Terms of Reference for System Assessment Reports for Municipal Drinking Water Systems

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Approved By: S, J. Snook, Deputy Minister

# TABLE OF CONTENTS

## PART I - INTRODUCTION

1.0 Preamble. ................................................. 1
1.1 Purpose............................................. 1
1.2 Authority........................................... 2
1.3 Application....................................... 2
1.4 Preparation of the System Assessment Report. .............. 3
1.5 Document Layout. .................................... 3

## PART II - CHARACTERIZATION OF THE WATER SOURCE

2.0 Source Water Characterization. ......................... 4
2.1 Source Description and Schematic. ..................... 4
2.2 Microbial Risks. .................................... 4
2.2.1 Surface Water Sources........................... 5
2.2.2 Groundwater Sources............................. 5
2.3 Chemical Risks. ..................................... 6
2.3.1 Disinfection By-Products. ......................... 6
   a) Trihalomethanes.................................. 6
   b) Haloacetic Acids.................................. 7
   c) Other Disinfection By-Products.................. 8
2.3.2 Lead and Corrosion Control........................ 8
   a) Lead............................................ 8
   b) Corrosion Control................................ 9
2.3.3 Aluminum......................................... 9
2.3.4 Guidelines for Canadian Drinking Water Quality. .......... 11
2.3.5 Guidelines for Monitoring Public Drinking Water Supplies. .. 12
2.3.6 Source Water Protection Plan Monitoring............... 12
2.4 Filter Backwash Water. ................................ 13
2.5 Source Quantity. .................................... 13
2.6 Source Water Protection Plan................................ 13
2.7 Conclusions and Recommendations....................... 13

## PART III - TREATMENT PROCESSES, FACILITIES AND EQUIPMENT

3.0 Evaluation of Treatment Processes, Facilities and Equipment. ... 16
3.1 Treatment Processes. .................................. 16
3.1.1 Treatment Process Schematic. .................... 16
3.1.2 Turbidity Levels and Associated Criteria.................. 16
   a) Surface Water.................................... 16
   b) GUDI Wells....................................... 18
   c) Non-GUDI Wells.................................. 19
3.1.3 Membrane Filtration - Additional Requirements.......... 20

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**Originating Division:** Environmental Science and Program Management  
**Scope:** Standard under the *Environment Act*  
**Nova Scotia Environment**
PART IV - OPERATIONS AND MANAGEMENT

4.0 Review of Operations, Maintenance, Monitoring and Management. ........ 30
   4.1 Operations and Maintenance. ........................................... 30
   4.2 Monitoring and Reporting. .............................................. 30
   4.3 Management. ............................................................... 31
   4.4 Conclusions and Recommendations. ...................................... 31

PART V - REPORT SUBMISSION

5.0 Ability to Comply. ............................................................ 32

6.0 Report Preparation. ......................................................... 32

TABLES TO SUBMIT AS PART OF THE SYSTEM ASSESSMENT REPORT.... 34
<table>
<thead>
<tr>
<th>Table 1</th>
<th>Other Disinfection By-Products Requiring Routine Monitoring by Municipal Water Utilities.</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2</td>
<td>Direct Integrity Testing: Summary of Requirements.</td>
<td>21</td>
</tr>
<tr>
<td>Table A.1</td>
<td>Groundwater Under the Direct Influence of Surface Water: Microscopic Particulate Analysis (MPA) Test Results.</td>
<td>35</td>
</tr>
<tr>
<td>Table A.2</td>
<td>Quarterly Trihalomethane Levels (THMs) by Sample Location.</td>
<td>36</td>
</tr>
<tr>
<td>Table A.3</td>
<td>Quarterly Haloacetic Acid Levels (HAA5) by Sample Location.</td>
<td>37</td>
</tr>
<tr>
<td>Table A.4</td>
<td>Health-Related Parameters in the Guidelines for Canadian Drinking Water Quality.</td>
<td>38</td>
</tr>
<tr>
<td>Table A.5</td>
<td>Guidelines for Monitoring Public Drinking Water Supplies.</td>
<td>43</td>
</tr>
<tr>
<td>Table A.6</td>
<td>Water Withdrawals.</td>
<td>45</td>
</tr>
<tr>
<td>Table B.1</td>
<td>Membrane Filtration - Direct Integrity Testing Using Pressure Decay.</td>
<td>46</td>
</tr>
<tr>
<td>Table B.2</td>
<td>Filter Backwash Water.</td>
<td>48</td>
</tr>
<tr>
<td>Table C.1</td>
<td>Operator in Overall Direct Responsible Charge.</td>
<td>50</td>
</tr>
</tbody>
</table>
PART I - INTRODUCTION

1.0 Preamble

1.1 Purpose

The first round of System Assessment Reports were 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, 2013. The 2013 System Assessment Report shall include all information requested in these Terms of Reference including the repetition of any relevant information from the 2003 report; it is not acceptable to refer to the previous report.

The purpose of the System Assessment Report is to verify that municipal drinking water systems meet:

- current environmental standards, which are frequently updated and enhanced for public health protection;
- 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 2013 assessments is to:

- demonstrate performance with 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 treatment facilities are adequately managed
1.2 Authority

Nova Scotia Environment (NSE) has been designated as the lead agency to take such measures as are reasonable to provide access to safe, adequate and reliable municipal 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 drinking water systems remain current with environmental standards for producing and distributing safe drinking water:

- a characterization of the water source;
- an evaluation of treatment processes, facilities and equipment;
- a review of operations, monitoring and management of the municipal drinking water system.

Assessments of municipal drinking water systems 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;
- 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 NSE.

This standard applies to municipal drinking water systems that utilize surface water sources, GUDI wells, non-GUDI wells or that purchase treated water from an adjoining 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 and 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 drinking water systems, 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 owner of the municipal drinking water system and NSE. Three copies of the report shall be submitted to NSE.

The Engineer shall evaluate and inspect the municipal drinking water system and shall meet with the owner to discuss the System Assessment Report. If the owner of the municipal drinking water supply system disagrees with any facts or findings in the System Assessment Report then the owner 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 drinking water system. Part V outlines report submission requirements.
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 describe the source(s) that is/are used to meet water consumption demands of the municipal drinking water system (e.g. surface water, groundwater or both). The Engineer shall also describe any other sources that are used as back-up supplies. The source(s) shall be identified on a map and submitted with the System Assessment Report.

For back-up supplies, the Engineer shall document what precautions are required to utilize these (e.g. boil water advisory). If a back-up supply is intended to be used without precautions, the Engineer shall verify that it meets the Nova Scotia Treatment Standards 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 system.

For municipal water utilities that purchase treated water from an adjoining system, the location of system connections shall be identified on a map of the distribution system and submitted with the System Assessment Report. The Engineer shall document the name of the municipal system(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 Cryptosporidium and Giardia 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 summarize microbial risks and water quality variability of the surface water source(s) used to meet system demands.

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

2.2.2 Groundwater Sources

The Engineer shall 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 the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*. The Engineer shall 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). For wells that are no longer in use, the Engineer shall identify if the well has been properly decommissioned or is being maintained as a back-up well or monitoring well.

For GUDI wells, the Engineer shall complete Table A.1 to verify that the GUDI classification has not changed based on the results of microscopic particulate analysis (MPA) testing required every two years. The Engineer shall verify that samples were taken in the spring 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* (e.g. if there is a 15 day time-of-travel, then the well shall be sampled 15 days after a surface water event).

The Engineer shall inspect the site(s) to verify that there are no changes to the surrounding area to warrant re-classification at the well(s).

The Engineer shall 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;
- any other concerns identified by the Engineer.

Raw water quality data for total coliforms and *E. coli* bacteria shall be submitted for the most recent calendar year as an Appendix to the System Assessment Report. For GUDI wells, any raw water quality data for *Cryptosporidium* or *Giardia* (if available) shall be submitted for the most recent calendar year as an Appendix to the System Assessment Report.
2.3 Chemical Risks

2.3.1 Disinfection By-Products

a) Trihalomethanes

The Engineer shall complete Table A.2 to summarize quarterly total trihalomethanes concentrations (THMs) by sampling location. For municipal water utilities with non-GUDI systems that have had their quarterly sampling reduced to annual sampling approved by NSE, the Engineer shall:

- note the approval date for this reduction in sampling frequency;
- modify Table A.2 to summarize annual results, including sampling date.

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

If the locational running annual average for any sampling location exceeds the maximum acceptable concentration, corrective actions shall be recommended.

The Engineer shall also 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.
- An adequate number of sites are to be sampled to represent exposure levels system-wide.

THMs sampling locations shall be identified on a map of the distribution system and submitted with the System Assessment Report. The Engineer shall recommend sampling location/frequency changes if necessary.
b) **Haloacetic Acids**

The Engineer shall complete Table A.3 to summarize quarterly haloacetic acids concentrations (HAA5) by sampling location.

For municipal water utilities with non-GUDI systems that have had their quarterly sampling reduced to annual sampling approved by NSE, the Engineer shall:

- note the approval date for this reduction in sampling frequency;
- modify Table A.3 to summarize annual results, including sampling date.

Other systems are not eligible for a reduction in HAA5 sampling; an increased sampling frequency may be required for facilities using surface water or GUDI sources during peak by-product formation periods.

If the locational running annual average for any sampling location exceeds the maximum acceptable concentration, corrective actions shall be recommended.

The Engineer shall also 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) shall be targeted.
- In systems with booster chlorination stations and water tanks/reservoirs, HAA5 concentrations shall be monitored downstream of these components.
- An adequate number of sites are to be sampled to represent exposure levels system-wide.

HAA5 sampling locations shall be identified on a map of the distribution system and submitted with the System Assessment Report. The Engineer shall recommend sampling location/frequency changes if necessary.
c) **Other Disinfection By-Products**

Other disinfection by-products are listed in Table 1. The Engineer shall identify which other disinfection by-products are required to be monitored and compare this to existing monitoring that is conducted.

The Engineer shall verify that sampling locations are appropriate. Sampling locations shall be identified on a map of the distribution system and submitted with the System Assessment Report. The Engineer shall recommend sampling location/frequency changes if necessary.

The Engineer shall summarize concentrations for the most recent calendar year. If any maximum acceptable concentration is exceeded, corrective actions shall be recommended.

### 2.3.2 Lead and Corrosion Control

Approvals to Operate require municipal water systems 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 verify that sampling locations and frequencies for lead are appropriate as follows:

- An annual grab sample (flushed) is collected during the warmest month at select distribution system sample point(s) per the Approval to Operate.

- Flushed samples are collected at a point where water is consumed and at appropriate locations to identify problems per Health Canada’s guidance on controlling corrosion (e.g. residences with lead service lines, fountains in non-residential facilities, etc.)

- Stagnant samples are collected using first-draw sampling protocols per Health Canada’s guidance on controlling corrosion (e.g. minimum six hour stagnation period, number of sampling locations dependent on community size, etc.)

Lead sampling locations shall be identified on a map of the distribution system and submitted with the System Assessment Report. The Engineer shall recommend sampling location/frequency changes if necessary.
The Engineer shall summarize lead concentrations by sampling location and sample type (e.g. flushed or stagnant). If flushed sample results exceed the maximum acceptable concentration or stagnant sample results exceed recommended action limits, this information shall be considered as part of the corrosion control program review (see Section 2.3.2(b) below).

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 review the corrosion control program to verify that:

- one exists;
- it includes monitoring of lead concentrations at points of consumption;
- it targets areas where problems are expected;
- it includes monitoring of parameters that provide the information that is needed to determine corrective measures that should be undertaken when elevated concentrations of lead, or other metals, are observed (e.g. pH, alkalinity, chloride to sulfate mass ratio, etc.);
- it includes action limits that trigger follow-up.

The Engineer shall summarize the water quality results of the corrosion control program for the most recent calendar year. Corrective actions shall be recommended if lead concentrations exceed the maximum acceptable concentration for flushed samples or the action limit for stagnant samples or other concerns are identified from the review of the corrosion control program.

If a corrosion control program does not exist, the Engineer shall document why, including water quality results that demonstrate non-corrosivity of the water, or recommend the need for a more comprehensive corrosion control program. The Engineer is not required to develop a corrosion control program as part of the System Assessment Report.

**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.

2.3.3 **Aluminum**

For facilities using aluminum-based coagulants, the Engineer shall verify that monthly aluminum residuals are collected at the treatment facility and distribution system point(s). The stipulated limit shall be compared to the average of the 12 monthly samples collected at the treatment facility. The concentrations observed in the distribution system provide an indication of water quality stability.

If stipulated limits are exceeded, corrective actions shall be recommended.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum Acceptable Concentration (mg/L)</th>
<th>Considerations</th>
<th>Sampling Frequency</th>
<th>Sampling Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bromate</td>
<td>0.01</td>
<td>• Forms when ozone reacts with naturally-occurring bromide</td>
<td>• Monthly monitoring required by municipal water systems using ozone</td>
<td>• In treated water entering the distribution system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Forms in sodium hypo-chlorite solutions that are not stored appropriately</td>
<td>• Monitoring required by municipal water systems that store solutions for more than three months</td>
<td>• In treated water entering the distribution system</td>
</tr>
<tr>
<td>Chlorate</td>
<td>1.0</td>
<td>• By-product of chlorine dioxide</td>
<td>• A minimum of quarterly sampling is required by municipal water systems using chlorine dioxide</td>
<td>• Mid-point and far-point in the distribution system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Forms in sodium hypo-chlorite solutions that are not stored appropriately</td>
<td>• Monitoring required by municipal water systems that store solutions for more than three months</td>
<td>• In treated water entering the distribution system</td>
</tr>
<tr>
<td>Chlorite</td>
<td>1.0</td>
<td>• By-product of chlorine dioxide</td>
<td>• A minimum of quarterly sampling is required by municipal water systems using chlorine dioxide</td>
<td>• Mid-point and far-point in the distribution system</td>
</tr>
<tr>
<td>NDMA</td>
<td>0.000 04 (0.04 µg/L)</td>
<td>• By-product of chloramination</td>
<td>• A minimum of quarterly sampling is required by municipal water systems using chloramination</td>
<td>• In treated water entering the distribution system and far-point in the distribution system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• May be found in chlorinated systems with nitrogen or humic substances present in the source water</td>
<td>• Quarterly</td>
<td>• In treated water entering the distribution system</td>
</tr>
</tbody>
</table>

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.
### 2.3.4 Guidelines for Canadian Drinking Water Quality

The Engineer shall verify that the full suite of health-related parameters have been analysed a minimum of once every five years for all raw water sources and treated water by:

- documenting the sampling dates;
- reviewing the data to:
  - verify that sampling locations and frequencies are appropriate for the following parameters:
    - cyanobacterial toxins - surface water supplies should be sampled in late summer or early fall when water temperature is warmest
    - pesticides - should be sampled when the highest potential concentrations are expected (i.e. following a rainfall event after pesticide application)
  - identify if any maximum acceptable concentrations have been exceeded;
  - identify parameters with detectable concentrations;
  - discussing any trends for parameters with detectable concentrations;
  - including laboratory results from the last round of sampling as an Appendix to the System Assessment Report;
  - identifying when the next round of sampling is scheduled to occur.

If any maximum acceptable concentrations are exceeded, corrective actions shall be recommended.

The Engineer shall also recommend any changes to the monitoring program if sampling is inappropriate for cyanobacterial toxins, pesticides or other parameters; enhanced monitoring shall be recommended for parameters that have detectable concentrations. The Engineer shall recommend sampling location changes if necessary.

A full listing of the health-related parameters specified in the Guidelines for Canadian Drinking Water Quality is included in Table A.4.

**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 same 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.

**2.3.5 Guidelines for Monitoring Public Drinking Water Supplies**

The Engineer shall verify that the parameters in the *Guidelines for Monitoring Public Drinking Water Supplies* have been analysed as required (i.e. every year for surface water and GUDI; every two years for non-GUDI) in all raw water sources and treated water by:

- documenting the sampling dates;
- reviewing 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;
- discussing any water quality trends;
- including laboratory results from the last round of sampling as an Appendix to the System Assessment Report;
- identifying when the next round of sampling is scheduled to occur.

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

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

A full listing of parameters specified in the Guidelines for Monitoring Public Drinking Water Supplies is included in Table A.5.

**2.3.6 Source Water Protection Plan Monitoring**

For municipal water utilities monitoring any other chemical parameters for source water protection purposes (e.g. hydrocarbons, pesticides, etc.), the Engineer shall summarize the parameters, their sampling frequency, and their measured concentrations. If concentrations are detectable or increasing, recommendations shall be identified.
The Engineer shall review the source water protection plan monitoring program (i.e. Step 5 of the source water protection process) to verify that:

- one exists;
- it includes monitoring of parameters that provide the information that is needed to evaluate the effectiveness of the source water protection plan.

The Engineer shall provide recommendations if necessary.

2.4 Filter Backwash Water

If water from the filter backwash treatment system is discharged upstream of the raw water intake, the Engineer shall document the impact on the raw water source. If this discharge impacts the source, the Engineer shall provide recommendations.

2.5 Source Quantity

The Engineer shall compile existing water withdrawal approvals and include copies of these as an Appendix to the System Assessment Report.

The Engineer shall complete Table A.5 to compare water withdrawals to approved limits. If water withdrawals are greater than approved limits, recommendations shall be identified, including water conservation measures. If water withdrawals are approaching approved limits and growth is forecast to increase withdrawals beyond approved limits, recommendations shall be identified.

2.6 Source Water Protection Plan

The Engineer shall:

- identify the source water protection zone(s) on a map and submit this information with the System Assessment Report.
- submit the source water protection zone(s) in GIS format to NSE; if the protection zone(s) are not available in GIS format, the Engineer shall contact the NSE Watershed Planner to determine what requirements shall apply.
- summarize the status of the source water protection plan (SWPP) and implementation schedule;
- document the dates of the last two SWPP meetings;
- note the status of meeting actions and/or SWPP deliverables.

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

- **Treatment Requirements to Protect Against Pathogenic Organisms** - what is the source type and treatment standard to be met; 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** - has the well classification changed based on MPA results; inspect wells to verify no changes to the surrounding area?

  - Table A.1

- **Disinfection By-Products** - are disinfection by-products being adequately monitored; are levels below the maximum acceptable concentrations?

  - Table A.2 for trihalomethanes (THMs)
  - Table A.3 for haloacetic acids (HAA5)
  - Others as required

- **Lead and Corrosion Control** - are lead concentrations being adequately monitored; is a corrosion control program in place?

- **Aluminum** - are aluminum concentrations being adequately monitored by facilities using aluminum-based coagulants?

- **Guidelines for Canadian Drinking Water Quality** - are parameters being adequately monitored; are health-related parameters below the maximum acceptable concentration; do any parameters have detectable levels that require enhanced monitoring; when is the next round of sampling scheduled?

  - Table A.4
  - Include laboratory results from last round of sampling

- **Guidelines for Monitoring Public Drinking Water Supplies** - are parameters being adequately monitored; are health-related parameters below the maximum acceptable concentration; are there concerns with other parameters (e.g. compromise treatment or disinfection efficacy); when is the next round of sampling scheduled?

  - Table A.5
  - Include laboratory results from last round of sampling
• **Source Water Protection Plan Monitoring** - what other parameters are being monitored for source water protection purposes; what is the sampling frequency and concentrations; are concentrations detectable or increasing; is a plan in place?

• **Filter Backwash Water Discharge** - if the discharge point is upstream of the raw water intake, summarize the impact on the source.

• **Source Quantity** - compare actual water withdrawals to approved limits; is the source quantity adequate?

  - Compilation of existing water withdrawal approvals
  - Table A.6

• **Source Water Protection Plan** - source water protection zone(s) map and GIS format, summarize the status of the 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.

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 compile existing Approval(s) to Operate and include copies of these as an Appendix to the System Assessment Report.

For municipal water utilities that purchase treated water from an adjoining system, the Engineer shall document the name of the treatment facility and proceed to Section 3.2.

3.1.1 Treatment Process Schematic

The Engineer shall 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 verify that filtration technologies are meeting specified turbidity limits to receive the assigned removal credits for Cryptosporidium, Giardia and viruses outlined in Table 1 of the Nova Scotia Treatment Standards for Municipal Drinking Water Systems 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);
- 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.

Individual filter effluent turbidity values shall be submitted for the most recent calendar year 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 1 of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*.

For facilities that do not meet stipulated turbidity limits, the Engineer shall recommend corrective actions.

The Engineer shall 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 exceeds stipulated values;
- procedures have been implemented and communicated to all operations staff;
- procedures have been documented in the operations manual.

The Engineer shall also 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. The Engineer shall 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;
- they have a maintenance and quality assurance/calibration program.
The Engineer shall inspect the filtration process to verify that there are a minimum of two filters (i.e. redundancy). The Engineer shall document if the maximum day flow can be met with the largest filter out of service.

The Engineer shall make recommendations to address any concerns identified by the review of the filtration SOPs, inspection of on-line turbidimeters, and filter redundancy.

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 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 1 of the Nova Scotia Treatment Standards for Municipal Drinking Water Systems 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);
- 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.

Individual GUDI well turbidity values shall be submitted for the most recent calendar year by month (Option 1) or by the time interval graphed (Option 2).

Note: Option 1 is preferred.

For GUDI wells that do not meet stipulated turbidity limits, the Engineer shall contact NSE to determine what requirements shall apply.
The Engineer shall also 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. 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;
- they have a maintenance and quality assurance/calibration program.

The Engineer shall make recommendations to address any concerns identified by the inspection of on-line turbidimeters.

c) Non-GUDI Wells

The Engineer shall summarize turbidity levels in non-GUDI wells (for individual or combined flows) as follows. The Engineer shall note if measurements are by daily grab samples or continuous on-line turbidimeters.

Option 1: Calculating turbidity values for individual wells or combined flow using daily grab or continuous measurements (e.g. minimum of one 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);
- identify when the well was in operation.

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

Non-GUDI system turbidity shall be submitted for individual wells or combined flow for the most recent calendar year by month (Option 1) or by the time interval graphed (Option 2).

For non-GUDI wells that do not meet stipulated turbidity limits, the Engineer shall contact NSE to determine what requirements shall apply.
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;
- they have a maintenance and quality assurance/calibration program.

Where grab samples are taken, the Engineer shall 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.

The Engineer shall 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;
- 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 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. The Engineer shall make recommendations to address any concerns identified.

For facilities with integrated membrane systems, the Engineer shall summarize the process used to verify the rejection rate remains adequate for organics removal. The Engineer shall make recommendations to address any concerns identified.
### Table 2 - Direct Integrity Testing: Summary of Requirements

<table>
<thead>
<tr>
<th>Topic</th>
<th>Summary of Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale of Testing</td>
<td>• Testing shall be conducted on each membrane treatment unit in service (e.g. an individual train, skid, rack, stage, etc.).</td>
</tr>
<tr>
<td>Resolution</td>
<td>• The test method used shall have a resolution of 3 µm or less.</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>• 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 NSE.</td>
</tr>
<tr>
<td>Control Limit</td>
<td>• 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 NSE.</td>
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<tr>
<td></td>
<td>• If the direct integrity test results exceed the control limit for any membrane unit, that unit shall be removed from service.</td>
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<tr>
<td></td>
<td>• 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.</td>
</tr>
<tr>
<td>Frequency</td>
<td>• 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.</td>
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<tr>
<td></td>
<td>• 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.</td>
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<tr>
<td>Reporting</td>
<td>• Results shall be reported annually to NSE.</td>
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<td></td>
<td>• NSE 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 NSE.</td>
</tr>
<tr>
<td></td>
<td>• All direct integrity test results must be retained for a minimum of three years.</td>
</tr>
</tbody>
</table>
3.1.4 Primary Disinfection

The Engineer shall document how many inactivation log credits are required by disinfection by target microorganism (e.g. protozoa and/or viruses). The Engineer shall 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 NSE and the owner of the municipal drinking water system. Corrective action shall be taken immediately to remediate the situation.

a) Chemical Disinfection (CT Concept)

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;
- minimum water temperature;
- maximum pH of the water for free chlorine or optimum pH for chlorine dioxide or ozone;
- maximum flow and minimum retention time - if the tank used to achieve CT is subject to water levels fluctuates, the Engineer shall verify if the inflow or outflow represents the maximum flow condition.

The Engineer shall calculate the design CT. The Engineer shall verify that operational conditions remained within the design range for achieving CT at all times during the most recent calendar year.

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

The Engineer shall make recommendations to address any concerns identified.
b) **UV Disinfection (IT Concept)**

Where UV disinfection is used, the Engineer shall 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);
- sleeve cleaning method.

The Engineer shall verify that the unit has been designed to deliver a UV dose of 40 mJ/cm². The Engineer shall verify that the following conditions were met at all times during the most recent calendar year:

- intensity - was above the minimum required;
- flow - was below the maximum allowed;
- transmittance - was above the minimum required.

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

The Engineer shall provide recommendations to address any concerns identified.

c) **Redundancy, Continuous Monitoring and Alerting**

The Engineer shall 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;
- protocols are in place to prevent inadequately disinfected water from entering the distribution system.
The Engineer shall inspect the on-line instrumentation to ensure that:

- they have the required range and accuracy;
- they are in good working order;
- they have a maintenance and quality assurance/calibration program.

The Engineer shall provide recommendations to address any concerns identified.

d) **Standard Operating Procedures**

The Engineer shall 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;
- have been documented in the operations manual.

The Engineer shall provide recommendations to address any concerns identified.

3.1.5 **Secondary Disinfection**

The Engineer shall describe the secondary disinfection process. The Engineer shall 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;
- there is a maintenance and quality assurance/calibration program in place.

Where free chlorine is used for both primary and secondary disinfection, the Engineer may 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).
Where UV light is used for primary disinfection to receive protozoa inactivation credits, the Engineer shall calculate the design CT for virus inactivation credits. The Engineer shall verify that operational conditions remained within the design range for achieving CT at all times during the most recent calendar year. Where operational conditions went outside the design range, the Engineer shall identify the cause, document the corrective actions taken and verify that CT was calculated during every such event.

The Engineer shall provide recommendations to address any concerns identified.

3.1.6 Other Critical Processes

The Engineer shall evaluate and inspect other critical processes such as coagulation/flocculation, clarification, etc. The Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution and Operations of Drinking Water Supply Systems establish minimum requirements.

The Engineer shall recommend corrective actions where necessary.

3.1.7 Waste Streams

a) Filter-to-Waste

The Engineer shall describe the filter-to-waste process. For municipal water utilities that use chemically-assisted filtration, the Engineer shall verify that turbidity is less than or equal to 0.2 NTU before returning a filter to service. Recommendations shall be identified, if necessary, to meet the Nova Scotia Treatment Standards for Municipal Drinking Water Systems, as amended from time to time.

b) Filter Backwash Water

The Engineer shall complete Table B.2 to summarize the location of the filter backwash water discharge and its quality. If the water quality does not meet the discharge criteria stipulated in the utility’s approval to operate, as amended from time to time, recommendations shall be identified to meet the requirements specified in Section 4.3.1 of the Nova Scotia Treatment Standards for Municipal Drinking Water Systems.

If the backwash water discharges into a municipal wastewater system, Table B.2 shall be modified to identify any issues related to meeting the requirements specified in Section 4.3.1(b) of the Nova Scotia Treatment Standards for Municipal Drinking Water Systems, as amended from time to time.
c) Other Waste Streams

The Engineer shall review other waste streams and verify that they are being managed appropriately. Recommendations shall be identified where necessary.

3.2 Distribution System Water Quality

3.2.1 Chlorine Residual Levels

The Engineer shall review distribution system chlorine residuals for the most recent calendar year available. Where residuals are routinely less than 0.20 mg/L where free chlorine is used, or 1.0 mg/L combined chlorine for chloraminated systems, corrective actions shall be recommended.

The Engineer shall 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. The Engineer shall 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.

The Engineer shall recommend corrective actions where necessary.

3.2.2 Microbiological Water Quality

The Engineer shall review total coliforms and E.coli results for the most recent calendar year available. The presence of bacteria in the distribution system shall be discussed and recommendations identified where necessary.

The Engineer shall also verify that sampling locations and frequencies meet the requirements of the Guidelines for Canadian Drinking Water Quality and the Guidelines for Monitoring Public Drinking Water Supplies, including re-sampling after the presence of bacteria is detected.

Sampling locations shall be identified on a map of the distribution system and submitted with the System Assessment Report. The Engineer shall recommend sampling location/frequency changes if necessary.

3.2.3 Turbidity

The Engineer shall review distribution system turbidity results for the most recent calendar year available. The Engineer shall verify that a protocol exists for investigating the cause of turbidity values above 5 NTU. Values above 5 NTU shall be discussed and recommendations identified where necessary.
3.2.4 Other Distribution System Monitoring/Programs

The Engineer shall 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. The Engineer shall provide recommendations where necessary.

3.3 On Site Inspection

The Engineer shall conduct an on site inspection to evaluate treatment processes, as well as other facilities and equipment; the on 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
  - 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
    - 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
  - 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
  - Preparing for the closing interview
• Closing interview on inspection findings
  • Presentation of findings, particularly any significant deficiencies
  • Informing management of next steps (e.g. writing and submitting the report, corrective action, etc.)

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;
• any other utility specific issue.

3.4 Conclusions and Recommendations

The Engineer shall provide conclusions and recommendations regarding the treatment processes, facilities and equipment from his/her review to address the following:

• Filtration - are stipulated limits being met to assign log removal credits; are SOPs and on-line monitoring in place; what is the level of filter redundancy?

• Membranes - were integrity breaches detected and corrective action taken; do test results verify the removal efficiency of the membrane filtration system to be greater than or equal to the credit awarded by NSE; for integrated membrane systems, are TOC results acceptable?

  - Table B.1 to confirm log removal credit for membrane treatment units used for pathogen reduction credits
  - Other water quality results for membrane treatment units used for the reduction of organics
- **Primary Disinfection** - has the required log inactivation been met at all times (CT or IT); are redundant units in place; are SOPs and on-line monitoring in place?
  - Chlorine
  - Alternate disinfectants

- **Secondary Disinfection** - is on-line monitoring in place?
  - If UV is used for primary disinfection, verify log inactivation for viruses is met

- **Other Critical Processes** - are they meeting requirements?

- **Waste Streams** - is filter-to-waste meeting stipulated requirements; is filter backwash wastewater meeting stipulated requirements; are other waste streams present meeting stipulated requirements?
  - Table B.2 for filter backwash wastewater

- **Distribution System Water Quality** - is quality maintained throughout the distribution system; what 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** - what concerns were highlighted; are chemicals used NSF approved; what is required to ensure the sustainable operation of system 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 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;
• operations staff are aware of its contents.

The Engineer shall also evaluate the procedures an operator follows to identify any problems with the process, determine the changes needed to correct the problem and how adjustments to the process are approved and performed as needed.

The Engineer shall verify that a maintenance program exists and is adequate to ensure the long-term viability of the municipal drinking water system, including distribution system components.

Recommendations shall be identified where necessary.

4.2 Monitoring and Reporting

The Engineer shall review the annual monitoring program to verify that:

• one exists;
• it is current and up to date;
• it includes compliance monitoring, QA/QC requirements, process monitoring, response monitoring, source water characterization and protection monitoring and any other applicable monitoring;
• it includes action levels for responding to treatment issues;
• it is available on site;
• operations staff are aware of its contents.

The Engineer shall identify the laboratories being used for water quality analyses and verify that the municipal water utility is operating in accordance with the Policy on Acceptable Certification of Laboratories.
The Engineer shall review reporting requirements and verify that the municipal water utility has complied with the immediate, annual and ad hoc reporting requirements outlined in Appendix G of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*.

The Engineer shall review the most recent annual report. Any concerns shall be identified in the System Assessment Report.

Recommendations shall be identified where necessary.

### 4.3 Management

The Engineer shall review the number of certified operators and back-up personnel to verify that the municipal water utility is operating in accordance with Part I of the *Water and Wastewater Facilities and Public Drinking Water Supplies Regulations*.

The Engineer shall 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.

The Engineer shall review the water quality goals that the municipal water utility has and evaluate the plan(s) the utility has to accomplish or maintain these goals (e.g. strategic plan, management plan, due diligence program, etc.).

Recommendations shall be identified where necessary.

### 4.4 Conclusions and Recommendations

The Engineer shall provide conclusions and recommendations regarding the system operation, monitoring and management from his/her review to address the following:

- **Operations and Maintenance** - does a comprehensive operations manual exists; are procedures in place to identify and correct problems; is a maintenance program in place?

- **Monitoring and Reporting** - does an annual monitoring program exist; is the lab policy being adhered to; have reporting requirements been met; any concerns with the annual report?

- **Management** - are certified operators and back-up personnel available; who is the operator in overall direct responsible charge; what procedures are in place during this operator’s absence; are programs in place to manage other issues?
PART V - REPORT SUBMISSION

5.0 Ability to Comply

The Engineer shall summarize conclusions and identify all recommendations necessary to meet current environment standards and the Nova Scotia Treatment Standards for Municipal Drinking Water Systems 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.

The Engineer shall 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 NSE varies from this risk-based approach, written justification shall be included for varying the priority.

Obvious problems associated with the municipal drinking water system that jeopardize treated water quality to the point that it no longer meets the health protection standards adopted by NSE are to be highlighted in the System Assessment Report.

6.0 Report Preparation

The municipal water utility shall provide to NSE a System Assessment Report by the required timeline. The report shall be acceptable to NSE.

The System Assessment Report is to be completed at the sole expense of the municipal water utility. The municipal water utility may apply for funding assistance under the Provincial Capital Assistance Program.

The System Assessment Report shall address the following items; the Engineer may add additional sections as necessary:

- Engineer’s Declaration
- Introduction
- Purpose
- Characterization of the Water Source (Part II)
  - Source description and schematic
  - Treatment Requirements to Protect Against Pathogenic Organisms
  - Disinfection By-products
  - Lead and Corrosion Control Program
  - Aluminum
  - Guidelines for Canadian Drinking Water Quality
  - Guidelines for Monitoring Public Drinking Water Supplies
  - Source Water Protection Plan Monitoring
- Filter Backwash Water (if applicable)
- Source Quantity
- Source Water Protection Plan

**Treatment Processes, Facilities and Equipment (Part III)**
- Treatment Process Schematic
- Turbidity Limits
- Filter Redundancy (if applicable)
- GUDI Classification (if applicable)
- Direct Integrity Testing (if applicable)
- Primary Disinfection
- Secondary Disinfection
- Other Critical Processes
- Waste Streams (if applicable)
  - Filter-to-Waste
  - Backwash Water
  - Other Waste Streams
- Distribution System Water Quality
  - Chlorine Residual Levels
  - Microbiological Water Quality
  - Distribution System Turbidity
- On site Inspection
  - Treatment Processes
  - Other System Facilities and Equipment
  - NSF Approved Chemicals
  - Utility Specific Issues

**Operations, Monitoring and Management**
- Operations and Maintenance
  - Operations Manual
  - Operations
  - Maintenance
- Monitoring and Reporting
  - Annual Monitoring Program
  - Lab Policy
  - Reporting Requirements
  - Annual Report
- Management
  - Staffing
  - Operator in Overall Direct Responsible Charge
  - Procedures for Absence of ODRC Operator
  - Other Procedures
  - Water Quality Goals

**Conclusions**

**Recommendations**

**Requirements to comply**
- Required Improvements
- Schedule (prioritized according to risk)
- Preliminary Estimates
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

<table>
<thead>
<tr>
<th>Year</th>
<th>GUDI Well 1</th>
<th>GUDI Well 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MPA Score</td>
<td>Sample Date</td>
</tr>
<tr>
<td>2003</td>
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<tr>
<td>2004</td>
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<tr>
<td>2012</td>
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</tbody>
</table>

**Has the GUDI well classification changed?**

**Do changes to the surrounding area warrant re-classification?**

**Notes:**

1. MPA testing is required every two years, in the spring 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.
### Table A.2 - Quarterly Trihalomethanes Concentrations (THMs) By Sample Location

<table>
<thead>
<tr>
<th>Sampling Period/Month (Specify Sampling Date)</th>
<th>Sample Location 1 (Specify Name)</th>
<th>Sample Location 2 (Specify Name)</th>
<th>Sample Location 3 (Specify Name)</th>
<th>Sample Location 4 (Specify Name)</th>
<th>Sample Location 5 (Specify Name)</th>
<th>Sample Location 6 (Specify Name)</th>
<th>Sample Location 7 (Specify Name)</th>
<th>Sample Location 8 (Specify Name)</th>
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</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
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Originating Division: Environmental Science and Program Management
Scope: Standard under the Environment Act
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[^2]: Indicates drinking water quality parameter.
[^3]: Indicates primary drinking water contaminants.
[^4]: Indicates drinking water quality parameter.
[^5]: Indicates drinking water quality parameter.
[^6]: Indicates drinking water quality parameter.
[^b]: Indicates drinking water quality parameter.
## Sampling Period

### Parameter

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<td>Vinyl chloride</td>
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### Maximum Acceptable Concentration

- Pentachlorophenol: 0.06 mg/L
- Phorate: 0.002 mg/L
- *Picloram: 0.19 mg/L
- Selenium: 0.01 mg/L
- *Simazine: 0.01 mg/L
- *Terbufos: 0.001 mg/L
- Tetrachloroethylene: 0.03 mg/L
- 2,3,4,6-Tetrachlorophenol: 0.1 mg/L
- Trichloroethylene: 0.005 mg/L
- 2,4,6-Trichlorophenol: 0.005 mg/L
- *Trifluralin: 0.045 mg/L
- Trihalomethanes (THMs): 0.100 mg/L
- Turbidity: See Approval
- *Uranium: 0.02 mg/L
- Vinyl chloride: 0.002 mg/L

* Denotes parameters for which the health-based guideline was developed as an interim maximum acceptable concentration.

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Originating Division: Environmental Science and Program Management
Scope: Standard under the Environment Act
Nova Scotia Environment
Notes:
1. Copy columns for multiple supply/well systems.
2. As of January 2012. Update information if parameters are added or limits change.
3. Until a health-based standard for aluminum is set, municipal water approvals require water treatment plants using aluminum-based coagulants to reduce residual aluminium levels in treated water to the lowest extent possible as a precautionary measure. Values of less than 0.1 mg/L total aluminium for conventional treatment plants and less than 0.2 mg/L total aluminium for other types of treatment systems have been set. Any attempt to minimize aluminum residuals must not compromise the effectiveness of the disinfection process or interfere with the removal of disinfection by-product precursors.
4. Because first-drawn water may contain higher concentrations of metals than are found in running water after flushing, faucets should be thoroughly flushed before water is taken for consumption or analysis.
5. The guideline is considered protective of human health against exposure to all microcystins that may be present.
6. 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.
7. 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.
8. 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).
9. Equivalent to 0.007 mg/L for paraquat ion.
### Table A.5 - Guidelines for Monitoring Public Drinking Water Supplies

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum Acceptable Concentration</th>
<th>Aesthetic Guideline</th>
<th>Raw or Treated(^1) Provide Sampling Dates for Appropriate Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mg/L)</td>
<td>(mg/L)</td>
<td>2003</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Aluminum(^3)</td>
<td>0.1/0.2</td>
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</tr>
<tr>
<td>Ammonia</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>*Antimony(^4)</td>
<td>0.006</td>
<td>-</td>
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<tr>
<td>Arsenic</td>
<td>0.010</td>
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</tr>
<tr>
<td>Barium</td>
<td>1</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>*Boron</td>
<td>5</td>
<td>-</td>
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</tr>
<tr>
<td>Cadmium</td>
<td>0.005</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>-</td>
<td>&lt;250</td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>0.05</td>
<td>-</td>
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</tr>
<tr>
<td>Colour</td>
<td>-</td>
<td>&lt;15 TCU</td>
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</tr>
<tr>
<td>Conductivity</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>-</td>
<td>&lt;1.0</td>
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</tr>
<tr>
<td>Fluoride(^5)</td>
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<td>-</td>
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<td>Hardness</td>
<td>-</td>
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<tr>
<td>Iron</td>
<td>-</td>
<td>&lt;0.3</td>
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<tr>
<td>Lead(^4)</td>
<td>0.01</td>
<td>-</td>
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<tr>
<td>Magnesium</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Manganese</td>
<td>-</td>
<td>&lt;0.05</td>
<td></td>
</tr>
</tbody>
</table>

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**Originating Division:** Environmental Science and Program Management  
**Scope:** Standard under the *Environment Act*  
**Nova Scotia Environment**
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum Acceptable Concentration (mg/L)</th>
<th>Aesthetic Guideline (mg/L)</th>
<th>Raw or Treated Raw or Treated&lt;sup&gt;1&lt;/sup&gt; Provide Sampling Dates for Appropriate Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (no units)</td>
<td>-</td>
<td>6.5-8.5&lt;sup&gt;7&lt;/sup&gt;</td>
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<tr>
<td>Potassium</td>
<td>-</td>
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</tr>
<tr>
<td>Selenium</td>
<td>0.01</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>-</td>
<td>≤200</td>
<td></td>
</tr>
<tr>
<td>Sulphate</td>
<td>-</td>
<td>≤500</td>
<td></td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>-</td>
<td>≤500</td>
<td></td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Turbidity</td>
<td>See Approval</td>
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</tr>
<tr>
<td>*Uranium</td>
<td>0.02</td>
<td>-</td>
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</tr>
<tr>
<td>Zinc</td>
<td>-</td>
<td>≤5.0</td>
<td></td>
</tr>
</tbody>
</table>

* Denotes parameters for which the health-based guideline was developed as an interim maximum acceptable concentration.

Notes:
1. Copy table for raw or treated sampling dates; copy columns for multiple supply/well systems.
2. As of January 2012. Update information if parameters are added or limits change.
3. Until a health-based standard for aluminium is set, municipal water approvals require water treatment plants using aluminium-based coagulants to reduce residual aluminium levels in treated water to the lowest extent possible as a precautionary measure. Values of less than 0.1 mg/L total aluminium for conventional treatment plants and less than 0.2 mg/L total aluminium for other types of treatment systems have been set. Any attempt to minimize aluminium residuals must not compromise the effectiveness of the disinfection process or interfere with the removal of disinfection by-product precursors.
4. Because first-drawn water may contain higher concentrations of metals than are found in running water after flushing, faucets should be thoroughly flushed before water is taken for consumption or analysis.
5. 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.
6. 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).
7. pH will depend on the corrosion control strategy; can be as high as 10.

Originating Division: Environmental Science and Program Management
Scope: Standard under the Environment Act

Nova Scotia Environment
## A.6 - Water Withdrawals (*modify table as necessary based on number of sources/wells*)

<table>
<thead>
<tr>
<th>Month</th>
<th>Source 1*</th>
<th>Source 2*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Monthly Withdrawal (m$^3$/d)</td>
<td>Average Day (m$^3$/d)</td>
</tr>
<tr>
<td>January</td>
<td></td>
<td></td>
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<tr>
<td>February</td>
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<td>March</td>
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<td>December</td>
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<tr>
<td>Total Annual Withdrawal</td>
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<tr>
<td>Maximum Day</td>
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</tbody>
</table>

Specify Withdrawal Limits (m$^3$/d) | Exceeds (Yes/No) | Specify Withdrawal Limits (m$^3$/d) | Exceeds ? (Yes/No)

Monthly
Average
Maximum

---

Originating Division: Environmental Science and Program Management  
Scope: Standard under the *Environment Act*  
*Nova Scotia Environment*
### Table B.1 - Membrane Filtration Direct Integrity Testing Using Pressure Decay

<table>
<thead>
<tr>
<th>Day</th>
<th>Pressure (kPa)</th>
<th>$\Delta P_{\text{init}}$ (kPa/min)</th>
<th>Within UCL?</th>
<th>Corrective Action Taken (if required)</th>
<th>Filtrate Flow (Lpm)</th>
<th>TMP’ (kPa)</th>
<th>ALCR?</th>
<th>LRV’ Verified</th>
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<tbody>
<tr>
<td>1</td>
<td>Initial</td>
<td>Final</td>
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</tr>
<tr>
<td>Day</td>
<td>Pressure (kPa)</td>
<td>$\Delta P_{\text{init}}$ (kPa/min)</td>
<td>Within UCL?</td>
<td>Corrective Action Taken (if required)</td>
<td>Filtrate Flow (Lpm)</td>
<td>TMP (kPa)</td>
<td>ALCR</td>
<td>LRV Verified</td>
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</tr>
</tbody>
</table>

**Notes:**

1. The Engineer shall submit one table per membrane unit used for pathogen reduction credits.
2. The Engineer shall direct integrity test results for the most recent calendar year 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

a) Specify Discharge Location

b) Specify Discharge Environment

<table>
<thead>
<tr>
<th>Discharge Environment</th>
<th>☐</th>
<th>☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater</td>
<td>☐</td>
<td>Sanitary Sewer</td>
</tr>
<tr>
<td>Marine</td>
<td>☐</td>
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</tr>
<tr>
<td>Brackish</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Non-Aquatic</td>
<td>☐</td>
<td></td>
</tr>
</tbody>
</table>

c) Is discharge upstream of raw water intake? If yes, refer to Section 2.3; document conclusions and recommendations.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
d) For freshwater water, marine, brackish or non-aquatic discharges - Specify Wastewater Quality

<table>
<thead>
<tr>
<th>Month</th>
<th>Suspended Solids (mg/L)</th>
<th>Aluminum (mg/L)</th>
<th>Chlorine Residual (mg/L)</th>
<th>pH</th>
<th>Fish Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>February</td>
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<tr>
<td>Specify Discharge Limits</td>
<td></td>
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</tr>
</tbody>
</table>

Wastewater quality meets or exceeds discharge criteria?

---

e) For discharges into municipal wastewater systems - Summarize any issues

_________________________________________________________________________________________
Table C.1 - Operator in Overall Direct Responsible Charge

The operator in overall direct responsible charge (ODRC) is: ________________________________

Signature of operator: ____________________________ Date: ____________

(Specify name - add additional lines if more than one ODRC operator)

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

When on vacation: ________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

When ill: ________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

Other (specify) ________________________________________________________________

_____________________________________________________________________________