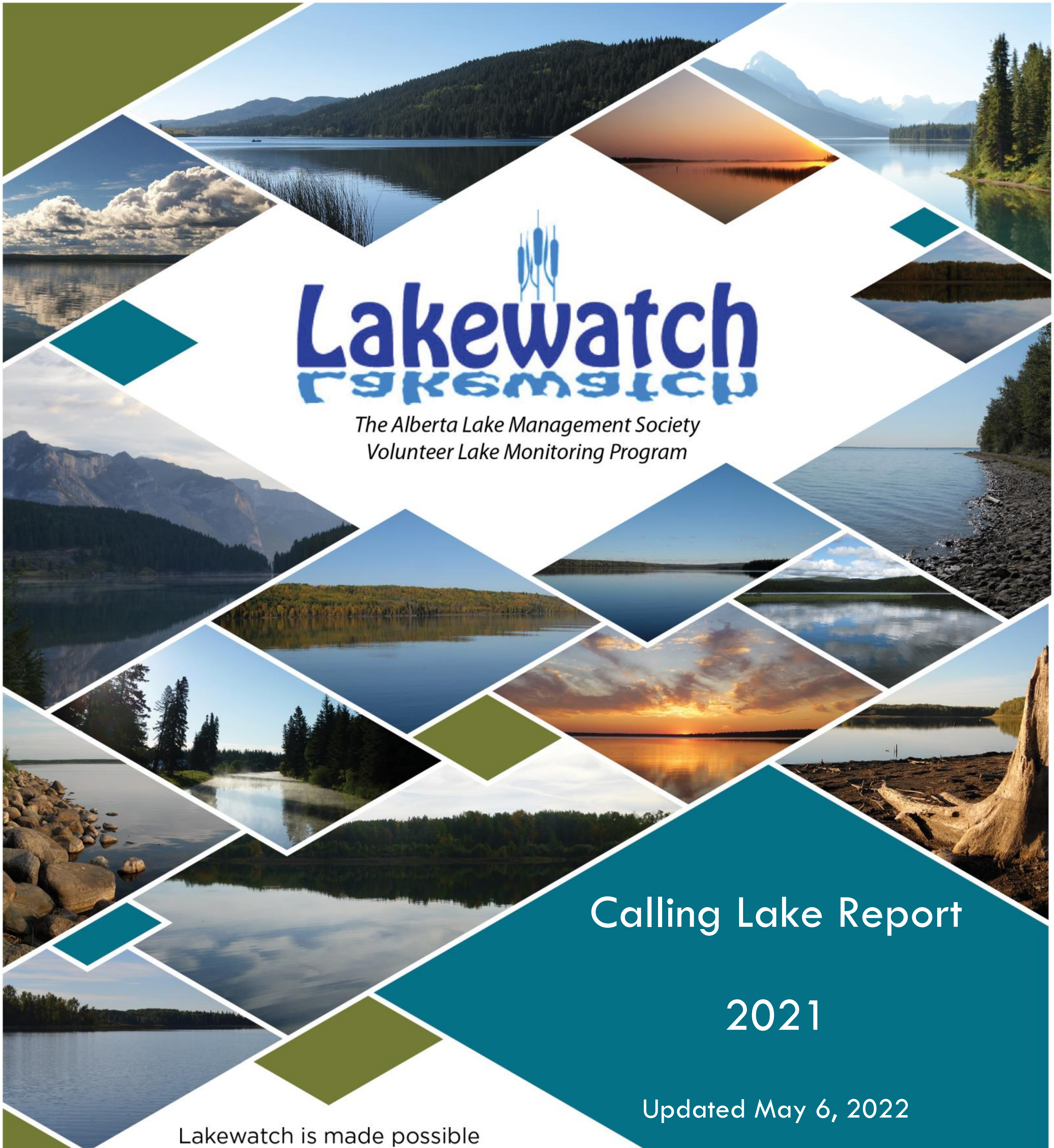

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Calling Lake Report

2021

Updated May 6, 2022

Lakewatch is made possible with support from:

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ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data from Alberta's Lakes. Equally important is educating lake users about aquatic environments, 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 the widest 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.

If you require data from this report, please contact ALMS for the raw data files.

ACKNOWLEDGEMENTS

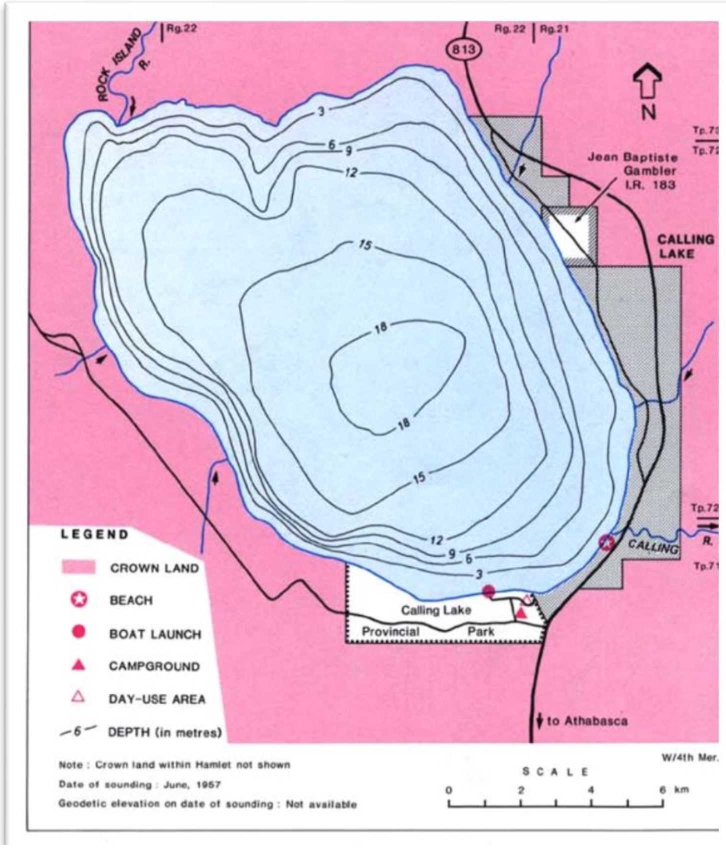
The LakeWatch program is made possible through the dedication of its volunteers. A special thanks to Annette Manning, Angie, Trish and Doug Bone, Burt, Owen, and Micheal and Marie Haupton for their commitment to collecting data at Calling Lake. We would also like to thank Keri Malanchuk and Brittany Onysyk, who were summer technicians in 2021. 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.

Before reading this report, check out [A Brief Introduction to Limnology](#) at alms.ca/reports

CALLING LAKE

Calling Lake is located in the Municipal District of Opportunity No. 17, approximately 200 km north of the city of Edmonton, in the Athabasca River watershed. The hamlet of Calling Lake and the St. Jean Baptiste Gambler Indian Reserve No. 183 are located on the lake's eastern shore.

The lake's name is a translation of the Cree words Kitow Sâkâhikan which refers to the loud noises heard when the lake freezes over[1]. The Calling Lake area has been inhabited for thousands of years; archaeological digs have discovered remnants of a hunter-gatherer band dating as far back as 6000 B.C.[2] In recent history, the area was inhabited by the Woodland Cree and early fur traders, who used the lake to catch their winter supply of fish[3]. Calling Lake Provincial Park was established in 1971 on 741 ha of land on the southern shore of the lake. Today, the park is a popular summer vacation area used for camping, fishing, motor boating, swimming, and canoeing.



Bathymetric map of Calling Lake obtained from Mitchell and Prepas, 1990

The main sport fish are northern pike (Esox lucius), yellow perch (Perca flavescens), walleye (Sander vitreus), burbot (Lota lota), and lake whitefish (Coregonus clupeaformis).

Calling Lake has a large drainage basin covering an area of 1,092 km^2, mostly to the north of the lake.[4] The main outlet, the Calling River, flows from the southeast end of the lake to the Athabasca River, approximately 25 km downstream. Calling Lake has a surface area of 138 km^2, making it one of Alberta's larger lakes, with a moderate maximum depth of 18.3 m in the centre of the basin.

WATER CHEMISTRY

ALMS measures a suite of water chemistry parameters. Phosphorus, nitrogen, 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. See Table 2 for a complete list of parameters.

The average total phosphorus (TP) concentration for Calling Lake was 50 µg/L (Table 2), falling into the eutrophic, or high productivity trophic classification. This value falls within the range of historical averages. TP ranged from a minimum of 20 µg/L on the July 19th sampling event, and increased through the season to a maximum of 120 µg/L on September 3rd (Figure 1).

Average chlorophyll-*a* concentration in 2021 was 54.8 µg/L (Table 2), falling into the hypereutrophic, or very highly productive trophic classification. Chlorophyll-*a* was lowest during the July 19th sampling event at 14.8 µg/L, and then rose sharply to a high of 134.0 µg/L on September 3rd. Chlorophyll-*a* concentrations were significantly positively correlated with TP ($r = 0.98$, $p = 0.02$). It is likely that the increased TP and chlorophyll-*a* levels are related to complete lake mixing occurring prior to the September 3rd sampling event, after a summer of sustained stratification (Figures 4 & 5).

The average TKN concentration was 1.2 mg/L (Table 2) and displayed two main levels through the season; approximately 0.7 mg/L in June and July, and then 1.6 mg/L in August and September (Figure 1).

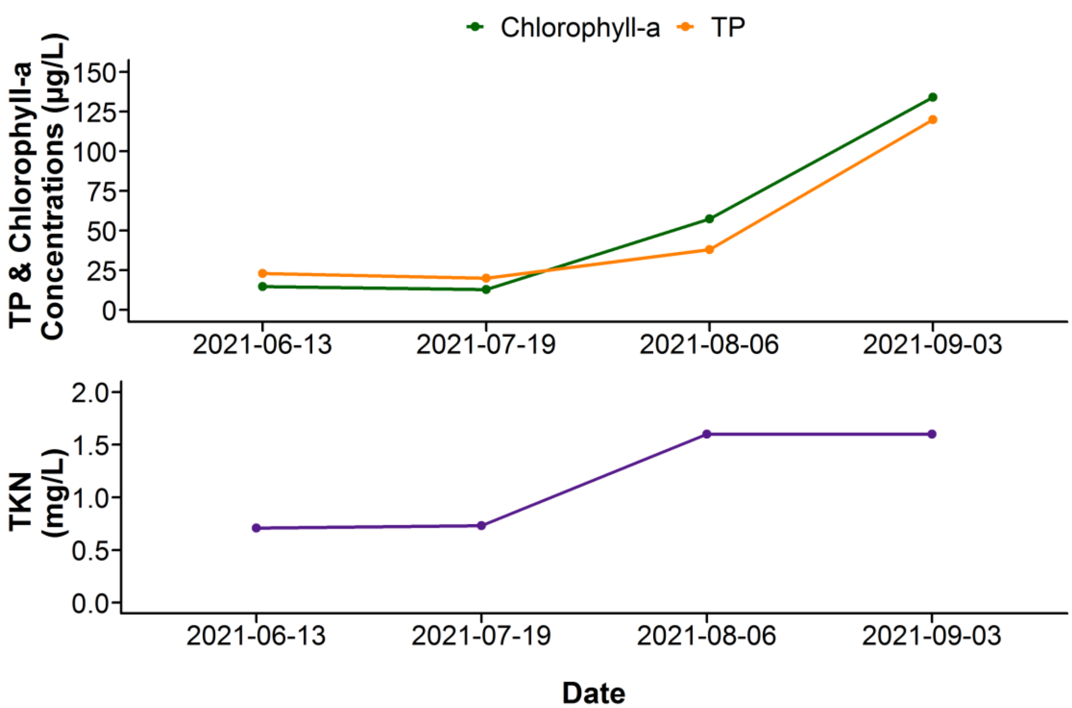


Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Calling Lake.

Average pH was 7.95 in 2021, buffered by low alkalinity (85 mg/L $CaCO_3$) and bicarbonate (102 mg/L HCO_3). Aside from bicarbonate, only calcium was appreciably higher than all other major ions, and all ions together contributed to a low conductivity of 180 µS/cm (Figure 2, top; Table 2). Calling Lake displays lower ion levels compared to other LakeWatch lakes sampled in 2021 (Figure 2, bottom).

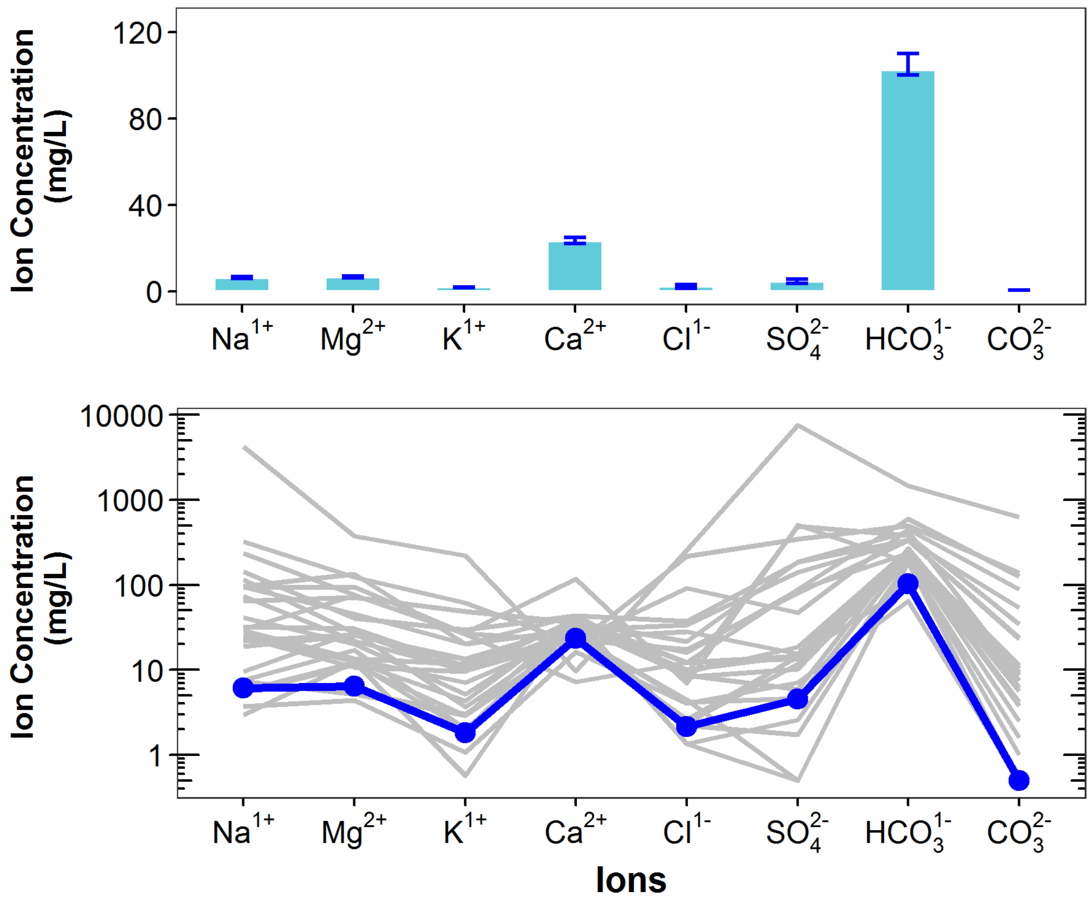


Figure 2. Average levels of cations (sodium = Na^{1+}, magnesium = Mg^{2+}, potassium = K^{1+}, calcium = Ca^{2+}) and anions (chloride = Cl^{1-}, sulphate = SO_4^{2-}, bicarbonate = HCO_3^{1-}, carbonate = CO_3^{2-}) from four measurements over the course of the summer at Calling Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Calling Lake (blue line) compared to 25 lake basins (gray lines) sampled through the LakeWatch program in 2021 (note log_{10} scale on y-axis of bottom figure).

METALS

Metals will naturally be present in aquatic environments due to in-lake processes or the erosion of rocks, or introduced to the environment from human activities such as urban, agricultural, or industrial developments. Many metals have a unique guideline as they may become toxic at higher concentrations. Where current metal data are not available, historical concentrations for 27 metals have been provided (Table 3).

Metals were not measured at Calling Lake in 2021, but Table 3 displays historical metal concentrations.

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, but 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 depth. Two times the Secchi depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

The average euphotic depth of Calling Lake in 2021 was 4.40 m, corresponding to an average Secchi depth of 2.20 m (Table 2). Euphotic depth varied over the season, ranging from as deep as 6.1 m on July 19th to as shallow as 2.80 m on September 3rd (Figure 3). The relatively lower water clarity measured during the September sampling event is likely due to slightly increased algal growth, as indicated by the chlorophyll-*a* peak (Figure 1).

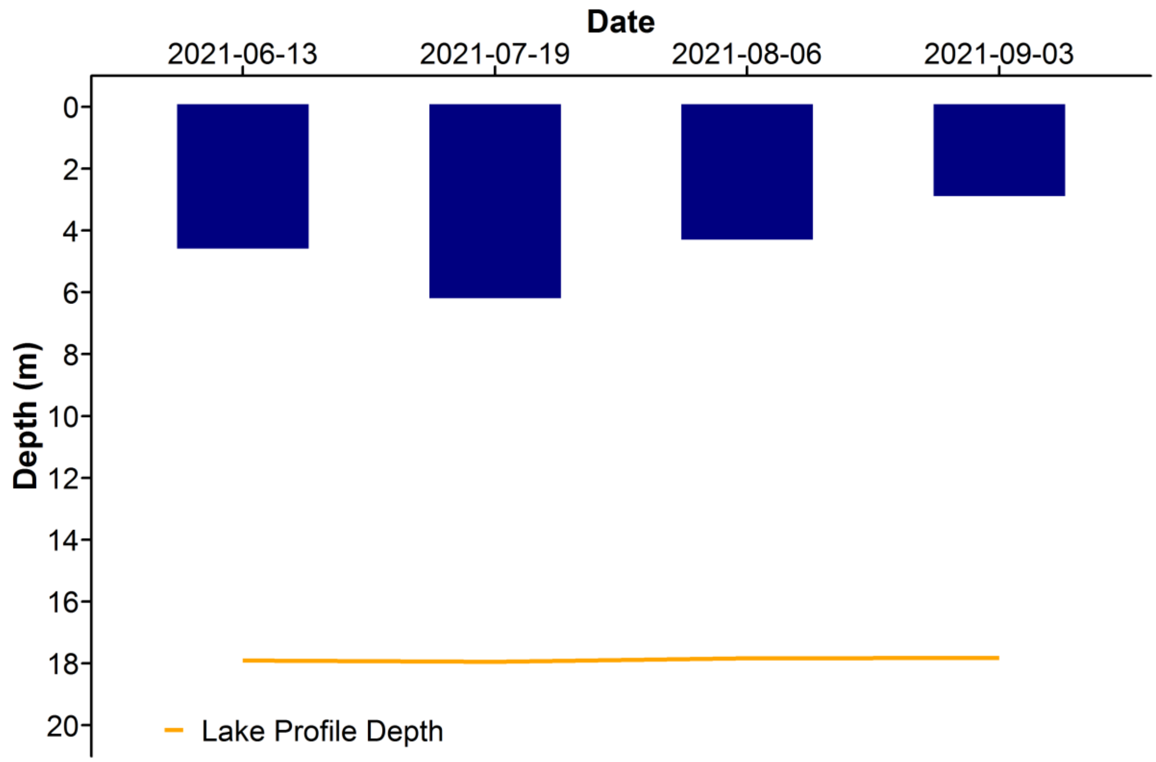


Figure 3. Euphotic depth values measured four times over the course of the summer at Calling Lake in 2021.

WATER TEMPERATURE AND DISSOLVED OXYGEN

Water temperature and dissolved oxygen (DO) profiles in the water column can provide information on water quality and fish habitat. The depth of the thermocline is important in determining the depth to which dissolved oxygen from the surface can be mixed. Please refer to the end of this report for descriptions of technical terms.

Surface temperatures of Calling Lake varied throughout the summer, with the August 6th sampling date having the warmest temperatures at 20.6°C (Figure 4a). The lake was stratified during all sampling trips, except the September sampling event, in which the lake was fully mixed. Interestingly, the thermocline depth was comparable in the June and July sampling events, while the August sampling event displayed two thermoclines. This is likely due to the timing of sampling after both a warm and relatively calm spell (Figure 6).

Calling Lake was well oxygenated in the surface waters on all sampling dates, measuring above the CCME guidelines of 6.5 mg/L dissolved oxygen (Figure 4b). However, surface levels were surprisingly low on July 19th. This may have been caused in part by significant smoky conditions, which would have inhibited algal production of oxygen in the surface waters due to reduced light. Oxygen levels dropped below thermocline depths on all sample dates, with levels approaching 0 mg/L during the July and August sampling events.

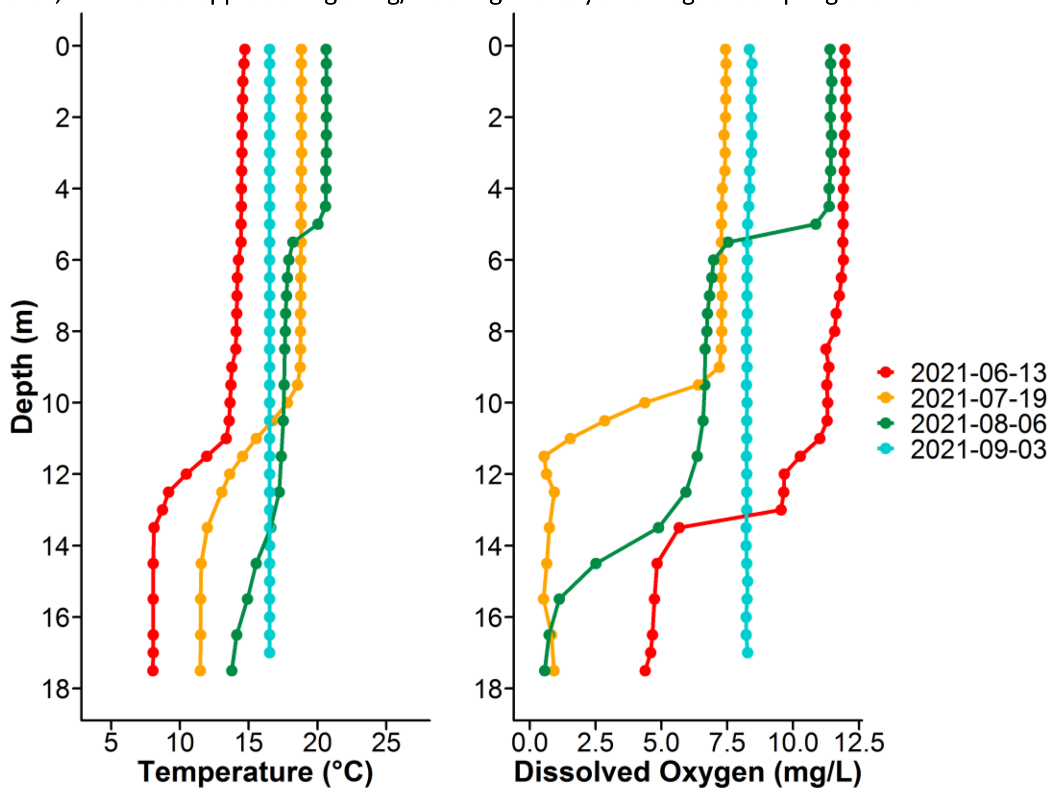


Figure 4. a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Calling Lake measured four times over the course of the summer of 2021.

MICROCYSTIN

Microcystins are toxins produced by cyanobacteria (blue-green algae) which, when ingested, 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. Blue-green algae advisories are managed by Alberta Health Services. Recreating in algal blooms, even if microcystin concentrations are not above guidelines, is not recommended.

Microcystin levels in Calling Lake fell below the recreational guideline of 10 μg/L during every sampling event in 2021. In addition, microcystin levels from July 19^{th} and August 6^{th} were below the laboratory detection limit of 0.10 μg/L. A value of 0.05 μg/L is assigned to each date that is below detection in order to calculate an average. Even though low levels of microcystin were detected, caution should always be observed when recreating around cyanobacteria.

Table 1. Microcystin concentrations measured four times at Calling Lake in 2021.

Date	Microcystin Concentration (μg/L)
13-Jun-21	<0.10
19-Jul-21	0.10
6-Aug-21	<0.10
3-Sep-21	0.24
Average	0.11

INVASIVE SPECIES MONITORING

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 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 2021, no mussels or spiny water flea were detected at Calling Lake.

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 suspect watermilfoil species identification.

A watermilfoil specimen was collected from Calling Lake during the August 6th sampling event, and was confirmed to be the native Northern Watermilfoil.

WATER LEVELS

There are many factors influencing water quantity. Some of these factors include the size of the lake's drainage basin, precipitation, evaporation, water consumption, ground water influences, and the efficiency of the outlet channel structure at removing water from the lake. Requests for water quantity monitoring should go through Alberta Environment and Parks Monitoring and Science division.

Water levels at Calling Lake in 2021 remain near the historical average, but dropped relative to 2020 water levels (Figure 5).

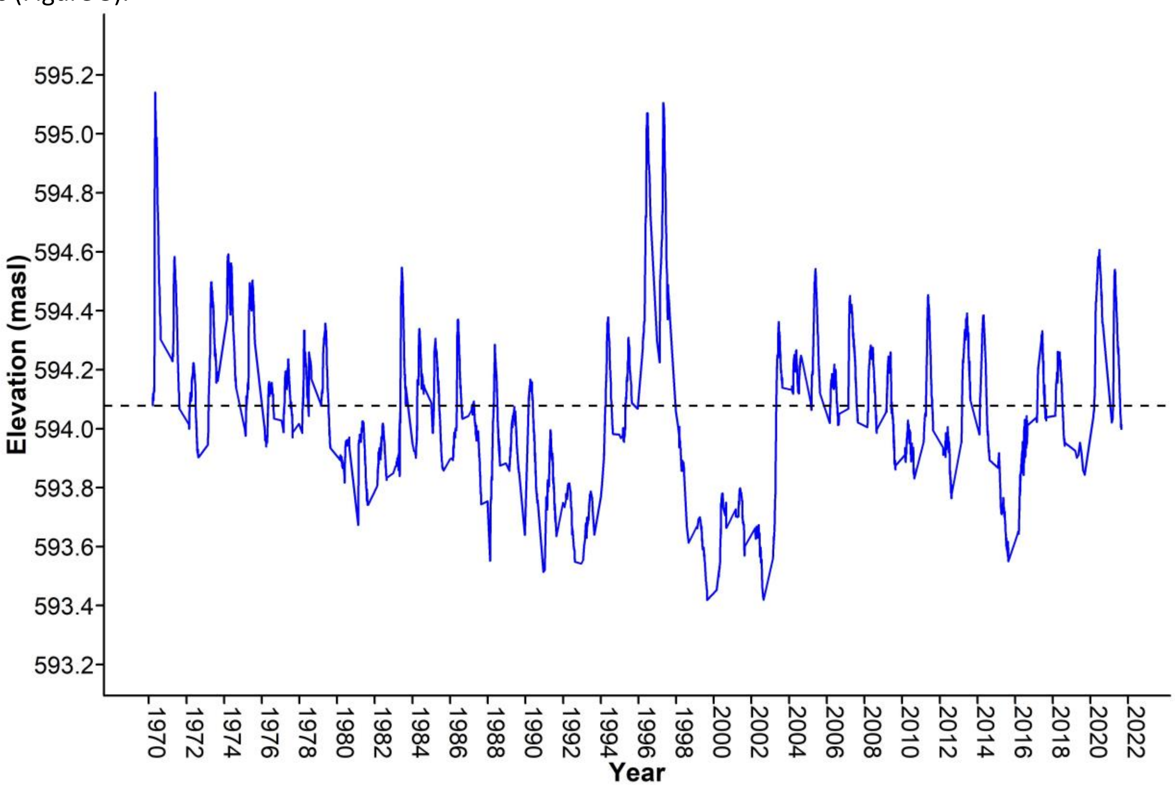


Figure 5. Water levels measured at Calling Lake in metres above sea level (masl) from 1970-2021. Data retrieved from Environment Canada and Alberta Environment and Parks. Black dashed line represents historical yearly average water level.

WEATHER & LAKE STRATIFICATION

Air temperature will directly impact lake temperatures, and result in different temperature layers (stratification) throughout the lake, depending on its depth. Wind will also impact the degree to which a lake mixes, and how it will stratify. The amount of precipitation that falls within a lake's watershed will have important implications, depending on the context of the watershed and the amount of precipitation that has fallen. Solar radiation represents the amount of energy that reaches the earth's surface, and has implications for lake temperature & productivity.

Calling Lake experienced a warmer, drier, and less windy summer compared to normal (Figure 6). Despite the higher wind levels and the size of the lake, the lake remained stratified the majority of the summer until temperatures dropped following a windy spell, leading to complete lake mixing by the September 3rd sampling event.

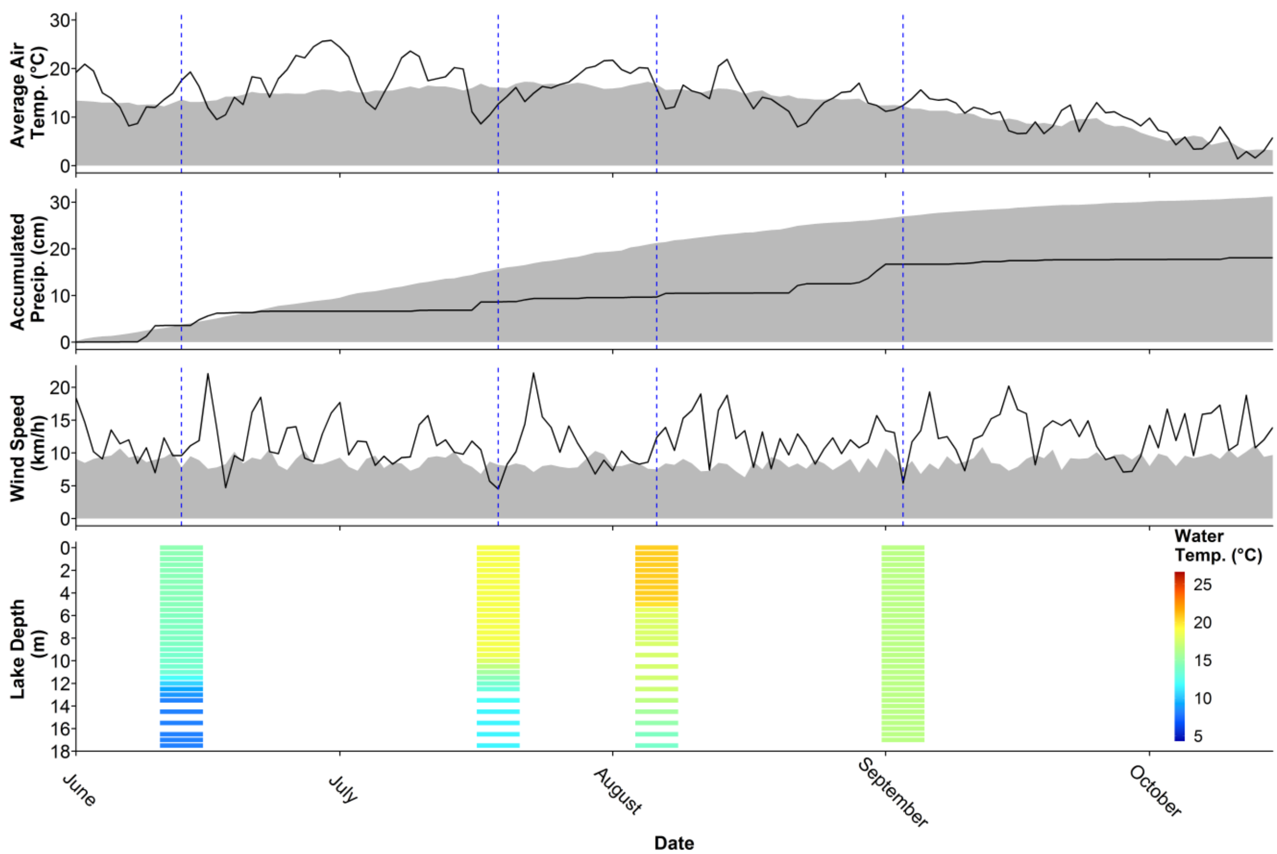


Figure 6. Average air temperature (°C) and accumulated precipitation (cm) measured from Rock Island Lake Auto, as well as wind speed (km/h) measured from Clearwater Auto, with Calling Lake temperature profiles (°C) at the bottom. Black lines indicate 2021 levels, gray indicates long-term normals, and blue lines indicate sampling dates for Calling Lake over the summer. Further information about the weather data provided is available in the LakeWatch 2021 Methods report. Weather data provided by Agriculture, Forestry and Rural Economic Development, Alberta Climate Information Service (ACIS) https://acis.alberta.ca (retrieved April 2022). *Note: Solar Radiation not available at Rock Lake Auto.

Table 2. Average Secchi depth and water chemistry values for Calling Lake. Historical values are given for reference. Number of sample trips are inconsistent between years.

Parameter	1987	1988	2000	2010	2011	2017	2018	2019	2021
TP (µg/L)	71	50	41	42	76	57	55	38	50
TDP (µg/L)	17	19	12	11	43	26	22	16	13
Chlorophyll-*a* (µg/L)	31.7	19.1	18.2	16.6	20.7	20.5	26.2	16.4	54.8
Secchi depth (m)	2.10	2.74	2.80	2.40	2.86	2.20	2.35	2.85	2.20
TKN (mg/L)	0.8	0.8	0.7	0.9	1.0	0.9	0.9	0.8	1.2
NO_2-N and NO_3-N (µg/L)	3	6	4	4	17	15	3	6	3
NH_3-N (µg/L)	33	33	16	14	127	42	48	53	22
DOC (mg/L)	10	10	12	11	11	11	12	11	12
Ca^{2+} (mg/L)	21	22	22	/	/	25	24	25	23
Mg^{2+} (mg/L)	6	6	6	/	/	7	7	7	6
Na^{+} (mg/L)	5	5	5	7	5	7	6	6	6
K^{+} (mg/L)	2	2	2	2	2	2	2	2	2
SO_4^{2-} (mg/L)	3	4	3	7	3	3	4	2	4
Cl^{-} (mg/L)	1	1	1	1	1	2	2	2	2
CO_3^{2-} (mg/L)	2	0.2	2	/	1	1	1	0.5	0.5
HCO_3^{-} (mg/L)	96	100	105	111	111	110	110	120	102
pH	7.99	7.27	8.19	8.20	8.26	8.24	8.25	8.22	7.95
Conductivity (µS/cm)	167	168	176	182	184	187	188	192	180
Hardness (mg/L)	77	79	80	66	82	92	89	91	84
TDS (mg/L)	90	95	91	94	95	107	105	102	102
Microcystin (µg/L)	/	/	/	0.71	0.08	0.12	0.10	0.19	0.11
Total Alkalinity (mg/L $CaCO_3$)	82	82	86	91	92	92	92	96	85

Table 3. Concentrations of metals measured in Calling Lake. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference. Bottom sample taken from 1 m off bottom. Note that metal sample collection method changed in 2016 from composite to single surface grab at the profile location.

Metals (Total Recoverable)	2017 Top	2017 Bottom	Guidelines
Aluminum μg/L	5.2	7.3	100[a]
Antimony μg/L	0.034	0.037	/
Arsenic μg/L	0.72	0.74	5
Barium μg/L	34.8	34.8	/
Beryllium μg/L	0.004	0.0015	100[c,d]
Bismuth μg/L	0.0015	0.0015	/
Boron μg/L	24.5	23.8	1500
Cadmium μg/L	0.005	0.005	0.15[b]
Chromium μg/L	0.05	0.05	/
Cobalt μg/L	0.033	0.012	50,1000[c,d]
Copper μg/L	0.18	0.09	2.20[b]
Iron μg/L	83	85.3	300
Lead μg/L	0.015	0.046	2.86[b]
Lithium μg/L	7.49	7.51	2500[d]
Manganese μg/L	35.3	44.2	240[e]
Mercury (dissolved) ng/L	0.24	0.35	/
Mercury (total) ng/L	0.37	0.36	26
Molybdenum μg/L	0.1	0.084	73
Nickel μg/L	0.015	0.015	89.7[b]
Selenium μg/L	0.1	0.1	1
Silver μg/L	0.003	0.001	0.25
Strontium μg/L	130	128	/
Thallium μg/L	0.006	0.003	0.8
Thorium μg/L	0.004	0.003	/
Tin μg/L	0.03	0.03	/
Titanium μg/L	1.32	1	/
Uranium μg/L	0.021	0.02	15
Vanadium μg/L	0.12	0.099	100[c,d]
Zinc μg/L	0.6	0.6	30[f]

Values represent means of total recoverable metal concentrations.

[a] Based on pH ≥ 6.5

[b] Based on 2017 avg. water hardness (as CaCO3) with CCME equation

[c] Based on CCME Guidelines for Agricultural use (Livestock).

[d] Based on CCME Guidelines for Agricultural Use (Irrigation).

[e] Based on CCME Manganese variable calculation (https://ccme.ca/en/chemical/129#_aql_fresh_concentration), using 2017 avg. water hardness (as CaCO3) and avg. pH

[f] Based on 2017 avg. water hardness (as CaCO3), avg. pH, and avg. DOC with CCME equation

A forward slash (/) indicates an absence of data or guidelines