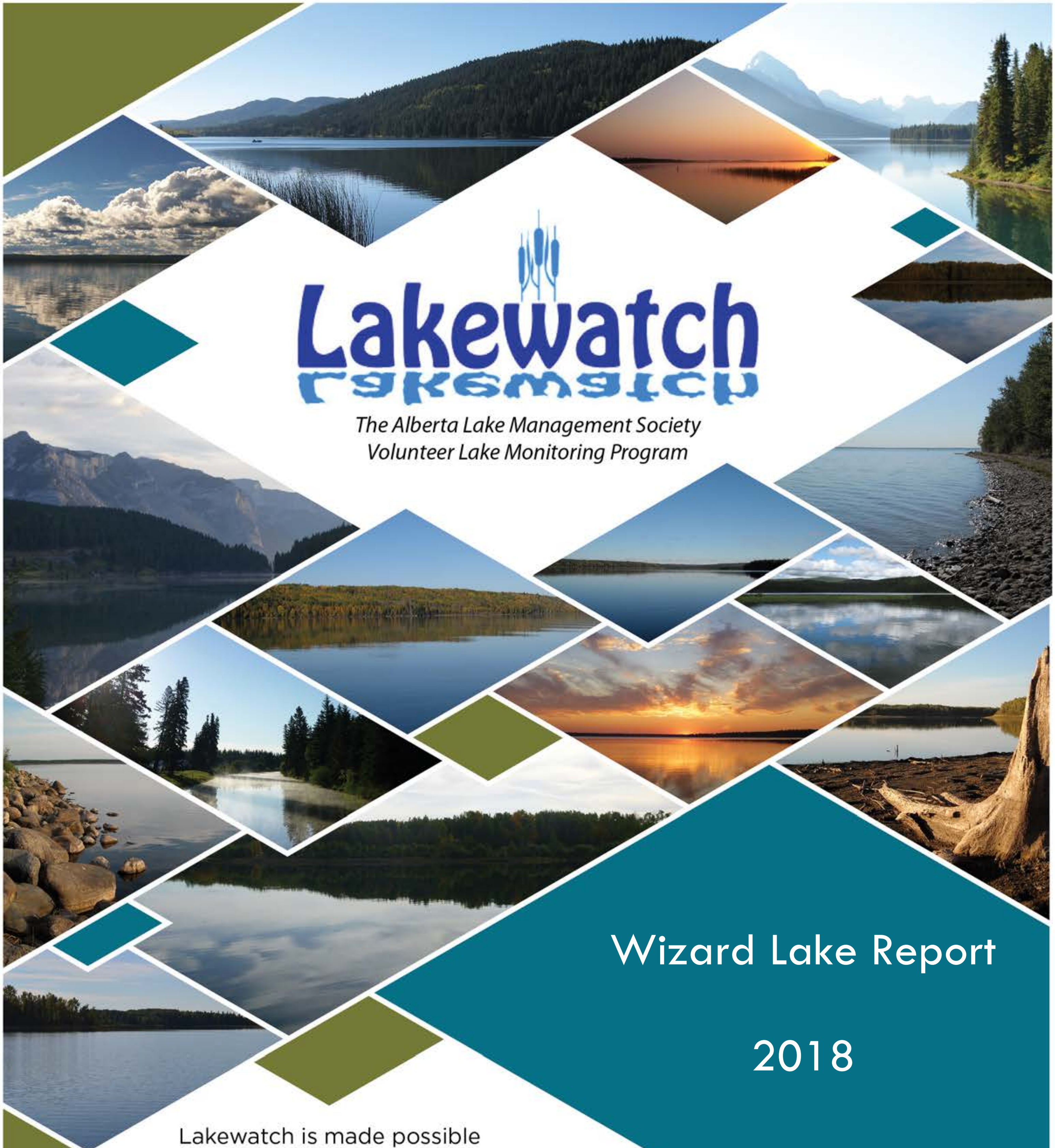


Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Wizard Lake 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.

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

ACKNOWLEDGEMENTS

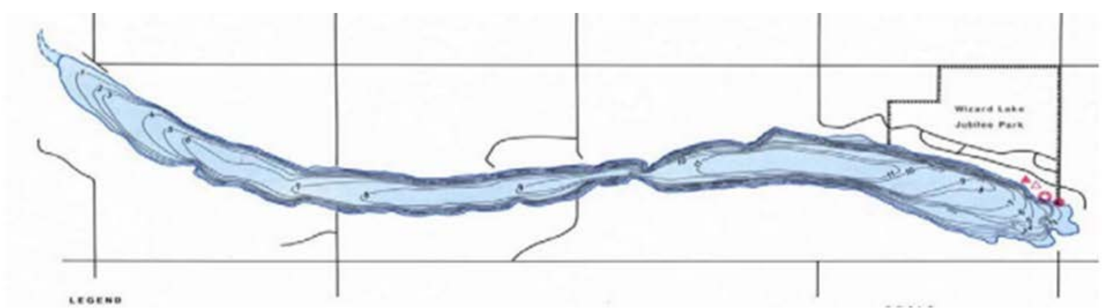
The LakeWatch program is made possible through the dedication of its volunteers. A special thanks to Larry McPherson for his commitment to collecting data at Wizard Lake. We would also like to thank Alanna Robertson, Lindsay Boucher and Shona Derlukewich, who were summer technicians in 2018. Executive 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.

Wizard Lake

Wizard Lake is a long serpentine lake lying in a heavily forested, deep glacial meltwater channel 60 km southwest of the city of Edmonton. The valley provides excellent shelter from winds, making this lake very popular for water skiing. The northern shore of the lake is in the county of Leduc and the southern shore of the lake is in the county of Wetaskiwin. The Nehiyawak name for the lake is Seksyawas Sakigan, which translates to Lizard Lake, and until the late 1960's the popular name for the lake was Conjuring Lake[1]. Cree legends said strange noises in the lake came from 'conjuring creatures'; the creek draining the lake, which enters the North Saskatchewan River ~5 km west of Devon, is still called Conjuring Creek[2].

Wizard Lake 2011. Photo by Jessica Davis

The year 1904 saw both the first settlers and the opening of a sawmill in the lake area. The sawmill was short-lived, closing in 1905 when the railway was not built across the area as expected. The sawmill was succeeded by the building of an underground coalmine, in operation until the 1940's. Today, the area surrounding the lake includes Wizard Lake Jubilee Park and 110 cottages on the north shore, 61 cottages on the south, and a subdivision.



Bathymetric map of Wizard Lake (Mitchell & Prepas 1990)

[1] 1 Aubrey, M. K. 2006. Concise place names of Alberta. Retrieved from http://www.albertasource.ca/placenames/resources/searchcontent.php?book=1

[2] Aquality Environmental Consulting (2013). Wizard Lake State of the Watershed Report 2012. Retrieved from: http://www.Wizardlake.ca/uploads/1/8/0/3/18037581/state_of_watershed_complete.pdf January 9, 2014.

Wizard Lake is a popular recreation area for water skiing, SCUBA diving, and fishing. Intensive use of the lake, especially on summer weekends, led to conflict between water skiers, high-speed boat operators, canoers, and anglers. A lake management plan was prepared in 1979, which recommended dividing the lake into two zones: the boat speed in the west half of the lake was to be limited to 12 km/hr to facilitate access to anglers, while the boat speed in the east half was to be limited to 65 km/hr to allow water skiing. Yellow perch and northern pike are the most commonly fished species in the lake. Wizard Lake occupies an area of 2.48 km^2, with a maximum depth of 11 m and a mean depth of 6.2 m. The length of the lake stretches 11.5 km and has a maximum width of 0.55 km. Wizard Lake lies in the Strawberry Creek sub-basin of the North Saskatchewan River Watershed[2] . It is a eutrophic lake, usually clear, but can experience dense blue-green algae blooms during the summer months. For more detailed information on Wizard Lake and its watershed, view the State of the Watershed Report available on the Wizard Lake website at:

Cyanobacterial bloom on the surface of Wizard Lake, 2011

http://www.wizardlake.ca/uploads/1/8/0/3/18037581/state_of_watershed_complete.pdf

The watershed area for Wizard Lake is 36.99 km^2 and the lake area is 2.67 km^2. The lake to watershed ratio of Wizard Lake is 1:14. A map of the Wizard Lake watershed area can be found http://alms.ca/wp-content/uploads/2016/12/Wizard.pdf

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 Wizard Lake was 46.5 µg/L (Table 2), falling into the eutrophic, or highly productive trophic classification. This value falls within the range of observed historical averages. Detected TP was lowest when first sampled in June at 38 µg/L, and rose throughout the season until the final sampling at 54 µg/L in September (Figure 1).

Average chlorophyll-*a* concentration in 2018 was 35.3 µg/L (Table 2), falling into the hypereutrophic, or very high productivity trophic classification. Like TP, chlorophyll-*a* rose throughout the season, from a minimum of 15 µg/L in June to a maximum of 54 µg/L in September.

Finally, the average TKN concentration was 1.3 mg/L (Table 2) with concentrations increasing over the course of the sampling season.

Average pH was measured as 8.49 in 2018, buffered by moderate alkalinity (172.5 mg/L $CaCO_3$) and bicarbonate (207.5 mg/L HCO_3). Calcium was the dominant ion contributing to a low conductivity of 350 µS/cm (Table 2).

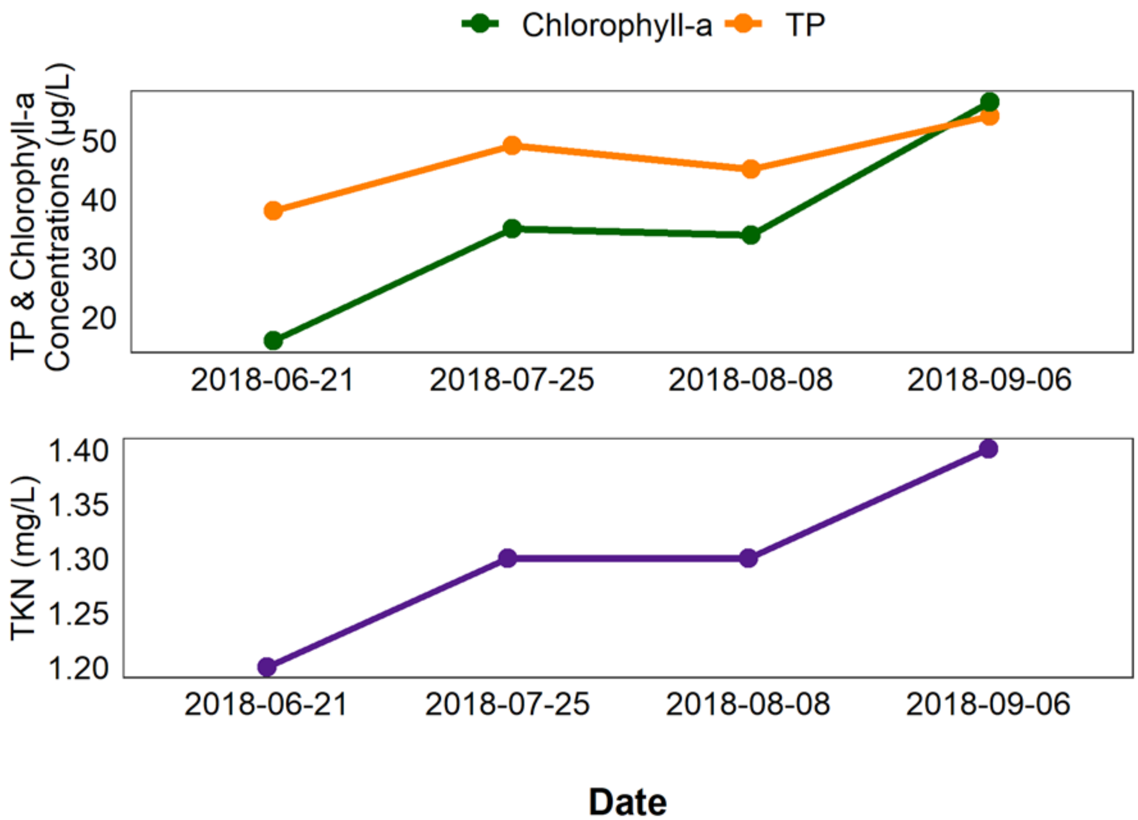


Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Wizard Lake.

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 Wizard Lake in 2018. Table 3 presents historical metal concentrations from previously sampled years.

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 Wizard Lake in 2018 was 1.16 m (Table 2). Secchi depth decreased sharply between June 21 and July 25. This decrease in water clarity may have been due to increasing algae concentrations over the season, as indicated by increasing chlorophyll-a levels (Figure 2).

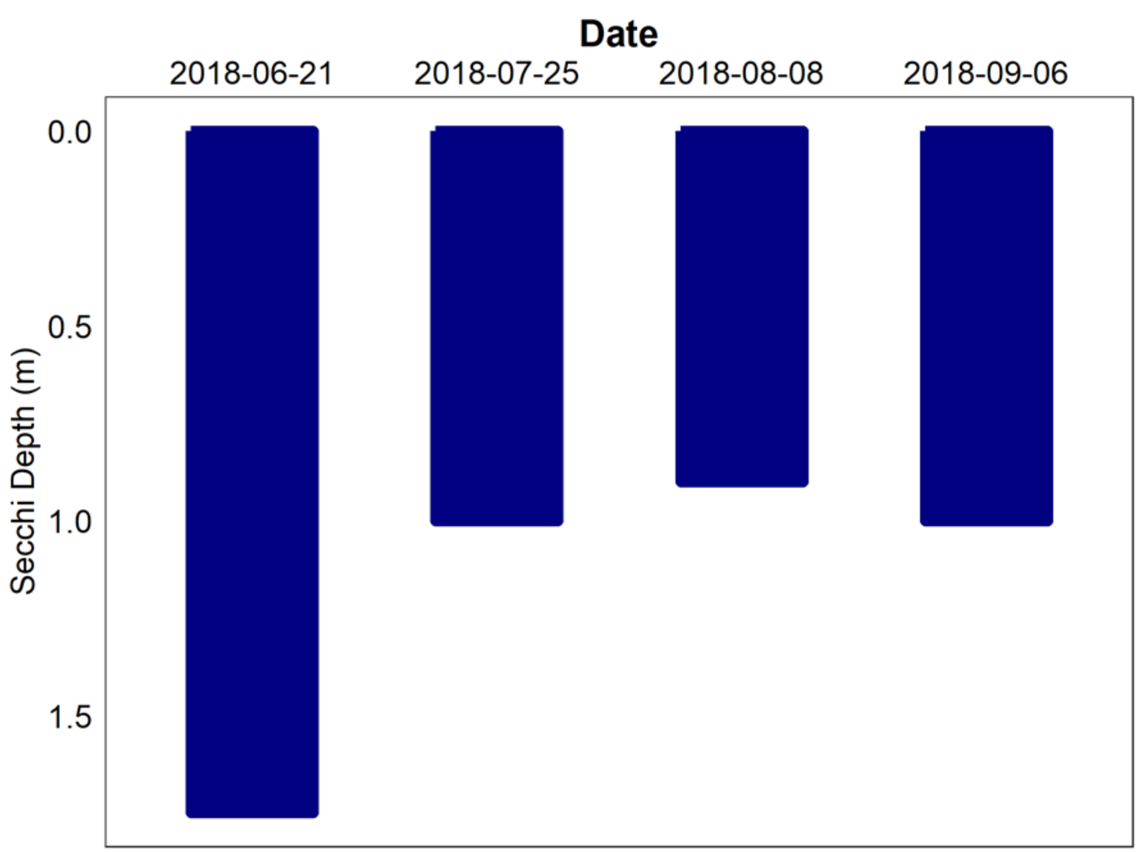


Figure 2 – Secchi depth values measured four times over the course of the summer at Wizard Lake in 2018.

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 Wizard Lake varied throughout the summer, with a maximum temperature of 21.2°C measured at the surface on August 18 (Figure 3a). The lake was weakly stratified from June to August, with a thermocline beginning at only 2.5 meters in June, but deepening to around 7 meters in July and August. The lake was mixing fully when sampled in September.

Wizard Lake remained well oxygenated for most 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 fell below this level in the bottom 3 to 5 meters from June to September. The lack of oxygen at greater depths is due to the decomposition of organic matter at lake bottom, combined with isolation from surface oxygen due to thermoclines that prevent mixing. In September, most of the water column had a DO concentration of less than 6.5 mg/L despite a lack of thermocline. Oxygen levels may have been depleted at this time because mixing of oxygen from surface waters was not sufficient to oxygenate the anoxic water that was being stirred up from below.

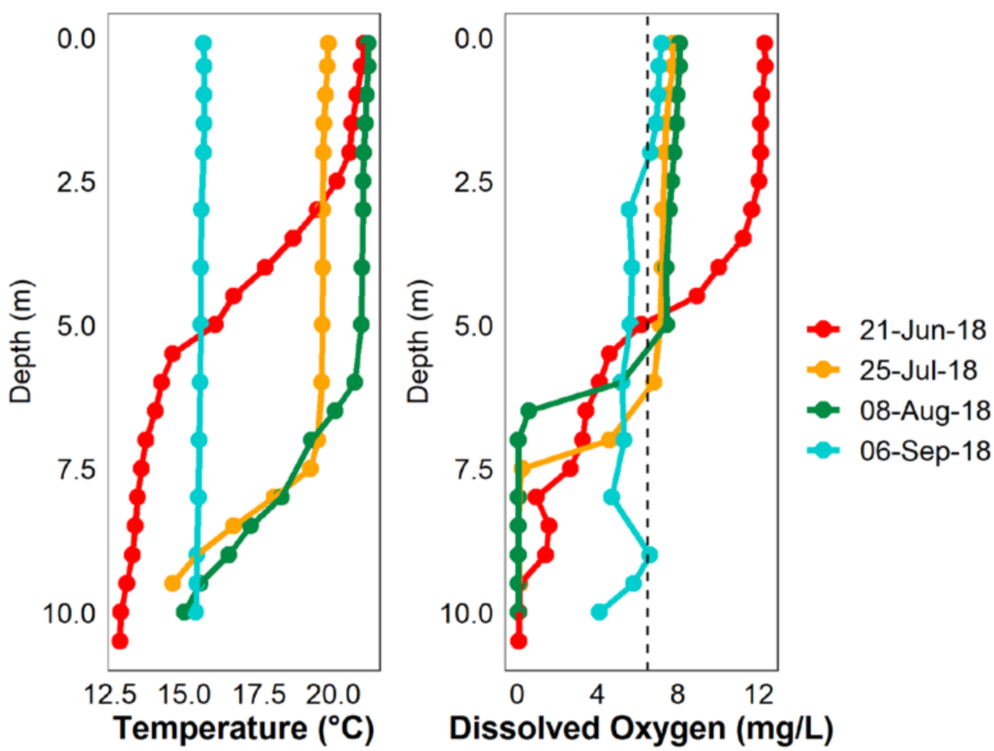


Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Wizard Lake measured four times over the course of the summer of 2018.

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 Wizard Lake fell below the recreational guideline of 20µg/L for at the locations and times sampled in Wizard Lake in 2018.

Table 1 – Microcystin concentrations measured four times at Wizard Lake in 2018.

Date	Microcystin Concentration (µg/L)
21-Jun-18	0.18
25-Jul-18	0.23
08-Aug-18	0.52
06-Sep-18	0.58
Average	**0.38**

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 Wizard 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 water levels at Wizard Lake date back to 1968 (Fig 4). Lake levels have been relatively stable, fluctuating only 1.3 m over this time period, and returning to the overall average of 783.9 m at some point in most years.

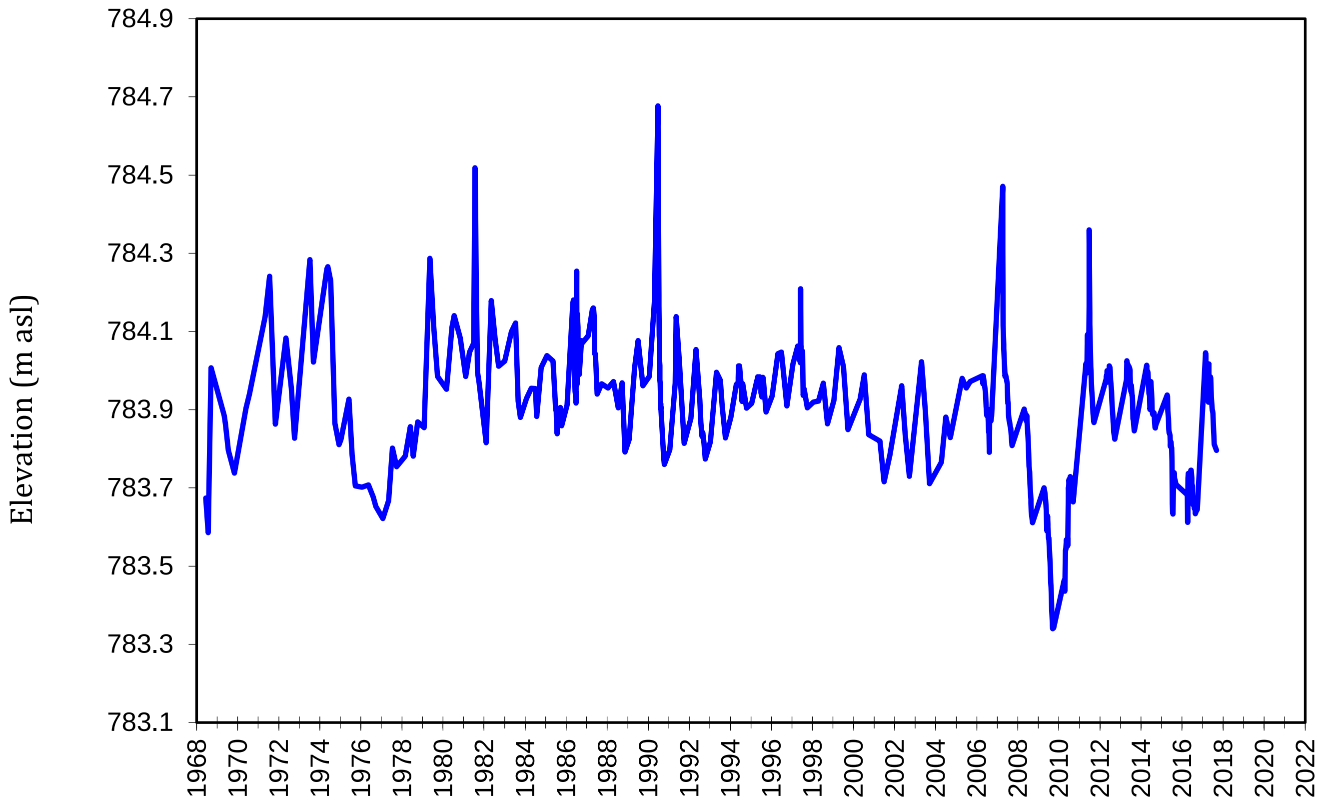


Figure 4: Surface elevation of Wizard Lake from 1968 to 2018. Data retrieved from Alberta Environment and Parks.

Table 2: Average historical Secchi depth and water chemistry values for Wizard Lake.

Parameter	2006	2008	2009	2010	2011	2013	2016	2018
TP (µg/L)	48.4	50.2	51.5	47.5	75.6	52.6	43	46.5
TDP (µg/L)	13.6	12.4	18	19.5	14.2	18.8	6	6.4
Chlorophyll-*a* (µg/L)	32.6	23.9	26.8	17.1	39.2	23.8	44	35.3
Secchi depth (m)	1.33	1.43	1.81	2.71	1.15	1.36	1.52	1.16
TKN (mg/L)	1.3	1.216	1.263	1.255	1.574	1.246	1.22	1.3
NO_2 and NO_3 (µg/L)	7	2.5	46	19.5	2.5	6.4	2.5	4.2
NH_3 (µg/L)	31.4	20.6	29	81	19.4	27.6	25	26.5
DOC (mg/L)	/	/	/	12.2	14.5	13.1	12	12.5
Ca (mg/L)	25	27.9	27.8	24.45	27.5	29	25.6	24.75
Mg (mg/L)	8.5	8.9	9.73	9.09	9.25	9.23	10.6	10.25
Na (mg/L)	36	34.9	37.5	38	32.3	37.4	39.4	41
K (mg/L)	6	5.8	6	6.15	5.83	6	7	7.2
SO_4^{2-} (mg/L)	3.5	4.5	5	4.25	3	5.83	2.76	1.93
Cl^- (mg/L)	4.7	4.5	4.9	5.65	5	5.2	6.34	7.3
CO_3 (mg/L)	6	10	5.5	/	3.6	5.1	3.85	4.05
HCO_3 (mg/L)	202	206.3	207.3	215.5	199.8	202.4	210	207.5
pH	8.3	8.3	8.44	8.29	8.45	8.472	8.5	8.49
Conductivity (µS/cm)	335	337.3	341.3	346	337.2	354	350	350
Hardness (mg/L)	97	106	109.4	96	106.9	110.3	105.4	102.5
TDS (mg/L)	186	191	196	193	185	197.3	202	200
Microcystin (µg/L)	/	/	/	0.091	0.25	0.25	1.41	0.38
Total Alkalinity (mg/L $CaCO_3$)	172	175	176	176.5	170	174.2	176	172.5

Table 3: Concentrations of metals were last measured in Wizard Lake in 2016. The CCME metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

Metals (Total Recoverable)	2013	2016	Guidelines
Aluminum μg/L	18	7.7	100[a]
Antimony μg/L	0.06565	0.074	6[d]
Arsenic μg/L	1.205	1.17	5
Barium μg/L	60.35	52.8	1000[d]
Beryllium μg/L	0.0015	0.029	100[c,e]
Bismuth μg/L	0.00255	0.004	/
Boron μg/L	43.85	39.3	1500
Cadmium μg/L	0.00225	0.029	0.26[b]
Chromium μg/L	0.3215	0.08	/
Cobalt μg/L	0.0312	0.06	1000[e]
Copper μg/L	0.7635	0.51	4[b]
Iron μg/L	52.15	56.3	300
Lead μg/L	0.0277	0.053	7[b]
Lithium μg/L	15.5	12.4	2500[f]
Manganese μg/L	74.6	88.1	200[f]
Molybdenum μg/L	0.3795	0.376	73[c]
Nickel μg/L	0.2135	0.095	150[b]
Selenium μg/L	0.095	0.23	1
Silver μg/L	0.011475	0.028	0.25
Strontium μg/L	230.5	211	/
Thallium μg/L	0.001175	0.0358	0.8
Thorium μg/L	0.00015	0.0148	/
Tin μg/L	0.015	0.033	/
Titanium μg/L	0.7815	0.9	/
Uranium μg/L	0.328	0.342	15
Vanadium μg/L	0.1915	0.23	100[e,f]
Zinc μg/L	1.914	0.5	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 Canadian Drinking Water Quality guideline values.
[e] Based on CCME Guidelines for Agricultural use (Livestock Watering).
[f] Based on CCME Guidelines for Agricultural Use (Irrigation).
A forward slash (/) indicates an absence of data or guidelines.