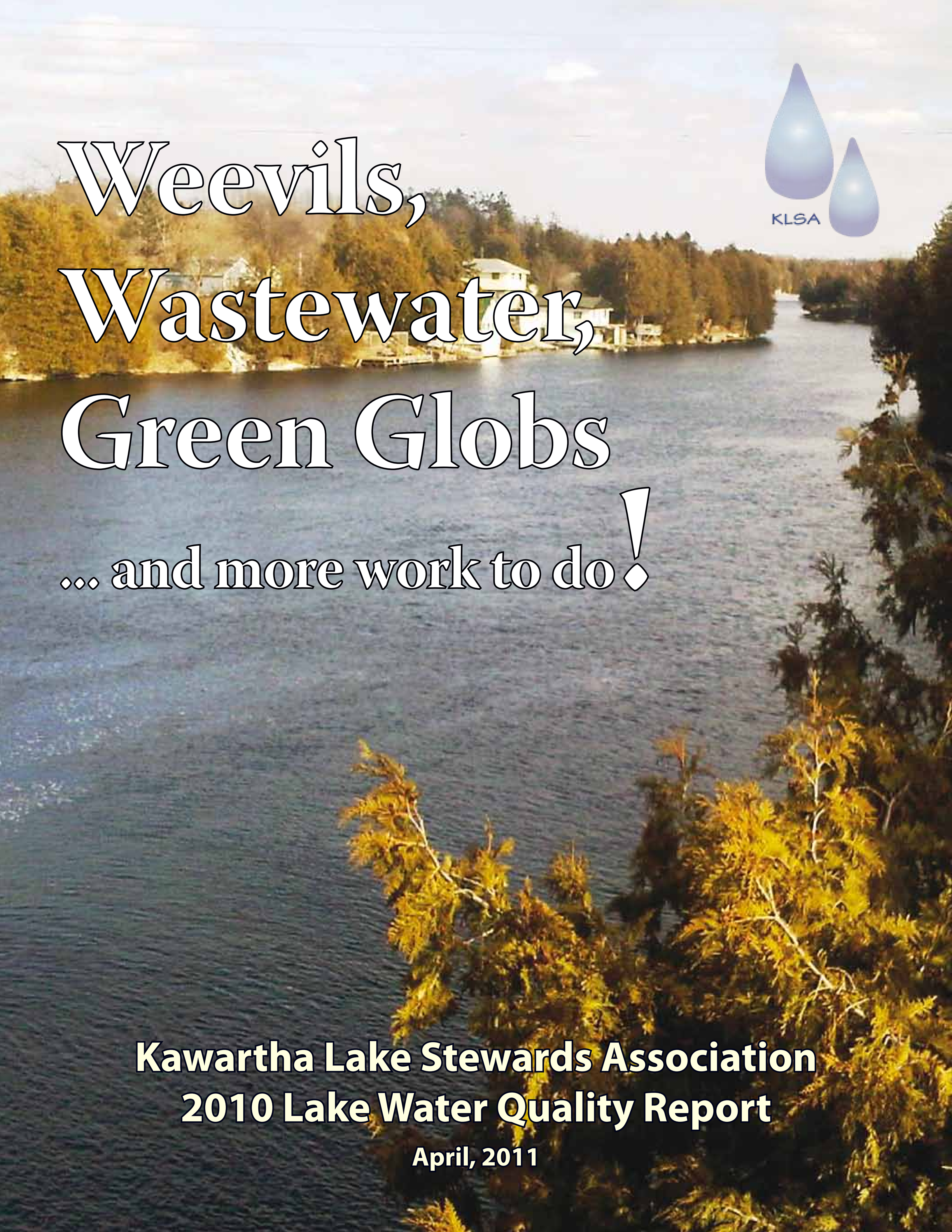

Weevils, Wastewater, Green Globs

... and more work to do!

Kawartha Lake Stewards Association

2010 Lake Water Quality Report

April, 2011

KLSA

Kawartha Lake Stewards Association

Lake Water Quality Report - 2010

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

Kawartha Lake Stewards Association
24 Charles Court, RR 3, Lakefield, ON K0L 2H0
Email: kawarthalakestewards@yahoo.ca

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

klsa.wordpress.com

KLSA is grateful for the funding from the Ontario Trillium Foundation for a two-year study of algae in the Kawartha Lakes.

Cover photo by Kevin Walters: Fenelon River from the Fenelon River Gorge toward Sturgeon Lake

THE ONTARIO TRILLIUM FOUNDATION

LA FONDATION TRILLIUM DE L'ONTARIO

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Chair's Message

by Mike Stedman, Chair, KLSA

As a KLSA supporter you must sometimes wonder what we are doing and why. I'll try to provide some answers to that question starting with a message recently received from our well recognized scientific advisor Dr. Eric Sager.

> *"Very little is being done right now around lake planning and water quality issues without KLSA's name coming up. Congrats on all your efforts."*

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

This eleventh edition of our annual KLSA Water Quality Report provides you with fascinating reading concerning our more familiar pursuits as defined by the four goals stated in the KLSA mandate:

1. Water testing and monitoring in the Kawartha Lakes
2. Scientific research to better understand the dynamics of our lake ecosystems
3. Providing insightful background that promotes more informed public participation
4. Partnerships to strengthen our pursuit of KLSA objectives

There is more to KLSA than this report can possibly cover.

Jeff Chalmers

The KLSA 2010 Board of Directors: (clockwise from left) Janet Duval, Kevin Walters, Paul Frost (Scientific Advisor), Mark Potter, Kathleen Mackenzie, Ann Ambler, Sheila Gordon-Dillane, Pat Moffat, Rod Martin, Robert Green and Mike Stedman. Missing from photo: Jeff Chalmers.

What else is KLSA doing?

Two years ago, your KLSA Board decided to place greater emphasis on working with the community and, where appropriate, entering into constructive partnerships. So let's see what we have done.

Kawartha Conservation has initiated a ***Sturgeon Lake Management Plan*** and at its request KLSA is a member of its Community Advisory Panel. In fact, KLSA Board member Chris Appleton recently took over as chair of this panel and our scientific advisor Dr. Paul Frost is a member of its Scientific Advisory Panel. Primary objectives include the coordination of all the volunteer lake testing and input to assure agreement on recommendations concerning future broad-based community actions. For more information, visit www.kawarthaconservation.com.

Many of you thought the 2008 Panel Report on the future of the Trent-Severn Waterway (TSW) *It's All About the Water* was long forgotten. Not so. KLSA provided input to that report and continues to press for increased support for our TSW. We have chosen to do so by participating at the board level in the ***Voices for the TSW*** and we continue to act as a stakeholder. Our role is to provide advice related to water quality issues in support of the TSW Water Management Advisory Council's balanced water management goals. Are we being listened to? It appears so.

Is good water quality a given?

At the invitation of the TSW, KLSA attended the January Trent University and Parks Canada Leaders' Round Table. The task was to build on the recommendations of the Panel on the Future of the TSW and agree on a collective vision for the long-term economic, cultural and environmental sustainability for our watershed. Over 150 participants in several workshops defined their concerns for the TSW watershed, suggested key strategies and finally developed a vision statement for their special interests, be it water management, tourism, First Nations, TSW infrastructure, communications, governance, etc.

KLSA representatives participated in two water quality workshops. It came as a shock at the end of the day to observe how little attention had been devoted to water quality. Were participants so busy dealing with their interest groups that they just assumed water quality was either not an issue or was someone else's issue? Is this because water quality is such a complex issue? Or is it because we are comfortable with today's water quality and do not realize that the lakes are in a delicate balance? If there was serious erosion of the quality we have today it would take years to correct. Having reached this conclusion, our workshop recommended that each of the strategic interest groups rethink their vision statement to include a priority on water quality. This was a lesson in how easy it is to forget that all these good TSW initiatives are dependent on sustainable, healthy water quality.

Is it time for biological control of milfoil?

At our 2010 Fall General Meeting you heard our KLSA steward from Big Cedar Lake say what many of us are thinking. Eurasian milfoil seems to be increasing in our lakes. What can we do about it? After much planning, KLSA submitted an application for a Fleming College Credit for Product research project entitled "**Biological Control**: the ecology, feasibility and regulatory considerations of using the weevil to control Eurasian watermilfoil in the Kawartha Lakes". Our efforts will be rewarded if this project is as successful as our 2009 Lindsay stormwater pollution study (see details of follow-up work on this project elsewhere in this report). By the way, you have all commented on the enthusiasm that Trent University

Masters candidate Kyle Borrowman has brought to KLSA, first as a member of our Aquatic Plants Study and now as science mentor for this Fleming College team. If you have a question about weevils and milfoil Kyle is your man.

Latornell Conservation Symposium

We are partnered with Lakeland Alliance and responded to a request to speak last November at the **A.D. Latornell Conservation Symposium**: ***Biodiversity: Connecting People, Land and Water***. The meeting was attended by more than 500 people from government agencies and Conservation Authorities. They picked KLSA to speak as an authority on community lake stewardship and, equipped with our new KLSA PowerPoint presentation, we delivered.

Can our meetings be more productive?

Many of you completed a **meeting effectiveness survey** at our last General Meeting. The results indicated that you still consider algae and aquatic plants to be your major concerns. An update on milfoil and management control methods was also mentioned. A question of preference for future meetings prompted most respondents to say that they liked our current format. Another significant

Anita Locke

Snapping turtle

suggestion was separate workshops or break-out sessions. There were several suggestions for meeting improvement including keeping the agenda on time, taking a short break half way through, starting Q&A at 11:30, limiting questions to one per person per topic, developing more proactive action proposals and having more experts on water quality. Your KLSA Board is listening.

What should KLSA's emphasis be?

Preparing for this annual report gives me insight into the many Kawartha Lakes water quality issues that our members and partners are wrestling with. You cannot help but be impressed by their endeavours and this year we have an article that is 'over the top'. Our 'chief guru' board member, Kevin Walters, gives us something to really think about. Perhaps you and I need to refrain from becoming trapped in the orthodox solutions to lake water quality problems. Over the years we have been told nutrients were a problem, so we measure phosphorus and campaign against poor septic systems. *E.coli* may pose a risk to our children swimming at community waterfronts, so we measure it. As we canoe the shoreline we look in distaste at the mega homes buttressed with armour rock, so we contemplate legislation. Shoreline protection is probably the priority today. None of this is wrong but it might be too simplistic knowing what we know about Kawartha Lake water quality issues and the solutions available today. Century-old legislation made water quantity the TSW's mandate. Isn't water quality just as important? Kevin's writings force us to rethink where we put our emphasis.

Perhaps this review of KLSA activities combined with the following content will help demonstrate what you, the members, are doing and can do to support the sustainability of our Kawartha Lakes water quality. We hope this report lives up to the good works our volunteers continue to give to the community - volunteers I am gratified to represent as Chair.

For generous donations of their time and talents, special thanks to:

Kyle Borrowman, Trent University

Simon Conolly, The Lakefield Herald

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

George Gillespie, McColl Turner LLP

Andrea Hicks, Community Stream Steward Program, OFAH

Sara Kelly, Fleming College

Dr. Eric Sager, Coordinator, Ecological Restoration Program, Fleming College
and Adjunct Professor, Trent University

KLSA is successful only to the extent that we have your support.

Executive Summary - 2010 Report

by Sheila Gordon-Dillane, KLSA Director

The Kawartha Lake Stewards Association (KLSA) is a volunteer-driven, non-profit organization of cottagers, year-round residents and local business owners in the Kawartha Lakes watershed. Established to provide a coordinated approach to lake water monitoring, the Association tests lake water for phosphorus, water clarity and *E.coli* bacteria during the spring, summer and early fall. In recent years, KLSA has expanded its activities significantly, primarily into the areas of research and public education. Over the past decade, KLSA has forged valuable partnerships with Trent University, Fleming College and Kawartha Conservation, resulting in research studies of aquatic plant and algae management, sources of phosphorus and stormwater pollution. In more recent years, additional partnerships have been developed for public education and advocacy purposes through involvement in such initiatives as the Sturgeon Lake Management Plan and the deliberations of the Voices for the Trent-Severn Waterway. In 2010, KLSA research initiatives have investigated algae in the Kawartha Lakes and the impact of shoreline development on phosphorus levels in the water. Public education initiatives arising from the algae project will be implemented in 2011 and 2012.

Our Kawarthas: The Lower Lakes and Lake Scugog

In our past four reports, Board member Kevin Walters has described the physical geography and early history of the Kawartha Lakes. The 2006 article provided an overview of the lakes. The 2007 article described the Upper Lakes, including Shadow, Silver, Balsam and Cameron. The Central Lakes: Sturgeon, Pigeon, Little and Big Bald, Sandy, Buckhorn and Chemong Lakes and the Mississagua River were discussed in 2008 and the 2009 article described Buckhorn and the Lovesicks. See these reports at www.klsa.wordpress.com.

In this report, Kevin concludes the series with a description of two remaining areas, Stony and Clear Lakes and their outlet lakes, Katchewanooka and White Lakes at the eastern end of the Kawarthas below Burleigh Falls, and Lake Scugog to the south. Stony and Clear Lakes are the names for different ends of the same body of water. Stony Lake is further subdivided into Upper Stoney and Lower Stony Lakes, on either side of Boshing Narrows. The Shield rock in and around the Stony-Clear basin includes solid granite, granite-like alaskite and extensive areas of soft calcitic marble and other metamorphic rocks. To the east is an area known for its minerals and mining. Lower Stony Lake also contains a very unique 80 hectare island, Fairy Island, which has a lake, Fairy Lake, within it. Upper Stoney is fed mainly by water from two northern tributaries, Eels Creek and Jacks Creek, both of which are regulated by dams and tumble into Stony Lake with scenic waterfalls. The Stony and Clear Lakes empty into the Otonabee River and the smaller Indian River, both of which flow into Rice Lake, where they rejoin to form the Trent River. Katchewanooka Lake serves as an outlet lake for the Otonabee stream flowing from Clear Lake. The Indian River spills from Stony Lake's Gilchrist Bay into White Lake (formerly Dummer Lake).

Lake Scugog occupies a vast area shaped like a race track, with a large oval island in the middle. It is divided into two basins and in warm weather, produces marl, calcium carbonate precipitate. Fed by the marshy Nonquon River, the water at times takes on a murky yellow or brown colour. The article provides a detailed description of the geography and aspects of the history of the area.

***E.coli* Bacteria Testing**

In 2010, KLSA volunteers tested 106 sites in 13 lakes. Each site was tested up to six times during the summer for *E.coli* bacteria. Samples were analyzed by SGS Lakefield Research and the Centre for Alternative Wastewater Treatment (CAWT) laboratory at Fleming College in Lindsay. Public beaches are posted as unsafe for swimming when levels reach 100/*E.coli*/100 mL of water. The KLSA believes that counts in the

Kawartha Lakes should not exceed 50/*E.coli*/100 mL. In general, *E.coli* levels were low throughout the summer, consistent with other years. Of the 106 sites tested, 61 were "very clean" (no readings above 20), 25 were "clean" (one or two readings above 20), seven were "somewhat elevated" (three readings between 20-100) and seven were designated as "needing observation" because they had more than two counts over 100 or more than three counts over 20. The high results were generally in areas of low water circulation, near wetlands or were due to pollution from waterfowl. Detailed lake and site results can be found in Appendix E. Thank you to all our volunteer water samplers for their efforts to collect the samples and deliver them to the laboratories.

Phosphorus Testing

In 2010, as part of the Ministry of the Environment's Lake Partner Program, volunteers collected water samples six times per year (May to October) at 38 sites on 14 lakes for phosphorus testing. Samples were analyzed by the Ministry laboratory. Volunteers also measured water clarity, using a Secchi disk. The Ministry's Provincial Water Quality Objectives consider average phosphorus levels exceeding 20 ppb to be of concern since at that point algal growth accelerates, adversely affecting enjoyment of the lakes. Overall in the summer of 2010, average phosphorus levels were similar to those of the past nine years. The usual patterns of rising and falling phosphorus levels occurred from month to month (low in May, rising from June to August and declining in September). One unusual situation is an increase in phosphorus levels between Balsam Lake and Sturgeon Lake. Additional testing in Cameron Lake is needed to solve this mystery. Detailed results of the 2010 Lake Partner Program are provided in Appendix F. The KLSA is grateful to the many volunteers who participate in our monitoring programs.

The Ministry of the Environment's Lake Partner Program

An article by Anna DeSellas, from the Ministry of the Environment's Dorset Environmental Science Centre (DESC), describes the Ministry's Lake Partner Program, a volunteer-based water quality monitoring program that began in 1996. Each year, more than 800 volunteers , including KLSA testers, monitor total phosphorus and water clarity in more than 600 inland lakes. Total phosphorus is measured because it is the element that controls algal growth – more phosphorus generally means more algae. Monitoring of water clarity levels may indicate that changes are occurring in the algal biomass, climate or land use within a watershed. The processes for collection and analysis of the samples are described. In 2008, the Lake Partner Program added calcium sampling to its program. Calcium is an essential part of the structural components of aquatic creatures such as crustaceans, molluscs and a type of water flea, the Daphnia. A study of calcium levels in the Daphnia, an essential part of lake food webs because they eat algae, showed that Daphnia do poorly in lakes with low calcium levels. Also in 2008, the MOE partnered with the Ministry of Natural Resources to launch the Broadscale Inland Lakes Monitoring Program to monitor fish, fish contaminants, water chemistry and invasive species in approximately 1,000 lakes over a five-year cycle. Lake Partner Program data are also being used to examine the influence of precipitation on total phosphorus concentrations in different regions of the province. The data collected in these programs will help to assess the current state of Ontario's inland lakes, the impact of precipitation and climate warming, trends and changes over time.

The Squaw (Miskwaa Ziibi) River Study

In the summer of 2010, Laura Manson, an Environmental Studies student from Scotland, conducted a study of the effect of shoreline development on levels of *E.coli* and phosphorus in a small river. Weekly samples were collected at two separate sites above and below the developed section of the shoreline. Flow rate was also measured. The results did not show any negative effect of human activity on levels of phosphorus or *E.coli* and in fact there was a reduction in levels from the upper undeveloped site to the more developed lower site. Unfortunately, heavy rainfalls may have diluted the samples or disturbed the sediments, affecting the results. The study will be repeated and expanded in 2011 if funding permits.

Sewage Treatment Plants: 2009 Report Review

Each year, KLSA Vice-Chair Kevin Walters monitors and reports on output from local sewage treatment plants. Phosphorus output is a key indicator, and the cause of increased plant and algal growth in our lakes. Bobcaygeon's sewage treatment plant (STP) experienced operational problems resulting in a very low removal rate of 40% for phosphorus in 2009, compared to 98% at Lindsay. It discharges over five times more phosphorus than Lindsay, despite the fact that it is only one-seventh the size of the Lindsay plant. STPs at Fenelon Falls, Coboconk and Omemee had acceptable performance although there was a significant overflow on one occasion at the Fenelon Falls plant and the others are at risk of exceeding their capacity. Continued monitoring of all STPs is vital. The Bobcaygeon plant in particular requires significant improvement and private STPs serving new housing developments should be opposed, since they may perform poorly and are difficult to monitor.

Assessing Water Quality in Urban Stormwater in Lindsay

One of the partnerships KLSA has developed in recent years is with the Fleming College Ecosystem Management Technology Program. Under the supervision of Professor Sara Kelly, with assistance from KLSA Board member Kevin Walters, in 2009, three third year students undertook a study in the City of Kawartha Lakes (CKL) as a Credit for Product (C4P) course. The study measured the amount of phosphorus and *E.coli* found in runoff from eight storm sewer outfalls in Lindsay. High levels of bacteria were found at some sites and further investigation was recommended. In 2010 a second C4P study was undertaken by the City of Kawartha Lakes in collaboration with the Fleming College Centre for Alternative Wastewater Treatment (CAWT). Seven stormwater outfall sites and two river grab sites were sampled, two in wet weather and one in dry weather. The study was more comprehensive than the 2009 project. The 2010 bacteria levels were lower than those found in 2009 although there was significant *E.coli* in the stormwater outfalls. Significant increases in *E.coli* were also found in the samples taken from the Scugog River downstream of Lindsay. Ammonia, a constituent of organic waste and fertilizers, was also found in samples from three outfalls. The next step is to determine if the source of *E.coli* is human or animal. The City and CAWT will conduct additional tests during both wet and dry weather to obtain more comprehensive results.

Algae in the Kawartha Lakes & Elephant Snot, Algae Gardens and the Kawartha Lakes

An article by Dr. Paul Frost describes an important initiative of the KLSA and Trent University. The KLSA received Ontario Trillium Foundation funding for a two-year collaborative project with a Trent University research team led by Dr. Paul Frost, to answer basic but important questions about algae in the Kawartha Lakes. The study aims to identify the primary algal species in the Kawartha Lakes, the nutrients that affect algal growth and methods of preventing excessive algal growth. The article describes the methodology undertaken during the summer of 2010 and presents preliminary results. The analysis generally indicated that phosphorus is the primary limiting nutrient. Additional analysis will continue in 2011. Workshops for shoreline residents will also be held in 2011 and an educational booklet on algae, similar to the Aquatic Plants Guide, will be published and distributed in 2012.

In a companion article, Andrew Scott, one of the researchers in the Frost Lab at Trent University, provides a personal perspective from members of the research team on the algae study and introduces readers to 'elephant snot' and 'algae gardens'. Thank you to the KLSA volunteers who assisted the researchers on many occasions.

Eurasian Watermilfoil in the Kawarthas: The Past, Present and Future of Management

Trent University graduate student Kyle Borrowman has been conducting studies of the use of weevils to control Eurasian watermilfoil in the Kawarthas. Milfoil is a rapidly growing aquatic plant that proliferates through fragmentation, making removal methods such as cutting and harvesting counter-productive. The article provides a history of milfoil control in the Kawarthas and the observation in the 1980s in Lake

Scugog that large stands of milfoil declined, apparently due to damage from a native milfoil weevil and an aquatic moth. The milfoil weevil has shown promise as a method of biological control and experiments with commercial applications are occurring both in Ontario and the United States. A 2009 pilot project conducted in Lake Scugog succeeded in severely damaging stands of milfoil over two summers. In the summer of 2010, a survey of 21 Ontario lakes within Central Ontario and the Sudbury District was conducted to study milfoil weevil density and types of milfoil in the various lakes. Both weevils and aquatic moths were found although weevil density levels were insufficient to destroy the plants. Further studies will be conducted in the summer of 2011.

Wild Rice on the Trent-Severn Waterway

Beth Cockburn of Parks Canada and Jeff Beaver, Environmental Steward for Alderville First Nation, have contributed an article describing the recovery of wild rice populations in recent years throughout the Trent-Severn Waterway. The TSW is aware of concerns of residents about wild rice and of the need for a policy to address the management of this resource. A consultation process will be undertaken in 2011. Until a policy is developed, wild rice will continue to be protected and removal permits will not be granted.

The Sturgeon Lake Management Plan in 2010

The KLSA is a participant in the process to develop a management plan for Sturgeon Lake. Dave Pridham and Alex Shulyarenko, staff at Kawartha Conservation, outline the objectives and the process for the Sturgeon Lake Management Plan (SLMP), initiated as a four-year program involving water and resource inventories, data analyses, consultations and plan preparation. Water monitoring began in June of 2010. Flow data is also being collected and precipitation is being measured. The project management structure consists of a Project Management Team, a Science and Technical Committee, an Executive Liaison Group and a Community Advisory Panel.

Phosphorus sources on the Kawartha Lakes: What Matters Most?

The report concludes with an article by Kevin Walters providing a historical perspective and an analysis of sources of phosphorus in the Kawarthas. Factors affecting phosphorus levels over the years have included changes in settlement patterns, economic development, agricultural practices, government regulation and invasive species such as zebra mussels. A common perception that faulty septic systems, boat greywater and unnatural shorelines are to blame does not appear to be borne out by evidence. Attention must turn to agriculture, sewage treatment plants and urban stormwater runoff. Also, KLSA is anxious to study nutrients in sediments in the lakes. It is important to continue to support organizations that monitor water quality and delve into issues that affect our use and enjoyment of the lakes.

Thank you

The Kawartha Lake Stewards Association could not achieve its goals without the extraordinary support of the many volunteers who participate in our monitoring programs, our member cottage associations, ratepayer associations, municipalities and businesses that provide financial support. We are also very grateful to the Trent-Severn Waterway for its annual grant and to the Ontario Trillium Foundation for funding our algae project. Thank you also to Dr. Eric Sager, Dr. Paul Frost, Professor Sara Kelly and their colleagues at Trent University and Fleming College for their scientific advice and ongoing support of our work, staff at the Ministry of the Environment Lake Partner Program and staff at SGS Lakefield Research and the Centre for Alternative Wastewater Treatment for assisting with the testing program. Special thanks to our auditor George Gillespie and our publisher Simon Conolly.

For further details of the work of the Kawartha Lake Stewards Association, please visit our website: klsa.wordpress.com.

Our Kawarthas: The Lower Lakes and Lake Scugog

By Kevin Walters, B.A. Sc., P. Eng.
Vice-Chair, KLSA

In four previous Annual Reports, Kevin Walters described the physical geography and early history of the Kawartha Lakes. 2006 provided an overview of the lakes' creation, geography and history. The 2007 report looked at the Upper Lakes, including Shadow, Silver, Balsam and Cameron. The Central Lakes were featured in 2008: Sturgeon, Pigeon, the Balds, Chemong, Buckhorn and Sandy. In 2009 Kevin discussed Buckhorn and the Lovesicks. You can review these online at klsa.wordpress.com. This year his series concludes with a description of two remaining areas, Stony-Clear, White and Katchewanooka Lakes at the eastern end of the Kawarthas, and Lake Scugog to the south.

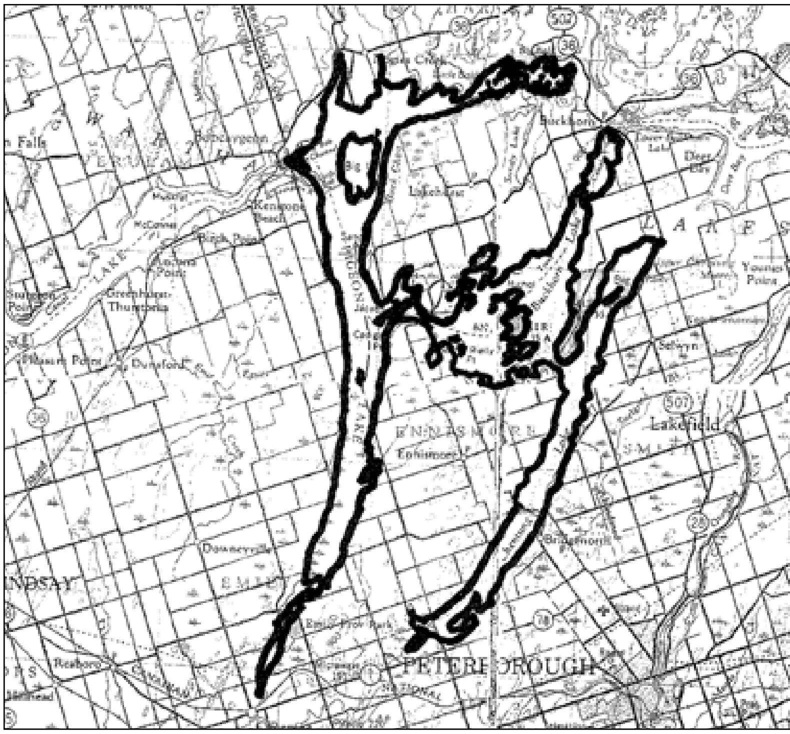
John Balatka

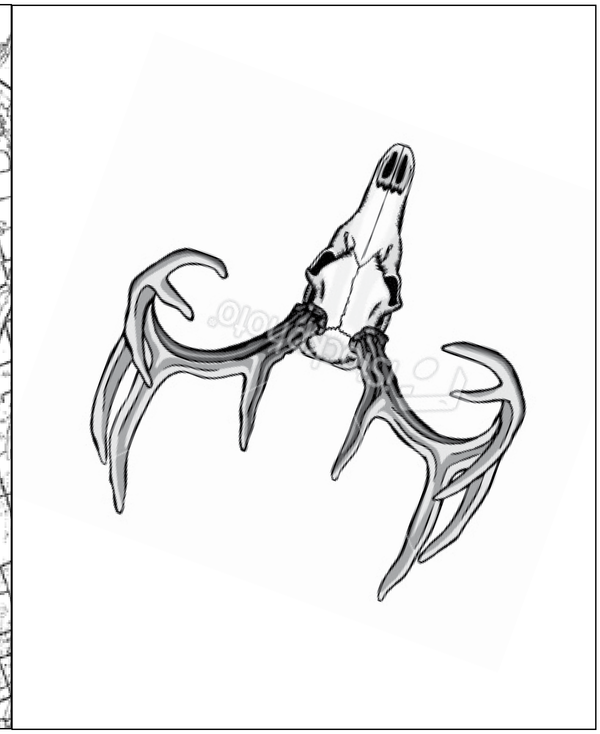
Burleigh Falls

You may recall that the Kawarthas are divided into several large basins. At the eastern end we have three main basins, the tripartite Stony-Clear Lake group and the twin outlet lakes of Katchewanooka and White. The total surface area of these lakes is about 39 square kilometres.

The two cataracts of Fenelon Falls and Burleigh Falls have been selected as the division between the 'Upper,' 'Central' and 'Lower' Lakes, and here we begin with the description of the Lower Lakes, those below Burleigh Falls.

In last year's Report we left off with the description of the Lovesicks (today's Lower Buckhorn and Lovesick Lakes) just above Burleigh Falls, and above that the vast body of water locally known as 'the





tri-lakes' that we could call either 'Lake Kawartha' or 'Great Buckhorn.' The name of Buckhorn appears to have originated in the shape of the group of lakes resembling the head of a buck with its antlers. Unfortunately, one of our illustrations last year was inverted. We run this map again here so as to better show the resemblance between the shape of the lake and the head and antlers of a buck.

Stony and Clear

Stony and Clear Lakes are at different ends of the same body of water, comprising nearly 28 square kilometres. Stony Lake is further subdivided by locals into Upper and Lower, as the lake is pinched somewhat in the middle at **Boshing Narrows**, differentiating the two halves. The boundary between Stony and Clear Lake is far less easily determined, and is essentially defined as the part of the lake 'clear' of the Stony part's rocks or 'stones.' This is a more likely explanation for the name as opposed to some particular clarity of the water, which is actually clearer in Upper Stoney Lake. (Note the locally used change in spelling here.) Clear Lake might just as easily have been called 'Clear Bay,' which may indeed be a better term for this end of the lake.

The reason for the absence of islands and shoals in Clear Lake is a geological fault in the Canadian Shield, which has caused all the bedrock south of a line drawn roughly due west from Bobcaygeon to be at a lower elevation, with its knobby granitic/gneissic surface well submerged below the lake.

At one time, Clear Lake and Lower Stony Lake were together called Salmon Trout Lake, while Upper Stoney Lake alone carried the name of Stony Lake. Yet another early 19th century map has Clear Lake apparently applying to both today's Clear as well as 'Lower' Stony Lakes, and other references have the predictable variant of 'Rock Lake.' Other early maps or references have the entire lake named 'Trout Lake' or 'Boshing Lake,' which is likely the origin of the name of the narrows connecting the upper and lower lakes. *The Valley of the Trent*[1] notes the early native name 'Cheboutequion' meaning 'big long rocky water.'

The large size of the basin along with its abundance of scenic islands, perhaps as many as a thousand, led to a very early and extensive cottaging tradition. Few of the islands large enough to hold a cottage were retained for ultimate designation as Indian Reserve. Hence, this part of the **Islands in the Trent Waters Reserve** is limited to one island and a few rocks and shoals.

The basin is quite similar to the **Lovesick** basin upstream, in terms of geology and physiography. Limestone escarpment contains much of the south shore of the basin, with the Shield rock forming the floor of it. Large patches of outlying limestone caprock can be found to the north. In the **Clear Lake** portion, as in **Deer Bay** to the west, limestone predominates along the shore. It is almost a larger copy of the Lovesick basin, in that the shape is similar, it is composed of three distinct parts, and a large island-free bay extends southward. The chief difference is that the outlets are at the south, as opposed to the east end.

In one particular island-studded section of **Lower Stony Lake** where it meets with Clear Lake is a tortuous passageway known as **Hells Gate**, apparently named for the difficulties lumbermen encountered routing their logs through it. Here we find the most unique island in the Kawarthas, **Fairy Lake Island**, an island of 80 hectares or so having a lake within it of about 16 hectares, known of course as **Fairy Lake**.

The Shield rock in and surrounding the Stony-Clear basin is much more varied than at 'the Lovesicks,' ranging from solid granite to granite-like alaskite, quarried for a time on **Eagle Mount** and **Quarry Island**, to extensive areas of soft calcitic marble and many other metamorphic rocks. To the east is a mineral resource region of considerable commercial interest, including a large nepheline syenite mine only a few kilometres to the northeast. For a long period of time, before today's highways existed, quarried rock from this mine was transported via barge from a wharf at **Stonyridge** at the east end of the lake to the railroad in Lakefield.

Unlike the Central Lakes, the Lower Lakes have their outlet in the southwest, meaning that isostatic rebound (the local tilting of the crust of the earth due to the retreat of the glaciers) is tilting the water out, and hence water levels are inexorably dropping, particularly at the east end of Upper Stoney. This is somewhat apparent with bare rocky shores and islands looking similar to the Thirty Thousand Islands in Georgian Bay, where the same process is occurring, albeit on a far greater, more rapid scale. The rate of decline in Upper Stoney Lake is approximately the same as the rate of rise in the Central Lakes.

The deepest water in the Kawartha Lakes since the Fenelon gorge is found in Upper Stoney, with a central crater-like basin reaching 32 metres deep, whereas Lower Stony and Clear have maximum depths of 15 and 12 metres respectively.

Feeder streams from the north

Upper Stoney Lake is fed mainly by water from two northern tributaries, both of which are regulated by dams on the respective reservoir lakes carrying the same name as the streams. They are **Eels Creek** and **Jacks Creek**. The former is actually large enough by local standards to be labelled a river, and it is unfortunate that **Eels Creek** is not known as the Eels River. Aside from the fact that it is larger than all the other named creeks, confusion with the much smaller Eels Creek flowing into Pigeon Lake arises.

[1] Guillet, Edwin Clarence, *Valley of the Trent* (Toronto, Ontario: Champlain Society, 1957). The entire text is available online at www.ourroots.ca

The watershed of **Jacks Creek** is primarily located on an area of calcitic marble, meaning that the stream water contains a greater amount of hardness and nutrient than is typically found in our northern streams. Both streams tumble into Stony Lake with scenic waterfalls close to the edge of the lake. These streams compensate for the summer evaporation that occurs off this large lake surface, as well as the deficit incurred upstream in the Central Lakes, and allows the usual 17 cubic metres per second (600 cubic feet per second) to be discharged downstream.

The clear, relatively low-nutrient and low-mineral inflow results in a much lower nutrient and hardness level in Upper Stoney than is found in the rest of the basin. However significant mixing of the lake waters undoubtedly occurs during periods of blustery southwesterly winds, which drive surface water from Lower Stony into Upper Stoney through the straits of **Boshing Narrows**, with compensating outflow occurring well beneath the surface.

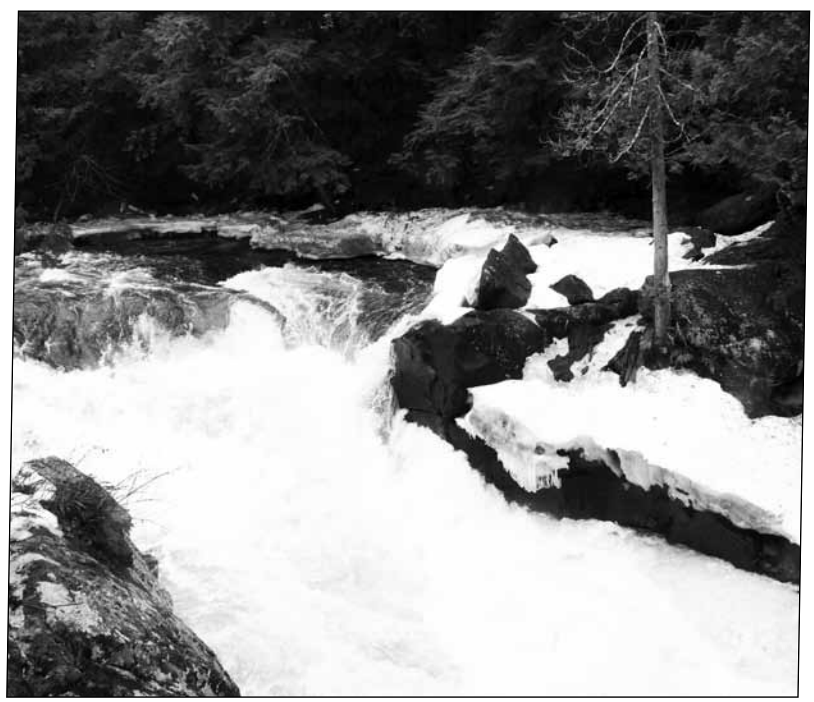
Split drainage begins

Stony-Clear has two outlets, the **Otonabee River** and the smaller **Indian River**, which send the Trent waters south by independent paths to **Rice Lake**, where they rejoin to form the **Trent River**. A huge nameless island thus exists between the two streams and two lakes.

Prehistorically, more water discharged down the Indian outlet. Isostatic rebound has been favouring the Otonabee outlet over the Indian, and is steadily reducing the flow in the former in favour of the latter ever since the retreat of the glaciers. Geology has also favoured the Otonabee outlet, given that this outlet is on limestone, which is softer and spalls easily with frost action, causing the outlet to enlarge with time. The Indian outlet is controlled by hard Shield rock, which is far more resistant to erosion by either flowing water or frost.

In more recent times, but before human intervention, the **Indian River** was an overflow or floodway for spring and fall runoff leaving Stony-Clear, via a number of channels in the Shield rock in close proximity. This was true until the damming of the lake at **Young's Point**, which allowed a constant flow of water down the Indian. Later still, the outlet from **Gilchrist Bay** was improved in the 1830s in order to better float logs down this river. Some time after logging ended, a dam was constructed within the improved channel to regulate the flow.

Regulation by the Trent-Severn Waterway has since reduced the flow in the Indian to an aesthetic minimum in order to ensure 17 metres per second (600 cfs) along the Otonabee, in order to maximize hydroelectric power generation and to dilute Peterborough sewage effluent.



Anita Locke

Eels Creek, North Kawartha Township

A small, unoperated, partly open dam and a couple of blind dams now prevent higher flows from entering the Indian River, and therefore spring flood waters no longer find relief in the Indian River.

The outlet lakes

As they leave Stony and Clear Lakes, both streams enter one last lake before becoming purely rivers. The **Otonabee** spills into **Katchewanooka Lake** from Clear Lake. The **Indian River** spills from Stony Lake's **Gilchrist Bay** into **White Lake**. White Lake is unregulated at its outlet, having no control dam, whereas Katchewanooka Lake is controlled for navigation as part of the Trent-Severn Waterway. White Lake is bounded by limestone scarp but founded largely on the Shield, whereas Katchewanooka Lake is entirely on the limestone and mostly hemmed in by the glacial deposits of the **Dummer Moraine**.

Katchewanooka Lake has had variant spellings over time, including Katchiwano and Katchewanoonk. White Lake was until recently called Dummer Lake, after the name of the township survey in which it is located. Both lakes contain about 18 islands, although many of those in White Lake are mere rocks.

To the east of Katchewanooka, there is a group of three high outcroppings of Shield rock, similar to Red Rock north of Sturgeon Lake, one of which is called **Lynch's Rock**. Like Red Rock, this towering knob of gneiss forced a local road to be routed around it. Another Shield rock hill, similarly poking through the limestone caprock and glacial overburden, can also be found near the southwest side of White Lake.

Both lakes are relatively small, about four and two square kilometres respectively. Katchewanooka – or just Katchewano – and White Lake each have a maximum depth of 10 metres. The drop in elevation from Stony-Clear to either of these lakes is about two metres.

Some reports describe Katchewanooka as an artificial lake created by the Lakefield dam. This lake is however quite natural, and the Lakefield dam merely increased its size, as dams did for most of the Kawartha Lakes. The incorrect theory is likely due to some early maps which didn't identify the lake, referring to the stretch of the Otonabee River from **Peterborough** to Young's Point as "rapids." This was either a bit of over-simplification or it was simply because mapmakers ignored Katchewanooka's relatively small size. To be fair, Katchewanooka would have been more like a small chain of lakes, not unlike the Mud Turtle group at the opposite end of our system, having narrows with fast water or even rapids in between. One interpretation of the name Katchewanooka is 'lake of many rapids,' although another has it as 'lake

Anita Locke

Indian River, Douro-Dummer Township

at the head of the rapids.' Either seems quite appropriate.

At the outlets of these two lakes, long stretches of river extend south to **Rice Lake** where they rejoin, leaving Rice Lake as the **Trent River**. The Indian River follows a relatively even gradient from White to Rice, and was apparently the natives' favoured route for upstream travel to the Lower Lakes. The **Otonabee** leaves **Lakefield** via the 'Nine Mile Rapids of the Otonabee,' an almost continuous steep pitch all the way to **Little Lake** at Peterborough, and then continues in a more placid flatwater and meandering channel from the rapids at the outlet of Little Lake to Rice Lake. With its higher flows, the Otonabee has cut a gorge in the limestone below Lakefield, whereas the Indian flows mainly on a flat limestone plain. However, about midway near **Warsaw**, it has found a passage within the limestone and travels underground through a jumble of collapsed bedrock for some distance.

Nutrient levels of the water reaching the outlets of the Lower Lakes generally are at their lowest since the upper cataract at **Fenelon**, save for a minor increase occurring again in Katchewanooka, likely the result of **Miller Creek** flowing in from the south. During the summer months, the volume of water leaving these lakes is much the same as that coming in the top end at **Norland**, having been fed by numerous rivers and streams along the way, but simultaneously diminished to the same extent by the high rate of evaporation off of the warm, weedy and wonderful Kawartha Lakes.

Lake Scugog and the Scugog River

Whether properly a Kawartha Lake, or on its own along with Rice Lake, **Lake Scugog** needs to be described here in order to understand its influence – or lack of it – on the balance of the Kawartha Lakes. This unusual lake behaves quite differently from any of the others. It has an interesting early physical history as well.

Its name, according to *The Valley of the Trent*[2], means 'shallow water.'

Two lakes in one

Lake Scugog occupies a vast area shaped like a race track, with a large oval island in the middle. Centuries ago, it was effectively two lakes occupying either side of the oval, linked in the north by a vast shallow-water flat filled with grasses, likely including wild rice and rushes. There was a large, mainly shallow basin on the east side, and a smaller, generally deeper one to the west, connected together by a broad river channel through the surrounding marshy flat. A number of almost-islands sat in the basin, with deep water on the west side, and marsh or swamp on the other. The south end of the oval was occupied by a mixture of swamp and marsh, rather than open water. This was produced by the retreat of the glaciers that left the formerly level basin somewhat tilted, as the weight of the remaining ice was concentrated to the north. The lake's chief inflow is the **Nonquon River** entering the west basin. Its waters flow out of an elongated bay coming off the top end of the eastern basin, then head north via the **Scugog River** to enter **Sturgeon Lake** at its southern end.

In the early 1800s a dam was constructed at present-day **Lindsay**, in a rapids section formed by a sill of limestone in the Scugog River, in order to generate water power. The dam raised the river by more than three metres, restoring the lake more or less to its pre-tilted limits, and created a single lake with real

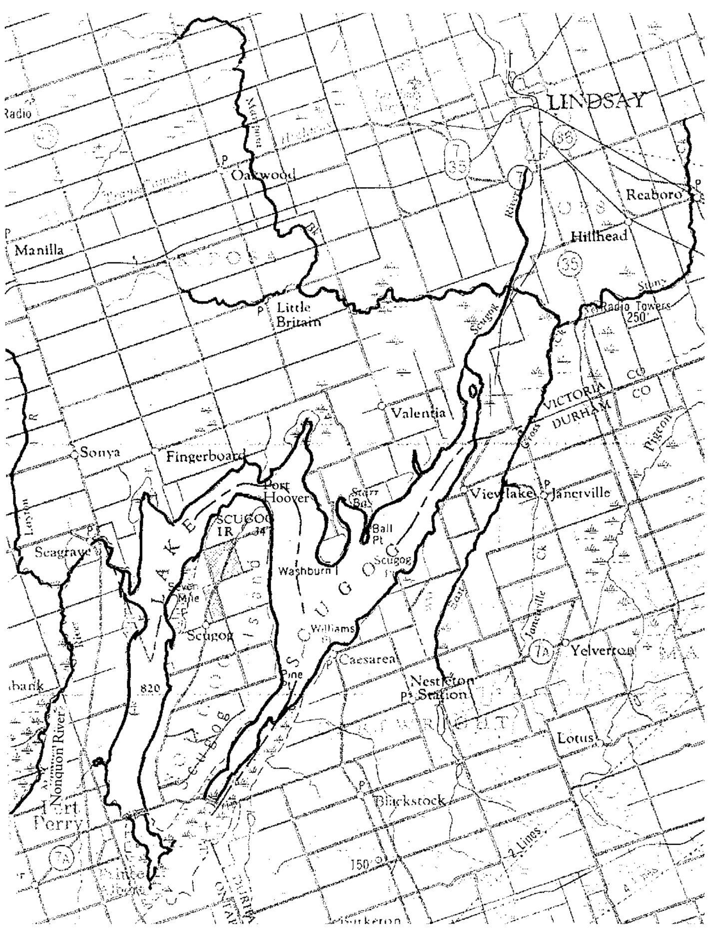
[2]Guillet, Edwin Clarence, *Valley of the Trent* (Toronto, Ontario: Champlain Society, 1957). The entire text is available online at www.ourroots.ca

islands instead of almost-ones. But as the land so inundated was privately owned, the flooding

was unpopular. Added to this was the prevalent belief that flooded land produced unhealthy living conditions from swamp gases, including mysterious ailments like 'lake fever' or a malarial fever labelled 'ague.' 'Bad air' was, after all, the origin of the name 'malaria.' The locals demanded the dam be removed, and ultimately a decision was made to reduce the extent of flooding, somewhat, but not entirely, due to the associated benefits of water power and improved navigation. By the 1830s the lake was reduced to where it is today, more or less. The new dam height set the raised water level at about two metres, raising the lake levels under one metre above normal spring water levels, not all that different from what occurred later on in the rest of the Kawarthas or the upstream reservoir lakes. Summer water levels are now just over a metre higher than they were in 1800.

Today we still see the legacy of the formerly raised lake system. It has taken over a century for most maps to show Scugog in an inverted U shape as opposed to the former complete ring, and the former islands like **Scugog Island, Washburn Island, Platten Island** and **Seven Mile Island**, while no longer islands, still bear those names, although Scugog Island is still an island by virtue of a man-made channel cut through the marsh in the south end. Seven Mile Island was previously known as Nonquon Island. Ridges formed by ice push are common along the shoreline, a product of the lake still adjusting to its new limits.

Scugog is often referred to as an artificial lake, but this is quite inaccurate. The lake size in fact is little changed from what naturally existed. It is only now somewhat deeper on a year-round basis. Today, we can see the original shape of the twin basins from nautical charts, as the area indicated roughly below the one-metre depth contour. Scugog still is, in effect, two lakes. A pinch point between the north end of Scugog Island and **Port Hoover** keeps the lake divided somewhat into two basins, the western one with a maximum depth of five metres and the larger eastern one with a maximum depth of at least seven metres. Water quality differs significantly between the two basins.



In fact, today, we have effectively three lakes. Where once a floating bridge crossed the lake at **Port Perry**, we now have a causeway which isolates the extreme south portion from the balance of the western basin. Over time, this causeway, which prevents boat access into the southern portion, has accumulated surrounding beds of cattails which further isolate the southern portion.

The effect of marl and peat

Scugog is one of our Kawartha marl lakes meaning that it is a hard water lake that produces marl, calcium carbonate precipitate, during warm weather. This production of marl is reportedly filling in the lake at a rate of about one millimetre per year.

Marl production is one of the two primary infillers of lakes. It is produced when slightly acidic rain water containing carbon dioxide dissolves limestone found in a watershed, making the runoff water hard. Once in the lake, carbon dioxide is lost due to summer warming or photosynthesis by plants and algae. The acidity of the lake water lessens and limestone precipitates out as marl. Southern Ontario has many smaller marl lakes that have either been completely filled in and marshed over, or are still in the process of doing so. For a period, this marl was sought after in the production of Portland cement, and many plants were established in the early 1900s on marl lakes or marshes for purposes of extraction.

The lake water of Scugog, fed largely by the marshy Nonquon River, is stained a yellowish brown. When the marl precipitates, the water takes on a murky yellow or brown colour, distinctly muddy looking. The shallowness of the lake undoubtedly causes the lightweight marl to become resuspended during windy weather, adding to the murky appearance.

The other lake infiller is the accumulation of peat, which primarily occurs where marshes surround a water body, or where marshy streams provide a constant source of vegetative detritus. This too occurs in Scugog as well as many other Kawartha lakes, but the infilling is usually confined to shallow marshy bays and inlets where wind and waves sweep in the lightweight material and deposit it.

Low water and a reversing stream

Lake Scugog has an insatiable water demand in summer. The shallow southern waters warm quickly leading to substantial evaporation. This evaporation can result in the loss of approximately two cubic metres per second (m^3/s) off of the lake and surrounding marsh surface. At some point, water can stop flowing over the dam at Lindsay and the water levels continue to drop behind it. As a result, the southern portion of the Scugog River is a reversing stream, being one of two such streams in the Kawartha Lakes.

Two major tributaries feeding the Scugog River are located just downstream (north) of the lake, being **Mariposa Brook** (once called West Cross Creek) and **East Cross Creek**. The 'Cross Creeks' continue to feed the river in summer, which then flows south from their concurrent entry points to the lake, offsetting the losses due to evaporation. The south Scugog River therefore flows slowly backward during extended dry summer weather.

This effect left the canal designers little water to operate the lock at **Lindsay**. They added a third set of gates to effectively reduce the size of the lock whenever possible, so as to conserve water on the Scugog waterway. During dry weather, the only water flowing through Lindsay is a little lockage water, dam and lock leakage, and water for municipal use. The southern Scugog River also reverses when the TSW raises the lake water level, as the waters of the 'Cross Creeks' assist in feeding the lake.

McLarens Creek, and another one-time tributary of the Scugog River where it meets Sturgeon Lake, add additional southern drainage into the south end in **Goose Bay**, an area having considerable now drowned marshland like Lake Scugog itself. Goose Bay once contained a large low island called Goose Island but the lack of hydrographic charting here has obscured its presence.

E.coli Bacteria Testing

By Kathleen Mackenzie, KLSA Vice-Chair

Over the summer of 2010, KLSA volunteers tested 106 sites in 13 lakes for *E.coli*. Each site was tested up to six times over the summer. Samples were analyzed at SGS Lakefield Research or at the Centre for Alternative Wastewater Management at Fleming College, Lindsay. The complete results and a description of our protocol can be found in Appendix E.

The summer of 2010 could be remembered as 'the summer that everyone liked'. It was warm (but never too hot) and sunny, with enough rain to keep everything growing right through August. Although the water was warm much earlier than usual, for *E.coli*, it was 'business as usual'. Almost all the sites were the same ones as those tested in 2009, and the results were very similar; that is, there were a few 'hot spots', but the large majority of the sites showed reliably low counts (see below).

Site Rating	Number of Sites	Comments
"Very clean": all readings less than 20 *E.coli*/100 mL	61	These low counts indicate excellent recreational quality and reflect careful shoreline management by cottagers.
"Clean": 1 or 2 readings over 20 *E.coli*/100 mL	25	
"Somewhat elevated": 3 readings over 20 *E.coli*/100 mL	7	These sites are still considered to have excellent recreational quality. Reasons for slightly elevated counts include low circulation, presence of large populations of waterfowl, inflow from wetlands.
"Needing observation": More than 2 counts over 100, or more than 3 counts over 20 *E.coli*/100 mL	7	5 of these sites are at the mouths of creeks. 2 sites are shallow areas with thick sediments, which may have been churned up by storms.

This year, just before two popular test dates, July 19 and August 9, there were heavy storms that many volunteers reported in their logs. It was interesting to see that counts did not seem to increase on these two dates (see below) – a sign that we are, in general, minimizing runoff with good shoreline practices. In an urban stream, for instance, counts would have risen noticeably after such rain events.

	***E.coli*/100 mL at 42 Sites**				
Date	**10 or less**	**11 – 20**	**21 – 50**	**50 – 100**	**Over 100**
Jul.5	31	6	3	2	0
Jul.19	28	8	3	0	3
Jul.26	29	6	6	0	1
Aug.3	26	10	4	2	1
Aug.9	31	5	1	1	4
Sep.7	29	6	6	1	0

Many thanks to our fleet of volunteers who spent hours in their boats and cars, collecting and delivering samples. Special thanks go to Rod Martin and Doug Erlandson, who coordinated delivery of samples to the Lindsay laboratory.

Kevin Walters

A Lovesick island in spring 2010. During lock repairs at Buckhorn, water levels reached historic lows in some lakes.

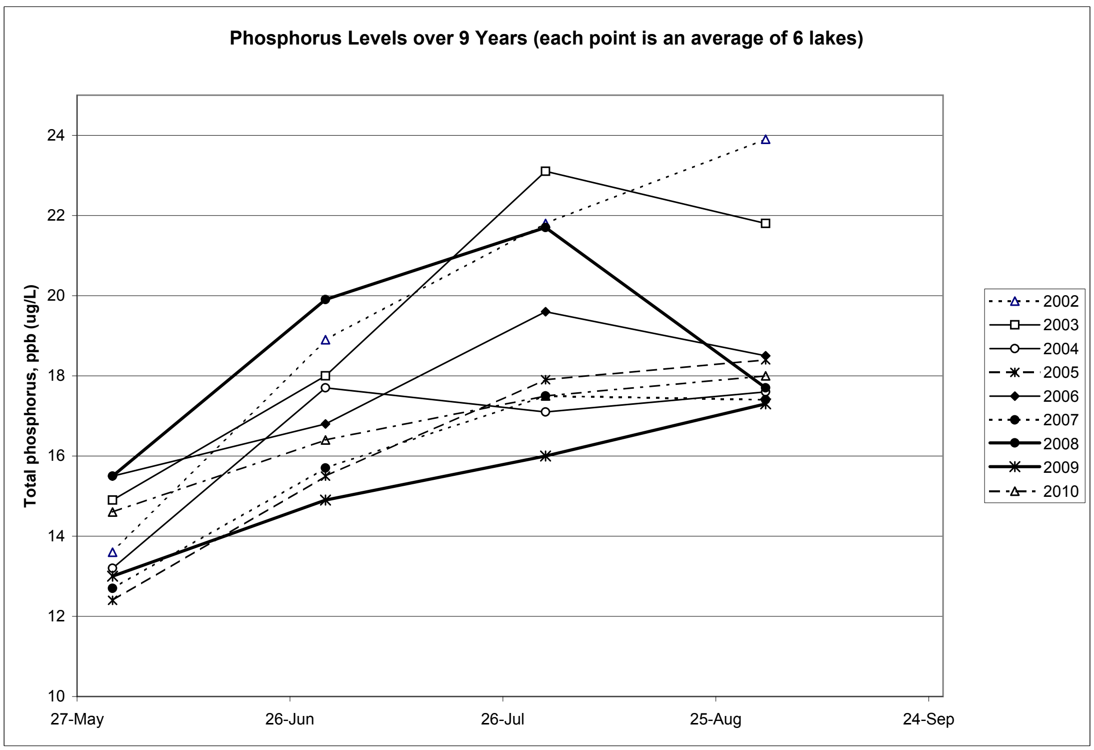
Phosphorus Testing

By Kathleen Mackenzie, KLSA Vice-Chair

In 2010, KLSA volunteers collected water samples from 38 locations in 14 lakes. These were analyzed at the Ministry of the Environment's Lake Partner Program laboratory. Please see Appendix F for complete data and lake-by-lake analysis.

2010: An average year

How does 2010 compare to other years? As seen below, phosphorus levels on the Waterway in 2010 were average compared to other years. There certainly don't seem to be any obvious trends over the past nine years; phosphorus levels have gone up and down, but in a seemingly random way.



Balsam-Sturgeon phosphorus jump: still a mystery

There is a mystery we at KLSA think we should be able to solve: Why does the phosphorus level jump 5 parts per billion (ppb) between the time water exits Balsam Lake (East Grand Island site) and the time it enters Sturgeon Lake (South Fenelon Falls site)? Between these two lakes is Cameron Lake. Does the phosphorus jump occur somewhere in Cameron Lake or at the top of Sturgeon Lake at Fenelon Falls? It's difficult to say, as we have had very little phosphorus data over the past five years from Cameron Lake. With some historical data we have scrabbled together for Cameron Lake, it appears that the jump happens, not in Cameron Lake, but below Fenelon Falls (see table below). Could it be Fenelon Falls storm water and/or its sewage treatment plant? With more testing in Cameron Lake, we should be able to pinpoint the location of the phosphorus jump and be closer to finding its cause.

Total Phosphorus, ppb (ug/L)*			
Site	**July 1**	**Aug 1**	**Sep 1**
Balsam; E. Grand Is.	10.9	12.0	10.9
Cameron; south end**	11.0	10.2	6.5
Sturgeon; south of Fenelon Falls	15.9	15.6	13.6

*Data is an average calculated from Lake Partner Program data and from Dillon, P.J. 1975. The phosphorus budget of Cameron Lake, Ontario. Limnol. Oceanogr. 20(1).

**There is limited data on Cameron Lake.

Kevin Walters

Low water – Lovesick Lake

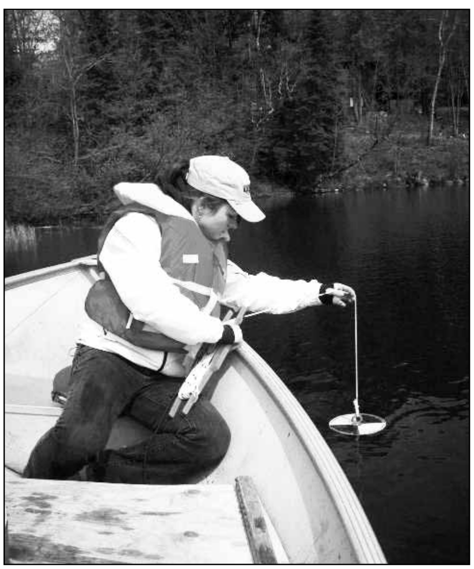
The Ministry of the Environment's Lake Partner Program

By Anna DeSellas, Dorset Environmental Science Centre

The Lake Partner Program is a volunteer-based water quality monitoring program. The program began in 1996 in partnership with the Federation of Ontario Cottagers' Associations (FOCA) and the Lake of the Woods District Property Owners' Association (LOWDPOA). Since 2002, the Ontario Ministry of the Environment has coordinated the program from the Dorset Environmental Science Centre. Each year, more than 800 volunteers monitor total phosphorus and water clarity in more than 600 inland lakes.

An aerial view of the Dorset Environmental Science Centre, located in south-central Ontario

Total phosphorus is measured because it is the element that controls algal growth in the majority of Ontario lakes. Generally, more phosphorus means more algal growth. Secchi disc measurements can detect changes in water clarity which may indicate that changes are occurring in the algal biomass, climate or land use within the watershed. It is important to note that if your lake is coloured or "tea stained", the water clarity observations may not be indicative of the amount of algae that is in the lake.



A volunteer uses a Secchi disc to record water transparency.

Each year, the Ministry of the Environment (MOE) sends volunteer 'Lake Stewards' a sampling kit that contains the materials necessary to conduct water clarity measurements and take water samples for testing of total phosphorus concentrations. Volunteers return their water samples, postage paid, to the Dorset Environmental Science Centre (DESC). Upon arrival, the glass phosphorus sample tubes are moved to racks and refrigerated until analysis by DESC's low-level phosphorus laboratory. At the lab, each TP sample is given a unique identifier number before being analysed.

During analysis, acid and heat are used to convert all forms of phosphorus within each water sample to the inorganic form, orthophosphate. An aliquot from each tube is then combined with two different reagents. The orthophosphate reacts with these reagents producing a blue colour proportional to the amount of phosphorus present in the sample, which is measured by a colourimeter. The resulting total phosphorus data are checked and then entered into a large nutrient database housed at DESC. By January, these data are posted on the Lake Partner webpage (www.ontario.ca/lakepartner) and the FOCA webpage (www.foca.on.ca/lake-partner).

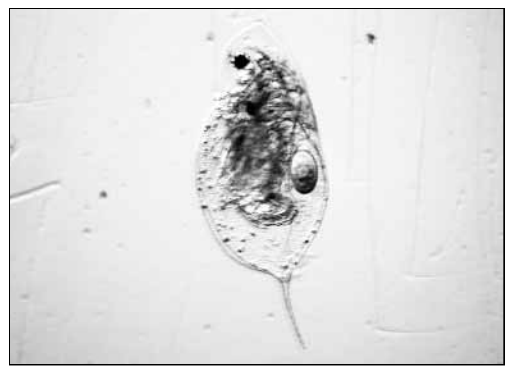
Laboratory analyst Vicky Jackson analyses Lake Partner Program total phosphorus samples in the Dorset Environmental Science Centre's low-level phosphorus laboratory.

The data are used by members of the public, partner agencies, government and academic researchers and private consultants to assess and report on water quality in lakes across Ontario.

Calcium in Ontario's inland lakes

In 2008, the Lake Partner Program added a third component to its lake sampling program – calcium. Calcium is an important element in lakes, as it is an essential part of the structural components of many aquatic creatures, particularly crustaceans and molluscs. A recent report studied the calcium requirements of a type of water flea, the Daphnia. Daphnia are essential parts of lake food webs despite their small size of about 2 millimetres long, as they eat algae by filtering the lake water with their tiny appendages. The researchers chose to study Daphnia because they are easy to find in Ontario lakes and because they need a lot of calcium. The researchers found that Daphnia do poorly in lakes with low calcium levels.

Along with total phosphorus, the Lake Partner Program will continue to examine calcium levels from most water samples submitted each year. These valuable calcium data will provide a snapshot of current calcium concentrations in Lake Partner lakes across the province. By continuing to monitor calcium concentrations over the next few years, we can begin to look for trends through time.



Dr. Shelley Arnott, Queen's University

Daphnia mendotae - an example of a calcium-rich crustacean zooplankton

Ontario's Broadscale Inland Lakes Monitoring Program

In 2008, the Ontario Ministry of Natural Resources, in partnership with the MOE, launched its Broadscale Inland Lakes Monitoring Program. The goal of this program is to address the state and pressures on the fisheries resource in Ontario by monitoring fish, fish contaminants, water chemistry and invasive species in approximately 1,000 lakes over a five-year cycle. (Find out more by visiting www.mnr.gov.on.ca/en/Business/LetsFish/2ColumnSubPage/STEL02_166749.html.)

The water chemistry data obtained through the Broadscale Monitoring Program, in combination with data obtained through the Lake Partner Program and other inland lake monitoring programs, will allow scientists to begin to assess the current state of Ontario's inland lakes. For example, this dataset will help scientists to determine: how lakes compare regionally across the province and nation; what lakes are above or below critical thresholds for water quality and aquatic biota; how current trends might influence biological communities and the spread of aquatic invasive species; and how current concentrations of water chemistry variables have changed over time. One of the ways that researchers plan to answer these questions is by using Geographical Information Systems (GIS), which will allow them to manipulate the data on a spatial scale and create many useful and interesting maps.

Precipitation and phosphorus

Lake Partner Program data are also being used to examine the influence of precipitation on total phosphorus concentrations in different regions of the province. An examination of Lake Partner water quality data has shown that the amount of precipitation entering a lake impacts lakes in Ontario depending on their average total phosphorus concentrations. Oligotrophic lakes with total phosphorus concentrations below 10 µg/L may show increases in spring phosphorus concentrations with increases in precipitation. In contrast, lakes with phosphorus concentrations higher than 10 µg/L may show decreases in spring phosphorus concentrations with more precipitation due to dilution of the phosphorus.

These preliminary findings imply that the changes in weather patterns and amounts of precipitation associated with climate warming will have varying effects on Ontario's inland lakes with respect to total phosphorus concentrations. However, it is important to keep in mind that the amount of phosphorus that enters a lake's surface may also vary among lakes depending on the size of the lake in relation to the size of the watershed. Therefore, future research will take lake and watershed size into account when examining these trends in total phosphorus and precipitation.

It is important to continue to monitor and examine the total phosphorus concentrations of as many lakes as possible within Ontario in order to better understand the different trends and relationships with phosphorus. Thank you to all of the dedicated Lake Partner volunteers who helped to gather these total phosphorus, water clarity and calcium data.

Anita Locke

Cormorants on Stony Lake

The Squaw River Study

Does the presence of human dwellings affect the total phosphorus and* Escherichia coli *levels along Squaw River (Miskwaa Ziibi)?

By Laura Manson, Biology Dept., University of St. Andrews, Scotland on behalf of KLSA
Edited by Janet Duval and Kevin Walters

Increased rates of total phosphorus deposition in water systems are usually associated with human interference within the water basin, in spite of the many rules and regulations in place in an attempt to reduce this human input. An influx of nutrients such as phosphorus is also thought to be linked with increased algal growth which can lead to eutrophication. If this continues for an extended period of time, there may be a shift within the ecosystem to an alternate, usually unfavourable, stable state. It takes a great deal of reverse engineering to return to the original state so it is best to avoid allowing such a condition to occur in the first place.

Although there has been a significant amount of research carried out on the effects of phosphorus within lake systems, there has been surprisingly little research on the impact of residential areas on the levels of phosphorus input. This is why the Kawartha Lake Stewards Association decided to start a pioneer investigation this summer. The effect of 136 homes, all on septic systems or holding tanks, approximately 21 of which seem to be occupied on a full time basis, was recorded over a six week period in 2010 on a stretch of creek 2.8 kilometres long. The creek in question was the Miskwaa Ziibi, known locally as Squaw River. Although it is labelled a river, the majority of the watercourse is classifiable as a creek; the name derives from the broad mouth flowing through the marshy portion of Little Bald Lake.

The Squaw has a relatively small drainage area, a watershed of 195 square kilometres, an average annual flow rate of 2.3 cubic metres per second, and generally a low summertime flow rate. It was hoped that this fairly small volume of water would allow any changes in phosphorus content to be easily seen and measured. Unfortunately, the summer of 2010 was a particularly wet year with a great deal more precipitation than there had been in previous years. This resulted in much higher flow rates than are normally seen during a dry summer. Although samples were never taken on a day when there had been rainfall, this increase in water volume would have diluted the concentration of *E.coli* and phosphorus coming from groundwater sources within the samples.

Method

Water samples were taken from two separate sites above and below the developed portion. There was an approximate 10 metre change in elevation between the two sites. The first test was taken at the Upper Site, located on the upstream side of the County Road 36 bridge over the Squaw. There is no human habitation above this point, meaning it is perfectly positioned to test the water quality before it flows past houses and cottages. The second site, referred to as the Lower Site, was on the weir upstream of where the creek flows into the lake.

Once a week, a sample of water was taken from the Upper Site using a weighted bottle lowered from the bridge. This ensured that the water did not come in contact with the skin and a sample was taken from the central flow, not the river edge where disruption of sediment may have interfered with the results. The approximate time taken by the water to reach the Lower Site was calculated as 70 minutes. After this time had passed, the Lower sample was taken from the corner of the weir closest to the central flow. This was done with the bottle facing upstream, where the water was not contaminated by the sampler's presence. The samples were then taken to SGS Labs in Lakefield for *E.coli* analysis, and Caduceon Environmental Labs in Richmond Hill for total phosphorus analysis.

In order to determine the flow rate, the depth of the water on the weir was measured and the following calculations used.

There were two different sections to the weir; a sharp crest (the central stop-logs) and broad crests (the concrete sections). Each has a slightly different formula, both in metric.

The sharp crest formula $q= Cw\ 0.666\ (2g)^{0.5}\ H^{3/2}$

The broad crest formula $q= 0.35\ (2g)^{0.5}H^{3/2}$

In these formulae, q is the flow per metre of weir, Cw is a weir coefficient, g is the acceleration due to gravity (9.806) and H is the depth of flow over the weir in metres.

From other formulae, Cw as 0.7 was selected; and $(2g)^{0.5} = 4.43$.

The weir has 1½ metres of sharp crest and 10 metres of broad crest, so this becomes

$$q= 0.366\ (2g)^{0.5}\ H^{3/2}; \text{ or } q= 1.62\ H^{3/2}.$$

Finally, due to the length of the weir (11½ metres), the formula becomes $Q=18.77\ H^{3/2}$.

Janet Duval

Whimsical camp fire circle in a clearing near Lower Buckhorn Lake

Results

It was discovered that two of the samples were taken on days when the flow rate exceeded the mean annual flow rate of 2.3m/s. As this increase of water volume will likely have diluted the substances examined, an adjusted dataset was also examined which excluded the data from those two days.

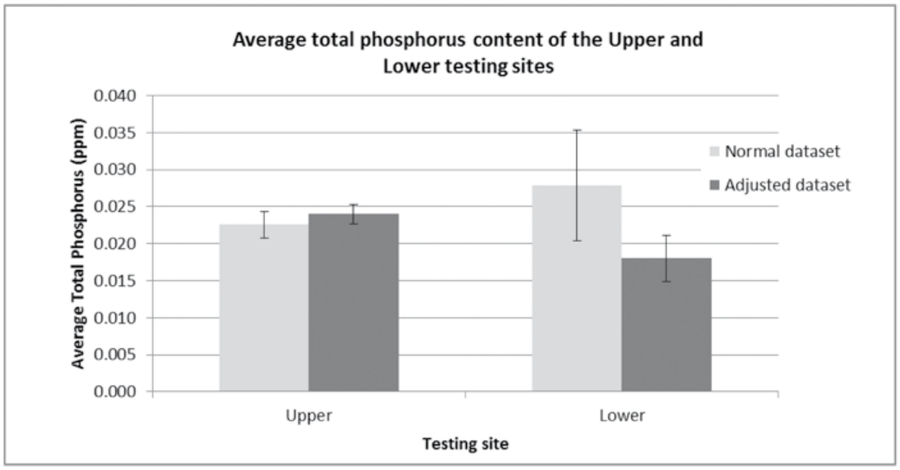


Figure 1 A comparison of the average total phosphorus in parts per million (ppm) found at the Upper and Lower testing sites using both the normal and altered datasets. There is no significant difference (paired $t(5) = 0.394$, $p > 0.05$) between the normal dataset ($n = 6$) Upper (0.023ppm, SE ± 0.002) and Lower (0.028ppm ± 0.007) total phosphorus. After the dataset had been altered ($n = 4$), the Upper total phosphorus content was still not significantly different (paired $t(3) = 2.599$, $p > 0.05$) from the Lower Site (0.024ppm, SE ± 0.001 and 0.018, SE ± 0.003 respectively).

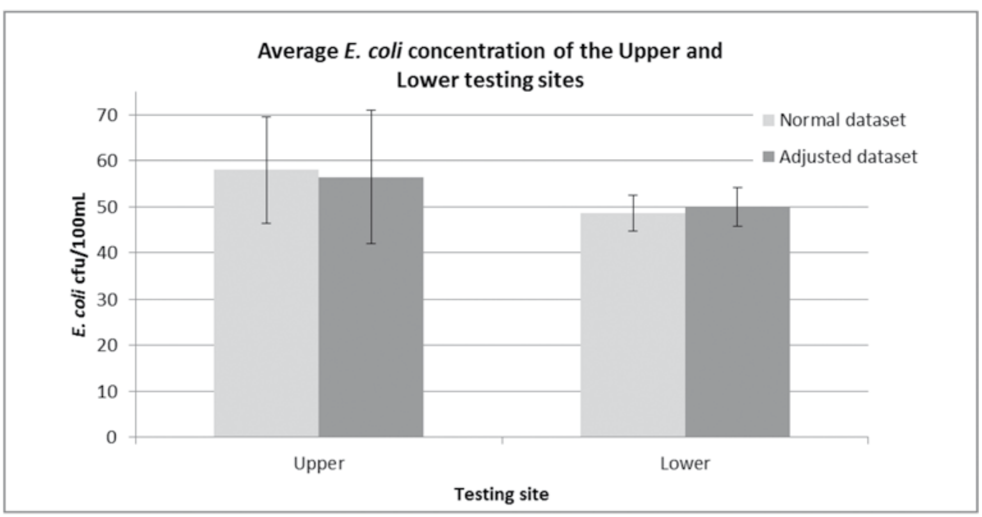


Figure 2 The average *E. coli* concentration at the Upper and Lower testing sites of both the normal and adjusted datasets. There was no significant difference (paired $t(5) = 0.705$, $p > 0.05$) in the *E. coli* concentration between the normal dataset ($n = 6$) Upper (58.05 cfu/100mL, SE ± 11.56) and Lower (48.62 cfu/100mL, SE ± 3.96) sites or the adjusted dataset (paired $t(3) = 0.458$, $p > 0.05$) ($n = 4$) Upper (56.50 cfu/100mL, SE ± 14.61) and Lower (50.0 cfu/100mL, SE ± 4.28) sites.

All data tested was normally distributed but after statistical analysis it was found that there was no significant relationship between the Upper and Lower total phosphorus or *E.coli* levels. There was also no correlation between the difference in *E.coli* and total phosphorus results in the normal or adjusted datasets.

Discussion

In an attempt to reduce the noise created by very high flow rates, a second analysis was carried out. (See 'adjusted data sets' in Figures 1 and 2.) The two measurements which were taken when the flow rate was above the mean flow rate of $2.3m^3$ s-1 were removed. It was thought that these might be more representative of the general conditions as the high flow rates obscured the local inputs. However, an increase in flow rate may also cause more particle re-suspension within the water body. Indeed, this may explain the greater concentration of total phosphorus at the Lower Site on the two sample days with the highest flow rate.

One of the main issues with this investigation was the large number of confounding variables and relatively small number of repeat tests. There may have been disturbance of sediments or dead organic matter further upstream, both due to both human activity such as dog walking and fishing. It is likely that some of the variation in results was also due to natural factors; there are several beaver dams further upstream of the bridge. After a high rainfall, any waste products trapped behind the dam would have been released causing higher levels of *E.coli* in some areas. Disturbance of sediment caused by geese and the feces from the geese themselves may also have affected the results.

This study cannot be taken as a whole system conclusion as only 0.15% of the water basin was examined and there are many other influencing factors which have not been taken into account. This basic investigation should be used as an example for future, more detailed, work.

We can therefore conclude that when considering very localised situations such as this, with a relatively small number of dwellings, the levels of *E.coli* and total phosphorus are not significantly altered by human presence. However, this should not be looked on as an excuse to relax standards or control methods. It may be that the very laws set in place to prevent excess *E.coli* and total phosphorus are the reason behind the results seen in this investigation. So although it appears that the impact is minimal, it is highly recommended that we continue environmentally sound practices in the future.

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Appendix

Week	*E. coli* cpu/100ml			Total Phosphorus (ppm)			Flow Rate
	Upper	Lower	Difference	Upper	Lower	Difference	
1	52	45	-7	0.015	0.016	0.001	2.4
2	36	52	16	0.027	0.026	-0.001	1.12
3	56	41	-15	0.023	0.014	-0.009	0.61
4	107	64	-43	0.026	0.023	-0.003	1.13
5	42	37	-5	0.020	0.060	0.040	2.77
6	27	43	16	0.020	0.010	-0.010	1.12
Average	**53.33**	**47.0**	**-6.33**	**0.022**	**0.025**	**0.003**	**1.52**

Table 1. Raw results gathered at the Upper and Lower Squaw testing sites

Comments and update from Kevin Walters, KLSA Vice-Chair, who supervised this study

The reduction of phosphorus and *E.coli* that we saw could possibly be explained by the fact that streams improve water quality over distance, as nature and oxygenation absorb or break down contaminants. The reduction seen did however seem to be greater than one might expect over such a relatively short distance.

KLSA intends to undertake a detailed study of this system in 2011or 2012 to determine what, if any, difference in water quality exists in this stream between the upstream and downstream ends. It will include a stream assimilation analysis to produce results that are more realistic and enlightening.

Anita Locke

Mississagua River at high water

Sewage Treatment Plants 2009 Report Review

By Kevin Walters, B.A. Sc., P. Eng.
Vice-Chair, KLSA

Each year Kevin monitors and reports on effluent from local CKL sewage treatment plants, based on municipal data. Phosphorus output is a key cause of increased plant and algal growth in our lakes.

We continue to see that **Bobcaygeon** is a big problem. It had operational problems mainly in the spring, resulting in average annual combined phosphorus removal from its two plants being a mere 40% in 2009. As well, there were odour complaints and a pumping station spill, apparently contained. Bobcaygeon discharges over five times the phosphorus that Lindsay does, and yet it's only one-seventh the size. That's about 40 times the concentration. We need to publicize this problem and press for improvement.

Lindsay continues to provide excellent effluent with phosphorus removal at about 98%. There was one pumping station overflow to the Scugog River of 332 cubic metres of raw sewage.

Fenelon Falls seems to be functioning well, although we were expecting to see some deficiencies occurring given high phosphorus in north Sturgeon. Phosphorus removal was 94%. On February 12, 2009 a bypass of the Colbourne Street pumping station occurred due to heavy rainfall and snow melt, introducing 2157 cubic metres of raw sewage into Cameron Lake. That works out to be about one cubic foot per second for a full day which is quite a lot.

Coboconk has acceptable discharges with nearly 98% removal, although it seems that flow rates are increasing and more frequently exceeding the facility's design capacity. We will have to continue to monitor this situation.

Omemee, which is scheduled for an upgrade or replacement, also had borderline acceptable phosphorus removal of 84% during winter discharges to the Pigeon River. This, however, is a very minor phosphorus contribution compared with Bobcaygeon, especially given that discharge only occurred for a few days in February.

Elsewhere, we have a prime example of why we should strongly oppose any new sewage treatment plant intended to serve a new housing development. There is one such case on Lake Scugog near Seagrave. **King's Bay** was a new development built in green field with its own new sewage plant. The plant is functioning miserably, with none of its very loose criteria being met. Phosphorus reduction in 2010 was under 70%. Fortunately, this plant discharges to a subsurface tile bed system so that most of that phosphorus will likely be retained by the soil as with septic systems. However, we really don't want to see a proliferation of this sort of development leading to numerous sewage treatment plants, which we then have to keep track of, and any of which could fail.

Assessing Water Quality in Urban Stormwater in Lindsay

Collaborative Student Study between the Credit for Product course at Fleming College, CAWT at Fleming College, and the City of Kawartha Lakes
By
Lucy Burke, Acting Supervisor, Water and Wastewater
and
David Kerr, Manager, Environmental Services

Background and purpose of the study

The City of Kawartha Lakes put forward a proposal to the students of the fall 2010 Credit for Product (C4P) third-year course of the Ecosystem Management program at Fleming College. The proposal was for a follow-up study on a previous fall 2009 Credit for Product project commissioned by the Kawartha Lake Stewards Association. The original student study was an assessment of water quality in urban stormwater outfalls in Lindsay, Ontario. The study involved sampling eight stormwater outfalls during one rainfall event. The results of the study showed varying levels of bacteria and the report recommended further investigation. [See KLSA's Lake Water Quality Report 2009, *A Decade of Stewardship*, p. 26.] This current report is a summary of the fall 2010 study which expands on the previous C4P study.

Fleming College

Storm sewer outfall in Lindsay at the end of a residential street. It drains directly into the Scugog River.

The fall 2010 study was a collaborative student study between a team of students in the third year Credit for Product course of the Ecosystem Management program at Fleming College, the Centre for Alternative Wastewater Treatment (CAWT) at Fleming College, and the City of Kawartha Lakes. Four third-year students comprised the team of Credit for Product students. The CAWT provided equipment for sampling, orientation on lab analysis, and completed all laboratory analysis for the samples. In addition, staff from the CAWT – Dr. Brent Wootton, Director, Dr. Gordon Balch, Senior Scientist, and Heather Broadbent, Research Technician – provided assistance with interpretation of the results. The City of Kawartha Lakes provided orientation to the sampling sites, maps, training in sampling techniques and assistance in preparation with the Terms of Reference and final report.

Methodology

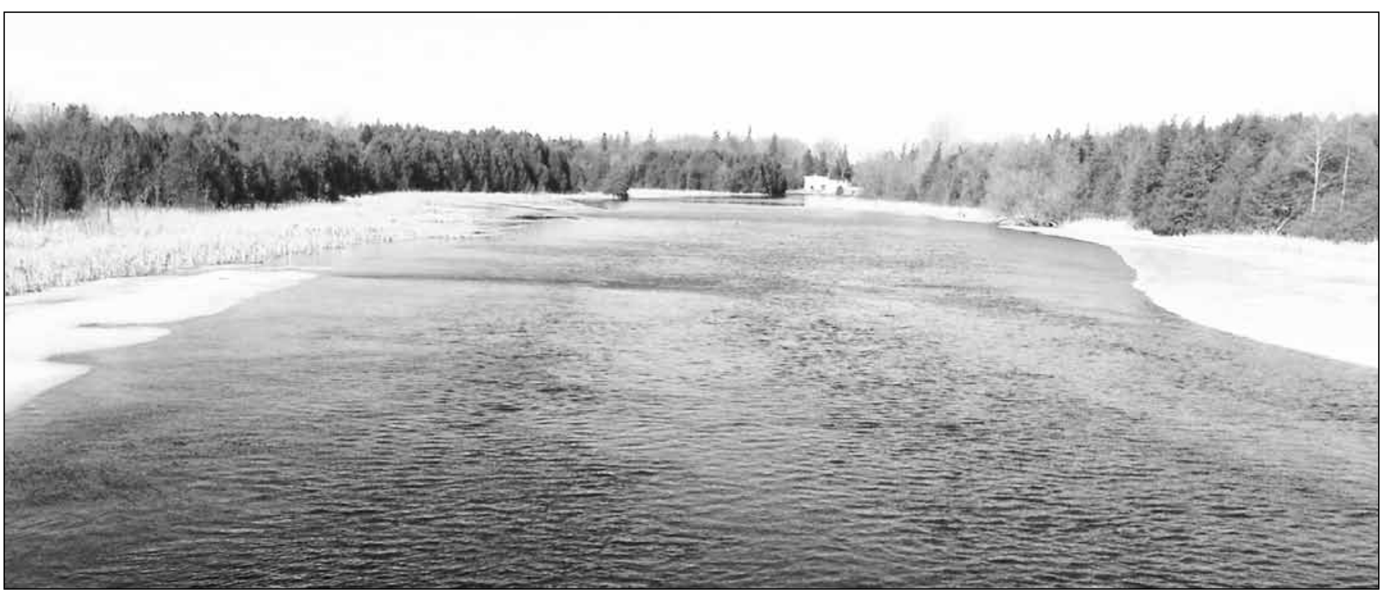
The intent of the study was to sample seven stormwater outfall sites and two river grab samples during five rainfall events and one dry event. However due to time constraints the program was condensed to two sampling events taken in wet weather and one in dry weather. Sampling took place during the months of September and October. Of the two river samples, one was taken upstream of all the outfalls and one was taken downstream.

In order to ensure representative results and to obtain an increased comprehension of the data, the following protocols were implemented beyond those of the 2009 KLSA-C4P study:

- Increased number of samples
- Samples taken during wet and dry weather events
- Duplicate samples taken at sample outfalls
- Documentation of flow rates
- Completion of an observation form at each site during each sampling event
- On-site training in sampling techniques

Students also performed an extensive literature review. This student study was specific to assessment and investigation and did not address mitigation measures.

Seven outfalls were selected for sample locations. These outfalls were selected based on safe



Kevin Walters

The Scugog River

accessibility and the elevation of the outfall to ensure that it was not discharging in the river partially or fully submerged. Of the seven outfalls identified for sampling, one location was not sampled due to stagnant water at the outfall and therefore inaccurate results would be obtained. All samples were analyzed for the following parameters:

> pH, alkalinity ($CaCO_3$), conductivity, COD [chemical oxygen demand], CBOD5 [5-day carbonaceous biochemical oxygen demand], total coliform, *E.coli*, total suspended solids, dissolved oxygen, nitrite, nitrate, ammonia, total phosphate, total phosphorus, dissolved phosphate, chloride, and sulphide.

Results

Results indicate the following:

1) Previous *E.coli* sampling in 2009 at the same outfalls showed much higher bacteria levels than the 2010 verification sampling.

For instance, *E.coli* levels at:

Outfall #1 (Lindsay St. South at Scugog River) in 2009 had 1300 cfu (colony forming units)/100mL, whereas in 2010 they ranged from less than 3 to 980 cfu/100mL.

Outfall #5 (at the Scugog River between Duke St. South and Lindsay St. South) in 2009 was analyzed at 23,600 cfu/100mL, whereas in 2010 they ranged from 1600 to 20,600 cfu/100mL.

Outfall #6 (Wellington St. at the Scugog River) in 2009 had 30,400 cfu/100mL, whereas in 2010 they ranged from 1520 to 7400 cfu/100mL.

Outfall #7 (Bond St. at the Scugog River) in 2009 had 26,000 cfu/100mL, whereas in 2010 they ranged from 280 to 1560 cfu/100mL.

Outfall #8 (Pottinger St. at the Scugog River) in 2009 was analyzed at 2,000,000 cfu/100mL, whereas in 2010 samples from there ranged from 280 to 1520 cfu/100mL.

Although the 2010 results are consistently lower than the 2009 results, there continues to be significant *E.coli* in the stormwater outfalls.

The students' 2010 report speculates that the possible sources of bacteria could be runoff from feces from a variety of animal species such as cats, dogs and raccoons, as well as possibly human sources.

2) The *E.coli* levels in the Scugog River adjacent to the urban area of Lindsay are the same or higher compared to the sample upstream of Lindsay. For instance, samples taken on September 28, 2010 upstream were 19 cfu/100mL, whereas downstream they were 330 cfu/100ml. On October 14, 2010 samples taken upstream were 13 cfu/100mL, whereas downstream they were 220 cfu/100mL, and on October 26, 2010 both upstream and downstream samples were the same at 50 cfu/100mL.

This is interesting since both the September 28 and October 14 samples were taken during or shortly after a rainstorm and both these events showed higher downstream *E.coli* levels in comparison to upstream as well as higher overall concentrations. The October 26 sample was taken during a dry period.

Therefore, preliminary results from *E.coli* sampling in 2010 from the Scugog River indicate that *E.coli* is contributed from the Lindsay urban area and is transported to the river via rain events. However, although these results are not unexpected in areas such as Lindsay where urban stormwater runoff is prevalent, it is interesting to note that some *E.coli* is consistently present in the Scugog River upstream of Lindsay.

For the sake of comparison, the government posts public beaches as unsafe for swimming when the geometric mean of five water samples for *E.coli* is greater than 100 cfu/mL.

The report provides some speculation that the downstream Scugog River samples may be impacted by a nearby boat harbour and associated onboard sewage waste systems.

3) Ammonia concentrations in the water samples from the corresponding outfalls that were sampled for *E.coli* indicate that ammonia levels were highest during the dry sampling period at Outfalls #5, #6 and #8, which is reverse of the *E.coli* trend in the downstream Scugog River. *E.coli* in the downstream Scugog River was highest during a precipitation event. This suggests that the *E.coli* source may be different from the ammonia source. Ammonia is a common constituent of organic waste and fertilizers; it is often associated with *E.coli* but can also be associated with many non-bacterial sources. Therefore, due to some uncertainty as to the source of the ammonia and *E.coli* and their differing responses, we are recommending that further investigations of these three outfalls be prioritized for diagnostic testing to determine if the ammonia and *E.coli* sources are human or animal.

The next steps

Due to the wide variety of possible sources, the 2010 student study recommended that the next step to be taken would be to determine if the source is human or animal. The City has consulted with the CAWT and has determined that it will proceed with either continine (related to nicotine) or caffeine indicator testing. Tests of this nature can assist in broad source identification and help determine if the source is human or animal. For instance, if caffeine or continine is found in a stormwater sample there is a strong indication that the source is human in nature since humans consume caffeine and nicotine. As previously mentioned, Outfalls #5, #6 and #8 have been selected for this type of analysis in the hopes of obtaining clear results. The intention is that through this further analysis the source may be isolated. The report additionally recommends that should the tests for either continine or caffeine come back negative, then an alternate analysis would be microbial source tracking (a more complex analysis involving DNA).

Currently the City is working with the CAWT to schedule when the next round of tests will be conducted. It is anticipated that the sampling may occur during both wet and dry events to obtain the most comprehensive results. The City looks forward to continuing its partnership with the CAWT of Fleming College on this innovative and important project.

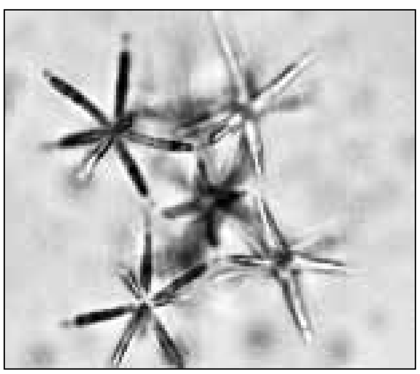
KLSA Editors' note: The lower counts in this study versus the 2009 study might be explained by the timing of the sampling. In 2009 the students were encouraged to collect their samples soon after the rain event had started. This ensured that contaminants were identified prior to the storm washing them away. In contrast, according to the full Fleming report, the 2010 study sampled within 24 hours of the rain event. While not reported herein, we note from the full Fleming report that the phosphorus levels ranged from 50 ppb to 500 ppb.

Algae in the Kawartha Lakes

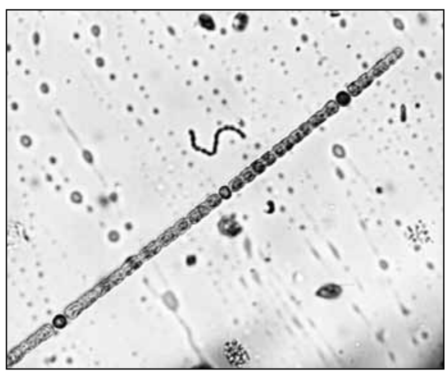
By Dr. Paul Frost,
David Schindler Professor of Aquatic Science, Trent University

Algae are small aquatic organisms that inhabit all lakes including our Kawartha Lakes. These microscopic plants are often found either floating in the water column or attached to different surfaces (rocks, mud, rooted plants) in the shallow areas of lakes. Most of the time, algae are inconspicuous to human observers, who may fail to notice the slight greenish colour of lake water or realize that the slippery slime of rocks is partly composed of algal cells.

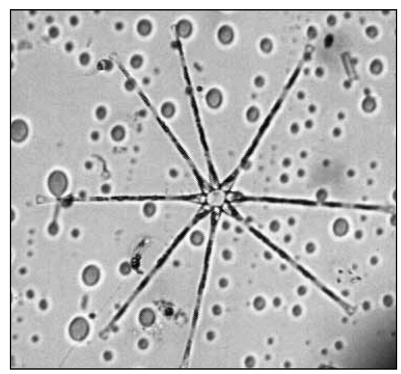
At other times, algae are far more noticeable when their populations grow to excessive proportions and reduce water quality. Algal blooms usually manifest themselves as thick green clouds in the water column, as films or scum on the water's surface, or as large filamentous blobs near the shoreline. Algal blooms usually result from excessive nutrients in surface waters, which originate from a variety of natural and human sources in the lake's watershed. Blooms are highly undesirable because they can adversely affect aesthetic aspects (taste, clarity and colour) of lake water, can have negative effects on zooplankton communities, and when they decompose, can produce fish die-offs. Despite their commonness and potential to adversely affect water quality, freshwater algae and their ecology within the Kawartha Lakes have received relatively little directed study in recent years.



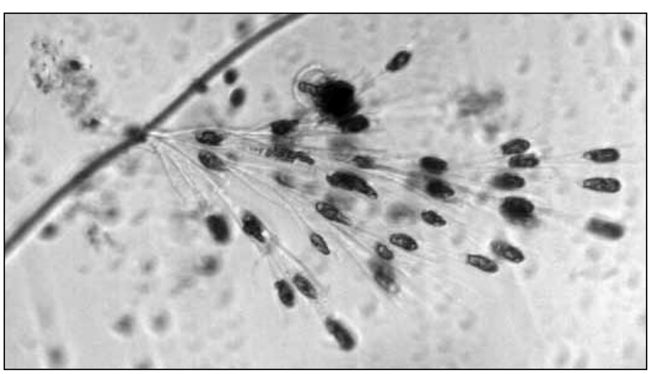
Actinastrum



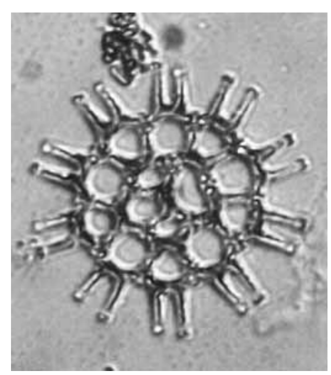
Anabaena



Asterionella



Dinobryon



Pediastrum

Microscope photos courtesy of Andrew B. Scott, Freshwater Ecology Lab Manager , Trent University

To address this lack of information on algae in the Kawartha Lakes, the KLSA and Trent University initiated a new project in 2010 that is funded by the Ontario Trillium Foundation. This project aims to answer some basic questions about algae in the Kawartha Lakes:

1) What are the primary algal species in the Kawartha Lakes?
2) Which nutrient limits the growth of [or has the greatest stimulatory effect on] algal communities within the Kawartha Lakes? and
3) What can be done to help prevent future occurrences of excessive algal growth? To address these questions, Trent researchers with assistance provided by the KLSA sampled and studied the algae of several Kawartha Lakes during the summer of 2010.

The information generated by this project on the algae of the Kawartha Lakes will be presented to cottage owners and lakeshore residents. We will be holding several workshops over the summer of 2011 that will present an in-depth look at the algae of the Kawartha Lakes. Included will be PowerPoint presentations on general algal ecology, detailed discussions on different algal species found in the Kawartha Lakes, and hands-on demonstrations of algal sampling and identification. [Check the KLSA website after April for details on these workshops.] We will also create and distribute a booklet on algae for lake residents and the general public that will highlight important aspects of algal ecology, explain the biodiversity of algal communities in the Kawartha Lakes, provide information for reporting nuisance algal blooms, and explain the primary means for keeping algal blooms out of our lakes.

Work on the Kawartha Lakes Algae Project, Summer 2010

Due to the fast growth rate of their populations, algal communities are very dynamic and can undergo rapid succession over the course of a few weeks. To characterize this seasonal variability in algae, we sampled monthly from May to August over the summer of 2010 at 12 locations across the Kawartha Lakes. In addition, a larger spatial sampling was completed in early August when we visited 55 sites in the Kawartha Lakes.

During each sampling event, we collected water to measure nutrients, assessed basic water quality (e.g., clarity and oxygen concentration), and assessed the biomass of algal populations. We also preserved algae samples that could be examined with microscopes during later dates.

We complemented our descriptive work on algal communities in the Kawartha Lakes with several experiments that manipulated the nutrients in the water and measured the growth rate of algal populations. One set of these experiments provided suspended algal communities held in plastic bags with different types of nutrients and measured their growth after three days. Our other experiments used artificial rocks to which we added different types of nutrients and then placed the artificial rocks in about one metre of water in different lakes for about one month. By altering the nutrients available, these experiments provide evidence of which nutrient (e.g., nitrogen or phosphorus) is limiting the growth of algal communities in the Kawartha Lakes.

The algae sampling and experiments involved several students and researchers from Trent and many volunteers from the KLSA. In addition, several KLSA volunteers collected and preserved algal samples from different Kawartha Lakes over the summer while they were completing their regular water quality monitoring. Several volunteers assisted with our late-summer lake survey by ferrying us up and down their lakes for several hours. In addition, shoreline access was provided on five Kawartha Lakes during our 'algal garden' experiments. We greatly appreciated all of the assistance from the KLSA volunteers over the summer.

Early results

We collected a large number of algal samples from the Kawartha Lakes during our summer 2010 sampling. There were considerable differences within and among lakes and through time in the type and amount of algae that we found during our collections. For example, during our regular seasonal sampling, we observed quite low concentrations of chlorophyll a (one index of algal abundance) under the snow-covered ice at the beginning of March, which is perhaps not surprising. After ice-out, we observed increasing chlorophyll a concentrations in all of the sampled locations although the size and timing of this increase varied among different lakes. These increases in algal abundance through the summer are typical for most north temperate lakes as water temperatures increase. In the Kawartha Lakes, high algal abundance was found in many locations during the later summer.

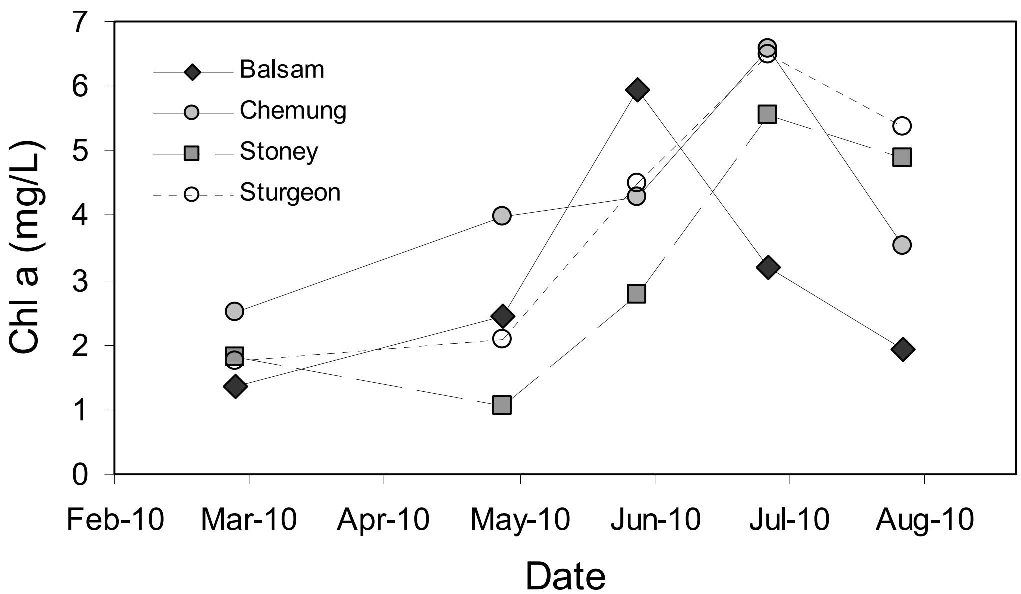


Figure 1. Chlorophyll a concentrations in four Kawartha Lakes during the summer of 2010

We also examined the growth rate of algae (in the absence of [*added - Ed.*] nutrients) sampled from different Kawartha Lakes. This measurement demonstrates the potential of algae in different lakes to grow provided the nutrients are available in the lake at the time of the experiment. In June, we found low rates of growth for algae taken from Balsam, Chemung, and Stony and surprisingly, no growth in algae collected from Sturgeon Lake (Fig. 2). In August, algae from Balsam and Sturgeon both grew slowly whereas Chemung and Stony Lakes exhibited relatively higher growth rates (Fig. 2). These data on algal growth allow us to make comparisons among the different Kawartha Lakes, which receive water from tributaries with different concentrations of nutrients. We also measured how much growth increased in algae provided with different nutrients, which indicates which specific nutrient is directly limiting – in other words, which is most influential in stimulating growth. Our experiments from 2010 generally suggest that phosphorus is the primary limiting nutrient, although the intensity and nature of this limitation varied among lakes and between floating and attached algal communities.

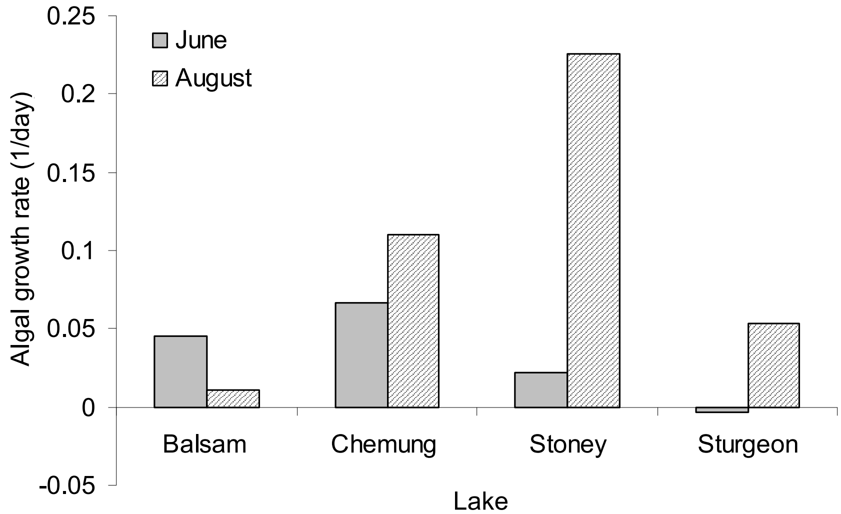


Figure 2. Growth rates of floating algae (with no nutrients added) collected from four different Kawartha Lakes estimated from our June and August experimental data

Plans

The Kawartha Lakes algae study generated several lines of interesting and intriguing information about the interactions between lake location, algal biomass and nutrient supply within this dynamic lake ecosystem. We are currently carefully examining preserved algal samples to determine which species of algae were living where in the Kawartha Lakes. These data on algal community composition will be coupled with the chemical indices of nutrients and algal abundance to provide a more complete understanding of algal ecology in the Kawartha Lakes, including how to control algal blooms more effectively. During the upcoming year, we will use this information to create workshops and a booklet summarizing our knowledge of Kawartha Lakes algae.

Elephant Snot, Algae Gardens and the Kawartha Lakes

By Andrew B. Scott
Freshwater Ecology Lab Manager, Trent University

In early April, I found out that I would help complete a project to study the algae of the Kawartha Lakes. This project would be a partnership between Trent University and the Kawartha Lakes Stewards Association (KLSA) with funding provided by the Ontario Trillium Foundation. I jumped at the chance to spend time in the Kawartha Lakes. This would be a great way to spend the summer.

Soon after the ice had melted and May arrived, our algae group at Trent began receiving e-mails and phone calls about algae sightings around the lakes. The algae had been described as elephant snot, pea soup, lime green soccer balls and toilet paper blooms. I thought the members of the KLSA were quite the creative bunch when it came to describing algae. Although elephant snot leaves a pretty distinct image in your head, I had to see it for myself before I fully understood what they were talking about.

We began our sampling in late May by launching our boat, 'The Plankton Hunter,' into Buckhorn Lake. I immediately noticed what appeared to be some large rocks with algae growing on the sides of them. I pulled out a paddle to give us a push off the shoreline before starting the boat's motor. The paddle slid right through the perceived rocks. I realized these weren't rocks at all. They were giant globs of elephant snot! We took a slimy sample and put it under the microscope back at the university to determine that it was the algae *Mougeotia*. I must agree though that "elephant snot" describes it much better than its Latin name.

Andrew Scott getting ready to launch the Plankton Hunter

A crucial part in the success of the Algae Project during the summer of 2010 was the help that we received from the volunteers through the KLSA. This help consisted of day trips out on the boats of volunteers, monthly samples collected for us, and access to shorelines around the Kawartha Lakes system, all of which were invaluable to our study. One element of our summer research project was termed the algae garden. We had a great response from many volunteers right from the beginning, many of whom agreed to help out with the algae gardens without asking any questions. I think the volunteers who signed up for the algae garden project were quite relieved when we showed up with only a medium sized basket and 24 small clay pots inside. Often they remarked, "That's it? Great! I really wasn't sure what to expect!"

Algae garden being prepared in the lab

Another aspect of our research plan was sampling the lakes in the middle of the summer. This mid-summer sweep sampling had us heading out with a volunteer or two on their boat to collect anywhere from five to ten water samples depending on the size and shape of the lake. This sampling took three to five hours and yielded some great information exchange between the researchers and the cottagers. The local volunteers shared stories about the local history, unique spots in the lakes to visit, information on cottage architecture and their thoughts on what made their lake different from all the others in the system. I really felt each volunteer had a genuine sense of pride in their lake which was great to see and hear about.

The volunteers also taught us about things we were not expecting to learn. We learned how to pour coffee while cruising on plane in a boat. We learned that there is always time to see those one, two or three really unique spots on the lake even when the day has dragged on way beyond the time frame expected. We learned that you never know who you might meet while out on the lake, like the mother of a lead singer in a famous rock band, and that when you build a cottage on an island, you often have to be creative with its construction. One other unique unexpected question we were faced with this summer was: If there is an earthquake while you are out on a boat in Big Bald Lake, will you feel it? The answer is no, but you will hear about it, as an earthquake felt in Peterborough and the Kawarthas did top the news on June 23rd, 2010.

Mindy Morales and Andrew Scott sampling as Cowboy Scientists, a theme one Friday

This summer sampling out on the Kawartha Lakes made for many great memories. There is always a great deal of work that accompanies this lake research. We had a great research crew on the KLSA project that enjoyed having fun, even during the hectic long days. Our summer was more than just a sampling season, it was an adventure.

I would like to thank the research team at the Frost Lab: Mindy Morales, Emily Malcolm, Nicole Wagner and Ryan Little as well as all the other lab members who helped out. I would like to thank all the KLSA board members and volunteers for their help and generosity with completing this intensive project and for the coffee, lunches, snacks and great hospitality while out sampling. Finally, thanks to the Ontario Trillium Foundation for providing funds for this project.

Robin Blake

Ruby-throated Hummingbird

Eurasian Watermilfoil in the Kawarthas:
The Past, Present and Future of Management

By Kyle Borrowman, BSc, MSc(c), Trent University, Peterborough

As we prepare for another summer on the Kawarthas, this may be a good time to talk about the bane of every cottage owner's existence and my favourite topic: Eurasian watermilfoil (*Myriophyllum spicatum*). What better way to start off the season than to get to know this invasive-exotic macrophyte (aquatic plant) a little better? So let's get down to it – the bottom line is that aquatic plants become 'weeds' when they are considered to be a nuisance and Eurasian watermilfoil is often a culprit for this type of behaviour in North America.

Since the 1960s, Eurasian watermilfoil (native to Europe and Asia) has become one of the most troublesome weeds in North American lakes. Eurasian watermilfoil (hereafter referred to as milfoil) is a 'nuisance' within our lakes due to its growth habit. This perennial aquatic plant grows rapidly in the spring once water temperatures reach 15ºC. Upon reaching the surface of the water, milfoil begins to branch, creating a thick canopy that can block available sunlight needed for other aquatic plant species. The creation of these thick canopies early in the season can lower plant and invertebrate diversity, increase surface water temperature and impede water flow and navigation.

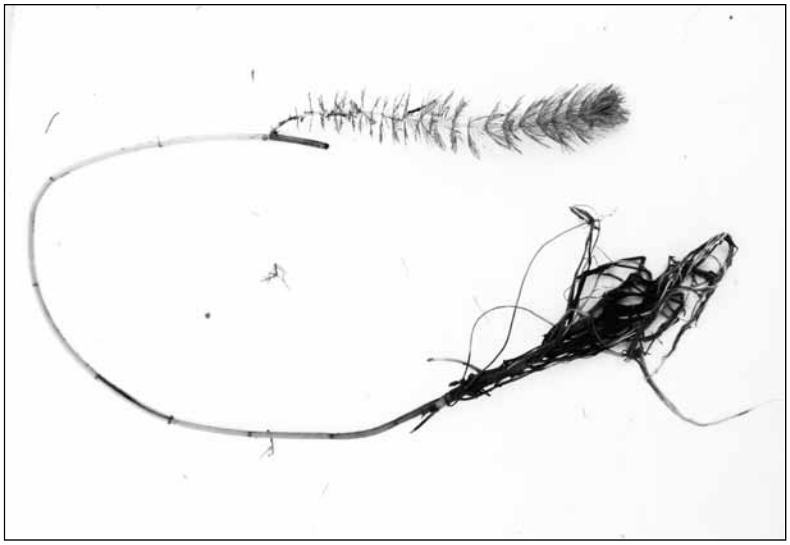
Nuisance stands of milfoil are often sustained year to year through the fragmentation of stems. Although these plants can grow from seeds and stolons, fragmentation is the most common form of reproduction and can occur as a result of human disturbance (boat motors, cutting, harvesting, etc.). It is, however, also caused by the plant itself through a process called 'auto-fragmentation'. Once these fragments are free from their rooted appendages, their natural buoyancy allows them to disperse throughout the water column and re-colonize upon sinking and rooting in the sediment. These fragments are extremely resilient and can be introduced to new lakes by hitching a ride on boats and boat trailers.

Identification of milfoil species can be tricky due to overlapping physical similarities between Eurasian watermilfoil and native (non-invasive) milfoil species. In total, there are six watermilfoil species that are native to Ontario but do not share the same invasive capabilities of Eurasian watermilfoil with the exception in some cases of alternate-leaved milfoil (*Myriophyllum heterophyllum*). New concerns and difficulty in proper identification have recently been raised due to the discovery of hybridization between Eurasian watermilfoil and the native, northern watermilfoil (*Myriophyllum sibiricum*).

A history of milfoil control in the Kawarthas

There is a rich history of milfoil in the Kawarthas dating back to the 1970s when milfoil had become a dominant species, often creating large, dense stands. Aiken et al. (1979) illustrated the contempt for these stands of milfoil by stating: "Such dense stands curtail recreational activities, create habitats favourable for the production of blood-sucking insects and clog industrial and potable water supply systems". At this time, milfoil dominated the aquatic plant communities within the Kawarthas. Roughly $150,000 was spent annually by the Ontario Ministry of Natural Resources and an additional $60,000 by the private sector in an attempt to control rampant production of these "blood-sucking insect" habitats.

Traditional forms of management used to control milfoil include harvesting and herbicides. Harvesting can consist of local treatments such as raking, hand harvesting or the use of small cutters that can be attached to the transom of a boat. Large scale harvesting projects may consist of the use of mechanical harvesters that work much like a combine across a field of crops. Although these forms can be very effective, it is important to consider that milfoil is such a successful invasive because it reproduces from fragmentation. Any fragments that are not collected during the cutting process may perpetuate nuisance populations by re-establishing themselves (and in some cases creating a thicker patch than before). In addition, the use of harvesters and cutters can exacerbate the problem by removing beneficial native plants needed to stabilize sediments and promote healthy plant community composition.



This picture shows a stem of Eurasian watermilfoil collected in 2010 from the treatment area of the 2009 Lake Scugog Stocking Project. Notice the dark/decomposing end of the stem caused by milfoil weevil damage where the upper portion of the plant became weakened and broke off. Milfoil can be very resilient; this plant has grown a new shoot below the damage.

The use of herbicides can be very detrimental to native aquatic plant and invertebrate communities and may also create the potential for resistant strains of milfoil to become abundant. It is often very difficult to determine the proper dosage needed to cause declines due to variation in water flow, weather conditions and dilution within the water column. In addition, herbicide use in the Trent-Severn Waterway is currently being phased out by Parks Canada.

Biological control of Eurasian watermilfoil

Towards the end of the 1970s through the mid-1980s, major declines in milfoil populations were observed throughout the Kawarthas. These drastic changes to the aquatic plant community were most evident in Buckhorn Lake where aerial cover of Eurasian watermilfoil declined from 78% to 1% with drastic changes in 1979 and 1986. During the summer of 1985, large stands of milfoil in Lake Scugog also went through a noticeable decline, for which damage by the aquatic moth, *Acentria spp*., and a native milfoil weevil, *Euhrychiopsis lecontei*, was suspected to be responsible. Similar declines in milfoil density were identified throughout Wisconsin, Vermont and Minnesota, which led to extensive research into the use of the milfoil weevil (and to a lesser extent the aquatic moth) as a form of biological control.

Of the two species identified, the milfoil weevil has been considered the best candidate for biological control of milfoil due to its species-specific feeding preference. The milfoil weevil is a native aquatic beetle that spends summer months submersed in milfoil beds throughout all life stages feeding on the plant. The most notable damage to milfoil caused by the weevil occurs during its larval stage when the weevil burrows through the stem of the plant feeding on the plant cortex, which is essential for the movement of nutrients and plant buoyancy. The milfoil weevil is broadly distributed across North America associated with populations of the native, northern watermilfoil with the most notable populations occurring throughout the mid-western United States and Ontario. This species only feeds on members of the milfoil genus (*Myriophyllum*) and in laboratory tests, weevil life stage development and performance is greater on Eurasian watermilfoil in comparison to milfoil species native to North America.

Although this insect is native to North America and prefers Eurasian watermilfoil to native milfoil species, in-lake populations of the weevil are often too low to provide significant declines in Eurasian watermilfoil populations. There are many factors that may contribute to this including fish predation, overwintering habitat and low reproduction rates. In an attempt to tackle these issues, research into augmenting native in-lake populations with laboratory cultured weevils eventually led to the commercial application of the milfoil weevil as a form of biological control. There have been many stocking projects throughout the United States as well as several projects within Ontario including a recent stocking project in Lake Scugog.

As many people may have probably experienced on the Kawarthas, navigating through Eurasian watermilfoil can be a frustrating experience. This was a typical scene during our 2010 surveys where our boat motor became entangled in the thick stands of milfoil that we were studying.

There are several reasons why lake residents may be apprehensive about using the milfoil weevil as a form of biological control of Eurasian watermilfoil. These concerns include the cost and variable success of weevil application projects. There is a lot of variability in weevil populations from lake to lake and year to year which can influence the success of stocking projects. Target weevil density needed to cause significant declines in nuisance milfoil stands is roughly one weevil per stem of milfoil (although this will vary lake to lake). At the price of roughly one dollar per weevil, this can be a costly endeavour that may not produce noticeable results in the first season. Stocking projects are a long-term approach to milfoil suppression, which may include stocking through consecutive seasons. Once stocked, it is necessary to take a hands-off approach to management that may provide long-term suppression of milfoil by feeding damage as well as the re-establishment of the native plant species from viable seed banks within the sediment. Although initial weevil-stocking costs are expensive, there is great potential for long-term success with a hands-off approach. In comparison, mechanical harvesters often charge by the acre and harvesting may be needed multiple times throughout a season. The fragmentation that occurs from harvesting can help sustain nuisance milfoil stands and can have negative effects on beneficial aquatic plant species that cannot re-establish themselves after harvesting.

In July 2009, the Scugog Lake Stewards, Inc. with the assistance of the Baagwating Community Association commercially stocked 20,000 weevils into Lake Scugog to tackle a nuisance population of Eurasian watermilfoil. By the end of August there appeared to be dramatic differences between the stocked weevil site and the control site (where stocking did not occur). In the summer of 2010 the remaining stems of milfoil within the treatment area appeared to be severely damaged by milfoil weevil feeding.

Eurasian watermilfoil can create thick monotypic stands such as this one in Lake Scugog. The use of an outboard motor (not to mention swimming!!) in this type of stand can become extremely difficult. The average shoot density of milfoil in this site was above 100 shoots/m^2!

The pilot weevil-stocking project in Lake Scugog sparked research interest, not only due to the potential for biological control of milfoil in Ontario, but also the discovery of milfoil hybridization in Ontario. Upon closer inspection, the milfoil bed consisted of robust pink stems and overlapping traits of both Eurasian watermilfoil and northern watermilfoil; samples were collected and determined to be a hybrid of the two species. This was the first positive identification of a milfoil hybrid within Ontario lakes.

With the discovery of milfoil hybridization and the recent interest in biological control in Ontario, questions surfaced around the relationship between the milfoil weevil and Eurasian watermilfoil and its hybrids. These included: Does the milfoil weevil naturally occur on hybrid milfoil? Are there environmental and geographical factors that limit milfoil populations in Ontario? Are we seeing an emergence of hybrid milfoil across the province? Does weevil population vary depending on the presence of hybrids or the nutrient content of the plant?

Current milfoil research in the Kawarthas

In the summer of 2010, outfitted with a 4.3 metre (14 ft.) aluminum boat, wetsuits and snorkels, two research assistants and I embarked on a quest to explore the relationships between Eurasian watermilfoil, its hybrids and milfoil weevil populations in Central Ontario. Working under the supervision of Dr. Eric Sager (Coordinator of the Ecological Restoration program at Fleming College, Adjunct Professor at Trent University and scientific advisor to the 2008 KLSA aquatic plant study), we set out to survey 21 Ontario Lakes within Central Ontario and the Sudbury District. These included the following local lakes: Lake Scugog, Pigeon Lake, Big Bald Lake, Lower Buckhorn Lake, Stony Lake, Coon Lake and Jacks Lake. Specific beds of milfoil greater than 100m^2 were surveyed within each lake to determine species richness, density, milfoil hybridization, milfoil weevil and aquatic moth density.

Although the milfoil weevil was present within all lakes surveyed, milfoil weevil density in the Kawarthas was above the average density for all lakes surveyed (0.41 weevils/stem) with the exception of Big Bald Lake (0.27 weevils/stem). These densities were determined by collecting stems of milfoil within each patch and searching for the presence of weevils within each life stage. Although weevil densities in the Kawarthas were above average in comparison to other lakes surveyed, the target density to create a significant decline of milfoil is 1.0 weevils/stem, roughly double the natural density in the Kawarthas.

Milfoil hybridization has also been identified within Lower Buckhorn Lake, Pigeon Lake and Big Bald Lake; samples are currently being processed from our 2010 survey to determine if this hybrid is found within our other study lakes. In addition to finding milfoil weevils within our study sites in the Kawarthas, other milfoil herbivores were also identified. These include aquatic moth populations in Pigeon Lake and a species of milfoil weevil native to Europe, the Eurasian milfoil weevil (*Phytobius leucogaster*), in Lower Buckhorn Lake. Although the European weevil has been identified within the Kawarthas, it has been present in North America for several decades at much lower populations than the native milfoil weevil.

There are a lot of questions that still need to be asked regarding the relationship between milfoil and the milfoil weevil. What is the extent of milfoil hybridization in Ontario and how does it affect weevil populations? Are milfoil hybrids more or less invasive? What factors limit success of the milfoil weevil in these lakes? How does success differ in oligotrophic lakes? The results of our 2010 survey are adding pieces to the puzzle as well as creating new questions and directions to follow through the summer of 2011. We are planning to hit the lakes again this summer to find out more about the relationship between Eurasian watermilfoil, milfoil hybrids and the milfoil weevil, as well as their relationship to other members of their community. Although there are no stocking projects slated for the summer of 2011, monitoring of the 2009 pilot project in Lake Scugog will continue to assess long-term impacts to the aquatic plant community. As more information becomes available from our survey and similar research in this field, we are able to create a bigger picture of the successes and limitations of biological control of Eurasian watermilfoil.

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Wild Rice on the Trent-Severn Waterway

By
Beth Cockburn, Species at Risk Program Manager, Parks Canada,
Trent-Severn Waterway National Historic Site of Canada
and
Jeff Beaver, Environmental Steward, Alderville First Nation

From a Trent-Severn Waterway perspective, wild rice (*Zizania palustris*) provides both historic and ecological benefits. As a National Historic Site of Canada, the Trent-Severn Waterway (TSW) places high value on wild rice as a cultural resource and an integral part of our history, and honours the commitment to preserve and protect it for present and future generations. As part of the diverse composition of TSW wetlands, wild rice, an annual self-seeding grass, provides essential habitat and a food source for many species, including some of the more elusive species at risk.

There has been a recovery of wild rice populations throughout the Trent-Severn Waterway in recent years. While we are unsure of all the factors that are specifically contributing to this, we are aware that this event is being viewed with mixed feelings among a variety of Waterway users and stakeholders. Some are thrilled to see this historically and culturally significant resource re-establishing itself, and view its presence as a positive indication that water quality is improving. Others find it a nuisance and would like to obtain permits to remove it from the vicinity of their shorelines. Currently, the TSW is aware of the need for a policy that will adequately address the management of this resource and afford

Canoe loaded with a harvest of wild rice. When ripe, the grains can easily be knocked into the canoe, then taken home for the more laborious steps of parching, winnowing and cooking.

A stand of wild rice on Mitchell Lake, near Kirkfield

it sustainable protection for the long term, while addressing the needs of the many stakeholders and users of the Waterway.

Wild rice currently has a broad distribution throughout the system, occupying many areas along the Severn River, throughout the Kawartha Lakes region and down the Trent River. It can be found to some degree on most of the bodies of water found in the TSW. Natural restrictions that curb the growth and distribution of wild rice include weather and water level/movement. Most threats to wild rice populations are of human origin – boat wakes, mechanical damage and intentional removal or destruction. It no longer exists to the extent it once did.

There is a long history of wild rice on the Waterway. It was once much more widespread, occupying more than 2000 hectares in Rice Lake alone, with that one lake producing an estimated 50,000 bushels in 1906. It has been significant to the culture and tradition of First Nations for generations, as well as being a highly valued source of nutrition. Called 'Manomin' in Ojibway, the meaning of its name, 'good berry' and 'sacred gift from the creator,' is an accurate reflection of its value to First Nations peoples. Annual rice harvesting activities are community social events, and cause for celebration. Culture is preserved and passed on, along with the stories and history attached to this time honoured tradition.

What will happen now? We must find a way to incorporate wild rice into our management regime in such a way that this once prolific species remains an important part of our landscape, history and ecology, while still addressing the needs of a broader group of TSW users. This will require research and the input of sound advice from representative stakeholders. TSW staff plan to initiate this process during 2011. Until such time as a policy has been completed and accepted, wild rice will remain a protected resource on the Waterway, and permits for its removal will not be granted. We do trust, however, that as its values become more broadly understood, it will be viewed in a more positive light, and enjoyed for the history it preserves and species it supports.

If you would like to learn more about wild rice, its history and biology, please contact Jeff Beaver of Alderville First Nation at mikwag@eagle.ca.

The Sturgeon Lake Management Plan in 2010

By
Dave Pridham
Manager, Environmental and Technical Services, Kawartha Conservation
and
Alex Shulyarenko
Water Quality Specialist, Kawartha Conservation

Maintaining the environmental health of our lakes has great economic and social significance for a growing community such as the City of Kawartha Lakes. There is considerable community interest in water quality research, identifying environmental stressors and key lake issues, with lake management plans being identified as a priority by City of Kawartha Lakes (CKL) municipal staff and Council, the CKL Environmental Advisory Committee, lake associations and local residents.

The Scugog Lake Environmental Management Plan was completed and endorsed in 2010. Following discussions with CKL staff and potential project partners, a series of lake management plans for lakes within the City of Kawartha Lakes, commencing with Sturgeon Lake, was proposed to the Kawartha Conservation Board of Directors and the CKL Council in February of 2010. The Kawartha Conservation Board of Directors endorsed this multi-year project proposal, with approval being granted by the City of Kawartha Lakes for phase one.

Project scope

A lake management plan involves several steps, including:

- Organizing effective partnerships
- Developing a system of project governance
- Implementing a scientifically credible process for measuring the current environmental health of a lake, including the sources, amounts and impacts of various factors affecting environmental health
- Determining pressures, priorities and prescribing an implementation plan of activity measures to either restore the lake to better health or maintain its current state

The Sturgeon Lake Management Plan (SLMP) was initiated as a four-year program to include water and resource inventories, data analyses, consultations and plan preparation. It is of necessity a multi-dimensional program that examines key natural and human components of Sturgeon Lake and the associated watershed, by evaluating the physical, chemical and biological characteristics of the tributaries and water body in terms of human health, water use and aquatic ecosystem health and sustainability.

In 2011, the project will extend to Cameron and Balsam Lakes and, in future years, it is proposed for Pigeon Lake and then for the smaller northern lakes of the City of Kawartha Lakes.

Partners and volunteers in lake management planning

The development of credible lake management plans requires coordinated activities and clear objectives, based on scientific protocols when conducting fieldwork. For a decade or more, volunteers and volunteer organizations have been collecting data and reporting on environmental issues within the Kawartha Lakes. In addition, various agencies and post-graduate students have been conducting their own specialized studies. Coordinated efforts with partners will identify gaps, facilitate greater information gathering capacity, reduce the duplication of efforts and result in credible, defensible science and data.

Sturgeon Lake monitoring network

Monitoring activities for the SLMP began in June 2010. Kawartha staff generally collects samples bi-weekly from the tributaries, and monthly from the lake during the open water period. Samples are taken over a three-year period to account for natural variations in weather and other environmental factors, to ensure the reliability of the data.

The primary monitoring network consists of four stations on the lake and eleven stations on the tributaries (including the Sturgeon Lake outlet). Water samples are analysed for total phosphorus, all chemical forms of nitrogen and total suspended solids. Additional samples from four monitoring locations are being analysed for metals and major ions within the framework of the Provincial Water Quality Monitoring Network (PWQMN) program, a partnership with the Ontario Ministry of the Environment.

Anita Locke

Omemee millpond

In addition to Kawartha Conservation's monitoring network, project partners operate a number of monitoring sites. Fleming College collected samples four times at three monitoring sites on small urban tributaries of the Scugog River. Members of the Kawartha Lake Stewards Association (KLSA) and the Haliburton, Kawartha, Pine Ridge District Health Unit collected a number of *E.coli* samples from the lake throughout the last summer. KLSA also collected samples from three sites on the lake for the Ministry of the Environment's Lake Partner Program and for Kawartha Conservation and from one more site specifically for Kawartha Conservation. Trent University collected a number of samples from two streams in the watershed.

Kawartha Conservation has installed flow monitoring stations on various tributaries to collect flow data needed for future phosphorus load calculations. This involves discharge measurements to develop the relationships between water levels and flow. The Trent-Severn Waterway (TSW) has provided flow data for the Lindsay dam, Fenelon Falls dam and Bobcaygeon dam.

Precipitation is measured at two locations: the Kawartha Conservation Administrative Centre and the Hawkers Creek flow monitoring station.

Water quality and quantity monitoring, as well as the collection of scientific data from other sources, plays an important role in determining environmental pressures on our lakes. This information will help us all understand the issues and stresses impacting the lake, and enable us to develop effective recommendations and municipal planning policies for protecting and enhancing Sturgeon Lake and other lakes in the short and long term.

Plan governance

The proposed project management structure consists of a Project Management Team, a Science and Technical Committee, an Executive Liaison Group and a Community Advisory Panel, which is described in greater detail below. It is expected that this structure will evolve to meet ongoing needs as the lake management program moves beyond Sturgeon Lake.

Community Advisory Panel

This Panel is presently comprised of 20 members representing municipal staff (e.g., Planning/Public Works, and the Agricultural and Environmental Advisory Committees), TSW, the Ministry of Natural Resources (MNR), KLSA and other lake associations, Kawartha Protect Our Water (KPOW), Trent University and Fleming College, and a representative of the local agricultural industry. Volunteers from the community who participate on this Panel are critical to the success of this initiative.

Looking into the future, the partnership of this broad range of community organizations and agencies, developed during the planning process, will form the foundation for broad-based stewardship activities and be most effective in terms of acquiring resources to support plan implementation.

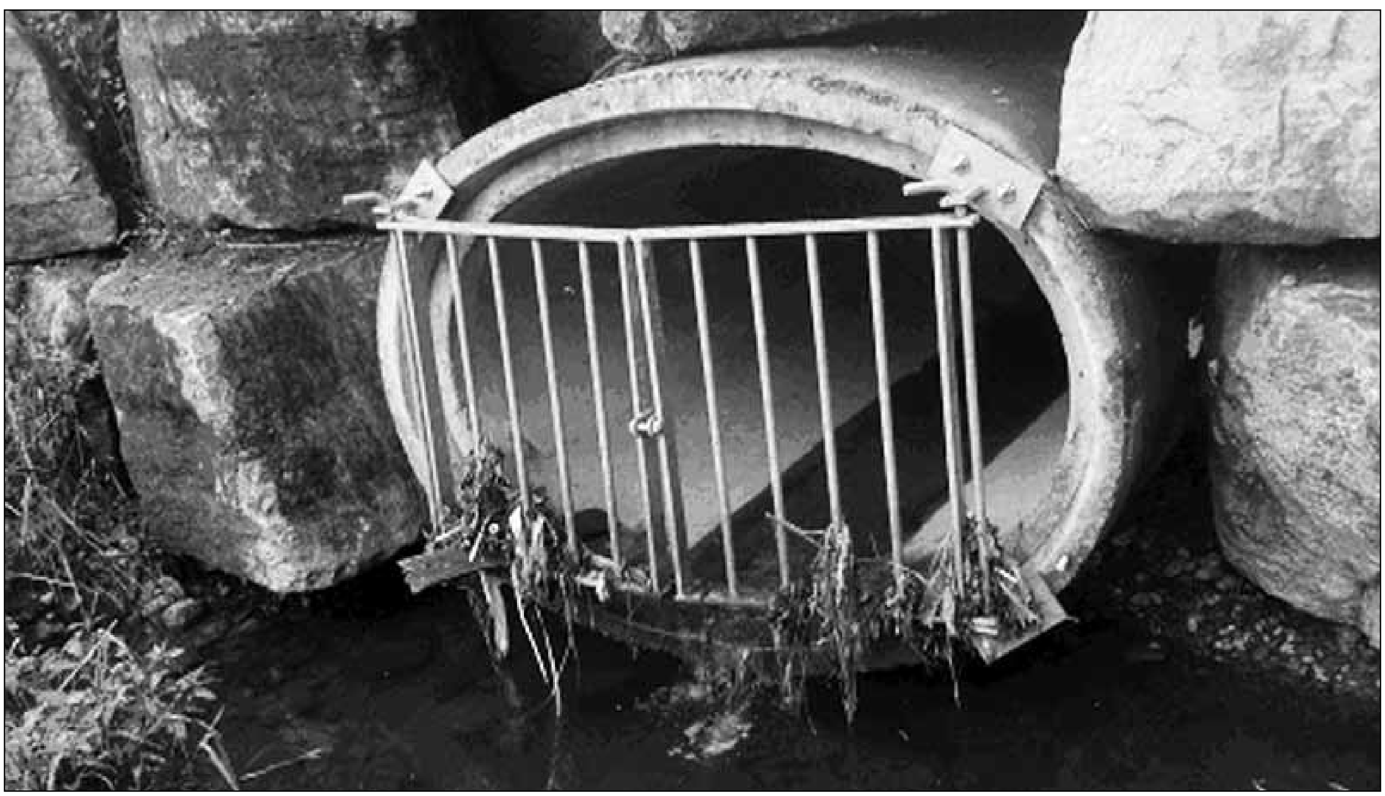
Phosphorus in the Kawartha Lakes: What Matters Most?

By Kevin Walters, B.A. Sc., P.Eng.
Vice-Chair, KLSA

*In its 2007 Annual Report, KLSA published Kevin Walters' landmark article "*Sustainable Lakeshore Living and Shoreline Naturalization – What you can do.*" Kevin explained how simple changes in landscaping can reduce nutrient runoff into lakes, so shore dwellers can be "working with nature and not against it." Available under the "What you can do" tab on our web site wordpress.klsa.com, it quickly became the most read page. In this article, Kevin turns his attention to other sources of nutrient loading in our lakes.*

We hear so much about what we should be doing to protect our lakes, mostly focusing on shoreline protection measures such as naturalization projects or native plantings. This leaves one with the impression that all will be well with our water if the shoreline is left essentially as nature intended it. But does this really have the desired effect? What is the significance of the rest of the watershed in all this? After all, very little of the water entering our lakes comes off the immediate shoreline. Where does the rest of our lake water come from, and how does it compare to the water coming from our shores?

When shoreline residents are asked to name the major source of phosphorus in our lakes they usually say, "septic systems". But is this really true? It was always assumed that *E.coli* came from leaking septic systems, and yet, through our years of testing, KLSA has found that the most common sources by far



Fleming College

Storm sewer outfall in Lindsay on the Scugog River appear to be natural systems such as wetlands, waterfowl and the sediments in our lakes. If *E.coli* does not seem to be coming from septic systems, is phosphorus? We may be as surprised as we were with *E.coli* when we discover the actual sources of phosphorus.

These once were algae-dominated lakes

Let's look at the Kawartha situation. The Kawartha Lakes, before European settlement, were likely clearwater systems with low algae concentrations and relatively few weeds compared with today. They were extremely varied, from deepwater sections to areas with moderate depths, to extensive shallow bodies slightly shallower than today; often they had deep marly deposits, especially in the hardwater bodies of Scugog, Chemong, south Pigeon and Sandy Lakes. Emergent plants like wild rice and rushes in the shallow flats were likely common. We can infer this from neighbouring lakes that are unaltered by dam construction or unaffected by development.

We have seen significant change in the Kawarthas since then. Back in the last century, probably from about the late 1800s to the 1970s, we had an algae-dominated system. Substantially increased nutrients introduced to the lakes resulted in the growth of algae suspended in the water column that caused pea-soup lake conditions. Aerial photos dating from the 1940s in the Peterborough Ministry of Natural Resources (MNR) office show cloudlike plumes in most of the lakes.

Two things had occurred in the 1800s. First we had logging, followed by settlement, agrarian primarily. This resulted in a denuded landscape surrounding the lakes, resulting in increased runoff and severe erosion, filling them in places with nutrient-rich sediment. Then towns developed to support the surrounding farm or lumber businesses. Ultimately, these towns generated sewage. At first, the lakes and their connecting channels seemed like excellent disposal systems. When this proved unacceptable, sporadic sewage treatment, in a rather rudimentary form, was implemented. These treatment plants however did little to remove the primary nutrient for plant growth, phosphorus. To make matters worse, this element was being added to detergents in increasing amounts, since it was found to aid in their cleansing power. Consequently, phosphorus was being added to the lakes in increasing amounts, compounded by an increasing population. A 1971 Provincial report on the Water Quality in Sturgeon Lake indicates that Fenelon Falls had no public sewage treatment facilities, with inadequately treated sewage entering the lake (similar to Bobcaygeon), while the sewage lagoons at Lindsay were at capacity and had no phosphorus removal.

Regulation brings change

The phosphorus amounts in detergents soon had to be regulated by the government since it was clear that problems were developing in all of our lake systems receiving sewage plant effluent. The effect on Lake Erie was infamous, although the effect was similar elsewhere. This regulation went into effect in the 1970s and has been tightened up more recently.

Nonetheless this alone proved insufficient, since much of the phosphorus still contained within sewage had sources that were impractical to regulate, and sewage plants were obliged to remove phosphorus in a new third-stage treatment process. How much has to be removed is something yet to be fully resolved; removal criteria are becoming increasingly stringent with time. However, Lindsay was obligated to remove 80% of its phosphorus by 1973. The result of these measures has been a dramatic reduction in phosphorus levels in our lakes, lessening the suspended algae and reducing the frequency of the blooms.

At the same time, better soil- and nutrient-conserving agricultural practices and regulations have reduced the agricultural contribution, a very substantial component, further reducing algae growth. Also, in recent years, zebra mussels invaded the Kawartha Lakes, gobbling up most of the suspended algae still being produced, we suspect. All of this occurring simultaneously has caused a big change. Suddenly, with suspended algae drastically reduced, the water became clear again.

What's in the sediment?

During the years that algae flourished in the lakes, some died and settled to the bottom, while other algae passed on downstream with the current. Over time, this left rich sediment on the bottom of the lakes, under now-clear water. In these conditions aquatic plants have found a perfect home. We see them now proliferate, and we don't quite know where it will end. While suspended algae was more of a nuisance, making the lake unappealing for swimmers or as a source of water for domestic use, weeds severely hamper both swimming and boating.

So, what do we conclude needs to be done to reduce the weed growth, if reducing the phosphorus may have been partly responsible for more weeds?

Consider that the lake bottoms have accumulated, over the past century at least, a vast amount of phosphorus-rich sediment, which is now being thoroughly enjoyed by the weeds. As these weeds die and decay, they release some phosphorus back into the water, but the rest sinks to the bottom and returns much of the nutrient to the sediment. Unlike most terrestrial systems, this phosphorus is not endlessly recycled in place; we have a substantial river flowing through most of the Kawartha Lakes, which flushes phosphorus in the water column downstream, and ultimately out to sea. So it would seem that, over time, the artificially created sediments will become depleted, ultimately resulting in fewer weeds, the weeds being their own undoing. It would thus appear that, in order to assist with this process, and return the lakes to a more natural condition more quickly, we need to restrict the inputs of phosphorus to the system even more, and ideally enhance the flushing rate.

Sources of phosphorus: a Lake Scugog study

How do we do this? First we need to determine where the excess phosphorus is coming from. Kawartha Conservation's recent study of Lake Scugog determined that about 80% of the phosphorus entering the lake had a non-natural or 'anthropogenic' source, and the largest input of anthropogenic phosphorus was agriculture, being about 24% of the total load to the lake. This came not just from agriculture along the lakeshore, but from everywhere within the watershed.

The sewage lagoons in Port Perry appeared only responsible for about two per cent, so further controls here will do little. It appears that the Port Perry lagoons have come a long way from those early days when news stories circulated about how the receiving stream, the Nonquon River, would scum over with thick algae below the sewage plant discharge point.

Urban stormwater contributes 18% of the phosphorus in Lake Scugog, a huge amount and quite controllable, considering that Port Perry alone accounts for most of this stormwater discharge.

Septic tanks around the lake were estimated to contribute only 9.7% of the phosphorus, in spite of their vast number distributed evenly around most of the lakeshore, many of them old

Jeff Chalmers

Agriculture is a major source of phosphorus in our lakes.

and potentially functioning less than ideally. It is hoped Kawartha Conservation's funding initiative for replacement of defective systems will reduce that input significantly. Even so, this 9.7% is only an estimate, as it is very difficult to measure the quantity of phosphorus when it is coming from under the ground surface and distributed so widely. Nonetheless, this study is a most honest attempt to quantify that amount, refuting the routine and incorrect assumption that what went into the tank ultimately goes to the lake. So it would appear that most *E.coli* and phosphorus in our lakes are not coming from the oft-maligned septic systems. Curiously, Kawartha Conservation did not identify any percentage of input coming from non-natural shorelines, such as graded lawns, man-made beaches, and properties with concrete shorewalls.

On our other lakes, can we expect the same or similar percentages? Each lake will be a bit different. Some have less agriculture than others (Shadow, the Balds, Stony), some have more sewage plant inputs (Sturgeon and Pigeon), some have greater stormwater inputs (Sturgeon and Pigeon) and some, such as Chemong, may have significantly greater septic system inputs. Ideally, studies such as those carried out by Kawartha Conservation on Lake Scugog and Sturgeon Lake should get a handle on these percentages for each lake system.

The Kawartha Lake Stewards Assocation (KLSA) has been assessing the annual inputs from sewage plants and has determined that more can be done to reduce their phosphorus discharges. Stormwater has been identified as a significant input by both Kawartha Conservation and KLSA studies, yet currently there are no controls on this whatsoever. Hopefully, such controls will be forthcoming.

All of this shows us that it is what goes on in the total watershed that really matters, not just what happens along the shoreline. It seems that all lakes are much more a product of their watersheds and their assimilation characteristics, than of what happens along the shoreline.

Who is adding phosphorus?

Ontario's Lake Partner Program, in which KLSA participates, has produced vast amounts of data. When scrutinized, this data shows that the nutrient level in our lakes correlates with their geographic location and physical characteristics, as well as the nature of their watershed, but not with the amount of lakeshore development. It is most apparent from this data that it is the watershed characteristics, along with those of the lake itself, which govern. Lakes are fed by perpetually flowing streams, and what is in those streams determines what the lake will be like, subject to the lake's ability to cleanse whatever is pouring into it.

We have to recognize that there is no difference between a waterfront lot where the owners fertilize right down to the water's edge, and homeowners, say, in the suburbs of Lindsay, a kilometre from the nearest creek, who apply the same amount of fertilizer on their lawn. Runoff from the former enters the lake in minutes, the other in perhaps hours, as storm sewers pick up the runoff and carry it to the nearest stream that flows into the lakes. What difference is there between the cottager who washes his boat on the boat ramp running directly to the lake, and the Lindsay homeowner who washes her car in the driveway? Again, nothing.

Perhaps I will grant one difference. Now that lakeshore residents are well informed about runoff, there is probably much more phosphorus loading from urban properties than from those along the lakeshore. Have you ever seen someone pour a bucket of dirty washwater from their garage directly into a lake? Or a jug of used motor oil? No? How about the same going down a street drain? Yes? Unfortunately, that happens all the time. Minutes or hours later, it's all in the lake. What has been effective in preventing such actions in other jurisdictions has been to paint yellow fish symbols on all roadway drains to remind people that the storm sewer goes to a waterway, not to a treatment plant. This would be an excellent, low-cost program for all Kawartha Lake communities.

But what about that shoreline development, including those septic systems? Won't a slew of lakeshore lots have an impact on our water quality? Aside from the Lake Partner data that tends to say no, previous inspections of lakeshore septic systems around the province have generally shown very few to be actual polluters, although many may have been considered 'substandard'. It is likely, too, that the oldest and most deficient systems have been replaced by now, as few property owners have a cavalier attitude to their own systems if they are clearly defective. No one wants to pollute their own lake. But this still does not really quantify the impact.

A unique study: are shore dwellers with septics the problem?

KLSA has long wanted to quantify what the average, overall input from shoreline septic systems might be. To do this, KLSA looked for a site that would allow measurement of the quality of runoff from a typical developed waterfront including any septic inputs. The site needed to have a very limited amount of water and

City of Lethbridge

Yellow fish symbols on all roadway drains remind people that the storm sewer goes to a waterway, not to a treatment plant.

as small as possible a watershed in order to minimize the factors of dilution and settling that occur in lake systems, and the dilution that occurs in large river systems.

We found just such a test site within our watershed, a creek called the Squaw River or 'Miskwaa Ziibi,' between County Road 36 and Little Bald Lake. This stream has no upstream reservoirs to maintain higher flow rates in summer, and the barren rock and swamp in this area create a watershed contributing little or no flow in dry summer weather. During low summertime flows, it would provide an excellent opportunity to detect any inputs from fertilizers or septic systems emerging from underground. A preliminary, simplified study was undertaken for us by an Environmental Studies student from Scotland, Laura Manson. You can read her detailed findings elsewhere in this Annual Report.

As it turned out, 2010 was one of the wettest summers on record. Nonetheless, we were somewhat surprised that, in all four tests where the flow rate was low enough to have some meaning, Laura saw a consistent decrease in both phosphorus and *E.coli* concentrations at the bottom end. Interestingly, Dr. Eric Sager of Trent University undertook a similar sampling at an earlier date on Nogies Creek and obtained a similar result.

Accordingly, it would appear from this preliminary work that waterfront development on septic systems has no detectable impact whatsoever on water quality. This is a conclusion hard to accept, although that review of Ontario's long-term testing of lakes (Lake Partner Program and prior) shows no increase over time of phosphorus levels in most lakes, as well as no correlation of phosphorus concentrations between lakes with a lot of shoreline development and those with little.

Phosphorus sources: other suspects

Now onto other potential sources. What about the contributions from boat greywater discharge? People bathing in the lake? Put into perspective, the amount that either would contribute is extremely minor. Consider that we have perhaps 30,000 urban residents on sewage treatment plants in the Kawarthas. Assuming that these plants remove about 85% of the inputs, and effectively discharge the remaining 15% to the lakes, then we're looking at the equivalent impact of 4,500 people discharging all of their raw, albeit disinfected, sewage into the waterways year round. That's kitchen sinks, washing machines, toilets, restaurant waste, everything that goes down the drain in towns. Now compare that to the greywater from a few hundred boats and perhaps as many as a thousand people occasionally bathing or washing hair in the lakes in summer. These pale in comparison. Besides, recent government regulations have greatly reduced the amount of phosphorus in domestic detergents, so the impact of lake bathing and boat greywater is even less than it once was. This is unlike commercial/industrial cleaners that are permitted to maintain their much higher phosphorus levels, meaning that municipal sewage plants receive higher phosphorus concentrations than your average cottage septic system. So, if you don't need to wash in the lake, don't do it, but if you haven't got a bathtub handy, don't feel overly guilty about it. Better to use a bucket to rinse off on shore, though.

Consider also the tonnes of vegetative matter that enter the lakes from the land, particularly in the autumn, with leaves blowing directly into lakes and also into rivers, streams and swamps that flow into the lakes. All that biomass represents an equivalent volume of aquatic weed growth potential, a natural input that we can do little to prevent – nor should we.

So, in the grand scheme of things, those unnatural shorelines likely have little or no impact on lake water quality, other than the impact of lawn runoff containing fertilizers and pesticides. Planting of native vegetation along the shoreline (or non-native for that matter) will do little or nothing in terms of stopping that runoff from reaching the lake. However, this is not to let shoreline property owners off the hook completely. Many shore property owners are guilty of altering the environment in other ways, and ruining the natural aesthetics[1].

The real culprits

So, what can we do? For the time being at least, there are three sources of nutrients that require our focus, which are entirely different from what most people think. They are agriculture, sewage treatment plants (some, not all) and stormwater runoff. The pet issues of boat greywater, lakeshore septic systems, unnatural shorelines and bathing in the lakes are inputs of secondary concern.

There may be exceptions though. Chemong Lake has phosphorus levels in excess of what might be expected. Chemong, a marl basin, has very little flowthrough, not being on any significant tributary flow system. It also has a high degree of dense, year-round residential lakeshore development, much of it in place for many decades, or a century in the case of Bridgenorth. There are undoubtedly old and perhaps defective septic systems, as well as car washing, urban lawns and lawn fertilizing resulting in substantial dirty stormwater runoff flowing unimpeded to the lake. The ground in these areas may be saturated with phosphorus and unable to absorb any more, so groundwater flowing to the lake may be unnaturally high in phosphorus.

Other remedies

Chemong Lake is a prime candidate area for resident education, stormwater quality treatment and perhaps even a sewage treatment plant to collect the sewage from urban-type lots, treat it to a high degree and discharge it to the nearest tributary stream – Miller Creek, removing the sewage from the basin entirely. This stream flows to Katchewanooka, the last lake in the system, which also happens to have the highest flow rate, thereby maximizing dilution. A study is needed to determine what the septic and stormwater inputs are in the Chemong basin and how best to reduce them.

What else can we do? Increasing the summertime flushing rate may reduce the growth of weeds in summer, provided that any added flushing water is low-nutrient. This might initially appear to involve additional drawdown of reservoir lakes or, alternatively, increasing reservoir capacity, since at the current time, property owners around the northern reservoir lakes are opposed to drawing down their lakes any more than is absolutely necessary. However, reservoirs are expensive, and they really don't increase the flushing rate; they only increase the rate during drawdown periods, but the average annual flushing rate remains unchanged. So reservoirs or their operation are not part of the answer.

At the moment, the lake system that is suffering the most from excessive weed growth is the shallow 'tri-lakes' or 'Great Buckhorn,' which includes the Bald Lakes and the Chemong basin. We have previously identified that this system at one time enjoyed a greater flowthrough than today, because the Mississagua River originally had a divided mouth, with approximately half of its flow discharging to the Bald lakes while the other half went to the Lovesick group, i.e., Lower Buckhorn Lake[2]. If the Bald Lake branch were restored, this very low nutrient stream would dilute the higher nutrient water and result in a significant dilution of phosphorus levels in the lakes between Bobcaygeon and Buckhorn, while also increasing the flushing rate, all without changing the amount of water drawn from the reservoir lakes. Re-establishing this west outlet to the river wouldn't require a great deal of effort – mainly just a new box culvert under County Road 36.

All of these measures should result in water in our lakes improving over time in terms of nutrient enrichment, turning back the clock to close to pre-European settlement conditions.

What else can we do?

Another study KLSA is anxious to undertake is a study of the sediments in the lakes. We envision taking core samples from the bottoms of various lakes to see what changes might be reflected in them, to get a more accurate picture of the way they were in the past, and to find out what we've done to them since.

On another front, we need continued support for organizations that continue to monitor water quality and delve into issues that affect our use and enjoyment of the lakes. Kawartha Protect Our Water (KPOW) is one, that ever-vigilant group which continues to turn over stones in that hotbed area of Lindsay, including stones, no doubt, that some would prefer were left unturned. Another group doing champion work is, of course, your Kawartha Lake Stewards Association.

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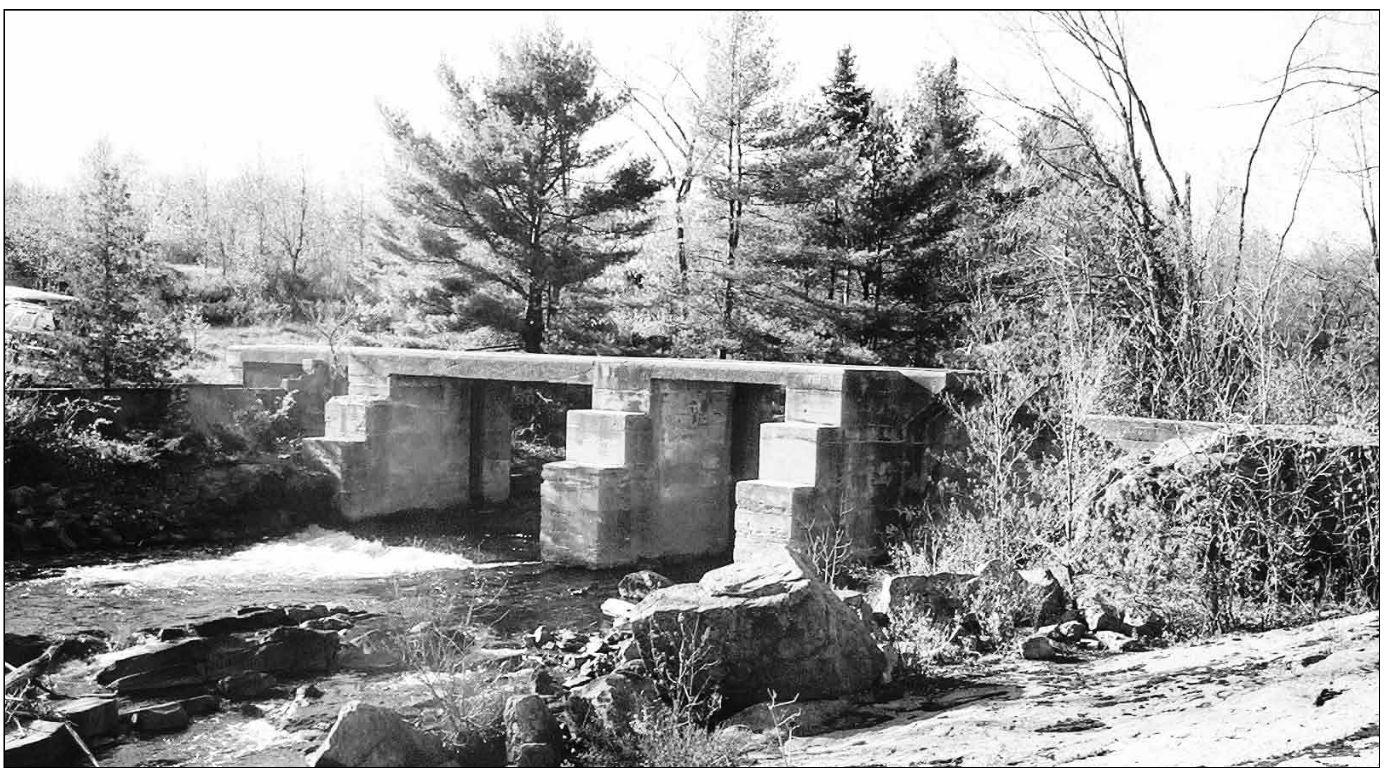
[1]See the "Sustainable Shorelines" article in KLSA's 2007 annual report *Making a Splash*, available on the KLSA website www.wordpress.klsa.com

[2]See KLSA's 2006 report, *Looking Deeper*, p. 54, KLSA's 2008 report, *The Root of the Matter*, p.15 and KLSA's 2009 report, *A Decade of Stewardship*, p. 17.



Kevin Walters

Scott's Mills dam on the Mississagua River. This Parks Canada dam can be refurbished and used to return river water to the west branch leading to Big Bald Lake.

Appendix A:

KLSA Mission Statement, Board of Directors & Volunteer Testers

Mission Statement

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

2010-2011 Board of Directors

Mike Stedman, Chair
Lakefield

Kathleen Mackenzie, Vice-Chair
Stony Lake

Kevin Walters, Vice-Chair
Shadow, Lovesick and Sandy Lakes

Chris Appleton, Treasurer
Sturgeon Lake

Ann Ambler, Secretary
Lovesick Lake

Sheila Gordon-Dillane, Recording Secretary
Pigeon Lake

Pat Moffat, Past Chair
Lovesick Lake

Jeff Chalmers, Director
Clear Lake

Mike Dolbey, Director
Katchewanooka Lake

Janet Duval, Director
Lower Buckhorn

Rod Martin, Director
Sturgeon Lake

Mark Potter, Director
Lower Buckhorn Lake

****

Scientific Advisors

Dr. Eric Sager, Coordinator of the Ecological Restoration program at Fleming College and Adjunct Professor at Trent University

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

Volunteer Testers 2010

Balsam Lake Association: Ross Bird, Cathrine Couchman, Bruce Crosland, Douglas and Peggy Erlandson, Leslie Joynt, Barbara Peel, Diane Smith, Jeff Taylor, Bob Tuckett, Steve and Laura Watt

Big Bald Lake Association: Ron Brown, John Shufelt

Big Cedar Lake: Rudi Harner

Buckhorn Lake – Buckhorn Sands Property Owners: Jackie Shaver

Cameron Lake: Erin Macey

Clear Lake – Birchcliff Property Owners Association: Jeff Chalmers, Dominique Murray
Kawartha Park Cottagers' Association: Vivian Walsworth

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

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

Lower Buckhorn Lake Owners' Association: Richard Johnston, Jim Keyser, Jeff Lang, Peter Miller, Mike Piekny, Mark and Diane Potter, Dave Thompson

Pigeon Lake – Concession 17 Pigeon Lake Cottagers Association: Jim Dillane, Sheila Gordon-Dillane

Pigeon Lake – North Pigeon Lake Ratepayers' Association: Tom McCarron, Francis Kerr

Pigeon Lake – Victoria Place: Ralph and Nona Erskine

Sandy Lake Cottagers Association: Mike and Diane Boysen

Sandy Lake – Harvey Lakeland Commonlands Owners' Association: Percy Payette

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

Sturgeon Lake Association: Chris Appleton, Don Holloway, Rod Martin, Dan McInnis, Phil Mayville

Upper Stoney Lake Association: Karl, Kathy, Ken and Kori Macarthur

White Lake Association: Wayne Horner

Appendix B: Financial Partners

Thank You to our 2010 Financial Partners

Federal Government
Trent-Severn Waterway (Parks Canada)

Provincial Government
Ontario Trillium Foundation

Municipal Government
City of Kawartha Lakes
Township of Douro-Dummer
Township of Galway-Cavendish & Harvey
Township of Smith-Ennismore-Lakefield

Community Association Donations
Big Cedar Road Committee Big Cedar Lake
East Beehive Community
Killarney Bay – Cedar Point Cottage Association
Kawartha Protect Our Water (KPOW)
Lovesick Lake Association
Sandy Lake Cottagers Association
Stony Lake Heritage Foundation
Upper Stoney Lake Cottagers Association
White Lake Association

Private Business Donations

Beachwood Resort
Buckeye Marine
Buckhorn Hardware
Clearview Cottage Resort
Egan Houseboat Rentals
Lakefield Foodland
Lakeside Cottages
Pinewood Cottages and Trailer Park
Reach Harbour Marina
Red Eagle Family Campground
Reynolds Group
Shining Waters B&B

Individual Donations

Anonymous
Eleanor Andrews
David Bain
Wally and Monica Berdin
Eleonore Boljkovac
Lori Bowerman
Robert Brown
Mike Dolbey
Bev and Dorothy Flemming
Edward and Mary Hill
Allan Hobbs
Sharon King
Rick Morgan
Lou and Judy Probst

Many thanks to all of our generous supporters

Appendix C: Treasurer's Report

Chris Appleton, Treasurer KLSA Mike Stedman, Chair KLSA

17 Feb 2011

The attached financial statement shows the 2009 and 2010 income and operating expenses for the Kawartha Lake Stewards Association.

As in previous years, our financial statements have been reviewed by McColl Turner LLP Chartered Accountants in Peterborough, Ontario. A copy of their Review Engagement Report is included. Our thanks to Mr. George Gillespie for his continued support for KLSA.

For purposes of distributing charitable donation receipts, KLSA works through the Stony Lake Heritage Foundation.

KLSA income for 2010 was $52,136. Our primary sources of income were:

- Trent-Severn Waterway (Parks Canada) grant - $3,000
- Ontario Trillium Foundation grant (Algae Study Phase I) - $35,000
- Municipal Township grants - $5,750
- Association water testing fees - $4,185
- Community association donations - $2,515
- Private business/individual donations - $1,686

KLSA's normal operating expenses remained consistent with past years at just over $12,000.

The primary operating expenses included:

- *E.coli* water testing fees - $5,025
- KLSA insurance for volunteers and Board members - $1,552
- Printing for the 2010 KLSA Annual Report - $3,470
- General administration (supplies, postage, bank fees, meetings) - $2,436

Our major project-related 2010 expenses of $36,000 included:

- Algae Project Phase I Collaborative Agreement with Trent University - $35,000
- Squaw River Preliminary Study - $600
- KLSA PowerPoint Presentation - $300

The Algae Project is in the first year of a 27-month study in collaboration with Trent University and is funded by an Ontario Trillium Foundation (OTF) grant of $71,000. OTF monitors our progress through regular reports. Work is on schedule for completion in the last half of 2012.

As of this writing, KLSA is projecting 2011 revenues of $38,800 from our traditional funding sources as well as $20,000 from OTF, which represents the third payment of our Ontario Trillium Foundation Grant. We are forecasting 2011 expenditures of over $48,000, leaving a shortfall of revenues to expenditures of $9,380. Our usual expenses for insurance, test fees, annual report and general administration remain at their usual levels. The $20,000 from OTF covers Phase II of the KLSA/Trent University Collaborative Algae Study.

The other extraordinary forecast expense of $16,000 is for an expanded Squaw River Project. KLSA is undertaking fundraising initiatives to improve our forecast year-end financial position.

Financial Statements of

KAWARTHA LAKES STEWARDS ASSOCIATION

December 31, 2010

Note To The Financial Statements
December 31, 2010

BASIS OF PRESENTATION

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

In 2010, the Association collaborated with Trent University on an Algae Project with funding from the Ontario Trillium Foundation. The project is a 27 month study and the 2010 funding from Ontario Trillium Foundation was for $35,000 (2009 – Aquatic plant project $4,500) while expenditures totalled $35,976 during this fiscal year (2009 – Aquatic plant project $14,106).

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

MCCOLL TURNER

McCOLL TURNER

McColl Turner LLP
Chartered Accountants
362 Queen St., Peterborough, ON
K9H 3J6

Telephone 705 743 5020
Facsimile 705 743 5081
Email info@mccollturner.com
Website www.mccollturner.com

REVIEW ENGAGEMENT REPORT

To Mr. Mike Stedman, Chair

KAWARTHA LAKES STEWARDS ASSOCIATION

We have reviewed the statement of financial position of Kawartha Lakes Stewards Association as at December 31, 2010 and the statement of operations for the year then ended. Our review was made in accordance with Canadian generally accepted standards for review engagements and accordingly consisted primarily of enquiry, analytical procedures and discussion related to information supplied to us by the Association.

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

Based on our review, nothing has come to our attention that causes us to believe that these financial statements are not, in all material respects, in accordance with Canadian generally accepted accounting principles.

McColl Turner LLP

Licensed Public Accountants

Peterborough, Ontario
February 3, 2011

KAWARTHA LAKES STEWARDS ASSOCIATION

Statement of Financial Position - December 31, 2010

	(Unaudited) 2010	2009
ASSETS		
Current Assets		
Cash	$ 7,294	8,617
Guaranteed Investment Certificate	5,000	-
	12,294	8,617
NET ASSETS	12,294	8,617
	$ 12,294	$ 8,617

Statement of Operations
Year ended December 31, 2010

	(Unaudited) 2010	2009
REVENUE		
Parks Canada, Trent-Severn Waterway	$ 3,000	$ 3,000
Ontario Trillium Foundation Grant	35,000	4,500
Municipal grants	5,750	5,756
Associations	6,700	4,975
Private contributions	1,686	1,470
Interest	-	42
	52,136	19,743
EXPENDITURES		
Water testing fees	5,025	4,973
Algae project / Aquatic plant project	35,976	14,106
Annual report costs	3,470	3,438
Insurance	1,552	1,828
Telephone, copies and other administrative costs	2,387	1,479
Bank charges	49	44
	48,459	25,868
EXCESS OF (EXPENDITURES OVER REVENUE) REVENUE OVER EXPENDITURES FOR THE YEAR	3,677	(6,125)
NET ASSETS - beginning of year	8,617	14,742
NET ASSETS - end of year	$ 12,294	$ 8,617

McCOLL TURNER

Appendix D: Privacy Policy

Jeffrey Chalmers, KLSA Privacy Officer

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

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

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

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

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

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

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

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

Contacting us: We may be contacted by email at kawarthalakestewards@yahoo.ca or by regular mail to: KLSA, 24 Charles Court, RR #3 Lakefield, ON K0L 2H0

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

By Kathleen Mackenzie, KLSA Vice-Chair

Choosing sites

The goals of this testing were threefold:

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

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

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

Please note:

- *KLSA does not test drinking water. Only surface waters are tested. All untreated surface waters are considered unsafe for drinking.*
- *KLSA results are valid only for the times and locations tested, and are no guarantee that a lake will be safe to swim in at all times and in all locations.*

Why did we test for *E.coli*?

E.coli was the bacteria of choice because:

- The presence of *E.coli* usually indicates fecal contamination from warm-blooded animals such as birds or mammals, including humans. The presence of *E.coli* indicates the possible presence of other disease-causing organisms found in fecal material, such as those causing gastrointestinal and outer ear infections.

- *E.coli* is present in fecal material in very high numbers. Healthy humans excrete about 100 million *E.coli* per ¼ teaspoon of fecal matter! Therefore, it is easier to 'find' than most other less plentiful bacteria.

- *E.coli* itself can be dangerous. Although most strains of *E.coli* are harmless, some strains cause serious disease, such as in the Walkerton tragedy, or occasionally in ground beef 'scares'. The basic analysis done by the laboratories cannot distinguish the difference between the harmless and the deadly, so we always treat *E.coli* as if we were dealing with a harmful strain.

Note: <3 means less than 3.

Lake-by-Lake *E.coli* Results

To put the results in perspective:

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

Balsam Lake								
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL								
Site	**5-Jul-10**	**19-Jul-10**	**22-Jul-10**	**26-Jul-10**	**3-Aug-10**	**9-Aug-10**	**12-Aug-10**	**7-Sep-10**
00	11	8	-	22	13	13	-	5
01	11	8	-	3	13	13	-	3
02	3	<3	-	5	13	8	-	5
03	3	3	-	<3	8	8	-	3
04	3	11	-	8	16	3	-	25
05	8	16	-	5	<3	8	-	11
06	3	<3	-	8	3	8	-	<3
07	19	5	-	<3	<3	3	-	5
08	3	<3	-	3	<3	3	-	22
12A	3	30	-	<3	13	**136**	5,8,5	<3
12B	<3	3	-	16	16	3	-	5
12C	3	**over 2,424**	<6,<6,<6,<6,<6	<3	46	<3	-	3

As in previous years, counts were generally very low on Balsam Lake.

Regarding Site 12C/Jul. 19, the reason for the exceptionally high reading is unknown. Retesting resulted in excellent results. The lab reviewed the original data and the sequence in which the samples were analysed. No discrepancies were identified. The lab has described the event as either an anomaly or transitory.

Regarding Site 12A/Aug. 9, this site is near a stream that runs through an agricultural field. Due to recent rain the stream was flowing on August 9; it is often dry at this time of the year.

Big Bald Lake						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	5-Jul-10	20-Jul-10	26-Jul-10	3-Aug-10	9-Aug-10	7-Sep-10
1	3	4	4	1	5	2
2	0	22	6	1	1	0
3	2	7	1	4	3	0
5	0	0	0	0	0	1
7	0	0	1	3	0	1
8	1	0	0	0	0	5

Similar to previous years, counts were consistently low on Big Bald Lake.

To put the results in perspective:

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

Big Cedar Lake						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	5-Jul-10	19-Jul-10	3-Aug-10	9-Aug-10	30-Aug-10	7-Sep-10
640	5	2	1	1	2	0

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

Buckhorn L: Buckhorn Sands						
2010 *E.coli* Lake Water Testing – E.coli/100 mL						
Site	5-Jul-10	19-Jul-10	26-Jul-10	3-Aug-10	9-Aug-10	7-Sep-10
A	0	7	0	0	0	0
B	5	0	0	0	0	2
C	3	7	0	1	0	0
D	0	7	0	0	0	1

As in previous years, counts were uniformly low in all locations tested in the Buckhorn Sands area.

Clear Lake: Birchcliff Property Owners							
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL							
Site	7-Jul-10	21-Jul-10	28-Jul-10	5-Aug-10	11-Aug-10	13-Aug-10	17-Sep-10
BB	4	10	28	0	3	-	31
1	0	2	0	0	0	-	2
2	0	1	0	0	0	-	1
3	18	0	0	7	**66**	8, **260**, 3, 4, 0	6
4	0	0	1	9	4	-	6
5	0	3	0	0	0	-	34
6	1	1	1	0	1	-	21
7	0	1	0	0	24	-	4
8	6	2	2	16	**136**	7, 9, 6, 10, 4	5

Over the years, Site 8 occasionally has had counts over 50. This is a shoal where birds sometimes roost, likely the source of bacteria. Site 3 is also near this shoal.

On Aug. 10 some cottagers were removing aquatic plants very near Site 3 and 8, which would have disturbed the sediments. It is thought that *E.coli* can reside in lake sediments, so the weed removal may have contributed to the higher counts at Sites 3 and 8 on Aug. 11.

The slightly higher counts at Sites 5 and 6 on Sep. 17 may have been due to a week of onshore winds. Again, these would have disturbed the sediments.

To put the results in perspective:

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

Clear L: Kawartha Park						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	5-Jul-10	19-Jul-10	26-Jul-10	9-Aug-10	12-Aug-10	8-Sep-10
B	1	0	0	0	-	0
C	2	3	0	1	-	0
D	2	0	0	2	-	0
P	6	2	0	**106**	1, 5, 1, 3, 2	3
S	0	2	-	1	-	1
W	2	0	1	0	-	0

As in previous years, the Kawartha Park area exhibited very low counts, except for the one very unusual high reading. There was no obvious explanation. Testing was immediately after the August long weekend, and there had been many people staying at the cottage closest to the site. However, this is just a guess as to the cause. The majority of Kawartha cottages are full of guests on this very popular weekend, and counts historically don't tend to be higher on this date.

Katchewanooka Lake: Sites 1,7						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	5-Jul-10	19-Jul-10	26-Jul-10	2-Aug-10	9-Aug-10	7-Sep-10
1	4	4	2	1	1	1
7	6	24	1	15	9	2

Katchewanooka Lake: Sites 2,5,6							
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL							
Site	6-Jul-10	19-Jul-10	21-Jul-10	26-Jul-10	3-Aug-10	10-Aug-10	9-Sep-10
2	5	50	34, 19, 31	36		9	14
5	11	**127**	5, 7, **55, 66, 56**	**60, 64, 54, 57**, 10	8, 16, 41, 8, 11	29	17
6	1	6	-	3	12	3	1

As in previous years, Site 2 had the occasional count over 50, so was not as consistently low as Sites 1, 6, and 7. There is no obvious reason for this.

Site 5 has had good years and bad years. It showed very low counts in 2001/02/05/06/07, but this year has frequent counts over 50, similar to 2003/04/08/09. This is at the mouth of a creek. Upstream are farms, a golf course and a wetland area, any of which may be contributing to the counts. Fortunately, Site 5 is not a swimming area.

To put the results in perspective:

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

Lovesick Lake						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	6-Jul-10	20-Jul-10	26-Jul-10	3-Aug-10	17-Aug-10	10-Sep-10
15	2	0	0	2	2	4
16	0	1	1	1	4	2
17	1	0	2	0	6	3

This is the third year of testing on these three locations. As in 2008/09, counts were uniformly low.

Lower Buckhorn Lake						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	5-Jul-10	19-Jul-10	26-Jul-10	3-Aug-10	9-Aug-10	6-Sep-10
1	16	15	5	3	18	0
2	0	4	4	2	0	1
3	17	43	17	26	42	22
4A	**62**	**102**	42	13	**69**	27
4B	**60**	**440**	30	35	**103**	26
5	0	1	1	0	1	0
8	0	1	0	9	1	4
9	0	18	3	0	0	3
10	0	0	0	1	-	-
11	1	9	4	9	4	11
12	40	14	26	15	4	5
13	12	-	4	5	9	2
14	2	2	2	5	4	4

Sites 4A and 4B had counts similar to previous years. These sites are close to an inflow from a large wetland area, whose streams have high *E.coli* counts (see KLSA Annual Report 2004 Appendix E).

Pigeon Lake: Concession 17 Pigeon Lake Cottagers Assn.						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	5-Jul-10	19-Jul-10	26-Jul-10	2-Aug-10	15-Aug-10	14-Sep-10
A	2	0	0	6	0	2
B	0	0	0	0	1	0
3	0	1	0	14	7	0

Counts were uniformly low on all the above sites, which is consistent with past years.

To put the results in perspective:

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

Pigeon Lake: North Pigeon Lake Ratepayers' Assn.				
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL				
Site	5-Jul-10	26-Jul-10	3-Aug-10	8-Sep-10
1A	0	0	3	2
5	13	32	7	3
6	18	16	23	25
8	0	0	0	0
13	4	8	15	3

Sites 5 and 6 have had counts between 50 and 100 intermittently, probably due to the presence of a large population of Canada Geese. These sites had consistently low counts this year.

Pigeon Lake: Victoria Place						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	5-Jul-10	19-Jul-10	26-Jul-10	3-Aug-10	9-Aug-10	7-Sep-10
1	8	13	8	<3	3	11
2	5	<3	<3	<3	<3	3
3	5	3	<3	<3	<3	3
4	3	8	<3	<3	13	3
5	8	<3	<3	11	13	3

Counts were uniformly low on all the Victoria Place sites. Although there was a thunderstorm during the night before the July 19 test, it did not seem to raise the counts.

Sandy Lake: Fire Route 48					
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL					
Site	5-Jul-10	19-Jul-10	30-Jul-10	6-Aug-10	3-Sep-10
D1	0	0	0	0	18
D2	0	2	0	0	3

As in 2008/09, counts were uniformly very low on these Sandy Lake sites.

To put the results in perspective:

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

Sandy Lake: Harvey Lakeland Estates					
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL					
Site	5-Jul-10	21-Jul-10	4-Aug-10	16-Aug-10	18-Aug-10
SR/1	10	16	44	**1900, 740, 720, 124**	**55**, 32, 3, 0
SS/2	10	15	**95**	**1300, 1180, 380**, 8	20, 20, 27, 1
PP/3	1	34	**144**	**66**	7, 18, 36, 8
CW/4	4	2	17	-	-
PS/5	3	3	7	-	-

The high counts are probably due to waterfowl populations congregating on rock islets in very shallow water. These sites are not in swimming locations.

Stony Lake: Association of Stony Lake Cottagers							
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL							
Site	6-Jul-10	19-Jul-10	21-Jul-10	26-Jul-10	4-Aug-10	9-Aug-10	7-Sep-10
E	1	35	-	2	25	9	2
F	1	3	-	2	1	1	2
I	2	5	-	8	1	3	0
L	13	0	-	0	44	5	1
P	2	1	-	0	33	12	0
26	17	**93**	32, 31, 2, 27, 20	16	9	49	13
27	11	**640**	14, 44, 7, 7, 7	5	3	13	4
28	25	3	-	0	0	3	16

Stony Lake: Association of Stony Lake Cottagers – Sites J,K						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	7-Jul-10	20-Jul-10	26-Jul-10	3-Aug-10	8-Aug-10	7-Sep-10
J	1	9	0	4	9	2
K	0	1	1	0	1	0

Generally, counts on Stony Lake were low. However, there were some elevated counts at Site 26 and 27 on July 19. These sites are both located on long, narrow, shallow dead-end bays with sloped shores and fairly dense cottage development. There was a heavy downpour 6 hours prior to testing (see Appendix H). The KLSA tester noticed that the water looked murky at Site 27, so runoff was probably the source of these high counts. This has been observed occasionally in other years at these sites; they are somewhat prone to elevated counts after heavy rainfalls. Two days later, counts were back down.

To put the results in perspective:

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

Sturgeon Lake: North Shore Combined Group									
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL									
Site	5-Jul-10	19-Jul-10	22-Jul-10	26-Jul-10	3-Aug-10	5-Aug-10	9-Aug-10	12-Aug-10	7-Sep-10
NS2	3	5	-	13	**76**	**72, 76, 65**	5	-	5
NS2A	5	5	-	28	16	-	16	-	22
NS3	43	<3	-	**130**	**59**	**206, 226, 213**	**114**	-	**92**
NS4	8	13	-	11	8	-	3	-	<3
NS5	8	**110**	16, 10, 22, 26, 22	3	16	-	<3	-	11
WS1	5	22	-	30	22	-	8	-	13
SB1	5	<3	-	19	**106**	**282, 302, 292**	**188**	**1588, 1388, 1876**	10
SB2	36	16	-	<3	3	-	3	-	6
SS1	-	-	-	-	5	-	3	-	16
SS2	-	-	-	-	<3	-	28	-	22
NS8A	-	-	-	-	-	-	30	-	33
NS8B	-	-	-	-	-	-	11	-	16

As in the past, there were several high counts, some over 100, in several locations in Sturgeon Lake. Over the past seven years, sites NS4 and SB2 could be said to have counts that are normal for a Kawartha Lake, i.e., occasional counts between 20 and 50, all other counts under 20. The other six sites that have been regularly tested (NS2, NS2A, NS3, NS5, WS1 and SB1) have exhibited high counts more frequently than this. The dates of the high counts and the actual sites vary from year to year, so it seems like there is a regional cause for this. Is Sturgeon Lake more prone to storms, thereby stirring up the sediments? Is there agricultural or wetland inflow? We still don't know.

Kawartha Conservation, together with various stakeholders, has embarked on a four-year Sturgeon Lake Management Plan. Among other things, they will be examining what is affecting water quality in this lake; perhaps this new data will provide some answers to this puzzle.

To put the results in perspective:

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

Upper Stoney Lake: Upper Stoney Lake Assn.						
2010 *E.coli* Lake Water Testing – *E.coli*/100 mL						
Site	5-Jul-10	19-Jul-10	21-Jul-10	26-Jul-10	3-Aug-10	7-Sep-10
6	4	**117**	32	10, 5, 3	29	9
20	0	0	-	2	1	0
21	0	11	-	1	16	4
52	27	**94**	27	20, 32, 27	8	2
65	6	1	-	0	4	**78**
70	0	3	-	0	0	0
78A	0	1	-	0	0	0

There was a heavy rainfall just before testing on July 19 (see Appendix H). This was probably the reason for elevated counts at Sites 6 and 52 (one a shallow, quite enclosed bay; the other the mouth of a stream). In the past, these two sites have occasionally shown a rise in counts after a heavy storm.

The high count at Site 65/Sep. 7 is unusual, and there was no obvious reason for it.

Anita Locke

Kawartha lake cattail marsh

Appendix F: 2010 Phosphorus and Secchi Data

By Kathleen Mackenzie, KLSA Vice-Chair

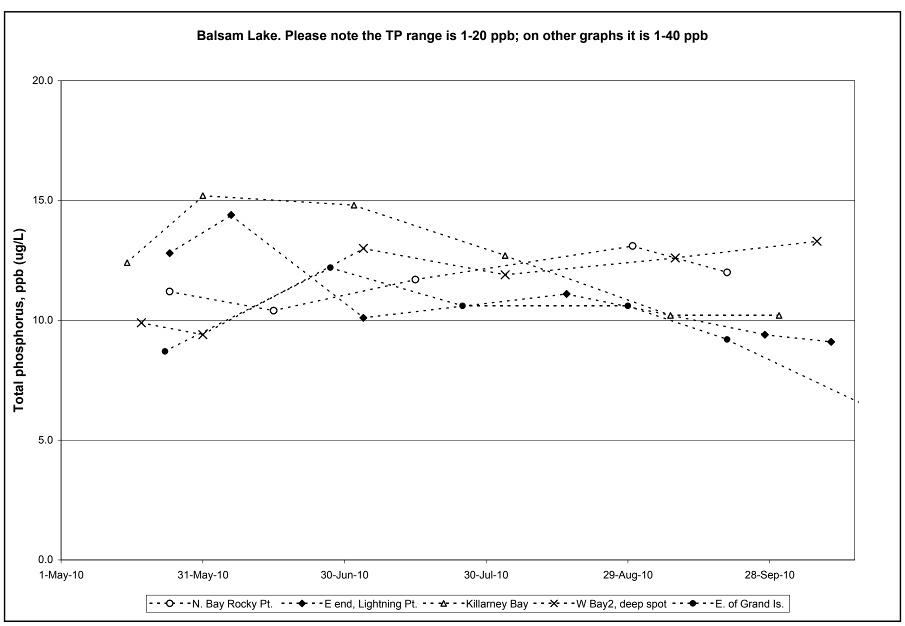
Why test for phosphorus? Arguably, phosphorus is the chemical that does the most aesthetic damage to inland lakes. Phosphorus encourages algal growth, resulting in a turbid lake and eventually thicker, enriched sediments that are more likely to grow aquatic plants. The Ontario Ministry of the Environment's Interim Provincial Water Quality Objective for Total Phosphorus is as follows:

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

Natural sources of lake phosphorus include rock, soil and runoff from native vegetation. Human sources include sewage treatment plants, septic systems, fertilizers, and urban and agricultural runoff.

Phosphorus levels are constantly changing in the Kawartha Lakes. They change in each lake from month to month, and on any one date, phosphorus levels differ from lake to lake. And they are somewhat different from year to year! Tracking these fluctuating phosphorus levels helps us to understand the chemistry of our lakes.

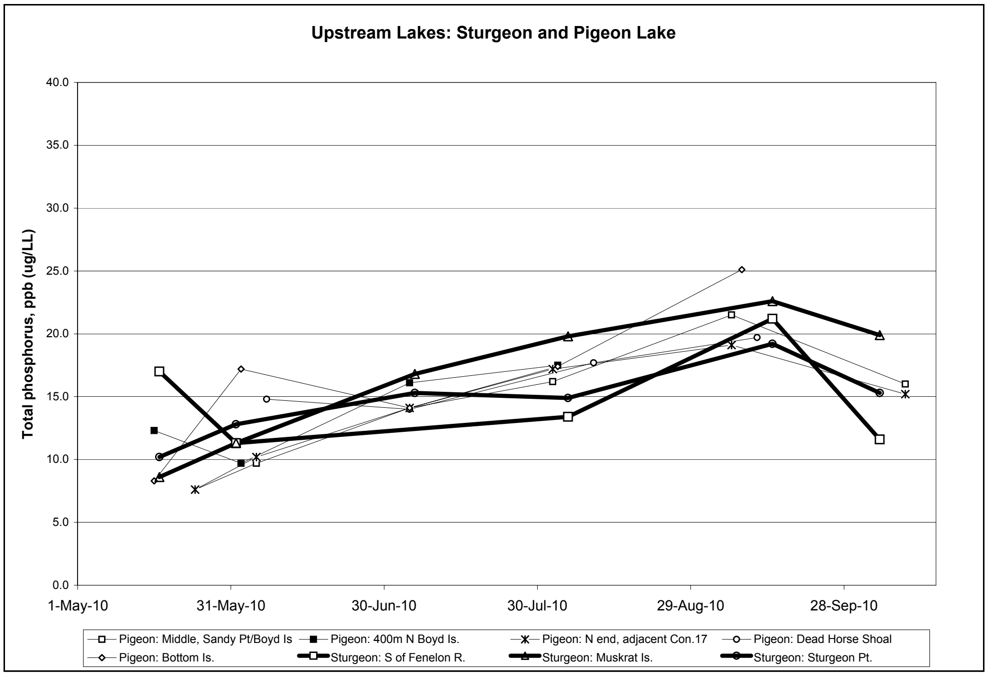
Balsam Lake, our heterogeneous lake



Most of the flow through Balsam Lake is across the northeast corner; water flows in from the north from Gull River and flows out to the east to Cameron Lake. The rest of this H-shaped lake experiences much less mixing than the northeast corner, so different parts of Balsam Lake have somewhat different water quality;

it's quite heterogeneous. This can be seen in the criss-crossing of the lines on the graph, not seen in the other graphs. As a whole, phosphorus levels are low in Balsam Lake compared to lakes downstream (with the exception of the low phosphorus lakes). Balsam Lake levels stay within a narrow range of 10 to 15 ppb.

Upstream lakes

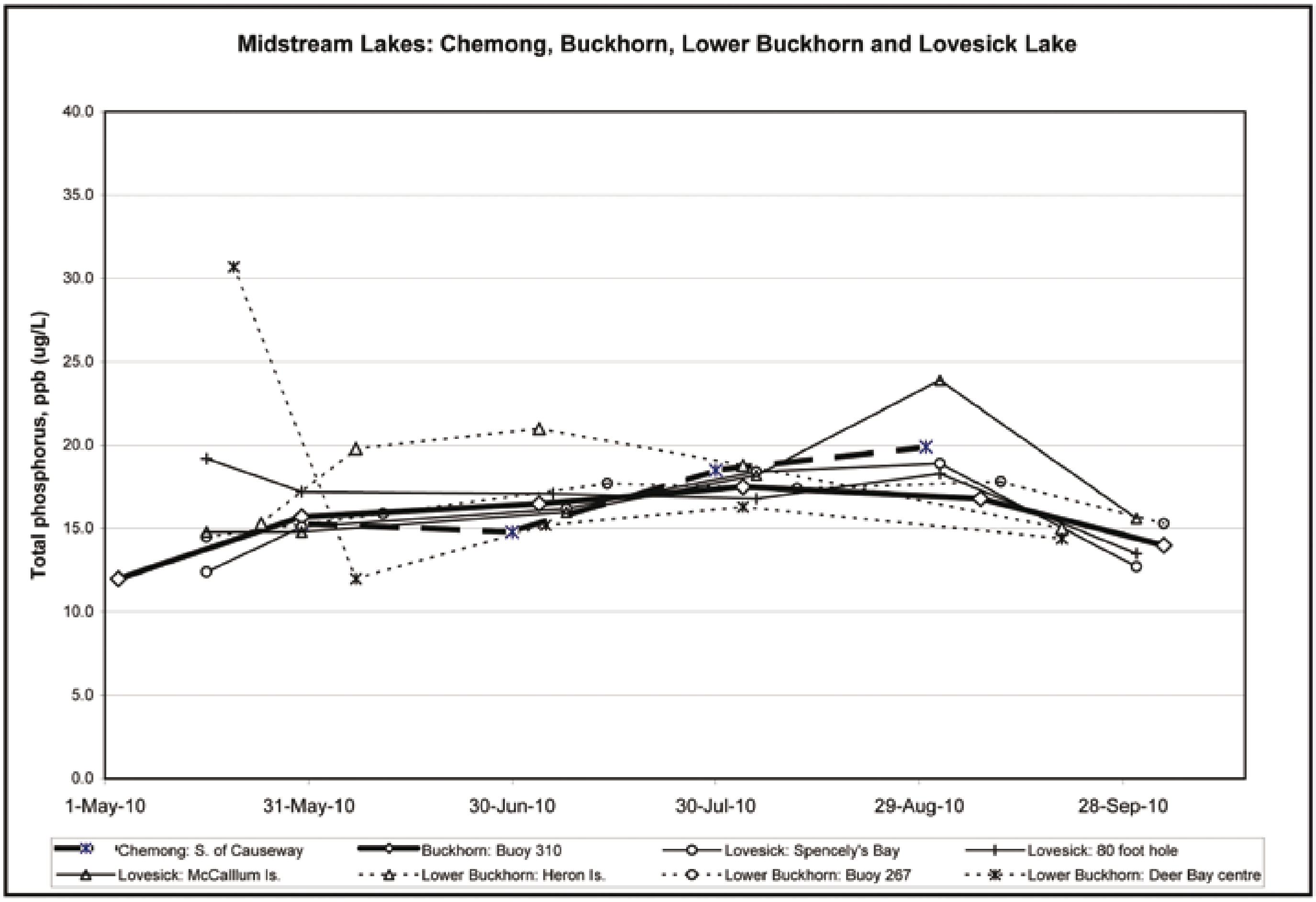


As in the past, Sturgeon and Pigeon Lake have phosphorus levels about 5 ppb higher than Balsam by August. This is a significant increase. We would know more specifically where this increase happens (at the inflow of Burnt River? Fenelon Falls?) if we had some phosphorus readings from Cameron Lake. Are there any Cameron-ites out there looking for an excuse to go out for a few boat rides next summer? We would love to hear from you!

It is interesting to note the high mid-May reading at Sturgeon Point. Could this be caused by the Scugog River? As seen in the chart below, Snug Harbour, at the south end of Sturgeon Lake, had a very high phosphorus reading in mid-May. Snug Harbour is fed by the Scugog River, which contains runoff from the town of Lindsay's stormwater and sewage treatment plant, from agriculture, and from the Lindsay landfill site. Occasional phosphorus peaks are a characteristic of Snug Harbour.

Phosphorus Levels, Snug Harbour, Sturgeon Lake	
Date	**Total Phosphorus, ppb (ug/L)**
May 17/10	81
June 1/10	27
August 4/10	17
September 13/10	7

Midstream lakes

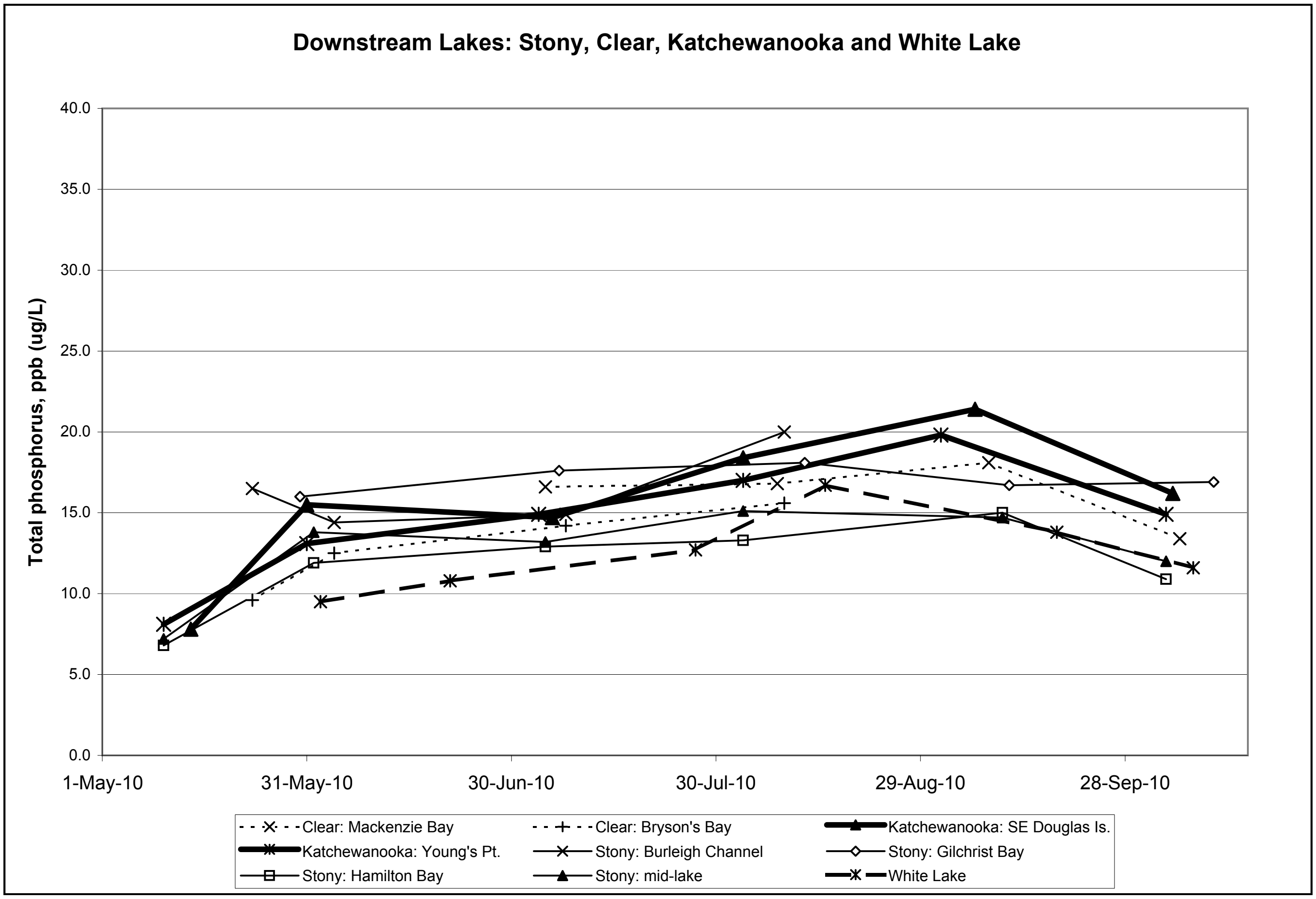


As in previous years, these lakes started in May with somewhat higher phosphorus levels than Sturgeon and Pigeon, but reached the same levels in August.

The high May reading at Deer Bay was most likely a testing error.

The high reading at Spencely's Bay in early September may also have been due to a testing error. However, a very similar peak – same date, same phosphorus level – was observed at the McCallum Island site in 2007. Perhaps there is some sort of phosphorus release around this time.

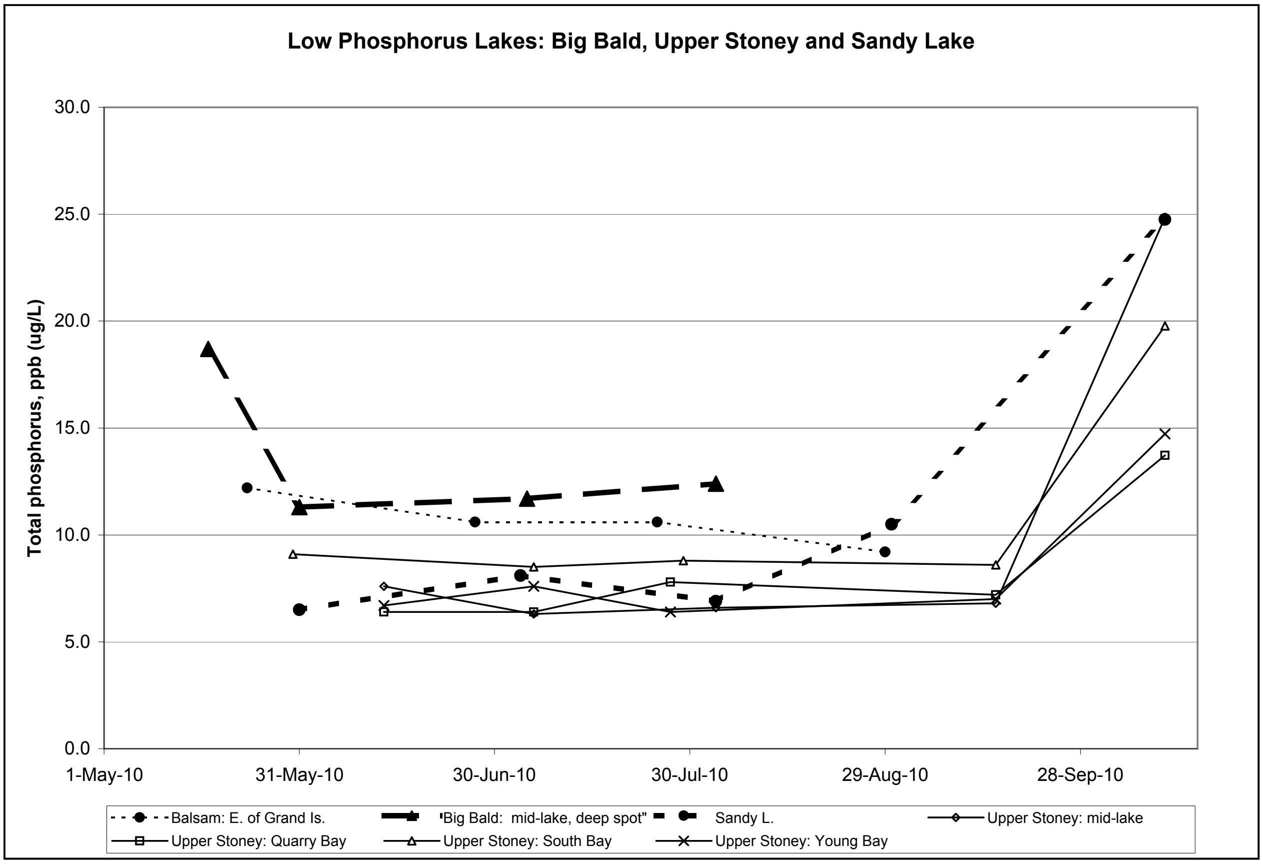
Downstream lakes



As seen in the past, the Burleigh Falls site in Stony Lake had phosphorus levels similar to Lovesick Lake, which is directly upstream. However, the next two sites downstream, mid-lake and Hamilton Bay, had lower phosphorus levels due to the diluting effect of water from Upper Stoney Lake (see the "Low Phosphorus Lakes" graph, below). As in 2008, Gilchrist Bay was slightly higher in phosphorus than the other Stony Lake sites, perhaps because it's somewhat shallower and has a fair amount of boat traffic.

Levels rose downstream from Stony, by a small amount in Clear Lake, and somewhat more in Katchewanooka Lake. In contrast, in water flowing from Gilchrist Bay to White Lake, phosphorus levels decline about 3 ppb. Might this be due to dilution by groundwater inputs?

Low phosphorus lakes



These lakes are off the main stream, and/or receive almost all their water from the low-phosphorus Canadian Shield.

The spike on October 11 on Sandy Lake and on all four locations on Upper Stoney was unusual. It was not observed in four other KLSA sites tested on October 10 or 11.

Conclusion

Phosphorus patterns were similar to previous years:

· Low phosphorus lakes had levels of 6 – 10 ppb all season.

· In the high phosphorus lakes, mid-May saw phosphorus levels between 8 and 15 ppb. These increased steadily to 15 or 20 ppb by September 1, and then dropped quite quickly (relative to other years) in September to 10 or 15 ppb. There wasn't as much lake-to-lake difference as in some years.

· As in other years, phosphorus 'jumped' 5 ppb between Balsam and Sturgeon; we need more information in Cameron Lake and around Fenelon Falls to be able to find out the reason for this.

· Phosphorus mysteriously shot up from 7 ppb to anywhere between 15 and 25 ppb on October 11 on five locations on low phosphorus lakes.

Following is the complete record of total phosphorus (TP) measurements taken by KLSA volunteers in 2010. The complete Lake Partner Program database of TP for the last ten years can be found on the website of the Federation of Ontario Cottagers' Associations, www.foca.on.ca.

Following is the complete record of total phosphorus (TP) measurements taken in 2010.

Lake Name	Site Description	Date	TP1 (µg/L)	TP2 (µg/L)	Average TP (µg/L)
BALSAM LAKE	N Bay Rocky Pt.	24-May-10	11.2	11.2	11.2
BALSAM LAKE	N Bay Rocky Pt.	15-Jun-10	10.4	10.4	10.4
BALSAM LAKE	N Bay Rocky Pt.	15-Jul-10	11.6	11.8	11.7
BALSAM LAKE	N Bay Rocky Pt.	30-Aug-10	12.2	14.0	13.1
BALSAM LAKE	N Bay Rocky Pt.	19-Sep-10	12.4	11.6	12.0
BALSAM LAKE	N/E end-Lightning Point	24-May-10	12.8		12.8
BALSAM LAKE	N/E end-Lightning Point	6-Jun-10	14.4	14.4	14.4
BALSAM LAKE	N/E end-Lightning Point	4-Jul-10	10.2	10.0	10.1
BALSAM LAKE	N/E end-Lightning Point	16-Aug-10	11.2	11.0	11.1
BALSAM LAKE	N/E end-Lightning Point	27-Sep-10	10.4	8.4	9.4
BALSAM LAKE	N/E end-Lightning Point	11-Oct-10	8.6	9.6	9.1
BALSAM LAKE	South Bay-Killarney Bay	15-May-10	12.8	12.0	12.4
BALSAM LAKE	South Bay-Killarney Bay	31-May-10	13.6	16.8	15.2
BALSAM LAKE	South Bay-Killarney Bay	2-Jul-10	15.6	14.0	14.8
BALSAM LAKE	South Bay-Killarney Bay	3-Aug-10	12.0	13.4	12.7
BALSAM LAKE	South Bay-Killarney Bay	7-Sep-10	12.0	8.4	10.2
BALSAM LAKE	South Bay-Killarney Bay	30-Sep-10	10.6	9.8	10.2
BALSAM LAKE	W Bay2, deep spot	18-May-10	10.2	9.6	9.9
BALSAM LAKE	W Bay2, deep spot	31-May-10	9.4	9.4	9.4
BALSAM LAKE	W Bay2, deep spot	4-Jul-10	13.8	12.2	13.0
BALSAM LAKE	W Bay2, deep spot	3-Aug-10	11.4	12.4	11.9
BALSAM LAKE	W Bay2, deep spot	8-Sep-10	15.8	9.4	12.6
BALSAM LAKE	W Bay2, deep spot	8-Oct-10	13.2	13.4	13.3
BALSAM LAKE	E of Grand Is	23-May-10	8.8	8.6	8.7
BALSAM LAKE	E of Grand Is	27-Jun-10	12.8	11.6	12.2
BALSAM LAKE	E of Grand Is	25-Jul-10	10.4	10.8	10.6
BALSAM LAKE	E of Grand Is	29-Aug-10	10.4	10.8	10.6
BALSAM LAKE	E of Grand Is	19-Sep-10	9.8	8.6	9.2
BALSAM LAKE	E of Grand Is	24-Oct-10	6.0	5.8	5.9
BIG BALD LAKE	Mid Lake, deep spot	17-May-10	20.2	17.2	18.7
BIG BALD LAKE	Mid Lake, deep spot	31-May-10	11.8	10.8	11.3
BIG BALD LAKE	Mid Lake, deep spot	5-Jul-10	11.6	11.8	11.7
BIG BALD LAKE	Mid Lake, deep spot	3-Aug-10	12.4	12.4	12.4
BIG BALD LAKE	Bay nr golf course	8-Sep-10	11.6	12.2	11.9
BIG CEDAR LAKE	Mid Lake, deep spot	30-May-10	6.0	6.0	6.0

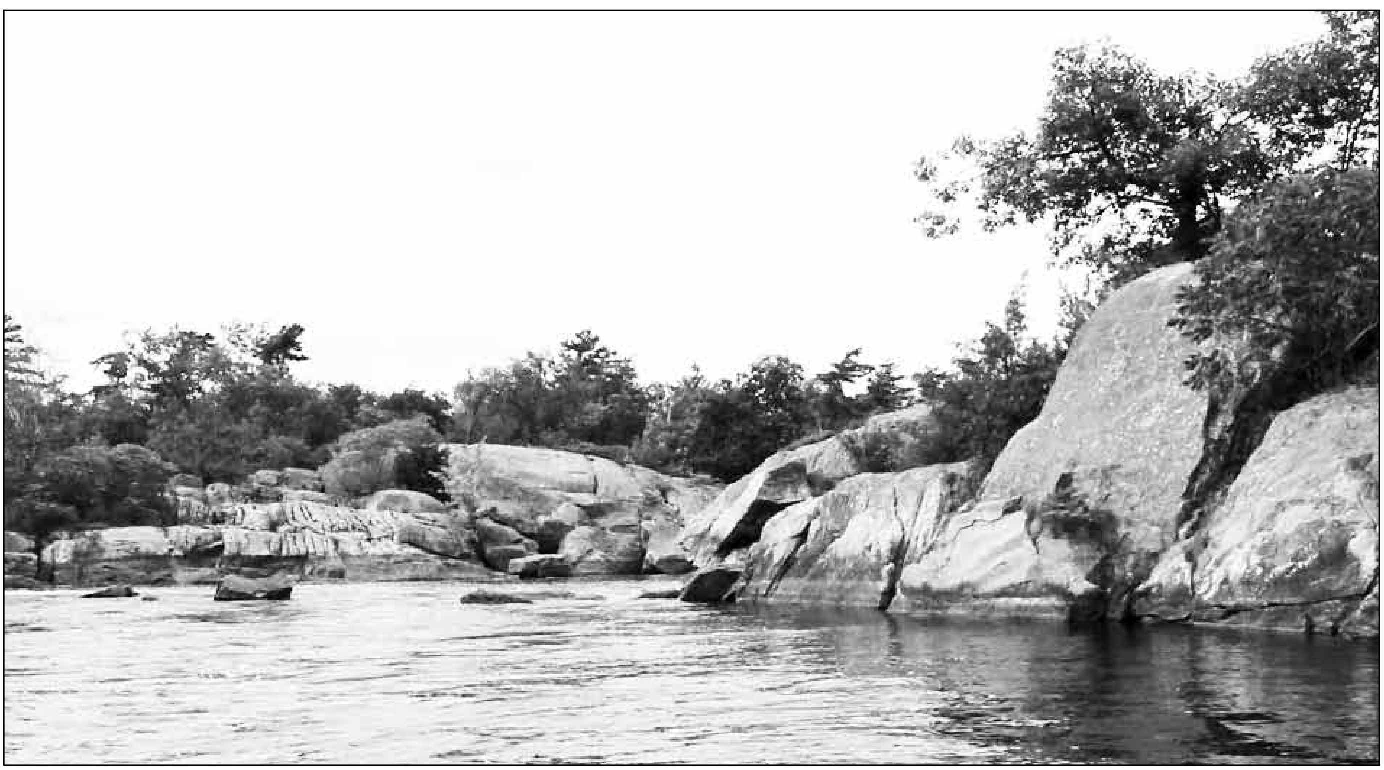
BUCKHORN LAKE (U)	Narrows, red buoy C310	3-May-10	12.4	11.6	12.0
BUCKHORN LAKE (U)	Narrows, red buoy C310	30-May-10	15.4	16.0	15.7
BUCKHORN LAKE (U)	Narrows, red buoy C310	4-Jul-10	18.2	14.8	16.5
BUCKHORN LAKE (U)	Narrows, red buoy C310	3-Aug-10	17.8	17.2	17.5
BUCKHORN LAKE (U)	Narrows, red buoy C310	7-Sep-10	17.0	16.6	16.8
BUCKHORN LAKE (U)	Narrows, red buoy C310	4-Oct-10	14.0	14.0	14.0
CHEMONG LAKE	S. of Causeway	30-May-10	18.8	11.8	15.3
CHEMONG LAKE	S. of Causeway	30-Jun-10	15.4	14.2	14.8
CHEMONG LAKE	S. of Causeway	30-Jul-10	17.6	19.4	18.5
CHEMONG LAKE	S. of Causeway	30-Aug-10	20.6	19.2	19.9
CLEAR LAKE	MacKenzie Bay	5-Jul-10	16.0	17.2	16.6
CLEAR LAKE	MacKenzie Bay	8-Aug-10	17.0	16.6	16.8
CLEAR LAKE	MacKenzie Bay	8-Sep-10	16.4	19.8	18.1
CLEAR LAKE	MacKenzie Bay	6-Oct-10	13.4	13.4	13.4
CLEAR LAKE	Main Basin, deep spot	7-Jul-10	13.2	13.2	13.2
CLEAR LAKE	Main Basin, deep spot	30-Jul-10	14.4	13.8	14.1
CLEAR LAKE	Fiddlers Bay	7-Jul-10	10.8	10.6	10.7
CLEAR LAKE	Fiddlers Bay	30-Jul-10	14.4	15.4	14.9
CLEAR LAKE	Brysons Bay	23-May-10	9.4	9.8	9.6
CLEAR LAKE	Brysons Bay	4-Jun-10	12.4	12.6	12.5
CLEAR LAKE	Brysons Bay	8-Jul-10	13.6	14.8	14.2
CLEAR LAKE	Brysons Bay	9-Aug-10	15.4	15.8	15.6
KATCHEWANOOKA LAKE	S/E Douglas Island	14-May-10	7.8	7.8	7.8
KATCHEWANOOKA LAKE	S/E Douglas Island	31-May-10	14.6	16.4	15.5
KATCHEWANOOKA LAKE	S/E Douglas Island	6-Jul-10	14.6	14.8	14.7
KATCHEWANOOKA LAKE	S/E Douglas Island	3-Aug-10	18.4	18.4	18.4
KATCHEWANOOKA LAKE	S/E Douglas Island	6-Sep-10	21.8	21.0	21.4
KATCHEWANOOKA LAKE	S/E Douglas Island	5-Oct-10	15.0	17.4	16.2
KATCHEWANOOKA LAKE	Young Pt near locks	10-May-10	7.8	8.4	8.1
KATCHEWANOOKA LAKE	Young Pt near locks	31-May-10	13.6	12.6	13.1
KATCHEWANOOKA LAKE	Young Pt near locks	4-Jul-10	14.6	15.2	14.9
KATCHEWANOOKA LAKE	Young Pt near locks	3-Aug-10	17.2	16.8	17.0
KATCHEWANOOKA LAKE	Young Pt near locks	1-Sep-10	19.6	20.0	19.8
KATCHEWANOOKA LAKE	Young Pt near locks	4-Oct-10	14.8	15.0	14.9
LOVESICK LAKE	80' hole at N. end	16-May-10	19.8	18.6	19.2
LOVESICK LAKE	80' hole at N. end	30-May-10	17.2		17.2
LOVESICK LAKE	80' hole at N. end	6-Jul-10	17.2	17.0	17.1
LOVESICK LAKE	80' hole at N. end	5-Aug-10	16.8	16.8	16.8
LOVESICK LAKE	80' hole at N. end	1-Sep-10	18.0	18.6	18.3

LOVESICK LAKE	80' hole at N. end	30-Sep-10	13.4	13.6	13.5
LOVESICK LAKE	Spenceley's Bay	16-May-10	11.8	13.0	12.4
LOVESICK LAKE	Spenceley's Bay	30-May-10	15.4	14.8	15.1
LOVESICK LAKE	Spenceley's Bay	8-Jul-10	16.2	16.2	16.2
LOVESICK LAKE	Spenceley's Bay	5-Aug-10	18.4	18.4	18.4
LOVESICK LAKE	Spenceley's Bay	1-Sep-10	19.0	18.8	18.9
LOVESICK LAKE	Spenceley's Bay	30-Sep-10	12.6	12.8	12.7
LOVESICK LAKE	McCallum Island	16-May-10	18.0	11.6	14.8
LOVESICK LAKE	McCallum Island	30-May-10	14.0	15.6	14.8
LOVESICK LAKE	McCallum Island	8-Jul-10	15.6	16.4	16.0
LOVESICK LAKE	McCallum Island	5-Aug-10	19.4	17.0	18.2
LOVESICK LAKE	McCallum Island	1-Sep-10	24.2	23.6	23.9
LOVESICK LAKE	McCallum Island	30-Sep-10	13.2	18.0	15.6
LOWER BUCKHORN LAKE	Heron Island	24-May-10	15.6	15.0	15.3
LOWER BUCKHORN LAKE	Heron Island	7-Jun-10	19.8	19.8	19.8
LOWER BUCKHORN LAKE	Heron Island	4-Jul-10	21.8	20.2	21.0
LOWER BUCKHORN LAKE	Heron Island	3-Aug-10	19.4	18.2	18.8
LOWER BUCKHORN LAKE	Heron Island	19-Sep-10	15.4	14.6	15.0
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	16-May-10	15.0	14.0	14.5
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	11-Jun-10	16.4	15.4	15.9
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	14-Jul-10	18.4	17.0	17.7
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	11-Aug-10	18.2	16.6	17.4
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	10-Sep-10	18.6	17.0	17.8
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	4-Oct-10	13.0	17.6	15.3
LOWER BUCKHORN LAKE	Deer Bay-centre	20-May-10	26.2	35.2	30.7
LOWER BUCKHORN LAKE	Deer Bay-centre	7-Jun-10	11.6	12.4	12.0
LOWER BUCKHORN LAKE	Deer Bay-centre	5-Jul-10	14.6	15.8	15.2
LOWER BUCKHORN LAKE	Deer Bay-centre	3-Aug-10	16.2	16.4	16.3
LOWER BUCKHORN LAKE	Deer Bay-centre	19-Sep-10	14.8	14.0	14.4
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	24-May-10	7.2	8.0	7.6
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	5-Jun-10	10.0	9.4	9.7
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	5-Jul-10	13.4	14.8	14.1
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	2-Aug-10	16.2	16.2	16.2
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	6-Sep-10	22.6	20.4	21.5
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	10-Oct-10	16.0	16.0	16.0
PIGEON LAKE	N-400m N of Boyd Is.	16-May-10	13.6	11.0	12.3
PIGEON LAKE	N-400m N of Boyd Is.	2-Jun-10	10.0	9.4	9.7
PIGEON LAKE	N-400m N of Boyd Is.	5-Jul-10	15.4	16.8	16.1
PIGEON LAKE	N-400m N of Boyd Is.	3-Aug-10	16.6	18.4	17.5

PIGEON LAKE	N end, Adjacent Con 17	24-May-10	7.6	7.6	7.6
PIGEON LAKE	N end, Adjacent Con 17	5-Jun-10	10.2	10.2	10.2
PIGEON LAKE	N end, Adjacent Con 17	5-Jul-10	14.8	13.4	14.1
PIGEON LAKE	N end, Adjacent Con 17	2-Aug-10	18.0	16.4	17.2
PIGEON LAKE	N end, Adjacent Con 17	6-Sep-10	19.6	18.6	19.1
PIGEON LAKE	N end, Adjacent Con 17	10-Oct-10	15.2	15.2	15.2
PIGEON LAKE	C 340 off Dead Horse Shoal	7-Jun-10	13.2	16.4	14.8
PIGEON LAKE	C 340 off Dead Horse Shoal	5-Jul-10	13.6	14.4	14.0
PIGEON LAKE	C 340 off Dead Horse Shoal	10-Aug-10	17.6	17.8	17.7
PIGEON LAKE	C 340 off Dead Horse Shoal	11-Sep-10	19.0	20.4	19.7
PIGEON LAKE	N-300yds off Bottom Is.	16-May-10	8.2	8.4	8.3
PIGEON LAKE	N-300yds off Bottom Is.	2-Jun-10	14.4	20.0	17.2
PIGEON LAKE	N-300yds off Bottom Is.	5-Jul-10	14.4	13.8	14.1
PIGEON LAKE	N-300yds off Bottom Is.	3-Aug-10	18.4	16.4	17.4
PIGEON LAKE	N-300yds off Bottom Is.	8-Sep-10	22.6	27.6	25.1
SANDY LAKE	mid-lake	31-May-10	5.6	7.4	6.5
SANDY LAKE	mid-lake	4-Jul-10	8.0	8.2	8.1
SANDY LAKE	mid-lake	3-Aug-10	6.2	7.6	6.9
SANDY LAKE	mid-lake	30-Aug-10	10.2	10.8	10.5
SANDY LAKE	mid-lake	11-Oct-10	24.7	24.8	24.7
STONY LAKE	Burleigh locks chan.	23-May-10	16.2	16.8	16.5
STONY LAKE	Burleigh locks chan.	4-Jun-10	14.0	14.8	14.4
STONY LAKE	Burleigh locks chan.	8-Jul-10	14.0	15.8	14.9
STONY LAKE	Burleigh locks chan.	9-Aug-10	19.2	20.8	20.0
STONY LAKE	Gilchrist Bay	30-May-10	17.2	14.8	16.0
STONY LAKE	Gilchrist Bay	7-Jul-10	17.2	18.0	17.6
STONY LAKE	Gilchrist Bay	12-Aug-10	18.8	17.4	18.1
STONY LAKE	Gilchrist Bay	11-Sep-10	16.4	17.0	16.7
STONY LAKE	Gilchrist Bay	11-Oct-10	17.0	16.8	16.9
STONY LAKE	Mouse Is.	10-May-10	7.6	6.8	7.2
STONY LAKE	Mouse Is.	1-Jun-10	11.0	16.6	13.8
STONY LAKE	Mouse Is.	5-Jul-10	13.2	13.2	13.2
STONY LAKE	Mouse Is.	3-Aug-10	15.2	15.0	15.1
STONY LAKE	Mouse Is.	10-Sep-10	14.6	14.8	14.7
STONY LAKE	Mouse Is.	4-Oct-10	11.6	12.4	12.0
STONY LAKE	Hamilton Bay	10-May-10	7.2	6.4	6.8
STONY LAKE	Hamilton Bay	1-Jun-10	11.4	12.4	11.9
STONY LAKE	Hamilton Bay	5-Jul-10	12.2	13.6	12.9
STONY LAKE	Hamilton Bay	3-Aug-10	13.6	13.0	13.3
STONY LAKE	Hamilton Bay	10-Sep-10	15.0		15.0

STONY LAKE	Hamilton Bay	4-Oct-10	11.8	10.0	10.9
STURGEON LAKE	Muskrat Is. at Buoy C388	17-May-10	9.0	8.2	8.6
STURGEON LAKE	Muskrat Is. at Buoy C388	1-Jun-10	10.8	11.8	11.3
STURGEON LAKE	Muskrat Is. at Buoy C388	6-Jul-10	17.4	16.2	16.8
STURGEON LAKE	Muskrat Is. at Buoy C388	5-Aug-10	20.6	19.0	19.8
STURGEON LAKE	Muskrat Is. at Buoy C388	14-Sep-10	21.0	24.2	22.6
STURGEON LAKE	Muskrat Is. at Buoy C388	5-Oct-10	21.4	18.4	19.9
STURGEON LAKE	Sturgeon Point Buoy	17-May-10	8.6	11.8	10.2
STURGEON LAKE	Sturgeon Point Buoy	1-Jun-10	13.0	12.6	12.8
STURGEON LAKE	Sturgeon Point Buoy	6-Jul-10	16.6	14.0	15.3
STURGEON LAKE	Sturgeon Point Buoy	5-Aug-10	14.2	15.6	14.9
STURGEON LAKE	Sturgeon Point Buoy	14-Sep-10	20.0	18.4	19.2
STURGEON LAKE	Sturgeon Point Buoy	5-Oct-10	14.4	16.2	15.3
STURGEON LAKE	S of Fenelon R-Buoy N5	17-May-10	16.8	17.2	17.0
STURGEON LAKE	S of Fenelon R-Buoy N5	1-Jun-10	10.8	11.8	11.3
STURGEON LAKE	S of Fenelon R-Buoy N5	5-Aug-10	13.6	13.2	13.4
STURGEON LAKE	S of Fenelon R-Buoy N5	14-Sep-10	20.0	22.4	21.2
STURGEON LAKE	S of Fenelon R-Buoy N5	5-Oct-10	11.2	12.0	11.6
STURGEON LAKE	Snug Harbour	17-May-10			81.0
STURGEON LAKE	Snug Harbour	1-Jun-10			27.0
STURGEON LAKE	Snug Harbour	6-Jul-10			14.0
STURGEON LAKE	Snug Harbour	4-Aug-10			17.0
STURGEON LAKE	Snug Harbour	13-Sep-10			7.0
UPPER STONEY LAKE	Quarry Bay	12-Apr-10	7.8	7.6	7.7
UPPER STONEY LAKE	Quarry Bay	13-Jun-10	6.8	6.0	6.4
UPPER STONEY LAKE	Quarry Bay	6-Jul-10	6.4	6.4	6.4
UPPER STONEY LAKE	Quarry Bay	27-Jul-10	8.4	7.2	7.8
UPPER STONEY LAKE	Quarry Bay	15-Sep-10	7.6	6.8	7.2
UPPER STONEY LAKE	Quarry Bay	11-Oct-10	14.8	12.7	13.7
UPPER STONEY LAKE	Young Bay	12-Apr-10	7.2	7.0	7.1
UPPER STONEY LAKE	Young Bay	13-Jun-10	6.2	7.2	6.7
UPPER STONEY LAKE	Young Bay	6-Jul-10	7.2	8.0	7.6
UPPER STONEY LAKE	Young Bay	27-Jul-10	6.4	6.4	6.4
UPPER STONEY LAKE	Young Bay	15-Sep-10	7.0	7.0	7.0
UPPER STONEY LAKE	Young Bay	11-Oct-10	15.5	14.0	14.7
UPPER STONEY LAKE	S Bay, deep spot	12-Apr-10	20.6	20.4	20.5
UPPER STONEY LAKE	S Bay, deep spot	30-May-10	9.4	8.8	9.1
UPPER STONEY LAKE	S Bay, deep spot	6-Jul-10	8.4	8.6	8.5
UPPER STONEY LAKE	S Bay, deep spot	29-Jul-10	8.8		8.8

UPPER STONEY LAKE	S Bay, deep spot	15-Sep-10	8.4	8.8	8.6
UPPER STONEY LAKE	S Bay, deep spot	11-Oct-10	22.1	17.4	19.8
UPPER STONEY LAKE	Crowes Landing	12-Apr-10	8.8	8.4	8.6
UPPER STONEY LAKE	Crowes Landing	30-May-10	6.4	8.8	7.6
UPPER STONEY LAKE	Crowes Landing	6-Jul-10	7.0	8.2	7.6
UPPER STONEY LAKE	Crowes Landing	29-Jul-10	5.6	6.8	6.2
UPPER STONEY LAKE	Crowes Landing	15-Sep-10	7.0	8.8	7.9
UPPER STONEY LAKE	Crowes Landing	11-Oct-10	10.9	10.7	10.8
UPPER STONEY LAKE	Mid Lake, deep spot	12-Apr-10	8.6	8.8	8.7
UPPER STONEY LAKE	Mid Lake, deep spot	13-Jun-10	6.8	8.4	7.6
UPPER STONEY LAKE	Mid Lake, deep spot	6-Jul-10	6.2	6.4	6.3
UPPER STONEY LAKE	Mid Lake, deep spot	3-Aug-10	5.6	7.6	6.6
UPPER STONEY LAKE	Mid Lake, deep spot	15-Sep-10	6.8	6.8	6.8
UPPER STONEY LAKE	Mid Lake, deep spot	11-Oct-10	23.9	25.9	24.9
WHITE LAKE (DUMMER)	S end, deep spot	2-Jun-10	9.6	9.4	9.5
WHITE LAKE (DUMMER)	S end, deep spot	21-Jun-10	11.6	10.0	10.8
WHITE LAKE (DUMMER)	S end, deep spot	27-Jul-10	12.6	12.8	12.7
WHITE LAKE (DUMMER)	S end, deep spot	15-Aug-10	17.4	16.0	16.7
WHITE LAKE (DUMMER)	S end, deep spot	18-Sep-10	13.4	14.2	13.8
WHITE LAKE (DUMMER)	S end, deep spot	8-Oct-10	11.4	11.8	11.6



Ian Mackenzie

Burleigh Falls

2010 Secchi Depth Measurements

LAKE_NAME	Site Description	Date	Secchi (metres)	Average Annual Secchi (metres)
BALSAM LAKE	N Bay Rocky Pt.	24-May-10	4.3	4.7
BALSAM LAKE	N Bay Rocky Pt.	15-Jun-10	5.5	
BALSAM LAKE	N Bay Rocky Pt.	2-Jul-10	4.5	
BALSAM LAKE	N Bay Rocky Pt.	15-Jul-10	5.0	
BALSAM LAKE	N Bay Rocky Pt.	3-Aug-10	4.5	
BALSAM LAKE	N Bay Rocky Pt.	11-Aug-10	4.5	
BALSAM LAKE	N Bay Rocky Pt.	20-Aug-10	4.8	
BALSAM LAKE	N Bay Rocky Pt.	19-Sep-10	4.5	
BALSAM LAKE	N/E end-Lightning Point	6-Jun-10	2.2	3.6
BALSAM LAKE	N/E end-Lightning Point	4-Jul-10	3.1	
BALSAM LAKE	N/E end-Lightning Point	19-Jul-10	3.6	
BALSAM LAKE	N/E end-Lightning Point	16-Aug-10	4.0	
BALSAM LAKE	N/E end-Lightning Point	27-Sep-10	4.2	
BALSAM LAKE	N/E end-Lightning Point	11-Oct-10	4.5	
BALSAM LAKE	South Bay-Killarney Bay	16-May-10	2.8	3.2
BALSAM LAKE	South Bay-Killarney Bay	31-May-10	3.8	
BALSAM LAKE	South Bay-Killarney Bay	2-Jul-10	2.6	
BALSAM LAKE	South Bay-Killarney Bay	3-Aug-10	3.4	
BALSAM LAKE	South Bay-Killarney Bay	7-Sep-10	3.2	
BALSAM LAKE	South Bay-Killarney Bay	30-Sep-10	3.1	
BALSAM LAKE	W Bay2, deep spot	18-May-10	3.0	3.6
BALSAM LAKE	W Bay2, deep spot	30-May-10	3.8	
BALSAM LAKE	W Bay2, deep spot	5-Jul-10	3.8	
BALSAM LAKE	W Bay2, deep spot	19-Jul-10	4.3	
BALSAM LAKE	W Bay2, deep spot	3-Aug-10	3.5	
BALSAM LAKE	W Bay2, deep spot	31-Aug-10	3.8	
BALSAM LAKE	W Bay2, deep spot	7-Sep-10	2.9	
BALSAM LAKE	W Bay2, deep spot	11-Oct-10	3.8	
BALSAM LAKE	E of Grand Is	24-May-10	3.3	3.3
BALSAM LAKE	E of Grand Is	27-Jun-10	3.0	
BALSAM LAKE	E of Grand Is	30-Aug-10	3.5	
BALSAM LAKE	E of Grand Is	19-Sep-10	3.0	
BALSAM LAKE	E of Grand Is	24-Oct-10	3.5	
BIG CEDAR LAKE	Mid Lake, deep spot	30-May-10	5.8	5.2
BIG CEDAR LAKE	Mid Lake, deep spot	14-Jun-10	5.0	

BIG CEDAR LAKE	Mid Lake, deep spot	2-Jul-10	5.3	
BIG CEDAR LAKE	Mid Lake, deep spot	11-Jul-10	5.0	
BIG CEDAR LAKE	Mid Lake, deep spot	31-Jul-10	4.2	
BIG CEDAR LAKE	Mid Lake, deep spot	7-Aug-10	4.2	
BIG CEDAR LAKE	Mid Lake, deep spot	18-Aug-10	5.5	
BIG CEDAR LAKE	Mid Lake, deep spot	30-Aug-10	5.3	
BIG CEDAR LAKE	Mid Lake, deep spot	11-Sep-10	6.3	
BIG CEDAR LAKE	Mid Lake, deep spot	10-Oct-10	5.0	
BUCKHORN LAKE (U)	Narrows, red buoy C310	1-May-10	3.8	3.8
BUCKHORN LAKE (U)	Narrows, red buoy C310	16-May-10	5.0	
BUCKHORN LAKE (U)	Narrows, red buoy C310	30-May-10	5.0	
BUCKHORN LAKE (U)	Narrows, red buoy C310	14-Jun-10	3.7	
BUCKHORN LAKE (U)	Narrows, red buoy C310	5-Jul-10	4.3	
BUCKHORN LAKE (U)	Narrows, red buoy C310	19-Jul-10	2.4	
BUCKHORN LAKE (U)	Narrows, red buoy C310	3-Aug-10	3.4	
BUCKHORN LAKE (U)	Narrows, red buoy C310	16-Aug-10	2.4	
BUCKHORN LAKE (U)	Narrows, red buoy C310	1-Sep-10	4.2	
BUCKHORN LAKE (U)	Narrows, red buoy C310	17-Sep-10	4.0	
BUCKHORN LAKE (U)	Narrows, red buoy C310	2-Oct-10	3.4	
CHEMONG LAKE	S. of Causeway	30-May-10	3.5	3.1
CHEMONG LAKE	S. of Causeway	30-Jun-10	3.0	
CHEMONG LAKE	S. of Causeway	30-Jul-10	3.0	
CHEMONG LAKE	S. of Causeway	30-Aug-10	3.0	
CLEAR LAKE	MacKenzie Bay	5-Jul-10	3.7	3.5
CLEAR LAKE	MacKenzie Bay	5-Jul-10	3.7	
CLEAR LAKE	MacKenzie Bay	19-Jul-10	3.5	
CLEAR LAKE	MacKenzie Bay	3-Aug-10	2.8	
CLEAR LAKE	MacKenzie Bay	23-Aug-10	2.7	
CLEAR LAKE	MacKenzie Bay	7-Sep-10	3.4	
CLEAR LAKE	MacKenzie Bay	21-Sep-10	3.5	
CLEAR LAKE	MacKenzie Bay	6-Oct-10	4.3	
CLEAR LAKE	Main Basin, deep spot	7-Jul-10	4.6	4.4
CLEAR LAKE	Main Basin, deep spot	7-Jul-10	4.6	
CLEAR LAKE	Main Basin, deep spot	31-Jul-10	4.0	
CLEAR LAKE	Fiddlers Bay	7-Jul-10	4.4	4.2
CLEAR LAKE	Fiddlers Bay	7-Jul-10	4.4	
CLEAR LAKE	Fiddlers Bay	31-Jul-10	3.8	
KATCHEWANOOKA LAKE	S/E Douglas Island	14-May-10	5.0	4.6
KATCHEWANOOKA LAKE	S/E Douglas Island	31-May-10	4.6	

KATCHEWANOOKA LAKE	S/E Douglas Island	6-Jul-10	6.3	
KATCHEWANOOKA LAKE	S/E Douglas Island	19-Jul-10	5.4	
KATCHEWANOOKA LAKE	S/E Douglas Island	3-Aug-10	4.5	
KATCHEWANOOKA LAKE	S/E Douglas Island	17-Aug-10	3.9	
KATCHEWANOOKA LAKE	S/E Douglas Island	9-Sep-10	4.0	
KATCHEWANOOKA LAKE	S/E Douglas Island	21-Sep-10	3.7	
KATCHEWANOOKA LAKE	S/E Douglas Island	5-Oct-10	3.7	
KATCHEWANOOKA LAKE	Young Pt near locks	10-May-10	6.8	5.0
KATCHEWANOOKA LAKE	Young Pt near locks	31-May-10	4.5	
KATCHEWANOOKA LAKE	Young Pt near locks	15-Jun-10	6.3	
KATCHEWANOOKA LAKE	Young Pt near locks	5-Jul-10	6.5	
KATCHEWANOOKA LAKE	Young Pt near locks	19-Jul-10	4.5	
KATCHEWANOOKA LAKE	Young Pt near locks	2-Aug-10	4.2	
KATCHEWANOOKA LAKE	Young Pt near locks	20-Aug-10	5.0	
KATCHEWANOOKA LAKE	Young Pt near locks	7-Sep-10	4.4	
KATCHEWANOOKA LAKE	Young Pt near locks	20-Sep-10	4.6	
KATCHEWANOOKA LAKE	Young Pt near locks	2-Oct-10	4.1	
KATCHEWANOOKA LAKE	Young Pt near locks	17-Oct-10	4.1	
LOVESICK LAKE	80' hole at N. end	16-May-10	6.0	4.8
LOVESICK LAKE	80' hole at N. end	1-Jun-10	5.0	
LOVESICK LAKE	80' hole at N. end	5-Jul-10	6.0	
LOVESICK LAKE	80' hole at N. end	3-Aug-10	3.0	
LOVESICK LAKE	80' hole at N. end	7-Sep-10	4.0	
LOVESICK LAKE	80' hole at N. end	7-Oct-10	5.0	
LOVESICK LAKE	Spenceley's Bay	16-May-10	5.0	4.3
LOVESICK LAKE	Spenceley's Bay	1-Jun-10	4.0	
LOVESICK LAKE	Spenceley's Bay	5-Jul-10	5.0	
LOVESICK LAKE	Spenceley's Bay	3-Aug-10	3.0	
LOVESICK LAKE	Spenceley's Bay	7-Sep-10	4.0	
LOVESICK LAKE	Spenceley's Bay	1-Oct-10	5.0	
LOVESICK LAKE	McCallum Island	16-May-10	6.0	4.5
LOVESICK LAKE	McCallum Island	1-Jun-10	4.0	
LOVESICK LAKE	McCallum Island	5-Jul-10	5.0	
LOVESICK LAKE	McCallum Island	3-Aug-10	3.0	
LOVESICK LAKE	McCallum Island	7-Sep-10	4.0	
LOVESICK LAKE	McCallum Island	1-Oct-10	5.0	
LOWER BUCKHORN LAKE	Heron Island	20-May-10	4.2	3.9
LOWER BUCKHORN LAKE	Heron Island	7-Jun-10	3.4	
LOWER BUCKHORN LAKE	Heron Island	5-Jul-10	3.6	
LOWER BUCKHORN LAKE	Heron Island	3-Aug-10	3.3	

LOWER BUCKHORN LAKE	Heron Island	19-Sep-10	5.2	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	16-May-10	6.7	4.8
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	28-May-10	4.4	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	11-Jun-10	5.6	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	4-Jul-10	4.5	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	14-Jul-10	5.6	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	28-Jul-10	3.0	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	11-Aug-10	3.7	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	2-Sep-10	4.0	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	10-Sep-10	4.5	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	20-Sep-10	4.3	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	4-Oct-10	5.6	
LOWER BUCKHORN LAKE	Deer Bay W-Buoy C267	9-Oct-10	5.7	
LOWER BUCKHORN LAKE	Deer Bay-centre	20-May-10	6.2	4.5
LOWER BUCKHORN LAKE	Deer Bay-centre	7-Jun-10	4.7	
LOWER BUCKHORN LAKE	Deer Bay-centre	5-Jul-10	3.9	
LOWER BUCKHORN LAKE	Deer Bay-centre	3-Aug-10	4.3	
LOWER BUCKHORN LAKE	Deer Bay-centre	19-Sep-10	3.4	
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	24-May-10	5.2	3.6
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	5-Jun-10	3.7	
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	5-Jul-10	3.9	
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	2-Aug-10	3.1	
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	6-Sep-10	2.7	
PIGEON LAKE	Middle, Sandy Pt/Boyd Is.	10-Oct-10	3.0	
PIGEON LAKE	N end, Adjacent Con 17	24-May-10	4.3	3.5
PIGEON LAKE	N end, Adjacent Con 17	5-Jun-10	3.3	
PIGEON LAKE	N end, Adjacent Con 17	5-Jul-10	3.7	
PIGEON LAKE	N end, Adjacent Con 17	2-Aug-10	3.0	
PIGEON LAKE	N end, Adjacent Con 17	6-Sep-10	3.0	
PIGEON LAKE	N end, Adjacent Con 17	10-Oct-10	3.4	
PIGEON LAKE	C 340 off Dead Horse Shoal	7-Jun-10	3.4	3.1
PIGEON LAKE	C 340 off Dead Horse Shoal	5-Jul-10	3.1	
PIGEON LAKE	C 340 off Dead Horse Shoal	19-Jul-10	3.1	
PIGEON LAKE	C 340 off Dead Horse Shoal	10-Aug-10	2.9	
PIGEON LAKE	C 340 off Dead Horse Shoal	24-Aug-10	2.9	
PIGEON LAKE	C 340 off Dead Horse Shoal	7-Sep-10	3.0	
STONY LAKE	Gilchrist Bay	30-May-10	4.3	3.7
STONY LAKE	Gilchrist Bay	7-Jul-10	3.3	
STONY LAKE	Gilchrist Bay	12-Aug-10	4.0	
STONY LAKE	Gilchrist Bay	11-Sep-10	3.5	

STONY LAKE	Gilchrist Bay	11-Oct-10	3.5	
STONY LAKE	Mouse Is.	13-May-10	5.1	4.5
STONY LAKE	Mouse Is.	1-Jun-10	5.4	
STONY LAKE	Mouse Is.	5-Jul-10	4.2	
STONY LAKE	Mouse Is.	3-Aug-10	4.0	
STONY LAKE	Mouse Is.	7-Sep-10	4.5	
STONY LAKE	Mouse Is.	4-Oct-10	3.7	
STONY LAKE	Hamilton Bay	13-May-10	4.0	4.0
STONY LAKE	Hamilton Bay	1-Jun-10	4.0	
STONY LAKE	Hamilton Bay	5-Jul-10	4.0	
STONY LAKE	Hamilton Bay	3-Aug-10	4.0	
STONY LAKE	Hamilton Bay	7-Sep-10	4.1	
STONY LAKE	Hamilton Bay	4-Oct-10	3.7	
STURGEON LAKE	Muskrat Is. at Buoy C388	17-May-10	4.5	3.3
STURGEON LAKE	Muskrat Is. at Buoy C388	1-Jun-10	4.9	
STURGEON LAKE	Muskrat Is. at Buoy C388	6-Jul-10	2.8	
STURGEON LAKE	Muskrat Is. at Buoy C388	5-Aug-10	2.6	
STURGEON LAKE	Muskrat Is. at Buoy C388	13-Sep-10	2.4	
STURGEON LAKE	Muskrat Is. at Buoy C388	5-Oct-10	2.6	
STURGEON LAKE	Sturgeon Point Buoy	17-May-10	4.5	3.3
STURGEON LAKE	Sturgeon Point Buoy	1-Jun-10	3.2	
STURGEON LAKE	Sturgeon Point Buoy	6-Jul-10	3.4	
STURGEON LAKE	Sturgeon Point Buoy	5-Aug-10	3.2	
STURGEON LAKE	Sturgeon Point Buoy	13-Sep-10	2.6	
STURGEON LAKE	Sturgeon Point Buoy	5-Oct-10	3.0	
STURGEON LAKE	S of Fenelon R-Buoy N5	17-May-10	3.2	3.0
STURGEON LAKE	S of Fenelon R-Buoy N5	1-Jun-10	2.8	
STURGEON LAKE	S of Fenelon R-Buoy N5	6-Jul-10	2.8	
STURGEON LAKE	S of Fenelon R-Buoy N5	5-Aug-10	2.9	
STURGEON LAKE	S of Fenelon R-Buoy N5	13-Sep-10	3.3	
STURGEON LAKE	S of Fenelon R-Buoy N5	5-Oct-10	3.0	
UPPER STONEY LAKE	Quarry Bay	12-Apr-10	4.4	6.6
UPPER STONEY LAKE	Quarry Bay	11-Jun-10	7.6	
UPPER STONEY LAKE	Quarry Bay	5-Jul-10	7.5	
UPPER STONEY LAKE	Quarry Bay	3-Aug-10	6.3	
UPPER STONEY LAKE	Quarry Bay	17-Sep-10	7.4	
UPPER STONEY LAKE	Quarry Bay	11-Oct-10	6.3	
UPPER STONEY LAKE	Young Bay	12-Apr-10	5.7	6.9
UPPER STONEY LAKE	Young Bay	11-Jun-10	7.5	
UPPER STONEY LAKE	Young Bay	5-Jul-10	7.8	

UPPER STONEY LAKE	Young Bay	3-Aug-10	6.4	
UPPER STONEY LAKE	Young Bay	17-Sep-10	7.0	
UPPER STONEY LAKE	Young Bay	11-Oct-10	6.7	
UPPER STONEY LAKE	S Bay, deep spot	12-Apr-10	0.5	0.5
UPPER STONEY LAKE	S Bay, deep spot	11-Jun-10	0.5	
UPPER STONEY LAKE	S Bay, deep spot	5-Jul-10	0.5	
UPPER STONEY LAKE	S Bay, deep spot	3-Aug-10	0.5	
UPPER STONEY LAKE	S Bay, deep spot	17-Sep-10	0.5	
UPPER STONEY LAKE	S Bay, deep spot	11-Oct-10	0.5	
UPPER STONEY LAKE	Crowes Landing	12-Apr-10	4.9	6.7
UPPER STONEY LAKE	Crowes Landing	11-Jun-10	7.2	
UPPER STONEY LAKE	Crowes Landing	5-Jul-10	7.3	
UPPER STONEY LAKE	Crowes Landing	3-Aug-10	6.4	
UPPER STONEY LAKE	Crowes Landing	17-Sep-10	7.4	
UPPER STONEY LAKE	Crowes Landing	11-Oct-10	6.7	
UPPER STONEY LAKE	Mid Lake, deep spot	12-Apr-10	4.8	6.3
UPPER STONEY LAKE	Mid Lake, deep spot	11-Jun-10	6.1	
UPPER STONEY LAKE	Mid Lake, deep spot	5-Jul-10	7.1	
UPPER STONEY LAKE	Mid Lake, deep spot	3-Aug-10	6.4	
UPPER STONEY LAKE	Mid Lake, deep spot	17-Sep-10	7.2	
UPPER STONEY LAKE	Mid Lake, deep spot	11-Oct-10	6.3	
WHITE LAKE (DUMMER)	S end, deep spot	25-May-10	4.1	4.0
WHITE LAKE (DUMMER)	S end, deep spot	15-Jun-10	3.9	
WHITE LAKE (DUMMER)	S end, deep spot	30-Jun-10	3.9	
WHITE LAKE (DUMMER)	S end, deep spot	14-Jul-10	3.8	
WHITE LAKE (DUMMER)	S end, deep spot	24-Jul-10	3.8	
WHITE LAKE (DUMMER)	S end, deep spot	1-Aug-10	3.8	
WHITE LAKE (DUMMER)	S end, deep spot	18-Aug-10	3.9	
WHITE LAKE (DUMMER)	S end, deep spot	18-Sep-10	4.2	
WHITE LAKE (DUMMER)	S end, deep spot	10-Oct-10	4.9	

Appendix G: Glossary

Algae – Simple, one-celled or colonial plant-like organisms that grow in water, contain chlorophyll and do not differentiate into specialized cells and tissues like roots and leaves.

Alaskite – A granitic rock composed mainly of quartz and alkali feldspar with few dark minerals in it.

Aliquot – In chemistry, a portion or sample of the total amount of a solution.

Anthropogenic – Caused by human activity; usually means human effects on the natural environment.

Canadian Shield – Also called the Precambrian or Laurentian Shield, it covers as bedrock much of central and northeastern Canada and the United States. The Shield is one of the oldest geological formations in the world, composed of metamorphosed rocks originally laid down between 4.5 billion and 540,000 million years ago. Often covered with forest, it is a melted down, cooked-up, hardened mixture of all rock types previously existing. Owing to an abundance of non-soluble rocks, it provides relatively low-phosphorus water to the Kawartha Lakes.

Chlorophyll a – A green plant pigment found in photosynthesizing organisms; the amount of chlorophyll a in surface water samples indicates the amount of free-floating algae.

Colony-forming units (cfu) – In microbiology, a measure of viable cells of bacteria or fungus, i.e. those that are alive and can reproduce; expressed as cfu/100 millilitres, this measure is equivalent to *E.coli*/100mL.

***E.coli* bacteria** – Bacteria living in the intestines of warm-blooded animals such as birds, beavers and humans. It is now known that it also dwells in the sediments in lakes and in wet beach sand. While most are harmless, a few strains of *E.coli* can cause severe gastrointestinal illness. Drinking water and recreational water are tested for the presence of these bacteria, mainly as an indicator of the presence of other pathogenic organisms.

Eutrophication – The 'aging' of a body of water as it increases in dissolved nutrients like phosphorus and declines in oxygen. This is a natural process that can be accelerated by human activities. (See also "Oligotrophic".)

Glacial overburden – The material left on the surface bedrock by the glaciers; it consists of scraped-off and ground-up rock usually originating in areas to the north.

Gneiss – A coarse-grained, layered metamorphic rock often somewhat similar to granite.

Groundwater – Water that resides underground (i.e., the water table), which may emerge as springs, or in wetlands or in lakes.

Isostatic rebound – Local tilting of the earth's crust due to the slow retreat of the glaciers; it has left the more northern areas still depressed by the glacial weight after the more southern areas were relieved of it.

Limiting nutrient – An often scarce but necessary nutrient within the environment that is, as a result, most influential in controlling the growth of a particular organism; it is often noted that phosphorus appears to be the limiting nutrient for algae.

Macrophyte – A plant, generally aquatic, that is visible to the eye, i.e. not microscopic.

Marl –Calcium carbonate (limestone) that forms when carbon dioxide is forced out of solution in lakes with dissolved limestone in its waters; this comes about either through photosynthesis by plants or algae, or simply due to the warming of the lake water in summer. The marl collects on the lake bottom as a soft 'mud', eventually filling the water body over time.

Nepheline syenite – A medium- to coarse-grained igneous industrial mineral used extensively in the manufacture of glass and other products.

Oligotrophic – Referring to lakes or other aquatic habitats that are low in nutrients and plant life and high in dissolved oxygen. At the other end of the scale are eutrophic lakes, which are high in nutrients and biological production. In between are mesotrophic lakes.

Parts per billion (ppb) – A measure of concentration used for extremely small quantities of one substance within another substance. One part per billion of phosphorus, for example, means one unit of phosphorus within a billion units of water, which corresponds to one minute in 2000 years, a single penny in $10 million, or one drop of water in an Olympic-sized swimming pool. For our purposes, micrograms per litre and parts per billion are equal.

Phosphorus – A widely occurring chemical element that stimulates the growth of terrestrial and aquatic plants as well as algae. Much phosphorus in the Kawarthas comes from the atmosphere, from within the bedrock (especially the limestone), as well as from decaying vegetation. Much also comes from human sources such as agriculture, sewage treatment plants and urban stormwater runoff.

Physiography – The study of the physical features of the earth's surface.

Safe swimming level – The Ontario Ministry of the Environment's stated level of 100 *E.coli* bacteria per 100 millilitres of lake or river water. At that level or higher, beaches are posted as unsafe for swimming.

Secchi disk – A circular disk with alternating black and white quarters, which is lowered to specific depths in surface water to estimate water clarity.

Spall (verb) – To break up into chips, fragments or flakes.

Stolon – A horizontal shoot from a plant that grows on top of or below the soil surface with the ability to produce new clones of the same plant from buds at the tip.

Stream assimilation – The effect of the natural cleansing processes within flowing streams on concentrations of compounds contained within the water.

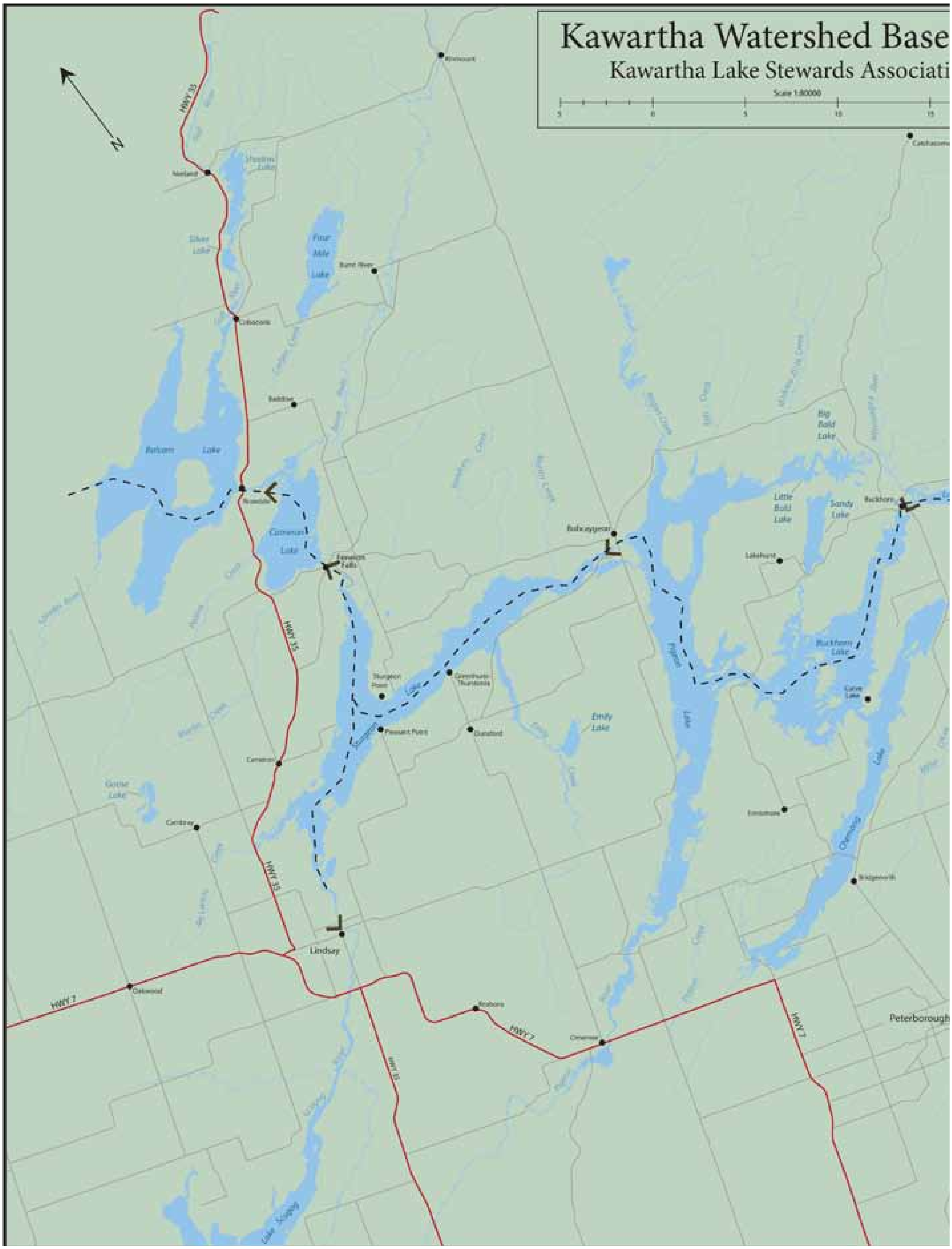
Water column – A hypothetical cylinder of water from the surface to the bottom of a stream, river or lake, within which scientists measure physical and/or chemical properties.

Zooplankton – The tiny animals drifting in great numbers near the surface of water bodies, such as *Daphnia*, protozoa and various larvae; they float along with phytoplankton or tiny plants such as certain types of algae. Plankton forms the basis of the aquatic food web.

Appendix H: Rainfall in the Kawarthas - Summer 2010

This chart shows rainfall (mm) at five sites in the Kawarthas during the summer of 2010. Rainfall over 10 mm is in **bold**. Gauge locations are Stony Lake (SL), Trent University (TU), southwest Sturgeon Lake (SWS), northeast Sturgeon Lake (NES), and Katchewanooka Lake (KAT).

	Rainfall, mm						Rainfall, mm				
Date/10	SL	TU	SWS	NES	KAT	Date/10	SL	TU	SWS	NES	KAT
Jun25	5	0	0	0	0	Aug1	0	0	0	0	0
Jun26	0	7.5	0	0	0	Aug2	2.9	0	0	0	3
Jun27	0	**15.5**	0	0	0	Aug3	0	0	0	2.7	0
Jun28	**14.7**	2.7	**21.5**	0	**22**	Aug4	0.9	0	0	0	0
Jun29	0	0	2.5	**31.4**	3	Aug5	0	0	0	0	0
Jun30	0	0	0.4	0	0	Aug6	0	0	0	**33.9**	**10**
June Total		113.2	178.9	208.3		Aug7	0	0	0	0	0
June Avg.		78.9				Aug8	**21.7**	**32.8**	0	0	0
Jul1	0	0	0	0	0	Aug9	7.3	1.5	0	0	**18**
Jul2	0	0	0	0	0	Aug10	0	0	0	0	4
Jul3	0	0	0	0	0	Aug11	0	0	0	**21.2**	0
Jul4	0	0	0	0	0	Aug12	0	0	0	0	0
Jul5	0	0	0	0	0	Aug13	0	0	0	0	0
Jul6	0	0	0	0	0	Aug14	0	0	0	0	0
Jul7	0	0	0	0	0	Aug15	8.2	1.1	0	0	0
Jul8	6	0	0	0	3	Aug16	0	0	0	0	4
Jul9	**21**	**18.7**	0	0	0	Aug17	0	0	0	0	0
Jul10	0	0	0	0	**24**	Aug18	0	0	0	0	0
Jul11	0	0	0	0	**23**	Aug19	7.3	3.7	0	**38.4**	4
Jul12	0	0	0	**27.2**	0	Aug20	0	0	0	0	0
Jul13	3.5	**23.8**	0	0	0	Aug21	5.0	4.5	0	0	0
Jul14	0	0	0	**74.8**	0	Aug22	0	**11.4**	0	0	13
Jul15	0	0	0	0	0	Aug23	0	0	**19.9**	**14.2**	0
Jul16	0	0	0	1.8	0	Aug24	0	0	0	0	0
Jul17	0	0	0	0	3	Aug25	0	0	0	0	0
Jul18	0	**15.3**		0	0	Aug26	0	0	0	0	0
Jul19	**24.3**	**12.7**	**65.0**	**24.7**	**40**	Aug27	0	0	0	0	0
Jul20	3.4	0	0	0	0	Aug28	0	0	0	0	0
Jul21	0	0	0	0	0	Aug29	0	0	0	0	0
Jul22	0	0	0	0	0	Aug30	2.0	0	0	0	0
Jul23	5.0	**12.2**	0	0	6	Aug31	0	0	0	0	0
Jul24	0	0	0	0	0	Aug Total	55.3	55.0	19.9	112.4	56
Jul25	0	0	0	0	0	Aug Avg.		91.6			
Jul26	0	0	0	**10.6**	0	Sep1	0	0	0.2	2.0	0
Jul27	0	0	0	0	0	Sep2	**16.2**	0	0	0	0
Jul28	5.9	4.1	0	0	1	Sep3	7.3	4.7	0	0	**10**
Jul29	0	1.1	**19.4**	**10.4**	3	Sep4	2.4	3.2	0	0	0
Jul30	0	0	0	0	0	Sep5	3.5	3.7	0	0	0
Jul31	0	0	0.2	0	0	Sep6	0.8	1.0	0	0	**16**
July Total	63.6	87.9	84.6	149.5	103	Sep7	0.3	0	0	0	0
July Avg.		68.4				Sep8	0.1	2.1	**33.6**	**36.5**	6
						Sep9	0	0	0	0	0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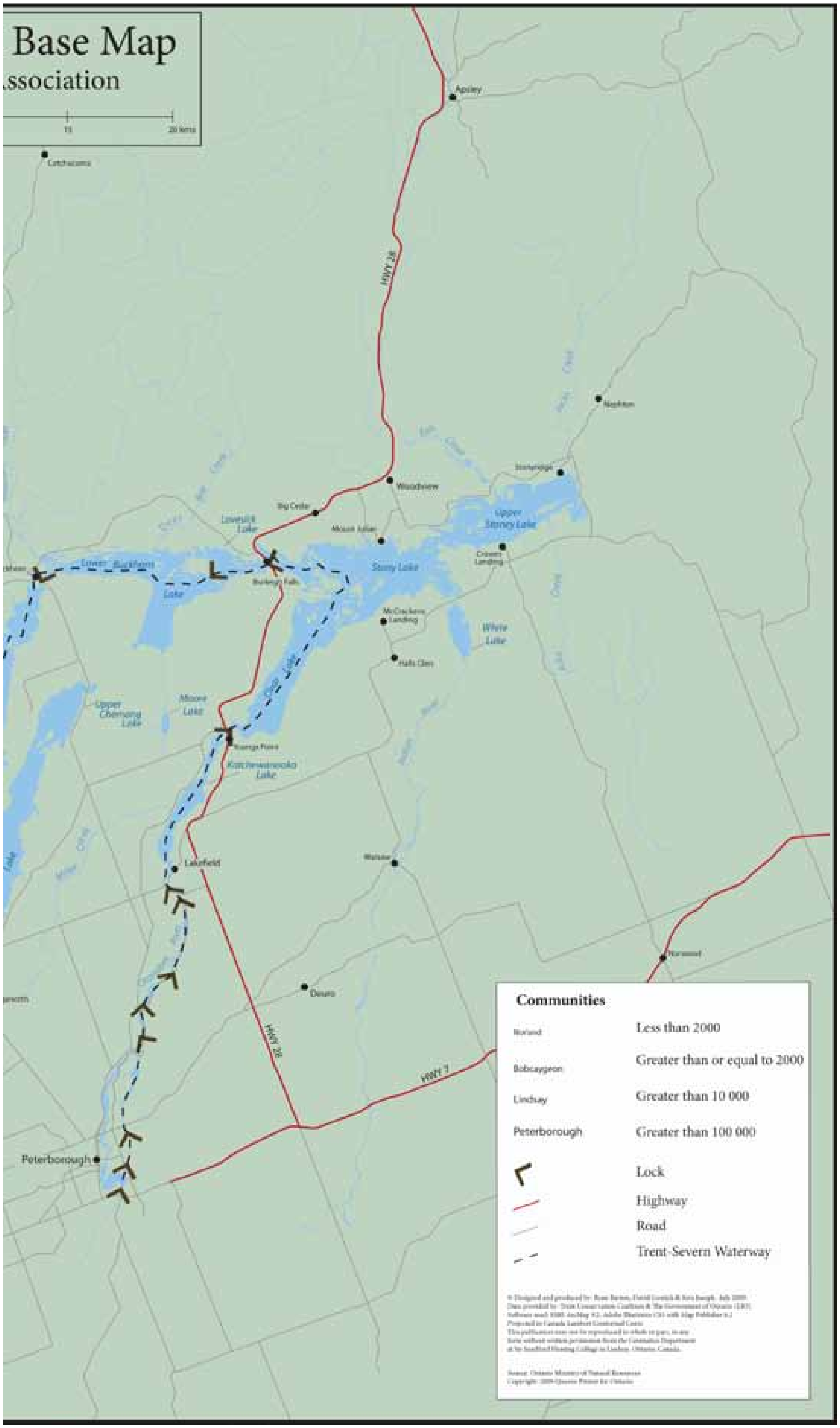
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Bobcaygeon
Greater than or equal to 2000
Lindsay
Greater than 10 000
Peterborough
Greater than 100 000
Lock
Highway
Road
Trent-Severn Waterway

KLSA Meetings Spring and Fall Coming Up!

KLSA's spring meeting will be held on:

Saturday May 7th, 2011, 10:00 a.m.
At the Bobcaygeon Arena/Community Centre
51 Mansfield St., Bobcaygeon

A highlight of the spring meeting will be a roundtable discussion by several of the authors who have contributed to this 2010 Annual Water Quality Report. Topics will include: Control of Eurasian Watermilfoil, Understanding our KLSA Test Results, Phosphorus Sources: What Matters Most? Dr. Paul Frost will discuss global change and how it is expected to affect the Kawartha Lakes.

KLSA's Fall Annual General Meeting will be held on:

Saturday, October 1, 2011, 10:00 a.m.
At the Buckhorn Community Centre
1801 Lakehurst Road, Buckhorn

Among other topics, we will have a wrap-up of our project on Algae in the Kawartha Lakes, supported by the Ontario Trillium Foundation. The AGM is also KLSA's annual business meeting, with election of directors to serve on the Board.

We hope to see you at these meetings!
Bring your questions and comments! Bring your neighbours!

klsa.wordpress.com

Find us on Facebook. What's new on your lake?
Share your findings; learn what others are doing.

The KLSA Editorial Committee at work on the 2010 report: (l-r) Simon Conolly, Sheila Gordon-Dillane, Pat Moffat, Janet Duval, Kevin Walters and Kathleen Mackenzie.

Greg Dillane

Pileated Woodpecker

You can make a difference in this world

How? Pick an organization that's working for something you care about, and support it. KLSA cares about the future of our precious lakes. We hope you do too. Will you help? This year, KLSA will conduct pioneering research on:

- A weevil that attacks **milfoil**
- **Algae** in the Kawartha Lakes
- Effluent from Kawartha **sewage treatment plants**

As always, KLSA volunteers will sample our lake waters for *E.coli*, phosphorus and clarity. With strong local partnerships and a well-managed, lean budget, KLSA provides excellent value for every dollar it receives, and gratefully acknowledges every donor.

✂ *Please clip and mail to KLSA*

❒ Here's a donation of $________

❒ This gift is from my business, or from my cottage or road association. (Cheque to KLSA.)

Personal donations of $40 or more qualify for a charitable tax receipt, issued by our friends at The Stony Lake Heritage Foundation. Individual donors please tick one box below:

❒ This gift is a personal donation of $40 or more. My cheque is made out to ***The Stony Lake Heritage Foundation***, which will issue my receipt. I have marked "For KLSA" on my cheque.

❒ This personal donation is for less than $40. My cheque is made out to KLSA.

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