Stormwater Research at UMN

Andy Erickson

Legislative Water Commission Meeting: July 26, 2018

https://luzernecd.org/programs/dirt-gravel-roads/ http://www.cityofconcord.org/streetsweeping/







https://www.perfectwater.co.za/eutrophication/ https://www.pca.state.mn.us/water/state-lakes

Iron Enhanced Sand Filters (Phosphorus)	Stormwater Ponds, Contaminated Sediments (PAHs), Phosphorus Release	Granular Activated Carbon Filters (Nitrate)	Internal Phosphorus Loading in Lakes (treatment options)	Water Quality of Low Volume Roads	Roadside Ditches and Swales (enhancing performance)	Source (nutrient) Reduction

Road Salt Research at UMN

Andy Erickson

Legislative Water Commission Meeting: July 26, 2018

http://americancityandcounty.com/products-work/fabric-structure-efficiently-stores-road-salt-illinois

https://www.quora.com/Why-is-salt-bad-for-the-soil

Permeable Pavement in lieu of Road Salt

Statewide Salt Budget (road, softening, fertilizers, etc.)

Chloride storage in soils

Road Salt Research in Minnesota

Ben Janke

Collaborators, Past and Present Research:

Profs. Heinz Stefan, Omid Mohseni, & John Gulliver; William Herb, Eric Novotny, Andy Erickson, Andrew Sander, Dan Murphy, Pete Weiss

ST. ANTHONY FALLS LABORATORY

http://stormwater.safl.umn.edu/

UNIVERSITY OF MINNESOTA

Driven to Discover®

Sources of Salt (Chloride)

Problems with Excess Salt (Chloride)



Total Cost: $1,026 - $3,564 per ton of salt (salt + labor + damages) *MPCA, 2014*



Water Quality Standards for Chloride

Aquatic Life

- Chronic (4 days): 230 mg/L
- Acute (1 day) : 860 mg/L

→ TCMA Lakes/Streams:
39 impaired, 38 high risk

1 tsp

5 gal

Drinking Water

- 250 mg/L (taste)

Road De-Icers (Salt)

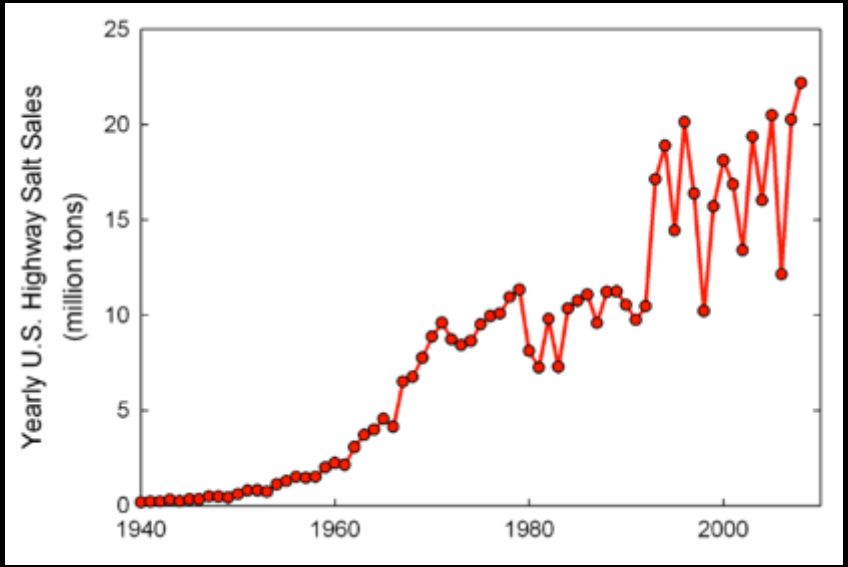
Primarily Sodium Chloride (NaCl)

Alternatives:

- Other Chloride Salts: $CaCl_2$, $MgCl_2$, KCl
- Acetate (liquid) -- bridges
- Beet sugar by-products
- Cheese Brine
- Abrasives: sand/gravel

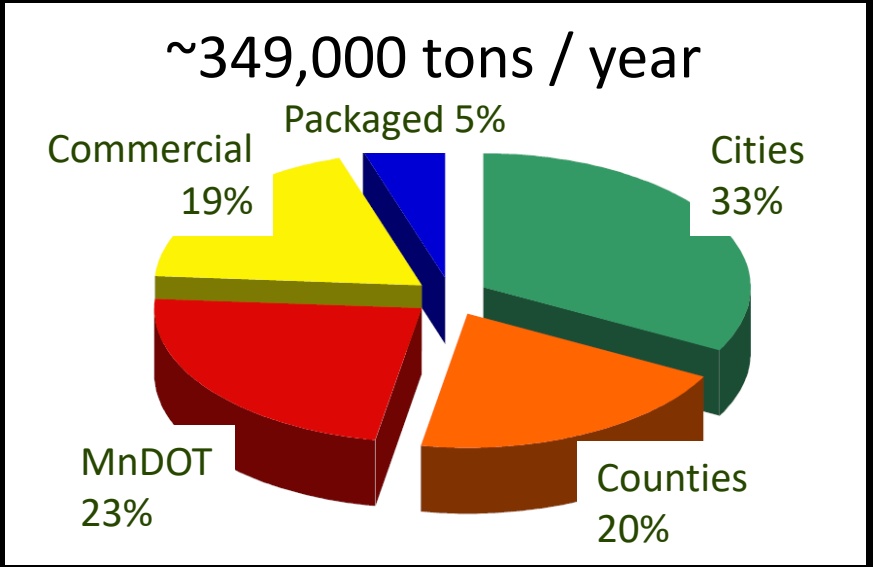
Road Salt: How Much?

U.S. Highway Salt Sales since 1940[1]



1: Data -- Salt Institute; Graph -- Walt Kelly (illinois.edu/blog/view/789/62191)

Salt Use in the Twin Cities, 2000-2005[2]



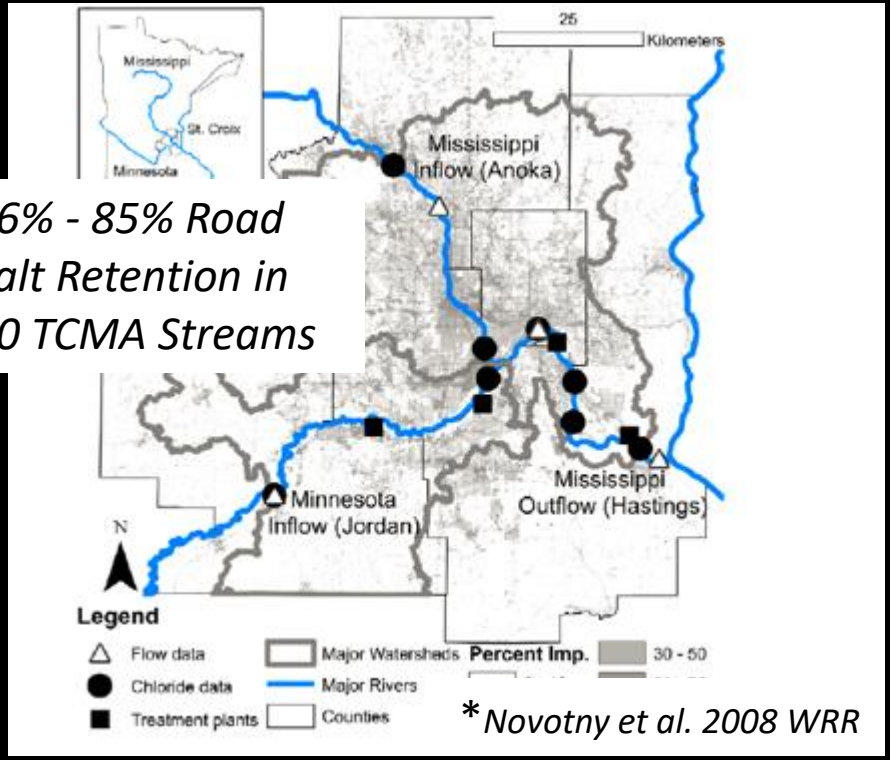
2: Sander et al. 2007 (St. Anthony Falls Lab)

Road Salt: Where does it go?

77% of Road Salt Used in the TCMA from 2000 – 2005* Remained in the Landscape ("Retention")

- Infiltrated to soil, groundwater
- Accumulated in bottom of lakes, ponds

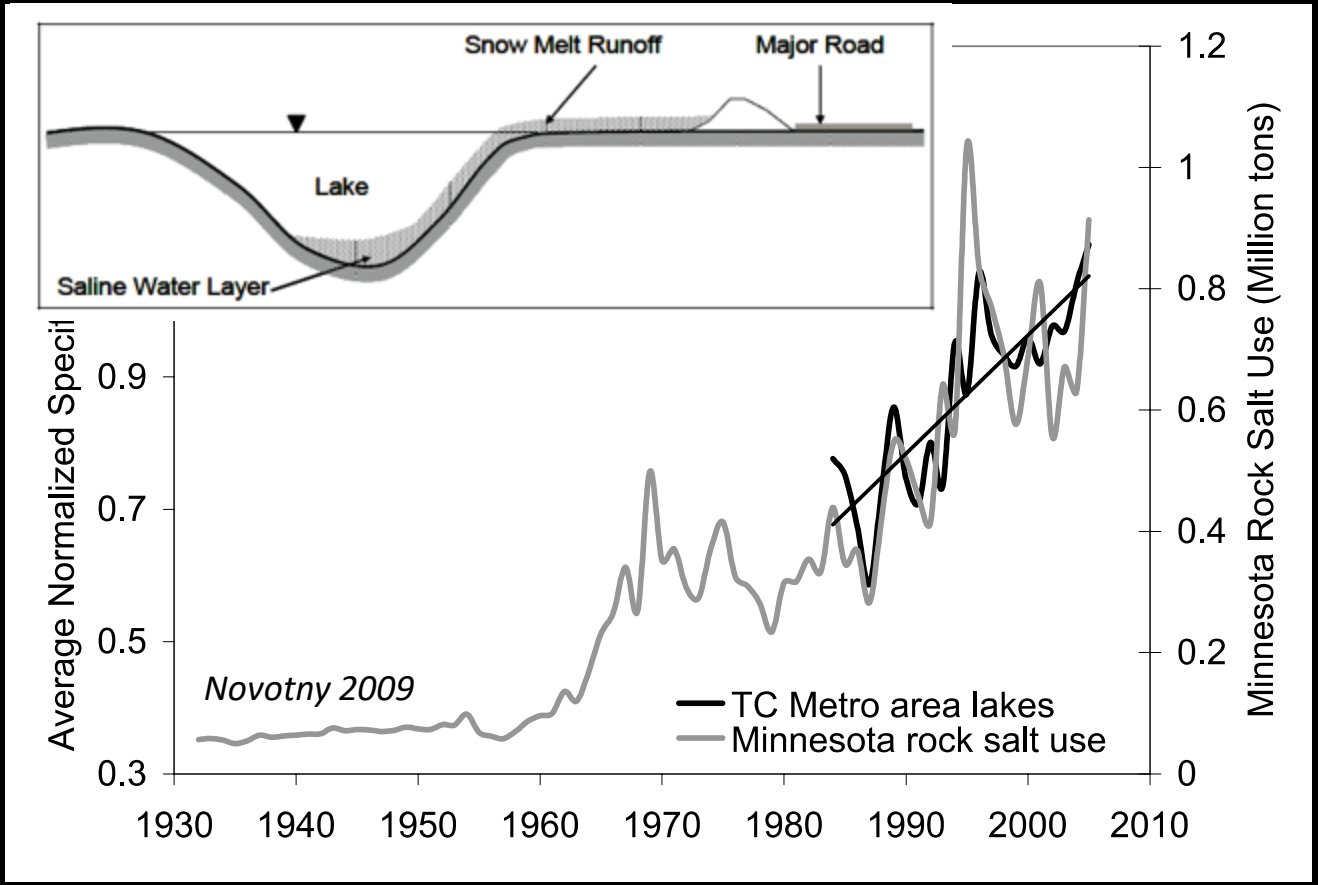
109,000 tons/year Chloride



56% - 85% Road Salt Retention in 10 TCMA Streams

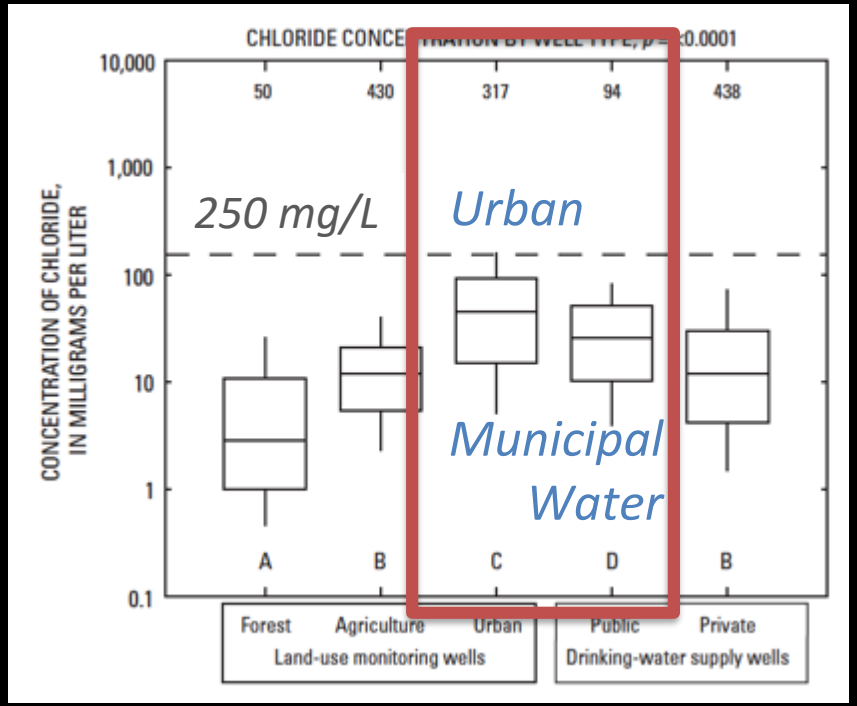
**Novotny et al. 2008 WRR*

Road Salt: Accumulation in Lakes



Road Salt: Accumulation in Groundwater

Northern USA (USGS, 2009)



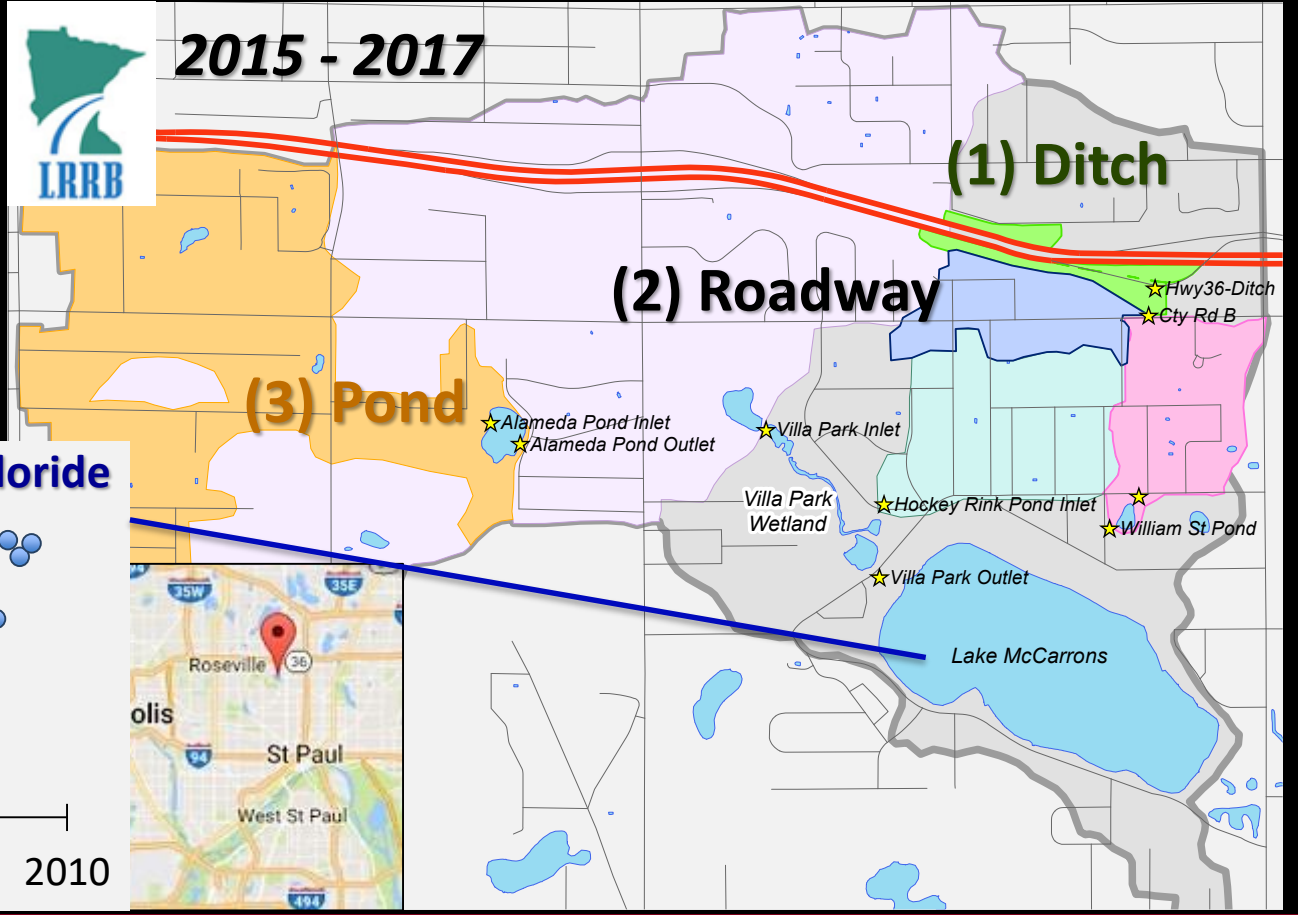
Minnesota (MPCA, 2013)

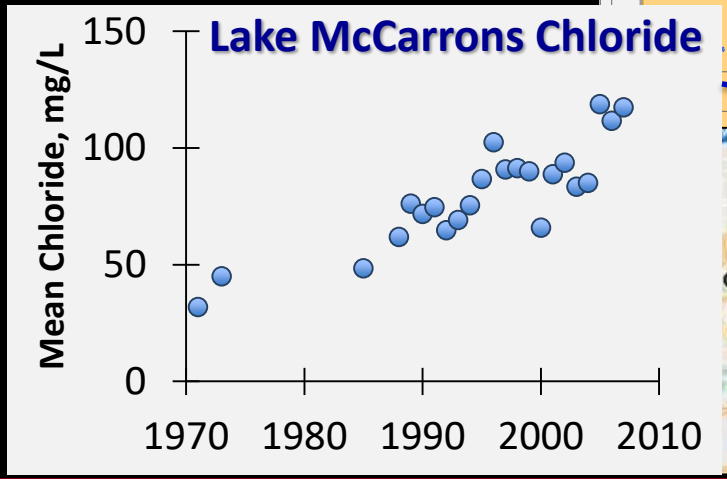
- 27% of shallow wells in TCMA in excess of drinking water standard for chloride (250 mg/L)
- Median Chloride in TCMA wells 5X that in rural wells

Current/Very Recent Road Salt Work at SAFL

1. How variable is road salt transport in snowmelt and runoff at small (management) scale
   - roadway, ditch, stormwater pond
2. How effective are permeable pavements for snow/ice removal?
3. How much salt is stored in roadside soils?

Where does road salt go, and When? How long does it stay there?



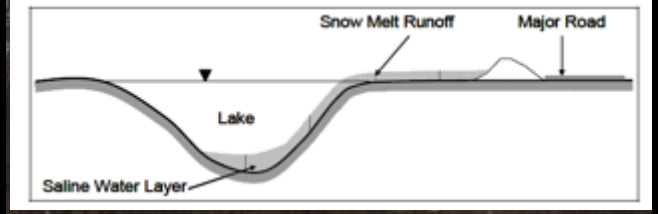


Primary Results (Take-Homes)

- Road Salt Retention is Highly Variable in the Urban Landscape (…Why?)

Ditch 94%

Curb & Gutter 52%

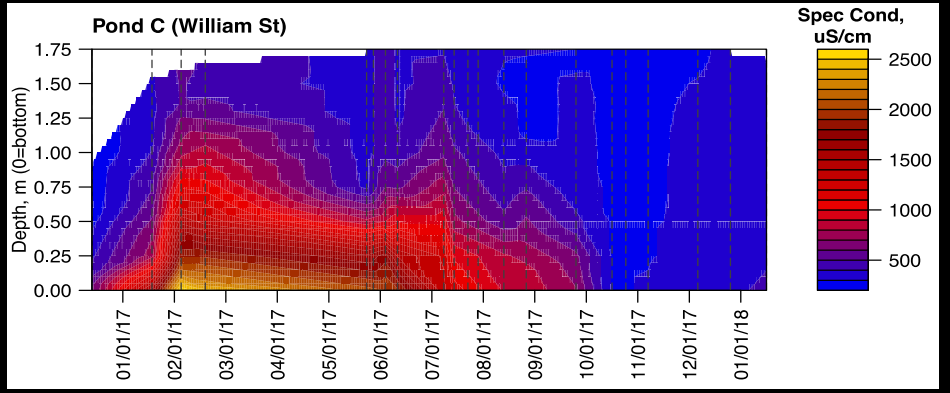


Pond: ~30%

Primary Results (Take-Homes)

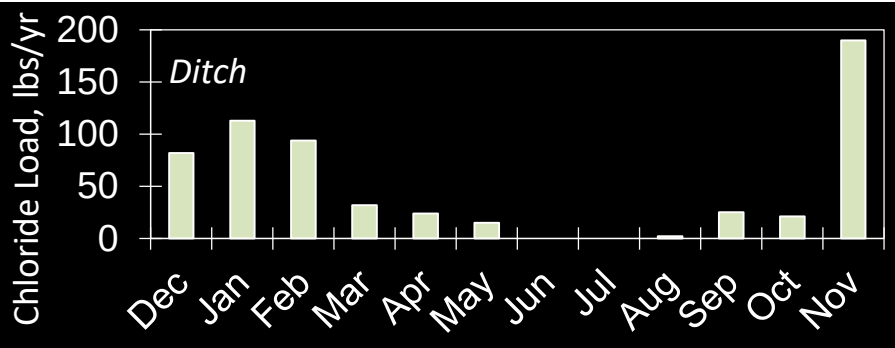
Salt Accumulates Even in Shallow Stormwater Ponds -- Through Summer

- Leads to low oxygen at pond bottom (impacts aquatic life, pond function)



Salt Transport Occurs from Ditches & Ponds Throughout the Season

- Especially in large storms, even in Late Fall



How to Manage Chloride? (Can we?)

- Reduction of Road Salt Use is most effective option
  - Balanced against need to protect human life, safe driving
  - Opportunities: “smart” trucks, home/business-owner education for smart salting, re-adjust expectations for winter driving
- Diversion of salty runoff at roadways or from ponds?
  - Expensive, treatment/disposal of runoff
- Alternative de-icers?
- Alternative pavements? (current research at SAFL)

Contact Information

Andy Erickson *eric0706@umn.edu (612-239-2046)*

Ben Janke *janke024@umn.edu* (612-716-6012)

St. Anthony Falls Laboratory

2 Third Ave SE

Minneapolis, MN 55414