Chloride Impact Study for the Southeastern Wisconsin Region

June 05, 2020

5th Annual Healthy Lakes Conference

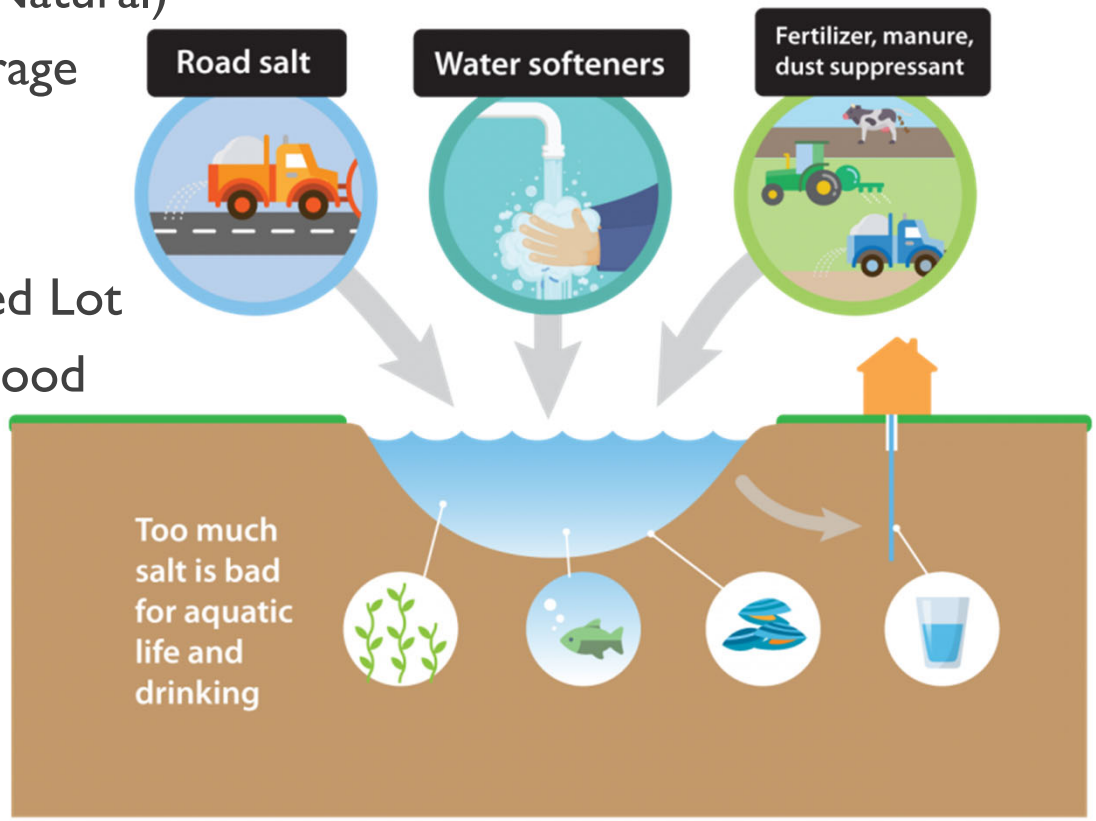
Serving the Counties of Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha

What is Chloride?

- Naturally occurring - Halite
- 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

Sources of Chloride in the Environment

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



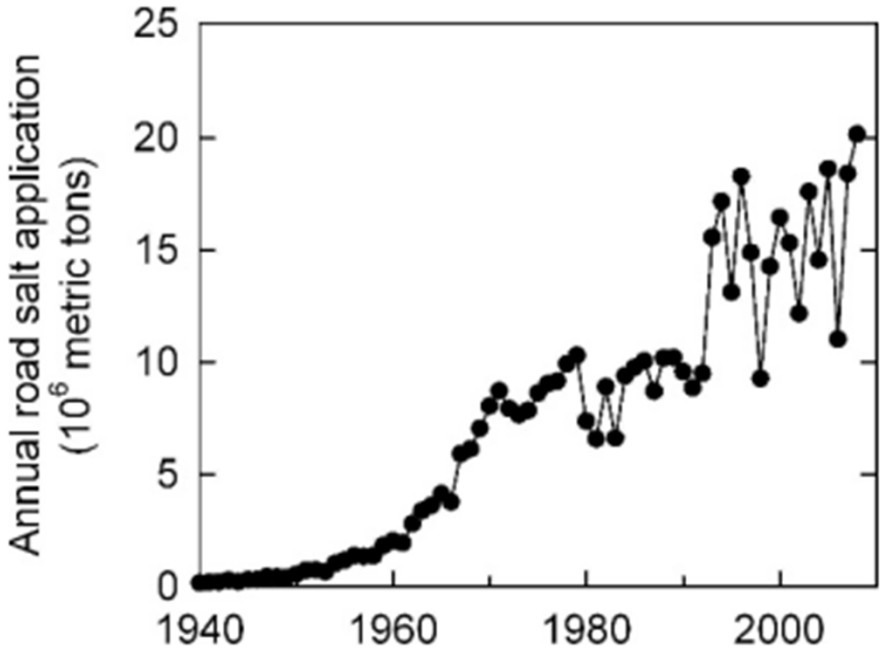
https://www.pca.state.mn.us/water/chloride-101

Chloride Criteria for Acute and Chronic Toxicity

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

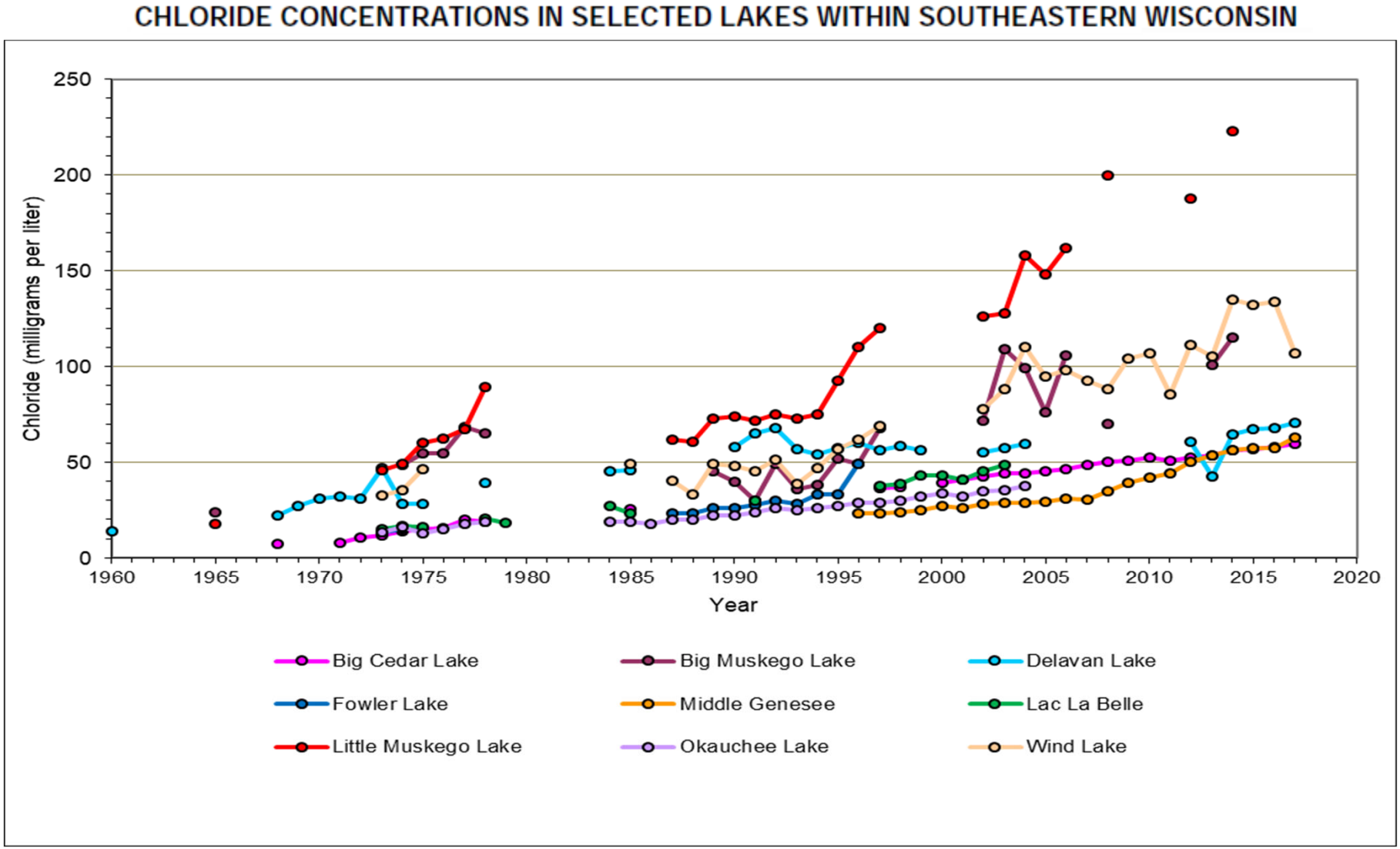
- US EPA Drinking Water Secondary Standard for Chloride: 250 mg/L (salty taste)
- Pre-Settlement Concentrations < 5 mg/L
- 1 teaspoon of road salt can pollute 5 gallons of water

Chloride Trends – Road Salting and Winter De-Icing



Graph: Kelly et all 2012, Illinois State Water Survey Bulletin 74

Chloride Trends – Lakes



Source: U.S. Geological Survey, Wisconsin Department of Natural Resources, and SEWRPC.

SEWRPC Study Scope and Schedule

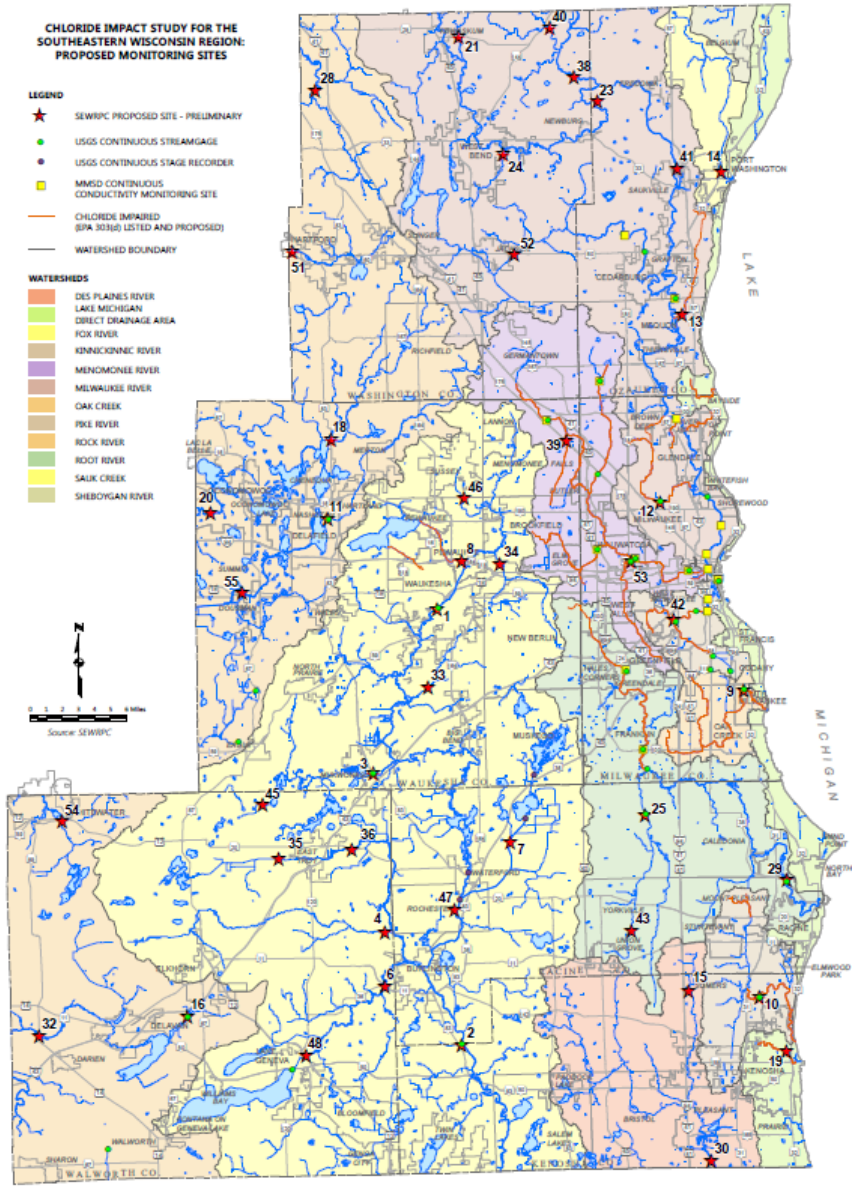
- Project Schedule
  - Four-Year Study
  - Two-Year Data Collection (2018-2020)

Public Works Magazine

- Chloride loading analyses and forecasts
  - Sampling and data collection
  - Estimate chloride loads from all sources
- Review state-of-the-art technology and evaluate best practices
  - Road De-icing
  - Water Softening
- Develop alternate chloride management scenarios that meet public safety objectives while minimizing harm to the environment

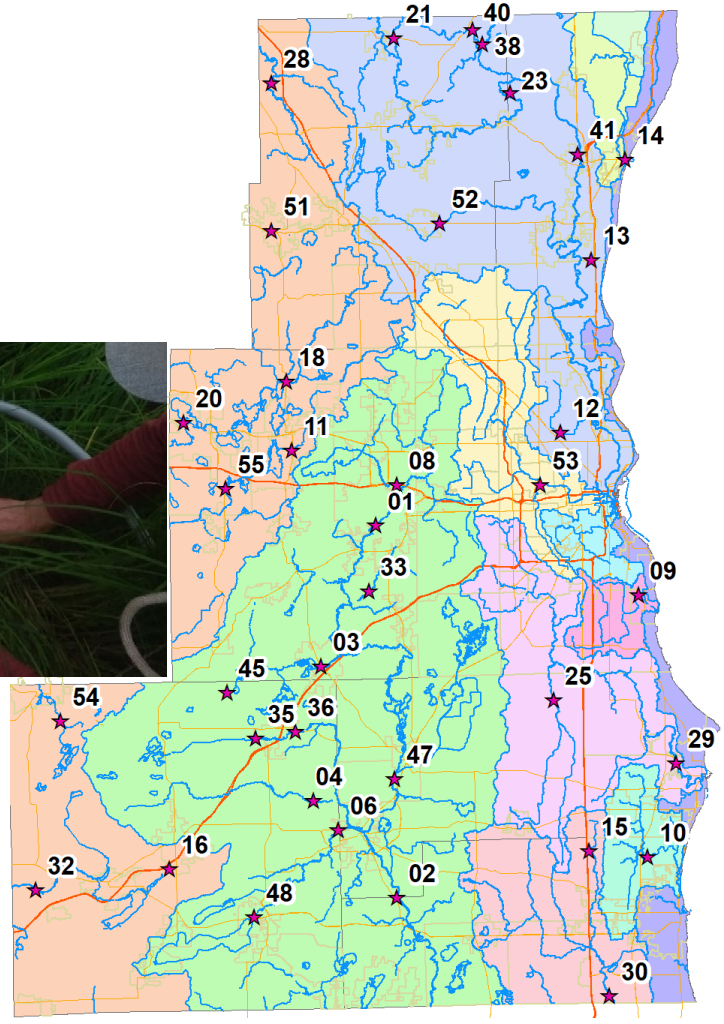
Monitoring Locations – Site Selection

- Distribution throughout the Region and among the major watersheds
- Existing streamflow gage locations
- Existing and historical conductance/chloride monitoring locations
- Contributing area land use
- Wastewater treatment plants
- Chloride-impaired waters 303(d)
- Public lands and ease of access

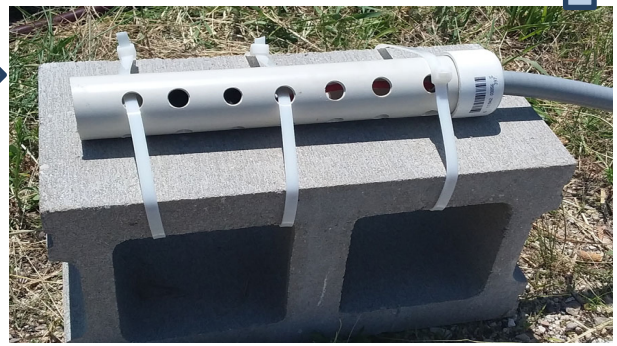


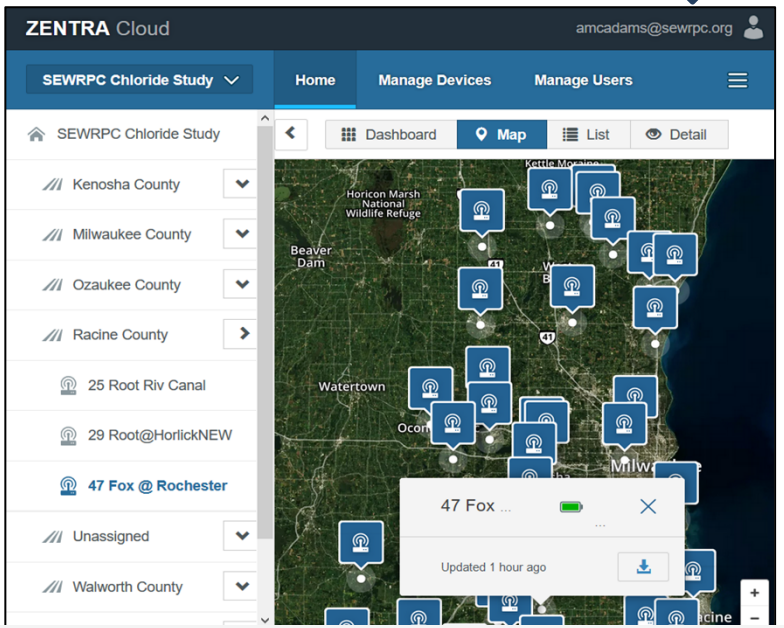
Installed Monitoring Sites

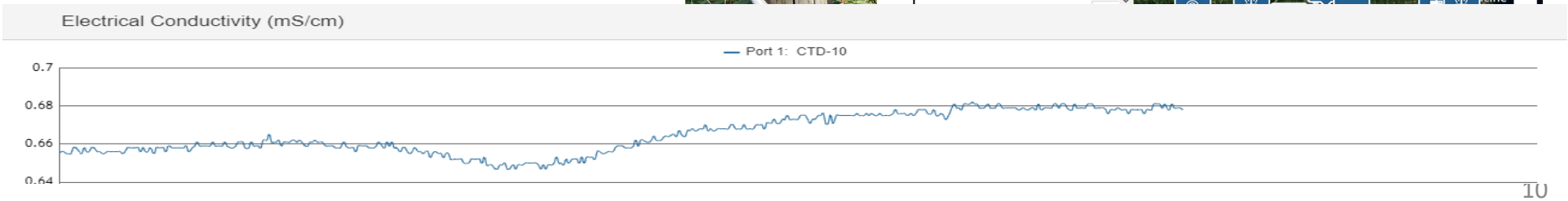
- 37 sites of 55 preliminary sites were selected and installed across the Region during Summer 2018
- October 2018 – official start data collection
- 3 sites added in 2019 to Milwaukee county
- 40 sites total in the region



Monitoring Site Setup





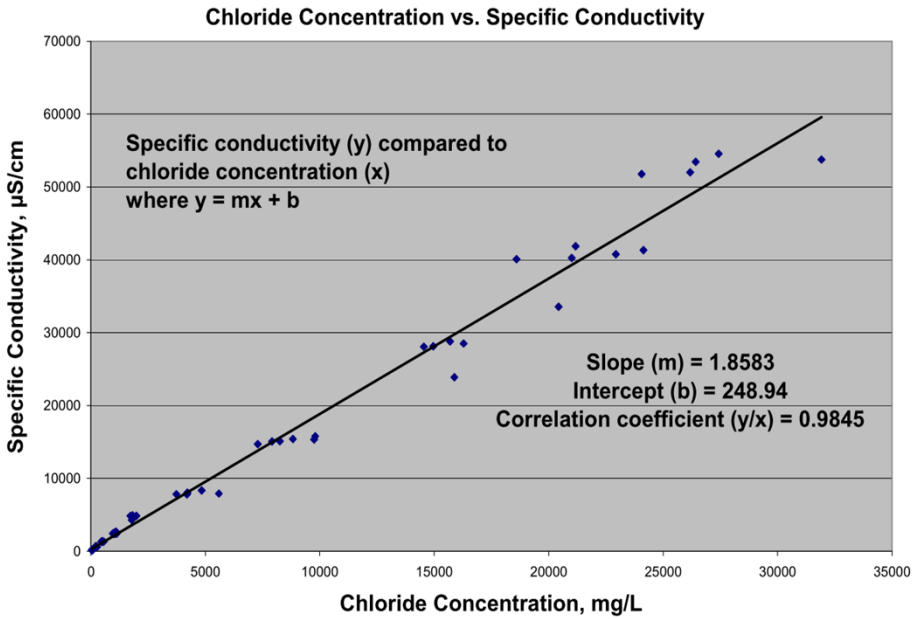


Monthly Sampling at Monitoring Sites

- Collect physical water samples
  - Take Monthly samples at each site
  - Chloride, Sulfate (Anions)
  - Major Ions/Metals (Cations)
    - Potassium
    - Sodium
    - Magnesium
  - Hardness (CaCo3)

- Conductivity is a proxy for chloride

- CTD data combined with Cl samples, will help to establish the relationship for linear regression model



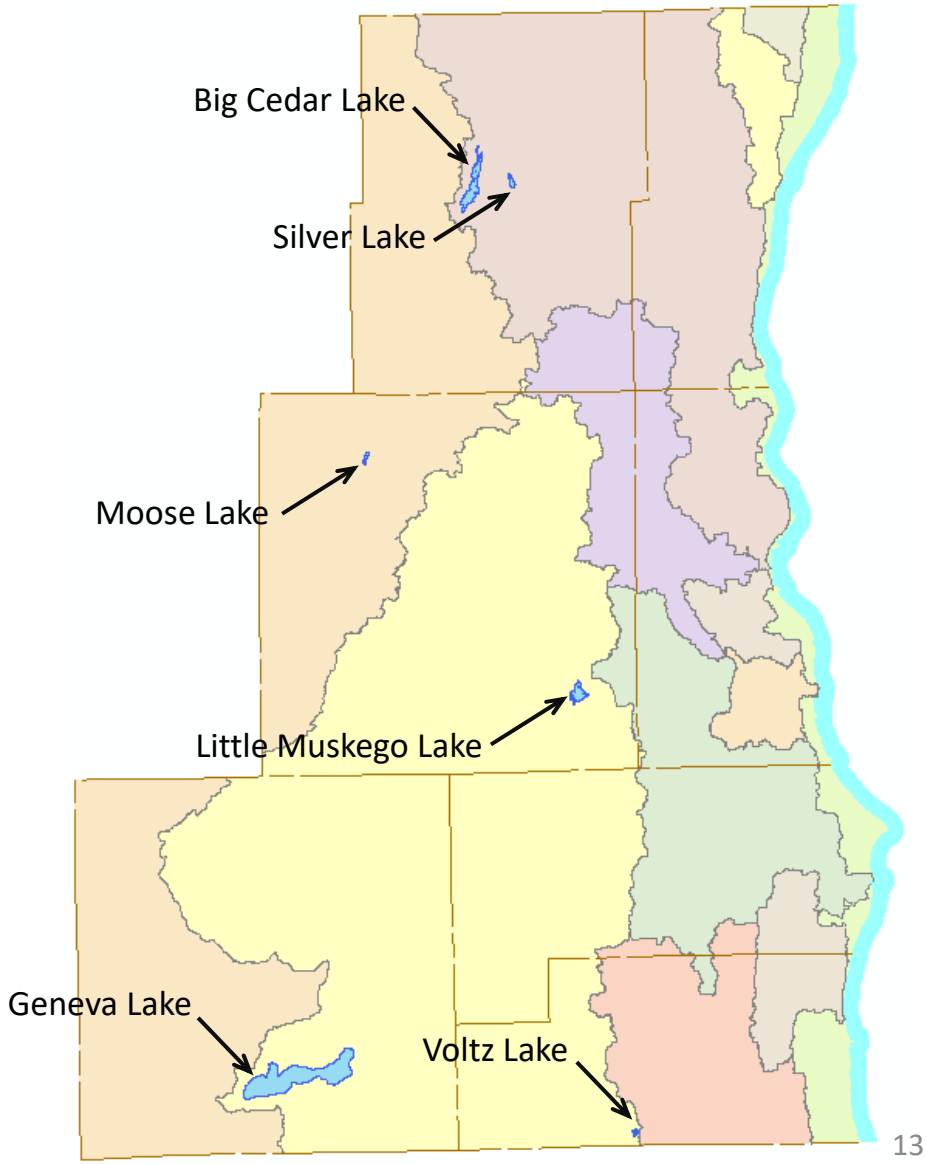
Equipment Maintenance at Monitoring Sites

Lake Sampling Overview

- Six lakes in the SEWRPC Region were chosen for study
- Sample Quarterly

- Varying lake types: seepage, spring, and drainage lakes
  - Drainage: inlet and outlet
  - Seepage: no inlet or outlet
  - Spring: No inlet, has an outlet

- Varying attributes: land use, shoreline development, watershed system, and others



Lake Sampling

- In-Situ Sonde
- Niskin type sampler
- Borrowed boats/snowmobiles
- Ice Auger
- Sled

Adventures in Winter Limnology

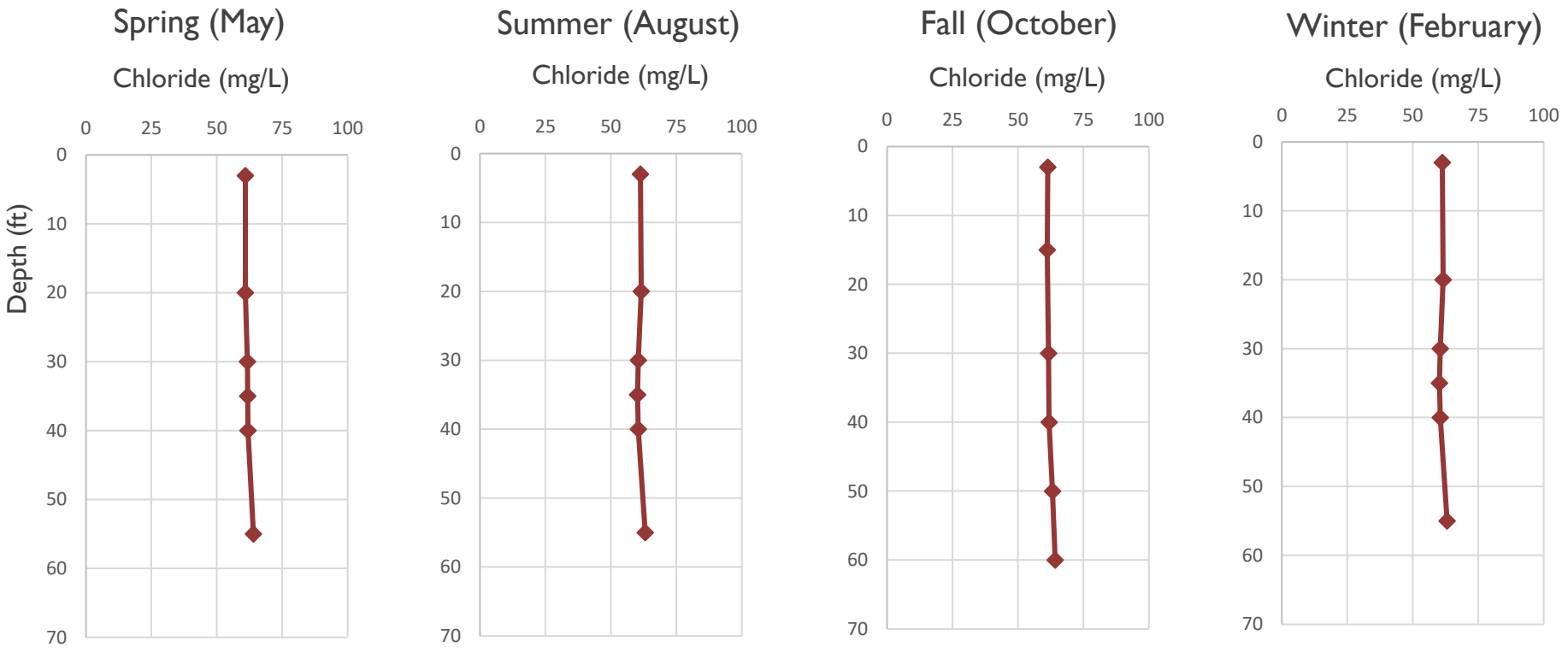
- Advantages
  - No need to coordinate boat use
- Disadvantages
  - Ice MUST be safe
  - -15° F to 20° F temperatures
  - Freezing equipment

Seasonal Chloride Profiles – 2019 PRELIMINARY DATA

- **Moose Lake (Waukesha County)**
  - Maximum Chloride: 66.3 mg/L
  - Minimum Chloride: 56.6 mg/L

Chloride Toxicity Criteria

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



Seasonal Chloride Profiles – 2019 PRELIMINARY DATA

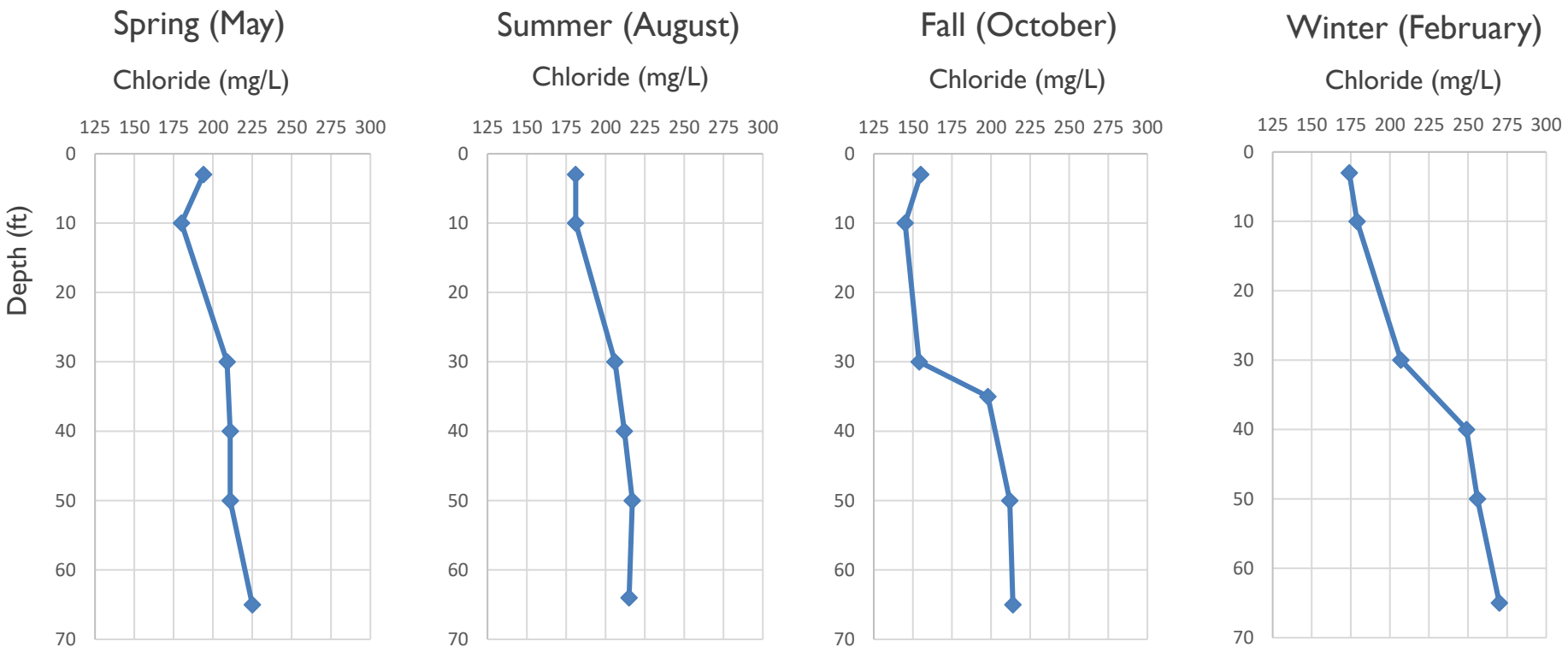
- **Little Muskego**

  Maximum Chloride: 270 mg/L

  Minimum Chloride: 145 mg/L

Chloride Toxicity Criteria

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



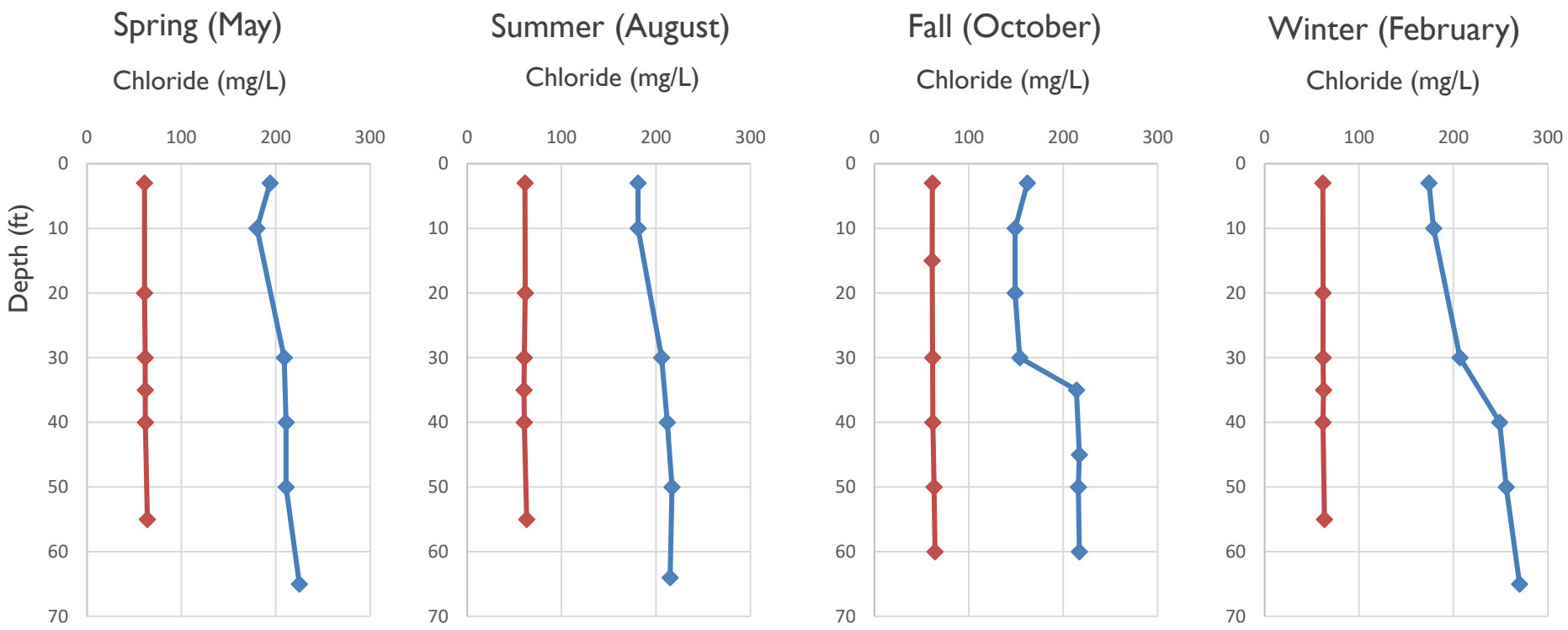
Seasonal Chloride Profiles – 2019 PRELIMINARY DATA

- **Moose Lake and Little Muskego Comparison**

Little Muskego Lake sees generally higher chloride concentrations all year round AND sees seasonal changes in chloride distribution across the water column.

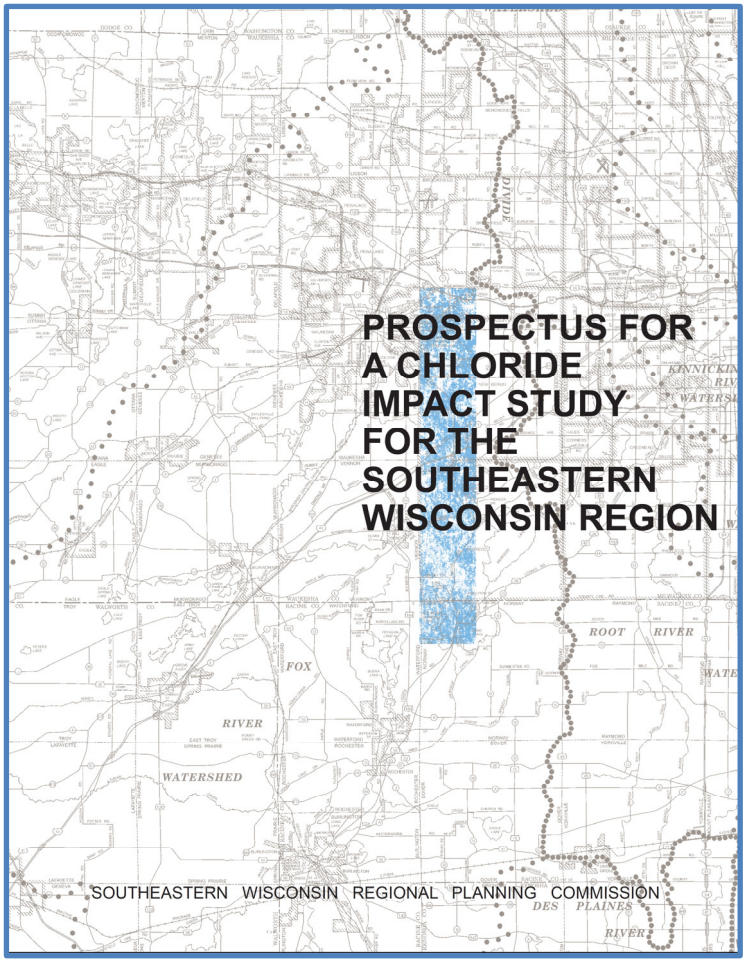
Chloride Toxicity Criteria

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



Next Steps

- Continue field work and data collection
- Develop framework for data management and analysis
- Continue collecting chloride source data, including road salting/de-icing information from communities
- Continue gathering state-of-the-art technology information for sources of chloride



Commission Staff Contributors

- Laura Herrick Chief Environmental Engineer
  - Mike Hahn
  - Joe Boxhorn
  - Ron Printz
  - Karin Hollister
  - Aaron Owens
  - Megan Beauchaine
  - Nicklaus Neureuther
  - Alexis McAdams
  - Julia Orlowski
  - Zijia Lee
  - James Mahoney
  - Kathy Sobottke

- Thomas M. Slawski, PhD Chief Biologist
  - Dale Buser
  - Justin Poinsatte
  - Zofia Noe
  - Mike Borst
  - Emma Weiss-Burns
  - Kim Walsh

Funding Partners and Additional Information

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
Clearly making a deep impact.

WISCONSIN DEPT. OF NATURAL RESOURCES

MMSD
PARTNERS FOR A CLEANER ENVIRONMENT

Laura K. Herrick, PE, CFM
Chief Environmental Engineer
lherrick@sewrpc.org

Thomas M. Slawski, PhD
Chief Biologist
tslawski@sewrpc.org

Study Website: http://www.sewrpc.org/SEWRPC/Environment/ChlorideImpactStudy.htm