KENORA RESOURCE CONSULTANTS


# BLACK STURGEON LAKES WATER QUALITY MONITORING

## 2018 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 2018, the water quality assessment contract was awarded to Kenora Resource Consultants Inc. (note – Ryan Haines Consulting was incorporated into Kenora Resource Consultants Inc. in 2012).

# 2.0 METHODOLOGY

Two sampling sessions were conducted during the 2018 season, a spring session on May 21$^{st}$ and a late summer session on August 19$^{th}$. 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*. The site on Upper Black Sturgeon 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 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. Data comparisons were also made to phosphorous concentrations from a sampling site in the middle of Upper Black Sturgeon Lake as well as two Lake Partner Program sampling sites on Island Lake (Figure 1).

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 and Island Lake

## 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 2018 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.

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 an YSI 55 Dissolved Oxygen Meter.

A water sample from the bottom of the water column (approximately one meter from the bottom of the lake) was taken at sites #2, #3, and #4 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.

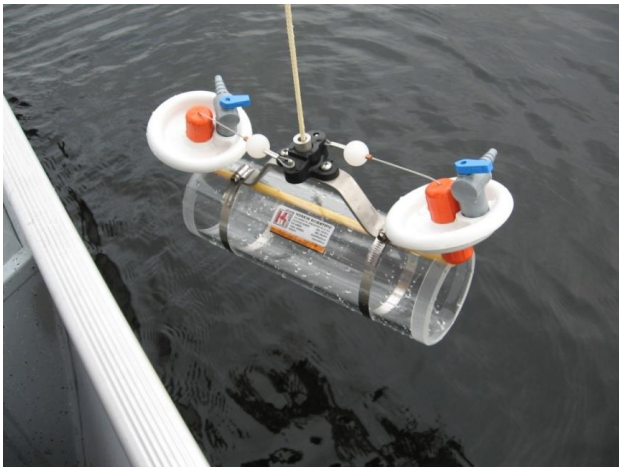


Figure 4 – Horizontal Beta Sampler prior to deployment

All water samples collected were transferred immediately upon collection to sample bottles for analysis at a laboratory. Samples were shipped via Greyhound bus to ALS Laboratory Group in Winnipeg, MB, for analysis.

# 3.0 RESULTS

## 3.1 Sampling Session Dates and Locations

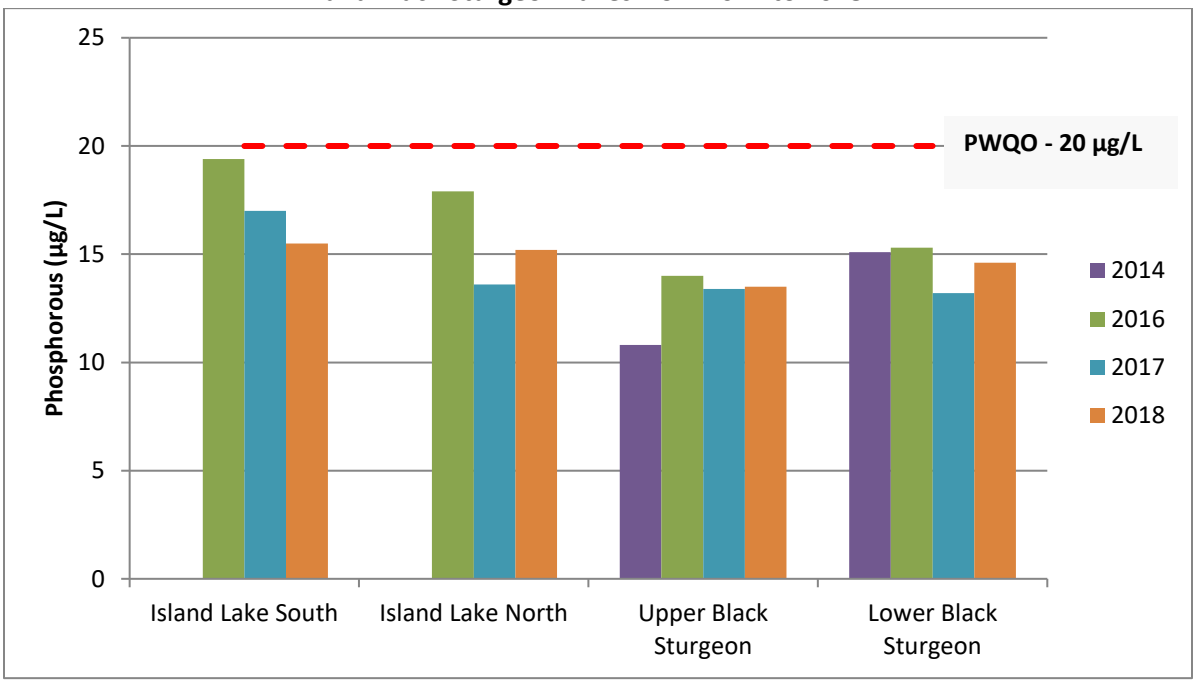
The 2018 sampling sessions were conducted on May 21st and August 19th. The depth of the sampling sites was 28.8 m for Site 1, 16.9 m for Site 2, 9.8 m for Site 3, and 6.9 m for Site 4.

## 3.2 Total Phosphorous

The 2018 spring sampling results for phosphorous concentration results from the ALS laboratory were abnormally low and did not match with the results from previous years or the Lake Partner Program laboratory results for 2018. This was consistent with what was found on other projects conducted by Kenora Resource Consultants in 2018 with respect to the ALS laboratory results for phosphorous concentrations. The anomalies in the results appear to be limited to the phosphorous results and were not found in any of the other parameters analyzed for 2018. The samples sent in to the Dorset laboratory from Lower Black Sturgeon Lake were 14.8 µg/L and 14.4 µg/L and samples from the middle of the basin of Upper Black Sturgeon Lake were 13.4 µg/L and 13.6 µg/L. Note that the Lake Partner

Program requires duplicate samples be sent to their laboratory as part of their volunteer sampling protocol. Kenora Resource Consultants has also collected water samples from Island Lake, one of the upstream watersheds from Black Sturgeon Lakes. Data collected for the Lake Partner Program from Black Sturgeon Lakes and Island by Kenora Resource Consultants and the Ministry of Environment, Conservation, and Parks from 2014 to 2018 can be found in Figure 5.

**Figure 5 – Spring Turnover Total Phosphorous Concentrations for Four Sampling Sites on Island Lake and Black Sturgeon Lakes from 2014 to 2018.**




### 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 2018 results for Site 2 were comparable to the results for the 2010, 2015, 2016 and 2017 analyses and were all within the provincial water quality objectives (PWQO) for the parameters where an objective is provided. For both arsenic and copper, the more stringent interim PWQO was used to achieve the greatest level of aquatic protection. The copper concentrations, which exceeded the PWQO in 2017 (lab result of 0.00116 mg/L with a PWQO of 0.001), were below the PWQO in 2018 (0.00088 mg/L). The full results can be found in Appendix 1.

## 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 water samples (i.e. Lake Partner Program) have been collected and sent to the laboratory, which enables analysis of trends over time using a larger database.

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). While the ALS laboratory results for phosphorous were removed from the data set for the 2018 field season, an analysis of the Lake Partner Program data from 2014 to 2018 provides insights into the health of the watershed. The results from an upstream watershed, Island Lake, will be included in this analysis to help determine the potential inputs to phosphorous into the Black Sturgeon Lakes watershed. Island Lake phosphorous results were higher than the downstream results at Black Sturgeon Lakes for all sampling seasons. The results for both Island Lake and Black Sturgeon Lakes were below the provincial water quality objective for phosphorous for all sampling seasons.

### 4.2 Chemical Analysis - Water Quality Characteristics

The 2018 Site 2 results were comparable to the results for the 2010, 2015, 2016, and 2017 analyses and were all within the provincial water quality objectives (PWQO) for the parameters where an objective is provided. This data supports the findings of the phosphorous results indicating that the water quality health of Black Sturgeon Lakes has remained relatively consistent over the past several years.

## 5.0 SUMMARY AND RECOMMENDATIONS

Lower Black Sturgeon Lake is within the provincial water quality objectives for a healthy lake for all of the parameters measured and analyzed in this study. All results indicate that Black Sturgeon Lakes has the water quality characteristics to be expected in a dystrophic lake (i.e. heavily coloured due to presence of humic compounds of plant origin) located in northwestern Ontario. In addition, the 2018 water quality results are consistent with results of previous water monitoring studies conducted on Lower Black Sturgeon Lake. This indicates that the health of the water body has remained consistent and is not deteriorating over time.

The results for copper in 2017 at site 2 (0.00116 mg/L) were higher than those found in the 2010 (0.00073 mg/L), 2015 (0.00087 mg/L) and 2016 (0.00062 mg/L). It was noted in the 2017 report that the upward trend from 2016 to 2017 should be noted and, if this trend continued in the 2018 field season, it may be cause for concern. The 2018 copper concentration results (0.00088 mg/L) are within the range of the previous years of this study as well as below the PWQO of 0.001 mg/L. Therefore, it is not felt that copper concentrations are a potential water quality issue on Lower Black Sturgeon Lake.

The variation shown during the 2009, 2010, 2015, 2016, 2017, and 2018 sampling seasons demonstrates the importance of collecting data annually to establish and maintain robust data sets. The summer of 2009 was characterized by relatively cool conditions and therefore the information collected during this season provides a detailed synopsis of Lower Black Sturgeon Lake water quality during a cool summer. The 2010 open water season was exceptionally long and wet which produced a data set that reflects these climatic conditions. However, the results of these varying summer patterns was that despite the fact there were no major changes to land use, the 2009 and 2010 sampling seasons produced different

water quality sampling results. The 2015 sampling season produced results from a more *average* or *typical* open water season with results that were often in between the two baseline sampling seasons. The 2016 season phosphorous concentrations were lower than those found in the previous sampling seasons, potentially the result of cool, dry spring conditions and a snow pack that had seen significant melting well before ice-out on Black Sturgeon Lakes. The 2018 sampling season demonstrated not only the annual variations in results, but also the benefit of collecting additional samples from more sampling sites and taking advantage of the Lake Partner Program for a larger and more robust data set.

## 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

# APPENDIX 1 – DISSOLVED OXYGEN/TEMPERATURE PROFILE RESULTS AND SECCHI DEPTHS FOR 2018 LATE SUMMER SAMPLING SESSION

**Site 1 – August 19, 2018**

| Secchi Depth (m) | B.P. (mmHg) | Time | Depth (m) |
|---|---|---|---|
| 3.5 | 751.4 | 18:00 | 25.9 |

| Depth | Temp | DO (%) | DO (mg/L) |
|---|---|---|---|
| 0.5 | 21.6 | 99.4 | 8.77 |
| 1 | 21.7 | 99.2 | 8.76 |
| 2 | 21.7 | 99.2 | 8.73 |
| 3 | 21.7 | 99.4 | 8.69 |
| 4 | 21.7 | 98.9 | 8.69 |
| 5 | 21.7 | 98.9 | 8.68 |
| 6 | 21.8 | 98.0 | 8.66 |
| 7 | 21.7 | 98.1 | 8.59 |
| 8 | 20.3 | 85.8 | 7.71 |
| 9 | 15.6 | 56.6 | 5.60 |
| 10 | 14.8 | 54.0 | 5.43 |
| 11 | 11.4 | 52.8 | 5.73 |
| 12 | 10.7 | 52.8 | 5.83 |
| 13 | 9.4 | 53.0 | 6.09 |
| 14 | 8.7 | 52.6 | 6.13 |
| 15 | 8.4 | 51.9 | 6.10 |
| 16 | 8.0 | 50.6 | 6.00 |
| 17 | 7.8 | 49.4 | 5.92 |
| 18 | 7.6 | 49.7 | 5.99 |
| 19 | 7.4 | 49.2 | 5.94 |
| 20 | 7.2 | 47.7 | 5.75 |
| 21 | 7.0 | 44.3 | 5.28 |
| 22 | 6.9 | 40.7 | 4.96 |
| 23 | 6.8 | 39.8 | 4.82 |
| 24 | 6.8 | 37.6 | 4.53 |
| 25 | 6.8 | 35.9 | 4.35 |

**Site 2 – August 19, 2018**

| Secchi Depth (m) | B.P. (mmHg) | Time | Depth (m) |
|---|---|---|---|
| 3.5 | 751.0 | 16:10 | 13.0 |

| Depth | Temp | DO (%) | DO (mg/L) |
|---|---|---|---|
| 0.5 | 22.6 | 104.4 | 9.01 |
| 1 | 22.6 | 103.5 | 9.02 |
| 2 | 22.5 | 104.6 | 9.00 |
| 3 | 22.5 | 103.3 | 8.95 |
| 4 | 22.3 | 101.3 | 8.88 |
| 5 | 18.2 | 70.9 | 6.63 |
| 6 | 16.9 | 65.6 | 6.33 |
| 7 | 14.8 | 59.5 | 6.05 |
| 8 | 11.9 | 54.6 | 5.88 |
| 9 | 10.1 | 50.5 | 5.71 |
| 10 | 9.6 | 49.5 | 5.64 |
| 11 | 9.2 | 49.2 | 5.68 |
| 12 | 9.1 | 49.3 | 5.64 |

**Site 3 – August 19, 2018**

| Secchi Depth (m) | B.P. (mmHg) | Time | Depth (m) |
|---|---|---|---|
| 2.75 | 751.1 | 16:50 | 9.2 |

| Depth | Temp | DO (%) | DO (mg/L) |
|---|---|---|---|
| 0.5 | 21.9 | 100.3 | 8.77 |
| 1 | 21.9 | 99.9 | 8.79 |
| 2 | 21.8 | 99.3 | 8.72 |
| 3 | 21.8 | 97.7 | 8.58 |
| 4 | 21.6 | 96.2 | 8.45 |
| 5 | 17.8 | 21.1 | 1.99 |
| 6 | 12.1 | 2.8 | 0.31 |
| 7 | 9.0 | 1.8 | 0.20 |
| 8 | 7.5 | 1.2 | 0.14 |
| 9 | 7.0 | 0.9 | 0.10 |

**Site 4 – August 19, 2018**

| Secchi Depth (m) | B.P. (mmHg) | Time | Depth (m) |
|---|---|---|---|
| 3.0 | 751.1 | 17:20 | 6.3 |

| Depth | Temp | DO (%) | DO (mg/L) |
|---|---|---|---|
| 0.5 | 21.7 | 98.1 | 8.66 |
| 1 | 21.7 | 96.9 | 8.53 |
| 2 | 21.6 | 95.9 | 8.44 |
| 3 | 21.6 | 95.5 | 8.42 |
| 4 | 21.5 | 93.4 | 8.22 |
| 5 | 21.2 | 86.5 | 7.68 |
| 6 | 20.9 | 80.3 | 7.11 |

# APPENDIX 2 – 2010 TO 2018 LABORATORY RESULTS FOR WATER QUALITY CHARACTERISTICS – SITE 2 (OUTLET OF LOWER BLACK STURGEON LAKE)

| Parameter | 2010 | 2015 | 2016 | 2017 | 2018 | Unit | PWQO |
|---|---|---|---|---|---|---|---|
| Alkalinity, Bicarbonate (HCO3) | 21.3 | 16.8 | 26.5 | 21.2 | 20.5 | 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 | mg/L | |
| Chloride (Cl) | < | 3.76 | 4.16 | 3.86 | 3.83 | mg/L | |
| Flouride (F) | 0.15 | 0.037 | 0.044 | 0.045 | 0.042 | mg/L | |
| Sulphate (SO4) | < | 1.93 | 1.97 | 1.81 | 1.58 | mg/L | |
| Colour, True | 20 | 18 | 24.2 | 30.1 | 29 | CU | |
| Dissolved Organic Carbon | 8.7 | 7.5 | 7.78 | 8.14 | 8.84 | mg/L | |
| Turbidity | 1.2 | 1.1 | 1.31 | 1.34 | 1.28 | NTU | |
| pH | 7.3 | 7.44 | 6.78 | 7.11 | 7.44 | pH units | 6.5 - 8.5 |
| Aluminum (Al)-Total | 0.044 | 0.0513 | 0.0655 | 0.0641 | 0.0452 | mg/L | 0.075 |
| Antimony (Sb)-Total | < | < | < | < | < | mg/L | 0.02 |
| Arsenic (As)-Total | < | 0.00032 | 0.00030 | 0.00037 | 0.00036 | mg/L | 0.005 |
| Barium (Ba)-Total | 0.00832 | 0.00845 | 0.00822 | 0.00808 | 0.00764 | mg/L | n/a |
| Beryllium (Be)-Total | < | < | < | < | < | mg/L | 0.011 |
| Bismuth (Bi)-Total | < | < | < | < | < | mg/L | n/a |
| Boron (B)-Total | < | < | < | < | < | mg/L | 0.2 |
| Cadmium (Cd)-Total | < | < | < | < | < | mg/L | 0.0001 |
| Calcium (Ca)-Total | 5.05 | 5.77 | 5.25 | 5 | 4.85 | mg/L | n/a |
| Cesium (Cs)-Total | < | < | < | < | < | mg/L | n/a |
| Chromium (Cr)-Total | < | < | < | < | 0.00023 | mg/L | 0.001 |
| Cobalt (Co)-Total | < | < | < | < | < | mg/L | 0.0009 |
| Copper (Cu)-Total | 0.00073 | 0.00087 | 0.00062 | 0.00116 | 0.00088 | mg/L | 0.001 |
| Iron (Fe)-Total | 0.065 | < | 0.111 | 0.119 | 0.097 | mg/L | 0.3 |
| Lead (Pb)-Total | < | 0.0001 | < | < | < | mg/L | 0.001 |
| Lithium (Li)-Total | n/a | < | < | < | 0.0013 | mg/L | n/a |
| Magnesium (Mg)-Total | 1.5 | 1.79 | 1.61 | 1.62 | 1.63 | mg/L | n/a |
| Manganese (Mn)-Total | 0.00496 | 0.00529 | 0.0151 | 0.0127 | 0.00929 | mg/L | n/a |
| Molybdenum (Mo)-Total | < | < | < | < | 0.000066 | mg/L | 0.04 |
| Nickel (Ni)-Total | 0.00048 | < | < | < | 0.00065 | mg/L | 0.025 |
| Phosphorus (P)-Total | < | < | < | < | < | mg/L | 0.02 |
| Potassium (K)-Total | 0.954 | 1.08 | 0.995 | 1.02 | 0.968 | mg/L | n/a |
| Rubidium (Rb)-Total | 0.00161 | 0.00202 | 0.00193 | 0.00198 | 0.00194 | mg/L | n/a |
| Selenium (Se)-Total | < | < | < | < | 0.000131 | mg/L | 0.1 |
| Silicon (Si)-Total | 1.16 | 0.88 | 1.07 | 1.43 | 0.7 | mg/L | n/a |

| Parameter | 2010 | 2015 | 2016 | 2017 | 2018 | Unit | PWQO |
|---|---|---|---|---|---|---|---|
| Silver (Ag)-Total | < | < | < | < | < | mg/L | 0.0001 |
| Sodium (Na)-Total | 2.53 | 3.25 | 3.07 | 3.04 | 3.1 | mg/L | n/a |
| Strontium (Sr)-Total | 0.0219 | 0.0239 | 0.023 | 0.0244 | 0.0234 | mg/L | n/a |
| Tellurium (Te)-Total | < | < | < | < | < | mg/L | n/a |
| Thallium (Tl)-Total | < | < | < | < | < | mg/L | 0.0003 |
| Thorium (Th)-Total | n/a | < | < | < | < | mg/L | n/a |
| Tin (Sn)-Total | < | < | < | < | < | mg/L | n/a |
| Titanium (Ti)-Total | 0.00094 | 0.00124 | 0.00162 | 0.00136 | 0.00099 | mg/L | n/a |
| Tungsten (W)-Total | < | < | < | < | < | mg/L | 0.03 |
| Uranium (U)-Total | < | < | < | < | 0.000089 | mg/L | 0.005 |
| Vanadium (V)-Total | < | 0.0002 | 0.00022 | 0.00023 | < | mg/L | 0.006 |
| Zinc (Zn)-Total | < | < | < | < | < | mg/L | 0.03 |
| Zirconium (Zr)-Total | < | < | < | < | 0.000122 | mg/L | 0.004 |
| Nitrate | n/a | < | 0.049 | 0.0623 | < | mg/L | |
| Nitrate + Nitrite | 0.057 | < | n/a | < | < | mg/L | |
| Nitrite | n/a | < | < | < | < | mg/L | |
| Total Kjeldahl Nitrogen | n/a | 0.37 | 0.35 | 0.38 | 0.29 | mg/L | |
| Total Nitrogen Calculated | n/a | 0.37 | n/a | 0.38 | 0.29 | mg/L | |
| Total Organic Carbon | | | 8.14 | 7.84 | 8.11 | mg/L | |
| Phosphorus (P)-Total | | 0.014 | 0.012 | 0.018 | n/a | mg/L | 0.02 |
| UV Transmittance | | | 58.6 | 55.1 | 54.7 | % T | |
| Total Dissolved Solids | | | 52 | 42.6 | 45.3 | mg/L | |
| Langelier Index 4C | | | -2.7 | -2.5 | -2.2 | | |
| Langelier Index 60C | | | -1.9 | -1.7 | -1.4 | | |
| Hardness Calculated | | | 19.7 | 19.2 | 18.9 | mg/L | |
| Conductivity | | | 57.3 | 56.4 | 53.2 | umhos/cm | |
| Bromide in Water by IC | | | <0.10 | | < | mg/L | |