

Technical Report No. 66

## STATE OF THE ART IN CHLORIDE MANAGEMENT

### Chapter 1

# INTRODUCTION

## 1.1 PURPOSE OF THIS REPORT

This Technical Report presents a review of the relevant technical literature regarding best management and state-of-the-art practices aimed at reducing chloride inputs to the environment. Chloride is a conservative contaminant, meaning it is not physically or chemically transformed to a non-toxic substance in soil or receiving waters. Once chloride enters the environment, it can accumulate to levels that can be detrimental to the built infrastructure and biological integrity of ecosystems of the Region. Dissolved chloride also has high mobility in water and can move easily between groundwater and surface water resources.

Concentrations of chloride in surface waters and groundwater in southeastern Wisconsin have been increasing over time. The Southeastern Wisconsin Regional Planning Commission (Commission) has documented these trends for portions of the Southeastern Wisconsin Region (Region) in several reports.<sup>1</sup> Chloride conditions and trends have been documented for the entire Region as part of the Chloride Impact

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<sup>1</sup> See for example, *SEWRPC Technical Report No. 39, Water Quality Conditions and Sources of Pollution in the Greater Milwaukee Watersheds, November 2007*; *SEWRPC Community Assistance Planning Report No. 315, A Water Resources Management Plan for the Village of Chenequa, Waukesha County, Wisconsin, June 2014*; *SEWRPC Community Assistance Planning Report No. 316, A Restoration Plan for the Root River Watershed, July 2014*; and *SEWRPC Community Assistance Planning Report No. 330, A Restoration Plan for the Oak Creek Watershed, December 2021*.

Study developed by the Commission.<sup>2</sup> Trends of increasing chloride concentrations in and around the Region have also been reported in other research.<sup>3</sup>

Chloride contributions to surface waters and groundwater can come from a variety of sources, including road salt applied for anti-icing and deicing of public and private roads, sidewalks, and parking lots; water softening systems and other sources that discharge to sanitary sewer systems or private onsite wastewater treatment systems; large agricultural feedlots; fertilizers; landfills; chemical manufacturing; food processing; and deposition from the atmosphere. The trends of increasing chloride concentrations in the surface water and groundwater resources of the Region indicate that some of the past and current patterns of practices that input chloride to the environment are unsustainable. While chloride concentrations in the waterways of the Region have been increasing over time, awareness of the negative impacts of chlorides in the environment has also grown. There has been a strong desire for public entities, residents, and private industry to act before even greater and more widespread impacts are caused by chloride pollution.

The most effective way to reduce the negative impacts of chloride is to reduce the volume of chloride products used. Significant progress has been made in winter anti-icing and deicing methods that minimize salt applications while ensuring public safety and substantially reducing winter road maintenance costs for municipalities, states, and private applicators. Similarly, public awareness and improved technologies have allowed for more efficient at-home water softening while using significantly less, or no chloride salts. The smart use of products containing chloride is essential to maintain the viability of critical infrastructure and the biological integrity of the Region.

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<sup>2</sup> *Technical Report No. 63, Chloride Conditions and Trends in Southeastern Wisconsin, in preparation.*

<sup>3</sup> *See for example, Richard C. Lathrop, "Chloride and Sodium Trends in the Yahara Lakes, Research Management Findings, No. 12, Wisconsin Department of Natural Resources, June 1998; S.R. Corsi, L.A. De Cicco, M.A. Lutz, and R.M. Hirsch, "River Chloride Trends in Snow-Affected Urban Watersheds: Increasing Concentrations Outpace Urban Growth Rate and Are Common Among All Seasons," Science of the Total Environment, 508:488-497, 2015; and J.A. Thornton, T.M. Slawski, and H. Lin, "Salinization: The Ultimate Threat to Temperate Lakes, with Particular Reference to Southeastern Wisconsin (USA)," Chinese Journal of Oceanology and Limnology, 33:1-15, 2015.*

## 1.2 RELATIONSHIP OF THIS REPORT TO THE CHLORIDE IMPACT STUDY

This Technical Report presents some of the findings from the Commission's Chloride Impact Study.<sup>4</sup> This Study was initiated due to heightened public concern over the growing use of road salt and evidence of increasing chloride concentrations in surface water and groundwater in the Region. The findings of this Study are being presented in a series of reports.

Major objectives of the Chloride Impact Study include:

1. Documenting historical and existing conditions and trends in chloride concentrations in surface water and groundwater in the Southeastern Wisconsin Region
2. Evaluating the potential for increased amounts of chloride in the environment to cause impacts to surface water, groundwater, and the natural and built environment in the Region
3. Identifying the major sources of chloride to the environment in the Region
4. Investigating and defining the relationship between the introduction of chloride into the environment and the chloride content of surface and groundwater
5. Developing estimates of chloride loads introduced into the environment under existing conditions and forecasts of such loads under planned land use conditions
6. Evaluating the potential effects of climate change on the major sources of chloride under planned land use conditions
7. Reviewing the state-of-the-art of technologies and best management practices affecting chloride inputs to the environment and developing performance and cost information for such practices and technologies
8. Exploring legal and policy options for addressing chloride contributions to the environment

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<sup>4</sup> *Planning Report No. 57, A Chloride Impact Study for Southeastern Wisconsin, in preparation.*

9. Developing and evaluating alternative chloride management scenarios for minimizing impacts to the environment from chloride use while meeting public safety objectives
  
10. Presenting recommendations for the management of chloride and mitigation of impacts of chloride on the natural and built environment

This Report reviews literature and other resources focused on state-of-the-art technologies and best management practices affecting inputs of chloride to the environment, fulfilling Objective 7. In addition, this Report contributes to addressing Objectives 9 and 10 by providing information on the current technologies and practices available to develop alternative strategies that address the impacts chloride can have on the natural and built environment in the Region.

### **1.3 REPORT FORMAT AND ORGANIZATION**

This Report is based on the review of the relevant scientific and technical literature and is organized into five chapters. Following this introductory chapter, Chapter 2 reviews the array of equipment, methods, strategies, and designs utilized by public and private entities for winter maintenance and the best available management practices for deicing and anti-icing. This review also assesses the performance and costs of such practices, when available.

Chapter 3 reviews the chloride reduction alternatives available to municipal water and wastewater utilities. This review also assesses the effectiveness, ease of implementation, and cost of the available chloride reduction strategies for these public entities.

Chapter 4 reviews the best management practices and state-of-the-art technology available for reducing chloride inputs to the environment from private residential water softening systems. This Chapter also reviews strategies to reduce inputs of chloride from private onsite wastewater treatment systems. Where available, this Chapter provides the performance and costs of these practices.

Chapter 5 reviews best management practices for agricultural producers in the use of fertilizers containing chloride as well as the management of chloride inputs from agricultural feedlots. This Chapter also reviews best management practices and technologies available to reduce chloride inputs to the environment originating from industrial processes such as food processing and chemical manufacturing.