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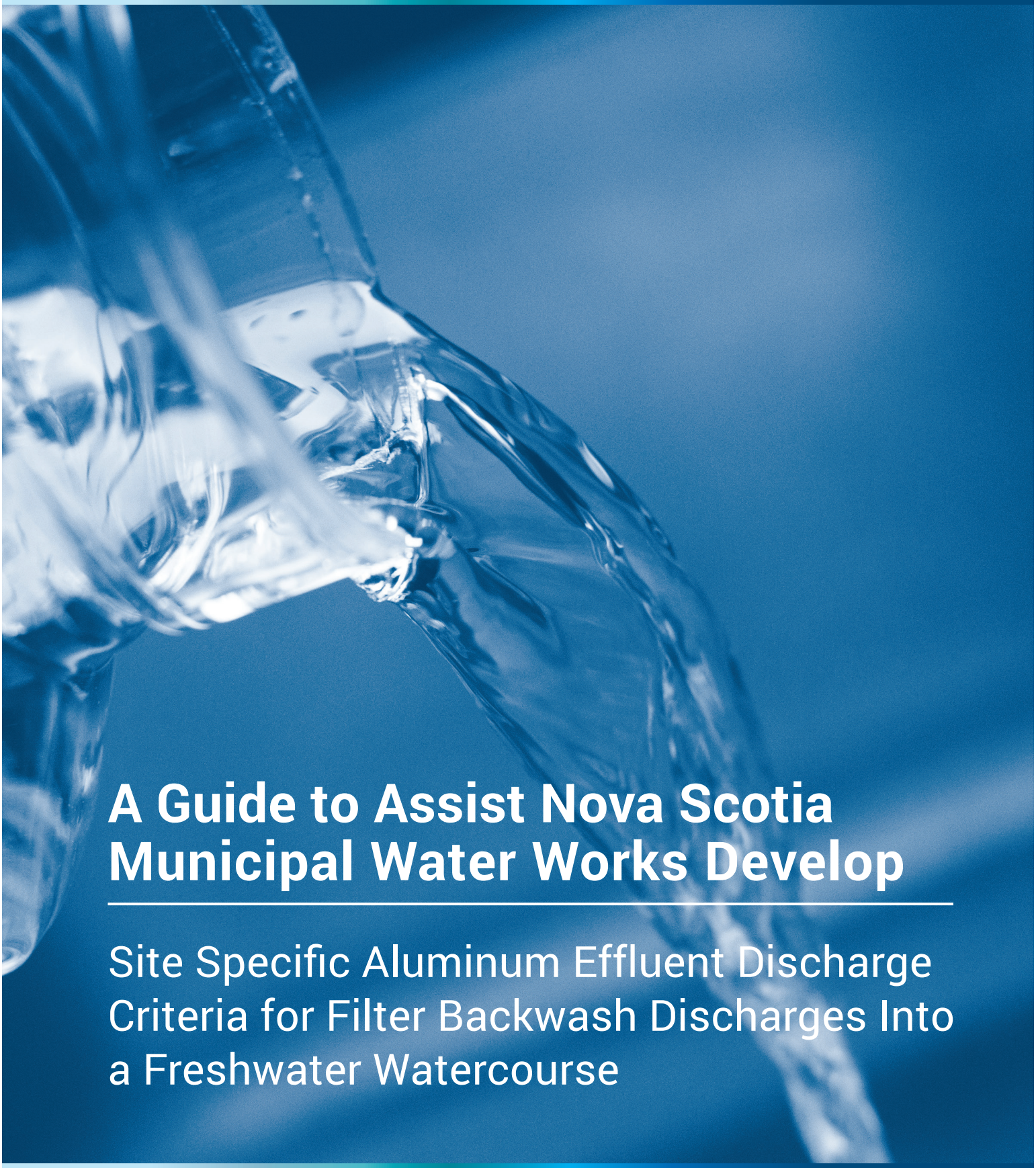

A Guide to Assist Nova Scotia Municipal Water Works Develop

Site Specific Aluminum Effluent Discharge Criteria for Filter Backwash Discharges Into a Freshwater Watercourse

A Guide to Assist Nova Scotia Municipal Water Works Develop
Site Specific Aluminum Effluent Discharge Criteria for Filter Backwash Discharges Into
A Freshwater Watercourse

Department of Environment and Climate Change

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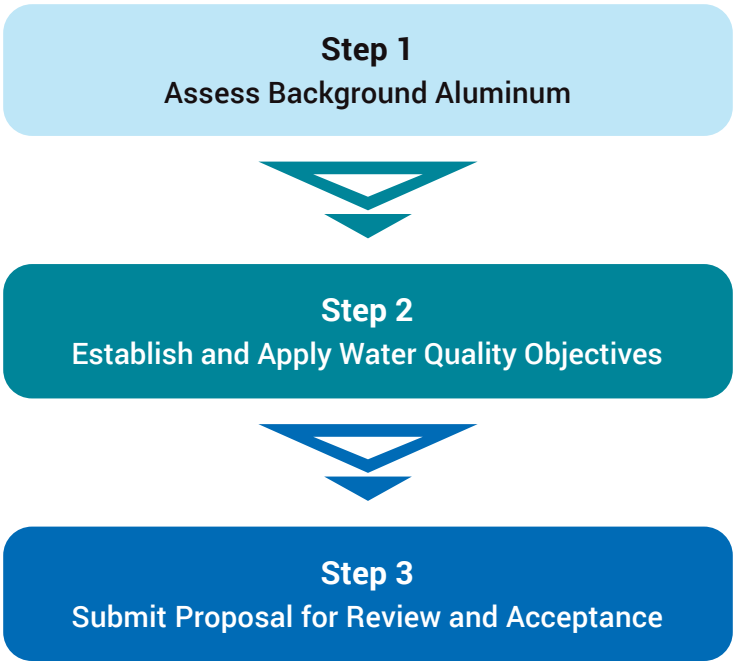
Contents

Introduction

This guide outlines the minimum criteria and an acceptable methodology[1] for Approval Holders to propose site-specific aluminum discharge limits where the Approval Holder cannot achieve the limits stipulated in their Approval to Operate.

A summary of the steps for establishing criteria is outlined in Figure 1 below and further explained in this guidance:

Figure 1 – Pathway to Establishing Site-Specific Water Quality Objectives for Municipal Water Treatment Effluent Discharges.



1 The Department may consider alternative approaches to establishing site-specific aluminum effluent discharge criteria. It is recommended that Approval Holders seek acceptance from the Department before undertaking these studies.

Step 1–Assess Background Aluminum

The background concentration of a substance in surface water can be influenced by geological conditions and physical/chemical changes in the environment introduced by human development and industrialization.

The following section outlines criteria for establishing an ambient water quality characterization program to establish site-specific aluminum effluent water quality objectives.

Ambient background concentrations represent concentrations of chemicals in the environment reflecting natural and regional anthropogenic (not site-related) sources of chemicals that are not related to activities at the site.

1.1 Select an Appropriate Monitoring Site

The monitoring site should be selected based on the following criteria:

- Must not be affected by activities at the site[2];
- Located upstream of the effluent discharge point and/or mixing zone;
- Representative of effluent receiving water quality (e.g. have similar geological, biological, physical, and chemical characteristics);
- Accessible year-round, where possible[3].

For systems drawing from lakes that do not drain to a river or the ocean, adjacent water bodies may be suitable ambient water quality monitoring stations if they have similar geological, biological, physical, and chemical characteristics as the receiving water.

In complex systems, an Approval Holder may need to seek the advice of a qualified professional for assistance in selecting an appropriate number and location of monitoring sites.

A qualified professional, in this document, is defined as a hydrologist, a registered engineer or registered geoscientist with relevant experience.

2 If there is evidence of impact from site activities (e.g., change in footprint, activities, or hydrology at the site) during the ambient background water quality characterization period, new monitoring station(s) must be selected following the criteria above.

3 It is recognized that some sampling sites may not be accessible year-round due to freezing. The sampling schedule has made allowances for 6 missed sampling events over the 3-year assessment period to accommodate for site access restrictions.

1.2 Conduct Monitoring to Establish Ambient Background Water Quality

Minimum sampling requirements for each monitoring site are given in the table below.

Table 1–Minimum Sampling to Establish Ambient Background Water Quality

Parameter	Analysis	Sampling Method	Frequency	Location(s)
Total Aluminum	Lab	Grab sample	Minimum Monthly – all parameters should be analyzed during the same sampling event.	All parameters should be analyzed/sampled at each ambient water quality monitoring station.
pH	Field	In-situ		

Rivers and Streams

For ambient water quality monitoring sites located in rivers and streams, samples should be collected from areas that are turbulent/well-mixed. Where feasible and safe to do so, samples should be collected at the center of the stream, at 60% depth.

Lakes

For ambient water quality monitoring sites in lakes, samples should be collected from the deepest area of the lake, at sample depths between 0.5 – 1 meter from the surface, where feasible and safe to do so.

Step 2–Establish and Apply Water Quality Objectives

2.1 Calculate the 95th Percentile Value

To establish background concentrations, a minimum number of 30 sampling events/data points from each ambient water quality monitoring site(s) collected over a period of 3 years is required to establish a statistically robust value. Where more than 2 sampling events are missed in a year due to site accessibility restrictions, two samples, staggered, may be collected the following month.

The water quality objective for aluminum can then be established as follows:

- Calculate the median value for the dataset. Where multiple monitoring sites have been established for the characterization study, all data should be used in the calculation with equal weighting unless advised otherwise by a qualified professional. In such cases, rationale for the selected weighting should be provided. Note that data outliers should not be excluded from the calculation.
- Determine the 95th percentile concentration for the dataset. This calculated value will serve as the water quality objective for the site.

There are two approaches to applying the water quality objective for aluminum at the site:

1. Achieving the water quality objective at the end-of-pipe (refer to section 2.2)
2. Achieving the water quality objective at the edge of an approved mixing zone (refer to section 2.3)

2.2 Apply the Water Quality Objective at the End-of-Pipe

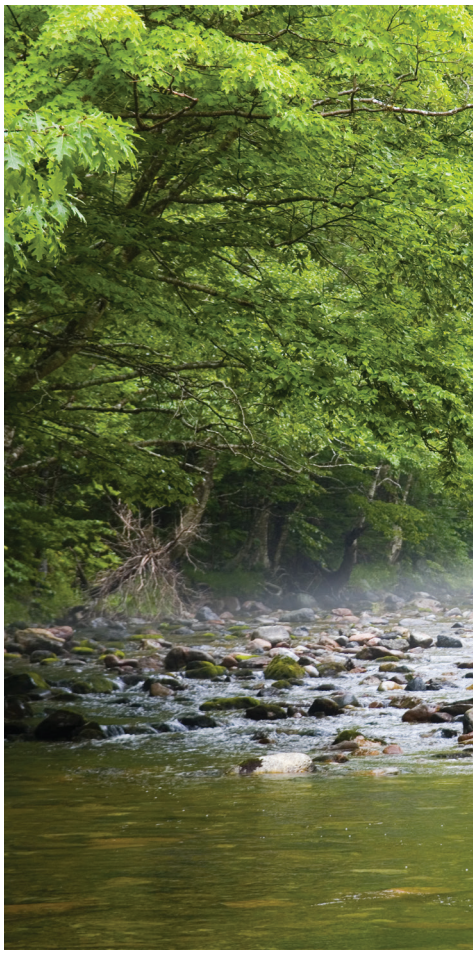
In this approach, the water quality objective for aluminum calculated above will serve as the compliance value for the effluent at the end-of-pipe.

2.3 Apply the Water Quality Objective at the Edge of an Approved Mixing Zone and Establish an End-of-Pipe Discharge Objective

An Approval Holder may opt to conduct concurrent[4] site characterization to establish an end-of-pipe discharge objective that utilizes the assimilative capacity of the receiving water to meet the water quality objective for aluminum[5] at the edge of the mixing zone.

Note: This approach will require Approval Holders to complete additional compliance sampling outlined in Appendix A immediately upon acceptance of the proposal by the Department.

The following section outlines the minimum design considerations and criteria for conducting a mixing zone study for this specific application. Due to their complexity, mixing zone studies must be conducted by a "qualified professional" with relevant experience.



In the context of this document, **"end-of-pipe"** is defined as the last point of treatment and/or control by the Approval Holder before effluent is discharged to a freshwater aquatic environment.

4 Mixing zone studies must be completed within the 3-year assessment period.

5 For the purposes of modeling, the water quality objective at the edge of the mixing zone must not exceed the 95th percentile aluminum value calculated + 5 µg/L total aluminum.

2.3.1 Mixing Zone Allocation Criteria

The mixing zone allocated for the receiving water must meet the following criteria adapted from the **CCME Technical Supplement 3: Canada-wide Strategy for the Management of Municipal Wastewater Effluent – Standard Method and Contracting Provisions for the Environmental Risk Assessment (2008).**

Mixing zones should:

- Be as small as possible;
- Not impinge on critical fish or wildlife habitats (e.g., spawning or rearing areas for fish, overwintering habitats for migratory waterfowl);
- Not be acutely toxic to aquatic organisms;
- Not cause acute or short-term chronic toxicity to aquatic life;
- Allow a zone of passage for migrating aquatic organisms;
- Not block migration into tributaries;
- Not overlap with adjacent effluent discharges;
- Not unduly attract aquatic life or wildlife, thereby causing increased exposure to chemicals of potential concern;
- Not be established such that drinking water intakes are contained therein;
- Not allow for the accumulation of substances in water or sediment to toxic levels;
- Not allow for the bioconcentration of substances of concern to level that are harmful to the health of organisms, aquatic-dependant wildlife or humans;
- Not adversely effect the aesthetic qualities of the receiving water system (e.g., odour, colour, scum, oil, floating debris, etc.); and
- Not result in changes to the nutrient status of the water body (e.g. eutrophication or presence of toxic algal blooms).

2.3.2 Mixing Zone Design Criteria

The following criteria for mixing zone designs have been adapted from CCME (2008) for this specific application. In all receiving waters, the mixing zone must not extend more than 100 m downstream of the effluent discharge location and must not exceed 1:100 dilution ratio. Additional design criteria are outlined below based on the receiving water characteristics.

Streams with no-flow conditions: a mixing zone is not allowed except where the stream empties into a larger, year-round receiving body of water that is no more than 100 m downstream of the effluent discharge location.

Streams and rivers: the mixing zone must not exceed 25% of the cross-sectional area or volume flow, also called the fraction of flow (ff). The fraction of flow must be applied to a low flow condition (e.g., a seven-day low flow with a ten-year return period 7Q10). The mixing zone must not encompass more than 33% of the river width at any transect.

Lakes: the mixing zone must be less than 10% of the volume of the portion of the receiving water available for mixing and must not exceed 100 m from the point of discharge in any direction.

Note that where several limits are in place, the first one to be reached sets the maximum extent of the mixing zone allowed for the dilution assessment.

2.3.3 Acceptable Modelling

The following approaches to assessing the assimilative capacity of the receiving water are acceptable:

- Mass-balance
- Steady-state (e.g. PLUME or CORMIX)
- Dynamic models (e.g. WASP)

Modelling must be based on worst-case scenarios of periods of high effluent discharge and low-flow conditions in the receiving water.

2.3.4 Validation and Verification

The model shall be validated and verified following best practices as determined by a qualified professional with experience in completing hydrological modelling. A summary of this work shall be submitted with the report including any field data collected.

Step 3–Submit Proposal for Review and Acceptance

Once you have completed Steps 1 and 2, append all supporting documentation, and submit the report to your local District Office for review and acceptance.

Note that water quality objectives for the site are subject to review every 10 years or at the request of the Approval Holder if there are suspected or known impacts to the receiving water quality unrelated to site activities.

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Nova Scotia Department of Environment and Climate Change. (2021). *Table 5 Substances Potentially Considered as Background Occurrences.*

Appendix A – Additional Compliance Monitoring Requirements for Approved Plans Utilizing the Assimilative Capacity of the Receiving Water to Achieve Aluminum Water Quality Objectives at the Edge of a Mixing Zone

Parameters	Analysis	Sampling Method	Frequency	Location(s)
Total Aluminum	Lab	Grab for plants with **intermittent discharges** at the start and end of each discharge event. Where multiple discharges occur monthly, a minimum of 1 monthly sample is required. A monthly 24-hour composite sample for plants with **continuous discharges**	Monthly	Edge of the mixing zone
Acute toxicity test: 48h Daphnia magna single concentration	Lab	**Continuous discharges:** 24-hour composite flow proportional or equal time/equal volume. **Intermittent discharges:** 2 grab samples, one at the start of discharge and one near the end.	**Year 1:** **Continuous discharges:** monthly **Intermittent discharges:** at each discharge event or monthly for facilities with multiple discharge events each month. **Year 2:** **Continuous discharges:** quarterly **Intermittent discharges:** quarterly or at each discharge event if less than 4 per year. **Upon request from Department thereafter**	End-of-pipe discharge


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