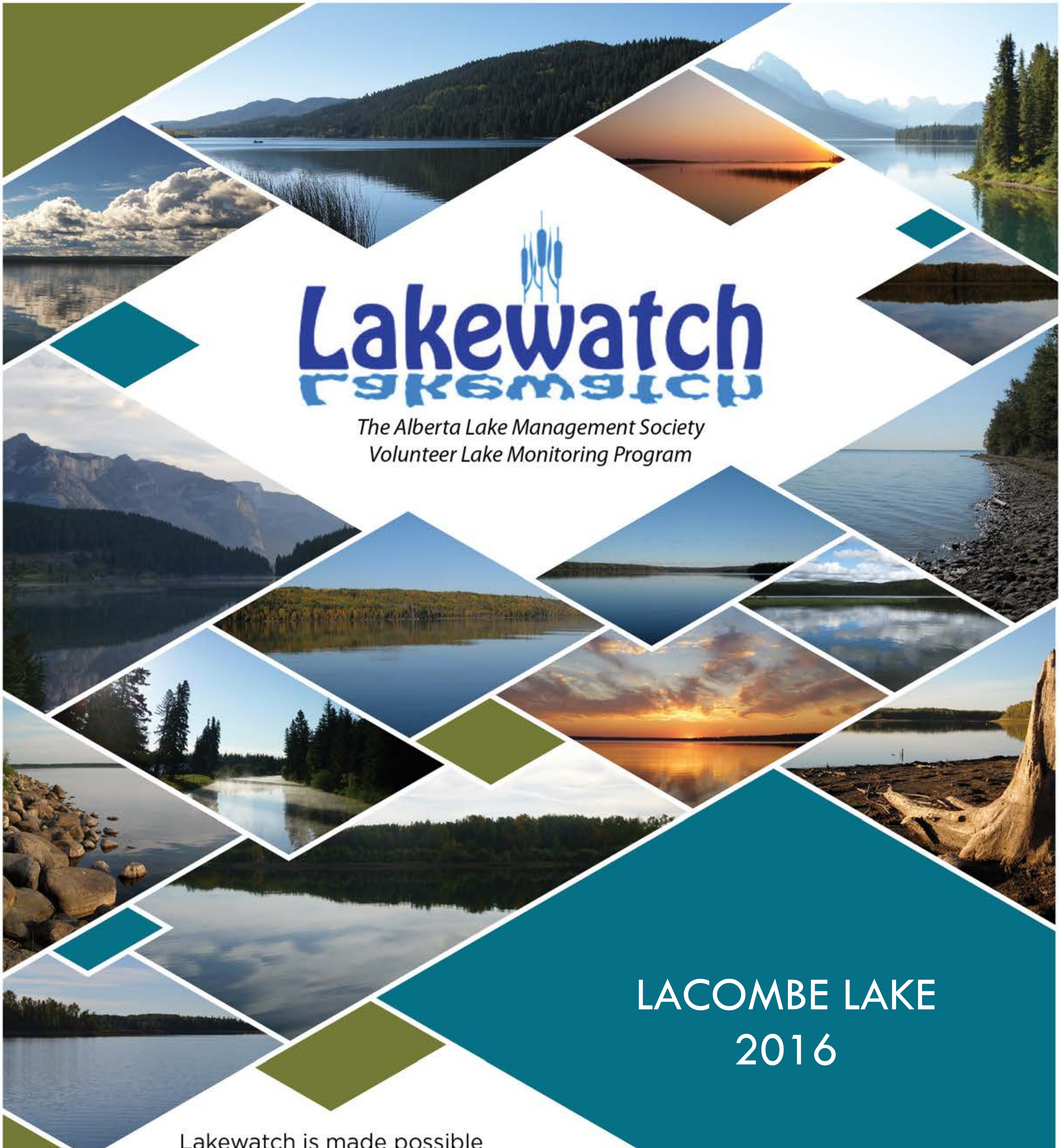

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

LACOMBE LAKE
2016

Lakewatch is made possible
with support from:

Beaver River Watershed Alliance

Red Deer River Watershed Alliance

LICA Lakeland Industry & Community Association

Alberta

Cargill

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ALMS

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.

This report has been prepared with un-validated data.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Anto & Ted Davis, Cliff Soper, and Bill & Griselda Hill for their enthusiasm, dedication, and kindness during the sampling of Lacombe 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. 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.

LACOMBE LAKE

Lacombe Lake is a pothole lake found in Lacombe County in central Alberta. It is located 5 km north of the town of Blackfalds and 15 km north of Red Deer. There are no public campgrounds around the lake as most of the land is private farms and homesteads as well as public land and reserves. It is thought that the lake was once called Jackfish Lake due to the northern pike found in the lake, though in 1975 the name was changed to Lacombe Lake. The Lacombe Lake area is part of the Treaty 6 Nations and was an area where the Samson and Erminskin Cree Nations hunted and travelled. Permanent camps were traditionally located in wooded areas as well as along rivers, and a known trade existed just south of Gull Lake.

The lake is long and narrow, with a length of about 3 km, a maximum depth of ~3.0 m, and a maximum width of about 500 m. Lacombe Lake has numerous bays and points which give it a distinct shape. It is not known to be a popular fishing destination but the lake is used for non-motorized recreational water sports as well as swimming. Lacombe Lake is found in the Aspen Parkland ecoregion of Alberta, much of which is now farmland with other foliage such as trembling aspen, oak, mixed tall shrubs, and intermittent fescue grasslands[1].

Known sportfish species at Lacombe Lake are the northern pike, though angling websites state that other species may include walleye, burbot, whitefish, rainbow trout, brown trout, and brook trout[2]. Lacombe Lake has a large population of macrophytes, including yellow pond lily, various pondweeds, chara, cattail, bulrushes, and bladderwort. Due to its small size, dense macrophytes, and limited recreational activity, waterfowl are known to frequent the lake. Known species include the mallard, common grebe, goldeneye, scaup, and ruddy duck[2]. Larger vertebrates that are found around the lake are deer, muskrat, lynx, and beavers. In the 1960s, the Prairie Farm Rehabilitation Association constructed a weir on Whelp Creek to control and direct the flow into the north end of Lacombe Lake during periods of high flow.

Anto Davis sampling Lacombe Lake.

In the years previous to 2008, residents observed deteriorations in water quality as well as dense macrophyte growth. The diversion of Whelp Creek was stopped and Golder Associates Ltd. assessed the water quality of Lacombe Lake over a period of 4 years.

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[1] Ecoregions of Canada. 1995. Available at: http://ecozones.ca/English/region/156.html

[2] http://www.hookandbullet.com/fishing-lacombe-lake-blackfalds-ab/ 2015

Golder Associates Ltd. concluded that the diversion may have brought in excess nutrients into Lacombe Lake and recommendations included enhanced monitoring, finding the source of nutrients and bacteria, and improving water quality through best management practices[3]. Best management practices include watershed controls such as fertilizer restrictions, restoration of riparian vegetation along shorelines, and nutrient management planning.

METHODS

ALMS collected water chemistry samples on five days throughout the summer of 2016: June 1st, July 2nd, August 6th, September 10th, and October 3rd. These samples were split into a composite sample and a profile sample. The composite samples were comprised of water from ten locations across the length of the lake and include most of the water chemistry parameters. The profile samples were recorded at one location on Lacombe Lake and include the dissolved oxygen, temperature, and Secchi disk parameters. Key parameters are presented in this report.

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 Lacombe Lake had an average concentration of 16 μg/L in 2016, putting it in the mesotrophic trophic classification (Table 2). TP levels in Lacombe Lake in 2016 were historically low. TP increased throughout the summer, with the maximum concentration of 22 μg/L on October 3 (Figure 1). The high abundance of macrophyte populations in Lacombe Lake are likely a key player in the lake's nutrient cycling process.

Chlorophyll-*a* concentrations increased over the course of the summer, with an average concentration of 8.6 μg/L in 2016 (Table 2) - this puts Lacombe Lake into the mesotrophic trophic classification. A maximum concentration of 10.7 μg/L was reached on September 10 (Figure 1).

Lacombe Lake had an average Total Kjeldahl Nitrogen (TKN) concentration of 1.3 mg/L over 5 sampling dates in 2016 (Table 2). On July 2, TKN concentrations spiked to a seasonal maximum of 1.5 mg/L, and then decreased to a minimum of 1.2 mg/L on both September 10 and October 3 (Figure 1).

Average pH measured as 8.62 in 2016, buffered by moderate alkalinity (224 mg/L $CaCO_3$) and bicarbonate (254 mg/L HCO_3). Magnesium, sodium and chloride were the dominant ions contributing to a relatively low conductivity measure of 490 μS/cm (Table 2).

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[3] Golder Associates Ltd. 2013. Lacombe Lake Water Quality Assessment - Alberta

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

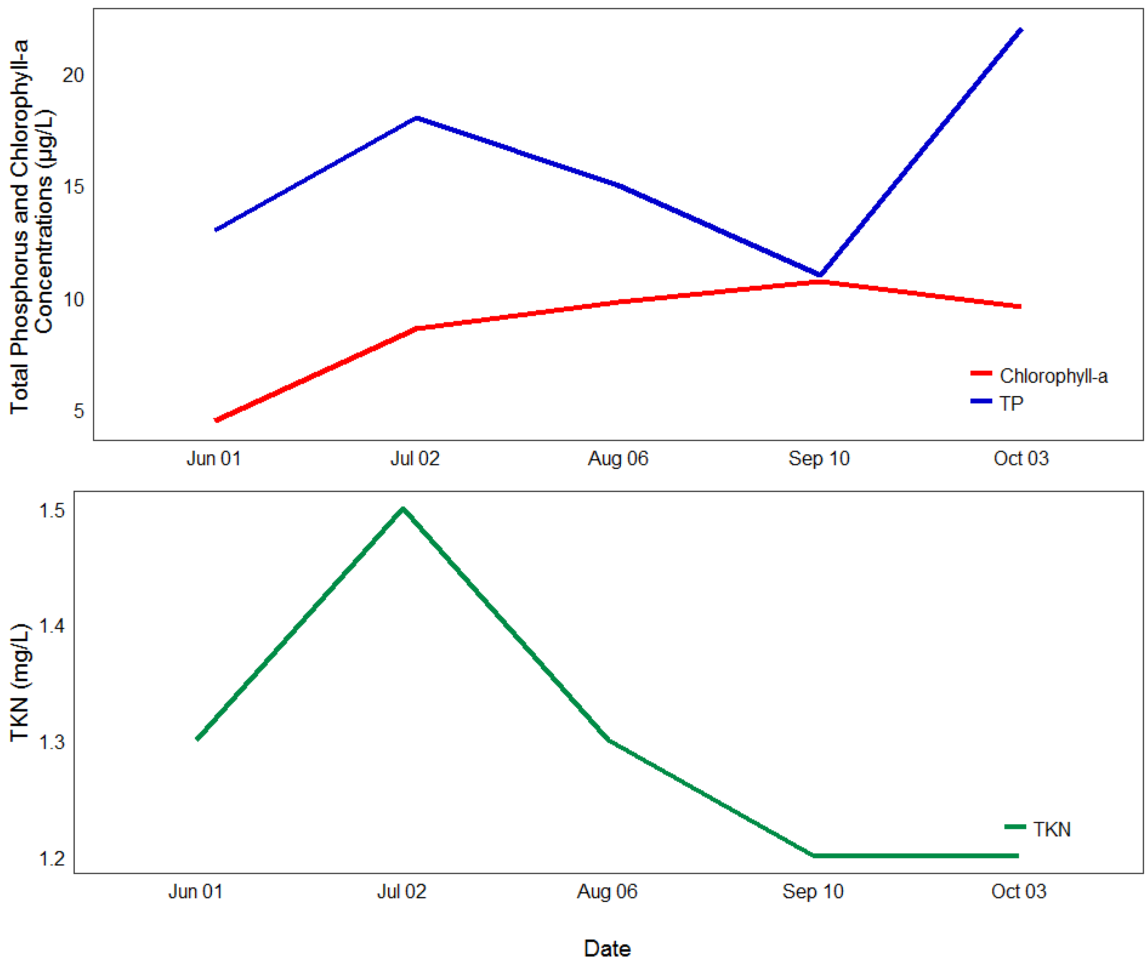

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured five times over the course of the summer at Lacombe Lake.

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 1.77 m, classifying Lacombe Lake as eutrophic, or productive (Figure 2). A maximum Secchi depth of 2.5 m was recorded on June 1st. Secchi depth decreased throughout the summer, with a minimum depth of 0.85 m on August 6. However, for the remainder of the season, Secchi depths were relatively deep and water clarity was good.

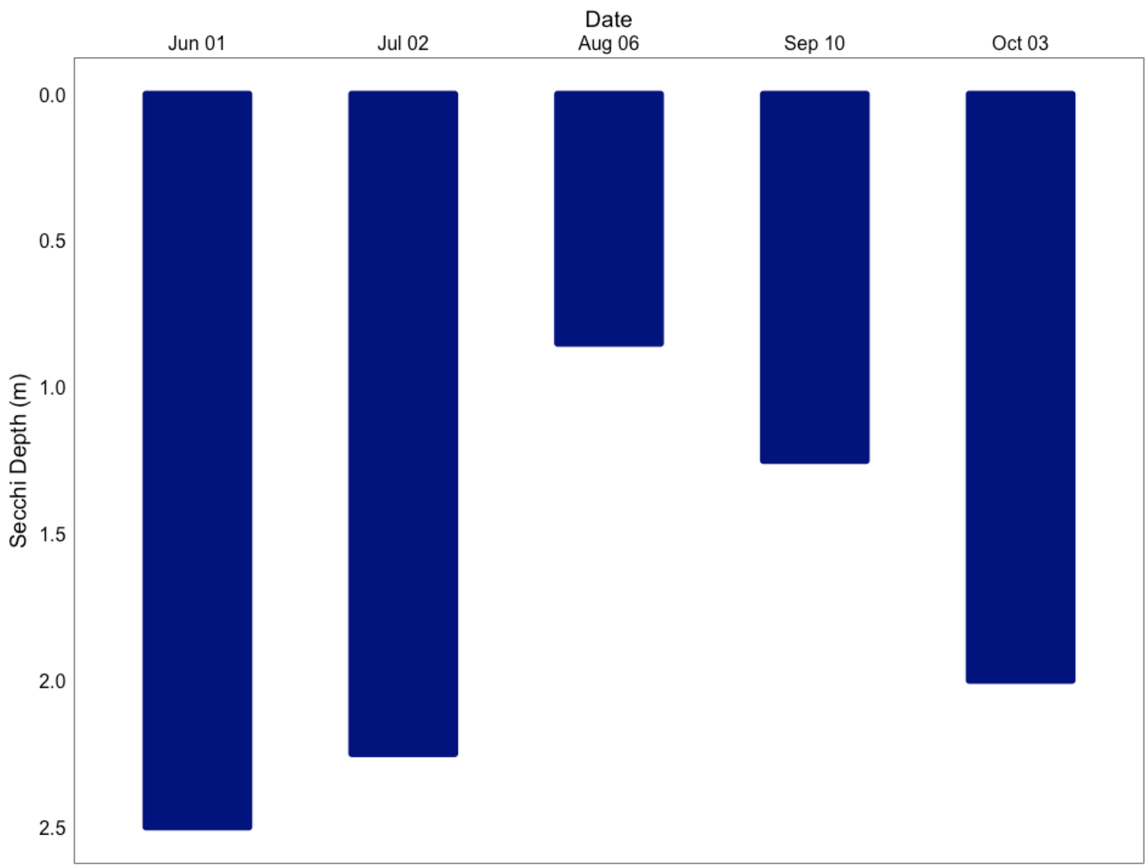

Figure 2 – Secchi depth values measured five times over the course of the summer at Lacombe Lake in 2016.

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.

Lacombe Lake water temperatures varied throughout the summer (Figure 3a). A maximum temperature of 22.86 °C was observed on July 2, and by October 3, the entire water column was approximately 11°C. Given the shallow depth of Lacombe Lake, it never reaches full thermal stratification, though it was weakly stratified during the warmest visit on July 2. Lacombe Lake can therefore be classified as polymictic, because it mixes fully multiple times over the course of the summer.

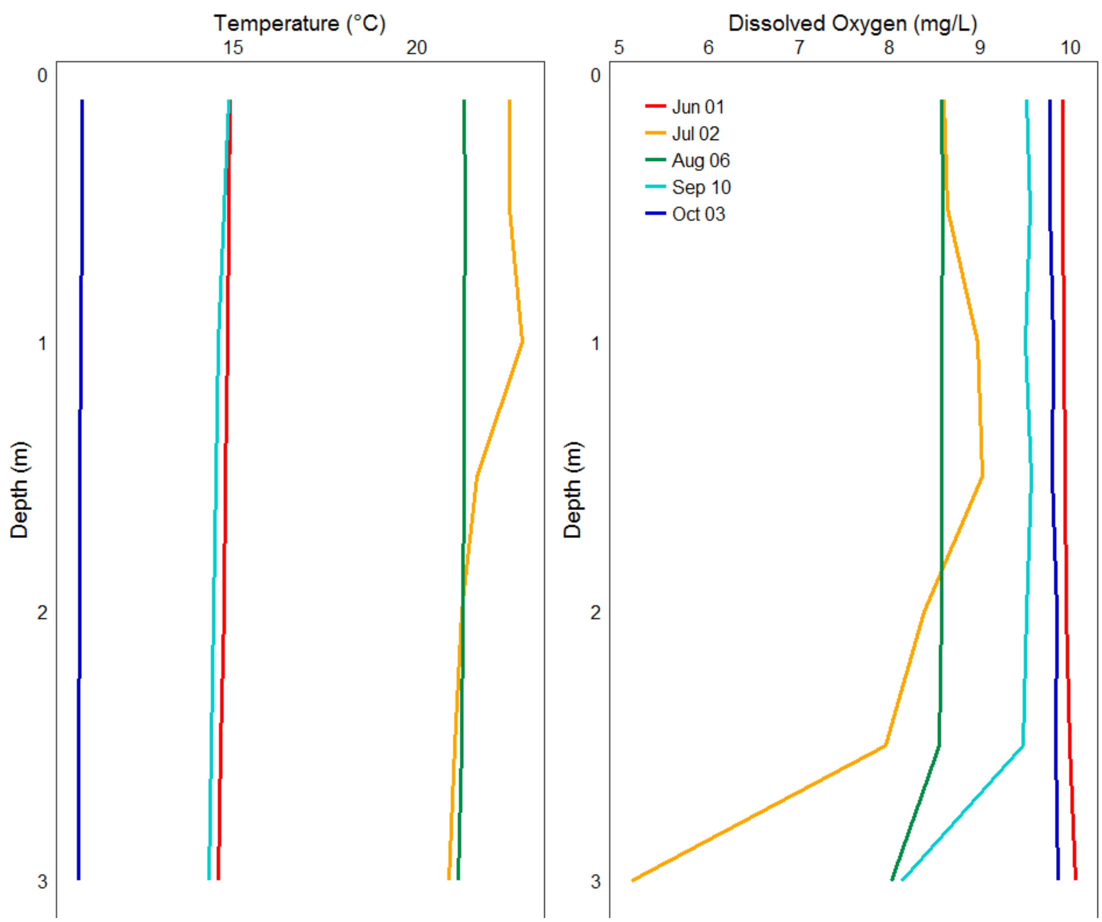

Figure 3– a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Lacombe Lake measured five times over the course of the summer of 2016.

Lacombe 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). Oxygen concentrations only proceeded below 6.5 mg/L on July 2nd, when they measured around 5 mg/L at 3 m of depth. For the remainder of the summer, the lake was well mixed through the water column.

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.

Microcystin levels in Lacombe Lake fell below the recreational guideline for the entire sampling period of 2016 (Table 1).

Table 1 – Microcystin concentrations measured five times at Lacombe Lake in 2016.

Date	Microcystin Concentration (μg/L)
Jun 1	0.14
Jul 2	0.13
Aug 6	0.41
Sep 10	0.57
Oct 3	0.13
Average	0.28

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 Lacombe lake. In 2016, no mussels were detected in Lacombe Lake.

Edited Table: Average water quality values for Lacombe Lake. This table has been updated to exclude data collected by Golder and Associates from 2008, 2009, and 2010 due to high detection limits (11/19/18).

Parameter	2008	2009	2010	2011	2012	2014	2015	2016	2017
TP (µg/L)	\	\	\	46	16	23	19	16	27
TDP (µg/L)	\	\	\	\	\	5.1	6	2.7	4.4
Chlorophyll-*a* (µg/L)	\	\	\	\	\	8	7.5	8.6	15
Secchi depth (m)	\	\	\	\	\	1.54	1.74	1.77	1.45
TKN (mg/L)	\	\	\	1.6	1.3	1.3	1.4	1.3	1.3
NO_2-N and NO_3-N (µg/L)	\	\	\	4.5	3	4.8	2.5	2.5	\
NH_3-N (µg/L)	\	\	\	143	75	19	25	54	\
DOC (mg/L)	\	\	\	\	\	\	17	14.6	15.2
Ca (mg/L)	\	\	\	\	\	27	20	21	24
Mg (mg/L)	\	\	\	\	\	31	32	34	31
Na (mg/L)	\	\	\	\	\	33.8	33	36	33
K (mg/L)	\	\	\	\	\	12.4	12	12	11
SO_4^{2-} (mg/L)	\	\	\	\	\	14.1	16	14	13
Cl^- (mg/L)	\	\	\	\	\	21.1	25	25	27
CO_3 (mg/L)	\	\	\	\	\	7.93	14	8	7
HCO_3 (mg/L)	\	\	\	\	\	266	230	254	255
pH	\	\	\	\	\	8.49	8.78	8.62	8.53
Conductivity (µS/cm)	\	\	\	\	\	503	478	490	515
Hardness (mg/L)	\	\	\	\	\	196	182	192	185
TDS (mg/L)	\	\	\	\	\	278	266	280	278
Microcystin (µg/L)	\	\	\	\	\	0.15	0.38	0.28	1.41
Total Alkalinity (mg/L $CaCO_3$)	\	\	\	\	\	230	212	224	220

2010 & 2011 data retrieved from Hyatt, C. "Lacombe Lake Water Quality Assessment - Alberta." Golder and Associates. Project No. 12-1151-0333
2014 & 2017 data collected by Alberta Environment and Parks.

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

Metals (Total Recoverable)	2014	2015	2016	Guidelines
Aluminum µg/L	14	11.5667	7.2	100[a]
Antimony µg/L	0.0595	0.0643	0.057	6[e]
Arsenic µg/L	0.9115	0.9550	0.803	5
Barium µg/L	62.25	45.67	44.5	1000[e]
Beryllium µg/L	0.004	0.0073	0.004	100[d,f]
Bismuth µg/L	0.0005	0.0302	5.00E-04	/
Boron µg/L	45.75	46.63	47.7	1500
Cadmium µg/L	0.0015	0.0030	0.001	0.09[b]
Chromium µg/L	0.175	0.180	0.04	/
Cobalt µg/L	0.033	0.041	0.01	1000[f]
Copper µg/L	0.3975	0.6967	0.37	4[c]
Iron µg/L	17.7	12.4	10.4	300
Lead µg/L	0.01475	0.1047	0.021	7[c]
Lithium µg/L	19.8	22.13	24.7	2500[g]
Manganese µg/L	48.1	53.2	51	200[g]
Molybdenum µg/L	0.137	0.104	0.102	73[d]
Nickel µg/L	0.042	0.109	0.035	150[c]
Selenium µg/L	0.175	0.057	0.22	1
Silver µg/L	0.001	0.005	0.001	0.25
Strontium µg/L	199.5	139.3	131	/
Thallium µg/L	0.001575	0.0121	0.00045	0.8
Thorium µg/L	0.001975	0.0938	0.0035	/
Tin µg/L	0.00775	0.0320	0.02	/
Titanium µg/L	0.865	0.9833	0.76	/
Uranium µg/L	0.6785	0.5223	0.524	15[e]
Vanadium µg/L	0.185	0.1667	0.2	100[f,g]
Zinc µg/L	0.95	1.37	0.6	30

[a] Based on pH ≥ 6.5; calcium ion concentrations [Ca+2] ≥ 4 mg/L; and dissolved organic carbon concentration [DOC] ≥ 2 mg/L.
[b] Based on water Hardness of 50 mg/L (as CaCO3)
[c] Based on water hardness > 180mg/L (as CaCO3)
[d] CCME interim value.
[e] Based on Canadian Drinking Water Quality guideline values.
[f] Based on CCME Guidelines for Agricultural use (Livestock Watering).
[g] Based on CCME Guidelines for Agricultural Use (Irrigation).
A forward slash (/) indicates an absence of data or guidelines.

PLANT MONITORING


ALMS Technician Breda Muldoon sampling Lacombe Lake

A bioblitz for aquatic plants and macro-algae was conducted on July 24th as a way to identify the composition of the native plant community and to scan for the presence of invasive species. The lake's shoreline was divided into three sections, and each section was assigned sample points 150-m apart (Appendix Figure 1). At each sample point, volunteers threw a double sided rake over the side of a canoe and bagged or identified plants collected. If comfortable doing so, volunteers also identified plants which could be seen from the canoe but which were not collected with a rake throw.

Much of Lacombe Lake's shoreline is dominated by bulrushes, however these observations were not included in the data summary. In Lacombe's open-water areas the lakebed is covered in dense beds of *Chara* spp. (pers. obs.) - due to the design of the sampling program, these beds are not included in the data summary. Voucher specimens collected during the bioblitz are presented in Figure 2 of the Appendix.


Bradley Peter and Ageleky Bouzetos of ALMS sampling plants in Lacombe Lake.

In total, not including emergents such as rushes and reeds, 10 unique species of plants were identified and 117 observations were recorded (Table 4). These plants included Arrowhead (*Saggitaria cuneata*), Bladderwort spp. (*Utricularia* spp.), Chara spp.(*Chara* spp.), Floating-Leaf Pondweed (*Potamogeton natans*), Northern Milfoil (*Myriophyllum sibricum*), Richardson's Pondweed (*Potamogeton richardsonii*), Sago Pondweed (*Stuckenia pectinata*), Sheathed Pondweed (*Stuckenia vaginata*), Spiral Ditchgrass (*Ruppia cirrhosa*), and Yellow Water-lily (*Nuphar variegata*). Previous aquatic plant sampling events at Lacombe Lake have identified Fries' Pondweed (*Potamogeton friesii*) which was not observed in 2016. No invasive species were detected in 2016.

Table 4 - the number of observations of each plant species during the July 26th bioblitz at Lacombe Lake.

Common Name	# Observations
Floating-leaf Pondweed	1
Sago Pondweed	1
Arrowhead	3
Spiral Ditchgrass	4
Pondweed spp.	10
Northern Milfoil	11
Sheathed pondweed	12
Bladderwort spp.	18
Richardson's Pondweed	18
Chara spp.	19
Yellow Water-lily	20
Total Observations	**117**

APPENDIX

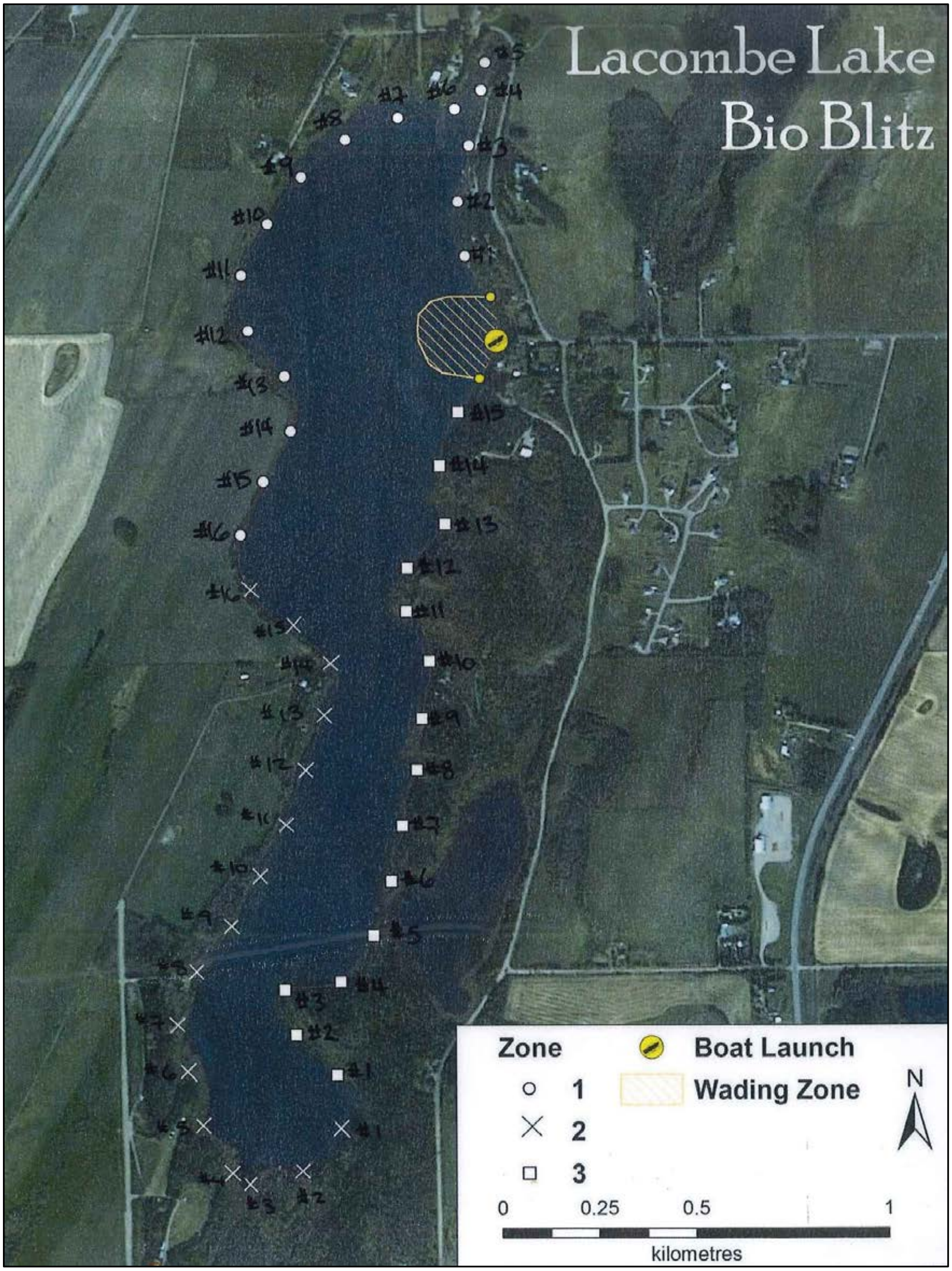

Figure 1 - Aquatic plant sample locations for the July 26th Lacombe Lake bioblitz.

Table 1 - Sample locations and plant species (common names) collected or seen at each location.

Location	Plant Species Collected (Common Names)						
Square 1	Chara	Sheathed pondweed	Yellow Water-lily				
Square 2	Sago Pondweed	Yellow Water-lily					
Square 3	Bladderwort spp.	Spiral Ditchgrass					
Square 4	Bladderwort spp.	Richardson's Pondweed	Yellow Water-lily				
Square 5	Richardson's Pondweed	Sheathed pondweed	Yellow Water-lily				
Square 6	Chara	Sheathed pondweed					
Square 7	Richardson's Pondweed	Sheathed pondweed					
Square 8	Richardson's Pondweed	Sheathed pondweed					
Square 9							
Square 10							
Square 11	Chara	Pondweed spp.	Yellow Water-lily				
Square 12	Chara	Richardson's Pondweed					
Square 13	Chara						
Square 14	Chara						
Square 15	Chara						
Square 16							
Circle 1	Inaccessible due to Yellow Water-lily						
Circle 2	Inaccessible due to Yellow Water-lily						
Circle 3	Inaccessible due to Yellow Water-lily						
Circle 4	Richardson's Pondweed	Yellow Water-lily					
Circle 5	Bladderwort spp.	Northern Milfoil	Richardson's Pondweed	Yellow Water-lily			
Circle 6	Bladderwort spp.	Northern Milfoil	Pondweed spp.	Richardson's Pondweed	Yellow Water-lily		
Circle 7	Northern Milfoil	Pondweed spp.					
Circle 8	Bladderwort spp.	Northern Milfoil	Pondweed spp.	Richardson's Pondweed	Spiral Ditchgrass	Yellow Water-lily	
Circle 9	Bladderwort spp.	Northern Milfoil	Richardson's Pondweed	Yellow Water-lily			
Circle 10	Bladderwort spp.	Northern Milfoil	Pondweed spp.	Yellow Water-lily			
Circle 11	Bladderwort spp.	Chara	Pondweed spp.	Richardson's Pondweed	Yellow Water-lily		
Circle 12	Yellow Water-lily	Pondweed spp.					
Circle 13	Pondweed spp.						
Circle 14	Arrowhead	Chara	Northern Milfoil	Pondweed spp.	Richardson's Pondweed		
Circle 15	Arrowhead	Bladderwort spp.	Northern Milfoil	Pondweed spp.	Richardson's Pondweed	Yellow Water-lily	
Circle 16	Arrowhead	Bladderwort spp.	Chara	Northern Milfoil	Yellow Water-lily	Richardson's Pondweed	Sheathed pondweed
X 1	Chara	Sheathed pondweed					
X 2	Chara	Richardson's Pondweed					
X 3	Bladderwort spp.						
X 4	Bladderwort spp.	Richardson's Pondweed					
X 5	Bladderwort spp.	Chara					
X 6	Bladderwort spp.	Chara	Richardson's Pondweed	Sheathed pondweed			
X 7	Bladderwort spp.						
X 8	Bladderwort spp.	Sheathed pondweed					
X 9	Sheathed pondweed	Yellow Water-lily					
X 10	Chara	Northern Milfoil	Spiral Ditchgrass				
X 11	Northern Milfoil	Spiral Ditchgrass					
X 12	Bladderwort spp.	Yellow Water-lily	Richardson's Pondweed	Sheathed pondweed			
X 13	Chara	Floating-leaf Pondweed					
X 14	Bladderwort spp.	Chara					
X 15	Chara						
X 16	Chara	Sheathed pondweed					

Figure 2 - Pressed voucher specimens submitted to the University of Alberta Vascular Plant Herbarium

Bladderwort spp.
(Utricularia spp.)

Spiral Ditchgrass
(Rupia Cirrhosa)

Sheathed Pondweed
(Stuckenia vaginata)

Sago Pondweed
(Stuckenia pectinata)

Richardson's Pondweed
(Potamogeton richardsonii)

Northern Milfoil
(Myriphyllum sibricum)

Floating-leaf Pondweed
(Potamogeton natans)

Chara spp.
(Potamogeton natans)