Progress Report - Lake and Stream Surveys in Northwestern Ontario, 2012 and 2013

Fort Hope, on Eabamet Lake

Cooperative Freshwater Ecology Unit

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2014

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Background

Protecting lakes and rivers in northern Ontario depends on having good information to help make the right decisions. However, so far there is very little scientific knowledge about waters in the far north of Ontario. In future, there will likely be new developments in parts of the north including mines, forestry operations, and hydroelectric projects that will affect the natural environment. The far north is also an area that is expected to be greatly affected by future climate change. These are just some of the threats that lakes and rivers might face. To understand how northern waters might change in the future, and how to best protect them we need to better understand what they are like now and how they may have already changed.

As an important step toward developing this baseline knowledge, starting in summer 2012, sampling was conducted on selected lakes and streams to obtain basic information on what they are like now. With the particular interest in potential mining development in the "Ring of Fire" area of northwestern Ontario, these aquatic science surveys were done in that general area, based from the community of Fort Hope. In initial discussions with the Eabametoong First Nation, interest was expressed about adding current scientific knowledge to their store of traditional knowledge, to assist with future resource management decisions. Survey planning involved members of the Eabametoong First Nation at Fort Hope. Study lakes and streams were selected in consultation with band members, and covered a range of different lake and stream types present in the region. Other First Nations communities in the area, including Neskantaga and Webequie, were consulted during the planning process and will be kept informed on the progress of the studies.

Fort Hope Area Lake Sampling, 2012

During July 11–15, 2012, 29 lakes were sampled in a large area of northwestern Ontario using a float-equipped aircraft. The locations of the lakes sampled are shown in Figure 1, and coordinates are provided in the Appendix to this summary report. A summary of the sampling conducted on specific lakes during 2012-2103 is provided in Table 1. For this project, study lakes were picked that are not currently affected by industry-related activity and are in natural condition. The sampling crew consisted of Bill Keller, Josef MacLeod, and Chantal Sarrazin-Delay from Laurentian University, and Adam Jeziorski and Kathryn Hargan from Queen's University.

Josef measuring oxygen and temperature

Sampling was completed on each lake for temperature/oxygen conditions, water clarity (Secchi disk), and water chemistry (composite sampler). Phytoplankton (the very small plants in the water that capture energy from the sun) and zooplankton (the small animals in the water that eat phytoplankton and pass energy up the food chain) were also sampled. The types of phytoplankton and zooplankton in a lake tell much about the lake's condition. This project will characterize the range of selected physical, chemical, and biological

characteristics in lakes of the region. The results of chemistry and zooplankton analyses are provided in the Appendix. These data are currently being worked up and will form the basis of a Master's thesis by Josef MacLeod at Laurentian University, as well as being published in future scientific papers. The phytoplankton samples have been sent out for processing but we do not yet have results.

Adam and Kathryn coring lake sediment

On 14 of the study lakes, cores of the lake bottom sediment were collected and sliced at very fine intervals. The bottom sediments of a lake contain a record of a lake's past conditions, including the plants and animals that lived there. By dating the individual slices of a core and looking at the plant and animal remains in the slices we can see how lakes have changed through time. These samples are currently being analysed at Queen's University. The results will be published in scientific papers, and provided in future progress reports.

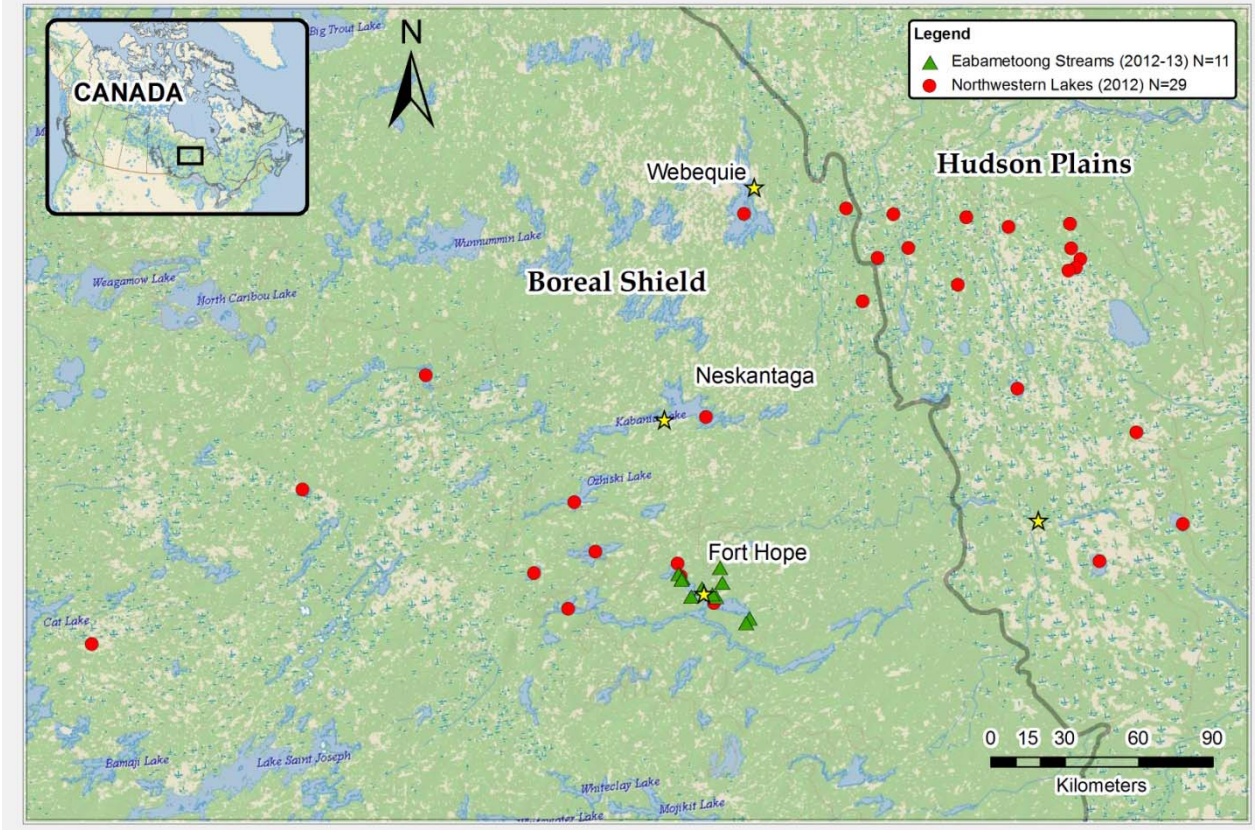


Figure 1. Map of the Fort Hope study region showing the location of the study lakes and streams.

Table 1. Sample inventory for the study lakes and streams, 2012 - 2013.

		Water Chemistry		Phytoplankton		Zooplankton		Benthic Invertebrates		Sediment Core	
	Lake/Year	**'12**	**'13**	**'12**	**'13**	**'12**	**'13**	**'12**	**'13**	**'12**	**'13**
Lakes	Eabamet	√	√	√	√	√	√			√	
	Minimiska	√		√		√					
	Lang	√		√		√					
	Rond	√		√		√					
	Opikeigan	√		√		√					
	Troutfly	√		√		√				√	
	Keezhik	√		√		√				√	
	Ozhiski	√		√		√					
	Menako	√		√		√					
	Attawapiskat	√		√		√				√	
	Wigwascence	√		√		√					
	Winisk	√		√		√					
	Goods	√		√		√				√	
	Leaver	√		√		√					
	Wabemieg	√		√		√					
	Muskwabik	√		√		√				√	
	Lingen	√		√		√				√	
	Streatfield	√		√		√					
	ROF-065	√		√		√				√	
	ROF-064	√		√		√					
	Symons	√		√		√				√	
	ROF-063	√		√		√				√	
	ROF-061	√		√		√				√	
	ROF-037	√		√		√					
	ROF-056	√		√		√				√	
	ROF-041	√		√		√					
	ROF-050	√		√		√				√	
	McFauld's	√		√		√				√	
	Duego	√		√		√					
Streams	Squirrel Creek	√						√			
	Fruit Creek	√						√			
	Old Bay Creek	√						√			
	Lornjack Creek	√						√			
	Reserve Creek	√						√			
	Eabamet Tributary	√						√			
	Opikeigen River	√						√			
	Rond River	√						√			
	Old Mine Creek	√						√			
	Pioneer Creek		√						√		
	Tidy Creek		√						√		
		38	**3**	**29**	**1**	**29**	**1**	**9**	**2**	**14**	**0**

Fort Hope Area Lake Sampling, 2013

On August 22nd, 2013, Eabamet Lake was sampled again at the same location as in 2012. Lake temperature, dissolved oxygen and water clarity were measured. A composite water sample was taken for water chemistry, and phytoplankton and zooplankton samples were collected. The survey crew consisted of Lance Waboose of Eabamatoong First Nation, Chantal Sarrazin-Delay and Stephanie Delay from Laurentian University as well as Jan Vandermeer grade 9 science teacher at JC Yesno School.

Lance measuring oxygen and temperature

Fort Hope Area Stream Sampling, 2012-13

In July 2012, sampling was conducted on 9 streams draining into Eabamet Lake. Five of these streams were not affected by industry-related activity and are in natural condition: Squirrel and Fruit Creeks, Lornjack River, Opikeigen River (AKA Rond Lake Rapids) and Rond River (AKA Rond Lake Waterway). Four streams were affected by human activities: Old Mine and Reserve Creeks (historical mine exploration), Old Bay Creek (historical community) and Eabamet Tributary (current community). The survey crew consisted of Xavier Sagutch of Eabamatoong First Nation, Chantal Sarrazin-Delay from Laurentian University and Kathryn Hargan from Queen's University. This work has provided important baseline information which will allow assessment of future changes, and could be a first step in the development of a long-term monitoring program.

Xavier at Lornjack Creek

At each river, water samples were collected and the communities of bottom-living invertebrates (insects, crustaceans, worms, etc.) were sampled. A 3-minute kick and sweep invertebrate sample was taken as described in Environment Canada's CABIN (Canadian Aquatic Biomonitoring Network) method. The results of the chemistry and invertebrate surveys are provided in the Appendix.

In August 2013, 2 additional streams were sampled: Pioneer and Tidy Creeks. These creeks are somewhat affected by individuals using the land for its natural resources e.g. firewood. The survey crew consisted of Lance Waboose and Louie Sugarhead of Eabamatoong First Nation and Chantal Sarrazin-Delay and Stephanie Delay from Laurentian University. These data are also provided in the Appendix.

Chantal with Lance sampling Pioneer Creek

Observations to date

Lake Water Chemistry:

The lakes sampled in July 2012 reflected the two physiographic regions they fell in: Precambrian Shield and Hudson Bay Lowlands (Table 2, Appendix 2). Lowlands lakes had higher dissolved organic carbon, color, iron and total nitrogen and total phosphorus than Shield lakes. In contrast, conductivity, pH, dissolved inorganic carbon, silica, calcium, potassium, magnesium and sulphate were lower in Lowlands lakes than in Shield lakes. .

Table 2. Range in water chemistry values for the study lakes, 2012. Metals for which values were very low or not detected are not reported here but can be found in Appendix 2.

	Shield lakes (N=14)		Lowlands lakes (N=15)	
	Range	Average	Range	Average
Calcium (mg/L Ca)	7.78-34.9	14.7	3.14-13.6	7.5
Carbon; dissolved inorganic (mg/L Ca)	4.26-23.5	10.2	1.62-9.28	4.6
Carbon; dissolved organic (mg/L Ca)	4.9-15.4	11.2	9.8-18.6	14.1
Chloride (mg/L)	0.1-0.41	0.2	0.11-0.4	0.2
Magnesium (mg/L)	1.33-7.3	3.0	0.475-2.75	1.2
Potassium (mg/L)	0.18-1.04	0.4	0.09-0.255	0.2
Alkalinity; Gran (mg/L CaCO3)	21.4-110	47.6	9.65-46	23.1
Alkalinity; total fixed endpt (mg/L)	23.7-110	48.7	10.9-46.8	24.1
Silicon; reactive silicate (mg/L)	0.28-1.96	1.0	<0.02-0.56	0.2
Sodium (mg/L)	0.415-0.9	0.6	0.315-0.8	0.5
Sulphate (mg/L)	0.1-1.65	0.6	<1-0.35	0.2
pH	7.41-8.22	7.7	6.94-7.77	7.4
Colour; true (TCU)	5.2-93.2	49.9	49.6-155	92.7
Nitrogen; ammonia+ ammonium (ug/L)	10-26	16	<2-24	14
Nitrogen; nitrate+ nitrite (ug/L)	<2-12	3	<2-6	4
Nitrogen; total Kjeldahl (ug/L)	161-470	353	293-509	393
Phosphorus; total (ug/L)	3.6-15.4	9.6	8-25.2	15.9
Aluminum (ug/L)	1.8-67.9	21.1	21.4-238	70.7
Arsenic (ug/L)	<0.5-1.6	0.5	<0.5-0.9	0.6
Barium (ug/L)	4.2-19.2	7.2	2.5-6.8	4.2
Boron (ug/L)	2-4	3	2-4	3
Copper (ug/L)	0.4-1.4	0.7	0.2-0.9	0.6
Iron (ug/L)	<10-190	68	60-480	175
Manganese (ug/L)	4-33.1	16.4	2.2-35.2	11.0
Strontium (ug/L)	12.8-30.7	17.6	7.7-26.7	14.3
Zinc (ug/L)	<0.5-1.8	0.9	1-2.9	2.1
Conductivity (uS/cm)	48-214	97	21.2-93.2	48

Lake Zooplankton:

Thirty-six species of crustacean zooplankton were collected from the 29 lakes sampled. Overall, the most common species were *Bosmina freyi*, *Chydorus sphaericus*, *Daphnia mendotae, Holopedium glacialis, Leptodiaptomus minutus, Diacyclops bicuspidatus thomasi*, *Epischura lacustris*, and *Diaphanosoma birgei* all of which occurred in over 50% of the lakes (Appendix 3). Within individual lakes, the overall species richness per collection ranged from 6 to 16 (Figure 1). Fewer species were collected in Lowlands lakes (6-11 species, average 8) than in Shied lakes (8-16 species, average 12).The crustacean zooplankton species most commonly (> 1 lake) collected have all been generally reported from other surveys of lakes further south in Ontario.

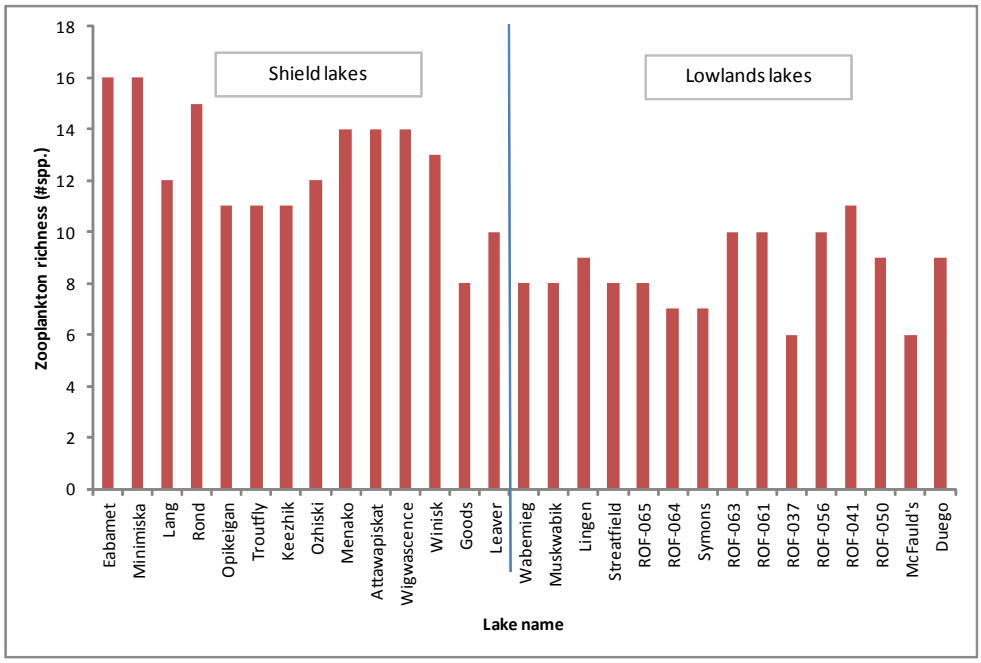


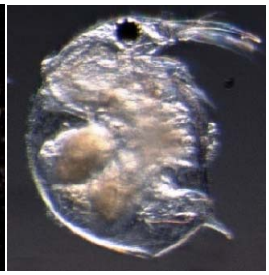
Figure 1. Crustacean zooplankton species richness (number of species) in the study lakes, 2012.

ZOOPLANKTON encountered:

Cladocerans

Chydorus sphaericus

Holopedium glacialis



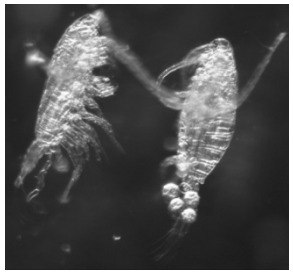
Bosmina freyi

Daphnia mendotae

Copepods

Calanoid naupli
(Immature)

Epischura lacustris



Leptodiaptomus minutus
(male & female)

Cyclops bicuspidatus thomasi

Mesocyclops edax
(male & female)

Stream Water Chemistry

The streams sampled in July 2012 and August 2013 all drained into Eabamet Lake as shown in Appendix 4. The values for the water chemistry parameters are shown in Table 3 and Appendix 5. Old Bay and Old Mine Creeks had higher alkalinity and conductivity than the other streams sampled. Tidy Creek had lower pH. Opikeigen and Rond Rivers had lower nutrients and less color likely owing to the fact that they are immediately downstream of Opikeigen and Rond Lakes and the water has not yet interacted with wetlands in the watershed.

Table 3. Range in water chemistry values for the study streams, 2012-13. Metals for which values were very low or not detected are not reported here but can be found in Appendix 5.

Water Chemistry Parameter	Range	Average
Calcium-mg/L	9.18-41.1	21.4
Carbon; Dissolved Inorganic-mg/L	7.56-21	13.2
Carbon; Dissolved Organic-mg/L	11.8-23	17.6
Chloride-mg/L	0.06-0.4433	0.2
Magnesium-mg/L	1.68-5.84	3.7
Potassium-mg/L	0.155-0.64	0.3
Alkalinity; Gran-mg/L $CaCO_3$	25.4-89	56.7
Alkalinity; Total Fixed Endpoint-mg/L $CaCO_3$	26.4-90	57.2
Silicon; Reactive Silicate-mg/L	0.88-2.64	1.7
Sodium-mg/L	0.31-1.13	0.6
Sulphate-mg/L	<1-0.4	0.2
pH	6.71-7.77	7.5
Colour; True-TCU	48.2-176	98.0
Nitrogen: Ammonia+Ammonium-ug/L	6-36	23
Nitrogen: Nitrate+Nitrite-ug/L	<2-18	8
Nitrogen: Total Kjeldahl-ug/L	343-598	468
Phosphorus; Total-ug/L	9-35.4	17.4
Aluminum-ug/L	11.3-55.1	22.4
Arsenic-ug/L	0.5-1.4	0.9
Barium-ug/L	4-8.7	5.5
Boron-ug/L	1-5	3
Copper-ug/L	<0.2-0.5	0.3
Iron-ug/L	30-410	174
Manganese-ug/L	15-118	40
Strontium-ug/L	10.5-33.5	20.6
Titanium-ug/L	<0.5-2.3	0.6
Zinc-ug/L	0.6-2.9	1.2
Conductivity-uS/cm	56.4-179	114

Stream Bottom dwelling invertebrates

Seventy families of benthic invertebrates were collected from the 11 streams sampled. The highest richness was in Squirrel, Fruit, Pioneer and Tidy Creeks (Figure 3). A gradient of invertebrate types by stream bottom substrate was found (Appendix 6 &7). Muddy bottom creeks with slow moving water (e.g. Reserve, Old Mine and Old Bay Creeks) had more tolerant invertebrates typical of that habitat (snails, worms, midges). Reserve Creek also had dragonflies and scuds. The other streams all had rocky bottoms with more insect larva (stoneflies, mayflies, caddisflies).

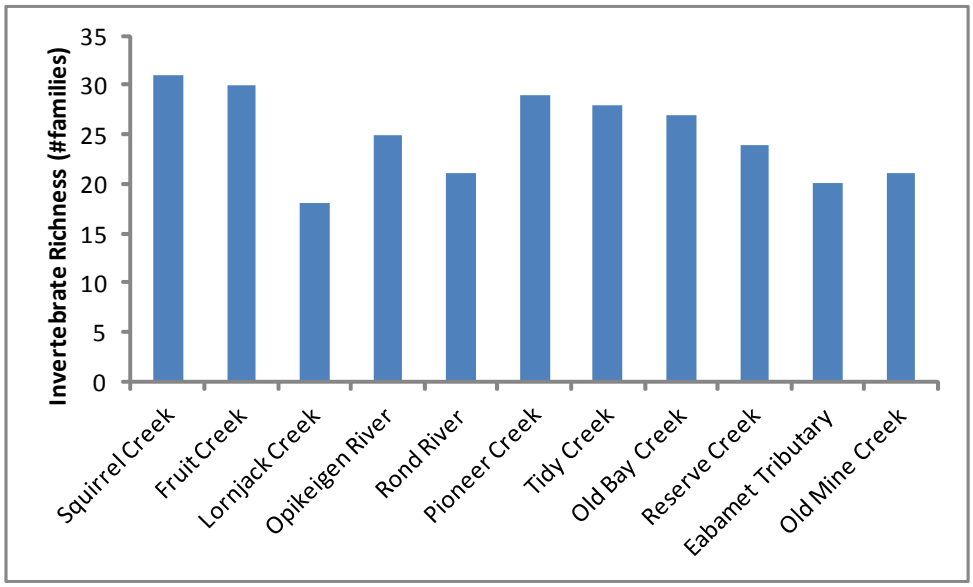
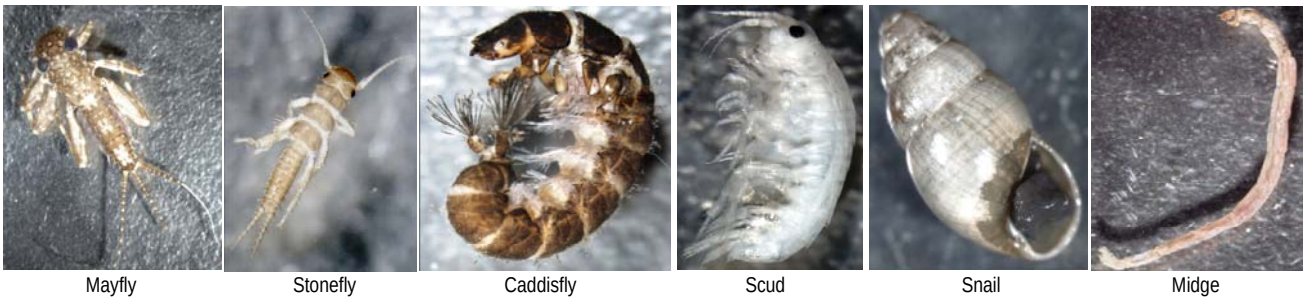


Figure 3. Number of invertebrate families found in 11 streams draining into Eabamet Lake.

<u>BOTTOM DWELLING INVERTEBRATES encountered:</u>



Mayfly (Heptageniidae) | Stonefly (Perlodidae) | Caddisfly (Hydropsychidae) | Scud (Hyalellidae) | Snail (Lymnaeidae) | Midge (Chironomidae)

Summary

As part of a collaboration between the Eabametoong First Nation and Laurentian and Queen's Universities, studies are being conducted on selected lakes and streams in northwestern Ontario. These studies will help increase our knowledge of the characteristics of lakes and streams in the Far North of Ontario and will help us understand how sensitive they are to various stressors. Our overall goal is to improve the scientific understanding of waters in the north, to allow better predictions of their sensitivity to future industrial development or changes in climate. As it becomes available, new information from these studies will be shared with all those involved in managing and protecting waters in the north.

Acknowledgements

This work was supported by the Ontario Ministry of the Environment through the Climate Change and Multiple Stressor Research Program at Laurentian University and by W. Garfield Weston Foundation Fellowships from the Wildlife Conservation Society Canada (to Josef MacLeod and Kathryn Hargan). Invertebrate photographs were supplied by Lynne Witty, Laurentian University.

Planning the 2012 survey - (left to right): Kathryn Hargan, Harry Papah, Xavier Sagutch, Josef MacLeod, Bill Keller and Adam Jeziorski,

Appendices

Appendix 1 – Locations of 29 lakes sampled in 2012-13.

Appendix 2 - Results of chemistry analyses for 29 lakes sampled in 2012 and 2013.

Appendix 3 - Zooplankton species (% of the sample) found in the lakes sampled in 2012.

Appendix 4 - Locations of 11 streams sampled in 2012-13

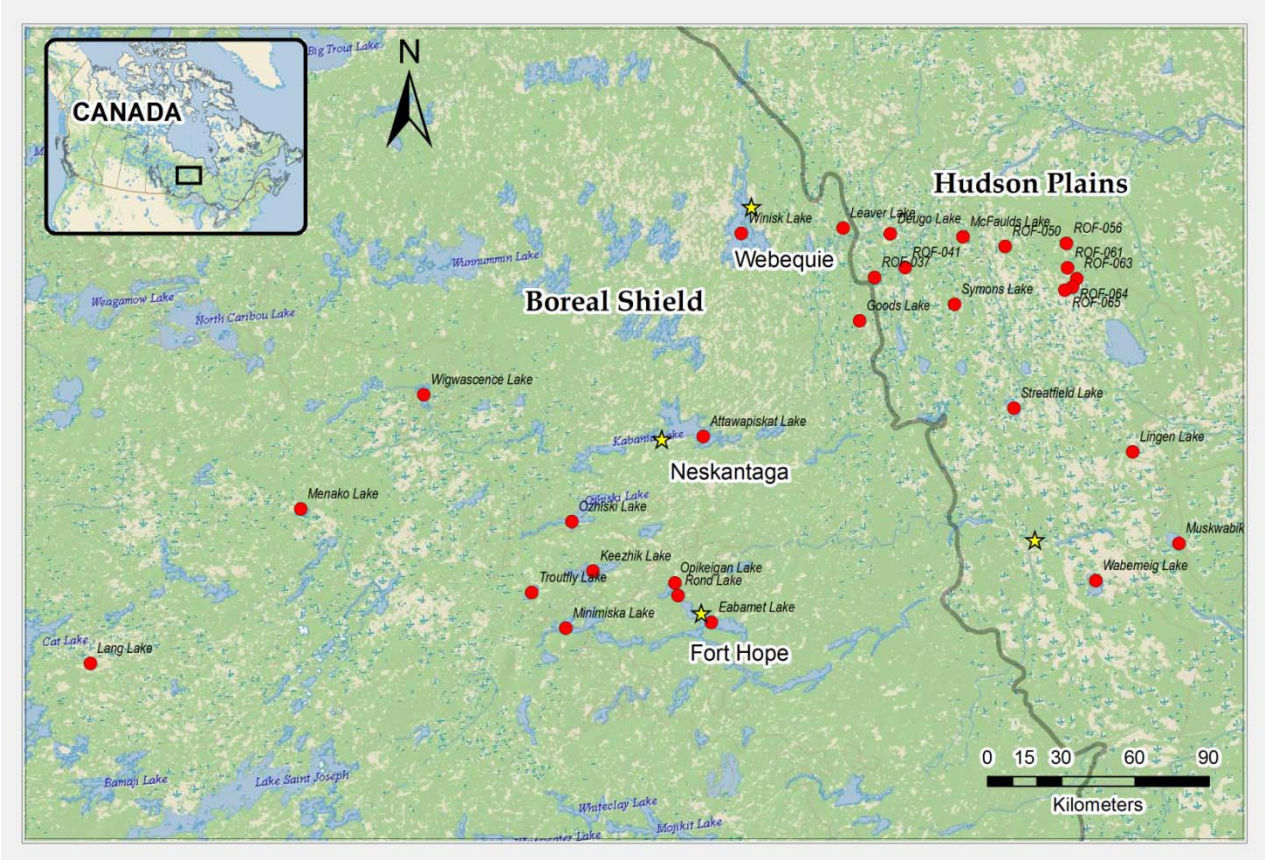
Appendix 5 - Results of chemistry analyses for streams sampled in 2012 and 2013.

Appendix 6 – Summary of habitat characteristics at stream sampling sites, 2012 and 2013

Appendix 7 - Bottom dwelling invertebrates found in streams sampled in 2012 and 2013.

Chantal, Louie and Lance measuring water quality at Pioneer Creek

Appendix 1 – Locations of 29 lakes sampled in 2012-13.



Attawapiskat Lake

Appendix 2 - Results of chemistry analyses for 29 lakes sampled in 2012 and 2013.

	2013	2012								
Lake	Eabamet	Eabamet	Minimiska	Lang	Rond	Opikeigan	Troutfly	Keezhik	Ozhiski	Menako
Depth at Site (m)	8.9	9.0	3.3	5.6	1.9	6.6	14.5	17.0	12.8	6.5
Secchi Depth (m)	2.7	2.8	1.8	2.5	1.9	2.5	5.0	4.0	1.1	1.7
Latitude	51.520	51.520	51.561	51.583	51.632	51.679	51.702	51.756	51.944	52.086
Longitude	87.863	87.852	88.707	91.515	88.029	88.038	88.885	88.511	88.603	90.203
Calcium (mg/L Ca)	15.3	14.0	12.7	8.4	13.8	13.3	34.9	22.2	12.6	10.8
Carbon; dissolved inorganic (mg/L Ca)	11.1	10.3	9.3	5.5	10.2	9.8	23.5	16.1	8.6	7.4
Carbon; dissolved organic (mg/L Ca)	9.9	10.9	11.4	11.1	12.1	11.2	4.9	7.3	14.4	11.5
Chloride (mg/L)	0.2	0.4	0.2	0.1	0.2	0.2	0.3	0.3	0.2	0.2
Magnesium (mg/L)	3.1	3.1	2.6	1.8	2.9	2.8	7.3	4.5	2.6	2.1
Potassium (mg/L)	0.4	0.4	0.5	0.4	0.4	0.4	1.0	0.6	0.4	0.4
Alkalinity; Gran (mg/L CaCO3)	50.6	47.0	42.7	27.2	45.7	45.9	110.0	73.5	40.9	34.7
Alkalinity; total fixed endpt (mg/L)	52.1	47.8	43.3	28.4	48.5	46.7	110.0	73.6	41.7	35.7
Silicon; reactive silicate (mg/L)	1.2	0.9	1.0	0.7	1.0	0.8	2.0	1.3	1.2	0.9
Sodium (mg/L)	0.5	0.5	0.6	0.5	0.5	0.5	0.9	0.6	0.5	0.5
Sulphate (mg/L)	0.4	0.5	0.7	0.8	0.4	0.4	1.7	0.9	0.6	0.4
pH	7.8	7.8	7.8	7.5	7.8	7.8	8.2	8.1	7.7	7.6
Colour; true (TCU)	39.8	41.0	54.0	52.0	48.4	43.0	5.2	15.8	86.8	55.2
Nitrogen; ammonia+ ammonium (ug/L)	20	22	14	10	20	14	10	18	18	18
Nitrogen; nitrate+ nitrite (ug/L)	ND	ND	4	ND	ND	ND	ND	ND	12	ND
Nitrogen; total Kjeldahl (ug/L)	346	336	395	325	380	364	161	261	408	347
Phosphorus; total (ug/L)	25	8.6	11.0	6.6	10.6	7.2	3.6	6.4	15.4	9.8
Aluminum (ug/L)	22.5	4.8	24.2	15.4	11.9	7.3	1.8	2.8	67.9	13.6
Antimony (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic (ug/L)	0.5	0.5	0.5	ND	0.5	ND	ND	ND	1.6	ND
Barium (ug/L)	5.7	4.7	6.5	4.8	6.2	6.2	19.2	9.4	6.9	5.2
Beryllium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron (ug/L)	1.0	2.0	3.0	3.0	3.0	2.0	4.0	3.0	3.0	3.0
Cadmium (ug/L)	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND
Chromium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper (ug/L)	0.3	0.5	0.7	0.6	0.5	0.5	0.5	0.5	1.4	0.8
Iron (ug/L)	70	20	90	40	60	40	ND	ND	190	90
Lead (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manganese (ug/L)	10.8	4.6	22.9	8.3	17.1	12.1	4.0	11.5	33.1	28.4
Molybdenum (ug/L)	ND	ND	ND	0.2	ND	ND	0.3	ND	ND	ND
Nickel (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Strontium (ug/L)	14.9	16.3	15.6	12.8	17.1	16.7	30.7	23.6	15.5	13.2
Thallium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Titanium (ug/L)	1.0	ND	0.7	ND	ND	ND	ND	ND	2.8	ND
Uranium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc (ug/L)	ND	0.5	0.5	ND	0.6	ND	1.8	1.3	0.8	0.5
Conductivity (uS/cm)	101.0	96.4	89.6	57.2	96.6	93.2	214.0	146.0	83.0	72.4

Appendix 2 cont.

	2012									
Lake	Attawapiskat	Wigwascence	Winisk	Goods	Leaver	Wabemieg	Muskwabik	Lingen	Streatfield	ROF-065
Depth at Site (m)	10.4	2.9	2.5	3.3	2.0	1.9	1.3	1.8	2.1	1.8
Secchi Depth (m)	1.5	1.5	2.5	1.4	1.7	0.5	0.7	0.7	0.5	1.0
Latitude	52.195	52.458	52.911	52.538	52.881	51.478	51.564	51.919	52.144	52.540
Longitude	87.766	89.405	87.385	86.746	86.767	85.580	85.062	85.245	85.905	85.493
Calcium (mg/L Ca)	12.8	12.3	19.9	7.8	9.8	7.8	13.6	7.7	9.4	7.0
Carbon; dissolved inorganic (mg/L Ca)	8.8	8.4	13.9	4.3	6.7	4.7	9.3	4.6	6.4	3.7
Carbon; dissolved organic (mg/L Ca)	14.0	12.9	8.7	15.4	11.6	16.9	18.6	14.4	13.3	14.4
Chloride (mg/L)	0.2	0.1	0.4	0.3	0.3	0.2	0.2	0.2	0.3	0.2
Magnesium (mg/L)	2.8	2.4	3.8	1.3	1.8	1.6	2.8	1.3	1.9	0.9
Potassium (mg/L)	0.4	0.5	0.7	0.2	0.2	0.2	0.2	0.2	0.3	0.1
Alkalinity; Gran (mg/L CaCO3)	41.8	40.8	64.2	21.4	31.1	23.9	46.0	23.2	31.3	19.6
Alkalinity; total fixed endpt (mg/L)	43.0	41.6	65.1	23.7	32.1	24.8	46.8	24.3	32.2	20.7
Silicon; reactive silicate (mg/L)	1.2	1.4	0.7	0.8	0.3	0.2	0.6	0.1	0.2	0.1
Sodium (mg/L)	0.6	0.6	0.7	0.4	0.5	0.6	0.8	0.5	0.8	0.5
Sulphate (mg/L)	0.6	0.5	0.4	0.1	0.2	0.1	0.2	0.3	0.2	0.2
pH	7.7	7.6	8.0	7.4	7.6	7.4	7.8	7.4	7.6	7.4
Colour; true (TCU)	72.0	71.6	19.8	93.2	41.2	95.6	144.0	92.8	83.0	119.0
Nitrogen; ammonia+ ammonium (ug/L)	26	22	12	12	10	ND	20	12	4	12
Nitrogen; nitrate+ nitrite (ug/L)	8	ND	ND	4	ND	4	4	4	ND	4
Nitrogen; total Kjeldahl (ug/L)	381	389	360	371	470	421	410	348	447	299
Phosphorus; total (ug/L)	10.6	12.6	8.6	9.2	14.6	25.2	21.0	20.6	23.4	10.8
Aluminum (ug/L)	36.9	43.0	3.8	37.0	25.1	145.0	238.0	127.0	128.0	43.7
Antimony (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic (ug/L)	0.8	0.7	ND	0.6	0.5	0.7	0.9	0.6	0.5	0.7
Barium (ug/L)	6.0	6.9	9.2	4.2	5.2	5.2	6.8	4.0	5.4	3.7
Beryllium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron (ug/L)	3.0	3.0	2.0	3.0	3.0	4.0	4.0	3.0	4.0	2.0
Cadmium (ug/L)	ND	ND	ND	ND	ND	ND	0.2	ND	0.2	ND
Chromium (ug/L)	ND	ND	ND	ND	ND	ND	0.6	ND	ND	ND
Cobalt (ug/L)	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND
Copper (ug/L)	0.8	0.5	0.4	0.5	1.2	0.7	0.9	0.7	0.8	0.5
Iron (ug/L)	70	120	30	130	60	340	480	210	260	230
Lead (ug/L)	ND	ND	ND	ND	ND	0.4	0.3	0.3	0.2	ND
Manganese (ug/L)	9.2	21.8	15.4	20.1	20.7	35.2	32.5	8.4	35.0	3.3
Molybdenum (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel (ug/L)	ND	ND	ND	ND	ND	ND	0.6	ND	ND	ND
Selenium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Strontium (ug/L)	15.9	17.1	22.5	13.3	16.7	14.4	26.7	12.6	20.6	12.5
Thallium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Titanium (ug/L)	1.2	1.7	0.1	1.0	0.6	5.7	8.8	4.3	5.8	1.1
Uranium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium (ug/L)	ND	ND	ND	ND	ND	0.5	0.7	0.5	0.5	ND
Zinc (ug/L)	1.2	0.8	1.8	1.7	0.8	2.0	2.3	2.4	2.9	1.6
Conductivity (uS/cm)	87.6	81.0	130.0	48.0	64.6	51.0	93.2	48.0	64.0	41.4

Appendix 2 cont.

	2012									
Lake	ROF-064	Symons	ROF-063	ROF-061	ROF-037	ROF-056	ROF-041	ROF-050	McFaulds	Deugo
Depth at Site (m)	1.6	1.7	2.0	2.0	1.9	1.3	1.2	1.7	2.0	2.1
Secchi Depth (m)	0.8	1.4	1.0	1.5	1.6	1.2	1.0	1.4	1.4	1.3
Latitude	52.546	52.549	52.574	52.618	52.687	52.706	52.707	52.730	52.788	52.836
Longitude	85.445	86.165	85.412	85.456	86.619	85.440	86.427	85.809	86.053	86.488
Calcium (mg/L Ca)	4.9	9.0	11.6	6.9	3.1	9.2	5.8	5.1	7.2	3.9
Carbon; dissolved inorganic (mg/L Ca)	2.5	6.2	7.3	4.3	1.6	6.4	2.4	2.5	4.6	1.9
Carbon; dissolved organic (mg/L Ca)	14.9	13.0	12.5	12.0	12.0	9.8	18.6	15.3	12.0	13.2
Chloride (mg/L)	0.2	0.3	0.2	0.2	0.1	0.2	0.1	0.4	0.3	0.3
Magnesium (mg/L)	0.5	1.8	1.7	0.8	0.5	1.4	0.8	0.8	1.2	0.5
Potassium (mg/L)	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1
Alkalinity; Gran (mg/L CaCO3)	14.0	29.8	36.8	19.2	9.7	29.1	14.4	15.4	22.0	11.7
Alkalinity; total fixed endpt (mg/L)	15.0	31.5	37.5	21.0	10.9	30.1	15.3	16.4	22.8	12.8
Silicon; reactive silicate (mg/L)	ND	0.3	0.3	0.1	0.1	0.3	0.3	0.3	0.0	0.1
Sodium (mg/L)	0.3	0.6	0.6	0.4	0.3	0.5	0.4	0.5	0.4	0.4
Sulphate (mg/L)	0.3	0.2	0.2	0.2	0.2	0.2	0.1	ND	0.2	0.4
pH	7.1	7.6	7.6	7.3	6.9	7.6	7.1	7.1	7.4	7.0
Colour; true (TCU)	90.0	67.4	71.8	60.2	80.4	54.0	155.0	126.0	49.6	101.0
Nitrogen; ammonia+ ammonium (ug/L)	14	16	18	20	12	14	14	18	24	18
Nitrogen; nitrate+ nitrite (ug/L)	4	ND	4	4	4	ND	6	6	4	4
Nitrogen; total Kjeldahl (ug/L)	472	346	364	503	293	333	384	404	509	366
Phosphorus; total (ug/L)	20.0	11.2	16.4	17.2	9.4	15.6	8.0	9.0	18.0	12.2
Aluminum (ug/L)	45.0	55.4	68.3	30.3	25.8	21.4	40.8	31.9	28.9	30.5
Antimony (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic (ug/L)	0.5	0.7	0.5	0.5	0.5	0.5	0.7	0.9	ND	0.7
Barium (ug/L)	3.6	4.3	5.2	3.5	2.5	3.8	2.9	4.3	4.9	3.0
Beryllium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron (ug/L)	2.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
Cadmium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2
Chromium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper (ug/L)	0.5	0.8	0.7	0.5	0.8	0.4	0.6	0.2	0.6	0.2
Iron (ug/L)	120	90	150	60	70	70	140	240	70	90
Lead (ug/L)	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manganese (ug/L)	7.6	6.1	6.9	6.4	2.5	5.7	4.4	2.2	5.4	3.7
Molybdenum (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Strontium (ug/L)	7.7	23.1	17.7	9.7	10.0	14.3	11.8	12.9	12.5	8.6
Thallium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Titanium (ug/L)	1.3	1.6	2.2	0.5	ND	ND	0.6	ND	0.5	ND
Uranium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc (ug/L)	2.7	1.5	2.3	2.3	2.8	1.7	1.1	2.5	2.7	1.0
Conductivity (uS/cm)	28.8	61.8	73.6	41.6	21.2	59.6	31.8	32.2	46.2	24.8

Appendix 3 - Zooplankton species (% of the sample) found in the lakes sampled in 2012.

	2012								
Species	**Eabamet**	**Minimiska**	**Lang**	**Rond**	**Opikeigan**	**Troutfly**	**Keezhik**	**Ozhiski**	**Menako**
Alona sp.				0.16				0.26	
Ceriodaphnia sp.	0.29	0.15	0.15					0.52	
Chydorus sphaericus	0.15	0.92	0.92	1.95	1.31	0.13	1.51	0.26	2.82
Daphnia (Daphnia) catawba								0.79	
Daphnia (Hyalodaphnia) mendotae	1.92	1.42	4.99	6.16	2.32	0.13	5.98	8.11	18.62
Daphnia (Hyalodaphnia) longiremis	1.18	0.37	2.15		0.66	1.78	0.55		1.69
Daphnia (Daphnia) pulicaria									
Daphnia (Daphnia) retrocurva		0.86		0.49	1.97			4.27	
Eurycercus lamellatus									
Holopedium glacialis	0.29	0.49	1.23	0.49	0.66		2.75		0.28
Leptodora kindtii	0.15								
Polyphemus pediculus				0.16					
Sida crystallina		0.25		1.46					
Eubosmina (Eubosmina) longispina	1.47	0.37							
Diaphanosoma birgei	1.77	0.49	5.68	0.16	1.97	0.13	0.14	0.79	0.56
Daphnia sp.									
Bosmina (Bosmina) freyi	5.37	1.20	2.15	1.95	25.11	8.44	12.39	0.26	5.64
Bosmina (Bosmina) liederi	0.15								
Leptodiaptomus ashlandi	2.21								
Leptodiaptomus minutus	0.29	0.37	1.99			4.29	0.28		
Skistodiaptomus oregonensis		0.61	0.37	6.16	7.56	0.59	0.41	0.26	
Leptodiaptomus sicilis									
Leptodiaptomus siciloides									3.96
Epischura lacustris		0.21						0.45	
Epischura lacustris copepodid	0.88	0.61	9.13	1.78	1.97	1.17	1.65	0.79	1.13
Diacyclops bicuspidatus thomasi	4.86	0.18	1.69	0.49	0.98	3.94	4.54	1.27	4.23
Acanthocyclops vernalis complex	0.88	0.37							
Euscyclops agilis								0.26	
Mesocyclops edax	0.44	0.37		3.74	7.88	0.25			
Tropocyclops extensus			0.92	0.16			0.28		0.28
Eubosmina sp.				0.16		0.13			
Calanoid copepodid (Immature)	36.74	0.12	38.71	1.46	3.28	0.76	0.28		6.70
Calanoid nauplius	3.13	33.34	4.83	16.55	3.94	15.44	2.93	6.29	1.23
Cyclopoid copepodid (Immature)	11.42	8.34	14.50	8.76	8.37	28.66	26.63	8.39	11.99
Cyclopoid nauplius	26.45	52.96	1.74	38.93	14.22	34.39	41.16	7.63	32.42
Harpacticoida nauplius									

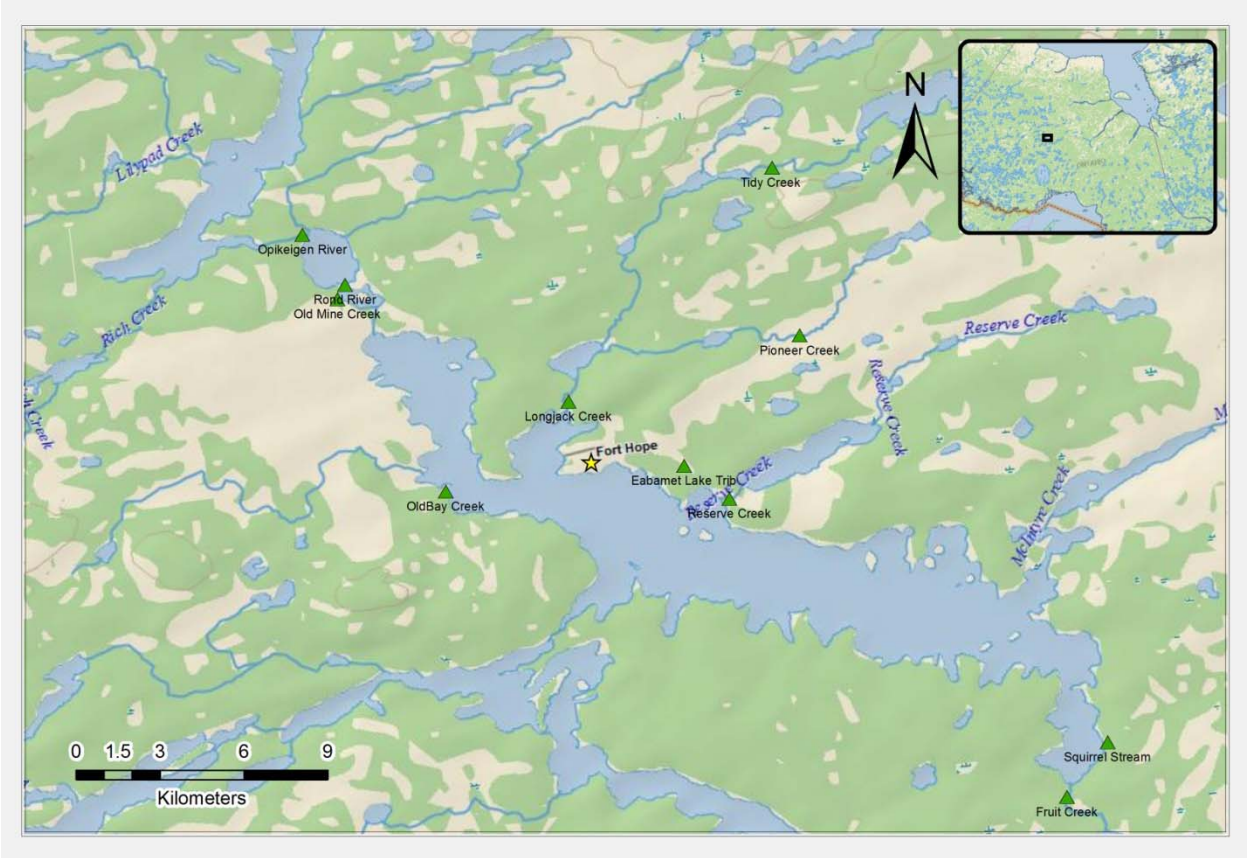
Appendix 3 cont.

	2012									
Species	**Attawapiskat**	**Wigwascence**	**Winisk**	**Goods**	**Leaver**	**Wabemieg**	**Muskwabik**	**Lingen**	**Streatfield**	**ROF-065**
Alona sp.		1.00			0.13					
Ceriodaphnia sp.		1.49					2.35			
Chydorus sphaericus	0.15	0.30	6.82	0.78	13.92	4.23	0.19	2.98	2.13	2.45
Daphnia (Daphnia) catawba	0.15									
Daphnia (Hyalodaphnia) mendotae	7.84	1.30	9.93	25.39	0.25			0.73	0.97	8.59
Daphnia (Hyalodaphnia) longiremis	3.92		2.55		0.63					
Daphnia (Daphnia) pulicaria	0.15									
Daphnia (Daphnia) retrocurva		3.79	0.78			1.55	0.19			
Eurycercus lamellatus						0.26				
Holopedium glacialis	0.29	1.00	0.99	0.31	3.80	0.26		1.16		0.24
Leptodora kindtii					0.63					
Polyphemus pediculus										
Sida crystallina							0.56			
Eubosmina (Eubosmina) longispina	1.33	0.40								
Diaphanosoma birgei	0.88	2.59	0.99	0.47		1.24	0.93	0.44	4.85	0.49
Daphnia sp.	0.44									
Bosmina (Bosmina) freyi	2.36	39.46	3.53	1.33	8.35	18.82	21.82	8.97	1.36	18.44
Bosmina (Bosmina) liederi										
Leptodiaptomus ashlandi										
Leptodiaptomus minutus		1.00	0.20					0.44	0.97	1.23
Skistodiaptomus oregonensis	0.15	1.00	0.20	3.56				0.86	3.11	
Leptodiaptomus sicilis	2.62									
Leptodiaptomus siciloides		0.20								
Epischura lacustris				0.47		0.14			0.30	
Epischura lacustris copepodid	0.44	0.80	4.85	9.43		2.27	0.12	1.94	0.58	6.13
Diacyclops bicuspidatus thomasi	2.80	0.80	5.30	2.66	0.63	1.34	4.32	1.16	17.15	1.43
Acanthocyclops vernalis complex					0.13					
Euscyclops agilis										
Mesocyclops edax	1.33									
Tropocyclops extensus			0.20		0.32					
Eubosmina sp.		1.00	0.20							
Calanoid copepodid (Immature)	17.65	0.60	2.16	0.39	0.63			0.86	0.58	3.48
Calanoid nauplius	16.92	1.75	15.00	41.39	0.63	18.13	0.99	21.69	8.14	13.30
Cyclopoid copepodid (Immature)	11.47	13.15	14.11	7.52	45.63	23.96	16.68	3.99	29.66	1.43
Cyclopoid nauplius	3.98	32.88	32.96	7.52	26.59	28.27	51.87	31.65	32.55	25.36
Harpacticoida nauplius										

Appendix 3 cont.

				2012						
Species	**Symons**	**ROF-064**	**ROF-063**	**ROF-061**	**ROF-037**	**ROF-056**	**ROF-041**	**ROF-050**	**McFauld's**	**Duego**
Alona sp.				0.23						
Ceriodaphnia sp.						0.12	0.63			
Chydorus sphaericus	0.44	19.40	2.93	43.76	5.78	11.12	0.38	0.63	8.67	2.13
Daphnia (Daphnia) catawba	1.56		0.77					11.26		
Daphnia (Hyalodaphnia) mendotae		27.87	49.33	0.60		0.93		1.93	0.74	
Daphnia (Hyalodaphnia) longiremis										
Daphnia (Daphnia) pulicaria										
Daphnia (Daphnia) retrocurva										
Eurycercus lamellatus										
Holopedium glacialis	0.44	0.17		0.63	0.95	0.23	0.13	0.63	0.26	13.98
Leptodora kindtii			0.39	0.23						
Polyphemus pediculus										
Sida crystallina										
Eubosmina (Eubosmina) longispina							0.56			0.33
Diaphanosoma birgei	0.24	0.52					0.13	0.16		2.13
Daphnia sp.										
Bosmina (Bosmina) freyi	2.50	2.68	0.85	38.57	18.62	14.34	82.27	4.33	0.45	3.90
Bosmina (Bosmina) liederi				0.23			0.85			
Leptodiaptomus ashlandi										
Leptodiaptomus minutus	1.68	6.70	1.23	0.39	0.53	0.58	0.38	0.63	0.22	2.94
Skistodiaptomus oregonensis						0.35				
Leptodiaptomus sicilis										
Leptodiaptomus siciloides										
Epischura lacustris								0.53		
Epischura lacustris copepodid	0.16		1.54	0.23	0.84	2.89	0.11	11.42	0.78	2.29
Diacyclops bicuspidatus thomasi		0.67	2.31	0.23		0.69				
Acanthocyclops vernalis complex			0.77			0.12				
Euscyclops agilis								0.16		
Mesocyclops edax										
Tropocyclops extensus			0.15		1.74		0.45			0.16
Eubosmina sp.										
Calanoid copepodid (Immature)	5.19	9.11	0.39	1.83	0.16	3.35	0.22	0.85	1.38	4.42
Calanoid nauplius	86.19	5.69	19.75	5.29	48.49	4.86	0.13	49.49	11.76	16.68
Cyclopoid copepodid (Immature)	0.28	5.87	6.79	0.93	4.48	27.13	3.64	8.46	0.41	8.34
Cyclopoid nauplius	1.33	21.35	14.18	9.45	18.96	33.32	12.16	1.15	4.49	16.35
Harpacticoida nauplius							0.25			0.16

Appendix 4 – Locations of 11 streams Sampled in 2012 and 2013



Fruit Creek and stonefly

Appendix 5 - Results of chemistry analyses for streams sampled in 2012 and 2013.

Water Chemistry Parameter	Squirrel Creek	Fruit Creek	Lornjack Creek	Opikeigen River	Rond River	Old Bay Creek	Reserve Creek	Eabamet Tributary	Old Mine Creek	Pioneer Creek	Tidy Creek
Calcium-mg/L	25.9	14.3	13.8	13.8	13.7	36.9	41.1	17.0	28.4	21.6	9.2
Carbon; Dissolved Inorganic-mg/L	13.8	9.8	9.3	10.0	10.0	21.0	9.9	15.7	20.9	17.1	7.6
Carbon; Dissolved Organic-mg/L	16.7	19.2	16.5	11.8	12.2	20.0	15.1	22.2	21.0	15.4	23.0
Chloride-mg/L	0.202	0.170	0.127	0.245	0.264	0.083	0.176	0.191	0.443	0.110	0.060
Magnesium-mg/L	4.10	2.96	2.97	2.91	3.05	5.84	3.64	4.29	5.25	4.48	1.68
Potassium-mg/L	0.155	0.195	0.195	0.385	0.385	0.565	0.285	0.205	0.640	0.245	0.200
Alkalinity; Gran-mg/L $CaCO_3$	63.1	44.0	43.5	48.6	47.0	89.0	54.9	55.2	84.9	68.3	25.4
Alkalinity; Total Fixed Endpoint-mg/L $CaCO_3$	63.8	44.8	44.6	49.2	47.9	90.0	50.5	56.4	85.6	69.7	26.4
Silicon; Reactive Silicate-mg/L	1.96	1.88	1.08	0.92	0.88	2.44	1.10	2.48	2.64	2.08	1.04
Sodium-mg/L	0.475	0.490	0.485	0.490	0.485	0.565	0.580	1.130	0.540	0.630	0.310
Sulphate-mg/L	0.10	0.10	0.15	0.40	0.40	0.10	0.25	0.20	0.05	ND	ND
Ph; Other-none	7.76	7.56	7.59	7.69	7.77	7.64	7.73	7.27	7.48	7.23	6.71
Colour; True-TCU	96.6	124.0	88.6	48.2	51.0	115.0	74.6	109.0	98.0	97.2	176.0
Nitrogen: Ammonia+Ammonium-ug/L	14	26	32	24	18	36	22	6	28	18	26
Nitrogen: Nitrate+Nitrite-ug/L	10	18	6	4	2	18	4	6	16	ND	ND
Nitrogen: Total Kjeldahl-ug/L	423	508	494	343	343	528	448	500	489	473	598
Phosphorus; Total-ug/L	10.5	15.8	12.6	15.0	11.2	28.2	14.7	9.0	13.7	25.0	35.4
Aluminum-ug/L	14.6	22.9	14.3	13.0	12.8	53.9	15.3	11.3	12.6	20.6	55.1
Antimony-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic-ug/L	0.7	0.7	1.3	0.5	0.6	1.4	1.2	0.7	0.9	1.1	0.6
Barium-ug/L	4.8	4.3	4.2	6.2	6.1	8.7	4.0	5.3	6.7	5.1	5.1
Beryllium-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron-ug/L	4	3	4	3	3	5	3	3	3	2	1
Cadmium-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper-ug/L	0.3	0.3	0.3	0.3	0.4	0.5	0.3	ND	0.3	0.2	0.3
Iron-ug/L	170	240	100	40	30	340	80	140	180	180	410
Lead-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manganese-ug/L	33.2	28.6	29.6	15.3	20.0	59.8	15.0	41.8	118.0	23.7	56.1
Molybdenum-ug/L	ND	ND	ND	ND	ND	0.2	ND	ND	0.6	ND	ND
Nickel-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Strontium-ug/L	21.9	19.7	16.7	16.5	17.1	30.4	16.7	22.5	33.5	21.1	10.5
Thallium-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Titanium-ug/L	0.4	0.6	ND	ND	ND	2.3	0.8	ND	ND	0.7	0.8
Uranium-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium-ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc-ug/L	1.0	1.0	0.6	0.6	0.7	0.9	2.9	1.3	1.4	0.9	1.7
Conductivity; Other-uS/cm	129.0	91.2	89.0	96.0	96.0	179.0	96.8	116.0	171.0	134.0	56.4

Appendix 6 – Summary of habitat characteristics at stream sampling sites, 2012 and 2013

	Squirrel Creek	Fruit Creek	Lornjack Creek	Opikeigen River	Rond River	Old Bay Creek	Reserve Creek	Eabamet Tributary	Old Mine Creek	Pioneer Creek	Tidy Creek
Latitude	51.499	51.434	51.578	51.641	51.624	51.554	51.541	51.554	51.619	51.590	51.644
Longitude	87.658	87.683	87.914	88.041	88.022	87.983	87.837	87.858	88.027	87.791	87.795
Altitude (m)	253	246	261	251	259	258	262	262	258	268	290
Depth-Avg (cm)	19	13	23	49	18	58	73	9	61	22	21
Depth-Max (cm)	40	32	48	66	28	76	106	14	88	50	36
Velocity-Avg (m/s)	0.18	0.23	0.13	0.44	0.24	0.01	0.10	0.11	0.00	0.40	0.20
Velocity-Max (m/s)	0.51	0.52	0.62	0.68	0.33	0.03	0.15	0.37	0.01	0.99	0.57
Width-Bankfull (m)	6.5	12.5	22.0	40.0	60.0	13.0	25.0	5.0	20.0	15.5	8.9
Width-Wetted (m)	5.8	12.5	18.0	35.0	57.0	11.0	13.0	2.1	8.0	9.3	7.4
Macrophyte (PercentRange)[1]	0	2	2	1	1	1	3	0	4	1	1
%CanopyCoverage (PercentRange)[1]	3	1	1	0	0	0	0	4	0	1	1
Pools (Binary)[2]	0	0	0	0	0	0	0	0	0	0	0
Rapids (Binary)[2]	1	0	0	0	0	0	0	0	0	0	0
Riffles (Binary)[2]	0	1	1	1	1	0	0	1	0	1	1
StraightRun (Binary)[2]	0	0	0	0	0	1	1	1	1	0	0
Veg-Coniferous (Binary)[2]	1	1	1	1	0	0	0	0	1	1	1
Veg-Deciduous (Binary)[2]	1	0	1	0	1	1	0	0	0	1	1
Veg-GrassesFerns (Binary)[2]	0	0	0	1	0	0	1	0	0	0	0
Veg-Shrubs (Binary)[2]	1	1	1	0	1	1	1	1	1	1	1
1stDominantSubstrate- (Category(0-9))[3]	8	8	6	6	7	2	2	4	0	8	8
2ndDominantSubstrate- (Category(0-9))[3]	7	7	4	4	8	1	1	5	1	7	7
SurroundingMaterial (Category(0-9))[3]	6	6	8	8	5	0	3	3	1	4	4
SubstrateEmbeddedness (Category(1-5))[4]	3	3	2	2	3	1	1	3	1	3	4

1 Percent Range - 0=0% 1=1-25% 2=26-50% 3= 51-75% 4=76-100%

2. Binary - 0=absent, 1=present

3. Category(0-9) - 0=Organic, 1=Silt, 2=Sand, 3=Gravel, 4=Small pebble, 5=Large pebble, 6=Small cobble, 7=Large cobble, 8=Boulder

4. Category (1-5) - 1=Completely embeded, 2=3/4 embeded, 3=1/2 emebeded, 4=1/4 embeded, 5=unembeded

Appendix 7 - Bottom dwelling invertebrates found (3-min kick) in streams sampled in 2012 & 2013.

Common name	Family	Squirrel Creek	Fruit Creek	Lornjack Creek	Opikeigen River	Rond River	Old Bay Creek	Reserve Creek	Eabamet Tributary	Old Mine Creek	Pioneer Creek	Tidy Creek
Stonefly	Capniidae		10									
	Leuctridae	50	20									10
	Nemouridae								38			10
	Perlidae	10	10	44	13							10
	Pteronarcyidae		20									
Caddisfly	Apataniidae					8						
	Glossosomatidae	40	40		13							
	Hydropsychidae	14	200	122	175	558		40		9	367	120
	Hydroptilidae	8	60				4	40	50	18	20	50
	Lepidostomatidae	28	10	11	25							30
	Leptoceridae	8	10	33	38	17					27	30
	Limnephilidae				25				75	9		10
	Molannidae				13							
	Philopotamidae	18	280									
	Phryganeidae			11		8	4		13			20
	Polycentropodidae		10			367	9			9		10
	Psychomyiidae										20	
	Rhyacophilidae		10									
Mayfly	Baetidae	56	340	322	325	283	230	40	175		227	140
	Caenidae	2	10		13	50				9	113	
	Ephemerellidae	20	60	11	88	8	4	20		9	27	330
	Heptageniidae	8	50	33	25	58					167	220
	Leptohyphidae	2	10	11	88	8						
	Leptophlebiidae	4	10			8	9		25		47	30
	Siphlonuridae									73		
	Ephemeridae							20				
Dragonfly	Aeshnidae						9	40	13		13	
	Cordulegastridae							20				
	Corduliidae		10					60			13	
	Gomphidae	6	50		25						20	60
Beetle	Dytiscidae						30		25	164		
	Elmidae	8	30	22	25			20			67	
	Gyrinidae			22			4	40				
	Haliplidae						17			45		
True bug	Corixidae						65	20		36		
	Notonectidae						4					
	Veliidae	38	30					20				
	Noctuidae	4										
True fly	Ceratopogonidae						52	20	225	73	33	20
	Chironomidae	198	700	556	1325	433	696	1200	1213	2700	207	180
	Empididae	2	10	22							7	120
	Muscidae	4										
	Sciomyzidae						4					
	Simuliidae		220	244	113	417		4300	1500		187	680
	Tipulidae	4										
	Tachinidae				25							
Mite	Hydrozetidae	2	10					20	13			10
	Arrenuridae	2					9			18		
	Hygrobatidae	8	40		50	17			100	18	7	10
	Lebertiidae						4		38		7	
	Limnesiidae						4			18		10
	Mideopsidae					17		40				
	Oxidae								25			
	Pionidae						4					
	Sperchontidae	10							238		13	
	Unionicolidae						13					
Hydra	Hydridae				75							
Scud	Hyalellidae	4			25	17	30	680		9	87	
Damselfly	Coenagrionidae						4					20
Snail	Ancylidae							20			27	10
	Lymnaeidae				13	17	35					
	Physidae				250	25	17				7	
	Planorbidae	42	50		125	8		200		227	7	
	Valvatidae							80	63		7	
	Hydrobiidae										140	
Worm	Enchytraeidae	2		11					150			20
	Naididae	4	10	67	125	25	9	40	25	318	7	90
	Lumbriculidae			33			9	40		73		30
Clam	Pisidiidae	52	1060	2256	1025	175	22	100	25	145	527	980
Leech	Erpobdellidae										27	
	Glossiphoniidae									136		