Department of Environmental Conservation

Harmful Algal Bloom (HAB) Roadmap

A FIVE-YEAR PLAN TO STUDY, MANAGE, AND REDUCE HABS IN NEW YORK STATE

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List of Abbreviations and Acronyms

604(b) ..... Clean Water Act Section 604(b) Water Quality Planning Grants

9E PLAN .. Nine Element Watershed Management Plan

ACWA ..... Association of Clean Water Administrators

ARP..... Advanced Restoration Plan

CALM..... Consolidated Assessment and Listing Methodology

CWA..... Clean Water Act

DEC..... New York State Department of Environmental Conservation

DOW..... Division of Water, Department of Environmental Conservation

GVs..... Guidance Values

HAB ..... Harmful Algal Bloom

NYHABS .. New York Harmful Algal Bloom System

NYSAGM.. New York State Department of Agriculture and Markets

NYSDOH .. New York State Department of Health

NYSDOS .. New York State Department of State

TMDL ..... Total Maximum Daily Load

USGS ..... United States Geological Survey

USEPA..... United States Environmental Protection Agency

WQS..... Water Quality Standards

WQX..... Water Quality Exchange

Table of Contents

Table of Figures and Tables

HAB Roadmap for New York State Department of Environmental Conservation

> Roadmap Goal Statement: Reduce the frequency, extent, and overall risk to public health and recreation from HABs in New York State through monitoring and assessment, research, education and outreach, watershed management, point and nonpoint pollution source controls, and in-waterbody mitigation.

Purpose and Overview

Harmful algal blooms (HABs) in freshwater systems generally consist of cyanobacteria, which have existed for billions of years and are naturally present in low numbers in surface waters. Certain environmental conditions can contribute to accumulations of these microscopic organisms and become HABs. HABs pose a risk to human and animal health and can impact recreation, aquatic life, and cause aesthetic and economic issues. HABs can produce scum, discolored water, or floating mats that are visible in open water or along the shoreline and while some HABs produce toxins, some do not. The conditions that drive the formation of HABs may be unique to individual waterbodies, regions, or ecosystems. For these reasons, DEC developed this comprehensive approach that incorporates monitoring, research, outreach, planning, nutrient controls, and mitigation considerations to lessen the impact of HABs.

In recent decades, nutrients, biological and physical factors, as well as increasing temperatures from climate change, have contributed to increases in documented HABs in the United States and across the world. Between 2012 and 2020, the New York State Department of Environmental Conservation (DEC) documented reports of freshwater HABs in more than 450 waterbodies across New York State (NYS) (Gorney et al. 2023; see Figure 1). Each year, HABs are confirmed in new waterbodies by DEC's Division of Water (DOW).

In response to the increasing number of reported HABs and the growing need to provide a resource for clear and efficient communication of HAB occurrences, the New York Harmful Algal Bloom System (NYHABS) was established in 2019. NYHABS is one of the most comprehensive monitoring and reporting programs in the nation and provides a resource for drinking water operators, beach managers, and the public to quickly access information regarding HAB occurrences throughout NYS.

DEC works closely with other State agencies such as the NYS Department of Health (NYSDOH), which maintains important HAB resources on their website. In response to the growing impact of HABs in the state, DEC, in collaboration with NYSDOH and the NYS Department of Agriculture and Markets (NYSAGM), launched a HAB initiative that led to the following proposals:

- Development of HAB Action Plans for 13 key waterbodies impacted by HABs
- Initiation of several HAB mitigation studies
- Applied research directed to help understand and develop strategies to address HABs.

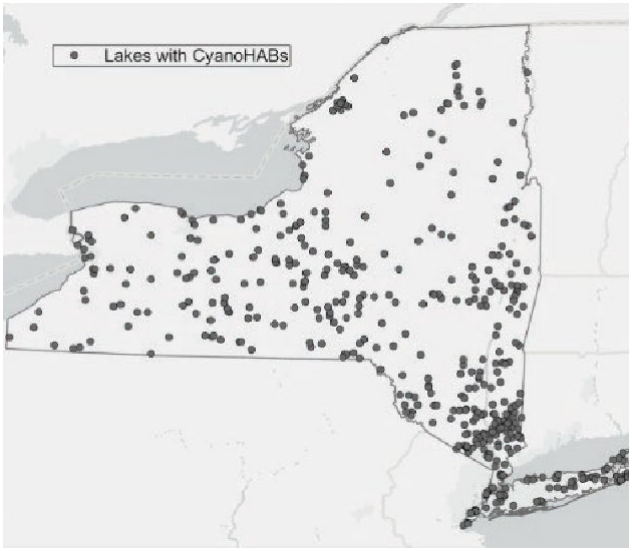
DEC currently offers competitive water quality improvement funding for projects supporting HAB Action Plans and other Clean Water Planning efforts.[1] DEC continues to direct funding through programs such as the Water Quality Improvement Project (WQIP) and the Non-Agricultural Nonpoint Source Planning and MS4 Mapping Grant (NPG) to reduce nutrient pollution across a spectrum of waters in NYS. Directed by the HABs Research Guide and the current understanding of HAB causes, NYS has committed $614 million for nutrient-reduction projects that address a root cause of HABs and $14 million to support research to better understand algal blooms.

HABs present unique management challenges due to their wide-ranging human health, recreational, economic, and environmental health impacts. Factors such as the varying duration of algal blooms and the lack of regulatory thresholds specific to NYS ambient waters complicate assessment, permitting, and management decisions. While HABs are often driven by excessive nutrients, they also occur in low-nutrient waterbodies. Therefore, it may not be feasible to address all causes of algal blooms with existing water quality protection and restoration tools. While watershed protection and nutrient reduction remain a priority for all waters experiencing HABs, additional tools are needed.

Although significant progress has been made in understanding and managing HABs and their causes and impacts, a deliberate plan is needed to guide DEC in its mission to reduce HAB occurrences. This roadmap provides that guide.

[1] For DEC grant funding opportunities, see www.dec.ny.gov/get-involved/grant-applications

Figure 1. NYS lakes with confirmed HABs, 2012-2020.



The map above was produced by Gorney et al. (2023). Researchers examined the frequency, intensity, and duration of HABs across NYS from 2012–2020. The map displays locations of waterbodies with HABs that were confirmed by DEC staff either visually or through analysis of water chemistry during the study period.

Approach

This strategic roadmap for NYS provides a coordinated, science-based approach that sets priorities, fills data gaps, and guides the development of new tools and management strategies. The roadmap focuses on understanding and addressing the drivers of HABs, impacts to public health and recreation, and development of short- and long-term solutions. By clearly defining its approach to addressing HABs, DEC will build upon and refine current efforts and continue to make nation-leading investments in watershed-scale nonpoint source management activities, improvements to clean water infrastructure, as well as researching in-waterbody HAB in-waterbody mitigation technologies.

This roadmap will serve as a five-year guide with six focus areas aligning research, monitoring, watershed management, regulatory tools, and in-water mitigation strategies to ensure consistent decision-making, protect public health and ecosystems, and support long-term and sustainable water quality improvement. Each focus area includes a goal statement along with associated projects and tasks that will guide DEC in accomplishing its mission to protect and conserve the water resources of NYS. Projects, tasks, and objectives are identified as short- and long-term actions. Additionally, certain tasks and objectives are dependent on completion of previous tasks. DOW will coordinate project prioritization to ensure critical projects are initiated before dependent tasks.

DEC's approach to addressing HABs will focus on six distinct areas:

1. Monitoring and Assessment
2. Water Quality Standards and Guidance Values
3. Planning and Implementation
4. General and In-Waterbody Mitigation Research
5. Permitting In-Waterbody Mitigation Practices
6. Public Outreach and Reporting

Focus Area 1. Monitoring and Assessment

> Roadmap Goal Statement: Design and implement monitoring approaches to identify the presence and abundance of cyanobacteria and other HABs or their indicators and support the evaluation of new HAB in-waterbody mitigation and reduction strategies. Develop monitoring approaches to improve data usage for various objectives (e.g., HAB screening, assessment, or modeling) and fill knowledge gaps.

DEC manages several programs coordinating water quality sampling across NYS to help evaluate and manage water quality by identifying contaminant sources and developing strategies to prevent and reduce their occurrence. Monitoring HABs in surface waters is critical to protecting public health and the environment. That's because identifying the presence of cyanobacteria and associated toxins helps to provide early warning and prevent HAB exposure to people and animals and helps evaluate impacts to water quality and aquatic life.

An important element to the success of DEC's efforts to address HABs is the ability to identify and document them over time. HABs are a key component of DEC's surface water monitoring programs. Monitoring HABs using a consistent approach provides understanding and a means of evaluating the effectiveness of short- and long-term approaches to address them. It also ensures the application of effective management, in-water mitigation, and reduction strategies.

Clumps of cyanobacteria are shown suspended in a water sample collected from Cayuga Lake, NY. DEC's sampling efforts of HABs in the state have evolved since 2012 from a widespread and opportunistic sampling regime to a refined approach that complements concurrent statewide monitoring programs and applied research projects. This transition coincided with the implementation of NYHABS in 2019 and DEC's shift to using images to confirm potential HAB reports, which increased public communication and awareness.

Targeted Actions to Support Monitoring and Assessment

Short-Term Actions (1–5 years)

Action 1. Evaluate, qualify, and provide access to existing HAB data sources. Various projects have been initiated over the past decade, including DEC's HAB monitoring programs and several applied research projects. It is critical that these data be made easily available to the public, government agencies, and researchers.

- **a)** Evaluate data according to collection methods, use of established quality assurance procedures, and data quality objectives.
- **b)** Define data quality according to the intended use. Possible data use categories include, but are not limited to, assessment, modeling and trend analysis, general research, and education/outreach.
- **c)** Integrate external data sources into DEC programs from partner organizations such as NYSDOH; Office of Parks, Recreation and Historic Preservation (OPRHP); New York City Department of Parks and Recreation; United States Geological Survey (USGS); United States Environmental Protection Agency (USEPA); and other DEC divisions. This can be done by utilizing tools such as the Water Quality Exchange (WQX), a centralized USEPA maintained database to store, maintain, and make data available in a standardized format. (See "Focus Area 6. Public Outreach and Reporting" for possible data access solutions.)

Action 2. Explore novel analytical and monitoring strategies to provide key insights into understanding the causes of HABs, their formation potential, and their efficient detection. Possible strategies include, but are not limited to, remote sensing using satellite imagery, solid phase absorption toxin tracking (SPATT), quantitative polymerase chain reaction (qPCR), digital droplet PCR (ddPCR), and other environmental DNA (eDNA) approaches.

Action 3. Revise and maintain DOW's *Standard Operating Procedure 212: HAB Sampling and Analysis* to reflect the most up-to-date sampling guidance to ensure consistent and high-quality data.

- **a)** Develop pre- and post-implementation and in-waterbody mitigation monitoring guidance.[2] Clear and consistent documentation of HAB in-waterbody mitigation projects and their effectiveness will provide important information on development of recommended options and strategies to address HABs.
- **b)** Consider the utility of benthic (attached to the bottom of a waterbody) HABs monitoring protocols.

Action 4. Publish applied research findings with the specific aim to inform DOW monitoring and management efforts as well as those of our external partners. Research efforts such as the DEC-USGS HABs Advanced Monitoring Pilot Project and various other research projects have all advanced understanding of HABs and potential management and in-waterbody mitigation options. Research publications should provide recommendations to guide water resource managers in their monitoring and management efforts.

Action 5. Support and utilize citizen and community science for HAB monitoring. Data collected by the public can be an efficient and broad means of generating important information on HAB occurrences and understanding public concerns related to HABs

[2] See "Focus Area 5. Permitting" for overlap.

(see Figure 2); citizen and community science efforts should also engage local communities or partners with waterbody and watershed management objectives.

Action 6: Investigate, monitor, and characterize occurrences and impacts of benthic HABs. The development of quantitative and qualitative methods for collection and analysis of benthic HABs is important in understanding the potential risk to public health and the environment.

Action 7. Collect, compile, and inventory HAB data to support development of WQS and GVs (action is dependent on "Focus Area 2. Water Quality Standards and Guidance Values").

Long-Term Actions (over 5 years)

Action 1. Incorporate new analytical methods (e.g., Liquid Chromatography with Tandem Mass Spectrometry, ddPCR) and novel monitoring approaches such as remote sensing into statewide HAB monitoring and assessment protocols.

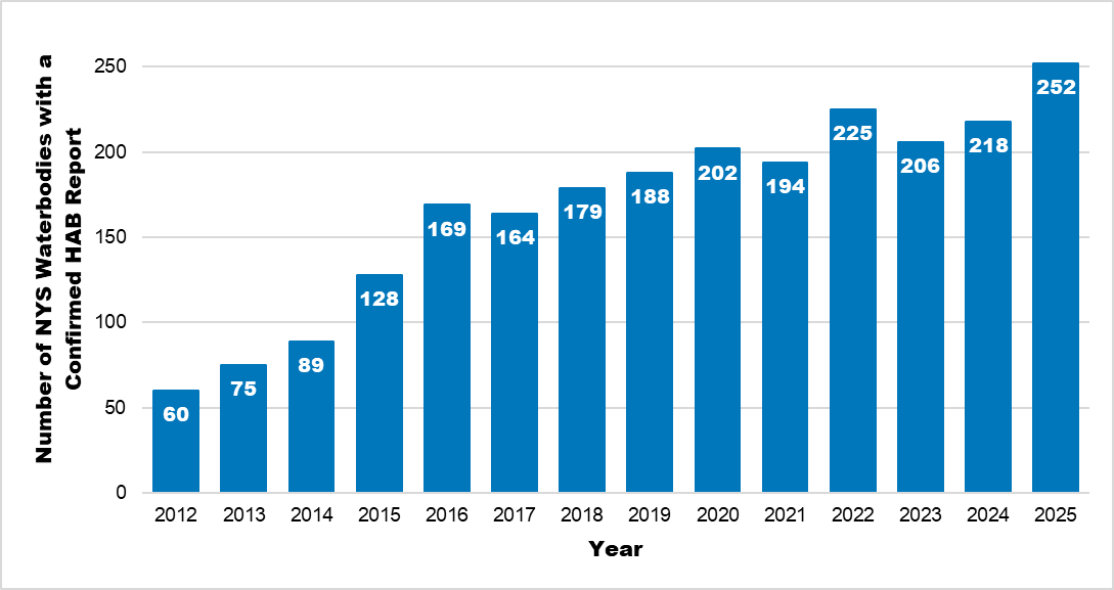
Action 2. Continue long-term trend monitoring of HABs and data analysis (see Figure 2). Consistent monitoring for HABs will be an important tool in measuring changes in HAB occurrences. Long-term monitoring and collection of data through State-run programs are critical to understanding how past management strategies and projects have influenced water quality and HAB conditions, and shaped management strategies according to observed trends.

Conduct probability-based surveys through existing monitoring program. Probability- based surveys include random selection of sampling locations and provides an unbiased, scientifically accurate way to assess data. Probability-based surveys have been used in NYS monitoring programs since 2008. Incorporating HAB monitoring endpoints will provide the ability to characterize HAB conditions statewide. This sampling approach for HABs may be better suited to less ephemeral parameters than typical HAB endpoints such as toxin concentrations or cyanobacteria cell counts, which are vulnerable to spatial and seasonal changes. For example, the presence of toxin-producing genes or other eDNA approaches are likely stable enough to be detected in the absence of toxins or bloom conditions.

a) Statewide—Evaluate satellite-based data collection. Traditional sampling approaches are vulnerable to seasonal variability, and this is particularly true for HABs, which are inherently ephemeral. Satellite imagery analysis has the potential to provide frequent and objective results to overcome this vulnerability and to detect overarching developing trends statewide. Depending on the satellite platform, imagery analysis could also extend several decades into the past to achieve an objective view.

b) Regional (beyond NYS)—Consider inclusion of HAB monitoring into existing Regional Monitoring Network collection efforts such as those intended to generate long-term data for lakes and streams in the eastern and midwestern United States. DOW has participated in these regionally coordinated monitoring efforts at sentinel monitoring locations using standard protocols for easy comparison across the Northeast (e.g., Vermont, Maine, New Hampshire, Massachusetts).

Figure 2. Number of NYS Waterbodies with HAB reports, 2012-2025



This bar graph depicts the number of NYS waterbodies with a confirmed HAB report from 2012 through 2025. DEC confirms the presence of HABs on waterbodies through reports submitted by trained users and the public. Since 2012, several HAB monitoring programs across the state were initiated and public awareness of HABs has increased concurrently. The increasing number of waterbodies with HABs shown above likely tracks an increasing public awareness of HABs.

Focus Area 2. Water Quality Standards (WQS) and Guidance Values (GVs)

> Roadmap Goal Statement: Identify key parameters of HABs that can be feasibly monitored for and relied upon to identify waters where best uses[3] are currently or potentially impacted by HABs. Identify WQS and/or develop GVs based on key parameters of HABs that can be controlled through State Pollutant Discharge Elimination System permits, nonpoint source controls, or other regulatory means.

WQS and GVs in NYS establish maximum allowable levels of pollutants and provide a basis to protect state waters. DEC establishes these thresholds (narrative and numeric) for many specific substances to protect best uses (fishing, recreation, drinking water sources, etc.). Best uses are assigned to waterbodies according to their classification (AA, A, AA-S, A-S, B, C, D) and may be used for permitting, compliance, enforcement, monitoring, and assessment. While HABs and associated water quality indicators pose a unique challenge for the development of regulatory thresholds, these thresholds are a critical step in the development of management plans and strategies to mitigate HABs. Development of WQS or GVs based on the best science available will provide a fundamental step to water resource management and the protection of human health and ecological integrity from HABs.

Kayaks are shown near a typical HAB. Boating is a form of recreation which DEC designates as one of the best uses that a waterbody can provide. Determining whether HAB conditions are impeding waterbodies from meeting their best uses through the development of WQS and GVs is an important aspect of managing healthy waters in NYS.

Targeted Actions to Support WQS and GV Development

Short-Term Actions (1–5 years)

Action 1. Review and evaluate current monitoring strategies, scientific literature, analytical capabilities, and existing NYS regulations alongside USEPA water quality criteria recommendations to inform the development of WQS and/or GVs based on the best available science. USEPA provides national water quality criteria through the Clean Water Act (CWA) Section 304(a), which guides states and Indian Nations toward development of WQS.

a) Initiate a survey through the Association of Clean Water Administrators (ACWA) to compile current NYS and Indian Nations' monitoring designs and regulatory approaches toward addressing HABs. ACWA is an organization of state, interstate and territorial officials who are responsible for implementing surface water protection programs throughout the nation.

b) Review and evaluate scientific literature and NYS publications to generate an assessment and regulatory strategy for addressing HABs. Literature review is a critical step in building on the work of others and efficiently addressing complex scientific questions.

[3] NYS defines "best uses" in the Environmental Conservation Law (ECL) and Title 6 of New York Codes, Rules, and Regulations (NYCRR). All of NYS waters are classified according to best uses such as drinking, bathing, boating, fishing, and shellfishing (ECL 17-0301 and Title 6 NYCRR, Part 701 and Parts 800-941).

Action 2. Evaluate current DEC WQS and GVs to determine if revisions or new numerical interpretations are needed for HAB assessment and regulation. WQS can be either narrative or numeric and are found in 6 NYCRR Part 703.

a) Evaluate the application of existing narrative WQS for cyanotoxins and nutrients for regulation and assessment of HABs.

b) Define WQS or GVs for core indicator[5] variables for best uses impacted or impaired by HABs that provide a clear translation to assessment endpoints. This will enable the development of clean water plans, advanced restoration plans (ARPs), and total maximum daily loads (TMDLs) to address HABs.

Action 3. Develop assessment methods to incorporate into DEC's Consolidated Assessment and Listing Methodology (CALM) (action dependent on "Focus Area 2. Water Quality Standards and Guidance Values"). Incorporation into CALM would require identification of core or supplemental indicators[6], data quality and quantity requirements, and defining the spatial extent and duration of a bloom that cause impairment to the best uses of a waterbody. Establishment of indicators that can be modeled using existing in-waterbody modeling tools is critical to addressing HABs.

Clean Water Planning is an important strategy to protect and restore water quality. Effective and targeted planning can keep water clean, restore the condition of waters, and provide opportunities for safe recreation.

Focus Area 3. Planning and Implementation

> Roadmap Goal Statement: Develop adaptive and efficient planning mechanisms that will set in motion appropriate implementation programs to help reduce the occurrences and frequency of HABs. Planning efforts should align with the goals of DEC's existing clean water planning efforts (e.g., TMDLs, Nine Element Watershed Management Plans, or 9E Plans, and ARPs). Continue and expand funding opportunities and partnerships for planning efforts to mitigate HABs and their impacts. Prioritize implementation funding that addresses causes and long-term impacts from HABs. Utilize pre- and post-implementation HAB monitoring and reporting deliverables.

Developing and implementing clean water plans is an effective strategy in DEC's effort to protect and restore water quality across NYS. DEC's monitoring programs, along with those of external partners, generate data to evaluate if waterbodies support best uses, which helps prioritize resources for protecting and restoring waterbody health. An important element of clean water planning is identifying a pollutant reduction target to protect or restore waterbody health. Although HABs can impact waterbody health, it is important that the development of watershed planning efforts also identify controllable factors such as phosphorus, nitrogen, and other pollutants that contribute to HABs and can be reduced. Due to many management challenges posed by HABs, and several factors influencing the occurrence, duration, frequency, and intensity of blooms, HABs require an adaptive approach to fit into the existing clean water planning process.

[4] Guidance Values, as listed in "Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations," serve as numeric interpretations of narrative WQS.

[5] Core Indicators are parameters with WQS adopted in 6 NYCRR.

[6] Supplemental Indicators (e.g., biological, lake morphometry, and satellite imagery) include indicators that may correlate to and be driven by the presence of HABs as well as indicators that are not based on WQS adopted in 6 NYCRR (e.g., DOH maximum contaminate level exceedances and beach closures).

Targeted Actions to Support Planning and Implementation

Short-Term Actions (1–5 years)

Action 1. For clean water plans (e.g., TMDLs, 9E Plans, and ARPs) and DEC's Vision prioritization process[7], include HAB information when evaluating and prioritizing planning efforts for waterbodies impaired by nutrients.

Action 2. For waterbodies where there is not a clear linkage between excess nutrients[8] and the occurrence of HABs, DOW will explore the development of an additional clean water plan framework to support HAB in-waterbody mitigation. While excess nutrients are widely recognized as a leading driver of HABs, HABs can persist in waterbodies with low nutrient levels. For this reason, existing clean water planning strategies that focus solely on nutrient pollutant reduction may not be a suitable planning tool to support mitigation in these types of waterbodies (action dependent on "Focus Area 2. Water Quality Standards and Guidance Values").

- **a)** Review approaches used by other states, programs, and by USEPA.
- **b)** Coordinate with USEPA to determine an acceptable form of clean water planning to address waterbodies where HABs are not linked to water quality impairment from nutrient pollution.

Long-Term Actions (Over 5 Years)

Action 1. Evaluate federal and NYS co-funding opportunities to further align climate resilience and equity considerations to HABs as they relate to DEC's planning and implementation efforts such as the Federal Emergency Management Agency (FEMA) and New York State Department of State (NYSDOS).

Action 2. Align funding programs such as WQIP, NPG, and CWA Section 604(b) Water Quality Planning Grants, and identify contracting mechanisms (e.g, watershed-specific funding in the NYS Environmental Protection Fund, NYSDOS, NYSAGM, NYS Environmental Facilities Corporation) to implement proven technologies that mitigate HABs (action dependent on "Focus Area 4b. In-Waterbody Mitigation Research").

- **a)** Develop a framework within existing grant programs where planning and design for eligible HAB in-waterbody mitigation practices may be funded (e.g., 604b and NPG).
- **b)** Develop a menu of HAB in-waterbody mitigation practices eligible for funding.
- **c)** Define post-implementation monitoring and reporting contract requirements to adequately document outcomes of in-waterbody mitigation efforts.
- **d)** Identify specific funding for in-waterbody mitigation-related planning, design, and implementation.

Focus Area 4. General and In-Waterbody Mitigation Research

While the scientific community has been studying HABs for decades, many questions remain unanswered. More recently, DOW published the HABs Research Guide as a resource for DEC staff, local, state, or federal agencies, and research partners to identify priority research areas to improve understanding and reduce HABs. While many contributing factors to HABs have been documented, it can be unclear how those causal mechanisms interact, what management strategies could be used to reduce their occurrences, and which in-waterbody mitigation options could lessen the effects of HABs on waterbody uses. Additionally, the impact of climate change and invasive species' presence on HABs may complicate the ability to evaluate waterbody responses to nutrient reductions or other actions to reduce HABs. Research should be focused on advancing knowledge about causes related to HAB frequency, intensity, toxicity, and occurrence outlined below in 4a. General Research, and 4b. In-Waterbody Mitigation Research.

[7] DEC's "Vision Approach to Implement the CWA 303(d) Program and Clean Water Planning" is based on direction from USEPA's "Vision for the CWA 303(d) Program."

[8] Nutrient concentrations violating narrative or numeric WQS or GVs.

Table 1. Some examples of research from DEC scientists

Title and Link	Author (Year)	Summary
Detections of cyanobacteria harmful algal blooms (cyanoHABs) in New York State, United States (2012–2020)	Gorney et al. (2023)	Analyzed patterns of frequency, intensity, and duration of HABs during 2012–2020. Frequency of HABs increased, most likely due to increased awareness/reporting. Neither intensity nor duration of HABs changed during the study.
Patterns and impacts of cyanobacteria in a deep, thermally stratified oligotrophic lake	Prestigiacomo et al. (2023)	Assessed multiple indicators of HABs in Canandaigua Lake during 2019 to track down the starting point of HABs and their effect on recreation and drinking water. HABs originated in offshore surface water several days before migrating to shorelines, causing beach closures. HAB indicators were detected in deeper water where drinking water intakes were located, but there were no detections of the toxin microcystin in finished drinking water.
An evaluation of a spectral fluorometer for monitoring chlorophyll-a in New York State lakes	Prestigiacomo et al. (2022)	Compared the difference between Chlorophyll-a (Chl-a) concentrations of lake water measured via traditional laboratory processing and those measured using a Chl-a instrument in the field. The study identified that using the Chl-a instrument can produce sufficiently accurate results to replace time-consuming and costly laboratory processing.

Recent peer-reviewed research was produced by DEC scientists to expand the understanding of HAB occurrences in NYS and how to detect, monitor, and mitigate HABs more effectively.

4a. General Research

> Roadmap Goal Statement: Conduct and support applied research that fills knowledge gaps on the occurrence, abundance, and toxicity of HABs and their impacts on freshwater systems in NYS. Utilize research findings to improve DEC's programs.

Targeted Actions to Support General Research

Short-Term Actions (1–5 years)

Action 1. Create a centralized and shareable HABs research database for inventory and tracking of NYS HABs research projects. This system would be accessible to all public users and would provide clear understanding of project status and progress made toward research objectives. Development and maintenance of this resource would aid in directing HAB research funding.

Action 2. Use the HABs Research Guide and developing scientific literature to identify priority data and research gaps. DEC should contribute to filling these gaps through intra-agency studies, monitoring, and collaborations between DOW and other DEC divisions and programs such as Division of Marine Resources, Division of Fish and Wildlife, and the Hudson River Estuary Program. Collaboration is critical to maximizing use of existing resources and creating synergy in the effort to understand and address HABs.

Action 3. Conduct directed and applied research as prioritized in the HABs Research Guide, which emphasizes important focus areas to advance the study, management, and in-waterbody mitigation of HABs across NYS.

- **a)** DOW staff will conduct studies to fill research and data gaps and publish findings; potential for collaboration between NYS agencies should be evaluated to achieve program efficiencies.
- **b)** Develop and release a HAB Research Request for Applications (RFAs) and/or other funding mechanisms to support and direct HAB research by external entities as prioritize in the HABs Research Guide.

Action 4. Review and update the HABs Research Guide on a five-year cycle (updated in 2026) to reflect shifting priorities and advances in scientific understanding of HABs.

Long-Term Actions (Over 5 Years)

Action 1. Continue support of HAB research through long-term commitments to RFAs or other funding mechanisms.

Conducting research and filling data gaps is a priority in the HABs Research Guide. Applied research and monitoring will aid in DOW programmatic operations that can be used to support HAB management.

4b. In-Waterbody Mitigation Research

> Roadmap Goal Statement: Evaluate the efficacy of new and existing permitted strategies to help support in-waterbody efforts to mitigate the impact of HABs in NYS.

Targeted Actions to Support In-Water Mitigation Research

Short-Term Actions (1–5 years)

Action 1. Generate and publish conclusions from mitigation pilot projects conducted to date. Based upon completed research and recommendations, update research priorities through the HABs Research Guide or other prioritization documents.

Action 2. Determine metrics for evaluating and documenting effective HAB mitigation practices. Develop consistent approaches that include clear metrics to evaluate a method's efficacy for potential permitting and implementation.

Action 3. Ensure guidance on HAB mitigation research covers common permit-related questions. Permitting of novel mitigation practices (see "Focus Area 5. Permitting") requires understanding concerns such as toxicity, impacts to non-target biological communities, NYS and federal certification requirements, WQS violations, and formation of treatment byproducts. Treatment byproducts are formed in ambient water with the interaction of products such as chlorine and organic material.

Long-Term Actions (Over 5 Years)

Action 1. Support long-term research of novel HAB mitigation practices through a HAB research RFA. A key to addressing HABs is continuing to advance research and understanding of mitigation options.

Action 2. Incorporate emerging HAB research and findings to update recommendations for effective mitigation practices best suited for specific waterbody types and watershed conditions. Ensure recommendations consider implementing long-term mitigation practices and best management practices when recommending in-waterbody HAB mitigation options.

Focus Area 5. Permitting In-Waterbody Mitigation Practices

> Roadmap Goal Statement: Evaluate and develop permitting for in-waterbody HAB mitigation. Identify, clarify, and communicate to the public DEC's current permitting pathways for existing in-water mitigation practices and develop a consistent, reasonable, effective, and adaptive approach for permitting future novel technologies. Develop in-waterbody mitigation permitting language, thresholds, and monitoring requirements specific to HAB indicators to balance the needs of environmental protection and sustainable economic development.

The CWA of 1972 established the basis for permitting of pollutant discharges in waters of the United States. Under Article 70 of the Environmental Conservation Law (ECL) DEC manages a system of permits under the Uniform Procedures Act. This ensures permitting is conducted in a fair, timely, thorough, and consistent manner. Regulation 6 NYCRR Part 621 describes the various activities that require permits through

DEC programs. For water, permits are issued to be protective of water quality, wetlands, erosion, etc.., through the regulation of wastewater, stormwater, and water withdrawal. However, current research and development of novel HABs in-waterbody mitigation practices are not directly considered in NYS ECL permitting regulations. and procedures for issuing permits consistent with these practices are not well established. This poses a challenge to ensure that these emerging technologies are safe for the environment and effective, as well as ensuring applicable permits are issued in a timely manner with a consistent and thorough review.

Targeted Actions to Support Permitting

Short-Term Actions (1–5 Years)

Action 1. Evaluate other states' permitting strategies for HAB in-waterbody mitigation practices to understand approaches that have been successfully implemented. Reviewing successful permitting of HAB in-waterbody mitigation practices in other states provides key insights into potential pathways for effective permitting in NYS.

Action 2. Evaluate requirements for HAB in-waterbody mitigation practices. Develop consistent and clear communication of permit requirements to allow appropriate and effective implementation of in-waterbody mitigation options. This action will ensure efficient permitting and improve the ability to address rapidly changing conditions often observed in the environment.

Action 3. Identify and implement lessons learned from prior experiences of permitting HAB in-waterbody mitigation projects. DEC will incorporate the experience from several in-waterbody mitigation pilot projects to improve the way permits are issued for these projects. Permits should consider factors such as environmental conditions and reporting requirements. DEC will improve guidance, efficiency, safety, and effectiveness in permitting HAB in-waterbody mitigation projects by building upon experience and considering new permitting pathways specific to HAB in-waterbody mitigation.

- **a)** Develop standardized environmental permit applications, procedures, and guidance for potential applicants. Standardized permit applications for effective in-waterbody mitigation options will enable efficient deployment of technologies and methods to help address HABs and their ephemeral nature.
- **b)** Develop standardized monitoring conditions and best management practices for HAB in-waterbody mitigation projects and consider various pathways for project data storage and record keeping. Consider reporting and storage of permit monitoring data through new pathways specific to HAB in-waterbody mitigation such as WQX and the Discharge Monitoring Report Online System. Improved accessibility and consistency of the data will improve transparency of the permitting process and support future permit development.

Action 4. Improve and streamline the process for permitting HAB in-waterbody mitigation projects, water quality improvement tools, and mechanisms (e.g., decision trees, procedural steps, and digitization of permit conditions) to improve clarity and consistency of the permitting process. DEC will consider establishing internal workgroups to coordinate communication between central and regional representatives to ensure consistent implementation across NYS, including the following:

- **a)** Evaluate and consider new or revised standard permit applications for HAB in-waterbody mitigation practices.
- **b)** Evaluate and consider standard permit conditions for HAB in-waterbody mitigation practices.

Action 5. Establish consistent and documented monitoring over the life of a project to ensure the effectiveness of a treatment method. In addition to documenting effectiveness in reducing HABs, monitoring guidance should include elements such as the potential for formation of treatment byproducts in ambient water, effluent toxicity, and the effect on non-target organisms. Coordination and collaboration between DEC Divisions is important to ensure a broad consideration of potential environmental influences.

Long-Term Actions (Over 5 Years)

Action 1. Develop a pathway for the use of novel technologies that do not easily fit within existing permitting frameworks. New and developing approaches for treating HABs are often presented and may require new permitting methods or demonstrations of efficacy, such as pilot testing. Standardize the information to be submitted or collected to allow for an efficient review and assessment of permitting options for novel technologies.

Action 2. Evaluate the potential for development of an in-waterbody general permit for any HAB in-waterbody mitigation practice, such as a Standard Activity Permit.

Focus Area 6. Public Outreach and Reporting

> Roadmap Goal Statement: Conduct public outreach and reporting on DEC HABs monitoring, research, and in-waterbody mitigation to ensure transparency for the public, other researchers, and various levels of government. Proactive, efficient, and effective outreach and reporting will enhance public understanding and coordinated management of HABs throughout NYS.

Communication and reporting are essential components in safeguarding ecosystems, public health, and water quality. Continued and enhanced public outreach and reporting is essential to ensure public awareness of actions DEC and NYSDOH continue taking to monitor, research, and advance understanding of HABs. DOW's interactive reporting platform, NYHABS, helps communicate statewide occurrences of HABs and will continue to play an important role in communicating information about blooms statewide.

Strong public outreach also encourages support for collaboration among researchers, municipalities, watershed organizations, and others looking to address HABs. Educating the public will help individuals recognize statewide efforts to reduce HABs, fully understand risks associated with HABs, and improve their ability to recognize and report blooms promptly. In the long run, a public informed about HABs and related water quality issues will facilitate informed governmental decision-making around water quality management.

This HAB sign is located near a waterbody in New York City. Signage is an important part of public outreach and education about HABs throughout NYS.

HABs can vary in appearance. They can appear in shades of green, blue-green, yellow, brown, red, or white. They can look like spilled paint, pea soup, surface streaks, or floating dots or clumps.

Targeted Actions to Support Public Outreach and Reporting

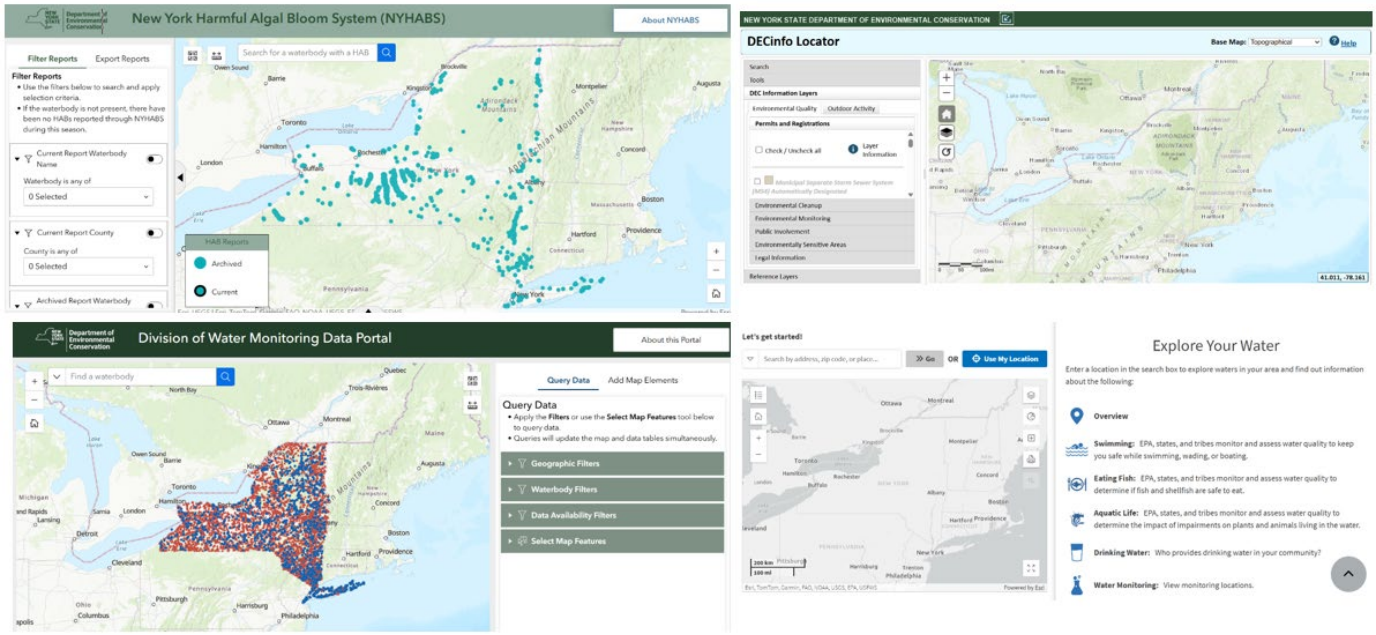
Short-Term Actions (1–5 years)

Action 1. Increase public transparency for DEC's HAB-related activities for each step forward in the following process: monitoring, assessment, research, planning, implementation, permitting, and in-waterbody mitigation.

- **a)** Increase public accessibility of data and quality assurance documentation. Provide timely reporting of annual DOW ambient surface water quality monitoring data through regular updates of reporting resources such as the DOW data portal, DECinfo Locator, Open NY, WQX, and USEPA's How's My Waterway?

- **b)** Conduct public outreach for clean water planning, permitting, and funding opportunities and resources that target reducing the occurrences of HABs (e.g, announcements in DOW's e-newsletter, training, and grant management documents through regional planning boards).

Figure 3. HABs Communication and Reporting Resources



DEC uses a variety of online communication tools, including NYHABS, DEC InfoLocator, and the DOW Data Portal. USEPA's website, *How's My Waterway*?, (see links above) provides additional access to data generated by DEC and other data providers who upload data to USEPA's WQX. These resources are publicly available and are used to disseminate information regarding HABs and other water quality data.

Action 2. Work with DEC's Division of Communication, Education, and Engagement to develop and publish web content to the DEC HABs website to clearly convey information to target audiences. Ensure HAB web content is regularly updated and includes any recent HAB-related publications and reports developed by DOW and their partners.

Action 3. Identify opportunities to coordinate with stakeholders at multiple levels of government (e.g., state, county, and local) for monitoring and management objectives. Ensure that DOW's HAB management objectives and clean water planning and in-waterbody mitigation efforts are coordinated with regional planning boards and interstate commissions.

Action 4. Maintain and improve NYHABS as the primary means of monitoring and reporting HAB occurrences across NYS. Provide clear procedural guidance and consider opportunities for greater efficiency and enhanced communication of HAB reports to the public and other NYHABS data users.

Skaneateles Lake drone image of a HAB. Images are a powerful tool that NYHABS utilizes. Providing the public with up-to-date and clear images of HABs is an important part of outreach, education, and management objectives.

DEC's DOW staff sampling a HAB in New York City.

A water quality sampling event that included the collection of representative HAB samples along with other water quality parameters. Samples are collected and sent to a laboratory for analysis. Using established methods to collect samples that are representative of a waterbody's condition is important to evaluate current conditions and also document long-term trends.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