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CSA S900.1:18
National Standard of Canada



Climate change adaptation for wastewater treatment plants



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CSA S900.1:18

December 2018

Title: *Climate change adaptation for wastewater treatment plants*

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CSA S900.1:18
**Climate change adaptation for
wastewater treatment plants**



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*Published in December 2018 by CSA Group
A not-for-profit private sector organization
178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3*

*To purchase standards and related publications, visit our Online Store at store.csagroup.org
or call toll-free 1-800-463-6727 or 416-747-4044.*

*ICS 93.030
ISBN 978-1-4883-1744-6*

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Preface

This is the first edition of CSA S900.1, *Climate change adaptation for wastewater treatment plants*.

This Standard is intended to provide owners of wastewater treatment plants with a comprehensive resource for design, operation, and retrofit criteria that can be implemented to increase the resilience of such plants.

The Wastewater Treatment Plant Component and Climate Change Checklist Database aids users in deriving relationships between components of WWTP projects and the potential impacts of extreme weather events as they relate to climate change. The database identifies potential impacts based on plant components and weather impacts (ASHRAE Handbook—Fundamentals, Chapter 14). The database can be downloaded from the following link: https://csagroup.org/documents/CSA_S900.1-18-EM_Database_FINAL.xlsm.

This project was made possible through the generous support of the National Research Council of Canada as part of its Climate-Resilient Buildings and Core Public Infrastructure (CR-Build) project.

This Standard was prepared by the Technical Committee on Wastewater Treatment Plants, under the jurisdiction of the Strategic Steering Committee on Construction and Civil Infrastructure, and has been formally approved by the Technical Committee. This Standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Notes:

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- 2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
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 - b) *provide an explanation of the circumstances surrounding the actual field condition; and*
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 - c) *wording of the proposed change; and*
 - d) *rationale for the change.*

CSA S900.1:18

Climate change adaptation for wastewater treatment plants

0 Introduction

0.1 Two-pronged approach — Adaptation and mitigation

Climate change is a complex socio-economic, political, and scientific issue. Combatting it requires a two-pronged approach: mitigation and adaptation.

The term “mitigation” refers to reducing the extent of climate change. This is primarily done by decreasing the amount of greenhouse gas (GHG) emissions that are released into the atmosphere through anthropogenic causes. Enhancing carbon sinks — areas such as oceans and forests that capture and store carbon — is also a mitigation tactic. Mitigation is at the forefront of the climate change discussion. International agreements such as the Kyoto Protocol and the Paris Agreement focus on reducing anthropogenic emissions of carbon. On a national level, provinces such as British Columbia have implemented policy tools such as a carbon tax or cap-and-trade to decrease province-wide GHG emissions. Emission reduction remains a global issue and requires all states to work in unison. However, even if GHG emissions decrease rapidly in the future, a certain level of climate change has already occurred.

The term “adaptation” refers to adjusting to actual or expected changes in climate. The goal is to moderate harm or exploit beneficial opportunities. Adaptation will be required in a wide range of sectors across society and the economy, from agriculture to wastewater infrastructure, transportation, and financial industries. Climate change impacts are largely felt at the local level in communities and in individual systems that service those communities. The effects of climate change differ from region to region and, therefore, different adaptation strategies are appropriate in different geographical areas.

This Standard focuses on adaptation measures for wastewater treatment plants (WWTPs) and not on mitigation measures.

0.2 Adaptation landscape in Canada

0.2.1 Overview

While mitigation is still the primary concern, Canada has already begun to develop and implement adaptation strategies at all levels and in all sectors. Clause [0.2.2](#) summarizes selected provincial and federal climate change adaptation strategies in place at the time of writing of this Standard. Clause [0.2.3](#) describes examples of adaptation assessments and guidelines.

0.2.2 Examples of provincial and federal climate change adaptation strategies

0.2.2.1 Québec

The Government of Québec’s strategy for climate change adaptation (Government of Québec, 2012) includes the objective of strengthening the resilience of infrastructure. While the strategy does not

specifically address WWTPs, it does speak to compensating for climate change in the design of new facilities and also to adapting existing facilities during renovation or redevelopment.

0.2.2.2 Alberta

Developed for Alberta Sustainable Resource Development, the *Climate Change Adaptation Framework Manual* (Alberta Sustainable Resource Development, 2010) provides an evidence-based decision-support tool to help decision makers integrate a climate change adaptation strategy into enterprise risk management (ERM) systems. The tool sets out a four-step process:

- a) scope and preparation: establishing the context of the specific application;
- b) vulnerability assessment: evaluating the susceptibility of the organization;
- c) risk assessment: characterizing the likelihood and consequences of impacts; and
- d) adaptation options: identifying project-specific adaptation strategies.

While the strategy focuses on management systems and does not address infrastructure considerations or WWTPs, the general principles can be used to assess climate change impacts on WWTPs.

0.2.2.3 Ontario

In 2017, the Ontario Ministry of Environment and Climate Change (MOECC) proposed a new approach to adapting to climate change (MOECC, 2017b). Building on existing efforts, Ontario announced plans to create a new climate change adaptation organization to help build local adaptation capacity, enhance networks, and take action, and to work with climate change adaptation experts to undertake a province-wide risk assessment of the effects of climate change to better understand vulnerabilities and prioritize actions. In addition, Ontario is developing an enhanced all-of-government approach to climate change adaptation and will build on efforts to share information on the effects of climate change in order to help Ontario residents better understand the current and future effects of a rapidly changing climate.

The MOECC also issued guidelines for considering climate change in the environmental assessment process (MOECC, 2017a). The guide emphasizes considerations of climate change and resilience early in the project planning phase and describes self-assessment tools (e.g., vulnerability assessment).

0.2.2.4 British Columbia

British Columbia is taking climate change into account in diverse ways (see British Columbia Ministry of Environment, 2010). Examples relevant to the engineering sector include considering climate impacts in designing and maintaining highways; providing guidance to local governments and professionals on sea dike design and coastal development to protect people, buildings, and infrastructure from sea level rise; and providing projections of future climate conditions for British Columbia through collaboration with organizations such as the Pacific Climate Impacts Consortium.

Engineers and Geoscientists BC (the business name of the Association of Professional Engineers and Geoscientists of the province of BC) has developed professional practice guidelines (Engineers and Geoscientists BC, 2017) that provide guidance and case studies to support engineers in addressing climate change and extreme weather event factors when they are designing provincial highway infrastructure for the BC Ministry of Transportation and Infrastructure (BCMoTI). These guidelines were developed in response to the BCMoTI Technical Circular (T-06/15), which requires infrastructure design adaptation to climate change, and appropriate documentation, for BCMoTI projects. Highway designs already take into consideration climatic factors, but extreme weather resilience and climate change adaptation are increasingly being considered by professionals, based on the guidance provided by Engineers Canada [through the Public Infrastructure Engineering Vulnerability Committee (PIEVC) Protocol] and the American Society of Civil Engineers. These guidelines address climate science as it

relates to the practice of professional engineering and aim to spark a paradigm shift in engineering by supporting the development of designs based on a comprehensive climate vulnerability risk assessment and consideration of innovative approaches that include robust, flexible, and low- or no-regret designs. A comprehensive primer on climate science as it relates to the practice of professional engineering has also been provided in these guidelines.

0.2.2.5 National

At the national level, government adaptation actions include

- a) the Pan-Canadian Framework on Clean Growth and Climate Change (Government of Canada, 2018b), which includes plans to advance climate change adaptation and to build resilience;
- b) the Expert Panel on Climate Change Adaptation and Resilience Results (Government of Canada, 2018a), which will develop measures of adaptation progress and communicate with the public about this progress; and
- c) the Federal Adaptation Policy Framework (Government of Canada, 2016), which guides federal decision making and priority setting in light of climate change considerations.

0.2.3 Examples of adaptation assessments and guidelines

Warren and Lemmen (2014) note the rise of average air and ocean temperatures on a global scale and identify the impacts related to climate change in Canada. Their work highlights current perceptions as well as the risks and possibilities associated with climate change. Impact, adaptation, and planning strategies that are being implemented across different sectors in Canada are also discussed.

The chapter on water and transport infrastructure identifies new demands that have developed as a result of climate change and that require adaptations in the design, construction, operation, and maintenance of infrastructure to ensure that it can withstand the changing conditions that will affect it over its lifetime. Over the last decade, policies on such adaptations have been researched, and implementation has begun in some regions. Recent government budgets allocate significant funding for adaptation of existing infrastructure as Canada looks to meet the demands of climate change.

Adapting to Climate Change: An Introduction for Canadian Municipalities (Government of Canada, 2010) provides multiple case studies on adaptation projects in different municipalities around the country. Examples of note include storm surge preparation in Annapolis Royal, Nova Scotia; Vancouver's stormwater management program; and Regina's water conservation program.

Specific to WWTPs, the Water Environment Research Foundation (WERF, 2009) in the United States created a comprehensive guide outlining the potential impacts and implications of climate change for wastewater and stormwater agencies. While the guide focuses on the American context, it provides a good overview on climate change impacts affecting WWTPs and a risk assessment framework.

In Canada, the PIEVC Protocol, developed by Engineers Canada, is a tool to help engineers and other professionals assess the risks of climate change for infrastructure. The PIEVC Protocol was originally developed for water infrastructure but has been expanded for the evaluation of roads, bridges, and buildings. The Protocol screens for climate risks in the area of infrastructure under study, assesses the severity and probability of the risk occurring (risk assessment), and identifies climate resilience measures for high-risk scenarios. Professionals are then able to use their expert judgment to make adaptations when necessary to address climate change.

1 Scope

1.1

This Standard addresses considerations for adapting wastewater treatment plants (WWTPs) to a changing climate by reviewing climate, regulatory, risk, design, construction, and operations and maintenance aspects. It applies to existing, new, or retrofit/upgrade projects.

1.2

This Standard provides a user-friendly framework and tool for designers, engineers, and managers to use when designing, constructing, or operating/maintaining WWTPs.

Note: *The intention is to provide guidance for applying the tool to other infrastructure projects to assess risks related to climate change and to rank and prioritize actions to build in resilience and/or redundancy and to develop contingency plans, without indiscriminate overdesign.*

1.3

This Standard provides guidance on climate change data sources and how to use them in determining impacts on WWTP components.

1.4

This Standard highlights climate change adaptation measures for building resilience and addressing high-risk scenarios related to WWTPs.

1.5

This Standard applies to the WWTP itself and its processes and property. It does not apply to collection systems feeding into the plant or to disposal receivers.

1.6

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the standard.

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Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (nonmandatory) to define their application.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below.

Alberta Sustainable Resource Development

Climate Change Adaptation Framework Manual, 2010