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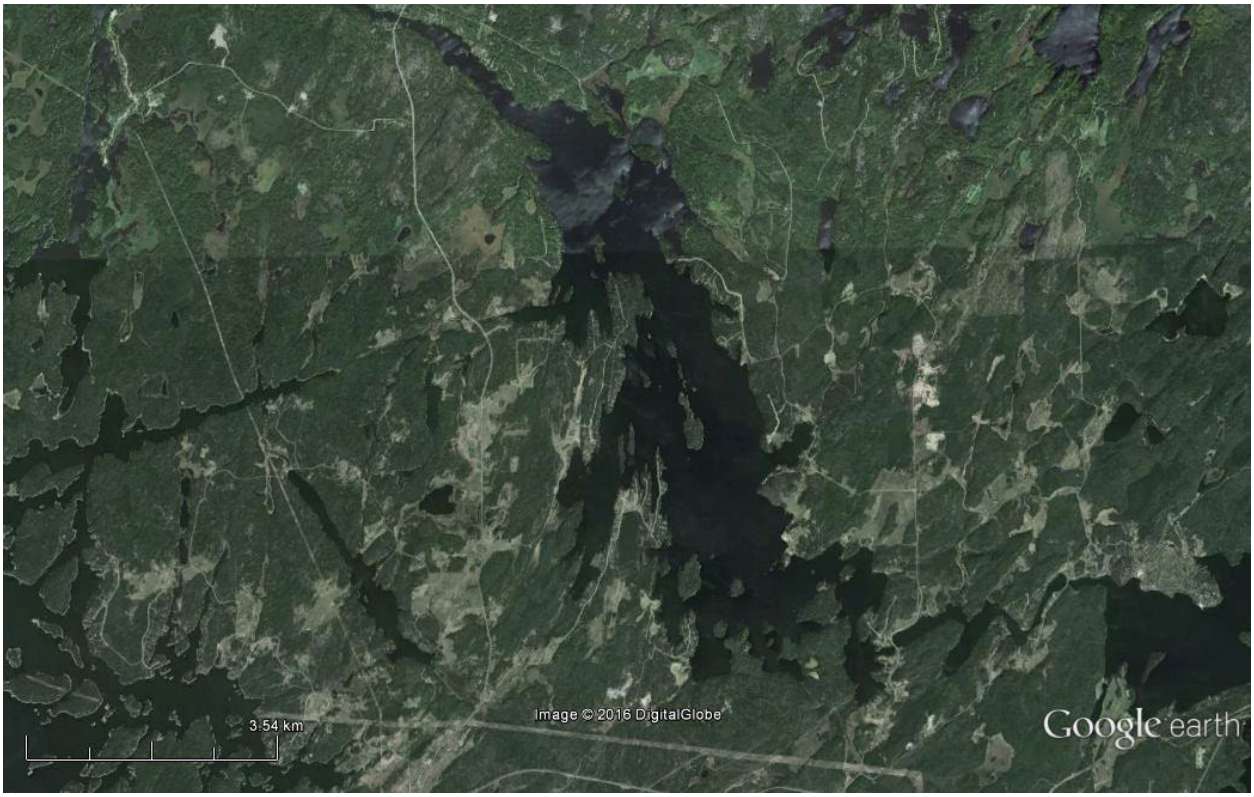


# BLACK STURGEON LAKES WATER QUALITY MONITORING

## 2020 REPORT

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# 1.0 BACKGROUND

In the fall of 2007, the City of Kenora was presented with the results of the *Lake Capacity and Management Study for Black Sturgeon Lake*. One of the recommendations of this study was to conduct a water quality assessment on Lower Black Sturgeon Lake for two consecutive years to establish baseline data and then once every five years to monitor changes to the water quality in the lake. Based on the results of the 2009, 2010, and 2015 sampling seasons, it was recommended by the consultant (Kenora Resource Consultants Inc.) that annual sampling focussing on one spring sampling session and one late summer sampling session would provide a more effective monitoring program than the original project design of 10 sampling sessions conducted every five years.

In 2009 and 2010, the City of Kenora awarded the contract to conduct the baseline data work for the first two-years of water quality monitoring on Black Sturgeon Lakes to Ryan Haines Consulting. From 2015 to 2020, the water quality assessment contract was awarded annually to Kenora Resource Consultants Inc. (note – Ryan Haines Consulting was incorporated into Kenora Resource Consultants Inc. in 2012).

The summer of 2020 was characterized by low water levels throughout the region with no significant rain events. There was a major rain event on September 17th, 2019 that significantly raised the water levels of Black Sturgeon Lakes into the late fall and winter.

# 2.0 METHODOLOGY

Two sampling sessions were conducted during the 2020 season, a spring session on May 19th and a late summer session on August 12th. Water samples were taken at two locations on Lower Black Sturgeon Lake and one location at Upper Black Sturgeon during each sampling session. Sample locations on Lower Black Sturgeon correspond to sites identified in the *Lake Capacity and Management Study for Black Sturgeon Lake*. A site on the western end of Upper Black Sturgeon Lake was added during the 2010 sampling season to help to better understand potential sources of the higher nutrient levels found at the upstream site on Lower Black Sturgeon during the 2009 sampling season.

The selection of the site locations has been designed to determine the impacts of development on the water quality of Black Sturgeon Lakes. Site 2 is located at the outlet of Black Sturgeon Lakes into the Winnipeg River, Site 3 is located at inlet of Black Sturgeon Creek into Lower Black Sturgeon Lake, and Site 4 is located at the outlet of Upper Black Sturgeon Lake (Figure 1) into Black Sturgeon Creek. Site 2 is the main sampling location used to assess the impacts of development on water quality because the new and proposed developments on Lower Black Sturgeon Lake are occurring upstream of this site.

All field work was conducted from a small motorboat with a sonar unit mounted to the stern. At each sampling site, an anchor was used to keep the boat in one location.

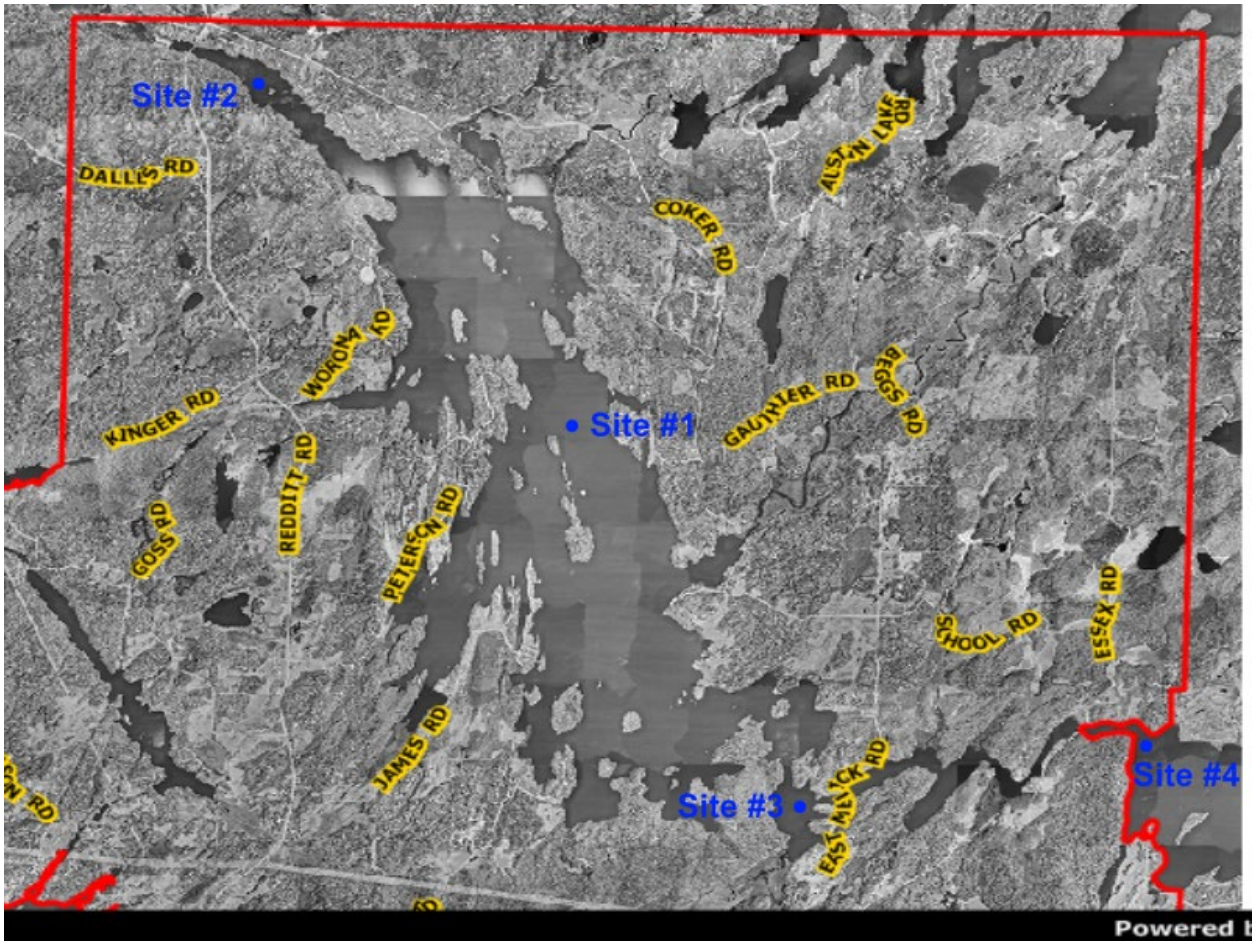



Figure 1 – Sampling Sites for Water Quality Monitoring on Black Sturgeon Lakes for 2019 sampling season

## 2.1 Spring Sampling

During the spring sampling session, the focus was on the euphotic zone (surface water) sampling to capture spring turnover or mixing of the lake. The spring field work consisted of recording Secchi depths and collecting euphotic zone composites at sites #2, #3, and #4. During the 2020 field season, spring euphotic zone composite samples were also collected from site #1 as well as the middle of the basin of Upper Black Sturgeon Lake for submission to the Ministry of the Environment, Conservation, and Parks (MECP) laboratory in Dorset as part of the Lake Partner Program. Results from the Lake Partner Program were not available when this report was submitted and will be provided in an addendum at a future date.

Secchi depth was determined at each site by lowering a Secchi disk (20-cm disk with alternating black and white quadrants) over the shady side of the boat (Figure 2). The disk was lowered until the observer could no longer distinguish between the white and black quadrants and then raised until the disk came back into view. This was repeated three times and then the depths at which the disk disappeared and then reappeared were averaged to give the Secchi depth.

Figure 2 – Lowering of Secchi disk

The euphotic zone is the section of the water column where enough light penetrates to facilitate algae growth (measured as 2X the Secchi depth). In order to obtain a water sample containing water from the euphotic zone, a weighted, 500 mL, small neck bottle (Figure 3) was lowered with a rope in the water column to a depth of 2X Secchi depth then quickly brought to the surface before the bottle became completely filled. For the two Lake Partner Program sampling sites, the water was filtered with an 80-micron filter as it was poured into the sampling bottles.

Figure 3 – Transferring water sample from euphotic zone composite into lab sample bottle

## 2.2 Late Summer Sampling

Late summer sampling included all of the field work conducted during the spring (Secchi depths and euphotic zone composite water sampling), but with the addition of temperature/oxygen profiles and lower water column samples to measure the impacts of the summer thermal stratification and oxygen depletion on water quality.

Temperature/oxygen profiles were obtained at Sites #1, #2, #3, and #4 during the late summer sampling session using a YSI 55 Dissolved Oxygen Meter.

During the later summer sampling session, an additional water sample was taken at sites #2, #3, and #4 approximately one meter from the bottom of the lake using a Beta horizontal water sampler (Figure 4). Both ends of the water sampler were opened prior to lowering it (using a rope) to the desired water depth. At the desired depth, a small weight was sent down through the water column along the length of the rope triggering a release mechanism on the sampler and causing the sampler caps to close.

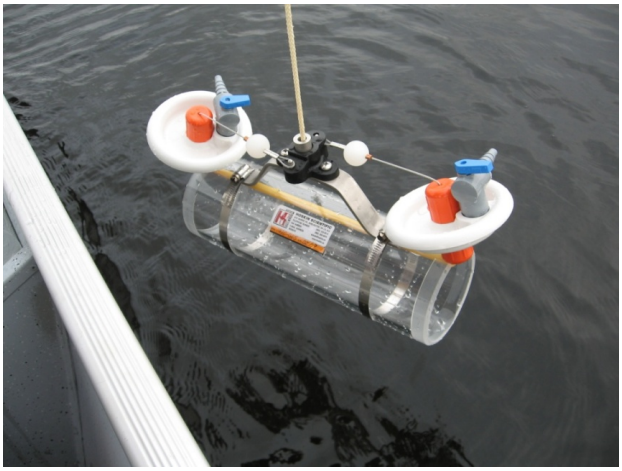


Figure 4 – Horizontal Beta Sampler prior to deployment

All water samples collected were transferred immediately upon collection to sample bottles for analysis at a laboratory. Samples were delivered by vehicle to the ALS Laboratory Group in Winnipeg, MB, for analyses.

# 3.0 RESULTS

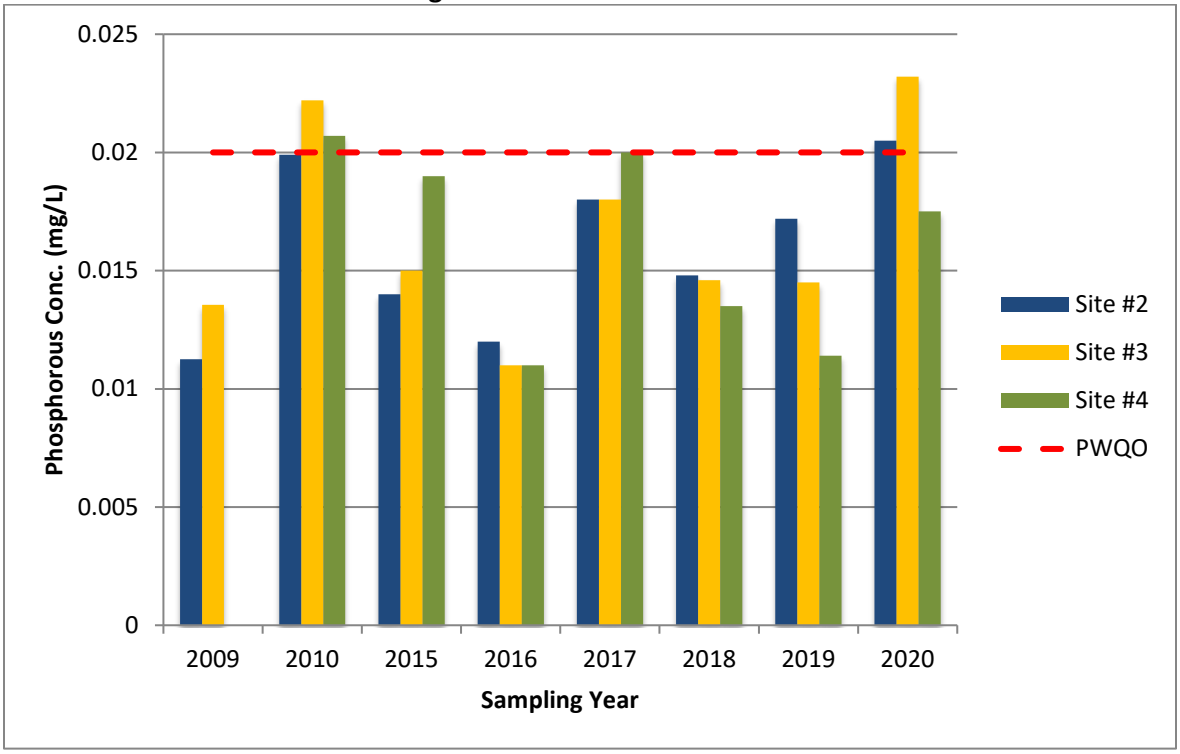
## 3.1 Sampling Session Dates and Locations

The 2020 sampling sessions were conducted on May 19th and August 12th. The depth of the sampling sites was 26.7 m for Site 1, 16.6 m for Site 2, 9.8 m for Site 3, and 6.4 m for Site 4.

## 3.2 Total Phosphorous

During 2020, the spring turnover euphotic zone phosphorous concentrations taken at Site 2 (0.0205 mg/L) and Site 3 (0.0232 mg/L) were above the provincial water quality objective (PWQO) of 0.0200 mg/L. The phosphorous concentration at Site 4 (0.0175 mg/L) was below the provincial water quality objective (PWQO) of 0.0200 mg/L. The phosphorous concentrations found at site #3 (inlet to Lower Black Sturgeon Lakes) and site #2 (the outlet of Black Sturgeon Lakes) in 2020 were the highest found since sampling began in 2009 (Figure 5).

**Figure 5 – Spring Turnover Total Phosphorous Concentrations for Three Sampling Sites on Black Sturgeon Lakes from 2009 to 2020.**




### 3.3 Chemical Analyses - Water Quality Characteristics

The spring turnover water samples were analyzed for 54 parameters encompassing dissolved organic carbon, colour, pH, alkalinity, turbidity and scans for cations/anions and trace metals. The 2020 results for Site 2 (outlet of Black Sturgeon Lakes and downstream of new development activities) were comparable to the results for the 2010, 2015, 2016, 2017, 2018, and 2019 analyses and were all within the provincial water quality objectives (PWQO) for the parameters where an objective is provided. The full results can be found in Appendix 1. The results at Site #2 in 2020 were the highest to date for several parameters including pH (7.58 pH units), lead (0.000626 mg/L), sodium (3.48 mg/L), molybdenum (0.000079 mg/L), vanadium (0.00059 mg/L), zinc (0.0065 mg/L), total organic carbon (8.41 mg/L), and hardness (20.3 mg/L). The concentrations at Site #3 were higher than those found at Site #2 for both sodium (4.24 mg/L) and hardness (21.1 mg/L).

## 4.0 DISCUSSION

### 4.1 Total Phosphorous

The total phosphorous readings that are of the most interest for water quality analyses are the ones taken during spring turnover. The reason for this is that turnover is when the phosphorous is mixed throughout the water column and provides an indication of overall phosphorous concentrations in the waterbody. Spring turnover is also when past phosphorous concentrations (i.e. Lake Partner Program)

have been measured, which enable analysis of trends over time using a larger database over a longer time period.

The Ontario provincial water quality objective for total phosphorous concentrations is less than 20 µg/L (0.02 mg/L) "to avoid nuisance concentrations of algae in lakes" (MOE 1994). The 2020 spring sampling results for phosphorous concentrations were above the provincial water quality objective (PWQO) of 0.0200 mg/L for Site 2 (0.0205 mg/L) and Site #3 (0.0232 mg/L), but below for Site #4 (0.0175 mg/L). The phosphorous concentrations for both site #2 and site #3 were the highest levels for each of these sites in the data collected since 2009.

The third sampling site on Upper Black Sturgeon Lake (site #4) was added for the 2010 and subsequent sampling seasons to help determine the potential source of higher levels of phosphorous found at the inlet of Black Sturgeon Lake (site #3) when compared to the outlet (site #2). During the 2020 sampling season, it was found that Lower Black Sturgeon had greater concentrations of phosphorous entering the water body at site #3 than leaving it at site #2. In addition, the outlet of Upper Black Sturgeon Lake at site #4 had the lowest phosphorous concentration result of the three sites in 2020 and was well below the PWQO (Figure 5). This indicates that there was a significant source of phosphorous in the wetland area between Upper and Lower Black Sturgeon Lakes and that this input of phosphorous may have been caused by the late fall flooding that occurred in 2019. This is consistent with research that indicates that wetlands can be sources of phosphorous or sinks (removing phosphorous from circulation) depending on the retention time of surface water and timing of precipitation events (Riemersma et al. 2006). The data shown in Figure 5 indicates that the wetland area between Upper and Lower Black Sturgeon Lakes was acting as a sink (phosphorous concentrations are higher at the outlet of Upper Black Sturgeon Lake (site #4) when compared to the inlet of Lower Black Sturgeon Lake (site #3)) in 2015 and 2017, as a source (phosphorous concentrations are lower at the outlet of Upper Black Sturgeon Lake (site #4) when compared to the inlet of Lower Black Sturgeon Lake (site #3)) in 2010, 2018. 2019, and 2020, and had a neutral balance in 2016.

## 5.0 SUMMARY AND RECOMMENDATIONS

The higher phosphorous levels at site #3 (inlet of Lower Black Sturgeon Lake) when compared to the levels at site #2 (outlet of Lower Black Sturgeon Lake) do not provide any evidence that the elevated levels of phosphorous in the waterbody are due to anthropogenic inputs from development activities in the area. Indications are that the major rainfall event(s) in the fall of 2019 and subsequent flooding of the waterbody resulted in the wetland area between Upper and Lower Black Sturgeon Lakes acting as a phosphorous source in the spring of 2020. However, phosphorous concentrations of more than 0.02 mg/L, if they persist, may result in algal blooms on Lower Black Sturgeon Lake which could impact upon the human enjoyment of the waterbody. For this reason, future years' sampling results should be monitored closely to determine whether these elevated levels are due to an isolated environmental event or are part of a long-term trend.

The 2020 site #2 sampling results for the additional water quality parameters (excluding phosphorous) were all within the provincial water quality objectives (PWQO) for the parameters where an objective is

provided. However, the highest results to date were found for pH, lead, sodium, molybdenum, vanadium, zinc, total organic carbon, and hardness. Much like for the elevated 2020 phosphorous results this may be due to the major flood event in the fall of 2019, but future years' sampling results should be monitored closely to determine whether these elevated levels are due to an isolated environmental event or are part of a long-term trend.

## 6.0 REFERENCES


Gartner Lee Ltd. and Kelli Saunders Environmental Management. October 2007. *Lake Capacity and Management Study for Black Sturgeon Lake, City of Kenora*.

Ministry of the Environment. 2015a. Lake Partner Total Phosphorous Data. Found on website at: http://desc.ca/programs/lpp

Ministry of the Environment. 2015b. Lake Partner Secchi Depth Data. Found on website at: http://desc.ca/programs/lpp

Ministry of Environment and Energy. July 1994. *Water Management: Policies; Guidelines; Provincial Water Quality Objectives of the Ministry of Environment and Energy.* Found on website at: http://www.ontario.ca/document/water-management-policies-guidelines-provincial-water-quality-objectives

Riemersma, S., Little, J., Ontkean, G., and Moskal-Hébert, T. 2006. Phosphorus sources and sinks in watersheds: A review. 82 pp. In Alberta Soil Phosphorus Limits Project. Volume 5: Background information and reviews. Alberta Agriculture, Food and Rural Development, Lethbridge, Alberta, Canada

# APPENDIX 1 – 2010 TO 2020 LABORATORY RESULTS FOR WATER QUALITY CHARACTERISTICS – SITE 2 (OUTLET OF LOWER BLACK STURGEON LAKE)

| Parameter | 2010 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Unit | PWQO |
|---|---|---|---|---|---|---|---|---|---|
| Alkalinity, Bicarbonate (HCO3) | 21.3 | 16.8 | 26.5 | 21.2 | 20.5 | 24.4 | 24 | mg/L | |
| Alkalinity, Carbonate (CO3) | < | < | < | < | < | < | | mg/L | |
| Alkalinity, Hydroxide (OH) | < | < | < | < | < | < | | mg/L | |
| Total Alkalinity (CaCO3) | 17.5 | 16.8 | 21.7 | 17.4 | 16.8 | 20 | 19.7 | mg/L | |
| Chloride (Cl) | < | 3.76 | 4.16 | 3.86 | 3.83 | 4.35 | 4.09 | mg/L | |
| Fluoride (F) | 0.15 | 0.037 | 0.044 | 0.045 | 0.042 | 0.043 | 0.040 | mg/L | |
| Sulphate (SO4) | < | 1.93 | 1.97 | 1.81 | 1.58 | 2.34 | 1.61 | mg/L | |
| Colour, True | 20 | 18 | 24.2 | 30.1 | 29 | 19.7 | 26.5 | CU | |
| Dissolved Organic Carbon | 8.7 | 7.5 | 7.78 | 8.14 | 8.84 | 7.73 | 8.17 | mg/L | |
| Turbidity | 1.2 | 1.1 | 1.31 | 1.34 | 1.28 | 1.81 | 1.35 | NTU | |
| pH | 7.3 | 7.44 | 6.78 | 7.11 | 7.44 | 7.3 | 7.58 | pH units | 6.5 - 8.5 |
| Aluminum (Al)-Total | 0.044 | 0.0513 | 0.0655 | 0.0641 | 0.0452 | 0.0489 | 0.0591 | mg/L | 0.075 |
| Antimony (Sb)-Total | < | < | < | < | < | <0.00010 | <0.00010 | mg/L | 0.02 |
| Arsenic (As)-Total | < | 0.00032 | 0.003 | 0.00037 | 0.00036 | 0.00042 | 0.00038 | mg/L | 0.005 |
| Barium (Ba)-Total | 0.00832 | 0.00845 | 0.00822 | 0.00808 | 0.00764 | 0.00821 | 0.00780 | mg/L | n/a |
| Beryllium (Be)-Total | < | < | < | < | < | <0.00010 | <0.00010 | mg/L | 0.011 |
| Bismuth (Bi)-Total | < | < | < | < | < | <0.000050 | <0.000050 | mg/L | n/a |
| Boron (B)-Total | < | < | < | < | < | <0.010 | <0.010 | mg/L | 0.2 |
| Cadmium (Cd)-Total | < | < | < | < | < | <0.0000050 | <0.0000050 | mg/L | 0.0001 |
| Calcium (Ca)-Total | 5.05 | 5.77 | 5.25 | 5 | 4.85 | 5.01 | 5.12 | mg/L | n/a |
| Cesium (Cs)-Total | < | < | < | < | < | <0.000010 | <0.000010 | mg/L | n/a |
| Chromium (Cr)-Total | < | < | < | < | 0.00023 | 0.00018 | 0.00021 | mg/L | 0.001 |
| Cobalt (Co)-Total | < | < | < | < | < | <0.00010 | <0.00010 | mg/L | 0.0009 |

| Parameter | 2010 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Unit | PWQO |
|---|---|---|---|---|---|---|---|---|---|
| Copper (Cu)-Total | 0.00073 | 0.00087 | 0.00062 | 0.00116 | 0.00088 | 0.00078 | 0.00081 | mg/L | 0.001 |
| Iron (Fe)-Total | 0.065 | < | 0.111 | 0.119 | 0.097 | 0.097 | 0.104 | mg/L | 0.3 |
| Lead (Pb)-Total | < | 0.0001 | < | < | < | 0.000050 | 0.000626 | mg/L | 0.001 |
| Lithium (Li)-Total | n/a | < | < | < | 0.0013 | 0.0012 | 0.0013 | mg/L | n/a |
| Magnesium (Mg)-Total | 1.5 | 1.79 | 1.61 | 1.62 | 1.63 | 1.82 | 1.82 | mg/L | n/a |
| Manganese (Mn)-Total | 0.00496 | 0.00529 | 0.0151 | 0.0127 | 0.00929 | 0.0113 | 0.00859 | mg/L | n/a |
| Molybdenum (Mo)-Total | < | < | < | < | 0.000066 | <0.000050 | 0.000079 | mg/L | 0.04 |
| Nickel (Ni)-Total | 0.00048 | < | < | < | 0.00065 | 0.00057 | 0.00061 | mg/L | 0.025 |
| Phosphorus (P)-Total | 0.0157 | 0.014 | 0.012 | 0.018 | 0.0148 | 0.0172 | 0.0205 | mg/L | 0.02 |
| Potassium (K)-Total | 0.954 | 1.08 | 0.995 | 1.02 | 0.968 | 0.980 | 1.02 | mg/L | n/a |
| Rubidium (Rb)-Total | 0.00161 | 0.00202 | 0.00193 | 0.00198 | 0.00194 | 0.00189 | 0.00194 | mg/L | n/a |
| Selenium (Se)-Total | < | < | < | < | 0.000131 | 0.000116 | 0.000090 | mg/L | 0.1 |
| Silicon (Si)-Total | 1.16 | 0.88 | 1.07 | 1.43 | 0.7 | 0.80 | 1.31 | mg/L | n/a |
| Silver (Ag)-Total | < | < | < | < | < | <0.000010 | <0.000010 | mg/L | 0.0001 |
| Sodium (Na)-Total | 2.53 | 3.25 | 3.07 | 3.04 | 3.1 | 3.27 | 3.48 | mg/L | n/a |
| Strontium (Sr)-Total | 0.0219 | 0.0239 | 0.023 | 0.0244 | 0.0234 | 0.0231 | 0.0240 | mg/L | n/a |
| Tellurium (Te)-Total | < | < | < | < | < | <0.00020 | <0.00020 | mg/L | n/a |
| Thallium (Tl)-Total | < | < | < | < | < | <0.000010 | <0.000010 | mg/L | 0.0003 |
| Thorium (Th)-Total | n/a | < | < | < | < | <0.00010 | <0.00010 | mg/L | n/a |
| Tin (Sn)-Total | < | < | < | < | < | <0.00010 | <0.00010 | mg/L | n/a |
| Titanium (Ti)-Total | 0.00094 | 0.00124 | 0.00162 | 0.00136 | 0.00099 | 0.00091 | 0.00110 | mg/L | n/a |
| Tungsten (W)-Total | < | < | < | < | < | <0.00010 | <0.00010 | mg/L | 0.03 |
| Uranium (U)-Total | < | < | < | < | 0.000089 | 0.000072 | 0.000087 | mg/L | 0.005 |
| Vanadium (V)-Total | < | 0.0002 | 0.00022 | 0.00023 | < | <0.00050 | 0.00059 | mg/L | 0.006 |
| Zinc (Zn)-Total | < | < | < | < | < | <0.0030 | 0.0065 | mg/L | 0.03 |
| Zirconium (Zr)-Total | < | < | < | < | 0.000122 | 0.000060 | <0.00020 | mg/L | 0.004 |
| Nitrate | n/a | < | 0.049 | 0.0623 | < | 0.0276 | <0.0050 | mg/L | |
| Nitrate + Nitrite | 0.057 | < | n/a | < | < | < | | mg/L | |

| Parameter | 2010 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Unit | PWQO |
|---|---|---|---|---|---|---|---|---|---|
| Nitrite | n/a | < | < | < | < | < | <0.0010 | mg/L | |
| Total Kjeldahl Nitrogen | n/a | 0.37 | 0.35 | 0.38 | 0.29 | 0.58 | 0.42 | mg/L | |
| Total Nitrogen Calculated | n/a | 0.37 | n/a | 0.38 | 0.29 | 0.58 | 0.42 | mg/L | |
| Total Organic Carbon | | | 8.14 | 7.84 | 8.11 | 7.57 | 8.41 | mg/L | |
| Phosphorus (P)-Total | 0.0157 | 0.014 | 0.012 | 0.018 | 0.0148 | 0.0172 | 0.0205 | mg/L | 0.02 |
| UV Transmittance | | | 58.6 | 55.1 | 54.7 | 60.3 | 56.0 | % T | |
| Total Dissolved Solids | | | 52 | 42.6 | 45.3 | 39 | 40.9 | mg/L | |
| Langelier Index 4C | | | -2.7 | -2.5 | -2.2 | -2.2 | -2 | | |
| Langelier Index 60C | | | -1.9 | -1.7 | -1.4 | -1.5 | -1.2 | | |
| Hardness Calculated | 18.8 | | 19.7 | 19.2 | 18.9 | 20 | 20.3 | mg/L | |
| Conductivity | 52.6 | | 57.3 | 56.4 | 53.2 | 54.6 | 53.9 | umhos/cm | |
| Bromide in Water by IC | | | <0.10 | | < | < | <0.010 | mg/L | |

< - concentrations are below the laboratory detection limit
PWQO – Provincial Water Quality Objective

# APPENDIX 2 – DISSOLVED OXYGEN/TEMPERATURE PROFILE RESULTS AND SECCHI DEPTHS FOR 2020 LATE SUMMER SAMPLING SESSION

**Site 1**

| Secchi Depth (m) | B.P. (mmHg) | Time | Depth (m) |
|---|---|---|---|
| 3.0 | 751.3 | | 26.7 |

| Depth | Temp | DO (%) | DO (mg/L) |
|---|---|---|---|
| 0.5 | 22.4 | 93.3 | 8.10 |
| 1 | 22.3 | 92.7 | 8.07 |
| 2 | 22.1 | 91.5 | 8.00 |
| 3 | 22.0 | 90.4 | 7.90 |
| 4 | 21.9 | 89.4 | 7.83 |
| 5 | 21.9 | 89.0 | 7.79 |
| 6 | 21.8 | 88.2 | 7.75 |
| 7 | 21.7 | 85.6 | 7.50 |
| 8 | 19.7 | 62.6 | 5.72 |
| 9 | 14.1 | 43.7 | 4.56 |
| 10 | 11.5 | 46.6 | 5.05 |
| 11 | 11.1 | 46.8 | 5.16 |
| 12 | 9.7 | 46.0 | 5.51 |
| 13 | 8.9 | 48.0 | 5.62 |
| 14 | 8.1 | 47.2 | 5.58 |
| 15 | 7.9 | 47.0 | 5.59 |
| 16 | 7.4 | 46.6 | 5.59 |
| 17 | 7.3 | 46.7 | 5.58 |
| 18 | 7.2 | 45.9 | 5.59 |
| 19 | 7.1 | 45.3 | 5.51 |
| 20 | 7.0 | 44.8 | 5.43 |
| 21 | 6.9 | 44.4 | 5.37 |
| 22 | 6.9 | 43.9 | 5.34 |
| 23 | 6.8 | 43.2 | 5.26 |
| 24 | 6.8 | 42.6 | 5.18 |
| 25 | 6.7 | 41.0 | 5.00 |
| 26 | 6.7 | 40.5 | 4.87 |

**Site 2**

| Secchi Depth (m) | B.P. (mmHg) | Time | Depth (m) |
|---|---|---|---|
| 3.5 | 750.8 | 09:34 | 16.6 |

| Depth | Temp | DO (%) | DO (mg/L) |
|---|---|---|---|
| 0.5 | 22.0 | 89.3 | 7.79 |
| 1 | 22.0 | 89.1 | 7.78 |
| 2 | 22.0 | 88.4 | 7.73 |
| 3 | 22.0 | 88.2 | 7.73 |
| 4 | 22.0 | 88.2 | 7.68 |
| 5 | 22.0 | 87.8 | 7.69 |
| 6 | 22.0 | 87.3 | 7.60 |
| 7 | 21.6 | 78.2 | 6.89 |
| 8 | 19.1 | 61.9 | 5.73 |
| 9 | 14.4 | 51.9 | 5.25 |
| 10 | 11.2 | 46.9 | 5.08 |
| 11 | 10.3 | 45.3 | 5.08 |
| 12 | 9.6 | 44.5 | 5.08 |
| 13 | 9.2 | 43.7 | 5.03 |
| 14 | 9.0 | 43.3 | 5.00 |
| 15 | 8.8 | 42.5 | 4.90 |
| 16 | 8.7 | 41.4 | 4.82 |

**Site 3**

| Secchi Depth (m) | B.P. (mmHg) | Time | Depth (m) |
|---|---|---|---|
| 3.5 | 750.6 | 10:25 | 9.8 |

| Depth | Temp | DO (%) | DO (mg/L) |
|---|---|---|---|
| 0.5 | 22.3 | 91.1 | 7.95 |
| 1 | 22.3 | 90.9 | 7.90 |
| 2 | 22.2 | 89.4 | 7.87 |
| 3 | 22.1 | 89.9 | 7.85 |
| 4 | 21.9 | 87.7 | 7.66 |
| 5 | 19.4 | 44.5 | 4.00 |
| 6 | 14.6 | 7.9 | 0.77 |
| 7 | 10.3 | 3.1 | 0.34 |
| 8 | 8.1 | 2.2 | 0.25 |
| 9 | 7.5 | 1.7 | 0.21 |

**Site 4**

| Secchi Depth (m) | B.P. (mmHg) | Time | Depth (m) |
|---|---|---|---|
| 3.0 | 751.1 | 11:00 | 6.4 |

| Depth | Temp | DO (%) | DO (mg/L) |
|---|---|---|---|
| 0.5 | 21.5 | 87.0 | 7.68 |
| 1 | 21.5 | 86.6 | 7.87 |
| 2 | 21.4 | 86.6 | 7.66 |
| 3 | 21.3 | 85.8 | 7.62 |
| 4 | 21.1 | 85.6 | 7.60 |
| 5 | 21.0 | 85.1 | 7.52 |
| 6 | 21.0 | 83.9 | 7.50 |