

To: Tony Plante
Members of the Windham Town Council
From: Highland Lake Association
Re: Watershed Protection Grant Funds
Date: January 15, 2018

On behalf of the Highland Lake Association (HLA) , I want to thank the Town of Windham for the grant allocation of \$4,000 awarded to the HLA in April, 2017.

This report will serve to inform the town regarding how these funds were utilized in the ongoing effort to determine the cause of the Picocyanobacteria (Pcy) bloom at Highland Lake (HL) . This report will highlight how this grant was a part of the ongoing proactive response within the HL water shed and surrounding water shed communities in the Windham community to focus attention, intensive study, and research into the causes and potential impact of the “bloom.”

A committee, the Discovery Highland Lake Recovery Project, (DHLR) was formed in April to oversee the implementation of the grant funds. This committee included members of the HLA Board of Directors and water shed residents.

Background:

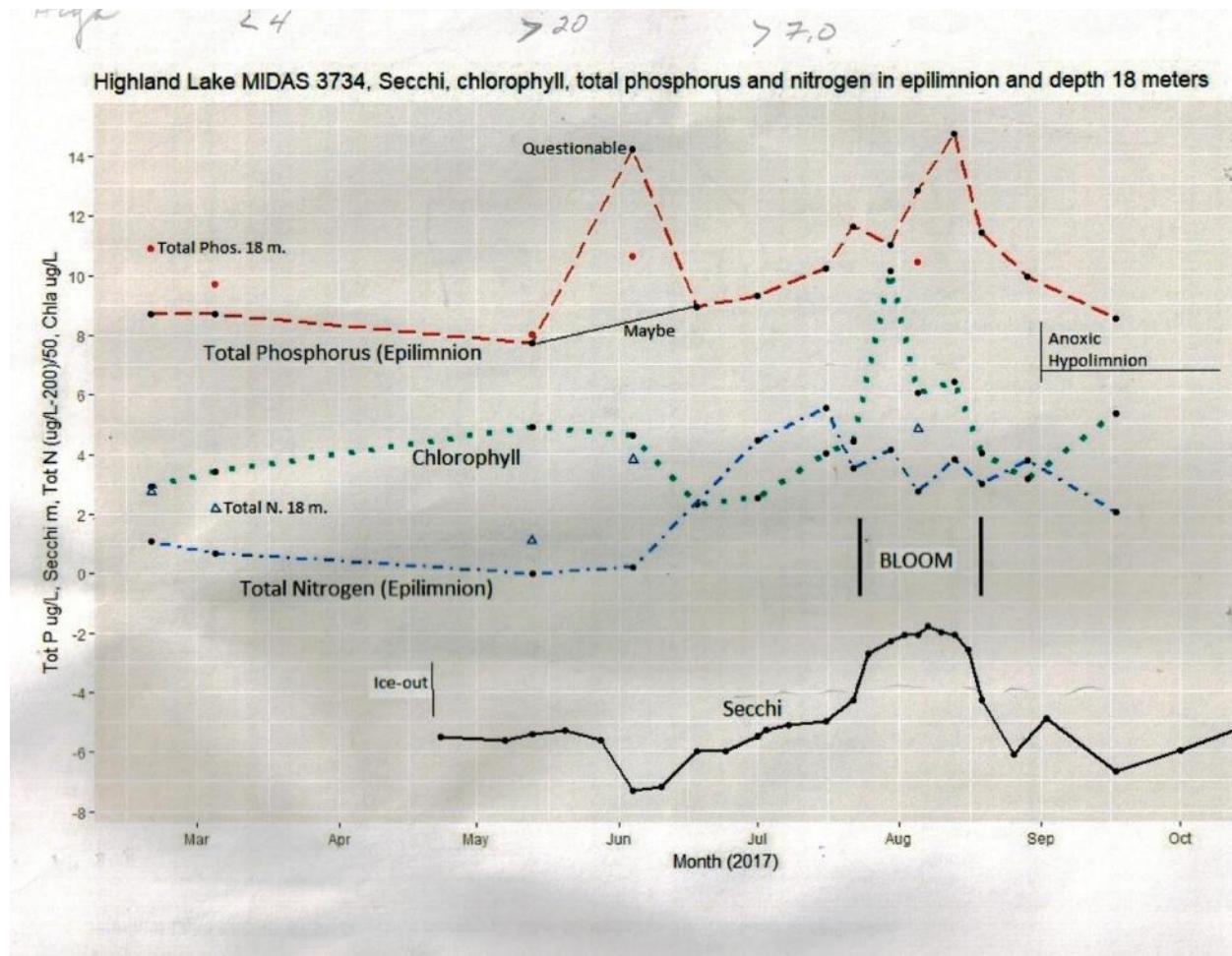
The Pcy bloom has displayed itself at HL for 4 seasons, lasting for about 4 weeks from mid-July through mid-August. The testing schedule increased significantly during the 2016 and 2017 seasons in the effort to more accurately determine what is going on in the lake ecology that may contribute to why the bloom is occurring at all, and more particularly, why is the bloom occurring in HL?

This phenomenon is unique among all lakes in the Northeast. The way that the pico (microscopic) cyanobacteria is exhibiting itself in HL, was characterized as a “Visitor of Murky Origin” – by Megan Doyle in an article focused on Highland Lake in the Portland Press Herald, December 16, 2017.

There is no doubt that HL has received a lot of publicity directly related to the recurring Pcy bloom. The community is very concerned about what is causing the bloom? Is it related to levels of total Phosphorus in the water? Is it related to the alewives spawning in HL? Does climate change play a role? Are there other factors related to the internal microscopic interactions occurring in the food chain that may be impacting the onset of the bloom?

These questions still remain unanswered. However as a result of the money that the Town of Windham invested in the ongoing Highland Lake Association’s Water Quality testing program, there are some new insights into the Pcy Bloom.

Graph # 1 depicts a precise picture of what is occurring in the lake prior to, during and following the bloom. Funding allowed water quality monitors to gather an increased number of samples in order to graph Phosphorus, Chlorophyll, Nitrogen, and Secchi disk readings in HL.



This graph was produced in a collaborative effort between Jeff Dennis (DEP) and Keith Williams.

Volunteers took weekly readings at HL for Dissolved Oxygen (at varying depths from the top of the lake (the Epilimnion) down to the bottom (the Hypolimnion), Secchi disk (which is the primary indicator of water clarity) , and temperature readings (indicating how the lake stratifies during the season).

Graph # 2 depicts the result of all samples collected during the 2017 season as assayed at the Center for Fresh Water Biology, University of New Hampshire.

Graph # 2

| Site ID | Total Phos (ug/l) | Total Nitrogen (ug/l) | Chl a (ug/l) | Diss. Color (CPU) |
|-------------------------------|----------------------|--------------------------|-----------------|----------------------|
| Deep 0-7.0 meters 2/19/17 | 8.7 | 254 | 2.9 | 29.3 |
| Deep 18.0 meters 2/19/17 | 10.9 | 337 | | |
| Deep 0-7.0 meters 3/5/17 | 8.7 | 233 | 3.4 | 30.2 |
| Deep 18.0 meters 3/5/17 | 9.7 | 308 | | |
| Deep 0-7.0 meters 5/13/17 | 7.7 | 198 | 4.9 | 35.3 |
| Deep 19.0 meters 5/13/17 | 8.0 | 255 | | |
| Deep 0-7.0 meters 6/4/17 | 14.2 | 208 | 4.6 | 32.8 |
| Deep 18.0 meters 6/4/17 | 10.6 | 390 | | |
| Deep 0-4.0 meters 6/18/17 | 8.9 | | 2.3 | 33.3 |
| Deep 0-5.0 meters 7/1/17 | 9.3 | 422 | 2.5 | 25.4 |
| Deep 0-5.0 meters 7/1/17 Dup | 10.0 | | | |
| Deep 0-5.0 meters 7/16/17 | 10.2 | 475 | 4.0 | 24.6 |
| Deep 0-5.0 meters 7/16/17 Dup | | | 4.1 | |
| Deep 0-4.0 meters 7/22/17 | 11.6 | 375 | 4.4 | 26.4 |
| Deep 0-5.0 meters 7/30/17 | 11.0 | 406 | 10.1 | 21.3 |
| Deep 0-5.0 meters 8/5/17 | 12.8 | 336 | 6.0 | 17.7 |
| Deep 18.0 meters 8/5/17 | 10.4 | 441 | | |
| Deep 0-5.0 meters 8/13/17 | 14.7 | 389 | 6.4 | 17.7 |
| Deep 0-3.0 meters 8/19/17 | 11.4 | 347 | 4.0 | 16.8 |
| Deep 0-3.0 meters 8/29/17 | 9.9 | 386 | 3.1 | 15.9 |

In addition, funds allowed the HLA to purchase and utilize a ZAPPR, (technically named The CyanoCasting kit. This a device consisted of several components: A plankton net to concentrate lake plankton; A Pocket ZAPPR for separating out bloom forming cyanobacteria and zooplankton; A transparent hose to collect lake water to assay for toxin; A photographing microscope for taking images of zooplankton and algae. Collections were to be performed according to a specified schedule particularly just prior to, during and following the "bloom."

Many cyanobacteria species produce a group of toxins known as microcystins, some of which are toxic. Microcystins as collected from Highland Lake were reviewed by Nancy Leland at University of New Hampshire. These tests did not reveal any toxic microcystins in the cyanobacteria. (See appendix for listing of the mycroystins that were evident in the sample.)

Assays for zooplankton are still being reviewed by researchers at USM and UNH. Dr. Karen Wilson has been studying the role of alewives in relationship with the zooplankton in HL for several years. Her research indicates that alewives consume a large percentage of available zooplankton, which leads to a depletion in the ecological food chain in the lake. This may be one of the factors impacting the bloom, and will part of ongoing investigations at HL.

Grant funding from the Town of Windham, served to promote the significance of the bloom. In September, 2017, Jeff Dennis and Linda Bacon (DEP) published "Highland Lake Summary." This report outlined the changes that have occurred in Highland Lake. One of the significant changes is the increase in Total Phosphorus in the lake – readings above 10 ppb have become more the norm, a troubling phenomenon, considering that the DEP cites any lake that has readings for phosphorus above 10 ppb may be moving toward eutrophication. "Tipping point" is another term that refers to the vulnerability of a lake, when phosphorus levels over time exceed the 10 ppb.

Another initiative resulting from the increased focus on the situation at HL was the development and implementation of the first Highland Lake Science Roundtable held on December 1, 2017 at the Inland Fisheries and Wildlife center in Gray, Maine. This meeting included about 20 researchers and scientists from UMO, USM, UNH, Bigelow Labs, Friends of Casco Bay, representatives from IFW, DEP, and DMR, water quality monitors, representatives from the Towns of Windham and Falmouth, and members of the HLA.

This roundtable focused on the questions: Why the bloom at HL, and Why now? Outcomes of the roundtable included:

1. Developing set of questions / hypotheses regarding the Pcy bloom
2. Projected testing / sampling protocol for HL for the 2018 season
3. Projected implementation plan for this protocol
4. List of professionals engaged in ongoing planning for the above strategy at HL
5. Development of the message to be conveyed to the HL water shed community

As part of the implementation of the above outcomes, a Public Forum is scheduled for March 7, 2018 as the platform for engaging the Highland Lake water shed community and town officials in a discussion and overview of how the community can become engaged in the ongoing work of protecting HL.

Another development was the re instituting of the Highland Lake Leadership Team, (HLLT) a collaborative group that includes representatives from the Towns of Windham and Falmouth and the HLA. The HLLT also utilizes as needed, representatives from Cumberland County Soil and Water Conservation District and the DEP in the ongoing work to improve and maintain water quality at HL.

In conclusion, the HLA and the wider community has greatly benefitted from the assistance that the Town of Windham provided in the form of a Watershed Protection Grant. It's as though this grant was as a pebble thrown in the water with the goal of directly aiding the water quality monitoring program at HL. This pebble greatly assisted the HLA in this effort; perhaps even more important was the ripple effect of this infusion of resources into the community as evidenced by the emergence of the HLLT, the initiation of the Science Roundtable, and the Public Forum .

Attached below are the following:

1. Budget outlining allocation of the \$4,000
2. Parameters included in water quality monitoring program at Highland Lake
3. Detail of result of testing of microcystins
4. DHLR project committee members

1. Budget allocation of the \$4000.

| | |
|--|----------------|
| Projected cost for water quality testing during the 2017 season. | \$2,029. |
| ZAPPR purchase | \$ 671. |
| Funding to be applied to stream sampling to be conducted in spring, 2018 | \$ 800. |
| Funds to be put toward the contract with Cumberland County Soil and Water Conservation District to conduct the Watershed Survey in the HL watershed. | \$ 500. |
| | |
| TOTAL | <u>\$4,000</u> |

NOTE: The HLA had previously designated an additional \$2000 from its General Fund to include in the Discovery Highland Lake Recovery project. However, the committee for the project decided unanimously to return this \$2000 to the HL a general fund, as it was agreed that in light of the anticipated upcoming expenses that the HLA would be facing during 2018, it would be advantageous to return this \$2000 to the HLA general fund.

2. Water Quality monitoring program by Highland Lake Association regularly tests for the following parameters of water quality:

Secchi Disk Transparency - (how clear the water is).

Dissolved Oxygen & Temperature - An adequate supply of dissolved oxygen (DO) in lake water is essential to fish and other aquatic life forms.

Phosphorus - Phosphorus is the nutrient that most influences the growth of algae in lakes.

Nitrogen – Another nutrient contributing to eutrophication in lakes

Chlorophyll a - Chlorophyll a, a pigment found in algae and other plants, can be used to estimate the population of algae in a lake.

Color - Natural water color is important to consider when assessing water quality.

pH (Acidity) - Among other effects, pH helps determine which plant and animal species can live in a lake.

- Alkalinity of the lake determines the capacity of the water to buffer from changes in pH.

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3. Tests on the microcystins for toxicity as performed by Nancy Leland

7/1/17; *Microcystis*,, *Woronichinia*, *D. lemmermanii*

7/16/17: *Microcystis*, *D. lemmermanii*

7/22/17: *D. lemmermanii*

7/30/17 *D. lemmermanii*, *Woronichinia*-

8/4/17: *D. lemmermanii*, *Microcystis*

4. Discovery Highland Lake Recovery Project Committee members:

Ginger Lawson, Jeff Wyman, Cathy Costa, Chantal Scott, John MacKinnon, Rosie Hartzler, Tom Bannen, Kim White, Joe Bickard, Corey Hallowell