



Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Wolf Lake Report

2024

Updated November 25, 2025

Lakewatch is made possible
with support from:



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 Paul Kip for their commitment to collecting data at Wolf Lake. We would also like to thank Katherine Cundict and Jordyn Lajeunesse, who were summer technicians in 2024. Executive Director Bradley Peter and Program Manager Brittany Onsyk were instrumental in planning and organizing the field program. This report was prepared by Brittany Onsyk and Bradley Peter.

BEFORE READING THIS REPORT,
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INTRODUCTION TO LIMNOLOGY](#)

WOLF LAKE

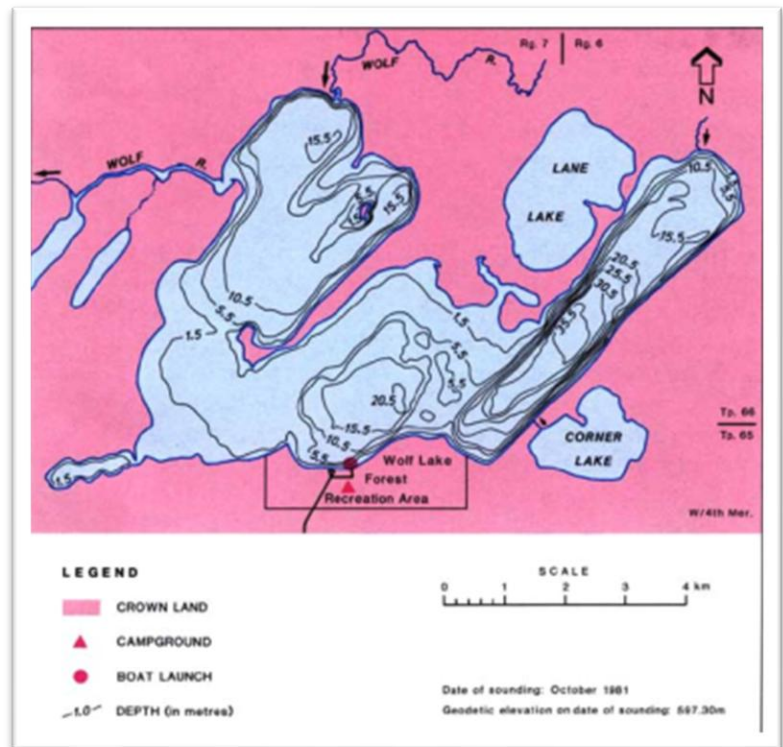
Wolf Lake is located just south of the Primrose Lake Air Weapons Range, approximately 70 km north of the town of Bonnyville and 310 km northeast of the city of Edmonton. The lake's name originates from Cree: *Mahikan Sakhahegan*.¹

Wolf Lake is located in the central mixed-wood natural subregion² with an intact shoreline surrounded by crown land. It is a large, deep lake (31.5 km²) with a maximum depth of 38.3 m and an average depth of 9 m. Wolf Lake consists of three distinct basins: the northwest basin slopes rapidly to a maximum depth of 15.5 m and most of it is deeper than 10 m; the central basin has a maximum depth of 20.5 m, but a large part of it is less than 6 m deep; the eastern basin is long and narrow and contains the deepest part of the lake. Numerous lakes and creeks run to the lake from the northeast. The outlet, Wolf River, flows west to the Sand River, which eventually joins the Beaver River.¹

The drainage basin of Wolf Lake is 22 times the size of the lake.¹ Most of the watershed is located northeast of the lake. Although mainly intact, the main human land uses in the lake's watershed are oil and gas exploration and development. An in-situ oilsands production facility east of the lake (CNRL Wolf Lake) was the site of a large bitumen spill in the summer of 2013.³ The only development on Wolf Lake's shoreline is Wolf Lake Provincial Recreation Area, with a small campground, boat launch, and beach located on the south shore. Some agricultural lands (grazing leases) are found south of the watershed, surrounding Margarite Lake.

Wolf Lake is classified as having low productivity, with low algae and nutrient concentrations. Due to its depth, Wolf Lake undergoes stratification during the summer months.

Wolf Lake supports a sportfishing community of whitefish, yellow perch, northern pike, walleye, ciscoes, and white suckers.⁴



Bathymetric map of Wolf Lake obtained from the Atlas of Alberta Lakes.



Early morning sampling at Wolf Lake in September 2024.

¹ Mitchell, P. and E. Prepas. 1990. Atlas of Alberta Lakes.

² Strong, W.L. and K.R. Leggat. 1981. Ecoregions of Alberta.

³ Canadian Natural Resources Limited. 201. Primrose Flow to Surface Final Report.

⁴ Government of Alberta. 2019. Wolf Lake FIN Summary 2018.



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 in 2024 for Wolf Lake was 9 µg/L (Table 2), falling into the oligotrophic, or low productivity trophic classification. This value falls on the low end of previously observed historical TP averages going back to 1986 (Table 2). TP ranged from a minimum of 8 µg/L on August 15, to a maximum of 10 µg/L on July 18 (Figure 1).

The average chlorophyll-*a* concentration in 2024 was 4.83 µg/L (Table 2), similarly falling into the mesotrophic, or moderately productive trophic classification. Chlorophyll-*a* was lowest at 4.1 µg/L on August 15 and peaked at 5.8 µg/L on July 18 (Figure 1). The average chlorophyll-*a* concentration in 2024 falls within the range of chlorophyll-*a* observed historically from 1986 (Table 2).

The average total Kjeldahl nitrogen (TKN) concentration was 0.6 mg/L (Table 2). TKN levels were steady throughout the season.

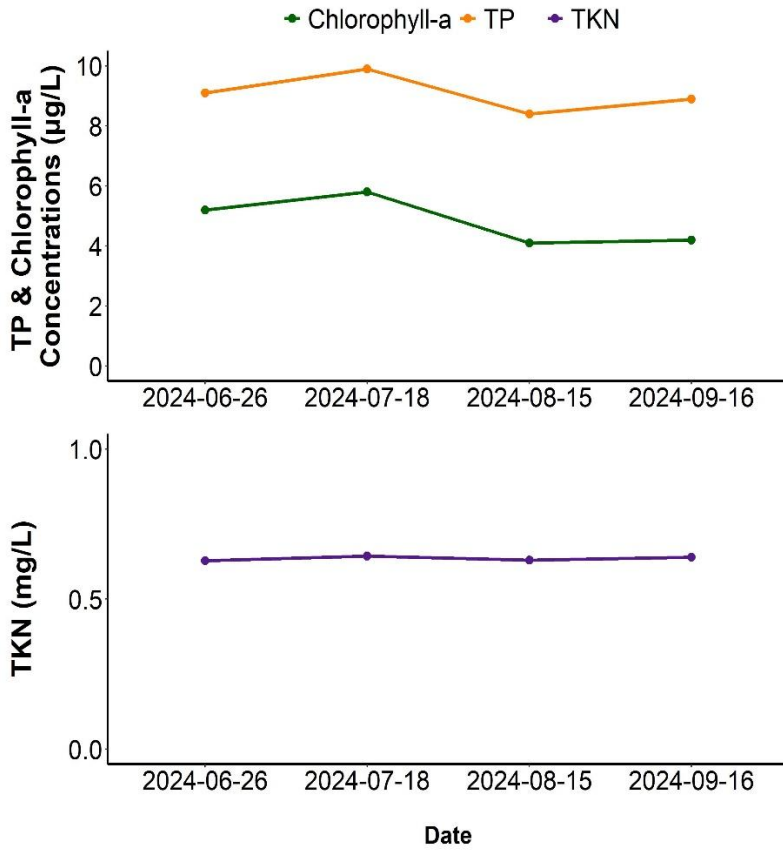


Figure 1. Total Phosphorus, Chlorophyll- α , and Total Kjeldahl Nitrogen concentrations measured over the course of the summer at Wolf Lake in 2024.

Average pH was measured as 8.23 in 2024, buffered by low alkalinity (170 mg/L CaCO₃) and bicarbonate (200 mg/L HCO₃⁻). All other major ions were low in concentration, resulting in an average conductivity of 292 μS/cm (Figure 2, top; Table 2). Ion concentrations at Wolf Lake fell on the low end of all LakeWatch lakes sampled in 2024 (Figure 2, bottom).

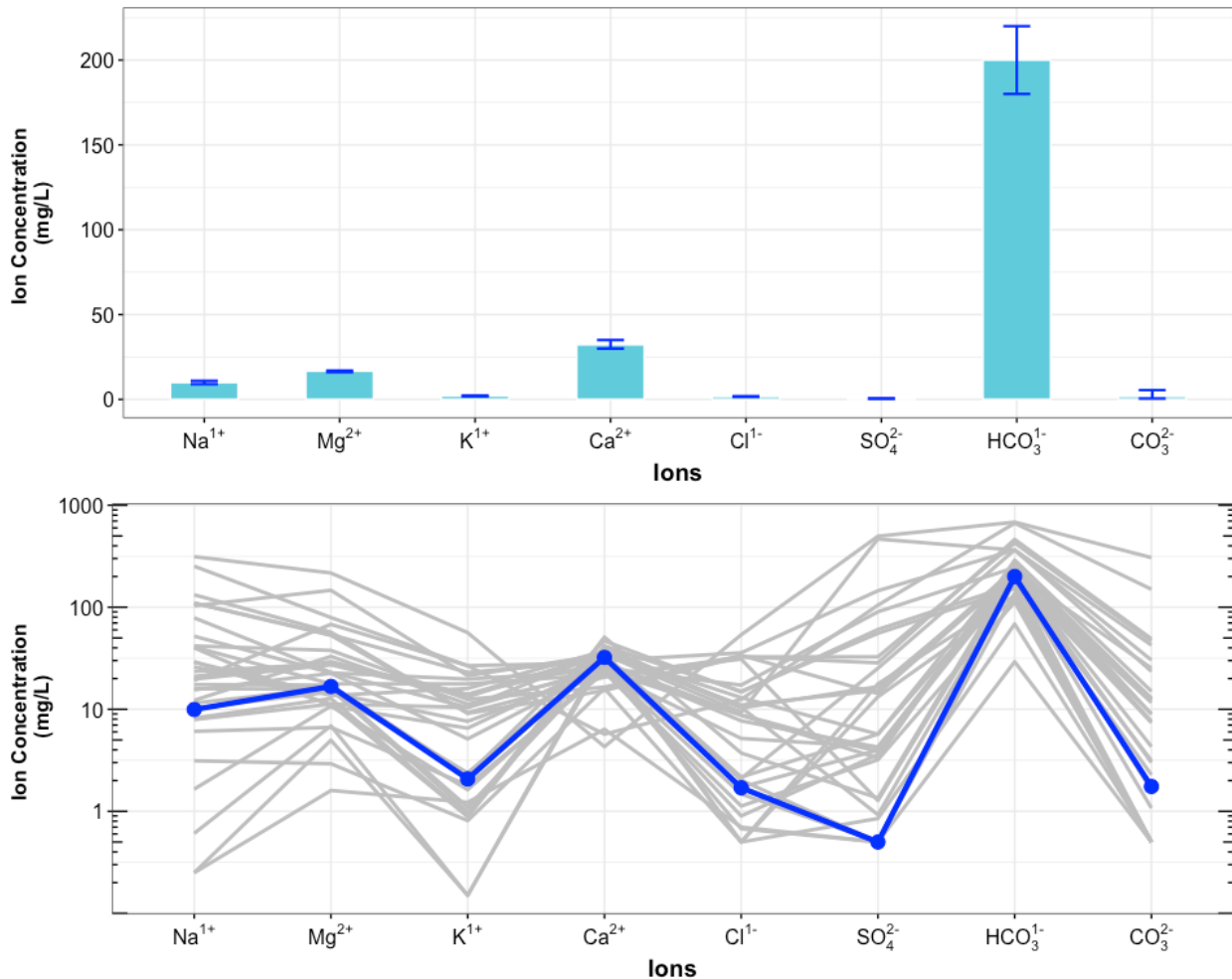


Figure 2. Average levels of cations (sodium = Na¹⁺, magnesium = Mg²⁺, potassium = K¹⁺, calcium = Ca²⁺) and anions (chloride = Cl¹⁻, sulphate = SO₄²⁻, bicarbonate = HCO₃¹⁻, carbonate = CO₃²⁻) from 4 measurements over the course of the summer at Wolf Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Wolf Lake (blue line) compared to 26 lake basins (gray lines) sampled through the LakeWatch program in 2024 (note log₁₀ 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 measured at Wolf Lake in 2024 (Table 3). No metals exceeded the CCME chronic guideline for the protection of aquatic life in 2024.⁴

⁴ Canadian Water Quality Guidelines. 2019. Canadian Council of Ministers of the Environment.

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 Wolf Lake in 2024 was 8.7 m, corresponding to a Secchi Depth of 4.35 m (Table 2). Euphotic depth varied over the season, ranging from as shallow as 7.2 m on August 15 to as deep as 10.2 m on June 26 (Figure 3). Considering the low levels of chlorophyll-*a* concentrations in the lake (Figure 1, Table 2), water colouration and/or suspended solids are likely the primary factors affecting water clarity at Wolf Lake.

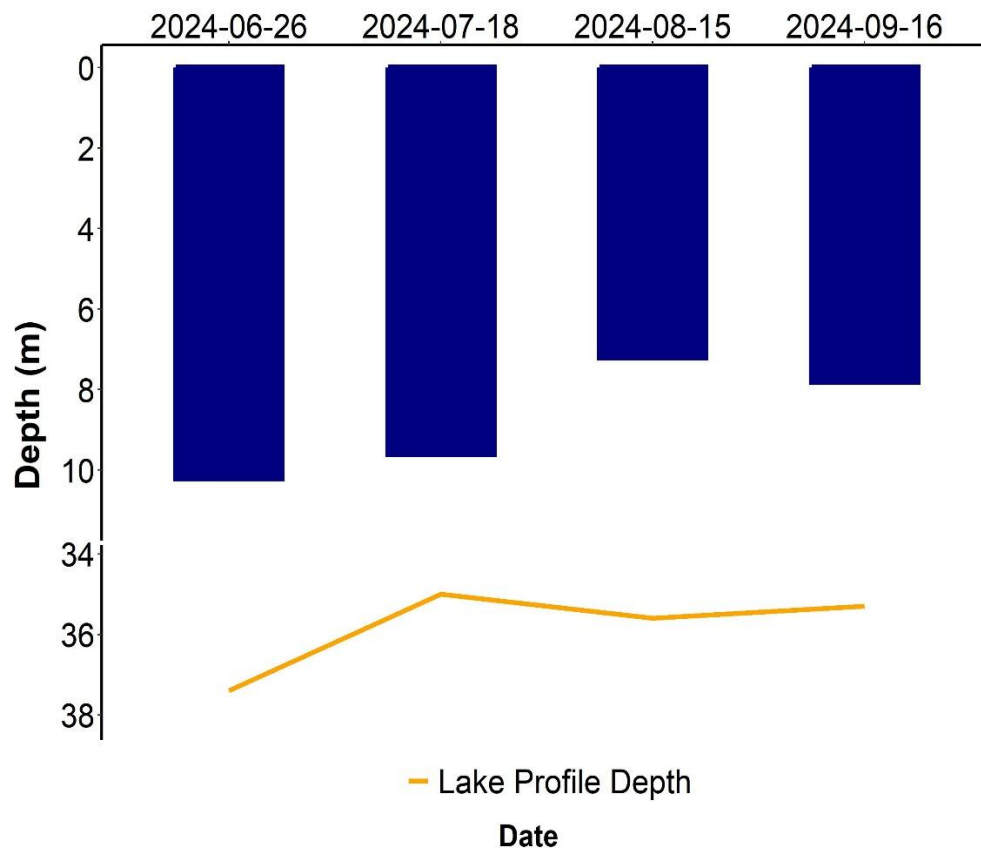


Figure 3. Euphotic depth values measured over the course of the summer at Wolf Lake in 2024.



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.

Wolf Lake was well stratified during each sampling event, meaning there is a clear differentiation between warm surface water and cooler, denser water near the bottom of the lake.

Surface temperatures of Wolf Lake varied throughout the summer, with the July 18 sampling having the warmest temperatures at 22.64°C (Figure 4). The lake was strongly stratified during each sampling trip and was especially strong during the July, August, and September sampling events. During each sampling event, the bottom layer of water (hypolimnion) approached 4°C.

Wolf Lake was well oxygenated in the surface waters on all sampling dates, measuring above the CCME guidelines of 6.5 mg/L dissolved oxygen⁵ (Figure 4b). During all sampling events, dissolved oxygen can be seen decreasing sharply at the thermocline, or mixing depth, at approximately 8 m (Figure 4). Due to strong thermal stratification, dissolved oxygen concentrations declined dramatically below the thermocline, reaching anoxia as early as 13 m on September 16 (Figure 4). Oxygen concentrations decrease below the thermocline due to the separation of bottom water from atmospheric oxygen, and the process of decomposition near the bottom of the lake that utilizing remaining oxygen.

⁵ Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of aquatic life: Dissolved oxygen (freshwater).

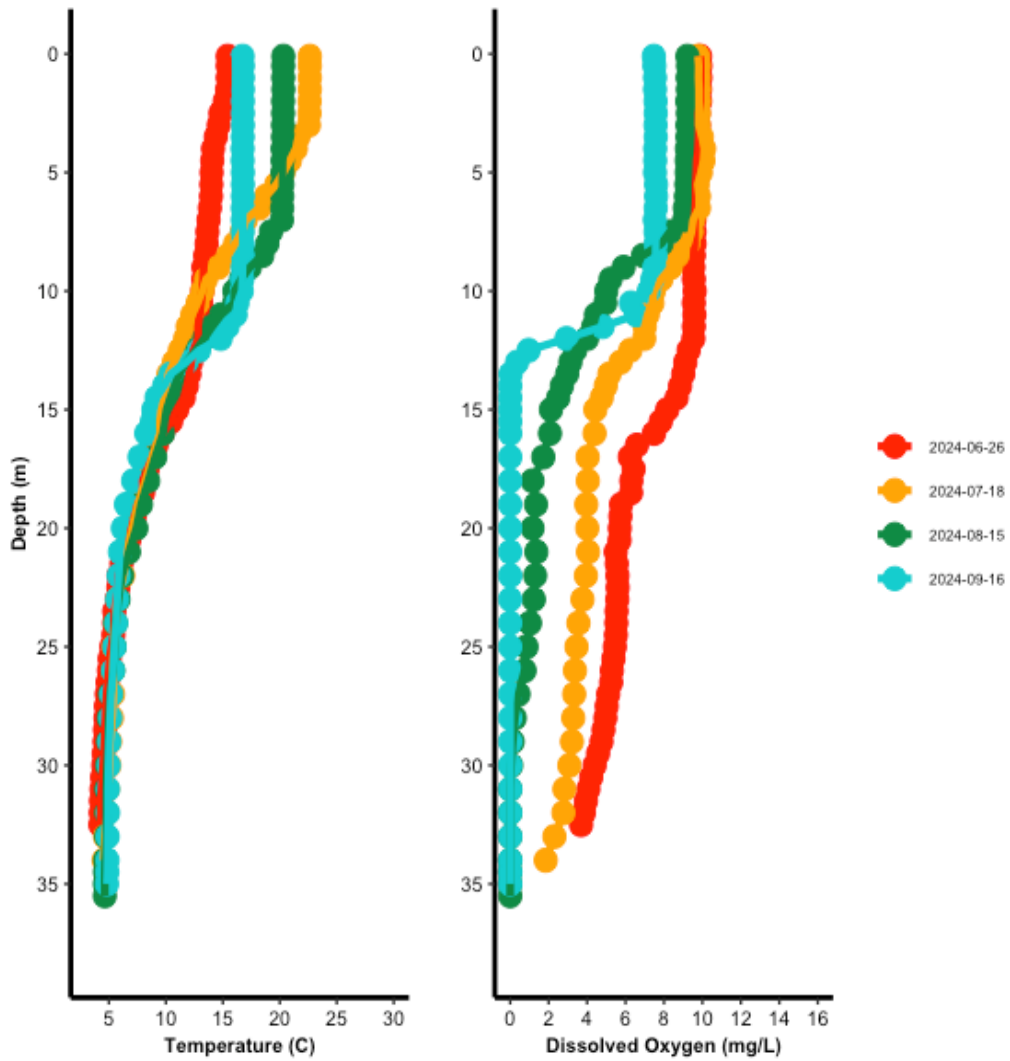


Figure 4. Temperature (°C) and dissolved oxygen (mg/L) profiles for Wolf Lake measured four times over the course of the summer of 2024.



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 Wolf Lake fell below the recreational guideline of 10 µg/L⁶ during every sampling event in 2024. Despite low levels of microcystin detected during sampling events, caution should be observed in areas of the lake where significant cyanobacteria accumulation occurs.

Table 1. Microcystin concentrations measured four times at Wolf Lake in 2024.

Date	Microcystin Concentration (µg/L)
06/26/2024	< 0.1
07/18/2024	< 0.1
08/15/2024	< 0.1
09/16/2024	< 0.1
Average	0.05

⁶ Health Canada. 2022. Guidelines for Canadian Recreational Water Quality.



INVASIVE SPECIES

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 for aquatic invasive species involved sampling with a 63 µm plankton net. This monitoring is designed to detect juvenile Dreissenid mussel veligers and spiny water flea. No zebra mussels, quagga mussels, or spiny water flea were detected in Moose Lake in 2024.

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.

Watermilfoil was collected from Hilda Lake on the August 15 sampling trip. The specimen was confirmed to be Northern Watermilfoil (*Myriophyllum sibiricum*).

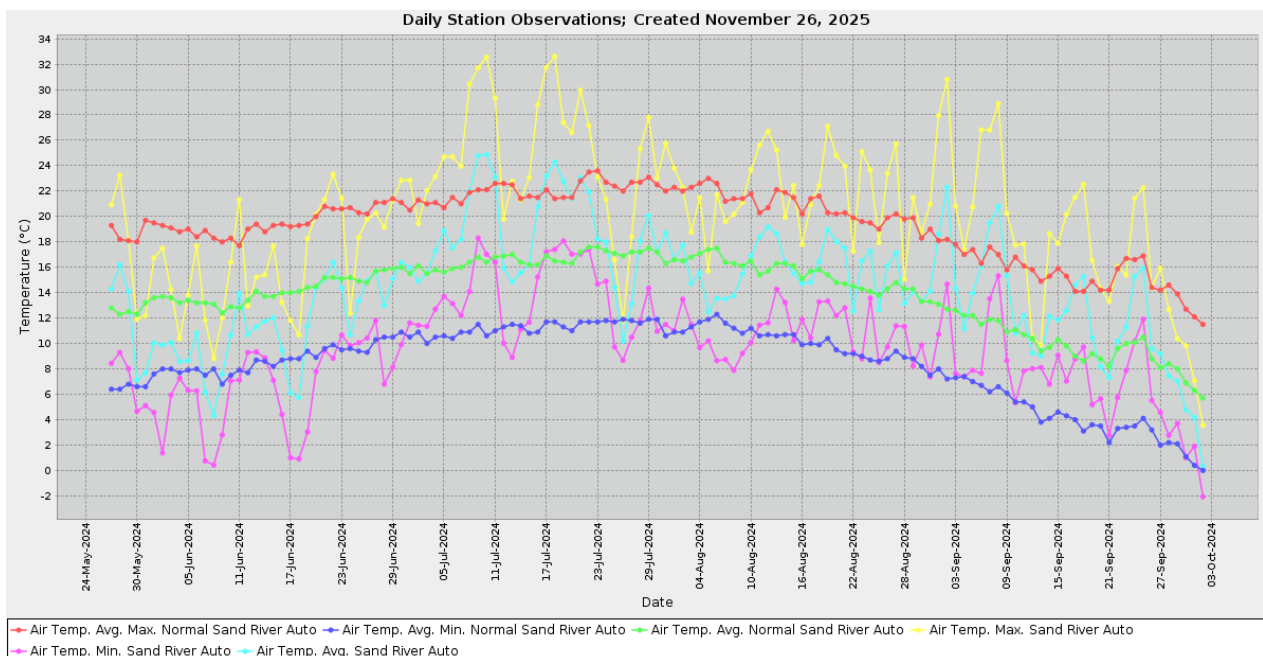
WEATHER AND LAKE STRATIFICATION

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.

In 2024, Wolf Lake experienced a warmer summer compared to normal, with normal accumulated precipitation and weaker wind conditions (Figure 5). Although it was warmer overall, the beginning of the sampling season was unseasonably cold and wet, with the month of June being cooler than normal, and breaking the record for coldest temperature recorded on both June 8 and 18. The lowest temperature recorded was on June 8 at 0.4°C. July was the warmest month, with the average temperature being 24.8°C. 2024 broke numerous heat records, including the hottest days recorded on July 10 and July 18 at 32.6°C. September also broke heat records on numerous days.

Wolf Lake received about normal precipitation in the summer of 2024 (approximately 300 mm total). June was unseasonably wet, with over 67 mm of precipitation falling in the first two weeks of the month. Precipitation fell in short bursts over the remaining summer months, with over 10 mm of precipitation occurring on numerous days over the summer.

Winds in the region were notably weaker than normal throughout the sampling season.



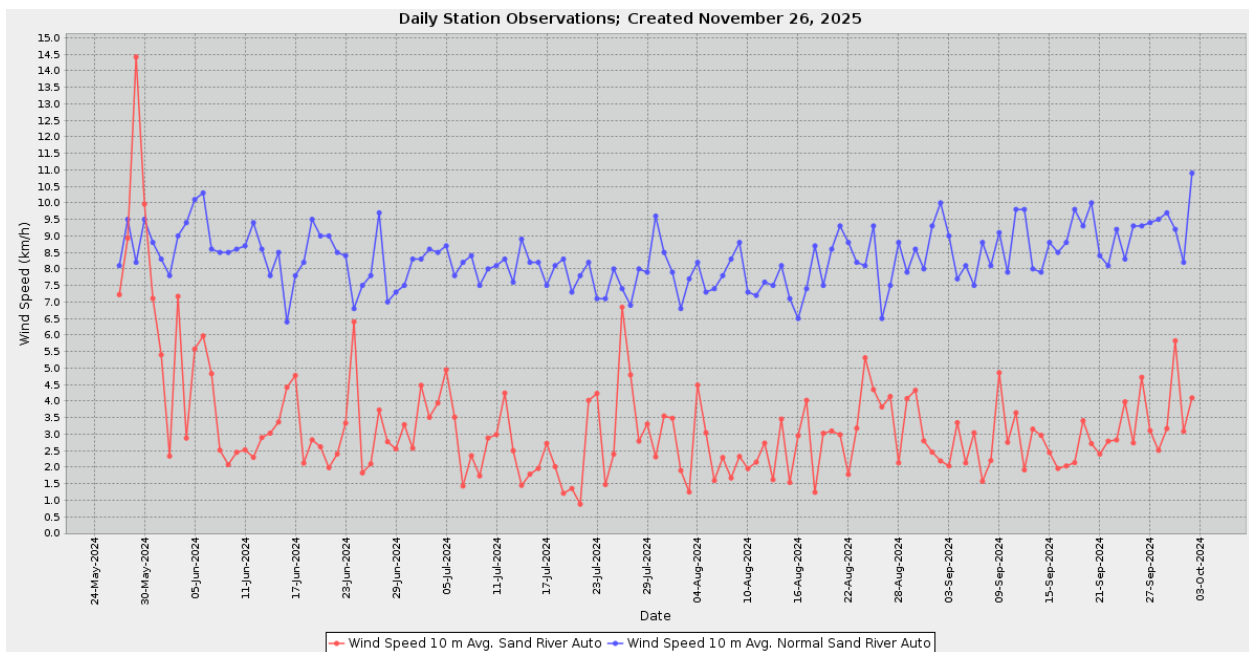
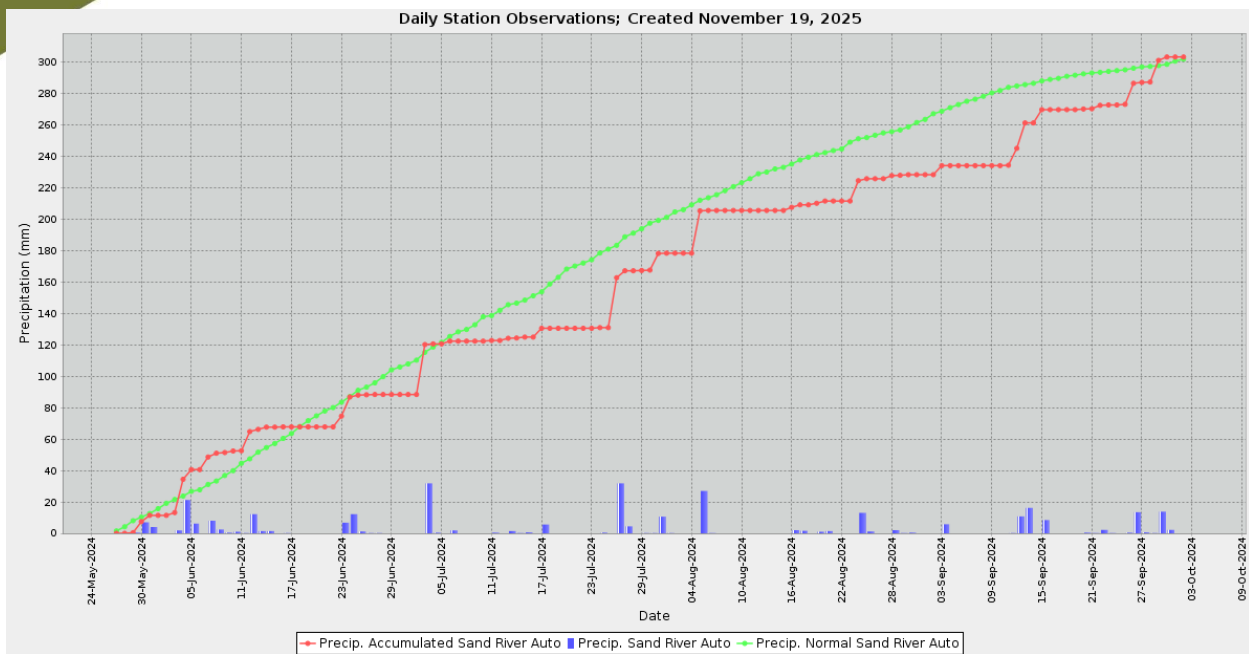


Figure 5. Air temperature ($^{\circ}\text{C}$), precipitation (mm), and wind speed (km/h) measured from the Sand River weather station south of Wolf Lake. Weather data provided by Agriculture, Forestry and Rural Economic Development, Alberta Climate Information Service (ACIS) <https://acis.alberta.ca>.

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

Parameter	1986	1993	2005	2006	2007	2013	2024
TP (µg/L)	42	17	22	19	18	33	9
TDP (µg/L)	18	5	7	8	7	14	4
Chlorophyll-a (µg/L)	7	-	4.6	3.3	2.7	3.1	4.8
Secchi depth (m)	2.65	2.90	3.52	3.31	3.56	2.58	4.35
TKN (mg/L)	0.9	0.9	0.8	0.8	0.8	0.9	0.6
NO ₂ -N and NO ₃ -N (µg/L)	0	0	4	2	6	2	2
NH ₃ -N (µg/L)	18	10	-	14	-	-	14
DOC (mg/L)	13	14	15	15	15	14	13
Ca ²⁺ (mg/L)	27	28	-	-	-	-	32
Mg ²⁺ (mg/L)	16	18	-	-	-	-	17
Na ⁺ (mg/L)	12	14	12	12	13	13	10
K ⁺ (mg/L)	2	2	2	2	2	2	2
SO ₄ ²⁻ (mg/L)	2	2	3	3	2	2	0
Cl ⁻ (mg/L)	0	1	1	1	1	2	2
CO ₃ ²⁻ (mg/L)	-	-	7	7.7	7.5	5.4	1.8
HCO ₃ ²⁻ (mg/L)	-	-	180	181.67	191.67	182.25	200
pH	8.50	8.76	8.52	8.61	8.37	8.59	8.23
Conductivity (µS/cm)	304	311	291	297	297	294	292
Hardness (mg/L)	133	144	-	-	-	-	148
TDS (mg/L)	159	169	156	161	164	160	165
Microcystin (µg/L)	-	-	0.1	0.04	0.08	0.03	0.05
Total Alkalinity (mg/L CaCO ₃)	159	171	159	162	165	158	170

Table 3. Concentrations of metals measured in Wolf 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	2005	2006	2007	2013	2024	Guidelines
Aluminum (µg/L)	4.04	18.99	4.62	17.89	2.1	100 ^a
Antimony (µg/L)	0.021	0.015	0.019	0.018	0.019	/
Arsenic (µg/L)	0.94	0.95	0.98	0.93	0.96	5
Barium (µg/L)	32	31.5	31.8	32.2	35.6	/
Beryllium (µg/L)	0.0015	0.0015	0.0015	0.006	0.0015	100 ^{c,d}
Bismuth (µg/L)	5e-04	0.0061	0.0026	0.0014	0.0015	/
Boron (µg/L)	54.7	55.5	40.5	41.1	35.6	1500
Cadmium (µg/L)	0.002	0.003	0.002	0.003	0.005	0.36 ^b
Chromium (µg/L)	0.123	0.045	0.1535	0.221	0.05	/
Cobalt (µg/L)	0.0188	0.01125	0.0101	0.0266	0.058	500, 1000 ^{c,d}
Copper (µg/L)	0.176	0.241	0.38	0.185	0.11	4 ^b
Iron (µg/L)	35.4	17.5	4.6	33.6	9	300
Lead (µg/L)	0.037	0.064	0.124	0.048	0.008	7 ^b
Lithium (µg/L)	11.3	13.6	11.8	12.9	11.7	2500 ^d
Manganese (µg/L)	33.5	19.25	23.3	24.25	13	130 ^e
Molybdenum (µg/L)	0.328	0.331	0.316	0.276	0.327	73
Nickel (µg/L)	0.002	0.087	0.002	0.098	0.13	150 ^b
Selenium (µg/L)	0.104	0.05	0.076	0.05	0.1	1
Silver (µg/L)	0.0022	0.0022	0.0072	0.0183	5e-04	0.25
Strontium (µg/L)	121	115.5	116	111.5	120	/
Thallium (µg/L)	1e-04	0.0016	9e-04	0.001	0.001	0.8
Thorium (µg/L)	0.004	0.007	0.004	0.002	0.001	/
Tin (µg/L)	0.03	0.01	0.08	0.01	0.03	/
Titanium (µg/L)	0.481	0.649	0.649	1.582	0.28	/
Uranium (µg/L)	0.103	0.105	0.109	0.091	0.132	15
Vanadium (µg/L)	0.084	0.108	0.078	0.093	0.028	100 ^{c,d}
Zinc (µg/L)	8.35	2.32	0.54	0.46	1	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#_aqf_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.