Kawartha Highlands Water Quality Report 2023

Trent University has a long history of studying the health and water quality of aquatic ecosystems in the Kawartha region. These data, collected over the decades since the 1960's, are a valuable resource for cottagers, government managers, businesses, and visitors to our region. With continued monitoring, this type of work can help us understand if and how our lakes are changing, provide important clues as to what causes change, and will continue to serve as a baseline with which to judge ecosystem health in the future.

The Trent Aquatic Research Program is building on this legacy of research by expanding on past work, initiating new studies, and developing new and deeper connections with local stakeholders and the provincial government. One part of this program involves the establishment and maintenance of a long term monitoring program that measuring the water quality of about 35 lakes around the Kawartha Highlands region annually. Data from the past summer (2022) are presented on pages 2-8 of this report. As part of this program, we are tracking multiple aspects of water chemistry, including nitrogen and phosphorus, water transparency and chlorophyll. We have also been deploying a water quality profiler to collect very detailed and precise measurements of temperature and dissolved oxygen (among other things) at different depths in the lakes (see page 9). All of these data are being used by Trent graduate students to better document and understand ecological interactions in inland waters and their responses to human-related change. More work is planned for the upcoming 2023 including more detailed measurements of lake dissolved oxygen and assessing zooplankton responses to low Ca. Much of our current efforts are focused on analyzing the last few years of water quality data collected by this program and for graduate student research projects.

All of these data are being carefully checked and will be archived for future use. We are working with the Gordon Foundation's Great Lakes DataStream to preserve these data and to make them more readily accessible to stakeholders in the future. You can find the data archive and data from your lake at: https://greatlakesdatastream.ca/

We hope you find this report useful and look forward to hearing your feedback on it and our water quality program.

This report was produced by the Trent Aquatic Research Program, Trent University, Peterborough, Ontario. Please direct all questions and inquiries about this report to Dr. Paul Frost. Email: paulfrost@trentu.ca

What did we measure?

Our water research program at Trent has access to world-class facilities and highly specialized equipment to study water quality in and between lakes. Below is a partial list of parameters that we measure as part of our program. For information on each of these parameters, please refer to our Primer Report 2021 or send us an email for a deeper description. All of these data for each lake are available on request. Parameters that are bolded are key indicators of water quality and are shown on the following pages for the lakes included in our on-going monitoring activities.

Parameter	Units
Specific conductivity	µS/cm
Dissolved oxygen, concentration	**mg/L**
Dissolved oxygen, percent saturation	**%**
Water temperature	°C
Secchi depth	m
pH	
Total suspended solids	mg/L
Dissolved organic carbon	mg C/L
Absorbance at 280 nm	cm^{-1}
Molar absorptivity at 280 nm	L mol C^{-1} cm^{-1}
Total phosphorus	µg P/L
Total dissolved phosphorus	µg P/L
Particulate phosphorus	µg P/L
Total dissolved nitrogen	µg N/L
Nitrate	µg N/L
Ammonium	µg N/L
Chlorophyll a	µg/L
Dissolved calcium	mg Ca/L

When and where did we sample?

We have water quality data for about 30 lakes collected on an on-going basis since 2015. Many of the lakes we sample every year whereas others, primarily ones in the Kawartha Highlands Provincial Park, are sampled on a less frequent basis (every 2 or 3 years). In 2022, we sampled lakes listed below on the dates indicated.

Lake	Date Sampled
Adams	August 23, 2022
Anstruther	August 10, 2022
Beaver	August 11, 2022
Big Cedar	August 8, 2022
Bottle	August 16, 2022
Buzzard	August 19, 2022
Catchacoma	August 11, 2022
Chandos	August 17, 2022
Compass	August 19, 2022
Eels	August 17, 2022
Gold	August 11, 2022
Jack	August 17, 2022
Kasshabog	August 17, 2022
Long	August 9, 2022

Lake	Date Sampled
Loon Call	August 10, 2022
Loucks	August 9, 2022
Lower Stoney	August 22, 2022
Mississauga	August 11, 2022
Pencil	August 12, 2022
Raccoon	August 8, 2022
Rathbun	August 24, 2022
Salmon	August 12, 2022
Sawmill	August 23, 2022
Sucker	August 16, 2022
Upper Stoney	August 22, 2022
Wolf	August 10, 2022

What did we find?

Secchi Depth (m) is a measurement of water clarity based on how deep you can see a disk dropped into the water. Generally, deeper depth indicates clearer waters and a Secchi depth of less than 2 m would be of concern.

Lake	Average*	2021	2022
Adams	5.24	n.s.	6
Anstruther	4.64	5.5	4.75
Beaver	4.43	3.25	6.25
Big Cedar	5.17	5.5	5.5
Bottle	2.61	2.5	2.5
Buzzard	5.44	5.75	5.4
Catchacoma	3.76	3.25	4.75
Chandos	4.94	4.75	6
Compass	4.5	n.s.	4.3
Eels	3.82	3.5	4.25
Gold	5.22	5.25	6.25
Jack	5.02	6.75	5.75
Kasshabog	4.85	4.75	5
Long	5.00	4	5.5
Loon Call	4.22	4.5	5.25
Loucks	4.06	3	4.5
Lower Stoney	3.09	3.5	4.75
Mississauga	4.49	4.25	5.75
Pencil	4.08	3.25	4.5
Raccoon	4.13	3.5	5
Rathbun	4.8	4.7	4.4
Salmon	6.83	6.25	9.5
Sucker	4.76	5.5	5.2
Upper Stoney	4.83	5	7
Wolf	4.13	3	4

Most of the lakes that we sample have Secchi depths of 3-6 m, which is entirely within the normal range for lakes in this region. The Secchi depth of Bottle Lake seen in 2022 is similar to past years and indicates that there are possible water quality problems in this lake. Most of the other lakes with shallower Secchi depths (<4 m) are either relatively small or have higher levels of dissolved organic materials (meaning more brown colour in the water).

*The average was calculated using all of the data we have for each lake between the years of 2015-2022 which for most lakes is 4 or 5 sampling years.

What did we find?

Chlorophyll (μg/L) is a pigment that we measure to estimate algal biomass in the surface waters. Values close to or below 5 μg/L are generally considered good and a sign of low algal biomass.

Lake	Average*	2021	2022
Adams	3.17	n.s.	4.87
Anstruther	3.41	2.52	4.05
Beaver	3.23	2.99	4.51
Big Cedar	3.21	2.04	6.03
Bottle	4.94	4.64	7.25
Buzzard	2.89	1.82	6.07
Catchacoma	2.65	2.00	2.01
Chandos	2.85	1.09	5.40
Compass	5.00	n.s.	5.00
Eels	4.17	3.96	4.17
Gold	4.19	1.61	4.19
Jack	4.06	1.71	4.06
Kasshabog	7.60	1.17	7.60
Long	2.43	2.01	4.08
Loon Call	4.03	3.46	5.65
Loucks	3.28	2.46	5.26
Lower Stoney	8.27	4.02	4.93
Mississauga	2.99	2.50	3.57
Pencil	3.30	2.30	6.71
Raccoon	5.09	1.78	5.09
Rathbun	2.95	1.79	4.30
Salmon	1.83	1.05	2.91
Sucker	4.84	1.71	12.34
Upper Stoney	3.88	2.04	3.90
Wolf	3.61	2.39	5.30

Most lakes in the Kawartha Highlands show very low levels of algal biomass as indicated by the low chlorophyll readings. We found higher chlorophyll concentrations in many lakes in 2022 but this increase would not be cause for concern unless it was repeated for several years and yielded much higher concentrations.

*The average was calculated using all of the data we have for each lake between the years of 2015-2021 which for most lakes is 4 or 5 sampling years.

What did we find?

Dissolved calcium (mg/L) is an important nutrient that is connected to whether your lake has hard or soft water. Values lower than 5 mg/L indicate soft water lakes whereas values above 10 mg/L are a sign that your lake has relatively harder water in our area.

Lake	Average*	2021	2022
Adams	5.04	n.s.	5.03
Anstruther	5.15	7.58	4.76
Beaver	6.27	6.06	6.62
Big Cedar	27.83	26.93	28.48
Bottle	2.69	2.90	2.83
Buzzard	2.09	2.18	2.03
Catchacoma	5.94	6.28	6.46
Chandos	21.60	20.95	22.79
Compass	3.41	n.s.	3.37
Eels	7.58	7.42	8.35
Gold	5.26	5.26	5.42
Jack	23.10	22.53	23.40
Kasshabog	7.77	7.30	8.15
Long	4.29	4.37	4.32
Loon Call	7.52	7.44	7.44
Loucks	4.18	3.71	3.34
Lower Stoney	29.69	28.11	29.06
Mississauga	6.24	6.34	6.86
Pencil	15.39	16.37	16.04
Raccoon	18.01	17.31	21.33
Rathbun	1.44	1.55	n.s.
Salmon	28.15	27.01	28.01
Sucker	2.65	3.30	2.68
Upper Stoney	25.60	26.69	26.08
Wolf	5.64	5.60	6.18

Kawartha Highlands lakes show a wide range of dissolve calcium concentrations, which likely reflect geological processes in their upstream catchments. Concentrations of calcium generally don't vary much year to year but, in some lakes, there is a decades long trend of decreasing values. We have seen no evidence of that in Kawartha Highlands lakes.

*The average was calculated using all of the data we have for each lake between the years of 2015-2021 which for most lakes is 4 or 5 sampling years.

What did we find?

Total phosphorus (μg/L) is an important water quality parameter as phosphorus is a growth-limiting nutrient that supports algal biomass.

Lake	Average*	2021	2022
Adams	4.30	n.s.	4.45
Anstruther	4.74	5.65	4.55
Beaver	5.83	7.32	3.79
Big Cedar	6.07	5.64	4.29
Bottle	8.93	10.52	6.96
Buzzard	5.87	8.40	5.81
Catchacoma	5.43	5.43	5.02
Chandos	7.17	9.83	6.33
Compass	7.88	n.s.	5.93
Eels	5.75	8.39	5.39
Gold	6.71	5.89	2.94
Jack	4.84	6.12	2.51
Kasshabog	5.31	6.79	4.60
Long	6.54	6.89	4.74
Loon Call	4.90	8.62	2.94
Loucks	4.70	2.05	5.12
Lower Stoney	14.01	15.10	11.36
Mississauga	5.59	6.57	4.66
Pencil	6.39	7.33	5.05
Raccoon	5.33	5.53	6.36
Rathbun	6.90	5.50	4.71
Salmon	6.53	5.95	9.06
Sucker	5.56	4.25	6.45
Upper Stoney	7.49	8.59	4.48
Wolf	6.17	5.73	6.54

Most Kawartha Highlands lakes show total phosphorus concentrations below 10 μg/L and this has been the case since we began monitoring in 2015. There are no emerging trends and no apparent long term changes in total phosphorus in Kawartha Highlands lakes. Generally, this is an indicator of good water quality in our region's lakes.

*The average was calculated using all of the data we have for each lake between the years of 2015-2021 which for most lakes is 4 or 5 sampling years.

What did we find?

Nitrate (μg/L) is an inorganic form of nitrogen that is available for algal growth. Values below 100 μg/L are generally considered to be very low with values above 500 μg/L usually found in areas of N pollution.

Lake	Average*	2021	2022
Adams	66.24	n.s.	170.81
Anstruther	14.27	<1.0	45.01
Beaver	9.09	3.81	19.50
Big Cedar	53.50	13.00	149.06
Bottle	8.90	19.05	21.91
Buzzard	16.98	1.50	32.29
Catchacoma	19.41	2.63	39.15
Chandos	22.02	5.05	33.38
Compass	14.17	n.s.	21.04
Eels	20.56	3.53	38.78
Gold	62.72	165.63	18.41
Jack	21.35	5.05	30.78
Kasshabog	22.31	4.82	40.45
Long	11.20	2.66	21.63
Loon Call	50.92	11.99	199.75
Loucks	11.19	13.19	11.13
Lower Stoney	57.49	7.35	126.97
Mississauga	8.98	14.45	0.13
Pencil	20.76	1.61	49.41
Raccoon	34.45	16.18	22.23
Rathbun	26.04	2.66	49.43
Salmon	28.57	43.50	38.03
Sucker	42.40	15.46	145.75
Upper Stoney	20.06	5.03	30.41
Wolf	19.12	13.03	21.72

Nitrate concentrations are quite low in Kawartha Highlands lakes. This suggests there are limited sources of inorganic N inputs as would be expected for relatively undeveloped forested lands.

*The average was calculated using all of the data we have for each lake between the years of 2015-2021 which for most lakes is 4 or 5 sampling years.

What did we find?

Dissolved oxygen is the amount of O_2 found dissolved in the water. Concentrations shown here are from measurements about 1 m from the lake floor. Also provided is the % saturation value, which if less than 20% indicates sustained O_2 consumption in the lake's hypolimnion.

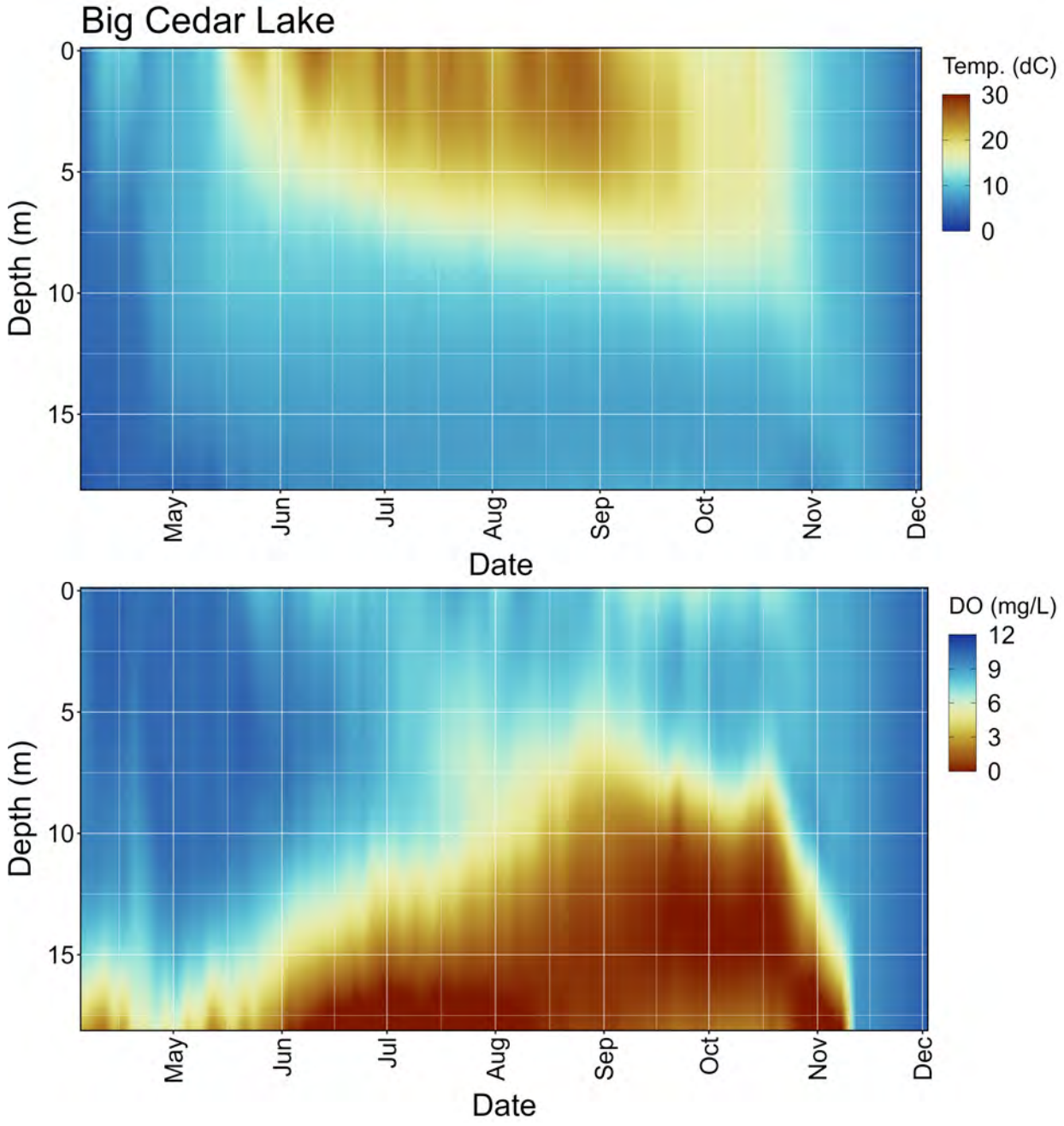
Lake	DO % saturation	DO Conc. (mg/L)
Adams	5.87	0.76
Anstruther	77.50	8.24
Beaver	11.82	1.48
Big Cedar	11.14	1.32
Bottle	46.64	5.76
Buzzard	12.70	1.65
Catchacoma	82.22	10.54
Chandos	45.45	5.77
Compass	6.71	0.76
Eels	37.16	4.75
Gold	74.39	9.51
Jack	56.79	7.22
Kasshabog	32.65	4.00
Long	53.90	6.80
Looncall	2.30	0.16
Loucks	19.99	2.49
Lower Stoney	29.44	2.54
Mississauga	74.69	9.35
Pencil	46.25	5.91
Raccoon	44.13	4.17
Rathbun	71.46	7.45
Salmon	8.30	1.06
Sucker	8.21	1.04
Upper Stoney	46.13	5.44
Wolf	1.70	0.17

These values are from the 2022 sampling of the Kawartha Highlands lakes.

Dissolved oxygen concentrations at the bottom of Kawartha Highlands lakes varies a lot from lake to lake. Lower values are generally found in shallower and darker lakes. Very low values in the lake's bottom waters are not necessarily a sign of lake impairment but can be problematic for populations of some fish species (e.g., lake trout). Very low DO was found in Adams, Compass, Loon Call, Rathbun, Salmon, and Sucker, and Wolf lakes in 2022.

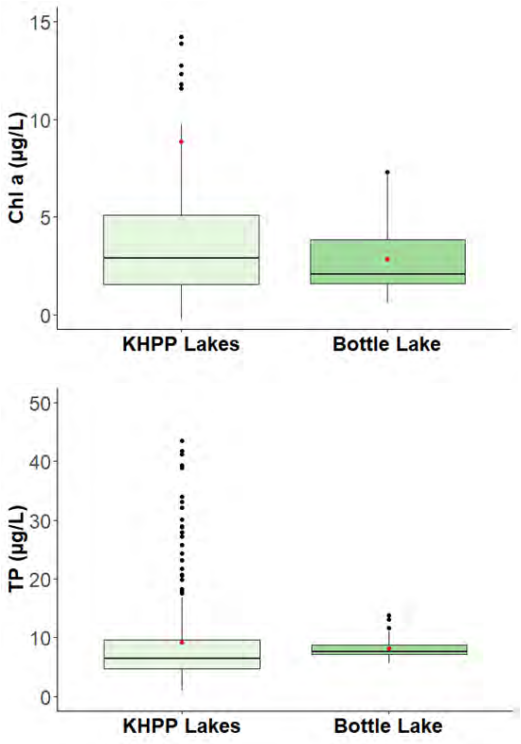
How does dissolved oxygen change over the summer?

In the summer of 2021, we frequently visited Big Cedar Lake to measure temperature and dissolved oxygen using our multi-parameter probe. With these data, we can visualize temperature and dissolved oxygen with depth as it changes over the spring-summer-fall seasons. Big Cedar reached a maximum surface temperature in August and was fully mixed around the end of October. The lake showed progressively lower dissolved oxygen concentrations over the summer with most bottom waters oxygen-free in September and October. We are currently analyzing this information to better understand the heat budget and oxygen dynamics in Big Cedar lake.



Bottle Lake Water Quality Project

In partnership with the Kawartha Highlands Provincial Park (KHPP), Trent MSc student, Duncan Ferguson, spent the summer of 2022 conducting an investigation of the water quality in Bottle Lake. This is partly in response to on-going concerns about low water clarity and excessive algal biomass based on anecdotal reports over the past few years. Duncan made twice monthly visits to Bottle Lake between May and September to measure water clarity, algal biomass, and phosphorus concentrations. His data show that Bottle Lake is typical and well within the range of other lakes in the Kawartha Highlands Provincial Park. Bottle Lake was found to have a darker colour (i.e., more brown), due to higher concentrations of dissolved organic matter, which reduces light penetration and water transparency. These data will be used to assess whether and how different lake uses (e.g., overnight camping) contributes to or exacerbates poor water quality in this lake.



Chlorophyl concentrations (top panel) and total phosphorus (bottom panel) in all KHPP lakes over the years 2015-2023 and from Bottle Lake sampled over the summer of 2022. Box plots show mean (solid line) and interquartile ranges (boxes)

Acknowledgments and Funding

We hope you've enjoyed this report and found it useful. The data for this report could not have been collected without the generous support of the North Kawartha Lakes Association and other supporters of our research program. Special thanks to Doug Wellman for his assistance with funding and coordinating our summer sampling efforts. This work also benefited from the contribution of the Kawartha Highlands Provincial Park through their help sampling park lakes. If you would like to see more limnology and water science in the Kawartha region, please consider supporting the Trent Aquatic Research Program. To learn more about our program and how you can donate, visit: https://mycommunity.trentu.ca/tarp.

Do you have a lake science question related to this report or just in general? Or would like one of our team members to come speak at an event? We are happy to share our knowledge and tell you about our work. Send us an email at paulfrost@trentu.ca and let us know how we can help.