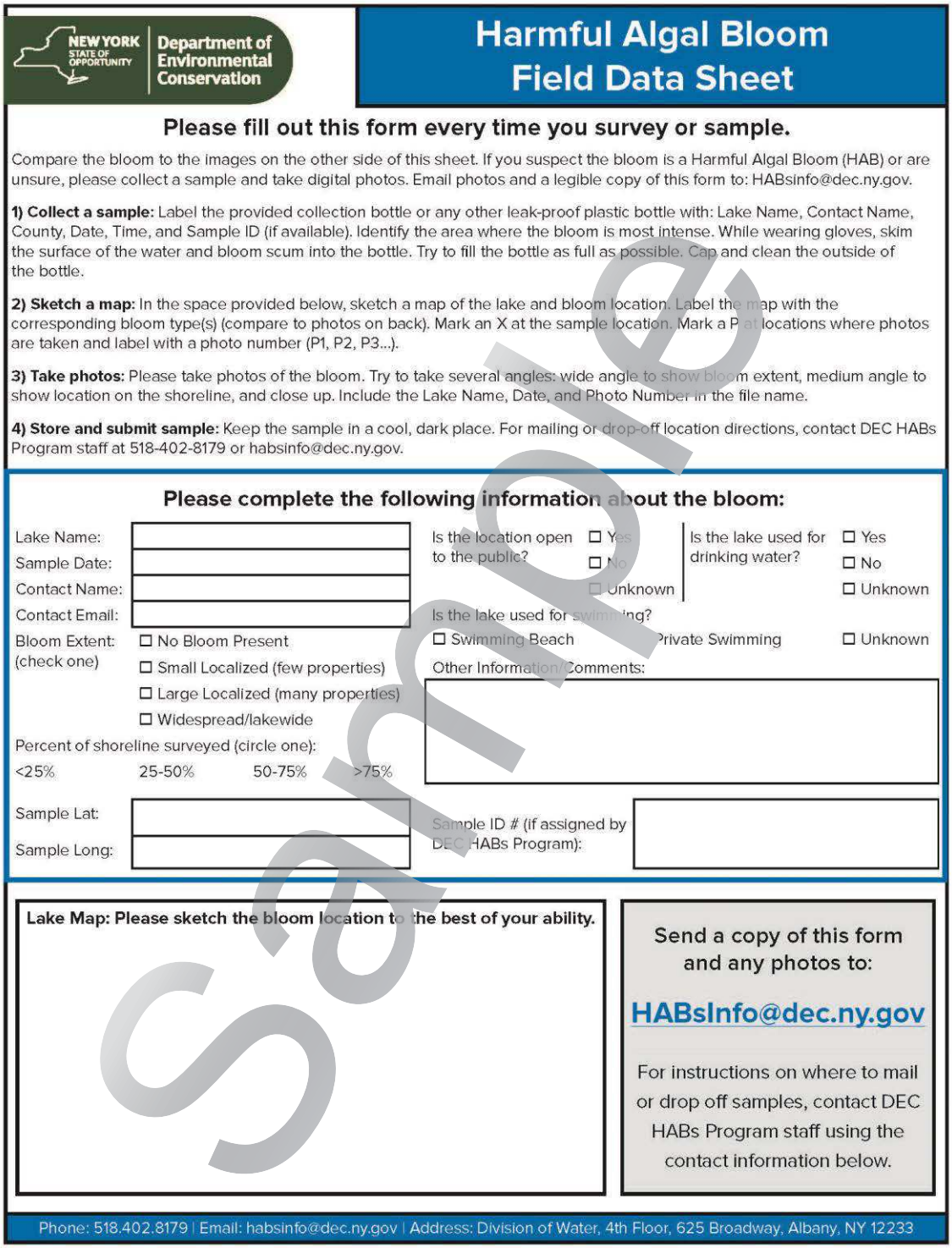
This is an example of the type of form provided by the DEC HABs Program to trained samplers that are part of HABs surveillance and sampling programs.



Sample

Appendix C. DEC HABs Field Data Sheet

This is an example of the type of form provided by the DEC HABs Program to agency staff that sample HABs on an episodic basis.



NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Harmful Algal Bloom Field Data Sheet

Please fill out this form every time you survey or sample.

Compare the bloom to the images on the other side of this sheet. If you suspect the bloom is a Harmful Algal Bloom (HAB) or are unsure, please collect a sample and take digital photos. Email photos and a legible copy of this form to: HABsinfo@dec.ny.gov.

1) Collect a sample: Label the provided collection bottle or any other leak-proof plastic bottle with: Lake Name, Contact Name, County, Date, Time, and Sample ID (if available). Identify the area where the bloom is most intense. While wearing gloves, skim the surface of the water and bloom scum into the bottle. Try to fill the bottle as full as possible. Cap and clean the outside of the bottle.

2) Sketch a map: In the space provided below, sketch a map of the lake and bloom location. Label the map with the corresponding bloom type(s) (compare to photos on back). Mark an X at the sample location. Mark a P at locations where photos are taken and label with a photo number (P1, P2, P3...).

3) Take photos: Please take photos of the bloom. Try to take several angles: wide angle to show bloom extent, medium angle to show location on the shoreline, and close up. Include the Lake Name, Date, and Photo Number in the file name.

4) Store and submit sample: Keep the sample in a cool, dark place. For mailing or drop-off location directions, contact DEC HABs Program staff at 518-402-8179 or habsinfo@dec.ny.gov.

Please complete the following information about the bloom:

Lake Name:
Sample Date:
Contact Name:
Contact Email:

Is the location open to the public? ☐ Yes ☐ No ☐ Unknown

Is the lake used for drinking water? ☐ Yes ☐ No ☐ Unknown

Is the lake used for swimming? ☐ Swimming Beach ☐ Private Swimming ☐ Unknown

Bloom Extent: (check one)
☐ No Bloom Present
☐ Small Localized (few properties)
☐ Large Localized (many properties)
☐ Widespread/lakewide

Other Information/Comments:

Percent of shoreline surveyed (circle one):
<25% 25-50% 50-75% >75%

Sample Lat:
Sample Long:

Sample ID # (if assigned by DEC HABs Program):

Lake Map: Please sketch the bloom location to the best of your ability.

Send a copy of this form and any photos to:

HABsInfo@dec.ny.gov

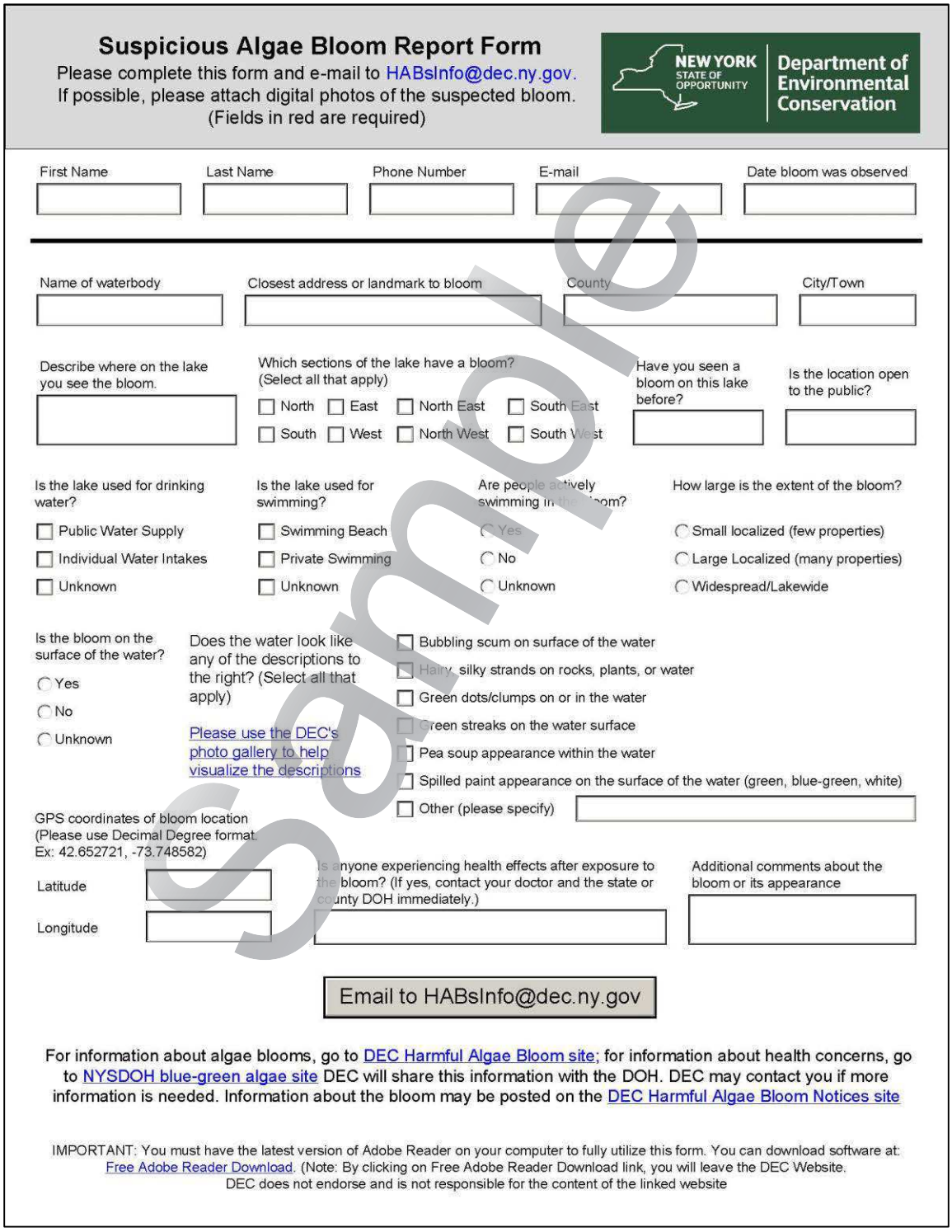
For instructions on where to mail or drop off samples, contact DEC HABs Program staff using the contact information below.

Phone: 518.402.8179 | Email: habsinfo@dec.ny.gov | Address: Division of Water, 4th Floor, 625 Broadway, Albany, NY 12233

Sample

Appendix D. DEC Suspicious Algal Bloom Report Form

This form is available for download at: www.dec.ny.gov/chemical/77118



Suspicious Algae Bloom Report Form

Please complete this form and e-mail to HABsInfo@dec.ny.gov.
If possible, please attach digital photos of the suspected bloom.
(Fields in red are required)

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

First Name | Last Name | Phone Number | E-mail | Date bloom was observed

Name of waterbody | Closest address or landmark to bloom | County | City/Town

Describe where on the lake you see the bloom.

Which sections of the lake have a bloom? (Select all that apply)
☐ North ☐ East ☐ North East ☐ South East
☐ South ☐ West ☐ North West ☐ South West

Have you seen a bloom on this lake before?

Is the location open to the public?

Is the lake used for drinking water?
☐ Public Water Supply
☐ Individual Water Intakes
☐ Unknown

Is the lake used for swimming?
☐ Swimming Beach
☐ Private Swimming
☐ Unknown

Are people actively swimming in the bloom?
◯ Yes
◯ No
◯ Unknown

How large is the extent of the bloom?
◯ Small localized (few properties)
◯ Large Localized (many properties)
◯ Widespread/Lakewide

Is the bloom on the surface of the water?
◯ Yes
◯ No
◯ Unknown

Does the water look like any of the descriptions to the right? (Select all that apply)

Please use the DEC's photo gallery to help visualize the descriptions

☐ Bubbling scum on surface of the water
☐ Hairy, silky strands on rocks, plants, or water
☐ Green dots/clumps on or in the water
☐ Green streaks on the water surface
☐ Pea soup appearance within the water
☐ Spilled paint appearance on the surface of the water (green, blue-green, white)
☐ Other (please specify)

GPS coordinates of bloom location
(Please use Decimal Degree format
Ex: 42.652721, -73.748582)

Latitude

Longitude

Is anyone experiencing health effects after exposure to the bloom? (If yes, contact your doctor and the state or county DOH immediately.)

Additional comments about the bloom or its appearance

Email to HABsInfo@dec.ny.gov

For information about algae blooms, go to DEC Harmful Algae Bloom site; for information about health concerns, go to NYSDOH blue-green algae site DEC will share this information with the DOH. DEC may contact you if more information is needed. Information about the bloom may be posted on the DEC Harmful Algae Bloom Notices site

IMPORTANT: You must have the latest version of Adobe Reader on your computer to fully utilize this form. You can download software at: Free Adobe Reader Download. (Note: By clicking on Free Adobe Reader Download link, you will leave the DEC Website.
DEC does not endorse and is not responsible for the content of the linked website

Sample

Appendix E. Example DEC HABs Notice Sign

This poster is available upon request for lake communities to alert lake users of the potential presence of a HAB on their waterbody.

Appendix F. References and Resources

DEC Harmful Algal Blooms webpage

www.dec.ny.gov/chemical/77118

NYS Department of Health Blue-green Algae and Health webpage

www.health.ny.gov/environmental/water/drinking/bluegreenalgae

U.S. Environmental Protection Agency: CyanoHABs Webpage

www.epa.gov/nutrient-policy-data/cyanohabs

World Health Organization: Guidelines for Safe Recreational Waters, 2009

www.who.int/water_sanitation_health/water-quality/recreational/guidelines-for-safe-recreational-environments/en/

New York Citizens Statewide Lake Assessment Program (CSLAP) Sampling Protocol

www.dec.ny.gov/docs/water_pdf/cslapsampro.pdf

New York Federation of Lake Associations

www.nysfola.org