

# **Water Quality Monitoring Report for Rafuse Cove**

Prepared for  
**Municipality of Chester**

By  
**Coastal Action**  
**45 School Street, Suite 403**  
**Mahone Bay, N.S.**  
**B0J 2E0**

**December 2020**



## Introduction and Program Background

In recent years, residents have expressed concerns regarding water quality and sedimentation issues in the Rafuse Cove/Goose Creek coastal area in Western Shore, NS. Rafuse Cove, and much of the coastal area west of Oak Island, has experienced significant sedimentation for many years, which many locals attribute to the Oak Island Causeway restricting tidal flow.

Throughout the summer of 2019, residents reported several algal bloom events, one of which was sampled by NS Environment and was confirmed to be a toxic cyanobacteria bloom. Samples collected in October 2019 by Coastal Action staff from the mouth of Goose Creek, and further out in the cove, were analyzed for fecal enterococci bacteria as well as nitrogen and phosphorus. Bacteria concentrations were very high and exceeded Health Canada guidelines for recreation (Health Canada, 2012).

The Municipality of Chester (MOC) contracted Coastal Action to conduct a small-scale water quality monitoring program from June to September 2020 to investigate the issue of bacteria contamination in Goose Creek and the surrounding coastal area.

## Objectives and Scope of Work

The objectives of this monitoring program were to:

- 1) Monitor fecal bacteria conditions in the area monthly from June to September 2020 to determine if bacteria contamination is a persistent issue. A program of this scale cannot identify sources of bacteria; however, if results do indicate an ongoing problem, a recommendation would be made for the implementation of a more comprehensive monitoring program, as well as an investigation into potential sources (i.e., sewage effluent, waterfowl/wildlife, seasonal properties, bottom sediments, etc.).
- 2) Monitor and sample algal blooms reported by residents to determine if the blooms are comprised of toxic cyanobacteria. Water samples would be collected in the event of an algal bloom to determine if the bloom is toxic or non-toxic (analyzed for Microcystin-LR).

A total of three sample sites were established in the cove (Figure 1). This includes a freshwater sample site at the mouth of Goose Creek (Site 1), which carries sewage treatment plant effluent and residential runoff into the ocean; a marine site between Oak Island and the mainland (Site 2); and a marine site near seasonal trailer, cottage, and residential properties located on both Crandall Road and Harold Road (Site 3).



Figure 1. Map of sample sites in the Rafuse Cove/Goose Creek area of Western Shore, NS.

### Water Quality Monitoring Results

Coastal Action monitored fecal enterococci bacteria monthly from June to September 2020 along with additional in-situ water quality characteristics during the collection of the samples using a YSI Professional Plus water meter (i.e., water temperature, dissolved oxygen, total dissolved solids, pH, specific conductivity) (Table 1). The September 2<sup>nd</sup> Site 1 sample was taken at high tide and thus consisted mainly of saltwater, which accounts for the high values for specific conductivity (SPC), total dissolved solids (TDS), and salinity. October 8<sup>th</sup> was too windy to sample the two open-water sites by canoe; however, Site 1 was accessible and sampled.

Table 1. Water quality characteristics and bacteria results for the three sample sites in Rafuse Cove/Goose Creek area in Western Shore, NS.

	Date	Water Temp (°C)	Dissolved Oxygen (mg/L)	SPC (mg/L)	TDS (mg/L)	Salinity (mg/L)	ph	Fecal Enterococci (cfu/100 mL)
<b>Site 1</b>	08-Jul-20	13.8	10.74	0.144	94	0.07	5.9	190
	29-Jul-20	22.7	8.14	0.239	155	0.11	7.08	270
	02-Sep-20	13.8	9.11	44.215	28800	88.72	5.85	150
	08-Oct-20	12.6	9.73	0.111	72	0.05	5.8	80
<b>Site 2</b>	08-Jul-20	18.4	9.34	45.325	29460	29.4	7.79	<10
	29-Jul-20	25.2	9.17	45.266	29535	29.33	8.54	30
	02-Sep-20	14.6	9.21	47.022	30564	30.59	6.25	<10
	08-Oct-20	Too windy	-	-	-	-	-	-
<b>Site 3</b>	08-Jul-20	18	8.93	46.356	30131	30.15	7.83	10
	29-Jul-20	25.6	9.04	45.872	29815	29.72	8.6	30
	02-Sep-20	14.5	9.14	47.03	30565	30.58	5.4	<10
	08-Oct-20	Too windy	-	-	-	-	-	-

Bacteria concentrations were lowest at the open-water marine sites (Sites 2 and 3) throughout the sampling period and did not exceed the recommended Health Canada enterococci guideline of  $\leq 70$  cfu/100 mL for primary contact recreation (i.e., swimming, surfing, waterskiing, white-water canoeing/rafting/kayaking, windsurfing, or subsurface diving). Site 1 samples at the mouth of Goose Creek, however, were consistently above the Health Canada guidelines for primary contact for all months and were above the guideline for secondary contact ( $\leq 175$  cfu/100 mL) (i.e., rowing, sailing, canoe touring, or fishing) for the summer months (Table 1) (Health Canada, 2012).

There were no algal blooms reported in the area during the monitoring period.

### Discussion and Recommendations

The purpose of this monitoring program was to examine fecal bacteria concentrations in the area, along with the sampling of reported algal blooms to determine toxicity. Based on the results of this program, bacteria contamination appears to be focused in Goose Creek; however, the limited sampling frequency and number of sample locations may not be sufficient to identify other areas of concern.

The Western Shore Sewage Treatment Plant was identified as a possible source of contamination because it discharges its effluent into Goose Creek approximately 250 m

upstream from the mouth of the stream (Site 1). Several sampling dates for this monitoring program were selected to coincide with the monthly effluent sampling conducted by MOC staff at the plant. Effluent sampling occurs within the holding tanks after treatment and prior to discharge into Goose Creek (J. Borden, personal communication, September 1, 2020). Concurrent sampling efforts occurred on September 2<sup>nd</sup> and October 8<sup>th</sup>, with MOC staff collecting additional samples from Goose Creek, upstream and downstream of the effluent discharge area. MOC's effluent results from April to October 2020 ranged from <1 to 15 MPN/100 mL *E. coli*, far below the *E. coli* concentrations observed at points upstream and downstream of the effluent pipe (Table 2).

Direct comparisons cannot be made between the plant's *E. coli* effluent tests and this program's enterococci tests, as these are two different species of bacteria. However, Health Canada provides recreational water quality guidelines for both species. The *E. coli* primary contact guideline is  $\leq 400$  cfu/100 mL and the secondary contact guideline is  $\leq 1,000$  cfu/100 mL (Health Canada, 2012). The *E. coli* samples collected from upstream and downstream of the effluent pipe did not exceed these recreational guidelines; however, they do identify a source of bacteria in the stream which warrants further investigation.

Table 2. *E. coli* bacteria results (MPN/100 mL) from Goose Creek and wastewater treatment plant effluent tests conducted on the same days as this monitoring program.

Date	Upstream of Treatment Plant	Effluent (prior to release)	Downstream of Treatment Plant	Site 1 (enterococci cfu/100 mL)
2-Sep-20	228	1	152	150
8-Oct-20	84	1	93	80

The Western Shore Sewage Treatment Plant is not a likely source of the fecal bacteria contamination that is occurring in Goose Creek. Several potential sources of fecal contamination have been identified within the drainage area of Goose Creek including a residential property with livestock and a large, improperly stored manure pile. Focused bacteria sampling at several points along Goose Creek is required to isolate the locations of fecal bacteria inputs, under both dry and wet conditions.

The open-water samples collected from Sites 2 and 3 were below the Health Canada enterococci guideline for primary contact and the other water quality characteristics are all within acceptable levels for water quality (Health Canada, 2012). Bacteria contamination does not appear to be an issue at Sites 2 and 3; however, these sites are in relatively open-water

locations and may not be indicative of bacteria conditions within the many small coves in this area.

Bacteria monitoring, in both the water column and bottom sediments, is recommended for Rafuse Cove, which is located directly south of the cove that receives discharge from Goose Creek. Rafuse Cove has experienced several decades of sedimentation and infilling and may be slowly getting cut off from the greater cove by saltmarsh bars expanding across the narrow opening of this small cove. The deep bottom sediments in this cove may be acting as a bacterial reservoir environment. Disturbance of these bottom sediments, from recreational activities, shorebirds, waterfowl, and other wildlife, may be resuspending significant concentrations of bacteria into the water. Marine sediments can act as significant reservoirs for bacteria and concentrations can be several orders of magnitude higher than the overlying water column. Bacteria can persist and survive longer in these environments, as they provide protection from the environmental stressors that would cause them to die off faster in the water column (i.e., UV inactivation, starvation, predation, etc.) (Byappanahalli et al., 2012).

As bacteria and algae both require nutrients to grow, including nutrient sampling (total phosphorous and total nitrogen) in future water quality monitoring activities would provide insight into the conditions that favor algal blooms and bacteria proliferation in the area.

Further water quality monitoring is recommended to isolate, identify, and mitigate the source(s) of bacteria entering Goose Creek; and to investigate the bacteria conditions within Rafuse Cove and determine whether the deep bottom sediments are acting as a bacterial reservoir and thus an ongoing source of contamination.



## References

- Byappanahalli, M.N., Nevers, M.B., Korajkic, A., Staley, Z.R., & Harwood, V.J. (2012). Enterococci in the Environment. *Microbiology and Molecular Biology Reviews*. **76(4)**, p. 685-706.
- Health Canada. (2012). Guidelines for Canadian Recreational Water Quality, Third Edition. Water Air, and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No H129-15/2012E).