Cyanobacterial Harmful Algal Bloom (HAB)Freshwater Response

2022 Summary Report

Division of Water Monitoring, Standards and Pesticide Control

Cover Photo- Mercer Lake
Mercer County, 8/17/22

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Cyanobacterial Harmful Algal Bloom (HAB) Freshwater Recreational Response

2022 Summary Report

New Jersey Department of Environmental Protection

Water Resource Management

Division of Water Monitoring, Standards and Pesticide Control

Bureau of Freshwater and Biological Monitoring

Victor Poretti, Bureau Chief

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Report prepared by:
Victor Poretti, Bureau Chief
Dean Bryson, Supervisor
Tom Miller, Research Scientist 2
Leigh Lager, Geographic Information Systems Specialist

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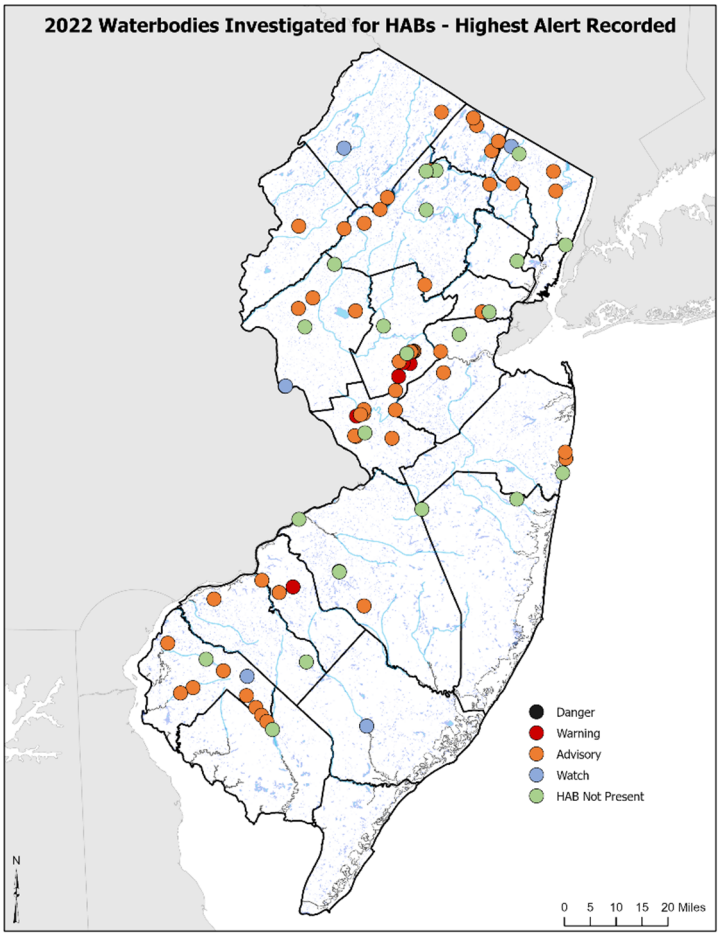
Executive Summary

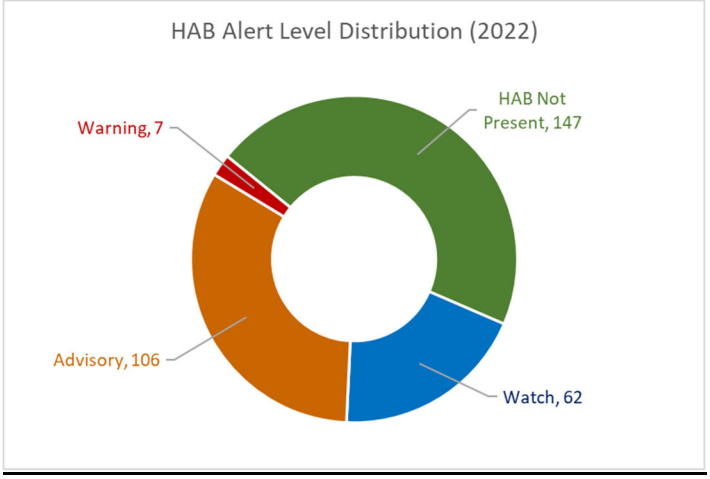
In 2017, the NJDEP implemented a Cyanobacterial Harmful Algal Bloom (HAB) Freshwater Recreational Response Strategy (Response Strategy). The purpose of the Response Strategy is to provide a unified statewide approach to respond to cyanobacterial HABs in freshwater recreational waters, from public recreational bathing facilities to sources of drinking water, and to protect the public from risks associated with exposure to cyanobacteria and related toxins.



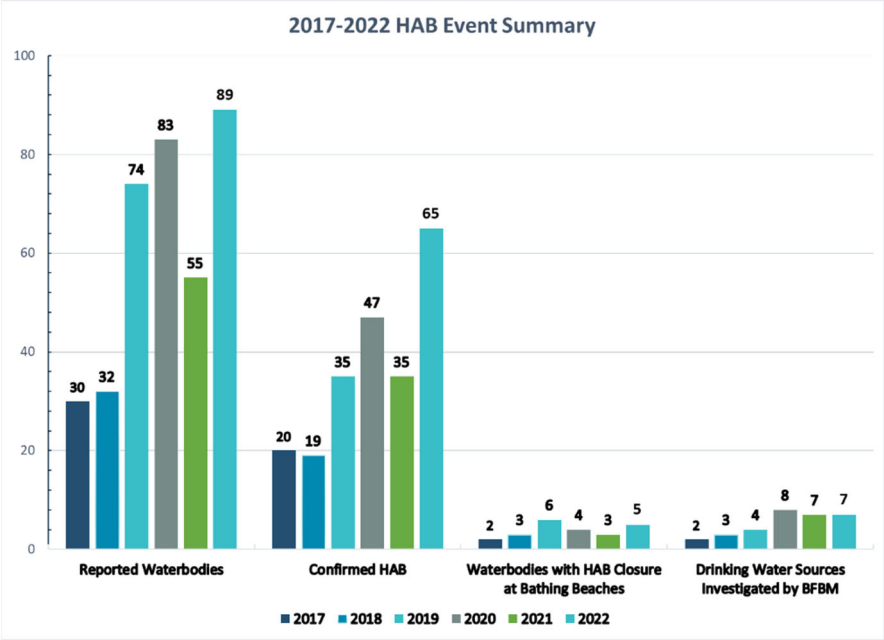
In 2020, a tiered public information and signage system was developed as an enhancement to the HAB Response Strategy. The alert tiers provide clear guidance on advisable recreational activities in waterbodies when a HAB is present. At the same time, the DEP HAB Interactive Map Reporting and Communication System was developed and is used to gather initial information on suspected HABs and to communicate data and alerts to the public.

In 2022, DEP responded to reports of suspected HABs at 89 waterbodies.* Of these, 65 waterbodies had at least one site confirmed by laboratory analysis as having a HAB at or above a Watch Alert tier (>20,000 cells/ml and/ or toxins above thresholds).

*Data in this report reflect investigations of HABs reported to or discovered by DEP during routine monitoring. Other HAB events may have occurred and not reported to DEP.



At each of the 89 waterbodies investigated, multiple sites may have been sampled, depending on localized occurrences in the waterbody, totaling 322 site-specific HAB postings. The pie chart above, illustrates the HAB alert level distribution for all sites at all waterbodies.



These 89 reports of suspected HABs represent a 62% increase from 2021, and a 7% increase from 2020 which at the time had the highest occurrence of suspected HAB reports. This translated into a significant increase of waterbodies with confirmed HABs (Watch Alert or above) by 38% since the program began. As compared to 2021, confirmed HABs rose by 85%. The number of confirmed HABs at drinking water sources remained the same as in 2021 while the number of waterbodies with at least one beach closure increased.* In addition, 50% of waterbodies with confirmed HABs in 2022, had a previous confirmed HAB at least once from 2017-2021. Data shows the statewide occurrence of HABs in New Jersey have increased, and are recurring in many waterbodies since 2017, when the DEP initiated monitoring per the Response Strategy . Further evidence of continued HAB activity is the persistence of blooms into the winter months.

*Information of investigation at sources of drinking water are not to be used to interpret the safety of finished drinking water. The Department and the United State Environmental Protection Agency have established guidance levels and Health Advisory levels with respect to cyanotoxin detections in finished treated drinking water. The DWSG has a guidance document on when to issue public notification based on these levels.

As of the end of 2022, there were 19 waterbodies with at least one site with a HAB Alert level of Watch or above. This is an increase from 12 waterbodies in 2021 and the previous high set in 2020.

Though the program began by reacting and responding solely to reports of HABs, the program has since implemented background monitoring, with the expansion of the continuous monitoring buoy network, Home Page | NJDEP DWM&S Continuous Data Monitoring Program (rutgers.edu). The continuous monitoring network provides valuable data at waterbodies where HABs have reoccurred. In addition to informing immediate HAB response actions, continuous data will be used by DEP to research water quality factors that may predict or contribute to HAB formation.

The Division of Water Monitoring, Standards and Pesticide Control (DWMSPC) and the New Jersey Sea Grant Consortium (NJSGC) has recruited an Expert Team of lakes management and cyanobacterial HAB experts to develop guidance documents for the prevention and management of HABs and to provide technical advice on proposed prevention and mitigation technologies.

Learn more about the HAB expert team.

Introduction

In 2017, the NJDEP implemented a Cyanobacterial Harmful Algal Bloom (HAB) Freshwater Response Strategy (Response Strategy). The purpose of the Response Strategy is to provide a unified statewide approach to respond to suspected cyanobacterial HABs from freshwater recreational waters to sources of drinking water, and to protect the public from risks associated with exposure to cyanobacteria and related toxins. Although the primary focus of the Response Strategy is the protection of human health, it provides some information and recommendations regarding exposure and prevention of potential impacts to domestic animals (pets), livestock, and wildlife, as well.

The scope of the Response Strategy is for freshwater lakes, ponds, rivers and streams with potential public access, recreational use, public recreational bathing facilities as defined in N.J.A.C. 8:26, and sources of drinking water. These waterbodies may be owned or operated by state, county, municipal, federal, or private entities. As such, coordination of the investigation and response activities will vary depending on ownership and use.

It should be noted that while this Response Strategy is used to address sources of drinking water, it does not address the response for cyanotoxin detections in finished treated drinking water. The detection of cyanotoxins in finished treated drinking water is handled by the Division of Water Supply & Geoscience (DWSG) who has established guidance to best prevent, mitigate, and treat HABs/cyanotoxin as well as developing an emergency protocol for responding to and handling HAB/cyanotoxin events that affect a drinking water source/finished treated drinking water. However, the two Divisions work closely together along with the impacted water supplier during all stages of the incident to provide details and keep all relevant staff updated on the incident. Additional parties included in the coordination include but are not limited to, the Division of Water Enforcement, and other State agencies such as the New Jersey Department of Health, Board of Public Utilities, New Jersey Water Supply Authority, and New Jersey Department of Community Affairs, if appropriate.

Because the easiest way to deal with HABs/cyanotoxins is preventing them from happening, the DWSG also focuses on working with water systems to be better prepared for HAB/cyanotoxin events including creating and maintaining adequate Cyanotoxin Management Plans as well as convening a Drinking Water HAB Task Force to develop strategies and guidance. The DWSG's HAB website contains resources, tools, guidance, templates, and other useful information for water purveyors.

Since 2017, NJDEP has continued to enhance all aspects of its approaches including, monitoring, testing, and communication/notification.

This report focuses on the response and monitoring performed in 2022**.** Data in this report reflect investigations of HABs reported to, or discovered by DEP during routine monitoring. Other HAB events may have occurred but were not reported to DEP. For more information on other enhancements developed and implemented such as a data downloads, real-time telemetry buoys, and training videos, visit the HAB Website.

Alert Tiers and Communication

In 2020, a tiered public information and signage system was developed as an enhancement to the HAB Strategy. The Alert tiers (Table 1) provide clear guidance on advisable recreational activities in impacted waterbodies, depending on levels of cyanobacteria and/or cyanotoxins present. Color-coded signs provide the public with current conditions and recommendations on which recreational activities are advisable and those that are not. The index makes it clear to the public that, in some instances, boating and related activities may still be suitable when lower levels of harmful algal blooms are detected.

While exposure to cyanobacterial cells that are not producing toxins can result in the allergenic-like, flu-like and irritative effects, more serious health effects can result from exposure to cyanotoxins. Blooms may begin producing toxins at any time during an active HAB.

In developing the Alert tiers in 2020, DEP conducted an evaluation of NJ-specific HAB data to determine if there was a level of cyanobacterial cell density that is associated with an appreciable likelihood that a bloom will produce toxins at levels above the NJ toxin thresholds.

HAB Alert Tiers

HAB ALERT LEVEL	CRITERIA	RECOMMENDATIONS
NONE	HAB report investigated and no HAB found	NONE
WATCH *Suspected or confirmed HAB with potential for allergenic and irritative health effects*	Suspected HAB based on visual assessment or screening test OR Lab confirmed cell counts between 20k – 40k cells/mL AND No known toxins above public health thresholds	Public Bathing Beaches Open (dependent upon local health authority evaluation and assessment) Waterbody Accessible: Use caution during primary contact (e.g. swimming) and secondary (e.g. non-contact boating) recreational activities Do not ingest water (people/pets/livestock) Do not consume fish
ALERT *Confirmed HAB that requires greater observation due to increasing potential for toxin production* *PUBLIC BATHING BEACHES INCREASE MONITORING*	Lab confirmed cell counts between 40k – 80k cells/mL AND No known toxins above public health threshold	WATCH remains in effect. Public Bathing Beaches Open (dependent upon local health authority evaluation and assessment) and should observe and report changing bloom conditions Waterbody Accessible: Use caution during primary contact (e.g. swimming) and secondary (e.g. non-contact boating) recreational activities Do not ingest water (people/pets/livestock) Do not consume fish
ADVISORY *Confirmed HAB with moderate risk of adverse health effects and increased potential for toxins above public health thresholds*	Lab testing for toxins exceeds public health thresholds OR Lab confirmed cell counts above 80K cells/mL OR Field measurement evidence indicating HAB present and above guidance thresholds (e.g. phycocyanin readings)	Public Bathing Beaches Closed Waterbody Remains Accessible: Avoid primary contact recreation (e.g. swimming) Use caution for secondary contact recreation (e.g. boating without water contact) Do not ingest water (people/pets/livestock) Do not consume fish
WARNING *Confirmed HAB with high risk of adverse health effects due to high toxin levels*	Toxin (microcystin) 20 - 2000 µg/l AND/OR Additional evidence, including, expanding bloom, increasing toxin levels (i.e. duration, spatial extent or negative human or animal health impacts) indicates that additional recommendations are warranted	Public Bathing Beaches Closed Waterbody Remains Accessible: Avoid primary contact recreation (e.g. swimming) May recommend against secondary contact recreation (e.g. boating without water contact) with additional evidence Do not ingest water (people/pets/livestock) Do not consume fish
DANGER *Confirmed HAB with very high risk of adverse health effects due to very high toxin levels*	Toxin (microcystin) > 2000 µg/l AND/OR Additional evidence, including, expanding bloom, increasing toxin levels (i.e. duration, spatial extent or negative human or animal health impacts) indicates that additional recommendations are warranted	Closure of Public Bathing Beaches Possible closure of all or portions of waterbody and possible restrictions access to shoreline. Avoid primary contact recreation (e.g. swimming) May recommend against secondary contact recreation with additional evidence Do not ingest water (people/pets/livestock) Do not consume fish

Table 1. HAB Alert Level Tiers.

The HAB data were evaluated by analyzing the percentage of samples exceeding the NJ advisory guidance level for microcystins (the most common group of cyanotoxins) of 2 µg/L for various ranges of cyanobacteria cell counts. Cell count ranges were used to allow for a sufficient number of samples for statistical analysis within each range. Each year this evaluation is performed using additional data collected from the previous season. When including 2022 results, the data continue to show a substantial increase in the likelihood of toxin levels above the NJ guidelines when cell counts exceeded 80,000 cells/ml (Figure 1).

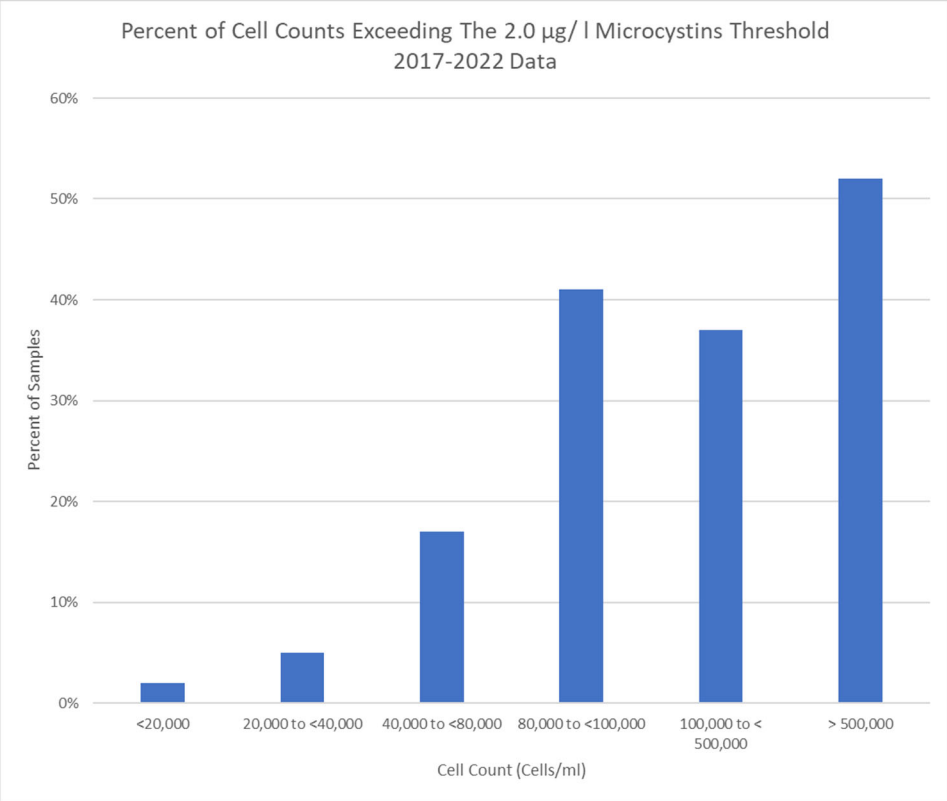


Figure 1. Tier Threshold Analysis.

A Winter Watch sign (Figure 2) was developed and implemented in 2021, to be used during the winter season. As shown by laboratory data, HABs may persist at some waterbodies or recur at other waterbodies. Day-to-day conditions may change and not reflect past Alert postings. The Winter Watch sign is intended to be used at these waterbodies where HABs have a likelihood of recurring during the winter. Because signs posted during the recreational season may not reflect current conditions, or the public may disregard signs they perceive as "old", this new sign provides a fresh perspective during the off season to alert users to be cautious.

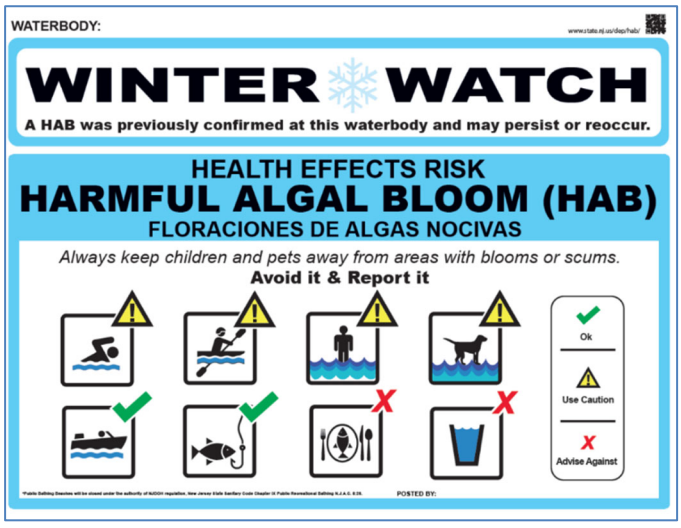


Figure 2. Winter Watch Sign

The DEP HAB Interactive Map Reporting and Communication System (Figure 3) was developed in 2020 and is used to gather initial information such as: location coordinates, photos, known recreational activities, and extent of the waterbody affected. This information is used to inform DEP to initiate appropriate response actions. After DEP completes the investigation of the suspected HAB, results and any recommendations for public alerts are communicated through the HAB System.

All Alert information and HAB data are accessible by clicking each point on the interactive map. The map reflects sampling results for suspected or confirmed HAB events reported to DEP.

In 2021, a new feature was added to the system that enables users to download all available data to date. Data downloads can be accessed here: NJDEP Harmful Algal Bloom (HAB) Data Retrieval (arcgis.com)

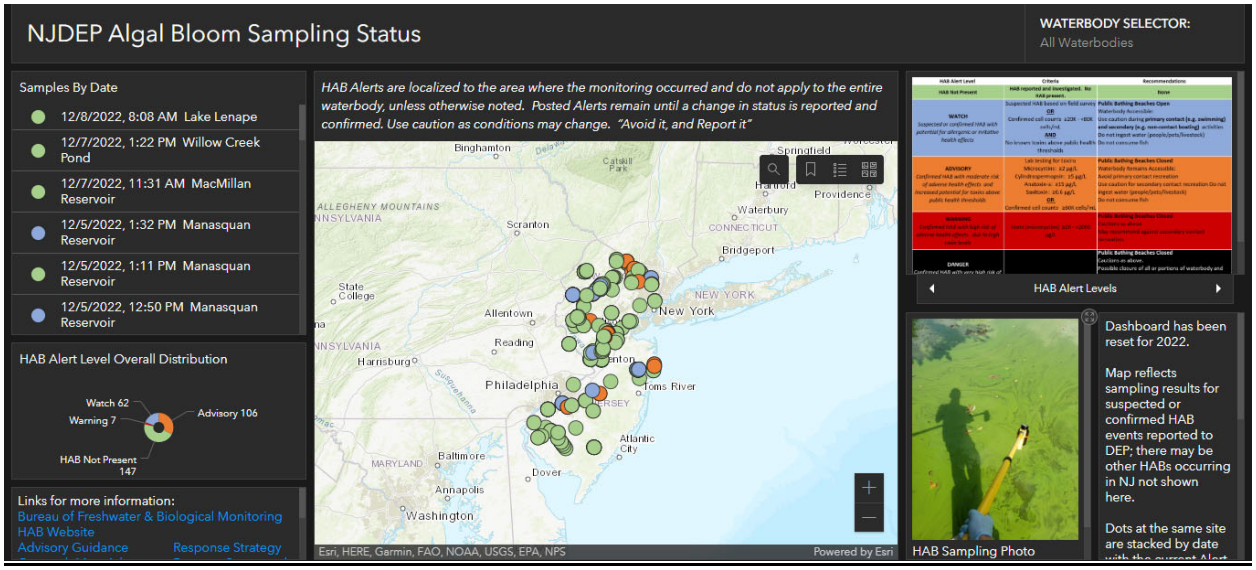


Figure 3. HAB Interactive Map.

Cyanobacterial Harmful Algal Bloom (HAB) Freshwater Recreational Response Procedures

Response

Response of suspected HABs is initiated in multiple ways both internally at DEP and outside. If trained DEP staff observe a suspected HAB while collecting water quality samples as part of the routine Ambient Lakes Monitoring Network,, Rivers and Streams routine monitoring networks, or other programs, a field survey, including sample collection (if necessary) is immediately conducted. Also, aircraft flight surveillance * and continuous monitoring buoy data are utilized by BFBM and DWMSPC designated staff to determine if a site survey and sampling is needed. Staff are deployed to areas of the waterbody, as shown by fight data or at buoy locations, where a HAB is suspected above NJ Guidance Thresholds for cell concentration.

Upon receipt of suspected HAB report from within DEP or the public, the BFBM HAB coordinator or designee assesses the information provided in the suspected HAB report, deploys staff, and/or coordinates with partners as necessary. The BFBM HAB coordinator also notifies the responsible agency designated for the waterbody, such as a State Park, Wildlife Management Area (WMA), or local health department. If the responsible agency has trained HAB sampling staff and proper sampling equipment and supplies, they may be requested to perform response activities.

Every effort is made to respond to reported suspected HABs as soon as possible, usually within one business day. In the event resources are limited, the monitoring will be prioritized based on risk to public health. Priority approaches are listed in Table 2.

*Flights are performed weekly weather permitting and described in Supporting Programs section.

1. Prioritization Response Approach for Lakes, Ponds, Reservoirs, Rivers & Streams including Delaware and Raritan Canal

a. Drinking Water Sources

Initial Response	Sampling Frequency	Duration/Season	Final Response
Confirm ASAP	*per Division of Water Supply & Geoscience direction*	*Year Round*	*Continue monitoring at predetermined frequency until clear or per Division of Water Supply & Geoscience direction*

b. **Public Recreational Beaches (PRB)** (in-season, out-of-season skip to *c. Other Recreational Use*) and Secondary Contact Recreational Waters

Initial Response	Sampling Frequency	Duration/Season	Final Response
Confirm ASAP	*Alert tier for bathing beaches only (see table 1) coordinate with partners on additional monitoring. Confirmed HAB Beach Closing – Sample when notified by partners that visual observations or phyco measurement indicates a change of HAB status.*	*May through September*	*After September 30 sample when notified HAB has visually subsided.*

c. **Other Recreational Use** - boating, fishing, public bathing beach (out of season), hunting, domestic animal use, wildlife

Initial Response	Sampling Frequency	Duration/Season	Final Response
Confirm ASAP	*Sample when notified by partners that visual observations or phyco measurement indicates a change of HAB status.*	*Recreational Season or Year Round if necessary*	*December. If HAB is still present or likely to reoccur, a "Winter Watch" alert is posted*

2. Approach for Private Lakes wholly on private property, Ditches, Canals, Stormwater Basins

Initial Response	Sampling Frequency	Duration/Season	Final Response
Assess if there is public access (e.g. fishing or pet access in a private community). Contact owner. Sample on case-by-case basis.	*As needed*	*As needed*	*When clear*

Table 2. Response and Monitoring Priorities

Field Survey

A field survey is performed to gather information following reports of suspected HABs. BFBM staff or partners record site coordinates, observations, take photos, and phycocyanin measurements. BFBM then determines if sampling is warranted. All survey and subsequent sampling information is recorded and submitted using the NJDEP HAB Interactive Map Reporting and Communication System.

Figure 4. Field Fluorometer For Measuring Phycocyanin

Phycocyanin is a pigment unique to cyanobacteria, therefore the presence of a high concentration of phycocyanin is an indicator of a cyanobacteria bloom. Handheld field fluorometers measure the presence and relative concentration of phycocyanin and are used to qualitatively demonstrate whether cyanobacteria, if present, are in bloom densities. Phycocyanin measurements are used to approximate cell concentration and cannot predict toxin production, toxin levels, identify taxa present, nor quantify cell density directly. However, these measurements can be used as a screening tool for suspected HABs and to monitor the status of confirmed HABs.

Figure 5. Continuous multi-parameter meter.

BFBM uses three types of fluorometers: a handheld field meter, laboratory meter, and a YSI data sonde. The YSI data sonde is used for real time continuous monitoring in conjunction with telemetry buoys (Figures 4, 5), but units can also be used for discreet measurements by samplers.

The DWMSPC has developed correlations between phycocyanin measurements and cell concentration. All New Jersey-specific data available, where both cell count and phycocyanin samples were analyzed, were used to statistically correlate these parameters. Note that the model of meter has different ranges and requires a separate correlation (Figure 6 & Table 3).

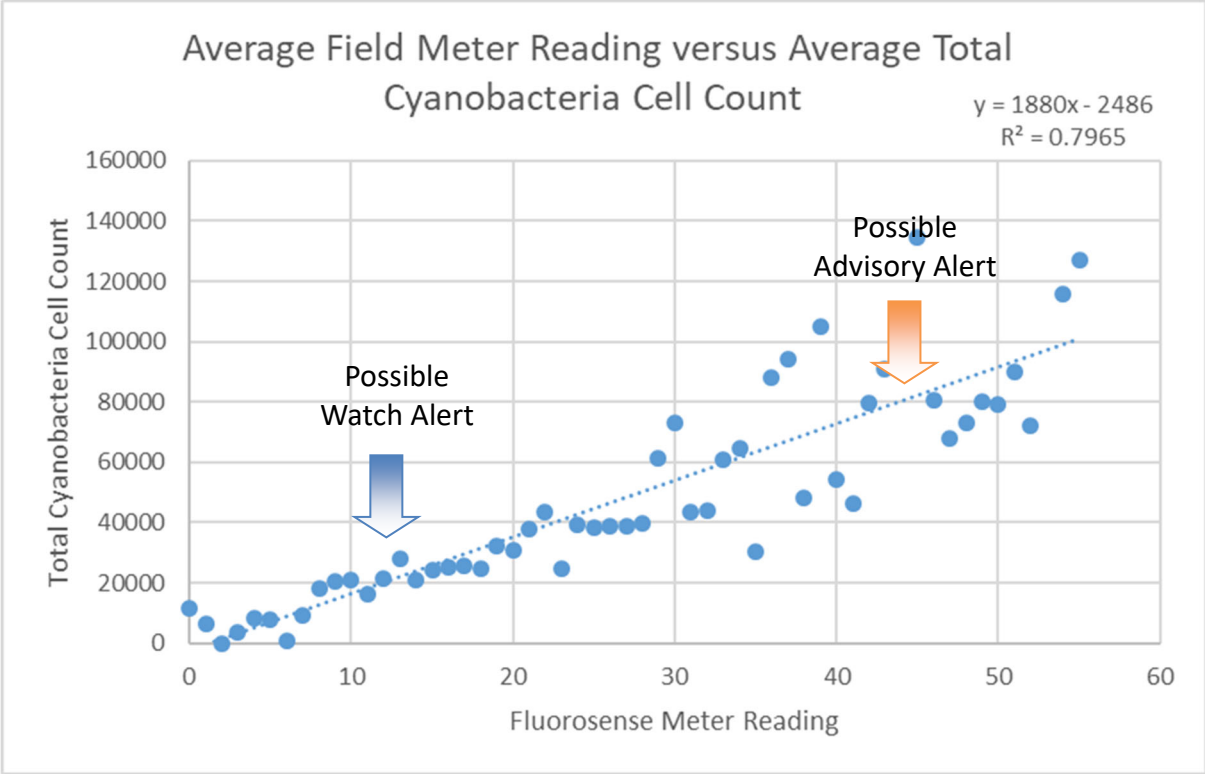


Figure 6. Phycocyanin and cell count correlation for FluoroSense field meter

Estimated individual cell counts cells/ml	Continuous & Discreet Meter µg/L	Estimated FluoroSense RFU	Estimated Lab Fluorometer RFU
20000	1.15	12	33
40000	1.87	23	45.9
80000	3.29	44	71.5
100000	4.00	55	84.3

Table 3. Phycocyanin and cell count correlation for all meters used.

Laboratory Analysis

Laboratory analysis is performed when it is confirmed that measurable cyanobacteria are present in a sample.

Toxin analysis is performed at the BFBM laboratory and uses an Enzyme-Linked Immunosorbent Assay (ELISA) method with Eurofins Abraxis brand test kits for cyanotoxin analysis of microcystins, anatoxin-a, cylindrospermopsin, and saxitoxin. Assays are performed using the Cyanotoxin Automated Analyzer System (CAAS) (Figure 6), Eurofins Abraxis brand, PN 475200S or equivalent Microtiter plate reader, capable of reading sample absorbance at 450 nm. Reporting levels for each toxin are adequate to accurately detect and quantify toxins below NJ Health Guidance.

Figure 7. Cyanotoxin Automated Analyzer System (CAAS)

Currently, EPA Standardized Analytical Method for Determining Total Microcystins by the use of the ELISA Method (EPA 546) is the only EPA-approved ELISA method for toxin analysis. Anatoxin-a, cylindrospermopsin, and saxitoxin are also analyzed using the ELISA methods. Procedures specific to these toxins follow the manufacturer's instructions for the kits and instrumentation.

Cyanobacteria cell concentrations are determined in the BFBM laboratory by examining under a compound microscope using direct counts on a Hemocytometer. Standard phytoplankton identification guides are used for taxa identification. Cell counts are reported as cells/ml and all cyanobacteria taxa are identified. The dominant taxa, i.e., most abundant, is noted and posted with the data on the interactive map.

2022 Results and Discussion

Waterbody Summary

In 2022, BFBM responded to suspected HAB reports at 89 waterbodies. Of these, 65 waterbodies had at least one site, confirmed by laboratory analysis, as having a HAB at or above a Watch Alert level (>20,000 cells/ml and/or toxins above thresholds). A site was determined as not having a HAB when: field visual observations or phycocyanin measurements indicated no HAB was present and therefore a sample was not collected or; a sample was collected but lab analysis for cell count and toxins were below all thresholds. At each of the 89 waterbodies investigated for a suspected HAB, multiple sites may have been sampled, depending on extent of occurrences in the waterbody. In addition, sites may have been sampled many times over the season due to changing conditions and concerns. The Alert levels intended for the immediate area where the HAB was confirmed through laboratory analysis, and the rest of the waterbody can be used for recreation with normal appropriate precautions. However, even when Alerts are posted, there may be other HABs occurring within that same waterbody or at other waterbodies, which have not yet been reported and confirmed. Therefore, recreators are advised to avoid anything that looks like a HAB and to report it to the DEP ("Avoid It and Report It"). Figure 8 shows a map of the waterbodies investigated in 2022 with the highest alert level recorded for that waterbody for the season.

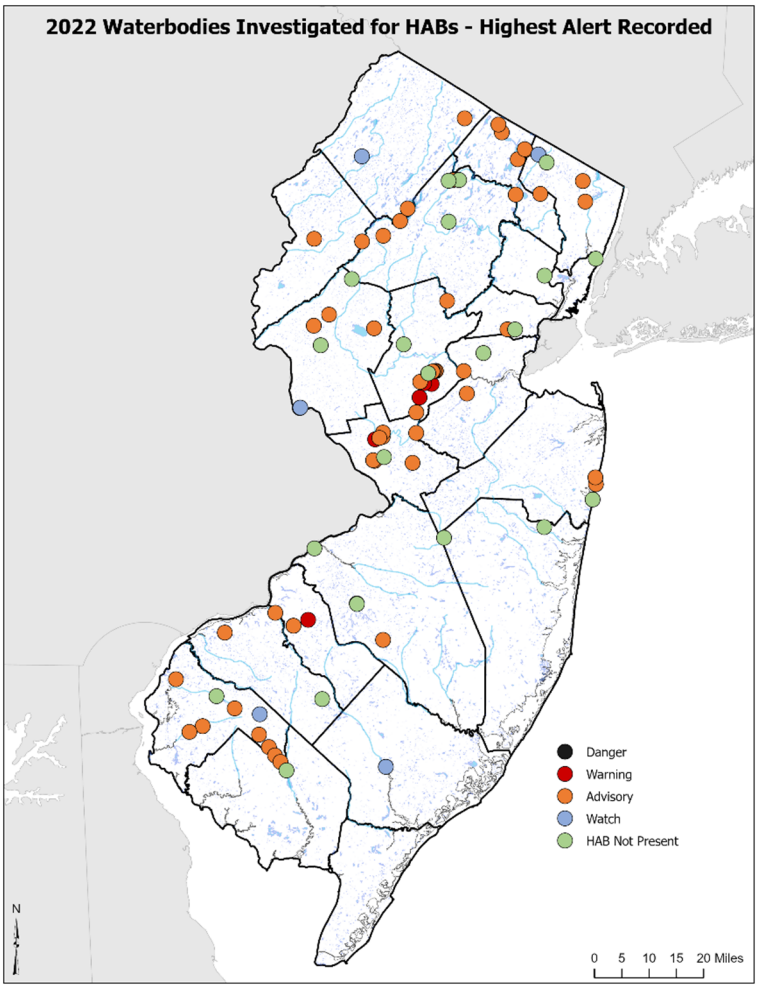


Figure 8. Map of 2022 Waterbodies Investigated.

Table 4 lists these waterbodies by county and municipality.

Waterbody name	Municipality	County	Highest Advisory Tier
Lake Lenape	Hamilton	Atlantic	Advisory
Haledon Reservor	Franklin Lakes	Bergen	Advisory
Pompton Lake	Oakland	Bergen	Advisory
Pompton River	Pompton Plains	Bergen	Advisory
Van Saun Mill Brook	Oradell	Bergen	Advisory
Woodcliff Lake Reservoir	Woodcliff Lake Borough	Bergen	Advisory
Darlington Lake	Mahwah	Bergen	HAB Not Present
MacMillan Reservoir	Ramapo	Bergen	Watch
Indian Mills Lake	Shamong	Burlingtion	Advisory
Pemberton Lake	Pemberton	Burlingtion	Advisory
Amico Island Pond	Delran	Burlingtion	HAB Not Present
Rancocas Creek trib	Medford	Burlingtion	HAB Not Present
Smithville Park Lake	Smithville	Burlingtion	Watch
Bellmawr Lake	Bellmawr	Camden	Advisory
Brookdale Echelon Lake	Voorhees	Camden	Warning
Pond at Timber Creek Dog Park	Gloucester Twp	Camden	Warning
Branch Brook Lake	Newark	Essex	HAB Not Present
Greenwich Lake	Greenwich	Gloucester	Advisory
Timber Lake	Monroe	Gloucester	HAB Not Present
James Braddock Park Pond	North Bergen	Hudson	HAB Not Present

Table 4. 2022 Waterbodies Investigated/ Highest Recorded Alert.

Waterbody name	Municipality	County	Highest Advisory Tier
Cushetunk Lake	Lebanon	Hunterdon	Advisory
Manny's Pond	Clinton	Hunterdon	Advisory
Old Canoe Pond	Lebanon	Hunterdon	Advisory
Spruce Run Reservoir	Clinton	Hunterdon	Advisory
Little Pond (Tetertown Reserve)	Lebanon	Hunterdon	HAB Not Present
Rodger's Pond	Franklin	Hunterdon	HAB Not Present
Arboretum pond	Lebanon	Hunterdon	Watch
Quarry Road Pond	Delaware Twp	Hunterdon	Watch
Carnegie Lake	Princeton	Mercer	Advisory
Green Turtle Lake	Hopewell	Mercer	Advisory
Honey Lake	Princeton	Mercer	Advisory
Lake Ceva	Ewing	Mercer	Advisory
Lake Sylva	Ewing	Mercer	Advisory
Mercer Lake	Hamilton	Mercer	Advisory
Rosedale Lake	Hopewell	Mercer	Advisory
Willow Lake	Hopewell	Mercer	Advisory
Centennial Lake	Ewing	Mercer	HAB Not Present
Curlis Lake	Pennington	Mercer	Warning

Figure 4 continued. 2022 Waterbodies Investigated/ Highest Recorded Alert

Waterbody name	Municipality	County	Highest Advisory Tier
D&R Canal	New Brunswick	Middlesex	Advisory
Farrington Lake	East Brunswick	Middlesex	Advisory
Raritan River	New Brunswick	Middlesex	Advisory
Dismal Swamp	Edison	Middlesex	HAB Not Present
Fletcher Lake	Asbury	Monmouth	Advisory
Manasquan Reservoir	Howell	Monmouth	Advisory
Sunset Lake	Asbury	Monmouth	Advisory
Lake Como	Belmar	Monmouth	HAB Not Present
Budd Lake	Mt. Olive	Morris	Advisory
Cozy Lake	Jefferson	Morris	Advisory
Carib Pond	Jefferson	Morris	HAB Not Present
Green Pond	Rockaway	Morris	HAB Not Present
Oakford Lake	New Egypt	Ocean	HAB Not Present
Ocean County Park Pond	Lakewood	Ocean	HAB Not Present
Erskine Lake	Ringwood	Passaic	Advisory
Greenwood Lake	West Milford	Passaic	Advisory
Skyline Lake	Wanaque	Passaic	Advisory
Upper Lake Erskine	Ringwood	Passaic	Advisory

Table 4 continued. 2022 Waterbodies Investigated/ Highest Recorded Alert

Waterbody name	Municipality	County	Highest Advisory Tier
Alloway Lake	Alloway	Salem	Advisory
Daretown Lake	Daretown	Salem	Advisory
Laurel Lake	Quinton	Salem	Advisory
Muddy Run	Vineland	Salem	Advisory
Palatine Lake	Pittsgrove	Salem	Advisory
Parvin Lake	Elmer	Salem	Advisory
Rainbow Lake	Vineland	Salem	Advisory
Unnamed Carney's Point	Pennsville	Salem	Advisory
East Lake	Pilesgrove	Salem	HAB Not Present
Maurice River	Vineland	Salem	HAB Not Present
Elmer Lake	Elmer	Salem	Watch
Branta Pond	Califon Boro	Somerset	Advisory
Duck Pond	Franklin	Somerset	Advisory
Fox Chase Pond	Hillsborough	Somerset	Advisory
Mettlers Pond	Franklin	Somerset	Advisory
Powder Mill Pond	Franklin	Somerset	Advisory
Spooky Brook Pond	Franklin	Somerset	Advisory
Unnamed Pond Vanderhaven Villa	Bridgewater	Somerset	HAB Not Present
Millstone River	Blackwells Mills	Somerset	Warning
Pembroke Pond	Hillsborough	Somerset	Warning
Highland Lakes	Vernon	Sussex	Advisory
Lake Hopatcong	Hopatocong	Sussex	Advisory
Lake Musconetcong	Stanhope	Sussex	Advisory
Swartswood Lake	Stillwater	Sussex	Watch
Middlesex Reservoir	Clark	Union	Advisory
Rahway River Park Lake	Rahway	Union	HAB Not Present
Mountain Lake	Liberty Twp	Warren	Advisory
Willow Creek	Hacketstown	Warren	Advisory

Table 4 continued. 2022 Waterbodies Investigated/ Highest Recorded Alert

Data and Alert Levels for all sites sampled can be found on the DEP HAB Interactive Map Reporting and Communication System.

Figure 9 shows the distribution of all sites and Alert levels in 2022.

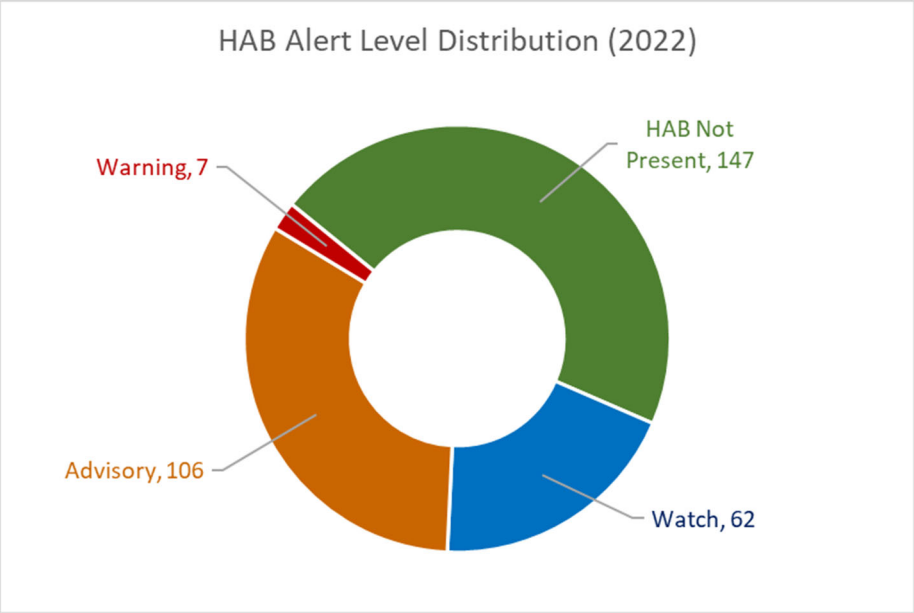


Figure 9. HAB Alert Distribution by Site.

Figure 10. HAB Event Summary by Waterbody

Figure 10 summarizes HAB events by waterbody since 2017.

Public Recreational Bathing Beaches (PRB) and Drinking Water Sources

2022 Beaches with in-season HAB closures (Memorial Day – Labor Day):

1. Bellmawr Lake
2. Cozy Lake
3. Awosting Beach (Greenwood Lake)
4. Crescent Cove Beach (Lake Hopatcong), Shore Hills Beach (Lake Hopatcong)
5. Lake Lenape

Recreational Bathing Beach Confirmation

When a HAB was confirmed at Advisory/Beach Closure levels at Public Recreational Bathing Beaches (PRB) during the operating season of Memorial Day – Labor Day, the NJ Department of Health, Youth Camps/PRB Project Coordinator was immediately notified. The NJDOH PRB Coordinator then notified the appropriate local authority of the closure Alert and ensured onsite notices were posted. BFBM, or with the assistance of local authorities, monitored the status conditions of the HAB at these PRBs. The Strategy protocol recommends monitoring the HAB status at PRBs until bloom conditions dissipate to below Advisory/ Beach Closure levels, at which time samples are collected for laboratory confirmation analysis. Guidance in the Strategy further states that PRB closures should not be lifted until:

- With no phycocyanin field measurements - two (2) subsequent lab analyses were below cell count and toxin thresholds, or
- If phycocyanin measurements approximated cell counts below beach closing thresholds for consecutive days, then only one laboratory analysis with cell count and toxin results below thresholds was necessary.

2022 Confirmed HABs at Recreational Waterbodies used as Drinking Water Sources*:

1. Spruce Run Reservoir
2. Manasquan Reservoir
3. Millstone River
4. Farrington Lake
5. Delaware and Raritan Canal
6. Woodcliff Lake
7. Raritan River

*Drinking Water Source Confirmation**

When a suspected HAB is reported at a possible drinking water source, BFBM immediately notifies the Division of Water Supply & Geoscience (DWSG) to confirm the location and possible use as a drinking source. If confirmed as a drinking water source, DWSG then informed the appropriate system operators who sampled their raw and finished water per their specific Cyanotoxin Management Plan. **This report summarizes drinking water sources investigated by BFBM that are also open to the public for recreation. Water suppliers may conduct their own investigations which are not reflected in this report.**

*The Advisories addressed in the document are for recreational public bathing beaches or sources of untreated drinking water and are not to be used to interpret the safety of finished drinking water. The Department and the United State Environmental Protection Agency have established guidance levels and Health Advisory levels with respect to cyanotoxin detections in finished treated drinking water. The DWSG has a guidance document on when to issue public notification based on these levels.

Laboratory Cell Count and Toxin Results

In 2022, laboratory analysis was consistent with the high number of reports investigated. There was a significant increase in toxin analysis in 2022 due to the high number of confirmed HABs with microcystins over the 2.0 µg/l. When microcystins are present above 2.0 µg/l, it is protocol to analyze for the other toxins as their likelihood of being present increases. Intensive surveys performed at Lake Hopatcong and Greenwood Lake in 2019 greatly increased the analysis performed that year. The higher numbers in 2017 and 2018 are due to samples collected at routine Ambient Lake Monitoring Network sites to develop toxin analysis capacity. Because routine lake sampling does not target active HABs, results were nearly all non- detect, or very low detection, unless a HAB was occurring at the time of sampling. Beginning in 2020, toxin sampling at Ambient Lake Monitoring Network sites was not performed unless an active HAB was visually observed or measured by field meters. As of 2020, analysis was focused strictly on response sampling. Therefore, toxin analysis in 2017-2019 was biased high compared to the number of sites investigated. (Figure 11)

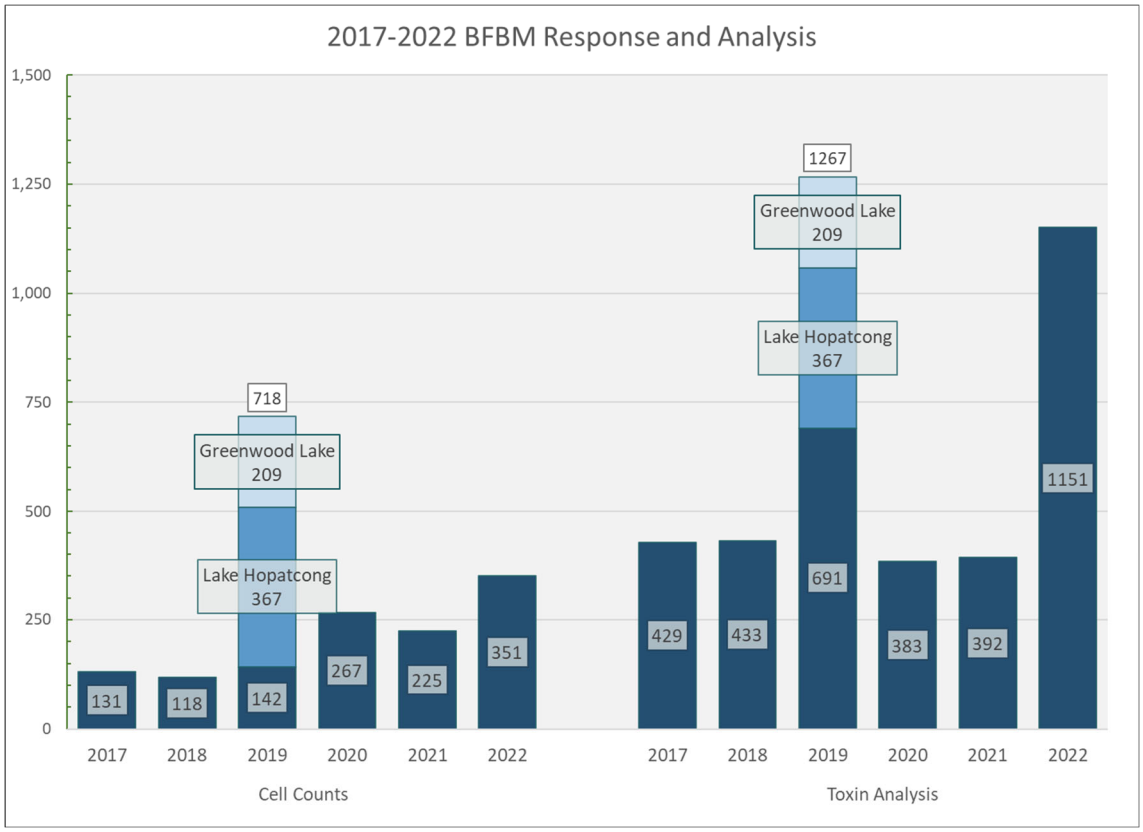


Figure 11. 2017 – 2022 HAB Analysis Summary.

Figure 12 summarizes the maximum cell count density at any given waterbody investigated during the 2022 and 2021 seasons. In 2022, the majority (81%) of waterbodies with confirmed HABs had a peak cell count greater than 80,000 cells/ml, placing it in the Advisory Alert or higher category; an increase from 2021. 19% of waterbodies with confirmed HABs had a peak alert in the Watch category between 20,000 and 80,000 cells/ ml. An internal action level of 40,000 to 80,000 cells/ml initiates additional monitoring at bathing beaches only. This is to ensure the levels do not exceed the bathing beach closure threshold of 80,000 cells/ ml and the proper Alert level is in place to protect bathers.

The highest recorded cell concentration, 51,000,000 cells/ml, was at Manasquan Reservoir, Monmouth County, while Pembroke Pond, Somerset County recorded the highest microcystins toxin result (Figure 12) of 622 µg/L.

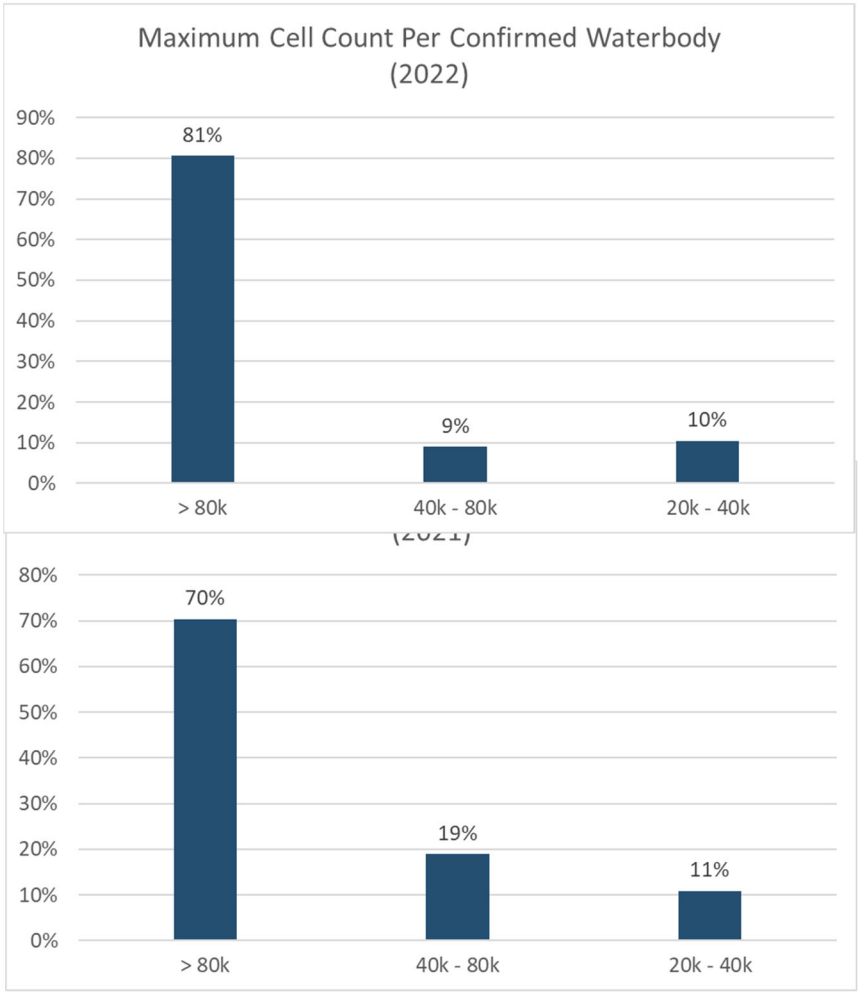


Figure 12 Maximum Cell Count by Waterbody 2022 & 2021.

The majority of peak microcystins concentration at waterbodies with confirmed HABs, 40%, were between the analysis Reporting Level (RL) of 0.15 µg/L and the Advisory Alert threshold of 2.0 µg/L. 48% were in the Advisory Alert category and 13% in the Warning Alert category. This is a significant increase in high toxin occurrence from 2021 and previous years. (Figure 13) There were no results above recreational thresholds for cylindrospermopsin and anatoxin-a. Saxitoxin exceeded the 0.60 µg/L threshold at four water bod000000ies: Pemberton Lake (1.23 µg/L), Brookdale Echelon Lake (1.21 µg/L) , Fletcher Lake (1.11 µg/L), and Woodcliff Lake Reservoir (0.67 µg/L). Each of these waterbodies were among the highest recorded cell counts in 2022. Pemberton Lake and Brookdale Echelon Lake exceeded the microcystins threshold as well. Table 5 lists the waterbodies with the highest microcystins and cell count concentrations.

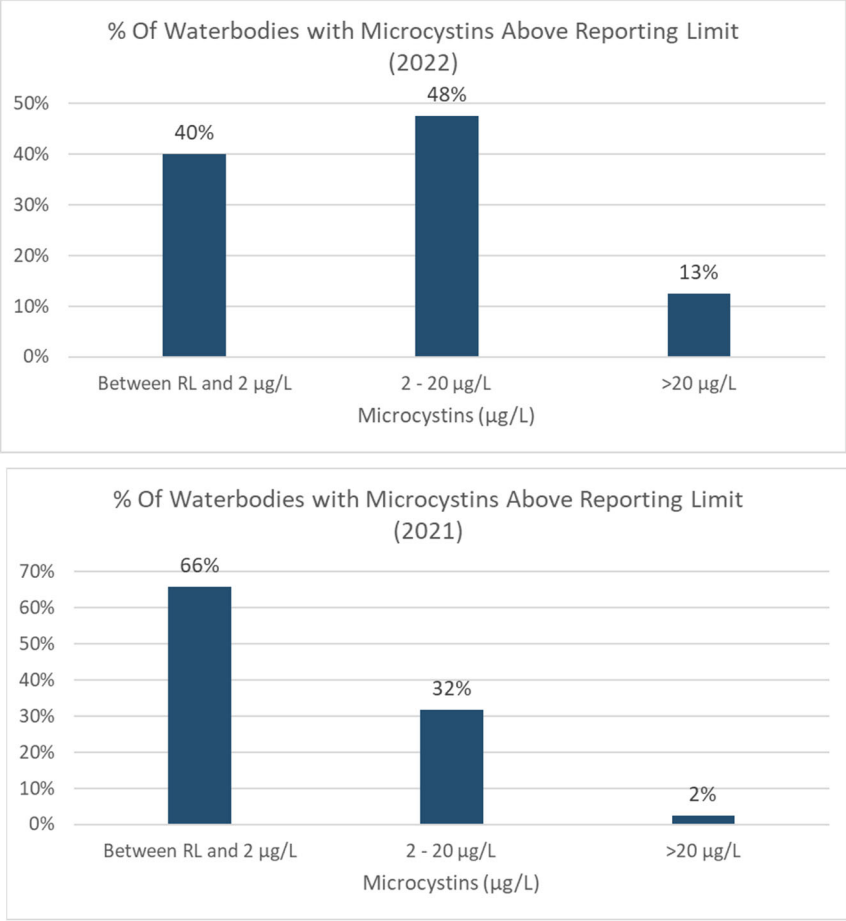


Figure 13. Maximum Toxin Level by Waterbody 2022 & 2021

2022 Microcystins Above Threshold (Highest To Lowest)					
Waterbody name	Cell Count cells/ml	Total Cyano Genera	Predominant Taxa	Microcystins µg/l	Site Visit Date and Time
Pembroke Pond	1600000	1	Microcystis	622	11/15/2022, 11:57 AM
Millstone River at Griggstown	9210000	3	Microcystis	417	7/21/2022, 12:28 PM
Brookdale Echelon Lake	23392500	2	Dolichospermum	364.4	7/28/2022, 8:35 AM
Pond at Timber Creek Dog Park	249750	2	Microcystis	161.5	9/14/2022, 2:49 PM
Curlis Lake	310000	3	Microcystis	88.02	6/21/2022, 11:46 AM
Millstone River at Co Rt 518	0	3	Microcystis	50.2	7/21/2022, 10:09 AM
Millstone River at Blackwells Mill	73750	3	Microcystis	32.94	7/21/2022, 12:49 PM
Spruce Run Reservoir	546250	6	Dolichospermum	19.68	6/13/2022, 8:45 AM
Cushetunk Lake	610000	2	Microcystis	16.42	8/30/2022, 8:38 AM
Raritan River	11750	1	Phormidium	15.82	7/27/2022, 1:37 PM
Alloway Lake	36848750	3	Aphanizomenon	9.235	6/23/2022, 9:07 AM
Greenwood Lake	160500	8	Phormidium	9.18	8/24/2022, 9:26 AM
Pemberton Lake	2109500	8	Microcystis	8.04	6/27/2022, 7:30 AM
Millstone River	67000	3	Microcystis	7.48	8/3/2022, 12:38 PM
Rosedale Lake	766250	3	Other	7.45	6/8/2022, 10:36 AM
Lake Sylva	7292500	3	Microcystis	6.99	7/8/2022, 9:23 AM
Pembroke Pond	962750	3	Microcystis	6.9	8/5/2022, 8:44 AM
Spruce Run Reservoir	109250	4	Microcystis	6.806	6/13/2022, 9:30 AM
Carnegie Lake	900250	8	Microcystis	6.64	7/21/2022, 11:38 AM
Budd Lake	1479250	7	Microcystis	6.292	6/14/2022, 12:04 PM
Van Saun Mill Brook	20500	1	Microcystis	5.364	6/1/2022, 9:16 AM
Lake Ceva	4287500	4	Microcystis	5.36	7/8/2022, 9:40 AM
Greenwood Lake	103750	6	Planktothrix/Phormidium	5.2	9/6/2022, 11:24 AM
Millstone River	226500	3	Phormidium	4.89	8/10/2022, 10:47 AM
Timber Creek Park Pond	20000	3	Microcystis	4.54	10/27/2022, 8:19 AM
Spruce Run Reservoir	1812500	6	Lyngbya	4.52	8/29/2022, 10:15 AM
Spooky Brook Pond	2097750	6	Microcystis	4.006	8/10/2022, 9:07 AM
Honey Lake	891750	7	Microcystis	3.93	7/28/2022, 1:39 PM
Laurel Lake	77750	1	Dolichospermum	3.9	7/26/2022, 10:14 AM
Van Saun Mill Brook	18000	1	Microcystis	3.447	6/1/2022, 9:02 AM
Mercer Lake	310000	2	Dolichospermum	2.88	8/16/2022, 8:20 AM
Greenwood Lake	160750	7	Other	2.755	8/2/2022, 10:44 AM
Mercer Lake	1067500	2	Dolichospermum	2.58	8/16/2022, 7:45 AM
Rosedale Lake	0	0	null	2.548	6/13/2022, 2:44 PM
Fox Chase Pond	1794250	3	Phormidium	2.51	7/29/2022, 12:05 PM
Greenwood Lake	86875	6	Planktothrix/Phormidium	2.5	10/6/2022, 9:15 AM
Mountain Lake	54500	4	Jaaginema	2.42	4/18/2022, 11:00 AM
Mountain Lake	77250	4	Other	2.118	5/16/2022, 10:00 AM
Mountain Lake	32000	4	Jaaginema	2.1	4/18/2022, 10:20 AM
Budd Lake	144750	3	Microcystis	2.096	7/20/2022, 8:49 AM

Table 5. Maximum Toxin and Cell Count by Waterbody

2022 Highest Cell Counts (> 1 million cells/ml)					
Waterbody name	**Cell Count cells/ml**	**Total Cyano Genera**	**Predominat Taxa**	**Microcystins µg/L**	**Site Visit Date and Time**
Manasquan Reservoir	51000000	3	Dolichospermum	1.36	10/25/2022, 10:48 AM
Alloway Lake	36848750	3	Aphanizomenon	9.235	6/23/2022, 9:07 AM
Brookdale Echelon Lake	23392500	2	Dolichospermum	364.4	7/28/2022, 8:35 AM
Millstone River at Griggstown	9210000	3	Microcystis	417	7/21/2022, 12:28 PM
Lake Sylva	7292500	3	Microcystis	6.99	7/8/2022, 9:23 AM
Woodcliff Lake Reservoir	4700000	5	Planktothrix	1.581	8/17/2022, 11:01 AM
Lake Ceva	4287500	4	Microcystis	5.36	7/8/2022, 9:40 AM
Erskine Lake	2875000	1	Aphanizomenon	0.118	11/18/2022, 10:48 AM
Fletcher Lake	2762050	12	Other	0.15	7/27/2022, 8:26 AM
Manasquan Reservoir	2250000	3	Dolichospermum	0.32	10/25/2022, 11:07 AM
Lake Hopatcong	2112250	3	Cylindrospermopsis	0.34	8/11/2022, 10:08 AM
Pemberton Lake	2109500	8	Microcystis	8.04	6/27/2022, 7:30 AM
Spooky Brook Pond	2097750	6	Microcystis	4.006	8/10/2022, 9:07 AM
Spruce Run Reservoir	1812500	6	Lyngbya	4.52	8/29/2022, 10:15 AM
Fox Chase Pond	1794250	3	Phormidium	2.51	7/29/2022, 12:05 PM
Pembroke Pond	1600000	1	Microcystis	622	11/15/2022, 11:57 AM
Highland Lakes	1554750	7	Dolichospermum	0.23	8/12/2022, 9:03 AM
Budd Lake	1479250	7	Microcystis	6.292	6/14/2022, 12:04 PM
Rosedale Lake	1400750	3	Dolichospermum	0.84	7/11/2022, 1:15 PM
Mercer Lake	1067500	2	Dolichospermum	2.58	8/16/2022, 7:45 AM
Mettlers Pond	1008800	9	Aphanocapsa	0.238	8/10/2022, 9:29 AM
Parvin Lake	1007500	1	Aphanizomenon/Cuspidothrix	0.068	9/27/2022, 1:59 PM

Table 5 continued. Maximum Toxin and Cell Count by Waterbody

During the 2022 season, 72.5% of multispecies blooms with microcystins (MC) concentrations >2.0 µg/L (29 of 40 samples) contained Microcystis sp. Although Microcystis sp. was present in these samples, data indicates that it was the dominant cyanobacteria taxa in only 21 samples, or about half. Maximum MC concentration from Pembroke Lake in Nov. 2022 was 622 µg/L (highest recorded in 2022) and was associated with a Microcystis sp. only bloom (1,600,000 cells/mL).

Aphanizomenon sp. (6 sites), *Dolichospermum sp*. (17 sites), *Lyngbya* sp. (6 sites), and *Woronichnia sp* (15 sites) were the most frequently observed potentially toxigenic (PTOX) cyanobacteria taxa associated with the *Microcystis sp.* in the majority of multispecies blooms with microcystins above 2.0 µg/L. (Table 6) These taxa, in addition to the *Microcystis sp.,* are often associated with the production of microcystins.

Sample Date	Waterbody Name	Cell density (cells/mL) of all cyanobacteria taxa observed w/in hemocytometer counting grid	*Aphanizomenon sp.	*Aphanocapsa sp.	*Chroococcus sp.	Cuspidothrix sp.	*Dolichospermum spp.	*Lyngbya sp.	*Merismopedia sp.	*Microcystis sp.	*Oscillatoria sp.	*Planktothrix sp.	*Pseudanabaena sp.	*Raphidiopsis sp.	*Snowella sp.	Unknown filament	Unknown colonial	*Woronichinia sp.	MC (µg/l)
11/15/2022, 11:57 AM	Pembroke Pond	1600000		+		+				+							+		622
7/21/2022, 12:28 PM	Millstone River (Griggstown)	9210000				+	+			+			+						417
7/28/2022, 8:35 AM	Brookdale Echelon Lake	23392500								+									364.4
9/14/2022, 2:49 PM	Pond at Timber Creek Dog Park	249750				+	+			+									161.5
6/21/2022, 11:46 AM	Curlis Lake	310000	+				+	+		+								+	88.02
6/13/2022, 8:45 AM	Spruce Run Reservoir	546250								+								+	19.68
8/30/2022, 8:38 AM	Cushetunk Lake	610000					+			+			+			+			16.42
7/27/2022, 1:37 PM	Raritan River	11750	+							+								+	15.82
6/23/2022, 9:07 AM	Alloway Lake	36848750	+				+			+								+	9.235
8/24/2022, 9:26 AM	Greenwood Lake (Awosting Bea	160500	+				+			+									9.18
6/27/2022, 7:30 AM	Pemberton Lake	2109500					+	+		+					+			+	8.04
6/8/2022, 10:36 AM	Rosedale Lake	766250					+	+		+								+	7.45
7/8/2022, 9:23 AM	Lake Sylva	7292500	+				+	+		+								+	6.99
7/21/2022, 11:38 AM	Carnegie Lake	900250				+	+			+									6.64
6/14/2022, 12:04 PM	Budd Lake	1479250					+		+				+	+					6.292
6/1/2022, 9:16 AM	Van Saun Mill Brook	20500					+	+		+								+	5.364
7/8/2022, 9:40 AM	Lake Ceva	4287500			+		+		+	+								+	5.36
10/27/2022, 8:19 AM	Timber Creek Park Pond	20000				+	+			+		+						+	4.54
8/10/2022, 9:07 AM	Spooky Brook Pond	2097750					+			+								+	4.006
7/28/2022, 1:39 PM	Honey Lake	891750					+				+		+			+			3.93
7/26/2022, 10:14 AM	Laurel Lake	77750					+	+				+						+	3.9
8/16/2022, 8:20 AM	Mercer Lake	310000	+							+								+	2.88
7/29/2022, 12:05 PM	Fox Chase Pond	1794250								+								+	2.51
4/18/2022, 11:00 AM	Mountain Lake	54500								+								+	2.42

Cyanobacterial taxa observed anywhere on the face of the hemocytometer were recorded as present (+). Cells highlighted green indicate the most dominant taxa observed within the counting grid on the hemocytometer face. "*" indicate taxa associated with the potential to produce microcystins.

Table 6. Dominant taxa in samples with high microcystins

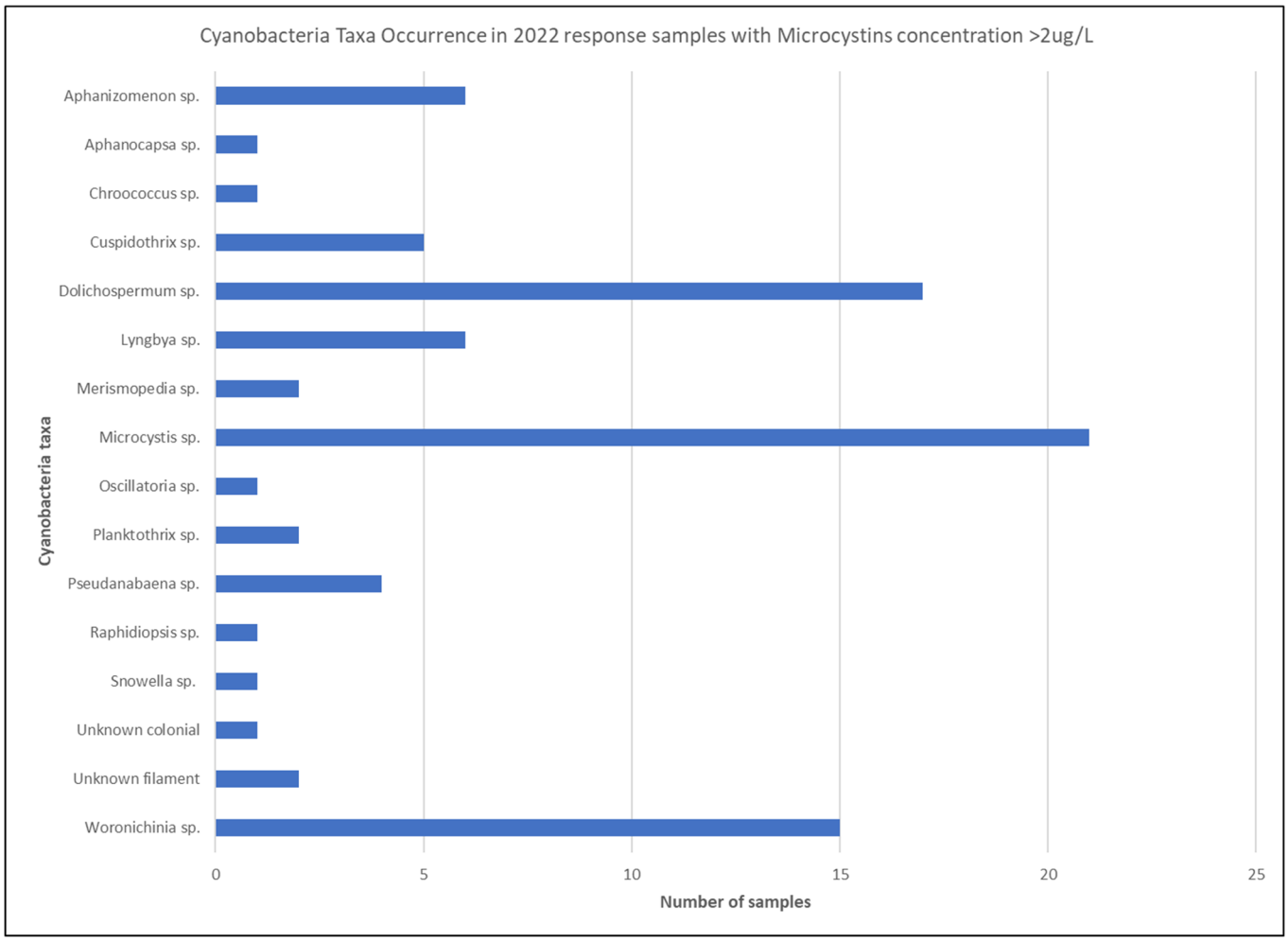


Figure 14. Number of Samples Cyanobacterial with microcystins (MC) concentrations >2.0 µg/L In Which a Specific Taxa Occur in 2022

All samples were analyzed for microcystins. When micocystins results were above 2.0 µg/L, some samples were analyzed for the three other toxins if a waterbody had a significant recreational health risk and/ or cell concentrations was above 150,000 cells/ml. The toxins and their respective NJ recreational guidance thresholds are: anatoxin-a (15 µg/L), cylindrospermopsin (5 µg/L), and saxitoxin (0.6 µg/L). Anatoxin-a and cylindrospermopsin were detected at or above the lower detection limits of the tests in some samples, but none approached their recreational guidance threshold. Only Saxitoxin exceeded the 0.60 µg/L threshold at four waterbodies. An internal literature review was performed to determine taxa with the potential to produce each toxin.

- Anatoxin-a (ATX) was detected in 31.8 % of these samples. *Dolichospermum* sp., *Microcystis sp.*, and *Woronichnia sp*. were associated with some of these blooms. All of these are known anatoxin-a producers.
- Cylindrospermopsin (CYL) was detected in 11.9 % of these samples. *Dolichospermum* sp., *Microcystis sp.,* and *Woronichnia sp*. were associated with some of these blooms. Of these, only *Dolichospermum sp*. is a known cylindrospermopsin producer.
- Saxitoxin (STX) was detected in 22.7 % of these samples. *Aphanizomenon sp.*, *Cuspidothrix sp., Dolichospermum* sp., *Microcystis sp*., and *Woronichnia sp*. are associated with some of these blooms. Other than *Woronichnia sp*., these are all known saxitoxin producers.

Figure 15. Examples of potential toxin producing cyanobacteria observed in samples with microcystins > 2.0 µg/L

Supporting Programs

As part of HAB response and monitoring, BFBM partners with several DEP and external partners.

DEP's Division of Water Enforcement (C&E) aided in response screening and sampling.

The State Park Service is also a significant partner providing assistance with response screening and sampling as well as posting Alerts when needed and monitoring the daily status of Park waterbodies.

NJ Forest Fire Service perform flight (Figure 16) surveillance at several larger Northern NJ lakes of concern. Visual observations are recorded as well as remote sensing of phycocyanin pigment. DWMSPC Bureau of Marine Water Monitoring developed a customized algorithm that can reliably detect and estimate phycocyanin concentrations in freshwaters through wavelength reflectance signatures. These measurements are not used as a replacement for confirmation analysis, but as a screening and status monitoring tool to detect relative increases and decreases in phycocyanin pigment concentrations. When levels change significantly i.e., indicate a change in Alert status, sampling staff are deployed for confirmation laboratory analysis. As an enhancement in 2022, flight data was made available to the public at: [NJDEP New Jersey Department of Environmental Protection - Algal Bloom Remote Sensing (rutgers.edu)]

Figure 16. Forest Fire Service

Flights were performed once per week during the recreational season at the following lakes (weather permitting):

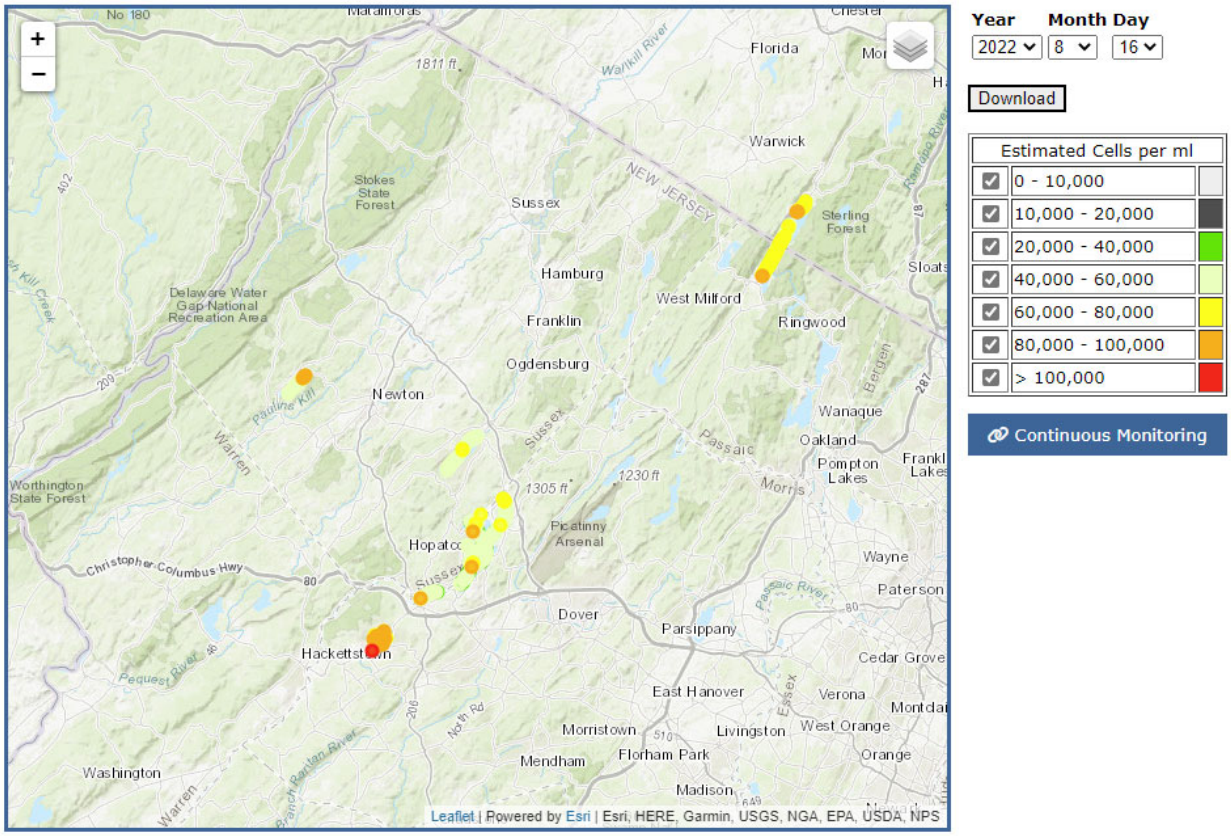


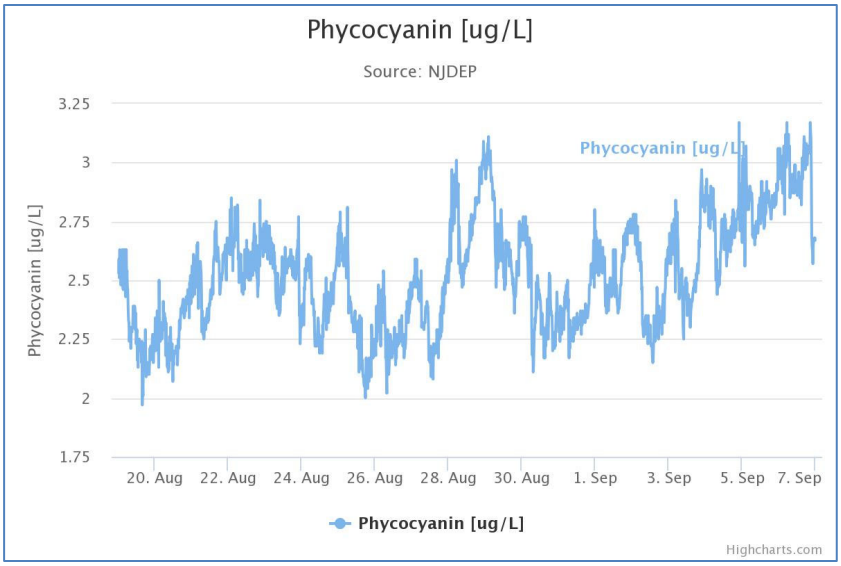
Figure 17. Examples of flight data.

Lake Hopatcong, Greenwood Lake, Musconetcong Lake, Budd Lake, Spruce Run Reservoir, Lake Mohawk, Swartswood Lake, and Round Valley Reservoir (non-HAB control lake). Other lakes were added as needed. Figure 17 shows examples of the flight data.

The Bureau of Marine Water Monitoring has also assisted in developing a program using buoys equipped with continuous monitoring meters and real-time telemetry technology (Figure 18). Eleven (11) buoys were deployed at select waterbodies. The sites were chosen due to recreational and/or drinking water significance, repeated HAB occurrence, duration, and previous elevated levels of HABs at these waterbodies. The waterbodies had one or more remote monitoring devices to provide best feasible coverage for HAB status monitoring & response:
Lake Hopatcong – 4 meters
Spruce Run Reservoir– 1 meter
Swartswood Lake – 2 meters
Budd Lake – 1 meter
Greenwood Lake – 1 meter
Greenwich Lake – 1 meter
Daretown Lake – 1 meter

Figure 18. Real-Time Continuous Buoy Program

These meters also measure other water quality parameters such as temperature, dissolved oxygen, and pH. As with phycocyanin measurements previously mentioned, this data is used for screening and status monitoring. Water quality data may be used to assess factors that may contribute to or characterize HAB production. Data can be downloaded or viewed in real time at the NJDEP DWM&S Continuous Data Monitoring Program website. Figure 19 shows an example of a downloadable graph with phycocyanin measurements at Greenwood Lake.



Cells per ml	Meter
20000	1.15
40000	1.87
80000	3.29
100000	4.00

Figure 19. Example Real-Time Continuous Data Download

The program will continue in 2023. Based on data collected in 2022, buoys may be deployed at other waterbodies.

A field phycocyanin meter loan program was implemented in 2020 and expanded in 2022 from 12 to 40 meters respectively. Meters were loaned to various internal and external partners:

- 10 -Water systems: AC MUA, North Brunswick WTP, Newton Twp, NJWSA (2), Sussex Borough Water, New Brunswick WA, City of Newark, Butler, NJ American North
- 5 -County/ local HDs: Sussex Co, Monmouth Co, Salem Co, Burlington Co, Hopatcong City Hall
- 2 -County/Local parks: Mercer Co, Hunterdon
- 7 -DEP Parks: North, Central, South, Swartswood, Wawayanda, Spruce Run (2)
- 5 -DEP C&E
- 12 – Commissions and Lake Associations: Greenwood Lake Commission (2), Mountain Lake, Watershed Institute (3), Lake Hopatcong Foundation (2), Lake Owassa, Cranberry Lake, Branta Lake, Lake Hopatcong Commission

These partners played a significant role in screening, status monitoring, and sampling. Partners contributed to approximately 26% of all samples collected for lab analysis in 2022.

Conclusions

In 2022, there was a 62% increase in reports of suspected HABs from 2021. This translated into a significant increase in the number of waterbodies with confirmed HABs (Watch Alert or above) by 85%. Data shows the statewide occurrence of HABs in New Jersey has increased, and are recurring in many waterbodies, since 2017 when the DEP initiated monitoring per the Response Strategy. 50% of waterbodies with confirmed HABs in 2022, had confirmed HABs in a previous year since HAB response was initiated in 2017 (Table 7).

CONFIRMED 2022 WATERBODIES FROM PRIOR YEARS						
Waterbody Name	2017	2018	2019	2020	2021	2022
Alloway Lake				X		X
Bellmawr Lake					X	X
Branta Pond					X	X
Budd Lake	X	X	X	X	X	X
Canoe Pond					X	X
Ceva Lake	X		X		X	X
Cozy Lake				X		X
Daretown Lake			X	X		X
Duck Pond		X				X
Elmer Lake			X			X
Farrington Lake				X	X	X
Greenwich Lake				X		X
Greenwood Lake			X	X	X	X
Haledon Reservoir				X		X
Lake Hopatcong			X	X	X	X
Lake Musconetcong			X	X	X	X
Lake Sylvia	X		X		X	X
Little Pond					X	X
Manasquan Reservoir			X	X	X	X
Manny's Pond	X	X	X		X	X
Mountain Lake			X	X	X	X
Pemberton Lake	X		X	X	X	X
Pompton Lake				X		X
Pompton River	X					X
Quarry Pond				X		X
Ramapo River				X		X
Rosedale Lake			X	X	X	X
Smithville Lake					X	X
Spruce Run Reservoir			X	X	X	X
Sunset Lake			X	X		X
Swartswood Lake	X	X	X	X	X	X
Van Saun Mill Brook					X	X
Woodcliff Lake Reservoir				X	X	X

Table 7. 2021 2022 Confirmed HAB Waterbodies with Previous HABS

Continued evidence of significant HAB activity is the persistence of blooms into the winter. Sampling and confirmation analysis for 2022 was completed in December and there were 16 waterbodies with at least one site with a HAB Alert level of Watch or above (Table 8). This is an increase from 12 waterbodies in 2021 and the highest number to date. A Winter Watch Alert was recommended for the 2022/2023 winter season at these waterbodies.

2022 HABs Not Dissipated By The End Of The Year (Minimum 1 Site/ Waterbody)		
Waterbody Name	**Alert Tier**	**County**
Budd Lake	Watch	Morris
Duck Pond	Advisory	Somerset
Fletcher Lake	Advisory	Monmouth
Greenwood Lake	Watch	Passaic
Lake Hopatcong	Watch	Sussex
Manasquan Reservoir	Watch	Monmouth
Mettlers Pond	Advisory	Somerset
Mountain Lake	Watch	Warren
Pemberton Lake	Advisory	Burlington
Pembroke Pond	Warning	Somerset
Skyline Lake	Advisory	Passaic
Smithville Lake	Watch	Burlington
Spooky Brook Pond	Advisory	Somerset
Sunset Lake	Advisory	Monmouth
Timber Creek Park Pond	Advisory	Gloucester
Willow Pond	Watch	Warren

Table 8. 2022 HABs Not Dissipated by End of Year

In previous years, cell concentrations above recreational guidance thresholds were the main reason for Alert postings. In 2021 only 34% of waterbodies with confirmed HABs had microcystin toxins above the recreational guidance threshold of 2.0 µg/L. In 2022, this percentage increased to 66% with the majority of confirmed HABs also having toxins above thresholds. These toxin levels are usually associated with multispecies blooms where *Microcysts sp* is present or dominant. Of the other toxins, only Saxitoxin exceeded the 0.60 µg/L threshold at four water bodies. Multi-species blooms (especially those containing *Aphanizomenon sp., Cuspidothrix sp., Dolichospermum* sp., *Microcystis sp*., and *Woronichnia sp.*) were present in samples where other toxins were detected by laboratory analysis. Therefore, it is recommended that the complete suite of toxins with recreational guidance thresholds in New Jersey be analyzed when these taxa are present in a sample.

The USEPA states (https://www.epa.gov/cyanoHABs/causes-cyanoHABs): "There is widespread agreement within the scientific community that the incidence of HABs is increasing both in the U.S. and worldwide. This recent increase in the occurrence of HABs has been attributed to increasing anthropogenic activities and their interaction with factors known to contribute to the growth of cyanobacterial blooms. Point sources (which may include discharges from municipal and industrial wastewater treatment plants, concentrated animal feeding operations (CAFOs), Municipal Separate Storm Sewer Systems (MS4s), stormwater associated with industrial activity, and other and non-point sources (which may include diffuse runoff from agricultural fields, roads and stormwater), may be high in nitrogen and phosphorus and can promote or cause excessive fertilization (eutrophication) of both flowing and non-flowing waters."

The expansion of the continuous buoy network provides valuable data at waterbodies where HABs have reoccurred. In addition to informing immediate HAB response actions, continuous data will be used by DEP to research water quality factors that may predict or contribute to HAB formation.

The Division of Water Monitoring, Standards and Pesticide Control (DWMSPC) and the New Jersey Sea Grant Consortium (NJSGC) has recruited a team of lakes management and cyanobacterial HAB experts to address the second component of the Governor's HAB initiative, focusing on enhancing scientific expertise and building the state's capacity for HAB response. The HAB Expert Team's primary objective is to provide guidance to DEP on HAB prevention, mitigation and management for NJ lakes and other waterbodies. The team has complete a comprehensive literature review on the prevention and treatment of HABs and summarized this review in a Resource Guide available here: NJDEP | Harmful Algal Blooms | ET Resources. They have reviewed HAB and water quality data and provided recommendations, many of which have been incorporated into the HAB response program. Guidance documents for lake management in New Jersey and in final development and are anticipated to be available in 2023 and will include best management practices (BMPs) for the prevention and management of HABs to be used by NJ lake managers.

The team also provides technical advice and reviews on proposed mitigation technologies for NJ lakes and review the progress of DEP-funded HAB mitigation grant projects. Additionally, the team will develop a HAB lake management training program for DEP staff and interested stakeholders and conduct a minimum of three one-day training workshops at various locations in the state. This training is expected concurrent to the release of the Guidance Document in 2023.