



*The Alberta Lake Management Society
Volunteer Lake Monitoring Program*

Summary Report

LICA Region Lakes 2022

Updated February 3, 2023

LakeWatch is made possible within the
LICA region with support from:





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 financial support of the Lakeland Industry and Community Association and the dedication of volunteers. We would also like to thank Kurstyn Perrin and Dominic Wong who were summer technicians in 2022. Executive Director Bradley Peter and Program Manager Caleb Sinn were instrumental in planning and organizing the field program. This report was prepared by Caleb Sinn and Bradley Peter.



INTRODUCTION

In 2022, 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 2022, 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 2022 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 contain 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 2022, each of the ten lakes in the LICA region were sampled four times, with the exception of Minnie Lake which was sampled only three times as Trip 1 was missed due to volunteer scheduling issues (Table 1). This sampling record represents a 98% completion rate.

Table 1- The LICA region lakes LakeWatch sample completion record for 2022.

Lake	Trip 1	Trip 2	Trip 3	Trip 4
Amisk	7-Jun	13-Jul	16-Aug	13-Sep
Crane	18-Jun	15-Jul	10-Aug	12-Sep
Laurier	28-Jun	22-Jul	17-Aug	15-Sep
Minnie	MISSED	6-Jul	10-Aug	6-Oct
Moose	21-Jun	15-Jul	6-Aug	14-Sep
Muriel	29-Jun	23-Jul	17-Aug	16-Sep
Pinehurst	9-Jun	6-Jul	9-Aug	6-Sep
Skeleton North	7-Jun	12-Jul	16-Aug	13-Sep
Skeleton South	18-Jun	12-Jun	15-Aug	3-Sep
Touchwood	10-Jun	7-Jul	9-Aug	7-Sep

STAFF, VOLUNTEERS, PARTNERS

Two LakeWatch technicians were hired by ALMS in May 2022 to conduct water quality sampling, and one was assigned the LICA region lakes. ALMS worked with 16 volunteers and partner technicians in the LICA region for a total of 209 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. In addition, ALMS partnered with Lac La Biche County Environmental Services Staff to sample Touchwood Lake and Pinehurst Lake, who provided a boat and assisted with sampling procedures.



LakeWatch volunteer Jeff sampling at Muriel Lake, 2022

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, Chlorophyll-a, Microcystin, major ions, and select metals. Please note that variation within these parameters does not necessarily reflect a degree of lake management, as many factors outside of human control also impact lake water quality. The depth of the lake, the size of the drainage basin, lake order (indicative of groundwater influx and position in hydrological network), and the composition of bedrock and sediment are just some of the factors which affect lake water quality and should be taken into consideration when interpreting these results. Results are also presented as seasonal averages for comparability. Seasonal trends (and in some cases, historical trends where enough data for a trend analysis is available) for some of the parameters presented below are available in each lake's individual 2022 LakeWatch [reports](#). 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](#).



LakeWatch Technician Dominic sampling Pinehurst Lake, 2022

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 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 2022 ranged from a minimum of 1.15 m at Skeleton Lake North to a maximum of 9.48 m at Touchwood Lake (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 (Kendalls' Tau-b, $\tau_b = -0.60$, $p\text{-value} = 0.02$). This means that water turbidity appeared to be primarily associated with elevated growth of cyanobacteria and algae. Muriel Lake also displayed an average euphotic depth that was almost as deep as the average lake profile depth (Figure 1). This means that light was likely reaching the bottom sediments across the majority of depths of the lake throughout the summer, likely having a large influence on the lake's aquatic plant distribution, and benthic (lake bottom) algae and cyanobacteria communities.

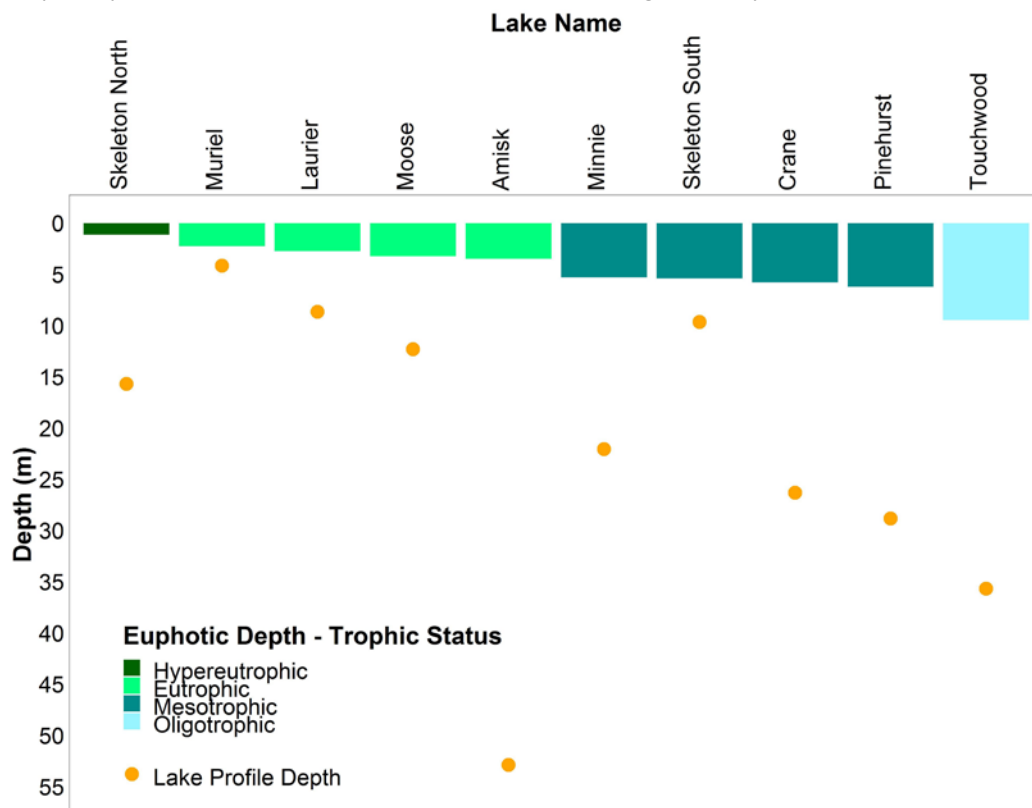


Figure 1. Average euphotic depth (m) and lake profile depth (m) values from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2022.

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 the extent to which nutrient and chlorophyll-a levels are natural or human-caused.

Average total phosphorus concentrations ranged from a minimum of 7.6 µg/L at Touchwood Lake to a maximum of 91.0 µg/L at Laurier Lake (Figure 2, Table 3). Total phosphorus and total Kjeldahl nitrogen averages were significantly positively correlated across lakes (Kendalls' Tau, $\tau = 0.69$, $p\text{-value} = 0.005$), meaning that for lakes sampled in the LICA region in 2022, increased levels of phosphorus were proportional to increased nitrogen levels.

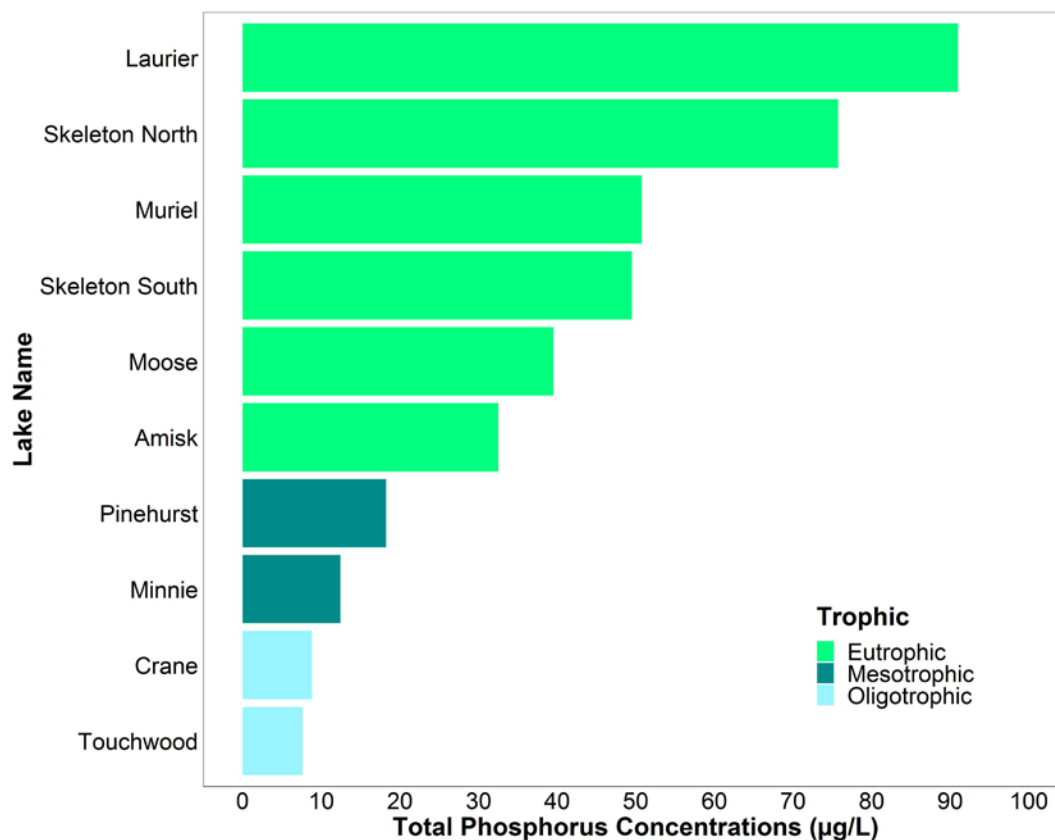


Figure 2. Average total phosphorus (TP) concentrations from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2022.

WATER CHEMISTRY – Total Kjeldahl Nitrogen

As with phosphorus, nitrogen is a nutrient that primary producers require in order to grow. Many 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 0.46 mg/L at Touchwood Lake to a maximum of 3.45 mg/L at Muriel Lake (Figure 3, Table 3). Chlorophyll-*a* and total Kjeldahl nitrogen averages were significantly positively correlated across lakes (Kendalls' Tau, $\tau = 0.51$, $p\text{-value} = 0.047$), meaning that for lakes sampled in the LICA region in 2022, high levels of nitrogen were correlated with high levels of cyanobacteria and algae.

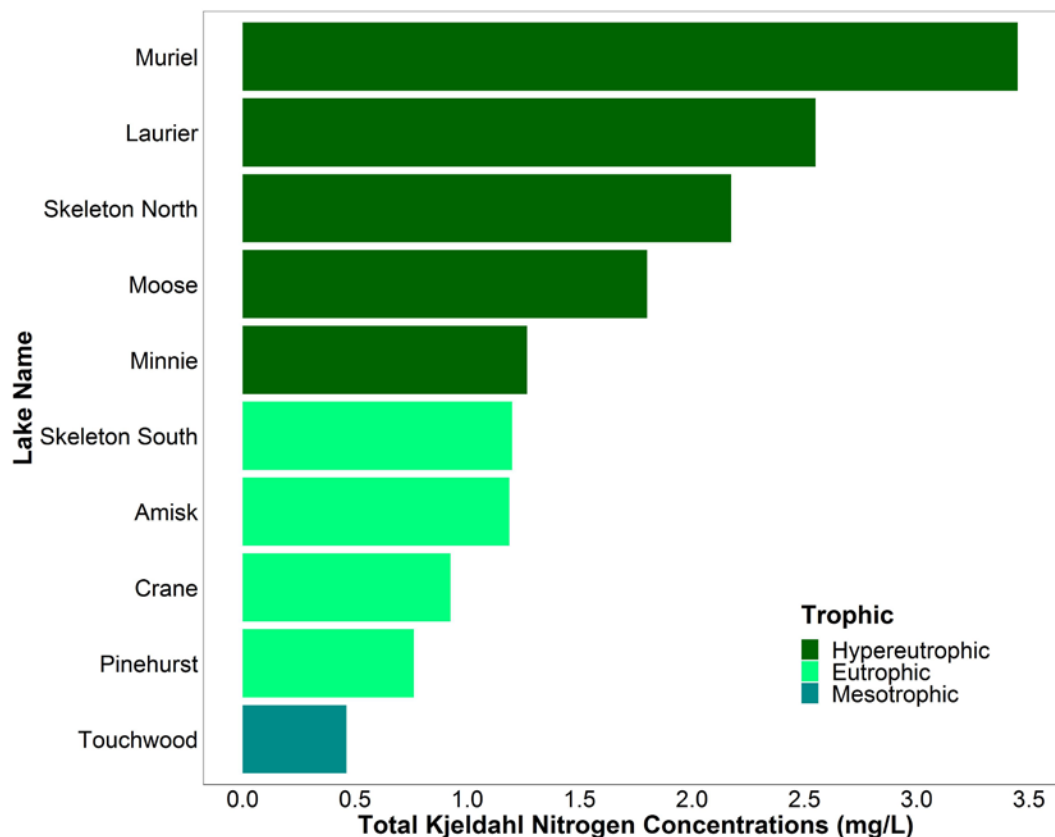


Figure 3. Average total Kjeldahl nitrogen concentrations from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2022.

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 3.05 µg/L at Touchwood Lake to a maximum of 66.65 µg/L at Laurier Lake (Figure 4, Table 3). Chlorophyll-a and total phosphorus averages were significantly positively correlated across lakes (Kendalls' Tau, $\tau = 0.73$, $p\text{-value} = 0.002$), meaning that for lakes sampled in the LICA region in 2022, high levels of phosphorus were correlated with high levels of cyanobacteria and algae.

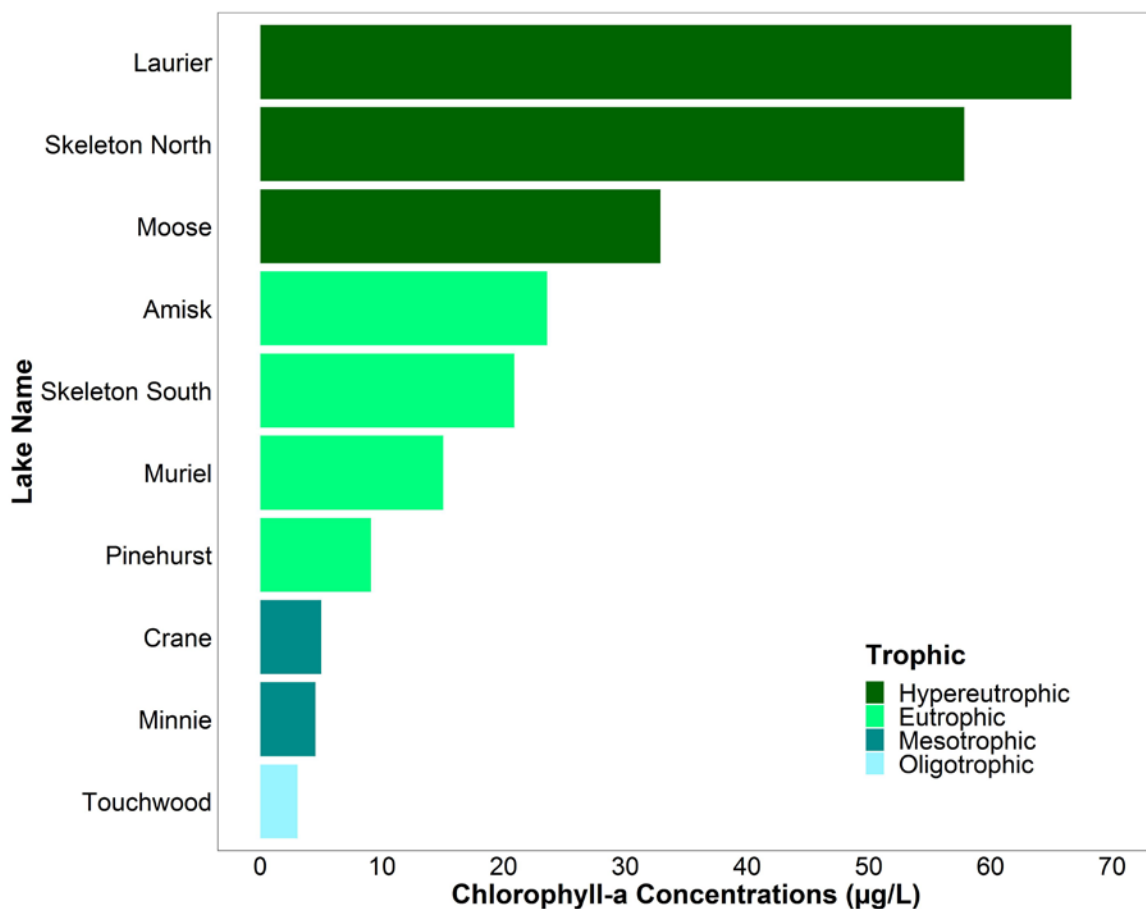


Figure 4. Average chlorophyll-a values from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2022.

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 2022, 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 Crane Lake, Touchwood Lake and Pinehurst Lake, to 9.48 µg/L at Skeleton Lake North (Figure 5, Table 3). The only lake to measure higher than the recreational guideline of 10 µg/L during any single sampling event was Skeleton Lake North, during the June 7th and July 12th sampling events, with levels of 15.32 µg/L and 10.20 µg/L respectively. Individual locations not sampled by ALMS at each lake 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.

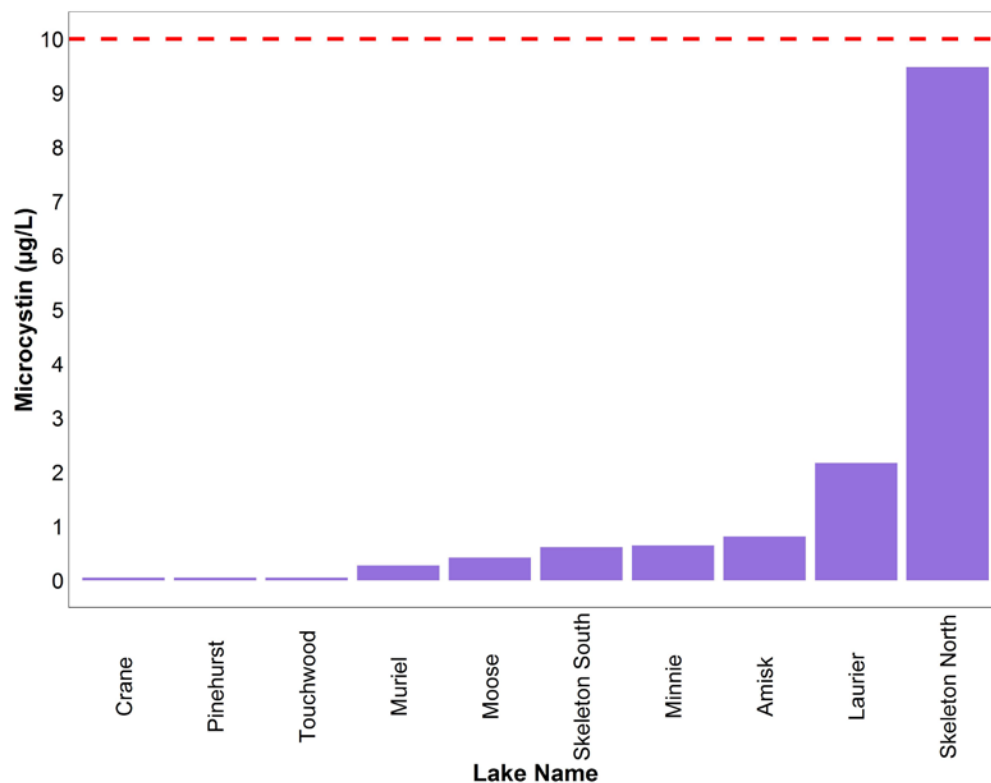


Figure 5. Average microcystin concentrations from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2022. Note that Alberta's recreational guideline of 10 µg/L is indicated by the red horizontal dashed line.

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. Levels may also increase in times of low rainfall and high temperatures, as evaporation of lake water will concentrate ion levels. 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 ions varied between the lakes sampled in the LICA region within the 2022 LakeWatch season (Figure 6). Low variability in calcium and bicarbonate was observed across lakes. Touchwood Lake and Pinehurst Lakes displayed the lowest levels of all ions, with the exception of calcium, where Muriel Lake and Crane Lake displayed the lowest levels. Muriel Lake, Laurier Lake, Moose Lake, and Minnie Lake generally displayed the highest levels of all other ions. Interestingly, ion levels were comparable for both Skeleton Lake North and South, except for sulphate, where Skeleton Lake North had levels nearly three times as high as the South basin. Touchwood Lake and Pinehurst Lake also displayed similar ion abundances.

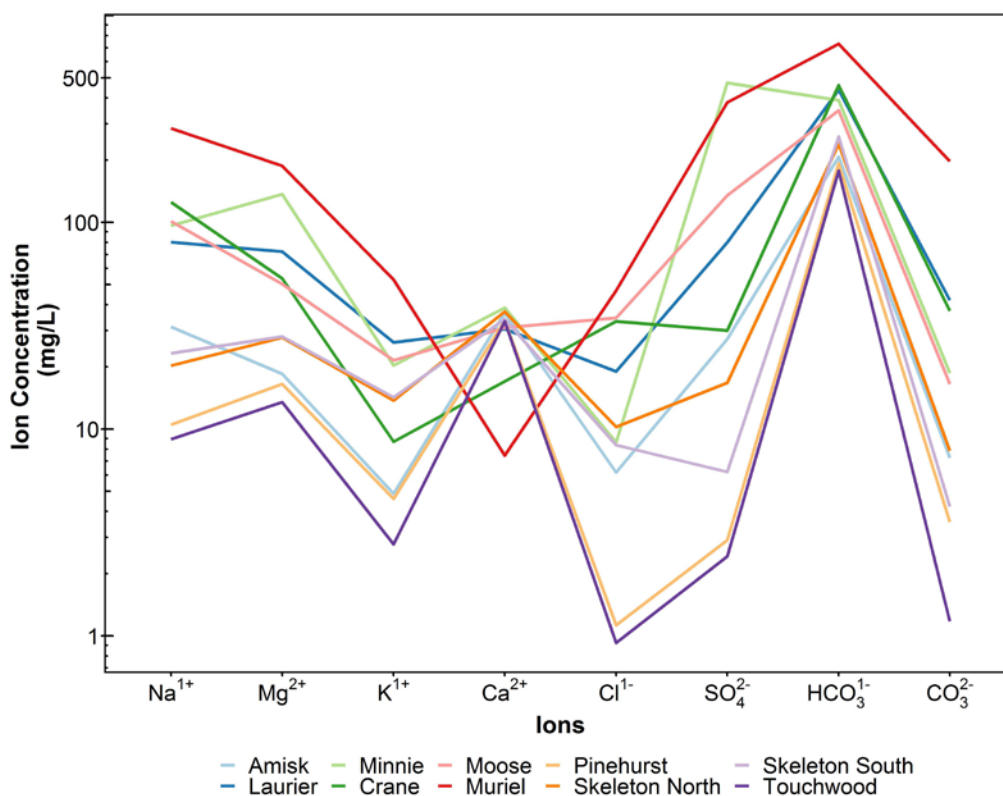


Figure 6. Average levels of cations (sodium = Na¹⁺, magnesium = Mg²⁺, potassium = K¹⁺, calcium = Ca²⁺) and anions (chloride = Cl¹⁻, sulphate = SO₄²⁻, bicarbonate = HCO₃¹⁻, carbonate = CO₃²⁻) from 10 LICA region lakes sampled through the LakeWatch program during the summer of 2022 (note log₁₀ scale on y-axis).

SUMMARIZED PARAMETERS

Table 3. 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 2022.

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	32.5	1.19	23.58	0.81	3.50	52.9
Crane	8.80	0.93	5.00	<0.1	5.80	26.3
Laurier	91.0	2.55	66.65	2.17	2.75	8.7
Minnie	12.4	1.27	4.53	0.64	5.30	22.1
Moose	39.5	1.80	32.88	0.42	3.25	12.3
Muriel	50.8	3.45	15.05	0.28	2.25	4.2
Pinehurst	18.3	0.76	9.10	<0.1	6.23	28.9
Skeleton North	75.8	2.18	57.85	9.48	1.15	15.7
Skeleton South	49.5	1.20	20.88	0.61	5.40	9.7
Touchwood	7.60	0.46	3.05	<0.1	9.48	35.7

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 exacerbate 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 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.

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 sampled. In 2022, 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 grows in dense mats preventing light penetration through the water column, reduces oxygen levels when the dense mats decompose, and outcompetes native aquatic plants. Eurasian watermilfoil can look similar to the native Northern watermilfoil, thus genetic analysis is ideal for species identification.

Suspect watermilfoil specimens were collected from Minnie, Touchwood, and Crane lakes sampled through the LakeWatch program in 2022, along with Garner, Kehewin, Floatingstone, Hope, Fork, Elinor, and Beaver lakes through ALMS' other plant monitoring initiatives. All specimens collected were confirmed to be the native Northern watermilfoil (*Myriophyllum sibiricum*) upon genetic confirmation by the Alberta Plant Health Laboratory.

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 arsenic, boron, aluminum 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 due to groundwater discharge and the weathering of rocks and sediments.

Even though aluminum can be found in water naturally, examples of anthropogenic (human caused) sources of aluminum include dust produced from agriculture, mining, and coal combustion. In 2022, none of the lakes sampled were in exceedance of the aluminum CCME guidelines for the Protection of Aquatic Life (100 µg/L; Table 4). Arsenic is naturally elevated in the Beaver River Watershed and can be introduced into the aquatic environment through industrial or municipal discharges or from the combustion of fossil fuels. In 2022, arsenic levels in Muriel Lake and Minnie Lake exceeded the CCME guidelines for the Protection of Aquatic Life (5 µg/L; Table 4). Boron is naturally occurring in many minerals, particularly in clay-rich sediments, and natural weathering often releases boron into the environment at rates comparable to or greater than anthropogenic sources, such as municipal wastewater, coal power plants, irrigation, copper smelters and other industries that use boron. In 2022, none of the lakes sampled in the LICA region exceeded the CCME guidelines for Boron concentrations (1500 µg/L; Table 4). Selenium can be found in water from both natural and anthropogenic sources. Examples of anthropogenic sources of selenium are the burning of coal and oil, and from agriculture. In 2022, none of the lakes sampled in the LICA region exceeded the CCME guidelines for the Protection of Aquatic Life (1 µg/L; Table 4).

Table 4. Values of select metals for LICA region lakes sampled through the LakeWatch program during August 2022. Also provided are the Canadian Council for Ministers of the Environment (CCME) recommended guidelines for the Protection of Aquatic Life.

Lake	Aluminum (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Selenium (µg/L)
CCME PAL Guideline	100	5	1500	1
Amisk	17	1.2	96	<0.2
Crane	7	4.3	321	<0.2
Laurier	8	2.3	155	<0.2
Minnie	6	6.8	198	<0.2
Moose	8	1.8	178	<0.2
Muriel	32	10.0	388	<0.2
Pinehurst	7	0.7	44	<0.2
Skeleton North	5	0.8	109	<0.2
Skeleton South	6	1.2	109	<0.2
Touchwood	4	0.6	36	<0.2