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The Distribution of Deicing Chemicals in Ground-Water and Surface Water in Glaciated Parts of the United States, Relation to Explanatory Variables, and Implications for Management

Abstract

Introduction

Increasing urbanization in the United States has lead to a need for an understanding of the consequences on water resources. The glacial surficial aquifers in the Northern United States are an important resource, providing drinking water for public and domestic supplies, and to maintain streamflow quantity and quality, providing for aquatic habitat, water supply, recreation, and wastewater dilution. Aquifers in the glacial deposits of the United States have many similarities, including the geology and texture of deposits, susceptibility to contamination, and the degree to which ground-water and surface water resources interact.

The use of deicing salt has been increasing in the United States since about 1950. Consequently several studies have identified trends in primarily sodium and chloride concentrations in streams (references) and elevated concentrations in ground water in comparison with undeveloped areas.

This will be a fairly long introduction, further defining the problem.

Purpose and scope

Ground-water quality networks

A description of the NAWQA land use well networks

Surface-water quality networks

A description of the NAWQA indicator basin networks

Physical Setting

Glacial framework

Climate

Application rates of deicing chemicals

A summary of the data that we have been able to compile on typical usage rates for States and Cities in the study area

Previous Investigations

A summary of the literature review, including NAWQA reports, USGS reports, and journals

Methods and approach

Water-quality data synthesis

Multiple-linear regression modeling

Estimation of application rates

Base-flow separation

Estimation of constituent loads

Distribution of deicing chemicals

The section will describe concentrations of sodium, chloride and related ions in ground water, surface water, and baseflow.

Ground water

Sodium chloride

Other ions

Surface water

Sodium chloride

Other ions

Base-flow ion chemistry

Changes to overall water chemistry

This section will discuss cation exchanges that may have taken place in soils and aquifer materials

Ground water as a source of deicing chemicals to surface water

This section will describe the relation of ground-water loading of chloride to total loading of chloride. Other constituents may also be summarized.

Relation of concentrations of deicing chemicals to explanatory variables

The relation of chloride/other ion concentrations to explanatory variables will be described through the use of multiple regression modeling or some other multivariate analysis. The results of statistical analysis will be presented in this section.

Natural

Anthropogenic

Trends in deicing chemicals in representative areas of the glacial aquifer

This part of the report will look into further details in several areas where NAWQA has collected both ground-water and surface water quality data. The information could include surface-water

baseflow trends, baseflow loading of deicing constituents, comparison of ground-water travel times, hydrogeologic variables and land use changes.

Hockanum River (Manchester, Conn) flow-path area (Eastern areas-coarse grained)

York or Detroit (Central Area)

Shingle Creek (Minneapolis, MN) flow-path area (West-central area, coarse grained)

Implications for the mangement of deicing chemicals

We will put the results into the context of the implications for the findings of the study.

Summary

References