

DISTRICT OF LAKELAND #521

**2016 WATER QUALITY PROGRAM
FIELD SAMPLING REPORT**

**Prepared for:
District of Lakeland #521 Council**

**Prepared by:
Wayne Hyde
District of Lakeland #521
Water Quality Monitoring Program**

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1. Executive Summary

This report presents the 2016 results of the District of Lakeland Water Quality Monitoring Program. The field data collected in 2016 was obtained at the Baseline sites established by the Saskatchewan Water Security Agency for a provincial water quality monitoring program that was carried out from 2005 to 2008. The Baseline sites are generally located over deep centrally located spots. The sampling at the Shoreline sites located near beaches were dropped from the program for the time being. It was felt that sufficient data has been collected at these shallow sites at this time.

The original program objectives established in 2010 remained in effect for 2016. The primary program objective was to determine the compliance to the Saskatchewan Surface Water Quality Objectives for Recreation and Aesthetics and for the Protection of Aquatic Life. The secondary program objective was to gather physical and chemical parameter data that could be used for comparisons over time and thus determine any trends.

During the 2016 open water season, three sampling trips were made to Anglin and Emma Lakes and two trips were made to Christopher and McPhee Lakes to collect physical parameter data. During the September visits to all of the lakes a water sample was obtained for analysis by the Saskatchewan Research Council laboratory in Saskatoon.

The 2016 water quality data collected on all four lakes met the provincial objectives for Recreation and Aesthetics and for the Protection of Aquatic Life. The data figures from the one water sample collected for analysis in 2016 on all of the lakes remained fairly consistent with the data collected at all of the sites for the 2005 - 2015 period. The highest variability in the data was seen in the Chlorophyll "a" values for Anglin, Christopher and Emma lakes which showed a significant increase over the last three years but were in the range seen in 2011. The McPhee Lake Chlorophyll "a" level on the other hand were much lower than the 2014 level. Chlorophyll "a" is a measure of the active green pigment in plants and indicates the amount of photosynthesizing plants in a sample which could be either algae or phytoplankton.

A water quality sampling program review was begun in 2015 with the hiring of a University of Saskatchewan grad student supervised by members of the Environmental Advisory Committee. His mandate was to review the data collected over the last few years to determine if enough data has been collected for some parameters and whether or not some parameters should be added or dropped from the program. As well, he was to look into the question of whether or not one mid-lake sampling location per lake is sufficient to give us an indication of lake health. Also included in the review is the question of the value of one bulk water sample analysis per season in the center of each lake is sufficient or should it be expanded and if so to what locations.

Unfortunately the report submitted by the student did not fulfil the project objectives laid out in the contract. This report is currently being reworked.

2. Introduction

The four main lakes within the District, Anglin, Christopher, Emma and McPhee continue to remain one of its most valuable resources and assets. Residents and vacationers to the area continue to enjoy these lakes for a number of reasons but ultimately all are responsible for their overall health and protection.

The monitoring and archiving of various physical, chemical and biological parameters of our lakes is an important element in any area management plan. This data collected over time will be a useful indicator of any changes to the water quality of these lakes. Many factors can change or have an effect on the water quality of a water body and these include precipitation amount and intensity, soil and vegetation types, the geology of the area, groundwater, inflow and human activities. This data being collected through this program will enhance and contribute to the District of Lakeland Environmental Management Plan as well as continuing to populate and increase the data base of water quality data for these lakes.

In 2016, the District received a fewer number of calls regarding the water quality of our lakes but in talking to cottage owners, the concerns that were expressed centered around the water clarity and algae. The water clarity issues raised, especially on Emma Lake, focused primarily on boat activity. There remains a great deal of concern regarding the number of wake boats and size and their travel in shallow areas stirring up lake bottom sediments, weeds and eroding shorelines. The growth of both algae and weeds during mid-summer remained a consistent concern in all of the lakes.

This report details provides the 2016 program delivery and the data collected. The 2016 program continued to enlist a number of volunteers at each of the lakes to provide boat support and transportation to each of the sampling locations. Without this support this program would be considerably more difficult and costly to deliver so special thanks must be extended to the following individuals: Al Christensen from Anglin Lake, Rick Johnson, Wayne Bartel from Christopher Lake and Pauline and Louie Smith from McPhee Lake. All of the sampling on Emma Lake was done by Wayne Hyde who also assembled all of the data and authored this report.

3. Sampling Methods

The YSI ProPlus multimeter was used throughout the 2016 season at all of the sites to collect the physical parameter data. Prior to each of the samplings, all of the probes on the multimeter were calibrated using standard solutions purchased for that purpose. A Secchi Disc was used to collect water clarity data at each of the sampling sites and it was also used to measure the total lake depth at each sampling station. During this season two issues were encountered with the multimeter that resulted in fewer sampling trips. A new pH probe was purchased and installed prior to the sampling season but problems arose in the data collection and as a result the multimeter had to be returned to the supplier to diagnose and correct the problem. Just after its return the probes began ending

intermittent data and the multimeter was returned once more to the supplier and it was determined that the probe cable had to be replaced due to a wire break.

The water samples collected once per year at the Baseline stations on each of the lakes was a grab sample taken one meter below the surface. The samples that required preservation for shipping were treated immediately upon their collection and all of the sample bottles were sealed in a shipping cooler packed with ice packs. All of the samples were shipped to the Saskatchewan Research Council laboratory in Saskatoon the same day as they were collected via Saskatchewan Transportation Company buses and were received in the lab the next morning. The results from the analysis were generally received within ten days of the sampling date.

4. Sampling Stations

There were no changes made to the location of the sampling sites. The sites were established by the Saskatchewan Water Security Agency for their water quality sampling program carried out during the period 2005 - 2008.

5. Physical Parameter Sampling Methodology

Depth profiles were obtained during each visit to all of the sites on conductivity, dissolved oxygen, pH and water temperature. Each of these physical parameters can provide an indication of the lake health. This data also provides us with information on lake overturn or stratification, lake bottom decomposition, productivity and acidity. The depth profile data was logged at each location by a YSI ProPlus multi-meter with the first reading taken just below the lake surface. Additional measurements were obtained at one meter intervals for stations with total depths over three meters. If the total station depth was under three meters, the sampling interval was reduced to one half meter. The data was also recorded manually on field sheets to provide a backup. The field sheets were also used to record the lake depth, Secchi depth, field party as well as general observations of the meteorological and lake conditions.

Following each of the field sampling trips, the data captured by the multi-meter was downloaded to a PC and then copied into Excel spread sheets. These physical parameter results are found at the end of this report and are labelled Tables 1 through 5. The laboratory results on the samples analyzed by the Saskatchewan Research Council were also put into Excel spreadsheets and these results are also found at the end of the report and are labelled Tables 6 through 10.

6. Water Chemistry Results

In 2016 one water sample was collected at each of the Baseline stations on Anglin, Christopher, Emma and McPhee Lakes. Each lake has one Baseline station except for Emma Lake which has two, one on each of the first two lakes. The samples obtained for analysis in 2016 were taken by plunging a sampling bottle attached to a depth of one meter below the water surface. The Saskatchewan Water Security Agency indicated that taking the sample in this manner was acceptable. They did not see the need to obtain a depth integrated or near bottom water sample as they had not detected a significant difference between those methods when they carried out their program. They also indicated that a water sample obtained once a year and analyzed for general chemistry and nutrients would be sufficient for long term monitoring of the health of the four lakes.

All of the sample water collected was put into sample bottles provided by the Saskatchewan Research Council laboratory in Saskatoon and preservatives were added where required as per their instructions. All of the samples were packed in coolers with ice packs supplied by the laboratory and were shipped from Christopher Lake via Saskatchewan Transportation bus. All of the samples were shipped the same day as they were collected and were received by the laboratory no later than the morning of the next day.

The parameters that were analyzed for in 2012 were maintained for the 2016 analysis. On the recommendation of the Saskatchewan Water Security Agency and the National Hydrological Research Institute, additional parameters were added to the analysis list beginning in 2012. The parameters added were dissolved phosphorus, ammonia as nitrogen, nitrite and nitrate as nitrogen, ortho-phosphate phosphorus, organic carbon, dissolved organic carbon, chlorophyll b and chlorophyll c. It was thought that these additional parameters, to analyze for nutrients, would give us data that was more in line with other lake health monitoring projects.

The water chemistry analysis data for Anglin, Christopher, Emma and McPhee lakes is found in Tables 6 - 10. The first page of each of the water chemistry data tables has the results of the Saskatchewan Watershed Authority study carried out from 2005 to 2008. The second page of each of the tables contains the results of the District of Lakeland sampling program from 2011 to 2016 which enables data comparison.

During the 2016 season weed growth along a number of shorelines on Emma and Anglin Lake was a concern raised by many cottage owners. Some of the shallow bays on Emma Lake experienced very intensive and highly visible weed beds emerging to the surface. As well, a number of localized algal blooms were noted and these can be influenced by weather conditions such as a wet cycle combined with summer sun and winds along with the presence of natural occurring nutrients in the water. Algal and weed growths can vary considerably with depth. In shallower depths, sunlight penetrates further into the water column promoting increased photosynthesis and higher algal, phytoplankton and weed growth and as they naturally die off additional nutrients are produced to further enhance this cycle. As the days of summer advance and there is more sunlight and warmer temperatures one can observe the water clarity drop as these growths increase. This fact can be observed in the Secchi Disc readings as they drop off over the summer and then generally increase again in the fall as the algae, weeds and nutrient levels drop off along with the air and water temperatures. However with cooler fall weather often there is an increase in winds which may stir up sediments in shallower areas which can offset the reduction in algae. Further complicating this scenario is lake turn as the surface waters cool and the summer temperature stratification weakens and a mixing occurs releasing bottom nutrients which may promote a fall algal bloom.

The measure of Turbidity is widely used as a measurement to indicate the clarity of water. In general most people prefer water that is clear for recreational activities and link the quality of water with its clarity. The turbidity data measured on all four lakes in 2015 was found to be well below the Saskatchewan Surface Water Quality Objective of 50 Nephelometric Turbidity Units for Recreation and Aesthetics. All of the lakes with the exception of McPhee Lake had a turbidity level lower or consistent with previous years data. The McPhee Lake turbidity level was the second highest measured over the last six years but the reason for this increase is unknown. Turbidity in general is often used to describe the optical clarity of water and recreation users prefer waters that have high clarity or are clear. Turbidity is caused by particles, organic matter and microscopic organisms suspended in the water. Turbidity levels are affected by weather events such as wind, runoff from precipitation, water movement from boat activity and particles produced within the lake such as phytoplankton.

The measurement of the amount of algae in lakes can be done simply and inexpensively with Secchi disc readings or by measuring Chlorophyll-a. Chlorophyll-a is the pigment that makes plants and algae green and allows them to photosynthesis. This measurement can be used to estimate the amount of algal biomass present in the water. The September Secchi disc readings at the Emma Lake Baseline 1 station and at McPhee Lake both approached the provincial water quality objective of 1.2 meters. The Chlorophyll-a readings at both of these sites also were much higher than measured in previous years and visibly there was a considerable amount of material present in the water.

7. Conclusion

The District of Lakeland Water Quality Program will be continued in 2017 to collect baseline data which can be used in data comparisons to determine if there are any lake changes occurring. During the summer of 2015, a University of Saskatchewan graduate student was employed by the District of Lakeland to perform a review of the water quality data on the lakes to see if any trends in the measured parameters was evident. The review was also to examine the parameters being measured along with the sampling sites and recommend potential changes to both. This review and the report generated from it will be reviewed in 2017 with respect to recommendations regarding any program adjustments or changes.

The program will employ the same sampling procedures used in 2016. Efforts will be made to increase the number of physical parameter samples collected wherever possible. At the recommendation of the Saskatchewan Water Security Agency, an effort will be made to obtain more frequent Secchi Disc readings on the four lakes. Although such readings can be highly variable throughout the open water season, it is a good measure of the water transparency and is an indicator of turbidity and productivity in a lake.

The watch for extensive algae growth will continue and will be noted. Scientists find it extremely difficult to identify what causes algae growths in different locations and why they may be abundant one year and not the next. Therefore, this program can only make note of potentially strong influencing factors such as weather events and human activity. Increased nutrient levels, especially phosphorus, nitrate and ammonia, will be watched as they can cause an increase in algal blooms and decreased water clarity. Although they are essential for the health of all organisms, excessive levels can lead to poor water quality. Nutrients can come from natural geological sources, releases from lake bottom sediments or a variety of human activities. As these lakes have no industrial or farm effluents entering them, it is really up to the residents and visitors to our lakes to be the guardians and protectors of these valuable resources. Some of the potential sources of human influences are septic tank leaks, grey water discharges, fertilizer runoff and soil erosion from land clearing or construction on or in the area of the water body.

With the dissolution of provincial bus system, Saskatchewan Transportation Company, an alternative and possibly more costly avenue will be required to get the annual water samples to the lab in Saskatoon. The program utilizes a number of volunteers to provide transportation by boat to the sampling sites other than on Emma Lake and this approach will be employed in 2017. A log of the time involved to run this program in 2016 is included as Table #11 in this report.

8. References

Saskatchewan Environment, 2006. **Surface Water Quality Objectives, Interim Edition, EPB 356**

Science, Information and Monitoring Branch Stewardship Division, 2009. **Anglin, Emma and Christopher Lakes-Water Quality Report for 2005-2008**

Crosby Hanna & Associates, 2005. **District of Lakeland #521 Municipal Planning Program Background Report**

Lake Monitoring Field Manual – Inland Lakes Manual.pdf.

<http://www.glsc.usgs.gov/files/research>