

Beach Protocol Discussion for RWAB

The attached protocols have been used by HRM for several years. We are looking for feedback to make them as strong as possible, with the dual aims of public health and safety and keeping HRM’s supervised beaches open for as much of the short season as possible

Current recreational water standards that apply to these beach protocols are:

For bacteria:

Beach Type	Indicator Bacteria	Maximum Allowable Concentration (CFU*)	
		Geometric mean of >1 sample**	Individual sample
Freshwater	<i>E. coli</i>	200/100 mL	400/100 mL
Marine & Brackish	<i>Enterococci</i>	35/100 mL	70/100 mL

For cyanobacteria: 20µg/L total microcystins

Some things to consider:

- What are other municipalities doing to keep their urban beaches open (if known), and what can you suggest based on your expertise to help us keep beaches open safely for more days throughout the summer?
- The increasingly prevalent problem of cyanobacteria in our lakes
 - o Our protocol right now is very reactive. While the protocol is set for this season, we are looking for ways to be more proactive in detection and control going forward
 - o We are working with the Centre for Water Resources at Dalhousie to this end
- Bacteria at beaches from stormwater
 - o Should testing aim to consider flush events after dry periods?
- Some beaches are experiencing persistent closures. Outside this protocol we are trying to determine the source of the water quality issues leading to some of these closures (typically bacteria).

Other ideas for improving this protocol for the coming years are welcome!

Halifax Beach Water Quality Monitoring Protocol Summer 2022

Beach Management

The Municipality's supervised outdoor swim (beaches) program is offered as a public service during the summer months of every year. Normally running annually from July 1 through August 31, 2022. This service, offered at 18 locations throughout HRM in 2022 (see Appendix A) is highly valued by our residents, and is one of the signature recreational services available during summer months. Public services offered in natural environments can only be offered when an adequate measure of public safety can be assured. Both freshwater and marine aquatic environments pose potential threats to human health, due to the possibility of contact with various chemicals or biological materials, and physical hazards.

The primary hazard posed by water quality is the potential for contact with microorganisms associated with fecal contamination. An emerging hazard to beach water quality in Halifax is harmful algae blooms and the potential for these blooms – particularly those of cyanobacteria, also called “blue-green algae”, to produce toxins harmful to humans and other animals. The best way to manage these risks is through the effective operation of a water quality monitoring program, including the use of risk awareness measures, appropriate guidelines and standards for collection, handling, analysis, and reporting. This program is operated in partnership with contracted laboratory services, provided in 2022 by Bureau Veritas Laboratories (“BV Labs”).

Beach Operation

Supervised beaches are to be open to the public except in the following circumstances:

- The [geometric mean](#) (hereafter, “geomean”) of five test results for a given beach is above the limit for the appropriate indicator bacteria (i.e., based on measured bacterial counts);
- Beach personnel suspect water quality concerns (precautionary – all sites); and
- Visual observation of algae blooms

Beach staff responses to circumstances triggering beach closures are described later in this protocol.

Due to different considerations for bacteria and algae, the protocols guiding beach openings, closures, and advisories are markedly different for these conditions, as reflected in the details presented below. 2022 is the fifth year for a planned response to algae blooms. Given uncertainty in the likelihood of appearance, toxicity, number and location of blooms, and current testing limitations among other factors, the Municipality's principal response is to use a risk-based approach based on species identification and toxin testing, as further described in the Cyanobacteria Overview. Water quality sample handling guidelines are similar for bacteria-based and algae-based testing practices alike and are addressed below.

Fecal Bacteria Overview

Water quality test results drive the opening and closure of beaches. Halifax personnel collect, handle, and deliver water samples and associated documentation to the analytical laboratory, and the lab is responsible for confirming documentation and analytical procedures, conducting analytical procedures, and reporting analytical results to Halifax staff. Halifax and lab staff responsibilities are described separately below.

Water Quality - Halifax Front End: Sample Collection, Handling, Delivery & Documentation
Sample collection is the process of obtaining an uncompromised sample of water from five locations within a supervised beach area. Samples are best collected from the position in the water nearest the greatest concentration of swimmers. The specific location, and the depth at that location, varies from beach to beach, but five samples are to be collected at each.

To clearly distinguish between the five samples collected at each beach location, each sample will be assigned a unique identifier, A through E, representing their relative location within the beach area. From the perspective of a lifeguard standing on the beach surveying the water, Sample A is on the far left, Sample E is on the far right, and Samples B-D are arranged equidistant from all other sample stations in sequential order.

At each sampling location, the open bottle should be submerged below the water surface 30 cm, with the open end facing downwards until the bottle has reached 30 cm (1 foot) below the surface. The most important consideration in sample collection is to avoid contaminating the sample. Human skin naturally harbors several varieties of microorganisms, including bacteria, even when freshly washed. If a hand touches the inside of the bottle or the inside of the lid, these bacteria could be transferred to the water sample, which could cause false test results, which could result in unnecessary beach closures, further testing requirements, and unnecessary expense.

Beach program supervisors have the option to use telescoping sampling poles to enable them to collect samples from the appropriate locations within the beach while remaining dry on shore – but these poles should only be used if the supervisors can reliably obtain full samples in a single immersion while orienting bottles properly throughout the procedure.

Halifax strives to meet the intent of the [Canadian Recreational Water Quality Guidelines](#) (Health Canada, 2012), and this protocol has been developed in consultation with Nova Scotia Environment & Climate Change (NSECC), including the division (Environmental Health) representing the interests of the district Medical Officer of Health.

Each beach should be monitored once weekly, and preferably all by end of day Wednesday. Five samples will be collected during each monitoring event, one at each of five stations (Station A, Station B, etc.). The geomean will be calculated from the results from each station.

In 2022, Halifax has beaches in both freshwater and brackish water environments. Monitoring protocols are identical in these environments, except for two factors, as depicted in Table 1:

Table 1. Beach Monitoring Indicators and Maximum Concentrations

Beach Type	Indicator Bacteria	Maximum Allowable Concentration (CFU*)	
		Geometric mean of >1 sample**	Individual sample
Freshwater	<i>E. coli</i>	200/100 mL	400/100 mL
Marine & Brackish	<i>Enterococci</i>	35/100 mL	70/100 mL

* CFU = Colony Forming Unit; ** Beach closures and re-openings should always be based on geometric means

A summary of monitoring requirements at all beaches is provided in Appendix B. Beach Supervisors receive hands-on training on proper sample collection procedures from HRM’s Water Resource Specialist at the start of each beach season. Only Beach Supervisors should collect water samples from supervised beaches. In extenuating circumstances, they may delegate collection to other staff, if delegates are informed of proper collection procedures and care is taken to ensure they are followed.

Handling procedures for water samples are intended to ensure safe, secure, and controlled collection of samples from the time they are collected until delivered to the lab. They include proper bottle labelling and storage – including refrigeration. Bottles must be labelled with the following information:

- Date and Time of sample collection
- Sample ID: Beach Name, Station Name
- Sample Type: FW (Fresh Water) **or** SW (Salt Water)
- Analysis: *E. coli* **or** *Enterococci* (SW)

The lab prefers water samples to be 10°C or cooler, so freshly collected samples should be immediately placed into a cooler upon return to the vehicle. If electronic coolers are unavailable or non-functional, Beach Supervisors should immediately make alternate arrangements, such as the use of standard ‘picnic’ coolers and crushed ice to cool the samples during transport.

The same type of bottle is used for both *E. coli* and *Enterococci* samples. This bottle contains a substance, sodium thiosulphate (Na₂S₂O₃) in crystalline (powder) form. This substance is immaterial to our concerns – it is used as a dechlorination agent for treated drinking water, and consequently does not matter if the powder escapes the bottle upon sample collection. This material will not contact municipal staff under normal handling procedures. If the material does get onto someone’s skin, thorough washing with soap and water is recommended. The Material Safety Data Sheet (MSDS) for sodium thiosulphate is given as Appendix C.

Documentation of water samples is critical because incomplete, inaccurate, or false paperwork can lead to confusing, misleading, or useless sample results. In some circumstances, however unlikely, these could result in the swimming public being exposed to unsafe waters under municipal supervision – a condition that Halifax strives to avoid.

The primary documentation to be completed for water samples is a Chain of Custody (COC) form, customized for the beaches program and supplied by BV Labs - see Appendix D. To complete this form, staff must provide the following information:

- Field Sample Identification (i.e., Beach name & Station #)
- Date of sample collection

- Time of sample collection
- # and Type of Bottles (per site) – report each sampling station on its own line (row) *
- Matrix (i.e., Fresh Water or Salt Water)
- Identification of Analysis Required - check *E. coli*, *Enterococci*, or Microcystin
- Name of (HRM staff delivering samples), plus date and time of delivery

Water samples collected for bacteriological analysis are only valid if analytical testing begins within 24 hours of sample collection, so Halifax staff must ensure the delivery of all samples to the lab on the same day they are collected. If this is not possible, samples will be stored in a refrigerated environment, preferably a dedicated refrigerator, or in a cool location with ice changes as needed. Samples must be delivered to the lab as soon as possible the following morning, BEFORE 24 hours has elapsed from the earliest sample collection event the previous day, ideally not later than 20 hours past the time of sample collection. Samples delivered more than 24 hours after collection are not reliable indicators of water quality, cannot be used to determine the safety of the beach and should be repeated.

Due to the COVID-19 pandemic, BV Labs has implemented a non-contact sample receipt protocol. All samples should be left in the building lobby, accompanied by completed Chain of Custody forms. These forms should be completed before leaving samples in the lobby to minimize traffic in the drop-off area.

Water Quality – Laboratory Back End: Documentation Confirmation, Analysis & Reporting

Halifax contracts with only accredited and certified laboratories for the testing of water samples through the Beaches program. These labs apply thorough quality control and assurance programs at all stages of their work, which begins with sample reception. Reception staff are responsible for confirming that the number and type of bottles received match those reported on the COC form, and for following up on any inconsistencies, errors, or uncertainties with the client. Normally this would be the Halifax Beach Supervisor who is delivering and signing for the samples at the time of sample submission, but it may also or instead be the primary client contact (Pat McGrath).

Upon satisfactory receipt and confirmation of all samples, the lab conducts the appropriate analysis as requested on the COC. Bureau Veritas Laboratories conducts all *E. coli* and *Enterococci* analyses on-site.

As previously indicated, samples remain viable for analysis only when received and initially processed by the laboratory within 24 hours of sample collection. With a lag of up to 3 hours between receipt and processing, samples need to be delivered within 21 hours of collection. It is therefore critical to accurately observe and record the collection time, and to deliver samples less than 24 hours later. Table 2, below, identifies the key drop times and corresponding reporting periods for all parameters on a weekly basis.

Table 2. Sample Drop-off Times for Bureau Veritas Laboratories

Drop-Off Day	Parameter	<u>Preferred Drop Time (same day)</u>	<u>Latest Acceptable Drop Time</u>	Results Availability
Monday – Thursday	<i>E. coli</i>	4pm	10am (day after sample collected)	Noon on Day 2
Monday-Thursday	<i>Enterococci</i>	4pm	10am (day after sample collected)	Noon on Day 3
Monday - Friday	Microcystin	n/a	n/a	Standard = 7 Business Days; Rush: 3 or 5
Friday	<i>E. coli</i> & <i>Enterococci</i>	n/a	2pm (same day)	Noon on following Monday
<p>The tests for <i>E. coli</i> and <i>Enterococci</i> must run for 24 hours and 48 hours, respectively. If samples are received in the afternoon the results will not be ready by noon the following day; they will be reported by noon on the second day. (i.e., if sample dropped off Monday at 3pm the results will be reported on Wednesday by noon).</p>				
<p>Notice for sample drop-off beyond regular cut-off times should be given as early as possible. During business hours, please contact <u>Preeti Kapadia</u> 902.420.0203 ext. 252 or backup <u>Maryann Comeau</u> (ext. 298). After business hours, please contact <u>Suzanne Rogers</u> (Lab Manager, 902.209.4055), <u>Robyn Edwards</u> (Lab Supervisor, 902.448.4337).</p>				

Bureau Veritas Laboratories sends analytical results to the following personnel via email:
 Elizabeth Montgomery, Ahmed Abdel-Hameid & Pat McGrath.

Blue-Green Algae (Cyanobacteria) Overview

Algae are microscopic aquatic plants that naturally live in freshwater and marine environments. These organisms can multiply rapidly during the summer, leading to extensive growth called a bloom. Commonly occurring forms of algae in freshwater systems include green, yellow-green, diatoms, dinoflagellates, and blue-green algae. Cyanobacteria, also called blue-green algae, are a type of bacteria that naturally occur in the same freshwater environments as true algae and behave the same way, occasionally forming blooms if the right conditions are present.

Cyanobacteria and some bloom-forming types of marine algae can produce toxins when they bloom, but toxin production does not always occur. As algae blooms die and decay, any toxins that have been produced will be released into the water. People who contact blue-green algae blooms may experience health issues, including skin irritations/rashes, sore throat, red eyes, swollen lips, and hay-fever like symptoms. People and other animals who drink affected water may be at risk of headaches, fever, diarrhea, vomiting, cramps, muscle and joint pain, and even liver damage. Consumption of this water can be fatal to humans and animals.

It is difficult to predict if blooms will form, and if blooms, when formed, will produce and subsequently release toxins. Since toxins are only formed in the presence of blooms, cyanobacteria monitoring is triggered by the observation of blooms.

Blooms of algae and blue-green algae may vary considerably in colour, consistency, and overall appearance. Staff will assess blooms observed directly and as reported by the public.

To streamline, document, and enable the assessment of public reports, Environment & Climate Change (ECC) has initiated a review process in consultation with staff from the Parks division. This review includes the collection of caller name and contact info, and the date, location, and description of the suspected bloom. For reported blooms in lakes associated with supervised municipal beaches or other formal recreational programming, Environment & Climate Change or Parks staff will conduct a site visit. The purpose of this visit is to visually assess the environment of the bloom and reach one of two conclusions: 1) verify its presence; or 2) determine that the alleged bloom is, in effect, a “false report” – i.e., staff observations are not consistent with algae blooms.

This protocol adopts the approach that Halifax should only issue risk advisory notices for lakes and other water bodies where the Municipality directly manages access to the water and promotes its use, such as the 18 Municipal beaches where Halifax currently conducts water quality monitoring to protect public safety. For all other watercourses, supervised or not, urban or rural, Halifax maintains that the Province of Nova Scotia has jurisdiction, and Halifax will duly notify staff at Nova Scotia Environment ((1) Environmental Health & (2) Bedford Office, Inspection, Compliance, & Enforcement Division) to enable their own risk assessment, risk management, and, if necessary, public communications procedures.

Once staff suspect the presence of blooms near Halifax lifeguard-supervised beaches or other lakes where Halifax directly manages access, Public Affairs will issue public risk advisory notifications via Public Service Announcement (PSA) and Twitter, advising the public of possible cyanobacteria presence, to avoid swimming, allowing pets to enter the water, and to take additional precautions. Associated Municipal beaches will also be closed as a precautionary measure.

Following the initial risk advisory notification, staff will initiate the following three-step risk assessment process:

1. Taxonomic identification;
2. Toxin analysis through accredited laboratory services; and
3. Toxin level assessment through test-strips.

1. Taxonomic Identification.

The first step is to identify what species of algae are present – are they blue-green algae (cyanobacteria) or not. To conduct this test, municipal staff collect algae samples from bloom sites, label the sample containers, and bring them to Bio-Limno Research & Consulting (BLRC) - a qualified laboratory in Halifax specializing in this work. Taxonomic identification is the process of recognizing the identity of organisms. To do this with algae, specimens are placed under a microscope, and their size, shape, and other features can be used to identify individual organisms down to the species level. BLRC staff also identify which algae species are forms of cyanobacteria, and of those, which can produce toxins (microcystin, anatoxin, saxitoxin, nodularin, or cylindrospermopsin). The results of this assessment are anticipated to be available within 48 hours of sample submission.

If this assessment determines the bloom does not contain cyanobacteria, or that those cyanobacteria present do not produce toxins, then staff will lift the initial risk advisory regarding the presence of a possible blue-green algae bloom. If the assessment confirms that the bloom contains cyanobacteria that may produce toxins, then staff will leave the initial advisory in place and begin a period of regular visual observations. These observations will occur at least twice each week (between Monday and Friday) until the bloom has dissipated (is no longer visible) and remains undetected for a period of seven consecutive days since its last confirmed observation.

Once this seven-day period of no visible blooms has passed, staff will begin to conduct toxin assessments, described further below.

Toxin Assessments:

Cyanobacteria is the most common taxa producing harmful algae blooms in Canadian freshwater environments. Microcystin is the most frequently observed form of toxin produced by the toxin-forming species of cyanobacteria, and it is the only toxin for which Health Canada has published guideline values to protect public health. Consequently, microcystin is the form of toxin that will be assessed. It is also the only toxin for which accredited analyses are available via BV Labs.

2. Toxin Analysis by BV Labs

Seven days after a toxin-producing bloom has dissipated, samples for toxin analysis will be collected by E&E staff and submitted to BV Labs. Sample collection procedures are comparable for all forms of assessment. Although the health risks to personnel collecting samples for assessment are assessed to be minimal, to further reduce the risk of adverse reactions due to exposure, staff will wear rubber boots or waders, and nitrile gloves. For each bloom location sampled, five individual water samples will be collected and mixed in a clean common container, from which a subsample will be collected. This single subsample is submitted to the lab for analysis.

Table 2, above, identifies the key drop times and corresponding reporting periods for all parameters on a weekly basis for BV Labs. For toxin analysis, staff will request a “rush”

turnaround time of 3 days. Microcystin samples received by BV Labs' Bedford office will be shipped to an accredited BV Lab affiliate in Mississauga for analysis.

If the toxin levels fall within acceptable guidelines ($\leq 20 \mu\text{g/L}$), and no new blooms appear in the area, staff will use test-strips to test current toxin levels.

3. Toxin level assessment by test strip

This secondary assessment is performed to ensure that toxin (microcystin) concentrations have not increased above safe levels since the date that samples were collected for laboratory analysis. ECC staff collect water samples for immediate subsequent assessment using a microcystin test strip, specifically designed to indicate whether the concentration of microcystins in fresh water are present in a concentration under or over the guideline value. Halifax will apply the current guideline value for microcystins as published by Health Canada: 20 micrograms per litre ($20 \mu\text{g/L}$). The sampling procedure used is in accordance with the Manufacturer's User Guidelines for the Microcystin Test Strip in Recreational Waters (Appendix E).

This assessment will typically be completed within 2 hours of return to the office following sample collection. Consequently, test results will usually be available on the same day as sample collection, unless staff return to the office after 2pm. In such cases, assessments will be completed the following day.

If test strip results indicate that toxin concentrations are below the guideline level, then staff will lift the risk advisory and open any affected beaches. If, however, they indicate that toxin levels are above the guideline level, then the existing risk advisory will remain in effect and ECC staff will repeat step 2 in this risk assessment process, until such time as toxin levels are finally assessed and confirmed to remain below the guideline value. At that time, the advisory will be lifted, beaches reopened, and algae-bloom signage removed.

Beginning in 2020, Halifax added additional protocols for lakes with multiple beaches and public access points such as Lake Banook and Lake Micmac. In instances where blooms are contained to one portion of the lake, additional testing will take place to ensure that blooms and toxins have not spread to other portions of the lake. If this is the case, then public access points other than the beach where the bloom was first confirmed, can open.

The authority to issue, revise, and lift risk advisories lies with Water Resources Specialist Elizabeth Montgomery. In Elizabeth's absence, that authority resides with Environment & Climate Change's Director Shannon Miedema. Staff will advise the Directors of Property, Fleet & Environment, and Parks and Recreation of forthcoming risk advisories prior to their publication.

Water Quality Results

Halifax uses the best available scientific guidance, in consultation with NSECC, to determine the bacteria levels at which swimming and other primary contact recreation is safe. This guidance comes from Health Canada, which publishes Guidelines for Canadian Recreational Water Quality. The current edition of these guidelines was published in 2012.

E. coli is recommended as the best indicator of fecal contamination in fresh water, and as a suitable indicator in marine waters. *Enterococci* is recommended as the best indicator of fecal contamination in salt water, and as a suitable indicator in fresh waters.

In concordance with the Guidelines, Halifax uses *E. coli* as indicator of water quality for freshwater beaches, and *Enterococci* as the indicator of water quality for marine and brackish beaches. Kinap Beach is the Municipality's only supervised brackish beach this year and is exclusively managed via *Enterococci* results. All other supervised beaches are exclusively managed based on *E. coli* results.

Municipal Response to Water Quality Results

Lab results are received by the Water Quality Coordinator and Aquatic Specialist. For supervised beaches, where bacteriological results exceed guideline limits, Beach Supervisors will arrange to retest the affected beach as soon as possible and follow the steps outlined in Table 3.

Table 3. Action Items for Bacteria Exceedances & Algae Blooms at Supervised Beaches

Step	Action	Person(s) Responsible
1	Laboratory contact to notify Manager of Aquatic & Inclusion Services	Aquatic Specialist or Beach Supervisor on Office duty
2	Notify lifeguard(s) on affected beach(es)	Beach Staff
3	Place appropriate signage at site	Lifeguard(s) on site
4	Notify Public Affairs Office to publish PSA Email: mediarelations@halifax.ca	Aquatic Specialist or Water Quality Coordinator
5	Remain on station for at least 7 days for public relations	Lifeguard(s) on site
6	Direct all media questions to the Public Affairs Office for redirection to Water Quality Coordinator or designate. Staff to maintain "no comment" unless otherwise directed.	All staff
7	Notify NSECC: 1) Primary Contact - Environmental Health Consultant, Rodney Lahey, 902.565.9881, rodney.lahey@novascotia.ca ; if Rodney is unavailable, contact Manager of Environmental Health Programs, Colin Poirier, 902.943.9842, colin.poirier@novascotia.ca 2) NS Inspection, Compliance & Enforcement Division, Central Region (Bedford Office) a. 902-424-7773 or Bedford.Office@novascotia.ca (M - F 08:30-16:30); or b. Environmental Emergencies Hotline: 1-800-565-1633 between 16:30 and 08:30 M-F and weekends	Water Quality Coordinator

As mentioned previously, the Municipality will conduct water quality monitoring at the Malay Beach, which is unsupervised in 2022 and for which the following steps outlined in Table 4.

Table 4. Action Items for Bacteria Exceedances & Algae Blooms at Unsupervised Beaches

Step	Action	Person(s) Responsible
1	Notify Manager of Aquatic & Inclusion Services	Aquatic Specialist or Beach Supervisor
2	Place appropriate signage at site	Beach Supervisor
3	Notify Public Affairs Office to publish PSA: Email: mediarelations@halifax.ca	Beach Staff or Water Quality Coordinator
4	Direct all media questions to Public Affairs for redirection to the Water Quality Coordinator or designate.	Public Affairs; All staff
5	Notify NSECC: 1) Primary Contact - Environmental Health Consultant, Rodney Lahey, 902.565.9881, rodney.lahey@novascotia.ca . If Rodney is unavailable, contact Manager of Environmental Health Programs, Colin Poirier, 902.943.9842, colin.poirier@novascotia.ca 2) NS Inspection, Compliance & Enforcement Division, Central Region (Bedford Office) a. 902-424-7773 or Bedford.Office@novascotia.ca (M – F 08:30 – 16:30); or b. Environmental Emergencies Hotline: 1-800-565-1633 between 16:30 and 08:30 M-F and weekends	Water Quality Coordinator

Beach Retesting in Case of Closure

When water sample results lead to closures of any municipal beach, affected beaches are re-sampled as soon as practical, typically the following weekday. Beaches will remain closed until the geometric mean of five samples is equal to or less than the guideline limits (200 *E. coli*, 35 *Enterococci*).

When wastewater (sewage) system overflows are the cause of beach closures, water samples (*E. coli* and *Enterococci*) should be collected on the next weekday after the overflow. Beaches will remain closed until the geometric mean of five samples is equal to or less than guideline limits.

During retesting conditions, Beach Supervisors should consider documenting the following conditions to assist in interpreting water results as necessary:

- Was it raining at the time of collection or at any time during the previous 24-hour period?
- How clear or turbid was the water?
- Were ducks, geese, or other birds present? How many?
- Did you see any other signs of potential water contamination, or plausible causes for such contamination?

Halifax Beach Program Contacts:

Water Resources Specialist	Elizabeth Montgomery Environment & Climate Change, Property, Fleet & Environment 902.943.1954 elizabeth.montgomery@halifax.ca
Manager, Aquatic & Inclusion Services	Pat McGrath Beaches – Parks & Recreation 902.220.6329 mcgratjo@halifax.ca
Aquatic Specialist	Ahmed Abdel-Hameid Beaches – Parks & Recreation 902.490.4605 abdelha@halifax.ca
Beach Office	Beaches – Parks and Recreation 902.490.5458 (ext. 3)
Beach Supervisor	Maggie Biggs Beaches – Parks & Recreation Maggie.Biggs@halifax.ca
Beach Supervisor	Gabrielle Tofflemire Beaches – Parks & Recreation toffleg@halifax.ca
Beach Supervisor	Hunter McGrath Beaches – Parks & Recreation jo49661@halifax.ca
Beach Supervisor	Joseph McMullin Beaches – Parks & Recreation joseph4459@hotmail.com
Beach Supervisor	Kane Lee Beaches – Parks & Recreation Seokhyun.Lee@halifax.ca

List of Appendices:

Appendix A: Beach Locations 2022
Appendix B: Beach Monitoring Summary 2021
Appendix C: MSDS Sodium Thiosulphate Na₂S₂O₃
Appendix D: Sample Customized Chain of Custody Form 2021
Appendix E: Microcystin Test Strip User Guide

Director Approvals:

Director, Property, Fleet & Environment

Date

Director, Parks & Recreation

Date