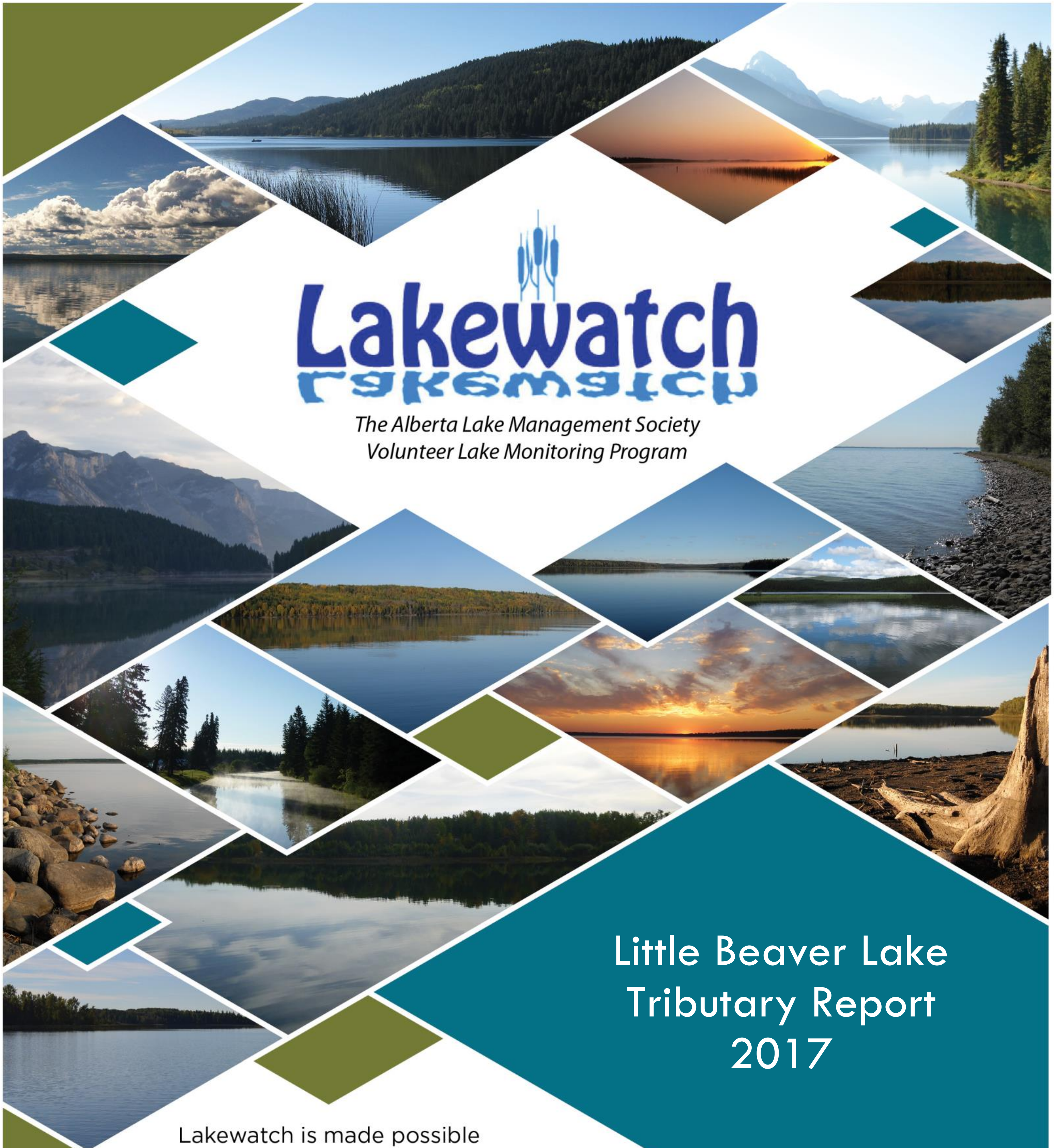

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Little Beaver Lake Tributary Report 2017

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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 Tony Cable and Doug Jensen of the Friends of Little Beaver Lake Society for helping to initiate this project at Little Beaver Lake. We would also like to acknowledge the Little Beaver Lake Stewardship Society for their financial contributions to this project. Field sampling and report writing was conducted by Bradley Peter and Laura Redmond.

INTRODUCTION

Little Beaver Lake is a quiet, scenic lake 35 km south of Camrose and 107 km south of Edmonton in the Battle River Watershed. This shallow lake is approximately 3.5 km long and 500 m wide, and is surrounded by forested rolling hills and agricultural development. The county subdivision of Little Beaver Lake Estates lies on its west shore, and the Village of Ferintosh lies on its east shore.

The northern tributary flows from a similarly sized lake to Little Beaver Lake through a culvert undercutting Highway 21 just south of the railroad tracks. The lake surface area is 1.66 km^2 and the lake watershed is approximately 63 km^2. Little Beaver Lake's lake:watershed ratio is 1:38 (Figure 1).

The purpose of this study was to determine the loading of key nutrients entering Little Beaver Lake through the northern tributary from March 31-May 5.

ALMS Program Coordinator Laura Redmond assessing the state of the stream.

HOW WERE DATA COLLECTED?

The downstream side of the northern culvert was sampled four times (Table 1) in the Spring of 2017 for information related to flow and water chemistry.

Flow: The width of the culvert and depth of the stream were used to calculate the cross-sectional area of flow. The velocity of the stream was measured using a Gurley Price meter connected to a Wading Rod. This device uses rotating cups held below the surface of the stream to measure velocity. The area of flow and stream velocity were used to calculate discharge in m^3/s. Discharge was assumed constant until the subsequent sampling event.

Water Chemistry: Water samples were collected from below the surface and tested for various parameters, including: total phosphorus (TP), total dissolved phosphorus (TDP), nitrate and nitrite (NO_3+NO_2), total Kjeldahl nitrogen (TKN), and ammonia. These parameters include various forms of phosphorus and nitrogen, nutrients which are important for growth in Little Beaver Lake. Water chemistry was assumed constant until the subsequent sampling event. Concentrations of these parameters were combined with discharge to calculate the loadings (mass) of nutrients passing through the culvert. Daily loadings were multiplied by the number of days between sampling events to determine total mass loading of each nutrient into the lake over the sampling period.

Table 1. Dates of culvert sampling and number of days between sampling visits.

Date	Days Between Samples
31-Mar	6
7-Apr	9
17-Apr	17
5-May	14*

*Assumed number of days before end of flow.

RESULTS AND DISCUSSION:

Little variation was observed in the stream's flow from March 31 – May 5. The cross-sectional area of flow ranged from 0.60-0.67 m^2, while the velocity ranged from 0.10-0.13 m/s. These measurements resulted in a minimum discharge of 0.066 m^3/s on March 31 and a maximum discharge of 0.092 m^3/s on April 17 (Table 2).

Table 2. Discharge (m^3/s) and concentration of various nutrients (mg/L) observed on each sampling date in the northern tributary of Little Beaver Lake.

Date	Discharge (m^3/s)	TP (mg/L)	TDP (mg/L)	NO_3+NO_2 (mg/L)	TKN (mg/L)	Ammonia (mg/L)
31-Mar	0.066	0.74	0.66	1.60	2.70	0.551
7-Apr	0.069	0.75	0.62	0.11	2.60	0.069
17-Apr	0.092	0.56	0.47	0.08	2.20	0.050
5-May	0.073	0.95	0.88	0.02	3.10	0.130

The total volume and mass loadings for the sampling season were calculated (Table 3). In sum, 3.1×10^8 L passed through the culvert between March 31-May 19, transporting 226 kg of total phosphorus, of which 198 kg were dissolved, 73 kg of nitrate + nitrite, and 807 kg of total Kjeldahl nitrogen including 41 kg of ammonia.

Table 3. Volume of water (L) and mass of nutrients (kg) passing through the northern tributary culvert at Little Beaver Lake.

Date	Volume (L)	TP (kg)	TDP (kg)	NO_3+NO_2 (kg)	TKN (kg)	Ammonia (kg)
March 31-April 6	3.4×10^7	25.4	22.7	55.0	92.8	18.9
April 7-April 16	5.4×10^7	40.3	33.4	5.9	139.9	3.7
April 17-May 4	1.4×10^8	76.0	63.8	10.5	298.6	6.8
May 5-May 19	8.9×10^7	84.3	78.1	1.4	275.2	11.5
Total March 31-May 19	**3.1×10^8**	**226**	**198**	**73**	**807**	**41**

Given that sampling events occurred at different intervals, the average concentration of nutrients in the stream over the period of sampling can be calculated as a flow weighted mean – see Table 4.

Table 4. Flow weighted mean concentrations (mg/L) of each nutrient for the period March 31-May 19.

Calculated Variable	TP (mg/L)	TDP (mg/L)	NO_3+NO_2 (mg/L)	TKN (mg/L)	Ammonia (mg/L)
Flow Weighted Mean Concentration (mg/L)	0.723	0.633	0.233	2.58	0.131

Concentrations of nutrients in the stream were high, often exceeding concentrations observed in the lake during summer sampling in previous years. For example, the 2016 average total phosphorus concentration in Little Beaver Lake was 0.168 mg/L compared to an average concentration of 0.723 mg/L observed in the northern tributary. High nutrient concentrations are likely attributed to the melting of winter snow stores which carry nutrients from the landscape. Wetlands on the north side of Little Beaver Lake may help reduce nutrient concentrations before tributary water enters the lake. Beneficial management practices applied to the landscape in Little Beaver Lake's watershed may result in improvements to Little Beaver Lake's water quality.

FUTURE DIRECTIONS:

Further studies are needed to gain a more holistic view of the Little Beaver Lake watershed and inflows. This study included only a few sampling events in one season. A greater number of sampling visits, including sampling during summer storm events, would increase the precision of mass loading measurements. For the purposes of this study, flow was assumed to end two weeks after the final sampling trip. Future studies should aim to monitor the tributaries until no-flow conditions are observed. Moreover, sampling across seasons would help provide clarity regarding the impact of seasonal variability. Future research may involve the preparation of a phosphorus budget including all tributaries leading to and from Little Beaver Lake.

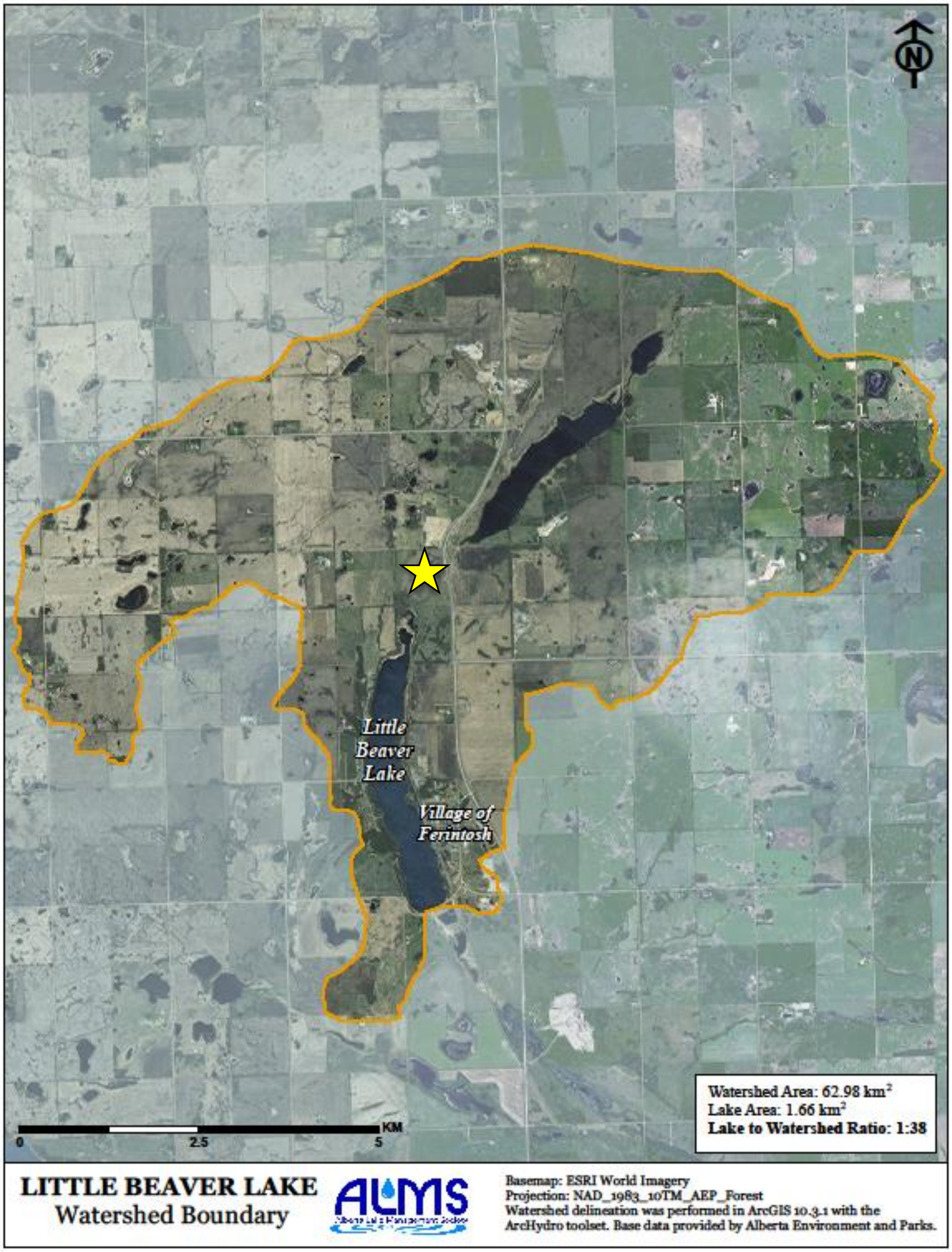

Figure 1: Little Beaver Lake watershed boundary. The sampled tributary is indicated by a star.