Water Management in the Shediac Bay Watershed

By:

The Shediac Bay Watershed Association Inc.

March 2022

Report produced for the New Brunswick Environmental Trust Fund

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Acknowledgements

The Shediac Bay Watershed Association Board of Directors sends thanks to the numerous groups and individuals that contributed to making our programs a success again this year. In particular, the SBWA extends its appreciation to following individuals and organizations for their interest and involvement with the Shediac Bay Watershed Association during the 2021-2022 fiscal year.

Thanks to the *Department of Environment and Local Government* Erin Douthwright, Nicole Duke and Don Fox for working closely with the SBWA on the water sampling program. Thanks to RPC Laboratory Michael Lawlor, April Boudreau, Peter Crowhurst, Nadine Godin, for their invaluable support, as well as all the support staff at RPC.

Additionally, we wish to thank the *Department of Environment and Local Government* for their continued work on the Integrated Watershed Management Plan for the Shediac Bay Watershed, as well as the members of the new IWMP implementation committee.

Thanks to the «*Institut national de la recherche scientifique*" (INRS) in the province of Quebec, for their partnership in the water temperature monitoring for providing equipment, knowledge and expertise.

Thanks to the Shediac Cape Community Garden and the Shediac Anglican Parish for permission to maintain our native tree nursery. Also, thanks to Frank Leblanc for his volunteer time to build the planting boxes.

We would like to thank our school partners in the Adopt-A-River program, for continuing the field trips to the Scoudouc River to deliver this educational program on habitat quality monitoring. Thank you to our landowners for continuing to grant access to our school groups to the Edna's pond section of the Scoudouc River.

We would like to acknowledge the NB Department of Transportation and Infrastructure that gave permission to replant trees along the stream in Shediac.

Finally, thanks to the SBWA staff and the board of directors' volunteers for their dedication in improving water quality in the Shediac Bay watershed.

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1. INTRODUCTION

The primary mandate of the Shediac Bay Watershed Association is the protection and enhancement of water quality as well as increasing 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 over the past 20 years. To better understand the suitability for fish habitat and collect data on changing temperature trends, 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 2021, we worked to reduce stream bank erosion in two areas of the watershed. Stream clean-ups are also regularly undertaken with the help of the summer students.

The publication of a new Integrated Watershed Management Plan for the Shediac Bay watershed by the Department of Environment and Local Government in 2021 is helping the SBWA to better plan and strategize our activities. An implementation committee was formed to help target the action items outlined in the plan.

The SBWA continues to develop public educational materials such as signage, interpretation panels, videos, handouts and social media postings. The Association has expanded its digital outreach on several social media platforms. Normally, a variety of presentations and activities are done with both schools and the general public. Several programs were either modified or cancelled in 2021 due to the COVID-19 pandemic.

The present report highlights the monitoring results and actions that have been undertaken in 2021.

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 (Figure 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.

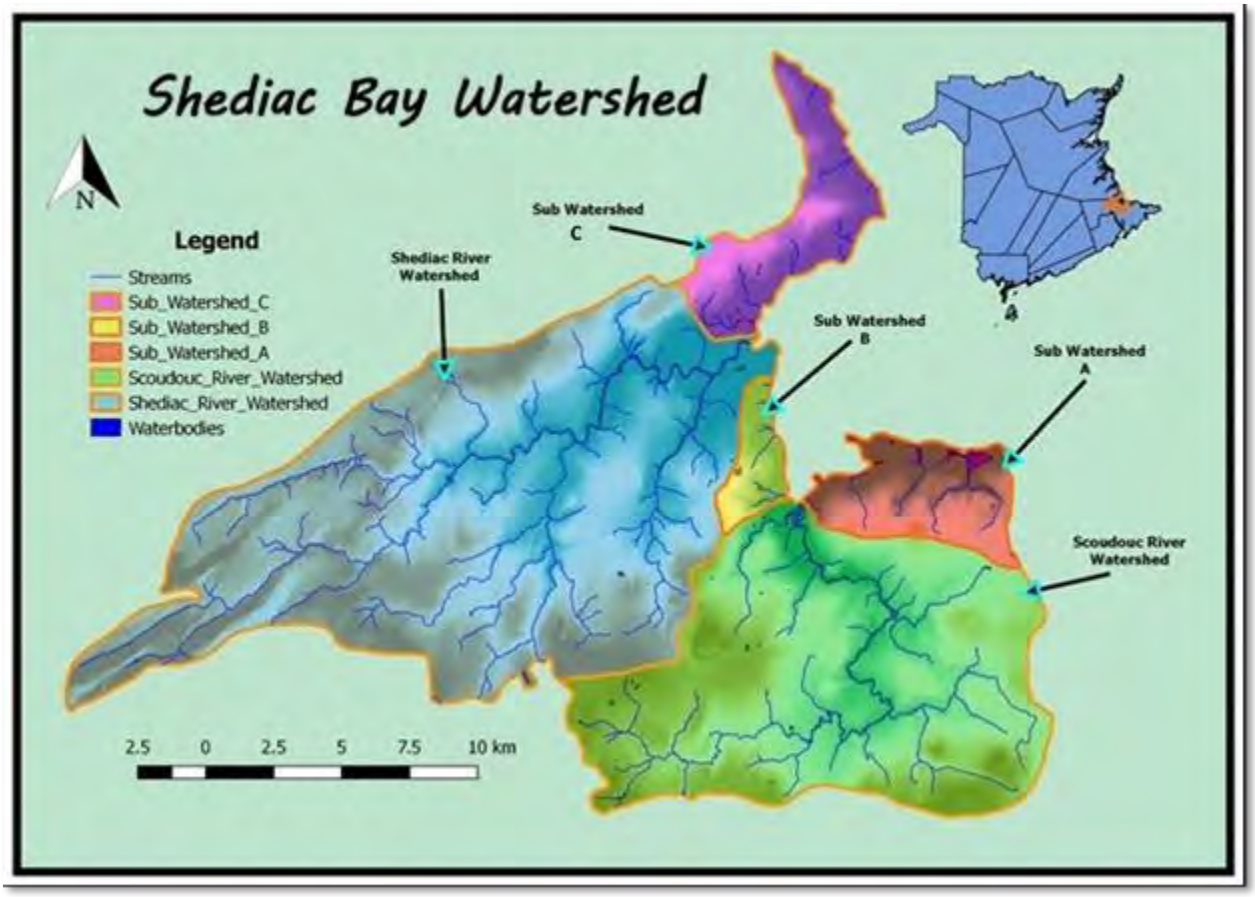


Figure 1: Map of Shediac Bay watershed boundaries and sub-watersheds

2. METHODOLOGY

2.1 Water Quality Sampling Protocol

Water quality monitoring was conducted once a month from May to October 2021, at 21 sampling stations in the major rivers and small tributaries of the Shediac Bay watershed. Water quality sampling was performed using the protocol developed by the New Brunswick Department of Environment.

Regular water samples are to be collected during a period of dry weather, without the influence of non-point source pollution discharged in stormwater runoff. Ambient water quality data is used to determine the general health and water quality trends of a waterbody. A storm event sampling is the collection of water samples during or following a significant rainfall event. The result of a storm event sampling is an estimate of the pollution load leaving an area of land. It helps to better characterize concentrations of diffused contaminants entering a watercourse under a range of flow conditions.

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 habitat data includes; laboratory issued sample bottles, labels, latex or nitrile gloves, clipboard, waterproof paper for field sheets, pencils, waders or rubber boots, orange reflective vests for safety, GPS, a digital camera, YSI (water conditioning metre), metre stick, survey measuring tape, and a cooler with ice for the water samples.

2.2 Site Information

2.2.1 Shediac and Scoudouc River Sampling

The following describes the sample site information for the 10 water classification monitoring stations established in 1999 (Table 1 & Figure 2).

Table 1: Shediac and Scoudouc River 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

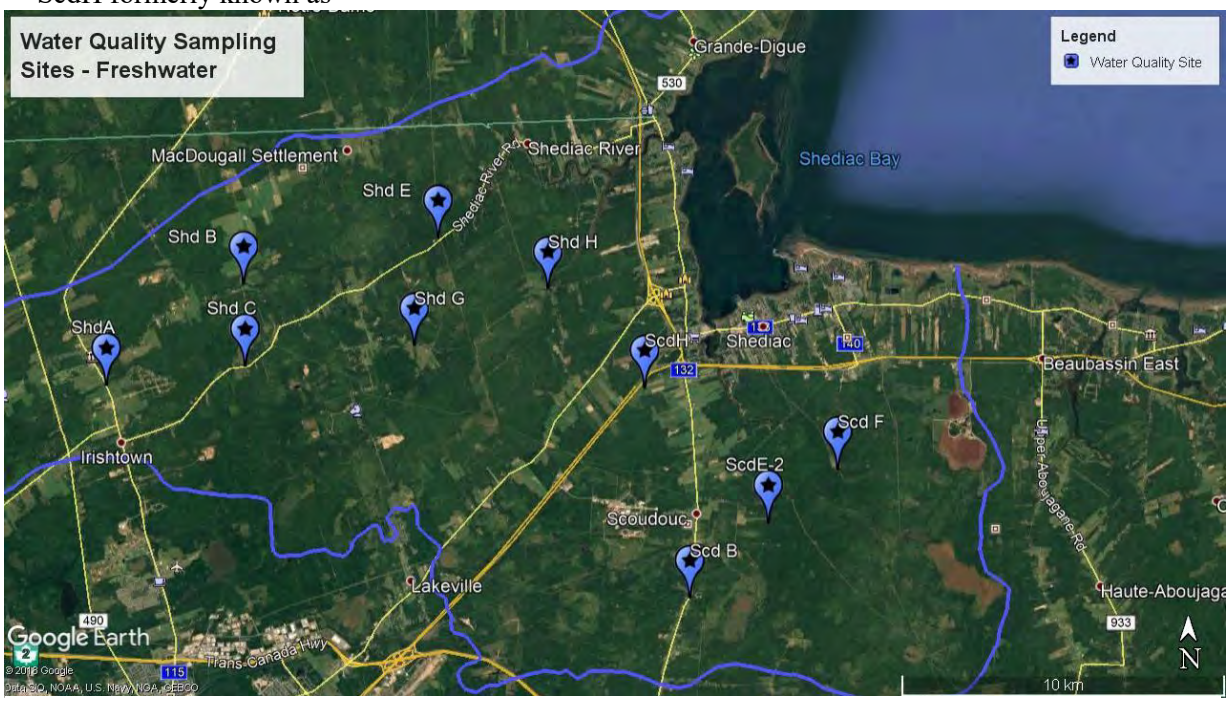


Figure 2. Water Quality Sampling Sites – Water Classification Stations

2.2.2 Shediac Bay Small Stream Sampling

The following describes the sample site information for the 11 small stream water quality monitoring stations established in 2017 (Table 2 & Figure 3).

Table 2: Shediac Bay Small Stream Sampling

Site ID	Latitude	Longitude	Elevation (m) Google Earth	Brook Name	Location Description
WQ-1	N46°13'24.19"	W64°28'30.36"	10	Unnamed Brook	907 route NB-133, Boudreau-Ouest, Dirt Road after this address, going through the field (sample upstream of the culvert)
WQ-2	N46°13'35.25"	W64°29'48.39"	9	Unnamed Brook	725 route NB-133, Boudreau-Ouest (sample upstream from culvert)
WQ-3	N46°13'18.25"	W64°31'30.94"	13	Unnamed Brook	482 Main St., Shediac, In front of Shediac Bakery (sample upstream of culvert)
WQ-4	N46°13'11.25"	W64°32'56.17"	3	Unnamed Brook	Shediac Town Hall, 290 Main st, sample downstream culvert
WQ-5	N46°13'22.17"	W64°33'58.17"	8	Unnamed Brook	Park at Atkinson Court, walk on Route 133 (sample upstream from culvert)
WQ-6	N46°14'23.90"	W64°34'2.29"	8	Unnamed Brook	Park at Old Mill Rd (Sample upstream from culvert)
WQ-7	N46°14'43.38"	W64°34'7.29"	3	Unnamed Brook	Brook flows between Bay Vista Lodge at 3521 Route 134, Shediac Cape, (sample upstream from culvert)
WQ-8	N46°15'11.99"	W64°34'14.01"	1	Unnamed Brook	In front of Dr. Chiropractor, 3694 Route NB-134, Shediac Cape, (sample upstream of culvert)
WQ-9	N46°16'41.70"	W64°35'13.77"	1	Albert-Gallant Brook	2487 Shediac Rd (sample downstream from culvert due to beaver flooding)
WQ-10	N46°17'8.24"	W64°34'29.13"	3	Unnamed Brook	Brook is after Antoine Rd, Grande-Digue, (sample from upstream of culvert)
WQ-11	N46°17'52.15"	W64°33'18.27"	1	Unnamed Brook	Brook crossing Route 530 in Grande-Digue, near Chemin des Sœurs. Sample upstream of double culvert, in pool
WQ-11B	N 46°17'52.37"	W 64°33'18.73"	1	Unnamed Brook	Sample is collected approximately 15 metres upstream of the pool WQ-11, brook flowing from the northern field

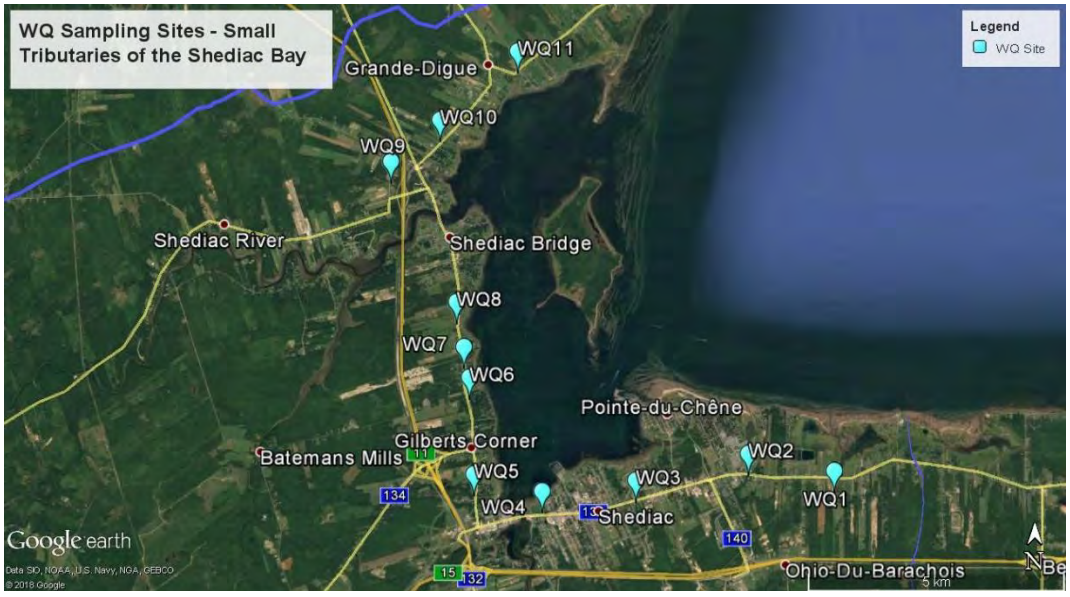


Figure 3: Water Quality Sampling Sites - Small Streams

2.3 Water Quality Parameters

The water quality monitoring program analyses many chemical and physical parameters to assess the overall water quality for the protection of aquatic life. Although all results are presented in the report, only a few key parameters will be discussed in the report (Table 3, 4, 5, 6, 7), as some of these were above the recommended guidelines or they are of greater significance to the assessment of the overall water quality.

2.3.1 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 ($^{\circ}$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 $^{\circ}$C is said to cause thermal stress to salmonid populations, causing them to stop feeding and search for thermal refugia.

2.3.2 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.

2.3.3 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.

2.3.4 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 fishery. Consequently, a higher conductivity level may indicate a higher amount of dissolved material in the water and the presence of contaminants.

2.3.5 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 2.9 mg/l (NO3).

2.3.6 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.

2.3.7 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 for recreational purposes is set at 400 MPN/100 ml.

2.3.8 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).

2.3.9 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).

2.3.10 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.

2.3.11 Lead

In many cases, the factors that influence the toxicity of xenobiotic substances have been identified. For example, relationships between water hardness and acute toxicity to fish have been established for several metals (e.g., cadmium, copper, lead, nickel, and zinc; CCREM 1987; Nagpal 1997).

In the case of Lead, the guidelines for the protection of aquatic life is as follows: when the hardness ($CaCO_3$) ranges from 0-60 mg/L, the limit is set at 1 µg/L, from 60-120 mg/L the limit is 2 µg/L, from 120-180 mg/L the limit is 4 µg/L, and when the hardness is higher than 180 mg/L the limit is 7 µg/L. The combination of low dissolved oxygen and toxic chemicals may lead to stress responses in aquatic organisms. The toxicities of zinc, lead, copper, pentachlorophenol, cyanide, hydrogen sulphide and ammonia are enhanced by low dissolved oxygen. Dissolved metals may be removed from the water column by adsorption, precipitation, and co-precipitation processes. Lead, for example, is strongly adsorbed to particles and can be removed from the water column and concentrated in sediments (Canadian Council of Ministers of the Environment, 2008)

2.4 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		

2.5 CCME - Canadian Environmental Quality Guidelines (CEQGs) for the Protection of Aquatic Life (Freshwater)

Table 4: Summary of the CCME Canadian Environmental Quality Guidelines

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY						
Parameter	Condition	Value (mg/L)	Condition	Value (mg/L)	Equation Between Conditions	Notes
Ag	—	—	Long-Term	0.00025	—	The following parameters did not have CCME recommended guidelines for the protection of aquatic life and were therefore omitted from the table:
Al	pH<6.5	0.005	pH≥6.5	0.1	—	
As	—	—	Upper	0.005	—	
B	Short-Term	29	Long-Term	1.5	—	
Cd (Short-Term)	HARD<5.3	0.00011	HARD>360	0.0077	10^(1.016*LOG(HARD)-1.71)	
Cd (Long-Term)	HARD<17	0.00004	HARD>280	0.00037	10^(0.83*LOG(HARD)-2.46)	
Cl	Short-Term	640	Long-Term	120	—	
CLRA	Narrative; refer to CCME website for more information.				—	
Cu	HARD<82	0.002	HARD>180	0.004	0.2*EXP(0.8545*LN(HARD)-1.465)	
DO (warm) †	Early	6	Other	5.5	—	
DO (cold)	Early	9.5	Other	6.5	—	
E-coli ‡	—	—	Upper	400 MPN/100mL	—	
Fe	—	—	Upper	0.3	—	
Mo	—	—	Upper	0.073	—	
NH3_T	Table; refer to CCME website for more information.				—	
NH3_Un	—	—	Long-Term	0.019	—	
Ni	HARD≤60	0.025	HARD>180	0.15	EXP(0.76*LN(HARD)+1.06)	
NO2	—	—	Upper	0.197	—	
NO3	Short-Term	124	Long-Term	2.9	—	
Pb	HARD≤60	0.001	HARD>180	0.007	EXP(1.273*LN(HARD)-4.705)	
pH	Lower L-T	6.5	Upper L-T	9	—	
Se	—	—	Upper	0.001	—	
Tl	—	—	Upper	0.008	—	
U	Short-Term	0.033	Long-Term	0.015	—	
Zn	—	—	Upper	0.03	—	

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.

Table 5: 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		

Table 6: CCME Guidance framework for Phosphorus

CCME Guidance Framework for Total Phosphorus (TP-L)					
Parameter	Description	Value	Units	Notes	
TP-L*	Hyper-eutrophic	> 0.100	mg/L	†	The CCME recommended guidelines for the protection of aquatic wildlife (freshwater) indicates 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	0.035 - 0.100	mg/L		
	Meso-eutrophic	0.020 - 0.035	mg/L		
	Mesotrophic	0.010 - 0.020	mg/L		
	Oligotrophic	0.004 - 0.010	mg/L		
	Ultra-oligotrophic	< 0.004	mg/L	*	Total phosphorus level

Table 7: CCME Canadian Environmental Quality Guidelines for Nitrates

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY						
Parameter	Condition	Value (mg/L)	Condition	Value (mg/L)	Equation Between Conditions	Notes
NO3	Short-Term	124	Long-Term	2.9	—	

2.6 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 inorganic results. The following provides the terms and definitions of the acronyms used in the data tables.

Table 8: 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 water 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 which water at 20 degrees Celsius is saturated with calcium carbonate
TDS	mg/L	Total dissolved solids measured in milligrams per litre
TURB	NTU	Water turbidity measured in nephelometric turbidity units

Table 9: 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_3I	µg/L	Total ammonia measured in micrograms per litre	—	—	—

Table 10: 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. RESULTS

3.1 Shediac and Scoudouc River Sampling

The following section contains the results on all the data collected during the water quality monitoring for 2021. 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.

The purpose of a long-term monitoring program is to evaluate a waterbody under various conditions, such as changes in surrounding land uses and changes in climate patterns. A long-term monitoring program allows to establish baseline trends in water quality, to detect abnormalities and significant changes over time. This year has demonstrated some abnormalities in bacterial results.

It was discovered 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. 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, the site code was changed to ScdE-2.

In 2021, most water quality samplings were done under ambient conditions, with four sampling performed following after a light rain event. No planned rain sampling was done in 2021 due to the lack of rain. Only one sampling event occurred during light showers (May).

3.1.1 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 (Figure 4). 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 5 years; 2 maps were added to compare the surrounding between 2015 and 2017 (Figure 4 & 5).

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 a cattle fence along the river, but there is an access that allows the cows to cross the river in one area upstream of the sample site. There is a section of the brook, approximately 100 m in length near the cattle crossing area, that has a thin buffer zone (> 10 m) or none in some areas (Figure 6).

An apple orchard was established in 2016-2017, approximately 200 metres from the sampling site. Approximately 20 hectares was cleared of vegetation for the orchard. There is no tree buffer to help prevent drainage from these fields from reaching the river. 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 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. The water temperature, however, exceeded the limit for thermal stress in salmonids of 22.5˚C in June (22.9˚C) (Table 11).

Bacterial levels exceeded the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) in June (1,274 MPN/100 mL) (Table 11).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were: in the mesotrophic range (0.010 – 0.020 mg/L) from May to September and in the meso-eutrophic range (0.020 – 0.035 mg/L) in October (Table 12).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) reached or exceeded the guidelines of 0.100 mg/L (pH ≥ 6.5) in May (0.116 mg/L) and October (0.117 mg/L). The concentration of iron (Fe) exceeded the guideline of 0.3 mg/L in July (0.38 mg/L), September (0.41 mg/L), and October (0.41 mg/L) (Table 13).

Table 11: Water chemistry data and *E. coli* results for ShdA, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	23	17.0	0.10	9.42	10	51	33	0.169	0.159	58.0	-0.58	7.73	7.8	8.4	133.35	91	2.9
21-06-29	DND	22.9	0.10	N/A	1,274	79	11	0.212	0.246	107.0	0.15	7.63	8.1	7.9	143.65	136	1.3
21-07-27	26	19.6	0.08	8.66	75	57	37	0.168	0.174	66.7	-0.28	8.56	8.0	8.3	84.00	98	3.6
21-08-24	26	21.2	0.10	8.37	313	77	14	0.203	0.230	93.7	0.09	8.20	8.1	8	142.35	128	2.3
21-09-29	16	14.6	0.09	9.25	160	70	41	0.159	0.201	78.1	0.07	8.35	8.2	8.1	128.70	116	5.5
21-10-25	8	8.4	0.09	11.38	20	60	45	0.129	0.195	70.1	-0.35	8.02	7.9	8.3	20.00	103	3.7

Table 12: Nutrient results for ShdA, 2021

SITE ShdA: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	50.7	0.02	17.9	0.301	9.1	0.13	0.67	3.22	6.5	<0.05	<0.001	<0.05	0.60	0.60	13.0	—	0.7	6.2	0.016
21-06-29	78.0	0.02	33.8	0.923	11.7	0.17	0.84	5.41	7.1	<0.05	<0.001	<0.05	1.09	1.09	21.0	—	1.1	3.2	0.015
21-07-27	56.4	0.02	20.9	0.530	9.1	0.15	0.65	3.53	6.4	<0.05	<0.001	<0.05	0.71	0.71	13.0	—	0.8	6.2	0.017
21-08-24	76.0	0.02	29.8	0.899	9.9	0.15	0.76	4.67	7.1	<0.05	<0.001	<0.005	1.12	1.12	20.0	—	1.0	3.4	0.013
21-09-29	68.9	0.02	24.3	1.030	12.2	0.27	0.84	4.24	7.1	<0.05	<0.001	<0.05	1.01	1.01	13.0	—	0.9	6.3	0.019
21-10-25	69.6	0.02	21.1	0.444	16.6	0.27	1.19	4.23	9.3	<0.05	<0.001	<0.05	0.66	0.60	10.0	—	1.0	8.2	0.025

Table 13: Inorganics results for ShdA, 2021

SITE ShdA: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	0.116	<0.001	0.019	0.035	<0.00001	<0.0001	<0.001	<0.001	0.23	0.0015	0.016	0.0015	<0.001	0.0001	0.0008	<0.0001	0.256	0.0009	<0.001	<0.001
21-06-29	0.059	<0.001	0.032	0.053	<0.00001	<0.0001	<0.001	<0.001	0.22	0.0025	0.033	0.0028	<0.001	0.0001	0.0011	0.0001	0.396	0.0023	<0.001	<0.001
21-07-27	0.083	<0.001	0.020	0.032	<0.00001	<0.0001	<0.001	<0.001	0.38	0.0015	0.024	0.0016	<0.001	0.0002	0.0008	<0.0001	0.227	0.0013	<0.001	<0.001
21-08-24	0.070	<0.001	0.027	0.045	<0.00001	<0.0001	<0.001	<0.001	0.26	0.0023	0.029	0.0026	<0.001	0.0001	0.0011	0.0001	0.321	0.0020	<0.001	<0.001
21-09-29	0.098	<0.001	0.023	0.036	<0.00001	0.0001	<0.001	<0.001	0.41	0.0019	0.032	0.0017	<0.001	0.0002	0.0010	0.0001	0.290	0.0015	<0.001	<0.001
21-10-25	0.117	<0.001	0.021	0.032	<0.00001	<0.0001	<0.001	<0.001	0.41	0.0017	0.017	0.0013	<0.001	0.0001	0.0010	<0.0001	0.226	0.0013	<0.001	<0.001

Figure 4: ShdA site location and surrounding land uses (imagery view of 2015)

Figure 5. ShdA site location and surrounding land uses (imagery view of 2017)

Figure 6: Site photos for water quality sampling site ShdA

3.1.2 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.) (Figure 7). The sample is taken upstream of the culvert. The surrounding land uses includes; residences, agricultural fields, cattle farms, and a mineral extraction pit (Figure 8).

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 point 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 2021, meet the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. However, the water temperature exceeded the limit for thermal stress in salmonids of 22.5˚C in June (26.2˚C) and August (23.4˚C) (Table 14).

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) (Table 14).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were: in the oligotrophic range (0.004 – 0.010 mg/L) in June; in the mesotrophic range (0.010 – 0.020 mg/L) in May, July, and August; and meso-eutrophic range (0.020 – 0.035 mg/L) in August and October (Table 15).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the sample taken in July (0.108 mg/L) and October (0.181 mg/L). Iron (Fe) levels exceeded the guideline of 0.3 mg/L in the samples taken in June (0.47 mg/L), September (0.40 mg/L), and October (0.39 mg/L) (Table 16).

Table 14: Water chemistry data and *E. coli* results for ShdB, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	24	18.4	0.04	8.45	10	34	54	0.082	0.094	29.6	-1.35	7.28	7.5	8.8	60.45	54	1.3
21-06-29	DND	26.2	0.08	N/A	121	70	17	0.171	0.183	67.0	-0.39	7.44	7.8	8.2	108.55	98	1.6
21-07-27	27	21.3	0.06	8.22	108	45	56	0.119	0.121	41.1	-0.89	8.27	7.7	8.6	60.00	68	1.8
21-08-24	27	23.4	0.10	8.89	238	85	14	0.198	0.211	76.7	-0.27	7.86	7.8	8.1	132.60	114	1.3
21-09-29	17	14.9	0.08	8.93	275	60	44	0.134	0.174	59.2	-0.52	7.93	7.8	8.3	107.90	92	4.7
21-10-25	8	8.2	0.07	11.65	31	49	98	0.099	0.150	49.4	-0.79	7.76	7.7	8.5	31.00	76	3.5

Table 15: Nutrient results for ShdB, 2021

SITE ShdB: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	33.9	0.02	8.6	0.101	7.0	0.18	0.58	1.96	5.7	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.2	8.7	0.013
21-06-29	69.6	0.04	20.5	0.413	9.2	0.15	1.00	3.85	9.8	<0.05	<0.001	<0.05	<0.05	<0.05	6.0	—	0.3	4.4	0.010
21-07-27	44.8	0.03	12.3	0.211	8.6	0.27	0.60	2.53	7.3	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.3	8.9	0.014
21-08-24	84.5	0.05	22.9	0.501	11.6	0.16	0.94	4.73	11.6	<0.05	<0.001	<0.05	<0.045	<0.05	6.0	—	<0.2	4.0	0.013
21-09-29	59.6	0.04	17.6	0.353	13.6	0.33	0.82	3.71	10.6	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.4	7.8	0.028
21-10-25	48.7	0.03	14.4	0.229	15.9	0.37	0.98	3.27	10.4	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.5	12.9	0.026

Table 16: Inorganics results for ShdB, 2021

SITE ShdB: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	0.037	<0.001	0.008	0.038	<0.00001	<0.0001	<0.001	<0.001	0.20	0.0007	0.041	0.0004	<0.001	<0.0001	0.0007	<0.0001	0.050	<0.0001	<0.001	<0.001
21-06-29	0.054	0.001	0.013	0.078	<0.00001	0.0001	<0.001	<0.001	0.47	0.0009	0.277	0.0007	<0.001	0.0001	0.0013	<0.0001	0.114	0.0002	<0.001	<0.001
21-07-27	0.108	<0.001	0.009	0.042	<0.00001	<0.0001	<0.001	<0.001	0.28	0.0007	0.072	0.0006	<0.001	0.0001	0.0008	<0.0001	0.071	0.0001	<0.001	<0.001
21-08-24	0.033	<0.001	0.012	0.081	<0.00001	<0.0001	<0.001	<0.001	0.26	0.0010	0.127	0.0009	<0.001	<0.0001	0.0011	<0.0001	0.130	0.0003	<0.001	<0.001
21-09-29	0.093	<0.001	0.012	0.066	<0.00001	0.0001	<0.001	<0.001	0.40	0.0009	0.120	0.0008	<0.001	0.0002	0.0011	<0.0001	0.098	0.0002	<0.001	<0.001
21-10-25	0.181	<0.001	0.011	0.056	0.00001	0.0001	<0.001	<0.001	0.39	0.0009	0.050	0.0005	<0.001	0.0002	0.0010	<0.0001	0.081	0.0001	<0.001	0.001

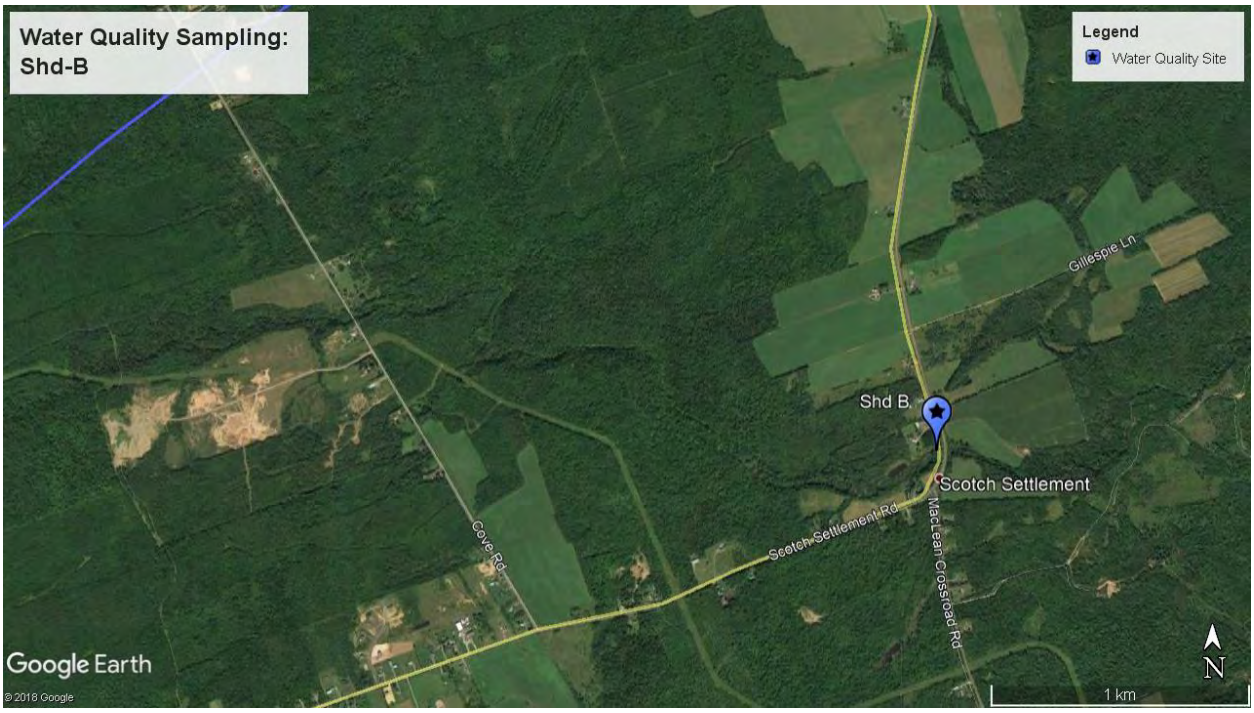


Figure 7: ShdB site location and surrounding land uses

Figure 8: Site photos for water quality sampling site ShdB

3.1.3 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) (Figure 9). The sample is taken upstream of the bridge (Figure 10). 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 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. However, the water temperature exceeded the limit for thermal stress in salmonids of 22.5˚C in June (23.3˚C) (Table 17).

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) (Table 17).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, all the samples were in the mesotrophic range (0.010 – 0.020 mg/L) (Table 18).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the samples taken in May (0.142 mg/L), July (0.107 mg/L), and October (0.102 mg/L) (Table 19).

Table 17: Water chemistry data and *E. coli* results for ShdC, 2021

SITE ShdC: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (mS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
21-05-27	24	18.3	0.05	9.35	10	49	45	0.092	0.143	49.7	-0.76	7.02	7.7	8.5	68.25	87	3.1
21-06-29	DND	23.3	0.10	N/A	52	80	9	0.216	0.236	100.0	0.02	7.50	8.0	8	144.95	134	0.6
21-07-27	26	20.0	0.07	9.60	41	53	47	0.153	0.162	56.4	-0.38	8.57	8.0	8.4	76.00	92	2.4
21-08-24	26	21.7	0.11	10.25	131	89	8	0.224	0.250	96.0	0.34	8.53	8.3	8	155.35	141	1.2
21-09-29	16	14.8	0.09	11.10	85	70	31	0.153	0.202	73.9	0.14	8.66	8.3	8.2	124.15	115	2.3
21-10-25	8	8.7	0.09	10.65	52	63	52	0.137	0.203	68.7	-0.34	7.77	7.9	8.2	52.00	107	2.4

Table 18: Nutrient results for ShdC, 2021

SITE ShdC: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	48.7	0.02	15.4	0.229	11.3	0.16	0.82	2.73	9.1	<0.05	<0.001	<0.05	0.17	0.17	9.0	—	0.4	9.5	**0.020**
21-06-29	79.2	0.02	31.1	0.744	12.8	0.18	1.21	5.53	9.2	<0.05	<0.001	<0.05	0.61	0.61	19.0	—	0.8	4.2	**0.012**
21-07-27	52.5	0.02	17.5	0.494	11.9	0.24	0.88	3.08	8.0	<0.05	<0.001	<0.05	0.27	0.27	8.0	—	0.5	9.1	**0.016**
21-08-24	87.3	0.03	29.8	1.640	16.2	0.16	1.15	5.24	10.3	<	<0.001	<0.05	0.51	0.51	18.0	—	0.5	3.7	**0.011**
21-09-29	68.6	0.03	22.8	1.290	14.6	0.26	1.05	4.13	9.1	<0.05	<0.001	<0.05	0.36	0.36	12.0	—	0.5	7.8	**0.017**
21-10-25	62.5	0.03	20.9	0.467	19.2	0.27	1.34	4.02	11.6	<0.05	<0.001	<0.05	0.26	0.26	10.0	—	0.7	9.6	**0.016**

Table 19: Inorganics results for ShdC, 2021

SITE ShdC: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	**0.142**	<0.001	0.013	0.039	<0.00001	<0.0001	<0.001	<0.001	0.21	0.0009	0.017	0.0006	<0.001	0.0001	0.0009	<0.0001	0.146	0.0004	<0.001	<0.001
21-06-29	0.030	<0.001	0.025	0.069	<0.00001	<0.0001	<0.001	<0.001	0.04	0.0012	0.026	0.0014	<0.001	<0.0001	0.0011	<0.0001	0.302	0.0010	<0.001	<0.001
21-07-27	**0.107**	<0.001	0.015	0.039	<0.00001	<0.0001	<0.001	<0.001	0.28	0.0009	0.025	0.0008	<0.001	0.0001	0.0009	<0.0001	0.149	0.0005	<0.001	<0.001
21-08-24	0.038	<0.001	0.023	0.062	<0.00001	<0.0001	<0.001	<0.001	0.10	0.0013	0.023	0.0017	<0.001	<0.0001	0.0011	<0.0001	0.285	0.0012	<0.001	<0.001
21-09-29	0.076	<0.001	0.019	0.049	<0.00001	<0.0001	<0.001	<0.001	0.21	0.0012	0.025	0.0012	<0.001	0.0001	0.0010	<0.0001	0.220	0.0007	<0.001	<0.001
21-10-25	**0.102**	<0.001	0.018	0.045	<0.00001	<0.0001	<0.001	<0.001	0.29	0.0012	0.020	0.001	<0.001	<0.0001	0.0010	<0.0001	0.210	0.0008	<0.001	<0.001

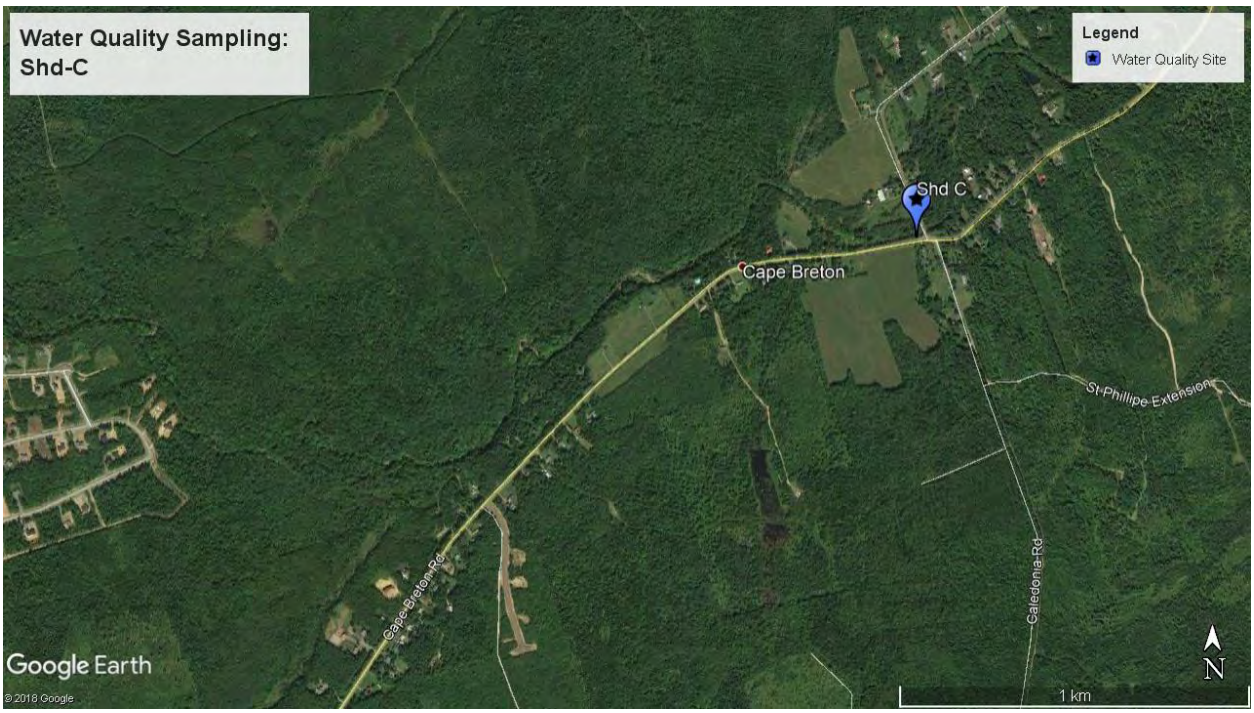


Figure 9: ShdC site location and surrounding land uses

Figure 10: Site photos for water quality sampling site ShdC

3.1.4 Shediac River – ShdE

This water quality sampling site is located in the main branch of the Shediac River, at the old covered bridge (Figure 11). The sample is taken upstream of the covered bridge (Figure 12). 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 30 m.

The water sampling results for the site ShdE, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. The water temperature slightly exceeded the limit for thermal stress in salmonids of 22.5˚C in June (25.9˚C) and August (23.3˚C) (Table 20).

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) (Table 20).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, all the samples were in the mesotrophic range (0.010 – 0.020 mg/L) (Table 21).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the samples taken in May (0.141 mg/L) and October (0.126 mg/L). The concentration of iron (Fe) exceeded the guideline of 0.3 mg/L in July (0.36 mg/L), September (0.31 mg/L), and October (0.31 mg/L) (Table 22).

Table 20: Water chemistry data and *E. coli* results for ShdE, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	23	18.5	0.05	10.82	41	35	59	0.090	0.105	33.0	-1.28	7.58	7.5	8.8	66.30	63	2.0
21-06-29	DND	25.9	0.06	N/A	52	68	12	0.128	0.203	81.5	-0.02	7.80	8.1	8.1	81.90	111	0.7
21-07-27	26	20.8	0.06	10.74	41	46	58	0.127	0.130	45.8	-0.52	8.66	8.0	8.5	63.00	72	2.0
21-08-24	26	23.3	0.09	10.05	201	77	11	0.190	0.204	79.2	0.21	8.55	8.3	8.1	127.46	113	1.1
21-09-29	15	14.0	0.08	9.45	75	57	41	0.127	0.168	58.5	-0.43	7.87	7.9	8.3	104.00	92	2.3
21-10-25	8	7.9	0.08	11.19	52	55	69	0.113	0.177	60.3	-0.65	7.83	7.7	8.3	52.00	92	2.5

Table 21: Nutrient results for ShdE, 2021

SITE ShdE: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	34.9	0.02	10.0	0.104	8.4	0.21	0.71	1.94	6.2	<0.05	<0.001	<0.05	<0.05	<0.05	4.0	—	0.3	9.5	0.020
21-06-29	67.1	0.02	25.8	0.794	12.6	0.17	1.16	4.14	8.7	<0.05	<0.001	<0.05	0.15	0.15	12.0	—	0.4	4.2	0.012
21-07-27	45.5	0.02	14.3	0.428	9.5	0.23	0.78	2.46	6.9	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.4	9.1	0.016
21-08-24	75.5	0.02	24.8	1.420	10.7	0.15	1.08	4.20	8.5	<0.05	<0.001	<0.05	0.08	0.08	12.0	—	<0.2	3.7	0.011
21-09-29	56.6	0.03	18.1	0.422	13.2	0.24	1.04	3.24	8.4	<0.05	<0.001	<0.05	0.08	0.08	5.0	—	0.4	7.8	0.017
21-10-25	54.7	0.03	18.2	0.258	17.3	0.32	1.28	3.61	10.2	<0.05	<0.001	<0.05	0.01	0.01	7.0	—	0.6	9.6	0.016

Table 22: Inorganics results for ShdE, 2021

SITE ShdE: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	0.141	<0.001	0.008	0.042	<0.00001	<0.0001	<0.001	<0.001	0.28	0.0008	0.027	0.0003	<0.001	0.0001	0.0008	<0.0001	0.078	0.0002	<0.001	<0.001
21-06-29	0.028	<0.001	0.015	0.080	<0.00001	<0.0001	<0.001	<0.001	0.12	0.0013	0.045	0.0008	<0.001	<0.0001	0.0013	<0.0001	0.200	0.0005	<0.001	<0.001
21-07-27	0.094	<0.001	0.010	0.041	<0.00001	<0.0001	<0.001	<0.001	0.36	0.0008	0.032	0.0002	<0.001	0.0002	0.0009	<0.0001	0.095	0.0002	<0.001	<0.001
21-08-24	0.034	<0.001	0.013	0.075	<0.00001	<0.0001	<0.001	<0.001	0.15	0.0012	0.026	0.0009	<0.001	<0.0001	0.0012	<0.0001	0.193	0.0005	<0.001	<0.001
21-09-29	0.073	<0.001	0.013	0.062	<0.00001	<0.0001	<0.001	<0.001	0.31	0.0011	0.022	0.0007	<0.001	0.0001	0.0010	<0.0001	0.141	0.0003	<0.001	<0.001
21-10-25	0.125	<0.001	0.014	0.062	<0.00001	<0.0001	<0.001	<0.001	0.31	0.0011	0.018	0.0007	<0.001	0.0001	0.0011	<0.0001	0.159	0.0005	<0.001	<0.001

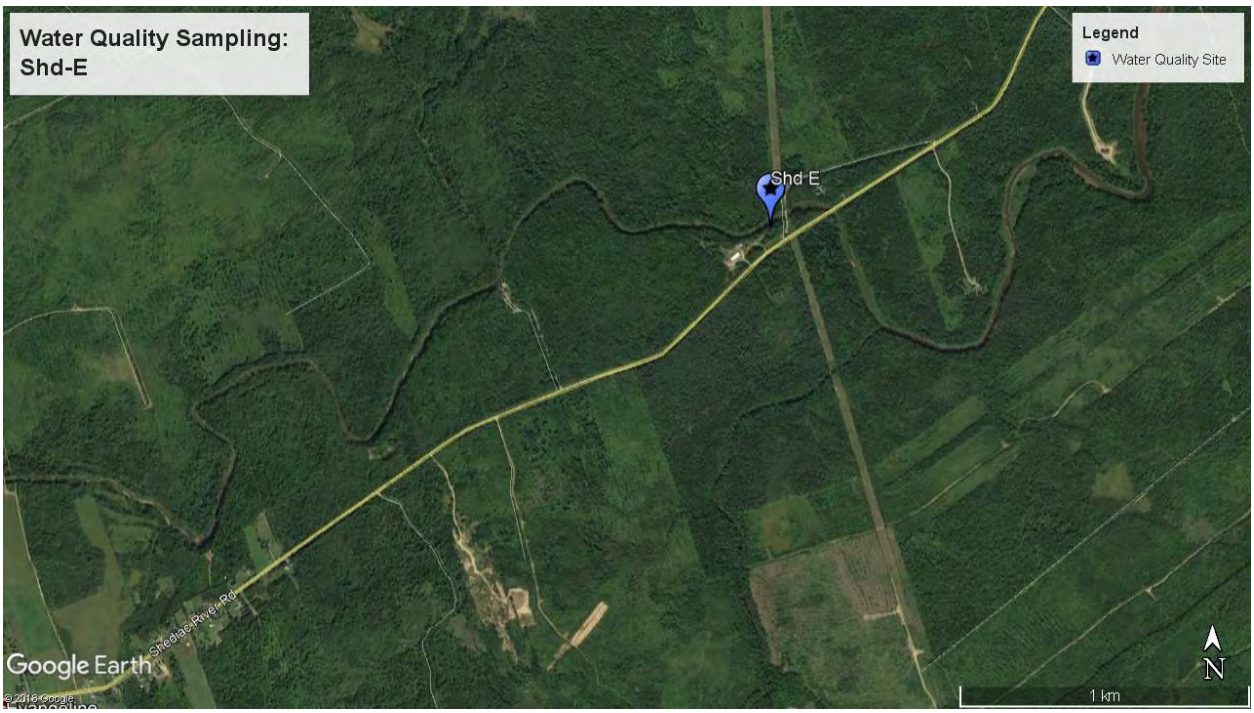


Figure 11: ShdE site location and surrounding land uses

Figure 12: Site photos for water quality sampling site ShdE

3.1.5 Shediac River – ShdG

This water quality sampling site is located in the Weisner Brook, at the small bridge on St-Philippe Rd (Figure 13). 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 (Figure 14). Sampling could not be completed in October due to road closures and construction on the St-Philippe road.

The Weisner Brook is a major tributary of the Shediac River, a combination of many small streams and the Calhoun Brook. A defining characteristic of this brook is the cold-water temperatures, in comparison to the rest of the Shediac River system. This factor is created by long stretches of forested riparian habitats and cold springs input into its tributaries. The Weisner Brook is recognized by the Department of Natural Resources as a "summer resting refuge for mature trout" due to the cooler temperatures. In addition, the *Department of Fisheries and Oceans Canada* has placed a variation order (GVO-2004-004) on this watercourse that prohibits any retention of brook trout (catch and release only, bag limit 0 at all times) within the "Weisner Brook from its confluence with the Shediac River upstream to its source, including all tributaries."

A few areas along the brook, in the open fields, have thinner buffer zone (> 10 m) mostly made up of young shrubs. To the left of the sampling site (looking upstream) directly upstream of the bridge, is a field recently transformed into a corn crop. In 2017-2018, the buffer zone was cut and the field was tilled in preparation for agriculture activities. The clearing had reached the riverbank, and has left little vegetation in the riparian area spanning approximately 175 m. Some alders on the riverbank were also shredded during the tilling of the field (see site photos). The field is being used to grow corn crops since 2018.

A gravel/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 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 23).

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were: in the mesotrophic range (0.010 – 0.020 mg/L) in June and

August; in the meso-eutrophic range (0.020 – 0.035 mg/L) in May and September; and in the Eutrophic range (0.035 – 0.100 mg/L) in July (Table 24).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the samples taken in May (0.160 mg/L) and July (0.172 mg/L). The concentration of iron (Fe) exceeded the guideline of 0.3 mg/L in May (0.39 mg/L), July (0.73 mg/L), and September (0.50 mg/L) (Table 25).

Table 23: Water chemistry data and *E. coli* results for ShdG, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	23	16.8	0.03	10.00	31	22	150	0.056	0.067	22.8	-1.99	6.80	7.2	9.2	42.90	50	1.2
21-06-29	DND	20.5	0.06	N/A	158	58	23	0.123	0.148	59.8	-0.77	7.40	7.6	8.4	87.75	81	0.6
21-07-27	25	18.3	0.03	9.00	52	28	212	0.074	0.078	30.6	-1.75	7.70	7.2	8.9	37.00	65	1.5
21-08-24	26	19.7	0.06	11.42	231	56	48	0.124	0.144	56.7	-0.32	8.30	8.1	8.4	89.70	79	0.9
21-09-29	16	13.5	0.04	9.96	108	36	142	0.075	0.100	37.8	-1.17	7.46	7.6	8.8	62.40	69	1.3

Table 24: Nutrient results for ShdG, 2021

SITE ShdG: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	22.0	0.02	6.0	0.033	5.6	0.26	0.45	1.90	4.1	<0.05	<0.001	<0.05	0.06	0.06	3.0	—	0.4	14.5	0.032
21-06-29	57.8	0.02	16.0	0.216	6.7	0.18	0.81	4.81	6.0	<0.05	<0.001	<0.05	0.40	0.40	3.0	—	0.6	5.7	0.018
21-07-27	28.0	0.02	8.2	0.042	6.5	0.47	0.40	2.45	5.0	<0.05	<0.001	<0.05	0.07	0.07	3.0	—	0.6	21.0	0.040
21-08-24	55.3	0.03	14.9	0.654	7.7	0.22	0.72	4.73	6.6	<0.05	<0.001	<0.05	0.14	0.14	2.0	—	0.3	7.3	0.015
21-09-29	35.8	0.03	10.0	0.134	7.4	0.44	0.70	3.11	5.5	<0.05	<0.001	<0.05	0.17	0.17	3.0	—	0.6	15.5	0.032

Table 25: Inorganics results for ShdG, 2021

SITE ShdG: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	0.160	<0.001	0.019	0.037	<0.00001	0.0001	<0.001	<0.001	0.39	0.0008	0.036	<0.0001	<0.001	0.0001	0.0005	<0.0001	0.034	<0.0001	<0.001	0.001
21-06-29	0.026	<0.001	0.024	0.066	<0.00001	0.0001	<0.001	<0.001	0.17	0.0017	0.096	0.0001	<0.001	<0.0001	0.0009	<0.0001	0.088	<0.0001	<0.001	<0.001
21-07-27	0.172	<0.001	0.020	0.041	<0.00001	0.0002	<0.001	<0.001	0.73	0.0010	0.060	<0.0001	<0.001	0.0002	0.0006	<0.0001	0.047	0.0001	<0.001	0.002
21-08-24	0.040	<0.001	0.051	0.054	<0.00001	<0.0001	<0.001	<0.001	0.28	0.0016	0.046	0.0001	<0.001	<0.0001	0.0008	<0.0001	0.076	0.0001	<0.001	<0.001
21-09-29	0.093	<0.001	0.023	0.049	<0.00001	0.0001	<0.001	<0.001	0.50	0.0012	0.045	<0.0001	<0.001	0.0001	0.0009	<0.0001	0.055	<0.0001	<0.001	<0.001

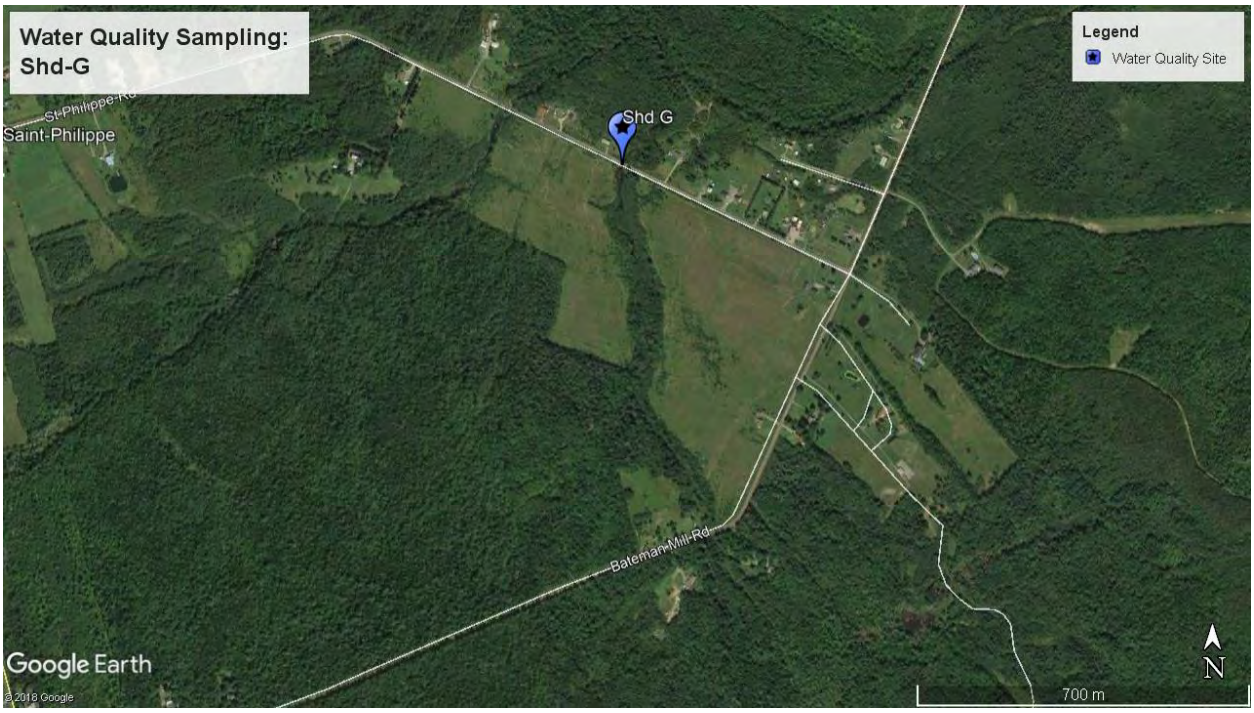


Figure 13: ShdG site location and surrounding land uses

Figure 14: Site photos for water quality sampling site ShdG

3.1.6 Shediac River – ShdH

This water quality sampling site is located in the Bateman Brook, at the culvert on Bateman Mill Rd (Figure 15). 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 (Figure 16). 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 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. The water temperature slightly exceeded the limit for thermal stress in salmonids of 22.5˚C in June (23.1˚C) (Table 26).

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were: in the mesotrophic range (0.010 – 0.020 mg/L) in May, June and August; in the meso-eutrophic range (0.020 – 0.035 mg/L) in September; and in the eutrophic range (0.035 – 0.100 mg/L) in July and October (Table 27).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of iron exceeded the guideline (0.3 mg/L) in every sample taken in 2021; May (0.47 mg/L), June (0.51 mg/L), July (0.72 mg/L), August (0.44 mg/L), September (0.66 mg/L) and October (0.67 mg/L). Concentrations of aluminum exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the samples taken in May (0.133 mg/L), July (0.116 mg/L), and October (0.173 mg/L) (Table 28).

Table 26: Water chemistry data and *E. coli* results for ShdH, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	21	17.1	0.05	5.44	62	32	94	0.102	0.116	30.5	-1.45	6.68	7.4	8.8	74.75	70	1.7
21-06-29	DND	23.1	0.09	N/A	173	69	26	0.177	0.200	71.6	-0.56	6.87	7.6	8.2	120.90	109	1.2
21-07-27	24	19.4	0.06	8.11	158	40	106	0.132	0.136	39.4	-1.44	7.54	7.2	8.6	66.00	82	2.7
21-08-24	26	20.6	0.09	9.53	98	68	29	0.167	0.192	65.7	-0.61	7.72	7.6	8.2	118.95	100	2.0
21-09-29	14	14.3	0.08	8.15	195	47	79	0.133	0.175	50.7	-1.07	7.39	7.4	8.5	108.55	98	3.0
21-10-25	8	8.6	0.08	11.04	199	40	155	0.115	0.171	45.8	-1.29	7.31	7.3	8.6	199.00	89	4.0

Table 27: Nutrient results for ShdH, 2021

SITE ShdH: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	31.9	0.02	9.4	0.075	16.3	0.20	0.63	1.73	9.5	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.4	12.2	**0.015**
21-06-29	68.7	0.03	22.4	0.257	20.3	0.16	0.93	3.80	12.8	<0.05	<0.001	<0.05	0.08	0.08	<1	—	0.4	5.5	**0.018**
21-07-27	39.9	0.03	12.3	0.059	17.1	0.29	0.64	2.10	10.3	<0.05	<0.001	<0.05	0.08	0.08	<5	—	0.5	13.2	**0.055**
21-08-24	67.7	0.03	20.5	0.253	16.4	0.14	0.90	3.56	11.0	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.2	5.7	**0.016**
21-09-29	46.9	0.04	15.9	0.111	25.0	0.28	1.03	2.68	12.8	<0.05	<0.001	<0.05	0.08	0.08	<1	—	0.5	10.6	**0.033**
21-10-25	39.9	0.04	14.2	0.075	31.2	0.42	1.21	2.52	14.5	<0.05	<0.001	<0.05	<0.05	<0.05	<5	—	0.6	14.8	**0.035**

Table 28: Inorganics results for ShdH, 2021

SITE ShdH: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	**0.133**	<0.001	0.005	0.062	0.00001	0.0001	<0.001	<0.001	**0.47**	0.0008	0.074	<0.0001	<0.001	0.0002	0.0007	<0.0001	0.054	0.0001	<0.001	0.001
21-06-29	0.037	<0.001	0.006	0.113	<0.00001	0.0002	<0.001	<0.001	**0.51**	0.0014	0.199	0.0001	<0.001	0.0001	0.0012	<0.0001	0.125	0.0002	<0.001	<0.001
21-07-27	**0.116**	<0.001	0.005	0.063	<0.00001	0.0002	<0.001	<0.001	**0.72**	0.0010	0.125	<0.0001	<0.001	0.0003	0.0009	<0.0001	0.071	0.0002	<0.001	0.001
21-08-24	0.042	<0.001	0.005	0.102	<0.00001	<0.0001	<0.001	<0.001	**0.44**	0.0013	0.087	0.0001	<0.001	<0.0001	0.0011	<0.0001	0.110	0.0002	<0.001	<0.001
21-09-29	0.094	<0.001	0.007	0.092	<0.00001	0.0002	<0.001	<0.001	**0.66**	0.0012	0.115	<0.0001	<0.001	0.0002	0.0014	<0.0001	0.091	0.0001	<0.001	0.001
21-10-25	**0.173**	<0.001	0.005	0.083	<0.00001	0.0002	<0.001	<0.001	**0.67**	0.0010	0.062	<0.0001	<0.001	0.0002	0.0014	<0.0001	0.088	0.0001	<0.001	0.001

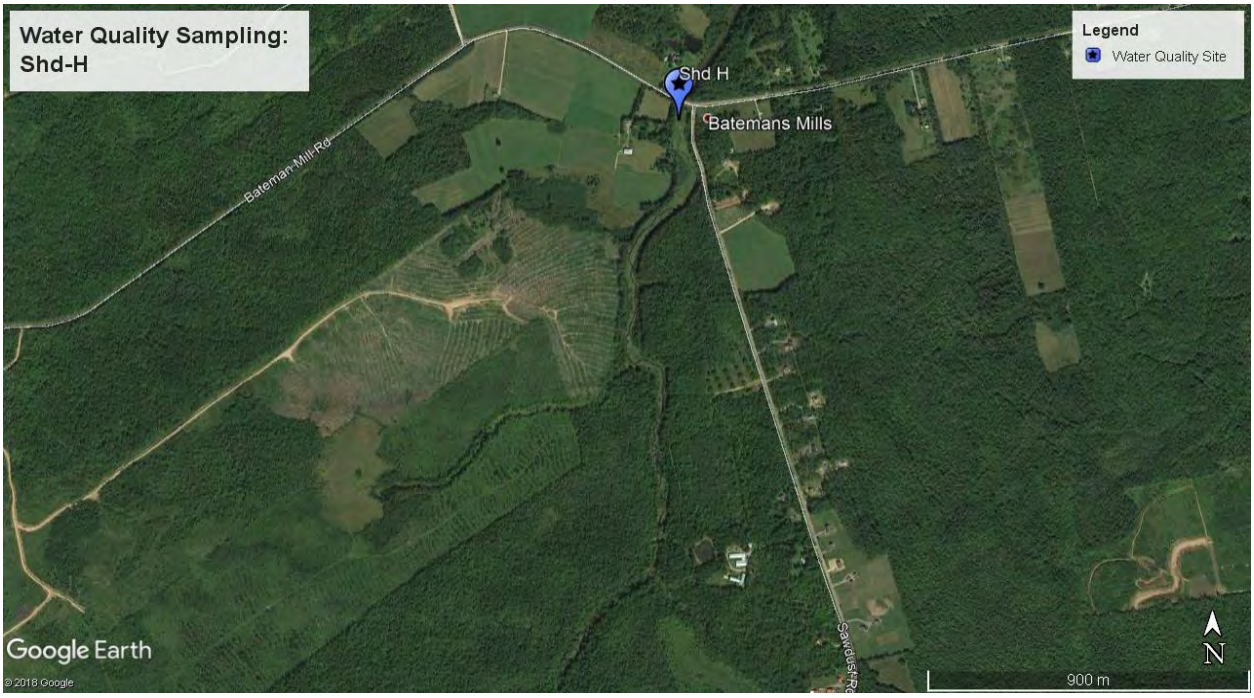


Figure 15: ShdH site location and surrounding land uses

Figure 16: Site photos for water quality sampling site ShdH

3.1.7 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* (Figure 17). 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) (Figure 18).

The water sampling results for the site ScdB, for 2021, 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 August (3.14 mg/L) (Table 29).

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) for the sample taken in August (465 MPN/100 mL) (Table 29).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were: in the mesotrophic range (0.010 – 0.020 mg/L) in May; and in the eutrophic range (0.035 – 0.100 mg/L) from July to October (Table 30).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum exceeded the CCME water quality guideline of 0.100 mg/L when the pH is ≥6.5 in the sample taken in every sample except in June; May (0.298 mg/L), July (286 mg/L), August (0.121 mg/L), September (0.225 mg/L), and October (0.230 mg/L). Concentrations of iron exceeded the guideline (0.3 mg/L) in every sample taken in 2020; May (0.61 mg/L, June (0.94 mg/L), July (1.66 mg/L), August (1.63 mg/L), September (1.96 mg/L) and October (1.53 mg/L) (Table 31).

Table 29: Water chemistry data and *E. coli* results for ScdB, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	22	16.6	0.04	8.79	31	16	233	0.069	0.076	18.4	-2.44	6.8	6.9	9.3	52.00	66	1.8
21-06-29	DND	20.8	0.09	N/A	110	66	83	0.177	0.211	74.6	-0.75	7.0	7.4	8.1	125.45	124	4.7
21-07-27	20	18.1	N/A	6.86	145	28	290	0.096	0.094	29.5	-1.99	7.2	6.9	8.9	48.00	87	4.2
21-08-24	26	20.6	0.08	**3.14**	**465**	65	162	0.156	0.173	63.2	-1.11	7.1	7.1	8.2	110.50	91	6.2
21-09-29	15	14.6	0.06	7.49	110	25	248	0.102	0.130	31.7	-1.83	7.1	7.1	8.9	82.55	97	5.1
21-10-25	7	8.3	0.05	9.89	41	18	243	0.072	0.103	23.3	-2.30	7.8	6.9	9.2	41.00	56	2.5

Table 30: Nutrient results for ScdB, 2021

SITE ScdB: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	16.0	0.03	5.8	0.012	13.6	0.30	0.36	0.94	7.9	<0.05	<0.001	<0.05	<0.05	<0.05	<5	—	0.5	27.0	**0.015**
21-06-29	65.8	0.07	24.4	0.155	25.2	0.27	0.84	3.33	14.2	0.060	<0.001	<0.05	<0.05	<0.05	<1	—	0.6	13.6	**0.052**
21-07-27	28.0	0.04	9.6	0.021	12.9	0.60	0.43	1.33	8.1	<0.05	<0.001	<0.05	<0.05	<0.05	2.0	—	0.9	33.0	**0.048**
21-08-24	64.9	0.07	9.8	0.077	14.9	0.37	0.68	2.68	9.8	<0.05	<0.001	<0.05	<0.05	<0.05	<5	—	0.7	20.0	**0.044**
21-09-29	25.0	0.05	13.4	0.030	26.7	0.64	0.95	1.64	13.4	<0.05	<0.001	<0.05	<0.05	<0.05	<5	—	0.9	26.0	**0.052**
21-10-25	18.0	0.04	7.3	0.013	22.5	0.57	0.85	1.25	11.2	<0.05	<0.001	<0.05	<0.05	<0.05	<5	—	0.8	30.0	**0.035**

Table 31: Inorganics results for ScdB, 2021

SITE ScdB: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	**0.298**	<0.001	0.016	0.023	0.00001	0.0002	<0.001	<0.001	**0.61**	0.0006	0.058	0.0001	<0.001	0.0003	0.0007	<0.0001	0.026	0.0001	<0.001	0.003
21-06-29	0.080	<0.001	0.012	0.045	0.00001	0.0005	<0.001	<0.001	**0.94**	0.0009	0.554	0.0003	<0.001	0.0004	0.0018	<0.0001	0.090	0.0004	<0.001	0.001
21-07-27	**0.286**	<0.001	0.017	0.027	<0.00001	0.0006	<0.001	<0.001	**1.66**	0.0007	0.318	0.0002	0.001	0.0006	0.0010	<0.0001	0.042	0.0002	<0.001	0.003
21-08-24	**0.121**	<0.001	0.013	0.041	<0.00001	0.0007	<0.001	<0.001	**1.63**	0.0008	0.883	0.0003	<0.001	0.0005	0.0016	<0.0001	0.073	0.0004	<0.001	0.002
21-09-29	**0.225**	<0.001	0.010	0.038	0.00002	0.001	<0.001	<0.001	**1.96**	0.0007	0.465	0.0001	<0.001	0.0005	0.0018	<0.0001	0.048	0.0001	<0.001	0.003
21-10-25	**0.230**	<0.001	0.009	0.031	0.00001	0.0004	<0.001	<0.001	**1.53**	0.0007	0.219	<0.0001	<0.001	0.0004	0.0015	<0.0001	0.034	<0.0001	<0.001	0.003

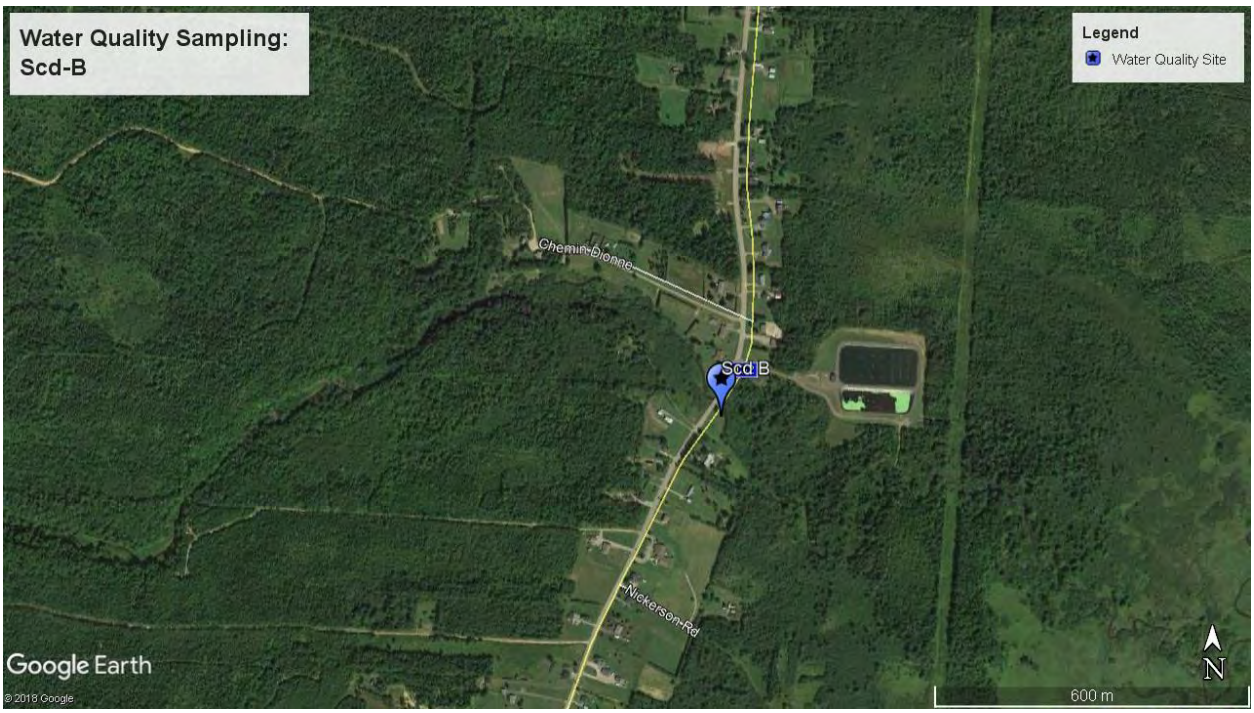


Figure 17: ScdB site location and surrounding land uses

Figure 18: Site photos for water quality sampling site ScdB

3.1.8 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) (Figure 19). 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) (Figure 20).

The water sampling results for the site ScdE-2, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 32).

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) for the sample taken in August (504 MPN/100 mL) (Table 32).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were: in the mesotrophic range (0.010 – 0.020 mg/L) in May; in the meso-eutrophic range (0.020 – 0.035 mg/L) in June, September, and October; and in the Eutrophic range (0.035 – 0.100 mg/L) in July and August (Table 33).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum exceeded the CCME water quality guideline (0.100 mg/L when the pH is ≥6.5) in every sample taken except in June; May (0.284 mg/L), July (0.333 mg/L), August (0.101 mg/L), September (0.143 mg/L), and October (0.227 mg/L). Concentrations of iron also exceeded the CCME water quality guideline (0.3 mg/L) in every sample taken in 2021; May (0.63 mg/L), June (0.57 mg/L). July (1.42 mg/L), August (1.14 mg/L), September (0.94 mg/L), and October (0.87 mg/L) (Table 34).

Table 32: Water chemistry data and *E. coli* results for ScdE-2, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	21	17.1	0.03	8.22	52	13	227	0.052	0.061	15.5	-2.70	6.6	6.8	9.5	39.65	57	2.0
21-06-29	DND	20.6	0.06	N/A	31	39	91	0.109	0.132	39.7	-1.03	6.9	7.6	8.6	76.70	81	1.8
21-07-27	22	19.2	0.03	6.35	52	20	315	0.072	0.074	23.0	-2.44	6.9	6.7	9.1	36.00	74	2.5
21-08-24	26	21.8	0.05	6.84	**504**	31	176	0.098	0.108	30.4	-1.54	7.4	7.3	8.8	68.25	54	3.2
21-09-29	15	15.2	0.05	7.23	31	30	199	0.085	0.110	32.5	-1.53	7.2	7.3	8.8	68.25	81	2.4
21-10-25	7	8.7	0.04	7.75	10	18	211	0.058	0.085	225.0	-2.41	7.2	6.8	9.2	10.00	46	2.5

Table 33: Nutrient results for ScdE-2, 2021

SITE ScdE-2: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	13.0	0.03	4.9	0.008	9.6	0.27	0.32	0.81	6.5	<0.05	<0.001	<0.05	<0.05	<0.05	2.0	—	0.5	24.0	**0.017**
21-06-29	38.8	0.07	13.0	0.145	16.7	0.26	0.52	1.76	11.5	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.5	12.9	**0.025**
21-07-27	20.0	0.04	7.4	0.009	12.4	0.60	0.42	1.12	6.6	<0.05	<0.001	<0.05	<0.05	<0.05	1.0	—	0.9	31.0	**0.049**
21-08-24	30.9	0.07	9.7	0.058	12.8	0.38	0.50	1.50	8.9	<0.05	<0.001	<0.05	0.06	0.06	<5	—	0.6	21.0	**0.041**
21-09-29	29.9	0.05	10.4	0.056	16.6	0.55	0.74	1.59	9.1	<0.05	<0.001	<0.05	0.06	0.06	<6	—	0.8	22.0	**0.034**
21-10-25	18.0	0.04	7.0	0.011	16.7	0.55	0.75	1.20	8.0	<0.05	<0.001	<0.05	<0.05	<0.05	<7	—	0.9	27.0	**0.027**

Table 34: Inorganics results for ScdE-2, 2021

SITE ScdE-2: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	**0.284**	<0.001	0.011	0.023	0.00001	0.0002	<0.001	<0.001	**0.63**	0.0005	0.045	<0.0001	<0.001	0.0003	0.0007	<0.0001	0.026	<0.0001	<0.001	0.004
21-06-29	0.053	<0.001	0.011	0.031	<0.00001	0.0002	<0.001	<0.001	**0.57**	0.0007	0.076	0.0002	<0.001	0.0003	0.0013	<0.0001	0.077	<0.0001	<0.001	0.001
21-07-27	**0.333**	<0.001	0.010	0.031	0.00002	0.0003	<0.001	<0.001	**1.42**	0.0006	0.134	0.0001	0.001	0.0004	0.0011	<0.0001	0.042	<0.0001	<0.001	0.004
21-08-24	**0.101**	<0.001	0.008	0.028	<0.00001	0.0002	<0.001	<0.001	**1.14**	0.0007	0.094	0.0001	0.001	0.0003	0.0013	<0.0001	0.059	<0.0001	<0.001	0.001
21-09-29	**0.143**	<0.001	0.012	0.036	<0.00001	0.0002	<0.001	<0.001	**0.94**	0.0007	0.050	0.0001	<0.001	0.0002	0.0015	<0.0001	0.054	<0.0001	<0.001	0.002
21-10-25	**0.227**	<0.001	0.006	0.030	<0.00001	0.0001	<0.001	<0.001	**0.87**	0.0006	0.039	<0.0001	<0.001	0.0002	0.0012	<0.0001	0.038	<0.0001	<0.001	0.002

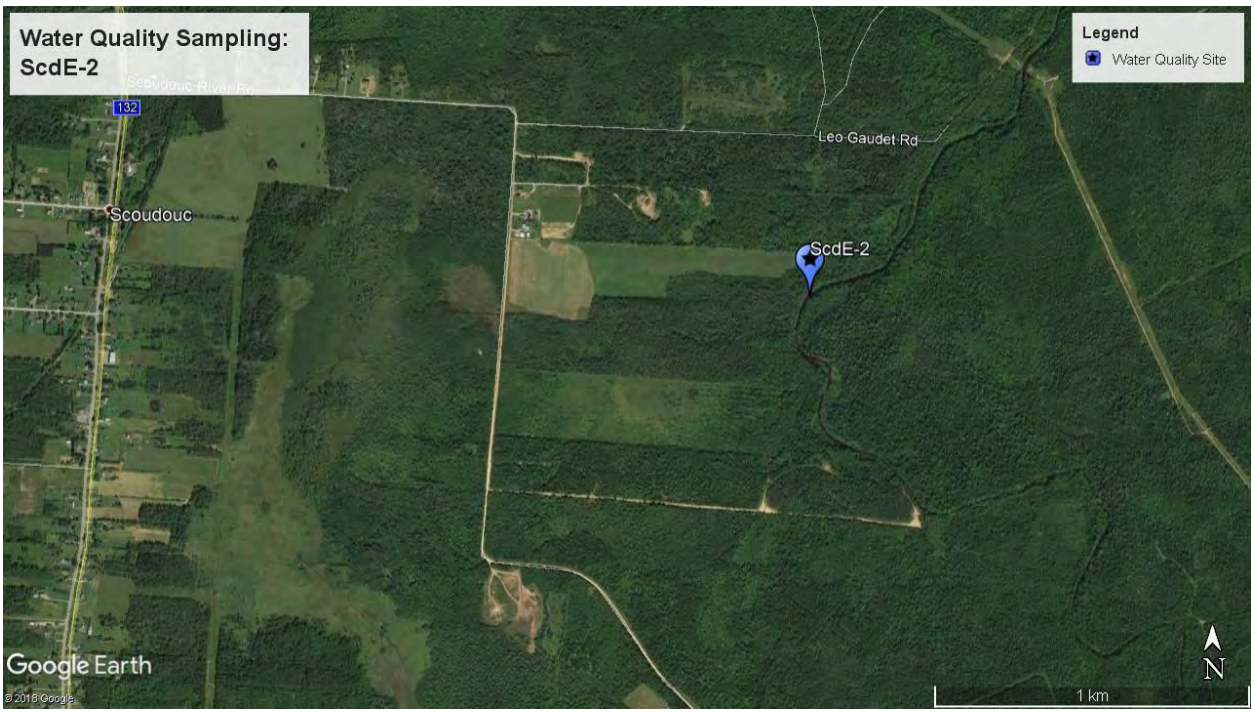


Figure 19: ScdE-2 site location and surrounding land uses

Figure 20: Site photos for water quality sampling site ScdE-2

3.1.9 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 (Figure 21). 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 (Figure 22). The peat moss extraction spans over 200 hectares as seen and measured on aerial imagery of 2017.

The water sampling results for the site ScdF, for 2021, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 35).

Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) for the sample taken in July (563 MPN/100 mL) and September (677 MPN/100 ml) (Table 35).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were: in the meso-eutrophic range (0.020 – 0.035 mg/L) in May and June; and in the eutrophic range (0.035 – 0.100 mg/L) from July to October (Table 36).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum exceeded the CCME water quality guideline (0.100 mg/L when the pH is ≥6.5) in every samples taken in 2021; May (0.448 mg/L), June (0.123 mg/L), July (0.381 mg/L), August (0.180 mg/L), September (0.334 mg/L), and October (0.490 mg/L). Concentrations of iron exceeded the guideline (0.3 mg/L) in every sample taken in 2021; May (0.96 mg/L), June (1.15 mg/L), July (1.53 mg/L), August (1.73 mg/L), September (1.53 mg/L) and October (1.42 mg/L) (Table 37).

Table 35: Water chemistry data and *E. coli* results for ScdF, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	18	17.0	0.02	7.40	63	12	272	0.040	0.044	15.2	-2.36	7.56	7.2	9.6	30.55	73	10.8
21-06-29	DND	21.2	0.11	N/A	**563**	50	112	0.220	0.121	50.7	-0.63	8.1	7.8	8.4	149.50	77	4.3
21-07-27	DND	18.8	N/A	5.80	85	19	320	0.059	0.058	22.8	-2.28	6.8	6.9	9.2	29.00	66	9.3
21-08-24	24	21.2	0.04	5.57	160	38	266	0.087	0.096	39.9	-1.34	7.4	7.3	8.6	61.75	54	6.0
21-09-29	20	14.4	0.04	5.65	**677**	27	309	0.061	0.078	29.9	-1.81	7.2	7.1	8.9	49.40	70	15.8
21-10-25	DND	9.6	0.03	9.57	265	14	319	0.042	0.059	20.2	-2.78	8.1	6.6	9.4	265.00	32	19.6

Table 36: Nutrient results for ScdF, 2021

SITE ScdF: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	12.0	0.02	4.5	0.018	6.3	0.23	0.36	0.96	3.4	0.060	<0.001	<0.05	<0.05	<0.05	1.0	—	0.5	48.0	**0.033**
21-06-29	49.7	0.03	15.9	0.295	5.7	0.23	0.72	2.66	5.1	<0.05	<0.001	<0.05	0.09	0.09	2.0	—	0.6	12.7	**0.030**
21-07-27	19.0	0.03	7.0	0.014	7.1	0.55	0.39	1.27	3.6	<0.05	<0.001	<0.05	<0.05	<0.05	1.0	—	0.8	32.0	**0.055**
21-08-24	37.9	0.03	4.4	0.071	7.0	0.40	0.56	2.12	4.4	<0.05	<0.001	<0.05	<0.05	<0.05	2.0	—	0.6	23.0	**0.037**
21-09-29	27.0	0.03	4.1	0.032	7.3	0.58	0.69	1.67	4.1	<0.05	<0.001	<0.05	<0.05	<0.05	2.0	—	2.0	26.0	**0.068**
21-10-25	14.0	0.03	6.0	0.005	8.1	0.59	0.70	1.29	4.0	<0.05	<0.001	<0.05	<0.05	<0.05	1.0	—	1.0	32.0	**0.070**

Table 37: Inorganics results for ScdF, 2021

SITE ScdF: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	**0.448**	<0.001	0.004	0.320	0.00002	0.0003	<0.001	<0.001	**0.96**	0.0007	0.084	<0.0001	<0.001	0.0006	0.0009	<0.0001	0.032	0.0001	<0.001	0.003
21-06-29	**0.123**	0.001	0.005	0.045	0.00001	0.0004	<0.001	<0.001	**1.15**	0.0006	0.191	0.0002	<0.001	0.0007	0.0018	<0.0001	0.087	0.0002	<0.001	0.002
21-07-27	**0.381**	0.001	0.005	0.037	<0.00001	0.0004	<0.001	<0.001	**1.53**	0.0010	0.143	<0.0001	<0.001	0.0007	0.0011	<0.0001	0.047	0.0002	0.001	0.003
21-08-24	**0.180**	0.001	0.004	0.044	0.00001	0.0003	<0.001	<0.001	**1.73**	0.0008	0.166	0.0001	<0.001	0.0006	0.0015	<0.0001	0.072	0.0002	0.001	0.001
21-09-29	**0.334**	0.001	0.006	0.047	0.00002	0.0005	<0.001	<0.001	**1.53**	0.0009	0.184	0.0001	<0.001	0.0008	0.0016	<0.0001	0.057	0.0003	0.001	0.004
21-10-25	**0.490**	<0.001	0.005	0.043	0.00002	0.0004	<0.001	<0.001	**1.42**	0.0010	0.112	<0.0001	<0.001	0.0007	0.0013	<0.0001	0.044	0.0002	0.001	0.005

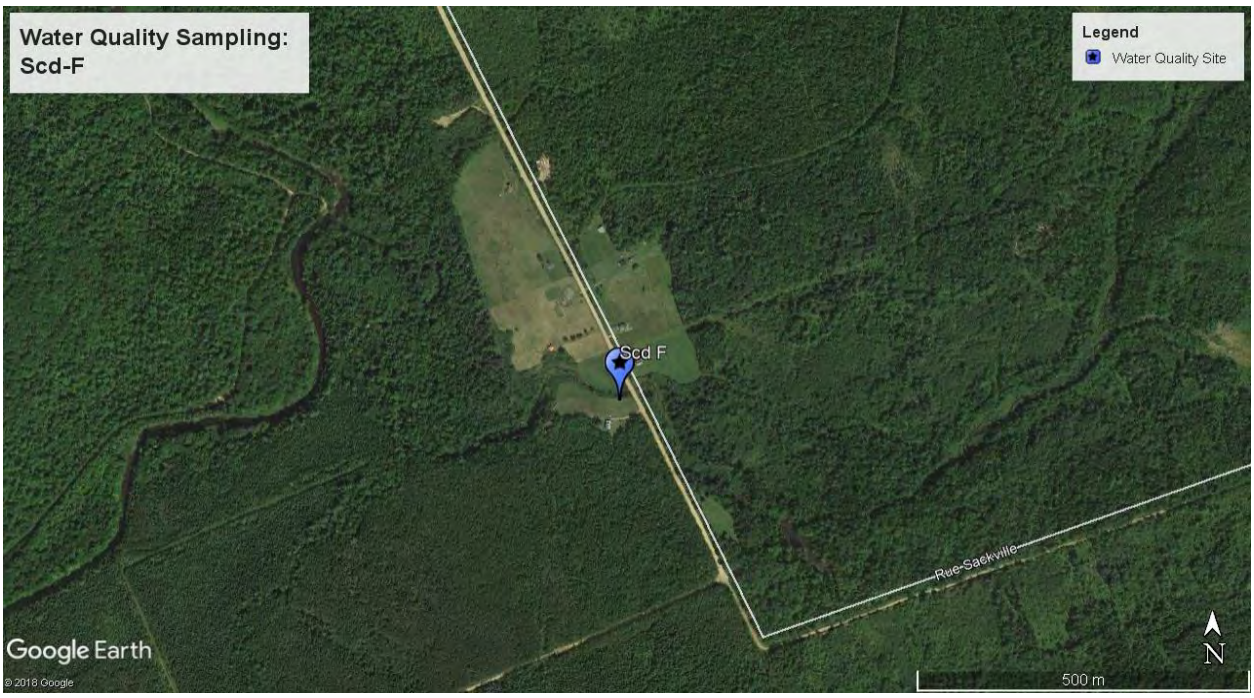


Figure 21: ScdF site location and surrounding land uses

Figure 22: Site photos for water quality sampling site ScdF

3.1.10 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 (Figure 23).

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 (Figure 24). 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 are located near the Scoudouc 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 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 38).

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) for the samples taken in August (1,223 MPN/100 mL) and September (426 MPN/100 mL) (Table 38).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME Guidance framework for Phosphorus, were in the mesotrophic range (0.010 – 0.020 mg/L) in May, June and August; in the meso-eutrophic range (0.020 – 0.035 mg/L) in September; and in the eutrophic range (0.035 – 0.100 mg/L) in July and October (Table 39).

Concentration results for the nitrate ion (NO3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the samples taken in May (0.128 mg/L) and October (0.206 mg/L). The concentration of iron (Fe) exceeded the guideline of 0.3 mg/L in May (0.31 mg/L), July (0.49 mg/L), September (0.30 mg/L), and October (0.51 mg/L) (Table 40).

Table 38: Water chemistry data and *E. coli* results for ScdH, 2021

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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-27	18	14.4	0.09	10.83	41	41	82	0.158	0.200	32.5	-1.40	7.1	7.3	8.7	129.35	113	1.2
21-06-29	DND	20.6	0.19	N/A	146	100	20	0.358	0.440	90.9	-0.11	7.5	7.8	7.9	253.50	233	2.0
21-07-27	20	16.4	DND	8.65	331	69	83	0.319	0.323	52.3	-0.79	7.5	7.5	8.3	155.00	178	1.7
21-08-24	24	20.2	0.14	12.01	**1,223**	90	18	0.275	0.317	75.4	0.37	8.6	8.4	8	195.00	168	1.2
21-09-29	15	13.2	0.20	9.74	**426**	78	57	0.315	0.431	61.2	-0.49	7.6	7.7	8.2	264.55	227	1.4
21-10-25	6	8.0	0.19	11.32	41	63	127	0.240	0.400	46.9	-1.00	7.6	7.4	8.4	41.00	198	2.6

Table 39: Nutrient results for ScdH, 2021

SITE ScdH: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	40.9	0.05	10.6	0.077	36.3	0.21	1.04	1.47	25.0	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.4	12.6	**0.014**
21-06-29	99.4	0.12	30.6	0.590	71.5	0.21	1.89	3.53	55.9	<0.05	<0.001	<0.05	0.05	0.05	<1	—	0.5	7.5	**0.018**
21-07-27	68.8	0.09	17.4	0.205	57.5	0.38	1.36	2.16	43.0	<0.05	<0.001	<0.05	0.09	0.09	<1	—	0.7	12.5	**0.040**
21-08-24	87.8	0.07	32.7	2.070	45.1	0.18	1.50	3.15	32.7	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	<0.2	5.1	**0.017**
21-09-29	77.6	0.11	58.5	0.366	82.2	0.40	2.26	2.61	58.5	<0.05	<0.001	<0.05	0.11	0.11	<1	—	0.6	12.6	**0.030**
21-10-25	62.8	0.13	15.2	0.148	80.0	0.49	2.71	2.17	58.2	<0.05	<0.001	<0.05	<0.05	<0.05	<5	—	0.7	17.3	**0.045**

Table 40: Inorganics results for ScdH, 2021

SITE ScdH: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-27	**0.128**	<0.001	0.081	0.050	0.00001	0.0002	<0.001	<0.001	**0.31**	0.0007	0.042	0.001	<0.001	0.0002	0.0008	<0.0001	0.055	<0.0001	<0.001	0.002
21-06-29	0.056	<0.001	0.356	0.093	0.00002	0.0003	<0.001	<0.001	0.15	0.0013	0.128	0.0019	0.001	0.0001	0.0015	<0.0001	0.158	0.0004	<0.001	0.002
21-07-27	0.096	<0.001	0.160	0.054	<0.00001	0.0002	<0.001	<0.001	**0.49**	0.0009	0.086	0.0013	0.001	0.0002	0.0010	<0.0001	0.084	0.0001	<0.001	0.001
21-08-24	0.046	<0.001	0.147	0.080	<0.00001	<0.0001	<0.001	<0.001	0.14	0.0010	0.026	0.0011	<0.001	<0.0001	0.0011	<0.0001	0.124	0.0002	<0.001	<0.001
21-09-29	0.063	<0.001	0.257	0.070	0.00001	0.0002	<0.001	<0.001	**0.30**	0.0011	0.050	0.0012	<0.001	0.0001	0.0013	<0.0001	0.104	0.0001	<0.001	0.001
21-10-25	**0.206**	<0.001	0.215	0.057	0.00002	0.0002	<0.001	<0.001	**0.51**	0.0009	0.039	0.0013	0.001	0.0003	0.0014	<0.0001	0.079	<0.0001	<0.001	0.003

Figure 23: ScdH site location and surrounding land uses

Figure 24: Site photos for water quality sampling site ScdH

3.1.11 Sampling Summary

For the Shediac River, only one samples surpassed the Canadian Recreational Water Quality Guideline (400 MPN/100 mL) in 2021. The ShdA site's bacterial levels in the month of June were 1,274 MPN/100 mL (Figure 25). This sampling occurred during a light rain event.

For the Scoudouc River, there are 6 samples that surpassed the Canadian Recreational Water Quality Guideline (400 MPN/100 mL) in 2021: the site ScdB in August; the site ScdE-2 in August; the site ScdF in June and September; and the site ScdH in August and September (Figure 26).

The average total phosphorous levels for the Shediac and Scoudouc Rivers sites fell into three different categories; Mesotrophic (0.010 – 0.020 mg/L), Meso-eutrophic (0.020 – 0.035 mg/L), and Eutrophic (0.035 - 0.100 mg/L) (Table 41). These categories are derived from the CCME Guidance framework for Phosphorus (freshwater) (Table 6).

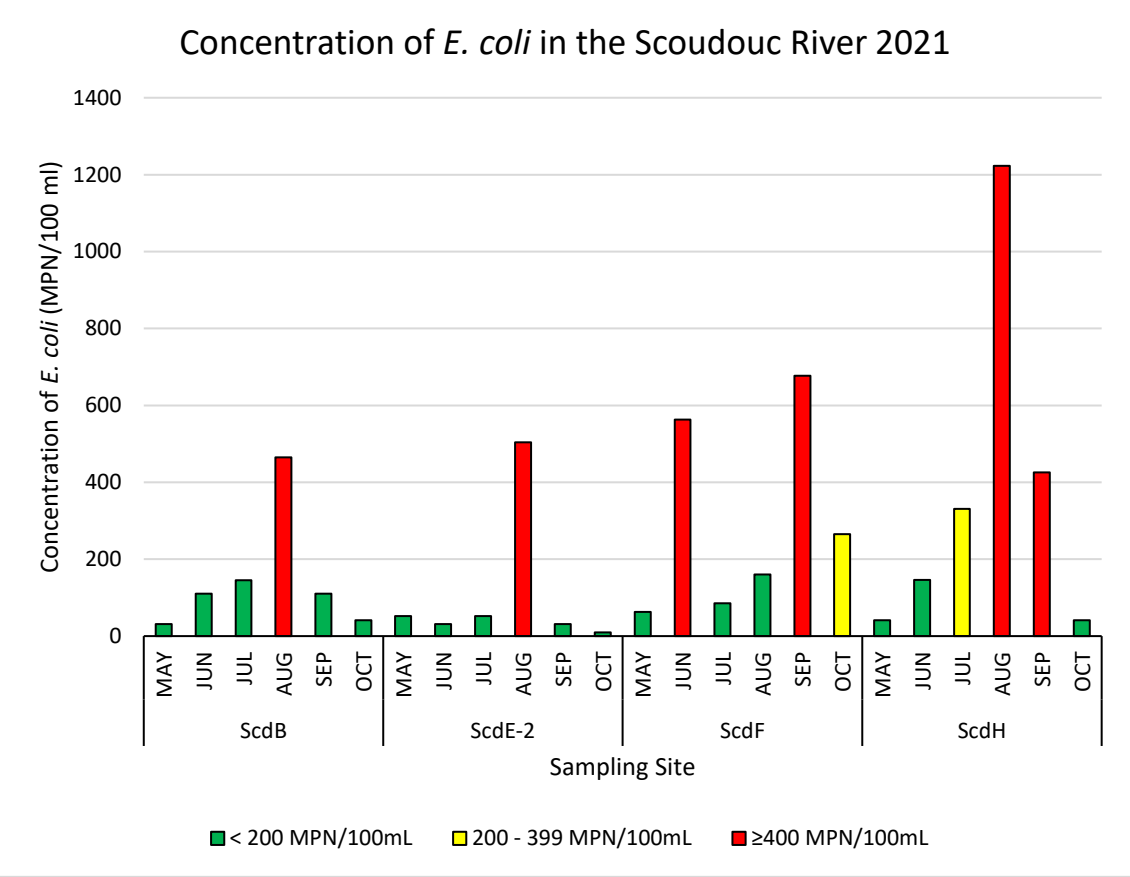


Figure 25: Summary of water quality results for *E. coli*, Scoudouc River sampling 2021

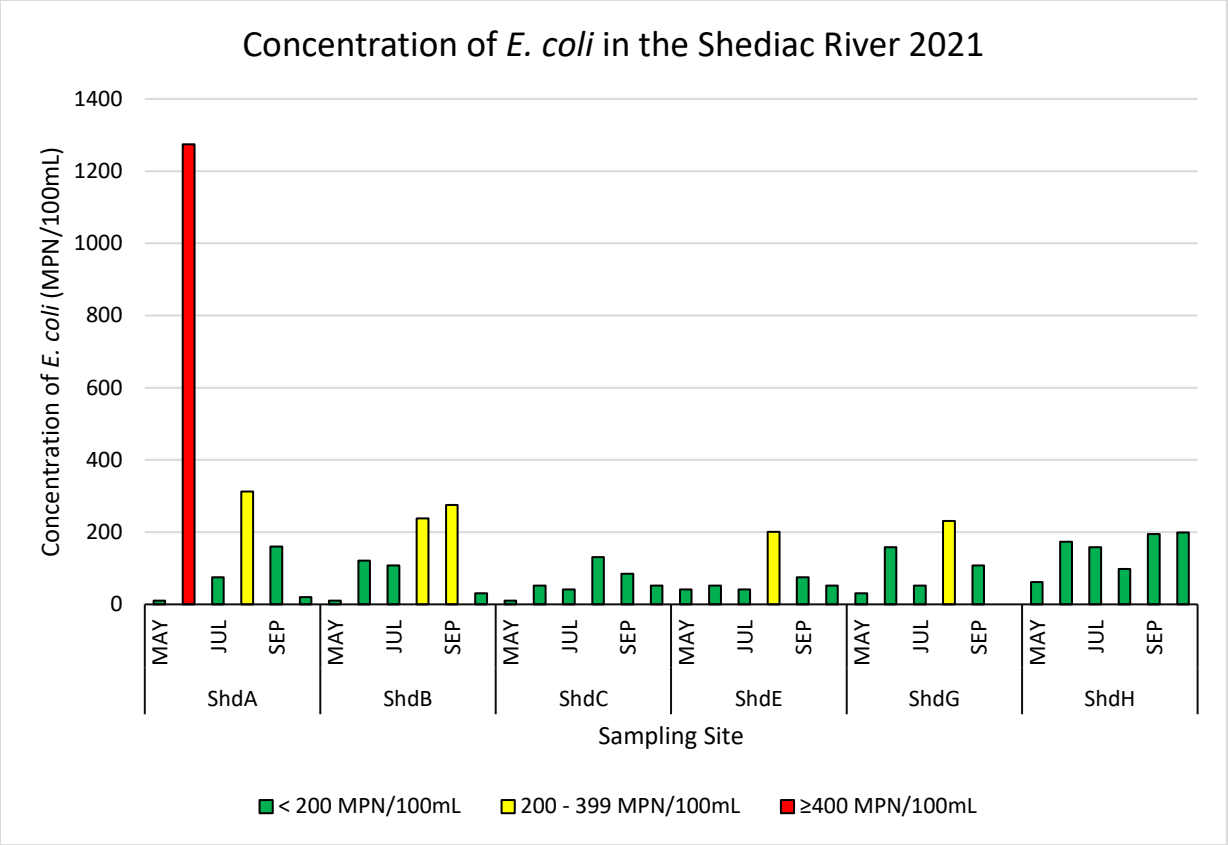


Figure 26: Summary of water quality results for *E. coli*, Shediac River sampling 2021

Table 41: Average total phosphorous for the Shediac and Scoudouc river sites in 2021

Site	Average of TP-L (mg/L)
ScdB	0.041
ScdE-2	0.032
ScdF	0.049
ScdH	0.027
ShdA	0.018
ShdB	0.017
ShdC	0.017
ShdE	0.015
ShdG	0.027
ShdH	0.029

3.2 Shediac Bay Small Stream Sampling

The following section will describe the water quality data collected at the 11 small streams sampling sites for the 2021 field season. 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.

The surrounding land uses, as visible from aerial imagery from several years of images on *Google Earth*, are also described for each site. The information is meant to complement the data and provide information on potential causes for contamination.

The purpose of a long-term monitoring program is to evaluate a waterbody under various conditions, such as changes in surrounding land uses and changes in climate patterns. A long-term monitoring program allows to establish baseline trends in water quality, to detect abnormalities and significant changes over time. This year has demonstrated some abnormalities in bacterial results.

In 2021, most water quality samplings were done under ambient conditions, with a one sampling performed following a light rain event (May). No planned rain event sampling was done in 2021 due to the lack of rain.

3.2.1 WQ-1

This water quality sampling site is located in a residential area in Boudreau-West, and is accessed by a private dirt road (with landowner permission) connected to NB-Route 133 (Figure 27). The samples are taken upstream from the culvert of the dirt road. The surrounding land uses includes agricultural fields, several gravel pits, and the Highway 15. The buffer zone dividing the stream and the farm fields (± 10 hectares, 2 hectares, 1.3 hectare) ranges between 15 and 50 metres in density. There is a good buffer zone that separates the brook and the gravel pits (> 50 m on each side) that should prevent sediment from running off into the water (Figure 28).

The tributary joins the Shediac Bay approximately 1 km downstream of the sampling site. The small stream ends with a small estuary surrounded by a salt marsh. Next to this salt marsh is the Greater Shediac Sewage Commission's aeration lagoons, as well as a lift station with an outfall discharge pipe at the edge of the estuary. The water quality station is located higher than the highest tidal zone.

The water sampling results for the site WQ-1, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 42).

Bacterial levels exceeded the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) in October (640 MPN/100 mL) (Table 42).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were: in the mesotrophic range (0.010 – 0.020 mg/L) in May, August and September; and in the meso-eutrophic (0.020-0.035 mg/L) in June, July, and October (Table 43).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in October (0.107 mg/L). The concentration of iron (Fe) exceeded the CCME guideline of 0.3 mg/L in and October (0.49 mg/L) (Table 44).

Table 42: Water chemistry data and E. coli results for WQ-1, 2021

SITE WQ-1: 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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-19	7	7.8	0.13	12.95	< 10	29	22	0.183	0.280	52.9	-1.07	7.23	7.60	8.70	175.80	140	0.60
21-06-22	24	13.9	0.15	10.14	10	46	<5	246.100	0.362	79.9	-0.92	6.92	7.40	8.30	202.80	180	0.50
21-07-20	DND	14.6	0.17	10.37	259	48	27	0.282	0.381	84.7	-0.68	7.30	7.60	8.30	228.15	189	1.30
21-08-16	19	13.1	N/A	308	110	42	59	0.308	0.401	83.8	-0.95	7.43	7.40	8.30	N/A	197	0.90
21-09-22	DND	11.9	0.19	12.96	52	43	60	0.292	0.402	82.2	-0.44	7.69	7.90	8.30	253.50	200	0.60
21-10-20	7	8.2	0.13	12.42	**640**	37	202	0.180	0.274	61.8	-1.21	8.09	7.30	8.50	176.80	138	1.20

Table 43: Nutrient results for WQ-1, 2021

SITE WQ-1: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	28.9	0.04	16.9	0.108	62.0	0.18	0.72	2.61	28.7	<0.05	<0.001	<0.05	0.51	0.51	5.0	—	0.6	3.3	**0.015**
21-06-29	45.9	0.05	24.8	0.108	75.6	0.08	1.06	4.36	35.1	<0.05	<0.001	<0.05	0.63	0.63	6.0	—	0.7	1.9	**0.021**
21-07-27	47.8	0.05	26.5	0.179	80.4	0.19	0.89	4.50	36.2	<0.05	<0.001	<0.05	0.66	0.66	4.0	—	0.8	4.1	**0.025**
21-08-24	41.9	0.05	25.8	0.099	87.4	0.19	0.93	4.71	44.2	<0.05	<0.001	<0.05	0.63	0.63	<1	—	0.8	5.5	**0.019**
21-09-29	42.2	0.05	26.0	0.318	90.1	0.22	0.89	4.19	42.8	<0.05	<0.001	<0.05	0.70	0.70	<1	—	0.7	6.7	**0.015**
21-10-25	36.9	0.05	19.4	0.069	60.8	0.48	1.10	3.25	29.0	<0.05	<0.001	<0.05	0.28	0.28	<5	—	0.7	18.9	**0.030**

Table 44: Inorganics results for WQ-1, 2021

SITE WQ-1: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	0.047	<0.001	0.009	0.050	<0.00001	<0.0001	<0.001	<0.001	0.12	0.0007	0.039	<0.0001	<0.001	<0.0001	0.0006	<0.0001	0.044	<0.0001	<0.001	0.001
21-06-22	0.022	<0.001	0.010	0.076	<0.00001	<0.0001	<0.001	<0.001	0.07	0.0009	0.055	<0.0001	<0.001	<0.0001	0.0010	<0.0001	0.067	<0.0001	<0.001	0.001
21-07-20	0.032	<0.001	0.009	0.075	<0.00001	<0.0001	<0.001	<0.001	0.15	0.0009	0.066	<0.0001	<0.001	<0.0001	0.0010	<0.0001	0.071	<0.0001	<0.001	<0.001
21-08-16	0.043	<0.001	0.011	0.077	<0.00001	<0.0001	<0.001	<0.001	0.23	0.0010	0.042	<0.0001	<0.001	<0.0001	0.0009	0.0002	0.074	<0.0001	<0.001	<0.001
21-09-22	0.028	<0.001	0.010	0.082	<0.00001	<0.0001	<0.001	<0.001	0.19	0.0010	0.029	<0.0001	<0.001	<0.0001	0.0009	<0.0001	0.068	<0.0001	<0.001	<0.001
21-10-20	**0.107**	<0.001	0.009	0.068	<0.00001	<0.0001	<0.001	<0.001	**0.49**	0.0009	0.028	<0.0001	<0.001	0.0001	0.0011	<0.0001	0.063	<0.0001	<0.001	0.002

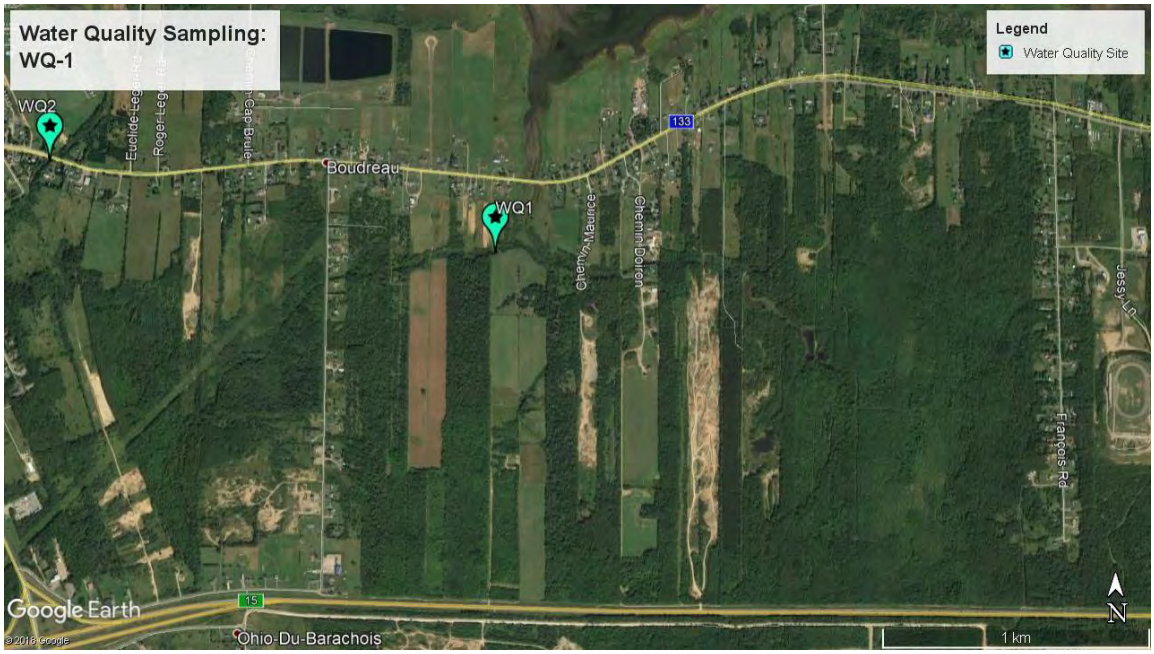


Figure 27:WQ-1 site location and surrounding land uses

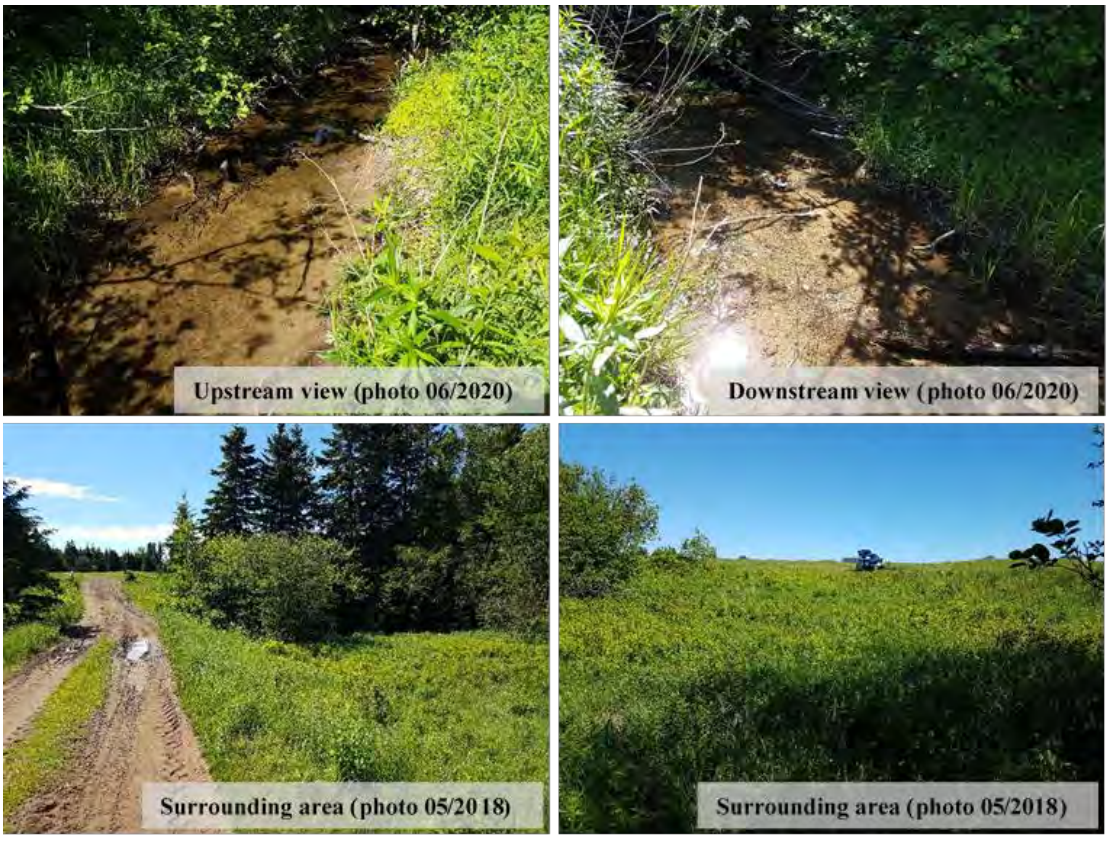


Figure 28: Site photos for the water quality monitoring station WQ-1

3.2.2 WQ-2

This water quality sampling site is also located in a residential area in Boudreau-West, near the convenience store "Handy Andy's" on Route NB-133 (Figure 29). The samples are taken upstream of the wooden culvert. The surrounding land uses is mainly residential, roads, and has a drive-in movie theatre upstream (300 m) (Figure 30). Below the culvert of Route NB-133, directly following the sampling site, is the beginning of a provincially regulated freshwater wetland. The freshwater wetland is approximately 170 metres in length before transitioning to a coastal salt marsh at the highest tidal point.

Within the salt marsh area is the *Ocean Surf RV Campground*. There are no trees between the campground and the wetland and brook areas, making any buffer zone only made up of wild grasses and shrubs. The Shediac Bay Watershed Association has been working with Ocean Surf to improve their coastal zone. A living shoreline workshop held in 2020 concentrated on restoring 225 m of coastline in the campground.

The water sampling results for the site WQ-2, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 45).

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the samples taken in May (749 MPN/100 mL) and July (404 MPN/100 mL) (Table 45).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance framework for Phosphorus were: in the mesotrophic range (0.010 – 0.020 mg/L) in May, July, August and September; and in the meso-eutrophic range (0.020 – 0.035 mg/L) in June and October (Table 46).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

The results for all parameters of heavy metals and other elements for WQ-2, in all samples collected in 2021, did not exceed any of the recommended CCME water quality guidelines (Table 47).

Table 45: Water chemistry data and E. coli results for WQ-2, 2021

SITE WQ-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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-19	7	7.8	0.18	13	**749**	36	12	0.252	0.375	66.1	-0.80	7.29	7.70	8.50	24,570.00	184	0.80
21-06-22	24	15.7	0.19	9.05	185	60	<5	316.400	0.442	104.0	-0.61	7.00	7.50	8.10	250.25	214	0.50
21-07-20	DND	15.4	0.19	10.07	**404**	66	<5	327.400	0.448	107.0	-0.45	7.32	7.60	8.10	260.65	219	1.40
21-08-16	19	14.1	N/A	9.76	355	53	<5	0.350	0.452	101.0	-0.67	7.61	7.50	8.20	N/A	220	0.80
21-09-22	18	13.0	0.22	11.68	241	60	<5	0.348	0.463	104.0	-0.41	7.62	7.70	8.10	293.15	226	0.50
21-10-20	8	8.7	0.21	11.89	364	62	47	0.300	0.438	93.9	-0.73	7.75	7.40	8.10	282.75	218	2.00

Table 46: Nutrient results for WQ-2, 2021

SITE WQ-2: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	35.8	0.04	20.9	0.169	85.1	0.14	0.86	3.38	41.9	<0.05	<0.001	<0.05	0.35	0.35	5.0	—	0.5	2.9	**0.017**
21-06-29	59.8	0.05	32.1	0.178	86.8	0.10	1.21	5.70	42.0	0.09	<0.001	<0.05	0.40	0.40	6.0	—	0.6	1.6	**0.022**
21-07-27	65.7	0.05	33.3	0.246	88.2	0.13	1.09	5.89	39.8	<0.05	<0.001	<0.05	0.37	0.37	7.0	—	0.5	1.8	**0.012**
21-08-24	52.8	0.05	31.5	0.157	90.5	0.15	1.03	5.44	47.7	<0.05	<0.001	<0.05	0.41	0.41	7.0	—	0.5	1.9	**0.011**
21-09-29	59.7	0.05	32.5	0.281	97.9	0.26	1.02	5.55	42.4	<0.05	<0.01	<0.005	0.29	0.29	7.0	—	0.4	1.7	**0.011**
21-10-25	61.8	0.05	29.2	0.146	88.4	0.21	1.28	5.10	48.8	<0.05	<0.001	<0.05	0.27	0.27	6.0	—	0.5	5.9	**0.023**

Table 47: Inorganics results for WQ-2, 2021

SITE WQ-2: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	0.047	<0.001	0.008	0.079	<0.00001	<0.0001	<0.001	0.001	0.14	0.0008	0.096	<0.0001	<0.001	<0.0001	0.0007	<0.0001	0.060	0.0006	<0.001	0.001
21-06-22	0.016	<0.001	0.011	0.121	<0.00001	<0.0001	<0.001	<0.001	0.08	0.0017	0.061	<0.0001	<0.001	<0.0001	0.0012	<0.0001	0.094	0.0003	<0.001	<0.001
21-07-20	0.027	<0.001	0.010	0.125	<0.00001	<0.0001	<0.001	<0.001	0.16	0.0016	0.106	0.0001	<0.001	<0.0001	0.0011	<0.0001	0.098	0.0006	<0.001	<0.001
21-08-16	0.084	<0.001	0.012	0.112	<0.00001	<0.0001	<0.001	<0.001	0.25	0.0015	0.126	<0.0001	<0.001	0.0004	0.0010	0.0002	0.086	0.0004	<0.001	0.002
21-09-22	0.013	<0.001	0.011	0.123	<0.00001	<0.0001	<0.001	<0.001	0.09	0.0016	0.093	<0.0001	<0.001	<0.0001	0.0010	<0.0001	0.089	0.0003	<0.001	<0.001
21-10-20	0.086	<0.001	0.011	0.109	<0.00001	<0.0001	<0.001	<0.001	0.26	0.0013	0.066	<0.0001	<0.001	0.0001	0.0011	<0.0001	0.086	0.0003	<0.001	<0.001

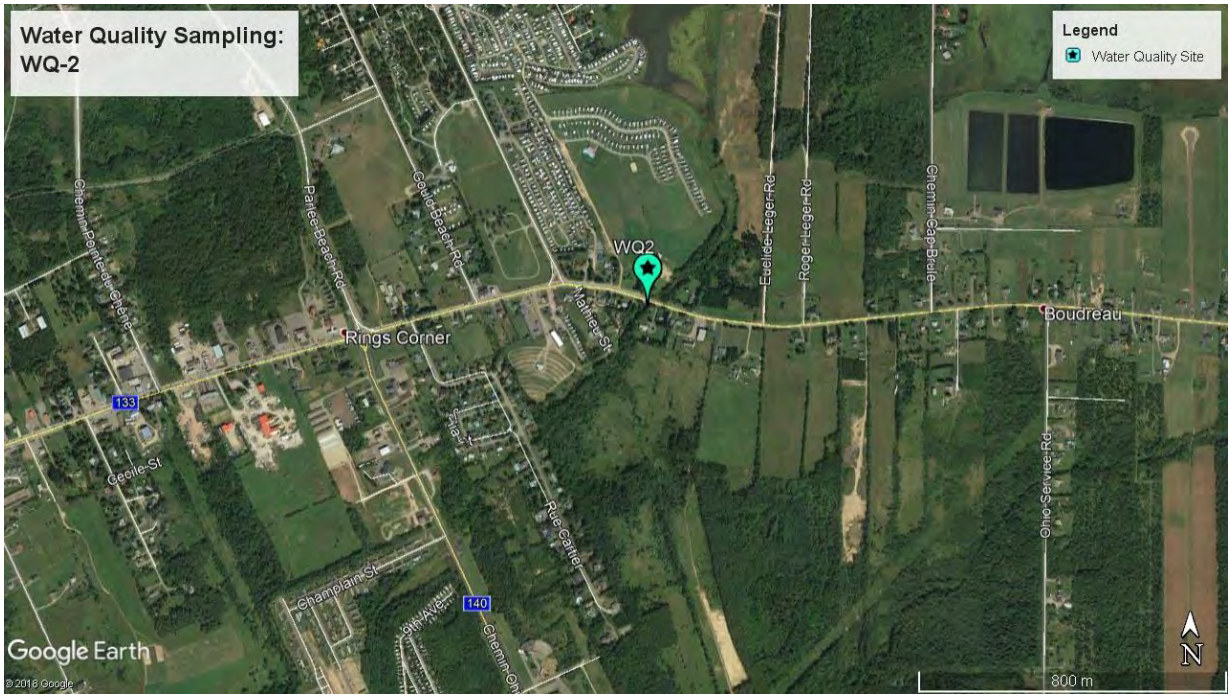


Figure 29: WQ-2 site location and surrounding land uses

Figure 30: Site photos for the water quality monitoring station WQ-2

3.2.3 WQ-3

This water quality sampling site is located in a residential and commercial area in the Town of Shediac, directly off Main St., next to the *Shediac Bakery* (Figure 31). The samples are taken upstream of the culvert (Figure 32). The surrounding land uses upstream is mainly a large residential sector, up to the approximate headwaters below Highway 15. It is important to note that for most of the riparian zones along this brook, there are inadequate buffer zones (< 15 m). This unnamed brook reaches the tidal zone approximately 400 metres downstream of the sampling site.

The water sampling results for the site WQ-3, for 2021, exceeded the recommendations for the survival of freshwater aquatic life based on pH (pH < 6 & pH > 9) on the field reading in July (9.12) (Table 48). However, the lab result for pH in the same sample showed the level to be within normal range. Levels of dissolved oxygen meet or exceeds CCME recommendations.

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for most samples taken in 2021: May (464 MPN/100 mL), July (24,196 MPN/100 mL), August (1,918 MPN/100 mL), September (771 MPN/100 mL) and October (441 MPN/100 mL) (Table 48).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance framework for Phosphorus were: in the meso-eutrophic range (0.020 - 0.035 mg/L) from May to September; in the eutrophic range (0.035 – 0.100 mg/L) in September; and in the hyper-eutrophic range (>100 mg/L) in October (Table 49).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in October (0.721 mg/L). The concentration of iron (Fe) exceeded the CCME guideline of 0.3 mg/L in and October (0.68 mg/L) (Table 50).

Table 48: Water chemistry data and E. coli results for WQ-3, 2021

SITE WQ-3: 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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-19	7	8.1	0.14	12.66	**464**	54	20	0.198	0.298	66.5	-0.29	7.48	8.00	8.30	189.80	147	2.10
21-06-22	25	17.6	1.13	8.62	246	92	7	240.500	0.323	102.0	-0.10	7.66	8.00	7.90	182.00	174	0.70
21-07-20	DND	17.8	0.16	9.12	**24,196**	100	7	280.500	0.395	115.0	0.28	**9.12**	8.10	7.80	211.90	213	1.50
21-08-16	20	16.1	0.16	8.98	**1,918**	90	12	0.277	0.342	109.0	-0.02	8.27	7.90	7.90	217.75	187	1.50
21-09-22	20	14.4	0.17	12.43	**771**	100	8	0.287	0.386	117.0	0.29	8.25	8.10	7.80	243.00	199	3.50
21-10-20	8	9.1	0.17	11.83	**441**	82	94	0.247	0.362	93.9	-0.28	7.96	7.70	8.00	230.75	194	188.00

Table 49: Nutrient results for WQ-3, 2021

SITE WQ-3: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	53.4	0.05	22.4	0.502	47.9	0.14	0.94	2.57	25.4	<0.05	<0.001	<0.05	0.82	0.82	7.0	—	0.9	3.5	**0.023**
21-06-29	91.1	0.05	33.4	0.856	43.4	0.12	1.38	4.55	21.8	<0.05	<0.001	<0.05	0.69	0.69	8.0	—	0.7	2.2	**0.026**
21-07-27	98.8	0.06	37.6	1.170	60.6	0.23	1.53	5.15	30.6	<0.05	<0.001	<0.05	0.98	0.98	9.0	—	0.9	2.4	**0.026**
21-08-24	89.3	0.06	35.6	0.667	47.1	0.13	1.30	4.84	27.1	<0.05	<0.001	<0.05	1.19	1.19	8.0	—	1.1	2.8	**0.027**
21-09-29	98.8	0.05	38.6	1.170	50.3	0.17	1.34	5.07	26.7	<0.05	<0.001	<0.05	0.93	0.93	9.0	—	1.0	2.4	**0.035**
21-10-25	81.6	0.05	30.8	0.384	57.1	0.25	1.55	4.13	35.7	<0.05	<0.001	<0.05	0.80	0.80	10.0	—	0.8	7.7	**0.380**

Table 50: Inorganics results for WQ-3, 2021

SITE WQ-3: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	DND	<0.001	0.010	0.062	<0.00001	<0.0001	<0.001	0.001	0.12	0.0008	0.019	<0.0001	<0.001	<0.0001	0.0008	<0.0001	0.054	0.0005	<0.001	0.002
21-06-22	0.032	<0.001	0.012	0.091	<0.00001	<0.0001	<0.001	<0.001	0.04	0.0009	0.028	<0.0001	<0.001	<0.0001	0.0012	<0.0001	0.072	0.0007	<0.001	<0.001
21-07-20	0.054	<0.001	0.013	0.101	<0.00001	<0.0001	<0.001	<0.001	0.06	0.0007	0.020	0.0002	<0.001	<0.0001	0.0013	<0.0001	0.081	<0.0012	<0.001	<0.001
21-08-16	0.055	<0.001	0.012	0.088	<0.00001	<0.0001	<0.001	<0.001	0.06	0.0008	0.018	0.0002	<0.001	<0.0001	0.0011	0.0002	0.074	0.0010	<0.001	<0.001
21-09-22	0.084	<0.001	0.022	0.102	<0.00001	<0.0001	<0.001	<0.001	0.09	0.0009	0.022	<0.0001	<0.001	0.0001	0.0011	0.0001	0.083	<0.0013	<0.001	<0.001
21-10-20	**0.721**	<0.001	0.022	0.117	<0.00001	0.0004	<0.001	<0.001	**0.58**	0.0010	0.061	<0.0001	<0.001	0.0015	0.0015	0.0001	0.072	0.0010	0.002	0.003

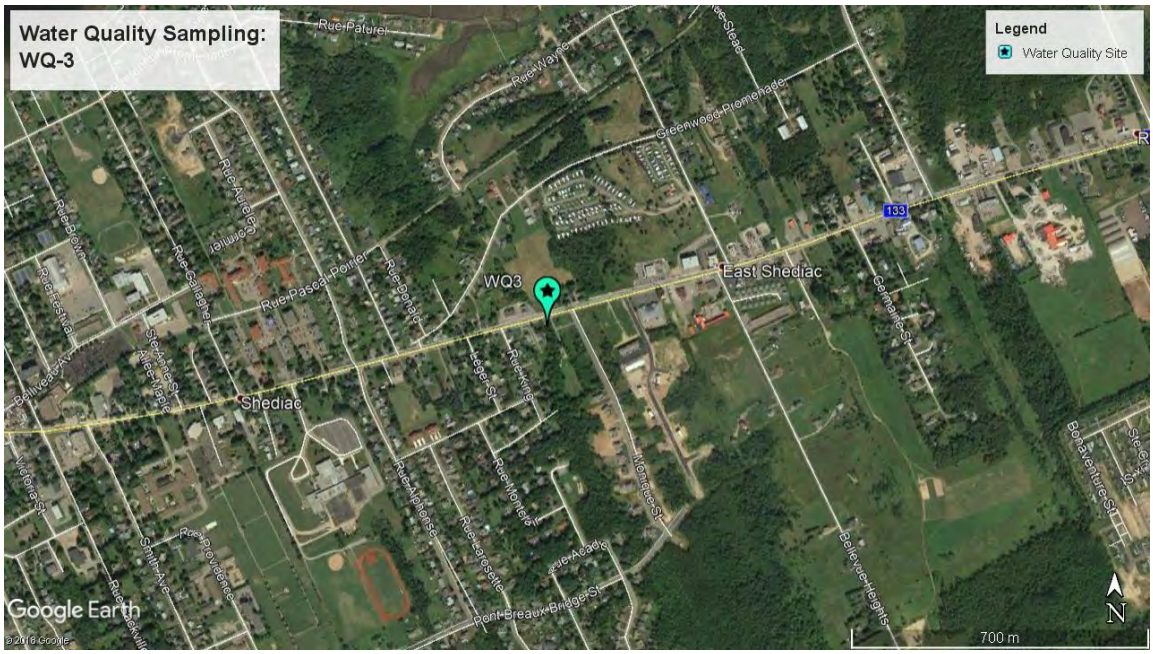


Figure 31: WQ-3 site location and surrounding land uses

Figure 32: Site photos for the water quality monitoring station WQ-3

3.2.4 WQ-4

This water quality sampling site is located behind the Town of Shediac city hall (Figure 33). There is a culvert where this brook exits the underground canal along the edge of the parking lots for Town Hall and *Auberge Gabrièle's Inn & Restaurant,* and the sample is taken directly below this culvert. The surrounding land uses for small unnamed brook is mainly residences, business parking lots and roads (Figure 34). A part of this brook is channelled in an underground pipe somewhere along Chelsey Street, before reaching Main Street. There is also a dog park upstream (600 metres) next to a drainage ditch that connects to this brook. The SBWA built its first rain garden below this dog park, in an effort to capture stormwater runoff from the park and from the surrounding area (parking lot of the *Vestiaire St-Joseph* and Centennial Park). The brook flows into the Shediac Bay approximately 200 metres downstream from the sampling site, and is unaffected by normal tides.

The water sampling results for the site WQ-4, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 51).

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) (Table 51).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were: in the mesotrophic range (0.010 – 0.020 mg/L) in September; in the meso-eutrophic range (0.020 – 0.035 mg/L) in May, July, and August; in the eutrophic range (0.035 – 0.100 mg/L) in July; and in the hyper-eutrophic range (>100 mg/L) in October (Table 52).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the sample taken in October (0.670 mg/L). Iron (Fe) levels also exceeded the CCME guideline of 0.3 mg/L in the sample taken in October (0.73 mg/L) (Table 53).

Table 51: Water chemistry data and E. coli results for WQ-4, 2021

SITE WQ-4: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (mS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
21-05-19	7	8.8	0.40	11.26	41	67	<5	0.570	0.831	157.0	-0.01	7.31	7.90	7.90	533.00	385	0.60
21-06-22	25	13.5	0.47	9.44	272	110	<5	729.000	1.060	198.0	-0.03	7.24	7.60	7.60	611.00	555	0.50
21-07-20	23	14.5	0.31	10.66	110	130	<5	514.000	0.702	178.0	0.13	7.53	7.70	7.60	416.00	397	1.00
21-08-16	20	15.2	0.35	9.96	41	120	<5	0.580	0.731	174.0	-0.08	7.64	7.70	7.60	468.00	394	0.40
21-09-22	DND	15.1	0.39	11.58	86	120	<5	0.640	0.786	181.0	0.49	7.66	8.10	7.60	513.50	418	0.30
21-10-20	10	13.2	0.30	10.87	185	120	<5	0.483	0.632	180.0	0.01	7.81	7.60	7.60	405.60	325	122.00

Table 52: Nutrient results for WQ-4, 2021

SITE WQ-4: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	66.5	0.07	50.1	0.497	172.0	0.17	2.23	7.67	85.3	<0.05	<0.001	<0.05	1.80	1.80	17.0	—	2.1	1.9	0.030
21-06-29	110.0	0.10	62.3	0.410	261.0	0.12	2.82	10.40	132.0	<0.05	<0.001	<0.05	1.87	1.87	18.0	—	1.8	1.4	0.035
21-07-27	129.0	0.09	56.7	0.610	149.0	0.22	2.21	8.95	74.2	<0.05	<0.001	<0.05	1.69	1.69	17.0	—	1.7	1.5	0.024
21-08-24	119.0	0.10	54.5	0.563	147.0	0.22	2.62	9.28	78.9	<0.05	<0.001	<0.05	1.92	1.92	19.0	—	1.9	1.2	0.021
21-09-29	119.0	0.08	56.6	1.400	169.0	0.18	2.64	9.58	78.8	<0.05	<0.001	<0.05	1.97	1.97	18.0	—	1.9	1.2	0.018
21-10-25	120.0	0.07	56.9	0.447	99.9	0.19	2.50	9.16	56.8	<0.05	<0.001	<0.05	1.99	1.99	17.0	—	2.0	2.3	0.408

Table 53: Inorganics results for WQ-4, 2021

SITE WQ-4: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	0.028	<0.001	0.018	0.172	<0.00001	<0.001	<0.001	0.005	0.11	0.0018	0.043	0.0002	<0.001	<0.0001	0.0014	<0.0001	0.173	0.0011	<0.001	0.003
21-06-22	0.016	<0.002	0.021	0.267	<0.00001	<0.0001	<0.001	0.001	0.05	0.0036	0.029	0.0006	<0.001	<0.0001	0.0019	<0.0001	0.261	0.0042	<0.001	0.002
21-07-20	0.024	<0.001	0.020	0.244	<0.00001	<0.0001	<0.001	0.001	0.06	0.0046	0.029	0.0005	<0.001	<0.0001	0.0015	<0.0001	0.264	<0.0001	<0.001	<0.001
21-08-16	0.012	<0.001	0.023	0.236	<0.00001	<0.0001	<0.001	0.003	0.06	0.0044	0.026	0.0007	<0.001	<0.0001	0.0018	0.0002	0.227	0.0037	<0.001	0.002
21-09-22	0.016	<0.001	0.024	0.263	<0.00001	<0.0001	<0.001	0.001	0.08	0.0033	0.035	0.0005	<0.001	<0.0001	0.0018	<0.0001	0.223	0.0041	<0.001	0.001
21-10-20	0.670	<0.001	0.030	0.258	0.00004	0.0005	<0.001	0.003	0.73	0.0032	0.141	0.0008	<0.001	0.0042	0.0021	<0.0001	0.211	0.0031	0.002	0.006

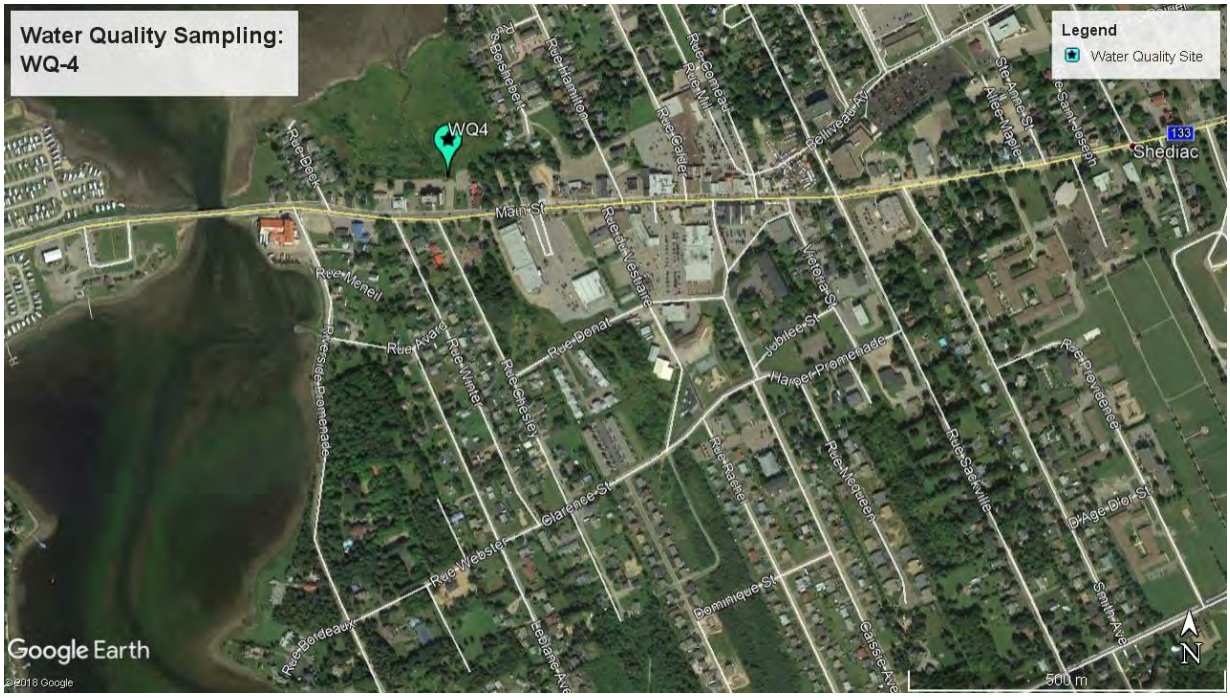


Figure 33: WQ-4 site location and surrounding land uses

Figure 34: Site photos for the water quality monitoring station WQ-4

3.2.5 WQ-5

This water quality sampling site is also located off Route 133, past *Guy's Frenchys* heading towards Gilbert's Corner (Figure 35). The stream crosses the road 75 m past Atkinson Court. The samples are taken upstream from the culvert. The sample site is located approximately 90 m from the tidal zone and the beginning of a salt marsh.

The surrounding land uses is mainly residential, forested land, and farm fields. The riparian area around the residential properties have little buffer (< 15 m), but this constitutes small sections of the brook (Figure 36). However, there are good buffer zones between the farmlands and the head ponds of this brook; 25 m – 50 m in tree density. There is a thinner buffer zone where the pond discharges into the brook, approximately 20 m between the bank and a field. Another brook joins these ponds upstream, supplying water from the other side of Highway 11, up to Route 134 (Lakeville Road). In this area, there is more cultivated land where the brook passes, but there is no buffer zone visible from aerial imagery. There is no indication that animals, such as cows, are being pastured in that field, but the lack of a buffer around this brook passing around and through these fields may be impacted by sediment and could explain the higher levels of total phosphorus.

The water sampling results for the site WQ-5, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 54).

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) (Table 54).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were: in the meso-eutrophic range (0.020 – 0.035 mg/L) in May and July; in the eutrophic range (0.035 – 0.100 mg/L) in June, August, September, and October (Table 55).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of iron (Fe) exceeded the CCME water quality guideline (0.3 mg/L) in May (0.32 mg/L), August (0.39 mg/L) and October (0.51 mg/L) (Table 56).

Table 54: Water chemistry data and E. coli results for WQ-5, 2021

SITE WQ-5: 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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-19	7	10.2	0.29	11.73	31	51	27	0.422	0.006	76.7	-0.58	7.67	7.70	8.30	382.20	283	2.20
21-06-22	25	18.7	0.30	7.7	52	79	7	541.000	0.704	125.0	-0.19	7.33	7.70	7.90	4.30	370	1.80
21-07-20	N/A	18.3	0.37	8.76	10	99	13	650.000	0.809	126.0	-0.10	7.52	7.70	7.80	481.00	442	1.40
21-08-16	24	18.6	0.35	8.28	31	92	17	0.630	0.723	127.0	-0.13	7.79	7.70	7.80	468.00	386	1.30
21-09-22	N/A	14.6	0.37	11.47	30	80	8	0.610	0.768	120.0	-0.11	7.88	7.80	7.90	494.00	410	2.70
21-10-20	11	9.8	0.35	11.18	41	70	47	0.500	0.718	102.0	-0.54	7.89	7.50	8.00	461.50	374	2.30

Table 55: Nutrient results for WQ-5, 2021

SITE WQ-5: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	50.7	0.04	26.3	0.239	136.0	0.17	1.10	2.69	75.4	<0.05	<0.001	<0.05	<0.05	<0.05	3.0	—	0.3	6.1	0.029
21-06-29	78.6	0.05	43.3	0.370	180.0	0.11	1.46	4.09	86.2	<0.05	<0.001	<0.05	<0.005	<0.005	3.0	—	0.3	3.5	0.060
21-07-27	98.5	0.05	43.8	0.464	210.0	0.14	1.36	4.10	114.0	<0.05	<0.001	<0.05	<0.05	<0.05	3.0	—	0.4	4.8	0.032
21-08-24	91.5	0.06	43.5	0.431	177.0	0.19	1.24	4.44	97.6	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.3	5.1	0.050
21-09-29	79.5	0.06	41.5	0.472	202.0	0.11	1.45	4.10	103.0	<0.05	<0.001	<0.05	0.10	<0.05	4.0	—	0.3	3.8	0.052
21-10-25	69.8	0.05	34.3	0.207	188.0	0.24	2.53	3.87	101.0	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.4	9.1	0.045

Table 56: Inorganics results for WQ-5, 2021

SITE WQ-5: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	0.060	<0.001	0.006	0.122	<0.00001	<0.001	<0.001	<0.001	0.32	0.0005	0.476	<0.0001	<0.001	<0.0001	0.0008	<0.0001	0.064	<0.0001	<0.001	<0.001
21-06-22	0.007	<0.001	0.009	0.147	<0.00001	<0.0001	<0.001	<0.001	0.14	0.0004	0.285	<0.0001	<0.001	<0.0001	0.0015	<0.0001	0.083	<0.0001	<0.001	<0.001
21-07-20	0.008	<0.001	0.009	0.151	<0.00001	<0.0001	<0.001	<0.001	0.25	0.0004	0.411	<0.0001	<0.001	<0.0001	0.0015	<0.0001	0.091	0.0006	<0.001	<0.001
21-08-16	0.009	<0.001	0.009	0.163	<0.00001	<0.0001	<0.001	<0.001	0.39	0.0005	0.674	<0.0001	<0.001	0.0001	0.0013	0.0002	0.098	0.0001	<0.001	<0.001
21-09-22	0.005	<0.001	0.010	0.165	<0.00001	<0.0001	<0.001	<0.001	0.12	0.0005	0.302	<0.0001	<0.001	<0.0001	0.0014	<0.0001	0.088	<0.0001	<0.001	<0.001
21-10-20	0.092	<0.001	0.009	0.164	<0.00001	0.0002	<0.001	<0.001	0.51	0.0005	0.845	<0.0001	<0.001	0.0001	0.0019	<0.0001	0.089	<0.0001	<0.001	<0.001

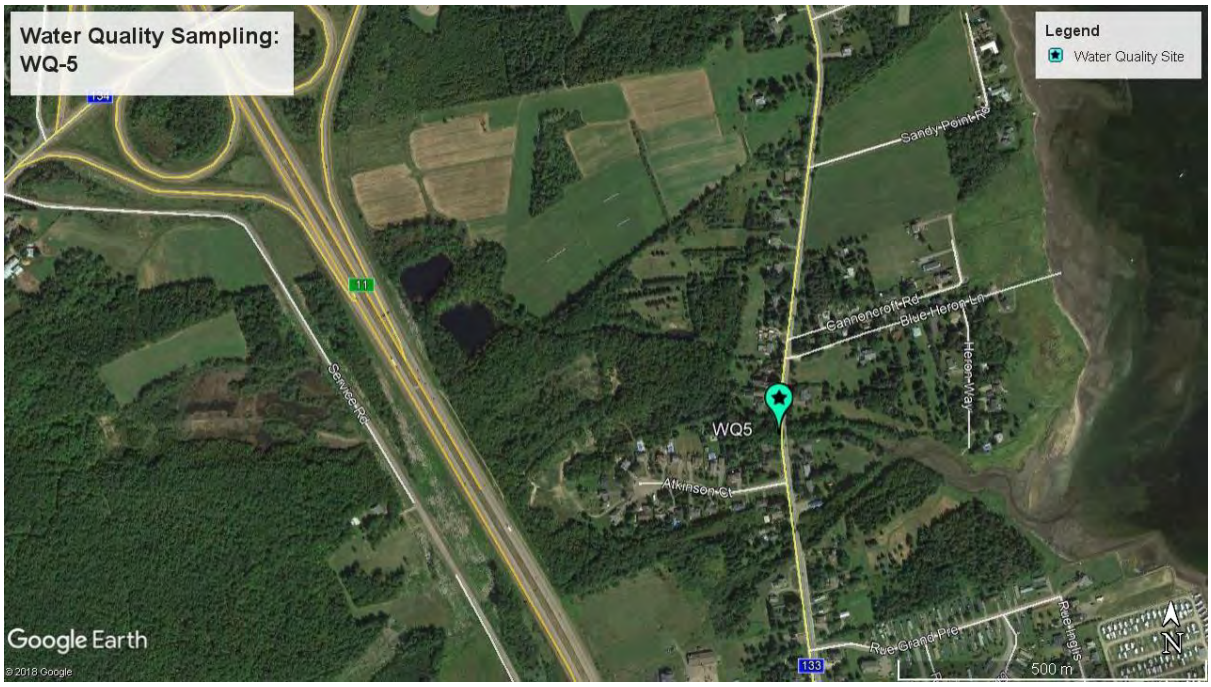


Figure 35: WQ-5 site location and surrounding land uses

Figure 36: Site photos for the water quality monitoring station WQ-5

3.2.6 WQ-6

This water quality sampling site is located off Route 134, past the Shediac Cape School, right next to Old Mill Road (Figure 37). The vehicle is parked on Old Mill Road, and the samples are taken downstream of the culvert crossing Route 134, to capture the water coming from both directions; coming from along Old Mill Road and along Route 134 (Figure 38). The sample site is located approximately 175 m from the tidal zone.

The surrounding land uses includes; residential, active farm fields for cultivation and pasture (cows seen on aerial imagery), and a gravel pit. There is very little or no buffer along the brook as it flows through the fields. It is unknown if cows are held in this area on a regular basis, but there are visible cow tracks that cross the brook in one particular area and animals visible in aerial views from several years. There is also no buffer between the gravel pit area and the brook. Passed the gravel pit heading upstream is a more forested lot, with healthier riparian zones. The next parcel of land and leading up to the end of the brook near Highway 11 are more cow pastures, as animals, cow tracks and cattle fencing can be seen on aerial imagery. There is more vegetation in the buffer zones in this field, with tree density ranging from 5 – 30 metres.

The water sampling results for the site WQ-6, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 57).

Bacterial levels exceeded the maximum concentration of E. coli from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the sample taken in June (3,076 MPN/100 mL) (Table 57).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance framework for Phosphorus were: in the oligotrophic range (0.004 – 0.010 mg/L) in June; in the mesotrophic range (0.010 – 0.020 mg/L) in May, July, August, and September; in the meso-eutrophic range (0.020 – 0.035 mg/L) in October (Table 58).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

The results for all parameters of heavy metals and other elements for WQ-6, in all samples collected in 2021, did not exceed any of the recommended CCME water quality guidelines (Table 59).

Table 57: Water chemistry data and E. coli results for WQ-6, 2021

SITE WQ-6: 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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-19	7	9.0	0.20	11	41	49	15	0.287	0.396	77.8	-0.49	7.60	7.80	8.30	269.70	192	0.90
21-06-22	26	13.7	0.20	7.76	3,076	85	<5	306.400	0.292	105.0	-0.43	6.83	7.50	7.90	271.05	149	0.30
21-07-20	N/A	15.2	0.23	7.9	75	91	8	308.100	0.488	112.0	-0.39	7.34	7.50	7.90	306.15	247	0.70
21-08-16	24	14.5	0.20	8.15	10	94	7	0.340	0.427	126.0	-0.24	7.49	7.60	708.00	275.60	230	0.30
21-09-22	23	13.1	0.23	8.05	10	86	6	0.373	0.454	119.0	0.01	7.59	7.90	7.90	313.30	236	0.20
21-10-20	11	9.1	0.24	10.26	63	82	20	0.340	0.490	102.0	-0.57	7.82	7.40	8.00	317.20	243	0.60

Table 58: Nutrient results for WQ-6, 2021

SITE WQ-6: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	48.7	0.04	25.0	0.289	79.2	0.17	0.93	3.73	40.1	<0.05	<0.001	<0.05	0.56	0.56	5.0	—	0.0	4.8	0.017
21-06-29	84.7	0.03	32.6	0.252	37.1	0.08	1.40	5.79	13.6	<0.05	<0.001	<0.05	1.64	1.64	5.0	—	1.5	1.4	0.010
21-07-27	90.7	0.05	35.3	0.270	87.6	0.15	1.35	5.86	48.0	<0.05	0.001	<0.05	1.08	1.08	5.0	—	1.1	3.1	0.015
21-08-24	93.6	0.06	38.9	0.350	72.7	0.13	1.22	7.13	42.2	<0.05	<0.001	<0.05	1.06	1.06	3.0	—	1.1	2.8	0.011
21-09-29	85.3	0.05	37.8	0.637	83.5	0.11	1.39	6.04	42.9	<0.05	<0.001	<0.05	1.03	1.03	5.0	—	1.1	2.4	0.012
21-10-25	81.8	0.04	32.5	0.193	91.3	0.20	1.69	5.00	54.9	<0.05	<0.001	<0.05	0.60	0.60	5.0	—	0.7	6.0	0.022

Table 59: Inorganics results for WQ-6, 2021

SITE WQ-6: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	0.034	<0.001	0.006	0.066	<0.00001	<0.001	<0.001	<0.001	0.14	0.0003	0.091	<0.0001	<0.001	<0.0001	0.0007	<0.0001	0.049	0.0001	<0.001	<0.001
21-06-22	0.007	<0.001	0.011	0.083	<0.00001	<0.0001	<0.001	<0.001	0.07	0.0007	0.073	<0.0001	<0.001	<0.0001	0.0008	<0.0001	0.056	<0.0001	<0.001	0.001
21-07-20	0.007	<0.001	0.010	0.089	<0.00001	<0.0001	<0.001	<0.001	0.12	0.0006	0.112	<0.0001	<0.001	<0.0001	0.0009	<0.0001	0.067	0.0012	<0.001	<0.001
21-08-16	0.006	<0.001	0.010	0.093	<0.00001	<0.0001	<0.001	<0.001	0.10	0.0006	0.074	<0.0001	<0.001	<0.0001	0.0008	0.0002	0.075	0.0003	<0.001	<0.001
21-09-22	0.004	<0.001	0.010	0.089	<0.00001	<0.0001	<0.001	<0.001	0.08	0.0006	0.069	<0.0001	<0.001	<0.0001	0.0010	<0.0001	0.066	0.0002	<0.001	<0.001
21-10-20	0.016	<0.001	0.009	0.075	<0.00001	<0.0001	<0.001	<0.001	0.13	0.0004	0.054	<0.0001	<0.001	<0.0001	0.0012	<0.0001	0.061	0.0001	<0.001	<0.001

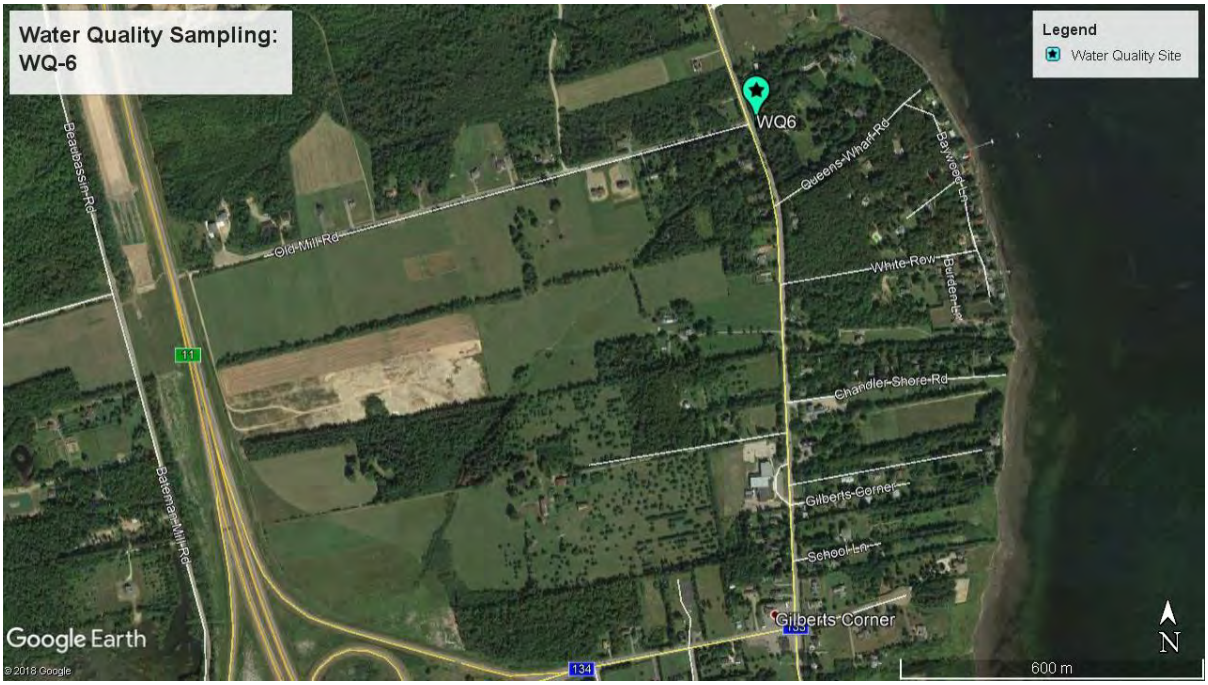


Figure 37: WQ-6 site location and surrounding land uses

Figure 38: Site photos for the water quality monitoring station WQ-6

3.2.7 WQ-7

This water quality sampling site is located off Route 134, on the property of *Bay Vista Lodge* (Figure 39). The samples are taken upstream of the culvert crossing the main road. The sample site is located approximately 160 m from the tidal zone and the beginning of a salt marsh.

The surrounding land uses is mainly residential the cottages of *Bay Vista*. This brook is very short; the only obvious source of water being a pond (1,700 m^2) approximately 200 m away (Figure 40). The brook does not appear on GeoNB, only a separate brook nearby which flows into the same coastal wetland. This other nearby brook leads up to a gravel pit approximately 550 metres upstream from Route 134, but it is surrounded by forested lots.

The water sampling results for the site WQ-7, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. The field reading for pH in October is below the recommended range (pH < 6 & pH > 9) showing a result of 5.81. However, the lab result for the same samples shows the result is within range (Table 60).

Bacterial levels did not exceed the maximum concentration of E. coli from Health Canada recreational guideline (≥ 400 MPN/100 mL) (Table 60).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were: in the mesotrophic range (0.010 – 0.020 mg/L) in August; in the meso-eutrophic range (0.020 – 0.035 mg/L) in May, June, July, and September; in the eutrophic range (0.035 – 0.100 mg/L) in October (Table 61).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the sample taken in October (0.141 mg/L). Iron (Fe) levels also exceeded the CCME guideline of 0.3 mg/L in the sample taken in May (0.38 mg/L) (Table 62).

Table 60: Water chemistry data and E. coli results for WQ-7, 2021

SITE WQ-7: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (mS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
21-05-19	7	10.2	0.20	11.78	41	43	28	0.292	0.419	91.3	-0.62	7.42	7.70	8.30	264.55	195	2.20
21-06-22	26	20.7	0.16	5.65	336	60	11	311.200	0.386	103.0	-0.53	7.25	7.60	8.10	219.70	193	2.30
21-07-20	23	19.8	0.15	7.52	148	56	11	287.700	0.000	91.3	-0.70	7.40	7.50	8.20	207.35	177	2.00
21-08-16	24	19.2	0.19	7.06	213	58	7	0.344	0.394	106.0	-0.53	7.62	7.60	8.10	250.90	203	1.30
21-09-22	23	16.3	0.17	8.85	135	54	6	0.303	0.372	98.7	-0.29	7.69	7.90	8.20	236.60	188	0.70
21-10-20	11	9.5	0.15	10.7	<10	54	19	0.222	0.322	89.4	-0.82	5.81	7.40	8.20	205.40	165	4.00

Table 61: Nutrient results for WQ-7, 2021

SITE WQ-7: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	42.8	0.05	27.2	0.202	87.4	<0.05	1.02	5.67	36.4	<0.05	<0.001	<0.05	<0.05	<0.05	6.0	—	0.3	4.7	0.028
21-06-29	59.8	0.05	30.3	0.224	76.3	0.10	1.21	6.55	31.6	0.09	<0.001	<0.05	0.14	0.14	6.0	—	0.4	3.1	0.032
21-07-27	55.8	0.04	27.1	0.166	70.5	0.13	0.99	5.85	26.8	<0.05	<0.001	<0.05	0.18	0.18	8.0	—	0.3	2.2	0.022
21-08-24	57.8	0.05	31.2	0.216	84.0	0.13	1.20	6.81	34.4	<0.05	<0.001	<0.05	0.11	0.11	7.0	—	0.3	2.4	0.017
21-09-29	53.6	0.04	29.3	0.400	78.2	0.09	1.05	6.20	29.0	<0.05	<0.001	<0.05	0.08	0.08	8.0	—	<0.2	2.1	0.027
21-10-25	53.9	0.03	26.5	0.127	64.2	0.29	1.17	5.65	24.2	<0.05	<0.001	<0.05	0.06	0.06	9.0	—	<0.2	3.6	0.040

Table 62: Inorganics results for WQ-7, 2021

SITE WQ-7: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	DND	<0.001	0.005	0.085	<0.00001	0.0002	<0.001	<0.001	0.38	0.0015	0.106	<0.0001	<0.001	0.0002	0.0008	<0.0001	0.065	0.0001	<0.001	0.001
21-06-22	0.057	<0.001	0.007	0.102	<0.00001	<0.0001	<0.001	<0.001	0.24	0.0016	0.084	0.0001	<0.001	<0.0001	0.0011	<0.0001	0.073	0.0002	<0.001	<0.001
21-07-20	0.067	<0.001	0.007	0.082	<0.00001	<0.0001	<0.001	<0.001	0.18	0.0014	0.064	<0.0001	<0.001	0.0001	0.0008	<0.0001	0.064	0.0002	<0.001	<0.001
21-08-16	0.051	<0.001	0.007	0.090	<0.00001	<0.0001	<0.001	<0.001	0.24	0.0015	0.047	<0.0001	<0.001	<0.0001	0.0009	0.0002	0.075	0.0002	<0.001	<0.001
21-09-22	0.043	<0.001	0.006	0.088	<0.00001	<0.0001	<0.001	<0.001	0.21	0.0016	0.068	<0.0001	<0.001	0.0001	0.0008	<0.0001	0.067	0.0001	<0.001	<0.001
21-10-20	0.141	<0.0001	0.006	0.081	<0.00001	<0.0001	<0.001	<0.001	0.28	0.0015	0.035	<0.0001	<0.001	0.0001	0.0009	<0.0001	0.063	0.0001	<0.001	<0.001

Figure 39: WQ-7 site location and surrounding land uses

Figure 40: Site photos for the water quality monitoring station WQ-7

3.2.8 WQ-8

This water quality sampling site is located off Route 134, in front of a chiropractor's office (3694 Route NB-134, Shediac Cape) (Figure 41). The site is within the tidal zone, being approximately 75 metres from the outlet into the Shediac Bay. The samples are taken upstream from the culvert (Figure 42).

The surrounding land uses includes; residences, farmlands and a chicken farm. The farm fields possess little to no buffer around the lots; mainly wide-open fields with little tree line density. There is a settling pond behind the chicken farm buildings, with a thin band of vegetation surrounding it (> 10 m). Observations taken during the sampling includes dark colouration and bad odours in the water.

The water sampling results for the site WQ-8, for 2021, meets or exceeds the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 63).

Bacterial levels exceeded the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in June (7,701 MPN/100 mL), July (405 MPN/100 mL), August (3,873 MPN/100 mL), and October (5,794 MPN/100 mL) (Table 63).

Total phosphorus levels for long-term eutrophic conditions according to the CCME Guidance Framework for Phosphorus were: in the eutrophic range (0.035 – 0.100 mg/L) in May, September, and October; and in the hyper-eutrophic range (>100 mg/L) from June to August (Table 64).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of iron (Fe) exceeded the CCME water quality guideline of 0.3 mg/L in May (0.60 mg/L) and September (1.00 mg/L). Concentration of boron (B) also exceeded the short term CCME water quality guideline of 1.5 mg/L in June, July, August, and October. It is important to note that this site is impacted by tides, and that marine water disqualifies several flagged parameters that only apply to freshwater, and that includes boron. There is a correlation between the flagged samples of boron and the high salinity (Table 65).

Table 63: Water chemistry data and E. coli results for WQ-8, 2021

SITE WQ-8: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (mS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
21-05-19	7	12.7	22.30	6.9	52	60	25	27.260	7.380	1,250.0	-0.27	7.31	7.70	8.00	23,114.00	5280	3.00
21-06-22	26	20.5	23.55	4.85	7,701	120	14	33.907	249.000	2,720.0	0.28	7.38	7.60	7.30	24.12	13800	4.20
21-07-20	23	22.4	2.51	2.43	405	110	13	36034.000	0.000	2,480.0	-0.16	7.10	7.20	7.40	24,648.00	20000	8.00
21-08-16	25	21.2	23.29	5.9	3,873	110	10	34.520	36.400	2,200.0	-0.15	7.64	7.30	7.50	24,258.00	14800	7.90
21-09-22	23	18.8	14.36	12.38	341	110	9	20.900	5.920	1,390.0	0.17	7.66	7.80	7.60	15,535.00	4660	1.40
21-10-20	13	11.3	26.32	7.8	5,794	110	<5	30.340	58.000	4,490.0	0.58	7.47	7.60	7.00	26,767.00	25000	1.00

Table 64: Nutrient results for WQ-8, 2021

SITE WQ-8: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	59.7	14.20	89.0	0.281	2,030.0	0.50	80.90	250.00	2,190.0	<0.05	<0.001	<0.05	<0.05	<0.05	601.0	—	1.0	6.1	0.043
21-06-29	120.0	25.40	195.0	0.447	7,500.0	1.00	161.00	542.00	4,440.0	0.37	0.006	<0.05	<5	<5	940.0	—	1.1	5.3	0.205
21-07-27	110.0	24.20	172.0	0.164	13,200.0	2.60	141.00	498.00	4,120.0	0.09	<0.001	<0.05	<0.05	<0.05	1740.0	—	1.6	10.9	0.468
21-08-24	110.0	20.40	158.0	0.206	10,100.0	2.00	143.00	438.00	3,590.0	0.29	0.002	<0.05	<0.05	<0.05	306.0	—	0.8	5.1	0.163
21-09-29	109.0	14.10	107.0	0.648	1,610.0	0.53	84.50	273.00	2,300.0	0.11	0.003	<0.05	<0.05	<0.05	210.0	—	0.8	2.8	0.070
21-10-25	110.0	43.70	299.0	0.410	13,800.0	2.60	283.00	909.00	7,660.0	0.05	<0.001	<0.05	<0.05	<0.05	1980.0	—	0.3	3.4	0.040

Table 65: Inorganics results for WQ-8, 2021

SITE WQ-8: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	DND	<0.001	0.920	0.070	<0.0001	<0.001	<0.01	<0.01	0.60	0.0380	0.410	0.003	<0.001	<0.001	0.0240	<0.001	1.820	<0.001	<0.01	<0.01
21-06-22	<0.005	<0.001	2.000	0.230	<0.0001	<0.005	<0.005	<0.05	<1	0.0780	0.760	<0.005	<0.05	<0.005	0.0470	<0.005	3.370	<0.005	<0.005	<0.05
21-07-20	<0.05	<0.05	1.680	0.090	<0.005	<0.005	<0.005	<0.05	<1	0.0650	0.600	<0.005	<0.05	<0.005	0.0420	<0.005	2.890	<0.005	<0.05	<0.05
21-08-16	0.080	<0.05	1.520	0.190	<0.0005	<0.005	<0.05	<0.05	<1	0.0620	0.940	<0.005	<0.05	<0.005	0.0350	0.0070	2.580	<0.005	<0.05	<0.05
21-09-22	0.066	<0.005	0.937	0.127	<0.00005	<0.0005	<0.05	<0.005	1.00	0.0365	0.517	0.0029	<0.0005	<0.0005	0.0221	<0.0005	1.580	0.0010	<0.005	<0.005
21-10-20	0.060	<0.05	2.830	<0.05	<0.005	<0.005	<0.05	<0.05	<1	0.1190	0.120	0.009	<0.005	<0.005	0.0810	<0.005	5.710	<0.005	<0.05	<0.05

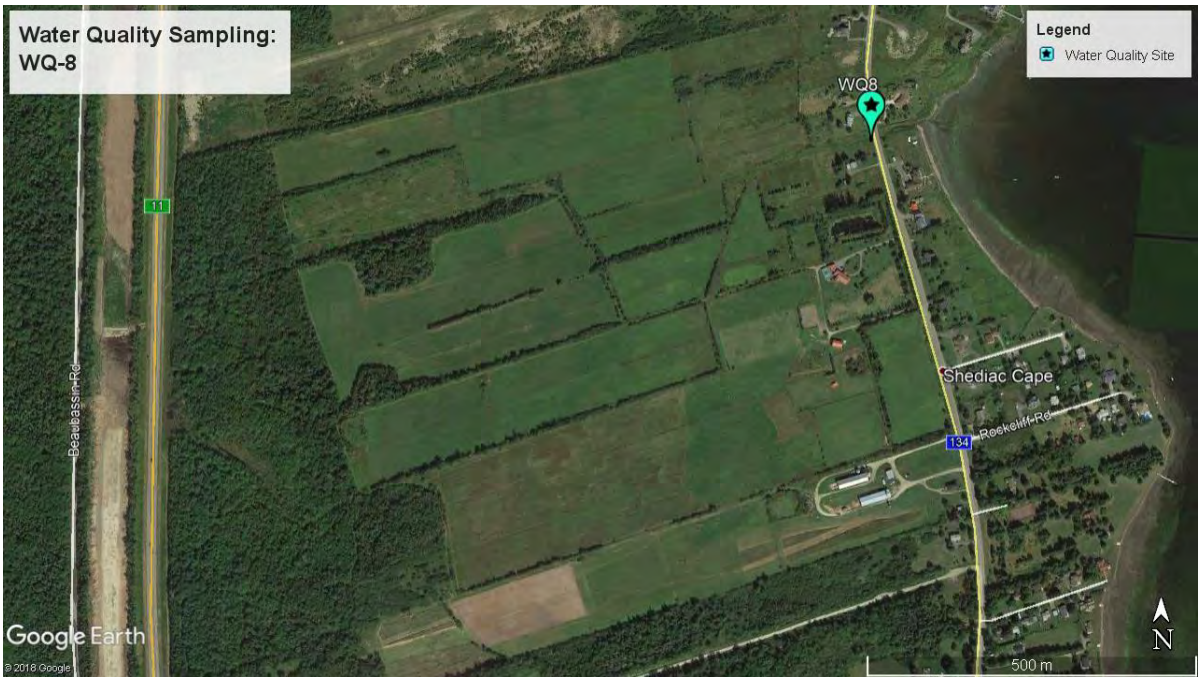


Figure 41: WQ-8 site location and surrounding land uses

Figure 42: Site photos for the water quality monitoring station WQ-8

3.2.9 WQ-9

This water quality sampling site is located in the Ruisseau Albert-Gallant, off Babineau Access Road, 320 m after turning to the left off Viaduc Road (turning to the right is Shediac River Road) (Figure 43). The samples are taken downstream of the culvert, due to flooding on the other side caused by a beaver dam at the mouth of the culvert, creating conditions unfit for chest waders (Figure 44). The sample site is located approximately 300 m from the tidal zone.

The surrounding land uses is mainly residences and large agricultural fields. There is a farming lot (1.2 hectare) along the right side of the brook (looking upstream), with no buffer zone along the total length of its riverbank (100 metres). On the left side of the sampling site is a much larger cultivated farm field; 14.6 Hectares and another lot 5.3 Hectares. The drainage from these fields flows down to the ditch along Shediac River Rd. and Babineau Access Rd., and may flow down to the brook's culvert. There are no trees around any of these farm fields. There is also the presence of the large junkyard of *Bastarache's Auto Salvage*, but there is approximately 1 km of forested buffer between the salvage lot and the head ponds of the brook (as delineated on GeoNB).

The water sampling results for the site WQ-9, for 2021, meet the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen (Table 66).

Bacterial levels exceeded the maximum concentration of E. coli from Health Canada recreational guideline (≥ 400 MPN/100 mL) in June (487 MPN/100 mL) (Table 66).

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were: in the meso-eutrophic range (0.020 – 0.035 mg/L) from July to September; in the eutrophic range (0.035 – 0.100 mg/L) in May, June, and October (Table 67).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of iron (Fe) exceeded the CCME water quality guideline (0.3 mg/L) in every sample taken; May (0.41 mg/L), June (0.58 mg/L), July (0.66 mg/L), August (0.60 mg/L), September (0.45 mg/L), and October (2.14 mg/L) (Table 68).

Table 66: Water chemistry data and E. coli results for WQ-9, 2021

SITE WQ-9: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (mS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
21-05-19	7	10.2	0.09	9.83	98	39	33	0.095	0.134	41.7	-1.11	8.02	7.50	8.60	85.80	42	3.40
21-06-22	27	21.9	0.08	7.72	487	75	17	158.200	0.184	72.4	-0.50	7.37	7.60	8.10	109.20	97	1.90
21-07-20	23	20.5	0.08	5.55	364	71	26	153.900	0.000	69.0	-0.84	7.41	7.30	8.10	109.20	99	2.40
21-08-16	25	21.0	0.08	5.9	243	70	30	0.156	0.170	66.2	-0.86	7.32	7.30	8.20	109.85	93	1.40
21-09-22	25	17.3	0.09	9.3	161	66	21	0.153	0.170	63.1	-0.70	7.82	7.50	8.20	117.00	92	1.30
21-10-20	12	9.9	0.02	7.47	63	49	79	0.102	0.136	48.4	-1.34	7.96	7.10	8.40	93.60	75	9.20

Table 67: Nutrient results for WQ-9, 2021

SITE WQ-9: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	38.9	0.03	13.5	0.116	11.8	0.17	0.77	1.93	7.1	<0.05	<0.001	<0.05	0.25	0.25	<1	—	0.4	5.8	0.045
21-06-29	74.7	0.03	23.9	0.280	10.7	0.11	0.92	3.09	6.9	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.4	4.7	0.040
21-07-27	70.9	0.04	23.0	0.133	12.6	0.15	0.98	2.82	8.0	0.09	<0.001	<0.05	0.09	0.09	<1	—	0.5	5.9	0.032
21-08-24	69.9	0.04	22.0	0.131	10.3	0.18	0.83	2.74	7.0	<0.05	<0.001	<0.05	0.09	0.09	<1	—	0.4	6.0	0.032
21-09-29	65.8	0.04	21.0	0.196	11.5	0.16	0.90	2.60	7.3	0.10	0.001	<0.05	0.08	0.08	2.0	—	0.3	4.6	0.026
21-10-25	48.9	0.04	15.9	0.058	12.4	0.24	1.82	2.11	6.9	<0.05	<0.001	<0.05	0.06	0.06	3.0	—	0.6	10.9	0.092

Table 68: Inorganics results for WQ-9, 2021

SITE WQ-9: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	DND	<0.001	0.006	0.042	<0.00001	<0.0001	<0.001	<0.001	0.41	0.0006	0.200	<0.0001	<0.001	0.0002	0.0008	<0.0001	0.039	<0.0001	<0.001	<0.001
21-06-22	0.051	<0.001	0.007	0.044	<0.00001	<0.0001	<0.001	<0.001	0.58	0.0008	0.628	0.0002	<0.001	<0.0001	0.0011	<0.0001	0.063	<0.0001	<0.001	0.002
21-07-20	0.036	0.002	0.008	0.081	<0.00001	<0.0002	<0.001	<0.001	0.66	0.0008	0.974	0.0002	<0.001	<0.0001	0.0011	<0.0001	0.069	<0.0001	<0.001	0.002
21-08-16	0.029	0.001	0.008	0.073	<0.00001	<0.0001	<0.001	<0.001	0.60	0.0008	0.618	0.0001	<0.001	<0.0001	0.0009	0.0002	0.067	<0.0001	<0.001	0.002
21-09-22	0.032	<0.001	0.007	0.073	<0.00001	<0.0001	<0.001	<0.001	0.45	0.0007	0.420	0.0001	<0.001	<0.0001	0.0009	<0.0001	0.063	<0.0001	<0.001	0.001
21-10-20	0.239	0.001	0.009	0.074	0.00002	0.0003	<0.001	0.002	2.14	0.0007	0.719	<0.0001	<0.001	0.0008	0.0016	<0.0001	0.048	0.0001	0.001	0.004

Figure 43: WQ-9 site location and surrounding land uses

Figure 44: Site photos for the water quality monitoring station WQ-9

3.2.10 WQ-10

This water quality sampling site is located off Route 530 (Grande-Digue Rd.), 100 m after Chemin Antoine (Figure 45). The samples are taken upstream of the culvert (Figure 46). The sample site is located approximately 130 m from the tidal zone.

The surrounding land uses is mainly residences and a possible agricultural field (> 1 ha.). There is a buffer zone that separates the field and the brook (average 5-15 m in thickness).

The water sampling results for the site WQ-10, for 2021, 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 June (6.15 mg/L) (Table 69).

Bacterial levels did exceed the maximum concentration of E. coli from Health Canada recreational guideline (≥ 400 MPN/100 mL), for every samples taken in 2021 except in May; June (24,196 MPN/100 mL), July (15,531 MPN/100 mL), August (1,291 MPN/100 mL), September (2,481 MPN/100 mL) and October (548 MPN/100 mL) (Table 69).

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were: in the meso-eutrophic range (0.020 – 0.035 µg/L) in May, September, and October; and in the eutrophic range (0.035 - 100 mg/L) from June to August (Table 70).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum (Al) exceeded the CCME water quality guideline of 0.100 mg/L (pH ≥6.5) in the sample taken in October (0.383 mg/L). Iron (Fe) levels also exceeded the CCME guideline of 0.3 mg/L in every sample taken; May (0.48 mg/L), June (0.39 mg/L), July (1.05 mg/L), August (1.35 mg/L), September (0.65 mg/L), and October (1.10 mg/L) (Table 71).

Table 69: Water chemistry data and E. coli results for WQ-10, 2021

SITE WQ-10: 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 (mS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
21-05-19	7	9.1	0.05	12.26	41	15	142	0.073	0.104	20.0	-2.14	7.46	7.20	9.30	66.30	57	3.20
21-06-22	27	21.0	0.10	6.15	24,196	51	26	188.620	0.233	68.2	-0.81	6.65	7.50	8.30	132.00	120	1.40
21-07-20	23	18.7	0.09	7.41	15,531	42	121	165.400	0.213	59.3	-1.05	7.34	7.40	8.50	122.20	126	2.60
21-08-16	25	18.6	0.11	7.42	1,291	42	76	0.203	0.234	66.6	-1.01	7.37	7.40	8.40	150.15	127	2.80
21-09-22	25	16.4	0.09	9.52	2,481	38	122	0.162	0.196	54.2	-1.04	7.64	7.50	8.50	126.10	111	1.70
21-10-20	12	9.0	0.06	11.87	548	21	351	0.088	0.128	32.6	-2.10	7.26	6.90	9.00	81.90	70	2.10

Table 70: Nutrient results for WQ-10, 2021

SITE WQ-10: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	15.0	0.03	6.2	0.022	17.6	0.24	0.35	1.11	9.8	<0.05	<0.001	<0.05	<0.05	<0.05	<1	—	0.4	12.3	0.030
21-06-29	50.8	0.04	21.6	0.151	41.8	0.10	0.94	3.47	15.1	0.22	0.003	<0.05	0.27	0.27	<1	—	<0.0001	4.0	0.048
21-07-27	41.9	0.04	18.9	0.099	45.8	0.34	0.67	2.94	16.7	0.27	0.003	<0.05	0.21	0.21	<1	—	0.8	12.2	0.058
21-08-24	41.9	0.05	20.9	0.099	44.3	0.28	0.72	3.51	19.2	0.16	0.002	<0.05	0.18	0.18	<2	—	0.6	9.2	0.058
21-09-29	37.9	0.04	17.0	0.113	38.8	0.43	0.70	2.86	15.3	0.09	0.001	<0.05	<0.05	<0.05	<1	—	0.4	11.4	0.028
21-10-25	21.0	0.03	10.2	0.016	29.5	0.74	0.66	1.73	12.9	<0.05	<0.001	<0.05	<0.05	<0.05	<5	—	0.5	31.0	0.027

Table 71: Inorganics results for WQ-10, 2021

SITE WQ-10: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	0.214	<0.001	0.004	0.024	0.00002	0.0002	<0.001	<0.001	0.48	0.0003	0.077	<0.0001	<0.001	0.0003	0.0005	<0.0001	0.023	<0.0001	<0.001	<0.001
21-06-22	0.072	<0.001	0.011	0.045	<0.00001	0.0002	<0.001	<0.001	0.39	0.0004	0.323	<0.0001	<0.001	0.0002	0.0016	<0.0001	0.057	<0.0001	<0.001	0.001
21-07-20	0.240	<0.001	0.008	0.054	0.00003	0.0005	<0.001	<0.001	1.05	0.0004	0.953	<0.0001	<0.001	0.0007	0.0012	<0.0001	0.052	0.0001	<0.001	0.003
21-08-16	0.235	<0.001	0.008	0.058	0.00003	0.0006	<0.001	<0.001	1.35	0.0005	1.160	<0.0001	<0.001	0.0009	0.0012	0.0002	0.058	0.0001	<0.001	0.002
21-09-22	0.102	<0.001	0.007	0.041	<0.00001	0.0001	<0.001	<0.001	0.65	0.0005	0.228	<0.0001	<0.001	0.0002	0.0011	<0.0001	0.046	<0.0001	<0.001	<0.001
21-10-20	0.383	<0.001	0.005	0.039	0.00001	0.0002	<0.001	<0.001	1.10	0.0006	0.168	<0.0001	<0.001	0.0003	0.0008	<0.0001	0.032	<0.0001	<0.001	0.002

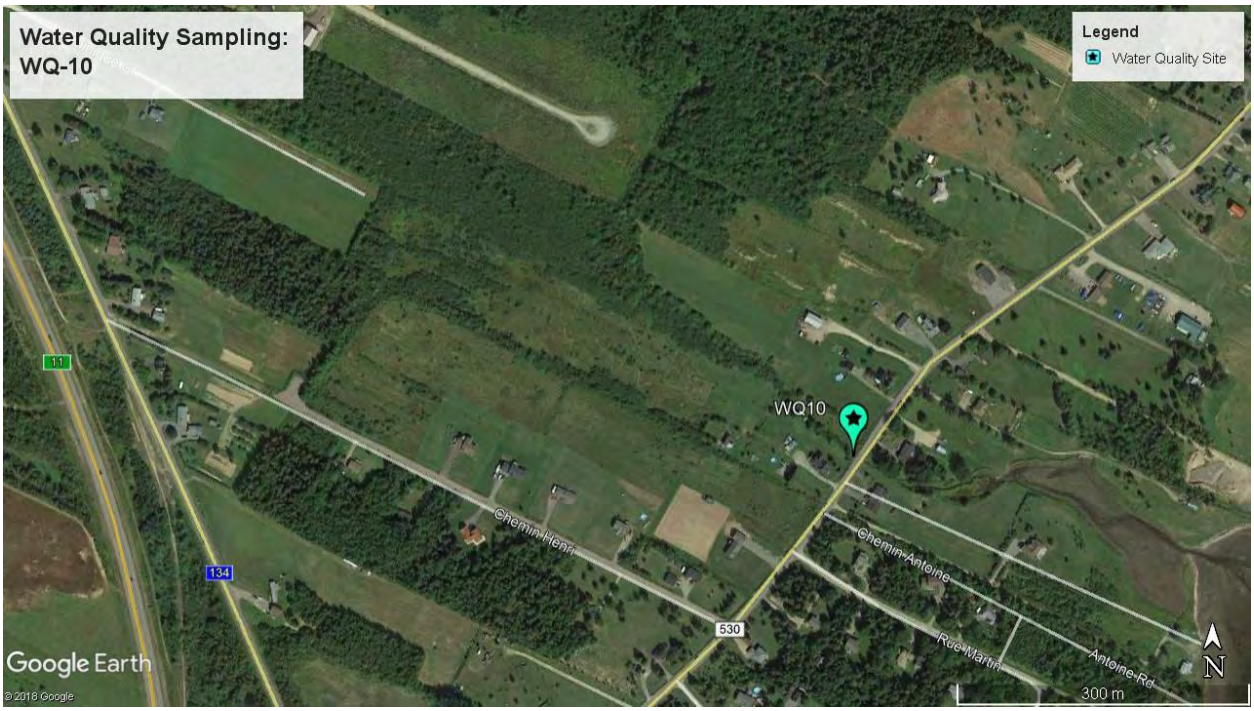


Figure 45: WQ-10 site location and surrounding land uses

Figure 46: Site photos for the water quality monitoring station WQ-10

3.2.11 WQ-11B

This water quality sampling site is located off Route 530 (Grande-Digue Rd.), just before the Chemin des Soeurs (Figure 47). The samples are taken upstream of the culvert. The sample site is located approximately 80 m from the tidal zone.

The surrounding land uses is mainly residential and agricultural farms. The farm lands are made up of various parcels of land, spanning over 58 hectares of land leading up to the watershed boundary. There is very little evidence of any tree buffer over this area from aerial imagery, except for one forested parcel and a few thin lines of trees along property lines (Figure 48).

The water sampling results for the site WQ-11B, for 2021, meet the recommendations for the survival of freshwater aquatic life based on pH. However, the levels of dissolved oxygen fell below the recommendation (6.5 mg/L) for general cold-water organisms in July (4.86 mg/L) and October (3.95 mg/L) (Table 72).

Bacterial levels exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in June (554 MPN/100 mL), July (4,884 MPN/100 mL), August (670 MPN/100 mL, and September (538 MPN/100 mL) (Table 72).

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were: in the oligotrophic range (0.004 – 0.010 mg/L) in July; in the mesotrophic range (0.010 – 0.020 mg/L) in September; in the meso-eutrophic range (0.020 – 0.035 mg/L) in July and August; and in the eutrophic range (0.035 – 0.100 mg/L) in October (Table 73).

Concentration results for the nitrate ion (NO_3) are below the short term (124 mg/L) and long-term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of iron exceeded the CCME water quality guideline of 0.3 mg/L in June (4.40 mg/L), July (0.90 mg/L), and August (0.60 mg/L) (Table 74).

Table 72: Water chemistry data and E. coli results for WQ-11B, 2021

SITE WQ-11B: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (mS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
21-05-19	7	9.4	0.54	10.3	10	44	20	0.760	0.773	94.5	-0.89	7.34	7.60	8.50	708.50	357	4.40
21-06-22	28	22.0	21.53	7.33	554	96	12	32.331	8.530	1,420.0	-0.25	7.11	7.40	7.70	22.32	5550	2.20
21-07-20	23	21.5	3.74	4.86	4,884	100	13	6408.000	11.700	872.0	-0.60	7.24	7.20	7.80	4,472.00	5230	4.30
21-08-16	25	20.4	2.41	7.84	670	90	21	3.970	2.640	255.0	-0.59	7.27	7.40	8.00	2,925.00	1180	1.60
21-09-22	DND	16.0	0.49	8.35	538	92	10	0.730	0.986	120.0	-0.02	7.55	8.00	8.00	624.00	454	0.70
21-10-20	13	11.6	24.30	3.95	211	78	19	28.360	12.800	1,170.0	-0.73	6.85	7.10	7.80	24,875.00	6860	2.10

Table 73: Nutrient results for WQ-11B, 2021

SITE WQ-11B: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
21-05-27	43.8	0.57	19.2	0.164	171.0	0.17	3.75	11.30	91.2	<0.05	<0.001	<0.05	0.34	0.34	27.0	—	0.5	4.9	0.031
21-06-29	95.8	13.80	117.0	0.226	2,170.0	0.44	86.60	275.00	2,250.0	0.07	<0.001	<0.05	<0.05	<0.05	580.0	—	<0.001	3.6	0.032
21-07-27	99.8	7.90	77.0	0.149	3,260.0	0.65	47.70	165.00	1,280.0	0.15	<0.001	<0.05	<0.05	<0.05	335.0	—	0.5	5.3	0.008
21-08-24	89.8	1.66	38.8	0.212	730.0	0.31	12.50	38.40	283.0	0.10	<0.001	<0.05	<0.05	<0.05	22.0	—	0.4	4.5	0.027
21-09-29	91.1	0.42	28.9	0.856	246.0	0.21	3.72	11.50	73.1	<0.05	<0.0021	<0.05	<0.05	<0.05	31.0	—	0.2	2.8	0.014
21-10-25	77.9	11.00	96.0	0.092	4,000.0	0.71	63.40	225.00	1,880.0	0.11	<0.001	<0.05	<0.05	<0.05	550.0	—	0.4	6.9	0.042

Table 74: Inorganics results for WQ-11B, 2021

SITE WQ-11B: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Rb (mg/L)	Sb (mg/L)	Sr (mg/L)	U (mg/L)	V (mg/L)	Zn (mg/L)
21-05-19	0.158	<0.001	0.045	0.035	<0.00001	0.0001	<0.001	<0.001	0.17	0.0016	0.098	0.0001	<0.001	0.0002	0.0015	<0.0001	0.101	0.0001	<0.001	<0.001
21-06-22	1.950	<0.001	1.050	0.120	<0.00001	0.003	<0.01	<0.01	4.40	0.0400	3.090	0.002	<0.001	0.0070	0.0270	<0.001	1.770	0.0010	<0.01	0.010
21-07-20	0.060	<0.02	0.570	0.080	<0.0002	<0.002	<0.02	<0.02	0.90	0.0200	1.100	<0.002	<0.02	<0.002	0.0150	<0.002	1.010	<0.002	<0.02	<0.02
21-08-16	0.023	<0.005	0.128	0.069	<0.00005	<0.0005	<0.005	<0.005	0.60	0.0038	0.760	<0.0005	<0.005	<0.0005	0.0040	0.0007	0.272	<0.0005	<0.005	<0.005
21-09-22	0.024	<0.001	0.042	0.049	<0.00001	0.0001	<0.001	<0.001	0.27	0.0012	0.196	0.0002	<0.001	<0.0001	0.0016	<0.0001	0.116	0.0002	<0.001	<0.001
21-10-20	0.090	<0.02	0.700	0.110	<0.0002	<0.002	<0.02	<0.02	<0.4	0.0260	0.170	<0.002	<0.002	<0.002	0.0190	<0.002	1.380	<0.002	<0.02	<0.02

Figure 47: WQ-11B site location and surrounding land uses

Figure 48: Site photos for the water quality monitoring station WQ-11B

3.2.12 Sampling Summary

The bacterial levels in the small stream sites in 2021 exceeded the Canadian Recreational Water Quality Guideline (400 MPN/100 mL) on 22 occasions. Additionally, four sites have exceeded 5000 MPN/100 mL. The WQ-10 site was the worst in terms of bacterial levels; it exceeded the limit every sampling month except May. The only sites who did not exceed the water quality guidelines are WQ-4, WQ-5, and WQ-7 (Figure 49).

The average total phosphorous for the small stream sites fell into four different categories; Mesotrophic (0.010 – 0.020 mg/L), Meso-eutrophic (0.020 – 0.035 mg/L), Eutrophic (0.035 - 0.100 mg/L), and Hyper-eutrophic (>0.100 mg/L) (Table 75). These categories are derived from the CCME Guidance framework for Phosphorus (freshwater) (Table 6).

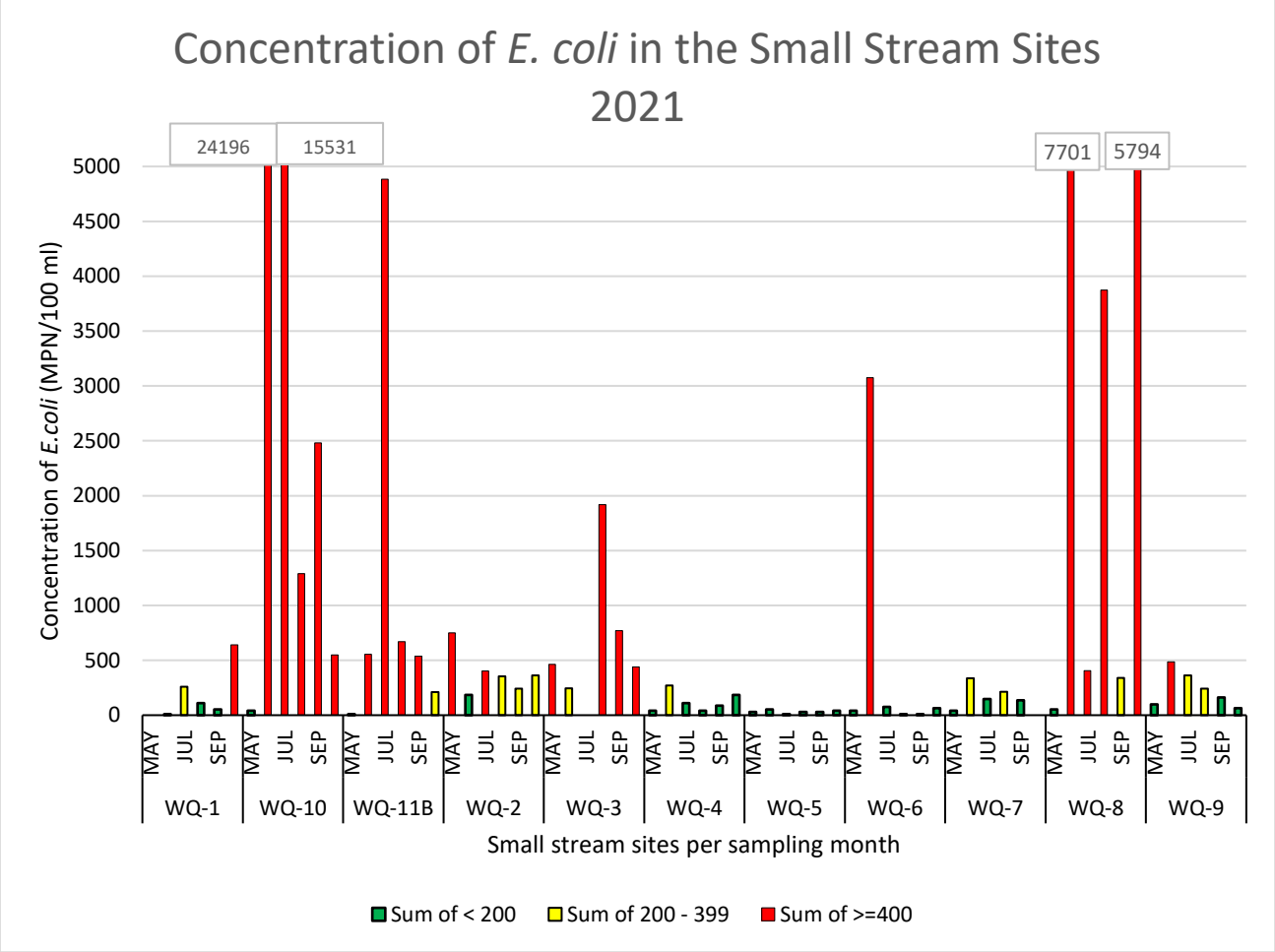


Figure 49: Summary of water quality results for *E. coli*, small stream sampling 2021

Table 75: Average total phosphorous for the small stream sites in 2021

Sampling Site	Average TP-L (mg/L)
WQ-1	0.021
WQ-2	0.016
WQ-3	0.086
WQ-4	0.089
WQ-5	0.045
WQ-6	0.015
WQ-7	0.028
WQ-8	0.165
WQ-9	0.045
WQ-10	0.042
WQ-11B	0.026

4. WATER TEMPERATURE MONITORING

This part of the project is done in partnership with the "*Institut national de la recherche scientifique*" (INRS-ETE) in the province of Quebec. This partnership began in 2016, where INRS-ETE provided the SBWA with 3 temperature loggers in addition to the ones purchased with funding from NB-ETF.

The strategy is to monitor temperatures fluctuations in strategic locations (Table 76). Areas of interest are those determined to be high risk for thermal stress in juvenile salmonids and other cold-water species. Other areas of interest are those determined to be colder zones suitable for thermal refugia, i.e. habitats containing colder water that provides a refuge for fish from high water temperatures.

The monitoring program normally includes seven sites in the watershed. In 2020, two loggers were lost in the water. In 2021, two new loggers were purchased, but due to shortages caused by the pandemic, these new loggers were only received late August. Therefore, only five sites were monitored in 2021. Unfortunately, again, two loggers were lost in the fall of 2021. The SBWA will re-evaluate the installation method for next year. Therefore, the following section reports on the data retrieved from three temperature loggers.

Table 76: Thermograph Monitoring Sites information, SBWA 2021

Site ID	Watercourse Name	Latitude	Longitude	Installation date	Date of retrieval
T-ShdB	McQuade Brook	N46° 13' 54.9"	W64° 44' 31.9"	2021/06/03	2021/09/28
T-ShdE	Shediac River	N46° 14' 41.5"	W64° 39' 56.3"	2021/06/03	2021/09/28
T-ShdM	Weisner Brook	N46° 12' 27.1"	W64° 40' 21.0"	2021/06/03	2021/09/28
T-ScdD*	Scoudouc River	N46° 11' 2.3"	W64° 30' 39.8"	2021/06/03	2021/09/28
T-ScdB*	Scoudouc River	N46° 08' 39.2"	W64° 33' 36.6"	2021/06/03	2021/09/28

*Lost temperature logger

The temperature loggers were primarily installed on June 3rd and retrieved on September 28th . The following section of this report shows the thermograph data (daily maximum temperatures) recorded. The recommended temperature limits indicate the threshold for thermal stress beginning at 22.5°C for juvenile Atlantic salmon, and lethal limit of 25°C or greater (Crisp 1999).

Figure 50: Installation of a water temperature logger in-stream

4.1 Water Temperature Monitoring Shediac River

Five sites are monitored in the Shediac River and its tributaries; two in the main branch, two in the Weisner Brook and one in the McQuade Brook. The following section reports on the T-ShdB, T-ShdE, and T-ShdM temperature logger data for 2021 (Figure 51).

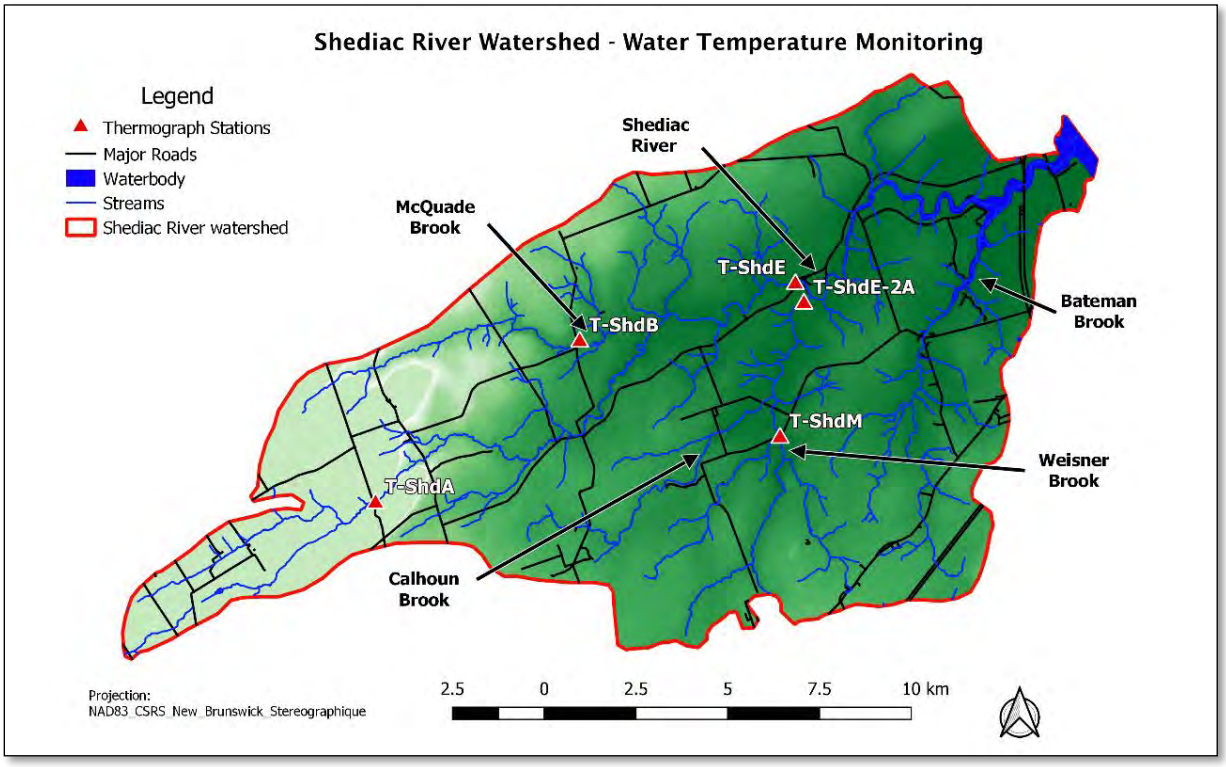


Figure 51: Map of temperature logger placement in the Shediac River

4.1.1 T-ShdB Monitoring Site

This temperature logger was installed in the McQuade Brook, approximately 35 metres downstream of the Scotch Settlement Road. The logger is downstream of the fish ladder.

The thermograph shows the maximum daily temperatures between June 3st and October 5th. The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 56 occasions during the peak of the summer months. Of those 57 days, the maximum temperatures exceeded the lethal limit (25°C) on 23 occasions. There was a 13-day stretch during which the maximum daily temperatures surpassed the thermal stress level, from August 10 to August 12. During that period, the maximum daily temperature surpassed the lethal levels on 7 occasions (Figure 52).

The highest temperature recorded during this time period was 28.3°C on August 13. The highest average daily temperature for this site was 24.7°C.

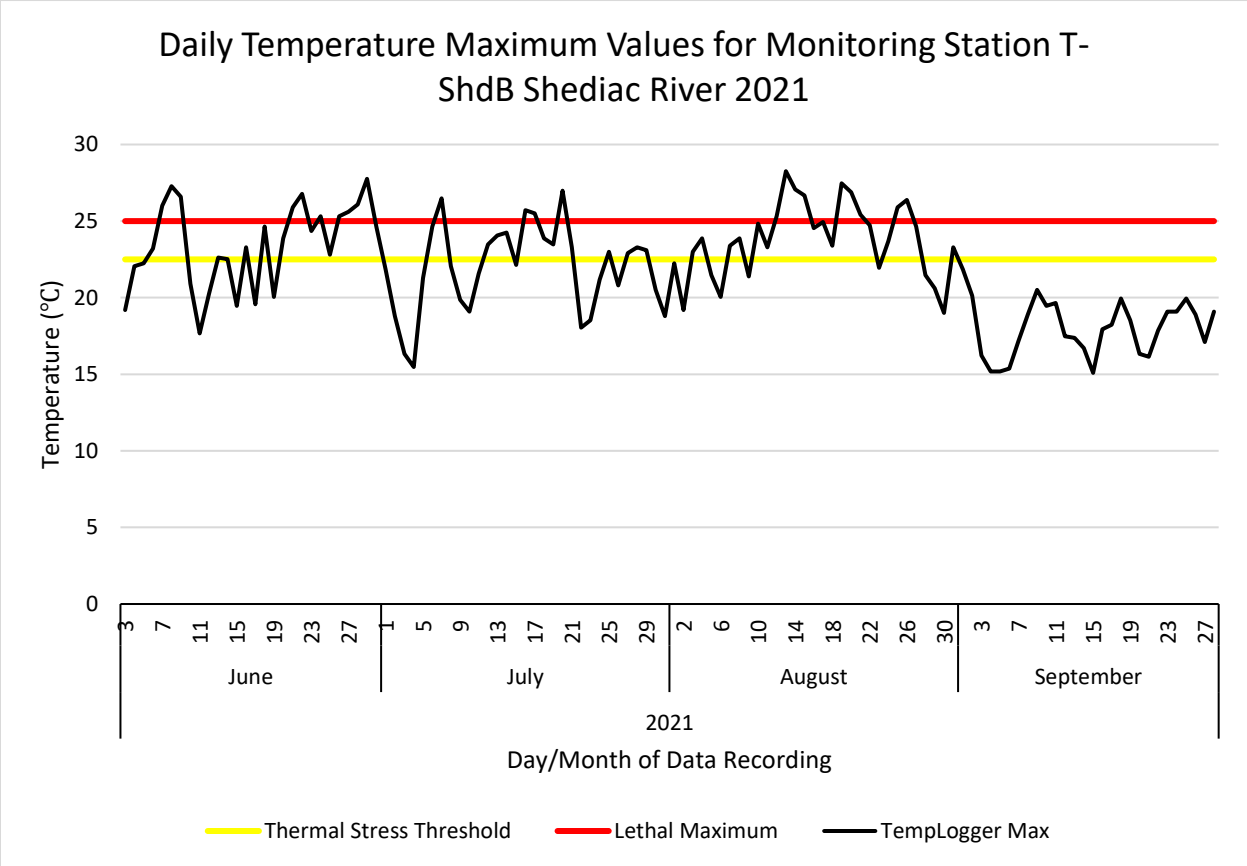


Figure 52: Thermograph data chart for monitoring station ID T-ShdB, McQuade Brook 2021

4.1.2 T-ShdE Monitoring Site

This temperature logger is located in the mid to lower reaches of the main branch of the Shediac River, 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 shows the maximum daily temperature between June 3rd and September 28th. The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 27 occasions during the peak of the summer months. During these 27 days, the maximum temperatures exceeded the lethal limit (25°C) on 5 occasions. Temperatures reached the thermal stress levels for 6 consecutive days, from August 12 to August 17 (Figure 53).

The highest maximum temperature recorded at this station was 26.0°C, on August 14. The highest average daily temperature was 23.4°C.

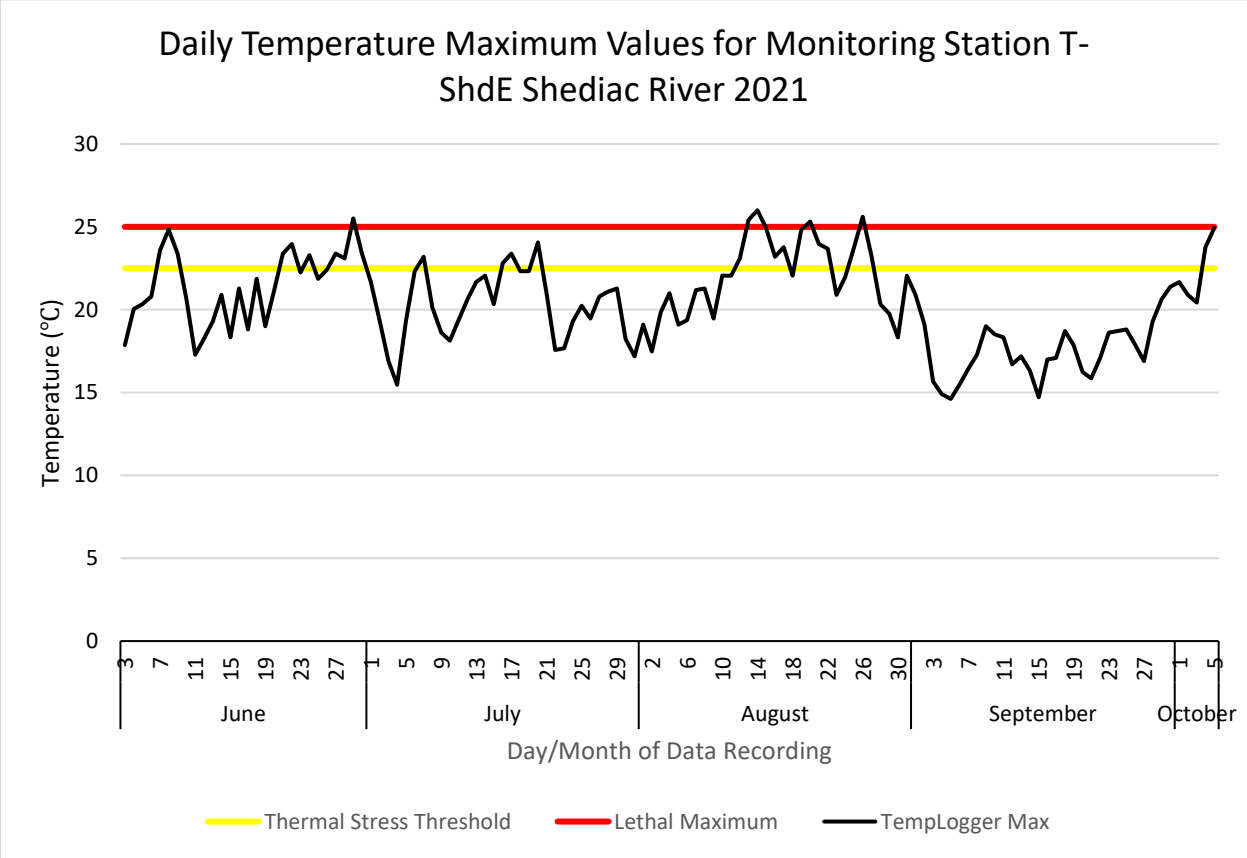


Figure 53: Thermograph data chart for monitoring station ID T-ShdE, Shediac River 2021

4.1.3 T-ShdM Monitoring Site

This temperature logger was installed in the Weisner Brook, a tributary of the Shediac River. This logger was predicted to show cooler temperatures, as the brook is recognized as a summer resting area for mature brook trout by the Department of Natural Resources and Energy Development, due to its colder characteristics. This stream has an excellent tree coverage; undeveloped forested lands along the majority of the brook. It also has a lot of input of cold water from natural underground springs. These conditions of shade from the forest and cold-water springs are great to keep the water temperatures cool.

The thermograph shows the maximum daily temperature between June 3rd and October 5th. The maximum temperatures did not exceed thermal stress threshold (22.5°C) or the lethal limit (25°C). The highest maximum temperature recorded at this station was 21.9°C, on October 4th (Figure 54).

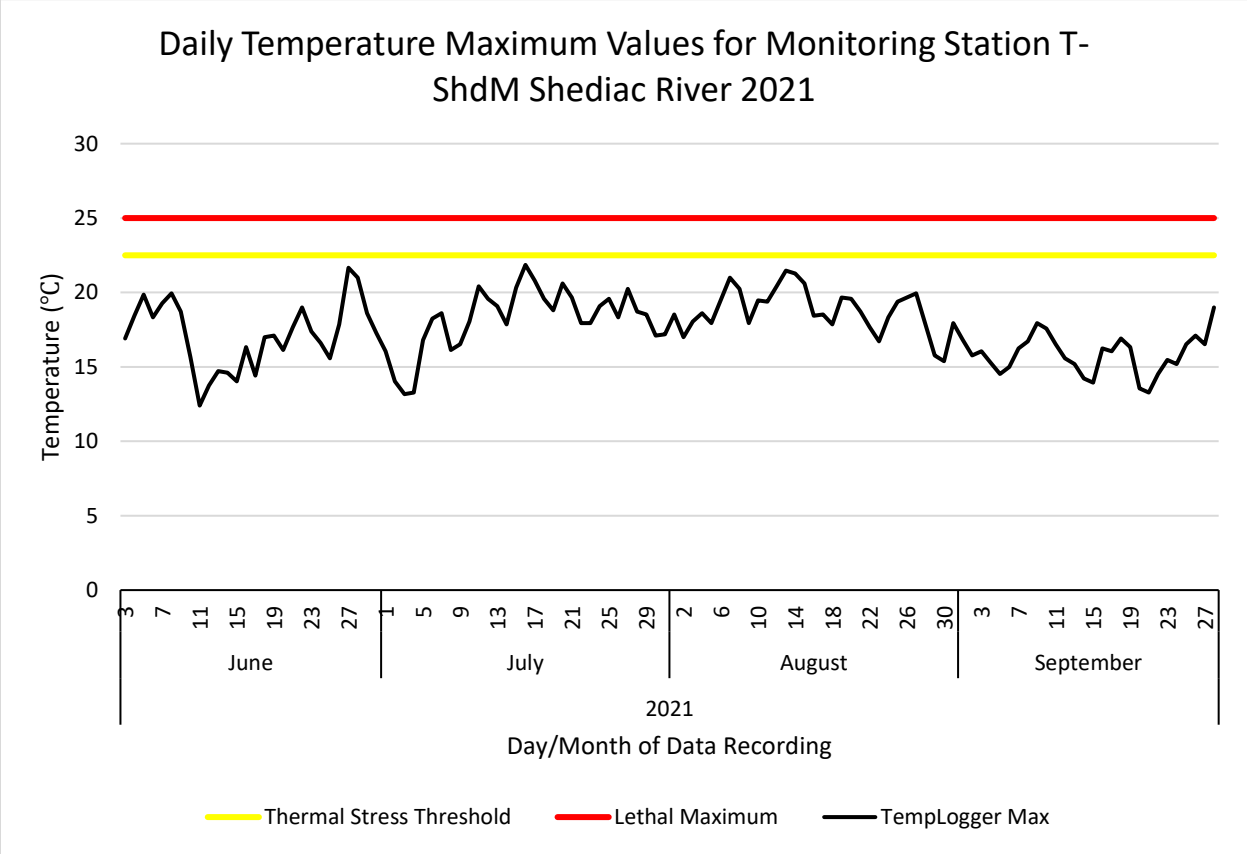


Figure 54: Thermograph data chart for monitoring station ID T-ShdM, Weisner Brook 2021

4.2 Temperature monitoring Scoudouc River

Two sites are monitored for water temperature in the Scoudouc River. The temperature loggers for both Scoudouc river monitoring sites were lost. There is no temperature data to be reported for the Scoudouc river in 2021 (Figure 55).

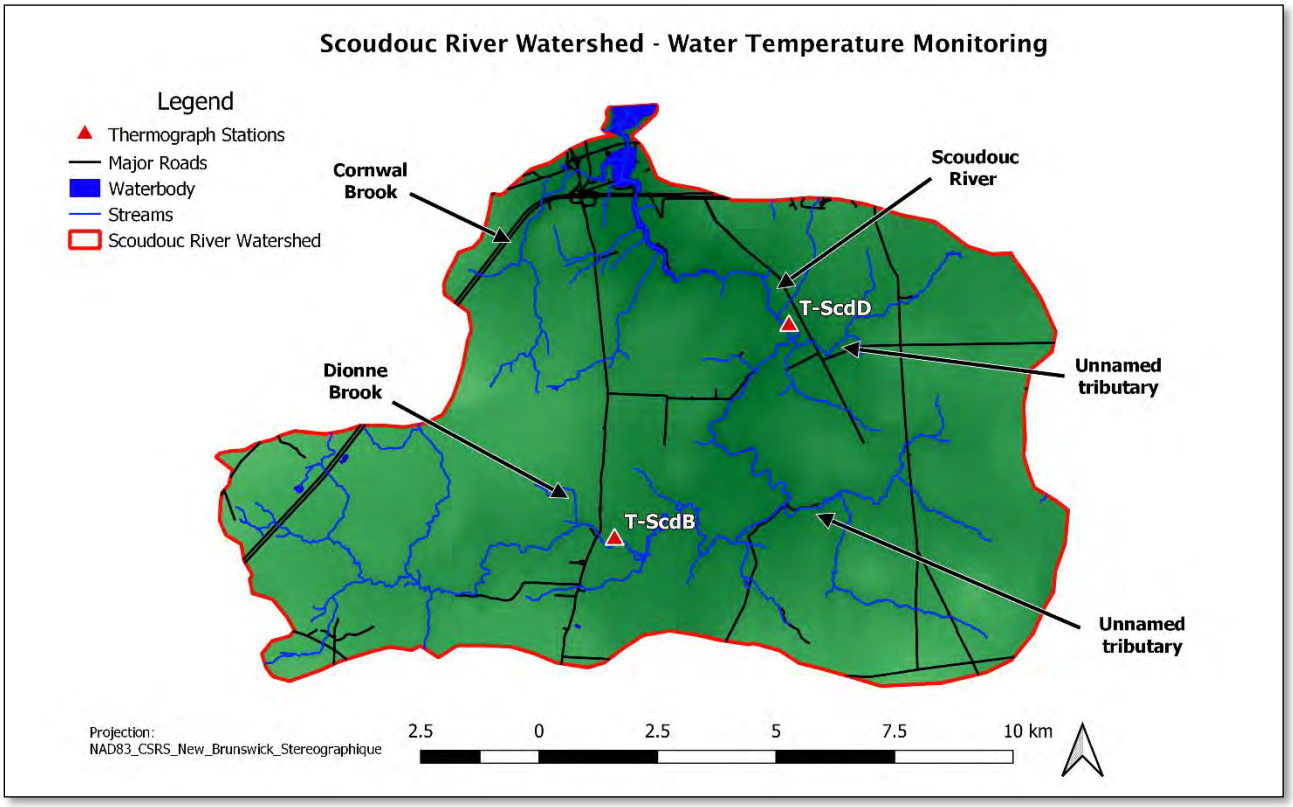


Figure 55: Map of temperature logger placement in the Scoudouc River

5. 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. All water quality data recorded by SBWA is uploaded to an open access platform called *Atlantic DataStream.* This platform allows the sharing of water quality datasets.

In partnership with the Atlantic Water Network (AWN), the SBWA will begin developing a water quality monitoring plan. This plan will help standardize water quality sampling by offering summer students and new employees a comprehensive document detailing the following:

- Program design considerations
- Type of monitoring programs
- Monitoring location and sites
- Monitoring parameters
- Sampling frequency and duration
- Data use and management
- Quality assurance, quality control, and safety

5.1 Water Quality Monitoring in the Shediac and Scoudouc River

The bacterial analysis of these 10 water quality monitoring sites in 2021 has demonstrated some higher levels of diffused sources of bacterial contamination in certain areas. The results for the Shediac River this year showed only one instance of elevated E. coli concentrations. The Scoudouc River exceeded the recommended *E. coli* guideline more frequently compared to the Shediac River sites. Every Scoudouc river site had at least one instance of exceeding the Canadian Recreational Water Quality Guideline.

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

Looking at the averages of total phosphorous levels (TP-L), most sites in the Shediac River fall within the mesotrophic (0.010 – 0.020 mg/L) to meso-eutrophic range (0.020 – 0.035 mg/L). For the Scoudouc River and its tributaries, most sites fall within the meso-eutrophic range (0.020 – 0.035 mg/L) to eutrophic range (0.035 – 0.100 mg/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.

5.2 Water Quality Monitoring in Small Streams of the Shediac Bay

The bacterial analysis of these 11-water quality monitoring sites in 2021 has demonstrated high levels of diffused sources of bacterial contamination.

All pH levels were found to be within the guidelines; between 6.5 and 9. Dissolved oxygen recorded were mostly with the guidelines except two instances for site WQ-11D and one occasion for site WQ-10.

The average total phosphorous for the Shediac and Scoudouc river sites fell into four different categories; Mesotrophic (0.010 – 0.020 mg/L), Meso-eutrophic (0.020 – 0.035 mg/L), Eutrophic (0.035 - 0.100 mg/L), and Hyper-eutrophic (>0.100 mg/L). These categories are derived from the CCME recommended guidelines for the protection of aquatic wildlife (freshwater) (Table 74).

The site WQ-8 had elevated levels of total phosphorous levels in 4 out of the 6 samples in 2021. Similar to the Shediac and Scoudouc river sites, the small streams sites had elevated iron and aluminium.

5.3 Water Temperature Monitoring

There are two levels of temperature that are evaluated for the protection of cold-water fish species: thermal stress (22.5°C) and lethal limits (25°C). When water temperatures attain these levels, fish such as salmonids, can be forced to migrate in search of colder water sources, such as deep-shaded pools and natural cold springs. The longer these temperatures remain, the higher the risk of fish mortality. Water temperature monitoring using pendant loggers is a widely used tool to monitor

temperature fluctuations in watersheds. The goal is to identify hot spots and cold zones suitable for thermal refuge in periods of thermal stress among fish. The data is used to measure changes over time, due to the impacts of human activities and development, as well as climate change. This year, over half of the data loggers were either lost or not retrieved

Located in the McQuade Brook, the T-ShdB site had the highest recorded temperature with 28.2°C. The logger recorded thermal stress levels on 56 occasions and lethal limits on 23 occasions, of which there was 13 consecutive days with temperatures exceeding 22.5°C.

The T-ShdE site was the second-warmest site in 2021; the highest temperature reading was 26°C, and thermal stress levels were reached 27 times. The lethal limits were exceeded 5 times.

The Weisner Brook (T-ShdB) had the coldest recorded temperature. The logger did not record a temperature above the thermal stress limit of 22.5ºC. Its average temperature across the monitoring period was 20.8ºC.

Our summers our becoming increasingly hot and dry. Longer periods without rainfall combined with extreme heats can cause water levels to drop and become warmer than is safe for cold-water loving species. Water temperatures will continue to be monitored to measure the impacts of our ever-changing climate.

6. ENVIRONMENTAL RESTORATION

6.1 Buffer zone reforestation

The reforestation of buffer zones around streams and wetlands is a priority for the SBWA. The riparian buffer zone is a natural, permanent strip of vegetation bordering a watercourse. Composed of a mixture of wildflowers, grasses, shrubs and trees native to the area, it is a transition zone between aquatic and terrestrial environments. Healthy riparian buffer zones filter pollutants before they can enter watercourses. Improving riparian zones also benefits the fish and insects that live in them.

Another area of focus for reforestation is where bank erosion occurs. This 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. The SBWA mostly uses vegetation and bioengineering techniques to stabilize banks (Figure 56).

In 2021, three sites were selected for buffer zone enhancements. Work continued at the existing restoration site along the Scoudouc River known as Edna's Pond. The second site is a cattle farm located of the Scoudouc River. The third restoration site was at a stream with an inadequate buffer zone within the municipality of Shediac.

Figure 56: Native tree planting for riparian restoration is a technique used by the SBWA

6.1.1 SBWA Restoration Nursery

To help the Association save cost and provide a variety of tree and shrub species community native tree nurseries were implemented in 2017. In 2020, significant work was undertaken to improve the nursery. In the spring, trees were relocated from three existing tree nurseries located at the MFB School, the Grande-Digue School and at the Shediac community garden to a newly built tree nursery in the Shediac Cape community garden. Having all the trees in one location will be easier to maintain.

A total of 8 raised beds (4 m x 1.5 m x 0.5 m) were made using rough hemlock lumber (Figure 57). The boxes were filled halfway with different sizes of logs and branches mixed with leaves and other organic materials. The remainder was filled with compost. This technique is known as "hügelkultur" and it creates a natural decomposition process that can keep fertilizing the raised beds for years to come.

By maintaining a tree nursery for the Association, a steady supply of native trees is now available for various tree planting projects. The Association can grow species of native trees that are sometimes not available at local commercial nurseries. Also, CO2 emissions are diminished by reducing travelling to various tree nurseries. Finally, perhaps as important as habitat restoration, is the education possibilities that the tree nurseries provide for the community. Presentations and voluntary work are often taking place at the nursery, involving school students and the overall community. An educational sign has been placed at the nursery boxes so that patrons of the community garden understand how these trees will be used to restore riparian buffer zones.

In 2021, a total of 43 trees from the nursery were planted this includes the following; 15 Spruce, 15 White pine (*Pinus strobus*), 6 Maples (*Acer spp.),* 5 Oaks (*Quercus rubra*), and 2 Mountain ash (*Sorbus aucuparia*).

Figure 57: Map of the SBWA tree nursery

6.2 Edna's Pond Restoration Site

Every year, SBWA continues to maintain our habitat restoration site on the Scoudouc River, at the area known as Edna`s pond. This site is an important Atlantic salmon habitat for the Shediac Bay watershed. Assuring that enough trees will take at this location is crucial for the stabilization of the banks and runoff control to minimize sedimentation in the salmon pool.

The five sediment deflectors in the area require constant maintenance every year. They capture sediments from runoff which causes a sediment buildup on the logs. In the summer of 2021, the sediment traps were cleaned manually with shovels so that they can continue to work efficiently.

We have been in contact with a local ATV club who've received funding to build a new bridge to cross the Scoudouc River. This partnership will help to eliminate in-stream crossing at Edna's pond, and redirect off-road traffic towards the new crossing. The bridge is scheduled for construction in 2022-2023.

Students from Polyvalent Louis-J.-Robichaud visited the restoration site during the Adopt-a-River field trip. They were taught about the importance of buffer zone restoration, sediment control, and the impacts of in-stream crossing by off-road vehicles.

Figure 58: Map of the tree planting area of Edna`s pond in the Scoudouc River

6.3 Farm Restoration

In 2019, an agricultural restoration site was identified on the Scoudouc River. Located on the property of a local dairy farmer, an unnamed brook was selected for restoration due to the lack of vegetated buffer zones and the lack of cattle fencing along most of the brook. The Unnamed brook has been sampled through the investigative sampling program, and demonstrated high levels of nutrient and bacterial loading. There is also significant erosion of the stream banks due to the lack of large root systems. In 2021, the land owner gave permissions to the SBWA to implement its stream bank restoration project.

6.3.1 Stream Assessment

A stream survey was conducted by the SBWA environmental technicians on November 17, 2021. The Survey commenced on the east side of highway 132 in Scoudouc, where the fenced-in cattle pasture starts. The survey had 14 point where photographs of each site were taken using a GoPro (Figure 59). The substrate was identified, and other notable observations were made on erosion pattern and other stream features. The most apparent issue with this stream is the severe erosion on the banks mainly due to heavy cattle use and lack of trees or shrubs (Table 77) (Appendix B).

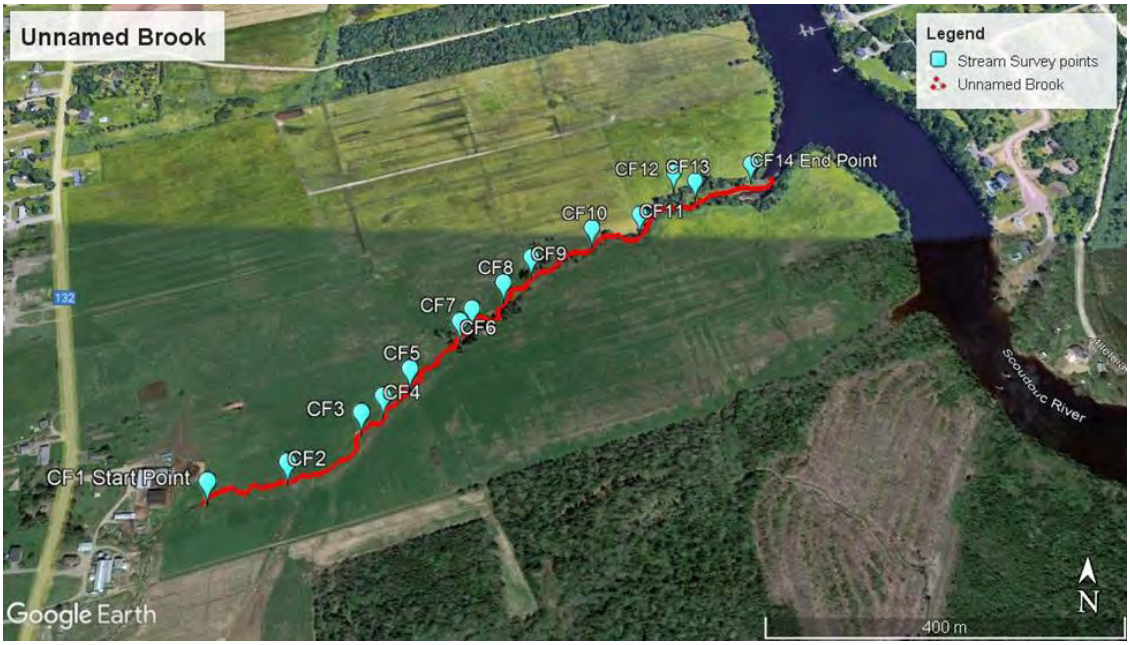


Figure 59: Stream Survey Points on Unnamed Brook in Scoudouc, NB 2021.

Table 77: 2021 Unnamed Brook Stream Survey

Site ID	Position	Survey Photos	Substrate	Observations and comments
CF1	N46° 11.909' W64° 33.685'	GoPro9166	Gravel, Sand	Start point, Cattle crossing,
CF2	N46° 11.923' W64° 33.614'	GoPro9168	Gravel, Fines	Connecting brook, Field, No trees
CF3	N46° 11.958' W64° 33.551'	GoPro9169	Silt, Fines	Severe erosion, Field, No trees
CF4	N46° 11.970' W64° 33.532'	GoPro9170	Silt, Fines, Rock	Severe erosion, Cattle crossing
CF5	N46° 11.990' W64° 33.509'	GoPro9171	Silt, Fines, Rock	Severe erosion, Cattle crossing
CF6	N46° 12.026' W64° 33.464'	GoPro9172	Silt, Rock	Severe erosion, Cattle crossing, Trees >10m
CF7	N46° 12.036' W64° 33.453'	GoPro9173	Rock	Severe erosion, Undercut bank, Trees
CF8	N46° 12.057' W64° 33.423'	GoPro9175	Rock, Gravel	Severe erosion, WQ site, Cattle crossing
CF9	N46° 12.078' W64° 33.396'	GoPro9177	N/A	Severe erosion, Undercut bank, Bridge, Some trees
CF10	N46° 12.103' W64° 33.334'	GoPro9178	Rock	Severe erosion, Undercut bank, Less trees
CF11	N46° 12.116' W64° 33.284'	GoPro9179	Rock, Fines	Severe erosion, Trees, Cattle crossing, Bufferzone starts 10m on each side
CF12	N46° 12.153' W64° 33.247'	GoPro9181	Rock, Gravel	Severe erosion, Bufferzone, Connecting brook,
CF13	N46° 12.147' W64° 33.224'	GoPro9182	Silt	Mild erosion, Tidal area starts?, Pond overflow, Water was frozen over
CF14	N46° 12.163' W64° 33.163'	GoPro9185	Silt	Natural erosion, Connects to Scoudouc River, Still frozen

6.3.2 Stream Restoration

On October 27, 2021, the SBWA started the restoration project on the unnamed brook by planting a total of 334 trees. The trees planted were mostly spruce with a few trees from other species including birch, pine, willow, maple, oak, and others. Cows being naturally curious plucked some of the trees out of the ground without harming them. They were able to be replanted in hopes that they will established a strong root system to deter the cattle from pulling them out. The trees were planted around two meters away from the brook to eventually eliminate some of the cattle crossing points (Figure 60). The trees will also naturally stabilize the bank as well as provide shade to keep the water cool as it flows to Scoudouc River.

6.4 Cornwall Brook Restoration site

During the major road construction of a traffic circle and modification of the highway in 2018, a section of the Cornwall Brook was modified and left with no buffer zone. Downstream from the newly installed road containing a concrete double culvert is the location of this site's habitat restoration by buffer zone implementation. A line of native trees was planted on both sides of the stream in 2020 to increase the protection of the stream banks from erosion (Figure 61). The planting of native tree species was continued in 2021 by the SBWA.

In 2020, a total of 60 native trees were planted along the section of Cornwall Brook that was modified due to road construction. The trees had relative success establishing themselves with some species faring better than others. The spruce (*Picea spp.*) was the most successful. Mostly dead and dried up, the hardwoods did not take well to the banks of the brook.

In 2021, the habitat restoration took place on October 7th and the following trees were planted: 15 Spruce, 15 White pine (*Pinus strobus*), 6 Maples (*Acer spp.*), 5 Oaks (*Quercus rubra*), and 2 Mountain ash (*Sorbus aucuparia*). The planting of willows was abandoned due to the presence of beavers. Beavers are knowns to prefer willow, poplar, and birch.

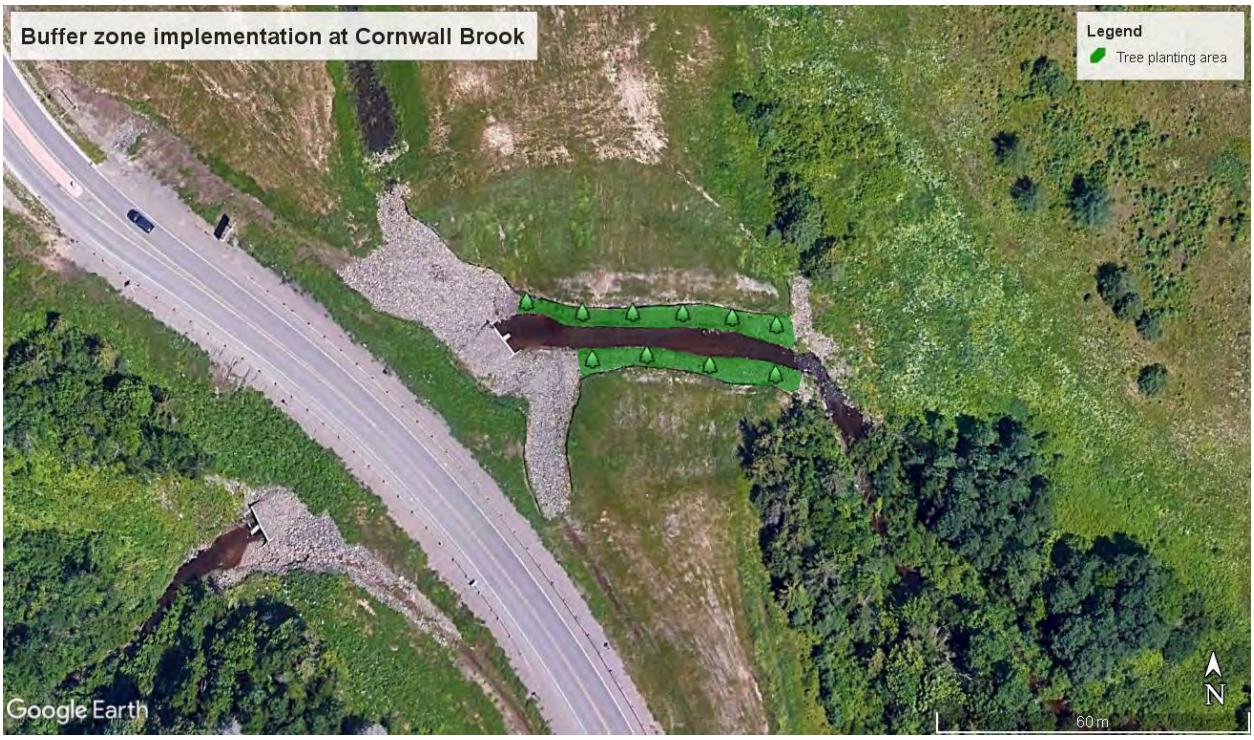


Figure 60: Map of the tree planting location at Cornwall Brook

7. EDUCATION

7.1 Adopt a River

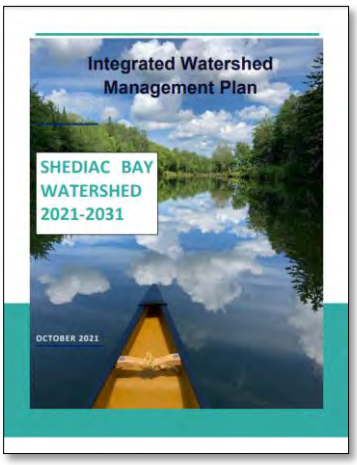
In the 2021 fiscal year, SBWA continued with presentations to LJR school for the annual Adopt-A-River program. On May 28th, an in-person presentation was done to both 10th grade biology classes about biomonitoring using macroinvertebrates. In June, the classed went to the Scoudouc River (Edna's pond) to do the macroinvertebrate sampling and to collect other habitat measurements and observations.

Following the field trip, another in-class activity was done so that the students could identify the macroinvertebrates found in their samples using a dichotomous key. The activity was followed by a second presentation to go through their results, and evaluate the ecosystem quality using the macroinvertebrate species sensitivity

Figure 61: LJR students collecting macroinvertebrate samples at the Scoudouc River

Figure 62: LJR students identifying macroinvertebrate samples

8. WATERSHED MANAGEMENT COMMITTEE



In 2019, a working group was formed by the Department of Environment and Local Government of New Brunswick to develop a watershed management plan for the Shediac Bay watershed. The Working Group met regularly between November 2019 and July 2021 and in total, three rounds of engagement took place in October 2019, August 2020 and February 2021. Engagement with First Nations has been on-going since the beginning of the project. The plan was finally published in both official languages on October 22, 2021.

The main purpose of the Shediac Bay Watershed Management Plan (WMP) is to address water quality issues in the watershed namely, anthropogenic or human sources of nutrients and bacteria. This will in turn, help protect and improve water quality at Parlee Beach.

The Shediac Bay WMP is not regulatory in nature. The use of a partnership-based approach will therefore be critical for the successful implementation of the plan as it will encourage local ownership and participation. Therefore, the plan will apply an "Adaptive Management Approach, through the creation of an implementation committee.
With the help of the DELG, recruitment of representatives from various governmental agencies (municipal, provincial and federal), from First Nations groups, from stakeholder and from the general public took place in November and December. The first meeting was held virtually on January 31st, 2022. The second meeting will take place on March 23rd.

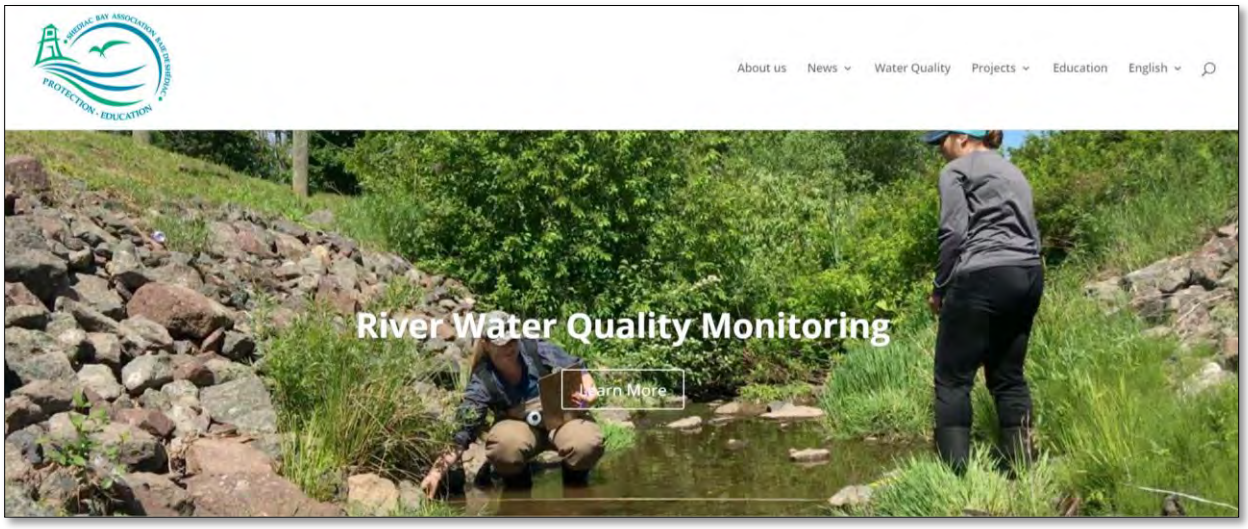
9. MEDIA OUTREACH

9.1 Newsletter

During the 2021-2022 fiscal year, 3 bilingual newsletters were produced. Two have been released and the third will be published in early March. The newsletters display information and photos on the various projects that the SBWA has been doing in the year. The newsletter is now distributed electronically by email list and is available on our website and Facebook page.

9.2 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.



www.shediacbayassociation.org

www.facebook.com/#!/shediacbaywatershedassociation

https://www.instagram.com/bvshediacwatershed/?hl=en

https://www.youtube.com/channel/UCT1bsN08OyOeIzqqwn9ZhlQ

10. CLOSING COMMENTS

The Shediac Bay Watershed Association had a successful year in 2021, thanks to the support of the NB Environmental Trust Fund. Although some activities were affected by the COVID-19 pandemic, the majority of activities could be accomplished while following the guidelines of the department of health. An additionnal challenge was the transition to a new manager during the summer months. Even with the challenges, the SBWA was able to meet the great majority of it's deliverables.

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 implementation of the watershed management plan for the Shediac Bay watershed. Recommendations and action items from the WMP will help guide future activities of the Association.

Partnerships are essential for environmental groups to accomplish their work. The Association has built strong 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 the Shediac Bay. The next step for the Association is to work more closely with the agricultural sector in our territory.

The Shediac Bay Watershed Association will continue to monitor water quality in the Shediac and Scoudouc rivers and implement environmental improvement initiatives in the years to come thanks to the support or the NB Environmental Trust Fund.

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APPENDIX A - WATER CHEMISTRY METHODOLOGY

Table 78: 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 79: 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 – FARM RESTORATION

Figure 63: GoPro9166-StartPoint-CF1

Figure 64: GoPro9168-CF2

Figure 65: GoPro9169-CF3

Figure 66: GoPro9170-CF4

Figure 67: GoPro9171-CF5

Figure 68: GoPro9172-CF6

Figure 69: GoPro9173-CF7

Figure 70: GoPro9175-CF8

Figure 71: GoPro9177-CF9

Figure 72: GoPro9178-CF10

Figure 73: GoPro9179-CF11

Figure 74: GoPro9181-CF12

Figure 76: GoPro9182-CF13

Figure 76: GoPro9185-EndPoint-CF14