Stream Habitat Assessment:
Mapleton Park Brooks

Bronwyn Pavey, Project Coordinator
Petitcodiac Watershed Monitoring Group
PO BOX 23046, 236 St. George, Suite 109
Moncton, New Brunswick E1A 6S8

506.384.3369 (phone)
pwmg@nbnet.nb.ca

The Petitcodiac Watershed Monitoring Group (PWMG-GSBP Inc.) is a non-profit environmental science and education organization that promotes sustainable use of the Petitcodiac River and its tributaries. In addition, since 1997, the group has been involved in a monitoring program of established sites in Petitcodiac tributaries of concern or interest. These sites are verified through the following stream health indicators: temperature, dissolved oxygen content, total coliforms, E.Coli, Nitrate nitrogen, Phosphorus, bottom substrate and observable changes. More information about the group's activities are available on the following website: www.pwmg-gsbp.org

New Nouveau Brunswick

Your Environment Trust Fund at Work!
Vos Fonds en fiducie pour l'environnement au travail!

TABLE OF CONTENTS

LIST OF FIGURES and TABLES

PROJECT TEAM

Petitcodiac Watershed Monitoring Group

Bronwyn Pavey, Graduate Student	Project Coordinator
Will Kingston , BSc.	Environmental Technician
Lindsay Doiron	Environmental Technician

Reference to be cited:

Pavey, B., W. Kingston and L. Doiron. 2005. Stream Habitat Assessment: Mapleton Brooks. Report produced by Petitcodiac Watershed Monitoring Group. 20 p + appendices.

1.0 INTRODUCTION

1.1 Context

A detailed stream habitat assessment of the streams running through the North-East corner of Mapleton Park was conducted by PWMG staff during the period of July and August 2005. While it is within the mandate of PWMG to develop a database of stream and river habitat within the Petitcodiac and Memramcook watersheds, the importance of surveying this section was heightened following the sale of land through which these streams traverse. This area is slated for commercial development by AVIDE, the land development branch of Co-op Atlantic. The streams are hereafter named, Mapleton Inner Brook and Mapleton Outer Brook with respect to their location vis-à-vis Mapleton rd.

The eastern most brook (termed outer Mapleton brook) in Mapleton park previously went through Hoppers field. Hoppers field was managed by one farm property and the stream ran alongside it. This field was formerly located east of Mapleton park on the opposite side of Mapleton rd., south of the Trans Canada Highway. In this area, a commercial area is currently under development. Maps, dated from 1950, are located at city hall and clearly show this area. As a result of the current development and highway, the stream is no longer in a pristine state. The stream is now fed by run-off from the commercial development being built on Hopper's field, the highway and Mapleton road.

The inner brook runs through the north-east corner of the park under the Trans-Canada Highway, into a field at the junction of Northwood rd and Old Barn rd. There is little historical information regarding this portion of the brook. The information available however does not indicate that any diversions or human-mediated changes have made to the water course excepting the culvert under the TCH, installed originally in 1960 with upgrading occurring in 1990-1991 when the highway was widened (Fisher, S. pers.comm.). This brook is also fed in part, by a ditch draining the houses North of the TCH and on the West side of Mapleton rd. The major ditch joins the brook at the TCH culvert.

1.2 Objectives

This is the first technical report on the habitat of the Mapleton Park brooks. The objective is to inventory the location as it stands to thus better be able to monitor any impending changes.

The water quality and habitat of the streams are provided within this report.

1.3 Study Area

The area studied is within the Hall's Creek Watershed Area, part of the larger Petitcodiac Watershed. Hall's Creek Watershed has a total area of 125.9 km^2 of which 6.1% is industrial, 18.73% is woodland and 40.28% is residential (PWMG-GSBP inc. data).

Specifically, the North-East corner of the park was examined. All watercourses extending north into this section of the park from West Branch Hall's Creek were surveyed (See figure 1). The primary brook is approximately 650 meters in length.

2.0 METHODOLOGY

The stream habitat assessment was performed using the protocol set-out by the New Brunswick Department of Environment and Local Environment and the Federal Department of Fisheries and Oceans.

Detailed inventory sheets were provided to the PWMG by each organization. Additional information was taken from the United States Department of Agriculture, *Stream Visual Assessment Protocol*, Technical Note 99-1 and Aquatic Habitat Assessment: Common Methods by Bain and Stevenson (1999).

The reach surveys were conducted during typical low flow conditions such that habitat features were most evident.

Equipment Used:
Marsh-McBirney Flow meter
Clipboards, Pencils
GPS Unit
Measuring Tape
Plant Identification Keys
YSI meter (dissolved oxygen, water temp)
Lamotte Kit (pH, nitrate-nitrogen, phosphate)
Coliplates? (Total coliform counts, *E.Coli* levels)

3.0 WATER CHARACTERISTICS

3.1 Dissolved Oxygen

The amount of dissolved oxygen (DO) present in an aquatic ecosystem is a very important measure of water quality. High levels of DO usually indicate a healthy, and stable ecosystem capable of supporting many different kinds of aquatic life. Different organisms require varying levels of dissolved oxygen. Trout and salmon require high levels of DO (7-14ppm) while carp and catfish flourish in waters with low levels of DO (below 7ppm). Aquatic insects are also influenced by DO levels, with some species living in oxygen-rich waters and others prevailing in oxygen-poor waters.

There are several factors which influence the amount of dissolved oxygen present in a body water:

(1) Temperature

Water Temperature and Dissolved Oxygen are directly related to each other. As water temperature increases, DO decreases thus cold water holds more oxygen than warm water. The combined effects of DO and temperature are taken into consideration when the percent saturation of water is calculated.

(2) The level of photosynthesis

(3) Degree of light penetration (turbidity and water depth)

(4) The level of turbulence

Turbulence plays a role by promoting the mixing of water and air, thereby facilitating the diffusion of oxygen into the water

(5) Amount of decaying organic matter and nutrients

As the amount of organic material and excessive nutrients increases, the biological oxygen demand (BOD) tends to increase, which in turn lowers the overall level of dissolved oxygen. This occurs primarily just before daybreak.

The Mapleton Park brooks had an average DO of 8.13 mg/L with an average water temperature of 18.65 C . This transfers into a percent saturation of approximately 90% (see Figure 2). Generally, saturation levels between 90 to 110% are indicative of a healthy system (Kaill and Frey, 1973).

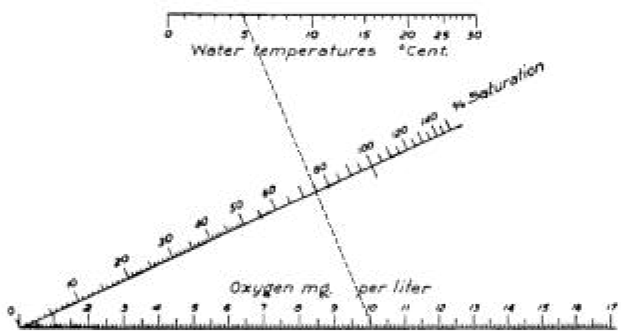

Figure 2 : Nomogram for calculating Dissolved Oxygen Saturation

Table 1: Guideline for the Interpretation of Dissolved Oxygen Readings

Dissolved Oxygen (mg/L)	
0-2 mg/L:	not enough oxygen to support life
2-4 mg/L:	only a few kinds of fish and insects can survive
4-7 mg/L:	acceptable for warm water fish
7-11 mg/L:	very good for most stream fish including cold water fish
Percent Saturation (%)	
Below 60%:	poor; water too warm or bacteria using up DO
60-79%:	acceptable for most aquatic organisms
80-125%:	excellent for most aquatic organisms
112% or more:	too high, may be dangerous to fish

Adapted from *Testing the Waters*, S. Behar, River Water Network, 1996

3.2 PH

The USEPA (U.S. Environmental Protection Agency 1976, 1986) classifies waters suitable for biota as pH 6.5 - 9. Severe stress to aquatic life is evident at pH levels below 4 units.

The Mapleton streams have a pH of 7.8 units, an acceptable pH for most aquatic life.

3.3 Temperature

Water temperature strongly influences the composition of aquatic communities (Bain and Stevenson, 1999). Many fish survive and thrive only within a limited temperature range. Brook Trout require cooler temperatures, growing and surviving best in a temperature range between 13 – 18 C but able to live in water up to 22 C. See Appendix 2 for additional Brook Trout information. Physiological functions are commonly influenced by temperature, some behaviours are linked to temperature, and temperature is closely associated with many life cycle changes.

Water temperature varies with time of day, season, and water depth. Heat gain and loss occurs more rapidly in streams, such as the Mapleton Brooks, which is shallow and mobile. Although temperatures are particularly dependent on direct solar radiation, they are also influenced by:

(1) water velocity
(2) climate
(3) elevation
(4) stream order
(5) amount of streamside vegetation providing shade
(6) water source
(7) temperature and volume of groundwater input
(8) the dimensions of the stream channel and;
(9) human impact

Runoff can indirectly add warm water to streams. Rainwater running off from heated surfaces such as parking lots, roof tops and roads has been documented to increase stream temperatures.

The average temperature of the Mapleton Brooks is 18.65 C. The temperature recorded for each reach of the Mapleton brooks is detailed in Appendix 1.

3.4 Discharge (Flow)

Streamflow, otherwise known as discharge, is the quantity of water passing through a cross section of a stream channel per unit time. Discharge is a product of the hydrological cycle; therefore, it varies with topography, geology, climate, season, vegetation and drainage area (Bain and Stevenson, 1999). Streams with land surface runoff and tributary inflows tend to have highly variable flow, whereas streams with substantial groundwater input have more stable flows. In the case of the Mapleton Brooks, flow levels are highly correlated to precipitation events.

In the mouth of the Mapleton Park Brook and West Branch Hall's Creek, low flow condition (several days without rain) was calculated at 0.4 L/s (See Appendix 4 for calculation methods). At the south side of the TransCanada Culvert (in Mapleton Park), flow was recorded to be 0.13 L/s. This indicates that the Outer Mapleton Park Brook is contributing to increased flow as are other sources within the park, including the structure along Mapleton Road (see figures 3 and 4).

Evidently, several flow calculations are preferable to gain a better picture of flow conditions.

Figures 3 and 4: Drainage Structure off of Mapleton Park Path, Mapleton Brook located in background

3.5 Nitrate Nitrogen and Phosphorus

Nitrate and Phosphorus are two important nutrients required by plants and algae for growth. Smith *et al.* (1993) use a nitrate concentration of 1 mg/L N as indicative of agricultural and urban runoff effects. Canadian guidelines (CCME, 1999) simply indicate that nitrate concentrations that stimulate weed growth should be avoided. Mapleton brook had a nitrate concentration of exactly 1.0 mg/L N.

There are no CCME guidelines for phosphorus. Phosphorus is a limiting component of water chemistry that ensures there isn't uncontrolled plant growth leading to eutrophication of the system (dead zone). In an undisturbed stream in a forested basin, phosphate levels are found between 0.005-0.05 mg/L. The phosphate level in Mapleton brook is 0.1 mg/L, an acceptable concentration that falls within the USEPA quality limit for flowing waters.

3.6 Alkalinity

Alkalinity is a measure of negative ion concentrations, expressed in ppm or mg/L of $CaCO_3$. The level of alkalinity determines the buffering capacity or ability to neutralize acid and is used to identify habitats that are vulnerable to acidification. The USEPA (US Environmental Protection Agency) specifies a minimum alkalinity of 20 mg/L. The alkalinity of the Mapleton Brook (Inner) was measured at 140 mg/L using a Lamotte Water Monitoring kit. This indicates these waters have a high buffering capability and acid rain does not pose a direct threat.

3.7 Turbidity (Water Transparency)

Turbidity is a measure of the extent to which light penetration in water is reduced from suspended solids (Armantrout, 1998). No turbidity measurements were taken during this survey. Visual observations indicate that water was clear in general but remained turbid for several days following a rain event.

3.8 Total Coliform and *E.Coli*

Both total coliform count and *E.Coli* are used to assess the microbiological quality of the water. Fecal coliforms, including *E.Coli*, indicate that there are mammal or bird feces in the water. In an urban watershed, sewer/ sewage cross connections often lead to water contamination. An interesting discussion of fecal coliform bacteria counts is found at www.oasisdesign.net/water/quality/coliform.htm

The total coliform count is Mapleton Brook is 69 MPN (most probably number) and *E.Coli* was measured at 16 MPN/100 mL. Both of these values are well below the CCME recreational guideline of 200 MPN/100 ml for fecal coliforms.

4.0 PHYSICAL CHARACTERISTICS

4.1 Instream Cover

For aquatic organisms, instream cover provides refuge from aquatic, terrestrial and airborne (birds) predators as well as physical conditions such as high current velocities and bright sunlight. Cover includes boulders and logs, aquatic vegetation, water turbulence and concealing water depths (Armantrout 1998).

The methods used to assess appropriate instream cover are fairly arbitrary (read: visual) but can provide a general idea of cover area. There was a fair amount of large woody debris in the stream, which in some places impedes flow, creating a pool on its upstream side which can be considered both positively or negatively (if it impedes fish passage). There is also a considerable amount of overhanging vegetation particularly on the lower reach of the stream. Rocks tend to be greatly embedded in the substrate reducing available habitat for macroinvertebrates (water insects) who like to live beneath them. This is a consequence of upstream urban runoff which carries and deposits sediment into the stream thus covering the bottom substrate.

Appendix 1 details the stream cover by 25 m stream reach in the categories overhanging vegetation, large woody debris, % Site (pools and riffles) and % Shade.

4.2 Riffle/ Run and Pool

Riffles are characterized by shallow, fast-moving, turbulent water running over rocks. Runs are deep with fast-moving water with little or no turbulence. The lower reach of the stream (from the park entrance to the West Branch Halls creek confluence) appears to have a more fish-suitable riffle/run pattern. The upper section is characterized by slow moving runs of water with little interruption. Riffles help to improve water oxygen content as the water bubbles over the rocky bottom increasing habitat suitability for fish and other aquatic organisms. Pools (deep pockets of water) are present throughout the system.

4.3 Substrate

In the lower reaches of Mapleton Brook, the bottom substrate is naturally rocky. Silt levels increase as one approaches the Mapleton road storm drain. Silt levels (fine sediment covering natural stream bottom) decrease slightly upstream of the drain. The gradient of this section (Culvert at the park entrance road downstream to the West branch Hall's Creek confluence) is more pronounced with a drop in elevation from 25 meters above sea level to 12 meters above sea level whereas the upper section (TCH to the park entrance road) did not always drop in elevation. For more topography information, see section 4.6.

On the north side of the park entrance (moving upstream) the stream substrate changes to a predominately sandy bottom, common of slow-moving, low-gradient streams.

4.4 Topography

Figure 5 illustrates the topographic measurements of the primary Mapleton Brook. The overall trend is downwards (direction of flow) from the TCH culvert to the confluence at West Branch Hall's Creek, going from right to left on the graph. As indicated above, this stream changes very little in elevation from the point at which it enters the park to when it meets with West Branch Hall's creek. This may explain areas of stagnant water observed along the water course.

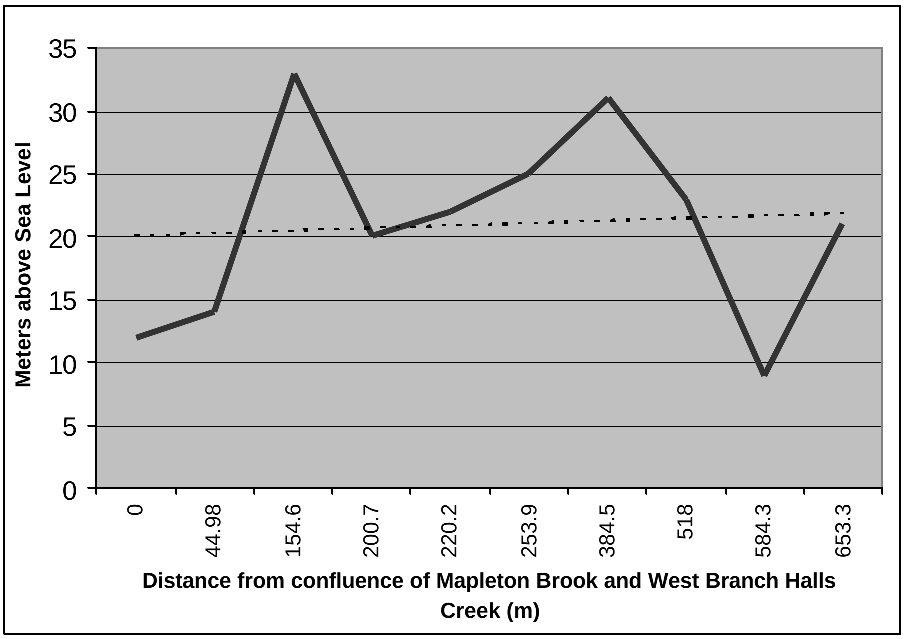

Figure 5: Topography of Mapleton Brook

5.0 PLANT INVENTORY

A quick, visual plant inventory was taken. Plants were identified following *Roland's Flora of Nova Scotia*, revised by Marian Zinck (1998).

Figure 6: Field Horsetail, Equisetum arvense

Figure 7: Sensitive Fern, Onoclea sensibilis

Figure 8: Clematis (?)

Figure 9: Bunchberry, Cornus Canadensis

Figure 10: Twisted Stalk, Streptopus

Figure 11: Spruce, Picea

Figure 12: Ostrich Fern or Fiddlehead Fern, Metteuccia struthiopteris

Other plants and trees identified in the Mapleton Stream riparian zone include but are not limited to:

- Goldenrod
- Alder
- Maple Tree
- Braken Fern
- Willow
- Buttercup
- Raspberry Bushes
- Cucumber root

6.0 RELATED LAWS AND GUIDELINES

Fisheries Act
The Fisheries Act, Section 35(1) requires that no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.

NB Clean Water Act
The NB Clean Water Act requires that any development within 30 meters of a stream located on a 1:10 000 map be required to obtain a *Stream Alteration Permit*.

Land development guidelines for the Protection of Aquatic Habitat
Land development guidelines have been issued by both the NB Department of Environment and Local Government and the Department of Fisheries and Oceans for shoreline development.

City by-laws
The area must be designed in a manner appropriate to the development which will be undertaken

7.0 CONCLUSION

Common methods were used to undertake this stream habitat assessment. The descriptions given provide baseline information regarding the current state of the Mapleton brook stream habitat.

A second habitat assessment will be completed following any future developments.

8.0 REFERENCES

Armantrout, NB, *compiler*. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society, Bethesda, Maryland.

Bain, MB and NJ Stevenson, *editorsi*.1999. Aquatic Habitat Assessment: Common Methods. American Fisheries Society, Bethesda, Maryland.

Canadian Council of Ministers of the Environment. 1999. Canadian environmental quality guidelines. Canadian Council of Ministers of the Environment, Winnipeg.

Fisher, R. Assistant to the District Engineer. District 3, New Brunswick Department of Transportation. September 7, 2005.

Kaill, W. and J. Frey. 1973. Environments in Profile: an aquatic perspective. Canfield Press.

Smith, RA., RB Alexander and KJ Lanfear. 1993. Stream water quality in the conterminous United States – status and trends of selected indicators during the 1980's. US Geological Survey, Water Supply Paper 2400, Reston, Virginia.

APPENDIX 1 N/A

APPENDIX 2 – Brook Trout and Creek Chub

BROOK TROUT, *Salvelinus fontinalis*

The brook trout is a native to eastern North America. These fish are cold water species most commonly found in cool, clear, high-oxygen streams, rivers and lakes throughout the Atlantic provinces. When temperatures rise in the summer, brook trout seek cooler water and swim downstream to lakes or out to the ocean.

The appearance of brook trout varies from place to place and with age and sex of the fish. The average length of a brook trout varies between 10-12 inches and can weigh between 4-6 pounds. This growth rate for brook trout varies and the majority usually mature at about 2-4 years of age and rarely live longer than 5 years. Typical colouring is olive-green to dark brown on the back with silvery sides and pale spotting. However, the colours intensify at spawning time.

Brook trout spawn in late summer or fall in gravel beds in the shallows of headwaters of streams. The female fans silt and debris away from the nesting area with her caudal fin where she lays 100-5000 eggs depending on her size. When spawning is complete, the female covers the eggs with gravel. The eggs hatch 50-100 days after spawning and become free-swimming when they are about 38mm (1.5 inches) long. The majority of young brook trout live in the quiet shallow edge areas of streams and small brooks.

Brook trout are carnivorous and eat a variety of food, including plankton, insects, snails, clams and fish, depending on their size. Brook trout exhibit a range of adaptations to its environments, which explains why this species is so widespread.

Figure X: Brook Trout, Mapleton Park, 27 June 2005

http://aged.ces.uga.edu/2004cds/cd1/Hot_Potatoes/Fish_Identification/Brook%20trout%20small.jpg

Creek Chub, Semolitus atromaculatus

Commonly known as a minnow, the creek chub is a medium-sized fish that can reach lengths of 20-30 cm. Throughout most of the year creek chubs appear black or bluish with a silvery belly, though during the spring spawning season male creek chubs take on a bright, rosy colour and develop at least four large tubercles on each side of their heads. These breeding tubercles are the basis for one of the common names for the creek chub, "horned dace." Creek chubs also have a single, small barbel in the corner of each jaw that is sometimes hidden between the maxillary and premaxillary bones. Adult fish are most easily identified by a prominent dark spot at the base of the dorsal fin. The male creek chub builds and carefully guards a mound of small stones in which the eggs are deposited.

http://fish.dnr.cornell.edu/nyfish/Cyprinidae/creekchubpic.html

APPENDIX 3 - Flow Calculations

Flow is calculated most accurately using the following method -
First subarea: $Q_n = v_n \times [(d_n + d_{n+1)})/2] \times z_n$
Each subarea: $Q_n = v_n \times [(d_{n-1} - d_{n+1)})/2] \times [(z_{n-1} + z_{n+1})/2]$
Last subarea: $Q_n = v_n \times [(d_n - d_{n+1)})/2] \times {}^3/_2\, z_n$
Where,
Q_n = discharge for subsection *n,*
v_n = mean velocity of subsection *n,*
d_n = distance along tape measure (width),
z_n = depth at subsection *n.*

Table 1: Flow at confluence of Mapleton Park Stream and West Branch Hall's Creek

Distance from left bank (m)	Water Depth (m)	Water Velocity (m/S)	cell discharge (Cubic meters per second)	Notes
0	0	0	-	water edge
0.6	0.02	0.02	0.00012	
0.7	0.02	0.03	0.00007875	
0.75	0.05	0.04	8E-05	
0.8	0.06	0.05	0.00020625	
0.9	0.06	0.09	0.000495	
1	0.05	0.01	0.00004	
1.1	0.02	0.04	0.00016	
1.2	0.03	0.15	0.0003	
1.3	0.02	0.15	0.000375	
1.4	0.02	0.10	0.0003	
1.5	0.04	0.14	0.00042	
1.6	0.04	0.10	0.0004	
1.7	0.04	0.15	0.00045	
1.8	0.02	0.07	0.00021	
1.9	0.02	0.07	0.00014	
2	0.02	0.10	0.0002	
2.1	0.02	0.10	0.0001	
2.2	0	0.00	0	water edge
		TOTAL	0.004075	0.4075 L/s

Table 2: Flow at TCH Culvert (South Side)

Distance from left bank (m)	Water Depth (m)	Water Velocity (m/S)	cell discharge (Cubic meters per second)	Notes
0	0	0		water edge
0.7	0.02	0.01	0.00007	
0.85	0.02	0.00	0	
0.9	0.08	0.01	0.0000375	
1	0.08	0.01	0.00009	
1.1	0.1	0.03	0.00027	
1.2	0.1	0.03	0.00033	
1.3	0.12	0.03	0.0003	
1.4	0.1	0.00	0	
1.5	0.08	0.01	7E-05	
1.6	0.04	0.02	0.00012	
1.7	0.04	0.01	0.00002	
1.8	0	0.00	0	water edge
		TOTAL	0.0013075	0.13075 L/s