



WINTER MAINTENANCE AT A GLANCE

2017-2018

The Snow Must Go On



Introduction

Snow and ice control is a critical element of operations on our state highway system. To meet level of service goals in this area, Wisconsin DOT contracts with the state's 72 county highway departments for winter maintenance on these highways, a unique and mutually beneficial partnership. WisDOT receives the services of a skilled, experienced work force, and supports the counties through training, research initiatives, and testing of products, equipment and methods.

This summary document highlights key aspects of the 2017-2018 winter, including weather, materials and equipment use, performance, and costs. The complete Annual Winter Maintenance Report, which provides further detail on these areas and others, will be available at:

<http://wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/default.aspx>

Inside

Statewide Winter Summary	2-3
Materials and Costs	4-5
Measuring and Advancing Performance	6-7
Looking Ahead	Back cover

Statewide Winter Summary

Winter by the Numbers

In 2017-2018, Wisconsin experienced a more costly winter than the previous year, and winter was slightly more severe than in 2016-2017. Compared to last year's winter costs of \$87,836,693, this winter's costs totaled \$97,831,087; an increase of 11 percent. The state experienced an average of 33 winter storms this winter, resulting in an average of 77.8 total inches of snowfall. This average represents a 29 percent increase from last year's statewide average of 60.2 inches of snow.

This year the statewide average Winter Severity Index was 97.53 which is six percent lower than the average of the previous ten winters (103.4). [Figure 1](#) on page 3 shows county 2017-2018 winter severity indices versus 5 year averages. Salt use was eight percent higher than 2016-2017, at 567,600 tons.

[Table 1.](#) summarizes key facts and statistics from this winter in several core areas. The 2017-2018 Annual Winter Maintenance Report provides more detail on all topics in this table.

Table 1. Statewide Summary: This Winter by the Numbers

	Measure	Previous Winter	2017-2018
Infrastructure	Lane miles	34,620 miles	34,678 miles
	Patrol sections ⁴	755.0	754.0
	Average patrol section length ⁴	45.85 lane miles	46.0 lane miles
Weather	Average statewide Winter Severity Index	91.14	97.53
	Number of storms, statewide average and range across counties	Average: 26 Range: 13 to 55	Average: 33 Range: 20 to 61
	Snowfall, statewide average and range across counties	Average: 60.2 Range: 14.8 to 132	Average: 77.8 Range: 25.8 to 222.6
Materials ¹	Salt used	526,199 tons 15.20 tons per lane mile	567,600 tons 16.40 tons per lane mile
	Average cost of salt	\$68.74 per ton	\$67.60 per ton
	Prewetting liquid used	3,018,207 gal.	3,359,432 gal.
	Calcium chloride brine used		164,695 gal.
	Magnesium chloride brine used		146,059 gal.
	Total brine and blends used		5,742,575 gal.
	Anti-icing agents used	1,918,324 gal.	2,383,143 gal.
	Sand used	14,036 cubic yd.	19,955 cubic yd.
Costs and Performance	Total winter costs ²	\$87,836,693	\$97,831,087
	Total winter costs per lane mile	\$2,537	\$2,821
	Average crew reaction time from start of storm	2.22 hours	4.25 hours
	Percentage of roads to bare/wet pavement (Within WisDOT target times)	70%	66%
	Road Weather Information System (RWIS) stations	68	68
	Underbody plows	355	753
	Counties that used anti-icing agents during the winter season	63 of 72 (88%)	64 of 72 (89%)
Labor and Services	Regular county winter labor hours ³	147,395 hrs.	166,741 hrs.
	Overtime county winter labor hours	122,220 hrs.	140,471 hrs.
	Public service announcements aired	13,936 total 12,269 radio; 1,667 TV \$36,000	9,954 total 8,385 radio; 1,569 TV \$36,000
	Cost of public service announcements	(\$498,411 market value)	(\$334,564 market value)

1. All material usage quantities are from the county storm reports except for salt. Salt quantities are from WisDOT's Salt Inventory Reporting System.

2. Costs refer to final costs billed to WisDOT for all winter activities, including activities such as installing snow fences and thawing culverts.

3. Labor hours come from county storm reports, and reflect salting, sanding, plowing and anti-icing efforts.

4. Patrol sections and average length include hybrid sections in some counties which may include a portion of county highway.

Statewide Winter Summary

Up and Down

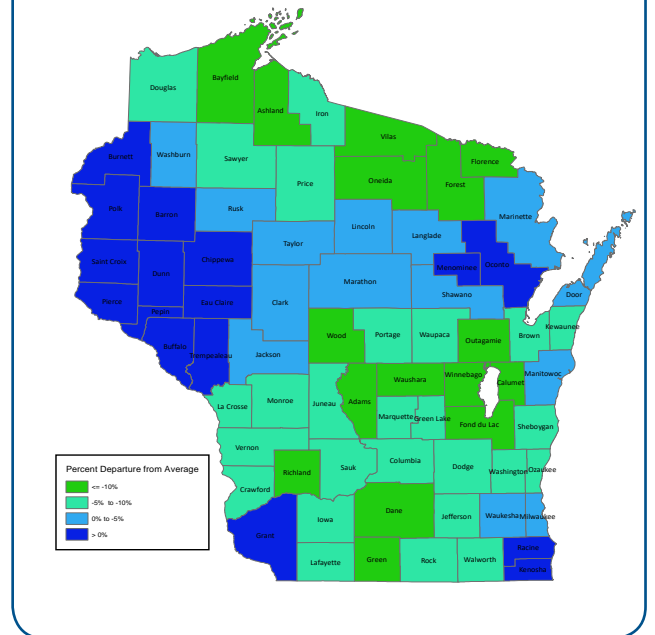
Winter started off on the mild side. There was little snowfall in November and the first Arctic air outbreak didn't occur until the last 10 days of December. Then January temperatures fluctuated wildly, but in the end monthly temperatures were about average. February was much colder than January and had one major snowstorm in southern Wisconsin and another in northwest Wisconsin. March was a return to average conditions. April featured record cold across the state. Temperatures averaged about 10 degrees Fahrenheit below normal for the month. Most of Wisconsin received over seven times the normal amount of snow for April.

During the 2017-18 winter season, county highway departments responded to:

- A statewide average of 33 winter events per county, or 7 more than the previous winter. The high was 61 events in Douglas County and the low was 20 events in Milwaukee County.
- A statewide average of 4 frost events.
- A statewide average of 5 freezing rain events.

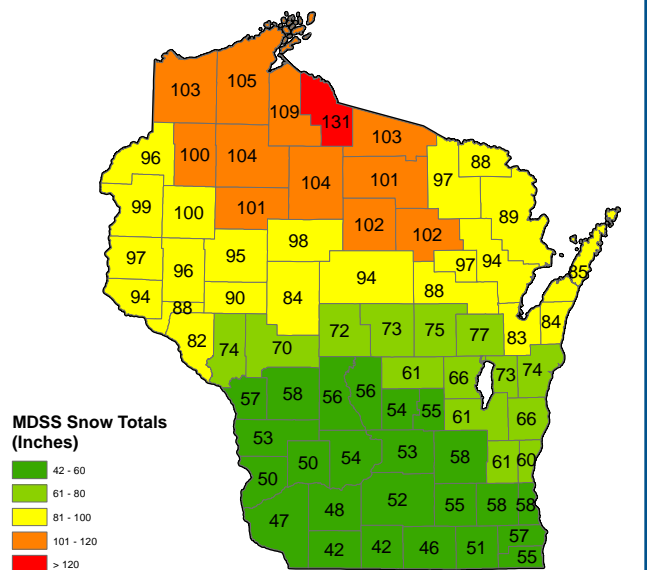
Figure 2 shows the total snowfall received in Wisconsin this winter based on storm report data. Snowfall varied significantly across the state; the highest snowfall recorded was in Iron County, at 131 inches; the lowest was in Lafayette and Green Counties, at 42 inches. This winter's statewide average total snowfall was 77.8 inches.

Figure 1. 2017-2018 Winter Severity Index vs. 5-Year Average



Note: If you are looking at black-and-white versions of the maps in this report, you may download a color version of the report at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.

Figure 2. Statewide Snowfall, 2017-2018



Statewide average: 77.8 inches

Note: Snowfall totals are based on winter storm reports data.

Salt and Anti-icing Work Together

Salt use was eight percent higher than the previous year, at 567,600 tons. Figure 3 shows county 2017-2018 salt usage per lane mile versus 5 year averages. Figure 4 shows statewide historical salt usage per lane mile overlaid with average severity index. WisDOT encourages counties to use salt efficiently by making use of best practices such as anti-icing and prewetting. Use of anti-icing materials was up 33 percent over last year, with counties using a record 2,556,031 gallons of anti-icing liquid. 64 counties made at least one anti-icing application. Use of prewetting materials was up approximately 11 percent over last year with counties using 3,359,432 gallons.

In contrast, WisDOT actively discourages counties from using sand on the state trunk highway system. Sand is not effective at high traffic speeds, negatively impacts the environment, and ultimately decreases the level of service provided. Counties used 19,955 cubic yards of sand on state highways this year, a 42 percent increase from the previous year. This was likely due to a higher number of freezing rain events.

Wisconsin counties applied a statewide average of 16.4 tons of salt per lane mile, an increase of eight percent compared with the 2016-2017 winter. When compared with nearby states, which differ by winter severity and level of service standards, Wisconsin salt use is relatively high. In 2017-2018 Wisconsin used 16.4 tons of salt per lane mile on state highways. In that same year, Minnesota (8.2 tons per lane mile) and Iowa (7.2) used less, while Michigan (19.3) used more.

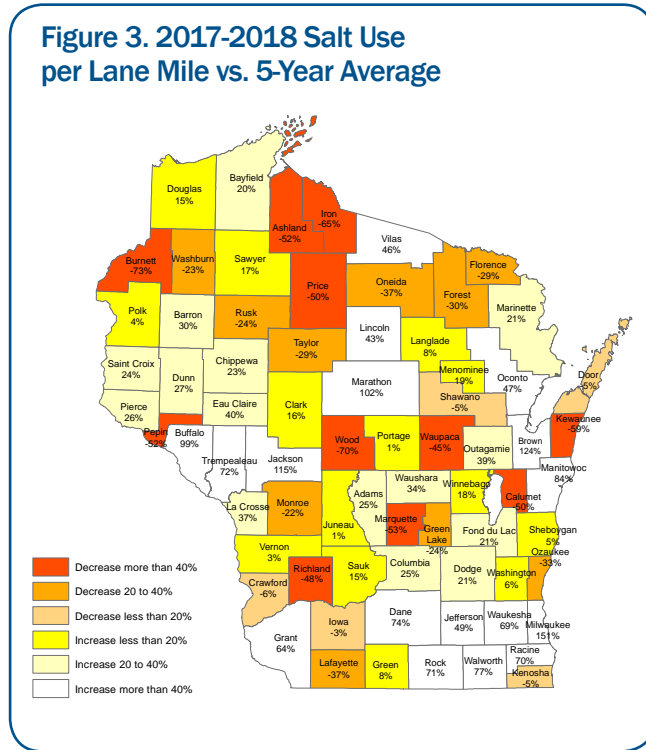
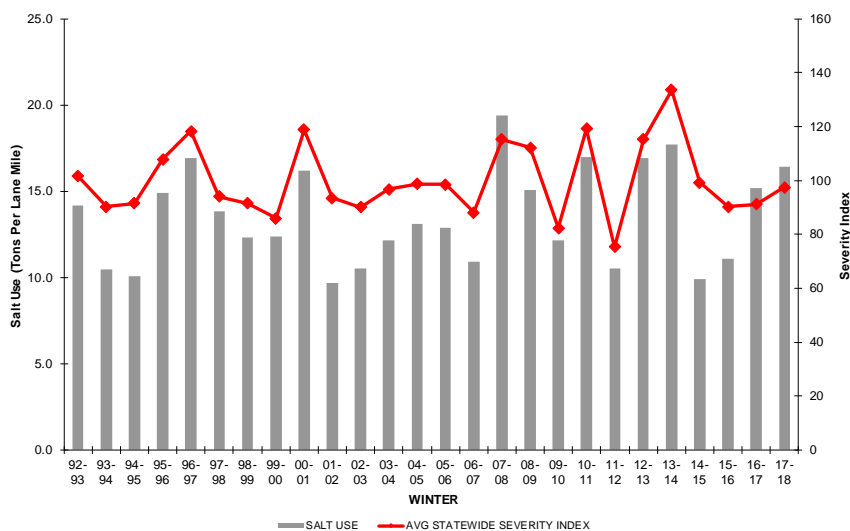


Figure 4. Salt Use per Lane Mile and Average Severity Index
From Salt Inventory Reporting System, 1992-2018



Higher Labor and Equipment Costs

The total cost of statewide winter operations this winter was \$97.8 million, making it 11 percent more costly than 2016-2017. The winter was more severe in 2017-2018 which likely accounts for some of the increase in cost. Figure 5 also demonstrates an 11 percent increase in winter costs from the average of the previous five years. This winter's statewide average cost per lane mile of \$2,821 was 11 percent higher than last year's cost of \$2,537 per lane mile.

WisDOT spent \$38.3 million on salt, \$29.2 million on equipment-related expenses, \$24.0 million on labor, and \$3.4 million on materials other than salt, such as sand. Administrative costs added \$2.8 million to the total. Similar to previous winters, anti-icing activities only make up only about 2 percent of total expenditures.

As is to be expected, winter costs per lane mile tend to increase as statewide average winter severity increases. Annual increases in labor rates and salt pricing also affect overall winter maintenance cost, even in less severe winters. This winter was more severe than last year and costs were slightly higher this year. Total salt expenditures increased by five percent compared to the prior year, while cost of salt per ton decreased two percent. The cost for materials other than salt increased by nine percent. Labor and equipment costs increased by 16 percent and 17 percent, respectively. Salt continues to be the largest expenditure, accounting for 39 percent of all costs (see Figure 6).

Salt prices have generally leveled out after several years of increases. The average of \$67.6 per ton is a decrease of two percent (2%) from last year. Each of the previous two winters WisDOT has renewed its existing salt contracts at lower prices in lieu of rebidding. Figure 7 shows historical salt prices for Wisconsin and for 14+ states nationwide.

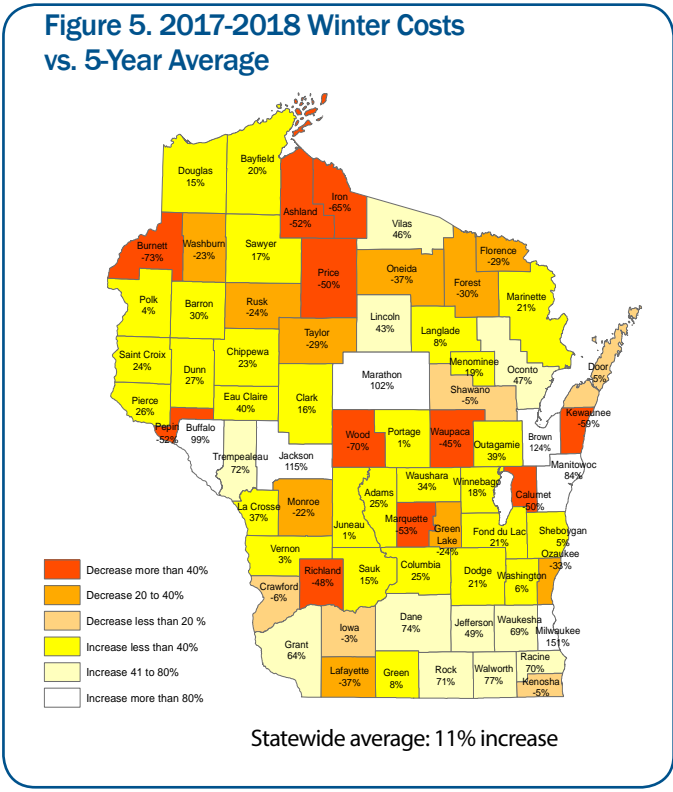


Figure 6. Expenditures by Category, 2017-2018

Statewide Winter Costs
2017-18 Total Cost: \$97,831,087

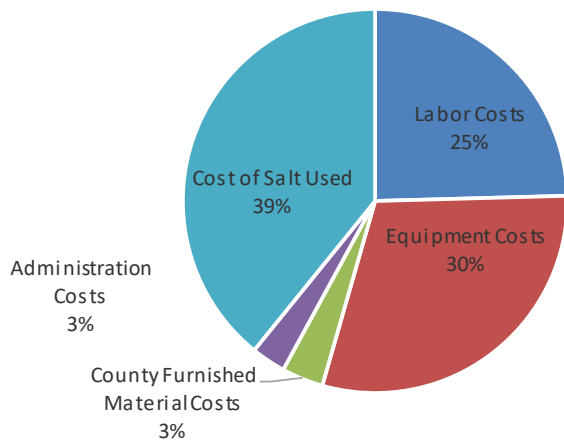
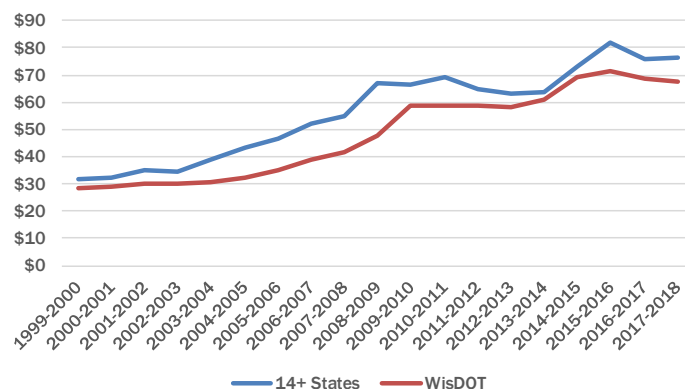


Figure 7. Salt Prices Over Time

Historical data supplied by Clear Roads. From 1999 to present, the number of states reporting data has increased from 14 to 35 states.



Coordinating Counties' Response

This winter WisDOT continued its emphasis on close communication between the counties and WisDOT regional staff. Before each event, regional staff worked with the counties to coordinate available materials, staffing and equipment, and regional staff assisted the counties in managing shifts for long events.

This winter WisDOT also continued to implement its Adverse Conditions Communication/Coordination Plan to provide improved coordination during severe weather or other emergencies. The regions worked closely with the Wisconsin State Patrol in advance of storm events to ensure readiness across the affected areas. WisDOT staff helped man the state Emergency Operations Center in Madison, increasing the department's level of engagement during winter events and its ability to respond to severe incidents on the highway system.

Response Time

The counties continue to work on becoming more proactive in responding to winter storm events. Average response time this winter was 2 hours and 53 minutes. This is 40 minutes slower than 2016-2017. See Table 2.

"Time to bare/wet pavement" is measured from a storm's reported end time. Heavily traveled urban highways tend to be returned to a bare/wet condition sooner than rural roads. WisDOT expects 24-hour roads to be clear within four hours of the end of the storm and 18-hour roads to be clear within six hours. This year, on average statewide, 66 percent of roads were to bare/wet pavement within the targeted time frame (see Table 3 on page 7).

Tracking the Winter

Each week during winter, representatives from the 72 county highway departments complete winter storm reports. These reports give WisDOT the tools to manage statewide materials use and maintenance expenses as the winter progresses. Winter storm reports are also used to create the "Winter Severity Index" and other statewide performance measures.

Table 2. Maintenance Crew Reaction Time

Winter Service Group	Avg. Reaction Time (hours)		10-year Average	Percent change
	2016-2017	2017-2018	2008-2009 to 2017-2018	2017-2018 vs. 10-year Average
A	0.37	0.52	0.88	-41%
B	1.07	1.34	1.82	-26%
C	2.22	2.61	2.91	-10%
D	2.06	2.70	3.50	-23%
E	3.94	5.04	4.72	+1%
F	3.64	5.13	6.07	-15%
Statewide average (unweighted)	2.22	2.89	3.25	-11%

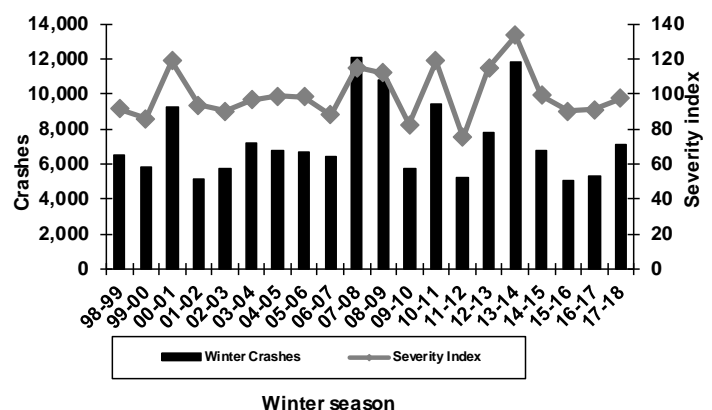
Analyzing Travel and Crashes

By keeping roads as clear as possible within their expected level of service (18- or 24-hour coverage), maintenance crews have an opportunity to help prevent crashes. This year, there were 7,137 winter weather crashes (those that occurred on pavements covered with snow, slush or ice).

The statewide average crash rate (number of crashes per 100 million vehicle miles traveled) increased from 18 to 24, a 33 percent increase over the previous winter. Last year, 5,282 winter crashes were reported.

Crash rates tend to correlate with winter severity. Compared with recent years that had similar severity indices, this winter's crash rate was similar. Figure 8 shows the trends in total crashes statewide over the last 20 years overlaid with the Winter Severity Index.

Figure 8. Crashes and Winter Severity Index



Using Performance Measures

Developed in 2001, Compass is WisDOT's quality assurance and asset management program for highway operations. As indicated in Table 3, this winter was more costly than the previous four winters when adjusted for winter severity. This winter, the success rate of getting bare/wet pavement within 4 or 6 hours (depends on road level of service) of the end of the storm decreased from last year and the number of winter weather crashes increased, when compared to the prior year.

Table 3. Statewide Compass Measures for Winter

	2013-14	2014-15	2015-16	2016-17	2017-18
Percentage of roads to bare/wet pavement (Within WisDOT target times)	63%	70%	74%	70%	66%
Cost per lane mile	\$3,304	\$2,155	\$2,087	\$2,537	\$2,821
Winter Severity Index	133.6	99.3	90.4	91.1	97.5
Cost per lane mile per Winter Severity Index point	\$24.73	\$21.71	\$23.09	\$27.85	\$28.93
Winter weather crashes	44 per 100 million VMT	25 per 100 million VMT	18 per 100 million VMT	18 per 100 million VMT	24 per 100 million VMT

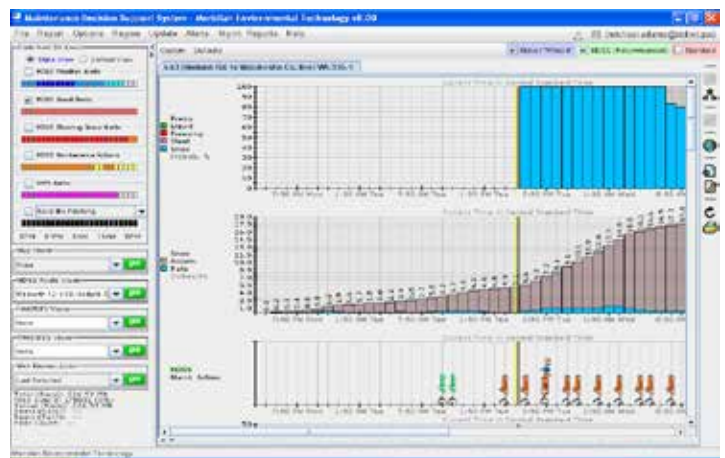
MDSS and AVL-GPS Initiative

MDSS is a major project undertaken by WisDOT since 2009. Highlights from 2017-2018 include:

MANAGEMENT TOOLS. BHM collaborated with the MDSS Pooled Fund Technical Panel to develop new management tools for WebMDSS. While the old tools in the graphical user interface (GUI) were somewhat cumbersome, it is anticipated that these new tools (which should be deployed prior to the 2018-19 winter season) will be much more user friendly.

MONITORING. BHM stopped using MDSS Usage as a performance metric. It had been useful during the original deployment, but it only measured usage on the GUI. As more users transitioned to the web and mobile platforms, the metric wasn't tracking this. BHM continues to coordinate with Iteris to come up with a way to use Google Analytics to measure overall usage.

PATENT ISSUES. The patent issue preventing WisDOT from integrating live plow truck data into MDSS was resolved in FY 2017, allowing WisDOT to once again begin incorporating it in FY 2018. All live truck data is now being ingested into MDSS.



When integrated with AVL/GPS equipment, the MDSS system can show past applications and future treatments as well as actual precipitation amounts and predicted snowfall, with probabilities. The vertical line shows actual time with the past being to the left and the future to the right.

Looking Ahead

The Wisconsin Department of Transportation Bureau of Highway Maintenance will always continue to look toward efficiencies that reduce winter maintenance costs. Using brine in many ways helps us use less salt and in-turn results in less environmental impact. As was reported last year, WisDOT and some counties are testing and piloting the use of only brine on some routes. WisDOT created the Brine Technical Advisory Committee (TAC) and from that group made up of county and DOT folks, a new term for this method of fighting winter called “Mostly Liquid Route” was generated. At least 9 counties will be attempting at least one Mostly Liquid Route in the winter of 2018-19. Jefferson County will be implementing this on many routes including Interstate routes (a first in Wisconsin.) These Mostly Liquid Routes will not see the application of granular rock salt unless necessary, and instead, those roads will see a brine or brine mixture. The Brine TAC expects to see significant salt reductions on routes where this method is used while keeping the road at a winter level of service that WisDOT policy and the public expects.

WisDOT has hired the University of Wisconsin – Madison Traffic Operations and Safety (TOPS) Laboratory to collect data from these pilot - Mostly Liquid Routes and to research the effectiveness of different brine mixtures in varying weather conditions. These results are expected to promote statewide use of Mostly Liquid Routes in the near future, as equipment is upgraded and personnel adapt to the change in the industry.

WisDOT will continue to explore other methods of reducing rock salt usage on the state highway system. Through our partnership with the counties, we will continue to implement route optimization, which has proven to enhance efficiency. The Maintenance Decision Support System will continue to be improved, including the option of having treatment recommendations sent directly to plow drivers. Through the Wisconsin County Highway Association, winter maintenance training at all levels will be implemented using materials and methods created by Clear Roads and other expert sources.

All these efforts are aimed at providing users of Wisconsin’s highways the safest possible experience in spite of harsh winter weather, at the same time WisDOT safeguards the state’s natural environment by implementing sustainable practices.

Winter Operations Staff

Allan Johnson, P.E.
Winter Maintenance Engineer
allan.johnson@dot.wi.gov
(608) 266-8460

Michael J. Adams, Meteorologist
RWIS Program Manager
michael.adams@dot.wi.gov
(608) 266-5004



Wisconsin Department of Transportation
Division of Transportation System Development
Bureau of Highway Operations
4802 Sheboygan Ave., Room 501
P.O. Box 7986
Madison, WI 53707-7986