Improving Water Quality in the Shediac and Scoudouc Rivers

Final Report

By:

The Shediac Bay Watershed Association Inc.

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TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

1. INTRODUCTION

The primary mandate of the Shediac Bay Watershed Association is the protection and enhancement of water quality as well as increase public awareness of environmental issues. Since the implementation of the water classification program in 1999, the SBWA has conducted a water quality monitoring program for surface water in the Shediac and Scoudouc rivers. The program has evolved and improved during the last 20 years. Monitoring of aquatic insects with the Community Aquatic Biomonitoring was added to our monitoring program in 2015 to get more information on water quality and habitat health. To better understand the suitability for fish habitat, water temperature loggers have been installed in different areas of the watershed since 2016.

A long-term water monitoring program allows the association and government agencies to detect changes or trends in water quality data. This information is used to prioritize areas that require restoration work or more in-depth investigations. Stream surveys are undertaken to determine specific restoration projects when needed.

Each year, actions are done to help improve riparian habitat based on the information gathered from monitoring and stream surveys. Stream banks are stabilized and reforested to help improve water quality. In 2018, we worked with local ATV clubs to reduce sediments in watercourses and limit access to riverbeds. Stream clean-ups are also regularly undertaken with the help of the summer students.

Education is an important part of the mandate of the Association and we will continue to work with local schools and residents to educate on the importance of a healthy watershed.

This report will highlight the monitoring results and actions that have been undertaken in 2018.

1.1 Overview of the Shediac Bay Watershed

The Shediac Bay watershed covers 420 km^2 of land area and stretches along 36 km of coastline, from Cap Bimet to Cap de Cocagne (Fig. 1). The Shediac Bay watershed is composed of two major river systems emptying into Shediac Bay: the Shediac River and the Scoudouc River. The Shediac and the Scoudouc Rivers are characterized by dendritic patterns of small tributaries covering a watershed of 201.8 and 143.3 km^2, respectively. The Shediac River is composed of two major water arms. The northern water arm is created by the convergence of the McQuade Brook, the Weisner and the Calhoun Brook. The southern large water arm of the Shediac River is the continuation of the Batemans Brook. Water velocity in both rivers is generally weak due to the gentle regional elevation. The watershed boundaries stretch into both Kent and Westmorland County and cross into both Shediac and Moncton.

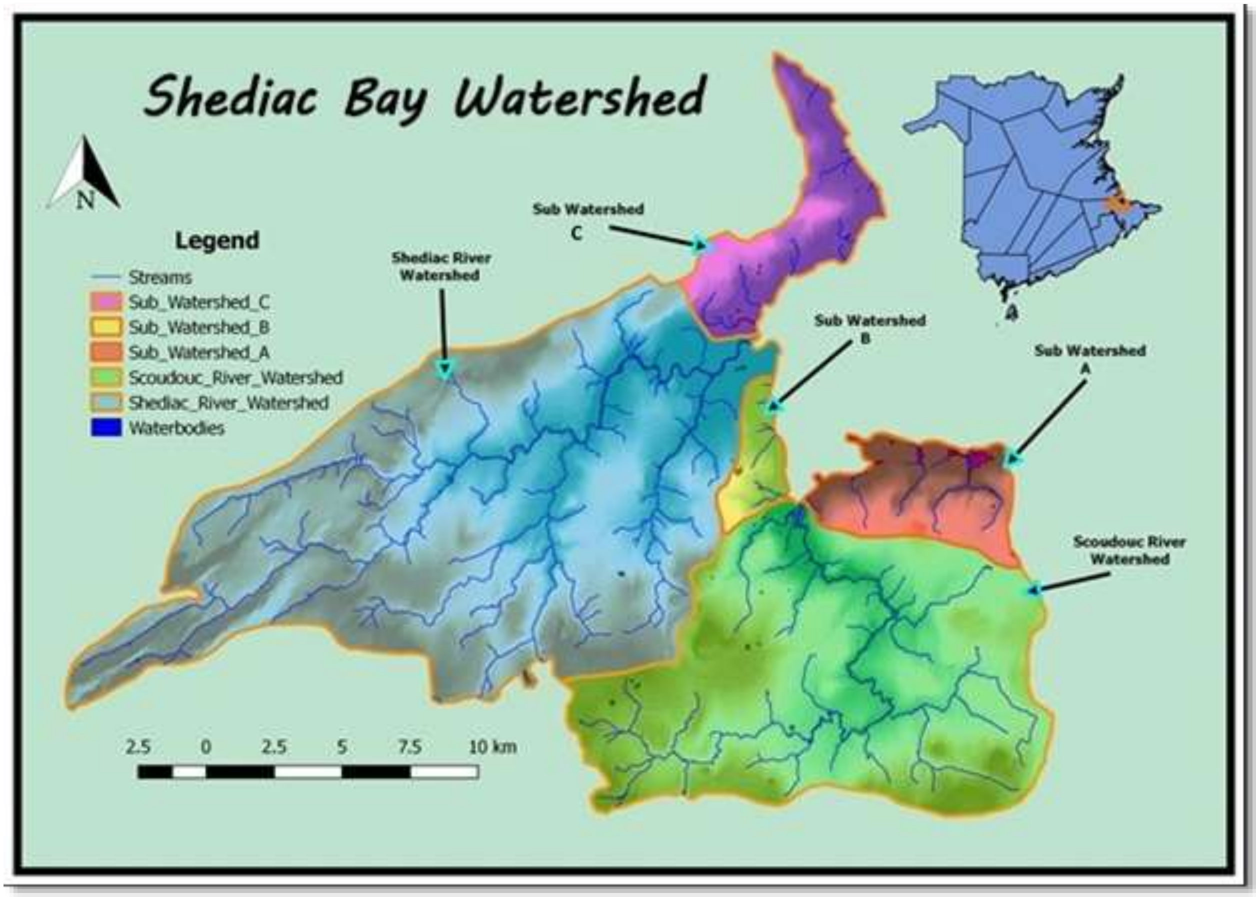


Figure 1: Map of Shediac Bay watershed boundaries and sub-watersheds

2. METHODOLOGY

2.1 Water Quality Sampling

Water quality monitoring was conducted once a month from May to September 2018, at 10 sampling stations in the major rivers and tributaries of the Shediac Bay watershed. Water quality sampling was performed using the protocol developed by the New Brunswick Department of Environment. Water samples were not collected after heavy rainfall events.

Basic water quality parameters (DO, temperature, pH, conductivity and salinity) were measured using a new YSI- *Professional Plus* multi-parameter metre. Water samples were sent to *RPC Laboratory* for analysis of *E.coli* and inorganic elements.

The equipment needed to conduct the sampling and collect the habitat data includes; laboratory issued sample bottles, labels, latex or nitrile gloves, clipboard, waterproof paper for field sheets, pencils, waders or rubber boots, GPS, digital camera, YSI (water conditioning metre), metre stick and survey measuring tape.

2.2 Macroinvertebrates

The protocol used to conduct macroinvertebrate survey is the Canadian Aquatic Biomonitoring Network (CABIN) program. SBWA staff are well trained and certified under this national program by Environment and Climate Change Canada. The sampling originally began in 2014 with one single test site in the Weisner Brook (SHM-01). In 2015, the test sites in the Shediac River near Irishtown (SHA-01) and in the McQuade Brook (SHB-01) were added. In 2016, a suitable location was found in the Scoudouc River, and was added as the fourth test site (SCF-01). In 2017, the site in the McQuade Brook was impacted by flooding from a new beaver dam downstream. Therefore, 3 sites were sampled in 2018; Weisner Brook, Shediac River, and Scoudouc River. All the sampling data from the 5 years of the CABIN sampling have been added to the Environment and Climate Change Canada website. They are added in the study managed by the *Southern Gulf of St-Lawrence Coalition on Sustainability* (Coalition SGSL).

Sampling was done using a 400µm D-frame net (kick-net). Benthos was disturbed during a 3-minute period with the net facing upstream to allow collection of disturbed benthos and invertebrates in the kick-net. The invertebrates were fixed used 10% Formalin buffer, diluted 3:1. All specimens were stored and preserved using 70 % ethanol. Macroinvertebrates were sent to a certified biologist for identification. Water samples were sent to be analyzed at the RPC Laboratory in Moncton, methodology can be found in Appendix A. The data from field sheets, laboratory analysis, and site photos have been entered in the CABIN Data Management website, and the downloaded reports can also be found in Appendix B.

2.3 Site Information – Water Classification Stations

The following describes the sample site information for the 10 water classification monitoring stations established in 1999.

Table 1: Water Quality Monitoring Site Information

Site ID	Latitude	Longitude	Elevation (m) Google Earth	Location Description
Shd A	N46°12'13.42"	W64°47'53.01"	83	On route 115, Irishtown Rd, in between junction with Ammon Rd and Scotch Settlement Rd, just upstream of culvert
Shd B	N46°13'55.17"	W64°44'35.81"	27	On Scotch Settlement Rd, North of junction with MacLean Crossroad Rd, just upstream of culvert
Shd C	N46°12'33.10"	W64°44'33.24"	27	On Cape Breton Rd, at junction with McLean Crossroad Rd, just upstream from bridge and downstream from tributary
Shd E	N46°14'43.24"	W64°39'52.21"	7	At the covered bridge of the Shediac River, upstream from covered bridge
Shd G	N46°12'53.56"	W64°40'29.74"	13	Weisner Brook, at bridge on St-Philippe Rd, upstream from bridge
Shd H	N46°13'50.95"	W64°37'15.89"	11	Bateman Brook, on Bateman's Mill Road, approx. 10 m upstream from bridge
Scd B	N46° 8'42.74"	W64°33'51.55"	24	Scoudouc River, downstream from bridge on Route 132, next to *Waggin' Tail Inn* and Dionne road
***Scd E-2**	N46° 9'57.12"	W64°31'58.13"	11	Scoudouc River, at 156 Scoudouc River Rd, take trail between garage and field, access is marked down the field
Scd F	N46°10'50.52"	W64°30'17.78"	13	Unnamed tributaries of the Scoudouc River, on Pellerin Rd
****Scd H**	N46°12'12.32"	W64°34'55.49"	17	Cornwall Brook, take Harbour view drive, after Chevy Dealership to end of road then first left through field

*ScdE-2 formerly known as ScdE
**ScdH formerly known as ScdG

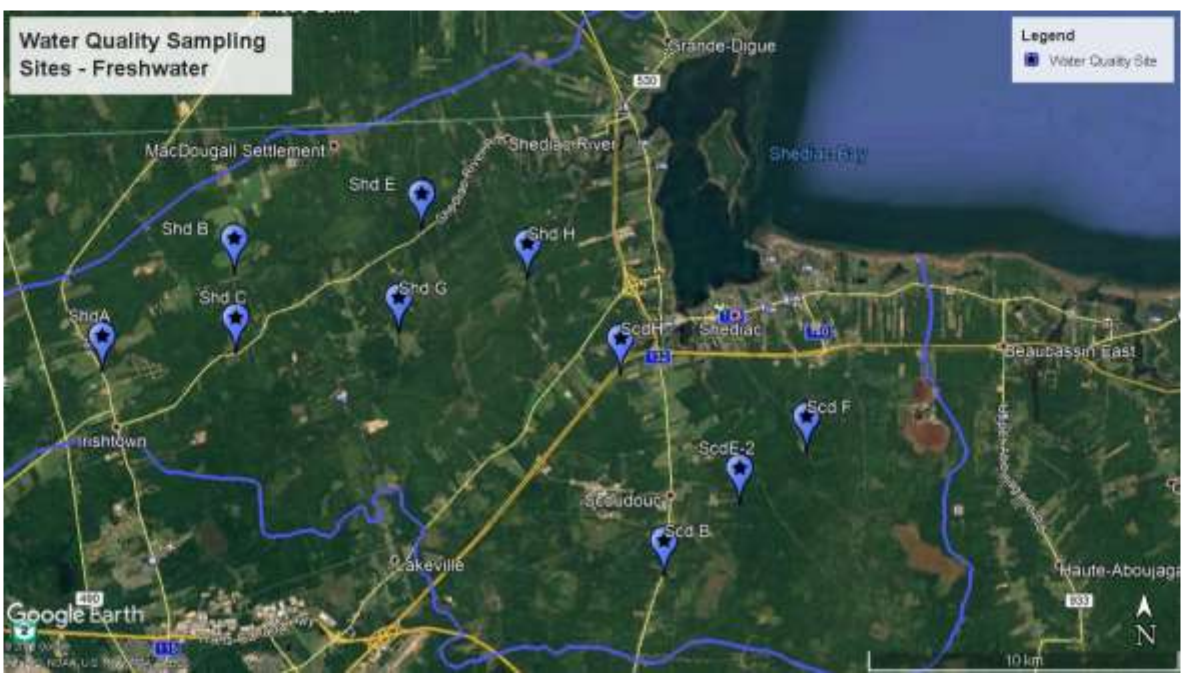


Figure 2: Water Quality Sampling Sites – Water Classification Stations

2.4 Water Quality Parameters

2.4.1 Water Temperature

Water temperature can fluctuate depending on the period of the day and during seasonal changes. Values are influenced by numerous factors such as the tree canopy providing shade, water velocity and depths, presence of cold springs, etc. It is considered that water above 25 or 29 degrees Celsius (°C) tends to be of poor quality because less oxygen can be dissolved. Therefore, water temperature directly influences the dissolved oxygen levels. Water temperatures above 22 °C is said to cause thermal stress to salmonid populations, causing them to stop feeding and search for thermal refugia.

2.4.2 Potential Hydrogen (pH)

The potential hydrogen (pH) level indicates if the water is acidity or basic. It affects how much other substances, such as metals, dissolve in the water. In facts, the pH affects the solubility and toxicity of chemicals and heavy metals in water. Many aquatic organisms are sensitive to changes in pH and may be adversely affected by the pH that is either too high or too low. The pH varies naturally depending on bedrock, climate and vegetation cover, but may also be affected by industrial or other effluents, the exposure of some type of rock (for example during road construction) or drainage from mining operations. According to the CCME's Canadian water quality guidelines, pH should be between 6.5 and 9, as pH levels move away from this range it can stress animal systems and reduce hatching and survival rates in the stream.

2.4.3 Dissolved Oxygen

Dissolved oxygen (DO) represents the concentration of oxygen in gaseous form in the dissolved in the water column. Most of the oxygen in the water comes from the surface atmosphere and is mixed in the water by turbulence and current. The measurement of the concentration of dissolved oxygen in surface waters is essential for measuring changes in water condition and evaluating water quality. It has a direct effect on aquatic life and can be influenced by stream habitat alteration. DO is essential for the survival of fish and many other forms of aquatic life. The temperature limits the amount of oxygen that can dissolve in water, dissolved oxygen varies with temperature and tends to be lower when the water temperature is high. However, temperature is not the only cause of low-oxygen, too many bacteria and an excess amount of biological oxygen demand from the oxygen consumption used by the microorganisms (aerobic bacteria) in the oxidation of organic matter also affects the dissolved oxygen concentrations. According to the Canadian Council of Ministers of the Environment (CCME) Canadian water quality guidelines, the lowest acceptable DO concentration for aquatic life in cold water is 9.5 mg/l for early life stages and 6.5 mg/l for other life stages.

2.4.4 Conductivity

Conductivity is the measurement of the ability of water to pass an electrical current. It is affected by the amount of inorganic dissolved solids (nitrate, chloride, sulfate, sodium, etc.) found in the water. The conductivity level may be influenced by rainwater, agricultural or urban runoff and the geology of the area. There are no set criteria for conductivity levels for water quality, but the US Environmental Protection Agency states that stream conductivity levels ranging between 0.15 and 0.5 mS/cm usually seem to support a good mixed fisheries. Consequently, a higher conductivity level may indicate a higher amount of dissolved material in the water and the presence of contaminants.

2.4.5 Nitrate-Nitrogen

Nitrogen is essential for plant growth, but the presence of excessive amounts in water presents a major pollution problem. Nitrogen compounds may enter water as nitrates or be converted to nitrates from agricultural fertilizers, sewage, industrial and packing house wastes, drainage from livestock feeding areas, farm manures and legumes. The acceptable amount of Nitrate-nitrogen for the protection of aquatic life in freshwater is set at 13 mg/l (NO3).

2.4.6 Phosphates

Phosphates exist in different forms: orthophosphate, metaphosphate and organically compound contains phosphorus. These forms of phosphate occur in living and decomposing plants and animals, as free ions, chemically bonded in aqueous system or mineralized compounds in sediments, soils and rocks. Large amount of phosphate coming from cleaning products (detergents), run off from agricultural and residential fertilizer components can lead to eutrophication. Soil erosion is a major contributor of phosphorus to stream. It is recommended by Environment Canada to apply the Canadian Framework for phosphorus. Trigger ranges are based on the range of phosphorus concentrations in water that define the reference trophic status for a site. Measured phosphorus concentrations should not exceed predefined trigger ranges and should not increase more than 50% over baseline (reference) levels. Total phosphorus levels should be under 0.025 mg/L to maintain its unaffected trophic state.

2.4.7 Escherichia Coli

Escherichia coli (*E. coli*) is one of many species of bacteria living in the lower intestines of mammals. The presence of *E. coli* in water is a common indicator of fecal contamination. The acceptable count of E.coli in water is set at 400 MPN/100 ml.

2.4.8 Aluminum

A high concentration of aluminum, due to non-point sources such as rain and snowmelt leaching from watershed soils, can pose a risk to fish in freshwater habitats. For example, ionoregulatory and osmoregulatory complications can develop in fish where aluminum concentrations exceed the CCME recommended guideline of 5 $\mu g \bullet L^{-1}$ when the pH is less than 6.5, and 100 $\mu g \bullet L^{-1}$ when the pH is greater than or equal to 6.5. Furthermore, respiratory problems can occur due to the precipitation of aluminum on the gills, as the positively charged aluminum ion (Al^{3+}) binds with the negatively charged epithelium of the gill.

Many of Atlantic Canada's freshwater habitats naturally contain aluminum concentrations that often exceed CCME guidelines for the protection of aquatic wildlife; however, various fish species are abundant in New Brunswick's rivers. This increased amount of aluminum and other metals is often accompanied by runoff organic carbon due to Atlantic Canada's relatively flat topography and impermeability (Dennis & Clair, 2012). The organic carbon possesses a negatively charged carboxylic functional group, which attracts and binds with the positively charged dissolved aluminum ion. This neutralizes the aluminum ion, rendering it inert and therefore unable to bind with the negatively charged epithelium of the fish gill. Despite this, aluminum ion levels in Atlantic Canada can still reach levels dangerous to fish (Dennis & Clair, 2012).

2.4.9 Iron

Iron enters freshwater habitats in a similar manner to aluminum. Rain and snowmelt leach iron from rocks and watershed soils, and the runoff enters rivers and streams. Anthropogenic sources, such as wastewater and storm water discharges, are also non-point sources of iron in freshwater habitats. A high concentration of iron may cause physiological and/or morphological changes in aquatic plant species (Xing & Liu, 2011).

2.4.10 Copper

Because copper is an essential metal, aquatic organisms have developed methods of copper regulation in the body. Despite this, however, copper toxicity is still possible at high concentrations.

2.4.11 Chloride

Chloride ions (Cl-) in a freshwater habitat are the result of dissolved salts from various sources, and can negatively impact aquatic wildlife sensitive to increased chloride concentration. Although a naturally contributing source of chloride is estuarine backflow from the ocean during rising tide, road salt runoff can also increase chloride concentrations. Since freshwater organisms are generally hyperosmotic, they depend on a low concentration of chloride for proper osmoregulation. A higher concentration of chloride may decrease the ability for freshwater organisms to osmoregulate, affecting endocrine balance, oxygen consumption following long-term exposure, and overall changes in physiological processes. Increased chloride levels may also increase the rigidity in spotted salamander eggs, lowering permeability and in turn, oxygen consumption (Canadian Council of Ministers of the Environment, 2011).

2.4.12 Boron

Boron (B) is ubiquitous in the environment, occurring naturally in the earth's crust and various minerals. Although boron is relatively non-toxic, it may cause sensitivities in some species of fish. Long-term exposure to boron has shown to cause sensitivities in amphibians and water fleas (Canadian Council of Ministers of the Environment, 2009).

2.4.13 Ammonia

Ammonia (NH_3) has many different point and non-point sources, including not only natural causes, but also anthropogenic (e.g. municipal, agricultural, and industrial) causes. Natural sources of ammonia include the decomposition of dead organic matter and waste, gas exchange with the atmosphere, forest fires, animal waste, human breath, discharge of ammonia by biota, and nitrogen fixation processes. Sewage treatment plants and waste burning are examples of municipal sources, whereas intensive farming, ammonia-rich fertilizer spills, and the decomposition of wastes from livestock are examples of agricultural sources. Finally, industrial sources include, but are not limited to, iron and steel mills, fertilizer plants, oil refineries, meat-processing plants, mining, and the fabrication of explosives.

High concentrations of unionized ammonia can result in adverse health effects in freshwater biota. Since unionized ammonia is neutral, it can diffuse across biological membranes more readily than ammonium ion (NH_4^+). A study done by Thurston and Russo (1984) showed that long-term exposure of rainbow trout to ammonia causes pathological lesion formation on the gills and tissue degradation in the kidneys (Canadian Council of Ministers of the Environment, 2010).

2.5 CCME - Canadian Environmental Quality Guidelines (CEQGs)

Table 2: Summary of the CCME Canadian Environmental Quality Guidelines

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY					
Parameter	Condition	Value (µg/L)	Condition	Value (µg/L)	Equation Between Conditions
Ag	—	—	Long-Term	0.25	—
Al	pH<6.5	5	pH≥6.5	100	—
As	—	—	Upper	5	—
B	Short-Term	29,000	Long-Term	1,500	—
Cd (Short-Term)	HARD<5.3	0.11	HARD>360	7.7	10^(1.016*LOG(HARD)-1.71)
Cd (Long-Term)	HARD<17	0.04	HARD>280	0.37	10^(0.83*LOG(HARD)-2.46)
Cl	Short-Term	640,000	Long-Term	120,000	—
CLRA	Narrative; refer to CCME website for more information.				—
Cu	HARD<82	2	HARD>180	4	0.2*EXP(0.8545*LN(HARD)-1.465)
DO (warm) †	Early	6000	Other	5500	—
DO (cold)	Early	9500	Other	6500	—
E-coli ‡	—	—	Upper	400 MPN/100mL	—
Fe	—	—	Upper	300	—
Mo	—	—	Upper	73	—
NH3_T	Table; refer to CCME website for more information.				—
NH3_Un	—	—	Long-Term	19	—
Ni	HARD≤60	25	HARD>180	150	EXP(0.76*LN(HARD)+1.06)
NO2	—	—	Upper	197	—
NO3	Short-Term	550 000	Long-Term	13 000	—
Pb	HARD≤60	1	HARD>180	7	EXP(1.273*LN(HARD)-4.705)
pH	Lower L-T	6.5	Upper L-T	9.0	—
Se	—	—	Upper	1	—
Tl	—	—	Upper	0.8	—
U	Short-Term	33	Long-Term	15	—
Zn	—	—	Upper	30	—

Notes

The following parameters did not have CCME recommended guidelines for the protection of aquatic life and were therefore omitted from the table:

ALK_T	Ba	Be	HCO3
Bi	Br	Ca	CO3
Co	COND	Cr	F
HARD	K	Lang_Ind (20°C)	
Li	Mg	Mn	Na
NOX	Rb	pH (Sat)	Sb
Sn	SO4	Sr	TDS
Te	TKN	TOC	TP-L
TURB	V		

† The guideline for dissolved oxygen is separated into warm water biota, early life stages; warm water biota, other life stages; cold water biota, early life stages; and cold water biota, other life stages.

‡ There is no limit for the protection of aquatic wildlife. The limit of 400 MPN/100mL for the protection of environmental and human health is used instead.

2.6 Health Canada - Guidelines for Canadian Recreational Water Quality

Table 3: Guidelines for Health Canada Recreational Water Quality: Summary Table

Guidelines for Health Canada Recreational Water Quality		
Parameter	Considerations	Guideline
Escherichia coli (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples)	≤ 200 *E. coli* /100 mL
	Single sample maximum concentration	≤ 400 *E. coli* /100 mL
Enterococci (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples)	≤ 35 Enterococci /100 mL
	Single sample maximum concentration	≤ 70 Enterococci /100 mL
*Advice regarding waters intended for secondary-contact recreational activities is provided in Section 4.2. of the *Guidelines for Canadian Recreational Water Quality: Third Edition*		
https://www.canada.ca/content/dam/canada/health-canada/migration/healthy-canadians/publications/healthy-living-vie-saine/water-recreational-recreative-eau/alt/pdf/water-recreational-recreative-eau-eng.pdf		

2.7 CCME Recommendation Guidelines for the Protection of Aquatic Life (Freshwater)

Table 4: CCME Recommendation Guidelines for the Protection of Aquatic Life (Freshwater)

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY OF OTHER PARAMETERS					
Parameter	Description	Value	Units	Notes	
Dissolved O_2 †	Early life stages, cold water biota†	9.5	mg/L	†	The guidelines for the lowest acceptable dissolved oxygen concentrations are divided into four different categories to accommodate the wide range of tolerances exhibited by freshwater species at various life stages, and with warmer or colder temperature preferences.
	Other life stages, cold water biota	6.5	mg/L		
	Early life stages, warm water biota	6	mg/L		
	Other life stages, warm water biota	5.5	mg/L		
pH	Lower long-term limit	6.5	—	‡	There is no limit for the protection of aquatic wildlife for E. coli. The limit of 400 MPN/100 mL for the protection of environmental and human health is used instead.
	Upper long-term limit	9	—		
E. coli ‡	Upper limit	400	MPN/100 mL		

2.8 CCME Guidance framework for Phosphorus

Table 5: CCME Guidance framework for Phosphorus

CCME Guidance Framework for Phosphorus (TP-L)				
Parameter	Description	Value	Units	Notes
TP-L*	Hyper-eutrophic	> 100	µg/L	The CCME recommended guidelines for the protection of aquatic wildlife (freshwater) indicate the concentrations of total phosphorus at which each condition may occur. This does not suggest that a stream with hyper-eutrophic levels of total phosphorus will necessarily exhibit hyper-eutrophic properties, for example.
	Eutrophic	35 – 100	µg/L	
	Meso-eutrophic	20 – 35	µg/L	
	Mesotrophic	10 – 20	µg/L	
	Oligotrophic	4 – 10	µg/L	
	Ultra-oligotrophic	< 4	µg/L	* Total phosphorus level

2.9 Terms and Definitions

All data collected during the sampling season has been organized in 3 distinct tables: water chemistry data and *E. coli* results, nutrient results, and inorganics results. The following provides the terms and definitions of the acronyms used in the data tables.

Table 6: Terms and definitions for water chemistry and bacterial data tables

TERMS AND DEFINITIONS FOR FIELD DATA COLLECTED BY YSI AND LABORATORY SAMPLES		
Parameter	Unit	Definition
Temp	°C	Air and w ater temperature measured in degrees Celsius
SAL	ppt	Salinity measured in parts per thousand
Dissolved O_2	mg/L, %	Dissolved oxygen measured in milligrams per litre and percentage
E. coli	MPN/100mL	Escherichia coli concentration measured in most probable number per 100 millilitres
ALK_T	mg/L	Total alkalinity measured in milligrams per litre
CLRA	TCU	Water colour measured in true colour units
COND	µS/cm	Conductivity measured in microsiemens per centimetre in the field and laboratory
HARD	mg/L	Hardness measured in milligrams per litre
Lang_Ind (20°C)	—	Langlier index at 20 degrees Celsius
pH	—	Potential of hydrogen measured in the field and laboratory, and the saturation pH at 20 degrees Celsius
Sat (20°C)	—	The pH at w hich w ater at 20 degrees Celsius is saturated w ith calcium carbonate
TDS	mg/L	Total dissolved solids measured in milligrams per litre
TURB	NTU	Water turbidity measured in nephelometric turbidity units

Table 7: Terms and definitions for nutrients data tables

TERMS AND DEFINITIONS FOR NUTRIENT DATA					
Parameter	Unit	Definition	Parameter	Unit	Definition
HCO_3	mg/L	Bicarbonate measured in milligrams per litre	NH_3_Un	µg/L	Ammonia unionized at 20°C measured in micrograms per litre
Br	µg/L	Bromine measured in micrograms per litre	NO_2	µg/L	Nitrite measured in micrograms per litre
Ca	mg/L	Calcium measured in milligrams per litre	NO_3	µg/L	Nitrate measured in micrograms per litre
CO_3	µg/L	Carbonate measured in micrograms per litre	NO_X	µg/L	Nitrite + Nitrate measured in micrograms per litre
Cl	mg/L	Chloride measured in milligrams per litre	SO_4	mg/L	Sulphate measured in milligrams per litre
F	µg/L	Fluoride measured in micrograms per litre	TKN	mg/L	Total Kjedhal nitrogen measured in milligrams per litre
K	mg/L	Potassium measured in milligrams per litre	TN	mg/L	Total nitrogen calculated in milligrams per litre
Mg	mg/L	Magnesium measured in milligrams per litre	TOC	mg/L	Total organic carbon measured in milligrams per litre
Na	mg/L	Sodium measured in milligrams per litre	TP-L	µg/L	Total phosphorus measured in micrograms per litre
NH_3T	µg/L	Total ammonia measured in micrograms per litre	—	—	—

Table 8: Terms and definitions for inorganics data tables

TERMS AND DEFINITIONS FOR HEAVY METAL DATA					
Parameter	Unit	Definition	Parameter	Unit	Definition
Al	µg/L	Aluminum measured in micrograms per litre	Mn	µg/L	Manganese measured in micrograms per litre
As	µg/L	Arsenic measured in micrograms per litre	Mo	µg/L	Molybdenum measured in micrograms per litre
B	µg/L	Boron measured in micrograms per litre	Ni	µg/L	Nickel measured in micrograms per litre
Ba	µg/L	Baryium measured in micrograms per litre	Pb	µg/L	Lead measured in micrograms per litre
Cd	µg/L	Cadmium measured in micrograms per litre	Rb	µg/L	Rubidium measured in micrograms per litre
Co	µg/L	Cobalt measured in micrograms per litre	Sb	µg/L	Antimony measured in micrograms per litre
Cr	µg/L	Chromium measured in micrograms per litre	Sr	µg/L	Strontium measured in micrograms per litre
Cu	µg/L	Copper measured in micrograms per litre	U	µg/L	Uranium measured in micrograms per litre
Fe	µg/L	Iron measured in micrograms per litre	V	µg/L	Vanadium measured in micrograms per litre
Li	µg/L	Lithium measured in micrograms per litre	Zn	µg/L	Zinc measured in micrograms per litre

3. Sampling Results

The follow section contains the results on all the data collected during the water quality monitoring for 2018. All water samples are assigned with a designated field number so that it can be logged into the *Department of Environment and local Government* database.

It was discovered this year that during the water classification sampling years (1999-2003), the site ScdG was actually located in the higher reaches of the Scoudouc River, just above the Trans-Canada Highway. When the sampling program was restarted in 2005-2006, it is unknown why the station was changed to the Cornwall Brook, but the site code remained the same. Therefore, the station ID was changed to ScdH, and all data taken since 2006 under the site ID ScdG will now be compared to the data under the site name ScdH.

A similar mistake was done in 2005-2006 at the site ScdE; in 1999-2003, the sample was taken approximately 1 km downstream of the current day location (Table 1). The original ScdE was located under the transmission power lines crossing the Scoudouc River, and was most likely reached using an ATV. In 2005-2006, it is believed that staff found a different way of getting close to the area by contacting landowners and gaining permission of access. Since it is not in the exact location, a decision was taken to rename the site ScdE-2.

3.1 Shediac River – ShdA

This water quality sampling site is located in the main branch of the Shediac River, off Route 115 in Irishtown. The sample is taken upstream of the culvert. The surrounding land uses includes; residential, agricultural fields, farmlands containing cattle, a mineral extraction pit and a golf course. It is important to note that there is intense development of new residential sectors and roads upstream of the sampling site (off NB-490). There has been a lot of changes in the land uses around this site in the last 2-3 years, therefore 2 maps were added to compare the surrounding areas between 2015 and 2017.

The farm fields on both sides of the river are used for the cultivation of hay and as cattle pastures. Intense tree planting was done with the help of the SBWA back in the early 2000s, to increase the buffer zones. There is cattle fencing along the river, but it does allow the cows to cross the river in one area upstream of the sample site. There is a section of the brook, 100 m in length in the cow crossing area, that only has a thin buffer zone (> 10 m) or none at all in some spots.

A new apple orchard field has been established in 2016-2017 less than 200 metres from the sampling site. Approximately 20 hectares was cleared of vegetation for the orchard and possibly for the cultivation of other products. There are no tree buffers that would prevent drainage from these fields from reaching the river when flowing down to NB-115 and following the ditch to the water. Near the top of the parcel of land, trees were cut and land was tilled up to 15 metres from the river. Depending of land elevations and drainage direction, this area may be high risk for the river.

Next to the orchard is another plot of land (20 ha) that was previously used for agriculture and possibly farm animals, but aerial imagery from 2017 demonstrates evidence of the land being sold, possibly for mineral extraction. The fields have been stripped of its vegetation, house and barn, and is now an empty field that contains a road and a gravel/mineral pit at the top of the field. The pit currently takes up 1 hectares of the parcel. The only trees visible are the ones outside of the property lines. These fields are located approximately 700 metres away from the sample site (distance measured along the road), continued monitoring is important to measure whether these activities will have an impact on the Shediac River.

The golf course is located to the right of the river (looking upstream) approximately 500 m away from the sample site (distance measured along the road), and it is unknown if any runoff from this location reaches the site by the ditch along NB-115. One of the cattle fields separate the river and the golf course. The sampling parameters used in this report may not include the detection of certain chemicals present in pesticides that are commonly used in golf courses. It is unknown whether or not the golf courses use pesticides and/or fertilizers on their lawns.

The water sampling results for the site ShdA, for 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the mesotrophic range (10 – 20 µg/L) from May to July, down to the Oligotrophic range (4-10 µg/L) in August, then an increase to the eutrophic range (35 – 100 µg/L) in September. Aluminum exceeded the guidelines in September (102 µg/L), when the recommendation is 100 µg/L when the pH value is ≥ 6.5. Iron also exceeded the guidelines in September (400 µg/L), when the recommendation is 300 µg/L. Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 9: Water chemistry data and *E. coli* results for ShdA, 2018

SITE ShdA: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	18.0	15.40	0.09	11.11	5.2	55	22	0.149	185	71.7	-0.27	7.67	8.0	8.3	118.30	98	2.8
18-06-27	-	16.80	0.08	9.95	63.7	56	57	0.145	172	67.6	-0.47	7.32	7.8	8.3	111.80	93	2.3
18-07-31	29.0	23.20	0.12	9.57	178.2	91	13	0.240	241	104	0.41	8.47	8.3	7.9	161.20	131	1.7
18-08-28	30.0	20.90	0.12	8.65	55.0	81	10	0.226	240	101	0.15	8.18	8.1	8	159.90	127	1
18-09-26	21.0	12.50	0.12	10.02	80.8	78	13	0.195	251	96.3	0.1	7.81	8.1	8	167.05	136	11.6

Table 10: Nutrient results for ShdA, 2018

SITE ShdA: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	54.4	20	22.4	511	10.7	140	0.71	3.84	7.0	<50	<1	<50	680	680	16	0.2	0.9	3.8	15
18-06-27	55.6	20	21.3	330	10.1	170	0.61	3.51	7.3	<50	<1	<50	550	550	13	0.3	0.9	6.0	14
18-07-31	89.2	20	33.7	1670	9.1	190	0.79	4.83	6.1	<50	<1	<50	650	650	18	0.2	0.8	2.3	15
18-08-28	80.0	20	32.6	947	10.3	160	0.79	4.84	6.4	<50	<1	<50	720	720	19	0.2	0.9	2.4	5
18-09-26	77.0	20	30.7	911	15.7	190	0.88	4.78	8.4	<50	<1	<50	600	600	25	0.2	0.8	2.3	42

Table 11: Inorganics results for ShdA, 2018

SITE ShdA: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	76	<1	23	40	<0.01	<0.1	<1	<1	230	1.7	24	1.9	<1	0.1	0.7	<0.1	363	0.9	<1	2
18-06-28	69	<1	21	38	<0.01	<0.1	<1	<1	270	1.5	24	1.7	<1	0.1	0.7	<0.1	284	0.8	<1	4
18-07-31	45	<1	32	51	0.01	0.1	<1	<1	280	2.2	47	3.6	<1	0.1	1	0.1	449	1.6	<1	<1
18-08-28	29	<1	30	48	<0.01	<0.1	<1	<1	180	2.1	25	3.1	<1	<0.1	0.8	0.1	413	1.9	<1	<1
18-09-26	**102**	<1	26	50	<0.01	<0.1	<1	<1	**400**	2.1	50	2	<1	0.2	0.9	<0.1	424	2	<1	<1

Figure 3: ShdA site location and surrounding land uses (imagery view of 2015)

Figure 4: ShdA site location and surrounding land uses (imagery view of 2017)

Figure 5: Site photos for water quality sampling site ShdA, 2018

3.2 Shediac River – ShdB

This water quality sampling site is located in the McQuade Brook, off Scotch Settlement Road (175 m after turning right off MacLean Crossroad rd.). The sample is taken upstream of the culvert. The surrounding land uses includes; residences, agricultural fields, cattle farms, and a mineral extraction pit. It is important to note that beavers have moved back into the area, building a dam inside the culvert of Scotch Settlement rd. The sample protocol was not changed, and measurement and samples were taken in the beaver habitat. In the summer, the stagnant water became warm, low in dissolved oxygen, turbid, had a bad odour.

Most of the drainage providing from agricultural and cattle fields around the site would flow into other small tributaries of the McQuade Brook, converging at a lower points in the system. The gravel/mineral pit is close to the brook approximately 3 km upstream of the sampling site. There is a buffer zone between the riverbanks and the pit, ranging from 20 m to 100 m or more in density. Further upstream, the watercourse crosses transmission power lines. The McQuade Brook is made up of a lot of small tributaries from around McQuade and Scotch Settlement, which are places with several farms and clear cut lots from past logging activity.

The water sampling results for the site ShdB, for 2018, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in July (3.50 mg/L) and August (5.54 mg/L). Low levels of DO can be explained by the presence of beaver dams around this site, causing disruptions in the natural flow and creating warm, stagnant water with low DO saturations. The water temperature reached the limit for thermal stress in salmonids (22.5˚C) in July (23.80˚C).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were: in the meso-eutrophic range (20 – 35 µg/L) in May and September; in the mesotrophic range (10 – 20 µg/L) in June; and in the eutrophic range (35 – 100 µg/L) in July and August. Iron exceeds the guideline (300 µg/L) in each sample except June. The highest iron concentration was in the month of July (1460 µg/L). Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) for the sample taken in August and September; 497.8 MPN/100 mL and 870.4 MPN/100 mL.

Table 12: Water chemistry data and *E. coli* results for ShdB, 2018

SITE ShdB: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	18.0	14.50	0.06	9.93	20.3	39	34	0.096	121	40.1	-1.25	7.43	7.4	8.7	78.00	59	1.1
18-06-27	18.0	17.20	0.06	7.77	104.6	41	68	0.108	126	44.1	-1.09	7.18	7.5	8.6	81.90	66	1.7
18-07-31	29.0	**23.80**	0.11	**3.50**	78.0	94	35	0.222	216	79.2	-0.30	8.04	7.7	8	148.20	113	3.9
18-08-28	-	21.20	0.11	**5.54**	**497.8**	80	22	0.217	218	77.6	-0.38	7.92	7.7	8.1	152.10	114	4.9
18-09-26	21.0	12.90	0.11	8.70	**870.4**	85	15	0.181	229	82.3	-0.34	7.69	7.7	8	153.40	120	1.8

Table 13: Nutrient results for ShdB, 2018

SITE ShdB: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	38.9	30	12.0	92	11.4	150	0.69	2.46	8.2	<0.05	<1	<50	<50	<50	<1	0.2	0.2	5.9	21
18-06-27	40.9	30	13.3	122	10.8	180	0.78	2.64	9.1	<0.05	<1	<50	<50	<50	4	0.3	0.3	10.0	19
18-07-31	93.5	60	24.2	440	10.3	200	1.32	4.56	11.5	0.1	2	<50	<50	<50	<1	0.4	0.4	4.9	41
18-08-28	79.6	40	23.6	375	12.5	190	1.18	4.53	12.3	0.06	<1	<50	<50	<50	9	0.4	0.4	4.2	54
18-09-26	84.6	60	24.9	399	13.1	180	1.07	4.88	12.4	<0.05	<1	<50	50	50	10	0.2	0.2	2.8	24

Table 14: Inorganics results for ShdB, 2018

SITE ShdB: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	65	<1	9	49	<0.01	0.1	<1	<1	200	0.1	116	0.5	<1	0.1	0.7	<0.1	68	0.1	<1	10
18-06-28	92	<1	10	56	0.01	0.2	<1	1	**370**	0.7	205	0.6	<1	0.2	0.9	<0.1	73	0.1	<1	22
18-07-31	61	4	15	132	0.01	0.7	<1	<1	**1460**	0.9	1720	1.2	<1	0.4	2	<0.1	158	0.2	<1	2
18-08-28	79	2	15	105	0.01	0.3	<1	<1	**760**	1	656	0.9	<1	0.4	1.5	<0.1	153	0.2	<1	1
18-09-26	50	1	12	95	<0.01	0.2	<1	<1	**620**	0.8	412	0.7	<1	0.2	1.1	<0.1	166	0.4	<1	1

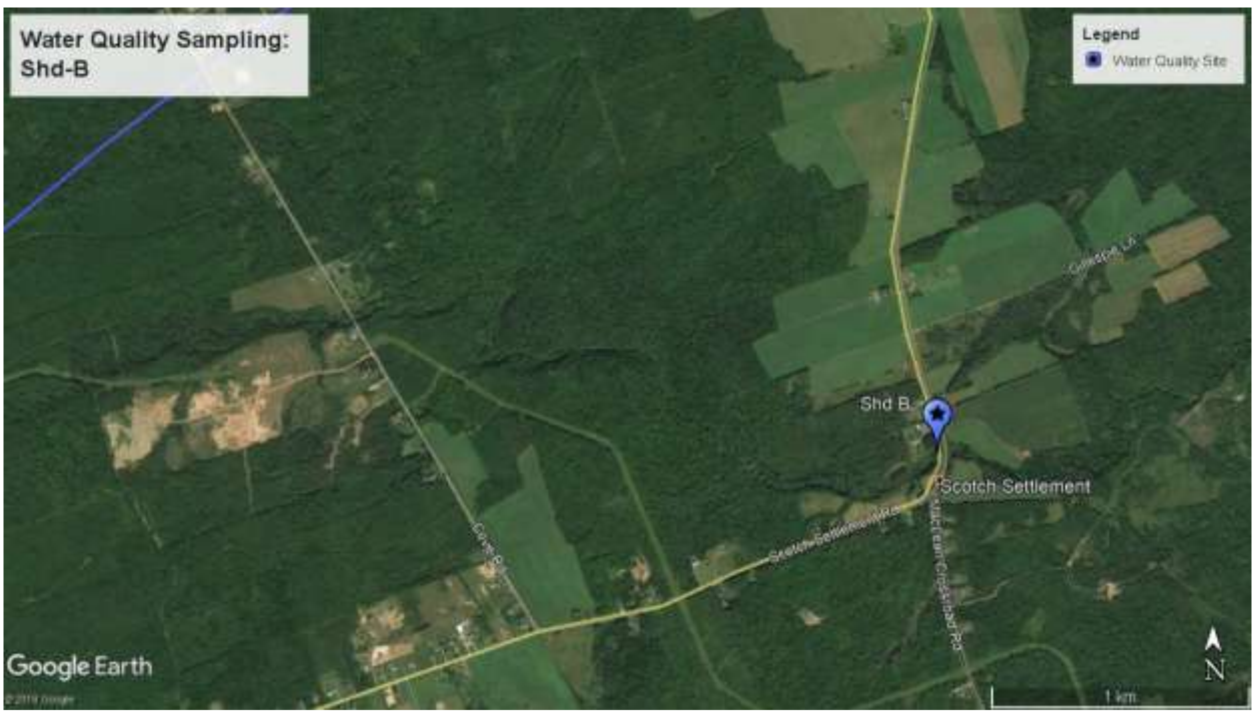


Figure 6: ShdB site location and surrounding land uses

Figure 7: Site photos for water quality sampling site ShdB, 2018

3.3 Shediac River - ShdC

This water quality sampling site is located in the main branch of the Shediac River, at the bridge of MacLean Crossroad rd. (at the junction with Shediac River Road/Cape Breton Road). The sample is taken upstream of the bridge. The surrounding land uses is mainly residences and forested land. This site is located over 5.3 km downstream of the site ShdA, and there is little more than houses and cabins in regards to land use in between those two sites. From aerial imagery, there is evidence of an ATV crossing without an appropriate bridge approx. 1.6 km downstream of the site.

The water sampling results for the site ShdC, for 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were in the mesotrophic range (10 – 20 µg/L) from May to July, and in the oligotrophic range (4 – 10 µg/L) in August and September. Results did not exceed any of the recommended CCME water quality guidelines for inorganics (heavy metals and other elements). Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 15: Water chemistry data and *E. coli* results for ShdC, 2018

SITE ShdC: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	17.0	15.10	0.09	11.55	12.0	50	22	0.148	181	62.3	-0.57	7.43	7.8	8.4	118.66	92	1.1
18-06-27	-	16.80	0.08	10.23	96.0	54	47	0.134	173	61	-0.44	7.33	7.9	8.3	105.35	92	1.7
18-07-31	29.0	22.20	0.12	10.79	78.8	93	6	0.233	240	98.1	0.28	8.33	8.2	7.9	159.90	132	0.7
18-08-28	-	19.40	0.10	10.98	33.6	86	7	0.185	249	101	0.25	8.14	8.2	7.9	134.55	132	0.5
18-09-26	21.0	12.50	0.12	11.04	40.2	84	5	0.196	255	102	0.14	7.75	8.1	8	163.15	135	0.6

Table 16: Nutrient results for ShdC, 2018

SITE ShdC: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	49.7	20	19.0	295	15.1	130	0.96	3.60	10.3	<50	<1	<50	270	270	11	0.2	0.5	4.3	18
18-06-27	53.6	20	18.8	400	14.1	170	0.95	3.42	10.6	<50	<1	<50	240	240	10	0.3	0.5	6.3	14
18-07-31	91.6	30	30.5	1360	11	170	1.18	5.34	7.9	<50	<1	<50	180	180	18	0.1	0.3	2.0	11
18-08-28	84.7	20	31.4	1260	12.5	160	1.31	5.56	9.1	<50	<1	<50	200	200	18	0.2	0.4	2.4	4
18-09-26	83.0	20	31.4	982	12.9	180	1.01	5.84	8.1	<50	<1	<50	280	280	23	0.1	0.4	1.7	7

Table 17: Inorganics results for ShdC, 2018

SITE ShdC: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	57	<1	15	54.0	<0.01	<0.1	<1	<1	120	1.0	33	0.9	<1	<0.1	0.8	<0.1	223	0.4	<1	<1
18-06-28	68	<1	16	48.0	<0.01	<0.1	<1	<1	180	1.0	29	0.9	<1	<0.1	0.8	<0.1	205	0.4	<1	1
18-07-31	25	<1	23	75.0	<0.01	<0.1	<1	<1	50	1.3	33	1.7	<1	<0.1	1.1	<0.1	341	0.8	<1	2
18-08-28	18	<1	24	71.0	<0.01	<0.1	<1	<1	60	1.2	31	1.8	<1	<0.1	1	<0.1	365	0.9	<1	<1
18-09-26	19	<1	19	65.0	<0.01	<0.1	<1	<1	70	1.1	33	1.3	<1	<0.1	0.7	<0.1	360	1.3	<1	<1

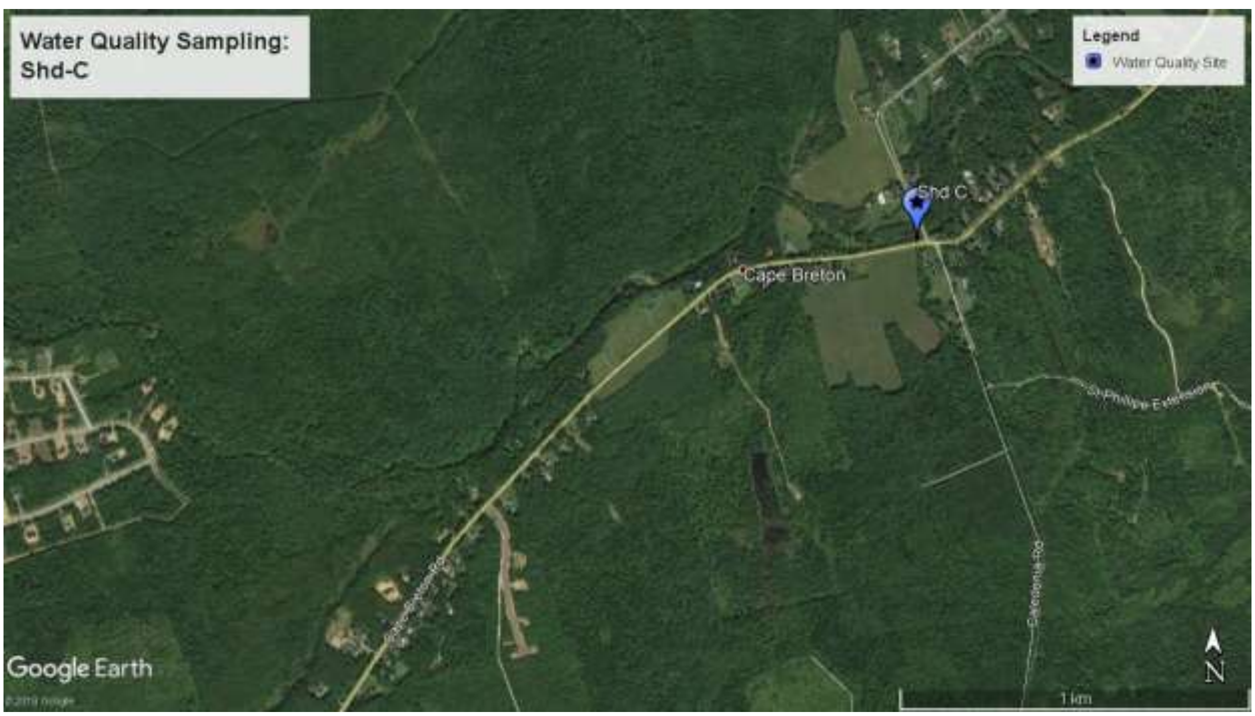


Figure 8: ShdC site location and surrounding land uses

Figure 9: Site photos for water quality sampling site ShdC, 2018

3.4 Shediac River – ShdE

This water quality sampling site is located in the main branch of the Shediac River, at the old covered bridge. The sample is taken upstream of the covered bridge. The surrounding land uses is mainly residences, forested land, ATV trails, and transmission power lines crossing overhead of the site. There are some clear-cut lots along the river further upstream, and some buffer zone in these areas may be less than 10-15 m.

The water sampling results for the site ShdE, for 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. The water temperature reached the limit for thermal stress in salmonids (22.5˚C) in July (23.20˚C). Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the mesotrophic range (10 – 20 µg/L) from May to July, and in the oligotrophic range (4 – 10 µg/L) in August and September. Results did not exceed any of the recommended CCME water quality guidelines for inorganics (heavy metals and other elements). Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 18: Water chemistry data and *E. coli* results for ShdE, 2018

SITE ShdE: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	16.0	15.40	0.07	11.23	4.1	42	29	0.113	139	48.4	-0.84	7.40	7.7	8.5	88.70	71	1.4
18-06-27	22.0	18.20	0.07	9.94	25.9	45	57	0.121	139	49	-0.80	6.95	7.7	8.5	90.35	75	2.0
18-07-31	27.0	23.20	0.10	8.94	16.0	81	9	0.212	213	84	-0.03	7.77	8	8	143.00	112	0.7
18-08-28	-	21.00	0.10	7.96	19.6	77	11	0.199	213	81.7	-0.46	7.86	7.6	8.1	140.40	111	0.7
18-09-26	21.0	13.00	0.10	11.04	8.2	71	5	0.161	202	75.4	-0.04	7.64	8.1	8.1	135.85	102	0.7

Table 19: Nutrient results for ShdE, 2018

SITE ShdE: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	41.8	20	15.0	197	13	130	0.82	2.65	8.2	<50	<1	<50	90	90	5	0.2	0.3	4.9	19
18-06-27	44.8	30	15.3	211	12.6	170	0.86	2.62	9.4	<50	<1	<50	80	80	6	0.3	0.4	7.7	14
18-07-31	80.2	30	26.5	754	10.8	180	1.21	4.32	8.4	<50	<1	<50	<50	<50	11	0.2	0.2	2.8	11
18-08-28	76.7	30	25.7	287	12.1	150	1.29	4.26	9.2	<50	<1	<50	<50	<50	11	0.2	0.2	3.3	9
18-09-26	70.1	20	23.6	830	11.1	170	0.94	4.01	7.6	<50	<1	<50	<50	<50	11	0.1	<0.2	2	6

Table 20: Inorganics results for ShdE, 2018

SITE ShdE: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	65	<1	10	57	<0.01	<0.1	<1	<1	200	0.9	40	0.5	<1	0.1	0.7	<0.1	125	0.2	<1	2
18-06-27	83	<1	11	54	<0.01	<0.1	<1	<1	300	0.9	41	0.5	<1	0.2	0.9	<0.1	123	0.2	<1	21
18-07-31	24	<1	17	86	<0.01	<0.1	<1	<1	120	1.2	53	1.1	<1	<0.1	1.2	<0.1	238	0.4	<1	2
18-08-28	24	<1	16	90	<0.01	<0.1	<1	<1	120	1.2	46	1	<1	<0.1	1.1	<0.1	236	0.4	<1	<1
18-09-26	16	<1	13	75	<0.01	<0.1	<1	<1	120	1.1	38	0.7	<1	<0.1	0.8	<0.1	217	0.5	<1	<1

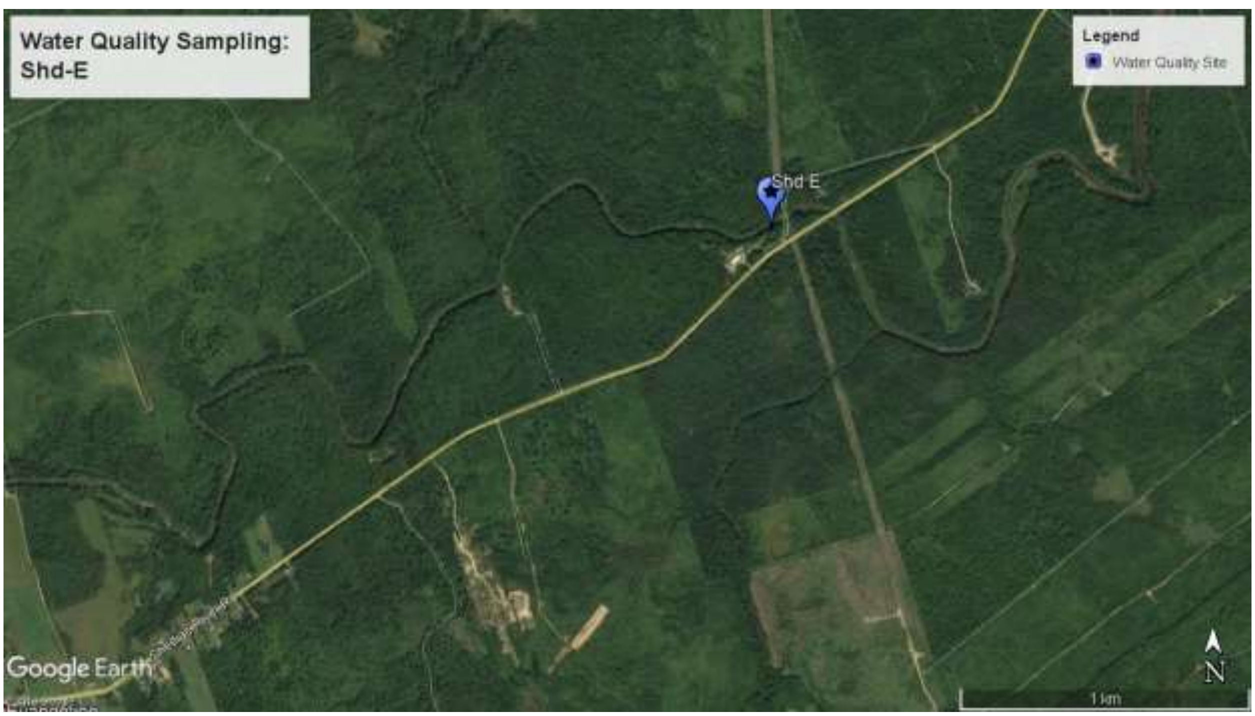


Figure 10: ShdE site location and surrounding land uses

Figure 11: Site photos for water quality sampling site ShdE, 2018

3.5 Shediac River – ShdG

This water quality sampling site is located in the Weisner Brook, at the small bridge on St-Philippe Rd. The sample is taken downstream of the bridge, due to a large beaver dam spanning the length of the bridge, creating deep beaver habitat unfit for chest waders. The surrounding land uses includes; residences, large open fields with ATV activity, forested land, transmission power lines, mineral extraction pit and farmland.

A few areas along the brook, in the open fields, have thinner buffer zone (> 10 m) mostly made up of young shrubs, but there is no agriculture or farming. However, to the left of the sampling site (looking upstream) directly upstream of the bridge, is a newly cut parcel of land. This lot clearing has reached the riverbanks in several areas, and has left little vegetation in the riparian area spanning approx. 175 m. The mineral extraction pit is located in the upper reaches of the Weisner Brook, over 3.3 km upstream. There is a tree buffer between the pit and the brook (> 160 m). Further upstream from the pit are few farm fields and clear cut areas, also with good tree density separating the fields from the brook (> 150 m).

The water sampling results for the site ShdG, for 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were in the: meso-eutrophic range (35 - 100 µg/L) in May and June; in the mesotrophic range (10 – 20 µg/L) in July and September; and finally in the ultra-oligotrophic range (>4) in August. Concentrations of iron exceeded the CCME water quality guideline (300 µg/L) in the months of May (330 µg/L) and June (430 µg/L). Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 21: Water chemistry data and *E. coli* results for ShdG, 2018

SITE ShdG: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	15.0	13.00	0.04	11.88	5.2	32	75	0.069	90.6	33.8	-1.47	7.16	7.4	8.9	58.50	47	1.0
18-06-27	22.0	16.50	0.04	10.90	28.8	32	113	0.068	81	31.3	-1.59	6.67	7.3	8.9	52.65	44	1.1
18-07-31	27.0	18.40	0.08	9.81	40.8	65	15	0.146	163	65.6	-0.50	7.55	7.8	8.3	109.20	83	1.0
18-08-28	-	17.40	0.06	8.64	90.0	51	58	0.116	131	51.4	-1.2	7.85	7.3	8.5	87.75	62	1
18-09-26	20.0	11.10	0.08	9.20	230.6	64	12	0.125	162	61.9	-0.44	7.65	7.9	8.3	110.50	81	0.8

Table 22: Nutrient results for ShdG, 2018

SITE ShdG: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	31.9	20	8.9	75	6.5	160	0.48	2.83	5.0	<50	<1	<50	<50	<50	3	0.4	0.4	8.3	27
18-06-27	31.9	20	8.4	60	5.8	200	0.37	2.52	5.1	<50	<1	<50	<50	<50	2	0.3	0.3	12.5	26
18-07-31	64.6	30	17.3	383	6.4	190	0.78	5.45	6.4	<50	<1	<50	<50	<50	7	0.2	0.2	3.4	14
18-08-28	50.9	20	13.3	95	6.1	190	0.63	4.42	5.6	<50	<1	<50	<50	<50	<1	0.3	0.3	9.5	0
18-09-26	63.5	20	16	474	6.4	190	0.85	5.34	6.4	<50	<1	<50	<50	<50	7	0.2	0.2	3	11

Table 23: Inorganics results for ShdG, 2018

SITE ShdG: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	70	<1	19	43	<0.01	0.1	<1	<1	**330**	1.1	88	<0.1	<1	0.2	0.5	<0.1	55	<0.1	<1	3
18-06-28	83	<1	14	43	<0.01	0.1	<1	<1	**430**	1.0	82	<0.1	<1	0.1	0.5	<0.1	50	<0.1	<1	3
18-07-31	29	<1	65	73	<0.01	0.1	<1	<1	180	1.9	99	0.1	<1	<0.1	0.8	<0.1	109	0.1	<1	<1
18-08-28	33	<1	44	64	<0.01	0.1	<1	<1	290	1.6	92	1	<1	<0.1	0.7	<0.1	0.09	<0.1	<1	2
18-09-26	27	<1	66	74	<0.01	0.1	<1	<1	160	1.8	81	<0.1	<1	0.1	0.8	<0.1	108	0.1	<1	<1

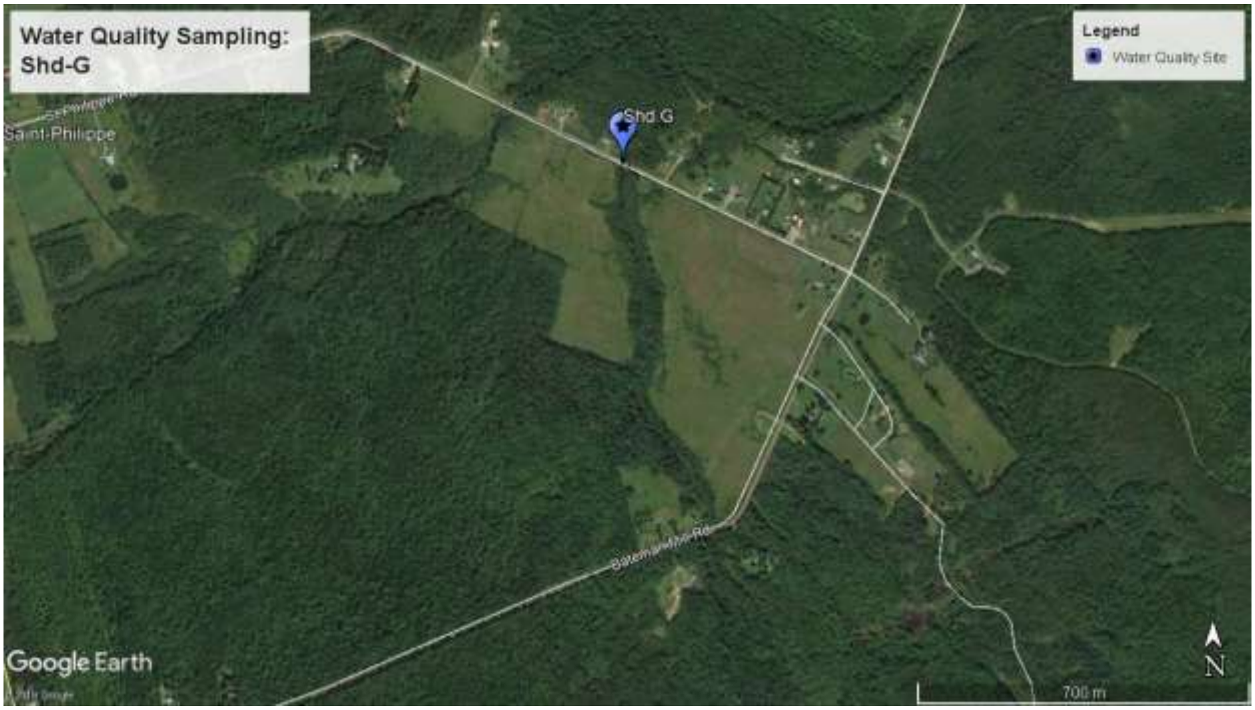


Figure 12: ShdG site location and surrounding land uses

Figure 13: Site photos for water quality sampling site ShdG, 2018

3.6 Shediac River – ShdH

This water quality sampling site is located in the Bateman Brook, at the culvert on Bateman Mill Rd. The sample is taken upstream from the culvert. The surrounding land uses includes mainly residences and farm fields for both the cultivation of hay and cattle. The building of a pig farm with an adjoining settling pond is evident on aerial imagery, but it is unknown whether there is still any activity. Further upstream in the Bateman Brook system are several active and/or recently active logging fields.

The tree buffer between the cattle/cultivation fields and the sampling site is on average 15 -20 m in density. Upstream from these fields is logging activity, also with tree lines as little at 10 - 20 m. The forestry activity takes place in various areas of the tributaries and wetlands of the Bateman Brook. Some areas show little in terms of buffer between fields and water or wetlands. Woody debris can be seen in a wetland from aerial imagery.

The water sampling results for the site ShdH, for 2018, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in June (6.17 mg/L), July (3.37 mg/L) and August (5.68 mg/L).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were in the meso-eutrophic range (20 – 35 µg/L) for all samples in 2018. Concentrations of iron exceeded the CCME water quality guideline (300 µg/L) for every sample taken in 2018. The highest level of iron was measured in the month of July; 1250 µg/L, more than 4X the recommended guideline. Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) for the sample taken in August; 449.4 MPN/100 mL.

Table 24: Water chemistry data and *E. coli* results for ShdH, 2018

SITE ShdH: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	14.0	14.20	0.07	9.25	48.0	38	56	0.116	146	45.3	-1.30	7.50	7.3	8.6	94.90	73	2.3
18-06-27	25.0	17.40	0.07	6.17	51.2	38	78	0.123	142	40.7	-1.55	7.60	7.1	8.6	93.60	75	1.8
18-07-31	26.0	21.00	0.10	3.37	131.4	80	29	0.200	209	75.2	-0.88	7.57	7.2	8.1	141.05	109	3.6
18-08-28	-	18.20	0.11	5.68	449.4	68	24	0.193	214	69.3	-0.68	7.92	7.5	8.2	143.65	107	2.5
18-09-26	19.0	10.80	0.12	7.95	262.8	76	12	0.176	232	80.7	-0.28	7.58	7.8	8.1	156.65	120	2.8

Table 25: Nutrient results for ShdH, 2018

SITE ShdH: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	37.9	30	14.2	71	17.8	130	0.71	2.39	10.9	<50	<1	<50	<50	<50	3	0.3	0.3	7.3	29
18-06-27	37.9	30	12.8	45	20.3	210	0.55	2.13	12.8	<50	<1	<50	<50	<50	2	0.4	0.4	10.0	23
18-07-31	79.9	40	23.7	119	18.1	140	0.80	3.88	11.1	<50	<1	<50	<50	<50	<1	0.2	0.2	3.7	29
18-08-28	67.8	30	21.7	202	23.6	150	0.80	3.67	13.7	<50	<1	<50	<50	<50	<1	0.2	0.2	4.6	22
18-09-26	75.5	30	25.4	448	25.2	140	1.57	4.20	13.0	<50	<1	<50	<50	<50	3	0.1	<0.2	2.4	21

Table 26: Inorganics results for ShdH, 2018

SITE ShdH: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	74	<1	5	78	<0.01	0.2	<1	<1	**460**	1.0	134	<0.1	<1	0.2	0.7	<0.1	84	0.1	<1	8
18-06-28	90	<1	5	77	<0.01	0.3	<1	<1	**740**	0.9	273	<0.1	<1	0.2	0.7	<0.1	75	0.1	<1	7
18-07-31	15	<1	5	141	<0.01	0.5	<1	<1	**1250**	1.6	757	0.1	<1	0.1	1.1	<0.1	152	0.2	<1	2
18-08-28	33	<1	5	133	<0.01	0.3	<1	<1	**850**	1.5	600	1	<1	0.1	1	<0.1	0.14	0.2	<1	1
18-09-26	34	<1	5	139	<0.01	0.2	<1	<1	**590**	1.6	238	<0.1	<1	0.3	1.8	<0.1	166	0.3	<1	1

Figure 14: ShdH site location and surrounding land uses

Figure 15: Site photos for water quality sampling site ShdH, 2018

3.7 Scoudouc River – ScdB

This water quality sampling site is located in the main branch of the Scoudouc River, at the bridge on Route 132, next to the *Waggin' Tail Inn*. The sample is taken downstream of the bridge. The surrounding land uses includes; residences, the Greater Shediac Sewerage Commission's aeration lagoons, the Scoudouc Industrial Park, the Highway 15 (in the headwaters of the river) and forested land.

The sample site is upstream from the treated wastewater's discharge pipe. The property to the left of the sampling site (looking upstream) mows the lawn up to the riverbank, leaving only a few shrubs and grass on the riparian area. Another property upstream of the bridge, to the right, also has similar lawn mowing trends. Erosion is evident on the left bank. The industrial park has forested land between the edge of the property and the wetlands and drainage system (> 900 m in tree density).

The water sampling results for the site ScdB, for 2018, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in July (4.65 mg/L), August (4.52

mg/L) and September (6.02 mg/L). Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the meso-eutrophic range (20 – 35 µg/L) in June, and in the eutrophic range (35 - 100 µg/L) in all other samples in 2018. Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in all samples taken in 2018. The highest aluminum value was in June (306 µg/L); 3X the recommended limit. Concentrations of iron exceeded the CCME water quality guideline (300 µg/L) for every sample taken in 2018. The highest iron value was in July (1620 µg/L), more than 5X the recommended limit. Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in the sample of August and September; 626.0 MPN/100 mL and 522.6 MPN/100 mL respectively.

Table 27: Water chemistry data and *E. coli* results for ScdB, 2018

SITE ScdB: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	11.0	13.00	0.06	7.23	82.0	30	120	0.092	118	35.2	-2.12	7.1	7.1	8.8	77.35	60	3.4
18-06-27	21.0	13.70	0.04	8.88	146.7	15	202	0.064	80	19.5	-2.44	6.9	6.9	9.3	53.30	45	2.4
18-07-31	26.0	20.90	0.07	4.65	344.8	50	140	0.134	139	47.5	-1.24	7.2	7.2	8.4	94.90	80	7.7
18-08-28	-	17.40	0.08	4.52	626.0	60	170	0.141	160	57.2	-0.89	7.4	7.4	8.3	107.25	85	9.2
18-09-26	18.0	10.60	0.11	6.02	522.6	80	61	0.174	226	86.2	-0.2	7.8	7.8	8	156.00	119	13.4

Table 28: Nutrient results for ScdB, 2018

SITE ScdB: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	30.0	40	11.5	36	14	200	0.51	1.58	10.2	<25	<1	<25	<25	<25	3	0.5	0.5	15.3	36
18-06-27	15.0	30	6.2	11	13.5	350	0.27	0.94	9.3	<25	<1	<25	<25	<25	2	0.7	0.7	5.1	24
18-07-31	49.9	60	15.6	74	19	290	0.60	2.07	9.5	<25	<1	<25	<25	<25	<5	0.8	0.8	19.2	60
18-08-28	59.8	80	19	141	15	300	0.66	2.38	9.1	<25	<1	<25	<25	<25	<5	0.8	0.8	20	58
18-09-26	79.5	110	28.9	472	18.4	200	0.94	3.42	11.1	<25	<1	<25	<25	<25	5	0.4	0.4	7.7	53

Table 29: Inorganics results for ScdB, 2018

SITE ScdB: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	149	<1	9	27	0.01	0.3	<1	<1	570	0.6	184	0.2	<1	0.4	0.8	<0.1	49	0.2	<1	8
18-06-27	306	<1	8	24	0.02	0.2	<1	<1	750	0.6	89	<0.1	<1	0.3	0.5	<0.1	28	0.1	<1	9
18-07-31	162	1	8	39	0.03	0.6	<1	<1	1620	0.9	548	0.2	<1	0.8	1.4	<0.1	76	0.3	1	4
18-08-28	141	<1	11	41	<0.01	0.7	<1	<1	1480	0.9	866	0.3	<1	0.6	1.5	<0.1	79	0.5	1	2
18-09-26	187	<1	8	54	0.02	0.7	<1	<1	1180	1.2	561	0.2	<1	1.4	1.5	<0.1	109	0.9	4	4

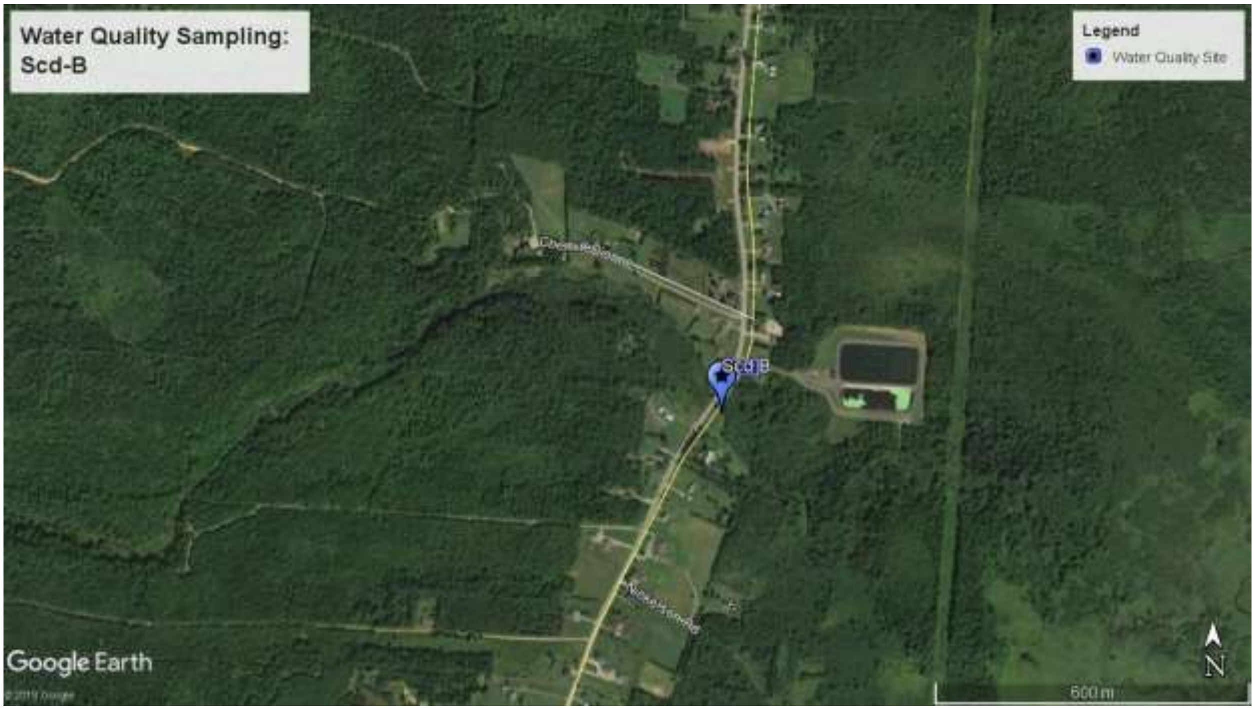


Figure 16: ScdB site location and surrounding land uses

Figure 17: Site photos for water quality sampling site ScdB, 2018

3.1 Scoudouc River – ScdE-2

This water quality sampling site is located in the main branch of the Scoudouc River, and is accessed through a private property with landowner permission. Off Scoudouc River Rd, there is a large field that the staff uses to access a trail in the far right corner (1 km from the road). The path is marked with flagging tape and leads to the River. This site is located approx. 11 km downstream from the aeration lagoons. The surrounding land uses is mainly a few residences, forested land, wetlands, ATV trails, and one mineral extraction pit. The pit has a dense tree buffer between the outer limit and the beginning of the wetlands surrounding the river (> 350 m).

The water sampling results for the site ScdE-2, for 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were in the eutrophic range (35 – 100 µg/L) from May to July, and in the meso-eutrophic range (20 – 35 µg/L) in August and September. Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) for the sample taken in May, June and August. Concentrations of iron exceeded the CCME water quality guideline (300 µg/L) for every sample taken in 2018. The highest iron value was in August (1140 µg/L), nearly 4X the recommended limit. Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 30: Water chemistry data and *E. coli* results for ScdE-2, 2018

SITE ScdE-2: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	12.0	13.90	0.04	8.86	4.1	20	130	0.064	82.7	23.7	-1.69	7.0	7.0	9.1	52.65	44	2.1
18-06-27	24.0	16.60	0.03	9.09	65.7	16	187	0.061	72	19	-2.62	6.7	6.7	9.3	46.80	42	2.9
18-07-31	26.0	21.40	0.05	6.90	73.3	30	150	0.094	97	29.5	-1.66	7.2	7.2	8.9	65.65	54	3.7
18-08-28	-	18.50	0.04	6.69	181.6	30	220	0.077	83	25.9	-1.51	7.4	7.4	8.9	57.20	52	2.8
18-09-26	17.0	10.60	0.06	10.45	134.0	32	92	0.090	115	30.1	-1.12	7.7	7.7	8.8	79.95	59	3.4

Table 31: Nutrient results for ScdE-2, 2018

SITE ScdE-2: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	20.0	30	7.7	19	14	210	0.35	1.08	7.5	<25	<1	<25	<25	<25	<5	0.4	0.4	14.3	36
18-06-27	16.0	30	6.1	8	15.7	290	0.28	0.90	8.4	<25	<1	<25	<25	<25	2	0.7	0.7	4.4	36
18-07-31	29.9	50	9.6	45	15	280	0.34	1.36	8.5	<25	<1	<25	<25	<25	<5	0.7	0.7	21.0	37
18-08-28	29.9	50	8.55	71	14	330	0.39	1.11	7.9	<25	<1	<25	<25	<25	<5	0.8	0.8	27	29
18-09-26	31.8	80	9.84	150	16.1	240	0.48	1.34	10.8	<25	<1	<25	<25	<25	<5	0.4	0.4	12.4	24

Table 32: Inorganics results for ScdE-2, 2018

SITE ScdE-2: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	**146**	<1	7	24	<0.01	0.2	<1	<1	**600**	0.7	81	<0.1	<1	0.3	0.6	<0.1	40	<0.1	<1	4
18-06-27	**273**	<1	6	25	0.01	0.2	<1	<1	**790**	0.5	108	<0.1	<1	0.3	0.5	<0.1	31	<0.1	<1	7
18-07-31	99	<1	7	35	<0.01	0.2	<1	<1	**900**	0.6	117	0.1	<1	0.3	0.9	<0.1	59	<0.1	<1	2
18-08-28	**167**	<1	6	32	0.01	0.2	<1	<1	**1140**	0.7	132	0.1	<1	0.3	0.8	<0.1	52	<0.1	<1	2
18-09-26	56	<1	5	33	<0.01	0.2	<1	<1	**540**	0.7	85	<0.1	<1	0.3	0.8	<0.1	74	<0.1	<1	<1

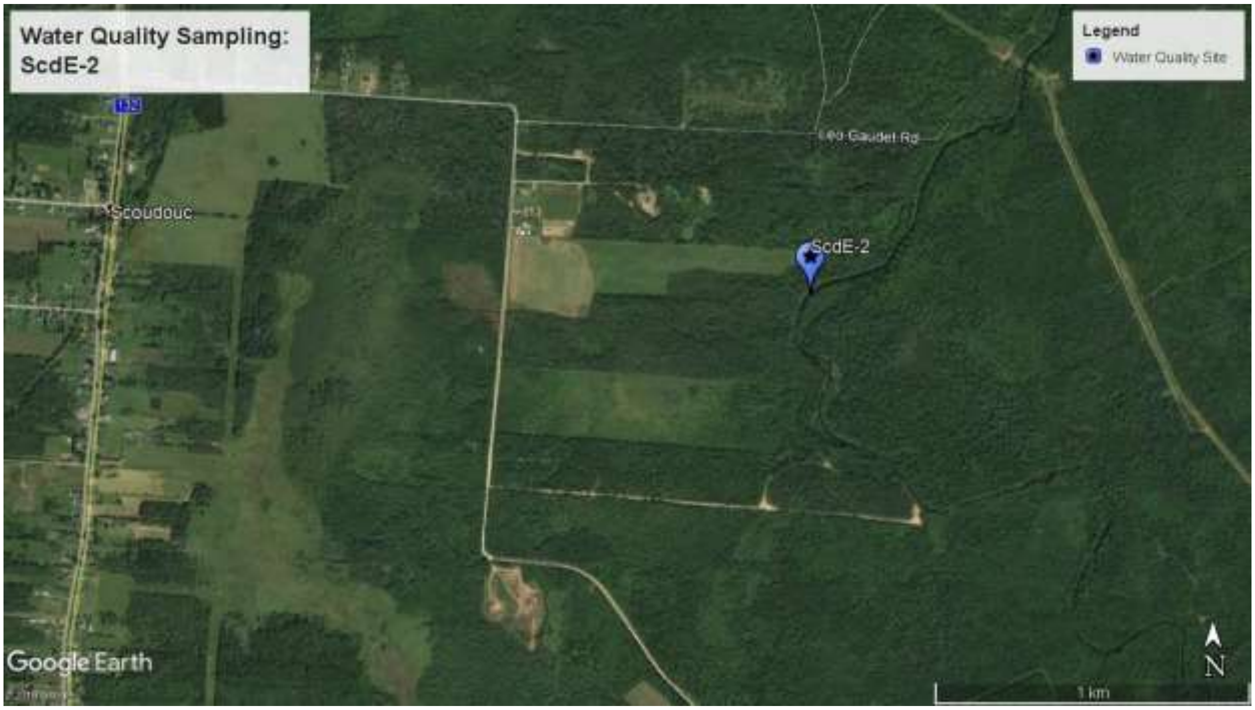


Figure 18: ScdE-2 site location and surrounding land uses


Figure 19: Site photos for water quality sampling site ScdE-2, 2018

3.2 Scoudouc River – ScdF

This water quality sampling site is located in an unnamed tributary of the Scoudouc River, accessed by the public dirt road, Pellerin Rd, off Lino Road. On Google maps, the road shows up as Sackville Road. The sample is taken downstream of the road's culvert. The surrounding land uses in mainly cottages, forests, wetlands, ATV trails, and at the headwaters, a bog being exploited for peat moss. The peat moss extraction spans over 200 hectares as seen and measured on aerial imagery of 2017. The site was inaccessible because of road conditions in May and June.

The water sampling results for the site ScdF, for 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were in the eutrophic range (35 – 100 µg/L) in July and August, and in the hyper-eutrophic range (>100 µg/L) in September. Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in all samples taken in 2018. The highest aluminum value was in September (813 µg/L); 8X the recommended limit. Concentrations of iron exceeded the CCME water quality guideline (300 µg/L) for every sample taken in 2018. The highest iron value was in September (1680 µg/L); over 5X the recommended limit. Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 33: Water chemistry data and *E. coli* results for ScdF, 2018

SITE ScdF: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30				-								-	-				
18-06-27				-								-	-				
18-07-31	20.0	19.20	0.05	7.01	162.4	38	<5	0.098	106	45	-1.00	7.6	7.6	8.6	71.50	67	12.6
18-08-28	-	17.00	0.04	7.95	357.0	40	250	0.069	79	32.6	-1.11	7.6	7.6	8.7	53.95	49	6.8
18-09-26	15.0	10.80	0.06	8.00	202.4	44	87	0.092	111	47.4	-0.81	7.7	7.7	8.5	81.90	59	159

Table 34: Nutrient results for ScdF, 2018

SITE ScdF: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30																			
18-06-27																			
18-07-31	37.8	40	14.3	141	5.1	220	0.68	2.26	4.6	90	1	<50	<50	<50	15	0.5	0.5	14.7	49
18-08-28	39.8	20	10.2	149	6	320	0.59	1.74	3.8	<25	<1	<50	<25	<50	<5	0.7	0.7	25	38
18-09-26	43.8	20	15	206	4.7	210	0.91	2.42	4.7	<25	<1	<50	<05	<50	2	0.3	0.3	9.6	440

Table 35: Inorganics results for ScdF, 2018

SITE ScdF: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30																				
18-06-27																				
18-07-31	**150**	1	5	50	0.01	0.3	<1	<1	**1300**	0.7	184	0.2	<1	0.7	1.3	<0.1	234	0.2	1	3
18-08-28	**204**	<1	5	49	<0.01	0.2	<1	<1	**1360**	0.9	111	0.2	<1	0.5	1	<0.1	75	0.3	1	2
18-09-26	**813**	<1	4	86	0.02	1.1	<1	1	**1680**	1.2	195	<0.1	1	3.2	1.5	<0.1	89	0.3	2	5

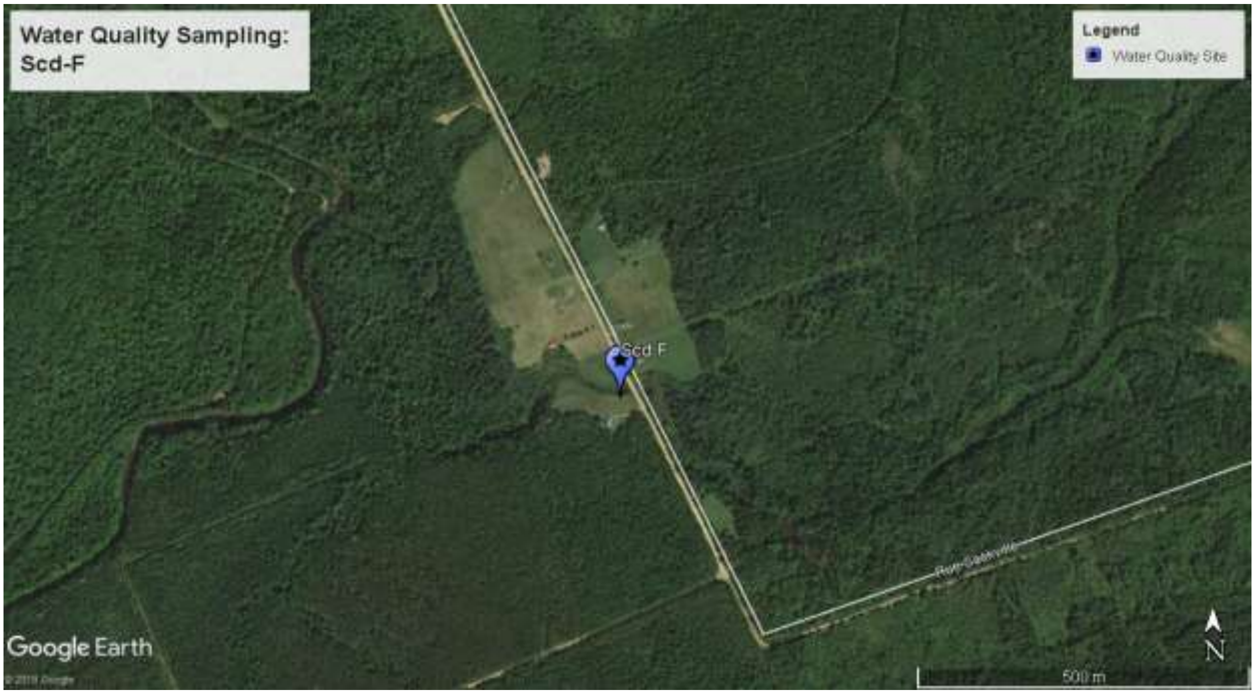


Figure 20: ScdF site location and surrounding land uses

Figure 21: Site photos for water quality sampling site ScdF, 2018

3.3 Scoudouc River – ScdH

This water quality sampling site is located in the Cornwall Brook, accessed through a farmer's road, with permission. This small road is located passed the end of Promenade Harbour View, behind the *Seaside Chevrolet Dealership*. The surrounding land uses includes; residences, agricultural fields, cattle fields, Highway 15, a mineral extraction pit, transmission power lines and the Scoudouc Industrial Park.

The farm fields on both sides of the sampling site has buffer zones ranging from 10 -30 metres. There is a beaver dam directly above the sample site, and beaver activity has reduced the density of trees in the buffer zone. Other clear cut fields upstream now serve as cattle pastures, and seem to have buffer zones > 25 m. The sand/gravel pit upstream (approx. 3 ha.) has a forested buffer over 400 m. However, there seems to be drainage near the pit that flows towards the brook. The headwaters of the Cornwall Brook is located near the industrial park. There is forested land between the industrial zone and the wetlands, and based on approximate land elevations, there does not appear to be drainage heading towards the brook.

The water sampling results for the site ScdH, for 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were in the meso-eutrophic range (20 – 35 µg/L) in May,July and August, and in the eutrophic range (35 – 100 µg/L) in June and September. Results slightly exceeded long term limits for chloride in freshwater (120 mg/L) in July, August and September. The short term limits for chloride in freshwater were not exceeded (640 mg/L). Consultations are needed to determine the possible sources and impacts of chloride on this watercourse. Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) for the samples taken in June. Concentrations of iron exceeded the CCME water quality guideline (300 µg/L) for the samples taken in June and September. Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 36: Water chemistry data and *E. coli* results for ScdH, 2018

SITE ScdH: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-30	10.0	9.60	0.14	10.92	10.8	59	33	0.203	292	56.4	-0.92	7.4	7.4	8.3	186.55	140	3.1
18-06-27	21.0	12.50	0.14	11.05	73.8	2	76	0.218	286	42.4	-1.03	7.5	7.5	8.5	185.90	146	2.4
18-07-31	22.0	20.00	0.41	6.80	156.5	140	30	0.750	809	115	0.1	7.8	7.8	7.7	539.50	417	1.6
18-08-28	-	17.30	0.35	7.16	197.4	120	26	0.610	691	99.7	-0.22	7.6	7.6	7.8	461.50	356	1.8
18-09-26	15.0	11.30	0.56	8.18	207.8	140	29	0.820	1080	108	0.24	8	8	7.8	728.00	561	2.7

Table 37: Nutrient results for ScdH, 2018

SITE ScdH: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-30	58.8	60	18.7	139	45.7	140	1.40	2.36	35.4	<50	<1	<50	<50	<51	<1	0.3	0.3	6.3	22
18-06-27	47.8	70	14.0	142	56.5	260	1.03	1.81	42.1	<50	<1	<50	70	70	<1	0.5	0.6	11.2	36
18-07-31	139.0	200	38.7	825	157	250	3.98	4.47	108.0	<50	<1	<50	200	200	18	0.4	0.6	7.9	34
18-08-28	120.0	140	33	447	131	240	3.24	4.20	92.4	<50	<1	<50	400	400	16	0.4	0.8	6.2	32
18-09-26	139.0	210	35.6	1300	229	270	5.90	4.60	173.0	<50	<1	<50	230	230	26	0.5	0.7	8	55

Table 38: Inorganics results for ScdH, 2018

SITE ScdH: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-30	59	<1	123	68	<0.01	0.1	<1	<1	170	0.9	119	0.9	<1	0.1	0.8	<0.1	96	0.1	<1	6
18-06-27	138	<1	135	56	0.01	0.2	<1	<1	330	0.8	69	0.8	<1	0.2	0.7	<0.1	71	<0.1	<1	3
18-07-31	51	<1	634	127	0.01	0.3	<1	<1	300	1.7	252	2.2	1	0.1	2.5	<0.1	96	0.5	1	1
18-08-28	51	<1	304	112	0.01	0.2	<1	<1	260	1.2	250	1.4	<1	0.1	1.7	<0.1	178	0.5	2	1
18-09-26	71	<1	501	120	0.02	0.3	<1	<1	370	1.3	294	1.4	1	0.2	3.2	<0.1	208	0.5	1	2

Figure 22: ScdH site location and surrounding land uses

Figure 23: Site photos for water quality sampling site ScdH, 2018

3.4 Bacterial Sampling Summary

The bacterial levels measured in the 2018 sampling of the Shediac and Scoudouc River are summarized below.

For the Shediac River, there are 3 samples that surpassed the Canadian Recreational Water Quality Guideline (400 MPN/100 mL); the site ShdB in August and September, and the site ShdH in August. There was no rainfall in the 24 hours prior to the sampling in August. There was an occurrence of rainfall (> 10 mm) in the 24-hour period prior to a sample was in the month of September.

For the Scoudouc River, there are 2 samples that surpassed the Canadian Recreational Water Quality Guideline (400 MPN/100 mL); the site ScdB in August and September. As mentioned above, there was an occurrence of rainfall (> 10 mm) in the 24-hour period prior to a sample was in the month of September.

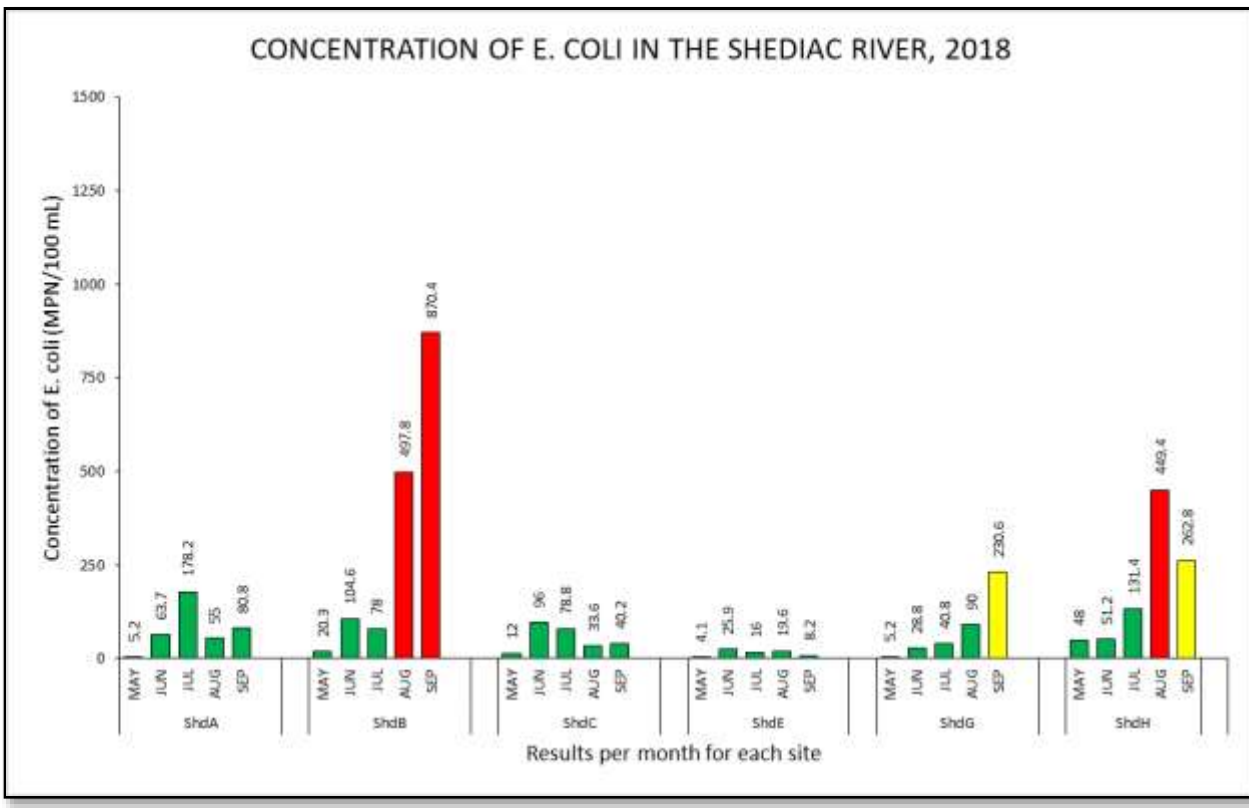


Figure 24: Summary of water quality results for *E. coli*, Shediac River sampling 2018

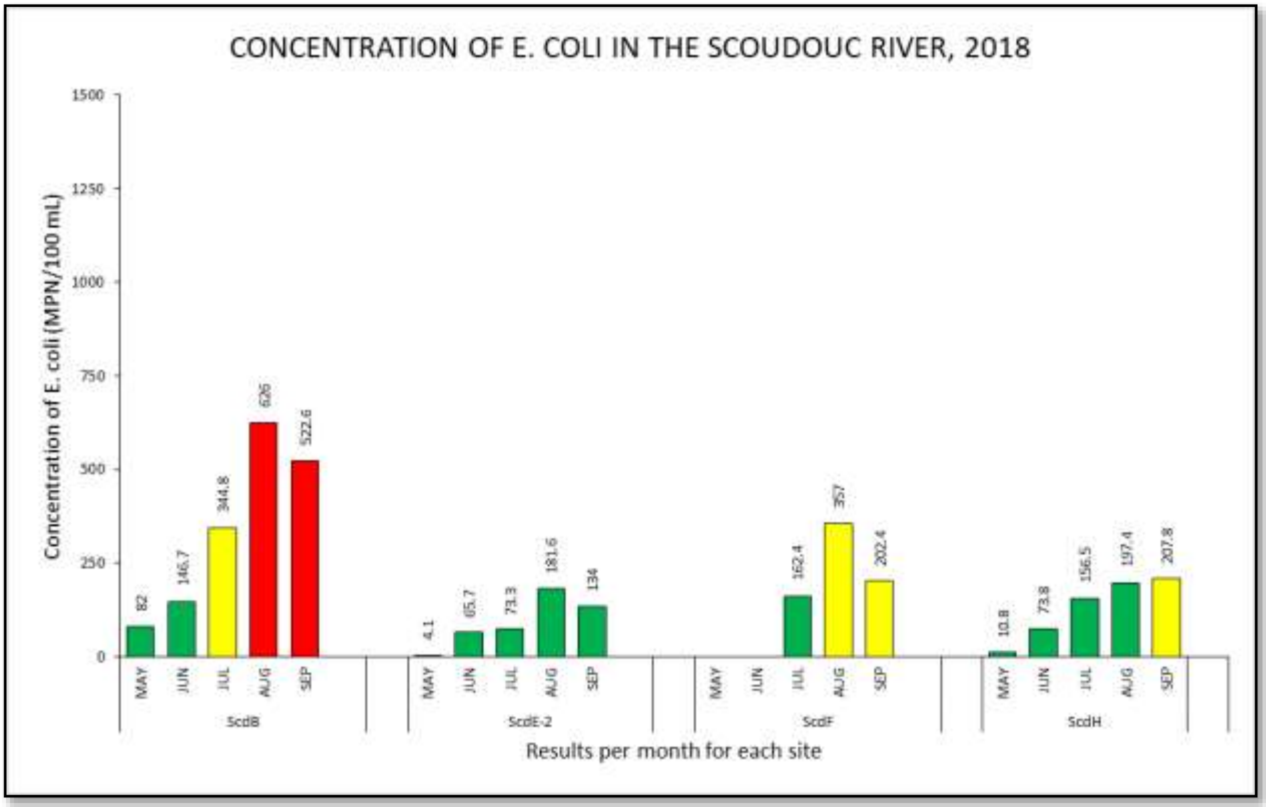


Figure 25: Summary of water quality results for E. coli, Scoudouc River sampling 2018

4. Water Temperature Monitoring

This part of the project is done in partnership with the "*Institut national de la recherche scientifique*" (INRS) in the province of Quebec. In 2016, the SBWA received 3 loggers from INRS to be installed in major tributaries. In 2017, the SBWA purchased 4 additional loggers of the same type (HOBO light pendants), and placed them in strategic locations to monitor temperature fluctuations. Having a total of 7 loggers, the strategy is to monitor temperatures in areas determined to be high risk for thermal stress in juvenile salmonids, and to monitor areas that are determined to be cold zones suitable for thermal refugia.

The watercourses being monitored are the main branch of the Shediac River, the McQuade Brook, the Weisner Brook, and the main branch of the Scoudouc River. The McQuade Brook has been shown to be an important salmon spawning brook in this watershed. The Weisner Brook is considered to be a cold-water refuge for salmonids according to the *Department of Natural Resources of New Brunswick*. The area of the covered bridge is considered to be very warm, due to the lack of canopy coverage and wide shallow channel. It is assumed that in periods of high temperatures and thermal stress, salmonids and other fish could migrate downstream to seek the colder waters of the Weisner Brook.

The temperature loggers were installed at the end of May, and recovered at the end of September. The following section of this report is the thermograph data showing daily maximum temperatures recorded by the loggers. The recommended temperature limits indicate the threshold for thermal stress begins at 22.5°C for juvenile Atlantic salmon, and upper lethal limits are 25°C or greater (Crisp 1999).

Table 39: Thermograph monitoring site information, SBWA 2018

Monitoring station	Name of the watercourse	Latitude	Longitude	Installation date	Date of retrieval
T-ShdA	**Shediac River**	**N46°11'36.70''**	**W64°48'56.00''**	05/28/2018	09/27/2018
T-ShdB	**McQuade Brook**	**N46°13'55.10''**	**W64°44'32.05''**	05/28/2018	09/27/2018
T-ShdE	**Shediac River**	**N46°14'41.50''**	**W64°39'56.30''**	05/28/2018	09/27/2018
T-ShdE-2A	**Weisner Brook**	**N46°14'28.90''**	**W64°39'39.00''**	05/28/2018	09/27/2018
T-ShdM	**Weisner Brook**	**N46°12'26.50''**	**W64°40'20.30''**	05/28/2018	09/27/2018
T-ScdB	**Scoudouc River**	**N46°08'39.20''**	**W64°33'36.60''**	05/28/2018	09/27/2018
T-ScdD	**Scoudouc River**	**N46°11'02.03''**	**W64°30'39.83''**	05/28/2018	09/27/2018

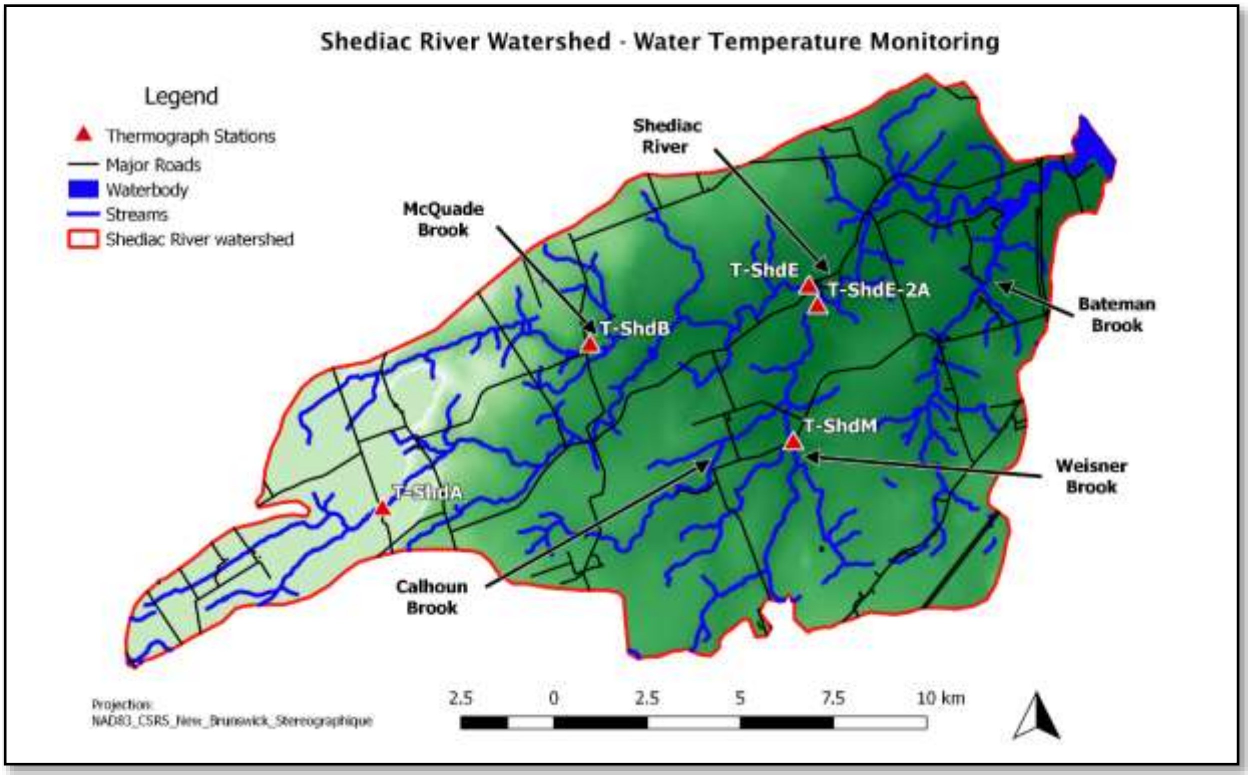


Figure 26: Map of temperature logger placement in the Shediac River, SBWA

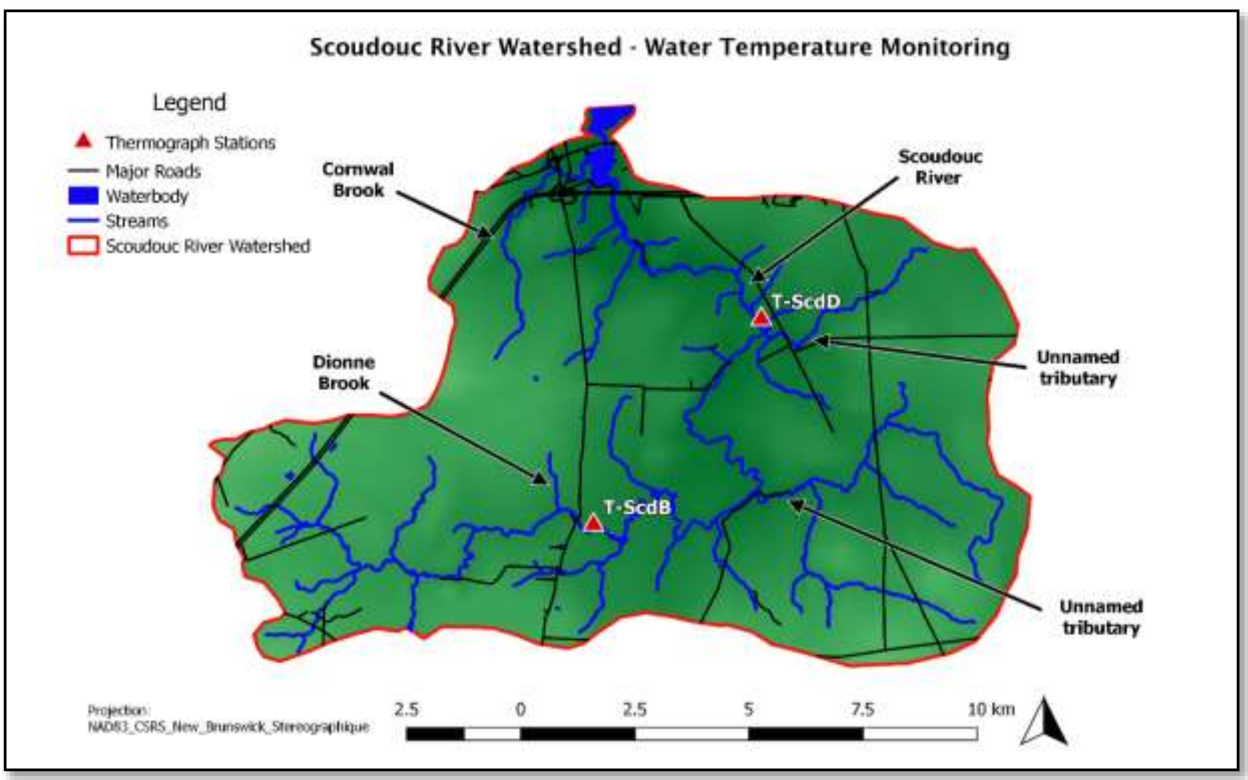


Figure 27: Map of temperature logger placement in the Scoudouc River, SBWA

4.1 Thermograph monitoring station T-ShdA

This temperature logger is located in the main branch of the Shediac River, in the upper-reaches near Irishtown. This area was predicted to have lower temperatures due to the canopy coverage and narrow channel. However, the logger is placed in the same area where new development of a residential area is currently taking place. This logger is collecting baseline data of current water temperatures, and will be used to measure the impact of the deforestation taking place directly next to the site.

The thermograph data shows the maximum daily temperatures between May 29th and September 26th. The maximum temperatures exceeded the thermal stress threshold on 41 occasions during the peak of the summer months. Of those 41 days, the maximum temperatures exceeded the lethal limit on 12 occasions. The maximum temperatures exceeded the threshold for 32 consecutive days (July 16 to August 16). The highest maximum temperature recorded at this station was 26.68°C on July 25 and the highest average daily temperature was 24.30°C.

Considering that 2018 was a warmer year than 2017, there is a considerable increase in temperature readings in 2018. In 2017, maximum temperatures exceeded the threshold on 25 days, of only 7 were consecutive, and exceeded the lethal limit only once.

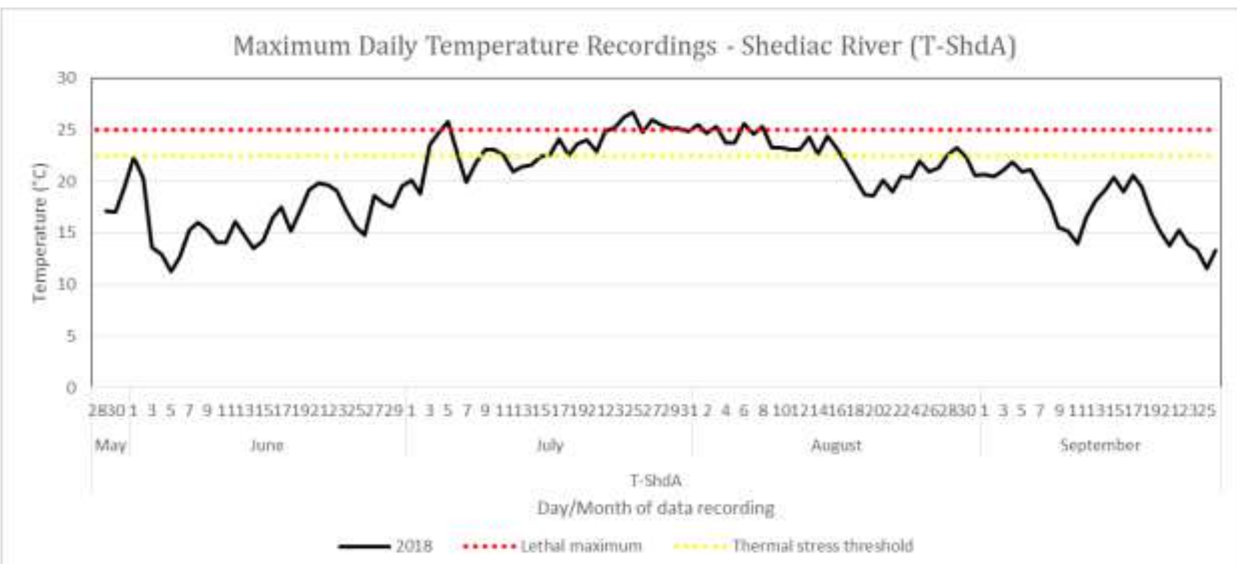


Figure 28: Thermograph data chart for monitoring station ID T-ShdA, Shediac River 2018

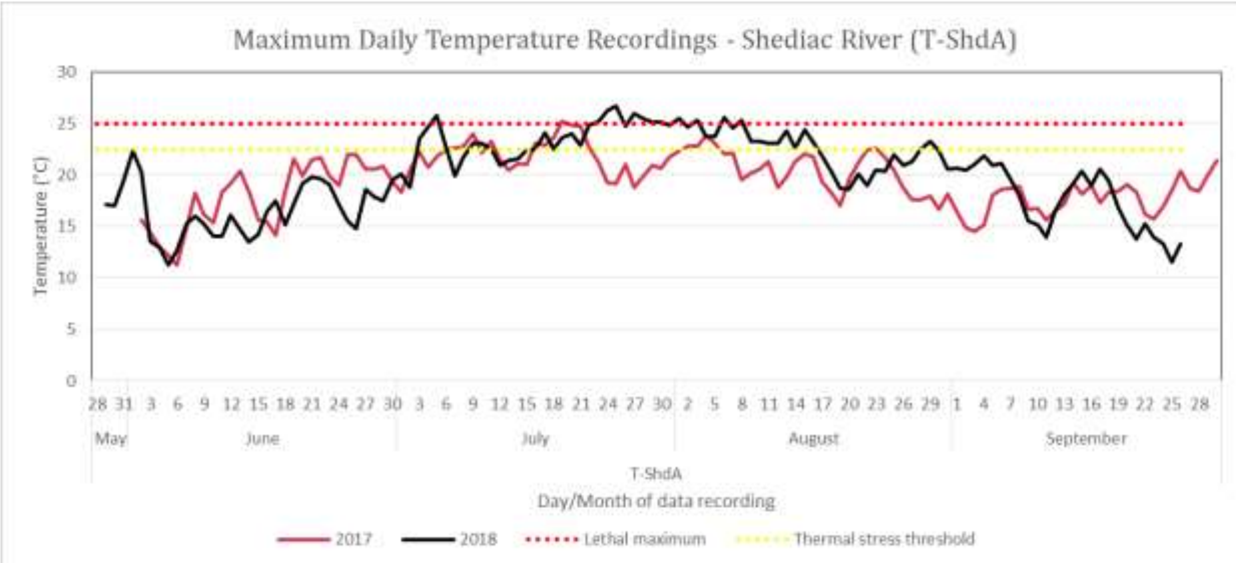


Figure 29: Thermograph data chart for monitoring station ID T-ShdA, Shediac River 2017-2018

4.2 Thermograph monitoring station T-ShdB

This temperature logger was installed in the McQuade Brook, directly below the fish ladder and upstream of the electrofishing site EShdB-02.

The thermograph shows the maximum daily temperature between May 29th and September 26th. The maximum temperatures exceeded the thermal stress threshold on 43 occasions during the peak of the summer months. During theses 43 days, the maximum temperatures exceeded the lethal limit on 15 occasions. The thermal stress threshold was exceeded for 33 days (July 15 to August 16). The highest maximum temperature recorded at this station was 26.59°C, which occurred on 2 occasions (on July 25 and July 27). The highest average daily temperature was 24.04°C.

The temperatures for this site are significantly higher than the two previous year's readings. In 2016, the thermal stress threshold was surpassed 13 times in total during the peak of the summer months, in July and August. Those occasions lasted between 2 and 4 consecutive days. The highest temperatures measured at this station did not surpass lethal limits.

In 2017, maximum temperatures exceeded the threshold on 39 days, in which on three occasions exceed the thermal stress threshold on 14 occasions during the peak of the summer months; 4 independent days, 6 consecutive days in July and 4 in August. The maximum daily temperatures exceeded the lethal maximum limit only once.

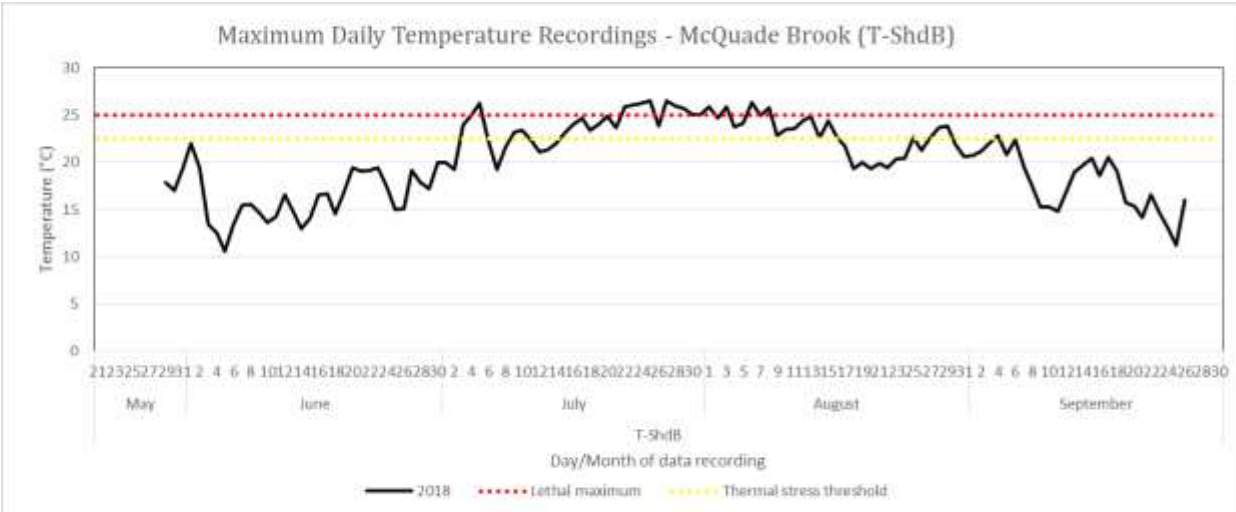


Figure 30: Thermograph data chart for monitoring station ID T-ShdB, Shediac River 2018

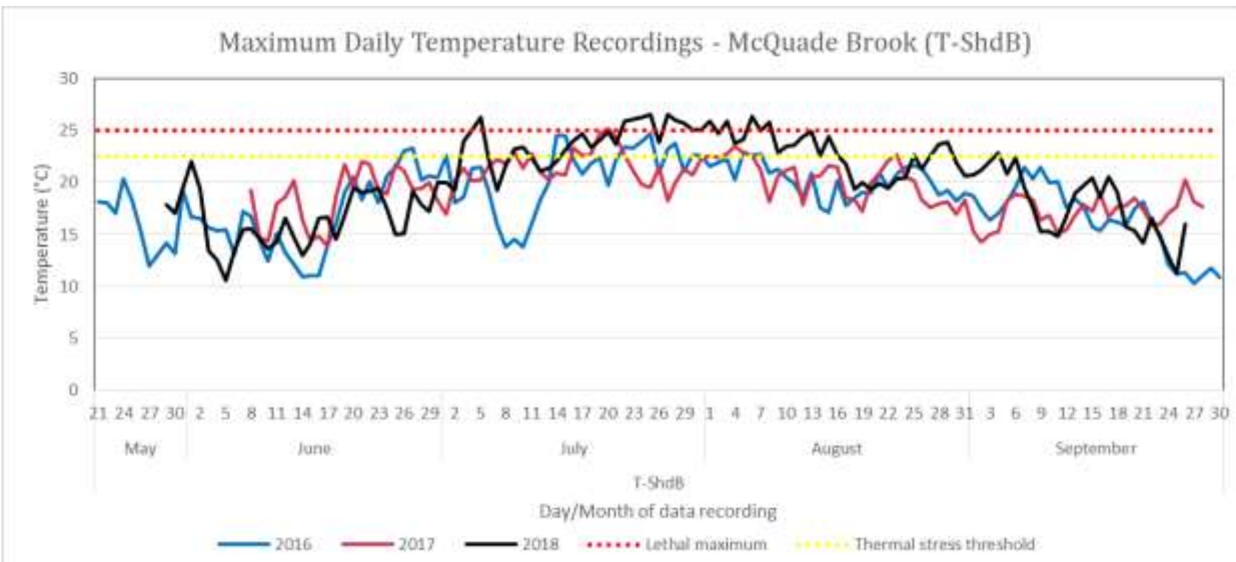


Figure 31: Thermograph data chart for monitoring station ID T-ShdB, Shediac River 2016-2018

4.3 Thermograph monitoring station T-ShdE

This temperature logger is located in the main branch of the Shediac River, in the mid-lower reaches near the covered bridge. This area was predicted to have warmer waters due to the lack of canopy coverage, and its wide and shallow channel.

The thermograph data shows the maximum daily temperature between May 29th and September 26th. The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 63 occasions during the peak of the summer months. Of those 63 days, the maximum temperatures exceeded the lethal limit (25°C) on 33 occasions. For an alarming stretch of 17 consecutive days (from July 19 to August 4), the maximum temperatures exceeded the lethal limits, ranging from 25.22°C to 30.05°C. The highest maximum temperature recorded at this station was 30.05°C on July 24, and the highest average daily temperature was 26.01°C.

In 2017, maximum temperatures exceeded the threshold on 56 occasions during the peak of the summer months, on 22 consecutive days in July. The thermograph also shows that the maximum temperatures exceeded the lethal maximum on 23 occasions.

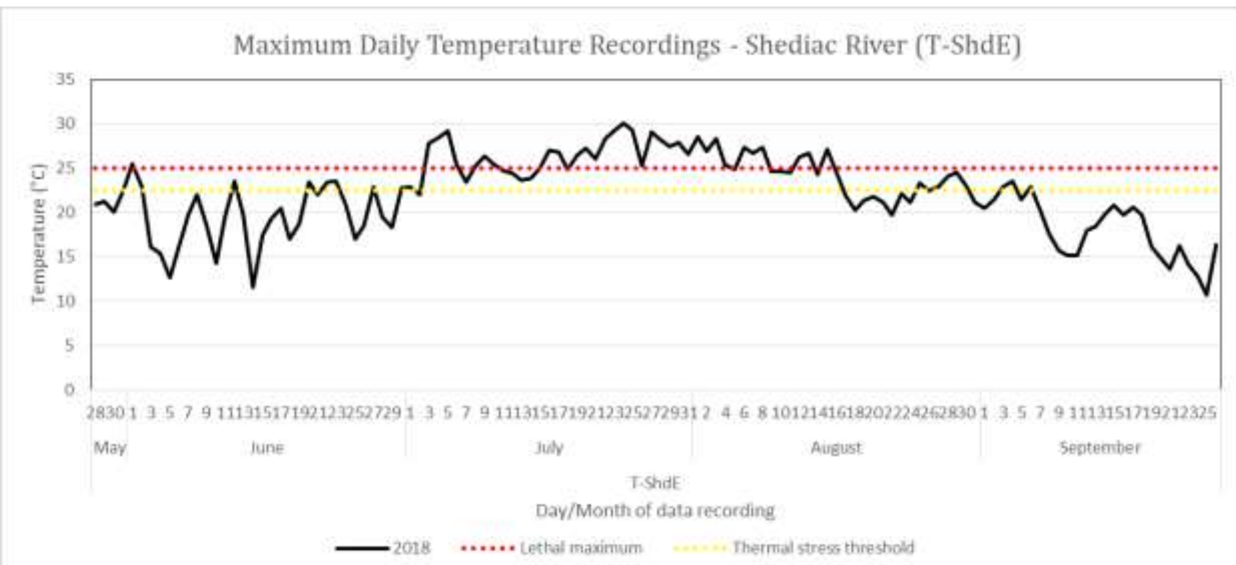


Figure 32: Thermograph data chart for monitoring station ID T-ShdE, Shediac River 2018

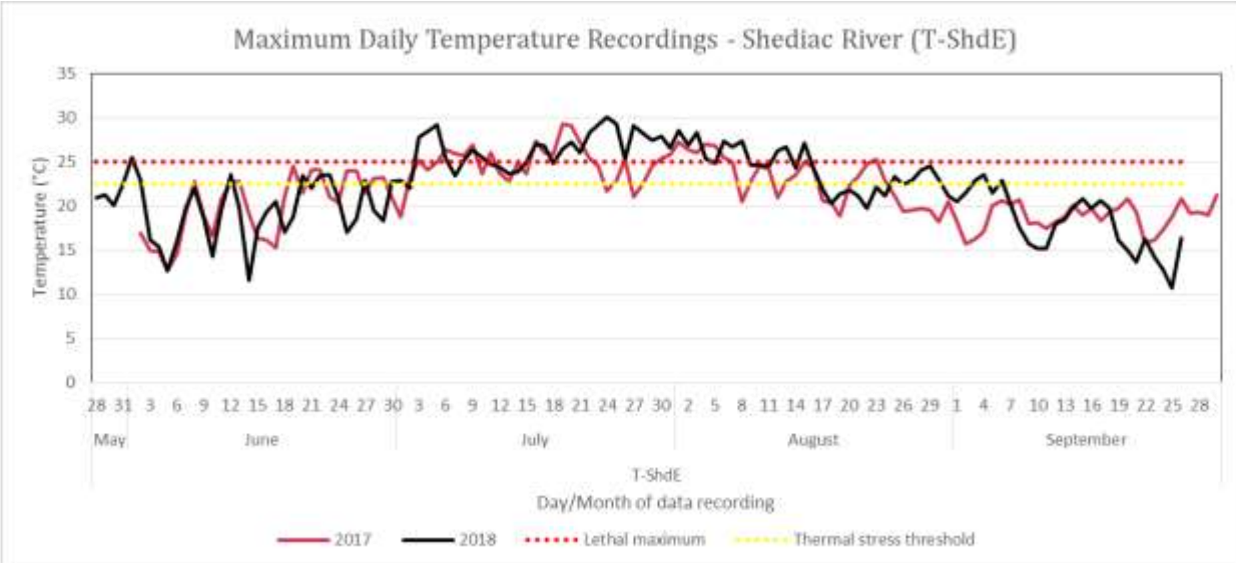


Figure 33: Thermograph data chart for monitoring station ID T-ShdE, Shediac River 2017-2018

4.4 Thermograph monitoring station T-ShdE-2A

This temperature logger was installed in a tributary of the Shediac River (Weisner Brook), about a half kilometres from the ShdE temperature logger station. This station's temperature readings exceeded fewer thermal stress threshold and lethal limit temperatures than the ShdE station. This is most likely due to the depth of the stream and the abundant canopy of trees on both sides providing adequate shade.

The thermograph shows the maximum daily temperatures between May 29th and September 26th. The maximum temperatures exceeded the thermal stress threshold on 32 occasions during the peak of the summer months. Of those 32 days, the maximum temperatures exceeded the lethal limit on only 10 occasions. The maximum temperatures exceeded the thermal stress threshold for 17 consecutive days (July 19 to August 4). During this time, the maximum temperatures exceed the lethal limit for 3 consecutive days (July 23 to July 25) and for 4 consecutive days (July 24 to July 30). The highest maximum temperature recorded at this station was 26.98°C on July 24 and the highest average daily temperature was 23.36°C.

Only one year of data is available for this site, due to the accidental loss of the data on the logger in 2017.

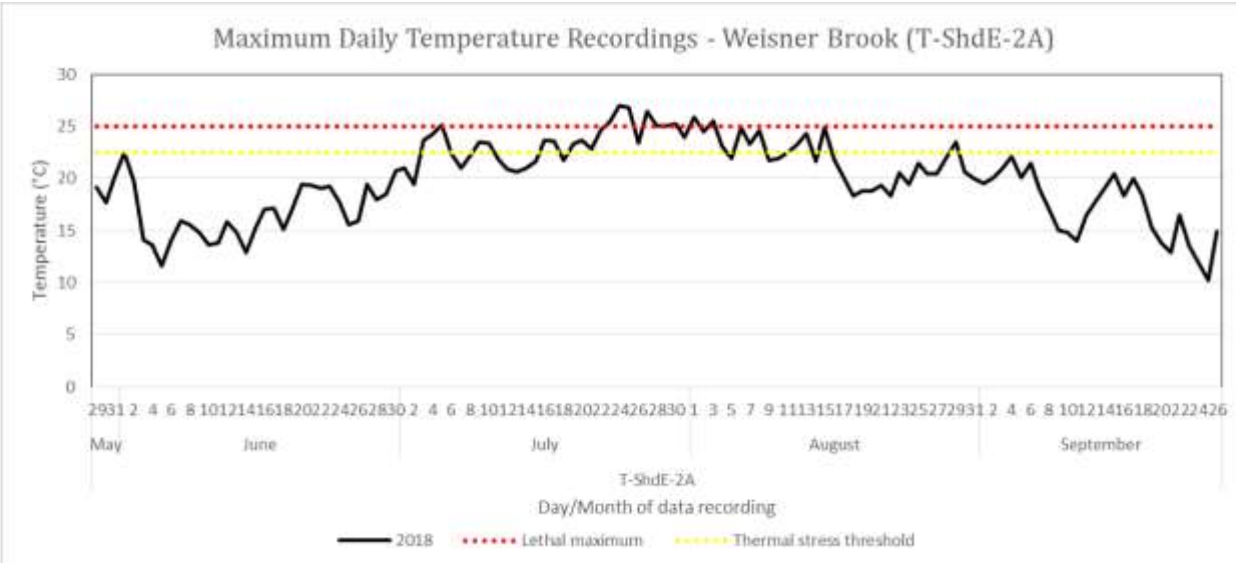


Figure 34: Thermograph data chart for monitoring station ID T-ShdE-2A, Weisner Brook 2018

4.5 Thermograph monitoring station T-ShdM

This temperature logger was installed in the Weisner Brook, a tributary of the Shediac River. This logger was predicted to show cold temperatures, as the Weisner Brook is considered to be a summering area for mature brook trout by DNR.

The thermograph shows the maximum daily temperatures between May 29th and September 26th. During this time period, the daily maximum temperatures only exceeded the thermal stress threshold twice (July 3 and July 4). The highest temperature recorded was 22.91 °C on July 3. The highest daily average temperature for this site was 20.93 °C.

The temperature readings for this site are slightly higher than 2017, where temperatures never exceeded the threshold value (highest temperature recorded was 21.19 °C). Regardless, the temperatures in 2018 are still very good. This stream has an excellent tree cover on both sides that creates adequate shade to keep water temperatures down.

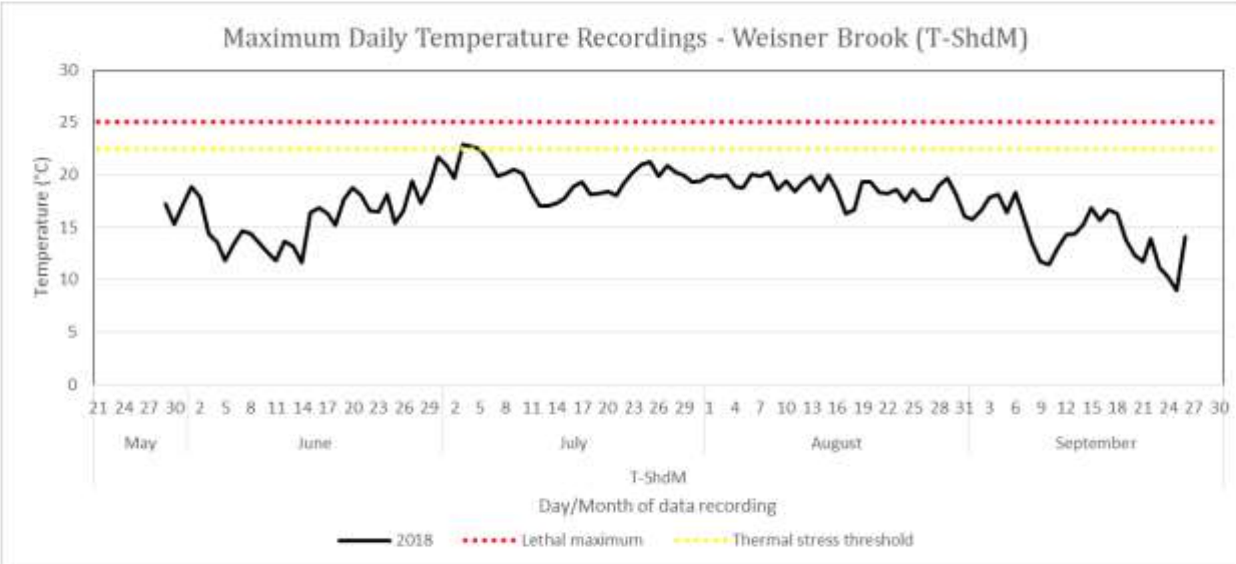


Figure 35: Thermograph data chart for monitoring station ID T-ShdM, Shediac River 2018

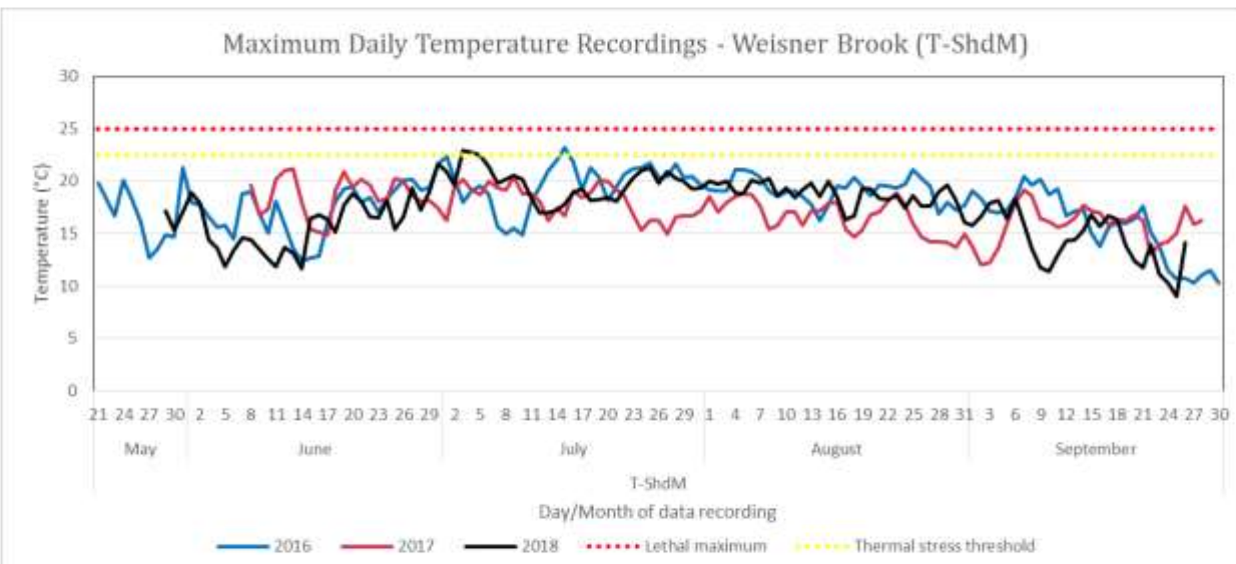


Figure 36: Thermograph data chart for monitoring station ID T-ShdM, Shediac River 2016-2018

4.6 Thermograph monitoring station T-ScdB

This temperature logger was installed at a location of the main branch of the Scoudouc River. For the third consecutive year, the maximum temperatures at this site did not exceed the lethal limit. This is due to the high water levels of this channel and the abundant alder canopy on both sides of the stream.

The thermograph shows the maximum daily temperatures between May 29th and September 26th. The maximum temperatures exceeded the thermal stress threshold on 26 occasions during the peak of the summer months (19 consecutive days from July 22 to August 9). The highest temperature recorded during this time period was 24.55°C on July 4. The highest average temperature daily temperature for this site was 23.54°C.

When comparing the three years of data for this site, temperatures in June of 2017 were higher than the other two years. However, overall temperature recordings for 2018 are warmer than 2016 and 2017.

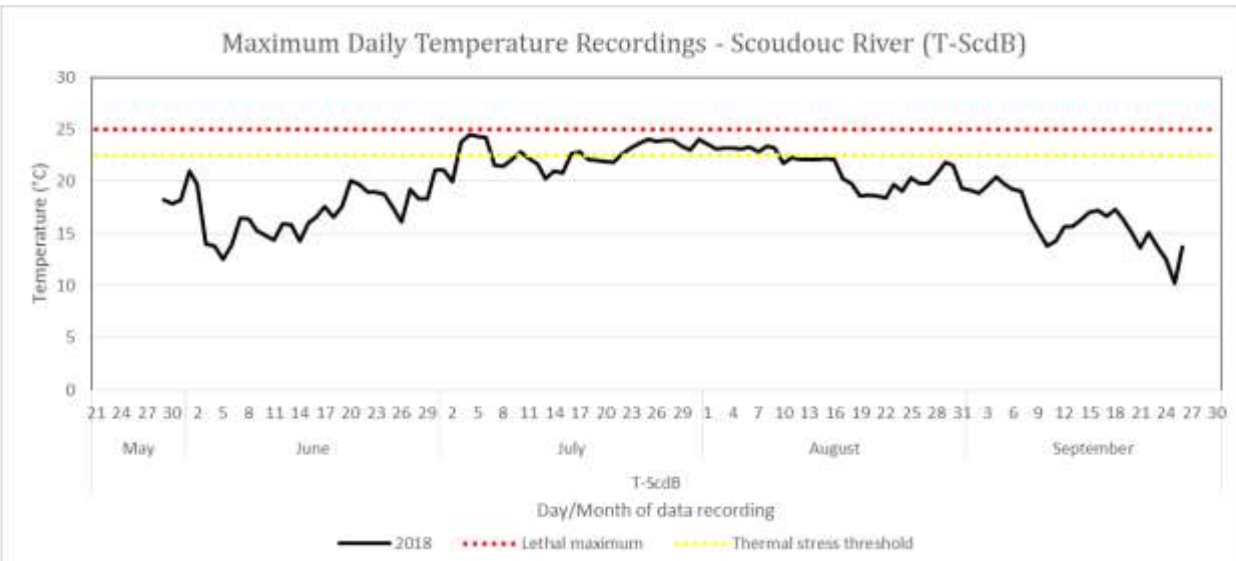


Figure 37: Thermograph data chart for monitoring station ID T-ScdB, Scoudouc River 2018

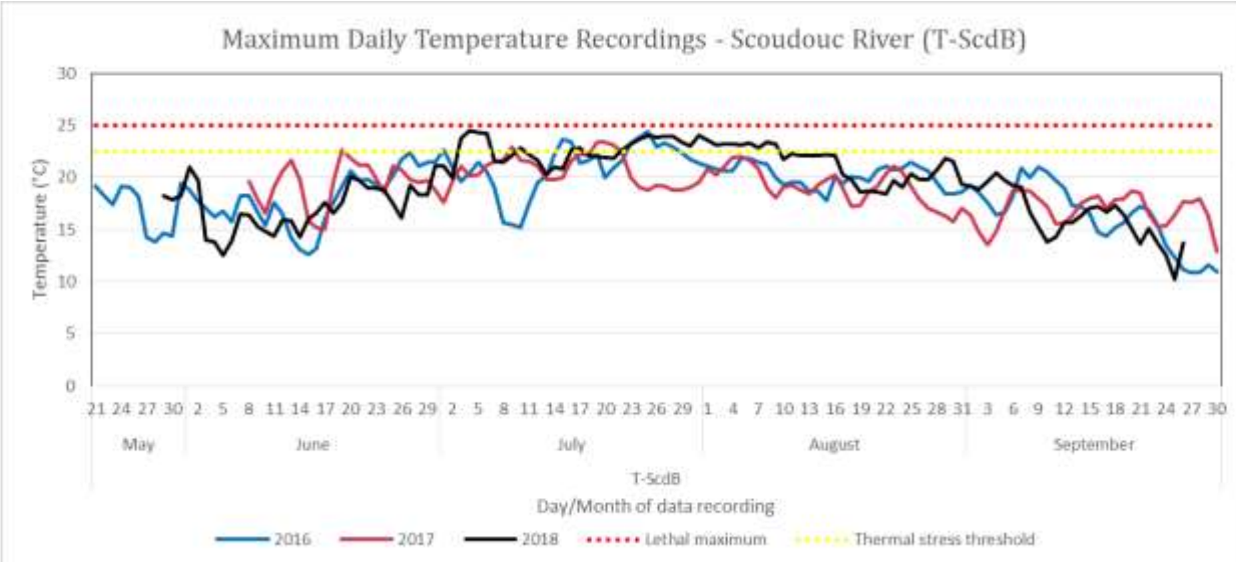


Figure 38: Thermograph data chart for monitoring station ID T-ScdB, Scoudouc River 2016-2018

4.7 Thermograph monitoring station T-ScdD

This temperature logger was installed in the Scoudouc River, at an important salmon habitat, downstream of ``Edna`s pond`` and ATV Trail restoration site.

The thermograph shows the maximum daily temperatures between May 29th and September 26th. The maximum temperatures exceeded the thermal stress threshold on 50 occasions during the peak of the summer months. Of those 50 days, the maximum temperatures exceeded the lethal limit on 26 occasions. The maximum temperatures exceeded the thermal stress threshold for 45 consecutive days (July 3 to August 16). During this time, the maximum temperatures exceed the lethal limit for 14 consecutive days (July 22 to August 4). The highest maximum temperature recorded at this station was 27.27°C on July 24 and the highest average daily temperature was 24.98°C.

The summer of 2018 was very hot and dry, more so than last year. In 2017, maximum temperatures exceeded the threshold on 39 days, in which on three occasions exceed the threshold for at least 7 consecutive days (July 5 to 11, July 16 to 22 and July 31 to August 7, 2017). Temperatures exceeded the lethal limit on 9 occasions; twice in June, 5 times in July and twice in August.

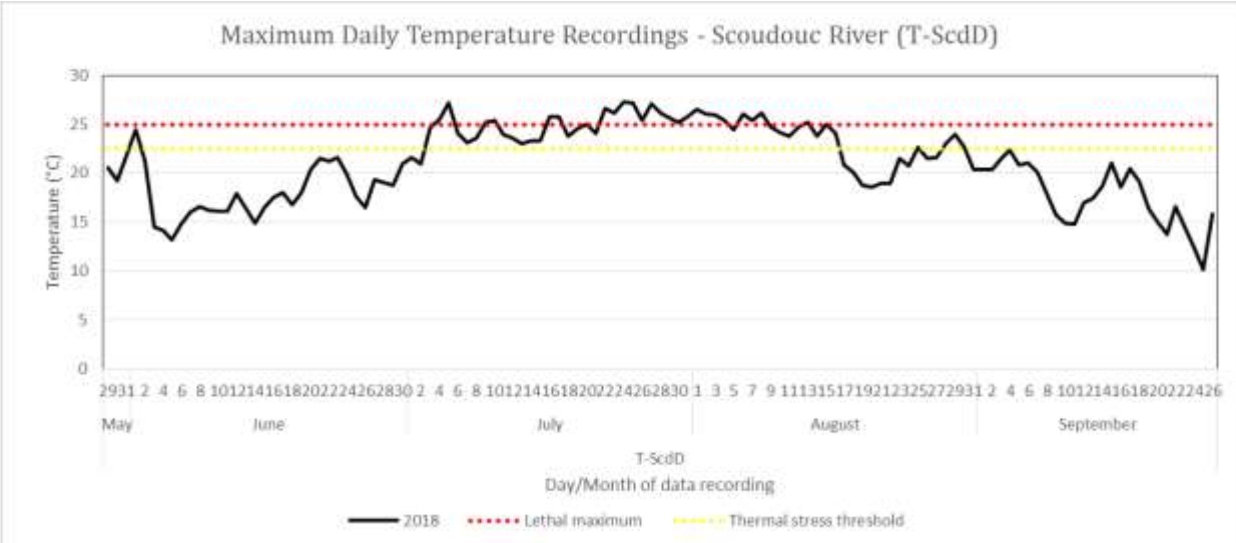


Figure 39: Thermograph data chart for monitoring station ID T-ScdD, Scoudouc River 2018

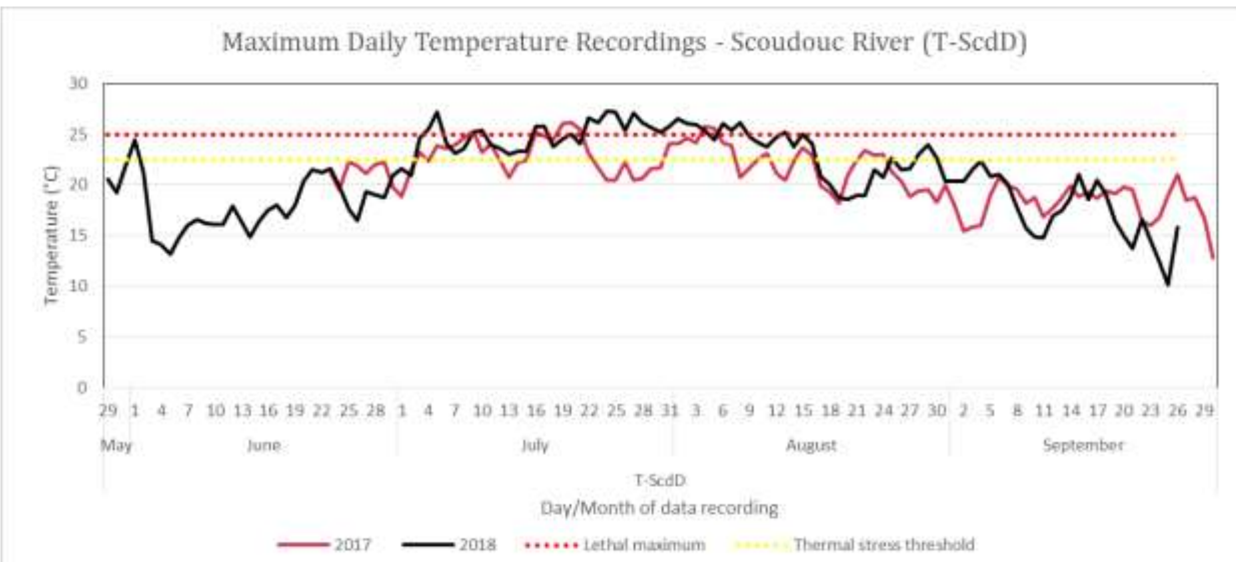


Figure 40: Thermograph data chart for monitoring station ID T-ScdD, Scoudouc River 2017-2018

5. MACROINVERTEBRATE SURVEY

In 2018, 3 sites were sampled for macroinvertebrates using the CABIN protocol; the Weisner Brook (SHM-01), the Shediac River (SHA-01), and the Scoudouc River (SCF-01). The fourth established CABIN site, SHB-01 in the McQuade Brook, has been flooded by a beaver dam, disqualifying the site for sampling (no riffle).

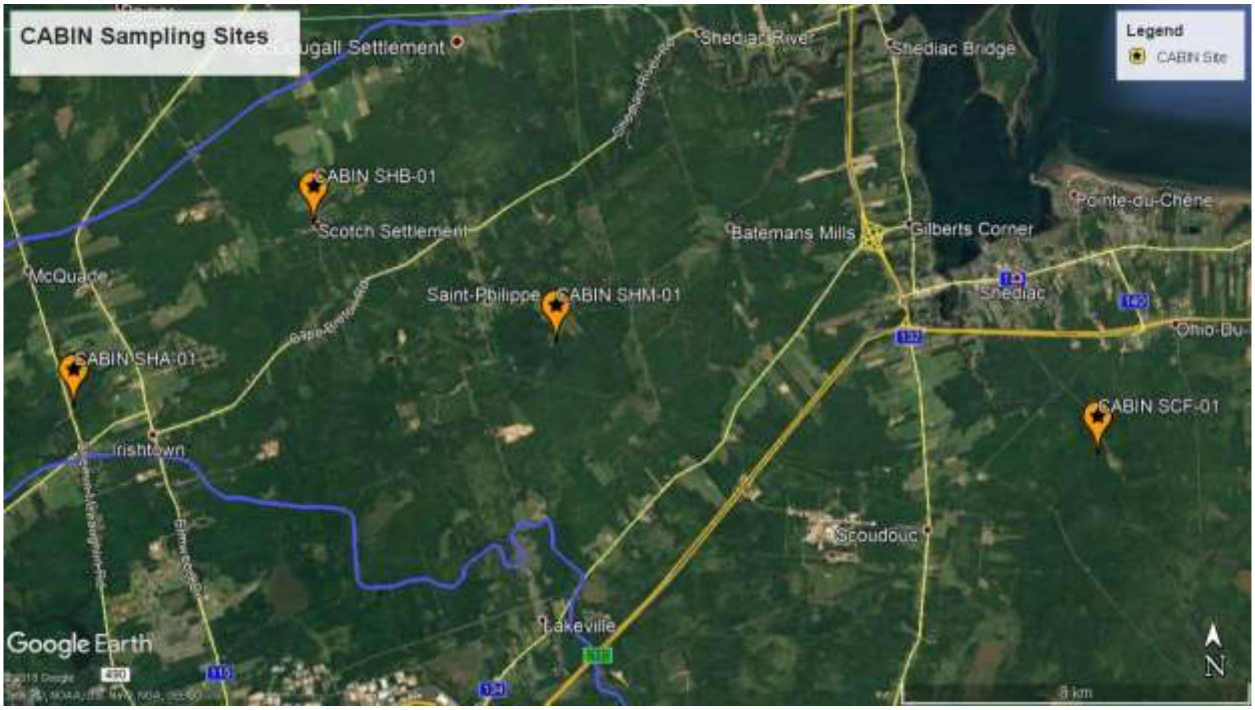


Figure 41: CABIN sampling sites

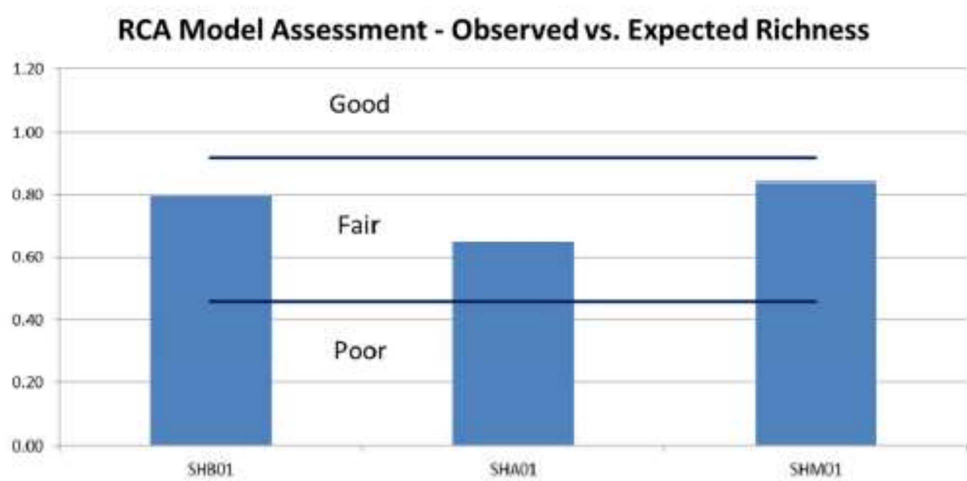
Table 40: CABIN Site information

Site ID	Latitude	Longitude	Elevation (m) Google Earth	Brook Name	Location Description
SHA-01	N46°11'36.80"	W 64°48'55.75"	115	Shediac River	Off NB-490, approx. 50 metres downstream from the culvert
SHM-01	N46°12'24.77"	W 64°40'20.02"	21	Weisner Brook	Off Bateman Mill Road, approx. 90 metres upstream from culvert
SCF-01	N 46°11'1.97"	W 64°30'38.71"	8	Scoudouc River	Off Pellerin road (public dirt road), accessed by ATV Trail (250 metres from road), approx. 40 metres downstream from access point

All the sampling data has been added to the Environment and Climate Change Canada website. They are added in the study managed by the Southern Gulf of St-Lawrence Coalition on Sustainability (Coalition SGSL). The downloaded reports of the habitat data, water chemistry and invertebrate data can be found in Appendix B.

The data collected will serve in the CABIN analytical tool "Reference Condition Approach" (RCA) assessment, to assess the invertebrate data based on pristine reference sites. The tool is developed for the Western provinces and territories, but for our area, additional steps using GIS software must be done using datasets provided to the SBWA by Environment and Climate Change Canada. A step-by-step guide was also provided as a tool to do these first steps. SBWA staff still needs to receive additional training to perform the work needed to complete the RCA assessments.

In the 2015, the sampling was done in partnership with the Miramichi River Environmental Assessment Committee (MREAC), as part of their project "The Atlantic Provinces Canadian Aquatic Biomonitoring Network Collaborative", funded by AEI (Atlantic Ecosystem Initiative). The RCA model assessment was done for the SBWA's site by MREAC staff (Figure 42).



Site_Ids	O/E Richness	O/E Berger_Parker	O/E Simpson	O/E Pielou	O/E Shannon
SHB01	0.80	1.52	1.26	1.31	1.30
SHA01	0.65	1.36	1.16	1.13	1.10
SHM01	0.84	1.33	1.17	1.11	1.13

Figure 42: RCA Model Assessment – Observed vs. Expected Richness, CABIN 2015

According to the RCA Model Assessment, all tree sites sampled in 2015 fall in the same category of fair. In order of best to worst; the Weisner Brook (SHM-01), the McQuade Brook (SHB-01) and the Main Branch of the Shediac River (SHA-01).

The area surrounding the site SHA-01 near Irishtown has been under development in the last 3-4 years; a new sub development of residences nearby and a new road requiring clear cutting along the river less than 100 metres away. The SBWA became aware of poor construction practises when heavy rains turned the Shediac River brown with fine sediments. The province was contacted and the Environmental inspector reported that no sediment control measures were put in place. A hydrologist was hired and sediment traps were installed. These sediment loads were flowing into the river by the trench of the road, Route 490, approximately 50 metres away from the sampling site.

The site in the McQuade Brook (SHB-01) is located within the restoration site that began in 2014. Once debris accumulations had been cleaned by the SBWA, heavy loads of sediment was flushed out, revealing clean gravel and new riffles. One on those riffles became the sampling site. Unfortunately, beavers moved back into the area and transformed the sampling site into a small lake.

The site with the best results, SHM-01 in the Weisner Brook, is mainly impacted by a few roads crossings, although far apart, residences, a crossing of transition power lines and a mineral extraction pit approximately 2 km upstream. Other than those factors, the site is mostly surrounded by dense mixed forest except for one side that has mowed grass up to the bank from the nearby house.

Figure 43: SBWA team doing CABIN surveys

6. Discussion

The first disclaimer is that SBWA does not by any means proclaim to be water quality experts. The purpose of this project is to collect samples, organize the data, look at surrounding land uses and buffer zones, then pass on the information to experts. We can point out trends from our limited sampling results, but changes occur so quickly that general patterns are not always evident. Our sampling is simply a snapshot of the results on that collection day. It would be very expensive to monitor water quality changes on a daily or even weekly basis. As a non-profit environmental organization, we do not have the resources or capacity for this. Our goal is to look for gross abnormalities in general patterns and hope to identify possible causes.

Many of the flagged parameters above can have a wide range of negative impacts on various aquatic species when concentrations exceed their threshold of tolerance. This threshold varies depending on species, life stage, and sometimes concentrations of other parameters.

The concentrations for the following metals were below their respective detection limits for all samples at every site. These metals were not included in the above tables; Silver (Ag), Beryllium (Be), Bismuth (Bi), Selenium (Se), Tin (Sn), Tellurium (Te), Thallium (Tl).

Most sites were under the limits for E. coli based on Health Canada Recreational Guidelines, except for ShdB, ShdH and ScdB (5 samples in total were above 400 MPN/100 mL).

All pH levels were found to be within the guidelines; between 6.5 and 9. However, dissolved oxygen for ScdB and ShdB fell below the recommended 6 mg/L for the protection of aquatic life, for early life stages of cold-water species.

Looking at total phosphorous levels, most of our site falls into mesotrophic to eutrophic range. However, four sites had samples containing total phosphorous levels low enough to be classed in the oligotrophic range (4-10 µg/L), and one sample that fell in the ultra-oligotrophic range (>4 µg/L).

Inorganic's results that were over the CCME recommended water quality guideline were mainly iron and aluminum. The province of New Brunswick is known to have higher levels of naturally occurring aluminum. Chloride was flagged in the Cornwall Brook for the second year. More investigation ad consultation with experts is needed to interpret these inorganic results.

Water temperature monitoring using loggers is a widely used tool to monitor temperature fluctuation in watersheds. The goal is to identify hot spots and cold zones suitable for thermal refugia in periods of thermal stress among fish. When looking at the predictions of which site would be warm and which would be cooler, the site at the covered bridge (T-ShdE) was indeed extremely warm and the Weisner Brook was correctly assumed to be the coldest tributary. The site in Irishtown (T-ShdA), located next to new development of a residential area and new major road, showed warmer temperatures than expected. This could possibly be due to a warmer and dryer summer than usual, or could possibly be related to the deforestation activities going on around the site. This location will continue to be monitored to measure changes over time. The second location that was warmer than expected is the Scoudouc River (T-ScdD), where again could be attributed to extremely low water levels and very warm summer. This site will also continue to be monitored to measure temperatures from year to year. Water temperatures in the McQuade Brook (T-ShdB) have surpassed temperature previously measured in 2016 and 2017. These increases are cause for concern considering that the McQuade Brook is an important spawning brook for Atlantic salmon.

This past summer was extremely hot and dry, as it was in 2017. Long periods without rainfall combined with extreme heats have caused water levels to drop and become warmer than is safe for cold water loving species. Temperatures will continue to be monitored to measure the impacts of our ever-changing climate.

7. HABITAT AND WATER QUALITY ENHANCEMENT

Fish Habitat restoration and water quality enhancement is a major initiative of the SBWA. Areas where bank erosion occurs causes an excess of sediment in the watercourse. Sedimentation can cause various issues for aquatic ecosystems; it can suffocate fish and fish eggs, bury aquatic insects, can carry harmful pollutants such as heavy metals and excessive nutrients that can further worsen conditions of the ecosystem, etc.

Blockage to fish migration are both naturally occurring and man-made, like debris jams, hanging culverts, and man-made dams. When these barriers occur in lower areas of a watershed, it can close off a large amount of suitable spawning grounds for important migratory fish species like the Atlantic salmon.

Culvert assessments were conducted in 2018, in an effort to identify fish migration impediments and other crossing issues. A stream assessment survey was performed in an area of the Cornwall Brook most affected by the changes and constructions on the Highway 15 in the Shediac area.

Two sites were selected for habitat enhancement. The habitat enhancements involved repairs of last year`s restoration work at “Edna`s pond” along the Scoudouc River, and enhancement of the buffer zone at the water quality monitoring site ScdF. In addition, an old ATV crossing along the Shediac River was blocked off to help protect the habitat, due the presence of a recently built steel bridge.

The following section provides a summary report on the work accomplished in 2018.

7.1 Edna’s Pond Restoration Site

Figure 44: Signage at Edna’s Pond

An area in the Scoudouc River was selected for remediation due to erosion and sedimentation problems surrounding sensitive salmon habitat in 2017. This year, the restoration of this site was continued. There was a bit of damage from the spring`s canoe and ATV run. The fourth log, at the bottom of the hill, had been taken off and thrown to the side of the trail. This summer, the log was retrieved and reinstalled at the same location as well as a new piece of geotextile. The restoration also involved in the maintenance of the channel stabilizers, by digging trenches towards the woods, where fine sediments had accumulated on the logs over the winter and spring. Fall rye was planted all over the restoration site again this year due to the destruction made by this year`s ATV run. It is important to establish a good amount of fall rye on the trail to further stabilize the soil that was disturbed by the creation of this project.

Figure 45: Map showing where restoration work was done at the Scoudouc River in 2017-2018

Additional native trees were planted. Some of the trees planted in 2017 didn`t survive the winter, and others were damaged by ATVs. Approximately 15 native trees were planted in the fall of 2018 to help replace the ones that died. It was important to replace the trees that didn't survive by the river. These will help to stabilize the eroding river bank. Large trees were selected to help ATV drivers to see them more clearly and not trample over them. The trees used were provided by the wood lot of "*Vert l'Avenir*" farm.

The tree planting was done with the help of grades 7-8 students from Shediac Cape School, as part of the Adopt-A-River program. This project involves taking students at the river and sampling for benthic macro-invertebrates. They can learn the processes of sampling and how to measure habitat attributes. After the activity, some of the students crossed the river to the restoration site and helped plant the 15 native trees. Planting trees is a good activity for young minds; it informs them of the benefits of trees for water quality and the overall aquatic habitats.

One more sign was installed at the Edna`s pond restoration site to add to the other 5 that was installed in 2017. This sign contains information on the functions and purpose of the channel stabilizers. It was installed on the side of the trail where it is easily visible next to a channel stabilizer.

A new handout was designed and printed for distribution amongst the off-roading community, in an attempt to raise awareness about the impacts of motor vehicles crossing aquatic habitats.

Figure 46: New information handout on the salmon population of Edna's Pond

7.2 Buffer Zone Restoration on unnamed tributary of the Scoudouc River

The water quality monitoring station ScdF is located on a tributary of the Scoudouc River. This tributary may be an important habitat for Atlantic salmon. The surrounding banks around this site is being subject to severe erosion due to the lack of vegetation. This site was selected for a buffer zone enhancement and bank stabilization by the planting of native trees. A Water and Wetland Alteration Permit (WAWA) was acquired.

Figure 47: Map of tree planting area along the unnamed tributary of the Scoudouc River

A total of 224 native trees were planted on October 31st and November 1st. The native trees include; 158 White Spruces, 3 Balsam Firs, 1 White Pine, 2 Red Oaks, 2 Mountain Ash, 32 Red Maples, 7 Grey Birches, 2 willows, 1 Trembling Aspen, 1 rose bush, 2 meadowsweet and 13 Tamaracks. The trees were transplanted from *Vert l'Avenir* Farm woodlot.

The native trees were planted on both sides of the stream. The erosion was more severe on the southern bank of the stream, thus a thicker layer of trees was planted there. Mostly coniferous trees, such as white spruce, was selected for this buffer zone enhancement due to the history of beaver activity in the region.

Two signs were installed to prevent the new trees from being mowed during the usual maintenance of the fields on both sides on the watercourse.

Figure 48: Signage for tree planting zone installed on both sides of the stream

7.3 Restoration Nurseries

In 2017, four restoration nurseries were implemented in partnership with the local schools and community gardens. More than 500 seedlings have been planted to be used in restoration projects in 2019. The advantage of the tree nurseries is to increase the survival rate and provide three-year-old trees at an affordable price. Students from the schools will participate in reforestation projects in 2019.

A tree planting activity was accomplished with the students of Shediac Cape School during the adopt-a-stream field trip. More reforestation activities will be organized with the students to transplant the trees next to marshes and watercourses.

A presentation on using native trees for environmental restoration was given on September 22nd during the TD tree day activity in Pointe-du-Chêne. The manager of the SBWA, Rémi Donelle gave a presentation on the importance of trees in protecting wetlands. He emphasized on establishing a good buffer zone and increasing the biodiversity of the area by planted various species of native trees.

Presentations were given to students at Mgr-François-Bourgeois school Dec 5th and 6th on the Acadian forest and the importance of trees to improve water quality. Tree planting activities will be organized with these classes in the spring.

Figure 49: Example of one nursery bed

7.4 ATV Crossing Blockage on the Shediac River

An area along the Shediac River had traditionally allowed for ATV vehicles to cross a sensitive habitat for freshwater mussels and other aquatic species. A bridge was built in recent years by the Kent ATV Club. However, the original crossing through the river remained accessible and showed signs on ongoing use.

In the fall of 2018, the SBWA initiated talks with the local ATV club, who were most receptive to the idea of putting up a barrier to discourage crossing through the river, thus encouraging the use of their bridge. They donated and installed the 4 large posts. The Shediac Bay Watershed Association bought the cables and clamps, and subsequently designed and installed signage.

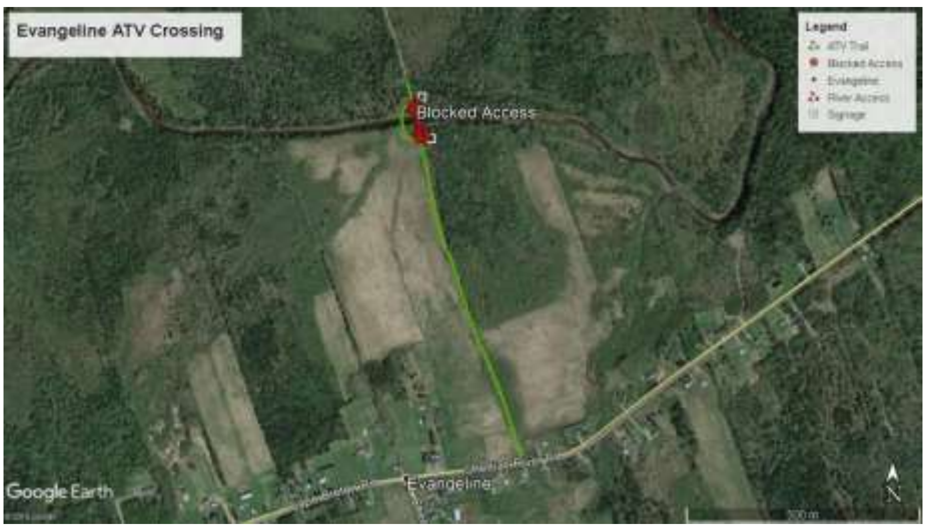


Figure 50: Location of Evangeline ATV Crossing

Figure 51: Images of the old crossing and new bridge

The same signs and cables were placed on both sides of the river. The cable gate has a lock so the cable can be unhooked to allow passage of the trail groomer in the winter. This was a great partnership to help protect river habitat from unwanted access by all-terrain and other off-road vehicles. The Kent ATV club was super supportive of our initiative and provided lots of in-kind and monetary partnership assistance.

Figure 52: Images of the signage and trail closure

7.5 Culvert Assessment

In the summer of 2018, the SBWA field team received training and conducted culvert assessments within the Shediac Bay watershed. The objective of these assessments was to target culverts located on Atlantic salmon and/or Brook Floater host fish bearing streams, then classify them as either passable, partial barrier or full barrier to fish passage.

Aquatic connectivity is very important for the biodiversity of a watershed. Culverts modify the morphology and the hydrology of a stream, and can sometimes hinder that connectivity by creating barriers. The presence of an outflow drop, steep culvert slopes, deteriorating culverts, and the presence of beaver dams or debris blockages within the culvert, can all negatively influence fish passage. Problematic culverts in terms of passage prevent fish to access upstream habitats.

In 2016, the *Petitcodiac Watershed Alliance* (PWA) developed the Atlantic Canada Culvert Assessment Toolkit (ACCAT), a rapid assessment version of the protocol developed by NSLC Adopt-A-Stream. The goal was to standardize a protocol for culvert assessments, and to allow other watershed groups to easily and effectively assess their water crossings. The toolkit included; data sheets, field equipment checklist, informative videos, data calculation, classification instructions, and remedial guidelines.

During the summer of 2018, 20 culverts of concerns were assessed within the Shediac Bay watershed. The assessments consisted of using surveying equipment to measure specific elevation points; the inlet and outlet of the culvert, and the first and second riffle downstream of the crossing. The culvert`s dimensions (height, width and length) were measured using a tape measure. The culvert slope, the outflow drop and the downstream slope were calculated with the formulas provided by the protocol. Information such as the presence of beaver dams, debris blockages, culvert condition, and evidence of erosion were noted. Four photographs were taken for each culvert assessed; the upstream habitat, the inlet of the culvert, the downstream habitat, and the outlet of the culvert. Photos of assessed culverts are included in Appendix C. The results are summarized in Table 41.

Seven culverts that were assessed are located in areas impacted by tides. The protocol did not include information on how to assess tidal sites. Some of the parameters could not be measured due to the nature of tidal streams, such as outflow drops and downstream slope. The morphology of tidal streams often lack riffles that are used as a guide for measurements. Three tidal sites were classified as full barriers as they were visited at both low and high tide, and a significant drop was present during those conditions. The other four culverts could not be classified under the ACCAT protocol. In addition, 15 other culverts were visited, of which 7 were located in seasonal streams. A full assessment was not conducted for these culverts, only a rapid assessment was done for fish passage classification, see Table 42.

Table 41: Culvert Assessment Summary Results for 2018

Culvert ID	Stream	Stream Type	Available habitats (km)	Culvert slope (%)	Outflow drop (m)	Classification
DFO-16901	McQuade Brook	**Non-tidal**	**2.78**	**1.21 and 0.93**	**0.05 and 0.02**	**Both Partial barrier**
DFO-17616	Shediac tributary	**Non-tidal**	**3.15**	**0.30**	**0.6**	**Full barrier**
DFO-16886	McQuade Brook tributary	**Non-tidal**	**1.05**	**1.06**	**-0.18**	**Partial barrier**
DFO-16884	McQuade Brook tributary	**Non-tidal**	**1.85**	**-4.76 and -4.80**	**-**	**Both Partial barrier**
DFO-16866	Shediac tributary	**Non-tidal**	**1.11**	**1.55**	**0.1**	**Partial barrier**
DFO-16860	Calhoun Brook	**Non-tidal**	**10**	**-0.19**	**-0.36**	**Passable**
DFO-15974	Weisner Brook	**Non-tidal**	**3.22**	**-1.19 and -0.86**	**-**	**Passable**
DFO-15937	Scoudouc tributary	**Non-tidal**	**3.24**	**-0.2**	**-0.13**	**Passable**
DFO-15939	Scoudouc tributary	**Non-tidal**	**2.47**	**0.4**	**0.02**	**Partial barrier**
DFO-16868	Weisner Brook tributary	**Non-tidal**	**2.88**	**0.33**	**-0.16**	**Passable**
DFO-16858	Weisner Brook	**Non-tidal**	**0.86**	**-0.94**	**-0.13**	**Partial barrier**
DFO-16865	Calhoun Brook	**Non-tidal**	**1.68**	**1.71**	**-0.74**	**Partial barrier**
DFO-15980	Weisner Brook	**Non-tidal**	**5.86**	**-0.49, 0.20- and -0.83**	**0.19, -0.01 and 0.16**	**Full, Passable, Full**
DFO-17597	Shediac tributary	**Tidal**	**0.75**	**0.99**	**0**	**Unknown***
DFO-17605	Shediac tributary	**Tidal**	**2.23**	**0.27**	**0**	**Unknown***
DFO-17593	Shediac tributary	**Tidal**	**3.08**	**-0.26**	**0.30**	**Full barrier**
DFO-17601	Shediac tributary	**Tidal**	**1.48**	**1.51**	**0.72**	**Full barrier**
DFO-17600	Shediac tributary	**Tidal**	**0.79**	**6.23**	**0.30**	**Full barrier**
DFO-17589	Shediac tributary	**Tidal**	**1.97**	**2.85**	**0.08**	**Unknown***
DFO-16853	Bateman Brook	**Tidal**	**18.96**	**0.19**	**-0.8**	**Unknown***
***Protocol not adapted for tidal sites, to be reassessed**						

Table 42: Rapid Assessment Summary Results for 2018

Culvert ID	Stream	Stream Type	Classification
DFO-17580	Ruisseau Albert-Gallant	Non-tidal	Passable
DFO-17582	Ruisseau Albert-Gallant	Tidal	Unknown
DFO-17581	Ruisseau Albert-Gallant	Seasonal	Dry
DFO-16870	Weisner Brook tributary	Seasonal	Dry
DFO-16875	McQuade Brook tributary	Non-tidal	Full barrier
DFO-16864	Batemans Brook tributary	Seasonal	Dry
DFO-16855	Batemans Brook tributary	Non-tidal	Passable
DFO-16862	Batemans Brook tributary	Seasonal	Dry
DFO-16903	Shediac River tributary	Seasonal	Dry
DFO-16904	Shediac River tributary	Seasonal	Dry
DFO-16906	Shediac River tributary	Seasonal	Passable
DFO-16889	Shediac River main branch	Non-tidal	Passable
DFO-16854	Batemans Brook tributary	Non-tidal	Passable
DFO-15934	Scoudouc River tributary	Non-tidal	Dry
DFO-15946	Scoudouc River tributary	Non-tidal	Passable

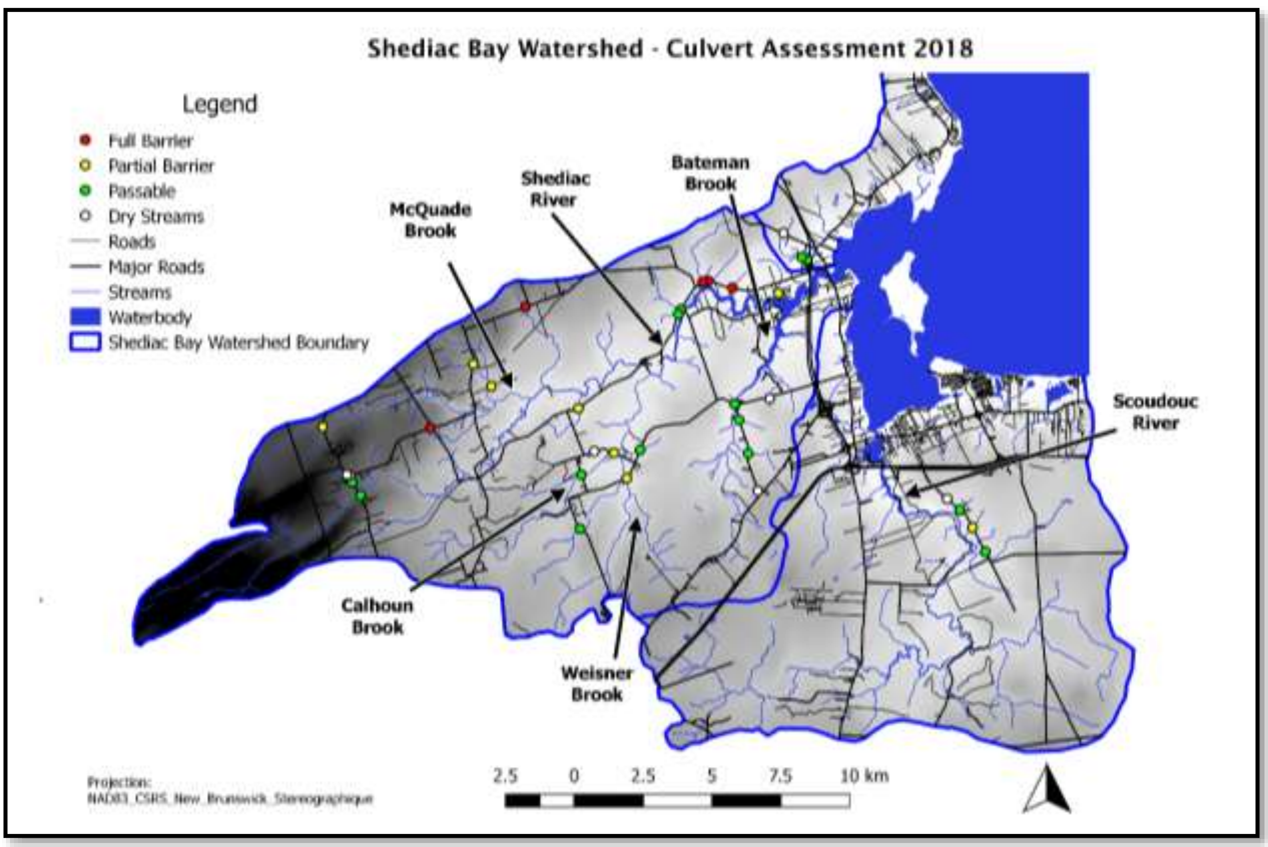


Figure 53: Culvert classification for the Scoudouc River, 2018

7.6 Cornwall Brook Stream Assessment

In the spring of 2018, the SBWA field team conducted a stream assessment of a section of the Cornwall Brook. The assessment was done downstream of the recent construction work on Highway NB-115. A new overpass, 3 new concrete culverts and a traffic circle were built in the area. The surrounding land has gone through some changes in slopes and the removal of vegetative buffer zones. The purpose of conducting an assessment in this area was to measure the impacts of the construction of the stream, and to identify problematic areas and possible restoration options.

The start point of the stream assessment was where Route 11 crosses over the Cornwall Brook (N46°12'28.00" W64°34'39.10") and ended at the culvert of Cornwall Road (N46°12'46.53" W64°33'53.17"). The assessment consisted of walking 1.6 km in the stream, observing and identifying possible issues (e.g. erosion, debris pile ups, garbage, lack of buffer zones, etc.). Photographs and GPS coordinates were taken at 18 points, where issues were identified (see survey details in Table 43 and photos in Appendix D).

Figure 54: Cornwall Brook stream assessment 2018

Some of the environmental impacts from the highway construction observed during this stream assessment included:

- The presence of garbage in and around the stream (e.g. plastic tarp, road cones, plywood, metal mesh, etc.)
- The removal of vegetation resulting in a lack of buffer zones between the highway and the stream
- fallen trees and debris pileup caused by the disruption of the area.
- Erosion from the highway runoff and heavy sediment deposits throughout the stream (downstream of the construction zone)

The following table below demonstrate the issues that were identified with coordinates and description of all the 18 points of assessment.

After analyzing the outcome of the stream assessment, recommendations for the restoration of the Cornwall Brook should begin with a preliminary cleanup of the garbage in and around the stream. The next step will be a clearing of the woody debris pileups caused by the fallen trees.

Figure 55: Image of trash in stream

After the cleanup of trash and debris, an ample number of native trees should be replanted where damage from construction occurred and where there is insufficient buffer zones. This will enhance the overall habitat, by increasing vegetative diversity and help prevent further erosion of the stream banks. The buffer zone enhancement will also help prevent the diminishment of Cornwall Brook`s water quality from the highway runoff.

Figure 56: Examples of degraded buffer zones along the Cornwall Brook

Table 43: Cornwall Brook Stream Assessment Results, 2018

Site ID	Latitude	Longitude	Corresponding Photos	Observations (going downstream)
CW-1	N46°12'28.00"	W64°34'39.10"	150-0662, 150-0663, 150-0665	Wood debris on the stream banks
CW-02	N46°12'30.90"	W64°34'40.40"	150-0666, 150-0667	Big rocks in the stream and brown filamentous algae on the rocks
CW-03	N46°12'32.00"	W64°34'40.30"	150-0669	In between the two culverts crossing the highway, there is a rust-like puddle in the stream
CW-04	N46°12'35.30"	W64°34'37.60"	150-0670, 150-0671, 150-0672	Water flowing from highway filled with green algae
CW-05	N46°12'34.70"	W64°34'38.20"	150-0673, 150-0674	Sediment accumulation D/S of small highway culvert, brown filamentous algae on rocks
CW-06	N46°12'35.00"	W64°34'37.60"	150-0675, 150-0676	Erosion on right stream bank, no buffer zone between highway and left bank
CW-07	N46°12'36.00"	W64°34'37.00"	150-0678, 150-0679	Lots of wood debris and metal screens (from construction)
CW-08	N46°12'36.20"	W64°34'36.60"	150-0680, 150-0681, 150-0682	Severe erosion on left stream bank and fallen tree debris pile up
CW-09	N46°12'36.20"	W64°34'35.60"	150-0683	Sediment pile up from culvert of highway and erosion on the bank of the stream
CW-10	N46°12'36.00"	W64°34'33.80"	150-0684, 150-0685	Heavy algae from highway runoff into the stream and sedimentation pile up
CW-11	N46°12'36.80"	W64°34'29.00"	150-0686	Severe erosion on right stream bank and sedimentation pile up
CW-12	N46°12'37.60"	W64°34'24.80"	150-0687	Sedimentation on right side of the stream and garbage
CW-13	N46°12'37.90"	W64°34'23.30"	150-0688, 150-0689	Beaver dam or debris pile up and sedimentation
CW-14	N46°12'39.40"	W64°34'18.40"	150-0690, 150-0691	Erosion on right stream bank and lots of green filamentous algae on rocks
CW-15	N46°12'40.60"	W64°34'18.80"	150-0692, 150-0693	Severe erosion on both sides of the stream, heavy clay deposits on the right side of the stream
CW-16	N46°12'47.90"	W64°34'11.40"	150-0694	Two patches of sedimentation
CW-17	N46°12'50.60"	W64°34'6.90"	150-0695	Patches of sedimentation U/S of culvert, lots of silt in the culvert
CW-18	N46°12'52.00"	W64°34'3.90"	150-0696, 150-0697	Sedimentation and erosion on left side of stream from highway runoff and garbage and no buffer zones

7.7 Trash cleaning along walking trails and stream in the Town of Shediac

During the summer 2018, SBWA staff conducted a trash cleanup initiative along bicycle/walking trails within the boundaries of the Town of Shediac. In the area of a bike trail connected to Pascal Poirier Road, a small brook crosses the path. This area had a visible trash problem, ranging from plastics to small kitchen appliances. Employees cleaned trash upstream and downstream of the trail, and collected 3 large garbage bags of litter, in addition to 3 household appliances. Combined with the cleanup around this small stream, a total of 12 large garbage bags of trash were collected.

Figure 57: Trash cleanup along small stream crossing bike trail off Pascal Poirier Road, 2018

8. EDUCATIONAL KIOSKS

8.1 Shediac Farmer's Market

An education kiosk was displayed on Sundays at the Shediac Farmer's market, for 10 weeks out of the summer. The main objective was to speak on water conservation and stormwater management, and giveaway water conservation kits and rain barrels. SBWA staff and summer students talked to visitors of all ages on the various other projects of the year. In the summer of 2018, staff spoke to approximately 450 visitors about the watershed group, local environmental issues and projects realized to mitigate these issues. The market kiosk is always a great tool to find people interested in receiving free rain barrels and water conservation kits for their homes.

Figure 58: Shediac Farmer's Market in the Park

8.2 Lobster Festival

In partnership with the Homarus Eco-centre, a kiosk was set up for four days at the Shediac Lobster festival from July 4th to July 7th. Our summer students spoke of our projects in the same fashion as the Shediac Farmer's market in the Park.

Figure 59: Shediac Lobster Festival

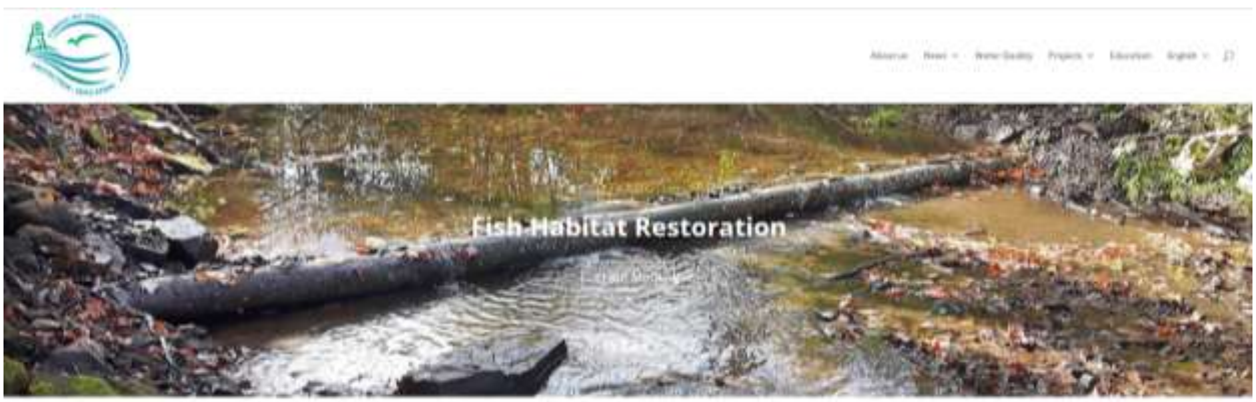
8.3 Media Outreach

8.3.1 Newsletter

A bilingual newsletter was produced during the 2018-2019 fiscal year. The newsletter display information and photos on the various projects that the SBWA has been doing in the year. The Association had 250 copies produced for each edition, printed on 100% recycled paper. The newsletters are distributed to various businesses, medical offices, hair salons, and anywhere else that had a waiting area or that was appropriate to leave newsletters for the public to take. The rest were distributed during the Shediac Market, during public presentations and other meetings. The newsletters can be found on the Shediac Bay Watershed Association website.

8.3.2 Socials Medias and Website

The SBWA is working to keep its website and social media up to date, posting photos and short description of activities and projects. The SBWA now has a dedicated employee who focuses on outreach and communications, and the design and production of educational materials. Therefore, 2018 was a turning point for social media outreach. See Table 44 for details.



www.shediacbayassociation.org www.facebook.com/#!/shediacbaywatershedassociation

Table 44: SBWA Social Media Outreach 2018

Published Date	Genre	Number of times your Page's post entered a person's screen (Total Count)	Published Date	Genre	Number of times your Page's post entered a person's screen (Total Count)
1-23-18	Photo	142	7-18-18	SharedVideo	112
2-2-18	Link	110	7-18-18	Photo	159
2-25-18	SharedVideo	181	7-19-18	SharedVideo	87
3-9-18	Photo	144	7-21-18	Link	164
3-13-18	Photo	138	7-24-18	Video	1048
3-21-18	Photo	127	7-24-18	Photo	518
3-28-18	Photo	105	7-24-18	Link	446
4-4-18	Photo	152	7-25-18	Photo	172
4-8-18	SharedVideo	173	7-26-18	Photo	470
4-26-18	Link	593	8-1-18	Photo	163
4-26-18	Link	427	8-2-18	Video	1004
4-26-18	Link	112	8-6-18	Link	194
4-27-18	Link	678	8-8-18	Photo	249
5-1-18	SharedVideo	81	8-9-18	Photo	806
5-2-18		536	8-9-18	Video	4087
5-3-18	Status	141	8-14-18	Photo	468
5-3-18	Status	182	8-15-18	Photo	439
5-8-18	Link	431	8-20-18	Photo	574
5-10-18	Photo	465	8-21-18	Photo	173
5-10-18		413	8-29-18	Photo	187
5-11-18		75	9-5-18	Photo	163
5-16-18	Photo	0	9-7-18	Link	80
5-16-18		272	9-12-18	Photo	143
5-20-18	Link	73	9-13-18	Link	362
5-22-18	Photo	1117	9-19-18	Photo	197
5-23-18	Photo	474	9-19-18	Photo	777
5-31-18	Status	198	9-20-18	Link	202
5-31-18	Status	172	9-20-18	Link	96
6-5-18	Photo	805	9-24-18	Photo	440
6-7-18	Photo	411	9-26-18	Photo	196
6-12-18	Link	325	9-26-18	Photo	2503
6-13-18	Photo	1178	10-2-18	Video	1139
6-14-18	Photo	64	10-2-18	Video	1400
6-19-18		345	10-3-18	Photo	793
6-20-18	Photo	619	10-10-18	Photo	235
6-21-18	Link	65	10-16-18	Photo	531
6-26-18	Link	83	10-31-18	Photo	240
7-11-18	Photo	168	11-1-18	Photo	238
7-12-18	Photo	246	11-7-18	Photo	3352
7-12-18	Photo	81	11-14-18	Photo	202
7-16-18	SharedVideo	91	11-27-18	Photo	535
7-17-18	Photo	79			
				TOTAL	**37,616**

9. Closing Comments

The Shediac Bay Watershed Association had a successful year in 2018-2019, thanks to the support of the NB Environmental Trust Fund. The Association has met its targets regarding the monitoring and partnerships created to improve water quality in the Shediac Bay watershed. Sampling results will help in the development of new projects with the purpose of addressing environmental issue targeting water quality. With the help of sampling results, land use investigation, habitat evaluations and several invaluable partners such as the *Department of Environment and Local Government*, an action plan can be developed to address contamination sources. When dealing with non-point source pollution in a watershed, one cannot be expected to solve the issues of human activities overnight. Problems related stormwater runoff and faults in both private and municipal infrastructure can take several years and even decades to be detected and resolved. Collaborations between environmental groups, businesses, private citizen and government are crucial in the development and implementation of an action plan.

Habitat restoration projects for fish have been funded by different organizations in 2018-19, including the Atlantic Salmon Conservation Fund, the NB Wildlife Trust Fund and the NB Environmental Trust Fund. The support received allowed for more projects to be realized. The restoration sites will be monitored in future years to ensure that measures taken will have a positive impact on water quality and fish populations.

The studies on climate change adaptation will benefit the association by providing action priorities for adaptation projects that can then be applied by the SBWA and its partners.

Partnerships are essential for environmental groups to accomplish their work. The Association is building good relationships with the town of Shediac, the local schools and other local groups. We hope to diversify our activities to involve more people in the protection of water quality in Shediac Bay. The Association will continue to participate in the various local events and give presentations when requested.

The Environmental Trust Fund remains a critical partner for the Shediac Bay Watershed Association. Improving water quality is a long-term endeavour that can be accomplished one project at a time. We hope to continue receiving support as our programs develop to address water quality issues in the Shediac Bay watershed.

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APPENDIX A - WATER CHEMISTRY METHODOLOGY

Table 45: RPC Laboratory Analytical Methods

RPC LABORATORY ANALYTICAL METHODS				
Analyte	Parameter	RPC SOP Number	Method Reference	Method Principle
Ammonia	NH_3T	4.M47	APHA 4500-NH3 G	Phenate Colourimetry
pH	pH	4.M03	APHA 4500-H+ B	pH Electrode - Electrometric
Alkalinity (as CaCO3)	ALK_T	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	Cl	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	F	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	SO_4	4.M45	APHA 4500-SO4 E	Turbidimetry
Nitrate + Nitrite (as N)	NO_X	4.M48	APHA 4500-NO3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	NO_3	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Phosphorus - Total	TP-L	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Dissolved Organic	TOC	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	TURB	4.M06	APHA 2130 B	Nephelometry
Colour	CLRA	4.M55	APHA 2020 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	COND	4.M04	APHA 2510 B	Conductivity Meter, Pt Electrode
Trace Metals	—	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Table 46: RPC Laboratory Analytical Methods for E. coli

RPC LAB ANALYTICAL METHODS FOR E. COLI		
Method	ID	Max Detection Limit
Membrane Filtration	FSA-01	10000 MPN/100 mL
Colilert	FSA-10	2419.6 MPN/100 mL

APPENDIX B – CABIN DATA 2018

Table 47: CABIN Site Data Report for SHA-01, 2018

Site Information			
Variable	**Value**		
Site Code	SHA-01		
Name	Shediac River		
Basin	Northumberland Strait		
Stream Order (1:50000)	3		
Eco-Region	Maritime Lowlands		
Eco-Zone	Atlantic Maritime		
Envirodat Code	RPC Fredericton Lab		
Sampling Device	Kick Net		
Protocol	CABIN - Wadeable Streams		
Date	2018-10-16		
Sample(s) Taken	1		
Kick Time (Min)	3		
Mesh Size (µ.m)	400		
Description	The site is downstream from culvert, located on Route 490 near Irishtown, approximately 1 km north from Ammon road.		
Latitude & Longitude	46.1935 & -64.815472222		
Altitude	112 meters		
Datum	nad83		
Taxonomist	Jo-Anne Monahan		
ID Date	2018-12-02		
Certifications			
Sampling Crew	Rémi Donelle		
	Jolyne Hébert		
	Ryan LeBlanc		
Habitat			
Type	**Variable**	Value	Unit
Channel	% Canopy Coverage	3	PercentRange
Channel	Avg Channel Depth	19.1	cm
Channel	Avg Velocity	1.09	m/s
Channel	Bank Full Width	8.2	m
Channel	Bankfull-Wetted Depth	58	cm
Channel	Dominant Streamside Vegetation	3	Category(1-4)
Channel	Max Channel Depth	21.8	cm
Channel	Max Velocity	1.57	m/s
Channel	Pool in Reach	0	Binary
Channel	Presence of Coniferous Trees	0	Binary
Channel	Presence of Deciduous Trees	1	Binary
Channel	Presence of Grasses	1	Binary

Channel	Presence of Shrubs	1	Binary
Channel	Rapid in Reach	0	Binary
Channel	Riffle in Reach	1	Binary
Channel	Slope	0.016	m/m
Channel	Straight Run in Reach	0	Binary
Channel	Velocity Measurement Method	1	Category(1-3)
Channel	Wetted Width	6.7	m
Substrate Data	% Bedrock	0	%
Substrate Data	% Boulder	0	%
Substrate Data	% Cobble	55	%
Substrate Data	% Gravel	1	%
Substrate Data	% Pebble	44	%
Substrate Data	% Sand	0	%
Substrate Data	% Silt+Clay	0	%
Substrate Data	2nd Dominant Substrate	5	Category(0-9)
Substrate Data	Dominant Substrate	6	Category(0-9)
Substrate Data	Embeddedness	4	Category(1-5)
Substrate Data	Geometric Mean Particle Size	6.4	cm
Substrate Data	Median Particle Size	6.8	cm
Substrate Data	Periphyton Coverage	2	Category(1-5)
Substrate Data	Surrounding Material	3	Category(0-9)

Water Chemistry

Type	Variable	Value	Unit
Water Chemistry	Air Temperature	10	Degrees Celsius
Water Chemistry	Bottom Dissolved Oxygen	11.3	mg/L
Water Chemistry	Conductivity	95	µS/cm
Water Chemistry	Nitrate	0.31	mg/L
Water Chemistry	Nitrate/Nitrite	0.31	mg/L
Water Chemistry	Nitrite	0.025	mg/L
Water Chemistry	pH	8	pH
Water Chemistry	Temperature	8.6	Degrees Celsius
Water Chemistry	Total Phosphorus (Water)	0.046	mg/L

Taxonomy

Phylum	Class	Order	Family	Raw Count	Mean Count	Notes
Arthropoda	Arachnida	Sarcoptiformes		1	20	
Arthropoda	Insecta	Trichoptera		1	20	Immature
Arthropoda	Insecta	Odonata	Aeshnidae	1	20	
Arthropoda	Insecta	Diptera	Athericidae	1	20	
Arthropoda	Insecta	Ephemeroptera	Caenidae	1	20	
Arthropoda	Insecta	Plecoptera	Capniidae	10	200	
Arthropoda	Insecta	Diptera	Ceratopogonidae	5	100	

Arthropoda	Insecta	Diptera	Chironomidae	76	1520	
Arthropoda	Insecta	Plecoptera	Chloroperlidae	2	40	
Arthropoda	Insecta	Megaloptera	Corydalidae	2	40	
Arthropoda	Insecta	Coleoptera	Elmidae	54	1080	
Arthropoda	Insecta	Diptera	Empididae	1	20	
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	56	1120	
Arthropoda	Insecta	Odonata	Gomphidae	1	20	
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	17	340	
Arthropoda	Insecta	Trichoptera	Hydropsychidae	16	320	
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	1	20	
Arthropoda	Insecta	Trichoptera	Leptoceridae	2	40	
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	13	260	
Arthropoda	Insecta	Plecoptera	Leuctridae	1	20	
Arthropoda	Insecta	Trichoptera	Limnephilidae	1	20	
Annelida	Clitellata	Lumbriculida	Lumbriculidae	6	120	
Annelida	Clitellata	Tubificida	Naididae	2	40	
Arthropoda	Insecta	Trichoptera	Odontoceridae	4	80	
Arthropoda	Insecta	Plecoptera	Perlidae	6	120	
Arthropoda	Insecta	Trichoptera	Philopotamidae	55	1100	
Arthropoda	Insecta	Trichoptera	Polycentropodidae	2	40	
Arthropoda	Insecta	Trichoptera	Psychomyiidae	1	20	
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	1	20	
Arthropoda	Insecta	Diptera	Tipulidae	9	180	
Arthropoda	Arachnida	Trombidiformes	Torrenticolidae	1	20	

Table 48: CABIN Site Data Report for SHM-01, 2018

Site Information	
Variable	**Value**
Site Code	SHM01
Name	Shediac River
Basin	Northumberland Strait
Stream Order (1:50000)	3
Eco-Region	Maritime Lowlands
Eco-Zone	Atlantic Maritime
Envirodat Code	RPC Fredericton Lab
Sampling Device	Kick Net
Protocol	CABIN - Wadeable Streams
Date	15-October-2018
Sample(s) Taken	1
Kick Time (Min)	3

Mesh Size (µ.m)	400		
Description	This site is located in Weisner Brook, tributary of the Shediac River, at a bridge on Bateman Mill rd. It is a residential area but surrounded by forest, there is a house on the land of the site.		
Latitude & Longitude	46.206888889 & -64.672277778		
Altitude	21 meters		
Datum	nad83		
Taxonomist	Jo-Anne Monahan		
ID Date	2018-12-03		
Certifications			
Sampling Crew	Rémi Donelle		
	Jolyne Hébert		
	Ryan LeBlanc		
Habitat			
Type	Variable	Value	Unit
Channel	% Canopy Coverage	2	PercentRange
Channel	Avg Channel Depth	27.4	cm
Channel	Avg Velocity	0.45	m/s
Channel	Bank Full Width	7.4	m
Channel	Bankfull-Wetted Depth	22.5	cm
Channel	Dominant Streamside Vegetation	3	Category(1-4)
Channel	Macrophyte Score	1	PercentRange
Channel	Max Channel Depth	36.5	cm
Channel	Max Velocity	0.99	m/s
Channel	Pool in Reach	1	Binary
Channel	Presence of Coniferous Trees	1	Binary
Channel	Presence of Deciduous Trees	1	Binary
Channel	Presence of Grasses	1	Binary
Channel	Presence of Shrubs	1	Binary
Channel	Rapid in Reach	0	Binary
Channel	Riffle in Reach	1	Binary
Channel	Slope	0.003	m/m
Channel	Straight Run in Reach	0	Binary
Channel	Velocity Measurement Method	1	Category(1-3)
Channel	Wetted Width	7.4	m
Substrate Data	% Bedrock	2	%
Substrate Data	% Boulder	0	%
Substrate Data	% Cobble	18	%
Substrate Data	% Gravel	8	%
Substrate Data	% Pebble	68	%
Substrate Data	% Sand	0	%
Substrate Data	% Silt+Clay	4	%
Substrate Data	2nd Dominant Substrate	4	Category(0-9)
Substrate Data	Dominant Substrate	5	Category(0-9)
Substrate Data	Embeddedness	4	Category(1-5)

Substrate Data	Geometric Mean Particle Size	2.8	cm
Substrate Data	Median Particle Size	4.15	cm
Substrate Data	Periphyton Coverage	1	Category(1-5)

Water Chemistry

Type	Variable	Value	Unit
Water Chemistry	Air Temperature	11	Degrees Celsius
Water Chemistry	Bottom Dissolved Oxygen	11.83	mg/L
Water Chemistry	Conductivity	68	µS/cm
Water Chemistry	pH	8.5	pH
Water Chemistry	Temperature	7.8	Degrees Celsius

Taxonomy

Phylum	Class	Order	Family	Raw Count	Mean Count	Notes
Arthropoda	Insecta	Trichoptera		20	222.22	Immature
Arthropoda	Insecta	Ephemeroptera	Baetidae	8	88.89	
Arthropoda	Insecta	Trichoptera	Brachycentridae	1	11.11	
Arthropoda	Insecta	Plecoptera	Capniidae	14	155.56	
Arthropoda	Insecta	Diptera	Ceratopogonidae	6	66.67	
Arthropoda	Insecta	Diptera	Chironomidae	56	622.22	
Arthropoda	Insecta	Megaloptera	Corydalidae	1	11.11	
Arthropoda	Insecta	Coleoptera	Elmidae	19	211.11	
Arthropoda	Insecta	Diptera	Empididae	3	33.33	
Annelida	Clitellata		Enchytraeidae	1	11.11	
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	56	622.22	
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	3	33.33	
Arthropoda	Insecta	Odonata	Gomphidae	1	11.11	
Arthropoda	Insecta	Trichoptera	Helicopsychidae	1	11.11	
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	17	188.89	
Arthropoda	Insecta	Trichoptera	Hydropsychidae	9	100	
Arthropoda	Insecta	Trichoptera	Hydroptilidae	1	11.11	
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	1	11.11	
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	13	144.44	
Arthropoda	Insecta	Plecoptera	Leuctridae	1	11.11	
Arthropoda	Insecta	Trichoptera	Limnephilidae	2	22.22	
Annelida	Clitellata	Lumbriculida	Lumbriculidae	6	66.67	
Mollusca	Gastropoda	Basommatophora	Lymnaeidae	1	11.11	
Annelida	Clitellata	Tubificida	Naididae	2	22.22	
Arthropoda	Insecta	Plecoptera	Perlidae	2	22.22	
Mollusca	Bivalvia	Veneroida	Pisidiidae	5	55.56	
Mollusca	Gastropoda	Basommatophora	Planorbidae	1	11.11	

Arthropoda	Insecta	Trichoptera	Psychomyiidae	1	11.11	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	1	11.11	
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	3	33.33	
Arthropoda	Insecta	Diptera	Syrphidae	1	11.11	
Arthropoda	Insecta	Diptera	Tipulidae	6	66.67	
Arthropoda	Insecta	Trichoptera	Uenoidae	19	211.11	

Table 49: CABIN Site Data Report for SCF-01, 2018

Site Information	
Variable	**Value**
Site Code	SCF01
Name	Scoudouc River
Local Basin Name	Northumberland Strait
Stream Order (1:50000)	0
Eco-Region	Maritime Lowlands
Eco-zone	Atlantic Maritime
Envirodat Code	
Sampling Device	Kick Net
Protocol	CABIN - Wadeable Streams
Date	17-October-2018
Sample(s) Taken	1
Kick Time (min)	3
Mesh Size (µm)	400
Description	Near Southeast Regional Correctional Center in Shediac, down the road turn on left on Pellerin Rd. drive 3.4 km and there's a ATV trail on the right walk 230 m.
Latitude & Longitude	46.1838806 & -64.5107528
Altitude	9 meters
Datum	nad83
Taxonomist	Jo-Anne Monahan
ID Date	2018-12-03
Certifications	
Sampling Crew	Rémi Donelle
	Jolyne Hébert
	Ryan LeBlanc

Habitat			
Type	Variable	Value	Unit
Channel	% Canopy Coverage	1	PercentRange
Channel	Avg Velocity	2.27	m/s
Channel	Bank Full Width	15.2	m
Channel	Bankfull-Wetted Depth	36	cm

Channel	Dominant Streamside Vegetation	4	Category(1-4)
Channel	Macrophyte Score	1	PercentRange
Channel	Max Velocity	2.72	m/s
Channel	Pool in Reach	1	Binary
Channel	Presence of Coniferous Trees	1	Binary
Channel	Presence of Deciduous Trees	1	Binary
Channel	Presence of Grasses	1	Binary
Channel	Presence of Shrubs	1	Binary
Channel	Rapid in Reach	0	Binary
Channel	Riffle in Reach	1	Binary
Channel	Slope	0.00522	m/m
Channel	Straight Run in Reach	1	Binary
Channel	Velocity Measurement Method	1	Category(1-3)
Channel	Wetted Width	12.9	m
Substrate Data	% Bedrock	42	%
Substrate Data	% Boulder	1	%
Substrate Data	% Cobble	39	%
Substrate Data	% Gravel	2	%
Substrate Data	% Pebble	16	%
Substrate Data	% Sand	0	%
Substrate Data	% Silt+Clay	0	%
Substrate Data	2nd Dominant Substrate	6	Category(0-9)
Substrate Data	Dominant Substrate	9	Category(0-9)
Substrate Data	Embeddedness	5	Category(1-5)
Substrate Data	Geometric Mean Particle Size	8.1	cm
Substrate Data	Median Particle Size	8.15	cm
Substrate Data	Periphyton Coverage	3	Category(1-5)

Water Chemistry

Type	Variable	Value	Unit
Water Chemistry	Air Temperature	9	Degrees Celsius
Water Chemistry	Bottom Dissolved Oxygen	10.35	mg/L
Water Chemistry	Conductivity	40	µS/cm
Water Chemistry	pH	6.7	pH
Water Chemistry	Temperature	6.9	Degrees Celsius

Taxonomy

Phylum	Class	Order	Family	Raw Count	Mean Count	Notes
Arthropoda	Insecta	Trichoptera		4	26.67	Immature
Arthropoda	Insecta	Trichoptera	Apataniidae	2	13.33	
Arthropoda	Insecta	Ephemeroptera	Baetidae	3	20	
Arthropoda	Insecta	Trichoptera	Brachycentridae	2	13.33	

Arthropoda	Insecta	Plecoptera	Capniidae	4	26.67	
Arthropoda	Insecta	Diptera	Ceratopogonidae	3	20	
Arthropoda	Insecta	Diptera	Chironomidae	28	186.67	
Arthropoda	Insecta	Diptera	Empididae	3	20	
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	36	240	
Arthropoda	Insecta	Odonata	Gomphidae	1	6.67	
Arthropoda	Insecta	Trichoptera	Helicopsychidae	1	6.67	
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	41	273.33	
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae	2	13.33	
Arthropoda	Insecta	Trichoptera	Hydropsychidae	29	193.33	
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	62	413.33	
Arthropoda	Insecta	Trichoptera	Leptoceridae	11	73.33	
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	35	233.33	
Arthropoda	Insecta	Trichoptera	Limnephilidae	22	146.67	
Annelida	Clitellata	Lumbriculida	Lumbriculidae	6	40	
Arthropoda	Insecta	Trichoptera	Odontoceridae	1	6.67	
Arthropoda	Insecta	Plecoptera	Perlidae	6	40	
Mollusca	Bivalvia	Veneroida	Pisidiidae	3	20	
Arthropoda	Insecta	Trichoptera	Polycentropodidae	1	6.67	
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	2	13.33	
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	5	33.33	
Arthropoda	Arachnida	Trombidiformes	Torrenticolidae	1	6.67	
Arthropoda	Insecta	Trichoptera	Uenoidae	1	6.67	

11. Appendix C - Culvert Assessment Photos

DFO-15937

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet




DFO -15939

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet




DFO-16901

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-17616

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-16886

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-16884

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-16866

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-16860

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-15974

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-16853

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-16868

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-16858

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO-16865

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet




DFO-15980

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet




DFO -17597

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet




DFO -17605

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet




DFO -17593

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet




DFO -17601

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet




DFO -17600

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

DFO -17589

Top: upstream of culvert and inlet

Bottom: downstream of culvert and outlet

12. APPENDIX D - CORNWALL BROOK STREAM ASSESSMENT PHOTOS

150-0662

150-0663

150-0665

150-0666

150-0667

150-0669

150-0670

150-0671

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