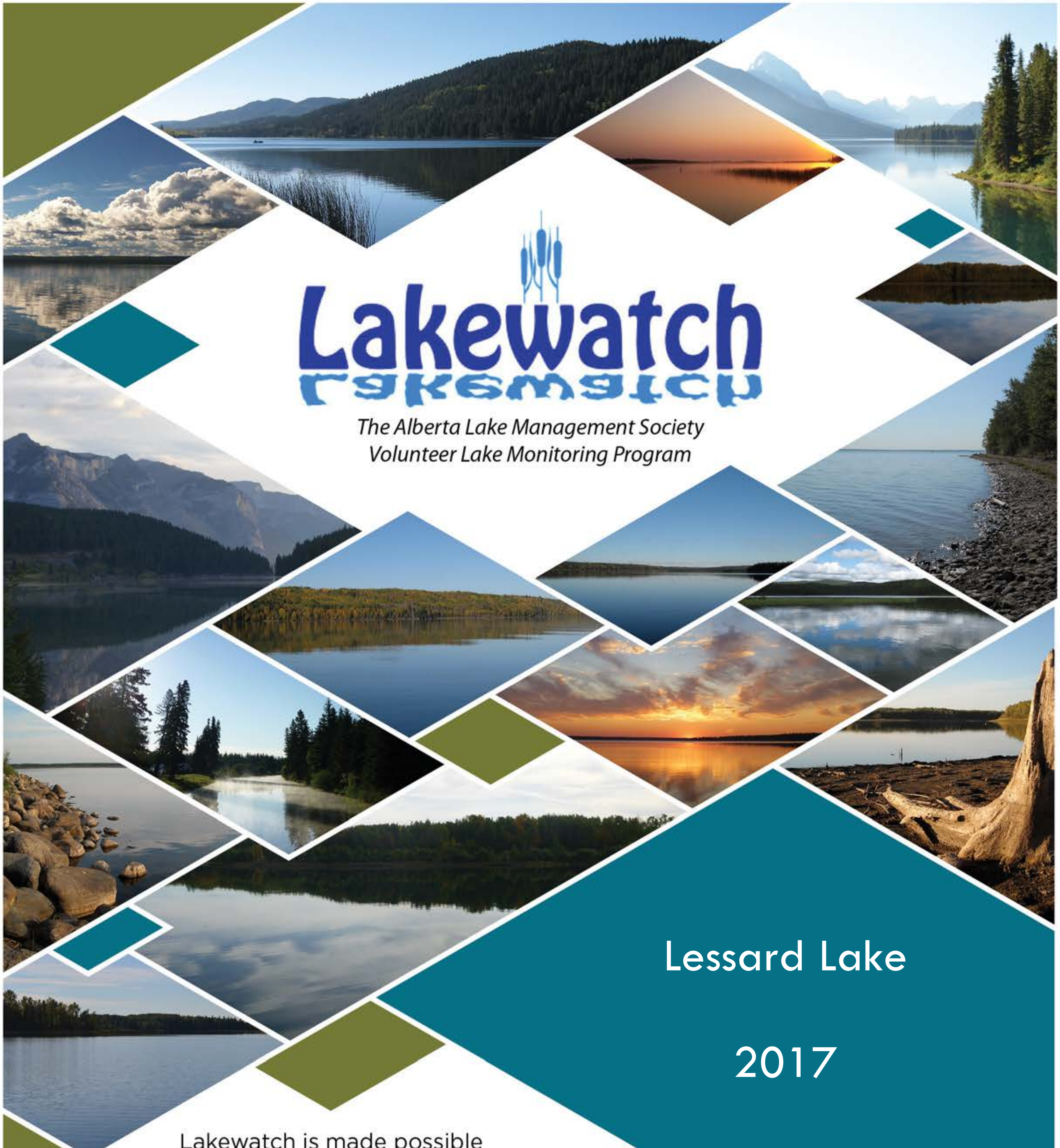

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Lessard Lake

2017

Lakewatch is made possible with support from:

Cargill — Helping the world thrive
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Pigeon Lake Watershed Association
LICA — Lakeland Industry & Community Association
Red Deer River Watershed Alliance
Beaver River Watershed Alliance
Alberta Environment and Parks

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.

ALMS is happy to discuss the results of this report with our stakeholders. If you would like information or a public presentation, contact us at info@alms.ca.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Adrianne Miller for the time and energy put into sampling Lessard Lake in 2017. We would also like to thank Elashia Young and Melissa Risto who were summer technicians in 2017. Executive Director Bradley Peter and LakeWatch Coordinator Laura Redmond was instrumental in planning and organizing the field program. This report was prepared by Laura Redmond and Bradley Peter. The Beaver River Watershed, the Lakeland Industry and Community Association, Environment Canada, and Alberta Environment and Parks are major sponsors of the LakeWatch program.

LESSARD LAKE

Lessard Lake—photo by Laura Redmond 2017

Lessard Lake is a small lake located in Lac Ste. Anne County about 20 km away from the town of Gunn on Highway 43. From above, Lessard Lake looks like a hand print with four bays pointing to the east. The lake was thought to be named after Edmund Lessard who was elected into the Alberta Legislature in 1909 and then the senate in 1925. Lessard Lake is found in the Moist Mixedwood subregion of the Boreal Mixedwood ecoregion in Alberta, and much of the land surrounding the lake is covered in forest[1]. There are a few subdivided plots along the north shore, a 161 lot subdivision on the south side of the lake, as well as a public campground with 50 sites which are serviced or basic on the south east bay of the lake. There is an education center located at Lessard Lake which provides an opportunity for large groups of people to enjoy what the lake has to offer.

The lake is small pothole lake with a water surface area of 3.21 km^2.[2] Average depth of Lessard Lake is 3.9 m and maximum depth is approximately 6 m. Lessard Lake has a small drainage basin which is less than 3 times the size of the surface area of the lake. The lake has no clearly defined inlets or outlets and groundwater is believed to be the major contributor of water to the lake[2].

The lake is primarily used for recreational purposes for activities such as swimming, boating, canoeing, kayaking, paddle boarding, and other water sports. Boaters should be cautious while driving around the lake as there is a large mound of rocks that almost completely spans across the two northeast bays of the lake. Winter kills in 73/74 as well as 74/75 almost completely destroyed the fish populations at Lessard Lake, but through the stocking of pike and perch, the populations rebounded and grew to the point where perch from Lessard Lake were transplanted to stock Nakamun Lake[3]. A brief macrophyte survey in 1975 found that the majority of the shoreline was comprised of bulrush and patches of water lily. A 2014 macrophyte survey at Lessard Lake found: hornwort, flat-stem pondweed, Richardson's pondweed, water lily, arrowhead, sago pondweed, and northern water milfoil.

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[1] Strong, W.L. and K.R. Leggat. (1998). Ecoregions of Alberta. Alta. En. Nat. Resour., Resour. Eval. Plan. Div., Edmonton.

[2] University of Alberta. (2005). Atlas of Alberta Lakes. University of Alberta Press. Available at: http://sunsite.ualberta.ca/Projects/Alberta-Lakes/

[3] Clements, G.D. (1975). A preliminary limnological survey of Lessard Lake. Alta. Rec. Parks Wild., Fish Wld. Div., Edmonton.

METHODS

Profiles: Profile data is measured at the deepest spot in the main basin of the lake. At the profile site, temperature, dissolved oxygen, pH, conductivity and redox potential are measured at 0.5- 1.0 m intervals. Additionally, Secchi depth is measured at the profile site and used to calculate the euphotic zone. On one visit per season, metals are collected at the profile site by hand grab from the surface and at some lakes, 1 m off bottom using a Kemmerer.

Composite samples: At 10-sites across the lake, water is collected from the euphotic zone and combined across sites into one composite sample. This water is collected for analysis of water chemistry, chlorophyll-a, nutrients and microcystin. Quality control (QC) data for total phosphorus was taken as a duplicate true split on one sampling date. ALMS uses the following accredited labs for analysis: Routine water chemistry and nutrients are analyzed by Maxxam Analytics, chlorophyll-*a* and metals are analyzed by Alberta Innovates Technology Futures (AITF), and microcystin is analyzed by the Alberta Centre for Toxicology (ACTF). In lakes where mercury samples are taken, they are analyzed by the Biogeochemical Analytical Service Laboratory (BASL).

Invasive Species: Monitoring for invasive quagga and zebra mussels involved two components: monitoring for juvenile mussel veligers using a 63 µm plankton net at three sample sites and monitoring for attached adult mussels using substrates installed at each lake.

Data Storage and Analysis: Data is stored in the Water Data System (WDS), a module of the Environmental Management System (EMS) run by Alberta Environment and Parks (AEP). Data goes through a complete validation process by ALMS and AEP. Users should use caution when comparing historical data, as sampling and laboratory techniques have changed over time (e.g. detection limits). For more information on data storage, see AEP Surface Water Quality Data Reports at aep.alberta.ca/water.

Data analysis is done using the program R.[1] Data is reconfigured using packages tidyr [2] and dplyr [3] and figures are produced using the package ggplot2 [4]. Trophic status for each lake is classified based on lake water characteristics using values from Nurnberg (1996)[5]. The Canadian Council for Ministers of the Environment (CCME) guidelines for the Protection of Aquatic Life are used to compare heavy metals and dissolved oxygen measurements. Pearson's Correlation tests are used to examine relationships between TP, chlorophyll-*a,* TKN and Secchi depth, providing a correlation coefficient (r) to show the strength (0-1) and a p-value to assess significance of the relationship.

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[1] R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.
[2] Wickman, H. and Henry, L. (2017). tidyr: Easily Tidy Data with 'spread ( )' and 'gather ( )' Functions. R package version 0.7.2. https://CRAN.R-project.org/package=tidyr.
[3] Wickman, H., Francois, R., Henry, L. and Muller, K. (2017). dplyr: A Grammar of Data Manipulation. R package version 0.7.4. http://CRAN.R-project.org/package=dplyr.
[4] Wickham, H. (2009). ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York.
[5] Nurnberg, G.K. (1996). Trophic state of clear and colored, soft- and hardwater lakes with special consideration of nutrients, anoxia, phytoplankton and fish. Lake and Reservoir Management 12: 432-447.

BEFORE READING THIS REPORT, CHECK OUT A BRIEF INTRODUCTION TO LIMNOLOGY AT ALMS.CA/REPORTS

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 Lessard Lake was 72.8 µg/L (Table 2), falling into the eutrophic, or productive, trophic classification. This is the highest average TP measured historically. TP increased over the course of the sampling season, peaking in August (Figure 1).

Average chlorophyll-*a* concentration in 2017 was 35.7 µg/L (Table 2), putting Lessard Lake into the hypereutrophic classification. This is a two fold increase in chlorophyll-*a* compared to the 2015 average and the highest in historical records. Chlorophyll-*a* concentrations were highest on August 22, reaching a maximum concentration of 62.3 µg/L. Chlorophyll-*a* concentrations were significantly correlated with TP (r=0.95, p-value=0.05).

Finally, the average TKN concentration was 1.9 mg/L (Table 2), and the maximum concentration was measured on August 22. TKN and chlorophyll-*a* trends were also significantly correlated (r=0.97, p-value=0.03).

Average pH was measured as 8.32 in 2017, buffered by moderate alkalinity (150 mg/L $CaCO_3$) and bicarbonate (185 mg/L HCO_3). Calcium was the dominant ions contributing to a low conductivity of 312.5 µS/cm (Table 2).

METALS

Samples were analyzed for metals (Table 3). In total, 27 metals were sampled for. 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.

On August 22, metals as well as total and dissolved mercury were measured once at Lessard Lake at the surface and at 1m off bottom. In 2017, all measured values fell within their respective guidelines (Table 3).

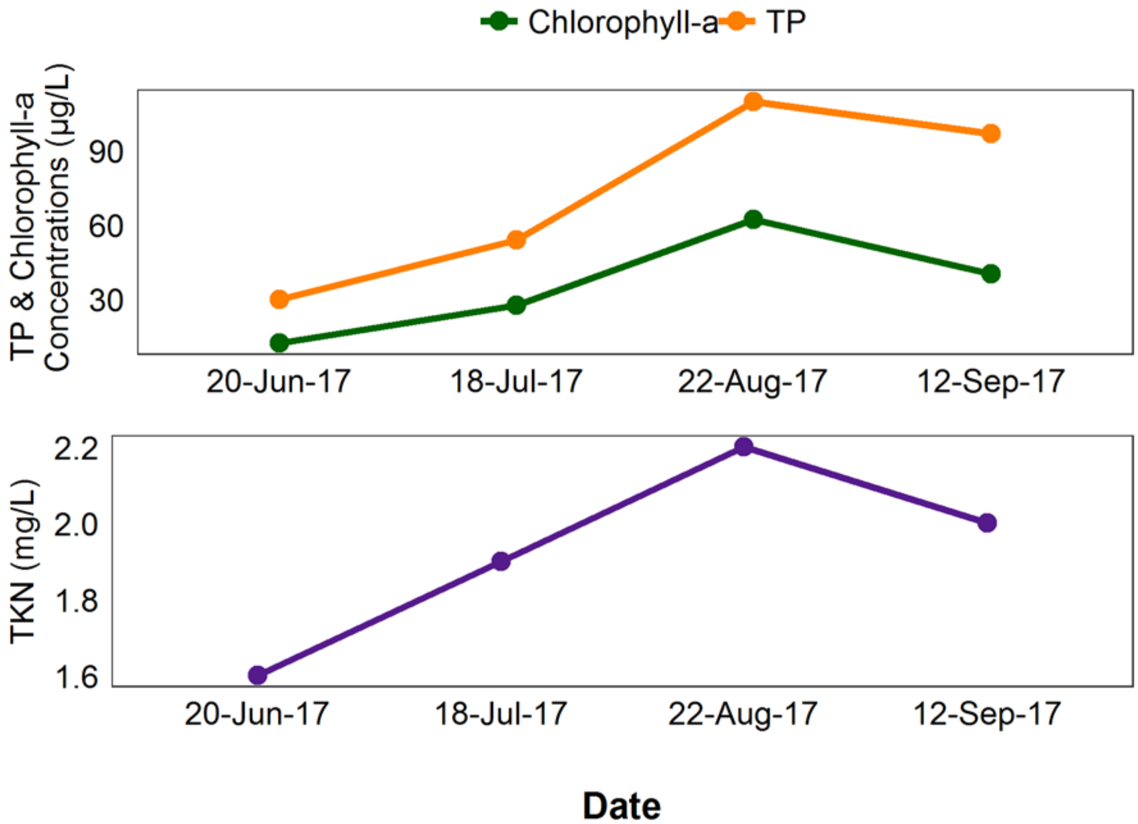

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Lessard Lake.

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

The average Secchi depth of Lessard Lake in 2017 was 1.44 m (Table 2). Water clarity measured as Secchi depth was lowest on August 22, when chlorophyll-*a* levels were highest. Secchi depth was negatively correlated with chlorophyll-*a* concentrations (r=-0.95, p-value=0.05). The decreasing water clarity could be associated with increasing algae biomass in the warmer months of the summer.

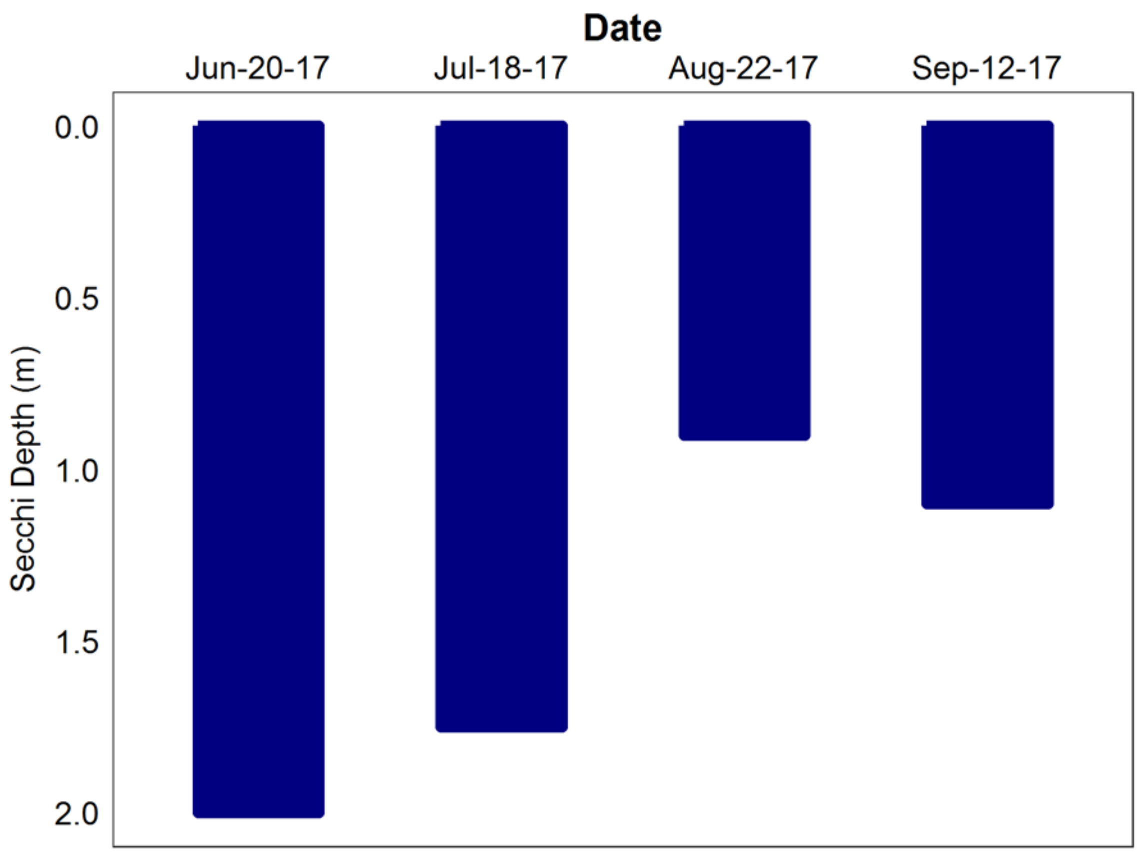

Figure 2 – Secchi depth values measured four times over the course of the summer at Lessard Lake in 2017.

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.

Temperatures of Lessard Lake varied throughout the summer, with a maximum temperature of 19.3 °C measured at the surface on July 18 (Figure 3a). Given the shallow depth of Lessard Lake, it was well mixed and stratification did not occur during 2017 sampling.

Lessard Lake remained well oxygenated at the surface throughout the summer, measuring above the CCME guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 3b). Oxygen levels decreased near the bottom likely due to the decomposition of algae and other biomass.

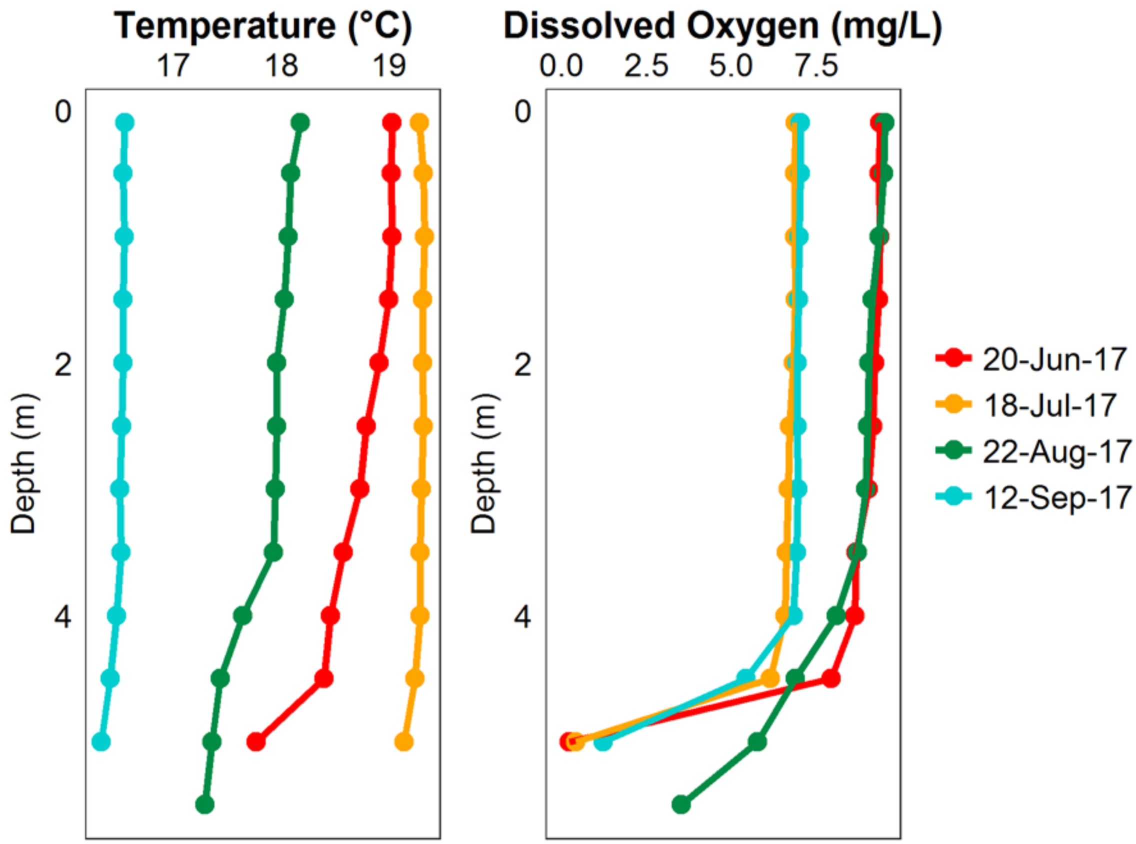

Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Lessard Lake measured four times over the course of the summer of 2017.

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. 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 Lessard Lake fell below the recreational guideline for the entire sampling period of 2017 (Table 1).

Table 1 – Microcystin concentrations measured four times at Lessard Lake in 2017.

Date	Microcystin Concentration (µg/L)
Jun-20-17	0.18
Jul-18-17	1.24
Aug-22-17	2.16
Sep-12-17	1.27
Average	1.21

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. No mussels have been detected in Lessard Lake.

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 in Lessard Lake have historically remained within a two metre range since monitoring began in 1969 (Figure 4). Water levels have been decreasing in Lessard Lake since the late 1990's. In 2010, water levels were at a minimum since the beginning of monitoring at 698.4 m asl.

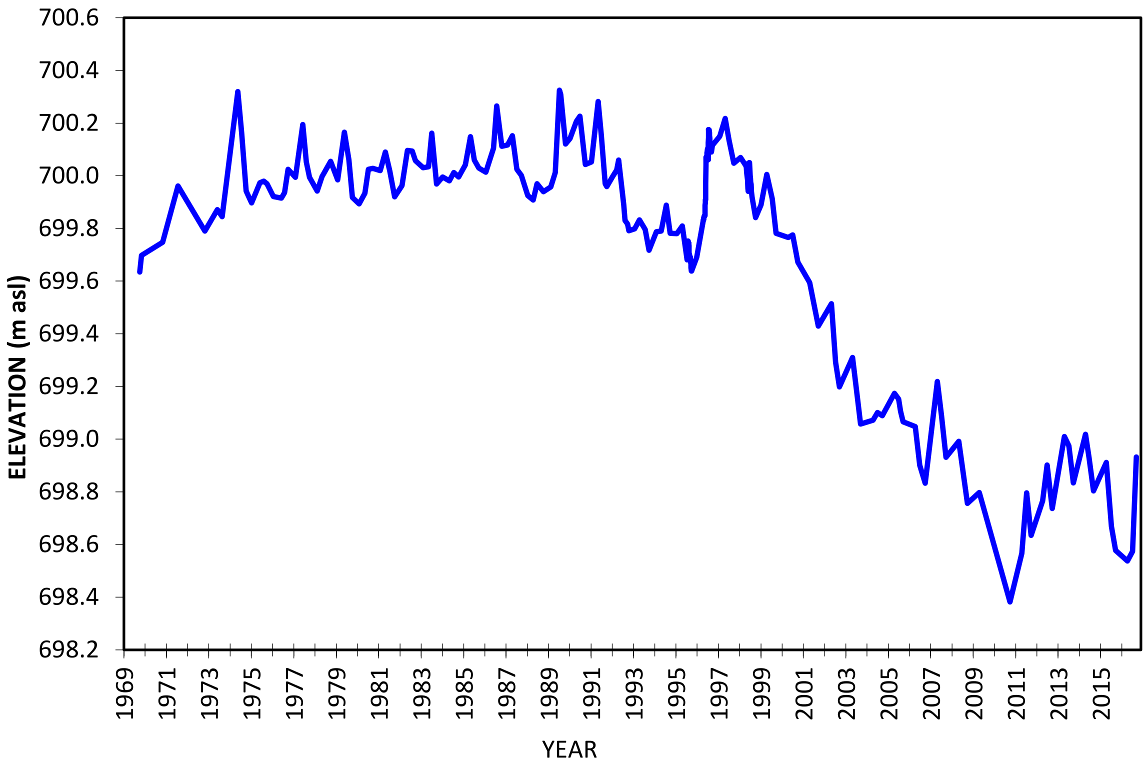

Figure 4- Water levels measured in metres above sea level (m asl) from 1969-2017. Data retrieved from Alberta Environment.

Table 2: Average Secchi depth and water chemistry values for Lessard Lake. Historical values are given for reference.

Parameter	1982	2014	2015	2017
TP (µg/L)	30	48.5	28.2	72.8
TDP (µg/L)	/	14	10	19.6
Chlorophyll-*a* (µg/L)	14.9	17.75	17.8	35.7
Secchi depth (m)	1.9	1.25	1.47	1.44
TKN (mg/L)	1.4	1.7	1.8	1.9
NO_2-N and NO_3-N (µg/L)	14	0.02	3.4	2.9
NH_3-N (µg/L)	/	32	54	44
DOC (mg/L)	/	118.13	20	22
Ca (mg/L)	35	27.3	26	34.25
Mg (mg/L)	14	13.4	15	15
Na (mg/L)	6	8.09	8	7.55
K (mg/L)	12	16.25	16	16.25
SO_4^{2-} (mg/L)	/	2.65	0.7	4.5
Cl^- (mg/L)	/	4.35	4.4	4.85
CO_3 (mg/L)	0	0.3	6.2	1.69
HCO_3 (mg/L)	132	188.5	164	185
pH	7.8	8.38	8.63	8.32
Conductivity (µS/cm)	239	311	290	312.5
Hardness (mg/L)	145	123.5	126	147.5
TDS (mg/L)	166	177.5	164	175
Microcystin (µg/L)	/	0.28	1.16	1.21
Total Alkalinity (mg/L $CaCO_3$)	132	154.25	144	150

Table 3: Concentrations of metals measured in Lessard Lake. Concentrations were measured at the surface and 1m off bottom. Historical values are given for reference. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

Metals (Total Recoverable)	**2014**	**2015**	**2017 Top**	**2017 Bottom**	**Guidelines**
Aluminum µg/L	31.4	11.2	5	5.7	100[a]
Antimony µg/L	0.031	0.024	0.029	0.026	/
Arsenic µg/L	0.705	0.664	0.76	0.73	5
Barium µg/L	76.2	62.2	74.9	75.1	/
Beryllium µg/L	0.0075	0.004	0.0015	0.0015	100[c,d]
Bismuth µg/L	0.0005	0.004	0.0015	0.006	/
Boron µg/L	61.35	68.6	60	60.5	1500
Cadmium µg/L	0.002	0.001	0.005	0.005	0.26[b]
Chromium µg/L	0.2415	0.12	0.05	0.05	/
Cobalt µg/L	0.007	0.016	0.05	0.048	1000[d]
Copper µg/L	0.273	0.173	0.27	0.2	4[b]
Iron µg/L	46.7	74.6	128	132	300
Lead µg/L	0.061	0.022	0.023	0.019	7[b]
Lithium µg/L	11.7	14.1	12.7	12.7	2500[e]
Manganese µg/L	58.9	57.8	135	145	200[e]
Mercury (dissolved) ng/L	/	/	0.4	0.51	/
Mercury (total) ng/L	/	/	0.81	0.77	26
Molybdenum µg/L	0.0245	0.0367	0.045	0.041	73[c]
Nickel µg/L	0.004	0.004	1.23	1.29	150[b]
Selenium µg/L	0.13	0.04	0.2	0.1	1
Silver µg/L	0.001	0.001	5.00E-04	5.00E-04	0.25
Strontium µg/L	151	136	153	150	/
Thallium µg/L	0.000725	0.00083	0.001	0.001	0.8
Thorium µg/L	0.00258	0.00118	0.012	0.021	/
Tin µg/L	0.046	0.013	0.03	0.03	/
Titanium µg/L	1.79	1.21	1.45	1.21	/
Uranium µg/L	0.028	0.024	0.017	0.016	15
Vanadium µg/L	0.15	0.11	0.102	0.076	100[d,e]
Zinc µg/L	1.4	0.4	0.5	0.4	30

Values represent means of total recoverable metal concentrations.

[a] Based on pH ≥ 6.5

[b] Based on water hardness > 180mg/L (as $CaCO_3$)

[c] CCME interim value.

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

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

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