Southeastern Wisconsin
Regional Planning Commission

Chloride Impact Study for the Southeastern Wisconsin Region

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April 4, 2024
Waukesha Stormwater Workshop

#272527

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Outline

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- SEWRPC Background
- Chloride Impact Study Scope
- Study Field Monitoring Work
- Analysis Work
- Next Steps

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SE WI Regional Planning Commission Background

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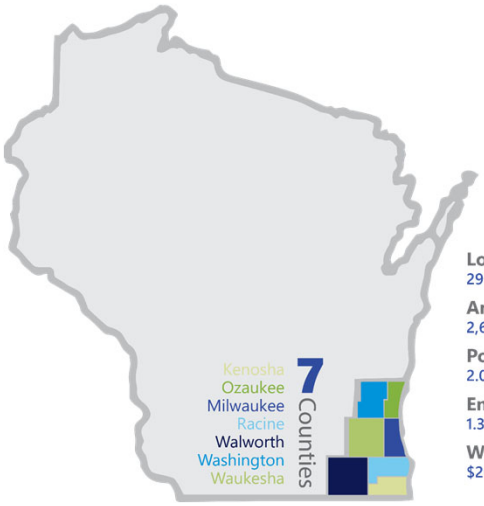

Local Governments
29 Cities | 64 Villages | 54 Towns

Area
2,689 Square Miles | 5% of State

Population
2.05 Million | 35% of State

Employment
1.30 Million Jobs | 35% of State

Wealth
$204.9 Billion Equalized Valuation | 35% of State

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SEWRPC Background

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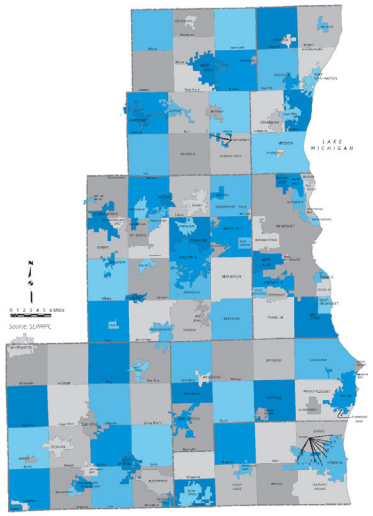
- Official Areawide Public Planning Agency for the Seven County Region
- Created in 1960 under State Legislation
- Purpose:
  - Address physical development and infrastructure problems that extend beyond municipal and county boundaries
  - State designated Areawide Water Quality Management Planning Agency
  - Prepare regionwide advisory long-range plans
    - Land Use
    - Transportation
    - Water Quality Management
    - Flooding Management
    - Parks and Open Space
    - Environmental Corridors
    - Natural Areas
    - Water Supply



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Study Background

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Prospectus developed 2014-2016

Technical Advisory Committee

Funding provided by

U.S. Department of Transportation Federal Highway Administration

SEWRPC Serving the counties of Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha

Fund for Lake Michigan

MMSD PARTNERS FOR A CLEANER ENVIRONMENT

WISCONSIN DEPT. OF NATURAL RESOURCES

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Study Scope

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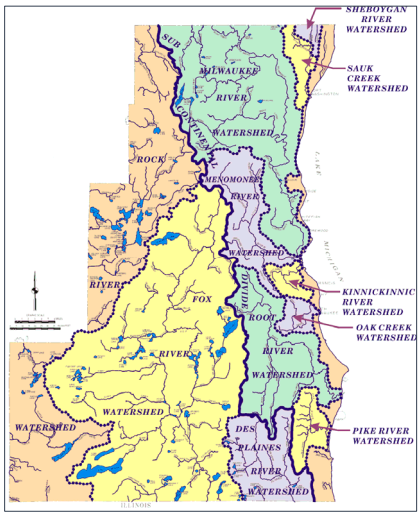
- Gather conductance data for up to 40 stream locations and 6 lakes in the Region
- Compile existing data on chloride levels in water resources of the Region
- Develop relationships between conductance and chloride levels
- Estimate chloride loads from all sources for study period
- Look at future (2050) conditions for both land use and climate predictions
- Gather state-of-the art information for sources of chloride to the environment



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What is Chloride?

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- Naturally occurring – Halite (rock salt)
- A component of salt (NaCl)
- An essential electrolyte
- Soluble and highly mobile
- Relatively non-reactive
- Difficult to remove from the environment
- Problematic at high concentrations

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Sources of Chloride to the Environment

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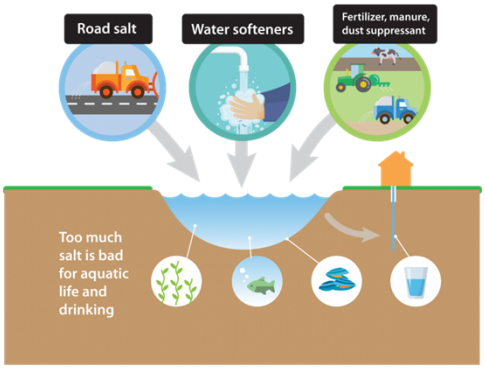
- Mineral and Soil Weathering
- Atmospheric Deposition
- Road Salt Application and Storage
- Water Softening
- Wastewater Treatment Plants
- Chemical Manufacturing and Food Processing
- KCl Fertilizer (Potash)
- Animal Waste/Agricultural Feed Lots
- Landfill Leachate



https://www.pca.state.mn.us/water/chloride-101

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Chloride Criteria

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	Chronic	Acute
Wisconsin	395 mg/L	757 mg/L
US EPA	230 mg/L	860 mg/L

- Chronic: sub-lethal adverse effects with prolonged exposure
- Acute: adverse effects with short-term exposure
- US EPA Drinking Water Secondary Standard for Chloride: 250 mg/L (salty taste)
- 1 teaspoon of salt can pollute 5 gallons of water
- Pre-Settlement Concentrations < 5 mg/L

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Stream Monitoring Locations

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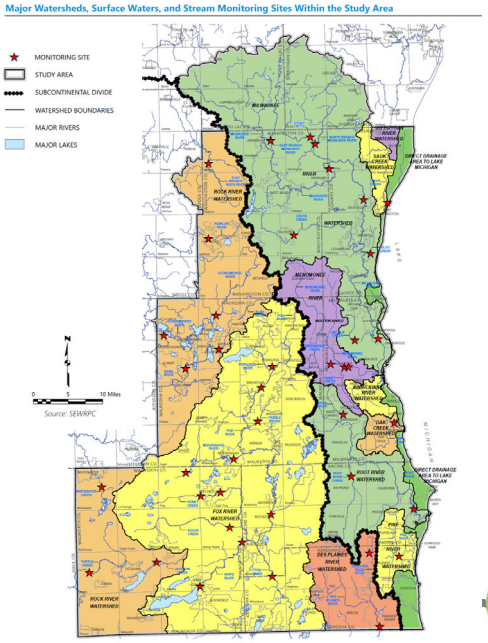

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Study Monitoring

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41 stream monitoring sites were installed for the Study, starting in October 2018 with operation extending into 2021

- Continuous monitoring of specific conductivity, water temperature, and water depth above sensor
- Data gathered every five minutes

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Monthly Sampling at Sites

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- Collected monthly grab samples at each site during the October 2018 to October 2020 monitoring period
- Collected event sampling into 2021 (added one more winter)
- Grab samples were analyzed for the following constituents
  - Chloride, Sulfate (Anions)
  - Major Ions/Metals (Cations)
    - Potassium
    - Sodium
    - Magnesium
    - Calcium
  - Hardness ($CaCO_3$)

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Select Urban Sites – Sampling Results

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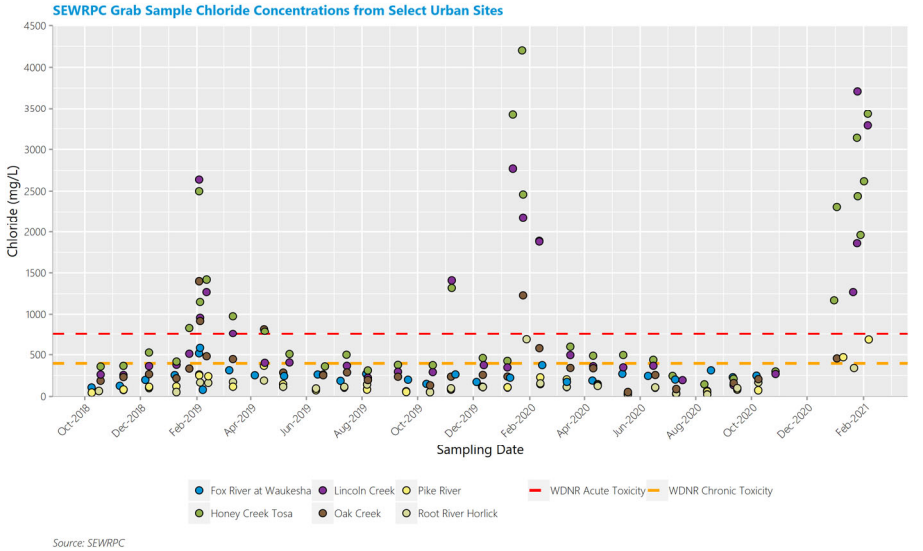

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Lincoln Creek in Milwaukee Site

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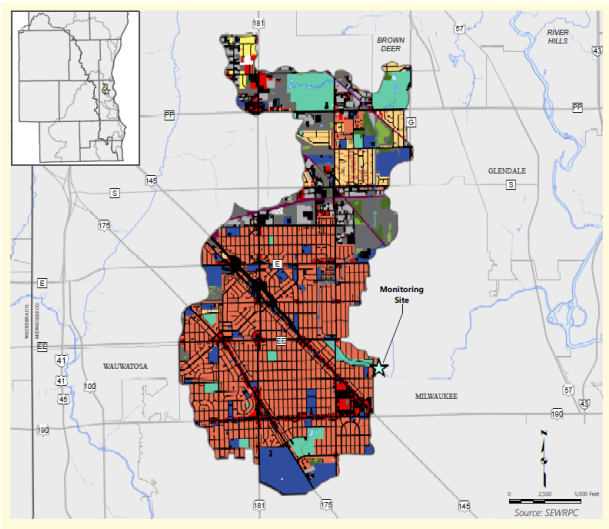
- High density residential (34%)
- Roads and Parking Lots (28%)
- Government and Institutional (9%)

Source: TR-61 Field Monitoring Summary



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Lake Sampling

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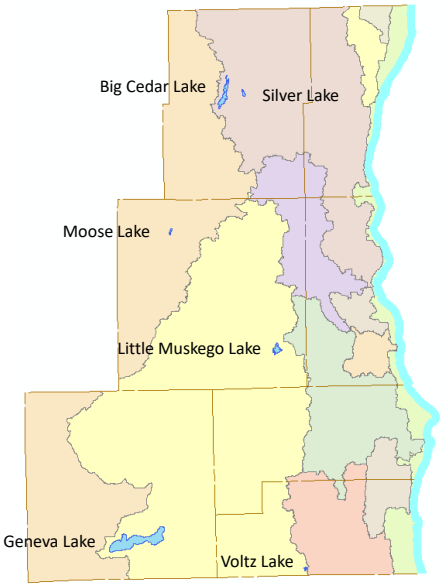
- Six lakes in the SEWRPC Region were sampled summer 2018 – winter 2021
- Sampled Quarterly
- Little Muskego levels are of concern – approaching 250 mg/l taste threshold
- Did not see high chloride accumulation at the bottom of any of the lakes during sampling period



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- SEWRPC Background
- Chloride Impact Study Scope
- Study Field Monitoring Work
- Analysis Work
  - TR-61 Field Monitoring Summary
  - TR-62 Impacts of Chloride
  - TR-63 Chloride Trends
  - TR-64 Regression Analysis of Specific Conductance and Chloride
  - TR-67 Legal and Policy Considerations
- Next Steps

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TR-61 Field Monitoring Summary

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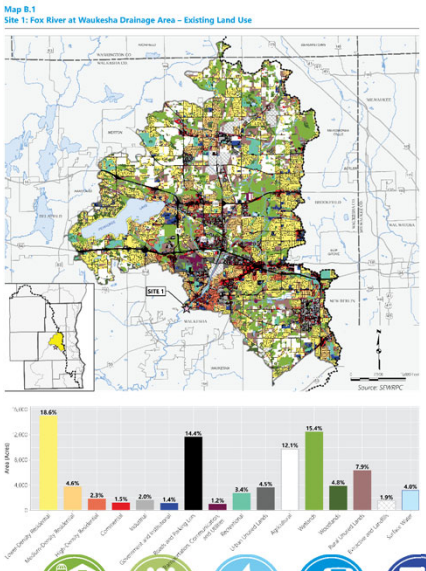
- Monitoring Site Selection and Characterization
- Monitoring Site Installation, Field Equipment, and Data Collection Procedures
- Data Management and Documentation



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TR-61 Field Monitoring Summary

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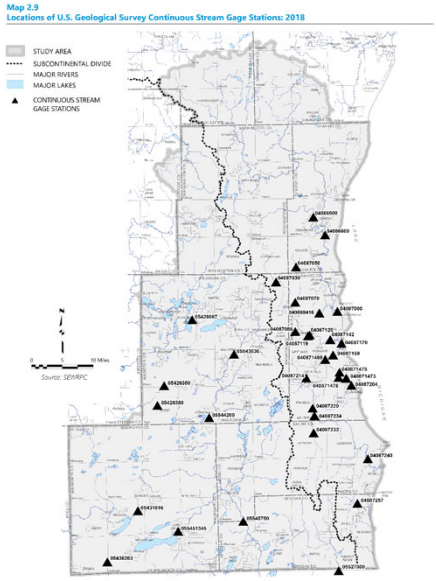

Site Selection Considerations for stream and lake monitoring sites

➢Proximity to USGS Stream Gage Stations

- 34 continuous recording streamflow gaging stations
- Prioritized establishing monitoring sites near these gages

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TR-62 Impacts of Chloride Salts

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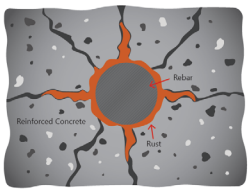
- Chloride salts change the chemical characteristics of water
  - Increase acidity, lower solubility of gases
  - Chloride salts increase the density of water which can reduce pond and lake mixing
- Chloride salts promote the release of heavy metals from rock, soil, sediment, and infrastructure
  - In drinking water, they can increase release of lead from pipes
- Chloride salts hasten the degradation of metal and concrete infrastructure

Figure 4.5
Reinforced Concrete BeamDamaged by Rebar Corrosion

Source: WisDOT

Figure 4.6
Steel Reinforcement Corrosion Causing Concrete Damage



Source: SEWRPC

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TR-62 Impacts of Chloride Salts

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- Chloride salts adversely affect organisms
  - Toxicity
  - Reduced growth, reproduction, and longevity
  - Deformities
- Chloride salts can affect human health
  - Sodium is a cause of high blood pressure which can lead to stroke, heart failure, and kidney disease
  - Sodium contributes to osteoporosis in post-menopausal women
  - Salts in the air contribute to fine particulates which are a factor in lung cancer and respiratory diseases

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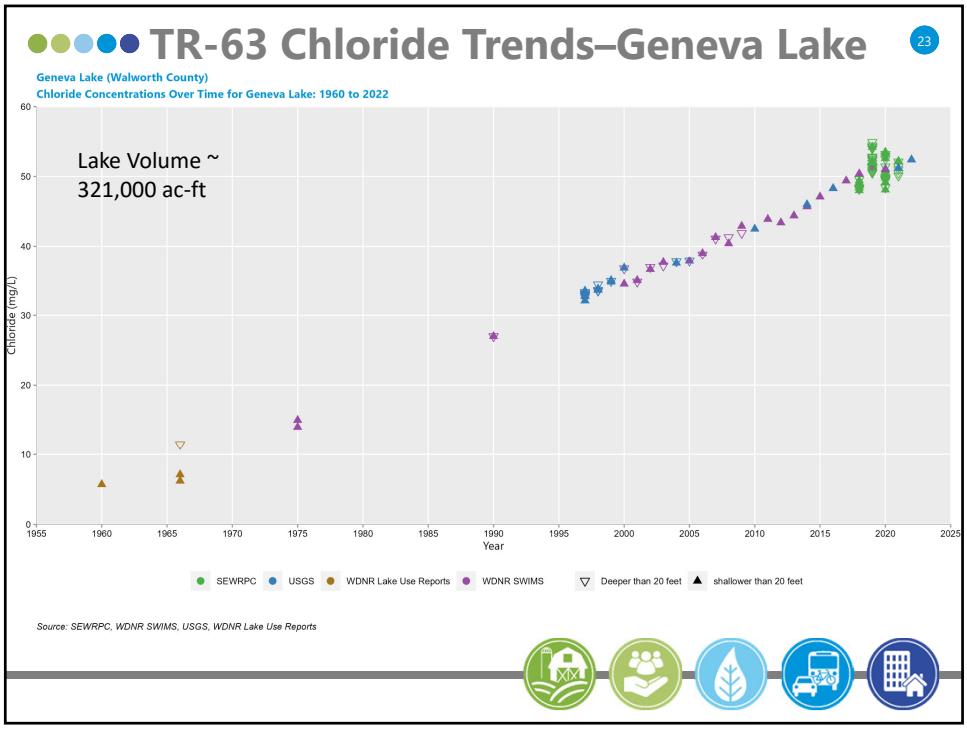
TR-63 Chloride Trends–Geneva Lake
23
Geneva Lake (Walworth County)
Chloride Concentrations Over Time for Geneva Lake: 1960 to 2022
Lake Volume ~
321,000 ac-ft
Chloride (mg/L)
Year
SEWRPC
USGS
WDNR Lake Use Reports
WDNR SWIMS
Deeper than 20 feet
shallower than 20 feet
Source: SEWRPC, WDNR SWIMS, USGS, WDNR Lake Use Reports

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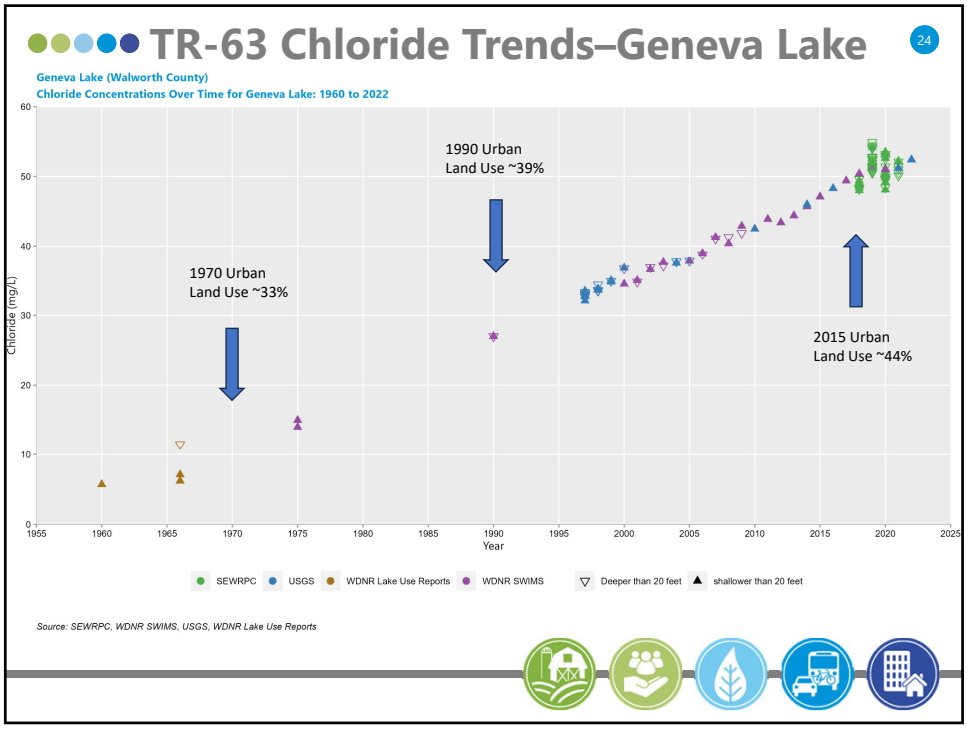
TR-63 Chloride Trends–Geneva Lake
24
Geneva Lake (Walworth County)
Chloride Concentrations Over Time for Geneva Lake: 1960 to 2022
1990 Urban
Land Use ~39%
1970 Urban
Land Use ~33%
2015 Urban
Land Use ~44%
Chloride (mg/L)
Year
SEWRPC
USGS
WDNR Lake Use Reports
WDNR SWIMS
Deeper than 20 feet
shallower than 20 feet
Source: SEWRPC, WDNR SWIMS, USGS, WDNR Lake Use Reports

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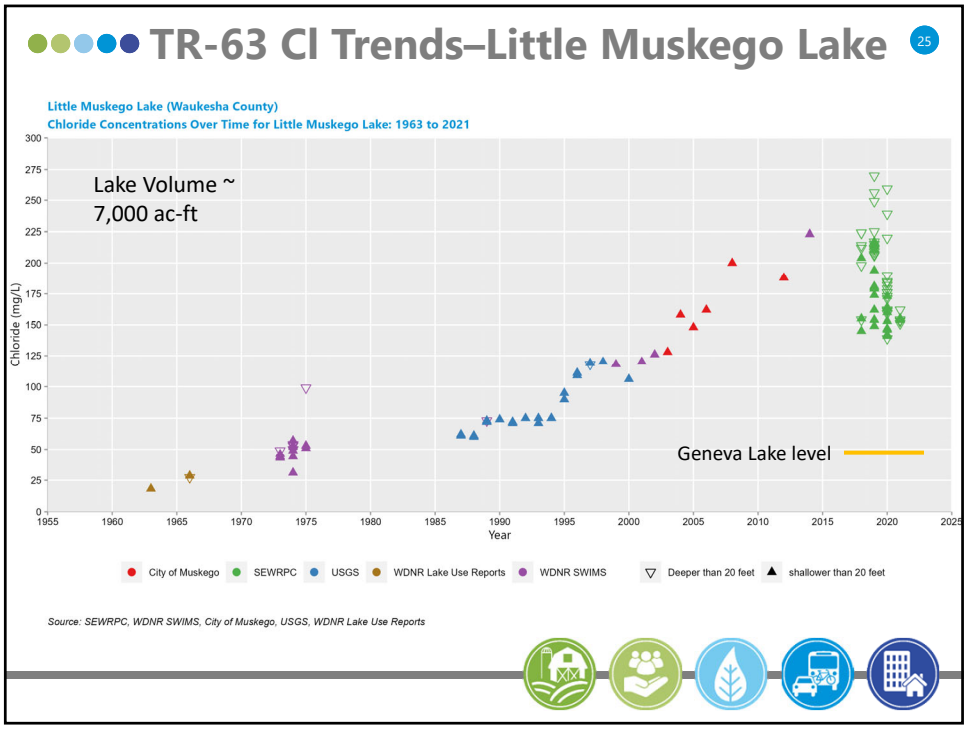
TR-63 Cl Trends–Little Muskego Lake
25
Little Muskego Lake (Waukesha County)
Chloride Concentrations Over Time for Little Muskego Lake: 1963 to 2021
Lake Volume ~
7,000 ac-ft
Geneva Lake level
Chloride (mg/L)
Year
City of Muskego
SEWRPC
USGS
WDNR Lake Use Reports
WDNR SWIMS
Deeper than 20 feet
shallower than 20 feet
Source: SEWRPC, WDNR SWIMS, City of Muskego, USGS, WDNR Lake Use Reports

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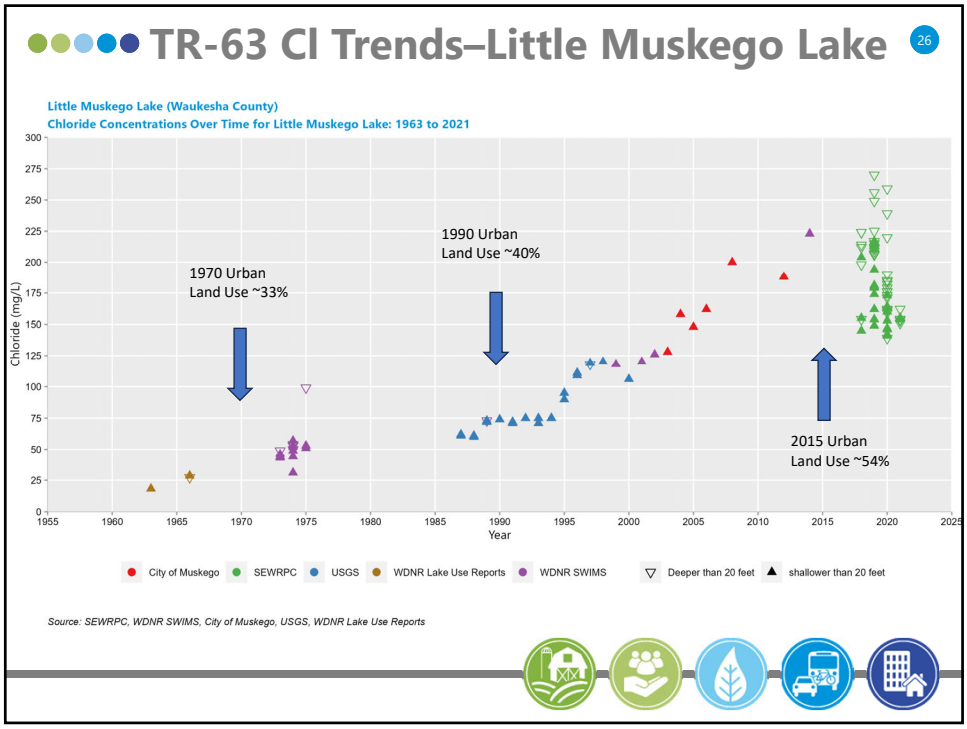
TR-63 Cl Trends–Little Muskego Lake
26
Little Muskego Lake (Waukesha County)
Chloride Concentrations Over Time for Little Muskego Lake: 1963 to 2021
1970 Urban
Land Use ~33%
1990 Urban
Land Use ~40%
2015 Urban
Land Use ~54%
Chloride (mg/L)
Year
City of Muskego
SEWRPC
USGS
WDNR Lake Use Reports
WDNR SWIMS
Deeper than 20 feet
shallower than 20 feet
Source: SEWRPC, WDNR SWIMS, City of Muskego, USGS, WDNR Lake Use Reports

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TR-64 Regression Analysis

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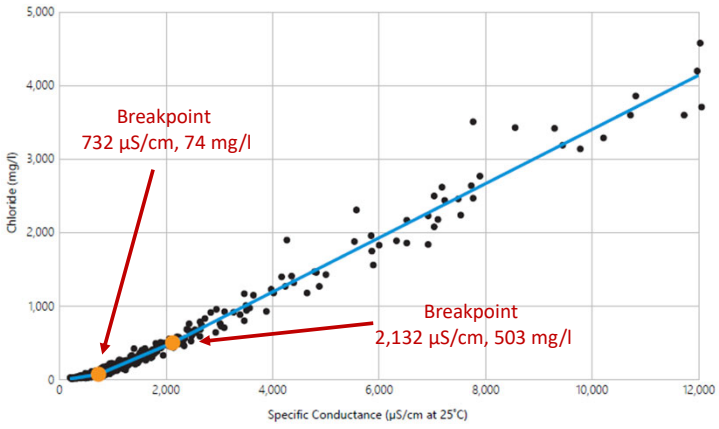
Figure 3.1
Piecewise Regression Model for Estimating Chloride from Specific Conductance in Southeastern Wisconsin Streams



Note: Black dots indicate the data used to develop the model. Orange dots indicated the breakpoints in the model.

Source: SEWRPC

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TR-64 Regression Analysis

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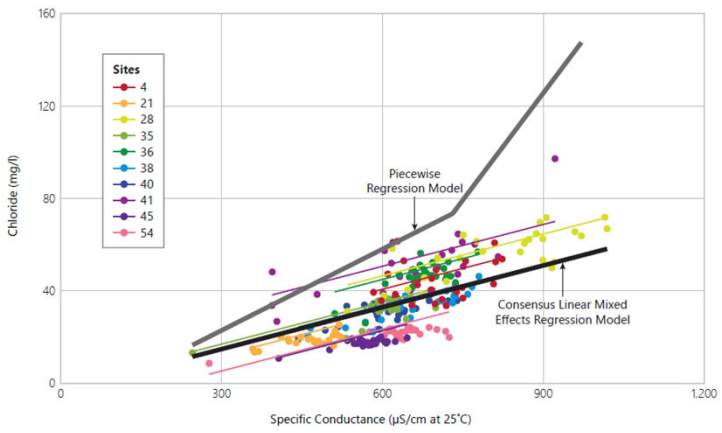
Figure 3.4
Linear Mixed Effects Model for Estimating Chloride from Specific Conductance in Southeastern Wisconsin Streams



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TR-64 Linear Mixed Effects Regression Model

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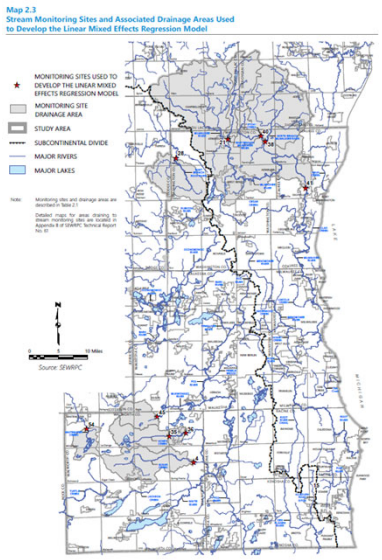
- 11 sets of equations
  - 10 for individual sites
  - 1 consensus equation
- Set chloride concentrations to 0 at and below where the regression line crosses the x-axis



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TR-67 Legal and Policy Considerations

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Responsive Policy Options

- Limiting liability
- Informational strategies
- Direct regulatory strategies
- Chloride alternatives
- Water quality trading
- Integrated watershed management
- Economic measures and assistance

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Limiting liability

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- Fear of slip-and-fall liability drives overuse; must address this directly
- Example: New Hampshire program provides snow- and ice-related liability waiver to certified parties after training on best practices
- Multiple levels of certification options
  - Individual
  - Organizational
- Periodic recertification required

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

NEW HAMPSHIRE CERTIFIED GREEN SnowPro

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Next Steps for Study - Reports

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Technical Reports in progress

- TR 63 – Chloride Conditions and Trends in SE WI
- TR 65 – Mass Balance Analysis for Chlorides in SE WI
- TR 66 – State-of-the-Art of Chloride Management

Planning Report PR 57

- Will summarize information in the technical reports above as needed and then provide documentation for alterative scenarios, future conditions, and recommendations

www.sewrpc.org/chloridestudy

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Commission Staff Contributors

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- Laura Herrick
  Chief Environmental Engineer
  - Mike Hahn - retired
  - Joe Boxhorn
  - Ron Printz - retired
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  - Aaron Owens
  - Megan Shedivy
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  - Alexis McAdams – former staff
  - Julia Orlowski
  - Zijia Li - former staff
  - James Mahoney
  - Kathy Sobottke
  - Kim Walsh - intern
  - Santos Quispe - intern

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  Chief Biologist
  - Dale Buser - retired
  - Justin Poinsatte
  - Zofia Noe - former staff
  - Mike Borst - retired
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  - Alexa Carzoli - former staff
  - Megan Deau
  - Patti Bouchard

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Contact Information

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Webpage for study
www.sewrpc.org/chloridestudy

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