Terms of Reference for

System Assessment Reports for Municipal Drinking Water Systems

NOVA SCOTIA

Version Control

This document replaces:

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Approved by: Lora MacEachern, Deputy Minister

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PART I
Introduction

1.0 Preamble

1.1 Purpose

The first round of System Assessment Reports was initiated on April 1, 2003, as part of the Nova Scotia Drinking Water Strategy. This standard sets out the requirements for the next round of system assessments to be completed by April 1, 2023. The 2023 System Assessment Report shall include all information requested in these Terms of Reference including the repetition of any relevant information from previous reports; it is not acceptable to refer to the previous report.

The overall intent of the System Assessments is to verify that Municipal Public Drinking Water Supplies meet:

- Current environmental standards, which are frequently updated and enhanced for public health protection; and

- The minimum requirements set out in the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.

More specifically, the purpose of the 2023 system assessments is to:

- Demonstrate performance with applicable disinfection criteria:
    - Surface water, groundwater under the direct influence of surface water (GUDI) and secure groundwater (non-GUDI) systems shall achieve the stipulated requirements to be awarded log inactivation credits for disinfection.

- Demonstrate performance with turbidity criteria:
    - Surface water and GUDI systems shall achieve the stipulated turbidity limit to be awarded log removal credits for filtration.
    - Non-GUDI systems shall achieve the stipulated turbidity limit or provide documentation to allow a less stringent value.

- Demonstrate that on-line equipment is in place and appropriately alarmed to continuously monitor:
    - Chlorine residual for surface water, GUDI and non-GUDI systems.
    - Individual filter effluent for surface water and GUDI systems.
    - Parameters for other primary disinfectants such as ultraviolet disinfection (UV), chlorine dioxide or ozone, where applicable.
    - Distribution system storage tanks chlorine residual.

- Confirm that waste streams generated by the Municipal Public Drinking Water Supply are adequately managed.

1.2 Authority

Nova Scotia Department of Environment & Climate Change (the Department) has been designated as the lead agency to take such measures as are reasonable to provide access to safe, adequate and reliable Municipal Public Drinking Water Supplies (*Environment Act*, Section 104(c)). To carry out this mandate, Section 105(3)(c) of the *Environment Act* states:

(3) The Minister may

(c) establish or adopt water-quality guidelines, objectives and standards.

1.3 Application

A system assessment report includes the following components to verify that Municipal Public Drinking Water Supplies remain current with the standards for producing and distributing safe drinking water:

- A characterization of the water source;
- An evaluation of treatment processes, facilities and equipment; and
- A review of operations, monitoring and management of the Municipal Public Drinking Water Supply.

Assessments of Municipal Public Drinking Water Supplies shall be conducted to:

- Evaluate the capability of the system to consistently and reliably deliver an adequate quantity of safe drinking water;
- To verify compliance with regulatory requirements, as amended from time to time; and
- Present options, preliminary costs and timelines to address identified deficiencies and/or concerns.

The System Assessment Report shall be completed in accordance with these Terms of Reference, as amended from time to time. The System Assessment Report shall be acceptable to the Department.

These Terms of Reference apply to Municipal Public Drinking Water Supplies that utilize surface water sources, GUDI wells, non-GUDI wells or that purchase treated water from another municipal system.

1.4 Preparation of the System Assessment Report

The System Assessment Report is to be completed by a professional engineer, or under the supervision of a professional engineer, with competencies in drinking water treatment and who is eligible for membership in Engineers Nova Scotia. Where a professional engineer is responsible for the day-to-day operations of the Municipal Public Drinking Water Supply, the assessment may be completed by the municipal engineer.

The Engineer shall prepare a written System Assessment Report outlining conclusions and recommendations that shall be relied upon by the Approval Holder of the Municipal Public Drinking Water Supply and the Department. Three copies of the report shall be submitted to the Department.

The Engineer shall evaluate and inspect the Municipal Public Drinking Water Supply and shall meet with the Approval Holder to discuss the System Assessment Report. If the Approval Holder disagrees with any facts or findings in the System Assessment Report, the Approval Holder may attach a written statement of disagreement to the System Assessment Report. The statement shall contain the reasons for each disagreement.

The report shall contain a signed declaration made by the Engineer responsible for the report as follows:

> "I, the undersigned, hereby declare that to the best of my knowledge, the information contained herein and the information in support of this submission, as completed by me, is complete and accurate in accordance with my obligations under the *Engineering Profession Act* and its regulations. I further declare that this submission has been prepared in accordance with the published standard for this submission."

1.5 Document Layout

These Terms of Reference are structured in five parts. Part I provides an overview. Part II details requirements to complete the source water characterization. Part III summarizes requirements necessary to evaluate the treatment processes, facilities, and equipment. Part IV details requirements to evaluate the operations, monitoring and management of the Municipal Public Drinking Water Supply. Part V outlines report submission requirements.

1.6 System Assessment Report Terms of Reference Checklist

A checklist was prepared as a companion document to the *Terms of Reference for System Assessment Reports for Municipal Drinking Water Systems*, 2022. A complete copy of the checklist is required with all report submissions.

PART II
Characterization of the Water Source

2.0 Source Water Characterization

Section 35 of the *Water and Wastewater Facilities and Public Drinking Water Supplies Regulations* requires that an owner of a public drinking water supply provides safe water that meets the latest version of the health-related *Guidelines for Canadian Drinking Water Quality* as published by Health Canada.

Choosing the highest quality source, whether surface water or groundwater, is an important part of delivering a sustainable supply of high-quality drinking water. Protecting the source is the first barrier in the multiple-barrier approach used in Nova Scotia. As such, the first step in the system assessment is to characterize the source.

2.1 Source Description and Schematic

The Engineer shall:

i. Describe the source(s) that is/are used to meet water consumption demands of the Municipal Public Drinking Water Supply (e.g., surface water, groundwater or both).

ii. Describe any other sources that are used as back-up supplies.

iii. Identified all sources on a map and submit this with the System Assessment Report.

iv. Document what precautions are required to utilize these (e.g., boil water advisory).

v. If a back-up supply is intended to be used without precautions, the Engineer shall verify that it meets the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time, as part of the System Assessment Report unless the back-up supply is a connection to an adjoining municipality that meets the treatment standards. In this case, the Engineer shall document the name of the Municipal Public Drinking Water Supply.

vi. For Municipal Public Drinking Water Supplies that purchase treated water from another municipal system to which they are connected, identify the location of the system on a map of the distribution system and submit this with the System Assessment Report.

vii. Document the name of the Municipal Public Drinking Water Supply(s) that the water is purchased from and proceed to Section 2.3.

2.2 Microbial Risks

Health Canada recommends that treatment for surface water and groundwater under the direct influence of surface water (GUDI) be based on 3-log reduction of protozoa (*Cryptosporidium* and *Giardia)* and 4-log reduction of viruses unless source water quality requires a higher log reduction. For non-GUDI supplies, Health Canada recommends that treatment be based on 4-log reduction of viruses.

2.2.1 Surface Water Sources

The Engineer shall:

i. Summarize microbial risks and water quality variability of the surface water source(s) used to meet system demands.

ii. Submit raw water quality data for total coliforms and *E. coli,* as well as *Cryptosporidium* or *Giardia,* if available. Data shall be submitted for the most recent calendar year[1] as an Appendix to the System Assessment Report.

[1] Where data is required to be submitted for "the most recent calendar year", Approval Holders may submit 12 consecutive months of data within a 2-year period from the date the system assessment report is due.

2.2.2 Groundwater Sources

The Engineer shall:

i. Verify that all individual wells have been classified in accordance with the *Protocol for Determining Groundwater Under the Direct Influence of Surface Water* (GUDI Protocol) as outlined in Appendix A of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.

ii. Summarize the GUDI status by individual well and identify at which step in the GUDI Protocol the well was categorized as GUDI or non-GUDI (e.g., Step 1, 2 or 3).

iii. For wells that are no longer in use, identify if the well has been properly decommissioned or is being maintained as a back-up well or monitoring well.

iv. For GUDI wells, complete Table A.1 and verify that the GUDI classification has not changed based on the results of microscopic particulate analysis (MPA) testing required every two years.

v. Verify that samples were taken following a rainfall event in accordance with Step 3 of the *Protocol for Determining Groundwater Under the Direct Influence of Surface Water* as outlined in Appendix A of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time (e.g., if there is a 15-day time-of-travel, then the well shall be sampled 15 days after a surface water event).

vi. Inspect the well site(s) to verify that there are no changes to the surrounding area to warrant re-classification of the well(s). Refer to Section A.3.6. GUDI – Reclassification Process in Appendix A of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems,* as amended from time to time.

vii. Recommend corrective action for wells:

- For which MPA test results indicate a change in GUDI classification;
- Where changes to the surrounding area have occurred to warrant re-classification of the well per the GUDI Protocol; and/or
- Any other concerns identified by the Engineer.

Note: All requests for reclassification must be submitted to a Department Regional Hydrogeologist for acceptance and shall include all relevant MPA scores and an evaluation of all GUDI assessment work completed to-date. The evaluation shall be completed by a Qualified Hydrogeologist. (See Section A.3.6. GUDI – Reclassification Process in Appendix A of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems,* as amended from time to time).

viii. Submit raw water quality data for total coliforms and *E. coli* bacteria for the most recent calendar year[1] as an Appendix to the System Assessment Report.

ix. For GUDI wells, submit any raw water quality data for *Cryptosporidium* or *Giardia* (if available) for the most recent calendar year[1] as an Appendix to the System Assessment Report.

2.3 Chemical Risks

2.3.1 Disinfection By-Products

a) Trihalomethanes

The Engineer shall:

i. Complete Table A.2 to summarize quarterly total trihalomethanes concentrations (THMs) by sampling location.

ii. For Municipal Public Drinking Water Supplies with non-GUDI systems that have had their quarterly sampling reduced[2] to annual sampling accepted by the Department:
- Note the acceptance date for this reduction in sampling frequency; and
- Modify Table A.2 to summarize annual results, including sampling date.

iii. If the locational running annual average for any sampling location exceeds the maximum acceptable concentration, recommend corrective actions.

iv. Verify that sampling locations are appropriate as follows:
- Samples are to be collected at the point(s) in the distribution system with the highest potential THM concentrations. These points generally represent the areas in the distribution system with the longest disinfection retention time which are typically at the far end of the distribution system farthest from the source; and
- An adequate number of sites are to be sampled to represent exposure levels system wide.

v. Identify THMs sampling locations on a map of the distribution system and submit this with the System Assessment Report.

vi. Recommend sampling location/frequency changes if necessary.

[2] Other systems are not eligible for a reduction in THMs sampling; an increased sampling frequency may be required for facilities using surface water or GUDI sources during peak by-product formation periods

b) Haloacetic Acids

The Engineer shall:

i. Complete Table A.3 to summarize quarterly haloacetic acids concentrations (HAA5) by sampling location.

ii. For Municipal Public Drinking Water Supplies with non-GUDI systems that have had their quarterly sampling reduced[2] to annual sampling accepted by the Department:
- Note the acceptance date for this reduction in sampling frequency; and
- Modify Table A.3 to summarize annual results, including sampling date.

iii. If the locational running annual average for any sampling location exceeds the maximum acceptable concentration, recommend corrective actions.

iv. Verify that sampling locations are appropriate as follows:
- Samples are to be collected at the location(s) where historical data show the highest HAA5 concentrations. Where historical data are not available, HAA5 concentrations shall be monitored in the middle and extremities (e.g., farthest from source) of the distribution system;
- Areas where disinfectant residuals are significantly lower than the system average because of long residence time (e.g., dead end, low flow areas etc.) shall be targeted;
- In systems with booster chlorination stations and water tanks/reservoirs, HAA5 concentrations shall be monitored downstream of these components; and
- An adequate number of sites are to be sampled to represent exposure levels system-wide.

v. Identify HAA5 sampling locations on a map of the distribution system and submit this with the System Assessment Report.

vi. Recommend sampling location/frequency changes if necessary.

c) Other Disinfection By-Products

The Engineer shall:

i. Identify which other disinfection by-products are required to be monitored and compare this to existing monitoring that is conducted (refer to Table 1).

ii. Verify that sampling locations are appropriate.

iii. Identify sampling locations on a map of the distribution system and submit this with the System Assessment Report.

iv. Recommend sampling location/frequency changes if necessary.

v. Summarize concentrations for the most recent calendar year[1].

vi. Recommend corrective actions if any maximum acceptable concentration is exceeded.

2.3.2 Lead and Corrosion Control

Approvals to Operate require Municipal Public Drinking Water Supplies to minimize corrosion to the water distribution system and plumbing systems. This is to protect distribution infrastructure, as well as minimize the release of lead into drinking water through contact with plumbing materials with lead components.

a) Lead

The Engineer shall:

i. Verify that sampling locations and frequencies for lead are appropriate as follows:
   - The residential sampling program meets the minimum requirements as outlined in the *Lead and Copper Management Requirements – Municipal Public Drinking Water Supplies,* as amended from time to time, or as otherwise accepted by the Department; and
   - Residences suspected to be at the highest risk for lead are targeted in the residential sampling program.

ii. Recommend sampling location/frequency changes if necessary.

iii. Summarize and append lead and copper concentrations by sampling location and sample protocol used for the most recent calendar year[1].

iv. Summarize corrective actions taken when residential sample results exceeded the maximum acceptable concentration, as outlined in the *Lead and Copper Management Requirements – Municipal Public Drinking Water Supplies,* as amended from time to time:
   - Are the corrective actions taken in line with the minimum requirements outlined or as otherwise accepted by the Department?

v. Recommend program improvements where applicable.

b) Corrosion Control

Approvals to Operate require quarterly monitoring of parameters per the corrosion control program at select distribution system sample point(s).

The Engineer shall:

i. Review the corrosion control program to verify that:
   - One exists;
   - It includes the minimum monitoring requirements as outlined in the *Guidelines for Monitoring Municipal Public Drinking Water Supplies – Part I*, as amended from time to time; and
   - It includes action limits that trigger follow-up.

ii. Summarize the water quality results of the corrosion control program for the most recent calendar year[1] as an Appendix.

iii. Recommend corrective actions if concerns are identified from the review of the corrosion control program.

iv. If a corrosion control program does not exist, document why, including water quality results that demonstrate non-corrosivity of the water, or recommend the need for a more comprehensive corrosion control program.

Note: The Langelier Index is no longer considered an adequate measure of corrosivity. The submission of water quality results based solely on a positive Langelier Index will not be accepted as justification for not having a corrosion control program.

Note: The Engineer is not required to develop a corrosion control program as part of the System Assessment Report.

Table 1 - Other Disinfection By-Products Requiring Routine Monitoring by Municipal Water Utilities

Parameter	Maximum Acceptable Concentration (mg/L)	Considerations	Sampling Frequency	Sampling Location
Bromate	0.01	• Forms when ozone reacts with naturally-occurring bromide • Forms in sodium hypo- chlorite solutions that are not stored appropriately [1]	• Monthly monitoring required by Municipal Public Drinking Water Supplies using ozone • Monitoring required by Municipal Public Drinking Water Supplies that store solutions for more than three months	• In treated water entering the distribution system • In treated water entering the distribution system
Chlorate	1.0	• By-product of chlorine dioxide • Forms in sodium hypo-chlorite solutions that are not stored appropriately [1]	• A minimum of quarterly sampling is required by Municipal Public Drinking Water Supplies using chlorine dioxide • Monitoring required by Municipal Public Drinking Water Supplies that store solutions for more than three months	• Mid-point and far-point [2] in the distribution system • In treated water entering the distribution system
Chlorite	1.0	• By-product of chlorine dioxide	• A minimum of quarterly sampling is required by Municipal Public Drinking Water Supplies using chlorine dioxide	• Mid-point and far-point [2] in the distribution system
NDMA [3]	0.000 04 (0.04 µg/L)	• By-product of chloramination • May be found in chlorinated systems with nitrogen or humic substances present in the source water	• A minimum of quarterly sampling is required by Municipal Public Drinking Water Supplies using chloramination • Quarterly [3]	• In treated water entering the distribution system and far-point [2] in the distribution system • In treated water entering the distribution system

Notes:

1. To be stored in a cool dry location away from sunlight where the temperature does not exceed 30 degrees Celsius.
2. Areas in the distribution system with the longest disinfectant retention time (e.g. typically farthest from chlorine injection site(s)).
3. NDMA = *N*-Nitrosodimethylamine. Quarterly monitoring may be reduced to annual frequency if the monitoring program consistently does not show the presence of NDMA in the treated water entering the distribution system.

2.3.3 Guidelines for Canadian Drinking Water Quality

The Engineer shall:

i. Verify that the full suite of health-related parameters (Refer to Table A.4) has been analyzed a minimum of once every five years for all raw water sources and treated water, complete the following and document the sampling dates.

ii. Review the data to:
- Verify that cyanobacterial toxins are sampled in late summer or early fall when water temperature is warmest in surface water supplies and that pesticides are sampled when the highest potential concentrations are expected (e.g., following a rainfall event after pesticide application).
- Identify if any maximum acceptable concentrations have been exceeded.
- Identify parameters with detectable concentrations.

iii. Discuss any trends for parameters with detectable concentrations.

iv. Append laboratory results from the last round of sampling to the System Assessment Report.

v. Identify when the next round of sampling is scheduled to occur.

vi. Recommend corrective actions if any MACs are exceeded.

vii. Recommend any changes to the monitoring program (frequency/location) if sampling is inappropriate for cyanobacterial toxins, pesticides or other parameters, with enhanced monitoring recommended for parameters that have detectable concentrations.

Note: Results of the treated water analysis are not acceptable for the purposes of raw water characterization regardless of the type of treatment involved, including disinfection. For multi-well systems, raw water characterization may not need to be done for each well separately provided that a hydrogeological study, concluding that the raw water characteristics for the particular wells should be identical, has been completed and the Engineer submits a copy of the study as an Appendix to the System Assessment Report. This does not apply to microbiological parameters (e.g., total coliforms and *E. coli*) that must be sampled separately for each well regardless of the findings of the hydrogeological study.

2.3.4 Guidelines for Monitoring Public Drinking Water Supplies

The Engineer shall:

i. Verify that the parameters in the *Guidelines for Monitoring Public Drinking Water Supplies-Part I*, as amended from time to time, (Refer to Table A.5) have been analyzed as required (e.g., every year for surface water and GUDI and every two years for non-GUDI) in all raw water sources and treated water and document the sampling dates.

ii. Review the data to:
- Verify that sampling locations and frequencies are appropriate.
- Identify if any maximum acceptable concentrations have been exceeded.
- Identify any aesthetic parameters that may compromise disinfection or other critical processes.

iii. Discuss any water quality trends.

iv. Append laboratory results from the last round of sampling to the System Assessment Report.

v. Identify when the next round of sampling is scheduled to occur.

vi. If any maximum acceptable concentrations are exceeded, corrective actions shall be recommended. An exceedance of an aesthetic objective may also require a corrective action plan if it is found to compromise disinfection or other critical treatment processes.

vii. The Engineer shall recommend any changes to the monitoring program, sampling location/frequencies, etc. if necessary.

2.3.5 Source Water Protection Plan Monitoring

The Engineer shall:

i. For Municipal Public Drinking Water Supplies monitoring any other chemical parameters for source water protection purposes (e.g., hydrocarbons, pesticides, etc.), summarize the parameters, their sampling frequency, and their measured concentrations.

ii. Recommend corrective actions if concentration are detectable or increasing.

iii. Review the source water protection plan monitoring program (e.g., Step 5 of the source water protection process) to verify that:
   - One exists; and
   - It includes monitoring of parameters that provide the information that is needed to evaluate the effectiveness of the source water protection plan.

2.3.6 Cyanobacteria

The Engineer shall:

i. Identify whether the source of supply has been impacted by cyanobacterial blooms.

ii. Summarize and append any results for cyanobacterial blooms through visual observation and/or confirmation from laboratory results including dates.

iii. Discuss any corrective actions taken when cyanobacteria have been detected in the source water.

iv. Discuss the treatment capability of the facility to remove microcystin toxins and identify any vulnerabilities.

v. Provide recommendations if necessary.

2.4 Filter Backwash Water

The Engineer Shall:

i. Document the impact on the raw water source if water from the filter backwash treatment system is discharged upstream of the raw water intake.

ii. Provide recommendations if this discharge impacts the source.

2.5 Source Quantity

The Engineer shall:

i. Compile existing Water Withdrawal Approvals and include copies of these as an Appendix to the System Assessment Report.

ii. Complete Tables A.6.a and A.6.b to compare water withdrawals to approved limits.

iii. Recommend corrective actions, including water conservation measures, if water withdrawals are greater than approved limits.

iv. Recommend corrective actions if water withdrawals are approaching approved limits and growth is forecast to increase withdrawals beyond approved limits.

2.6 Source Water Protection Plan

The Engineer shall:

i. Identify the source water protection zone(s) on a map and submit this information with the System Assessment Report.

ii. Submit the source water protection zone(s) in GIS format to the Department. If the protection zone(s) are not available in GIS format, the Engineer shall contact the Department's Watershed Planner to determine what requirements shall apply.

iii. Summarize the status of the source water protection plan (SWPP) and implementation schedule.

iv. Document the dates of the last two SWPP meetings.

v. Note the status of meeting actions and/or SWPP deliverables.

vi. The Engineer shall make recommendations to address any concerns identified by the advisory committee or the source water protection planning process.

2.7 Conclusions and Recommendations

The Engineer shall:

i. Provide conclusions and recommendations regarding source characterization from his/her review to address the following:

Treatment Requirements to Protect Against Pathogenic Organisms

- Identify the source type and treatment standard to be met and summarize water quality results:
    - Surface water and GUDI sources require 3-log reduction for protozoa *(Cryptosporidium* and *Giardia)* and 4-log reduction for viruses.
    - Non-GUDI sources require 4-log reduction for viruses.

GUDI Classification

- Identify whether the well classification has changed based on MPA results; and
- Inspect wells to verify no changes to the surrounding area that could affect the GUDI classification

Disinfection By-Products

- Assess whether disinfection by-products are being adequately monitored; and
- Identify whether levels are below the maximum acceptable concentrations

Lead and Corrosion Control

- Assess whether lead concentrations are being adequately monitored; and
- Identify if there a corrosion control program in place and assess its suitability.

Guidelines for Canadian Drinking Water Quality

- Identify whether the parameters are being adequately monitored;
- Identify whether health-related parameters are below the maximum acceptable concentration;
- Identify any parameters that have detectable levels and that require enhanced monitoring; and
- Identify the date of the next round of sampling.

Guidelines for Monitoring Public Drinking Water Supplies – Part I

- Assess whether parameters are being adequately monitored;
- Identify whether health-related parameters are below the maximum acceptable concentration;
- Discuss any concerns with other parameters that may compromise treatment or disinfection efficacy (e.g., iron); and
- Identify the date of the next round of sampling.

Source Water Protection Plan Monitoring

- Identify what other parameters are being monitored for source water protection purposes;
- Identify the sampling frequency and concentrations;
- Discuss whether concentrations are detectable or increasing; and
- Identify whether there is a plan in place.

Filter Backwash Water Discharge

- Summarize the impact on the source if the discharge point is upstream of the raw water intake

Source Quantity

- Compare actual water withdrawals to approved limits and identify whether the source quantity is adequate

Source Water Protection Plan

- Identify and map source water protection zone(s) in GIS format; and
- Summarize the status of the source water protection plan and implementation schedule, as well as meeting actions and deliverables.

PART III
Treatment Processes, Facilities and Equipment

3.0 Evaluation of Treatment Processes, Facilities and Equipment

The second barrier in the multiple barrier approach used in Nova Scotia involves making water safe by having adequate treatment in place to remove natural or man-made impurities. As such, the second step in the system assessment is to verify that treatment is achieving this desired goal.

3.1 Treatment Processes

The goal of treatment is to reduce the presence of disease-causing organisms and associated health risks to an acceptable or safe level. In some cases, treatment is also required to minimize the formation of disinfection by-products and/or remove chemical contaminants that exceed maximum acceptable concentrations as set out in the *Guidelines for Canadian Drinking Water Quality,* as amended from time to time.

Critical treatment processes include primary disinfection for all systems and filtration for surface water and GUDI systems. Where chemically assisted filtration is used, coagulation/flocculation and filter ripening are other critical processes. Secondary disinfection is also critical for residual maintenance in the distribution system.

The Engineer shall:

i. Compile existing Approval(s) to Operate and append copies of these to the System Assessment Report. For Municipal Public Drinking Water Supplies that purchase treated water, document the name of the Municipal Public Drinking Water Supply from which water is purchased and proceed to Section 3.2.

3.1.1 Treatment Process Schematic

The Engineer shall:

i. Provide a schematic of the treatment process from the source to treated water entering the distribution system as part of the System Assessment Report.

3.1.2 Turbidity Levels and Associated Criteria

a) Surface Water

The Engineer shall:

i. Verify that filtration technologies are meeting specified turbidity limits to receive the assigned removal credits for *Cryptosporidium*, *Giardia* and viruses outlined in Table C2 of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time, by:

Option 1: Calculating individual filter effluent turbidity values using continuous measurements (i.e., minimum of once every five minutes) recorded when the filter is in operation (i.e., exclude measurements recorded during filter-to-waste and backwashing); values can be calculated using:

- Percent of measurements made per calendar month; or
- Percent of time by calendar month.

Option 2: Providing graphs of continuous measurements for each individual filter; the graph shall:

- Specify the time interval between graphed readings (maximum allowed is one hour); and
- Identify when the filter was in operation.

The Engineer shall visually estimate the “individual filter effluent turbidity” value when the filter was in operation for the time interval graphed.

ii. Submit individual filter effluent turbidity values for the most recent calendar year[1] by month (Option 1) or by the time interval graphed (Option 2).

Note: Option 1 is preferred; Option 1 is mandatory if applying for additional log removal credits in accordance with Table C2 of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.

iii. Recommend corrective actions if the supply does not meet stipulated turbidity limits.

iv. For Municipal Public Drinking Water Supplies with cartridge filters assigned log reduction credits for protozoa, the Engineer shall provide the highest recorded individual filter differential pressure reading for each month of the most recent calendar year[1].

v. Review the standard operating procedures (SOPs) for the filtration process to verify that:
- Control limits have been set to alarm and notify operators of issues related to the filtration process;
- Procedures have been developed to remove a filter or membrane unit from service before turbidity or differential pressure exceeds stipulated values;
- Procedures have been implemented and communicated to all operations staff; and
- Procedures have been documented in the operations manual.

vi. Inspect the filtration process to verify that continuous on-line turbidity measurements are taken for the effluent of each individual filter (i.e., individual filter effluent) at a minimum of once every five minutes.

vii. Inspect the on-line turbidimeters to ensure that:
- They have the required range and accuracy to measure turbidity levels;
- They are in good working order; and
- They have a maintenance and quality assurance/calibration program.

viii. Inspect the filtration process to verify that there are a minimum of two filters (e.g., redundancy).

ix. Document if the maximum day flow can be met with the largest filter out of service.

x. Make recommendations to address any concerns identified during the review of the filtration SOPs, inspection of on-line turbidimeters, and filter redundancy.

Note: If the facility is unable to meet maximum day flows with the largest filter out of service, improvements to meet the treatment standards may be deferred to a future expansion provided SOPs are in place to minimize filter rate changes and spikes in turbidity which can result in the filter breakthrough.

b) GUDI Wells

The Engineer shall:

i. Verify that natural filtration is achieving specified turbidity limits to receive the assigned removal credit for *Cryptosporidium* and *Giardia* for each individual GUDI well as outlined in Table C2 of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems,* as amended from time to time, by:

Option 1: Calculating individual GUDI well turbidity values using continuous measurements (i.e., minimum of once every five minutes) recorded when the well is in operation; values can be calculated using:

- Percent of measurements made per calendar month; or
- Percent of time by calendar month.

Option 2: Providing graphs of continuous measurements for each individual GUDI well; the graph shall:

- Specify the time interval between graphed readings (maximum allowed is one hour); and
- Identify when the well was in operation.

The Engineer shall visually estimate the "individual GUDI well turbidity" value when the well was in operation for the time interval graphed.

ii. Submit individual GUDI well turbidity values for the most recent calendar year[1] by month (Option 1) or by the time interval graphed (Option 2).

Note: Option 1 is preferred.

iii. For GUDI wells that do not meet stipulated turbidity limits, contact the Department to determine what requirements shall apply.

iv. Inspect the site(s) to verify that continuous on-line turbidity measurements are taken at each individual GUDI wellhead at a minimum of once every five minutes.

v. Inspect the on-line turbidimeters to ensure that:
- They have the required range and accuracy to measure turbidity levels;
- That they are in good working order; and
- They have a maintenance and quality assurance/calibration program.

vi. Make recommendations to address any concerns identified by the inspection of on-line turbidimeters.

c) Non-GUDI Wells

The Engineer shall:

i. Summarize turbidity levels in non-GUDI wells (for individual or combined flows) as follows:

Option 1: Calculating turbidity values for individual wells or combined flow using daily grab or continuous measurements (i.e., minimum of once every five minutes) recorded when the well is in operation; values can be calculated using:

- Percent of measurements made per calendar month; or
- Percent of time by calendar month.

Option 2: Providing graphs of continuous measurements for individual wells or combined flow; the graph shall:

- Specify the time interval between graphed readings (maximum allowed is one hour); and
- Identify when the well was in operation.

The Engineer shall visually estimate the “turbidity” value for the time interval graphed.

ii. Note if measurements are by daily grab samples or continuous on-line turbidimeters.

iii. Submit non-GUDI system turbidity for individual wells or combined flow for the most recent calendar year[1] by month (Option 1) or by the time interval graphed (Option 2).

iv. For non-GUDI wells that do not meet stipulated turbidity limits, contact the Department to determine what requirements shall apply.

v. Where continuous measurements are taken, the Engineer shall inspect the on-line turbidimeters to ensure that:
- They have the required range and accuracy to measure turbidity levels;
- That they are in good working order; and
- They have a maintenance and quality assurance/calibration program.

vi. Where grab samples are taken, inspect the monitoring equipment, standard operating procedures, maintenance and quality assurance/calibration program to ensure equipment is in good working order and measurements are appropriate.

vii. Make recommendations to address any concerns identified by the inspection of on-line turbidimeters or grab sample protocols.

3.1.3 Membrane Filtration - Additional Requirements

Direct integrity testing represents the most accurate means of assessing the integrity of individual membrane treatment units used for pathogen reduction credits to:

- Demonstrate that they are free of integrity breaches;
- Determine the actual removal efficiency of the membrane treatment unit during operation; and
- Verify that they are producing treated water that is safe for consumption.

The requirements associated with direct integrity testing are summarized in Table 2.

The Engineer shall:

i. Complete Table B.1 to verify that each individual membrane treatment unit that is used for pathogen reduction credits is free of any integrity breaches and determine its log removal value using pressure-based testing.

ii. Make recommendations to address any concerns identified.

iii. For facilities with integrated membrane systems, summarize the process used to verify the rejection rate remains adequate for organics removal.

iv. Make recommendations to address any concerns identified.

Table 2 - Direct Integrity Testing: Summary of Requirements

Topic	Summary of Requirements
Scale of Testing	• Testing shall be conducted on each membrane treatment unit in service (e.g., an individual train, skid, rack, stage, etc.).
Resolution	• The test method used shall have a resolution of 3 µm or less.
Sensitivity	• The test method used shall have sensitivity sufficient to verify the ability of the membrane filtration system to remove protozoa at a level commensurate with the credit awarded by the Department.
Control Limit	• A control limit shall be established within the sensitivity limits of the direct integrity test that indicates the membrane treatment unit is integral and capable of achieving the log removal credit awarded by the Department. • If the direct integrity test results exceed the control limit for any membrane unit, that unit shall be removed from service. • Any unit taken out of service for exceeding a direct integrity test control limit cannot be returned to service until repairs are confirmed by subsequent direct integrity test results that are within the control limit.
Frequency	• Direct integrity testing shall be conducted on each membrane treatment unit at a frequency of no less than once each day that the unit is in operation. • Turbidity measurements greater than 0.1 NTU for a period of greater than 15 minutes from an individual membrane unit shall immediately trigger an investigation of membrane integrity.
Reporting	• Results shall be reported annually to the Department. • The Department shall be immediately notified if corrective action taken is unable to restore the actual log removal value (determined by direct integrity testing) to the credit awarded by the Department. • All direct integrity test results must be retained for a minimum of three years.

3.1.4 Primary Disinfection

The Engineer shall:

i. Document how many inactivation log credits are required by the disinfection process for each target microorganism (e.g., protozoa and/or viruses).

ii. Discuss how disinfection is achieved (e.g., chemical disinfectants, UV or both).

Note: Malfunctioning of primary disinfection equipment shall be immediately reported by the Engineer to the Department and the Approval Holder. Corrective action shall be taken immediately to remediate the situation.

a) Chemical Disinfection (CT Concept)

The Engineer shall:

i. Where chemical disinfectants are used (e.g., free chlorine, chlorine dioxide, ozone), the Engineer shall provide a schematic of the primary disinfection process including, but not limited to:
   - Tank(s) dimensions;
   - Baffling configuration and assumed baffling factor;
   - Water level operating range, highlighting the low level;
   - Disinfection type (e.g., free chlorine, chlorine dioxide, ozone);
   - Minimum disinfectant concentration at the CT control point
     Note: The CT control point is the outlet of the contact chamber or end of pipe used to achieve the minimum required CT.
   - Minimum water temperature;
   - Maximum pH of the water for free chlorine or optimum pH for chlorine dioxide or ozone; and
   - Maximum flow and minimum retention time - if the tank used to achieve CT is subject to water level fluctuations, the Engineer shall verify if the inflow or outflow represents the maximum flow condition.

ii. Calculate the design CT.

iii. Verify that operational conditions remained within the design range for achieving CT at all times during the most recent calendar year[1].

iv. Where operational conditions went outside the design range, identify the cause, document the corrective actions taken and verify that CT was calculated during every such event.

v. Make recommendations to address any concerns identified.

b) UV Disinfection (IT Concept)

The Engineer shall:

i. Where UV disinfection is used, provide a schematic of the primary disinfection process including, but not limited to:
- Unit manufacturer and model;
- Validation standard;
- Maximum flow;
- Minimum intensity at the end of lamp life;
- Minimum transmittance at the end of lamp life;
- Correction for water temperature;
- Maximum concentrations for water quality parameters that promote fouling (e.g., iron, manganese, hardness); and
- Sleeve cleaning method.

ii. Verify that the unit has been designed to deliver a UV dose of 40 mJ/cm^2 or Department accepted alternate dose. For Department accepted alternate doses, specify the alternate dose.

iii. Verify that the following conditions were met at all times during the most recent calendar year[1]:
- Intensity - was above the minimum required;
- Flow - was below the maximum allowed; and
- Transmittance - was above the minimum required.

iv. Where operational conditions went outside the design range, identify the cause, document the corrective actions taken and verify that IT was calculated during every such event.

v. Provide recommendations to address any concerns identified.

c) Redundancy, Continuous Monitoring and Alerting

The Engineer shall:

i. Inspect the primary disinfection process to verify the following:
   - There are a minimum of two primary disinfection units (i.e., redundancy);
   - Primary disinfection units are sized to meet maximum day demand with one unit out of service;
   - On-line monitoring of the primary disinfection process is in place with measurements taken at least once every five minutes;
   - Control limits have been set to alarm and notify operators that the primary disinfection process is not working properly; and
   - Protocols are in place to prevent inadequately disinfected water from entering the distribution system.

ii. Inspect the on-line instrumentation to ensure that:
   - They have the required range and accuracy;
   - They are in good working order; and
   - They have a maintenance and quality assurance/calibration program.

iii. Provide recommendations to address any concerns identified.

d) Standard Operating Procedures

The Engineer shall:

i. Review the standard operating procedures (SOPs) for the disinfection process to verify that they:
   - Specify the design ranges for achieving CT (e.g., temperature, disinfectant residual, flow, pH) or IT (e.g., intensity, flow, transmittance);
   - Include notification and response procedures when operational conditions are outside CT or IT design ranges;
   - Include procedures to ensure the disinfection process is working properly;
   - Include response procedures when the disinfection process is not working properly;
   - Have been implemented and communicated to all operations staff; and
   - Have been documented in the operations manual.

ii. Provide recommendations to address any concerns identified.

3.1.5 Secondary Disinfection

The Engineer shall:

i. Describe the secondary disinfection process.

ii. Inspect the secondary disinfection process to verify the following:
- On-line continuous chlorine residual monitors are in place to measure chlorine residual entering the distribution system at least once every five minutes;
- The on-line chlorine residual monitors are in good working order; and
- There is a maintenance and quality assurance/calibration program in place.

iii. Where free chlorine is used for both primary and secondary disinfection, refer to Section 3.1.4 and note if the chlorine dose is controlled by CT (primary disinfection) or distribution system residual maintenance (secondary disinfection).

iv. Where UV light is used for primary disinfection to receive protozoa inactivation credits, calculate the design CT for virus inactivation credits.

v. Where UV light is used for primary disinfection to receive protozoa inactivation credits, verify that operational conditions remained within the design range for achieving CT for virus inactivation at all times during the most recent calendar year.

vi. Where operational conditions went outside the design range, identify the cause, document the corrective actions taken and verify that CT was calculated during every such event.

vii. Provide recommendations to address any concerns identified.

3.1.6 Other Critical Processes

The Engineer shall:

i. Evaluate and inspect other critical processes such as coagulation/flocculation, clarification, etc. The *Atlantic Canada Water Supply Guidelines,* as amended from time to time, establish minimum requirements.

ii. Recommend corrective actions where necessary.

3.1.7 Waste Streams

a) Filter-to-Waste

The Engineer shall:

i. Describe the filter-to-waste process.

ii. For Municipal Public Drinking Water Supplies that use chemically-assisted filtration, verify that turbidity is less than or equal to 0.2 NTU before returning a filter to service.

iii. Identify recommendations, if necessary, to meet the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.

b) Filter Backwash Water – Discharge into a Freshwater Watercourse

The Engineer shall:

i. Summarize the treatment of filter backwash water and identify the watercourse and location of discharge.

ii. Identify the effluent discharge criteria from the Approval to Operate.

iii. Complete Table B.2 to summarize effluent discharge water quality results and assess the following:
- The sampling program meets the minimum requirements as outlined in the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.
- Results demonstrate that effluent quality meets the discharge criteria stipulated in the Approval to Operate.

iv. If the water quality does not meet the discharge criteria stipulated in the Municipal Public Drinking Water Supply's Approval to Operate or there are no criteria specified in the Approval to Operate, identify recommendations to meet the requirements specified in Part V – Management of Waste Streams of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems,* as amended from time to time.

v. Recommend corrective actions where necessary to address any concerns identified.

c) Filter Backwash Water – Discharge To Land Or Soil

Discharge to land or soil must not occur unless it is done in accordance with the accepted Discharge Management Plan, meeting requirements specified in Part V – Management of Waste Streams of *the Nova Scotia Treatment Standards for Municipal Drinking Water Systems,* as amended from time to time.

The Engineer shall:

i. Summarize treatment of the filter backwash water, if applicable, and identify the location of discharge.

ii. Identify whether the Approval Holder has a Discharge Management Plan in accordance with Part V – Management of Waste Streams of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems,* as amended from time to time.

iii. Identify the effluent discharge criteria specified in the Approval to Operate and/or the Discharge Management Plan.

iv. Complete Table B.3. to summarize effluent discharge water quality results and assess the following:
- Results demonstrate that effluent quality meets the discharge criteria stipulated in the Approval to Operate and/or the Discharge Management Plan.

v. If the water quality does not meet the criteria stipulated in the Approval to Operate or the accepted Discharge Management Plan, identify recommendations to meet the minimum requirements for a plan as specified in Part V – Management of Waste Streams of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems,* as amended from time to time

vi. Identify operational, maintenance, and monitoring procedures in the Discharge Management Plan that do not meet the minimum requirements for a plan as specified in Part V – Management of Waste Streams of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time

vii. Recommend corrective actions where necessary to address any concerns identified.

d) Filter Backwash Water – Discharge To A Marine Or Brackish Environment

The Engineer shall:

i. Summarize the treatment of filter backwash water and identify the watercourse and location of discharge.

ii. Identify the effluent discharge criteria specified in the Approval to Operate.

iii. Complete Table B.4. to summarize effluent discharge water quality results and assess the following:
- Results demonstrate that effluent quality meets the discharge criteria stipulated in the Approval to Operate.

iv. Recommend corrective actions where necessary to address any concerns identified.

e) Other Waste Streams

The Engineer shall:

i. Review other waste streams and verify that they are being managed appropriately.

ii. Provide recommendations to address any concerns identified.

3.2 Distribution System Water Quality

3.2.1 Chlorine Residual Levels

The Engineer shall:

i. Review distribution system chlorine residuals for the most recent calendar year[1] available.

ii. Recommend corrective actions where residuals are routinely less than 0.20 mg/L or 0.40 mg/L (depending on the concentration specified in the Municipal Public Drinking Water Supply's Approval to Operate) where free chlorine is used, or less than 1.0 mg/L combined chlorine for chloraminated systems.

iii. Inspect all distribution water storage tanks to verify that on-line continuous chlorine residual monitors are in place to measure chlorine residual at the storage tank outlet at least once every five minutes.

iv. Inspect the on-line chlorine residual monitors to ensure that they are in good working order and that a maintenance and quality assurance/calibration program is in place.

v. Recommend corrective actions where necessary.

3.2.2 Microbiological Water Quality

The Engineer shall:

i. Review total coliforms and *E. coli* results for the most recent calendar year[1] available.

ii. Discuss any presence of bacteria in the distribution system and identify recommendations where necessary.

iii. Verify that sampling locations and frequencies meet the requirements of the *Guidelines for Monitoring Public Drinking Water Supplies - Part I*, as amended from time to time, including any re-sampling required after the presence of bacteria is detected.

iv. Identify sampling locations on a map of the distribution system and submit this with the System Assessment Report.

v. Recommend sampling location/frequency changes if necessary.

3.2.3 Turbidity

The Engineer shall:

i. Review distribution system turbidity results for the most recent calendar year[1] available.

ii. Verify that a procedure exists for investigating the cause of turbidity values above 5 NTU.

iii. Discuss any values above 5 NTU and identify recommendations where necessary.

3.2.4 Cross Connection Control Program

The Engineer shall:

i. Review the cross connection control program:
   - Assess whether it meets the minimum requirements outlined in *A Guide to Assist Nova Scotia Municipal Water Works Develop a Cross Connection Control Program*, as amended from time to time.
   - Review whether the Approval Holder is meeting implementation timelines as outlined in the program plan and provide 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.

ii. Provide recommendations as necessary.

3.2.5 Other Distribution System Monitoring/Programs

The Engineer shall:

i. Review any other distribution system monitoring or programs that are in place to deal with threats to distribution system integrity, including but not limited to infrastructure age, watermain breaks, leak detection, pressure transients, etc.

ii. Provide recommendations where necessary.

3.3 Site Inspection

The Engineer shall:

i. Conduct a site inspection to evaluate treatment processes, as well as other facilities and equipment; the site inspection shall include but not be limited to the following parts:

Opening interview

- Introductions;
- Review the purpose of the system assessment;
- Review the parts of the on site inspection and the schedule for the inspection;
- Review of the facility layout and location of the intake(s)/well(s) and treatment processes; and
- General discussion of basic system information - the condition of the system and its operation, staffing and management; whether relevant plans and procedures have been developed and are adequate

Discussion of

- Deficiencies identified in previous system assessments;
- Any violations/compliance problems since the last assessment; and
- Corrective actions taken and their effectiveness in addressing the deficiencies and problems.

Walk through

- Physical inspection of the treatment processes, facilities and equipment;
- Asking questions of appropriate personnel for clarification and to check information obtained during records review and other aspects of assessment planning and preparation; and
- Note taking for documentation and writing up the findings in the System Assessment Report.

Organization of findings and documentation

- Filling in gaps in inspection notes and add detail where needed;
- Completing any checklists/forms;
- Clarification of any remaining issues with water system personnel;
- Obtaining any documentation still needed; and
- Preparing for the closing interview.

Closing interview on inspection findings

- Presentation of findings, particularly any significant deficiencies; and
- Informing management of next steps (e.g., writing and submitting the report, corrective action, etc.).

Systems & Equipment

In addition to specific inspection requirements for the treatment processes noted in this and previous sections, other system facilities and equipment to be evaluated and inspected include, but are not limited to:

- Controls and instrumentation;
- Equipment condition;
- Chemical feeders;
- Chemical storage;
- Chemicals applied and dosage of chemicals in last year;
- Confirm that chemicals used are NSF approved;
- Housekeeping and cleanliness;
- Reliability;
- Metering;
- In-plant cross-connection control;
- Distribution system;
- Finished water storage;
- Pumps/pump facilities and controls;

- Watermain replacement/rehabilitation;
- Standard operating procedures - particularly those for disinfection and filtration; and
- Any other issues specific to the Municipal Public Drinking Water Supply.

3.4 Conclusions and Recommendations

The Engineer shall:

i. Provide conclusions and recommendations regarding the treatment processes, facilities and equipment from his/her review to address the following:

Filtration

- Confirm stipulated limits being met to assign log removal credits;
- Confirm that SOPs and on-line monitoring are in place; and
- Identify the level of filter redundancy.

Membranes

- Identify whether any integrity breaches were detected and the corrective actions taken;
- Assess whether test results verify the removal efficiency of the membrane filtration system to be greater than or equal to the credit awarded by the Department; and
- Confirm TOC results are acceptable for integrated membrane systems.

Primary Disinfection

- Confirm that the required log inactivation has been met at all times (CT or IT);
- Confirm that SOPs and on-line monitoring are in place; and
- Identify the level of filter redundancy.

Secondary Disinfection

- Confirm that on-line monitoring is in place; and
- If UV is used for primary disinfection, verify log inactivation for viruses is met.

Other Critical Processes

- Confirm requirements are being met.

Waste Streams

- Confirm that filter-to-waste processes are meeting stipulated requirements;
- Confirm that the filter backwash wastewater is meeting stipulated requirements; and
- Confirm that any other waste streams present are meeting stipulated requirements

Distribution System Water Quality

- Assess whether water quality is being maintained throughout the distribution system; and
- Identify what, if any, threats exist that may compromise distribution system integrity:
    - Chlorine residuals
    - Total coliforms and E. coli
    - Turbidity
    - Age of infrastructure
    - Watermain breaks
    - Leak detection
    - Pressure transients
    - Other

On Site Inspection

- Summarize any concerns that were highlighted from the inspection;
- Confirm that chemicals used are NSF approved; and
- Recommend actions to ensure the sustainable operation of the Municipal Public Drinking Water Supply facilities and equipment, etc.

PART IV
Operations, Monitoring and Management

4.0 Review of Operations, Maintenance, Monitoring and Management

The final stage in the multiple-barrier approach is proving that the drinking water is safe through effective operations, monitoring, reporting and management.

4.1 Operations and Maintenance

The Engineer shall:

i. Review the comprehensive operations manual to verify that:
   - One exists;
   - It is current and up to date;
   - It includes standard operating procedures, emergency notification procedures and contingency plans;
   - It is available on site or an alternate location accepted by the Department; and
   - Operations staff are aware of its contents.

ii. Evaluate the procedures an operator follows to identify any problem(s) with treatment and distribution system processes, determine the changes needed to correct the problem(s) and how adjustments to processes are approved and performed as needed.

iii. Verify that a maintenance program exists and is adequate to ensure the long-term viability of the Municipal Public Drinking Water Supply, including treatment and distribution system components.

iv. Identify recommendations where necessary.

4.2 Monitoring and Reporting

The Engineer shall:

i. Review the annual monitoring program to verify that:
   - One exists;
   - It is current and up to date;
   - It meets the minimum requirements outlined in the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems* and *A Guide to Assist Nova Scotia Municipal Water Works Prepare Annual Sampling Plans,* as amended from time to time; and
   - Operations staff are aware of its contents.

ii. Identify the laboratories being used for water quality analyses.

iii. Verify that the Municipal Public Drinking Water Supply is operating in accordance with the *Policy on Acceptable Certification of Laboratories*, as amended from time to time.

iv. Verify that the Approval holder has complied with the immediate, annual and ad hoc reporting requirements outlined in the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.

v. Review the most recent annual report and identify any concerns in the System Assessment Report.

vi. Identify recommendations where necessary.

4.3 Management

The Engineer shall:

i. Review the number of certified operators and back-up personnel to verify that the Municipal Public Drinking Water Supply is operating in accordance with Part I of the *Water and Wastewater Facilities and Public Drinking Water Supplies Regulations,* as amended from time to time.

ii. Complete Table C.1 to identify the operator(s) in overall direct responsible charge (ODRC) and summarize what protocols are in place during the absence of the operator(s) in ODRC.

iii. Review the water quality goals that the Municipal Public Drinking Water Supply has and evaluate their plan(s) to accomplish or maintain these goals (e.g., strategic plan, management plan, due diligence program, etc.).

iv. Identify recommendations where necessary.

4.4 Conclusions and Recommendations

The Engineer shall:

i. Provide conclusions and recommendations regarding the system operation, monitoring and management from his/her review to address the following:

Operations and Maintenance

- Confirm that a comprehensive operations manual exists;
- Assess whether there are adequate procedures in place to identify and correct problems; and
- Assess whether there is a comprehensive maintenance program in place.

Monitoring and Reporting

- Confirm that an annual monitoring program exists;
- Confirm whether the lab policy being adhered to;
- Confirm that all reporting requirements have been met; and
- Identify and summarize concerns with the annual report.

Management

- Assess whether there are a sufficient number of certified operators and back-up personnel available to operate the supply;
- Identify the operator in overall direct responsible charge;
- Identify the procedures in place when the ODRC is absent; and
- Identify whether programs and/or procedures are in place to adequately manage issues that may impact the operation of the plant.

PART V
Report Submission

5.0 Ability to Comply

5.1 Summary

The Engineer shall:

i. Summarize conclusions and identify all recommendations necessary to meet the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time, in accordance with the following sections of these Terms of Reference:
   - Part II - source water characterization;
   - Part III - treatment processes, facilities and equipment;
   - Part IV - operations, maintenance, monitoring and management.

ii. Include preliminary cost estimates and an implementation schedule to address the above requirements. Costs shall be presented and prioritized with respect to public health risks. If the corrective action plan submitted to the Department varies from this risk-based approach, written justification shall be included for varying the priority.

iii. Highlight any obvious problems associated with the Municipal Public Drinking Water Supply that jeopardize treated water quality to the point that it no longer meets the health protection standards adopted by the Department.

5.2 Report Preparation

The System Assessment Report is to be completed at the sole expense of the Municipal Public Drinking Water Supply. The Approval Holder may apply for funding assistance under the Provincial Capital Assistance Program.

The System Assessment Report shall, at a minimum, address all applicable sections in the Terms of Reference; the Engineer may add additional sections as necessary.

The Approval Holder shall:

i. Provide to the Department three copies of the System Assessment Report and completed checklists by the required timeline. The report shall be acceptable to the Department. For ease of reference, reports should follow the format and sequence of the Terms of Reference Checklist. Where possible, section references should follow section and sub-section numbering conventions used in the checklist.

The Engineer shall:

i. Provide their declaration (refer to section 1.4).

Tables to Submit as Part of the System Assessment Report

Table A.1 - Groundwater Under the Direct Influence of Surface Water: Microscopic Particulate Analysis (MPA) Test Results[1]

	GUDI Well 1[2]				GUDI Well 2[2]			
Year[3]	**MPA Score**	**Sample Date**	**GUDI Classification**	**Test completed per Step 3**	**MPA Score**	**Sample Date**	**GUDI Classification**	**Test completed per Step 3**
Has the GUDI MPA score increased?[4]								
Do changes to the surrounding area warrant re- classification?[5]								

Notes:

1. MPA testing is required every two years, following a rainfall event, to verify that the GUDI classification remains appropriate; MPA testing shall be completed in accordance with Step 3 of the *Protocol for Determining Groundwater Under the Direct Influence of Surface Water* (e.g. if there is a 15 day time-of-travel, then the well shall be sampled 15 days after a surface water event).
2. Copy columns for systems with more than two GUDI wells.
3. Insert sample results for appropriate years.
4. For any increase in MPA results, the Approval Holder must immediately notify the Department and take any necessary corrective action. Refer to Appendix A of the Nova Scotia Treatment Standards for Municipal Drinking Water Systems, Section A.3.6. GUDI – Reclassification Process subsection b), as amended from time to time.
5. Refer to Appendix A of the Nova Scotia Treatment Standards for Municipal Drinking Water Systems, Section A.3.6. GUDI – Reclassification Process subsection c), as amended from time to time.

Table A.2 - Quarterly Trihalomethanes Concentrations (THMs) By Sample Location

Sampling Period/Month (Specify Sampling Date)		Sample Location 1 (Specify Name)	Sample Location 2 (Specify Name)	Sample Location 3 (Specify Name)	Sample Location 4 (Specify Name)	Sample Location 5 (Specify Name)	Sample Location 6 (Specify Name)	Sample Location 7 (Specify Name)	Sample Location 8 (Specify Name)
Q1	January								
	February								
	March								
Q2	April								
	May								
	June								
Q3	July								
	August								
	September								
Q4	October								
	November								
	December								
Locational Running Annual Average									
Meets maximum acceptable concentration of 0.1 mg/L (100 µg/L)									

Table A.3 - Quarterly Haloacetic Acid Concentrations (HAA5) By Sample Location

Sampling Period/Month (Specify Sampling Date)		Sample Location 1 (Specify Name)	Sample Location 2 (Specify Name)	Sample Location 3 (Specify Name)	Sample Location 4 (Specify Name)	Sample Location 5 (Specify Name)	Sample Location 6 (Specify Name)	Sample Location 7 (Specify Name)	Sample Location 8 (Specify Name)
Q1	January								
	February								
	March								
Q2	April								
	May								
	June								
Q3	July								
	August								
	September								
Q4	October								
	November								
	December								
Locational Running Annual Average									
Meets maximum acceptable concentration of 0.08 mg/L (80 µg/L)									

Table A.4 - Health-Related Parameters in the Guidelines for Canadian Drinking Water Quality*

**It is the responsibility of the Engineer to ensure that the most up-to-date parameters and compliance limits, from the individual parameter guideline technical documents, are used at the time of the submission of the System Assessment Report. This table was compiled based on information valid as of June 2022.*

		Raw Water[1]			Treated Water[1]		
		Sampling Period			Sampling Period		
Parameter[2]	**Maximum Acceptable Concentration[2] (mg/L)**	**20__-20__ Provide Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Scheduled Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Scheduled Sample Date**
Bacteria Total Coliforms *E. coli*	 none per 100 mL none per 100 mL						
Aluminum	2.9						
Antimony	0.006						
Arsenic	0.010						
Atrazine + metabolites	0.005						
Barium	2						
Benzene	0.005						
Benzo[a]pyrene	0.00004						
Boron	5						
Bromate	0.01						
Bromoxynil	0.03						
Cadmium	0.007						
Carbon tetrachloride	0.002						
Chlorate	1.0						
Chlorite	1.0						

		Raw Water[1]			Treated Water[1]		
		Sampling Period			Sampling Period		
Parameter[2]	**Maximum Acceptable Concentration[2] (mg/L)**	**20__-20__ Provide Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Scheduled Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Scheduled Sample Date**
Chlorpyrifos	0.09						
Chromium	0.05						
Copper	2.0						
Cyanide	0.2						
Cyanobacterial toxins (as total microcystins)	0.0015						
Dicamba	0.11						
1,4-Dichlorobenzene[3]	0.005						
1,2-Dichloroethane	0.005						
1,4-Dioxane	0.05						
1,1-Dichloroethylene	0.014						
Dichloromethane	0.05						
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.1						
Dimethoate	0.02						
Diquat	0.05						
Ethylbenzene	0.14						
Fluoride[4]	1.5						
Glyphosate	0.28						
Haloacetic Acids (HAA5)	0.080						
Lead	0.005						

		Raw Water[1]			Treated Water[1]		
		Sampling Period			Sampling Period		
Parameter[2]	**Maximum Acceptable Concentration[2] (mg/L)**	**20__-20__ Provide Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Scheduled Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Scheduled Sample Date**
Malathion	0.19						
Manganese	0.12						
Mercury	0.001						
2-Methyl-4-chlorophenoxyacetic acid (MCPA)	0.35						
Metribuzin	0.08						
Nitrate-nitrogen[5]	10						
Nitrilotriacetic acid (NTA)	0.4						
Nitrite-nitrogen[5]	1						
N-Nitrosodimethylamine (NDMA)	0.00004						
Pentachlorophenol	0.06						
Perfluorooctane Sulfonate (PFOS)	0.0006						
Perfluorooctanoic Acid (PFOA)	0.0002						
Selenium	0.05						
Strontium	7.0						
Tetrachloroethylene	0.01						
Toluene	0.06						

		Raw Water[1]			Treated Water[1]		
		Sampling Period			Sampling Period		
Parameter[2]	**Maximum Acceptable Concentration[2] (mg/L)**	**20__-20__ Provide Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Scheduled Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Provide Sample Date**	**20__-20__ Scheduled Sample Date**
Trichloroethylene	0.005						
2,4,6-Trichlorophenol	0.005						
Trihalomethanes (THMs)	0.100						
Turbidity	See Approval						
Uranium	0.02						
Vinyl chloride	0.002						
Xylenes (total)	0.09						

Notes:

1. Copy columns for multiple supply/well systems.
2. Parameters and limits valid as of June 2022. It is the responsibility of the Engineer to ensure that the most up to date information is used at the time of the submission of the System Assessment Report.
3. In cases where total dichlorobenzenes are measured and concentrations exceed the most stringent value (0.005 mg/L), the concentrations of individual isomers should be established.
4. The maximum acceptable concentration for naturally occurring fluoride is 1.5 mg/L. Where fluoride is added for the control of dental caries, it is recommended that the concentration of fluoride be adjusted to the optimum range of 0.7 mg/L.
5. The Health Canada documentation indicates that the maximum acceptable concentration for nitrate is 45 mg/L. This is equivalent to 10 mg/L as nitrate- nitrogen. Concentrations of nitrate and nitrite in drinking water are often expressed in the literature in units of nitrate-nitrogen and nitrite-nitrogen respectively, as follows: 1 mg nitrate-nitrogen/L = 4.43 mg nitrate/L and 1 mg nitrite-nitrogen/L = 3.29 mg nitrite/L. As such, the 10 mg/L as nitrate-nitrogen is specified in this document. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L or 1.0 mg/L as nitrite-nitrogen. Where both nitrate and nitrite are present, the total of the two should not exceed 10 mg/L (as nitrogen).

Table A.5 - Guidelines for Monitoring Public Drinking Water Supplies*

**It is the responsibility of the Engineer to ensure that the most up-to-date parameters and compliance limits, from the individual parameter guideline technical documents, are used at the time of the submission of the System Assessment Report. This table was compiled based on information valid as of June 2022.*

Parameter[2]	Maximum Acceptable Concentration	Aesthetic Guideline	Raw or Treated[1] Provide Sampling Dates for Appropriate Year									
	(mg/L)	(mg/L)										
Alkalinity	-	-										
Aluminum	2.9	-										
Ammonia	-	-										
Antimony	0.006	-										
Arsenic	0.010	-										
Barium	2	-										
Boron	5	-										
Cadmium	0.007	-										
Calcium	-	-										
Chloride	-	≤250										
Chromium	0.05	-										
Colour	-	≤15 TCU										
Conductivity	-	-										
Copper	2	≤1.0										
Fluoride[3]	1.5	-										
Hardness	-	-										
Iron	-	≤0.3										
Lead	0.005	-										
Magnesium	-	-										

Parameter[2]	Maximum Acceptable Concentration	Aesthetic Guideline	Raw or Treated[1] Provide Sampling Dates for Appropriate Year									
Manganese	0.12	≤0.02										
Nitrate – nitrogen[4]	10	-										
Nitrite – nitrogen[4]	1	-										
pH (no units)[5]	-	7.0 – 10.5										
Potassium	-	-										
Selenium	0.05	-										
Sodium	-	≤200										
Strontium	7.0	-										
Sulphate	-	≤500										
Total Dissolved Solids	-	≤500										
Total Organic Carbon	-	-										
Turbidity	See Approval	-										
Uranium	0.02	-										
Zinc	-	≤5.0										

Notes:

1. Copy table for raw or treated sampling dates; copy columns for multiple supply/well systems and specify whether the sample results are raw or treated water.
2. As of June 2022. Update information if parameters are added or limits change.
3. The maximum acceptable concentration for naturally occurring fluoride is 1.5 mg/L. Where fluoride is added for the control of dental caries, it is recommended that the concentration of fluoride be adjusted to the optimum range of 0.7 mg/L.
4. Health Canada indicates that the maximum acceptable concentration for nitrate is 45 mg/L. This is equivalent to 10 mg/L as nitrate- nitrogen. Concentrations of nitrate and nitrite in drinking water are often expressed in the literature in units of nitrate-nitrogen and nitrite-nitrogen respectively, as follows: 1 mg nitrate-nitrogen/L = 4.43 mg nitrate/L and 1 mg nitrite-nitrogen/L = 3.29 mg nitrite/L. As such, the 10 mg/L as nitrate-nitrogen is specified in this document. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L or 1.0 mg/L as nitrite-nitrogen. Where both nitrate and nitrite are present, the total of the two should not exceed 10 mg/L (as nitrogen).
5. pH will depend on the corrosion control strategy; can be as high as 10.5.

Table A.6.a - Water Withdrawal Data (*Modify Table as Necessary Based on Number of Sources/Wells)

	Source 1 * Withdrawals [1]				Source 2 * Withdrawals [1]			
Month	**Monthly Maximum Daily Rate (Litres/day)[2]**	**Monthly Average Daily Rate (Litres/day)[3]**	**Monthly Withdrawal Volume (Litres)[4]**	**Annual Withdrawal Volume (Litres)[5]**	**Monthly Maximum Daily Rate (Litres/day)[2]**	**Monthly Average Daily Rate (Litres/day)[3]**	**Monthly Withdrawal Volume (Litres)[4]**	**Annual Withdrawal Volume (Litres)[5]**
January								
February								
March								
April								
May								
June								
July								
August								
September								
October								
November								
December								
Total Annual Withdrawal								

Notes:

1. Data is required to be submitted for "the most recent calendar year", Approval Holders may submit 12 consecutive months of data within a 2-year period from the date the system assessment report is due.
2. Monthly Maximum Daily Rate is the maximum daily rate reported within the month.
3. Monthly Average Daily Rate equals the cumulative pumping rate for the monthly period, divided by the number of days in the month.
4. Monthly Withdrawal Volume equals the total volume for the month.
5. Annual Withdrawal Volume equals the total volume for the year.

Table A.6.b Water Withdrawal Data Comparison to Approved Limits

Source 1			Source 2		
Specify Approved Withdrawal Limits		**Exceeds (Yes/No)[1]**	**Specify Approved Withdrawal Limits**		**Exceeds? (Yes/No)[1]**
Maximum daily rate - Litres/d			Maximum daily rate - Litres/d		
Average daily rate - Litres/d			Average daily rate - Litres/d		
Volume[2] – 30 day - Litres			Volume[2] – 30 day - Litres		
Volume – Annual - Litres			Volume – Annual - Litres		

Notes:

1. Exceedances are to be determined by comparing relevant data in Table A.6.a with Approved Withdrawal Limits.
2. For comparison to Approved 30 day Volumes, maximum Monthly Withdrawal Volumes from Table A.6.a should be used.

Table B.1 - Membrane Filtration Direct Integrity Testing Using Pressure Decay[1]

Month[2]_____ Utility _____

Year[2]_____ Facility Name _____

Membrane Unit No. _____ Test Duration (in minutes) _____

Volume of System (V_{sys}) (in litres) _____ Volume Concentration Factor (VCF) _____

Upper Control Limit (UCL) _____ Total No. UCL Violations _____

Day[2]	Pressure (kPa)		P_{test} (kPa/min)	Within UCL[3]?	Corrective Action Taken (if required)	Filtrate Flow (Lpm)	TMP[3] (kPa)	ALCR[3]	LRV[3] Verified
	Initial	Final							
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Day[2]	Pressure (kPa)		P_{test} (kPa/min)	Within UCL[3]?	Corrective Action Taken (if required)	Filtrate Flow (Lpm)	TMP[3] (kPa)	ALCR[3]	LRV[3] Verified
	Initial	Final							
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									

Notes:

1. The Engineer shall submit one table per membrane unit used for pathogen reduction credits.
2. The Engineer shall provide direct integrity test results for the most recent calendar year[1] or results for the life of the membrane treatment units, whichever is less.
3. Acronyms:
   UCL = upper control limit
   TMP = transmembrane pressure
   ALCR = air-liquid conversion ratio
   LRV = log removal value

Table B.2 - Filter Backwash Water – Discharges to A Freshwater Watercourse

a) Specify Discharge Location:
b) Is discharge upstream of raw water intake? If yes, refer to Section 2.3; document conclusions and recommendations.
c) Complete table:

	Parameters				
Month	**Suspended Solids (mg/L)**	**Aluminum (mg/L)**	**Chlorine Residual (mg/L)**	**pH**	**Fish Toxicity**
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Specify Discharge Limits					
Wastewater quality meets or exceeds discharge criteria?					

Table B.3 - Filter Backwash Water – Discharge to Land or Soil

a) Specify Discharge Location (e.g. surface or subsurface):

b) Complete Table:

	*Parameters				
Month					
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Specify Discharge Limits (if applicable)					
Wastewater quality meets or exceeds discharge criteria?					

** Copy table if number of parameters exceeds number of available columns*

Table B.4 - Filter Backwash Water – Discharge to A Marine Or Brackish Environment

a) Specify Discharge Location _____

b) Summarize discharge water quality

	*Parameter(s)				
Month					
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Specify Discharge Limits					
Wastewater quality meets or exceeds discharge criteria?					

** Copy table if number of parameters exceeds number of available columns*

Table C.1 - Operator in Overall Direct Responsible Charge

The operator in overall direct responsible charge (ODRC) is: *(Specify name - add additional lines if more than one ODRC operator)*

_____

_____

Signature of operator:_____

Date:_____

Protocols in place during the absence of the operator in ODRC include (specify):

When on vacation:

_____

_____

_____

When ill:

_____

_____

_____

Other (specify)

_____

_____

_____