Kawartha Lake Stewards Association

2018 Annual Lake Water Quality Report

Our Kawartha Lakes: Past, Present and Future

MAY 2019

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Cover Photo:

The Kawarthas are one of the best places in the world to watch ospreys, also known as fish hawks.

by Simone Goulet

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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 and research and public education about water quality issues. KLSA has partnered with universities, colleges and governmental agencies to conduct research studies and produce publications. KLSA is led by a 12-member Board of Directors, chaired by William A. Napier. A list of the members of the Board is provided in Appendix A. A summary of articles contained in the *2018 KLSA Annual Water Quality Report: Our Kawartha Lakes, Past, Present and Future* follows.

Landscapes or Shorelines? Lakes or Tributaries?

From 2010 to 2018, Kawartha Conservation was contracted by the City of Kawartha Lakes to undertake a multi-lake management planning project. Eleven lakes were included in the study. Each project involved a three to four year process with extensive community involvement resulting in a management plan and a background technical report for each lake. Criteria were developed to measure land use pressures, natural habitats and water quality conditions. The management plans identify the relative level of management focus needed to maintain healthy lakes and shorelines for future generations.

Ontario Waterways – Harnessing the Power of Water

Ontario Waterways, consisting of the Trent-Severn Waterway (TSW) National Historic Site of Canada and the Rideau Canal World Heritage Site of Canada manage 588 km of flowing water. The waterways provide water for power generation, municipal water supplies, agriculture, recreation and habitat for fish and wildlife. The TSW spans 386 km and is made up of two major watersheds, the Trent and the Severn. Water management occurs throughout the year to prevent flooding and maintain water quality. Decisions regarding the regulation of water levels are based on past experience, daily monitoring of water levels and flow rates and weather forecasts. There is an annual drawdown of reservoir lakes to ensure adequate water flow into the canal sections downstream.

Written in Mud: Historical Phosphorus and Lake Productivity Levels

Beginning in 2016, KLSA collaborated with Queen's University on a paleolimnological study age-dating and analyzing the sediments in core samples collected in three lakes: Cameron, Pigeon and Stony. The study examined phosphorus levels over a period of 300 years. The study found that phosphorus levels were stable until the early 1800s when European settlement began. Levels varied since then as activities such as logging and agriculture occurred. Lakes can be classified by nutrient levels based on phosphorus concentrations and productivity as oligotrophic, mesotrophic and eutrophic. All three lakes have eutrophic characteristics but Pigeon Lake requires the most attention.

KLSA and Fleming College: Dissolved Oxygen in the Kawartha Lakes

KLSA and Fleming College collaborated on a Credit for Product project on dissolved oxygen in three Kawartha Lakes. This course allows students in the School of Environmental and Natural Resource Sciences at Fleming College to gain field experience with environmental organizations. Dissolved oxygen is required to support aquatic life. Water samples collected in Pigeon Lake, Lovesick Lake and Stony/Clear Lake were analyzed at the Fleming College laboratory. Dissolved oxygen levels were within a normal range although low levels were found in deep water in Pigeon Lake. A comprehensive report prepared by the student team can be found on the KLSA website.

The *Love Your Lake Program* in Trent Lakes

In 2017 and 2018, the Cavendish Community Ratepayers Association Inc. sponsored the *Love Your Lake Program* assessing shorelines on more than 1,250 properties covering over 130 km of shoreline on 11 cottage lakes and part of the Mississagua River in the Municipality of Trent Lakes. Shoreline properties were assessed by students from a boat using GIS and GPS technology and were categorized as Natural, Regenerative, Ornamental or Degraded. Confidential reports were given to each property owner and aggregated data was given to CCRAI. A summary report was prepared for each lake and the river segment. Most lakes met the target of 75% of their shorelines in the Natural or Regenerative categories but there were a significant number on all lakes with Ornamental shorelines. Advice was provided confidentially to property owners and presentations on shoreline naturalization will be held in 2019.

New Kawartha Land Trust Cation Wildlife Preserve Near Balsam Lake

The Kawartha Land Trust (KLT) is a non-governmental land conservation organization working to protect the Kawartha Lakes and surrounding lands. KLT has secured 17 properties comprising 1,660 hectares and is involved in partnerships for an additional five properties. The article describes the most recent property protected in 2018, donated by the Cation family. The property, which contains a wetland, is home to a wide variety of wildlife. It will be open for hiking and other passive recreational uses.

Executive Summary

2017 Kawartha Lakes Sewage Treatment Plants Report

Each year, KLSA monitors output from local sewage treatment plants that discharge effluent either directly into the Kawartha lakes or their watershed, or to water bodies that flow into the lakes. Data for 2017, the latest year available, was analyzed. Phosphorus (P) output is a key indicator and a primary cause of increased plant and algae growth in our lakes. KLSA would like all STPs that discharge directly into the lakes to achieve a 99% P removal rate. The report includes results for Minden, Coboconk, Fenelon Falls, Lindsay, Bobcaygeon, Omemee, King's Bay and Port Perry. The total amount of phosphorus discharged from all these plants in 2017 was 566 kg, an increase from 465 kg in 2016 and well below the 99% P removal goal. Continued monitoring of all STPs is vital.

Beech Bark Disease

Beech trees are an important home for birds and wildlife and their nuts are a source of food for bears and deer. In Ontario, beech bark disease has become prevalent in eastern and southern forests. Invasive scale insects feed on the tree sap by creating small openings in the bark. A fungus then grows, creating cankers which cut off the veins of the tree, causing it to weaken or die. Sightings of beech bark disease should be reported and firewood should not be moved.

Starry Stonewort: An Invasive Species Now in Stony Lake

Two years ago, cottagers on Stony Lake discovered an algae called starry stonewort in their lake. It is an invasive species that forms dense mats on the bottom of lakes, potentially destroying fish spawning areas. In shallow water, it grows right up to the surface. Because it spreads by fragmentation and lies dormant during the winter, it is very hard to eradicate. Cottagers conducted an awareness campaign and contacted academic researchers who were studying the species in Lake Scugog. They also contacted provincial Ministries and municipalities to request their involvement and funding. Sightings of starry stonewort should be reported.

***E. coli* Bacteria Testing**

In 2017, KLSA volunteers tested 65 sites in 12 lakes for *E. coli* bacteria. Samples were analyzed by SGS Canada Inc. in Lakefield. *E. coli* levels were low throughout the summer of 2017, consistent with other years. Of the total 376 tests conducted, 347 were in the 0-20 range, 23 were in the 21-49 range, six were in the 50-100 range and none exceeded 100 *E. coli* cfu/100 mL. The sites with elevated counts were usually in places where wildfowl congregated or areas with low water circulation. Most returned to normal when retests were conducted. Lakes west of Pigeon Lake, which used the laboratory at Fleming College in Lindsay, did not participate in 2018 since there was no one to coordinate sample drop-off. KLSA hopes to resume the program in 2019. Lake-by-lake 2018 results can be found in Appendix E.

Phosphorus Testing

In 2018, as part of the Ministry of the Environment, Conservation and Parks' Lake Partner Program (LPP), KLSA volunteers collected water samples four to six times (monthly from May to October) at 45 sites on 16 lakes for phosphorus testing. Samples were analyzed by the Ministry laboratory. Volunteers also measured water clarity, using a Secchi disk. Overall in the summer of 2018, average total phosphorus levels were lower than usual in June, likely due to a very cold April delaying the northern melt. Patterns were similar to those of other years during the summer and fall. For the first time, calcium levels are provided. Detailed results are provided in Appendix F.

KLSA Support and Public Meetings

KLSA relies 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 2019, the spring meeting will be held at the Bobcaygeon Community Centre on Saturday, May 11 at 10 a.m.

Thank you

KLSA appreciates 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 our scientific advisors and staff at the Lake Partner Program and SGS Canada Inc. who assist with the water testing programs. We are also grateful to Danielle Shaw (Gull's Graphic Design) who prepared the layout and the *Lakefield Herald* for arranging for the publication of this report. For further details, visit our website: http://klsa.wordpress.com.

KLSA Editorial Committee:

Sheila Gordon-Dillane (Chair), Janet Duval, Tom McAllister, Kathleen Mackenzie, Alyssa Stewart and Kimberly Ong.

Chair's Message

2018 Annual Report

William A. Napier, Chair
Kawartha Lake Stewards Association

We have created a world from our thinking with great benefits for humankind. For the past dozen years, two by-products of our advances - cultural eutrophication and human-induced global warming have dominated discussions here in the Kawarthas. As a citizen science organization, we continue the process to understand this new world and consider measures to change our thinking.

We are an all-volunteer group of concerned cottagers, year-round residents, local businesses and interested parties. Our programs include testing lake water for phosphorus and *E. coli* bacteria, monitoring the performance of sewage treatment plants and providing environmental education through publications and public meetings. The Kawartha Lake Stewards Association (KLSA) includes members from about 16 local lake associations in the Kawartha Lakes continuum which extends from Balsam Lake to Katchewanooka Lake. In 2018 KLSA coordinated water quality testing at 65 sites for bacteria and 43 sites for phosphorus.

In mid-2018, KLSA with its partners released the study entitled *"Assessment of Algal and Elemental Changes in Three Kawartha Lakes: A Paleolimnological Assessment, 2018".* The Report was prepared by K. R. Laird, Ph.D. (Research Associate, Paleoecological Environmental Assessment and Research Laboratory (PEARL), Department of Biology, Queen's University), and. B. F. Cumming, Ph.D. (Professor and Head, Department of Biology and Co-director of PEARL) see: *https://klsa.files.wordpress.com/2018/09/klsa-paleolimnology-study-june-2018.pdf.* The purpose and summary of the study can be found in the KLSA 2016 and 2017 annual water quality reports. Included in this year's Annual Water Quality Report is a synopsis of the historical total phosphorus readings and changes to the lakes' algal communities. To some extent, all the lakes have experienced varying degrees of human-caused increased eutrophication. Recovery time under eutrophication management plans varies widely from less than a year to several decades or longer, and, in some cases, a return to baseline conditions may not be possible. Lake management plans such as those developed by Kawartha Conservation provide a valuable framework and guide for further mitigation.

KLSA continues to work with our partners and policymakers to monitor our lakes by changing our thinking. Examples over the past year include:

- We collaborated in a grant application with Kawartha Conservation to monitor lake water temperature levels. If this grant application is successful, we will be seeking volunteers to conduct the water sampling.
- We are participating with Watershed Canada and The Land Between Blue Flag program in the development of a new eco label called the Blue Lakes program. Lake associations that agree to adopt stewardship principles and actions will receive the eco label. For more information see: *www.bluelakes.ca.*
- We again worked with the Fleming College Credit for Product program. The student team collected water samples which were then analyzed for total phosphorus, benthos and dissolved oxygen. A copy of their report: *"Report On The Status Of Dissolved Oxygen Levels In Pigeon, Lovesick and Stony Lakes"* is found on the KLSA website. Mara Van Meer, one of the students, summarized their findings in the article entitled *"KLSA and Fleming College: Dissolved Oxygen in the Kawartha Lakes"* which is featured in this Report.
- For the 2018 spring meeting we were fortunate to have Jacob Rodenburg, Executive Director, Camp Kawartha & The Camp Kawartha Outdoor Education Centre/Environment Centre give a presentation entitled *"Pathways to Stewardship & Kinship".* Our second speakers were Bretton Clark, Briagh Hoskins-Hasbury and family - co-founders of Land-Canadian Adventures. In their presentation, *"Environmental Education - from Toddlers to Paddlers"* they provided tips on how to engage youngsters in environmental education.
- At the fall meeting, Dr. Eric Sager made a delightful presentation entitled *"Wumps, weevils and the zombie plant",* aka fighting invasive aquatic plants. Dr. Sager is one of KLSA's Scientific Advisors and his contributions are gratefully acknowledged.

Chair's Message

"The world as we have created it is a process of our thinking. It cannot be changed without changing our thinking."

- Albert Einstein

There were changes to this year's KLSA Board of Directors. Colleen Dempster and Shari Paykarimah did not stand for re-election. Colleen will continue to provide technical advice on KLSA projects. We wish Shari and Colleen all the best with their new endeavours and growing families! The KLSA welcomes two new Directors, Ed Leerdam and Brett Tregunno, to our ranks. Ed and Brett have already brought enthusiasm and insight to the organization. The many contributions of the members of our Board of Directors are greatly appreciated.

KLSA relies on your support and interest. We are indebted to the people at Grant Thornton LLP and the Lakefield Herald for their ongoing help. Our Scientific Advisors at Queen's University, Trent University and Fleming College provide us with technical support and knowledge. I would also like to thank those in the business community, municipal and government agencies and private donors who continue to provide financial support for our work.

Our paleolimnology project demonstrates that we can learn from our history, by analyzing the past 300 years of lake sediments. Our water testing programs, public education meetings, website and annual reports share information about present stewardship initiatives, thereby helping us to preserve our natural heritage and plan for the future. The article following this Message summarizes the highlights of predictive models of local climate change over the next 80 years. We are pleased to present this 2018 Annual Water Quality Report, aptly entitled *Our Kawartha Lakes: Past, Present and Future.* We are very grateful to those who submitted articles for the report and to our Editorial Committee for their work preparing it.

Our 2019 Spring meeting is scheduled for 10:00 a.m. Saturday, May 11, 2019 at the Bobcaygeon Community Centre/Arena. All are welcome.

Predictions of the Impact of Climate Change on the Kawarthas

William A. Napier, Chair
Kawartha Lake Stewards Association

Climate change is caused by increased greenhouse gas emissions resulting from human activity. What might be the implications for the Kawartha region? Ontario's climate has warmed by about 1.6 °C over the past 63 years, and increases in both temperature and precipitation are projected to continue over the next century. Using international models, the Ministry of Natural Resources and Forestry has predicted changes in climate for the Province and has prepared a summary report for the Lake Ontario sub-basin (see: McDermid, J., S. Fera and A. Hogg. 2015. *Climate Change Projections for the Lake Ontario watershed: An updated synthesis for policymakers and planners.* Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, Ontario. Climate Change Research Report CCRR-44. 44. 2015 *http://www.climateontario.ca/MNR_Publications/CCRR-44.pdf).*

Tables 1 and 2 summarize the following information:

- The baseline timeframe is from 1971 to 2000 using the Peterborough Dobbin Trent Severn meteorological station as the reference site.
- Three modeling scenarios are used. Scenario 1 assumes medium-low greenhouse gas (GHG) emission increases with aggressive mitigation. Emissions peak early, and then fall due to active removal of atmospheric carbon dioxide. In Scenario 2, GHG emissions stabilize by 2100 and for scenario 3 there are very high emissions and a failure to curb warming by 2100. GHG emissions are up to seven times higher than preindustrial levels.
- The changes in temperature and precipitation levels are projected for three time periods (2011–2040, 2041–2070 and 2071–2100).

(°C)	1971-2000 Baseline	2011 – 2040 S-1	S-2	S-3	2041 to 2070 S-1	S-2	S-3	2071 to 2100 S-1	S-2	S-3
Annual	6	8.3	8.3	8.4	9.1	9.8	10.6	9	10.6	13.6
Summer	18.7	20.6	20.7	20.8	21.3	21.9	23.1	21.3	22.8	26.3
Winter	-7.7	-5.0	-5.3	-4.9	-4.2	-3.2	-2.5	-4.2	-2.3	0.4

Table 1: **Temperature changes from current baseline conditions under three scenarios for three time periods.**

(mm)	1971 - 2000	2011 – 2040 S-1	S-2	S-3	2041 to 2070 S-1	S-2	S-3	2071 to 2100 S-1	S-2	S-3
Annual	900.5	955.6	923.4	936.8	963.0	961.5	973.1	974.8	967.2	1,002.5
Summer	230.9	230.8	223.4	227.6	227.9	226.1	221.4	236.1	233.6	220.3
Winter	214.3	236.5	239.3	235.2	249.8	240.7	258.6	248.0	252.8	286.3

Table 2: **Precipitation changes from current baseline conditions under three scenarios for three time periods.**

- Temperature and precipitation are estimated annually and for the summer (June to September) and winter (December to March) seasons.

Annual average temperature in this area is projected to increase by 3.0 to 7.6 °C above the baseline period by the year 2100. For all scenarios, there is a progressive increase in average annual and seasonal temperatures. Winter temperatures are projected to increase at a faster rate than summer temperatures. Table 1 shows the projected average temperatures for all three scenarios, and all three timeframes, as compared to the annual and seasonal baseline temperature in the Kawarthas. To provide some geographical context, the current annual average temperature of Albany NY is 9 °C and that of Richmond VA is 14 °C *(https://www.usclimatedata.com/)*, compared to 6 degrees in the Kawarthas. Annual precipitation is projected to increase across the watershed, under all climate scenarios, by 7% to 10% by the end of the 21st C. However, seasonal precipitation rates vary. Summers are projected to be drier, on average, in most scenarios, while winters are projected to be wetter across all scenarios. There is high variation (uncertainty) of the precipitation projections, as compared to the temperature projections. In addition to estimating climate change indicators, the Province prepared a report entitled: *"The State of Climate Change in the Great Lakes Basin, 2015" (https://climateconnections.ca/our-work/great-lakes-basin/)* in which the impacts of climate change are discussed and data confidence is assessed. This Report's predictions for physical parameters relating to climate and precipitation rates have high evidence and high confidence. There is low evidence and low agreement on the frequency of wind gusts and incidents of freezing rain. The Report assesses other physical effects, water chemistry, ecological effects and changes in biodiversity. The information also provides predictions on what is in store for us as certain terrestrial and aquatic habitats expand while others contract.

Wood duck on Lower Buckhorn Lake

Photo: Robin Blake

Landscapes or Shorelines? Lakes or Tributaries?

Prioritizing where and what lakes to manage in the western Kawartha Lakes based on select water quality and land use information

Brett Tregunno, Aquatic Biologist
Debbie Balika, Water Quality Specialist
Kawartha Conservation

Introduction

It is generally recognized that the greater the amount of natural cover (e.g., trees, shrubs and grasslands) that exists in the broader landscape surrounding lakes and along their shorelines, the greater their ability to maintain good wildlife habitat and good water quality conditions. The purpose of this article is to provide a brief summary of select land use and water quality data collected for the western Kawartha Lakes by Kawartha Conservation to help understand their differences and similarities in terms of lake health to inform management prioritization efforts.

From 2010 to 2018, Kawartha Conservation was contracted by City of Kawartha Lakes to undertake a multi-lake management planning project. There were 11 lakes within the scope of this study ***(Table 1, Figure 1)***, which include most of the large lakes within the municipality. Each project was a 3-4 year endeavour, at the end of which a management plan

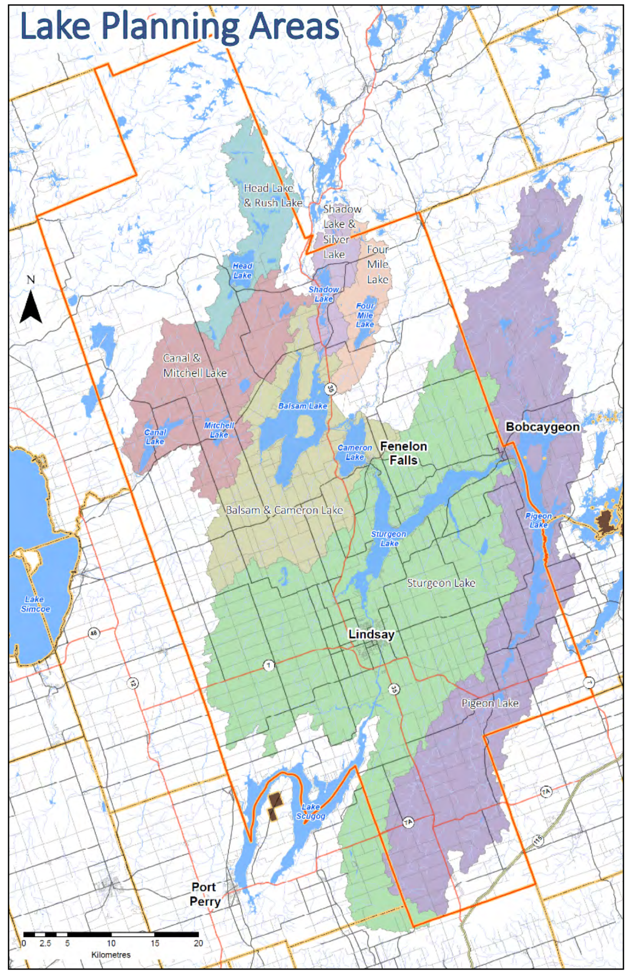

Figure 1: **Map showing the geography within scope of each Lake Plan.**

Table 1: **General information related to each lake, and lake planning project.**

Lake Name	Years Studied	Landscape Area (km^2)	Watershed Area (km^2)	Lake Area (km^2)	Shoreline Length (km)
Sturgeon	2010-2013	1028	4600	47	97
Balsam	2011-2014	336[1]	1636	48	98
Cameron	2011-2014	336[1]	3100	15	43
Pigeon	2012-2015	711	5287	57	145
Canal	2012-2015	470[2]	256	9	40
Mitchell	2012-2015	470[2]	44	3	23
Four Mile	2013-2016	69	51	8	21
Head and Rush	2014-2017	130	130	9	19
Shadow and Silver	2014-2017	63	1346	4	22

[1] *Balsam Lake and Cameron Lake merged into one project.*
[2] *Canal Lake and Mitchell Lake merged into one project.*

and background technical report was completed for each lake.

Landscapes and shorelines: land use pressures

To determine the severity of land use pressures within the land area around our lakes, guidance provided in the publication *How Much Habitat is Enough?*[3] is particularly useful. The scientific evidence presented in this document provides a compelling case that there are minimum amounts of natural habitats required on our landscapes to ensure that there are viable wildlife populations. These minimum requirements help to maintain a high level of resilience in our lake ecosystems that in turn provides benefits that we, until relatively recently, took for granted such as good water quality for swimming and the opportunity to view birds, mammals, and other aspects that attract us to the Kawartha Lakes.

Kawartha Conservation used this scientific advice to study the status of three of the several indicators listed in *How Much Habitat is Enough?*, including: forests, wetlands and stream-side vegetation (often termed 'riparian areas'). The amounts of each were determined for the Planning Areas around each lake from aerial imagery taken in 2008 or 2013 and were graphed against their respective minimum guidelines for maintaining a high level of ecosystem resiliency: forest cover greater than 50%, wetland cover greater than 10% and riparian areas greater than 75% ***(Figure 2)***. Results show that forest cover ranged from 24 to 69% and the guideline was only met for three lake areas: Shadow and Silver Lake, Four Mile Lake, and Head and Rush Lake. Forest cover for Pigeon Lake was just under this guideline (minus 2%), Sturgeon Lake had significantly less (minus 26%), and the remaining lakes were in the minus 10% to minus 20% range. Wetland cover ranged from 8 to 26% and the guideline was met in all lakes except Shadow and Silver Lake. Riparian areas ranged from 64 to 98% and the guideline was met in all lakes except Sturgeon Lake (minus 11%) and Cameron Lake (minus 8%). Riparian areas for Balsam Lake were just above the guideline whereas Four Mile Lake, Head and Rush Lake, and Shadow and Silver Lake were significantly above this guideline.

Unfortunately, no such landscape guidelines exist for shorelines. Therefore, to determine the severity of land use pressures along the shoreline of our lakes, land cover types determined from aerial imagery in 2008 or 2013 (within a 30 metre strip along the

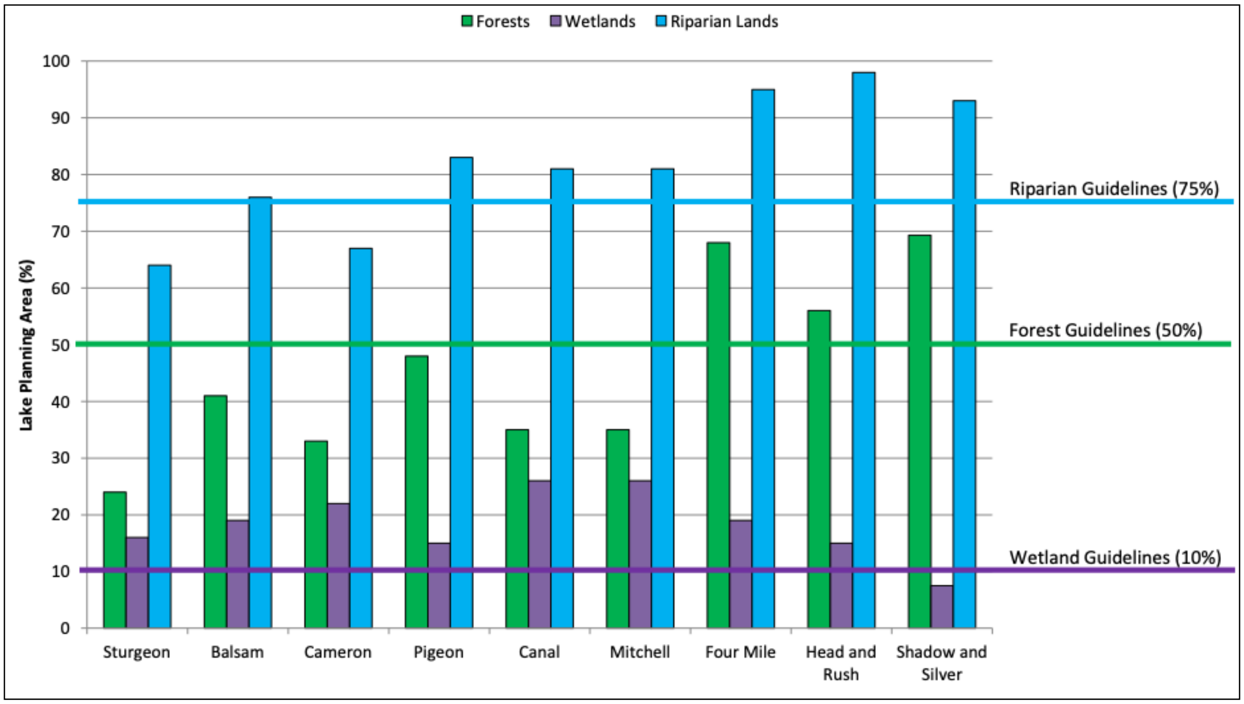

Figure 2: **Landscape-based natural habitat amounts in relation to guidelines for maintaining resilient ecosystems**

[3] *Environment Canada. 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, Ontario.*

Landscapes or Shorelines? Lakes or Tributaries?

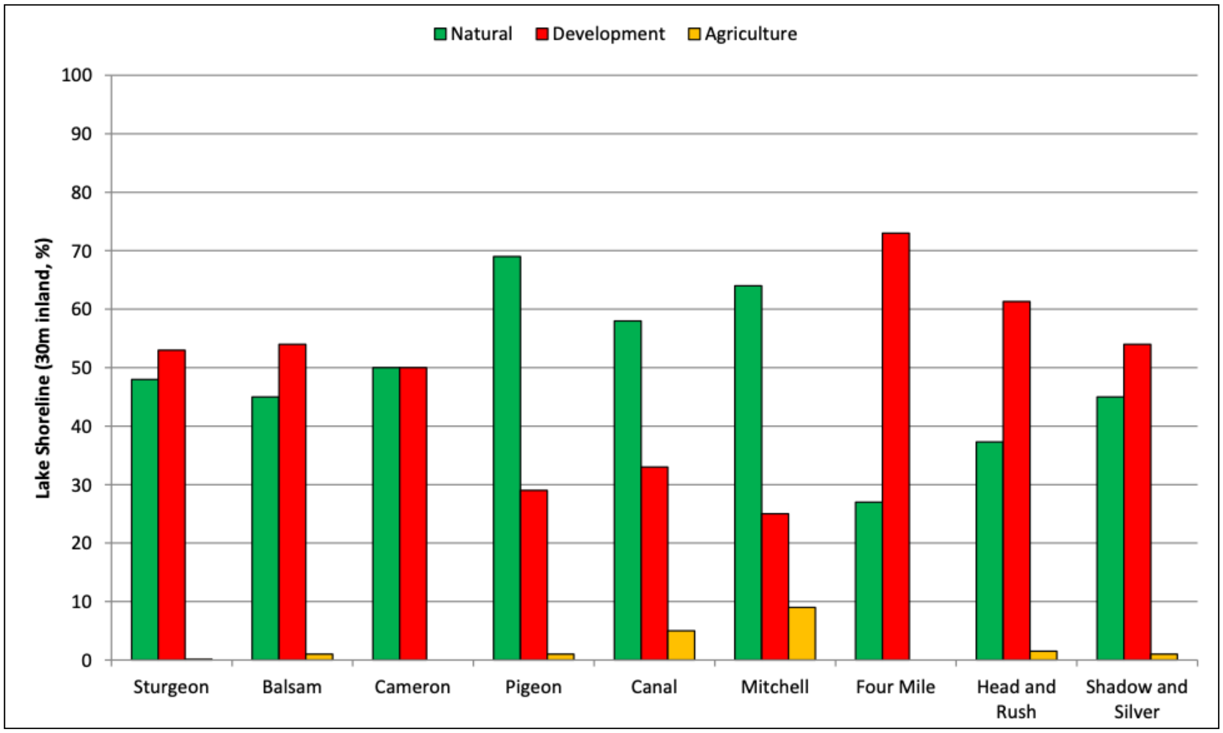

Figure 3: **Shoreline-based major land cover types, and relative amounts, along a 30m wide strip around each lake.**

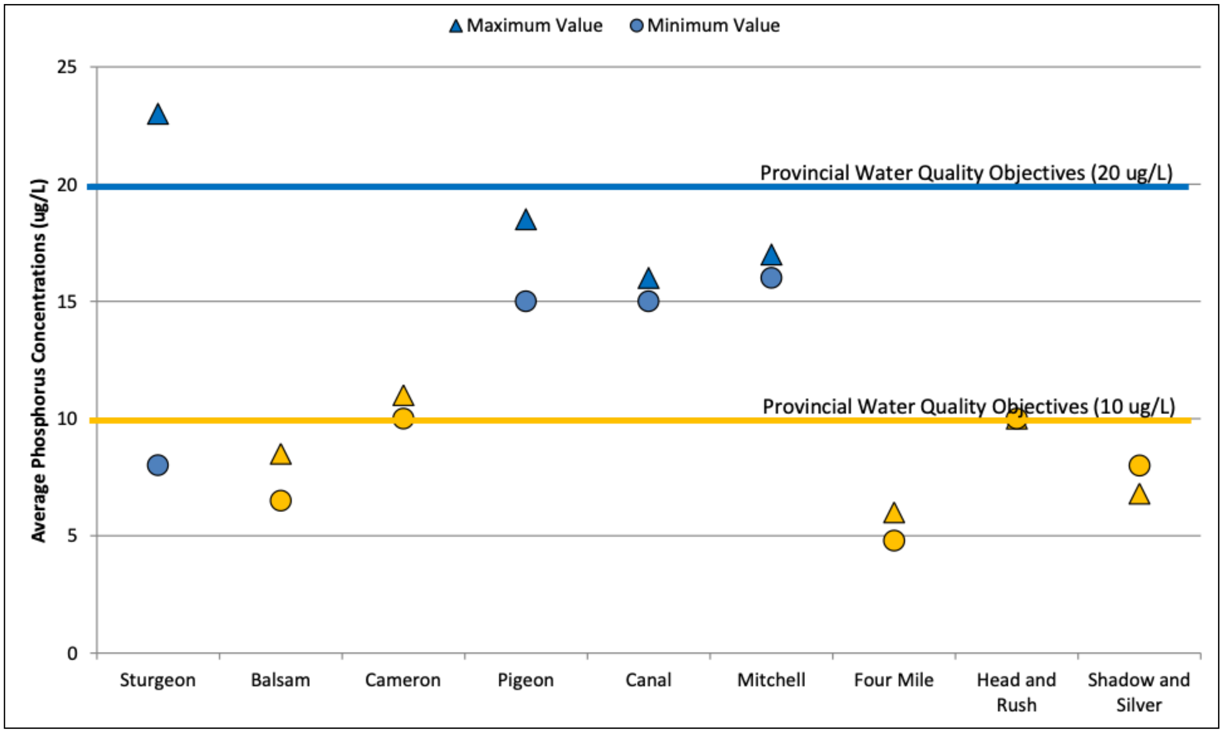

Figure 4: **Average maximum and average minimum phosphorus concentrations recorded at sites within each lake.**

shoreline) were simply lumped into three categories: development, agriculture, and natural ***(Figure 3)***. Results indicate that development was the highest land use category along the shorelines in most lakes (ranging from 25 to 73%), except for Pigeon Lake, Canal Lake and Mitchell Lake where natural areas were highest. Natural areas were the second highest land use on most lakes, ranging from 27 to 69%. There are significantly more developed shorelines relative to natural shorelines along Four Mile Lake, and Head and Rush Lake, and significantly less on Pigeon Lake, Canal Lake and Mitchell Lake. Agricultural land use along the shorelines is relatively low or non-existent (ranging from 0 to 9%), and is relatively higher on Mitchell Lake and Canal Lake.

Lakes and their tributaries: water quality conditions

To determine the water quality condition of the lakes and their connecting tributaries, guidance provided in the publication *Provincial Water Quality Objectives*[4] is particularly useful. Phosphorus was selected as an appropriate indicator, given there is ample scientific evidence that a relationship exists between the amount of land use pressure and the concentration of this nutrient in waters. As such, there are minimum guidelines for phosphorus concentrations: the more we artificially enrich our waters with nutrients (with lawn fertilizers and septic tanks, for example), the greater the likelihood of poor water quality. Long-term phosphorus sampling in our lakes, as most of our readers are fully aware, is a core and important responsibility of the Kawartha Lake Stewards Association.

Kawartha Conservation studied phosphorus concentrations in the lakes and their major inflow tributaries, and compared them against the guidelines. Lakes that have phosphorus values below the guidelines offer a higher level of protection against aesthetic deterioration by avoiding nuisance concentrations of algae. ***Figure 4*** shows the range of average phosphorus values recorded at sites within each lake, compared to guidelines for lakes (10 micrograms per litre (µg/L) for lakes that naturally have low nutrient levels, and 20 µg/L for lakes that naturally have moderate nutrient levels). ***Figure 5*** shows the range of average phosphorus values

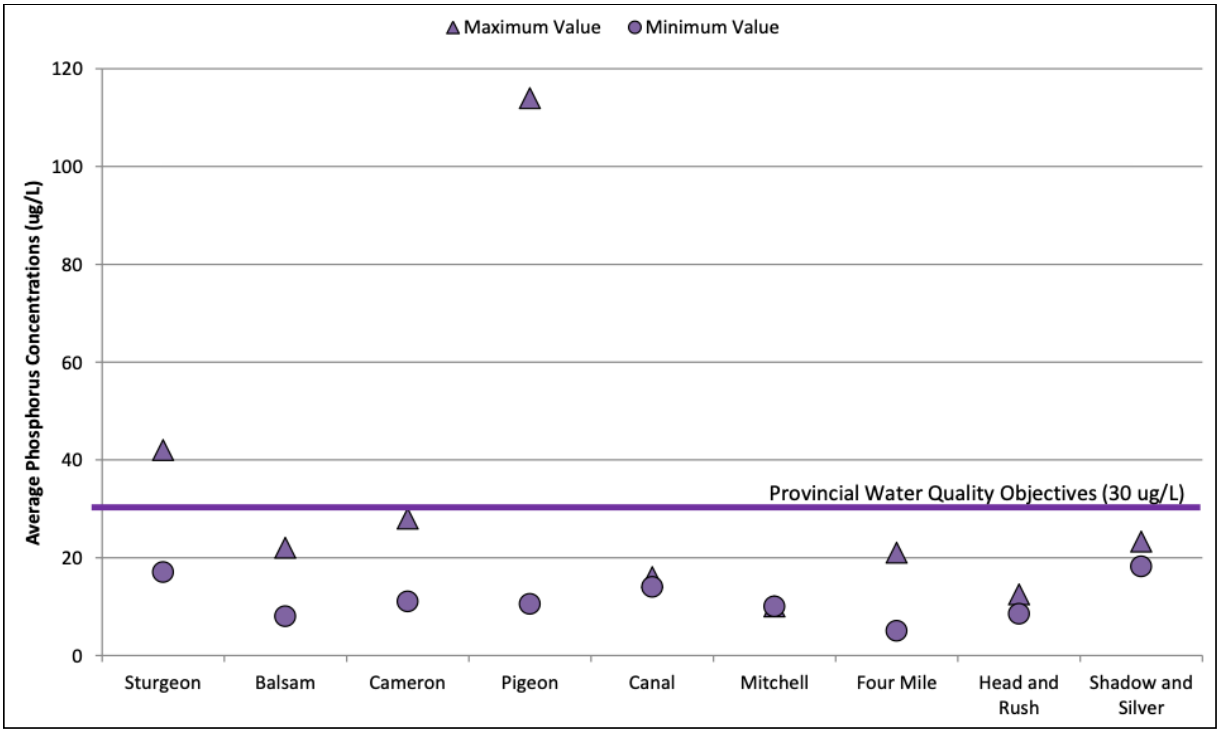

Figure 5: **Average maximum and average minimum phosphorus concentrations recorded within tributaries that directly flow into each lake.**

[4] Ministry of the Environment and Energy. 1994. Water Management - Policies, Guidelines, Provincial Water Quality Objectives. Toronto, Ontario.

Landscapes or Shorelines? Lakes or Tributaries?

Lake Name	Land Use Pressures		Water Quality Condition	
	Landscape	Shoreline	Tributaries	Lake
Sturgeon Lake	Red	Red	Red	Red
Balsam Lake	Yellow	Red	Green	Yellow
Cameron Lake	Red	Red	Yellow	Red
Pigeon Lake	Yellow	Yellow	Red	Yellow
Canal Lake	Yellow	Yellow	Green	Green
Mitchell Lake	Yellow	Yellow	Green	Green
Four Mile Lake	Green	Red	Green	Green
Head and Rush Lake	Green	Red	Green	Yellow
Shadow and Silver Lake	Green	Red	Green	Green

***Table 2:* Summary of the relative level of management focus needed for each Planning Area, based on land use pressures and water quality conditions.**

Red: relatively high level of water quality management focus needed. Yellow: relatively moderate level of water quality management focus needed. Green: relatively low level of water quality management focus needed.

recorded at the outlets of major rivers and streams flowing into each lake, compared to guidelines for flowing waters (30 µg/L). Phosphorus concentrations within each lake range from 5 to 23 µg/L, and were met for all lakes except Sturgeon Lake (plus 3 µg/L) and Cameron Lake (plus 1 µg/L). Head and Rush Lake are right at the guideline, whereas Balsam Lake and Pigeon Lake are just within. There is significant variation in phosphorus values in Sturgeon Lake, moderate variation in Pigeon Lake and Balsam Lake, and low variation in the remaining lakes. Phosphorus concentrations for tributaries range between 5 and 114 µg/L and the guideline was met in all of them except within tributaries of Pigeon Lake (plus 84 µg/L) and Sturgeon Lake (plus 12 µg/L). Tributaries flowing into Cameron Lake just meet guidelines. There is significant variation in phosphorus values in the tributaries of Pigeon Lake, moderate variation in Sturgeon Lake, Balsam Lake and Four Mile Lake, and low variation in the remaining tributaries.

Prioritizing where and what lakes are in need of enhanced management

Data collected from Kawartha Conservation's Lake Management Planning project indicates that even though the landscapes, shorelines, lakes and their tributaries visually appear quite similar, science tells us that in fact land use pressures, natural habitats, and water quality conditions within each of the western Kawartha Lakes are unique. ***Table 2*** provides a summary of the level of management focus needed for each lake, based on the data summarized in this article. Lakes in this study have a relatively high level of management focus needed on the shoreline given that there exists considerable development and modification along this area. Land use pressures within the greater landscape of the lakes are more variable, having a low-to-high range of management focus needed. Data also indicate that water quality conditions in specific lakes and specific tributaries of lakes are still in need of a high degree of management attention.

In summary, results show that certain lakes and their landscapes are better off than others; however there is certainly more work to do if we want to maintain healthy lakes for our current and future generations.

For more information please visit:

http://www.kawarthaconservation.com/watershed/management-plans

Or, contact staff directly:

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Ontario Waterways – Harnessing the Power of Water

Aarin Crawford, Public Relations and Communications Officer, *Parks Canada*

Water is one of the strongest and most important elements known to the world today, with its ability to move mountains, alter shorelines, change landscapes and give and take life. To manage an element so immense is no easy feat. The Ontario Waterways, made up of the Rideau Canal World Heritage Site of Canada and the Trent-Severn Waterway National Historic Site of Canada, is faced with the tremendous task of managing 588 km of flowing water seven days a week for 365 days a year.

Each waterway, though not directly connected, but linked through Lake Ontario, is made up of a series of interconnected lakes, improved river channels and artificial canal cuts. The Waterways, including their tributary lakes and rivers, are an important economic, environmental and recreational resource used by thousands of boaters, shoreline residents, businesses and vacationers every year. They provide water for power generation, municipal water supplies and agriculture and support a tremendous variety of fish and wildlife along their routes.

The Trent-Severn Waterway spans 386 km through the heart of Ontario and is made up of two major watersheds: the Trent and the Severn. This beautiful waterway extends from Port Severn, on Georgian Bay in the north to Trenton, on Lake Ontario in the south and plays an integral role in all the communities and wilderness through which it flows. In an area nearly four times the size of Prince Edward Island, this includes 60 lakes (including reservoir and flow-through lakes), more than 250 marshes, swamps and other wetlands, 15 rivers and 102 operating dams. The Trent River is the largest river in Southern Ontario, while Lake Simcoe, in the Severn watershed, is the largest lake.

The Rideau Canal extends over 202 km from the confluence of the mighty Ottawa River and the Rideau River in our beautiful capital city, Ottawa, Ontario and flows south to Canada's first capital (1841-1844), Kingston, on Lake Ontario. The water in the system comes from two major watersheds: The Cataraqui River and the Rideau River. The Rideau Canal is a hand-operated lock system constructed in the 19th century at a time of military threat. It connects a scenic string of rivers and lakes which have become a diverse outdoor playground where history mingles with the bucolic Eastern Ontario countryside.

What is water management?

Water management is the manipulation of water levels and water flows (volume/speed) by human actions throughout a system using water management structures such as operable dams. Water management incorporates data collection and analysis and the application of models and tools that guide us in making decisions about changing water levels and flows. This is accomplished through the manipulation of dams by adding or removing logs, or changing mechanized dam settings in dams throughout

Lock 15 Healey Falls, approximately 11 km upstream of Campbellford, ON **Photo by Parks Canada**

the system. Because these changes have impacts both upstream and downstream, water management must be approached on a total system basis.

To manage such a complex network, these Ontario waterways have a dedicated well experienced Water Management Team that works in collaboration with several other organizations such as Ontario Ministry of Natural Resources and Forestry, local Conservation Authorities and various hydro power producers. Our team utilizes a system of water gauges located strategically along both waterways, many of which are automated and produce real time data that tells us levels and flows on various parts of the system. This is supplemented by many manual gauges, as well as data provided by various weather forecasters including Environment Canada and the Ontario Ministry of Natural Resources and Forestry on precipitation and weather patterns.

Historic data and seasonal patterns are also used as an important reference point. This data in combination with extensive waterway knowledge and daily water level and flow readings are used to implement daily changes at various water management structures. These changes are undertaken by either the removal or insertion of stops logs into our operating dams and mechanized structures.

Why do we manage water?

Water is managed for several reasons including navigation, municipal water supplies, public safety, flood mitigation, for the protection of environment, fisheries, and wildlife habitat as well as recreation and hydro generation. The complexities of these multiple and interconnected considerations dictate the need to monitor and manage water on a full time basis, continuously throughout the year.

Water levels and flows fluctuate for a number of reasons. The most notable is the spring freshet - the sudden outflow of a river or stream as a result of heavy rain or snow melt. On the waterways this could mean flooding of low lying lands. Similarly, large amounts of rain can cause lake levels to rise while extended periods of drought can have the reverse effect. Dam adjustments to rebalance water levels and flows may cause lakes to rise or drop while moving towards target levels. It is important to note that water levels are only one consideration and are intricately connected to flow rates. Certain flow rates are required at certain locations throughout the system to ensure that water supplies and water quality are maintained.

Old Slys Waste Weir - Smiths Falls, ON
Photo by Parks Canada

What is drawdown?

Drawdown is annual process that varies depending on location. The annual drawdown of the reservoir lakes is completed in order to provide adequate water flow into the canal sections located downstream. Reservoir lakes in the system are subject to an equal percentage drawdown, developed through collaboration with the local communities. In order to provide the water necessary for canal operation and to reach winter holding levels to support the cold water fish spawn, the drawdown must begin in the summer. Dropping water levels significantly after mid-October in these lakes can result in fish eggs being left exposed above the water surface. Think of the management of water levels as a domino effect; what happens to one lake or river is known to have impact on rivers and lakes both upstream and downstream. Equal percentage drawdown was developed in response to local desires to make the drawdown fairer to all shoreline owners and users by distributing the impact of drawdown over as many lakes as possible. If drawdown is not executed accurately, meeting target levels and flows within the planned timeframe, public safety and property along the waterway can be severely impacted. The drawdown of the canal lakes and rivers is conducted annually at roughly the same time. The drawdown in this case is the lowering of water levels to make room for the precipitation that occurs in the fall, winter and spring. Drawdown is guided by research, engineering and decades of experience. It is a complex process that

Young boaters celebrate Canada Day at Lock 32 Bobcaygeon **Photo by Parks Canada**

takes into consideration storage capacity of the lakes on the system, timing of fishery spawning, requirements for flood mitigation, typical fall and winter precipitation levels, downstream topography including constrictions like narrow river beds or dams, and overall volumes and flow rates.

The final case of drawdown is that which applies to Lake Simcoe and Lake Couchiching on the Trent-Severn. A unique guideline, called a "rule curve," is used to guide the lowering of water levels. Due to the vast size of these lakes and the outflows being so small relative to the volume of water within them, the drawdown must be carefully managed to mitigate flooding and protect public safety.

Why do water levels fluctuate?

Water levels in a lake may appear to be low or high for a variety of reasons. Typically, watersheds rise or fall in the spring depending upon the rate and volume of the snow melt and spring rainfall. During a typical summer, the water stored from spring will be gradually released to meet varying demands across the watershed – subject to the weather. On lakes with a broad surface and shallow depths, evaporative losses over the summer months typically exceed rainfall gains and water levels can drop for this reason. Conversely, when rains are heavy or winds are strong, levels can rise. In response to these natural factors, water levels are managed to target levels by dam log changes, the number of spillways opened and the number of dams constricting a body of water.

When does water management happen?

Water management is a continuous process throughout the year. Dam-controlled water level adjustments are dependent on weather conditions across the entire waterway and vary by season and location. Water management information and water level reports are typically updated daily, excluding weekends and holidays and all records are maintained in an archive to assist in water management for future years.

For more information on Ontario Waterways, visit our Water Management InfoNet for each canal:

- Trent-Severn Waterway at https://www.pc.gc.ca/en/lhn-nhs/on/trentsevern/info/infonet
- Rideau Canal at https://www.pc.gc.ca/en/lhn-nhs/on/rideau/info/infonet

Part 1. Historical Phosphorus Levels

William A. Napier, KLSA Chair

Since 2000, volunteers of the Kawartha Lake Stewards Association (KLSA) have been measuring total phosphorus in our lakes as part of Ontario's Lake Partner Program. Phosphorus levels are of concern in our lakes, as rising phosphorus can cause increased algal growth. A lake with under 10 µg/L total phosphorus is a clear lake; a lake with 10 – 25 µg/L, though not as clear, is satisfactory for human recreation; a lake with a phosphorus level over 25 µg/L can have turbid water and unsightly algal overgrowths. A rise in lake phosphorus is usually human-induced, due to agriculture, human waste, and accelerated erosion due to clearing of the land for forestry and human habitation.

KLSA members were curious to know the history of phosphorus levels on our lakes, particularly in the period since European settlement. To do this, they worked with PEARL (Paleoecological Environmental Assessment Research Laboratory), world-renowned experts in the field of paleolimnology (history of lakes) at Queen's University. In the spring of 2016, PEARL scientists collected three sediment cores, one each in Cameron Lake, northern Pigeon Lake, and Stony Lake. The cores were then frozen and cut into 1-cm or 2-cm slices. Slices were dated using radioactive methods. By looking at the species of algae that had lived at various times, the PEARL scientists could infer how much phosphorus was present in our lakes.

What the mud tells us about the history of lake phosphorus levels

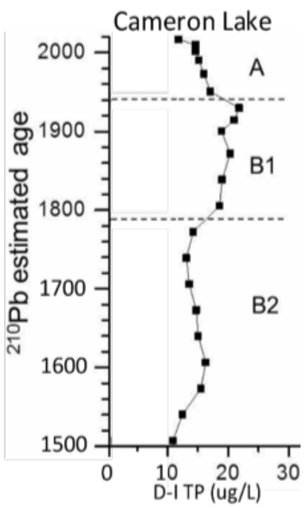
The three charts below show how phosphorus has fluctuated over the past three centuries in Cameron Lake, northern Pigeon Lake, and Stony Lake.

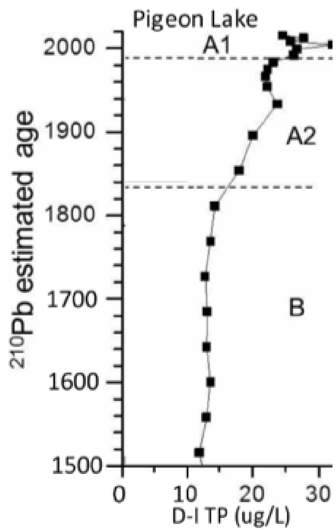
Cameron Lake is fed by northern water from Gull River and Burnt River. These rivers flow through sparsely inhabited, forested lands, with little agriculture. Pre-colonial total phosphorus levels in Cameron Lake were about 14 µg/L, and this continued through the 1700s. Phosphorus levels became higher in the 1800s, probably due to widespread logging around and upstream from Cameron Lake. From about 1940 on, phosphorus levels decreased, probably because of regrowth of forests upstream from Cameron Lake. The Pigeon Lake core was collected in the northeast corner of the lake, which is not flushed by the main flow of the Trent-Severn Waterway. This area of the lake is fed by Nogies Creek and the Miskwaa Ziibi River (via the Bald Lakes), both low phosphorus streams flowing from the north. Area geology results in minimal inflow from the south. Therefore, the sediments here tell the story of this north portion of Pigeon Lake and the land to its north. Like Cameron Lake, phosphorus levels remained less than 15 µg/L until about 1830. Intensive logging started at about this time, likely the main cause of the gradual rise to 22 µg/L by 1940. By 1940 reforestation had begun in earnest, but its effects may have been offset by cottage development. In the late summer and fall, flow from the Miskwaa Ziibi River and Nogies Creek decreases, so there is less flushing of the area, keeping late summer/fall phosphorus levels high. After 1990, phosphorus levels continued to increase to about 27 µg/L. The reasons for this are uncertain, but may be related to increased human activities.

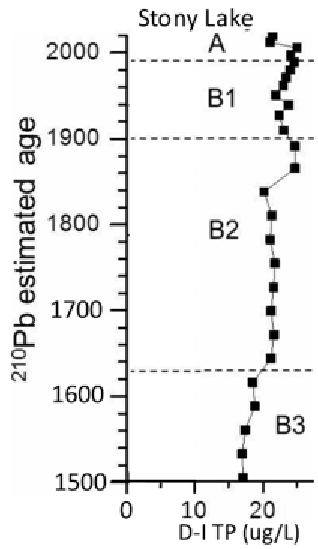
Stony Lake receives most of its water from the Trent-Severn Waterway. A minor portion comes from lower-phosphorus Upper Stoney Lake which, like Cameron Lake, is fed by water from northern forests. Stable phosphorus levels of about 17 µg/L indicate that Stony Lake was historically higher in phosphorus than its upstream cousins Cameron or Pigeon Lake. Then, as today, phosphorus levels rise as water moves downstream from Cameron Lake to Stony Lake. Starting in the mid-17th century, there was a rise in phosphorus concentrations to about 22 µg/L, staying stable until the early 1800s. The reason for the increase is not known, but may indicate indigenous cultivation, vast forest fires or other alterations to the regional landscape. About 1840 there was a rise to about 25 µg/L probably as a result of logging. By the end of the 19th century phosphorus levels dropped to about 23 µg/L. The construction of dams and locks, a reduction in logging and increased settlement in the area may be factors.

Sediment core from Stony Lake

Photo: PEARL







In conclusion, it can be seen that phosphorus levels on all three lakes were quite stable until the early 1800s, which was the beginning of European settlement. Since that time, phosphorus levels have been higher and less stable, probably due to various human activities. Since 1990 both Cameron and Stony phosphorus levels have stabilized or slightly decreased while Pigeon Lake's is still elevated. These changes are not well understood but may be due to increased development, climate change and/or the invasion of zebra mussels. It appears that an increase in human-induced TP concentrations has caused the effects of cultural eutrophication to varying degrees. The implementation of the Kawartha Conservation Lake Management Plans (Cameron and Pigeon Lakes) should assist in managing phosphorus levels. For lakes without management plans, it is timely for the responsible agency to demonstrate their commitment to an integral and healthy lake ecosystem.

For further information on the health of our lakes, see the Kawartha Lake Stewards Association website: https://klsa.wordpress.com/

Paleolimnology is the use of physical, chemical and biological remains in lake sediments to reconstruct past lake environments.

Dr. Brian Cumming at PEARL, Queen's University, Kingston

Photo courtesy of PEARL

Part 2. Historical Lake Productivity Levels

William A. Napier, KLSA Chair

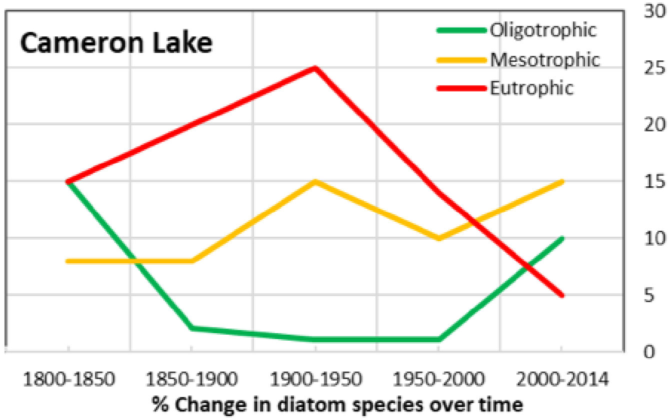
For the past three years the Kawartha Lake Stewards Association (KLSA) has been working with Queen's University's PEARL Laboratory and our partners to develop a historical perspective on how the lakes within our area have changed and whether these changes are caused by human activity. By studying age-dated sediment cores, called Paleolimnology[1], the changes in a lake's water quality history can be evaluated. Sediment cores were collected and analyzed from Cameron Lake, Pigeon Lake and Stony Lake.

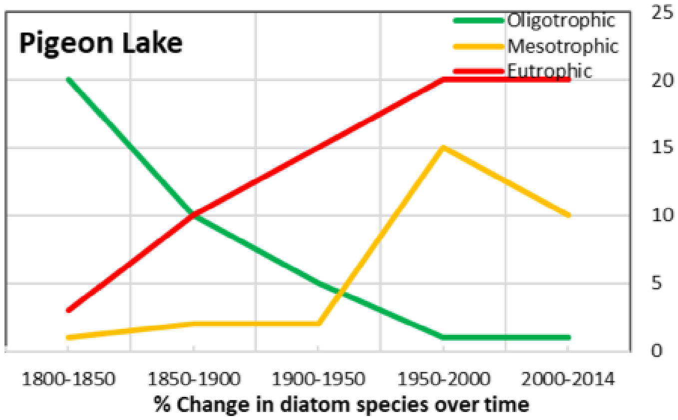
As algae and other matter are deposited in the lake bottom, a chronology of the types of algal species and their population numbers is stored in the sediment. Diatoms are single-celled algae that have shells made of silica which do not decompose. Each species of diatom has a different shell shape allowing them to be identified. Like plants, different species of diatoms prefer to grow in different conditions and this allows researchers to determine the conditions of a lake when the diatoms were deposited and how lake conditions have changed over time.

Lakes can be divided into three categories based on their nutrient level, or productivity[2]: oligotrophic lakes have low phosphorus levels with corresponding low productivity, mesotrophic lakes have intermediate phosphorus concentrations and medium productivity, and eutrophic lakes have high phosphorus levels with high productivity. Lakes naturally evolve over time becoming more productive and eventually filling in. These processes can take thousands of years. However, human activity can change the amount of nutrients in a water body which in turn changes its productivity and speeds up or slows down this natural process. When humans alter the natural eutrophication process, it is called cultural eutrophication.

What the mud tells us about the history of lake productivity levels

The three charts below show how lake productivity has changed over the past few hundred years based on the relative amounts of oligotrophic, mesotrophic and eutrophic diatom species present at different core depths. In Cameron Lake oligotrophic diatoms were historically present, but during the 19th and 20th centuries their numbers decreased significantly being replaced by eutrophic species. Since the 1950s this trend has reversed. Interestingly the oligotrophic species present in the 19th century have been replaced by a different diatom species today. The resurgence of oligotrophic diatoms is partly attributable to lower phosphorus concentrations found in the lake today. Human activities such as land clearing, forestry, lock and dam construction and agricultural practices accounted for the increase



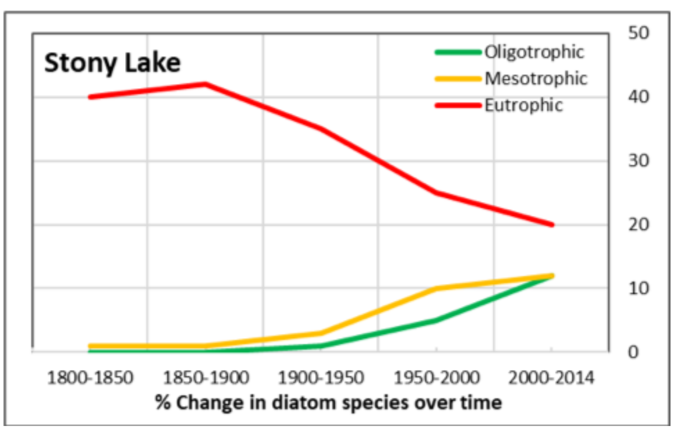


[1] For a description of the eutrophication process and how humans can influence eutrophication see: Napier W.A., Cumming B. Paleolimnology: what is it and why is it useful. KLSA 2017 Annual Report. Dated May 2018. KLSA website: https://klsa.wordpress.com/
[2] For an in-depth description of these lake categories, see Schindler D.W. and Valentine J.R. 2008. The Algal Bowl. University of Alberta Press.

in phosphorus concentrations in the 19th century which resulted in the corresponding shift to more eutrophic diatom species. However, as logging declined and revegetation occurred particularly in the northern area, there has been a return of oligotrophic species and a reduction in eutrophic diatoms.

Northern Pigeon Lake has experienced the most dramatic change over time. The number of oligotrophic species has all but disappeared, while there has been a continual increase in species and numbers of mesotrophic and eutrophic diatoms. The shift from oligotrophic to mesotrophic/eutrophic diatoms started in the middle of the 19th century and has continued into the 21st century. The sediment core was collected in the north part of Pigeon Lake northeast of Bobcaygeon which receives no direct flushing from Sturgeon Lake. Limited inflow from the Miskwaa Ziibi River and Nogies Creek appears to be insufficient to offset the increase in phosphorus due to human development around north Pigeon and the upstream Bald Lakes. The emerging and continued presence of mesotrophic and eutrophic algae will continue unless management activities to lower phosphorus are implemented. Kawartha Conservation has prepared a Management Plan outlining mitigation measures which could partially address the high biological productivity occurring in Pigeon Lake[3].

Stony Lake has experienced historically elevated phosphorus levels when compared to the other two core sites because it is the only site that receives some water from the more productive southern watersheds such as Lake Scugog as well as northern water from Cameron Lake. The proportion of eutrophic diatoms increased after about 1830 when settlement began in southern areas. It peaked in the late 1800s and has declined since that time with an increase in the proportion of oligotrophic and mesotrophic species suggesting lower productivity in recent years. The improvement of the quality of water from Cameron Lake and the installation of improved sewage treatment plants in Lindsay, Fenelon Falls and Bobcaygeon may have contributed to this improvement. Blue green algae have become more prevalent in the past 60 years. Stony/Upper Stoney Lake Environment Council has prepared a lake management plan[4]. The Plan recommends that accountable government agencies should embrace the Lake Plan watershed philosophy and promote lakeshore legislation. The time for action is now.



KLSA Chair Bill Napier presented preliminary results of the paleolimnology study at KLSA's Spring meeting in May, 2018

Photo: KLSA

[3] See: Kawartha Conservation. Pigeon Lake Management Plan Draft - July 2018. https://www.kawarthaconservation.com/images/PigeonLakeManagementPlanJuly2018-DRAFT.pdf
[4] Stony/Upper Stoney Lake Environment Council. A Delicate Balance. The Clear, Ston(e)y and White Lake Plan. Undated. http://www.environmentcouncil.ca/wp-content/uploads/2018/10/LRPReport.pdf

KLSA and Fleming College: Dissolved Oxygen in the Kawartha Lakes

Mara Van Meer, School of Environmental and Natural Resource Sciences
Fleming College, Lindsay

Dissolved oxygen (DO) is an inert gas required for aquatic species respiration. Ranges of DO influence the type of aquatic species that exist in a lake and impact overall water quality. Dissolved oxygen enters lakes through the atmosphere and aquatic plants. Levels of DO can decrease due to respiration and decomposition within the lake system, and increase with photosynthesis. Generally DO should increase towards the bottom of a lake, due to a decrease in temperature. However, in the fall and in the spring, lakes experience mixing, in which the DO profile is consistent from the surface to the lake bottom. Dissolved oxygen requirements vary from species to species. For aquatic life in young and adult stages, acceptable DO values range from 6 and 5.5 mg/L respectively. When considering cold water species, acceptable values are higher, 9.5 mg/L for young and 6.5 mg/L for adult life stages. Anoxic conditions occur when there is not enough DO to support aquatic life.

In the fall of 2018, the Kawartha Lake Stewards Association (KLSA) in partnership with Fleming College and Kawartha Conservation, facilitated a Credit for Product project. This course allows students at the School of Environmental and Natural Resource Sciences to gain field experience with local environmental organizations. The purpose of the KLSA project was to analyze DO levels in three Kawartha lakes: Pigeon Lake, Lovesick Lake and Stony/Clear Lake. Dissolved oxygen was the focus of this study because it can show if there are potentially dangerously low oxygen (also known as 'anoxic') conditions. Additionally, measuring DO can indicate usage, including respiration of living organisms and the breakdown of organic material.

Study sites for data collection were chosen by the KLSA based on previous data collection sites to ensure comparable analysis of the data acquired. The deepest sites at each lake were sampled to provide a general profile for the lake. In Pigeon Lake, both study sites were located in the northern portion of the lake, and were sampled on September 17th, 2018. In Lovesick Lake, both sites were located in the northeast area of the lake and sampled on September 24th, 2018. In Stony Lake, two sites were sampled in the northern portion of the lake, and one site was located in Clear Lake, sampled on October 3rd, 2018.

At each site, numerous variables were measured in addition to DO to help understand lake water quality. Secchi depth (the depth to which visible light can penetrate) was measured using a Secchi disk. Measurements were taken as close to noon as possible as that is when the sun is directly overhead. Temperature (°C), conductivity (µS/cm), pH, Dissolved Oxygen (%) and Dissolved Oxygen (mg/L), were all measured using a YSI meter provided by Kawartha Conservation. Measurements were taken at 1 metre intervals throughout the lake profile. Total phosphorus (TP) was measured to indicate productivity of the lake, as well as trophic status. TP samples were collected using a Van Dorn. Samples were taken from 1 m below the lake surface and 1 m above the lake substrate. Samples were collected using gloves and a sterile bottle before being placed in a cooler to be analyzed by the Centre for Wastewater Treatment (CAWT) at Fleming College. Finally, benthic community populations were measured using an Ekman dredge, sieve bucket (500 micron mesh), and sorting buckets to indicate species richness and quality of lake water.

In general, it was found that Lovesick Lake and Stony Lake displayed expected DO values, considering the time of year the samples were acquired. Lovesick Site 1 ranged from 8.44-8.75 mg/L, while Lovesick Site 2 ranged from 9.27-10.23 mg/L. The temperature profile for both sites on Lovesick showed little variation from top to bottom, ranging from 18.7 -19.1 °C. Stony Lake had the most consistent DO levels, at all three sites. Stony Lake Site 1 ranged from 8.79-8.88 mg/L, while Stony Lake Site 2 ranged from 8.69-8.03 mg/L, and Stony Lake Site 3 ranged from 9.53-9.01 mg/L. The temperature throughout the lake profile had little variation as well, ranging between 15.3-16.7 °C for both sites.

Pigeon Lake displayed below-threshold levels of DO for aquatic life to survive towards the bottom of the lake. This may be because of the greater depth which could result in poor lake mixing, and therefore poor diffusion of oxygen into the lower depths of the lake. In addition, chemical (redox) reactions at the bottom of the lake may have depleted DO levels. Further research is required to determine if anoxic conditions are present. Dissolved oxygen at Pigeon

KLSA and Fleming College: Dissolved Oxygen in the Kawartha Lakes

The Fleming College team conducting field work **Photo by Bill Napier**

Lake Site 1 (named PL4) ranged from 6.07 -10.94 mg/L, while Pigeon Lake Site 2 (PL5) ranged from 6.58-11.75 mg/L. However, temperature was consistent throughout the profile of the lake, between 17 and 24 °C for both sites. Values for TP in all sites ranged from 10-35 µg/L, indicating the lakes are meso-eutrophic or mesotrophic, as expected based on past data and the time sampled.

The benthic community populations for Lovesick and Stony/Clear Lakes displayed low diversity, while the population found in Pigeon Lake exhibited increased diversity. None of the populations indicated anoxic conditions. However, given that the Ontario Benthos biomonitoring Network: Protocol (OBBN) (2007) was not met at all study sites, this should be re-evaluated for conclusive results.

Long-term sampling campaigns ensure that the data is consistent, given that lakes display varying measurements during different seasons. As such, multi-season sampling should occur as anoxic conditions are most likely to occur in the winter season. This is when the lakes experience reduced re-aeration due to a layer of ice and also experience influxes of oxygen-depleted groundwater.

In Pigeon Lake, this data indicates that DO is being consumed at deeper depths during the summer months, which could result in dangerously anoxic conditions for fish and other aquatic life. Lovesick Lake's DO profile shows signs of "healthy" water quality which could support aquatic life in all stages of their life cycle. Lovesick Lake is considered to mix very well and the oxygenation profile found within our data supports this. Stony/Clear Lake had very consistent DO profiles at all three sites. Stony/Clear Lake is another very well mixed lake system and the DO levels can sustain aquatic life, even at the deepest parts of the lake. This is also evident in past monitoring of Stony/Clear Lake, completed by Roz Moore. On May 27th, 2017, DO levels ranged from 9.98 mg/L at the surface of the lake to 9.56 mg/L at the depth of the lake. On July 19th, 2017, DO ranged from 8.58- 6.73 mg/L at the top and bottom of the lake respectively. In data collected August 15th, 2017, DO levels ranged from 8.73-

KLSA and Fleming College: Dissolved Oxygen in the Kawartha Lakes

The Fleming College team and mentors: Connor Hill, Mara Van Meer, Colleen Dempster, Bill Napier, Chris Vieau and Chelsea Houston **Photo by KLSA**

5.51 mg/L at the top and bottom of the lake. To ensure that anoxic conditions are not present, further research and data collection should occur. For benthos to be considered as a water quality indicator, OBBN protocol should be followed. Sampling should also occur in tributaries of each lake to indicate sources of nutrient loading carried by rivers.

Overall, it appears that DO in the Kawartha Lakes is within a normal range, but is low in the depths of Pigeon Lake. However, further research with finer TP measurements, as well as longer sampling campaigns throughout the year are required to indicate the presence of anoxic conditions.

The complete report including the interpretation of the other parameters measured is found on the KLSA website: https://klsa.wordpress.com/2019/01/28/fleming-c4p-dissolved-o2-study/

This article was written by Mara Van Meer summarizing a report written by the Fleming College Team including Connor Hill, Chelsea Houston, Mara Van Meer and Chris Vieau. Their course instructor was Professor Sara Kelly, Faculty, Ecosystem Management Program, Fleming College. KLSA Mentors were William A. Napier and Colleen Dempster. Assistance was also provided by Brett Tregunno, Aquatic Biologist and Debbie Balika, Water Quality Specialist, Kawartha Conservation.

The *Love Your Lake Program* in Trent Lakes

Gary Jarosz, President
Cavendish Community Ratepayers Association Inc. (CCRAI)

Ted Spence, Professor Emeritus
York University and CCRAI Lake Steward

In 2017 and 2018, the Cavendish Community Ratepayers Association Inc. (CCRAI), sponsored the *Love Your Lake Program* (LYL) assessing shorelines on over 1,250 properties covering more than 130 kilometres of shoreline on 11 cottage lakes and a section of the Mississagua River along County Road 507 in the Municipality of Trent Lakes.

The *Love Your Lake Program* is a shoreline assessment and educational stewardship program being undertaken by many shoreline communities in Canada. The program is developed and administered by Watersheds Canada and the Canadian Wildlife Federation and delivered by organizations like CCRAI, focused on environmental measures to protect our lakes and their water quality. In Trent Lakes, the CCRAI worked in collaboration with the Coalition of Haliburton Property Owners Associations, a group committed to protecting and improving water quality in recreational lakes in Haliburton. CCRAI was also supported by the local cottage and lake associations on the individual lakes. Grant assistance covered about 90% of the costs of this program with the remaining 10% being absorbed by a combination of voluntary donations by property owners, local lake, cottage or property owners' associations and the CCRAI.

Excellent water quality is critical to both the recreational and economic value of all shoreline properties. Shoreline ecology specialists recommend that 75% of a lake's shoreline be maintained in a natural state to support healthy lake ecosystems and high levels of water quality. Unfortunately, the presence of manicured and fertilized lawns right to the water's edge has a detrimental effect on natural shoreline water filtering with excessive nutrients flowing into the lake and impacting water quality.

The shoreline assessments were conducted by a team of student evaluators trained by Trent University and certified through the *Love Your Lake Program*. These shoreline assessments were conducted from the water using Geographical Information Systems (GIS) data and Global Positioning Systems (GPS) technology from a boat. Each shoreline was assessed with regard to the degree to which natural conditions had been replaced through shoreline development. No shore access was required to complete the surveys. Conditions were recorded in four shoreline condition categories: Natural, Regenerative, Ornamental and Degraded.

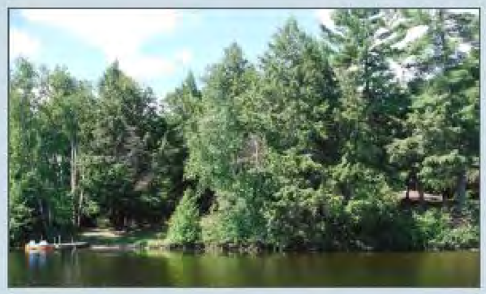
The actual shoreline surveys on the 11 lakes and the river section were undertaken in the summer of 2017 between July 12th and August 9th. A total of 1,268 shoreline properties were evaluated across all 11 lakes and the Mississagua River by three evaluators and a host of volunteers from each of the lakes who provided their boats, boat drivers and accommodations for the evaluators. The data collected was treated as confidential and transferred to the *Love Your Lake* team at Watersheds Canada for analysis.

Following the analysis in the spring of 2018, each shoreline property owner received a personal letter from the Canadian Wildlife Federation and the CCRAI with a website link and a confidential password where they could access their confidential report on their shoreline's status. The property owner was the only one given access to this information and no individual property information was shared with any government agency or local association. The confidential report to each landowner provided recommendations for potential re-naturalization options that the property owner might wish to consider. These options focused on increasing the amount of natural shoreline area and were intended to be compatible with traditional shoreline activities. The report also provided links to native plant material sources as well as advice and support resources for re-naturalization work. It is up to the individual property owner to decide what, if any, work they wish to undertake.

As the local coordinating group, the CCRAI received aggregated data and a Shoreline Assessment Summary Report for each of the 11 lakes and the river segment. This data was presented by the CCRAI at their public meeting in August 2018 and was also shared with local cottage associations. The next step will be a series of presentations on shoreline naturalization at CCRAI sponsored meetings in 2019.

The aggregated results were presented by property where each of the 1,268 properties was categorized by its dominant classification, and by percentage of the total 130 kilometres of actual shoreline in each

The *Love Your Lake Program* in Trent Lakes

Classification & Description	Photograph Example*
Natural – A healthy buffer of vegetation and/or a natural shoreline of sand or exposed rock that is undisturbed and undeveloped.	
Regenerative – Natural vegetation has been removed in the past, but is in the process of growing back towards a natural state.	
Ornamental – All natural vegetation has been removed and replaced with mowed lawn and other non-native vegetation; structures such as docks, decks, boathouses and boat ramps are predominantly present at the shore.	
Degraded – Natural vegetation has been lost; soil erosion, undercutting of the bank and/or exposed roots of shrubs and trees are significant.	

category for each lake. The aggregated results, as presented by CCRAI, showed that while almost all the lakes surveyed met the target of 75% of their shorelines in Natural or Regenerative categories, there were a significant number of properties, approaching 25%, with Ornamental shorelines on all lakes. There were also significantly more shorelines in the Regenerative category than in the Natural category. This indicates that many landowners are allowing their shorelines to regenerate. The goal for the future is a series of follow-up initiatives to see the natural and regenerative shorelines protected and enhanced, and to see some of the ornamental shorelines replanted and allowed to regenerate.

Additional information about the *Love Your Lake Program* can be found on the Watersheds Canada website at: watersheds.ca

Kawartha Land Trust Cation Wildlife Preserve

New Kawartha Land Trust Cation Wildlife Preserve Near Balsam Lake

Tara King, Development Manager,
Kawartha Land Trust

Introduction

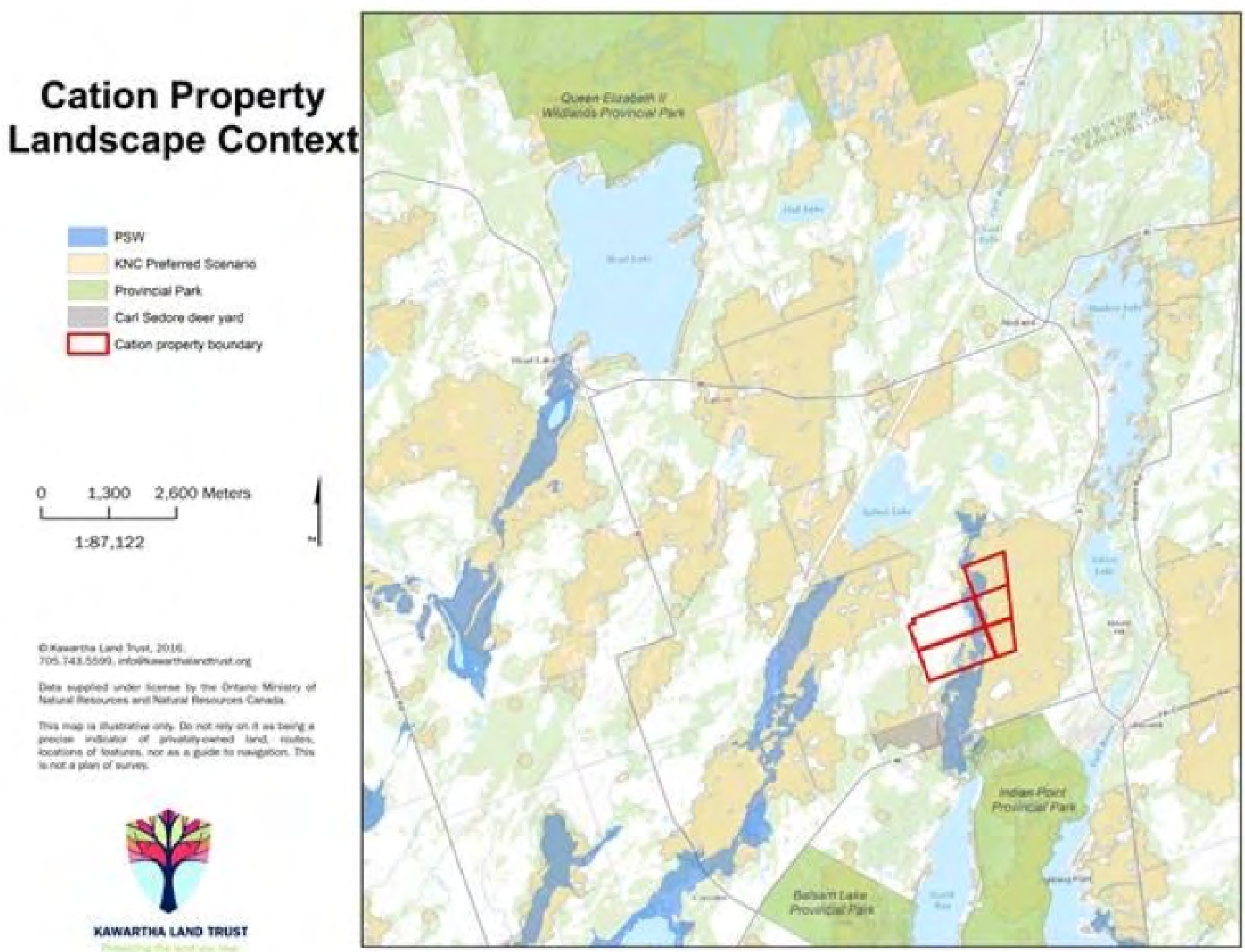
The momentum for conservation in the Kawarthas has continued to grow. Kawartha Land Trust (KLT), a non-governmental charitable organization, announced the protection of five new properties in 2018.

KLT now protects 17 properties including 1,660 hectares (4,101 acres) of diverse and significant landscapes. KLT assists in the management of five additional properties including one owned by Trent-Severn Waterway, Parks Canada (John Earle Chase Memorial Park) with shoreline on Pigeon Lake.

The most recent property KLT protected is the Cation Wildlife Preserve. The water flows through this property into Balsam Lake, the highest point on the Trent-Severn Waterway.

David and Sharon Cation have protected the vast majority of a very special 270 hectare (668 acre) piece of land in a conservation corridor between Balsam Lake and Queen Elizabeth II Wildlands Provincial Park.

When David's mother died in 1998, he and his brother didn't know exactly what to do with her small estate. He eventually decided to purchase a property and protect it. He came to know KLT through the 'Save Boyd Island Campaign', and has since volunteered on a number of properties, helping with trail cleanup and other stewardship activities.



Kawartha Land Trust Cation Wildlife Preserve

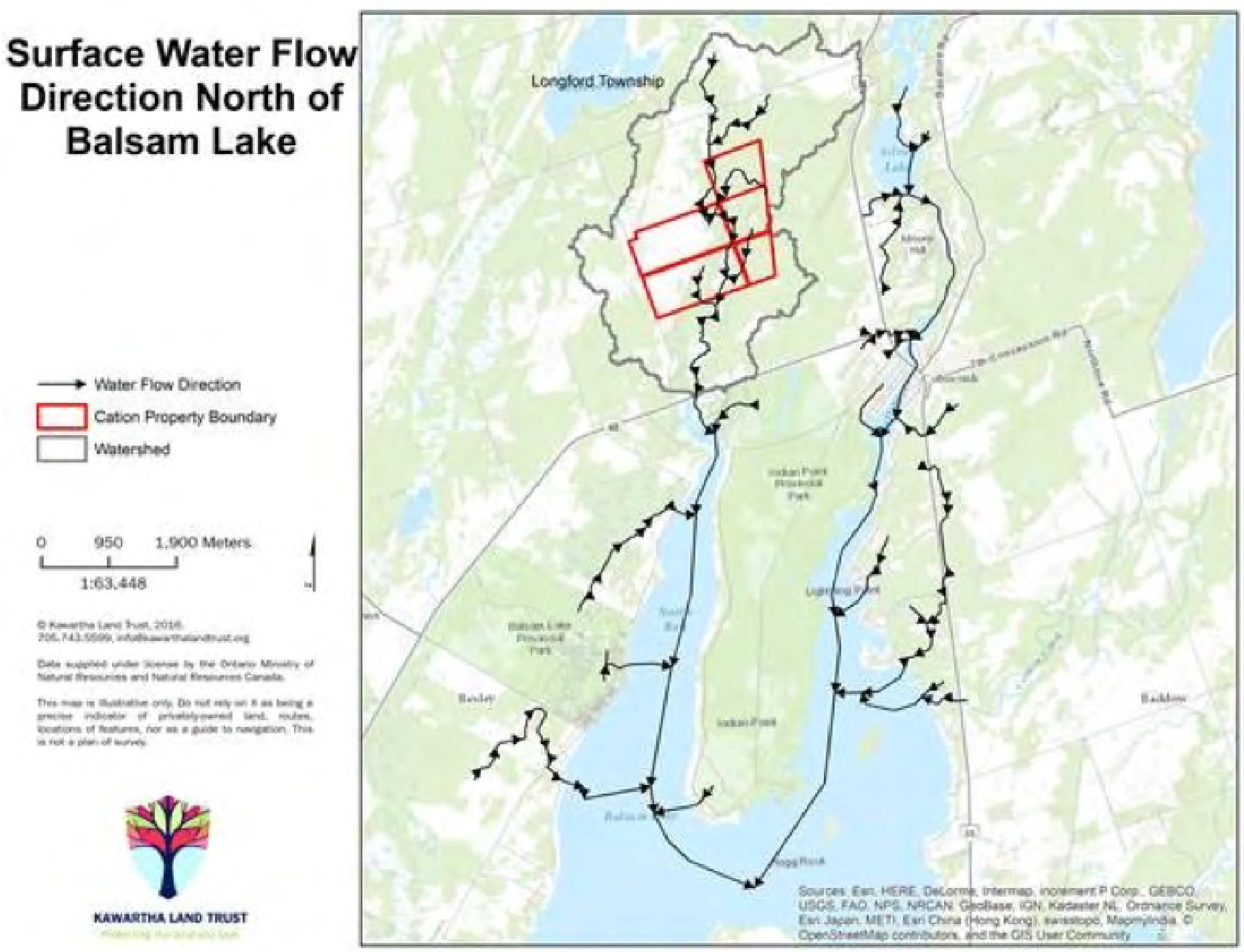
"We decided to buy land for future generations which is what our parents had done all their lives," David said. "Buying the French Settlement Road property to protect for future generations is merely keeping her legacy alive. We wish she could be here to participate."

As soon as they saw it, the Cations recognized the beauty of this unique piece of land and anyone who visits the property knows this is a special place.

What makes the Cation Wildlife Preserve special? The property is made up of rolling areas that were once pasture grasslands, and is now comprised of shrubby meadow thickets, early successional and mixed hardwood forests and a swamp that is part of a large 73 hectare Provincially Significant Wetland. (See kawarthalandtrust.org for more information on this property.)

It sits right in the middle of several important protected areas including the Altberg Wildlife Sanctuary Nature Reserve, Indian Point, Balsam Lake, and Queen Elizabeth II Wildlands Provincial Parks and the Carl Sedore Wildlife Management Area.

The landscape is vibrant and full of life. A trail system passes through the grasslands and meadows that are filled with different butterflies and moths flying between the many wildflowers and milkweed plants. The air is filled with the songs of different grassland bird species including eastern towhees, American goldfinches and field sparrows that are foraging through the shrubs and trees. The Cation property is a wildlife hot spot. Bird enthusiasts have spotted several rare species on the property such as golden-winged warblers and bald eagles. Upland sandpipers and brown thrashers have also been seen there.



Kawartha Land Trust Cation Wildlife Preserve

Belted kingfisher Photo Kawartha Land Trust

Closer to the wetland in the middle of the property there are tons of leopard and green frogs hopping along and across the trails. Belted kingfishers, hooded mergansers and painted turtles are regular inhabitants of this swampy area.

The staghorn sumac, wild red raspberry and blackberry bushes found throughout the property are an excellent food source to many species, especially mammals. There are signs that white-tailed deer, coyotes, black bears and even moose have visited the property. This shows that this is a popular natural corridor that provides a safe haven for wildlife to roam and connect to the adjacent landscape.

History of the property

Seeing this growing and thriving area, it's hard to believe how much damage people have done to the property over more than a century of hard use. In the 1800s this property was heavily logged, wiping out old hardwoods and conifers which reduced the forests and opened up the landscape. The open fields were then used as a range, with cattle grazing here for many years.

Another round of logging occurred less than 30 years ago which wiped out the larger trees and significantly reduced the property's biodiversity. The land was eventually sold to a recreational hunter who used the area to train dogs to hunt coyotes. The property was completely surrounded with an electrical fence to keep the dogs in and the coyotes and other large wildlife out. The fencing prevented several species from using the natural corridor and accessing the protected natural spaces in the area. As a result the species composition was altered, which in turn changed the environment and ecosystems on the property.

After several years of this use, the land was left vacant and the landscape began to heal. Grasses and shrubby plants began to grow; muddy open areas where the dogs once ran became covered with native vegetation. The fencing deteriorated which allowed large wildlife to once again use the property as a natural corridor.

The forest is now in an early successional state, made up of species such as poplars, birches, juvenile maples and ironwood trees. It will be exciting to see the changes to this beautiful piece of land in the future. An additional benefit of their decision is that the old dog kennels, including gates and locks, wire fencing and old rain barrels on the property are being repurposed by the Kawartha Wildlife Centre (KWC). Volunteers spent two days this summer taking everything apart so it can be remade into wildlife enclosures and raccoon beds for KWC wildlife rehabilitation. There is so much wire fencing that other wildlife organizations, including Speaking of Wildlife, will also be able to use the old fence to construct new enclosures and other projects.

Beaver lodge in the wetlands
Photo Kawartha Land Trust

Kawartha Land Trust Cation Wildlife Preserve

Soon the public will be able to enjoy the trails on the Cation property. Photo KLT

With the landscape regenerating and the materials once used for harm now being used to help heal and rehabilitate wildlife, it feels as though the property has come full circle. This land now serves as a beautiful example of how resilient nature can be and how fast it recovers when left untouched.

Kawartha Land Trust future plans

Donors of land, money and time have come together to actualize the protection of the Cation Wildlife Preserve with KLT. KLT has an interest in protecting more land in this significant corridor. Other landowners have already expressed their interest in learning about land protection options.

This project was undertaken with the financial support of the Government of Canada through the federal Department of Environment and Climate Change.

The community will be invited to use the trails for passive recreation (hiking, snowshoeing and cross-country skiing) once they are formally marked. An event to celebrate the opening of the trails and property to the public will be scheduled in 2019.

To learn more about land protection options or to make a donation to Kawartha Land Trust visit: www.kawarthalandtrust.org

KAWARTHA LAND TRUST
Protecting the land you love.

2017 Kawartha Lakes Sewage Treatment Plants Report

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

Each year, KLSA monitors the performance of Sewage Treatment Plants (STPs) that discharge effluent either directly to the Kawartha Lakes or their watershed, or to waterbodies that flow into the Kawartha Lakes. The purpose of STPs is to protect public health by minimizing the discharge of pathogens and to protect the environment by minimizing the discharge of phosphorus (P) to our lakes. Of primary interest to KLSA is the quantity of phosphorus that is discharged by these plants to our lakes because phosphorus is known to be the most likely nutrient to cause increases in the growth of aquatic plants and algae.

Lake management studies have shown that the amount of phosphorus now discharged from STPs is only a small percentage of the phosphorus entering our lakes from all sources. This was not always the case. Prior to the 1970s, STPs discharged between 50 and 100 times more phosphorus than modern STPs. However, unlike most other phosphorus sources that are widely distributed, STPs are localized sources that can be controlled and municipalities spend considerable taxpayers' dollars to build and operate these plants to protect our health and the environment.

KLSA monitors the performance of STPs to determine if they are being operated to their fullest potential. Ideally KLSA would like all STPs that discharge directly to our lakes to achieve a 99% phosphorus removal rate. This means that only one part in 100 of the phosphorus entering the plant leaves in the effluent. A drop of removal efficiency to 95% means five parts in 100 leave the plant, which is five times more phosphorus released compared to 99% removal efficiency. What might seem like a small change in removal efficiency can have a very large consequence!

As we have indicated in past years, our STP data is always one year behind, because the reports for the previous year are not available to us before going to press. This year all of the reports were available online on the websites of their respective municipalities. Due to changes in the City of Kawartha Lakes website, key tables in their online reports were not legible but readable versions were provided upon request. Again this year we have included three STPs, Minden, Port Perry and King's Bay, which do not discharge directly into the Kawartha Lakes. These plants are upstream of our Kawartha Lakes and have at least one body of water in between to attenuate the effects of their effluent discharge.

Minden

Minden's STP discharges to the Gull River just above Gull Lake, which is two lakes away from our most upstream Kawartha lake, Shadow Lake. In 2017 this plant again incorrectly reported an overall removal efficiency of 97.1%. This was the best removal efficiency achieved in the month of October. The average annual removal efficiency was only 93.9% without accounting for bypasses. During March, April and May, Minden's STP was overwhelmed by rain and snowmelt causing bypassing of its tertiary filters on three occasions and the Orde Street pumping station bypassed some raw sewage to the Gull River from May 1 to 26. An estimated 42,480 m^3 of raw and partially treated sewage entered the river. Total Phosphorus (TP) content of samples taken during these events varied considerably but it is estimated that the P load to the river from these events was 8.65 kg. This increased the total annual P load to **32.9 kg** reducing the Minden STP's effective removal efficiency to **92.3%**. Measurements of TP in the Gull River both upstream and downstream of the raw sewage outfall showed that there was no measurable increase in TP of river water. No other spills, bypasses or overflows were reported and no complaints were received during the year.

Average *E. coli* discharges were generally low during the year except during the May flood period. During the bypass events in May the geometric mean of 24 readings was 297 cfu/100mL with the highest reading being 4,600 cfu/100mL, well above the plant's Certificate of Approval level of 200 cfu/100mL.

Coboconk

This lagoon system continued to function well in 2017, with planned discharges to the Gull River just above town occurring in April and November. The average phosphorus content of effluent discharges was 0.11 mg/L in the spring and 0.03 mg/L in the fall. 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 seven years, the overall phosphorus removal rate was **greater than 97.3%** during that period and the 2017 total annual discharge of phosphorus was estimated to be **5.08 kg.**

Average *E. coli* in the discharges in spring and fall were a low 2.7 and <2.0 cfu/100mL respectively. No spills, bypasses or overflows were reported. Two odour complaints were received during the year. Both were attributed to unusually warm weather.

Fenelon Falls

In 2017 the Fenelon Falls Waste Water Treatment Plant (WWTP) performed adequately with no spills or overflows at the plant. The annual average removal rate was 94.8%, down from last year's 96.0% and well below our target of 99%. This resulted in a P discharge from the WWTP to Sturgeon Lake of 47.5 kg for the year. However, snow melt and high flows on three occasions during late winter and spring required some bypassing of the tertiary filters at the plant. It is estimated that this resulted in an additional 1.6 kg of phosphorus entering Sturgeon Lake. Consequently, the Fenelon Falls system as a whole discharged a total of up to **49.1 kg** of phosphorus to Sturgeon Lake and had an effective P removal rate of **94.6%**. Due perhaps to the wetter than usual year, raw influent volume was 25% higher in 2017 than 2016 so despite the similar annual removal efficiency, the phosphorus discharge was about 25% higher than in 2016.

The wet weather flow detention tank at the Ellice Street pumping station that was completed in April 2017 probably reduced the severity of the above-mentioned bypasses. It was also probably responsible for the excellent news that there were no reports of raw sewage discharges from the Colborne Street pumping station such as have occurred many times in the previous six years.

Again this year *E. coli* levels in the effluent from the Fenelon Falls WWTP were generally low with an annual average of 2.3 cfu/100mL. Again this year, there were several odour complaints from one resident on Ellice Street near the WWTP.

Lindsay

The Lindsay WWTP is the largest on the lakes. The City of Kawartha Lakes owns the Lindsay WWTP but its operation is contracted to the Ontario Clean Water Agency (OCWA) which operates all the other sewage treatment plants owned by CKL. In 2017 the Lindsay WWTP operated very well with no reported spills, bypasses or abnormal discharges from the plant. It is estimated that the 2017 annual average phosphorus removal rate was **97.5%**, somewhat lower than last year's 98.6%. This resulted in a P discharge to Sturgeon Lake of **311.7 kg**, up from 176.8 kg last year.

The annual average *E. coli* in the discharge was 11 cfu/100mL with a maximum of 39 cfu/100mL in February. A two-hour overflow of raw sewage occurred at the Colborne Street Pumping Station during heavy rain on June 23, 2017. The estimated discharge of phosphorus due to this event was less than 0.5 kg. Two complaints about odour from pumping stations were reported in 2017. Remedial actions were taken.

Bobcaygeon

In 2017 the average phosphorus removal rate for the Bobcaygeon WWTP was calculated to be **94.2%**, down from last year's 95.8%. This is well below the performance of earlier years and our desired target of 99%. The reported annual phosphorus load to the lake was **114.7 kg**, slightly less than last year's 125.6 kg. There were no operational problems reported that explain the apparent poor performance. The Bobcaygeon WWTP has a Rated Capacity of 3,055 m^3/day and a Peak Capacity of 10,440 m^3/day. The average daily flow for the year was 3,169.8 m^3/day or 103.8% of the rated capacity. In 2017, daily flow exceeded the rated capacity in 9 of the 12 months and reached a maximum flow of 6,270 m^3/day, 205% of rated capacity, in May. The report suggests that the higher than usual annual influent flow was due to the very wet weather in 2017. A study conducted in 2015 indicated that Bobcaygeon's sewage collection system is subject to considerable inflow and infiltration (I&I) during wet weather due to "joints, cracks, manhole covers, etc., sump pumps, storm drain tie-ins, etc." A study by OCWA in 2017 showed that influent volumes have increased by 50% in the past three years and influent TP concentrations have dropped due to dilution. The WWTP's performance is believed to be adversely affected by the high volumes of lower concentration influent.

The City of Kawartha Lakes needs to address the serious problems in the collection system in order to optimize the current plant process and defer future plant expansion/major capital upgrades.

E. coli discharges were relatively low during the year except during April when a geometric mean of 4 samples resulted in readings of 53.7 cfu/100mL. No spills, bypasses or abnormal discharges occurred during the year. One complaint was received about the amount of truck traffic to and from the plant during a period when sludge was being removed.

Omemee

This facility consists of two large settling lagoons. Until 2014 all of the effluent was spray-irrigated onto nearby fields during the summer months. A subsurface effluent disposal system was commissioned at the site in March, 2014. Both the spray irrigation and subsurface disposal systems were used in 2017 with about 61% of the effluent being sprayed between late May and early November. Earlier problems with the subsurface disposal system appear to have been overcome. Approximately 39% of the 2017 effluent was disposed of by this system during the colder months.

We are pleased to see that more detailed information about the quantity and quality of raw influent and treated effluent continued to be provided for this facility in 2017. The average effluent phosphorus concentration in 2017 was 0.44mg/L, slightly higher than last year's 0.39 mg/L but well below the allowable 1.0 mg/L. Lagoon systems can have considerable volume buffering capacity with the volume of raw influent and treated effluent varying considerably from year to year. In 2017 the effluent discharged was about 92% of the influent volume. Based on the numbers provided, phosphorus removal was estimated to be **~76%** with ~115.3 kg being distributed to the irrigation fields and subsurface system. However, because the effluent is applied to land far from Pigeon Lake, removal is probably almost **100%** with respect to our lakes.

The annual average *E. coli* level in the effluent was 150 cfu/100mL this year. This lagoon facility did not require any emergency discharges to the Pigeon River in 2016 and there were no spills or bypasses reported and no complaints were received.

King's Bay

The King's Bay STP serves a golf course community situated on a peninsula between Lake Scugog and the Nonquon River. Houses down the centre of the peninsula are surrounded by the golf course. Treated effluent from the STP at the apex of the peninsula is discharged into two large disposal beds under the golf course on each side of the peninsula. One up-gradient and three down-gradient wells are located around each disposal bed to monitor groundwater for phosphorus migration.

A major breakdown of one of the two Rotating Biological Contactor units (RBC#2) in November 2016 necessitated all treatment to be done by RBC#1 until repairs were completed in May 2017. Then in June 2017 RBC#1 went offline due to a chain failure and remained out of service for the rest of the year. Despite these difficulties the system performed well. Effluent TP concentration of discharge to the underground disposal beds averaged 0.31 mg/L, up slightly from 0.27 mg/L in 2016, out of an allowable 1.0 mg/L. The annual daily loading for 2017 was 0.015 kg per day, less than 10% of the allowable discharge of 0.17 kg per day. Phosphorus annual average removal efficiency within the plant was a very good **98.8%** this year. No bypasses, spills or abnormal discharges occurred in 2017 and there were no complaints about the plant.

Monitoring wells located both up and down gradient from the disposal sites have had sporadic high TP readings in past years. In 2016 the TP measurement procedure was changed to collecting a field filtered grab sample from each well twice a year. TP levels in all wells were generally low in 2017. The purpose of the monitoring wells is to detect phosphorus migration towards the lake or the Nonquon River. Since these wells average 100 m from the lake or the Nonquon River, it is probable that, at least for the time being, we still have effectively **100%** removal.

Port Perry

Port Perry is served by the Nonquon Waste Pollution Control Plant (WPCP) which discharges treated effluent into the Nonquon River northwest of Port Perry, which, in turn, empties into Lake Scugog at Seagrave, where the King's Bay facility is located. Prior to March 1, 2017 this system was an MOECC Class Two waste water treatment plant designed

2017 Kawartha Lakes Sewage Treatment Plants Report

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/100mL)	Bypasses, Spills, Comments
Minden - Gull river	2012	98.0%	12.8	6.4	2.7	None reported
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	None reported
	2015	96.4%	17.9	4.9	68.0	None reported
	2016	89.7%	44.9	4.4	81.0	Bypass resulted in ~22 kg extra P load
	2017	92.3%	32.9	5.4	297.0	Bypass resulted in ~8.7 kg extra P load
Coboconk - Gull River Mill Pond	2012	99.4%	1.2	1.2	5.5	None reported
Dual lagoons	2013	97.4%	3.2	1.0	12.4	None reported
semiannual discharge to river	2014	>97.8%	< 3.1	1.7	3.7	None reported
	2015	>98.0%	< 2.2	1.1	2.5	None reported
	2016	>97.6%	4.2	1.2	3.4	None reported
	2017	>97.3%	5.1	1.1	2.7	None reported
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
	2015	96.3%	26.3	7.2	2.0	None reported
	2016	94.6%	38.8	7.2	3.3	Bypass resulted in ~ 10.4 kg extra P load
	2017	94.6%	49.1	9.1	2.3	Bypass resulted in ~ 1.6 kg extra P load
Lindsay - Sturgeon Lake	2012	98.1%	193	101.6	2.4	None reported
Flow equalization lagoons;	2013	98.0%	220	112.2	4.0	None reported
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	2015	>98.2%	<239.4	131.7	2.5	None reported
	2016	>98.6%	<176.8	134.3	3.5	None reported
	2017	97.5%	311.7	125.9	11	Overflow resulted in ~0.5 kg extra P load
Bobcaygeon - Pigeon Lake	2012	97.8%	43.2	19.6	2.5	None reported
Extended aeration activated sludge	2013	96.9%	85.4	27.5	3.4	None reported
process with tertiary treatment	2014	97.9%	61.7	29.4	7.4	None reported
	2015	98.0%	51.8	26.9	21.0	None reported
	2016	95.8%	125.6	30.0	31.0	Spill of 1 Litre reported
	2017	94.7%	114.7	19.7	53.7	None reported
Omemee - Fields/Underground	2012	100.0%	0	0.0	309.0	None reported
Dual lagoons with spray irrigation;	2013	100.0%	0	0.0	-	None reported
pumped into underground disposal	2014	100.0%	0	0.0	-	None reported
beds beginning 2015	2015	100.0%	0	0.0	143.0	None reported
	2016	100.0%	0	0.0	496.0	None reported
	2017	100.0%	0	0.0	150	None reported
King's Bay – Underground	2012	100.0%	0	0.0	-	None reported
Pumped into underground disposal	2013	100.0%	0	0.0	-	None reported
beds.	2014	100.0%	0	0.0	-	None reported
	2015	100.0%	0	1.1	-	Spill resulted in ~1.14 kg release to lake
	2016	100.0%	0	0.0	-	None reported
	2017	100.0%	0	0.0	-	None reported
Port Perry - Lake Scugog	2012	96.7%	148.9	45.1	-	None reported
Extended aeration activated sludge	2013	97.0%	121.3	40.4	-	None reported
process with tertiary treatment;	2014	96.6%	144.2	42.4	-	None reported
effluent discharge to Nonquon River.	2015	98.2%	69.7	37.8	-	None reported
	2016	97.8%	75.3	33.6	-	None reported
	2017	98.8%	52.3	45.3	2	None reported

(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.

2017 Kawartha Lakes Sewage Treatment Plants Report

for an average flow rate of 3,870 cubic metres per day (m³/d) utilizing two aerated lagoon cells and six seasonal facultative retention ponds. A new modern plant has been built and as of March 1, 2017 the MOECC reclassified Nonquon WPCP as a Class Three waste water treatment plant, designed to treat waste water at an average daily flow rate of 5,900 m³/d utilizing an extended aeration process with tertiary treatment. Thus, 2017 is a transition year between the old and new systems. The new system generally performed well except for the scum removal system that allowed excessive scum and grease to flow through the secondary clarifiers and accumulate in the sand filters. Initially this resulted in some exceedances of effluent objectives for total suspended solids and total phosphorus. Continuous monitoring and manual cleaning of the filters is being performed to prevent filter clogging until a permanent solution is implemented. In 2017, phosphorus was reduced to a monthly average of 0.05 mg/L for a total loading of **52.3 kg**, down from last year's 75.3 kg and significantly less than in earlier years. This reflects a very good removal rate of **98.8%**. *E. coli* levels this year were between 0 and 2 cfu/100mL. There were no reported bypasses, spills or abnormal discharges and no complaints were received during 2017.

Summary

The total weight of phosphorus discharged to the mainstream Kawartha Lakes from the Lindsay, Fenelon Falls and Bobcaygeon WWTPs in 2017 was 476 kg, considerably more than last year's 341 kg. If we include all the plants that we now monitor, we had total phosphorus loading to the lakes of 566 kg in 2017 compared to 465 kg in 2016. If all plants had achieved the 99% removal rate that we would like, the total phosphorus discharge for the year would have been about 206 kg or about 36% of the 2017 total.

Beech Bark Disease

Tracy Logan, ISA Certified Arborist (ON – 6021A), *Logan Tree Experts; KLSA Director*

Affected Tree Species: American Beech and European Beech

When it comes to beech bark disease, it's a team effort between pest and disease. Still a relatively unknown issue in most of our province, the disease has been slowly killing beech trees in Canada and the United States from east to west for decades. In Ontario, the disease has been making the most impact in the eastern and southern forests.

Trunk of diseased tree **Photo: Ontario.ca**

Beech trees are large, shade tolerant deciduous trees found in rich mixed woodlands. They are most easily recognized by their smooth bark and are most commonly found alongside sugar maple, yellow birch and eastern hemlock. They are of ecological significance as their nuts are a source of food for bears and deer and the trees are an important home for birds and other wildlife.

Beech Bark Disease

Trunk with Cankers **Photo: vtinvasives.org**

The disease has two stages – first the tree is infested by invasive scale insects, introduced from Europe, which are moved by wind, animals or by the movement of infected wood. These scale insects feed on the beech tree sap by creating tiny openings in the bark. The tiny openings then allow for the second stage of the disease, the colonization of a nectria fungus, which is thought to be native in North America and spread by wind and rain splash. This fungus causes cankers to form which cuts off the 'veins' of the tree and causes the tree to die. The disease appears to only affect beech trees over eight inches in diameter and may not kill all trees that it infects, however trees are ultimately weakened making them susceptible to other stresses. When inspecting beech trees, look for trees that are thinning or yellowing in the upper canopy. Look for tiny (less than 1 mm) wingless scale insects on the bark. After feeding, the scale cover themselves in a white, waxy coating that can be visible on the bark surface. Once the scale insect has created an opening in the bark and the fungus has infected the wound, fruiting bodies can be visible as deep orange-red, oval shaped marks seen on the bark in the late summer and fall. The fruiting bodies may also be identified as an oozing from the bark.

Removing diseased trees will help keep the fungus from further spreading, however the public is encouraged not to move the firewood which could unintentionally infect new stands of beech trees. If you notice a large healthy beech tree in a stand of diseased trees, please contact the Ministry of Natural Resources and Forestry as this could show signs of disease resistance.

Scale insects with white fuzzy covering
Photo: Ontario.ca

Nectria fungus fruiting bodies
Photo: Patrick Hodge-MNRF

Report all sightings of beech bark disease to the Invading Species Hotline at 1-800-563-7711 or report a sighting online through their website: http://www.invadingspecies.com/invading-species-reporting/

Starry Stonewort – an Invasive Species Now in Stony Lake

Patty Macdonald and Carol Cole,
Stony Lake Cottagers

Two years ago I noticed a new type of aquatic plant growing in the Lost Channel by Fairy Lake Island. I was curious but not alarmed. This summer I was surprised to find it now carpeted the bottom of my bay at the end of the channel closest to St. Peter's. It wasn't until I had guests up for the long August weekend that we finally identified what it was. It is an aggressive, invasive macro algae called starry stonewort. A quick Google search turned up a number of articles posted by the Scugog Lake Stewards and many more from eight U.S. states where it has been a problem for four decades. It spreads rapidly and forms dense mats on the bottom of lakes and slow moving rivers. It can be over two metres thick and will grow in water up to

Starry stonewort. After an hour's work with rakes and pitchforks, a narrow swath was cleared from one side of this dock. It barely made a dent in the bay's plant mass.

Photo Carol Cole

about 23 metres deep. There has been no success in trying to eradicate it once it is established.

Appreciating what this could mean to the aquatic habitat and recreational enjoyment of Stony Lake and the Kawarthas, myself and my lake neighbours, Carol Cole and Greg Finlay, embarked on an ad hoc awareness campaign. We initially contacted the four cottage associations on the lake and the environmental council for Clear, Ston(e)y and White Lakes. Our goal was to create a growing team of concerned individuals.

We used the balance of the summer and fall to find out as much as we could about the algae, including what had been tried in other areas to limit and manage its spread. Local environmental agencies and groups including the Ontario Federation of Anglers and Hunters (OFAH), the Federation of Ontario Cottagers' Associations (FOCA) and the Otonabee Region Conservation Authority (ORCA) were contacted. We looked at existing legislation like the Invasive Species Act and how it might assist us as we moved forward.

We also wanted to know if starry stonewort was anywhere else on the lake. We used Facebook to post our findings and followed up on leads that we received from cottagers who thought they had starry stonewort in their area. Luckily, most of the leads turned out to be other species; mostly native types of weeds. We have definitively identified starry stonewort in Stony Lake in three key locations:

- The Lost Channel and its adjacent bays off of Fairy Lake Island (#63 – St. Peter's Church on the Rock side and #2702 – Juniper Point side leading to the Burleigh Channel)
- Little's Marina #918 in Gilchrist Bay
- The east side of Gilchrist Bay by Wildfire Golf Club

We discovered that there are a couple of research teams aware of and studying this invasive species in Ontario. We contacted both of them so they would be aware that starry stonewort has been identified on Stony Lake. Dr. Eric Sager, Ecological Restoration Program Coordinator at Trent University and Fleming College was the first researcher in Ontario to identify starry stonewort in the Port Perry area. A second research team at the University of Ontario Institute of Technology, led by Dr. Andrea Kirkwood, has been working closely with the Scugog Lake Stewards (SLS). In 2016, Dr. Kirkwood's group received a $369,000 three-year grant from the Ontario Trillium Foundation (OTF) to continue vital research to develop a comprehensive and sustainable approach to help with fish habitat conservation in Lake Scugog. It is hoped that their funding will be extended to

Starry Stonewort – an Invasive Species Now in Stony Lake

Here's what you need to know about starry stonewort:

It is identified by small, white, star shaped bulbils found on the branches of the algae. These small white stars do not die off over the winter. Rather, they will lie dormant and regenerate when waters warm and will create new infestations. It's not a plant or weed as it has no seed or roots.

Starry stonewort (*Nitellopsis obtusa*) is a green macro algae (family Characeae) native to Europe and Asia. It is spread primarily through fragmentation. It grows in water up to 23 metres deep, carpeting the bottom in dense mats up to about two metres thick. By covering the bottom of the lake it can potentially destroy fish spawning areas. In shallower water, three metres or less, it will grow right up to the surface. Initially you may notice that your shoreline appears to have significantly fewer weeds. This is because once starry stonewort is established, it chokes out native species and other invasive species such as Eurasian milfoil. It becomes so dense it is impossible for fish and other water inhabitants to swim through it.

Starry stonewort in the waters of Stony Lake
Photo Carol Cole

(Above) Starry stonewort, freshly harvested
Photo Patty Macdonald

(Below) Notice the *white bulbils on the branches*
Photo Patty Macdonald

enable them to expand their work to other areas in the province. Stony Lake would be an ideal addition to this important work as its geological makeup is very different than that of Lakes Scugog, Couchiching and Simcoe. Sadly, there is no federal or provincial involvement or support for this project. In fact, virtually all such research relies on grants, fundraising and volunteers to support research teams headed by scientists like Drs. Kirkwood and Sager.

The fall municipal elections provided another opportunity to create awareness with local cottagers, area residents and those hoping to fill vacant council seats. We also sent letters to our provincial representatives including Jeff

Yurek, Ministry of Natural Resources and Forestry (MNRF) and Rod Phillips, Ministry of the Environment, Conservation and Parks (MECP) along with our MPP, Dan Smith and opposition critics.

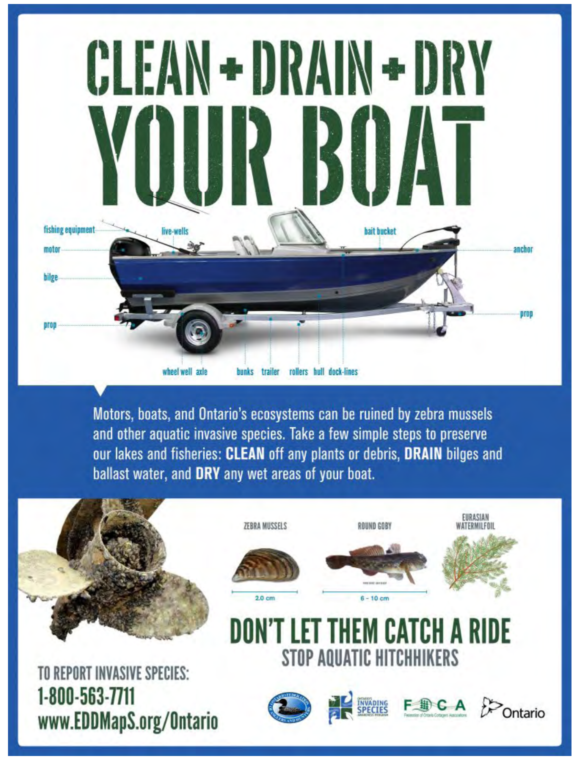
The responses we received ranged from auto replies to repetition of information we already had such as the response below from Rosalyn Lawrence, Assistant Deputy Minister MNRF Policy Division:

…"Experience in other jurisdictions has shown that starry stonewort is extremely difficult to control. Mechanical harvesting can provide short-term control, but new populations can arise from fragments. Algaecides containing copper as an active ingredient have had some success in the U.S., but there are no federally registered products available in Canada for open-water use… I trust this is helpful to your concerns. Thank you for writing."…

So after a flurry of activity, it seems that it will be up to us, cottagers and area residents, to work together to protect the many natural gifts of the Kawartha Lakes region and ensure they remain for further generations to enjoy.

Do whatever you can to share this information with your family and neighbours. Encourage them to contact our provincial and local representatives and tell them that this is an urgent matter and you want their involvement and assistance. If you think you have or have seen starry stonewort, call the Invading Species hotline 1-800-563-7711 as OFAH has agreed to track all reporting until it can be formally added to the invasive species database. Finally, and perhaps, most importantly, work with your area marina operators and those trailering water craft in and out of your lake to make sure they are aware of their role in preventing the spread of all invasive species.

Starry stonewort reproduces when fragments break off and find their way into new areas – from bilge water, motors, etc. CLEAN, DRAIN, and DRY your boat before coming into, or going out of, any lake or new area…as you don't want to unintentionally transport, aid and abet in the proliferation of this unwelcome visitor.



Dr. Eric Sager presenting on aquatic plants at the October 2018 KLSA Annual General Meeting

Photo: Bill Napier

E. coli Bacteria Testing

Kathleen Mackenzie, KLSA Vice-Chair

Kawartha Lake Stewards Association (KLSA) *E. coli* testers enjoyed a sunny summer in 2018. Sampling boat rides, though pleasurable, were also purposeful as we tested 65 sites on 12 Kawartha lakes, each five or six times over the course of the summer. Thanks to all of our faithful testers, who not only collected samples, but also delivered them in a timely fashion to the SGS laboratory in Lakefield. Good work!

All readings are recorded in Appendix E.

Sampling sites were almost identical to those in the past few years, and results were also very similar. Our lakes show low bacterial counts, with the large majority being less than 20 *E. coli* cfu/100 mL (see chart below). These generally low counts indicate good shoreline management.

Elevated counts occurred at sites where they have occurred in previous years. This is usually where waterfowl congregate, often along grassy shorelines. KLSA recommends keeping a 'buffer zone' of natural vegetation along your shoreline as a deterrent to geese. For a long-term overview of the KLSA *E. coli* testing program, please see KLSA's *E. coli* Testing Program: Analysis of Results 2001 – 2017 in the 2017 KLSA Annual Report.

KLSA would like to have bacteria testing on the more western Kawartha lakes. All we need is a few volunteers, plus a coordinator to work with the laboratory at Fleming College. Please let us know if you are on Balsam, Sturgeon, Cameron or west Pigeon and are interested in participating in this important program. If you would like to test a location of your choice on your lake, please let KLSA know. There is an excellent instructional video on our website in the 'Publications' section about bacteria testing if you would like to see what is involved.

Number of readings	0 – 20 *E. coli* cfu/100 mL	21 – 49 *E. coli* cfu/100 mL	50 – 100 *E. coli* cfu/100 mL	Over 100 *E. coli* cfu/100 mL
2018	347	23	6	0
2017	324	16	6	6
2016	351	12	4	3
2015	296	17	16	5
2014	333	23	13	1

Support the Lake Partner Program

Late last year, the Federation of Ontario Cottagers' Associations (FOCA) requested Lake Associations and others to send a letter of support to the Minister of the Environment, Conservation and Parks (MECP) expressing support for the Lake Partner Program (LPP). There were indications this program may be curtailed by the Ontario Government. The LPP is a cost effective, collaborative effort between FOCA and the Ontario Government whereby water samples are collected by volunteers and analyzed for phosphorus and other parameters by the Provincial Government laboratory. The data collected as part of this program for almost 20 years is evaluated and used by KLSA and others. More than 25 lake associations heeded the call.

On March 14, 2019, KLSA sent a letter to the Hon. Rod Phillips, requesting the government to consider five recommendations supporting LPP, based on a scientific and policy based rationale. **For further information, see the KLSA letter at klsa.wordpress.com.**

Phosphorus Testing 2018

Mike Dolbey, PhD, P.Eng, KLSA Director
Kathleen Mackenzie, KLSA Vice-Chair

Thank you to all our wonderful volunteers for the many kilometres covered as you collected water samples. As in the past, sampling was conscientiously done, and we now have up to 17 years of measurements on our lakes.

Although many of us missed the May measurement due to the very cold spring, things warmed up nicely, and it was a lovely sunny summer to be out on the lake. Total phosphorus (TP) was measured at 45 sites on 16 lakes, 5 or 6 times over the summer. Samples were analyzed by the Ministry of the Environment, Conservation and Parks Lake Partner Program. The TP data for hundreds of sites on Ontario lakes can be found on the Lake Partner Program site and also on the Federation of Ontario Cottagers' Associations (FOCA) site.

If you are unable to continue testing, please let any director in KLSA know, so we can help find a replacement for you. The program is free, and kits are mailed to you along with instructions. We have fairly complete coverage of the Kawartha Lakes, but are looking for testers on Cameron Lake, south Sturgeon Lake, south Pigeon Lake, and Chemong Lake north of the causeway. Please let us know if you are interested.

This section is a summary of the 2018 results. The complete chart of TP measurements, Secchi depths, and calcium levels is found in Appendix F.

Why measure phosphorus levels in lake water?

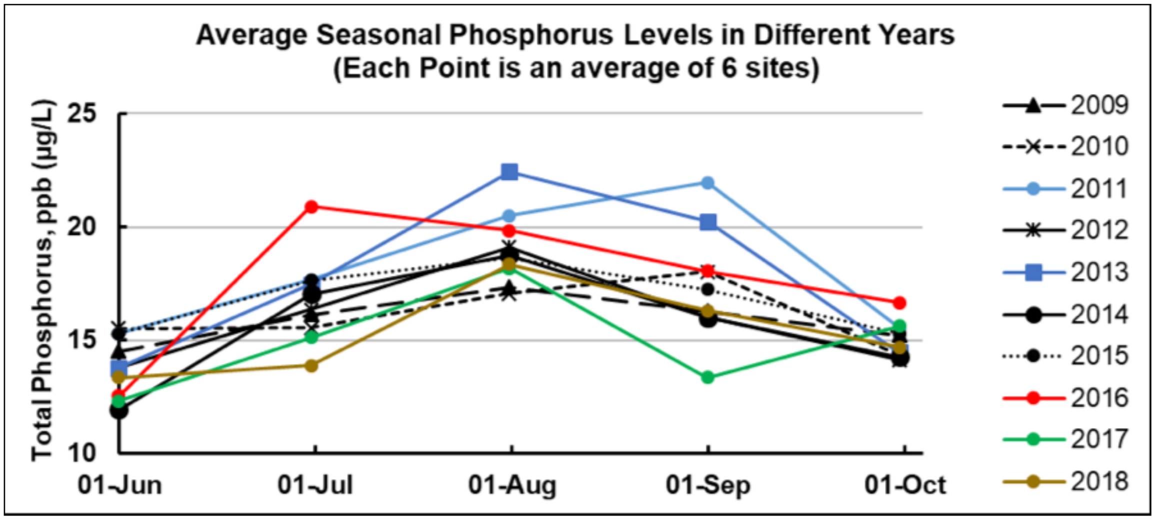
Phosphorus is generally the chemical that is most responsible for increased algal growth in freshwater lakes, causing murky water. Sources of phosphorus include shoreline erosion, fertilizers, wildlife, septic systems, sewage treatment plants and pets. Limited fertilizer use and a well-vegetated shoreline are good ways to limit your phosphorus input.

The Ontario Ministry of the Environment, Conservation and Parks has issued the following guidelines for total phosphorus in our lakes:

- **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.**

2018: A delayed spring flush

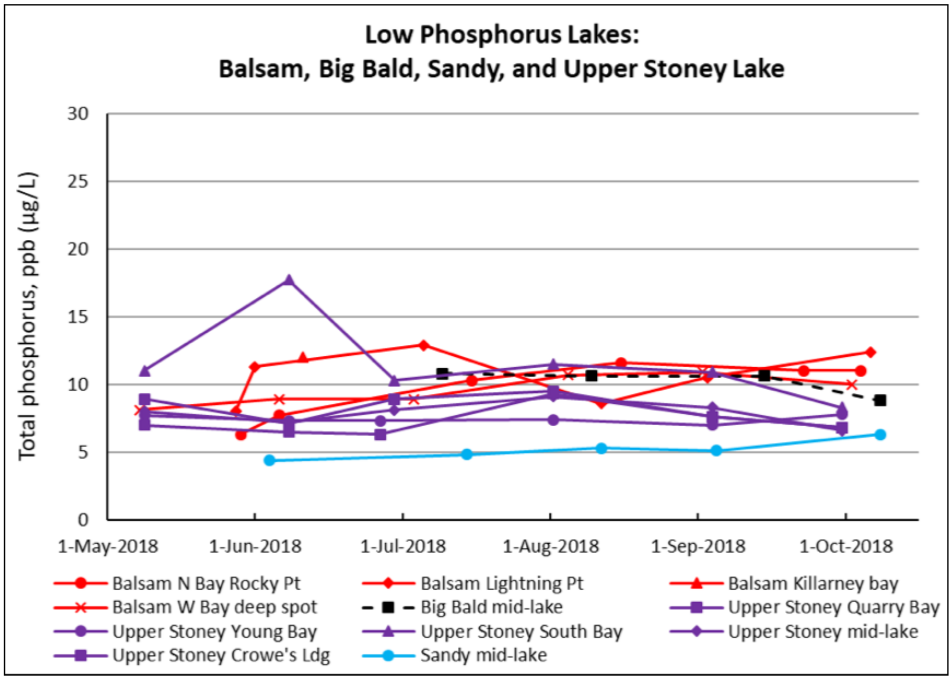
For most Kawartha lakes, phosphorus levels are low in May due to a spring flush of northern water. TP levels then rise in early June until early August, and fall off somewhat in the fall. In 2018, however, (see below) the rise in phosphorus was delayed about a month; TP levels did not rise at all in June. This was likely due to a very cold April which delayed the northern melt. However, TP levels were only slightly below average for the rest of the year.



Phosphorus Testing 2018

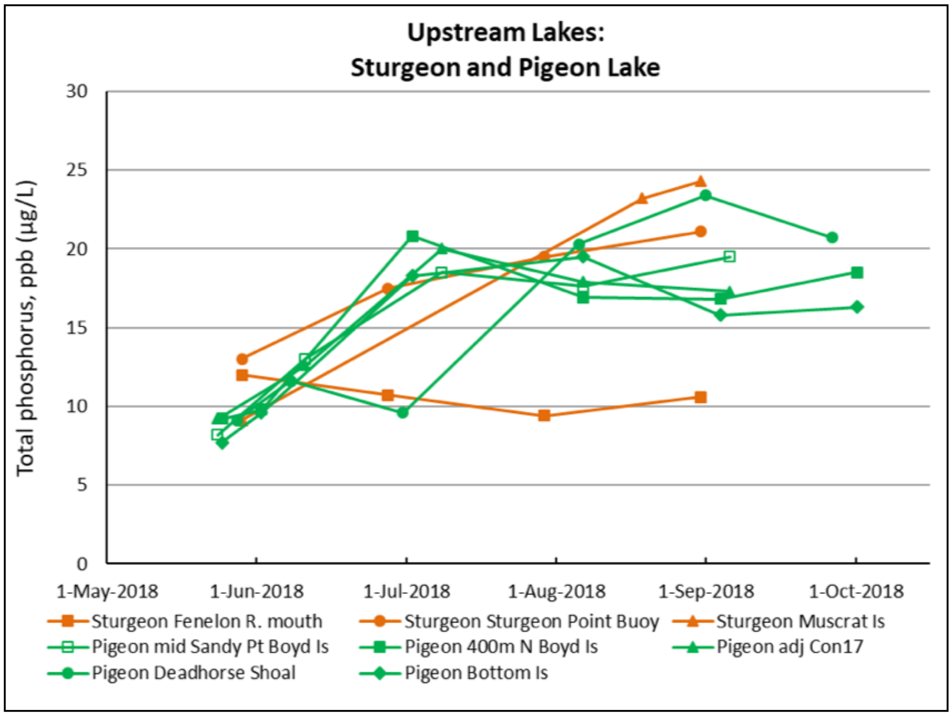
Lake-to-Lake Phosphorus Results

The lake-to-lake phosphorus pattern is very similar in the Kawarthas from year to year. All lakes start the season with low phosphorus levels, due to a large spring flush of water from the north. As the summer goes on, we see that lakes that are fed directly from the north continue to show low phosphorus levels. Lakes further downstream show rising phosphorus levels during June and July, which then level off in August and September.



Low Phosphorus Lakes

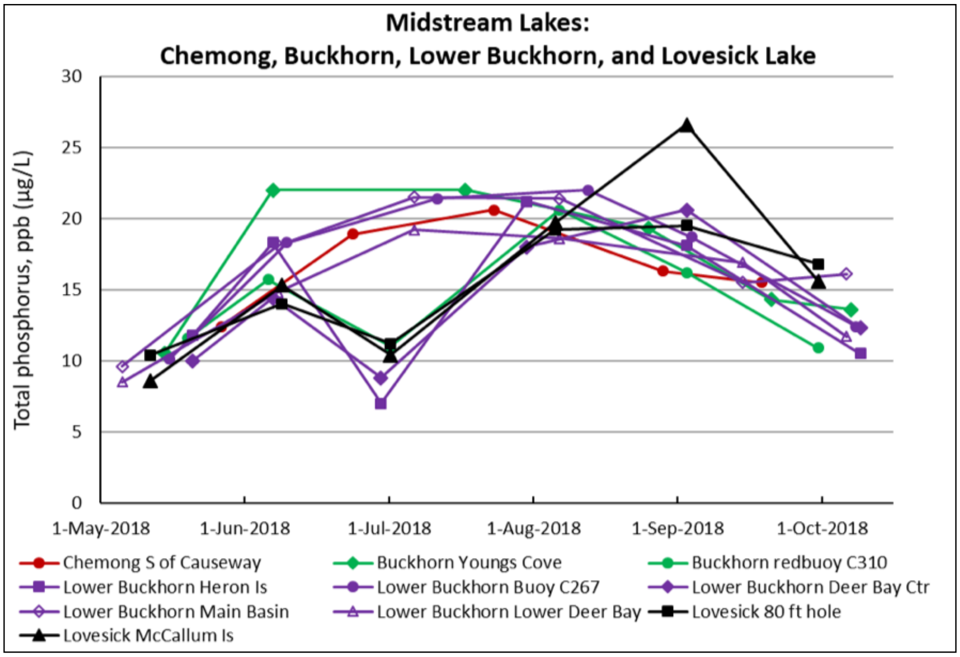
The low-phosphorus lakes have stable TP levels, well below 15 ppb. Balsam, Upper Stoney and Big Bald Lake are fed directly with low-phosphorus water from the north. Sandy Lake is unusual in that its lake phosphorus is precipitated into the sediments during the summer (which incidentally accounts for its attractive turquoise colour). The high reading in early June on Upper Stoney's South Bay was also observed in 2017. South Bay is a 'dead-end' bay, with relatively shallow water, so the chemistry of this 'corner' of lake can be somewhat different from the rest of Upper Stoney Lake.



Upstream Lakes

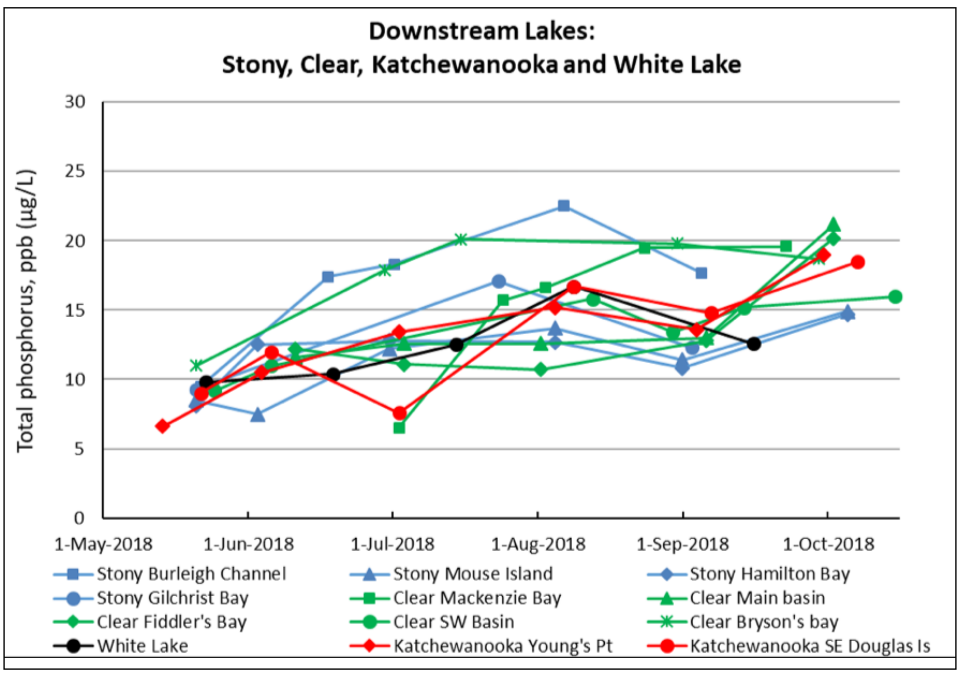
Water quality at the upstream end of Sturgeon Lake (Fenelon R. mouth) is similar to the low-phosphorus lakes. However, as water moves downstream through Sturgeon Lake it mixes with more southern water from Lindsay via the Scugog River, and from surrounding agricultural land. Phosphorus levels rise throughout June and July and then level off.

Phosphorus Testing 2018



Midstream Lakes

The midstream lakes have similar phosphorus levels to the upstream lakes.



Downstream Lakes

As water flows into Stony Lake (Burleigh Channel site) phosphorus levels are similar to those of its upstream neighbour, Lovesick Lake. However, as the water moves through Stony Lake it mixes with low-phosphorus water flowing in from Upper Stoney Lake resulting in lower phosphorus levels (Mouse Island, Hamilton Bay and Gilchrist Bay sites). Levels then remain about the same as water continues flowing through Clear Lake and Katchewanooka Lake.

Summary of 2018

The phosphorus levels were similar to other years, the only difference being that the summer rise in phosphorus started a month late, in early July rather than in early June. This was probably due to a very cold April, resulting in a delayed spring flush.

Appendix A - Mission Statement & Board of Directors

KLSA Mission Statement

The Kawartha Lake Stewards Association (KLSA) was founded to carry out a coordinated, consistent water quality testing program (including bacteria and phosphorus) in lake water in the Kawartha Lakes. KLSA ensures that water quality test results, prepared according to professionally validated protocols with summary analysis, are made available to 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.

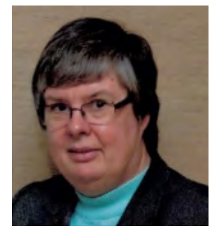
2018 – 2019 Board of Directors

William A. Napier
Chair
Lovesick Lake

Kathleen Mackenzie
Vice-Chair
Stony Lake

Lynn Woodcroft
Secretary
Buckhorn

Mike Stedman
Treasurer
Lakefield



Sheila Gordon-Dillane
Recording Secretary
Pigeon Lake

Jeffrey Chalmers
Director
Clear Lake

Doug Colmer
Director
Big Cedar Lake

Colleen Dempster*
Director
Pigeon Lake

Tracy Logan
Director
Big Bald Lake

Mike Dolbey
Director
Katchewanooka Lake

Tom McAllister
Director
Lower Buckhorn Lake

Shari Paykarimah*
Director
Peterborough

Ed Leerdam**
Director
Trent Lakes

Brett Tregunno***
Director
Omemee

** until October 13, 2018*
*** effective October 13, 2018*
**** effective November 26, 2018*

Appendix A - Scientific Advisors & Volunteer Testers

Scientific Advisors

Dr. Brian Cumming, Professor and Head, Department of Biology; Director, School of Environmental Studies; Co-Director, Paleoecological Environmental Assessment and Research Laboratory (PEARL), Queen's University, Kingston

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

Sara Kelly, Faculty, Ecosystem Management Program, Fleming College, Lindsay

Dr. Eric Sager, Ecological Restoration Program, Fleming College and Trent University, Peterborough

KLSA Volunteer Testers 2018

Balsam Lake - Douglas and Peggy Erlandson, Jim and Kathy Armstrong, Nicole and Shawn Samson, Richard Braniff, Ross Bird

Big Bald Lake - Big Bald Lake Cottagers Association: Rich Corbin, Norm Maia, John and Nancy Boyce, Dave Stanyar

Big Cedar Lake - Big Cedar Lake Stewardship Association: Ralph and Diane Trauzzi

Chemong Lake – Brian and Linda Neck

Clear Lake – Birchcliff Property Owners Association: Jeff Chalmers
Clear Lake - Kawartha Park Cottagers Association: Judy Finch

Katchewanooka Lake – Peter Fischer, Mike Dolbey

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

Lower Buckhorn Lake – Lower Buckhorn Lake Owners Association: Mark and Diane Potter, Dave Thompson, Harry Shuman, Paul Pause, Brian Brady. Paul and Janet Duval

Pigeon Lake – Concession 17 Pigeon Lake Cottagers Association: Donald Morrison, Ruth Russell
Pigeon Lake – North Pigeon Lake Association: Line Pinard, George Brown
Pigeon Lake – Victoria Place: Brenda Ounjian, Bob Johnson

Sandy Lake – Sandy Lake Cottagers Association: The Boysen family, the Streeter family

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

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

Upper Buckhorn Lake - Buckhorn Sands Property Owners Association: Craig, Anastasia, Henry and Lawrence Charlton
Upper Buckhorn Lake - Darrell Darling

Upper Stoney Lake - Upper Stoney Lake Association: Karl Macarthur

White Lake – White Lake Association: Wayne Horner

Appendix B - Financial Partners

Thank You to our 2018 Supporters

FOUNDATIONS AND MUNICIPALITIES

Gold ($5,000+)

Silver ($1,000 - $4,999)
Township of Douro-Dummer

Bronze (less than $1,000)
Township of Selwyn

ASSOCIATION/BUSINESSES/INDIVIDUALS

Gold ($200+)

Agnico Eagle Mines Limited
Ann and John Ambler
Balsam Lake Association
Doug Colmer
Mike Dolbey
Sheila Gordon-Dillane
Happy Days Houseboats
Mary and Jim Keyser
Kathleen and Blair Mackenzie
Patti and Tom McAllister
Lois and Bill Napier
Pinewood Cottages and Trailer Park
Judy and Lou Probst
Donelda and Mike Stedman

Silver ($100 - $199)

Big Cedar Lake Stewardship Association
Birch Bend Cottage Resort
Birch Cliff Property Owners Association
Camp Kawartha
Clearview Cottage Resort
Curve Lake First Nation
Colleen Dempster
Janet and Paul Duval
Egan Marine
Fire Route 44 Cottagers Association
Forest Hill Lodge
Killarney Bay Cedar Point Cottage Association
Lakefield Foodland
Penny and Rob Little
Betsy and Bob Matheson
Ted Oakes
Peterborough Pollinators
Rosedale Marina
Sandy Lake Cottagers Association
Jackie and Murray Shaver
Janet Haslett-Theall and Larry Theall
Cathy and Jeff Webb

Bronze (less than $100)

Mary Auld
Big Bald Lake Cottagers Association
Buckhorn Sands Property Owners Association
Peter Chappell
Marcine DuBois
East Beehive Community Association
Carol and Ralph Ingleton
David MacLellan
Audrey and Tom McCarron
Violet and Daniel McMurdy
Peter Miller
Norma and Alan Walker
Peter Watson

Appendix C - Treasurer's Report

Mike Stedman, KLSA Treasurer

This Treasurer's Report refers to the 2018 calendar year and the Grant Thornton LLP Chartered Accountants Statement of Financial Position summarizing revenue, expenditures and assets for 2017 and 2018. Our thanks to Mr. John West who provided this community service.

2018 revenue of $12,208 is almost identical to the previous year. A 30% increase in business and individual donations is attributed to support for our paleolimnology study.

Our continuing sources of income were:

- Water testing fees $2,660
- Municipal grants $1,215
- Private business/individual donations $7,498
- Association donations $ 835

2018 total expenses of $16,278 included a $7,500 final payment to Queen's University Paleoecological Environmental Assessment and Research Laboratory (PEARL) for the collection, analysis and age-dating of sediment cores.

Reoccurring operating expenses included:

- *E. coli* test costs $2,791
- KLSA insurance $1,743
- KLSA Annual Report $3,845

In terms of total assets, we closed 2018 with a cash balance of $8,837, enough to cover working capital requirements for early 2019 annual report and insurance expenditures.

In February 2018 the final payment for the Paleo Project Queen's involvement of $40,000 was paid. Some donor contributions are not seen in our KLSA accounts because their bylaws require direct payment to Queen's. This project was made possible by significant "project related" financial support from the Stony Lake Heritage Foundation, Kawartha Conservation Authority, the City of Kawartha Lakes Advisory Council and several individual donors.

Notice to Reader

Grant Thornton LLP
362 Queen Street
Peterborough, ON
K9H 3J6

T +1 705 743 5020
F +1 705 743 5081
www.GrantThornton.ca

On the basis of information provided by the organization, we have compiled the statement of financial position of Kawartha Lake Stewards Association as at December 31, 2018 and the statement of operations and changes in net assets for the year then ended.

We have not performed an audit or a review engagement in respect of these financial statements and, accordingly, we express no assurance thereon.

Readers are cautioned that these statements may not be appropriate for their purposes.

Grant Thornton LLP

Peterborough, Canada
February 20, 2019

Chartered Professional Accountants
Licensed Public Accountants

Audit | Tax | Advisory

Kawartha Lake Stewards Association
Statement of Operations and Changes in Net Assets
(Unaudited - see Notice to Reader)

Year ended December 31	2018	2017
Revenues		
Private contributions and donations	$ 7,498	$ 3,856
Water testing fees	2,660	2,705
Municipal grants	1,215	4,450
Associations	835	1,070
Interest income	-	26
	12,208	12,107
Expenditures		
Special projects	7,500	12,500
Annual report costs	3,845	4,313
Water testing fees	2,791	2,640
Insurance	1,743	1,724
Office and administration	373	323
Bank charges	26	47
	16,278	21,547
Excess of expenditures over revenues	(4,070)	(9,440)
Net assets, beginning of year	12,907	22,347
Net assets, end of year	$ 8,837	$ 12,907

See accompanying note to the financial statements.

Kawartha Lake Stewards Association

Note to the Financial Statements

(Unaudited - see Notice to Reader)
December 31, 2018

1. Basis of presentation

The accompanying financial statements relate to the incorporated association registered by Letters Patent as Kawartha Lake 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 Lake 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 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.

Appendix D - Privacy Policy

Lynn Woodcroft, 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 - *E. coli* Test Results

Rationale for *E. coli* Testing and 2018 Lake-by-Lake Results

Kathleen Mackenzie, KLSA Vice-Chair
Tom McAllister, KLSA Director

Providing context for these results

- In Ontario, a public beach is "posted" when the level of *E. coli* in the water exceeds 100 *E. coli* cfu/100mL (colony-forming units/100ml) of water. This means that the water is unsafe for recreational use, including human bathing (swimming).
- KLSA considers counts over 50 cfu/100mL as somewhat high for the Kawartha Lakes, and cause for re-testing where possible.
- Counts of 20 and below, with an occasional reading between 20 and 50, are normal for the Kawartha Lakes.

Choosing sites for the KLSA *E. coli* testing program

The goals of this testing are threefold:

- To see how safe the water was for swimming at these 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 would 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 wildlife (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 and Long-Term Care's Operational Approaches to Recreational Water Quality, 2018.

- 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 or illness, as occurs in occasional ground beef 'scares' which can lead to food poisoning. 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/100 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 - *E. coli* Test Results

What do this year's results tell us?

E. coli readings were, as in other years, predominantly less than 20 cfu/100 mL, with a few readings between 20 and 50, and no readings over the 'safe swimming limit' of 100 cfu/100 mL.

Big Bald Lake - Big Bald Lake Cottagers' Association						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 3	July 18	July 30	August 7	August 13	September 4
1	35	5	2	5	2	1
3	1	3	1	0	2	3
9	6	0	1	1	1	0
10	18	1	1	0	1	8
12	0	2	0	**1**	2	**0**

Counts were consistently low on all 5 sites on Big Bald Lake.

Big Cedar Lake - Big Cedar Lake Stewardship Association					
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 3	July 25	August 5	August 10	August 26
640	0	0	1	1	1

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

Buckhorn Lake - Buckhorn Sands Property Owners Association						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 13	July 23	July 31	August 7	August 13	September 4
7	0	0	0	2	0	0
8	11	2	5	39	0	0
9	2	1	0	1	0	0
10	0	5	3	2	2	1

Counts were low at the four locations tested by Buckhorn Sands.

Clear Lake – Kawartha Park Cottagers Association					
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 13	July 25	August 7	August 24	September 7
A	2	19	11	2	0
B	4	2	0	0	0
C	1	40	0	0	0
D	1	1	3	1	1
P	6	5	0	0	0
W	0	16	11	4	2

***E. coli* counts were consistently low at all six Kawartha Park sites.**

Appendix E - *E. coli* Test Results

Clear Lake – Birchcliff Property Owners Association						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 4	July 23	August 9	August 13	August 23	September 6
2	0	2	0	0	0	0
3	0	3	0	0	0	1
4	0	0	3	1	15	5
5	2	1	10	46	0	48
6	1	0	4	1	0	0
7	1	0	0	2	3	9
8	0	17	0	6	0	**53**
B-B	0	1	3	3	0	4

There was only one count over 50. The Site 8/Sep 6 reading was at a shoal on which birds and turtles congregate. Depending on the wind, wave action and sequence of birds, the count in the past has shown similar temporary spikes.

Katchewanooka Lake – Site 2						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 3	July 23	August 1	August 8	August 13	September 5
2	6	12	6	4	29	2

Counts were consistently low at Site 2 on Katchewanooka Lake.

Katchewanooka Lake – Site 7						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 5	July 23	July 30	Aug 7	August 13	September 4
7	7	9	8	8	2	3

All counts were very low at Site 7.

Lovesick Lake – Lovesick Lake Association						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 3	July 24	July 31	August 7	August 17	September 4
16	4	1	1	0	1	3
18	3	4	2	1	0	0
19	2	0	2	1	0	0

Counts were very low at these three locations on Lovesick Lake.

Lower Buckhorn Lake - Lower Buckhorn Lake Owners Association						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 3	July 25	July 31	August 9	September 3	September 11
2	1	12	7	4	1	2
5	3	28	2	8	1	0
11	0	24	1	2	5	2
13	3	-	2	-	-	-
20	0	29	0	0	0	14

Counts were consistently low on the Lower Buckhorn Lake sites.

Appendix E - *E. coli* Test Results

Pigeon Lake – Concession 17 Pigeon Lake Cottagers Association					
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 9	July 2	August 7	August 20	September 6
A	0	0	4	0	1
B	0	0	1	2	0
3	0	0	1	0	1

Counts were consistently low at all three sites in the Pigeon Lake Concession 17 area.

Pigeon Lake – North Pigeon Lake Association						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 3	July 24	July 30	August 7	August 13	September 4
1A	1	4	0	0	0	0
5A	20	26	43	6	10	9
6	**82**	11	40	53	25	34
8	1	4	1	4	20	0
13	11	8	16	38	33	11

Site 6 has over the years shown more elevated counts than the average Kawartha Lake site (see KLSA's *E. coli* Testing Program: Analysis of results 2001-2017 in the 2017 Annual Report). The high counts would appear to be due to large numbers of geese that congregate on the shorelines in this area.

Pigeon Lake – Victoria Place						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 3	July 23	July 30	August 7	August 13	September 4
1	17	12	2	3	2	1
2	31	13	7	0	0	0
3	3	10	0	1	0	2
4	3	16	9	1	1	1
5	5	18	17	4	0	1

Counts were generally very low on these Victoria Place sites.

Sandy Lake – Sandy Lake Cottagers Association						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 4	July 16	July 30	August 7	August 13	September 4
1	0	0	1	0	0	2
2	0	1	1	0	0	0
3	0	2	0	5	2	5

Counts were extremely low at all three Sandy Lake sites.

Appendix E - *E. coli* Test Results

Stony Lake – Association of Stony Lake Cottagers						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 3	July 23	July 30	August 7	August 13	September 4
E	5	8	31	8	1	4
F	1	6	4	8	6	0
I	2	**59**	6	11	0	18
L	0	0	0	3	0	2
P	0	1	0	1	0	0
PRV28	32	11	1	**68**	26, 6	4

Generally, counts were low on Stony Lake.

The count of 68 at PRV 28/July 23 is similar to occasional elevated counts seen at this site in past years. This is a narrow bay with low circulation and fairly heavy human use on the shoreline.

Site I is very close to an area with lots of geese, and lots of algae indicating still water. This area may have been the source of the high counts at nearby Site I on July 23.

Stony Lake – Association of Stony Lake Cottagers – Site J, K							
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL							
Site	July 3	July 23	July 30	August 7	August 13	August 14	September
J	5	2	3	25	14	-	5
K	4	6	0	0	-	2	1

Counts were low at these two Stony Lake sites.

Upper Stoney Lake – Upper Stoney Lake Association						
2018 *E. coli* Lake Water Testing – *E. coli* cfu/100mL						
Site	July 3	July 24	July 30	August 7	August 13	September 7
6	5	**64**	16	6	18	12
20	5	6	0	3	4	2
21	5	1	1	1	0	1
52	28	5	6	13	7	6
65	1	0	0	12	0	2
70	0	0	0	0	1	0
78A	3	1	1	0	2	0

Upper Stoney Lake counts were typical for a Kawartha Lake – most below 20, with an occasional elevated reading.

Appendix F - Phosphorus Measurements

Total Phosphorus (TP) Measurements

In 2018 volunteers tested 45 sites in 16 Kawartha lakes. Results are listed below. Two TP measurements are in bold type. These were considered outliers, and were not used to calculate the TP average.

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.	29-May-2018	7.00	5.60	6.30
6902	2	BALSAM LAKE	N Bay Rocky Pt.	6-Jun-2018	7.80	7.60	7.70
6902	2	BALSAM LAKE	N Bay Rocky Pt.	16-Jul-2018	10.60	10.00	10.30
6902	2	BALSAM LAKE	N Bay Rocky Pt.	16-Aug-2018	11.40	11.80	11.60
6902	2	BALSAM LAKE	N Bay Rocky Pt.	23-Sep-2018	11.20	10.80	11.00
6902	2	BALSAM LAKE	N Bay Rocky Pt.	5-Oct-2018	10.40	11.60	11.00
6902	2	BALSAM LAKE	N Bay Rocky Pt.	19-Nov-2018	10.60	10.00	10.30
6902	5	BALSAM LAKE	NE end-Lightning Pt	28-May-2018	8.00	8.00	8.00
6902	5	BALSAM LAKE	NE end-Lightning Pt	1-Jun-2018	11.20	11.40	11.30
6902	5	BALSAM LAKE	NE end-Lightning Pt	6-Jul-2018	12.80	13.00	12.90
6902	5	BALSAM LAKE	NE end-Lightning Pt	12-Aug-2018	8.80	8.40	8.60
6902	5	BALSAM LAKE	NE end-Lightning Pt	3-Sep-2018	8.80	12.20	10.50
6902	5	BALSAM LAKE	NE end-Lightning Pt	7-Oct-2018	9.80	15.00	12.40
6902	7	BALSAM LAKE	South B-Killarney B	11-Jun-2018	12.00	12.00	12.00
6902	8	BALSAM LAKE	W Bay2, deep spot	8-May-2018	8.20	8.00	8.10
6902	8	BALSAM LAKE	W Bay2, deep spot	6-Jun-2018	9.00	8.80	8.90
6902	8	BALSAM LAKE	W Bay2, deep spot	4-Jul-2018	8.40	9.40	8.90
6902	8	BALSAM LAKE	W Bay2, deep spot	5-Aug-2018	10.60	10.80	10.70
6902	8	BALSAM LAKE	W Bay2, deep spot	2-Sep-2018	10.80	11.00	10.90
6902	8	BALSAM LAKE	W Bay2, deep spot	3-Oct-2018	10.00	10.00	10.00
6941	1	BIG BALD LAKE	Mid Lake, deep spot	10-Jul-2018	10.40	11.20	10.80
6941	1	BIG BALD LAKE	Mid Lake, deep spot	10-Aug-2018	10.80	10.40	10.60
6941	1	BIG BALD LAKE	Mid Lake, deep spot	15-Sep-2018	11.00	10.20	10.60
6941	1	BIG BALD LAKE	Mid Lake, deep spot	9-Oct-2018	9.00	8.60	8.80
6941	2	BIG BALD LAKE	Bay nr golf course	9-Jun-2018	11.60	11.60	11.60
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	6-May-2018	5.80	6.40	6.10
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	20-May-2018	11.80	11.40	11.60
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	6-Jun-2018	15.80	15.60	15.70
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	2-Jul-2018	11.00		11.00
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	7-Aug-2018	21.00	20.20	20.60
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	3-Sep-2018	15.60	16.80	16.20
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	1-Oct-2018	9.00	12.80	10.90
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	15-May-2018	11.00	10.00	10.50
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	7-Jun-2018	22.00	22.00	22.00
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	18-Jul-2018	22.20	21.80	22.00
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	26-Aug-2018	20.00	18.60	19.30
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	21-Sep-2018	14.40	14.20	14.30

Appendix F - Phosphorus Measurements

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	8-Oct-2018	13.20	14.00	13.60
6951	9	CHEMONG LAKE	S. of Causeway	27-May-2018	12.60	12.20	12.40
6951	9	CHEMONG LAKE	S. of Causeway	24-Jun-2018	18.60	19.20	18.90
6951	9	CHEMONG LAKE	S. of Causeway	24-Jul-2018	20.80	20.40	20.60
6951	9	CHEMONG LAKE	S. of Causeway	29-Aug-2018	15.80	16.80	16.30
6951	9	CHEMONG LAKE	S. of Causeway	19-Sep-2018	15.60	15.40	15.50
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	8-May-2018	12.80	16.40	14.60
6955	1	CLEAR LAKE	MacKenzie Bay	3-Jul-2018	7.00	6.00	6.50
6955	1	CLEAR LAKE	MacKenzie Bay	25-Jul-2018	15.60	15.80	15.70
6955	1	CLEAR LAKE	MacKenzie Bay	3-Aug-2018	15.80	17.40	16.60
6955	1	CLEAR LAKE	MacKenzie Bay	24-Aug-2018	19.40	19.60	19.50
6955	1	CLEAR LAKE	MacKenzie Bay	23-Sep-2018	19.40	19.80	19.60
6955	2	CLEAR LAKE	Main Basin-deep spot	11-Jun-2018	11.20	12.00	11.60
6955	2	CLEAR LAKE	Main Basin-deep spot	4-Jul-2018	12.80	12.40	12.60
6955	2	CLEAR LAKE	Main Basin-deep spot	2-Aug-2018	12.60	12.60	12.60
6955	2	CLEAR LAKE	Main Basin-deep spot	6-Sep-2018	13.20	12.80	13.00
6955	2	CLEAR LAKE	Main Basin-deep spot	3-Oct-2018	20.00	22.40	21.20
6955	3	CLEAR LAKE	Fiddlers Bay	11-Jun-2018	12.00	12.40	12.20
6955	3	CLEAR LAKE	Fiddlers Bay	4-Jul-2018	11.00	11.20	11.10
6955	3	CLEAR LAKE	Fiddlers Bay	2-Aug-2018	10.60	10.80	10.70
6955	3	CLEAR LAKE	Fiddlers Bay	6-Sep-2018	13.20	12.40	12.80
6955	3	CLEAR LAKE	Fiddlers Bay	3-Oct-2018	21.40	19.00	20.20
6955	4	CLEAR LAKE	Brysons Bay	21-May-2018	10.80	11.20	11.00
6955	4	CLEAR LAKE	Brysons Bay	30-Jun-2018	17.40	18.40	17.90
6955	4	CLEAR LAKE	Brysons Bay	16-Jul-2018	20.60	19.60	20.10
6955	4	CLEAR LAKE	Brysons Bay	31-Aug-2018	19.80	19.80	19.80
6955	4	CLEAR LAKE	Brysons Bay	30-Sep-2018	18.40	19.00	18.70
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	25-May-2018	8.20	10.20	9.20
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	6-Jun-2018	11.20	10.80	11.00
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	13-Aug-2018	16.60	15.00	15.80
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	30-Aug-2018	13.40	13.40	13.40
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	14-Sep-2018	15.00	15.40	15.20
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	16-Oct-2018	14.80	17.20	16.00
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	19-Jun-2018	7.20	8.00	7.60
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	30-Jul-2018	7.40	7.60	7.50
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	30-Aug-2018	5.00	7.80	6.40
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	27-Sep-2018	5.00	5.20	5.10
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	22-Oct-2018	5.20	7.40	6.30
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	22-May-2018	9.00	9.00	9.00
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	6-Jun-2018	13.80	10.20	12.00
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	3-Jul-2018	7.60		7.60
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	9-Aug-2018	16.20	17.20	16.70
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	7-Sep-2018	15.00	14.60	14.80

Appendix F - Phosphorus Measurements

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	8-Oct-2018	19.20	17.80	18.50
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	14-May-2018	6.80	6.40	6.60
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	4-Jun-2018	9.80	11.20	10.50
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	3-Jul-2018	13.80	13.00	13.40
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	5-Aug-2018	15.40	15.00	15.20
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	4-Sep-2018	12.60	14.60	13.60
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	1-Oct-2018	18.60	19.40	19.00
7076	3	KATCHEWANOOKA LAKE	S. End adjacent to LCS	20-Jun-2018	15.20	15.80	15.50
7087	1	LOVESICK LAKE	80' hole at N. end	12-May-2018	11.60	9.20	10.40
7087	1	LOVESICK LAKE	80' hole at N. end	9-Jun-2018	14.20	13.80	14.00
7087	1	LOVESICK LAKE	80' hole at N. end	2-Jul-2018	11.20		11.20
7087	1	LOVESICK LAKE	80' hole at N. end	6-Aug-2018	19.20	19.20	19.20
7087	1	LOVESICK LAKE	80' hole at N. end	3-Sep-2018	19.00	20.00	19.50
7087	1	LOVESICK LAKE	80' hole at N. end	1-Oct-2018	16.00	17.60	16.80
7087	3	LOVESICK LAKE	McCallum Island	12-May-2018	8.60	**33.00**	8.60
7087	3	LOVESICK LAKE	McCallum Island	9-Jun-2018	15.40	15.20	15.30
7087	3	LOVESICK LAKE	McCallum Island	2-Jul-2018	10.40		10.40
7087	3	LOVESICK LAKE	McCallum Island	6-Aug-2018	19.60	19.80	19.70
7087	3	LOVESICK LAKE	McCallum Island	3-Sep-2018	26.60	**36.80**	26.60
7087	3	LOVESICK LAKE	McCallum Island	1-Oct-2018	15.80	15.40	15.60
6990	1	LOWER BUCKHORN LAKE	Heron Island	21-May-2018	12.40	11.20	11.80
6990	1	LOWER BUCKHORN LAKE	Heron Island	7-Jun-2018	17.40	19.20	18.30
6990	1	LOWER BUCKHORN LAKE	Heron Island	30-Jun-2018	7.00		7.00
6990	1	LOWER BUCKHORN LAKE	Heron Island	31-Jul-2018	20.80	21.60	21.20
6990	1	LOWER BUCKHORN LAKE	Heron Island	3-Sep-2018	18.00	18.20	18.10
6990	1	LOWER BUCKHORN LAKE	Heron Island	10-Oct-2018	10.60	10.40	10.50
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	16-May-2018	9.80	10.40	10.10
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	10-Jun-2018	18.60	18.00	18.30
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	12-Jul-2018	24.40	18.40	21.40
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	13-Aug-2018	22.80	21.20	22.00
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	4-Sep-2018	18.60	18.80	18.70
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	9-Oct-2018	12.80	12.00	12.40
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	21-May-2018	9.60	10.40	10.00
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	7-Jun-2018	14.40	14.40	14.40
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	30-Jun-2018	8.80		8.80
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	31-Jul-2018	18.40	17.60	18.00
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	3-Sep-2018	20.80	20.40	20.60
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	10-Oct-2018	11.80	12.80	12.30
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	6-May-2018	8.40	8.60	8.50
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	8-Jun-2018	14.80	14.80	14.80
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	7-Jul-2018	20.00	18.40	19.20
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	7-Aug-2018	18.80	18.40	18.60
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	15-Sep-2018	17.40	16.40	16.90

Appendix F - Phosphorus Measurements

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	7-Oct-2018	12.20	11.20	11.70
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	6-May-2018	10.40	8.80	9.60
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	8-Jun-2018	18.40	17.80	18.10
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	7-Jul-2018	22.60	20.40	21.50
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	7-Aug-2018	20.60	22.20	21.40
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	15-Sep-2018	16.00	15.00	15.50
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	7-Oct-2018	19.20	13.00	16.10
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	24-May-2018	8.00	8.40	8.20
6919	3	PIGEON LAKE	Middle-Sandy Pt Boyd I	11-Jun-2018	13.40	12.60	13.00
6919	3	PIGEON LAKE	Middle-Sandy Pt Boyd I	9-Jul-2018	18.80	18.20	18.50
6919	3	PIGEON LAKE	Middle-Sandy P tBoyd I	7-Aug-2018	17.60	17.60	17.60
6919	3	PIGEON LAKE	Middle-Sandy Pt Boyd I	6-Sep-2018	19.20	19.80	19.50
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	25-May-2018	9.60	8.80	9.20
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	2-Jun-2018	9.20	10.40	9.80
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	3-Jul-2018	19.00	22.60	20.80
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	7-Aug-2018	16.40	17.40	16.90
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	4-Sep-2018	16.00	17.60	16.80
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	2-Oct-2018	18.60	18.40	18.50
6919	13	PIGEON LAKE	N end-Adjacent Con17	24-May-2018	10.00	8.40	9.20
6919	13	PIGEON LAKE	N end-Adjacent Con17	11-Jun-2018	12.80	12.40	12.60
6919	13	PIGEON LAKE	N end-Adjacent Con17	9-Jul-2018	19.80	20.20	20.00
6919	13	PIGEON LAKE	N end-Adjacent Con17	7-Aug-2018	18.20	17.60	17.90
6919	13	PIGEON LAKE	N end-Adjacent Con17	6-Sep-2018	17.20	17.40	17.30
6919	15	PIGEON LAKE	C340-DeadHorseSho	28-May-2018	9.20	9.00	9.10
6919	15	PIGEON LAKE	C340-Dead Horse Sho	8-Jun-2018	11.60	11.60	11.60
6919	15	PIGEON LAKE	C340-Dead Horse Sho	1-Jul-2018	9.60		9.60
6919	15	PIGEON LAKE	C340-Dead Horse Sho	6-Aug-2018	21.60	19.00	20.30
6919	15	PIGEON LAKE	C340-Dead Horse Sho	1-Sep-2018	24.80	22.00	23.40
6919	15	PIGEON LAKE	C340-Dead Horse Sho	27-Sep-2018	21.40	20.00	20.70
6919	16	PIGEON LAKE	N300yds off Bottom I	25-May-2018	7.40	8.00	7.70
6919	16	PIGEON LAKE	N300yds off Bottom I	2-Jun-2018	9.20	10.00	9.60
6919	16	PIGEON LAKE	N300yds off Bottom I	3-Jul-2018	17.00	19.60	18.30
6919	16	PIGEON LAKE	N300yds off Bottom I	7-Aug-2018	18.40	20.60	19.50
6919	16	PIGEON LAKE	N300yds off Bottom I	4-Sep-2018	16.00	15.60	15.80
6919	16	PIGEON LAKE	N300yds off Bottom I	2-Oct-2018	16.40	16.20	16.30
7241	2	SANDY LAKE	Mid Lake, deep spot	4-Jun-2018	4.40	4.40	4.40
7241	2	SANDY LAKE	Mid Lake, deep spot	15-Jul-2018	4.80	4.80	4.80
7241	2	SANDY LAKE	Mid Lake, deep spot	12-Aug-2018	5.20	5.40	5.30
7241	2	SANDY LAKE	Mid Lake, deep spot	5-Sep-2018	5.20	5.00	5.10
7241	2	SANDY LAKE	Mid Lake, deep spot	9-Oct-2018	6.00	6.60	6.30
7133	4	STONY LAKE	Burleigh locks chan.	22-May-2018	9.60	9.40	9.50
7133	4	STONY LAKE	Burleigh locks chan.	18-Jun-2018	17.60	17.20	17.40
7133	4	STONY LAKE	Burleigh locks chan.	2-Jul-2018	17.20	19.40	18.30

Appendix F - Phosphorus Measurements

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
7133	4	STONY LAKE	Burleigh locks chan.	7-Aug-2018	23.00	22.00	22.50
7133	4	STONY LAKE	Burleigh locks chan.	5-Sep-2018	17.20	18.20	17.70
7133	6	STONY LAKE	Gilchrist Bay	21-May-2018	9.40	9.20	9.30
7133	6	STONY LAKE	Gilchrist Bay	24-Jul-2018	17.20	17.00	17.10
7133	6	STONY LAKE	Gilchrist Bay	3-Sep-2018	12.60	12.00	12.30
7133	7	STONY LAKE	Mouse Is.	21-May-2018	8.40	8.60	8.50
7133	7	STONY LAKE	Mouse Is.	3-Jun-2018	7.80	7.20	7.50
7133	7	STONY LAKE	Mouse Is.	1-Jul-2018	12.20	12.20	12.20
7133	7	STONY LAKE	Mouse Is.	5-Aug-2018	13.20	14.20	13.70
7133	7	STONY LAKE	Mouse Is.	1-Sep-2018	11.40	11.40	11.40
7133	7	STONY LAKE	Mouse Is.	6-Oct-2018	15.80	14.00	14.90
7133	8	STONY LAKE	Hamilton Bay	21-May-2018	8.20	8.00	8.10
7133	8	STONY LAKE	Hamilton Bay	3-Jun-2018	11.80	13.20	12.50
7133	8	STONY LAKE	Hamilton Bay	1-Jul-2018	12.60	13.00	12.80
7133	8	STONY LAKE	Hamilton Bay	5-Aug-2018	12.40	13.00	12.70
7133	8	STONY LAKE	Hamilton Bay	1-Sep-2018	11.00	10.60	10.80
7133	8	STONY LAKE	Hamilton Bay	6-Oct-2018	14.00	15.40	14.70
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	29-May-2018	9.00	9.20	9.10
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	19-Aug-2018	24.00	22.40	23.20
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	31-Aug-2018	24.60	24.00	24.30
6924	5	STURGEON LAKE	Sturgeon Point Buoy	29-May-2018	13.20	12.80	13.00
6924	5	STURGEON LAKE	Sturgeon Point Buoy	28-Jun-2018	18.00	17.00	17.50
6924	5	STURGEON LAKE	Sturgeon Point Buoy	30-Jul-2018	20.00	19.00	19.50
6924	5	STURGEON LAKE	Sturgeon Point Buoy	31-Aug-2018	21.00	21.20	21.10
6924	9	STURGEON LAKE	Fenelon R. mouth	29-May-2018	11.40	12.60	12.00
6924	9	STURGEON LAKE	Fenelon R. mouth	28-Jun-2018	11.20	10.20	10.70
6924	9	STURGEON LAKE	Fenelon R. mouth	30-Jul-2018	9.20	9.60	9.40
6924	9	STURGEON LAKE	Fenelon R. mouth	31-Aug-2018	11.00	10.20	10.60
5178	1	UPPER STONEY LAKE	Quarry Bay	9-May-2018	7.00	7.00	7.00
5178	1	UPPER STONEY LAKE	Quarry Bay	8-Jun-2018	6.40	6.60	6.50
5178	1	UPPER STONEY LAKE	Quarry Bay	27-Jun-2018	6.20	6.40	6.30
5178	1	UPPER STONEY LAKE	Quarry Bay	2-Aug-2018	9.40	9.20	9.30
5178	1	UPPER STONEY LAKE	Quarry Bay	4-Sep-2018	8.00	7.20	7.60
5178	1	UPPER STONEY LAKE	Quarry Bay	1-Oct-2018	6.80	6.80	6.80
5178	3	UPPER STONEY LAKE	Young's Bay	9-May-2018	8.00	7.40	7.70
5178	3	UPPER STONEY LAKE	Young's Bay	8-Jun-2018	6.60	8.00	7.30
5178	3	UPPER STONEY LAKE	Young's Bay	27-Jun-2018	6.40	8.20	7.30
5178	3	UPPER STONEY LAKE	Young's Bay	2-Aug-2018	7.60	7.20	7.40
5178	3	UPPER STONEY LAKE	Young's Bay	4-Sep-2018	7.20	6.80	7.00
5178	3	UPPER STONEY LAKE	Young's Bay	1-Oct-2018	8.00	7.60	7.80
5178	4	UPPER STONEY LAKE	S Bay, deep spot	9-May-2018	10.60	11.40	11.00
5178	4	UPPER STONEY LAKE	S Bay, deep spot	8-Jun-2018	17.80	17.60	17.70
5178	4	UPPER STONEY LAKE	S Bay, deep spot	30-Jun-2018	10.60	10.00	10.30

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	2-Aug-2018	12.40	10.60	11.50
5178	4	UPPER STONEY LAKE	S Bay, deep spot	4-Sep-2018	10.20	11.60	10.90
5178	4	UPPER STONEY LAKE	S Bay, deep spot	1-Oct-2018	8.20	8.40	8.30
5178	5	UPPER STONEY LAKE	Crowes Landing	9-May-2018	8.20	9.60	8.90
5178	5	UPPER STONEY LAKE	Crowes Landing	8-Jun-2018	7.20	7.00	7.10
5178	5	UPPER STONEY LAKE	Crowes Landing	30-Jun-2018	8.40	9.40	8.90
5178	5	UPPER STONEY LAKE	Crowes Landing	2-Aug-2018	9.00	10.00	9.50
5178	5	UPPER STONEY LAKE	Crowes Landing	4-Sep-2018	7.60	7.60	7.60
5178	5	UPPER STONEY LAKE	Crowes Landing	1-Oct-2018	6.60	7.00	6.80
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	9-May-2018	8.20	7.80	8.00
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	8-Jun-2018	7.20	7.20	7.20
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	30-Jun-2018	8.40	7.80	8.10
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	2-Aug-2018	9.20	9.00	9.10
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	4-Sep-2018	7.80	8.80	8.30
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	1-Oct-2018	6.60	6.60	6.60
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	23-May-2018	10.60	9.00	9.80
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	19-Jun-2018	11.00	9.80	10.40
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	15-Jul-2018	13.40	11.60	12.50
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	9-Aug-2018	16.60	16.80	16.70
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	16-Sep-2018	12.40	12.80	12.60

2018 Secchi Depth Measurements

Named after its inventor, Angelo Secchi, a Secchi disk is a device for measuring water clarity. It is a weighted disc 20 cm in diameter with alternate black and white quadrants. When lowered into a lake, the depth at which the disc can no longer be seen (the black and white quadrants cannot be distinguished) is called the Secchi depth. The deeper the Secchi depth, the clearer the water. Basic water clarity can be affected by the amount of sediment or Dissolved Organic Matter (DOM) that the water contains. Seasonal variation of water clarity is usually related to the amount of algae it contains resulting in spring and fall Secchi depths being greater than mid-summer values. The Lake Partner Program (LPP) asks volunteers to measure the Secchi Depth every two weeks between early May to early October but for practical reasons many sites can only be measured in conjunction with phosphorus sample collection, about six times a year.

STN	Site ID	Lake	Site Description	Date	Secchi Depth (m)
6902	2	BALSAM LAKE	N Bay Rocky Pt.	29-May-2018	9.50
6902	2	BALSAM LAKE	N Bay Rocky Pt.	8-Jun-2018	8.00
6902	2	BALSAM LAKE	N Bay Rocky Pt.	16-Jun-2018	6.50
6902	2	BALSAM LAKE	N Bay Rocky Pt.	6-Jul-2018	5.60
6902	2	BALSAM LAKE	N Bay Rocky Pt.	16-Jul-2018	5.50
6902	2	BALSAM LAKE	N Bay Rocky Pt.	27-Jul-2018	5.00

Appendix F - Secchi Depth Measurements

STN	Site ID	Lake	Site Description	Date	Secchi Depth (m)
6902	2	BALSAM LAKE	N Bay Rocky Pt.	16-Aug-2018	5.00
6902	2	BALSAM LAKE	N Bay Rocky Pt.	11-Sep-2018	5.50
6902	2	BALSAM LAKE	N Bay Rocky Pt.	23-Sep-2018	5.66
6902	2	BALSAM LAKE	N Bay Rocky Pt.	1-Oct-2018	5.00
6902	8	BALSAM LAKE	W Bay2, deep spot	8-May-2018	3.30
6902	8	BALSAM LAKE	W Bay2, deep spot	6-Jun-2018	3.90
6902	8	BALSAM LAKE	W Bay2, deep spot	3-Jul-2018	6.00
6902	8	BALSAM LAKE	W Bay2, deep spot	5-Aug-2018	3.20
6902	8	BALSAM LAKE	W Bay2, deep spot	17-Aug-2018	3.40
6902	8	BALSAM LAKE	W Bay2, deep spot	2-Sep-2018	3.70
6902	8	BALSAM LAKE	W Bay2, deep spot	16-Sep-2018	3.40
6902	8	BALSAM LAKE	W Bay2, deep spot	3-Oct-2018	3.60
6941	2	BIG BALD LAKE	Mid Lake, deep spot	9-Jun-2018	5.90
6941	2	BIG BALD LAKE	Mid Lake, deep spot	10-Jul-2018	5.30
6941	2	BIG BALD LAKE	Mid Lake, deep spot	10-Aug-2018	3.80
6941	2	BIG BALD LAKE	Mid Lake, deep spot	15-Sep-2018	4.40
6941	2	BIG BALD LAKE	Mid Lake, deep spot	10-Oct-2018	5.10
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	20-May-2018	5.20
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	9-Jun-2018	7.60
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	16-Jun-2018	8.00
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	30-Jun-2018	7.10
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	27-Jul-2018	6.30
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	10-Aug-2018	6.20
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	26-Aug-2018	6.70
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	20-May-2018	3.30
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	6-Jun-2018	3.60
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	2-Jul-2018	3.30
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	3-Aug-2018	2.50
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	3-Sep-2018	2.80
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	1-Oct-2018	3.90
6951	9	CHEMONG LAKE	S. of Causeway	24-Jun-2018	2.50
6951	9	CHEMONG LAKE	S. of Causeway	24-Jul-2018	1.50
6951	9	CHEMONG LAKE	S. of Causeway	29-Aug-2018	2.00
6951	9	CHEMONG LAKE	S. of Causeway	18-Sep-2018	2.00
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	8-May-2018	2.70
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	24-May-2018	2.60
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	16-Jun-2018	2.90
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	29-Jun-2018	2.90
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	9-Jul-2018	2.60
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	26-Jul-2018	2.10
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	11-Aug-2018	2.00
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	31-Aug-2018	2.30

Appendix F - Secchi Depth Measurements

STN	Site ID	Lake	Site Description	Date	Secchi Depth (m)
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	13-Sep-2018	2.60
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	26-Sep-2018	2.60
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	8-Oct-2018	3.10
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	18-Oct-2018	3.10
6955	1	CLEAR LAKE	MacKenzie Bay	25-Jul-2018	3.30
6955	1	CLEAR LAKE	MacKenzie Bay	7-Aug-2018	3.35
6955	1	CLEAR LAKE	MacKenzie Bay	24-Aug-2018	2.21
6955	1	CLEAR LAKE	MacKenzie Bay	7-Sep-2018	3.85
6955	1	CLEAR LAKE	MacKenzie Bay	23-Sep-2018	3.59
6955	2	CLEAR LAKE	Main Basin-deep spot	11-Jun-2018	4.15
6955	2	CLEAR LAKE	Main Basin-deep spot	4-Jul-2018	3.57
6955	2	CLEAR LAKE	Main Basin-deep spot	2-Aug-2018	3.56
6955	2	CLEAR LAKE	Main Basin-deep spot	6-Sep-2018	3.57
6955	2	CLEAR LAKE	Main Basin-deep spot	3-Oct-2018	4.40
6955	3	CLEAR LAKE	Fiddlers Bay	11-Jun-2018	4.05
6955	3	CLEAR LAKE	Fiddlers Bay	4-Jul-2018	3.93
6955	3	CLEAR LAKE	Fiddlers Bay	2-Aug-2018	4.04
6955	3	CLEAR LAKE	Fiddlers Bay	6-Sep-2018	3.87
6955	3	CLEAR LAKE	Fiddlers Bay	3-Oct-2018	4.24
6955	4	CLEAR LAKE	Brysons Bay	30-May-2018	3.00
6955	4	CLEAR LAKE	Brysons Bay	22-Jun-2018	3.10
6955	4	CLEAR LAKE	Brysons Bay	26-Jul-2018	3.20
6955	4	CLEAR LAKE	Brysons Bay	31-Aug-2018	2.90
6955	4	CLEAR LAKE	Brysons Bay	25-Sep-2018	3.10
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	5-May-2018	3.50
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	6-Jun-2018	4.30
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	13-Aug-2018	3.80
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	30-Aug-2018	3.60
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	14-Sep-2018	3.80
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	16-Oct-2018	3.50
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	18-Jun-2018	5.10
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	29-Jul-2018	3.80
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	30-Aug-2018	5.20
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	27-Sep-2018	4.30
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	22-Oct-2018	5.90
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	22-May-2018	5.15
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	6-Jun-2018	6.95
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	3-Jul-2018	4.90
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	9-Aug-2018	4.85
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	7-Sep-2018	5.00
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	8-Oct-2018	5.80
7076	2	KATCHEWANOOKA LAKE	Young’s Pt near locks	4-Jun-2018	5.80

Appendix F - Secchi Depth Measurements

STN	Site ID	Lake	Site Description	Date	Secchi Depth (m)
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	16-Jun-2018	5.30
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	3-Jul-2018	4.20
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	23-Jul-2018	4.40
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	7-Aug-2018	6.00
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	20-Aug-2018	5.50
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	4-Sep-2018	5.80
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	18-Sep-2018	6.00
7076	2	KATCHEWANOOKA LAKE	Young's Pt near locks	3-Oct-2018	6.00
7087	1	LOVESICK LAKE	80' hole at N. end	12-May-2018	5.00
7087	1	LOVESICK LAKE	80' hole at N. end	9-Jun-2018	5.00
7087	1	LOVESICK LAKE	80' hole at N. end	2-Jul-2018	4.00
7087	1	LOVESICK LAKE	80' hole at N. end	6-Aug-2018	5.10
7087	1	LOVESICK LAKE	80' hole at N. end	3-Sep-2018	5.00
7087	1	LOVESICK LAKE	80' hole at N. end	1-Oct-2018	5.00
7087	3	LOVESICK LAKE	McCallum Island	12-May-2018	5.00
7087	3	LOVESICK LAKE	McCallum Island	9-Jun-2018	4.00
7087	3	LOVESICK LAKE	McCallum Island	2-Jul-2018	4.00
7087	3	LOVESICK LAKE	McCallum Island	6-Aug-2018	4.50
7087	3	LOVESICK LAKE	McCallum Island	3-Sep-2018	4.00
7087	3	LOVESICK LAKE	McCallum Island	1-Oct-2018	4.50
6990	1	LOWER BUCKHORN LAKE	Heron Island	21-May-2018	4.90
6990	1	LOWER BUCKHORN LAKE	Heron Island	7-Jun-2018	3.50
6990	1	LOWER BUCKHORN LAKE	Heron Island	30-Jun-2018	3.20
6990	1	LOWER BUCKHORN LAKE	Heron Island	1-Aug-2018	3.40
6990	1	LOWER BUCKHORN LAKE	Heron Island	3-Sep-2018	3.30
6990	1	LOWER BUCKHORN LAKE	Heron Island	10-Oct-2018	6.40
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	21-May-2018	3.90
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	7-Jun-2018	3.60
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	30-Jun-2018	3.20
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	1-Aug-2018	3.10
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	3-Sep-2018	2.90
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	10-Oct-2018	6.20
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	6-May-2018	2.00
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	8-Jun-2018	1.90
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	7-Jul-2018	2.00
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	7-Aug-2018	1.90
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	15-Sep-2018	1.90
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	7-Oct-2018	1.70
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	6-May-2018	2.90
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	8-Jun-2018	2.80
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	7-Jul-2018	2.50
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	7-Aug-2018	2.80

Appendix F - Secchi Depth Measurements

STN	Site ID	Lake	Site Description	Date	Secchi Depth (m)
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	15-Sep-2018	2.60
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	7-Oct-2018	2.40
7241	2	SANDY LAKE	Main basin, deep- spot	4-Jun-2018	5.30
7241	2	SANDY LAKE	Main basin, deep- spot	25-Jun-2018	6.70
7241	2	SANDY LAKE	Main basin, deep- spot	15-Jul-2018	4.20
7241	2	SANDY LAKE	Main basin, deep- spot	12-Aug-2018	3.80
7241	2	SANDY LAKE	Main basin, deep- spot	5-Sep-2018	3.50
7241	2	SANDY LAKE	Main basin, deep- spot	9-Oct-2018	3.30
7133	6	STONY LAKE	Gilchrist Bay	21-May-2018	3.25
7133	6	STONY LAKE	Gilchrist Bay	24-Jul-2018	3.00
7133	6	STONY LAKE	Gilchrist Bay	3-Sep-2018	3.75
7133	7	STONY LAKE	Mouse Is.	21-May-2018	4.10
7133	7	STONY LAKE	Mouse Is.	3-Jun-2018	4.60
7133	7	STONY LAKE	Mouse Is.	1-Jul-2018	4.60
7133	7	STONY LAKE	Mouse Is.	5-Aug-2018	4.90
7133	7	STONY LAKE	Mouse Is.	1-Sep-2018	4.45
7133	7	STONY LAKE	Mouse Is.	6-Oct-2018	5.80
7133	8	STONY LAKE	Hamilton Bay	21-May-2018	4.10
7133	8	STONY LAKE	Hamilton Bay	3-Jun-2018	4.10
7133	8	STONY LAKE	Hamilton Bay	1-Jul-2018	4.10
7133	8	STONY LAKE	Hamilton Bay	5-Aug-2018	4.10
7133	8	STONY LAKE	Hamilton Bay	1-Sep-2018	4.10
7133	8	STONY LAKE	Hamilton Bay	6-Oct-2018	4.10
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	30-May-2018	4.30
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	18-Aug-2018	1.50
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	4-Sep-2018	2.10
6924	5	STURGEON LAKE	Sturgeon Point Buoy	29-May-2018	2.30
6924	5	STURGEON LAKE	Sturgeon Point Buoy	28-Jun-2018	2.90
6924	5	STURGEON LAKE	Sturgeon Point Buoy	12-Jul-2018	3.00
6924	5	STURGEON LAKE	Sturgeon Point Buoy	30-Jul-2018	2.80
6924	5	STURGEON LAKE	Sturgeon Point Buoy	17-Aug-2018	2.80
6924	5	STURGEON LAKE	Sturgeon Point Buoy	30-Aug-2018	2.30
6924	5	STURGEON LAKE	Sturgeon Point Buoy	10-Sep-2018	2.10
6924	9	STURGEON LAKE	Fenelon R. mouth	29-May-2018	2.80
6924	9	STURGEON LAKE	Fenelon R. mouth	28-Jun-2018	3.00
6924	9	STURGEON LAKE	Fenelon R. mouth	12-Jul-2018	3.20
6924	9	STURGEON LAKE	Fenelon R. mouth	30-Jul-2018	3.80
6924	9	STURGEON LAKE	Fenelon R. mouth	17-Aug-2018	3.60
6924	9	STURGEON LAKE	Fenelon R. mouth	10-Sep-2018	3.60
5178	3	UPPER STONEY LAKE	Young’s Bay	8-May-2018	4.20
5178	3	UPPER STONEY LAKE	Young’s Bay	6-Jun-2018	3.10
5178	3	UPPER STONEY LAKE	Young’s Bay	3-Jul-2018	3.40

Appendix F - Secchi Depth & Calcium Measurements

STN	Site ID	Lake	Site Description	Date	Secchi Depth (m)
5178	3	UPPER STONEY LAKE	Young's Bay	7-Aug-2018	5.10
5178	3	UPPER STONEY LAKE	Young's Bay	4-Sep-2018	3.50
5178	3	UPPER STONEY LAKE	Young's Bay	1-Oct-2018	7.40
5178	5	UPPER STONEY LAKE	Crowes Landing	8-May-2018	4.40
5178	5	UPPER STONEY LAKE	Crowes Landing	6-Jun-2018	6.20
5178	5	UPPER STONEY LAKE	Crowes Landing	3-Jul-2018	6.30
5178	5	UPPER STONEY LAKE	Crowes Landing	7-Aug-2018	4.90
5178	5	UPPER STONEY LAKE	Crowes Landing	4-Sep-2018	6.30
5178	5	UPPER STONEY LAKE	Crowes Landing	1-Oct-2018	6.30
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	8-May-2018	4.40
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	6-Jun-2018	6.10
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	3-Jul-2018	6.30
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	7-Aug-2018	5.00
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	4-Sep-2018	4.90
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	1-Oct-2018	6.20
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	23-May-2018	5.30
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	18-Jun-2018	4.70
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	15-Jul-2018	4.50
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	9-Aug-2018	4.00
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	8-Sep-2018	4.60
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	11-Oct-2018	5.10

2018 Calcium Measurements

Calcium is a nutrient that is required by all living organisms. Aquatic species from zooplankton to crayfish depend on extracting calcium from lake water in order to grow. Levels of calcium below 2.5 mg/L can threaten the survival of many aquatic species. Calcium in lake water is derived from mineral weathering of rocks and atmospheric deposition of calcium-rich dust. Many Ontario lakes on the Precambrian Shield have been found to have very low calcium levels believed to be due to the low rate of weathering of hard, low calcium content rocks and the removal of calcium from the watershed by forest harvesting. As a result, since 2008 the Lake Partner Program (LPP) has been measuring the calcium concentration of lake water samples for all lakes tested for Total Phosphorus. As shown in the table below, the Kawartha Lakes do not have a calcium deficiency. The limestone bedrock and calcareous soils to the south of the lakes provide more than enough calcium to sustain the aquatic life in our lakes.

STN	Site ID	Lake	Site Description	Date	Calcium mg/L
6902	2	BALSAM LAKE	N Bay Rocky Pt.	29-May-2018	22.70
6902	2	BALSAM LAKE	N Bay Rocky Pt.	6-Jun-2018	20.30
6902	2	BALSAM LAKE	N Bay Rocky Pt.	16-Jul-2018	20.50
6902	5	BALSAM LAKE	NE end-Lightning Pt	28-May-2018	13.50
6902	5	BALSAM LAKE	NE end-Lightning Pt	1-Jun-2018	12.90
6902	5	BALSAM LAKE	NE end-Lightning Pt	6-Jul-2018	9.02

Appendix F - Calcium Measurements

STN	Site ID	Lake	Site Description	Date	Calcium mg/L
6902	7	BALSAM LAKE	South B-Killarney B	11-Jun-2018	21.60
6902	8	BALSAM LAKE	W Bay2, deep spot	8-May-2018	20.40
6902	8	BALSAM LAKE	W Bay2, deep spot	6-Jun-2018	21.50
6902	8	BALSAM LAKE	W Bay2, deep spot	4-Jul-2018	18.40
6941	1	BIG BALD LAKE	Mid Lake, deep spot	10-Jul-2018	34.60
6941	2	BIG BALD LAKE	Bay nr golf course	9-Jun-2018	39.10
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	6-May-2018	27.70
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	20-May-2018	39.80
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	6-Jun-2018	35.00
7131	1	BUCKHORN LAKE (U)	Narrows-red buoy C310	2-Jul-2018	30.90
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	15-May-2018	38.80
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	7-Jun-2018	34.10
6951	9	CHEMONG LAKE	Young's Cove, Deep Spot	27-May-2018	49.60
6951	9	CHEMONG LAKE	Young's Cove, Deep Spot	24-Jun-2018	39.90
6951	10	CHEMONG LAKE	Deep Spot, N. of Bridgenorth	8-May-2018	45.10
6955	2	CLEAR LAKE	Main Basin-deep spot	11-Jun-2018	34.20
6955	2	CLEAR LAKE	Main Basin-deep spot	4-Jul-2018	30.90
6955	2	CLEAR LAKE	Main Basin-deep spot	4-Jul-2018	32.00
6955	3	CLEAR LAKE	Fiddlers Bay	11-Jun-2018	34.30
6955	4	CLEAR LAKE	Brysons Bay	21-May-2018	37.10
6955	4	CLEAR LAKE	Brysons Bay	3-Jul-2018	29.70
6955	4	CLEAR LAKE	Brysons Bay	16-Jul-2018	32.60
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	25-May-2018	36.60
6955	5	CLEAR LAKE	Southwest Basin, Deep Spot	6-Jun-2018	37.10
7075	2	JULIAN LAKE	Mid Lake, Deep Spot	19-Jun-2018	48.00
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	22-May-2018	37.90
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	6-Jun-2018	35.30
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	3-Jul-2018	35.10
7076	2	KATCHEWANOOKA LAKE	Young’s Pt near locks	14-May-2018	35.20
7076	2	KATCHEWANOOKA LAKE	Young’s Pt near locks	4-Jun-2018	37.40
7076	2	KATCHEWANOOKA LAKE	Young’s Pt near locks	3-Jul-2018	33.20
7076	3	KATCHEWANOOKA LAKE	S. End adjacent to LCS	20-Jun-2018	32.60
7087	1	LOVESICK LAKE	80' hole at N. end	9-Jun-2018	35.50
7087	1	LOVESICK LAKE	80' hole at N. end	2-Jul-2018	31.50
7087	3	LOVESICK LAKE	McCallum Island	9-Jun-2018	36.10
7087	3	LOVESICK LAKE	McCallum Island	2-Jul-2018	36.20
6990	1	LOWER BUCKHORN LAKE	Heron Island	21-May-2018	37.60
6990	1	LOWER BUCKHORN LAKE	Heron Island	7-Jun-2018	34.70
6990	1	LOWER BUCKHORN LAKE	Heron Island	30-Jun-2018	33.40
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	16-May-2018	36.20
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	10-Jun-2018	34.10
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	12-Jul-2018	29.40

Appendix F - Calcium Measurements

STN	Site ID	Lake	Site Description	Date	Calcium mg/L
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	21-May-2018	37.10
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	7-Jun-2018	36.20
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	30-Jun-2018	41.80
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	6-May-2018	33.90
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	8-Jun-2018	10.70
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	7-Jul-2018	28.10
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	6-May-2018	28.00
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	8-Jun-2018	31.90
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	7-Jul-2018	23.90
6919	3	PIGEON LAKE	Middle-Sandy Pt Boyd I	24-May-2018	32.80
6919	3	PIGEON LAKE	Middle-Sandy Pt Boyd I	11-Jun-2018	30.10
6919	3	PIGEON LAKE	Middle-Sandy Pt Boyd I	9-Jul-2018	28.50
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	25-May-2018	30.40
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	2-Jun-2018	33.50
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	3-Jul-2018	31.60
6919	13	PIGEON LAKE	N end-Adjacent Con17	24-May-2018	31.90
6919	13	PIGEON LAKE	N end-Adjacent Con17	11-Jun-2018	30.90
6919	13	PIGEON LAKE	N end-Adjacent Con17	9-Jul-2018	29.00
6919	15	PIGEON LAKE	C340-DeadHorseShoal	28-May-2018	33.80
6919	15	PIGEON LAKE	C340-DeadHorseShoal	8-Jun-2018	30.60
6919	15	PIGEON LAKE	C340-DeadHorseShoal	1-Jul-2018	29.60
6919	16	PIGEON LAKE	N300 yds off Bottom I	2-Jun-2018	33.40
6919	16	PIGEON LAKE	N300 yds off Bottom I	3-Jul-2018	30.80
7241	2	SANDY LAKE	Mid Lake, deep spot	4-Jun-2018	49.20
7241	2	SANDY LAKE	Mid Lake, deep spot	25-Jun-2018	40.90
7241	2	SANDY LAKE	Mid Lake, deep spot	15-Jul-2018	42.30
7133	4	STONY LAKE	Burleigh locks chan.	22-May-2018	37.30
7133	4	STONY LAKE	Burleigh locks chan.	18-Jun-2018	32.30
7133	4	STONY LAKE	Burleigh locks chan.	2-Jul-2018	30.60
7133	6	STONY LAKE	Gilchrist Bay	21-May-2018	36.70
7133	7	STONY LAKE	Mouse Is.	21-May-2018	36.30
7133	7	STONY LAKE	Mouse Is.	3-Jun-2018	33.10
7133	7	STONY LAKE	Mouse Is.	1-Jul-2018	31.90
7133	8	STONY LAKE	Hamilton Bay	21-May-2018	35.30
7133	8	STONY LAKE	Hamilton Bay	3-Jun-2018	34.40
7133	8	STONY LAKE	Hamilton Bay	1-Jul-2018	32.20
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	29-May-2018	28.10
6924	5	STURGEON LAKE	Sturgeon Point Buoy	29-May-2018	26.70
6924	5	STURGEON LAKE	Sturgeon Point Buoy	28-Jun-2018	25.20
6924	9	STURGEON LAKE	Fenelon R. mouth	29-May-2018	22.10
6924	9	STURGEON LAKE	Fenelon R. mouth	28-Jun-2018	19.50
5178	1	UPPER STONEY LAKE	Quarry Bay	9-May-2018	25.70

Appendix F - Calcium Measurements

STN	Site ID	Lake	Site Description	Date	Calcium mg/L
5178	1	UPPER STONEY LAKE	Quarry Bay	8-Jun-2018	25.50
5178	1	UPPER STONEY LAKE	Quarry Bay	27-Jun-2018	27.00
5178	3	UPPER STONEY LAKE	Young's Bay	9-May-2018	24.60
5178	3	UPPER STONEY LAKE	Young's Bay	8-Jun-2018	26.10
5178	3	UPPER STONEY LAKE	Young's Bay	27-Jun-2018	26.20
5178	4	UPPER STONEY LAKE	S Bay, deep spot	9-May-2018	27.80
5178	4	UPPER STONEY LAKE	S Bay, deep spot	8-Jun-2018	26.70
5178	4	UPPER STONEY LAKE	S Bay, deep spot	30-Jun-2018	29.00
5178	5	UPPER STONEY LAKE	Crowes Landing	9-May-2018	24.20
5178	5	UPPER STONEY LAKE	Crowes Landing	8-Jun-2018	26.20
5178	5	UPPER STONEY LAKE	Crowes Landing	30-Jun-2018	26.30
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	9-May-2018	24.10
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	8-Jun-2018	25.40
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	30-Jun-2018	26.30
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	23-May-2018	37.10
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	19-Jun-2018	34.60

Pigeon Lake Sunset **Photo: Simone Goulet**

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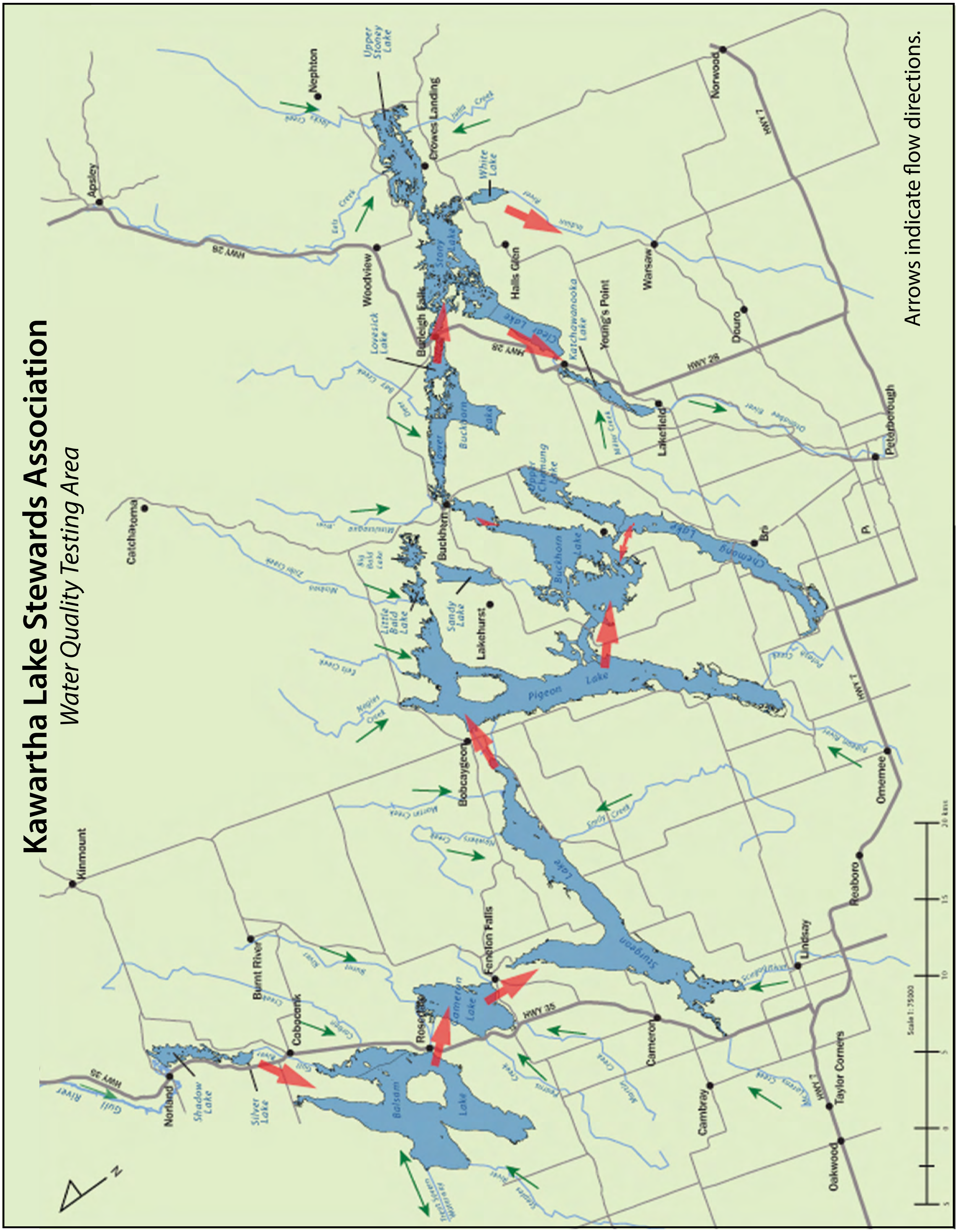
Map of Testing Area



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