Environmental Evaluation of the Health of the Shediac Bay

Final Report

New Nouveau Brunswick
Your Environmental Trust Fund at Work
Votre Fonds en fiducie pour l'environnement au travail

The Shediac Bay Watershed Association Inc.

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1 Introduction

The Shediac Bay Watershed Association (SBWA) was founded in 1999 as a result of growing concerns from local community residents over the ecological health of Shediac Bay. In order to establish a long-term water quality-monitoring program, a community-based association was formed. To address growing concerns on water quality in the Shediac Bay, a new program was initiated in 2016 to assess water contamination sources and the quality of coastal habitats.

The Association has been monitoring water quality in the Shediac River and Scoudouc River watersheds since 1999. The freshwater sampling program has been ongoing at the same monitoring stations that were established for the purpose of the development of the NB Water Classification Legislation. Since the beginning of the monitoring program the focus was on freshwater samplings. Only in recent years with the Shediac Bay evaluation program has funding been acquired to collect water quality data in the saltwater ecosystems of the watershed.

During 2015, the SBWA began monitoring E.coli in Shediac Bay with 7 sampling sites along the coastline of Pointe-du-Chêne, around the mouth of the Scoudouc River and the outer edges of the Shediac River estuary. The sampling continued in 2016 with the addition of 3 new sites. The water sampling was done for *E. coli*, and was done only once a month (from May to August) due to limited capacity. Although the quantity and frequency of these samplings are insufficient to collect the amount of data needed for a complete assessment, it did provide information on where to concentrate our next efforts.

In 2016, a study was done using Environmental DNA to assess the *source* of the *E. coli* bacteria that causes water contamination and beach closures. Since E.coli is present in the lower intestines of humans and warm-blooded animals, the source of fecal contamination can be traced back to the species of which it came from by analyzing the DNA of the bacteria. The results are available online in the archives of the SBWA. This information was used to help prioritize sites for restoration and actions to help reduce bacterial contamination.

Also in 2016, a partnership was formed with the *Southern Gulf of Saint Lawrence Coalition on Sustainability* to begin the assessment of the eelgrass habitats in the Shediac Bay. The first study site, and monitoring transect, was established in the Scoudouc River estuary, and the second was done in the Shediac River estuary in 2017. In 2018, a new monitoring transect was established near Pointe-du-Chêne, at the mouth of the South Cove estuary. These transect are monitored once per year using the SeagrassNet protocol, to measure changes in density of the eelgrass beds due to the threat of the invasive green crab. A final site will be installed in Grande-Digue in 2019 to measure different areas in the bay.

Turning the attention toward coastal habitats, a "Marsh Monitoring Program" from Bird Studies Canada began in 2015 to evaluate wetlands for their health and habitat quality for various bird populations. In 2016, staff received training to perform wetland evaluations under the WESP-AC (*Wetland Ecosystem Services Protocol for Atlantic Canada*) evaluation program. The WESP-AC was designed to provide an assessment of the health of both freshwater and saltwater marshes, as well as their ecosystem benefits, functions and services. Two salt marshes were chosen for monitoring in 2018.

As always, public education is always an integral part of all SBWA projects. The SBWA continued work with the Shediac Bay Yatch club to promote best practices for boaters. The Yatch club is in the process of applying for a blue flag certification in 2019. This certification will promote more partnerships with the marina and the SBWA for educational programs.

The SBWA also has a number of public education materials such as a series of interpretation panels installed on walking trails and other green spaces around Shediac. The Association also does a variety of presentations for schools and the public.

1.1 Overview of the Shediac Bay Watershed

The Shediac Bay Watershed covers 420 km^2 of land area and stretches along 36 km of coastline, from Cap Bimet to Cap de Cocagne (Fig. 1). The Shediac Bay Watershed is composed of two major river systems emptying into Shediac Bay: the Shediac River and the Scoudouc River. The Shediac and the Scoudouc Rivers are characterized by small tributaries covering watersheds of 201.8 Km2 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 water arm of the Shediac River is the continuation of the Batemans Brook.

Figure 1: Map of Shediac Bay watershed boundaries

2 Water Quality Sampling in Shediac Bay

The SBWA has expanded the water quality sampling program to evaluate the smaller tributaries of the Shediac Bay. These small brooks had never been assessed for water contaminants or evaluated for surrounding land uses and buffer zones. Due to the rise of concern for the health of the Shediac Bay, 11 new sites were added along the coastline from Boudreau-Ouest to Grande-Digue in 2017, to assess possible bacterial and contamination sources. All samples are analyzed by RPC Laboratory, and all sample results are sent to the *Department of Environment and Local Government*.

The purpose of the samples taken by the SBWA is to determine priority areas where the association can implement restoration programs such as tree planting along riparian zones. The data is not used to determine the safety of the recreational uses of the bay, such as swimming advisories.

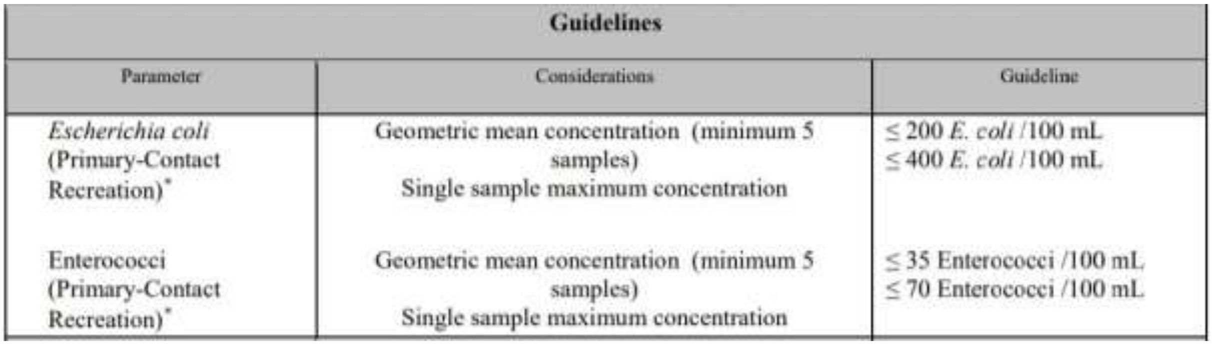
There are many different guideline criteria for determining water quality. For example, Health Canada recommended microbiological guideline values for recreational water quality. The values are based on the presence of fecal indicator bacteria, namely, *Enterococci* for marine water, and *Escherichia coli* for freshwater.

In marine water, the guideline value is set at a geometric mean of 35 enterococci/100 mL when a minimum of 5 samples are collected (average bacterial concentrations of the 5 bottles must be below 35 MPN/100 mL), and the value of a single sample must be below 70 enterococci/100 mL.

In freshwater, the guideline value is set at a geometric mean of 200 *E. coli* /100 mL when a minimum of 5 samples are collected (average bacterial concentrations of the 5 bottles must be below 200 MPN/100 mL), and the value of a single sample must be below 400 *E. coli* /100 mL.

For this project, all samples collected are single samples and are analyzed for *E. coli*, since the small tributaries are freshwater (however, 2 sites are impacted by rising tides, but *E. coli* can still be used for brackish water). All bacterial data in this report is flagged when levels exceed 400 MPN/100 mL.

Table 1: Guidelines for Health Canada Recreational Water Quality: summary table



Guidelines		
Parameter	Considerations	Guideline
Escherichia coli (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples) Single sample maximum concentration	≤ 200 *E. coli* /100 mL ≤ 400 *E. coli* /100 mL
Enterococci (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples) Single sample maximum concentration	≤ 35 Enterococci /100 mL ≤ 70 Enterococci /100 mL

3 Methodology

3.1 Water Quality Sampling

Water quality monitoring was conducted once a month from June to September 2018, at 11 new sampling sites in small tributaries along the coast of the Shediac Bay. Water quality sampling was performed using the protocol developed by the New Brunswick Department of Environment. Water samples were not collected after heavy rainfall events.

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

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

3.2 Site Information - Small Tributaries of the Shediac Bay

The following describes the sample site information for the 11 small stream water quality monitoring stations.

Table 2: Water Quality Monitoring – Small Streams Site Information

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 is before on your left of Chemin des Sœurs, Grande-Digue, (sample from upstream of culvert)

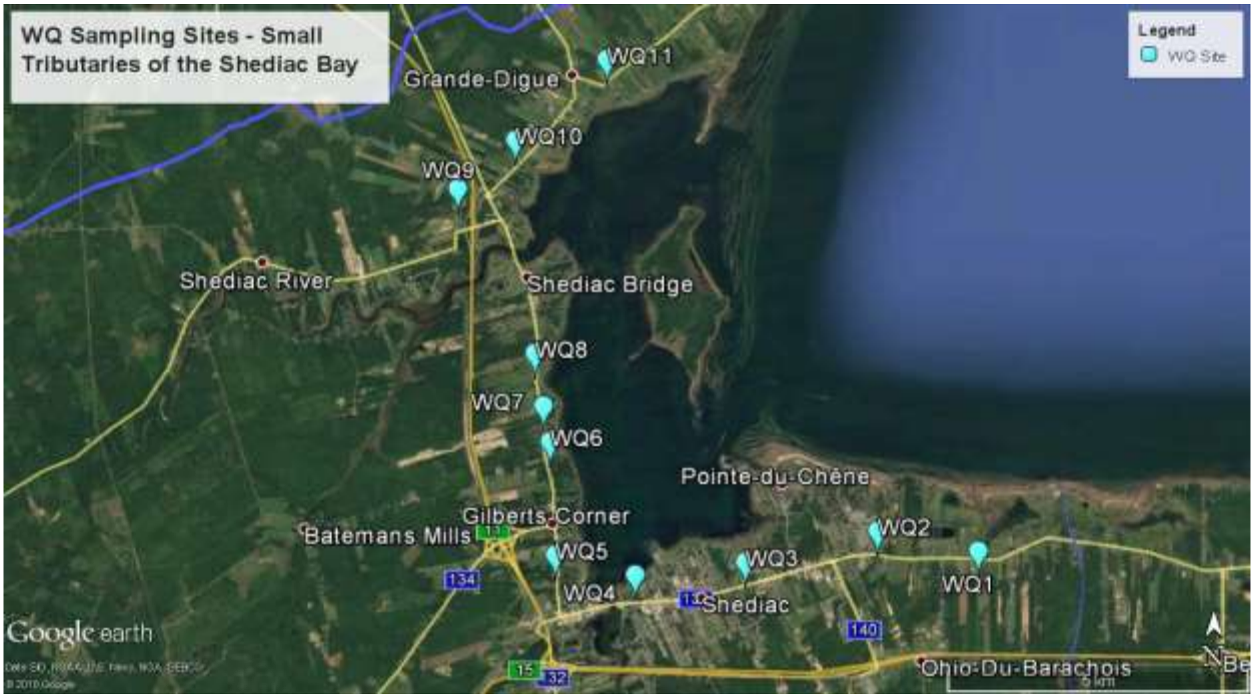


Figure 2: Water Quality Sampling Sites - Small Streams

3.3 Water Quality Parameters

3.3.1 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.

3.3.2 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.

3.3.3 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.

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

3.3.5 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 13 mg/l (NO3).

3.3.6 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.

3.3.7 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 is set at 400 MPN/100 ml.

3.3.8 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).

3.3.9 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).

3.3.10 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.

3.3.11 Chloride

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

3.3.12 Boron

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

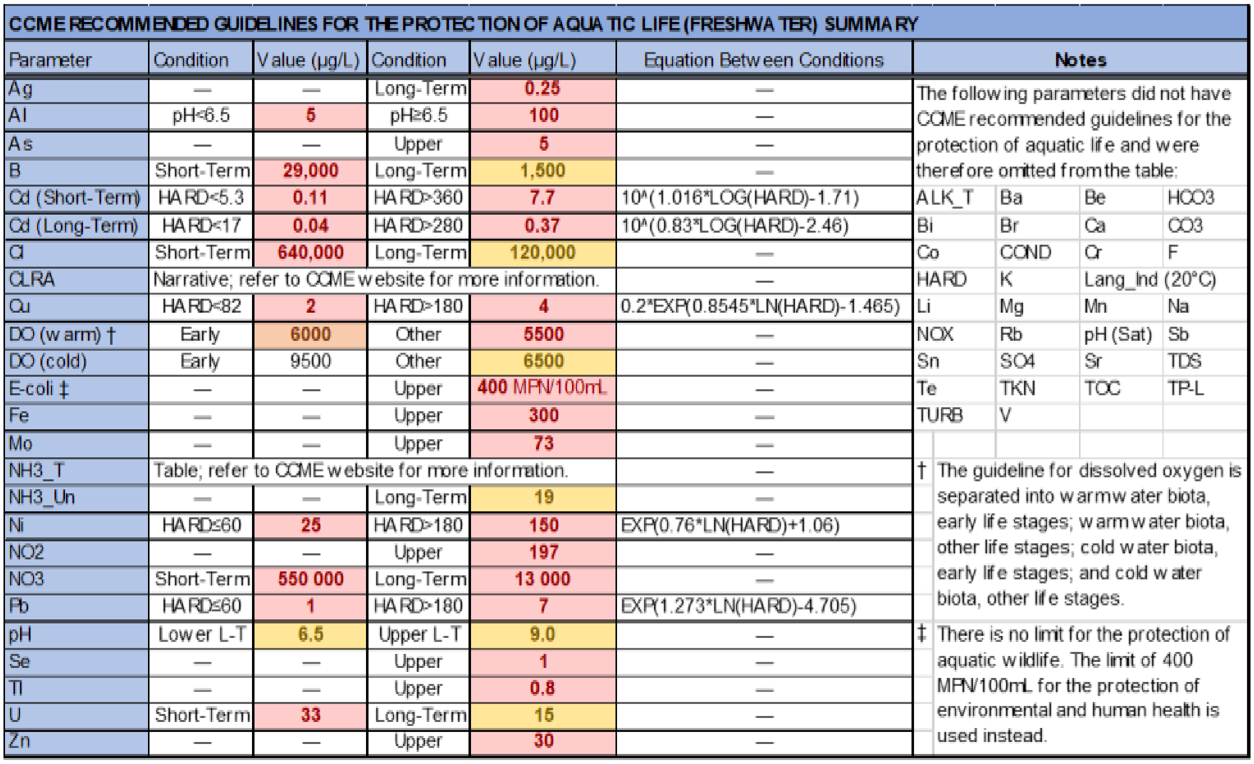
3.3.13 Ammonia

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

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

3.4 CCME - Canadian Environmental Quality Guidelines (CEQGs)

Table 3: Summary of the CCME Canadian Environmental Quality Guidelines



CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY

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

Notes

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

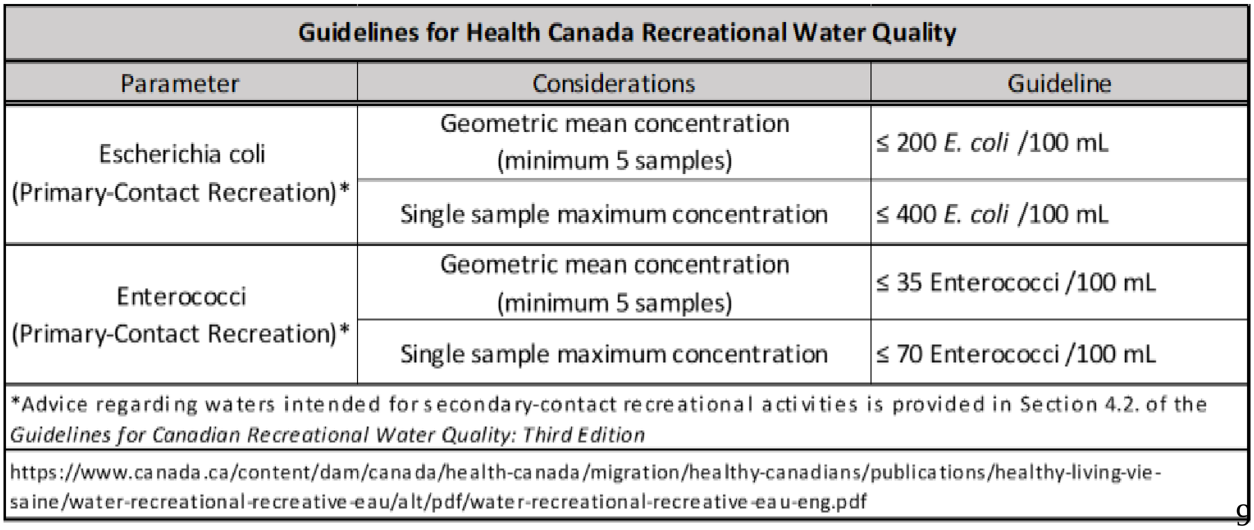
ALK_T	Ba	Be	HCO3
Bi	Br	Ca	CO3
Co	COND	Cr	F
HARD	K	Lang_Ind (20°C)	
Li	Mg	Mn	Na
NOX	Rb	pH (Sat)	Sb
Sn	SO4	Sr	TDS
Te	TKN	TOC	TP-L
TURB	V		

† The guideline for dissolved oxygen is separated into warmwater biota, early life stages; warmwater 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.

3.5 Health Canada - Guidelines for Canadian Recreational Water Quality

Table 4: Guidelines for Health Canada Recreational Water Quality: Summary Table



Guidelines for Health Canada Recreational Water Quality

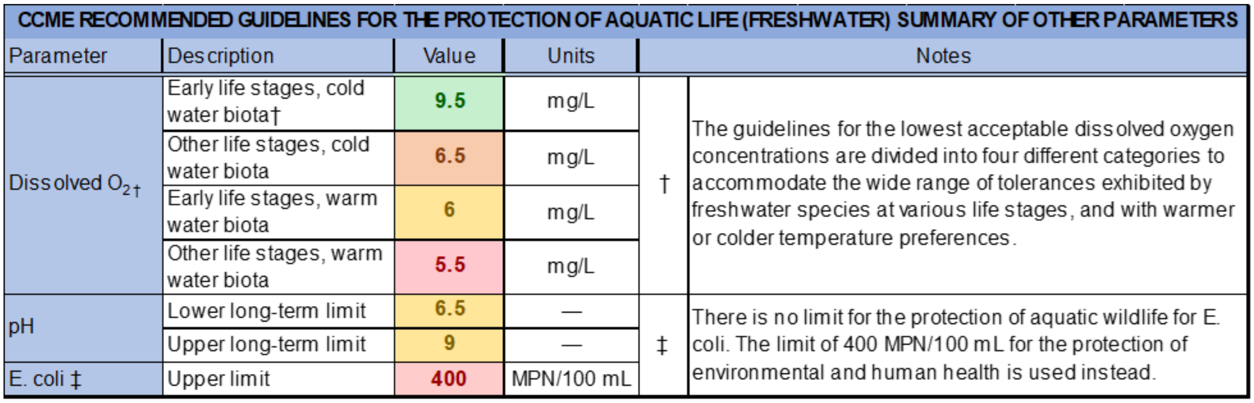
Parameter	Considerations	Guideline
Escherichia coli (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples)	≤ 200 *E. coli* /100 mL
	Single sample maximum concentration	≤ 400 *E. coli* /100 mL
Enterococci (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples)	≤ 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

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

Table 5: CCME Recommendation Guidelines for the Protection of Aquatic Life (Freshwater)

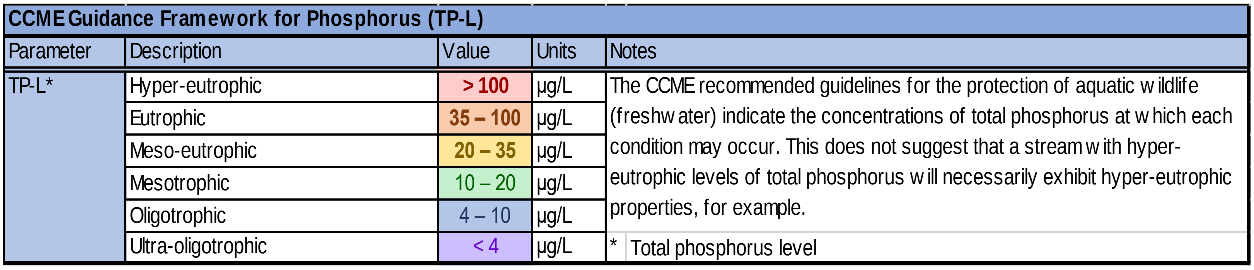


CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY OF OTHER PARAMETERS

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		

3.7 CCME Guidance framework for Phosphorus

Table 6: CCME Guidance framework for Phosphorus



CCME Guidance Framework for Phosphorus (TP-L)

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

3.7.1 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 7: 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 8: Terms and definitions for nutrients data tables

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

Table 9: Terms and definitions for inorganic 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

4 Sampling Results

The following section will describe the water quality data collected at the 11 small streams sampling sites for the 2018 field season. 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.

4.1 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. 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 zones dividing the stream and the farm fields (± 10 hectares, 2 hectares, 1.3 hectares) 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.

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 treated wastewater from the lagoons is discharged further out into the bay, but there is a possibility that contaminants may come into this estuary during incoming tides or storm surges. The water quality station is located higher than the highest tidal zone.

The water sampling results for the site WQ-1, for 2018, meet the recommendations for the survival of freshwater aquatic life based on dissolved oxygen. However, the pH in July was above the recommended long term limit using the field probe, but the laboratory test showed readings in the normal range.

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were in the mesotrophic range (10 – 20 µg/L) from May to July, in the meso-eutrophic (20-35 µg/L) in August, and in the oligotrophic range (4-10 µg/L) in September.

Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in the sample taken in August (148 µg/L). Iron also exceeded the guidelines in August (480 µg/L), when the recommendation is 300 µg/L.

Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guidelines (≥ 400 MPN/100 mL), for the sample taken in August (456.4 MNP/100 mL).

Table 10: Water chemistry data and *E. coli* results for WQ-1, 2018

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		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	12.0	8.8	0.11	12.05	23.3	31	75	0.163	237	51.4	-1.46	7.59	7.2	8.7	154.05	121	1
18-06-21	17.0	11.9	0.13	11.3	86.2	36	99	0.209	282	61.2	-0.72	8.76	7.8	8.5	181.35	134	0.8
18-07-26	22.0	15.6	0.19	9.66	77.8	47	7	0.325	389	87.4	-0.67	9.24	7.6	8.3	255.45	190	0.6
18-08-21	19.0	13.5	0.12	9.35	**456.4**	30	210	0.199	250	58	-1.42	8.96	7.2	8.6	165.75	123	1.9
18-09-18	-	14.5	0.21	9.65	10.2	49	9	DND	435	102	-0.5	8.90	7.7	8.2	287.30	205	0.5

Table 11: Nutrient results for WQ-1, 2018

SITE WQ-1: NUTRIENT DATA

Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	30.9	40	16	46	55.2	160	0.81	2.78	24.2	<50	<1	<50	600	600	<1	0.2	0.8	6.7	18
18-06-21	35.8	40	19.3	212	57.7	200	0.78	3.16	28.6	<50	<1	<50	480	480	<1	0.3	0.8	8.2	18
18-07-26	46.8	50	27.3	175	82.2	70	1.04	4.68	35.7	<50	<1	<50	730	730	7	0.1	0.8	1.3	16
18-08-21	29.9	50	18.3	45	55	420	0.74	2.98	25.4	<25	<1	<25	400	400	<5	0.6	1.0	23	27
18-09-18	48.7	50	31.9	229	85.4	130	1.23	5.32	40.7	<50	<1	<50	790	790	7	<0.1	0.8	1.2	8

Table 12: Inorganics results for WQ-1, 2018

SITE WQ-1: HEAVY METALS AND OTHER ELEMENTS

Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	76	<1	8	53	<0.01	<0.1	<1	<1	240	0.7	35	<0.1	<1	0.1	0.7	<0.1	46	<0.1	<1	1
18-06-21	71	<1	8	64	<0.01	<0.1	<1	<1	290	0.8	32	<0.1	<1	0.1	0.8	<0.1	59	<0.1	<1	2
18-07-26	18	<1	10	88	<0.01	<0.1	<1	<1	90	1.0	47	<0.1	<1	<0.1	1	<0.1	75	<0.1	<1	<1
18-08-21	**148**	<1	8	71	<0.01	<0.1	<1	<1	**480**	0.9	39	<0.1	<1	0.2	0.8	<0.1	63	0.1	1	4
18-09-18	20	<1	11	99	<0.01	<0.1	<1	<1	90	1.0	38	<0.1	<1	<0.1	1.1	<0.1	87	<0.1	<1	1

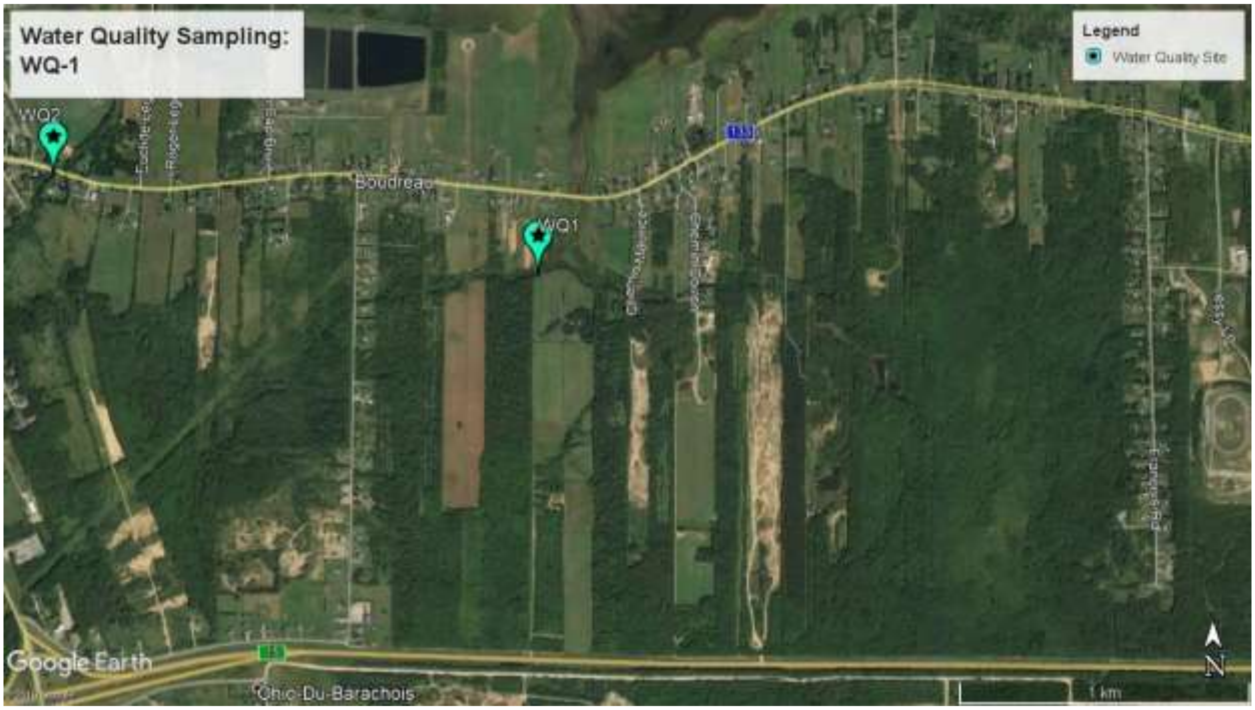


Figure 3: WQ-1 site location and surrounding land uses

Figure 4: Site photos for the water quality monitoring station WQ-1

4.2 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. 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). 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. In the southern part of the campground, the 30-metre buffer zone is respected by the maintenance crew, by not mowing grass past a certain line. However, another part of the campground is built within the buffer zone of the estuary, with camping lots placed along the edges of a rock armoured bank. A partnership was formed with *Ocean Surf* to begin planting trees in the buffer zone, as part of a multi-year goal of enhancing the riparian zone. In 2017, 182 native trees were planted.

The water sampling results for the site WQ-2, for 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions according to the “CCME Guidance framework for Phosphorus” were in the meso-eutrophic range (20 – 35 µg/L) in May, and in the mesotrophic range (10 - 20 µg/L) from June to September. Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in the sample/s taken in August (382 µg/L). Concentrations of iron also exceeded the guidelines in August (2690 µg/L), when the recommendation is 300 µg/L. Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the sample taken in July; 1960.8 MPN/100 mL.

Table 13: Water chemistry data and *E. coli* results for WQ-2, 2018

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		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	12.0	9.5	0.16	11.9	59.8	42	12	0.229	324	65.7	-1.04	7.21	7.4	8.4	211.90	161	0.9
18-06-21	17.0	12.4	0.19	10.7	93.1	51	15	0.296	390	80.5	-0.47	8.18	7.8	8.3	253.50	190	1.2
18-07-26	22.0	17.2	0.20	8.16	**1960.8**	64	<5	0.356	413	105	-0.57	8.34	7.5	8.1	274.30	210	0.8
18-08-21	19.0	14.1	0.22	8.88	258.2	59	10	0.362	453	94.5	-0.65	8.11	7.5	8.2	297.05	223	1.4
18-09-18	21.0	16.0	0.23	8.67	60.2	96	<5	0.387	459	117	0.04	8.15	7.9	7.9	304.20	230	0.7

Table 14: Nutrient results for WQ-2, 2018

SITE WQ-2: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	41.9	40	20.4	99	42	100	1.00	3.58	35.0	<50	<1	<50	300	300	5	0.2	0.5	2.9	21
18-06-21	50.7	50	25.2	301	80.7	140	1.06	4.27	40.5	<50	<1	<50	260	260	6	0.2	0.5	2.6	14
18-07-26	63.8	50	32.8	190	82	110	1.29	5.67	34.8	<50	<1	<50	500	500	6	0.1	0.6	1.3	15
18-08-21	58.8	50	29.4	175	91.4	160	1.27	5.12	48.1	<50	<1	<50	490	490	9	0.2	0.7	2	16
18-09-18	95.2	100	36.6	711	74.4	230	1.39	6.19	43.3	<50	<1	<50	190	190	8	<0.1	<0.2	1	14

Table 15: Inorganics results for WQ-2, 2018

SITE WQ-2: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	49	<1	8	79	<0.01	<0.1	<1	<1	150	0.9	94	<0.1	<1	<0.1	0.8	<0.1	99	0.1	<1	5
18-06-21	44	<1	9	96	<0.01	<0.1	<1	<1	140	1.2	67	<0.1	<1	<0.1	0.9	<0.1	76	0.2	<1	1
18-07-26	382	<1	11	240	0.08	1.2	<1	1	**2690**	1.8	3100	<0.1	<1	1.2	1.4	<0.1	103	0.5	1	10
18-08-21	26	<1	12	118	<0.01	<0.1	<1	<1	150	1.4	107	<0.1	<1	<0.1	1.1	<0.1	95	0.3	1	2
18-09-18	22	<1	17	166	<0.01	<0.1	<1	<1	190	4.4	199	0.4	<1	<0.1	1.1	<0.1	204	0.3	<1	2

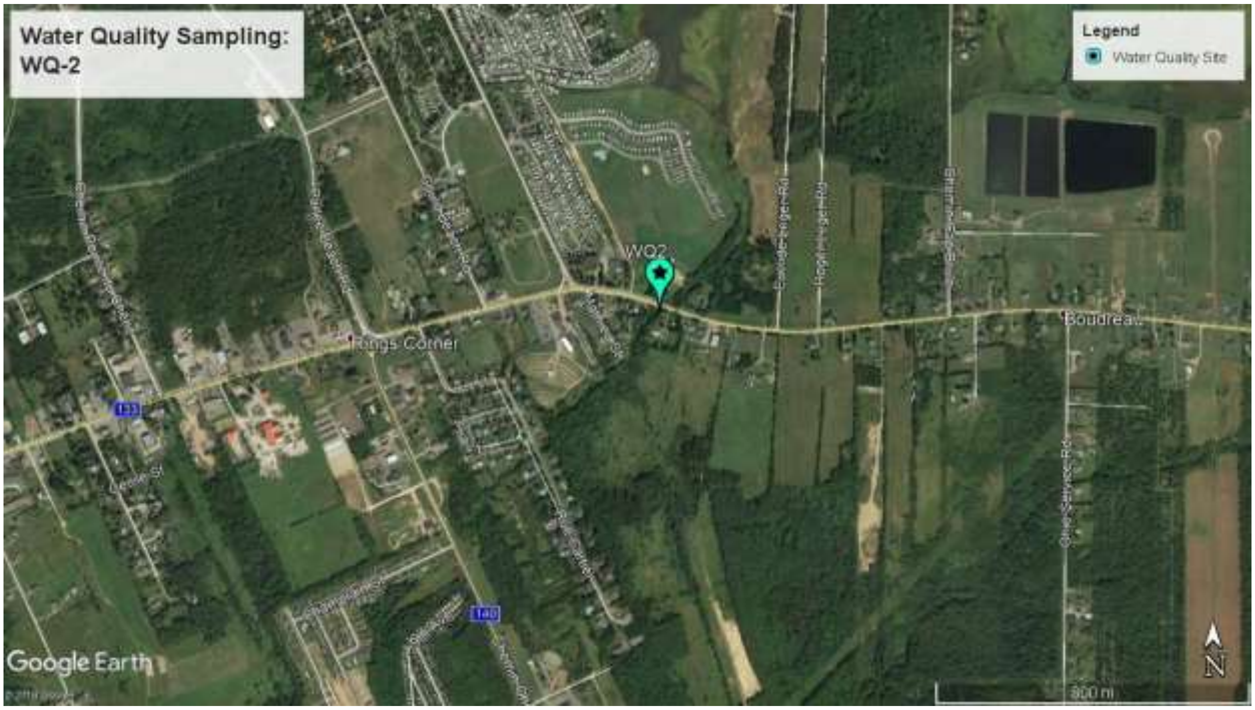


Figure 5: WQ-2 site location and surrounding land uses

Figure 6: Site photos for the water quality monitoring station WQ-2

4.3 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*. The samples are taken upstream of the culvert. 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 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance framework for Phosphorus" were in the meso-eutrophic range (20 -35 µg/L) for all samples except for June that was in the mesotrophic range (10 – 20 µg/L). Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in the sample taken in May (144 µg/L). Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the sample taken in July; 4839.2 MPN/100 mL.

Table 16: Water chemistry data and *E. coli* results for WQ-3, 2018

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		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	12.0	9.6	0.11	12.4	125.9	55	24	0.166	238	61.6	-0.71	7.48	7.6	8.3	152.75	130	8.7
18-06-21	17.0	13.3	0.16	11.1	135.4	84	21	0.265	344	90.4	-0.07	8.09	7.9	8.0	222.30	178	1.4
18-07-26	22.0	20.0	0.15	7.21	**4839.2**	87	10	0.287	310	101	-0.02	8.30	7.9	7.9	206.05	159	0.4
18-08-21	19.0	15.2	0.20	8.58	240.2	100	14	0.340	413	110	0.06	8.08	7.9	7.8	271.70	220	1.5
18-09-18	22.0	16.1	0.24	8.7	176.8	130	<5	0.403	477	123	0.5	8.02	8.2	7.7	316.25	256	0.6

Table 17: Nutrient results for WQ-3, 2018

SITE WQ-3: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	54.8	30	20.3	205	55	130	1.12	2.64	22.2	<50	<1	<50	420	420	9	0.2	0.6	4.7	33
18-06-21	83.3	50	30.5	622	47.2	150	1.37	3.47	31.4	<50	<1	<50	600	600	10	0.2	0.8	3.5	18
18-07-26	86.3	50	33.2	644	38.2	140	1.50	4.48	19.3	<50	<1	<50	570	570	7	0.2	0.8	2.2	29
18-08-21	99.2	80	35.9	741	59.6	220	1.49	4.97	39.5	<50	<1	<50	790	790	14	0.2	1.0	2.8	29
18-09-18	128.0	140	39.7	1910	68.7	290	1.46	5.76	49.1	<50	<1	<50	100	100	11	0.2	0.3	0.9	28

Table 18: Inorganics results for WQ-3, 2018

SITE WQ-3: HEAVY METALS AND OTHER ELEMENTS																		
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	**144**	<1	8	59	<0.01	<0.1	<1	2	170	0.8	17	<0.1	<1	0.3	0.9	<0.1	205	0.4	1	5
18-06-21	66	<1	12	80	<0.01	<0.1	<1	1	90	0.9	13	0.2	<1	<0.1	1.1	<0.1	82	0.6	<1	4
18-07-26	22	<1	12	91	<0.01	<0.1	<1	<1	40	0.7	19	0.2	<1	<0.1	1.41	<0.1	77	0.7	2	2
18-08-21	57	<1	17	100	<0.01	<0.1	<1	<1	70	2.1	13	0.4	<1	<0.1	1.2	<0.1	137	1.1	2	2
18-09-18	35	<1	26	160	<0.01	<0.1	<1	<1	60	5.7	12	0.9	<1	<0.1	1	<0.1	279	1.1	1	3

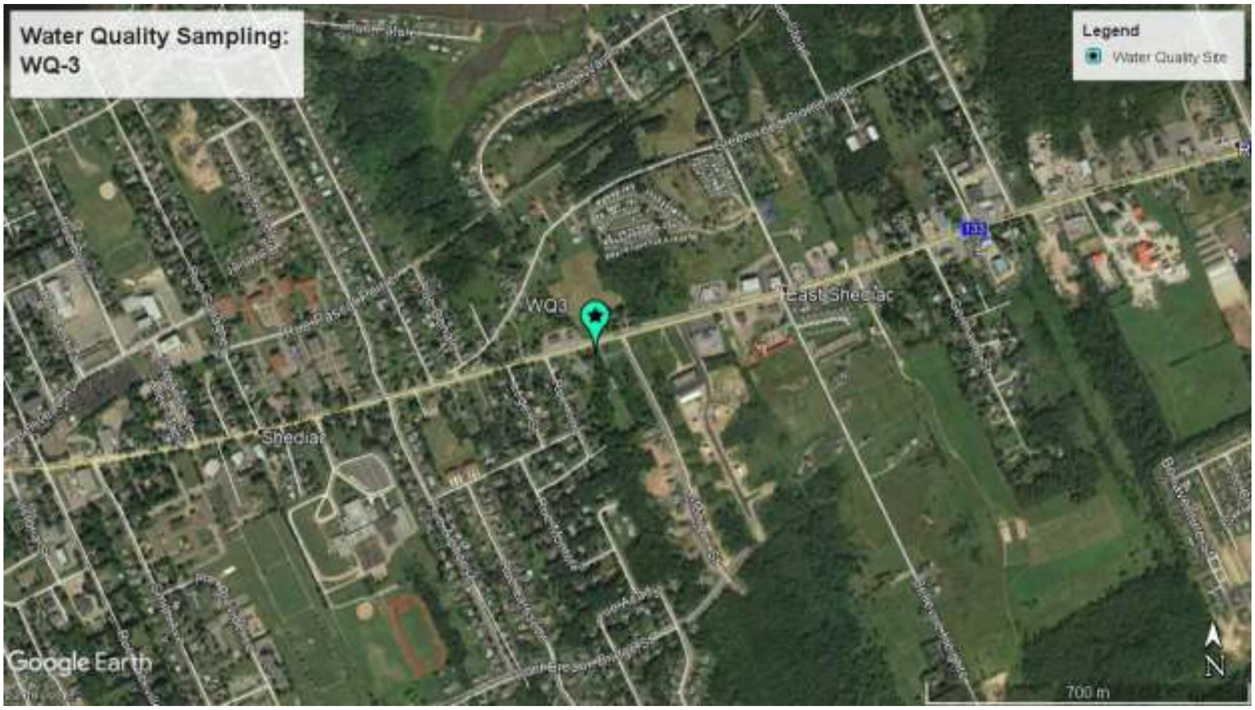


Figure 7: WQ-3 site location and surrounding land uses

Figure 8: Site photos for the water quality monitoring station WQ-3

4.4 WQ-4

This water quality sampling site is located behind the Town of Shediac's city hall. 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. 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 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were in the mesotrophic range (10 – 20 µg/L) in June, in the meso-eutrophic (20 - 35 µg/L) in May and August, and in the eutrophic range (35 - 100 µg/L) in July and September.

Levels of copper exceeded the CCME water quality guidelines for freshwater (2 µg/L when hardness ≥82, and 4 µg/L when hardness is ≤180 mg/L, see Table 2). However, this site may be impacted by extreme tides and there are no guidelines for marine water. The other possibility for elevated copper levels can be explained by the underground pipes from which this brook is channelled through under the Town of Shediac. Levels for chloride also surpass the short term CCME water quality guidelines for freshwater (120 mg/L) in May, July and September. Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the sample taken in May; 1986.3 MPN/100 mL.

Table 19: Water chemistry data and *E. coli* results for WQ-4, 2018

SITE WQ-4: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES

Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	12.0	10.2	0.32	11.27	**1986.3**	100	8	4.730	669	148	-0.45	7.33	7.3	7.8	429.65	354	5.5
18-06-21	17.0	12.5	0.30	11.12	104.6	120	6	0.470	633	165	0.37	7.64	8	7.6	401.05	317	0.8
18-07-26	22.0	15.0	0.41	8.54	90.4	130	<5	0.670	820	192	0.05	8.00	7.6	7.6	526.50	435	0.5
18-08-21	19.0	15.6	0.32	8.36	159.6	110	<5	0.530	654	164	0.03	7.84	7.7	7.7	422.50	343	0.8
18-09-18	22.0	16.7	0.41	9.15	357.8	140	<5	DND	812	223	0.44	7.73	7.9	7.5	533.00	436	1.4

Table 20: Nutrient results for WQ-4, 2018

SITE WQ-4: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	99.8	60	47.2	187	**142**	120	2.14	7.34	70.6	<50	<1	<50	1730	1730	16	0.2	1.9	2.7	28
18-06-21	119	80	52.4	1120	102	160	2.23	8.21	56.1	<50	<1	<50	1510	1510	16	0.2	1.7	1.3	18
18-07-26	129	80	60.3	485	**173**	150	2.45	9.99	84.6	<50	<1	<50	1680	1680	18	0.1	1.8	1.0	49
18-08-21	109	90	52.1	516	119	180	2.76	8.22	63.0	<50	<1	<50	2700	2700	19	<0.1	2.7	1.2	23
18-09-18	139	80	69.8	1040	**169**	170	2.72	11.80	71.9	<50	<1	<50	1780	1780	17	0.2	2.0	1	51

Table 21: Inorganics results for WQ-4, 2018

SITE WQ-4: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	87	<1	17	173	0.01	<0.1	<1	**12**	210	2	53	0.3	<1	0.3	1.5	<0.1	162	0.7	<1	6
18-06-21	28	<1	18	234	<0.01	<0.1	<1	**4**	80	4.4	33	0.3	<1	0.1	1.7	<0.1	249	0.8	<1	4
18-07-26	21	<1	23	315	<0.01	<0.1	<1	2	60	4.6	26	0.3	<1	<0.1	1.8	<0.1	303	0.9	2	3
18-08-21	25	<1	25	222	<0.01	<0.1	<1	**7**	80	3.7	30	0.4	<1	<0.1	2.1	<0.1	222	0.8	2	3
18-09-18	91	<1	28	327	0.02	0.1	<1	**4**	200	4.4	98	0.3	<1	0.6	2	<0.1	364	1.1	<1	6

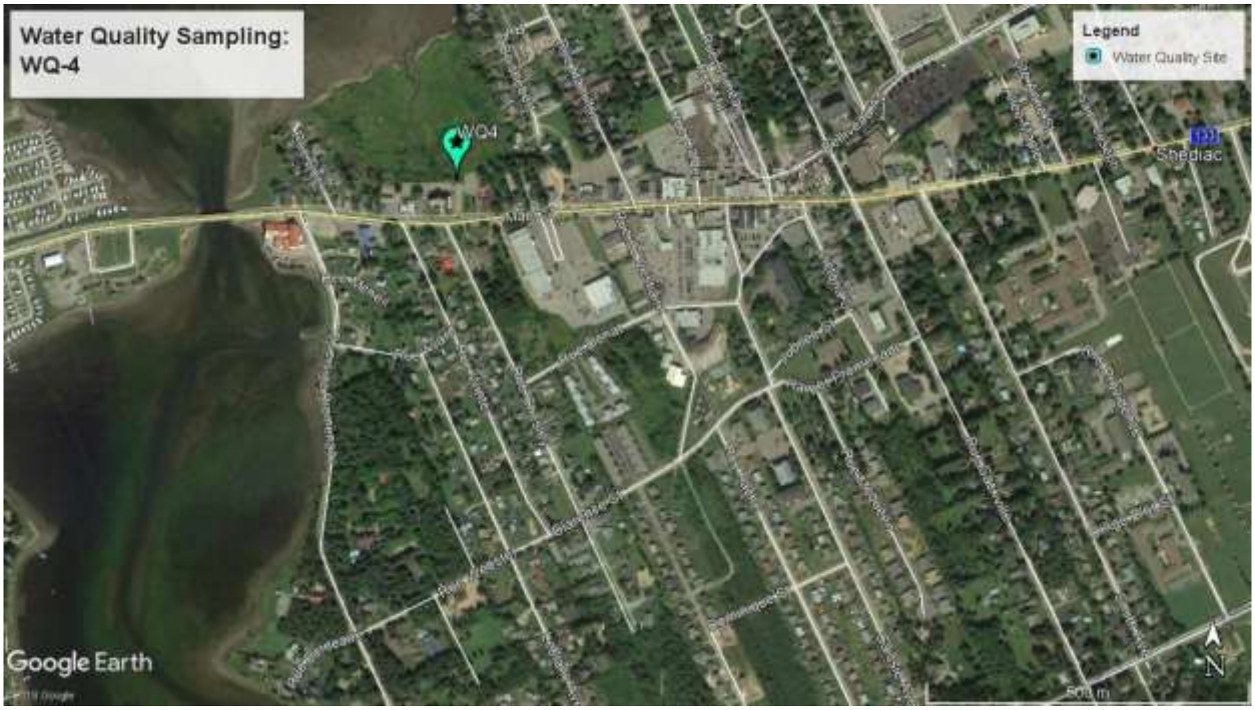


Figure 9: WQ-4 site location and surrounding land uses

Figure 10: Site photos for the water quality monitoring station WQ-4

4.5 WQ-5

This water quality sampling site is also located off Route 133, past *Guy's Frenchys* heading towards Gilbert's Corner. 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. 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 2018, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. Total phosphorus levels for long-term eutrophic conditions according to the “CCME Guidance Framework for Phosphorus” were in the meso-eutrophic range (20 - 35 µg/L) in June and September, and in the eutrophic range (4 - 10 µg/L) in May, July and August.

Results did exceed the recommended CCME water quality guidelines for chloride in freshwater, from June to September, exceeding the long-term limit (120 mg/L) but the short-term limit was not exceeded (640 mg/L). Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in the sample taken in May (126 µg/L). Concentrations of iron also exceeded the guidelines in May, June, and July (420 µg/L, 360 µg/L and 370 µg/L respectively), when the recommendation is 300 µg/L. Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 22: Water chemistry data and *E. coli* results for WQ-5, 2018

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		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	12.0	14.7	0.16	10.8	101.4	56	26	0.265	335	68.6	-0.65	7.75	7.6	8.2	214.50	171	7.3
18-06-21	17.0	17.4	0.35	9.48	20.3	72	24	0.610	727	98.8	-0.34	7.79	7.7	8.0	468.00	350	1.6
18-07-26	22.0	18.9	0.31	7.87	52.8	83	9	0.570	649	105	-0.24	8.03	7.7	7.9	442.00	326	1.9
18-08-21	19.0	16.1	0.36	8.2	181.6	58	26	0.620	740	99.6	-0.43	7.85	7.7	8.1	481.00	375	2.4
18-09-18	21.0	16.0	0.35	7.9	24.4	76	<5	0.590	704	110	-0.16	7.72	7.8	8	468.00	346	0.7

Table 23: Nutrient results for WQ-5, 2018

SITE WQ-5: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	55.8	30	23.8	209	71.4	120	1.47	2.23	37.4	<50	<1	<50	<50	<50	<1	0.3	0.3	6.9	48
18-06-21	71.6	60	33.6	337	**169**	140	1.23	3.61	96.9	<50	1	<50	<50	<50	<1	0.3	0.3	5.4	28
18-07-26	82.6	50	36.3	389	**153**	110	1.34	3.44	79.5	<50	<1	<50	100	100	<1	0.2	0.3	2.8	44
18-08-21	57.7	50	33.8	272	**186**	200	1.75	3.68	99.4	60	<1	<50	130	130	13	0.4	0.5	5.6	38
18-09-18	75.5	50	38.1	448	**158**	110	1.64	3.73	95.7	<50	<1	<50	100	100	2	0.2	0.3	2	31

Table 24: Inorganics results for WQ-5, 2018

SITE WQ-5: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	**126**	<1	5	120	<0.01	0.2	<1	<1	**420**	0.6	279	0.1	<1	0.3	1	<0.1	54	0.2	<1	2
18-06-21	29	<1	8	167	<0.01	0.2	<1	<1	**360**	0.5	877	0.2	<1	<0.1	1.1	<0.1	88	0.1	<1	2
18-07-26	54	<1	11	167	<0.01	0.2	<1	<1	**370**	0.4	1030	<0.1	<1	0.2	1.5	<0.1	81	0.1	<1	1
18-08-21	41	<1	12	157	<0.01	0.1	<1	<1	300	0.5	494	0.1	<1	<0.1	1.5	<0.1	86	<0.1	1	2
18-09-18	6	<1	12	135	<0.01	<0.1	<1	<1	90	0.4	143	<0.1	<1	<0.1	1.4	<0.1	80	<0.1	<1	<1

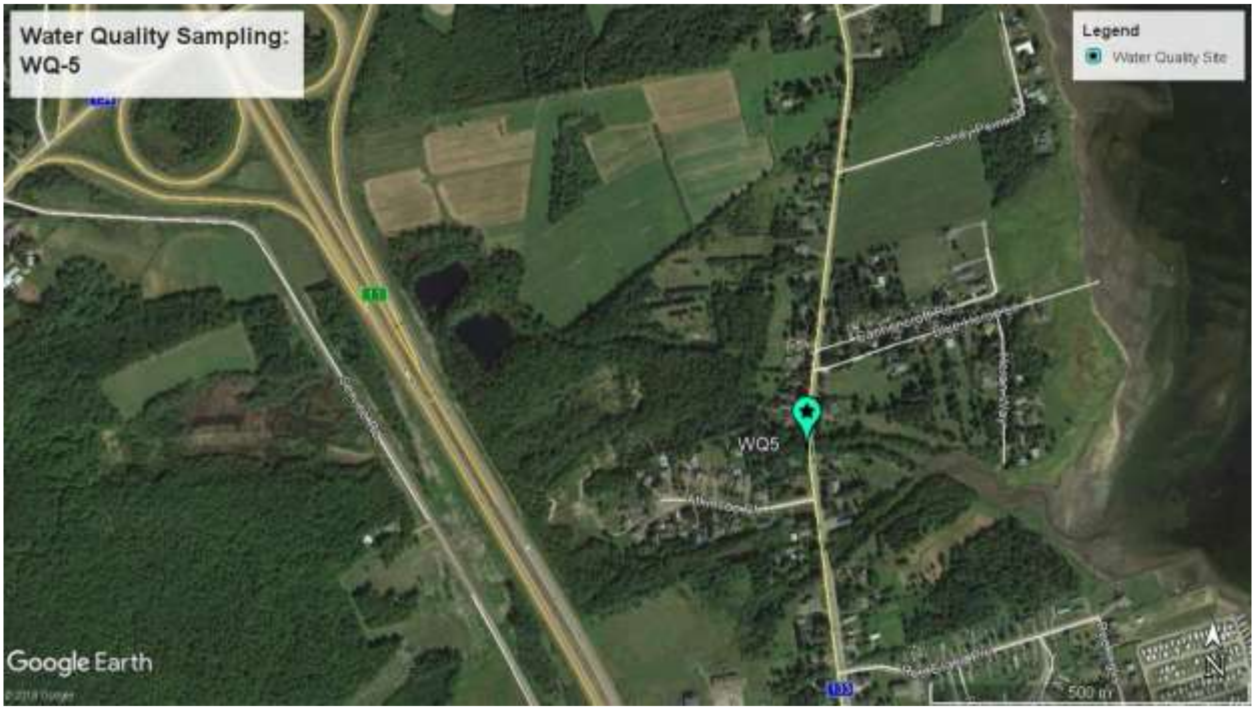


Figure 11: WQ-5 site location and surrounding land uses

Figure 12: Site photos for the water quality monitoring station WQ-5

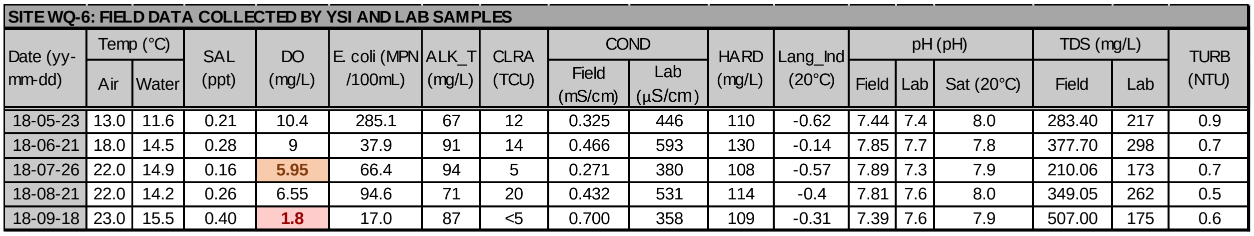
4.6 WQ-6

This water quality sampling site is located off Route 134, past the Shediac Cape School, right next to Old Mill Road. 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. 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 obvious cow tracks that criss-crosses 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 2018, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in the months of July and September (5.95 mg/L and 1.80 mg/L respectively). Total phosphorus levels for long-term eutrophic conditions according to the “CCME Guidance framework for Phosphorus” were in the mesotrophic range (10 - 20 µg/L) in each sample. Results exceed the recommended CCME water quality guidelines for chloride in freshwater in the month of June (121 mg/L), exceeding the long-term limit (120 mg/L) but the short-term limit was not exceeded (640 mg/L).

Concentrations of iron exceeded the guidelines in July (340 µg/L), when the recommendation is 300 µg/L. Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 25: Water chemistry data and *E. coli* results for WQ-6, 2018



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		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	13.0	11.6	0.21	10.4	285.1	67	12	0.325	446	110	-0.62	7.44	7.4	8.0	283.40	217	0.9
18-06-21	18.0	14.5	0.28	9	37.9	91	14	0.466	593	130	-0.14	7.85	7.7	7.8	377.70	298	0.7
18-07-26	22.0	14.9	0.16	**5.95**	66.4	94	5	0.271	380	108	-0.57	7.89	7.3	7.9	210.06	173	0.7
18-08-21	22.0	14.2	0.26	6.55	94.6	71	20	0.432	531	114	-0.4	7.81	7.6	8.0	349.05	262	0.5
18-09-18	23.0	15.5	0.40	**1.8**	17.0	87	<5	0.700	358	109	-0.31	7.39	7.6	7.9	507.00	175	0.6

Table 26: Nutrient results for WQ-6, 2018

SITE WQ-6: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	66.8	40	35.1	158	83.5	120	1.36	5.42	41.9	<50	<1	<50	960	960	4	0.3	1.3	3.8	20
18-06-21	90.5	50	41.5	426	121	140	1.29	6.31	62.5	<50	<1	<50	870	870	6	0.3	1.2	4.1	14
18-07-26	93.8	40	34.2	176	38.9	100	1.49	5.45	23.2	<50	<1	<50	1490	1490	5	0.2	1.7	1.5	19
18-08-21	70.7	40	36	265	99.1	180	1.73	5.79	56.4	<50	<1	<50	810	810	16	0.3	1.1	3.8	19
18-09-18	86.7	30	34.3	324	43.3	110	2.09	5.78	25.0	<50	<1	<50	1380	1380	5	0.2	1.6	1.3	13

Table 27: Inorganics results for WQ-6, 2018

SITE WQ-6: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	27	<1	8	79	<0.01	<0.1	<1	<1	180	0.5	97	<0.1	<1	<0.1	1.0	<0.1	71	0.2	<1	6
18-06-21	16	<1	9	90	<0.01	<0.1	<1	<1	180	0.5	108	<0.1	<1	<0.1	1	<0.1	86	0.3	<1	3
18-07-26	63	<1	11	100	<0.01	0.1	<1	<1	340	0.6	359	<0.1	<1	0.3	0.9	<0.1	59	0.2	2	2
18-08-21	13	<1	12	94	<0.01	<0.1	<1	<1	180	0.5	182	<0.1	<1	<0.1	1.2	<0.1	73	0.1	1	2
18-09-18	5	<1	14	90	<0.01	<0.1	<1	<1	110	0.7	212	<0.1	<1	<0.1	0.9	<0.1	55	<0.1	<1	1

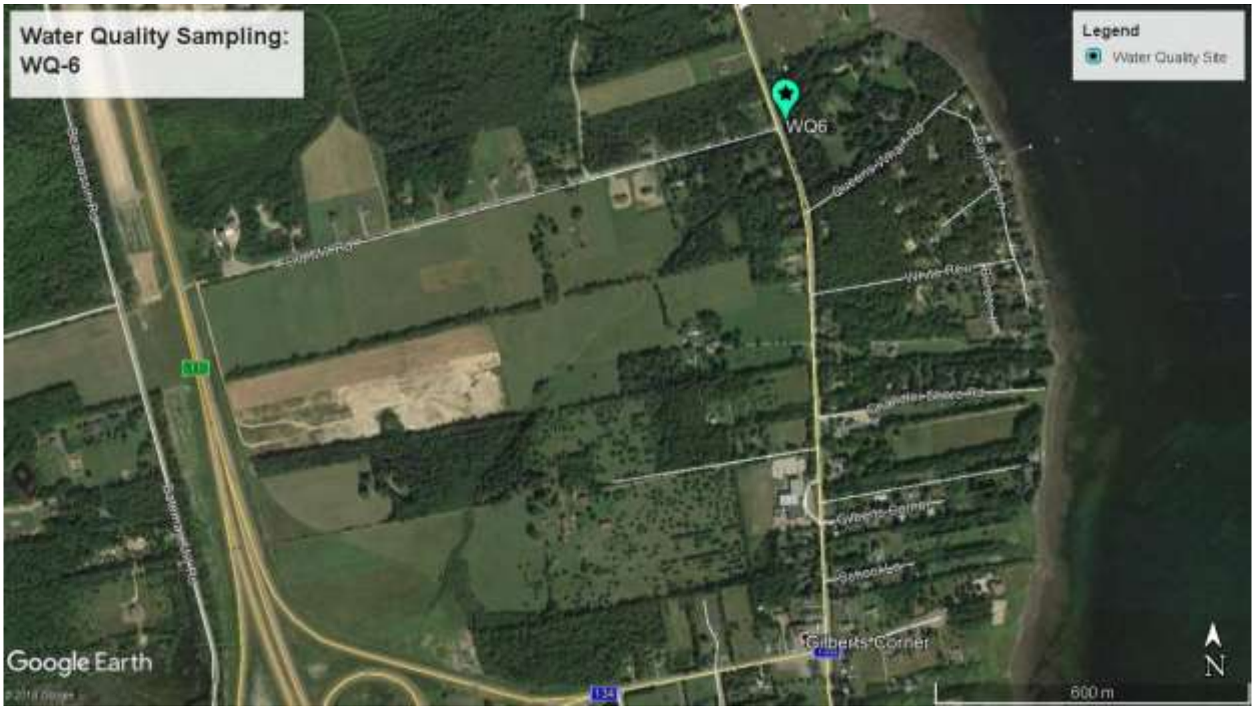


Figure 13: WQ-6 site location and surrounding land uses

Figure 14: Site photos for the water quality monitoring station WQ-6

4.7 WQ-7

This water quality sampling site is located off Route 134, on the property of *Bay Vista Lodge*. 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. 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 2018, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in July and September (4.16 mg/L and 4.97 mg/L respectively). Total phosphorus levels for long-term eutrophic conditions according to the “CCME Guidance Framework for Phosphorus” were in the meso-eutrophic range (20 -35 µg/L) in June, August and September, in the eutrophic range (35 – 100 µg/L) in May, and in the hyper-eutrophic range (>100 µg/L) in July.

Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in the samples taken in May (147 µg/L) and July (198 µg/L). Concentrations of iron also exceeded the guidelines in all samples except September; May (640 µg/L), June (510 µg/L), July (2010 µg/L) and August (390 µg/L), when the recommendation is 300 µg/L. Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 28: Water chemistry data and *E. coli* results for WQ-7, 2018

SITE WQ-7: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	12.0	14.1	0.13	9.66	8.6	42	37	0.221	281	70.1	-1.02	7.43	7.4	8.4	180.70	134	1.9
18-06-21	18.0	18.6	0.14	9.22	14.6	52	30	0.250	287	75.4	-0.60	7.56	7.7	7.7	185.25	139	1.8
18-07-26	22.0	23.7	0.15	**4.16**	19.2	67	28	0.322	320	88.5	-0.83	7.82	7.3	8.1	209.30	163	11.7
18-08-21	22.0	17.9	0.13	6.83	40.2	40	24	0.233	265	70.8	-0.94	7.79	7.5	8.4	174.850	133	1.8
18-09-18	23.0	19.6	0.13	**4.97**	229.0	54	8	0.249	272	79.2	-0.77	7.53	7.5	8.3	180.05	138	0.8

Table 29: Nutrient results for WQ-7, 2018

SITE WQ-7: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	41.9	0.04	20.7	0.099	55.9	0.13	0.99	4.48	24.9	<50	<1	<50	<50	<50	<1	0.5	0.5	4.4	75
18-06-21	51.7	0.04	22.5	0.244	50.8	0.13	1.06	4.67	23.4	<50	<1	<50	<50	<50	4	0.3	0.3	4.3	21
18-07-26	66.9	0.05	26.1	0.125	59.5	0.10	1.45	5.66	23.4	50	<1	<50	<50	<50	3	0.8	0.8	3.9	153
18-08-21	39.9	0.04	21	0.119	51.4	0.14	0.99	4.47	21.0	<50	<1	<50	<50	<50	9	0.2	0.2	3.6	25
18-09-18	53.8	0.04	22.9	0.160	49.5	0.12	1.20	5.35	19.1	<50	<1	<50	<50	<80	6	0.2	0.2	1.9	32

Table 30: Inorganics results for WQ-7, 2018

SITE WQ-7: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	**147**	<1	5	65	0.01	0.3	<1	<1	**640**	1.2	239	<0.1	<1	0.4	0.8	<0.1	55	0.1	6	3
18-06-21	74	<1	5	69	<0.01	0.1	<1	<1	**510**	1.4	128	<0.1	<1	0.2	1	<0.1	60	0.1	<1	5
18-07-26	**198**	2.0	7	114	0.02	0.8	<1	2	**2010**	1.7	1370	<0.1	<1	1	1.4	<0.1	78	0.2	60	6
18-08-21	70	<1	6	71	<0.01	<0.1	<1	<1	**390**	1.4	79	<0.1	<1	0.1	0.9	<0.1	56	<0.1	8	4
18-09-18	21	<1	7	99	<0.01	<0.1	<1	1	260	1.3	278	<0.1	<1	<0.1	1	<0.1	66	<0.1	30	2

Figure 15: WQ-7 site location and surrounding land uses

Figure 16: Site photos for the water quality monitoring station WQ-7

4.8 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). 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. 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 2018, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in July and August (0.06 mg/L and 6.13 mg/L respectively). Total phosphorus levels for long-term eutrophic conditions according to the “CCME Guidance Framework for Phosphorus” were in the meso-eutrophic range (20 -35 µg/L) in May, in the eutrophic range (35 – 100 µg/L) in June, and in the hyper-eutrophic range (>100 µg/L) in July, August and September.

It is important to note that this site is impacted by tides, and that marine water disqualifies several flagged parameters that only apply for freshwater: chloride, aluminum, boron, iron and zinc. There are no marine limits set for these elements. There is a correlation between some of these elements and the salinity content listed in Table 31. However, there is a CCME water quality guideline for arsenic in marine water of 12.5 µg/L, and this level was surpassed in August (20.0 µg/L).

Bacterial levels exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in June (816.4 MPN/100 mL), July (865 MPN/100 mL) and September, where levels exceeded the maximum detection limit of > 2419.6 MPN/100 mL.

Table 31: Water chemistry data and *E. coli* results for WQ-8, 2018

SITE WQ-8: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	12.0	13.6	23.48	7.35	24.3	76	22	28.900	11200	764	-0.57	7.35	7.4	8	23948.00	4590	0.9
18-06-21	18.0	21.1	0.99	8.99	**816.4**	86	26	1.900	630	102	-0.2	7.54	7.9	7.9	1215.05	320	1.1
18-07-26	22.0	22.5	39.33	**0.06**	**865.0**	120	18	38.800	41800	3140	0.51	7.95	7.7	7.2	26468.00	19600	6.4
18-08-21	22.0	17.3	2.33	**6.13**	51.2	100	21	3.760	3180	162	-0.56	7.46	7.5	8.1	2320.590	1340	27.5
18-09-18	23.0	16.6	0.10	7.15	**>4839.2**	117	8	0.106	42300	2770	0.33	6.66	7.6	7.3	78.65	19200	5.1

Table 32: Nutrient results for WQ-8, 2018

SITE WQ-8: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	75.8	7580	68.3	179	**2590**	620	44.80	144.00	1330.0	<50	<1	<50	<50	<50	370	0.5	0.5	2.4	34
18-06-21	85	45	24.4	637	**123**	190	3.81	10.10	85.1	430	13	<50	110	110	19	0.8	0.9	5.9	97
18-07-26	119	36100	225	563	**10600**	1480	197.00	625.00	6340.0	490	10	<50	<25	<25	1550	1.1	1.1	<25	412
18-08-21	100	1020	29.7	296	**910**	320	9.47	21.30	188.0	180	2	<50	500	500	111	1.8	2.3	5	323
18-09-18	117	29200	198	436	**10900**	1350	177.00	552.00	5870.0	570	9	<50	<1000	<4000	1430	1.6	1.6	<12.5	233

Table 33: Inorganics results for WQ-8, 2018

SITE WQ-8: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	40	<5	523	76	<0.05	<0.5	<5	<5	**400**	19.3	121	1.3	<5	<0.5	13.2	<0.5	1000	<0.5	<1	<5
18-06-21	27	<1	47	111	<0.01	0.1	<1	<1	**360**	3.5	115	0.2	<1	0.1	1.5	<0.1	171	0.3	<1	1
18-07-26	70	<20	**2250**	32	<0.2	<2	<20	<20	**1400**	98	1620	5	<20	<2	59	<2	4540	2	2	<20
18-08-21	**607**	**20.0**	90	245	0.05	0.8	<1	2	**4030**	7.8	245	0.2	<1	5.6	2.9	<0.1	323	0.7	1	14
18-09-18	20	<20	**2130**	27	<0.2	<2	<20	<20	**1100**	81	400	5	<20	<2	49	<2	3760	<2	<1	<20

Figure 17: WQ-8 site location and surrounding land uses

Figure 18: Site photos for the water quality monitoring station WQ-8

4.9 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). 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. 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 hectares) 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 2018, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms July, August and September (3.26

mg/L, 5.33 mg/L and 4.95 mg/L respectively). Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were in the meso-eutrophic range (20 -35 µg/L) in May, and in the eutrophic range (35 – 100 µg/L) from June to September.

Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in the sample taken in May (136 µg/L). Concentrations of iron also exceeded the guidelines in all samples: May (690 µg/L), June (1340 µg/L), July (1380 µg/L), August (940 µg/L) and September (690 µg/L), when the recommendation is 300 µg/L. Concentrations of arsenic exceeded the CCME water quality guideline (5 µg/L) in August with a value of 10 µg/L. Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 34: Water chemistry data and *E. coli* results for WQ-9, 2018

SITE WQ-9: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	10.0	14.0	0.11	9.78	52.9	44	50	0.800	121	43.9	-1.03	8.63	7.5	8.5	141.70	67	2.8
18-06-21	19.0	21.6	0.07	8.68	42.2	60	45	0.145	150	57.4	-0.57	7.66	7.7	7.7	100.75	82	3.4
18-07-26	25.0	22.5	0.09	**3.26**	143.4	79	35	0.183	181	68.4	-0.68	8.62	7.4	8.1	124.80	95	6.1
18-08-21	22.0	18.4	0.08	**5.33**	71.8	54	44	0.143	152	57.3	-0.92	7.81	7.4	8.3	164.600	78	4.1
18-09-18	19.0	18.5	0.10	**4.95**	14.6	83	18	0.190	212	83.7	-0.19	8.41	7.8	8.0	141.70	107	2.7

Table 35: Nutrient results for WQ-9, 2018

SITE WQ-9: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	43.9	0.03	14.4	0.130	14.9	0.15	0.77	1.92	6.9	<50	<1	<50	<50	<50	<1	0.3	0.3	7.4	29
18-06-21	59.7	0.04	19.5	0.281	12	0.14	0.70	2.12	8.9	<50	<1	<50	<50	<50	<1	0.5	0.5	7.4	59
18-07-26	78.8	0.05	23.3	0.186	10.3	0.14	0.87	2.48	7.6	<50	<1	<50	<50	<50	<1	0.4	0.4	5.3	42
18-08-21	53.9	0.05	19.5	0.127	8.3	0.17	1.20	2.09	7.2	<50	<1	<50	<50	<50	5	0.4	0.4	7	36
18-09-18	82.5	0.04	28.5	0.489	12.8	0.14	1.43	3.05	8.6	<50	<1	<50	<50	<80	<1	0.4	0.4	4.9	38

Table 36: Inorganics results for WQ-9, 2018

SITE WQ-9: HEAVY METALS AND OTHER ELEMENTS																			
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	**136**	<1	6	36	0.01	0.2	<1	<1	**690**	0.6	250	0.1	<1	0.2	0.8	<0.1	46	<0.1	<1	3
18-06-21	91	2	8	61	<0.01	0.3	<1	<1	**1340**	0.7	884	0.2	<1	0.2	0.7	<0.1	58	0.1	<1	9
18-07-26	43	2	12	102	<0.01	0.2	<1	<1	**1380**	0.8	765	0.2	<1	0.2	1.0	<0.1	72	0.1	2	2
18-08-21	58	**10**	12	68	<0.01	0.2	<1	<1	**940**	0.5	294	0.1	<1	0.1	1.4	<0.1	54	<0.1	1	2
18-09-18	17	<1	8	85	<0.01	0.2	<1	<1	**690**	0.7	734	0.1	<1	<0.1	1.7	<0.1	100	<0.1	<1	2

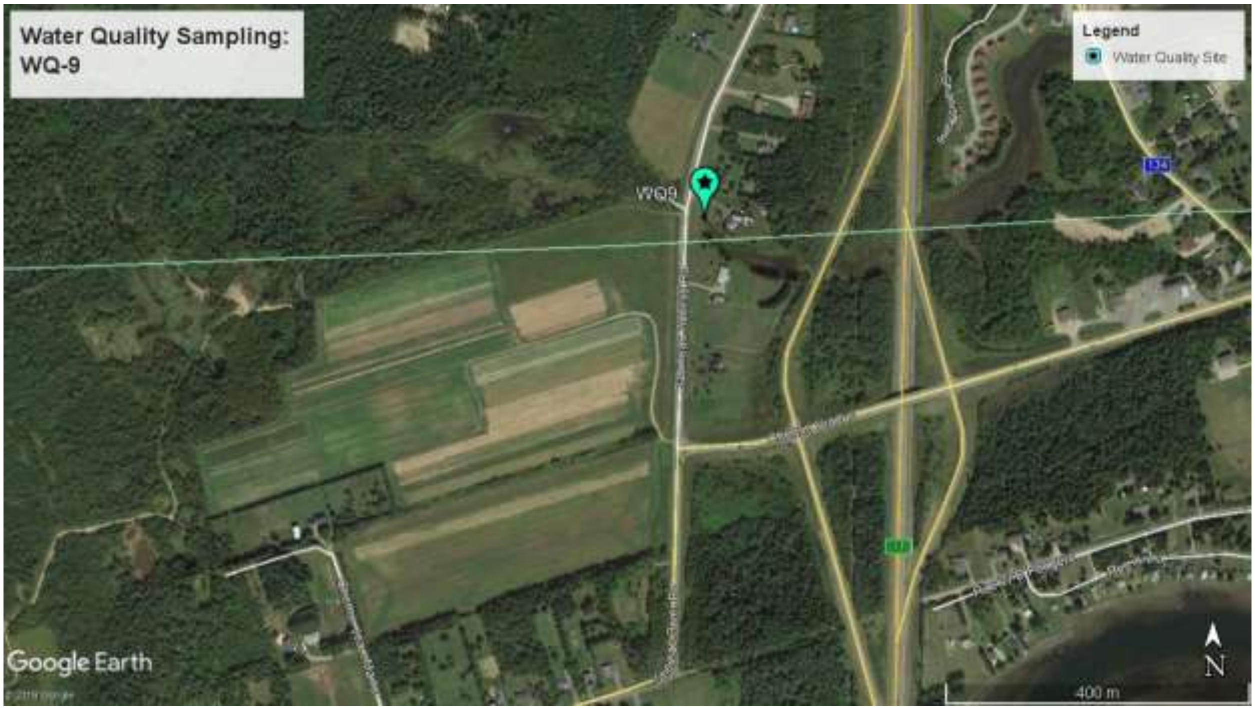


Figure 19: WQ-9 site location and surrounding land uses

Figure 20: Site photos for the water quality monitoring station WQ-9

4.10 WQ-10

This water quality sampling site is located off Route 530 (Grande-Digue Rd.), 100 m after Chemin Antoine. The samples are taken upstream of the culvert. The sample site is located approximately 130 m from the tidal zone. The surrounding land uses is mainly residences and a possible agricultural fields (> 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 2018, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in July and September (4.13 mg/L and 2.92 mg/L respectively). Total phosphorus levels for long-term eutrophic conditions according to the “CCME Guidance Framework for Phosphorus” were in the meso-eutrophic range (20 -35 µg/L) in May and June, in the eutrophic range (35 – 100 µg/L) in August and September, and in the hyper-eutrophic range (>100 µg/L) in July. Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in all samples except September. Concentrations of iron also exceeded the guidelines (300 µg/L) in all samples except September. Bacterial levels exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in July and August; 2599.4 MPN/100 mL and 1158.8 MPN/100 mL respectively.

Table 37: Water chemistry data and *E. coli* results for WQ-10, 2018

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		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	8.0	12.1	0.06	10.88	118.7	18	132	0.097	122	24.2	-1.99	7.90	7.2	9.2	83.88	62	3.4
18-06-21	19.0	18.1	0.08	8.7	248.1	23	141	0.147	170	33.1	-1.55	7.48	7.4	9	109.85	84	4.5
18-07-26	25.0	19.7	0.15	**4.13**	**2599.4**	59	24	0.295	321	93.4	-0.93	7.96	7.2	8.1	210.60	158	16.6
18-08-21	22.0	16.5	0.10	7.34	**1158.8**	43	74	0.177	215	64.1	-1	7.65	7.4	8.4	137.15	107	8.5
18-09-18	17.0	17.2	0.25	**2.92**	287.8	100	13	0.431	551	155	-0.31	7.37	7.4	7.7	328.90	257	2.7

Table 38: Nutrient results for WQ-10, 2018

SITE WQ-10: NUTRIENT DATA

Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	18.0	30	7.54	27	26.9	220	0.47	1.31	14.2	<50	<1	<50	<50	<50	<1	0.4	0.4	13	31
18-06-21	22.9	40	10.5	54	33.8	220	0.50	1.68	19.9	<50	<1	<50	<50	<50	3	0.5	0.5	13.8	32
18-07-26	58.9	50	30	88	62.2	150	1.14	4.50	19.1	160	1	<50	340	340	<1	1.0	1.3	4.5	246
18-08-21	42.9	50	20.6	101	37.7	190	1.18	3.07	15.5	<50	<1	<50	200	200	<1	0.6	0.8	10.2	95
18-09-18	99.8	50	50.4	236	99.7	150	1.84	7.10	30.3	90	<1	<50	90	90	5	0.4	0.5	2.8	47

Table 39: Inorganics results for WQ-10, 2018

SITE WQ-10: HEAVY METALS AND OTHER ELEMENTS

Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	**214**	<1	5	27	0.01	0.2	<1	<1	**510**	0.2	97	<0.1	<1	0.3	0.6	<0.1	25	<0.1	<1	1
18-06-21	**204**	<1	6	33	0.01	0.1	<1	<1	**680**	0.3	101	<0.1	<1	0.3	0.8	<0.1	36	<0.1	<1	1
18-07-26	**274**	<1	11	93	0.06	0.9	<1	<1	**1400**	0.4	2450	<0.1	<1	<0.1	2.1	<0.1	81	0.1	2	5
18-08-21	**161**	<1	11	50	0.02	0.4	<1	<1	**980**	0.3	703	0.1	<1	0.5	1.5	<0.1	58	<0.1	1	3
18-09-18	5	<1	17	61	<0.01	<0.1	<1	<1	140	0.4	544	<0.1	<1	<0.1	2.1	<0.1	109	<0.1	<1	1

Figure 21: WQ-10 site location and surrounding land uses

Figure 22: Site photos for the water quality monitoring station WQ-10

4.11 WQ-11

This water quality sampling site is located off Route 530 (Grande-Digue Rd.), just before the Chemin des Soeurs. 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.

The water sampling results for the site WQ-11, for 2018, meet the recommendations for the survival of freshwater aquatic life based on pH. In September, the field pH reading was below this limit (6.46), but the pH tested in the lab was within the normal range. The dissolved oxygen levels fell below the recommendation (6.5 mg/L) for general cold water organisms in July, August and September (0.04 mg/L, 2.49 mg/L and 2.05 mg/L respectively). Total phosphorus levels for long-term eutrophic conditions according to the “CCME Guidance Framework for Phosphorus” were in the eutrophic range (35 – 100 µg/L) in May, June and July, and in the hyper-eutrophic range (>100 µg/L) in August and September.

It is important to note that this site is impacted by tides, and that marine water disqualifies several flagged parameters that only apply for freshwater: chloride, aluminum, boron, iron and zinc. There are no marine limits set for these elements. There is a correlation between these elevated elements and the salinity content listed in Table 40. Bacterial levels exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in July (8164 MPN/100 mL), August (774.6 MPN/100 mL) and September (2599.4 MPN/100 mL).

Table 40: Water chemistry data and *E. coli* results for WQ-11, 2018

SITE WQ-11: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field (mS/cm)	Lab (µS/cm)			Field	Lab	Sat (20°C)	Field	Lab	
18-05-23	7.0	11.8	0.92	8.62	32.3	36	70	1.370	1070	143	-1.5	7.38	7.1	8.6	1170.00	586	2.0
18-06-21	19.0	21.7	20.41	8.55	259.0	49	52	31.930	1060	95.9	-1.08	6.74	7.4	8.5	22113.00	462	2.5
18-07-26	25.0	22.1	23.46	**0.04**	**8164.0**	102	23	34.940	18200	779	-0.5	7.53	7.3	7.8	24056.50	4200	7.2
18-08-21	22.0	**25.2**	24.80	**2.49**	**774.6**	104	21	39.150	42300	4250	0.01	6.97	7.2	7.2	25000.34	21000	19.9
18-09-18	17.0	**23.4**	26.44	**2.05**	**2599.4**	111	13	39.940	19100	3150	-0.1	**6.46**	7.2	7.3	26892.00	12400	27.7

Table 41: Nutrient results for WQ-11, 2018

SITE WQ-11: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (µg/L)	Ca (mg/L)	CO3 (µg/L)	Cl (mg/L)	F (µg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (µg/L)	NH3_Un (µg/L)	NO2 (µg/L)	NO3 (µg/L)	NOX (µg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (µg/L)
18-05-23	36.0	1090	20.4	43	**302**	230	7.34	22.30	176.0	<50	<1	<50	130	130	34	0.5	0.6	9.3	36
18-06-21	48.9	57	18.6	115	**251**	220	4.47	12.00	109.0	<50	<1	<50	110	110	35	0.5	0.6	7.9	44
18-07-26	102.0	8000	72.9	191	**2230**	580	47.40	145.00	1330.0	60	<1	<50	<50	<50	310	0.6	0.6	<10	47
18-08-21	104.0	45800	242	155	**11200**	1440	269.00	886.00	6720.0	560	4	<50	<500	<500	1580	1.2	1.2	<10	375
18-09-18	111.0	32900	223	165	**5510**	840	199.00	629.00	5010.0	150	<1	<50	<50	<50	778	6.6	6.6	<10	990

Table 42: Inorganics results for WQ-11, 2018

SITE WQ-11: HEAVY METALS AND OTHER ELEMENTS																				
Date (yy-mm-dd)	Al (µg/L)	As (µg/L)	B (µg/L)	Ba (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Pb (µg/L)	Rb (µg/L)	Sb (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
18-05-23	**110**	<1	82	50	0.01	0.3	<1	<1	**660**	3	314	0.3	<1	0.2	2.8	<0.1	212	0.1	1	6
18-06-21	70	<1	52	58	<0.01	0.2	<1	<1	**620**	1.9	301	0.3	<1	0.2	2	<0.1	174	0.1	<1	3
18-07-26	**140**	<10	570	140	<0.1	<1	<10	<10	**700**	21	1440	1	<10	1	15	<0.1	1170	<1	20	**100**
18-08-21	**120**	<50	**3140**	200	<0.5	<5	<50	<50	**2000**	123	3380	7	<50	<0.50	79	<5	5890	<5	120	<50
18-09-18	30	<20	**2440**	20	<0.2	<2	<20	<20	**2900**	80	2320	5	<20	<2	54.0	<2	4180	<2	50	<20

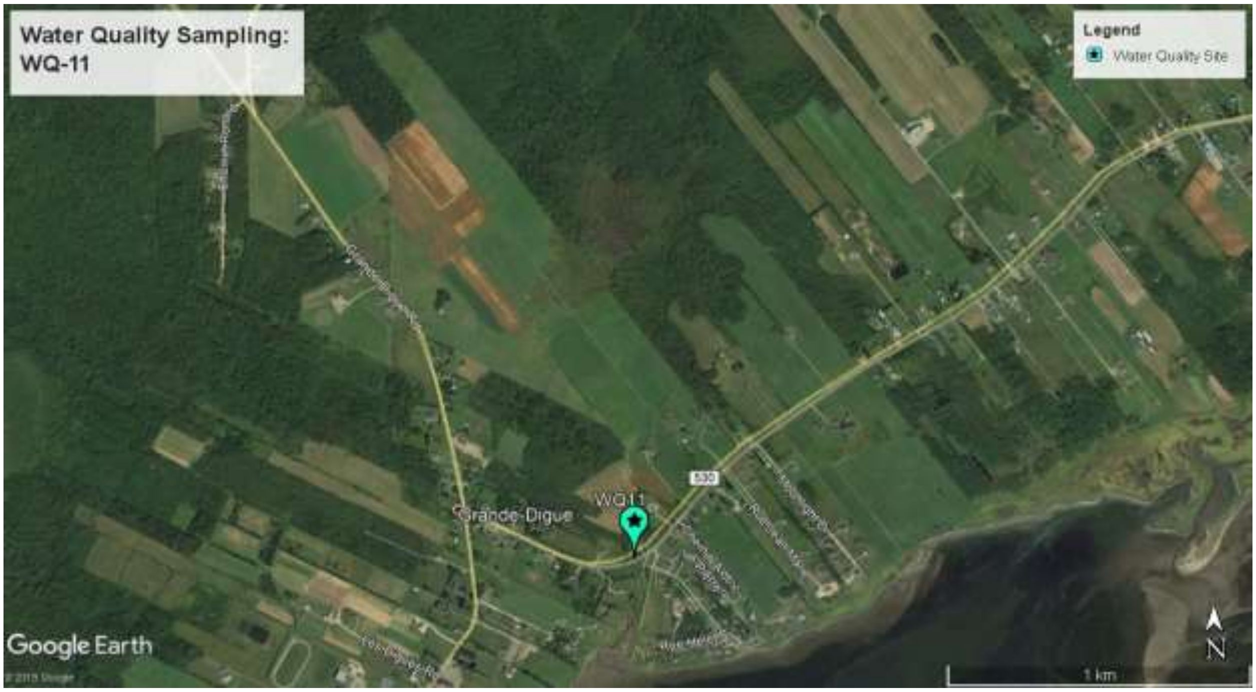


Figure 24: Site photos for the water quality monitoring station WQ-11

4.12 Bacterial Sampling Summary

The bacterial levels in some of the small streams sites shows the need for more investigation around land uses. Valuable data has been collected in 2018 and will be used in the planning of future studies and remediation action plans.

Most sampling stations had at least one instance of a bacterial spike over the recommended 400 MPN/100 mL limit in 2018. The sites that did not have an instance of bacterial spike are; WQ-5, WQ-6, WQ-7, and WQ-9. Based on the bacterial levels alone, the stations that merit further investigations for sources of fecal coliforms are; WQ-2, WQ-3, WQ-4, WQ-8, WQ-10 and WQ-11.

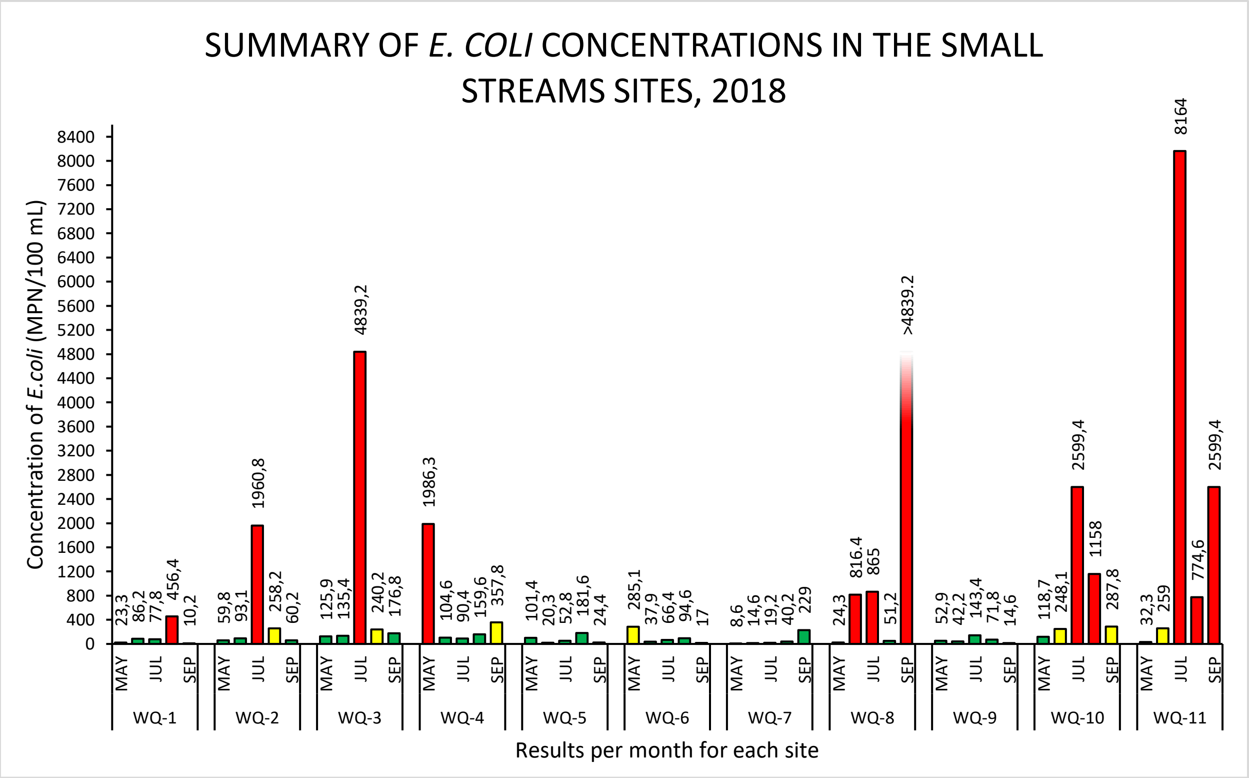


Figure 25: Summary of water quality results for *E. coli*, small streams sampling 2018

4.13 Discussion

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

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

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

Most sites were generally under the limits for *E. coli* based on Health Canada Recreational Guidelines. Four stations had at one instance of bacterial spike, one station had 2 instances of elevated bacterial levels, and two stations (WQ-8 and WQ-11) had 3 instances of elevated bacterial levels. These last two stations were also the most severe sites for *E. coli* in 2017, and merit further investigation.

All pH levels were found to be within the guidelines; between 6.5 and 9. However, dissolved oxygen was very poor in certain areas during the summer months. With very warm temperatures and very little or infrequent rainfall in the summer 2018, the water in some of those sampling sites became very warm and stagnant. The presence of bacteria and algae can further decrease the levels of dissolved oxygen available for aquatic life.

Looking at total phosphorous levels, most of our site falls into mesotrophic to eutrophic range. However, four stations have sample levels in the hyper-eutrophic range (> 100 µg/L); WQ-7, WQ-8, WQ-10 and WQ-11. The highest level of total phosphorous measured was at WQ-11 in September, at 990 µg/L.

Inorganic's results that were over the CCME recommended water quality guideline were mainly iron and aluminum. There were a few instances of copper, boron and chloride that also surpassed the limits. The province of New Brunswick is known to have higher levels of naturally occurring aluminum and iron. More investigation ad consultation with experts is needed to interpret the inorganic results.

5 Eelgrass Monitoring in the Shediac Bay

The SeagrassNet program is a global seagrass monitoring network that monitors the status of seagrass and the threats to these ecosystems. The program started in 2001, and now includes more than 126 sites in 33 countries. The protocol for the sampling can be found at www.seagrassnet.org.

The Southern Gulf of Saint Lawrence Coalition on Sustainability (Coalition-SGSL) has implemented the SeagrassNet program in Atlantic Canada since 2015. They have provided equipment and training to the SBWA for the monitoring program to begin in the Shediac Bay. The first monitoring site was established in the estuary of the Scoudouc River in 2016, and a second site was established in the Shediac River estuary in 2017. In 2018, a third monitoring site was added in the Shediac Bay, near the mouth of the South Cove Estuary (near Pointe-du-Chêne).

The data collected from these annual surveys will serve to measure changes in eelgrass density in these sensitive habitats. Since the first appearance of the invasive green crab in the Shediac Bay in 2010. Green crab population monitoring has shown a trend of constant increase in their numbers. The green crab is an invader is capable of devastating eelgrass habitats. The SeagrassNet program provides a protocol to measure the impacts of the green crab in the Shediac Bay.

The SBWA is working with the Coalition-SGSL eelgrass consortium to have access to experts to evaluate the results. It will take a few more years of data before any trends can be confirmed for eelgrass health and density.

A map of eelgrass beds for the Shediac Bay is being produced by the Coalition-SGSL in partnership with DFO. The maps will be available in the spring of 2019. These maps will help determine areas that may be suitable for future restoration projects. A more detailed report on the eelgrass project will be available in March 2019.

Figure 27: Sampling quadrant

Figure 26: Green crabs in sampling trap

5.1 Scoudouc River – Heron Lane

This eelgrass monitoring site is located in the estuary of the Scoudouc River, near the small private road Heron Lane (N46°13'32.3" W64°33'26.2"). The SBWA received permission from the property owners to use the road and park vehicles in a convenient location for easy access to the beach. This site was established and surveyed in 2016 and surveyed again in 2017. In 2018, the team spent a significant amount of time looking for the permanent station markers, using GPS and snorkelling to search the substrate for the anchors, but none were found. Due to a lack of time, this site was not surveyed in 2018. In 2019, the team will attempt to locate the anchors, and if they are not found, new anchors will be installed. Survey photos and field sheets can be found in Appendix B and C.

Figure 28: Google Earth satellite image of the Scoudouc River estuary and the location of each station markers in the site.

Figure 29: Epiphytes present on eelgrass in the Scoudouc River site in 2016.

5.2 Shediac River

The Shediac River site is located east of the bridge on Route NB-134 (N46°16'16.54" W64°34'23.30"). This site was established and surveyed in August of 2017, and a second survey was performed in August 2018. Four station markers (screw anchors) had been torn out of the substrate over the winter 2017-2018, and were replaced using a GPS, compass bearings and measuring tape triangulation. Survey photos and field sheets can be found in Appendix B and C.

Figure 30: Google Earth satellite image of the Shediac River estuary and the location of the eelgrass monitoring transects

Figure 31: Photo of the Shediac River site near the Route 134, Shediac Bridge.

5.3 Shediac Bay – Stead Street/South Cove

This eelgrass monitoring site is located in the Shediac Bay, near the mouth of the estuary of South Cove, near Pointe-du-Chêne (N46°13'53.7" W64°31'27.34"). This site was newly established in 2018, and its first survey was performed on August 7 & 8th. Survey photos and field sheets can be found in Appendix B and C.

Figure 32: Google Earth satellite image of the Shediac Bay near Pointe-du-Chêne/South Cove estuary, and the location of the Stead Street eelgrass monitoring transect

Figure 33: Photo of eelgrass survey in a healthy eelgrass bed surrounded by fish

5.4 Restoration 2018

In partnership with *Homarus* , the SBWA participated in an eelgrass restoration pilot project in the Shediac River, during the summer of 2018. SBWA staff assisted the Homarus biologist in the installation and transplanting eelgrass into specially design quadrants meant to measure the efficacy of two different transplanting methods; freehand planting and planting using empty mollusk shells.

Due to the plans for a new bridge crossing the Shediac River, part of the twinning of Highway NB-11, the SBWA decided to collect the eelgrass located in the construction zone of the new bridge. Since the eelgrass would be destroyed anyway, it was the perfect opportunity to test the transplant methods on a greater scale than the quadrants.

Using simple snorkelling equipment, SBWA staff dove to collect thousands of eelgrass plants in the shallow waters of the bridge construction zone. Floating crates were built by drilling holes into storage containers and fitting pool floaters for easy collection and transportation of the eelgrass. The plants were gently excavated from the soft substrate (mixture of sand and fine sediments) by digging with both hands and lifting from under the rhizome system, maintaining as much connected rhizomes as possible. Any eelgrass shoots with visible fish eggs were left alone.

Figure 34: Eelgrass collection and photo of rhizomes

Once collected, a portion of the plants were threaded through pre-drilled shells. The shells used were oyster and quahog shells, collected in other areas of the Shediac Bay and cleaned properly before use.

Figure 35: Threading eelgrass plants through pre-drilled shells

Transplanting eelgrass was done by first digging a hole approximately 5 cm into the substrate with an open hand, then inserting the shell or bare rhizomes at a 45 degree angle. Then, taking care of completely covering the rhizomes with sediment, firmly pressing down to compact as much substrate on top as possible.

In addition to shells, rocks with reasonable weight were collected along the shore to be used as anchors for some of the eelgrass that was absent a shell. It is important to note that shell collection, cleaning and drilling can be a time-consuming process. In order to maximize the number of transplanted eelgrass from the construction impact zone to the new bed, on-site materials were used to increase the chances of survival of the plants.

Figure 36: Transplanting eelgrass using oyster shells

The study was continued by Homarus that revisited the transplant area in August and determined that the transplants had survived except for one quadrant containing eelgrass anchored with oysters that had been destroyed. The site will be re-evaluated in 2019 to determine long-term survival rate.

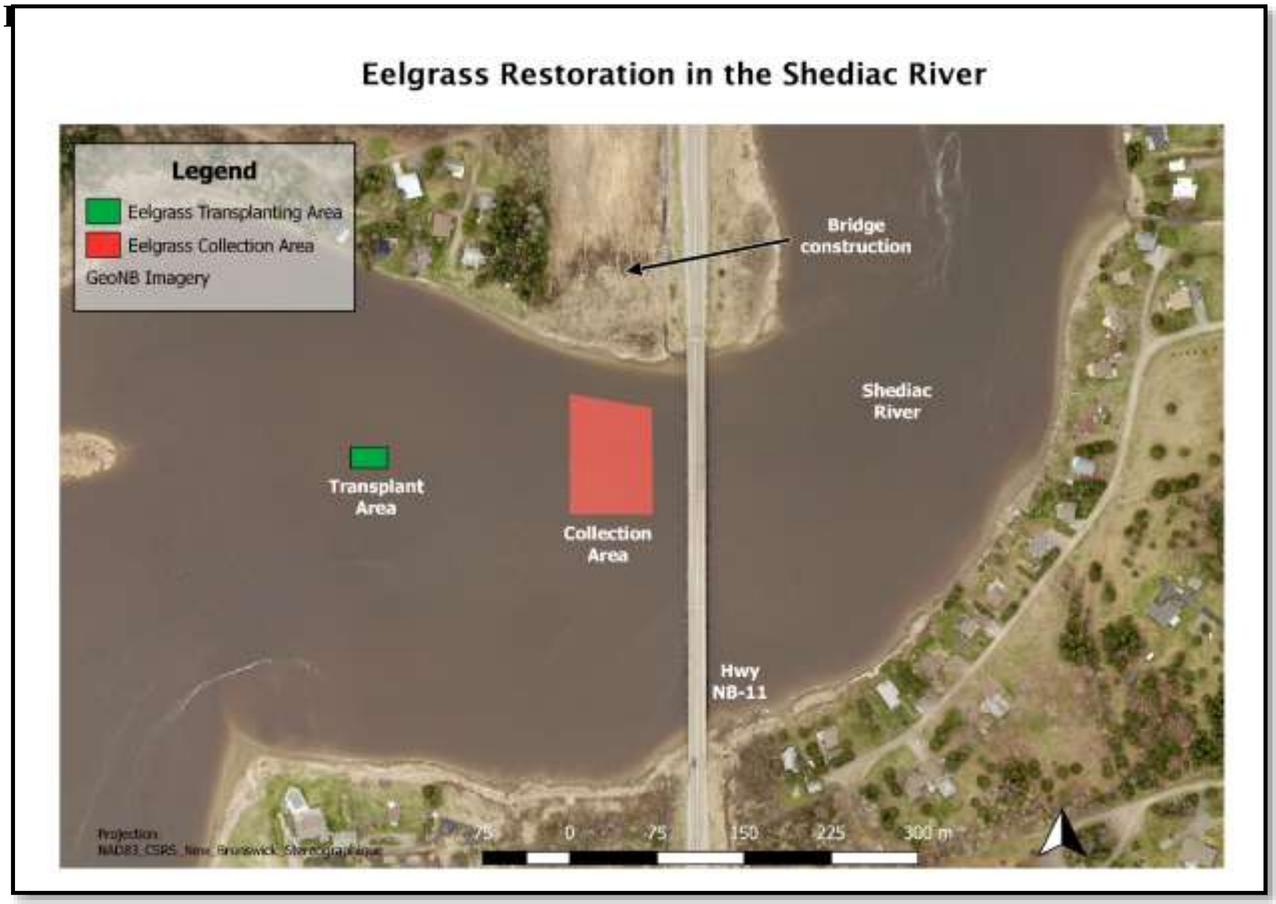


Figure 37: Eelgrass Restoration Map; Collection and Transplant Areas, 2018

6 WESP-AC Salt Marsh Assessment

The Shediac Bay Watershed Association did a trial assessment using the Wetland Ecosystem Services Protocol for Atlantic Canada (WESP-AC) for two tidal wetlands in the Shediac Bay. The first marsh is located in Pointe-du-Chêne and the second one in Grande-Digue. These marshes were chosen as they are of interest to the community to serve as educational areas to learn about wetlands.

The Grande-Digue marsh is of interest to the community group Sentier Pluriel that has developed a partnership with the Université de Moncton to develop interpretation panels and an educational trail in the marsh area. The second marsh is owned by the Anglican parish of Shediac. A partnership is being formed with the SBWA to create an educational park on a vacant lot next to the wetland.

The goal of completing the WESP-AC assessment was to gather any information that might be used in the educational materials. Also, the association wanted to test the methodology as it may apply to evaluate other wetlands that are in need of restoration.

Figure 38: Grande-Digue marsh

The WESP-AC provides ratings for 9 functions. These ratings are relative estimates but can serve to compare wetlands or measure the consequences of wetland alterations. Tidal wetlands serve other functions such as carbon storage, support of shellfish and other invertebrates. These other functions have not been included in the WESP-AC as information was lacking to create a rapid assessment. The definitions of the different functions are presented in the following table. More background information on the studies and factors that determine the evaluation can be found in the protocol (Annex 1).

WESP-AC Functions definitions

Storm Surge Interception
Definition: The effectiveness for intercepting tidal surges associated with infrequent but severe storm events, and reducing their height. Storm-surge elevation is the difference between the observed water level during the surge and the level that the tide would normally rise to in the absence of storm activity.

Water Purification
Definition: Effectiveness for maintaining or restoring naturally occurring levels of suspended sediment, salinity, inorganic nutrients, metals, hydrocarbons, and other substances in coastal waters.

Organic Nutrient Export
Definition: The effectiveness for producing and subsequently exporting organic nutrients, either particulate or dissolved, along with associated compounds and elements such as iron.

Fish Habitat
Definition: The capacity to support an abundance and/or diversity of resident and/or anadromous fish species. Support occurs only seasonally or for brief times for the purpose of spawning, rearing, or feeding. The scoring model will not predict habitat suitability accurately for every tidal wetland fish species in this region.

Waterbird Habitat
Definition: The capacity to directly support an abundance or diversity of waterbirds, mainly those that migrate or winter in the region but including a few that sometimes nest in tidal wetlands. This includes shorebirds (sandpipers, plovers, phalaropes, etc.), waterfowl (ducks, geese, swans), gulls, cormorants, loons, grebes, and others. The scoring model will not predict habitat suitability accurately for every species in this group.

Songbird and Raptor Habitat
Definition: The capacity to directly support an abundance or diversity of songbirds and raptors, both residents and migrants, and especially those that commonly feed or nest in saline tidal wetlands and ones that commonly feed or nest in tidal fresh or brackish wetlands. The scoring model will not predict habitat suitability accurately for every species in this function group.

Biodiversity Maintenance
Definition: The capacity to directly support plant and animal species which, by their rarity or narrow habitat requirements, contribute disproportionately to the overall richness of flora and fauna of this region.

Wetland Stability
Definition: The likelihood that the tidal wetland will persist physically in the face of rising sea levels and climate change.

Public Use or Recognition
Definition: The potential and/or actual capacity to support non-consumptive (e.g., birding, education, research) and/or sustainable consumptive (e.g., hay harvesting, fishing) uses.

Source: Manual for Wetland Ecosystem Services Protocol for Atlantic Canada (WESP-AC), Tidal Wetlands: New Brunswick Department of Environment and Local Government, April 2018

6.1 Pointe-du-Chêne Marsh

A portion of the marsh in South Cove Pointe-du-Chêne was evaluated. The section that was evaluated was chosen as it will be the first phase in a future marsh education park. The site was accessed from the walking trail at the end of Railway Avenue.

Figure 39: Assessment area for Pointe-du-Chêne Marsh

6.1.1 Results

The following table shows the scores for the WESP-AC evaluation followed by a brief explanation of the factors that have influenced the score.

Table 43: WESP-AC scores for Pointe-du-Chêne Marsh

Functions or Attributes	Normalized Score	Rating
Storm Surge Interception (SS)	4,72	Higher
Water Purification (WP)	1,09	Lower
Organic Nutrient Export (OX)	4,07	Lower
Fish Habitat (FH)	5,82	Moderate
Waterbird Habitat (WH)	2,61	Lower
Songbird & Raptor Habitat (SRH)	6,01	Moderate
Biodiversity Maintenance (BM)	4,34	Moderate
Wetland Stability (WS)	5,95	Higher
Public Use & Recognition (PUR)	5,11	Higher

Storm surge interception – The score for storm surge interception is higher as the vegetation in salt marshes provides friction and reduces the height of incoming tidal surges. Although, the degree of protection the marsh offers is dependent on the tide and direction of the winds. A storm surge when marsh vegetation is already covered by the high water still risk damages to surrounding properties.

Water purification – The water purification rating for the marsh is considered lower as the marsh width and area are taking in consideration and this marsh area has been narrowed by residential development and infilling. The marsh still serves the function of water purification by retaining and depositing sediment over time.

Organic nutrient export – Marshes are deemed to store carbon and other nutrients because of the high productivity of vegetation that supports the food webs. The Pointe-du-Chêne Marsh has a lower rating for this function as the upper marshes is a residential area and there are few tidal channels in the marsh.

Fish habitat – The fish habitat for the Pointe-du-Chêne Marsh is considered moderate as there is no fresh water stream flowing in the marsh and few tidal inlets.

Waterbird habitat – Waterbird habitat is considered lower for this marsh as it is small and does not have extensive open water that would benefit waterbirds such as ducks.

Songbird and raptor Habitat – The marsh has moderate habitat for songbirds and raptors. A good percentage of the marsh is considered high marsh, the preferred habitat for songbirds.

Biodiversity maintenance- This marsh has the presence of the vegetation species characteristic of a salt marsh. The presence of a rare species would have rated the site higher.

Wetland stability – If no further development is done along the wetland edge, the marsh should be able to migrate normally with Sea level rise.

Public use and recognition – The presence of the walking trail next to the marsh gives a good vantage point to appreciate this marsh. A project proposal is submitted to designate the marsh as an educational park that will increase public use in a sustainable manner.

6.2 Grande-Digue Marsh

The Grande-Digue marsh is situated south of route 530 and can be accessed by following the shoreline from the fishing wharf in Caissie Cape or by contacting a local landowner.

Figure 40: Assessment area for Grande-Digue Marsh

6.2.1 Results

The following table shows the scores for the WESP-AC evaluation followed by a brief explanation of the factors that have influenced the score.

Table 44: WESP-AC scores for Grande-Digue Marsh

Functions or Attributes	Normalized Score	Rating
Storm Surge Interception (SS)	3,30	Moderate
Water Purification (WP)	0,18	Lower
Organic Nutrient Export (OX)	5,58	Moderate
Fish Habitat (FH)	6,47	Moderate
Waterbird Habitat (WH)	3,59	Moderate
Songbird & Raptor Habitat (SRH)	6,24	Moderate
Biodiversity Maintenance (BM)	4,59	Moderate
Wetland Stability (WS)	4,88	Moderate
Public Use & Recognition (PUR)	4,09	Higher

Storm surge interception – The score for storm surge interception is moderate as the vegetation in salt marshes provides friction and reduces the height of incoming tidal surges. The degree of protection the marsh offers is dependent on the tide and direction of the winds. A storm surge when marsh vegetation is already covered by the high water still risk damages to surrounding properties.

Water purification – The water purification rating for the marsh is considered lower as the presence of ditches in the marsh reduces the ability to filter water compared to a marsh with no modifications to its flow. The marsh still serves the function of water purification by retaining and depositing sediment over time.

Organic nutrient export – Marshes are deemed to store carbon and other nutrients because of the high productivity of vegetation that supports the food webs. The Grande-Digue Marsh as a moderate rating for this function as the drainage has been modified and a portion of the high marsh is mowed.

Fish habitat – Fish habitat is considered moderate for the Grande-Digue marsh due to the presence of ditches and the lack of a freshwater stream flowing into the marsh.

Waterbird habitat – Waterbird habitat is considered moderate for this marsh as it is large and has open water and ponds that benefit waterbirds such as ducks. The surrounding area is also open and undeveloped.

Songbird and raptor Habitat – The marsh has moderate habitat for songbirds and raptors. The large size and elevated percentage of the marsh that is in the high zone increase preferred habitat for songbirds.

Biodiversity maintenance- The marsh has the vegetation and biodiversity that is normal for salt marshes in the area. No rare species was found during the survey.

Wetland stability – The wetland has no development in its vicinity and will be able to adapt to sea-level rise. The presence of drainage ditches lowered the rating from high to moderate.

Public use and recognition – The marsh now has a trail and observation deck that will allow the public to enjoy the marsh. This marsh is considered an important part of the local landscape and is protected by zoning.

Figure 41: SBWA staff during WESP-AC assessment and Sea lavender, a salt marsh plant

7 Buffer Zone Enhancement in Boudreau-Ouest

The Boudreau-Ouest marsh is a small estuary of the unnamed brook at Cap-Brulé located next to route 133. This salt water marsh was in need of restoration due to erosion and the lack of buffer zones. Landowners' permission and a WAWA permit was acquired in order to plant native trees to create a buffer zone on each side of the stream. The planting of 417 native trees was conducted on June 5, 7, 13, 14 and 21. A diversity of trees was selected, including: white spruce, tamarack, red maple, red oak, grey and yellow birch and trembling aspen.

Unfortunately, there was a miscommunication between one of the landowners and the person that mows the field every summer. During the summer, the field in which trees were planted on one side of the stream, was mowed. It is unknown how many trees died during this process. However it was observed that some survived. A thorough survival count will be conducted in 2019. Following this tragic event, the SBWA is to place signs on all of their newly planted area. The signs simply indicates that there are young trees planted in the area in order to increase the buffer zone and stabilize the stream banks.

Figure 42: Map of the tree planting site at the Boudreau-Ouest saltmarsh

Figure 43: Photos of tree planting site in the Boudreau-Ouest saltmarsh

8 Public Education, Outreach and Involvement

8.1 Boater Awareness Program

Educational materials for boaters developed in 2018 was distributed to local marinas during the summer. The pamphlet and poster lists pump-out stations locations that are available in Southeast New Brunswick to properly dispose of sewage. Both marinas in Shediac Bay have updated their systems in 2018.

The Shediac Bay Watershed Association will be participating in an environmental committee for the Blue Flag designation of the Shediac Bay Yatch Club. The Blue Flag is an international eco-label to ensure marinas meet strict criteria in different categories. The Shediac Bay Watershed Association will expand its partnership with the marina to have more educational materials and events at the Yatch Club.

The Pointe-du-Chêne Harbour Autority has an advisory committee to oversee recommendations for future maintenance and development of the wharf. The SBWA is participating in this committee to provide recommendations regarding the environmental impacts and opportunities for environmental education or restoration.

These partnerships that have been formalized in 2018 will allow the SBWA to expand environmental stewardship activities with pleasure boat users.

PROTECTING THE MARINE ENVIRONMENT

INFORMATION FOR RECREATIONAL BOATERS

Figure 44: Boater Awareness pamphlet side 1 (English)

8.2 Beach Sweep

In celebration of World's Oceans Day, a public beach sweep event is organized every year by the SBWA, in partnership with the Town of Shediac. This activity aims to combat marine litter, to raise awareness, and contribute to the protection and conservation of our marine environment in the Shediac Bay. The event was advertised to begin at the Homarus Eco-Centre, at the Pointe-du-Chêne wharf on Saturday, June 9 2018.

It was a beautiful warm sunny day, and 17 volunteers showed up to pick up trash along the coastline of the Town of Shediac. SBWA staff greeted volunteers and provided them with gloves, garbage bags and small handout gifts.

People were directed to different parts of the coastline in order to cover as much ground as possible. There were designated drop-off points for their garbage bags, which would then be picked up by staff of the Town of Shediac. Our volunteers were then invited to a lunch of subs donated by the *Shediac Subway*, along with fruit and vegetable platters donated by the *Shediac Coop IGA*. Special thanks go out to Oceanside Fitness Gym and Shediac Dixie Lee, for donated gift certificates as prize draws for the volunteers; 2 one month free memberships at the gym, and two 10$ gift cards at Dixie Lee. Other toy prizes were drawn for the children participating in the event.

In total, 14 large garbage bags in addition to larger trash items were collected by the volunteers and brought back to the Homarus Eco-Centre.

It is not a surprise that the items found in greater quantities includes cigarette buds, food wrappers, coffee cups, plastic bags, Styrofoam, cans, bottle caps, etc.

Based on volunteer feedback an estimate of 3.5 km of coastline was cleaned that day.

Figure 45: Annual Beach Sweep June 9, 2018

8.3 TD Tree Day 2018

Every year, the Shediac Bay Watershed Association (SBWA) teams up with TD Bank and members of the community to plant 150 trees as part of the TD Tree Days events throughout Canada. On September 22nd, 34 motivated volunteers, TD employees and the SBWA staff planted 170 native trees to establish a buffer zone for the protection of a salt marsh located in Pointe-du-Chêne. Everyone gathered at the site at 9 in the morning. Coffee, water and snacks were provided by TD.

To begin the event, Rémi Donelle of the SBWA, gave a presentation on the importance of protecting wetlands. He emphasized the importance of establishing a good buffer zone and the importance to help increase the biodiversity of the area by planted various species of native trees. After the presentation, everyone grabbed a shovel to plant the 170 native trees in the designated area.

Figure 46: Photo of the presentation before the tree planting event and a photo of the volunteers at work.

Figure 47: Photo of the TD Tree Days site and volunteers working

Only native trees were chosen for this tree planting event. The trees were purchased from two local nurseries: Sunrise Nursery and Springfield Trees. SBWA and Petitcodiac Watershed Alliance (PWA) provided the shovels for the event. After the event, each tree was verified to see if they were planted properly.

Figure 48: Aerial view of the TD Tree Days site in Pointe-du-Chêne

The 2018 TD Tree Days event was a success. All the 170 trees were planted in just one hour, which is very impressive. The SBWA would firstly like to thank the Anglican Parish of Shediac for giving permission to have this wonderful event on their land. The SBWA would also like to thank PWA for their generosity in lending their shovels for the event.

Figure 49: Group photo of the volunteers

8.4 Educational Kiosks

8.4.1 Shediac Farmer’s Market

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

Figure 50: Shediac Farmer's Market in the Park

8.4.2 Lobster Festival

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

Figure 51: Shediac Lobster Festival

8.5 Media Outreach

8.5.1 Newsletter

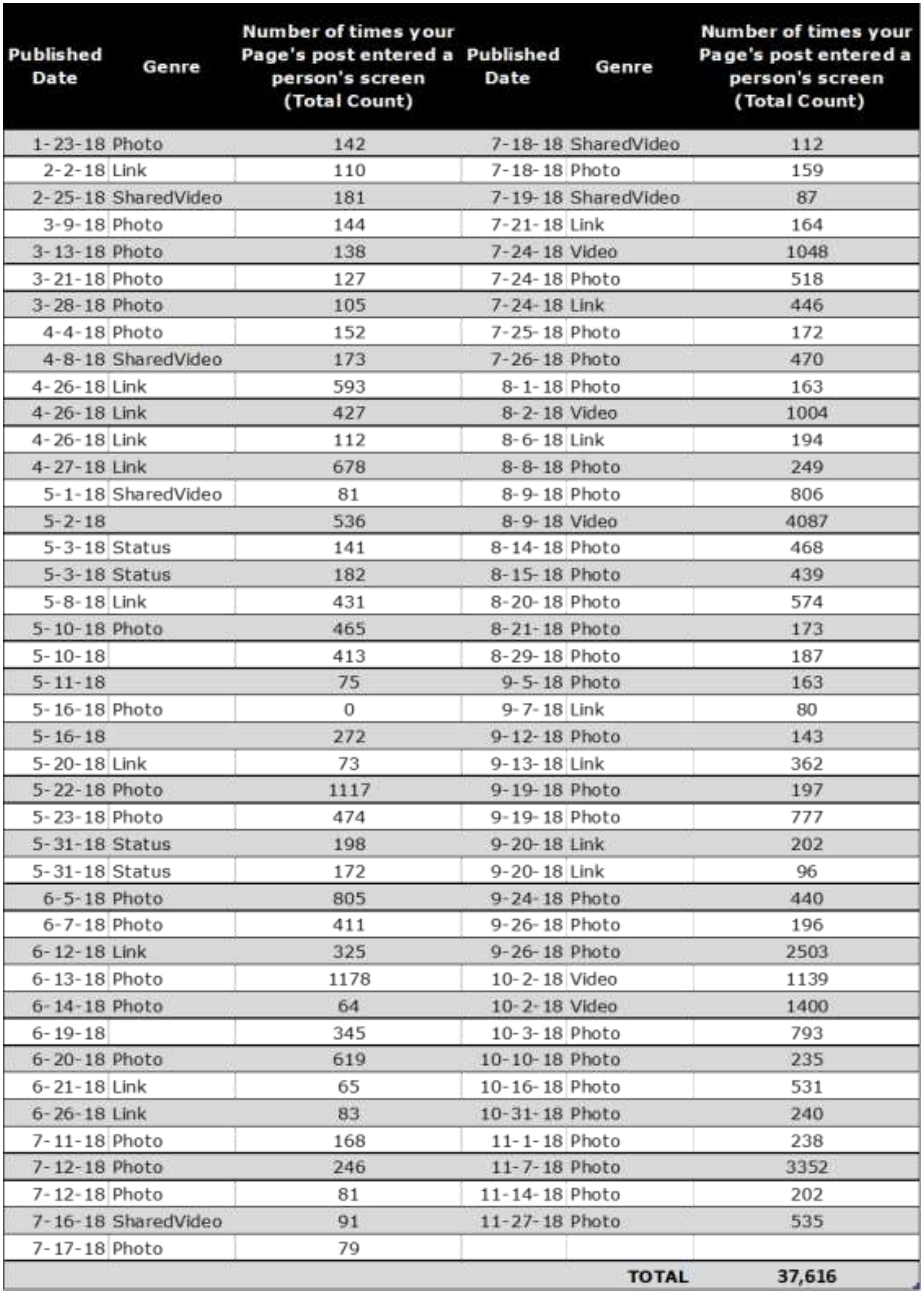
A bilingual newsletter was produced during the 2018-2019 fiscal year. The newsletter display information and photos on the various projects that the SBWA has been doing in the year. The Association had 250 copies produced for each edition, printed on 100% recycled paper. The newsletters are distributed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

8.5.2 Socials Medias and Website

The SBWA is working to keep its website and social media up to date, posting photos and short description of activities and projects. The SBWA now has a dedicated employee who focuses on outreach and communications, and the design and production of educational materials. Therefore, 2018 was a turning point for social media outreach. See Table 45 for details.

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

Table 45: SBWA Social Media Outreach 2018



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

9 Closing Comments

The evaluation of the Health of Shediac Bay program has terminated its third year. The aim of the program is to identify areas and ecosystems that can benefit from restoration and gather data on the health of the Shediac Bay.

The water quality monitoring is showing some areas that have samples with high bacterial counts in small streams. Land use around these areas will be examined to determine if the cause of the contamination can be found. Landowners will be invited to participate in restoration efforts and stewardship programs to reforest the streams.

The Shediac Bay Watershed Association will also be working more closely with the Town of Shediac to develop storm water management projects and stewardship activities in the town limits.

When dealing with non-point source pollution in a watershed, one cannot be expected to solve the issues of human activities overnight. Problems related storm water runoff and faults in both private and municipal infrastructure can take several years and even decades to be detected and resolved. Collaborations between environmental groups, businesses, private citizens and government are crucial in the development and implementation of an action plan.

The Coalition for the Sustainability of the Southern Gulf of Saint Lawrence coordinates a working group on eelgrass monitoring and restoration. The working group brings, government agencies, academics, ENGO’s and First Nations around the table to discuss different projects on eelgrass that is conducted in the region. The eelgrass beds of Shediac Bay have been surveyed by different methods to determine the present extent of the beds. The SeagrassNet protocol will help validate data that is collected remotely. A final eelgrass monitoring site will be added in Grande-Digue to have sites in all areas around the bay. It will take several years of monitoring to determine if the green crab has a negative impact on eelgrass and if restoration or protection measures are needed.

Salt marshes are an important part of the bay ecosystem. The SBWA will expand on its education program to include more activities around salt marshes. The WESP-AC evaluation can be useful to compare different salt marshes around the bay and prioritize them for restoration or protection activities. A project is proposed for the marsh in Pointe-du-Chêne to create a marsh education park. This would allow the SBWA to do marsh discovery activities with schools and the public. The Grande-Digue marsh is also the focus of a community project for educational trails in the community. A group is formed for the Grande-Digue Marsh with the Université de Moncton, the Shediac Bay Watershed and local residents to restore the sand dune and protect the salt marsh.

The next phases of this project will develop more shoreline restoration solutions for landowners to reduce erosion and increase biodiversity. A workshop on living shorelines will be presented in March 2019 to local landowners. We hope to recruit interested participants for a pilot project in Shediac Bay. The use of native plants and artificial reefs to improve shorelines will be explored further.

A restoration priority for the association will be to continue reforesting buffer zones around marshes and small streams. By helping streams and marshes regain a more naturalized state their function to improve water quality will be enhanced. The reforestation will also help biodiversity by providing habitat for birds and other animals.

The Shediac Bay Watershed Association will continue the various educational campaigns around the health of the Shediac Bay. The association will continue to increase opportunities for stewardship activities with the public such as shoreline clean-ups and tree planting activities. Partnerships with the local marinas will help promote best practices for boaters that are regular users of Shediac Bay. Other partnerships such as the beach sweep with the town of Shediac will be developed to help increase awareness around the importance of a healthy environment.

Educational materials will continue to be produced by the SBWA for all its projects. There will be an increase of the presence in social media and at local events.

The Shediac Bay Health Evaluation project has gathered a wide range of information since 2016. The project will continue to expand in the coming years with increasing partnerships. There is still more that can be done to improve our knowledge about the Shediac Bay. As the project evolves the association will concentrate on more stewardship projects to help improve the environment around Shediac Bay.

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Appendix A – WATER CHEMISTRY METHODOLOGY

Table 46: RPC Laboratory Analytical Methods

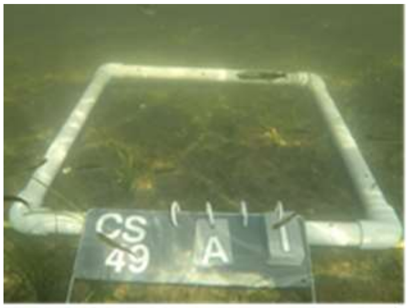
RPC LABORATORY ANALYTICAL METHODS				
Analyte	Parameter	RPC SOP Number	Method Reference	Method Principle
Ammonia	NH_3T	4.M47	APHA 4500-NH3 G	Phenate Colourimetry
pH	pH	4.M03	APHA 4500-H+ B	pH Electrode - Electrometric
Alkalinity (as CaCO3)	ALK_T	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	Cl	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 47: 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: Eelgrass Monitoring Transect Photos

Eelgrass Monitoring Transect Photos: Stead St./South Cove



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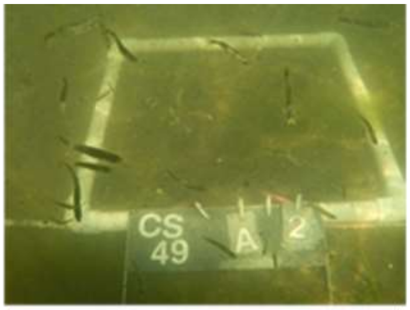

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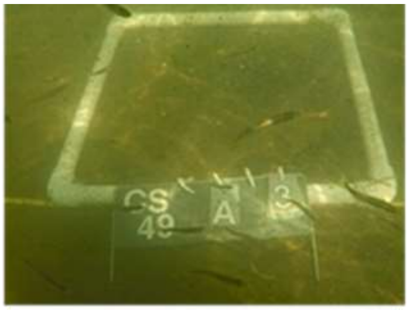

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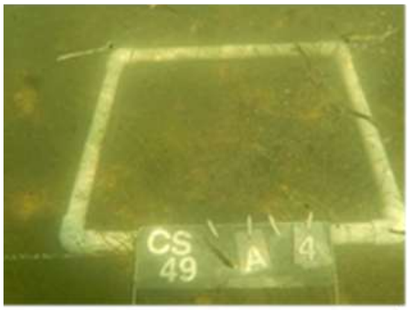

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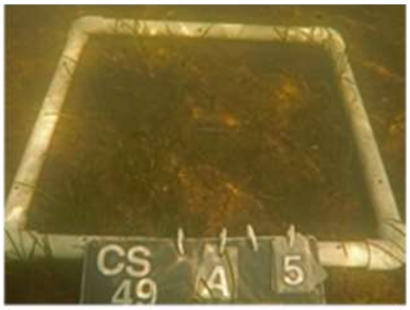

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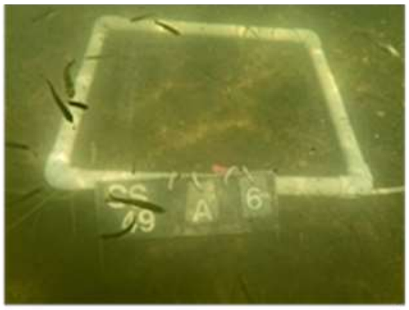

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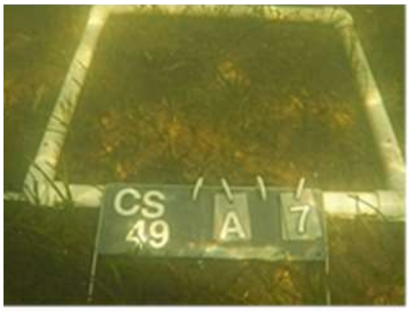

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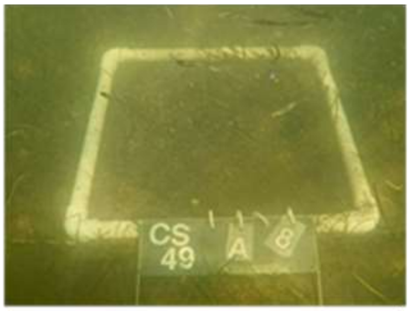

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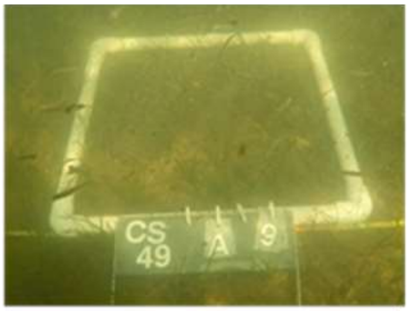

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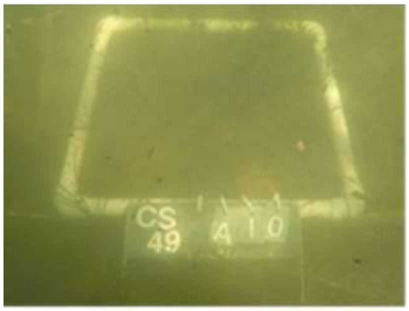

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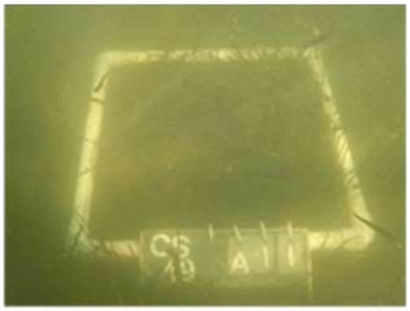

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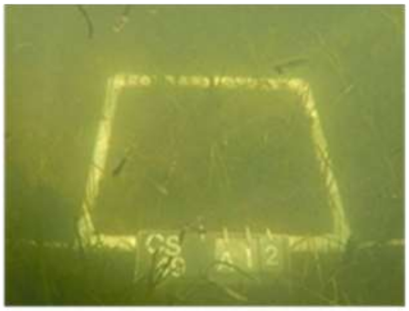

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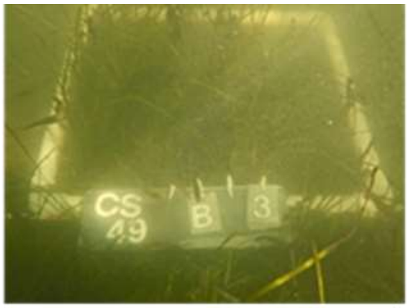

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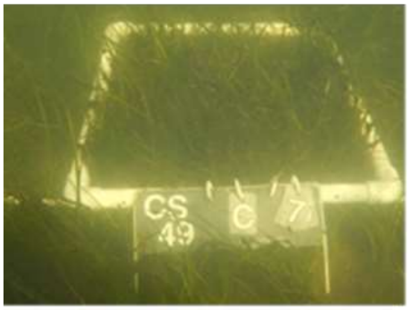

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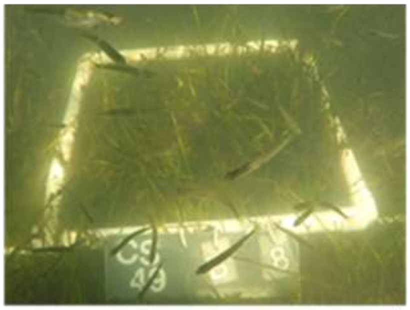

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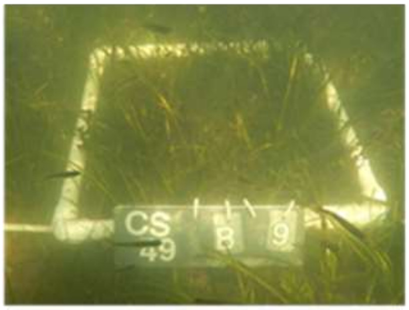

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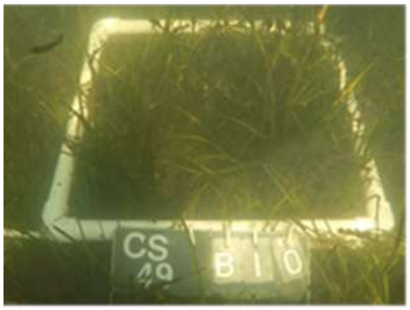

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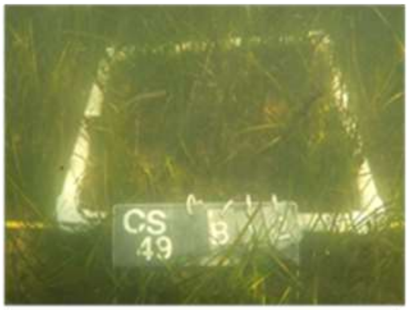

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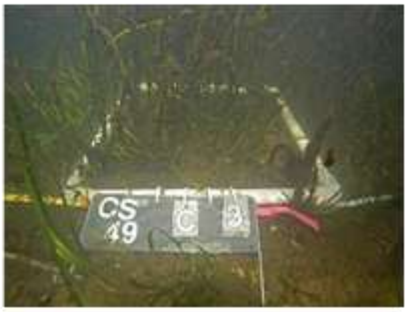

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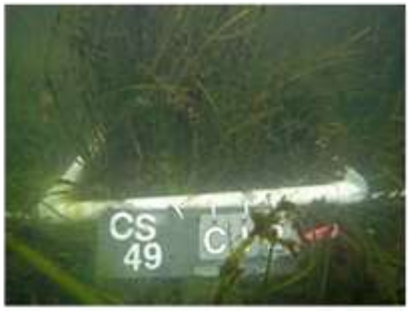

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Eelgrass Monitoring Transect Photos: Shediac River

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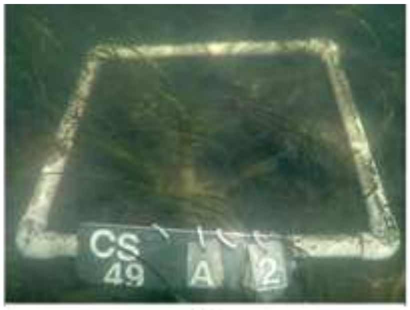

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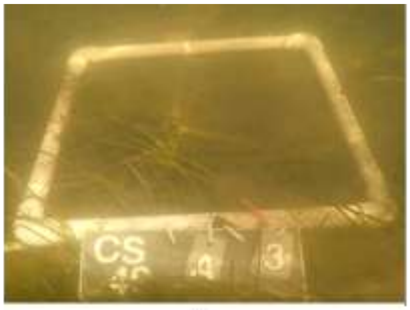

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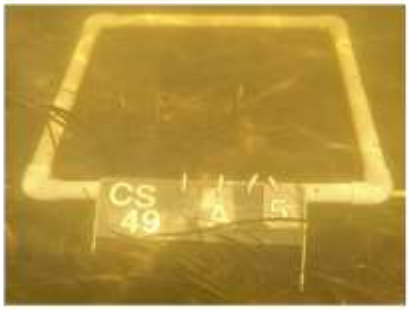

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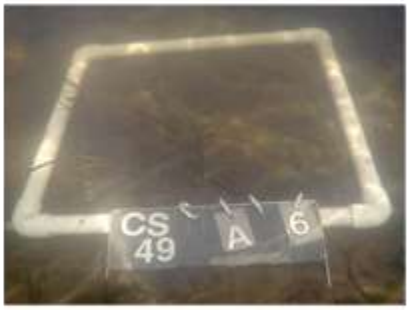

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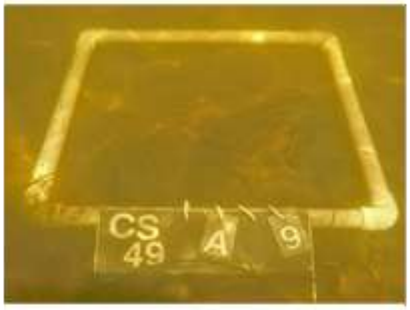

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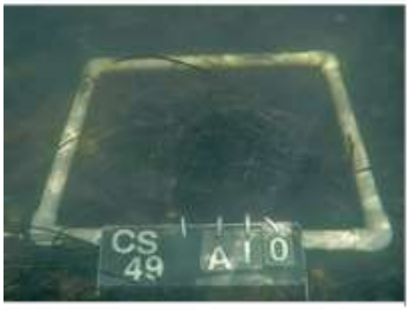

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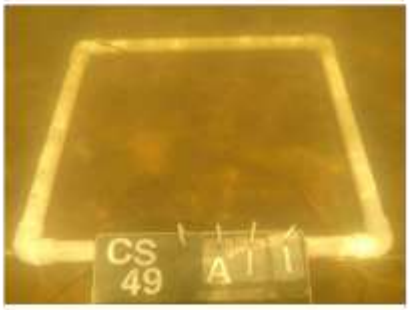

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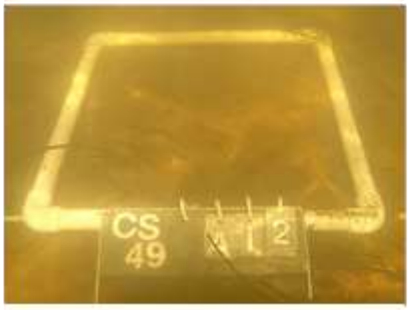

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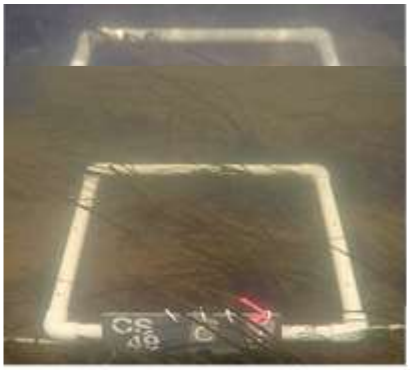

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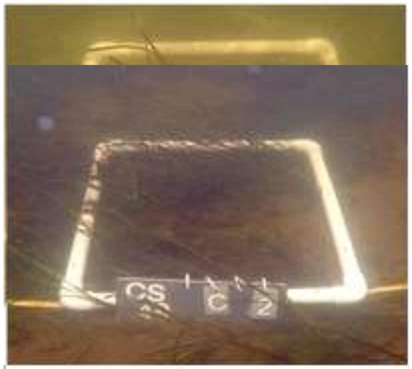

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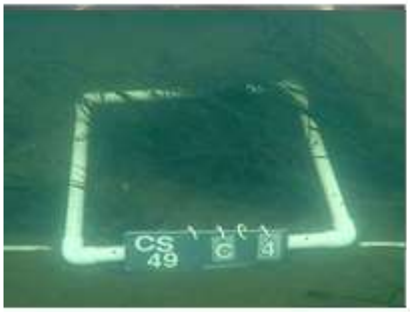

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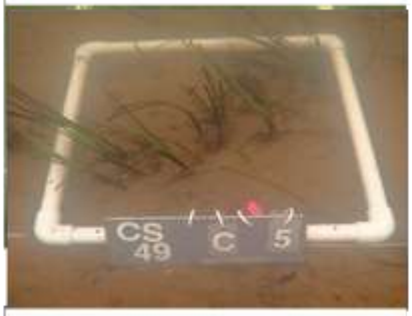

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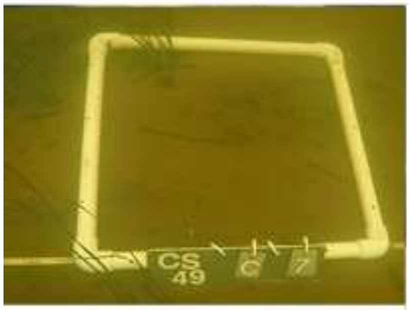

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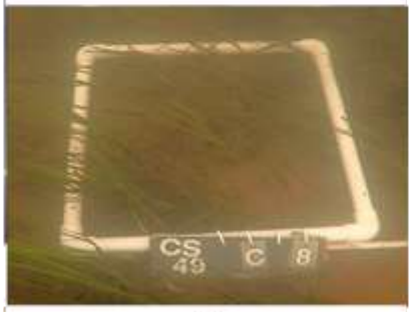

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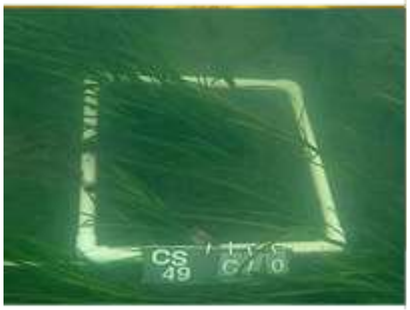

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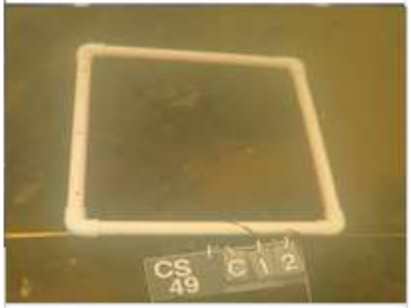

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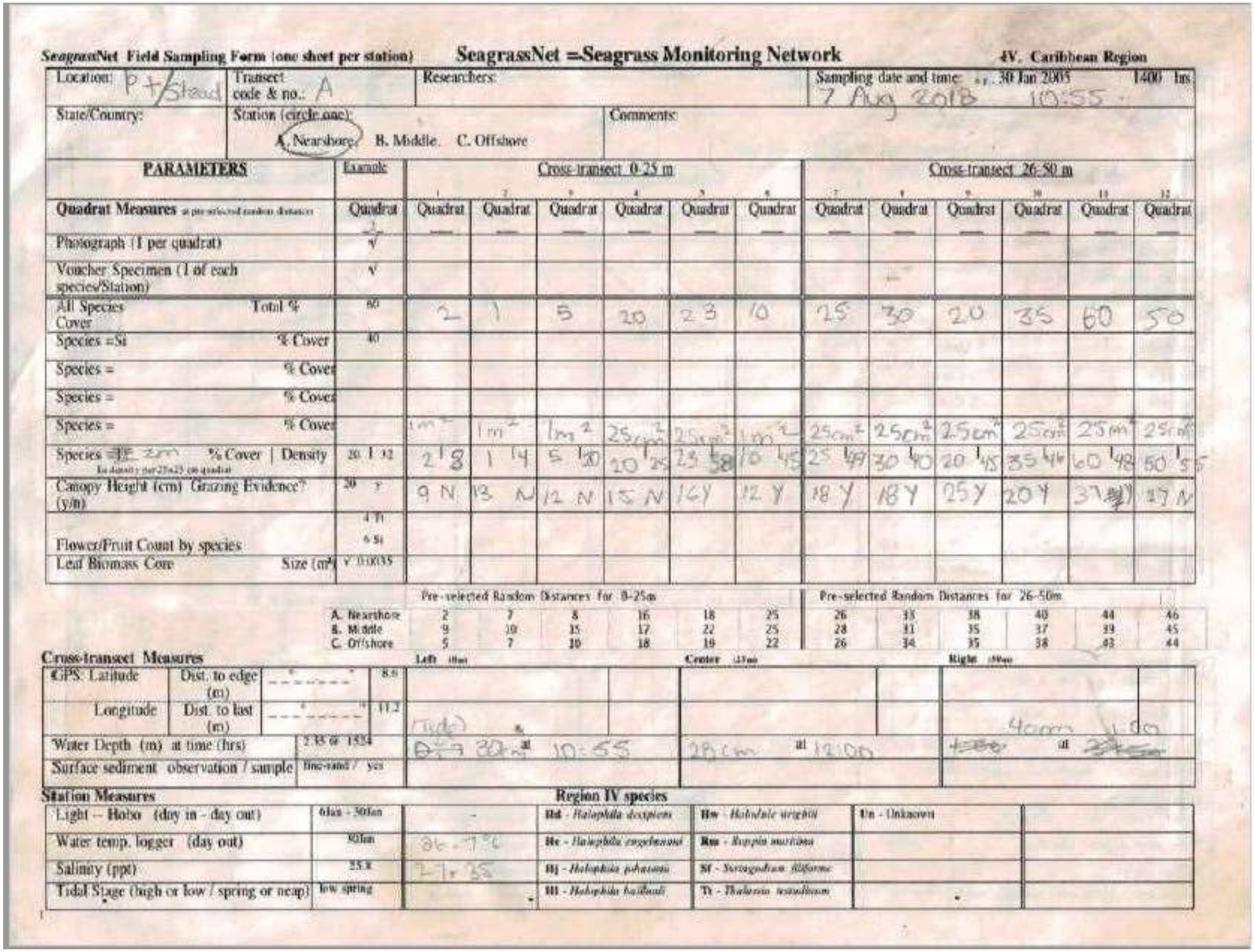
Appendix C: Eelgrass Monitoring Field Sheets

Eelgrass Monitoring Field Sheets: Stead St./South Cove



SeagrassNet Field Sampling Form (one sheet per station) **SeagrassNet =Seagrass Monitoring Network** 4V. Caribbean Region

Location: Pt/Stead	Transect code & no.: A	Researchers:	Sampling date and time: e.g. 30 Jan 2005 1400 hrs 7 Aug 2018 10:55
State/Country:	Station (circle one): [✓ A. Nearshore] B. Middle C. Offshore	Comments:	

PARAMETERS	Example	Cross-transect 0-25 m						Cross-transect 26-50 m					
		1	2	3	4	5	6	7	8	9	10	11	12
Quadrat Measures at pre-selected random distances	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat
Photograph (1 per quadrat)	√												
Voucher Specimen (1 of each species/Station)	√												
All Species Cover Total %	60	2	1	5	20	23	10	25	30	20	35	60	50
Species =Si % Cover	40												
Species = % Cover													
Species = % Cover													
Species = % Cover		1m²	1m²	1m²	25cm²	25cm²	1m²	25cm²	25cm²	25cm²	25cm²	25m²	25m²
Species =EE Zm % Cover | Density (Ex density per 25x25 cm quadrat)	20 | 32	2 | 8	1 | 14	5 | 20	10 | 25	23 | 58	10 | 45	25 | 49	30 | 40	20 | 45	35 | 46	60 | 48	50 | 55
Canopy Height (cm) Grazing Evidence? (y/n)	20 Y	9 N	13 N	12 N	15 N	16 Y	12 Y	18 Y	18 Y	25 Y	20 Y	37	17 N
Flower/Fruit Count by species	4 Tt 6 Si												
Leaf Biomass Core Size (m²)	Y 0.0035												

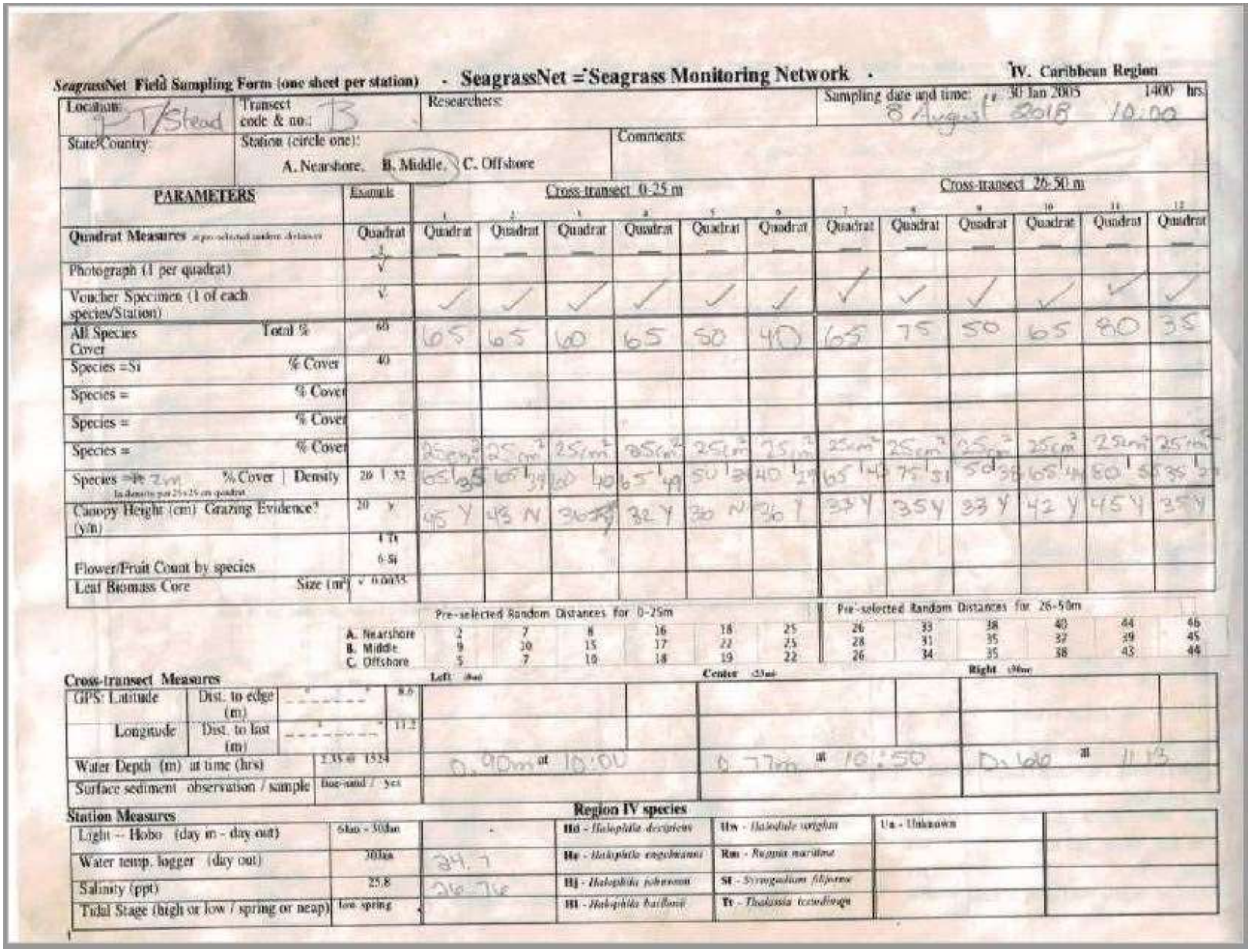
	Pre-selected Random Distances for 0-25m						Pre-selected Random Distances for 26-50m					
A. Nearshore	2	7	8	16	18	25	26	33	38	40	44	46
B. Middle	9	10	15	17	22	25	28	31	35	37	39	45
C. Offshore	5	7	10	18	19	22	26	34	35	38	43	44

Cross-transect Measures

				Left (0m)	Center (25m)	Right (50m)
GPS: Latitude	Dist. to edge (m)	° '	8.6			
Longitude	Dist. to last (m)	° '	11.2	(Tide)		40cm 1:00
Water Depth (m) at time (hrs)			2.35 @ 1524	[illegible] 30cm at 10:55	28cm at 12:00	~~[illegible]~~ at ~~[illegible]~~
Surface sediment observation / sample			fine-sand / yes			

Station Measures **Region IV species**

Light -- Hobo (day in - day out)	6Jan - 30Jan	-	**Hd** - *Halophila decipiens*	**Hw** - *Halodule wrightii*	**Un** - Unknown	
Water temp. logger (day out)	30Jan	26.7°C	**He** - *Halophila engelmanni*	**Rm** - *Ruppia maritima*		
Salinity (ppt)	25.8	27, 35	**Hj** - *Halophila johnsonii*	**Sf** - *Syringodium filiforme*		
Tidal Stage (high or low / spring or neap)	low spring		**Hb** - *Halophila baillonii*	**Tt** - *Thalassia testudinum*		



SeagrassNet **Field Sampling Form (one sheet per station)** - **SeagrassNet = Seagrass Monitoring Network** - **IV. Caribbean Region**

Location: J-T/Stead	Transect code & no.: 13	Researchers:	Sampling date and time: " 30 Jan 2005 1400 hrs 8 August 2018 10:00
State/Country:	Station (circle one): A. Nearshore, [✓ B. Middle,] C. Offshore	Comments:	

PARAMETERS	Example	Cross-transect 0-25 m						Cross-transect 26-50 m					
		1	2	3	4	5	6	7	8	9	10	11	12
Quadrat Measures at pre-selected random distances	Quadrat 1	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —
Photograph (1 per quadrat)	√												
Voucher Specimen (1 of each species/Station)	√	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
All Species Cover Total %	65	65	65	60	65	50	40	65	75	50	65	80	35
Species =Si % Cover	40												
Species = % Cover													
Species = % Cover													
Species = % Cover		$25 cm^2$	$25 cm^2$	$25 m^2$	$35 cm^2$	$25 cm^2$	$25 cm^2$	$25 cm^2$	$25 cm^2$	$25 cm^2$	$25 cm^2$	$25 cm^2$	$25 cm^2$
Species => 2m % Cover | Density In density per 25x25 cm quadrat	20 | 32	65 | 35	65 | 34	60 | 40	65 | 49	50 | 38	40 | 29	65 | 43	75 | 31	50 | 38	65 | 44	80 | 5	35 | 2
Canopy Height (cm) Grazing Evidence? (y/n)	20 y	45 Y	43 N	30 [illegible]	32 Y	30 N	36 Y	37 Y	35 Y	33 Y	42 Y	45 Y	35 Y
Flower/Fruit Count by species	4 Tt 6-Si												
Leaf Biomass Core Size (m^2)	√ 0.0033												

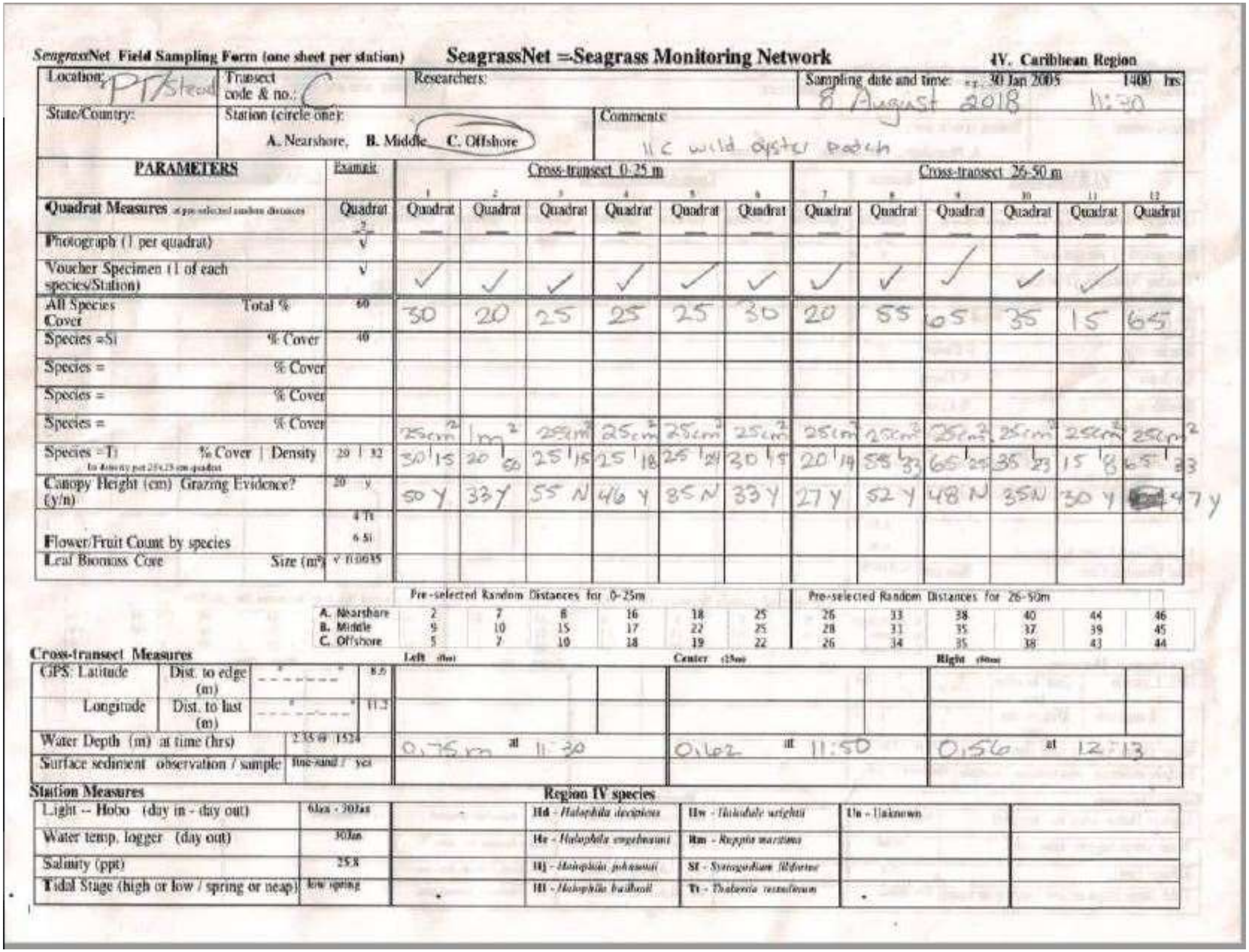
	Pre-selected Random Distances for 0-25m						Pre-selected Random Distances for 26-50m					
A. Nearshore	2	7	8	16	18	25	26	33	38	40	44	46
B. Middle	9	10	15	17	22	25	28	31	35	37	39	45
C. Offshore	5	7	10	18	19	22	26	34	35	38	43	44

Cross-transect Measures

				Left (0m)		Center (25m)		Right (50m)	
GPS: Latitude	Dist. to edge (m)	° ' "	8.6						
Longitude	Dist. to last (m)	° ' "	11.2						
Water Depth (m) at time (hrs)		1.35 @ 1524		0.90m at 10:00		0.77m at 10:50		0.66 at 11:13	
Surface sediment observation / sample		fine-sand / yes							

Station Measures

			Region IV species			
Light -- Hobo (day in - day out)	6Jan - 30Jan	-	**Hd** - *Halophila decipiens*	**Hw** - *Halodule wrightii*	Un - Unknown	
Water temp. logger (day out)	30Jan	24.7	**He** - *Halophila engelmanni*	**Rm** - *Ruppia maritima*		
Salinity (ppt)	25.8	26.76	**Hj** - *Halophila johnsonii*	**Sf** - *Syringodium filiforme*		
Tidal Stage (high or low / spring or neap)	low spring		**Hl** - *Halophila baillonii*	**Tt** - *Thalassia testudinum*		



SeagrassNet **Field Sampling Form (one sheet per station)** **SeagrassNet =Seagrass Monitoring Network** **IV. Caribbean Region**

Location: PT/Stead	Transect code & no.: C	Researchers:	Sampling date and time: ex. 30 Jan 2005 1400 hrs 8 August 2018 11:30
State/Country:	Station (circle one): A. Nearshore, B. Middle [✓ C. Offshore]	Comments: 1/C wild oyster patch	

PARAMETERS	Example	Cross-transect 0-25 m 1	2	3	4	5	6	Cross-transect 26-50 m 7	8	9	10	11	12
Quadrat Measures at pre-selected random distances	Quadrat 2	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat
Photograph (1 per quadrat)	√												
Voucher Specimen (1 of each species/Station)	√	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
All Species Cover Total %	60	30	20	25	25	25	30	20	55	65	35	15	65
Species =Si % Cover	40												
Species = % Cover													
Species = % Cover													
Species = % Cover		25cm²	1m²	25cm²	25cm²	25cm²	25cm²	25cm²	25cm²	25cm²	25cm²	25cm²	25cm²
Species =Tt % Cover | Density In density per 25x25 cm quadrat	20 | 32	30 | 15	20 | 60	25 | 15	25 | 18	25 | 24	30 | 15	20 | 14	55 | 33	65 | 25	35 | 23	15 | 8	65 | 33
Canopy Height (cm) Grazing Evidence? (y/n)	20 y	50 Y	33 Y	55 N	46 Y	85 N	33 Y	27 Y	52 Y	48 N	35 N	30 Y	47 y
Flower/Fruit Count by species	4 Tt 6 Si												
Leaf Biomass Core Size (m²)	√ 0.0035												

	Pre-selected Random Distances for 0-25m						Pre-selected Random Distances for 26-50m					
A. Nearshore	2	7	8	16	18	25	26	33	38	40	44	46
B. Middle	9	10	15	17	22	25	28	31	35	37	39	45
C. Offshore	5	7	10	18	19	22	26	34	35	38	43	44

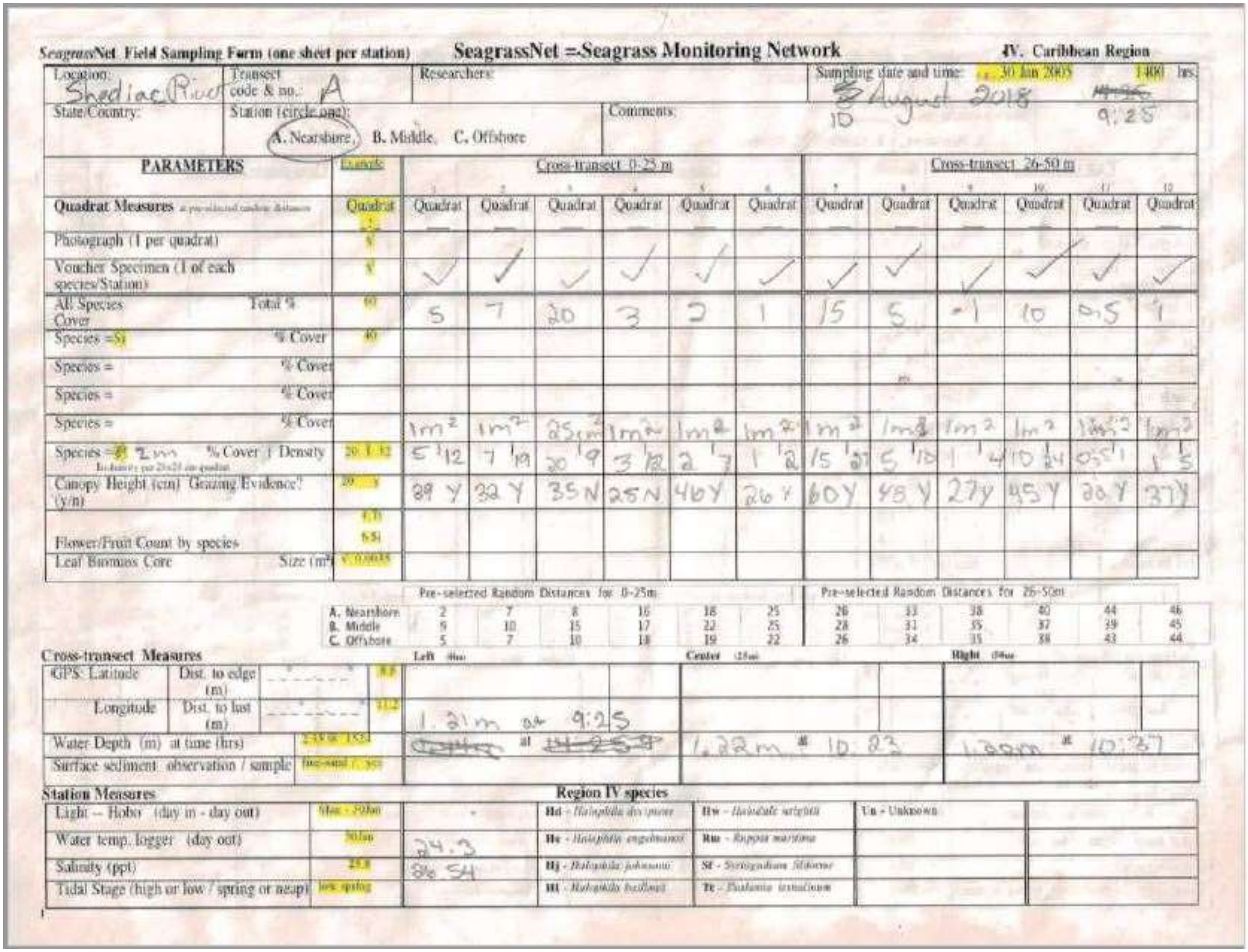
Cross-transect Measures

				Left (0m)		Center (25m)		Right (50m)	
GPS: Latitude	Dist. to edge (m)	° '	8.0						
Longitude	Dist. to last (m)	° '	11.2						
Water Depth (m) at time (hrs)		2.35 @ 1524		0.75m at 11:30		0.62 at 11:50		0.56 at 12:13	
Surface sediment observation / sample		fine-sand / yes							

Station Measures **Region IV species**

Light -- Hobo (day in - day out)	6Jan - 30Jan		Hd - *Halophila decipiens*	Hw - *Halodule wrightii*	Un - Unknown	
Water temp. logger (day out)	30Jan		He - *Halophila engelmanni*	Rm - *Ruppia maritima*		
Salinity (ppt)	25.8		Hj - *Halophila johnsonii*	Si - *Syringodium filiforme*		
Tidal Stage (high or low / spring or neap)	low spring		Hb - *Halophila baillonii*	Tt - *Thalassia testudinum*		

Eelgrass Monitoring Field Sheets: Shediac River



SeagrassNet Field Sampling Form (one sheet per station) **SeagrassNet =-Seagrass Monitoring Network** **IV. Caribbean Region**

Location: Shediac River	Transect code & no.: A	Researchers:	Sampling date and time: e.g. 30 Jan 2005 1400 hrs. ~~3~~ August 2018 ~~[illegible]~~
State/Country:	Station (circle one): [✓ A. Nearshore] B. Middle C. Offshore		Comments: 10 9:25

PARAMETERS	Example	Cross-transect 0-25 m						Cross-transect 26-50 m					
		1	2	3	4	5	6	7	8	9	10	11	12
Quadrat Measures at pre-selected random distances	Quadrat 2	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat
Photograph (1 per quadrat)	Y												
Voucher Specimen (1 of each species/Station)	Y	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
All Species Cover Total %	60	5	7	20	3	2	1	15	5	-1	10	0.5	1
Species = Si % Cover	40												
Species = % Cover													
Species = % Cover													
Species = % Cover		1m²	1m²	25cm²	1m²	1m²	1m²	1m²	1m²	1m²	1m²	1m²	1m²
Species = Si Zm % Cover / Density Individuals per 20x20 cm quadrat	20 / 12	5 / 12	7 / 19	20 / 9	3 / 12	2 / 7	1 / 2	15 / 27	5 / 10	1 / 4	10 / 24	0.5 / 1	1 / 5
Canopy Height (cm) Grazing Evidence? (y/n)	20 Y	39 Y	32 Y	35 N	25 N	46 Y	26 Y	60 Y	45 Y	27 Y	45 Y	20 Y	37 Y
Flower/Fruit Count by species	4 Tt 5 Si												
Leaf Biomass Core Size (m²)	[illegible]												

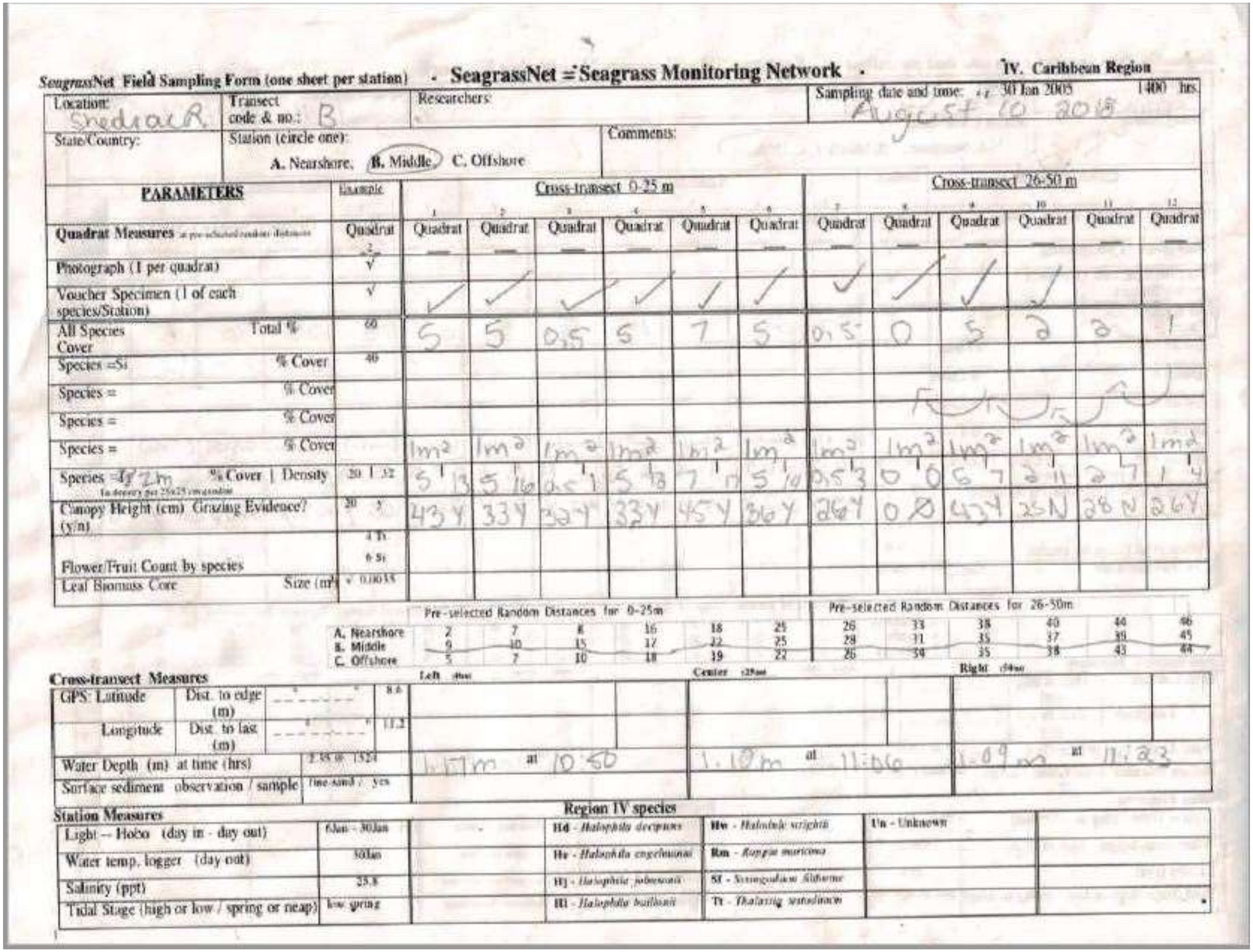
	Pre-selected Random Distances for 0-25m						Pre-selected Random Distances for 26-50m					
A. Nearshore	2	7	8	16	18	25	26	33	38	40	44	46
B. Middle	9	10	15	17	22	25	28	31	35	37	39	45
C. Offshore	5	7	10	18	19	22	26	34	35	38	43	44

Cross-transect Measures

			Example	Left (0m)	Center (25m)	Right (50m)
GPS Latitude	Dist. to edge (m)		[illegible]			
Longitude	Dist. to last (m)		[illegible]	1.21m at 9:25		
Water Depth (m) at time (hrs)			[illegible]	~~[illegible]~~ at ~~[illegible]~~	1.22m at 10:23	1.20m at 10:37
Surface sediment observation / sample			fine-sand / yes			

Station Measures

	Example		Region IV species			
Light -- Hobo (day in - day out)	[illegible]		Hd - *Halophila decipiens*	Hw - *Halodule wrightii*	Un - Unknown	
Water temp. logger (day out)	30Jan	24.3	He - *Halophila engelmannii*	Rm - *Ruppia maritima*		
Salinity (ppt)	[illegible]	26 54	Hj - *Halophila johnsonii*	Sf - *Syringodium filiforme*		
Tidal Stage (high or low / spring or neap)	low spring		Hl - *Halophila baillonii*	Tt - *Thalassia testudinum*		



*Seagrass*Net Field Sampling Form (one sheet per station) · **SeagrassNet = Seagrass Monitoring Network** · **IV. Caribbean Region**

Location: ShediacR.	Transect code & no.: B	Researchers:	Sampling date and time: e.g. 30 Jan 2005 1400 hrs. August 10 2018
State/Country:	Station (circle one): A. Nearshore, [✓ B. Middle] C. Offshore		Comments:

PARAMETERS		Example	Cross-transect 0-25 m						Cross-transect 26-50 m					
			1	2	3	4	5	6	7	8	9	10	11	12
Quadrat Measures at pre-selected random distances		Quadrat 2	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat
Photograph (1 per quadrat)		√												
Voucher Specimen (1 of each species/Station)		√	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
All Species Cover	Total %	60	5	5	0,5	5	7	5	0,5	0	5	2	2	1
Species =Si	% Cover	40												
Species =	% Cover													
Species =	% Cover													
Species =	% Cover		1m²	1m²	1m²	1m²	1m²	1m²	1m²	1m²	1m²	1m²	1m²	1m²
Species =Tt Zm Tt density per 25x25 cm quadrat	% Cover | Density	20 | 32	5 | 13	5 | 16	0,5 | 1	5 | 13	7 | 11	5 | 14	0,5 | 3	0 | 0	5 | 7	2 | 11	2 | 7	1 | 4
Canopy Height (cm) Grazing Evidence? (y/n)		20 y	43 Y	33 Y	32 Y	33 Y	45 Y	36 Y	26 Y	0 Ø	43 Y	25 N	28 N	26 Y
Flower/Fruit Count by species		4 Tt 6 Si												
Leaf Biomass Core	Size (m²)	√ 0.0035												

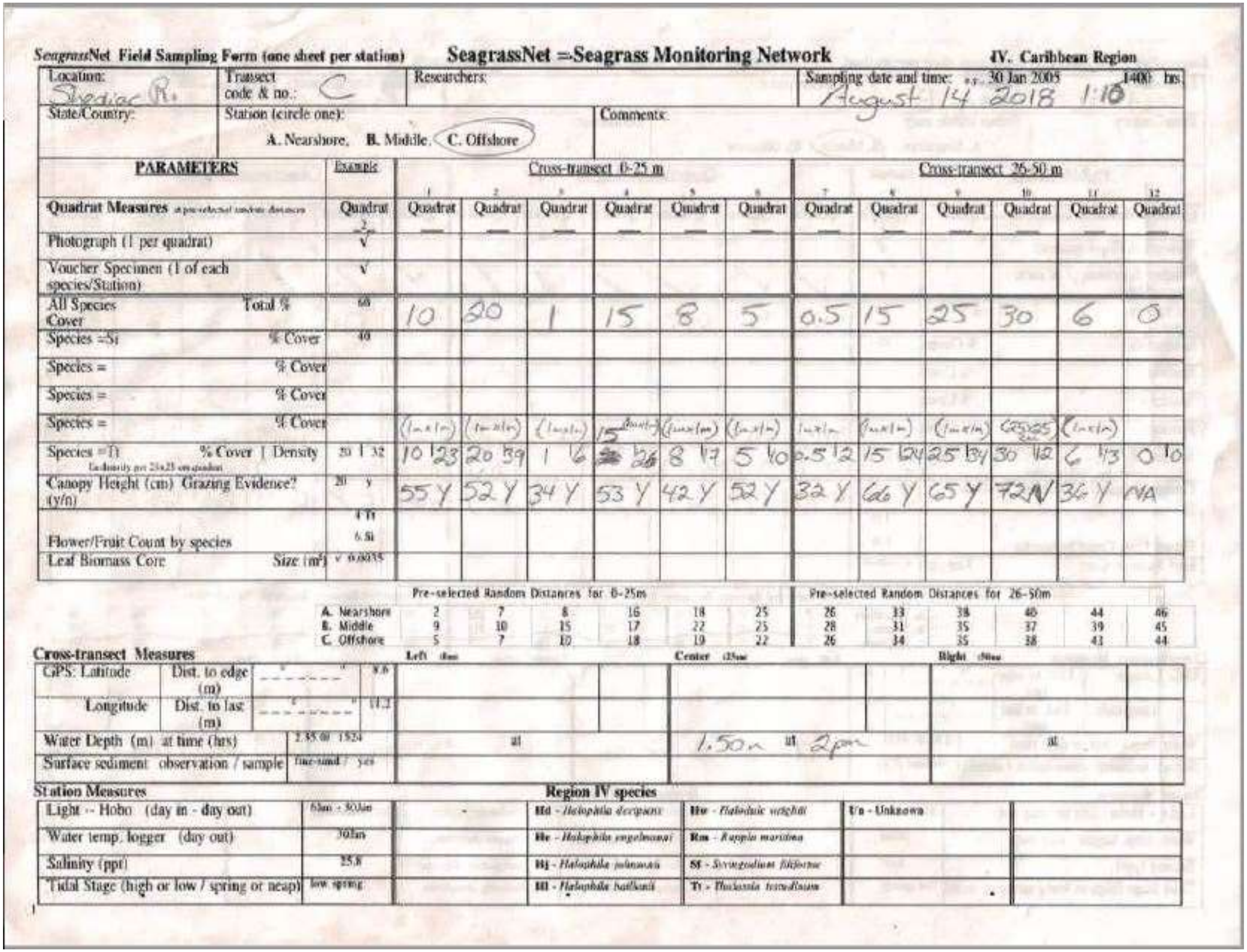
	Pre-selected Random Distances for 0-25m						Pre-selected Random Distances for 26-50m					
A. Nearshore	2	7	8	16	18	25	26	33	38	40	44	46
B. Middle	9	10	15	17	22	25	28	31	35	37	39	45
C. Offshore	5	7	10	18	19	22	26	34	35	38	43	44

Cross-transect Measures

				Left (0m)		Center (25m)		Right (50m)	
GPS: Latitude	Dist. to edge (m)	° '	8.6						
Longitude	Dist. to last (m)	° '	11.2						
Water Depth (m) at time (hrs)		2.55 @ 1524		1.57m at 10:50		1.10m at 11:06		1.09m at 11:23	
Surface sediment observation / sample		fine sand / yes							

Station Measures

			Region IV species			
Light -- Hobo (day in - day out)	6Jan - 30Jan		**Hd** - *Halophila decipiens*	**Hw** - *Halodule wrightii*	**Un** - Unknown	
Water temp. logger (day out)	30Jan		**He** - *Halophila engelmannii*	**Rm** - *Ruppia maritima*		
Salinity (ppt)	25.8		**Hj** - *Halophila johnsonii*	**Sf** - *Syringodium filiforme*		
Tidal Stage (high or low / spring or neap)	low spring		**Hb** - *Halophila baillonii*	**Tt** - *Thalassia testudinum*		



*Seagrass*Net Field Sampling Form (one sheet per station) **SeagrassNet =Seagrass Monitoring Network** **IV. Caribbean Region**

Location: Shediac R.	Transect code & no.: C	Researchers:	Sampling date and time: e.g. 30 Jan 2005 1400 hrs August 14 2018 1:10
State/Country:	Station (circle one): A. Nearshore, B. Middle, [✓ C. Offshore]	Comments:	

PARAMETERS	Example	1	2	3	4	5	6	7	8	9	10	11	12
		Cross-transect 0-25 m						Cross-transect 26-50 m					
Quadrat Measures at pre-selected random distances	Quadrat 2	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —	Quadrat —
Photograph (1 per quadrat)	√												
Voucher Specimen (1 of each species/Station)	√												
All Species Cover Total %	60	10	20	1	15	8	5	0.5	15	25	30	6	0
Species = Si % Cover	40												
Species = % Cover													
Species = % Cover													
Species = % Cover		(1m x 1m)	(1m x 1m)	(1m x 1m)	15 Quadrat	(1m x 1m)	(1m x 1m)	1m x 1m	(1m x 1m)	(1m x 1m)	(25x25)	(1m x 1m)	
Species = Tt % Cover | Density Ea density per 25x25 cm quadrat	20 | 32	10 | 23	20 | 39	1 | 6	26	8 | 17	5 | 40	0.5 | 2	15 | 24	25 | 34	30 | 12	6 | 13	0 | 0
Canopy Height (cm) Grazing Evidence? (y/n)	20 y	55 Y	52 Y	34 Y	53 Y	42 Y	52 Y	32 Y	66 Y	65 Y	72 N	36 Y	NA
Flower/Fruit Count by species	4 Tt 6 Si												
Leaf Biomass Core Size (m²)	√ 0.0035												

	Pre-selected Random Distances for 0-25m						Pre-selected Random Distances for 26-50m					
A. Nearshore	2	7	8	16	18	25	26	33	38	40	44	46
B. Middle	9	10	15	17	22	25	28	31	35	37	39	45
C. Offshore	5	7	10	18	19	22	26	34	35	38	43	44

Cross-transect Measures

				Left (0m)		Center (25m)		Right (50m)	
GPS: Latitude	Dist. to edge (m)	° ' "	8.6						
Longitude	Dist. to last (m)	° ' "	11.2						
Water Depth (m) at time (hrs)		2.35 @ 1524		at		1.50m at 2pm		at	
Surface sediment observation / sample		fine sand / yes							

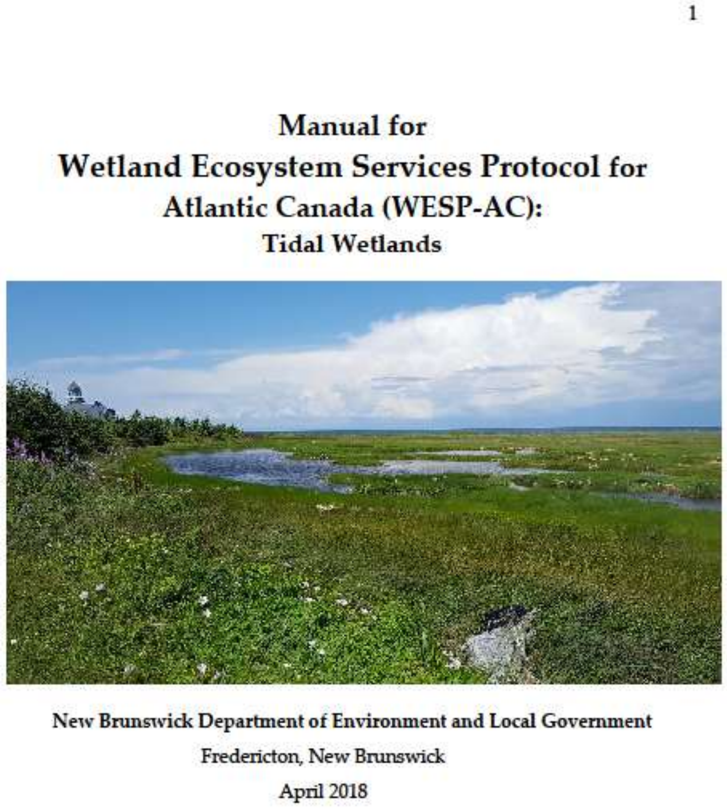
Station Measures

Light -- Hobo (day in - day out)	6Jan - 30Jan	-	
Water temp. logger (day out)	30Jan		
Salinity (ppt)	35.8		
Tidal Stage (high or low / spring or neap)	low spring		

Region IV species

Hd - *Halophila decipiens*	**Hw** - *Halodule wrightii*	**Un** - Unknown
He - *Halophila engelmanni*	**Rm** - *Ruppia maritima*	
Hj - *Halophila johnsonii*	**Sf** - *Syringodium filiforme*	
Hb - *Halophila baillonii*	**Tt** - *Thalassia testudinum*	

Annex 1 - *Manual for Wetland Ecosystem Services Protocol for Atlantic Canada (WESP-AC): Tidal Wetlands*



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Manual for
Wetland Ecosystem Services Protocol for
Atlantic Canada (WESP-AC):
Tidal Wetlands

New Brunswick Department of Environment and Local Government
Fredericton, New Brunswick
April 2018