



# SEWRPC's Regional Chloride Study

March 1, 2019

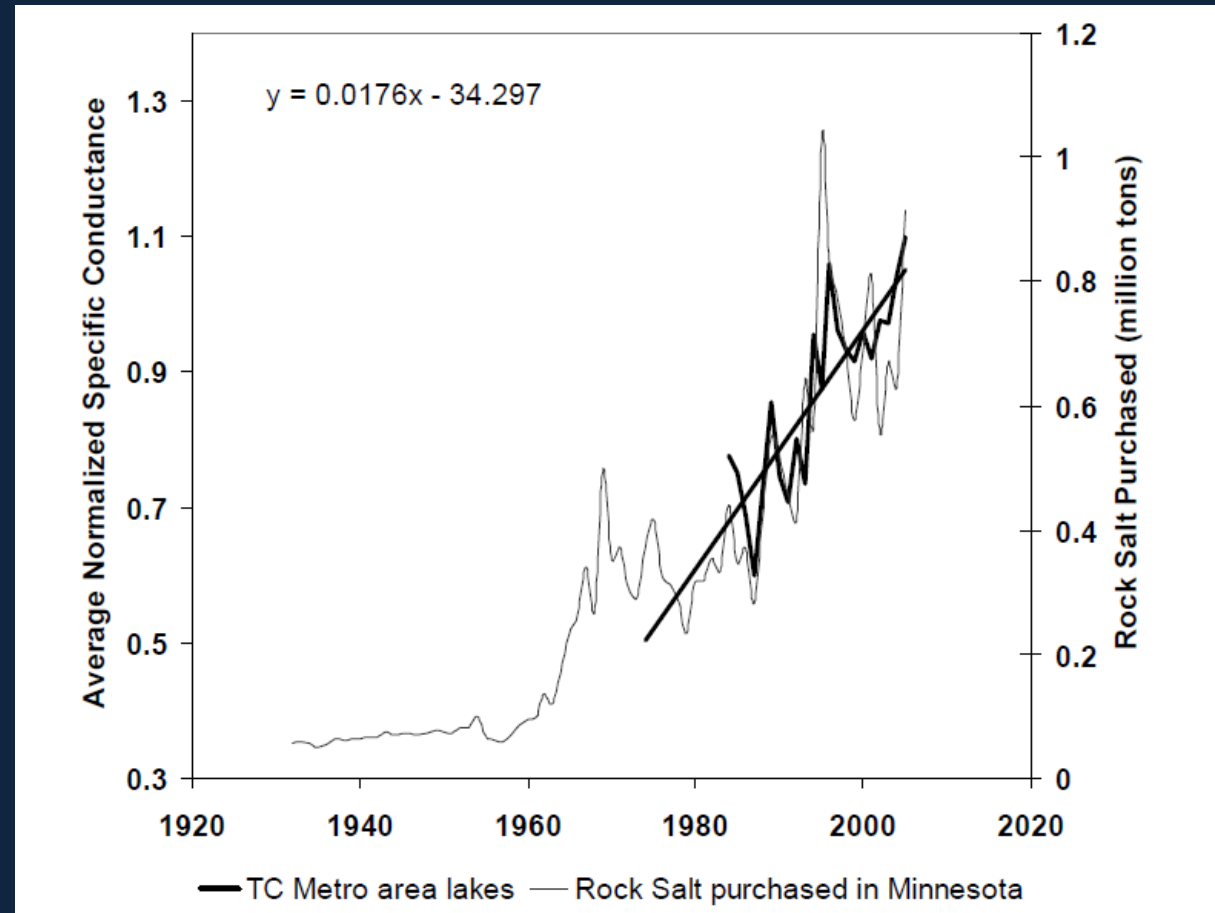
AWRA Wisconsin Section 43<sup>rd</sup> Annual Meeting

Delavan, Wisconsin



# Why Does Chloride Matter? Background

- Halite – pervasive yet largely under-appreciated pollutant.
- Chloride – highly mobile conservative pollutant, no easy way to put the genie back in the bottle.
- “Natural” – toxicity



*Minnesota Department of Transportation*



# Why Does Chloride Matter? Background

- Surface-water chloride standards
  - Based upon animal survival.

	Chronic	Acute
Wisconsin	395 mg/L	757 mg/L
Exposure	Substantial portion of natural life expectancy	Maximum daily average once in three years
US EPA	230 mg/L	860 mg/L
Exposure	Indefinite	Short term (<24 hours)



# Why Does Chloride Matter? Background

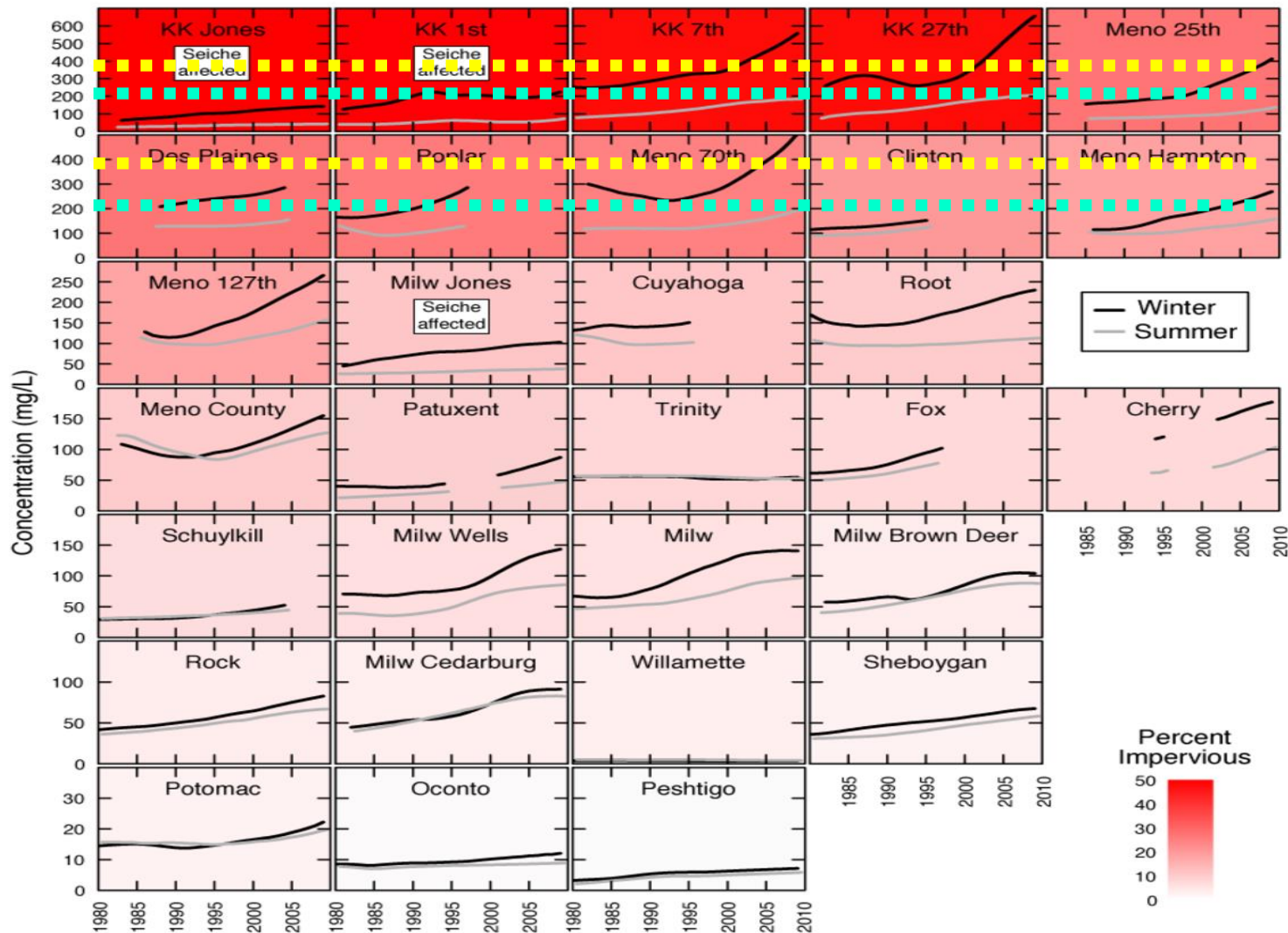
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- Pre-settlement concentrations <5 mg/L
- 96 hour LC50 roughly 1 400 mg/L
- Plants, algae?
- Favor AIS?



# Why Does Chloride Matter? Rivers



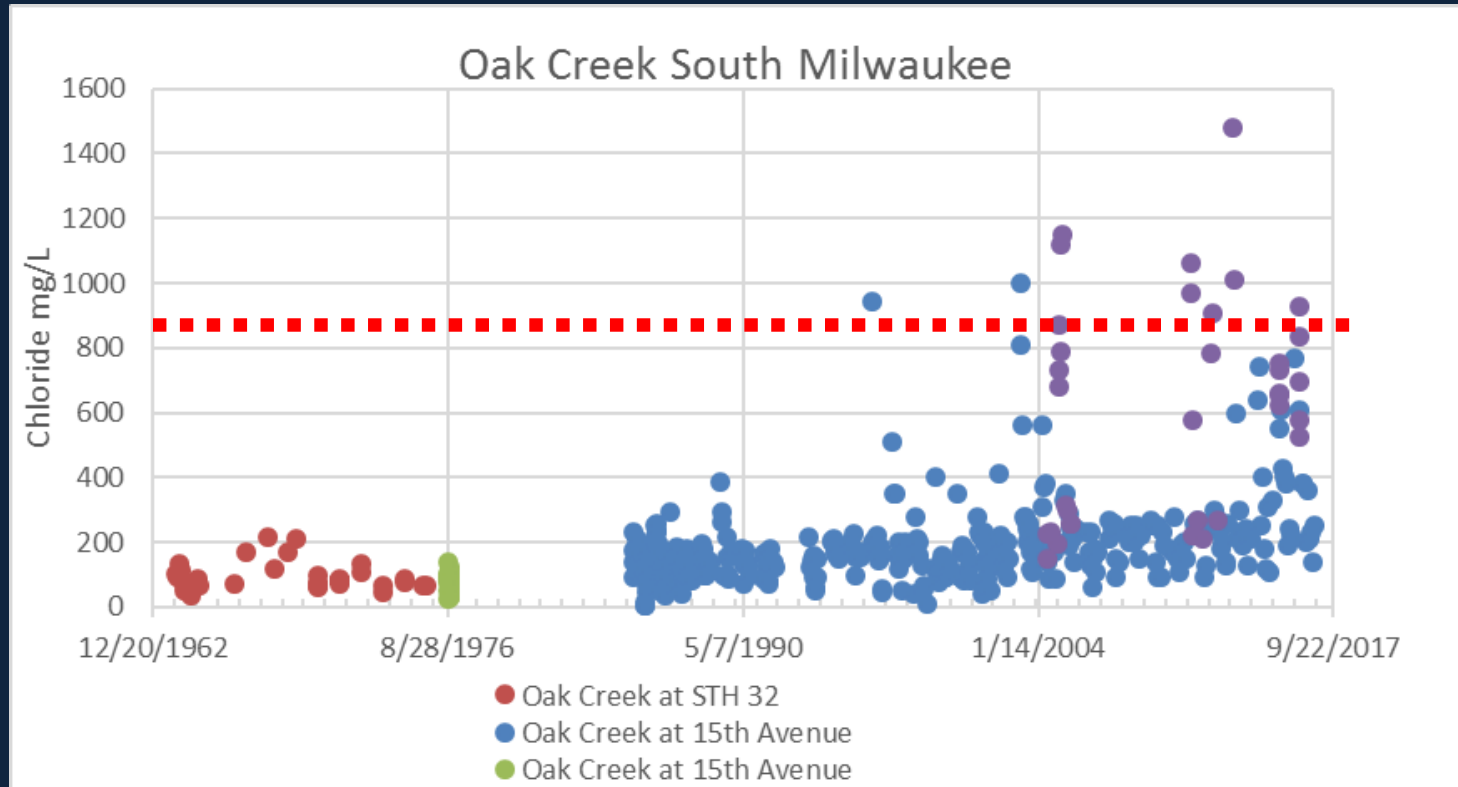


# Why Does Chloride Matter? Streams

- What about Smaller Streams?
  - Honey Creek – highly urbanized Milwaukee watershed.
  - LC50 exceeded for 4 to 19 days stretches nine times in slightly less than three years.
  - What does this suggest for stream ecology?
  - Brackish?



# Why Does Chloride Matter? Streams

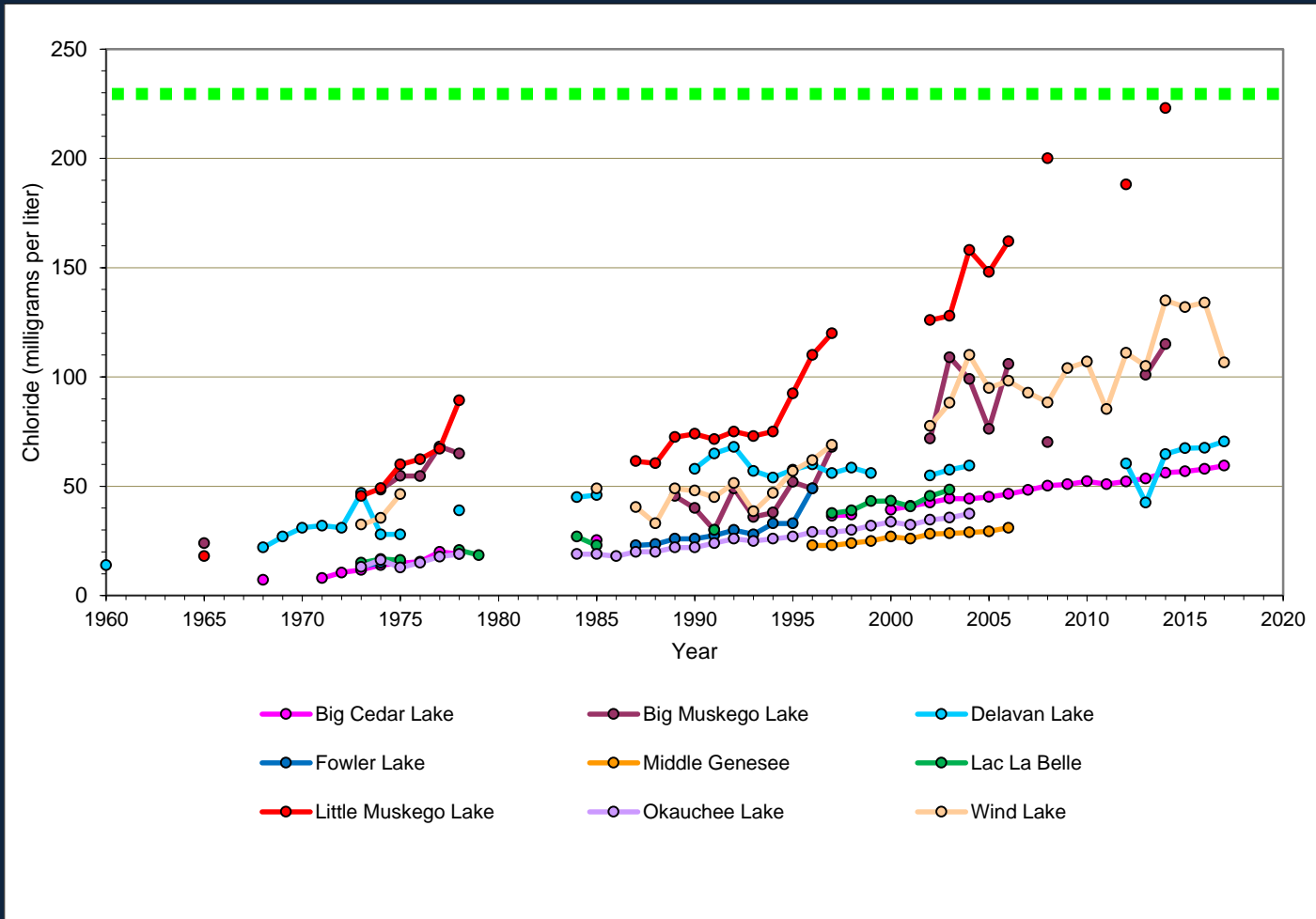


- Grab samples . . . peak values = ?, duration = ?



# Why Does Chloride Matter? Lakes

## ■ What about Lakes?

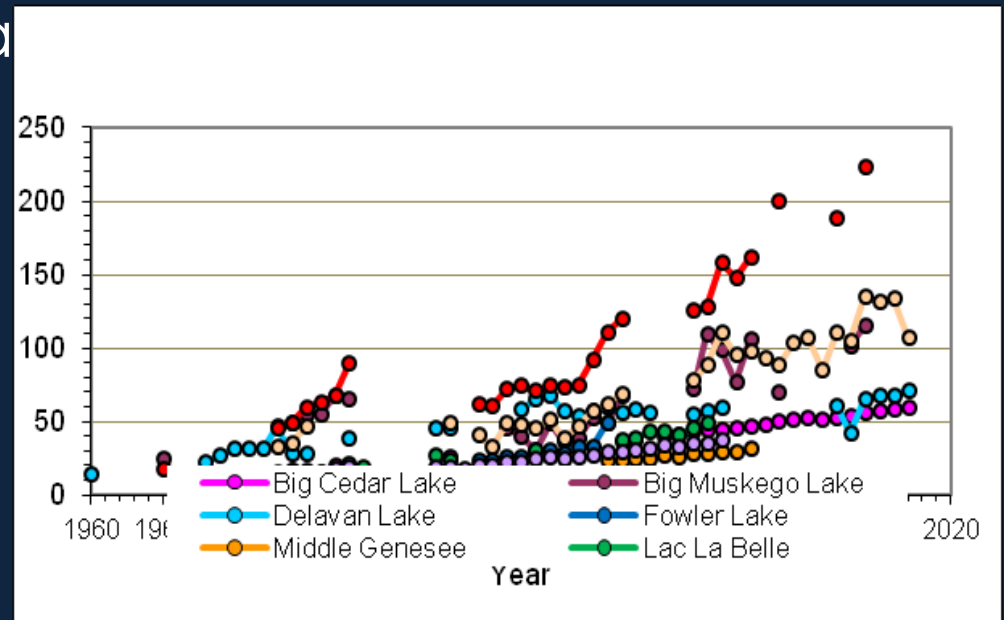






# Why Does Chloride Matter? Lakes

- Data projections suggest:
  - Urbanized lakes could exceed Wisconsin chronic threshold in less than 15 years and acute threshold in less than 30 years.
  - More rural lakes could exceed Wisconsin chronic threshold in less than 50 years and acute threshold in less than 75 years.

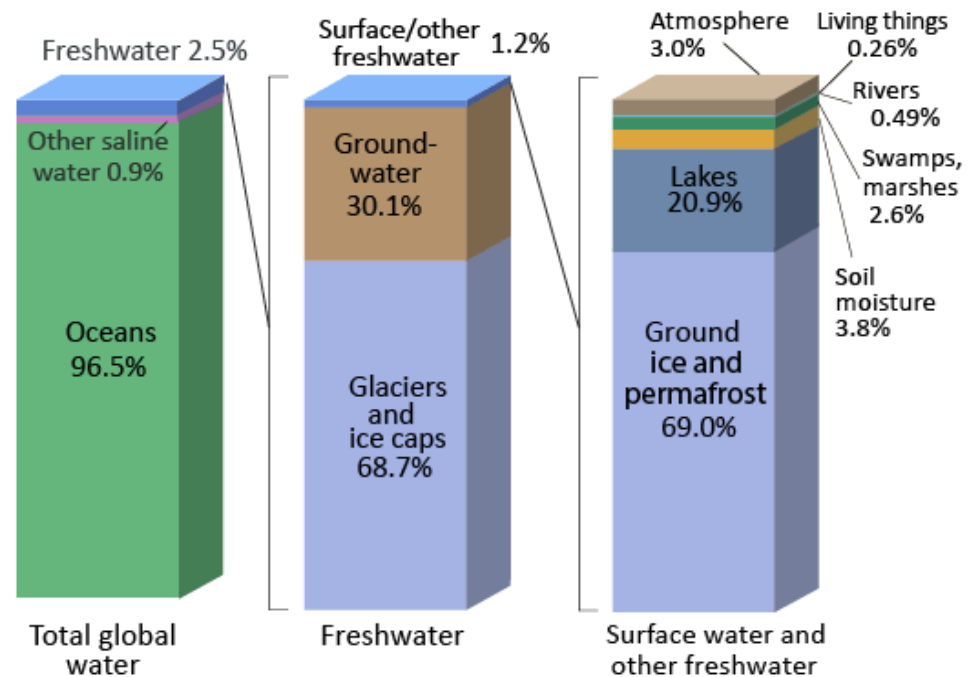




# Why Does Chloride Matter? Groundwater

- Only a few mg/L chloride under natural conditions.
- Taken for granted as a source for high quality baseflow and drinking water.
- Large volume. Slow to react (and recover) – dilution and transport.

## Where is Earth's Water?



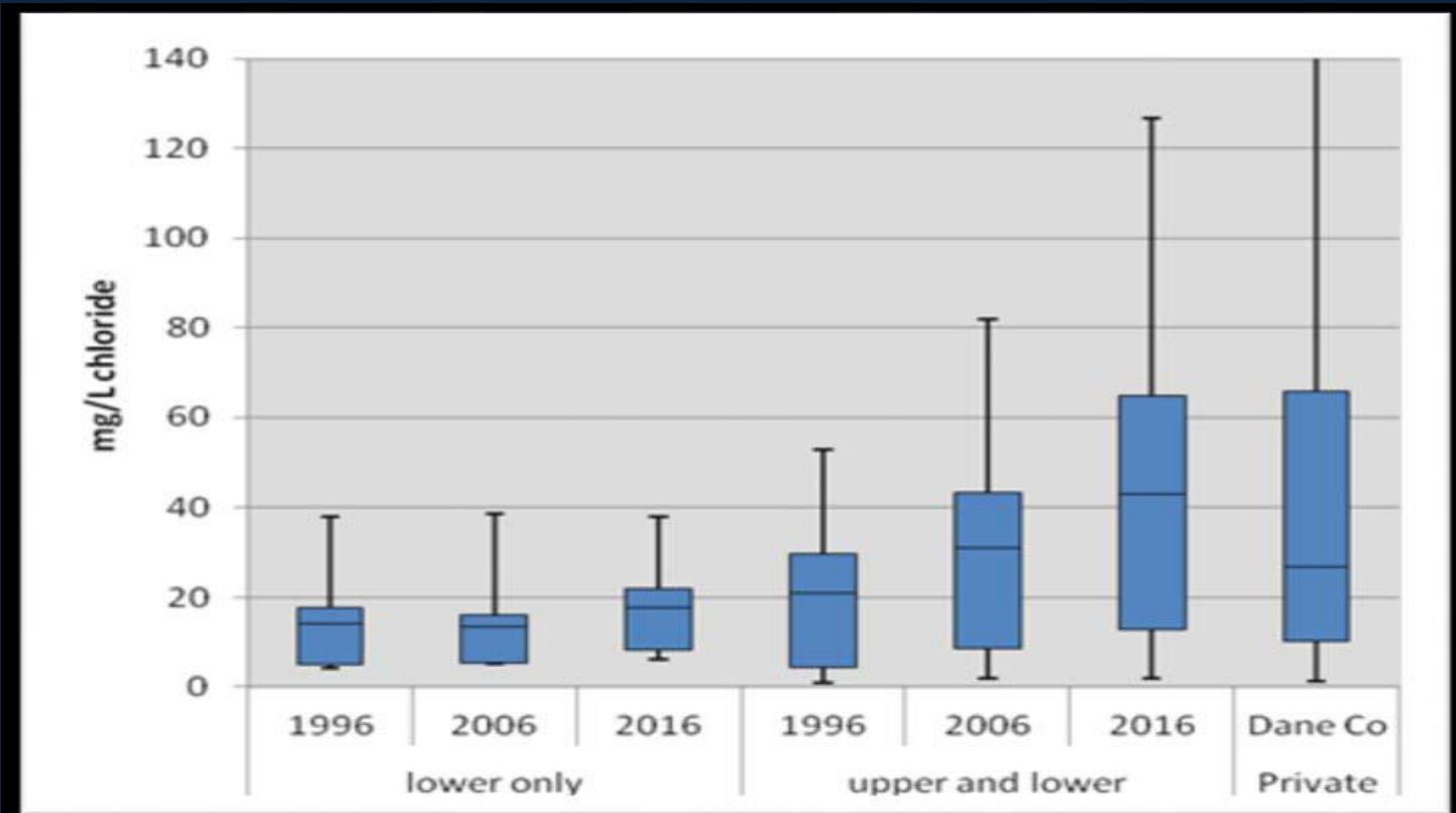
Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, *Water in Crisis: A Guide to the World's Fresh Water Resources*.  
NOTE: Numbers are rounded, so percent summations may not add to 100.

USGS



# Why Does Chloride Matter? Groundwater

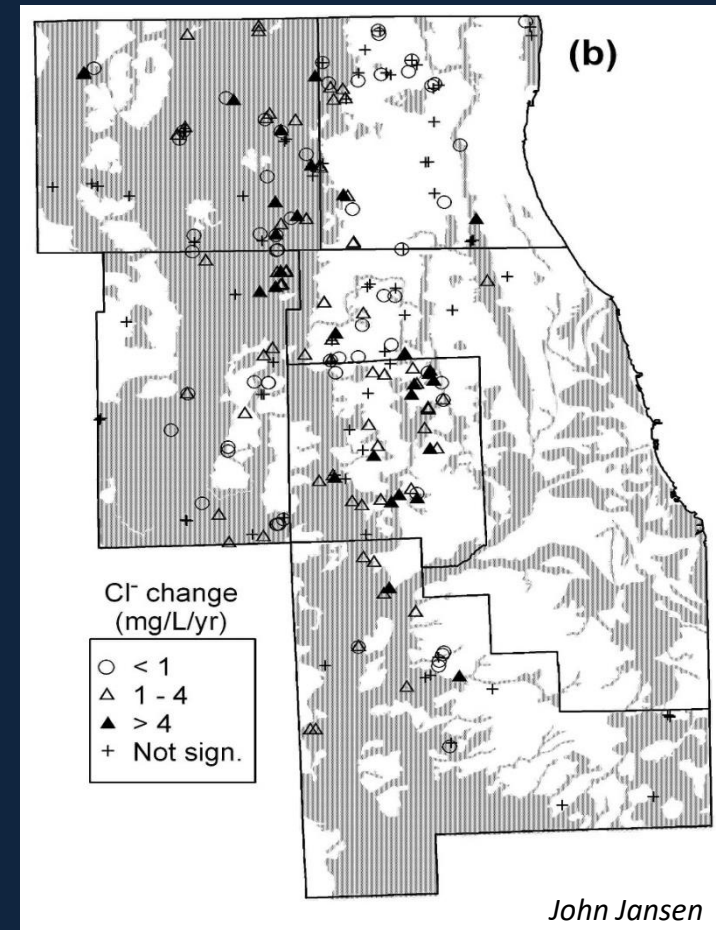
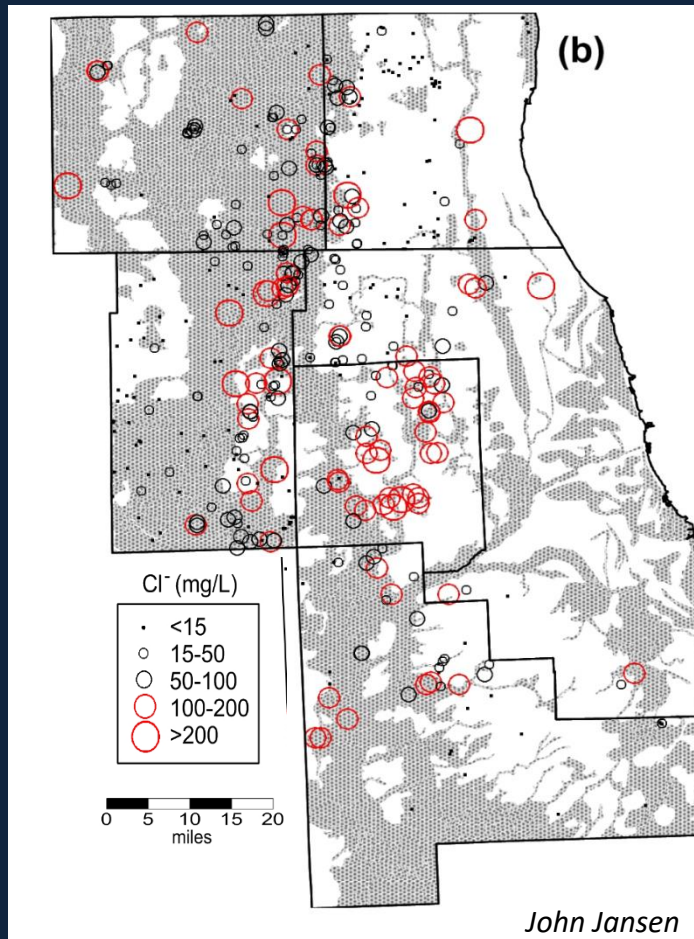
- Average annual chloride in Madison, Wisconsin wells has doubled in twenty years.
- Dane County Wisconsin shallow private wells – up to 970 mg/L.



Public Health Madison and Dane County



# Why Does Chloride Matter? Groundwater



- Drinking supply water for millions.
- Chloride threshold – 250 mg/L.



# What is SEWRPC Doing?

- Four Year study (2018-2022).
- Two Year monitoring (2018-2020).



U.S. Department of Transportation  
**Federal Highway Administration**



**SEWRPC**

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



**MMSD**

PARTNERS FOR A CLEANER ENVIRONMENT



Fund for  
**Lake Michigan**

Clearly making a deep impact.

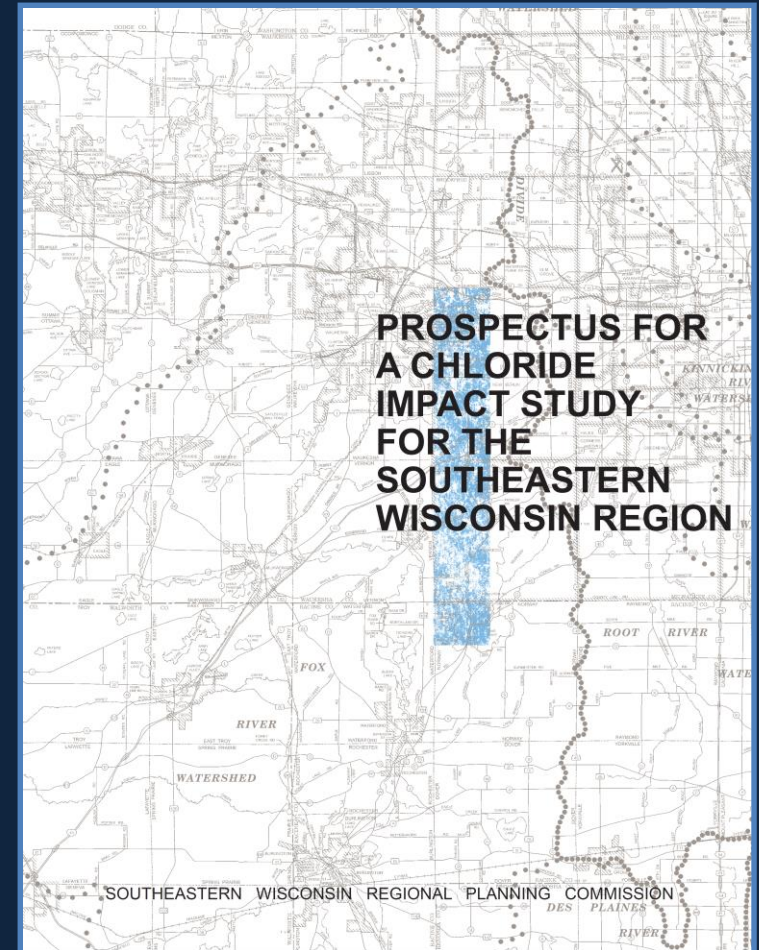


**WISCONSIN**  
DEPT. OF NATURAL RESOURCES



# Select Project Elements

- Compile historical and new chloride, conductance, general water chemistry, and flow data for streams, lakes, and groundwater resources.
- Evaluate equipment and establish real-time stream monitoring sites and regular lake monitoring sites.
- Project website:



<http://www.sewrpc.org/SEWRPC/Environment/ChlorideImpactStudy.htm>.



# Monitoring Equipment Pilot Tests

- Monitoring equipment assessment.
  - 1<sup>st</sup> choice - ion-specific sensor (chloride).
  - 2<sup>nd</sup> choice – conductivity.



# Monitoring Equipment Pilot Tests

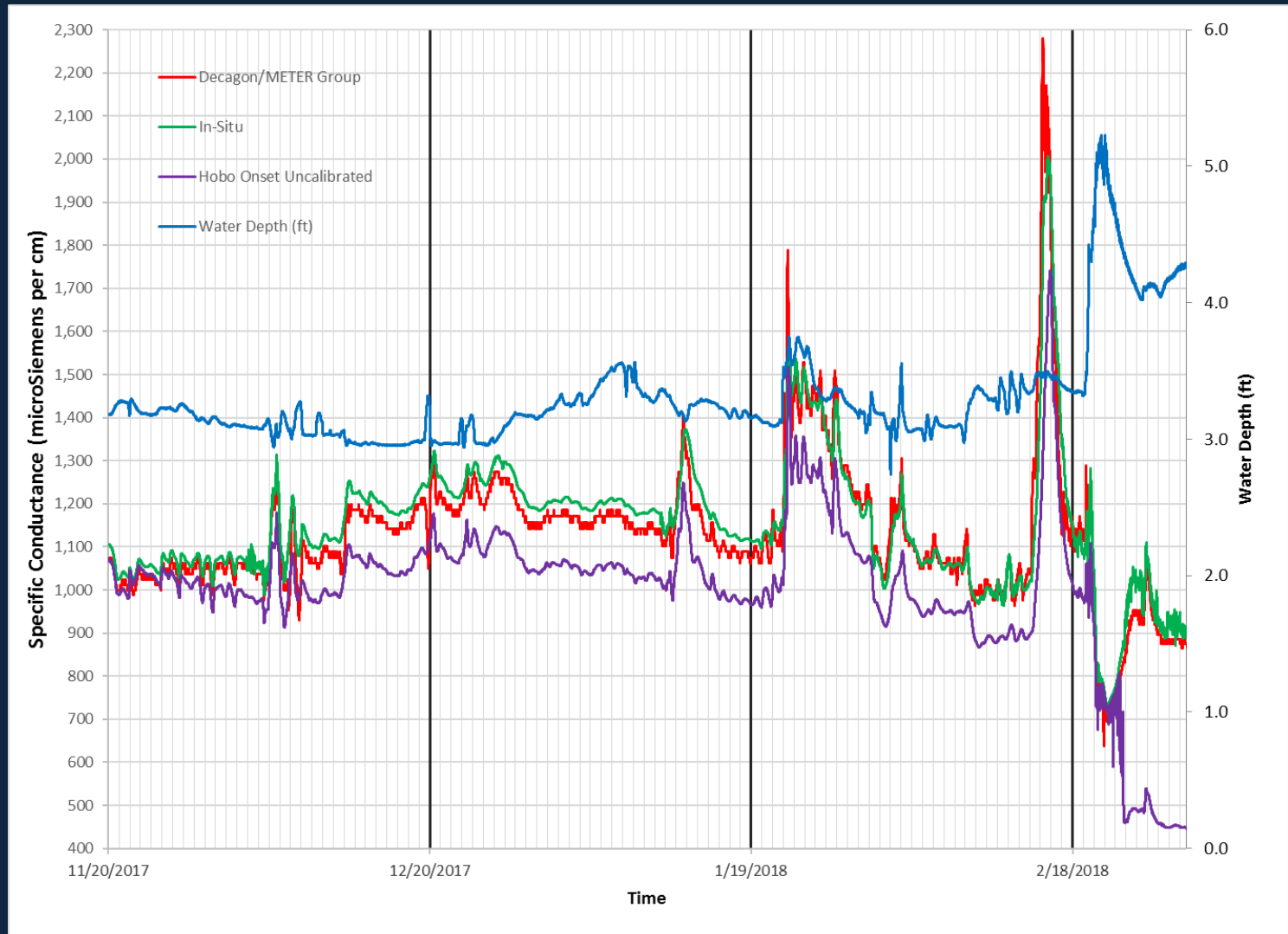
- Deployed several conductance sensor/data logger models at one location.
- Compared relative performance:
  - Lab samples
  - Range
  - Water level (pressure) sensor
  - Temperature
  - Calibration
- Developed deployment tactics.
- Evaluated data interval (5-15 min).
- Evaluated device fouling.
- Ion specific electrode - chloride.





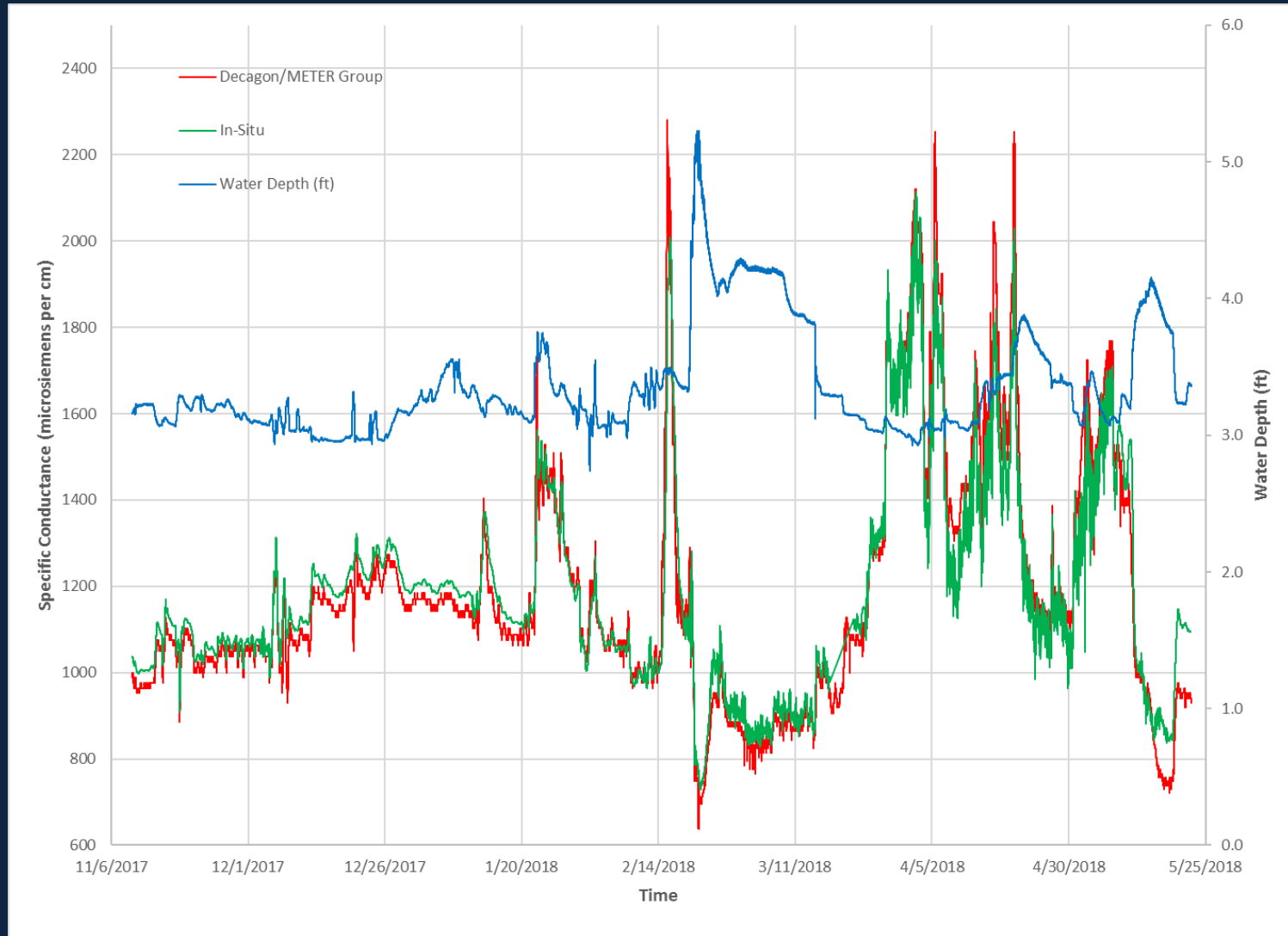


# Pilot Site – Instrument Comparison



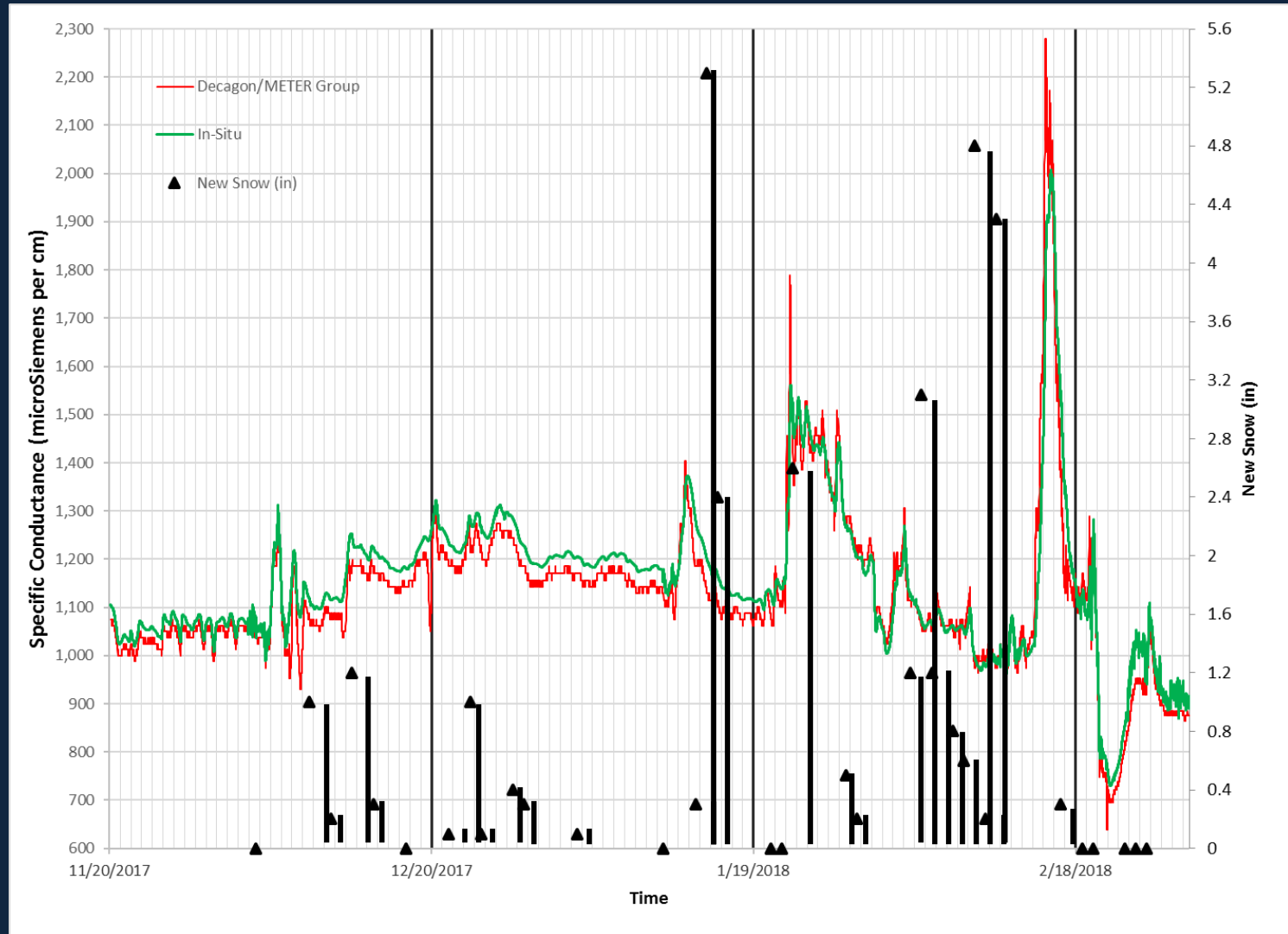


# Pilot Site – Extended Comparison



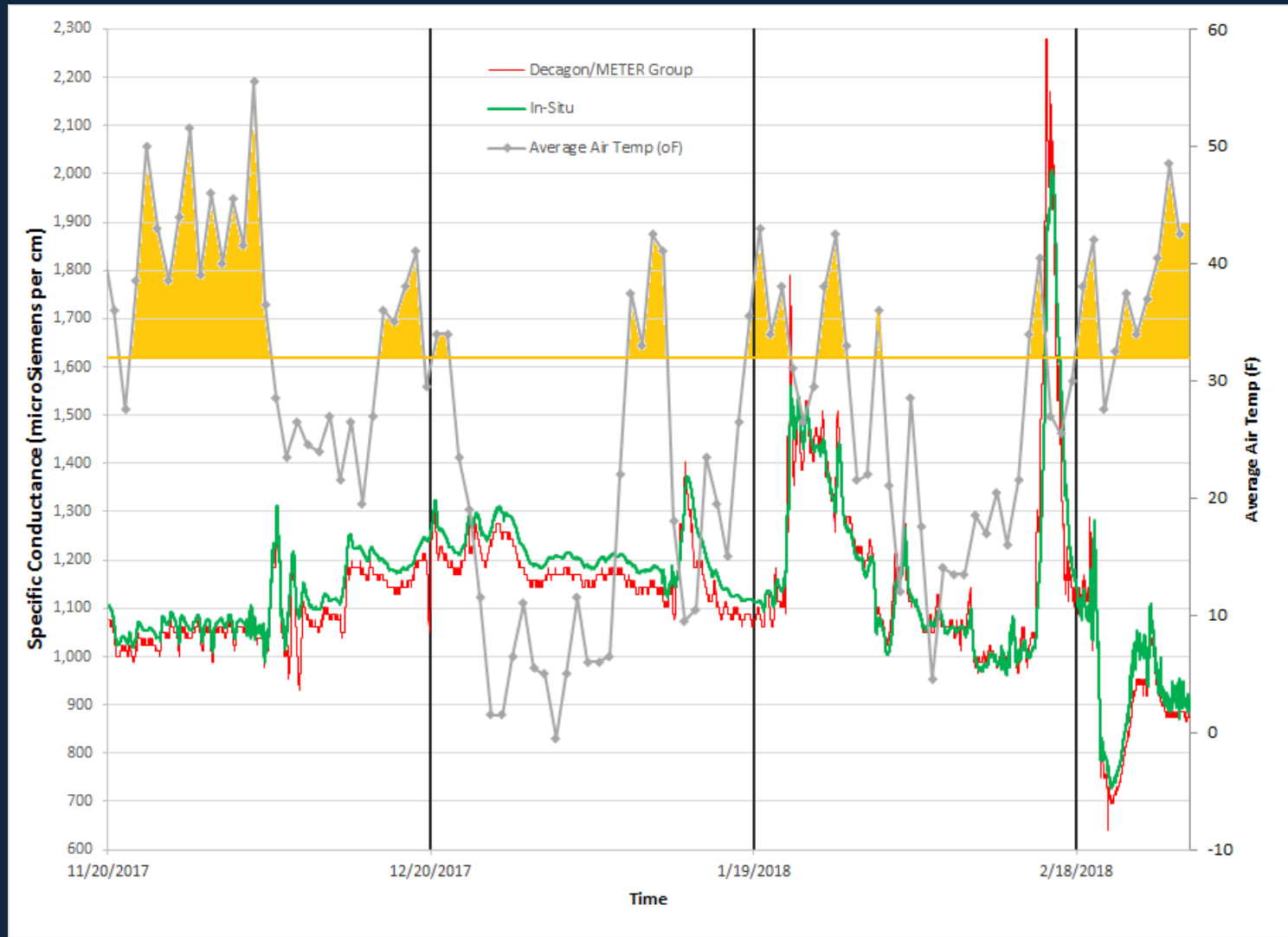


# Pilot Site – Preliminary Data Presentation





# Pilot Site – Preliminary Data Presentation





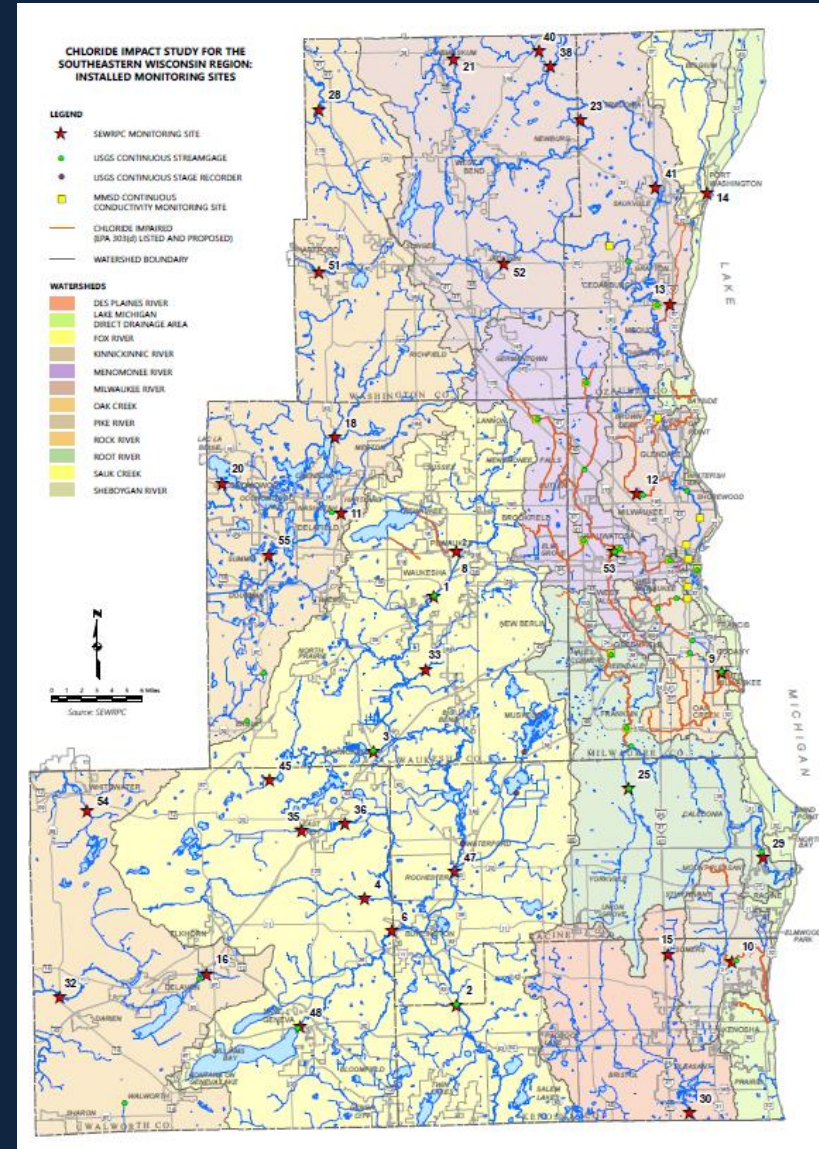
# Pilot Site – Preliminary Data Presentation





# Monitoring Network Deployment

- 37 stream and four lake monitoring sites deployed during Summer 2018.
- Year-round monitoring over 2,700 square mile study area.
- Distributed throughout Region and amongst major watersheds.





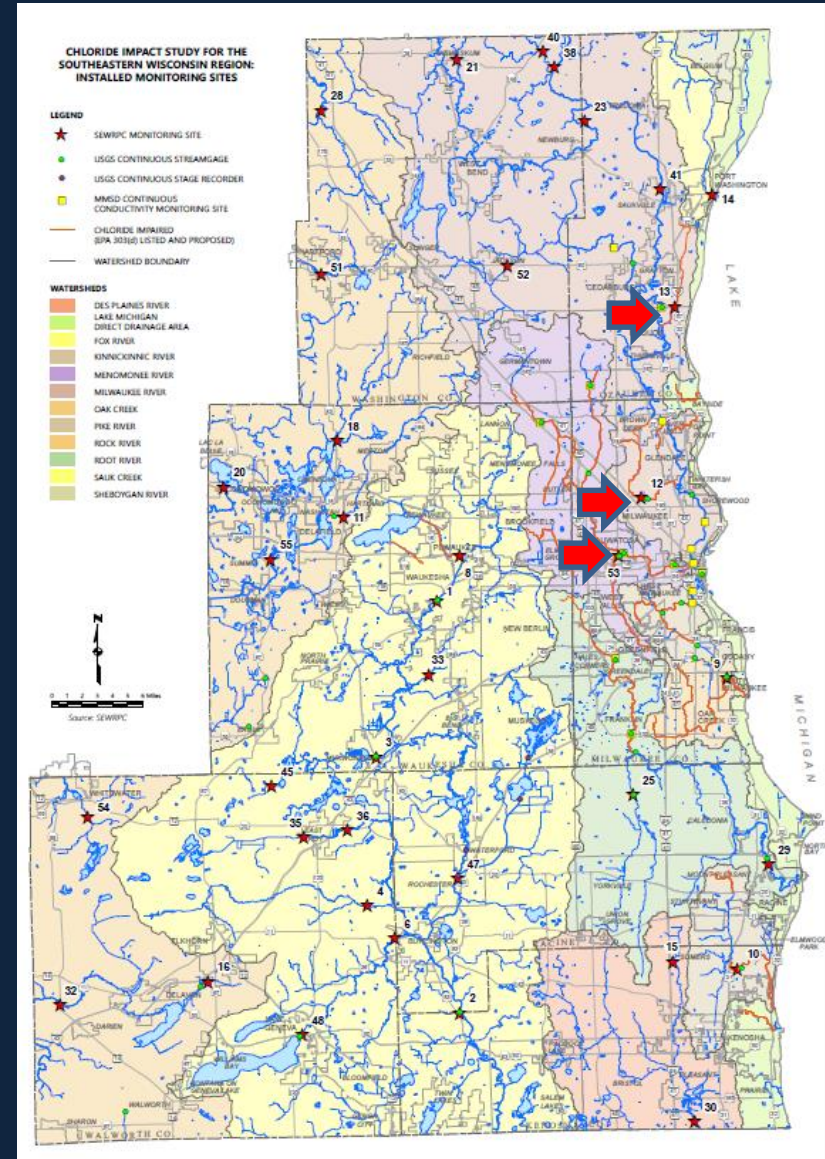
# What Have we Found Thus Far?





# What Have We Found Thus Far?

- All stream sites operational and reliable.
- Collecting conductivity, water depth, and temperature data every 5 minutes.
- Large data set – summary not yet available.
- Quick random examples – Honey, Lincoln, and Ulao Creeks.







# Honey Creek

- Urban tributary to Menomonee River in Milwaukee.
- Warm season data suggests:
  - Fair weather chloride concentrations range between roughly 260 and 340 mg/L.
  - Higher concentrations during extended dry weather.
  - Concentrations much lower during runoff events – roughly 50 to 100 mg/L.
  - Concentrations quickly recover to pre-storm levels.
- Snow and snowmelt runoff events suggest chloride concentrations easily range up to roughly 1900 - 2300 mg/L .



# Lincoln Creek.

- Urban tributary to Milwaukee River in Milwaukee.
- Warm season data suggests:
  - Fair weather chloride concentrations range between roughly 210 and 340 mg/L.
  - Higher concentrations during extended dry weather.
  - Chloride concentrations much lower during runoff events – roughly 50 to 100 mg/L.
  - Chloride concentrations quickly recover to pre-storm levels.
- Snow and snowmelt runoff events suggest chloride concentrations easily range up to roughly 1500 - 2200 mg/L .








# Ulao Creek.

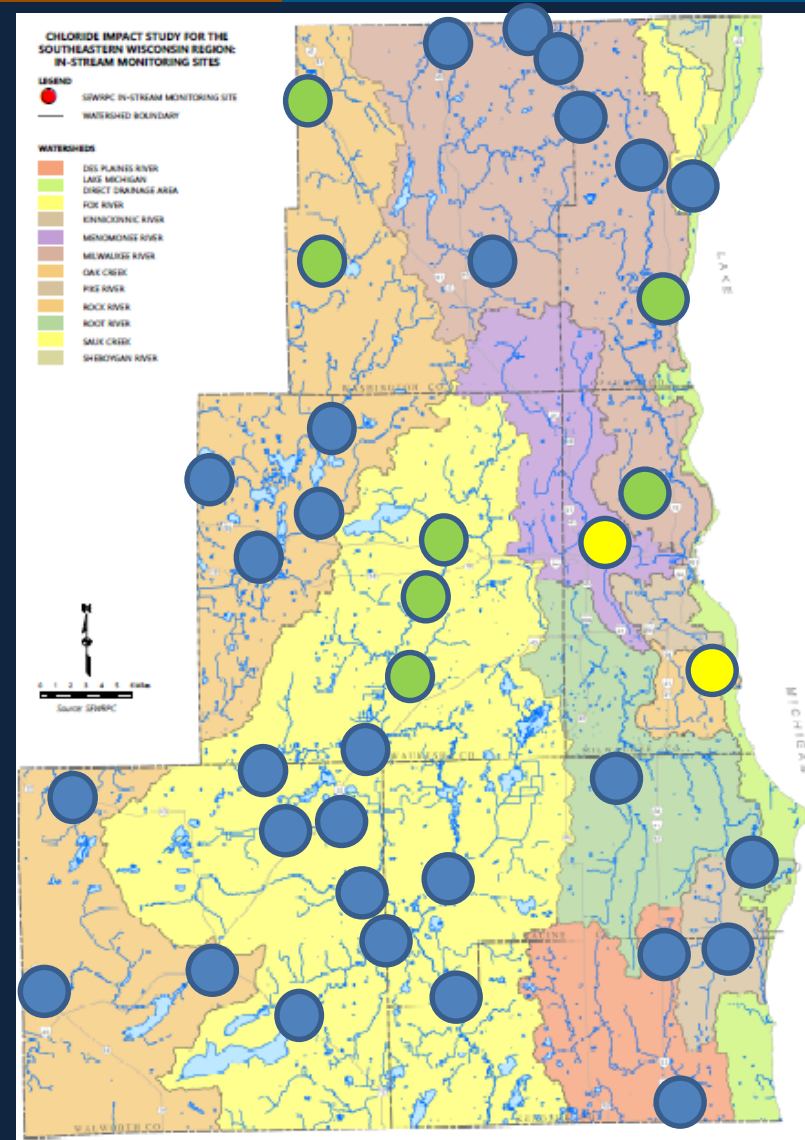
- Semi-rural urbanizing tributary to Milwaukee River paralleling freeway and associated recent development.
- Warm season data suggests:
  - Fair weather chloride concentrations range between roughly 110 and 140 mg/L.
  - Much higher concentrations during extended dry weather (260 to 380 mg/L)
  - Chloride concentrations much lower during runoff events – roughly 50 mg/L or less.
- Snow and snowmelt runoff events suggest chloride concentrations easily range up to roughly 570 mg/L .



# What Have We Found Thus Far?

October 27, 2018 6:00 p.m.






-  <100 mg/L chloride
-  100 – 230 mg/L chloride
-  230-395 mg/L chloride
-  395-860 mg/L chloride
-  >860 mg/L chloride

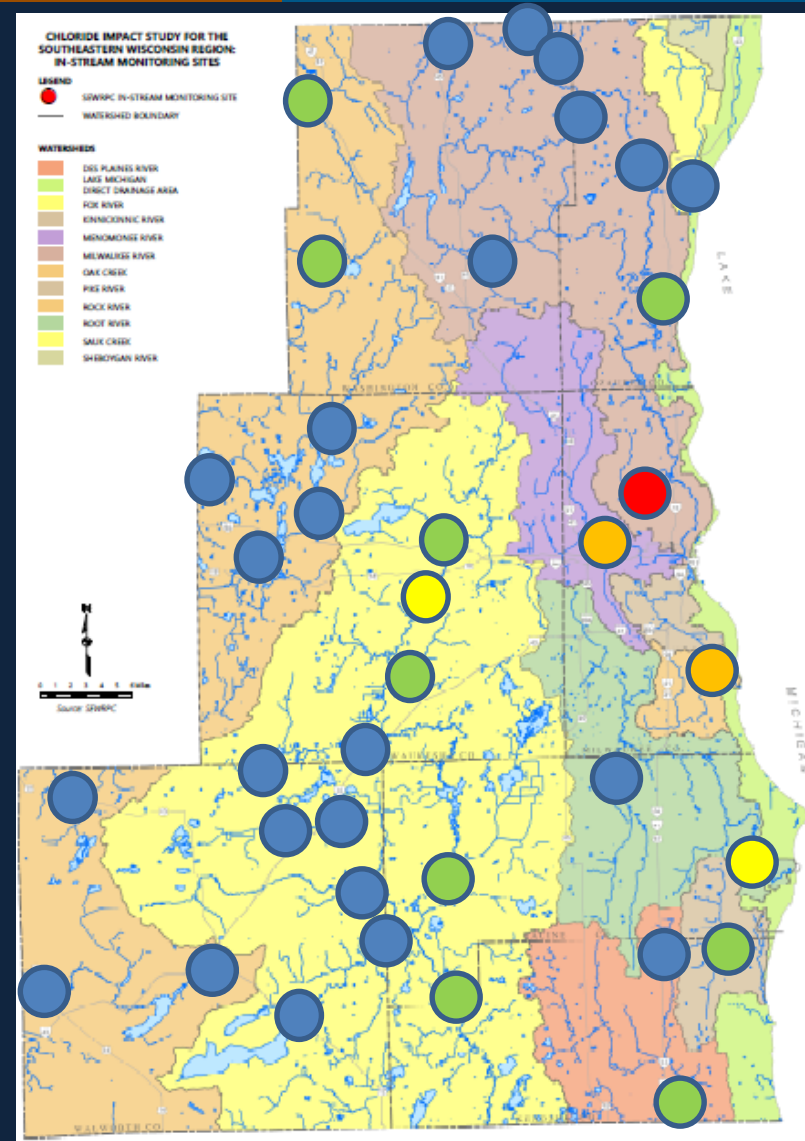




# What Have We Found Thus Far?

February 18, 2019 2:00 a.m.

-  <100 mg/L chloride
-  100 – 230 mg/L chloride
-  230-395 mg/L chloride
-  395-860 mg/L chloride
-  >860 mg/L chloride

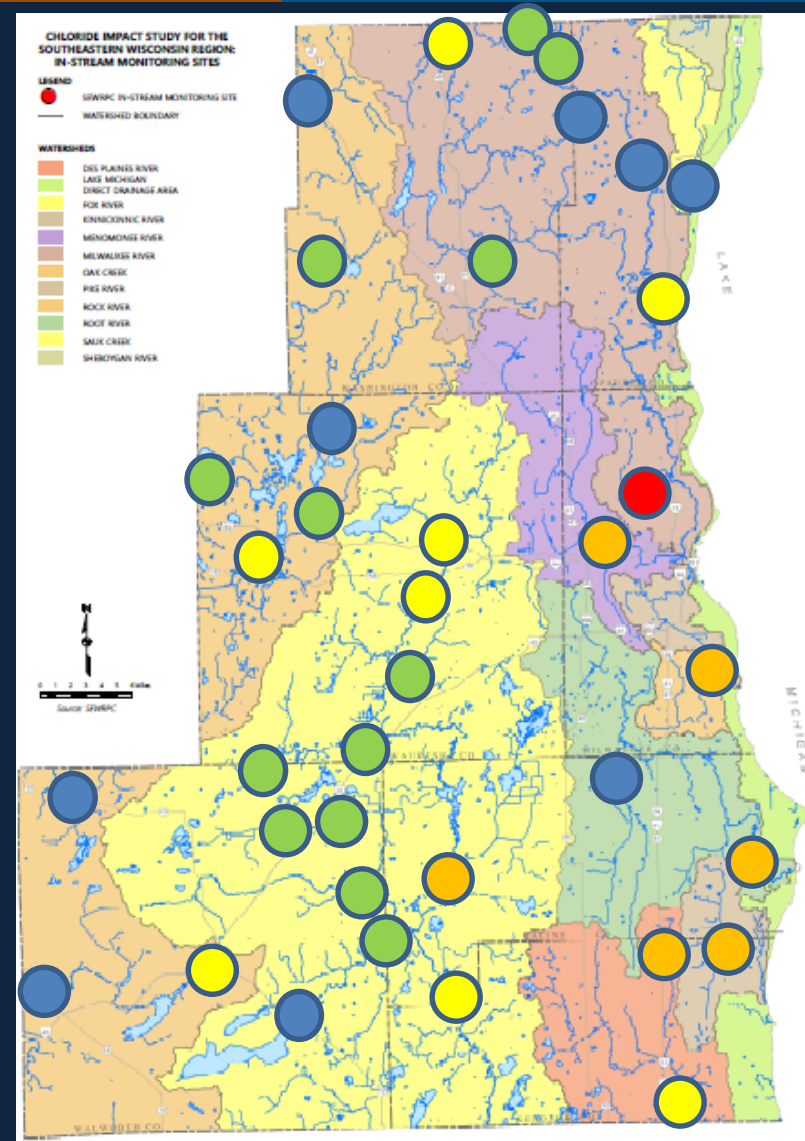




# What Have We Found Thus Far?

Change October 27, 2018 to February 18, 2019

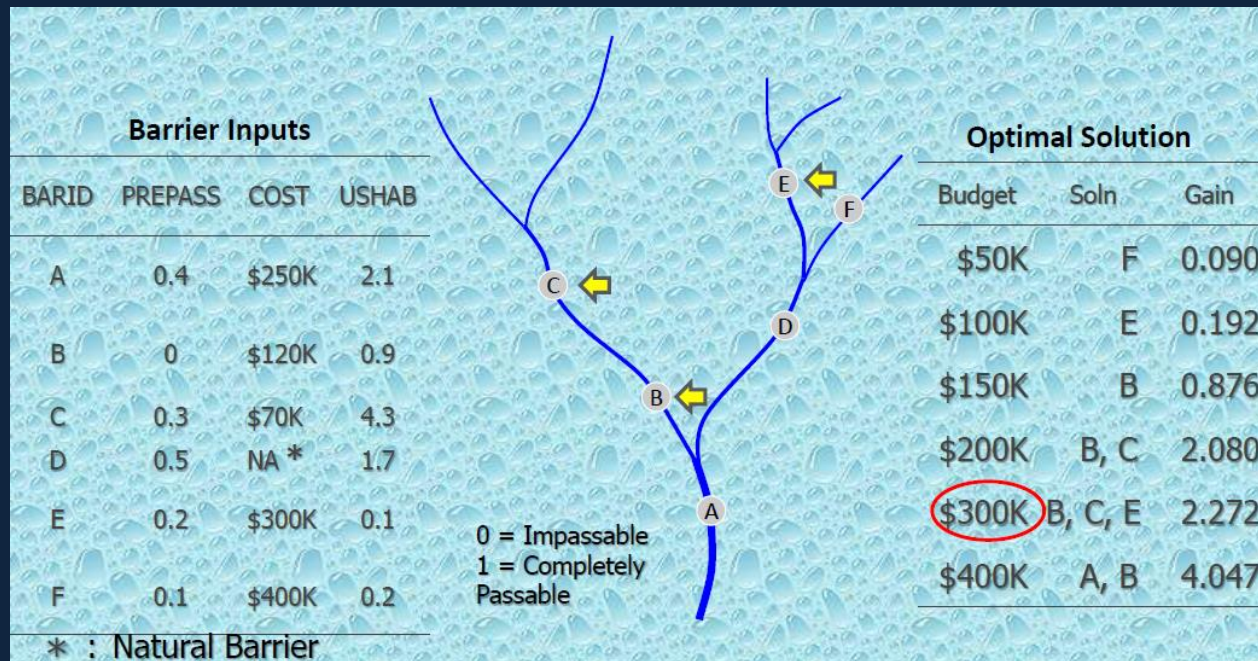
- -10% to -40%
- -10% to +10%
- +10% to +50%
- +50% to + 200%
- >+200%





# Stream Restoration Planning

- Aquatic organism passage planning initiatives commonly use watershed position, habitat availability, budget, and infrastructure description/mapping to set priorities.



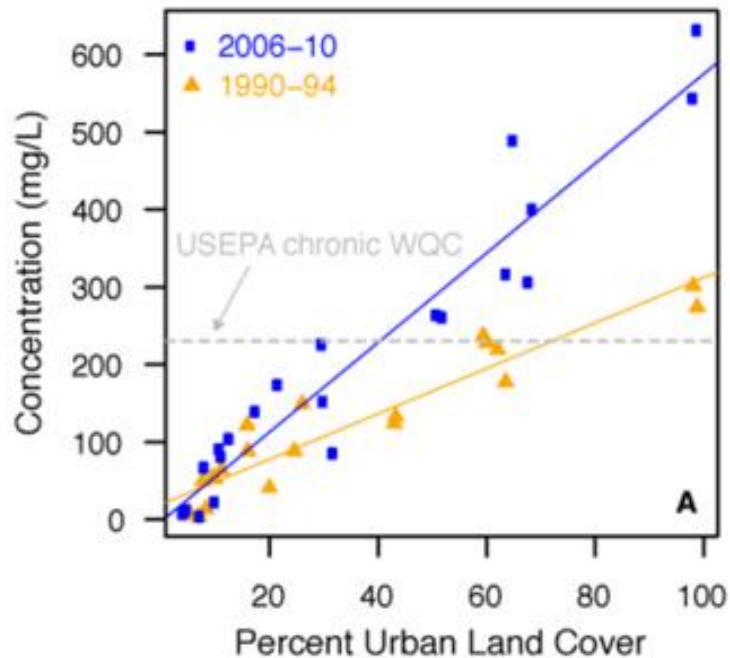
*Pacific States Marine Fisheries Commission*

- Why prioritize streams with water quality that may not support sustainable populations of target organisms?

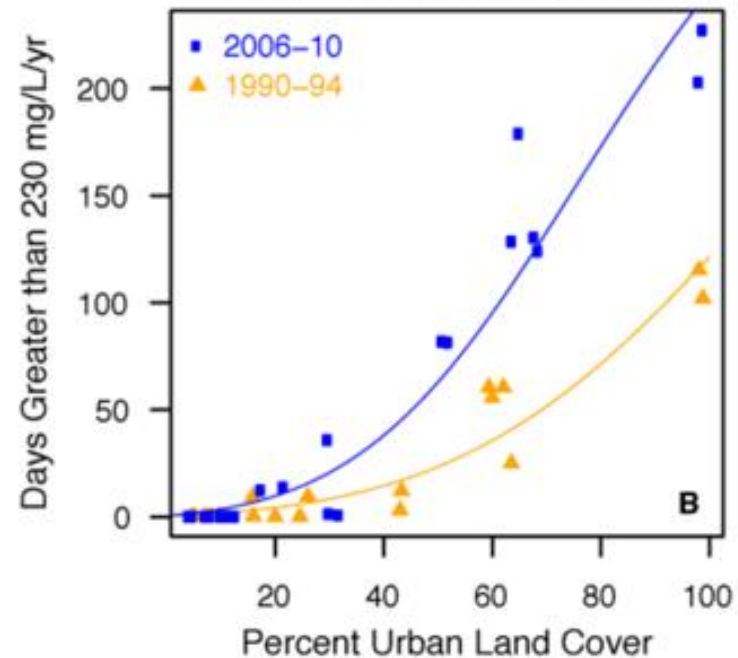


# Stream Restoration Planning

A. Average chloride concentrations



B. Expected days exceeding the chronic water-quality criteria per year



USGS

- Integrate actual, estimated, and/or projected chloride concentrations into management algorithms?
- Actual data, land use relationships, impervious surface.





# For More Information

## Contacts

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