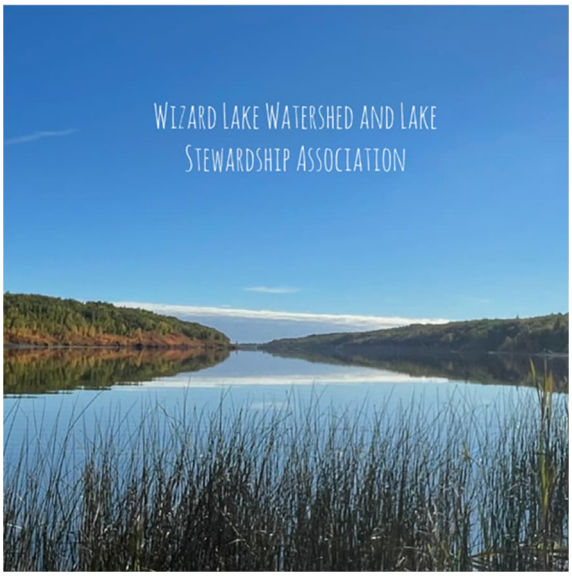
Associated Environmental

TECHNICAL MEMORANDUM

Wizard Lake Watershed and Lake Stewardship Association

Wizard Lake
2022 Data Summary



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NOVEMBER 2022

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1 INTRODUCTION

In 2006, community members who both lived near Wizard Lake and were interested in stewardship, created a registered society called Wizard Lake Watershed and Lake Stewardship Association (WLWLSA). In 2021, the WLWLSA retained Associated Environmental Consultants Inc. (Associated) to review the existing scientific papers, reports, and data that were previously collected by WLWLSA up to 2020 (Associated 2021). Associated interpreted the data and summarized the existing knowledge regarding the health of Wizard Lake and its watershed. In the 2021 report, Associated also evaluated both the WLWLSA's tributary sampling program and the data collected. One of the recommendations out of the 2021 report, was to continue to collect water quality samples from the tributaries for another two to three years to better understand the trends in water quality.

In 2022, the WLWLSA collected another set of water quality samples and retained Associated to assess the 2022 data and recommend the next steps. WLWLSA also requested that Associated review the winter water quality data collected by Winter LakeKeepers, a citizen monitoring program that is led and funded by the Alberta Lake Management Society (ALMS). ALMS prepares summary reports for the Winter LakeKeepers program; however, Associated reviewed the data to provide interpretation and reporting of the data that is more specific to Wizard Lake, along with recommendations for future monitoring.

2 TRIBUTARY SAMPLING PROGRAM

2.1 What Sampling Was Done?

Volunteers of the WLWLSA have collected water samples in several creeks, called tributaries, that flow into Wizard Lake (**Table 2-1**). This testing helps determine which areas are contributing the most nutrients and bacteria to the lake and assists in pinpointing areas to direct watershed stewardship activities. During each sampling year, volunteers collected water samples during spring run-off because this time of year represents the highest inputs from tributaries into Wizard Lake. During the summer and fall, these tributaries are often dry.

Wizard Lake volunteers collected water samples on April 1, 4, and 7, 2022, and submitted them to the Bureau Veritas laboratory to be tested for nutrients, *Enterococcus*, and some physical parameters (**Table 2-2**). Nutrients included phosphorus (total and total dissolved phosphorus) and nitrogen (including ammonia and total Kjeldahl nitrogen); these nutrients play a role in how much algae can develop. *Enterococcus* was a new parameter in 2022. Previously, water was tested for *Escherichia coli*; however, Alberta Health Services has recommended that *Enterococcus* be tested instead, because it is a better predictor of health risk due to fecal contamination. Additionally, pH, water temperature, and conductivity were measured in the field using a Hach field meter.

Table 2-1
Tributary Sample Locations and Dates

Sample Site	2007	2010	2011	2018	2022
Inflow 1	April 11	May 24	April 13	April 21	April 4
Inflow 2	April 16	Not sampled	April 26	April 21	April 7
Inflow 3	April 16	May 24	April 13	April 21	April 7
Inflow 4A	March 27	May 24	April 13	April 19	April 1
Inflow 4B	Not sampled	Not sampled	Not sampled	April 19	April 1
Tributary A	March 27	Not sampled	April 13	April 19	April 1
Tributary B	March 27	May 24	April 13	April 19	April 1
West End	Not sampled	Not sampled	Not sampled	Not sampled	April 4

Table 2-2
Parameters Tested in Tributaries

Parameter Group	Interpretation	Parameters Tested
Nutrients	Nutrients (especially phosphorus) feed lake algae, and if they are present in excess, they can cause algal blooms. Elevated ammonia and nitrate levels can be toxic to aquatic life.	• Ammonia nitrogen • Nitrate and nitrite nitrogen • Total Kjeldahl nitrogen • Total phosphorus • Total dissolved phosphorus
Bacteria	Excessive fecal bacterial levels can cause digestive illness in swimmers.	• *Enterococcus*
Physical	Physical parameters are important for fish habitat quality. Elevated temperature and pH can increase ammonia toxicity. Elevated pH can favor cyanobacteria over other algae	• Total suspended solids • pH • Temperature • Specific conductance

2.2 Sampling Locations

Volunteers collected six water samples (**Figure 2-1**), from the same locations as in previous years, including Inflows 1 to 4A, along with Tributary A and Tributary B (which are located along the creek that flows into Inflow 4) (**Figure 2-2**). Inflow 4B was sampled only in 2011 and 2022, making it more challenging to compare parameters between the sampling years for this location. All sampling locations were located on the south side of the lake due to the natural watershed drainage into the lake. Tributary A is just downstream of a farm (a previous feedlot), and Tributary B is just upstream of the same farm. The purpose of these paired samples was to understand whether the farm run-off affects

creek water quality. In 2022, a new sampling location was added at the west end of Wizard Lake to begin to understand the water quality in that area.

Figure 2-1
Wizard Lake Volunteers Collecting Water Samples

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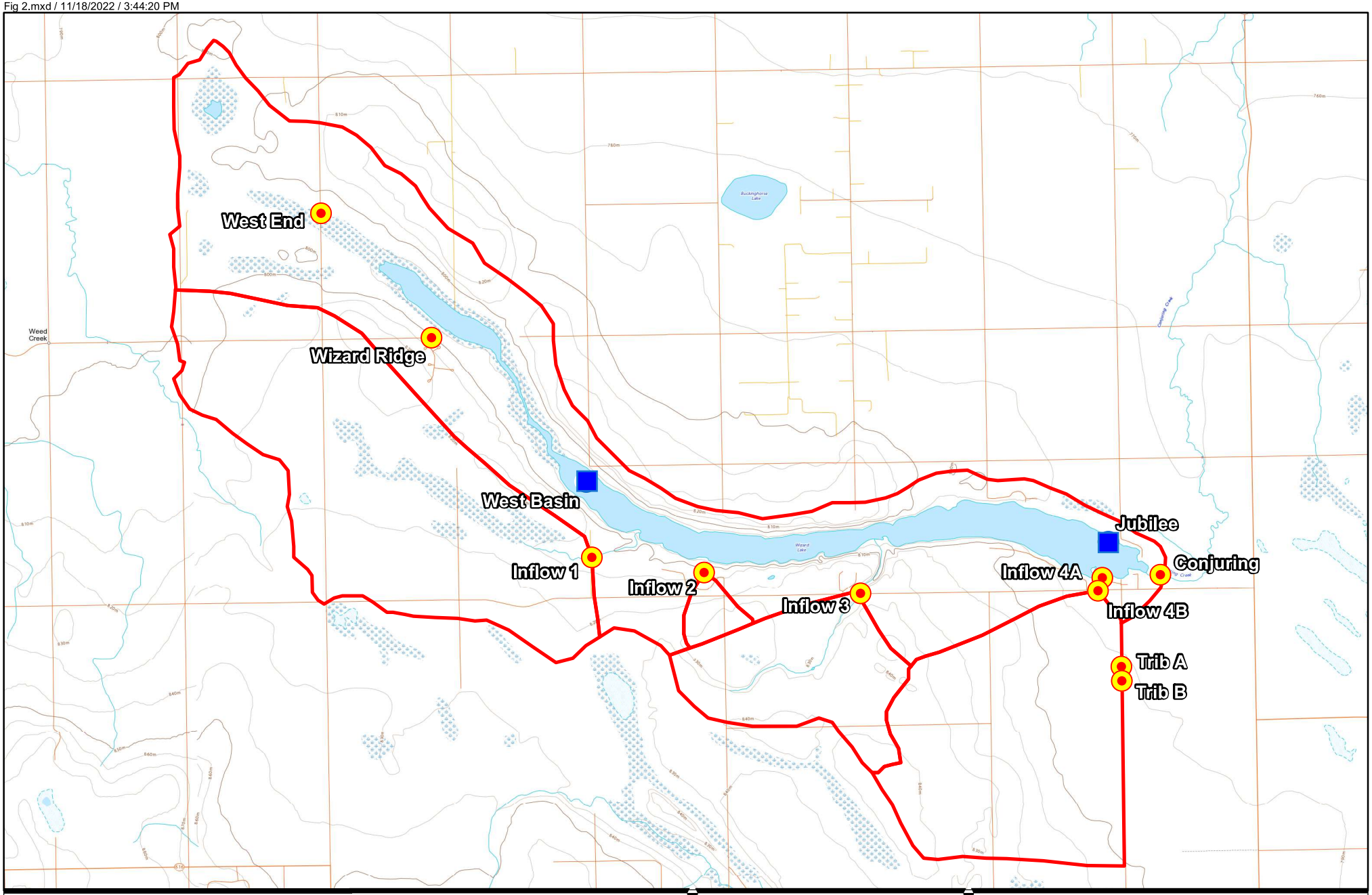

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DATE: November 2022

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FIGURE 2-2: WATERSHEDS FOR TRIBUTARY SAMPLING LOCATIONS

Wizard Lake Watershed & Lake Stewardship Association

Wizard Lake Data Summary

2.3 How Does the 2022 Data Compare to Previous Years?

As in 2010, the spring flows in 2022 were relatively low compared to 2007, 2011, and 2018. Water flows at the nearest hydrometric station (Station 05DF008) were reviewed. The highest peak in flow occurred in July 2022 and notably, there was no large increase in flow in spring 2022. This finding indicates that the water samples were likely representative of the water during spring run-off, and there was no issue with the timing of sample collection.

In 2022, volunteers collected the water temperature and pH in the field instead of having a laboratory test these parameters. This method provides more accurate readings that are important for the interpretation of ammonia data. Total ammonia is made up of ionized and un-ionized ammonia, with un-ionized ammonia being more toxic to aquatic life, particularly to fish. In 2022, the un-ionized ammonia met the guideline at all sampling locations.

Overall, the concentrations of all parameters tested in 2022 were very low, similar to what was seen in 2010 results (**Figure 2-3**, **Figure 2-4**, and **Figure 2-5**). As with previous years, the results from 2022 indicate that total phosphorus was primarily made up of total dissolved phosphorus, which is the more bioavailable form. This means that living organisms are more likely to take up phosphorus in this form. The total dissolved phosphorus and total phosphorus concentrations were both very low in 2022 compared to 2007, 2011, and 2018 so there would have been less phosphorus available in 2022. The highest levels of total phosphorus were observed at the new tributary sampling location at the west end of the lake. The 2021 report concluded that there was an impact from the farm area on the water quality. Although the levels were much lower in 2022, the levels of ammonia and total dissolved phosphorus were still higher at Tributary A compared to Tributary B which is consistent with the trends observed in the previous data.

Figure 2-3
Total Ammonia Nitrogen Concentrations in Wizard Lake Watershed

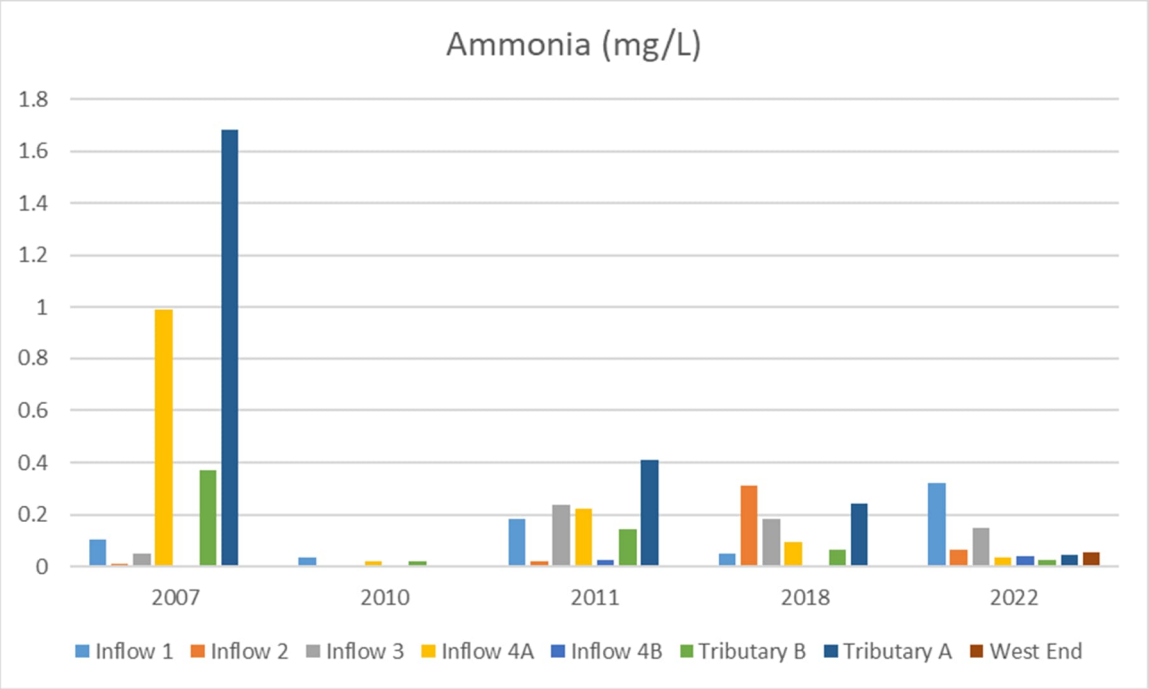


Figure 2-4
Dissolved Phosphorus Concentrations in Wizard Lake Watershed

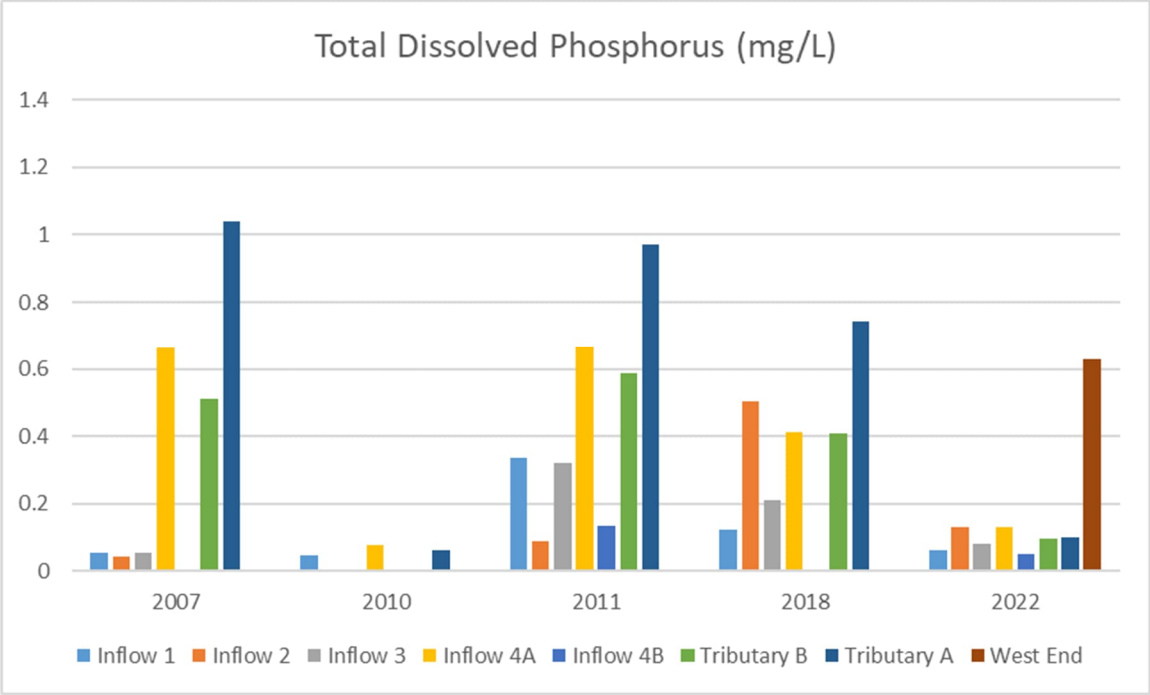
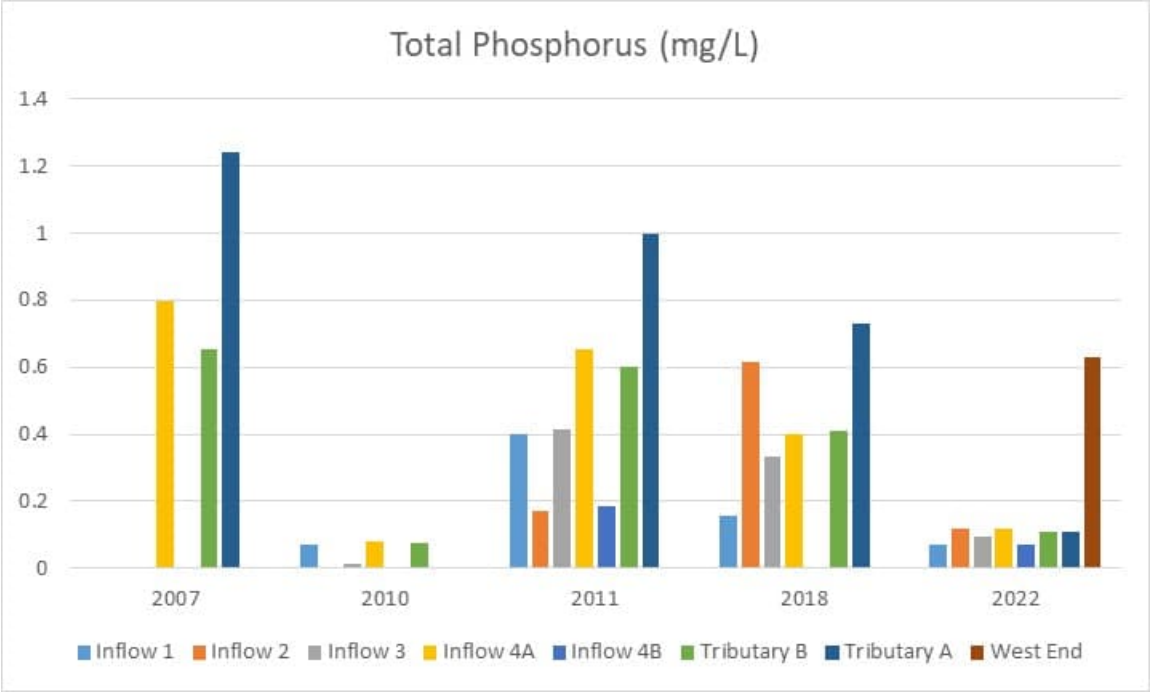


Figure 2-5
Total Phosphorus Concentrations in Wizard Lake Watershed



With respect to fecal matter inputs to the lake, all samples tested were below the guideline, suggesting that *Enterococcus* was only entering the lake in low levels from the tributaries during spring run-off in 2022. In previous years when *E. coli* was tested, only one sample exceeded the applicable guideline, suggesting that bacterial concentrations from the tributaries during spring run-off are typically low.

3 WINTER LAKEKEEPERS' DATA

3.1 What Was Measured?

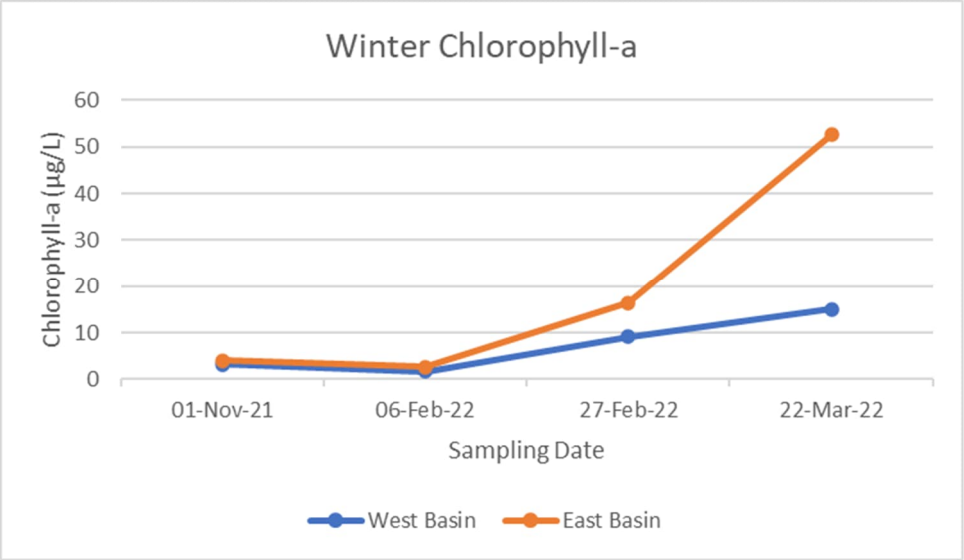
The Winter LakeKeepers program is run by ALMS. ALMS analyzes data from several lakes in Alberta and creates a summary report; however, WLWLSA would like to understand the data specific to Wizard Lake. LakeKeepers volunteers collected depth profile information by measuring dissolved oxygen and water temperature at several depths from the surface of the lake to the bottom of it. Water samples were also collected at a single depth in two locations: one in the east basin Wizard Lake (Jubilee Park Beach, where ALMS usually collects summer data for the LakeWatch program, see Section 4) and one from the west basin. Based on available information, the west basin has not been previously sampled for water quality, as it is considered an open-water wetland and only accessible by canoe in summer. WLWLSA was interested in gaining a better understanding of this area in Wizard Lake, which receives runoff from the western portion of the watershed.

The samples were collected by volunteers using equipment provided by ALMS and submitted to the laboratory to analyze them for nutrients (total nitrogen, ammonia, total Kjeldahl nitrogen, and total and dissolved phosphorus), chlorophyll-*a*, conductivity, chloride, dissolved organic carbon, and pH. These parameters were tested at four different sampling events in the winter, November 1, 2021, February 6 and 27, and March 22, 2022. Sulphate was also collected at one sampling event in 2001.

3.2 Results

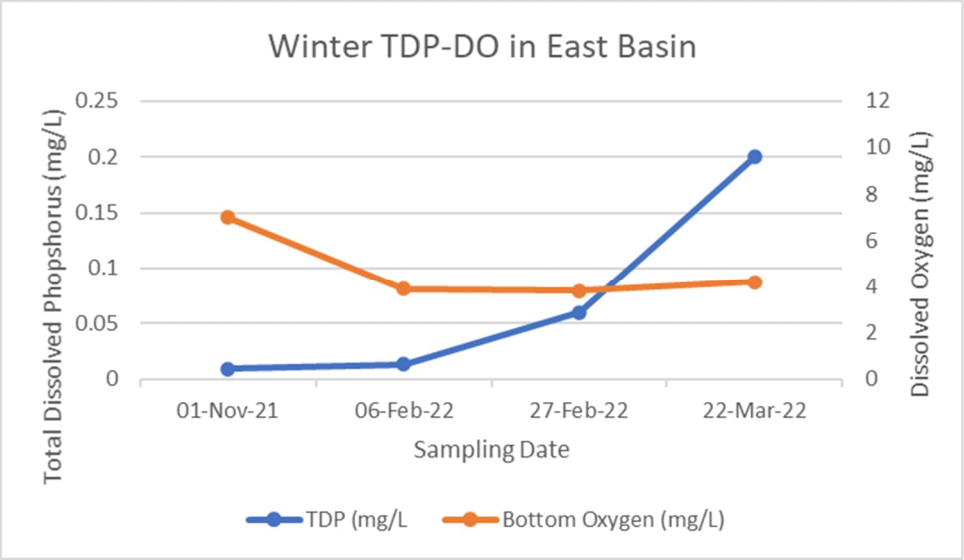
The data showed that there was a winter algal bloom in the east basin that started in February 2022 (**Figure 3-1**). The chlorophyll-a concentrations were as high as those detected in the summer of 2020. Certain species of algae can produce a toxin called microcystin, which is toxic to humans and animals. In the future, if the water has a green or red colour under ice, indicating an algae bloom, it would be useful to complete an algal speciation test which can determine which types of algae are present in a water sample. That will show if there is a potential for toxin presence or not.

Figure 3-1
Winter Chlorophyll-a at West Basin and East Basin



The data analysis also showed increasing concentrations of phosphorus in the east basin throughout the winter, which can be interpreted as evidence of phosphorus release from sediments (**Figure 3-2**). This release of phosphorus is related to low oxygen levels near the sediments.

Figure 3-2
Total Dissolved Phosphorus and Dissolved Oxygen in the East Basin



The highest ammonia concentrations were in November, at both the east and west locations. The elevated ammonia may have been the result of algal decay in the lake. There was no obvious trend in total nitrogen; however, total Kjeldahl nitrogen increased slightly throughout the winter in the east basin. There was also no obvious trend in dissolved organic carbon. Dissolved organic carbon is usually an indicator of the degree of organic plant matter brought into the lake from the watershed and therefore is not expected to change much throughout winter.

Dissolved oxygen is important for the health of aquatic life in the lake. To protect aquatic life, dissolved oxygen levels should be at least 6.5 mg/L, according to the Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta 2018). Dissolved oxygen met the guideline in the upper water column in the east basin and throughout the water column in the west basin, indicating good water quality to support fish. The dissolved oxygen at the bottom of the lake, however, did not meet the guidelines in the east basin, indicating reduced water quality for fish in deep waters. In the west basin, dissolved oxygen decreased from November 2021 to January 2022, but remained above 6.5 mg/L, meeting the guideline requirements. Low oxygen in bottom waters promotes phosphorus release from sediments. This was supported by the phosphorus data from the east basin in winter 2021-2022.

Conductivity is an indicator of various ions in the water. The conductivity at both sites decreased over the winter, which suggests that fresh water was entering the lake. The fresh water may have entered the lake during warmer periods, when melting events occurred in the watershed.

4 LAKEWATCH DATA

LakeWatch is a summer water quality monitoring program completed by ALMS with support from lake volunteers. This program has been completed in Wizard Lake first in 1999, and then about every two years since 2006, including 2022. The program collects water quality data using provincial standard methods and a more comprehensive suite of parameters than the Winter LakeKeepers program.

ALMS will issue a lake-specific annual report for the LakeWatch program in Wizard Lake early 2023. In addition, ALMS will prepare the first trend analysis report that will evaluate if there have been statistically significant trends over time in Wizard Lake water quality. The trend analysis report requires at least 10 years of data to complete the statistical analysis.

5 ALGAE DATA

5.1 What Was Collected and Why?

Alberta Health Services collects samples at priority lakes in Alberta and tests them for cyanobacteria (also called blue-green algae) and microcystin (the toxin that certain cyanobacteria produce) to understand the potential risk to humans and animals. The Alberta surface water quality guideline for recreation and aesthetics for cyanobacteria is 100,000 cells per millilitre, and the guideline for microcystin is 20 micrograms per litre (Government of Alberta 2018).

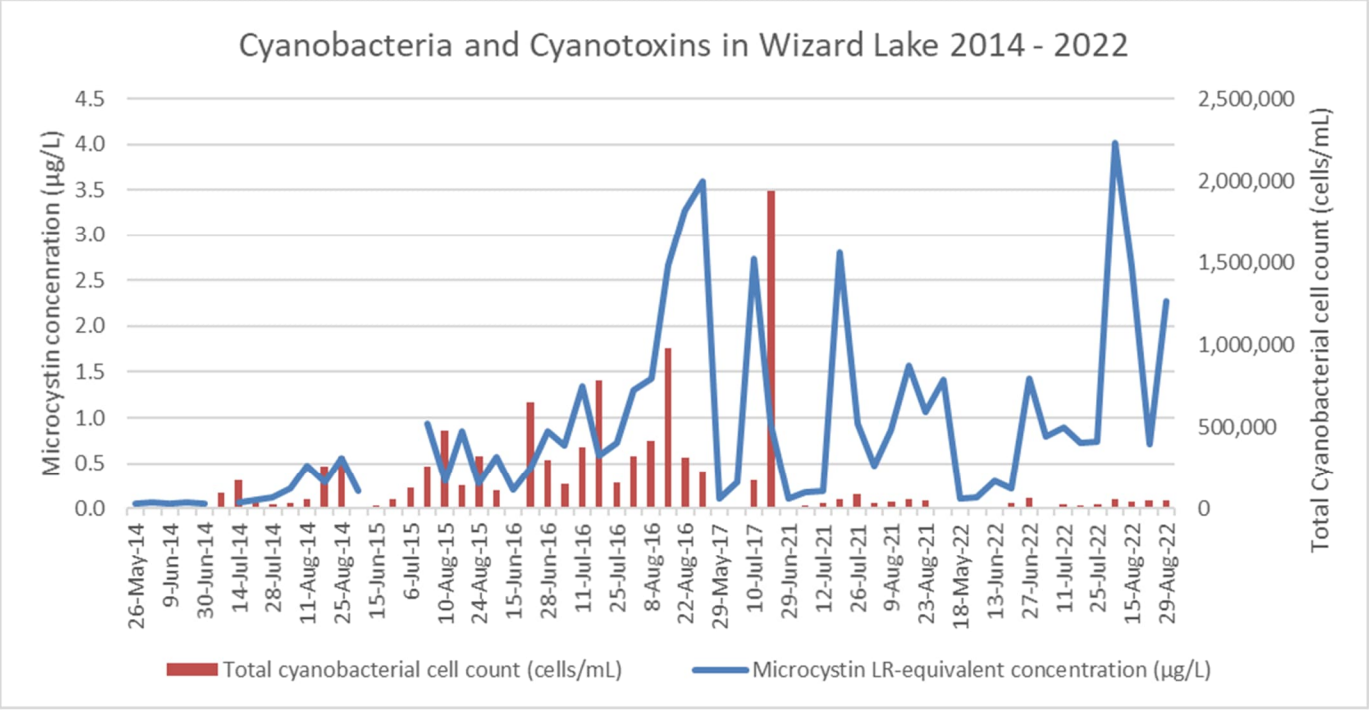
5.2 Results

The cyanobacteria counts (shown in red) and microcystin concentrations (shown in blue) in 2021 and 2022 were all below the applicable guidelines at all sampling events (**Figure 5-1**). The maximum microcystin concentration from

2021 to 2022 was 4 micrograms per litre which is much lower than the guideline of 20 micrograms per litre. The maximum cyanobacterial cell count was approximately 85,000 which well below the guideline of 100,000. Prior to 2021, cyanobacterial cell counts had exceeded the guideline several times but microcystin has been consistently below the guideline.

The dominant cyanobacteria types were *Aphanizomenon* in 2021 and *Dolichospermum* and *Microcystis* in 2022. All these taxa are known toxin-producers.

Figure 5-1
Cyanobacteria and Microcystin in Wizard Lake 2014 – 2022



6 SUMMARY AND RECOMMENDATIONS

6.1 Tributary Monitoring

In spring 2022, the concentrations of all water quality parameters in the tributaries were quite low compared to the data from 2007, 2011, and 2018. The spring 2022 concentrations were most like those in 2010, which were also very low, and potentially related to a very gradual spring melt with no flow peak and therefore less watershed erosion. These results indicate that in 2010 and 2022, the tributaries potentially added a smaller amount of bacteria and nutrients to Wizard Lake, indicating that water quality influence from tributaries on the lake varies among seasons.

The WLWLSA continues to collect meaningful and high-quality data, and Associated offers the following recommendations for future work that would add additional value to the current set of tributary data:

- Collect another two years of water quality data from all sampling locations to better understand trends over time and various spring melt conditions.

- Consider testing water samples for an additional parameter (ortho-phosphate) which is the more bioavailable form of phosphorus.
- Tributary data showed that the area between the sampling points Tributary A and B was contributing nutrients to Wizard Lake. If certain changes, such as wetland restoration or erosion and sediment control, are made in this area, then WLWLSA should collect additional samples at the same locations after the installation of watershed improvements to track potential improvements in water quality.
- Consider collecting samples for *Enterococcus* during the warmer months (June through September), when people are more likely to be swimming in the water and would therefore be exposed to fecal contamination.

6.2 Winter LakeKeeper's Data

An algal bloom was detected under ice in Wizard Lake that began in February 2022 with cell counts as high as the summer of 2020. Increasing phosphorus concentrations throughout the winter suggest that a phosphorus release from sediments occurred in the east basin. This release of phosphorus was likely related to the observed low oxygen levels near the bottom of the lake and may have contributed to the observed high algae abundance. The dissolved oxygen levels in the surface waters of both basins and at the bottom of the shallower west basin met the guidelines, but the levels in bottom waters of the deeper east basin did not.

Since the WLWLSA does not run the Winter LakeKeepers program, Associated recommends sharing the following recommendations with ALMS for further improvements to the program:

- Include an algal speciation test for the last sampling event of the winter to characterize the nature of the algal blooms and evaluate the potential risk of cyanotoxins that result from certain species of algae.
- Include sulphide in the list of parameters tested in the winter because it is often elevated in winter during ice-covered conditions. Sulphide levels above 0.0019 milligrams per litre can affect the health of aquatic life in the lake.

6.3 Algae Data

Alberta Health Services tracks the cyanobacterial (or blue-green algae) cell counts in the water in the east basin. As previously mentioned, cyanobacteria can produce a toxin called microcystin, so Alberta Health Services also tests the water for microcystin levels. Both cyanobacterial cell counts and microcystin levels were lower than the guidelines indicating that the humans and animals visiting Jubilee Beach in 2021 and 2022 were not at risk from blue-green algae.

The dominant cyanobacteria types encountered in Wizard Lake in 2021 and 2022 were all known toxin producers, but their numbers were too low to produce toxin levels of concern. These data, however, demonstrate that the potential for toxic algae blooms in the future cannot be ruled out, if the right conditions occur, such as elevated water temperatures and high nutrient levels. Therefore, any visible blooms should be reported to AHS to trigger beach sampling for cyanobacteria.

CLOSURE

This report was prepared for the Wizard Lake Watershed and Lake Stewardship Association to review the 2022 tributary water quality, algae data and Winter LakeKeepers data for Wizard Lake and to provide recommendations for future work.

The services provided by Associated Environmental Consultants Inc. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Environmental Consultants Inc.

Tracy MacDonald, Ph.D., P.Biol.
Aquatic Toxicologist

Dörte Köster, Ph.D., P.Biol.
Technical Specialist in Limnology

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