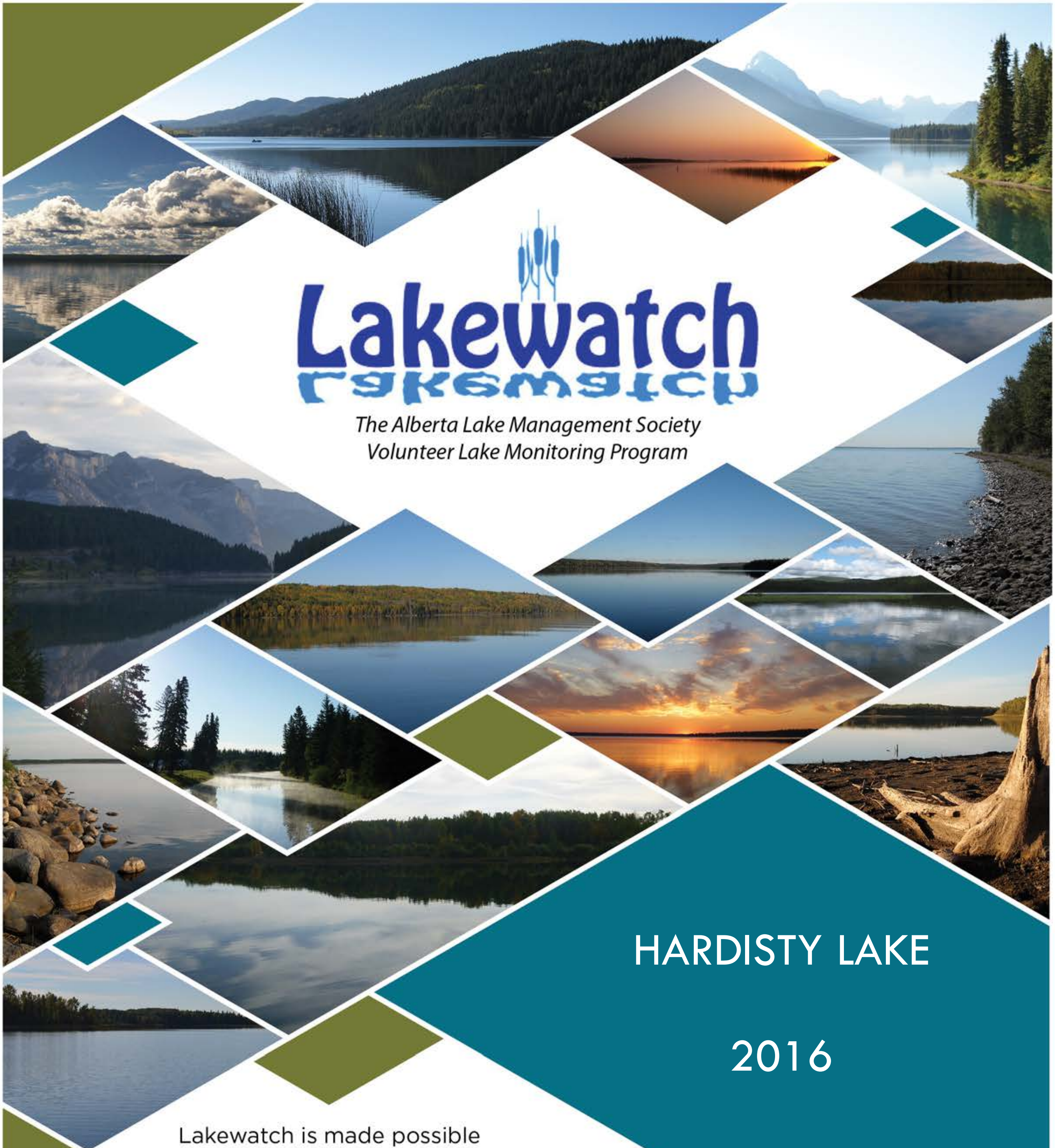

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

HARDISTY LAKE

2016

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with support from:

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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 Ivan Lesmeister and Robin for the time and energy put into sampling Hardisty 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. Alicia Kennedy was instrumental in report design. 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.

HARDISTY LAKE

Aerial view of Hardisty Lake (Google Earth 2011)

This small lake is located within the town limits of, and supplies drinking water to, the town of Hardisty, approximately 200 km southeast of Edmonton in Flagstaff County. Both the town and lake are named after Richard Hardisty, a former member of the Canadian Senate, and last chief factor of the Hudson Bay Company at Fort Edmonton[1]. The lake lies within the Central Parkland natural sub-region, and most of the shoreline borders grassland or private residential properties belonging to permanent or seasonal occupants. The lake has a teardrop-like shape, with the narrowest point in the northeast, and the larger section to the southwest. The surface area measures 0.26 km^2 , and the maximum depth has been recorded at approximately 5 m. Turbidity is high in Hardisty Lake, causing the lake to appear shades of brown or dark red throughout the year. Hardisty Lake Park, operated by the Hardisty Agricultural Society, is located on the north shore of the lake and provides camping facilities throughout summer months, as well as a sandy beach, large picnic area, and playground. Other facilities in the park include a public golf course, three baseball diamonds, and the rodeo grounds, which hosts the annual Hardisty Rodeo. Boats are banned within the park, however, there is a separate boat launch located on the opposite lakeshore. Motorized boating is permitted on the lake, but there are very specific restrictions, and a boating permit must first be obtained from the town[2]. The lake and its surrounding environment provide habitat for native upland birds, deer, and moose, as well as migrating ducks and geese[2] . No sportfish species are recorded for the lake, and the only fish observed have been small minnow and stickleback species. Northern milfoil (*Myriophyllum sibericum*) and Fries' pondweed (*Potamogeton fresii*) have been observed around the shores of Hardisty Lake. (pers. obs.)

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1 Place Names of Alberta (2006) Edited by Merrily K Aubrey. Calgary, AB. University of Calg. Press.

2 Hardisty Lake website – various pages (http://www.hardisty.ca/)

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.

Total phosphorus (TP) in Hardisty Lake had an average concentration of 33 µg/L in 2016, putting it in the eutrophic trophic classification (Table 2). TP levels in Hardisty Lake in 2016 were lower than in 2015, but more data is needed to assess long-term trends. TP was relatively constant throughout the summer, with the maximum concentration of 36 µg/L on September 3 (Figure 1).

Chlorophyll-*a* concentrations increased over the course of the summer, with an average concentration of 49.3 µg/L in 2016 (Table 2). This puts Hardisty Lake in the hypereutrophic trophic status class. A maximum concentration of 68.3 µg/L was reached on September 3 (Figure 1).

Hardisty Lake had an average TKN concentration of 2.68 mg/L over 4 sampling dates in 2016 (Table 2). On September 3, TKN concentrations spiked to a seasonal maximum of 2.8 mg/L (Figure 1).

Average pH measured as 9.00 in 2016, buffered by moderate alkalinity (555 mg/L $CaCO_3$) and bicarbonate (522.5 mg/L HCO_3). Magnesium, sodium and chloride were the dominant ions contributing to a high conductivity measure of 1200 uS/cm (Table 2).

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 measured once at Hardisty Lake and all measured values fell within their respective guidelines (Table 3).

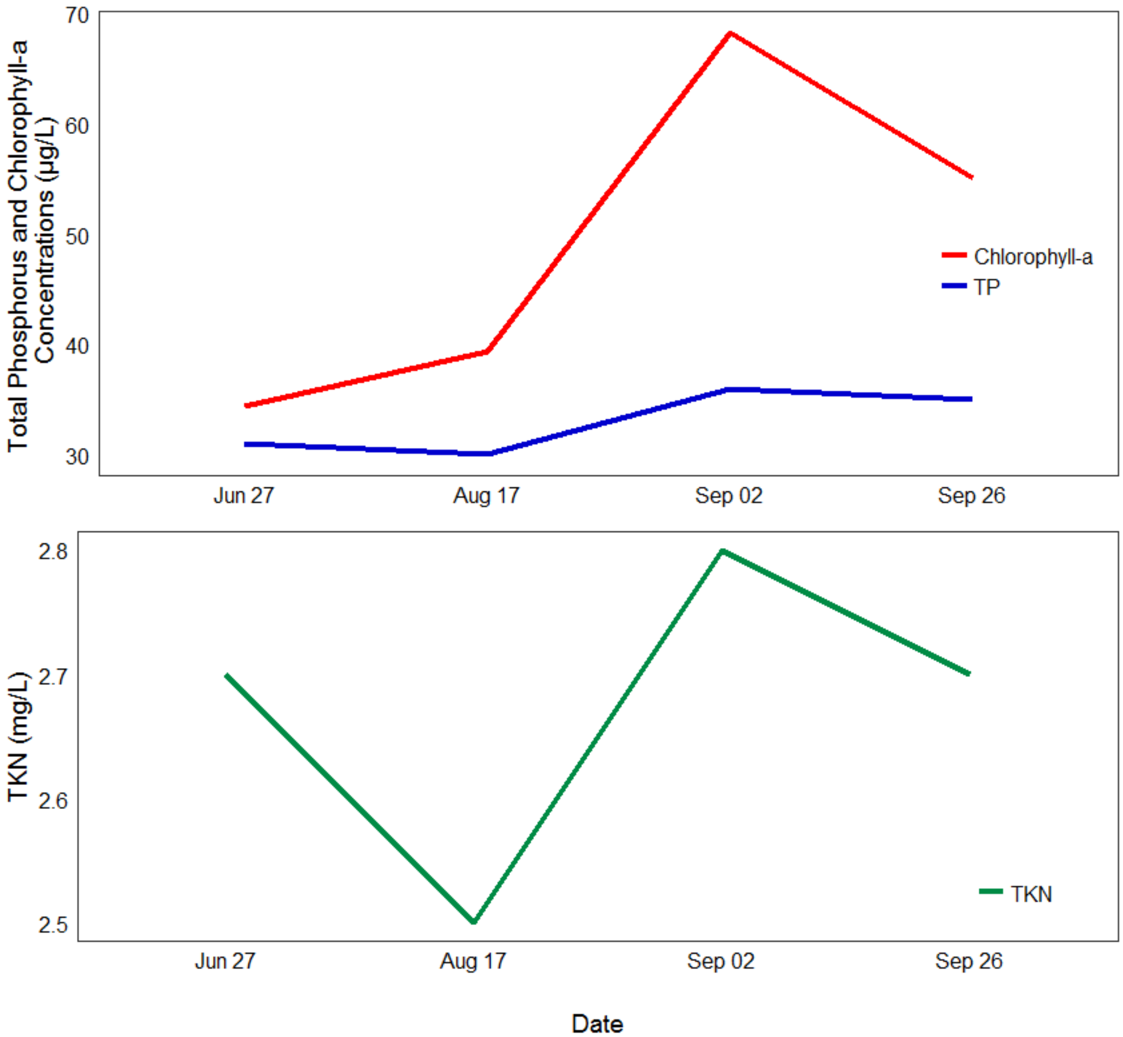

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Hardisty Lake.

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

Average Secchi depth in 2016 was 0.61 m, classifying Hardisty Lake as hypereutrophic, or highly productive (Figure 2). A maximum Secchi depth of 0.98 m was recorded on August 17, but it is unclear what caused this increase in water clarity. Secchi depth remained relatively constant throughout the sampling season. Given that chlorophyll-*a* levels were in the hypereutrophic range at on all sampling dates, it is assumed that low water clarity was associated with high algal biomass in addition to suspended sediments.

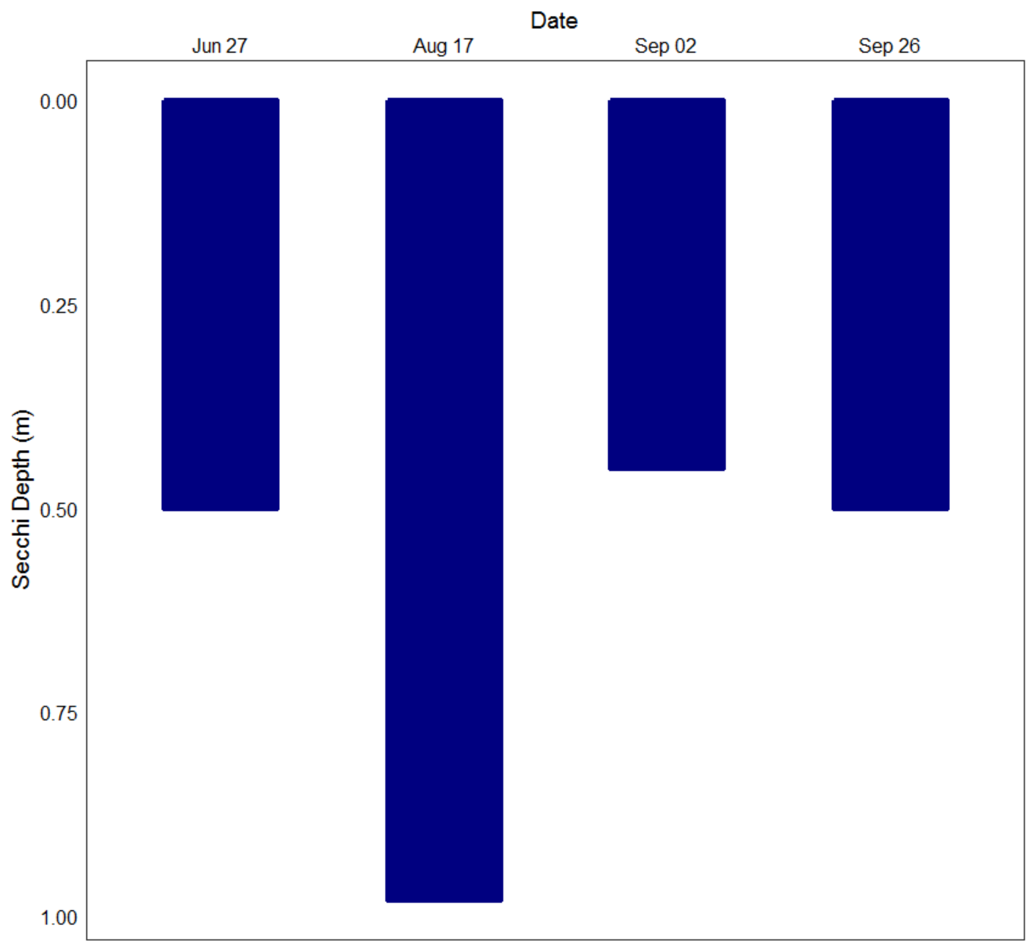

Figure 2 – Secchi depth values measured four times over the course of the summer at Hardisty Lake in 2016.

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.

Hardisty Lake water temperatures varied throughout the summer (Figure 3a). A maximum temperature of 22.89 °C was observed on August 17, and by September 26, the entire water column was approximately 12°C. Given the shallow depth of Hardisty Lake, it never reaches full thermal stratification. Hardisty Lake was weakly stratified during the warmest visit on August 17. Hardisty Lake can therefore be classified as polymictic, because it mixes fully multiple times over the course of the summer.

Hardisty Lake remained well oxygenated 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 3b). Hardisty reached anoxic conditions at the bottom of the lake on July 27 and August 17 - this could be due to decomposition processes occurring on the lake bed. For the remainder of the summer, the lake was well mixed through the water column.

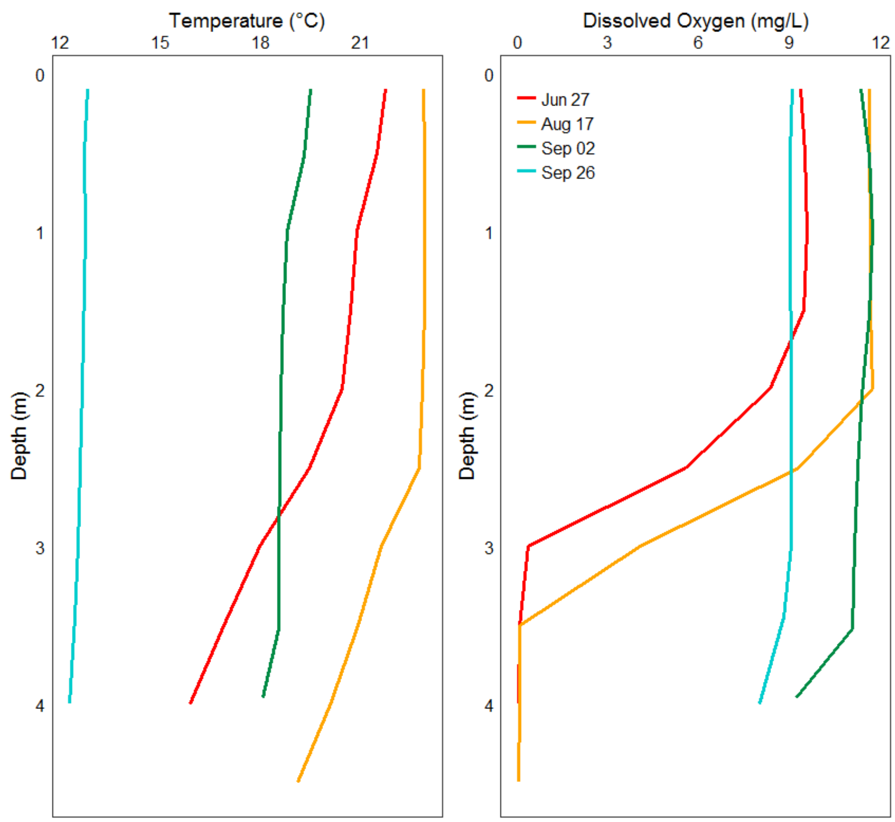

Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Hardisty Lake measured four times over the course of the summer of 2016.

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.

Table 1 – Microcystin concentrations measured four times at Hardisty Lake in 2016. Microcystin levels remained below recommended guidelines on all sampling dates.

Date	Microcystin Concentration (μg/L)
Jun 27	0.20
Aug 17	0.31
Sep 2	0.73
Sep 26	2.45
Average	0.9225

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 invasive mussels were detected in Hardisty Lake.

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

Parameter	2015	2016
TP (µg/L)	43	33
TDP (µg/L)	8	6
Chlorophyll-*a* (µg/L)	44	49.3
Secchi depth (m)	0.58	0.61
TKN (mg/L)	2.6	2.68
NO_2 and NO_3 (µg/L)	2.5	3.8
NH_3 (µg/L)	25	39
DOC (mg/L)	31	28
Ca (mg/L)	15	20
Mg (mg/L)	99	107
Na (mg/L)	97	102
K (mg/L)	28	31
SO_4^{2-} (mg/L)	53	47
Cl^- (mg/L)	69	71
CO_3 (mg/L)	89	76
HCO_3 (mg/L)	495	523
pH	9.09	9.00
Conductivity (µS/cm)	1175	1200
Hardness (mg/L)	445	477.5
TDS (mg/L)	698	717.5
Microcystin (µg/L)	0.48	0.92
Total Alkalinity (mg/L $CaCO_3$)	555	555

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

Metals (Total Recoverable)	2015	2016	Guidelines
Aluminum µg/L	15.7	7.3	100[a]
Antimony µg/L	0.142	0.12	6[d]
Arsenic µg/L	12.1	10.8	5
Barium µg/L	240	230	1000[d]
Beryllium µg/L	0.004	0.004	100[c,e]
Bismuth µg/L	0.012	5.00E-04	/
Boron µg/L	209	201	1500
Cadmium µg/L	0.006	0.001	0.26[b]
Chromium µg/L	0.19	0.04	/
Cobalt µg/L	0.09	0.049	1000[e]
Copper µg/L	1.17	1.03	4[b]
Iron µg/L	20.4	14.3	300
Lead µg/L	0.063	0.028	7[b]
Lithium µg/L	114	108	2500[f]
Manganese µg/L	18.8	22.5	200[f]
Molybdenum µg/L	2.01	1.64	73[c]
Nickel µg/L	0.488	0.454	150[b]
Selenium µg/L	0.07	0.54	1
Silver µg/L	0.003	0.001	0.25
Strontium µg/L	581	559	/
Thallium µg/L	0.003	0.0015	0.8
Thorium µg/L	0.047	0.005	/
Tin µg/L	0.019	0.019	/
Titanium µg/L	1.63	1.52	/
Uranium µg/L	2.7	2.26	15
Vanadium µg/L	0.47	0.42	100[e,f]
Zinc µg/L	1.2	1.6	30

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on water hardness > 180mg/L (as CaCO3)
[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.