



Environmental Applied Science Technology

2019 Report on the Ecological Health of Ponds in Charlottetown, Prince Edward Island, Canada

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1 INTRODUCTION AND OBJECTIVES

During the summer of 2019, Holland College Environmental Applied Science Technology students and faculty examined the ecological health of eleven (12) ponds and one (1) creek within the City of Charlottetown. One (1) reference pond was used outside the City, in Prince Edward Island (PEI), Canada. The project collected data on surface water quality, sediment chemistry and through macro-invertebrate surveys using the Hilsenhoff's Family Biotic Index (FBI), delineated the overall ecological health of the ponds sampled.

The information collected will help determine the underlying issues responsible for the relatively poor ecological health of some of the ponds surveyed. It will allow the City of Charlottetown and local watershed groups to develop action plans to improve or preserve the ecological health of the ponds studied.

1.1 SCOPE OF WORK

The scope of work included the following activities:

- Collection, identification and classification of 11 macroinvertebrates samples using the biotic index card,
- Field testing of water including physicochemical parameters such as dissolved oxygen (DO), pH, temperature total dissolved solids (TDS), salinity, turbidity, and conductivity,
- Collection of 52 surface water samples for water quality and chemical analyses,
- Analysis of surface water samples for Hardness, Alkalinity, Ammonia, Phosphates, and Nitrates were performed at Environmental Applied Science Technology (EAST) Lab Laboratory, Holland College,

- Chemical Analysis of surface water samples by the PEI Analytical Lab for the following: Barium (Ba), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Nickel (Ni), Magnesium (Mg), Phosphorus (P), Potassium (K), Sodium (Na), Sulfate (SO₄), Lead (Pb), Zinc (Zn), Manganese (Mn), Arsenic (As), Strontium (Sr), Calcium (Ca) and Faecal Coliforms,
- Collection and preparation of thirteen sediment samples for analyses,
- Analyses of the sediment samples by the PEI Analytical Laboratory for the following: Carbon (C), C:N ratio, Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Copper (Cu), Zinc (Zn), Boron (B), Chromium (Cr), Iron (Fe), Manganese (Mn), and pH,
- and Interpretation of the results and preparation of this report.

2 *DESCRIPTION OF SITES*

In total, fourteen different sites were assessed:

Governor's Pond (GOP)

The pond occupies an approximate area of 4,002 square meters (m²) and is located at the intersection between Terry Fox Drive and Kent Street, beside the parking lot of the Government Building. The site is in a commercial and residential area. It is surrounded by the parking lot and the two roads as mentioned above. It connects directly into Charlottetown Harbour through an underground storm drain. Historically, the Governor's Pond was part of a tidal estuary.

Dead Man's Pond (DMP)

Dead Man's Pond located in Victoria Park has an estimated area of 737 m². The pond area is a tranquil area surrounded by forest and a popular stop on a trail system that passes adjacent to the pond.

Lower Slick's Pond (LSP)

Part of the Hazards Creek system, the Lower Slick's Pond is visible from the Malpeque Rd (Route 2) behind Princess Auto. The pond occupies an approximate area of 1,424 m². It is surrounded by commercial and industrial development. It is the lower of two connected ponds constructed in the sixties to provide water for cattle. The ponds do not appear to have any official name. Ellen's Creek Watershed Group (ECWG) provided the name, Slick's Ponds, after a lifelong resident of area, Alexander (Slick) Rhynes.

MacNeill's Pond (MNP)

MacNeill's Pond is also part of Hazards Creek system. It is located at the intersection of Capital Drive and Lower Malpeque Road. MacNeill's Pond has an estimated area of 10,261 m². It is surrounded by commercial and residential development.

Hermitage Pond (HEP)

Hermitage Pond (also referred to as the Tremploy Pond) is situated in a residential area off Raiders Road adjacent to the Charlottetown Rural High School. It has an estimated area of 3,820 m². The dam creating the pond is an extension of Raiders Road which ends in a cul-de-sac at Tremploy Inc. A drop culvert outlet under the road connects the pond to Hermitage Creek, and the Ellen's Creek Estuary.

Farmers Market Pond (FMP)

Delimited by the Charlottetown Farmers Market parking lot in the North and a wetland and agricultural land in the South, Farmers Market Pond is located off Belvedere Avenue with an estimated area of 1,086 m².

Ag. Canada Pond (ACP)

The Ag. Canada Pond is located behind the Charlottetown Research and Development Centre of Agriculture and Agri-Food Canada Building of University Avenue. It occupies around 7,203 m². It is one in a series of man-made wetlands.

Jardine's Pond (JAP)

The Jardine's Pond occupies approximately 405 m² and its principal means of access is via a farm field behind a residential area on MacRae Drive. The site is in a wooded area surrounded by agricultural land. Upstream in the Northwest, there is an excavation pit and the Charlottetown Airport.

Barbour's Pond (BAP)

Barbour's Pond has an estimated area of 1,096 m² and is located downstream from Jardine's Pond. Access is off MacRae Drive through a path beside the Elmer MacFadyen Memorial Recreational Complex. There is a public walking trail along the lower end of the pond.

Andrew's Pond North (APN)

Andrew's Pond North is in a high-density residential area downstream from Barbour's Pond. It has an estimated area of 42,089 m². Access is from the walking trail along the lower end of Barbour's Pond.

Andrew's Pond South (APS)

Andrew's Pond South is across St. Peters Road, downstream from Andrew's Pond North. It has an estimated area of 18,769 m² and its access is from Oakland Drive.

Reardon's Pond (REP)

Reardon's Pond has an estimated area of approximately 25,000 m². It is part of the Pisquid Watershed. Located in between Donagh and Watervale. It is in a heavily wooded area with agricultural land nearby. The main access is from an ATV trail off a gravel road.

Ellen's Creek (ELC)

Located in West Royalty with access from Sherwood Road.

Cappers Pond (CAP)

Cappers Pond occupies approximately 6379 m². The pond is in a heavily wooded area with limited access year-round. Located in a valley between New Haven and Strathgartney.

Figures 1 to 6 (Appendix A) include photographs of the ponds cited above.

3 MATERIAL AND METHODS

The following materials and methods were used to conduct the sampling and the analysis:

Dissolved Oxygen was tested using the HACH 30 HQ 30d-flexi meter with a LDO probe.

pH was measured using the HACH 30 HQ 30d-flexi meter with a PHC 101 probe.

Conductivity was determined using the HACH sensION5 portable conductivity meter.

Turbidity was measured with a HACH 2100P Turbidimeter.

Nitrate was determined using HACH Method 10206, Nitrate TNTplus® Vial Test 835 (Range 0.2-13.5 mg/L NO₃-N).

Ammonia-N was determined using HACH Method 10205, Ammonia TNTplus® Vial Test 832 (Range: 2-47 mg/L NH₃-N).

Phosphorous was determined using HACH Method 10209, Phosphorus TNTplus® Vial Test 843 (Range: 0.05-1.50 mg/L PO₄-P, 0.15-4.50 mg/L PO₄)

Hardness was analyzed following the APHA (American Public Health Association) Standard Method 2340 for Hardness. The titrations were done in triplicates, with one blank before the samples were tested and QC (Charlottetown tap water) done before and after the samples were tested. Hardness was calculated using the following equations:

$$\begin{aligned} \text{Molarity of Cations } \left(\frac{\text{mols}}{\text{L}} \right) \\ = \frac{\text{Volume of titrant used (mL)} \times \text{titrant Molarity (M)}}{\text{Volume of sample used (mL)}} \end{aligned}$$

$$\begin{aligned} \text{Hardness } \left(\frac{\text{mg of CaCO}_3}{\text{L}} \right) \\ = \text{Molarity of Cations} \times \text{Molecular Weight } \left(\frac{100.0869\text{g}}{\text{mol}} \right) \times \frac{1000\text{mg}}{1\text{g}} \end{aligned}$$

Hardness materials and reagents:

- 1000ml Volumetric Flasks, Fisherbrand.

- 100-1000µl Pipette, Fisherbrand.
- 0.01M EDTA
- 0.1% Calmagite Indicator Catalog 1830-4, Ricca
- 125ml Erlenmeyer Flasks, Fisherbrand.
- 250ml Beakers, Kimax Kumble.
- 250ml Erlenmeyer Flasks, Fisherbrand.
- 25ml Graduated Cylinder, Kimax Kumble.
- 25ml Volumetric Flasks, Fisherbrand.
- 500µl and 1000µl Pipette, Eppendorf.
- 50ml Burette, Kimax Kumble.

Alkalinity was analyzed following the APHA (American Public Health Association) Standard Method 2320 for Alkalinity using hydrochloric acid as a titrant. The titrations were done in triplicates, with one blank before the samples were tested and QC (Charlottetown tap water) done before and after the samples were tested. Alkalinity was calculated using the following equations:

$$\text{Alkalinity} \left(\frac{\text{mg of CaCO}_3}{\text{L}} \right) = \frac{\text{Volume of titrant used (mL)} \times \text{Molarity of titrant (M)} \times 50,000}{\text{Volume of sample used (mL)}}$$

Alkalinity materials and reagents:

- 1000ml Volumetric Flasks, Fisherbrand.
- 100-1000µl Pipette, Fisherbrand.
- 0.1N HCl.
- 125ml Erlenmeyer Flasks, Fisherbrand.

- 250ml Beakers, Kimax Kumble.
- 250ml Erlenmeyer Flasks, Fisherbrand.
- 25ml Graduated Cylinder, Kimax Kumble.
- 25ml Volumetric Flasks, Fisherbrand.
- 500 μ l and 1000 μ l Pipette, Eppendorf.
- 50ml Burette, Kimax Kumble.
- HACH HQ 30d-flexi meter with PHC101 probe.

Family Biotic Index. The Hilsenhoff's Family Biotic Index (FBI) was used to assess the water quality condition (Hilsenhoff 1988).

FBI materials and reagents:

- Fisher brand 0.5mm mesh
- Microscope Stereo Master II, Model SPT-ITH manufactured by Fisher Scientific
- 70% Isopropyl alcohol

First, the samples were washed very gently in a fine sieve, removing as much mud and fine detritus as possible. Small amounts of each sample were placed in a white tray with approximately 10mm depth of water, and the material was spread out across the tray. The invertebrates were carefully sorted using tweezers and placed in beakers and weigh boats. To sort the next portion of the sample, the material was discarded, and the tray filled with clean water, and the process was repeated until the entire sample was sorted.

The animals were identified to their family level by using the keys by Voshell (2002). The results were recorded and prior to sorting the next sample, all the

equipment used was thoroughly cleaned.

A microscope (Stereo Master II, Model SPT-ITH manufactured by Fisher Scientific) was used to help with the identification. Some specimens were preserved in 70% isopropanol and stored in the fridge at a temperature around 0°C for further use in the EAST program at Holland College.

The Hilsenhoff’s Family Biotic Index (FBI) was used to assess the water quality condition (Hilsenhoff 1988). Tolerance values for the invertebrate families were assigned based on Bode et al (1996); Hauer & Lamberti (1996); Hilsenhoff (1988); Plafkin et al (1989); and Barbour et al. (1999). The following formula was used to obtain the FBI and the results were evaluated using Table 1.

$$FBI = \sum \frac{(xi \times ti)}{n}$$

x = the number of individual taxa, t = tolerance value, and n = total number of invertebrates in the sample.

Table 1 Evaluation of water quality using Hilsenhoff’s Family Biotic Index (Hilsenhoff, 1998)

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00 - 3.75	Excellent	Organic pollution unlikely
3.76 - 4.25	Very Good	Possible slight organic pollution
4.26 - 5.00	Good	Some organic pollution probable
5.01 - 5.75	Fair	Fairly substantial pollution likely

5.76 - 6.50	Fairly Poor	Substantial pollution likely
6.51 - 7.25	Poor	Very substantial pollution likely
7.26 - 10.00	Very Poor	Severe organic pollution likely

4 SAMPLING

4.1 FIELD ACTIVITIES

Field activities were performed in two rounds each month. The first round would occur in approximately the first two weeks of each month and the second round would take place in the third and fourth weeks of the month. One round was for collecting in-situ data and the other round was to collect any samples required as well as in-situ data to support the samples.

Each day, ponds would be selected to be sampled based upon the location of the ponds and the weekly objectives. Field equipment was thoroughly decontaminated with several rinses of deionized water between ponds.

A reference pond was selected to examine if freshwater ponds within Charlottetown are uniquely different from ponds outside the City. A new reference pond was selected this year after Cappers Pond was determined to not be a good reference pond anymore. The reasons for abandoning Cappers as a reference include that runoff from nearby construction was observed to be flowing into the pond as well as it appeared to be a recreational location. Rope swings, fire pits and lots of bottles and broken glass were seen. Reardon's Pond was selected as a new reference pond because it is located in a rural area, access is from a gravel road with low traffic, and it is mainly forested with some agricultural land nearby.

Invertebrate samples and surface water samples were collected for analyses at relatively the same location in each pond for each round. At each pond, dissolved oxygen, conductivity, pH, salinity, temperature, total dissolved solids (TDS) and turbidity measurements were completed in-situ. Sediment samples were collected once at each pond ranging over the rounds of sampling.

By the end, a total of 11 invertebrate samples, 13 sediment samples and 52 surface water samples were collected. See Appendix C for sampling locations.

During the field activities, the Holland College Health & Safety Plan was followed. Prior to initiating any activities, an evaluation was performed to detect any possible danger. It was decided that the collection of all samples would be performed from the edges of the ponds because the depth of water in some ponds, and the risk of entrapment in soft sediment.

4.2 *MACROINVERTEBRATES SAMPLING*

Invertebrates were sampled at the eleven (11) different sites. Lower Slick's Pond and MacNeill's pond were not sampled due to hazards that could not be mitigated.

The samples were collected at each site using a 400µm mesh net. Each pond was sampled for 3 minutes in total, where the 3 minutes refers to net-in-the-water time and it did not include the time moving between netting spots. Then, the samples were placed in 10.5 liter plastic buckets, labeled, and brought to the Environmental Applied Science Technology (EAST) Laboratory at Holland College where they were sorted and processed.

4.3 SURFACE WATER SAMPLING

Three surface water samples were collected at each pond between June 4, 2019 and September 5, 2019. See Appendix C for the sampling coordinates.

The water quality was assessed by measuring several physicochemical parameters. Field measurements of pH, temperature, conductivity, dissolved oxygen (DO), salinity, turbidity, and total dissolved solids (TDS) were recorded. Dissolved oxygen was measured using a HACH HQ 30d-flexi meter with a LDO probe. pH levels were measured using a HACH HQ 30d-flexi meter with a PHC 101 probe. Conductivity was measured using handheld HACH sensION5. Turbidity was measured with a HACH 2100P Turbidimeter. Water samples were collected with a 6-foot HDPE Dip Sampler, at some locations the probes were placed directly in the pond.

The equipment used for the surface water sampling was calibrated in accordance with the manufacturer's recommendation prior to starting the field measurements.

Surface water samples were collected using a dip sampler. The device was extended to the sample location and sample was collected by dipping the sampler into the water 15 cm. The pond water was transferred from the sampler to two (2) clean 500 ml home canning glass jars (commonly referred to as Mason jars) that were filled to the top without leaving an air space. The jars were labeled, stored in coolers with ice at temperatures below 4 °C (± 2 °C), and brought to the EAST lab.

In the field, a 250 ml sample from each pond was placed into a plastic bottle

provided by the PEI Analytical Laboratory, labeled and stored in coolers with ice at temperatures below 4 °C (± 2 °C). Samples were delivered that afternoon to PEI Analytical Lab. In total, twelve samples, one for each pond, were analysed for Barium (Ba), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Nickel (Ni), Magnesium (Mg), Phosphorus (P), Potassium (K), Sodium (Na), Sulfate (SO₄), Lead (Pb), Zinc (Zn), Manganese (Mn), Arsenic (As), Strontium (Sr), Calcium (Ca) and Faecal Coliforms.

Additionally, samples were analyzed at the EAST Lab for Hardness, Alkalinity, Ammonia, Phosphate, and Nitrate.

4.4 *SEDIMENT SAMPLING*

One sediment sample was collected at each pond between June 19 and September 5, 2019. Location of samples are presented in Appendix C.

Samples were collected using an auger and they were stored in 10.5 liter-buckets, labeled, and brought to the EAST Laboratory at Holland College. At the Lab, the samples were placed on a tray and dried in the Fisher Scientific Isotemp oven at 105°C for 48 hours. The dry samples were stored in airtight sealed plastic bags.

A portion of each sample (approximately 100g) was placed in bags provided by the PEI Analytical Lab, and delivered to the lab where samples were analyzed for Carbon (C), C:N ratio, Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Copper (Cu), Zinc (Zn), Boron (B), Iron (Fe), Manganese (Mn), Chromium (Cr) and pH. The remaining samples collected were kept in the EAST lab to be used for further analyses.

4.5 DATA VALIDATION

4.5.1 Equipment Calibration

Prior to initiating fieldwork activities, equipment used for recording physicochemical data was calibrated on a weekly basis in accordance with the manufacturer's instructions.

4.5.2 Equipment Decontamination

All non-disposable lab equipment was decontaminated before and after each sample collection event using the following procedure: washing and rinsing of equipment with fresh water and Fisherbrand™ Sparkleen™ Detergent with disposable sponges and brushes; rinsing with fresh water; and re-rinsing with de-ionized water.

All non-disposable field equipment and personal equipment such as nets, samplers, and waders were cleaned and inspected between different pond groups. All plants, animals, and mud were removed using high pressure and hot tap water. Eventually, the equipment was decontaminated with bleach following the Occupational Safety and Health Administration (OSHA) recommendations.

4.5.3 Applicable Environmental Guidelines

The federal guidelines were used to detect exceedances in water and sediment quality parameters under baseline conditions. The guidelines used to assess baseline water and sediment quality were:

- Canadian Council of the Ministers of the Environment (CCME) Canadian

Environmental Quality Guidelines (CEQG) for the Protection of Aquatic Life,

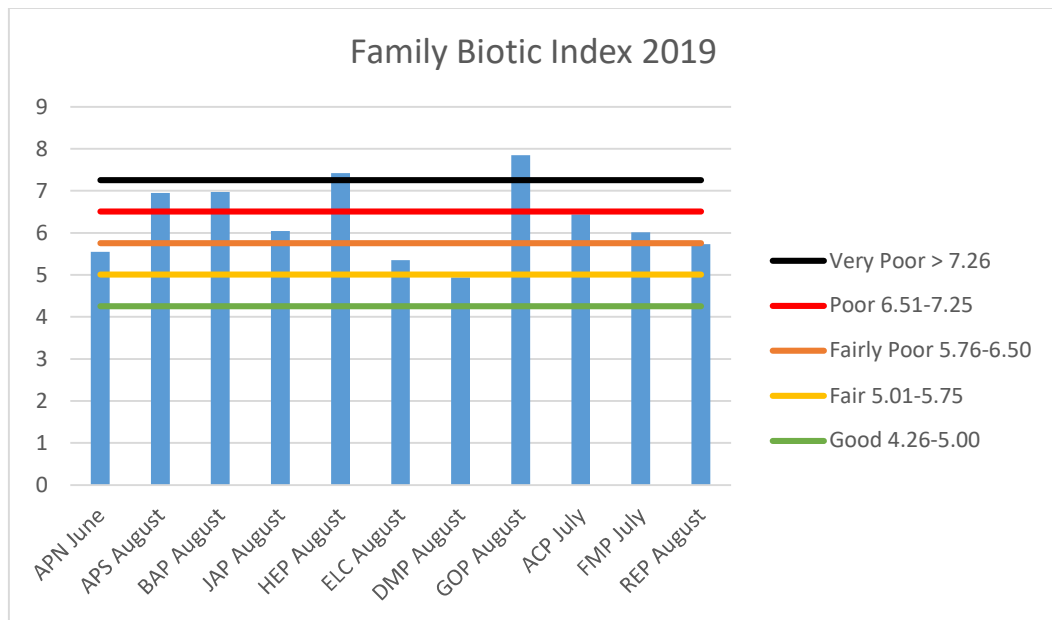
- and the CCME Canadian Sediment Quality Guidelines (CSQG).

5 RESULTS

5.1 MACROINVERTEBRATES

The results of the macroinvertebrates sorted and identified, as well as the FBI results are included in Table 1 of the Appendix B. Figure 1 presents a summary of the evaluation of water quality for each pond using Hilsenhoff’s Family Biotic Index. The FBI is a scale for showing the quality of an environment by indicating the types of organisms present in it. It is often used to assess the quality of water in rivers.

Figure 1. Hilsenhoff’s Family Biotic Index.



Using the index, the ecological health of Hermitage Pond and Governor’s Pond were classified as “Very Poor”. Barbour’s Pond and Andrew’s Pond South were

classified as “Poor”. Farmers Market Pond, Ag. Canada Pond and Jardine’s Pond were classified as “Fairly Poor”. Reardon’s Pond, Ellen’s Creek and Andrew’s Pond North were classified as “Fair”. Dead Man’s Pond was classified as “Good”.

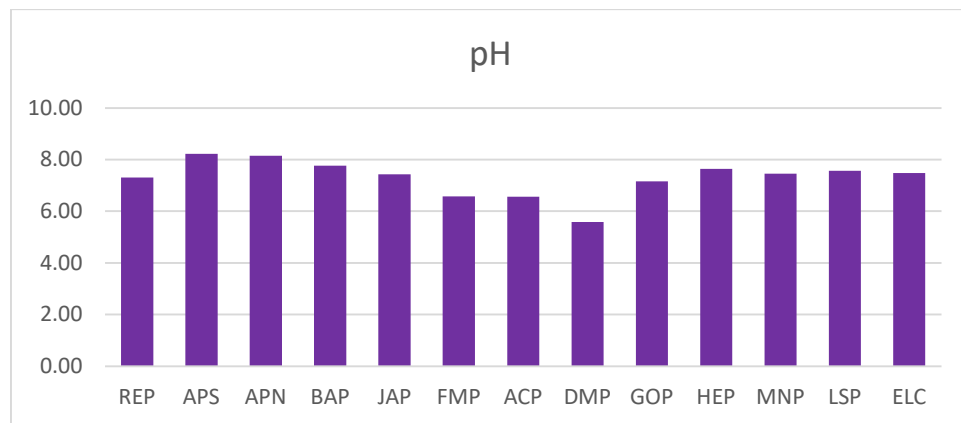
5.2 Surface Water Quality

5.2.1 Physicochemical Parameters

During the sampling of surface water, field measurements of pH, temperature, conductivity, salinity, total dissolved solids (TDS), turbidity, and dissolved oxygen (DO) were recorded. The results are presented in Figures 2 - 8 below. All data below are averages for 2019. See raw data in Appendix C.

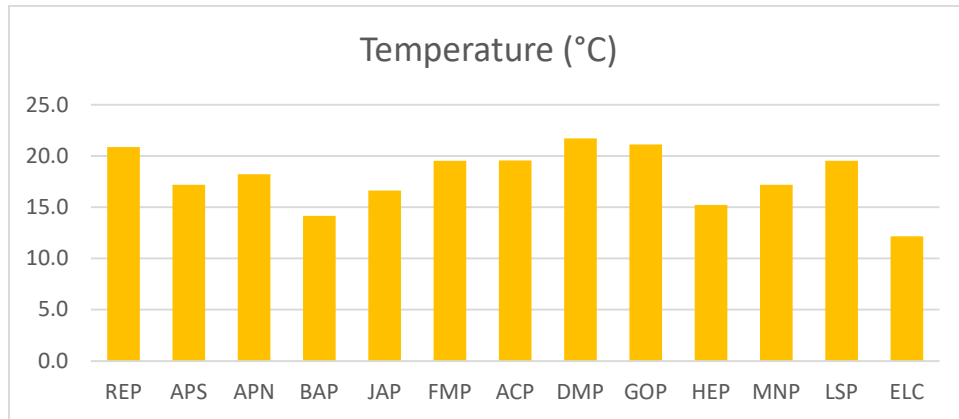
The pH values ranged from 5.58 in Dead Man's Pond to 8.22 in Andrew Pond South. See Figure 2.

Figure 2. pH in surface water



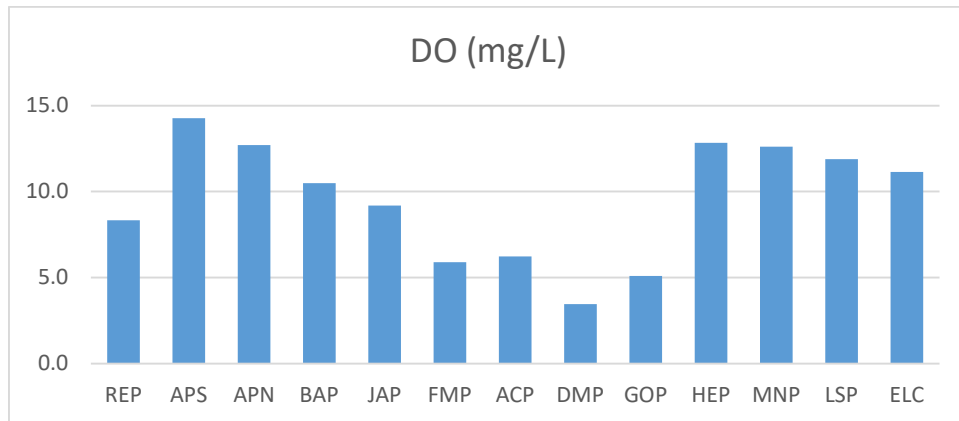
Temperature ranges from 12.2 °C in Ellen’s Creek to 21.7 °C in Dead Man’s Pond. See Figure 3.

Figure 3. Temperature in Surface Water



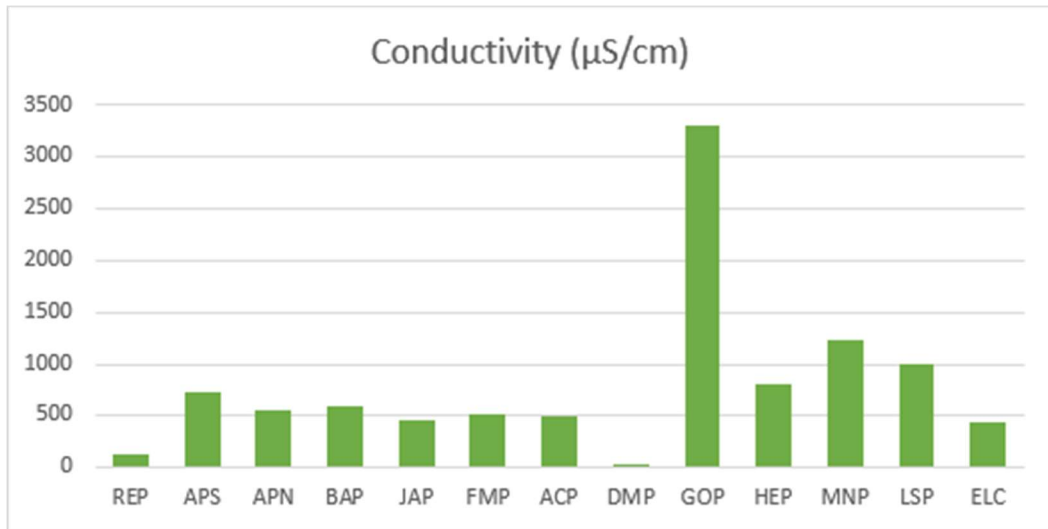
With regards to dissolved oxygen, readings ranged from 3.45 mg/L in Dead Man's Pond to 14.25 mg/L in Andrew's Pond South. See Figure 4.

Figure 4. Dissolved Oxygen



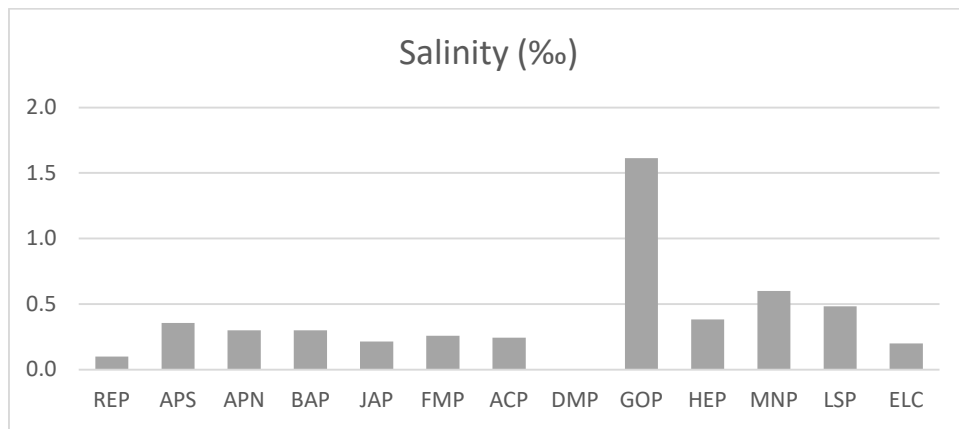
Conductivity values ranged from 3.3 $\mu\text{S}/\text{cm}$ at Governor's Pond to 1236 $\mu\text{S}/\text{cm}$ at MacNeill's Pond. See Figure 5.

Figure 5. Conductivity



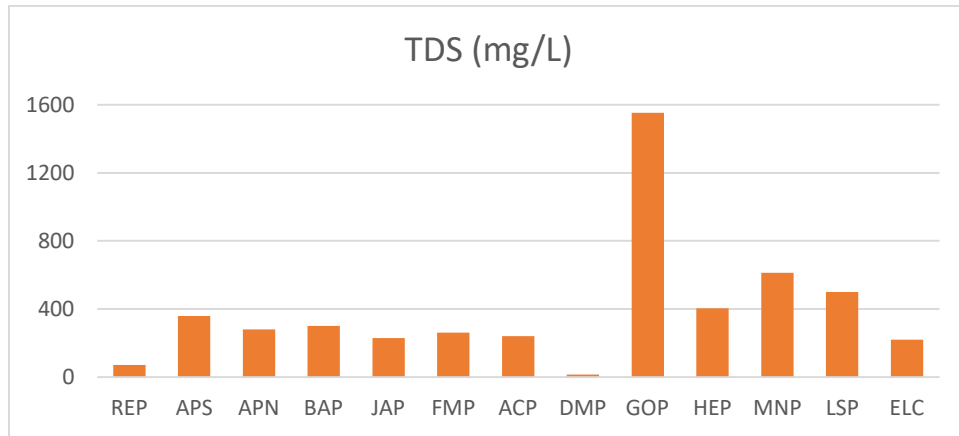
Salinity values ranged from 0.0 ‰ at Dead Man’s Pond to 1.6 ‰ at Governor’s Pond. See Figure 6.

Figure 6. Salinity



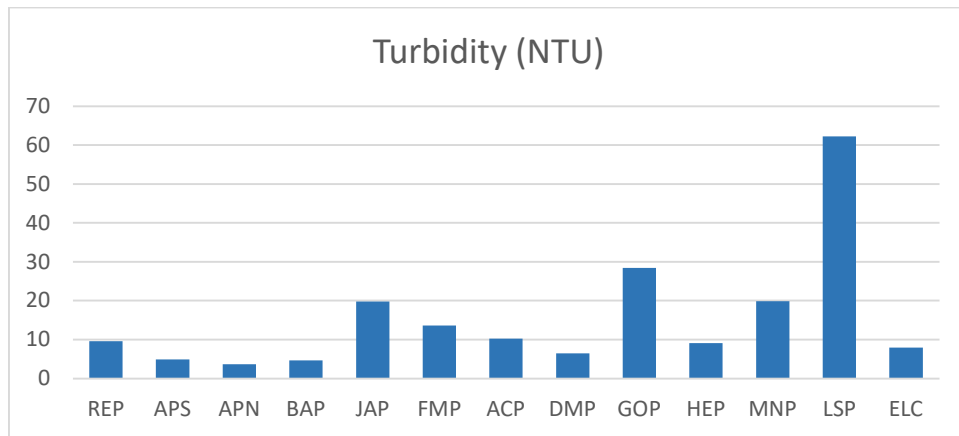
Total dissolved solids (TDS) vales ranged from 13.8 mg/L at Dead Man’s Pond to 1552 mg/L at Governor’s Pond. See Figure 7.

Figure 7. Total Dissolved Solids



Turbidity values ranged from 3.60 NTU at Andrew’s Pond North to 62.27 NTU at Lower Slick’s Pond. See Figure 8.

Figure 8. Turbidity



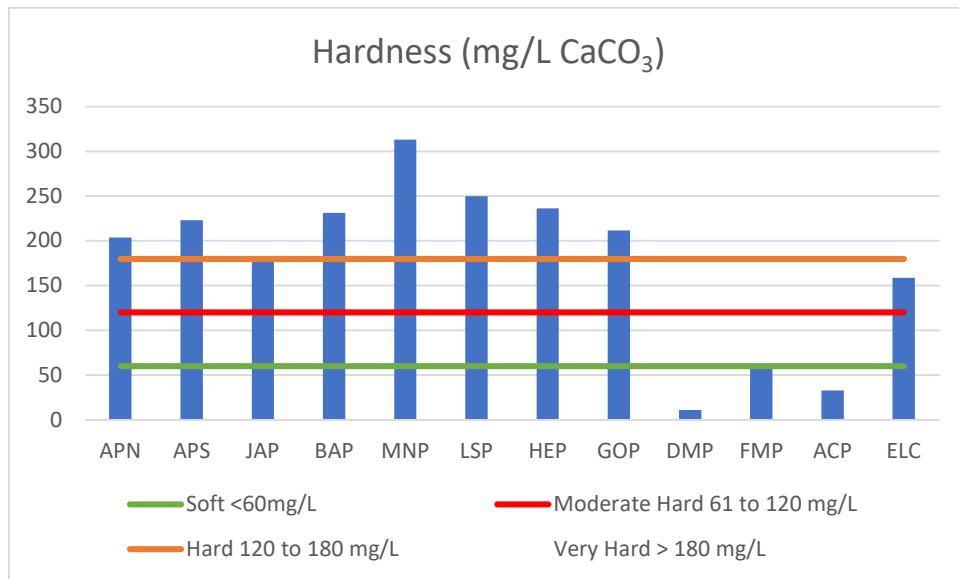
5.2.2 Hardness, Alkalinity, Ammonia, and Nitrate

Hardness is caused by compounds of calcium and magnesium, and by a variety of other metals. Hardness is measured as milligrams per liter of Calcium Carbonate (mg/L CaCO₃). The general guidelines for classification of water hardness by USGS are as follows:

0 to 60 mg/L CaCO₃ is classified as soft
 61 to 120 mg/L CaCO₃ is moderately hard
 121 to 180 mg/L CaCO₃ is hard
 > 180 mg/L CaCO₃ is very hard

Hardness measurements are represented in Figure 9. According to the results, most of the ponds, Governor’s Pond, Lower Slick’s Pond, MacNeil’s Pond, Hermitage Pond, Jardine’s Pond, Barbour’s Pond, Andrew Pond North, and Andrew Pond South, contained very hard water. Farmer’s Market Pond had moderate water. Ellen’s Creek had hard water. Dead Man’s Pond and the Ag. Canada Pond had soft water. See raw data in Table 2, Appendix C.

Figure 9. Total Hardness



Alkalinity values ranged from 14.8 mg/L CaCO₃ in Dead Man’s Pond to 200.5 mg/L CaCO₃ in MacNeill’s Pond. Shown in Figure 10.

Figure 10. Total Alkalinity

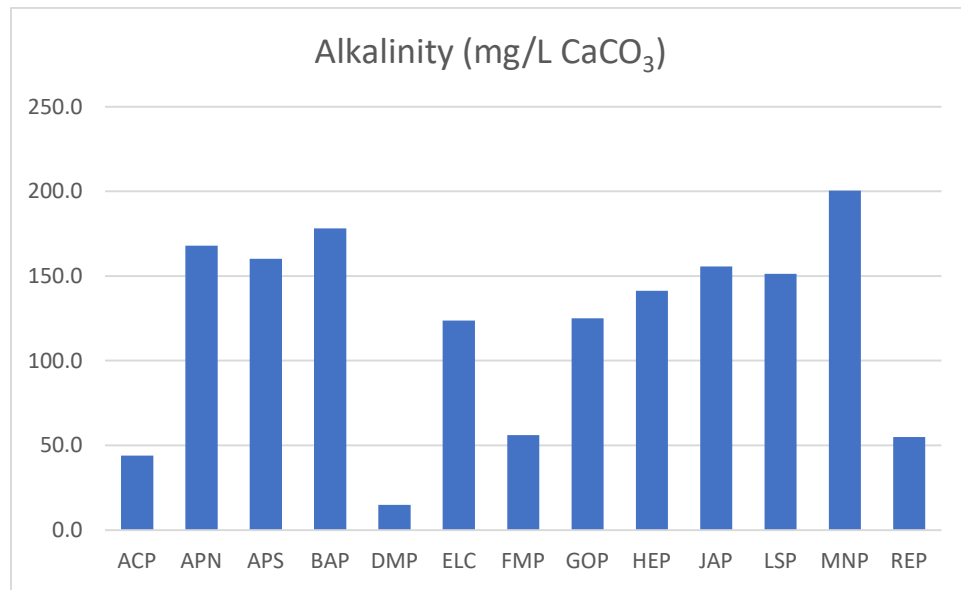
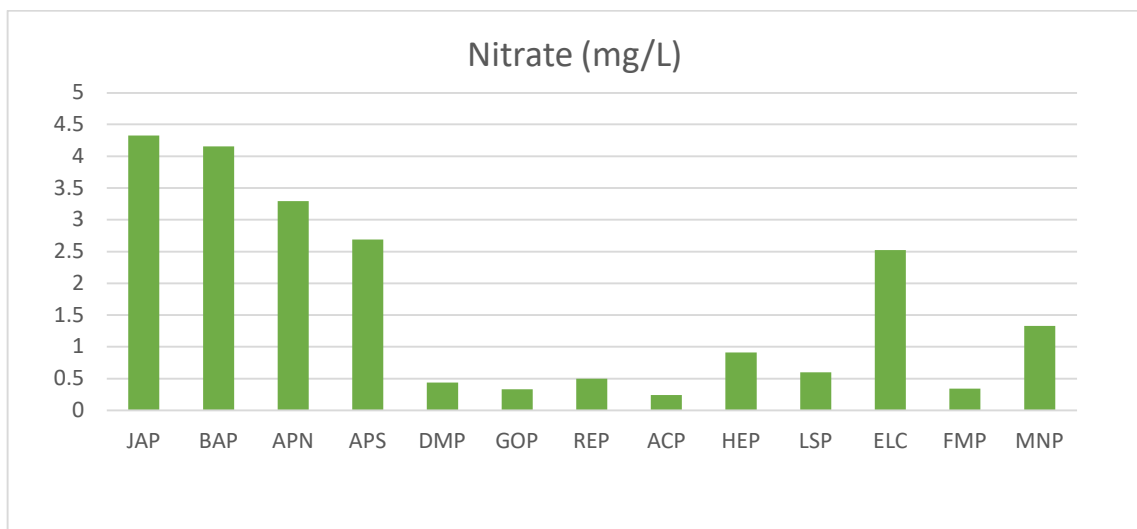


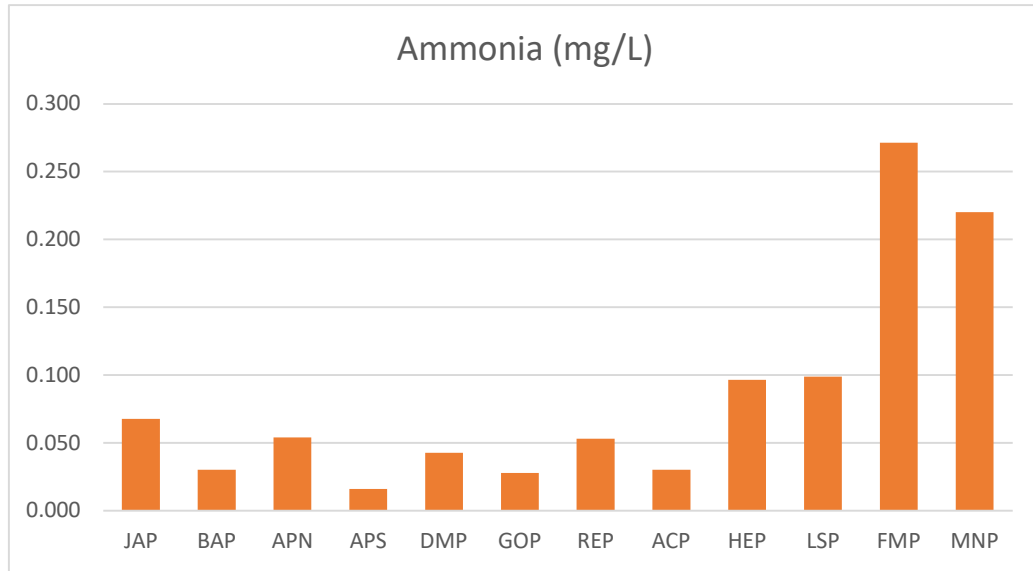
Figure 11 shows higher concentrations of Nitrate were found in Barbour's Pond, Jardine's Pond, Andrew's Pond South, Andrew's Pond North and Ellen's Creek.

Figure 11. Nitrate



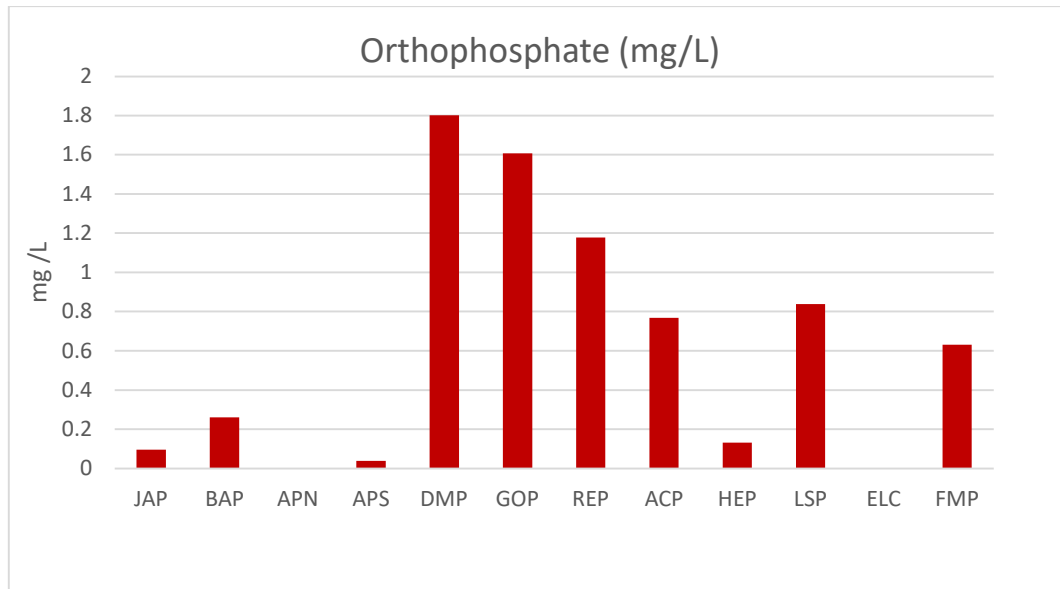
Concentrations of Total Ammonia were highest in Farmer's Market Pond and MacNeill's Pond. See Figure 12.

Figure 12. Total Ammonia



Concentrations of Phosphate were highest in Dead Man's Pond, Governor's Pond, and Reardon's Pond. See Figure 13.

Figure 13. Phosphate

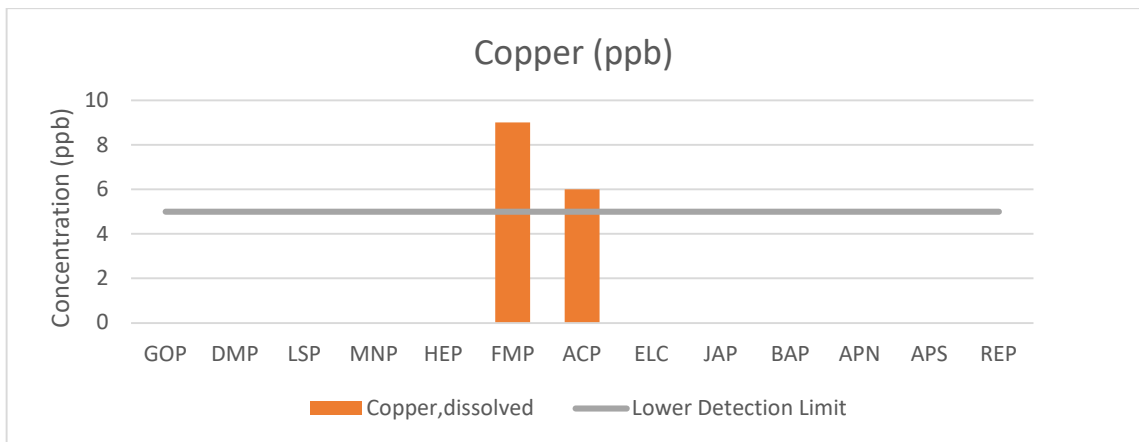


5.2.3 Analytical Results

One sample from each location was analyzed at PEI Analytical Laboratories. Table 1 in Appendix D summarizes the analytical data. Copies of the reports are in Appendix D. The PEI Analytical Laboratories reports results in ppb. One (1) ppb is almost equivalent to one (1) $\mu\text{g}/\text{L}$ which is the measurement used by Canadian Environmental Quality Guidelines (CEQG). CEQG guidelines are shown using their unit of measurement. Some elements were detected above the Canadian Environmental Quality Guidelines (CEQG) for the Protection of Aquatic Life.

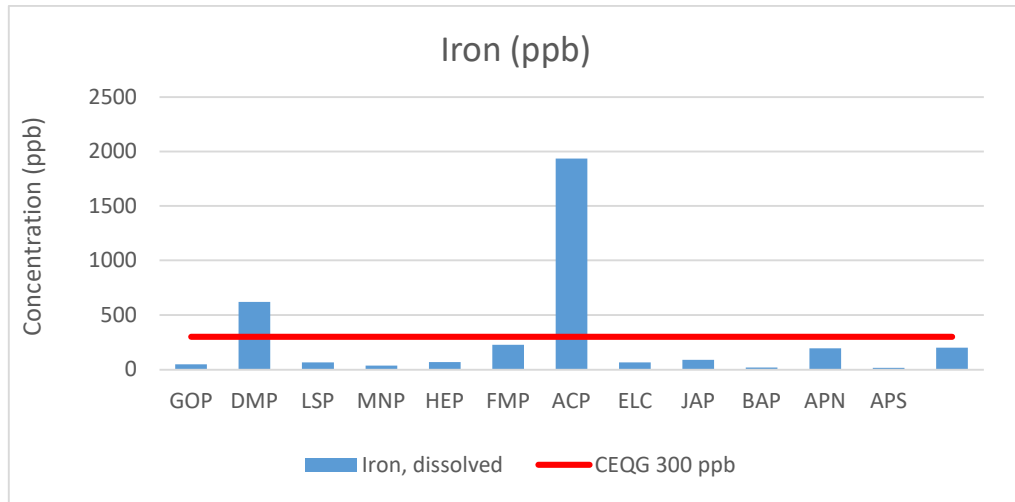
Concentrations of Copper were highest in Farmer's Market Pond (9 ppb) and Ag. Canada Pond (6 ppb). In the remainder of the ponds Copper concentrations were under the detection limit of 5 ppb. See Figure 14.

Figure 14. Concentration of Copper in surface water



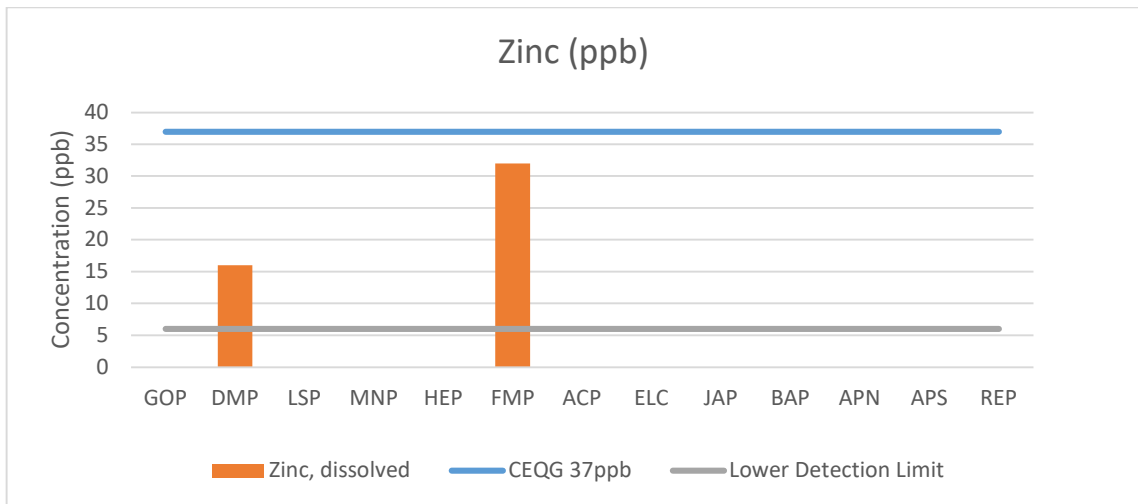
Concentrations of Iron were detected above the CEQG ($300 \mu\text{g}/\text{L}$) in Ag. Canada (1934 ppb), and Deadman's Pond (619 ppb). See Figure 15.

Figure 15. Concentration of Iron in surface water



Concentrations of Zinc were not detected above the CEQG (37 $\mu\text{g}/\text{L}$) in any of the locations. Farmer's Market Pond (32 ppb), and Dead Man's Pond (16 ppb) were the only locations to have Zinc concentrations over the 6 ppb detection limit. See Figure 16.

Figure 16. Concentration of Zinc in surface water



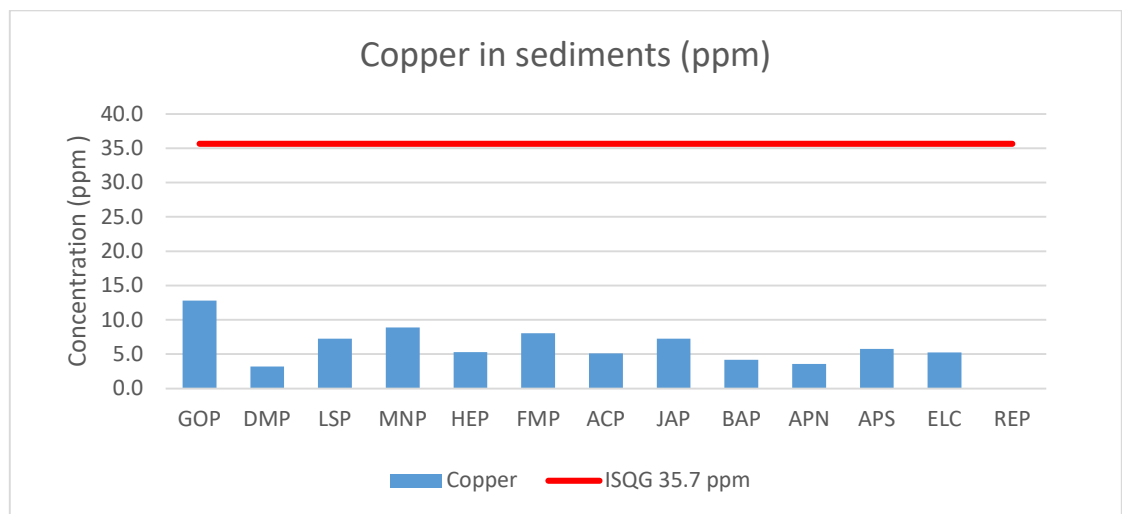
5.3 SEDIMENT QUALITY

5.3.1 Analytical Results

One sediment sample was collected from each location and sent to the PEI Analytical Lab. Lab reports are included in Appendix D, as well as the summary of the sediment results (Table 2).

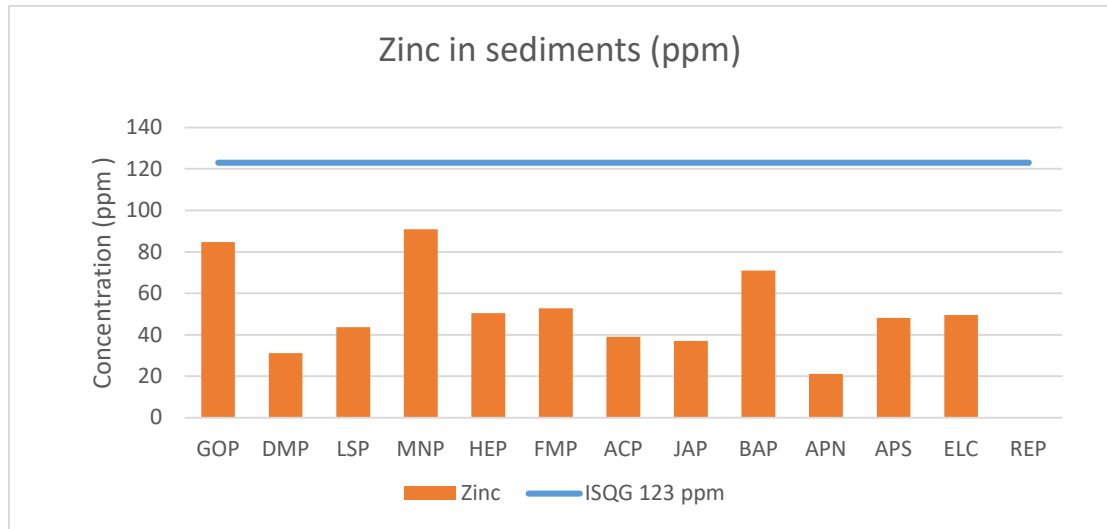
Concentrations of Copper were found below the Interim Sediment Quality Guidelines for aquatic life (ISQG) value. See Figure 17.

Figure 17. Concentration of Copper in sediments



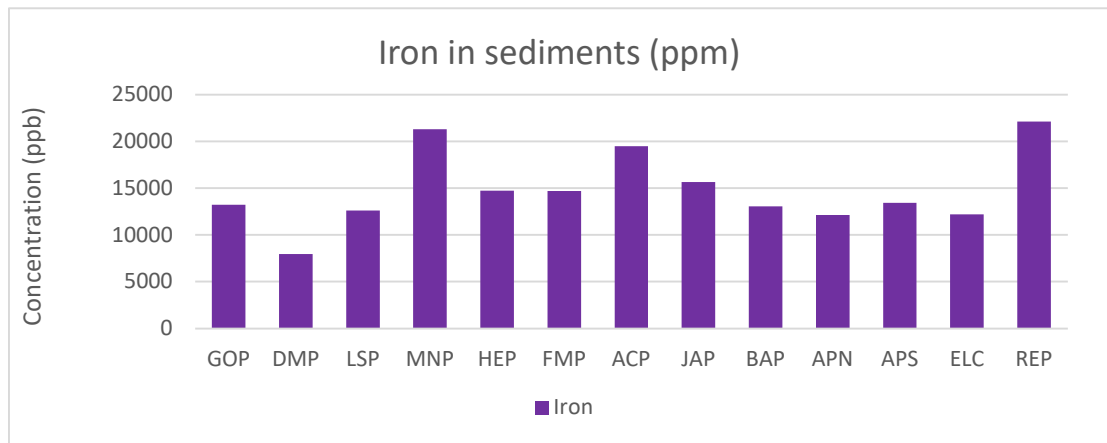
Concentrations of Zinc were detected below the ISQG for aquatic life (123 ppm) in all locations. The highest concentration of Zinc was detected in MacNeil's Pond, Governor's Pond and Barbour's Pond. See Figure 18.

Figure 18. Concentration of Zinc in sediments



Concentrations of Iron are shown in Figure 19 below. There is no ISQG for Iron in sediments.

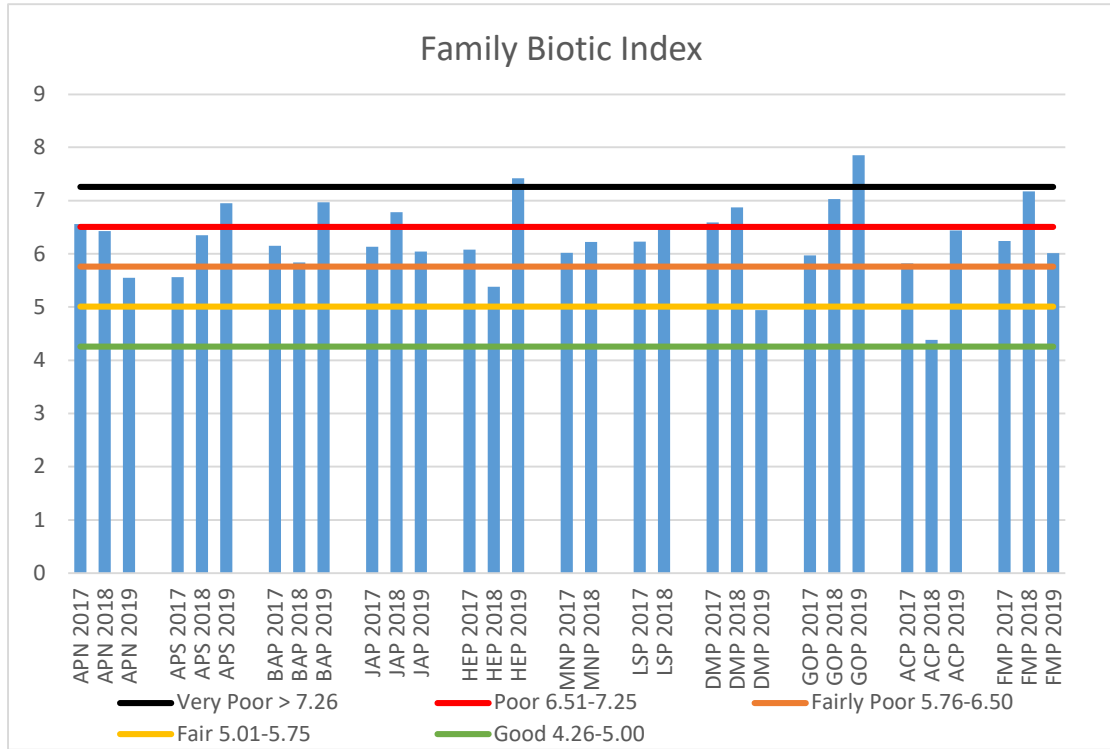
Figure 19. Concentration of Iron in sediments



5.4 COMPARATIVE RESULTS

5.4.1 Macroinvertebrates

Figure 20. Macroinvertebrates



5.4.2 Surface Water Physiochemical Parameters

Figure 21. pH Comparison

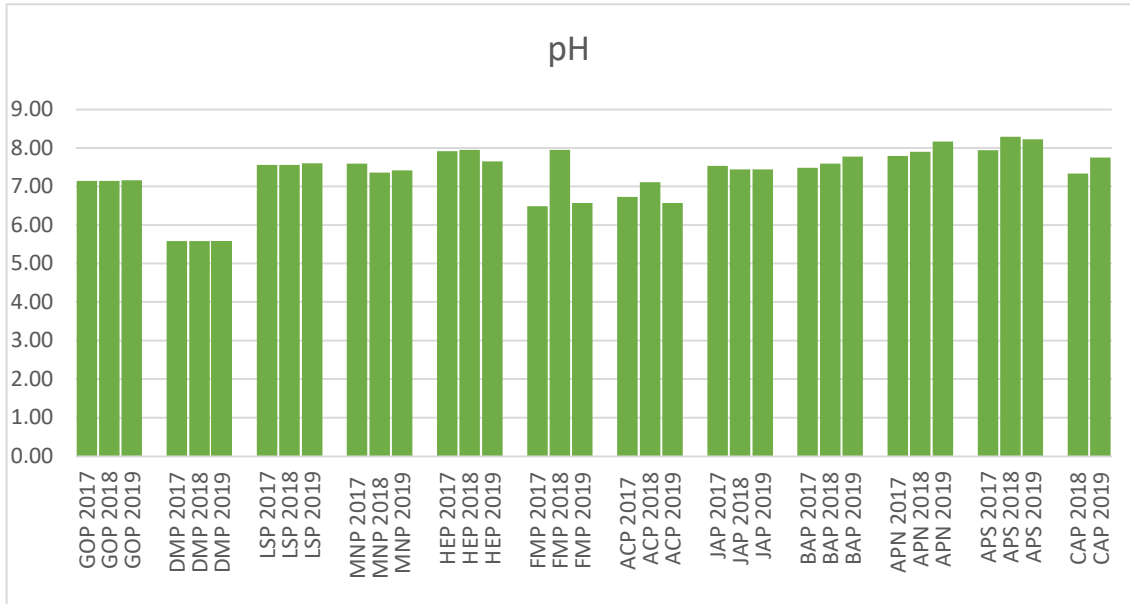


Figure 22. Temperature

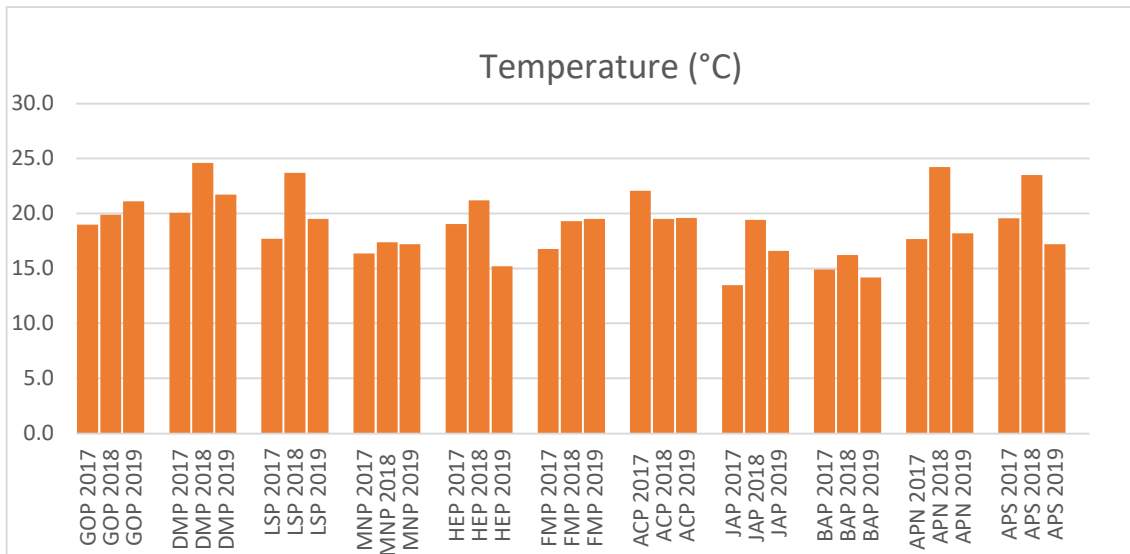


Figure 23. Dissolved Oxygen

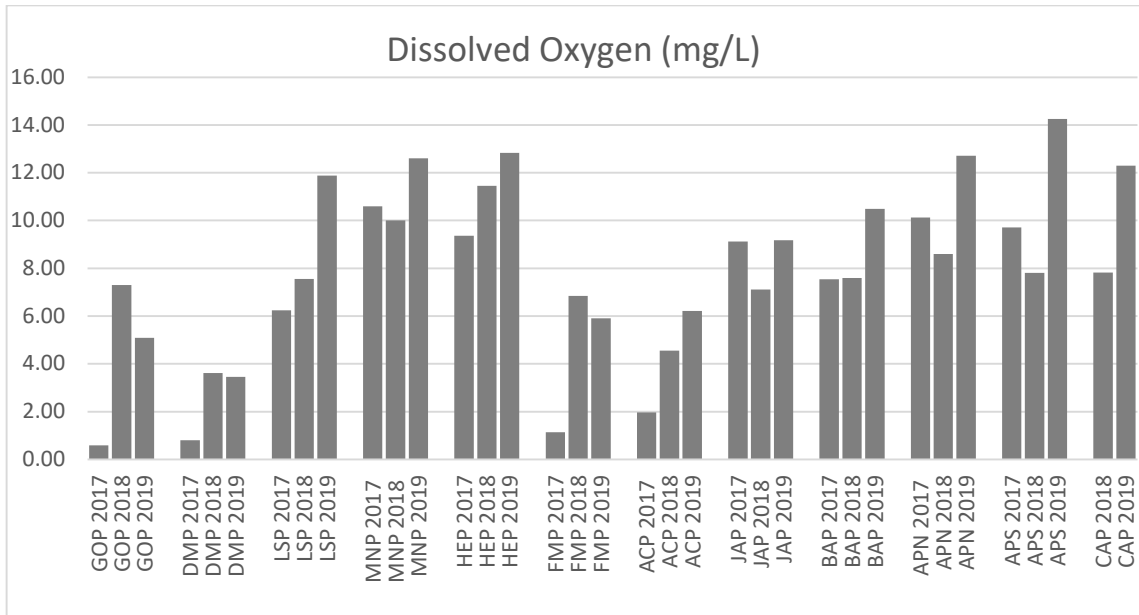
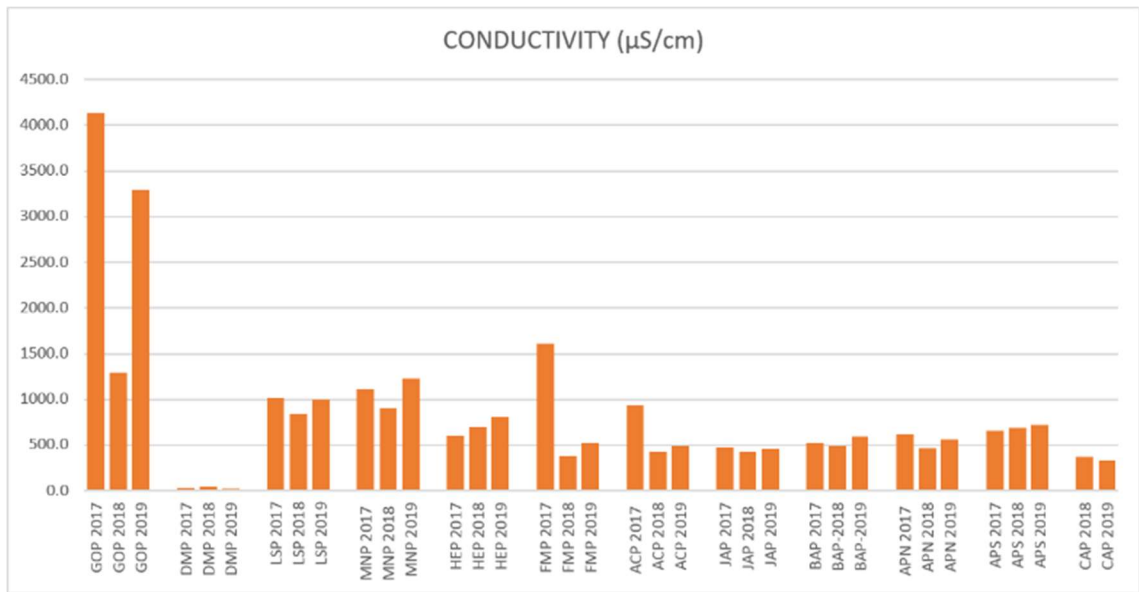


Figure 24. Conductivity



5.4.3 Surface Water Hardness, Ammonia, Nitrate and Phosphate

Figure 25. Water Hardness

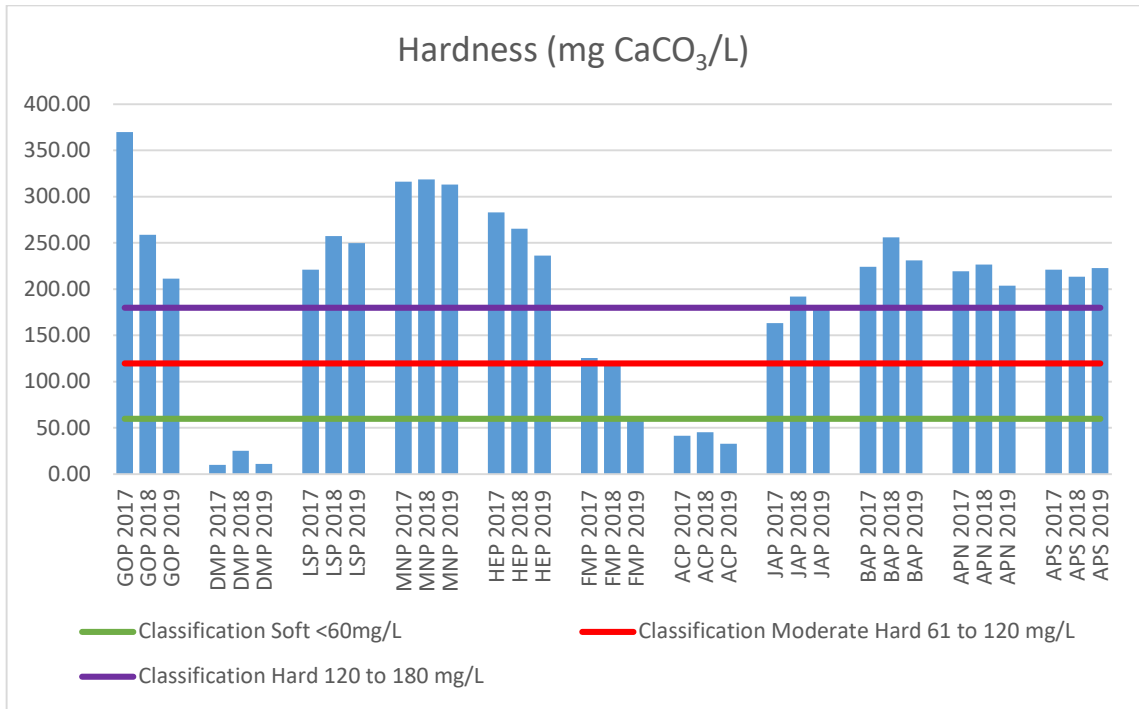


Figure 26. Nitrate 2018 v. 2019

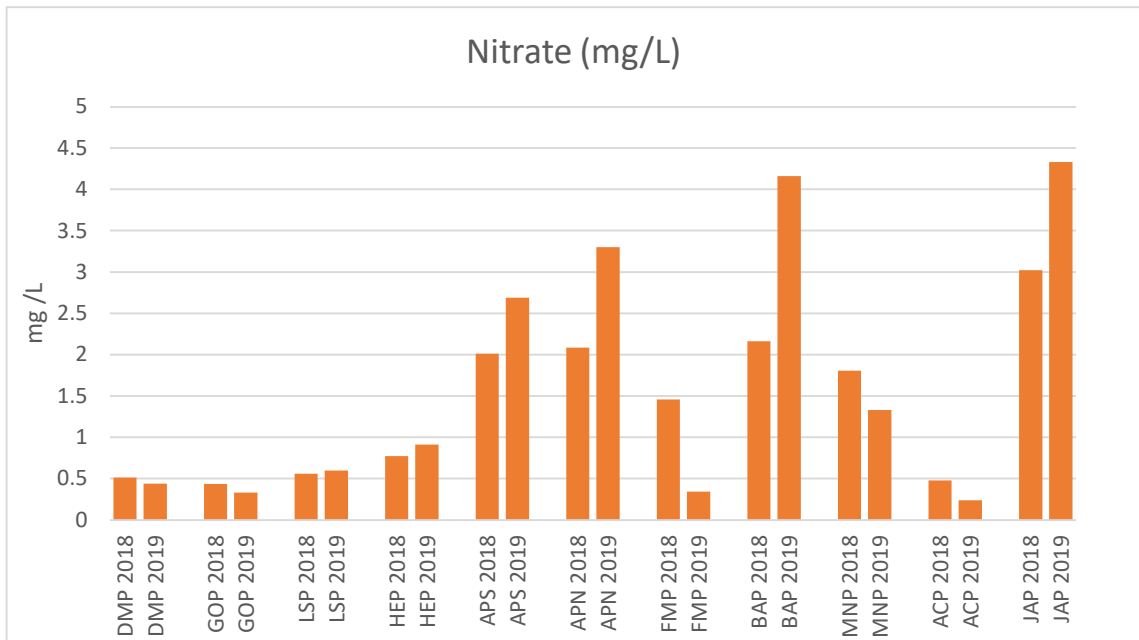


Figure 27. Ammonia 2018 v. 2019

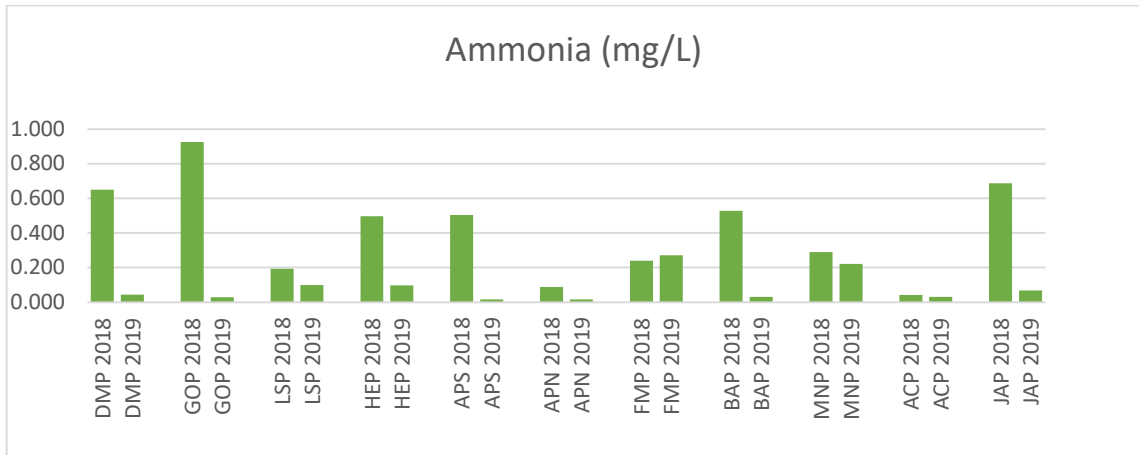
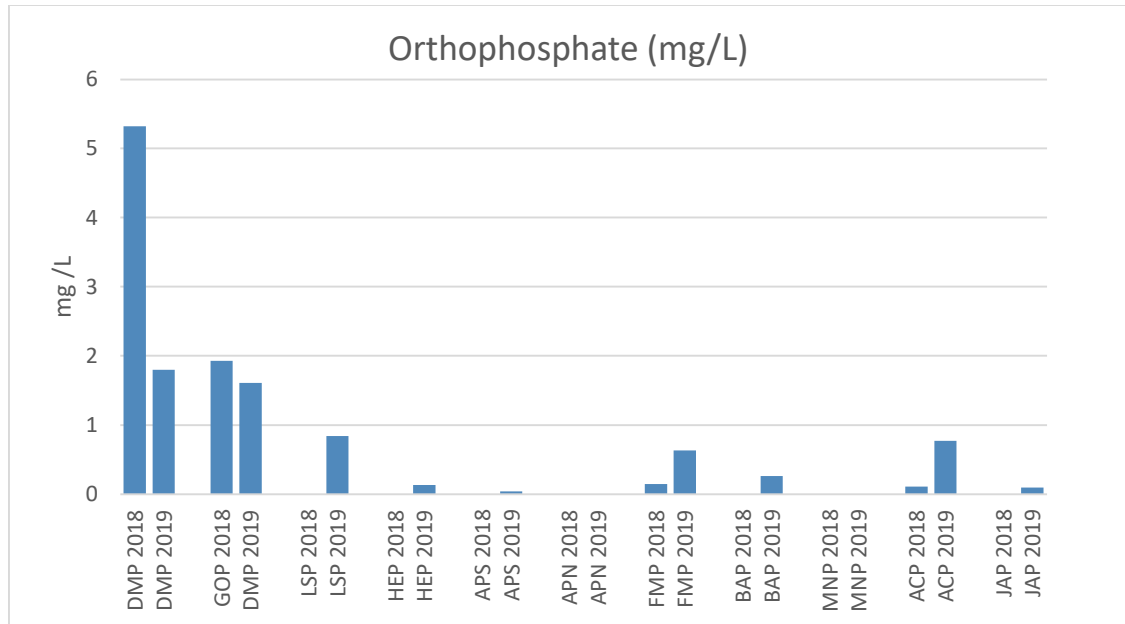


Figure 28. Phosphate 2018 v. 2019



5.4.4 Surface Water Analytical Results

Figure 29. Copper Concentrations in Surface Water 2018 v. 2019

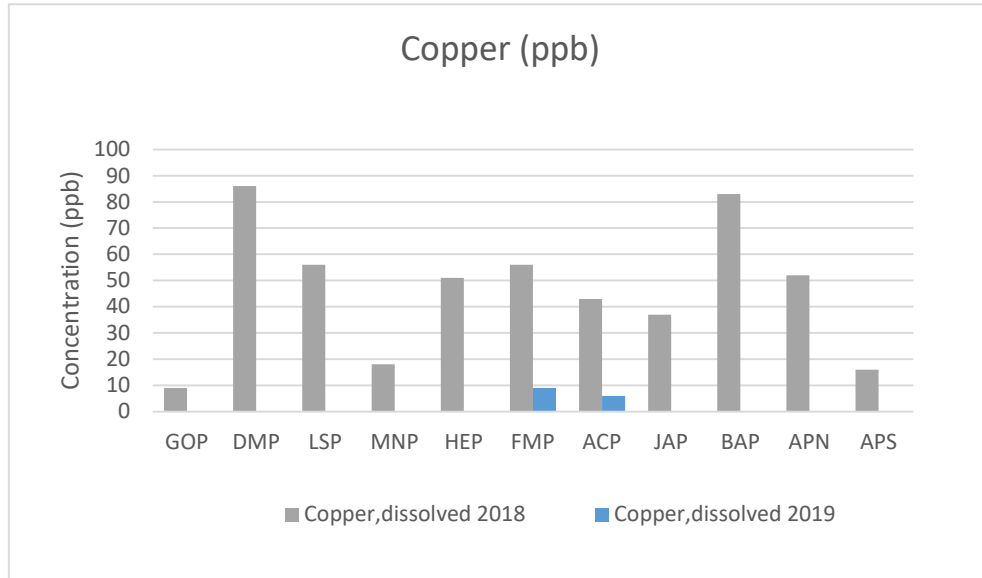


Figure 30. Iron Concentrations in Surface Water 2018 v. 2019

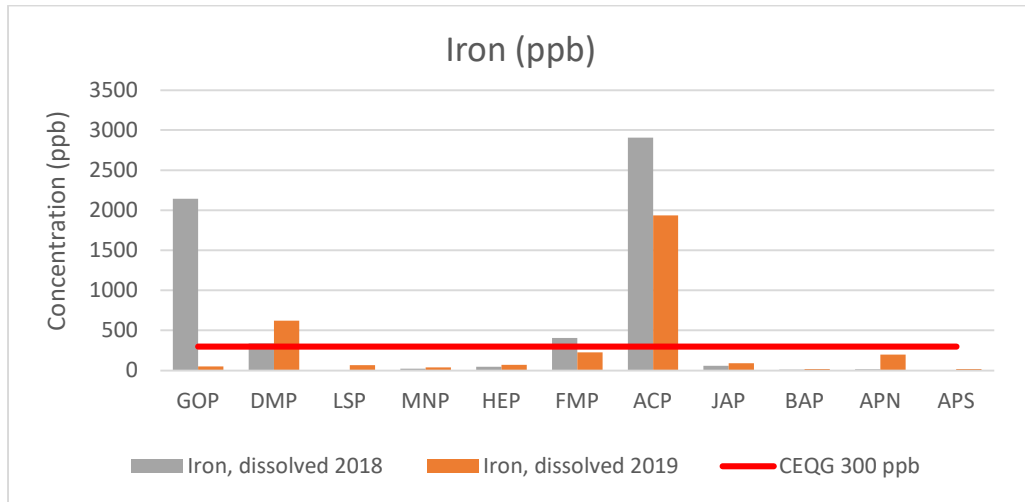
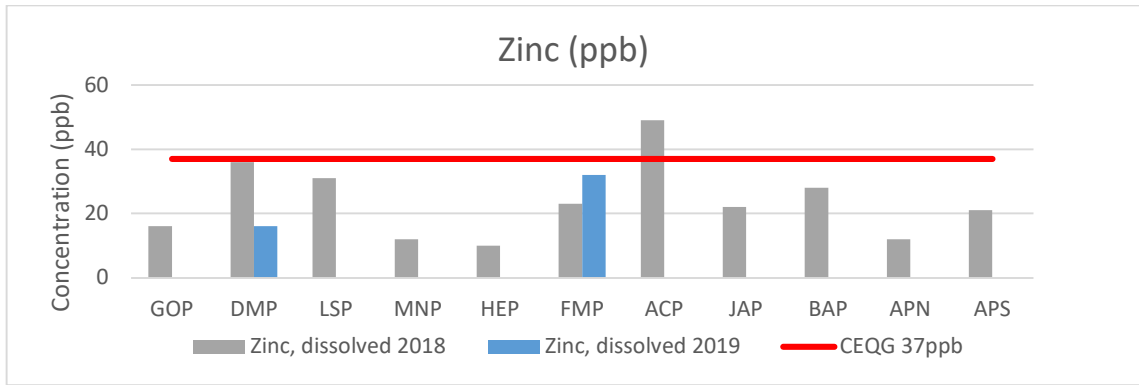


Figure 31. Zinc Concentrations in Surface Water 2018 v. 2019



5.4.5 Sediment Quality Analytical Results

Figure 32. Copper Concentrations in Sediments 2018 v. 2019

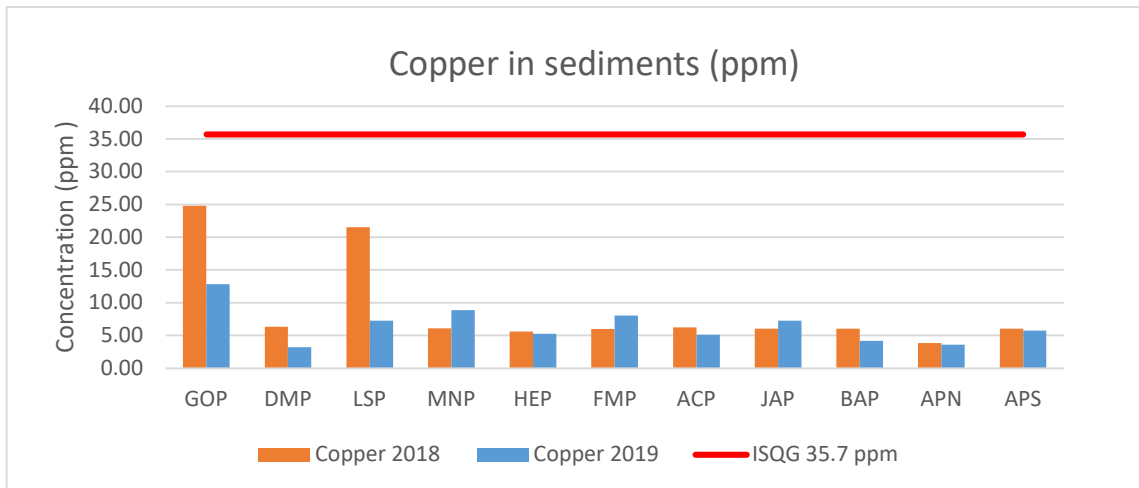


Figure 33. Zinc Concentrations in Sediments 2018 v. 2019

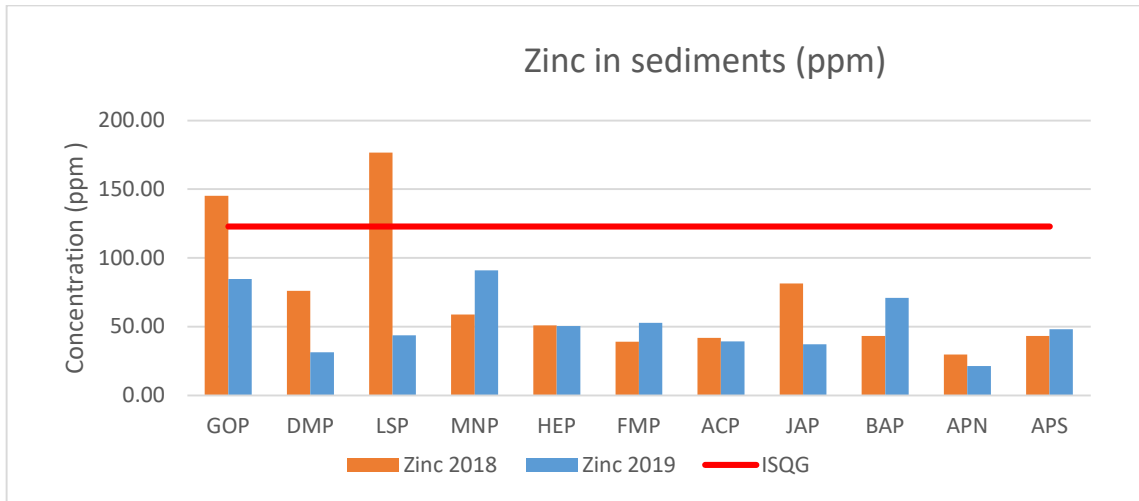
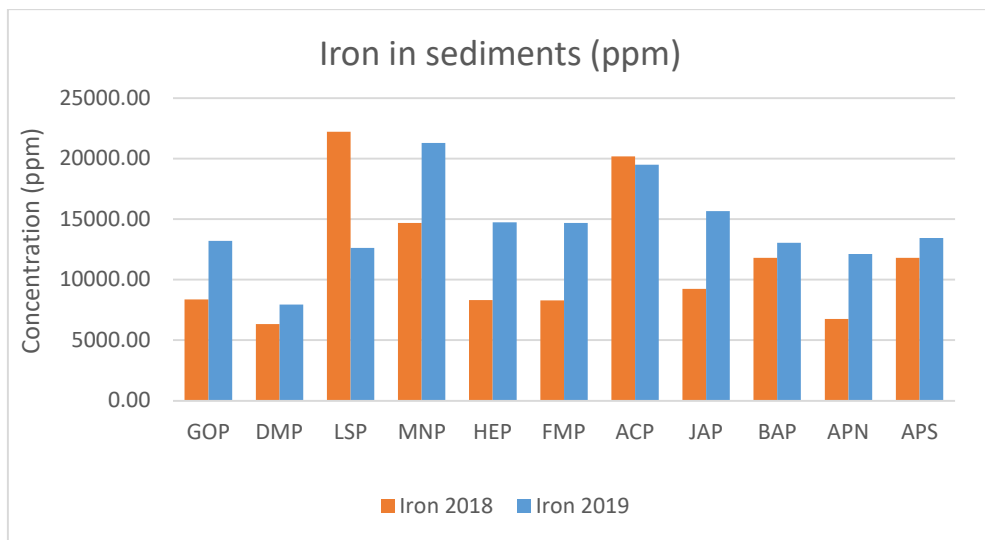


Figure 34. Iron Concentration in Sediments 2018 v. 2019



6 DISCUSSION

Regarding the macroinvertebrates indicators, using the Family Biotic Index (FBI), the water quality of most of the ponds was considered “Fairly poor” or worse, which indicates that the ponds are under substantial pollution. It is important to

note that FBI is an indicator of pollution, primarily applied in streams, and the index can be affected by low natural biological potential such as poor habitat condition.

The pH values ranged from 5.58 at Dead Man's Pond to 8.22 at Andrew Pond South which indicates a slightly acidic and a slightly basic environment, respectively.

With regards to dissolved oxygen, Dead Man's Pond had very low DO readings. Low dissolved oxygen is primarily related to excessive algae growth. As the algae die and decompose, the process consumes dissolved oxygen. However, this does not seem to be the cause of the very low DO readings in Dead Man's Pond. This requires more exploration.

Copper was detected above the guideline values in Farmer's Market Pond and Ag. Canada Pond. However, the guideline value is 2 ppb, which is lower than what can be detected (5 ppb). In the rest of the locations copper concentrations did not meet the detection limit. Water hardness has a significant effect on Cu and Zn toxicity on fish. Copper and Zn are more toxic in the soft water than in the hard water. Only Dead Man's Pond, Ag. Canada Pond and Farmer's Market Pond contain what is classified as soft water.

Regarding Total Ammonia concentration, Canadian Water Quality Guidelines for Protection of Aquatic Life vary by temperature and pH. They decrease as temperature and pH rises. None of the levels reported exceed guidelines.

Concentrations of iron were detected above the CEQG in the Ag. Canada Pond and Dead Man's Pond. The presence of iron in fresh water can occur naturally.

7 CONCLUSIONS

Based on the results of the assessment, it can be concluded that:

- Based on the macroinvertebrate surveys, the water quality of most of the ponds was considered “Fairly poor” or worse, which indicates that the ponds are under substantial pollution.
- The water in most of the ponds was hard or very hard, except for the water in Dead Man’s Pond, Ag. Canada Pond and Farmer’s Market Pond which were soft.
- Based on the surface water analyses, copper and iron were detected above the guideline values.
- Based on the sediment analyses, zinc and copper have concentrations detected below the guideline values.

It is recommended that the monitoring program continue as more data is needed to assess factors impacting the ecological health of the ponds in the Charlottetown area.

Improvements in sampling techniques and observational recordings such as photographing the ponds and their surroundings for changes, will be beneficial to ensure better data quality.

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APPENDIX A

PICTURES

Figure 1. View of Jardine's Pond May 2019 by Michelle Costello



Figure 2. View of Dead Man's Pond July 2019 by Michelle Costello



Figure 3. View of Governor's Pond August 2019 by Michelle Costello



Figure 4. View of Barbour's Pond August 2019 by Michelle Costello



Figure 5. View of Reardon's Pond May 2019 by Michelle Costello



Figure 6. View of Reardon’s Pond September 2019 by Michelle Costello



Figure 7. Macroinvertebrate sampling at Reardon's Pond August 2019 by Michelle Costello



Figure 8. Teamwork makes the dream work!



**Figure 9. Macroinvertebrate sampling at Andrew's Pond South August 2019
by Michelle Costello**



Figure 10. Sediment Sampling Reardon's Pond September 2019



APPENDIX B

FBI RAW DATA

Table 1. Summary of Family Biotic Index Results

Hilsenhoff Biotic Index (HBI)				
POND	Hilsenhoff Biotic Index Value	Hilsenhoff Biotic Index Result	# Not Classified as Unimpaired	*Overall Score
CONTROL POND				
Reardon's Pond	5.73	Unimpaired	2	Unimpaired
WRIGHT'S CREEK WATERSHED				
Andrew's Pond South	6.95	Possibly Impaired	5	Potentially Impaired
Andrew's Pond North	5.55	Unimpaired	6	Potentially Impaired
Barbour's Pond	6.97	Possibly Impaired	7	Potentially Impaired
Jardines Pond	6.04	Possibly Impaired	4	Unimpaired
ELLEN'S CREEK WATERSHED				
Hermitage Pond	7.42	Impaired	8	Potentially Impaired
Ellen's Creek	5.35	Unimpaired	6	Potentially Impaired
OTHER PONDS				
Farmers Market Pond	6.01	Possibly Impaired	7	Potentially Impaired
Agriculture Canada Pond	6.44	Possibly Impaired	8	Potentially Impaired
Dead Man's Pond	4.94	Unimpaired	6	Potentially Impaired
Governor's Pond	7.85	Impaired	8	Potentially Impaired

*Formula was used to determine degree of impairment

Table 2. Raw Data Family Biotic Index (FBI)

Benthic Data Analysis												
Stream:		Ag. Canada Pond										
Monitoring Date:		July 9, 2019										
Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria					
							Impaired	Possibly Impaired	Unimpaired			
Amphipoda	Scud	6	30	1 % Worm (Oligochatea, Nematoda and Tubellaria)	22.73%	Possibly Impaired	> 30%	10% to 30%	< 10%			
Anisoptera	Dragonfly	5	0	2 % Midge (Chironomidae)	4.55%	Unimpaired	> 40%	10% to 40%	< 10%			
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%			
Chironomidae	Midge	7	3	4 % Snails (Gastropoda)	0.00%	Possibly Impaired	-----	< 1% or > 10%	1% to 10%			
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	5	Impaired	≤ 11	-----	> 11			
Coleoptera	Beetle	4	0	6 % Dominant Taxon	45.45%	Impaired	> 45%	40% to 45%	< 40			
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	3.03%	Impaired	< 5%	5% to 10%	> 10%			
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	4.55%	Impaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%			
Diptera, Misc.	Misc. True Flies	NA	0	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Trichoptera, Zygoptera)	7.58%	Impaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%			
Ephemeroptera	Mayfly	5	0	10 Hilsenhoff Biotic Index (HBI)	6.44	Possibly Impaired	> 7	6 to 7	< 6			
Gastropoda	Snail	8	0									
Hemiptera	True Bug	5	0	Overall Result								
Hirudinea	Leech	8	0	# Not Classified as "Unimpaired"			8					
Isopoda	Aquatic Sowbug	8	0	Result			Potentially Impaired					
Oligochaeta	Aquatic Worm	8	15									
Trichoptera	Caddisfly	4	2									
Trombidiformes-Hydracarina	Water Mite	6	16									
Number (All Groups except Unknown)			66									
Number (Diptera)			3									
Number (Insects)			5									
Number (Most Abundant Group)			30									

Benthic Data Analysis

Stream:	Farmer's Market Pond
Monitoring Date:	July 16, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria				
							Impaired	Possibly Impaired	Unimpaired		
Amphipoda	Scud	6	41	1 % Worm (Oligochatea, Nematoda and Tubellaria)	0.00%	Unimpaired	> 30%	10% to 30%	< 10%		
Anisoptera	Dragonfly	5	0	2 % Midge (Chironomidae)	27.94%	Possibly Impaired	> 40%	10% to 40%	< 10%		
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%		
Chironomidae	Midge	7	19	4 % Snails (Gastropoda)	0.00%	Possibly Impaired	----	< 1% or > 10%	1% to 10%		
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	8	Impaired	≤ 11	----	> 11		
Coleoptera	Beetle	4	1	6 % Dominant Taxon	60.29%	Impaired	> 45%	40% to 45%	< 40		
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	2.94%	Impaired	< 5%	5% to 10%	> 10%		
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	30.88%	Unimpaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%		
Diptera, Misc.	Misc. True Flies	NA	2	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Tricoptera, Zygoptera)	38.24%	Impaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%		
Ephemeroptera	Mayfly	5	0	10 Hilsenhoff Biotic Index (HBI)	6.01	Possibly Impaired	> 7	6 to 7	< 6		
Gastropoda	Snail	8	0	Overall Result							
Hemiptera	True Bug	5	1							# Not Classified as "Unimpaired"	
Hirudinea	Leech	8	0	Result						Potentially Impaired	
Isopoda	Aquatic Sowbug	8	0								
Tricoptera	Caddisfly	4	2								
Trombidiformes-Hydracarina	Water Mite	6	1								
Zygoptera	Damselfly	7	1								
Number (All Groups except Unknown)			68								
Number (Diptera)			21								
Number (Insects)			26								
Number (Most Abundant Group)			41								

Benthic Data Analysis

Stream:	Andrew's Pond North
Monitoring Date:	June 4, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria				
							Impaired	Possibly Impaired	Unimpaired		
Amphipoda	Scud	6	0	1 % Worm (Oligochatea, Nematoda and Tubellaria)	18.18%	Possibly Impaired	> 30%	10% to 30%	< 10%		
Anisoptera	Dragonfly	5	1	2 % Midge (Chironomidae)	36.36%	Possibly Impaired	> 40%	10% to 40%	< 10%		
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%		
Chironomidae	Midge	7	4	4 % Snails (Gastropoda)	0.00%	Possibly Impaired	-----	< 1% or > 10%	1% to 10%		
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	5	Impaired	≤ 11	-----	> 11		
Coleoptera	Beetle	4	0	6 % Dominant Taxon	36.36%	Unimpaired	> 45%	40% to 45%	< 40		
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	27.27%	Unimpaired	< 5%	5% to 10%	> 10%		
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	45.45%	Possibly Impaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%		
Diptera, Misc.	Misc. True Flies	NA	1	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Tricoptera, Zygoptera)	81.82%	Possibly Impaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%		
Ephemeroptera	Mayfly	5	0	10 Hilsenhoff Biotic Index (HBI)	5.55	Unimpaired	> 7	6 to 7	< 6		
Gastropoda	Snail	8	0	Overall Result							
Hemiptera	True Bug	5	0							# Not Classified as "Unimpaired"	6
Hirudinea	Leech	8	0	Result							
Isopoda	Aquatic Sowbug	8	0							Potentially Impaired	
Oligochaeta	Aquatic Worm	8	2								
Tricoptera	Caddisfly	4	3								
Number (All Groups except Unknown)			11								
Number (Diptera)			5								
Number (Insects)			9								
Number (Most Abundant Group)			4								

Benthic Data Analysis

Stream:	Andrew's Pond South
Monitoring Date:	August 13, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria				
							Impaired	Possibly Impaired	Unimpaired		
Amphipoda	Scud	6	9	1 % Worm (Oligochatea, Nematoda and Tubellaria)	3.41%	Unimpaired	> 30%	10% to 30%	< 10%		
Anisoptera	Dragonfly	5	1	2 % Midge (Chironomidae)	0.00%	Unimpaired	> 40%	10% to 40%	< 10%		
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%		
Chironomidae	Midge	7	0	4 % Snails (Gastropoda)	58.52%	Possibly Impaired	----	< 1% or > 10%	1% to 10%		
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	11	Unimpaired	≤ 11	----	> 11		
Coleoptera	Beetle	4	12	6 % Dominant Taxon	58.52%	Impaired	> 45%	40% to 45%	< 40		
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	13.64%	Unimpaired	< 5%	5% to 10%	> 10%		
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	0.57%	Impaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%		
Diptera, Misc.	Misc. True Flies	NA	1	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Tricoptera, Zygoptera)	22.73%	Impaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%		
Ephemeroptera	Mayfly	5	2	10 Hilsenhoff Biotic Index (HBI)	6.95	Possibly Impaired	> 7	6 to 7	< 6		
Gastropoda	Snail	8	103	Overall Result							
Hemiptera	True Bug	5	2							# Not Classified as "Unimpaired"	5
Hirudinea	Leech	8	14	Result		Potentially Impaired					
Isopoda	Aquatic Sowbug	8	0								
Oligochaeta	Aquatic Worm	8	6								
Pelecypoda	Clam, Mussel	6	4								
Tricoptera	Caddisfly	4	22								
Number (All Groups except Unknown)			176								
Number (Diptera)			1								
Number (Insects)			40								
Number (Most Abundant Group)			103								

Benthic Data Analysis

Stream:	Barbour's Pond
Monitoring Date:	August 12, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria							
							Impaired	Possibly Impaired	Unimpaired					
Amphipoda	Scud	6	0	1 % Worm (Oligochatea, Nematoda and Tubellaria)	4.33%	Unimpaired	> 30%	10% to 30%	< 10%					
Anisoptera	Dragonfly	5	0	2 % Midge (Chironomidae)	61.50%	Impaired	> 40%	10% to 40%	< 10%					
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%					
Chironomidae	Midge	7	270	4 % Snails (Gastropoda)	23.23%	Possibly Impaired	----	< 1% or > 10%	1% to 10%					
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	7	Impaired	≤ 11	-----	> 11					
Coleoptera	Beetle	4	5	6 % Dominant Taxon	61.50%	Impaired	> 45%	40% to 45%	< 40					
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	8.43%	Possibly Impaired	< 5%	5% to 10%	> 10%					
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	61.50%	Impaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%					
Diptera, Misc.	Misc. True Flies	NA	0	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Tricoptera, Zygoptera)	71.07%	Unimpaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%					
Ephemeroptera	Mayfly	5	0	10 Hilsenhoff Biotic Index (HBI)	6.97	Possibly Impaired	> 7	6 to 7	< 6					
Gastropoda	Snail	8	102	Overall Result										
Hemiptera	True Bug	5	0							# Not Classified as "Unimpaired"	7			
Hirudinea	Leech	8	0							Result	Potentially Impaired			
Isopoda	Aquatic Sowbug	8	0											
Oligochaeta	Aquatic Worm	8	19											
Pelecypoda	Clam, Mussel	6	3											
Trichoptera	Caddisfly	4	37											
Trombidiformes-Hydracarina	Water Mite	6	3											
Number (All Groups except Unknown)			439											
Number (Diptera)			270											
Number (Insects)			312											
Number (Most Abundant Group)			270											

Benthic Data Analysis

Stream:	Jardines Pond
Monitoring Date:	August 14, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria				
							Impaired	Possibly Impaired	Unimpaired		
Amphipoda	Scud	6	3	1 % Worm (Oligochatea, Nematoda and Tubellaria)	9.69%	Unimpaired	> 30%	10% to 30%	< 10%		
Anisoptera	Dragonfly	5	2	2 % Midge (Chironomidae)	44.90%	Impaired	> 40%	10% to 40%	< 10%		
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%		
Chironomidae	Midge	7	88	4 % Snails (Gastropoda)	4.59%	Unimpaired	-----	< 1% or > 10%	1% to 10%		
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	14	Unimpaired	≤ 11	-----	> 11		
Coleoptera	Beetle	4	9	6 % Dominant Taxon	44.90%	Possibly Impaired	> 45%	40% to 45%	< 40		
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	15.31%	Unimpaired	< 5%	5% to 10%	> 10%		
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	49.49%	Possibly Impaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%		
Diptera, Misc.	Misc. True Flies	NA	9	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Trichoptera, Zygoptera)	71.94%	Unimpaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%		
Ephemeroptera	Mayfly	5	3	10 Hilsenhoff Biotic Index (HBI)	6.04	Possibly Impaired	> 7	6 to 7	< 6		
Gastropoda	Snail	8	9	Overall Result							
Hemiptera	True Bug	5	0							# Not Classified as "Unimpaired"	
Hirudinea	Leech	8	21	Result						Unimpaired	
Isopoda	Aquatic Sowbug	8	0								
Oligochaeta	Aquatic Worm	8	19								
Pelecypoda	Clam, Mussel	6	2								
Plecoptera	Stonefly	1	17								
Trichoptera	Caddisfly	4	10								
Trombidiformes-Hydracarina	Water Mite	6	1								
Zygoptera	Damselfly	7	3								
Number (All Groups except Unknown)			196								
Number (Diptera)			97								
Number (Insects)			141								
Number (Most Abundant Group)			88								

Benthic Data Analysis

Stream: Hermitage Pond

Monitoring Date: August 7, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria				
							Impaired	Possibly Impaired	Unimpaired		
Amphipoda	Scud	6	6	1 % Worm (Oligochatea, Nematoda and Tubellaria)	14.14%	Possibly Impaired	> 30%	10% to 30%	< 10%		
Anisoptera	Dragonfly	5	0	2 % Midge (Chironomidae)	23.14%	Possibly Impaired	> 40%	10% to 40%	< 10%		
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%		
Chironomidae	Midge	7	90	4 % Snails (Gastropoda)	43.19%	Possibly Impaired	----	< 1% or > 10%	1% to 10%		
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	8	Impaired	≤ 11	----	> 11		
Coleoptera	Beetle	4	1	6 % Dominant Taxon	43.19%	Possibly Impaired	> 45%	40% to 45%	< 40		
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	6.17%	Possibly Impaired	< 5%	5% to 10%	> 10%		
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	23.14%	Unimpaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%		
Diptera, Misc.	Misc. True Flies	NA	0	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Tricoptera, Zygoptera)	29.56%	Impaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%		
Ephemeroptera	Mayfly	5	0	10 Hilsenhoff Biotic Index (HBI)	7.42	Impaired	> 7	6 to 7	< 6		
Gastropoda	Snail	8	168	Overall Result							
Hemiptera	True Bug	5	0							# Not Classified as "Unimpaired"	8
Hirudinea	Leech	8	33	Result							
Isopoda	Aquatic Sowbug	8	0							Potentially Impaired	
Oligochaeta	Aquatic Worm	8	55								
Pelecypoda	Clam, Mussel	6	12								
Trichoptera	Caddisfly	4	24								
Number (All Groups except Unknown)			389								
Number (Diptera)			90								
Number (Insects)			115								
Number (Most Abundant Group)			168								

Benthic Data Analysis

Stream:	Dead Man's Pond
Monitoring Date:	August 20, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria								
							Impaired	Possibly Impaired	Unimpaired						
Amphipoda	Scud	6	0	1 % Worm (Oligochatea, Nematoda and Tubellaria)	0.00%	Unimpaired	> 30%	10% to 30%	< 10%						
Anisoptera	Dragonfly	5	0	2 % Midge (Chironomidae)	27.78%	Possibly Impaired	> 40%	10% to 40%	< 10%						
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%						
Chironomidae	Midge	7	5	4 % Snails (Gastropoda)	0.00%	Possibly Impaired	-----	< 1% or > 10%	1% to 10%						
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	3	Impaired	≤ 11	-----	> 11						
Coleoptera	Beetle	4	11	6 % Dominant Taxon	61.11%	Impaired	> 45%	40% to 45%	< 40						
Cuclidae	Mosquito	5		7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	0.00%	Impaired	< 5%	5% to 10%	> 10%						
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	27.78%	Unimpaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%						
Diptera, Misc.	Misc. True Flies	NA	0	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Tricoptera, Zygoptera)	100.00%	Impaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%						
Ephemeroptera	Mayfly	5	0	10 Hilsenhoff Biotic Index (HBI)	4.94	Unimpaired	> 7	6 to 7	< 6						
Gastropoda	Snail	8	0	<table border="1" style="width: 100%; text-align: center;"> <tr> <td colspan="2">Overall Result</td> </tr> <tr> <td># Not Classified as "Unimpaired"</td> <td>6</td> </tr> <tr> <td>Result</td> <td>Potentially Impaired</td> </tr> </table>						Overall Result		# Not Classified as "Unimpaired"	6	Result	Potentially Impaired
Overall Result															
# Not Classified as "Unimpaired"	6														
Result	Potentially Impaired														
Hemiptera	True Bug	5	2												
Hirudinea	Leech	8	0												
Isopoda	Aquatic Sowbug	8	0												
Number (All Groups except Unknown)			18												
Number (Diptera)			5												
Number (Insects)			18												
Number (Most Abundant Group)			11												

Benthic Data Analysis

Stream:	Governor's Pond
Monitoring Date:	August 21, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria		
							Impaired	Possibly Impaired	Unimpaired
Amphipoda	Scud	6	0	1 % Worm (Oligochatea, Nematoda and Tubellaria)	0.00%	Unimpaired	> 30%	10% to 30%	< 10%
Anisoptera	Dragonfly	5	0	2 % Midge (Chironomidae)	14.81%	Possibly Impaired	> 40%	10% to 40%	< 10%
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%
Chironomidae	Midge	7	4	4 % Snails (Gastropoda)	85.19%	Possibly Impaired	-----	< 1% or > 10%	1% to 10%
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	2	Impaired	≤ 11	-----	> 11
Coleoptera	Beetle	4	0	6 % Dominant Taxon	85.19%	Impaired	> 45%	40% to 45%	< 40
Cuclidae	Mosquito	5		7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	0.00%	Impaired	< 5%	5% to 10%	> 10%
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	14.81%	Impaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%
Diptera, Misc.	Misc. True Flies	NA	0	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Trichoptera, Zygoptera)	14.81%	Impaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%
Ephemeroptera	Mayfly	5	0	10 Hilsenhoff Biotic Index (HBI)	7.85	Impaired	> 7	6 to 7	< 6
Gastropoda	Snail	8	23						
Hemiptera	True Bug	5	0	Overall Result					
Hirudinea	Leech	8	0	# Not Classified as "Unimpaired"	8				
Isopoda	Aquatic Sowbug	8	0	Result	Potentially Impaired				
Number (All Groups except Unknown)			27						
Number (Diptera)			4						
Number (Insects)			4						
Number (Most Abundant Group)			23						

Benthic Data Analysis

Stream:	Reardon's Pond
Monitoring Date:	August 19, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria				
							Impaired	Possibly Impaired	Unimpaired		
Amphipoda	Scud	6	38	1 % Worm (Oligochatea, Nematoda and Tubellaria)	0.00%	Unimpaired	> 30%	10% to 30%	< 10%		
Anisoptera	Dragonfly	5	0	2 % Midge (Chironomidae)	18.39%	Possibly Impaired	> 40%	10% to 40%	< 10%		
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%		
Chironomidae	Midge	7	48	4 % Snails (Gastropoda)	3.83%	Unimpaired	-----	< 1% or > 10%	1% to 10%		
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	13	Unimpaired	≤ 11	-----	> 11		
Coleoptera	Beetle	4	7	6 % Dominant Taxon	29.50%	Unimpaired	> 45%	40% to 45%	< 40		
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	31.80%	Unimpaired	< 5%	5% to 10%	> 10%		
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	18.77%	Possibly Impaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%		
Diptera, Misc.	Misc. True Flies	NA	1	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Trichoptera, Zygoptera)	54.02%	Unimpaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%		
Ephemeroptera	Mayfly	5	4	10 Hilsenhoff Biotic Index (HBI)	5.73	Unimpaired	> 7	6 to 7	< 6		
Gastropoda	Snail	8	10	Overall Result							
Hemiptera	True Bug	5	0							# Not Classified as "Unimpaired"	
Hirudinea	Leech	8	25	Result						Unimpaired	
Isopoda	Aquatic Sowbug	8	0								
Megaloptera	Helgrammite, Fishfly, Alderfly	4	1								
Pelecypoda	Clam, Mussel	6	45								
Plecoptera	Stonefly	1	2								
Trichoptera	Caddisfly	4	77								
Trombidiformes-Hydracarina	Water Mite	6	2								
Zygoptera	Damselfly	7	1								
Number (All Groups except Unknown)			261								
Number (Diptera)			49								
Number (Insects)			141								
Number (Most Abundant Group)			77								

Benthic Data Analysis

Stream:	Ellen's Creek
Monitoring Date:	August 6, 2019

Taxon	Common Name	Tolerance Value	Count (#)	Index	Value	Result	Criteria				
							Impaired	Possibly Impaired	Unimpaired		
Amphipoda	Scud	6	0	1 % Worm (Oligochatea, Nematoda and Tubellaria)	3.04%	Unimpaired	> 30%	10% to 30%	< 10%		
Anisoptera	Dragonfly	5	1	2 % Midge (Chironomidae)	53.28%	Impaired	> 40%	10% to 40%	< 10%		
Ceratopogonidae	No-see-ums	NA	0	3 % Aquatic Sowbug (Isopoda)	0.00%	Unimpaired	> 5%	1% to 5%	< 1%		
Chironomidae	Midge	7	438	4 % Snails (Gastropoda)	0.36%	Possibly Impaired	-----	< 1% or > 10%	1% to 10%		
Coelenterata	Hydra	8	0	5 Number of Taxonomic Groups	10	Impaired	≤ 11	-----	> 11		
Coleoptera	Beetle	4	2	6 % Dominant Taxon	53.28%	Impaired	> 45%	40% to 45%	< 40		
Cuclidae	Mosquito	5	0	7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	27.13%	Unimpaired	< 5%	5% to 10%	> 10%		
Decapoda	Crayfish	5	0	8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	68.98%	Impaired	< 15% or > 50%	15% to 20%, or 45% to	20% to 45%		
Diptera, Misc.	Misc. True Flies	NA	129	9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Tricoptera, Zygoptera)	96.47%	Impaired	< 40% or > 90%	40% to 50%, or 80% to	50% to 80%		
Ephemeroptera	Mayfly	5	197	10 Hilsenhoff Biotic Index (HBI)	5.35	Unimpaired	> 7	6 to 7	< 6		
Gastropoda	Snail	8	3	Overall Result							
Hemiptera	True Bug	5	0							# Not Classified as "Unimpaired"	6
Hirudinea	Leech	8	0	Result							
Isopoda	Aquatic Sowbug	8	0							Potentially Impaired	
Nematoda	Roundworm	8	2								
Oligochaeta	Aquatic Worm	8	23								
Tricoptera	Caddisfly	4	26								
Trombidiformes-Hydracarina	Water Mite	6	1								
Number (All Groups except Unknown)			822								
Number (Diptera)			567								
Number (Insects)			793								
Number (Most Abundant Group)			438								

APPENDIX C

Raw Data Field Measurements by Pond

Table 1. Lower Slick's Pond Data

Lower Slick's Pond						
Date	May 23	June 7	June 17	July 2	July 15	August 9
Time	10:53	11:48	14:05	14:00	12:15	11:10
Air Temperature (°C)	9.0	15.0	21.0	16.0	18.3	22.0
Pressure (kPa)	102.0	101.3	101.2	100.5	100.7	100.3
Weather	Sunny/ partly cloudy	Sunny	Sunny w/cloud	Cloudy	Cloudy	Sunny
Humidity (%)	70	59	43	92	87	82
Location	46.27075°N	46.27076°N	46.27075°N	46.27077°N	46.27083°N	46.27079°N
	063.15020°W	063.15017°W	063.15019°W	063.150160°W	063.15021°W	063.15018°W
Level Above Sea Level (m)	-4	10	9	2	7	8
pH	6.99	7.31	7.77	7.10	7.86	8.36
Temp (°C)	9.7	18.7	25.0	17.8	20.4	25.5
(mV)	-7.9	-38.9	-70.6	-42	-92.9	-
DO (mg/L)	7.94	9.85	13.84	9.59	17.02	13.06
Temp (°C)	10.8	18.7	25.8	17.9	20.6	26.7
(%)	71.2	-	170.2	102.0	190.6	164.8
Pressure (hPa)	1020	-	1013	1005	1006	1002
Conductivity (µS/cm)	716	875	1148	875	1211	1163
Temp (°C)	9.5	18.0	24.8	17.3	20.6	25.1
Salinity (‰)	0.3	0.4	0.6	0.4	0.6	0.6
TDS (mg/L)	357	437	574	437	605	582
Turbidity (NTU)	95.20	62.80	28.80	-	-	-
Hardness (mg/L of CaCO₃)	-	-	-	204	-	295.5
Alkalinity (mg/L of CaCO₃)	-	139	-	138.5	-	176.5
						-
Ammonia (mg/L)	-	0.071	-	0.116	-	0.109
Nitrate (mg/L)	-	0.961	-	0.245	-	0.584
Phosphate (mg/L)	-	2.74	-	-0.425	-	0.200

Table 2. Hermitage Pond Data

Hermitage Pond						
Date	May 23	June 7	June 18	July 2	July 16	August 7
Time	12:08	11:19	13:30	13:43	11:30	10:20
Air Temperature (°C)	10.0	15.0	21.0	14.0	22.0	20.0
Pressure (kPa)	102.0	101.3	101.2	100.5	101.3	101.3
Weather	Sunny	Sunny	Sunny	Cloudy	Sunny	Sunny w/cloud
Humidity (%)	56	59	43	97	73	73
Location	46.25794°N	46.25794°N	46.25795°N	46.25793°N	46.25795°N	46.25797°N
	063.14812°W	063.14814°W	063.14812°W	063.14811°W	063.14812°W	063.14811°W
Level Above Sea Level (m)	1	4	0	7	0	-3
pH	7.51	7.19	7.57	7.41	7.59	8.60
<i>Temp (°C)</i>	11.0	13.5	16.7	15.5	16.8	17.8
<i>(mV)</i>	-34.3	-32.3	-58.6	-59.2	-78.1	-138.8
DO (mg/L)	12.74	8.65	13.80	10.64	13.20	17.98
<i>Temp (°C)</i>	12.0	15.5	16.9	15.4	19.1	17.5
<i>(%)</i>	117.6	86.7	142.5	107.1	142.3	188.0
<i>Pressure (hPa)</i>	1019	1013	1014	1006	1015	1013.0
Conductivity (µS/cm)	696	735	948	655	898	898
<i>Temp (°C)</i>	10.8	13.5	16.6	15.3	16.6	16.9
Salinity (‰)	0.3	0.4	0.5	0.3	0.4	0.4
TDS (mg/L)	350	369	475	327	452	448
Turbidity (NTU)	7.49	15.20	4.49	-	-	-
Hardness (mg/L of CaCO₃)	-	-	-	195.4	-	277
Alkalinity (mg/L of CaCO₃)	-	125	-	-	-	157.5
Ammonia (mg/L)	-	0.149	-	0.087	-	0.053
Nitrate (mg/L)	-	1.27	-	1.20	-	0.259
Phosphate (mg/L)	-	-0.464	-	0.193	-	0.774

Table 3. MacNeill's Pond Data

MacNeill's Pond						
Date	May 23	June 10	June 18	July 2	July 16	August 9
Time	11:21	11:48	13:44	13:25	11:46	11:26
Air Temperature (°C)	9.0	16.0	21.0	14.0	23.0	22.0
Pressure (kPa)	102.0	102.5	101.2	100.5	101.4	100.3
Weather	Sunny/ partly cloudy	Sunny	Sunny w/cloud	Cloudy	Sunny	Sunny
Humidity (%)	70	39	43	97	69	82
Location	46.26561°N 063.15736°W	46.26556°N 063.15735°W	46.26562°N 063.15735°W	46.26556°N 063.15737°W	46.26554°N 063.15735°W	46.26559°N 063.15739°W
Level Above Sea Level (m)	3	9	0	7	6	7
pH	7.42	7.52	7.49	7.43	7.50	7.35
<i>Temp (°C)</i>	10.8	17.9	19.8	14.2	18.6	21.9
<i>(mV)</i>	-30.1	-49.7	-54.2	-60.2	-73.6	-71.5
DO (mg/L)	11.53	14.87	13.10	14.00	15.92	6.19
<i>Temp (°C)</i>	12.7	17.3	21.6	14.7	18.6	22.0
<i>(%)</i>	108.0	153.0	148.8	139.2	169	71.5
<i>Pressure (hPa)</i>	1021	1025	1013	1005	1015	1003
Conductivity (µS/cm)	1136	1299	1298	1201	1303	1181
<i>Temp (°C)</i>	10.6	16.0	19.4	13.7	17.5	21.4
Salinity (‰)	0.6	0.6	0.6	0.6	0.6	0.6
TDS (mg/L)	568	651	651	600	653	550
Turbidity (NTU)	34.9	7.89	16.8	-	-	-
Hardness (mg/L of CaCO₃)	-	321.5	-	303.1	-	314.3
Alkalinity (mg/L of CaCO₃)	-	202.5	-	-	-	198.5
Ammonia (mg/L)	-	0.25	-	-	-	0.187
Nitrate (mg/L)	-	1.50	-	1.37	-	1.12
Phosphate (mg/L)	-	-0.86	-	-0.68	-	-

Table 4. Governor's Pond Data

Governor's Pond							
Date	May 23	June 4	June 18	July 3	July 16	August 5	August 21
Time	9:43	14:44	10:33	11:30	11:11	12:13	9:46
Air Temperature (°C)	9.0	16.0	18.0	13.0	22.0	20.0	22.0
Pressure (kPa)	102.1	101.0	101.3	101.0	101.3	100.8	101.6
Weather	Sunny/Partly Cloudy	Sunny	Sunny	Partly cloudy	Sunny	Sunny w/cloud	Sunny
Humidity (%)	72	44	68	82	73	64	63
Location	46.23177°N 063.13462°W	46.23170°N 063.13470°W	46.2317°N 063.1347°W	46.23170°N 063.13479°W	46.23174°N 063.13470°W	46.23175°N 063.13470°W	46.23170°N 063.13467°W
Level Above Sea Level (m)	9	4	-	1	1	2	-
pH	7.80	7.19	7.15	6.92	6.99	6.92	7.17
Temp (°C)	10.0	26.4	22.7	18.9	26.7	22.0	21.1
(mV)	-48.9	-32.8	-35.9	-32.8	-45.8	-47.9	-61.7
DO (mg/L)	10.65	10.20	1.88	4.69	5.93	0.92	1.39
Temp (°C)	10.7	26.1	22.5	18.9	27.0	24.1	22.4
(%)	-	126.2	21.6	50.8	74.3	10.9	15.9
Pressure (hPa)	-	1012	1014	1011	1012	1011	1016
Conductivity (µS/cm)	2.62	3.24	4.03	-	2.63	3.48	3.84
Temp (°C)	-	26.5	21.6	18.9	20.3	23.0	20.6
Salinity (‰)	1.3	1.7	2.1	1.0	1.4	1.8	2.0
TDS (mg/L)	1306	1618	2020	947	1314	1740	1921
Turbidity (NTU)	7.85	21.60	55.80	-	-	-	-
Hardness (mg/L of CaCO₃)	-	245.4	-	177.4	-	-	-
Alkalinity (mg/L of CaCO₃)	-	138.7	-	111.5	-	-	-
Ammonia (mg/L)	-	0.012	-	0.035	-	-	0.036
Nitrate (mg/L)	-	0.384	-	0.348	-	-	0.258
Phosphate (mg/L)	-	2.02	-	2.48	-	-	0.323

Table 5. Dead Man's Pond Data

Dead Man's Pond							
Date	May 23	June 4	June 18	July 3	July 16	August 5	August 20
Time	9:15	14:00	13:00	11:11	10:44	11:33	10:00
Air Temperature (°C)	9.0	16.0	21.0	13.0	22.0	20.0	-
Pressure (kPa)	102.1	101.0	101.3	101.0	101.3	100.8	-
Weather	Sunny/ partly cloudy	Sunny	Sunny	Partly cloudy	Sunny	Sunny w/cloud	-
Humidity (%)	72	44	40	83	73	64	-
Location	46.22953°N 063.14004°W	46.22935°N 063.13984°W	46.22950°N 063.14006°W	46.22955°N 063.14003°W	46.22962°N 063.14017°W	46.22960°N 063.13997°W	46.24805°N 063.15191°W
Level Above Sea Level (m)	-12	30	5	12	11	17	1
pH	5.96	6.09	5.63	5.29	5.28	5.26	5.57
<i>Temp (°C)</i>	-	21.3	25.4	17.2	22.1	21.9	22.5
<i>(mV)</i>	-	27.3	47.9	54.5	47.7	42.4	26.9
DO (mg/L)	4.13	5.59	4.85	3.61	2.05	1.86	2.08
<i>Temp (°C)</i>	10.9	22.7	25.2	17.3	23.2	22.0	22.6
<i>(%)</i>	-	65.1	59.0	37.7	23.9	21.4	24.11
<i>Pressure (hPa)</i>	-	1010	1013	1011	1015	1009	1013
Conductivity (µS/cm)	32.3	38.4	31.3	20.9	19.34	23.7	26.3
<i>Temp (°C)</i>	-	-	24.9	16.9	22.2	21.7	22
Salinity (‰)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TDS (mg/L)	16.1	19.2	16.0	10.5	9.7	11.8	13.2
Turbidity (NTU)	5.93	6.30	7.13	-	-	-	-
Hardness (mg/L of CaCO ₃)	-	11.2	-	10.8	-	-	-
Alkalinity (mg/L of CaCO ₃)	-	18.0	-	11.5	-	-	-
Ammonia (mg/L)	-	0.075	-	0.028	-	-	0.025
Nitrate (mg/L)	-	0.281	-	0.468	-	-	0.571
Phosphate (mg/L)	-	1.73	-	3.23	-	-	0.445

Table 6. Agriculture Canada Pond Data

Agriculture Canada Pond							
Date	May 23	June 7	June 18	July 2	July 9	July 16	August 28
Time	10:10	10:38	10:53	12:25	10:43	13:10	10:59
Air Temperature (°C)	9.0	14.0	18.0	14.0	-	24.0	21.0
Pressure (kPa)	102.1	101.3	101.3	100.5	-	101.4	101.4
Weather	Sunny/ partly cloudy	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Humidity (%)	72	67	68	100		61	73
Location	46.24878°N 063.13424°W	46.24912°N 063.13427°W	46.2491°N 063.1343°W	46.24876°N 063.13419°W	46.24863°N 063.13352°W	46.24877°N 063.13422°W	46.24874°N 063.13416°W
Level Above Sea Level (m)	6	9	7	17	6	15	16
pH	6.60	6.63	6.64	6.47	6.40	6.40	6.82
<i>Temp (°C)</i>	9.0	18.9	23.8	16.4	22.3	26.7	19.9
<i>(mV)</i>	-11.3	-2.2	-8.3	-9.1	-4.7	-13.3	-42.1
DO (mg/L)	10.80	7.89	8.11	5.02	2.69	4.16	4.9
<i>Temp (°C)</i>	9.8	19.8	24.4	17.7	24.8	26.3	21.2
<i>(%)</i>	94.7	86.6	97.1	53.2	32	51.5	55.2
<i>Pressure (hPa)</i>	1019	1012	1012	1004	1009	1013	1013
Conductivity (µS/cm)	407	554	556	370	438	490	633
<i>Temp (°C)</i>	8.9	18.2	23.5	17	23.3	25	19.4
Salinity (‰)	0.2	0.3	0.3	0.2	0.2	0.2	0.3
TDS (mg/L)	204	227	279	185.3	219	245	316
Turbidity (NTU)	-	8.88	11.5	-	-	-	-
Hardness (mg/L of CaCO₃)	-	-	-	32.8	-	-	-
Alkalinity (mg/L of CaCO₃)	-	41.5	-	46.5	-	-	-
Ammonia (mg/L)	-	-0.225	-	0.03	-	-	-
Nitrate (mg/L)	-	0.153	-	0.3	-	-	-
Phosphate (mg/L)	-	0.087	-	1.45	-	-	-

Table 7. Farmer's Market Pond Data

Farmer's Market Pond							
Date	May 23	June 10	June 18	July 2	July 16	August 9	August 19
Time	10:30	11:00	11:07	12:45	13:20	10:36	11:45
Air Temperature (°C)	9.0	17.0	20.0	14.0	24.0	22.0	21.0
Pressure (kPa)	102.1	103.5	101.3	100.5	101.4	100.3	101.4
Weather	Sunny/ partly cloudy	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Humidity (%)	72	48	46	94	61	83	-
Location	46.25191°N 63.1343°W	46.25194°N 063.1343°W	46.2319°N 063.1343°W	46.25196°N 063.13427°W	46.25196°N 063.13428°W	46.25196°N 063.13428°W	46.25195°N 063.13426°W
Level Above Sea Level (m)	12	13	13	10	23	18	22
pH	6.83	6.61	6.58	6.58	6.45	6.49	6.45
<i>Temp (°C)</i>	9.4	19.3	24.8	17.0	26.9	-	19.8
<i>(mV)</i>	-0.3	-4.2	-4.5	-14.5	-15.6	-	-22
DO (mg/L)	9.20	7.67	7.40	6.24	5.06	2.46	3.25
<i>Temp (°C)</i>	10.6	21.4	23.4	16.6	28.4	-	19.3
<i>(%)</i>	82.2	85.5	87	64.7	65.1	-	35.3
<i>Pressure (hPa)</i>	1019	1026	1012	1004	1014	-	1013
Conductivity (µS/cm)	451	601	555	300	731	778	231
<i>Temp (°C)</i>	9.6	19.1	22.8	16.5	26.5	21.9	18.8
Salinity (‰)	0.2	0.3	0.3	0.1	0.4	0.4	0.1
TDS (mg/L)	226	300	276	150.2	365	389	115.5
Turbidity (NTU)	22.60	8.71	9.49	-	-	-	-
Hardness (mg/L of CaCO₃)	-	53.2	-	38.8	92.1	-	-
Alkalinity (mg/L of CaCO₃)	-	54	-	46.5	-	67.5	-
Ammonia (mg/L)	-	0.07	-	0.05	-	0.70	-
Nitrate (mg/L)	-	0.21	-	0.16	-	0.65	-
Phosphate (mg/L)	-	0.82	-	0.26	-	0.81	-

Table 8. Jardines Pond Data

Jardines Pond							
Date	May 23	June 4	June 17	July 3	July 16	August 14	August 28
Time	13:00	10:00	13:25	13:40	14:03	10:15	12:00
Air Temperature (°C)	10.0	12.0	20.0	14.0	26.0	18.0	23.0
Pressure (kPa)	102.0	101.1	100.9	101.1	101.3	101.2	101.4
Weather	Cloudy	Party cloudy	Cloudy/light shower	Sunny	Sunny	Sunny	Sunny
Humidity (%)	56	72	83	82	51	73	62
Location	46.28038°N 063.11515°W	46.28046°N 063.11523°W	46.28048°N 063.11516°W	46.28054°N 063.11521°W	46.28049°N 063.11512°W	46.28050°N 063.11512°W	46.28048°N 063.11507°W
Level Above Sea Level (m)	32	22	44	30	47	19	29
pH	7.34	7.41	7.48	7.31	7.90	7.39	7.22
Temp (°C)	10.9	12.1	20.8	15.5	23.0	15.3	18.7
(mV)	-25.8	-43.8	-53.7	-53.9	-95.7	-70.6	-64.3
DO (mg/L)	9.93	10.51	8.09	10.10	11.86	7.18	6.58
Temp (°C)	11.7	13.4	21.4	16.6	24.0	16.0	19.8
(%)	91.0	101.0	91.9	104.1	141.0	73.0	72.3
Pressure (hPa)	1018	1009	1008	1009	1012	1010	1012
Conductivity (µS/cm)	274	472	524	476	573	612	267
Temp (°C)	11.2	11.8	20.7	15.3	22.7	15.2	18.3
Salinity (‰)	0.1	0.2	0.3	0.2	0.3	0.3	0.1
TDS (mg/L)	137.2	236	262	238	287	306	133.6
Turbidity (NTU)	27.5	11.0	20.8	-	-	-	-
Hardness (mg/L of CaCO₃)	-	181	-	183	-	-	-
Alkalinity (mg/L of CaCO₃)	-	164.7	-	146.5	-	-	-
Ammonia (mg/L)	-	0.08	-	0.06	-	0.0	-
Nitrate (mg/L)	-	4.32	-	3.98	-	4.7	-
Phosphate (mg/L)	-	-0.1	-	-0.82	-	0.1	-

Table 9. Barbour's Pond Data

Barbour's Pond							
Date	May 17	June 4	June 17	July 3	July 16	August 12	August 28
Time	13:24	10:31	13:45	14:00	14:30	11:19	12:25
Air Temperature (°C)	8.0	12.0	20.0	14.0	26.0	21.0	25.0
Pressure (kPa)	101.3	101.1 kPa	100.9	101.0	101.3	100.7	101.4
Weather	Sunny	Sunny	Partly cloudy	Sunny	Sunny	Sunny	Sunny
Humidity (%)	71	68%	83	82	51	64	60
Location	46.27607°N 063.11129°W	46.27613°N 063.11135°W	46.27615°N 063.11130°W	46.27612°N 063.11130°W	46.27611°N 063.11133°W	46.27611°N 063.11133°W	46.27604°N 063.11127°W
Level Above Sea Level (m)	10	10	7	1	7	16	7
pH	8.14	7.66	7.58	7.58	7.75	7.72	7.93
Temp (°C)	10.8	11.8	14.5	16.8	16.3	14.9	14
(mV)	-66.1	-56.4	-58.5	-68.6	-86.6	-87.4	-102.2
DO (mg/L)	13.98	10.55	9.35	9.74	10.46	9.13	10.19
Temp (°C)	11.3	12.0	18.9	17.7	18.5	16.7	15.9
(%)	127	98.0	98.0	102.4	111	94.4	103.1
Pressure (hPa)	1012	1011	1009	1011	1014	1007	1013
Conductivity (µS/cm)	573	586	614	586	629	626	574
Temp (°C)	11	11.9	14.1	17.0	15.9	14.7	14.2
Salinity (‰)	0.3	0.3	0.3	0.3	0.3	0.3	0.3
TDS (mg/L)	287	293	307	293	315	313	287
Turbidity (NTU)	7.00	2.13	4.64	-	-	-	-
Hardness (mg/L of CaCO₃)	-	221.4	-	223.4	-	248.6	-
Alkalinity (mg/L of CaCO₃)	-	166.0	-	173.5	-	195.0	-
Ammonia (mg/L)	-	-0.196	-	-0.22	-	0.03	-
Nitrate (mg/L)	-	4.14	-	3.95	-	4.38	-
Phosphate (mg/L)	-	-0.772	-	-0.774	-	0.261	-

Table 10. Andrew's Pond North Data

Andrew's Pond North						
Date	May 17	June 4	June 17	July 3	July 16	August 28
Time	13:45	10:50	14:00	14:20	14:22	12:39
Air Temperature (°C)	8.0	13.0	20.0	14.0	26.0	25.0
Pressure (kPa)	101.3	101.1	100.9	101.0	101.3	101.4
Weather	Overcast	Sunny	Sunny	Sunny	Sunny	Sunny
Humidity (%)	71	68	83	82	51	60
Location	46.27445°N	46.27434°N	46.27434°N	46.27431°N	46.27449°N	46.27451°N
	063.11082°W	063.11087°W	063.11082°W	063.11077°W	063.11092°W	063.11074°W
Level Above Sea Level (m)	4	1	9	13	9	12
pH	7.60	7.46	8.44	7.79	8.88	8.76
<i>Temp (°C)</i>	8.8	13.3	21.8	19.1	25.4	20.9
<i>(mV)</i>	-38.6	-46.1	-	-80.3	-150.1	-149.0
DO (mg/L)	14.11	10.37	13.64	12.37	11.72	14.03
<i>Temp (°C)</i>	9.2	15.7	21.8	20.5	26.1	21.0
<i>(%)</i>	122.7	104.5	156	137.2	144.7	157.3
<i>Pressure (hPa)</i>	1012	1011	1009	1011	1013	1014.0
Conductivity (µS/cm)	568	565	603	553	536	530
<i>Temp (°C)</i>	8.8	14.6	21.3	18.9	25.2	20.3
Salinity (‰)	0.3	0.3	0.3	0.3	0.3	0.3
TDS (mg/L)	284	282	301	277	268	265
Turbidity (NTU)	3.00	4.27	3.53	-	-	-
Hardness (mg/L of CaCO ₃)	-	208.2	-	199.4	-	-
Alkalinity (mg/L of CaCO ₃)	-	167.9	-	-	-	-
Ammonia (mg/L)	-	-0.15	-	0.054	-	-
Nitrate (mg/L)	-	4.11	-	2.54	-	-
Phosphate (mg/L)	-	-1.11	-	-0.996	-	-

Table 11. Andrew's Pond South Data

Andrew's Pond South							
Date	May 17	June 4	June 17	July 3	July 16	August 13	August 28
Time	12:56	11:37	13:03	13:20	13:45	10:40	11:40
Air Temperature (°C)	8.0	15.0	22.0	13.0	25.0	19.0	23.0
Pressure (kPa)	101.3	101.0	100.9	101.0	101.3	100.5	101.4
Weather	overcast	sunny	partly cloudy	partly cloudy	sunny	sunny w/ cloud	sunny
Humidity (%)	71	56	63	82	54	83	62
Location	46.27201°N 063.10582°W	46.27197°N 063.10579°W	46.27202°N 063.10590°W	46.27200°N 063.10578°W	46.27204°N 063.10585°W	46.27204°N 063.10586°W	46.27204°N 063.10595°W
Level Above Sea Level (m)	9	7	5	15	20	9	15
pH	8.23	8.17	8.55	8.30	8.45	7.92	7.93
<i>Temp (°C)</i>	10.2	15.1	20.5	16.6	21.7	19.2	17.0
<i>(mV)</i>	-70.6	-83.8	-102.1	-107.0	-125.4	-98.6	-102.8
DO (mg/L)	15.13	13.37	19.37	15.14	14.46	11.86	10.42
<i>Temp (°C)</i>	10.6	16.5	20.3	16.7	22.2	18.9	17.6
<i>Relative Humidity (%)</i>	136.2	137.5	215.3	156.1	165.7	128.7	109.1
<i>Pressure (hPa)</i>	1012	1010	1009	1011	1014	1005	1014
Conductivity (µS/cm)	775	713	676	710	729	755	737
<i>Temp (°C)</i>	10.6	16.0	18.2	16.3	21.2	19.0	17.6
Salinity (‰)	0.4	0.3	0.3	0.3	0.4	0.4	0.4
TDS (mg/L)	388	357	347	355	365	337	364
Turbidity (NTU)	3.00	7.32	4.31	-	-	-	-
Hardness (mg/L of CaCO₃)	-	229.4	-	216.2	-	-	-
Alkalinity (mg/L of CaCO₃)	-	159	-	161.5	-	-	-
Ammonia (mg/L)	-	-0.043	-	0.018	-	0.014	-
Nitrate (mg/L)	-	3.2	-	2.55	-	2.31	-
Phosphate (mg/L)	-	-0.843	-	-0.769	-	0.095	-

Table 12. Reardon's Pond Data

Reardon's Pond						
Date	June 7	June 17	July 3	July 16	August 5	August 19
Time	10:00	11:01	10:30	10:05	10:30	11:16
Air Temperature (°C)	12.0	19.0	13.0	20.0	19.0	22.0
Pressure (kPa)	101.3	101.0	101.0	101.3	100.8	101.1
Weather	Sunny	Sunny	Partly cloudy	Sunny	Sunny w/cloud	Sunny w/cloud
Humidity (%)	86	79	82	83	68	83
Location	46.26308°N	46.26299°N	46.26302°N	46.26296°N	46.26313°N	46.26313°N
	062.91751°W	062.91744°W	062.91745°W	062.91742°W	062.91748°W	062.91748°W
Level Above Sea Level (m)	30	31	31	26	37	31
pH	7.14	7.23	6.86	7.00	8.34	7.30
Temp (°C)	16.6	22.0	17.2	21.9	24.6	22.9
(mV)	-29.5	-40.2	-30.0	-46.6	-137.4	-70.1
DO (mg/L)	8.81	7.41	7.39	8.79	10.30	7.30
Temp (°C)	17.4	22.9	17.9	21.8	25.5	23.3
(%)	92.0	86.7	78.4	100.4	126.6	85.6
Pressure (hPa)	1013	1008	1007	1011	1006	1013
Conductivity (µS/cm)	134.6	132.9	119.7	162.4	138.3	151.5
Temp (°C)	15.8	21.8	17.1	21.7	24.4	23
Salinity (‰)	0.1	0.1	0.1	0.1	0.1	0.1
TDS (mg/L)	67.1	66.5	59.8	88.1	69.1	73.8
Turbidity (NTU)	9.60	-	-	-	-	-
Hardness (mg/L of CaCO ₃)	-	-	48	-	-	-
Alkalinity (mg/L of CaCO ₃)	58.5	-	51.5	-	-	-
Ammonia (mg/L)	-0.144	-	0.079	-	-	0.027
Nitrate (mg/L)	0.61	-	0.691	-	-	0.192
Phosphate (mg/L)	0.641	-	2.54	-	-	0.352

Table 13. Ellen's Creek Data

Ellen's Creek						
Date	May 23	June 7	June 17	July 2	July 16	August 6
Time	11:43	12:15	14:29	13:06	12:00	8:56
Air Temperature (°C)	9.0	15.0	20.0	14.0	23.0	18.0
Pressure (kPa)	102.0	101.3	100.9	100.5	101.4	101.4
Weather	Sunny	Sunny	Partly cloudy	Cloudy	Sunny	Sunny
Humidity (%)	61	59	78	94	69	77
Location	46.27821°N	46.27823°N	46.27829°N	46.27829°N	46.27828°N	46.27827°N
	063.16267°W	063.16278°W	063.16275°W	063.1627°W	063.16278°W	063.16272°W
Level Above Sea Level (m)	10	15	8	11	13	11
pH	7.56	7.58	7.45	7.42	7.41	7.43
<i>Temp (°C)</i>	9.7	15.0	10.9	11.9	13.7	11.7
<i>(mV)</i>	-36.8	-52.7	-51.7	-59.4	-68.3	-74.9
DO (mg/L)	11.70	11.78	10.81	11.40	10.65	10.49
<i>Temp (°C)</i>	11.0	14.7	12.6	13.5	17.0	11.9
<i>(%)</i>	105.4	116.0	102.1	110.2	110.2	97.3
<i>Pressure (hPa)</i>	1020	1014	1009	1005	1014	1013
Conductivity (µS/cm)	390	437	452	444	457	457
<i>Temp (°C)</i>	9.7	12.5	12.1	11.6	14.8	10.6
Salinity (‰)	0.2	0.2	0.2	0.2	0.2	0.2
TDS (mg/L)	194.3	218	226	222	228	228
Turbidity (NTU)	3.94	11.4	8.37	-	-	-
Hardness (mg/L of CaCO₃)	-	-	-	150.1	-	167.3
Alkalinity (mg/L of CaCO₃)	-	117.5	-	123.5	-	130
Ammonia (mg/L)	-	-0.231	-	-	-	-
Nitrate (mg/L)	-	2.50	-	2.55	-	-
Phosphate (mg/L)	-	-1.06	-	-0.571	-	-

Table 14. Capper's Pond Data

Capper's Pond	
Date	May 23
Time	14:20
Air Temperature (°C)	11
Pressure (kPa)	101.9
Weather	Sunny
Humidity (%)	50
Location	46.21397°N
	063.30682°W
Level Above Sea Level (m)	35
pH	7.75
<i>Temp (°C)</i>	10.3
<i>(mV)</i>	-46.5
DO (mg/L)	12.30
<i>Temp (°C)</i>	10.8
<i>(%)</i>	110.7
<i>Pressure (hPa)</i>	1018
Conductivity (µS/cm)	333
<i>Temp (°C)</i>	10.3
Turbidity (NTU)	9.90
TDS (mg/L)	167.8
Salinity (‰)	0.2

APPENDIX D

Laboratory Reports

Special Products Test Report

10/16/2019

Page 1 of 4

HOLLAND COLLEGE
C/O BRYAN GRIMMELT
140 WEYMOUTH STREET
CHARLOTTETOWN, PEI
CIA 4Z1

PEI Analytical Laboratories
PEI Department of Agriculture and Land
23 Innovation Way
PO Box 2000, Charlottetown, PEI, C1A7N8
Fax: (902) 368-6299
Telephone: (902) 620-3300



Client: 6498
Accession: 5063
Samples Reported: 9/24/2019
Samples Received: 9/13/2019

Analysis Performed	Lab #: 5063-1 Sample Type: Pond Sediment Sample Id: CLFE190901	Lab #: 5063-2 Sample Type: Pond Sediment Sample Id: LFE190901	Lab #: 5063-3 Sample Type: Pond Sediment Sample Id: AGC190709	Lab #: 5063-4 Sample Type: Pond Sediment Sample Id: APN190828
Dry Matter %	97.77	98.80	98.37	99.52
Carbon %	10.77	1.74	1.75	1.97
C:N Ratio	15.31	16.00	16.18	18.00
Nitrogen %	.70	.11	.11	.11
Phosphorus %	.12	< .03	< .03	< .03
Potassium %	.29	.15	.20	.10
Calcium %	.28	.09	.04	.06
Magnesium %	.51	.34	.45	.24
Copper ppm	4.35	25.63	5.12	3.57
Zinc ppm	46.83	38.37	39.08	21.15
Boron ppm	9.32	1.25	.55	.02
Iron ppm	25970.77	23491.36	19491.92	12119.70
Manganese ppm	722.72	339.28	319.01	226.50
pH	4.51	6.26	5.27	6.50

Date of analysis available upon request.

Comment:

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10/16/2019

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23 Innovation Way
PO Box 2000, Charlottetown, PEI, C1A7N8
Fax: (902) 368-6299
Telephone: (902) 620-3300





Client: 6498
Accession: 5063
Samples Reported: 9/24/2019
Samples Received: 9/13/2019

Analysis Performed	Lab #: 5063-5 Sample Type: Pond Sediment Sample Id: APS190813	Lab #: 5063-6 Sample Type: Pond Sediment Sample Id: BAP190812	Lab #: 5063-7 Sample Type: Pond Sediment Sample Id: DMP190619	Lab #: 5063-8 Sample Type: Pond Sediment Sample Id: ELC190806
Dry Matter %	98.77	98.51	98.54	99.03
Carbon %	4.89	3.22	2.62	2.10
C:N Ratio	18.33	15.57	16.63	23.56
Nitrogen %	.27	.21	.16	.09
Phosphorus %	.03	.07	.03	.03
Potassium %	.14	.15	.10	.09
Calcium %	.18	.20	.22	.27
Magnesium %	.24	.33	.19	.27
Copper ppm	5.73	4.18	3.20	5.23
Zinc ppm	48.09	70.95	31.22	49.46
Boron ppm	1.25	1.01		
Iron ppm	13429.33	13050.07	7943.23	12208.64
Manganese ppm	235.51	298.12	171.00	287.07
pH	6.66	6.61	5.58	7.23

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10/16/2019

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Telephone: (902) 620-3300



Client: 6498
Accession: 5063
Samples Reported: 9/24/2019
Samples Received: 9/13/2019

Analysis Performed	Lab #: 5063-9 Sample Type: Pond Sediment Sample Id: FMP190809	Lab #: 5063-10 Sample Type: Pond Sediment Sample Id: GOP190619	Lab #: 5063-11 Sample Type: Pond Sediment Sample Id: HEP190807	Lab #: 5063-12 Sample Type: Pond Sediment Sample Id: JAP190814
Dry Matter %	99.53	99.03	99.53	100.00
Carbon %	1.97	3.84	3.21	1.92
C:N Ratio	16.50	19.40	17.00	17.45
Nitrogen %	.12	.20	.19	.11
Phosphorus %	< .03	< .03	< .03	< .03
Potassium %	.18	.15	.17	.21
Calcium %	.05	.33	.11	.04
Magnesium %	.38	.30	.39	.38
Copper ppm	8.03	12.80	5.27	7.24
Zinc ppm	52.70	84.66	50.43	36.98
Boron ppm	.42	3.21	.93	2.72
Iron ppm	14683.67	13205.92	14740.07	15655.60
Manganese ppm	256.49	425.55	282.38	306.17
pH	6.06	7.62	7.12	6.05

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Special Products Test Report
10/16/2019

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PEI Department of Agriculture and Land
23 Innovation Way
PO Box 2000, Charlottetown, PEI, C1A7N8
Fax: (902) 368-6299
Telephone: (902) 620-3300



Client: 6498
Accession: 5063
Samples Reported: 9/24/2019
Samples Received: 9/13/2019

Analysis Performed	Lab #: 5063-13 Sample Type: Pond Sediment Sample Id: LSP190808	Lab #: 5063-14 Sample Type: Pond Sediment Sample Id: MNP190808	Lab #: 5063-15 Sample Type: Pond Sediment Sample Id: REP190905	Lab #: 5063-16 Sample Type: Pond Sediment Sample Id: HazCr0806
Dry Matter %	91.41	97.34	99.77	100.00
Carbon %	3.29	6.70	2.37	2.73
C:N Ratio	15.00	13.76	15.87	22.75
Nitrogen %	.22	.49	.15	.12
Phosphorus %	.11	.11	< .03	< .03
Potassium %	.18	.27	.26	.11
Calcium %	.09	.31	.11	.12
Magnesium %	.24	.43	.62	.27
Copper ppm	7.25	8.89	6.93	6.12
Zinc ppm	43.63	90.86	54.02	46.83
Boron ppm	1.08	3.60	.99	.17
Iron ppm	12614.65	21289.06	22121.28	11737.09
Manganese ppm	272.38	363.25	403.20	220.85
pH	5.47	6.25	6.07	6.82

Date of analysis available upon request.

Comment:

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AGRICULTURE CANADA POND



PEI Analytical Laboratories - Water Quality Test Report

23 Innovation Way, Charlottetown, PE C1E 0B7

Page 1 of 1

Client Name: Holland College: Bryan Grimmelt **Sample Number:** SW190828009
Sample Point: **Sample Location:**
Date Sampled: August 28, 2019 **Sampler:** Matthew McKendrick
Date Received: August 28, 2019 **Water Type:** Surface Water - Fresh

Water Chemistry Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
WCL_07M *	Barium, dissolved	33	ppb	2.00
WCL_07M *	Cadmium, dissolved	<2	ppb	2.00
WCL_07M *	Chromium, dissolved	<5	ppb	5.00
WCL_07M *	Copper, dissolved	6	ppb	5.00
WCL_07M *	Iron, dissolved	1934	ppb	9.00
WCL_07M *	Nickel, dissolved	<7	ppb	7.00
WCL_07M *	Magnesium, dissolved	2.29	ppm	0.10
WCL_07M *	Phosphorus, dissolved	0.08	ppm	0.02
WCL_07M *	Potassium, dissolved	0.55	ppm	0.10
WCL_07M *	Sodium, dissolved	102.50	ppm	0.20
WCL_07M *	Sulfate, calc from S diss	5.84	ppm	0.20
WCL_07M *	Lead, dissolved	<6	ppb	6.00
WCL_07M *	Zinc, dissolved	<6	ppb	6.00
WCL_07M *	Manganese, dissolved	344	ppb	3.00
WCL_07M *	Arsenic, dissolved	<4	ppb	4.00
WCL_07M *	Strontium, dissolved	47	ppb	3.00
WCL_07M *	Calcium, dissolved	15.73	ppm	0.20

Approved By: Lori Brine Date: September 11, 2019

Date of Analysis available upon request.

Water Microbiology Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
WML_09M *	Faecal coliforms A1	350	MPN	2.00

Approved By: Scott Brown Date: August 29, 2019

Date of Analysis available upon request.

Legend: MPN = Most Probable Number mg/L = milligrams per litre
 cfu/100 mls = colony forming unit per 100 millilitres nd = not detected; na = not analysed
 * = method accredited by Standards Council of Canada; ppm = parts per million ppb = parts per billion
 Ammonia is equivalent to (Ammonia + Ammonium)-N

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MACNEILS POND



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Page 1 of 1

Client Name: Holland College: Bryan Grimmelt **Sample Number:** SW190905002
Sample Point: **Sample Location:** MacNeils Pond
Date Sampled: September 05, 2019 **Sampler:** Michelle Costello
Date Received: September 05, 2019 **Water Type:** Surface Water - Fresh

Water Chemistry Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WCL_07M *	Barium, dissolved	175	ppb	2.00
WCL_07M *	Copper, dissolved	<5	ppb	5.00
WCL_07M *	Iron, dissolved	35	ppb	9.00
WCL_07M *	Lead, dissolved	<6	ppb	6.00
WCL_07M *	Zinc, dissolved	<6	ppb	6.00
WCL_07M *	Manganese, dissolved	50	ppb	3.00
WCL_07M *	Potassium, dissolved	3.26	ppm	0.10
WCL_07M *	Sodium, dissolved	65.90	ppm	0.20
WCL_07M *	Sulfate, calc from S diss	21.43	ppm	0.20
WCL_07M *	Cadmium, dissolved	<2	ppb	2.00
WCL_07M *	Calcium, dissolved	36.22	ppm	0.20
WCL_07M *	Chromium, dissolved	<5	ppb	5.00
WCL_07M *	Magnesium, dissolved	14.32	ppm	0.10
WCL_07M *	Nickel, dissolved	<7	ppb	7.00
WCL_07M *	Phosphorus, dissolved	0.09	ppm	0.02

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Water Microbiology Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WML_09M *	Faecal coliforms A1	>1600	MPN	2.00

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
 cfu/100 mls = colony forming unit per 100 millilitres
 * = method accredited by Standards Council of Canada;
 ppm = parts per million
 Ammonia is equivalent to (Ammonia + Ammonium)-N
 mg/L = milligrams per litre
 nd = not detected; na = not analysed
 ppb = parts per billion

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REARDONS POND



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Page 1 of 1

Client Name: Holland College: Bryan Grimmelt **Sample Number:** SW190905006
Sample Point: **Sample Location:** Not indicated on request form
Date Sampled: September 05, 2019 **Sampler:** Michelle Costello
Date Received: September 05, 2019 **Water Type:** Surface Water - Fresh

Water Chemistry Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WCL_07M	* Barium, dissolved	19	ppb	2.00
WCL_07M	* Copper, dissolved	<5	ppb	5.00
WCL_07M	* Iron, dissolved	200	ppb	9.00
WCL_07M	* Lead, dissolved	<6	ppb	6.00
WCL_07M	* Zinc, dissolved	<6	ppb	6.00
WCL_07M	* Manganese, dissolved	53	ppb	3.00
WCL_07M	* Potassium, dissolved	0.63	ppm	0.10
WCL_07M	* Sodium, dissolved	4.88	ppm	0.20
WCL_07M	* Sulfate, calc. from S diss	2.04	ppm	0.20
WCL_07M	* Cadmium, dissolved	<2	ppb	2.00
WCL_07M	* Calcium, dissolved	14.93	ppm	0.20
WCL_07M	* Chromium, dissolved	<5	ppb	5.00
WCL_07M	* Magnesium, dissolved	7.32	ppm	0.10
WCL_07M	* Nickel, dissolved	<7	ppb	7.00
WCL_07M	* Phosphorus, dissolved	0.07	ppm	0.02

Approved By: **Sandra Pinkham** Laboratory Technician
 Date of Analysis available upon request.

Water Microbiology Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WML_09M	* Faecal coliforms A1	2	MPN	2.00

Approved By: **Sandra Pinkham** Laboratory Technician
 Date of Analysis available upon request.

Legend: MPN = Most Probable Number
 cfu/100 ml = colony forming unit per 100 millilitres mg/L = milligrams per litre
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 Ammonia is equivalent to (Ammonia + Ammonium)-N

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ANDREWS POND NORTH



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Page 1 of 1

Client Name: Holland College: Bryan Grimmelt **Sample Number:** SW190828010
Sample Point: **Sample Location:**
Date Sampled: August 28, 2019 **Sampler:** MC MM AF
Date Received: August 28, 2019 **Water Type:** Surface Water - Fresh
 (analysed at 23 Innovation Way)

Water Chemistry Results

Method ID	Parameter	Results	Units	Detection Limit
WCL_07M *	Barium, dissolved	145	ppb	2.00
WCL_07M *	Cadmium, dissolved	<2	ppb	2.00
WCL_07M *	Chromium, dissolved	<5	ppb	5.00
WCL_07M *	Copper, dissolved	<5	ppb	5.00
WCL_07M *	Iron, dissolved	195	ppb	9.00
WCL_07M *	Nickel, dissolved	<7	ppb	7.00
WCL_07M *	Magnesium, dissolved	24.46	ppm	0.10
WCL_07M *	Phosphorus, dissolved	<0.02	ppm	0.02
WCL_07M *	Potassium, dissolved	2.37	ppm	0.10
WCL_07M *	Sodium, dissolved	36.27	ppm	0.20
WCL_07M *	Sulfate, calc from S diss	9.22	ppm	0.20
WCL_07M *	Lead, dissolved	<6	ppb	6.00
WCL_07M *	Zinc, dissolved	<6	ppb	6.00
WCL_07M *	Manganese, dissolved	147	ppb	3.00
WCL_07M	Arsenic, dissolved	<4	ppb	4.00
WCL_07M	Strontium, dissolved	32	ppb	3.00
WCL_07M *	Calcium, dissolved	37.75	ppm	0.20

Approved By: Lori Brine Date: September 11, 2019

Date of Analysis available upon request.

Water Microbiology Results

(analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
WML_09M *	Faecal coliforms A1	<2	MPN	2.00

Approved By: Scott Brown Date: August 29, 2019

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
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 ppm = parts per million ppb = parts per billion
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ANDREWS POND SOUTH



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Page 1 of 1

Client Name: Holland College: Bryan Grimmelt **Sample Number:** SW190828007
Sample Point: **Sample Location:**
Date Sampled: August 28, 2019 **Sampler:** MM, AKF, MC
Date Received: August 28, 2019 **Water Type:** Surface Water - Fresh
 (analysed at 23 Innovation Way)

Water Chemistry Results

Method ID	Parameter	Results	Units	Detection Limit
WCL_07M	* Barium, dissolved	198	ppb	2.00
WCL_07M	* Cadmium, dissolved	<2	ppb	2.00
WCL_07M	* Chromium, dissolved	<5	ppb	5.00
WCL_07M	* Copper, dissolved	<5	ppb	5.00
WCL_07M	* Iron, dissolved	16	ppb	9.00
WCL_07M	* Nickel, dissolved	<7	ppb	7.00
WCL_07M	* Magnesium, dissolved	24.29	ppm	0.10
WCL_07M	* Phosphorus, dissolved	<0.02	ppm	0.02
WCL_07M	* Potassium, dissolved	2.30	ppm	0.10
WCL_07M	* Sodium, dissolved	58.89	ppm	0.20
WCL_07M	* Sulfate, calc from S diss	11.86	ppm	0.20
WCL_07M	* Lead, dissolved	<6	ppb	6.00
WCL_07M	* Zinc, dissolved	<6	ppb	6.00
WCL_07M	* Manganese, dissolved	13	ppb	3.00
WCL_07M	Arsenic, dissolved	<4	ppb	4.00
WCL_07M	Strontium, dissolved	38	ppb	3.00
WCL_07M	* Calcium, dissolved	42.33	ppm	0.20

Approved By: Lori Brine Date: September 11, 2019

Date of Analysis available upon request.

Water Microbiology Results

(analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
WML_09M	* Faecal coliforms A1	23	MPN	2.00

Approved By: Scott Brown Date: August 29, 2019

Date of Analysis available upon request.

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BARBOURS POND



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Page 1 of 1

Client Name: Holland College: Bryan Grimmelt **Sample Number:** SW19082800.
Sample Point: **Sample Location:**
Date Sampled: August 28, 2019 **Sampler:** MC MM AF
Date Received: August 28, 2019 **Water Type:** Surface Water - Fresh
 (analysed at 23 Innovation Way)

Water Chemistry Results

Method ID	Parameter	Results	Units	Detection Limit
WCL_07M	* Barium, dissolved	170	ppb	2.00
WCL_07M	* Cadmium, dissolved	<2	ppb	2.00
WCL_07M	* Chromium, dissolved	<5	ppb	5.00
WCL_07M	* Copper, dissolved	<5	ppb	5.00
WCL_07M	* Iron, dissolved	18	ppb	9.00
WCL_07M	* Nickel, dissolved	<7	ppb	7.00
WCL_07M	* Calcium, dissolved	47.09	ppm	0.20
WCL_07M	* Phosphorus, dissolved	0.06	ppm	0.02
WCL_07M	* Potassium, dissolved	2.14	ppm	0.10
WCL_07M	* Sodium, dissolved	28.67	ppm	0.20
WCL_07M	* Sulfate, calc from S diss	11.01	ppm	0.20
WCL_07M	* Lead, dissolved	<6	ppb	6.00
WCL_07M	* Zinc, dissolved	<6	ppb	6.00
WCL_07M	* Manganese, dissolved	16	ppb	3.00
WCL_07M	Arsenic, dissolved	<4	ppb	4.00
WCL_07M	Strontium, dissolved	32	ppb	3.00
WCL_07M	* Magnesium, dissolved	23.66	ppm	0.10

Approved By: Lori Brine Date: September 11, 2019

Date of Analysis available upon request.

Water Microbiology Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
WML_09M	* Faecal coliforms A1	350	MPN	2.00

Approved By: Scott Brown Date: August 29, 2019

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
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DEADMAN'S POND



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Page 1 of 1

Client Name: Holland College: Bryan Grimmelt	Sample Number: SW190905005
Sample Point:	Sample Location: Not indicated on request form
Date Sampled: September 05, 2019	Sampler: Michelle Costello
Date Received: September 05, 2019	Water Type: Surface Water - Fresh

Water Chemistry Results (analysed at 23 Innovation Way)

<u>Method ID</u>	<u>Parameter</u>	<u>Results</u>	<u>Units</u>	<u>Detection Limit</u>
Sandra Pinkham				
WCL_07M *	Barium, dissolved	31	ppb	2.00
WCL_07M *	Copper, dissolved	<5	ppb	5.00
WCL_07M *	Iron, dissolved	619	ppb	9.00
WCL_07M *	Lead, dissolved	<6	ppb	6.00
WCL_07M *	Zinc, dissolved	16	ppb	6.00
WCL_07M *	Manganese, dissolved	452	ppb	3.00
WCL_07M *	Potassium, dissolved	1.05	ppm	0.10
WCL_07M *	Sodium, dissolved	0.86	ppm	0.20
WCL_07M *	Sulfate, calc from S diss	0.56	ppm	0.20
WCL_07M *	Cadmium, dissolved	<2	ppb	2.00
WCL_07M *	Calcium, dissolved	2.82	ppm	0.20
WCL_07M *	Chromium, dissolved	<5	ppb	5.00
WCL_07M *	Magnesium, dissolved	0.84	ppm	0.10
WCL_07M *	Nickel, dissolved	<7	ppb	7.00
WCL_07M *	Phosphorus, dissolved	0.10	ppm	0.02

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Water Microbiology Results (analysed at 23 Innovation Way)

<u>Method ID</u>	<u>Parameter</u>	<u>Results</u>	<u>Units</u>	<u>Detection Limit</u>
Sandra Pinkham				
WML_09M *	Faecal coliforms A1	540	MPN	2.00

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
 cfu/100 mls = colony forming unit per 100 millilitres
 * = method accredited by Standards Council of Canada;
 ppm = parts per million
 Ammonia is equivalent to (Ammonia + Ammonium)-N
 mg/L = milligrams per litre
 nd = not detected; na = not analysed
 ppb = parts per billion

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ELLENS CREEK



PEI Analytical Laboratories - Water Quality Test Report

23 Innovation Way, Charlottetown, PE C1E 0B7

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Client Name: Holland College: Bryan Grimmelt

Sample Number: SW190905007

Sample Point:

Sample Location: Not indicated on request form

Date Sampled: September 05, 2019

Sampler: Michelle Costello

Date Received: September 05, 2019

Water Type: Surface Water - Fresh

Water Chemistry Results

(analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WCL_07M	* Barium, dissolved	271	ppb	2.00
WCL_07M	* Copper, dissolved	<5	ppb	5.00
WCL_07M	* Iron, dissolved	64	ppb	9.00
WCL_07M	* Lead, dissolved	<6	ppb	6.00
WCL_07M	* Zinc, dissolved	<6	ppb	6.00
WCL_07M	* Manganese, dissolved	23	ppb	3.00
WCL_07M	* Potassium, dissolved	1.94	ppm	0.10
WCL_07M	* Sodium, dissolved	33.47	ppm	0.20
WCL_07M	* Sulfate, calc. from S diss	9.85	ppm	0.20
WCL_07M	* Cadmium, dissolved	<2	ppb	2.00
WCL_07M	* Calcium, dissolved	33.14	ppm	0.20
WCL_07M	* Chromium, dissolved	<5	ppb	5.00
WCL_07M	* Magnesium, dissolved	17.56	ppm	0.10
WCL_07M	* Nickel, dissolved	<7	ppb	7.00
WCL_07M	* Phosphorus, dissolved	0.06	ppm	0.02

Approved By: **Sandra Pinkham**

Laboratory Technician

Date of Analysis available upon request.

Water Microbiology Results

(analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WML_09M	* Faecal coliforms A1	240	MPN	2.00

Approved By: **Sandra Pinkham**

Laboratory Technician

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
 cfu/100 ml = colony forming unit per 100 millilitres
 * = method accredited by Standards Council of Canada;
 ppm = parts per million
 Ammonia is equivalent to (Ammonia + Ammonium)-N
 mg/L = milligrams per litre
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GOVERNORS POND



PEI Analytical Laboratories - Water Quality Test Report
23 Innovation Way, Charlottetown, PE C1E 0B7

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Client Name: Holland College: Bryan Grimmelt
Sample Point:
Date Sampled: September 05, 2019
Date Received: September 05, 2019

Sample Number: SW190905004
Sample Location: Not indicated on request form
Sampler: Michelle Costello
Water Type: Surface Water - Fresh

Water Chemistry Results

(analysed at 23 Innovation Way)

<u>Method ID</u>	<u>Parameter</u>	<u>Results</u>	<u>Units</u>	<u>Detection Limit</u>
Sandra Pinkham				
WCL_07M	* Barium, dissolved	125	ppb	2.00
WCL_07M	* Copper, dissolved	<5	ppb	5.00
WCL_07M	* Iron, dissolved	48	ppb	9.00
WCL_07M	* Lead, dissolved	<6	ppb	6.00
WCL_07M	* Zinc, dissolved	<6	ppb	6.00
WCL_07M	* Manganese, dissolved	442	ppb	3.00
WCL_07M	* Potassium, dissolved	6.36	ppm	0.10
WCL_07M	* Sodium, dissolved	406.20	ppm	0.20
WCL_07M	* Sulfate, calc. from S diss	32.32	ppm	0.20
WCL_07M	* Cadmium, dissolved	<2	ppb	2.00
WCL_07M	* Calcium, dissolved	67.08	ppm	0.20
WCL_07M	* Chromium, dissolved	<5	ppb	5.00
WCL_07M	* Magnesium, dissolved	23.96	ppm	0.10
WCL_07M	* Nickel, dissolved	<7	ppb	7.00
WCL_07M	* Phosphorus, dissolved	0.07	ppm	0.02

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Water Microbiology Results

(analysed at 23 Innovation Way)

<u>Method ID</u>	<u>Parameter</u>	<u>Results</u>	<u>Units</u>	<u>Detection Limit</u>
Sandra Pinkham				
WML_09M	* Faecal coliforms A1	350	MPN	2.00

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
 cfu/100 ml = colony forming unit per 100 millilitres
 * = method accredited by Standards Council of Canada;
 ppm = parts per million
 Ammonia is equivalent to (Ammonia + Ammonium)-N
 mg/L = milligrams per litre
 nd = not detected; na = not analysed
 ppb = parts per billion

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HERMITAGE POND



PEI Analytical Laboratories - Water Quality Test Report
23 Innovation Way, Charlottetown, PE C1E 0B7

Page 1 of 1

Client Name: Holland College: Bryan Grimmelt	Sample Number: SW190905003
Sample Point:	Sample Location: Not indicated on request form
Date Sampled: September 05, 2019	Sampler: Michelle Costello
Date Received: September 05, 2019	Water Type: Surface Water - Fresh

Water Chemistry Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WCL_07M	* Barium, dissolved	201	ppb	2.00
WCL_07M	* Copper, dissolved	<5	ppb	5.00
WCL_07M	* Iron, dissolved	68	ppb	9.00
WCL_07M	* Lead, dissolved	<6	ppb	6.00
WCL_07M	* Zinc, dissolved	<6	ppb	6.00
WCL_07M	* Manganese, dissolved	29	ppb	3.00
WCL_07M	* Potassium, dissolved	1.72	ppm	0.10
WCL_07M	* Sodium, dissolved	32.15	ppm	0.20
WCL_07M	* Sulfate, calc. from S diss	8.62	ppm	0.20
WCL_07M	* Cadmium, dissolved	<2	ppb	2.00
WCL_07M	* Calcium, dissolved	27.44	ppm	0.20
WCL_07M	* Chromium, dissolved	<5	ppb	5.00
WCL_07M	* Magnesium, dissolved	12.68	ppm	0.10
WCL_07M	* Nickel, dissolved	<7	ppb	7.00
WCL_07M	* Phosphorus, dissolved	0.05	ppm	0.02

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Water Microbiology Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WML_09M	* Faecal coliforms A1	>1600	MPN	2.00

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
 cfu/100 ml = colony forming unit per 100 millilitres
 * = method accredited by Standards Council of Canada;
 ppm = parts per million
 Ammonia is equivalent to (Ammonia + Ammonium)-N
 mg/L = milligrams per litre
 nd = not detected; na = not analysed
 ppb = parts per billion

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JARDINES POND



PEI Analytical Laboratories - Water Quality Test Report
23 Innovation Way, Charlottetown, PE C1E 0B7

Page 1 of 1

Client Name: Holland College: Bryan Grimmelt **Sample Number:** SW190828006
Sample Point: **Sample Location:**
Date Sampled: August 28, 2019 **Sampler:** MM MC AF
Date Received: August 28, 2019 **Water Type:** Surface Water - Fresh

Water Chemistry Results (analysed at 23 Innovation Way)

<u>Method ID</u>	<u>Parameter</u>	<u>Results</u>	<u>Units</u>	<u>Detection Limit</u>
WCL_07M *	Barium, dissolved	36	ppb	2.00
WCL_07M *	Cadmium, dissolved	<2	ppb	2.00
WCL_07M *	Chromium, dissolved	<5	ppb	5.00
WCL_07M *	Copper, dissolved	<5	ppb	5.00
WCL_07M *	Iron, dissolved	88	ppb	9.00
WCL_07M *	Nickel, dissolved	<7	ppb	7.00
WCL_07M *	Magnesium, dissolved	6.89	ppm	0.10
WCL_07M *	Phosphorus, dissolved	0.02	ppm	0.02
WCL_07M *	Potassium, dissolved	1.88	ppm	0.10
WCL_07M *	Sodium, dissolved	11.38	ppm	0.20
WCL_07M *	Sulfate, calc from S diss	7.07	ppm	0.20
WCL_07M *	Lead, dissolved	<6	ppb	6.00
WCL_07M *	Zinc, dissolved	<6	ppb	6.00
WCL_07M *	Manganese, dissolved	48	ppb	3.00
WCL_07M *	Arsenic, dissolved	<4	ppb	4.00
WCL_07M *	Strontium, dissolved	20	ppb	3.00
WCL_07M *	Calcium, dissolved	19.77	ppm	0.20

Approved By: Lori Brine Date: September 11, 2019

Date of Analysis available upon request.

Water Microbiology Results (analysed at 23 Innovation Way)

<u>Method ID</u>	<u>Parameter</u>	<u>Results</u>	<u>Units</u>	<u>Detection Limit</u>
WML_09M *	Faecal coliforms A1	110	MPN	2.00

Approved By: Scott Brown Date: August 29, 2019

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
 cfu/100 mls = colony forming unit per 100 millilitres mg/L = milligrams per litre
 * = method accredited by Standards Council of Canada; nd = not detected; na = not analysed
 ppm = parts per million ppb = parts per billion
 Ammonia is equivalent to (Ammonia + Ammonium)-N

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LOWER SLICKS POND



PEI Analytical Laboratories - Water Quality Test Report 23 Innovation Way, Charlottetown, PE C1E 0B7

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Client Name: Holland College: Bryan Grimmelt	Sample Number: SW190905001
Sample Point:	Sample Location: Lower Slicks Pond
Date Sampled: September 05, 2019	Sampler: Michelle Costello
Date Received: September 05, 2019	Water Type: Surface Water - Fresh

Water Chemistry Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WCL_07M	* Barium, dissolved	85	ppb	2.00
WCL_07M	* Copper, dissolved	<5	ppb	5.00
WCL_07M	* Iron, dissolved	64	ppb	9.00
WCL_07M	* Lead, dissolved	<6	ppb	6.00
WCL_07M	* Zinc, dissolved	<6	ppb	6.00
WCL_07M	* Manganese, dissolved	155	ppb	3.00
WCL_07M	* Potassium, dissolved	3.62	ppm	0.10
WCL_07M	* Sodium, dissolved	56.31	ppm	0.20
WCL_07M	* Sulfate, calc. from S diss	24.60	ppm	0.20
WCL_07M	* Cadmium, dissolved	<2	ppb	2.00
WCL_07M	* Calcium, dissolved	29.57	ppm	0.20
WCL_07M	* Chromium, dissolved	<5	ppb	5.00
WCL_07M	* Magnesium, dissolved	8.69	ppm	0.10
WCL_07M	* Nickel, dissolved	<7	ppb	7.00
WCL_07M	* Phosphorus, dissolved	0.05	ppm	0.02

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Water Microbiology Results (analysed at 23 Innovation Way)

Method ID	Parameter	Results	Units	Detection Limit
Sandra Pinkham				
WML_09M	* Faecal coliforms A1	<2	MPN	2.00

Approved By: **Sandra Pinkham** Laboratory Technician

Date of Analysis available upon request.

Legend: MPN = Most Probable Number
 cfu/100 ml = colony forming unit per 100 millilitres
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 ppm = parts per million
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 mg/L = milligrams per litre
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Table 1 Summary of Surface Water results and Canadian Environmental Quality Guidelines

Parameter	Unit	Canadian Environmental Quality Guidelines (CEQG)	G	D	L	M	H	F	A	E	J	B	A	A	R
			O	M	S	N	E	M	C	L	A	A	P	P	E
CCME 2014			P	P	P	P	P	P	P	C	P	P	N	S	P
Barium, dissolved	ppb	-	125	31	85	175	201	46	33	271	36	170	145	198	19
Cadmium, dissolved	ppb	0.12	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chromium, dissolved	ppb	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Copper, dissolved	ppb	-	<5	<5	<5	<5	<5	9	6	<5	<5	<5	<5	<5	<5
Iron, dissolved	ppb	300	48	619	64	35	68	226	1934	64	88	18	195	16	200
Nickel, dissolved	ppb	-	<7	<7	<7	<7	<7	9	<7	<7	<7	<7	<7	<7	<7
Magnesium, dissolved	ppm	-	23.96	0.84	8.69	14.32	12.68	2.28	2.29	17.56	6.89	23.66	24.46	24.29	7.32
Phosphorus, dissolved	ppm	-	0.07	0.10	0.05	0.09	0.05	0.08	0.08	0.06	0.02	0.06	<0.02	<0.02	0.07
Potassium, dissolved	ppm	-	6.36	1.05	3.62	3.26	1.72	1.25	0.55	1.94	1.88	2.14	2.37	2.30	0.63
Sodium, dissolved	ppm	-	406.20	0.86	56.31	65.90	32.15	27.50	102.50	33.47	11.38	28.67	36.27	58.89	4.88
Sulfate, calc from S dissolved	ppm	-	32.32	0.56	24.60	21.43	8.62	22.15	5.84	9.85	7.07	11.01	9.22	11.86	2.04
Lead, dissolved	ppb	1 to 7 ¹	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
Zinc, dissolved	ppb	37 - 7 ²	<6	16	<6	<6	<6	32	<6	<6	<6	<6	<6	<6	<6
Manganese, dissolved	ppb	-	442	452	155	50	29	28	344	23	48	16	147	13	53
Arsenic, dissolved	ppb	-	-	-	-	-	-	<4	<4	-	<4	<4	<4	<4	-
Strontium, dissolved	ppb	-	-	-	-	-	-	62	47	-	20	32	32	38	-
Calcium, dissolved	ppm	-	67.08	2.82	29.57	36.22	27.44	12.48	15.73	33.14	19.77	47.09	37.75	42.33	14.93
² CEQG guideline is hardness dependent: 1 µg/L at [CaCO ₃] = 0 to 60 mg/L; 2 µg/L at [CaCO ₃] = 60 to 120 mg/L; 4 µg/L at [CaCO ₃] = 120 to 180 mg/L; 7 µg/L at [CaCO ₃] > 180 mg/L.															
¹ Canadian Water Quality Guidelines (CWQGs) for the Protection of Aquatic Life for Dissolved Zinc for Specified Water Quality Conditions. Fresh water. Short-term exposure (37ppb) Long-term exposure (ppb)															
AO - aesthetic objective															
CEQG - Canadian Environmental Quality Guidelines															
CCME - Canadian Council of Ministers of the Environment															

Table 2 Summary of Sediments results and Canadian Environmental Guidelines

Analysis	Unit	CCME 2002		GOP	DMP	LSP	MNP	HEP	FMP	ACP	JAP	BAP	APN	APS	ELC	REP
		ISQG	PEL													
Dry Matter	%	-	-	99.03	98.54	91.41	97.34	99.53	99.53	98.37	100.00	98.51	99.52	98.77	99.03	99.77
Carbon	%	-	-	3.84	2.62	3.29	6.70	3.21	1.97	1.75	1.92	3.22	1.97	4.89	2.10	2.37
C:N Ratio		-	-	19.40	16.63	15.00	13.76	17.00	16.50	16.18	17.45	15.57	18.00	18.33	23.56	15.87
Nitrogen	%	-	-	0.20	0.16	0.22	0.49	0.19	0.12	0.11	0.11	0.21	0.11	0.27	0.09	0.15
Phosphorus	%			<0.03	<0.03	0.04	0.11	<0.03	<0.03	<0.03	<0.03	0.07	<0.03	0.03	<0.03	<0.03
Potassium	%	-	-	0.15	0.10	0.18	0.27	0.17	0.18	0.20	0.21	0.15	0.10	0.14	0.09	0.26
Calcium	%	-	-	0.33	0.05	0.09	0.31	0.11	0.05	0.04	0.04	0.20	0.60	0.18	0.22	0.11
Magnesium	%	-	-	0.30	0.19	0.24	0.43	0.39	0.38	0.45	0.38	0.33	0.24	0.24	0.27	0.62
Copper	ppm	35.7	197	12.80	3.20	7.25	8.89	5.27	8.03	5.12	7.24	4.18	3.57	5.73	5.23	6.93
Zinc	ppm	123	315	84.66	31.22	43.63	90.86	50.43	52.70	39.08	36.98	70.95	21.15	48.09	49.46	54.02
Boron	ppm	-	-	3.21	-	1.08	3.60	0.93	0.42	0.55	2.72	1.01	0.02	1.25	-	0.99
Iron	ppm	-	-	13205.92	7943.23	12614.65	21289.06	14740.07	14683.67	19491.92	15655.60	13050.07	12119.70	13429.33	12208.64	22121.28
Manganese	ppm	-	-	425.55	171.00	272.38	363.25	282.38	256.49	319.01	306.17	298.12	226.50	235.51	287.07	403.20
pH		-	-	7.62	5.58	5.47	6.25	7.12	6.06	5.27	6.05	6.61	6.50	6.66	7.23	6.07
Note:																
ISQG - Interin Freshwater Sediment Quality Guidelines																
PEL - Permissible Exposure Limit																

