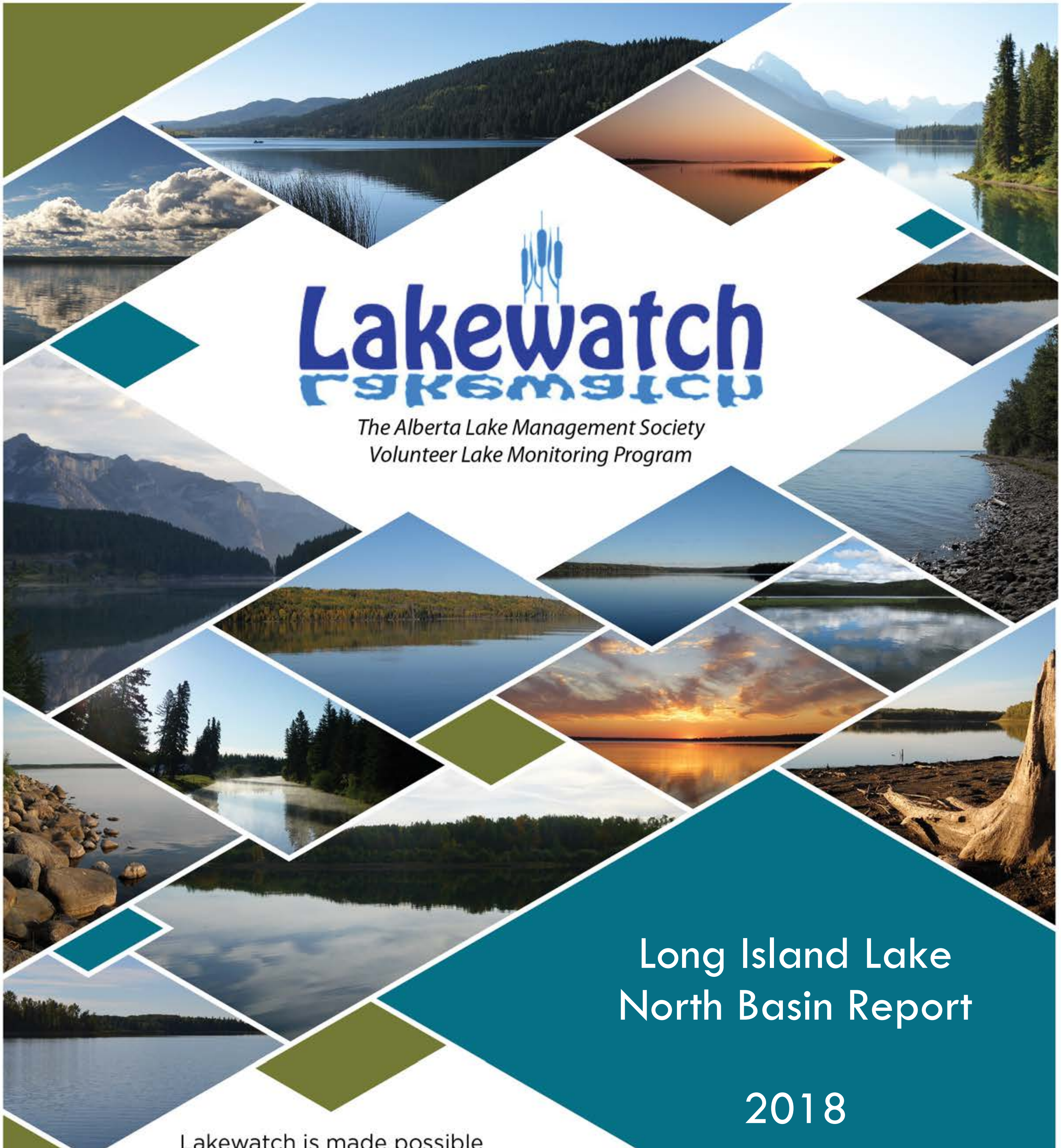

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Long Island Lake North Basin Report

2018

Lakewatch is made possible with support from:

Alberta · Pigeon Lake Watershed Association · Jackfish Lake · MD 61 Wainwright · LICA Environmental Stewards · Red Deer River Watershed Alliance · Cargill

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.

This report has been prepared with un-validated data.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. A special thanks to Ken Schauenberg for his commitment to collecting data at Long Island Lake. We would also like to thank Alanna Robertson, Lindsay Boucher and Shona Derlukewich, who were summer technicians in 2018. Executive Director Bradley Peter and Program Coordinator Laura Redmond were instrumental in planning and organizing the field program. This report was prepared by Caitlin Mader and Bradley Peter.

LONG ISLAND LAKE

Long Island Lake is a spring fed lake, located north of Edmonton on Highway 44 to Westlock, Township Road 63 and Range Road 25. Long Island Lake has an average depth of 7.4 m with a maximum depth of 14 m. The lake is comprised of 2 basins encompassing an area of 216 hectares (2.16 km^2) the north basin is larger and deeper than the south basin, and it is in the north basin that an island exists with a surface area of 16.2 hectares (0.16 km^2). The shoreline length of Long Island Lake is 15.9 km. The south basin has a Summer Village and the North Basin has cottages and a campground. In 2018, LakeWatch samples were taken only from the North Basin, with the exception of some invasive species monitoring.

Long Island Lake—Photo by Heather Jones

Algae blooms are known to occur during the late summer months due to the lakes natural productivity. The lake is moderately productive and has a moderate littoral area in relation to its surface area. A detailed algal composition has not been completed for the lake. The siltclay lake bed supports dense aquatic vegetation. In the north and south basins bulrush (*Scirpus* spp.), cattail (*Typha* spp.) and sedges (*Carex* spp.) are common. Terrestrial vegetation is mainly spruce (*Picea* spp.), willow (*Salix* spp.) and balsam poplar (*Populus balsamifera*). The only reported sport fish in the lake is Northern pike (*Esox lucius*) (AENV, 1983).

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 Innotech 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.

---

[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 the north basin of Long Island Lake was 16 µg/L (Table 2), falling into the threshold for mesotrophic, or highly productive trophic classification. This value is lower than historical averages. Detected TP was lowest when first sampled in June at 11 µg/L, and the highest detected level was during the August 28 sampling at 20 µg/L (Figure 1).

Average chlorophyll-*a* concentrations in 2018 was 4.7 µg/L (Table 2), falling into the mesotrophic, or low productivity trophic classification. Like TP, Chlorophyll-*a* rose throughout the season, from a minimum of 2.6 µg/L in June and reached an observed maximum of 6.9 µg/L in late August.

Finally, the average TKN concentration was 0.90 mg/L (Table 2) with concentrations ranging from a minimum 0.86 mg/L on October 2 to a maximum of 0.91 on July 18.

Average pH was measured as 8.14 in 2018, buffered by moderate alkalinity (133 mg/L $CaCO_3$) and bicarbonate (163 mg/L HCO_3). Calcium was the dominant ion contributing to a low conductivity of 253 µS/cm (Table 2).

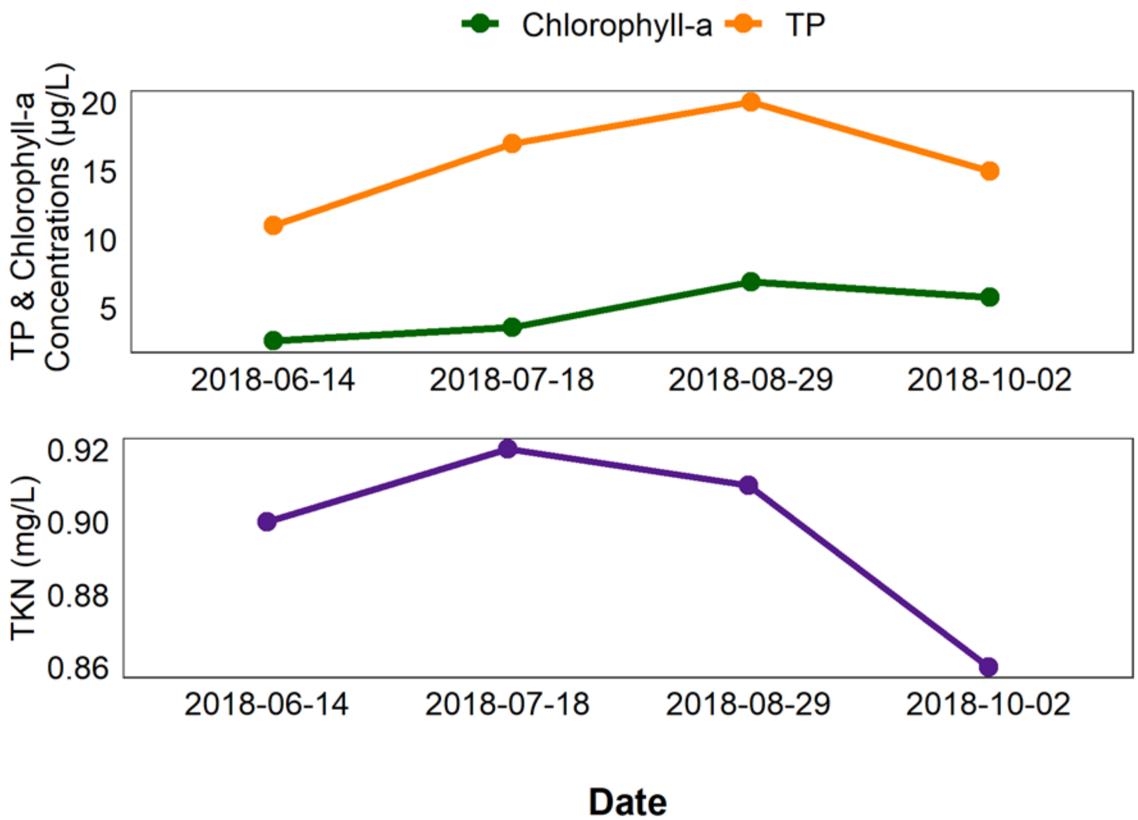

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer in the north basin of Long Island Lake.

METALS

Samples were analyzed for metals once throughout the summer (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.

Metals were not measured at Long Island Lake in 2018. Table 3 presents historical metal concentrations from previously sampled years in both the north and south basins.

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 the north basin of Long Island Lake in 2018 was 3.50 m (Table 2). Secchi depth was deepest on the first sampling event on June 16 at 4.10 m, and shallowest when sampled on August 29 at 2.50 m (Figure 2).

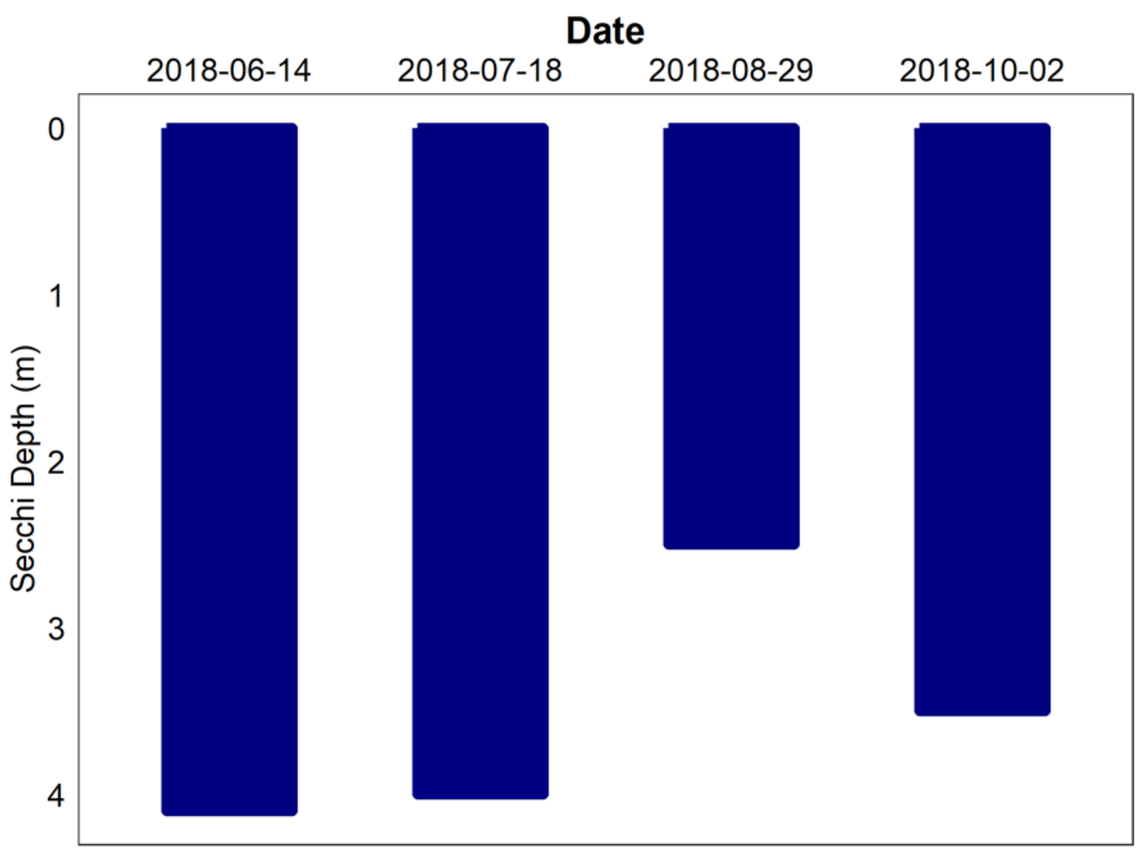

Figure 2 – Secchi depth values measured five times over the course of the summer in the north basin of Long Island Lake in 2018.

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 the north basin of Long Island Lake varied throughout the summer, with a minimum temperature of 6.7°C at 12.5 m on June 18, and a maximum temperature of 21.6°C measured at the surface on July 18 (Figure 3a). The lake was strongly stratified during all sampling trips until October 2, which indicates that the upper layers of the water column mix very little with the bottom layers. This is typical of deep temperate lakes such as Long Island Lake.

The north basin of Long Island Lake remained well oxygenated through the upper layer of the water column throughout the summer, measuring above the CCME guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 3b). The oxygen level was consistently below this level in the bottom 4 meters, which is typical of stratified lakes in which cold water at the bottom of the water is not oxygenated through mixing during the open water season.

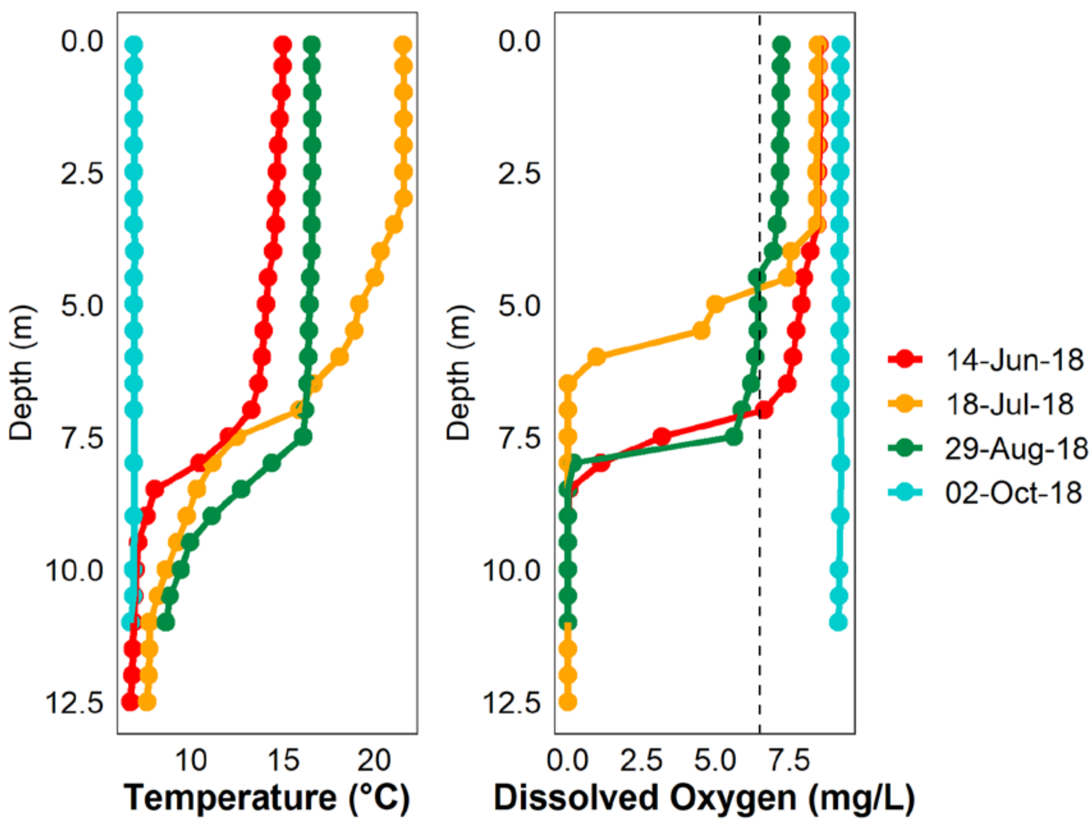

Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for the north basin of Long Island Lake measured four times over the course of the summer of 2018.

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 the north basin of Long Island Lake fell below detectable levels of 0.1 μg/L for at the locations and times sampled in the north basin of Long Island Lake in 2018 (Table 1). Recreational guidelines set an upper limit of 20 μg/L.

Table 1 – Microcystin concentrations measured four times in the north basin of Long Island Lake in 2018.

Date	**Microcystin Concentration (μg/L)**
14-Jun-18	<0.1
18-Jul-18	<0.1
29-Aug-18	<0.1
02-Oct-18	<0.1
Average	<0.1

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 mussels (veligers) using a plankton net and monitoring for attached adult mussels using substrates installed in each lake. No mussels have been detected in the north basin of Long Island 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.

Records of surface water elevation at the north basin of Long Island Lake date back to 1961 (Figure 4). Water levels maintained a 26 year period of stability from 1971 to 1997, with seasonal fluctuations between a minimum of 697.4 and a maximum of 697.8. Lake levels declined by 0.8 m from August 1997 to August 2003, and rebounded slightly by 0.2 m by August 2015. For a lake with a maximum depth of 12.5 m in 2018, these fluctuations represent a relatively small impact on lake area and volume.

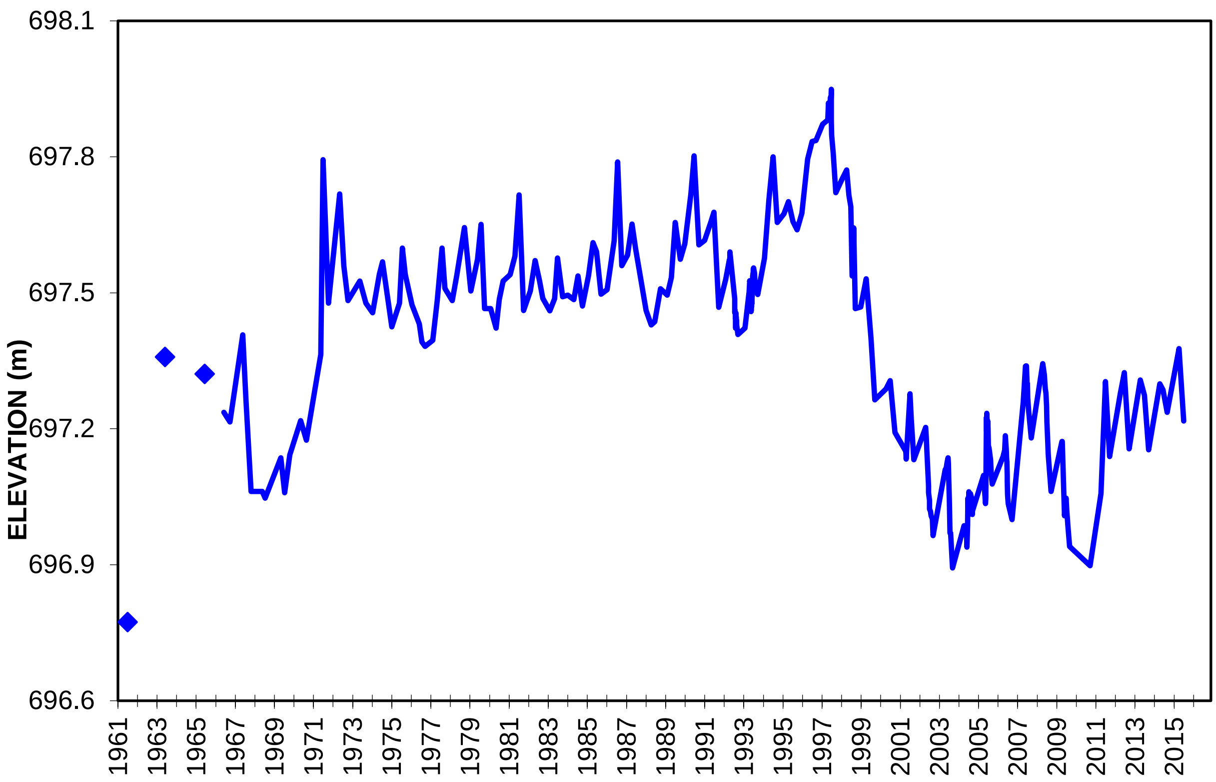

Figure 4: Surface elevation in meters above sea level for Long Island Lake from 1961 to 2015. Data retrieved from Alberta Environment and Parks.

Table 2: Average historical Secchi depth and water chemistry values for the north basin of Long Island Lake.

Parameter	**1992**	**2004**	**2007**	**2017**	**2018**
TP (µg/L)	25	30	28	21	16
TDP (µg/L)	11	11	13.3	6.5	5.9
Chlorophyll-*a* (µg/L)	8.9	15.7	5.3	7.6	4.7
Secchi depth (m)	4.6	2.95	3.7	2.68	3.5
TKN (mg/L)	0.92	1.08	0.97	0.99	0.90
NO_2-N and NO_3-N (µg/L)	3.2	5.2	<5	5.05	7.15
NH_3-N (µg/L)	/	/	/	18.5	45.3
DOC (mg/L)	-	-	16.0	13.25	15
Ca (mg/L)	28.2	27.6	30.3	26.2	29.7
Mg (mg/L)	11.4	11.6	12.6	11.35	13
Na (mg/L)	2.8	3	4.4	3.15	3.575
K (mg/L)	4.1	5	4.7	4.7	5.325
SO_4^{2-} (mg/L)	-	3	<3	0.5	1
Cl^- (mg/L)	0.567	0.7	1.1	1.9	1.375
CO_3 (mg/L)	-	4	6	0.25	1
HCO_3 (mg/L)	125	162	160	134	162.5
pH	8.2	8.33	8.2	8.16	8.14
Conductivity (µS/cm)	237	253	318	220	252
Hardness (mg/L)	/	/	/	112.8	127.5
TDS (mg/L)	/	/	135.7	115.8	135
Microcystin (µg/L)	/	/	/	0.17	0.1
Total Alkalinity (mg/L $CaCO_3$)	118	129	134.3	109.5	132.5

Table 3: Concentrations of metals were last measured in the two basins of Long Island Lake in August 2017. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference. No values were above guideline levels on any of the years sampled.

Metals (Total Recoverable)	2004 North	2004 South	2007 North	2007 South	2017 South	Guidelines
Aluminum µg/L	29	26.6	-	-	3	100[a]
Antimony µg/L	1.325	0.824	-	-	0.037	/
Arsenic µg/L	0.81	0.83	-	-	0.74	5
Barium µg/L	55.4	59.1	-	-	55.6	/
Beryllium µg/L	<0.003	<0.003	-	-	0.006	100[c,d]
Bismuth µg/L	0.002	0.002	-	-	0.003	/
Boron µg/L	30.3	32.9	-	-	32.1	1500
Cadmium µg/L	0.0024	0.0044	-	-	0.005	0.26[b]
Chromium µg/L	0.16	0.13	-	-	0.05	/
Cobalt µg/L	0.041	0.042	-	-	0.034	1000[d]
Copper µg/L	0.399	0.813	-	-	0.42	4[b]
Fluoride µg/L	0.15	0.15	-	-	-	-
Iron µg/L	163	85.4	63.9	39.1	58.2	300
Lead µg/L	0.057	0.044	-	-	0.021	7[b]
Lithium µg/L	8.55	8.3	-	-	7.21	2500[e]
Manganese µg/L	87.4	23.7	-	-	21.2	200[e]
Mercury (dissolved) ng/L	-	-	-	-	0.24	/
Mercury (total) ng/L	-	-	-	-	0.48	26
Molybdenum µg/L	0.23	0.24	-	-	0.236	73[c]
Nickel µg/L	0.009	0.03	-	-	0.32	150[b]
Selenium µg/L	0.067	<0.04	-	-	0.1	1
Silver µg/L	0.053	0.004	-	-	0.004	0.25
Strontium µg/L	121.5	125.5	-	-	107	/
Thallium µg/L	0.072	0.044	-	-	0.007	0.8
Thorium µg/L	0.014	0.009	-	-	0.013	/
Tin µg/L	0.048	<0.03	-	-	0.03	/
Titanium µg/L	0.88	0.7	-	-	0.31	/
Uranium µg/L	0.1925	0.3975	-	-	0.273	15
Vanadium µg/L	0.152	0.183	-	-	0.055	100[d,e]
Zinc µg/L	7.45	6.66	-	-	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.