NEW BRUNSWICK ENVIRONMENTAL TRUST FUND FINAL REPORT

Please accept this final report submitted on March 23, 2010 on the Blue-Green Algae Threat, Assessment, Treatment and Prevention in the Irishtown Nature Park – Project # 090251.

The City of Moncton understands that a hold back of $1232.34 is still remaining and final invoices will be sent by the end of March. See attached report for all details relating to the research carried out in 2009. Thank you for your support in this project.

Major Accomplishments

- ✓ Weekly limnological sampling
- ✓ Identification of nutrients in the water and in the sediments
- ✓ Monitoring of blooms as to species and absence or presence of toxins
- ✓ Fish survey
- ✓ Exploration of treatment methods and course of action for trial treatment in 2010
- ✓ Media communication through the web, press releases and interviews
- ✓ Open House Day – August 30th 2009
- ✓ Production of Brochures
- ✓ User survey

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New Brunswick Environmental Trust Fund

Year End Report

Blue Green Algae Threat, Assessment, Treatment & Prevention in Irishtown Nature Park

March 23, 2010

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New Nouveau Brunswick

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Introduction

Irishtown Nature Park is the most northern and largest of Moncton's municipal parks (Figure 1). The park covers approximately 2200 acres of forested land as well as a now decommissioned water reservoir of 250 acres. The water is a key feature of the park and supports abundant aquatic life including loons, ospreys, cormorants and bald eagles. The park also serves an educational role, stressing outdoor activities involving water quality assessment, physical education and geocaching. Recreationally, people walk the numerous trails, some of which provide dramatic views of the reservoir or they adventure out by canoe or kayak. Irishtown Nature Park is incontestably a highly valued resource with the advantage of being in close proximately to the city. Visitors and citizens alike have come to appreciate the unique experience that this park has to offer.

In 2007, Dr. Alyre Chiasson of the Université de Moncton, reported sporadic but minor blooms of blue-green algae in various sections of the reservoir during the summer (hereafter blue-greens will be referred to as Cyanobacteria). These observations were accompanied by a limited limnological survey at four water sampling stations in the reservoir. Results indicated that the reservoir was between mesotrophic (highly productive) and eutrophic (excessively productive). In August 2008, there was a major and dramatic bloom of Cyanobacteria after a week of particularly warm weather and calm winds. The reservoir was closed to recreational activity while the Cyanobacteria were tested for toxins and identified as to species. Toxins produced by Cyanobacteria can be fatal to pets, wildlife and humans if sufficient quantities of contaminated water are ingested. Elevated concentration of phosphate and nitrate are largely responsible for blooms of Cyanbacteria. There was therefore a clear need to better understand the circulation of these nutrients within the reservoir as well as their origin and any factors or conditions that might have contributed to the severity of the blooms (Figure 2).

In 2009, with the help of the New Brunswick Environmental Trust Fund, the New Brunswick Wildlife Trust Fund, the City of Moncton, The Petitcodiac Watershed Alliance and the Université de Moncton, a more in-depth study of the limnology of the reservoir was undertaken to track the evolution of the Cyanobacteria during the summers months and determine the concentrations of phosphate and nitrate in both the sediments and water (Figure 2). Phosphate and nitrates are the key nutriments that fuel the growth of Cyanobacteria. By identifying the sources, the concentrations and the cycling of these nutrients, a plan could be established for their control or elimination.

Approach

A total of 5 water monitoring stations were set up in early April of 2009 (Figure 3). In general, sampling was conducted on a weekly basis starting at the end of April 2009 and concluding in September 2009. Vertical profile sampling was conducted at each station from the surface to the bottom in 0.5 meter intervals. Dissolved oxygen, conductivity, temperature and pH were assed with a YSI 559 multiprobe meter. Calibration procedures were conducted as recommended in the manual as well as for all instrumentation that follows. Hanna meters were used to assess phosphate (model 93713), and nitrate (model 93728) in the surface waters at each station. Growth of Cyanobacteria was tracked indirectly using an 8 in. Secchi disk.

Secchi disk readings decrease as water becomes less transparent as the increasing abundance of Cyanobacteria block the light irradiating the instrument. Fish populations were assessed using minnow traps at 4 locations extending from the north to the south of the reservoir. Traps were set over 2 traps nights and verified each day. Traps were baited with cat food in pellet form.

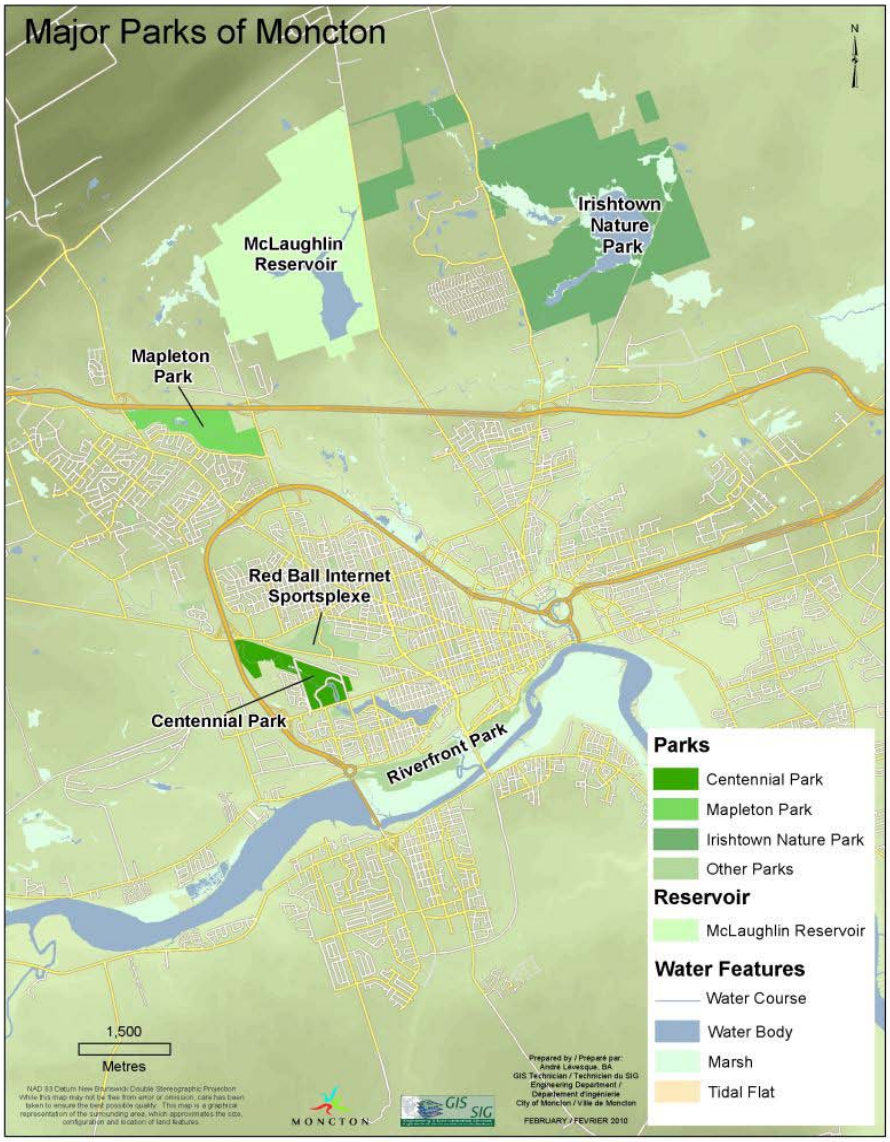

Figure 1. Municipal Parks in Moncton, New Brunswick.

Figure 2. Outbreak of Cyanobacteria in Irishtown Nature Park. August 20, 2009.

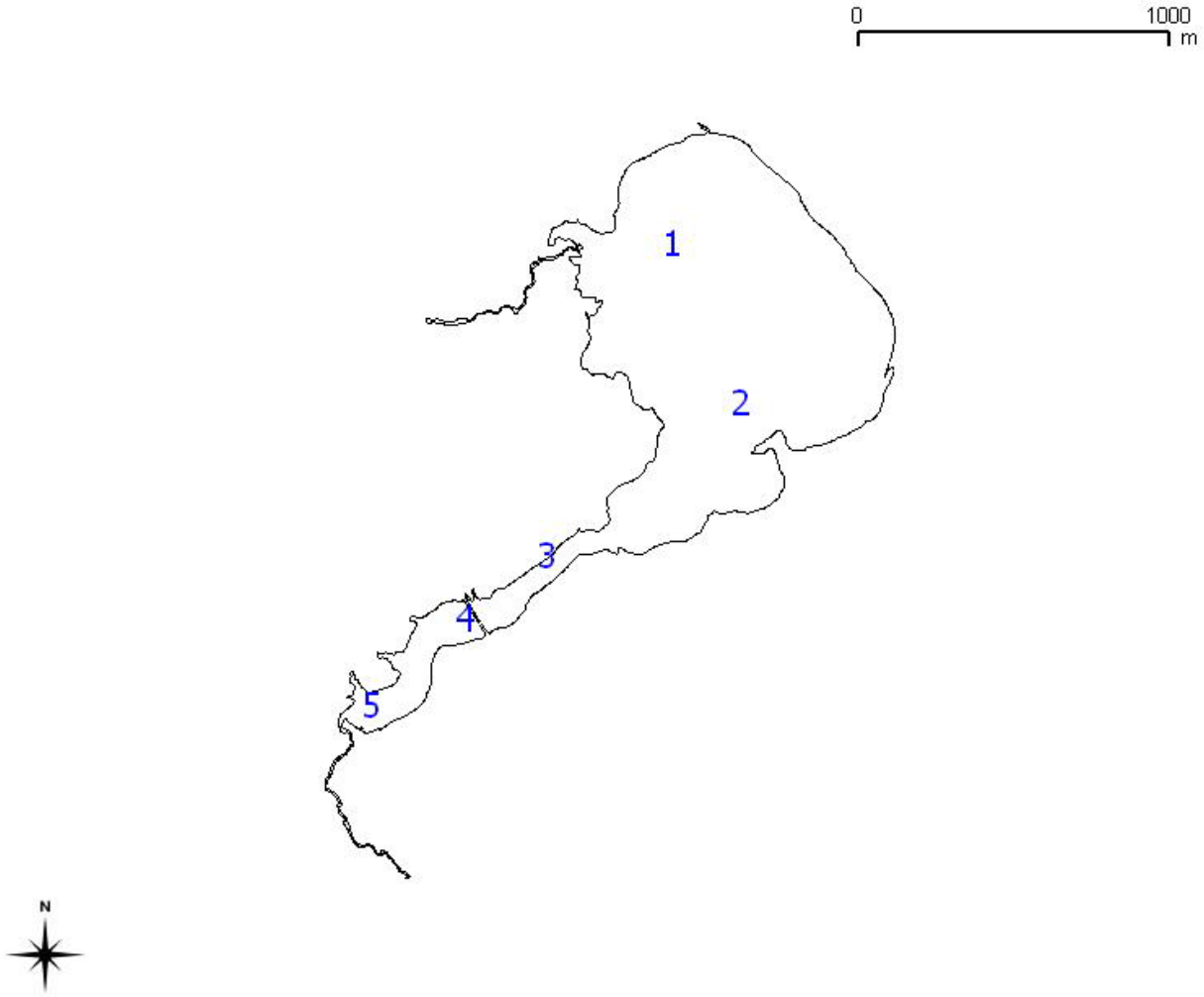

Figure 3. Water quality monitoring stations in the reservoir of Irishtown Nature Park, Moncton, New Brunswick.

Results

In 2009, either the total number of cells was below toxic levels or the species was known not to produce toxins. The dominate Genus were Anabaena and Microcystis (Figure 4). Both Anabaena and Microsystis concentrations were particularly high in August 2009, exceeding 300,000 colonies per ml but belonged to species known not to produce toxins. In general turbidity increased as summer progressed as witnessed by decreasing Secchi disk readings (Figure 4). Cyanobacteria could be seen in the surface waters as early as June as windrows and on certain days along the shoreline as clumps and mats. However, the bloom was not as extensive as in the previous year, perhaps because of a significant rainfall in August.

Table 1. Dominate Cyanobacteria in Irishtown Reservoir in the summer of 2009

Anabaena

Microcystis

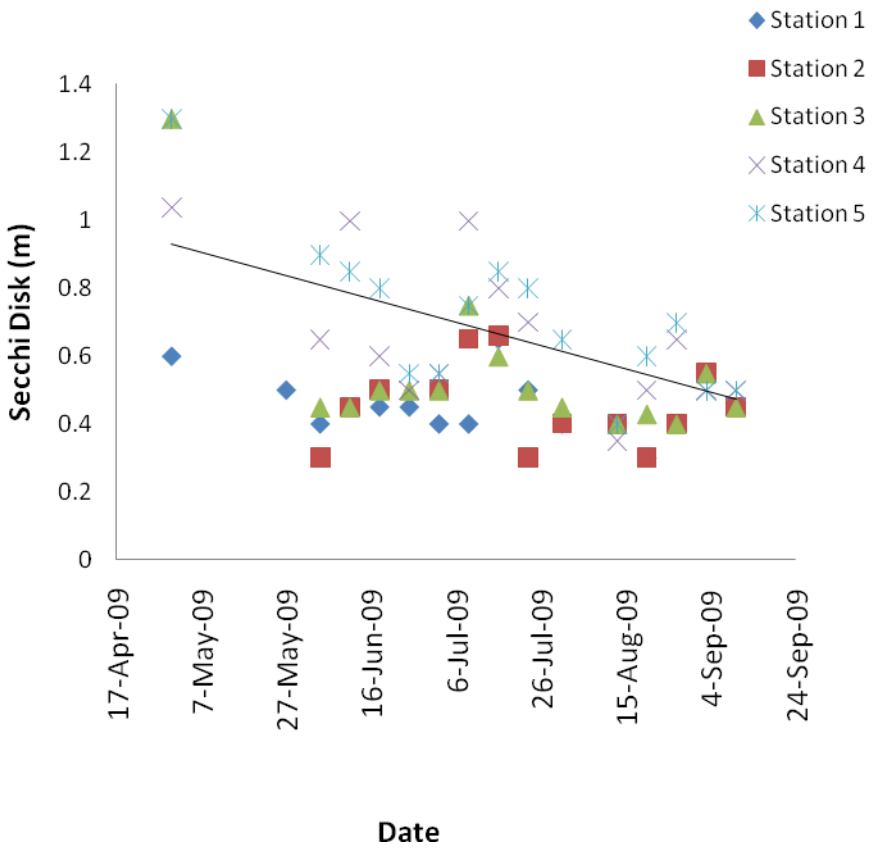

Figure 4. Secchi disk readings at the 5 sampling stations in Irishtown Reservoir in 2009. The line indicates a tendency to less light penetration as summer progressed.

In general, oxygen concentrations in the first 2 meters of the reservoir were within levels capable of supporting fish. However, oxygen concentrations below this depth showed a steady decline as summer progressed and only rebounded in September (Figure 5). By July, oxygen concentrations below 3 meters were too low to support most fish life. Beach seining and minnow traps were used to sample fish in the reservoir. In small shallow weedy bays, threespine stickleback dominated. In littoral waters, American eel, Lake Chub and golden shiners were found to be abundant. A small number of feral goldfish were also captured. Although, American eel can tolerate periods of low oxygen the same cannot be said of their food source. In general, the lower waters of the reservoir become unsuitable for fish during the summer.

Water temperatures reached a maximum of 26.6°C in August 2009. The high temperatures in the water column in August combined with the low oxygen concentrations in the lower but cooler waters combined to further restrict fish habitat in the reservoir. Cold water fish such as salmonids could not survive such extremes of temperatures and oxygen.

Only orthophosphate and nitrate were evaluated in the surface water of the reservoir. In general, blooms of Cyanobacteria can be avoided if orthophosphate concentrations are kept below 0.05 mg/L (Dunne and Leopold, 1978). Average concentration in the reservoir surface waters from April to September was 0.18 mg/L (n=43, SE= 0.07), well in excess of this value. The maximum value was 2.75 mg/L. There is therefore very good agreement between the presence of the blooms and elevated concentrations of orthophosphate seen during the summer. Concentrate of orthophosphate in the Royal Oaks pond across the road from the main tributary feeding into the reservoir was 0.13 mg/L (n=9, SE=0.5). This is below the average concentration in the reservoir but still above the 0.05 mg/L value of Donne and Leopold (1978). Overflow from the pond can potentially drain into the tributary feeding into the reservoir. This will be closely monitored in 2010.

Nitrate concentrations in the reservoir for the same period averaged 0.65 mg (NO_3)/L (n=43, SE= 0.05). Cyanobacteria are not limited by nitrogen in the water (nitrite and nitrate) because they can fix atmospheric nitrogen. This value is below the CCME criterion of 2.95 mg/L NO3-N (Canadian Council for Ministers of the Environment), though it appears not to be a limiting factor in the Irishtown Reservoir.

The concentration of phosphate was also measured in the bottom sediments of the reservoir. Based upon an evaluation by Hart et al. (1976), levels in excess of 900 mg/L were taken as indicative of eutrophication. Most of the sample sites were in excess of this value (Figure 7 and 8). There is therefore a large reservoir of phosphate in the sediments. In light of the low flushing rate of the reservoir and anoxic conditions in the bottom waters, sediments make be a continued source of this nutriment over a number of years even if all inputs of phosphate were to be halted.

Conclusions

Limnological findings are in accordance with the presence of excessive growth of Cyanobacteria in the Irishtown Reservoir in 2009. High levels of orthophosphate were found in the water, in excessive of concentrations that will trigger another bloom.

High concentrations of phosphate were found in the sediments. Even if further inputs of phosphate were to be halted, the anoxic conditions in the bottom waters of the reservoir would result in a re-release of phosphate.

As organisms die within a lake or reservoir, their remains are deposited in the bottom sediments. Under well- oxygenated conditions, phosphate released from this organic material remains locked in the sediments. Under low oxygen conditions phosphate is recycled back into the water column two times per year, mainly in the spring when the ice clears and the wind mixes the water or similarly in the fall when the water- cools and the wind mixes the water to a greater depth.

To prevent recycling of phosphate, this nutriment will have to be locked in the sediments. Therefore, in 2010, it is proposed that a product called Phoslock ©be evaluated for its ability to lock phosphate in the sediments and prevent its recycling.

The main tributary to the reservoir will be closely monitored in 2010 for any potential inputs of phosphate and nitrate originating from the surrounding land. High input of phosphate from outside the reservoir could possibility negate any improvement in water quality in the reservoir brought about by treatment with Phoslock.

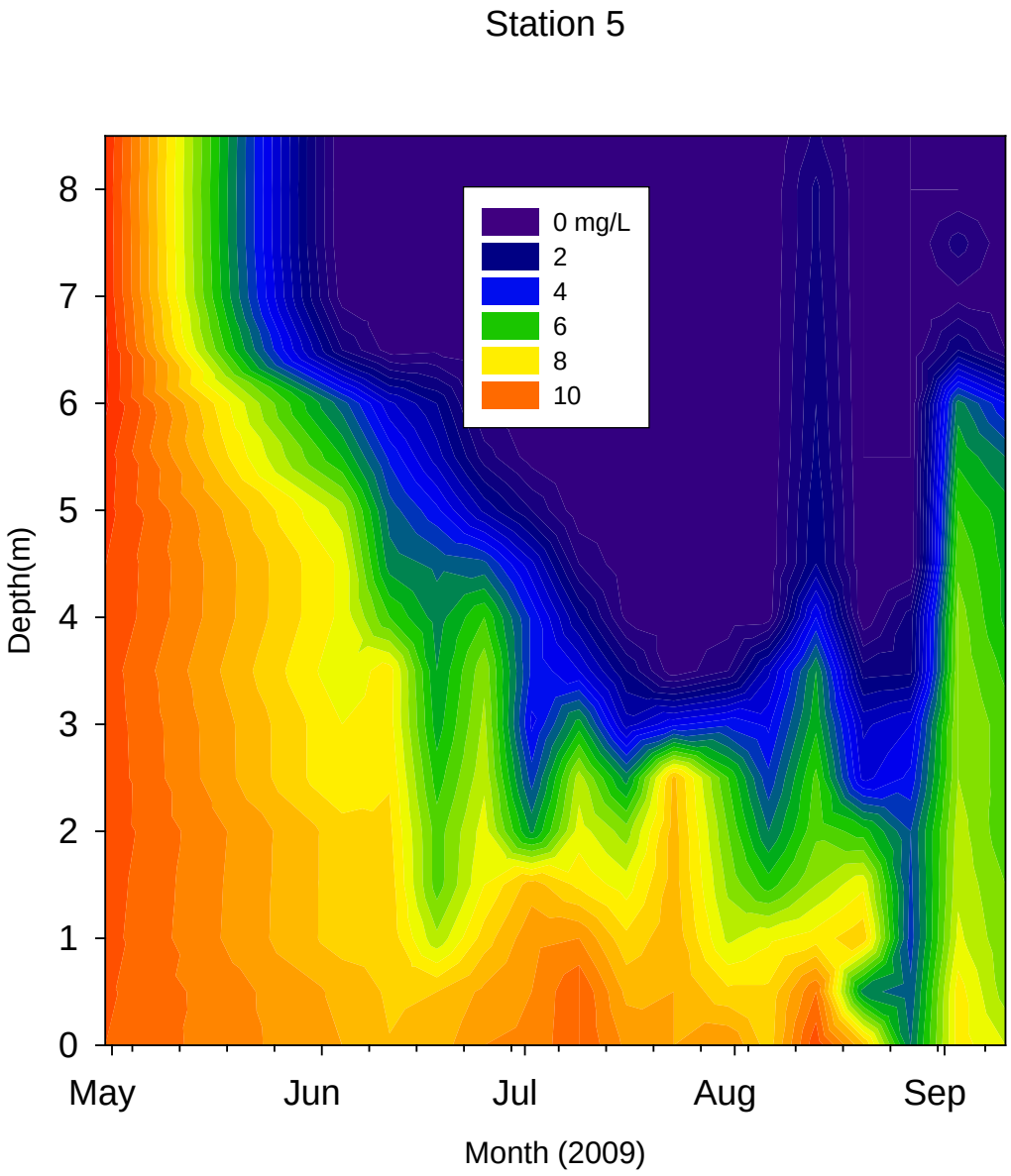

Figure 5. Oxygen concentrations in Irishtown Reservoir at Station 5 during the summer of 2009.

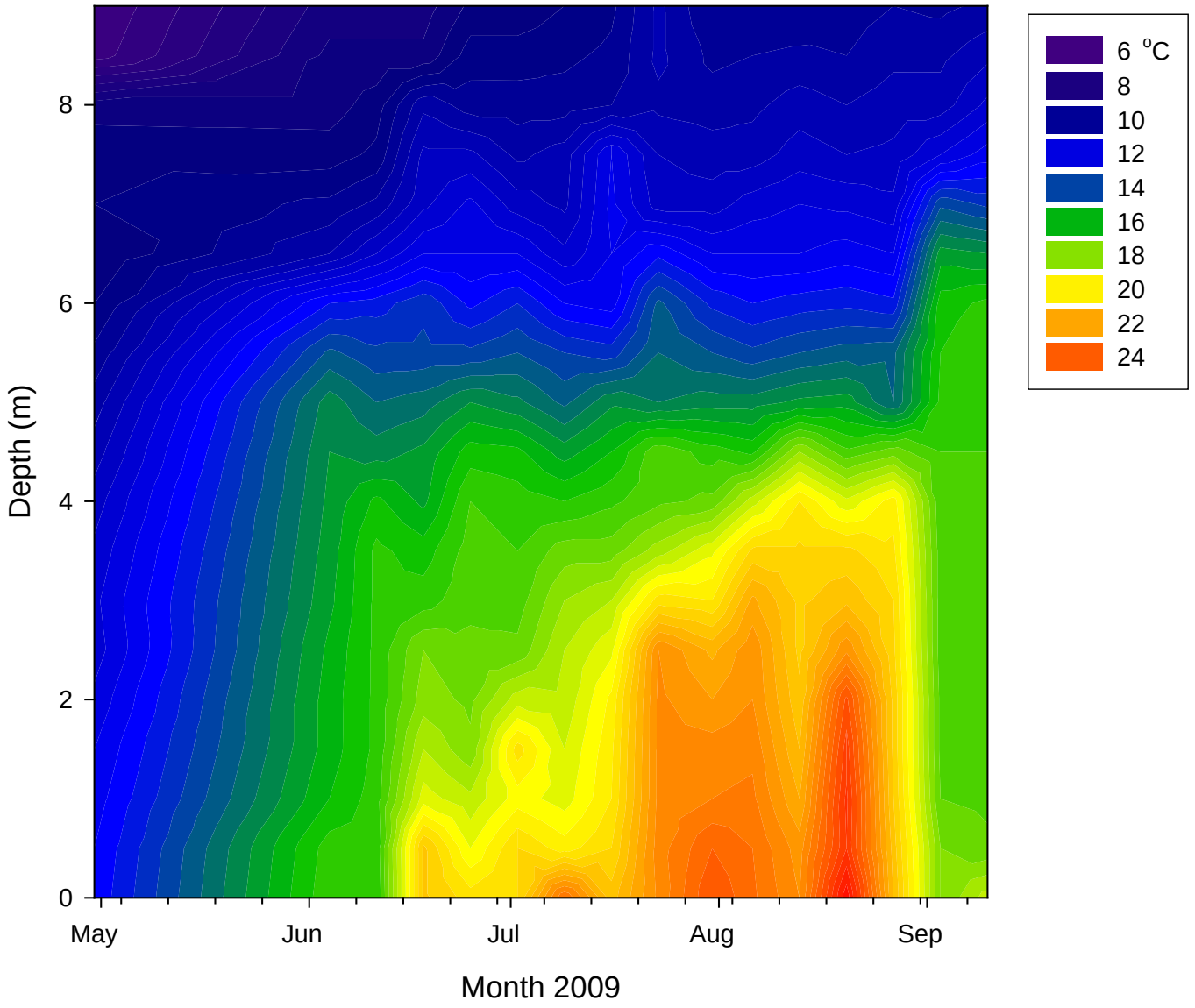

Figure 6. Temperature profile at Station 5, the deepest section of the Irishtown Reservoir as observed in the summer of 2009.

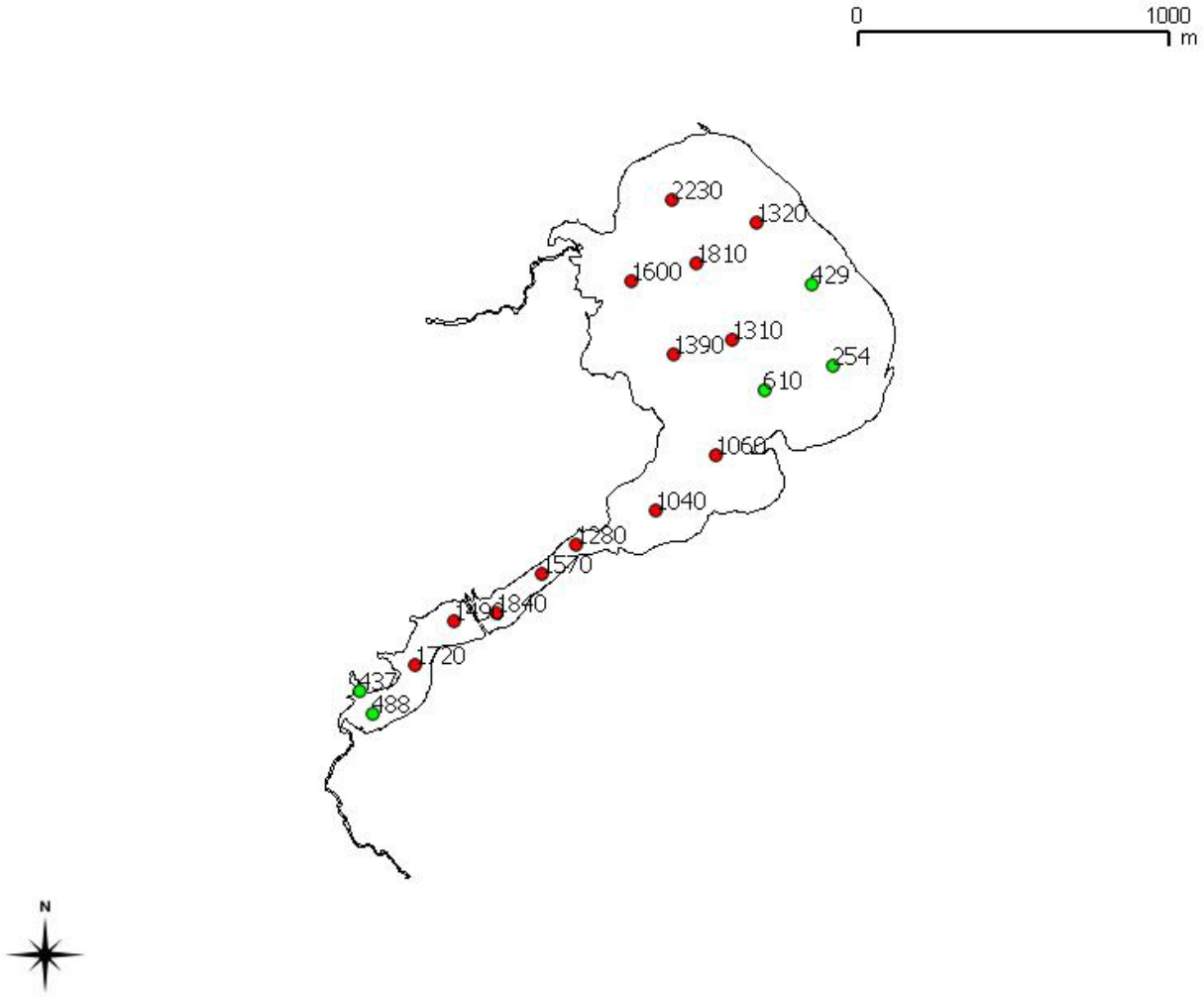

Figure 7. Total phosphate in the Irishtown Reservoir in September 2009. Concentration are in µg/L. Values in red are in excess of 900 in µg/L and are taken as indicative of eutrophic conditions.

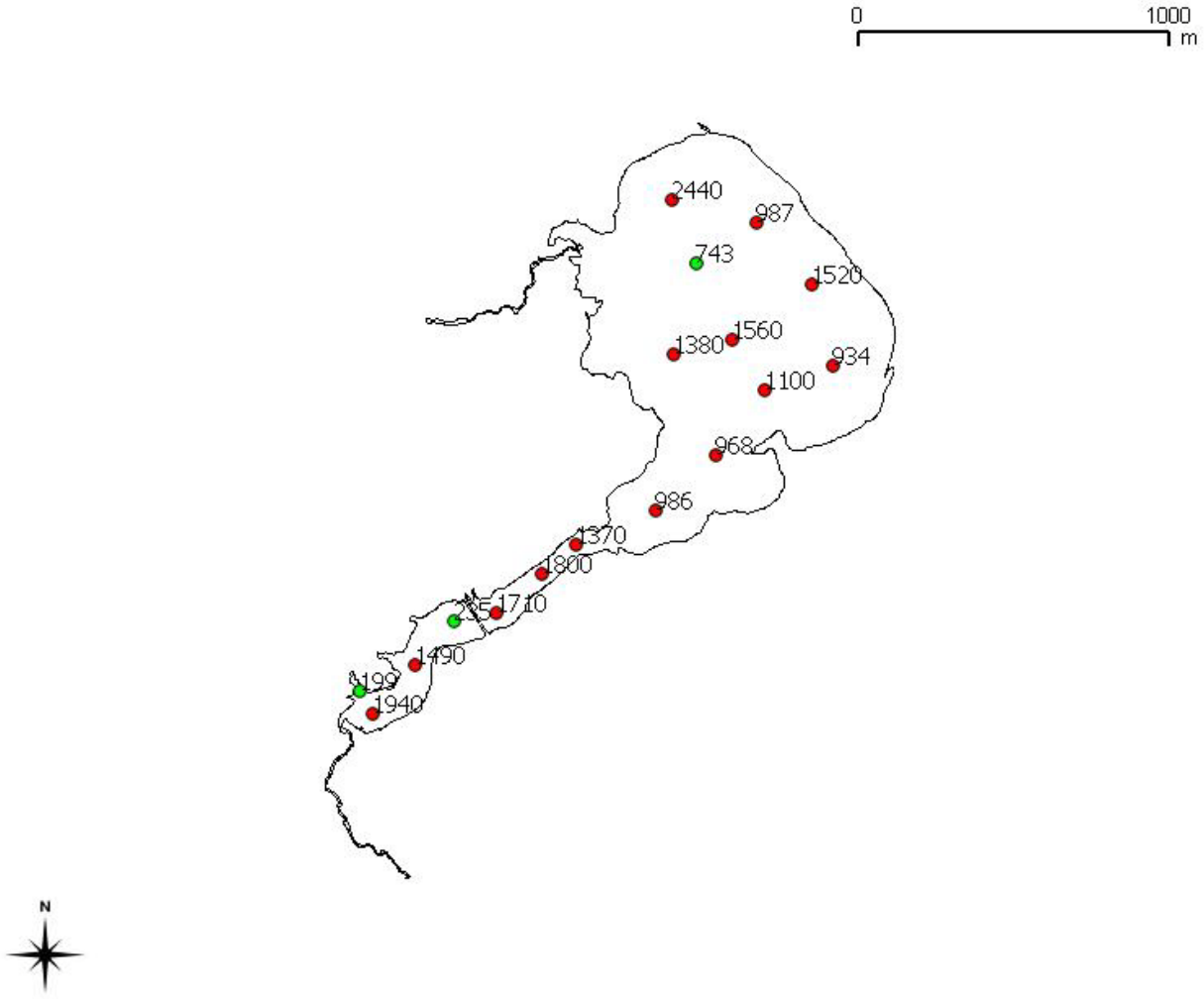

Figure 8. Total phosphate in Irishtown Reservoir in October 2009. Concentrations are in µg/L. Values in red are in excess of 900 in µg/L and are taken as indicative of eutrophic conditions.

References

Dunne, T., and L.B. Leopold. 1978. Water in Environmental Planning. W.H. Freeman an Company, New York.

Hart, B.T., McGregor, R.J., and W.S. Perriman. 1976. Nutrient status of the sediments in Lake Mulwala. I. Total phosphorus. Australian Journal of Marine and Freshwater Research 27: 129–135.

Research conducted in 2009 on the blue-green algae problem in the Irishtown Nature Park Reservoir using education as an effective communication tool

In response to the blue-green algae bloom in the reservoir in 2008/2009 the City of Moncton partnered with Dr. Alyre Chiasson of the Biology Department of the Universite' de Moncton and the Petitcodiac Watershed Alliance to find a solution to the problem and effectively engage the public and school groups. Our goal is to protect the ecological integrity of the park while providing the visitor with an enjoyable and educational experience through the many natural resources this park has to offer.

The initiative was led by Heather Hawker, from the City of Moncton with funding from the New Brunswick Environmental Trust Fund, Youth Engagement Funding Program and the Canadian Wildlife Service. This funding assisted the team in finding answers to the problem through science and education. The scientific aspect has lead to a better understanding of how nutrients circulate within the reservoir, their source(s) and how they evolve during the summer months to result in algal blooms.

One of the objectives of our research was to develop standards/sampling protocols involving over ten different water quality measurements on an approximately weekly basis from April to September 2009. Additional studies (fish populations, aquatic bird surveys, sediment tests along with adjacent land use evaluation) were linked to potential impacts on water quality.

The educational aspect of the project involved setting up a water quality environment lab by partnering with the Petitcodiac Watershed Alliance. This lab was used for outdoor education programs by various local area high schools, Envirothon classes and summer nature camps held at the park.

This lab helped promote sustainable use of the park while protecting both its aquatic and terrestrial resources in what is rated the third largest Municipal Nature Park in Canada.
This research project on algae blooms was incorporated into the outdoor education programs offered by the City of Moncton. Linkage was mainly through the incorporation of current water quality issues.

Another objective of the research study explored all potential point and non point sources of nutrients flowing into the reservoir as well as sediments within the reservoir. This information was critical in determining how to proceed on reducing the frequency if not eliminating further blooms of blue-green algae.

Communication and education were a strong component of this research study as the project unfolded. On June 19th 2009 the research team confirmed the presence of Anabaena in the water column although abundance levels were below the detection of a visible bloom. Water temperatures were higher earlier in 2009 then the previous years.

The research team dealt with all the public relations aspects of this project, which began in early May and ran until the end of September. This involved meeting with various media sources such as CBC, the local newspapers, TV's and radio stations. An interactive website was launched by the City of Moncton where weekly updates were posted, as well as a question and answer section.

An Open House – Explore INP Day (to discuss the research project with the public) was held on August 30th which was also the launching date for the City of Moncton's first Geocaching course which saw over 200 people in attendance. A brochure on eutrophication was produced and distributed at this event. Dr. Alyre Chiasson was also on site with various pieces of equipment used in this study and carried out a hands on talk to the public. The brochure was also posted on the city's website and used when school groups visited the park.

The City of Moncton updated the general public weekly as to bloom status via city's website (interactive website) and also alerted the pubic not to release any tropical fish into the reservoir or any other natural body of water (goldfish were found during the July fish survey). Foreign fish can introduce disease and compete with natural species which has unforeseeable consequences.

This ETF research project contributed to an overall assessment of water quality, in the reservoir, a comprehensive fish survey, and evaluation of nutrient sources, and a plan to combat the problem starting in 2010 with a trail evaluation of Phoslock. Effectively controlling or eliminating excessive nutrients will be an ongoing engagement with neighboring landowners in adopting best management practices that protect the
watershed of the Irishtown Nature Park.