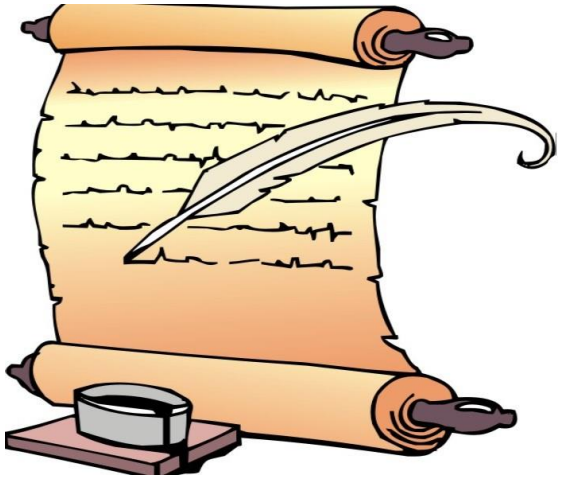
Salt Symposium October 24, 2019

James Hughes, P.E.
Wisconsin Department of Transportation
Chief State Highway Maintenance Engineer

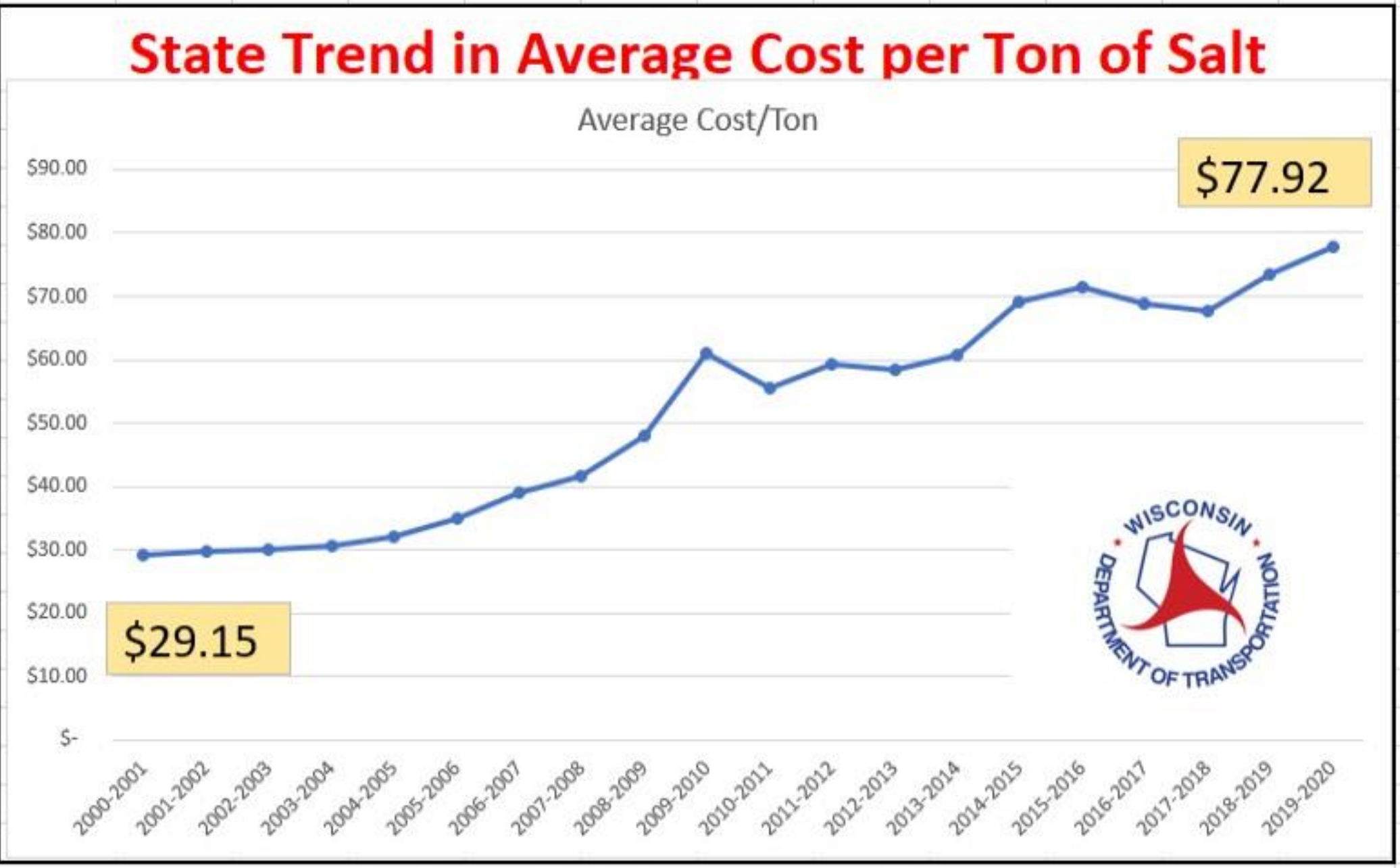
Presentation



- Wisconsin Salt (Cost Trend, Bid and Renewals)
- A look at Midwest States through Clear Roads Data
- Wisconsin 5 Regions Winter 2018/2019
- Wisconsin analysis of 5-year average salt use based on winter severity comparison to 2018/2019 winter salt use for all counties
- Top ten most improved counties in Wisconsin
- A view at Wisconsin's advanced Winter Maintenance County Results (Jefferson)
- Estimated savings in salt by ton and by cost due liquid application research and education for the 2018/2019 winter
- The Environmental Impacts
- Where Wisconsin is headed and the use of chemicals for Winter Maintenance

State Trend in Average Cost per Ton of Salt

Winter	Average Cost/Ton
2000-2001	$ 29.15
2001-2002	$ 29.92
2002-2003	$ 29.96
2003-2004	$ 30.57
2004-2005	$ 32.21
2005-2006	$ 34.98
2006-2007	$ 39.03
2007-2008	$ 41.69
2008-2009	$ 47.91
2009-2010	$ 60.92
2010-2011	$ 55.55
2011-2012	$ 59.18
2012-2013	$ 58.34
2013-2014	$ 60.78
2014-2015	$ 69.01
2015-2016	$ 71.35
2016-2017	$ 68.74
2017-2018	$ 67.60
2018-2019	$ 73.51
2019-2020	$ 77.92



Increase of 167% in 20 years

2019/2020 Wisconsin Salt Renewal

- Total salt renewal awarded 1.42M tons @ $107.7M
- State salt renewal award 485,591 tons @ $37.8M
- Local salt bid awarded 923,495 tons @ $69.9M
- We agreed to a 6% increase in salt prices over last season.
- Salt has become about 40% of our state highway total winter maintenance cost

Note:

The State highway system is 35.2% of the total state salt bid.

There are ~425 of the 1,924 local entities that could be on the state salt bid

Salt (NaCl) has environmental impacts

All money used to purchase salt leaves our State

2016/2017 Winter Material Cost

	State	Cost of all Materials	Lane Miles	Materials Cost per Lane Mile
1	New York	$ 60,000,000	43,716	$ 1,372.50
2	Wisconsin	$ 39,696,302	34,621	$ 1,146.60
3	Ohio	$ 37,626,000	43,304	$ 868.88
4	Massachusetts	$ 37,510,000	16,000	$ 2,344.38
5	Minnesota	$ 29,955,000	30,517	$ 981.58
6	Virginia	$ 28,687,066	130,338	$ 220.10
7	Colorado	$ 22,873,182	23,000	$ 994.49
8	Illinois	$ 19,899,000	43,146	$ 461.20
9	Washington	$ 17,972,971	18,900	$ 950.95
10	New Hampshire	$ 17,279,889	9,366	$ 1,844.96
11	Connecticut	$ 14,073,000	10,870	$ 1,294.66
12	Indiana	$ 13,701,683	26,507	$ 516.91
13	Pennsylvania	$ 12,500,000		
14	Nebraska	$ 11,977,138	23,168	$ 516.97
15	Missouri	$ 11,500,000	77,000	$ 149.35
16	Vermont	$ 10,996,965	6,511	$ 1,688.98

2016/2017 Winter Material Cost

	State	Cost of all Materials	Lane Miles	Materials Cost per Lane Mile
1	Massachusetts	$ 37,510,000	16,000	$ 2,344.38
2	New Hampshire	$ 17,279,889	9,366	$ 1,844.96
3	Vermont	$ 10,996,965	6,511	$ 1,688.98
4	New York	$ 60,000,000	43,716	$ 1,372.50
5	Maine	$ 10,748,715	8,300	$ 1,295.03
6	Connecticut	$ 14,073,000	10,870	$ 1,294.66
7	Wisconsin	$ 39,696,302	34,621	$ 1,146.60
8	Colorado	$ 22,873,182	23,000	$ 994.49
9	Minnesota	$ 29,955,000	30,517	$ 981.58
10	Washington	$ 17,972,971	18,900	$ 950.95
11	Ohio	$ 37,626,000	43,304	$ 868.88
12	Utah	$ 10,089,888	16,000	$ 630.62
13	Oregon	$ 10,683,195	19,090	$ 559.62
14	Nebraska	$ 11,977,138	23,168	$ 516.97
15	Indiana	$ 13,701,683	26,507	$ 516.91
16	Illinois	$ 19,899,000	43,146	$ 461.20

"FINAL" CLEAR ROADS 2015-2016 Winter Report					
	Wisconsin	Minnesota	Iowa	Michigan	Illinios
Lane Miles	34,486	30,632	24,122	30,043	43,094
Salt use (Tons)	399k	156K	148K	458K	317K
Brine/Liquid Use (Gallons)	4.0M	2.4M	20.2M	1.5M	1.8M
Material Costs	$31.1M	$24.5M	$11.4M	N/R	$19.3M
Equipment Costs	$20.8M	$40.5M	$5.5M	N/R	$26.7M
Labor Costs	$20.1M	$29.2M	$13.9M	N/R	$26.3M
Total Costs	$72.0M	$94.2M	$30.8M	$93.0M	$72.3M
COST/LANE MILE	$2,087	$3,074	$1,278	$3,096	$1,651
"Final" CLEAR ROADS 2016-2017 Winter Report					
Lane Miles	34,621	30,517	24,243	32,045	43,183
Salt use (Tons)	526k	453K	122K	432K	305K
Brine/Liquid Use (Gallons)	4.9M	0.13M	21.8M	1.3M	1.0M
Material Costs	$39.7M	$30.0M	$10.5M	N/A	$19.9M
Equipment Costs	$24.9M	$35.8M	$4.9M	N/A	$13.2M
Labor Costs	$23.2M	$31.3M	$10.9M	N/A	$15.2M
Total Costs	$87.8M	$97.1M	$26.3M	$99.0M	$48.3M
COST/LANE MILE	$2,537	$3,182	$1,085	$2,809	$1,118
"Final" Wisconsin 2017-2018 Winter Report					
Lane Miles	34,678	30,585	24,482	32,045	n/a
Salt use (Tons)	568K	439K	175K	619K	n/a
Brine/Liquid Use (Gallons)	5.7M	4.3M	32.4M	2.4M	n/a
Material Costs	$41.8M	$34.7M	$15.1M	n/a	n/a
Equipment Costs	$29.2M	$47.1M	$6.0M	n/a	n/a
Labor Costs	$26.8M	$42.2M	$13.5M	n/a	n/a
Total Costs	$97.8M	$124.0 M	$34.6M	n/a	n/a
COST/LANE MILE	$2,821	$4,054	$1,413	n/a	n/a
"Final" Wisconsin 2018-2019 Winter Report					
Lane Miles	34,774				
Salt use (Tons)	553K				
Brine/Liquid Use (Gallons)	9.4M				
Material Costs	$44.1M				
Equipment Costs	$36.3M				
Labor Costs	$31.3M				
Total Costs	$111.7M				
COST/LANE MILE	$3,212				

Data Not Available Yet

Wisconsin's 5 Winter Regions

2018/2019 Winter Results Region						
	NCR	NER	NWR	SWR	SER	Wisconsin
Salt (tons)/Lane Mile (range by counties)	10.17 -22.21	10.89 - 18.00	8.55 - 17.39	6.86 - 26.30	13.00 - 22.48	6.86 - 26.30

2018/2019 Individual Regions Materials Equipment and Labor Costs

Material Costs/ Lane Mile					
Average in Wisconsin	NCR	NER	NWR	SWR	SER
$1,266	$1,277	$1,138	$1,152	$1,392	$1,325

Equipment Costs/ Lane Mile					
Average in Wisconsin	NCR	NER	NWR	SWR	SER
$1,040	$1,113	$1,128	$1,047	$979	$998

Labor Costs/ Lane Mile					
Average in Wisconsin	NCR	NER	NWR	SWR	SER
$897	$772	$932	$838	$800	$1,243

Brine Operations in (Gallons/ Lane Mile)					
Average in Wisconsin	NCR	NER	NWR	SWR	SER
270.1	420.0	447.8	99.7	253.8	205.0

Sodium Chloride Brine vs Rock Salt

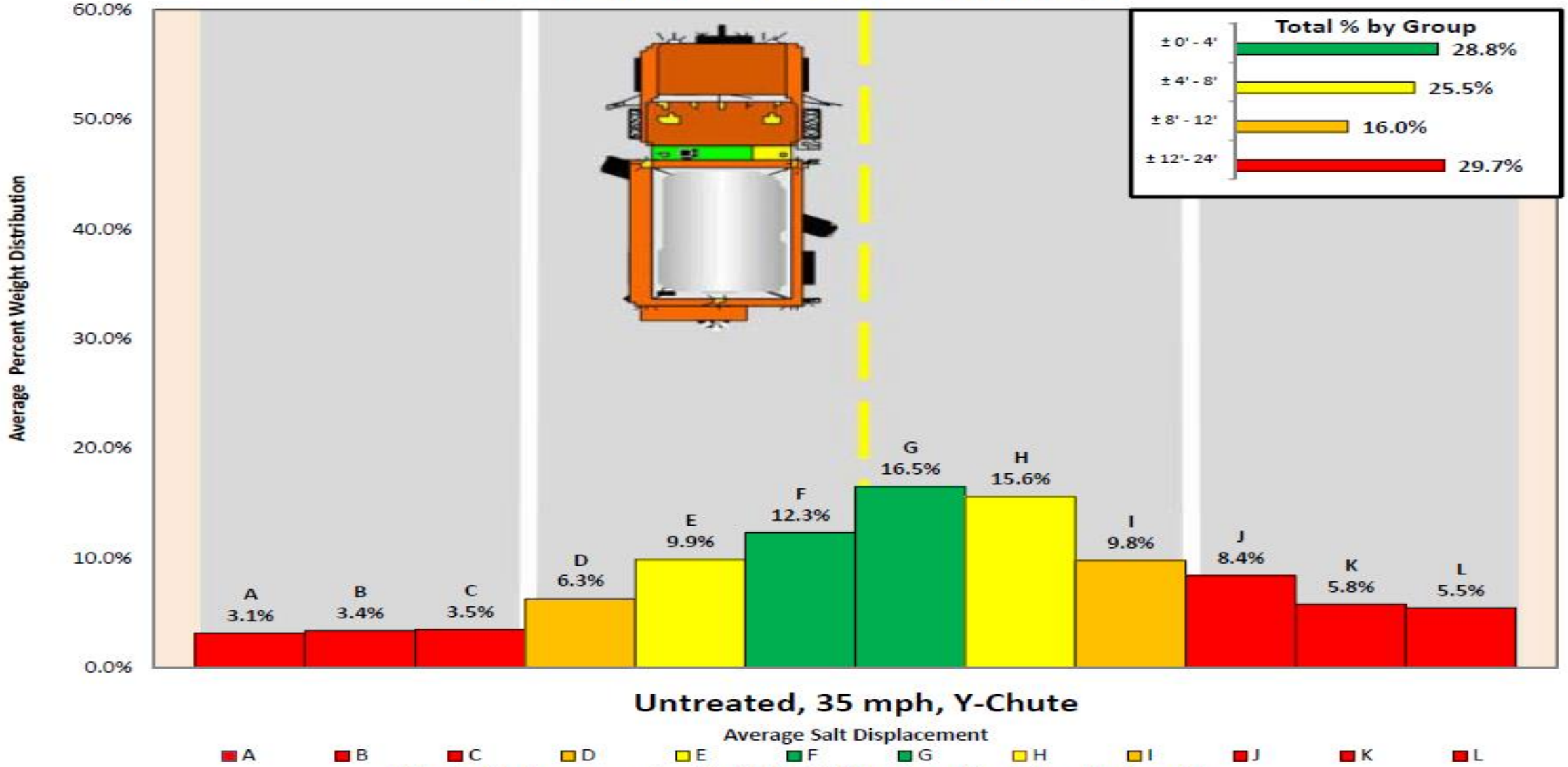
(research done by others)

- 25 gallons/acre of sodium chloride brine = 300 lbs. of salt/lane mile
- 43,560 sq ft/acre IMPLIES 25 gallons for a 15' lane goes 2,904' (.55 miles)
- It would take 50 gallons of brine to go 1.10 lane miles
- To make one gallon of brine is 2.29 pounds of salt (at 23.3% solution)
- It would take 2,290 lbs. or 1.145 tons of salt to make 1,000 gallons of brine
- **Liquid:** $70/ton of salt it would **cost $80.15** to brine 22 lane miles **(1.145 tons)**
- **Rock Salt:** $70/ton and 300lbs/lane mile **cost would be $231.00** to treat same 22 lane miles **(3.300 tons)**

$$$ Liquid Application results in **~3X** less cost than **Granular Salt** $$$

You're using about **~3X less salt** achieving the same results

Bounce and Scatter Collection Graphs



Untreated, 35 mph, Y-Chute

Average Salt Displacement

A B C D E F G H I J K L

Note: Each letter represents a 4' width by 100' length portion of the collection grid.

MDOT Michigan Department of Transportation

Operations Field Services Division

Southwest Region
June 2012

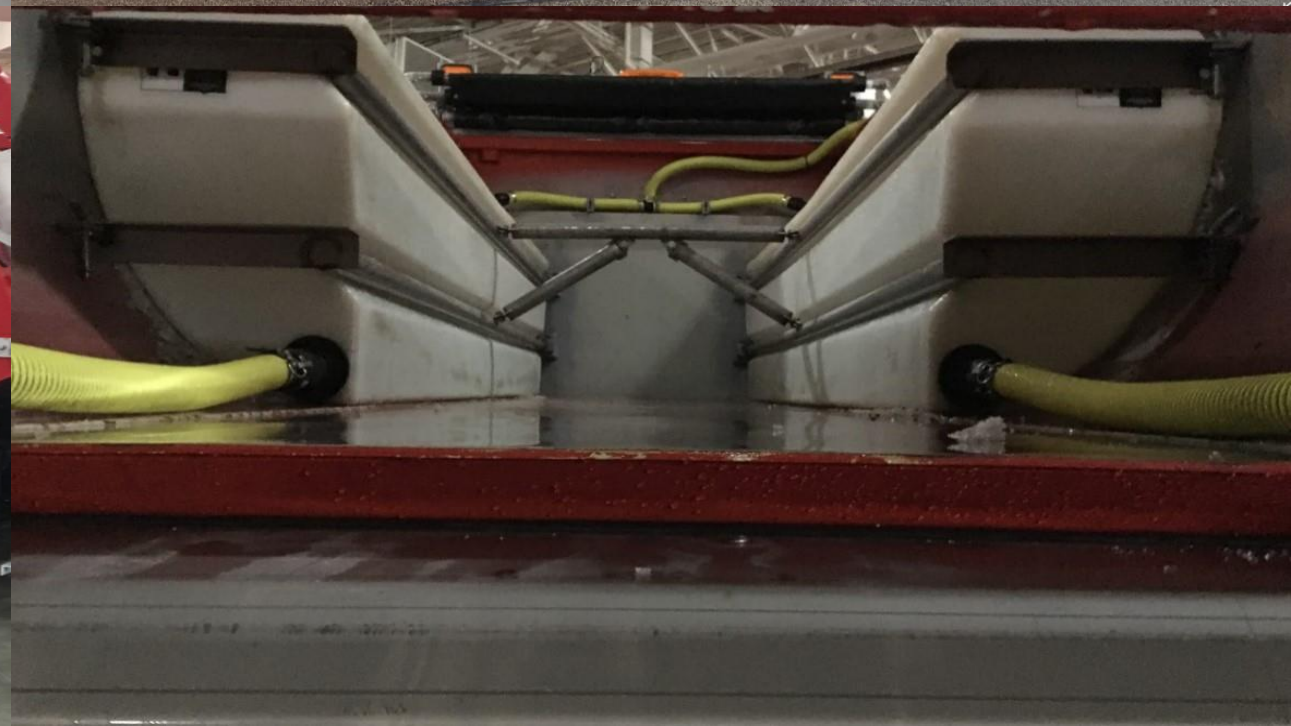
Using 300lbs/LM of Granular vs. 50Gals of Liquid/LM

Pre-Wet Salt 68/72

Anti-Icing 55/72

Mostly Liquid Routes 4/72

State purchased 15 New HC Brine Makers



Evaluation of Salt Use on State Highway System

2018/2019 State Highway Salt Use Analysis by County — Updated: 08-07-2019 with new lane mile

Updated: 5/30/2019		2013/2014-2017/2018			2018 -2019								
County	REGION	5-Year Average Winter Severity	5-Year Average Salt Use (tons)	5-Year Salt use Normalized at WS=100	2018/2019 WS	Projected Salt Use based on a 5-Year Ave Using WS	2018/2019 Actual Salt Use	2018/2019 Salt Use Decrease or Increase	Salt Cost/Ton	Actual Calculated Savings	% Increase or Decrease in Salt Use	State Data Provided to Plow Drivers	HC Brine Equipment Purchases
JEFFERSON	SW	74.6	8679	11,634	93.3	10,852	5,116	(5,735.90)	$ 74.53	$ (427,496)	-52.86%	X	X
OZAUKEE	SE	81.0	6666	8,230	96.7	7,961	4,023	(3,937.80)	$ 61.76	$ (243,199)	-49.46%	X	
VILAS	NC	139.2	7320	5,259	134.1	7,053	3,935	(3,117.97)	$ 90.67	$ (282,707)	-44.21%	X	
TAYLOR	NW	107.6	3101	2,882	113.0	3,258	2,232	(1,025.79)	$ 91.22	$ (93,573)	-31.49%		
SHAWANO	NC	87.7	7345	8,375	107.2	8,982	6,376	(2,606.41)	$ 69.23	$ (180,441)	-29.02%	X	X
PRICE	NC	124.1	4795	3,864	124.6	4,814	3,541	(1,272.23)	$ 87.35	$ (111,130)	-26.43%		X
IOWA	SW	70.2	5371	7,651	93.2	7,128	5,429	(1,698.46)	$ 69.28	$ (117,669)	-23.83%		
MARATHON	NC	98.2	11131	11,335	105.9	12,009	9,399	(2,609.91)	$ 84.85	$ (221,451)	-21.73%	X	XX

Top ten most improved counties in reducing salt use based on their own 5-year average (2018/2019 Winter)

1. Jefferson (SWR)= 52.9%
2. Ozaukee (SER) = 49.5%
3. Vilas (NCR) = 44.2%
4. Taylor (NWR) = 31.5%
5. Shawano (NCR) = 29.0%
6. Price (NCR) = 26.4%
7. Iowa (SWR) = 23.8%
8. Marathon (NCR) = 21.7%
9. Vernon (SWR) = 21.3%
10. Dodge (SWR) = 20.7%

Analysis of 5-year average salt use based on winter severity comparison to 2018/2019 winter salt use for all counties

48 of our 72 Counties Improved

Jefferson County 2018/2019

- Reduction of **52.9%** in salt use (over 5-year average using winter severity)
- Averaged **1,468 gallons** of brine per lane mile (Iowa ~1,324 gal/lm)
- At $74.53/ton saved the State **$427,496** in salt purchase
- Extra Cost to produce the brine was ~ $45,000
- Jefferson County reported saving $206,000 on their county system
- Jefferson below region average labor and equipment costs AND salt use!

	Southwest Region Average per Lane Mile	Jefferson County results per Lane Mile
Total Labor Cost	$800.36	$652.53
Total Equipment Cost	$978.55	$904.52
Total Salt Used (including salt used in brine)	17.19 tons	9.31 tons

2018/2019 Jefferson County Mostly Liquid Pilot Results

"through week 19 storm reports"

	Jefferson	Bordering Counties					
		Dodge	Waukesha	Walworth	Rock	Dane	Average
Ton/LM	6.8	14.8	10.5	20	13.6	20.8	14.725

	Average	Jefferson	Change
Ton/LM	14.725	6.8	7.925

	Change	Lane Miles	Salt Cost	Saving to Date
Cost Savings	7.925	549.67	$ 74.53	$ 324,662.72

Salt Saved
4,356 Tons

Estimated savings in salt by ton and by cost due to liquid application research and education for the 2018/2019 winter

State Highway Salt use Reduction

= 53,915 tons =~108M pounds

Estimated Cost Savings in Salt Purchase for State Highways

= $4,003,378

Salt and Our Environment

There are growing Environmental Concerns

Chloride Impact Study for the Southeastern Wisconsin Region

March 21, 2018
Laura K. Herrick, P.E., CFM
SEWRPC Chief Environmental Engineer

F241305

USGS science for a changing world

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Wisconsin Water Science Center

Evaluating chloride trends due to road-salt use and its impacts on water quality and aquatic organisms

Overview | Results | Publications | Multimedia | News | Partners

Chloride, a key component of road salt, is soluble, highly mobile in water, and, at high concentrations, can be toxic to aquatic vegetation and wildlife. USGS scientists have been analyzing temporal, seasonal, and environmental trends in chloride concentrations across the U.S. to determine the effects that road salt may be having on water quality and aquatic organisms.

Status - Active

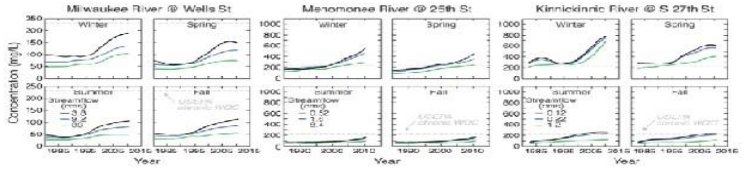


Figure 9. Chloride concentration estimates at 10, 50, and 90 percentile flow rates from the WRTDS model over time and grouped by seasons for three Wisconsin streams. Graphics are presented in order of increasing watershed size and then nearly urban land (urban from left to right). Streamflow is expressed in cubic meters per second (cms). Dashed line for USEPA chronic water quality criteria represents 230 mg/L.

High road salt use causing Wisconsin lakes to suffer

By: **Justin Thompson-Gee** Facebook | Twitter

Posted: Feb 20, 2018 10:35 PM CDT

FACEBOOK TWITTER @ EMAIL

POLITICS & POLICY

We're pouring millions of tons of salt on roads each winter. Here's why that's a problem.

By Greg Breining | 11/20/2017

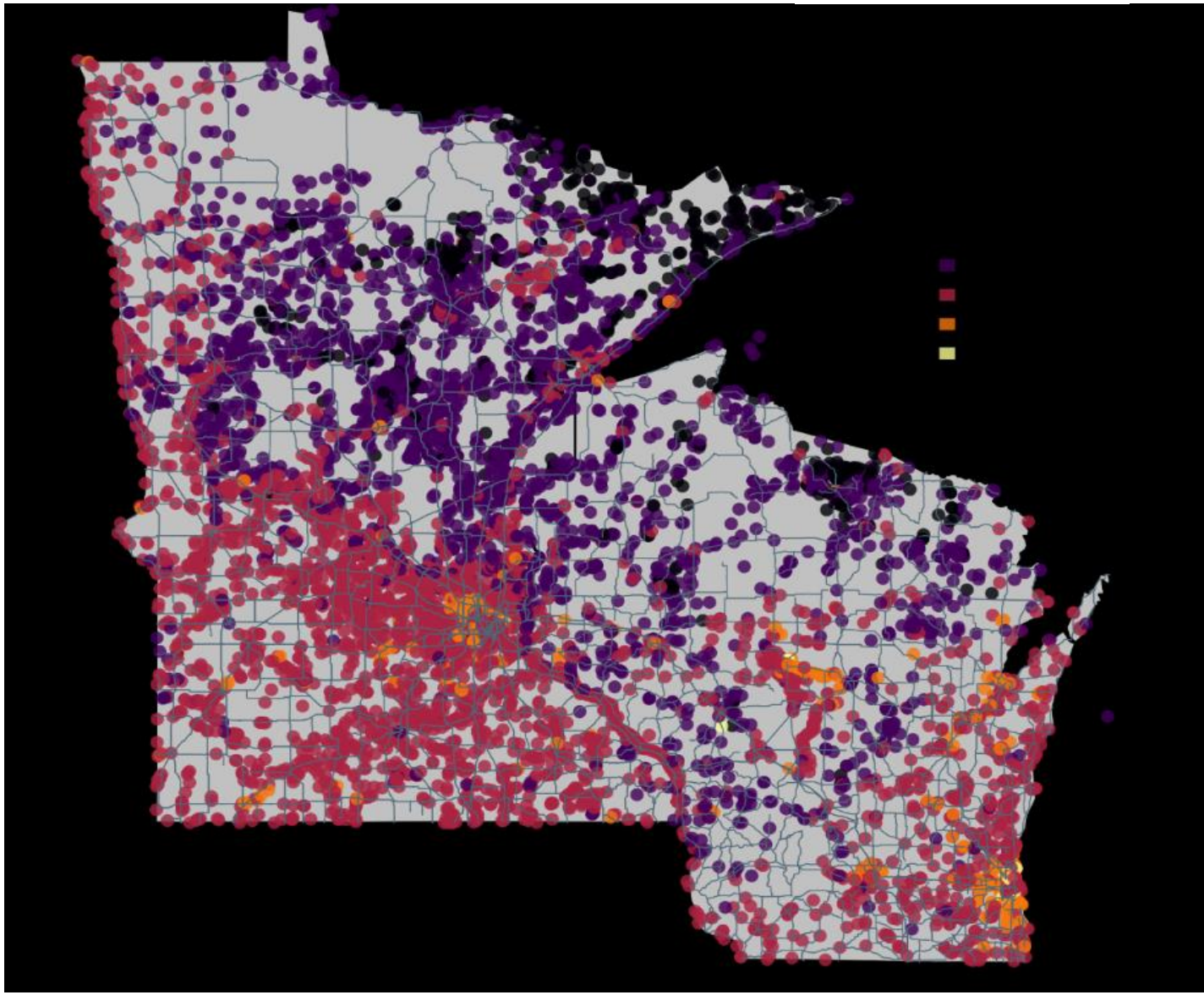
Email | Facebook | Twitter | Print

MnDOT

U.S. road maintenance departments have been spreading salt on streets and highways to melt snow and ice since the 1940s.

Chlorides affecting Lakes + Streams in Minnesota and Wisconsin

- <10mg/l = Normal
- 10-100 mg/l = Impacted
- 100-1,000 mg/l = Highly Impacted
- >1,000 mg/l = Severely Impacted



What are we doing about Salt?

- We put together a Technical Advisory Committee (TAC)
- The State has allocated monies to assist in the research of liquid application rates and additives
- State and counties working together bringing in experts to provide education and training.
- Pilot counties are sharing information with other counties, WisDOT and the University of Wisconsin Tops Lab.
- The State is assisting purchases of high capacity brine makers.
- Counties are engaging in additional plow driver training with an emphasis on material use. Some counties have “material use programs”
- Clear Roads has accepted a research project proposed by Wisconsin to better define liquid application rates and blends when using additives.

WisDOT created a “Brine Technical Advisory Committee” consisting of 14 counties, UW Tops Lab, all regional maintenance offices and Bureau of Highway Maintenance.

RESEARCH

Expanding Brine Recipes and Define Application Rates

$150,000 Estimated Cost

- The goal of this project is to expand the current brine application rate tables in Clear Roads Tables 15-01 to include brine blends, and update or expand DLA rates to include more scenarios. The expansion needs to include application rates beyond the capability of standard or prior equipment configurations and temperature ranges.

WANT TO REDUCE ROAD SALT IMPACTS ON ECOSYSTEMS AND INFRASTRUCTURE?
JUST ADD WATER.