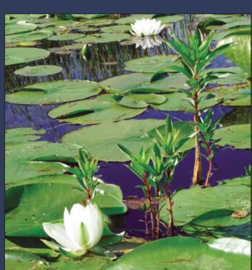

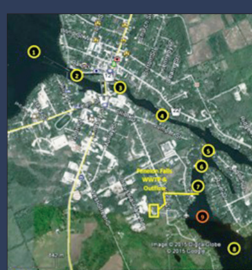

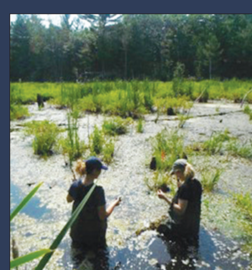

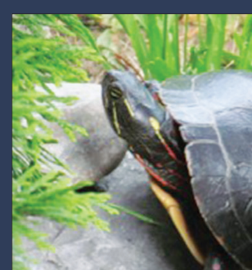

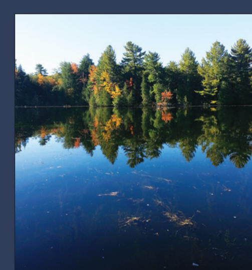

Protecting the Natural Beauty Around Us

KLSA

Kawartha Lake Stewards Association
2015 Annual Lake Water Quality Report

May 2016

Kawartha Lake Stewards Association

Lake Water Quality Report 2015

Please Note: To obtain copies of our report or to find out more about KLSA please contact:

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You can view Adobe pdf versions of KLSA reports on the KLSA website:

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Executive Summary

The Kawartha Lake Stewards Association (KLSA) is a volunteer-driven, non-profit organization of cottagers, year-round residents and local business owners in the Kawartha Lakes region. The Association's programs include the testing of lake water for phosphorus, clarity and *E. coli* bacteria during the spring, summer and early fall and research and public education about water quality issues. KLSA has formed valuable partnerships with Trent University, Fleming College and Kawartha Conservation resulting in research studies of aquatic plants and algae and the impact of nutrients on water quality. KLSA has published booklets such as the *Aquatic Plants Guide* (2009) and *The Algae of the Kawartha Lakes* (2012), which inform the public about causes of aquatic plant and algae growth and environmentally responsible management practices. This year's report addresses a wide range of issues that affect the water quality of the Kawartha Lakes.

KLSA is led by a 12-member Board of Directors. A list of the members of the Board is provided in Appendix A. A summary of articles contained in the 2015 KLSA Annual Water Quality Report follows.

Studies of Aquatic Plant Decomposition and Filamentous Green Algae Growth in the Kawartha Lakes

Lauren Banks, a Master of Science graduate of Trent University, studied aquatic plant (macrophyte) deterioration in the Kawartha Lakes. When plants decompose, nutrients such as nitrogen, phosphorus and carbon are deposited in both the water and the sediments and can affect water quality. The study identified factors that influence decomposition rates and found that the number and proportion of species at a site could predict decomposition rates. KLSA Director Colleen Middleton, who also completed her Master of Science degree at Trent University, studied filamentous green algae (FGA) growth in the Kawartha Lakes. Following up on her article, Understanding Algae Growth – A Scientific Perspective, (KLSA 2012 Water Quality Report), Colleen discusses the findings of her Master's project field study. Despite unexpected variability in water, sediment and algal chemistry within and between lakes, some important conclusions are drawn about predicting and managing FGA growth in the Kawartha Lakes.

Kawartha Lakes Sewage Treatment Plants Report: Phosphorus Discharges Increase Dramatically!

Each year, KLSA Directors monitor and report on output from local sewage treatment plants. Data for 2014, the latest year available, is analyzed. Phosphorus output is a key indicator, and a primary cause of increased plant and algae growth in our lakes. The report includes results for Minden, Coboconk, Fenelon Falls, Lindsay, Bobcaygeon, Omemee, Kings Bay and Port Perry. The total amount of phosphorus discharged from all these plants in 2014 was 904 kg, a 90% increase from 471 kg in 2013. This poor performance resulted from spring bypasses caused by the prolonged cold winter and late large spring snowmelt that overwhelmed storage facilities at the Fenelon Falls and Lindsay plants. There is still significant room for improvement to meet the goal of 99% phosphorus removal. Continued monitoring of all STPs is vital.

***E. coli* Bacteria Testing**

In 2015, KLSA volunteers tested 76 sites in 15 lakes for *E. coli* bacteria. Samples were analyzed by SGS Lakefield Research or the Centre for Alternative Wastewater Treatment (CAWT) laboratory at Fleming College in Lindsay. Public beaches are posted as unsafe for swimming when levels reach 100 *E. coli* cfu/100 mL of water. The KLSA believes that counts in the Kawartha Lakes should not exceed 50 *E. coli* cfu/100 mL, given their high recreational use. In general, *E. coli* levels were low throughout the summer of 2015, consistent with other years, reflecting excellent recreational water quality. Of the total 422 tests conducted, 375 were in the 0 - 20 *E. coli* cfu/100 mL range, 29 were in the 20 - 50 *E. coli* cfu/100 mL range, 12 were in the 50 - 100 range and only 6 tests were over 100 *E. coli* cfu/100 mL. Detailed results can be found in Appendix E.

Phosphorus Testing

In 2015, as part of the Ministry of the Environment and Climate Change's Lake Partner Program (LPP), volunteers collected water samples four to six times (monthly from May to October) at 42 sites on 14 lakes for phosphorus testing. Samples were analyzed by the Ministry laboratory. Volunteers also measured water clarity, using a Secchi disk. The Ministry's Provincial Water Quality Objectives consider average phosphorus levels exceeding 20 parts per billion (ppb) to be of concern since at that point algae growth accelerates, adversely affecting enjoyment of the lakes. Overall in the summer of 2015, average phosphorus levels were similar to

Executive Summary

those of previous years. Most lakes had phosphorus levels starting at 10 ppb in the spring, rising to about 20 ppb midsummer and dropping slightly in September. Detailed results of the 2015 Lake Partner Program are provided in Appendix F.

Investigation of the Apparent Increase in Total Phosphorus (TP) between Cameron Lake and Sturgeon Lake

Following up on Lake Partner Program results, KLSA Director Mike Dolbey studied whether sampling procedures (deep water vs. surface water or laboratory analysis methodology) or unknown sources of phosphorus along the Fenelon River could account for a consistent pattern of increased TP levels in Sturgeon Lake compared to Cameron Lake. The test results did not explain the differences found between the two lakes so additional factors such as nutrients in the sediments need to be examined.

Invasive Species in the Kawartha Lakes: Starry Stonewort and the Banded Mystery Snail

Two articles introduce invasive species discovered in Lake Scugog and Katchewanooka Lake. Dr. Ron Porter and Barbara Karthein of the Scugog Lake Stewards discovered that Eurasian Watermilfoil, usually the dominant aquatic plant in the lake, had been replaced by a new plant-like alga, Starry Stonewort. KLSA Director Mike Dolbey describes another new intruder, the Banded Mystery Snail, found in the summer of 2015 on the shoreline of Katchewanooka Lake. One other sighting has occurred at Lightning Point on Balsam Lake. Both Starry Stonewort and the Banded Mystery Snail may have implications for the fisheries. Continued monitoring is warranted.

Maintaining a Healthy Pigeon Lake: Boyd Island Now Protected and Pigeon Lake Management Planning

Boyd Island is the largest undeveloped island in southern Ontario. Ian Attridge, Lands Manager of the Kawartha Land Trust, describes a successful campaign to raise a million dollars in four months to create a fund to support the generous donation of Boyd Island to the Kawartha Land Trust by the owner. The KLT is developing a stewardship plan that will permit uses compatible with conservation of Boyd Island's cultural and natural features. Brett Tregunno, Aquatic Biologist at Kawartha Conservation, summarizes the first draft of a Pigeon Lake Management Plan currently being developed with significant community input.

Turtles and Trees – Protecting Habitat and Species At-Risk

Wendy Baggs, a volunteer with the Kawartha Turtle Trauma Centre and Matt Logan, President of Logan Tree Experts, speakers at the KLSA Fall 2015 public meeting, summarize their presentations. Seven of the eight species of turtle in Ontario are 'at-risk' due to habitat loss, road mortality and predators. The article provides advice on ways to preserve habitat and to assist turtles crossing roads. In Can You Identify a Tree's Call for Help?, Matt Logan provides information on identifying signs of disease in trees and when to call a certified arborist.

KLSA Membership and Public Meetings

In 2014, KLSA introduced a new system of paid membership. In 2016, the Board of Directors decided to discontinue the paid membership and to revert to relying on donations from individuals, businesses, municipalities and other government agencies. Please consider making a donation to support our work. KLSA holds two general meetings per year in the spring and fall. The fall meeting includes the Association's Annual General Meeting. In 2016, the spring meeting will be held at the Bobcaygeon Community Centre on Saturday, May 7 at 10 a.m.

Thank you

The Kawartha Lake Stewards Association could not achieve its goals without the extraordinary support of the many volunteers who participate in our monitoring programs and the individuals and organizations that provide financial support. Thank you also to Dr. Paul Frost, Dr. Eric Sager, Sara Kelly and their colleagues at Trent University and Fleming College for their scientific advice and ongoing support of our work, staff at the Ministry of the Environment Lake Partner Program and SGS Lakefield Research and the Centre for Alternative Wastewater Treatment at Fleming College who assist with the water testing programs. Thank you also to George Gillespie of McColl Turner LLP for reviewing our financial records. We are also very grateful to Joyce Volpe of the Lakefield Herald for her assistance with the publication of this report. For further details, visit our website: http://klsa.wordpress.com.

KLSA Editorial Committee: Sheila Gordon-Dillane (Chair), Tom Cathcart, Janet Duval, Ruth Kuchinad, Kathleen Mackenzie, Colleen Middleton, Pat Moffat, Joyce Volpe

Chair's Message

William A. Napier,
Chair, Kawartha Lake Stewards Association

This is the first time I have contributed to the KLSA annual water quality report. For the past few years, I have been an admirer of the content and detail of the report. Having an opportunity to work with those who prepare and assemble the report has given me greater appreciation of the talent of its contributors.

This year continued to show an increase in global air and water temperatures. Here in the Kawarthas, we witnessed changes to the monthly minimum, maximum and average monthly temperatures. January and February were colder than average while May was 2 ^{o}C warmer and this December was a whopping 7 ^{o}C warmer than the average monthly temperature. Changes in climate and weather are one of the many influences that can modify the Kawartha Lakes system. Other activities, such as urban and rural land use, shoreline development and the introduction of invasive species will alter the lakes as we currently know them. Therefore, the work undertaken by KLSA remains as important as it was when we were formed 15 years ago.

The collection of environmental information over the past decade and a half has resulted in a comprehensive baseline data set where trends and anomalies can be detected and investigated. KLSA is one of the key organizations undertaking 'citizen science' on the Kawartha Lakes. The Oxford Dictionary defines citizen science as "work undertaken by members of the general public, usually in collaboration with or under the direction of professional scientists and scientific institutions." KLSA undertakes annual data collection by participating in government coordinated water quality monitoring programs and through our own studies, usually in partnership with an academic institution, other community groups and/or government agencies. All of our efforts are directed at providing credible data and information to those who utilize the water resource to undertake economic, environmental and recreational activities and that includes those who call the Kawartha region home.

This year KLSA investigated, with the assistance of Kawartha Conservation and participating analytical laboratories, phosphorus variations in the Sturgeon-Cameron Lake area, as summarized later in this Report. KLSA continued to participate in the Fleming College Credit for Product course whereby students undertake a project under the auspices of a sponsoring organization, producing a video on *E. coli* testing techniques, and we offered comments to Kawartha Conservation on the draft Pigeon Lake Management Plan. Our efforts are not for naught. Because of popular demand, we ran a second edition of KLSA's *Aquatic Plants Guide*. This guide is being used by those living in the Kawartha area and further afield.

2016 promises to be an exciting year. KLSA is proposing with Trent University and Queen's University to undertake the collection and analysis of sediment core samples within the Kawartha Lakes. The purpose of the study is to collect a number of sediment core samples along the Kawartha Lakes chain to assess the geomorphological and biological nutrient loadings during the past two centuries. In the mid-1980s, the provincial government collected core samples in Sturgeon and Rice Lakes. Their study concluded that sediment deposition had increased significantly between the 1950s and the 1980s, the lake vegetation had changed significantly (with the increasing presence of aquatic plants) and the lakes were trending towards eutrophication. The updated information from our new study will allow us to evaluate these trends and the rate of eutrophication. Sediment cores provide an illustrative visual tool for the public to witness lake changes over time. The historical chronology of sediment distribution is a story that is of interest to all lake users. We hope by using this tool the following two messages will be conveyed: (i) lakes naturally change over time, and (ii) action may be required if the trend indicates the rate of eutrophication is accelerating because of the influences of human activity.

Each year about 65 volunteers spend their time on the lakes monitoring total phosphorus concentrations, water clarity, E.coli values and water temperature. Some of these dedicated volunteers have undertaken this sampling regime for well over a decade. We are grateful for their time, knowledge and dedication.

During this year there have been some changes to

Chair's Message

the KLSA Board of Directors. Doug Erlandson and Kevin Walters did not stand for re-election. We thank them for their considerable contributions to KLSA. Their presence will be missed. We have two new Board members and we welcome Colleen Middleton and Tom McAllister to our ranks as they bring their enthusiasm, talents and energy to the Board.

There are many people who contribute their time to various KLSA functions. A big thank-you is extended to the speakers who brought their passion and expertise to the spring and fall public meetings. Our costs would be overwhelming if it wasn't for the effort and the help provided by our friends at McColl Turner LLP and the Lakefield Herald. We are guided by our Scientific Advisors at Trent University and Fleming College. I would also like to acknowledge those businesses, municipal and government agencies and individuals who continue to support our work financially.

And to the reader: thank you for your interest in our work.

During the fall of 2015, KLSA, participated as project sponsor in the Fleming College Eco-system Management program. The Project was the preparation of the E. coli sampling instructional video which can be found on our website. KLSA would like to thank the students who worked on this year's Project (from left to right: David Forster, Ashliegh Evelyn, Taylor Vanderzwet, Myles Latter) and Professor Sara Kelly for their time and effort. KLSA Directors and members contributed to the study by supporting the field work and providing advice and information for the preparation of the video.

KLSA Editorial Committee:
Back row: Tom Cathcart, Pat Moffat, Colleen Middleton Front row: Kathleen Mackenzie, Sheila Gordon-Dillane, Joyce Volpe
Absent: Janet Duval, Ruth Kuchinad

KLSA

Below the Surface:
How Does Aquatic Plant Decomposition Affect Your Lake?

Lauren Banks,
B.Sc.(H)., M.Sc.

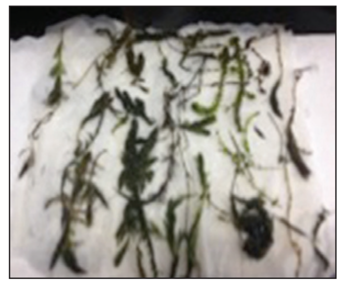
The Kawartha Lakes are a beautiful and unique network of lakes in southern Ontario. These shallow lakes are nutrient rich and thus highly productive, meaning they yield a lot of aquatic plant (macrophyte) and algal biomass. In this article, I have broadly summarized the aquatic plant decomposition research which I undertook in pursuit of my Masters of Environmental and Life Sciences. Along with members of Trent University's Freshwater Ecology Lab, I investigated how macrophytes decompose, and what factors in these lakes impact the decomposition rates.

In its *Aquatic Plants Guide* (2009), the KLSA estimated there to be approximately 0 - 3.5 kilograms of macrophytes for every square metre near the lake shoreline in the Kawartha Lakes. If all of Pigeon Lake had this level of coverage of macrophytes, there would be almost 60 million tons of macrophytes in the lake! These underwater forests provide habitat for creatures that make up the lake ecosystem, such as fish and their invertebrate food. Macrophytes compete with algae for nutrients, helping to clarify water, decrease erosion by slowing waves, reduce lake mixing, and prevent large algal blooms. However, aquatic plants can often be a nuisance for recreation by annoying swimmers and getting stuck in boat propellers.

We often think of aquatic plants as growing, flowering, and being a constant fixture in the lakes during spring and summer, but things are happening below the water's surface year-round. Similar to the leaves of deciduous trees in the fall, macrophytes also senesce as a part of their annual production-decomposition cycle. Senescence is a process where plants stop growing and begin to decompose. In lakes, decomposition processes can add nutrients back into the water and lake sediment, and may cause increased rates of terrestrialization (in-filling of a lake with sediments) over time. Macrophyte abundance has been well documented in the Kawartha Lakes, but little is known about how macrophytes decompose in these lakes -- and that's where I come in!

Aquatic plant decomposition – a hidden process

Decomposition of senesced macrophyte litter is aided by both microbial (bacterial and fungal) and invertebrate consumer activity. As consumers break down dead plant material, nutrients (nitrogen and phosphorus) are released back into the water. Sometimes, macrophyte litter isn't completely broken down and the remaining organic (plant) material is added to the sediment. An abundance of non-degraded organic material can lead to the accumulation of soft sediments in these shallow lakes. These decomposition processes are an important and often overlooked part of nutrient cycling in lakes that deserves further exploration.



Senesced macrophyte litter is often dark green or brownish in colour. In contrast fresh macrophytes are usually bright green. After collection during ice-off in May, we hand-selected all macrophyte material to ensure we used only senesced plants.

What determines macrophyte decomposition rates?

There appear to be two main controls on the rate of

Can you identify the macrophyte litter? (Myriophyllum heterophyllum).

decomposition of macrophyte litter in lakes, one being the diversity of the macrophyte community (litter quality) and the other being biotic and abiotic factors of the lake environment itself (site quality). In partnership with Trent University, I investigated how both litter quality and site quality affected decomposition rates of macrophytes in the Kawartha Lakes.

Jade, my field assistant, about to collect a lake water sample.

Macrophyte biodiversity

Aquatic plant community diversity, defined by species number and composition of species, across lake littoral (nearshore) zones is influenced by light, nutrient availability, and human development, among other things. Water depth and habitat can also affect how these species look and their chemical make-up. These differences between and within plant species can result in different decomposition rates between plant communities. We know that macrophyte communities in lakes are often comprised of many species. However, the majority of studies on macrophyte decomposition look at individual species, rather than the multiple species that create a macrophyte community. Based on studies in streams, we expect there to be differences in decomposition rates when we mix multiple species together compared to when they are held singly. The magnitude and direction of these interactions can have larger implications for lake nutrient cycling.

Experiment 1: Effects of biodiversity on aquatic macrophyte decomposition

All plants (and even humans!) are made up of specific elements in set proportions. Differences between plant species can be quantified based on differences in the key nutrient-linked elements: carbon (C), nitro-

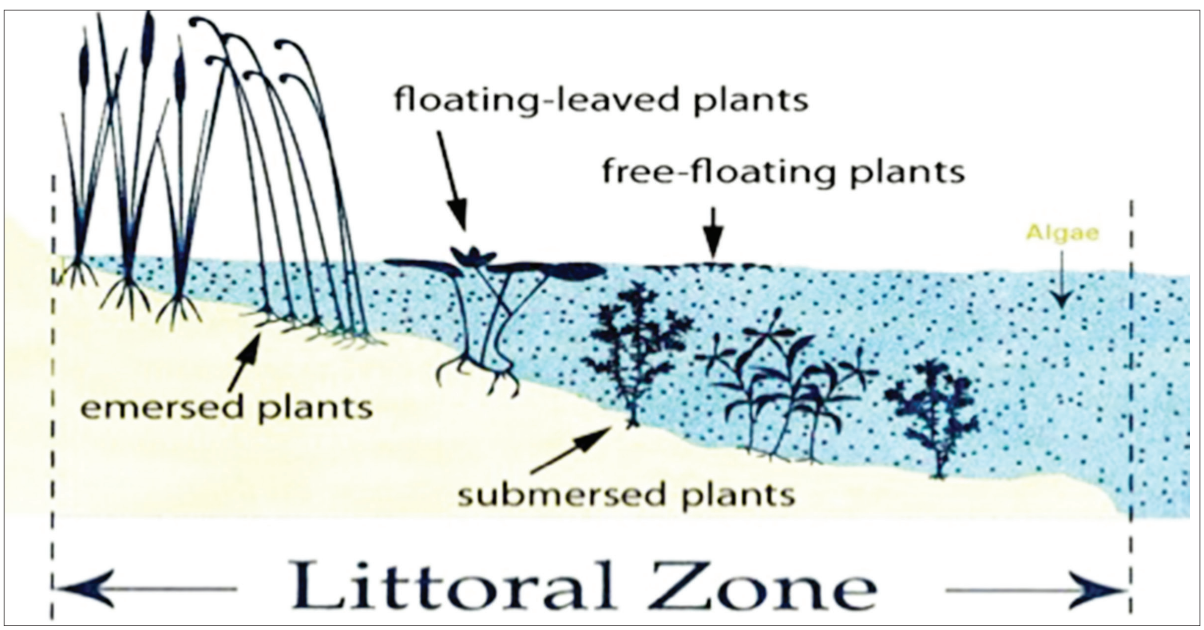


Figure 1. Classification of plants in the littoral (nearshore) zone based on whether they are emergent (also known as emersed), floating-leaved, free-floating, or submersed. Adapted from University of Florida.

gen (N) and phosphorus (P). Generally, submersed species have higher N and P relative to C, and faster decomposition rates compared to emergent species, which have lower N and P relative to C.

In this study, we used the emergent macrophyte common cattail hybrid (*Typha x glauca*), and three submersed macrophytes: variable-leaf milfoil (*Myriophyllum heterophyllum Michx*.), coontail (*Ceratophyllum demersum L.*), and fern-leaf pondweed (*Potamogeton robinsii Oakes*) to test for differences in decomposition rates in relation to the nutrient content of these plants.

Coontail litter is the most nutrient-rich, followed by milfoil, pondweed, and finally cattail which produced the most nutrient-poor litter. We then measured decomposition rates of decomposing litter (also known as detritus) from these four species in all possible combinations of single (4), double (6), triple (4) and quadruple (1) species mixtures in litterbags. The study was conducted over two summer months in 2013. Samples were collected from Pigeon Lake near Trent's Oliver Ecological Centre and analyzed at Trent University.

After 70 days, we calculated the decomposition rates of our single and multi-species mixtures based on dry mass loss over time. As expected, coontail decomposed fastest, followed by milfoil, then pondweed, and lastly cattail. We then used these single species rates to predict the decomposition rates of our multi-species mixtures, assuming there were no interactions between the component species. We also assessed how species composition (proportion of species) and richness (number of species) affected decomposition rates in the mixtures, and if the nutrient content of the mixed-species litter could predict decomposition rates.

Slower rates (inhibitory effects) were observed in only two of the eleven multi-species mixtures. Species composition affected decomposition rates, but we found no clear effect of species richness. We found that, generally, nutrient content did predict decomposition rates across our single and mixed-species packs. Based on this study, decomposition rates of whole aquatic plant communities may be readily predictable by considering the combined effects of single species rates in relation to species abundance.

Lake environment – site quality

As previously stated, site quality is important in controlling macrophyte decomposition rates. Site quality incorporates the physical and chemical environment that surrounds the macrophyte litter. External nitrogen and phosphorus inputs into ecosystems can influence the lake environment. Both natural and anthropogenic processes such as erosion, development, malfunctioning septic systems and agriculture can result in degradation of water quality and increased nutrients in lakes. It is thought that the amount of nutrients in the water and sediment can stimulate microbial decomposition by supplementing their demands for nutrients that are not met by the litter itself. With continued increases in external nutrient input in some lakes, further understanding of the influence on microbial decomposition dynamics can give insight into how decomposition processes are affected by changing environmental conditions. Additionally, residential waterfront development can shift macrophyte communities toward more submersed species, rather than emergent species. These changes can be caused by removal or loss of macrophytes near docks or swimming areas and the addition of sand or gravel to nearshore areas (Hicks and Frost 2011).

We wanted to examine how different lake environments would affect the decomposition rates of a submersed macrophyte. We would expect lakes with higher nutrients in the water and sediment to show faster rates of plant decomposition compared to lakes with lower nutrients. Because of the nutrient gradient that occurs within the Kawartha Lakes (White 2006) and abundant macrophytes to sample from, we can use these lakes to test if this prediction is accurate.

Experiment 2: *Myriophyllum heterophyllum* decomposition across the Kawartha Lakes

In this experiment we wanted to test the effect of site quality on decomposition rates of the variable-leaf milfoil (*Myriophyllum heterophyllum Michx.*) across the nutrient gradient in the Kawartha Lakes. With the generosity of members of the KLSA and Otonabee Regional Conservation Authority (ORCA), we were able to find sites on nine

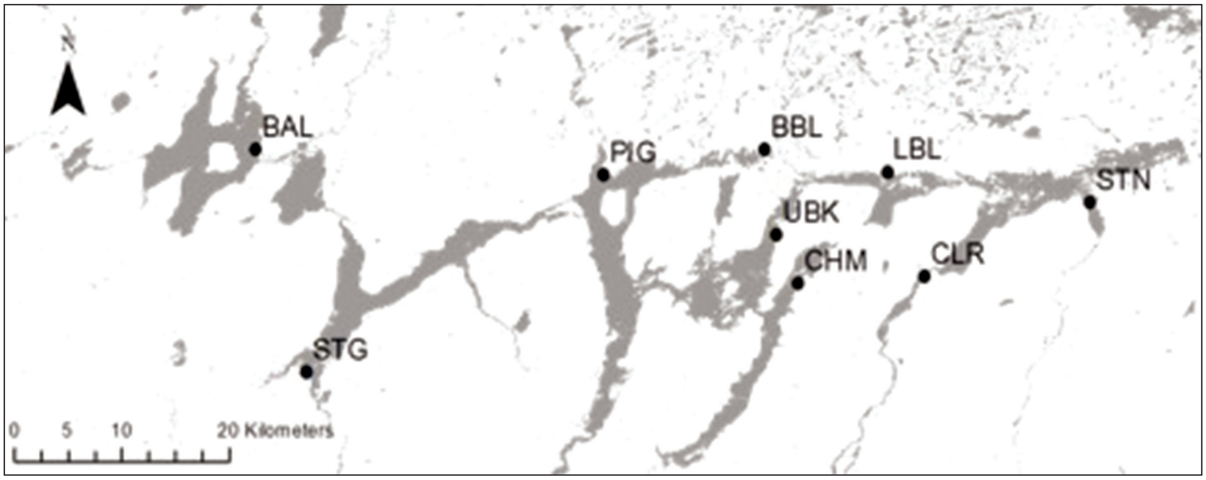


Figure 2. *Myriophyllum study sites in the Kawartha Lakes: Balsam Lake (BAL), Sturgeon Lake (STG), Pigeon Lake (PIG), Big Bald Lake (BBL), Chemong Lake (CHM), Upper Buckhorn Lake (UBK), Lower Buckhorn Lake (LBL), Lake Katchewanooka (CLR), and Stoney Lake (STN).*

lakes to perform our experiment (Figure 2). We incubated milfoil litter at each of these sites for three summer months in 2013. We also intermittently collected samples of the lake water and of the water between the sediment particles (also known as pore water) for nutrient and chemical analysis.

We found Sturgeon Lake consistently had the highest phosphorus and nitrogen in the water, and Big Bald Lake also showed high levels of nitrogen. Pore water phosphorus was the highest in Upper Buckhorn, Pigeon, and Balsam Lakes, whereas pore water nitrogen was highest in Chemong, Stoney, Lower Buckhorn, and Lake Katchewanooka.

Decomposition rates were highest in Lower Buckhorn, and lowest in Balsam and Stoney Lakes. Both Stoney and Balsam Lakes had low water N and P, so we expected these sites to have the slowest decomposition rates. We would have expected the most rapid rates to occur at sites in Sturgeon or Big Bald Lake, rather than Lower Buckhorn Lake. Our analysis only showed weak relationships between decomposition rates and nutrients in water and sediment.

Other water chemistry parameters such as dissolved oxygen, water temperature, and pH also didn't show clear relationships to decomposition rates. It is possible that the gradient of nutrient concentrations that we measured across the Kawartha Lakes weren't great enough to create a noticeable difference in decomposition rates between lakes, and that other factors, like microbial communities, may have had an important influence. We are currently working on a larger analysis to continue investigating how other site quality parameters may affect *Myriophyllum heterophyllum* decomposition rates.

Implications and recommendations

Our studies have made several important findings about aquatic plant decomposition in natural communities. The results show that aquatic macrophyte decomposition rates of communities can be predicted from the number and proportion of species found in a community. Our lake environment study suggests that there may be other factors beyond water nutrients that are responsible for differences in *Myriophyllum heterophyllum* decomposition rates. In lake littoral zones, the growth of macrophytes, their decomposition cycles and the nutrients in the water and the sediment are all intrinsically linked. By understanding relationships between the lake environment and macrophyte decomposition processes we can better inform our management strategies of these essential freshwater ecosystems.

Below the Surface:
How Does Aquatic Plant Decomposition Affect Your Lake?

Acknowledgements

Nicole Wagner and Clay Prater for their infinite patience in the lab, with statistical analyses, and for many conceptual conversations.

Jade Laycock for her assistance in the field, and for her humour.

Paul Frost for being my guide through the wavy waters of the Kawartha Lakes and my M.Sc.

The Oliver Center, KLSA, and ORCA for providing sites for this experiment.

Great appreciation goes to Natural Sciences and Engineering Research Council of Canada and Ontario Graduate Student Scholarship for providing funding for this project.

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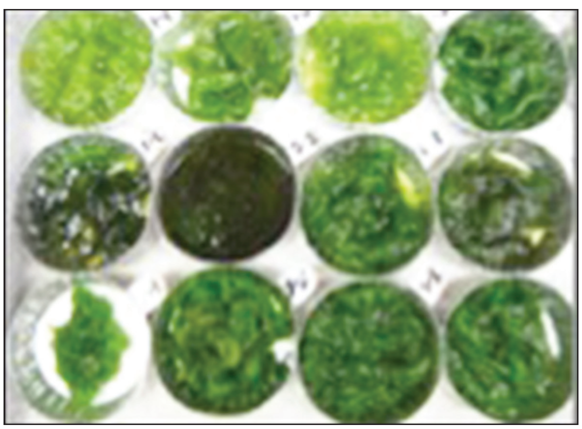
Lauren Banks and Paul Frost after Lauren's M.Sc. defense

Filamentous Green Algae Dynamics in the Kawartha Lakes

Colleen Middleton,
M.Sc., PG.ER., B.Sc., KLSA Director

For my Masters project, I studied a group of algae that is known to reach nuisance proportions in the Kawartha Lakes, specifically in near-shore environments in the spring and late summer. These algae are commonly known as Filamentous Green Algae (FGA) or 'Elephant Snot'. Scientifically, we call these algae by their Latin name, *Zygnemataceae*.

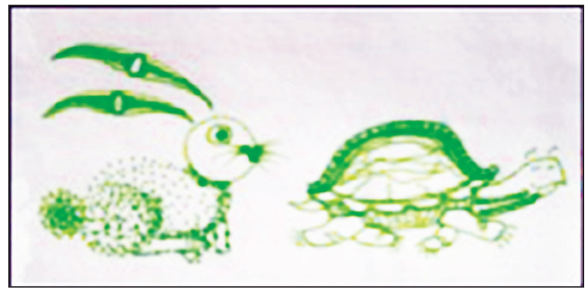
In attempts to better understand and potentially manage excessive growth of these algae, I determined the growth characteristics of one genera of *Zygnemataceae* called *Mougeotia* sp. I found that *Mougeotia* grew slowly but consistently in a wide range of nutrient conditions, and likened these algae to the growth strategy grouping called 'stress tolerators', as defined by the Universal Adaptive Strategy Theory (Grime 1977).



Colleen Middleton

Samples of FGA (Zygnemataceae) collected for chemical analysis as part of my field study.

For my field study, I tested my laboratory findings in the real world of the Kawartha Lakes. Because it is extremely difficult to quantify the abundance and growth rates of FGA *in situ*, I used internal nutrient composition as an indicator of the alga's health. It is agreed upon by phycologists (people who study algae) that the most important indicators of plant (and algae) nutrition are cellular carbon (C), nitrogen (N) and phosphorus (P) ratios. Higher C content is associated with structure, like bigger cell walls, N is essential for building amino acids and proteins, and P is an important component of DNA, RNA and phospholipids. In freshwater lakes, algae are usually limited by the amount of available P in their surrounding environment. We therefore often describe the nutritional quality or health of algae in terms of their N:P ratios, where a high N:P ratio is indicative of P-limitation and slower growth rates.



Drawing by Colleen Middleton

Single-celled microscopic algae (e.g., bloom-forming blue-green algae) usually reproduce quickly and may out-compete slower growing algae for resources and space when conditions are favourable. When environmental conditions become unfavourable, these algae are just as quick to die off. The slow-growing multicellular/macroalgae (visible to the naked eye, e.g., FGA) can out-compete single-celled microalgae in harsher conditions. This explains why Mougeotia and other FGA persist into the fall, when water nutrient levels drop off and other algal species 'starve' to death. Like the fable of the tortoise and the hare, slow and steady wins the race.

The N:P ratio at which the supply of N and P are perfectly balanced so that an alga is limited by neither one is known as its 'optimal N:P ratio'. For *Mougeotia*, the optimal ratio was difficult if not impossible to predict, since growth rates were so similar across all N:P supply ratios (Middleton 2014). For single-celled marine algae, the commonly accepted optimal N:P ratio is known as the Redfield Ratio, which is 16 N atoms to every 1 P atom (Redfield, 1958). This number can be used as a baseline on which to predict nutrient limited growth for algae in the Kawartha Lakes.

Filamentous Green Algae Dynamics in the Kawartha Lakes

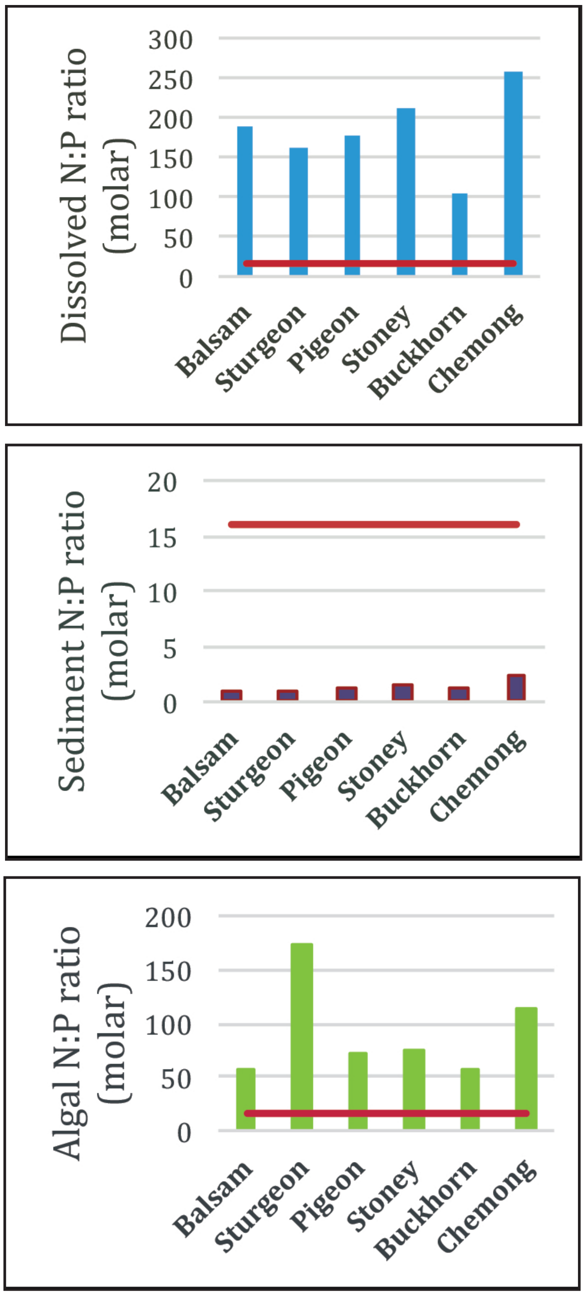


Figure 1. A) Water N:P, B) sediment N:P, and C) algal N:P at six Kawartha Lakes during late June 2012.

The red line represents the optimal conditions for the growth of marine planktonic algae (i.e., the Redfield Ratio). Above the red line, algae are P-limited, below the red line algae are N-limited.

How do the N:P dynamics of water, sediment and algae differ between Kawartha Lakes?

During late June of 2012 I examined water chemistry at several sites in six different Kawartha Lakes. The average dissolved (water) N:P ratio at each field site is shown in Figure 1A. I also looked at the N:P ratio in dried and homogenized sediment samples at the same sites (Figure 1B) as a potential source of nutrients to FGA. Finally, I studied algal chemistry on clean, dried and homogenized FGA samples (Figure 1C). I performed a regression analysis on the results, to determine if there was an effect of water N:P on algal N:P, and then to determine if there was an effect of sediment N:P on water N:P (Middleton 2014, unpublished data).

In Figure 1, the lakes are arranged in order of their water flow pattern from west to east. The Redfield Ratio (16 N to 1 P) is indicated on each figure with a red line from the y axis. As you can see in Figure 1A, water (dissolved) N:P is always far above 16:1, meaning the limiting nutrient in terms of supply is P (of the two). Similarly, FGA had a higher N:P than 16:1 in all lakes, which confirms that, according to the Redfield Ratio for optimal algae growth, FGA in the Kawartha Lakes is P-limited. It is important to note, however, that the Redfield Ratio was determined based on single-cellular algae, which may have slightly different nutrient requirements than filamentous algae.

Water (dissolved) N:P ratio generally exhibited a downward trend across the lake gradient (Figure 1A), which supports the P-gradient discussed in Mike White's 2006 report (Figure 2). Chemong appears to be an exception. All samples were taken in the northern part of Chemong Lake, which has relatively undisturbed shorelines and is surrounded by forested land. Perhaps this section of the lake is unique in its nutrient inputs and water chemistry.

Filamentous Green Algae Dynamics in the Kawartha Lakes

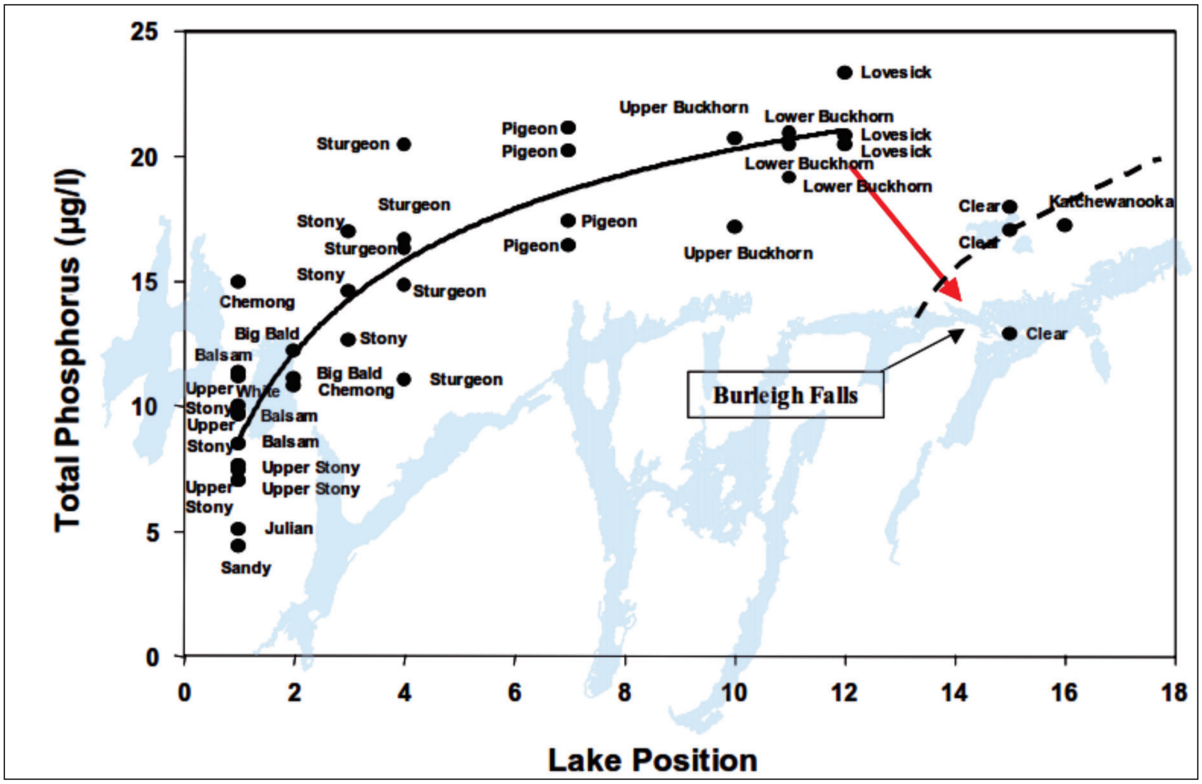


Figure 2. Recap of Mike White 2006 data showing increasing water total P levels on a west to east gradient among the Kawartha Lakes (adapted from White 2006). Lake Position is defined as 1 plus the number of lakes that eventually feed into it. A dilution occurs at Burleigh Falls, which feeds into Upper Stoney Lake, and results in a decrease in P concentration in Stony Lake.

Sediment chemistry follows a similar trend as water chemistry, but it is hard to discern in this Figure 1B because the numbers are so small. These low N:P ratios of sediment (around 1:1) indicate an abundance of P relative to N in all lakes. Note that sediment P was actually a measure of total P (TP), which includes both available and non-available forms. Regardless, sediment is likely a source of P to plants and algae.

Finally, algal chemistry also follows similar trends to water and sediment (Figure 1C). The exception here is Sturgeon Lake, which had a very high N:P ratio driven by a high percentage of N in the algal cells. In this case, water is most likely the source of N to these algae. This data could also show an error due to small sample size (two sites with algae), or some other site characteristic could have affected the alga's ability to take up P.

What does this mean for algal growth in the Kawartha Lakes?

While it may be hard to discern a pattern between water N:P and internal algal N:P in Figure 1, statistical analysis does reveal that there is a slight but significant relationship between water N:P and algal N:P in the Kawartha Lakes. What is more important, however, is the stronger relationship between algal N:P and sediment N:P. This could be due to the fact that FGA begin their lives as microscopic cells within or close to the lake bottom. Over time the growing 'blooms' of FGA may rise and fall within the water column, lending more significance to water chemistry at certain times in their life cycle.

I also found that water, sediment and algal N:P were highly variable WITHIN lakes. This is important because it indicates that in the Kawartha Lakes, nutrient

Filamentous Green Algae Dynamics in the Kawartha Lakes

dynamics are more diverse within lakes than between lakes, and we cannot generalize the presence and growth of FGA based on lakes alone. We must take site characteristics such as sediment type, water depth, dissolved oxygen, pH, light level, wave action and competition with other algae into account. Despite some variability in the data, my field study shows that site-specific sediment characteristics warrant greater consideration when attempting to predict the nutritional quality and associated growth rates of FGA on the Kawartha Lakes.

From a management perspective, addressing water nutrients alone is not enough to prevent the growth of some types of algae. In low water nutrient conditions, FGA may be obtaining nutrients from sediments. This helps explain why FGA are found in such a range of water nutrient conditions.

If you must manage for the presence of this alga, DO NOT attempt to chop it up. This only divides the filaments into millions of cells, which may then grow into new filaments. The KLSA's *Aquatic Plants Guide* (2009) discusses several plant and algae management techniques and their effects on the benthic community. They found that raking was the most effective method for removing algal biomass, and at the same time had the least detrimental effect on the benthic community.

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2014 Kawartha Lakes Sewage Treatment Plants Report

Phosphorus Discharges Increase Dramatically

Mike Dolbey,
Ph.D., P.Eng., Director, KLSA

As we have indicated before, our sewage treatment plant data is always behind one year, as the reports for the previous year are not available to us before going to press. Most of these reports are now online on the City of Kawartha Lakes website: http://www.city.kawarthalakes.on.ca/residents/water-and-wastewater/reports/annual-wastewater-reports.

Again this year we have included two 'indirect' sewage treatment plants (STPs), Minden and Port Perry, which are outside of the City of Kawartha Lakes. By indirect, we mean those plants that are not discharging directly to our Kawartha Lakes, and have at least one body of water in between to attenuate the effects of the effluent discharge.

Minden

Minden's plant discharges to the Gull River just above Gull Lake, which is two lakes away from our most upstream Kawartha lake, Shadow Lake. In 2014 this plant had a phosphorus (P) removal rate of 96.3%, down slightly from 2013's 97.2%, resulting in a P discharge to the river of 19.4 kg for the year. There were four minor bypasses of the tertiary filters in 2014 but it is estimated that they resulted in less than 0.1 kg extra P load, which is included in the total.

Average *E. coli* discharges were up from the previous year at 9.0 colony forming units per 100 mL (cfu/100 mL). No spills or overflows and no complaints were reported.

Coboconk

This lagoon system continued to function well in 2014, with discharges to the Gull River just above town occurring in April/May and November/December only. The average phosphorus contents of all effluent discharges were stated to be <0.03 mg/L, the minimum reporting resolution, which is excellent. With lagoon systems such as Coboconk's, the volume of effluent released from the lagoons each year may be considerably more or less than the volume of raw input to the plant during the year. This may be due to operational considerations and variable amounts of precipitation and evaporation. Hence determining the phosphorus removal rate is problematic. Considering all inputs and outputs over the past four years, the overall phosphorus removal rate was greater than 97.8% during that period and the 2014 total annual discharge of phosphorus was less than 3.1 kg. Although it did not achieve our desired target of 99%, it is quite good performance.

Average *E. coli* in the discharges in May were a normal 3.7 cfu/100 mL and in November/December were reported to be 0 cfu/100 mL. No spills, bypasses or overflows were reported. Only one odour complaint was received in May but it was brief and could not be confirmed.

Fenelon Falls

We are pleased to see that this year the Fenelon Falls plant report is correctly reporting the annual average phosphorus removal rate rather than the maximum month's phosphorus removal rate. For 2014, the removal rate was 96.6%, down from 97.1% in 2013 and below our target of 99%. This resulted in a P discharge to Sturgeon Lake of 30.8 kg for the year.

Cross-connections (storm sewer connections into sanitary sewer systems and vice versa) still appear to be a serious problem here. High rainfall and snowmelt between April 5 and 16th of 2014 resulted in two bypasses at the Colbourne Street pumping station. It was estimated that 4,214 and 14,806 m^3 of untreated waste were discharged directly to Sturgeon Lake. These discharges amount to almost 5% of the total amount of wastewater processed by the plant during the year. The large stormwater component of the bypass probably reduced the phosphorus concentration somewhat. Even so, the estimated additional amount of phosphorus that entered the lake from this source was 21 kg, which reduced the effective removal rate to 94.5%. To solve the ongoing inflow issue, CKL is planning to install a holding tank at the Ellice Street pumping station. Tenders for its construction have been issued and it should be completed by the end of 2016.

Again this year *E. coli* levels in the effluent were low at about 2 cfu/100 mL. No spills or overflows and no complaints were reported.

Lindsay

The Lindsay plant is the largest on the lakes. The 2014 phosphorus removal rate was 98.5%, up

Phosphorus Discharges Increase Dramatically

slightly from 98.0% in 2013. This resulted in a P discharge to Sturgeon Lake of 220.0 kg for the year. However, between April 14th - 20th there were bypasses of 210,306 m^3 of partially treated effluent and 77,165 m^3 of untreated effluent from the plant which amount to about 5.3% of the annual volume treated. Using a bypass phosphorus concentration of 1.4 mg/L, only half the annual average (2.8 mg/L), and less than the April average (1.77 mg/L), an additional 402 kg of phosphorus was bypassed to the lake reducing the plant's effective removal rate to 96.0%. The total 2014 phosphorus discharge, including the bypass, was 622 kg.

On a brighter note, average *E. coli* in the discharge was 2.6 cfu/100 mL, compared to 4.0 cfu/100 mL in 2013. No spills and overflows and no complaints were reported in 2014.

Bobcaygeon

This town has two side-by-side sewage treatment plants. In the past, one of the plants was problematic, with operational problems and high phosphorus discharges as documented in the separate reports for each plant. Since 2011, only one performance report has been produced giving results for the combined output of the two plants. In 2014 the average removal rate was 97.9%, up from last year's 96.9% but still below our desired target of 99%. The reported annual phosphorus load was 61.7 kg, down from last year's high 85.4 kg, but more than the 2012 load of 43.2 kg.

E. coli discharges were moderate at 7.42 cfu/100 mL on an annual basis. One overflow at SPS3 pumping station caused water to run into a storm sewer that may have resulted in spillage to the lake. No quantity or quality information was given. Odour from the plant was reported in previous years but no complaints were made in 2014. Various odour abatement technologies continue to be studied. Meanwhile, operational strategies are being employed to minimize the impact of odour on local residents.

Omemee

This lagoon facility did not require any emergency discharges to the Pigeon River in 2014 and much of the effluent was spray-irrigated onto nearby fields. A subsurface disposal system began commissioning trials at the site in March, 2014 and operated simultaneously with the spray-irrigation system for parts of the year. For reasons unknown, this facility is not required to provide the same level of detailed information about the quantity and quality of raw influent or treated effluent that is required of the other plants reviewed. It is stated that the average effluent phosphorus concentration was reduced to 1.0 mg/L, equal to the allowable 1.0 mg/L but there is no information that allows a removal rate to the point of spray irrigation or subsurface disposal to be determined. However, because the effluent is applied to land far from the lake, removal is probably almost 100% with respect to our lakes. No information was provided about *E. coli* levels this year.

Kings Bay

This plant functioned adequately in 2014, despite a few mechanical breakdowns, and the effluent targets continued to be met. Phosphorus discharge to the underground disposal bed averaged 0.38 mg/L, up from 0.21 mg/L in 2013, out of an allowable 1.0 mg/L. The annual daily loading for 2013 was 0.017 kg per day, only 10% of the allowable discharge volume of 0.17 kg per day. Phosphorus removal efficiency within the plant was 94.1%. However, actual loading to the lake likely remains nil since the discharge is to the ground, as with a septic tile bed.

Monitoring wells located both up and down gradient from the disposal site have had sporadic high P readings for a number of years. In September 2013 the well casings were repaired with 'screenings and holeplug' and the surface was graded around the wells to prevent infiltration of surface water. Monitoring in 2014 again provided occasional high readings believed to be due to sediment. The Tier 1 'Alert' monitoring (4 times a year) that has been in place since 2011 will continue. Apart from the occasional high readings the monitoring wells suggest no significant phosphorus migration towards the lake or the Nonquon River. For example, in December the 8 monitoring wells had an average P concentration of 0.068 mg/L and a maximum of 0.228 mg/L, all less than the alert trigger limit of 0.3 mg/L. Since these wells average 150 m from the lake or the Nonquon River, this suggests that, at least for the time being, we still have effectively 100% removal. No bypasses to the river were reported this year.

2014 Kawartha Lakes Sewage Treatment Plants Report

Phosphorus Discharges Increase Dramatically

Port Perry

This plant consists of lagoons that discharge seasonally into the Nonquon River northwest of Port Perry, which in turn empties into Lake Scugog at Seagrave, where the Kings Bay facility is located. In 2014, phosphorus was reduced to a monthly average of 0.19 mg/L for a total loading of 144.2 kg. However, this reflects a removal rate of only 96.6%, a poor performance compared to most other area sewage plants. No information was provided about *E. coli* levels this year. There were no reported bypasses or spills. One odour complaint was received from the public in April when odorous air was released as the ice melted on the lagoons.

The Port Perry lagoons are to be replaced by a new tertiary treatment plant to allow for the expansion of Port Perry. Construction began in May, 2015 with completion scheduled for the end of 2016. This new plant will have a much larger capacity than the old lagoon system and should result in reduced phosphorus discharge amounts and, we hope, a 99+% removal rate that we would like to see attained by all STPs in our area.

Summary

The total volume of phosphorus discharged to the mainstream Kawartha Lakes from the three aquatic discharge plants in 2014 was 737 kg compared to 351 kg in 2013, 265 kg in 2012, 392 kg in 2011 and 416 kg in 2010. This very poor performance in 2014 was the result of spring bypasses caused by the prolonged cold winter and late large spring snowmelt that overwhelmed the storage facilities at the Fenelon Falls and Lindsay plants.

If we include all the plants that we now monitor, we had total phosphorus loading to the lakes of 904 kg in 2014 compared to 471 kg in 2013, an increase of 90%. If all plants were to achieve the 99% removal rate that we would like, the total phosphorus discharge for the year would have been about 244 kg or about 27% of the 2014 total.

KLSA Annual Review of Area Sewage Treatment Plant Performance

Plant Location - Discharges to & Type	Year	Phosphorus Removal Rate % (1)	Total Annual TP Load Out kg (2)	Annual TP Load if 99% kg (3)	E. coli (cfu/100 ml)	Bypasses, Spills, Comments
Minden - Gull River	2012	98.0%	12.8	6.4	2.7	
Extended aeration activated sludge	2013	90.1%	53.9	5.4	7.2	Bypass resulted in ~40 kg extra P load
process with tertiary treatment	2014	96.7%	19.4	5.8	9.0	
Coboconk - Gull River Mill Pond	2012	99.4%	1.2	1.2	5.5	
Dual lagoons	2013	97.4%	3.2	1.0	12.4	
semi annual discharge to river	2014	>97.8%	< 3.1	1.7	3.7	
Fenelon Falls - Sturgeon Lake	2012	97.3%	27.5	8.7	2.0	Bypass resulted in ~ 8.1 kg extra P load.
Extended aeration activated sludge	2013	95.2%	45.6	9.1	2.0	Bypass resulted in ~ 19.1 kg extra P load.
process with tertiary treatment	2014	94.5%	51.8	9.1	2.0	Bypass resulted in ~ 21 kg extra P load.
Lindsay - Sturgeon Lake	2012	98.1%	193	101.6	2.4	
Flow equalization lagoons;	2013	98.0%	220	112.2	4.0	
extended aeration activated sludge	2014	96.0%	622	149.7	2.6	Bypass resulted in ~ 402 kg extra P load.
process with Actiflo tertiary treatment						
Bobcaygeon - Pigeon Lake	2012	97.8%	43.2	19.6	2.5	
Extended aeration activated sludge	2013	96.9%	85.4	27.5	3.4	
process with tertiary treatment	2014	97.9%	61.7	29.4	7.4	
Omemee - Fields/Underground	2012	100.0%	0	0.0	309.0	
Dual lagoons with spray irrigation;	2013	100.0%	0	0.0	-	
pumped into underground disposal	2014	100.0%	0	0.0	-	
beds beginning 2015						
King's Bay - Underground	2012	100.0%	0	0.0	-	
Pumped into underground disposal	2013	100.0%	0	0.0	-	
beds.	2014	100.0%	0	0.0	-	
Port Perry - Lake Scugog	2012	96.7%	148.9	45.1	-	
6 lagoons, 2 extended aeration cells	2013	97.0%	121.3	40.4	-	
effluent discharge to Nonquon River.	2014	96.6%	144.2	42.4	-	

(1) 'Phosphorus Removal Rate %' is the percentage of the phosphorus in the plant influent that is removed before effluent is discharged.
(2) 'Total Annual TP Load Out kg' is the total weight of phosphorus, in kilograms, that is discharged from the plant during the year.
(3) 'Annual TP Load if 99% kg' is the total weight of phosphorus, in kilograms, that would be discharged from the plant during the year if the plant achieved a 99% Phosphorus Removal Rate.

E. coli Bacteria Testing

Kathleen Mackenzie,
KLSA Vice-Chair

Our sincerest thanks go to our fleet of conscientious volunteers who not only collect samples, but also transport them to the laboratory, all during precious summer hours. Also thanks to our 'postman', Mike Dolbey, who distributes the results to all our volunteers at top speed.

In 2015, KLSA volunteers tested for *E. coli* at 76 sites, six times over the summer, on 15 lakes. A summary of the readings can be seen in the table below. Please see Appendix E for complete results.

E. coli levels	0 – 20 *E. coli* cfu/100 mL	20-50 *E. coli* cfu/100 mL	50-100 *E. coli* cfu/100 mL	Over 100 *E. coli* cfu/100 mL
Number of readings Total: 422	375	29	12	6

Consistent with past years, readings reflected excellent recreational water quality in the Kawartha Lakes. A typical Kawartha Lake site exhibits almost all readings below 20 cfu (colony-forming units) *E. coli*/100 mL, with a minority of sites having an occasional temporary reading between 20 cfu and 200 cfu. These numbers are excellent for a lake with plentiful wildlife.

A beach is declared unsafe for swimming at the level of 100 *E. coli*/100 mL. There were only 6 of these readings out of a total of 422, and the sites had returned to low levels when retested within a few days.

It would be interesting to know where the *E. coli* was coming from. Birds? Wild mammals? Livestock? People? Unfortunately, KLSA's testing protocol is not sophisticated enough to determine this. However, we can make educated guesses. This year, as in other years, we have seen that higher counts were found:

- in areas with plentiful waterfowl populations, either on the shoreline or on nearby shoals
- in enclosed bays after a heavy rainfall (indicating wildlife bacteria in runoff)
- areas with heavy human use. Higher counts here may come from stirred-up sediments.

We can help keep our lakes cleaner by:

- discouraging large populations of waterfowl by keeping our shorelines well vegetated. (Clear sightlines from the water to lush green grass are very inviting to geese!)
- reducing erosion, e.g., interrupt the flow of water off the land with plants and curving paths
- minimizing lake sediment disturbance, e.g., keep your boat's power down until you are in deeper water.

If you would like to test a location on your lake, please contact us. KLSA receives a very reasonable rate from our two laboratories, SGS Canada in Lakefield and the CAWT laboratory at Fleming College in Lindsay. KLSA will pay for up to three sites for an association, or one site for individuals, for the first year of testing. Try it out for free! You can see exactly what is involved by viewing our new *E. coli* testing video, found on the KLSA website.

Kathleen Mackenzie,
KLSA Vice-Chair

Many thanks go to our team of volunteer testers who headed out six times this summer to test for total phosphorus on 42 sites in 14 lakes. We all benefit from the time and miles you generously contribute. Also thanks to our phosphorus test coordinator, Shari Paykarimah, who ensured that everyone was trained and equipped.

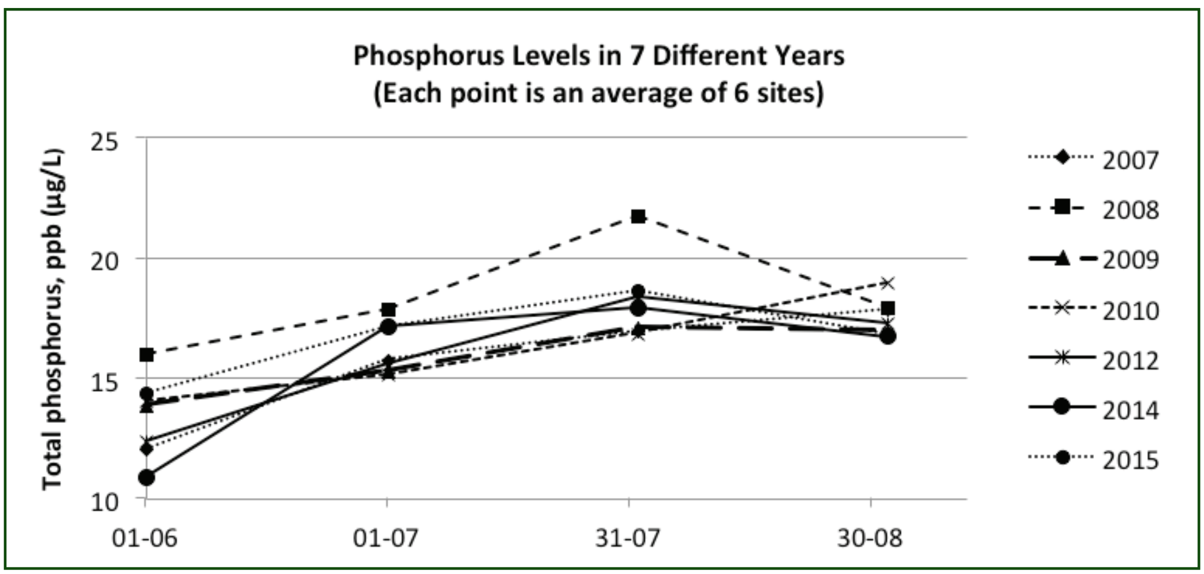
If you would be interested in testing (it's a good excuse for a boat ride!), please let us know. We are especially interested in finding a tester for Cameron Lake and for south Pigeon Lake. Kits are mailed directly to you, and the program is free.

This section is a summary of the 2015 results. For complete data and graphs, please see Appendix F.
It's important to keep track of phosphorus; rising phosphorus levels can result in nuisance algae 'blooms' and loss of water clarity. Rising phosphorus levels are thought to be due to increased phosphorus inputs from insufficient treatment of urban stormwater, careless agricultural practices involving fertilizers and manure, and less-than-perfect practices at sewage treatment plants. There is also potential phosphorus input from cottagers and shoreline residents. Stable phosphorus levels are an indication of a healthy, well-cared-for lake.

Was 2015 different from other years?
KLSA volunteers have now 'racked up' 14 years of Lake Partner Program phosphorus data. This allows us to look at a large watershed over a long period of time. A long term analysis of the data in our 2014 Annual Report determined that phosphorus levels have been stable for 13 years in all the Kawartha Lakes, and this stability has continued in 2015. One might have expected the extremely long winter and very late spring to have shifted spring phosphorus levels, but June levels were similar to those in previous years. The rest of the summer was also average. (See graph below.)

In this graph, each point represents the average phosphorus levels of six sites in different lakes. Think of mixing all the water in Pigeon, Upper Buckhorn, Lower Buckhorn, Lovesick, Stony and Katchewanooka Lakes together. Then measure the phosphorus level of this mega-lake. Two conclusions can be drawn from this graph:

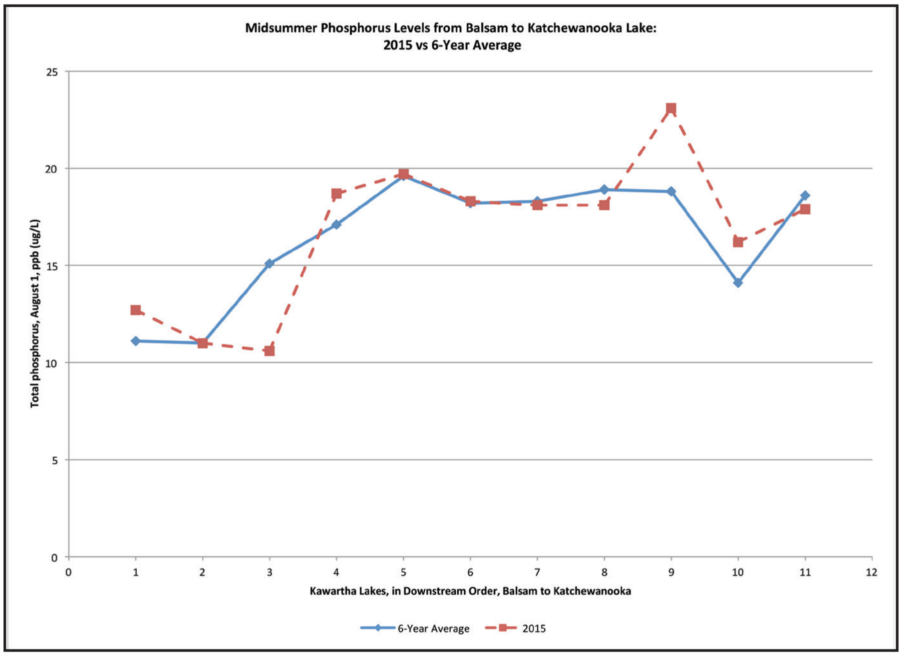
- Phosphorus levels on the Trent-Severn Waterway start out low in the spring, probably due to a large flow of northern water during the spring flush. Phosphorus levels rise until early August, then decrease somewhat by September 1. This pattern has been seen every year.
- 2015 was very similar to other years.



Phosphorus Testing

Same Pattern as Water Flows Downstream

Another way to compare 2015 to previous years is to look at the midsummer (peak) phosphorus levels on each lake, as in the graph below.



Each point on the x-axis represents one phosphorus testing site:

#1	Balsam: E. Grand Is.	#5	Sturgeon: Muskrat Is.	#9	Lovesick: McCallum Is.
#2	Cameron	#6	Pigeon: mid-Sandy Pt. Boyd	#10	Stony: Mouse Is.
#3	Sturgeon: Fenelon R.	#7	Buckhorn: Buoy 310	#11	Katchewanooka: Douglas Is.
#4	Sturgeon: Sturgeon Pt.	#8	Lower Buckhorn: Buoy 267		

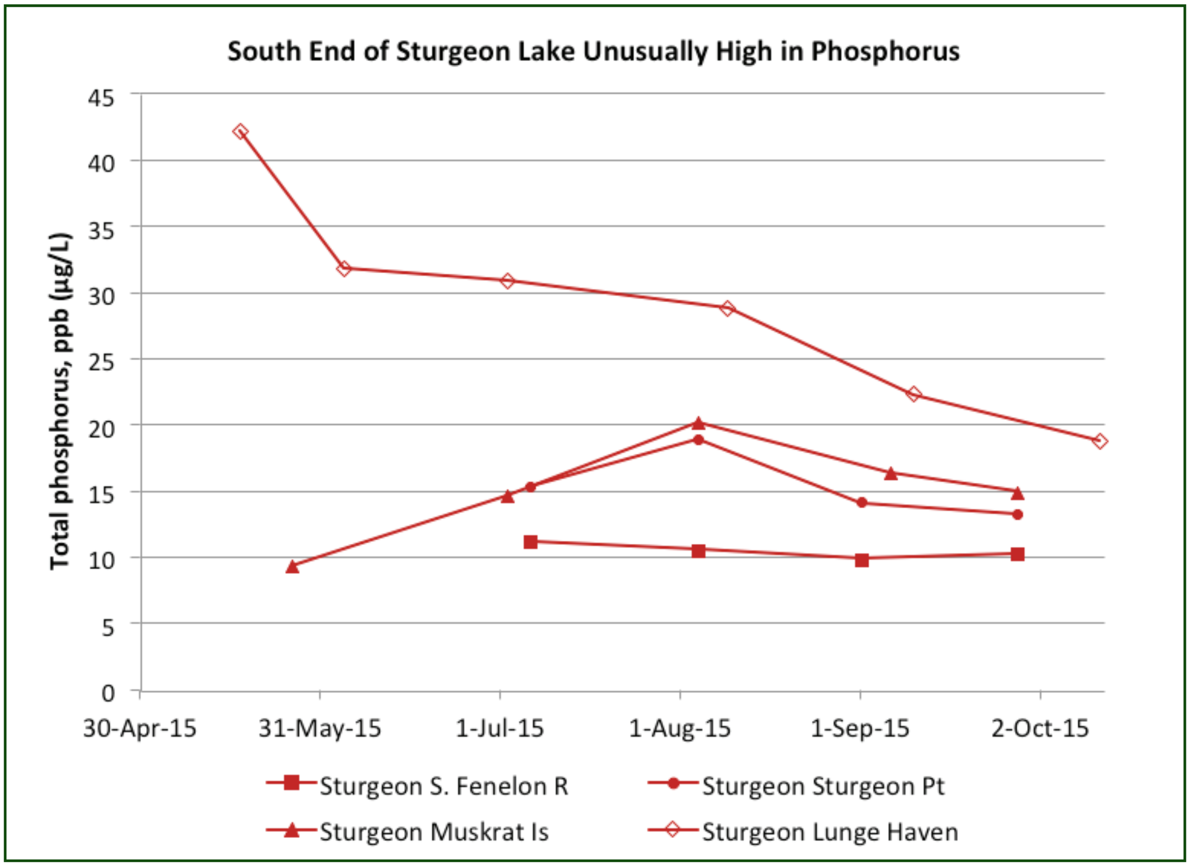
This graph tells us four things:

- Phosphorus levels start low in Balsam Lake, increase fairly sharply in Sturgeon Lake, stay at that level through Pigeon, Lower Buckhorn, Upper Buckhorn and Lovesick, decrease somewhat in Stony, and then start rising again in Katchewanooka. This pattern has been seen every year, and is further discussed in Appendix F.
- This year, the upstream end of Sturgeon Lake had phosphorus levels about 5 ppb lower than usual. However, the more downstream sites in Sturgeon Lake showed average phosphorus levels.
- This year, Lovesick Lake had midsummer phosphorus levels about 5 ppb higher than usual. One might wonder if the sample was contaminated, but a sample taken at another site in Lovesick Lake at the same time was also high. This probably relates to Stony Lake's somewhat high readings.
- Many of the Kawartha Lakes have midsummer readings approaching the 20 ppb level that the Ministry of the Environment suggests is maximum for good recreational value. (See Appendix F.) We want to ensure that our lakes do not become further enriched with phosphorus.

Phosphorus Testing

South end of Sturgeon Lake a special case

The south end of Sturgeon Lake, the Lunge Haven site, had very high phosphorus readings. See graph below.



In the past, KLSA has seen high counts in the south end of Sturgeon Lake (Snug Harbour site, 2005/6/7/8).This area is very shallow with thick sediments, so the high phosphorus levels may be caused by a stirring up of the sediments. It may be necessary to move to a deeper location to find measurements that are not contaminated with sediments.

Summary

2015 was, in general, an average year for phosphorus levels. Most lakes had phosphorus levels starting at 10 ppb, rising to about 20 ppb and falling somewhat in September. Four lakes – Balsam, Big Bald, Sandy and Upper Stoney -- were low-phosphorus lakes, whose levels remained near 12 ppb throughout the summer. The south end of Sturgeon Lake had high phosphorus levels compared to all other sites.

The only anomalies in 2015 were a low midsummer phosphorus level in the upstream end of Sturgeon Lake, and a high midsummer level in Lovesick Lake.

Investigation of the Apparent Increase in Total Phosphorus between Cameron Lake and Sturgeon Lake

Mike Dolbey
Ph.D., P.Eng., KLSA Director

Summary

A project carried out by KLSA in 2015 to investigate whether sampling procedure or unknown sources along the Fenelon River could be responsible for the apparent phosphorus jump seen in Lake Partner Program (LPP) Total Phosphorus (TP) data between Cameron Lake and Sturgeon Lake is described. It was concluded that there is no significant difference in TP content between samples collected near the surface and those collected from the entire water column, from the surface down to the measured Secchi depth. It was also concluded that there is no compelling evidence for significant additional sources of phosphorus entering the Fenelon River between Cameron Lake and Sturgeon Lake. The failure of these explanations to account for the apparent phosphorus jump has led to the development of a new hypothesis that it may be caused by silt stirred up by the incoming Fenelon River. Further investigation is recommended to explore this possibility. During this project, the TP content of commonly collected samples was measured by three different laboratories. While the pattern of the three sets of results was similar, the magnitudes varied significantly. The LPP results were consistent with expectations. Further investigation is recommended to resolve the variation between laboratories.

Background

The Ontario Ministry of the Environment's Lake Partner Program has facilitated the collection of Total Phosphorus measurements in Ontario Lakes since 2002. Since it began, KLSA has reviewed the results of these measurements for lakes in our area. In past years, it had been noted that a consistent increase in TP of between 2 and 4 parts/billion (ppb) appeared to occur between Cameron Lake and Sturgeon Lake. This increase has been referred to as the 'phosphorus jump'.

Cameron Lake receives most of its water from the north (approximately half its water from the Burnt River and half from Balsam Lake) and is considered a low phosphorus lake. LPP measurements in low phosphorus lakes are typically made only once a year. Measurements in Cameron Lake have been sporadic over the past 13 years of testing but the analyses have consistently produced a result of about 10 ppb as shown in Figure 1. Cameron Lake is one of the deepest of the Kawartha lakes with an average depth of 9.3 metres (m) and maximum depth of 18.2 m. Most LPP sites in Cameron Lake have been described as 'deep spots' and Secchi depth measurements have averaged 3.8 m. They are located well away from the Rosedale River and Burnt River, the primary inflows to Cameron Lake.

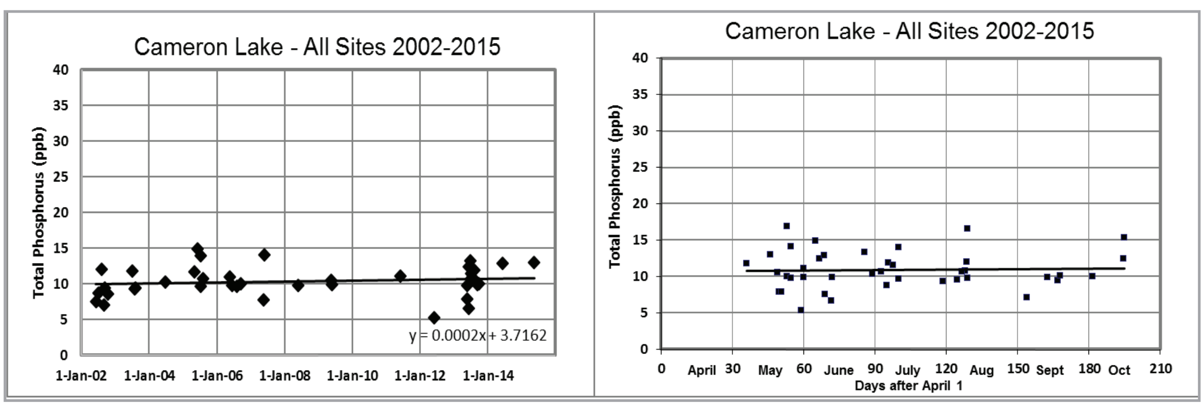


Figure 1. LPP Total Phosphorus results for Cameron Lake, LPP STN 6905 all sites 2002-2015.

The outflow of Cameron Lake is at Fenelon Falls where its waters drop ~7.2 m over a limestone escarpment into the Fenelon River. The narrow Fenelon River runs through a limestone gorge for approximately 1.5 km before emptying into the northwest arm of Sturgeon Lake. There are no other significant water sources into this area of Sturgeon Lake. However, the effluent outfall of the Fenelon Falls Wastewater Treatment Facility (WWTF) (located at 216 Ellice Street, Fenelon Falls) on the west side of Sturgeon Lake is known to be close to the outlet of the Fenelon River but its effect is expected to be minimal, as discussed further below.

Since 2005, TP measurements in Sturgeon Lake downstream of the outlet of the Fenelon River have been made by the same LPP tester. Between 2005 and 2012, measurements were made at the Trent-Severn Waterways (TSW) N5 buoy (GPS 44º-30′-31″N / -78º-43′-10″W) which is about 2 km south of the Fenelon River outlet. In 2013, at the request of Kawartha Conservation, the site was moved to the TSW N12 buoy (GPS 44º-31′-24″N / -78º-43′-39″W) which is about 0.2 km south of the Fenelon River outlet. The original site is well downstream of the Fenelon Falls WWTF. The new site is about 250 m downstream of the facility's outfall. The combined measurements from the two sites are shown in Figure 2. There has been considerable variability in readings over the years but the average annual peak TP based on all the data is around 14 ppb which is about 4 ppb higher than in Cameron Lake. The last five years of data (in red) have exhibited less variability with an average peak TP of 12.5 ppb. Both the old and new test sites are at locations close to the TSW boat channel, have water depth of about 3 m and have very silty bottom sediments.

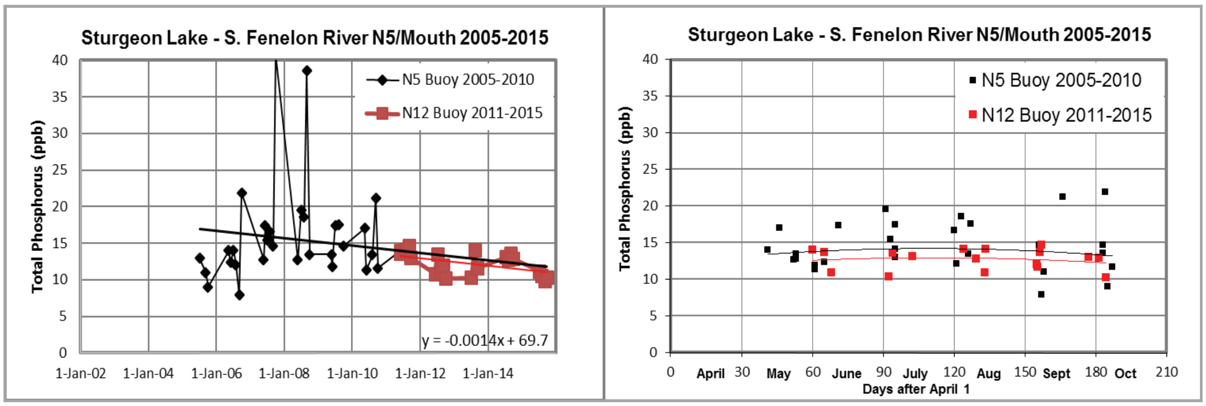


Figure 2. LPP TP results for Sturgeon Lake, LPP STN 6924 - Site 6 (N5 Buoy) 2005-2010 (black) and Site 9 (N12 buoy) 2011-2015 (red).

From 2010 to 2013, as research for the Sturgeon Lake Management Plan, Kawartha Conservation (KC) requested the LPP tester to collect an unfiltered surface water sample at this site in addition to the filtered LPP sample which is collected by lowering the sample bottle through the water column to the Secchi depth. At shallow sites, this depth is frequently close to the silty bottom. KC had TP analysis of the surface water samples, from these sites and from Cameron Lake, performed by a commercial laboratory, Caduceon. Dr. Alex Shulyarenko, formerly with KC, has said that his analysis of the data showed no significant difference between the Cameron Lake and the Sturgeon Lake TP results. It was his opinion that no significant difference in TP measurements should be expected between the two lakes because of the large flow and the lack of identified phosphorus sources between them. The study of surface versus water column sampling was initiated to investigate the difference between KC's conclusion and the LPP results.

What accounts for the apparent TP jump between Cameron and Sturgeon Lakes in the LPP data? One hypothesis is that the higher results in the Sturgeon Lake LPP tests are due to the difference in sampling collection depth. At the Sturgeon Lake LPP site the shallow depth, silty bottom and collection in close proximity to boat traffic may result in the sample containing more phosphorus at lower depths than at the surface. A second hypothesis is that a significant source of phosphorus is entering the Fenelon River somewhere between Cameron Lake and Sturgeon Lake. While the output of the Fenelon Falls WWTF cannot be ruled out, calculations suggest that it is too small a source to result in the observed TP increase. The WWTF would result in an increase of only 0.03 ppb if its output of 0.4 kg P/week is fully mixed with low summer river flow of 12 x 106 m^3/week. Hence other larger sources would be required to result in the apparent increase of 2 to 4 ppb between Cameron and Sturgeon Lakes.

In 2015, a KLSA research project was carried out to investigate the possible causes of the apparent phosphorus jump in LPP TP data between Cameron Lake and Sturgeon Lake.

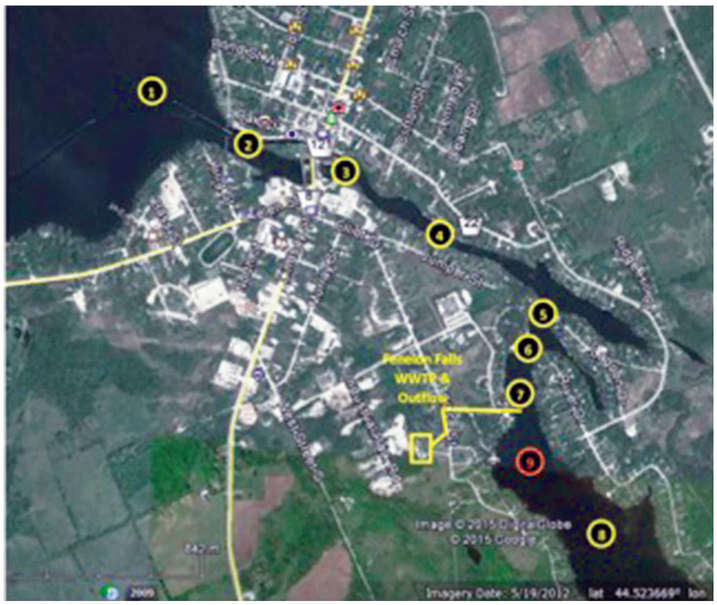
Investigation of the Apparent Increase in Total Phosphorus between Cameron Lake and Sturgeon Lake

Method

To test each of the two hypotheses outlined above, two series of measurements were carried out three times during the summer of 2015:

1) To determine if sampling at the surface (Surface) versus the water column to Secchi depth (Secchi Depth) resulted in different TP measurements, samples were collected at the LPP N12 buoy site (#9 in Figure 3) from each depth for comparative evaluation.

2) To determine if an additional source of phosphorus existed somewhere along the Fenelon River, eight samples were collected at intervals along the river between Cameron Lake and Sturgeon Lake as shown in Figure 3 (#1 to #8).



1. Cameron L. N20 Buoy
2. Fenelon R. Canal N inlet
3. Fenelon R. Canal S outlet
4. Fenelon R. middle
5. Fenelon R. after 1st inlet
6. Fenelon R. after 2nd inlet
7. Fenelon R. above WWTF
8. Sturgeon L. N10 Buoy
9. Sturgeon L. N12 Buoy

Figure 3. Sampling sites for the Cameron Lake to Sturgeon Lake P Jump investigation

Ideally all samples would have been tested by the LPP laboratory but this was not possible. Instead three laboratories were used: the LPP laboratory at the Dorset Environmental Research Centre (DESC), the Trent University laboratory at DESC operated by Joe Findeis that used the same type of equipment and procedures as the LPP lab (Findeis), and Caduceon Environmental Laboratories that is used by Kawartha Conservation for its TP testing (Caduceon). Both LPP and Findeis required glass sample containers to be rinsed and filled with filtered sample water. Caduceon required its plastic containers with preservative to be filled with unfiltered sample water. Only one large sample was collected at each location and it was then distributed to the containers for each of the laboratories. The measurements made at each site are summarized in Table 1.

Site	LPP	Findeis	Caduceon
LPP TP N5 Buoy (9)			
Surface		X	X
Secchi Depth	X	X	X
Fenelon R. Transect			
1		X	X
2		X	X
3		X	X
4		X	X
5		X	X
6		X	X
7		X	X
8		X	X

Table 1. Summary of TP Samples collected

Samples were collected at the LLP N12 buoy site on July 6, August 4 and September 1, 2015. Samples were collected on the Fenelon River Transect on July 15, August 17 and September 28, 2015.

Investigation of the Apparent Increase in Total Phosphorus between Cameron Lake and Sturgeon Lake

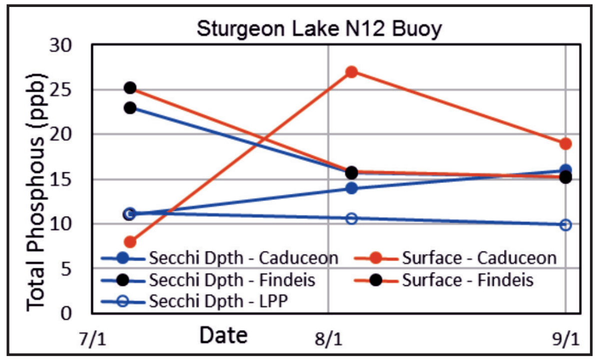
Results

The results of the Surface and Secchi Depth TP measurements at the Sturgeon Lake N12 Buoy are presented in Table 2 and graphed in Figure 4.

Table 2. Sturgeon L. N12 Buoy TP results in ppb from surface & Secchi depth samples

Sturgeon L. N12 Buoy	Laboratory	6-Jul-15	4-Aug-15	1-Sep-15
Surface (30 cm deep)	LPP	-	-	-
	Findeis	25.2	15.8	15.2
	Caduceon	8	27	19
Secchi Depth	LPP	11.2	10.6	9.9
	Findeis	23.0	15.7	15.3
	Caduceon	11	14	16.0
Secchi Depth - Surface Difference	LPP	-	-	-
	Findeis	-2.2	-0.1	0.1
	Caduceon	3	-13	-3

Figure 4. Graph of surface and Secchi depth TP measurements at the Sturgeon L. N12 Buoy

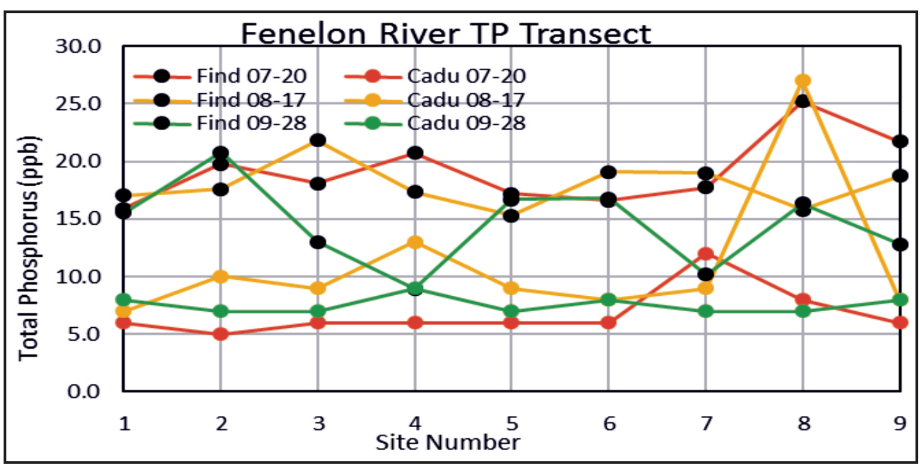


The results of the surface TP measurements along the Fenelon River Transect are presented in Table 3 and graphed in Figure 5.

Table 3. Fenelon River Transect surface TP results in ppb

Test Date	20-Jul-15		17-Aug-15		28-Sep-15	
Laboratory	Caduceon	Findeis	Caduceon	Findeis	Caduceon	Findeis
1-Cameron Lake N of N20 buoy	6	15.9	7	17.0	8	15.5
2-Fenelon R. Canal N inlet	5	19.8	10	17.6	7	20.8
3-Fenelon R. Canal S outlet	6	18.1	9	21.8	7	13.0
4-Fenelon R. Middle	6	20.7	13	17.4	9	8.9
5-Fenelon R. after 1st inlet	6	17.2	9	15.3	7	16.7
6-Fenelon R. after 2nd inlet	6	16.6	8	19.1	8	16.8
7-Sturgeon Lake above WWTF	12	17.8	9	19.0	7	10.2
9-Sturgeon Lake N12 buoy	8	25.2	27	15.8	7	16.3
8-Strugeon Lake N10 buoy	6	21.8	8	18.7	8	12.8

Figure 5. Graph of Fenelon River Transect surface TP measurements in ppb



Discussion

General: The Total Phosphorus (TP) contents of all the samples measured during this project are between 5 and 30 parts per billion (ppb): very small amounts. Hence it may not seem surprising that considerable variation was found. Any trace of contaminating organic matter might be expected to result in higher readings, but not lower. Caduceon Laboratories measure TP using method reference

Investigation of the Apparent Increase in Total Phosphorus between Cameron Lake and Sturgeon Lake

MOEE E3036A which has a R.L. about 10 times smaller, 0.2 ppb. These numbers correspond approximately to the Standard Deviation (SD) between analysis results of duplicate samples.

Surface versus Secchi depth measurements:
The difference between sample TP from Surface vs Secchi Depth samples at the Sturgeon Lake N12 buoy was generally low (average of 0.45 ppb in 5 of 6 samples) with one difference being a factor of 2 (27ppb vs 14 ppb) (Table 2, Figure 4). This high reading was from an unfiltered sample submitted to Caduceon and appears to be an outlier that may have resulted from contamination. These results suggest that there is not a significant difference in TP in samples collected at the surface vs those collected from the water column to Secchi depth. The Secchi Depth LPP results on all three dates were in a narrow range of 9.9 to 11.2 ppb which is consistent with past results at this site. Both the Surface and Secchi Depth Findeis samples collected on July 6 had much higher TP content than expected, 25.2 and 23.0 ppb, compared to Caduceon values of 11 and 8 ppb. Overall, the Caduceon result varied between 11 to 16 ppb and Findeis between 15.3 and 23.0 ppb. The wide difference between results from different laboratories is discussed further below.

Fenelon River transect measurements:
The results of the Fenelon River transect TP measurements present a conundrum. With few exceptions, Caduceon results are between 5 and 10 ppb whereas Findeis results are between 15 and 20 ppb; the LPP measurements at the N12 site during the past 4 years are between 10 and 15 ppb. With the exception of a few outliers, each set of data is self consistent, suggesting that a difference in lab protocol or calibration might be the cause of the variation in results. The consistency of the LPP results with those of previous years gives us confidence in the regularity of their procedures. Further investigation will be required to resolve the cause of these differences between laboratories.

Within the transect data set from each laboratory there was no significant change observed between Cameron Lake and Sturgeon Lake. The graph of the data, Figure 5, also contains the surface sample results from Site 9, the Sturgeon Lake N12 buoy, which is geographically located between transect sites 7 and 8. It is also ~250 m downstream from the Fenelon Falls WWTF. This might explain the more variable results at this site due to incomplete or variable mixing of the WWTF outflow with the river water. The samples for these measurements were also collected on different days than the transect samples which might influence the results. Because the LPP results for this site have been quite consistent for the past five years it is recommended that monitoring continue at this site.

Conclusions
The results of these experiments suggest that neither of the two hypotheses investigated explains the apparent increase in TP measurements that is observed between Cameron Lake and Sturgeon Lake. The results also suggest that the methods being used are not precise enough to resolve the questions being asked of them with certainty using individual measurements. Only by averaging many measurements over time will long-term trends emerge. The pattern of long-term data for Cameron Lake, Figure 1, and Sturgeon Lake, Figure 2, shows a more variable and an overall higher level of TP in Sturgeon Lake. What else could be its cause? It has been pointed out that the Cameron Lake sites are away from inflowing rivers in deep, relatively clear water (average Secchi depth = 3.8 m). The Sturgeon Lake sites are near the outlet of the fast flowing Fenelon River in shallow, murkier water (average Secchi depth 2.9 m) where the lake bottom is deep silty sediment. A new hypothesis might be that the incoming Fenelon River flow is continually stirring up fine sediment that results in higher TP concentrations in the water in Sturgeon Lake. The effect might be variable depending on river flow rate and might be more pronounced a short distance into the lake (the N5 buoy) than it is close to the river mouth (the N12 buoy). Further work is necessary to explore this possibility.

Acknowledgements

KLSA thanks all the people who assisted with this project.

Volunteer testers: **Rod Martin** and **Dave Young** provided boats and collected samples during their regular LPP sampling in July, August and September. **Kathleen Mackenzie** arranged the Findeis and Caduceon testing and collected samples in July. **Shari Paykarimah** collected the Fenelon River transect samples in July and August and **Mike Dolbey** collected samples in August and September. **Kawartha Conservation** received and arranged for the testing of Caduceon samples.

Monitoring in Lake Scugog in 2015: Is what happened here a harbinger of things to come in the Kawarthas and Trent-Severn Waterway?

Dr. Ron Porter,
Chair, Science and Monitoring, Scugog Lake Stewards

Barbara Karthein,
President, Scugog Lake Stewards

In the summer of 2015 we undertook a monitoring effort on Lake Scugog to better understand the effects of time and the environment on the ever-changing flora and fauna of the lake. As lake monitors, we learned firsthand that if we are to understand the annual changes in Lake Scugog, we have to make frequent and knowledgeable visits to the lake, armed with a reasonable understanding of what we are looking at, and backed up by professional colleagues to confirm what we see. All volunteer monitors were given an aquatic plant ID manual as a gift from the Scugog Lake Stewards' Board. In addition, the research group of the Stewards made monthly pontoon boat patrols during which observations on the status of the lake were made over the spring and summer. Others interested in the project were invited to accompany us on these trips. We were particularly delighted to welcome aboard local students who plan a career in lake science.

Dr. Andrea Kirkwood, a Professor in the Department of Biology at the University of Ontario Institute of Technology (UOIT), joined us on our September patrol. We then added her academic experience to that of Dr. Eric Sager of Trent University who made the initial critical observation of what was truly afoot in Lake Scugog in 2015.

From past experience, we had anticipated a summer of observing thick masses of invasive aquatic plants. Invasive aquatic plants can have a detrimental effect on the enjoyment, health and beauty of the lake. A hybrid variety of Eurasian Watermilfoil (EWM) had made huge inroads in extensive sections of the lake in recent years. This was occurring to such a degree that our scientific team had been planning to do a series of studies in 2015 on the use of jute matting as a benthic barrier in an attempt to contain the growth of the EWM in strategic areas.

Throughout May, June and early July 2015, our monitoring and sampling showed that the entire observable lake bed was covered by vegetation to an aerial percent cover of 95% or greater-- not by EWM as in previous years, but what we took to be the plant-like alga, known as Muskgrass, or *Chara* sp. We had noted this algae in past years, but only in small pockets in the lake. Among the billowing meadows of *Chara*, we also noted occasional invasive species such as EWM and native plants including Coontail (*Ceratophyllum demersum*), Bladderwort (*Utricularia sp.*), Broad-leaf Pondweed (*Potamogeton amplifolius*), Canadian Waterweed (*Elodea canadensis*) and White Water Lily (*Nymphaea odorata*) growing in small patches in secluded bays.

The Scugog Lake Stewards asked Dr. Eric Sager of Trent University and Fleming College about this new phenomenon. After a visit in mid-June, Dr. Sager determined that much of what we took to be *Chara* was actually the alga Starry Stonewort (*Nitellopsis obtusa*), intermingled with the *Chara*. Similar in appearance to *Chara*, Starry Stonewort is a plant-like alga that looks like tangled light green fishing line and which grows in thick billowy clouds, up to eight feet thick, which can reach almost to the surface of the water in shallow lakes like Lake Scugog. It is distinguished from its relatives by tiny bulbils that look like stars on the glass root-like stabilizers the alga has to connect it to the benthic layer. These strands are not, however, true roots, since algae do not have specialized body parts.

Starry Stonewort, which is on the endangered species list in the United Kingdom, is considered

Starry Stonewort (Nitollopsis obtusa) can reproduce by orange oospores. Photograph from Pullman and Crawford (2010)

Monitoring in Lake Scugog in 2015: Is what happened here a harbinger of things to come in the Kawarthas and Trent-Severn Waterway?

an invasive species in North American lakes and can be a danger to our fisheries. It can reduce habitat for both fish and the benthic bugs that they prey on. This information prompted a keen interest by the Stewards to learn more about this new invasive.

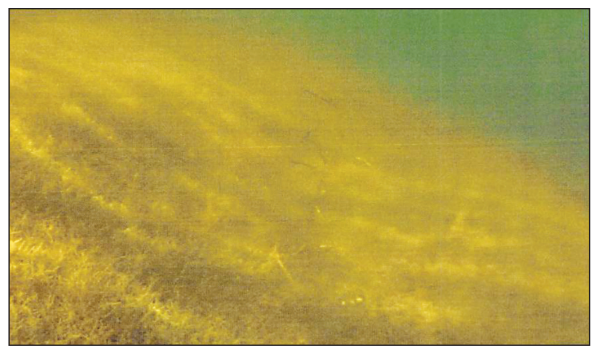
We made a further intriguing observation where the Nonquon River flows into Lake Scugog. In place of the usual modest stands of wild rice (*Zizania sp.,* also known as *manoomin*), at the mouth of the river, we now found acres of mature rice. In the path of the nutrient rich plume of river water as it flowed north toward the Scugog River, we observed a massive and apparently healthy growth of Sago Pondweed (*Stuckenia pectinata*). What did these new observations mean? Are wild rice and a small number of native aquatic plants able to out-compete Starry Stonewort?

Starry Stonewort is an ancient alga which can, when conditions are right, seemingly invade a lake opportunistically and extensively. In one winter, it appears to have grown to dominate the aquatic plant life in Lake Scugog both in shallow waters and at much greater depths, taking advantage of what seems to be the total collapse of hybrid EWM. The history of the arrival of this invasive in lakes and rivers of the St. Lawrence and Lake Erie watersheds over the past twenty years has not been this dramatic.

We believe that it was because of the apparent collapse of the hybrid EWM in Lake Scugog that the change in lake vegetation in one season was so dramatic. This newly exposed area would have made space for a new plant to 'move in'. What caused the change in EWM abundance? Could the predominance of this new alga have possible negative consequences for our fishery? Why might the invasive nature of Starry Stonewort be so different than its counterpart in Europe? Might we be facing a new and stronger hybrid of *Chara* and Starry Stonewort, as we had with EWM? Was the colder, rainy weather, and high water levels in Lake Scugog in recent years an important factor to these changes?

It was decided that we would bring together, for a roundtable meeting, colleagues from Kawartha Conservation, the Ministry of Natural Resources and Forestry, Trent University and UOIT. This meeting was held in Port Perry in October 2015. We will continue these connections this year and will hold a second roundtable in September 2016. Further, in an attempt to answer some of the questions that have arisen about Starry Stonewort and what effect it may have on our fishery, we are planning extensive research with Dr. Kirkwood in the next few years. We believe this research is important because, as the head water body of the Kawartha Lakes system, what happened in Lake Scugog in the summer 2015 may have major implications for the future downstream.

This year has seen a metamorphosis in Lake Scugog ecology, from a lake overgrown by EWM, to a EWM-free environment with clear, relatively plankton-free supernatant and the presence of all the invasive and native aquatic plants of past years reduced by the light-shading *Chara*/Starry Stonewort biomass. To the average viewer these apparent changes in the health and beauty of the lake may have increased its appeal to boaters, fishers and those living on the lake alike. What these changes actually mean for the fishery and for our lake ecosystem in the years ahead will be revealed by the passage of time.



A dense meadow of Starry Stonewort

Starry Stonewort (Nitellopsis obtusa) is a macroalgae that produces star-shaped bulbils most often seen in late fall and early spring. Photograph by Progressive AE

The Banded Mystery Snail – Another Invader of our Lakes

Mike Dolbey,
KLSA Director

In June 2014, I observed an unusually large number of snails on the shallow rocky bottom of the lake adjacent to my beach. I had never seen them before and as I broadened my search I found them all along my waterfront (Figure 1).

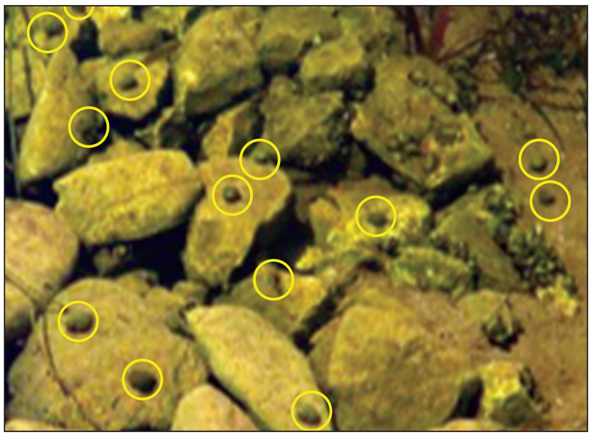


Figure 1. Many snails on lake bottom
Photo: M.P. Dolbey

An internet search of freshwater snails quickly led to the website of Ontario's Invading Species Awareness Program and their identity as mystery snails. There are two unrelated species of invasive mystery snails in Ontario that are similar in shape: the Chinese Mystery Snail, *Bellamya chinensis*, and the Banded Mystery Snail, *Viviparus georgianus*. The Chinese Mystery Snail is described as brownish to olive green in colour whereas the Banded Mystery Snail is yellow to greenish brown with three to four dark reddish brown spiral bands. When collected, my snails looked dark greenish black, leading me to suspect they were Chinese Mystery Snails. However, after scrubbing algae off their shells with an old toothbrush and allowing them to purge themselves while sitting in clean water overnight, the pale shell with reddish brown spiral bands of the Banded Mystery Snail became evident (Figure 2).

I reported my findings on Ontario's invasive species tracking system, EDDMapS Ontario, http://www.eddmaps.org/ontario/ and discovered that only one other sighting had been reported in the Kawartha Lakes, at Lightning Point on Balsam Lake. However, six sightings of the Chinese Mystery Snail had been reported close by in Stony Lake near McCracken's landing. I went there in August and found four snails, three of which were clearly Banded Mystery Snails. The fourth was a larger empty shell of the same shape but with no discernible bands. Could it be a Chinese Mystery Snail or were the earlier sightings misidentified?

The Banded Mystery Snail is native to the southeastern United States from Georgia south. They have gradually been introduced into more northern regions such as the Great Lakes Basin over the past century. Their use in aquariums and subsequent release is one suspected mechanism for their spread.

From spring to fall these snails live and breed in shallow waters, often amongst aquatic plants, or macrophytes. Along my shore they were most numerous in June when, in addition to a large number of large snails, there was a vast number of juveniles, three to five mm across, on the sandy bottom of the beach area, all in less than 30 cm of water. By late July as the water warmed, most snails had disappeared, probably into water containing more aquatic plants. In fall they migrate to deeper water in order to overwinter away from shore.

Apart from aesthetics, there appear to be no confirmed environmental impacts of the invasive Banded Mystery Snails to the Kawartha Lakes. However, the U.S. Geological Survey (USGS) suggests that this species may prey on fish embryos, leading to a reduction in the survival of largemouth bass.

More information about this recent invader can be found at the USGS website, http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1047

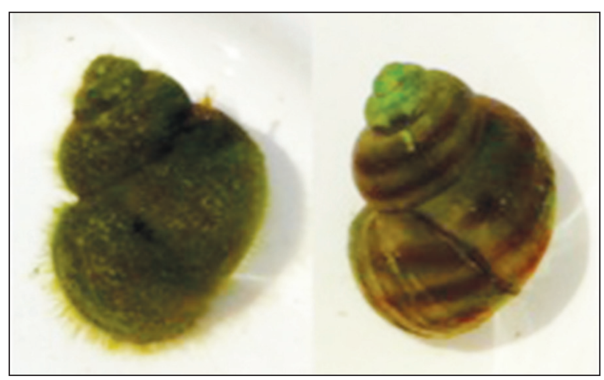


Figure 2. Snails before and after cleaning
Photo: M.P. Dolbey

Boyd Island (Chiminis) Now Protected!

Boyd Island Photo: KLT

Ian Attridge,
Lands Manager, Kawartha Land Trust

Boyd or Big Island is known as Chiminis by indigenous communities and is the largest undeveloped and (until recently) unprotected island in southern Ontario. The island is located in northern Pigeon Lake, east of Bobcaygeon, in the Municipality of Trent Lakes. It covers more than 1,100 acres and has 11 km of natural, diverse shoreline.

The site is home to unspoiled wetlands, diverse and old growth forests, wildlife and a wide variety of plant species. First Nations peoples used this island as a meeting and harvesting place thousands of years ago and today it has compelling cultural value to them and to many others in the area. In recent times, it was owned and farmed by the Boyd family, one of the first and most prominent settlement families from Bobcaygeon. Mossom Boyd, the 'Lumber King' of the Kawartha Lakes region, was the first purchaser of the island, and his son, Mossom Martin Boyd, ranched a hybrid of cattle and buffalo ('cattaloe') on the island.

After the family sold the island, it became subject to a variety of development plans in the 1990s and 2000s. This could have transformed the nature of the features and uses on the island. But the community fought these plans, and the property was sold a few years ago to Mike Wilson, a prominent member of the Canadian business community. This owner was approached by the Kawartha Land Trust (KLT), a non-governmental organization and registered charity dedicated to acquiring significant lands and maintaining them in a natural state.

KLT eventually convinced the new landowner to generously donate most of the island. In order to responsibly own and manage the island over the long term, the KLT Board challenged the community in August of 2015 to raise $1 million before being able to close the deal.

Fortunately, people across the region responded tremendously to this challenge! A community team was assembled, fundraisers were held, and people contacted friends and family, near and far. A brief film to profile the island was made in record time and posted to KLT's website. Fundraising thermometers, in the shape of a map of the island's development lots, were featured at local venues and online (see p. 35), gradually turning green with progress.

On December 7th, KLT announced that they had achieved their fundraising goal and, on December 21st, the ownership of the island was transferred to KLT. Chris Appleton, Campaign Chair, was ecstatic: "The campaign has made amazing strides and, in

Boyd Island (Chiminis) Now Protected!

only four short months, has exceeded the fundraising goal! I am thrilled by the generosity of the community, and the commitment and hard work of all the volunteers on our campaign team and beyond."

More than 600 people pledged funds to the campaign, dozens for $10,000 or more. Local supporting businesses included British Empire Fuels and Kawartha Dairy, while the Municipality of Trent Lakes and Curve Lake First Nation contributed substantially. Several pledged $100,000, including one charitable foundation, an anonymous donor, and Mike Wilson, the owner of the island. This project was also funded as part of the Natural Areas Conservation Program, with support from the Nature Conservancy of Canada and Environment and Climate Change Canada.

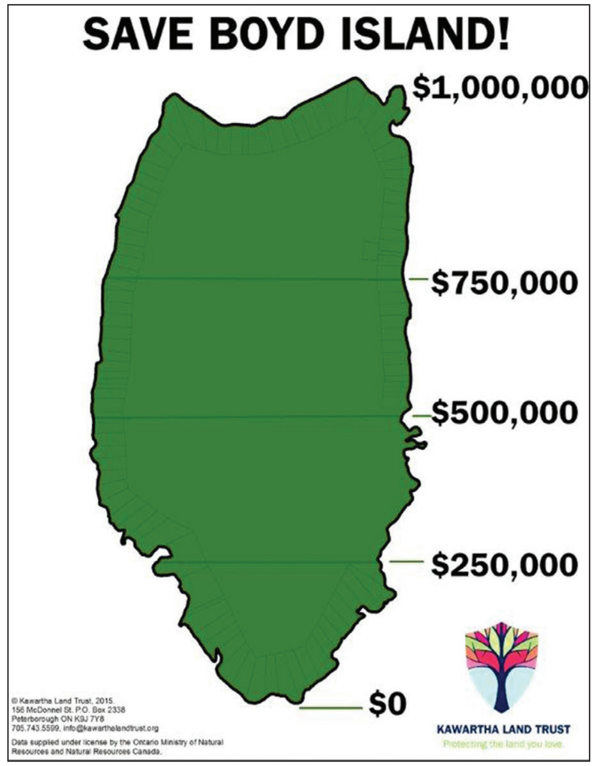
KLT intends to maintain Boyd Island's natural and cultural features and to continue compatible, responsible uses by the public. Plans are now in the works to establish a committee and public process to develop and implement a detailed stewardship plan and appropriate management activities for the property. These may include signage, trails and wildlife and invasive species management, among others.

There will also be an opportunity for scientific research and monitoring to better understand the island's features, functions and sensitivities. Past fishing records and water quality testing can be supplemented by new efforts with partners such as the Kawartha Lake Stewards Association, Trent University, Fleming College and others. KLT looks forward to working with the community to study and celebrate this significant site in the Kawarthas.

Beyond the island, over its first fifteen years KLT has partnered with several Kawartha area landowners to help directly protect ten other properties and has assisted other organizations to protect another ten significant natural sites. Through its community-based partnership approach, KLT has now permanently protected over 3,100 acres. It continues to work with others to identify natural heritage systems across the landscape.

Boyd Island or Chiminis is a classic example of what a land trust and the community can accomplish together -- creating a lasting conservation legacy that benefits us all.

Ian Attridge is a lawyer, ecologist, and the founder and Lands Manager of the Kawartha Land Trust. He and other staff played key roles in securing Boyd Island.



Boyd Island is popular for fishing. KLSA Director and KLT staff member Shari Paykarimah displays her catch. Photo KLT

Maintaining a Healthy Pigeon Lake

Scenic shoreline of Boyd Island in Pigeon Lake Photo KLT

Brett Tregunno,
Aquatic Biologist, Kawartha Conservation

Pigeon Lake is a central lake within the Kawartha Lakes, located downstream of Sturgeon Lake and upstream of Buckhorn Lake. The lake is one of the largest of the Kawartha Lakes. Being elongated in a north-south orientation for almost 30 km, its immediate drainage area contains most of the physical characteristics that typify the Kawartha region, including the Oak Ridges Moraine, Peterborough Drumlin Field, and Canadian Shield. Similar to most other Kawartha Lakes, the landscape is distinctly rural and developed areas are concentrated along the shorelines and in small urban centres around the lake. (Please refer to map on page 38).

In 2011, the City of Kawartha Lakes and Kawartha Conservation, along with other local municipalities and several community stakeholders, began a multi-year project to research and strategize how best to maintain the economic, social and ecological benefits that Pigeon Lake provides to those who live, work and play in the area. The culmination of these efforts is a suite of over 30 management recommendations that apply to all sectors around the lake, from governments to farmers to the individual shoreline resident. The Pigeon Lake Management Plan can be downloaded via the internet at: http://kawarthaconservation.com/watershed/management-plans.

As lake stewards, we all want to do the right thing for the health of our lakes but unfortunately many of us as individuals and businesses are unsure of what to do and where best to do it. Fortunately there are several actions that benefit the lake of which we are in complete control – those that take place on our own properties. Below is a management recommendation from the Pigeon Lake Management Plan to help get us started.

For more information on how best to undertake any of the items below please contact Holly Shipclark, Stewardship Coordinator at Kawartha Conservation, at: 705-328-2271 ext. 242 or hshipclark@kawarthaconservation.com.

Maintaining a Healthy Pigeon Lake

Action A1:
Urban and waterfront lot-level measures

Undertake lot-level measures such as reducing fertilizer use, increasing infiltration, capturing stormwater runoff and other practices that conserve water and reduce pollution in targeted urban areas and waterfront communities.

Urgency

- High

Rationale

- Developed areas account for approximately 7% of the Pigeon Lake planning area, yet contribute disproportionately high amounts of sediments, nutrients and other contaminants typically through increased surface water runoff over fertilized lawns, parks and hardened surfaces running into the lakes. In phosphorus loadings, it is estimated that urban areas contribute 19% (1 tonne per year) to Pigeon Lake from all local sources within the immediate drainage area of the lake. Most urban areas within the watersheds of the lakes are located along shorelines.

Priority areas

- Town of Bobcaygeon, Omemee, and other small urban communities along the shorelines

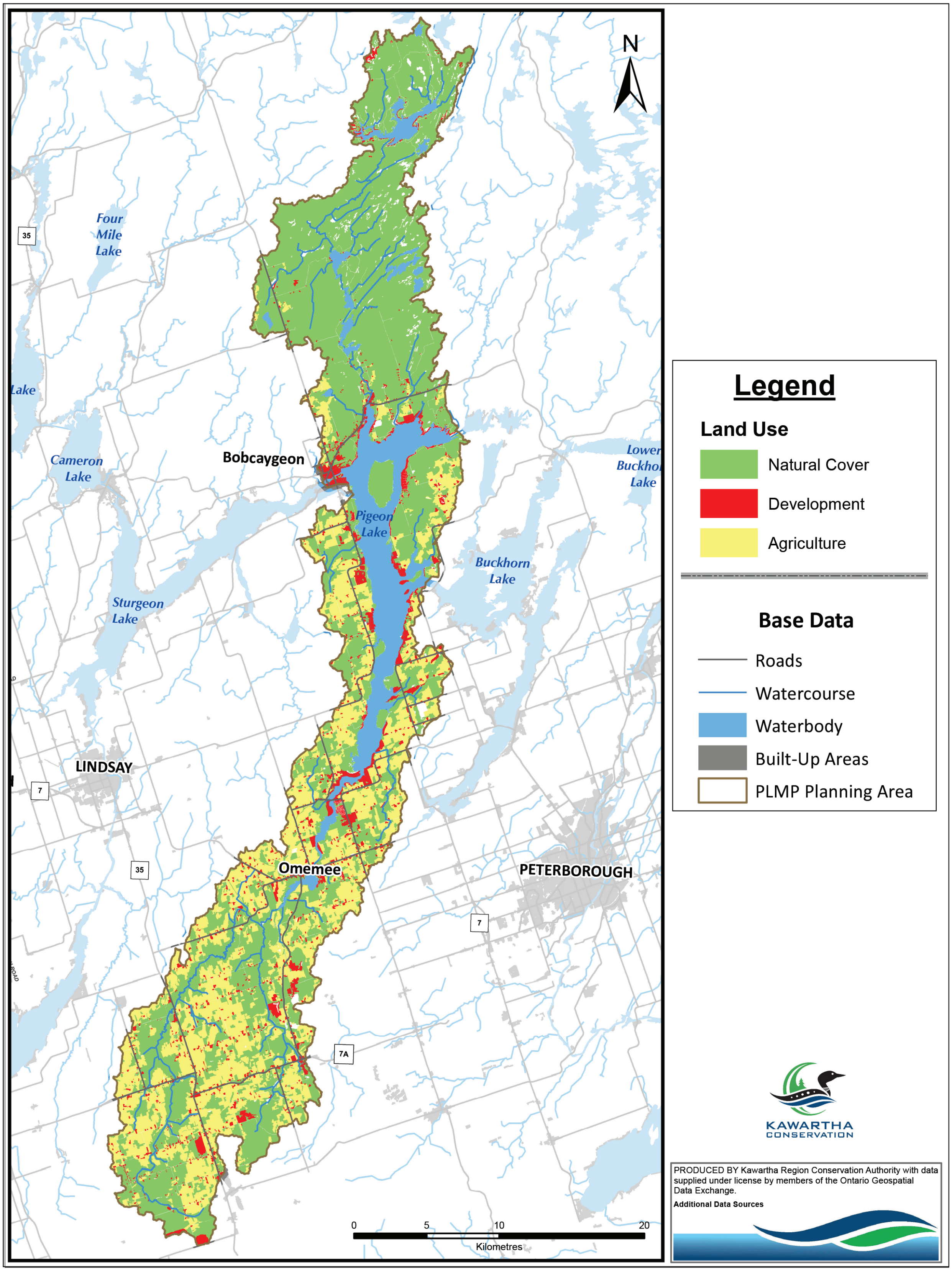
Lead and (partner) implementers

- Lake associations; shoreline residents; businesses; property managers; Emily Provincial Park; local municipalities; (Environmental Advisory Committees; Kawartha Conservation and Otonabee Conservation)

Deliverables

- Develop a program that provides educational and project management assistance, and financial assistance where possible, to urban and waterfront residents to support the uptake of lot-level measures for water stewardship action.
- Within a five-year period, achieve a target of 50% of urban residential, commercial and public properties implementing lot-level measures such as:
    - o Maintain a buffer strip of natural vegetation along urban waterfronts and stream banks to filter runoff, prevent erosion and provide wildlife habitat.
    - o Capture and store storm runoff via rain barrels, grassed swales, vegetated depressions, rain gardens, splash pads or 'roll up' attachments to downspouts, and private stormwater management ponds as applicable.
    - o Maintain trees and other landscape plants that help slow surface water runoff and reduce soil erosion; replace at-risk, dying, or storm-damaged trees with trees and shrubs of appropriate species.
    - o Mow lawns to no less than three inches in height to encourage healthier root development and help absorb more moisture.
    - o Work toward a low or no phosphorus fertilizer and gradual reduction, then eliminate chemical fertilizer use on lawns; leave mulched clippings to decompose and use yard compost for soil amendments; avoid discarding of clippings in waterways.
    - o Conduct soil testing to determine actual nutrient deficiencies.
    - o Maintain permeable surfaces, such as porous asphalt or vegetated swales, as alternatives to hardened driveways, walkways and parking lots.
    - o Maintain septic systems with regular pump-outs.
    - o Take advantage of hazardous waste and recycling programs.
    - o Dispose of pet wastes in the garbage and discourage feeding of waterfowl.
- Over the long term, achieve a 50% reduction in existing phosphorus loading from local urban sources to achieve a loading target of approximately 504 kg (1/2 tonne) per year for Pigeon Lake.

Maintaining a Healthy Pigeon Lake



The Kawartha Turtle Trauma Centre

Wendy Baggs,
Outreach Education Volunteer
and Turtle Taxi Volunteer for KTTC

In October, I had the opportunity to represent the Kawartha Turtle Trauma Centre (KTTC) at the KLSA meeting. Paddy, our 33 year old male snapping turtle joined me. The purpose of our educational outreach program is to increase the awareness of the challenges that face Ontario's native turtles. KTTC is the only wildlife rehabilitation centre dedicated solely to providing medical treatment and rehabilitative care to Ontario's turtles. Our goal is to protect and conserve Ontario's native turtles and their habitat. This is accomplished by research in the field, operating a turtle hospital that treats and releases injured turtles and an in-depth education/outreach program.

We have eight turtle species in Ontario and seven out of the eight are listed as 'species at risk'. The Painted Turtle is the only species not yet listed. Turtles are late maturing (most species live for 10 to 20 years before reproduction can occur). Aside from predation, road mortality and human interaction, habitat loss remains the most serious threat.

Habitat loss (75% and growing) is the major reason for the decline of our turtle population, and this is seen through the alteration/fragmentation of wetlands and riparian corridors, and the channelization of streams and rivers, causing the loss of basking and nesting sites. Other problems include the loss of traditional corridors that turtles use to travel from one site to another, through deforestation of hardwood forests and shrubbery, and the creation of access roads that encourage more traffic and urbanization (farmland, settlements, etc). Urbanization and suburbanization reduce turtle habitat by creating the perfect environment for predators such as raccoons.

Cultural eutrophication through pesticide pollution and industrial pollution poses a large risk, because pollutants can be carried long distances. The bio-accumulation in the food chain and its toxicity remain persistent in the environment. This water pollution can cause neck abscesses and malformation of the turtle's shell. Pollutants can cause disruption of the endocrine function and sex reversal: PCBs as environmental estrogen can disrupt embryo development.

With excessive use of fertilizers supplying nitrogen and phosphorus, the environment becomes enriched with nutrients which can cause algal blooms and plankton. Overcrowding occurs and plants compete for sunlight and oxygen. Below the plankton, plants struggle without sufficient light. This impairment to the aquatic ecosystem due to high rates of photosynthesis brings about hypoxia or even anoxia. Fish farming can cause eutrophication, and eutrophication can occur naturally over

Wendy Baggs and Paddy gave a presentation at KLSA's public meeting in October 2015. Photo credit KLSA

Paddy, a snapping turtle at KTTC, is 33 years old. He often performs at KTTC outreach presentations.

The Kawartha Turtle Trauma Centre

time. The introduction of exotic wetland plants, such as purple loosestrife, causes competition with native aquatic plants and reduces natural habitat. You can help turtles by maintaining a natural shoreline with native plant species, instead of a manicured lawn and a dredged lake bed.

Sharing information is vital for the survival of turtles. We can prevent the loss of wetlands and uplands by participating in local land use planning, reporting any suspicious activity and participating in habitat restoration projects. Knowing the proper way to assist a turtle (including the snapping turtle) across the road can make an enormous difference, because the loss of one reproducing female can be a huge loss to the turtle population. Watch out for them especially during prime nesting season from May to July when they may need to cross our roads.

How does the turtle cross the road?

If you see a snapper or any turtle on the road, here's how to move it to safety:

- Stand behind the turtle. It will be more frightened than you are.
- Lift the back of the shell, one hand on each side near the tail.
- Turn the turtle around and drag it across to safety.
- If you have an old blanket or mat handy in your car, you could put that under the turtle before you drag it.
- When the turtle is safely across, pivot it once again, so it's facing the direction it was going. Don't try to second-guess its travel plans!

Left: Snapping turtle with feeding tubes receiving care in hospital at KTTC. Photo credit KTTC.

Below right: Midland Painted Turtle searching for nest site Photo credit Wendy Baggs

Left: Common Snapping Turtle hatchlings ready to emerge from their nest in September. Photo credit Wendy Baggs

The Kawartha Turtle Trauma Centre

Above: Andrea, a Blandings Turtle that was seriously injured and is now one of our educational turtles. Photo credit KTTC

Right: Picasso, a Midland Painted Turtle, one of our educational turtles. He was being illegally kept as a pet. We do not know his place of origin so he cannot be released back into the wild. Photo credit KTTC

If you find an injured turtle:

Please place it in a well ventilated plastic container with no water, preferably on a towel. Call

Kawartha Turtle Trauma Centre
immediately at :

705-741-5000.

Field work tracking Blandings two-year-old hatchlings for Headstart program. Photo credit KTTC

Can You Identify a Tree's Call for Help?

Matt Logan, President,
Logan Tree Experts and Director, International Society of Arboriculture, Ontario Chapter

Trees are amazing organisms with many complex systems working simultaneously to create, promote and sustain health and growth. Trees are constantly affected by both internal and external forces that dictate the tree's health. Arborists are the certified professionals who work within the field of arboriculture to care for and maintain trees in all their stages of growth and life. Arborists understand and interpret your tree's 'call for help'. This requires knowledge of many fields including botany, entomology (bugs), physics and soils, just to name a few.

As a homeowner you can learn to recognize your tree's call for help. This could be the difference between an arborist inspecting, diagnosing and treating a tree to keep it standing, versus removing it. In short, trees do not die overnight, and identifying and treating tree issues before it is too late is the best option. Without a doubt, proactive tree work is far better, and usually more economical, than reactive tree work. Trees around your home and property require maintenance to promote health, safety and longevity. It's no surprise that many people are still unsure when to call a Certified Arborist and often wait until it is too late.

Consider calling an arborist when:

- You see dead branches, cracks, seams or holes in your trees
- Your trees are making sounds, e.g., creaking, popping
- Your tree loses its leaves during the growing season or is late to leaf out
- The leaves are small and/or discoloured
- You see mushrooms on or around the tree
- You find insects (e.g., ants) in or on the tree or find sawdust around the base of the tree
- There is no trunk flare
- The tree is hazardous or dead
- The tree is blocking a view and you would like to prune for sight lines
- The tree is making contact with a structure
- Branches are broken or hung up in the tree
- You are buying or selling a home/property
- You are building or renovating and want to protect your trees from damage
- You are unsure of the health and safety of your trees
- You want to plant trees properly.

And finally, if you are not sure - call anyway! Arborists are here to help you and your trees!

For information contact@logantreeexperts.com or visit www.logantreeexperts.com.

An arborist trims a pine tree to preserve health and beauty of form. Photo credit Logan Tree Experts.

Appendix A

KLSA Mission Statement, Board of Directors and Volunteer Testers

Mission Statement:

The Kawartha Lake Stewards Association was founded to carry out a coordinated, consistent, water quality testing program (including bacteria and phosphorus) in lake water in the Kawartha Lakes. The Kawartha Lake Stewards Association ensures that water quality test results, prepared according to professionally validated protocols with summary analysis, are made available to all interested parties. The Kawartha Lake Stewards Association has expanded into research activities that help to better understand lake water quality and may expand its program into other related issues in the future.

2015-2016 Board of Directors

William A. Napier, Chair*
Lovesick Lake

Kathleen Mackenzie, Vice-Chair*/Co-Chair**
Stony Lake

Kevin Walters, Vice-Chair/Co-Chair**
Shadow, Lovesick and Sandy Lakes

Mike Stedman, Treasurer
Lakefield

Lynn Woodcroft, Secretary
Buckhorn

Sheila Gordon-Dillane, Recording Secretary
Pigeon Lake

Jeffrey Chalmers, Director
Clear Lake

Mike Dolbey, Director
Katchewanooka Lake

Doug Erlandson, Director**
Balsam Lake

Tracy Logan, Director
Lakefield

Thomas McAllister, Director*
Lower Buckhorn Lake

Erin McGauley, Director
Peterborough

Colleen Middleton, Director*
Pigeon Lake

Shari Paykarimah, Director
Peterborough

*effective October 3, 2015
**until October 3, 2015

Scientific Advisors

Dr. Paul Frost
David Schindler Professor of Aquatic Science,
Trent University, Peterborough

Dr. Eric Sager
Manager, James Mclean Oliver Ecological Centre, Coordinator of the Ecological Restoration Program at Fleming College, Adjunct Professor at Trent University, Peterborough

Appendix A
KLSA Mission Statement, Board of Directors and Volunteer Testers

Volunteer Testers, 2015

Balsam Lake - Douglas and Peggy Erlandson, Jim and Kathy Armstrong, Jeff Taylor, Richard Braniff, Ross Bird, Leslie Joynt

Big Bald Lake - Big Bald Lake Cottagers Assoc.: Bruce Barnes, Doug Eddy, Heathyr Francis, Colin Hoag

Big Bald Lake - Big Bald Lake Road Association: Gord Rance

Big Cedar Lake - Big Cedar Lake Stewardship Association: Rudi Harner

Buckhorn Lake - Buckhorn Sands Property Owners Association: Craig, Anastasia, Henry and Lawrence Charlton.

Buckhorn Lake - Darrell Darling

Cameron Lake – Lisa Martin, Stu Kinsinger

Chemong Lake – Brian and Linda Neck

Clear Lake – Birchcliff Property Owners Association: Jeff Chalmers
Clear Lake - Kawartha Park Cottagers Association: Vivian Walsworth
Clear Lake – Kathy Gillespie

Katchewanooka Lake – Lake Edge Cottages: Peter Fischer, Mike Dolbey

Lovesick Lake – Lovesick Lake Association: Ron Brown, John Ambler

Lower Buckhorn Lake – Lower Buckhorn Lake Owners Association: Brian Brady, Jeff Lang, Mark and Diane Potter, Dave Thompson, Janet Duval

Mill Pond – Paul South

Pigeon Lake – Concession 17 Pigeon Lake Cottagers Association: Donald Morrison
Pigeon Lake – North Pigeon Lake Ratepayers' Association: Tom McCarron, Francis Currer
Pigeon Lake – Victoria Place: Brenda Oundjian, Bob Johnson
Pigeon Lake – Tate's Bay: Ted and Pat Oakes

Sandy Lake – Sandy Lake Cottagers Association: Mike and Diane Boysen, Eva and Hans Toomsalu

Shadow Lake and Silver Lake - Phil Taylor, Eveline Eilert

Stony Lake – Association of Stony Lake Cottagers: Bev and Don Foster, Ralph and Barb Reed, Kathleen Mackenzie, Bob Woosnam, Gail Szego, Rob Little

Sturgeon Lake – Bruce Hadfield, Sherry and Dave Young, Rod Martin, Kelly Tatchell

Upper Stoney Lake - Upper Stoney Lake Association: Karl and Kathy Macarthur

White Lake – White Lake Association: Wayne Horner

Appendix B
Financial Partners

Thank You to Our 2015 Supporters

Municipal Government Contributions

KLSA chose not to request grants from Municipalities in 2015

Community Association Donations

Balsam Lake Association
Big Cedar Lake Road Committee
Birchcliff Property Owners Association
East Beehive Community Association
Killarney Bay - Cedar Point Cottage Association
North Pigeon Lake Ratepayers' Association
Sandy Lake Cottagers Association
Stony Lake Heritage Foundation
White Lake Association

Private Business Donations

Birch Bend Cottage Resort
Buckeye Marine
Clearview Cottage Resort
Egan Houseboat Rentals
Lakefield Foodland
Pinewood Cottages and Trailer Park Ltd.
Rosedale Marina
Scotsman Point Resort
Agnico Eagle Mines Ltd.

Private Donations

Ann & John Ambler
Kathy Armstrong
Mike Dolbey
Janet Duval
Sheila Gordon-Dillane
Allen J. Heritage
Robert Hogg
Barbara Karthein
Jim Keyser
Tom McAllister
Bill Napier
Ted Oakes
Ruth Pillsworth

Appendix C:
Treasurer's Report

Mike Stedman,
KLSA Treasurer

This Treasurer's Report refers to the 2015 calendar year and the McColl Turner LLP Chartered Accountants Statement of Financial Position. As in previous years their Review Engagement Report summarizes revenue, expenditure and assets for 2014 and 2015. Our thanks to Mr. George Gillespie for his continued support providing this community service.

2015 revenue of $9,733 is considerably less than 2014 and previous years. KLSA had built up a reserve fund for research oriented water quality work and with no immediate project on the horizon advised our Townships and other funding agencies to defer 2015 grants. Today this is no longer the case. KLSA now has projects as described in this report and deserving of community support.

Our continuing sources of income were:

- Water testing fees $4,682
- Community Association donations $2,031
- Private business/individual donations $2,175
- Membership fees $ 804

2015 total expenses of $12,064 remained consistent with past years when you exclude major project activities like our Aquatic Plants Guide, Milfoil Weevil Guide and The Algae of the Kawartha Lakes study.

The major operating expense accounts included:

- *E. coli* water test fees $3,402
- KLSA insurance $1,709
- KLSA Annual Report $4,922
- Ongoing projects $1,553

Postage for the annual report at over $3.00 a copy forces us to minimize distribution by mail. The ongoing projects account includes costs for general meetings, a Fleming College Credit-for-Product project, special water testing and publication reprints.

In terms of total assets, we closed 2015 with a cash balance of $14,527 and an RBC GIC of $5,159 for total assets of $19,686. The Board considers we need approximately $8,000 for working capital leaving the remainder for project activity, employing our strategy to leverage KLSA monies with funds available from granting authorities such as the Ontario Trillium Foundation, RBC-Blue Water and Stony Lake Heritage Foundation. To this end, work is underway to define a project addressing KLSA's goals of partnership alliances, public awareness, lake water quality monitoring and related scientific research.

Please note: *E. coli* testing is designed to be revenue neutral, and historically has been so. One payment in 2014 was delayed, and so this was recorded as revenue in 2015. This accounts for the lower revenue in 2014 (relative to expenses), and the higher revenue in 2015 (relative to expenses).

KLSA could not effectively meet these goals without your support, both financial and in-kind.

Financial Statements of

KAWARTHA LAKES STEWARDS ASSOCIATION

December 31, 2015

Note To The Financial Statements
December 31, 2015

BASIS OF PRESENTATION

The accompanying financial statements relate to the incorporated association registered by Letters Patent as Kawartha Lakes Stewards Association. The Association conducts co-ordinated, consistent water quality testing programs (including bacteria and phosphorus) of lake water on lakes within the Trent Canal System watershed. The Association derives its revenue from those groups and individuals who are concerned about maintaining the quality of water within the watershed.

Kawartha Lakes Stewards Association qualifies as a non-profit organization under section 149(1)(l) of the Income Tax Act, and, as such, is not responsible to pay any income tax. The distribution of any of its assets or profits to, or for the personal benefit, of its members, directors or affiliates is prohibited.

McCOLL TURNER LLP
CHARTERED ACCOUNTANTS

McCOLL TURNER LLP
CHARTERED ACCOUNTANTS

362 Queen Street
Peterborough, ON
K9H 3J6

P: 705.743.5020
F: 705.743.5081
E: info@mccollturner.com
www.mccollturner.com

REVIEW ENGAGEMENT REPORT

To Mr. Mike Stedman, Treasurer

KAWARTHA LAKES STEWARDS ASSOCIATION

We have reviewed the statement of financial position of Kawartha Lakes Stewards Association as at December 31, 2015 and the statement of operations for the year then ended. Our review was made in accordance with generally accepted standards for review engagements and accordingly consisted primarily of enquiry, analytical procedures and discussion related to information supplied to us by the organization.

A review does not constitute an audit and consequently we do not express an audit opinion on these financial statements.

Based on our review, nothing has come to our attention that causes us to believe that these financial statements are not, in all material respects, in accordance with Canadian accounting standards for not-for-profit organizations.

McColl Turner LLP

Licensed Public Accountants

Peterborough, Ontario
February 24, 2016

KAWARTHA LAKES STEWARDS ASSOCIATION

Statement of Financial Position - December 31, 2015

	(Unaudited) 2015	2014
ASSETS		
Current Assets		
Cash	$ 14,527	16,899
Guaranteed Investment Certificate	5,159	5,118
	19,686	22,017
NET ASSETS	19,686	22,017
	$ 19,686	$ 22,017

Statement of Operations
Year ended December 31, 2015

	(Unaudited) 2015	2014
REVENUE		
Municipal grants	-	5,750
Associations	2,031	1,305
Private contributions and donations	2,175	2,114
Water testing fees	4,682	4,453
Membership fees	804	1,234
Interest	41	40
	9,733	14,896
EXPENDITURES		
Water testing fees	3,402	5,130
Special projects	1,553	3,016
Annual report costs	4,922	3,677
Insurance	1,709	1,675
Telephone, copies and other administrative costs	427	604
Bank charges	51	44
	12,064	14,146
EXCESS OF REVENUE OVER EXPENDITURES (EXPENDITURES OVER REVENUE) FOR THE YEAR	(2,331)	750
NET ASSETS - beginning of year	22,017	21,267
NET ASSETS - end of year	$ 19,686	$ 22,017

McCOLL TURNER LLP
CHARTERED ACCOUNTANTS

Appendix D:
Privacy Statement

Jeffrey Chalmers, KLSA Privacy Officer

As a result of Federal Privacy Legislation changes, all businesses and associations that collect personal information from their customers and members must develop and post a Privacy Policy. The following is the policy that your Board has developed to protect you and your personal information held by the Kawartha Lake Stewards Association (KLSA).

To our Membership: Your privacy is important to us. This policy tells you what information we gather about you, how we would use it, to whom we may disclose it, how you can opt out of the collection, use or disclosure of your personal information, and how to get access to the information we may have about you.

Collecting Information: We collect information about our members and volunteers such as name, address, relevant telephone numbers, email address and preferred method of communication. We obtain this information through the attendance form at our workshops and AGM, and by information provided by the many volunteers assisting in our lake water quality testing programs. We may keep the information in written form and/or electronically. Keeping your email address information at our email site allows us to send you information in an efficient and low cost manner. By providing this information to us, you enable us to serve you better.

Using Information: We use the information collected to provide you with information about the association activities and related lake water issues of interest to residents of the Kawartha Lakes. We will retain your personal information only for as long as required by law or as necessary for the purposes for which it is collected. Your personal information will not be used for other purposes without your consent.

Disclosing Information: We will not disclose any personal information collected about you to anybody else, unless required to do so by law. We will comply with all laws, which require us to supply the information to government agencies and others. We will not otherwise sell, transfer or trade any mailing list, which includes your information.

Keeping Information Secure: We will keep written information in a secure place.

Access to Information: If you wish to review the personal information we keep about you please contact the association c/o "Privacy Officer" at the address set out below. At your request, subject to applicable law, we will delete your personal information from our records. The Privacy Officer is not intended to be an elected position. It is an appointment to one of the elected directors of the Board providing they are in good standing and have the support of the Chair and other directors.

Obtaining Your Consent: By providing personal information to us, you are consenting to us using it for the purposes set out above and disclosing it to the parties described above. If you do not want us to use any personal information about you, or wish to limit the use or disclosure of such personal information by us, please contact the Privacy Officer at the address set out below by mail.

Contacting us: We may be contacted by email at kawarthalakestewards@yahoo.ca or by regular mail to:

KLSA
24 Charles Court
Lakefield, ON K0L 2H0

Appendix E:
Rationale for *E. coli* Testing and 2015 Lake-by-Lake Results

Tom McAllister,
KLSA Director

Kathleen Mackenzie,
KLSA Vice-Chair

Choosing sites

The goals of *E. coli* testing are threefold:

- To see how safe the water was for swimming at chosen sites
- To provide baseline data for ongoing monitoring in future years
- To discover sources of elevated bacterial counts

Almost all sites were chosen because it was thought that they would have the highest *E. coli* counts in the lake; that is, we were 'looking for trouble'. Therefore, please realize that the readings shown here do not represent the average bacterial levels on our lakes; rather, they represent some of the highest bacterial levels on our lakes. Test sites included:

- Areas of high use (resorts, live-aboard docking areas, etc.)
- Areas of low circulation (quiet, protected bays)
- Areas near inflows (from culverts, streams, wetlands)
- Areas of concentrated populations of wild life (near wetlands, areas popular with waterfowl)

Please note:

- KLSA does not test drinking water. Only surface waters are tested. All untreated surface waters are considered unsafe for drinking.
- KLSA results are valid only for the times and locations tested, and are no guarantee that a lake will be safe to swim in at all times and in all locations.
- Only sites consistent with provincial sampling protocol have been reported.

How and why did we test for *E. coli*?

The protocol for *E. coli* testing is found in the Ontario Ministry of Health's *Beach Management Guidance Document*, *2014*, in the section, 'Water Sample Collection'. This document can be found at http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/guidance/guide_beach.pdf

You can see the KLSA *E. coli* testing protocol 'in action' on our new video on the KLSA website!

E. coli was the bacteria of choice because:

- The presence of *E. coli* usually indicates fecal contamination from warm-blooded animals such as birds or mammals, including humans.

The presence of *E. coli* indicates the possible presence of other disease-causing organisms found in fecal material, such as those causing gastrointestinal and outer ear infections.

- *E. coli* is present in fecal material in very high numbers. Healthy humans excrete about 100 million *E. coli* per ¼ teaspoon of fecal matter! Therefore, it is easier to 'find' than most other less plentiful bacteria.
- *E. coli* itself can be dangerous. Although most strains of *E. coli* are harmless, some strains cause serious disease, as occurs in occasional ground beef 'scares'. The basic analysis done by the laboratories cannot distinguish the difference between the harmless and the deadly, so we always treat *E. coli* as if we were dealing with a harmful strain.

Results are expressed as *E. coli* cfu/l00 mL. When sample water is plated on growth medium in the laboratory, each live bacterium will grow to form a visible colony. 'Cfu' signifies 'colony forming units'. 'Cfu' generally represents numbers of live bacteria, as opposed to a microscopic count which would count both live and dead bacteria.

Appendix E:
Rationale for *E. coli* Testing and 2015 Lake-by-Lake Results

Lake-by-Lake *E. coli* Results

To put the results in perspective:

- 100 *E. coli* cfu/100 mL is the level at which public beaches are posted unsafe for swimming in Ontario
- KLSA considers counts over 50 *E. coli* cfu/100mL as somewhat high for the Kawartha Lakes, and cause for re-testing
- Counts 20 and below, with an occasional reading between 20 and 50, are normal for the Kawartha Lakes

Big Bald Lake							
2015 *E. coli* Lake Water Testing - *E. coli* cfu/100 mL							
Site	**07/16**	**07/20**	**07/30**	**08/12**	**08/14**	**08/21**	**08/31**
1	11	14	31	3	-	**51**	35
2	2	1	3	0	-	**74**	1
3	1	4	1	2	-	19	**136**
9	5	7	0	5	-	29	9
10	6	13	9	**121**	0,7,5,6,10	**63**	36
11	4	0	1	5	-	4	0

Counts were low in July, but there were several higher counts in August. Site 10 is a shallow area with slow circulation, and a regular colony of waterfowl inhabits a rock shelf just beyond the bay entrance. There is a high human residential density as well. Both factors may have accounted for the higher counts on August 12 and 2l. Note that the spike in the count at Site 10 on August 12 was followed by much lower counts when follow-up samples were taken two days later.

There were 3 elevated readings on August 2l. These sites were all in relatively enclosed bays, and they were tested only a couple of hours after a heavy rainfall.

Site 3 has recently become very popular with day boaters and swimmers, which may have accounted for the August 31 high reading.

Big Cedar Lake- Big Cedar Lake Road Association						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site	**07/06**	**07/20**	**07/29**	**08/04**	**08/10**	**09/08**
640	2	3	0	1	0	0

Counts were consistently low at this location on Big Cedar Lake.

Buckhorn Lake- Buckhorn Sands Property Owners Association						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site	**07/07**	**07/29**	**08/04**	**08/10**	**08/17**	**09/08**
7	24	0	0	1	3	3
8	10	10	4	11	3	2
9	0	0	6	1	3	0
10	5	5	9	2	0	1

Counts on all four sampling sites on Buckhorn Lake were consistently low.

Clear Lake- Birchcliff Property Owners Association						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site	**07/07**	**07/20**	**07/29**	**08/13**	**08/20**	**09/15**
1	0	1	0	0	0	7
2	0	0	0	0	0	0
3	7	18	0	1	**440**	37
4	6	7	0	1	15	12
5	4	0	4	0	0	1
6	19	3	2	0	**124**	0
7	0	3	0	0	1	2
8	2	5	4	0	2	33

Site 3's count of 440 on August 20 may have been a reflection of the ongoing presence of geese on a nearby shoal and on the lawns of several cottages.

Site 6's high count was surprising because counts in the past have been consistently low here. However, during the week previous to this date a whole flock of geese were in and out of the bay and up on the adjacent lawn.

At both Site 3 and Site 6, counts returned to normal levels by the time the next samples were taken.

Clear Lake- Kawartha Park Cottagers Association						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site/Date	**07/06**	**07/20**	**07/27**	**08/04**	**08/10**	**09/14**
A	0	1	1	9	0	3
B	0	2	3	31	0	7
C	1	0	3	2	4	8
D	1	2	27	2	0	3
P	0	4	3	2	0	1
W	0	8	1	10	0	23

Again this year, *E. coli* counts were low on all 6 sites tested by Kawartha Park.

Clear Lake – West Shore							
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL							
Site/Date	**07/06**	**07/10**	**07/20**	**07/27**	**08/04**	**08/10**	**09/08**
1	**227**	1,3,3,1,2	3	1	0	4	0

Follow-up testing showed a return to low levels following a spike in the count on July 6.

Appendix E:
2015 Lake-by-Lake *E. coli* Test Results

Katchewanooka Lake										
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL										
Site/Date	07/06	07/20	07/27	08/04	08/06	08/12	08/13	08/20	09/08	09/10
2	2	1	9	-	14	**87**	-	21	-	**88**
5	1	2	-	-	2	6	-	3	-	0
7	2	4	6	6	-	-	0	-	3	-

Counts were generally low. Site 2 is near a swim site that is visited by both dogs and people. Nearby is a small island occupied by seagulls and terns. This may have caused the two elevated counts at Site 2.

Lovesick Lake – Lovesick Lake Association						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site/Date	07/06	07/20	07/27	08/04	08/10	09/08
16	2	4	5	4	2	4
18	0	1	4	2	1	0
19	12	0	0	0	14	1

Counts were consistently low at these 3 locations on Lovesick Lake.

Lower Buckhorn Lake – Lower Buckhorn Lake Owners Association					
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL					
Site/Date	07/15	07/29	08/12	09/02	09/08
1	1	**64**	33	**340**	5
2	5	12	3	1	0
5	4	5	8	0	0
8	3	2	0	7	1
9	1	**73**	9	9	0
11	1	1	1	**68**	10

The two elevated readings on July 29 were at sites that have geese frequently, and there had been a recent heavy rainfall. The spike in the count at Site 1 on September 2 was followed by a low count just a few days later.

Coboconk M. P.				
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL				
Site/Date	**07/06**	**07/20**	**08/04**	**08/10**
01	3	3	13	5

Counts were consistently low at this sampling location.

Pigeon Lake- Concession 17 Pigeon Lake Cottagers Assoc.						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site/Date	**07/06**	**07/20**	**08/13**	**08/19**	**09/03**	**09/08**
A	10	1	**90**	0,0,1,0,0	1	4
B	0	2	3	-	0	0
3	31	0	0	-	1	0

Except for an elevated reading at Site A on August 13, readings at these sites were generally low. The volunteer saw nothing abnormal, and there had been only light rain previous to testing. Follow-up samples taken at Site A showed a prompt return to low levels.

Pigeon Lake- North Pigeon Lake Ratepayers' Assoc.				
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL				
Site/Date	**07/02**	**07/20**	**08/13**	**09/10**
1	5	3	43	30
5	3	16	1	6
6	37	8	38	16
8	0	0	1	-
13	2	7	25	-

While there was some variability, counts were generally low to moderate at these sampling sites.

Pigeon Lake- Tate's Bay					
2015 *E. coli* Lake Water Testing - *E. coli* cfu/100 mL					
Site/Date	**07/06**	**07/20**	**07/27**	**08/04**	**08/10**
TB1	11	7	<3	8	13

Counts were low to moderate in this second year of testing at Tate's Bay.

Appendix E:
2015 Lake-by-Lake *E. coli* Test Results

Pigeon Lake- Victoria Place					
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL					
Site/Date	07/06	07/20	07/27	08/04	08/10
1	<3	<3	<3	<3	11
2	8	3	5	3	3
3	<3	<3	3	<3	5
4	5	3	5	25	5
5	<3	<3	<3	21	25

Counts were normal for a Kawartha Lake (mainly less than 20, occasional count between 20 and 50) at these 5 sampling sites.

Sandy Lake – Sandy Lake Cottagers Association						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site/Date	07/07	07/20	07/27	08/04	08/11	09/08
1	0	0	1	7	0	5
2	1	1	2	1	0	1
3	3	1	5	0	0	5

Counts were consistently very low at these Sandy Lake sites.

Shadow Lake					
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL					
Site/Date	07/06	07/20	07/27	08/04	08/10
SH-01	<3	8	3	5	<3
SH-02	<3	11	11	13	5

Counts were consistently low at these Shadow Lake sites.

Silver Lake					
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL					
Site/Date	07/06	07/20	07/27	08/04	08/10
SI-01	3	16	3	8	<3

Counts were consistently low at this Silver Lake site.

Appendix E:
2015 Lake-by-Lake *E. coli* Test Results

Stony Lake- Association of Stony Lake Cottagers							
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL							
Site/Date	07/06	07/20	07/27	08/04	08/06	08/10	09/08
E	6	17	8	25	-	**63**	1
F	7	2	2	12	-	3	1
I	2	7	11	15	-	16	1
J	4	25	15	-	29	22	5
K	4	2	2	-	3	0	19
L	9	4	6	4	-	2	0
P	0	1	0	0	-	2	1
28	23	11	10	34	-	**77**	1

There were two elevated counts on Stony Lake on August 10, but with no obvious cause.

Stony Lake – Association of Stony Lake Cottagers						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site/Date	07/06	07/15	07/27	08/04	08/18	09/08
1	2	2	1	1	0	1

Counts were consistently very low at Site 1 in Stony Lake.

Upper Stoney Lake- Upper Stoney Lake Association						
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL						
Site/Date	07/06	07/20	07/27	08/04	08/10	09/08
6	0	17	9	13	3	5
20	7	6	10	6	7	2
21	0	1	3	3	0	0
52	4	7	5	9	13	10
65	7	6	2	2	14	2
70	0	0	1	1	0	3
78A	1	5	0	2	0	1

Counts were consistently low at the seven sampling sites on Upper Stoney Lake.

Sturgeon Lake				
2015 *E. coli* Lake Water Testing - *E. coli* cfu / 100 mL				
Site/Date	07/06	07/20	07/27	08/10
SS3	<3	**62**	22	33

There was one elevated count on July 20, but levels returned to normal the next week.

Appendix F:
2015 Phosphorus and Secchi Data

Kathleen Mackenzie,
KLSA Vice-Chair

Thanks to our volunteers for a thorough and careful job of collecting water samples. Because the levels of phosphorus in lake water are so low, it is very easy to contaminate a sample -- for example, with a fingertip or a poorly-aimed sneeze. However, over the years, we have had a very low rate of 'outliers', or very high counts, which is a sure testament to our expertise. Now that we have 14 years of data, it is easy for an unusual reading to 'pop out' and long term trends can be detected. (See KLSA 2014 Annual Report 'Analysis of Lake Partner Program'.)

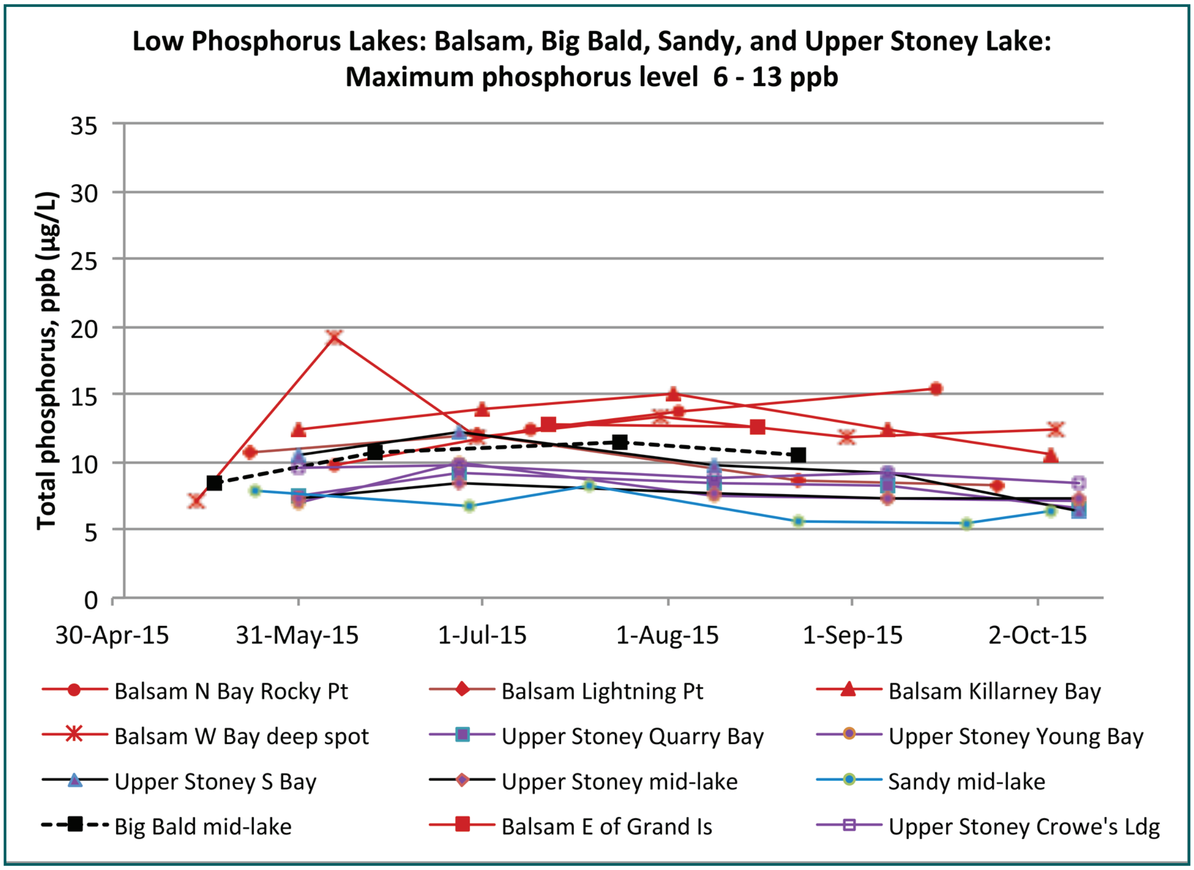
It is important to keep track of phosphorus levels on our lakes. The Ontario Ministry of the Environment's (MOE) Interim Provincial Water Quality Objective for Total Phosphorus is as follows:

> *Current scientific evidence is insufficient to develop a firm Objective at this time. Accordingly, the following phosphorus concentrations should be considered as general guidelines which should be supplemented by site-specific studies:*
>
> - *To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 20 µg/L;*
> - *A high level of protection against aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 10 µg/L or less.*

If you would like to know where the sites are located, you can find them on a map on the Lake Partner Program's (LPP) website at www.ontario.ca/environment-and-energy/map-lake-partner. Also, if you would like to compare your lake to others in Ontario, the complete LPP data set can be found on the LPP website, and also on the website of the Federation of Ontario Cottagers' Associations (FOCA). The FOCA website also has a how-to-test video, to show you how simple it is! You can find this by typing 'lpp' in the search box.

Following are graphs illustrating 2015 phosphorus levels in the Kawartha Lakes, along with a discussion of why they vary from lake to lake and from month to month.

Low-phosphorus Lakes



There are two reasons why these lakes have low, stable phosphorus levels compared to the rest of the Kawarthas:

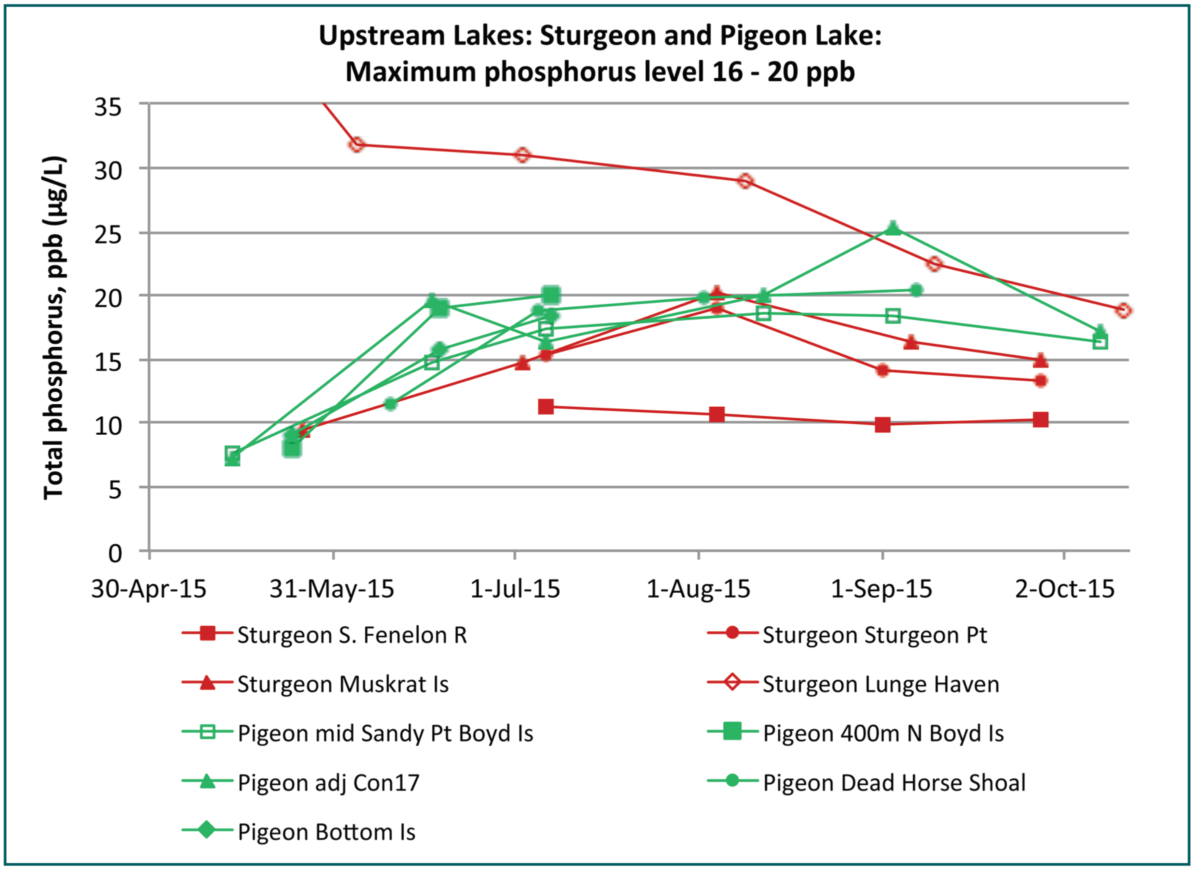
1. Upper Stoney Lake and Balsam Lake receive their water directly from the north through rivers. These rivers contribute low-phosphorus water because they come from an area of granitic rock, little soil, and sparse human population.

2. Big Bald Lake and Sandy Lake have a local watershed that provides water high in calcium carbonate. During warm weather, photosynthesis by aquatic plants and algae removes carbon dioxide from the lake water and causes calcium carbonate to precipitate, giving the lake a milky, turquoise appearance. The phosphorus in the water is co-precipitated, transporting it out of the water and into the sediments. For more information on marl lakes, see:

http://culturalecology.info/wetland_combi/Marllakes.html

Appendix F:
2015 Phosphorus and Secchi Data

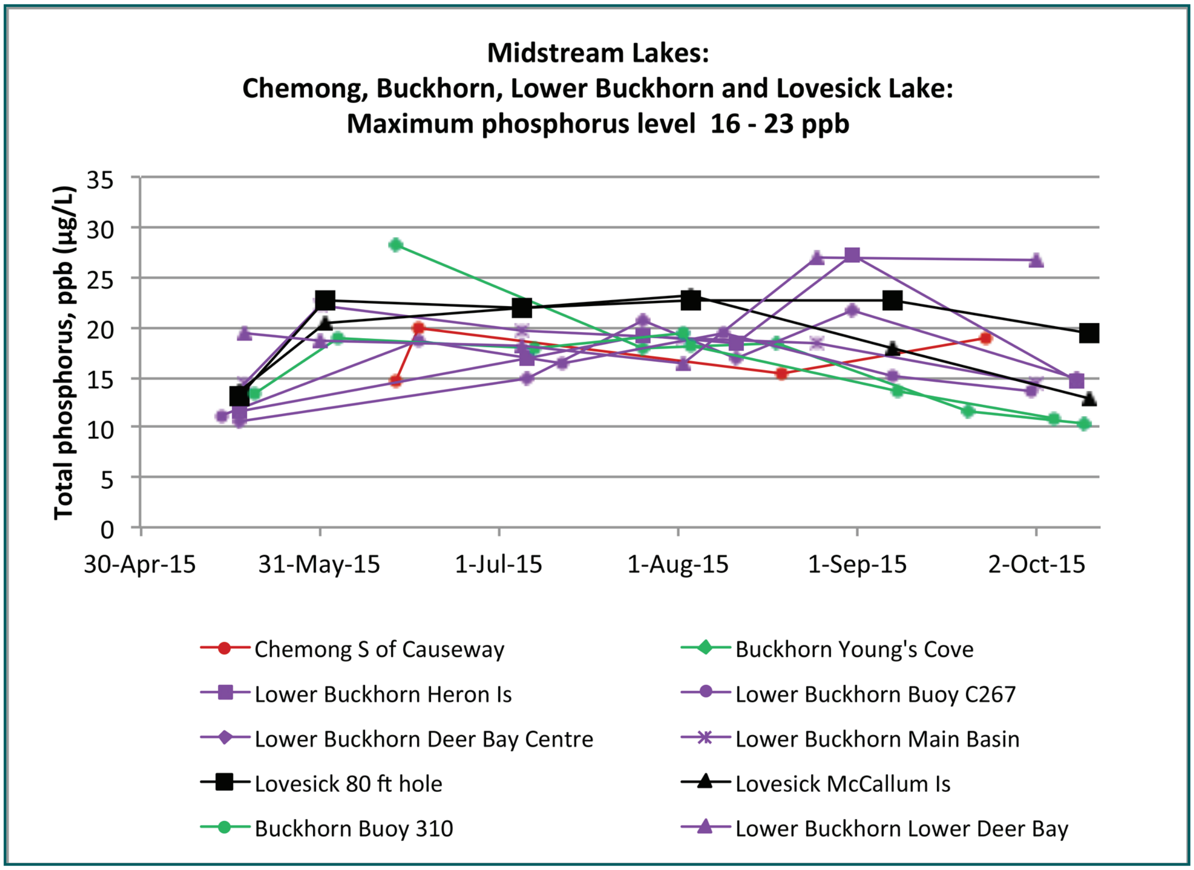
Upstream Lakes



Here we see the most common June-to-September pattern in the Kawartha Lakes: low phosphorus levels in the spring climbing to a maximum in early August, and falling somewhat by early September. The Sturgeon Fenelon R. site is lower, as it receives low-phosphorus water from Cameron Lake. The next two sites in Sturgeon Lake show higher phosphorus levels, probably because high-phosphorus water from south Sturgeon has been mixed in.

The Lunge Haven site is located in south Sturgeon Lake. The point missing on the graph was 42.3 ppb on May 17. (This point was omitted simply to make the graph easier to read.) South Sturgeon Lake was measured in 2005/6/7/8 at a nearby site, Snug Harbour, and levels were high then also. Because this area of Sturgeon Lake is shallow and silty, care needs to be taken not to disturb the sediments while testing. Possibly this is what occurred in the May reading. It will be interesting to see how future years compare to 2015.

Midstream Lakes

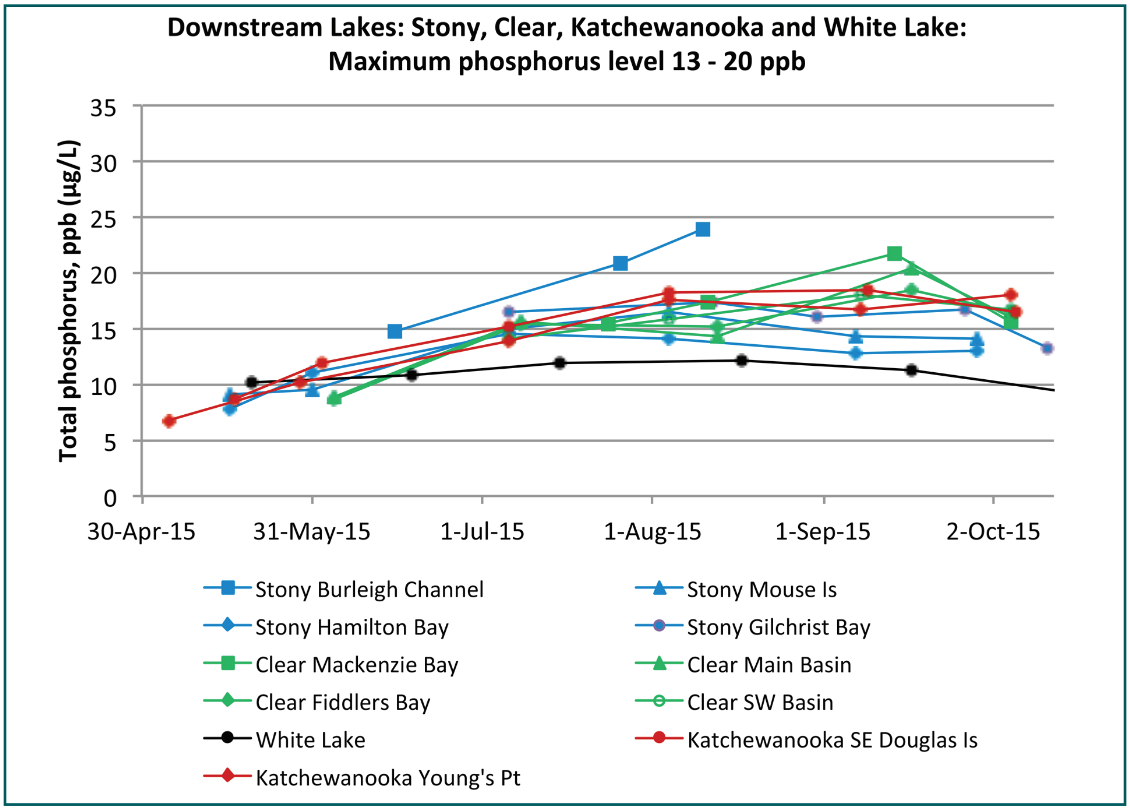


The seasonal pattern continues: low phosphorus in the spring, rising until August, and falling somewhat in September. Levels are similar to Sturgeon and Pigeon Lake.

Young's Cove on Buckhorn Lake is a new site. The high June reading and low September/October readings were unusual; it will be interesting to see if this recurs in future years.

Appendix F:
2015 Phosphorus and Secchi Data

Downstream Lakes



This graph of the four downstream lakes tells a story of the confluence of northern, low-phosphorus water and mainstream, higher-phosphorus water.

- The Stony Lake/Burleigh Channel site is directly downstream from Lovesick Lake, and has similar phosphorus levels.
- The other three sites in Stony Lake receive water from low-phosphorus Upper Stoney Lake, resulting in a drop in phosphorus levels.
- As water flows downstream from Stony Lake, phosphorus levels rise to somewhat higher levels in Clear Lake and Katchewanooka Lake.
- White Lake is its usual mysterious self. Water flows directly from Gilchrist Bay into small White Lake. For some reason, phosphorus levels fall in White Lake, despite high density residential shorelines and limestone shorelines. The most likely reason would be the presence of low-phosphorus springs.

Conclusion

North of the Kawarthas, the large majority of the lakes have phosphorus levels that vary only from about 6 to 12 ppb throughout the summer. Why do the Kawarthas have far more variable readings, from 7 ppb to 42 ppb?

- Most lakes start out in the spring with low phosphorus levels, probably due to a spring flush of water from the north moving through the system. Levels then rise to a peak in early August, decreasing somewhat in September.
- A few lakes are exceptions. They remain low in phosphorus throughout the summer. This is due to either constant inflows of river water from the north, or a marl chemistry which precipitates the phosphorus out of the water and into the sediments.
- In mid-to-late-summer, when phosphorus levels are highest, one can see a rise in phosphorus in Sturgeon Lake, then levelling out in the rest of the lakes, with a dip in Stony Lake due to dilution with low-phosphorus water from Upper Stoney Lake.
- The rise in phosphorus levels in Sturgeon Lake may be due to an inflow of high-phosphorus water from the south end of Sturgeon Lake.
- Many of the Kawartha Lakes exhibit phosphorus levels that approach 20 ppb in midsummer. As this is the maximum level recommended by the Ontario Ministry of the Environment and Climate Change for good recreational value, it is important that phosphorus levels are kept stable on the Kawartha Lakes.

Total Phosphorus (TP) Measurements

Three TP measurements are in bold. These were considered outliers, and were not used to calculate the average TP.

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg. TP (µg/L)
6902	2	BALSAM LAKE	N Bay Rocky Pt.	6-Jun-15	9.6	9.8	9.7
6902	2	BALSAM LAKE	N Bay Rocky Pt.	9-Jul-15	12.6	12.4	12.5
6902	2	BALSAM LAKE	N Bay Rocky Pt.	3-Aug-15	14.0	13.4	13.7
6902	2	BALSAM LAKE	N Bay Rocky Pt.	15-Sep-15	15.8	15.0	15.4
6902	5	BALSAM LAKE	NE end-Lightning Pt	23-May-15	10.6	11.0	10.8
6902	5	BALSAM LAKE	NE end-Lightning Pt	30-Jun-15	**77.5**	12.0	12.0
6902	5	BALSAM LAKE	NE end-Lightning Pt	23-Aug-15	8.6	8.8	8.7
6902	5	BALSAM LAKE	NE end-Lightning Pt	25-Sep-15	8.6	8.0	8.3
6902	7	BALSAM LAKE	South B-Killarney B	31-May-15	13.2	11.6	12.4
6902	7	BALSAM LAKE	South B-Killarney B	1-Jul-15	13.8	14.0	13.9
6902	7	BALSAM LAKE	South B-Killarney B	2-Aug-15	16.6	13.4	15.0
6902	7	BALSAM LAKE	South B-Killarney B	7-Sep-15	12.4	12.6	12.5
6902	7	BALSAM LAKE	South B-Killarney B	4-Oct-15	10.4	10.8	10.6
6902	8	BALSAM LAKE	W Bay2, deep spot	14-May-15	6.6	7.6	7.1
6902	8	BALSAM LAKE	W Bay2, deep spot	6-Jun-15	19.0	19.4	19.2
6902	8	BALSAM LAKE	W Bay2, deep spot	30-Jun-15	12.0	11.8	11.9
6902	8	BALSAM LAKE	W Bay2, deep spot	31-Jul-15	13.0	13.8	13.4
6902	8	BALSAM LAKE	W Bay2, deep spot	31-Aug-15	11.6	12.0	11.8
6902	8	BALSAM LAKE	W Bay2, deep spot	5-Oct-15	12.4	12.4	12.4
6902	9	BALSAM LAKE	E of Grand Is	12-Jul-15	13.0	12.6	12.8
6902	9	BALSAM LAKE	E of Grand Is	16-Aug-15	11.2	14.0	12.6
6941	1	BIG BALD LAKE	Mid Lake, deep spot	17-May-15	8.2	8.6	8.4
6941	1	BIG BALD LAKE	Mid Lake, deep spot	13-Jun-15	11.0	10.6	10.8
6941	1	BIG BALD LAKE	Mid Lake, deep spot	24-Jul-15	12.0	11.0	11.5
6941	1	BIG BALD LAKE	Mid Lake, deep spot	23-Aug-15	10.8	10.2	10.5
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	16-May-15	5.0	5.0	5.0
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	20-May-15	13.6	13.0	13.3
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	3-Jun-15	20.0	18.0	19.0
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	7-Jul-15	17.8	18.0	17.9
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	2-Aug-15	18.2	20.4	19.3

Appendix F: 2015 Phosphorus and Secchi Data

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg. TP (µg/L)
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	3-Aug-15	18.2	18.0	18.1
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	8-Sep-15	13.0	14.2	13.6
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	5-Oct-15	10.4	11.4	10.9
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	13-Jun-15	29.2	27.4	28.3
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	26-Jul-15	19.0	16.6	17.8
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	18-Aug-15	18.4	18.2	18.3
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	20-Sep-15	12.2	11.0	11.6
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	10-Oct-15	10.4	10.4	10.4
6905	6	CAMERON LAKE	S end, deep spot	17-May-15	10.6	15.4	13.0
6951	9	CHEMONG LAKE	S. of Causeway	13-Jun-15	14.6	14.6	14.6
6951	9	CHEMONG LAKE	S. of Causeway	17-Jun-15	21.6	18.2	19.9
6951	9	CHEMONG LAKE	S. of Causeway	19-Aug-15	16.4	14.4	15.4
6951	9	CHEMONG LAKE	S. of Causeway	23-Sep-15	20.4	17.2	18.8
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	6-May-15	14.0	8.8	11.4
6955	1	CLEAR LAKE	MacKenzie Bay	24-Jul-15	15.0	16.0	15.5
6955	1	CLEAR LAKE	MacKenzie Bay	11-Aug-15	17.6	17.2	17.4
6955	1	CLEAR LAKE	MacKenzie Bay	14-Sep-15	21.8	21.8	21.8
6955	1	CLEAR LAKE	MacKenzie Bay	5-Oct-15	15.6	15.6	15.6
6955	2	CLEAR LAKE	Main Basin-deep spot	4-Jun-15	8.8	8.8	8.8
6955	2	CLEAR LAKE	Main Basin-deep spot	8-Jul-15	15.8	15.6	15.7
6955	2	CLEAR LAKE	Main Basin-deep spot	13-Aug-15	14.4	14.4	14.4
6955	2	CLEAR LAKE	Main Basin-deep spot	17-Sep-15	20.2	20.6	20.4
6955	2	CLEAR LAKE	Main Basin-deep spot	5-Oct-15	16.0	16.0	16.0
6955	3	CLEAR LAKE	Fiddlers Bay	4-Jun-15	8.0	9.2	8.6
6955	3	CLEAR LAKE	Fiddlers Bay	8-Jul-15	15.4	15.6	15.5
6955	3	CLEAR LAKE	Fiddlers Bay	13-Aug-15	15.4	14.8	15.1
6955	3	CLEAR LAKE	Fiddlers Bay	17-Sep-15	19.2	17.8	18.5
6955	3	CLEAR LAKE	Fiddlers Bay	5-Oct-15	16.2	16.6	16.4
6955	4	CLEAR LAKE	Brysons Bay	15-Jun-15	14.2	14.0	14.1
6955	4	CLEAR LAKE	Brysons Bay	7-Aug-15	18.2	16.4	17.3
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	6-Jul-15	14.4	13.8	14.1
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	4-Aug-15	16.2	15.4	15.8
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	8-Sep-15	18.0	18.2	18.1

Appendix F: 2015 Phosphorus and Secchi Data

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg. TP (µg/L)
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	5-Oct-15	17.4	16.0	16.7
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	17-May-15	9.0	8.4	8.7
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	2-Jun-15	12.8	11.2	12.0
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	6-Jul-15	16.0	14.2	15.1
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	4-Aug-15	19.0	17.6	18.3
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	9-Sep-15	20.0	16.8	18.4
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	6-Oct-15	15.8	17.2	16.5
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	5-May-15	7.0	6.6	6.8
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	29-May-15	9.8	10.6	10.2
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	6-Jul-15	14.4	13.4	13.9
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	4-Aug-15	17.2	17.8	17.5
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	8-Sep-15	16.4	17.2	16.8
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	5-Oct-15	18.0	18.0	18.0
7087	1	LOVESICK LAKE	80' hole at N. end	17-May-15	12.4	13.8	13.1
7087	1	LOVESICK LAKE	80' hole at N. end	1-Jun-15	20.0	25.4	22.7
7087	1	LOVESICK LAKE	80' hole at N. end	5-Jul-15	24.4	19.6	22.0
7087	1	LOVESICK LAKE	80' hole at N. end	3-Aug-15	24.2	21.2	22.7
7087	1	LOVESICK LAKE	80' hole at N. end	7-Sep-15	21.2	24.2	22.7
7087	1	LOVESICK LAKE	80' hole at N. end	11-Oct-15	22.6	16.2	19.4
7087	3	LOVESICK LAKE	McCallum Island	17-May-15	15.6	11.6	13.6
7087	3	LOVESICK LAKE	McCallum Island	1-Jun-15	21.2	19.6	20.4
7087	3	LOVESICK LAKE	McCallum Island	5-Jul-15	22.0	21.8	21.9
7087	3	LOVESICK LAKE	McCallum Island	3-Aug-15	23.4	23.0	23.2
7087	3	LOVESICK LAKE	McCallum Island	7-Sep-15	17.6	18.0	17.8
7087	3	LOVESICK LAKE	McCallum Island	11-Oct-15	13.8	12.0	12.9
6990	1	LOWER BUCKHORN LAKE	Heron Island	17-May-15	12.6	10.6	11.6
6990	1	LOWER BUCKHORN LAKE	Heron Island	6-Jul-15	16.2	17.4	16.8
6990	1	LOWER BUCKHORN LAKE	Heron Island	26-Jul-15	17.8	20.6	19.2
6990	1	LOWER BUCKHORN LAKE	Heron Island	11-Aug-15	18.6	18.0	18.3
6990	1	LOWER BUCKHORN LAKE	Heron Island	31-Aug-15	28.4	26.2	27.3
6990	1	LOWER BUCKHORN LAKE	Heron Island	9-Oct-15	15.6	13.6	14.6
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	14-May-15	10.6	11.8	11.2
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	17-Jun-15	19.2	18.2	18.7

Appendix F:
2015 Phosphorus and Secchi Data

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg. TP (µg/L)
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	12-Jul-15	16.2	16.4	16.3
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	9-Aug-15	20.0	19.0	19.5
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	7-Sep-15	15.2	15.2	15.2
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	1-Oct-15	13.8	13.4	13.6
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	17-May-15	11.2	9.8	10.5
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	6-Jul-15	14.6	15.2	14.9
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	26-Jul-15	21.0	20.4	20.7
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	11-Aug-15	16.8	16.8	16.8
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	31-Aug-15	20.4	22.8	21.6
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	9-Oct-15	14.4	15.4	14.9
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	18-May-15	16.6	22.0	19.3
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	31-May-15	18.0	19.2	18.6
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	5-Jul-15	18.8	17.4	18.1
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	2-Aug-15	16.4	16.4	16.4
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	25-Aug-15	32	21.8	26.9
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	2-Oct-15	220	26.8	26.8
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	18-May-15	14.2	14.6	14.4
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	31-May-15	21.8	22.4	22.1
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	5-Jul-15	19.2	20.2	19.7
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	2-Aug-15	21.2	16.8	19.0
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	25-Aug-15	17.4	19.2	18.3
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	2-Oct-15	14.4	34.6	14.4
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	14-May-15	7.0	8.2	7.6
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	17-Jun-15	14.8	14.8	14.8
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	6-Jul-15	16.4	18.4	17.4
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	12-Aug-15	17.4	20.0	18.7
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	3-Sep-15	16.0	21.0	18.5
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	8-Oct-15	16.4	16.2	16.3
6919	12	PIGEON LAKE	N-100m N of Boyd Is.	24-May-15	8.2	7.8	8.0
6919	12	PIGEON LAKE	N-100m N of Boyd Is.	18-Jun-15	17.6	20.4	19.0
6919	12	PIGEON LAKE	N-100m N of Boyd Is.	7-Jul-15	21.0	19.0	20.0
6919	13	PIGEON LAKE	N end-Adjacent Con17	14-May-15	7.0	7.6	7.3
6919	13	PIGEON LAKE	N end-Adjacent Con17	17-Jun-15	20.2	19.0	19.6

Appendix F:
2015 Phosphorus and Secchi Data

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg. TP (µg/L)
6919	13	PIGEON LAKE	N end-Adjacent Con17	6-Jul-15	16.0	16.6	16.3
6919	13	PIGEON LAKE	N end-Adjacent Con17	12-Aug-15	19.2	20.8	20.0
6919	13	PIGEON LAKE	N end-Adjacent Con17	3-Sep-15	20.8	29.8	25.3
6919	13	PIGEON LAKE	N end-Adjacent Con17	8-Oct-15	16.4	18.0	17.2
6919	15	PIGEON LAKE	C340-DeadHorseShoal	10-Jun-15	11.0	11.8	11.4
6919	15	PIGEON LAKE	C340-DeadHorseShoal	5-Jul-15	18.6	19.0	18.8
6919	15	PIGEON LAKE	C340-DeadHorseShoal	2-Aug-15	18.8	21.0	19.9
6919	15	PIGEON LAKE	C340-DeadHorseShoal	7-Sep-15	21.8	19.0	20.4
6919	16	PIGEON LAKE	N300yds off Bottom I	24-May-15	9.2	9.0	9.1
6919	16	PIGEON LAKE	N300yds off Bottom I	18-Jun-15	16.0	15.6	15.8
6919	16	PIGEON LAKE	N300yds off Bottom I	7-Jul-15	17.2	19.8	18.5
7241	2	SANDY LAKE	Mid Lake, deep spot	24-May-15	9.4	6.4	7.9
7241	2	SANDY LAKE	Mid Lake, deep spot	29-Jun-15	6.8	6.8	6.8
7241	2	SANDY LAKE	Mid Lake, deep spot	19-Jul-15	8.6	8.0	8.3
7241	2	SANDY LAKE	Mid Lake, deep spot	23-Aug-15	6.0	5.4	5.7
7241	2	SANDY LAKE	Mid Lake, deep spot	20-Sep-15	5.6	5.4	5.5
7241	2	SANDY LAKE	Mid Lake, deep spot	4-Oct-15	6.2	6.4	6.3
7133	4	STONY LAKE	Burleigh locks chan.	15-Jun-15	16.0	13.4	14.7
7133	4	STONY LAKE	Burleigh locks chan.	26-Jul-15	20.8	20.8	20.8
7133	4	STONY LAKE	Burleigh locks chan.	10-Aug-15	24.2	23.6	23.9
7133	6	STONY LAKE	Gilchrist Bay	6-Jul-15	15.4	17.4	16.4
7133	6	STONY LAKE	Gilchrist Bay	12-Aug-15	17.6	17.2	17.4
7133	6	STONY LAKE	Gilchrist Bay	31-Aug-15	16.2	15.8	16.0
7133	6	STONY LAKE	Gilchrist Bay	27-Sep-15	16.6	16.8	16.7
7133	6	STONY LAKE	Gilchrist Bay	12-Oct-15	12.4	14.2	13.3
7133	7	STONY LAKE	Mouse Is.	16-May-15	9.8	8.4	9.1
7133	7	STONY LAKE	Mouse Is.	31-May-15	10.0	9.2	9.6
7133	7	STONY LAKE	Mouse Is.	6-Jul-15	14.6	15.4	15.0
7133	7	STONY LAKE	Mouse Is.	4-Aug-15	14.8	18.0	16.4
7133	7	STONY LAKE	Mouse Is.	7-Sep-15	14.2	14.6	14.4
7133	7	STONY LAKE	Mouse Is.	29-Sep-15	14.6	13.8	14.2
7133	8	STONY LAKE	Hamilton Bay	16-May-15	8.2	7.4	7.8
7133	8	STONY LAKE	Hamilton Bay	31-May-15	11.4	10.8	11.1

Appendix F:
2015 Phosphorus and Secchi Data

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg. TP (µg/L)
7133	8	STONY LAKE	Hamilton Bay	6-Jul-15	14.6	14.4	14.5
7133	8	STONY LAKE	Hamilton Bay	4-Aug-15	14.4	14.0	14.2
7133	8	STONY LAKE	Hamilton Bay	7-Sep-15	12.8	13.0	12.9
7133	8	STONY LAKE	Hamilton Bay	29-Sep-15	13.2	12.8	13.0
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	26-May-15	9.4	9.4	9.4
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	2-Jul-15	14.6	14.8	14.7
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	4-Aug-15	19.8	20.6	20.2
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	6-Sep-15	16.4	16.4	16.4
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	28-Sep-15	15.2	14.8	15.0
6924	5	STURGEON LAKE	Sturgeon Point Buoy	6-Jul-15	15.6	15.2	15.4
6924	5	STURGEON LAKE	Sturgeon Point Buoy	4-Aug-15	19.0	19.0	19.0
6924	5	STURGEON LAKE	Sturgeon Point Buoy	1-Sep-15	15.8	12.6	14.2
6924	5	STURGEON LAKE	Sturgeon Point Buoy	28-Sep-15	13.2	13.4	13.3
6924	9	STURGEON LAKE	Fenelon R. mouth	6-Jul-15	11.0	11.4	11.2
6924	9	STURGEON LAKE	Fenelon R. mouth	4-Aug-15	10.4	10.8	10.6
6924	9	STURGEON LAKE	Fenelon R. mouth	1-Sep-15	9.6	10.2	9.9
6924	9	STURGEON LAKE	Fenelon R. mouth	28-Sep-15	10.8	9.8	10.3
6924	10	STURGEON LAKE	Lunge Haven	17-May-15	39.0	45.6	42.3
6924	10	STURGEON LAKE	Lunge Haven	4-Jun-15	32.6	31.2	31.9
6924	10	STURGEON LAKE	Lunge Haven	2-Jul-15	30.4	31.6	31.0
6924	10	STURGEON LAKE	Lunge Haven	9-Aug-15	29.8	28.0	28.9
6924	10	STURGEON LAKE	Lunge Haven	10-Sep-15	21.6	23.2	22.4
6924	10	STURGEON LAKE	Lunge Haven	12-Oct-15	19.4	18.4	18.9
5178	1	UPPER STONEY LAKE	Quarry Bay	31-May-15	7.2	7.8	7.5
5178	1	UPPER STONEY LAKE	Quarry Bay	27-Jun-15	9.0	9.6	9.3
5178	1	UPPER STONEY LAKE	Quarry Bay	9-Aug-15	8.8	8.0	8.4
5178	1	UPPER STONEY LAKE	Quarry Bay	7-Sep-15	8.6	8.0	8.3
5178	1	UPPER STONEY LAKE	Quarry Bay	9-Oct-15	6.8	6.4	6.6
5178	3	UPPER STONEY LAKE	Young Bay	31-May-15	7.2	6.8	7.0
5178	3	UPPER STONEY LAKE	Young Bay	27-Jun-15	10.6	9.2	9.9
5178	3	UPPER STONEY LAKE	Young Bay	9-Aug-15	7.4	7.8	7.6
5178	3	UPPER STONEY LAKE	Young Bay	7-Sep-15	7.2	7.6	7.4
5178	3	UPPER STONEY LAKE	Young Bay	9-Oct-15	7.4	6.8	7.1

Appendix F: 2015 Phosphorus and Secchi Data

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg. TP (µg/L)
5178	4	UPPER STONEY LAKE	S Bay, deep spot	31-May-15	10.8	10.4	10.6
5178	4	UPPER STONEY LAKE	S Bay, deep spot	27-Jun-15	11.6	12.8	12.2
5178	4	UPPER STONEY LAKE	S Bay, deep spot	9-Aug-15	9.8	9.8	9.8
5178	4	UPPER STONEY LAKE	S Bay, deep spot	7-Sep-15	8.4	10.0	9.2
5178	4	UPPER STONEY LAKE	S Bay, deep spot	9-Oct-15	6.0	6.6	6.3
5178	5	UPPER STONEY LAKE	Crowes Landing	31-May-15	10.6	8.6	9.6
5178	5	UPPER STONEY LAKE	Crowes Landing	27-Jun-15	9.2	10.2	9.7
5178	5	UPPER STONEY LAKE	Crowes Landing	9-Aug-15	9.2	8.4	8.8
5178	5	UPPER STONEY LAKE	Crowes Landing	7-Sep-15	8.4	10.2	9.3
5178	5	UPPER STONEY LAKE	Crowes Landing	9-Oct-15	6.8	10.0	8.4
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	31-May-15	7.2	7.4	7.3
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	27-Jun-15	8.4	8.4	8.4
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	9-Aug-15	7.6	7.8	7.7
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	7-Sep-15	7.6	7.2	7.4
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	9-Oct-15	8.0	6.8	7.4
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	20-May-15	9.6	10.8	10.2
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	18-Jun-15	11.0	10.8	10.9
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	15-Jul-15	11.6	12.2	11.9
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	17-Aug-15	11.2	13.0	12.1
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	17-Sep-15	12.0	10.4	11.2
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	25-Oct-15	8.4	8.8	8.6

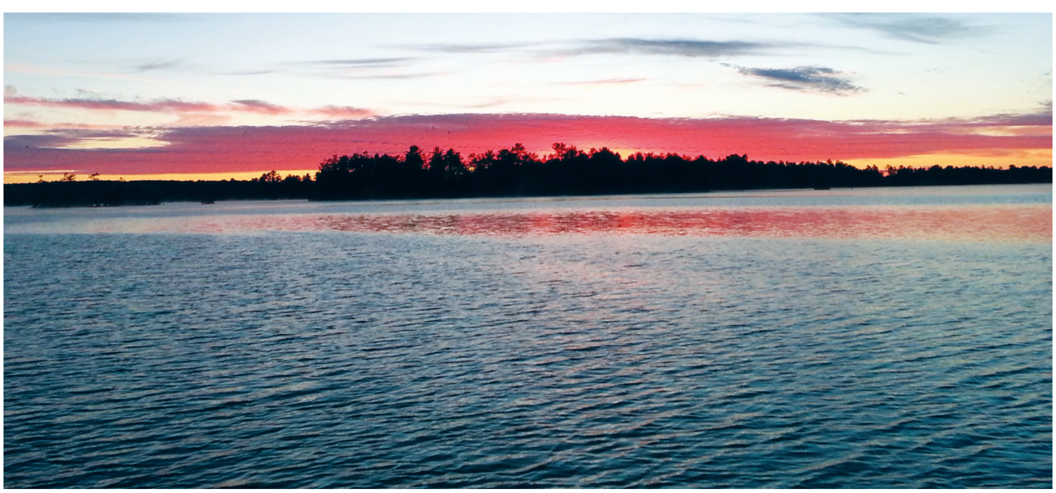


Photo Pat Moffat

Appendix F:
2015 Phosphorus and Secchi Data

2015 Secchi Depth Measurements

The Secchi depth is a measurement of how far one can see down into the lake water. Therefore, a small Secchi measurement indicates murky water; a larger Secchi depth number indicates clear water. There are a number of factors affecting Secchi depth:

- Phosphorus levels. Usually lakes with higher phosphorus levels have more algal growth, making them less clear. For example, the average Secchi reading in early August of three sites on low-phosphorus Upper Stoney Lake was 5.7 m while the average August reading for three sites on high-phosphorus Pigeon Lake was 3.1 m.
- Tea-coloured runoff (coloured by degraded plant tannins) from wetlands. This is most noticeable in the spring, but this colour can be seen in Cameron Lake and Little Bald Lake year-round due to the many wetlands in their watersheds.
- Marl precipitation. In hard-water lakes such as Chemong, Sandy, and Big Bald, a milky-looking precipitate forms in the water in warm weather. In cooler weather, this sinks to the bottom as powdery marl.
- Zebra mussels. These filter out large quantities of algae, clearing the water.

STN	Site ID	LAKE NAME	Site Description	Date	Secchi (m)
6902	2	BALSAM LAKE	N Bay Rocky Pt.	6-Jun-15	5.0
6902	2	BALSAM LAKE	N Bay Rocky Pt.	20-Jun-15	5.0
6902	2	BALSAM LAKE	N Bay Rocky Pt.	9-Jul-15	5.3
6902	2	BALSAM LAKE	N Bay Rocky Pt.	23-Jul-15	5.3
6902	2	BALSAM LAKE	N Bay Rocky Pt.	3-Aug-15	4.5
6902	2	BALSAM LAKE	N Bay Rocky Pt.	24-Aug-15	5.3
6902	2	BALSAM LAKE	N Bay Rocky Pt.	15-Sep-15	5.0
6902	5	BALSAM LAKE	NE end-Lightning Pt	23-May-15	3.0
6902	5	BALSAM LAKE	NE end-Lightning Pt	23-May-15	4.0
6902	5	BALSAM LAKE	NE end-Lightning Pt	30-Jun-15	0.1
6902	5	BALSAM LAKE	NE end-Lightning Pt	23-Aug-15	5.0
6902	5	BALSAM LAKE	NE end-Lightning Pt	25-Sep-15	3.8
6902	7	BALSAM LAKE	South B-Killarney B	31-May-15	2.7
6902	7	BALSAM LAKE	South B-Killarney B	1-Jul-15	3.1
6902	7	BALSAM LAKE	South B-Killarney B	2-Aug-15	3.8
6902	7	BALSAM LAKE	South B-Killarney B	7-Sep-15	3.6
6902	7	BALSAM LAKE	South B-Killarney B	4-Oct-15	3.7
6902	8	BALSAM LAKE	W Bay2, deep spot	14-May-15	4.5
6902	8	BALSAM LAKE	W Bay2, deep spot	6-Jun-15	3.2
6902	8	BALSAM LAKE	W Bay2, deep spot	20-Jun-15	3.3
6902	8	BALSAM LAKE	W Bay2, deep spot	30-Jun-15	3.8
6902	8	BALSAM LAKE	W Bay2, deep spot	15-Jul-15	4.2
6902	8	BALSAM LAKE	W Bay2, deep spot	31-Jul-15	4.1

STN	Site ID	LAKE NAME	Site Description	Date	Secchi (m)
6902	8	BALSAM LAKE	W Bay2, deep spot	16-Aug-15	4.0
6902	8	BALSAM LAKE	W Bay2, deep spot	31-Aug-15	3.5
6902	8	BALSAM LAKE	W Bay2, deep spot	16-Sep-15	3.4
6902	8	BALSAM LAKE	W Bay2, deep spot	5-Oct-15	3.2
6902	9	BALSAM LAKE	E of Grand Is	12-Jul-15	3.5
6902	9	BALSAM LAKE	E of Grand Is	16-Aug-15	3.5
6941	1	BIG BALD LAKE	Mid Lake, deep spot	17-May-15	6.7
6941	1	BIG BALD LAKE	Mid Lake, deep spot	13-Jun-15	4.2
6941	1	BIG BALD LAKE	Mid Lake, deep spot	24-Jul-15	5.0
6941	1	BIG BALD LAKE	Mid Lake, deep spot	23-Aug-15	4.3
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	20-May-15	3.6
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	3-Jun-15	3.4
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	7-Jul-15	3.4
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	3-Aug-15	3.4
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	7-Sep-15	3.6
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	5-Oct-15	4.4
6951	9	CHEMONG LAKE	S. of Causeway	17-Jun-15	3.0
6951	9	CHEMONG LAKE	S. of Causeway	12-Jul-15	3.3
6951	9	CHEMONG LAKE	S. of Causeway	17-Aug-15	3.5
6951	9	CHEMONG LAKE	S. of Causeway	23-Sep-15	3.0
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	6-May-15	3.1
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	25-May-15	2.6
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	3-Jun-15	2.4
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	18-Jun-15	3.0
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	3-Jul-15	3.1
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	13-Jul-15	2.8
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	7-Aug-15	2.7
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	19-Aug-15	2.1
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	10-Sep-15	2.9
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	23-Sep-15	3.1
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	11-Oct-15	3.0
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	2-Nov-15	3.0
6955	1	CLEAR LAKE	MacKenzie Bay	11-Aug-15	4.0
6955	1	CLEAR LAKE	MacKenzie Bay	14-Sep-15	4.7

Appendix F:
2015 Phosphorus and Secchi Data

STN	Site ID	LAKE NAME	Site Description	Date	Secchi (m)
6955	1	CLEAR LAKE	MacKenzie Bay	5-Oct-15	5.4
6955	2	CLEAR LAKE	Main Basin-deep spot	4-Jun-15	5.5
6955	2	CLEAR LAKE	Main Basin-deep spot	8-Jul-15	4.8
6955	2	CLEAR LAKE	Main Basin-deep spot	13-Aug-15	3.7
6955	2	CLEAR LAKE	Main Basin-deep spot	17-Sep-15	3.2
6955	2	CLEAR LAKE	Main Basin-deep spot	5-Oct-15	4.6
6955	3	CLEAR LAKE	Fiddlers Bay	4-Jun-15	3.9
6955	3	CLEAR LAKE	Fiddlers Bay	8-Jul-15	3.8
6955	3	CLEAR LAKE	Fiddlers Bay	13-Aug-15	3.0
6955	3	CLEAR LAKE	Fiddlers Bay	17-Sep-15	2.9
6955	3	CLEAR LAKE	Fiddlers Bay	5-Oct-15	3.1
6955	4	CLEAR LAKE	Brysons Bay	15-Jun-15	2.6
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	6-Jul-15	4.5
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	20-Jul-15	4.0
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	4-Aug-15	3.7
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	18-Aug-15	3.1
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	8-Sep-15	3.1
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	21-Sep-15	3.3
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	5-Oct-15	3.9
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	17-May-15	5.6
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	2-Jun-15	7.3
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	15-Jun-15	5.8
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	6-Jul-15	4.8
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	20-Jul-15	5.1
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	5-Aug-15	5.5
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	19-Aug-15	4.9
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	9-Sep-15	4.8
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	6-Oct-15	6.3
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	5-May-15	6.4
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	18-May-15	5.4
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	2-Jun-15	7.3
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	18-Jun-15	6.8
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	6-Jul-15	7.0
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	20-Jul-15	5.8
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	4-Aug-15	5.1

STN	Site ID	LAKE NAME	Site Description	Date	Secchi (m)
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	19-Aug-15	3.8
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	8-Sep-15	4.5
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	22-Sep-15	5.0
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	5-Oct-15	6.0
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	19-Oct-15	5.8
7087	1	LOVESICK LAKE	80' hole at N. end	17-May-15	5.0
7087	1	LOVESICK LAKE	80' hole at N. end	28-May-15	4.5
7087	1	LOVESICK LAKE	80' hole at N. end	5-Jul-15	4.5
7087	1	LOVESICK LAKE	80' hole at N. end	3-Aug-15	4.0
7087	1	LOVESICK LAKE	80' hole at N. end	7-Sep-15	3.5
7087	3	LOVESICK LAKE	McCallum Island	17-May-15	5.0
7087	3	LOVESICK LAKE	McCallum Island	28-May-15	4.5
7087	3	LOVESICK LAKE	McCallum Island	5-Jul-15	4.0
7087	3	LOVESICK LAKE	McCallum Island	3-Aug-15	4.0
7087	3	LOVESICK LAKE	McCallum Island	7-Sep-15	3.5
6990	1	LOWER BUCKHORN LAKE	Heron Island	6-Jul-15	4.1
6990	1	LOWER BUCKHORN LAKE	Heron Island	11-Aug-15	2.1
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	14-May-15	5.4
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	19-Jun-15	5.6
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	29-Jun-15	6.0
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	12-Jul-15	4.7
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	24-Jul-15	3.3
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	9-Aug-15	4.5
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	7-Sep-15	4.1
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	18-Sep-15	5.6
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	1-Oct-15	5.1
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	5-Oct-15	6.3
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	11-Aug-15	3.6
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	18-May-15	2.0
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	31-May-15	2.0
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	16-Jun-15	2.0
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	5-Jul-15	2.0
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	19-Jul-15	1.9
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	2-Aug-15	1.8
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	17-Aug-15	1.7

Appendix F: 2015 Phosphorus and Secchi Data

STN	Site ID	LAKE NAME	Site Description	Date	Secchi (m)
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	25-Aug-15	1.7
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	14-Sep-15	1.8
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	2-Oct-15	1.8
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	18-May-15	3.0
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	31-May-15	3.2
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	16-Jun-15	2.0
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	5-Jul-15	2.5
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	19-Jul-15	2.8
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	2-Aug-15	2.8
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	17-Aug-15	3.0
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	25-Aug-15	3.0
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	14-Sep-15	3.2
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	2-Oct-15	3.3
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	14-May-15	3.3
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	17-Jun-15	3.2
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	6-Jul-15	2.6
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	20-Jul-15	2.8
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	12-Aug-15	3.1
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	3-Sep-15	2.2
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	8-Oct-15	3.5
6919	13	PIGEON LAKE	N end-Adjacent Con17	14-May-15	3.8
6919	13	PIGEON LAKE	N end-Adjacent Con17	17-Jun-15	3.6
6919	13	PIGEON LAKE	N end-Adjacent Con17	6-Jul-15	2.7
6919	13	PIGEON LAKE	N end-Adjacent Con17	20-Jul-15	3.2
6919	13	PIGEON LAKE	N end-Adjacent Con17	12-Aug-15	2.9
6919	13	PIGEON LAKE	N end-Adjacent Con17	3-Sep-15	2.1
6919	13	PIGEON LAKE	N end-Adjacent Con17	8-Oct-15	3.9
6919	15	PIGEON LAKE	C340-DeadHorseShoal	10-Jun-15	3.2
6919	15	PIGEON LAKE	C340-DeadHorseShoal	5-Jul-15	3.2
6919	15	PIGEON LAKE	C340-DeadHorseShoal	2-Aug-15	3.2
6919	15	PIGEON LAKE	C340-DeadHorseShoal	9-Sep-15	3.0
7241	2	SANDY LAKE	Mid Lake, deep spot	24-May-15	4.7
7241	2	SANDY LAKE	Mid Lake, deep spot	29-Jun-15	4.9
7241	2	SANDY LAKE	Mid Lake, deep spot	19-Jul-15	4.2
7241	2	SANDY LAKE	Mid Lake, deep spot	21-Aug-15	3.6
7241	2	SANDY LAKE	Mid Lake, deep spot	20-Sep-15	4.5

STN	Site ID	LAKE NAME	Site Description	Date	Secchi (m)
7241	2	SANDY LAKE	Mid Lake, deep spot	4-Oct-15	3.9
7133	6	STONY LAKE	Gilchrist Bay	6-Jul-15	3.8
7133	6	STONY LAKE	Gilchrist Bay	29-Jul-15	2.5
7133	6	STONY LAKE	Gilchrist Bay	12-Aug-15	3.3
7133	6	STONY LAKE	Gilchrist Bay	31-Aug-15	3.3
7133	6	STONY LAKE	Gilchrist Bay	27-Sep-15	4.8
7133	6	STONY LAKE	Gilchrist Bay	12-Oct-15	5.0
7133	7	STONY LAKE	Mouse Is.	16-May-15	5.2
7133	7	STONY LAKE	Mouse Is.	31-May-15	5.0
7133	7	STONY LAKE	Mouse Is.	6-Jul-15	4.8
7133	7	STONY LAKE	Mouse Is.	4-Aug-15	4.2
7133	7	STONY LAKE	Mouse Is.	7-Sep-15	4.1
7133	7	STONY LAKE	Mouse Is.	29-Sep-15	4.0
7133	8	STONY LAKE	Hamilton Bay	16-May-15	4.1
7133	8	STONY LAKE	Hamilton Bay	31-May-15	4.1
7133	8	STONY LAKE	Hamilton Bay	6-Jul-15	4.1
7133	8	STONY LAKE	Hamilton Bay	4-Aug-15	4.1
7133	8	STONY LAKE	Hamilton Bay	7-Sep-15	4.1
7133	8	STONY LAKE	Hamilton Bay	29-Sep-15	4.1
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	26-May-15	4.0
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	2-Jul-15	3.1
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	9-Aug-15	2.1
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	28-Aug-15	3.3
6924	5	STURGEON LAKE	Sturgeon Point Buoy	6-Jul-15	2.3
6924	5	STURGEON LAKE	Sturgeon Point Buoy	4-Aug-15	2.5
6924	5	STURGEON LAKE	Sturgeon Point Buoy	28-Sep-15	3.1
6924	9	STURGEON LAKE	Fenelon R. mouth	6-Jul-15	2.8
6924	9	STURGEON LAKE	Fenelon R. mouth	4-Aug-15	3.2
6924	9	STURGEON LAKE	Fenelon R. mouth	28-Sep-15	2.8
6924	10	STURGEON LAKE	Lunge Haven	17-May-15	1.8
6924	10	STURGEON LAKE	Lunge Haven	4-Jun-15	1.8
6924	10	STURGEON LAKE	Lunge Haven	2-Jul-15	1.8
6924	10	STURGEON LAKE	Lunge Haven	9-Aug-15	1.8
6924	10	STURGEON LAKE	Lunge Haven	10-Sep-15	1.8
6924	10	STURGEON LAKE	Lunge Haven	12-Oct-15	1.8
5178	1	UPPER STONEY LAKE	Quarry Bay	2-Jun-15	7.3

Appendix F:
2015 Phosphorus and Secchi Data

STN	Site ID	LAKE NAME	Site Description	Date	Secchi (m)
5178	1	UPPER STONEY LAKE	Quarry Bay	6-Jul-15	5.2
5178	1	UPPER STONEY LAKE	Quarry Bay	10-Aug-15	5.6
5178	1	UPPER STONEY LAKE	Quarry Bay	8-Sep-15	6.2
5178	1	UPPER STONEY LAKE	Quarry Bay	8-Oct-15	7.0
5178	3	UPPER STONEY LAKE	Young Bay	2-Jun-15	7.7
5178	3	UPPER STONEY LAKE	Young Bay	6-Jul-15	5.4
5178	3	UPPER STONEY LAKE	Young Bay	10-Aug-15	5.9
5178	3	UPPER STONEY LAKE	Young Bay	8-Sep-15	6.8
5178	3	UPPER STONEY LAKE	Young Bay	8-Oct-15	7.5
5178	5	UPPER STONEY LAKE	Crowes Landing	2-Jun-15	7.7
5178	5	UPPER STONEY LAKE	Crowes Landing	6-Jul-15	5.1
5178	5	UPPER STONEY LAKE	Crowes Landing	10-Aug-15	5.5
5178	5	UPPER STONEY LAKE	Crowes Landing	8-Sep-15	6.2
5178	5	UPPER STONEY LAKE	Crowes Landing	8-Oct-15	6.7
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	2-Jun-15	7.7
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	6-Jul-15	5.4
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	10-Aug-15	5.9
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	8-Sep-15	6.2
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	8-Oct-15	7.0
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	20-May-15	5.1
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	19-Jun-15	5.0
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	20-Jul-15	4.3
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	16-Aug-15	4.1
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	17-Sep-15	4.5
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	25-Oct-15	4.9

Photo Pat Moffat

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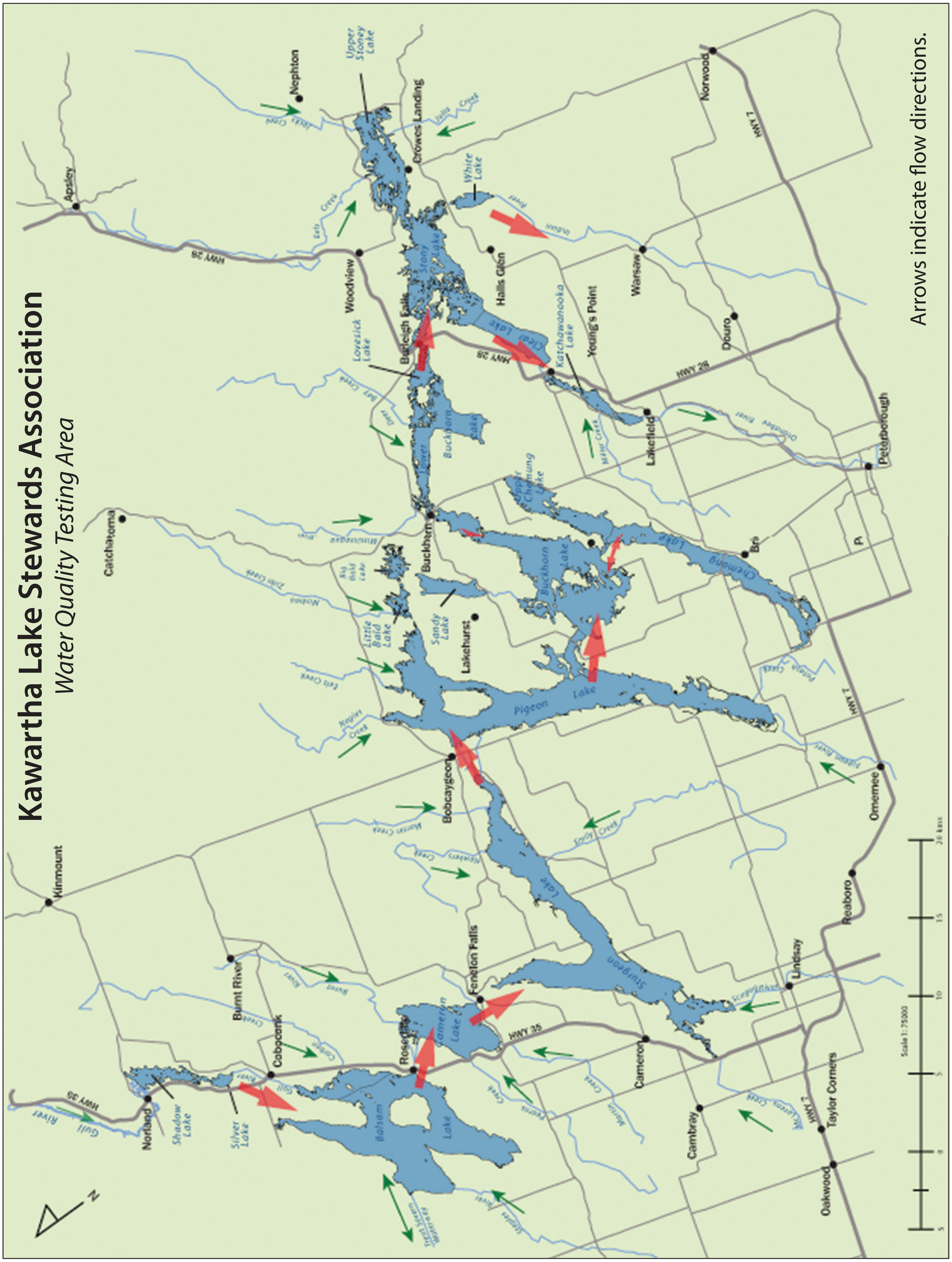
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Apsley
Nephton
Upper Stoney Lake
Crowes Landing
White Lake
Woodview
Stony Lake
Halls Glen
Burleigh Falls
Lovesick Lake
Clear Lake
Katchawanooka Lake
Young's Point
Warsaw
Norwood
Dourо
Lakefield
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Buckhorn Lake
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