

Nova Scotia Treatment Standards for
Municipal Drinking Water Systems

Version Control

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Table of Contents

PART I Context and General Requirements	1
1 Purpose and Application of this Document.....	1
1.1 Purpose	1
1.2 Application	1
<i>Applicable source water types</i>	<i>1</i>
<i>Water purchased for distribution.....</i>	<i>2</i>
2 Treatment Components and Document Structure	2
3 Compliance.....	3
3.1 Newly Constructed Municipal Public Drinking Water Supplies	3
3.2 Requirements by Source Water Type	3
4 System Assessment Reports and Corrective Action Plans	9
4.1 Purpose	9
4.2 Contents.....	9
4.3 Reporting Timelines.....	10
<i>Timelines for existing Municipal Public Drinking Water Supplies:</i>	<i>10</i>
<i>Timelines for Holders of Approvals issued after June 15th, 2022:.....</i>	<i>10</i>
5 Requirements Related to the Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol).....	11
6 Backup Water Systems.....	12
6.1 Notification.....	12
6.2 Boil Water Advisories.....	12
PART II Source Water Protection Requirements	13
1 Development of a Source Water Protection Plan	13
2 Submission and Review.....	14
PART III Requirements for Adequate Treatment and Operation.....	15
1 Treatment and Operational Requirements for Surface Water and GUDI Sources Not Assigned a Department-Accepted Natural Filtration Log Credit	15
1.1 General Requirements.....	15
1.2 Primary Disinfection.....	18
1.2.1 <i>Disinfection Units.....</i>	<i>18</i>
1.2.2 <i>Monitoring.....</i>	<i>18</i>
1.2.3 <i>Standard Operating Procedures (SOPs).....</i>	<i>18</i>
1.3 Turbidity and Filtration Requirements	19
2 Treatment and Operational Requirements for Non-GUDI and GUDI Sources Assigned a	

Department-Accepted Natural Filtration Log Credit(s)	24
2.1 General Requirements	24
2.1.1 <i>Non-GUDI</i>	24
2.1.2 <i>Low-Risk and Medium-Risk GUDI</i>	24
2.2 Primary Disinfection Requirements	25
2.2.1 <i>Disinfection:</i>	25
2.2.2 <i>Disinfection Units:</i>	25
2.2.3 <i>Monitoring:</i>	25
2.2.4 <i>Standard Operating Procedures (SOPs):</i>	26
2.3 Turbidity Requirements	27
2.3.1 <i>Non-GUDI</i>	27
2.3.2 <i>Low-Risk and Medium-Risk GUDI</i>	27
3 Bacterial Monitoring and Treatment Requirements in Groundwater Systems during the GUDI Evaluation	28
4 Bypassing Treatment	29
4.1 Notification.....	29
4.2 Boil Water Advisory	29
 PART IV Requirements for Distribution Systems	 30
1 Secondary Disinfection	30
1.1 Free Chlorine.....	30
1.2 Chloramines.....	30
1.3 Monitoring.....	31
1.4 Notification.....	31
1.5 Standard Operation Procedures (SOPs).....	31
2 Distribution System Turbidity	31
3 Cross-Connection Control	32
4 Corrosion Control, Lead and Copper Sampling	33
 PART V Management of Waste Streams	 34
1 Waste Residuals Management	34
2 Filter Backwash Water	35
2.1 Discharges into a Freshwater Watercourse.....	35
2.1.1 <i>Effluent Discharge Criteria</i>	35
2.1.2 <i>Site-specific Discharge Criteria Study</i>	36
2.1.3 <i>Compliance</i>	36
2.1.4 <i>Minimum Monitoring Requirements:</i>	37
2.2 Filter Backwash Discharges to Land or Soil.....	38
2.3 Filter Backwash Discharges to a Marine or Brackish Environment	38

PART VI Requirements Related to Operations, Monitoring, Reporting and Management.....	39
1 Operations	39
1.1 Operations Manual and General Requirements	39
1.2 Emergency Notification Procedures.....	40
1.3 Contingency Plan	40
2 Annual Monitoring Program	41
3 Reporting and Record-Keeping.....	42
3.1 Immediate Reporting.....	42
3.2 Annual Reporting.....	43
3.2.1 <i>Annual Report Timeline</i>	43
3.2.2 <i>Annual Report Content</i>	43
3.3 Information Available for Review upon Request	45
3.4 Record Keeping	46
4 Management of Operations.....	46
 PART VII GLOSSARY AND REFERENCES	 47
Glossary.....	47
References	50

PART I

Context and General Requirements

1 Purpose and Application of this Document

1.1 Purpose

The purpose of this document is to set out the minimum requirements an Approval Holder of a Municipal Public Drinking Water Supply in Nova Scotia must meet to achieve compliance with the health-based treatment goals for enteric viruses and protozoa in accordance with Health Canada's Guidelines for Canadian Drinking Water Quality, as amended from time to time.

Adhering to these requirements will assist in the production of clean, safe drinking water for public health protection while minimizing potential adverse environment effects.

1.2 Application

The requirements outlined in this document (the standards) apply to Municipal Public Drinking Water Supplies in Nova Scotia, as defined in the *Water and Wastewater Facilities and Public Drinking Water Supplies Regulations*, that use any of the source water types outlined below or purchase water for distribution only.

Applicable source water types

- Surface water
 - Where "surface water" means water that is found in lakes, rivers, streams, ponds, surface water impoundments, and other natural watercourses.
- Groundwater under the direct influence of surface water (GUDI)
 - Where "groundwater under the direct influence of surface water" (GUDI) means "any water beneath the surface of the ground with:
 - a. significant occurrence of insects or other macro-organisms, algae, organic debris, or large-diameter pathogens such as *Giardia* and *Cryptosporidium*; or

- b. significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH that closely correlate to climatological or surface water conditions” (U.S. EPA, 1991).
- Groundwater not under the direct influence of surface water (non-GUDI)
 - Where “non-GUDI” means a well that has been classified as not under the direct influence of surface water based on the *Protocol for Determining Groundwater Under the Direct Influence of Surface Water* (Appendix A) and has been accepted as such in writing by a Department of Environment and Climate Change (the Department) Regional Hydrogeologist.

Water purchased for distribution

Municipal Public Drinking Water Supplies that purchase treated water for distribution only must obtain the water from another Municipal Public Drinking Water Supply that complies with these standards.

2 Treatment Components and Document Structure

Nova Scotia’s approach to drinking water treatment is based on the universally accepted multiple-barrier approach to drinking water management. This document is organized by components of the multi-barrier approach, with each part outlining the minimum requirements an Approval Holder must meet related to that component, as follows:

- Source Water Protection (Part II)
- Adequate Treatment and Operation (Part III)
- Distribution System Integrity (Part IV)
- Management of Waste Streams (Part V)
- Operations, Monitoring, Reporting and Management (Part VI)

3 Compliance

3.1 Newly Constructed Municipal Public Drinking Water Supplies

- a. An Approval Holder of a Municipal Public Drinking Water Supply that begins operation after these standards come into effect (June 15th, 2022) must, upon commissioning, meet these standards as well as the requirements outlined in the *Atlantic Canada Water Supply Guidelines (Atlantic Canada Guidelines)*, as amended from time to time.
- b. The Approval Holder shall meet the minimum treatment requirements and adhere to the process of assigning log removal and inactivation credits for enteric protozoa and viruses as outlined in Appendix C based on source water type.
- c. Groundwater wells must comply with the *Protocol for Determining Groundwater Under the Direct Influence of Surface Water* outlined in Appendix A and the bacterial monitoring and treatment requirements outlined in Part III, Section 3 while undergoing the GUDI process.
- d. Subject to Part V Section 2.1, for an Approval Holder of a new Municipal Public Drinking Water Supply proposing to discharge filter backwash to a freshwater watercourse, the Department may consider site-specific effluent limits based upon a one year receiving water study.

3.2 Requirements by Source Water Type

The Department's requirements are based on the potential pathogens of concern in the source water used by a Municipal Public Drinking Water Supply and whether the Approval Holder treats water or purchases water from another Municipal Public Drinking Water Supply. Table 1 outlines the sections of this document Approval Holders' must comply with based on their source water type and the potential pathogens of concern.

Where multiple raw water sources are combined and treated in the same Municipal Public Drinking Water Supply, the minimum treatment requirements shall be based on the highest risk source water as outlined in Appendix C.

Table 1: Applicable Requirements by Source Water Type

Requirements that must be Complied with Based on the Municipal Public Drinking Water Supply Source water	Surface Water	Non-GUDI and GUDI (Assigned a Department-accepted Natural Filtration Log credit)	GUDI (Not Assigned a Department-accepted Natural Filtration Log Credit)	Distribution only
Part I Context and General Requirements				
Section 3 – Compliance	x	x	x	x
Section 4 – System Assessment Reports and Corrective Action Plans	x	x	x	x
Section 5 – Requirements Related to the GUDI Protocol		x	x	
Section 6 – Back-up Water Systems (For Systems that have a Back-up Water Supply)	x	x	x	
Part II Source Water Protection Requirements				
Section 1 – Development of a SWPP	x	x	x	
Section 2 – Submission and Review	x	x	x	

Requirements that must be Complied with Based on the Municipal Public Drinking Water Supply Source water	Surface Water	Non-GUDI and GUDI (Assigned a Department-accepted Natural Filtration Log credit)	GUDI (Not Assigned a Department-accepted Natural Filtration Log Credit)	Distribution only
Part III Treatment and Operational Requirements				
Section 1 – Treatment and Operational Requirements (Surface water and GUDI Sources not Assigned a Department-accepted Natural Filtration Log Credit)	x		x	
Section 2 – Treatment and Operational requirements (Non-GUDI and GUDI Sources Assigned a Department-accepted Natural Filtration Log Credit)		x		
Section 3 – Bacterial Monitoring and Treatment Requirements in Groundwater Systems Undergoing GUDI Evaluation		x	x	
Section 4 – Bypassing Treatment	x	x	x	x

Requirements that must be Complied with Based on the Municipal Public Drinking Water Supply Source water	Surface Water	Non-GUDI and GUDI (Assigned a Department-accepted Natural Filtration Log credit)	GUDI (Not Assigned a Department-accepted Natural Filtration Log Credit)	Distribution only
Part IV Requirements for Distribution Systems				
Section 1 – Secondary Disinfection	x	x	x	x
Section 2 – Distribution System Turbidity	x	x	x	x
Section 3 – Cross-Connection Control	x	x	x	x
Section 4 – Corrosion Control, Lead and Copper Management	x	x	x	x

Requirements that must be Complied with Based on the Municipal Public Drinking Water Supply Source water	Surface Water	Non-GUDI and GUDI (Assigned a Department-accepted Natural Filtration Log credit)	GUDI (Not Assigned a Department-accepted Natural Filtration Log Credit)	Distribution only
Part V Management of Waste Streams				
Section 1 – Waste Residuals Management (Applies only to Facilities that Generate Waste Residuals)	x	x	x	
Section 2.1 – Filter Backwash Discharge to Freshwater Aquatic Environments (Applies only to Facilities that Direct Filter Backwash to Freshwater)	x	x	x	
Section 2.2 – Filter Backwash Discharge to Non-Aquatic Environments (Applies only to Facilities that Direct Filter Backwash to Non-aquatic Environments)	x	x	x	

Requirements that must be Complied with Based on the Municipal Public Drinking Water Supply Source water	Surface Water	Non-GUDI and GUDI (Assigned a Department-accepted Natural Filtration Log credit)	GUDI (Not Assigned a Department-accepted Natural Filtration Log Credit)	Distribution only
Part VI Operations, Monitoring, Reporting, and Management				
Section 1 – Operations	x	x	x	x
Section 2 – Annual Monitoring Program	x	x	x	x
Section 3 – Reporting and Record Keeping	x	x	x	x
Section 4 – Management of Operations	x	x	x	x

4 System Assessment Reports and Corrective Action Plans

4.1 Purpose

The purpose of a **System Assessment Report** is to verify that the Approval Holder of the Municipal Public Drinking Water Supply meets current standards, including the minimum requirements set out by this document.

System Assessment Reports support the Approval Holder and the Department to:

- Evaluate the capability of the system to consistently and reliably deliver an adequate quantity of safe drinking water;
- Verify compliance with regulatory requirements, as amended from time to time; and
- Consider options and costs to address deficiencies.

The purpose of a **Corrective Action Plan** is to outline the implementation schedule that an Approval Holder must follow to address all deficiencies identified by the System Assessment Report.

It is the Approval Holder's responsibility to ensure that funding is in place to complete the System Assessment Report process and implement any required corrective action.

4.2 Contents

The Approval Holder must complete a System Assessment Report in accordance with the *Terms of Reference for System Assessment Reports for Municipal Drinking Water Systems*, as amended from time to time, published by the Department. The submitted System Assessment Report must be acceptable to the Department and must include the following components:

- A characterization of the source water;
- An evaluation of any changes that could affect the GUDI status;
- An evaluation of treatment processes, facilities, and equipment;
- An evaluation of the distribution system;
- An evaluation of waste streams; and
- A review of operations, maintenance, monitoring and management of the Municipal Public Drinking Water Supply

The Corrective Action Plan must be acceptable to the Department.,

4.3 Reporting Timelines

A Municipal Public Drinking Water Supply shall be assessed at least every ten years, or sooner, if required, as outlined below.

Timelines for existing Municipal Public Drinking Water Supplies:

System Assessment Reports: An Approval Holder with an existing Approval to Operate at the time these standards come into effect (June 15th, 2022) must submit a System Assessment Report on or before April 1st, 2023, and thereafter must submit a Report on or before April 1st of every subsequent ten-year period (e.g., April 1st, 2033; April 1st, 2043; etc.) for as long as the Municipal Public Drinking Water Supply is in operation. The Approval Holder must submit three copies of the completed System Assessment Report to the local Department office.

Corrective Action Plans: An Approval Holder with an existing Approval to Operate at the time these standards come into effect (June 15th, 2022) must submit a Corrective Action Plan to the local Department office on or before October 1st of the same year the System Assessment Report was due to address deficiencies identified by the System Assessment Report.

Timelines for Holders of Approvals issued after June 15th, 2022:

System Assessment Reports: An Approval Holder with an approval issued after June 15th, 2022, will receive a site-specific deadline from the Department by which they must submit their System Assessment Report. It is required that all newly constructed Municipal Public Drinking Water Supplies meet the standards outlined in this document. After the initial assessment, future System Assessment Reports shall be submitted on or before April 1st, 2033, and every ten years thereafter.

Corrective Action Plans: An Approval Holder with an Approval to Operate issued after June 15th, 2022, must submit a Corrective Action Plan to the Department within six months of the submission of the System Assessment Report. After the initial Corrective Action Plan is received, future Corrective Action Plans shall be submitted on or before October 1st, 2033, and every ten years thereafter.

5 Requirements Related to the Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol)

The GUDI Protocol (Appendix A) provides a process for determining whether a water well is classified as “groundwater under the direct influence of surface water” (GUDI) and, if so, its specific GUDI risk classification. This classification determines the applicable treatment and monitoring requirements.

- a. An Approval Holder that relies on groundwater must ensure that all wells in the Municipal Public Drinking Water Supply have been classified in accordance with *The Protocol for Determining Groundwater Under the Direct Influence of Surface Water* (GUDI Protocol) (Appendix A), as amended from time to time.
- b. A well assigned a GUDI classification under the previous *Nova Scotia Municipal Drinking Water Treatment Standards*, dated March 2012, does not need to be re-assessed and the existing Department-accepted classification remains valid unless evidence provided in the System Assessment Report, or other information, indicates a need for reclassification based on Appendix A section A.3.6.
- c. The Approval Holder is responsible for completing the GUDI Protocol as outlined in Appendix A and submitting the resulting GUDI classification to the Department for review and acceptance.
- d. GUDI classifications must be made by a Qualified Hydrogeologist registered to practice in Nova Scotia by the Association of Professional Geoscientists of Nova Scotia (Geoscientists Nova Scotia) or the Association of Professional Engineers of Nova Scotia (Engineers Nova Scotia). The classifying Qualified Hydrogeologist is considered the person responsible for all aspects of the GUDI Protocol assessment and this includes a duty to ensure the proper collection, integrity and use of data in accordance with the GUDI Protocol.
- e. The completion of the GUDI Protocol and the classification of wells must be acceptable to a Department Regional Hydrogeologist.

6 Backup Water Systems

6.1 Notification

- a. Prior to the use of a backup water system, the Approval Holder must immediately notify the Department, provide rationale for the use of the backup water system and identify the anticipated period of time that the backup system will be in service.

6.2 Boil Water Advisories

- a. For backup systems that do not meet the requirements set out in this document, the Approval Holder must immediately initiate a boil water advisory as stated in the *Guidelines for Monitoring Public Drinking Water Supplies – Part I*, as amended from time to time, prior to the use of the backup system. The Approval Holder shall maintain the boil advisory until otherwise advised by the Department.
- b. For backup systems that meet the standards set out in this document, the Approval Holder may continue to operate without the issuance of a boil water advisory until the main system is put back into service or as otherwise directed by the Department.

PART II

Source Water Protection Requirements

The Municipal Public Drinking Water Supply Approval Holder is responsible for taking reasonable steps to protect the source from contamination.

1 Development of a Source Water Protection Plan

- a. The Approval Holder must develop a source water protection plan (SWPP) in accordance with the following five guidance documents, as amended from time to time, published by the Department.
 - Step 1 - Form a Source Water Protection Advisory Committee
 - Step 2 - Delineation of a Source Water Protection Area Boundary
 - Step 3 - Identify Potential Contaminants and Assess Risk
 - Step 4 - Develop a Source Water Protection Management Plan
 - Step 5 - Develop a Monitoring Program to Evaluate the Effectiveness of a Source Water Protection Plan
- b. The Approval Holder shall complete the risk identification process in accordance with the following criteria, dependent on the system source water type:
 - Surface water: within the natural watershed boundary;
 - GUDI sources: within the natural watershed boundary and the 25-year time-of-travel; or
 - Non-GUDI sources: within the 25-year time-of-travel.

2 Submission and Review

- a. The Approval Holder shall submit a SWPP, including an implementation schedule, to the Department for review. The SWPP and schedule must be deemed acceptable by the Department.
- b. The Approval Holder shall review the SWPP and implementation plan annually. The Approval Holder shall summarize the results of the annual review, using the checklist published by the Department, in the Municipal Public Drinking Water Supply annual report due annually on or before April 1st.
- c. The Approval Holder shall modify the SWPP, including updating the plan, if directed to do so by the Department.

PART III

Requirements for Adequate Treatment and Operation

For newly constructed Municipal Public Drinking Water Supplies (including all constructed wells) or those undergoing process modification, the Approval Holder shall adhere to the minimum treatment requirements and process for assigning pathogen log reduction credits outlined in Appendices C and D to meet the minimum health-based treatment goals for enteric viruses and protozoa.

1 Treatment and Operational Requirements for Surface Water and GUDI Sources Not Assigned a Department-Accepted Natural Filtration Log Credit¹

1.1 General Requirements

- a. Using both the engineered filtration and disinfection processes, the Municipal Public Drinking Water Supply must meet the following treatment efficiencies:
 - i. Treatment shall ensure 3-log reduction of *Giardia* and *Cryptosporidium*; and
 - ii. Treatment shall ensure 4-log reduction of viruses.
- b. Primary disinfection through the use of chlorine, UV, and/or Department-accepted alternate disinfectant such as chlorine dioxide or ozone shall achieve a minimum of 0.5-log inactivation for *Giardia* when used in conjunction with filtration. The disinfection log inactivation shall be based on CT/IT values calculated as described in Appendix C.
- c. The Approval Holder shall adhere to the requirements outlined in Table 2 based on the type of primary disinfectant used.

¹ High-risk GUDI sources are not eligible to receive a Department accepted natural filtration log credit.

Table 2: Operational Requirements Based on Type of Primary Disinfectant

Primary Disinfectant	Requirements
<p>Free chlorine</p> <p>Note: Chloramines are not acceptable for use as a primary disinfectant.</p>	<p>a. The Approval Holder shall meet the required CT value, at a minimum, as outlined in Appendices C and D.</p> <p>b. In the event the minimum required CT is not achieved, contingencies shall be in place to prevent the distribution of inadequately disinfected water.</p> <p>c. The Approval Holder shall contact the Department to determine if site-specific requirements may apply.</p>
<p>Ultraviolet (UV) Light</p>	<p>The Approval Holder shall meet the following requirements:</p> <p>a. UV systems must provide a minimum dosage of 40 mJ/cm² at all points within the reactor at all times when water is passing through the unit, unless an alternate dose has been accepted by the Department.</p> <p>b. UV intensity and flow through the reactors shall be monitored a minimum of once every five minutes to ensure UV dose is greater than or equal to 40 mJ/cm², or alternate Department accepted dose.</p> <p>c. UV transmittance shall be calculated at a minimum of daily.</p> <p>d. Contingencies shall be in place to prevent the distribution of water if the UV dose drops below 40 mJ/cm², or alternate Department accepted dose, including during lamp warm-up time. Water flow shall be stopped, directed to waste, or another method of disinfection shall be used.</p> <p>e. In the event of UV bulb breakage during operation, contingencies shall be in place to prevent the distribution of inadequately disinfected water.</p> <p>f. The UV disinfection unit shall be equipped with UV sensors reading calibrated UV intensity. The UV sensors shall be calibrated on a monthly basis. Off-line reference sensors used for calibration shall be of equal quality to the on-line sensors and shall be calibrated annually.</p> <p>g. The Approval Holder shall record the results of the calibration as part of their QA/QC program and provide the results to the Department immediately upon request.</p> <p>h. The UV system shall be equipped with an alarm notification and shutdown procedures in the event of:</p> <ul style="list-style-type: none"> – High temperature in the reactor, lamp, ballast or transformer; – High flow rate that causes dose to fall below design specifications; – Low UV dose; – Low UV intensity; – UV has shutdown; or – Any other emergency situation. <p>i. The UV transmittance analyzer shall be calibrated weekly.</p> <p>j. UV lamp operation shall be monitored in a manner that ensures bulb replacement can be accomplished prior to the maximum</p>

Primary Disinfectant	Requirements
	<p>lamp life expectancy.</p> <p>k. The Approval Holder shall receive written verification from an independent third party that the manufacturer's system will continually meet the 40 mJ/cm² requirement, or alternate Department-accepted dose, and provide this information to the Department immediately upon request.</p> <p>l. The Approval Holder shall contact the Department to determine - if specific requirements may apply.</p>
Chlorine dioxide	<p>a. The Approval Holder shall meet the required CT value, at a minimum, as outlined in Appendices C and D.</p> <p>b. In the event the minimum CT is not achieved, contingencies shall be in place to prevent the distribution of inadequately disinfected water.</p> <p>c. The feed dose shall not exceed a maximum of 1.2 mg/L.</p> <p>d. The Approval Holder shall contact the Department to determine if site-specific requirements may apply.</p>
Ozone	<p>a. The Approval Holder shall meet the required CT value at a minimum as outlined in Appendices C and D.</p> <p>b. In the event the minimum CT is not achieved, contingencies shall be in place to prevent the distribution of inadequately disinfected water.</p> <p>c. The Approval Holder shall contact the Department to determine if site-specific requirements may apply.</p>

1.2 Primary Disinfection

1.2.1 Disinfection Units

- a. The Municipal Public Drinking Water Supply shall have a minimum of two primary disinfection units to ensure that inadequately disinfected water is not distributed.
- b. Each disinfection unit shall be capable of meeting the maximum day demand flow.
- c. Where more than two disinfection units are provided, the maximum day demand flow shall be met when the largest unit is out of service.

1.2.2 Monitoring

- a. Continuous on-line monitoring of the primary disinfection process is required at each Municipal Public Drinking Water Supply.
- b. Measurements must be taken and recorded at a minimum of once every five minutes to ensure that inadequately disinfected water does not enter the distribution system.
- c. Water systems shall be equipped with alarm capabilities to notify operations staff if the disinfection process fails to operate properly to prevent inadequately disinfected water from being distributed. Contingencies shall be in place to prevent the distribution of inadequately disinfected water.

1.2.3 Standard Operating Procedures (SOPs)

- a. SOPs for the disinfection process shall be developed, implemented, and communicated to all operations staff and documented in the operations manual required by these standards.
- b. The procedures and a log indicating the date and method of communication to staff shall be made available to the Department immediately upon request.
- c. SOPs shall indicate the design ranges for achieving CT (e.g., for free chlorine disinfection - minimum temperature and chlorine residual; maximum flow and pH) and/or IT (e.g., minimum UV intensity, minimum UV transmittance, and maximum water flow).
- d. When operational conditions are outside the design ranges for achieving CT/IT, the Approval Holder shall notify the Department as soon as the Approval Holder becomes aware, investigate the cause, and take necessary corrective action. CT/IT shall be calculated during every such event.

1.3 Turbidity and Filtration Requirements

- a. Continuous or grab sample monitoring for turbidity is required at least once a day for the raw water prior to pre-treatment.
- b. Filters:
 - i. A minimum of two filters or membrane units (redundancy) are required.
 - ii. Where two filters or membrane units are provided, each shall be capable of supplying maximum daily demands with the largest filter or membrane out of service.
 - iii. Where more than two filters or membrane units are provided, the maximum day demand shall be met with the largest filter or membrane out of service.
- c. Based on the type of filtration technology, the Approval Holder shall adhere to the requirements outlined in Table 3.
- d. Continuous or grab sample monitoring of the filter-to-waste product is required. Unless otherwise specified in the Approval to Operate, sampling and testing shall be completed prior to returning the filter to operation.
- e. The filtration process shall be operated in such a manner as to remove an individual filter or membrane unit from service if the turbidity exceeds the values specified in Table 3.
- f. Filtration processes for pathogen reduction are required to be continuously monitored, with turbidity measurements collected and recorded at a minimum frequency of once every five minutes.
- g. Filtration processes shall have a shut off feature and alarm when turbidity criteria are not achieved.
- h. The Approval Holder shall notify the Department as soon as they become aware of turbidity values that do not meet the requirements of Table 3.
- i. SOPs for the filtration process shall be developed, implemented, and communicated to all operations staff and documented in the operations manual required herein. The procedures and log of communication shall be made available to the Department immediately upon request.

Table 3: Filtration Requirements for Surface Water and GUDI Sources Not Assigned a Department-accepted Natural Filtration Log Credit

Treatment Technology	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
<p>Conventional filtration¹ - includes chemical mixing, coagulation, flocculation, clarification and rapid gravity filtration</p>	<p>a. Shall be less than or equal to 0.2 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month.</p> <p>b. Shall not exceed 1.0 NTU at any time.</p> <p>c. Filter-to-waste² filters shall be capable of directing filtered water to waste or recycle immediately following a backwash for a period of time until the filtrate turbidity value is below 0.2 NTU.</p> <p>d. For direct filtration systems that use free chlorine alone as their primary disinfectant, to achieve log reduction requirements for <i>Cryptosporidium</i>, the turbidity shall be less than or equal to 0.15 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month.</p>
<p>Direct filtration¹ - includes chemical mixing, coagulation, flocculation, and rapid gravity filtration</p>	
<p>Slow sand filtration</p>	<p>a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month.</p> <p>b. Shall not exceed 3.0 NTU at any time.</p> <p>c. Filter-to-waste² shall be provided to ensure filtered water, immediately after filter cleaning, is directed to a waste or recycle stream.</p>
<p>Diatomaceous earth filtration</p>	<p>a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month.</p> <p>b. Shall not exceed 3.0 NTU at any time.</p> <p>c. Filter-to-waste² shall be provided to ensure filtered water, immediately after filter backwashing, is directed to a waste or recycle stream.</p>

Treatment Technology	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
<p>Micro-filtration and Ultra-filtration</p>	<ul style="list-style-type: none"> a. Shall be less than or equal to 0.1 NTU in at least 99% of the measurements made or at least 99% of the time each calendar month. b. If turbidity exceeds 0.1 NTU for more than 15 minutes, direct integrity testing shall be immediately conducted on the membrane treatment unit. c. Shall not exceed 0.3 NTU at any time. d. Filter-to-waste² shall be provided for operational flexibility. e. The membrane system used for pathogen reduction shall have continuous indirect integrity testing. f. Continuous indirect integrity testing shall be conducted at a minimum frequency of once every 5 minutes. Indirect integrity testing shall follow that outlined in the <i>EPA Membrane Filtration Guidance Manual</i>, as amended from time to time. g. The actual removal efficiency of a membrane shall be verified by third party challenge testing. Acceptable challenge testing shall follow that provided in the <i>EPA Membrane Filtration Guidance Manual</i>, as amended from time to time. h. Direct integrity testing shall be able to verify a log removal value equal to or greater than the removal credit awarded to the membrane filtration process. i. Direct integrity testing shall be conducted on each membrane filtration unit at least once per day and as soon as the Approval Holder becomes aware when the turbidity exceeds 0.1 NTU for more than 15 minutes.

Treatment Technology	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
<p>Reverse osmosis and Nano-filtration</p>	<ul style="list-style-type: none"> a. Shall be less than or equal to 0.1 NTU in at least 99% of the measurements made or at least 99% of the time each calendar month. b. Shall not exceed 0.3 NTU at any time. c. Filter-to-waste² shall be provided for operational flexibility. d. To receive pathogen log reduction credits, direct integrity testing shall be available to verify removal efficiency. If the membrane process is assigned pathogen log reduction credits by the Department, the Approval Holder shall adhere to the following additional requirements: <ul style="list-style-type: none"> i. The membrane system used for pathogen reduction shall have continuous indirect integrity testing. ii. Continuous indirect integrity testing shall be conducted at a minimum frequency of once every 5 minutes. Indirect integrity testing shall follow that outlined in the <i>EPA Membrane Filtration Guidance Manual</i>, as amended from time to time. e. The actual removal efficiency of a membrane shall be verified by third party challenge testing. Acceptable challenge testing shall follow that provided in the <i>EPA Membrane Filtration Guidance Manual</i>, as amended from time to time. f. Direct integrity testing shall be able to verify a log removal value equal to or greater than the removal credit awarded to the membrane filtration process. g. Direct integrity testing shall be conducted on each membrane filtration unit at least once per day and as soon as the Approval Holder becomes aware when the turbidity exceeds 0.1 NTU for more than 15 minutes.

Treatment Technology	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
<p>Cartridge filtration (1 micron absolute pore size)</p>	<ul style="list-style-type: none"> a. For systems serving less than 500 persons, differential pressure across the filter medium is measured and recorded a minimum of once daily and does not exceed the manufacturer's requirements. b. For systems serving more than 500 persons, differential pressure across the filter medium is continuously measured and recorded at a minimum frequency of one measurement every five minutes and does not exceed the manufacturer's requirements. c. Shall be less than or equal to 0.3 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. d. Shall not exceed 1.0 NTU at any time e. The cartridge filtration process is tested and confirmed by an independent testing agency for at least 3 log removal of <i>Cryptosporidium</i> oocysts or surrogate particles. Challenge testing shall demonstrate at least 3 log removal of <i>Cryptosporidium</i> oocysts and <i>Giardia</i> cysts.

- 1 Municipal Public Drinking Water Supplies with conventional or direct filtration that achieve 0.15 NTU 95% of the time each calendar month in combined or individual filter effluent are eligible to receive additional log removal credits for protozoa to meet minimum treatment requirements as follows: combined 0.5-log; individual 1.0-log.
- 2 Alternatives that demonstrate an equivalent benefit to filter-to-waste may be considered by the Department on a case-by-case basis for existing Municipal Public Drinking Water Supplies. All new facilities shall include a filter-to-waste provision.

2 Treatment and Operational Requirements for Non-GUDI and GUDI Sources Assigned a Department-Accepted Natural Filtration Log Credit(s)

As the operational requirements are similar for both non-GUDI and GUDI sources assigned a Department-accepted natural filtration log credit, the Approval Holder shall adhere to the requirements outlined in this section. Where there are differences in requirements for non-GUDI and GUDI sources assigned a Department-accepted natural filtration log credit, the differences are specified.

The Approval Holder of a Municipal Public Drinking Water Supply using a GUDI source of supply may apply to the Department for a natural filtration log credits(s) as outlined in Appendix B.

2.1 General Requirements

2.1.1 Non-GUDI

Treatment shall be sufficient to ensure 4 log reduction of viruses for each well or, if water from individual wells is combined, for the combined flow.

2.1.2 Low-Risk and Medium-Risk GUDI

- a. Using both the natural filtration and disinfection processes, the Approval Holder shall meet the following treatment efficiencies:
 - i. Treatment shall be sufficient to ensure 3-log reduction of *Giardia* and *Cryptosporidium*; and
 - ii. Treatment shall be sufficient to ensure 4-log reduction of viruses.
- b. **For Low-Risk GUDI:** Upon acceptance by a Department Regional Hydrogeologist, verified natural filtration allows a 3-log reduction credit to be assigned for *Giardia* and *Cryptosporidium* treatment.
- c. **For Medium-Risk GUDI:** Upon acceptance by a Department Regional Hydrogeologist, verified natural filtration allows a 1-log reduction credit to be assigned for *Giardia* and *Cryptosporidium* treatment.

2.2 Primary Disinfection Requirements

The Approval Holder shall adhere to the requirements outlined in Table 2 based on the type of primary disinfectant used.

2.2.1 Disinfection:

- a. **For non-GUDI and low-risk GUDI assigned a Department-accepted natural filtration log credit**, primary disinfection through the use of chlorine, UV, and/or a Department-accepted alternate disinfection method shall contribute a minimum of 4-log inactivation for viruses for each well or, if water from individual wells is combined, for the combined flow.
- b. **For medium-risk-GUDI assigned a Department-accepted natural filtration log credit**, primary disinfection through the use of chlorine, UV, and/or a Department-accepted alternate disinfection method shall contribute a minimum of 2-log inactivation for *Giardia* and *Cryptosporidium* and 4-log reduction viruses for each well or, if water from individual wells is combined, for the combined flow.
- c. The disinfection log inactivation shall be based on CT/IT values calculated as described in Appendix C.

2.2.2 Disinfection Units:

- a. Flow from each well or the combined flow, if water from individual wells is combined, shall have a minimum of two primary disinfection units configured to apply disinfection treatment at all times to ensure that inadequately disinfected water does not enter the water distribution system, unless the Approval Holder makes an application for system-wide redundancy and the application is accepted by the Department.
 - i. Each disinfection unit shall be capable of meeting the maximum day demand flow.
- b. Where more than two disinfection units are provided, the maximum day demand flow shall be met when the largest unit is out of service.

2.2.3 Monitoring:

- a. Continuous on-line monitoring of the primary disinfection process is required at each Municipal Public Drinking Water Supply with measurements taken at a minimum of once every five minutes to ensure that inadequately disinfected water does not enter the distribution system.
- b. Water systems shall be equipped with alarm capabilities to notify operations staff if the disinfection process fails to operate properly to prevent inadequately disinfected water from being distributed.

2.2.4 Standard Operating Procedures (SOPs):

- a. SOPs for the disinfection process shall be developed, implemented and communicated to all operations staff and documented in the operations manual required by these standards.
- b. The procedures and a log indicating the date and method of communication to staff shall be made available to the Department immediately upon request.
- c. SOPs shall indicate the design ranges for achieving CT (e.g., for free chlorine disinfection - minimum temperature and chlorine residual; maximum flow and pH) and/or IT (e.g., minimum UV intensity, minimum UV transmittance, and maximum water flow).
- d. When operational conditions are outside the design ranges for achieving CT/IT, the Approval Holder shall notify the Department as soon as they become aware, investigate the cause, and take necessary corrective action. CT/IT shall be calculated during every such event.

2.3 Turbidity Requirements

2.3.1 Non-GUDI

- a. The turbidity levels entering the water distribution system from each well or combination of wells shall not exceed 1.0 NTU in:
 - i. at least 95% of the measurements taken by grab sample for each calendar month; or
 - ii. at least 95% of the time each calendar month if continuous monitoring is the method of turbidity measurement.
- b. A daily grab sample, collected once per day, or continuous monitoring, with measurements taken at no more than five-minute intervals, is required at each wellhead or combined flow.
- c. If the Municipal Public Drinking Water Supply cannot meet the 1.0 NTU turbidity requirements described in these standards, the Approval Holder may request to the Department that a less stringent value apply provided the Approval Holder can demonstrate to the Department that the turbidity is not health-related and that the disinfection process is not compromised by the use of a less stringent value.

2.3.2 Low-Risk and Medium-Risk GUDI

- a. The turbidity value at each wellhead shall be equal to or less than 1.0 NTU in:
 - i. at least 95% of the measurements; or
 - ii. at least 95% of the time based on each calendar month.
- b. Continuous turbidity monitoring and recording is required for each GUDI well, with measurements taken at no more than five-minute intervals.
- c. If the Municipal Public Drinking Water Supply cannot meet the 1.0 NTU turbidity requirements described in these standards, the Approval Holder may request to the Department that a less stringent value apply provided the Approval Holder can demonstrate to the Department that the turbidity is not health-related and that the disinfection process is not compromised by the use of a less stringent value.

3 Bacterial Monitoring and Treatment Requirements in Groundwater Systems during the GUDI Evaluation

- a. For groundwater wells, a minimum of two raw water bacteria (total coliform and *E. coli*) samples shall be collected to assess the water quality screening criteria in Step 1 of the GUDI Protocol (Appendix A), as amended from time to time. These samples must be collected at the middle and end of the 72-hour pumping test, as suggested in the Department's *Guide to Groundwater Withdrawal Approvals*, as amended from time to time.
- b. If a well being assessed under the GUDI protocol has bacteria detected in either of the two raw water samples, the Approval Holder must carry out additional sampling to confirm whether bacteria continue to be present.
 - i. The Approval Holder must collect a minimum of two additional samples, separated by a minimum of 24 hours, as outlined in Section A.2.1 of Appendix A.
 - ii. If any of the additional samples contain bacteria, the well shall fail Step 1, unless additional corrective action is undertaken, and further additional sampling demonstrates the well does not contain bacteria in the latest two consecutive samples.
 - iii. The iterative process of corrective action to a well followed by additional sampling may only be carried out twice before Step 1 results must be determined.
- c. For groundwater wells that fail Step 1 of the GUDI Protocol (Appendix A), as amended from time to time, for reasons other than water quality, the following shall apply:
 - i. The well may be connected to the distribution system to allow the completion of Steps 2 and 3 of the Protocol, in which case, the following shall apply:
 - The well shall be equipped with a disinfection system capable of achieving 4-log reduction for viruses;
 - A minimum of 0.4 mg/L free chlorine residual shall be maintained at the end of the distribution system; and
 - Twice weekly sampling and analysis for total coliform and *E.coli* bacteria of water in the distribution system shall be conducted.

- d. If the well failed Step 1 due to total coliform or *E. coli* bacteria presence, or if any subsequent samples are confirmed for bacteria, and the well is connected to the distribution system for the completion of the GUDI Protocol, the following shall apply:
 - i. The well shall be equipped with a disinfection system capable of achieving 3-log reduction for protozoa;
 - ii. The well shall be equipped with a disinfection system capable of achieving 4-log reduction for viruses;
 - iii. A 0.4 mg/L free chlorine residual shall be maintained at the furthest point in the distribution system; and
 - iv. Twice weekly sampling and analysis for total coliform and *E. coli* bacteria of water in the distribution system shall be conducted.
- e. Step 2 of the GUDI Protocol shall be completed under proposed “normal operating conditions” (e.g., proposed flow rate, well on/off cycling, etc.) for 52 weeks of operation in accordance with the GUDI Protocol (Appendix A), as amended from time to time..
- f. Step 3 shall be completed in accordance with the GUDI Protocol (Appendix A), as amended from time to time.

4 Bypassing Treatment

4.1 Notification

When it is necessary to use a by-pass to divert water around one or more treatment processes required to achieve log reduction requirements for enteric viruses and protozoa, the Approval Holder shall immediately notify the Department, provide rationale for the need to bypass treatment and identify the anticipated period of time that the by-pass will be necessary.

4.2 Boil Water Advisory

When it is necessary to use a by-pass to divert water around one or more treatment processes, the Approval Holder shall immediately initiate a boil water advisory as outlined in *the Guidelines for Monitoring Public Drinking Water Supplies – Part I*, as amended from time to time. The Approval Holder shall maintain the boil advisory until otherwise advised by the Department.

PART IV

Requirements for Distribution Systems

All Approval Holders must comply with the requirements outlined in this section.

Distribution system integrity: The Department recommends Approval Holders have active programs in place to deal with threats to distribution system integrity, including ageing infrastructure, leaks, pressure transients, storage tanks, and pumping stations.

1 Secondary Disinfection

1.1 Free Chlorine

For Approval Holders using free chlorine as their secondary disinfectant, the following requirements must be met:

- a. The disinfection process shall be operated in such a manner so as to ensure that a minimum free chlorine residual of 0.2 mg/L is achieved throughout the water distribution system at all times, except for systems using groundwater sources undergoing a GUDI assessment where the water is distributed for human consumption. In this case a minimum free chlorine residual of 0.4 mg/L shall be achieved throughout the water distribution system at all times.
- b. The maximum free chlorine residual shall not exceed 4 mg/L.

1.2 Chloramines

For Approval Holders using chloramines (combined chlorine) as their secondary disinfectant, the following requirements must be met:

- a. The disinfection process shall be operated in such a manner as to ensure that a minimum combined chlorine residual of 1 mg/L is achieved throughout the water distribution system at all times.
- b. The maximum combined chlorine residual shall not exceed 3 mg/L.

1.3 Monitoring

- a. Continuous monitoring and recording of the free or combined chlorine residual is required for finished water leaving the Municipal Public Drinking Water Supply and entering the water distribution system with measurements taken at no more than five-minute intervals.
- b. Continuous monitoring and recording of the free or combined chlorine residual is required for the water leaving any water storage structure within the water distribution system, with measurements taken at no more than five-minute intervals.
- c. Monitoring of the water distribution system for free or combined chlorine residual is required. Unless specified otherwise in the Approval to Operate, sampling frequency is the same as for bacteriological sampling requirements as stated in the *“Guidelines for Monitoring Public Drinking Water Supplies– Part I”*, as amended from time to time.

1.4 Notification

- a. The Approval Holder shall immediately notify the Department and undertake corrective action if the minimum free or combined chlorine residual drops below the minimum required concentration..

1.5 Standard Operation Procedures (SOPs)

- a. SOPs for the secondary disinfection process shall be developed, implemented, and communicated to all operations staff and documented in the operations manual required by these standards. The procedures and the log of communication shall be made available immediately upon request by the Department.

2 Distribution System Turbidity

- a. A turbidity value of 5.0 NTU or less shall be achieved in the water distribution system.
- b. Unless specified otherwise in the Approval to Operate, sampling and testing frequency is the same as for bacteriological sampling requirements as stated in the *Guidelines for Monitoring Public Drinking Water Supplies – Part I*, as amended from time to time.
- c. Where turbidity values of greater than 5.0 NTU are observed in the water distribution system, the Approval Holder shall investigate the cause, notify the Department immediately, and take corrective action as necessary.

3 Cross-Connection Control

- a. The Approval Holder shall develop and implement a Department-accepted Cross-Connection Control Program to protect the Municipal Public Drinking Water Supply from contamination due to cross-connections from commercial, institutional, industrial, multi-unit residential, and agricultural facilities, at a minimum, and avoid any cross-connections within the Municipal Public Drinking Water Supply.
 - i. For guidance on how to develop a Cross-Connection Control Program, see *A Guide to Assist Nova Scotia Municipal Waterworks Develop A Cross Connection Control Program*, as amended from time to time.
- b. The Cross-Connection Control Program shall be submitted to the Department for review. Upon review, the Department may require changes to the program.
- c. Once accepted by the Department, the Approval Holder shall implement their accepted Cross-Connection Control Program. Documentation of the implementation of the program shall be made available to the Department immediately upon request.
- d. The Approval Holder shall provide an update on the status of the Cross Connection Control Program in the annual report due on or before April 1st of each year, including any modifications to the plan or implementation schedule, and a summary of the activities taken to achieve the goals and objectives of the program.

4 Corrosion Control, Lead and Copper Sampling

- a. The treated water shall minimize corrosion of the water distribution and/or plumbing systems.
- b. The Approval Holder shall adhere to the minimum corrosion monitoring program requirements included in Appendix H of this document.
- c. The Approval Holder shall adhere to the minimum sampling, notification, corrective action, and reporting requirements for lead and copper outlined in *Requirements for Lead and Copper Management –Municipal Public Drinking Water Supplies*, as amended from time to time.
 - i. If the Approval Holder receives a laboratory analysis result for lead or copper above the maximum acceptable concentration as specified in the most recent version of Health Canada’s *Guidelines for Canadian Drinking Water Quality*, as amended from time to time, the Approval Holder shall immediately notify the Department, notify the residence owner within 14 days of receiving the results from the lab and prepare a corrective action plan to address the exceedance as outlined in the *Requirements for Lead and Copper Management – Municipal Public Drinking Water Supplies*, as amended from time to time.
 - ii. The Approval Holder shall submit the corrective action plan to the Department on or before October 31st of the same year the lead or copper exceedance occurred.
 - iii. The corrective action plan shall be acceptable to the Department.

PART V

Management of Waste Streams

Waste streams from all Municipal Public Drinking Water Supplies must be properly managed. Drinking water treatment waste streams may include, but are not limited to, filter backwash water, filter backwash solids, clarified solids, and spent media. Membrane filtration technology produces other waste streams that must be properly managed in accordance with Appendix G.

1 Waste Residuals Management

- a. All residual solid waste generated by the Municipal Public Drinking Water Supply shall be managed in accordance with a Residuals Management Plan accepted by the Department. Written authorization is required from the Department to modify the residuals management plan.
- b. The Residuals Management Plan shall contain, at a minimum, the following information for each waste stream:
 - Type of residual;
 - Processing method; and
 - Expected annual volume of residuals to be generated by the activity.
- c. The Approval Holder shall record the following information each time residuals are removed from the facility and make the records available to the Department immediately upon request:
 - The type of residual;
 - The volume of each residual transported, expressed as cubic metres or kilograms;
 - The name of the hauler, if applicable;
 - Date of transport; and
 - Final destination of residuals.

2 Filter Backwash Water

- a. Filter backwash water shall be discharged to a location accepted by the Department.
- b. If water from the filter backwash treatment system is discharged to the raw water reservoir/intake, it shall be at a location which is downstream of the raw water intake.
- c. When an existing Municipal Public Drinking Water Supply already has a discharge upstream, the Approval Holder shall demonstrate no impact on raw water quality. Otherwise, the Approval Holder shall develop a corrective action plan to remediate the situation. The corrective action plan shall be acceptable to the Department.
- d. Recycling of filter backwash water is permitted to the head of the treatment process provided it is acceptable to the Department. The Approval Holder shall contact the Department for site-specific requirements.

2.1 Discharges into a Freshwater Watercourse

2.1.1 Effluent Discharge Criteria

Where filter backwash water discharges to a freshwater watercourse, the following shall apply:

- a. Discharge shall be non-acutely lethal with acute toxicity determined using a Daphnia (*D magna*) single concentration 48-hour test or another method accepted by the Department.
- b. Maximum concentration of total suspended solids shall not exceed 25 mg/L unless otherwise specified in the operating approval.
- c. Chlorine residual shall not exceed 0.02 mg/L.
- d. pH shall be in the range of 6.5 to 9.0. If it is not possible to achieve this pH range, the Approval Holder shall complete a study to determine background values and recommend “end of pipe” discharge criteria for pH. The study shall be acceptable to the Department.
- e. Total aluminum:
 - ≤ 0.005 mg/L where the receiving water pH is < 6.5
 - ≤ 0.1 mg/L where the receiving water pH is > 6.5
- f. Sampling frequency shall meet the minimum requirements as outlined in Table 4 – Minimum Effluent Monitoring Requirements.
- g. The Department may establish discharge criteria for other parameters of concern.

2.1.2 Site-specific Discharge Criteria Study

If a Municipal Public Drinking Water Supply cannot achieve effluent criteria for total aluminum, the Approval Holder may complete a study to propose site-specific aluminum discharge limits.

- a. The study shall meet the minimum criteria outlined in *A Guide to Assist Nova Scotia Municipal Water Works Develop Site Specific Aluminum Effluent Discharge Criteria for Filter Backwash Discharges Into a Freshwater Watercourse*, as amended from time to time.
- b. The study shall be acceptable to the Department.
- c. Discharge criteria limits shall be specified by the Department once the study has been reviewed and accepted.
- d. Consultation may be required with the Department, Environment and Climate Change Canada, and Fisheries and Oceans Canada.

2.1.3 Compliance

Once discharge criteria limits have been set, the Approval Holder shall comply with the following:

- a. Discharge criteria limits shall be met before discharging into the watercourse (i.e., end of pipe limits) with the exception of aluminum discharge limits, which may be met at the edge of a mixing zone as accepted by the Department.
- b. Discharge criteria shall be met in 95% of samples.
- c. Sampling frequency shall meet the minimum requirements as outlined in Table 4 – Minimum Effluent Monitoring Requirements except where the Approval Holder is utilizing the assimilative capacity of the receiving water to meet effluent discharge criteria. In such circumstances, additional sampling is required as outlined in *A Guide to Assist Nova Scotia Municipal Water Works Develop Site Specific Aluminum Effluent Discharge Criteria for Filter Backwash Discharges Into a Freshwater Watercourse*, as amended from time to time.

It should be noted that membrane processes may concentrate naturally occurring compounds such as metals, solids and radionuclides in the waste streams. It is important that Approval Holders with membrane filtration technology establish discharge criteria, particularly where aluminum is naturally occurring in the source water.

2.1.4 Minimum Monitoring Requirements:

Table 4: Minimum Effluent Monitoring Requirements

Parameter	Analysis	Sampling Method	Frequency	Location(s)
Total Aluminum	Lab	Grab	Continuous discharges: monthly Intermittent discharges: at each discharge event or monthly for facilities with multiple discharge events each month.	End-of-pipe discharge
Chlorine Residual	Lab or Field	Grab		
Total Suspended Solids	Lab	Grab		
pH	Field	In Situ		
Acute toxicity test: 48h <i>Daphnia magna</i> single concentration	Lab	Continuous discharges: 24-hour composite flow proportional or equal time/equal volume. Intermittent discharges: 2 grab samples, one at the start of discharge and one near the end.	Upon request from Department	End-of- pipe discharge

2.2 Filter Backwash Discharges to Land or Soil

A Discharge Management Plan shall be developed by the Approval Holder using the guidance document entitled *A Guide to Assist Nova Scotia Municipal Water Works Develop a Discharge Management Plan for Filter Backwash Discharges to Land* published by the Department, as amended from time to time.

- a. The Approval Holder shall submit the Discharge Management Plan to the Department for review and acceptance. Upon review, the Department may require modifications to the Discharge Management Plan.
- b. The Discharge Management plan is subject to acceptance of the plan by the Department and the Approval Holder shall not discharge filter backwash water to a non-aquatic environment prior to the acceptance of the Discharge Management Plan by the Department.
- c. The Approval Holder shall not conduct any discharge to a non-aquatic environment unless it is done in accordance with the accepted Discharge Management Plan.
- d. The Approval Holder shall modify and update the Discharge Management Plan, if directed by the Department.

2.3 Filter Backwash Discharges to a Marine or Brackish Environment

Where filter backwash water discharges to a marine or brackish environment, the Approval Holder shall contact the Department to determine what requirements shall apply. The Approval Holder shall comply with these requirements.

PART VI

Requirements Related to Operations, Monitoring, Reporting and Management

1 Operations

1.1 Operations Manual and General Requirements

- a. The Approval Holder shall prepare an Operations Manual in accordance with *A Guide to Assist Nova Scotia Municipal Water Works Develop a Comprehensive Operations Manual*, as amended from time to time and keep it up-to-date.
- b. A copy of the Operations Manual is to be kept on-site, or a Department-accepted alternate location, at all times, and is to be made available for review immediately upon request by the Department.
- c. The Approval Holder shall ensure that all employees are trained in accordance with the Operations Manual and shall keep a record of training at the Municipal Public Drinking Water Supply for a minimum period of five (5) years.
- d. A set of drawings of the Municipal Public Drinking Water Supply, incorporating any amendments made from time to time, shall be retained on-site or a Department accepted alternate location for as long as the Municipal Public Drinking Water Supply is in operation and are to be made available for inspection or review by Department staff immediately upon request.
- e. The Approval Holder shall establish procedures for receiving and responding to complaints including a reporting system that records and documents what steps were taken to determine the cause of complaint and the corrective measures taken to alleviate the cause and prevent its recurrence.
- f. The Approval Holder shall establish security measures to assure the safety of the Municipal Public Drinking Water Supply system.

1.2 Emergency Notification Procedures

- a. The Approval Holder shall establish and submit, to the Department, Emergency Notification Procedures to be used to contact the Department and other relevant authorities in the case of an emergency situation.
- b. The Approval Holder shall ensure that the Emergency Notification Procedures are reviewed and updated on a yearly basis. The Approval Holder shall document in the annual report what modifications were made to the Emergency Notification Procedures and how the procedures were communicated to their staff.
- c. A copy of the Emergency Notification Procedures is to be maintained on-site, at the Municipal Public Drinking Water Supply or a Department-accepted alternate location, at all times, and are to be made available for review immediately upon request by the Department.
- d. The Approval Holder shall ensure that all employees are trained in accordance with the Emergency Notification Procedures and shall keep a record of training at the facility for a minimum period of five (5) years.

1.3 Contingency Plan

- a. The Approval Holder shall ensure the development and implementation of a Contingency Plan for the Municipal Public Drinking Water Supply system.
- b. The Contingency Plan is to meet the minimum requirements of the Department's *A Guide to Assist Nova Scotia Municipal Water Works Develop a Comprehensive Operations Manual and Contingency Planning Guidelines* as amended from time to time.
- c. The Approval Holder shall ensure that the Contingency Plan is reviewed and updated on a yearly basis. The Approval Holder shall document in the annual report what modifications were made to the plan and how the plan was communicated to their staff.
- d. The Approval Holder shall ensure that all employees are trained in accordance with the Contingency Plan and shall keep a record of training at the facility or Department accepted alternate location for a minimum period of five (5) years

2 Annual Monitoring Program

- a. The Approval Holder is responsible for implementing, on an annual basis, a monitoring program and subsequent revisions as deemed acceptable by the Department.
- b. Samples shall be collected from the Municipal Public Drinking Water Supply in accordance with a monitoring program that meets the minimum requirements outlined in the *Guidelines for Monitoring Public Drinking Water Supplies – Part I*, Appendix H of these standards, and *A Guide to Assist Nova Scotia Municipal Water Works Prepare Annual Sampling Plans*, as amended from time to time.
 - **Note:** The Approval Holder shall comply with the sampling requirements outlined in their accepted annual sampling plan. Sampling requirements are found in Appendix H of this document, based on source water type. Fillable word documents based on source water type are also available on the Department's website to assist the Approval Holder to prepare their annual sampling plan.
 - i. All monitoring data required to be reported to the Department must include the units of measurement.
 - ii. Sampling shall be representative of the water distribution system.
- c. The Approval Holder shall not move, relocate or otherwise alter the location of the sampling locations indicated in the accepted monitoring program without written permission from the Department.
- d. Following a review of the analytical results, the Department may alter the frequencies, location, and parameters for analyses or require other remedial action.
- e. On or before October 1st of each year, the Approval Holder shall recommend to the Department the monitoring program for the Municipal Public Drinking Water Supply for the following calendar year, highlighting any proposed changes and the reason for the changes. Any existing monitoring program shall remain in place until the recommended monitoring program is accepted by the Department.
- f. Any flow measuring devices and continuous water quality analyzers and indicators with alarm systems shall be installed, maintained and calibrated as specified by the instrument manufacturer's instructions. Calibration logs for each instrument shall be maintained at the site and be available for inspection immediately upon request by the Department.
- g. The Approval Holder shall establish a QA/QC program to validate the measurements obtained from continuous monitoring equipment and for all analysis conducted at the Municipal Public Drinking Water Supply or a non-certified laboratory.

3 Reporting and Record-Keeping

3.1 Immediate Reporting

The Approval Holder shall immediately notify the Department, by telephone, when any of the following occurs:

- a. Whenever the presence of total coliforms or *E. coli* bacteria is detected in the treated water;
- b. Upon receipt of results that indicate a maximum acceptable concentration has been exceeded in the treated water;
- c. There is a lack of disinfection or failure of the filtration process (where present) that prevents the Approval Holder from achieving the minimum treatment requirements for 3-log reduction for protozoa (surface water and GUDI sources) and 4-log reduction for viruses (all systems);
- d. There is a failure of a treatment process necessary to reduce the concentration of a parameter below the MAC specified in the most recent edition of Health Canada's *Guidelines for Canadian Drinking Water Quality*, as amended from time to time;
- e. Exceedance of turbidity values as specified in:
 - i. Table 3 based on the type of filtration technology for surface water supplies and GUDI sources where a Department-accepted natural filtration log credit was not awarded,
 - ii. Section Part III Section 2.3 for non-GUDI and GUDI sources where a Department-accepted natural filtration log credit was awarded;
- f. Use of emergency water supply from an untreated or inadequately treated source;
- g. A serious incident of raw water contamination including, but not limited to, an incident of surface water flooding of the well head area;
- h. When it is necessary to use a by-pass;
- i. When it is necessary to use a back-up water supply;
- j. Any incidents of non-compliance with these standards and the Approval to Operate;
- k. Any other incident that may adversely affect the quality of water within the system (including line breakage, cross connection, negative pressure, etc. that may result in contamination of potable water);
- l. If the chlorine residual in the water distribution system is less than that stipulated in Part IV of these standards;

- m. If the GUDI status of a well changes based on the results of MPA testing; or
- n. If the Municipal Public Drinking Water Supply does not have an Operator in Direct Responsible Charge (ODRC) of the treatment and/or distribution system.

3.2 Annual Reporting

3.2.1 Annual Report Timeline

The Approval Holder shall submit an annual report to the Department on or before April 1st following the completion of the calendar year being reported upon.

3.2.2 Annual Report Content

The annual report shall contain, but not necessarily be limited to, the following information:

- a. A summary and discussion of the quantity of water supplied during the reporting period on a per-month basis showing design values, maximum daily flow and average daily flow for each month and any other parameters or conditions specified in the Water Withdrawal Approval.
- b. A summary and interpretation of analytical results obtained in accordance with the monitoring and record keeping requirements of these standards and the Approval to Operate, including an explanation for any exceedance of the maximum acceptable concentration of health-related parameters listed in the *"Guidelines for Canadian Drinking Water Quality"*, latest edition and the actions taken to address the exceedance(s).
- c. Minimum annual reporting requirements as outlined in the *Requirements for Lead and Copper Management – Municipal Public Drinking Water Supplies*, as amended from time to time.
- d. A summary and interpretation of the analytical results obtained from the treatment process backwash monitoring program including but not limited to explanation for any exceedance of the effluent limits specified in these standards or the operating approval.
- e. Annual trend graphs for parameters that are continuously monitored.
- f. The date and description of any emergency or upset conditions which occurred during the period being reported upon and action taken to correct them.
- g. Any modifications to the contingency plan or emergency notification procedures including a description of how the information was communicated to staff.
- h. A list of the names of each laboratory used by the Approval Holder and the parameters analyzed by each laboratory.

- i. An update on the status of the Source Water Protection Plan, including any modifications to the plan or implementation schedule, and a summary of activities taken to achieve the goals and objectives of the plan.
- j. An update on the status of the Cross Connection Control Program, including any modifications to the plan or implementation schedule, and a summary of the activities taken to achieve the goals and objectives of the program.
- k. **If using free chlorine as a secondary disinfectant**, all incidents of free chlorine residual below 0.20 mg/L in the water distribution system, or below 0.4 mg/L in the case of Municipal Public Drinking Water Supplies undergoing a GUDI assessment where water is distributed for human consumption shall be detailed with a description of any actions taken.
- l. **If using combined chlorine as a secondary disinfectant**, all incidents of total chlorine residual below 1.0 mg/L in the water distribution system shall be detailed with a description of any actions taken.
- m. Verification that the operational conditions remained within the design range for achieving required CT/IT; if operational conditions went outside the design ranges, CT/IT calculations and a summary of corrective actions taken must be provided.
- n. For Municipal Public Drinking Water Supplies that generate waste from the treatment process, a summary of residual waste removed from the system, including type, volume (m³ or kg), hauler and date of transport, if applicable, and final destination.
- o. Incidents of non-compliance with these standards or the Approval to Operate, the date it was reported to the Department, and corrective actions taken by the Approval Holder.
- p. Any complaints received and the steps taken to determine the cause of the complaint and the corrective measures taken to alleviate the cause and prevent its recurrence.
- q. A review of the QA/QC program to validate the measurements obtained from continuous monitoring equipment and for all analysis conducted at the Municipal Public Drinking Water Supply or a non-certified laboratory. The review shall highlight any results where there is greater than 5% variation in the samples along with any actions taken to correct this.
- r. A list of each certified operator and their level of certification.
- s. For Municipal Public Drinking Water Supplies that use surface water and GUDI sources with no Department-accepted natural filtration log credit awarded, mathematical verification that the turbidity of the water leaving the individual filters does not exceed the turbidity limits specified in Table 3 based on the type of filtration technology.

- t. For Municipal Public Drinking Water Supplies using non-GUDI sources, mathematical verification that the turbidity of the water leaving the individual well(s) or combined flow does not exceed the turbidity limits specified in Part III section 2.3 requirement a.
- u. For Municipal Public Drinking Water Supplies using low-risk and/or medium-risk GUDI sources with a Department-accepted natural filtration log credit awarded, mathematical verification that the turbidity of the water leaving the individual well(s) does not exceed the turbidity limit specified in Part III section 2.3 requirement b.

3.3 Information Available for Review upon Request

- a. The Approval Holder shall provide information to the Department upon request, including but not limited to, the following:
 - i. The name of each laboratory used, and the parameters analysed by that laboratory;
 - ii. Verification that the UV system (if applicable) is capable of continually meeting the dosage requirement of 40 mJ/cm² or the dosage requirement otherwise accepted by the Department;
 - iii. Any monitoring results or reports required;
 - iv. Verification that chemicals used in the treatment process and all materials contacting the water meet ANSI standard NSF/60 (for chemical additives) or NSF/61 (for materials);
 - v. Standard Operating Procedures for the filtration and disinfection processes; and
 - vi. Laboratory certificates of analysis.
- b. The Approval Holder shall keep records continually updated in such a way, that weekly and/or monthly reporting of monitoring and sampling results can be immediately sent to the Department upon request.
- c. The Approval Holder shall ensure information is available for inspection or review upon request by Department, including but not limited to the following:
 - i. The operations manual including the emergency notification and contingency planning documents;
 - ii. Municipal Public Drinking Water Supply drawings, incorporating any amendments made from time to time; and
 - iii. Calibration logs for instrumentation, such as flow measuring devices and continuous water quality analysers and indicators.

3.4 Record Keeping

The Approval Holder must retain the following records for the prescribed time periods, as a minimum:

- a. Bacteriological, chlorine residual, turbidity analyses, and differential pressure measurements (for cartridge filters assigned log reduction credits for protozoa) shall be kept for two years;
- b. Calibration, maintenance records and continuous monitoring data shall be retained for a period of five years;
- c. All incidents of suspected and/or confirmed disease outbreaks attributed to the Municipal Public Drinking Water Supply shall be documented and kept for a minimum of ten years;
- d. Chemical analysis shall be kept for ten years;
- e. Annual water withdrawal records shall be kept for ten years; and
- f. A copy of project reports, construction documents and treatment/distribution system drawings and inspection reports shall be kept for the life of the Municipal Public Drinking Water Supply.

4 Management of Operations

Classified water treatment and water distributions facilities shall be operated by certified operators in accordance with the *Water and Wastewater Facilities and Public Drinking Water Supplies Regulations*, made pursuant to the *Environment Act*.

PART VII

GLOSSARY AND REFERENCES

Glossary

Average day demand means the average amount of water necessary in a 24-hour timeframe to meet all needs of all customers. It is determined by dividing annual usage by the total number of days in the year.

Contact time denoted as T_{10} is an effective contact time for disinfection in minutes and represents the time when 10 percent of the water passes the contact unit; that is 90 percent of the water remains in the unit and will be exposed to longer disinfection within the unit. T_{10} can be established by tracer studies or calculated using theoretical hydraulic detention times multiplied by an appropriate baffling factor.

Conventional filtration means a treatment process that includes chemical mixing, coagulation, flocculation, clarification (sedimentation or dissolved air flotation) and rapid gravity filtration. All filters should be designed so that the filtered water immediately after filter backwashing is directed into a waste stream ("filter-to-waste" provision).

Cryptosporidium means a widespread intestinal coccidian protozoan parasite about 3.5 micrometres in diameter, causing diarrhea and capable of infecting humans, birds, fish and snakes. It is responsible for waterborne disease outbreaks.

Department means the Nova Scotia Department of Environment and Climate Change.

Diatomaceous earth means the microscopic remains of the discarded outer surface of diatoms.

Diatomaceous earth filtration means a filtration method on which diatomaceous earth is used as the filtering medium.

Direct filtration means a treatment process that includes chemical mixing, coagulation, flocculation and rapid gravity filtration (e.g., no clarification process). All filters should be designed so that the filtered water immediately after filter backwashing is directed into a waste stream ("filter-to-waste" provision).

Disinfectant means an agent that destroys or inactivates harmful microorganisms.

Disinfection means the process of destroying or inactivating pathogenic organisms by either chemical or physical means.

Disinfection by-products means the chemical by-products that are formed when a disinfectant reacts with organic matter in the water.

Filtrate means the liquid that has passed through a filter.

Filtration means the removal of suspended materials in a fluid stream by passage of the fluid through a filter medium.

Filter-to-waste means a practice of discharging filtered water directly to disposal immediately following backwashing until the filtered water is of acceptable quality.

Giardia means the genus name for a group of single-celled, flagellated, pathogenic protozoans found in a variety of vertebrates, including mammals, birds and reptiles. These organisms exist either as trophozoites or as cysts, depending on the stage of the life cycle.

Log reduction means a negative of the base 10 logarithm of the fraction of pathogens remaining after the treatment process.

Maximum day demand means the highest daily use rate during the year.

Membrane filtration means a filtration process that uses pressure-driven semi-permeable membranes to reject particles and produce a filtrate. The most appropriate type of membrane depends on a number of factors including targeted material to be removed, source water quality characteristics, treated water quality requirements, membrane pore size, molecular weight cut-off, membrane material and system configuration. A “filter-to-waste” feature should be provided for initial start-up and commissioning of the membrane system and for emergency diversions in the event of a membrane integrity breach.

Municipal Public Drinking Water Supply means a public drinking water supply that holds a municipal water works approval issued under the *Activities Designation Regulations*, made pursuant to *the Environment Act*, for the collection, production, treatment, storage, supply, or distribution of potable piped water to the public.

Municipal water utility means a utility owned, operated or managed by a municipality, village or service commission either directly or through a board or commission, for the purpose of producing, transmitting, delivering or furnishing water directly or indirectly to or for the public.

Natural attenuation means the attenuation of particles through in-situ soil, filtration or adsorption prior to a location from which the water is withdrawn (e.g., well).

Natural watershed boundary means the area drained by or contributing to a stream, lake or other body of water. It is the area that topographically appears to contribute all the water that passes through a given cross-section of a stream. Topography is the change in height of land relative to sea level.

Peak hourly demand means the highest hourly use rate during the year; it is typically two to four times the average day flow and is generally supplied from storage tanks.

Redundancy means a minimum of two process units shall be provided (e.g., two filters, two primary disinfection units, two pumps, etc.). Where only two process units are provided, each shall be capable of meeting the maximum day demand at the unit’s rated capacity. Where more than two process units are provided, the process shall be capable of meeting maximum day demand with the largest unit out of service.

Slow sand filtration means filtration that depends on the formation of schmutzdecke,

which is a layer of bacteria, algae and other microorganisms on a biopopulation within the sand bed. Raw water passes through the sand bed where physical, chemical and biological mechanisms remove contaminants. The most important removal mechanism has been attributed to the biological process. No chemicals are added nor is there a need to backwash. The filter is cleaned by scrapping off the clogged sand and eventually replacing the sand. A filter-to-waste feature should be provided so that the filtered waste immediately after filter cleaning is directed into a waste stream.

Time-of-travel means the determination of the time in days/years for groundwater recharge to travel from a certain field point to the wellhead. In the Nova Scotia GUDI Protocol (Appendix A) time-of-travel (TOT) is evaluated by measuring chemical and physical site data. Such data is used to evaluate the hydraulic connection through the aquifer and evaluating whether this could allow rapid recharge of the well by water directly influenced by surface water. Appendix A outlines the use of groundwater and surface water chemical and physical data for evaluation. Based on guidance regarding protozoa viability (Appendix A reference AWWA 1996), a TOT of less than 90 days is considered indicative of “rapid recharge”.

For Source Water Protection Planning (SWPP) required for municipal well sources in Nova Scotia (see Part II), time-of-travel is often determined by modelling and has an additional context of longer-term protection and land-use planning zones. The 25-year zone is the largest zone. This zone is used to protect against chemical contaminants such as chlorinated solvents, nitrates and road salt. The 25-year zone sets the outer boundary for the source water protection planning process.

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