



Lakewatch ᐱᐱᐱᐱᐱᐱᐱᐱ

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Summary Report

LICA Region Lakes 2023

Updated February 8, 2024

LakeWatch is Made Possible By:



ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data on Alberta Lakes. Equally important is educating lake users about their aquatic environment, encouraging public involvement in lake management, and facilitating cooperation and partnerships between government, industry, the scientific community and lake users. LakeWatch Reports are designed to summarize basic lake data in understandable terms for a lay audience and are not meant to be a complete synopsis of information about specific lakes. Additional information is available for many lakes that have been included in LakeWatch and readers requiring more information are encouraged to seek those sources.

ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeWatch program. These leaders in stewardship give us hope that our water resources will not be the limiting factor in the health of our environment.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would also like to thank Madeleine Koning and Kirsten Letendre who were summer technicians in 2023. Executive Director Bradley Peter and Program Managers Caleb Sinn and Brittany Onysyk were instrumental in planning and organizing the field program. This report was prepared by Brittany Onysyk and Bradley Peter.



INTRODUCTION

In 2023, ALMS received funding from the Lakeland Industry and Community Association (LICA), and Alberta Environment and Protected Areas to conduct LakeWatch, a participatory water quality monitoring program, for select lakes in the LICA region. This report presents a concise summary of key parameters from ten lakes which were sampled within the LICA region in the summer of 2023, and the figures presented below are simply meant to contextualize lakes in the LICA region, and are not necessarily comparisons of lake health. More comprehensive water quality reports are available for each individual lake from data collected in the 2023 season, and can be accessed on the ALMS website (<https://alms.ca/reports/>), along with historical reports for those lakes. These individual LakeWatch reports may also present trend analysis results, where enough historical data exists, which is the best approach for evaluating lake water quality and health over time.

SAMPLE RECORD

From June through October 2023, each of the ten lakes in the LICA region were sampled four times (Table 1). This sampling record represents a 100% completion rate.

Table 1. The LICA region lakes LakeWatch sample completion record for 2023.

Lake	Trip 1	Trip 2	Trip 3	Trip 4
Amisk	6-Jun	4-Jul	1-Aug	7-Sep
Crane	22-Jun	19-Jul	29-Aug	18-Sep
Garner	23-Jun	31-Jul	21-Aug	6-Sep
Laurier	9-Jun	7-Jul	19-Aug	1-Oct
Long	6-Jun	4-Jul	8-Aug	5-Sep
Marie	21-Jun	19-Jul	28-Aug	19-Sep
Minnie	27-Jun	20-Jul	23-Aug	22-Sep
Moose	8-Jun	21-Jul	27-Aug	15-Sep
Skeleton North	13-Jun	11-Jul	1-Aug	7-Sep
Skeleton South	26-Jun	11-Jun	4-Aug	5-Sep

STAFF, VOLUNTEERS, PARTNERS

Two LakeWatch technicians were hired in May 2023 to conduct water quality sampling, and Madeleine Koning was assigned the LICA region lakes. ALMS worked with 12 volunteers in the LICA region for a total of 151 volunteer hours spent lake sampling. Volunteers provided boats used for sampling, operated the boats, and assisted the LakeWatch technician with sampling procedures. Volunteers provided invaluable local knowledge about their lake that was used to contextualize lake conditions and improve lake sampling safety. Each year ALMS volunteers show outstanding dedication and commitment to the LakeWatch program.



LakeWatch Technician Madeleine sampling with a LICA summer student at Laurier Lake July, 2023.

RESULTS

While ALMS collects a large suite of water chemistry parameters, this report will highlight the variability which exists between lakes across only a few major parameters: Euphotic Depth, Total Phosphorus, Total Kjeldahl Nitrogen, Chlorophyll-*a*, Microcystin, major ions, and select metals. Please note that variation within these parameters does not necessarily reflect a degree of lake management. Many factors outside of human control can also impact lake water quality. The depth of the lake, the size of the drainage basin, lake order, and the composition of bedrock and sediment are some natural factors that affect lake water quality. These factors should be taken into consideration when interpreting these results. The results in this report are also presented as seasonal averages for comparability. Seasonal trends for some of the parameters presented below are available in each lake's individual 2023 LakeWatch [reports](#) (historical trends may also be available if enough data has been collected over time). Results are categorized into trophic status, or degree of lake productivity. More on trophic status, along with class criteria, can be found in 'A Brief Introduction to Limnology' on the ALMS [website](#).



A beautiful sampling day on Marie Lake, 2023.

WATER CLARITY AND EUPHOTIC DEPTH

Water clarity is influenced by suspended materials both living and dead, as well as dissolved colored compounds in the water column. During the melting of snow and ice in the spring, lake water can become turbid (cloudy) from silt transported into the lake. Lake water usually clears in late spring, then becomes more turbid with increased algal growth as the summer progresses. The easiest and most widely used measure of lake water clarity is the Secchi disk depth – the depth to which a checkered disk disappears. Two times the Secchi disk depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

Average euphotic depths within the LICA region in 2023 ranged from a minimum of 0.98 m at Skeleton Lake North to a maximum of 9.50 m at Marie Lake (Figure 1, Table 2). Skeleton Lake South and Moose Lake also had average euphotic depths that were relatively shallow (Figure 1). Lake profile depth, or the depth of the location where the Secchi depth measurement was taken, is also presented for context. Euphotic depth averages were significantly negatively correlated with average chlorophyll-*a* concentrations across the lakes (*p-value* = 0.02). This means that water turbidity appeared to be primarily associated with elevated growth of cyanobacteria and algae.

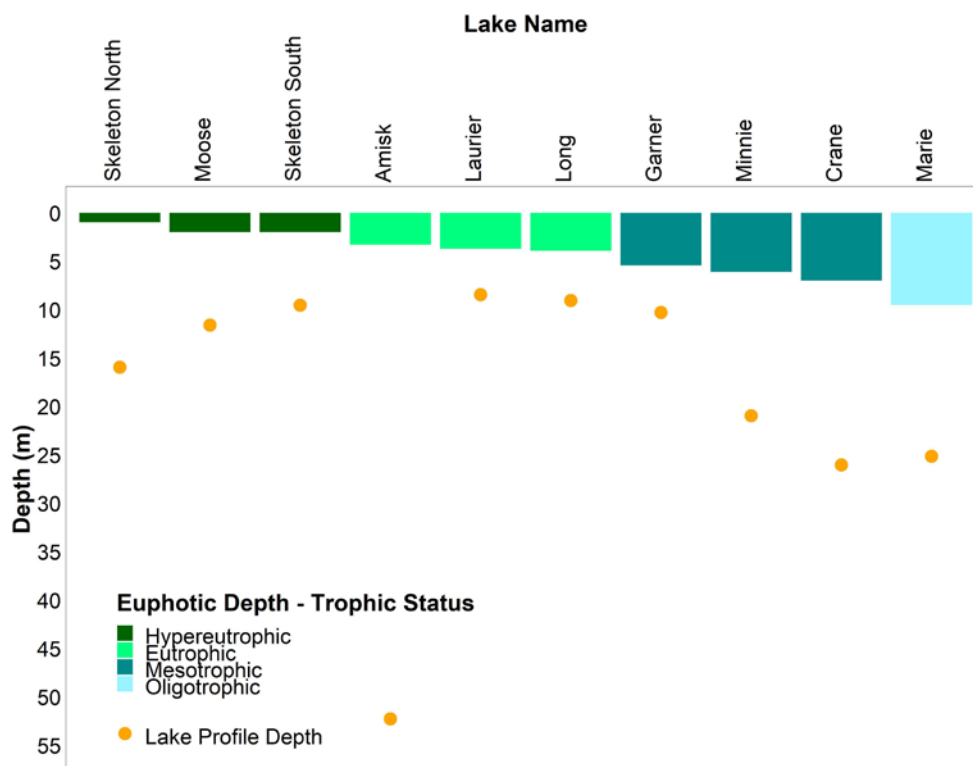


Figure 1. Average euphotic depth (m) and lake profile depth (m) values from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2023.

WATER CHEMISTRY – Total Phosphorus

ALMS measures a suite of water chemistry parameters. Phosphorus and chlorophyll-a are important because they are indicators of eutrophication, or excess nutrients, which can lead to harmful algal/cyanobacteria blooms. One direct measure of harmful cyanobacteria blooms are microcystins, a common group of toxins produced by cyanobacteria. Some lakes in Alberta have naturally high levels of phosphorus due to nutrient-rich geology, while others experience eutrophication resulting from human-related activities. High levels of phosphorus promote cyanobacteria growth, which is measured by assessing chlorophyll-a concentrations. Absolute values of phosphorus and chlorophyll-a alone do not point to human-caused eutrophication or naturally elevated nutrients, however the trajectory of those parameters over time, coupled with other lake information, may indicate whether the nutrient and chlorophyll-a levels are natural or human-caused.

Average total phosphorus concentrations ranged from a minimum of 7.3 µg/L at Marie Lake to a maximum of 71.5 µg/L at Skeleton Lake North (Figure 2, Table 2). Over the period of sampling by ALMS, upward trends in total phosphorus concentrations have been observed at Skeleton Lake North, Moose Lake, and Laurier Lake. These trends continue to be monitored, and ALMS has engaged with local stewards including the Moose Lake Watershed Society and the Skeleton Lake Stewardship Association.

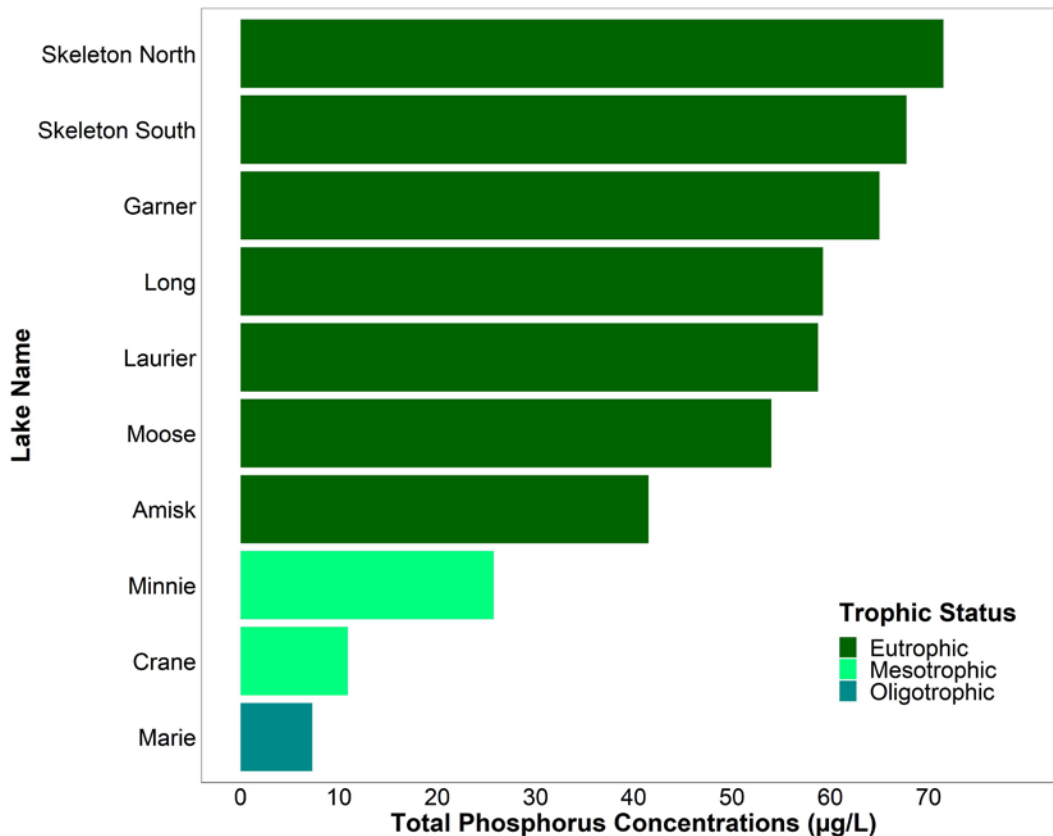


Figure 2. Average total phosphorus (TP) concentrations from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2023.

WATER CHEMISTRY – Total Kjeldahl Nitrogen

As with phosphorus, nitrogen is a nutrient that primary producers (plants and algae) require in order to grow. Some lakes in Alberta have naturally high levels of nitrogen due to nutrient-rich geology, while others experience eutrophication resulting from human-related activities. High levels of nitrogen may promote excessive cyanobacteria growth, although generally only if phosphorus levels are not limiting. Total Kjeldahl nitrogen represents the sum of organic forms of nitrogen, along with ammonia and ammonium.

Average total Kjeldahl nitrogen concentrations ranged from a minimum of 0.56 mg/L at Marie Lake to a maximum of 2.65 mg/L at Garner Lake (Figure 3, Table 2). Chlorophyll-*a* and total Kjeldahl nitrogen averages were significantly positively correlated across lakes (*p-value* = 0.047), meaning that for lakes sampled in the LICA region in 2023, high levels of nitrogen were correlated with high levels of cyanobacteria and algae. It should be noted that Skeleton Lake South had mid total Kjeldahl nitrogen concentrations of 1.80 mg/L, but experienced the highest levels of chlorophyll-*a* concentrations (67.48 µg/) (Figure 4, Table 2).

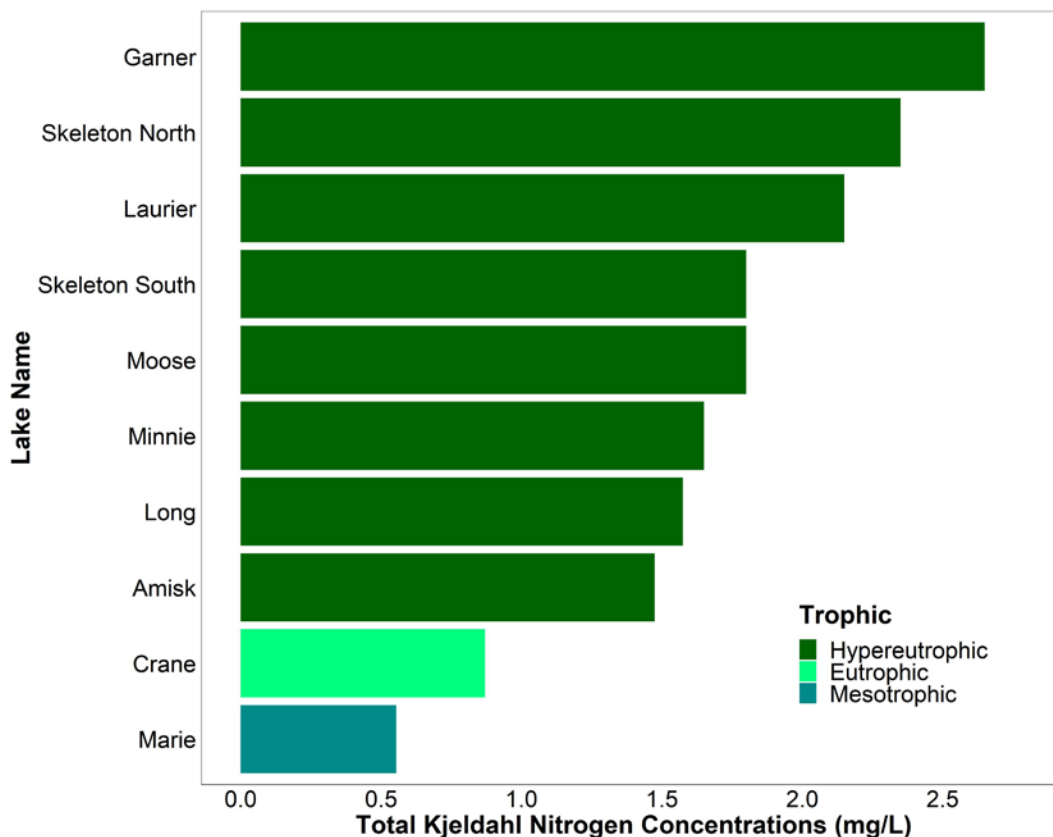


Figure 3. Average total Kjeldahl nitrogen concentrations from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2023.

WATER CHEMISTRY – Chlorophyll-a

Chlorophyll-a is the green pigment found in plants, algae, and cyanobacteria that allows them to photosynthesize. Measuring the concentration of chlorophyll-a is a proxy for how much algae and cyanobacteria is present in lake water, because all algae and cyanobacteria will produce chlorophyll-a to support photosynthesis.

Average chlorophyll-a concentrations ranged from a minimum of 3.13 µg/L at Marie Lake to a maximum of 67.48 µg/L at Skeleton Lake South (Figure 4, Table 2). Chlorophyll-a and total phosphorus averages were significantly positively correlated across lakes (p -value = 0.002), meaning that for lakes sampled in the LICA region in 2023, high levels of phosphorus were correlated with high levels of cyanobacteria and algae.

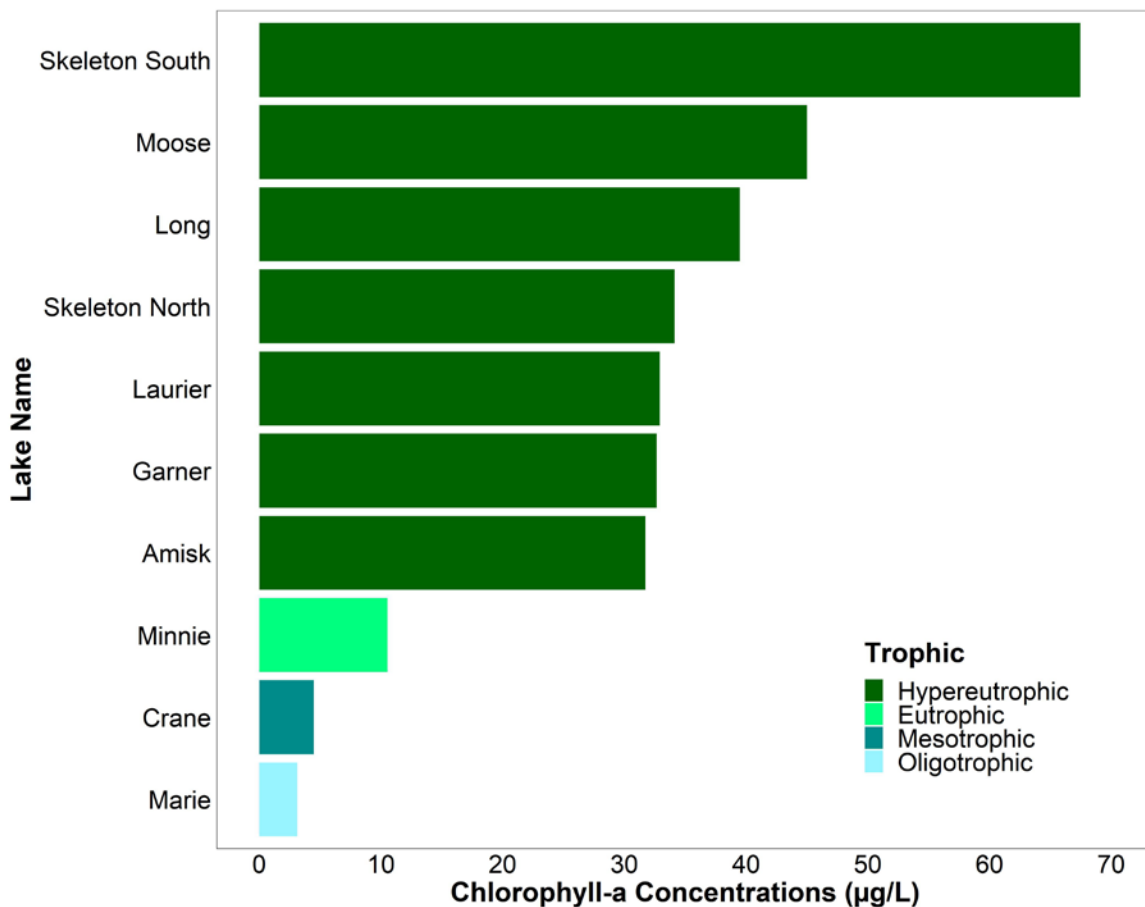


Figure 4. Average chlorophyll-a values from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2023.

WATER CHEMISTRY – Microcystin

Microcystins are toxins produced by cyanobacteria (blue-green algae) which, when ingested by mammals, can cause severe liver damage. Microcystins are produced by many species of cyanobacteria which are common to Alberta's Lakes, and are thought to be one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 10 µg/L, and as of 2023, the laboratory detection limit (the lowest level to which microcystin can be confidently detected by the analysis technique) is 0.1 µg/L.

Average microcystin concentrations ranged from <0.1 µg/L at Marie and Crane Lake to 10.04 µg/L at Skeleton Lake North (Figure 5, Table 2). The only lake to measure higher than the recreational guideline of 10 µg/L during any sampling event was Skeleton Lake North during the June 13th sampling event, with levels of 16.60 µg/L recorded. ALMS continue to monitor the situation at Skeleton Lake North, which has seen persistent toxic cyanobacteria blooms even throughout the winter season. ALMS has also designed an enhanced monitoring program to assess cyanotoxin concentrations at Moose Lake following dog mortalities in recent years. Specific locations on the lakes not sampled by ALMS may display toxin concentrations higher than the recreational guidelines, and caution should be observed when recreating in or around cyanobacteria. For more information about recreating in lakes with cyanobacteria, refer to [this document](#) produced by Alberta Health Services about frequently asked questions regarding cyanobacteria.

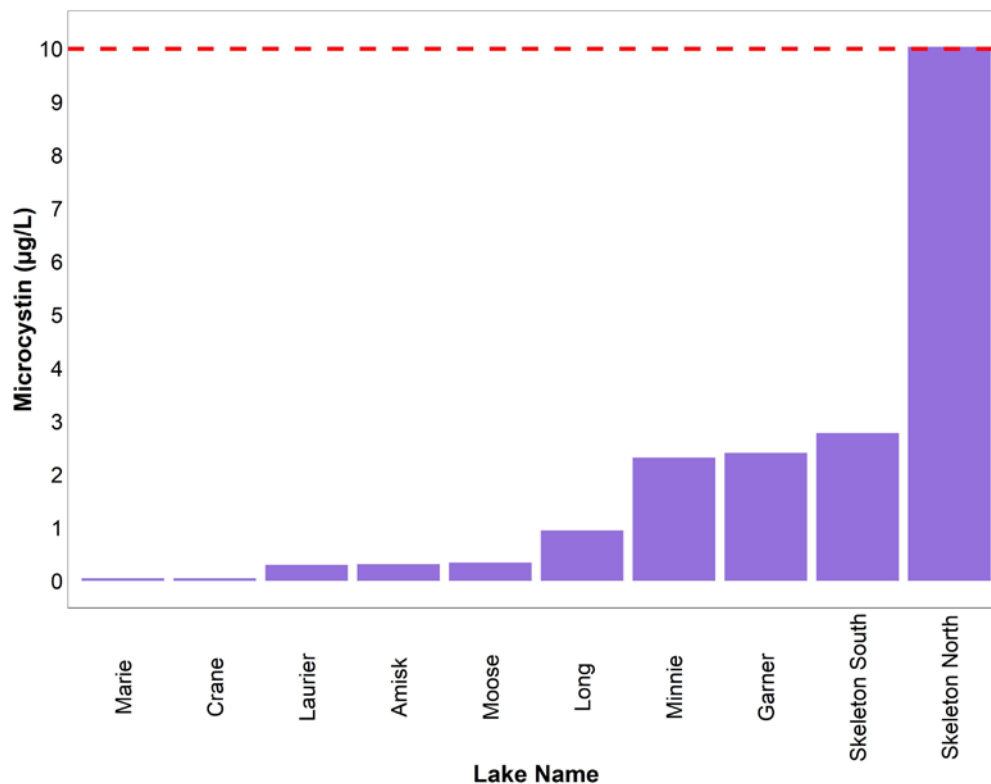


Figure 5. Average microcystin concentrations from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2023. Alberta's recreational guideline of 10 µg/L is indicated by the red horizontal dashed line.

WATER CHEMISTRY – Ion Chemistry

Measuring specific ion abundances helps to better understand the nuances between lakes in terms of their water chemistry. Differences in the levels of these ions, or salts, may indicate a relatively high groundwater contribution, run-off of surrounding geology or road salts applications, or if levels are low, that surrounding geology contributes little salts, and instead dilutes levels present in the lake. Ion concentration may also increase in times of low rainfall or increased evaporation of lake water. Ion levels are important to monitor as certain organisms will have sensitivities to specific ions, and high levels of certain ions may aid to identify the source, whether natural or human-caused.

Average levels of different ions varied between the lakes sampled in the LICA region within the 2023 LakeWatch season (Figure 6). Comparatively low variability in calcium and bicarbonate was observed across the lakes. Marie Lake displayed the lowest levels of all ions, with the exception of calcium, where calcium levels were actually the highest levels recorded. In contrast, Cane Lake experienced the lowest levels of calcium. Garner Lake, Moose Lake, and Minnie Lake displayed the highest levels of all other ions. Interestingly, ion levels were very comparable for both Skeleton Lake North and South, with the exception of sulphate, where Skeleton Lake North had levels over five times higher than those at Skeleton Lake South.

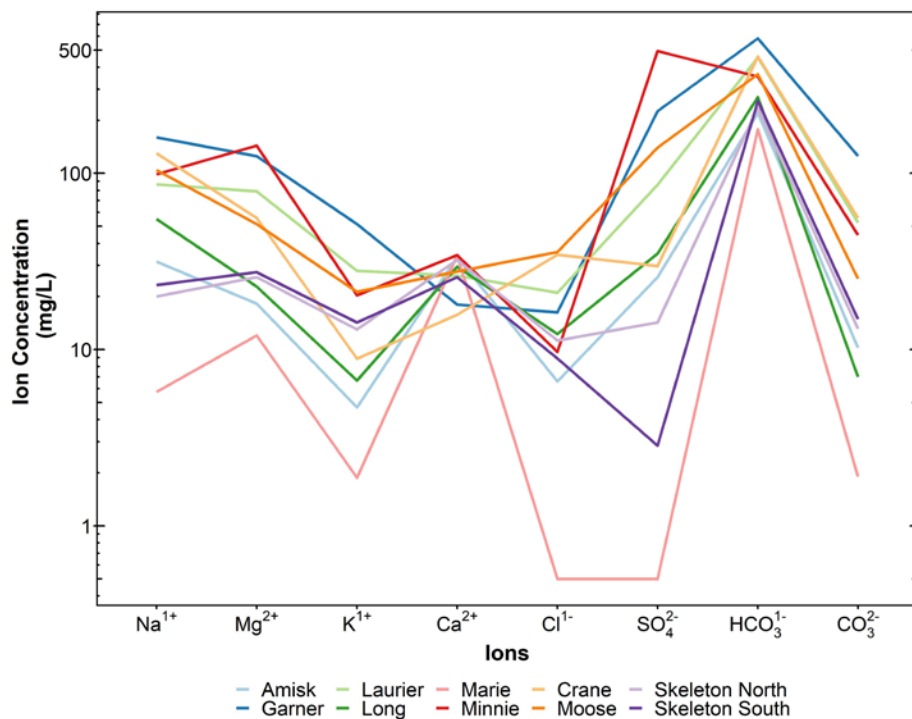


Figure 6. Average levels of cations (sodium = Na¹⁺, magnesium = Mg²⁺, potassium = K¹⁺, calcium = Ca²⁺) and anions (chloride = Cl¹⁻, sulphate = SO₄²⁻, bicarbonate = HCO₃¹⁻, carbonate = CO₃²⁻) from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2023 (note log₁₀ scale on y-axis).

SUMMARIZED PARAMETERS

Table 2. Average water chemistry (nutrients, chlorophyll-a, and microcystin), euphotic depth, and lake profile depth summaries for LICA region lakes sampled through the LakeWatch program during the summer of 2023.

Lake Name	Total Phosphorus (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Chlorophyll-a (µg/L)	Microcystin (µg/L)	Euphotic Depth (m)	Lake Profile Depth (m)
Amisk	41.5	1.48	31.73	0.31	3.29	52.3
Crane	10.9	0.87	4.48	<0.1	7.00	26.0
Garner	65.0	2.65	32.65	2.41	5.43	10.3
Laurier	58.8	2.15	32.90	0.30	3.70	8.4
Long	59.3	1.58	39.50	0.95	3.90	9.0
Marie	7.3	0.56	3.13	<0.1	9.50	25.1
Minnie	25.8	1.65	10.55	2.32	6.10	20.9
Moose	54.0	1.80	45.00	0.35	1.98	11.6
Skeleton North	71.5	2.35	34.13	10.04	0.98	15.9
Skeleton South	67.8	1.80	67.48	2.78	1.98	9.5

INVASIVE SPECIES

Dreissenid mussels pose a significant concern for Alberta because they impair the function of water conveyance infrastructure and adversely impact the aquatic environment. These invasive mussels can change lake conditions which can then lead to toxic cyanobacteria blooms, decrease the amount of nutrients needed for fish and other native species, and cause millions of dollars in annual costs for repair and maintenance of water-operated infrastructure and facilities. Spiny water flea also pose a concern for Alberta because they alter the abundance and diversity of native zooplankton, as they are aggressive zooplankton predators. Through over-predation, they will impact higher trophic levels such as fish. They also disrupt fishing equipment by attaching in large numbers to fishing lines.

Invasive species monitoring involved sampling with a 63 µm plankton net at three sample sites to look for juvenile mussel veligers and spiny water flea in each lake. In 2023, no mussels or spiny water flea were detected in the 10 LICA region lakes sampled.

Eurasian watermilfoil is a non-native aquatic plant that poses a threat to aquatic habitats in Alberta because it outcompetes native aquatic plants, grows in dense mats preventing light penetration through the water column, and reduces oxygen levels in the lake when these plants decompose. Eurasian watermilfoil can look similar to the native Northern watermilfoil, thus genetic analysis is necessary for species identification.

Watermilfoil specimens were collected from about half of the LICA region lakes sampled through the LakeWatch program in 2023. Samples were not collected from Amisk Lake, Laurier Lake, Marie Lake, Minnie Lake, and Skeleton Lake North, due to watermilfoil not being observed during sampling. All samples collected were identified as native Northern watermilfoil.

METALS

A surface sample was collected once at each lake in August to be used for metal analysis. In total, the abundance of 27 metals were investigated. It should be noted that many metals are naturally present in aquatic environments due to the weathering of rocks and may only become toxic at higher levels. In this report, we highlight the results of aluminum, arsenic, boron, and selenium as they have fallen above their recommended Canadian Council for Ministers of the Environment (CCME) guidelines in the LICA region in previous years. Individual LakeWatch reports will present the complete suite of metal results. In wet years, metals may be elevated as a result due to groundwater recharge and the weathering of rocks and sediments.

Although samples for metal analysis were collected from all 10 lakes in the LICA region, the samples from Skeleton Lake South did not arrive at the lab, and therefore no analysis was conducted on this lake.

Low levels of aluminum can be found in water naturally, however anthropogenic (human caused) sources of aluminum can include dust produced from agriculture, mining, and coal combustion. In 2023, none of the sampled lakes were in exceedance of the aluminum CCME guidelines for the Protection of Aquatic Life (100 µg/L; Table 3). Arsenic is found naturally elevated in the Beaver River Watershed. Arsenic can also be introduced into the aquatic environment through industrial or municipal discharges, or from the combustion of fossil fuels. In 2023, arsenic levels in Garner Lake and Minnie Lake exceeded the CCME guidelines for the Protection of Aquatic Life (5 µg/L; Table 3). Boron is naturally occurring in many minerals, particularly in clay-rich sediments. Natural weathering often releases boron into the environment at rates comparable to or greater than anthropogenic sources. Anthropogenic sources include municipal wastewater, irrigation (fertilizer and pesticide run-off), coal power plants, and other industries that use boron. In 2023, none of the sampled LICA region lakes exceeded the CCME guidelines for boron concentrations (1500 µg/L; Table 3). Selenium is an essential micronutrient for human function, and can also be found naturally in water. Anthropogenic sources of selenium include the burning of coal and oil, industrial and municipal wastewater, and agricultural run-off. In 2023, Minnie Lake exceeded the CCME guidelines for the Protection of Aquatic Life (1 µg/L; Table 3).

Table 3. Values of select metals for LICA region lakes sampled through the LakeWatch program in 2023. The Canadian Council for Ministers of the Environment (CCME) recommended guidelines for the Protection of Aquatic Life is included at the top of the table.

Lake	Aluminum (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Selenium (µg/L)
CCME PAL Guideline	100	5	1500	1
Amisk	9.3	1.17	79.7	0.2
Crane	4.4	4.41	304	0.8
Garner	8.3	5.47	251	0.8
Laurier	7.2	2.21	135	0.7
Long	12.3	1.62	111	0.2
Marie	3.9	0.55	18.7	<0.2
Minnie	2.7	8.00	147	1
Moose	2.5	2.05	164	0.7
Skeleton North	3.9	0.92	89.2	<0.2
Skeleton South	NA	NA	NA	NA