

SEWRPC Technical Report No. 62

IMPACTS OF CHLORIDE ON THE NATURAL AND BUILT ENVIRONMENT

**Chapter 1**

**INTRODUCTION**

**1.1 PURPOSE OF THIS REPORT**

This report presents the results of a review of the relevant technical literature regarding the impacts of chloride and chloride salts on the natural and built environment. It discusses information needed to assess the potential consequences of increasing concentrations of chloride in surface waters and groundwater on the physical, chemical, and biological integrity of ecosystems and the structural integrity of infrastructure in the Region.

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

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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*.

chloride impact study.<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, sidewalk, and parking lots; water softening systems and other sources that discharge to sanitary sewers or private onsite wastewater treatment systems; large agricultural feedlots; fertilizers; landfills; chemical manufacturing; food processing; and deposition from the atmosphere. Increased concentrations of chloride can have several effects on the natural and built environment. It can cause physical and chemical impacts to soil; sediment; surface water resources including streams, rivers, lakes, and wetlands; and groundwater. It can cause biological effects such as acute and chronic toxicity to organisms, reductions in the viability of individual species, and changes to the structure and functioning of aquatic communities and ecosystems. Higher chloride concentrations can damage materials such as metal and concrete, affecting the condition, structural integrity, and useful life of infrastructure such as roadway pavements, water mains, and street and highway bridges. It can also damage private property such as automobiles. Finally, increased chloride levels can affect human activities through impacts on agriculture, drinking water, human health, and the aesthetics of the environment.

## **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 within the Southeastern Wisconsin Region. The findings of this study are being presented in a series of reports.

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<sup>2</sup> SEWRPC 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.

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

Major objectives of the chloride impact study include:

1. Documenting historical and existing conditions and trends in chloride concentrations in surface 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
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 on the impacts of chlorides on the natural and built environment. By identifying and describing the reported impacts of contributions of chloride to the environment, it provides a basis for addressing Objective 2. It also contributes to addressing Objectives 8 and 10 by providing information that

will be useful for identifying and evaluating potential consequences of alternative management strategies for chloride.

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

This report summarizes the impacts of chlorides on the natural and built environment. It is based on review of the relevant scientific and technical literature and is organized into five chapters.

Following this introductory chapter, Chapter 2 reviews the physical and chemical impacts of chloride on the natural environment. This review describes the impacts of chlorides on lakes, streams and rivers, wetlands, groundwater, and soils.

Chapter 3 reviews the impacts of chloride on biological systems. This review discusses the toxicity and other effects of chloride compounds to organisms. It also includes discussions of impacts at higher levels of biological organization such as communities and ecosystems.

Chapter 4 reviews the impacts of chlorides on infrastructure and the built environment. This review describes the effects of chloride on concrete and metal. It also describes the impacts to public infrastructure and private property that can result from exposure to chlorides.

Chapter 5 reviews the impacts of chlorides on humans and human activities. This reviews the impacts that excessive chloride in the environment can have on agriculture, drinking water, human health, and the aesthetics of the environment.