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Olcott Harbor at Eighteenmile Creek

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Introduction

Eighteenmile Creek is one of the six Areas of Concern (AOC) in New York State. The International Joint Commission (IJC) and Great Lakes community are working on 42 Areas of Concern in the Great Lakes basin where beneficial uses of a waterbody have been identified as impaired. AOCs include harbors, river mouths, and river segments where Remedial Acton Plans (RAPs) have been developed and are being implemented to restore and to protect beneficial uses. Fourteen use impairment indicators have been applied to define water quality parameters.

Eighteenmile Creek has been polluted by past industrial and municipal discharges, the disposal of waste and the use of pesticides. Fish consumption has been impaired by PCBs and dioxins found in the flesh of various game fish. The health of the benthos has also been impaired by PCBs and metals in creek sediments. At the mouth of Eighteenmile Creek on Lake Ontario, dredging restrictions have been placed on the disposal of dredged material from Olcott Harbor. Dredging is needed to maintain recreational boating and requires land based confined disposal. Other use impairment indicators in the Remedial Action Plan (RAP) that require further investigation to assess impairment are: the degradation of fish and wildlife populations, fish tumors, bird or animal deformities or reproductive problems, and the degradation of plankton populations. The work plan was designed to investigate the status of the phytoplankton and zooplankton populations.

Objective and Schedule: The objective of this study workplan is to determine the health of the planktonic community in the Eighteenmile Area of Concern (AOC) and to establish the status of the Use Impairment Indicator in the Eighteenmile Creek Remedial Action Plan (RAP). Results from this study will be compared to results of previously studied community structure data from control / reference sites: an undisturbed creek on the south shore of Lake Ontario (Yanty Creek), the open waters of Lake Ontario, and from Braddock Bay on Lake Ontario.

Impairment Criteria: According to the International Joint Commission's (IJC) Listing and Delisting Criteria for the fourteen use impairment indicators for Great Lakes Areas of Concern, plankton are impaired when the phytoplankton or zooplankton community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, plankton will be considered impaired when relevant, field validated plankton bioassays (with appropriate quality assurance/quality controls) confirm toxicity in ambient waters. In the absence of community structure data, the beneficial use is considered restored when phytoplankton and zooplankton bioassays confirm no significant toxicity in ambient waters.

Ecologists have grappled with the concepts of biological integrity, ecosystem health, and biodiversity in trying to define the normal condition of ecosystems. The capability of the ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat in the region is most desired. If the system has this integrity, it will be healthy; however, the lack of diversity does not imply impairment.

Hence, comparable sites having known healthy and unimpacted characteristics are key to such evaluation. This study will therefore focus on maximizing the collection of community structure data in the study area and apply this to comparable sites in order to establish a status for the use impairment indicator.

To assess impairment, one needs to look at the characteristics of the plankton community composition and the relationship with other trophic levels. Plankton are small organisms, both plants (phyto) and animals (zoo), which live in the water column or attached to substrates in aquatic and marine environments. They possess limited or no ability to swim against currents, but move with the water. Phytoplankton form the base of the pelagic food web. Much of the energy captured by phytoplankton is consumed by zooplankton, which in turn are eaten by larger organisms such as larger zooplankton, benthos, and fish.

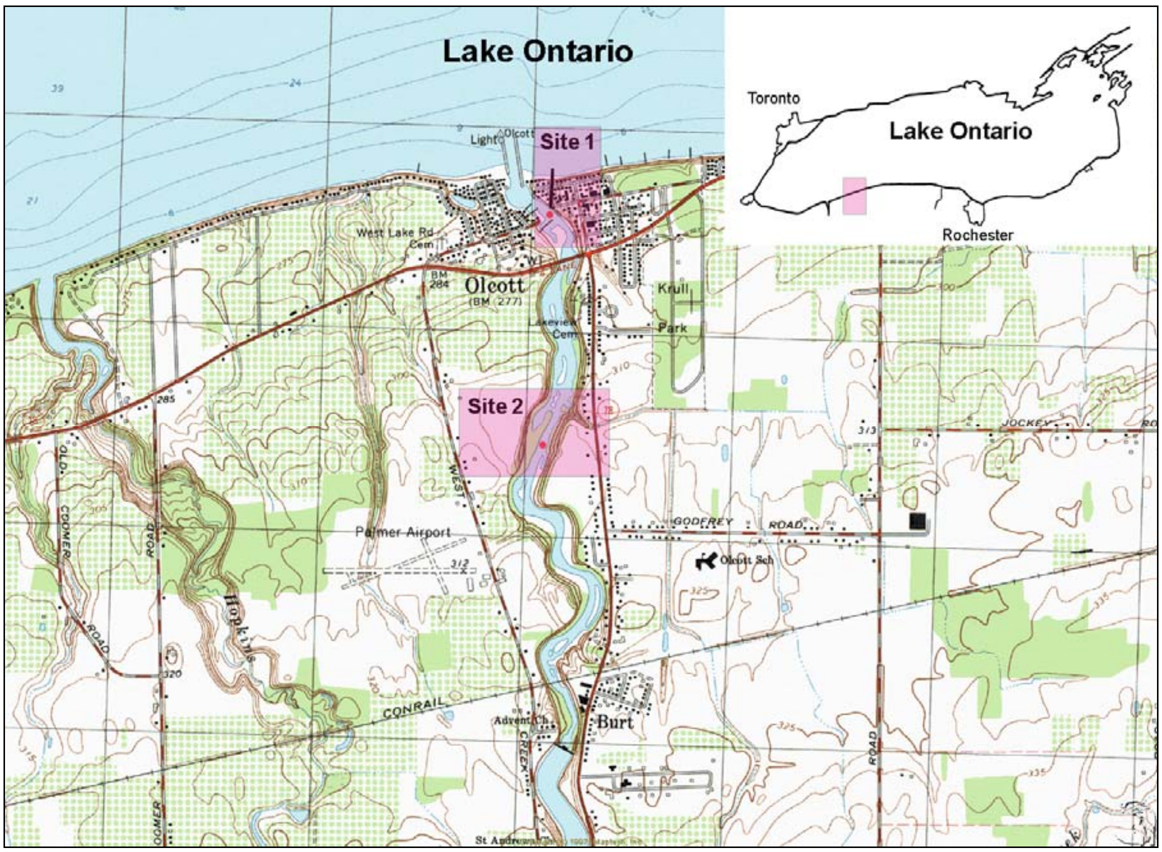

Figure 1. Plankton and water sampling sites on Eighteenmile Creek on Lake Ontario near Olcott, New York.

Methods

Two sites on Eighteenmile Creek were sampled on three dates (22 June, 25 July and 31 August 2000). Phytoplankton and zooplankton samples were taken on all three dates while physical data and water chemistry were sampled in July and August only.

Physical Field Data: Temperature, specific conductance (YSI model 3000 T-L-C thermistor) and dissolved oxygen (YSI model 58) was taken from a depth of 1 meter. Secchi disk depth was taken at each station with a standard 20 cm secchi disk.

Water Chemistry: All sampling bottles were pre-coded so as to ensure exact identification of the particular sample. All sample bottles were routinely cleaned with phosphate free RBS between sampling dates. Containers were rinsed prior to sample collection with the water being collected. In general, all procedures followed EPA standard methods (6) or Standard Methods for the Analysis of Water and Wastewater (7).

Water samples were taken from a depth of one meter with high-density polyethylene dark bottles. Sample water for dissolved nutrient analyses (SRP, nitrate + nitrite) was filtered immediately with 0.45-µm MCI Magna Nylon 66 membrane and either frozen or analyzed within 24 hours of collection.

Nitrate+Nitrite: Dissolved nitrate+nitrite nitrogen was performed by the automated (Technicon autoanalyser) cadmium reduction method (7).
Soluble Reactive Phosphorus: Sample water was filtered through a 0.45-µm membrane filter. The filtrate was analyzed for orthophosphate using the automated (Technicon) colorimetric ascorbic acid method (7). The formation of the phosphomolybdeum blue complex was read colorimetrically at 880nm.
Total Phosphorus: The persulfate digestion procedure was used prior to analysis by the automated (Technicon autoanalyser) colorimetric ascorbic acid method (7).
Total Suspended Solids: APHA (1995) Method 2540D was employed for this analysis.
Turbidity: Turbidity was measured with a Turner nephelometric turbidimeter.
pH: Analyses were made by electrode using a Beckman 45 pH meter, standardized using a two point calibration (4 and 9).
Chlorophyll *a*: Chlorophyll *a* was measured with a fluorometer following the method of Wetzel and Likens (1991).

Phytoplankton: Phytoplankton samples (100 mL) were taken just below the surface in the creek, then immediately preserved with 10 mL of gluteraldehyde. A total of six samples were taken for the study period. Phytoplankton enumeration and identifications were to the species level using the settling chamber procedure (Utermöhl 1958) at 500x. Each cell in a filament or colony was counted as an individual organism.

Zooplankton: Replicated zooplankton samples (n=3) were collected from each site with a 12.0 L Plexiglass Schindler trap (35-µm mesh net) (Schindler 1969). A total of 18 samples were taken for the study period. After collection, all zooplankton samples were transferred to 250 mL sample bottles and preserved with 3 mL of 5% buffered formalin per 100 mL of sample.

Adult Crustacea and most Rotifera were identified to species using Pennak (1989), Balcer *et al*. (1984) and Stemberger (1979). Because of the small volume collected, each sample was entirely enumerated. Aliquots of each sample were poured into sedimentation chambers and allowed to settle for at least two hours per centimeter of sample in the sedimentation chamber. Enumeration was accomplished with a Wild-Heerbrugg inverted microscope at 100x magnification. Because of the small volume, each sample is entirely enumerated.

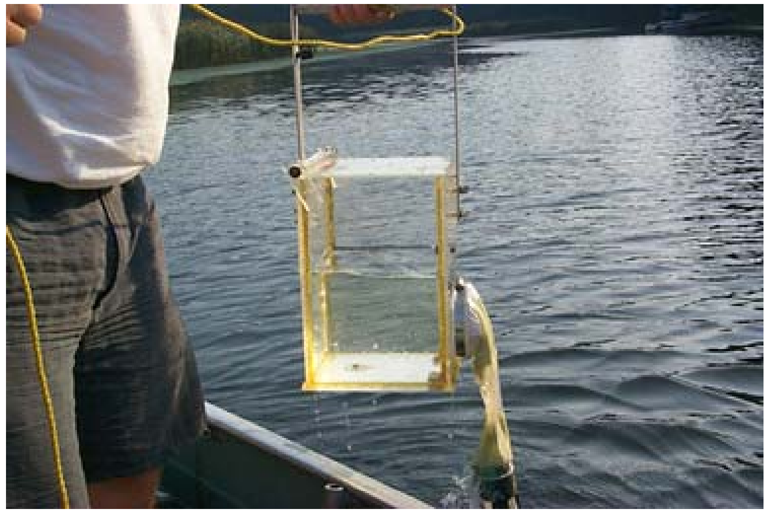

Figure 3. Schindler Trap employed for zooplankton collections

Quality Control:

The Water Chemistry Laboratory at SUNY Brockport is State and Nationally certified through the New York State Department of Health's Environmental Laboratory Approval Program (ELAP - # 11439) and the National Environmental Laboratory Accreditation Conference (EPA Lab Code NY 01449). These programs include bi-annual proficiency audits, annual inspections and good laboratory practices documentation of all samples, reagents and equipment (Tables 1 and 2).

Phytoplankton and zooplankton: Replicate identifications and counts were made on every 3rd sample to determine enumeration precision within a Division of phytoplankton and to establish consistency of identification. Analytical precision goals for enumerators were based on the Relative Percent Deviation (RPD = ((larger count-smaller count)/average)x100) (Csuros 1994, ARCS 1994). For example, the precision goal for replicated Bacillariophyta counts will be + 15%. Values outside this goal were rejected and the samples recounted unless a clear explanation was available; e.g., very low abundance of forms in any one division.

Results

A final report comparing the phytoplankton and zooplankton community in the Area of Concern to Braddock Bay, Yanty Creek, and Lake Ontario will be completed within one year of the completion of sampling. A determination of impairment for the

plankton community in the Eighteenmile Creek AOC will be made based on data assessment and comparison. Under this study, the use of known data from the three control / reference sites provides for maximum data collection in the Area of Concern. The control / reference sites provide very useful comparison of essentially unimpacted conditions. Braddock Bay is on the south shore of Lake Ontario and has one of the largest wetland complexes west of Oswego, New York. This wetland complex and adjacent streams are believed to be minimally affected by pollution. Zooplankton data are available from several habitats (emergent and submersed vegetation, open water and creek) in 1997 (Weaver 1998). Yanty Creek is located in the Hamlin Beach State Park area. The SUNY Brockport Research Foundation is currently (1999-2000) doing an ecological survey of this area for N.Y.S. Parks and Recreation that includes several habitats (ponds, creeks, etc.). Both the Yanty Creek and Braddock Bay sites are believed to be relatively unimpacted by excessive nutrient and soil loading from the watershed. At both the Braddock Bay (BB) and Yanty Creek (YC) sites, samples were taken with similar sampling gear (Likens Gilbert Filter) and at similar times of the year (BB: June, July and August; YC: June, August and October). These areas should provide for and allow reasonable comparisons to Eighteenmile Creek.
These comparisons would include diversity indices, species composition, indicator species and overall abundance. The Principle Investigator has authored several publications focusing on plankton community composition and structure that are directly applicable to the proposed study (Makarewicz and Bertram 1991, 1993, 1993, 1998,1998, 2000).

The selection of the control sites in this study is based on the need to have data from an unimpacted waterbody segment of similar characteristics to the lower Eighteenmile Creek Area of Concern. Upstream Eighteenmile Creek segments have been determined to be unsuitable for such a control site because of the potential influence of contamination. Therefore, the use of similar areas as control sites have been selected for this study. The Principal Investigator already has data from two such areas representative of what is believed to be the desired and best expected conditions for the plankton community in the study area.. Therefore, the collection of sampling data, in this limited funded study, will focus on the Area of Concern to best document the plankton community for the assessment of any use impairment in the Remedial Action Plan. Although a criticism of the study may involve the lack of historical data; this issue needs to be addressed by acknowledging that the best available data bases (i.e., comparable control site selection from the standpoint of stream length, discharge, land use, etc., and the fact that plankton data exists) have been utilized.

Phytoplankton: Sixty one species of phytoplankton were identified at both sites in Eighteenmile Creek during the study period. The Divisions Bacillariophyta, the diatoms (19 species), and Chlorophyta, the green algae (27 species), were the most diverse taxa, but the blue-green algae (Division Cyanophyta) were the dominant group of phytoplankton accounting for over 85% (range 62 to 92%) of total phytoplankton abundance site during each season sampled (Table 4). Phytoplankton abundance ranged from 9,547 to 36,162 cells/mL (Table 4). Average cell abundance for the two sites sampled was highest in June (27,366 cells/mL) and lowest in August (10,336 cells/mL). Average cell abundance for the study period was highest at Site 1 than Site 2 in June and

July. In August, upstream Site 2 samples away from Lake Ontario were higher in abundance than Site 1 (Table 4).

In June and July, phytoplankton taxa were evenly represented at both sites (evenness range = 0.405 to 0.447) with a somewhat variable species richness (range = 19-42 species) (Table 4). In August, dominance was concentrated in fewer taxa at both sites (evenness range: 0.319 to 0.389) although species richness remained high (27 to 30). In general, non-motile blue-green algae with a size of less than and greater than 1µm , Synechococcus sp., were the dominant taxa of Cyanophyta observed. Cryptomonas erosa and Rhodomonas minuta were the dominant Cryptophyta throughout the sampling period. Cyclostephanos invisitatus, a diatom, and Stichococcus sp, a green alga, were also prevalent during the study period. The chrysophyte Synura sp. was also prevalent at both sites in June (Table 2). No other species was dominant or prevalent in June, July, and August (Table 2)).

A comparison of phytoplankton from Eighteenmile Creek to a Lake Ontario nearshore and offshore site due north of Hamlin Beach State Park (Makarewicz 1985, 1987) indicate a lack of similarity between these two communities (Table 4). This is not surprising in that Eighteenmile Creek is a small riverine habitat with seasonal high flows compared to the lotic environment of a large Great Lake. Compared to Lake Ontario (evenness = 0.64 to 0.76), dominance of taxa is concentrated (i.e., not evenly distributed) in Eighteenmile Creek (evenness = 0.32 to 0.42), while abundance is much higher at Eighteenmile Creek. For example, August average abundance in Eighteenmile creek is greater than 10,000 cells/mL compared to less than 2,000 cells/mL in the nearshore and offshore of Lake Ontario (Table 4). The higher abundance at Eighteenmile Creek suggests a higher productivity at these sites.

Comparison of Eighteenmile Creek with other riverine habitats within the watershed of Lake Ontario indicates a great deal of similarity in abundance, species composition and other community indices. In August, evenness ranges from 0.31 in the Oswego River to 0.46 in Yanty Creek with Eighteenmile Creek lying between these two(Table 4). Similarly, abundance in August at Eighteenmile Creek (9,547 to 13,988 cells/mL), Yanty Creek (15,094 cells/mL0 and the Oswego River (26, 863 cells/mL) are probably not significantly different due to the high variability in enumeration. Species richness is very high at Oswego River compared to other creek sites in August. There is no good explanation for this result. Similarly, Yanty Creek abundance is much higher than Eighteenmile Creek in June. However, species compositions were similar. That is, cyanopthyes were clearly dominant at all riverine habitats in both June and August.
No Lake Ontario data are available for comparison to the “pond” sites in Yanty Creek during the month of June. In August, comparison of the “nearshore” of Lake Ontario and Oswego Harbor (Makarewicz 1987) to the Yanty Creek “ponds” suggests that dominance is concentrated in fewer species in the Yanty Creek ponds – mostly in species of blue-green algae. In Oswego Harbor and Lake Ontario, taxa were more evenly distributed with diatoms more predominant than at Yanty Creek. Abundance in the “ponds” tended to be higher than Lake Ontario and Oswego Harbor suggesting a higher productivity at these sites. By October, abundance, species composition and evenness of the communities were

similar among the “ponds at Yanty Creek, the near-shore of Lake Ontario and Oswego Harbor (Makarewicz 1987).

Zooplankton: Thirty eight species of zooplankton were identified in Eighteenmile Creek during the study period. The Rotifera comprised the largest number of species (23). Average zooplankton abundance ranged from a low of 5,370 individuals/m^3 to a high of 30,238 individuals/ m^3 (Table 3). Seasonally, average zooplankton abundance was always higher at Site 2 (average = 23,607/m^3) upstream from Lake Ontario, compared to Site 1 (16,385/m^3). Species richness (number of taxa) was similar at both sites with number of taxa being slightly higher in August compared to June. Taxa were evenly represented at both sites 1 and 2 during August (evenness range: 0.70 - 0.75) compared to June (eveness range: 0.31-0.36) and July (evenness range: 0.31-0.32), when the zoopalnkton community were dominated by a few species. The June zooplankton community was dominated by the veliger stage of Dreissena (75.0% of total abundance) and the nauplius stage of the the Copepoda (14.1% of the total abundance). Similarly, species dominance was concentrated in one cladoceran species Bosmina longirostris (79.4% of total abundance). By the August sampling, no single species species dominated; that is species abundance was evenly distributed within the zooplankton community (Table 3). In August at Site 2, cladoceran species associated with wetlands, Pleuroxus procurvus and Graptolebris testestudinaria, became more prevalent in the water column. Once again Bosmina longirostris was prevalent followed by the rotifer Polyarthra major (Table 3).

A comparison of the zooplankton communities from various creeks and habitats associated with Lake Ontario with Eighteenmile Creek suggests a strong degree of similarity in some of the communities during August (Table 5). For example, evenness is remarkably similar for Buttonwood Creek, Salmon Creek, Lake Ontario, Yanty Creek (submergent vegetation and Creek) and the open waters of Braddock Bay. Species richness (S.R.), that is the number of species, was significantly higher at both sites in Eighteenmile Creek (S.R. = Site1: 23; Site 2: 24) than various habitats (creek [11], open water [10], submergent vegetation [9]) in Yanty Creek, significantly lower than the submergent vegetation in Braddock Bay (S.R.= 46) but similar to Buttonwood (S.R.=23) and Salmon Creeks (S.R.=26) (Table 5). However, abundance (5-11 organisms per liter) of the Eighteenmile Creek zooplankton community is an order of magnitude lower than all other sites (e.g., Yanty Creek= 109 organisms per liter)(Table 5).

During June, species richness, evenness and abundance were lower at Eighteenmile Creek compared to Buttonwood and Salmon Creek and in the submergent vegetation of Braddock Bay (Table 5) and somewhat similar to Yanty Creek (Table 5). For example, abundance and evenness at Eighteenmile, Yanty Creek and the open water pond at Yanty Creek are similar. However, abundance and evenness in the submergent vegetation of Yanty Creek is comparatively high compared to both sites at Eighteenmile Creek. This may reflect the sampling location and seasonal hydrological influences. In June, both Yanty Creek and Eighteenmile, samples were taken upstream in an area heavily influenced by high water flows from the watershed. Samples at the Buttonwood and Salmon Creek sites were taken at the mouth of the creeks at their entrance to Braddock

Bay and were not as influenced by high water flows in June. That is, the June samples in Yanty and Eighteenmile Creek were from areas that would be best characterized as moderately flowing water and clearly a creek environment, while the Buttonwood and Salmon Creeks samples were in an area of slower flowing water within the mixing zone of Braddock Bay . As might be expected, abundance in the slower water of the vegetative area of Yanty Creek was higher. Because zooplankton are generally "at the mercy of the currents", high flow of water in a creek would simply carry zooplankton downstream into an area of slower water movement.

Considering species richness, the zooplankton community at the "open water pond sites" and at the Creek site in Yanty Creek marsh were relatively impoverished compared to other sampling in Eighteenmile Creek, submergent vegetation and compared to the open waters of Lake Ontario (Table 5). Makarewicz et al. (2000) attributed this result to the low water levels in the Yanty Creek ponds and the almost complete lack of vegetation or physical structure at these two locations. Depths at the Yanty Creek pond sites never exceeded 0.5 meters and were often lower. Except for areas sampled in submerged vegetation, depths at other locations generally exceeded 2m.

Although abundance is low compared to other creeks., they are no different than the control site at Hamlin Beach, this suggests that the community in not impacted.

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Table 1. Physical and chemical measurements for two sites on Eighteen Mile Creek on 25 July and 31 August 2000.

Date	Units	Site 1 7/25/2000	Site 2 7/25/2000	Site 1 8/31/2000	Site 2 8/31/2000
Total phosphorus	(µg P/L)	115.8	115.8	127.6	113.6
Nitrate	(mg N/L)	0.98	1.11	0.73	0.82
Total suspended solids	(mg/L)	1.9	1.1	0.4	1.9
Chlorphyll *a*	(µg/L)	1.1	1.1	0.9	1.5
Soluble reactive phosphorus	(µg P/L)	100.6	101.7	113.7	103.9
Turbidity	(NTU)	1.23	1.03	0.94	1.15
pH		7.89	7.67	7.12	6.89
Temperature	(°C)	22.4	21.4	23.8	24.2
Secchi Disk	(m)	1.8	1.6	3.7	3.9
Dissolved Oxygen	(mg/L)	7.04	6.09	7.81	5.83
Specific Conductance	(µmhos/cm)	634	629	877	878

Table 2. Phytoplankton abundance (cells/mL) in Eighteenmile Creek, Lake Ontario, 2000. GALD=Greatest Axial Linear Dimension.

	GALD (um)	22-Jun Site 1	26-Jul Site 1	31-Aug Site 1	22-Jun Site 2	26-Jul Site 2	31-Aug Site 2
Cyanophyta							
Aphanocapsa elachista	11	52.1	0.0	0.0	0.0	0.0	0.0
Aphanocapsa delicatissima	11	229.2	0.0	0.0	328.2	20.8	0.0
Merismopedia tenuissima	6.6	20.8	0.0	41.7	32.7	0.0	0.0
Non-motile blue-greens (<1.1 um)	0.9	10298.8	7724.1	3862.0	8,438.1	3862.0	2574.7
Non-motile blue-greens (>1 um)	1.8	13517.2	0	31.3	7,653.1	1287.4	643.7
Oscillatoria limnetica	35.2	83.3	0.0	0.0	36.8	0.0	0.0
Synechococcus sp. 1	1.8	7724.1	7724.1	3862.0	5692.1	6436.7	9655.1
Chlorophyta							
Ankistrodesmus convolutus	22	5.2	0.0	5.2	0.0	0.0	0.0
Ankistrodesmus falcatus	36.9	107.2	0.0	0.0	84.0	0.0	0.0
Apodochloris sp.	19.8	0.0	0.0	0.0	24.6	0.0	5.2
Chlamydomonas globosa	4.4	10.4	10.4	15.6	10.0	31.3	10.4
Chlamydomonas incerta	9.9	5.2	0.0	0.0	0.0	0.0	0.0
Chlamydomonas platystigma	8.8	5.2	0.0	15.6	19.4	26.0	10.4
Chlamydomonas sp.	17.6	0.0	0.0	0.0	0.0	0.0	5.2
Chloromonas chlorogoniopsis	7.3	0.0	239.6	83.3	62.0	88.5	72.9
Dictyosphaerium pulchellum	11	20.8	0.0	0.0	12.3	0.0	0.0
Micractinium pusillum	22	10.4	0.0	0.0	18.7	0.0	0.0
Monoraphidium capricornutum	3.3	15.6	20.8	0.0	14.8	0.0	0.0
Non-motile Chlorococcales-spherical	4.4	36.5	31.3	15.6	47.7	5.2	5.2
Oocystis parva	9.9	31.3	0.0	0.0	38.3	0.0	5.2
Pandorina morum	33	41.7	280.6	0.0	67.9	0.0	0.0
Scenedesmus bijuga	8.8	10.4	0.0	0.0	0.0	10.4	0.0
Scenedesmus dimorphus	14.9	26.0	0.0	0.0	10.8	0.0	0.0
Scenedesmus dispar	11	20.8	20.8	0.0	14.8	0.0	0.0
Schroederia judayi	22	5.2	0.0	5.2	0.0	0.0	0.0
Scenedesmus opoliensis v. carinatus	16.5	10.4	0.0	0.0	0.0	0.0	0.0
Scenedesmus quadricauda	23.3	87.5	0.0	0.0	104.0	20.8	0.0
Scenedesmus quadricauda v. longispina	29.3	125.0	0.0	0.0	78.4	0.0	0.0
Scenedesmus serratus	8.8	0.0	20.8	0.0	0.0	0.0	0.0
Selenastrum minutum	8.8	0.0	0.0	5.2	0.0	0.0	5.2
Sphaerellopsis sp.	17.6	5.2	0.0	0.0	0.0	0.0	0.0
Stichococcus sp.	3.3	1734.5	99.0	0.0	689.2	62.5	36.5
Stigeoclonium sp.	242	0.0	0.0	0.0	0.0	385.8	0.0
Euglenophyta							
Phacus sp.	17.6	5.2	0.0	0.0	0.0	0.0	0.0
Cryptophyta							
Cryptomonas erosa	14.7	36.5	31.3	5.2	5.2	5.2	10.4
Cryptomonas ovata	17.6	0	0.0	5.2	0.0	0.0	0.0
Cryptomonas rostratiformis	24.2	5.2	10.4	5.2	0.0	10.4	5.2
Rhodomonas minuta v.nannoplanctica	8.3	156.3	234.4	156.3	121.3	114.6	166.7
Bacillariophyta							
Achnanthes lanceolata ssp. frequentissima	9.9	0.0	0.0	0.0	0.0	0.0	5.2
Achnanthes minutissima	11	0.0	0.0	15.6	0.0	0.0	20.8
Amphora pediculus	8.8	0.0	0.0	5.2	0.0	0.0	0.0
Bacillaria paradoxa	66	0.0	0.0	5.2	0.0	0.0	0.0
Cocconeis placentula v. lineata	23.9	20.8	15.6	31.3	10.3	10.4	36.5
Cyclostephanos invisitatus	4.4	208.3	182.3	67.7	86.0	203.1	15.6
Fragilaria pinnata v. pinnata	8.8	10.4	0.0	0.0	0.0	0.0	0.0
Gomphonema olivaceum	24.2	0.0	0.0	5.2	0.0	5.2	15.6
Gomphonema parvulum	15.8	0.0	0.0	0.0	0.0	15.6	0.0
Navicula sp.	17.6	5.2	0.0	0.0	34.0	0.0	0.0
Navicula lanceolata	8.8	0.0	0.0	5.2	5.2	5.2	5.2
Nitzschia gracilis	55	5.2	0.0	0.0	0.0	0.0	0.0

Table ? (Continued)

	GALD (um)	22-Jun Site 1	26-Jul Site 1	31-Aug Site 1	22-Jun Site 2	26-Jul Site 2	31-Aug Site 2
Nitzschia inconspicua	6.6	5.2	0.0	0.0	0.0	0.0	0.0
Rhoicosphenia curvata	13.2	0.0	0.0	5.2	0.0	10.4	0.0
Stephanodiscus hantzschii	11	15.6	0.0	10.4	5.2	10.4	10.4
Synedra tenera	99	0.0	17.5	0.0	0.0	0.0	0.0
Pyrrhophyta							
Gymnodinium sp. 3	8.8	0.0	0.0	5.2	0.0	0.0	0.0
Chrysophyta							
Ochromonas sp.	8.8	0.0	0.0	5.2	0.0	0.0	0.0
Synura sp. (single)	16.5	234.4	0.0	0.0	329.5	0.0	0.0
Uroglena sp. (single)	4.4	36.5	31.3	15.6	0.0	0.0	0.0
Unidentified							
Misc. microflagellate	2.2	1145.9	625.0	1250.1	1436.7	416.7	625.0
Total		**36157**	**17345**	**9547**	**18570**	**13076**	**13957**

Table 3. Zooplankton composition and abundance (#/m^3) at Eighteenmile Creek, Lake Ontario, New York, 2000. Values are average of three samples for each site.

	22-Jun SITE 1	25-Jul SITE 1	31-Aug SITE 1	22-Jun SITE 2	25-Jul SITE 2	31-Aug SITE 2
Arthropoda						
Cladocera						
Bosmina longirostris	52.9	20661.4	264.6	185.2	24021.2	1349.2
Ceriodaphnia sp.	0.0	264.6	0.0	0.0	291.0	0.0
Ceriodaphnia reticulata?	0.0	0.0	26.5	0.0	0.0	0.0
Chydorus sphaericus	79.4	0.0	291.0	79.4	0.0	105.8
Eurycercus lamellatus	26.5	0.0	0.0	0.0	0.0	0.0
Graptolebris testestudinaria	0.0	0.0	0.0	0.0	0.0	238.1
Daphnia retrocurva	0.0	317.5	0.0	0.0	1931.2	0.0
Holopedium gibberrum	26.5	0.0	0.0	0.0	0.0	0.0
Pleuroxus procurvus	0.0	0.0	291.0	0.0	0.0	1851.9
Total Cladocera	185.2	21243.4	873.0	264.6	26243.4	3545.0
Copepoda						
Nauplius Stage	2486.8	3941.8	2513.2	4206.3	1613.8	1957.7
Calanoida						
Copepodite Stage	0.0	0.0	26.5	0.0	0.0	26.5
Diaptomus sp.	0.0	0.0	0.0	0.0	0.0	26.5
Total Calanoida	0.0	0.0	26.5	0.0	0.0	52.9
Cyclopoida						
Copepodite Stage	370.4	158.7	132.3	185.2	634.9	476.2
Cyclops vernalis	26.5	26.5	0.0	26.5	264.6	79.4
Tropocyclops prasinus	26.5	0.0	26.5	26.5	0.0	132.3
Cyclops sp. #2	0.0	0.0	0.0	0.0	0.0	0.0
Total Cyclopoida	423.3	185.2	158.7	238.1	899.5	687.8
Harpacticoida						
Canthocampus sp.	26.5	0.0	26.5	26.5	0.0	0.0
Total Harpacticoida	26.5	0.0	26.5	26.5	0.0	0.0
Rotifera						
Ascomorpha saltans	423.3	52.9	0.0	767.2	0.0	0.0
Asplanchna sp.	0.0	0.0	26.5	52.9	52.9	0.0
Brachionus angularis	0.0	26.5	158.7	79.4	26.5	0.0
Brachionus quadridentatus	158.7	0.0	0.0	158.7	0.0	0.0
Conochilus unicornis	0.0	0.0	0.0	0.0	0.0	52.9
Filinia longiseta	0.0	26.5	0.0	26.5	26.5	26.5
Gastropus sp.	0.0	0.0	79.4	0.0	0.0	26.5
Keratella cochlearis	661.4	52.9	264.6	767.2	238.1	529.1
Keratella quadrata	211.6	582.0	52.9	0.0	0.0	26.5
Keratella taurocephala	26.5	0.0	0.0	26.5	0.0	0.0
Lepadella ovalis	0.0	0.0	0.0	0.0	0.0	105.8
Notholca squamula?	52.9	0.0	52.9	79.4	52.9	105.8
Kellicottia bostonensis	1.3	0.0	0.0	0.0	0.0	0.0
Kellicottia longispina	26.5	132.3	238.1	105.8	52.9	264.6
Lecane sp.	52.9	0.0	132.3	0.0	105.8	1084.7
Lepadella ovalis	0.0	0.0	0.0	26.5	0.0	0.0
Ploesoma sp.	0.0	0.0	158.7	0.0	0.0	0.0
Polyarthra vulgaris	26.5	238.1	238.1	291.0	396.8	502.6
Polyarthra major	0.0	0.0	158.7	0.0	0.0	1798.9
Polyarthra remata	0.0	52.9	105.8	0.0	0.0	52.9
Pompholyx sp.	0.0	0.0	79.4	0.0	0.0	0.0
Rotatoria rotatoria	0.0	0.0	0.0	0.0	0.0	26.5
Trichocerca sp.	0.0	0.0	26.5	0.0	0.0	26.5
Total Rotifera	1641.5	1164.0	1772.5	2381.0	952.4	4629.6
Mollusca						
Veliger of Dreissena sp.	12460.3	26.5	0.0	23121.7	0.0	0.0
Total Mollusca	12460.3	26.5	0.0	23121.7	0.0	0.0
Total Abundance	17223.6	26560.8	5370.4	30238.1	29709.0	10873.0
Total Abundance (minus Dreissena)	4763.2	26534.4	5370.4	7116.4	29709.0	10873.0

Table 4. Comparison of phytoplankton abundance and community indices between Eighteenmile Creek, Yanty Creek, NY, Oswego River and Lake Ontario in June, August and October.. Abundances are in number per mL. YC=Yanty Creek, OR=Oswego River, OH=Oswego Harbor, Hamlin Beach= nearshore region of Lake Ontario, and LO (Sta 41) = pelagic elimnetic of Lake Ontario. SR=Species richness. ND=No Data. Counts of <u>Anacystis marina</u> are removed from the Oswego samples. These bacteria are not generally included in traditional plankton counts. Species richness is not included for the nearshore Lake Ontario samples from Hamlin Beach. Organisms were identified to genus only.

	Eighteenmile Creek		**Creek**	**Oswego River**	**Inner Pond**	**Outer Pond**	**Lake Ontario Nearshore**	**Lake Ontario Offshore**	**Oswego Harbor (Site 7)**
JUNE	**Site 1**	**Site 2**	**YC**	**OR**	**YC**	**YC**	**Hamlin**	**LO (Sta41)**	**OH**
Evenness	.422	ND	.576	ND	.565	.493	.639	ND	ND
S.R.	42	31	34	ND	33	35	ND	ND	ND
Abundance	36,162	18,570	62,845	ND	42,249	59,282	3061	ND	ND
BAC	302	141	11864	ND	4503	7700	1053	ND	ND
CHR	271	329	1189	ND	289	713	0	ND	ND
CHL	2315	1297	5872	ND	3430	3143	130	ND	ND
CRY	198	127	1023	ND	1338	1209	835	ND	ND
CYA	31926	15237	39435	ND	31107	44520	1042	ND	ND
EUG	5	0	73	ND	36	73	0	ND	ND
MIS	1146	1434	3386	ND	2865	1563	0	ND	ND
PYR	0	5.2	0	ND	0	0	0.7	ND	ND
JULY	**Site 1**	**Site 2**							
Evenness	.405	.447							
S.R.	19	24							
Abundance	17,345	13,061							
BAC	242	276							
CHR	31	0							
CHL	723	631							
CRY	276	130							
CYA	15448	11607							
EUG	0	0							
MIS	625	417							
PYR	0	0							
AUGUST	**Site 1**	**Site 2**	**YC**	**OR**	**YC**	**YC**	**Hamlin**	**LO(Sta41)**	**OH**
Evenness	.389	.319	.460	.307	.251	.207	.758	.731	.417
S.R.	30	27	32	107	23	25	ND	52	116
Abundance	9,547	13,988	15,094	26,863	2,659	66,332	1459	1814	39781
BAC	156	141	266	6349	83	115	65	32	6061
CHR	21	0	0	66	0	0	0	540	319
CHL	146	167	296	8182	49	200	417	736	6973
CRY	172	182	1314	696	44	970	426	532	1047
CYA	7797	12874	9611	16,478	2001	63798	548	450	23685
EUG	0	0	7	1015	0	0	0	0	0
MIS	1250	625	3559	368	446	1215	0	0	1514
PYR	5	0	35	74	0	0	3	8	106
COL	0	0	0	41	0	0	0	16	82

Table 5. Comparison of zooplankton abundance and community indices between Eighteenmile Creek, creeks of Braddock Bay, Yanty Creek marsh and Lake Ontario, NY in June and August. **Abundances are in number per liter**. YC=Yanty Creek, BC=Buttonwood Creek at Braddock Bay, SC= Salmon Creek at Braddock Bay, Open water at Yanty Creek (YC) and Lake Ontario (LO). Submergent vegetation represented samples taken from areas containing submergent vegetation. SR=Species richness. Total Abun= Total abundance. Braddock Bay data from Weaver (1997). ND=No Data. Lake Ontario data from Lampman and Makarewicz (1999). Yanty Creek data from Makarewicz et al. (2000).

	Creeks					**Open Water**		**Submergent Vegetation**	
JUNE	**S1**	**S2**	**YC**	**BC**	**SC**	**YC**	**LO**	**YC**	**BB**
Evenness	0.36	0.31	0.26	0.62	0.59	0.89	ND	0.91	0.56
S.R.	20	19	3	25	29	14	ND	5	34
Abundance									
Cladocera	0.19	0.26	0.0	5.7	406.6	7.4	ND	4.7	260.7
Calanoida	0.0	0.0	0.0	0.03	9.6	2.0	ND	0.0	9.8
Cyclopoida	0.42	0.24	15.1	10.8	31.8	2.0	ND	47.0	16.6
Copepoda Nauplii	2.5	4.2	15.1	37.3	52.8	6.4	ND	18.1	45.1
Rotifera	1.6	2.4	1.0	155	905.6	24.1	ND	4.7	1012
Dreissena	12.5	23.1	0.0	0.0	0.0	0	ND	0	0
Total Abun	17.2	30.2	16.2	209.7	1407	39.8	ND	75.2	1345
AUGUST	**S1**	**S2**	**YC**	**BC**	**SC**	**YC**	**LO**	**YC**	**BB**
Evenness	0.70	0.75	0.61	0.62	0.51	0.51	0.73	0.92	0.65
S.R.	23	24	11	23	26	10	28	9	46
Abundance									
Cladocera	0.87	3.5	6.2	7.5	32.6	0.8	19.8	5.1	22.2
Calanoida	0.03	0.06	0.00	0.4	0.03	1.1	0.6	0	10.0
Cyclopoida	0.16	0.69	17.3	3.6	3.7	12.1	41.6	25.4	53.3
Copepoda Nauplii	2.5	2.0	60.8	10.9	16.3	72.4	52.3	10.2	84.6
Rotifera	1.8	4.6	24.9	17.9	7.6	23.5	146.2	35.6	234.8
Dreissena	0	0	0	0	0	0	0	0	0
Total Abun	5.4	10.9	109	50.5	67.4	110	261	190	170.1

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Appendix 1. Results of the semi-annual New York State Environmental Laboratory Assurance Program (ELAP Lab # 11439, SUNY Brockport) Non-Potable Water Chemistry Proficiency Test, July 2000. Score Definition: Satisfactory, or Unsatisfactory.

WADSWORTH CENTER

NEW YORK STATE DEPARTMENT OF HEALTH

ENVIRONMENTAL LABORATORY APPROVAL PROGRAM

Proficiency Test Report

Lab 11439 SUNY BROCKPORT EPA Lab Id NY01449 Page 1 of 1
WATER LAB LENNON HALL
BROCKPORT, NY 14420

Shipment 233 Non Potable Water Chemistry
Shipment Date: 24-Jul-2000 Approval Category : **Non Potable Water**

Analyte	Sample ID	Result	Mean/Target	Satisfactory Limits	Method	Score
Sample: **Residue**						
Solids, Total Suspended	3302	64.5	59.9	49.8 - 70	SM18 2540D	Satisfactory
343 passed out of 361 reported results.						
Sample: **Organic Nutrients**						
Kjeldahl Nitrogen, Total	3304	5.25	6.09	4.24 – 7.95	EPA 351.3	Satisfactory
131 passed out of 136 reported results.						
Phosphorus, Total	3304	7.30	7.03	5.54 – 8.52	SM18 4500-PB,E	Satisfactory
144 passed out of 160 reported results.						
Sample: **Inorganic Nutrients**						
Nitrate (as N)	3307	25.54	26	20.9 – 31.2	SM18 4500-NO3 F	Satisfactory
123 passed out of 127 reported results.						
Orthophosphate (as P)	3307	2.74	2.74	2.32 – 3.16	SM18 4500-P F	Satisfactory
106 passed out of 116 reported results.						
Sample: **Metals I and II**						
Sodium, Total	3311	27.52	24.8	22 – 27.6	ASTM D-1688-95 C	Satisfactory
122 passed out of 142 reported results.						

Appendix 2. Phytoplankton species list with authorities.

Taxa	Division	Authority
Achnanthes lanceolata ssp. frequentissima	Bacillariophyta	Lange-Bertalot
Achnanthes minutissima	Bacillariophyta	Kützing
Amphora pediculus	Bacillariophyta	(Kützing) Grunow
Bacillaria paradoxa	Bacillariophyta	Gmelin
Cocconeis placentula v. lineata	Bacillariophyta	(Ehrenberg) Van Heurck
Cyclostephanos invisitatus	Bacillariophyta	(Hohn & Hel.) Ther., Stoerm. & Håkansson
Fragilaria pinnata v. pinnata	Bacillariophyta	Ehrenberg
Gomphonema olivaceum	Bacillariophyta	(Hornemann) de Brébisson
Gomphonema parvulum	Bacillariophyta	(Kützing) Kützing
Navicula lanceolata	Bacillariophyta	(Agardh) Ehrenberg
Navicula sp.	Bacillariophyta	Bory
Nitzschia gracilis	Bacillariophyta	Hantzsch
Nitzschia inconspicua	Bacillariophyta	Grunow
Nitzschia intermedia	Bacillariophyta	Hantzsch
Nitzschia palea	Bacillariophyta	(Kützing) W. Smith
Rhoicosphenia curvata	Bacillariophyta	(Kützing) Grunow
Stephanodiscus Hantzschii 22um	Bacillariophyta	Grunow
Stephanodiscus hantzschii 8-11um	Bacillariophyta	Grunow
Synedra tenera	Bacillariophyta	W. Smith
Ankistrodesmus convolutus	Chlorophyta	Corda
Ankistrodesmus falcatus	Chlorophyta	(Corda) Ralfs
Apodochloris sp.	Chlorophyta	Komárek
Chlamydomonas globosa	Chlorophyta	Snow
Chlamydomonas incerta	Chlorophyta	Pascher
Chlamydomonas platystigma	Chlorophyta	(Korshikoff) Pascher
Chlamydomonas sp.	Chlorophyta	Ehrenberg
Chloromonas chlorogoniopsis	Chlorophyta	Ettl
Cyst (Chlorophyte)	Chlorophyta	N/A
Dictyosphaerium pulchellum	Chlorophyta	Wood
Micractinium pusillum	Chlorophyta	Fresenius
Monoraphidium capricornutum	Chlorophyta	(Printz) Nygaard
Non-motile Chlorococcales-spherical	Chlorophyta	N/A
Oocystis parva	Chlorophyta	West & West
Pandorina morum	Chlorophyta	(Müller) Bory
Scenedesmus bijuga	Chlorophyta	(Turpin) Lagerheim
Scenedesmus dimorphus	Chlorophyta	(Turpin) Kützing
Scenedesmus dispar	Chlorophyta	(Brébisson) Rabenhorst
Scenedesmus opoliensis v. carinatus	Chlorophyta	Lemmermann
Scenedesmus quadricauda	Chlorophyta	(Turpin) de Brébisson
Scenedesmus quadricauda v. longispina	Chlorophyta	(Chodat) G.M. Smith
Scenedesmus serratus	Chlorophyta	(Corda) Bohlin
Schroederia judayi	Chlorophyta	G.M. Smith

Appendix 2. (Continued).

Selenastrum minutum	Chlorophyta	(Nägeli) Collins
Sphaerellopsis sp.	Chlorophyta	Korschikov
Stichococcus sp.	Chlorophyta	Nägeli
Stigeoclonium sp.	Chlorophyta	Kützing
Gymnodinium sp. 3	Chrysophyta	Stein
Ochromonas sp.	Chrysophyta	Wyssotzki
Synura sp. (single)	Chrysophyta	Ehrenberg
Uroglena sp. (single)	Chrysophyta	Ehrenberg
Cryptomonas erosa	Cryptophyta	Ehrenberg
Cryptomonas ovata	Cryptophyta	Ehrenberg
Cryptomonas rostratiformis	Cryptophyta	Skuja
Rhodomonas minuta v. nannoplanctica	Cryptophyta	Skuja
Aphanocapsa delicatissima	Cyanophyta	West & West
Aphanocapsa elachista	Cyanophyta	West & West
Merismopedia tenuissima	Cyanophyta	Lemmermann
Non-motile blue-greens (<1.1 UM)	Cyanophyta	N/A
Non-motile blue-greens (>1 UM)	Cyanophyta	N/A
Oscillatoria limnetica	Cyanophyta	Lemmermann
Synechococcus sp. 1	Cyanophyta	(Nägeli) Elenkin
Phacus sp.	Euglenophyta	Dujardin
Misc. microflagellate	Miscellaneous	N/A

Appendix3. Plankton Sampling Sites 1 and 2, Eighteenmile Creek, August, 2000