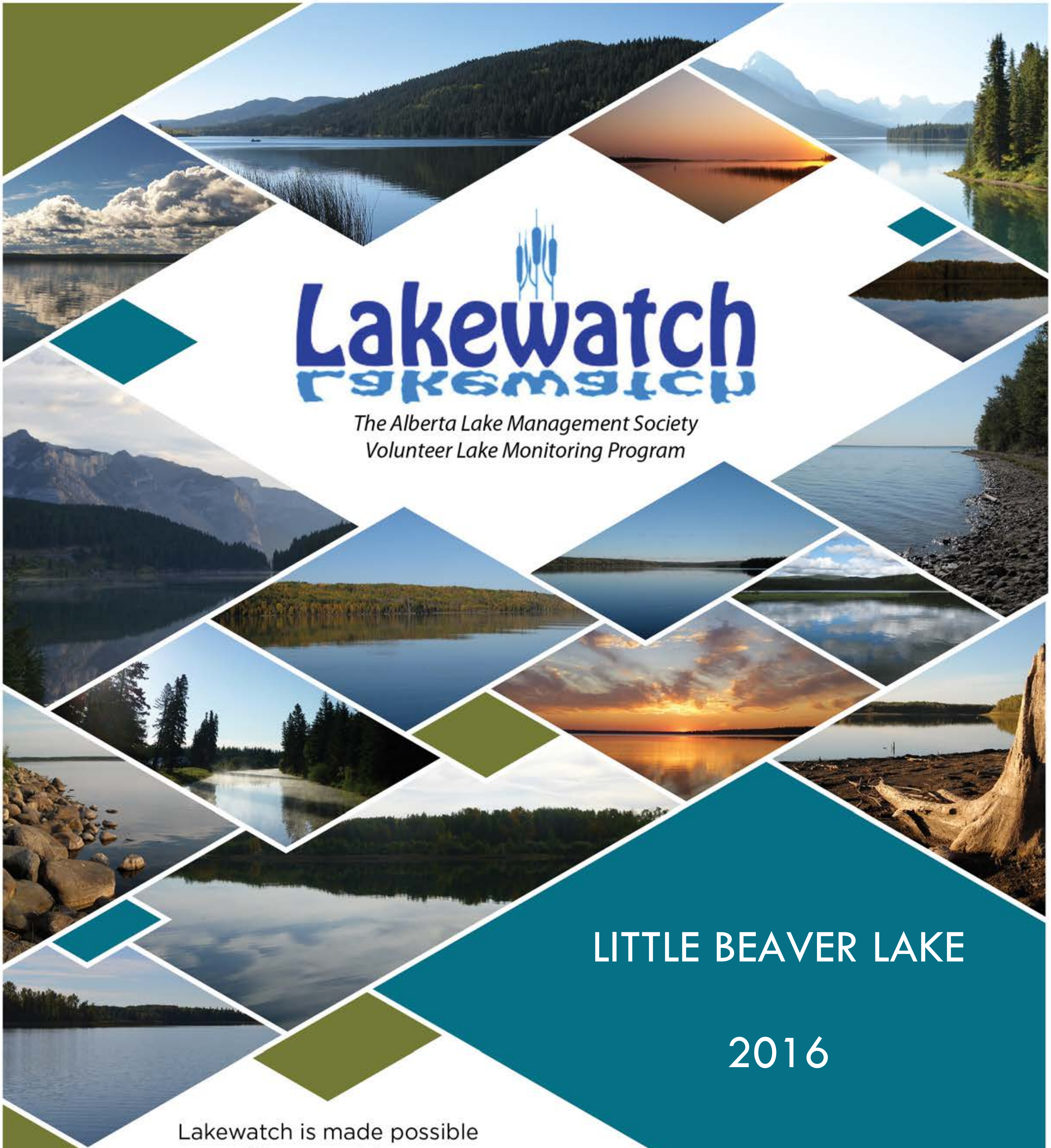

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

LITTLE BEAVER LAKE

2016

Lakewatch is made possible
with support from:

Beaver River Watershed Alliance

aemera.org

LICA
Lakeland Industry & Community Association

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ALMS

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 people prove that ecological apathy can be overcome and 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 like to extend a special thanks to Doug Jensen for his efforts in sampling Little Beaver Lake in 2016. We would also like to thank Alicia Kennedy, Ageleky Bouzetos, and Breda Muldoon who were summer technicians in 2016. Executive Director Bradley Peter was instrumental in planning and organizing the field program. This report was prepared by Bradley Peter and Laura Redmond. The Beaver River Watershed, the Lakeland Industry and Community Association, Environment Canada, and Alberta Environment and Parks are major sponsors of the LakeWatch program.

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 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, and in the 1890’s ranchers established in the watershed 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.

Figure 1 – Little Beaver Lake, Alberta. Photo taken by Jackson Woren, 2014.

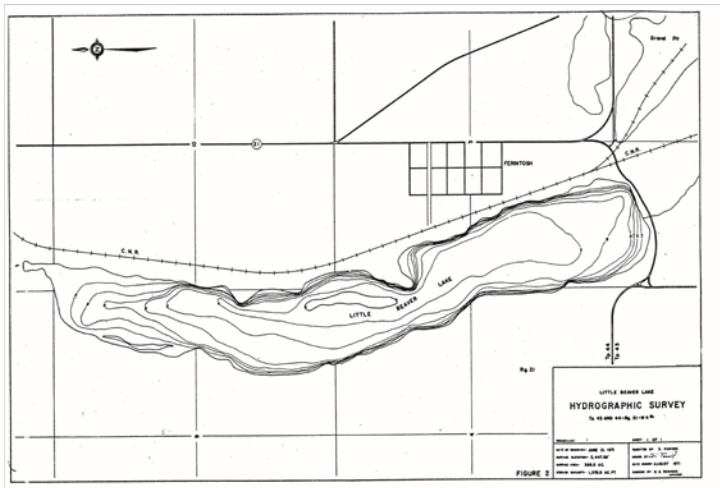

Figure 2– Bathymetric map of Little Beaver Lake (Angler’s Atlas)

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 of Little Beaver Lake in 2016 was 168 µg/L (Table 2). This classifies Little Beaver as hypereutrophic, or highly productive, but is historically low. TP increased over the course of the summer, reaching a maximum concentration of 200 µg/L on August 8 (Figure 3).

Chlorophyll-*a* concentrations also increased over the course of the summer (Figure 3), with an average concentration of 86.2 µg/L (Table 2). This value also puts Little Beaver Lake well into the hypereutrophic classification of lake productivity, though similar to TP, is historically low. Chlorophyll-*a* concentration peaked on August 8, with a value of 125 µg/L.

The average total Kjeldahl nitrogen (TKN) concentration of Little Beaver Lake was 4.1 mg/L (Table 2). TKN concentration increased over the sampling season, peaking at 4.2 mg/L on August 8 and September 19 (Figure 3).

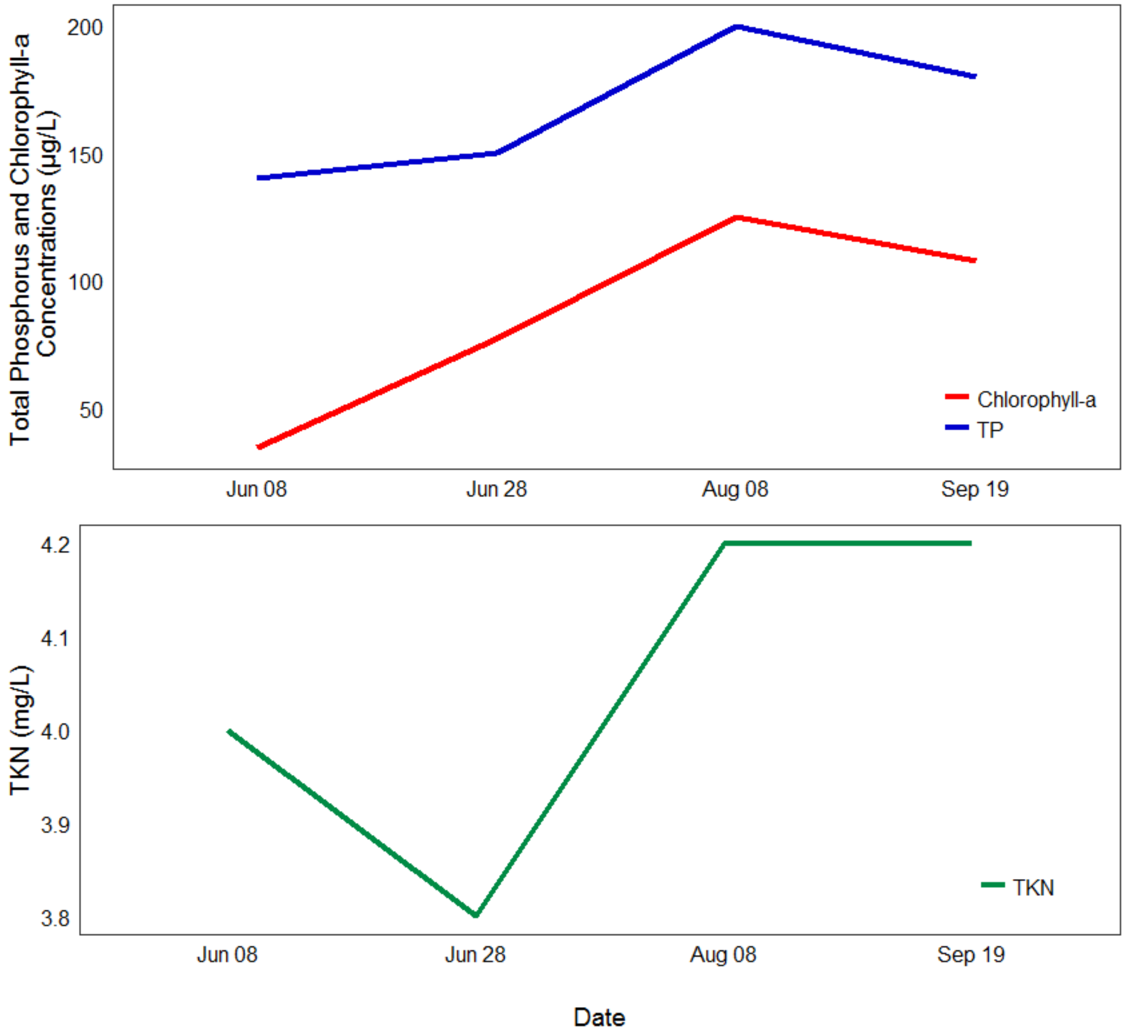

Figure 3- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Little Beaver Lake.

Average pH measured as 8.96 in 2016 and the lake water is buffered by moderate alkalinity (350 mg/L $CaCO_3$) and bicarbonate (357.5 mg/L HCO_3). Sodium and sulphate were the dominant ions contributing to a relatively high conductivity measure of 987.5 uS/cm (Table 2).

Metals were measured once at Little Beaver Lake and all measured values are listed in Table 3. All metals were within the recommended guidelines for the Protection of Freshwater Aquatic Life.

WATER CLARITY AND SECCHI 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 disk depth. Two times the Secchi disk depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

The average Secchi depth in 2016 was 0.53 m (Table 2), classifying Little Beaver Lake as hypereutrophic. Secchi depth was negatively correlated with chlorophyll-*a* (r= -0.97, df= 2, p-value= 0.03), indicating that water clarity decreased as phytoplankton biomass increased over the course of the summer.

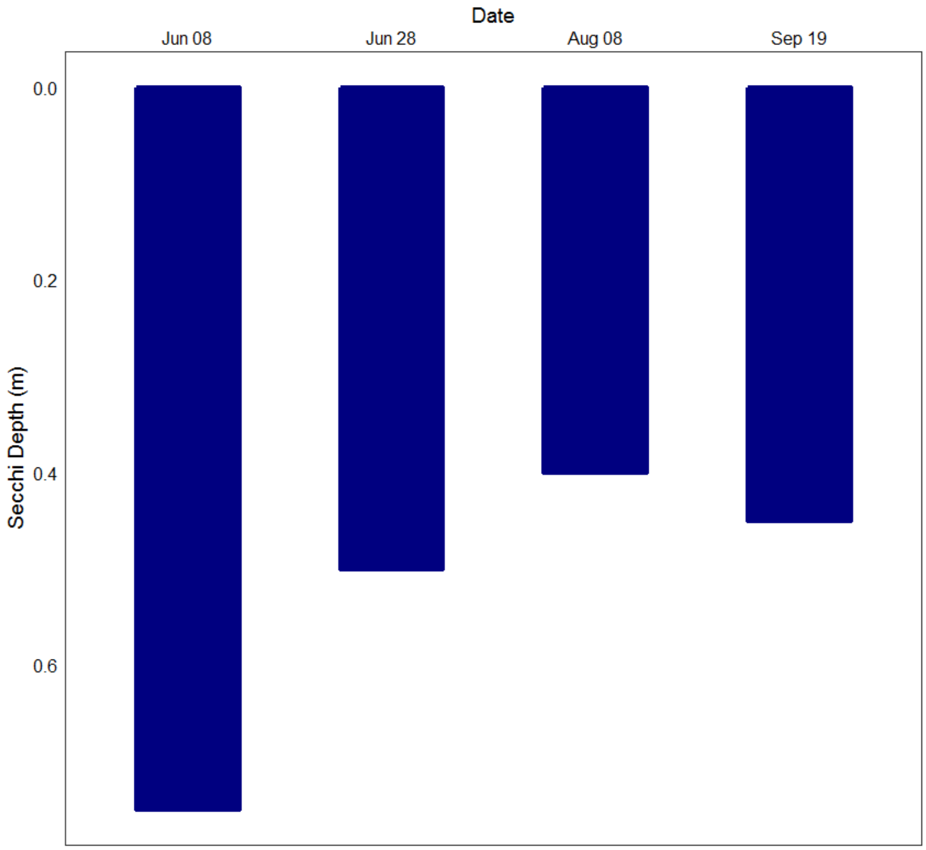

Figure 4 – Secchi depth values measured four times over the course of the summer at Little Beaver Lake in 2016.

WATER TEMPERATURE AND DISSOLVED OXYGEN

Water temperature and dissolved oxygen 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.

Water temperature varied across the sampling season in Little Beaver Lake. The maximum surface temperature (23.48 °C) was measured on June 29 (Figure 5a). By September 19, the entire water column was approximately 14°C. Little Beaver Lake can be classified as polymictic, because it is too shallow to stratify.

Little Beaver Lake remained well oxygenated (super-saturated) at the surface throughout the summer, measuring above the Canadian Council for Ministers of the Environment guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 5b). This is likely due to large amounts of photosynthetic activity occurring at the lake's surface. Little Beaver Lake displayed anoxia in June, and the process of decomposition, which consumes oxygen at the lakebed, could have contributed to oxygen decline. Given the lack of thermal stratification, the entire water column remained oxygenated for the rest of the summer.

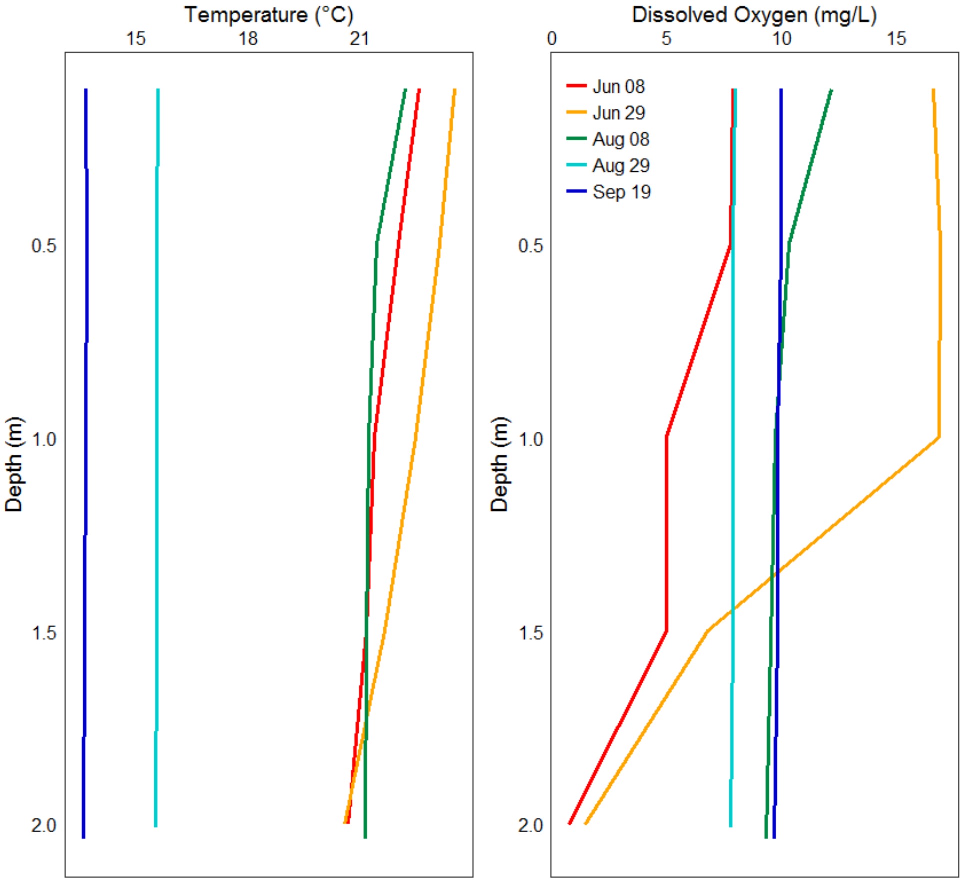

Figure 5 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Little Beaver Lake measured five times over the course of the summer of 2016.

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 the one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 20 µg/L.

Microcystin concentrations were measured four times over the course of the summer at Little Beaver Lake. ALMS samples are not used for advisory purposes as these samples are composited from 10 sites across the lake – individual sites in Little Beaver may actually exceed recreational guidelines and recreating in cyanobacteria blooms is not recommended. Average microcystin concentrations from ALMS composite samples in 2017 measured 5.03 ug/L. While this is below the recreational guidelines, it suggests there the cyanobacteria in Little Beaver lake are capable of producing significant amounts of microcystin.

Table 1 – Microcystin concentrations measured four times at Little Beaver Lake in 2016.

Date	Microcystin Concentration (µg/L)
Jun 8	2.32
Jun 28	8.98
Aug 8	4.00
Sep 19	4.80
Average	5.03

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 have been linked to creating toxic algae blooms, decreasing the amount of nutrients needed for fish and other native species, and causing millions of dollars in annual costs for repair and maintenance of water-operated infrastructure and facilities.

Monitoring involved two components: monitoring for juvenile mussel veligers using a plankton net and monitoring for attached adult mussels using substrates installed in each lake. In 2016, no mussels were detected in Little Beaver Lake.

Table 2: Average Secchi depth and water chemistry values for Little Beaver Lake. Historical values are given for comparison between years.

Parameter	2009	2010	2014	2016
TP (µg/L)	516.5	421.5	1300.8	168
TDP (µg/L)	83.5	91.5	178.2	25
Chlorophyll-a (µg/L)	195.7	107.9	173	86.2
Secchi depth (m)	0.20	0.38	0.20	0.53
TKN (mg/L)	8.0	6.0	8.3	4.1
NO2 and NO3 (µg/L)	99	11	32	3.8
NH3 (µg/L)	65.5	58.5	628.2	76.25
DOC (mg/L)	52.4	49.1	42.17	40.5
Ca (mg/L)	16.3	13.5	25.57	22.25
Mg (mg/L)	30.8	38.7	31.5	36.25
Na (mg/L)	181.3	169	160	147.5
K (mg/L)	32.6	26.7	27.02	30.25
SO42- (mg/L)	140.7	146	163.33	150
Cl- (mg/L)	31.3	32.1	29.23	31
CO3 (mg/L)	64.3	55	39.3	35.9
HCO3 (mg/L)	385	430	399	358
pH	9.29	9.16	8.91	8.96
Conductivity (µS/cm)	1067	1140	1040	988
Hardness (mg/L)	167.7	193	193.33	205
TDS (mg/L)	686.3	693	675.67	625
Microcystin (µg/L)	/	0.77	16.14	5.03
Total Alkalinity (mg/L CaCO3)	423	444	326.8	350

Table 3: Concentration 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.

Metals (Total Recoverable)	**2014**	**2016**	**Guidelines**
Aluminum µg/L	751	31.5	100[a]
Antimony µg/L	0.2375	0.214	6[e]
Arsenic µg/L	3.61	2.45	5
Barium µg/L	94.5	79	1000[e]
Beryllium µg/L	0.0223	0.004	100[d,f]
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	1000[f]
Copper µg/L	1.7	0.96	4[c]
Iron µg/L	553.5	168	300
Lead µg/L	0.519	0.163	7[c]
Lithium µg/L	81.05	96.3	2500[g]
Manganese µg/L	79	83.7	200[g]
Molybdenum µg/L	0.772	0.579	73[d]
Nickel µg/L	1.41	0.812	150[c]
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[f,g]
Zinc µg/L	3.11	1.6	30

Values represent means of total recoverable metal concentrations.

[a] Based on pH ≥ 6.5; calcium ion concentrations [Ca+2] ≥ 4 mg/L; and dissolved organic carbon concentration [DOC] ≥ 2 mg/L.

[b] Based on water Hardness of 205 mg/L (as CaCO3)

[c] Based on water hardness > 180mg/L (as CaCO3)

[d] CCME interim value.

[e] Based on Canadian Drinking Water Quality guideline values.

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

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

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