Limnological Survey of Three New Brunswick Lakes: Louis Lake, Burk Lake and an Unnamed Lake

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Summary

As part of a study to determine the suitability of three lakes, located within the Miramichi drainage in Northumberland County, New Brunswick, to support healthy and productive cold-water fish populations, a limnological survey of each lake was carried out on August 18 and 19, 2008. A secondary objective of the surveys was to collect information required to evaluate the status of the lakes with respect to their general health. The limnological parameters measured included depth profiles of water temperature, conductivity, dissolved oxygen, chlorophyll *a* concentration, pH, and micronutrient concentrations. Samples for analysis of zooplankton composition were also collected.

The results of the survey indicate that two of the lakes, Louis and Burk, were thermally stratified and contained areas of suitable summer cold water refugia located within the thermocline. The third lake surveyed, Unnamed Lake, was not thermally stratified due to its shallowness (less than two metres depth), and did not contain any cold water habitat making it unlikely to support a productive salmonid population during the summer months.

A general assessment of the health of each lake revealed all to be moderately productive with pH and alkalinity values that indicate none of the lakes to have been impacted by acid precipitation.

Further evaluation of the lakes related to their potential to support productive salmonid populations should include determining if additional cold water habitats exist resulting from cold groundwater inputs entering the bottom of each lake, or from groundwater-fed streams entering along the lake shorelines. In addition, studies should be conducted to determine the extent and suitability of spawning areas associated with each lake.

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1. Introduction

On August 18 and 19, 2008, Mike Brylinsky of Acadia University and Bill Hooper of Doaktown, N.B. carried out limnological surveys of three lakes located in northern New Brunswick. Emphasis was placed on determining the availability and suitability of cold-water salmonid* habitat during the warmer summer months, the most important limiting factor for salmonid populations, and collection of additional information to assess the general health of each lake.

The three lakes surveyed included Louis Lake, Burk Lake and an Unnamed Lake (Figure 1.1). A forth lake, First Lake, was also originally intended for survey, however, the trail to this lake was overgrown, and we were not able to transport the watercraft required for the survey to the lake shore.

No attempt was made to survey the fish species present or the availability of spawning habitat during these surveys. This will be the subject of further study, once the appropriate collection permits have been obtained, during mid-October 2008.

2. Lake Morphology

The general morphological characteristics of each lake were derived from previously published bathymetric maps (see Appendix I) and are listed in Table 2.1.

Louis Lake is the largest of the three lakes surveyed in terms of surface area, volume, mean depth and maximum depth. However, its drainage basin area is the smallest and, as a result, its flushing time** is longest. Unnamed Lake is very shallow and has a very small volume. This, together with its relatively large drainage basin area, results in a very high flushing rate of 40 times per year.

Examination of the bathymetric map and the relationship between percent lake volume and lake depth of each lake (Fig. 2.1) indicates Louis Lake to be steep-sided and saucer shaped with a gradual increase in lake volume with depth. In contrast, Burk Lake, although also steep-sided, tends to be more funnel shaped. Of the two, Louis Lake contains a greater percentage of its volume within deeper water depths.

Although we did not carry out an extensive survey of the inflows and outflows of the lakes, we did observe that Louis Lake had two areas along its northern shoreline where

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* Salmonid fish species include book, brown, and rainbow trout, arctic charr and all species of salmon.

** A lake's flushing time is the time it takes for all of the water it contains to be replaced by an equal volume of input water. Flushing rate is the number of times its volume is replaced each year by water entering the lake.

water was flowing into the lake. Based on temperature measurements of the inflowing water, it appeared that these flows originated as surface runoff as opposed to groundwater flow.

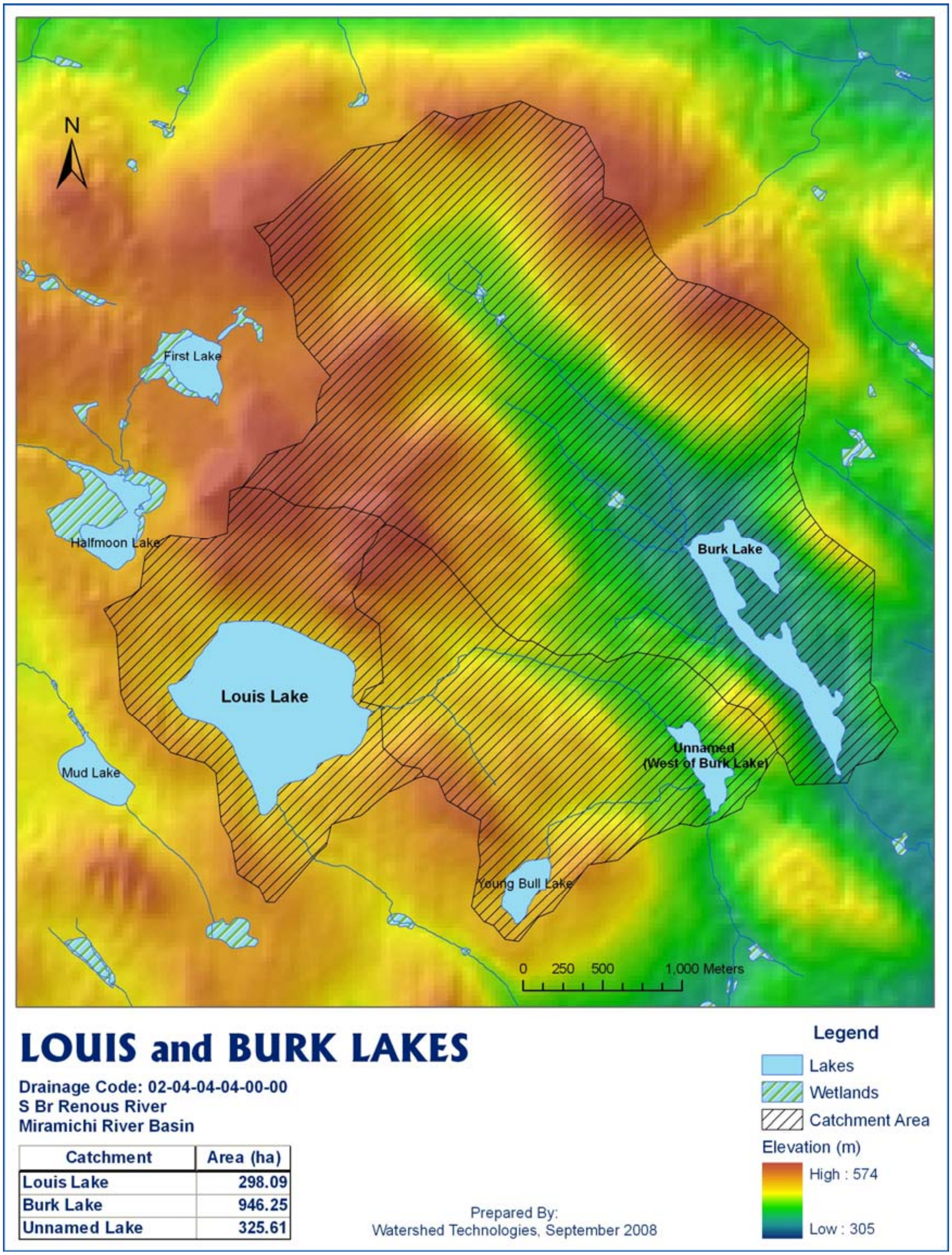

Figure 1.1 Map showing the location of each lake and its associated drainage basin.

We also observed a single outlet along the eastern shoreline which had a relatively large flow of water (Fig.2.2). The lack of any significant surface flows into the lake, together with the relatively large outflow, suggests that the main source of water input to Louis Lake is groundwater flow, which tends to be much colder that surface flow and would contribute to maintaining the cold water habitat necessary for salmonids.

Table 2.1 Morphological parameters of each lake.

Parameter	Louis Lake	Burke Lake	Unnamed Lake
Drainage Basin Area (ha)	298.1	946.3	325.6
Surface Area (ha)	88.3	36.5	9.1
Volume (m^3)	4,963,118	1,181,867	89,000
Maximun Depth (m)	11.3	10.1	1.7
Mean Depth (m)	5.9	3.2	1.0
Flushing Time (years)*	1.51	0.11	0.3
Flushing Rate (times/year)*	0.7	8.8	40

*Calculated assuming an average annual precipitation of 1100 cm.

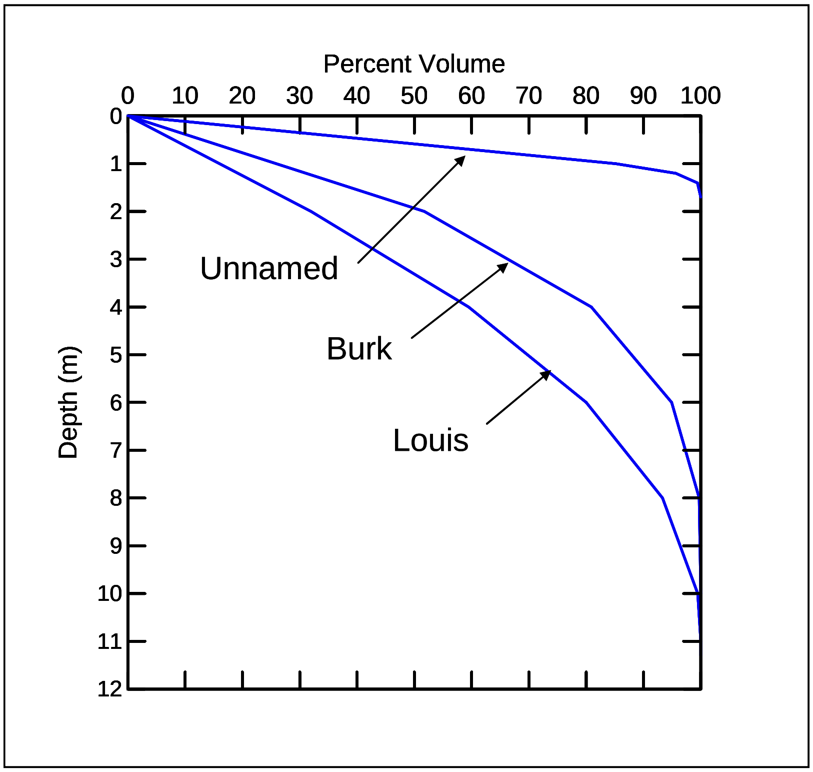

Fig. 2.1 Depth-volume curves for each lake surveyed.

Figure 2.2. Outflow along eastern shoreline of Louis Lake.

3. Survey Methodologies

The general approach used in the survey was to obtain depth profiles of the major limnological parameters at a site located at the deepest part of each lake. Temperature and dissolved oxygen concentration were measured at one meter depth intervals. All other parameters were measured at the surface, within the thermocline and within the hypolimnion in those cases where the lake had a thermally stratified water column. The parameters measured and the general techniques employed are listed in Table 3.1.

Table 3.1 Summary of survey methodologies.	
Parameter	**Methodology**
Water Temperature	YSI-SCT meter and YSI Data Logger
Dissolved Oxygen	YSI Model 55 DO Meter and Winkler Titration
Secchi Disk Depth	Depth of disappearance and reappearance
Color	Pt-Co Color Comparator
Turbidity	HACH Turbidimeter
Conductivity	YSI-SCT meter
pH	Accumet Model 910 pH Meter
Alkalinity	Sulfuric acid titration
Nutrients	Technitron nutrient analyzer
Phytoplankton Biomass	Acetone extraction
Zooplankton Numbers	Zooplankton net

Temperature: Water temperature depth profiles were measured at each station using a Yellow Springs Instruments Model 30 Salinity-Conductivity-Temperature Meter.

Dissolved Oxygen: Dissolved oxygen depth profiles were measured at one meter depth intervals at each station using a YSI Model 55 dissolved oxygen meter. In addition, water samples were collected at the surface, within the thermocline and within the hypolimnion where there was indication that the lake was thermally stratified. Water samples for dissolved oxygen measurements were also collected from the middle of the epi-, meta- and hypolimnion with a Van-Dorn water sampler, and transferred into 300 ml BOD bottles and fixed in the field. Analysis of dissolved oxygen for these samples was carried out using the Winkler procedure (American Public Health Association 1989). These measurements were used to calibrate the YSI Dissolved Oxygen meter.

Secchi Depth: Secchi depth was measured using a 20 cm diameter Secchi disk which was lowered into the water until it was no longer visible and then raised until it became visible. The average of the depth at which it disappeared and the depth of its reappearance was recorded as the Secchi depth.

Color: Color was measured using the platinum-cobalt standard procedure as described in the Environment Canada Analytical Methods Manual (1979) using water filtered through Watman GF/C filters.

Turbidity: Turbidity was measured using a Model 2100 HACH Turbidimeter.

Conductivity: Depth profiles of conductivity were recorded at each station using a Yellow Springs Instruments Model 30 Salinity-Conductivity-Temperature Meter.

pH pH measurements were made using an Accumet Model 910 pH meter.

Alkalinity: Alkalinity was measured using the sulfuric acid titration procedure as described in the HACH (1995) procedures manual.

Nutrients: Analyses of water samples for total phosphorous, phosphate, total nitrogen and inorganic nitrogen were carried out by the water quality laboratory of the K.C. Irving Environmental Science Centre at Acadia University using a Technitron automated nutrient analyzer.

Phytoplankton Biomass: Phytoplankton biomass was measured indirectly by determination of chlorophyll *a* concentration. Water samples were collected in 1-liter polyethylene containers and filtered the same day as collection through Watman GF/C filters under gentle vacuum (<20 mm Hg). The filters were placed into 20 ml of 95 percent acetone and stored refrigerated and in the in the dark until analysis. Analysis for chlorophyll *a* was carried out by centrifuging each sample at 2500 rpm for 5 min, decanting into a 5 cm pathlength cuvette and measuring absorption of the sample spectrophotometrically at 665 and 750 nanometers before and after acidification with 0.1 ml of 10 percent HCl. Chlorophyll *a* concentration was calculated according to the equations presented in Wetzel and Likens (1990).

Zooplankton: Zooplankton samples were collected by pouring 25 liters of water through a 200 μm plankton net. Samples were stored preserved in 10% formalin until analysis. Zooplankton were identified in the laboratory using a stereo microscope.

4. Results

4.1 Temperature, Dissolved Oxygen and Percent Dissolved Oxygen Saturation

A major habitat requirement of cold water fish species is the presence of summer refugia having cold water and adequate dissolved oxygen. Although brook trout and charr can withstand water temperatures as high as 24-27 ^{o}C for short periods, they prefer temperatures in the range of 12-14 ^{o}C and tend to avoid waters warmer than 20 ^{o}C (Elliot 1981). Both brook trout and arctic charr are seldom found in waters having dissolved oxygen levels less than 5.0 mg/l (Lagler 1956; Bennett 1970; Karr 2003), which at 20 ^{o}C is equal to about 50% dissolved oxygen saturation.

The critical period for trout and charr with respect to the availability of cold water refugia is during the late summer when water temperatures are highest and dissolved oxygen concentrations are lowest, which is when the lake surveys were carried out. Figure 4.1 illustrates the depth profiles of temperature, dissolved oxygen and percent dissolved oxygen saturation for Louis and Burk Lake. Both lakes exhibited typical summer water column stratification with warm surface waters (the epilimnion) and cold bottom waters (the hypolimnion) separated by waters having a strong temperature gradient (the thermocline)*.

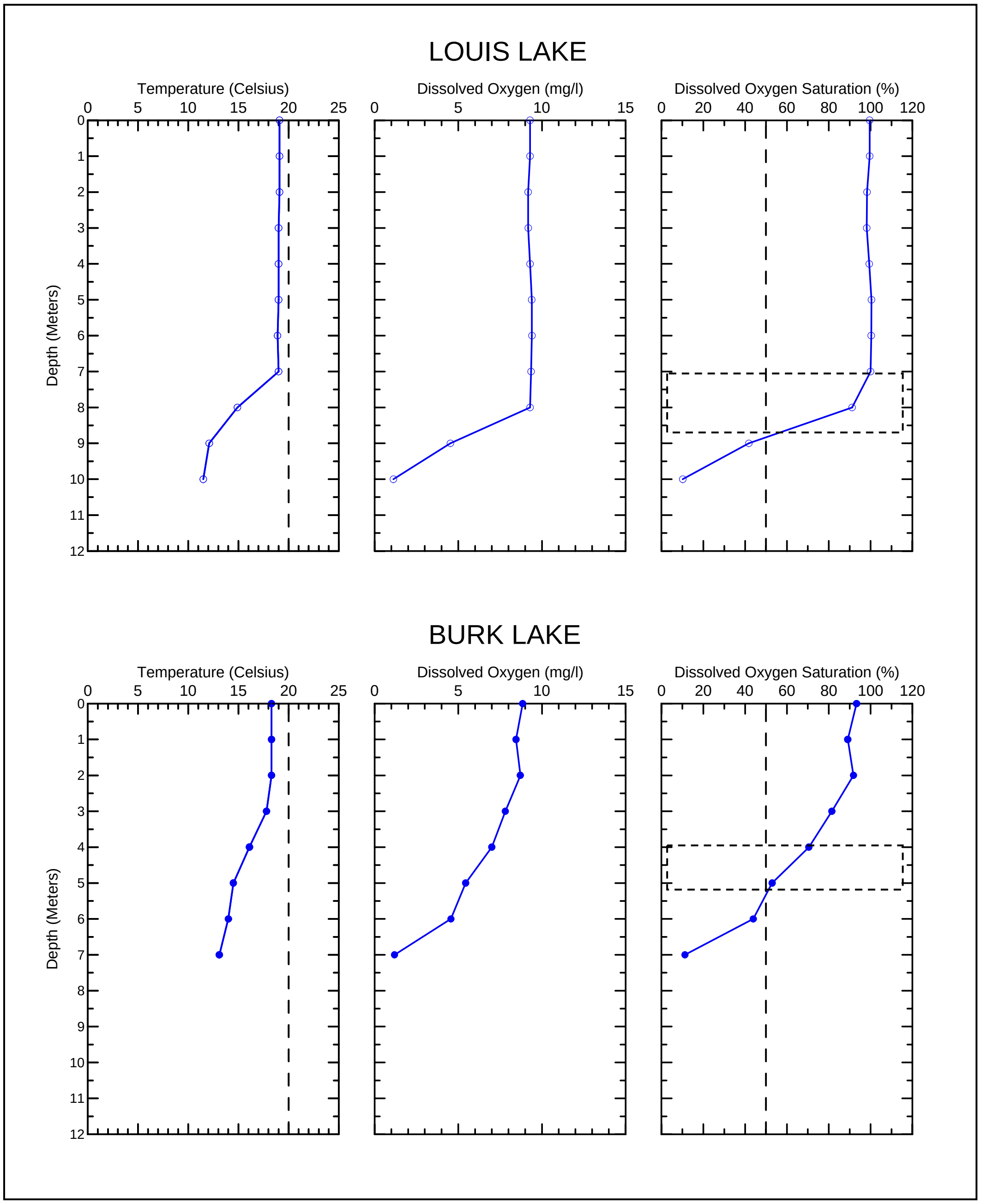

Figure 4.1 Depth profiles of temperature, dissolved oxygen and percent dissolved oxygen saturation for Louis and Burk Lake (the vertical dashed lines indicate the upper temperature and lower percent dissolved oxygen saturation limits for cold water fish species; dashed boxes indicate the depths containing suitable cold water summer refugia).

* We were unable to adequately sample the deeper hypolimnetic water (i.e., depths greater than 7 m) within Burke Lake because it occupies a very small area which proved difficult to precisely locate.

The epilimnion of Louis Lake was quite deep, extending to a depth of 7 metres, and had a temperature of about 19 °C, which is above the optimal range for salmonids, but still below the upper stressful limit of 20 °C. Dissolved oxygen levels within the epilimnion were quite high at 100% saturation. The thermocline extended from 7m to 9m depth and exhibited a decrease in temperature from 19 to 12 °C. This area also exhibited a decrease in dissolved oxygen with depth, but this decrease never resulted in dissolved oxygen saturation values becoming less that 50%, the lower limit for suitable cold water habitat. Below the thermocline within the hypolimnion, water temperatures reached a low of 11.5 °C and dissolved oxygen saturation values decreased to a low of 10%. Based on these observations, suitable summer cold water refugia within Louis Lake existed between about seven and nine metres depth.

Burk Lake exhibited much weaker thermal stratification than Louis Lake. The epilimnion was much shallower extending to a depth of only two meters, and the thermocline was much more extensive showing a gradual decrease in temperature from about 18.5 °C at two metres to 15 °C at seven metres. Dissolved oxygen levels also decreased with depth within the thermocline and became reduced to the 50% saturation level at about five metres. As a result, suitable cold water habitat was present only between about four and five metres depth.

Because of its shallowness, Unnamed Lake did not exhibit any thermal stratification. Water temperatures were about 18 °C throughout the water column and there was no evidence of a cold water layer near the lake bottom. As a result, it is unlikely to contain suitable summer cold water refugia for cold water fish species.

4.2 Secchi Depth, Colour and Turbidity

Secchi depth, colour, turbidity and dissolved organic carbon are all water parameters related to water clarity and as such are important in determining the ability of photosynthetic organisms to produce organic matter, and thus the general level of productivity attainable in an aquatic system. A lake's euphotic zone[*] is typically determined as twice the Secchi Disk depth. Water colour is most influenced by size and nature of a lake's watershed. A large watershed area relative to the surface area of the lake, and watersheds dominated by coniferous vegetation result in high color and high dissolved organic matter as a result of the leaching of the organic compounds contained in coniferous vegetation within the watershed. Turbidity is a term applied to the level of suspended particles contained within a waterbody and high values are usually associated with unstable substrates within the watershed that are susceptible to erosion.

Louis Lake contains exceptionally clear water, a reflection of it being a headwater lake with a very small drainage area. It has very few surface water inputs and is thought to receive its water inputs largely from groundwater flows. Most of the lake's volume, to a depth of 9 m, contains sufficient light for photosynthesis.

[*] The euphotic zone is the portion of a waterbody that contains sufficient light for photosynthesis to be carried out.

Table 4.1 Water clarity parameters for each lake.

Parameter	Louis	Burke	Unnamed
Secchi Depth (m)	4.5	2.4	Bottom Visible
Colour (TCUs)			
Surface	5	30	10
Thermocline	5	30	-
Hypolimnion	5	30	-
Turbidity (NTUs)			
Surface	1.31	0.84	0.85
Thermocline	1.43	1.76	-
Hypolimnion	1.61	1.86	-
Dissolved Organic Carbon (mg/L)			
Surface	2.8	8.6	4.7

Burke Lake is much more colored as a result of its much larger drainage area and the fact that it has numerous surface water inputs. Its Secchi depth is only half that of Louis Lake and the depth of its euphotic zone is only about 5 metres.

Unnamed Lake is intermediate between Louis and Burk Lakes. It is shallow and its euphotic zone extends to the bottom of the lake.

Turbidity levels are low in all of the lakes surveyed indicating that soils within the drainage basins are quite stable and not subject to excessive erosion.

4.3 Conductivity, Alkalinity and pH

Conductivity, alkalinity and pH are all related in that their values are dependent on the kinds and amounts of salt contained within a water body. Conductivity is a crude measure of salt content. In general, conductivity values of 0-100, 100-300, and greater than 300 represent, soft, moderate and hard waters, respectively. Higher salt contents typically result in higher alkalinities, a measure of 'buffering capacity', or the ability of water to resist changes in pH.

Because of the influence of acid precipitation, many water bodies within the Atlantic Maritimes having low salt contents have pH values as low as 4.0 which are stressful for many fish species. Table 4.2 lists the conductivity, alkalinity and pH values for the three lakes surveyed. Although the conductivity values for all of the lakes are quite low, their alkalinity and pH values are quite good and indicate that these lakes have not suffered the consequences of acid precipitation.

Table 4.2 Chemical parameters for each lake.

Parameter	Louis	Burke	Unnamed
Conductivity (µSi/cm)			
Surface	17.7	23.6	20.9
Thermocline	20.4	28.4	-
Hypolimnion	24.5	39.1	-
Alkalinity (mg/L)			
Surface	2.4	8.1	7.0
Thermocline	7.7	8.4	-
Hypolimnion	8.0	10.0	-
pH			
Surface	6.5	6.0	6.6
Thermocline	6.7	6.1	-
Hypolimnion	6.9	6.1	-

4.4 Micronutrients

The micronutrients most important in controlling the productivity of aquatic ecosystems are phosphorus and nitrogen. Of the two, phosphorous is the most important limiting nutrient in freshwater ecosystems. Surface water total phosphorus concentrations are relatively high in all of the lakes (Table 4.3). In contrast, both total and inorganic nitrogen are relatively low. All micronutrients generally exhibited an increase in concentration with depth, a reflection of the settling of nutrients from surface waters during the period of summer stratification. The levels of total phosphorus are indicative of moderately productive lakes. Further discussion of micronutrients and the productivity of each lake are contained in Section 4.6.

4.5 Zooplankton Composition

There was little difference in zooplankton composition among the three lakes surveyed. The zooplankton community was dominated by cladocerans, mostly of the species *Holopedium gibberum* (Fig. 4.2), followed by numerous species of calanoid copepods. There were very few rotifers present. The lack of rotifers and abundance of cladocerans is further evidence that the lakes surveyed are relatively productive.

Table 4.3 Micronutrient concentrations for each lake.			
Parameter	**Louis**	**Burke**	**Unnamed**
Total phosphorus (mg/L)			
Surface	0.013	0.022	0.024
Thermocline	0.018	0.024	-
Hypolimnion	0.020	0.025	-
Total nitrogen (mg/L)			
Surface	0.023	0.218	0.150
Thermocline	0.093	0.201	-
Hypolimnion	0.104	0.213	-
Nitrite + Nitrate (mg/L)			
Surface	0.004	0.017	0.013
Thermocline	0.010	0.032	-
Hypolimnion	0.012	0.032	-
Ammonia (mg/L)			
Surface	0.013	0.026	0.014
Thermocline	0.012	0.028	-
Hypolimnion	0.023	0.062	-

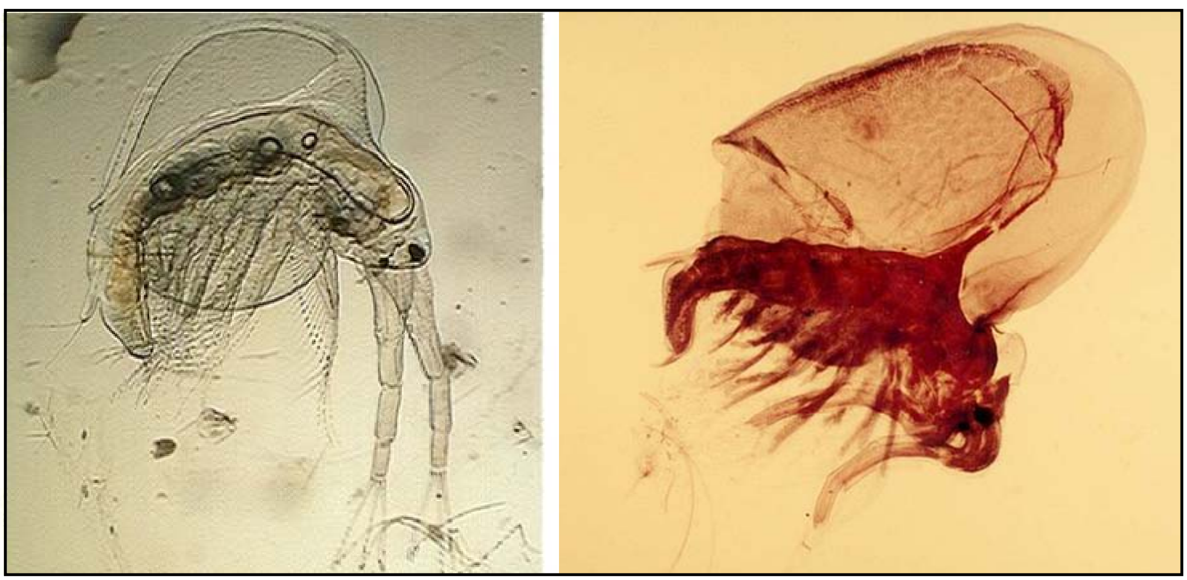

Fig. 4.2 Two pictures of *Holopedium gibberum*, a cladoceran zooplankton that dominated the zooplankton community of all of the lakes surveyed.

4.6 Trophic Status

A lake's trophic status is a general measure of its productivity. The terms '*oligotrophic*', '*mesotrophic*' and '*eutrophic*' literally mean '*little feeding*', '*moderate feeding*', and '*much feeding*', respectively. The criteria typically used to assess a lake's trophic status are listed in Table 4.4. The most important causal factor responsible for determining the trophic state of a lake is total phosphorus concentration, the nutrient that most often limits the level of lake productivity. An increase in phosphorus levels leads to an increase in the growth of algae and a corresponding decrease in water clarity. The two response variables are phytoplankton chlorophyll *a* (a measure of algal biomass), and Secchi Depth, a measure of water clarity.

Table 4.4. Trophic status criteria for temperate zone lakes (based on OECD 1985).

Parameter	Oligotrophic (Good)	Mesotrophic (Moderate)	Eutrophic (Poor)
Total Phosphorus (mg/l)	<0.010	≥0.010 – <0.020	≥0.020
Chlorophyll *a* (μg/l)	<3.5	≥3.5 - <5.0	≥5.0
Secchi Depth (meters)	>5	≥3 – ≤5	<3

Oligotrophic lakes are relatively pristine and are characterized by low phosphorus concentrations, low algal biomass (i.e., low chlorophyll *a* concentrations), high water clarity and high levels of dissolved oxygen. In contrast, eutrophic lakes are characterized by high phosphorus levels, high algal biomass, low water clarity and low dissolved oxygen concentrations. In general, salmonid species, because of their need for high dissolved oxygen concentrations and adequate food resources, do best in lakes that are within the upper oligotrophic or low mesotrophic category. Low oligotrophic and eutrophic categories are generally poor for salmonids because of either their lack of productivity (oligotrophic lakes) or low dissolved oxygen concentrations within the deeper, colder waters (eutrophic lakes).

Table 4.5 lists the trophic status of each of the lakes surveyed. Of the three lakes surveyed, Louis Lake is the most suitable for salmonid species based on trophic status alone. Burke is also suitable, but is likely to have less adequate salmonid habitat during especially warm summer periods. The Unnamed Lake, which has the highest phosphorus and chlorophyll *a* concentrations, is unlikely to contain much suitable salmonid habitat.

Table 4.5 Evaluation of the trophic status of each lake.

Lake	Secchi Depth (m)	Chlorophyll *a* (ug/L)	Total Phosphorus (ug/L)	Trophic Status
Louis	4.5	5.0	0.013	Mid-mesotrophic
Burk	2.4	4.7	0.022	Mesotrophic
Unnamed	Bottom Visible	5.5	0.024	Low-eutrophic

5. Historical Comparison

There can be considerable year to year variation within a lake depending on annual variations in climatic conditions, especially air temperature and amount of precipitation. With respect to summer refugia for cold water fish species, of particular relevance are the temperature and dissolved oxygen depth profiles of a lake since these can vary considerably from year to year depending on the time when water column stratification first occurs, which in turn depends on the time of occurrence of warm, calm weather during early spring. In the case where a lake stratifies early in the spring, cold water is entrained within the hypolimnion and, since cold water contains more dissolved oxygen than warm water, the hypolimnion will contain a greater amount of cold oxygenated water than if stratification occurs later in the spring. This leads to much better conditions for ensuring that cold water habitat is available during the warmer summer months when it is most critical.

Unless a lake has been surveyed a number of times, it is difficult to determine what may be its ‘normal’ status with respect to stratification. Unfortunately, none of the lakes surveyed in this study have been extensively monitored in the past. The only historical data available is for surveys carried on Louis and Burk Lake during 15-16 July 1997 (Sabine 1997). However, it was considered worthwhile to compare the results of those surveys with those of the present survey with respect to temperature and dissolved oxygen depth profiles, the critical parameters for assessing cold water summer refugia.

Fig. 5.1 illustrates the temperature and dissolved oxygen depth profiles observed during each survey. In the case of Louis Lake, there is little difference in the temperature depth profiles. There is, however, considerable difference in the dissolved oxygen and percent dissolved oxygen saturation depth profiles. During 1997, there was considerably more dissolved oxygen present within the lower thermocline and hypolimnion and the area of summer cold water refugia was much larger than in 2008. This may be partially due to the earlier time of the 1997 survey (mid-July).

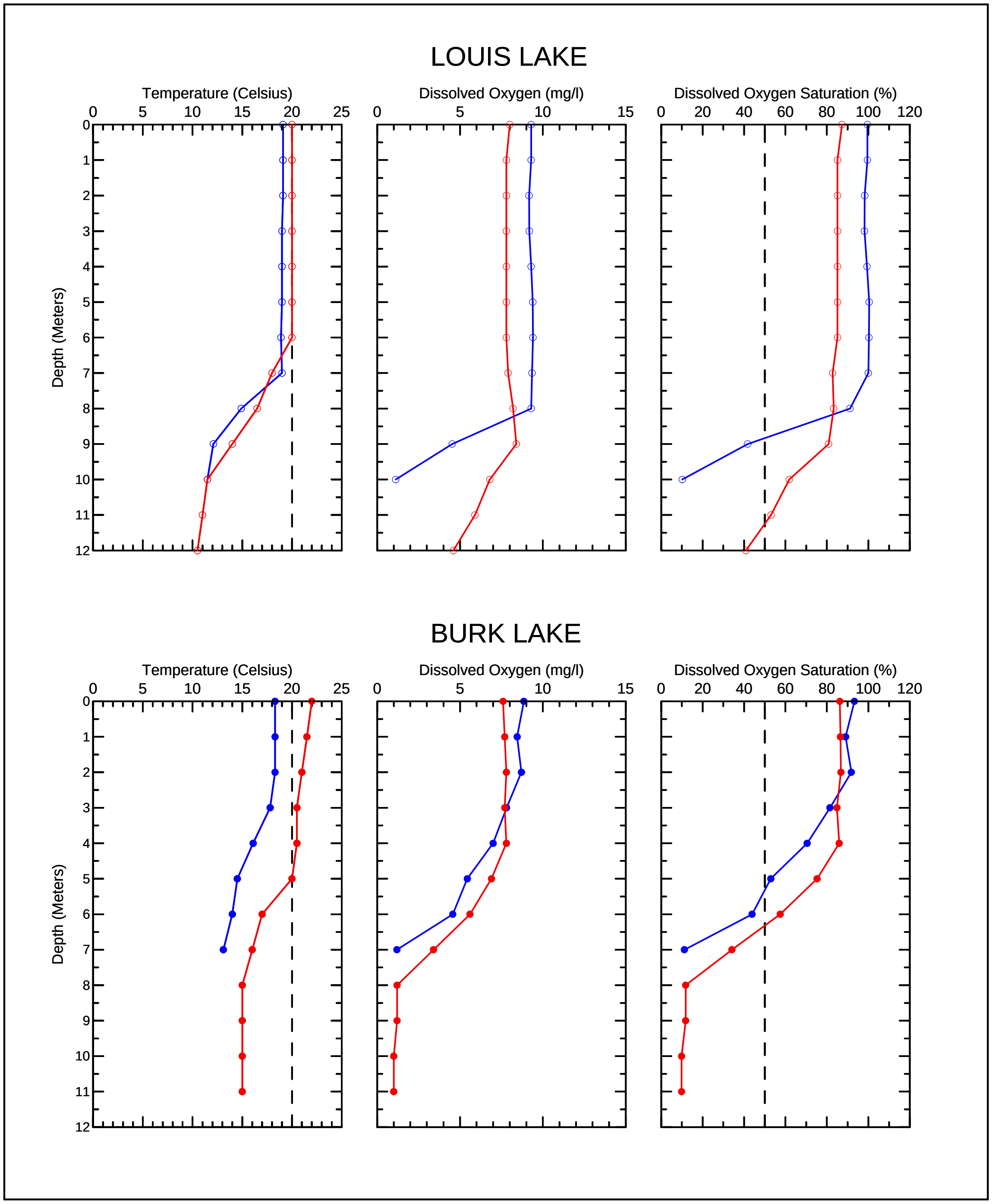

Figure 5.1 Depth profiles of temperature, dissolved oxygen and percent dissolved oxygen saturation for Louis Lake and Burk Lake during 15-16 July 1997 (red) and 18-19 August 2008 (blue). (The vertical dashed lines indicate the upper temperature and lower percent dissolved oxygen saturation limits for cold water fish species).

Burk Lake, in contrast, had warmer water throughout the water column and less dissolved oxygen within the thermocline during 1997, and, as a consequence, the area of summer cold water refugia was somewhat less than in 2008.

Further study is required to determine the degree to which cold water refugia during summer varies on an annual basis.

6. Discussion

The results of this survey indicate that both Louis and Burk Lake exhibit characteristics that make them suitable for maintaining healthy and productive stocks of salmonid fish populations. Both lakes exhibit thermal stratification and contain areas within the water column that have adequate cold water temperatures and dissolved oxygen concentrations necessary to provide the critical cold water summer refugia required for survival of cold water fish species during the warmer summer periods. The extent of this habitat is greater within Louis Lake than within Burk Lake. In contrast, Unnamed Lake, because of its shallowness and lack of thermal stratification, is unlikely to support a substantial population of cold water fish species during the warmer summer months. However, it may contain suitable habitat during the spring, fall and winter months.

Both Louis and Burk Lake are also moderately productive which ensures that they are likely to have sufficient food resources available. In addition, pH levels are quite high and there is no indication that any of the lakes surveyed have been impacted by acid precipitation.

It should be noted that no attempt was made to determine if cold water habitat is available within any of the streams entering Burk Lake. If cold, groundwater- fed streams do enter the lake, they may provide additional summer refugia for Burk Lake within the streams themselves or in areas of the lake where the streams enter. Further study should be carried out to evaluate these possibilities. In addition, no attempts were made to determine the extent of spawning habitat associated with each lake and this should also be the subject of further study.

The current fish populations of Louis and Burk Lakes are scheduled for assessment during October 2008. Past estimates of fish populations in these lakes and Unnamed Lake were carried out by Sabine (1997) and Dana (2003). Brook trout, arctic char and white suckers comprised most of the Louis Lake fish biomass. Four-spine stickleback, red belly dace and blacknose dace were also present. It should be noted that the presence of arctic charr in Louis Lake is quite unique considering that only three other lakes in New Brunswick are known to contain populations of arctic charr. Burk Lake contained brook trout, white suckers and creek chub, and Unnamed Lake contained brook trout and brook stickleback. In the 1997 study, numbers of brook trout in Louis Lake were estimated at 389 and numbers of arctic charr at less than 200. The 2002 study estimated 2,200 brook trout and 1,700 arctic charr. The substantial increase in both species was partially attributed to angling closures during previous years in attempts to increase trout and charr populations in Louis Lake.

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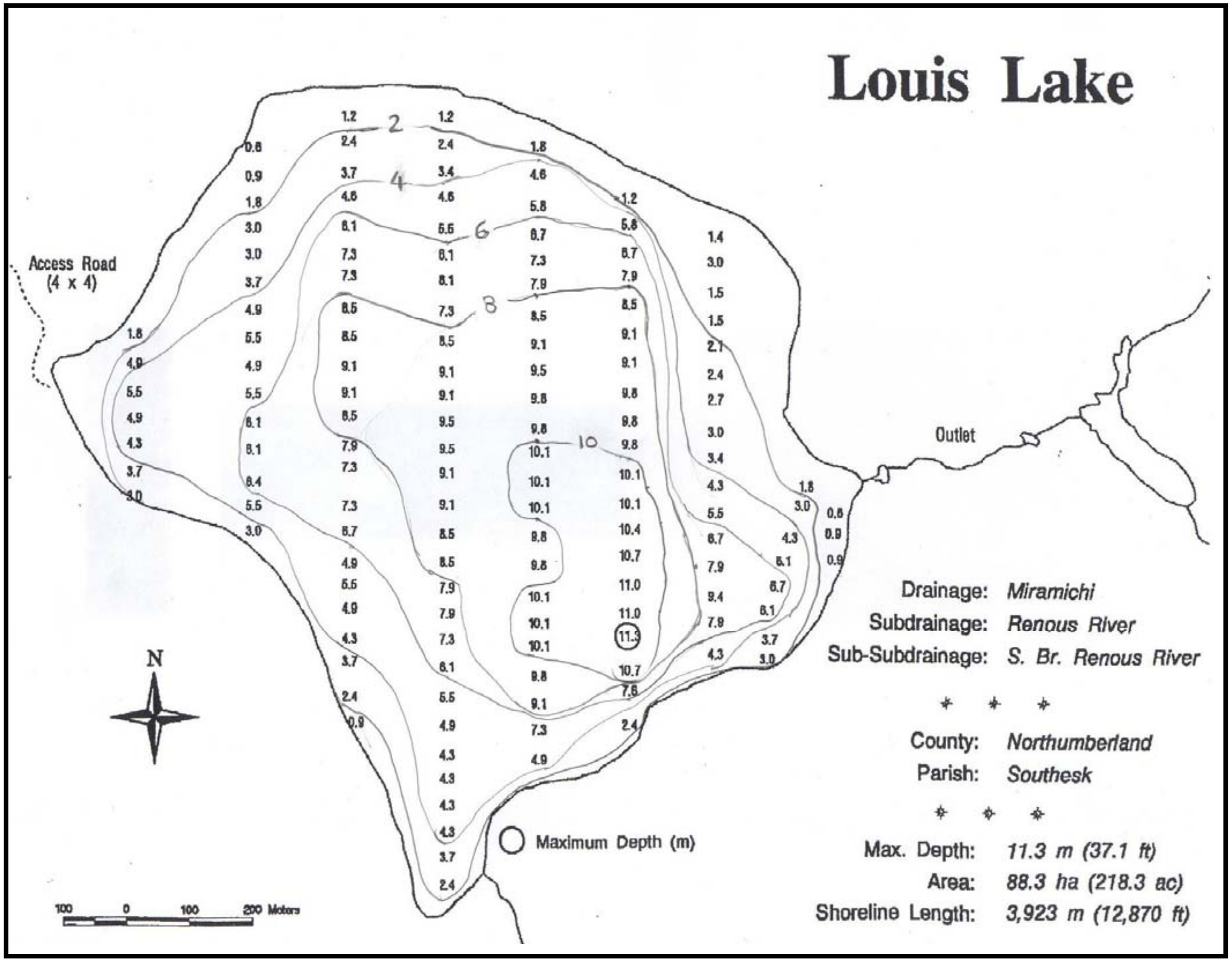
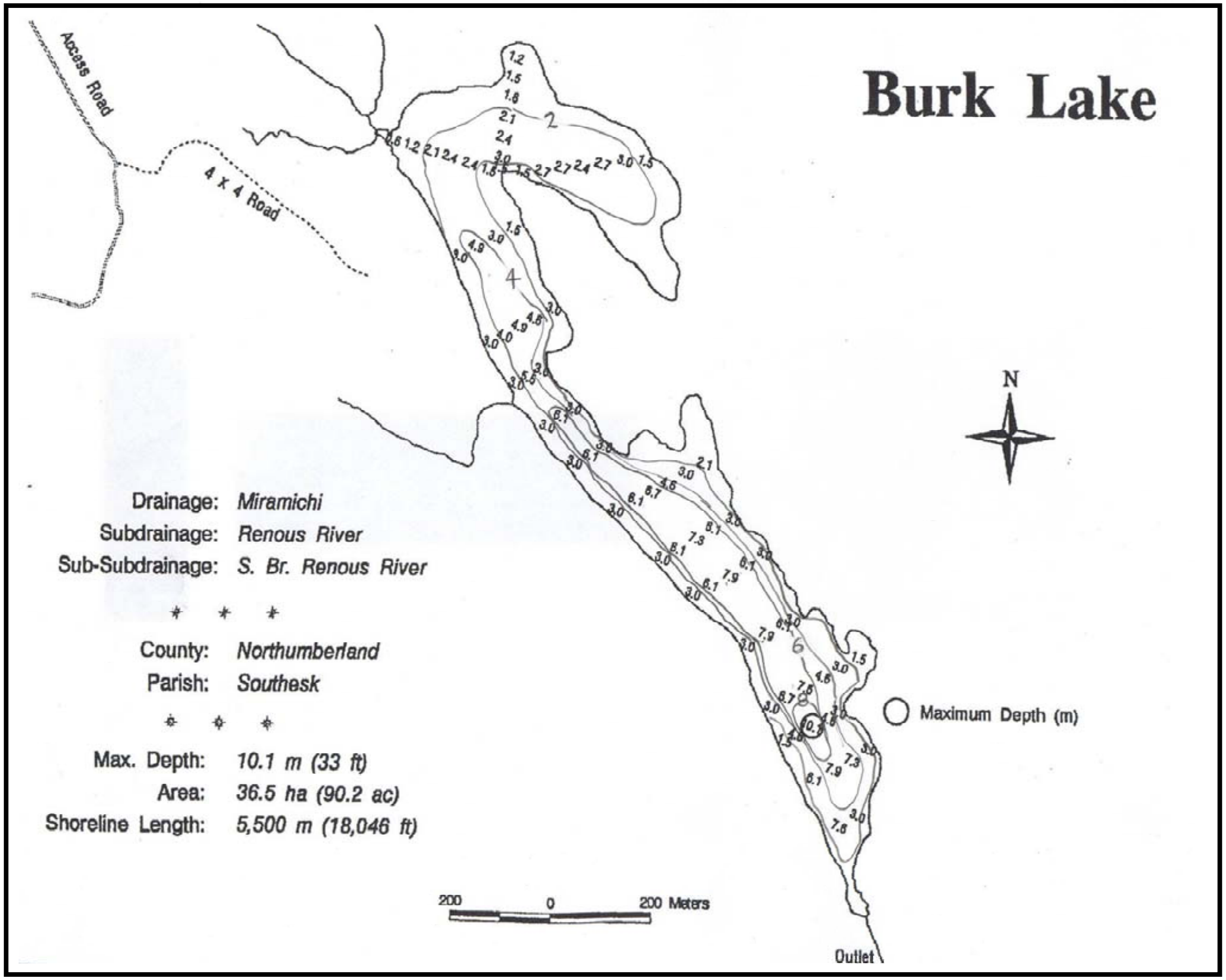
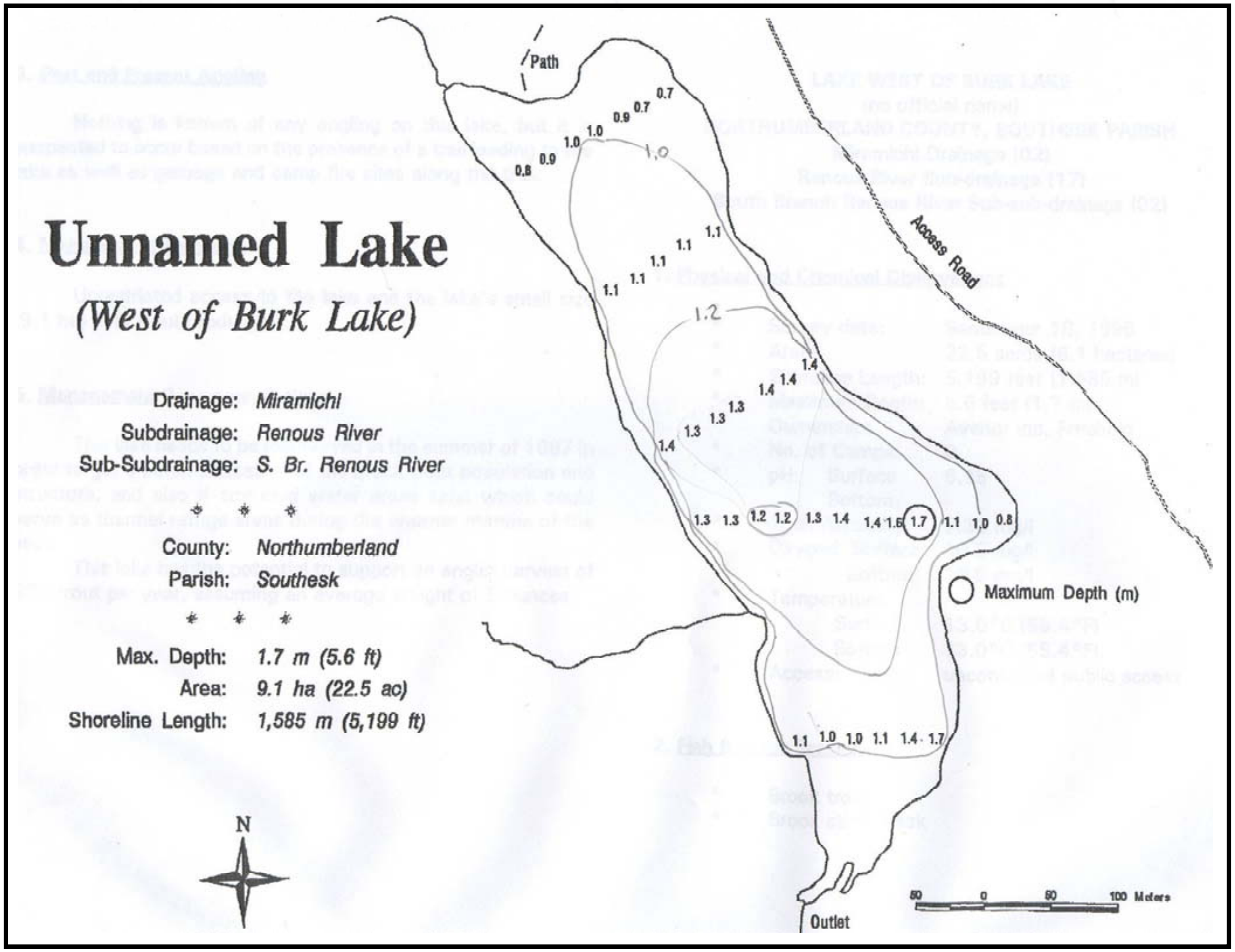
Appendix I

Bathymetric Maps


Louis Lake
Access Road
(4 x 4)
Outlet
N
100 0 100 200 Meters
Maximum Depth (m)
Drainage: Miramichi
Subdrainage: Renous River
Sub-Subdrainage: S. Br. Renous River
County: Northumberland
Parish: Southesk
Max. Depth: 11.3 m (37.1 ft)
Area: 88.3 ha (218.3 ac)
Shoreline Length: 3,923 m (12,870 ft)


Burk Lake
Access Road
4 x 4 Road
N
Maximum Depth (m)
Drainage: Miramichi
Subdrainage: Renous River
Sub-Subdrainage: S. Br. Renous River
County: Northumberland
Parish: Southesk
Max. Depth: 10.1 m (33 ft)
Area: 36.5 ha (90.2 ac)
Shoreline Length: 5,500 m (18,046 ft)
200 0 200 Meters
Outlet


Unnamed Lake
(West of Burk Lake)
Drainage: Miramichi
Subdrainage: Renous River
Sub-Subdrainage: S. Br. Renous River
County: Northumberland
Parish: Southesk
Max. Depth: 1.7 m (5.6 ft)
Area: 9.1 ha (22.5 ac)
Shoreline Length: 1,585 m (5,199 ft)
N
Path
Access Road
Maximum Depth (m)
Outlet
50 0 50 100 Meters