KLSA

Kawartha Lake Stewards Association

2022 Annual Lake Water Quality Report

Learning From Our Lakes

MAY 2023

LEARNING FROM OUR LAKES

The Kawartha Lake Stewards Association (KLSA) is a volunteer-driven, non-profit organization of cottagers and year-round residents in the Kawartha Lakes region. The Association's programs include the testing of lake water for phosphorus, clarity, calcium 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 twelve member Board of Directors. A list of the members of the Board is provided in Appendix A.

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

Kawartha Lake Stewards Association
264 Bass Lake Road, Trent Lakes ON K0M 1A0
Email: **klsa@klsa.info**

You can view Adobe pdf versions of KLSA reports on the KLSA website: **klsa.wordpress.com.**

Cover photo: Fishing Friends
Photo credit: Martha Hunt, Stoney Lake

Graphic Design by Danielle Shaw (Gull's Graphic Design)

Mission Statement

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

Editorial Committee:

Chair: Sheila Gordon-Dillane
Members: Carol Cole, L'Anne Greene, Tom McAllister, Jacqui Milne, Kimberly Ong and Carolyn Sutton

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KLSA

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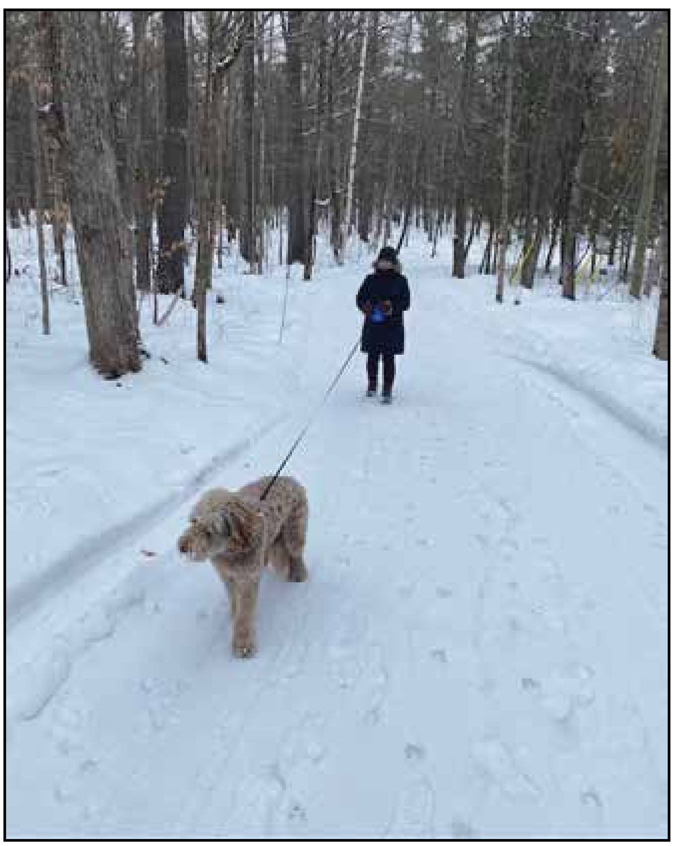
Chair's Message

Bob Bailey, *KLSA Chair*

Summer's long days on the water and warm evenings watching the sunset seem a very long way off as I write this on a frigid February morning. Luckily, Chris and I (and Oscar!) enjoy the winter and are close enough to our place at Lower Buckhorn Lake to occasionally get there for a walk or a ski.

Of course, more and more of our Kawartha Lakes neighbours are year-round residents, including several Indigenous communities. The Kawartha Lake Stewards Association (KLSA) brings together all who care about the health of our lakes and rivers with volunteers who engage in community science and other programs that will help sustain and enhance the Kawartha Lakes for generations to come. And we don't do this alone… in virtually all of our projects and programs KLSA works with many academic researchers and scientists at local, provincial and federal government and non-governmental agencies. This 2022 Annual Lake Water Quality Report, *Learning From Our Lakes,* includes the results of several programs conducted or supported by KLSA.



Lower Buckhorn Lake in winter. **Photo by Robert Bailey**

KLSA had another very active year in 2022, with a virtual Spring Meeting that included a great presentation and discussion on **Community Science** from partners Erin Smith at Ontario Tech University and Tanner Liang at the Kawartha Conservation Authority. It also featured our first annual report cover photo contest winner, Ann Gronow. This year's winner and the runners-up are featured on the cover and elsewhere in this report. In October, we had our first in-person Annual General Meeting since 2019, with more than 30 people in-person and another 30 or so online. We'll continue to use the hybrid model in future public meetings to maximize accessibility for all of our members. The AGM included a great presentation by Professor Sapna Sharma from York University… ***Climate Change is Turning Up the Heat on Lakes.*** Dr. Sharma's talk provoked lots of great discussion in the Q&A afterwards. She also contributed an informative article to this report.

Our management of ***E. coli*** **Water Sampling** continued in 2022, with 383 tests in 15 Kawartha lakes completed. With only 4% of the tests showing elevated values (>50cfu/100mL), things looked pretty good. Many KLSA members participate in the provincial **Lake Partner Program**, and we extract the data from Kawartha lakes for our own analysis and presentation elsewhere in this report. Many of our members are part of our **Aquatic Plant Monitoring Program**. Over the last few years we've been focused on Starry Stonewort and we will continue 'watching' SSW but also keep an eye on other invasive and native species. Our **Climate Change in Kawartha Lakes Program,** which monitors lake water temperature and dissolved oxygen in several of our lakes, completed Year Two of a three year pilot study in 2022. We will continue the program this year and have started to make plans for a longer term sampling program. We all see climate change is happening, but we also know that to measure its effects on the lake environment requires careful monitoring over the long haul. We also had a very active **Natural Edge Program** in 2022, with several shoreline sites significantly enhanced by planting of native vegetation. We have applied for funding to significantly expand the Natural Edge program in 2023 and beyond. Here's hoping this critical part of our work gets the support it needs. All of these KLSA programs required hundreds of hours of volunteer effort by a truly dedicated group of community members. The health and sustainability of our Kawartha Lakes are in good hands…your

Chair's Message

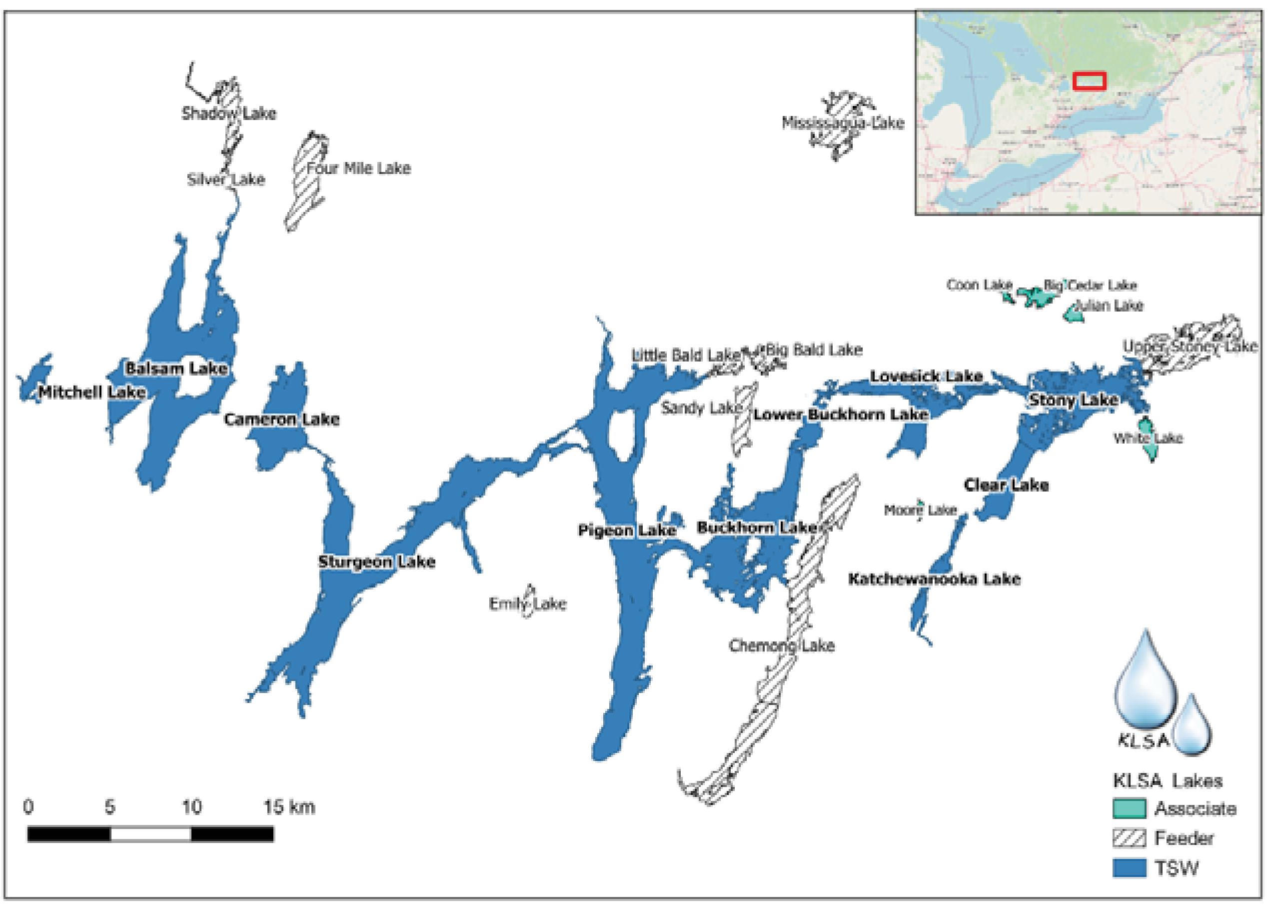
Family fun in the summer. Photo by Robert Bailey

hands.

Any great organization like ours needs both continuity and change to stay strong. This year, we bid a fond farewell to Jeffrey Chalmers and Mike Dolbey from our Board. Both Jeff, a founding member of KLSA, and Mike have served us in many capacities over many years, and both will continue to stay actively involved in KLSA programs as (very!) engaged members. Jacqui Milne completed her first full year as a Board member and L'Anne Greene and Darryl Kotton were elected to the Board at the AGM. Welcome L'Anne and Darryl! After the AGM, I had the honour of being elected your Chair, and the experience and wisdom of Tom McAllister as Vice-Chair and Ed Leerdam as Treasurer have kept me on course. Sheila Gordon-Dillane continues as our ever-efficient and accurate Board Secretary, and continuing Board members Carol Cole, Kimberly Ong, and Brett Tregunno complete a group of people who all work very hard to keep KLSA doing the great work it has done for more than 20 years.

See you at the lake in 2023!

Map of Kawartha Lake Stewards Association lakes



Note – Lake Scugog, south of Sturgeon Lake, not shown.

The Loss of Ice and its Consequences for Lakes Across the Northern Hemisphere

Sapna Sharma, *Department of Biology, York University, Toronto, Ontario, Canada*

Frozen lakes are synonymous with winter across northern countries and for centuries, lake ice has provided a way of life for these communities. Countless Canadian kids have learned how to skate and play hockey on frozen lakes and ponds. Remote communities rely on ice roads for access to food, fuel, and supplies over the long, cold, and dark winter months when air travel is difficult and expensive. Millions of people enjoy ice festivals each winter, ice fishing for recreation or catching fish for food. Frozen lakes even play a prominent role in some religious traditions. Because of our long history with lake ice, many records have been maintained for centuries, even long before the advent of meteorological stations. As lake ice is a sensitive indicator of climate (freshwater requires air temperatures to be below 0°C to freeze), the timing of ice-on and ice-off on lakes across the Northern Hemisphere can teach us about how climate is changing.

One of our longest and most consistent lake ice records is from Lake Suwa in Japan, which began in the 14th century! Shinto priests began recording and celebrating the date that a sinusoidal ice ridge forms on the frozen Lake Suwa, called the *omiwatari*. This was motivated by a belief that the *omiwatari* is formed from the footsteps of the Shinto male god, Takeminakata, when he crosses the frozen lake with his dragon to visit the shrine of the female god, Yasakatome, on the other side of the lake. Over fifteen generations of Shinto priests have recorded the date that Lake Suwa freezes and the *omiwatari* forms. They even used the size and direction of the ice ridge to forecast the agricultural harvest for the upcoming year. In the first 250 years of the ice record, Lake Suwa froze every winter, with the exception of three years. In the 21st century, the lake has only frozen seven times.

Lake Suwa, is one of many lakes losing its ice cover. Lakes across the Northern Hemisphere are freezing later in the winter and thawing earlier in the spring, thus experiencing shorter seasonal ice cover. In fact, in the last 25 years, lakes have been losing their ice cover at rates six times faster than any other time period in the past century. For example, Lake Superior is losing ice at an alarmingly fast rate. Bayfield Bay in Lake Superior has lost 60 days of ice cover, two months of winter, since 1857. Moreover, approximately 15,000 lakes are beginning to experience ice-free winters in recent decades. If the climate continues to warm and greenhouse gas emissions are not mitigated, 215,000 lakes may no longer freeze every winter and almost 5,700 lakes may permanently lose ice cover by the end of this century. Lakes found at lower latitudes or in coastal regions, where winter air temperatures hover around 0°C, are highly vulnerable to losing ice cover. In addition,

Lake ice cover on Lake Wilcox, Ontario

Please be cognizant of ice conditions when out on the lake

The Loss of Ice and its Consequences for Lakes Across the Northern Hemisphere

We have observed an increase in winter drownings through ice in warmer winters

large, deep lakes in cold regions are also sensitive to losing ice cover as these lakes require prolonged cold temperatures to sufficiently cool their waters to allow ice to form.

Ice is a key mediator of the worldwide changes in water quantity and water quality. With more than half of the world's lakes susceptible to freezing (i.e., >50 million lakes) in any given year, even small changes in ice cover could translate to large ecological impacts. Less or no ice cover can substantially increase lake evaporation rates as the physical barrier between the lake surface and atmosphere is removed as the lid of ice is lifted. Increasing lake evaporation rates, changing ratios of evaporation to precipitation, and increased human water use further threaten freshwater availability. Moreover, earlier ice break-up in response to warmer air temperatures can lead to a longer open-water season and warmer summer water temperatures. Longer and warmer summers, in addition to more storm events which deliver more nutrients to the lakes, can result in more algal blooms, some of which may be the bloom-forming, toxin-producing cyanobacteria.

Finally, the loss of ice can portend socioeconomic and cultural loss, some of which may be associated with ecological grief, the sense of loss of place, and even an increased loss of life. With shorter and less reliable ice cover, thinner ice, and the increased formation of poorer quality ice with lower load bearing capacity, we have observed an increase in winter drownings by falling through ice in warmer winters. Northern Indigenous communities who rely on ice for transportation and access to hunting grounds are at the highest risk of winter drownings. The loss of ice also contributes to shorter outdoor ice hockey and skating seasons, the delay in the construction of winter ice roads, and cancellation of skating and ice fishing tournaments, which all also translate into economic loss for local economies. Without climate change mitigation and adaptation, the loss of ice cover will continue to accelerate and impact the health of northern lakes and the people who depend upon them.

KLSA Photography Contest Runners-up

***Water Lily.* Photo by: David Morley, Chandos Lake**

***Juniper Channel.* Photo by: Martha Hunt, Stoney Lake**

Water Temperatures and Dissolved Oxygen Monitoring – 2022 Results

Brett Tregunno, *KLSA Director*

KLSA has been working to increase the profile of climate change and its potential impacts on our lakes. In 2020, with the help of community volunteer samplers, we initiated a pilot program to track water temperatures and dissolved oxygen concentrations in our nearshore and offshore waters. A warming climate is expected to result in warmer water temperatures and lower dissolved oxygen, which could have consequences for life in-and-around our lakes. Volunteers collect data in the shallow nearshore waters along their shoreline (water temperature only, by deploying a small data logger) and in the deeper basin in the middle of the lake (dissolved oxygen and water temperature, with the use of a water quality probe).

Annual Nearshore Water Temperatures

Every year of data collected since 2020 (3 years) adds more information into our annual 'thermograph' – which now includes over 1.1 million water temperature readings at 9 sites (Figure 1).

The thermograph shows that water temperatures change throughout the year in a similar fashion to air temperatures. Beginning in March and through to June our lakes warm rapidly, until they reach their peak in summer (June, July, and August). July and August are periods of relative stability where temperature fluctuates between 18 to 31 ºC and average around 24 ºC. The hottest water temperature so far recorded was 31 ºC (July 10th, 2020, in Lovesick Lake). Beginning in September and through to December, our lakes cool rapidly until they reach a cold stable period over winter.

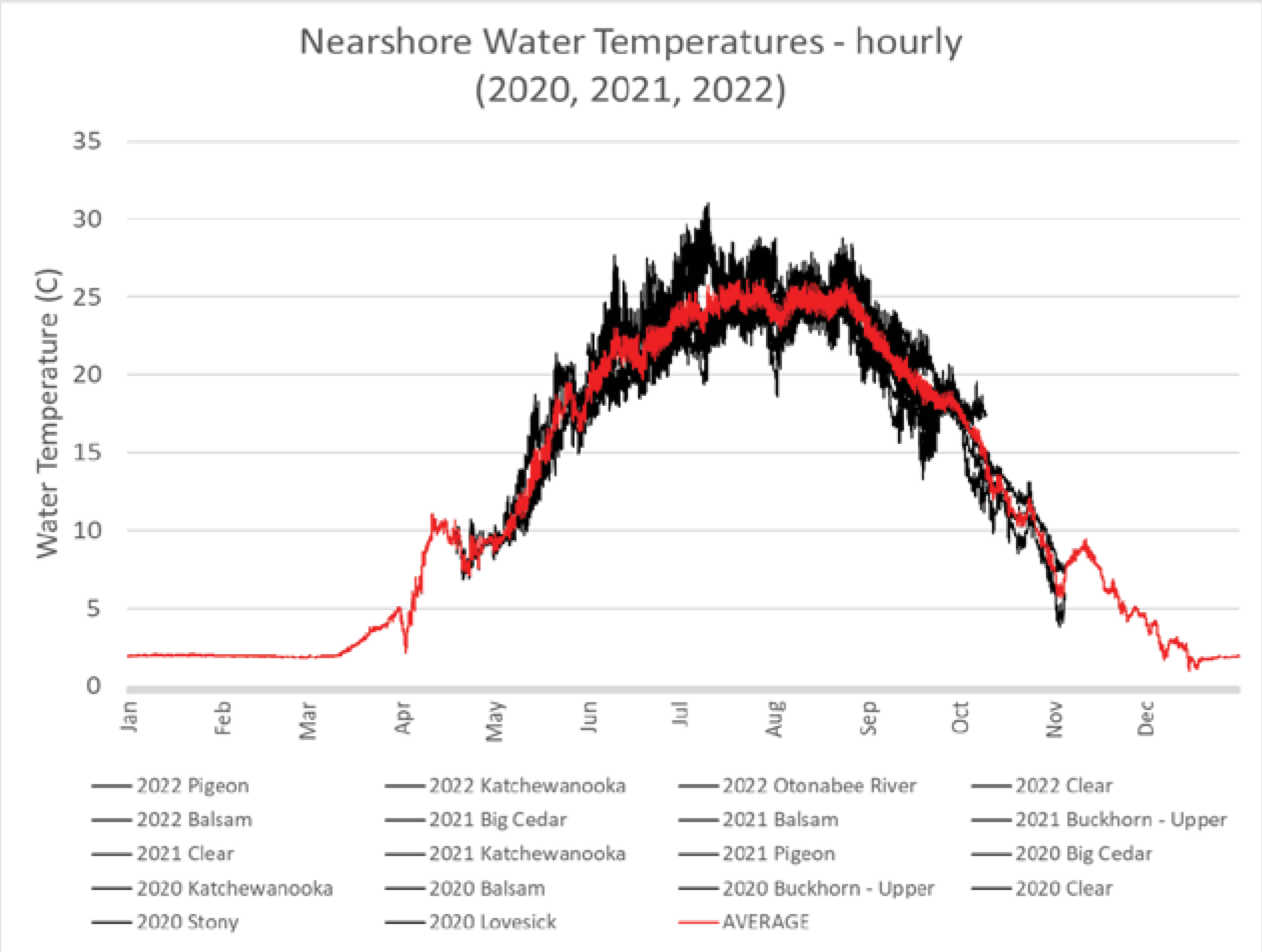


Figure 1: **Yearly patterns in nearshore water temperatures. Red line is average, and black lines are all available data. Limited data exists between October and May.**

Water Temperatures and Dissolved Oxygen Monitoring – 2022 Results

Figure 2. **A water temperature logging device deployed in mid-lake in summer 2022, to track hourly temperatures on an annual basis.**

Most of our data has been collected between June and September – outside of these months our lakes are often too chilly for volunteers to wade in and retrieve or deploy the temperature logging device. To help fill gaps, in summer 2022 we deployed logging devices in mid-lake sites (Balsam, Sturgeon, Pigeon, Buckhorn – Upper, and Katchewanooka) that will remain submerged all year round (Figure 2). These will be retrieved in the summer of 2023, and we will add a full year's worth of data at five additional sites to the thermograph.

2022 Summer Nearshore Water Temperatures

From June 1 to August 31, 2022, volunteers collected nearshore water temperatures at six sites, four of which were located on lakes, one on a river, and one on a creek. When excluding the Katchewanooka site (limited data available) and the Sandy Creek site (not on a lake), water temperatures ranged between 17.7 and 27.2 ºC, which is a fluctuation of 9.5 ºC. Average nearshore water temperatures were 23.2 ºC, which were about the same as in 2021 (23.3 ºC). Water temperatures followed a similar daily and monthly pattern for all sites and were strongly influenced by air temperature patterns (Figure 3). Sandy Creek

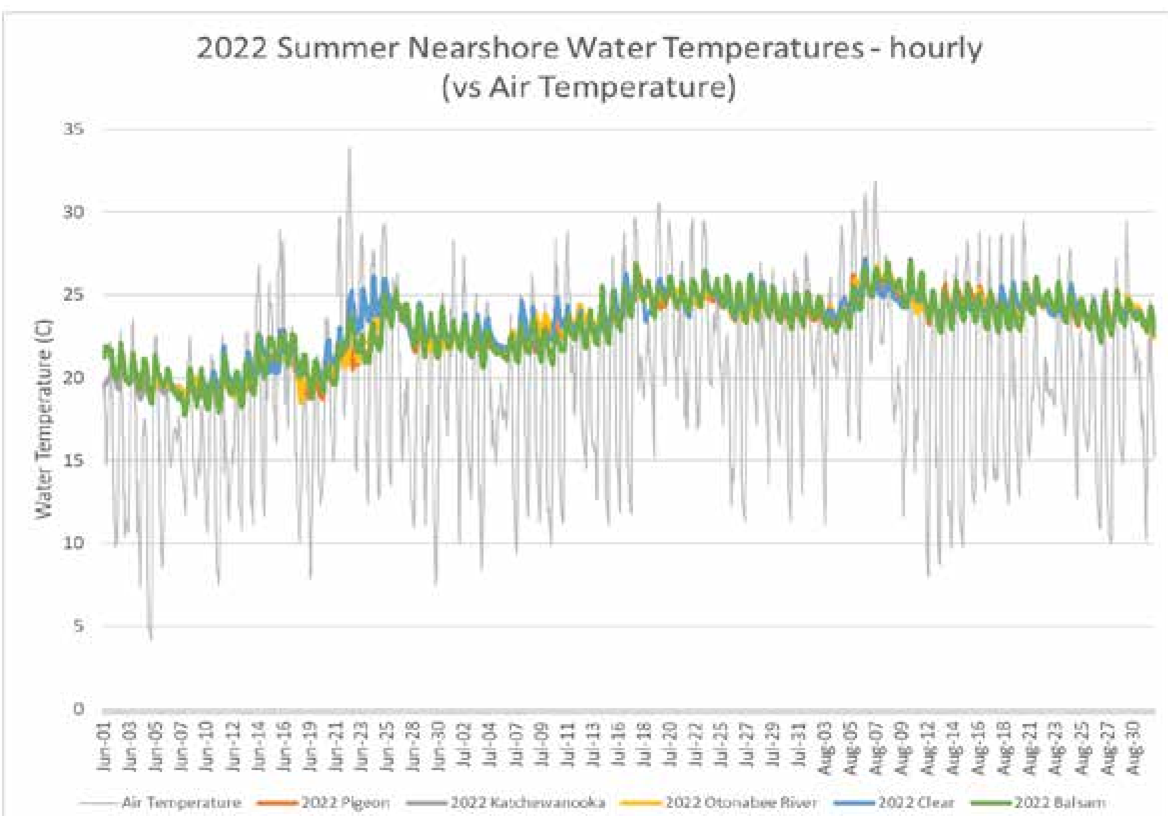


Figure 3. **2022 summer hourly nearshore water temperatures and air temperatures (recorded at Trent University, Peterborough), at lake sites only.**

experiences greater water temperature fluctuations than the lake and river sites, due to it being more susceptible to air temperatures (as noted in last year's Annual Lake Water Quality Report).

2022 Late Summer Deep Basin Water Temperatures and Dissolved Oxygen

Between August 15th and September 8th, volunteers collected deepest basin water temperatures and dissolved oxygen concentrations at nine sites (Figure 4). These sites are more variable and experience wider temperature fluctuations than the near-shore sites, with water temperatures from surface to bottom ranging by about 19 ºC (e.g., 25.7 ºC surface water in Lower Buckhorn Lake versus 6.8 ºC bottom water in Upper Stoney Lake).

Most lakes developed a layered (stratified) water column, with warmer waters resting above colder waters separated by a rapid temperature decline called the 'thermocline' between a depth of 6 to 12m. The depth of thermocline also coincided with a significant decline in dissolved oxygen concentrations with values in many sites dropping near the bottom that are considered too low (less than 1.0 mg/L) for fish populations. Balsam, Katchewanooka, and Lovesick Lake had uniform temperatures and dissolved oxygen throughout its water column. They too were likely stratified sometime prior to sampling but a period of relatively cold windy weather before sampling (end of August) likely caused their thermoclines to disappear. In addition, as noted in last year's Annual Lake Water Quality Report, the thermocline can disappear quite rapidly on lakes on the main Trent-Severn Waterway channel that have relatively fast water currents.

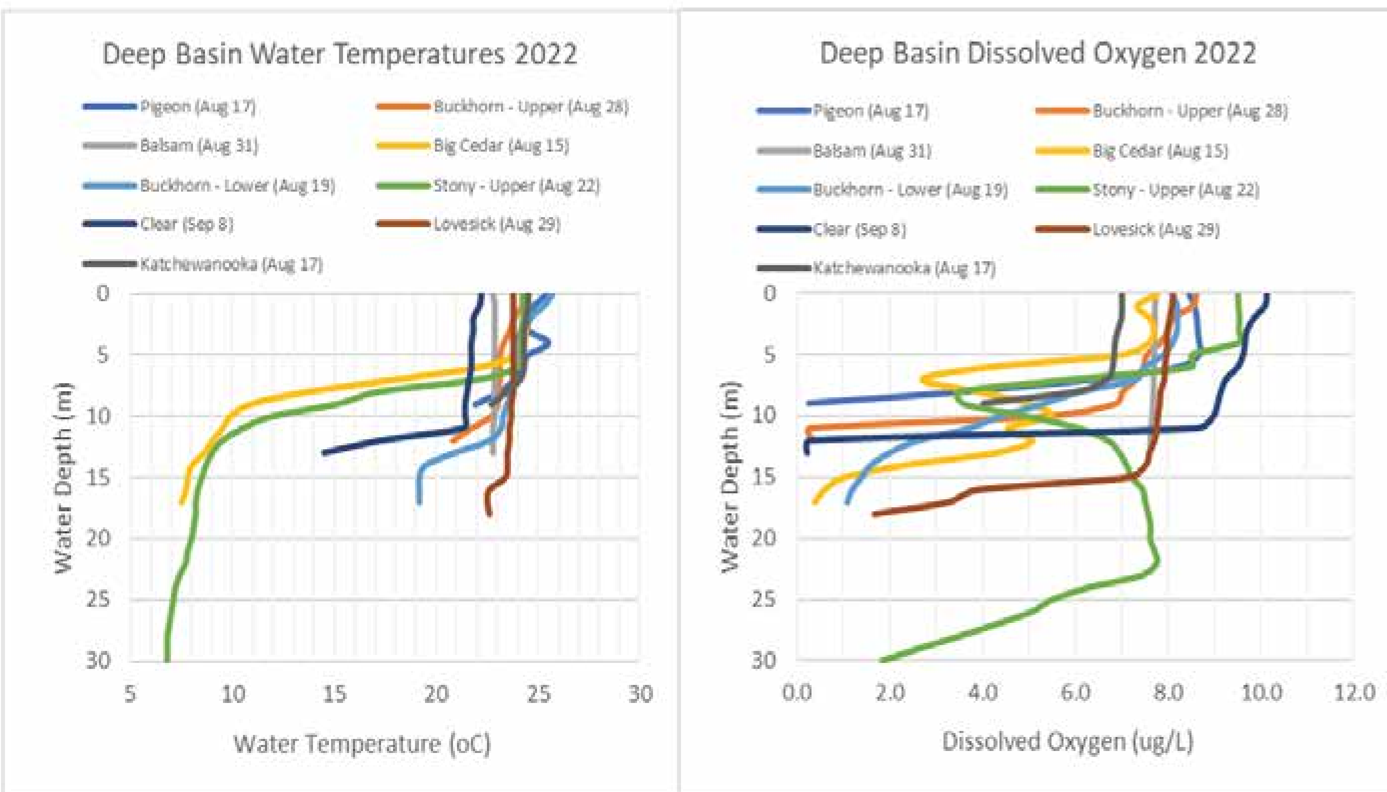


Figure 4. **2022 end of summer water temperature (left) and dissolved oxygen concentrations (right) at deep basin sites, at 1m increments from surface to bottom.**

Water Temperatures and Dissolved Oxygen Monitoring – 2022 Results

Data Summary Tables

Table 1 shows our attempt at distilling all the water temperature and dissolved oxygen data collected in 2022 into a few simple values. The more we collect data the more we obtain a clearer picture of trends and how they might correlate with changes observed in other aspects of our lakes including aquatic plants and aquatic life. In the future, we hope to partner with a university to help explore the data even further.

Thank you to 16+ volunteers who have dedicated their time in support of this program. If you are interested in monitoring water temperature or dissolved oxygen on your lake, please contact KLSA for more information: klsa@klsa.info.

	Nearshore Sampling (June, July, August)			Deep Basin Sampling (August 15th to September 15th)		
	Number of days above 25°C (#)	Average of daily maximums (°C)	Average of all temperatures (°C)	Depth of thermocline (m)	Surface water dissolved oxygen (mg/L)	Bottom water dissolved oxygen (mg/L)
Balsam	42	24	23	None[1]	7.7	7.6
Big Cedar				5	7.6	0.5
Buckhorn - Lower				12	8.2	1.2
Buckhorn - Upper				10	8.4	0.3
Clear	34	24	24	11	10	0.1
Katchewanooka	0[2]	20[2]	20[2]	None[1]	7	5.1
Lovesick				None[1]	8.1	2.5
Otonabee River	23	24	23			
Pigeon	23	24	23	8	8.6	2
Sandy Creek	48[3]	25[3]	23[3]			
Stoney – Upper				6	9.5	2.2
AVERAGE[4]	**30.5**	**24.0**	**23.3**	**8.7**	**8.3**	**2.4**

1. No thermocline present, water column mixed.
2. Data only available from June 1st to June 9th (logger malfunction).
3. Site is on a creek.
4. Average of all values not shaded in grey.

Table 1. **2022 summary of data used for annual tracking of water temperature and dissolved oxygen.**

Shoreline Studies: What is driving nearshore aquatic communities in the Kawartha Lakes?

Erin Smith, PhD, *Ontario Tech University*

Throughout my studies, I worked to better understand the water quality and biotic communities in the nearshore zone of the Kawartha Lakes. The nearshore zone is the location on a lake first impacted by human activity; it's where surface runoff and municipal effluent enter the lake, and physical alteration of the shoreline occurs. The nearshore zone is also the most important location for the aquatic community; it is where most of the lake's biological activity occurs. Due to its shallowness and proximity to terrestrial ecosystems, the nearshore zone provides a habitat with aquatic plant communities and various bottom substrates (woody debris, sand, gravel, etc.), and the abundance of algae provides food for many aquatic organisms. In previous studies, I found an impact of land use on nearshore water quality and a significant role of aquatic plants in supporting a diverse community. In this study, I expanded on previous work by considering many factors, such as land use, aquatic plants, and shoreline hardening.

In 2021, I conducted simultaneous citizen science water monitoring and a biological monitoring study to investigate the nearshore zone of Balsam, Cameron, Sturgeon, and Pigeon Lakes (Figure 1). Water samples were collected monthly from June – September and analyzed for water quality variables such as nutrients (phosphorus and nitrogen), water clarity, water temperature, conductivity, and dissolved oxygen. Monthly samples of phytoplankton (algae), zooplankton, and macroinvertebrates were collected and identified from June – September. I also collected samples of the aquatic plant community in August to determine the relative biomass and community composition at each sampling site. Finally, I assessed the shoreline type (natural, rip rap, armour stone, concrete) and land use at each sampling site. By collecting a wide variety

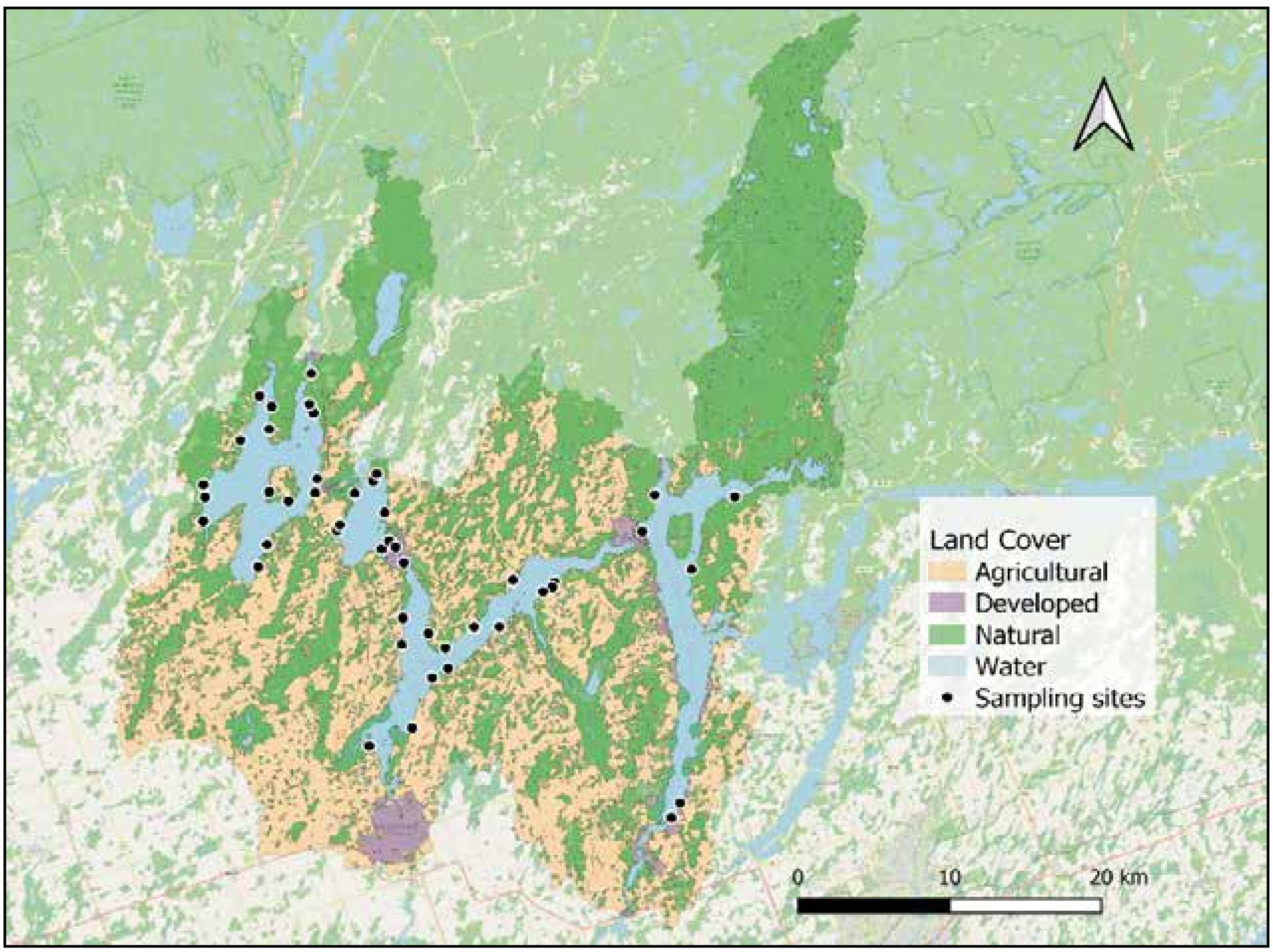


Figure 1. **Citizen science water quality sampling sites and watershed land use for Balsam, Cameron, Sturgeon, and Pigeon Lakes.**

of variables, I hoped to identify the key drivers of water quality and biotic communities in these lakes.

The water quality monitoring study matched previous monitoring patterns, with lower nutrient levels in Balsam and Cameron Lakes and higher levels in Sturgeon and Pigeon (Figure 2). The difference in nutrient levels is partly due to the land use of each lake's watershed. Sturgeon and Pigeon Lakes have more urban, exurban, and agricultural land use in their watersheds, which contribute nutrients through surface runoff. This was captured in our findings, with higher nutrient levels in the more developed southern portions of Sturgeon and Pigeon Lakes. Another important consideration is the physical characteristics of the lakes; Sturgeon and Pigeon Lakes are shallower than Balsam and Cameron, which can contribute to a naturally more nutrient-rich waterbody. When interpreting water quality findings, it is essential to consider the historical or baseline conditions of the waterbody, and with that in mind, it is not surprising that there is a split in nutrient levels between these sets of lakes.

The findings from the biological monitoring study add more context to the water quality findings. Sturgeon and Pigeon Lakes had higher aquatic plant biomass and macroinvertebrate abundance. Pigeon had higher phytoplankton (algae) biomass when compared to Balsam and Cameron Lakes. I also found a direct relationship between phosphorus and the abundance of each biotic community (phytoplankton, zooplankton, and macroinvertebrates). These findings indicate that the higher nutrient levels in Sturgeon and Pigeon Lakes support more primary productivity (plant and algae growth), which supports a more abundant and diverse aquatic community.

Overall, this project highlighted the crucial role of nutrients, especially phosphorus, in determining a lake's aquatic community. Although I considered a variety of potential drivers of the biotic community, nutrient levels proved to be the most influential factor in determining the lower aquatic food web in these lakes. Nearshore nutrient levels supported the split in productivity in the lakes: oligotrophic (low nutrient) conditions in Balsam and Cameron and mesotrophic (moderate nutrient) conditions in Sturgeon and Pigeon Lakes. This study also provided an important reminder of phosphorus' vital role in supporting abundant and diverse aquatic communities. Although the lake-wide trends did not indicate problematic nutrient levels, there was notable variation along the shorelines. Efforts to reduce nutrient inputs from human activities are essential to reduce the risk of future nutrient enrichment. Reducing land development, fertilizer application, and removal of native vegetation can help to keep the Kawartha Lakes healthy so that they can continue to be enjoyed by humans, fish and everything else!

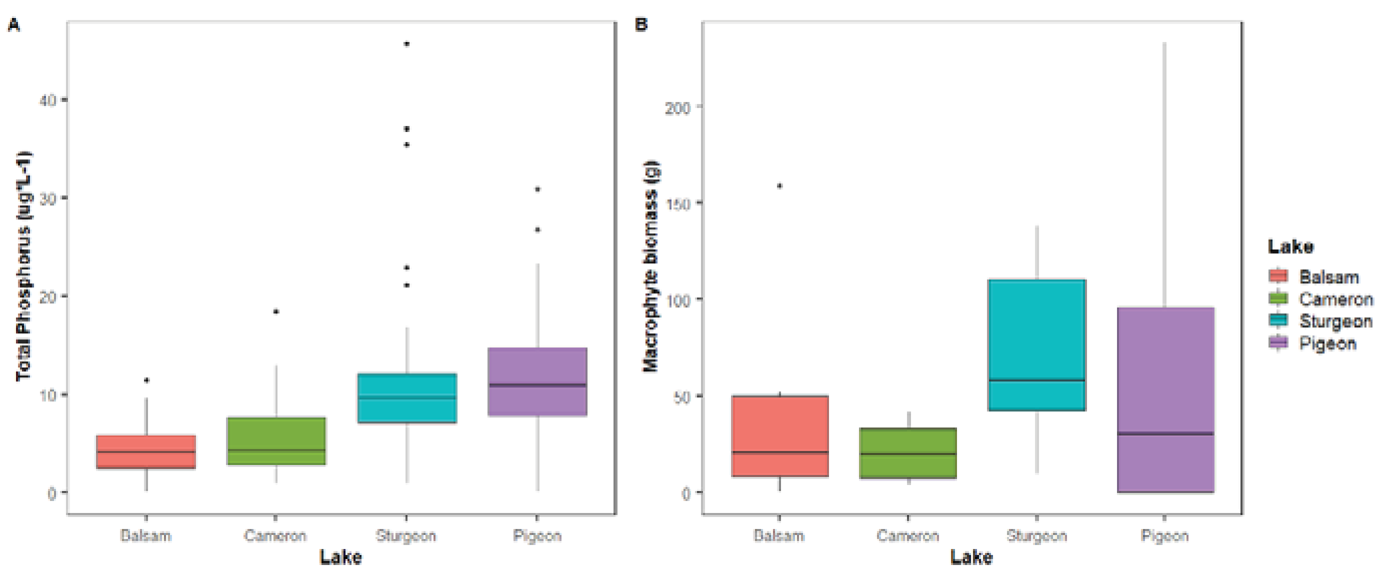


Figure 2. **Boxplots of a) total phosphorus and b) aquatic plant (macrophyte) biomass in Balsam, Cameron, Sturgeon, and Pigeon Lakes in 2021. The horizontal line indicates the lakes' median, the box outlines the range of the middle 50% of values for each lake, and the dots indicate outliers.**

Influences of Eutrophication, Climate and Development of the Trent-Severn Waterway in Three Kawartha Lakes Since the Early 1800s

Kathleen Laird, Cale Gushulak and Brian Cumming, *Paleoecological Environmental Assessment and Research Lab (PEARL) Queen's University, Biology Department, Kingston, Ontario*

Mud at the bottom of lakes holds a historical archive of past lake and watershed conditions that can be deciphered from the biological, chemical, and physical signals preserved in these sediments. Lake sediments can be retrieved and dated using radioisotopic analysis (see Cumming and Napier KLSA 2016 annual report) to provide a historical context of changes in lakes prior to the establishment of monitoring, and is often the only means to assess changes in lakes over decades to centuries. The rise in *Ambrosia* spp. pollen (common ragweed) in the lake sediments associated with European settlement was used in our study to provide an additional dating marker. Paleolimnological techniques (see Napier and Cumming KLSA 2016 annual report) were utilized to examine the history of lake production and estimates of total phosphorus (TP) in three Kawartha lakes (Cameron, Pigeon, Stony) since the early 1800s. Changes in the relative abundances and concentrations of diatoms (single-celled algae with silica walls), changes in pigment concentrations from various groups of algae (e.g., green algae, diatoms, cyanobacteria) and changes in cladoceran remains (water fleas) were analyzed from sediment cores (see Cumming and Napier KLSA 2016 annual report). This report provides a summary of these findings that were recently submitted to the journal of Lake and Reservoir Management.

Archives of biological remains preserved in lake sediments can provide a wealth of information on water quality changes over centuries to millennia. Diatoms have been analyzed as bioindicators since the early 1900s and are a diverse group of algae present in almost all aquatic environments (including hot springs). Diatoms typically preserve well in lake sediments because of their silica walls. Thousands of species are identifiable by their ornate patterns on their cell walls and are highly sensitive to changes in water quality. Each diatom species has preferred nutrient conditions from oligotrophic (low nutrients, < 10 µg/L TP), mesotrophic (moderate nutrients, ~ 12-25 µg/L TP) to eutrophic-hypereutrophic (high-very high nutrients, > 25 µg/L TP). These optima can be used to infer past TP conditions based on the species composition of assemblages preserved in the lake sediments. Preservation of various algal pigments associated with different groups of algae provides an additional assessment of changes in lake production through time. Increases in cyanobacteria (blue-green algae) is a common indicator of cultural eutrophication, with risk of blooms further intensified with climate variability. Chlorophyll *a* (Chl *a*), a pigment found in all algae can provide an overall assessment of primary production. Secondary producers (e.g., Cladocera: commonly referred to as water fleas) can be directly influenced by chemical and physical changes to the lake, as well as changes in primary producers. Analysis of cladoceran remains thus can provide an assessment of secondary production and potential food web changes. All these proxies taken together provide a more holistic view of water-quality changes through time.

The three study lakes vary in landscape position within the Trent-Severn Waterway (TSW) and capture gradients in lake-water conditions from a lower-nutrient headwater lake (Cameron Lake) in the west to the more nutrient-rich sites (Pigeon and Stony Lakes) to the east. The development of the TSW led to fundamental changes in the hydrologic connection of the Kawartha lakes, with varying lake response to nutrients and climate dependent in part on its location. Landscape position within a chain of lakes is often a determinant of lake trophic status (nutrient levels), generally increasing downstream. This trend can also be influenced by downstream influx of dilute nutrient sources, as in Stony Lake with the drainage from the northern forested lands.

Lake position and catchment characteristics, in conjunction with the physical lake characteristics and history of human disturbance, can influence the response of a lake to cultural eutrophication and climate. Significant changes in diatom (Figure 1) and cladocera assemblages in all lakes around the 1830s are consistent with increased water levels and elevated phosphorus conditions arising from intensification of forest harvest, agriculture, and development of the TSW. The significant changes included increases in mesotrophic-eutrophic planktonic diatom *Aulacoseira ambigua* and the littoral Cladocera (*Chydorus brevilabris*) found in more productive lakes. In contrast, the algal and cyanobacterial community composition, based on pigment concentrations, did not significantly change during this period (Figure 2). Prior to European settlement diatom-inferred TP

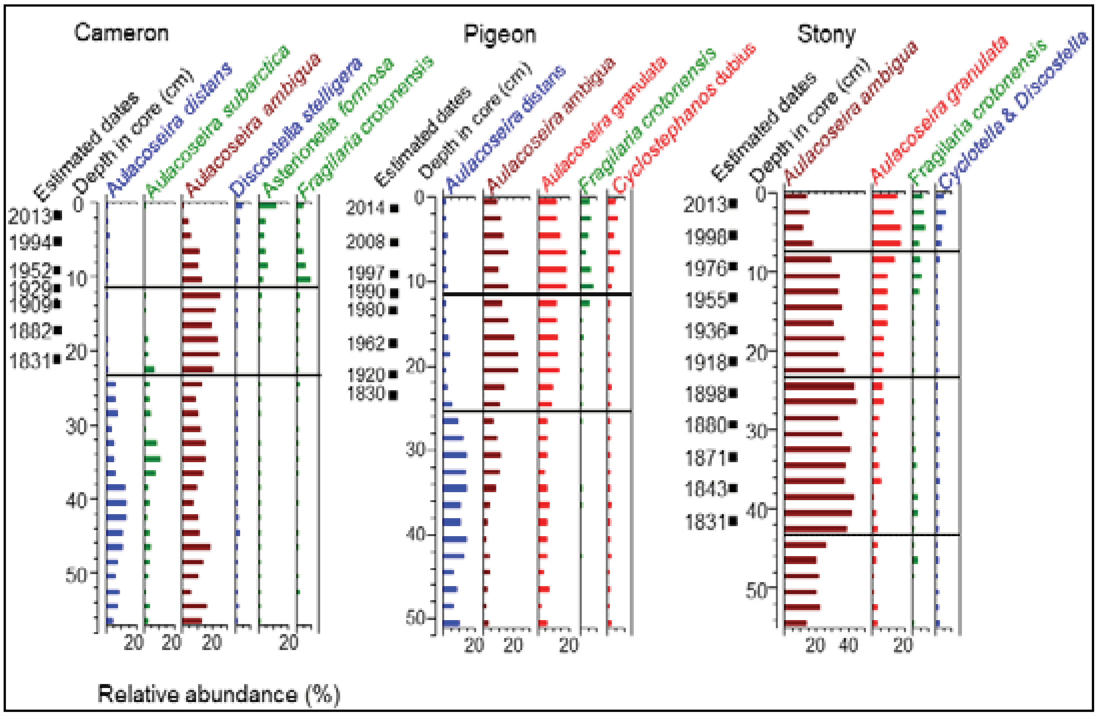


Figure 1. **Summary of common planktonic diatom species (% abundance) found in the sediment cores of three Kawartha lakes. These stratigraphies are presented according to depth and age with the most recent aged sediments at the top of the core depth and the oldest at the bottom. Each species is colour coded to its optima to nutrient levels: blue – oligotrophic, green – mesotrophic, maroon – eutrophic and red – hypereutrophic.**

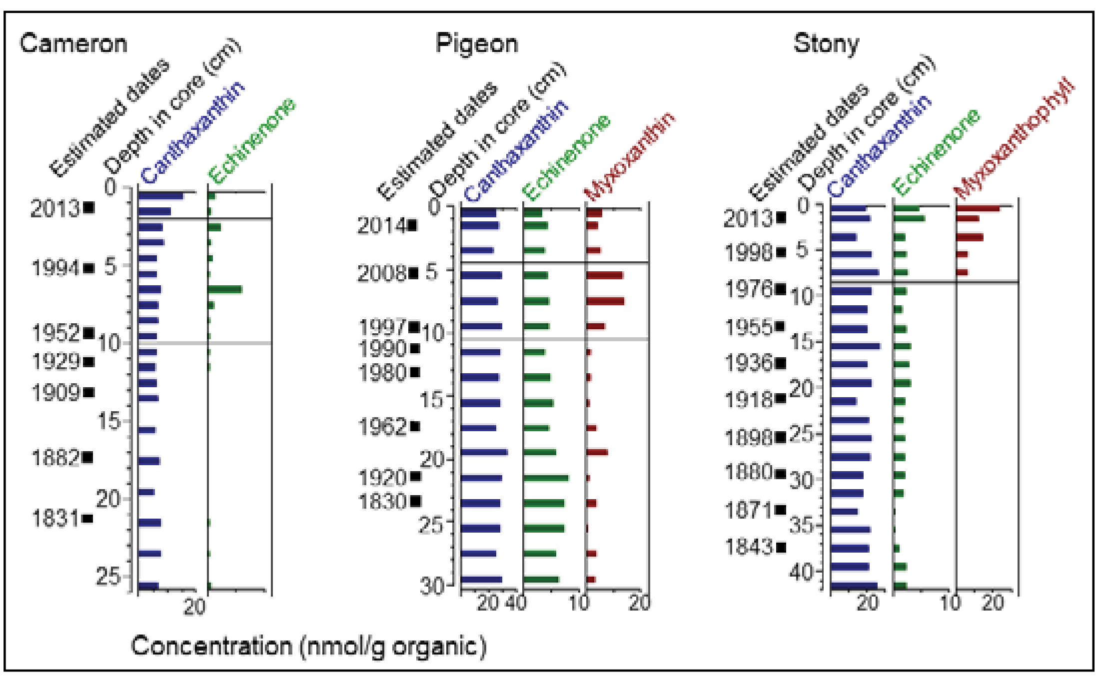


Figure 2. **Summary of the concentration of cyanobacteria (blue-green algae) pigments found in the sediment cores of three Kawartha lakes. These stratigraphies are presented according to depth and age with the most recent aged sediments at the top of the core depth and the oldest at the bottom. Each cyanobacteria pigment is colour coded for ease of comparison across the lakes.**

estimates suggest that all lakes were naturally mesotrophic, with an average summer TP of ~15 µg/L that increased to meso-eutrophic conditions following the landscape and hydrological disturbances (Figure 3). The combined paleoecological data suggests that both deep-water habitats and littoral regions expanded with flooding, with concomitant nutrient increases that led to the changes seen in the diatom and cladoceran assemblages.

Complex controls of lake recovery

Lake recovery from cultural eutrophication often requires substantial reduction in phosphorus inputs; however, even moderate declines in nutrient loading do not always result in declines in algal or cyanobacterial abundance. Mean annual TP has declined by ~20-38% in the Kawartha lakes since the 1970s, largely due to decreases in phosphorus from tertiary sewage treatment which started in 1975. However, these TP changes encompass a small nutrient range (mesotrophic to meso-eutrophic) and did not result in concurrent significant changes in diatom inferred TP (DI-TP), diatom assemblage composition, or pigment-based estimates of algal abundance. Release of phosphorus from lake sediments (internal loading) can occur under anoxic (depleted oxygen) conditions often associated with high algal production or prolonged, intensified thermal stratification (surface layer of warm, less dense water above a deeper cold, dense layer) often connected to climate warming. Continued inputs of diffuse sources of nutrient inputs from the watershed can also delay or limit the recovery process.

Invasion of zebra mussels into the Kawartha area in the 1990s, and changes in the composition of fish communities in recent decades (Kawartha Conservation 2015) may also complicate lake recovery. While some lakes within the Kawartha Lakes region show significant declines in turbidity commensurate with nutrient management and zebra mussel invasion, overall, Secchi disk data (i.e., water clarity) from the study lakes either reveal no consistent trends (Pigeon and Stony Lakes) or are too infrequent to detect changes since 1995 (Cameron Lake). Variability of Secchi depth in Pigeon Lake by ~ 2 m between north (deep, clear) and southern (shallow, turbid) basins (Kawartha Conservation 2018) contributes to the variable trends. Increases in water temperatures can favour warm-water fish species, such as smallmouth and largemouth bass, whereas walleye abundances have declined likely due to an interplay between temperature and water clarity.

Climate can play a significant role regulating phosphorus and algal abundance in lakes. Warmer surface waters typically increase algal growth and can change the composition of the algal community either directly or from changes in nutrient cycling and lake stratification. General warming in the Kawartha Lakes region since the late 1800s, accelerating since the 1970s-1980s, is conducive to increased algal growth. Increases in annual precipitation in Haliburton and Orillia since the late 1800s, with highs particularly evident since the 1960s-1970s can also influence nutrient dynamics, by changing the loading of phosphorus.

The modern algal and cladoceran community composition is unique in comparison to the assemblages of the past ~200 years. Interactions between climate and eutrophication modified by the lake position in the chain of Kawartha lakes are the likely controls of the recent unique diatom, pigment, and cladoceran assemblages in the three study lakes. The rise of smaller centric planktonic taxa such as *Cyclotella, Cyclostephanos*, and *Discostella* and colonial planktonic taxa such as *Fragilaria crotonensis* may reflect an increase in lake warming and strength of stratification as *Aulacoseira* planktonic species generally need more turbulent conditions. Lakes may experience blooms of hypereutrophic taxa, such as *Aulacoseira granulata* and *Cyclostephanos* spp. during mixing periods potentially augmented by internal phosphorus loading from the sediments, whereas during the stable periods of reduced water mixing and warmer temperatures cyanobacteria such as *Microcystis, Anabaena* and *Aphanizomenon* spp. may be favoured due to their buoyancy and persistence under warm, nutrient-rich conditions.

The degree to which compositional changes in diatoms, pigments and cladocera follow the nutrient trends (DI-TP) varies in the lakes (Figure 3). A qualitative assessment of directional changes based on general additive models (GAMs) provides insights into the role of nutrients (cultural and climate driven) versus a central role of climate (warming, ice phenology, stratification) in the recent diatom, cladoceran, and cyanobacterial changes. In Cameron Lake, DI-TP and diatom assemblage changes indicate similar directions through time, whereas in Pigeon Lake TP

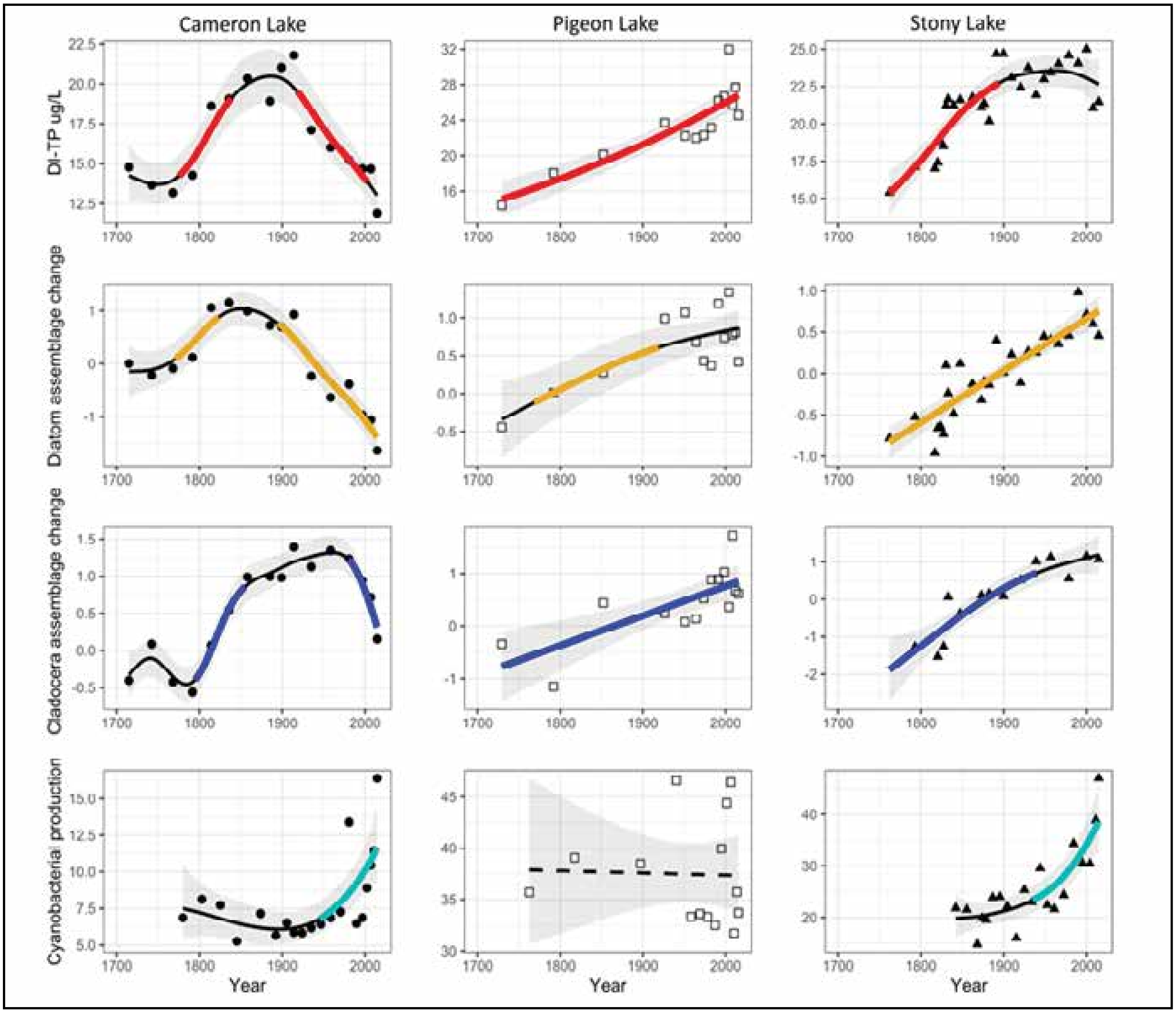


Figure 3. **Summary of changes in the diatom-inferred total phosphorus (DI-TP), diatom and Cladocera assemblages, and cyanobacterial production through time using generalized additive models (GAMs). Time is presented on the x-axis with oldest on the left and most recent on the right. Raw data for each lake are presented by symbols: closed circles – Cameron Lake, open squares – Pigeon Lake, and closed triangles – Stony Lake. The solid, black lines represent the fitted trend of the GAMs which show the direction and magnitude of change through time. Coloured, emboldened portions of the fitted GAM trends represent periods of statistically significant change, i.e., periods of time with rapid environmental change. The dashed line in the cyanobacteria pigments in Pigeon Lake indicates no period of significant change. This could be related to the lower number of samples before the 1900s.**

continues to increase while assemblage composition is relatively stable, and, in Stony Lake, significant changes in diatom assemblages occur without meaningful changes in DI-TP. The divergence of diatom assemblage changes from nutrient trends in Pigeon and Stony Lakes imply other factors are influencing the recent unique assemblages. Significant changes in pigment composition and cyanobacteria concentrations in Cameron and Stony Lakes do not strictly follow DI-TP trends. Physical dynamics, influenced by ice phenology and seasonal air temperatures, control algal /composition throughout the open-water season. Although linkages between nutrients, climate, and recent assemblage changes are complex, comparison of GAM trends in DI-TP to assemblage changes differentiates the magnitude of nutrient influence in the three study lakes.

Landscape and lake characteristics, along with other potential biotic influences on nutrient dynamics (e.g., zebra mussels, fish community composition), influence variation in nutrient status (as DI-TP) and community composition in the Kawartha lakes. Interactions between eutrophication, landscape position, and climate contribute to the changes to biological assemblages both within and between lakes during the past ~200 years.

Background readings from previous KLSA annual reports:

Napier, W.A. Written in mud: A 300-year history of the Kawartha lakes. Part 1. Historical phosphorus levels; Part 2. Historical lake productivity levels. KLSA 2018 annual report.

Napier, W.A., Cumming, B., Laird, K. Paleolimnological study: status and update. KLSA 2017 annual report.

Napier, W.A., Cumming, B. Paleolimnology: What is it and why is it useful? KLSA 2016 annual report.

Cumming, B., Napier, W.A. Kawartha lakes paleolimnological study: collection, analysis and age-dating of sediment cores. "Study the past to plan for the future" KLSA 2016 annual report.

KLSA Second Annual Photography Contest

KLSA held our second annual contest to pick the cover photograph for our 2022 Annual Lake Water Quality Report. Twenty-eight photos were submitted by sixteen talented photographers. The Editorial Committee was impressed by the quality of the photos and the variety of settings and subjects. Congratulations to Martha Hunt whose beautiful photo of two loons was selected for the cover. Her photograph of Juniper Channel tied for second place with a picture of a water lily by David Morley (see page 7). Again this year, the Editorial Committee decided that all of the photos were deserving of honourable mention so they are included throughout the Report. Thank you to all of the participants. We plan to make this an annual event so plan to participate next year.

Misty Morning. Photo by: Harry Shulman, Burleigh Falls

Wood Ducks and Heron. Photo by: Nick Vanderzwet, Pigeon River

Remote Sensing: Assessing Carbon Storage Capabilities in the Kawarthas

Kawartha Land Trust

How Kawartha Land Trust is using data from cutting-edge technology to identify carbon hotspots in the Kawarthas

View at Pipers' Woods. Protected by Kawartha Land Trust in 2022. (KLT)

What might at first glance look like a star in the night sky just may be a multi-national laboratory orbiting over 400 kilometres above the Earth — the International Space Station (ISS). The next time you spy this bright light in the sky, know that there is technology onboard that is assisting with the protection of carbon in the Kawarthas.

Kawartha Land Trust (KLT) is working with the team at Korotu Technology to interpret data collected from the latest technology in ecosystem monitoring — a remote sensor from the Global Ecosystems Dynamics Investigation (GEDI) mission aboard the ISS.

This powerful sensor can help identify carbon hotspots in the region through its precise measurements of forest canopy height, canopy vertical structure, and surface elevation.

Using this information, it's possible to estimate the aboveground biomass of a region and its carbon storage capabilities. The more forest cover present, the more aboveground biomass that exists. The sensor's ability to estimate the height of forests helps account for older and larger trees — mature forests have more carbon stored than younger forests.

And it's never been more important to protect our forests. Storing carbon in our local landscape helps reduce carbon in the atmosphere. As a society, to combat the effects of climate change, we must reduce our emissions *and* ensure carbon is captured, sequestered and stored in our landscape.

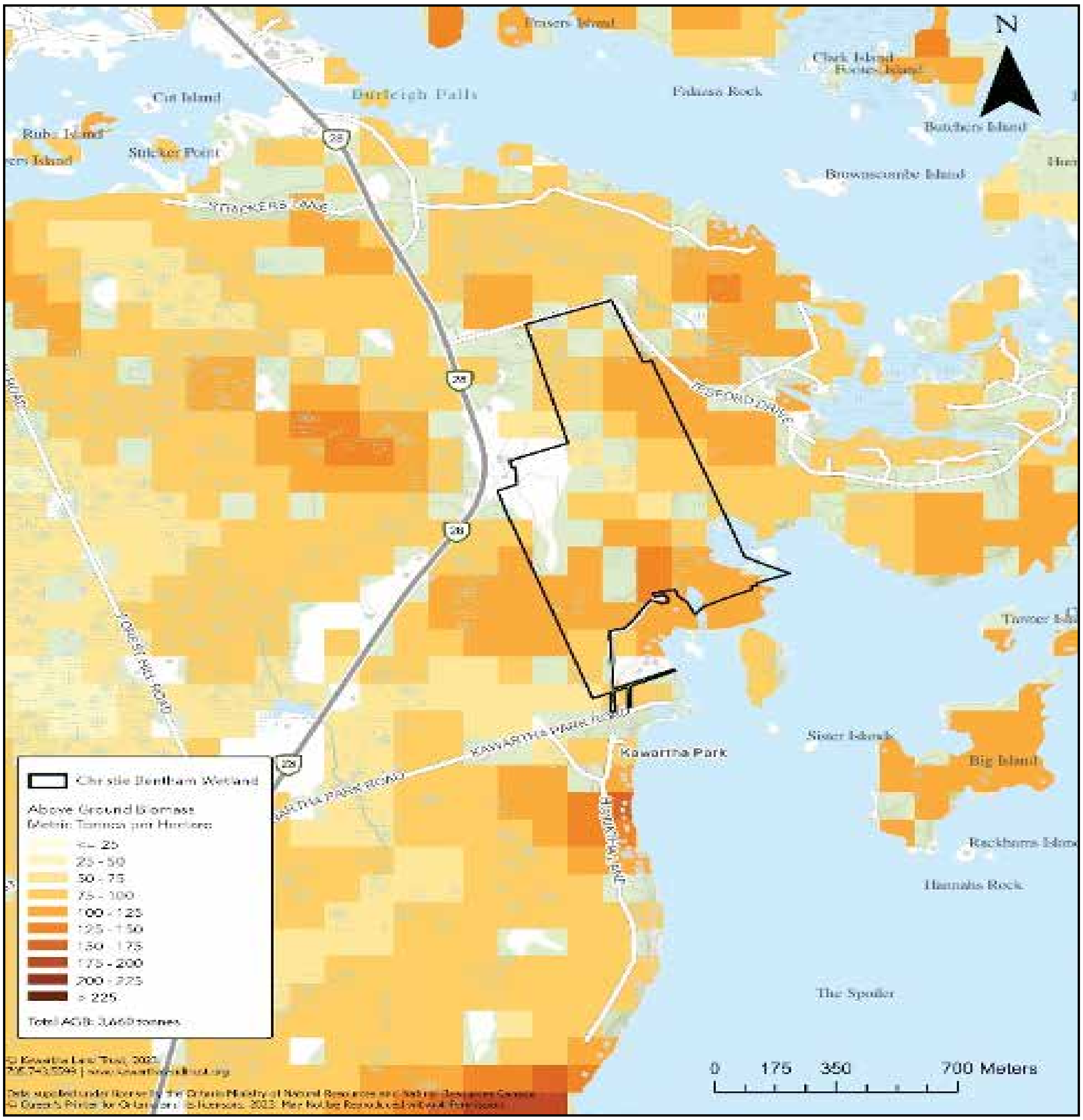
Trees are particularly good at sequestering and storing carbon — 50% of a tree's biomass is carbon, they live for a long time if permitted to live their full lifecycles, and rot slowly, particularly in cool climates like Ontario's.

Carbon is also stored in soil and these carbon stocks increase over time as roots grow and plants die and decompose. Many types of ecosystems, such as wetlands, are important carbon sinks because they continue to store carbon in the soil over years, decades, and even millennia.

Protecting and restoring carbon-rich ecosystems in the Kawarthas will also contribute to goals outlined in the Kunming-Montreal Global Biodiversity Framework (GBF) agreed upon at the recent United Nations Biodiversity Conference (COP15) in Montreal.

The framework calls for concrete measures to halt and reverse nature loss. The 23 targets include protecting 30% of the world's land and water and restoring 30% of all degraded lands in the next seven years.

Protecting our mature forests will ensure that carbon remains sequestered and not released into the atmosphere. Restoring degraded ecosystems will enable our region to store more carbon.



Above Ground Biomass on the Christie Bentham Wetland property and surrounding areas (KLT).

Remote Sensing: Assessing Carbon Storage Capabilities in the Kawarthas

"The Environment and Climate Change Canada (ECCC) Nature Smart Climate Solutions Fund (NSCSF) grant that KLT was awarded in 2022 has allowed the organization to investigate new technologies that will help KLT and the sector protect and steward the land," says Thom Unrau, Director of Community Conservation.

The ECCC's $1.7M investment over five years will support KLT's work to fight against carbon sequestration and storage through the protection of more than 2,000 acres of natural habitat in the Kawarthas. How will we achieve this? By inspiring landowners to protect their lands through a mix of short-term and permanent land-protection options – land donation and 30-year Conservation Easement Agreements (CEAs).

Together, we can not only protect carbon stores in the Kawarthas, but also enhance vital habitat for plant and animal species, including a number of species at-risk.

The maps created from the GEDI sensor's data, combined with on-the-ground verification and citizen science, will allow KLT to focus its efforts on protecting mature forests.

"We would like to encourage landowners to learn how their properties contribute to climate adaptation and what it means for our shared landscape," said Unrau.

"Being able to provide landowners with carbon maps of their properties is a new tool that we look forward to sharing with those who are interested in learning how forest management is important for climate change mitigation."

If you own a rural acreage (20+ acres) that features forested sections and would like a carbon map of your land, please reach out to Jeff Park, Landowner Outreach Officer, at jpark@kawarthalandtrust.org or 705-743-5599, ext. 1 (office) / 705-761-9001 (cell).

Through the support of its donors, Kawartha Land Trust now protects over 5,000 acres of land in the Kawarthas. To learn more, visit kawarthalandtrust.org.

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :

Environment and Climate Change Canada | Environnement et Changement climatique Canada

Foggy stillness with yellow chairs. **Photo by: Stefanie Hudon, Clear Lake**

Solo Exploring. **Photo by: Janet Klein, Nogies Creek**

Phosphorus Sequestration in Waterfront Property Septic Systems

Mike Dolbey, *KLSA Volunteer*

On September 15, 2022, I had the opportunity to address members of the Ontario Onsite Wastewater Association (OOWA) at their Peterborough Regional Meeting. Representing the Kawartha Lake Stewards Association, I discussed the results of our lake water monitoring programs and explained our concern about phosphorus in our lake environments. High levels of phosphorus in lake water may result in increased growth of aquatic plants and algae, a process known as eutrophication. Onsite wastewater systems of waterfront property owners have been considered to be a potential source of phosphorus due to the development of phosphorus plumes in calcareous soils as described by University of Waterloo's Professor Will Robertson in his 1998 review paper on the subject. Based on this work, I stated that I believed all new or renewed onsite wastewater systems on properties within 100 to 200 metres of a waterbody should be tertiary or BNQ Level 4-P2 systems that were capable of removing or immobilizing phosphorus. Additional information has come to my attention that has changed my opinion on this subject.

The Ontario Ministry of the Environment and Climate Change recently funded Professor Robertson et al. to write a review of their 30 years of work on phosphorus attenuation in groundwater plumes. Their paper, published in 2019[1], concluded that conventional onsite wastewater treatment systems constructed with the correct materials can immobilize up to 99% of effluent phosphorus as stable mineral precipitates in the drainfield zone 1–2 m below the infiltration pipes, which is primarily within the unsaturated zone. The phosphorus mineralization only occurs under acidic conditions usually generated by the oxidation of effluent ammonia (NH4). Filter sand in the drainfield must have less than 2% calcium (weight%, acid extractible) in order to maintain the acidic conditions required for phosphorus mineralization. The study showed that the phosphorus mineralization continued to occur equally in systems of all ages and that water table depth between 1 - 5 m had little effect. Most systems studied had loading rates of <2 cubic metres/day, typical of most residential properties, but further studies will be required to determine the removal effectiveness at higher loading rates. A number of the systems examined in the study were located on low permeability calcareous soils, but they still demonstrated high phosphorus removal rates because their drainfields had been constructed with sufficient imported non-calcareous sand.

The development of effluent phosphorus plumes outside the drainfield is dependent on the pH of the surrounding soil. In acidic soils (pH below 7), any residual phosphorus in the effluent water leaving the drainfield is primarily mineralized and minimal plumes develop. In neutral to calcareous soils (pH 7 and above), residual phosphorus is adsorbed by the soil (bound to the surface of soil particles). As the soil becomes saturated, phosphorus must travel further before being adsorbed resulting in a plume in the direction of groundwater flow. In waterfront properties this is usually towards the water. The rate of plume growth depends on several factors such as soil adsorption potential, effluent loading rate and groundwater velocity. However, the more phosphorus that is precipitated in the drainfield, the lower the phosphorus concentrations in the groundwater plume with measured values being typically less than 1 mg/L in systems with high drainfield phosphorus retention. This value is comparable to the current Ontario standard for most municipal sewage treatment plant effluent discharges, (OMECC, 2018).

Based on the above, I now believe that all new or renewed onsite wastewater treatment systems within 300 m of a waterbody should be constructed with approved filter sand that has a calcium content less than 1% (weight%, acid extractible). If such systems are constructed on calcareous soils, phosphorus plumes may still develop over time, but they will develop more slowly, and their phosphorus content should be low enough to avoid serious environmental damage.

It is generally accepted that failed septic systems may pose a public health risk, but they also may release high phosphorus content to the environment. Septic system reinspection has been introduced by many municipalities to address this concern. If all municipalities around our lakes required septic system reinspection and required the use of low calcium filter sand for all new and renewed systems within 300 m of waterbodies, our lakes would be protected from this potential source of environmental damage within 30 to 40 years. This would result in only a modest increase in cost to waterfront property owners. It is a small price to pay to protect substantial real estate investments and the publicly owned lakes on which much economic activity depends.

[1] Robertson, William D., Dale R. Van Stempvoort, Sherry L. Schiff, Review of phosphorus attenuation in groundwater plumes from 24 septic systems, Science of the Total Environment 692 (2019) 640–652.

Previously published in the OOWA newsletter, Onsite, Vol. 23, #3, Fall/Winter 2022.

The Natural Edge Program Continues into 2023

Kimberly Ong, *KLSA Director*

This past year was another wonderful year for the Natural Edge program! We restored five more shorelines, including our largest site yet, a 407 square-metre waterfront property that had been heavily damaged by the 2022 Spring windstorm. The Kawartha Lake Stewards Association (KLSA) has now restored over 1700 square-metres of shoreline, planting almost 1400 native shrubs, trees, and flowers at 15 sites on eight lakes: Lovesick, Big Cedar, Sturgeon, Big Bald, White, Upper Stoney, Stony and Buckhorn.

The Natural Edge program is available to all waterfront property owners in the Kawartha Lakes region who want to re-naturalize their shorelines. Landowners have joined the program for a wide range of reasons – to defend against erosion, to keep geese off the property, to provide better habitat for shoreline species, to protect our waters, to beautify the land, and even to reduce the need to mow! The goal of the Natural Edge program is to help landowners restore disturbed or altered shorelines back to a more natural state to realize all these benefits.

Mulch is placed around wildflowers to retain water. **Photo by Kimberly Ong**

Even shorelines with vegetation can be improved with native plants. **Photo by Kimberly Ong**

Each project is unique; volunteers help restore all types of shorelines! **Photo by Tina Warren**

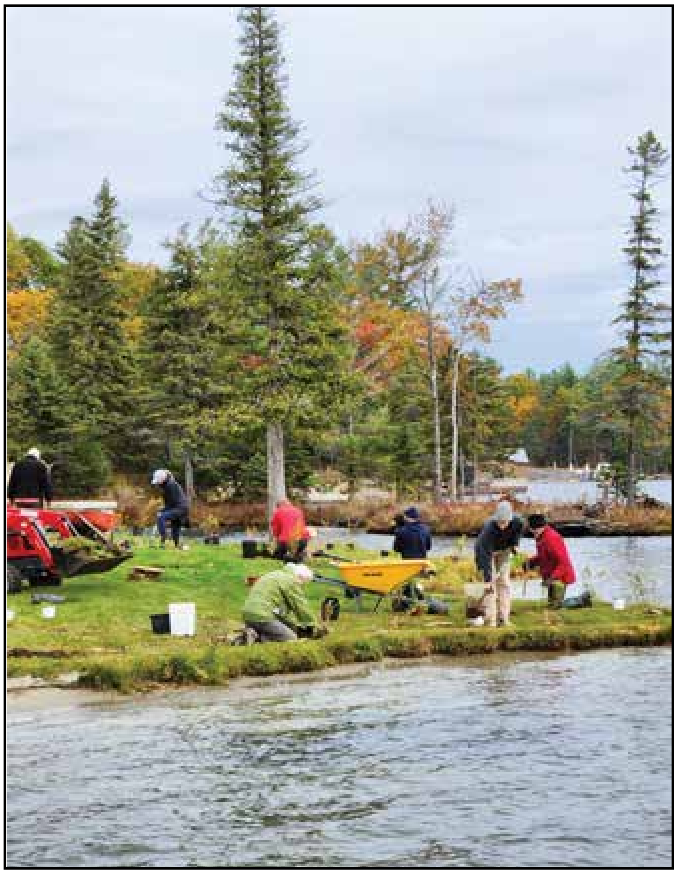
Volunteers help restore beautiful shorelines. **Photo by Kimberly Ong**

The Natural Edge Program Continues into 2023

As part of the program, we first visit your site, evaluate the conditions, and discuss your shoreline concerns and your vision for a restored shoreline. Then, using Watersheds Canada's specially created app, we design a personalized planting plan. This plan allows landowners to visualize the restoration and includes photos of the planting areas mapping the various native plant species. The plan also includes a description of the land characteristics of the planting area and information on each native plant, shrub, and tree that will be planted. We then order the plants on your behalf, planting materials like soil, mulch, planting mats, and tree guards to help the plants take root, and provide materials such as shoreline care guides. KLSA volunteers will pick up the plants and deliver them directly to the property! We can even bring volunteers to help with the planting, if you would like us to help. The cost to each owner is typically $250 to help offset the plant costs. It takes about three years for the plants to fully establish and fill the shoreline.

As interest in the Kawartha Lakes community grows, we continue to seek funding to support and expand this program into the future. We will continue the program in 2023 with continued support from our partners at Watersheds Canada. We were able to deliver the program in 2022 due to the wonderful support of the Environment Council. Funding support for the Natural Edge Program has been provided by the Daniel and Susan Gottlieb Foundation and the RBC Foundation 'RBC Tech for Nature Fund'. Chloe Lajoie of Watersheds Canada continued to provide the expertise and support to help us deliver the program. We were also lucky to have many volunteers from the local community, universities, and schools helping plant this past year - thank you to all of you, you were instrumental to the success of this program!

Find out more about the Natural Edge Program at https://naturaledge.watersheds.ca/. If you are interested in transforming your shoreline into a naturally beautiful, cost-effective, eco-friendly 'natural edge', please contact kim.ong@klsa.info.



Volunteers help naturalize a shoreline in October 2022.
Photo by Kimberly Ong

Volunteers help naturalize a shoreline in June 2022.
Photo by Kimberly Ong

Starry Stonewort Monitoring Project Review and New Direction

Carol Cole, *Starry Stonewort Monitoring Project Lead and KLSA Director*

KLSA's Starry Stonewort Monitoring Project began in 2020. We asked volunteers to do rake-toss aquatic plant sampling in 1-3 locations on their lake from mid-July until the end of September. Each sample was examined to determine if it contained the invasive species starry stonewort (SSW). Volunteers then recorded their observations using an app on their cellphone or computer. The goals of the project were to increase public awareness of SSW, to encourage lake users to learn how to identify it, and to contribute to invasive species distribution mapping efforts. Planning for our 2022 SSW season began, like always, with a review of how the project went the year before. Feedback from both our experts at Ontario Tech University, and our 2021 volunteers indicated a number of areas for improvement. The challenges arose from two key areas: accurate identification of SSW, and the use of the EDDMapS app.

The most significant challenge faced by our volunteers in 2021 was accurately identifying SSW. SSW is a tricky species to identify, even for trained biologists, so it was not surprising volunteers had some difficulty. There are a number of native look-alikes which are easily confused with SSW. As well, SSW, like many plants, can look different over the course of the growing season and under different conditions. As observations were submitted it also became clear that many volunteers had limited prior knowledge about aquatic plants common in our lakes. This made figuring out which plant might be SSW even more difficult for volunteers. In order for observations of SSW to be verified, volunteers were required to submit clear photos showing the plant structure, and distinguishing characteristics. This requirement was not understood by some volunteers so possible observations of SSW could not be verified.

The reporting method for observations was also a problem in 2021. Late in 2020, SSW had finally been added to the Early Detection and Distribution Mapping System (EDDMapS) so in 2021 we were quite excited to be able to use the EDDMapS app to enter our project observations. Unfortunately, the app proved to be less than user friendly for both our volunteers and our expert verifiers. Technical glitches in uploading observations, and difficulty entering information and photos were frustrating for volunteers. Another unanticipated disadvantage to using the EDDMapS app was that it did not promote volunteer learning about aquatic plants. With the EDDMapS app, only invasive species can be reported so there was no motivation to try and identify any of our native species. Volunteer feedback from our 2020 season, when the reporting app Survey123 was used, indicated that for many volunteers, trying to identify and report native species in their samples was actually their favourite part of the project. EDDMapS also did not create the same amount of volunteer engagement since there was often a delay between volunteer reports, expert verification and observation posting.

With these challenges in mind a number of changes were made for our 2022 project season. First, we decided to work primarily with returning volunteers. Feedback from our 2021 volunteers indicated some of the difficulties with SSW identification and the submission of verification photos were the result of our virtual training. We had overwhelmed our volunteers with too much information so our core instructions got lost. Working with returning volunteers allowed us to focus our June training session specifically on SSW identification and photo requirements. This resulted in less identification confusion and better quality photos being submitted in 2022.

Carol Cole sorting aquatic plant samples at Carveth's Marina, Stony Lake

Starry Stonewort Monitoring Project Review and New Direction

Due to the issues experienced with the EDDMapS app, volunteers were asked to use the more user-friendly iNaturalist app to report their findings in 2022. Along with being more user-friendly, the iNaturalist app allows both native and non-native plants to be reported. iNaturalist also provides suggestions for identification and basic species information which meant volunteers could learn to identify species commonly found in their lake. Users of iNaturalist can also interact with each other by verifying, commenting, or making suggestions on other people's observations. A KLSA specific project was established so our volunteers could see what other volunteers were finding and where. This made participation in the project feel a bit more like a team effort and created more volunteer engagement. Although our observations were not directly entered into EDDMapS, it should be noted that any invasive species reported through iNaturalist will at some point be uploaded to EDDMapS by the Invading Species Awareness Program.

Our 2022 project team consisted of 26 volunteers from 8 lakes (Big Bald, Jack, Katchewanooka, Scugog, Upper Buckhorn, Lovesick, Stony and Sturgeon), and Nogies Creek. From mid-July until October, project volunteers entered 257 observations of 35 aquatic plant species into iNaturalist. Of the 257 observations, only 14 were observations of possible SSW. Twelve of the observations of possible SSW were from Stony, Big Bald and Scugog Lakes. This was not surprising since SSW was previously known to be present in those lakes. The two observations of SSW from Sturgeon Lake were significant because the presence of SSW had not previously been reported there. Volunteer Alan Crook's Sturgeon Lake observation was verified by biologist Dr.Tyler Harrow-Lyle. Dr. Harrow-Lyle also noted that SSW was previously observed by researchers on Sturgeon Lake but it had not been reported through iNaturalist or EDDMapS. Thanks to Alan Crook reporting the presence of SSW on Sturgeon Lake, it is now part of the Invading Species Awareness Program's (ISAP) species distribution record.

Prior to the launch of our project in 2020, SSW was not mentioned on the websites of invasive species organizations in Ontario. Largely due to increased public awareness both the Invasive Species Centre, and the ISAP websites now include SSW information. SSW is also routinely mentioned during invasive species webinars. In 2020 there was no publicly available distribution record of SSW in Ontario. Although a number of researchers were aware of various infestations, that information was not widely known. Our public awareness efforts provided the impetus to have SSW added to EDDMapS and a record of SSW in Ontario is now available to anyone. The original goals for the project: to create more awareness of a little known invasive species, to encourage lake users to learn to identify it, and to contribute to distribution mapping efforts have largely been met. This means it's time for KLSA to set some new goals.

Volunteers Patty MacDonald and Greg Finlay doing aquatic plant sampling on Stony Lake

Through our SSW Monitoring Project we've learned that there is public interest in life beneath the surface of our lakes. People would like to know what the aquatic plants they encounter in the lake are. From an invasive species perspective that's important. If we know the plants that are commonly found in our lake there is a better chance of early detection when a new, potentially invasive species is introduced. As well, creating better understanding of the important role aquatic plants play in the lake ecosystem may encourage lake property owners to appreciate a natural waterfront. For this reason KLSA plans to launch a broader aquatic plant project in 2023. We want to encourage people to get curious about life under the surface of their lake. Hopefully, by learning more about the incredible plants in our lakes we'll better understand why it is so important to protect them.

The Naturalization of the Invasive Species Fanwort (*Cabomba caroliniana*)

Nicholas Weissflog, MSc, *Environmental and Life Sciences Program, Trent University*

Organisms have been moving to new ecosystems presumably since there have been distinct ecosystems (Vermeij 2005). This process, variably called the process of invasion by some or the process of naturalization by others, has been much discussed in the context of invasive species management of which lake management is included. What has not been so heavily discussed is what comes after invasion: naturalization, or the manner in which, simultaneously, a new species integrates into a new ecosystem and an ecosystem integrates a new species. We do not tend to account for naturalization within invasive species management and it would be better if we did.

However, one reason naturalization has not been considered is that the timescale on which this was presumed to occur was an evolutionary one, i.e., hundreds to thousands of years (e.g., Pysek and Richardson 2006), since naturalization would require an evolutionary response for integration to occur. In noticing that naturalization was not accounted for in my experience working in invasive species management, I designed a study with my Academic Supervisor Eric Sager to observe naturalization of the introduced species fanwort (*Cabomba caroliniana*) in Kasshabog Lake ecosystems.

In 2007 a study was conducted to assess the impact of the non-native aquatic plant species fanwort in Kasshabog Lake. Two sets of bays were studied: 3 with fanwort and 3 without. In each bay, the plants, invertebrates and fish were sampled to determine whether the fanwort was having a significant impact on the ecosystem through changes to its structure and function. In 2022, I revisited the 2007 study and went back to these bays to resample the plants and invertebrates. I was unable to sample the fish population.

In the bays that had fanwort 15 years ago, the fanwort had decreased from being 38% of the plant community (by weight) to 22%. The bays which previously contained no fanwort had subsequently been invaded and now had 55% fanwort. (see Figure 1).

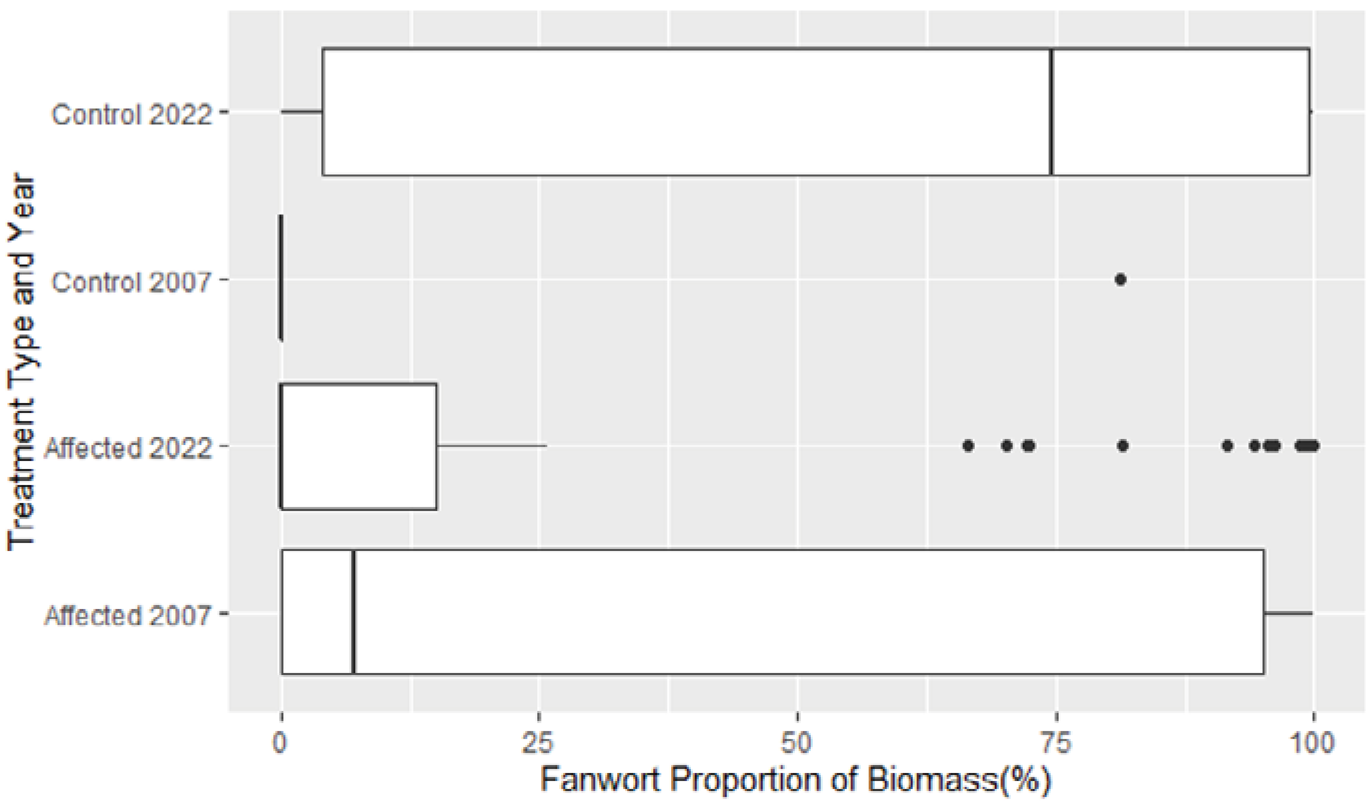


Figure 1. **Proportion of vegetation community biomass made up by fanwort ("Affected" indicates having had fanwort in 2007 and "Control" indicates having no fanwort in 2007).**

Species richness in the bays with fanwort 15 years ago had increased from an average of 12 to 13.3, a level close to the sites with no fanwort in 2007 which had an average species richness of 15.3.

The fanwort did not appear to categorically exclude other species. It was only very mildly negatively correlated (R=0.21) with tapegrass (*Vallisneria americana*), which means it tends not to grow close to it and otherwise did not significantly change the way the plant community operates. Every site, no matter whether there was fanwort or not, had an average of around 3 species per 0.1 m^2 space of the lake bed. On measures of diversity, over the course of the 15 year period, the bays with fanwort in 2007 had their diversity measures (Shannon's and Simpson's diversity index) increased to values that were very similar to the sites without fanwort in 2007 - they returned to a diversity level similar to what it had been prior to fanwort introduction. In addition, the bays without fanwort in 2007 saw their diversity scores in 2022 drop to levels that were not significantly different from the fanwort sites in 2007, as all of these sites had fanwort move into them in the time between 2007 and 2022.

Figure 2: **A fanwort flower with a true bug on the stem. Photo by Nick Weissflog**

The invertebrate community in the two sets of bays in any same year comparison were very similar. In 2007 the invertebrate communities in sites both with and without fanwort had functioning and diverse food webs. There were many of the different types of invertebrates you would expect in a lake present in these sites: dragonflies, damselflies, mites, scuds, mayflies, caddisflies, beetles and more. In 2022 the invertebrate communities in all sampled bays were also very similar regardless of the amount of fanwort present. The abundance or absence of fanwort did not seem to affect the structure of the invertebrate community.

This research indicates that 15 years seems to be a relevant timescale over which significant naturalization can occur. Fanwort proportions have declined significantly in the bays containing fanwort in 2007 (see Figure 1) and the community structure is now significantly approaching the native control sites without fanwort in 2007 (see Figure 1).There are no detectable differences in the invertebrate community on any metric we used, and no significant differences in richness at a quadrat level (spatial scale 0.1 m^2) were seen between any treatment type/year grouping. Site level richness (site spatial scale, on average ~20,000m^2+/- ~4,000 m^2) has significantly increased in the legacy sites and has significantly reapproached the levels seen in the no legacy fanwort sites in 2007, all of these are, to myself, indications that significant naturalization has occurred within 15 years.

What are the implications of this study for lake management? To myself I think it indicates that it would be wise to take the emphasis off invasive species control done for ecological reasons and onto ecological restoration and mitigation of impacts with the aim of supporting the ecosystem processes that allow new species to be integrated into a food web over time and eventually become regulated in a similar way to what was observed here. Prevention of the spread of introduced species remains important, clearly they have an impact on the ecosystem initially and mitigating compounding impacts to the lakes we love is important, however they will integrate over time and attempting to eradicate once spread has occurred is unrealistic and unsustainable as well as, sometimes, counter productive as herbicide and physical removal often add additional human impacts, recreating conditions that allow for invasion to occur.

Most of the bays that I studied were uninhabited barring a couple of cottages and were largely undisturbed, I suspect this reduces the timeline it takes for a species to integrate successfully on the spatial scale of a small bay (~20,000 square metres) as it has long been suggested that invasion is facilitated by

The Naturalization of the Invasive Species Fanwort (*Cabomba caroliniana*)

Figure 3: **Fanwort stems and flowers. (Government of Ontario 2023, Photo by Sam Brinker)**

human created disturbance (Elton 1958; Williamson et al. 1986). Finding ways to reduce your shoreline impact and support ecological restoration, particularly of wild rice which provides more habitat than any other aquatic plant (Aiken et al. 1988) and has been missing in many lakes in the Kawarthas, are some of the best ways to reduce the initial impacts of newly introduced species while the ecosystem (including human beings) is still figuring out how to learn to live with them.

References

1. Aiken, S.G., Lee, P.F., Punter, D., and Stewart, J.M. 1988. Wild Rice in Canada. Agriculture Canada Pubi. 1830. New Canada Publ., Toronto. 130 pp.

2. Elton, C. 1958. The Ecology of Invasions by Animals and Plants. T. Methuen and Co., London. http://dx.doi.org/10.1007/978-1-4899-7214-9

3. Government of Ontario 2023. Fanwort. URL: https://www.ontario.ca/page/fanwort

4. Vermeij GJ (2005) Invasion as expectation: a historical fact of life. In DF Sax, JJ Stachowicz, and SD Gaines, ed. Species invasions: insights into ecology, evolution and biogeography, pp. 315–339. Sinauer Associates, Inc., Sunderland, MA.

5. Pyšek P and Richardson DM (2006) The biogeography of naturalization in alien plants. Journal of Biogeography, 33, 2040–2050.

6. Williamson, M. H., Brown, K. C., Holdgate, M. W., Kornberg, H., Southwood, R., & Mollison, D. (1986). The Analysis and Modelling of British Invasions [and Discussion]. Philosophical Transactions of the Royal Society B: Biological Sciences, 314(1167), 505–522. doi:10.1098/rstb.1986.0070

Friends Kayaking. **Photo by: Stephanie Lake, Lakefield**

Purple Lake Sunrise. **Photo by: Stephanie Lake, Lower Buckhorn Lake**

Preventing the Spread of Aquatic Invasive Species: Ontario's Volunteer Water Steward Program

Alison Morris, *ISAP Coordinator, Ontario Federation of Anglers and Hunters*

With over 250,000 lakes and over 100,000 km of rivers, Ontario's waterways offer an almost endless landscape of recreational opportunity for watercraft users. Although recreationists are some of the greatest advocates for conservation, our activities are not without impact. The movement of watercraft has, unfortunately, been a major contributor to one of the province's greatest ecological threats: the spread of aquatic invasive species (AIS).

Hearty Hitchhikers

AIS can be resourceful little critters. They stow away in small puddles of water at the back of your boat, they stick to the underside of its hull or equipment, and they hide in the live-well. While most of us are familiar with how easily pieces of vegetation can get caught up in our trailers and gear, what many people don't realize is that even the smallest piece of some invasive aquatic plants, like Eurasian watermilfoil (*Myriophyllum spicatum*), can produce roots and re-establish itself.

When AIS do re-establish, whether it's in another section of the same lake or an entirely new waterbody, these aquatic invaders have the potential to cause serious damage. Over the last few decades, AIS have been the root cause of many severe losses in biodiversity, recreational opportunities, and even property values across Ontario.

Taking Action

Over the last several years, the Invading Species Awareness Program (ISAP) has implemented various initiatives targeting recreational anglers and boaters to promote actions we can all take to help protect our aquatic environments. With funding support from the Ontario Trillium Foundation's Grow Grant Program, the ISAP launched their new volunteer-based **Water Steward Program**, recruiting volunteers in the Durham, Haliburton, Kawartha, and Pine Ridge regions.

Given these outreach programs, the Ontario Federation of Anglers & Hunters (OFAH) and ISAP are pleased to see the Ontario government respond to this growing risk by addressing the boater pathway. Effective January 1, 2022, the Ontario government has regulated watercrafts (i.e., boats, canoes, and kayaks) and watercraft equipment as "carriers" under the *Invasive Species Act, 2015*.

Practising good watercraft stewardship

What are the new rules?

Boaters are now required to take reasonable precautions to ensure, before reaching a launch site or placing a watercraft in any waterbody in Ontario, that it is free of all aquatic plants, animals and algae. This includes boats, boating equipment, vehicles, and trailers. Boats must have drain plugs open or removed to allow water to drain from the boat and equipment before transporting them overland.

What does this mean?

Effectively, these new regulations make it a legal requirement for boaters to perform the first two steps of "Clean, Drain, Dry". These regulations exist to ensure that watercraft users of all kinds, whether recreational or professional, do not inadvertently transport invasive organisms between waterways.

The **Clean, Drain, Dry** message is:

✓ **CLEAN** the boat and all related equipment before leaving the waterbody and ensure it is clean before entering a new one. Look for any mud, vegetation, mussels, or other suspicious debris stuck in or on the vessel and its equipment.

✓ **DRAIN** all standing water by pulling the transom plug, draining the live-well, lowering the motor, and draining all other water-containing devices on the vessel. Draining helps to eliminate small organisms, such as spiny waterfleas and zebra mussel larvae from the vessel.

✓ **DRY** or disinfect. To eliminate unseen organisms, you can dry the vessel for at least 5 days in sunlight or clean it from top to bottom with hot water over

Preventing the Spread of Aquatic Invasive Species: Ontario's Volunteer Water Steward Program

50°C or pressurized water of at least 2500 psi.

How can you do more?

Though cleaning and draining are the only legally required actions, we still encourage you to prevent the spread of pathogens like viral hemorrhagic septicemia (VHS) by disinfecting the inside of your live-well with a 10% household bleach solution (100 ml of bleach to 900 ml of water) each time you leave a waterbody. Spray the inside of your live-well with this solution, then rinse it out with clean water (at least 30 metres away from any waterway).

Report!

Remember, if you think you've seen an invasive species, report it! Take a photo, mark your location, and call the Invading Species Hotline at: 1-800-563-7711 or report online at: www.EDDMapS.org

If you would like to become involved in the **Water Steward Program**, or to learn more about this or any other ISAP project, you can visit our website at: http://www.invadingspecies.com/.

Or contact Jeff Berthelette at: jeff_berthelette@ofah.org

To learn more about Ontario's new boater pathway regulations and other changes to the Invasive Species Act, 2015, visit: https://www.ontario.ca/page/invasive-species-ontario.

2021 Kawartha Lakes Sewage Treatment Plants Report

Mike Dolbey Ph.D., P.Eng., *KLSA Volunteer*

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 considerable public dollars are spent to build and operate these plants to protect our health and the environment. Municipalities fund STPs by charging the users of the systems an annual levy but they also receive grants from the federal and provincial governments, i.e., all taxpayers, that partly offset the cost of capital projects to repair, upgrade and increase the capacity of STPs.

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 rate to 95% means five parts in 100 leave the plant, which is five times more phosphorus released compared to 99% removal rate. What might seem like a small change in removal rate 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 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 included but they were provided upon request.

Again this year we have included three STPs, Minden, Nonquon (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. The average annual removal rate in 2021 was 97.51% without accounting for bypasses. Three bypasses of the tertiary sand filters occurred due to weather events in March, September and December. An estimated 3957 m^3 of partially treated sewage entered the river. Based on samples taken during these events it is estimated that the additional P load to the river was 0.39 kg. This increased the total annual P load to 18.8 kg, much higher than last year's 11.1 kg. The Minden STP's effective removal rate was 97.46% compared to 98.1% last year. No other spills, bypasses or overflows were reported, and no complaints related to the plant's operation were received during the year.

Average *E. coli* discharges were generally low during the year. The geometric mean of samples during the year ranged from 1.7 to 10.2 cfu/100 mL with an average value of 4.3 cfu/100mL, well within the plant's Certificate of Approval level of 200 cfu/100mL.

Coboconk

This lagoon system continued to function well in 2021, with planned discharges to the Gull River just above town occurring in April and December. The average phosphorus content of all effluent discharges was less than 0.04 mg/L. 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 eleven years, the overall phosphorus removal rate was greater than 97.0% during that period and the 2021 total annual discharge of phosphorus was estimated to be 2.7 kg.

The geometric mean of *E. coli* in the discharges in spring and fall were 6.7 and 1.26 cfu/100mL respectively. No spills or bypasses occurred during 2021, however there were three complaints about odour received during the year.

Fenelon Falls

In 2021 the Fenelon Falls Waste Water Treatment Plant (WWTP) again had difficulty coping with winter rain and snowmelt events. However, unlike last year, the problems were not with the Colborne Street sewage pumping station or the new Ellice SPS wet weather flow detention tank. At three different times, the volume of flow into the WWTP required partially treated wastewater to bypass the tertiary sand filters. However, all secondary treatment and disinfection was carried out. These three events, in January, March and December, resulted in approximately 3.0 kg of phosphorus to enter the lakes. The annual average removal rate of the plant was 97.4%, up from last year's 94.4% and the overflow and bypasses reduced the overall removal efficiency to 97.2%. This resulted in a P discharge to Sturgeon Lake of 55.5 kg for the year compared to 39.6 kg last year, despite similar influent flow volume. This unusual situation arose because the reported monthly influent TP concentrations in 2021 were typically 2.8 times higher than those in the past four years. The reason is unknown. However, since only one influent sample is taken each month and the influent is far from homogeneous, it may just be a low probability statistical fluke.

In 2021 *E. coli* levels in the effluent from the Fenelon Falls WWTP were generally low with an annual average geometric mean of 7.5 and a maximum of 34 cfu/100mL. No complaints about plant operations were received in 2021.

Lindsay

The Lindsay WWTP is the largest on the lakes. The City of Kawartha Lakes (CKL) owns the Lindsay plant and operated it until the end of July 2015 when its operation was contracted to the Ontario Clean Water Agency (OCWA) which operates all the other sewage treatment plants owned by CKL. Prior to 2015 the quantity of raw influent was not measured but reported to be equal to the measured quantity of effluent leaving the plant. This is a conservative estimate that does not include the volume of sludge removed during treatment which is typically 2% to 4% of the influent volume. The same procedure is used in the Fenelon Falls and Bobcaygeon plants. After 2015, influent volumes have been reported as being 15% to 18% higher than effluent flows which results in calculated phosphorus removal rates being 0.5% to 1% higher than they would be if using the former method. Upon enquiry I was told that effluent flows at all plants are measured with electromagnetic flow meters which are accurate reliable devices. At the Lindsay plant the influent flow is measured with a Parshall flume which has its limitations especially when flows are high. This year KLSA has used the sum of effluent and sludge volume to estimate the influent volume at the Lindsay plant which resulted in a calculated phosphorus removal rate that is believed to be more accurate and consistent with those calculated at other plants.

In 2021 the Lindsay WWTP had considerable problems with aerator breakdowns causing low dissolved oxygen conditions that resulted in higher-than-normal Total Phosphorus, *E. coli* and other parameters in the effluent during the months of June, August and October. No bypasses or abnormal discharges from the plant were reported. One spill occurred in July adjacent to the plant's aeration lagoon, but it was cleaned up without any escaping the area. It is estimated that the 2021 annual average phosphorus removal rate was 95.2%, down from last year's 97.7%. This resulted in a P discharge to Sturgeon Lake of 754.7 kg, more than double last year's 307.4 kg.

The annual average geometric mean of *E. coli* in the discharge was 259 cfu/100mL with a maximum of 1327 cfu/100mL in August. No complaints about the operation of the STP were reported in 2021.

Bobcaygeon

The significant improvement in the performance of the Bobcaygeon WWTP in 2019 continued in 2021. It appears that the 2019 repairs to sanitary sewers to reduce infiltration have substantially reduced inflows during wet weather easing the load on the plant. In 2021 the plant appeared to operate well with no reported bypasses, overflows, spills or abnormal events. Despite this, in 2021 the average phosphorus removal rate for the Bobcaygeon WWTP was calculated to be 96.3%, down from last year's 97.8%. The reported annual phosphorus load to the lake was 64.2 kg, up from last year's 37.9 kg. As discussed last year, only one influent sample is tested for Total Phosphorus each month and monthly results vary considerably. Hence calculated removal rates are influenced by this variability.

The annual average geometric mean density of *E. coli* in the discharge was 6.8 cfu/100mL with a maximum of 33.5 cfu/100mL in July. Several minor complaints about odour were received during the year and maintenance was performed.

Omemee

This facility consists of two large settling lagoons. Until 2014 all 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 with the intension that it would dispose of all the effluent. However, problems with the capacity of this system have required that both the spray irrigation and subsurface disposal systems be used in the past. In June 2020, the City of Kawartha Lakes gave notice of a Class Environmental Assessment study of the Omemee large subsurface disposal system (LSSDS) to evaluate long term solutions to its capacity issues. Consulting firm Greer Galloway was contracted to carry out the study. The final proposed solution was presented at a virtual public meeting on May 25, 2022; I was the only member of the public that attended! The proposed improvements include treatment of the effluent to reduce suspended solids and algae, enlarged wet well, improved distribution system to allow reduced hydraulic loading of the LSSDS and the concurrent use of both the LSSDS and the spray irrigation system. In 2021 all the effluent was directed to the subsurface disposal system and none was sprayed.

The average effluent phosphorus concentration in 2021 was 0.39 mg/L, almost double last year's 0.21 mg/L but 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 2021 the effluent discharged was about 111% of the influent volume. Based on the numbers provided, phosphorus removal was estimated to be ~84% with ~82.9 kg being distributed to the subsurface system. However, because the effluent is disposed of far from Pigeon Lake, removal is probably 100% with respect to our lakes.

The annual average geometric mean density of *E. coli* in the effluent was a rather high 3496 cfu/100mL this year, but it was disposed of in the subsurface system. This lagoon facility did not require any emergency discharges to the Pigeon River in 2021 and there were no bypasses, overflows or abnormal discharge events reported. However, there was a very small spill of <0.05m^3 in an air release chamber that was quickly dealt with. No complaints were received about the operation of the STP or collection system.

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.

The King's Bay STP treats sewage using two Rotating Biological Contactor (RBC) units. Both RBCs were used to treat waste during the first half of 2021 but RBC2 failed in July. Replacement was expected by early 2022. Total Suspended Solids (TSS) in the effluent continued to be higher than desired and process parameters were adjusted in an attempt to rectify the situation. Effluent TP concentration of discharge to the underground disposal beds averaged 0.36 mg/L, similar to the 0.37 mg/L in 2020, out of an allowable 1.0 mg/L. The annual daily loading for 2021 was 0.015 kg per day, about 10% of the allowable discharge of 0.17 kg per day. The annual average phosphorus removal rate within the plant was 98.8% this year. No bypasses, spills or abnormal discharges occurred in 2021. One complaint was received about long grass/weeds on the leaching beds. The area has been added to the grass cutting contract for maintenance.

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 the two upgradient wells have remained low over the past four years. However, a number of downgradient wells have had variably high readings for a few years but with no consistent pattern to the high readings. In 2021, one well in each of the downgradient ranks had an intermittent high reading. The purpose of the monitoring wells is to detect phosphorus migration towards the lake or the Nonquon River. Since these wells are on average 100 m from the lake or the Nonquon River, it is probable that, at least for the time being, there is still effectively 100% removal with respect to the lake.

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. A new modern plant designed to treat wastewater at an average daily flow rate of 5900 m^3/d was commissioned in 2017. The new system performed well in 2021. Previous difficulties with the scum removal system were not mentioned in the 2021 report and it is assumed they have been solved.

In 2021, phosphorus was reduced to an annual average of 0.047 mg/L for a total loading of 49.8 kg, well down from last year's 86.3 kg. This reflects a removal rate of 98.8%, close to our target of 99%. Monthly *E. coli* levels this year were between 1 and 77 cfu/100mL. There were no reported bypasses, spills or abnormal discharges, and only one unsubstantiated odour complaint was received during 2021.

Summary

The total weight of phosphorus discharged to the mainstream Kawartha Lakes from the Lindsay, Fenelon Falls and Bobcaygeon WWTPs in 2021 was 874 kg, more than double last year's 385 kg. If we include all the plants that we now monitor, we had total phosphorus loading to the lakes of 946 kg in 2021 compared to 485 kg in 2020. If all plants had achieved the 99% removal rate that we would like, the total phosphorus discharge for the year would have been about 344 kg or about 36% of the 2021 total.

KLSA Annual Review of Area Sewage Treatment Plant Performance

Plant Location - Discharges to & Type	Year	Phosphorus Removal Rate % (1)	Total Annual TP Load Out kg (2)	Annual TP Load if 99% kg (3)	E. coli (average) (cfu/100mL)	Bypasses, Spills, Comments
Minden - Gull River	2014	96.7%	19.4	5.8	9.0	None reported
Extended aeration activated sludge	2015	96.4%	17.9	4.9	68.0	None reported
process with tertiary treatment	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
	2018	96.2%	16.6	4.4	82	Bypass resulted in ~0.4 kg extra P load
	2019	95.3%	23.8	5.1	268	Bypass resulted in ~4.2 kg extra P load
	2020	98.1%	11.1	6.0	11.4	Bypass resulted in ~0.2 kg extra P load
	2021	97.5%	18.8	7.4	4.3	Bypass resulted in ~0.4 kg extra P load
Coboconk - Gull River Mill Pond	2014	>97.8%	< 3.1	1.7	3.7	None reported
Dual lagoons	2015	>98.0%	< 2.2	1.1	2.5	None reported
semiannual discharge to river	2016	>97.6%	4.2	1.2	3.4	None reported
	2017	>97.3%	5.1	1.1	2.7	None reported
	2018	>97.0%	4.0	1.2	1.6	Overflow of 50m^3 - no P load to Gull R
	2019	>96.9%	5.0	1.1	12.2	None reported
	2020	>96.9%	2.8	1.0	1.6	None reported
	2021	>97.9%	2.7	1.1	6.7	None reported
Fenelon Falls - Sturgeon Lake	2014	94.5%	51.8	9.1	2.0	Bypass resulted in ~ 21 kg extra P load
Extended aeration activated sludge	2015	96.3%	26.3	7.2	2.0	None reported
process with tertiary treatment	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
	2018	95.8%	34.0	8.0	2.2	Bypass resulted in ~ 1.5 kg extra P load
	2019	95.7%	33.7	7.7	9.0	None reported
	2020	93.9%	39.6	6.4	2.5	Bypass resulted in ~ 3.5 kg extra P load
	2021	97.5%	55.5	20.0	7.5	Bypass resulted in ~ 3.0 kg extra P load
Lindsay - Sturgeon Lake	2014	96.0%	622	149.7	2.6	Bypass resulted in ~ 402 kg extra P load
Flow equalization lagoons;	2015	>98.2%	<239.4	131.7	2.5	None reported
extended aeration activated sludge	2016	>98.6%	<176.8	134.3	3.5	None reported
process with Actiflo tertiary treatment	2017	97.5%	311.7	125.9	11.0	Overflow resulted in ~0.5 kg extra P load
	2018	97.4%	301.1	115.4	14.0	Overflow resulted in ~0.1 kg extra P load
	2019	97.2%	364.7	132.8	11.2	None reported
	2020	97.7%	307.4	131.2	4.0	None reported
	2021	95.2%	754.7	158.4	259.2	None reported
Bobcaygeon - Pigeon Lake	2014	97.9%	61.7	29.4	7.4	None reported
Extended aeration activated sludge	2015	98.0%	51.8	26.9	21.0	None reported
process with tertiary treatment	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
	2018	93.0%	171.3	24.4	98.8	None reported
	2019	96.7%	65.5	19.8	4.9	None reported
	2020	97.8%	37.9	16.9	2.8	Spill of 1 m^3 reported
	2021	96.3%	64.2	17.5	6.8	None reported
Omemee - Fields/Underground	2014	100.0%	0	0.0	-	None reported
Dual lagoons with spray irrigation;	2015	100.0%	0	0.0	143.0	None reported
pumped into underground disposal	2016	100.0%	0	0.0	496.0	None reported
beds beginning 2015	2017	100.0%	0	0.0	150	None reported
	2018	100.0%	0	0.0	172	None reported
	2019	100.0%	0	0.0	132	None reported
	2020	100.0%	0	0.0	190	None reported
	2021	100.0%	0	0.0	3496	None reported
King's Bay - Underground	2014	100.0%	0	0.0	-	None reported
Pumped into underground disposal	2015	100.0%	0	1.1	-	Spill resulted in ~1.14 kg release to lake
beds.	2016	100.0%	0	0.0	-	None reported
	2017	100.0%	0	0.0	-	None reported
	2018	100.0%	0	0.0	-	None reported
	2019	100.0%	0	0.0	-	None reported
	2020	100.0%	0	0.0	-	None reported
	2021	100.0%	0	0.0	-	None reported
Port Perry - Lake Scugog	2014	96.6%	144.2	42.4	-	None reported
Extended aeration activated sludge	2015	98.2%	69.7	37.8	-	None reported
process with tertiary treatment;	2016	97.8%	75.3	33.6		None reported
effluent discharge to Nonquon River.	2017	98.8%	52.3	45.3	2	None reported
	2018	99.0%	44.5	44.4	2	None reported
	2019	98.7%	52.0	40.9	1	None reported
	2020	97.9%	86.3	41.0	2	None reported
	2021	98.8%	49.8	39.9	21.5	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.

2022 *E. coli* Bacteria Testing Results

C. Lee & Mike Dolbey, *KLSA Volunteers*

KLSA volunteer testers were out on 15 Kawartha lakes during the summer of 2022, collecting water samples at 76 sites, 4 to 5 times over the course of the summer. We were pleased to welcome a new tester on Cameron and Sturgeon Lakes and the continuation of many volunteer testers on the other lakes. Thank you, all volunteers, for your dedication and hard work.

All results of 2022 tests are recorded in Appendix E.

In 2022 the number of tests for each site was reduced from 6 to 5, spread out over the same time period as in former years - Canada Day to Labour Day. With an increased cost for testing by SGS Laboratories, it was decided to reduce the number of tests per site rather than to increase the cost of testing per site. Based on KLSA's 20 years of *E. coli* testing, it was felt that the reduced number of tests would not significantly impair our ability to assess water quality.

Other than four new sites, two on Cameron and two on Sturgeon Lake, sampling locations were similar 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 both as a deterrent to geese and to reduce erosion and runoff.

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 more bacteria testing sites on Sturgeon or Cameron Lakes. For the past two years, C. Lee has been the coordinator for the western lakes and has transported samples to the SGS laboratory in Lakefield. An assistant willing to share this responsibility would be much appreciated. Please let us know if you are willing to help with this important program. If you would like to test a location of your choice on your lake, please contact KLSA. 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.

Year	Number of *E. coli* Readings (cfu/100mL)				
	Total	0-20	21-50	51-100	Over 100
2022	383*	330 (86.2%)	39 (10.2%)	10 (2.6%)	4 (1.0%)
2021	443	397 (89.6%)	38 (8.6%)	7 (1.6%)	1 (0.2%)
2020	383	357 (93.2%)	22 (5.7%)	3 (0.8%)	1 (0.3%)
2019	378	356 (94.2%)	16 (4.2%)	4 (1.1%)	2 (0.5%)
2018	376	347 (92.3%)	23 (6.1%)	6 (1.6%)	0 (0.0%)
2017	352	324 (92.0%)	16 (4.5%)	6 (1.7%)	6 (1.7%)

* 5 tests/site/year instead of 6 in previous years. Includes 14 retests.

***(Left) Waiting* for *Spring*. Photo by: Veronica De France, Clear Lake**

***(Right) Black and White View.* Photo by: Thomas Craig, Sturgeon Lake**

2021 Lake Partner Program Results
Total Phosphorus, Secchi Depth and Calcium

Mike Dolbey, *KLSA Director*
C. Lee, *KLSA Director*

Why measure phosphorus levels in lake water?

Phosphorus is regarded as the chemical that is most responsible for increased plant and algal growth in freshwater lakes. 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 and keep our lakes clear. The Ontario Ministry of the Environment, Conservation and Parks 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 (equal to 20 parts per billion, (ppb)).

• 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.

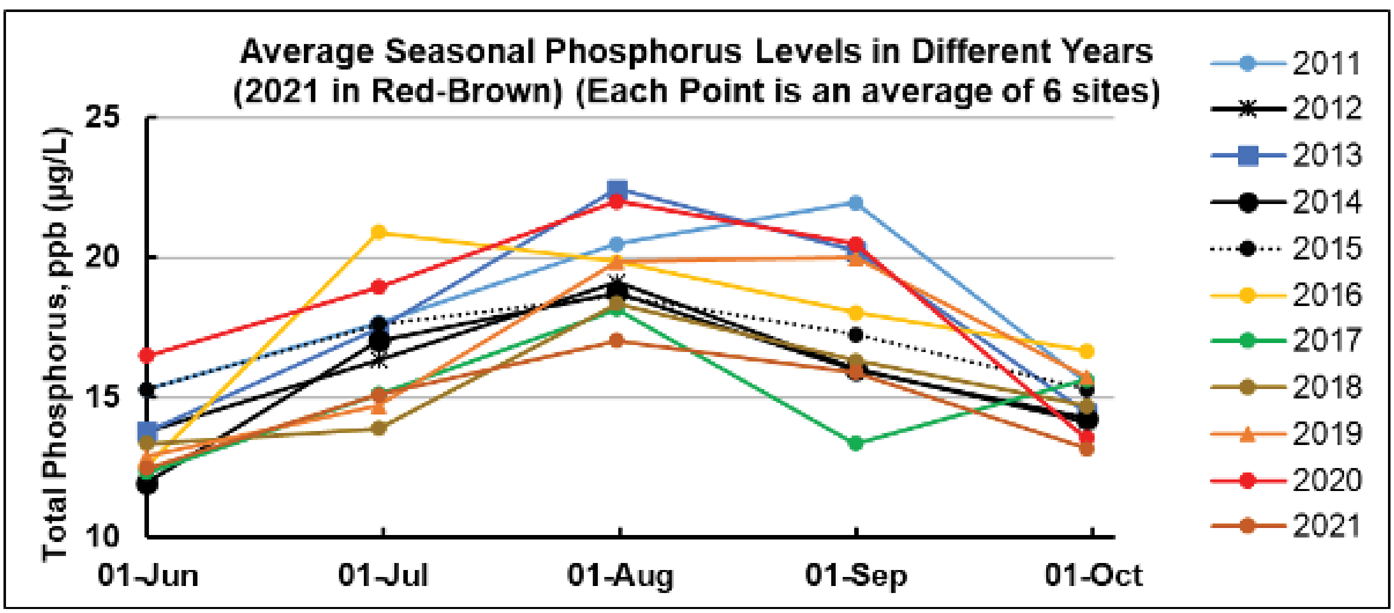
2021 Phosphorus Testing Results

Thank you to all our volunteer testers who were able to collect samples and measurements in 2021. The continuity of these long-term data sets to establish trends in this era of climate change is of great value. If you are unable to continue testing, please let any director in KLSA know, so we can help you find a replacement. The program is free, and kits are mailed to you along with instructions. We have fairly complete coverage of the Kawartha Lakes, but many volunteers would welcome an assistant.

After the COVID-19 pandemic decimated most of the 2020 Lake Partner Program (LPP) sampling season, we are pleased to report that testing in 2021 returned to normal. In 2021, total phosphorus (TP) and Secchi depths were measured at 47 sites on 17 lakes in our area. Four to six samples were collected at most sites between May and October. Samples were analyzed by the Ministry of the Environment, Conservation and Parks' Lake Partner Program. The TP data for hundreds of LPP sites on Ontario lakes can be found on the Federation of Ontario Cottagers' Associations (FOCA) website or in the Province of Ontario's Data Catalogue. Here we provide an analysis of the 2021 results for lakes in KLSA's area. The complete tables of TP measurements, Secchi depths and Calcium levels are presented in Appendix F.

Lake to Lake Phosphorus Results

In most of our Kawartha lakes TP varies seasonally starting low in the spring, increasing to a maximum in August/September before declining in the fall. The average seasonal variation, based on the same six sites across the system, for each of the past ten years is shown in the graph below. In 2021, while the variation remained typical, the maximum was the lowest in the past ten years. Over the years KLSA



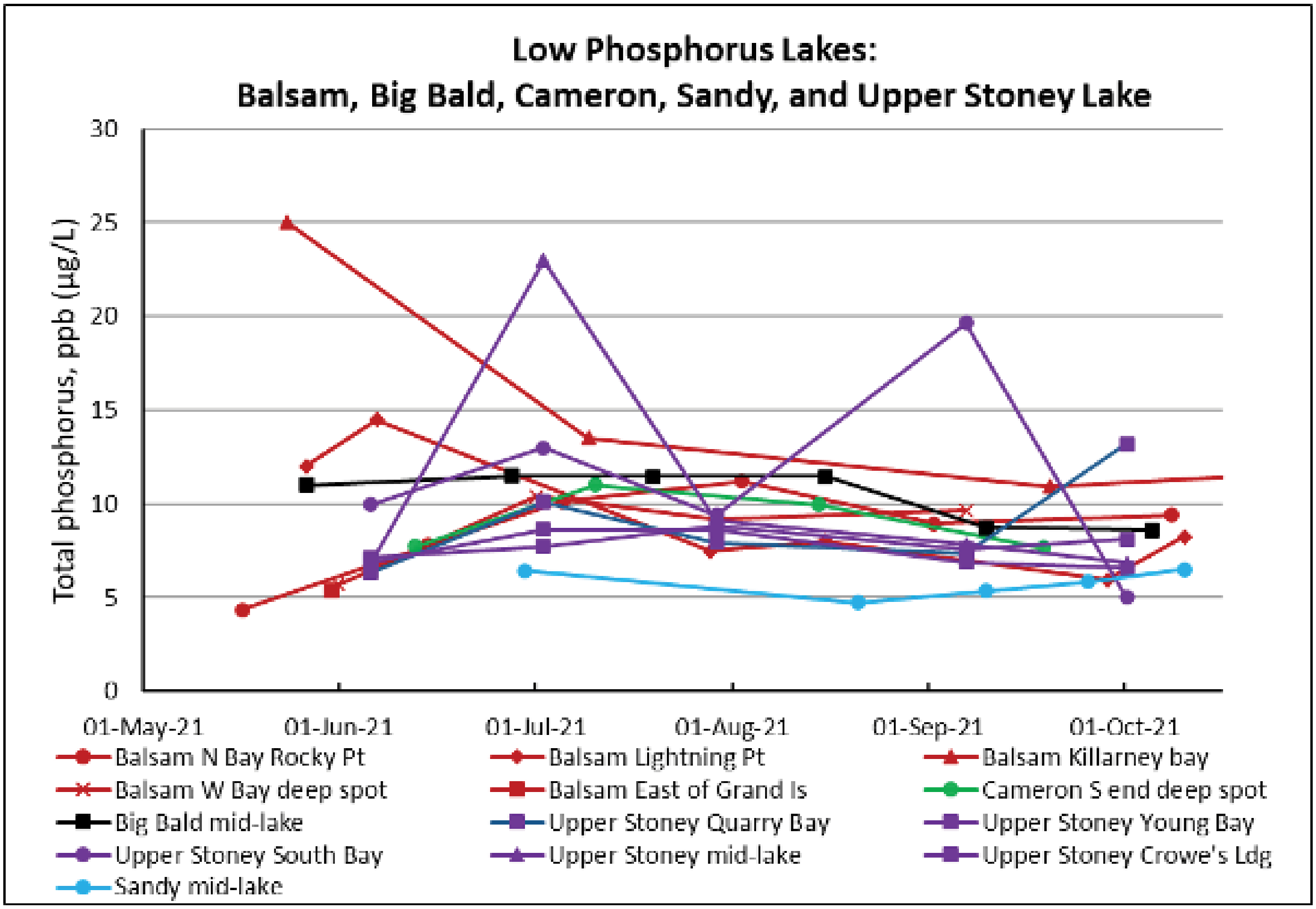
has attempted to determine what causes differences in TP levels from one year to the next with limited success. However, rainfall and its effect on flow in the Trent-Severn Waterway (TSW) appears to be a significant factor. Localized summer thunderstorms have relatively little effect but a day-long steady rain throughout the watershed often takes a week of high flow to restore TSW water levels. The high flows both flush the system of high phosphorus water and increase mixing of the surface and bottom water which reduces internal loading, i.e. the release of phosphorus from the sediments during anoxic conditions.

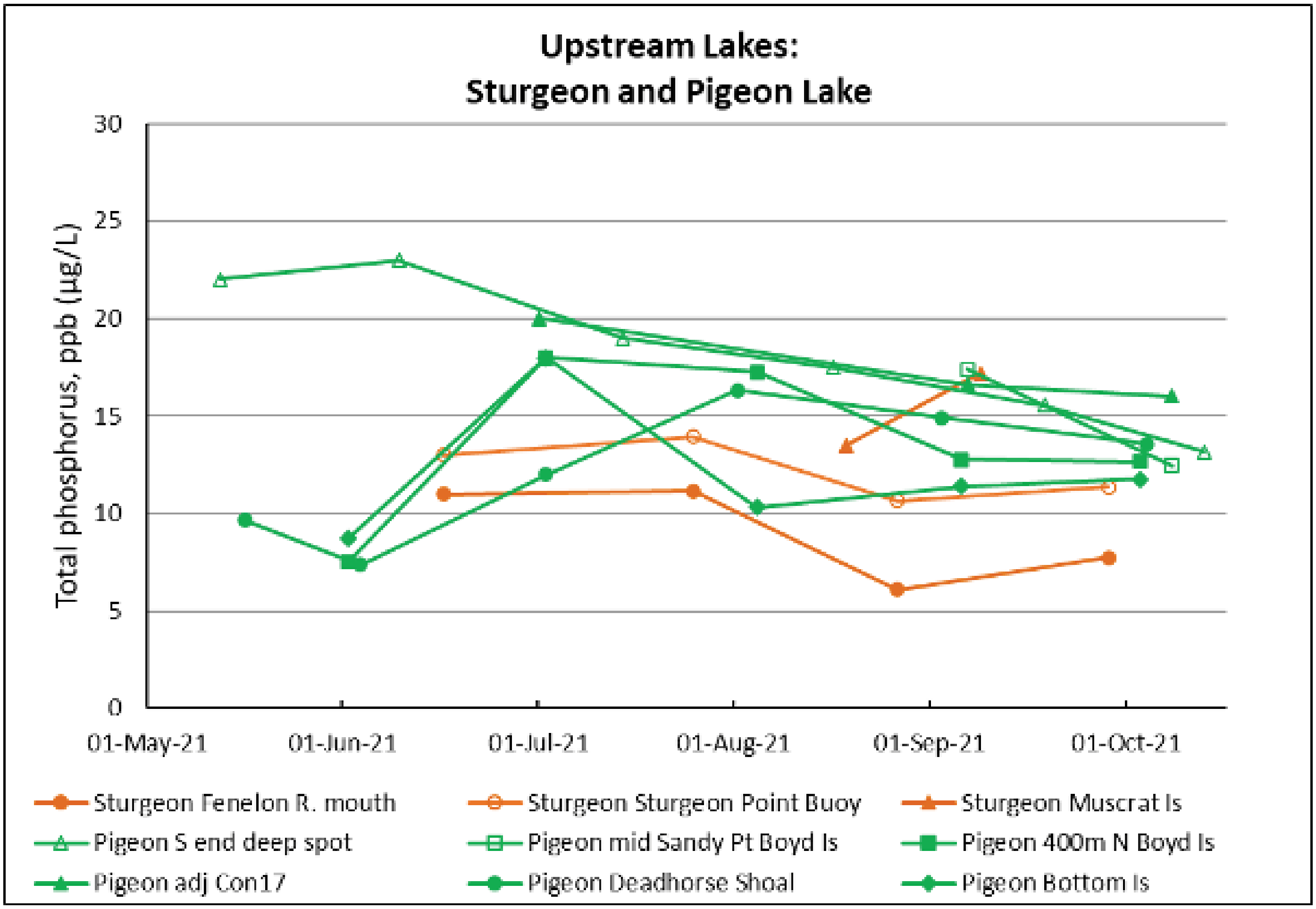
The winter of 2021 was characterized by moderate temperatures and little snow that resulted in an early and modest spring flood. May and June were quite dry followed by widespread rains in July that resulted in higher flow in the Trent-Severn Waterway throughout the month. August was dry with low flow followed by a wet September that again led to increased water flow that continued until late October as the Trent-Severn Waterway drew down the feeder lakes to prepare for next year's freshet. It appears that the widespread rains of July and September resulted in the lower than usual TP levels this year.

In general, the results for individual lakes follow a similar pattern to results from previous years. For consistency with past years, we present the results in graphical form grouped by the type of lake, Low Phosphorus Lakes, Upstream Lakes, Midstream Lakes and Downstream Lakes.

Low Phosphorus Lakes

The low phosphorus lakes traditionally have low, stable TP levels, being fed with low phosphorus water from the north. The early high readings in 2021 at Balsam Lake's South Bay/Killarney Bay site and Upper Stoney mid-lake are unusual and unexplained. The majority of readings fall between 7 and 12 µg/L, a bit lower than the 7 to 15 µg/L measured in 2019.





Upstream Lakes

Sturgeon Lake receives low phosphorus water from the Fenelon River to the north and high phosphorus water from the Scugog River to the south. This is reflected in the low results of the Fenelon River mouth site and higher readings at the Sturgeon Point site where the two flows mix. Unfortunately, we no longer have a test site in the high phosphorus south (Scugog) arm of Sturgeon Lake. Pigeon Lake receives water from Sturgeon Lake moderated by lesser inflows from the Bald Lakes and Nogies Creek to the north and the Pigeon River to the south. The high May and June readings at the Pigeon Lake south end deep spot are similar to 2019 and earlier results but we have little long-term data for this site. It is an important site because it monitors TP in inflow from the agricultural south of the watershed. Otherwise, the readings from Pigeon Lake follow the normal pattern but are generally lower in mid-year than in 2019.

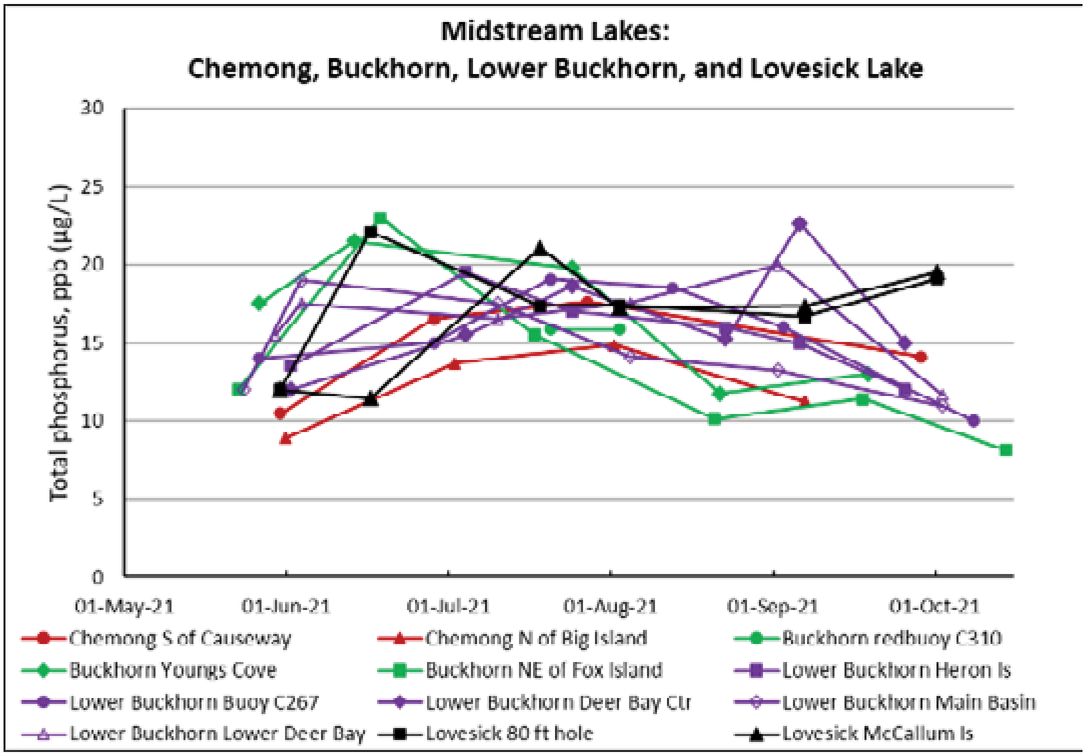
Midstream Lakes

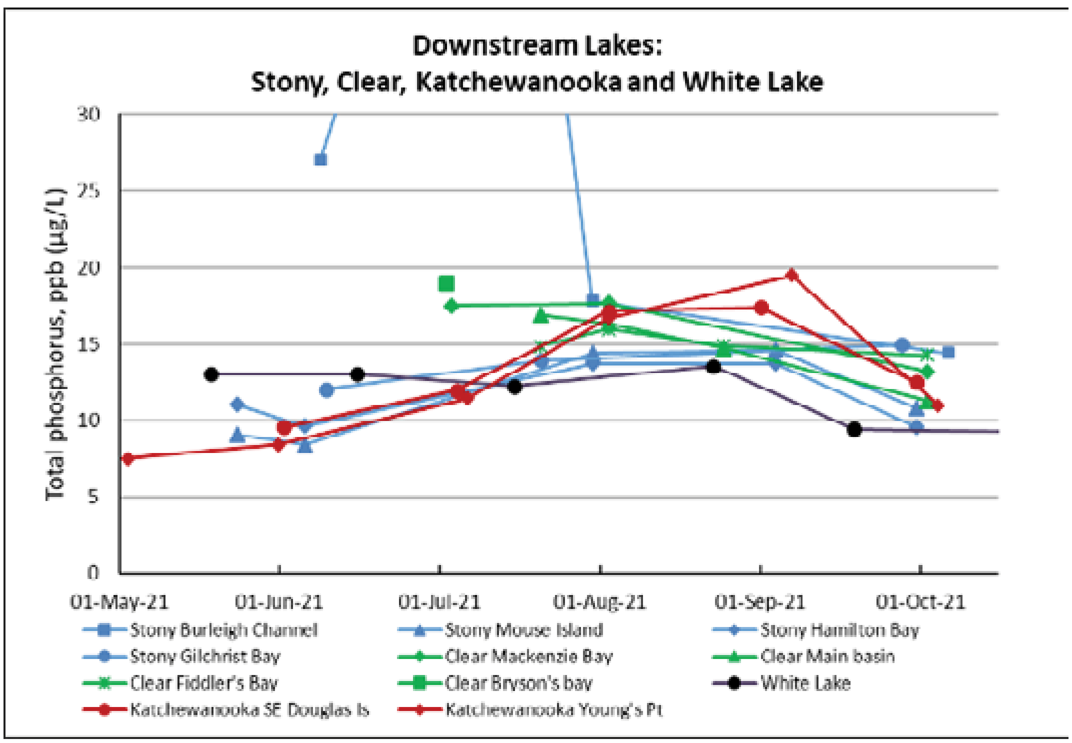
The midstream lakes usually have similar TP levels to the upstream lakes as was seen in 2021, including the generally lower mid-year levels compared to 2019. Two sites in the west end of Buckhorn Lake, sampled by different testers at about the same time in mid August, got similar low TP results for this time of year. TSW flow had been low for about a month by this time so flushing and mixing do not appear to provide an explanation.

Downstream Lakes

Higher phosphorus water flowing into Stony Lake from the midstream lakes is diluted with low phosphorus water from Upper Stoney Lake resulting in moderate levels of phosphorus in Clear and Katchewanooka Lakes. In 2021 we observed generally lower mid-year TP levels than in 2019 and lower early-year readings than in most years. The exceptionally high early results for the Stony Lake Burleigh Channel site are unusual and unexplained.

2021 Lake Partner Program Results
Total Phosphorus, Secchi Depth and Calcium





Summary of 2021 TP Results

In general, TP levels were lower in 2021 than they have been for the past ten years. While rainfall and its effect on TSW flow have been suspected to play some role in this result, no clear correlation has been found. Is it possible that, due to the COVID-19 pandemic, fewer people were visiting the Kawartha Lakes and that this has resulted in reduced phosphorus loading?

Kawartha Lake Stewards Association
Aquatic Plant Checklist

The Kawartha Lakes are home to a wide variety of amazing aquatic plants that play a vital role in our lake ecosystems. They sequester nutrients, filter suspended sediments, protect shorelines and provide important habitat for fish and wildlife. We've compiled a list of 30 species commonly found in our lakes. How many can you find in your lake?

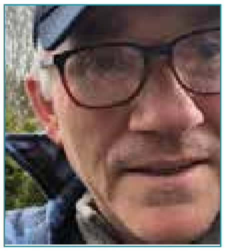
Share your observations with us by downloading the iNaturalist app onto your phone and joining our iNaturalist project: **Kawartha Lake Stewards Aquatic Plant Survey**.

** Indicates non-native species

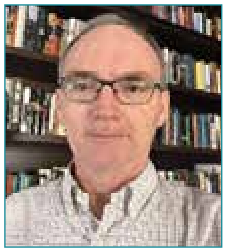
- ☐ Algae
- ☐ Arrowheads
- ☐ Bladderworts
- ☐ Bullrushes
- ☐ Canadian Waterweed
- ☐ Cattails
- ☐ Common Reed
- ☐ Coontail
- ☐ Curly-Leaved Pondweed **
- ☐ Duckweeds - star or common
- ☐ Eurasian and Hybrid Water-Milfoils **
- ☐ European Frog-bit**
- ☐ Fern Pondweed
- ☐ Flat-Stemmed Pondweed
- ☐ Fragrant Water Lily
- ☐ Large-Leaved Pondweed
- ☐ Muskgrass and Native Stoneworts
- ☐ Native Water-Milfoils (eg. Northern)
- ☐ Pickerelweed
- ☐ Richardson's Pondweed
- ☐ Slender Pondweed
- ☐ Starry Stonewort**
- ☐ Tape Grass
- ☐ Water Buttercup
- ☐ Water Marigold
- ☐ Water Nymph
- ☐ Water Star-Grass
- ☐ Watershield
- ☐ Wild Rice
- ☐ Yellow Pond Lily

Appendix A - Board of Directors, Scientific Advisors and Privacy Policy

2022 – 2023 Board of Directors

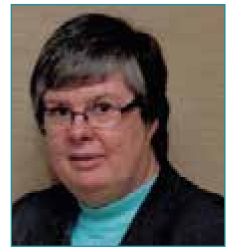


Robert Bailey
Chair[2]
Lower Buckhorn Lake

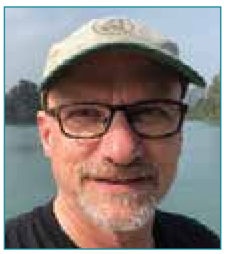


Tom McAllister
Vice-Chair
Lower Buckhorn Lake

Ed Leerdam
Treasurer
Nogies Creek

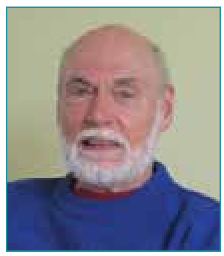


Sheila Gordon-Dillane
Secretary
Pigeon Lake

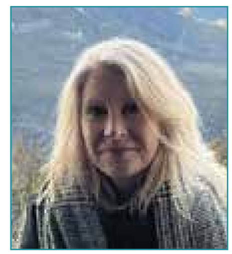


Jeffrey Chalmers[1]
Director
Clear Lake

Carol Cole
Director
Stony Lake



Mike Dolbey[1]
Director
Katchewanooka Lake

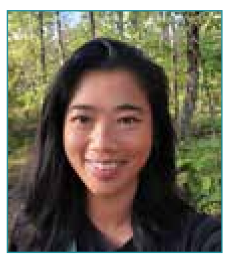


L'Anne Greene[2]
Director
Buckhorn Lake

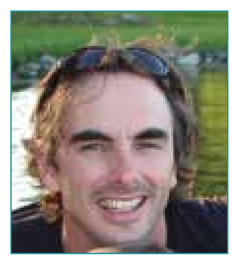
C. Lee[3]
Director
Balsam Lake

Darryl Kotton[2]
Director
Buckhorn Lake

Jacqui Milne
Director
Nogies Creek



Kimberly Ong
Director
Stony Lake



Brett Tregunno
Director
Omemee

[1] until October 1, 2022
[2] effective October 1, 2022
[3] until January 16, 2023

Scientific Advisors

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
Dr. Andrea Kirkwood, Associate Professor, Faculty of Science, Ontario Tech University, Oshawa

Appendix A - Board of Directors, Scientific Advisors and Privacy Policy

KLSA 2022 Annual Lake Water Quality Report

This report was prepared exclusively for the members of the KLSA, its funders, academics and researchers, other non-profit associations and individuals engaged in similar water quality testing in Ontario. The accuracy of the information and the conclusions in this report are subject to risks and uncertainties including but not limited to errors in sampling methodology, testing, reporting and statistics. KLSA does not guarantee the reliability or completeness of the data published in this report. Nothing in this report should be taken as an assurance that any part of any particular body of water has any particular water quality characteristics or is (or is not) safe for swimming or drinking. There can be no assurance that conditions that prevailed at the time and place that any given testing result was obtained will continue into the future or that trends suggested in this report will continue.

KLSA Privacy Policy

The complete KLSA Privacy Policy is on the KLSA website: klsa.wordpress.com.

KLSA collects information about our members and volunteers such as name, address, telephone number, email address and preferred method of communication. Information may be kept in written form or electronically. It is used to provide information about KLSA activities and related lake water issues of interest to residents of the Kawartha Lakes. Information will not be disclosed to anyone else unless required to do so by law and will be deleted when it is no longer required. Mailing lists will not be sold, transferred or traded. Information will be kept in a secure place. Further details can be obtained by contacting the KLSA Privacy Officer, Carol Cole, by email at klsa@klsa.info or by regular mail at 264 Bass Lake Road, Trent Lakes ON K0M 1A0.

***Loon with water droplets.* Photo by: Nick Vanderzwet, Pigeon River**

***Swimming Pup.* Photo by: Kelly Wagar, Lower Buckhorn Lake**

***Tiny Island.* Photo by: Diane Trauzzi, Big Cedar Lake**

***Fall Splendour.* Photo by: Diane Trauzzi, Big Cedar Lake**

Appendix B - Donors

Thank You to our 2022 Supporters

FOUNDATIONS AND MUNICIPALITIES

Gold ($5,000+)

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

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

ASSOCIATIONS/BUSINESSES/INDIVIDUALS

Gold ($200+)

Ann and John Ambler
Balsam Lake Association
Birch Point Marina
Susan and Mike Dolbey
Janet and Paul Duval
Sheila Gordon-Dillane and Jim Dillane
Carol and Ralph Ingleton
Mary and Jim Keyser
Patti and Tom McAllister
Paris Marine
Pinewood Cottage and Trailer Park
Judy and Lou Probst
Cathy and Jeff Webb

Silver ($100 - $199)

Nancy Austin and Chris Appleton
Kathy and Jim Armstrong
Big Bald Lake Cottagers Association
Birchcliff Property Owners Association
Peter Chappell
Carol Cole
Egan Marine Houseboat Rentals
Fire Route 44 Cottagers Association
Gill Fisher and Bob Woosnam
Elaine Gold
L'Anne and Dan Greene
Lakefield Foodland
Audrey and Tom McCarron
Ted Oakes
Rosemary and Claudio Rosada
Rosedale Marina
Jean and Joe Wood
David Young

Bronze (less than $100)

Mary Auld
Big Cedar Lake Stewardship Association
Buckhorn Sands Property Owners Association
Ed Leerdam
Carol and David MacLellan
Violet and Daniel McMurdy
Patricia and John Moffat
Peterborough Pollinators
Sandy Lake Cottagers Association
Heather and Hans Stelzer
Norma Walker
Lynn Woodcroft

Appendix C - Treasurer's Report

KLSA Treasurer's Report as of December 31, 2022

Ed Leerdam, *KLSA Treasurer*

This Treasurer's Report refers to the 2022 calendar year and the H & R Block Statement of Financial Position summarizing Revenue, Expenditures and Assets for 2021 and 2022 Fiscal Years. Our thanks to Mr. Chad Irvine of H & R Block for preparing these Financial Statements.

2022 Revenue of $17,316 decreased by 31.2% over 2021's revenue of $25,172, a difference of $7,856. The 1-time Watersheds Canada grant received in 2021 for the Natural Edge program accounts for $4,000 of the difference. Advertising receipts account for another $2,550 (this is a bit misleading – see below). Another $1,000 is explained by fewer properties' shorelines being naturalized in 2022 as planned (i.e., User Fees).

Noted are Contributions and Donations, down overall year-over-year by 8% or $490. Donations from businesses were up a bit at $150 (15%) while donations from individuals were down a bit at $180 (4.6%), and donations from Associations were down significantly at $460 (41.8%).

There was an increased number of water *E. coli* tests (i.e., more places tested – increase of over 4.4%), which seems to be trending year-to-year-to-year.

Our continuing sources of income were:

• Water Testing Fees	$4,711
• Municipal Grants	$2,275
• Individual Donations	$3,740
• Private Business Donations	$1,150
• Association Donations	$ 640
• Advertising in the KLSA Annual LWQR	$3,050[1]

[1] Ad sales remain constant year-to-year, however in the past, collection of the payments have come in split over the year-end / new year. Starting in 2023, ad sales for the LWQR will be collected in the same year as the report is published.

2022 Expenses of $13,454 decreased by11.25% or $1,704 over 2021 expenses. This is mostly attributed to less monies spent on indigenous plants ($2,440) for the Shoreline Restoration program, while Liability Insurance increased due to the addition of a rider covering in-water activities related to our Climate Change Project. The other year-over-year differences are evident in the Statement of Operations and Changes in Net Assets.

Recurring operating expenses included:

• E. Coli Lab Test Fees	$4,699
• Liability Insurance	$1,948
• KLSA Annual Lake Water Quality Report	$4,406
• Public Meetings	$ 125
• Office	$ 355
• Memberships	$ 125
• Professional Fees	$ 339
• Bank Charges	$ 67

We closed 2022 with a cash position of $28,839.

Kawartha Lake Stewards Association
Statement of Financial Position
As At December 31, 2022

	2022	2021
Assets		
Cash	28839	24845
Prepaid Expenses		132
	28839	24977
Liabilities		
Accounts Payable and Accrued	339	339
Net Assets	28500	24638
	28839	24977

Prepared Without Audit- See Notice to Reader

Kawartha Lake Stewards Association
Statement of Operations and Changes in Net Assets

Year Ended December 31, 2022

	2022	2021
Revenues		
Contributions and Donations:		
Private	3740	3920
Businesses	1150	1000
Associations	640	1100
Water Testing Fees	4711	4514
Advertising	3050	5600
Private Grants		4000
User Fees	1750	2750
Interest Earned		13
Municipal Grants	2275	2275
	17316	25172
Expenditures		
Annual Report Costs	4406	4754
Water Testing Fees	4699	4440
Meeting Costs	125	
Professional Fees	339	339
Memberships	125	125
Insurance	1948	1597
Special Projects	1390	3830
Office and Administration	355	
Bank Charges	67	73
Equipment		
	13454	15158
Excess of Revenues over Expenditures	3862	10014
Net Assets, Beginning of Year	24638	14624
Net Assets, End of Year	28500	24638

Prepared Without Audit- See Notice to Reader

Kawartha Lake Stewards Association

Notes to Financial Statements

Unaudited- See Notice to Reader

December 31, 2022

1. Basis of Presentation

The accompanying financial statements relate to the Incorporated Association registered by Letters Patent as the Kawartha Lake Stewards Association. The Association conducts coordinated 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) 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 or affiliates is prohibited.

Appendix C - Financial Statements

Notice to Reader

I have compiled the Statement of Financial Position of Kawartha Lake Stewards Association as at December 31, 2022 and the Statement of Operations and Changes in Net Assets for the year then ended from information provided by management.

I have not audited, reviewed or otherwise attempted to verify the accuracy or completeness of such information. Accordingly, readers are cautioned that these statements may not be appropriate for their uses.

Chad R Irvine

Bobcaygeon, ON

Jan 19, 2023

Appendix D - Thank You to our 2022 Volunteers

Without our volunteers, whether serving on our Board, leading a program, scooping water or aquatic plants out of our lakes, planting natural plants along shorelines, or attaching a temperature monitor on their docks, KLSA would not exist, and would not be able to do the work and collect the data that is so important in knowing how good (or not) our waters are in our lakes, and what's in them. We are very grateful to all our volunteers who help us in all these ways, and more.

(We strive to ensure no-one is missed when we acknowledge our volunteers. If you see we have missed you or we've made a mistake, please let us know.)

Mary Appleton, Upper Stoney Lake
Cadence Babcock, Sturgeon Lake
Hailey Babcock, Sturgeon Lake
Bob Bailey[1], Lower Buckhorn Lake
Drew Beatson, Chemong Lake
Sandy Beatson, Chemong Lake
Annette Bigg, Buckhorn Lake (Buckhorn Sands Property Owners' Association)
Holly Bigg, Buckhorn Lake (Buckhorn Sands Property Owners' Association)
John Boyce, Big Bald Lake (Big Bald Cottagers' Association)
Nancy Boyce, Big Bald Lake (Big Bald Cottagers' Association)
Diane Boysen, Sandy Lake (Sandy Lake Cottagers Association)
Mike Boysen, Sandy Lake (Sandy Lake Cottagers Association)
Brian Brady, Lower Buckhorn Lake (Lower Buckhorn Lake Owners' Association)
George Brown, Pigeon Lake (North Pigeon Lake Association)
Jeff Chalmers[1], Clear Lake (Birchcliff Property Owners of Douro-Dummer)
Graham Clark, Balsam Lake
Carol Cole[1,2], Ston(e)y Lake
Doug Colmer, Big Cedar Lake
Joan Connolly, Lovesick Lake
Rich Corbin, Big Bald Lake (Big Bald Cottagers' Association)
Mark Crane, Cameron Lake (East Cameron Lake Association)
Allan Crook, Sturgeon Lake
Nancy Cumming, Balsam Lake
Anna Currier, Catchacoma Lake
Darrell Darling, Young's Cove
Doug Dewar, Big Bald Lake
Erica Dixon
Mike Dolbey[1], Katchewanooka Lake
Warren Dunlop, Pigeon Lake (North Pigeon Lake Association)
Nancy Durocher, Lake Scugog
Janet Duval, Lower Buckhorn Lake (Lower Buckhorn Lake Owners' Association)
Paul Duval, Lower Buckhorn Lake (Lower Buckhorn Lake Owners' Association)
Emma Ekin, Buckhorn Lake
Doug Erlandson, Balsam Lake
Peggy Erlandson, Balsam Lake
Greg Finlay, Ston(e)y Lake
Steve Foulon, Clear Lake
Bev Foster, Ston(e)y Lake (Ston(e)y Lake Cottagers)
Don Foster, Ston(e)y Lake (Ston(e)y Lake Cottagers)
Rylee Goerlitz
Jessie Gordon, Pigeon Lake (Concession 17 Pigeon Lake Cottagers Association)
Sheila Gordon-Dillane[1], Pigeon Lake (Concession 17 Pigeon Lake Cottagers Association)
L'Anne Greene[1], Buckhorn Lake
Ann Gronow, Clear Lake
Bruce Hadfield, Sturgeon Lake
Don Halloway, Sturgeon Lake
Jill Hamilton, Lake Scugog
Guy Hanchet, Katchewanooka Lake
Richelle Hartjes, Sturgeon Lake
Doug Hawe, Balsam Lake
Dan Hickey, Pigeon Lake
Natasha Hirt
Martha Hunt, Stoney Lake
Imagine the Marsh
Sherrie Ireland, Sandy Lake
Sarah Jeffries
Peter Kelly, Balsam Lake
Jessie Kennedy, Sturgeon Lake
Sal Kennedy
Janet Klein, Nogies Creek (North Pigeon Lake Association)
Darryl Kotton[1], Buckhorn Lake

Appendix D - Thank You to our 2022 Volunteers

Ashley Krahn
Chloe LaJoie, Watersheds Canada
C. Lee[1,2,] Balsam Lake
Ed Leerdam[1], Nogies Creek (North Pigeon Lake Association)
Tracy Logan, Big Bald Lake
Bruce Long, Cameron Lake
Ruth Long, Cameron Lake
Stevie Lyons
Karl Macarthur, Upper Stoney Lake (Upper Stoney Lake Association)
Patty MacDonald, Ston(e)y Lake (Kawartha Park Cottagers' Association)
Kathleen Mackenzie, Ston(e)y Lake (Ston(e)y Lake Cottagers)
MacLellan family, Julian Lake
Dean Mairs, Balsam Lake
Rod Martin, Sturgeon Lake
Tom McAllister[1], Lower Buckhorn Lake (Fire Route 44 Cottagers Association)
Dean Michel, Balsam Lake
Jacqui Milne[1], Nogies Creek (North Pigeon Lake Association)
Roz Moore, Ston(e)y Lake
Sarie Murray
William Napier, Lovesick Lake
Brian Neck, Chemong Lake
Linda Neck, Chemong Lake
Michelle Newton, Ston(e)y Lake
Kimberly Ong[1,2], Ston(e)y Lake
Brenda Ounjian, Pigeon Lake (Victoria Place)
Pip Owens
Doug Paterson, Balsam Lake
Mike Perry, Cameron & Sturgeon Lakes
William Parish, Sturgeon Lake
Paul Pause, Lower Buckhorn Lake (Lower Buckhorn Lake Owners' Association)
Line Pinard, Pigeon Lake (North Pigeon Lake Association)
Rebecca Pomeroy
Diane Potter, Lower Buckhorn Lake (Lower Buckhorn Lake Owners' Association)
Denise Pratt, Balsam Lake
Rob Purdy, Upper Buckhorn Lake
Ralph Reed, Ston(e)y Lake (Ston(e)y Lake Cottagers)
Doug Ridge, Sturgeon Lake
Kim Ross, Lake Scugog
Ben Samann, Ston(e)y Lake
Jan Sanderson, Balsam Lake
Peter Sanderson, Balsam Lake
Sonny Seymour, Sturgeon Lake
Aaron Shafer, Ston(e)y Lake
Harry Shuman, Lower Buckhorn Lake (Lower Buckhorn Lake Owners' Association)
Kathy Simpson Price, Bass Lake
Robert Sproat, Balsam Lake
Steeter family, Sandy Lake (Sandy Lake Cottagers Association)
Patrick Strzalkowski, Clear Lake (Kawartha Park Cottagers' Association)
Carolyn Sutton, Ston(e)y Lake
David Sutton, Ston(e)y Lake
Gail Szego, Ston(e)y Lake (Ston(e)y Lake Cottagers)
Annette Thomson, Chemong Lake
Dave Thomson, Lower Buckhorn Lake (Lower Buckhorn Lake Owners' Association)
Steve Thomson, Chemong Lake
Eva Toomsalu, Sandy Lake (Sandy Lake Cottagers Association)
Hans Toomsalu, Sandy Lake (Sandy Lake Cottagers Association)
Diane Trauzzi, Big Cedar Lake (Big Cedar Lake Stewardship Association)
Ralph Trauzzi, Big Cedar Lake (Big Cedar Lake Stewardship Association)
Brett Tregunno[1,2], Buckhorn Lake
Robert Tuckett, Balsam Lake
Trish Voyer
Brenda Wall, Bass Lake (North Pigeon Lake Association)
Lois Wallace, Upper Stoney Lake
Tina Warren, Upper Stoney Lake
Steven Wildfong, Katchewanooka Lake
Bob Woosnam, Ston(e)y Lake (Ston(e)y Lake Cottagers)
Gill Woosnam, Ston(e)y Lake (Ston(e)y Lake Cottagers)
Jennifer Wortzman, Ston(e)y Lake
Dave Young, Sturgeon Lake

[1] KLSA Board
[2] KLSA Program Leads

Appendix E - 2022 *E. coli* Test Results

Rationale for *E. coli* Testing and 2022 Lake-by-Lake Results

C. Lee & Mike Dolbey, *KLSA Volunteers*

Providing context for these results

- In Ontario, a public beach is 'posted' when the level of *E. coli* in the water exceeds 200 *E. coli* /100mL which they claim is equivalent to *E. coli* cfu/100mL (colony-forming units/100mL) of water. This means that the water is unsafe for recreational use, including human bathing (swimming). (In 2018 the Province of Ontario increased the 'posting' level for public beaches from 100 to 200 *E. coli* /100mL based on the geometric mean of a minimum of 5 samples with a single-sample maximum concentration ≤ 400 *E. coli* /100mL. This brought Ontario's limit into agreement with the Canadian Federal guideline).

- 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 is 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 Guideline, 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 all *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. If there are so many live bacteria that the colonies on the growth medium merge, the sample is said to be 'overgrown', or OG in the table below.

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 100. There was one reading over the former 'safe swimming limit' of 100 cfu/100 mL, but counts were low upon further testing.

Balsam Lake – Balsam Lake Cottager's Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 18	August 2	August 15	September 6
00	16	39	11, 18	2	2
01	1	**62**	1, 2	0	0
02	3	10	6	0	2
03	0	4	0		2
03A	2	13	0	1	0
04A	0	31	1	0	0
06A	12	1	0	0	3
07	2	0	1	0	1
20	2	3	18	1	5
21	2	4		4	11/8

Balsam Lake results were generally low with only one intermediate reading.

Bass Lake – Bass Lake Homeowners Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 18/25	July 25	August 15	September 6
A1	1	0	1	0	0

Counts were consistently low at this location on Bass Lake.

Big Bald Lake – Big Bald Lake Cottager's Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 19/25	6	August 15	September 6
1	7	16	21	6	5
3	3	9	9	1	1
9	2	2	4	9	1
10	6	**56** R 10,6,23	13	2	1
12	10	1	24	2	0

One intermediate reading returned to normal on retest. Results generally improved later in the season.

Appendix E - 2022 *E. coli* Test Results

Big Cedar Lake – Big Cedar Lake Stewardship Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 25	August 2	August 15	September 6
600	4	**60**	**301**	R 1,1,3,12	2
610	0	4	0	4	1
620	3	13	4	3	10
630	21	2	5	2	2
640	0	39	5	3	4
650	4	**173**	5	7	1

Big Cedar Lake is typically a very clean lake so several high readings early in the season were a surprise. The cause was undetermined. All sites returned to low by September.

Buckhorn Lake – Buckhorn Sands Property Owners Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 19	August 3	August 15	September 5
A	2	22	**OG,** R 22,**88,52**	0, R 1	0
B	0	4	0	**OG**, R 35	0
C	6	11	1	2	12
D	2	4	0	8	4

After new sand was placed at site A in late July, the *E. coli* sample was 'overgrown' (OG) meaning too high to count. Retest showed results still high but measurable. Later an 'overgrown' result was obtained at a Site B. Retests at both sites confirmed that the samples had not been switched. Both sites returned to normal by the last test date. The cause of the 'overgrown' samples is not known.

Cameron Lake					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 18	August 2	August 15	September 5
CM20	22	**56**	38		23
CM21	2	13	**56**		33

Results were generally higher than expected at these two sites.

Clear Lake – Kawartha Park Cottager's Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 6	July 20	August 2	August 15	September 6
A	8	0	0	1	0
B	8	1	0	1	4
C	0	1	1	0	0
D	0	1	1	0	2
P	0	0	0	0	0
W	9	39	3	0	5

Counts were generally low at all six Kawartha Park sites.

Appendix E - 2022 *E. coli* Test Results

Clear Lake – Birchcliff Property Owners Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 18	August 10	September 1	September 7
4			6	7	1
7			4	1	0
8			44	7	**51**

Counts at BPOA site 8 on Clear Lake were somewhat elevated. This site has a history of above average results.

Katchewanooka Lake – Site 2					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 18	August 2	August 15	September 6
2	10	41	20	4	6

Counts were generally low at this site on Lake Katchewanooka.

Katchewanooka Lake – Site 7					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 19	August 2	August 15	September 6
7	0	7	31	2	1

Counts were generally low at this site on Lake Katchewanooka.

Lovesick Lake – Lovesick Lake Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 8	July 22	August 4	August 15	September 2
16	1	14	2	0	0
20	38	6	7	1	1
21	3	8	16	21	4

Counts were generally low at sites on Lovesick Lake.

Lower Buckhorn Lake – Lower Buckhorn Lake Owners Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 12	July 18	August 3	August 16	September 6
2	4	2	1	4	5
5	15	0	31	6	0
11	9	4	0	0	0
13	4	0	1	3	4
20	17	0	0	8	0

Counts were generally low at sites on Lower Buckhorn Lake.

Appendix E - 2022 *E. coli* Test Results

Pigeon Lake – Concession 17 Pigeon Lake Cottagers Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 19	August 2	August 15	September 5
A	1	1	6	4	0
B	0	1	2	0	0
C	0	2	1	0	0

Counts were generally low at these sites on Pigeon Lake.

Pigeon Lake – North Pigeon Lake Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 19	August 1	August 12	September 2
5A	5	21	0	3	1
6	30	28	26	24	6
8	0	2	1	1	0
13	9	28	20	20	7
14	4	4	2	5	11

Counts were higher at some sites early in the season probably due to waterfowl activity.

Pigeon Lake – Victoria Place					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 18	August 2	August 15	September 7
1	13	46	1	2	1
2	38	25	4	0	1
3	15	34	10	1	0
4	6	41	6	0	0
5	15	25	8	0	0

Counts were higher at some sites early in the season probably due to waterfowl activity.

Sandy Lake – Sandy Lake Cottagers Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 6	July 12	August 3	August 15	September 5
2	0	3	0		0

Counts were generally very low at this Sandy Lake site.

Appendix E - 2022 *E. coli* Test Results

Stony Lake – Association of Stony Lake Cottagers					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 19	August 2	August 16	September 6
E	30	19	7	5	6
F	1	6	2	2	2
I	4	**64**	**84**	18	10
L	7	1	0	0	0
M	1	6	2	1	0
PRV28	22	19	**50**	5	10

Counts are low at most sites on Stony Lake. Site I is very close to an area of still water where geese congregate which might explain the generally higher counts at this site.

Sturgeon Lake					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 18	August 2	August 15	September 5
SG20	2		8		11
SG21	1		0		5

Counts appear to be low at these new sites on Sturgeon Lake.

Upper Stoney Lake – Upper Stoney Lake Association					
2022 *E. coli* Lake Water Testing – *E. coli* cfu/100mL					
Site	July 4	July 18	August 2	August 15	September 6
6	7	34	9	5	4
20	0	28	6	1	1
21	0	0	0	0	0
52	14	6	10	4	26
65	2	2	0	0	1
70	0	7	0	0	1
78A		1	0	0	0

Counts were generally low at these sites on Upper Stoney Lake.

Pink and purple sky. Photo by: Thomas Lang, Stoney Lake

Sun on the water. Photo by: Thomas Lang, Stoney Lake

Appendix F – 2021 Phosphorus, Secchi Depth and Calcium Test Results

Total Phosphorus (TP) Measurements

In 2021 volunteers tested 47 sites in 17 Kawartha lakes. Results are listed below. A number of 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.	17-May-21	4.20	4.50	4.35
6902	2	BALSAM LAKE	N Bay Rocky Pt.	15-Jun-21	7.60	8.00	7.80
6902	2	BALSAM LAKE	N Bay Rocky Pt.	06-Jul-21	10.10	10.20	10.15
6902	2	BALSAM LAKE	N Bay Rocky Pt.	03-Aug-21	10.70	11.70	11.20
6902	2	BALSAM LAKE	N Bay Rocky Pt.	02-Sep-21	8.20	9.70	8.95
6902	2	BALSAM LAKE	N Bay Rocky Pt.	09-Oct-21	8.80	10.00	9.40
6902	5	BALSAM LAKE	NE end-Lightning Pt	27-May-21	12.00	12.00	12.00
6902	5	BALSAM LAKE	NE end-Lightning Pt	07-Jun-21	13.00	16.00	14.50
6902	5	BALSAM LAKE	NE end-Lightning Pt	29-Jul-21	7.20	7.80	7.50
6902	5	BALSAM LAKE	NE end-Lightning Pt	16-Aug-21	7.60	8.40	8.00
6902	5	BALSAM LAKE	NE end-Lightning Pt	29-Sep-21	5.80	6.10	5.95
6902	5	BALSAM LAKE	NE end-Lightning Pt	11-Oct-21	7.80	8.70	8.25
6902	7	BALSAM LAKE	South B-Killarney B	24-May-21	22.00	28.00	25.00
6902	7	BALSAM LAKE	South B-Killarney B	10-Jul-21	13.00	14.00	13.50
6902	7	BALSAM LAKE	South B-Killarney B	21-Aug-21	**133.00**	**222.00**	-
6902	7	BALSAM LAKE	South B-Killarney B	20-Sep-21	9.80	12.10	10.95
6902	7	BALSAM LAKE	South B-Killarney B	27-Oct-21	10.70	12.60	11.65
6902	8	BALSAM LAKE	W Bay2, deep spot	01-Jun-21	5.60	5.80	5.70
6902	8	BALSAM LAKE	W Bay2, deep spot	02-Jul-21	9.80	11.00	10.40
6902	8	BALSAM LAKE	W Bay2, deep spot	30-Jul-21	8.70	9.70	9.20
6902	8	BALSAM LAKE	W Bay2, deep spot	07-Sep-21	9.20	10.10	9.65
6902	9	BALSAM LAKE	E of Grand Is	31-May-21	5.30	5.40	5.35
6941	1	BIG BALD LAKE	Mid Lake, deep spot	27-May-21	11.00	11.00	11.00
6941	1	BIG BALD LAKE	Mid Lake, deep spot	28-Jun-21	11.00	12.00	11.50
6941	1	BIG BALD LAKE	Mid Lake, deep spot	20-Jul-21	11.30	11.60	11.45
6941	1	BIG BALD LAKE	Mid Lake, deep spot	16-Aug-21	10.70	12.20	11.45
6941	1	BIG BALD LAKE	Mid Lake, deep spot	10-Sep-21	8.60	8.90	8.75
6941	1	BIG BALD LAKE	Mid Lake, deep spot	06-Oct-21	8.50	8.70	8.60
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	24-May-21	6.20	6.70	6.45
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	21-Jul-21	15.50	16.20	15.85
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	03-Aug-21	15.80	15.90	15.85
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	27-May-21	17.00	18.00	17.50
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	14-Jun-21	20.00	23.00	21.50
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	25-Jul-21	15.40	24.20	19.80
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	22-Aug-21	11.40	12.10	11.75
7131	9	BUCKHORN LAKE (U)	Young's Cove, Deep Spot	19-Sep-21	12.90	13.10	13.00

Appendix F – 2021 Phosphorus, Secchi Depth and Calcium Test Results

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
7131	10	BUCKHORN LAKE (U)	NE of Fox Is	23-May-21	12.00	12.00	12.00
7131	10	BUCKHORN LAKE (U)	NE of Fox Is	19-Jun-21	20.00	26.00	23.00
7131	10	BUCKHORN LAKE (U)	NE of Fox Is	18-Jul-21	14.00	17.00	15.50
7131	10	BUCKHORN LAKE (U)	NE of Fox Is	21-Aug-21	10.10	10.20	10.15
7131	10	BUCKHORN LAKE (U)	NE of Fox Is	18-Sep-21	10.40	12.40	11.40
7131	10	BUCKHORN LAKE (U)	NE of Fox Is	15-Oct-21	8.00	8.30	8.15
6905	6	CAMERON LAKE	S end, deep spot	13-Jun-21	7.40	8.10	7.75
6905	6	CAMERON LAKE	S end, deep spot	11-Jul-21	11.00	11.00	11.00
6905	6	CAMERON LAKE	S end, deep spot	15-Aug-21	9.50	10.40	9.95
6905	6	CAMERON LAKE	S end, deep spot	19-Sep-21	7.40	7.90	7.65
6951	9	CHEMONG LAKE	S. of Causeway	31-May-21	10.00	11.00	10.50
6951	9	CHEMONG LAKE	S. of Causeway	29-Jun-21	16.00	17.00	16.50
6951	9	CHEMONG LAKE	S. of Causeway	28-Jul-21	13.10	22.10	17.60
6951	9	CHEMONG LAKE	S. of Causeway	25-Aug-21	**348.00**	**359.00**	-
6951	9	CHEMONG LAKE	S. of Causeway	29-Sep-21	13.90	14.30	14.10
6951	11	CHEMONG LAKE	N of Big Island	01-Jun-21	7.80	10.00	8.90
6951	11	CHEMONG LAKE	N of Big Island	03-Jul-21	13.30	14.10	13.70
6951	11	CHEMONG LAKE	N of Big Island	02-Aug-21	14.40	15.30	14.85
6951	11	CHEMONG LAKE	N of Big Island	07-Sep-21	10.20	12.30	11.25
6955	1	CLEAR LAKE	MacKenzie Bay	04-Jul-21	17.00	18.00	17.50
6955	1	CLEAR LAKE	MacKenzie Bay	03-Aug-21	17.60	17.70	17.65
6955	1	CLEAR LAKE	MacKenzie Bay	03-Oct-21	12.50	13.90	13.20
6955	2	CLEAR LAKE	Main Basin-deep spot	21-Jul-21	16.90	16.90	16.90
6955	2	CLEAR LAKE	Main Basin-deep spot	03-Aug-21	16.00	16.70	16.35
6955	2	CLEAR LAKE	Main Basin-deep spot	25-Aug-21	14.30	15.10	14.70
6955	2	CLEAR LAKE	Main Basin-deep spot	03-Oct-21	10.80	11.70	11.25
6955	3	CLEAR LAKE	Fiddlers Bay	21-Jul-21	14.70	15.00	14.85
6955	3	CLEAR LAKE	Fiddlers Bay	03-Aug-21	15.60	16.30	15.95
6955	3	CLEAR LAKE	Fiddlers Bay	25-Aug-21	14.50	15.30	14.90
6955	3	CLEAR LAKE	Fiddlers Bay	03-Oct-21	14.00	14.50	14.25
6955	4	CLEAR LAKE	Brysons Bay	03-Jul-21	19.00		19.00
7075	2	JULIAN LAKE	Mid Lake, deep spot	31-May-21	4.80	6.00	5.40
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	02-Jun-21	9.30	9.80	9.55
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	05-Jul-21	11.90	12.00	11.95
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	03-Aug-21	16.60	17.70	17.15
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	01-Sep-21	17.30	17.50	17.40
7076	1	KATCHEWANOOKA LAKE	S/E Douglas Island	01-Oct-21	12.20	12.70	12.45
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	03-May-21	7.10	7.90	7.50
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	01-Jun-21	8.20	8.60	8.40
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	07-Jul-21	10.80	12.00	11.40
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	03-Aug-21	16.20	17.20	16.70
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	07-Sep-21	19.30	19.60	19.45
7076	2	KATCHEWANOOKA LAKE	Young Pt near locks	05-Oct-21	10.90	11.00	10.95

Appendix F – 2021 Phosphorus, Secchi Depth and Calcium Test Results

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
7087	1	LOVESICK LAKE	80' hole at N. end	31-May-21	6.30	17.80	12.05
7087	1	LOVESICK LAKE	80' hole at N. end	17-Jun-21	22.10	**57.00**	22.10
7087	1	LOVESICK LAKE	80' hole at N. end	19-Jul-21	16.20	18.50	17.35
7087	1	LOVESICK LAKE	80' hole at N. end	03-Aug-21	14.30	20.50	17.40
7087	1	LOVESICK LAKE	80' hole at N. end	07-Sep-21	13.60	19.70	16.65
7087	1	LOVESICK LAKE	80' hole at N. end	02-Oct-21	19.10	**38.30**	19.10
7087	3	LOVESICK LAKE	McCallum Island	31-May-21	7.00	17.00	12.00
7087	3	LOVESICK LAKE	McCallum Island	17-Jun-21	5.90	17.00	11.45
7087	3	LOVESICK LAKE	McCallum Island	19-Jul-21	18.20	23.90	21.05
7087	3	LOVESICK LAKE	McCallum Island	03-Aug-21	13.20	21.30	17.25
7087	3	LOVESICK LAKE	McCallum Island	07-Sep-21	13.80	20.90	17.35
7087	3	LOVESICK LAKE	McCallum Island	02-Oct-21	16.10	22.90	19.50
6990	1	LOWER BUCKHORN LAKE	Heron Island	02-Jun-21	13.00	14.00	13.50
6990	1	LOWER BUCKHORN LAKE	Heron Island	05-Jul-21	18.00	21.00	19.50
6990	1	LOWER BUCKHORN LAKE	Heron Island	25-Jul-21	16.90	17.10	17.00
6990	1	LOWER BUCKHORN LAKE	Heron Island	23-Aug-21	14.90	17.00	15.95
6990	1	LOWER BUCKHORN LAKE	Heron Island	06-Sep-21	14.90	15.00	14.95
6990	1	LOWER BUCKHORN LAKE	Heron Island	26-Sep-21	12.00	12.10	12.05
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	27-May-21	13.00	15.00	14.00
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	29-Jun-21	14.00	16.00	15.00
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	21-Jul-21	18.30	19.80	19.05
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	13-Aug-21	18.00	19.00	18.50
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	03-Sep-21	15.70	16.30	16.00
6990	4	LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	09-Oct-21	9.10	10.90	10.00
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	02-Jun-21	11.00	13.00	12.00
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	05-Jul-21	14.00	17.00	15.50
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	25-Jul-21	17.90	19.30	18.60
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	23-Aug-21	15.20	15.30	15.25
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	06-Sep-21	21.90	23.40	22.65
6990	6	LOWER BUCKHORN LAKE	Deer Bay-centre	26-Sep-21	14.60	15.40	15.00
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	30-May-21	13.00	18.00	15.50
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	04-Jun-21	17.00	18.00	17.50
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	11-Jul-21	16.00	17.00	16.50
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	05-Aug-21	16.60	18.50	17.55
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	02-Sep-21	17.20	22.70	19.95
6990	7	LOWER BUCKHORN LAKE	Lower Deer Bay, Mid-deep	03-Oct-21	10.90	12.50	11.70
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	24-May-21	12.00		12.00
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	04-Jun-21	18.00	20.00	19.00
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	11-Jul-21	17.00	18.00	17.50
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	05-Aug-21	14.10	**45.10**	14.10
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	02-Sep-21	12.60	13.90	13.25
6990	8	LOWER BUCKHORN LAKE	Main basin, deep- spot	03-Oct-21	10.40	11.50	10.95
6919	1	PIGEON LAKE	S end, deep spot	13-May-21	22.00	22.00	22.00

Appendix F – 2021 Phosphorus, Secchi Depth and Calcium Test Results

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
6919	1	PIGEON LAKE	S end, deep spot	10-Jun-21	22.00	24.00	23.00
6919	1	PIGEON LAKE	S end, deep spot	15-Jul-21	19.00	19.00	19.00
6919	1	PIGEON LAKE	S end, deep spot	17-Aug-21	16.40	18.60	17.50
6919	1	PIGEON LAKE	S end, deep spot	19-Sep-21	15.50	15.60	15.55
6919	1	PIGEON LAKE	S end, deep spot	14-Oct-21	13.10	13.20	13.15
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	07-Sep-21	17.40	**24.40**	17.40
6919	3	PIGEON LAKE	Middle-SandyPtBoyd I	09-Oct-21	11.90	13.00	12.45
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	02-Jun-21	7.10	7.90	7.50
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	03-Jul-21	17.00	19.00	18.00
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	05-Aug-21	16.30	18.20	17.25
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	06-Sep-21	12.50	13.00	12.75
6919	12	PIGEON LAKE	N-400m N of Boyd Is.	04-Oct-21	12.30	13.00	12.65
6919	13	PIGEON LAKE	N end-Adjacent Con17	02-Jul-21	20.00	**37.00**	20.00
6919	13	PIGEON LAKE	N end-Adjacent Con17	07-Sep-21	16.30	16.90	16.60
6919	13	PIGEON LAKE	N end-Adjacent Con17	09-Oct-21	14.80	17.20	16.00
6919	15	PIGEON LAKE	C340-DeadHorseSho	17-May-21	8.30	11.00	9.65
6919	15	PIGEON LAKE	C340-DeadHorseSho	04-Jun-21	7.10	7.60	7.35
6919	15	PIGEON LAKE	C340-DeadHorseSho	03-Jul-21	12.00	12.00	12.00
6919	15	PIGEON LAKE	C340-DeadHorseSho	02-Aug-21	16.30	**24.50**	16.30
6919	15	PIGEON LAKE	C340-DeadHorseSho	03-Sep-21	14.60	15.20	14.90
6919	15	PIGEON LAKE	C340-DeadHorseSho	05-Oct-21	13.50	13.60	13.55
6919	16	PIGEON LAKE	N300yds off Bottom I	02-Jun-21	8.50	8.90	8.70
6919	16	PIGEON LAKE	N300yds off Bottom I	03-Jul-21	18.00	18.00	18.00
6919	16	PIGEON LAKE	N300yds off Bottom I	05-Aug-21	10.30	**20.20**	10.30
6919	16	PIGEON LAKE	N300yds off Bottom I	06-Sep-21	11.40		11.40
6919	16	PIGEON LAKE	N300yds off Bottom I	04-Oct-21	10.90	12.60	11.75
7241	2	SANDY LAKE	Mid Lake, deep spot	30-Jun-21	6.40	6.50	6.45
7241	2	SANDY LAKE	Mid Lake, deep spot	21-Aug-21	4.40	5.10	4.75
7241	2	SANDY LAKE	Mid Lake, deep spot	10-Sep-21	5.30	5.40	5.35
7241	2	SANDY LAKE	Mid Lake, deep spot	26-Sep-21	5.70	6.00	5.85
7241	2	SANDY LAKE	Mid Lake, deep spot	11-Oct-21	5.80	7.20	6.50
7133	4	STONY LAKE	Burleigh locks chan.	09-Jun-21	27.00	27.00	27.00
7133	4	STONY LAKE	Burleigh locks chan.	13-Jul-21	59.00	67.00	63.00
7133	4	STONY LAKE	Burleigh locks chan.	31-Jul-21	17.80	17.80	17.80
7133	4	STONY LAKE	Burleigh locks chan.	07-Oct-21	11.50	17.30	14.40
7133	6	STONY LAKE	Gilchrist Bay	10-Jun-21	12.00	12.00	12.00
7133	6	STONY LAKE	Gilchrist Bay	21-Jul-21	13.10	14.70	13.90
7133	6	STONY LAKE	Gilchrist Bay	28-Sep-21	14.20	15.70	14.95
7133	7	STONY LAKE	Mouse Is.	24-May-21	9.00	9.10	9.05
7133	7	STONY LAKE	Mouse Is.	06-Jun-21	8.30	8.50	8.40
7133	7	STONY LAKE	Mouse Is.	31-Jul-21	14.30	14.50	14.40
7133	7	STONY LAKE	Mouse Is.	04-Sep-21	14.40	14.80	14.60
7133	7	STONY LAKE	Mouse Is.	01-Oct-21	10.60	11.00	10.80

Appendix F – 2021 Phosphorus, Secchi Depth and Calcium Test Results

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
7133	8	STONY LAKE	Hamilton Bay	24-May-21	11.00	11.00	11.00
7133	8	STONY LAKE	Hamilton Bay	06-Jun-21	9.60	9.60	9.60
7133	8	STONY LAKE	Hamilton Bay	31-Jul-21	13.30	14.10	13.70
7133	8	STONY LAKE	Hamilton Bay	04-Sep-21	13.70	13.70	13.70
7133	8	STONY LAKE	Hamilton Bay	01-Oct-21	9.20	9.90	9.55
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	19-Aug-21	13.50	13.50	13.50
6924	4	STURGEON LAKE	Muskrat I-Buoy C388	09-Sep-21	16.90	17.50	17.20
6924	5	STURGEON LAKE	Sturgeon Point Buoy	17-Jun-21	13.00	13.00	13.00
6924	5	STURGEON LAKE	Sturgeon Point Buoy	26-Jul-21	13.90	14.00	13.95
6924	5	STURGEON LAKE	Sturgeon Point Buoy	27-Aug-21	7.10	14.20	10.65
6924	5	STURGEON LAKE	Sturgeon Point Buoy	29-Sep-21	11.10	11.60	11.35
6924	9	STURGEON LAKE	Fenelon R. mouth	17-Jun-21	11.00	11.00	11.00
6924	9	STURGEON LAKE	Fenelon R. mouth	26-Jul-21	11.10	11.20	11.15
6924	9	STURGEON LAKE	Fenelon R. mouth	27-Aug-21	6.10	6.10	6.10
6924	9	STURGEON LAKE	Fenelon R. mouth	29-Sep-21	7.50	8.00	7.75
5178	1	UPPER STONEY LAKE	Quarry Bay	06-Jun-21	5.70	7.00	6.35
5178	1	UPPER STONEY LAKE	Quarry Bay	03-Jul-21	9.20	11.00	10.10
5178	1	UPPER STONEY LAKE	Quarry Bay	30-Jul-21	7.80	8.10	7.95
5178	1	UPPER STONEY LAKE	Quarry Bay	07-Sep-21	7.00	7.70	7.35
5178	1	UPPER STONEY LAKE	Quarry Bay	02-Oct-21	13.20	**18.10**	13.20
5178	3	UPPER STONEY LAKE	Young Bay	06-Jun-21	6.60	7.20	6.90
5178	3	UPPER STONEY LAKE	Young Bay	03-Jul-21	7.70	9.60	8.65
5178	3	UPPER STONEY LAKE	Young Bay	30-Jul-21	8.10	9.20	8.65
5178	3	UPPER STONEY LAKE	Young Bay	07-Sep-21	6.90	6.90	6.90
5178	3	UPPER STONEY LAKE	Young Bay	02-Oct-21	5.70	7.50	6.60
5178	4	UPPER STONEY LAKE	S Bay, deep spot	06-Jun-21	9.90	10.00	9.95
5178	4	UPPER STONEY LAKE	S Bay, deep spot	03-Jul-21	13.00	**18.00**	13.00
5178	4	UPPER STONEY LAKE	S Bay, deep spot	30-Jul-21	8.90	9.90	9.40
5178	4	UPPER STONEY LAKE	S Bay, deep spot	07-Sep-21	19.50	19.80	19.65
5178	4	UPPER STONEY LAKE	S Bay, deep spot	02-Oct-21	5.00	13.50	5.00
5178	5	UPPER STONEY LAKE	Crowes Landing	06-Jun-21	6.70	7.60	7.15
5178	5	UPPER STONEY LAKE	Crowes Landing	03-Jul-21	7.10	8.40	7.75
5178	5	UPPER STONEY LAKE	Crowes Landing	30-Jul-21	8.80	**18.30**	8.80
5178	5	UPPER STONEY LAKE	Crowes Landing	07-Sep-21	7.40	7.80	7.60
5178	5	UPPER STONEY LAKE	Crowes Landing	02-Oct-21	8.10	8.10	8.10
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	06-Jun-21	6.50	7.00	6.75
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	03-Jul-21	23.00	23.00	23.00
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	30-Jul-21	9.10	9.10	9.10
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	07-Sep-21	7.20	8.50	7.85
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	02-Oct-21	6.30	7.40	6.85
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	19-May-21	12.00	14.00	13.00
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	16-Jun-21	13.00	13.00	13.00
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	16-Jul-21	11.80	12.60	12.20

Appendix F – 2021 Phosphorus, Secchi Depth and Calcium Test Results

STN	Site ID	Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Avg.TP (µg/L)
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	23-Aug-21	12.40	14.70	13.55
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	19-Sep-21	9.30	9.50	9.40
6963	1	WHITE LAKE (DUMMER)	S end, deep spot	18-Oct-21	9.20	9.30	9.25

2021 Secchi Depth and Calcium Measurements

Named after its inventor, Angelo Secchi, a Secchi disk is a device for measuring water clarity. It is a weighted disc 20cm 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 sediments 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. Since 2018, LPP have averaged the Secchi Depths and only provide the seasonal average which is presented here.

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 some lake water samples for all lakes tested for Total Phosphorus. The average Calcium measurement for each site in 2021 is provided in the table below. As shown in the table, 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	Secchi Depth (m)	Calcium (mg/L)
6902	2	BALSAM LAKE	N Bay Rocky Pt.	2021 Avg.	5.9	21.4
6902	5	BALSAM LAKE	NE end-Lightning Pt	2021 Avg.	3.9	17.1
6902	7	BALSAM LAKE	South B-Killarney B	2021 Avg.	4.4	21.1
6902	8	BALSAM LAKE	W Bay2, deep spot	2021 Avg.		21.7
6902	9	BALSAM LAKE	E of Grand Is	2021 Avg.	5.1	21.5
6941	1	BIG BALD LAKE	Mid Lake, deep spot	2021 Avg.	3.5	36.9
363	1	BIG CEDAR LAKE	Mid Lake, deep spot	2021 Avg.	5.7	25.8
7131	1	BUCKHORN LAKE (U)	Narrows-redbuoy C310	2021 Avg.		33.6
7131	9	BUCKHORN LAKE (U)	Young's Cove, deep spot	2021 Avg.		34.6
7131	10	BUCKHORN LAKE (U)	NE of Fox Is	2021 Avg.	3.3	26.8
6905	6	CAMERON LAKE	S end, deep spot	2021 Avg.		20.8
6951	9	CHEMONG LAKE	S. of Causeway	2021 Avg.		44.6
6951	11	CHEMONG LAKE	N of Big Island	2021 Avg.		50.8

Appendix F – 2021 Phosphorus, Secchi Depth and Calcium Test Results

STN	Site ID	Lake	Site Description	Date	Secchi Depth (m)	Calcium (mg/L)
6955	1	CLEAR LAKE	MacKenzie Bay	2021 Avg.		30.0
6955	2	CLEAR LAKE	Main Basin-deep Spot	2021 Avg.		30.9
6955	3	CLEAR LAKE	Fiddlers Bay	2021 Avg.		32.5
7075	2	JULIAN LAKE	Mid Lake, deep spot	2021 Avg.		42.0
7076	1	KATCHEWANOOKA	S/E Douglas Island	2021 Avg.		32.3
7076	2	KATCHEWANOOKA	Young Pt near locks	2021 Avg.	5.4	31.5
7087	1	LOVESICK LAKE	80' hole at N. end	2021 Avg.		34.1
7087	3	LOVESICK LAKE	McCallum Island	2021 Avg.		32.7
6990	1	LOWER BUCKHORN	Heron Island	2021 Avg.		33.0
6990	4	LOWER BUCKHORN	Deer Bay W-Buoy C267	2021 Avg.		32.0
6990	6	LOWER BUCKHORN	Deer Bay-centre	2021 Avg.		32.6
6990	7	LOWER BUCKHORN	Lower Deer Bay, Mid-deep	2021 Avg.	1.9	30.8
6990	8	LOWER BUCKHORN	Main basin, deep-spot	2021 Avg.	2.6	27.8
6919	1	PIGEON LAKE	S end, deep spot	2021 Avg.	2.6	30.5
6919	3	PIGEON LAKE	Middle-SandyPtBoyd Is	2021 Avg.	3.1	
6919	12	PIGEON LAKE	N-400m N of Boyd Is	2021 Avg.		36.4
6919	13	PIGEON LAKE	N end-Adjacent Con17	2021 Avg.	3.8	
6919	15	PIGEON LAKE	C340-Dead Horse Shoal	2021 Avg.	3.0	37.2
6919	16	PIGEON LAKE	N300yds off Bottom Is	2021 Avg.		36.8
7241	2	SANDY LAKE	Main basin, deep-spot	2021 Avg.	4.6	39.0
7133	4	STONY LAKE	Burleigh locks channel	2021 Avg.		31.1
7133	6	STONY LAKE	Gilchrist Bay	2021 Avg.		30.0
7133	7	STONY LAKE	Mouse Is.	2021 Avg.	4.4	29.6
7133	8	STONY LAKE	Hamilton Bay	2021 Avg.	4.0	27.4
6924	5	STURGEON LAKE	Sturgeon Point Buoy	2021 Avg.	2.9	29.8
6924	9	STURGEON LAKE	Fenelon R. mouth	2021 Avg.	3.1	21.7
5178	1	UPPER STONEY LAKE	Quarry Bay	2021 Avg.		27.5
5178	3	UPPER STONEY LAKE	Young Bay	2021 Avg.		26.6
5178	4	UPPER STONEY LAKE	S Bay, deep spot	2021 Avg.		24.6
5178	5	UPPER STONEY LAKE	Crowes Landing	2021 Avg.		27.8
5178	6	UPPER STONEY LAKE	Mid Lake, deep spot	2021 Avg.		27.1
6963	1	WHITE LAKE	S end, deep spot	2021 Avg.	4.8	31.8

Photographing Our Lakes

Chipmunk Chewing on Sumac. **Photo by: Harry Shulman, Deer Bay.**

Trumpeter Swans. **Photo by: Guy Hanchet, Lakefield Beach**

Wetland Kayaking. **Photo by: Janet Klein, Nogies Creek**

Sun Behind Clouds. **Photo by: Kelly Wagar, Lower Buckhorn Lake**

Winter friend in flight (above), Squirrel and Cardinal (below). **Photos by: Janet Watson, Bowmanville**

Photographing Our Lakes

Dock and Lake View. **Photo by: Philip McMichael, Clear Lake**

Two Rainbows. **Photo by: Philip McMichael, Clear Lake**

Family Walking. **Photo by: Thomas Craig, Sturgeon Lake**

Rainbow. **Photo by: Veronica De France, Clear Lake**

Heron on Sandy Creek. **Photo by: Sheri Ireland, Lakehurst**

You're Invited to the Kawartha Lake Stewards Association

2023 Annual Spring Meeting!!

When: Saturday, **May 6th**, from 10:00am - 12:00pm.

Where: In-person at the Buckhorn Community Centre, 1782 Lakehurst Road, Buckhorn. You also have the option to join us virtually.

Presentations By:

Jeff Berthelette, Invasive Species Awareness Program Outreach Liaison, discussing the Volunteer Water Steward Program.

Nolan Pearce, Post-Doctoral Fellow from Trent University presenting: Dissolved Oxygen Depletion: A Growing Concern in the Kawartha Lakes.

Our Spring Meeting is also an opportunity for you to:

- Meet our board of directors,
- Learn about the many projects KLSA is undertaking this summer,
- Pick up your copy of our ***"2022 Annual Lake Water Quality Report: Learning From Our Lakes."***

Whether you are attending in-person or virtually **please register** by clicking on the Eventbrite link:
https://www.eventbrite.com/e/kawartha-lakes-stewards-association-spring-meeting-2023-tickets-609624151247

You can also register by emailing us at: klsa@klsa.info

As always, we welcome donations to support the work of the KLSA.
For more information see our website: **https://klsa.wordpress.com/** or send us an e-mail at **klsa@klsa.info**

Participating in the Canadian Lakes Loon Survey

Want to monitor loons? Joining the program is easy: first contact Birds Canada at www.birdscanada.org to register. Then, pick a section of your lake that typically has loons. Seek out and record loon sightings once a month in June, July and August, and submit your data when you're finished to Birds Canada.

Please Support the Kawartha Lake Stewards Association

KLSA distributes all its publications, including this one, at no charge. We need your continued support to be able to provide these annual reports to cottage associations, libraries, government agencies, academics, and to people like you. If you have benefited from this report and would like to see this work continue, please consider making a donation. Completely run by volunteers, KLSA provides excellent value for every dollar it receives and gratefully acknowledges every donor in our annual report. Please give generously.

To make an e-transfer, please email us at the following address and we'll reply with the details: **klsa@klsa.info**

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To enquire about advertising in this report, please email tom.mcallister@klsa.info

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I am proud to support KLSA's work at the level of:

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If sending a cheque, please make it payable to: Kawartha Lake Stewards Association.
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