



*Town of
Wolfeboro*

Wolfeboro Board of Selectmen
Dave Senecal, Chairman
Brad Harriman, Vice Chairman
Linda T. Murray
Luke Freudenberg
Brian Deshaies

February 16, 2023

Dear New Hampshire Department of Environmental Services and NH Cyanobacteria Plan Advisory Committee:

Wolfeboro Waters is a standing Town of Wolfeboro Committee consisting of volunteers appointed by the Wolfeboro Board of Selectmen that was established after a local cyanobacteria bloom in Lake Winnepesaukee that was the subject of a NHDES Advisory for three weeks at the end of August 2018. The committee complements the longer-term efforts of the Wentworth Watershed Association, Rust Pond Association, Mirror Lake Protective Association, and Lake Winnepesaukee Association and collaborates with them to assess and protect local water quality. Wolfeboro Waters has a particular focus on the risks of cyanobacteria blooms and means to prevent and mitigate future ones and has sought the advice and involvement of numerous experts and institutions outside of Wolfeboro in its efforts.

We recognize the difficult task NHDES has in addressing cyanobacteria across the state. It oversees hundreds of waterbodies with water quality ranging from hyper-oligotrophic with few nutrients to eutrophic with major biological growth and large reservoirs of legacy nutrients. All lakes in the state have cyanobacteria and are being affected by a warming climate and more major storms.

Given the diversity of the lakes across the state, we hope that the future cyanobacteria program for the state will address five categories of needs:

1. The adoption or development of methods to rapidly identify the types of cyanobacteria being observed in significant quantities in NH waterbodies and to determine the extent that they pose cyanotoxin risks.
2. The development of guidance for sampling, processing, and identifying benthic (ones on the bottom) cyanobacteria, as well as ways to limit risks of cyanotoxins associated with benthic cyanobacteria.
3. The adoption or development of Best Management Practices (BMPs) that cost-effectively prevent nutrients, especially particulate and dissolved forms of phosphorus, from flowing into water bodies and that can easily be maintained and of policies to evaluate the continuing effectiveness of BMPs over time.
4. The development of policies covering potential efforts to dredge, treat, or otherwise limit the availability of legacy nutrients in waterbodies.
5. The development of communication strategies, in coordination with others, that encourage people across the state to protect the water quality of its lakes, to identify and report possible cyanobacteria blooms, to alert people quickly of confirmed blooms, and to enable people to take precautions to minimize their risks from cyanotoxins.

We are writing to inform you of some preliminary findings in Wolfeboro's lakes that are likely to apply to other lakes in the state. See the Wolfeboro Waters 2022 Assessment Subcommittee Summary Report accompanying this letter for more detail. We also would be happy to answer any questions and provide you with support for these findings.

Local volunteers have been sampling all our larger water bodies for many years as part of the UNH-Extension's LLMP and/or NHDES VLAP programs, which are valuable in classifying the trophic status of lakes and trends over years. All our lakes have been classified as oligotrophic (good), except Mirror Lake and Sargents Pond, which are mesotrophic (fair), and their classifications have not changed over the years.

Notwithstanding their oligotrophic classification, longtime residents on several of our lakes have observed significant increases over the decades in a wide range of biological growth (from plants to slime) along shallow shoreline bottoms. In addition, since 2018, NHDES has issued two cyanobacteria advisories for different Lake Winnepesaukee bays in Wolfeboro. In addition, significant concentrations of *Gloeotrichia* have been observed on Lake Wentworth several times. So, all is not well, and toxic cyanobacteria blooms have become a concern despite having oligotrophic status.

- The total phosphorus concentrations in the water column (epilimnion) measured as part of the ongoing LLMP in (oligotrophic) Lake Winnepesaukee are not a contemporaneous metric of cyanobacteria risks. For example, the total phosphorus concentrations in the water column **during the two recent blooms** were **4.6 ug/l** (very good) for the Aug 2018 bloom and were **5.2-5.7 ug/l** (also very good) for the June 2022 bloom.
- The concentrations of soluble reactive phosphorus in Winter Harbor sediment samples collected during the 2018 bloom were tenfold higher than the water column above, ranging from **53-96 ug/l** and are almost certainly a source of cyanobacteria risks. In addition, the fine sediment phosphorus inventory was orders of magnitude larger than the inventory of phosphorus in the water column above.
 - *Gloeotrichia* and *Dolichospermum*, the two types of cyanobacteria that bloomed locally in Lake Winnepesaukee, spend a significant portion of their lifecycles in or on the sediment.
- The total phosphorus concentrations in a stormwater runoff stream flowing into Winter Harbor near the 2018 bloom area have ranged over the past five year from **12 ug/l (low flow) to 7,857 ug/l (high flow)** (4789 ug/l during the bloom). A nearby stream has ranged from 12 ug/l to 46 ug/l.
 - Irrespective of the TP concentrations and flows of the streams, they had very little effect on the TP concentrations in the water during the warm weather months and only a short rise above 10 ug/l during spring snow melts and late fall major storms.
 - The phosphorus loadings from the streams undoubtedly are quickly taken up geochemically and biologically (especially during summers) by the sediment.
- We have yet to characterize most of the observed biological growth on the bottom of our lakes but fear there are significant concentrations of benthic cyanobacteria also being fed by nutrients from the sediment. We have observed mats that float below the surface to the shore and slime on rocks in Lake Winnepesaukee, like those reported elsewhere, to contain benthic cyanobacteria.

- These results indicate that reducing inputs of nutrients to the lake, particularly phosphorus (including dissolved forms), are a high priority to limit future cyanobacteria blooms and hopefully to enable the slow burial of the phosphorus in the sediment deep enough to limit its ability to stimulate biological growth in or over the sediment.

Note also:

- Bigelow Laboratory has run e-DNA analyses of ten samples from three local sites in Lake Winnepesaukee, two in Lake Wentworth, and one in Sargents Pond. All ten were dominated (>75%) by Cyanobium, a picocyanobacteria. Fluoroscopy indicates that the Cyanobium produces phycocyanin (PC) and not phycoerythrin (PE).
 - Scientific studies on picocyanobacteria are not nearly as numerous as those for larger bloom-forming cyanobacteria. However, several scientific studies report high, but varying, concentrations of Cyanobium are reported in other freshwater bodies-- particularly oligotrophic ones.
 - A few studies suggest that freshwater Cyanobium are nitrogen limited, while others report that they can release chemicals into the water that inhibit the growth of bloom-forming cyanobacteria and other potential predators.
- Bigelow scientists have also obtained full genomic assays on several samples of freshwater cyanobacteria, including some that we have provided. They found that the 2022 Gloeotrichia and Dolichospermum samples that we provided lack genes enabling the production of microcystin, a potentially serious cyanotoxin which others have reported are associated with both types of cyanobacteria in some other freshwater bodies.

While our results are still preliminary, we would urge NHDES, its future cyanobacteria program, and other lake associations to evaluate whether shoreline sediments are a major source of phosphorus for cyanobacteria in other waterbodies, particularly those that are oligotrophic. We also would suggest obtaining more e-DNA and genomic information on cyanobacteria blooming in the freshwater lakes of New Hampshire.

Sincerely,



Linda Murray, Chair

Wolfeboro Waters Committee

Abigail Adams

Katherine Barnard

Mary Devries

Luke Freudenberg

Richard Masse

Warren R. Muir, Assessment Subcommittee Chair

Libby Peard

Bree Rossiter

Art Slocum

Julie Brown