Kearney Watershed Water Monitoring Report 2016

Testing and instrument evaluation

performed by

Stan Walker with assistance from our volunteer Lake Stewards

Report prepared by

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1.0 Introduction

1.1 Background information - general

In 2014 the University of Waterloo Summit Centre for the Environment (WSCE) partnered with the Kearney Environmental Watershed Foundation (KWEF) to create a lake monitoring program. This lake monitoring program was meant to be a follow up on water testing done by the Town of Kearney several years ago with the Ministry of the Environment and Climate Change. The lakes sampled and tested were Groom/Lynx Lake, Emsdale Lake, Big Clam Lake, Little Clam Lake, Peters Lake, Beaver Lake, Hassard Lake, Perry Lake, Perbcth/Fisher Lake, Mason Lake, Island Lake, Sand Lake, Himbury Lake, Magnetawan Lake, Grass Lake and Loon Lake and two spots on the south branch of the Magnetawan River in the vicinity of the Graphite Mine. Each of these water bodies was sampled in the field and tested at the WSCE lab. The data collected is intended to be part of a long-term monitoring project in order detect any changes in the quality of the water over time. The long-term goals for this project were to annually sample the lakes in order to identify trends over time. The benefits of long-term water monitoring include detection of positive or negative changes in the data from large annual data sets (Halliday et al., 2012).

KWEF was created to help preserve the quality of air, water, and terrestrial ecosystems of the Almaguin area ("KWEF," n.d.). Most of the lakes within the Kearney region are part of the Ontario Lake Partner Program. This program monitors total phosphorus concentrations and secchi depth for Ontario's inland lakes collected by volunteer efforts. For this monitoring program, water composition (pH, DO, and conductivity) was tested in the lab as well as water nutrient levels (total phosphorus, phosphate, nitrate, and nitrate) using specific lab detection methods.

All of the 17 water bodies sampled were within 15 km of Kearney, a small town of approximately 850 year round residents (Statistics Canada, 2012). During summer months, the population increases with tourists who visit and stay in the area or travel to Algonquin Park to the east. The terrain in the Kearney region which adjoins the western edge of Algonquin Park varies from extensive deposits of sand and gravel or wetland areas along the Magnetawan River to the uplands of Canadian Shield granites (Gartner Lee Water Quality Study, 2002). There is a graphite mine just north of the town which has the potential to impact the water quality of the nearby Magnetawan River. The mine which has been closed for several years was planning to reopen in 2015 and aims to produce one million tonnes of ore and 20,000 tonnes of graphite per year ("The Kearney Mine", n.d.). The dense forest cover has attracted and sustained a large lumbering industry in the past, however water based recreation and tourism have emerged more recently as a source of greater economic growth (Gartner Lee Water Quality Study, 2002). While the town itself is small, tourism and development could impact the watershed .

In 2014 the report was issued in 2 parts. Students from the university sampled and reported results on 16 lakes and the Magnetawan River. IN 2015 students again sampled and issued one combined report on all 16 lakes and the river.

1.2 Background – 2016

Unfortunately in the spring of 2016 we learned that the University of Waterloo would not be able to participate in any way with the monitoring program. Our long term goal for this program was to continue to sample the lakes on an annual basis in order to identify trends over time. With this in mind KWEF looked at trying to continue the program itself by just duplicating the methodology employed the previous two years. With the departure of the WSCE from Huntsville the local lab for processing the water samples was also no longer available. This meant that the water samples would have to be shipped to a southern Ontario lab for analysis and we realized the costs would be prohibitive.

While looking for a solution, we learned that a portable field instrument and sensor package was on the market that would allow us to measure many of the same parameters that the lab tests provide. This instrument would measure Dissolved Oxygen (DO) conductivity, pH, and water temperature. The sensor package was connected to the instrument by a long cable which allowed the operator to lower the sensor package into the lake or river and take these measurements at various depths. Atmospheric pressure, file/site name and a time/date stamp can also be recorded with each set of readings in the instruments internal memory. The instrument did not have the ability to measure Phosphates or Nitrates and Nitrites at the low levels found in our lakes. Since the levels were low when measured in 2014 and 2015 we had decided that there was no urgent need to sample them again this year. In addition we would be able to obtain the TP (Total Phosphorous) readings for most of the lakes from the annual Lake Partners samples sent to MOE in Dorset. The other major benefit with this instrument was that we could take the readings from the sensors at various depths from the surface to the bottom of the lake to get a different perspective on conditions in the lake. We decided to use this instrument to gather data for 2016 Lake Monitoring Program and evaluate its suitability at the same time. For evaluation purposes we arranged two test dates in August approximately 2 weeks apart with a volunteer on each lake.

2.0 Lake Profiles, Maps and Sampling Sites

We used the previously selected sampling sites on each lake as much as possible. The smaller lakes had 3 sites the larger lakes had 6. Some sites were in shallow water and were obviously selected because they had the potential for higher nitrate and phosphate levels. Since we weren't measuring those parameters and there was the potential to lower the sensor into the muddy bottom we skipped those sites. During the second round of testing on Mason, Beaver, Hassard and Sand Lake when we were mainly evaluating the second instrument we just did a single deep spot profile. On Sand Lake we picked a new site that was more sheltered from the wind because we were having problems with the anchor dragging and the resultant problems with drift. We also did add a third site on the Magnetawan River well below the mine site to see how much the pH and conductivity levels had changed compared to readings closer to the mine site. Due to scheduling or logistical problems we visited Peters, Emsdale and Magnetawan Lakes only once. We didn’t feel that two complete sets of readings were necessary so we used the second set of test sessions to evaluate the second instrument. In the process we did obtain a lot more additional test data.

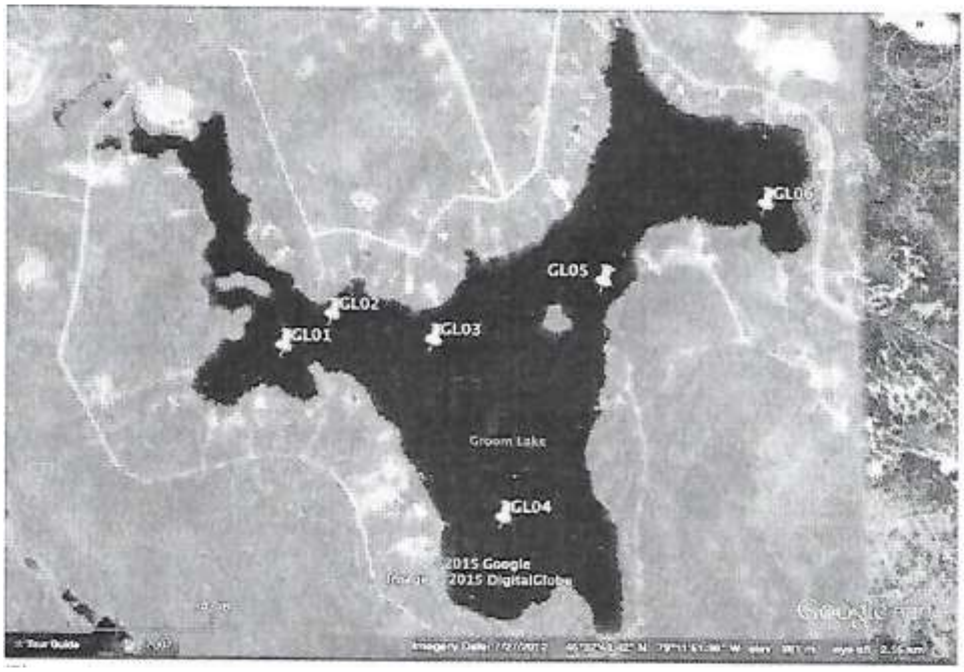
Each of the lakes monitored in this report were given a brief lake profile which is included with the lake outline and site map. The information provided was taken from the Ministry of Natural Resources and Forestry (MNRF) lake Fact sheet, Google Earth, and MBendi information services.

2.1 Grooml/Lynx Lake

Groom Lake, also known as Lynx Lake, is located 7 km southeast from the town of Kearney. There were several cottages visible from each sampling point. The lake does not have any surrounding crown land. The largest island is Squirrel Island. The map of the lake showing the sample points and the GPS coordinates for each sample site can be found below.

Groom/Lynx Lake Characteristics

Surface Area	Mean Depth	Max Depth	Perimeter
59.4 Ha	4.9m	12.5 m	6.7 km (plus 0.5 km island shoreline)



Map of Groom/Lynx Lake with sample sites, Retrieved from Google Earth

GPS Coordinates for sample sites at Groom Lake

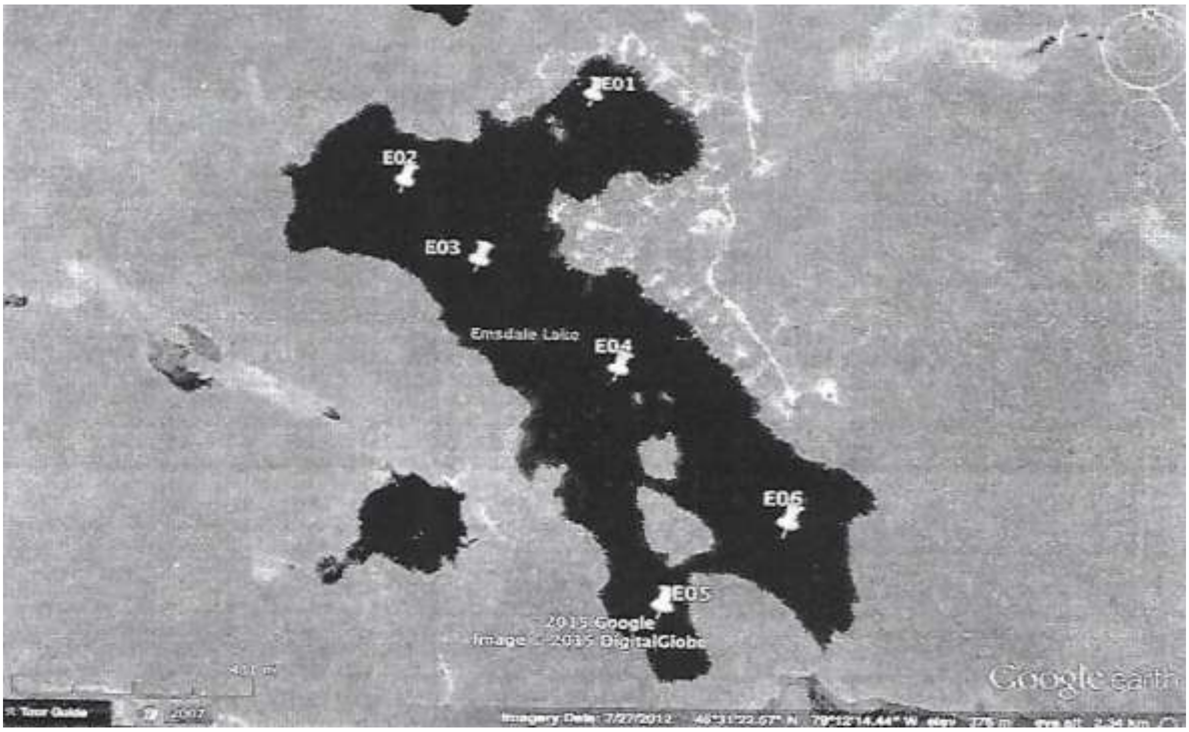
GLOI	N 45° 32' 19.1" W 79° II' 24.5"	GL04	N 45° 32' 7.0" W 79° 1 I' 2.5"
GL02	N 45° 32' 21.4" W 79° 11' 19.7"	GL05	N 45° 32' 23.9" W 79° 10' 52.7"
GL03	N45"32' 19.6" W 79° 11' 9.6"	GL06	N 45" 32' 29.5" W 79° 10' 36.5"

2.2 Emsdale Lake

Emsdale Lake is located 6 km south of Kearney, Ontario. There are a couple of cottages visible from the sampling points. Fifteen percent of the surrounding land is Crown Land. Compared to the other lakes, this lake's water is very clear due to less cottage input and being spring fed. The map of the lake showing the sample sites and the GPS coordinates for each sample site can be found below

Ernsdale Lake characteristics (MNRF, 2010).

Surface Area	Mean Depth	Max Depth	Perimeter
61 ha	9m	22 111	5.5 krn (plus 1 km island shoreline)



GPS Coordinates for sample sites at Emsdale Lake.

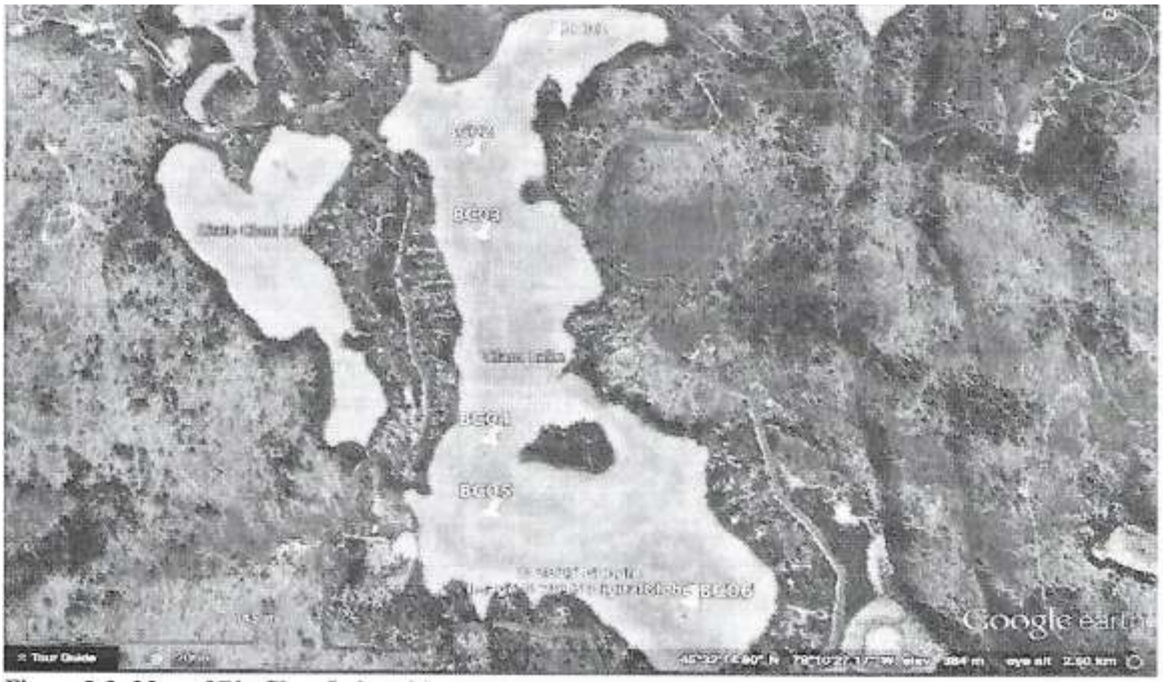
EOI	N 45° 31' 17.3" W 79° 11' 50.7"	E04	N 45° 30' 54.9" W 79°· 11' 45.8"
E02	N 45° 31' 08.7" W79°·12'08.0"	E05	N 45°· 30' 38.5" W 79° 11' 40.4"
E03	N 45° 31' 02.7" W 79° 11' 59.8"	E06	N 45°· 30' 44.7" W 79°' 11' 30.0"

2.3 Big Clam Lake

Big Clam Lake, also known as Clam Lake, is located 11.5 km southeast of Kearney, Ontario. There are a few visible cottages from the lake sample points, the shoreline is moderately developed, and 10% of the surrounding land is Crown Land. Big Clam Lake has one privately owned island known as Prince Edward Island. The map of the sample sites and the GPS coordinates for each sample site can be found below.

Big Clam Lake characteristics (MNRF, 2010).

Surface Area	Mean Depth	Max Depth	Perimeter
71 ha	6111	19 m	6 km (plus 0.5 km island shoreline)



Map of Big Clam Lake with sample sites, Retrieved from Googlc Earth

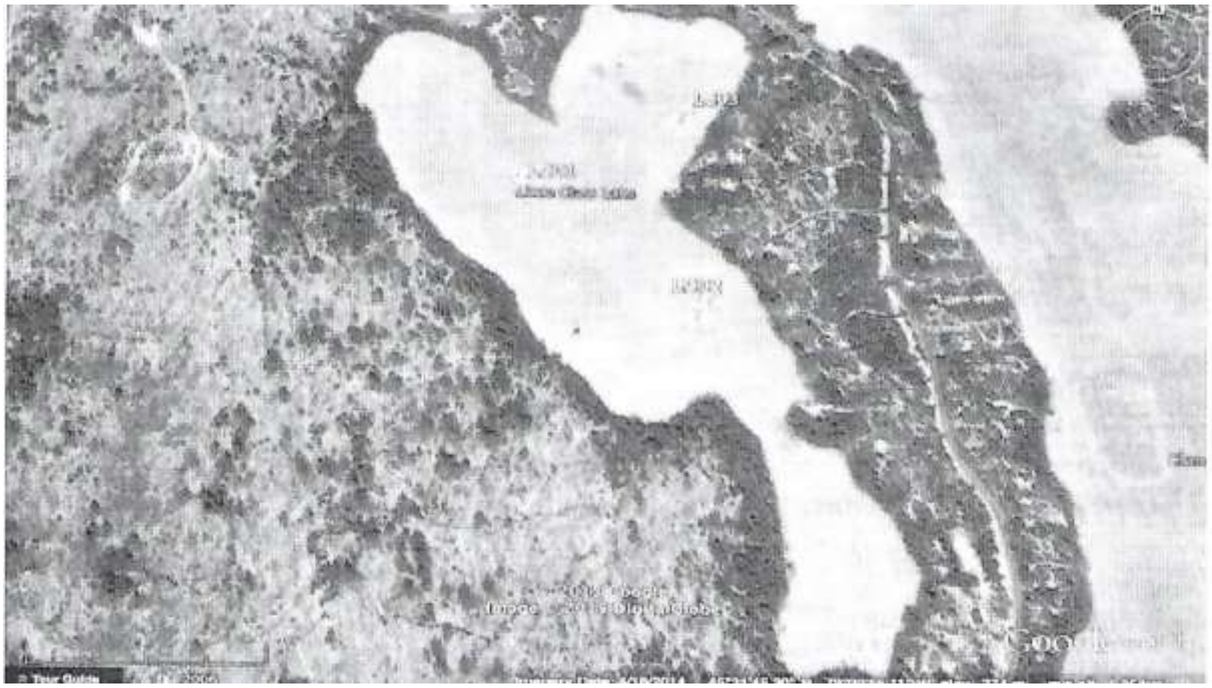
GPS Coordinates for sample sites at Big Clam Lake.

BCOI	N 45° 32' 10.3" W 79° 09' 26.3"	BC04	N 45° 31' 32.5" W 79°09' 32.1"
BC02	N 45° 31' 58.6" W 79° 09' 34.8"	BC05	N 45° 31' 26.7" W 79°' 09' 31.8"
BCO]	N 45° 31' 50.5" W 79° 09' 33.6"	BC06	N 45° 31' 19.9" W 79° 09' 13.0"

2.4 Little Clam Lake

Little Clam Lake is located 7.3 km southeast of Keamey, Ontario. There are a few visible cottages from the sampling points and Bennett's Beehive Cottages are located near sampling point LC03. The surrounding land is not Crown Land, but the lake is near the Upper Raft Lake Conservation Reserve. The lake is relatively shallow as seen below, with the deepest spot near the center of the lake. The map of the sample sites and the GPS coordinates for sample sites can be found below..

Little Clam Lake characteristics (MNRF, 2015). Surface Area 22 ha Mean Depth 6m Max Depth 16m Perimeter 3km



Map of Little Clam Lake with sample sites, Retrieved from Google Earth

GPS Coordinates for sample sites at Little Clam Lake.

LCOI	N 45° 31' 52.0" W 79° 09' 59.6"
LC02	N 45° 31' 46.3" W 79° 09' 50.8"
LC03	N 45° 31' 55.7" W 79° 09' 51.2"

2.5 Peters Lake

Peters Lake is located 10.1 km east of Kearney, Ontario. Peters Lake is a small shallow lake and does not have any visible cottages around the sampling points but was accessed through the Toronto District School Board (TDSB) outdoor children's camp called "Camp Kearney." Most of the surrounding land is owned by TDSB and 5% is Crown Land. The map of the sample sites and the GPS coordinates for sample sites can be found below.

Peters Lake characteristics (MNRF, 2010). Surface Area 48 ha Mean Depth 4m Max Depth 13m Perimeter 5km

Map of Peters Lake with sample sites, Retrieved from Google Earth

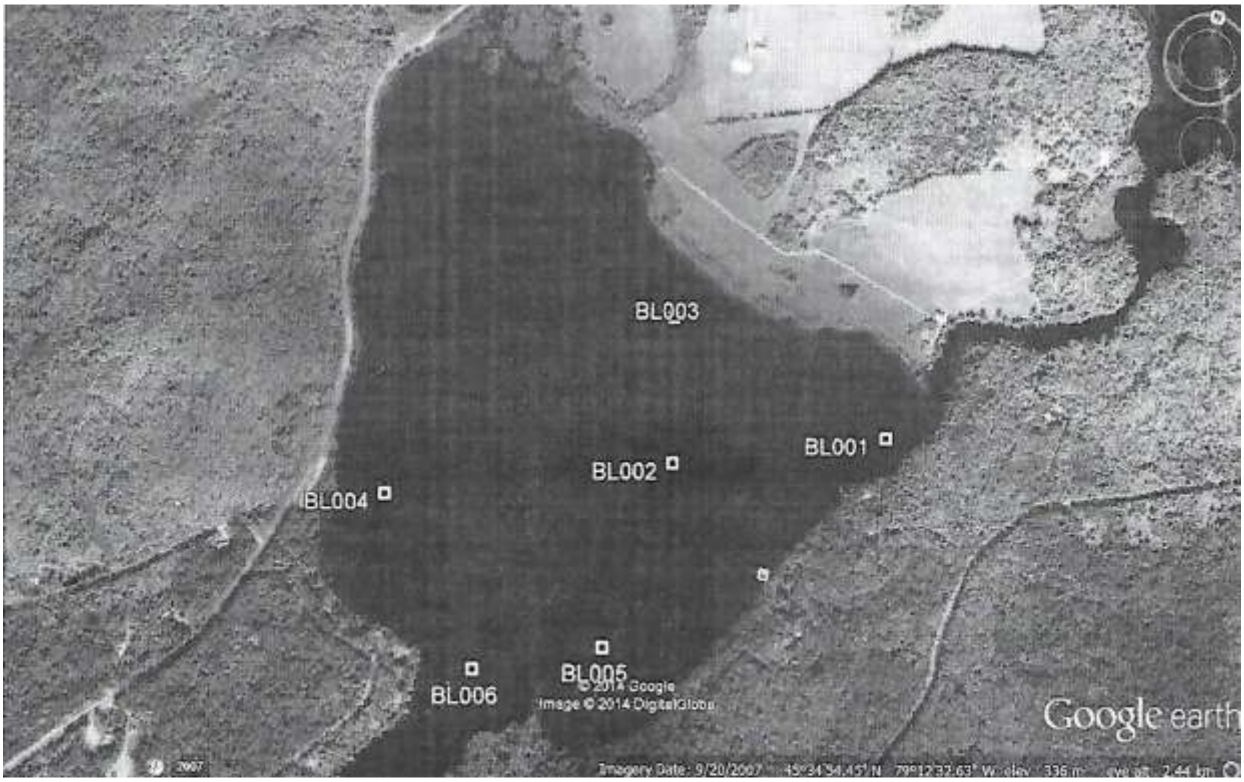
GPS Coordinates for sample sites at Peters Lake.

PETI	N 45° 32' 43.6" W 79° 08' 39.5"
PET2	N 45'' 32' 39.0" W 79° 08' 58.6"
PET3	N 45° 32' 29.3" W 79° 08' 46.3"

2.6 Beaver Lake

Beaver Lake is located 3.2 km north of Keamey. Highway 518 is located close to the lake and there are many visible cottages from each of the sampling sites. The map of the lake showing sample sites and the GPS coordinates for the sample sites can be found below

Beaver Lake characteristics (MNRF, 2015). Surface Area 13.6 Ha Max Depth 8.0m Perimeter 2.3 km



Map of Beaver Lake with sample sites, Retrieved from Google Earth

GPS Coordinates for sample sites at Beaver Lake

BOl	N 45°34' 1.7" W 79° 12' 9.0"	804	N 45° 34' 44.6" W 79° 12' 51.3"
802	N 45° 34' 50.8" W 79° 12' 27"	805	N 45° 34' 39.4" W 79° 12' 29.3"
803	N 45° 34' 59.4" W 79° 12' 30.3"	806	N 45° 34' 36.2" W 79° 12' 39.9"

2.7 Hassard Lake

Hassard Lake connects to both Beaver and Perry Lake. The lake is beside downtown Kearney, Ontario. Water flows from Beaver Lake into the northern end of Hassard Lake and exits at its southern end into Perry Lake. The surrounding land is developed. There are more lawns and less of a riparian zone visible from the sampling points. The map of the sample sites and the GPS coordinates for the sample sites can be found below.°

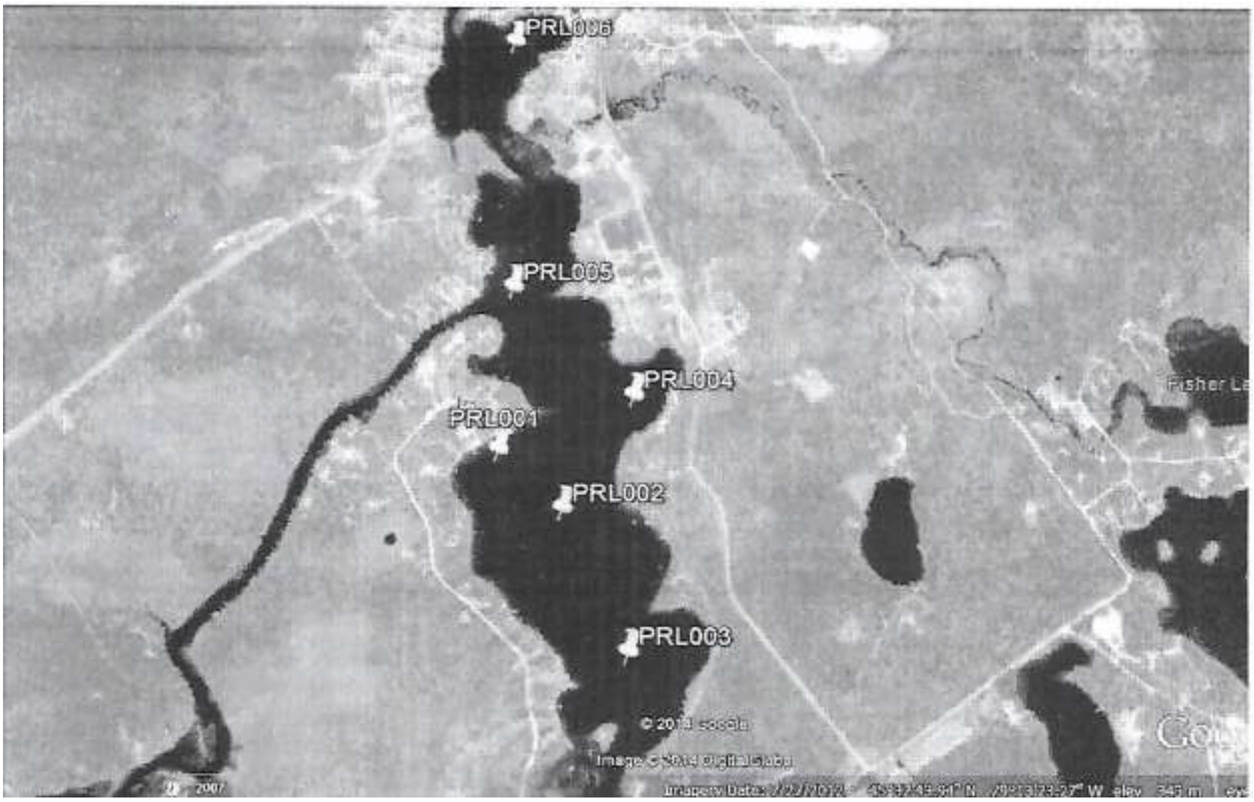
Map of Hassard Lake with sample sites, Retrieved from Google Earth

GPS Coordinates for sample sites at Hassard Lake.

HOI	N45°34' 1.7" W 79° 13' 4.1"	H04	N 45° 33' 28.7" W 79° 13' 29.7"
H02	N 45° 33' 47.0" W 79° 13' 27.7"	H05	N 45° 33' 33.1" W79° 13'32.6"
H03	N 45° 33' 34.6" W 79° 13' 22.4"	H06	N 45° 33' 37.8" W 79° 13' 26.7"

2.8 Perry Lake

Perry Lake is located in downtown Kearney. There is a public dock on Main St. and there are several cottages and homes visible from the sampling points. There is a heavy riparian zone south of the lake. The map of the lake showing the sample sites and the GPS coordinates for the sample sites can be found below.



GPS Coordinates for sample sites at Perry Lake.

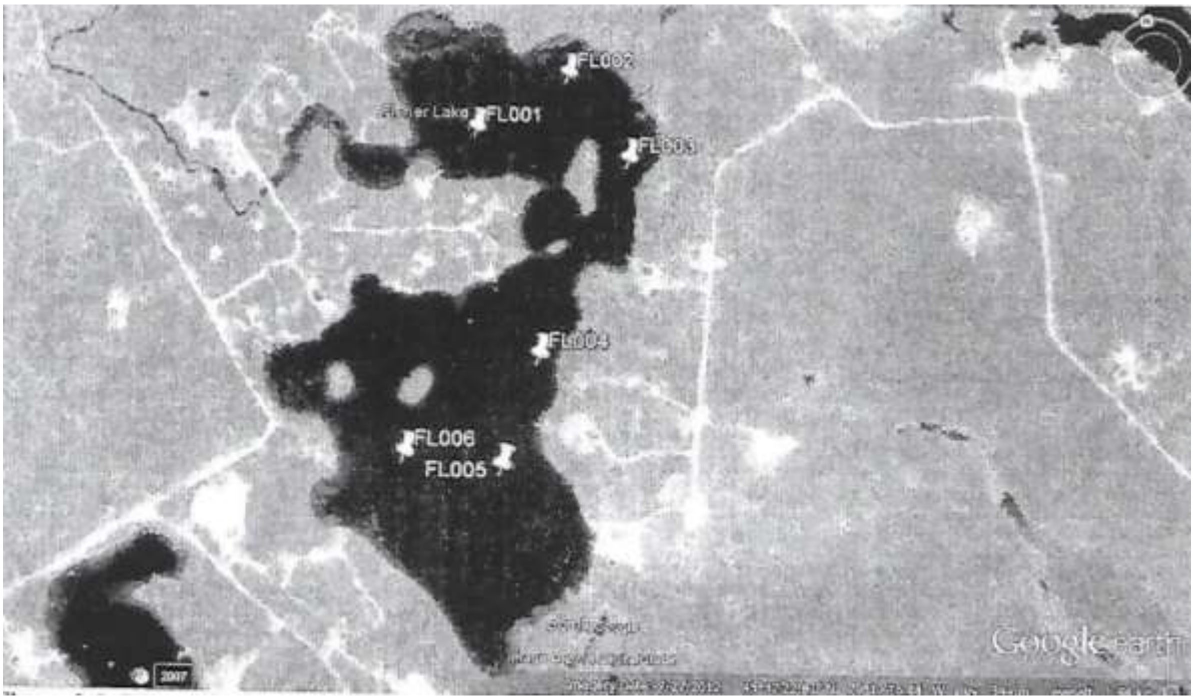
POI	N 45° 32' 42.9" W 79° 13' 47.7"	P04	N 45° 32' 44.9" W 79° 13' 30.9"
P02	N 4Y 32' 36.9" W79° 13' 41.9"	P05	N 45° 32' 56.2" W 79° 13' 42.0"
P03	N 45° 32' 24.2" W 79° 13' 38.i"	P06	N45°33' 17.9" W 79° 13' 35.3"

2.9 Perbeth/Fisher Lake

Perbeth Lake, also known as Fisher Lake, is located 2.8 km south of Kearney. It is a very shallow lake and has both springs and marshes in the lake. There is no Crown Land around the lake and the riparian zone is currently under construction with new cottages being built. The map of the lake with the sample sites and their GPS coordinates are shown below

Perbeth/Fisher Lake characteristics (MNRF, 2015).

Surface Area	Mean Depth	Max Depth	Perimeter
31 Ha	2m	4.5 m	4 km (plus 0.6 km island shoreline)



Map of Perbeth/Fisher Lake with sample sites, Retrieved from Coogle Earth

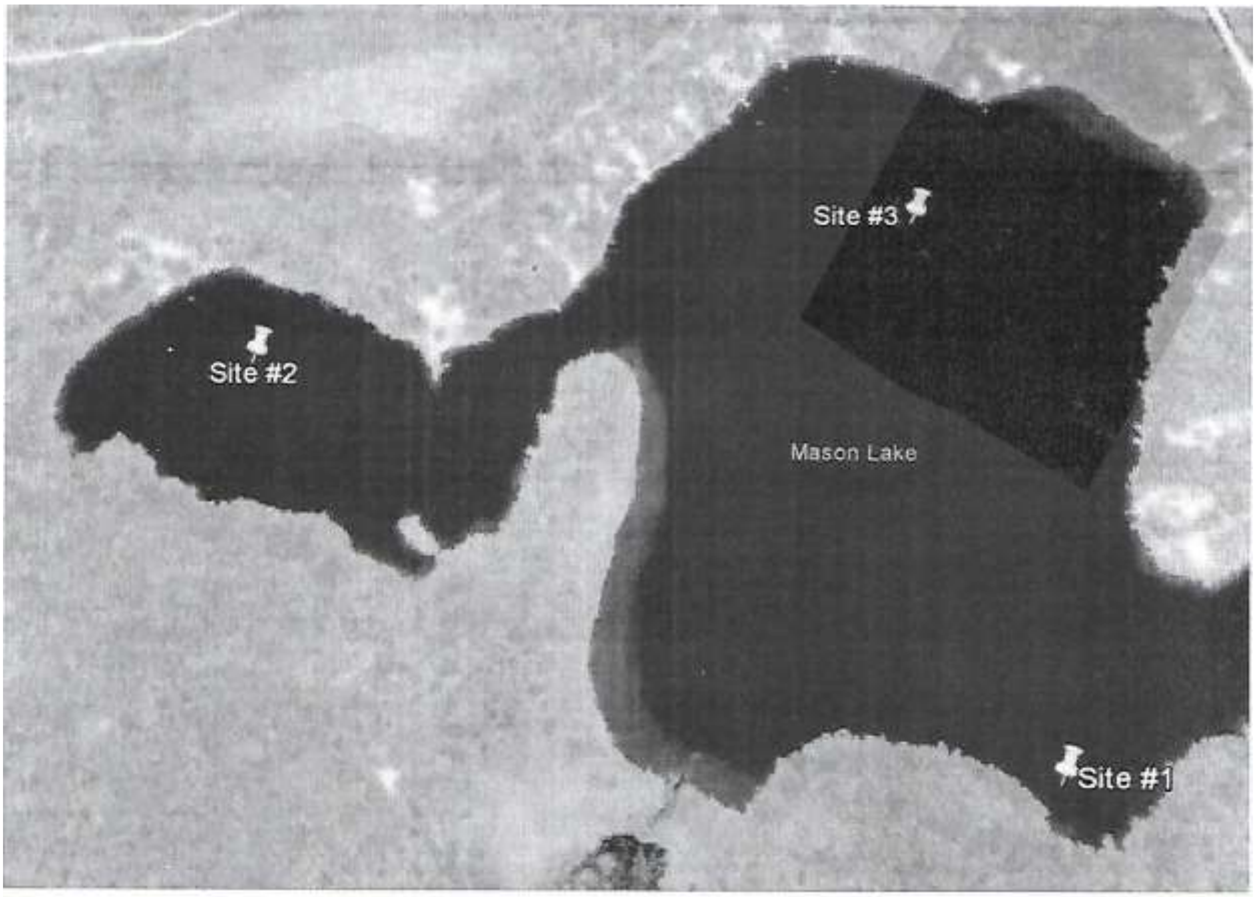
GPS Coordinates for sample sites at Perbeth/Fisher Lake.

PFOI	N 45° 32' 34.7" W 79° 12' 22.5"	PF04	N 45° 32' 22.4" W 79° 12' 12.2"
PF02	N 45° 32' 36.7" W 79° 12' 15.2"	Pf05	N 45° 32' 17.6" W 79° 12' 25.1"
PF03	N 45° 32' 31.5" VI 79° 12' 12.3"	PF06	N 45° 32' 19.1" W 79° 12' 31.3"

Above PF04 coordinates are incorrect we used N 45° 32’ 22.7” W 79° 12’ 20.8” based on the above map and our lake stewards memory of the location. PF04 would have put us several hundred feet into the bush.

2.10 Mason Lake

Mason Lake has a surface area of only 40 hectares and is the smallest lake sampled in this report. This lake is spring-fed on the northwestern side. Mason Lake is moderately developed with private residences without any public access points. A map of the lake and the location of sampling sites including their GPS coordinates are located below.



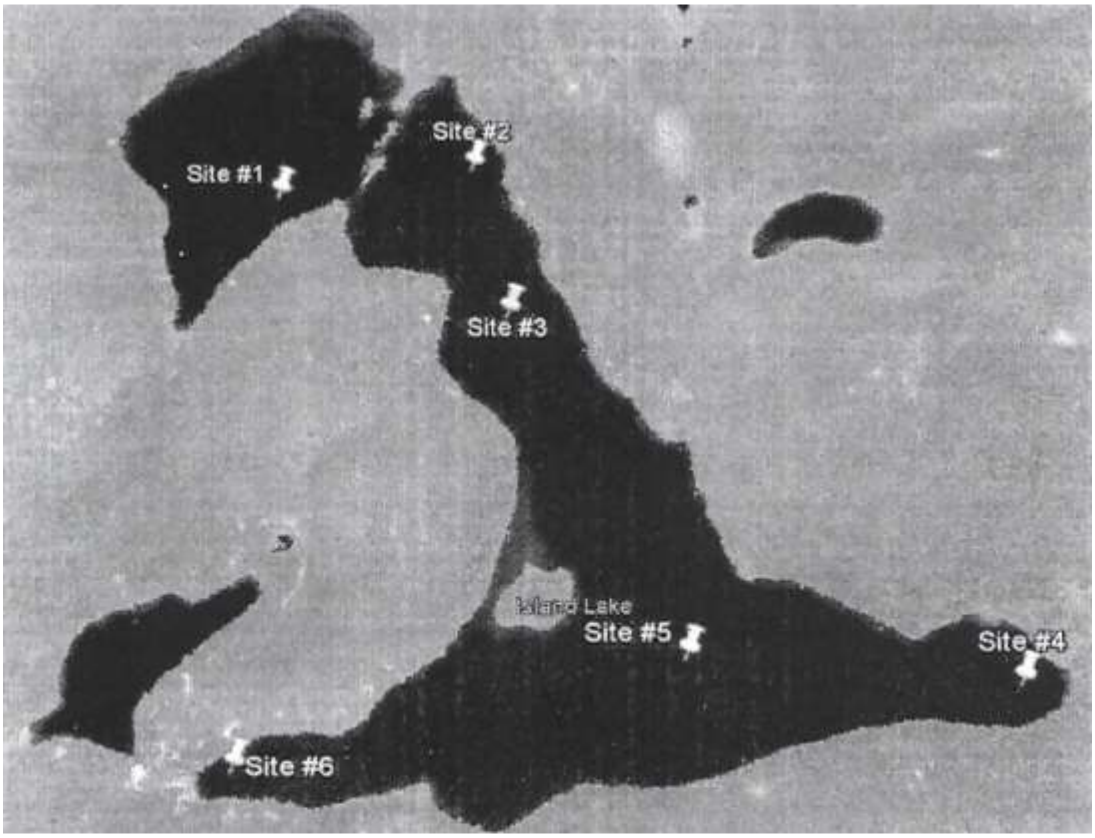
Map of Mason Lake with sample sites, Retrieved from Googlc Earth

Mason Lake sites and GPS coordinates.

Site	GPS Co-ordinate
Ml	N45°38' l5.9" W079°13'55.4"
M2	N45°38'27.S" W079°14'26.7"
M3	N45°38'32.7" W079°14'OO.8"

2.11 Island Lake

Island Lake, previously called Proudfoot Lake, is a medium-sized lake which supports a large diversity of fish species (US EPA, 2012b). There is a public access point at the southwestern tip of Island Lake with a small parking lot and dock for cottagers. There is a moderate amount of development surrounding the lake. A map of the lake showing the location of the sampling sites plus a list of their GPS coordinates are located below.



Map of Island Lake with sample sites, Retrieved from Coogle Earth

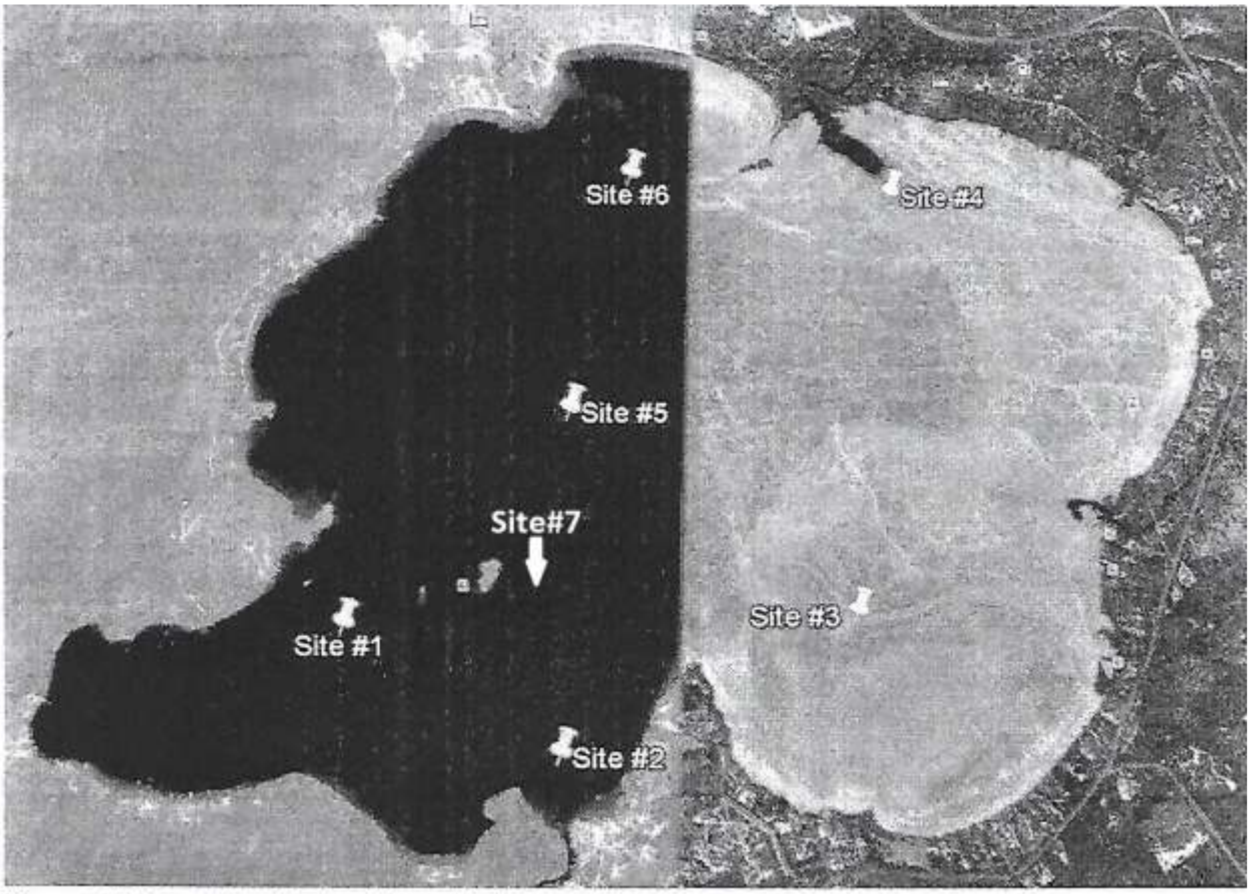
Island Lake sites and coordinates.

Site	GPS Coordinate	Site	GPS Coordinate
11	N45°41’30.6” W079°14’ 52.7”	14	N45° 40’ 52.6” W079°14'35.5”
12	N45°41’33.2” W079°14’ 31.9”	15	N45° 40’ 54.9” W079°14'07.6"
13	N45°41’22.5” W079°14’ 25.0”	16	N45° 40’ 47.5” W079°14' 51.0”

Site I1, I2 & I3 were all listed as being the same. Using the map above as a reference, our lake steward/volunteer took us to the sites as he remembered them and we recorded new coordinates

2.12 Sand Lake

Sand Lake has a surface area of 580 hectares and is highly developed with approximately 300 cottages along its perimeter and 4 public resorts. This lake can be accessed through a public access point. There are sandy beaches along several shores, which appear to be eroding and creating a shallow shoreline. The Magnetawan River flows in through the north side of the lake and exits at the south side. A map of the lake showing the location of sampling sites plus their GPS coordinates are located below.



Map of Sand Lake with sample sites, Retrieved from Google Earth

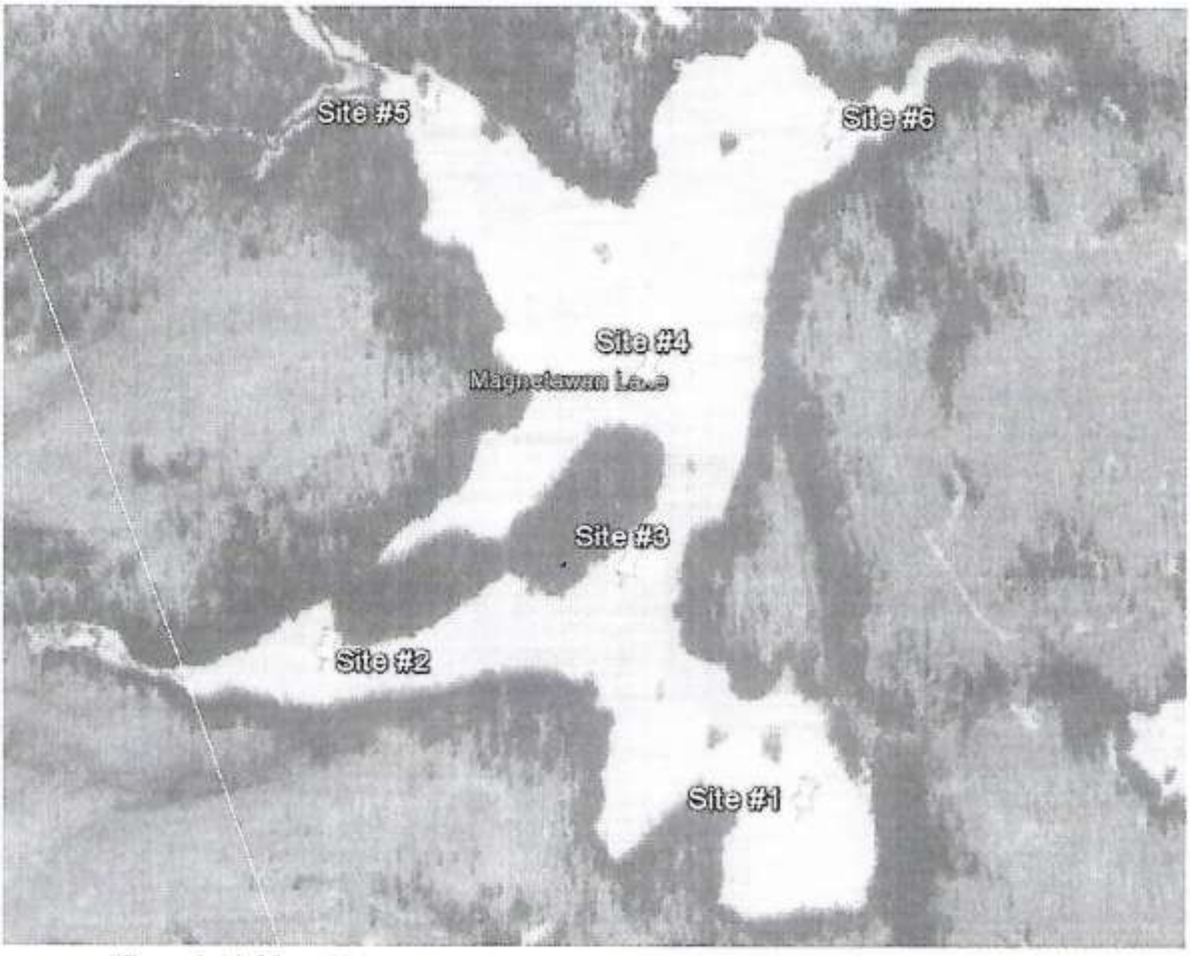
Sand Lake sites and coordinates

5ite	GP5 Co-ordinate	5ite	GP5 Co-ordinate
51	N45°37'12.7" W079°11'09.6"	54	N45°37'57.0" W79° 9' 55.7"
52	N45°37'09.7" W079°37'09.7"	55	N45°37'34.0" W079°10' 40.
53	N45°37'13.9" W079°10'01.2"	56	N45°38'12.1" W079°10'32.9" W079°10'32.9"

We found S2 coordinates very inaccurate and replaced them with N 45° 37' 04.6" W79° 10' 41.4" We had problems with high wind and a dragging anchor while evaluating the second instrument and picked Site #7 (N45°37' 17.3" W79° 10' 44.3") because it was deep but more sheltered. We don't anticipate including it as a regular sampling site.

2.14 Magnetawan Lake

Magnetawan Lake is located outside of Kearney and is situated inside the western boundary of Algonquin Provincial Park. This lake is the headwaters for the Magnetawan River and is surrounded by protected land. There are four campsites located around Magnetawan lake. A map of the lake showing the location of the sampling sites plus a list of their GPS coordinates are located below.



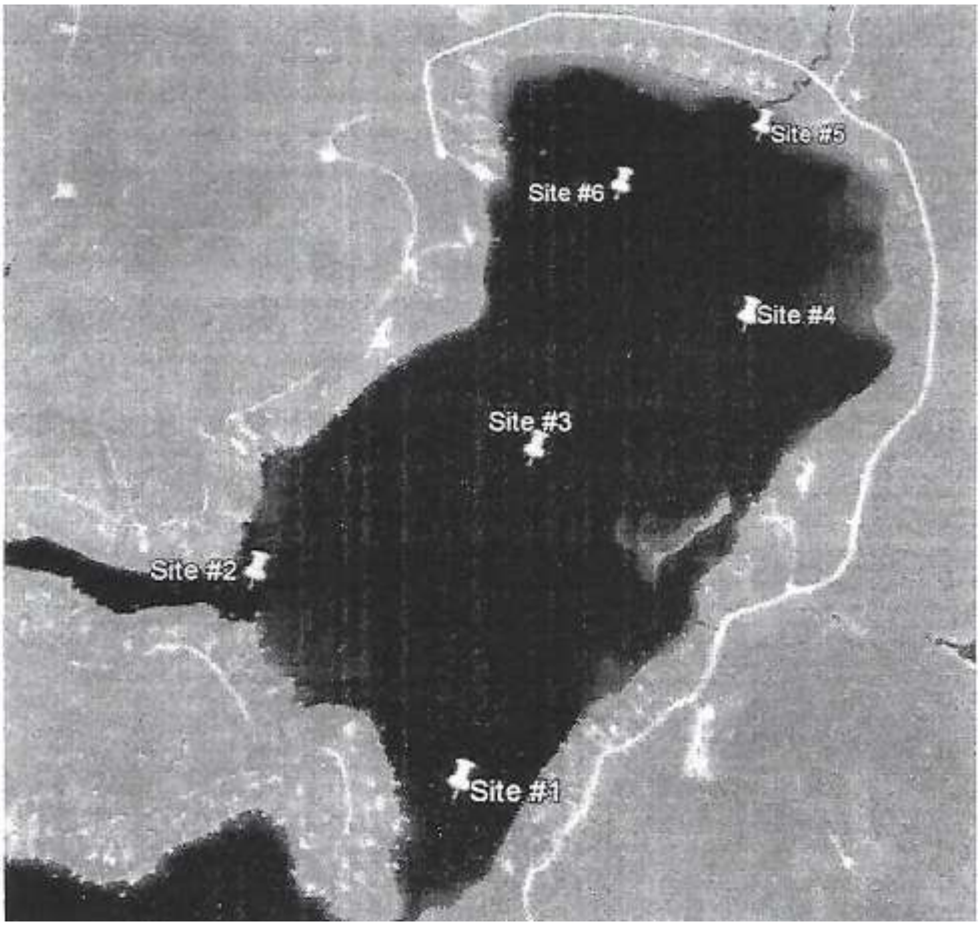
Map of Magnetawan Lake with sample sites, Retrieved from Coogle Earth

Magenetewan Lake sites and GPS Coordinates

Site	GPS Co-ordinate	Site	GPS Co-ordinate
MWl	N45° 39' 23.4" W078°59'04.2"	MW4	N45° 39' 47.7 W078° 59' l5.4"
MW2	N45° 39' 32.9" W078° 59'39.3"	MWS	N45° 40' 02.1" W078° 59' 32.0"
MW3	N45°39' 37.4" W078°59' 16.9"	MW6	N45°40' 0.07" W078° 59' l.5"

2.15 Grass Lake

Grass Lake is a medium-sized lake with a surface area of 138 hectares. This lake is developed with cottages located around the entire perimeter. Grass Lake is connected by a channel to Loon Lake where there is a dam that controls water levels. A map of the lake and the location of sampling sites plus a list of their GPS coordinates are located below.



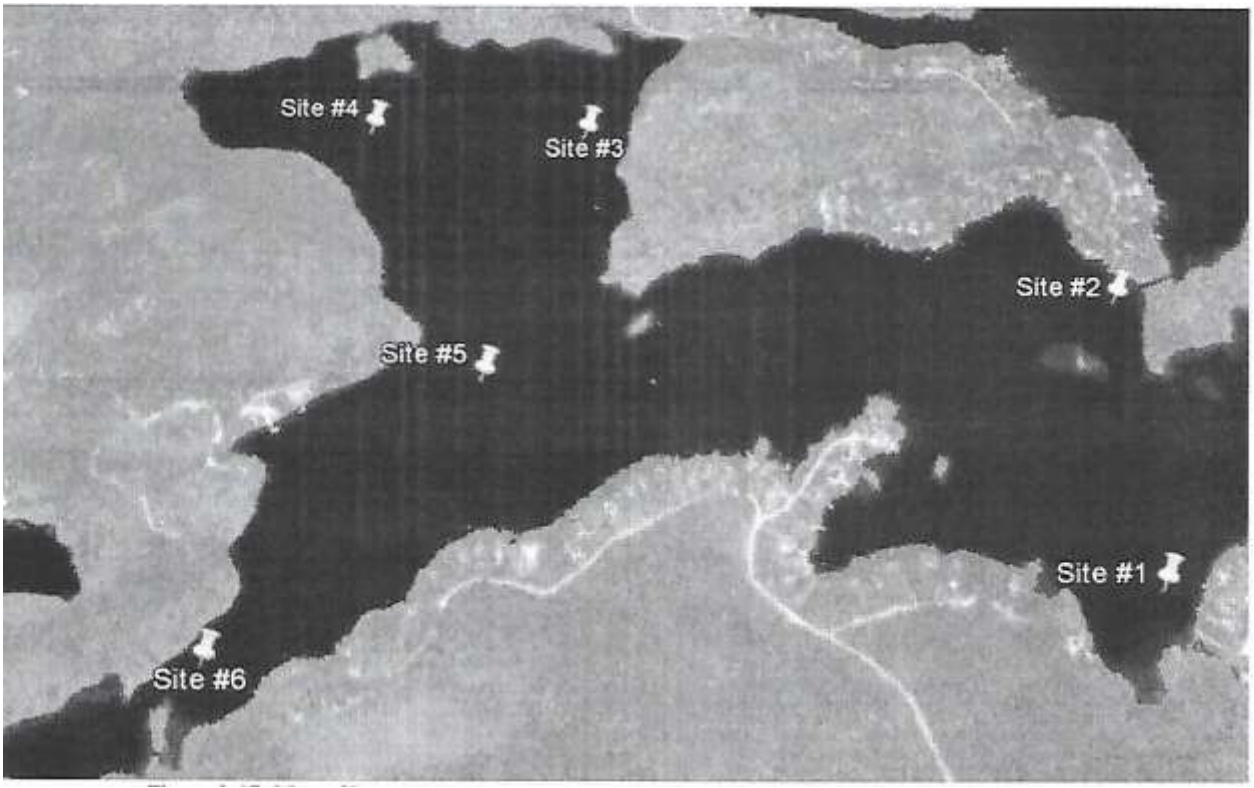
Map of Grass Lake with sample sites, Retrieved from Google Earth

Grass Lake Sites and Coordinates

Site	GPS Co-ordinate	Site	GPS Co-ordinate
Gl	N45° 40' 20.9" W79° 12' 20.6"	G4	N45° 40' 52.7" W79° 11' 56.0"
G2	N45° 40' 33.S" W79° 12' 38.9"	GS	N45° 41' 08.7" W79° 11' 53.7"
G3	N45° 40' 42.6" W79° 12' I5.4"	G6	N45° 41' 03.2" W79° 12' 07.8"

2.16 Loon Lake

Loon Lake has a surface area of 156 hectares with high development along the entire shoreline of this lake. There is a dam operated by the Ministry of Natural Resources that controls water levels in this lake. A map of the lake with the location of sampling sites plus their GPS coordinates are located below



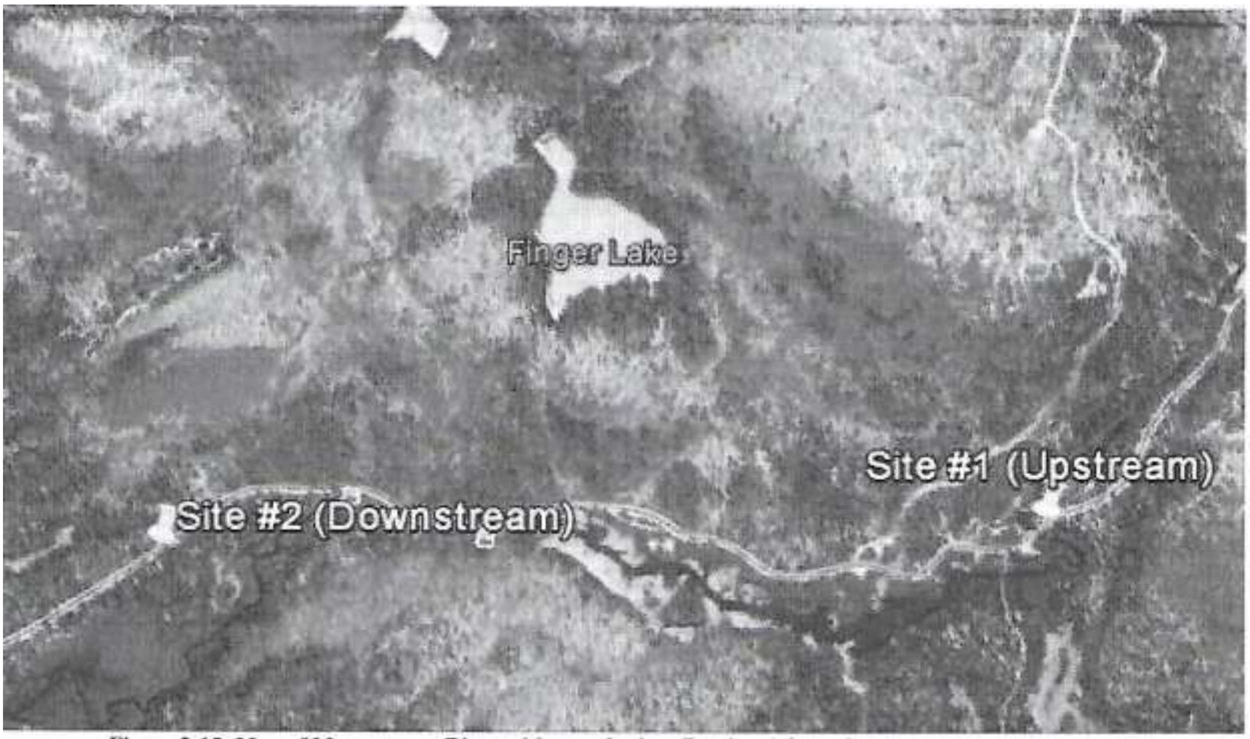
Map of Loon Lake with sample sites, Retrieved from Google Earth

Loon Lake sites and coordinates

Site	GPS Coordinate	Site	GPS Coordinate
Ll	N45° 39' 53.1" W79° 12' 27 .5"	L4	N45° 40' 23.4" W79° 13' 38.0"
L2	N 45° 40' 12.0" W79° 12' 29.6"	LS	N45° 40' O5.3" W79° 12' 29.6"
L3	N45° 40 '23.4" W79° 13' 17.9"	L6	N45° 39' 47.1" W79° 13' 44.2"

2.17(a) Magnetawan River

The Magnetawan River is 175 km long and originates in Algonquin Provincial Park at Magnetawan Lake. The river runs westward and exits into Georgian Bay linking many of the lakes sampled in this report. The sample site MRI is on a tributary that also rises in Algonquin Park passes close to the Kearney Graphite Mine and joins the Magnetawan River just below our sample site MR3. The MR1 sample site is upstream of the mine site and provides us with normal background reading levels. The second site, MR2, was selected about 1.6 km downstream from MRl and the decommissioned graphite mine. There were water quality concerns about mining effluent and tailings leakage. The MR2 sampling site is used to monitor this concern. A map of the river with the location of these two sampling sites plus their GPS coordinates are located below. Map and coordinates for MR3 are on the next page.



Map of Magnetawan River with sample sites, Retrieved from Coogle Earth

Magnetawan River sites and coordinates

Site	GPS Co-ordinate
MRl	N45° 42' 40.3" W79° 04' 07.S"
MR2	N45° 42' 36.7" W79° 05' 20.6"

2.17(b) Magnetawan River

We added a third site on the Magnetawan River several kilometers below MR2. This additional monitoring point was picked to see how much the pH and conductivity readings were reduced. The site on the river is easily accessed from a bridge over the river. The map of the river with the location of sampling site plus the GPS coordinates are located below.

Map of Magnetawan River with third sample site MR3

Site #3 GPS coordinates N 45° 40’ 12.0” W 79° 07’ 46.3

3.0 Measurement Methodology

All readings were taken by a field instrument on site. Our plan was to take a set of readings at 1 meter intervals from the surface to the bottom or at least to 20 meters if the depth permitted. The cable connecting the sensor package to the readout unit was marked off in meter intervals. We located the sample sites on the lake using a Magellan eXplorist 310 GPS handheld receiver and the co-ordinates provided in the 2015 reports. The co-ordinates were entered prior to arriving at the lake. Several of the volunteers had depth sounders/fish finders on their boats which provided confirmation of depths and information about the type and any obstacles on the lake bottom.

When we arrived at the sample site we dropped anchor, lowered the sonde into the water at the surface, waited for the readings to stabilize then took the initial set of readings by pressing the "take sample" button on the instrument. The data is recorded in the memory of the hand held display unit. After that the sensor package was lowered a meter at a time using the markings on the cable as a depth reference. At each depth we would wait for the readings to stabilize before recording the readings. All the readings for that particular site on the lake were kept in the same file in the memory of the display unit. We tried to avoid lowering the sensor package into bottom mud by stopping a few meters above the anticipated bottom.

On deep lakes, if there were six sample sites we found it took at least 2 – 2 1/2 hours to do a lake if we sampled at 1 meter intervals from the surface to the bottom. It would have been much faster if we had just located the thermocline and taken one set of readings to obtain data similar to that obtained in the reports of 2014/2015. Each evening the data collected that day was uploaded from the instrument into a spreadsheet on a personal computer.

Because of a logistical problem, the YSI Pro Plus instrument that we had intended to rent was not available at the beginning of August. As a temporary solution, Hoskins Scientific arranged for the use of a YSI 650 display unit connected by a long cable to a 600 XLM sonde with DO (using a stir independent Rapid Pulse sensor), conductivity, temperature, pH, ORP, depth, and barometric pressure sensors. Each individual set of readings included a time & date stamp and was stored in the display unit a user defined file system. The sonde was a long tube about 2 inches in diameter and 18 inches long that contained the electronics to gather & store the data in internal memory and included long life batteries and a sensor package . It was recommended that the sensor package be stored in a neutral solution when not in use and was kept immersed in lake water while not in use out on the lake and while travelling from lake to lake. The sensitive sensor package was contained inside a metal perforated shield that allowed water to enter but was protected from mechanical damage caused by accidentally bumping the unit against the boat, rocks in the water etc.

After we had completed the first round of testing we were notified that the original YSI Pro Plus unit that we had wanted to evaluate had been located and was available if we wanted to use it. We returned the YSI 650 / 600XLM and picked up the Pro Plus Unit. The sonde unit on the Pro Plus is physically much smaller and was not a stand alone unit. The Pro Plus had the same sensor capability - DO, pH, temperature, conductivity, barometric pressure, and the capability to time & date stamp each reading. It however did not have a depth sensor. It also operated essentially the same as the 650/600XLM with a couple of major differences. First, the Pro Plus once it is powered up needs a 15 minute warmup prior to recording any data and second, the installed polarographic DO sensor needs to be agitated (moved up and down in the water using a short bobbing motion) so that the sensor is continuously exposed to fresh water. If the motion stops the DO reading will decrease slowly. Once you move the sensor to a new depth the procedure is that you would continue to move it up and down in a bobbing motion until the DO reading stabilizes.

Since we had spent quite a bit of time getting a good set of readings during the initial Aug 4th to 15th period we used the second period from August 18-29th mainly to evaluate the second instrument and our test procedures.

Both instruments were calibrated at Hoskins Scientific before we picked them up and we were provided with standard solutions so that we could check the calibration. We checked both instruments at the start, midpoint and before the instrument was returned to be sure the unit was still calibrated.

We also took at least one Secchi disc reading on each lake. We are aware that there can be quite a variation in readings caused by amount of sunlight, wave action and what the individual observer considers a "visible" disc. Secchi readings are also taken by the Lake Partners volunteers throughout the summer and should be similar to our readings..

4.0 Measured Parameters and Water Quality Standards

The parameters measured were chosen by the community partners because of their ability to indicate the health of a lake (WHO, 20 II; EPA, 2012). Guidelines describing appropriate or safe levels for measured parameters were found in the MOECC's Provincial Water Quality Objectives (PWQO) and the World Health Organization's (WHO) Guidelines for Drinking-Water Quality (MOECC, 1994; WHO 2011). PWQO measure the aquatic toxicity, bioaccumulation, and mutagenicity of a water source in order to identify the quality of water for human recreation purposes and overall health of the lake (MOECC, 1994). In order to maintain the PWQO, the water quality of lakes in Ontario should be monitored regularly and compared to appropriate standards.

4.1 Temperature

The temperature of a water source can directly affect many of the physical, biological, and chemical factors of aquatic organisms (Environment Canada, 2013). If the temperature rises above the tolerance for a specific organism it can lead to detrimental effects (Environment Canada, 2013). Temperature can also affect other parameters within the water, such as, dissolved oxygen. High water temperatures can decrease oxygen levels and increase algal growth, while low water temperatures can increase oxygen levels (CCME, 2011).

4.2 Secchi Disc

Secchi discs are used to provide a visual measure of water clarity and optical depth (CCME, 2011). A secchi disc is lowered into the body of watcr in a shaded location; the best time of day to sample sec chi depth is midday (CClYlE, 2011). The deeper the secchi disc reading is, the clearer the lake. The CCME recommends that secchi measurements should be made every two weeks between June and October, if possible. Secchi depth provides an idea of how turbid the water is. High turbidity can be caused by soil erosion, waste discharge, urban runoff and excessive algal growth (EPA, 2012). The Provincial Water Quality Guidelines states that if the water body is for recreational use, and the bottom is not visible, the water should have a secchi reading of at least 1.2 m (MOECC, 1994).

4.3 Dissolved Oxygen

Dissolved oxygen (DO) is present in water due to photosynthetic activity and diffusion (CCME, 1993). The DO concentration is dependent on the temperature and atmospheric pressure within the water (CCME, 2011). Fast moving water will have higher dissolved oxygen due to the mixing of water with air (CCME, 1993). Oxygen is required for basic life processes. Higher levels can better support some sensitive lake species and is used as an indicator of water quality. The presence of agriculture, industry and deforestation can lower dissolved oxygen levels, because runoff from these sources can react with oxygen through decomposition reactions (CCME, 1993). Recommended levels for cold-water systems are no lower than 9.5 *mg/L* (CCME, 1993).

Dissolved Oxygen requirements for various fish Species

The following information was taken from the following website : http://www.fondriest.com/environmental-measurements/parameters/water-quality/dissolved-oxygen

Coldwater fish like trout and salmon are most affected by low dissolved oxygen levels. The mean DO level for adult salmonids is 6.5 mg/L, and the minimum is 4 mg/L . These fish generally attempt to avoid areas where dissolved oxygen is less than 5 mg/L and will begin to die if exposed to DO levels less than 3 mg/L for more than a couple days . For salmon and trout eggs, dissolved oxygen levels below 11 mg/L will delay their hatching, and below 8 mg/L will impair their growth and lower their survival rates. When dissolved oxygen falls below 6 mg/L (considered normal for most other fish), the vast majority of trout and salmon eggs will die.

Bluegill, Largemouth Bass, White Perch, and Yellow Perch are considered warm water fish and depend on dissolved oxygen levels above 5 mg/L. They will avoid areas where DO levels are below 3 mg/L, but generally do not begin to suffer fatalities due to oxygen depletion until levels fall below 2 mg/L. The mean DO levels should remain near 5.5 mg/L for optimum growth and survival .

Walleye also prefer levels over 5 mg/L, though they can survive at 2 mg/L DO levels for a short time. Muskie need levels over 3 mg/L for both adults and eggs . Carp are hardier, and while they can enjoy dissolved oxygen levels above 5 mg/L, they easily tolerate levels below 2 mg/L and can survive at levels below 1 mg/L .

The freshwater fish most tolerant to DO levels include fathead minnows and northern pike. Northern pike can survive at dissolved oxygen concentrations as low as 0.1 mg/L for several days, and at 1.5 mg/L for an infinite amount of time. Fathead minnows can survive at 1 mg/L for an extended period with only minimal effects on reproduction and growth.

As for bottom-dwelling microbes, DO changes don’t bother them much. If all the oxygen at their water level gets used up, bacteria will start using nitrate to decompose organic matter, a process known as denitrification. If all of the nitrogen is spent, they will begin reducing sulfate [17]. If organic matter accumulates faster than it decomposes, sediment at the bottom of a lake simply becomes enriched by the organic material.

4.4 Conductivity

Conductivity is a measure of the ability of water to conduct electricity. This parameter is affected by the number ions that are dissolved in the water (EPA, 2012).lfa lake were to have a high amount of inorganic solids, the water would be more conductive whereas if the lake were to have more amounts of organic solids it would be less conductive (EPA, 2012). The conductivity for lake water should be below 500 micro Siemens/centimeter. If a lake were to have a higher conductivity than the suggested limit, the water may not be suitable for living organisms (EPA, 2012).

4.5 pH

The pH of a solution is a measure of the concentration of H+ ions. The pH has a scale from 0-14, where a pH below 7 is acidic and a pH above 7 is basic. A pH of7 is considered to be neutral (Environment Canada, 2013). Water that has a pH from 6.5-9 is suitable for aquatic organisms (Environment Canada, 2013). The organisms that are most sensitive to extreme changes in pH are young fish and benthic invertebrates. The pH of a water body can be altered by acid rain, wastewater discharges and drainage from coniferous forests (Environment Canada, 2013).

4.6 Nitrate

Nitrate is an essential nutrient for plants, however in excess can be considered a contaminate (EPA, 2012). When nitrate is in excess it can accelerate eutrophication by causing increases in plant growth and changing the types of organisms found in the water. High nitrate levels can also lower the dissolved oxygen level and increase temperature (EPA, 2012). Sources of nitrate contamination are wastewater treatment plants, failing septic systems, runoff from fertilized lawns and manure storage sites. The natural level of nitrate in freshwater is commonly less than 1 mg/L, however, in effluent of some wastewater treatment plants nitrate levels can be 30 mg/L (EPA, 2012). Health Canada states that the maximum nitrate level allowable in drinking water is 45 mg/L (Health Canada, 2012).

4.7 Nitrite

Nitrite is usually found in minimal concentrations, but it can be damaging. The concentration increases with chloro-aminated waters, which is a result of waste water treatment (WHO, 2011). Nitrite quickly converts to nitrate when exposed to oxygen, which is part of the reason why nitrite is found in such low levels (Health Canada, 2011). It is naturally present due to the nitrogen cycle, but it can be present in higher levels due to agriculture, fertilizers, waste, and industry input (Health Canada, 2012). Infants are more susceptible to health risks from increased nitrite levels, but the common health concern related to nitrite is methemoglobinemia, which impairs the ability of blood cells to bind with oxygen (Health Canada, 2012). The maximum acceptable nitrite concentration in drinking water is 3 mg/L (Health Canada, 2012)

4.8 Phosphate

Phosphate (orthophosphate) is an inorganic form of phosphorus and an essential nutrient. Aquatic plants use orthophosphate and convert it to organic phosphate for their tissue (EPA, 2012). Phosphate tests measure only the orthophosphate form of phosphorus. Phosphate stimulates the growth of plankton and aquatic plants to provide food for fish. However, human or animal waste, industrial effluents and fertilizer runoff (Oram, n.d.) can provide excess phosphate conditions causing large growth bursts of undesirable organisms and accelerated eutrophication disrupting aquatic ecosystems. (Oram, n.d.). Human consumption of phosphorous has not been found to be a threat to human health, therefore there is no "acceptable" levels for phosphate in drinking water. However, excessive plant growth due to high phosphorous levels can occur at concentrations above 0.03 mg/L (Fleming & Fraser, 1999).

4.9 Total Phosphorus

Total phosphorous is the measure of all forms of phosphorous, including organic, inorganic and poly (EPA, 2012). Phosphorus occurs naturally in rocks and mineral deposits as poly-phosphorous but higher levels can occur as a result of agricultural runoff (CCME, 2011). Phosphorus is a limiting nutrient in freshwater and too much can be harmful resulting in algal blooms and eutrophication (CCME, 2012). Canadian guidelines provide 'trigger ranges' indicating the health of the system according to the total phosphorous level (CCME, 2004). The table below displays these ranges for different trophic systems. The lakes in this study are typically oligotrophic, not exceeding a level of 10 ug/L.

Canadian total phosphorous trigger ranges (CCME, 2004).

Trophic Status	Total Phosphorous (ug/L)
Ultra-oligotrophic	< 4
Oligotrophic	4 - 10
Mesotrophic	10 -- 20
Meso-eutrophic	20 - 35
Eutrophic	. 35 - 100
Hyper-eutrophic	> 100

5.0 Results

We have included one example from one lake of the readings obtained at one meter intervals at one of the deep spots on that lake. If the readers are interested in seeing these readings for the other lakes we can add those to the report as well. We found online some interesting information on the DO requirements for various fresh water fish species which was included in section 4.3

You will notice that the temperature in this example lake really starts to drop between 4 & 5 meters and the DO increases. Above that the temperature and DO is fairly uniform due to mixing by wind, waves etc. Between 4 and 7 meters the DO is higher than at the surface mainly because the colder water will absorb more oxygen. Based on the secchi disc readings sunlight can penetrate down to these depths so that photosynthesis can occur and oxygen is produced as a by product. Decomposition of plant material etc. at the lower depths consumes oxygen which is not being replenished on an ongoing basis.

Big Clam – Site#2

Date Time D/M/Y HH:MM:SS	Temp C	SpCond uS	DO mg/L	pH	Depth meters
06/08/16 13:23	25.42	24	7.83	6.53	1
06/08/16 13:23	25.29	26	7.83	6.65	2
06/08/16 13:24	24.9	24	7.88	6.67	3
06/08/16 13:24	22.49	26	8.61	6.73	4
06/08/16 13:25	17.82	23	10.55	6.77	5
06/08/16 13:25	11.91	25	11.62	6.69	6
06/08/16 13:26	9.09	24	10.12	6.11	7
06/08/16 13:26	7.64	26	7.79	5.85	8
06/08/16 13:27	6.86	24	6.49	5.72	9
06/08/16 13:27	6.51	26	5.87	5.68	10
06/08/16 13:28	6.32	25	5.52	5.63	11
06/08/16 13:28	6.06	26	5.22	5.62	12
06/08/16 13:29	5.94	25	4.97	5.58	13
06/08/16 13:29	5.84	27	4.53	5.57	14
06/08/16 13:30	5.72	26	4.13	5.54	15
06/08/16 13:30	5.64	29	3.39	5.53	16
06/08/16 13:31	5.62	28	2.56	5.51	17
06/08/16 13:31	5.6	31	1.7	5.51	18

Beaver Lake

Beaver-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	Ug\L
Site-1	42593.56	17.74	35	4.81	6	6.81		4.8 - 4.5
Site-2	42593.57	17.88	35	4.99	6	6.76	4	
Site-3	\							
Site-4								
Site-5	42593.6	23.89	37	7.68	4.9	6.22		
Site-6	42593.56	18.97	38	8.45	4.9	6.74		

Beaver-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1							
Site-2	42607.43	19.5	38	3.76	5	6.19	4
Site-3							
Site-4							
Site-5							
Site-6							

Big Clam Lake

Big Clam-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	06/08/16 13:03	18.6	23	10.19	5.0	6.71		3.4 - 4.0
Site-2	06/08/16 13:25	17.8	23	10.55	5.0	6.77		
Site-3	06/08/16 19:36	18.0	24	10.12	5.0	6.56		
Site-4	06/08/16 10:24	17.3	24	10.21	5.0	6.62	4.5	
Site-5	06/08/16 10:05	18.0	24	10.28	5.0	6.68		
Site-6	06/08/16 09:33	17.7	25	9.91	5.0	6.65	4.0	

Big Clam-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	20/08/16 11:50	19.4	24	9.79	5.0	6.48	
Site-2	20/08/16 11:14	18.2	24	10.43	5.0	6.45	
Site-3	19/08/16 15:57	17.8	24	10.81	5.0	6.58	4.5
Site-4	19/08/16 15:25	17.8	24	10.34	5.0	6.58	
Site-5	19/08/16 13:37	17.7	24	10.08	5.0	6.48	
Site-6	19/08/16 12:59	18.5	24	9.84	5.0	6.53	

Emsdale Lake

Emsdale-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	08/08/16 14:36	18.3	23	11.45	6.0	6.97	7.5	3.4 - 4.0
Site-2	08/08/16 14:56	19.2	23	11.28	6.0	7.03	7.3	
Site-3	08/08/16 15:24	18.1	25	11.86	6.0	6.93	7.6	
Site-4	08/08/16 15:40	18.5	23	11.63	6.0	6.91	7.3	
Site-5	08/08/16 15:57	18.9	26	11.44	6.0	6.87	7.4	
Site-6	08/08/16 16:11	19.0	23	11.81	6.0	2	7.3	

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1							
Site-2							
Site-3							
Site-4							
Site-5							
Site-6							

Fisher / Perbeth Lake

Fisher/Perbeth-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	08/08/16 11:26	23.4	30	7.96	1.7	6.69		8.4 - 14
Site-2	08/08/16 11:35	23.7	31	7.47	1.6	6.67		
Site-3	08/08/16 11:44	23.9	31	8.03	2.2	6.7		
Site-4	08/08/16 11:54	23.8	32	6.96	3.2	6.52		
Site-5	08/08/16 12:07	24.2	32	7.55	3.0	6.71		
Site-6	08/08/16 12:20	23.8	32	6.66	3.3	6.43		

Fisher/Perbeth-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	22/08/16 10:18	22.1	32	6.84	1.0	6.49	
Site-2	22/08/16 10:26	22.3	32	6.92	1.0	6.56	
Site-3	22/08/16 10:39	22.2	31	6.85	2.0	6.6	
Site-4	22/08/16 10:54	22.4	33	6.35	3.0	6.5	
Site-5	22/08/16 11:04	22.3	33	6.38	3.0	6.56	2.3
Site-6	22/08/16 11:14	22.3	33	6.61	3.0	6.56	

Grass Lake

Grass-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	10/08/16 09:26	20.8	19	10.62	6.0	6.57		3.2 - 3.2
Site-2	10/08/16 09:14	19.1	19	9.93	6.5	6.66		
Site-3	10/08/16 09:51	15.6	19	12.02	6.9	6.8		
Site-4	10/08/16 10:10	15.2	19	12.08	7.0	6.78		
Site-5	10/08/16 10:25	24.0	20	8.21	4.1	6.69		
Site-6	10/08/16 08:44	14.6	19	12.31	7.0	6.69	4.5	

Grass-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	24/08/16 09:25	17.2	19	11.08	7.0	6.46	
Site-2	24/08/16 09:11	18.1	19	10.72	7.0	6.43	
Site-3	24/08/16 09:36	18.2	20	10.51	7.0	6.28	
Site-4	24/08/16 09:48	15.1	19	12.21	7.0	6.41	
Site-5	24/08/16 10:06	22.1	20	7.64	5.0	6.53	
Site-6	24/08/16 08:44	11.7	19	13.19	7.0	6.42	5.5

Groom/Lynx Lake

Groom-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	05/08/16 09:02	24.9	27	6.70	2.5	6.44		7.6 - 8.2
Site-2	05/08/16 09:13	25.0	27	7.51	3.4	6.54	3.4	
Site-3	05/08/16 09:23	24.4	27	7.46	3.5	6.57	3.4	
Site-4	05/08/16 09:39	18.0	33	3.16	5.0	6.41	3.5	
Site-5	05/08/16 10:00	23.8	28	7.13	3.5	6.51	3.4	
Site-6	05/08/16 10:13	24.7	27	7.60	3.5	6.54	3.4	

Groom-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	19/08/16 08:37	22.7	27	6.82	2.0	6.24	2.7
Site-2	19/08/16 08:44	22.7	28	6.39	3.0	6.35	3.6
Site-3	19/08/16 08:55	22.3	29	5.34	4.0	6.26	3.8
Site-4	19/08/16 09:07	18.2	37	0.05	5.0	5.91	3.8
Site-5	19/08/16 09:28	22.2	29	5.34	4.0	6.32	4.1
Site-6	19/08/16 09:36	22.7	29	6.26	3.0	6.4	4.0

Hassard Lake

Hassard -1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	11/08/16 14:46	21.8	52	10.88	3.0	6.74		6.4 - 7.8
Site-2	11/08/16 15:00	21.6	39	8.29	4.0	6.97		
Site-3	11/08/16 15:13	22.0	35	8.17	4.0	6.71		
Site-4	11/08/16 15:28	21.8	38	8.27	4.0	6.83	3.5	
Site-5	11/08/16 15:44	20.9	37	8.38	4.0	6.9		
Site-6								

Hassard-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1							
Site-2							
Site-3							
Site-4							
Site-5							
Site-6	25/08/16 11:27	19.7	41	5.51	5.0	6.15	3.8

Himbury Lake

Himbury-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	11/08/16 08:57	19.7	21	11.19	6.0	6.81	4.5	3.4 - 3.6
Site-2	11/08/16 09:32	20.1	22	11.08	6.0	6.78		
Site-3	11/08/16 09:55	21.1	22	10.02	6.0	6.76		
Site-4					..			
Site-5								
Site-6								

Himbury-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	25/08/16 08:42	16.6	23	11.2	6.0	6.25	4.5
Site-2	25/08/16 09:08	15.6	23	11.2	6.0	6.58	
Site-3	25/08/16 09:21	23.0	23	7.41	5.0	6.69	
Site-4							
Site-5							
Site-6							

Island Lake

Island-1 Sampling site	Date Time D/M/Y HH:MM	Temp C	SpCond uS	DO mg/L	Depth meters	pH	Secchi meters	TP (Lpdata) ug\L
Site-1	10/08/16 14:42	18.5	21	11.90	6.0	6.80	5.0	4.2 - 3.6
Site-2	10/08/16 14:53	18.3	21	11.85	6.7	6.91		
Site-3	10/08/16 15:09	19.8	21	11.85	6.5	6.41		
Site-4	10/08/16 15:24	16.1	21	10.50	7.0	6.80		
Site-5	10/08/16 15:35	20.8	22	10.19	6.2	6.83		
Site-6	10/08/16 15:46	20.1	21	10.57	6.1	6.87		

Island-2 Sampling site	Date Time D/M/Y HH:MM:SS	Temp C	SpCond uS	DO mg/L	Depth meters	pH	Secchi meters
Site-1	24/08/16 13:25	19.4	22	12.26	6.0	6.86	5.0
Site-2	24/08/16 13:44	18.3	22	11.66	6.0	6.72	
Site-3	24/08/16 13:54	18.3	22	11.62	6.0	6.77	
Site-4	24/08/16 14:06	14.1	22	12.42	6.0	6.74	
Site-5	24/08/16 14:17	19.1	22	10.64	6.0	6.78	
Site-6	24/08/16 14:27	17.1	22	10.58	6.0	6.63	

Little Clam Lake

Little Clam Sampling site	Date Time D/M/Y HH:MM	Temp C	SpCond uS	DO mg/L	Depth meters	pH	Secchi meters	TP (Lpdata) ug\L
Site-1	06/08/16 11:39	21.1	23	10.94	6.0	6.75	5.0	N/A
Site-2	06/08/16 12:06	20.5	21	11.35	6.0	6.70		
Site-3	06/08/16 12:25	25.3	23	7.94	1.5	6.62		
Site-4								
Site-5								
Site-6								

Little Clam Sampling site	Date Time D/M/Y HH:MM:SS	Temp C	SpCond uS	DO mg/L	Depth meters	pH	Secchi meters
Site-1	18/08/16 16:33	21.5	23	11.81	6.0	6.38	4.8
Site-2	18/08/16 17:02	23.4	23	7.48	4.0	6.37	
Site-3	03/01/17 05:19	23.5	24	7.64	1.5	6.40	
Site-4							
Site-5							
Site-6							

Loon Lake

Loon-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	10/08/16 11:13	23.8	19	8.38	5.3	6.68		3.4 - 4.6
Site-2	10/08/16 11:21	22.9	19	9.16	6.0	6.54		
Site-3	10/08/16 11:33	15.9	19	11.94	6.8	6.81		
Site-4	10/08/16 11:44	15.5	19	12.10	7.0	6.80		
Site-5	10/08/16 12:00	17.9	19	11.57	6.5	6.78		
Site-6	10/08/16 12:15	16.9	19	11.12	6.9	6.68	6.9	

Loon-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	24/08/16 11:04	17.3	20	10.87	7.0	6.38	
Site-2	24/08/16 11:19	22.4	20	7.55	3.0	6.52	Drifted – readings unreliable
Site-3	24/08/16 11:36	18.6	20	10.48	7.0	6.46	
Site-4	24/08/16 11:56	17.9	20	11.07	7.0	6.45	
Site-5	24/08/16 12:16	17.6	20	11.11	7.0	6.33	
Site-6	24/08/16 12:25	16.8	20	11.51	7.0	6.53	6.1

Magnetawan Lake

Magnetawan Lake-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	09/08/16 10:05	19.7	15	9.75	5.0	6.00		
Site-2	09/08/16 10:32	19.8	14	10.30	5.0	6.06		
Site-3	09/08/16 11:05	19.9	14	10.27	5.0	6.08	4.5	
Site-4	09/08/16 11:29	21.7	13	9.82	4.9	5.98		
Site-5	09/08/16 11:54	21.8	14	10.16	4.7	5.99		
Site-6	09/08/16 12:08	14.6	14	10.83	6.0	6.09		

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1							
Site-2							
Site-3							
Site-4							
Site-5							
Site-6							

Magnetawan River

Magnetawan River-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	09/08/16 13:03	22.5	33	7.98	0.4	5.68		
Site-2	09/08/16 13:17	17.9	958	6.96	0.5	5.56	too shallow	not done
Site-3	09/08/16 13:38	23.2	85	8.50	0.3	6.27		
Site-4								
Site-5								
Site-6								

Magnetawan River-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters	
Site-1	04/09/16 16:58	20.4	52	7.32	0.5	6.10		
Site-2	04/09/16 17:20	17.5	1124	7.94	0.3	6.04	too shallow	not done
Site-3	04/09/16 16:35	21.6	112	7.77	0.5	6.30		
Site-4								
Site-5								
Site-6								

Mason Lake

Mason-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	15/08/16 09:13	20.3	23	10.58	4.0	6.80		4.8 - 4.8
Site-2	15/08/16 09:33	13.0	24	3.99	5.0	6.55		
Site-3	15/08/16 08:45	13.3	21	11.71	5.0	6.87	4.3	
Site-4								
Site-5								
Site-6								

Mason-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	26/08/16 09:17	12.3	21	7.36	5.0	5.49	
Site-2							
Site-3							
Site-4	26/08/16 09:42	19.7	22	8.27	5.0	6.08	
Site-5							
Site-6							

Perry Lake

Perry-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	08/08/16 08:44	17.7	38	9.16	5.0	24624.00		16.8 - 14.4
Site-2	08/08/16 09:01	17.2	37	9.27	5.0	6.75		
Site-3	08/08/16 09:23	16.9	37	9.10	5.0	6.74		
Site-4	08/08/16 09:52	17.4	37	9.21	5.0	6.65	3.2	
Site-5	08/08/16 10:11	17.8	41	8.40	4.9	6.63		
Site-6	08/08/16 10:28	17.1	43	3.39	5.0	5.99		

Perry-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	23/08/16 14:16	22.2	41	7.35	4.0	6.80	
Site-2	23/08/16 14:29	17.4	38	9.38	5.0	6.69	
Site-3	23/08/16 14:45	17.8	38	8.99	5.0	6.57	
Site-4	23/08/16 15:00	13.2	37	4.73	6.0	6.02	3.0
Site-5	23/08/16 15:09	22.5	41	7.35	4.0	6.74	
Site-6	23/08/16 15:18	22.6	41	7.27	3.0	6.70	Drifted – unreliable readings

Peters Lake

Peter-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1								N/A
Site-2								
Site-3	Lake steward N/A							
Site-4								
Site-5								
Site-6								

Peter-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-1	23/08/16 09:04	21.6	21	6.87	2.0	6.13	
Site-2	23/08/16 09:22	21.9	22	6.94	3.0	6.36	
Site-3	23/08/16 09:40	16.2	21	11.9	5.0	6.42	4.3
Site-4							
Site-5							
Site-6							

Sand Lake

Sand-1

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi	TP (Lpdata)
	D/M/Y HH:MM	C	uS	mg/L	meters		meters	ug\L
Site-1	15/08/16 11:58	14.1	31	10.01	7.0	6.82	4.3	5.4 - 5.4
Site-2	15/08/16 11:28	15.0	31	9.69	7.0	7.00	4.2	
Site-3	15/08/16 12:34	15.7	28	9.66	7.0	6.81	4.0	
Site-4	15/08/16 12:05	15.7	31	9.33	7.0	6.76	3.5	
Site-5	15/08/16 11:28	15.0	31	9.69	7.0	7.00	4.5	
Site-6	15/08/16 11:12	23.1	36	8.34	3.0	6.96	3.0	

Sand-2

Sampling site	Date Time	Temp	SpCond	DO	Depth	pH	Secchi
	D/M/Y HH:MM:SS	C	uS	mg/L	meters		meters
Site-7	26/08/16 11:43	16.3	33	8.04	7.0	6.39	

6.0 Conclusions and comments on the YSI instrument evaluation

1. The first instrument package (650 display & 600XLM sonde) because of its size, more specialized function and older technology would not be one that we would recommend for future projects. The RS232 computer interface and its file handling capability showed its age. While we didn't have to do any maintenance, changing batteries in the sonde and some of the maintenance of the sensors - especially changing the DO membrane sounded complicated. However it performed reliably and did introduce me to the benefits of the depth sensor as part of the sensor package.

2. The Pro Plus was a much more compact instrument, had a USB interface for connecting to computers and would handle a large number of site files in the display unit. However the lack of a depth sensor meant that if you were taking a number of readings to obtain a profile of the water column, you needed to log the time & depth when you took each measurement which almost required a second person to keep the log. A second problem which the depth sensor solves is when the sensor package doesn't remain suspended directly under the boat either because the boat is drifting or because of a strong underwater current. If there is no depth reading and the sensor package is swept off to the side the markings on the cable are no longer an accurate gauge of the depth of the sensor package. The need to constantly circulate water past the DO sensor required that the operator needed to be aware of this requirement and develop a technique to make this happen. The operator also needs to be aware of the warm up period and power the unit on at least 15 minutes before taking readings.

3. Because we took a set of readings at 1 meter intervals we recognized when we had passed through the thermocline but didn't necessarily find the exact starting point whereas the waterloo students actively looked for it and took their water sample just below it. Therefore our sampling points weren't necessarily taken at the same point as theirs. We also took our readings a month later and weather conditions (average temperature and rainfall) vary from year to year. As a consequence one can only make general comparisons between this year's readings and previous years. However, taking readings at specific intervals from the surface to the bottom provides a lot more information on the lake conditions than the single reading. On many lakes there was a dramatic variation in DO surrounding the thermocline.

4. If we were to repeat this project next year and wanted to repeat taking multiple readings at each site I would recommend that we rent the newer YSI DSS unit which has a built in depth sensor and uses optical technology for measuring DO that would avoid the need to agitate the sensor. We would need to devise a better anchor system and for some lakes we need anchor ropes greater than 100 feet. The use of a depth finder that could be attached to the volunteer's boat would allow us to see what depth of water we are working in and the type of bottom. We should investigate whether a turbidity sensor would provide additional critical information on water quality. Renting is a viable solution for doing a single round of tests. If we were to track the parameters over a whole season one would need to purchase the instrument because a year's rental would buy the instrument. As well as looking at the water column in greater detail, we could also look at what happens in the various lakes at "turn over" and the DO situation during winter months etc.

As part of the rental agreement both instruments were calibrated at Hoskins Scientific before we picked them up and we were provided with standard solutions so that we could check the calibration.

5. So far we have not found an instrument that would take accurate nitrate, nitrite and phosphate readings in the field at the low levels that were reported in 2014 & 2015 . It appears that we will still need to take water samples and send them to a lab for analysis so we will need to see if we can find a workable solution to this problem.

Pro Plus system accuracy for the following sensors

Dissolved Oxygen	0-20 mg/L range	+/- 2% of reading or .2 mg/L if greater
Temperature		+/- .2 deg C
Conductivity		+/- 0.5 % of reading or .001mS/cm "
pH		+/- .2 units
Barometer		+/- 1.5 mmHg

Note the 600XLM had equivalent accuracies

Please note that values were often reported to 2 decimal places to show variations but actual accuracy should be taken into consideration when looking at individual readings.

The specification data sheets for the two instruments we used are included in the Appendix

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8-0 Appendix

YSI Instrument Specifications

YSI

YSI 650 Multiparameter Display System

Rugged and Reliable Display and Data Logging System

The YSI 650 Multiparameter Display System

Easily log real-time data, calibrate YSI 6-Series sondes, set up sondes for deployment, and upload data to a PC with the feature-packed YSI 650MDS (Multiparameter Display System). Designed for reliable field use, this versatile display and data logger features a waterproof IP-67, impact-resistant case.

- **Compatible with EcoWatch® for Windows® data analysis software**
- **User-upgradable software from YSI's website**
- **Menu-driven, easy-to-use interface**
- **Multiple language capabilities**
- **Graphing feature**
- **Three-year warranty**

Feature-Packed Performance

Battery Life

With the standard alkaline battery configuration of 4 C-cells, the YSI 650 will power itself and a YSI 6600 sonde continuously for approximately 30 hours. Or, choose the rechargeable battery pack option with quick-charge feature.

Optional Barometer

Temperature-compensated barometer readings are displayed and can be used in dissolved oxygen calibration. Measurements can be logged to memory for tracking changes in barometric pressure.

Optional GPS Interface

Designed to NMEA protocol, the YSI 650 MDS will display and log real-time GPS readings with a user supplied GPS interfaced with YSI 6-Series sondes.

Memory Options

Standard memory with 150 data sets, or a high-memory option (1.5 MB) with more than 50,000 data sets; both options with time and date stamp.

Pure Data for a Healthy Planet.®

A powerful logging display for your data collection processes

The 650MDS can be used with YSI sondes for spot sampling as well as short-term data logging.

Supply a GPS with NMEA 0183 protocol, connect with the YSI 6115 kit, and collect GPS data along with water quality data.

Upload data from the 650 to EcoWatch® for instant data viewing.

To order, or for more information, contact YSI
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ISO 9001
ISO 14001

YSI 650MDS Specifications

Temperature	Operating	-10 to +60°C for visible display
	Storage	-20 to +70°C
Waterproof Rating		IP-67 for both the standard alkaline battery configuration and for the rechargeable battery pack option
Connector		MS-8; meets IP-67 specification
Dimensions	Width	4.7 in, 11.9 cm
	Length	9 in, 22.9 cm
	Weight with batteries	2.1 lbs, 0.91 kg
Display		VGA; LCD with 320 by 240 pixels with backlight
Power	Standard	4 alkaline C-cells with detachable battery cover
	Optional	Ni metal hydride battery pack with attached battery cover and 110/220 volt charging system
Communications		RS-232 to all sondes, for data transfer to PC, and for software updates
Optional GPS		NMEA 0183; requires user-supplied GPS and YSI 6115 Y-cable
Backlight		4 LEDs illuminating LCD; user-selectable
Keypad		20 keys, including instrument on/off, backlight on/off, enter, esc, 10 number/letter entry keys, 2 vertical arrow keys, 2 horizontal arrow keys, period key, and minus key
Warranty		3 years

Ordering Information

650-01	Instrument, standard memory
650-02	Instrument, high memory
650-03	Instrument, standard memory, barometer
650-04	Instrument, high memory, barometer
6113	Rechargeable battery pack kit with 110 volt charger and adapter cable
616	Charger, cigarette lighter
4654	Tripod
614	Ultra clamp, C-clamp mount
5081	Carrying case, hard-sided
5085	Hands-free harness
5065	Form-fitted carrying case
6115	Y-cable for interface with user-supplied GPS system

The 650MDS can interface with any YSI sonde for

- *spot sampling*
- *short-term studies*
- *surface and ground water monitoring*
- *water level monitoring*

Packaged together, the 600QS system includes a 600R conductivity sonde, 650MDS, field cable, and additional sensor options such as pH, dissolved oxygen, ORP, and vented level.

YSI

YSI 600XL and 600XLM Sondes

The YSI 600XL and 600XLM

Measure multiple parameters simultaneously

The YSI 600XL and YSI 600XLM compact sondes measure eleven parameters simultaneously:

Temperature	TDS
Conductivity	pH
Specific Conductance	ORP
Salinity	Depth or Level
Resistivity	Rapid Pulse™ DO (% and mg/L)

Connect with Data Collection Platforms

Either sonde can easily connect to the YSI 6200 DAS (Data Acquisition System), YSI EcoNet™ or your own data collection platform, via SDI-12 for remote and real-time data acquisition applications.

Economical Logging System

The YSI 600XLM is an economical logging system for long-term, *in situ* monitoring and profiling. It will log all parameters at programmable intervals and store 150,000 readings. At one-hour intervals, the instrument will log data for about 75 days utilizing its own power source. The 600XL can also be utilized in the same manner with user-supplied external power.

- **Either sonde fits down 2-inch wells**
- **Horizontal measurements in very shallow waters**
- **Stirring-independent Rapid Pulse® dissolved oxygen sensor**
- **Field-replaceable sensors**
- **Easily connects to data collection platforms**
- **Available with detachable cables to measure depth up to 200 feet**
- **Compatible with YSI 650 Multiparameter Display System**
- **Use with the YSI 5083 flow cell for groundwater applications**

Pure Data for a Healthy Planet.®

Economical, multiparameter sampling or logging in a compact sonde

Sensor performance verified*

The 6820 V2 and 6920 V2 sondes use sensor technology that was verified through the US EPA's Environmental Technology Verification Program (ETV). For information on which sensors were performance-verified, turn this sheet over and look for the ETV logo.

ETV

www.ysi.com

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ISO 9001
ISO 14001

CE

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YSI 600XL & 600XLM Sensor Specifications

	Range	Resolution	Accuracy
Dissolved Oxygen % Saturation ETV 6562 Rapid Pulse™ Sensor*	0 to 500%	0.1%	0 to 200%: ±2% of reading or 2% air saturation, whichever is greater; 200 to 500%: ±6% of reading
Dissolved Oxygen mg/L ETV 6562 Rapid Pulse™ Sensor*	0 to 50 mg/L	0.01 mg/L	0 to 20 mg/L: ± 0.2 mg/L or 2% of reading, whichever is greater; 20 to 50 mg/L: ±6% of reading
Conductivity+ 6560 Sensor* ETV	0 to 100 mS/cm	0.001 to 0.1 mS/cm (range dependent)	±0.5% of reading + 0.001 mS/cm
Salinity	0 to 70 ppt	0.01 ppt	±1% of reading or 0.1 ppt, whichever is greater
Temperature 6560 Sensor* ETV	-5 to +50°C	0.01°C	±0.15°C
pH 6561 Sensor* ETV	0 to 14 units	0.01 unit	±0.2 unit
ORP	-999 to +999 mV	0.1 mV	±20 mV
Depth & Level — Medium	0 to 200 ft, 61 m	0.001 ft, 0.001 m	±0.4 ft, ±0.12 m
Shallow	0 to 30 ft, 9.1 m	0.001 ft, 0.001 m	±0.06 ft, ±0.02 m
Vented Level	0 to 30 ft, 9.1 m	0.001 ft, 0.001 m	±0.01 ft, 0.003 m

+ Report outputs of specific conductance (conductivity corrected to 25°C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed 1989).

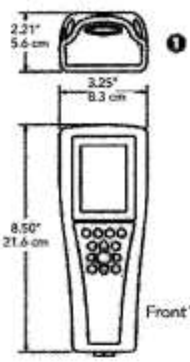
YSI 600XL & 600XLM Sonde Specifications

Medium		Fresh, sea or polluted water
Temperature	Operating	-5 to +50°C
	Storage	-10 to +60°C
Communications		RS-232, SDI-12
Software		EcoWatch®
Dimensions 600XL | 600XLM	Diameter	1.65 in, 4.19 cm | 1.65 in, 4.9 cm
	Length	16 in, 40.6 cm | 21.3 in, 54.1 cm
	Weight	1.3 lbs, 0.59 kg | 1.5 lbs, 0.69 kg
Power	External	12 V DC
	Internal (600XLM only)	4 AA-size alkaline batteries

YSI model 5083 flow cell and 600XL. This is an ideal combination for groundwater applications.

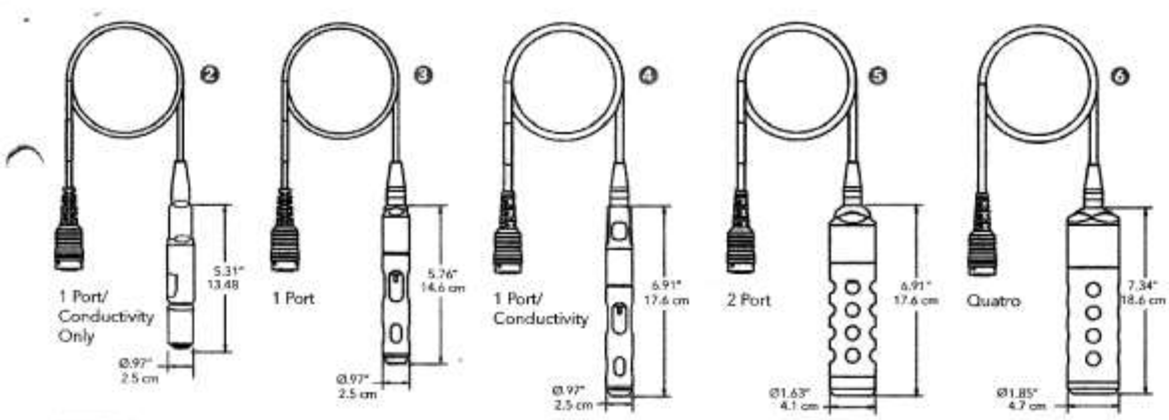
More Versatile

1 Pro Plus Instrument
2 Single Port Conductivity Only
3 Single Port Cable
4 Single Port Cable with Conductivity
5 Dual Port Cable
6 Quatro Multiparameter Cable



Professional Plus Instrument General Specifications

Auto Stable	User-defined auto-stable function holds stable readings on display when criteria is met
Barometer	Built-in barometer
Buffer Recognition	Auto buffer recognition for US and NIST buffers
Certifications	RoHS, CE, WEEE, C-Tick, VCCI, FCC, IP-67, 1-meter drop test, Assembled in USA
Connectivity	USB 2.0; ProComm II communications saddle and USB cable included; user-upgradeable software via USB and website
Connector	MS (military spec) waterproof with bayonet lock
Data Management	Data Manager desktop software included; 100 user-defined folders and site names
Data Memory	5,000 data sets (data, date, time, user-defined info); 100 GLP files
Dimensions	8.3 cm width x 21.6 cm length x 5.6 cm depth (3.25 in x 8.5 in x 2.21 in)
Display	Graphic display with detailed Help; backlit display AND keypad
DO Membrane Response Times (T95; 100%-0) and Flow Dependence	1.25 mil PE = 8 seconds and 6 in/sec flow 2.0 mil PE = 17 seconds and 3 in/sec flow 1 mil Teflon® = 18 seconds and 12 in/sec flow
DO Sensors	Polarographic or galvanic field sensors; self-stirring polarographic BOD sensor for the lab
Field Cables	Standard lengths of 1, 4, 10, 20, or 30 meters - up to 100 meters on DO only cables; all 4-meter and longer cables include a cable management kit
Flow Cell	Single, dual and multiparameter Quatro cable all flow cell compatible
GLP Compliance	Yes; detailed GLP information is stored and is available to view, download or print
Lab Cables	BOD sensor includes 2-meter cable; 1 or 4 meters on lab pH, ORP and pH/ORP cables
Languages	English, Spanish, German, French, Italian, Norwegian, Portuguese, Japanese, Chinese (Simplified & Traditional)
Logging Modes	Single or Continuous
Operating Temperature	-10 to 60°C
Power	2 alkaline C-cells provide 80 continuous hours at ambient temperature without backlight; ProComm II saddle provides USB power or optional wall power, cigarette lighter, and universal cell phone charger options
Storage Temperature	-20 to 70°C
User ID	Optional user ID for data security
Warranty	3-year instrument; 2-year field cables
Waterproof	IP-67 (even with the battery cover off); floats
Weight with Batteries	475 grams (1.05 lbs)



System Specifications (Cable and Sensors)

	Sensor Type	Range	Accuracy	Resolution	Units	Calibration
Dissolved Oxygen (%) (temp comp range -5 to 45°C)	Polarographic or Galvanic	0 to 500%	0 to 200% (± 2% of reading or 2% air saturation, whichever is greater) 200% - 500% (± 6% of reading)	1% or 0.1% air saturation (user selectable)	%	1 or 2-points with zero
Dissolved Oxygen (mg/L) (temp comp range -5 to 45°C)	Polarographic or Galvanic	0 to 50 mg/L	0 to 20 mg/L (± 2% of the reading or 0.2 mg/L, whichever is greater) 20 to 50 mg/L (±6% of the reading)	0.1 or 0.01 mg/L (user selectable); 0.1% air saturation	mg/L, ppm	1 or 2-points with zero
Temperature (Field rugged cables)		-5 to 70°C	±0.2°C (±0.3°C cables over 45-meters)		0.1°C	°C, °F, K
Temperature (Lab-grade)*		0 to 40°C	±0.35°C	0.1°C	°C, °F, K	
Conductivity**	Four electrode cell	0 to 200 mS/cm (auto range)	±0.5% of reading or 0.001 mS/cm, whichever is greater (1, 4-m cable) ±1% of reading or 0.001 mS/cm, whichever is greater (20-m cable)	0.001 mS (0 to 500 mS); 0.01 mS (0.501 to 50.00 mS); 0.1 mS (50.01 to 200 mS)	µS, mS	1 point
Salinity	Calculated from conductivity and temperature	0 to 70 ppt	±1.0% of reading or 0.1 ppt, whichever is greater	0.01 ppt	ppt, PSU	1 point
pH	Glass Combination Electrode	0 to 14 units	±0.2 units	0.01 units	mV, pH units	1, 2, 3, 4, 5, or 6 point (user selectable); US, NIST or Custom Buffers
ORP	Platinum button	-1999 to +1999 mV	±20 mV in redox standards	0.1 mV	mV	1 point
Ammonium*** (ammonia with pH sensor)	Ion Selective Electrode	0 to 200 mg/L-N, 0 to 30°C	±10% of reading or 2 mg/L-N, whichever is greater	0.01 mg/L	mg/L-N, mV	1, 2, or 3 point (user selectable)
Nitrate***	Ion Selective Electrode	0 to 200 mg/L-N, 0 to 30°C	±10% of reading or 2 mg/L-N, whichever is greater	0.01 mg/L	mg/L-N, mV	1, 2, or 3 point (user selectable)
Chloride***	Ion Selective Electrode	0 to 1000 mg/L, 0 to 40°C	±15% of reading or 5 mg/L, whichever is greater	0.01 mg/L	mg/L-Cl-, mV	1, 2, or 3 point (user selectable)
Total Dissolved Solids (TDS)	Calculated from conductivity and temperature	0 to 100 g/L TDS constant range 0.30 to 1.00 (0.64 default)		0.001, 0.01, 0.1 g/L	kg/L, g/L	
Barometer	Piezoresistive	375 to 825 mmHg	±1.5 mmHg from 0 to 50°C	0.1 mmHg	mmHg, inHg, mbar, psi, kPa, ATM	1 point

Instrument Only Specifications (at Ambient Temperature)

pH		-2.00 to 16.00	±0.1 mV (0.01 pH units)	0.1 mV (0.01 pH units)		
ORP		-1999 to +1999 mV	±0.5 mV	0.1 mV		
Conductivity		0.0 to 200 mS/cm each range	±0.1% FS ±1 digit for uS/cm to 0.1 mS/cm (range dependent)	0.0001 mS/cm or 0.1		
Dissolved Oxygen		0.00 to 90 mg/L; 0 to 550%	±0.2% FS (550% air saturation) ±1 digit (with 1.25 PE membrane at 10°C)	0.01 mg/L; 0.1% air saturation		
Temperature		-10 to 100.00°C	±0.2% FS ±1 digit	0.1°C	°C, °F, K	

*Lab-grade cables include 605107, -108, -109, 605177, -178, -179 ** Derived parameters can include resistivity, salinity, specific conductance, and total dissolved solids

***ISE sensors for freshwater only; 17-meter maximum depth

Specifications


onlyYSI
Rugged, durable field cable with a 2-year warranty standard
Professional Plus
onlyYSI
Backlit display AND keypad for use in true low-light conditions
onlyYSI
The file system allows for a 100 folder and site list structure to store and easily manage 5,000 data sets
onlyYSI
Adjustable right- or left-handed hand strap
onlyYSI
Detailed on-screen Help function
onlyYSI
Case is rubber over-molded to provide extra protection and prevent slipping; also allows for flat non-slip design on a table top and provides an IP-67 rating with or without the battery cover; 1-meter drop rated from all angles
YSI
onlyYSI
MS (military-spec) connectors – rugged, waterproof, keyed, bayonet style quarter-turn lock
onlyYSI
Multiple user-replaceable sensor options and a choice of galvanic or polarographic DO sensors
onlyYSI
This symbol refers to a feature or benefit only YSI offers on a handheld instrument.
mCERTS

Tougher

Do your job with confidence even in the harshest field conditions. The drop-tested Pro Plus was designed tough with military-spec connectors, a two-year warranty on all cables, weighted sensor guards, and a rubber over-molded case with three-year warranty. Its interchangeable sensors and extra-durable cables nearly eliminate down time. And its low overall cost of ownership means you're making a worthwhile investment for years to come.

The Pro Plus uses the rugged, IP67, Military Spec (MS) 1/4 turn lock, bayonet-style connector.

Quatro Cable

The multiparameter Quatro cable allows the measurement of temperature, conductivity, salinity, dissolved oxygen and any two ISEs -pH, ORP, ammonium, nitrate or chloride.

How Tough is TOUGH?

What a Come-back

A YSI customer accidentally dropped his Pro Plus off a 40-foot bridge into the river below. A week later, he and his team came back. Using a long pole to scrape the river bottom, they found the cable and then the meter. They were amazed to find that – after a week submerged in a muddy river bed – their Pro Plus still worked.

Not All is Lost

A YSI wastewater customer knocked a Pro Plus into an aeration basin. Seemingly lost for good, he reluctantly moved on. One year later, the tank was drained to complete minor maintenance. And there lay the meter. After a bit of cleaning, they turned it on. Not only did it work, but it's still being used today.