

Operational Approaches for Recreational Water Guideline, 2018

Population and Public Health Division,
Ministry of Health and Long-Term Care

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Preamble

The Ontario Public Health Standards: Requirements for Programs, Services, and Accountability (Standards) are published by the Minister of Health and Long-Term Care under the authority of section 7 of the *Health Protection and Promotion Act* (HPPA) to specify the mandatory health programs and services provided by boards of health.^{1,2} The Standards identify the minimum expectations for public health programs and services. Boards of health are accountable for implementing the Standards including the protocols and guidelines that are referenced in the Standards. Guidelines are program and topic-specific documents which provide direction on how boards of health shall approach specific requirement(s) identified within the Standards.

Purpose

The purpose of this guideline is to provide direction on how boards of health must approach requirements outlined in the Safe Water Standard and the *Recreational Water Protocol, 2018* (or as current) to reduce the risk of water-borne illness and injury related to recreational water use at public beaches and waterfronts used by recreational camps, and achieve consistency for specific program requirements.³

Reference to the Standards

This section identifies the standard and requirements to which this guideline relates.

Safe Water

Requirement 3. The board of health shall ensure the availability of education and training for owners/operators of small drinking water systems and recreational water facilities in accordance with the *Operational Approaches for Recreational Water Guideline, 2018* (or as current); the *Recreational Water Protocol, 2018* (or as current); the *Safe Drinking Water and Fluoride Monitoring Protocol, 2018* (or as current); and the *Small Drinking Water Systems Risk Assessment Guideline, 2018* (or as current).

Requirement 5. The board of health shall provide all the components of the Safe Water Program in accordance with:

- a) The *Safe Drinking Water and Fluoride Monitoring Protocol, 2018* (or as current) and all applicable statutes and regulations to protect the public from exposure to unsafe drinking water; and
- b) The *Operational Approaches for Recreational Water Guideline, 2018* (or as current) and the *Recreational Water Protocol, 2018* (or as current), to reduce the risks of illness and injuries at public beaches and recreational water facilities.

Requirement 8. The board of health shall ensure 24/7 availability to receive reports of and respond to:

- a) Adverse events related to safe water, such as reports of adverse drinking water of drinking water systems, governed under the *Health Protection and Promotion Act* or the *Safe Drinking Water Act, 2002*;

- b) Reports of water-borne illnesses or outbreaks;
- c) Safe water issues arising from floods, fires, power outages, or other situations that may affect water safety; and
- d) Safe water issues relating to recreational water use including public beaches in accordance with the *Infectious Diseases Protocol, 2018* (or as current); *Operational Approaches for Recreational Water Guideline, 2018* (or as current); the *Recreational Water Protocol, 2018* (or as current); the *Safe Drinking Water and Fluoride Monitoring Protocol, 2018* (or as current); and the *Small Drinking Water Systems Risk Assessment Guideline, 2018* (or as current).

Seasonal Beach Monitoring Program

Seasonal Program Planning

- 1) To support the requirements for monitoring public beaches under the *Recreational Water Protocol, 2018* (or as current),³ the board of health shall establish procedures to:
 - a) Confirm the inventory of public beaches within their jurisdiction;
 - b) Establish the commencement and duration of the monitoring season in consultation with operators;
 - c) Conduct environmental surveys before the start of the bathing season to collect and assess environmental conditions that may influence recreational water quality; and
 - d) Assess the quality of recreational water using the geometric mean approach (see the Geometric Mean for Recreational Water Monitoring section below) and *the Guidelines for Canadian Recreational Water, 2012* (or as current) for threshold values to guide public health actions, including communicating risk to the public.⁴

Pre-season Assessment of Public Beaches

- 2) The board of health shall carry out a review and analysis of water sampling data and observations made during the previous season to identify factors that may predict influences on water quality (e.g., heavy rainfall). This information may also inform predictive modelling analysis that lead to more timely assessments and communications to the public.
- 3) The board of health shall carry out pre-season environmental surveys of all public beaches to:
 - a) Identify possible sources of contamination to reduce or eliminate potential impact on recreational water quality;
 - b) Record observations of environmental factors that may influence recreational water quality using the *Environmental Survey – Field Data Report* (Appendix A) or equivalent tool; and
 - c) Collect water samples to assess recreational water quality prior to the commencement of the bathing season.

Surveillance

- 4) The board of health shall use a routine checklist or reporting tool to document observations and data when recreational water quality samples are collected throughout the season. This information will assist in identifying correlations or trends between environmental factors and bacterial water quality. These conditions shall be observed and recorded during routine public beach sampling to support data analysis. Environmental factors to be observed include:
- Water and ambient air temperature;
 - Rainfall within 24 and 48 hours;
 - Rain intensity;
 - Weather conditions (e.g. cloudy, sunny);
 - Wind speed and direction;
 - Water clarity/turbidity;
 - Wave height;
 - Pollution sources, such as waterfowl, industrial waste discharges, storm water outflows, septic system discharges, algal blooms and agricultural run-off; and
 - Other environmental factors that may be locally significant.

The *Environmental Survey – Field Data Report* (Appendix A) may be used to record this information.

Sampling Methods

Public Health Ontario Laboratory Services

- 5) The board of health shall consult with Public Health Ontario Laboratories (PHOL) prior to the start of the sampling program and follow established procedures for submitting samples and communicating test results. Water samples must be labelled and stored in insulated or refrigerated coolers for delivery to the nearest laboratory within one (1) day of collection. For further guidance on sample collection and submission, refer to Public Health Ontario's *Public Health Inspector's Guide to Environmental Microbiological Laboratory Testing, 2017* (or as current).⁵

Water Sample Collection

- 6) The board of health shall ensure public health unit staff are trained and adhere to all health and safety precautions to prevent injury or illness when collecting recreational water samples at public beaches.
- 7) Where the depth of water is 1 to 1.5 meters, the board of health shall obtain samples for bacteriological analysis 15 to 30 centimeters below the water surface. When the depth of water is less than 1 meter, samples shall be obtained as far offshore as possible within the bathing area. Water samples for bacteriological analysis shall be collected using sterile bottles provided by PHOL. For consistent analysis of water quality, samples should be collected at the same general locations, on the same day of the week, at approximately the same time of day. A diagram of the public beach may be used to ensure the program is consistently applied and includes:

- a) Approximate length of beach;
- b) Approximate depth of the water in the public beach area;
- c) Possible sources of pollution and the distances to the bathing area; and
- d) Numbered sampling points and the sequence the samples are collected.

Table 1: Water sampling points are determined by the length of the beach

Length of beach	Number of sampling points
1000 meters or less	5 points
Over 1000 meters	1 point per 200 meters
Over 5000 meters	1 point per 500 meters

Sampling Frequency

- 8) For the purposes of water testing, the board of health shall identify a minimum of five sampling points for each beach. Additional sampling points and more frequent sampling may be carried out as determined by the medical officer of health. Sampling frequency may be reduced to once per month where historical data of the geometric mean and environmental surveys indicate water quality was consistently within the water quality threshold for the previous bathing season and confirmed through the pre-season sampling results. Sampling may also be reduced to once per month for public beaches that historically fail to meet water quality thresholds for previous or entire bathing seasons. In this case, the medical officer of health shall implement a communication strategy to minimize use of the beach by the public (i.e. permanent posting).

Geometric Mean for Recreational Water Monitoring

- 1) The board of health shall review the bacterial test results, as calculated using the geometric mean, along with other environmental factors, to determine appropriate actions. For sample calculations on how to calculate the geometric mean refer to *Calculating the Geometric Mean* (Appendix B).

The geometric mean is a calculation used to average the bacterial levels of *E. coli* in samples collected from recreational water. Monitoring public beaches for *E. coli* bacteria and the use of the geometric mean approach permits more meaningful statistical evaluations. Assessment of the bacterial quality of recreational water requires more than a single result. Due to the uneven distribution of bacteria throughout a liquid medium, the count of microorganisms in a single "grab sample" does not represent the average concentration in a particular body of water. A random sample may demonstrate a concentration that is far above or below the average. To obtain an accurate assessment of the quality of recreational water, the results of a number of samples shall be combined in such a way that a random, unrepresentative sample will not unduly influence the average. Using the *Guidelines for Canadian Recreational Water Quality, 2012*,⁴ the following values apply:

- Geometric mean concentration (minimum of five samples): $\leq 200 E. coli / 100 \text{ mL}$
- Single-sample maximum concentration: $\leq 400 E. coli / 100 \text{ mL}$

Predictive Modeling

- 2) Predictive modeling is a statistical equation tool that the board of health may use to predict *E. coli* levels of recreational water based on turbidity, rainfall, wave height, wind speed, ambient air and water temperatures, etc. Predictive modelling, with sufficient data and observations, may allow public health inspectors to assess conditions at public beaches in real time. While the application of predictive modelling may not be suitable for all beaches, boards of health are encouraged to refer to the *Feasibility of Predictive Modeling for Beach Management in Ontario, 2013*.⁶

Communication to the Public

- 1) The board of health shall communicate the outcomes of recreational water sampling test results to owners/operators of public beaches as soon as possible and provide advice for appropriate action. Regular communication channels that provide information and the status of public beaches to the public shall be updated as new results are received. These communication channels to the public may include website announcements, media releases, automated phones/hotlines, public health unit disclosure systems, on-site postings at public beaches, etc.

Responding to Adverse Events at Public Beaches

- 2) A board of health that receives complaints or reports of adverse events related to recreational water use at public beaches shall assess the issue within 24 hours of notification, to determine the level of potential impact and the appropriate response required.
- 3) The board of health shall establish communication strategies with partner agencies to provide clear and timely information to the public regarding potential risks associated with the use of public beaches. Communications may include, but are not limited to: posting information on the board of health website, disseminating written materials, issuing media releases, and informing local stakeholders, including municipalities.

Potential adverse events at public beaches may include:

- Exceedance of recreational water threshold for bacteria;
- Chemical, oil, sewage or other waste spill;
- Waste water treatment plant bypass (unintentional or controlled);
- Blue-green algae bloom (confirmed by visual observation or laboratory test);
- Heavy algae growth or accumulation other than blue-green algae;
- Fish or other wildlife die-off at the beach; and
- Visible debris, metal, or sharp objects in the water or beach area.

Waterfront Areas at Recreational Camps

- 1) The board of health shall assess waterfronts used for aquatic activities at recreational camps during routine inspections and re-inspections to minimize the risks to the health and safety of the users. As part of the assessment, public health inspectors shall collect the following information:
 - a) A description of aquatic activities undertaken at the waterfront and applicable supervision procedures;
 - b) Identification of designated swimming areas by visual markers, including precautionary signs;
 - c) Available safety equipment (reaching pole or other rescue devices as recommended by recreational water safety associations); and
 - d) Availability of emergency communication procedure, including communication devices.
- 2) Should the operator of the recreational camp wish to implement a recreational water sampling program, the public health inspector shall provide advice to assist in developing the program based on the approach used by the board of health for public beaches.

Operators of recreational camps with waterfronts should be encouraged to consult with industry water safety experts to develop internal policies and procedures for the safe operation of recreational camps and waterfront areas.

Glossary

Adverse Condition: a situation that may be potentially harmful to the health and safety of beach and recreational water users.

Advisory: a precautionary notice that informs members of the public about specific risks to health and safety to allow them to take measures to protect themselves.

Bathing Area: the area at a public beach used for bathing. The bathing area should be determined in collaboration with the beach owner/operator.

Bathing Season: the period of time each year that a public beach is used for bathing. Bathing season generally begins in June and ends early September. The duration of the recreational water quality sampling program may vary depending on local needs as determined by the operators, primarily municipalities.

Beach Closure: to cause restriction/elimination of public access to a beach or specific beach areas where a significant risk to health and safety has been identified. The board of health will direct the owner/operator of the beach to post signage and/or erect barriers/barricades at appropriate locations to reduce the risk of public exposure to the health hazard.

Beach Posting: to communicate advisories and/or place signs in response to a

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swimming advisory or beach closure. Postings are typically communicated through an update on the local health unit's website or through local media/newspapers. Beach postings inform the public about potential risks to health and safety, based on an assessment of those risks. The owner/operator of the beach is primarily responsible for posting and removing the advisory/signs as conditions warrant.

Environmental Survey: an inspection of the physical beach area to identify changes to existing structures, installation of new structures (e.g., drainage lines, storm water outfalls, signs, etc.), changes in beach landscape that affects runoff, potential pollution sources, garbage or debris collection, and any other environmental factor that has the potential to impact water quality, water safety, and/or public health.

Geometric Mean Calculation: for the purposes of this guideline, the geometric mean is a calculation used to average the bacterial levels of *E. coli* in samples collected from recreational water.

Public Beach: includes any public bathing area owned/operated by a municipality to which the general public has access, and where there is reason to believe that there is recreational use of the water (e.g., beach signage, sectioned off swimming area, water safety/rescue equipment, lifeguard chairs, etc.), which may result in waterborne illness or injury as determined by the local medical officer of health.

Recreational Camp Waterfront: a waterfront area that is used for aquatic activities as part of a Recreational Camp, as defined in the Recreational Camps Regulation under the HPPA.

Swimming Advisory: may be issued when beach water quality is not suitable for recreational use. For example, exceedance of the recreational water accepted value for *E. coli* bacteria.

References

1. Ontario. Ministry of Health and Long-Term Care. Ontario public health standards: requirements for programs, services, and accountability, 2018. Toronto, ON: Queen's Printer for Ontario; 2018. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/default.aspx
2. Health Protection and Promotion Act, RSO 1990, c H.7. Available from: <https://www.ontario.ca/laws/statute/90h07>
3. Ontario. Ministry of Health and Long-Term Care. Recreational water protocol, 2018. Toronto, ON: Queen's Printer for Ontario; 2018. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/protocolsguidelines.aspx
4. Health Canada. Guidelines for Canadian recreational water quality. 3rd ed. Ottawa, ON: Her Majesty the Queen in Right of Canada, represented by the Minister of Health; 2012. Available from: <https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-recreational-water-quality-third-edition.html>
5. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Public health inspector's guide to environmental microbiology laboratory testing. 5th ed. Toronto, ON: Queen's Printer for Ontario; 2017. Available from: <https://www.publichealthontario.ca/en/ServicesAndTools/LaboratoryServices/Pages/PHIGuide.aspx>
6. Ontario. Ministry of Health and Long-Term Care. The feasibility of predictive modeling for beach management in Ontario, 2013 [unpublished]. Toronto, ON: Queen's Printer for Ontario; 2013.

Appendix A: Sample Report

Environmental Survey - Field Data Report	
Name of Beach:	Beach ID Number:
Surveyor Name:	Posted at Time of Sampling: <input type="checkbox"/> Yes <input type="checkbox"/> No
Address/Location:	Latitude: Longitude:
Date of Sampling:	Time at Sampling:
Name of Water Body:	Length of Bathing Area (m):
Are maps of the beach area attached? <input type="checkbox"/> Yes <input type="checkbox"/> No Are maps of the watershed attached? <input type="checkbox"/> Yes <input type="checkbox"/> No	Owner/Operator:
Part I: General Beach Conditions	
Air Temperature: _____ °C <input type="checkbox"/> °F <input type="checkbox"/>	Water Temperature: _____ °C <input type="checkbox"/> °F <input type="checkbox"/>
Rain Intensity: <input type="checkbox"/> Light (<2.5mm/hr.) <input type="checkbox"/> Medium (2.6-7.5mm/hr.) <input type="checkbox"/> Heavy (>7mm/hr.) <input type="checkbox"/> None	Rainfall: <input type="checkbox"/> <24 hrs. _____ cm rainfall measured/reported <input type="checkbox"/> <48 hrs. _____ cm rainfall measured/reported <input type="checkbox"/> <72 hrs. _____ cm rainfall measured/reported <input type="checkbox"/> >72 hrs. _____ cm rainfall measured/reported
Water Clarity (Turbidity): <input type="checkbox"/> <100 cm <input type="checkbox"/> >100 cm Value (NTU):	
Wave Height (cm): _____	
Sky Conditions: <input type="checkbox"/> Sunny <input type="checkbox"/> Mostly Sunny <input type="checkbox"/> Partly Cloudy <input type="checkbox"/> Mostly Cloudy <input type="checkbox"/> Cloudy	
Wind Direction: <input type="checkbox"/> None <input type="checkbox"/> Away from Shore <input type="checkbox"/> Toward Shore <input type="checkbox"/> Parallel to Shore Wind Speed: _____	
Beach Materials/Sediments: <input type="checkbox"/> Sandy <input type="checkbox"/> Mucky <input type="checkbox"/> Rocky <input type="checkbox"/> Other (specify) _____	
Subsurface Conditions: Does the bottom consist of material that is easily stirred up? <input type="checkbox"/> Yes <input type="checkbox"/> No Are the slopes gentle? <input type="checkbox"/> Yes <input type="checkbox"/> No Is the bottom free of large rocks, sharp objects and other obstructions? <input type="checkbox"/> Yes <input type="checkbox"/> No Is the bottom free of weeds? <input type="checkbox"/> Yes <input type="checkbox"/> No Is the beach susceptible to undertows or rip currents? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Comments/Observations:	

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Part II: Use of Beach			
Type: <input type="checkbox"/> Residential <input type="checkbox"/> Industrial <input type="checkbox"/> Commercial <input type="checkbox"/> Agricultural <input type="checkbox"/> Other (specify)_____			
Water Body Uses: <input type="checkbox"/> Boating <input type="checkbox"/> Fishing <input type="checkbox"/> Windsurfing <input type="checkbox"/> Bathing/Swimming <input type="checkbox"/> Recreational Camp <input type="checkbox"/> Aquatic Classes <input type="checkbox"/> Scuba Diving <input type="checkbox"/> Other (specify)_____			
Approximate number of people observed in the water:___		Approximate number of people using the beach but not in the water at time of observation:_____	
Part III: Potential Pollutants			
Type of Source	Concern		Describe how this source might contribute to beach pollution and its frequency of contribution
Wildlife/Waterfowl	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Domestic Animals	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Waterwaste Discharges	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Sewage Overflows	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Septic Systems	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Stormwater/Natural Outfalls	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Agricultural/Urban Runoff	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Watercraft Access/Boat Dockage	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Seasonal Watercourse	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Chemical Hazards	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Prone to Algal blooms	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Part IV: Water Quality			
Sample Number	Sample Point	Parameter: <input type="checkbox"/> E. coli <input type="checkbox"/> Other (specify)	Comments
Geometric Mean:			
Surveyor Signature:			
Part V: Diagram of Sampling Location and Pollution Sources			
Include location of: sample points, pollution sources, marinas, boat dockage, fishing, bathing/swimming, jetty, sanitary facilities, restaurants/bars, playground, parking lot(s), etc. *Remember to show North			

Appendix B: Calculating the Geometric Mean

Definition of Geometric Mean: An averaging method used to reduce the effect of a single high reading.

Mathematical Definition: the n^{th} root of the product of n values.

Practical Definition: the average of the logarithmic values of a data set, converted back to a base 10 number.

The geometric mean could be thought of as the average of the logarithmic values, converted back to a base 10 number.

The formula for the geometric mean is:

$$\text{Geometric Mean} = ((X_1)(X_2)(X_3)\dots(X_n))^{1/n}$$

where X_1 , X_2 , etc. represent the individual data points and n is the total number of data points used in the calculation.

Calculating the Geometric Mean

To calculate a geometric mean:

1. Compute the natural logarithm (ln) of each sample result.
2. Add the logarithm of each sample result together.
3. Divide the result by the number of samples.
4. Convert this product (logarithm of the geometric mean) back to an arithmetic value by computing the antilog of the product.

The formula for the logarithm of the geometric mean is:

$$\text{Logarithm of Geometric Mean} = ((\ln X_1) + (\ln X_2) + (\ln X_3) + \dots + (\ln X_N))/n$$

The following example illustrates how this is done:

Where <10, >1000, <10, 30, and 240 are sample data results of colony-forming units (cfu) per 100 ml of water, calculate the geometric mean. This calculation can be performed on a scientific calculator using the “log” key. For example, enter “10” on the calculator and then press the “log” key.

Table 2: Example Geometric Mean Calculation

Sample #	Sample Result	Logarithms
Sample 1	<10	$\ln(10) = 2.303$
Sample 2	>1000	$\ln(1000) = 6.908$
Sample 3	<10	$\ln(10) = 2.303$
Sample 4	30	$\ln(30) = 3.401$
Sample 5	240	$\ln(240) = 5.481$

Average of logarithms = 4.079

Antilog of average = 59

In this example, the geometric mean for the data is 59 cfu/100ml of water. Public health inspectors would use this value in addition to other public health factors to determine the necessity for posting or other advisory actions.

