Our Mission

The Lake Partner Program (LPP) was created from our deep love and passion for Ontario's freshwater lakes. These lakes serve as the backdrop for countless cherished memories for young and the young at heart. For over 28 years, the Lake Partner Program and its volunteers have worked to better understand the conditions of Ontario's lakes and how we as lake stewards can ensure their prosperity into the future.

Currently, freshwater lakes across Ontario are experiencing significant changes. These changes include issues directly measured in the LPP and discussed in this report, such as an increase in algal blooms and chloride levels, as well as challenges like climate change that are harder for the LPP to measure. Due to this, the fact remains that the time to begin ensuring the health and resiliency of our lakes is now. For resources on how you can help act as a steward for your favorite lake, please visit the *Best Practices* tab in this report.

We ask whomever reads these reports to keep this in mind.

To the many stewards who have helped make the Lake Partner Program what it is, thank you! We hope we can continue to work together to help ensure the health of Ontario's lakes.

Sincerely,

The Lake Partner Program team

and
Federation of Ontario Cottagers' Associations

Report Overview

Lake Data Report for Big Cedar Lake

STN 363

General Information

Big Cedar Lake has been monitored by Lake Partners from 2004 to 2024. During this time, water samples were collected in the spring for total phosphorus levels. Water clarity is sampled monthly using a Secchi disk. Calcium and chloride were included in the Lake Partner Program (LPP) in 2008 and 2015, respectively, and were sampled along with total phosphorus in the spring.

Scope of the Lake Report

This report provides background information on Ontario's LPP, summarizes and provides analysis for each of the four water quality indicators monitored as part of the program (*total phosphorus, calcium, chloride, and water clarity*), and provides information on how anyone can act as a steward for their lake.

A note on statistical significance and figure scales

Throughout this report, we use Mann-Kendall trend tests to determine if changes in certain measurements are statistically significant. This means we check if the changes are due to chance or if they show a real trend. We use a 95% confidence interval, meaning we're 95% sure the changes are real.

When viewing the figures in this report, please check the scales on the x-axis (horizontal axis) and y-axis (vertical axis) to understand the extent of the changes over time. Due to formatting difficulties, not all scales start at 0, which would have been preferrable. Keep this in mind when viewing the figures.

Also, note that this analysis is based on the LPP data and should not replace existing research on a lake or watershed. Instead, we hope it acts as a starting point to understanding lake chemistry.

How to navigate the Lake Data Report

Please note this digital report is best viewed in a "full screen" layout, using a Chrome or Edge browser.

This report consists of 5 sub-reports, which you can access from tabs at the top of this page (*Total Phosphorus*, *Calcium*, *Chloride*, *Water Clarity*). This report also includes *Background Information* on the LPP as well as a *Best Practices* for using or living on a lake.

Navigate between other tabs by clicking their labels. The indicator-specific tabs (*Total Phosphorus*, *Calcium*, *Chloride*, *Water Clarity*) contain basic information and data visualizations for each indicator. The *Background Information* tab provides links to further reading and the *References Tab* is where you can find all the literature we used to inform the report.

This report also contains two maps. These maps show your lake, sampling locations, and information about the LPP data collected. To access lake-specific information, click anywhere on the lake. To access site-specific information, click on the site indicator. (Note: only sites with at least five years of consistent data were included in these maps)

Big Cedar Lake's monitoring location and recent indicator averages

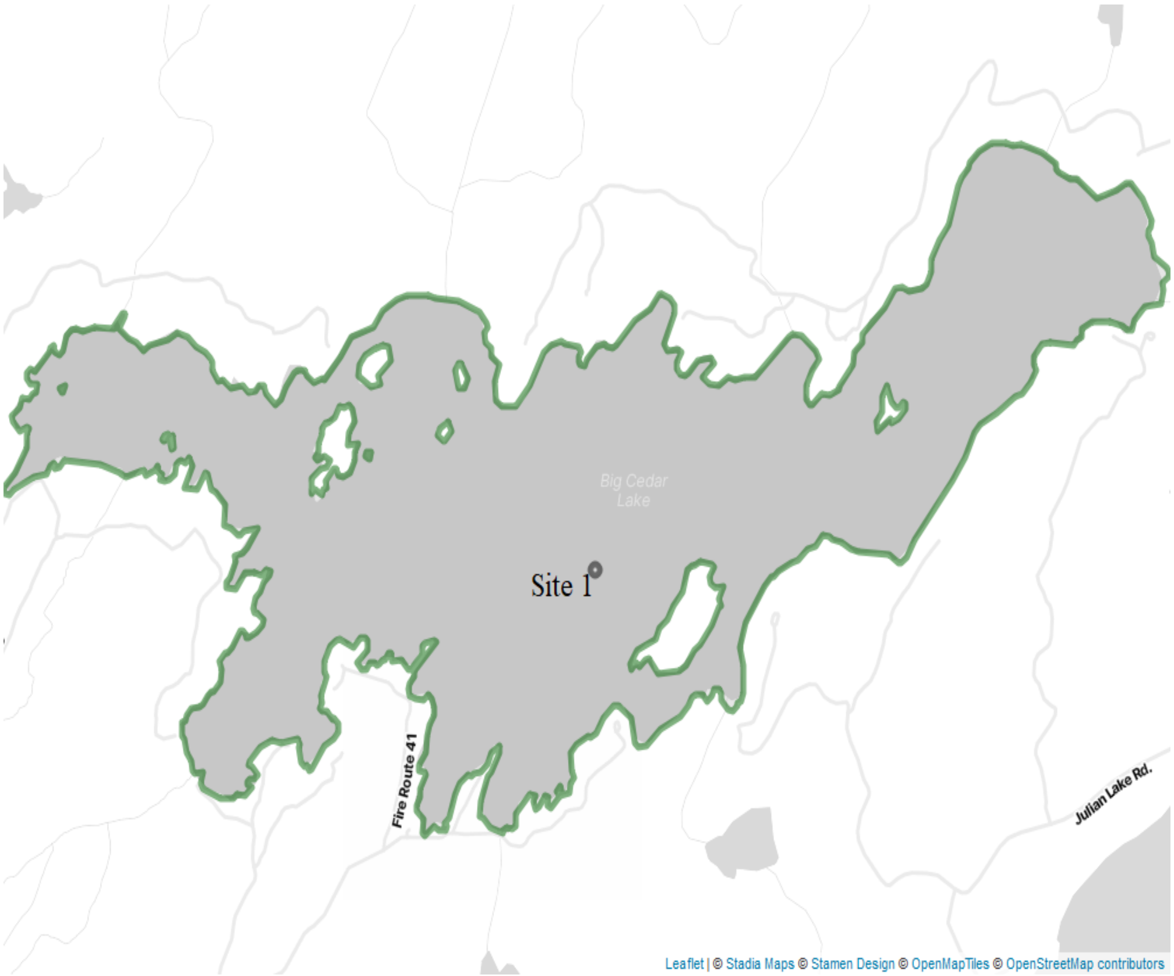


Figure 1. A map showing Big Cedar Lake and the location of the Lake Partner Program sampling sites. Past five year averages of the parameters for each site can be found in Appendix A. Sites with insufficient data were excluded from this analysis. All data were collected by Lake Partner volunteers from 2019-2024.

Total Phosphorus

What is total phosphorus?

Phosphorus is an essential element for aquatic systems and the organisms that inhabit them. Phosphorus is one of the many factors that control the growth of algae in Ontario lakes. Increases in phosphorus concentrations may enhance algal growth, resulting in decreased water clarity, and reduced deep-water oxygen concentrations. Lakes can be placed into three broad categories according to their TP concentrations. These categories of "lake trophic status" summarize the lake's overall biological productivity, are related to phytoplankton, abundance and water clarity, and are defined as follows:

- Lakes with less than 10 micrograms per litre (µg/L) of TP are **oligotrophic**. These lakes have low biologically productivity and tend to be deep, cold lakes.
- Lakes with TP between 10 and 20 µg/L are termed **mesotrophic** and have a medium level of biological production.
- Lakes over 20 µg/L are **eutrophic** and may exhibit persistent algal blooms due to the high levels of biological production.

What are algal blooms?

Algal blooms are short-lived events that occur when phytoplankton (also known as algae) rapidly proliferate in a water body, forming dense clusters on or near the water's surface. Elevated phosphorus concentrations can increase the likelihood of algae blooms occurring. Blooms can detract from the visual appeal of a lake, produce toxins, and affect taste or odour of the water.

While algal blooms do occur naturally, their frequency has increased in the last two decades in Ontario (Favot et al, 2023). Algae form the base of the food web in freshwater lake ecosystems, making them highly sensitive to change throughout the ecosystem. One significant factor affecting phytoplankton is climate change.

Climate change has led to rising lake temperatures, resulting in less ice cover and longer growing season for algae (Woolway et al., 2022). Additionally, increased extreme weather events, such as heavy precipitation, may cause pulses of nutrient-rich runoff into lakes from the watershed, boosting phosphorus levels and promoting algal blooms (Tewari, 2022; Woolway et al., 2022).

Other changes to freshwater ecosystems that have contributed to an increase in algal blooms includes (but is not limited to) invasive species which impact ecosystem dynamics (i.e Zebra Mussels and Sphiny Water Flea) and the de-naturalization of areas surrounding freshwater lakes (Favot et al, 2023; Woolway et al, 2021).

The role that phosphorus and climate change play in the increasing algal blooms seen across Ontario is a topic of ongoing research in Ontario and across the globe. But as climate change continues to effect our lakes it is important to ensure best practices are being used on and around lake ecosystems to maintain their resiliency in the coming decades.

Measuring Total Phosphorus in the LPP

In the LPP, we measure *total phosphorus* (TP, all forms of phosphorus in the water sample). Big Cedar Lake is located within the Ontario Shield ecozone. In the LPP, these "on-Shield" lakes are sampled once in the spring for TP. TP in the LPP is measured by lowering a sampling bottle to the Secchi depth and pulling up the bottle which collects water from the euphotic zone (Area in lake where light penetrates). The water is than filtered through a 80 micron filter before being funneled into two test tubes to be analyzed for TP.

How does Big Cedar Lake's TP compare to other on-Shield lakes in the LPP?

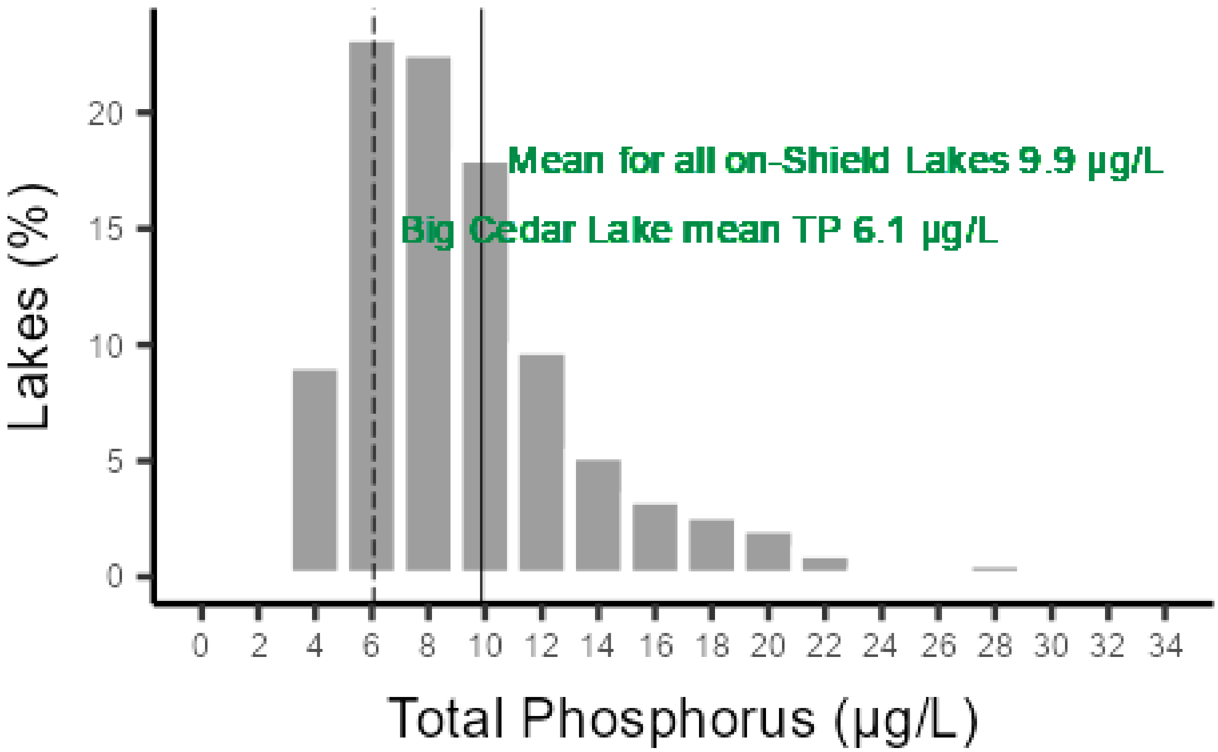


Figure 2. Histogram showing the distribution of average ice-free TP concentrations for 1217 lakes located on the Precambrian Shield, sampled as part of the Lake Partner Program between the years 2004-2024. The dashed line represents Big Cedar Lake's spring average TP concentration for the years 2004-2024 (6.1 μg/L). The solid black line represents the ice-free spring average TP concentration of all LPP lakes located on the Precambrian Shield from 2002-2024 (9.9 μg/L). Most lakes are less than the Provincial Water Quality Objective of 20 μg/L.

Summary: Big Cedar Lake's compared to other on-Shield lakes

- The average TP concentrations for Big Cedar Lake between 2004 and 2024 is 6.1 μg/L.
- Big Cedar Lake falls into the twentieth percentile of TP concentrations in on-Shield lakes monitored by LPP volunteers. This means that 80 percent of lakes have higher TP concentrations than Big Cedar Lake.
- The mean TP concentration of Big Cedar Lake is below the Provincial Water Quality Objective of 20 μg/L. Algae blooms can still occur at total phosphorus levels below 20 μg/L, please refer to the section on algae blooms above.

What does Big Cedar Lake's annual total phosphorus concentration look like over time?

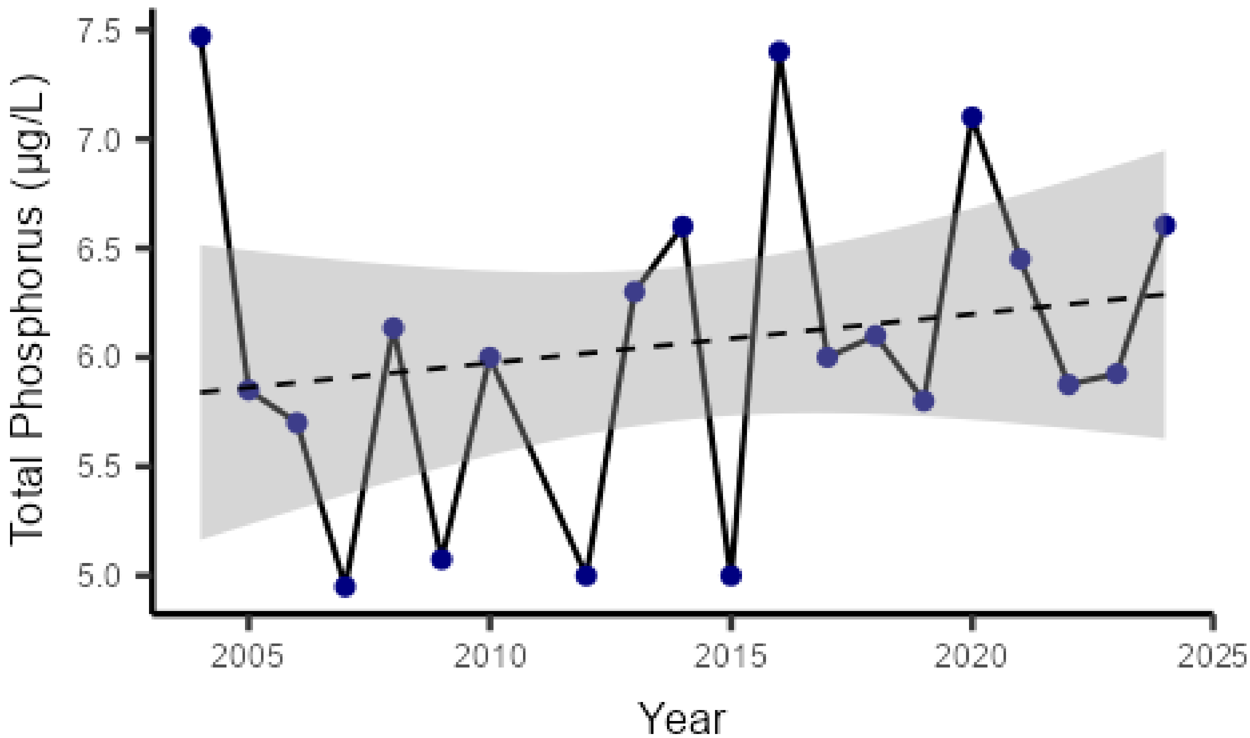


Figure 3. In general, the overall trend in TP concentrations of Big Cedar Lake have increased over time, but this change was not significant. This was determined using a Mann-Kendall trend test, which provided a p-value of 0.314 (a p-value indicates the likelihood of a trend, with a p-value of less than 0.05 providing strong evidence that there is a trend). The blue points represent the average ice-free spring TP concentration for each year. The dotted line represents a linear model representing the overall trend over time. The shaded area represents the range of values within which we are 95% confident the true TP concentration lies. Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the Lake Partner Program can affect lake water quality. The trends shown here are meant to provide general information only and may not capture the full complexity of the lake's water chemistry.

Summary: Big Cedar Lake's total phosphorus trends over time

- Big Cedar Lake is a low production oligotrophic lake.
- Between 2004 and 2024 phosphorus concentrations in Big Cedar Lake had no significant statistical change.
- During this time TP concentrations fluctuated between 5.0 μg/L in 2007 to 7.5 μg/L in 2004.

Total Phosphorus in nearby lakes within the past 5 years

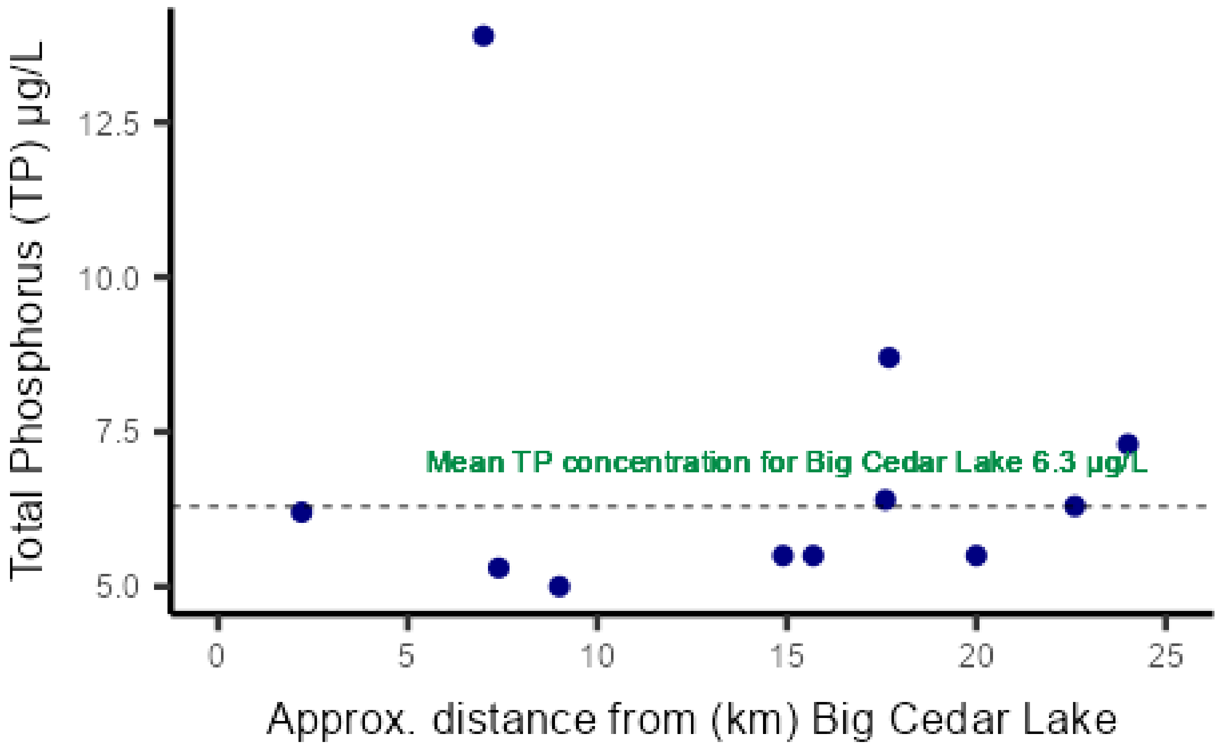


Figure 4. Scatterplot showing 5-year average total phosphorus concentrations (2019-2024) for lakes sampled within a 50-km radius of Big Cedar Lake. The dashed line represents Big Cedar Lake's average total phosphorus concentrations in the LPP since 2019. Lakes with insufficient data were excluded from this analysis. All data were collected by Lake Partner volunteers from 2019-2024. Information for each lake within distance of Big Cedar Lake can be found in the Appendix.

Summary of observations from nearby lakes

- In the LPP there are 11 lakes that have been sampled in the LPP within the last five years. The average total phosphorus concentrations of these lakes in the last 5 years is 6.9 μg/L.
- If you or someone you know would be interested in sampling a lake nearby Big Cedar Lake please reach out to lakepartner@ontario.ca to sign up to be a lake steward.
- When looking at nearby lakes please keep in mind that these lakes can be characteristically entirely separate from Big Cedar Lake and the only aspect that relates Big Cedar Lake to these other lakes is location and whether they are on the Canadian Shield or not.

Chloride

What is chloride?

Freshwater lakes and rivers naturally contain low concentrations of dissolved salts including chloride (Cl). Cl is an essential element in freshwater lake ecosystems, but elevated concentrations are toxic to aquatic organisms. Some lakes can have naturally elevated Cl levels but in the last decade research has shown an increase in Cl concentrations in freshwater lakes, specifically those near urban centers or roadways (Sorichetti et al, 2022). The LPP began measuring Cl in 2015 in response to increases in freshwater salinity.

Effects of chloride on freshwater lakes

The increase in Cl seen in freshwater lakes in Ontario can primarily be attributed to winter road salt use. In Canada, deicer's are in the form of sodium chloride, calcium chloride, magnesium chloride, or potassium chloride primarily. When road salt is applied to roads in the winter months it begins to build up in snowbanks and other areas surrounding these roadways. As spring snow melt begins and subsequent precipitation happens the Cl that is built up begins to make its way into the watershed and eventually into surrounding lakes and rivers. The Cl that does not make it into the watershed goes into the surrounding soil and over time gets washed into the surrounding waterways. Resulting in an initial pulse of Cl into lakes and rivers after snow melt and then a more gradual increase in Cl from surrounding soils over time (Arnott et al, 2020).

Recent research has shown that Cl concentrations below the Canadian Council for Ministers of the Environment (CCME) published guideline for Cl of 120 mg/L can have severe negative impacts on Zooplankton populations (Greco et al, 2023). In low nutrient lakes, specifically those with low calcium concentrations the effects of increased chloride concentrations can occur at levels well below the CCME guideline. In Shelley E. Arnott's 2020 paper they found that ***Daphnia*** were sensitive to low Cl concentrations in soft water conditions with decreased reproduction and increased mortality occurring between 5 and 40 mg/L of Cl. This effect on zooplankton, specifically ***Daphnia*** is significant because they play a vital role in regulating the algae population in aquatic ecosystems and are critical in the food web of aquatic ecosystems. To learn how you can help reduce Cl increases in lakes please visit the **Best Practices** tab.

Why are effects from road salt on *Daphnia* populations important for freshwater lakes?

Daphnia are a species of zooplankton (Microcrustaceans specifically) that float near the surface of the water column and filter-feed on other organisms floating in the water column. They are the principle consumers of algae and due to this are often referred to as the lawnmowers of the lake. Because of their consumption of algae and other organisms near the base of the food chain, **Daphnia** and zooplankton as a whole are pivotal in transporting photosynthetic energy (energy from the sun) up the food chain (Beaver et al., 2011).

Due to the outsized role that zooplankton and subsequently **Daphnia** play in overall water quality and ecosystem health it is extremely important to maintain the health of their population in the present and future (Arnott et al., 2020). This is why it is important to address the increasing chloride and decreasing calcium levels being seen in freshwater lakes across Ontario. Please visit the ***Best Practices*** tab to learn some ways you could help.

Big Cedar Lake's chloride concentrations compared to other on-Shield lakes?

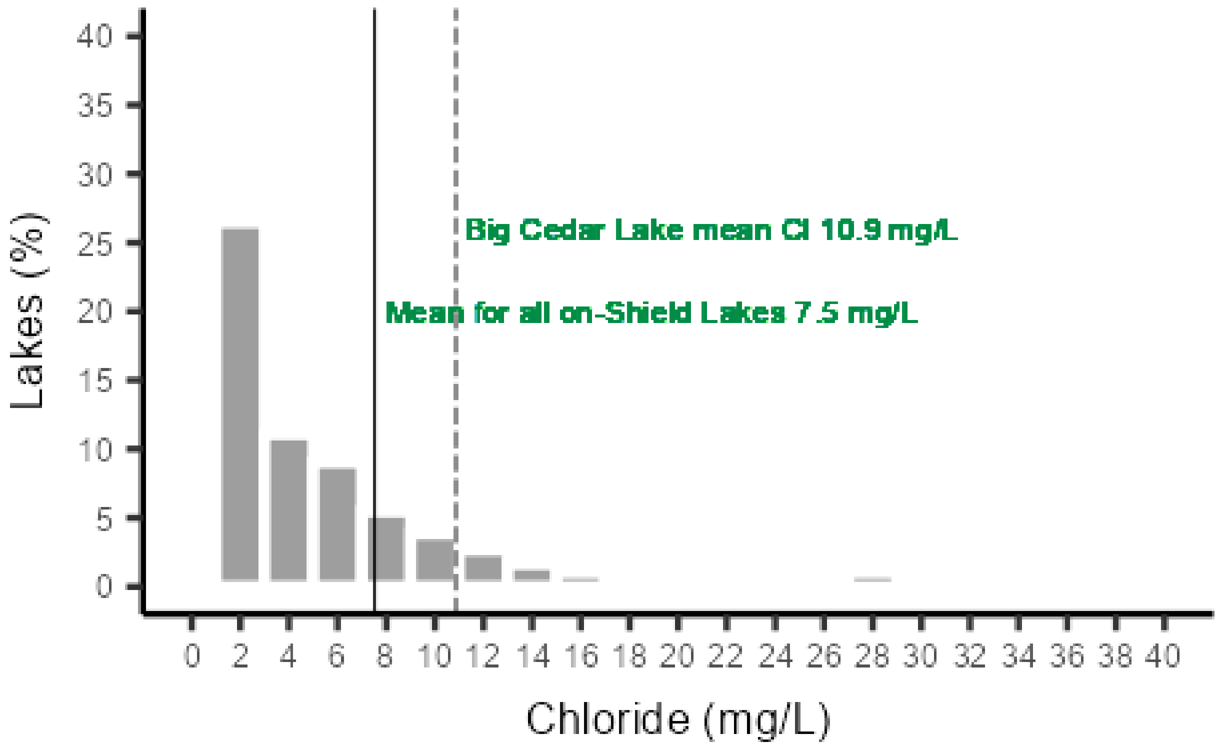


Figure 5. Histogram showing the distribution of ice-free spring average Cl concentrations for 701 lakes located on the Precambrian Shield sampled as part of the Lake Partner Program between the years 2015-2024. The dashed line represents Big Cedar Lake's spring average ice-free Cl concentration for the years 2015 to 2024 (10.9 mg/L). The solid black line represents the ice-free average Cl concentrations of all LPP lakes located on the Precambrian Shield (7.5 mg/L). All lakes in this data set fall below the Canadian Water Quality Guideline for the Protection of Aquatic Life of 120 mg/L Cl. Note: Some lakes exceed the 40 mg/L scale seen on this histogram, so they do not appear on this graph.

Takeaways from Big Cedar Lake's comparison to other on-Shield lakes:

- The average Cl concentration between 2015 and 2024 is 10.9 mg/L.
- Big Cedar Lake falls into the eighty-seventh percentile of Cl concentrations in on-Shield lakes. This means that 13 percent of lakes have higher Cl concentrations than Big Cedar Lake.

What are Big Cedar Lake's chloride concentrations look like over time?

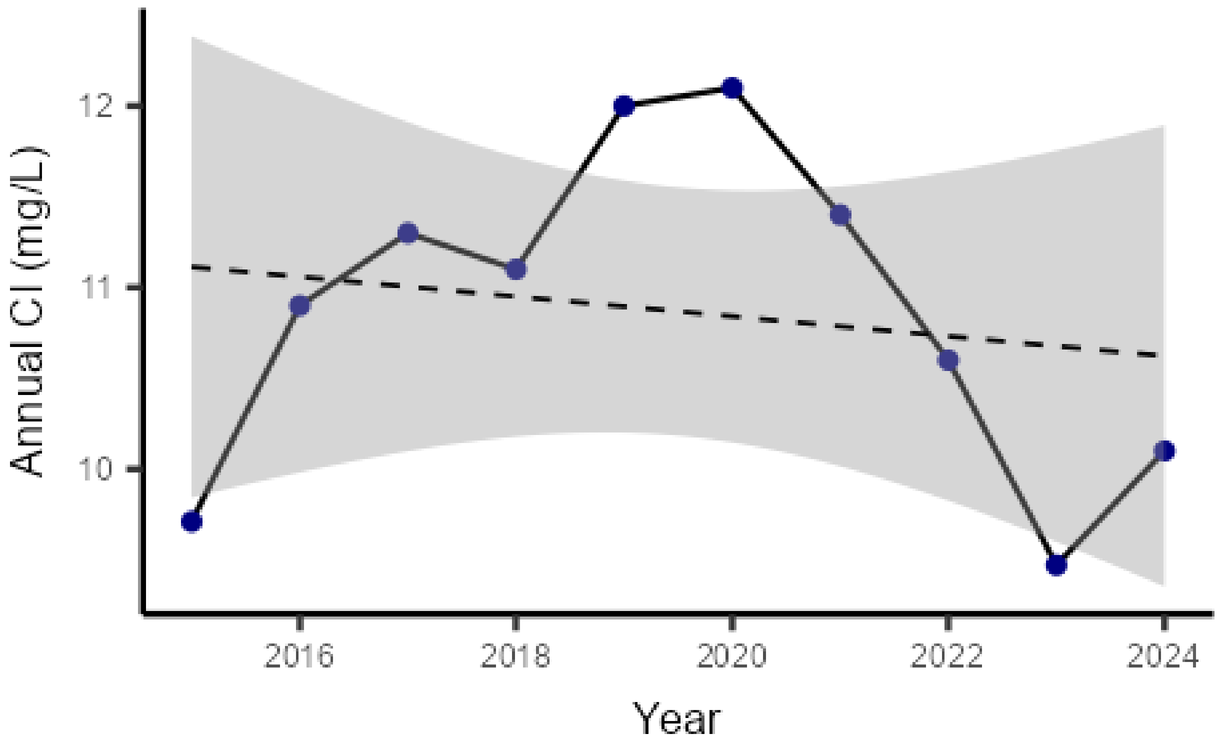


Figure 6. Cl concentrations in Big Cedar Lake decreased overtime, but this change was not significant. This was determined using a Mann-Kendall trend test, which provided a p-value of 0.9 (a p-value indicates the likelihood of a trend, with a p-value of less than 0.05 providing strong evidence that there is a trend). The shaded area represents the range of values within which we are 95% confident the true chloride concentration is. All samples were taken shortly after ice-off of each season. Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake water quality. The trends shown here are meant to provide general information only and may not capture the full complexity of the lake's water chemistry.

Summary: Big Cedar Lake's chloride trends over time

- Between 2015 and 2024 Cl concentrations in Big Cedar Lake had no significant statistical change.
- During this time Cl concentrations fluctuated between 9.5 mg/L in 2023 to 12.1 mg/L in 2020.

Chloride in nearby lakes within the past 5 years

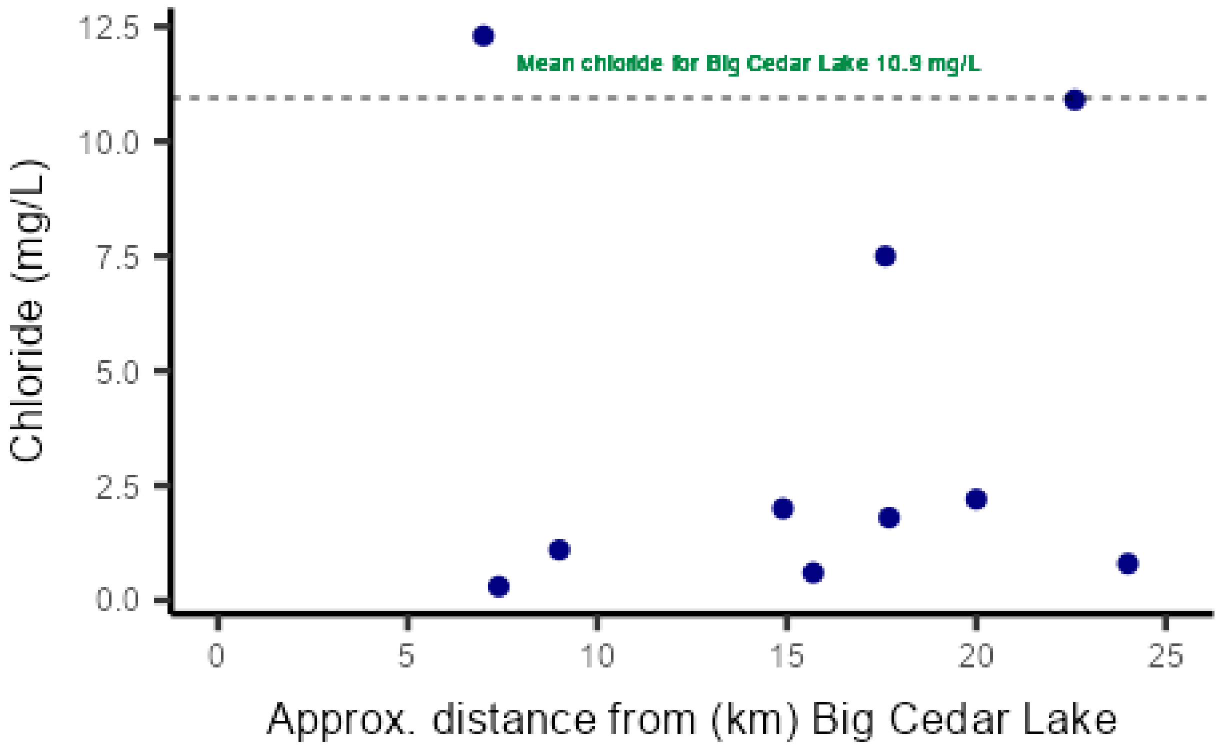


Figure 7. Scatterplot showing 5-year average chloride concentrations (2019-2024) for lakes sampled within a 50-km radius of Big Cedar Lake. The dashed line represents Big Cedar Lake's average chloride concentrations in the LPP since 2019. Lakes with insufficient data were excluded from this analysis. All data were collected by Lake Partner volunteers from 2019-2024. Information for each lake within distance of Big Cedar Lake can be found in the Appendix.

Summary of observations from nearby lakes

- In the LPP there are 11 lakes that have been sampled in the LPP within the last five years. The average Cl concentrations of these lakes in the last 5 years is 4.0 (mg/L).
- If you or someone you know would be interested in sampling a lake nearby Big Cedar Lake please reach out to lakepartner@ontario.ca to sign up to be a lake steward.
- When looking at nearby lakes please keep in mind that these lakes can be characteristically entirely separate from Big Cedar Lake and the only aspect that relates Big Cedar Lake to these other lakes is location and whether they are on the Canadian Shield or not.

Calcium

What is calcium?

Calcium (Ca) occurs naturally in soils as a result of weathering rocks, atmospheric deposition, and organic matter decomposition. Ca concentrations in many of Ontario's lakes within the Precambrian Shield have decreased over the last 40 years as a result of acid precipitation, deforestation, and land use change which have depleted watershed stores of Ca (Giardini and Yan, 2015).

Ca is an important nutrient to many lake-dwelling organisms, such as mollusks, clams, amphipods, and crayfish. **Daphnia**, commonly referred to as water fleas, are an important food source for fish and are susceptible to decreasing calcium levels. Laboratory research has shown that the growth and reproduction of sensitive ***Daphnia*** species may be negatively affected at Ca concentrations below 1.5 mg/L. Decreasing Ca levels can be particularly threatening to freshwater lakes when Cl levels are high or rising do to the additional stress it adds for zooplankton populations (Arnott et al, 2022). The LPP began monitoring Ca concentrations in lake water samples in 2008 to observe trends and identify lakes that were experiencing changes in lake Ca concentrations.

To learn more about why healthy **Daphnia** populations is so important for freshwater lakes please visit the ***Chloride*** tab. If you are interested in helping address Ca levels in the lake you steward please visit the **Best Practices** tab.

Big Cedar Lake's calcium concentrations compared to other on-Shield lakes

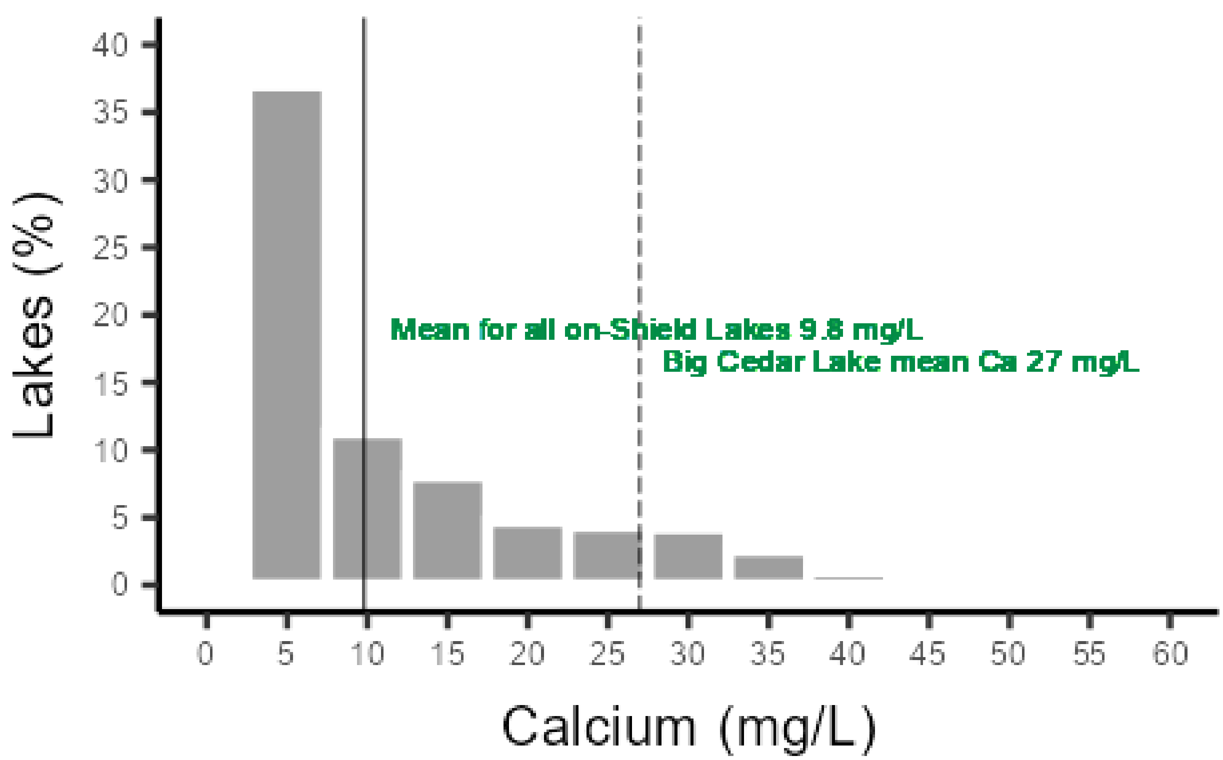


Figure 8. Histogram showing the distribution of ice-free spring average Ca concentrations for 786 lakes located on the Precambrian Shield sampled as part of the Lake Partner Program between the years 2008-2024. The dashed line represents Big Cedar Lake's spring average ice-free Ca concentration for the years 2008 to 2024 (27.0 mg/L). The solid black line represents the ice-free average calicum concentration of all LPP lakes located off the Precambrian Shield from 2008-2024 (9.8 mg/L). The level at which some aquatic animals (mainly, some ***Daphnia***) become at risk of Ca deficiency is 1.5 mg/L.

Summary: Big Cedar Lake's compared to other on-Shield lakes

- The average Ca concentration between 2008 and 2024 is 27.0 mg/L.
- Big Cedar Lake falls into the nintieth percentile of Ca concentrations in on-Shield lakes. This means that 10 percent of lakes have higher Ca concentrations than Big Cedar Lake.
- Ca in Big Cedar Lake is well above the threshold in which sensitive aquatic species may be at risk (1.5 mg/L).

What do Big Cedar Lake's calcium concentrations look like over time?

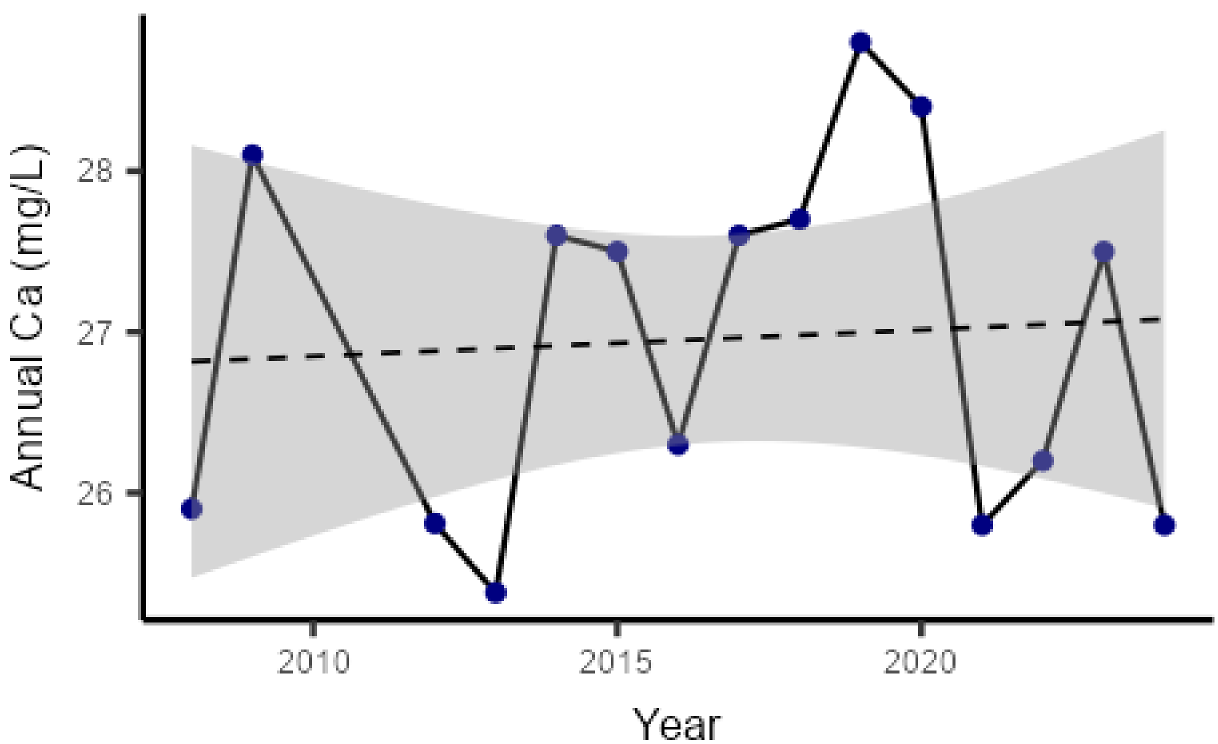


Figure 9. Ca concentrations in Big Cedar Lake increased over time, but this change was not significant. This was determined using a Mann-Kendall trend test, which provided a p-value of 1.0 (a p-value indicates the likelihood of a trend, with a p-value of less than 0.05 providing strong evidence that there is a trend). The shaded area represents the range of values within which we are 95% confident the true calcium concentration is. All samples were taken shortly after the ice-free period of each season. Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake water quality. The trends shown here are meant to provide general information only and may not capture the full complexity of the lake's water chemistry.

Summary: Big Cedar Lake's calcium trends over time

- Between 2008 and 2024 Ca concentrations in Big Cedar Lake had no significant statistical change.
- During this time Ca concentrations fluctuated between 25.4 mg/L in 2013 to 28.8 mg/L in 2019.

Calcium in nearby lakes within the past 5 years

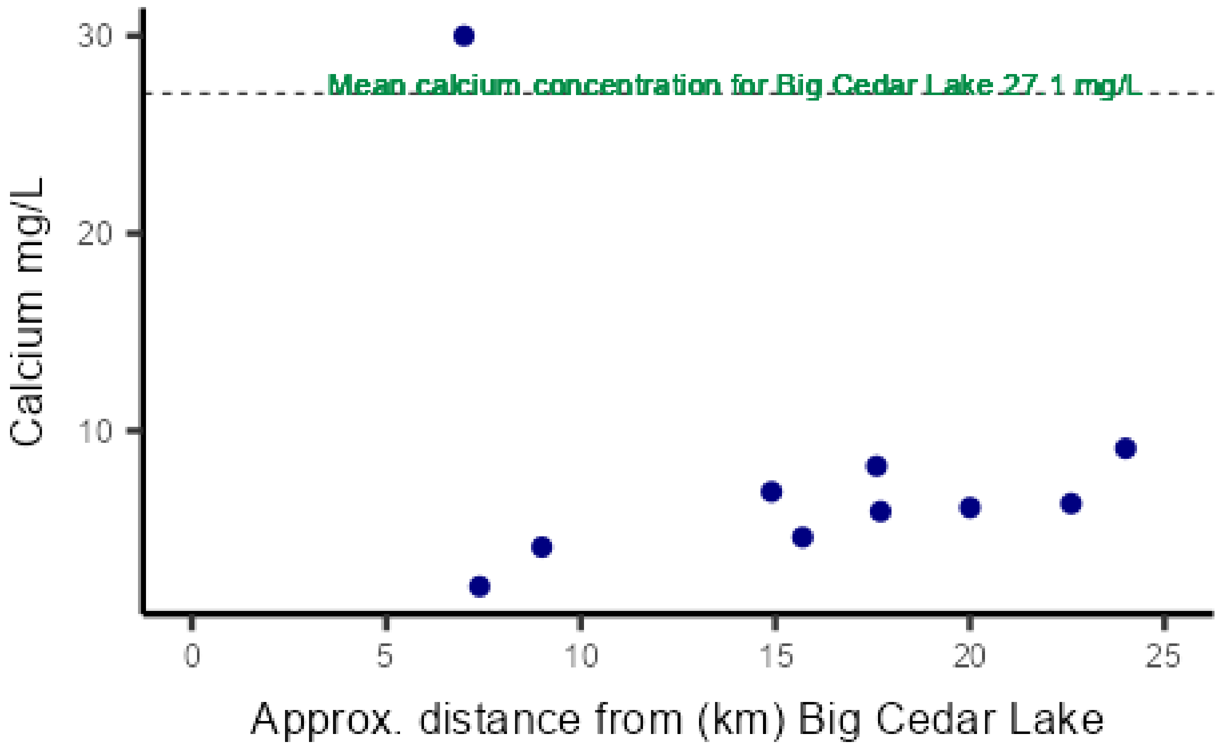


Figure 10. Scatterplot showing 5-year average calcium concentrations (2019-2024) for lakes sampled within a 50-km radius of Big Cedar Lake. The dashed line represents Big Cedar Lake's average calcium concentrations in the LPP since 2019. Lakes with insufficient data were excluded from this analysis. All data were collected by Lake Partner volunteers from 2019-2024.

Summary of observations from nearby lakes

- In the LPP there are 11 lakes that have been sampled in the LPP within the last five years. The average Ca concentrations of these lakes in the last 5 years is 8.3 (mg/L).
- If you or someone you know would be interested in sampling a lake nearby Big Cedar Lake please reach out to lakepartner@ontario.ca to sign up to be a lake steward.
- When looking at nearby lakes please keep in mind that these lakes can be characteristically entirely separate from Big Cedar Lake and the only aspect that relates Big Cedar Lake to these other lakes is location and whether they are on the Canadian Shield or not.

Water Clarity

What is Secchi Depth?

LPP volunteers track the water clarity of their lake by measuring how deep into the water a Secchi disk can be submerged before disappearing from sight. Light penetration into the lake can be controlled by dissolved organic carbon (DOC), biological turbidity (e.g. algae) and non-biological turbidity, which can influence the colour of the lake.

Water clarity readings with a Secchi disk are valuable for tracking change in lake transparency that may not be observed by monitoring TP concentrations alone. For example invasive species (e.g., zebra mussels) can alter water transparency, as can the presence of wetlands in a watershed.

Big Cedar Lake's water clarity compared to other on-Shield lakes

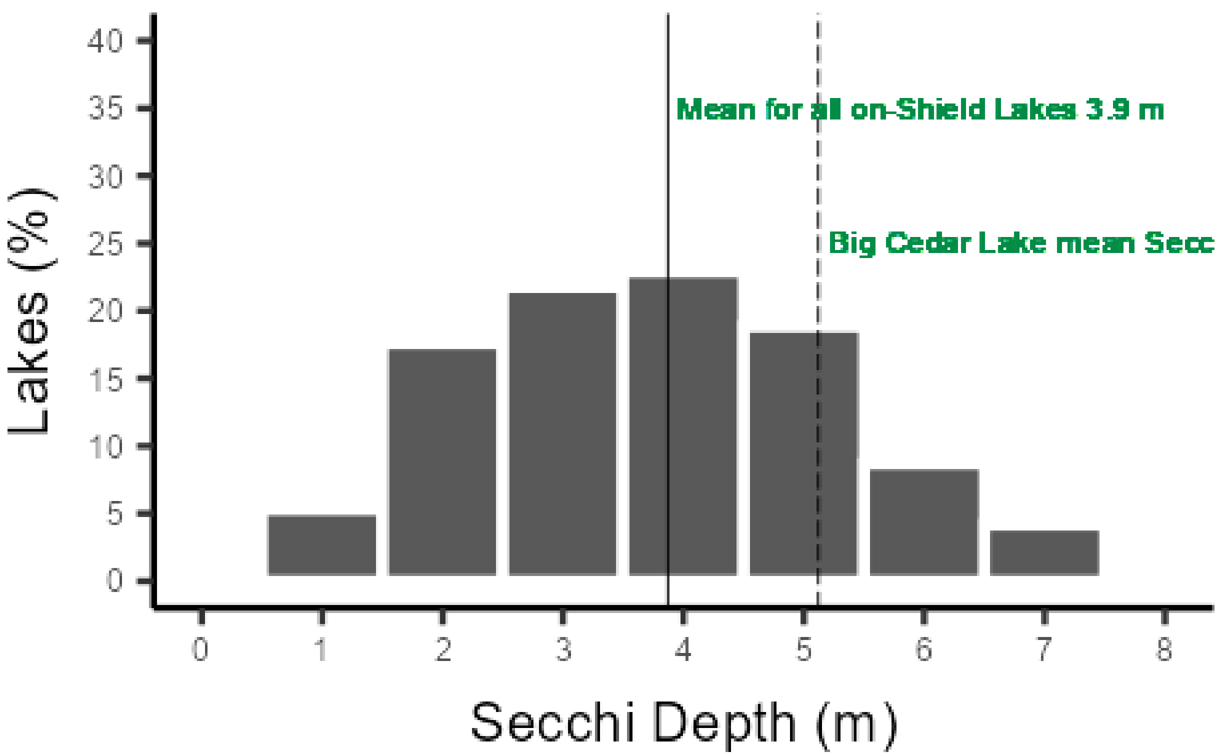


Figure 11. Histogram showing the distribution of Secchi depths (measured with a Secchi disk, Secchi depth is used as a representative of water clarity) for 895 LPP lakes for years 2000-2022. The dashed line represents the mean Secchi depth (5.1) (m) for Big Cedar Lake. The solid line represents the average Secchi depth of all LPP lakes located on the Precambrian Shield (3.9). Note that Secchi depth averages for each lake were calculated using data collected in July-September, as previous research has shown that these are the most stable months for inland lake water clarity and hence, are suitable for making comparisons among lakes (MECP, unpublished data; Bruhn & Soranno (2005)).

Summary: Big Cedar Lake's water clarity compared to other on-Shield lakes

- The average Secchi depths between 2000 and 2022 is 5.1 m.
- Big Cedar Lake falls into the seventy-seventh percentile of Secchi depth on-Shield lakes in the LPP. This means that 23 percent of lakes have higher Secchi depth's than Big Cedar Lake.

What does Big Cedar Lake's Secch depth look like over time?

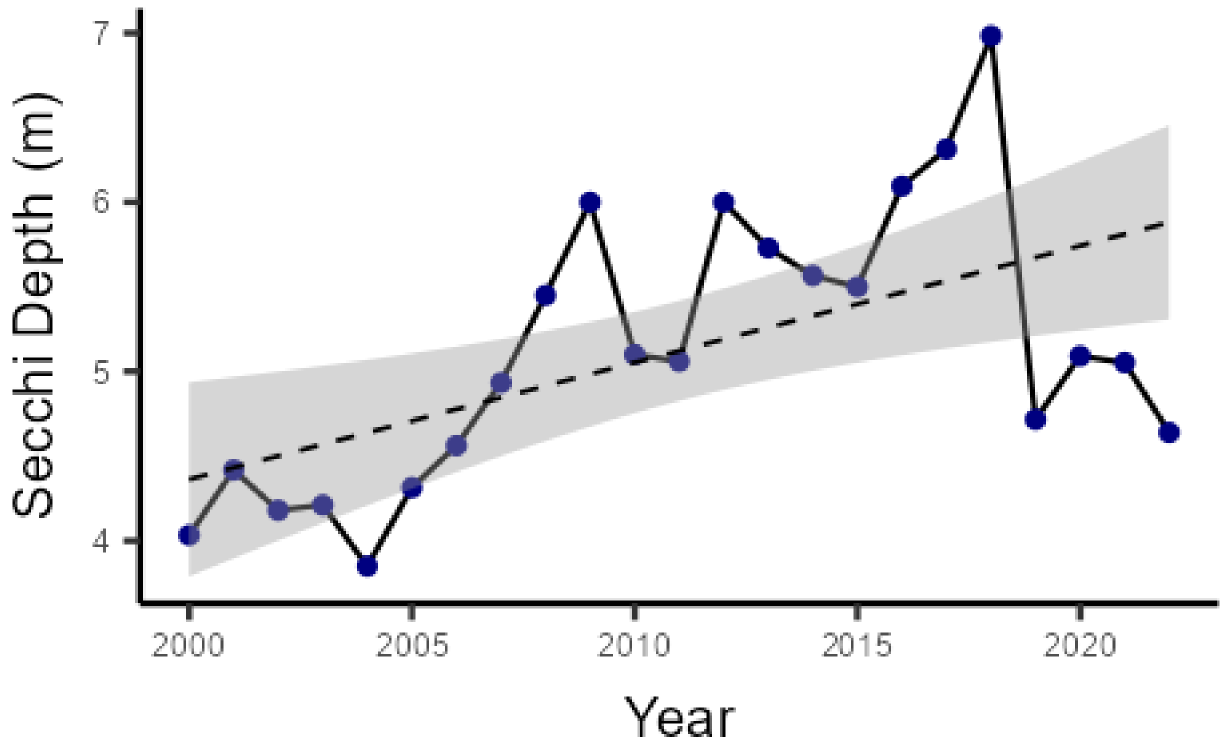


Figure 12. Water clarity (as measured with a Secchi disk) in Big Cedar Lake have increased over time, this change was significant. This was determined using a Mann-Kendall trend test, which provided a p-value of 0.002 (a p-value indicates the likelihood of a trend, with a p-value of less than 0.05 providing strong evidence that there is a trend). The blue points represent the average Secchi depths for July-September of each year. The dotted line represents a linear model representing the overall trend over time. The shaded area represents the range of values within which we are 95% confident the true Secchi depth lies. Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake health. All samples taken during ice-free season of each year (May-October). Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake water quality. The trends shown here are meant to provide general information only and may not capture the full complexity of the lake's water chemistry.

Summary: Trends in Big Cedar Lake's annual water clarity:

- Between 2000 and 2022 water clarity levels in Big Cedar Lake had significantly increased .
- During this time water clarity levels fluctuated between 3.8 m in 2004 to 7.0 m in 2018.

Secchi depth in nearby lakes within the past 5 years

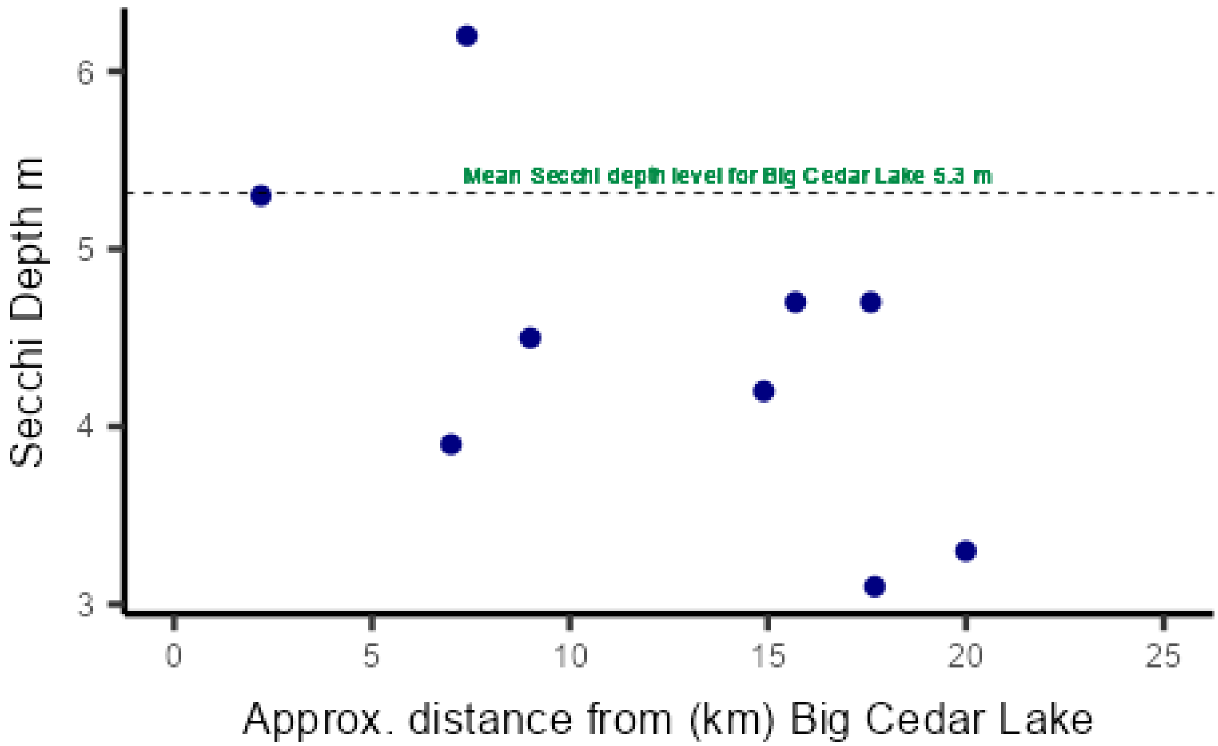


Figure 13. Scatterplot showing 5-year average Secchi depth levels (2019-2024) for lakes sampled within a 50-km radius of Big Cedar Lake. The dashed line represents Big Cedar Lake's Secchi depth levels in the LPP since 2019. Lakes with insufficient data were excluded from this analysis. All data were collected by Lake Partner volunteers from 2019-2024.

Summary of observations from nearby lakes

- In the LPP there are 11 lakes that have been sampled in the LPP within the last five years. The Secchi depths of these lakes in the last 5 years is 4.4 (m).
- If you or someone you know would be interested in sampling a lake nearby Big Cedar Lake please reach out to lakepartner@ontario.ca to sign up to be a lake steward.
- When looking at nearby lakes please keep in mind that these lakes can be characteristically entirely separate from Big Cedar Lake and the only aspect that relates Big Cedar Lake to these other lakes is location and whether they are on the Canadian Shield or not.

Best Practices

Importance of lake stewardship in a changing climate:

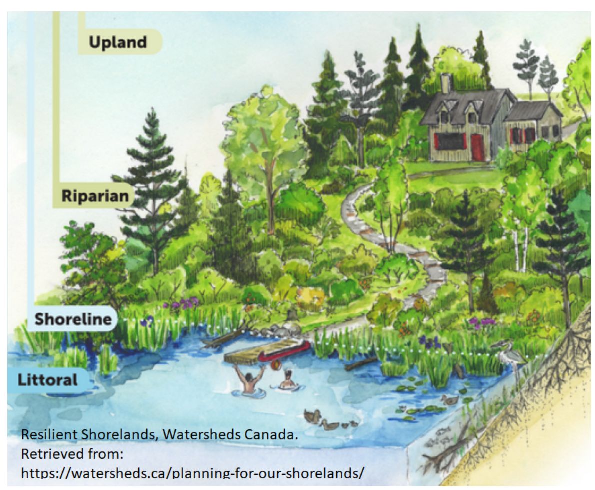
The impacts of climate change in Ontario are already being observed and are already effecting ecosystems across the province. As residents of Ontario that rely on and are stewards of the many freshwater lakes that bless this land we must base our stewardship and actions on the reality that climate change is and will continue to greatly effect these ecosystems.

The impacts of climate change that have already been seen include an increase in air temperature of over 2 degrees in northern Ontario and over 1 degree in southern Ontario over the last 40 years (Shah et al., 2022). Though this change seems small it has a large impact on the way ecosystems function. For instance, with this increase in air temperature has come an increase in water temperature, which has contributed to an increase in algae growth and ultimately algae blooms (Favot et al., 2023).

With this in mind, there is still many steps we can take to make lakes across Ontario more resilient to the effects of climate change and be less threatened and stressed by the many negative effects humans have on the ecosystem we rely on. In fact, those who live closest to these lakes are the ones who have the biggest opportunity to help steward these lakes for future generations.

Shorelines are the first line of defense:

Shorelines are the connection between lakes and land, playing a vital role in ensuring the strength and resiliency of freshwater lakes. What is often forgotten when discussing shorelines is that they extend beyond the point where water meets land, reaching from the upland area and far into the lake itself. Watershed Canada's **The Science Behind Vegetated Shoreline Buffers** discusses the importance of shorelines, the they play, and how you can establish a strong shoreline yourself. Much of the information in the following section is pulled from this resource, which is linked below.



Resilient Shorelands, Watersheds Canada. Retrieved from: https://watersheds.ca/planning-for-our-shorelands/

As seen in the image to the right, a strong, healthy, and resilient shoreline involves more than a small buffer zone along the water's edge. It begins with the upland area, which should consist of a forest-like community of shrubs, trees, and grasses. This area produces organic matter, such as leaf litter and woody debris, which helps cycle important nutrients and minerals like calcium back in the lake (Vanderbosch and Galatowitsch, 2010). The upland area also acts as the first barrier to land-based pollutants that may otherwise enter into the lake.

The riparian zone is the transition area from upland to shoreline. 70% of land-based species rely on the riparian zone at some point during their life cycle. This area of the shoreline should be biodiverse and consist of both moisture-tolerant and deep-rooted plants. This area also plays a critical role, similar to the upland area, in providing a line of defense for any pollutants entering the lake via surface water runoff.

The shoreline (where land meets the lakes edge) should similarly have a mix of herbaceous plants, shrubs, trees and woody species that can produce organic matter creating a net of roots and organic matter providing stabilization. Specifically, deep-rooted plants provide shoreline structure and prevent erosion from wakes, winter ice, rain, and wind.

Often when thinking of shorelines, people forget about the littoral zone, which is the area along the shore where light can still reach the lake bottom. This zone is crucial for the lake's ecosystem. Nearly all aquatic life will rely on the littoral zone sometime during their life cycle. Removing "weeds" in favor of sandy lake bottoms can harm many of the aquatic organisms who rely on these plants, ultimately harming the lake ecosystem. The emergent and submerged plants in the littoral zone also provide habitat for fish, frogs, snails and waterfowl. These plants act like an underwater forest by offering shelter and food. Removing them can be as harmful to aquatic species as deforestation is to land animals.

If you want to learn more about how you can improve your shoreland you can visit Watershed Canada's website and see their **Natural Edge** program that provides shoreline property owners with the resources to naturalize their shoreline. For more information on healthy shorelines please visit both of the links below available in the **References** section.

Curbing Road Salt Runoff in Your Area:

As discussed in the Chloride section of this report road salt runoff is contributing to the rise in the chloride levels in freshwater lakes across Ontario. This rise in chloride across freshwater lakes in Ontario is a threat to the lakes food structures and specifically the **Daphnia** populations in these lakes.

To help curb this trend, it's important to ensure that best practices are in place to reduce road salt runoff where possible. In the above section, we discussed how a healthy shoreline can discourage surface pollutants from entering the lake. Although these buffers can help prevent road salt from entering the lake, road salt still permeates in the environment despite vegetated buffers and other naturalized areas around lakes.

Due to salt's ability to persist in the environment, different techniques must be used to address the rise in salt across Ontario's freshwater lakes.**Smart about Salt** is an organization that has been working hard to get the message out about the effects of salt and how we can address it. Some of the individual acts you can do to curb road salt runoff include shoveling before using salt allowing for less salt use, using kitty liter or other traction tools to prevent slipping, sweeping up salt and saving it for later use, prevent future icy buildups by redirecting downspouts away from walkways and driveways as well as shoveling unsalted snow to lower areas such as laws to direct snow melt away from paved areas, and just using less salt can go a long way in preventing individual excessive salt use (Smart About Salt Council, Retrieved 2024, October 24).

A great way to improve salt use and salt runoff in your area is by ensuring snow removal companies, municipalities, and other relevant parties are trained on how to mitigate salt use while ensuring slip prevention. The Smart About Salt Council offers a **smart about salt training** that can go a long way to decreasing salt runoff.

General education of others on the effects of road salt runoff and how to decrease it is also an important step to decreasing salt runoff across Ontario. FOCA's website includes a road salt webpage that provides general information on this topic.

To find any of the resources mentioned please visit the **References** section below.

Addressing Declining Calcium Levels in Freshwater Lakes:

Freshwater lakes in Ontario have seen a decline in calcium levels in recent decades due to a combination of acid deposition and subsequent recovery, and deforestation and land use practices. As discussed in the **Calcium** section, concentrations below 1.5 mg/L can be threatening to certain organisms, especially if that lake also has high chloride concentrations (Arnott et al., 2020). Calcium is often introduced into lakes through erosion of bedrock overtime. Because of this process it can take a long time to replenish concentrations especially on the Canadian Shield where the granite bedrock erodes much slower than the limestone bedrock in southern Ontario (Giardini et al., 2015). This problem is further exaggerated when other calcium sources have been removed from the ecosystem through deforestation or land use change.

Increasing naturalized areas around lakes as a great way to re-establish calcium sources. Whether this be through protecting forested areas or by taking empty lots and re-foresting/naturalizing them it can have a positive long-term impact on the lake and the surrounding watershed. The reason having these naturalized areas around a watershed can help with calcium e-introduction is because leaf litter and woody debris contains calcium and when it is left to decompose back into the soils it allows for calcium to b re-introduced into the lake system.

Emerging research by **The Friends of the Muskoka Watershed** has looked at the potential of spreading residential wood ash on forest floors in central Ontario to re-introduce calcium into watersheds. If you are in the Muskoka area or just interested in this work you can visit their webpage in the **References** section and get involved with their work.

Background Info

History of the Lake Partner Program

The LPP is a volunteer-based, inland lakes water quality monitoring program in Ontario. The LPP enables lake stewards to monitor total phosphorus, calcium, chloride, and water clarity. LPP volunteers begin sampling each spring approximately two weeks after the lake ice has melted. Water samples are collected once per year for lakes located on the Precambrian Shield (representing about 90% of lakes in the program) and approximately six times per year for lakes located off the Precambrian Shield. Secchi disk measurements are made at least monthly throughout the sampling season (May-October). All data is posted online to Ontario's website. Please refer to the **Reference** page to find a link to this database.

The LPP began in 1996. The program evolved from the Ministry's Self-Help Program, which collected information on chlorophyll and water clarity since the early 1970s. In 2002, the LPP relocated from Toronto to the Dorset Environmental Science Center in Muskoka, where low-level total phosphorus analyses could be completed. The program continued to grow throughout the 2000s as the number of volunteers increased.

The LPP has partnered with the Federation of Ontario Cottagers' Associations (FOCA) since the start of the program in 1996. Through this partnership, FOCA's Lake Stewards are volunteer samplers, and FOCA provides outreach and stewardship to Ontario's lakefront communities and distributes water quality information to the public through their website, presentations, and email communications.

Federation of Ontario Cottagers' Associations

The Federation of Ontario Cottagers' Associations (FOCA) is a not-for-profit membership organization that has been the voice of the Ontario waterfront since 1963. Today, FOCA has over 525 lake, road and residents' association members, representing 50,000 waterfront property owning families across the province. FOCA's Lake Stewards contribute hundreds of water quality data points each year to the Lake Partner Program.

If you would like more information about what you can do, visit the FOCA webpage for resources on shoreline management, invasive species, and lake health management. Link available in the **References** page.

Why water monitoring is crucial

None of the information or data in this report would be possible without the monitoring of fresh water lakes across Ontario by the volunteers in the LPP. Monitoring of freshwater lakes is a key to understanding lake health and maintaining healthy lakes across Ontario. To learn more about citizen science and the importance of water monitoring, you cab download FOCA's Guide by visiting the link available in the **References** page.

How to contact us

For any questions about the report you can reach out to the lakepartner@ontario.ca email address or call us at 1-800-832-8700.

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FOCA's guide to citizen science: https://foca.on.ca/wp-content/uploads/2018/02/FOCA-Citizen-Science-Guide-PRINT-2021ADJ_REVfinal.pdf

FOCA's Lake Partner Program webpage: https://foca.on.ca/lake-partner-program/

Lake Partner Program public database: https://data.ontario.ca/dataset/ontario-lake-partner

Smart About Salt webpage: https://smartaboutsalt.wildapricot.org/

Smart About Salt Training program: https://smartaboutsalt.wildapricot.org/take-training

The Friends of the Muskoka Watershed webpage: https://fotmw.org/get-involved/#ash

Watershed Canada's publication **The Science Behind Vegetated Shoreline Buffers: why the Ribbon of Life Matters**: https://watersheds.ca/pfos-webinar-nov-28-2022/

Watershed Canada's Natural Edge Program: https://watersheds.ca/our-work/the-natural-edge/

Appendix A

Past five year averages of the parameters for each site on Big Cedar Lake can be seen in the table below. Sites with insufficient data were excluded from this analysis. All data were collected by Lake Partner volunteers from 2019-2024.

Lake Name	Site	Shield	Total Phosphorus mcg/L	Calcium mg/L	Chloride mg/L	Secchi Depth m
BIG CEDAR LAKE	1	TRUE	6.29	27.08	10.95	4.99

Note on Appendix A: If Site ID = NA it is representative of entire lake or mean of all sites. “mcg” and “μg/L” represent micrograms per liter.

Appendix B

A table displaying all parameters levels for the past 5-years of lakes within 25 kilometer distance of Big Cedar Lake. All data were collected by Lake Partner volunteers from 2019-2024.

Lake Name	STN	Distance (km)	Shield	Total Phosphorus mcg/L	Calcium mg/L	Chloride mg/L	Secchi Depth m
ANSTRUTHER LAKE	96	15.75	TRUE	5.52	4.60	0.60	4.74
BEAVER LAKE (MCINNIS)	7040	17.68	TRUE	8.68	5.87	1.82	3.12
BUZZARD LAKE	678	7.44	TRUE	5.32	2.06	0.32	6.18
CATCHACOMA LAKE	782	20.00	TRUE	5.45	6.11	2.15	3.27
JULIAN LAKE	7075	2.22	TRUE	6.24	NA	NA	5.35
KASSHABOG LAKE	2242	17.61	TRUE	6.37	8.17	7.47	4.70
LONG LAKE	2770	9.04	TRUE	4.99	4.13	1.08	4.47
LOON CALL LAKE	2805	14.94	TRUE	5.48	6.93	2.00	4.16
METHUEN LAKE	7092	24.00	TRUE	7.34	9.12	0.77	NA
STONY LAKE	7133	6.96	TRUE	13.94	29.99	12.34	3.92
WEST TWIN LAKE	5814	22.56	TRUE	6.32	6.35	10.90	NA

Note on Appendix B: “mcg” and “μg/L” represent micrograms per liter.

Apendix C

A table displaying all parameter trends for lakes within 25 kilometer distance of Big Cedar Lake. All data were collected by Lake Partner volunteers from 2002-2024.

Lake Name	STN	Distance (km)	Shield	Trend TP	Trend Cl	Trend Ca	Trend Secchi
ANSTRUTHER LAKE	96	15.75	TRUE	NA	NA	NA	NA
BEAVER LAKE (MCINNIS)	7040	17.68	TRUE	NA	NA	NA	NA
BUZZARD LAKE	678	7.44	TRUE	NA	significant decrease	NA	significant decrease
CATCHACOMA LAKE	782	20.00	TRUE	NA	significant increase	NA	significant increase
JULIAN LAKE	7075	2.22	TRUE	NA	NA	NA	NA
KASSHABOG LAKE	2242	17.61	TRUE	NA	significant decrease	NA	significant decrease
LONG LAKE	2770	9.04	TRUE	NA	NA	NA	NA
LOON CALL LAKE	2805	14.94	TRUE	significant decrease	NA	significant increase	NA
METHUEN LAKE	7092	24.00	TRUE	NA	NA	NA	NA
STONY LAKE	7133	6.96	TRUE	NA	significant increase	NA	significant increase
WEST TWIN LAKE	5814	22.56	TRUE	NA	NA	significant increase	NA