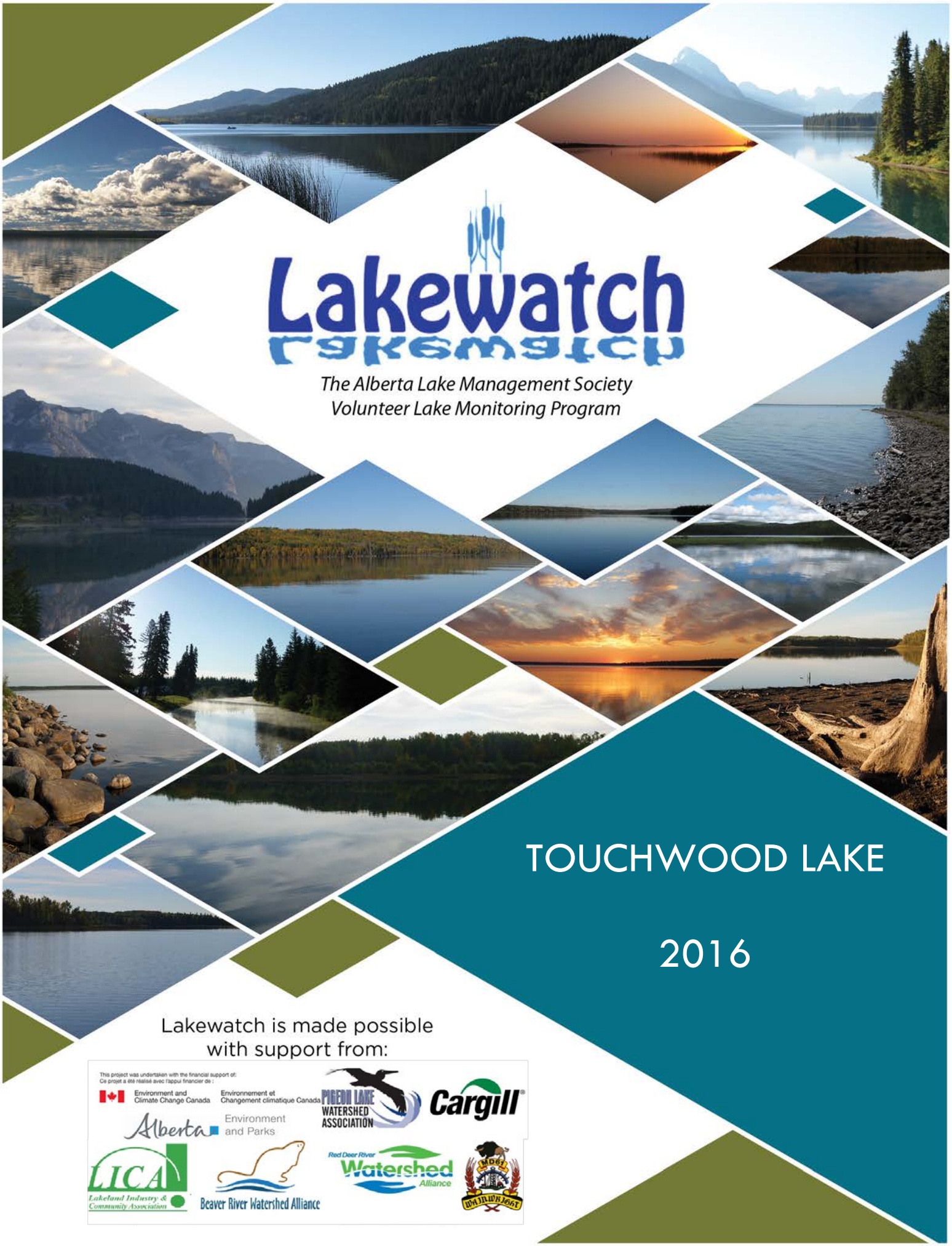

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

TOUCHWOOD LAKE

2016

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LICA Lakeland Industry & Community Association
Beaver River Watershed Alliance
Red Deer River Watershed Alliance
MD of Wainwright

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.

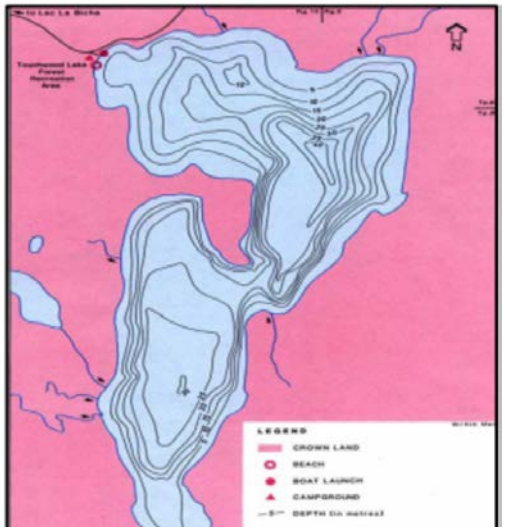
ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Tom Hannan, Ed Behnke, and Andy Gesner for the time and energy put into sampling Touchwood 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.

TOUCHWOOD LAKE

Touchwood Lake is a beautiful wilderness lake set in heavily forested, rolling hills. It is located in Lakeland County, 265 km northeast of Edmonton and 45 km east of the town of Lac La Biche, which is the closest large population centre. Touchwood Lake falls within the boundaries of the Lakeland Recreation Area, positioned between the Lakeland Provincial Park to the west and the Cold Lake Air Weapons Range to the east. It is a popular recreational lake for camping, fishing, and boating.

The word "touchwood" refers to birch punk, which was used to start fires with flint and steel. The Cree called Touchwood Lake Nameygos Sakahegan, which means Trout Lake, in reference to the abundant, large lake trout found there.[1] By the late 1920's, however, the trout population was decimated by the commercial fishery industry. Today, walleye and northern pike are the main species caught by the popular sport fishery. Concentrations of algae in Touchwood Lake are low throughout the open-water period, so the water is clear. The density of aquatic vegetation is sparse to moderate, with many un-vegetated areas along the lakeshore.



Bathymetric map of Touchwood Lake (Mitchell & Prepas 1990)

Touchwood Lake is one of the largest bodies of water in the Lakeland region (surface area = 29.0 km^2, mean depth = 15.0 m). It is separated into two basins by a large peninsula. The north basin, with a maximum depth of 40.0 m, is the deeper of the two. Touchwood Lake is a headwater lake. It drains quite a large area (111 km^2), but the drainage basin is less than four times the size of the lake. The outlet stream flows to Pinehurst Lake, six km to the south, and eventually to the Beaver River via Punk Creek and Sand River. The drainage basin is part of the Boreal Mixwood Ecoregion[2].. The dominant trees are an association of trembling aspen, balsam poplar, and lodgepole pine on moderately well-drained Gray Luvisols. Other species present are jack pine, white spruce, black spruce, willows, and sedges.

The watershed area for Touchwood Lake is 112.45 km^2 and the lake area is 28.91 km^2. The lake to watershed ratio of Touchwood Lake is 1:4. A map of the Touchwood Lake watershed area can be found at http://alms.ca/wp-content/uploads/2016/12/Touchwood.pdf.

[1] (Chipeniuk 1975)
[2] (Strong and Leggat 1981)

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 Touchwood Lake had an average concentration of 11 µg/L in 2016, putting it in the mesotrophic trophic classification (Table 2). This is historically low for Touchwood Lake. TP decreased over the course of the sampling season, with a maximum concentration of 23 µg/L on June 13 (Figure 1).

Chlorophyll-*a* concentrations remained low over the course of the summer, with an average concentration of 3.4 µg/L in 2016 (Table 2). This puts Touchwood Lake in the oligotrophic trophic status class. A maximum concentration of 4.7 µg/L was reached on September 22 (Figure 1).

Touchwood Lake had an average TKN concentration of 0.54 mg/L over four sampling dates in 2016 (Table 2). On June 13 TKN concentrations were at a seasonal maximum of 0.6 mg/L, but declined over the course of the sampling season (Figure 1).

Average pH measured as 8.49 in 2016, buffered by moderate alkalinity (147.5 mg/L $CaCO_3$) and bicarbonate (172.5 mg/L HCO_3). Calcium was the only dominant ions contributing to a relatively low conductivity measure of 275 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 Touchwood Lake and all measured values fell within their respective guidelines (Table 3).

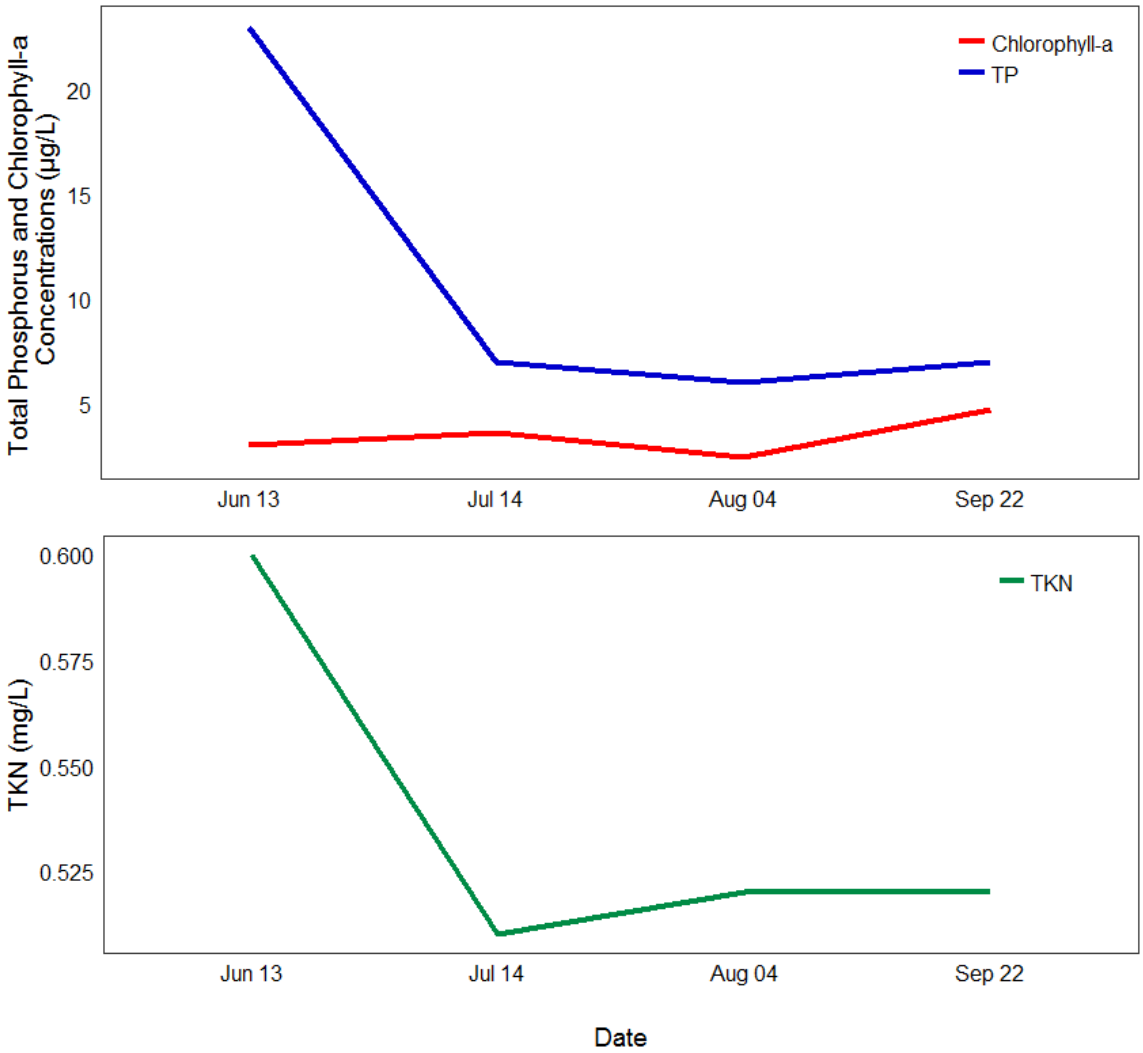


Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Touchwood Lake.

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 4.25 m, classifying Touchwood lake as oligotrophic, or low productivity (Figure 2). A maximum Secchi depth of 4.50 m was recorded on June 13 and July 14. Secchi depth remained relatively constant and water clarity was good throughout the sampling season.

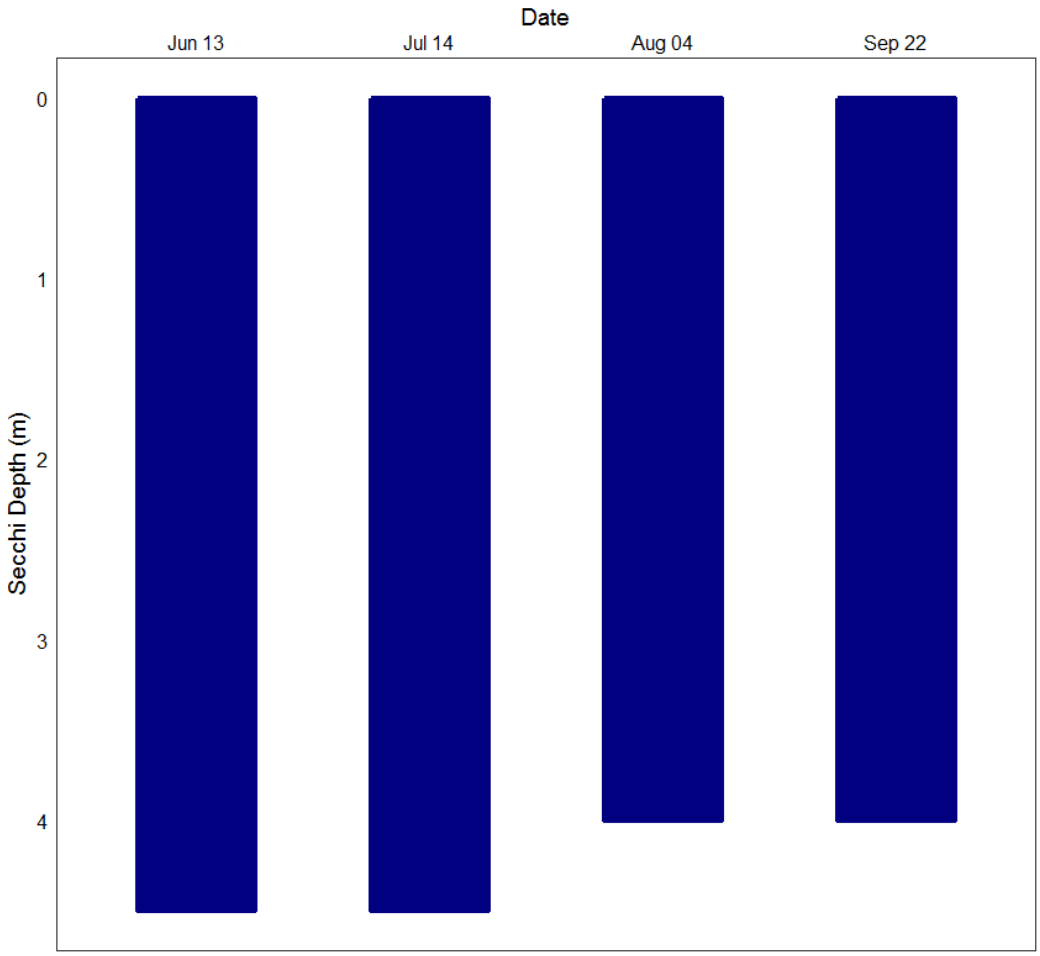


Figure 2 – Secchi depth values measured four times over the course of the summer at Touchwood Lake in 2016.

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.

Touchwood Lake water temperatures varied throughout the summer (Figure 3a). A maximum temperature of 20.88 °C was observed on August 4. Given that Touchwood Lake is quite deep, it reached thermal stratification on all sampling visits, with the thermocline deepening as the surface water warmed over the course of the summer.

Touchwood 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). Touchwood reached low oxygen or anoxic conditions at the bottom on all sampling dates except June 13. This could be due to the separation of atmospheric oxygen from the surface by way of thermal stratification. It is unclear what caused the lack of thermal and DO stratification on June 13, but could be a result of wind during sampling.

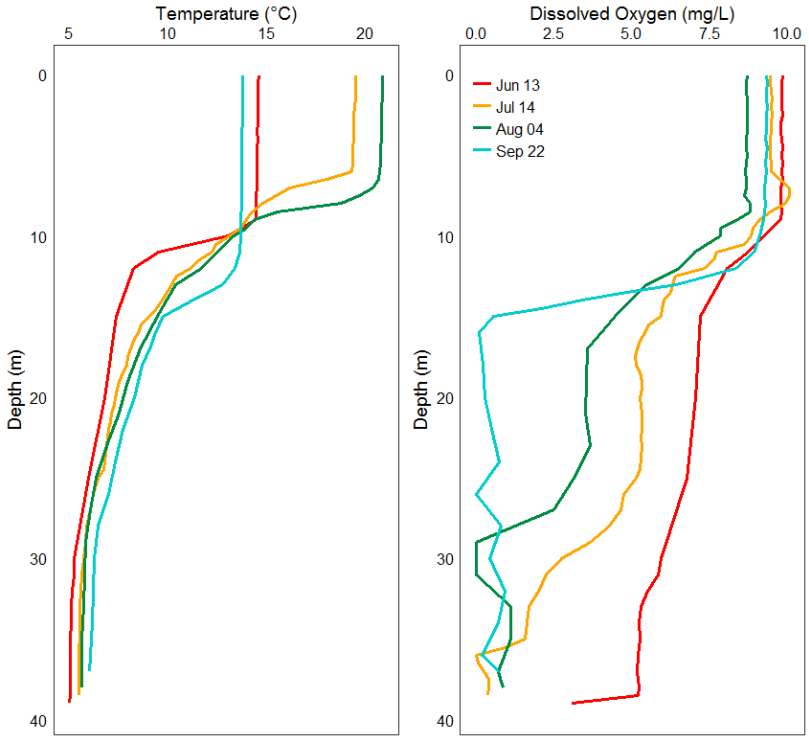


Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Touchwood Lake measured four times over the course of the summer of 2016.

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 Touchwood Lake in 2016. All measured concentrations remained below the recommended guideline for recreational use in 2016.

Date	Microcystin Concentration (µg/L)
Jun 13	0.05
Jul 14	0.05
Aug 4	0.05
Sep 22	0.05
Average	0.05

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 Touchwood Lake.

WATER LEVELS

There are many factors influencing water quantity. Some of these factors include the size of the lakes 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 Touchwood Lake have increased since Alberta Environment began monitoring the lake in 1969 (Figure 4). Since 1969, Touchwood Lake water levels have fluctuated between 630.9 m asl and 632.3 m asl, with a general increasing trend. Data from Alberta Environment was only available until 2013.

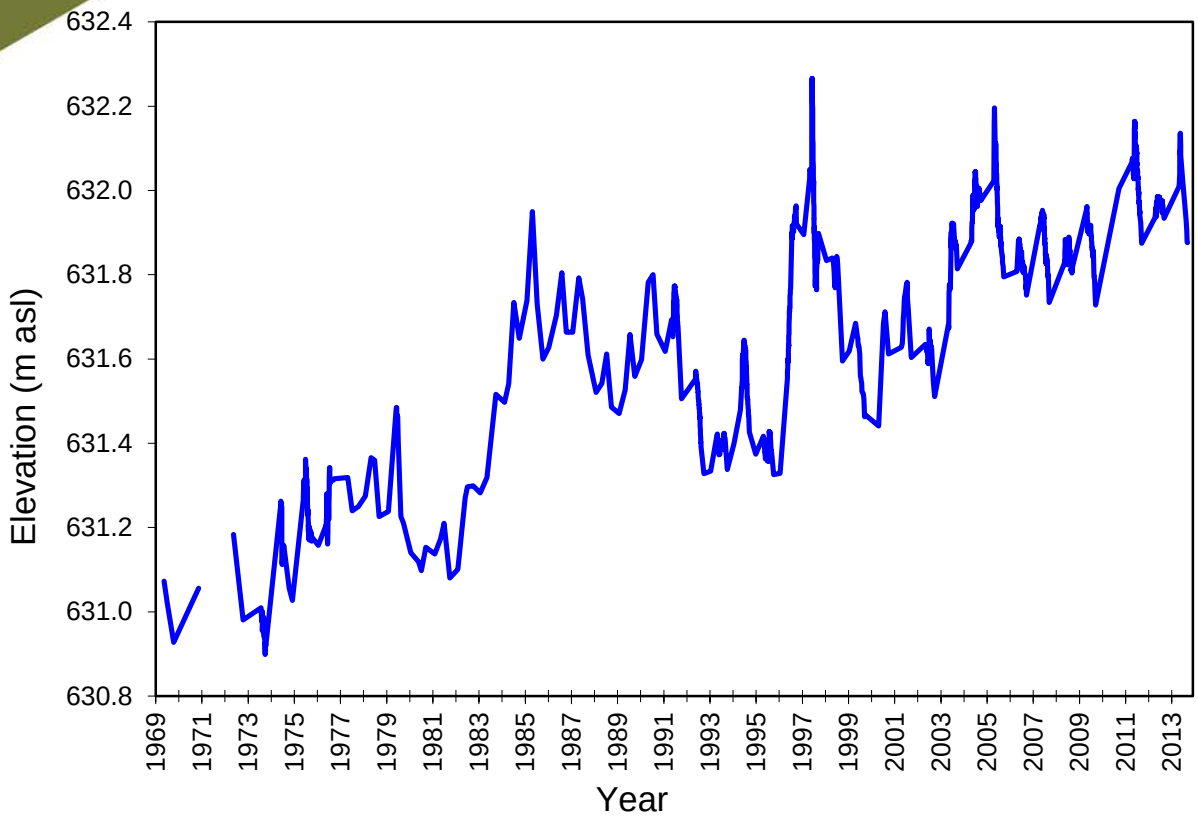


Figure 4- Water levels measured in meters above sea level (m asl) from 1969- 2013. Data retrieved from Alberta Environment.

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

Parameter	1986	2003	2004	2010	2014	2016
TP (µg/L)	22	15	19	16.8	14.1	11
TDP (µg/L)	/	9.2	1.5	8	5.9	3
Chlorophyll-*a* (µg/L)	4.6	3.5	3.7	1.9	1.94	3.40
Secchi depth (m)	4.9	3.8	4.5	4.65	5.55	4.25
TKN (mg/L)	0.77	0.59	0.6	0.65	0.59	0.54
NO_2 and NO_3 (µg/L)	10	9.1	3.7	6.5	28	2.5
NH_3 (µg/L)	26	16	9.2	14.8	16.8	25
DOC (mg/L)	11.1	/	10.2	10.8	19.13	9.45
Ca (mg/L)	33	29	31	27.3	29.63	31.5
Mg (mg/L)	11	12	12	13.5	13.13	14.5
Na (mg/L)	7.3	8.1	8	8.83	9.58	9.55
K (mg/L)	2.5	2.7	2.6	2.73	2.59	3.05
SO_4^{2-} (mg/L)	2.5	3	1.5	6.67	1.5	1.25
Cl^- (mg/L)	0.5	0.4	0.3	0.7	0.5	0.5
CO_3 (mg/L)	2.5	5.3	5.5	3	0.1	2.8
HCO_3 (mg/L)	170	165	166	176	174.6	172.5
pH	8.3	8.6	8.4	8.35	8.212	8.49
Conductivity (µS/cm)	267	/	271	272	269.2	275
Hardness (mg/L)	/	122	128	124	128	140
TDS (mg/L)	/	184	144	148	145.33	150
Microcystin (µg/L)	/	/	/	/	0.066	0.05
Total Alkalinity (mg/L $CaCO_3$)	143	144	146	146	142.8	147.5

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

Metals (Total Recoverable)	2003	2004	2010	2014	2016	Guidelines
Aluminum µg/L	15	29	21.2	15.05	15.2	100[a]
Antimony µg/L	0.007	0.029	0.0211	0.0237	0.029	6[d]
Arsenic µg/L	0.56	0.6	0.644	0.646	0.684	5
Barium µg/L	33	36	36.05	35.55	34.6	1000[d]
Beryllium µg/L	0.079	0.0015	0.00595	0.004	0.004	100[c,e]
Bismuth µg/L	0.004	0.0005	0.00195	0.0005	0.001	/
Boron µg/L	32	37	31.45	34	38.7	1500
Cadmium µg/L	0.01	0.003	0.0033	0.0025	0.003	0.26[b]
Chromium µg/L	0.28	0.13	0.063	0.196	0.09	/
Cobalt µg/L	0.021	0.014	0.01065	0.001	0.001	1000[e]
Copper µg/L	0.59	0.26	0.208	0.364	0.58	4[b]
Iron µg/L	15	22	21.15	9.75	12.7	300
Lead µg/L	0.23	0.05	0.0215	0.0274	0.115	7[b]
Lithium µg/L	9.4	11	9.76	9.53	11.5	2500[f]
Manganese µg/L	9.4	12	5.305	5.56	5.16	200[f]
Molybdenum µg/L	0.11	0.11	0.114	0.08995	0.11	73[c]
Nickel µg/L	0.03	0.0025	0.0486	0.004	0.294	150[b]
Selenium µg/L	0.4	0.09	0.05	0.03	0.13	1
Silver µg/L	0.0025	0.0011	0.00515	0.002	0.001	0.25
Strontium µg/L	127	130	125.5	130	130	/
Thallium µg/L	0.003	0.0014	0.00315	0.00045	0.0011	0.8
Thorium µg/L	0.004	0.0042	0.00635	0.014805	0.0033	/
Tin µg/L	0.05	0.037	0.015	0.008225	0.04	/
Titanium µg/L	0.9	0.74	0.684	0.537	0.63	/
Uranium µg/L	0.103	0.98	0.1255	0.124	0.134	15
Vanadium µg/L	0.147	0.16	0.1375	0.126	0.13	100[e,f]
Zinc µg/L	1.6	1.7	0.2855	0.8585	1.3	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.