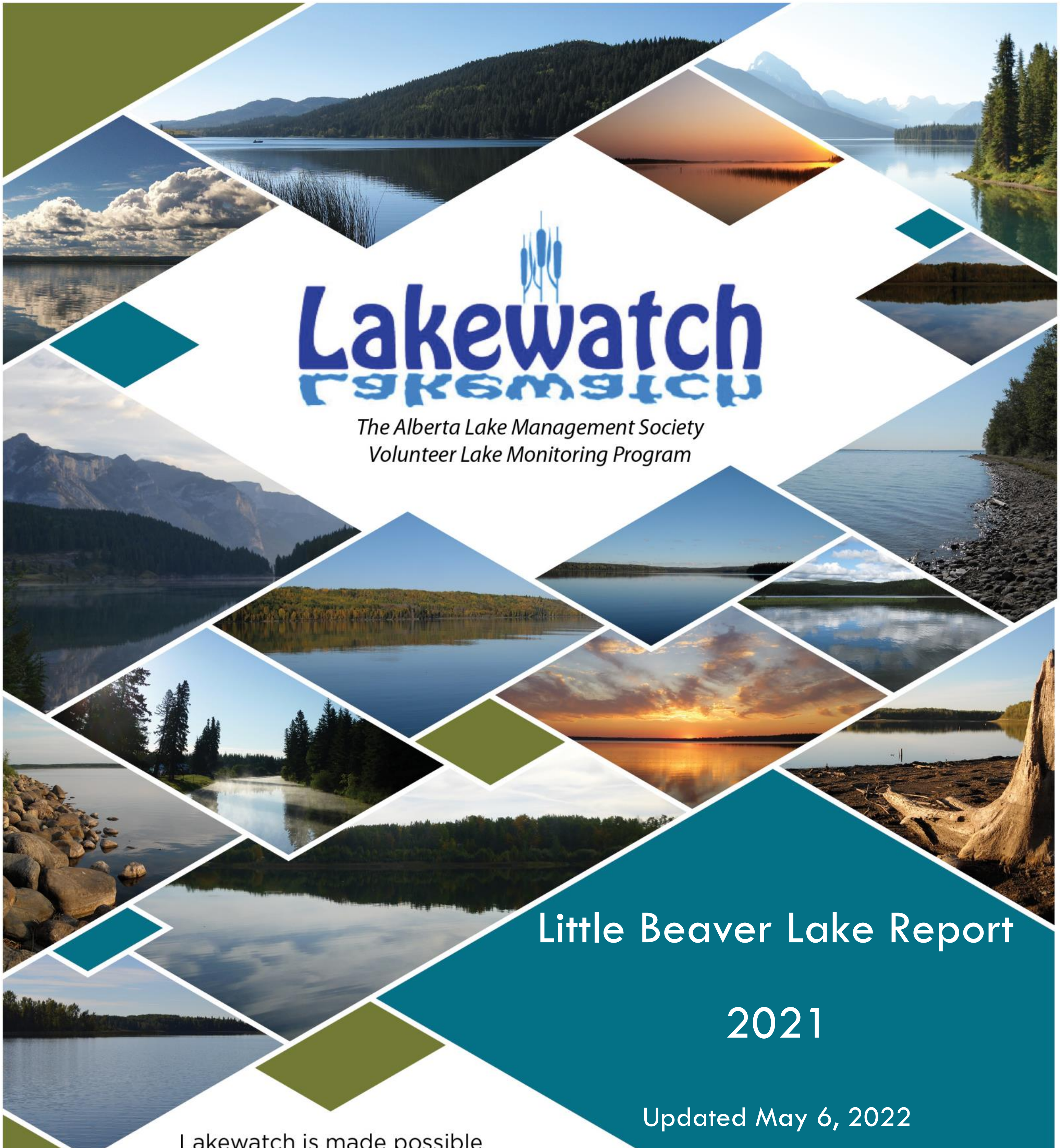

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Little Beaver Lake Report

2021

Updated May 6, 2022

Lakewatch is made possible
with support from:

Alberta
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Pigeon Lake Watershed Association
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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 Doug Jensen for his commitment to collecting data at Little Beaver 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.

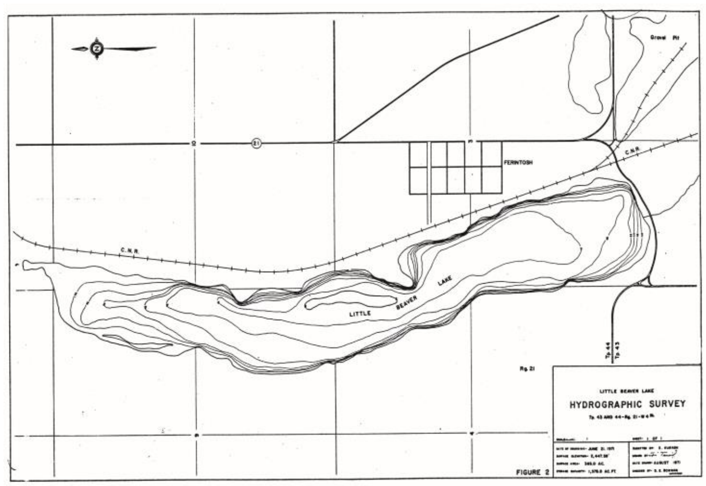
Before reading this report, check out [A Brief Introduction to Limnology](#) at alms.ca/reports

LITTLE BEAVER LAKE

Little Beaver Lake is a quiet, scenic lake 35 km south of Camrose and 107 km south of Edmonton. This shallow lake is approximately 3.5 km long and 500 m wide, and is surrounded by forested rolling hills and agricultural development. The county subdivision of Little Beaver Lake Estates lies on its west shore, and the village of Ferintosh lies on its east shore. It is situated within the Battle River watershed.

Little Beaver Lake was historically a meeting place for Aboriginal peoples, who called it 'Amiskoogis Saskihigan', meaning 'little lake belonging to the beaver'. During the 1880's, European fur traders hunted buffalo in the area. In the 1890's, ranchers established themselves in the watershed where they discovered rich soils suitable for agriculture. The first non-Aboriginal settlers arrived in the early 1900's by rail from the Edmonton-Calgary railway to establish homesteads. In 1910, the Grand Trunk Pacific Railway arrived, and the village was incorporated in 1911. The village of Ferintosh was originally known as Lassen, named after the first settlement of homesteads in the area belonging to J. J. Lassen. The village was renamed Ferintosh by Dr. J. R. McLeod in 1910, because a nearby town with a similar name created confusion for the postal service.

Little Beaver Lake, Alberta. Photo taken by Jackson Woren, 2014.



Bathymetric map of Little Beaver Lake (Angler's Atlas).

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 Little Beaver Lake was 802 µg/L (Table 2), falling into the hypereutrophic, or very highly productive trophic classification. This value falls on the higher end of historical averages. TP ranged from a minimum of 280 µg/L on the June 2nd sampling event, and rose through the season to a maximum of 1000 µg/L on August 13th and September 20th (Figure 1).

Average chlorophyll-*a* concentration in 2021 was 213 µg/L (Table 2), falling into the hypereutrophic, or very highly productive trophic classification. Chlorophyll-*a* was lowest earliest in the season, at 29.1 µg/L on June 2nd and peaked at 333.0 µg/L on August 13th (Figure 1).

The average TKN concentration was 4.9 mg/L (Table 2) and increased through the season, starting at 3.2 mg/L on June 2nd, and increased to a maximum of 6.6 mg/L on the September 20th sampling event (Figure 1).

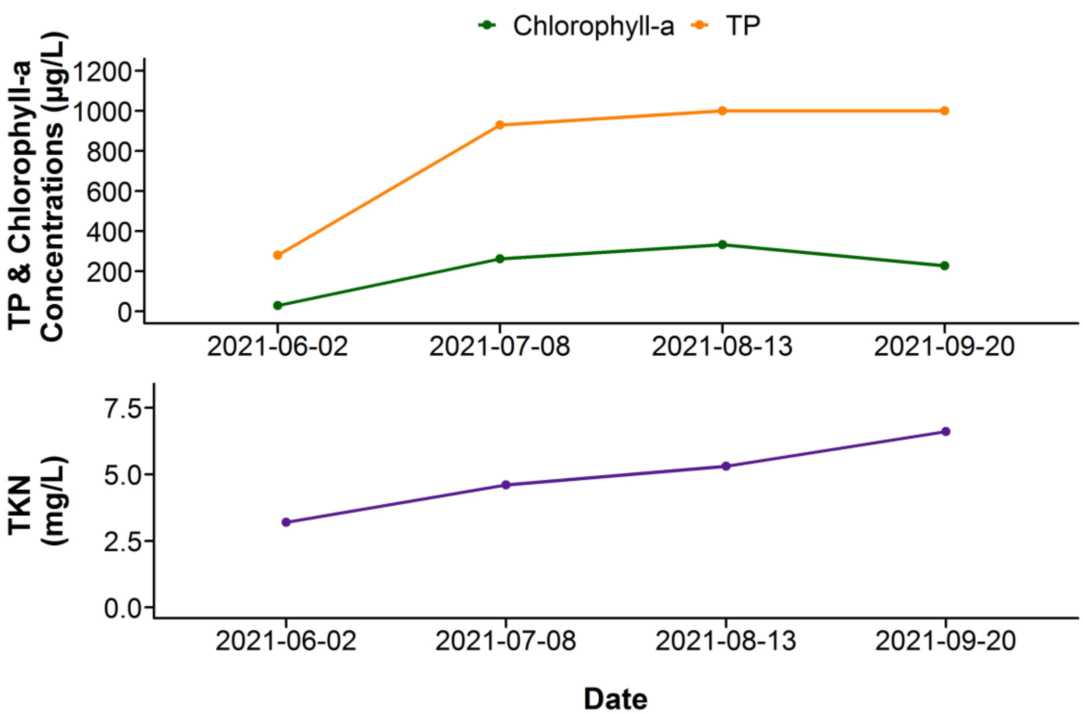


Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Little Beaver Lake.

Average pH was measured as 8.94 in 2021, buffered by high alkalinity (368 mg/L $CaCO_3$) and bicarbonate (338 mg/L HCO_3). Aside from bicarbonate, sodium and sulphate were relatively higher than all other major ions, and together contributed to a high conductivity of 1150 µS/cm (Figure 2, top; Table 2). The lake displayed high variation of bicarbonate and carbonate through the season. Little Beaver Lake is in the higher range of ion levels compared to other LakeWatch lakes sampled in 2021 (Figure 2, bottom).

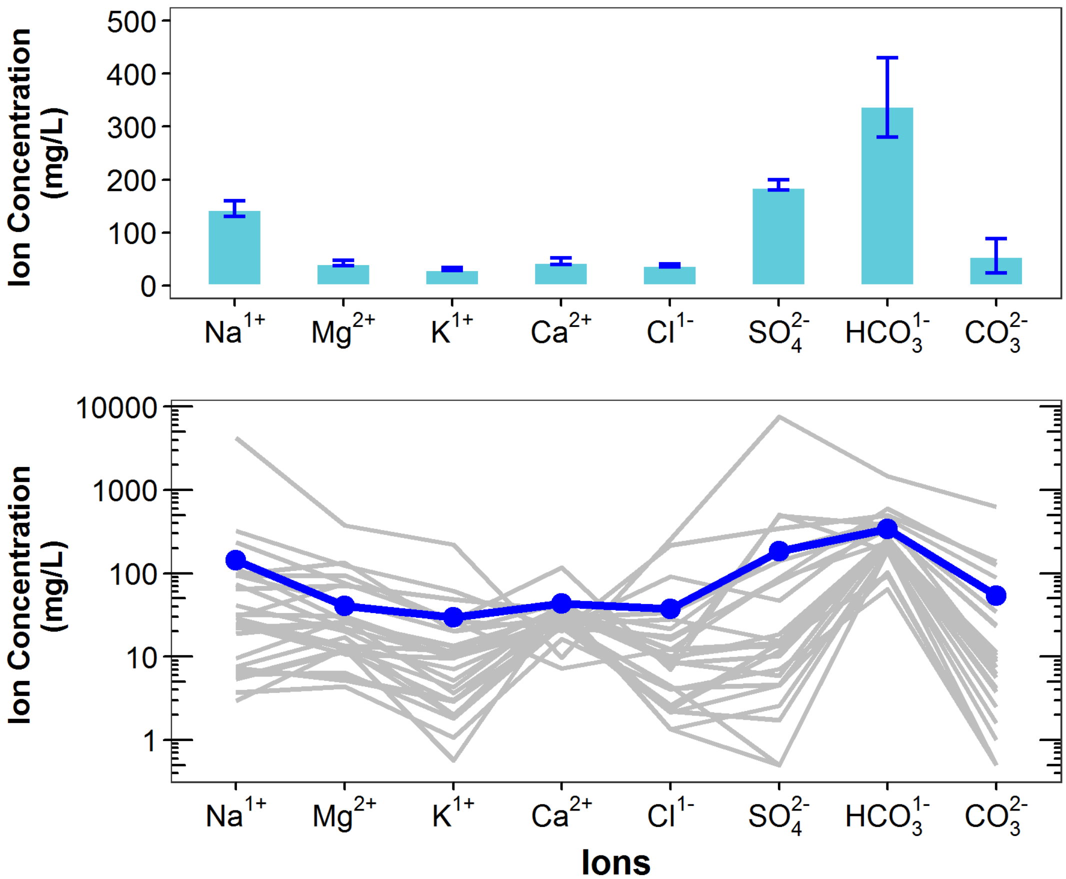


Figure 2. Average levels of cations (sodium = Na^{1+}, magnesium = Mg^{2+}, potassium = K^{1+}, calcium = Ca^{2+}) and anions (chloride = Cl^{1-}, sulphate = SO_4^{2-}, bicarbonate = HCO_3^{1-}, carbonate = CO_3^{2-}) from four measurements over the course of the summer at Little Beaver Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Little Beaver 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 Little Beaver 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 Little Beaver Lake in 2021 was 0.59 m, corresponding to an average Secchi depth of 0.30 m (Table 2). Euphotic depth decreased through the season, starting from 1.2 m on June 2nd and dropping to 0.2 m on September 20th (Figure 3). The decreasing water clarity through the season tracks with increasing levels of chlorophyll-a, as increasing cyanobacteria in the lake will decreased water clarity. Interestingly though, water clarity continued to decreased in September, while chlorophyll-a levels dropped slightly. This could be due to late-season degradation of cyanobacteria, where degrading surface scums form which will reduce water clarity, but may not result in proportionally higher chlorophyll-a levels.

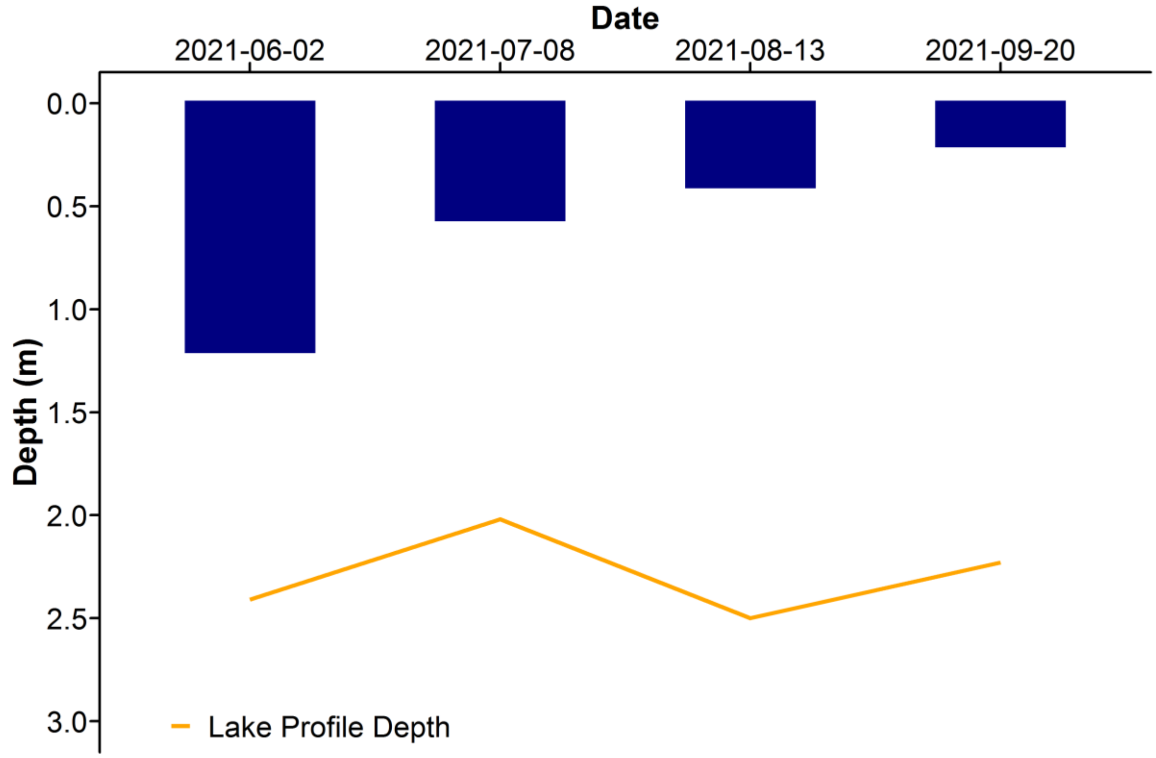


Figure 3. Euphotic depth values measured four times over the course of the summer at Little Beaver Lake in 2021.

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 Little Beaver Lake varied throughout the summer, with the July 8th sampling date having the warmest temperatures at 24.3°C (Figure 4a). The lake was mixed during all sampling trips, as indicated by the relatively consistent temperatures from top to bottom each day. That said, the July 8th sampling event displayed a temperature difference of nearly 2°C from top to bottom, likely due to the days leading up to the sampling event being relatively warmer and calmer (Figure 6).

Little Beaver Lake was well oxygenated in the surface waters only during the June, July and August sampling events, measuring above the CCME guidelines of 6.5 mg/L dissolved oxygen (Figure 4b). Whole-lake oxygen levels on September 20th were below 6.5 mg/L, which is likely a result of decomposition of algae and cyanobacteria that were in high abundance, earlier in the season. On July 8th, oxygen levels displayed an appreciable difference between the surface to bottom waters, where oxygen levels were very low, or anoxic. This was likely caused by reduced mixing, as indicated by water temperatures and climate conditions leading up to the sampling event. This would lead to high oxygen levels in the surface waters where photosynthesis is occurring, and low oxygen in the stagnant bottom waters as a result of high rates of decomposition.

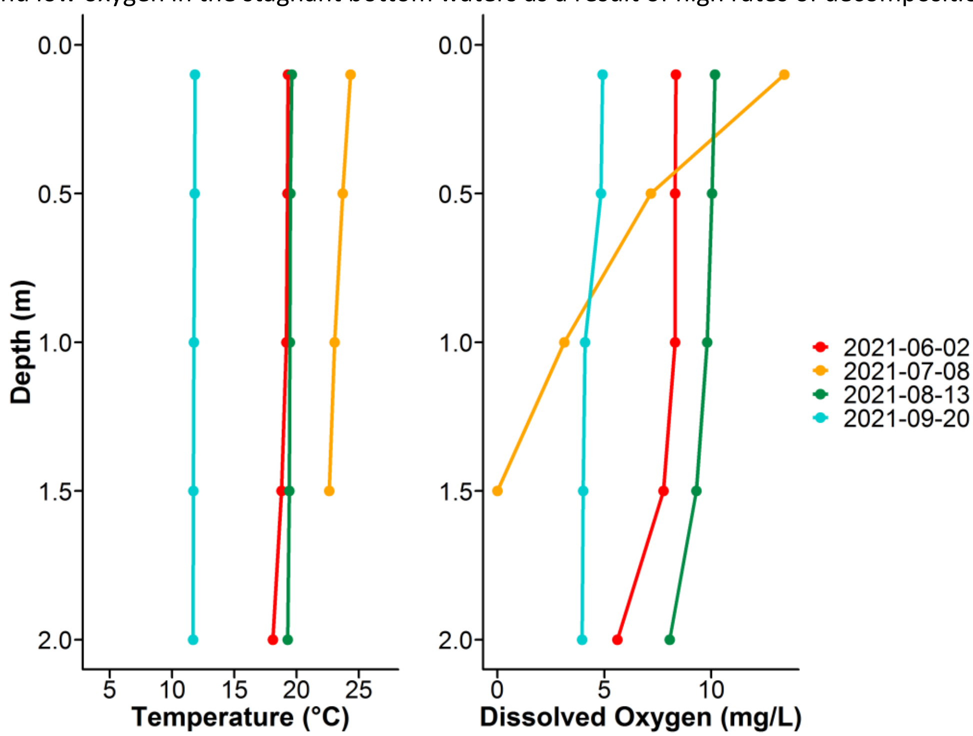


Figure 4. a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Little Beaver Lake measured four times over the course of the summer of 2021.

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 Little Beaver Lake were above the recreational guideline of 10 µg/L during the July 8th and August 13th sampling events. In addition, the seasonal average was above the recreational guideline. As high levels of microcystin were detected in Little Beaver Lake in 2021, caution should be observed when recreating in the lake when high levels of cyanobacteria are present.

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

Date	Microcystin Concentration (µg/L)
2-Jun-21	0.38
8-Jul-21	46.96
13-Aug-21	19.21
20-Sep-21	3.74
Average	17.57

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 Little Beaver 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.

No suspect watermilfoil was observed or collected from Little Beaver Lake in 2021.

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 Little Beaver Lake in 2021 remain above the historical average, but dropped relative to 2020 (Figure 5). The lake appears to have had an increasing trajectory of lake levels, since the historical low point recorded in the late 1970s.

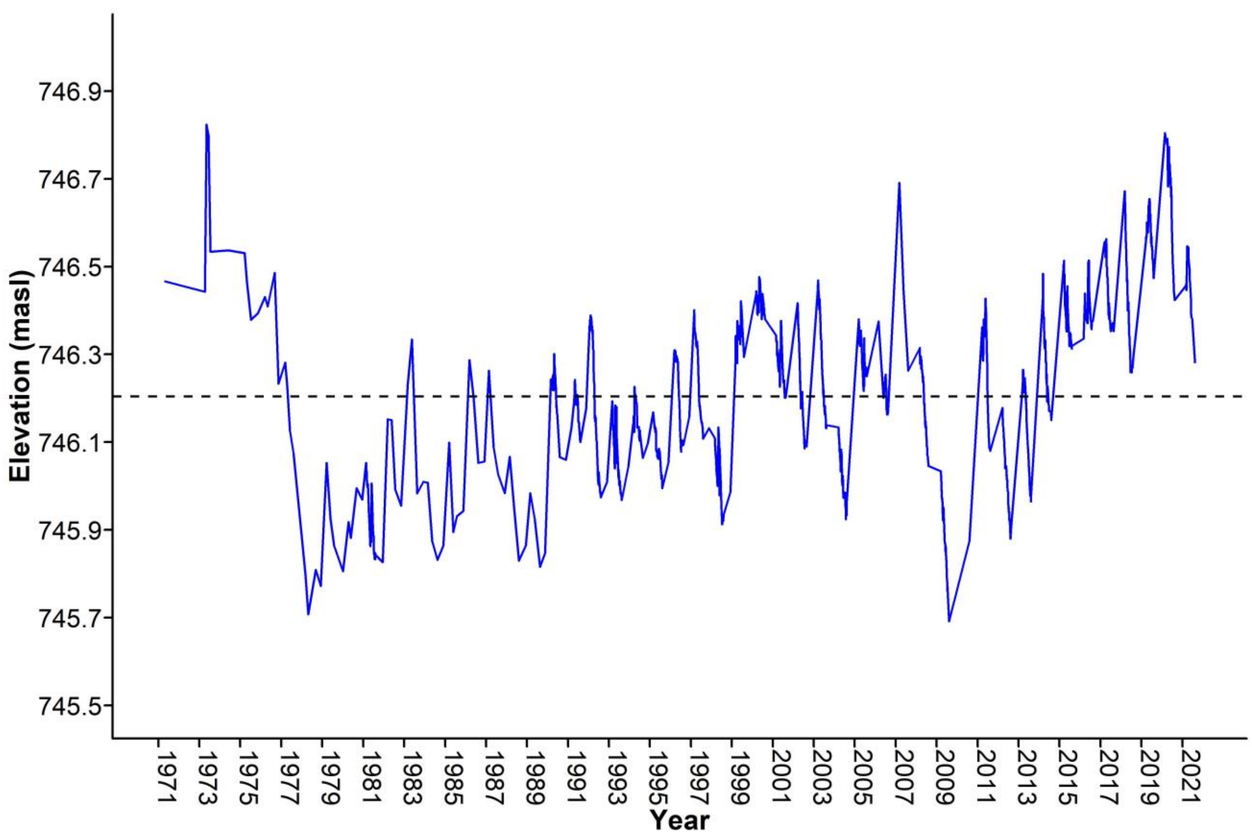


Figure 5. Water levels measured at Little Beaver Lake in metres above sea level (masl) from 1971-2021. Data retrieved from Alberta Environment and Parks. Black dashed line represents historical yearly average water level.

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.

Little Beaver Lake experienced a warmer, drier, less windy summer with slightly less solar radiation compared to normal (Figure 6). A warm spell prior to the July 8th sampling resulted in relatively high surface temperatures. As the lake is small and mixes frequently, lake temperatures followed average air temperatures through the season.

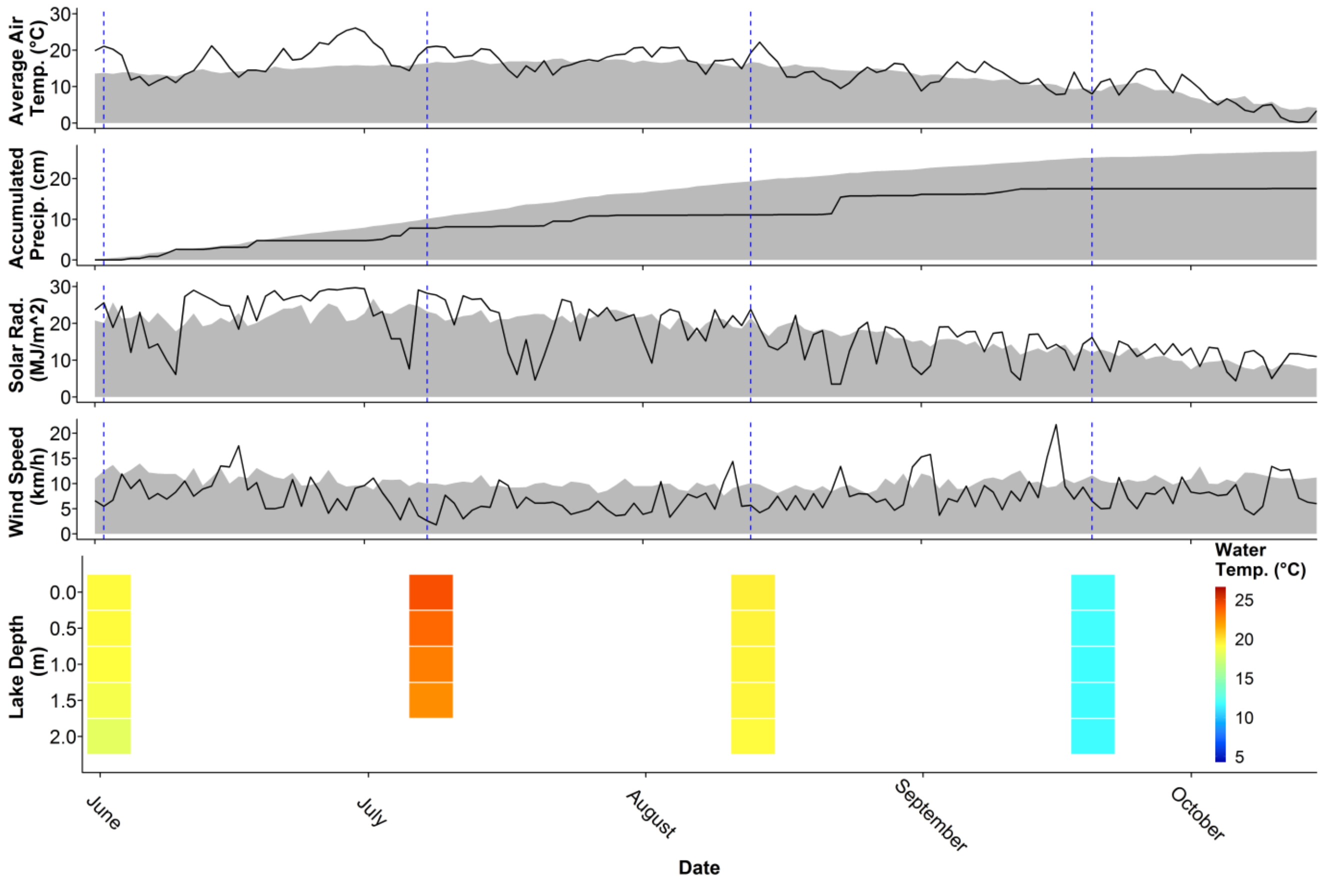


Figure 6. Average air temperature (°C), accumulated precipitation (cm), and wind speed (km/h) measured from Battle Ferintosh AGCM, as well as solar radiation (MJ/m^2) measured from Rosalind AGCM, with Little Beaver Lake temperature profiles (°C) at the bottom. Black lines indicate 2021 levels, gray indicates long-term normals, and blue lines indicate sampling dates for Little Beaver 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).

Table 2. Average Secchi depth and water chemistry values for Little Beaver Lake.

Parameter	2009	2010	2014	2016	2018	2019	2021
TP (µg/L)	517	422	1301	168	357	465	802
TDP (µg/L)	84	92	178	25	144	168	522
Chlorophyll-*a* (µg/L)	195.7	107.9	173.0	86.2	197.8	265.8	213
Secchi depth (m)	0.20	0.38	0.20	0.53	0.41	0.31	0.3
TKN (mg/L)	8.0	6.0	8.3	4.1	5.3	5.6	4.9
NO_2-N and NO_3-N (µg/L)	99	11	32	4	9	24	20
NH_3-N (µg/L)	66	59	628	76	330	452	369
DOC (mg/L)	52	49	42	41	32	34	32
Ca^{2+} (mg/L)	16	14	26	22	24	28	43
Mg^{2+} (mg/L)	31	39	32	36	36	33	40
Na^{+} (mg/L)	181	169	160	148	145	135	142
K^{+} (mg/L)	33	27	27	30	31	30	30
SO_4^{2-} (mg/L)	141	146	163	150	170	163	185
Cl^{-} (mg/L)	31	32	29	31	38	32	37
CO_3^{2-} (mg/L)	64	55	39	36	62	18	54
HCO_3^{-} (mg/L)	385	430	399	358	265	358	338
pH	9.29	9.16	8.91	8.96	9.25	8.75	8.94
Conductivity (µS/cm)	1067	1140	1040	988	998	975	1150
Hardness (mg/L)	168	193	193	205	208	205	272
TDS (mg/L)	686	693	676	625	640	620	702
Microcystin (µg/L)	/	0.77	16.10	5.00	14.50	10.76	17.57
Total Alkalinity (mg/L $CaCO_3$)	423	444	327	350	320	323	368

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

Metals (Total Recoverable)	2014	2016	Guidelines
Aluminum µg/L	751	31.5	100[a]
Antimony µg/L	0.2375	0.214	/
Arsenic µg/L	3.61	2.45	5
Barium µg/L	94.5	79	/
Beryllium µg/L	0.0223	0.004	100[c,d]
Bismuth µg/L	0.0005	0.002	/
Boron µg/L	58.85	65.8	1500
Cadmium µg/L	0.0151	0.001	0.29[b]
Chromium µg/L	1.905	0.1	/
Cobalt µg/L	0.5515	0.243	50,1000[c,d]
Copper µg/L	1.7	0.96	4[b]
Iron µg/L	553.5	168	300
Lead µg/L	0.519	0.163	7[b]
Lithium µg/L	81.05	96.3	2500[d]
Manganese µg/L	79	83.7	130[e]
Molybdenum µg/L	0.772	0.579	73
Nickel µg/L	1.41	0.812	150[b]
Selenium µg/L	0.652	0.57	1
Silver µg/L	0.003	0.003	0.25
Strontium µg/L	311.5	277	/
Thallium µg/L	0.006915	0.0021	0.8
Thorium µg/L	0.1078	0.0187	/
Tin µg/L	0.03265	0.013	/
Titanium µg/L	16.6	2.23	/
Uranium µg/L	3.29	2.81	15
Vanadium µg/L	2.34	1.01	100[c,d]
Zinc µg/L	3.11	1.6	30[f]

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on 2016 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 2016 avg. water hardness (as CaCO3) and avg. pH
[f] Based on 2016 avg. water hardness (as CaCO3), avg. pH, and avg. DOC with CCME equation
A forward slash (/) indicates an absence of data or guidelines