ANNUAL WINTER MAINTENANCE REPORT

2014-2015

Moving Back to Moderate

Wisconsin Department of Transportation
Division of Transportation System Development
Bureau of Highway Maintenance
Winter Operations Unit

November 2015

Acknowledgments

Many people at Wisconsin DOT contributed to the development of this report, including:

- James Hughes, Bureau of Highway Maintenance
- Mike Sproul, Bureau of Highway Maintenance
- Mike Adams, Bureau of Highway Maintenance
- Cathy Meinholz, Bureau of Highway Maintenance
- Lisa Meinholz, Bureau of Highway Maintenance
- Donald Lyden, Bureau of Transportation Safety
- Asadur Rahman, Transportation Modeling & Information Unit

We wish to thank these individuals for their contributions to and assistance with this report.

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1 Introduction

To our partners

We finally had a "normal" Wisconsin winter in 2014-15. Temperatures and snowfall amounts were near average and a welcome change from the previous two extreme winters. Salt prices, however, keep going up making winter maintenance activities again the biggest expenditure item in the state highway maintenance, management and operations budget. The winter of 2013-14 created a large hole in the expected year end and salt inventory that was not made whole despite the mild 2014-15 winter. This created an additional need for salt in 2015-16 that could only be covered by another request for funding to the joint committee on finance (§ 13.10). The request was approved in July.

We commend the county maintenance crews for their dedicated response this winter. We also want to recognize the role of WisDOT regional staff in coordinating these efforts and providing the counties with priorities. We continually stress the importance of improving processes and procedures for snow removal and especially applaud the counties for working closely with us in partnership to give an acceptable level of service for a reasonable cost. To capture these efforts, this report features:

- Five sections that correspond to the key components of winter and the counties' response, including Introduction, Winter Weather, Snow and Ice Control, Performance, and Looking Ahead.
- Two key tables that summarize important data at a glance: Winter by the Numbers (page 6) highlights statewide facts and figures. Winter in Wisconsin (pages 13-17) compiles key data for all 72 counties. These tables should be a first point of reference throughout the year whenever you need a winter statistic.
- Three maps that compare key data for this winter with the previous five years. These maps put each county's experience with winter severity (page 21), salt use (page 57) and total costs (page 95) in the context of what's normal for that county.
- Two graphs that put Wisconsin's experience with salt costs in the context of what other states pay (pages 36 and 37), and a map of salt cost data for all snowy states compiled by Washington State DOT (page 58).
- Best Practices sidebars throughout the report that highlight efficient practices.

Because this report has a wide and diverse audience, the text includes some explanations of winter maintenance technologies and best practices, such as Maintenance Decision Support System (MDSS), on-oboard pre-wetting, and use of Automatic Vehicle Location-Global Positioning System (AVL-GPS) Systems. The State Highway Maintenance Manual is the first resource for more information on any of these items, and there are other resources available on WisDOT's extranet site. Links to these resources are provided throughout this report. For more information, contact your regional WisDOT representative or Mike Sproul, WisDOT's state winter maintenance engineer, at michael.sproul@dot.wi.gov.

Sincerely,

Rose Phetteplace, Director
Bureau of Highway Maintenance

Table 1.1. Statewide Summary: This Winter Versus Last Winter, by the Numbers

		2013-2014 winter	2014-2015 winter
Infrastructure	Lane miles	34,339 miles	34,435 miles
	Patrol sections	753.5	755.0
	Average patrol section length	45.57 lane miles	45.61 lane miles
Weather	Average statewide Winter Severity Index	133.64	99.28
	Number of storms, statewide average and range across counties	Average: 43 Range: 30 to 69	Average: 33 Range: 18 to 63
	Snowfall, statewide average and range across counties	Average: 101.5 inches Range: 56 to 233 inches	Average: 60.3 inches Range: 28 to 235 inches
Materials[1]	Salt used	669,807 tons 19.5 tons per lane mile	388,797 tons 11.3 tons per lane mile
	Average cost of salt	$60.40 per ton	$69.01 per ton
	Prewetting liquid used	2,970,166 gal.	2,009,139 gal.
	Anti-icing agents used	887,415 gal.	1,531,787 gal.
	Sand used	58,870 cubic yd.	22,301 cubic yd.
Costs, Equipment and Performance	Total winter costs[2]	$113,473,270	$74,194,500
	Total winter costs per lane mile	$3,304	$2,155
	Average crew reaction time from start of storm	7.03 hours	2.66 hours
	Percentage of roads to bare/wet pavement (Within WisDOT target times)	63%	70%
	Road Weather Information System (RWIS) stations	58	65
	Counties with salt spreaders equipped with on-board prewetting unit	58 of 72 (80%)	68 of 72 (94%)
	Counties with salt spreaders equipped with ground-speed controller unit	69 of 72 (96%)	68 of 72 (94%)
	Underbody plows	658	355
	Counties with underbody plows	56 of 72 (78%)	54 of 72 (75%)
	Counties equipped to use anti-icing agents	66 of 72 (92%)	66 of 72 (92%)
	Counties that used anti-icing agents during the winter season	63 of 72 (88%)	63 of 72 (88%)
Labor and Services	Regular county winter labor hours[3]	244,602 hrs.	160,453 hrs.
	Overtime county winter labor hours	182,311 hrs.	91,691 hrs.
	Public service announcements aired	3,184 total 2,704 radio; 480 TV	6,080 total 5,085 radio; 995 TV
	Cost of public service announcements	$36,000 ($109,140 market value)	$36,000 ($235,659 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.

ABOUT THIS REPORT

Every year, WisDOT gathers a multitude of data on winter weather and the state's response to it. Tracking and analyzing this data helps us become more efficient by identifying good performance as well as areas that need improvement. In this way we use our limited resources to achieve the greatest benefit.

Through this report, WisDOT's Bureau of Highway Maintenance shares data with the department's regional maintenance staff and with our partners in the county highway departments. This allows regional and county staff to compare resource use with that of their peers across the state. The report has also been shared with the WisDOT Secretary's Office, the state legislature, national organizations such as Clear Roads, and the general public.

REPORT STRUCTURE AND DATA SOURCES

Following this section, this report is divided into four main sections:

- Section 2: Weather
- Section 3: Winter Operations
- Section 4: Performance
- Section 5: Looking Ahead

Each section has several subsections; refer to the Table of Contents for more detail. To improve readability,the report includes more statewide summary tables within the text, while county-by-county data appears at the end of each section.

Within many of the county-by-county tables in this report, the counties are grouped by region, in acknowledgement of the role that WisDOT's regional staff plays in coordinating winter maintenance in their counties. In some tables, counties are divided by Winter Service Group (Groups A, B, C , D, E and F), which reflect the difference in the level of service provided on roads in these counties and facilitate comparisons within these groups. See Table 1.3 on page 9 for more information on Winter Service Groups.

In most tables, raw numbers (such as total salt used) are presented along with data that has been adjusted for differences between counties (such as salt used per lane mile per Winter Severity Index point). This allows more accurate comparisons between regions in different parts of the state.

This report presents data from several sources:

- The weekly winter storm reports completed by the county highway departments, which detail the counties' estimates of the weather they faced and the materials, equipment and labor they used in responding to it. (See Section 4 for more information about storm reports.)
- Final cost and materials data as billed to WisDOT.
- Data on weather, crashes, travel and other topics from other bureaus within WisDOT and other agencies.

The final billed amounts are considered the most accurate source of cost and materials data, and are presented wherever possible.

When interpreting the data in this report, readers should remember that many factors affect a county's response to winter, including the local Winter Severity Index, local traffic generators, the mix of highway types and classifications in a county, the type of equipment being used, and the length of patrol sections. Some tables in this report give data that is adjusted for one or more of these factors (for example, salt use per lane mile per severity index point), while others provide raw data.

WORKING WITH COUNTY HIGHWAY DEPARTMENTS

WisDOT's Bureau of Highway Maintenance, in partnership with the five WisDOT regional offices, is responsible for the maintenance of the state trunk and Interstate highway system. This system includes 34,435 lane miles of highway and around 4,570 bridges.

WisDOT contracts with the state's 72 county highway departments to provide snow and ice control on all state- and U.S.-owned highways in Wisconsin, including the Interstate system. This partnership was set up more than 100 years ago and is unique in the nation.

This relationship benefits both WisDOT and the county highway departments. WisDOT receives the services of a skilled, experienced work force at fair labor rates, and the counties are able to purchase more pieces and types of equipment than they could otherwise afford. This equipment is then available for use on both county and state roads, an arrangement that allows WisDOT and the counties to avoid duplicating equipment and facilities. This arrangement also allows for increased efficiencies in work crews, thus reducing labor costs to taxpayers.

Staff at WisDOT's five regional offices work closely with the county highway departments. Regional managers administer the contracts with the counties, and work with the counties to plan maintenance activities and set priorities. Regional staff oversee county highway departments' maintenance expenditures, and are responsible for ensuring that the counties use resources efficiently and adhere to state guidelines for materials use. Regional staff also serve as a resource for the counties on state and federal rules and regulations, and can provide training assistance.

Figure 1.1. WisDOT Regional Divisions

Snow Removal Strategy

In order to gain the most benefit from limited resources, counties provide different levels of service on highways according to the amount of daily traffic they receive. High-volume roads typically receive 24-hour coverage, while lower-volume roads receive 18-hour coverage. On 18-hour routes the service hours are adjusted based on timing of the storms. On lower-volume four-lane highways, the passing lanes may receive less attention than the driving lanes and ramps.

Table 1.2. Highway Categories for Winter Maintenance

Category	Definition	Lane miles	% of total
1	Major urban freeways and most highways with six lanes and greater	3,170	9%
2	High volume four-lane highways (Average Daily Traffic ≥ 25,000) and some four-lane highways (ADT < 25,000), and some 6-lane highways.	3,283	10%
3	All other four-lane highways (ADT < 25,000)	8,893	26%
4	Most high volume two-lane highways (ADT ≥ 5,000) and some 2-lanes (ADT <5000)	4,639	13%
5	All other two-lane highways	14,451	42%
Total		34,435	

Table 1.2 shows how WisDOT categorizes the state's highways for winter maintenance. For more detail on the categories and which category each highway is assigned to, see Figure A-2 on page 114 in the Appendix.

To facilitate comparisons between counties that provide similar levels of service, WisDOT divides the 72 counties into six Winter Service Groups—A, B, C, D, E and F, with A being the most urban and F the most rural. Table 1.3 explains the divisions between the groups. This table also shows which counties are assigned to each service group. In many tables throughout this report, the counties are arranged according to these groups. Group A contains the fewest counties, while Group B has the most.

In addition, each county highway department divides its highways into winter patrol sections. One snowplow truck is generally assigned to each patrol section. This winter, there were 755 patrol sections on state-maintained highways, with an average of 45.61 lane miles per patrol section. Patrol section length is another factor that can affect performance; see Section 4 for a complete discussion of patrol sections

Table 1.3. County Winter Service Groups

Winter Service Group	Definition	County Names	Number of Counties	% of Counties
A	• 1,000 or more lane miles and all counties have some roads with six or more lanes • 900,000 or more square feet of bridge deck • 20 or more plow routes; most routes are 24 hour routes	Dane, Milwaukee,Waukesha	3	4%
B	• 600 to 1,000 lane miles; some counties have roads with six or more lanes; all counties have high mileage on four-lane roads • 400,000 to 900,000 square feet of bridge deck • 14 to 20 plow routes; most routes are 24 hour routes	Brown, Chippewa, Columbia, Dodge, Eau Claire, Fond du Lac, Grant, Jefferson, Kenosha, Marathon, Monroe, Outagamie, Portage, Racine, Rock, Sauk, St. Croix, Walworth, Washington, Waupaca, Winnebago	21	29%
C	• 450 to 600 lane miles; some counties have roads with six or more lanes; all counties medium mileage on four-lane roads • 170,000 to 450,000 square feet of bridge deck • 7 to 14 plow routes; mix of 18 and 24 hour routes	Barron, Clark, Crawford, Douglas, Dunn, Iowa, Jackson, Juneau, La Crosse, Lincoln, Manitowoc, Oconto, Pierce, Shawano, Sheboygan, Vernon, Wood	17	24%
D	• 325 to 450 lane miles; no counties have roads with six or more lanes; all counties have low to medium mileage on four-lane roads; highest mileage is in two-lane roads • 140,000 to 170,000 square feet of bridge deck • 4 to 7 plow routes; mix of 18 and 24 hour routes	Bayfield, Buffalo, Door, Green, Green Lake, Lafayette, Marinette, Marquette, Oneida, Ozaukee, Polk, Richland, Trempealeau, Washburn, Waushara	15	21%
E	• 175 to 325 lane miles; no counties have roads with six or more lanes; few counties have four-lane roads; medium to high mileage on two-lane roads • 50,000 to 140,000 square feet of bridge deck • 2 to 4 plow routes; nearly all with 18 hour routes	Ashland, Burnett, Calumet, Forest, Iron, Langlade, Pepin, Price, Rusk, Sawyer, Taylor, Vilas	12	17%
F	• 90 to 175 lane miles; no counties have roads with six or more lanes; counties have 0 to 5 lane miles of four-lane roads; two-lane roads have low to medium mileage • Less than 50,000 square feet of bridge deck • Fewer than 2 plow routes; all 18 hour routes	Adams, Florence, Kewaunee, Menominee	4	6%

This Winter in Wisconsin

Table 1.5 on pages 13-17 summarizes key data from this winter for all 72 counties, including total salt use and cost data. This table facilitates comparisons in these core areas across regions and counties, and serves as a quick reference for commonly used data. Data are sorted by salt used per lane mile per Severity Index. The table uses a similar format to the Storm Report Summary (Table A-1 on pages 115-120 of the Appendix), but the cost data in Table 1.5 are actual billed costs as submitted to WisDOT by the counties, rather than estimates from the storm reports.

Photo Credit: Al_HikesAZ (https://goo.gl/bXMuyY)

County-by-County
Quick Reference Winter Summary Table
for Section 1: Introduction

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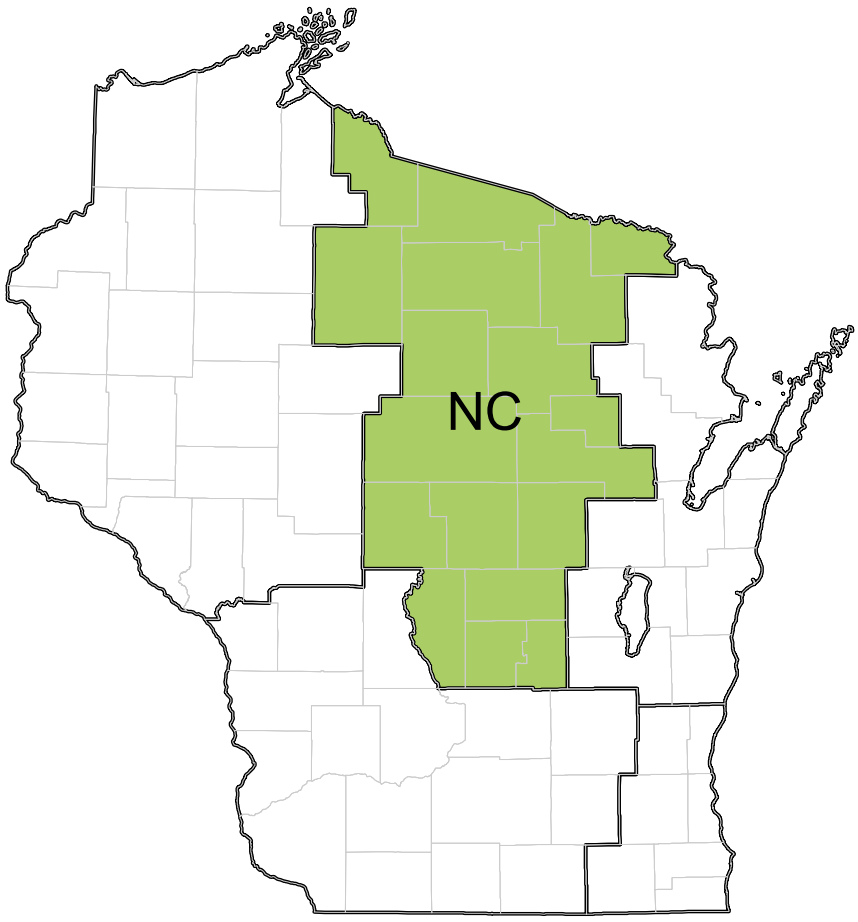
Table 1.4. Winter in Wisconsin, 2014-2015												
	County	Lane miles	Severity Index	Snowfall (inches)	Total salt used (tons)	Salt used (tons) per lane mile	Salt used per lane mile per Severity Index	Total salt costs	Total salt costs per lane mile	Total winter costs	Total winter costs per lane mile	Total winter costs per lane mile per Severity Index
North Central Region												
	Green Lake	158.36	71.87	34.2	731	4.62	0.06	$51,355	$324	$201,689	$1,274	$17.72
	Price	322.26	168.15	95.1	4,028	12.50	0.07	$302,158	$938	$758,148	$2,353	$13.99
	Portage	582.05	118.47	42.5	5,454	9.37	0.08	$412,159	$708	$1,257,738	$2,161	$18.24
	Iron	249.56	184.90	234.9	3,656	14.65	0.08	$267,820	$1,073	$866,588	$3,472	$18.78
	Lincoln	415.19	141.86	77.4	4,719	11.37	0.08	$337,387	$813	$1,014,857	$2,444	$17.23
	Wood	420.98	111.47	60.5	3,934	9.34	0.08	$299,405	$711	$770,642	$1,831	$16.42
	Marathon	869.93	140.65	62.8	10,965	12.60	0.09	$860,643	$989	$1,945,031	$2,236	$15.90
	Adams	193.20	94.17	30.1	1,674	8.66	0.09	$137,034	$709	$364,123	$1,885	$20.01
	Forest	312.38	148.84	133.4	4,946	15.83	0.11	$328,931	$1,053	$863,545	$2,764	$18.57
	Langlade	299.21	116.96	81.1	3,831	12.80	0.11	$245,307	$820	$652,772	$2,182	$18.65
	Shawano	520.57	92.82	65.3	5,455	10.48	0.11	$338,974	$651	$965,798	$1,855	$19.99
	Oneida	396.79	133.97	109.4	6,069	15.30	0.11	$465,383	$1,173	$1,133,279	$2,856	$21.32
	Waupaca	547.06	76.88	40.0	5,111	9.34	0.12	$320,038	$585	$880,624	$1,610	$20.94
	Waushara	345.01	65.62	37.8	2,771	8.03	0.12	$187,043	$542	$495,329	$1,436	$21.88
	Marquette	245.09	68.06	27.8	2,197	8.96	0.13	$156,924	$640	$365,372	$1,491	$21.90
	Florence	141.07	121.16	121.4	2,614	18.53	0.15	$179,344	$1,271	$423,873	$3,005	$24.80
	Menominee	90.26	76.61	52.8	1,248	13.83	0.18	$76,869	$852	$156,236	$1,731	$22.59
	Vilas	305.24	123.41	143.0	7,045	23.08	0.19	$564,445	$1,849	$1,154,600	$3,783	$30.65
Region total		**6,414.21**			**76,448**			**$5,531,219**		**$14,270,245**		
Region average		**356.35**	**114.22**	**80.5**	**4247**	**11.92**	**0.10**	**$307,290**	**$862**	**$792,791**	**$2,225**	**$19.48**
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data is taken from WisDOT's Salt Inventory Reporting System.												



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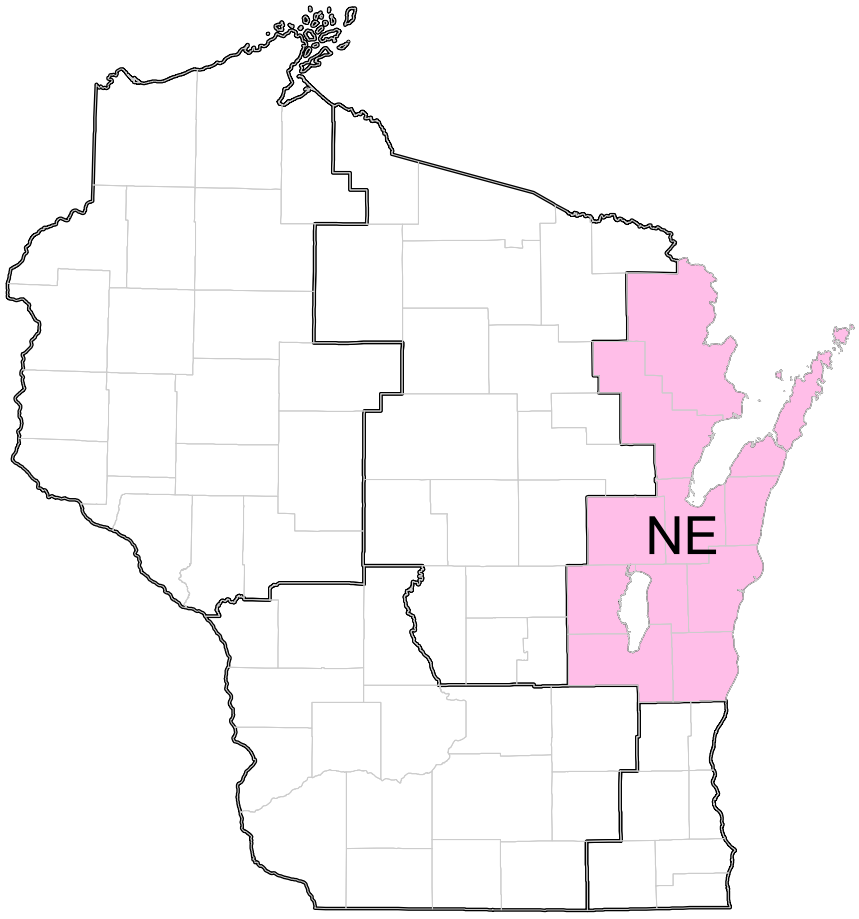
Northeast Region												
	Calumet	201.71	69.37	40.5	843	4.18	0.06	$50,877	$252	$274,102	$1,359	$19.59
	Oconto	468.36	94.86	74.5	3,044	6.50	0.07	$200,874	$429	$749,074	$1,599	$16.86
	Door	269.70	103.15	35.4	2,045	7.58	0.07	$131,251	$487	$517,362	$1,918	$18.60
	Sheboygan	522.93	80.86	32.9	3,117	5.96	0.07	$219,410	$420	$851,874	$1,629	$20.15
	Outagamie	538.55	76.11	53.1	3,357	6.23	0.08	$205,072	$381	$1,000,748	$1,858	$24.42
	Fond du Lac	597.46	64.77	32.2	3,266	5.47	0.08	$229,306	$384	$841,671	$1,409	$21.75
	Winnebago	623.16	87.41	31.2	5,499	8.82	0.10	$357,160	$573	$1,306,754	$2,097	$23.99
	Manitowoc	425.85	68.79	36.3	3,157	7.41	0.11	$193,145	$454	$800,871	$1,881	$27.34
	Brown	796.76	87.07	32.4	8,126	10.20	0.12	$436,854	$548	$1,533,435	$1,925	$22.10
	Marinette	427.96	104.32	88.6	5,850	13.67	0.13	$396,115	$926	$869,553	$2,032	$19.48
	Kewaunee	111.35	53.70	44.0	792	7.11	0.13	$44,400	$399	$172,289	$1,547	$28.81
Region total		**4,983.79**			**39,096**			**$2,464,464**		**$8,917,733**		
Region average		**453.07**	**80.95**	**45.6**	**3554**	**7.84**	**0.10**	**$224,042**	**$494**	**$810,703**	**$1,789**	**$22.11**
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data is taken from WisDOT's Salt Inventory Reporting System.												



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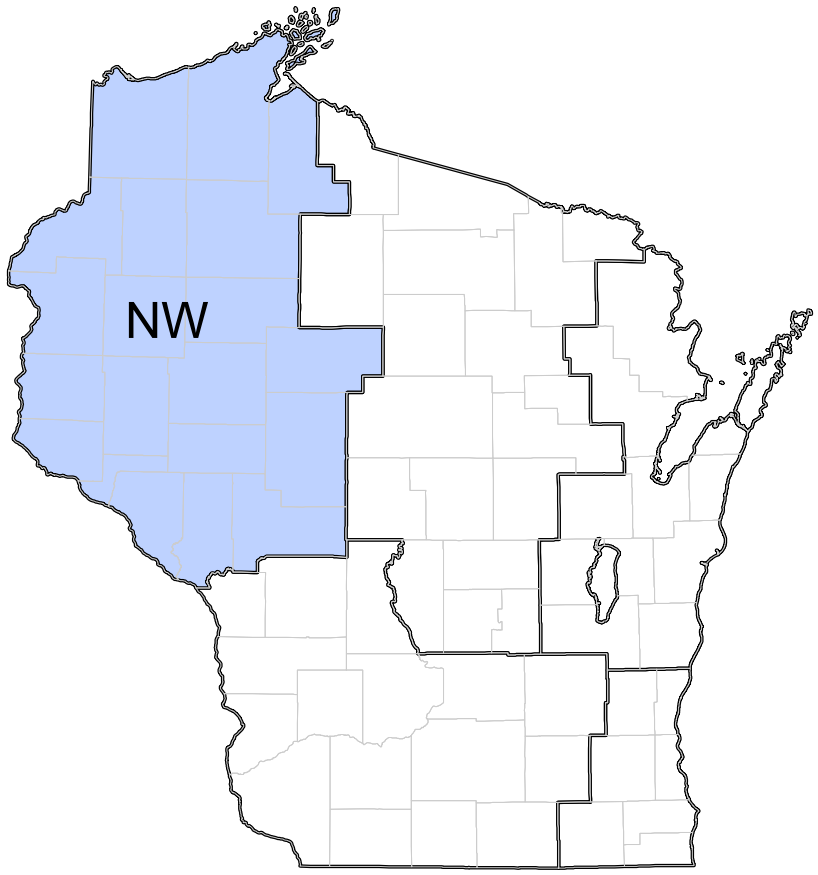
Northwest Region												
	Ashland	249.49	185.63	146.6	2,123	8.51	0.05	$153,250	$614	$562,556	$2,255	$12.15
	Buffalo	317.02	96.41	61.2	1,688	5.32	0.06	$119,325	$376	$459,953	$1,451	$15.05
	Pepin	112.38	73.67	45.4	531	4.73	0.06	$41,011	$365	$182,428	$1,623	$22.03
	Barron	423.09	122.06	70.7	3,691	8.72	0.07	$268,389	$634	$965,774	$2,283	$18.70
	Taylor	233.90	125.70	65.1	2,301	9.84	0.08	$197,588	$845	$548,864	$2,347	$18.67
	Clark	402.56	116.19	67.8	3,734	9.28	0.08	$292,858	$727	$802,859	$1,994	$17.16
	Sawyer	367.44	116.30	86.7	3,418	9.30	0.08	$267,288	$727	$628,346	$3,574	$30.73
	Polk	385.05	138.78	67.8	4,322	11.22	0.08	$321,181	$834	$795,543	$2,066	$14.89
	Bayfield	316.88	165.24	130.0	4,303	13.58	0.08	$288,430	$910	$829,724	$2,618	$15.85
	Douglas	440.80	123.41	77.2	4,672	10.60	0.09	$276,468	$627	$799,659	$1,814	$14.70
	Burnett	234.95	80.14	60.6	1,619	6.89	0.09	$108,583	$462	$321,753	$1,369	$17.09
	Pierce	365.50	88.84	49.8	2,801	7.66	0.09	$198,358	$543	$694,310	$1,900	$21.38
	Chippewa	654.65	103.11	68.7	6,569	10.03	0.10	$497,303	$760	$1,317,273	$2,012	$19.51
	Washburn	372.14	93.42	65.1	3,732	10.03	0.11	$254,817	$685	$672,200	$1,806	$19.34
	Jackson	515.14	107.74	58.5	6,026	11.70	0.11	$484,310	$940	$1,046,736	$2,032	$18.86
	Rusk	213.47	86.14	61.8	2,038	9.55	0.11	$155,598	$729	$367,608	$1,722	$19.99
	Trempeleau	442.00	105.25	48.1	5,166	11.69	0.11	$369,937	$837	$893,766	$2,022	$19.21
	Saint Croix	632.52	91.97	39.7	7,640	12.08	0.13	$487,356	$770	$1,313,400	$993	$10.80
	Dunn	516.58	90.37	49.6	6,393	12.38	0.14	$480,450	$930	$1,176,217	$2,277	$25.20
	Eau Claire	539.46	88.76	47.1	7,842	14.54	0.16	$593,326	$1,100	$1,400,409	$2,596	$29.25
Region total		**7,735.02**			**80,609**			**$5,855,825**		**$15,779,377**		
Region average		**386.75**	**109.96**	**68.4**	**4030**	**9.88**	**0.09**	**$292,791**	**$757**	**$788,969**	**$2,040**	**$18.55**
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data is taken from WisDOT's Salt Inventory Reporting System.												



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Southeast Region												
	Racine	683.28	84.91	51.8	7,565	11.07	0.13	$478,138	$700	$1,420,631	$2,079	$24.49
	Washington	607.89	97.40	34.6	7,880	12.96	0.13	$521,881	$859	$1,324,642	$2,179	$22.37
	Kenosha	653.56	72.08	39.2	7,381	11.29	0.16	$461,246	$706	$1,593,730	$2,439	$33.83
	Milwaukee	1,897.05	91.29	41.0	33,132	17.47	0.19	$1,999,963	$1,054	$6,758,516	$3,563	$39.03
	Walworth	706.03	60.34	53.6	8,887	12.59	0.21	$530,625	$752	$1,508,089	$2,136	$35.40
	Waukesha	1,121.60	64.61	49.4	15,362	13.70	0.21	$958,750	$855	$2,477,024	$2,208	$34.18
	Ozaukee	308.71	75.29	32.7	5,282	17.11	0.23	$299,120	$969	$840,163	$2,722	$36.15
Region total		**5,978.12**			**85,489**			**$5,249,723**		**$15,922,795**		
Region average		**854.02**	**77.99**	**43.2**	**12213**	**14.30**	**0.18**	**$749,960**	**$878**	**$2,274,685**	**$2,664**	**$34.15**
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data is taken from WisDOT's Salt Inventory Reporting System.												

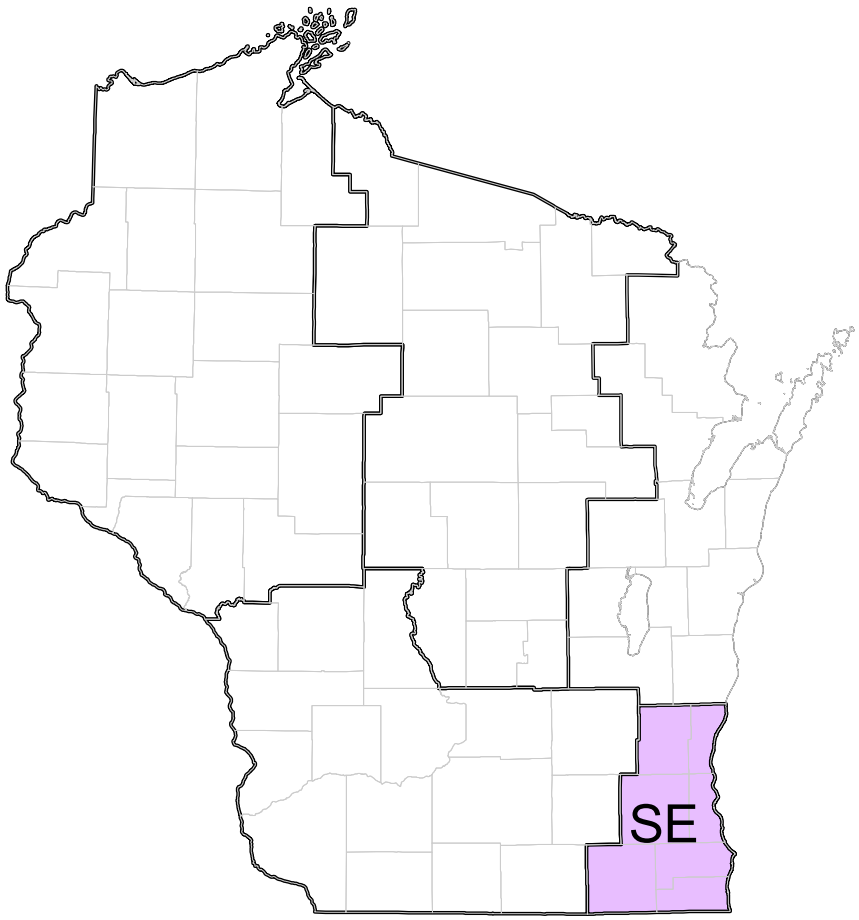
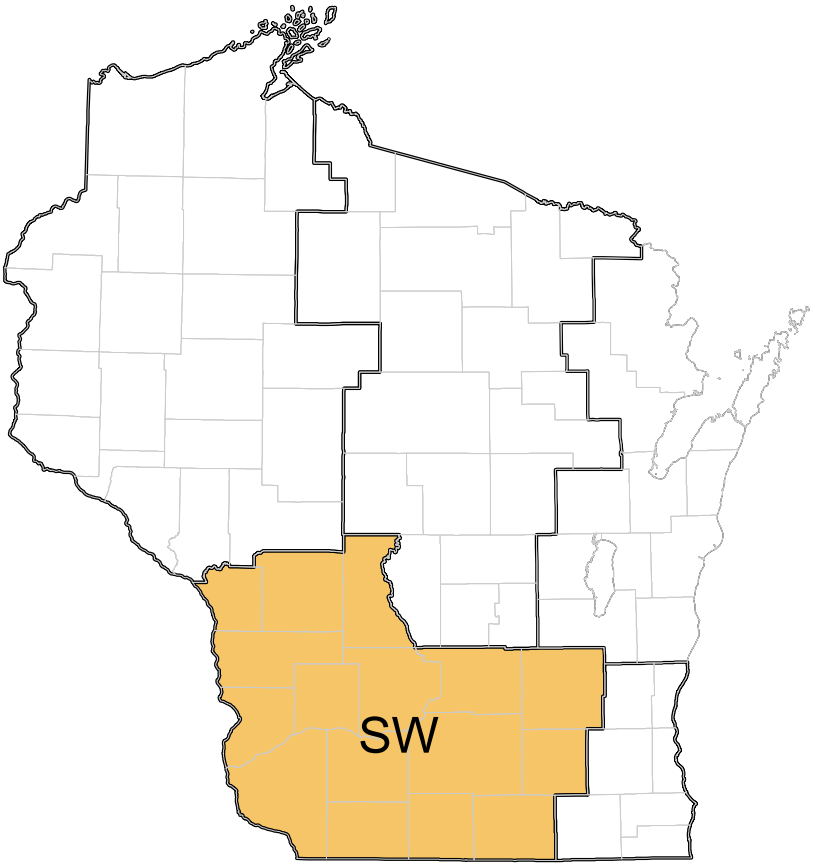


Table 1.4. Winter in Wisconsin, 2014-2015												
	County	Lane miles	Severity Index	Snowfall (inches)	Total salt used (tons)	Salt used (tons) per lane mile	Salt used per lane mile per Severity Index	Total salt costs	Total salt costs per lane mile	Total winter costs	Total winter costs per lane mile	Total winter costs per lane mile per Severity Index
Southwest Region												
	Lafayette	298.98	83.56	53.8	1,618	5.41	0.06	$111,238	$372	$578,181	$1,934	$23.14
	Crawford	394.99	112.35	44.4	2,893	7.32	0.07	$207,169	$524	$559,563	$1,417	$12.61
	Vernon	468.36	122.57	48.1	4,166	8.89	0.07	$280,663	$599	$837,637	$1,788	$14.59
	Green	315.55	64.26	42.5	1,523	4.83	0.08	$114,422	$363	$426,703	$1,352	$21.04
	Richland	327.64	79.46	33.6	2,157	6.58	0.08	$166,718	$509	$484,527	$1,479	$18.61
	Iowa	476.31	92.71	49.0	4,068	8.54	0.09	$284,190	$597	$826,611	$1,735	$18.72
	Juneau	494.25	106.22	50.6	5,020	10.16	0.10	$374,693	$758	$913,451	$1,848	$17.40
	Monroe	654.83	111.59	48.8	7,300	11.15	0.10	$556,672	$850	$1,295,506	$1,978	$17.73
	Sauk	577.36	101.61	44.9	6,233	10.80	0.11	$492,868	$854	$1,113,053	$1,928	$18.97
	LaCrosse	496.20	82.80	48.0	4,371	8.81	0.11	$286,217	$577	$1,029,710	$2,075	$25.06
	Grant	622.06	74.62	44.7	5,513	8.86	0.12	$350,627	$564	$832,377	$1,338	$17.93
	Columbia	786.13	107.35	41.5	11,150	14.18	0.13	$902,063	$1,147	$1,911,344	$2,431	$22.65
	Rock	687.78	68.45	44.8	6,876	10.00	0.15	$450,089	$654	$1,367,958	$1,989	$29.06
	Dodge	651.82	83.75	35.5	8,305	12.74	0.15	$591,000	$907	$1,290,145	$1,979	$23.63
	Jefferson	559.08	62.26	49.9	6,408	11.46	0.18	$444,805	$796	$1,099,623	$1,967	$31.59
	Dane	1,512.86	102.98	44.5	29,554	19.54	0.19	$2,146,625	$1,419	$4,737,959	$3,132	$30.41
Region total		**9,324.20**			**107,155**			**$7,760,061**		**$19,304,350**		
Region average		**582.76**	**91.03**	**45.3**	**6697**	**11.49**	**0.13**	**$485,004**	**$832**	**$1,206,522**	**$2,070**	**$22.74**
Statewide total		**34,435.34**		**60.3**	**388,797**	**11.29**		**$26,861,292**		**$74,194,500**		
Statewide average			**99.28**						**$765**		**$2,158**	
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data is taken from WisDOT's Salt Inventory Reporting System.												



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2 Winter Weather

In this section...

Photo Credit: Heather Kaiser (https://goo.gl/DcEMXX)

Every winter is different. The number and type of storms, the range of temperatures, the amount of snow – these factors, along with many others, combine to create varying challenges for Wisconsin's county highway departments each year.

The 2014-2015 winter season was much more mild than the severe winter of 2013-2014. Snowfall was much lighter statewide, with an average of approximately 60 inches. This was half the snowfall total of the previous winter.

This section describes the weather Wisconsin experienced during the 2014-2015 winter, and the tools and methodologies WisDOT uses to analyze individual storms and the winter as a whole. The Winter Severity Index is one such tool – WisDOT uses it to facilitate comparisons from one winter to the next, and from county to county within the same season.

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. *See page 69 for more information.*

Winter Weather, 2014–2015

	Statewide average	Range across counties
Total snowfall[1]	**60 inches**	**28-235 inches**
Winter Severity Index	**99**	**54-186**
Winter storms	**33**	**18-63**
Frost events	**3.1**	**0-24**
Freezing rain events	**10.8**	**2-25**

1. All data in this table is from Winter Storm Reports, 2014–2015.

WINTER WEATHER CHALLENGES

Each year, county highway departments face unique combinations of temperatures and storms, and draw on their experience in deciding what combination of snow and ice control strategies to employ. The number of storms has a more significant impact on resources expended than snowfall totals, since staff and equipment may be mobilized even if only 0.1 inches of snow or freezing rain falls. Weekend and evening storms may also be more costly than weekday storms because of overtime pay.

Storms with low temperatures can be difficult for crews because deicing agents become less effective at lower temperatures. Storms with high winds also are a challenge, because snow blows back onto the roadway quickly after the plows pass.

Counties in the northern half of the state tend to face colder temperatures and heavier snowfall than those in the southern half. Wisconsin's average annual snowfall ranges from about 40 inches in the south to as much as 160 inches along the shores of Lake Superior. The statewide average annual snowfall is 52.4 inches (30-year normal as recorded by the Wisconsin State Climatology Office).

On average, about 35 to 40 winter weather events hit Wisconsin each winter. While only a couple of large freezing rain events normally strike the state each winter, the state experiences numerous freezing drizzle and freezing fog events that cause roads to ice over.

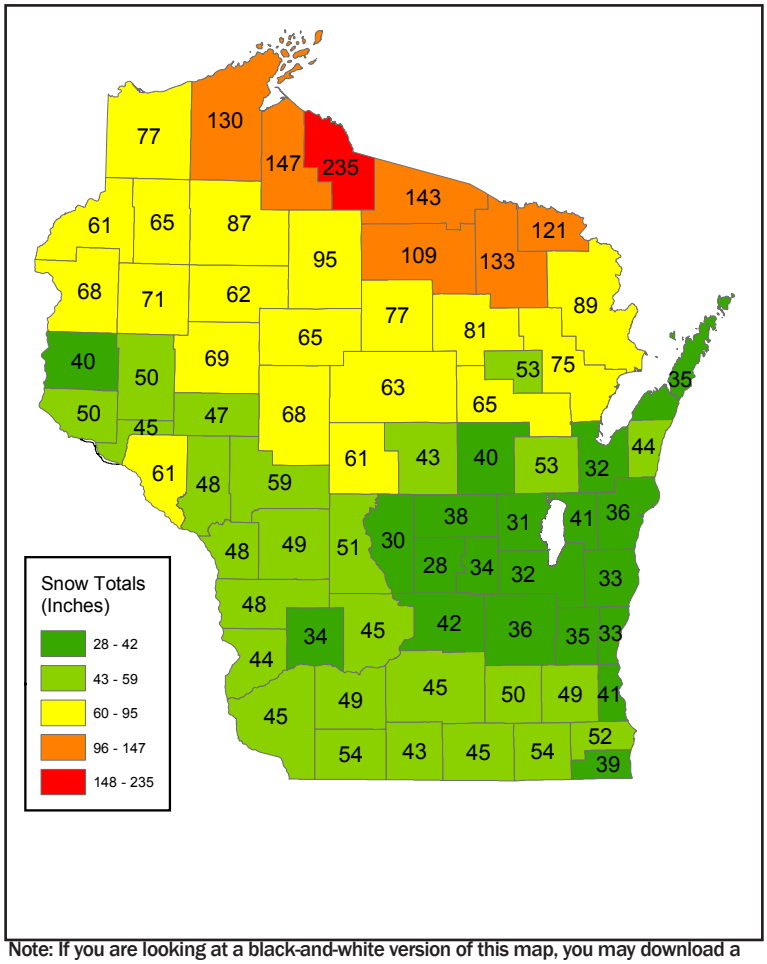
THIS WINTER'S WEATHER

The 2014-15 featured a return to more "normal" conditions following two consecutive harsh winters. Snowfall returned to more average levels, and temperatures averaged about 7 degrees warmer than in 2013-14.

The winter actually started with a bang. Several snow events hit the northern half of the state in November. Lake effect snows pummeled the counties along Lake Superior, with Iron County receiving upwards of 50 inches. December brought above-average temperatures and below-average snowfall to most of the state. Only northeastern Wisconsin experienced above-average snowfall for the month.

January was another mild month. Temperatures were once again above average, and snowfall was below average across the entire state. Extremely cold temperatures returned to Wisconsin in February. Average temperatures were some 10 to 15 degrees below 30-year averages. Fortunately, unlike the previous two winters, the cold did not bring heavy snowfall. In fact, February snowfall was below average for all but the southern quarter of the state. But no large-scale snow events occurred, as the largest storms tracked just south of the state.

Figure 2.1. Statewide Snowfall, 2014-2015
From Winter Storm Reports



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

March featured a split pattern. The north saw above-average temperatures and below-average snowfall. The opposite was true in the south. One storm brought up to 10 inches of snow to areas along the Mississippi River late in the month.

During the 2014-15 winter season, county highway departments responded to:

- A statewide average of 33 winter events per county, or 10 less than the previous winter. The high was 63 in Ashland County and the low was 18 in Fond Du Lac County.
- A statewide average of 3 frost events.
- A statewide average of 11 freezing rain events.

Figure 2.1 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 235 inches; the lowest was in Marquette County, at 27 inches. Statewide, this winter's total snowfall was near average at 60 inches.

WINTER SEVERITY INDEX

WisDOT's Winter Severity Index is a management tool that allows the department to maximize winter maintenance efficiency by evaluating the materials, labor and equipment used based on the severity of the winter in a given county or region.

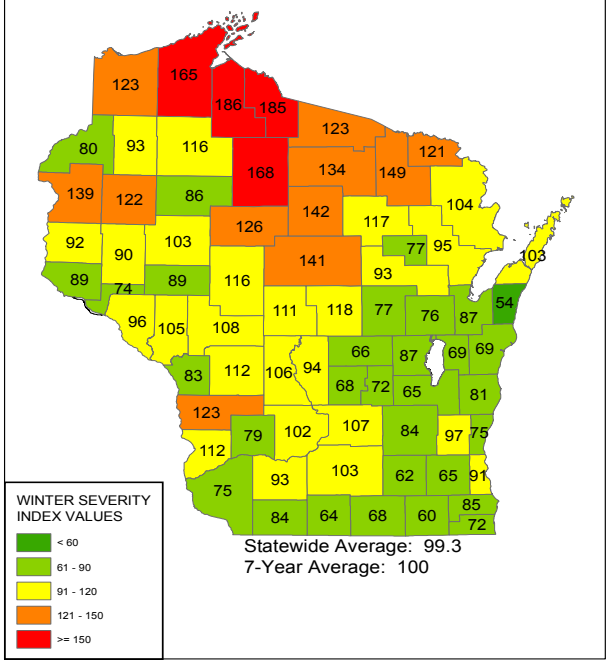
Developed in 1995, the severity index is calculated using a formula that includes:

- Number of snow events
- Number of freezing rain events
- Total snow amount
- Total storm duration
- Total number of incidents

Since all of these factors can affect materials use, the severity index gives the department a simple way to quantify severity that incorporates multiple factors into a single number. WisDOT uses the severity index in two ways:

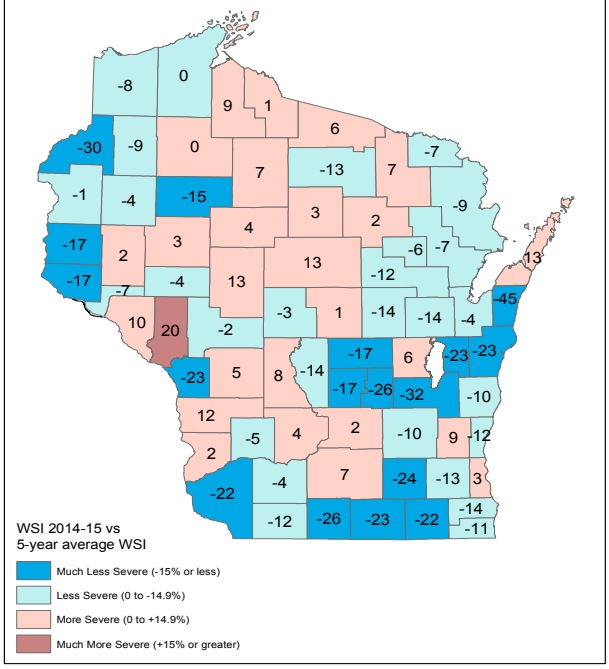
1. Season-to-season comparisons. This lets the department compare apples to apples when evaluating materials use and costs over several seasons, and identify trends in winter weather that can be useful in planning materials purchases. In the case of cost trends, adjusting cost data for severity index ranking can help WisDOT separate cost increases due to more severe winters from those due to increased labor costs, equipment costs, lane miles and other factors.

Figure 2.2. Winter Severity Index, 2014-2015



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

Figure 2.3. 2014-2015 Winter Severity Index vs. 5-Year Average (2010–2011 to 2014-2015)



2. Regional comparisons. Since snowfall, number of storms, and other factors vary widely across the state, the severity index also helps WisDOT compare resources use from one region or county to another within a single winter. This allows WisDOT to assess whether materials are being used consistently, whether counties have enough staff, and other factors that affect each region's response to winter.

Data from weekly storm reports are used to calculate the Winter Severity Index for each county according to a weighted formula. Results are scaled such that the 5-year average is 100. A number above 100 indicates higher-than-average severity; a number below 100 indicates lower-than-average severity. We have begun scaling severity this way in order to make the numbers more easily understood. This winter:

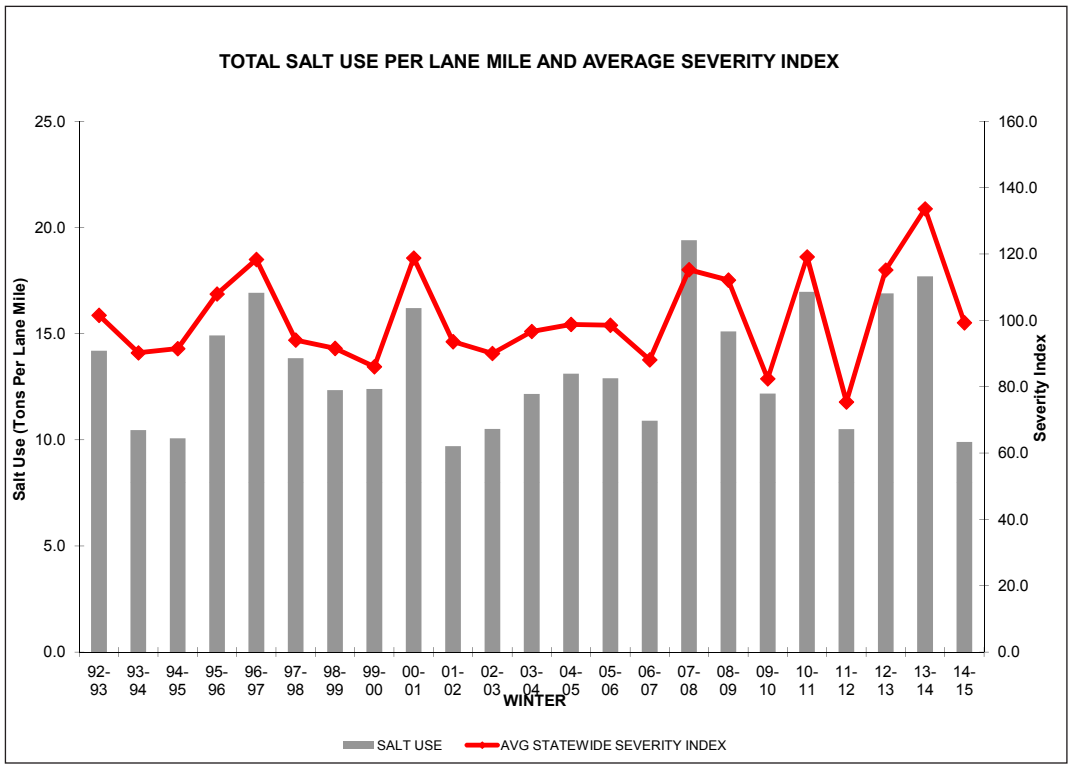
- The statewide average Winter Severity Index was 99.3, which is 0.7 percent lower than the average of the previous five winters (100), and four percent lower than the average of the previous ten winters (103.4).
- Ashland and Iron Counties had the highest severity indexes, 185.6 and 184.9 respectively.
- Walworth and Kewaunee Counties had the lowest severity indexes, 60.3 and 53.7 respectively.

With some exceptions across the state, this winter was much less severe than normal. Figure 2.2 on the previous page shows how severity index varied by county this winter, while Figure 2.3 shows how this winter's severity index for each county compares to the average of the previous five years in that county.

Figure 2.4 plots the average statewide salt use per lane mile versus the average statewide Winter Severity Index. Normally, salt use tends to increase as the severity index increases. Looking back over the past 20 plus years of data, this year's salt use and severity index was similar to 2001-02.

Since the Winter Severity Index is an important tool for comparing cost and materials data from year to year, this report includes several charts that compare trends in winter measures over time with changes in severity index.

Figure 2.4. Salt Use per Lane Mile and Average Severity Index
From Salt Inventory Reporting System, 1992–2015



This includes Figure 2.4, as well as Figure 3.2 (salt used per lane mile; page 35), Figure 4.1 (winter costs; page 72), and Figure 4.6 (winter crashes; page 79).

Because of concerns about consistency across all counties in reporting incidents, beginning with the 2005–2006 winter WisDOT adjusted the formula for computing the severity index to remove cleanup and bridge deck snow removal as components in the calculation. The effect of this change is slight, but readers should be aware of it when comparing severity index data from the last ten winters against earlier data. The severity index for some counties may appear slightly lower using the new formula.

More information on the severity index is available by request from WisDOT:

- A report describing the process that was used to develop the severity index, including data on the five-year-average severity index for each county (March 1998).
- A table showing Winter Severity Index values for each county for the previous 10 winter seasons.

On pages 27-32, Table 2.1 gives details about the types of storms and other incidents (such as frost, ice, and drifting or blowing snow) that each county experienced this winter, as reported by the counties in their winter storm reports.

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County-by-County
Tables for Section 2
Winter Weather

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Table 2.1. Storms and Incidents

From Winter Storm Reports, 2014-2015

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
NC	WAUPACA	40.0	547.06	2108	3.85	24	8	14	3	3	26	16	16	3	3	0	14	6
	GREEN LAKE	34.2	158.36	707	4.46	23	10	13	3	8	21	12	4	6	5	0	11	3
	WAUSHARA	37.8	345.01	2771	8.03	22	8	12	5	7	13	4	2	1	8	1	6	11
	ADAMS	30.1	193.20	1674	8.66	27	17	15	14	13	11	3	7	2	3	0	9	10
	MARQUETTE	27.8	245.09	2197	8.96	26	8	20	9	8	12	1	2	3	4	0	9	13
	WOOD	60.5	420.98	3934	9.34	38	31	20	7	10	19	15	11	9	6	0	10	14
	PORTAGE	42.5	582.05	5454	9.37	39	18	18	11	13	25	13	12	4	7	9	9	2
	SHAWANO	65.3	520.57	5455	10.48	28	14	12	4	4	38	17	5	4	3	12	21	14
	LINCOLN	77.4	415.19	4719	11.37	43	20	25	13	10	29	14	15	8	5	6	17	8
	PRICE	95.1	322.26	4028	12.50	53	29	17	16	1	26	14	3	0	0	0	16	3
	MARATHON	62.8	869.93	10965	12.60	43	20	19	5	4	51	13	15	9	19	11	21	25
	LANGLADE	81.1	299.21	3831	12.80	40	24	15	6	9	29	18	11	1	23	1	22	2
	MENOMINEE	52.8	90.26	1248	13.83	28	12	15	4	0	21	0	1	0	9	0	11	3
	IRON	234.9	249.56	3656	14.65	52	20	33	1	9	35	20	11	1	18	0	29	0
	ONEIDA	109.4	396.79	6069	15.30	44	16	31	7	8	10	0	2	3	8	1	6	7
	FOREST	133.4	312.38	4946	15.83	50	23	24	7	0	18	11	0	0	2	3	15	0
	FLORENCE	121.4	141.07	2614	18.53	41	34	17	5	5	37	12	0	1	4	8	23	13
	VILAS	143.0	305.24	7045	23.08	47	16	30	1	1	21	0	1	0	7	0	13	0
Region Average		80.5	356.35	4079	11.87	37	18	19	7	6	25	10	7	3	7	3	15	7

Final totals as of Thursday, July 02, 2015

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2014-2015

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
NE	CALUMET	40.5	201.71	843	4.18	23	6	13	5	2	18	9	10	3	3	0	11	2
	FOND DU LAC	32.2	597.46	3266	5.47	18	8	10	3	1	20	13	3	4	4	0	3	11
	SHEBOYGAN	32.9	522.93	3117	5.96	26	10	20	9	7	12	6	6	6	4	2	5	16
	OUTAGAMIE	53.1	538.55	3357	6.23	29	19	9	2	5	13	2	4	3	5	0	2	2
	OCONTO	74.5	468.36	3044	6.50	38	26	12	2	5	22	4	11	0	2	2	13	35
	KEWAUNEE	44.0	111.35	792	7.11	19	7	11	1	4	11	4	6	2	2	0	5	9
	MANITOWOC	36.3	425.85	3157	7.41	23	16	12	4	7	18	4	10	10	9	9	4	11
	DOOR	35.4	269.70	2045	7.58	32	15	22	6	7	29	21	21	1	13	0	8	8
	WINNEBAGO	31.2	623.16	5499	8.82	27	11	17	6	6	38	6	10	7	1	16	21	9
	BROWN	32.4	796.76	8126	10.20	30	12	14	7	1	14	1	9	4	2	0	2	38
	MARINETTE	88.6	427.96	5805	13.56	35	20	15	1	10	29	9	10	2	7	13	18	25
Region Average		45.6	453.07	3550	7.55	27	14	14	4	5	20	7	9	4	5	4	8	15

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2014-2015

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
NW	PEPIN	45.4	112.38	531	4.73	25	14	14	5	8	12	9	11	4	6	6	7	1
	BURNETT	60.6	234.95	1126	4.79	29	15	16	3	6	17	11	10	8	7	0	13	7
	BUFFALO	61.2	317.02	1688	5.32	35	15	16	4	1	24	15	2	0	5	3	12	6
	PIERCE	49.8	365.50	2801	7.66	34	11	25	7	16	15	9	5	0	11	5	11	4
	ASHLAND	146.6	249.49	2123	8.51	63	28	33	7	8	29	21	0	1	1	0	11	2
	BARRON	70.7	423.09	3691	8.72	39	20	21	4	10	41	26	17	2	6	15	21	2
	CLARK	67.8	402.56	3734	9.28	36	19	13	7	3	27	22	4	1	3	0	12	9
	SAWYER	86.7	367.44	3418	9.30	44	28	11	5	2	21	10	6	0	4	0	5	0
	RUSK	61.8	213.47	2038	9.55	25	13	9	3	6	29	13	14	1	4	4	12	0
	TAYLOR	65.1	233.90	2301	9.84	36	24	17	9	7	31	22	11	1	18	3	10	10
	WASHBURN	65.1	372.14	3732	10.03	32	19	13	2	12	24	6	3	4	15	2	7	5
	CHIPPEWA	68.7	654.65	6569	10.03	37	14	20	4	6	19	16	7	0	4	3	7	0
	DOUGLAS	77.2	440.80	4672	10.60	41	16	21	9	0	27	10	11	8	0	0	19	12
	POLK	67.8	385.05	4322	11.22	37	10	17	12	4	33	23	12	0	17	0	4	7
	TREMPEALEAU	48.1	442.00	5166	11.69	34	12	18	11	19	17	9	11	5	5	2	15	6
	JACKSON	58.5	515.14	6026	11.70	33	10	17	11	7	19	14	1	0	2	0	7	3
	SAINT CROIX	39.7	632.52	7615	12.04	34	11	21	4	2	20	14	3	0	7	2	6	0
	DUNN	49.6	516.58	6393	12.38	33	9	24	2	1	21	14	1	0	3	0	5	0
	BAYFIELD	130.0	316.88	4303	13.58	52	22	36	0	8	27	20	11	0	2	2	21	1
	EAU CLAIRE	47.1	539.46	7842	14.54	32	12	19	6	3	36	6	7	0	5	1	32	6
Region Average		68.4	386.75	4005	9.78	37	16	19	6	6	24	15	7	2	6	2	12	4

Final totals as of Thursday, July 02, 2015

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2014-2015

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting Snow	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
SE	WAUKESHA	49.4	1,121.60	7582	6.76	26	16	14	4	1	2	0	1	2	1	0	0	25
	RACINE	51.8	683.28	7565	11.07	30	10	19	4	4	18	12	7	0	7	8	14	7
	KENOSHA	39.2	653.56	7381	11.29	26	11	12	4	3	3	2	3	0	0	0	2	32
	WALWORTH	53.6	706.03	8887	12.59	24	13	16	3	3	11	3	2	1	2	0	7	16
	WASHINGTON	34.6	607.89	7880	12.96	38	16	14	11	1	8	7	5	13	0	1	4	15
	MILWAUKEE	41.0	1,897.05	30793	16.23	27	16	9	9	1	4	0	3	1	0	0	0	4
	OZAUKEE	32.7	308.71	5282	17.11	31	17	15	7	2	7	4	1	2	1	1	3	9
Region Average		43.2	854.02	10767	12.57	29	14	14	6	2	8	4	3	3	2	1	4	15

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2014-2015

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
SW	GREEN	42.5	315.55	979	3.10	20	7	13	7	6	24	4	0	1	6	0	20	27
	ROCK	44.8	687.78	2643	3.84	19	6	12	2	0	22	8	2	0	9	0	8	5
	LAFAYETTE	53.8	298.98	1618	5.41	27	10	8	10	4	9	2	2	0	4	1	3	19
	JEFFERSON	49.9	559.08	3055	5.46	25	7	14	1	4	12	5	4	3	2	0	4	0
	RICHLAND	33.6	327.64	2157	6.58	28	15	15	8	5	13	5	6	7	10	0	11	14
	IOWA	49.0	476.31	3388	7.11	25	11	8	7	2	28	17	2	3	6	1	9	29
	CRAWFORD	44.4	394.99	2893	7.32	35	10	23	14	5	21	7	6	3	7	0	11	9
	SAUK	44.9	577.36	4665	8.08	30	12	15	8	7	25	5	6	0	18	0	5	30
	LA CROSSE	48.0	496.20	4371	8.81	25	12	23	7	7	15	11	11	11	1	1	12	16
	GRANT	44.7	622.06	5513	8.86	23	12	9	5	5	19	2	6	1	6	0	7	2
	VERNON	48.1	468.36	4166	8.89	35	7	12	14	1	29	13	4	0	9	0	7	11
	JUNEAU	50.6	494.25	5020	10.16	40	20	11	12	1	13	5	2	0	1	0	10	15
	MONROE	48.8	654.83	7300	11.15	41	19	15	11	12	10	9	9	12	1	5	9	12
	DODGE	35.5	651.82	8025	12.31	32	11	11	11	7	6	2	2	1	0	0	3	12
	DANE	44.5	1,512.86	20887	13.81	39	16	17	12	4	1	0	1	24	0	0	0	26
	COLUMBIA	41.5	786.13	11150	14.18	27	5	15	5	8	34	8	19	4	6	7	11	33
Region Average		45.3	582.76	5489	8.44	29	11	14	8	5	18	6	5	4	5	1	8	16

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2014-2015

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
Statewide Averages		--	478	4941	9.93	32.9	15.0	16.8	6.4	5.4	20.7	9.5	6.5	3.1	5.7	2.3	10.4	10.4

3 Winter Operations

In this section...

Photo Credit: Kurt Haubrich (https://goo.gl/U6M1Ub)

Wisconsin county highway departments use an array of strategies to combat winter storms. Materials, equipment and labor are three key pieces of the puzzle; county patrol superintendents use their skills and experience to combine these pieces in the most efficient way possible for each storm.

This section describes the counties' response to the 2014-2015 winter season, including materials use, best practices in equipment and technology, and training efforts. Most counties have added prewetting and anti-icing to their arsenal of best practices—strategies that help them use materials efficiently, save money and minimize environmental impacts.

Statewide Materials Use, 2014-2015

Total salt used[1]	388,797 tons
Total salt used per lane mile	11.3 tons
Total cost of salt used[2]	$26,861,292
Average cost per ton of salt	$69.01
Total prewetting agents used[3]	2,009,139 gal.
Counties prewetting salt	68 of 72 (94%)
Total abrasives used	22,301 cubic yards
Counties prewetting abrasives	18 of 57 using sand (32%)
Total anti-icing agents used	1,531,787 gal.
Counties equipped to use anti-icing	66 of 72 (92%)

There's More on the Web!

Looking for more information about winter maintenance in Wisconsin? WisDOT's extranet site features detailed reports on products, equipment, best practices and more.

See https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.
(Note: new site address)

1. Salt use data is final data from WisDOT's Salt Inventory Reporting System.
2. Cost data is actual salt costs as billed to WisDOT by the counties.
3. Prewetting, abrasives and anti-icing data are estimates from Winter Storm Reports.

3A. MATERIALS

Salt remains the primary material used in winter maintenance. The advent of prewetting technology has improved the efficiency of materials use (by keeping more of the material on the road instead of scattering off the edges), and proactive anti-icing applications have reduced the amount of salt needed to keep roads clear.

Salt

Salt is a critical part of a highway crew's response to winter storms in Wisconsin. When salt combines with ice or snow, it creates a brine solution with a lower freezing point than water. This solution then acts to break the bond between the ice or packed snow and the pavement, which allows the snow to be removed more easily through plowing.

Because of cost and environmental concerns, maintenance crews strive to use the smallest amount of salt necessary to provide an appropriate level of service for each roadway. Using anti-icing agents can help reduce overall materials use; see pages 41 - 42 for details on statewide anti-icing use.

Historically, counties have used disproportionately more salt during more severe winters; see Figure 2.4 on page 22 for a detailed comparison. This winter's statewide Winter Severity Index of 99.28 was 26 percent lower than the previous year, while salt use was 42 percent lower than the previous year, at 388,797 tons. See Table 1.5 on pages 13-17 for county-by-county salt use data for this winter.

Wisconsin counties applied a statewide average of 9.93 tons of salt per lane mile on state highways, a decrease of 49 percent compared with the 2013-2014 winter. (See Figure 3.11 on page 57 for a county-by-county comparison.) When compared with nearby states, which differ by winter severity and level of service standards, Wisconsin salt use is relatively high. In the last year with comparable data available - 2009-2010 - Wisconsin used 12.2 tons of salt per lane mile on state highways. In that same year, Minnesota (5.9 tons per lane mile), Iowa (9.8) and Indiana (11.8) used less while Illinois (12.3) and Michigan (12.6) used more. Several factors may contribute to other states' lower rates of salt used per lane mile, including salt shortages that prevented several states from obtaining the quantity of salt that they would normally use. Winter severity also varies from state to state. Generally, states are employing better salt management strategies. Data on total salt use (not adjusted for lane miles) for most states is available on page 58 in a map of salt use and costs produced by Washington State DOT.

Figure 3.1. Salt Used per Lane Mile
From Salt Inventory Reporting System, 2014-2015

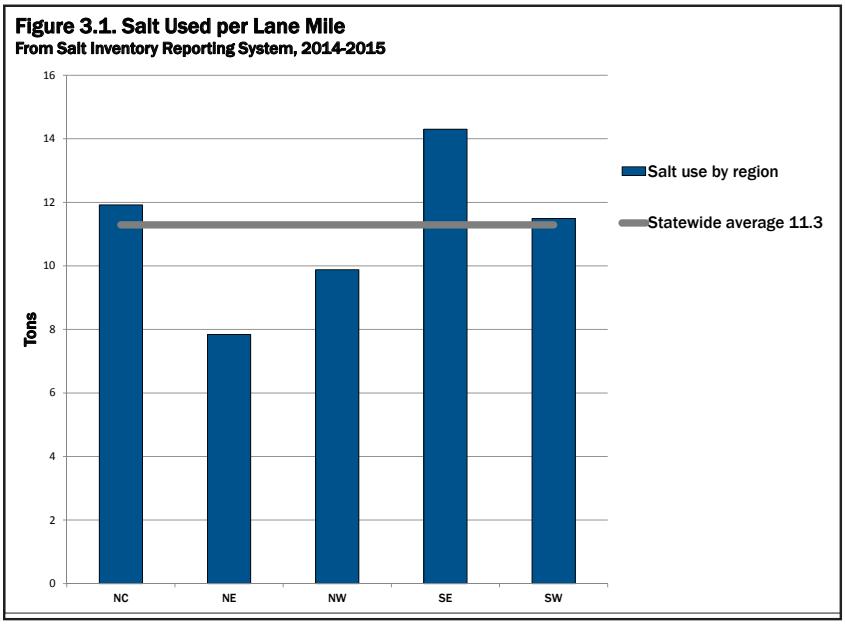


Figure 3.1 shows the regional levels of salt use per lane mile. Counties in the Southeast Region used an average of 14.3 tons of salt per lane mile, which reflects the greater number of highways in these counties receiving 24-hour service.

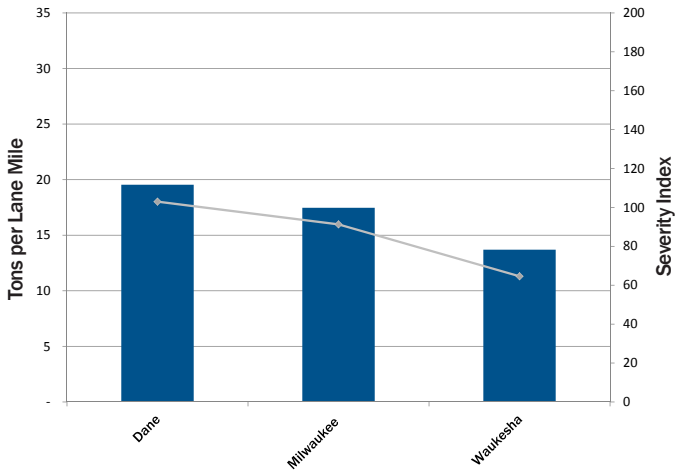
Figure 3.2 on page 35 shows salt use per lane mile in each county, overlaid with severity index to allow a further "apples to apples" comparison of salt use in each county. The counties in Winter Service Groups A and B have more urban highways and tend to use more salt per lane mile for a given level of severity.

For more detail on salt use in previous years, see Table A-9, "History of Salt Use on State Trunk Highways," on page 164 of the Appendix.

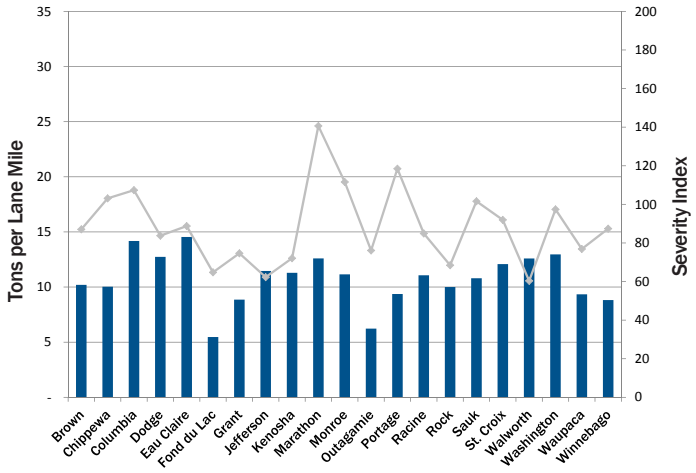
Figure 3.2. Salt Used per Lane Mile and Severity Index

From Salt Inventory Reporting System, 2014-2015

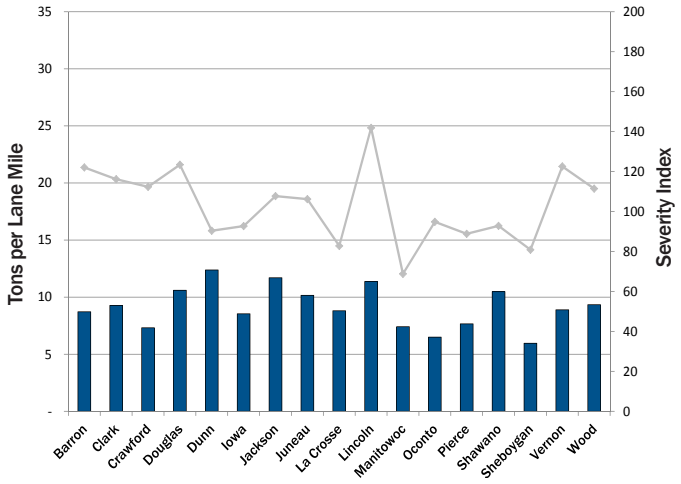
Salt Used per Lane Mile and Severity Index (Group A)



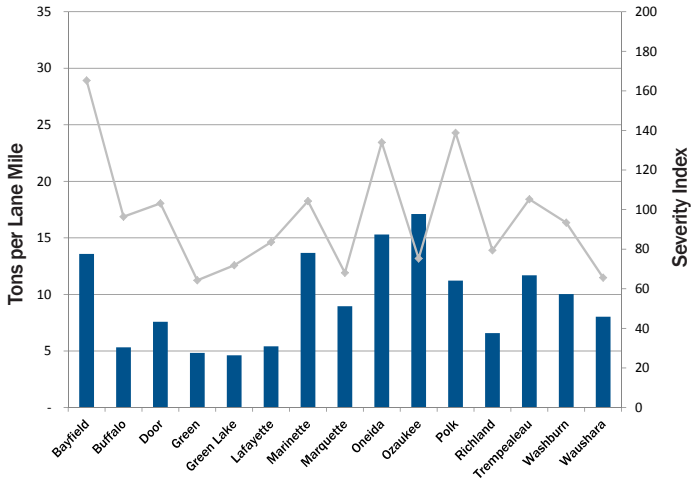
Salt Used per Lane Mile and Severity Index (Group B)



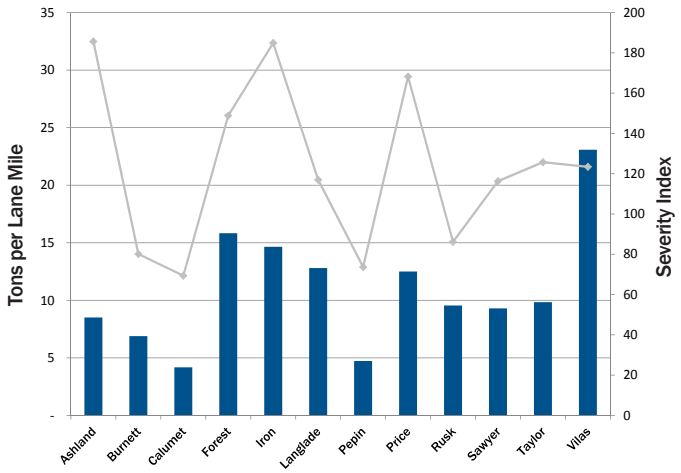
Salt Used per Lane Mile and Severity Index (Group C)



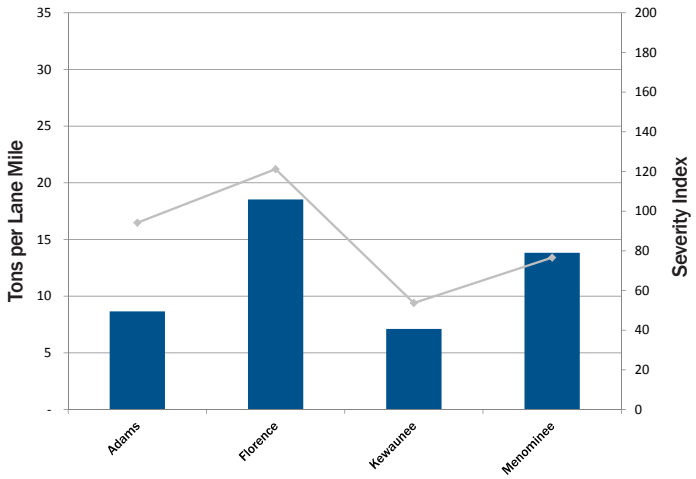
Salt Used per Lane Mile and Severity Index (Group D)



Salt Used per Lane Mile and Severity Index (Group E)



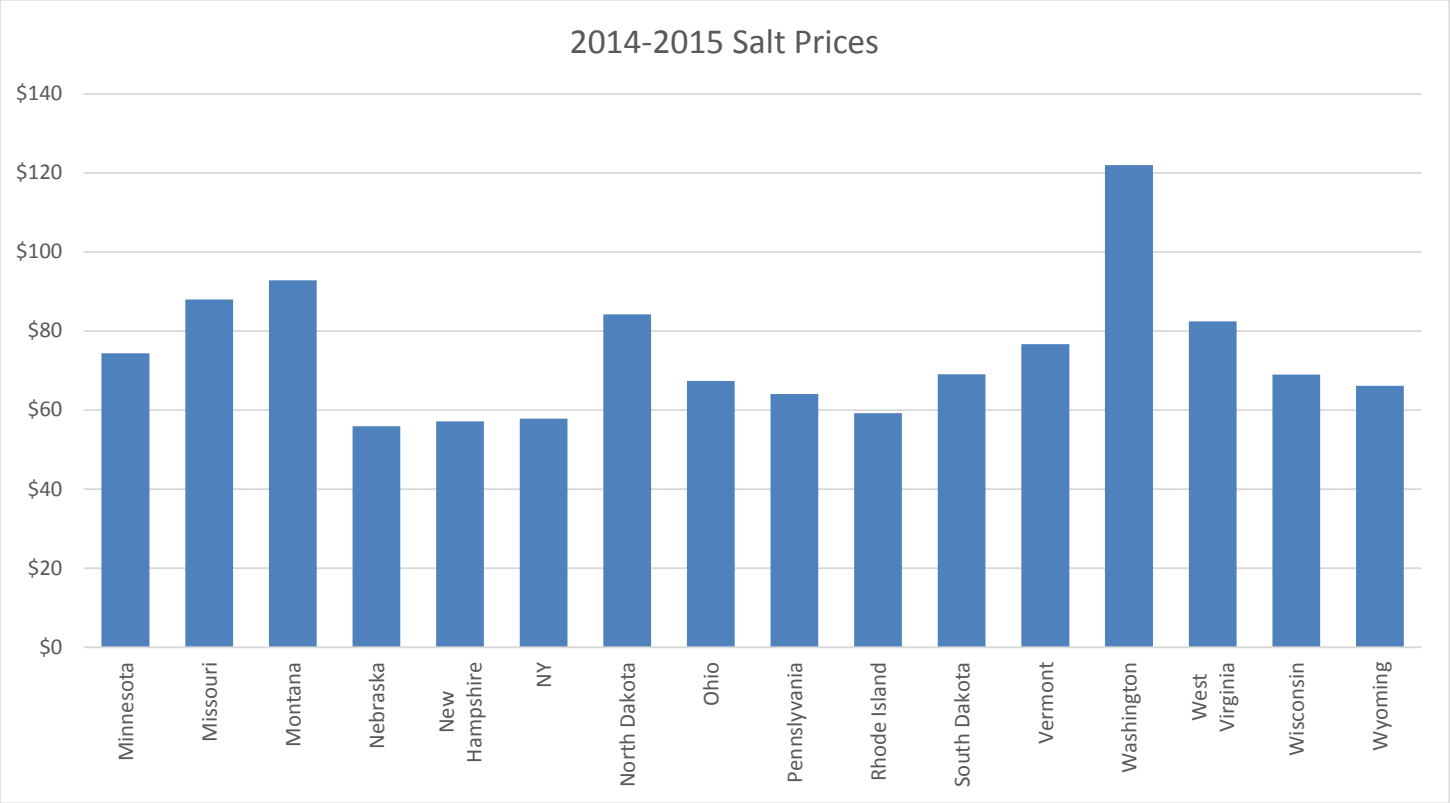
Salt Used per Lane Mile and Severity Index (Group F)



Salt used (tons) per lane mile — Severity Index

Figure 3.3. Salt Prices Across the United States

Source: Clear Roads



Cost of Salt

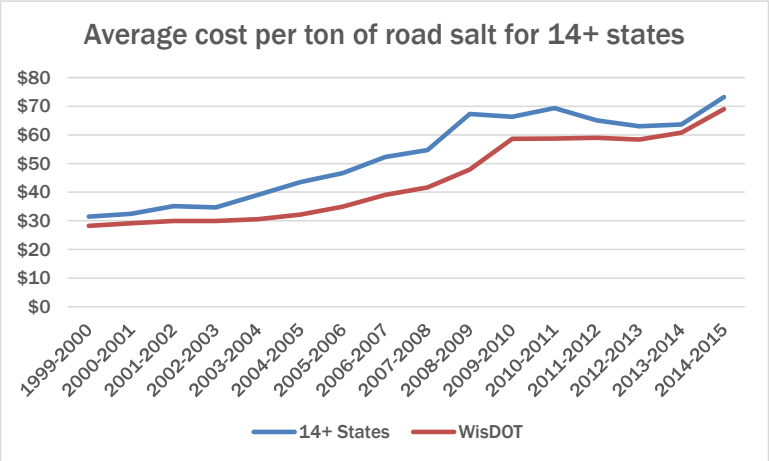
Salt prices continue to remain high, which WisDOT's salt vendors attribute to multiyear supply and demand issues. Prices have generally leveled out, however, after several years of large increases. This winter, WisDOT spent $26,861,292 on salt statewide, purchasing salt at an average of $69.01 per ton.

Fuel prices have contributed to higher salt transportation costs in recent years: The average of $69.01 per ton is a 14 percent increase compared to prices paid under last winter's salt contract and an increase of 114 percent compared with the average price of $32.21 ten years ago.

Despite this increase, WisDOT pays less per ton for salt than most other snowy states across the country, according to data compiled by Washington State DOT; see Figure 3.3. Washington State DOT created a map of per-ton salt costs and average salt use across the country, which we have reproduced in Figure 3.12 on page 58. Figure 3.4 shows that Wisconsin has historically paid less for salt than other states.

Figure 3.4. Salt Prices Over Time

Source: Data from 14+ states, 2002–2015



Source: Historical data supplied by Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, North Dakota, New York, Ohio, Virginia, Pennsylvania, Utah, Washington, West Virginia and Wisconsin and compiled by Iowa DOT. (the number of states included in the average has gradually increased to 19).

The department speculates that the flexibility of its contracting method may account for some of these cost savings. Wisconsin's contracts include a 100 percent provision, which means that the department guarantees that it will purchase 100 percent of the contracted amount of salt. Some other states' contracts include an 80/120 provision that requires the salt vendor to keep 120 percent of the contracted salt amount on reserve, and commits the state to purchasing only 80 percent of the contracted amount. This 40 percent spread could translate to higher costs for states under an 80/120 contract.

For more on costs, see Section 4 starting on page 67.

A Note About Materials Data

This winter marks the sixth year that all salt data in this report comes from WisDOT's Salt Inventory Reporting System (SIRS). In previous years, some tables used preliminary salt use data collected in the weekly winter storm reports. Sand use data continues to come from the storm reports, as does some detailed anti-icing and prewetting data. These materials use estimates are included in this report because they provide a level of detail and correlation with storm events that is not available from SIRS or from final financial data. The source of each table's data is indicated below the table title.

BEST PRACTICES: Underbody Plow

WisDOT encourages counties to use underbody plows when possible. If the plow blade is positioned in this way, it will apply downward pressure and can remove more snow pack and ice than a front-mounted plow. The underbody plow is most effective when removing hard packed snow and ice. In light and fluffy snow conditions, snow will compact a under truck with an underbody blade. Unevenness in pavement can also cause operating issues for this type of blade.

Photo credit: fancy-cats-are-happy-cats (https://commons.wikimedia.org/wiki/File:DesCoPlow.tif)

Abrasives

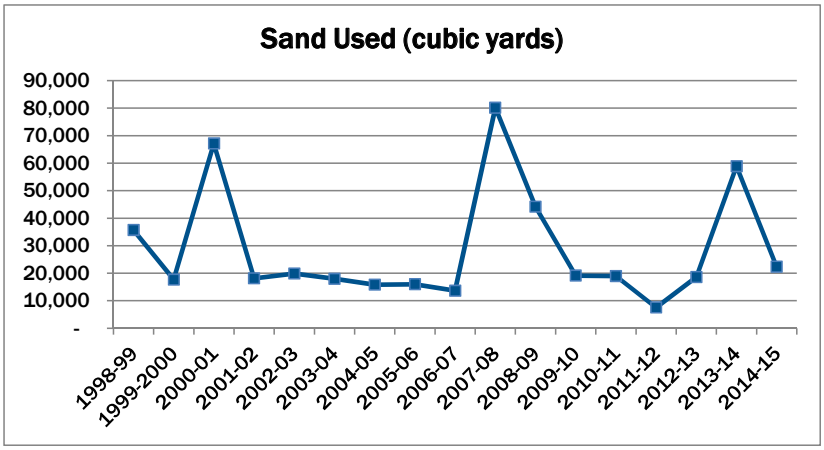
County highway departments sometimes use sand and other abrasives to improve vehicles' traction on icy or snowy roads when temperatures are too low for salt to be effective. Abrasives are somewhat effective in low-speed trouble spots and intersections. Abrasives should be prewetted with a liquid agent for better adherence to the roadway.

A total of 22,301 cubic yards of sand was used by 57 counties on state highways this winter, a decrease of 72 percent compared with 2007–2008's record-setting 80,133 cubic yards, and a 9 percent decrease from the average of the five previous winters (24,599 cubic yards).

In 2008, the Bureau of Highway Maintenance commissioned a synthesis report, "Limitations of the Use of Abrasives in Winter Maintenance Operations" to substantiate WisDOT's guidance to Wisconsin counties on reducing sand use. The report cites factors recommending against the use of sand that have been supported by research, and offers the following general conclusions:

- Sand exhibits limited effectiveness at higher vehicle speeds, especially when it has not been prewetted. Mixing sand with salt to keep it from freezing also limits sand's effectiveness.
- Sand used in a salt-abrasive mixture has not been shown to reduce accidents.
- Salt is more cost-effective than sand in winter maintenance operations.

Figure 3.5. Statewide Sand Use From Storm Reports Data, 1998-2015



The 2008 synthesis report is available on-line at:
http://clearroads.org/wp-content/uploads/dlm_uploads/tsr-limitations-of-abrasives.pdf

Figure 3.5 compares this winter's statewide sand use with previous years'. Spikes in sand usage during the winters of 2000-01 and 2007-08 reflect greater use of sand/salt mixes due to low salt supplies during the end of those winter seasons. Unusually high sand usage during the winter of 2008-09 reflected, in part, the use of sand left over from the prior winter. The 2013-14 spike in sand usage reflected extreme cold temperatures rendering salt ineffective, plus some counties went to a sand/salt mix when salt supplies ran short. Refer to Table A-8 on pages 158-163 of the Appendix for county-by-county sand use data for this winter.

The billed cost of sand varies greatly across the state, depending on the local availability of the sand and transportation costs. In 2011–2012, the last year for which data is available, most counties paid an average of $18.00 per cubic yard, with a statewide range of $5.15 to $52.00 per cubic yard. It should be noted that sand is typically mixed with 5 percent salt to keep it from freezing. The cost of the added salt and the mixing of the two together is typically not reported.

For more information on using and storing abrasives, see Chapter 6, Section 20 of the State Highway Maintenance Manual.

Prewetting

Prewetting salt and sand with liquid deicing agents before or during their application to the pavement has several advantages. When used with salt, prewetting reduces loss of salt from bouncing and traffic action, which reduces the amount of material needed. Prewetting also improves salt penetration into ice and snow pack, and begins dissolving the salt, which allows it to work more quickly. When used with abrasives, prewetting helps keep the sand on the pavement and may allow crews to use higher truck spreading speeds.

WisDOT encourages all county highway departments to prewet their salt and sand, and to explore stocking more than one deicing agent so that different agents can be used as conditions warrant. For example, salt brine can be reasonably used at pavement temperatures down to about 15°F, whereas agents such as magnesium chloride and calcium chloride are effective at lower pavement temperatures, to about 0°F. See Table 3.1 on page 40 for details on statewide prewetting agent use.

Salt brine is a relatively inexpensive choice for prewetting. Salt brine use has increased significantly since counties first tested it a decade ago; 62 counties used salt brine for prewetting this winter (see Table A-6 on page 150-151 of the Appendix for details). Counties used less salt brine for prewetting this winter—1,815,853 gallons—due to a significant decrease in the amount of salt used statewide compared with last year's extreme winter. Overall use of prewetting liquids decreased 31 percent compared with last year's total, and salt brine use decreased 26 percent.

In addition to salt brine, some counties used calcium chloride, magnesium chloride, or agricultural-based products for prewetting this year. See Table A-7 on pages 152-157 for details. Organic blends seem to be preferred over the straight chemical products. The addition of the organics helps reduce corrosion to equipment.

Although once the only option for prewetting, calcium chloride is a more corrosive chemical than other prewetting liquids, and can damage equipment and be more difficult for operators to handle. WisDOT encourages counties to explore other options for prewetting, such as salt brine.

BEST PRACTICES: On-Board Prewetting

WisDOT encourages counties to prewet both salt and sand before applying it to the roadway. Agencies across the country and worldwide consider prewetting a best practice, and some require that all material be prewetted before it is placed. Studies have shown that prewetting significantly improves the amount of material that stays on the road. On-Board prewetting is preferred because it is the simplest way to ensure that salt is being uniformly prewetted.

A 1973-74 study by Michigan DOT concluded that as much as 32 percent more salt stays on the roadway when prewetted versus dry salt is used. In 2012, another Michigan DOT study verified the results of their earlier research with respect to bounce and scatter. It concluded:

1) Speed is the biggest factor effecting salt bounce and scatter (25 mph speeds retain the most salt in the target zone, by far)

2) Treated salt scatters less than untreated salt

3) Rear cross conveyors outperform y-chute systems

A salt slurry generator mounted on a salt truck

For more information on prewetting, see Chapter 6, Section 20 of the State Highway Maintenance Manual.

Several counties have also tested pretreated salt, in which a liquid prewetting agent is spray-applied to the salt supply before the salt is placed in storage. See https://dot-auth-prod.wi.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/reports.aspx for details. According to the Minnesota Snow and Ice Control Field Handbook for Snowplow Operators (published by the Minnesota Local Road Research Board), when treating a stockpile of salt, a liquid deicing chemical should be applied at a rate of 4 to 6 gallons/ton. Since liquid prewetting increases the leach risk of the stockpile, salt should be stored on an impervious pad.

Table 3.1. Statewide Prewetting Agent Use for Salt

Deicing Agent	Gallons Used	Counties Using
Salt Brine	1,816,818	62
Calcium Chloride-based Products		
Calcium Chloride – liquid	102,282	12
Calcium Chloride with rust inhibitor	6,010	2
Magnesium Chloride-based Products		
Magnesium Chloride	10,682	7
Freeze Guard	32,378	13
Agricultural-based Products		
BioMelt 64	2,315	1
IceBite 55	7,065	4
MC95	14,489	9
Geomelt	49,958	8
TOTAL	2,041,997 gallons of liquid	68

While prewetting salt is the best practice in Wisconsin—68 of 72 counties (94 percent) prewetted their salt this winter—prewetting abrasives is far less common. Of the 57 counties that used sand this winter, only 18 counties prewetted it (see Table A-8 on page 162 for details). WisDOT strongly encourages counties to prewet their sand, since keeping sand on the pavement can reduce the amount of material used, which saves money and reduces environmental impacts. The Minnesota Snow and Ice Control Field Handbook for Snowplow Operators recommends prewetting sand at a rate of 4 gallons of salt brine/ton of sand.

BEST PRACTICES: Anti-icing

Anti-icing is a best practice not only nationwide, but across the globe. Agencies are finding that this technique, once reserved for bridge decks and trouble spots, yields excellent results on highways as well. More agencies are turning to anti-icing to help them use labor and materials efficiently, especially as salt prices continue to rise.

This winter, Wisconsin counties used 1,531,787 gallons of anti-icing liquid—the most on record and an increase of 73 percent over last winter's total. Yet at 1.4 percent of total winter expenditures, anti-icing continues to represent a small fraction of winter costs.

For more information on anti-icing, see Chapter 6, Section 15 of the State Highway Maintenance Manual.

Table 3.2. Cost of Anti-icing vs. Deicing

Winter Service Group	Average cost of anti-icing treatment for possible frost					Counties reporting anti-icing costs	Average cost of deicing treatment for frost event					Counties reporting deicing costs
	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015		2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	
A	$1,984	$3,949	$3,630	$2,088	$809	2	$18,284	$19,126	$16,382	$61,801	$26,133	1
B	$1,060	$1,186	$1,437	$932	$724	10	$4,459	$3,889	$4,240	$5,984	$4,062	11
C	$799	$686	$653	$710	$484	7	$3,583	$2,051	$1,567	$3,100	$3,223	8
D	$745	$739	$692	$789	$834	8	$1,854	$2,607	$1,734	$2,661	$2,759	8
E	$479	$531	$793	$486	$322	4	$1,962	$1,526	$1,770	$2,395	$2,113	6
F	$340	$485	$614	$620	$512	2	$1,694	$927	NA	$878	$3,067	1

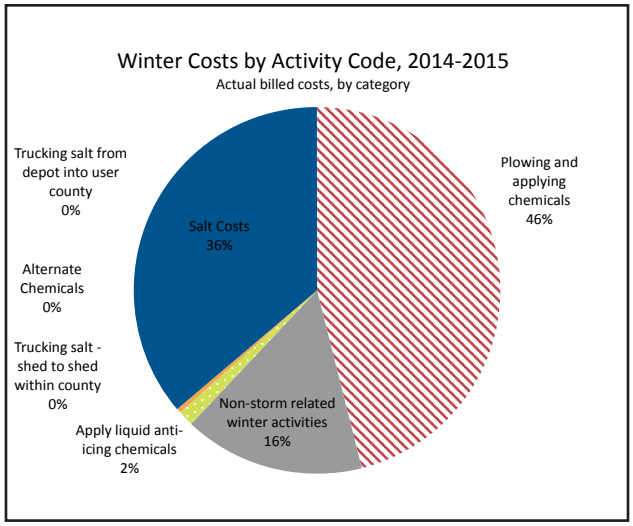
Anti-icing

Anti-icing is a proactive snow and ice control strategy that involves applying a small amount of liquid deicing agent to pavements and bridge decks before a storm to prevent snow and ice from bonding with the surface. It is often used prior to light snowfall or freezing drizzle, and is also effective at preventing frost from forming on bridge decks and pavements. Anti-icing can reduce salt use, reduce materials costs, and improve safety.

This winter, counties used a record 1,531,787 gallons of anti-icing liquid (see Table A-4 on pages 141-146 for details). Currently, 66 of 72 counties (92 percent) are equipped to perform anti-icing operations, and this winter 63 counties made at least one anti-icing application. (Counties may choose not to anti-ice if weather conditions do not warrant it.) The total statewide brine usage of 1,483,653 gallons was a 72% increase from the total used in 2013-14. See Table A-6 on pages 150-151 of the Appendix for county-by-county data on salt brine use.

WisDOT encourages counties to explore stocking more than one agent for prewetting and anti-icing, so that a choice of agents is available for use according to pavement temperature and weather conditions. Table 3.3 shows the agents used for anti-icing in Wisconsin this winter.

Figure 3.6. Winter Costs by Activity Code



Note: Total cost data differs slightly from cost data elsewhere in this report due to rounding.

Table 3.3. Statewide Anti-icing Agent Use

Chemical	Gallons used	Counties using
Salt brine	1,483,653	60
Calcium chloride – liquid	4,205	3
Magnesium chloride	4,340	2
Freeze Guard	9,315	4
IceBite55	1,400	1
Biomelt	293	1
GeoMelt	28,581	7
Total	1,531,787	

Figure 3.7. Counties Using Anti-Icing

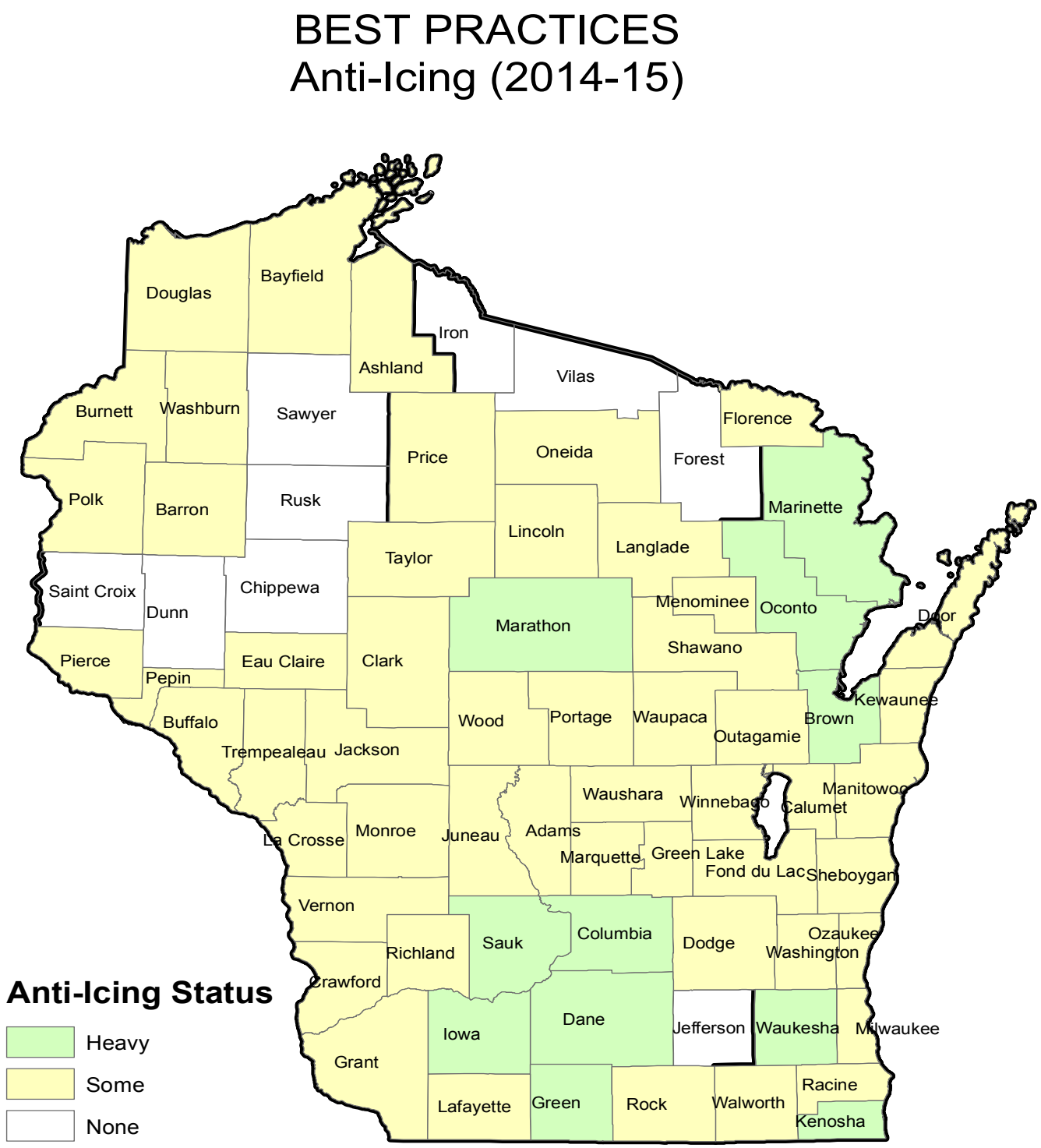


Figure 3.8. Counties Using Closed Loop Ground Speed Controllers

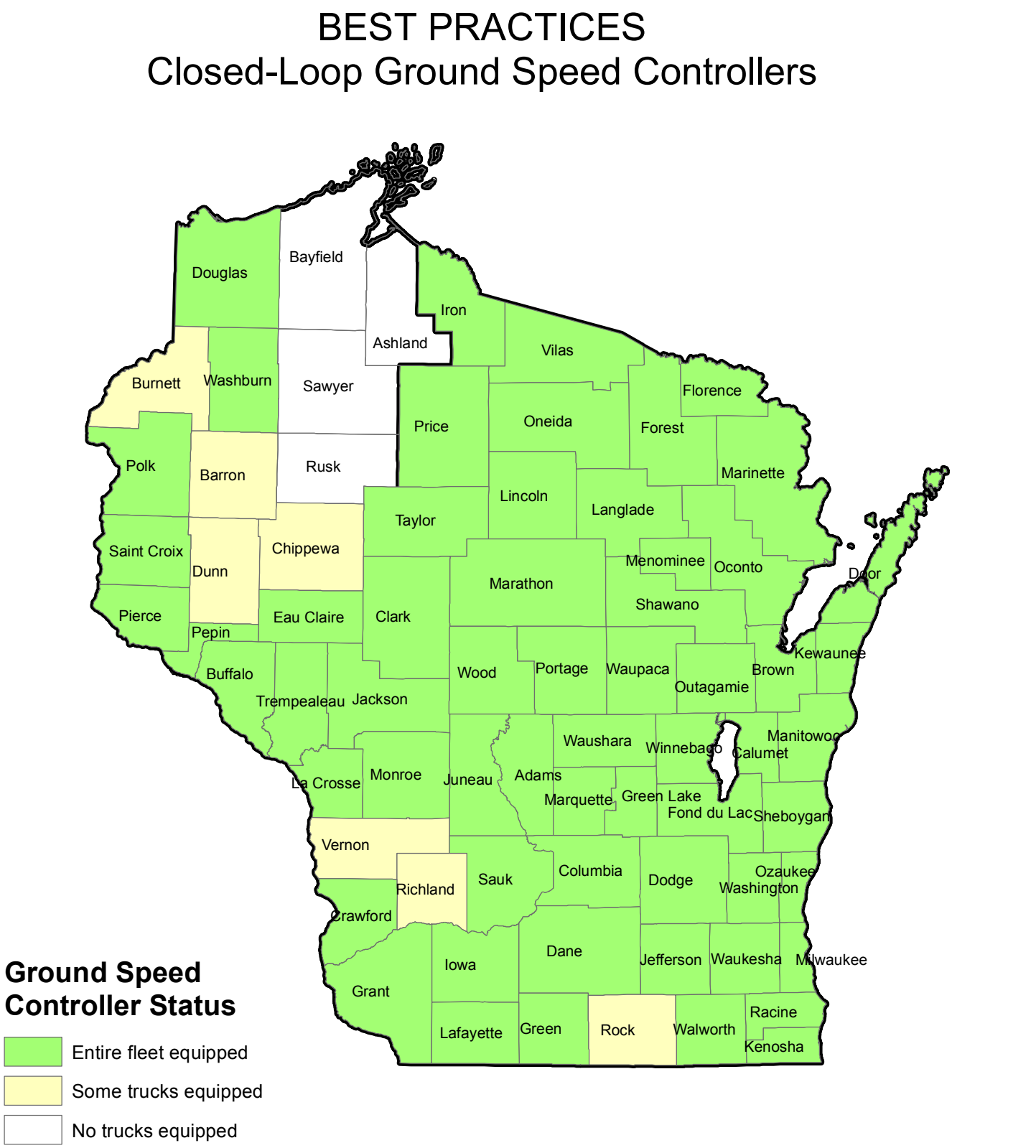


Figure 3.9. Counties Using Underbody Plows

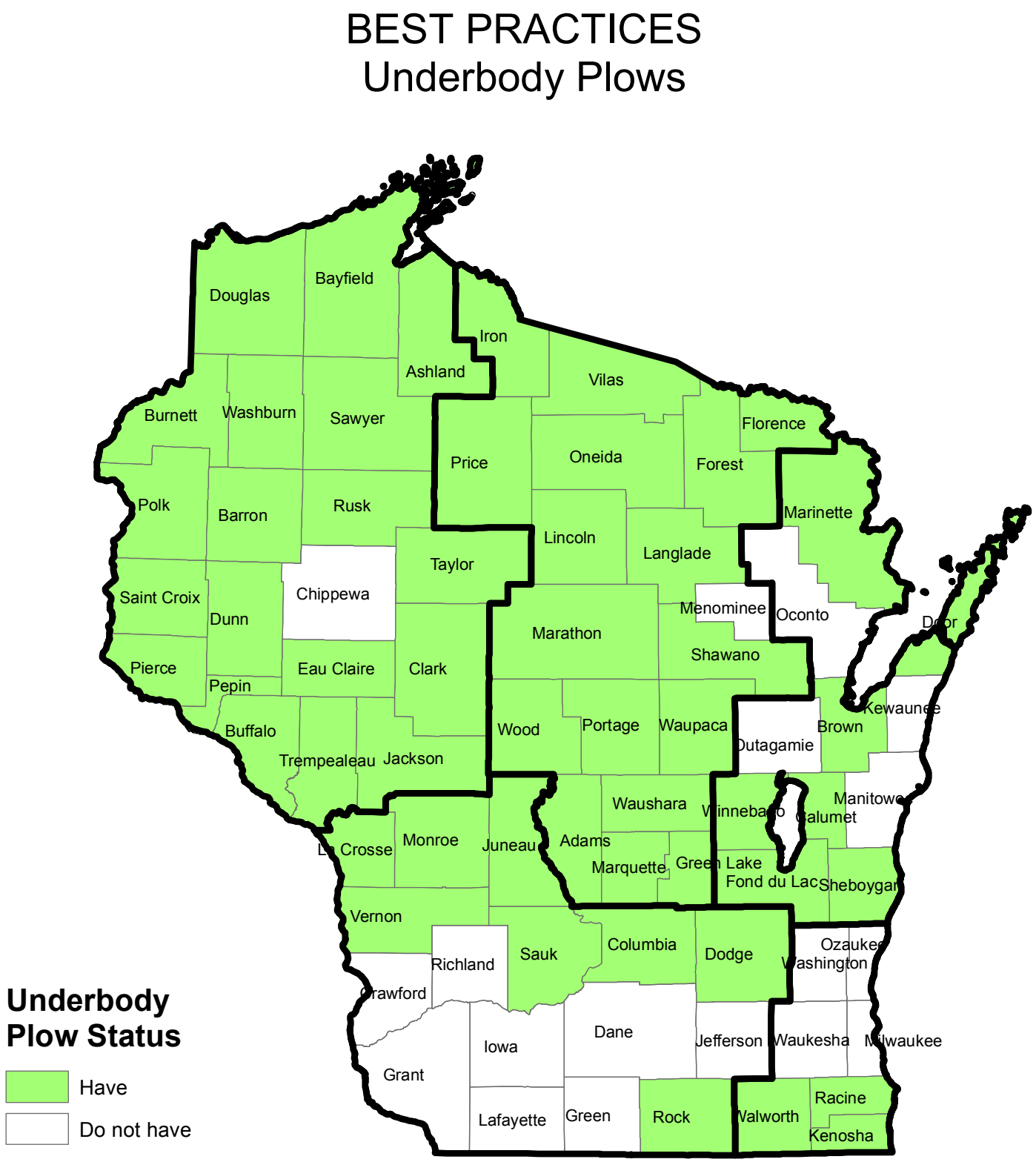
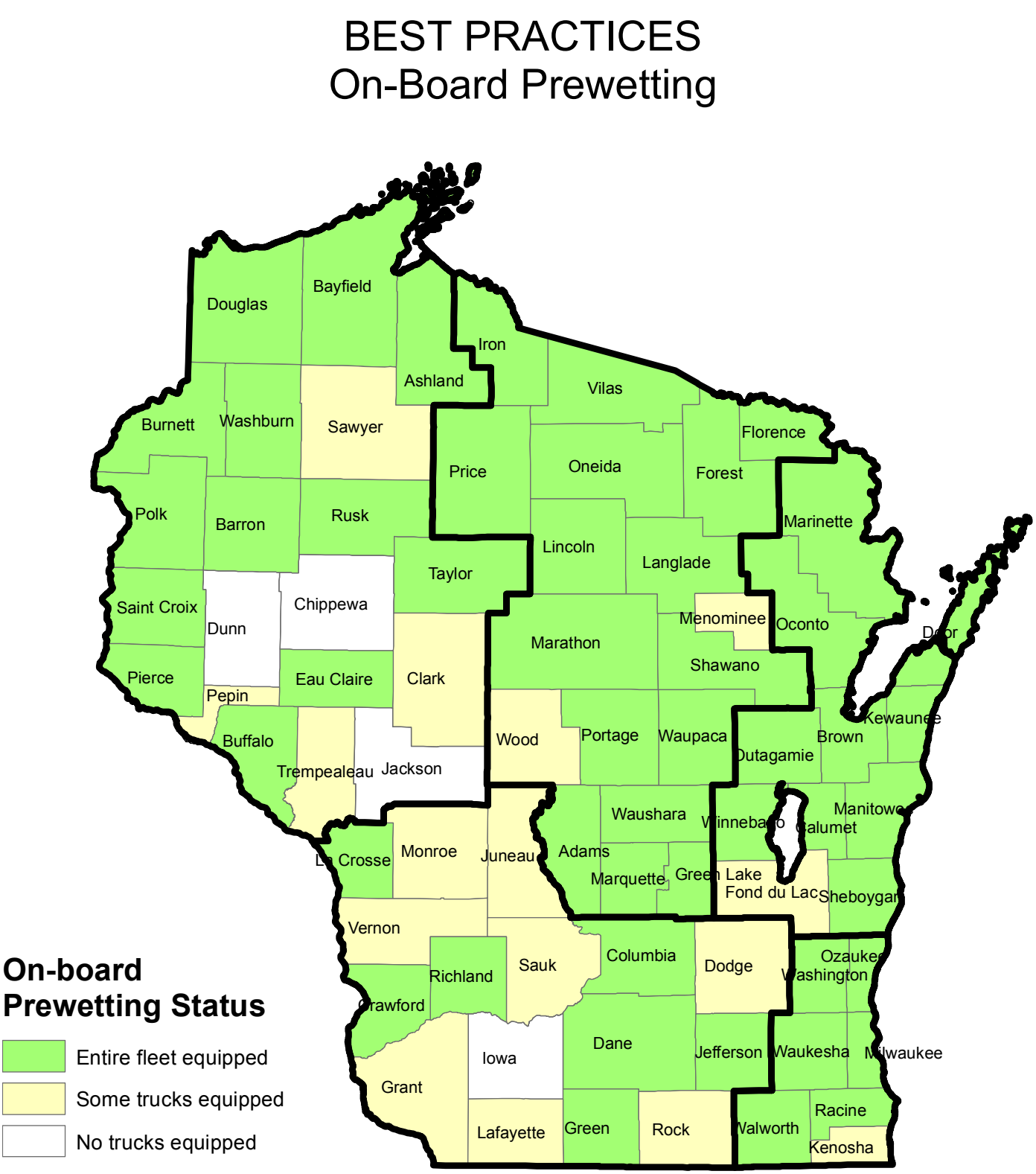


Figure 3.10. Counties Prewetting



3B. EQUIPMENT AND TECHNOLOGY

As winter maintenance technology and practices evolve, the counties are continually expanding their arsenal of snow and ice control strategies. Some of the counties' snowplows are equipped with underbody plows, which can be used in place of the front plow for removing lighter snowfalls of up to 4 inches. A portion of the counties' salt spreaders are equipped with ground speed controllers, and some have on-board prewetting units. In recent years, Road Weather Information Systems have become an increasingly important part of counties' efforts.

Road Weather Information Systems (RWIS)

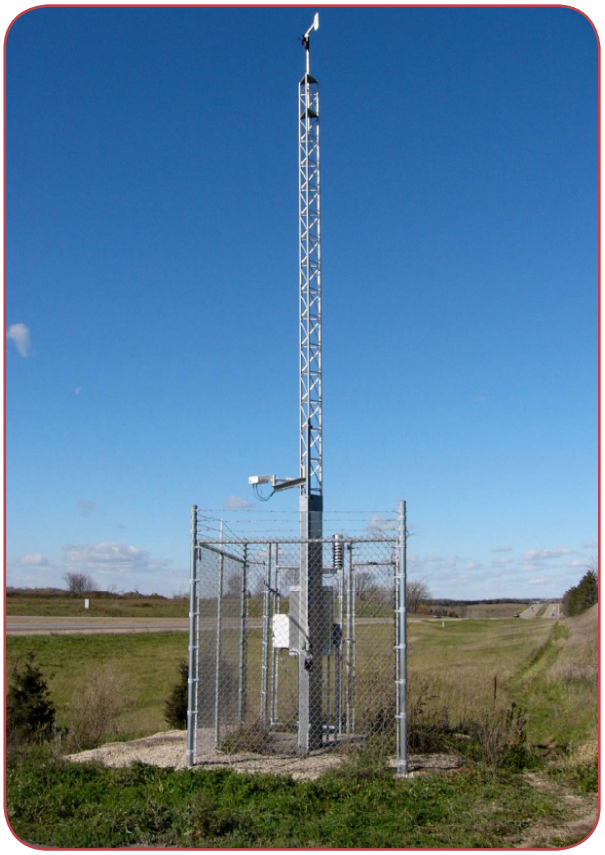
WisDOT has had a Road Weather Information System in place since 1986, and continues to expand and enhance the information available through this system. Designed to provide maintenance crews with the most accurate information about current and future weather conditions, WisDOT's RWIS system includes:

- 65 weather and pavement condition sensors along state highways.
- Detailed weather forecasts via the Maintenance Decision Support System (MDSS).
- A winter storm warning service for WisDOT and county highway departments.
- Over 1,000 mobile infrared pavement temperature sensors on patrol trucks around the state.

WisDOT contracts with an RWIS consultant to manage its RWIS program. This onsite consultant serves as WisDOT's staff meteorologist and RWIS program manager, and provides ongoing technical and administrative support for the state's RWIS systems.

Major activities in WisDOT's RWIS program this year included:

- Management of the MDSS, as well as attending three meetings of the MDSS Pooled Fund Technical Panel.
- Assisting with WisDOT's AVL-GPS.
- Coordinating with Iteris on forecast services.
- Performing an annual weather forecast verification study, monthly interim reports, and monitoring comments from counties using the service.
- Providing MDSS and RWIS training for regional operations staff, the STOC, and county highway departments.
- Overseeing maintenance and repair of the department's RWIS equipment.
- Managing WisDOT's rest area weather program.
- Representing WisDOT on the Aurora Program board.



A roadside weather sensor.

In addition, the RWIS program manager works to coordinate WisDOT's RWIS activities within Wisconsin and with other state and national agencies, including:

- Coordinating activities with the National Weather Service.
- Participating in national RWIS initiatives, such as MADIS.
- Providing RWIS presentations to WisDOT groups and agencies outside WisDOT.

Other ongoing services provided by the RWIS program manager include:

- Managing contracts for weather forecast and winter storm warning services, and for system maintenance.
- Coordinating use of Winter Severity Index data as an accurate tool to measure the relative severity of winter seasons and researching a potential new winter severity index based on MDSS data.
- Establishing a plan for replacement of aging infrastructure, such as roadside towers and television monitors at rest areas.
- Ongoing assessment of new RWIS technology.
- RWIS program management (budgeting, billing, planning, etc.).
- Developing enhanced methods of data display using GIS technology.

Maintenance Decision Support System (MDSS)

MDSS is a major project undertaken by WisDOT since 2009. Initial deployment took place in 2009 along the Interstate corridors. The bulk of the second phase of deployment occurred in 2010-11. During this phase, WisDOT added four or five "representative" routes in each county so that county highway departments could get an accurate weather forecast and treatment recommendation for the various types of routes in their county. In 2011, BHM input the remainder of the state's routes into MDSS. These will be used for tracking purposes only.

CONFIGURATION. WisDOT undertook a major effort to improve cycle time information in the MDSS configuration. Discussions with Iteris (the MDSS provider) and other states in the MDSS Pooled Fund Study (PFS) revealed that errors in cycle time information are a major cause of degraded treatment recommendations. A cycle time configuration that is longer than what actually occurs will lead to recommendations that are too high; the opposite is also true.

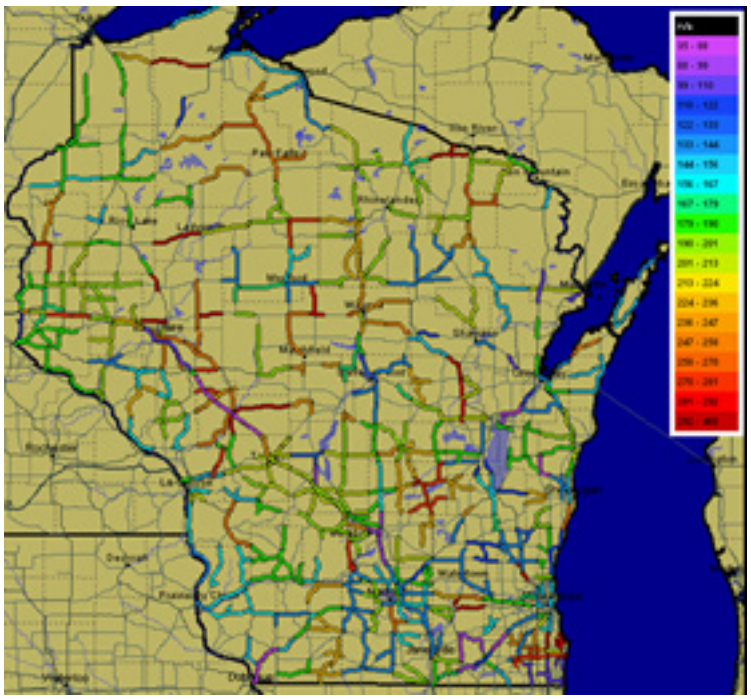
BHM created a short PowerPoint presentation depicting how to accurately determine cycle times. It demonstrated how to calculate cycle times for both two- and four-lane highways. This information was presented to the county patrol superintendents at the MDSS training sessions held in November/December 2014. BHM did receive some changes to cycle times, but not nearly as many as hoped.

BEST PRACTICES: Ground speed controllers

Ground speed controllers have been shown to reduce salt use by controlling the amount of salt spread according to the speed of the truck. These controllers can also provide accurate data on salt use.

In addition to reducing costs, controlling salt application can help limit the amount of chlorides that get into the environment, minimizing the degradation of plant species and water quality near roadways. See Chapter 6, Section 20 in the Winter Maintenance Manual for more information.

The map below shows cycle times along different routes; the color scale is in minutes. Anywhere there is a large jump in colors along a particular roadway, cycle times are likely incorrect. As the map below indicates, there are still major inconsistencies in cycle times along route corridors. While some differences can be expected in more rural areas, the large inconsistencies along Interstate corridors are troubling because they should not vary significantly. A new plan will be developed to try to eliminate these inconsistencies prior to the coming winter.



MANAGEMENT TOOLS. The major effort this year was in the development of a new, objective winter severity index.

TRAINING. Training was reconfigured slightly in FY 2015. Two introductory sessions for new users were held, one in Wisconsin Rapids and one in Waukesha. These covered the basics of MDSS for those who had never used it.

This allowed the "main" MDSS training effort to focus on more advanced topics. Sessions were held in each region. These were a joint effort between Iteris and WMS. BHM employed a storm from a previous winter to demonstrate how to integrate MDSS into the decision-making process. The training walked the attendees through a storm to demonstrate both the capabilities and limitations of the system. The sessions also delved into Management Tools, the web version, and the mobile version. There was a detailed session on how to set up winter storm alerts. Training was held in late November and early December. Users have asked for the training to be slightly earlier this year and BHM will accommodate that. Attendance was impacted by a couple early season snow events that led to the rescheduling of one of the sessions.

BHM sent out several "one-pagers" with step-by-step instructions on performing certain tasks. These included:

- Salt use calculations
- Pavement buckling alerts
- General alert setup
- Dashboard configuration

MONITORING. BHM worked with Iteris to obtain monthly MDSS usage statistics.

BHM also coordinated regularly with Iteris to obtain usage statistics for the mobile and web versions. Iteris did develop some tracking based on Google Analytics, but it remains to be seen how useful that will be. The major issue is the lack of ability to track by user. Google only tracks by user IP address. The usage map for 2014-15 is shown to the right.

PAVEMENT BUCKLING. BHM used previously-developed maps in MDSS to monitor conditions during the pavement buckle season. They coordinated with the STOC to have all notifications of buckles sent to him rather than relying on the regions to do it.

ALTERNATIVE PLATFORMS. The PM continued to coordinate with Iteris on a regular basis on two new MDSS platforms.

- Mobile Devices. As stated previously, BHM included training on mobile devices in the overall training sessions. MDSS apps are available for both Android and iOS. They work much better on tablets than on phones just due to the amount of information that can be displayed.
- Browser-based. BHM continued to provide feedback to Iteris in order to improve the web MDSS, which is called MxWx. Several bugs remain unfixed. Users can still access route forecasts by clicking on the map, but this problem needs to be fixed. The PM coordinated with Iteris to have a new map background installed for Wisconsin users.

COORDINATION. BHM attended three MDSS Pooled Fund Study Technical Panel meetings in Sioux Falls, SD.

Weather Forecast Service Use and Satisfaction

The weekly winter storm reports ask the counties to report whether they used the Iteris forecast service, and ask them to rate the quality of the forecast if they did use it. The Iteris forecast was used in 70 percent of winter storm events this year, up from the previous winter. Regionally, the usage rate varied from a high of 75 percent in the North Central Region to a low of 64 percent in the Northwest Region.

Statewide, the average number of times the winter storm reports were rated by the counties as "good" was 8.5 times, "fair" was 17 times and "poor" was only 4.4 times for the season.

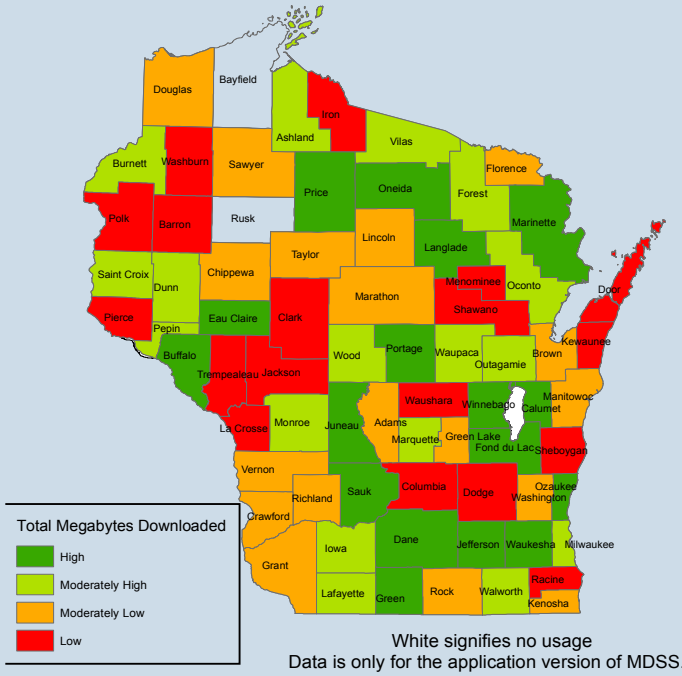
For more details on the evaluation of the Meridian forecast service, see a summary report on page 121 of the Appendix, or view the full report at https://dot-auth-prod.wi.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/reports.aspx. For more detail on the use of the service, see Table A-2 on pages 127-132 of the Appendix.

BEST PRACTICES: MDSS

The Maintenance Decision Support System (MDSS) was originally developed by the Federal Highway Administration and several National Laboratories beginning in 1999. The basic concept combines small-scale weather forecasts with an agency's rules of practice to produce treatment recommendations for winter weather. MDSS is a constantly evolving technology that has been proven to reduce salt usage in states with large deployments. A study conducted by the TOPS Lab showed a cost savings/benefit associated with MDSS.

The MDSS Pooled Fund (which WisDOT participates in) took the concept several steps beyond that. Its version of MDSS includes management tools, tracking of maintenance vehicles, and numerous other enhancements. Currently, 23 states and several local agencies nationwide are using some version of MDSS. WisDOT has fielded the system to a much greater extent than any other state.

MDSS Usage
Winter 2014-15

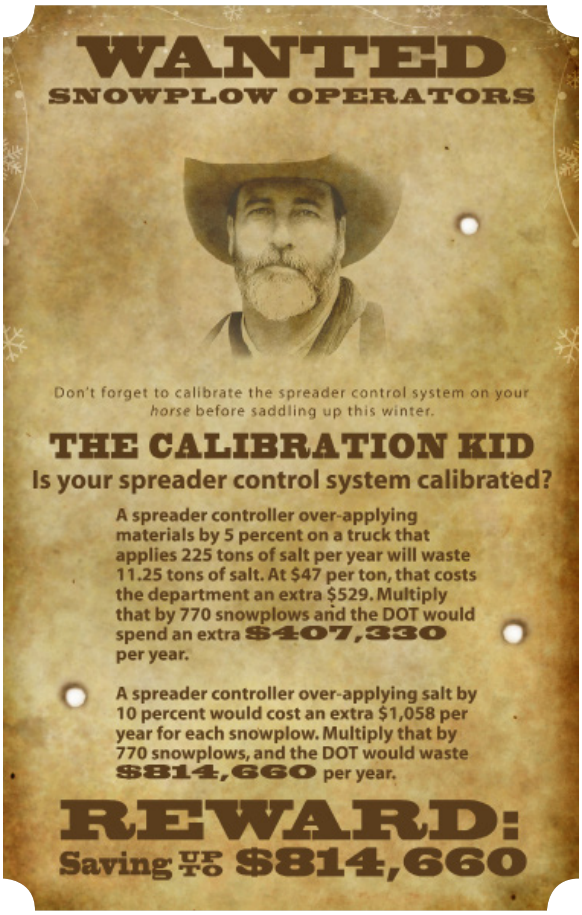


White signifies no usage
Data is only for the application version of MDSS. Many users have transitioned to the web-based version, for which we are currently developing metrics.

Equipment Calibration

Ensuring correct calibration of winter operations equipment—including salt spreaders, anti-icing applicators, and prewetting application equipment—is a key step in providing precise, consistent materials application, which reduces waste and saves money. Winter vehicles should be calibrated prior to the start of the season and whenever equipment is repaired. WisDOT regional staff are tasked with working with the counties to ensure proper calibration.

Calibration Scales – Proper calibration has and always will be an important part of winter maintenance. If the calibration is off by even 10 percent, thousands of dollars worth of salt can be wasted in one winter season. The purchase of three ScaleTech scales has shown that to be a benefit with respect to the process of calibrating salt spreaders. The scales increase the accuracy, speed up the process, and make the process safer for the technicians doing the work. Originally there was going to be a two year study on the scales but after calibrating a few spreaders it was very obvious that the scales would help the process. Therefore the study was discontinued and an email was sent to all the counties recommending that each county should consider adding a scale to their inventory. At about $3k per scale the costs of the scales can be recovered in less than one winter season.



Product and Equipment Testing

Winter maintenance is a continuously evolving field—new technology and innovations are developed each year. In previous years, WisDOT managed test and evaluation projects of the most promising new equipment by the counties. These test results are available on the WisDOT extranet.

WisDOT encourages county highway departments to consider new technologies when purchasing equipment. Testing new products—both equipment and materials—can lead to improved processes and more efficient operations. This year, WisDOT released a video Field Guide to Testing Deicing Chemicals. BHO staff are available to assist counties in structuring a testing and evaluation program for any products they wish to test.

Recent product and equipment evaluation projects have included:

- Alternative anti-icing and deicing materials:
  - Pretreated salt, where a liquid prewetting agent is spray-applied to the salt supply before the salt is placed in storage, exhibited good results in county tests.
  - Counties reported that prewetting salt with a mixture of salt brine and GeoMelt55 has been effective as an anti-icing agent. GeoMelt55 is less corrosive than traditional brines.
  - Counties have reported that blending pre-wetting materials with calcium and other mixes have made them more effective in lower temperatures.

More information on many test projects is available at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm (scroll to the "Winter maintenance research reports" heading).

Winter maintenance technology and equipment

TowPlow – TowPlow is one of the technologies implemented by the Wisconsin Department of Transportation to improve the efficiency and reduce the cost of winter maintenance operations. A TowPlow is a steerable trailer-mounted plow that is pulled behind a snowplow truck. Findings suggest that the TowPlow can reduce the cost of winter maintenance during a snow event. When compared to regular plows, TowPlow can result in operational cost (labor and fuel) savings between 32 to 43 percent. Based on the storm report database for the last 10 years, TowPlow could have been used by a county for 270 hours in a year on average. The resultant cost savings are estimated to be $14,500 per year, and the TowPlow could pay for itself in five years. For counties with greater snowfall, savings per year would be greater and cost recovery time shorter. A plow truck with a minimum of 350 hp engine is required to operate the TowPlow.

Winter Maintenance Research

In an effort to stay informed of the latest methods, equipment and materials, WisDOT joins other state DOTs in funding research projects of common interest. These pooled fund projects allow WisDOT to leverage its research dollars to support projects at a higher funding level that are important to all research partners. WisDOT participates in these three pooled fund projects:

Clear Roads. In 2008–2009, Wisconsin handed over the role of lead state in this pooled fund project to Minnesota. The pooled fund project focuses on rigorous testing of winter maintenance materials, equipment and methods for use by highway maintenance crews. Launched in 2004, Clear Roads now has 29 member states and has completed 23 research projects.

Clear Roads research addresses topics that may be of interest to Wisconsin counties and WisDOT regional staff. See the Clear Roads Web site (http://www.clearroads.org/completed-projects/) for a list of completed projects.

CLEAR ROADS
research for winter highway maintenance

Projects that have been completed include:

- Synthesis of Best Practices for Eliminating Fogging and Icing on Winter Maintenance Vehicles
  Results: The report compiles a range of solutions, both long-term and short-term, for keeping snow plow glass and mirror surfaces clean of winter precipitation.
- Determining Effectiveness of Deicing Materials and Procedures
  Results: A practical field guide for testing the effectiveness of deicers.
- Calibration Accuracy of Manual and Ground-Speed-Control Spreaders
  Results: The report provides guidelines to help snow plow operators establish and maintain accurate calibration of ground speed controllers. The project also included the development of a Calibration Guide for use in the field.
- Development of a Toolkit for Cost-benefit Analysis of Specific Winter Maintenance Practices, Equipment and Operation
  Results: A standard web-based tool and manual for cost-benefit analysis of specific winter maintenance practices, equipment and operations.

Transportation Synthesis Reports compile research and best practices on topics including:

- Limitations of abrasives
- Post-storm meetings
- Recording material use
- Training winter operations supervisors
- Material spreader use

These reports are available for download at http://clearroads.org/synthesis-reports/.

Clear Roads produces a quarterly e-newsletter of winter maintenance news items, publications and research in progress. Read the newsletter online at http://www.clearroads.org/winter-maintenance-news/. Highlights from the February 2015 edition included:

- Comparison of Materials Distribution Systems
- Salt Brine Blending to Optimize Deicing and Anti-Icing Performance and Cost Effectiveness
- Canada Issued Road Salt Targets for Implementing Best Practices in Environmental Management of Road Salt
- Virginia DOT Tested Bring-Only Routes
- Safety and Mobility Impacts of Winter Weather
- Benefit-Cost Analysis of Colorado DOT Fixed Automated Spray Technology (FAST) Systems

Aurora. Aurora is an international pooled fund partnership of public agencies that work together to perform joint research on road weather information systems (RWIS). Its membership includes 15 state DOTs, FHWA, and one international agency. WisDOT attended two meetings in person and participated in two web conferences. WisDOT is a member of several project technical panels. The most notable of these is a study of weight restriction models. WisDOT hosted a test site in the winter of 2014-15. WisDOT also took over as the lead agency on a project studying the accuracy of pavement condition forecasts.

Aurora
working to advance road weather information systems technology

See http://www.aurora-program.org/ for more information about this pooled fund project.

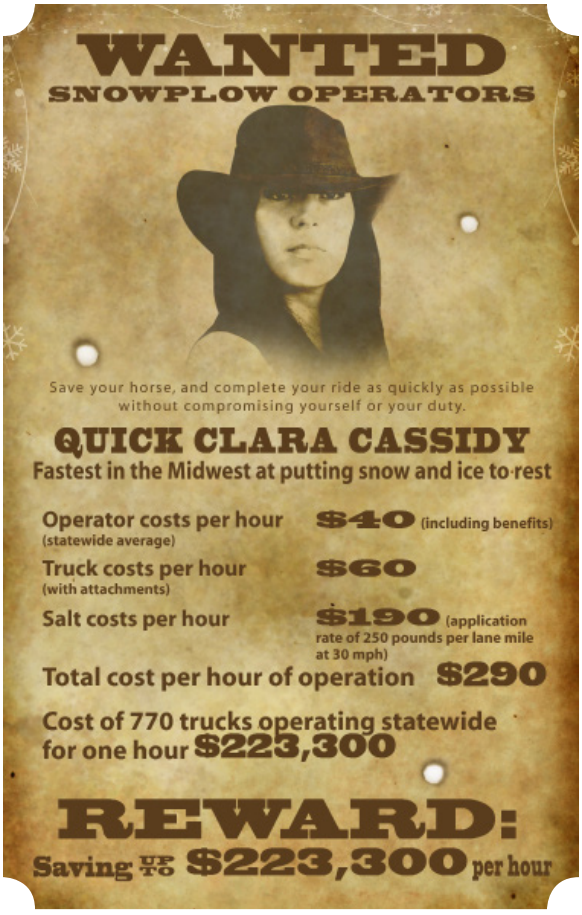
MADIS. A joint effort of FHWA and the National Weather Service, this initiative aims to consolidate all road weather data into a national database. A key feature of this database is the quality checking of all RWIS observations. A WisDOT representative attended the annual project meeting in Salt Lake City, UT in August 2014. The Clarus transition to the National Weather Service Meteorological Assimilation Data Ingest System (MADIS) is nearly complete. As of June 30, 2014, they have yet to integrate pavement variables into their quality checking routines and displays. Once that happens, WisDOT will begin using MADIS to retrieve and display RWIS data.

See http://madis-data.ncep.noaa.gov/ for more information.

3C. LABOR

Over 1,500 employees of Wisconsin's county highway departments are licensed to operate a snowplow, and over 1,000 of them are permanently assigned to the state highway system. Because a snowstorm can hit at any time of day, snowplow operators frequently put in overtime, and may plow for extended periods during heavy snowfall.

Labor costs vary from county to county according to each area's contracts, which also define when overtime hours can be charged. This winter, counties spent $19 million on labor, for an average of $552 per lane mile. Per-lane-mile labor expenditures decreased 34 percent compared with last year's winter. An average of 26 percent of counties' winter maintenance costs were spent on labor, with a high of 35 percent in the Southeast Region, where hourly labor rates tend to be higher. Labor hours were down 34 percent for regular hours and 50 percent for overtime hours compared with last winter, a decrease due to this winter's decrease in overall severity index. See Table 4.10 on pages 90-94 for county-by-county labor expenditures, and see Table 3.4 on pages 59-66 for county-by-county estimated labor hours and costs from the winter storm reports.



Winter Operations Training

Before each winter season, BHO provides and supports a variety of training efforts for WisDOT regional staff and county highway departments. Recent efforts have included:

- AASHTO Computer-Based Training. AASHTO offers eight computer-based training courses that can be completed by winter maintenance staff at their own pace as schedules permit. Course topics include anti-icing/RWIS, mitigating environmental impacts, equipment maintenance, plowing techniques, deicing, mitigating blowing snow, performance measures, and winter maintenance management. Counties are encouraged to have their operators complete the appropriate training courses, including courses for supervisors. For more information, see http://sicop.transportation.org/Documents/CBT_Flyer_v2b%5B1%5D.pdf.
- RWIS Training. WisDOT's RWIS program manager provides training for both WisDOT regional operations staff and county highway departments. A summary of these training activities can be found in the RWIS Annual Report, available at https://dot-auth-prod.wi.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/reports.aspx.
- Regional Operations/County Fall Training Sessions. These sessions are held in all regions in preparation for the upcoming winter season, at some locations in conjunction with Snowfighters' Roadeos. WisDOT provided support and participated in some of these training sessions.
- Snowfighters' Roadeos. These events are held by some counties annually, with some roadeos held jointly by two or three counties. WisDOT prepared a Roadeo Manual in August 1997 to assist counties in organizing these roadeos. In addition, organizations such as the Wisconsin chapter of the American Public Works Association and the Wisconsin County Highways Association periodically host statewide Snowfighters' Roadeos.
- MDSS Training. Training was reconfigured in FY 2015. Two introductory sessions for new users were held, one in Wisconsin Rapids and one in Waukesha. These covered the basics of MDSS for those who had never used it. This allowed the "main" MDSS training to focus on more advanced topics such as how to set up winter storm alerts and how to integrate MDSS into the decision-making process. Attendees included county patrol superintendents, state patrol, a few highway commissioners, and WisDOT Region personnel.

Photo Credit: Mark's Postcards from Beloit (https://goo.gl/zSPLnY)

County-by-County Tables and Figures for Section 3: Snow and Ice Control

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Figure 3.11. 2014-2015 Salt Use per Lane Mile vs. 5-Year Average

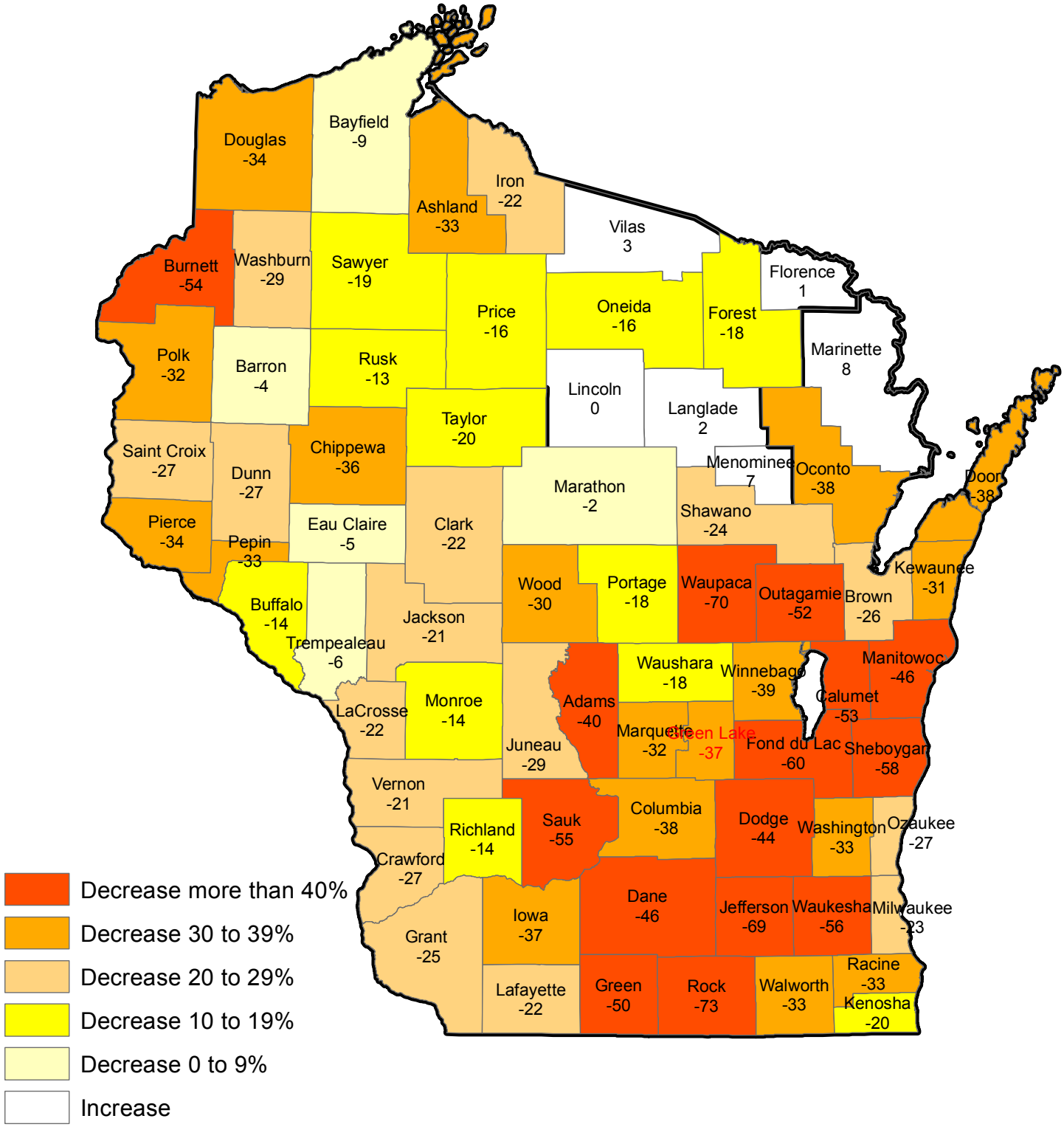


Figure 3.12 2014-2015 Nationwide Salt Price Comparison Map

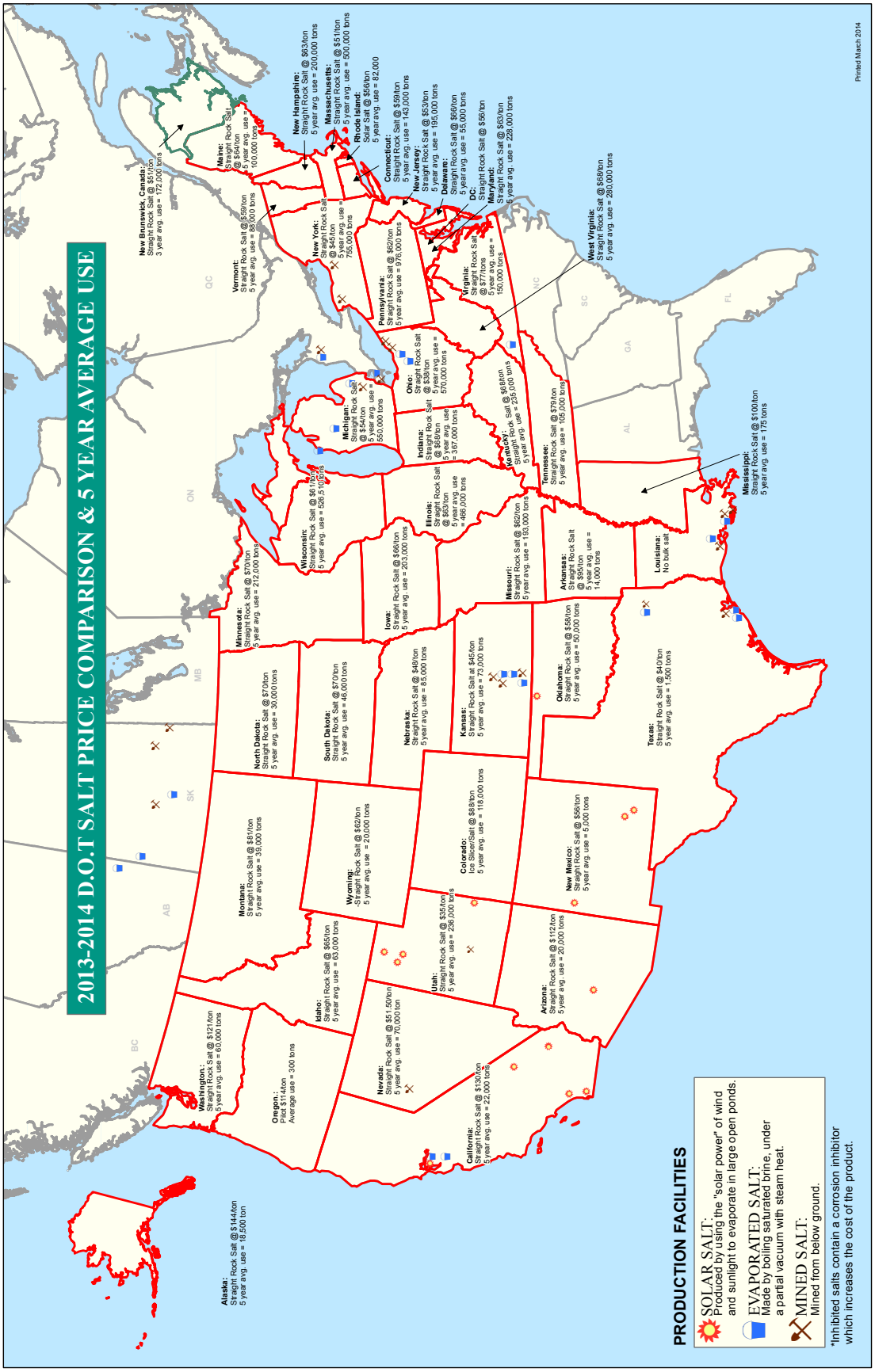


Table 3.4. Labor Hours/Lane Miles/Severity Index Ranking (Group A)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
DANE	SW	1512.86	102.98	13.81	$640	4743	9476	14219	66.6%	9.40	0.09
MILWAUKEE	SE	1897.05	91.29	16.23	$598	9540	8628	18168	47.5%	9.58	0.10
WAUKESHA	SE	1121.60	64.61	6.76	$336	4583	2727	7310	37.3%	6.52	0.10
Group F Avg		1,510.50	86.29	12.27	$524	6289	6944	13232	50.5%	8.50	0.10

Final totals as of Monday, July 06, 2015

Table 3.4. Labor Hours/Lane Miles/Severity Index Ranking (Group B)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
KENOSHA	SE	653.56	72.08	11.29	$516	4702	1769	6471	27.3%	9.90	0.14
EAU CLAIRE	NW	539.46	88.76	14.54	$492	3474	2287	5761	39.7%	10.68	0.12
RACINE	SE	683.28	84.91	11.07	$436	2555	2347	4902	47.9%	7.17	0.08
CHIPPEWA	NW	654.65	103.11	10.03	$409	2921	2335	5256	44.4%	8.03	0.08
PORTAGE	NC	582.05	118.47	9.37	$374	4497	868	5365	16.2%	9.22	0.08
MARATHON	NC	869.93	140.65	12.60	$374	5856	1850	7706	24.0%	8.86	0.06
SAINT CROIX	NW	632.52	91.97	12.04	$369	2059	2102	4161	50.5%	6.58	0.07
WINNEBAGO	NE	623.16	87.41	8.82	$362	2758	1920	4678	41.0%	7.51	0.09
COLUMBIA	SW	786.13	107.35	14.18	$349	2979	2433	5412	45.0%	6.88	0.06
ROCK	SW	687.78	68.45	3.84	$345	1910	2372	4282	55.4%	6.23	0.09
WALWORTH	SE	706.03	60.34	12.59	$337	4247	922	5169	17.8%	7.32	0.12
BROWN	NE	796.76	87.07	10.20	$334	5883	587	6470	9.1%	8.12	0.09
WASHINGTON	SE	607.89	97.40	12.96	$318	1690	2258	3948	57.2%	6.49	0.07
OUTAGAMIE	NE	538.55	76.11	6.23	$313	2704	966	3670	26.3%	6.81	0.09
MONROE	SW	654.83	111.59	11.15	$304	2631	2021	4652	43.4%	7.10	0.06
JEFFERSON	SW	559.08	62.26	5.46	$293	1355	1747	3102	56.3%	5.55	0.09
FOND DU LAC	NE	597.46	64.77	5.47	$290	1672	1712	3384	50.6%	5.66	0.09
SAUK	SW	577.36	101.61	8.08	$283	1920	1741	3661	47.6%	6.34	0.06

Final totals as of Monday, July 06, 2015

Table 3.4. Labor Hours/Lane Miles/Severity Index Ranking (Group B)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
DODGE	SW	651.82	83.75	12.31	$282	1721	1899	3620	52.5%	5.55	0.07
WAUPACA	NC	547.06	76.88	3.85	$236	2773	344	3117	11.0%	5.70	0.07
GRANT	SW	622.06	74.62	8.86	$231	1669	1701	3370	50.5%	5.42	0.07
KEWAUNEE	NE	111.35	53.70	7.11	$188	434	6	440	1.4%	3.95	0.07
Group F Avg		621.94	86.97	9.64	$338	2837	1645	4482	37.1%	7.05	0.08

Table 3.4. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
DUNN	NW	516.58	90.37	12.38	$427	2467	1698	4165	40.8%	8.06	0.09
BARRON	NW	423.09	122.06	8.72	$413	3569	679	4248	16.0%	10.04	0.08
LINCOLN	NC	415.19	141.86	11.37	$347	2466	808	3274	24.7%	7.89	0.06
PIERCE	NW	365.50	88.84	7.66	$344	1688	841	2529	33.3%	6.92	0.08
LA CROSSE	SW	496.20	82.80	8.81	$315	2044	1212	3256	37.2%	6.56	0.08
DOUGLAS	NW	440.80	123.41	10.60	$314	2076	755	2831	26.7%	6.42	0.05
CLARK	NW	402.56	116.19	9.28	$307	1588	1021	2609	39.1%	6.48	0.06
VERNON	SW	468.36	122.57	8.89	$306	1498	1488	2986	49.8%	6.38	0.05
IOWA	SW	476.31	92.71	7.11	$303	1710	1415	3125	45.3%	6.56	0.07
OCONTO	NE	468.36	94.86	6.50	$299	1854	1068	2922	36.6%	6.24	0.07
WOOD	NC	420.98	111.47	9.34	$290	1754	945	2699	35.0%	6.41	0.06
JUNEAU	SW	494.25	106.22	10.16	$289	1475	1569	3044	51.5%	6.16	0.06
SHAWANO	NC	520.57	92.82	10.48	$281	3032	672	3704	18.1%	7.12	0.08
SHEBOYGAN	NE	522.93	80.86	5.96	$266	1801	868	2669	32.5%	5.10	0.06
JACKSON	NW	515.14	107.74	11.70	$251	1913	1387	3300	42.0%	6.41	0.06
MANITOWOC	NE	425.85	68.79	7.41	$227	1777	460	2237	20.6%	5.25	0.08
CRAWFORD	SW	394.99	112.35	7.32	$217	1218	812	2030	40.0%	5.14	0.05

Final totals as of Monday, July 06, 2015

Table 3.4. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
Group F Avg		456.92	103.29	9.04	$306	1996	1041	3037	34.7%	6.66	0.07

Table 3.4. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
ONEIDA	NC	396.79	133.97	15.30	$480	4372	255	4627	5.5%	11.66	0.09
BAYFIELD	NW	316.88	165.24	13.58	$454	2616	889	3505	25.4%	11.06	0.07
MARINETTE	NE	427.96	104.32	13.56	$418	3393	245	3638	6.7%	8.50	0.08
DOOR	NE	269.70	103.15	7.58	$363	552	997	1549	64.4%	5.74	0.06
TREMPEALEAU	NW	442.00	105.25	11.69	$334	1783	1366	3149	43.4%	7.12	0.07
WASHBURN	NW	372.14	93.42	10.03	$306	1732	618	2350	26.3%	6.31	0.07
POLK	NW	385.05	138.78	11.22	$291	1894	575	2469	23.3%	6.41	0.05
OZAUKEE	SE	308.71	75.29	17.11	$288	1039	668	1707	39.1%	5.53	0.07
BUFFALO	NW	317.02	96.41	5.32	$281	1504	563	2067	27.2%	6.52	0.07
LAFAYETTE	SW	298.98	83.56	5.41	$259	850	984	1834	53.7%	6.13	0.07
RICHLAND	SW	327.64	79.46	6.58	$244	1171	646	1817	35.6%	5.55	0.07
GREEN	SW	315.55	64.26	3.10	$235	1154	713	1867	38.2%	5.92	0.09
MARQUETTE	NC	245.09	68.06	8.96	$216	700	471	1171	40.2%	4.78	0.07
GREEN LAKE	NC	158.36	71.87	4.46	$186	499	157	656	23.9%	4.14	0.06
WAUSHARA	NC	345.01	65.62	8.03	$162	1414	34	1448	2.3%	4.20	0.06
Group F Avg		328.46	96.58	9.46	$301	1645	612	2257	30.3%	6.64	0.07

Final totals as of Monday, July 06, 2015

Table 3.4. Labor Hours/Lane Miles/Severity Index Ranking (Group E)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
IRON	NC	249.56	184.90	14.65	$698	2082	1003	3085	32.5%	12.36	0.07
VILAS	NC	305.24	123.41	23.08	$478	1926	966	2892	33.4%	9.47	0.08
PRICE	NC	322.26	168.15	12.50	$455	2279	878	3157	27.8%	9.80	0.06
FOREST	NC	312.38	148.84	15.83	$440	2282	993	3275	30.3%	10.48	0.07
ASHLAND	NW	249.49	185.63	8.51	$402	1571	620	2191	28.3%	8.78	0.05
TAYLOR	NW	233.90	125.70	9.84	$350	1339	480	1819	26.4%	7.78	0.06
LANGLADE	NC	299.21	116.96	12.80	$347	1956	546	2502	21.8%	8.36	0.07
PEPIN	NW	112.38	73.67	4.73	$321	582	260	842	30.9%	7.49	0.10
RUSK	NW	213.47	86.14	9.55	$310	1096	395	1491	26.5%	6.98	0.08
SAWYER	NW	367.44	116.30	9.30	$302	1463	830	2293	36.2%	6.24	0.05
BURNETT	NW	234.95	80.14	4.79	$238	814	341	1155	29.5%	4.92	0.06
CALUMET	NE	201.71	69.37	4.18	$200	917	174	1091	15.9%	5.41	0.08
Group F Avg		258.50	123.27	10.81	$378	1526	624	2149	28.3%	8.17	0.07

Final totals as of Monday, July 06, 2015

Table 3.4. Labor Hours/Lane Miles/Severity Index Ranking (Group F)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
FLORENCE	NC	141.07	121.16	18.53	$430	1169	186	1355	13.7%	9.61	0.08
ADAMS	NC	193.20	94.17	8.66	$224	819	106	925	11.5%	4.79	0.05
MENOMINEE	NC	90.26	76.61	13.83	$107	279	16	295	5.4%	3.27	0.04
Group F Avg		141.51	97.31	13.67	$254	756	103	858	10.2%	5.89	0.06

4 Performance

In this section...

Photo Credit: Tobias (https://goo.gl/zoT4UT)

Since weather can vary drastically from year to year, planning and budgeting for winter highway maintenance can be challenging. Throughout the winter, WisDOT staff and county highway departments evaluate progress in several areas, including materials use, money spent, and response time. When the season is complete, WisDOT can gather all the data and analyze this winter's performance across all regions and compared to previous winters.

This section begins with a description of the winter maintenance portion of Compass, WisDOT's operations performance measurement program, which measures trends in areas like response time and winter costs per lane mile. This section also discusses costs, using charts to visually compare spending in different categories from region to region and from year to year, and presents winter crash rates and customer satisfaction data.

Performance and Costs, 2014-2015

Total lane miles	34,435
Total patrol sections	753.5
Average lane miles per patrol section	45.7
Roads to bare/wet pavement within WisDOT targets[1]	70%
Average crew reaction time from start of storm	2.66 hours
Total winter costs[2]	$74,194,500
Total winter costs per lane mile	$2,155
Total winter crashes[3]	6,773
Total winter crashes per 100 million VMT	25

1. Time to bare/wet pavement and crew reaction time data are from storm reports.
2. Cost data are actual costs as billed to WisDOT by the counties.
3. Crash data are from WisDOT's Bureau of Transportation Safety.

An Economical Choice

Proactive anti-icing operations are about three times less costly than treating frost once it has formed. Anti-icing costs made up only 1.4 percent of total winter maintenance costs this year. *See page 41 for more information on anti-icing costs.*

4A. COMPASS

Developed in 2001, Compass is WisDOT's quality assurance and asset management program for highway maintenance operations. Annual Compass reports provide information on winter maintenance activities as well as other aspects of highway operations.

Measures for winter operations were established in 2003, and data from the winter of 2003–2004 was used to establish baseline measures for future winter seasons. The measures that were chosen included:

- time to bare/wet pavement
- winter weather crashes per vehicle miles traveled
- cost per lane mile per Winter Severity Index point

Table 4.1 gives the statewide average values for these measures for the last six winters. More detail on these measures is provided later in this section.

WisDOT has gathered several years of baseline data and plans to establish targets for these measures. Until then, the data can be used to make a year-to-year comparison in these areas. Other winter measures that are being investigated for possible future use include:

- Percent of winter operations equipment that is calibrated before winter begins
- Average traffic speed recovery after a storm event (progress reports are available from WisDOT)

Table 4.1. Statewide Compass Measures for Winter

	2010-11	2011-12	2012-13	2013-14	2014-15
Percentage of roads to bare/wet pavement (Within WisDOT target times)	79%	79%	73%	63%	70%
Cost per lane mile	$2,696	$1,656	$2,778	$3,304	$2,155
Winter Severity Index	119.2	75.4	115.2	133.6	99.28
Cost per lane mile per Winter Severity Index point	$22.62	$21.99	$24.11	$24.73	$21.71
Winter weather crashes	35 per 100 million VMT	20 per 100 million VMT	29 per 100 million VMT	44 per 100 million VMT	25 per 100 million VMT

Annual Compass reports are available at http://wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/compass/reports/reports.aspx.

4B. WINTER MAINTENANCE MANAGEMENT

History of Snow and Ice Control in Wisconsin

The counties' plowing and salting strategies have evolved considerably over the past several decades. For many years beginning in the 1950s, WisDOT maintained a "bare pavement" policy for state highways, striving to ensure that the roadways were kept essentially clear of ice and snow during winter. Snowplows operated continuously during storms and simultaneously applied deicing salts. In the 1970s, however, economic and environmental concerns compelled the department to modify this policy. The national energy crisis and the high cost of employee overtime strained the maintenance budget, and WisDOT made the decision to reduce winter maintenance coverage on less traveled state highways. To address the risk of environmental damage by chloride chemicals, the policy was modified further to include provisions calling for the prudent use of chemicals, and limiting each application of salt to 300 pounds per lane mile.

In 2002, a detailed salt application table was added to the maintenance manual's winter guidelines. The table provides variable salt application rates for initial and repeated applications, depending on the type of precipitation, pavement temperature, wind speeds, and other weather variables. Anti-icing application rates were also established; county highway departments were instructed to perform anti-icing applications prior to predicted frost, black ice, or snow events in order to minimize the amount of salt used during the event. With the implementation of MDSS, this process has become more automated. Patrol superintendents receive treatment recommendations based on the characteristics of the route, such as traffic volume and pavement type, residual de-icers, and forecasted weather.

Storm Reports

One way that WisDOT has worked to increase efficiency in recent years is through the Winter Storm Reports. Every week during the winter, the county highway departments complete online storm report forms. These storm reports let county and WisDOT staff track the season's weather and the counties' response to it throughout the season, which allows the counties to adjust their resource use midseason if necessary. Storm reports track data such as types of storm events, salt use, anti-icing applications, labor hours, and cost estimates. Uses for this data include:

WisDOT Central Office

- Create weekly reports and maps that track salt use and costs. These can help identify inconsistencies in service levels provided by neighboring counties.
- Calculate the severity index; use this to justify additional funding if conditions are more severe than normal
- MAPSS measures
- DTSD Performance Measures

WisDOT Regional Offices

- Justify additional funding if conditions are more severe than normal
- Manage salt inventory
- Post-storm analysis of county's response
- Training tool for new staff

Counties

- Post-storm analysis of crew's response
- Compare their response (materials use, anti-icing, labor hours, etc.) to that of neighboring counties
- Justify funding to county boards

See https://transportal.cee.wisc.edu/storm-report/ for more detail on how to use the storm report data.

BEST PRACTICES: Automatic Vehicle Location (AVL)-GPS

AVL-GPS is used to determine the location of a vehicle and allows management to monitor the location of an entire fleet. This system can assist in the management of labor, equipment and materials.

Additionally, AVL can record and transmit operational data from snowplows. Data such as application rates, pavement temperatures, and the position of blades and plows can all be captured. This data can be stored and used for reporting and analysis at a later date.

WisDOT relies on the county highway departments to make the storm reports a reliable tool by entering data accurately each week. Historically, the cost and salt use data in the storm reports has been relatively accurate when compared with final costs billed to WisDOT and end-of-season salt inventory figures. In 2010 the UW TOPS Lab took over the storm report input programming. As a result the data entry has been restricted to the point that erroneous entries have been nearly eliminated. This will result in even more accuracy going forward.

Winter Patrol Sections

Many factors influence a county's response to winter storms, including the timing of snow events, the mix of highway types and classifications in a county, and the type of equipment being used. Another important factor is the length of each county's patrol sections.

Each county highway department divides the state highways it is responsible for plowing into patrol sections. In general, one snowplow operator is assigned to each patrol section. This winter, the state highway system was divided into 755 winter patrol sections, an average of 10.5 sections per county. The length of patrol sections varies, with counties that are more urban (Group A) tending to have shorter patrol sections than more rural counties (Groups D, E and F). Local traffic patterns, highway geometrics, number of traffic lanes, intersections, interchanges, and other factors affect the length of patrol sections in each county.

In responding to a storm, operators in longer patrol sections may use more salt in an effort to melt any snow that accumulates between plowings. In addition, drivers may notice that some roads appear to be cleared faster than others, since the longer a patrol section, the longer it takes a snowplow operator to clear all the roads in his section. Three counties have undertaken snowplow route optimization studies in the past to make their patrol section lengths as efficient as possible; see https://dot-auth-prod.wi.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/reports.aspx for details.

Table 4.2 shows the average patrol section length for the counties in each Winter Service Group. For county-by-county patrol section data, see Table 4.8 on page 83.

Table 4.2. Average Patrol Section Lengths by Winter Service Group

Winter service group	Average patrol section length (lane miles)	Range of average patrol section lengths by county (lane miles)
A	55.2	43 - 63
B	45.2	31 - 62
C	43.6	30 - 57
D	48.7	30– 62
E	49.0	34 - 61
F	42.0	37 - 47
Statewide average	45.6	30 - 63

4C. RESPONSE TIME

WisDOT tracks two types of response time data—the time it takes a maintenance crew to get on the road after the start of a storm, and the time it takes the pavement to return to a bare/wet condition after the end of a storm. The first measure can impact the second. In general, a quicker response means the crews are dealing with less packed snow. However, WisDOT guidelines dictate that lower-volume highways receive 18-hour winter maintenance coverage rather than 24-hour coverage, so slower average reaction times are expected on 18-hour roads.

Maintenance Crew Reaction Time

Being proactive in getting on the road—even before the start of a storm—can result in bare/wet pavement being achieved faster and with less effort. Knowing this, county highway departments are becoming more proactive in their response to winter storms. Plows and salt spreader trucks are often on the road before a storm starts or shortly afterward.

Using data from the weekly winter storm reports, Table 4.3 shows the average reaction time to storm events in each Winter Service Group. This winter's reaction time was much improved over last winter's. This winter the average reaction time of 2.66 was 13 percent faster than the latest 10-year average. As expected, average reaction times for Group A counties, which provide the highest level of service (24-hour coverage), were less than those counties that provide 18-hour coverage.

Last year's average reaction time of approximately 7 hours was by far the slowest reaction time recorded since the Department began tracking this metric. The slower reaction times from the 2013-14 season reflect the extreme cold temperatures the State experienced. Many times, counties would wait until the sun came out so their salting and plowing would be more effective. The 2014-15 winter was much more mild; this is reflected in a 62% decrease in average statewide reaction time from the prior year.

Table 4.3. Maintenance Crew Reaction Time

From winter storm reports, 2004/2005–2014/2015

	Average reaction time (hours)											10-year Average	Percent change
Winter Service Group	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	*2013-2014*	*2014-2015*	2004-2005 to 2013-2014	2014-2015 vs. 10-year Average
A	**1.03**	**0.56**	**1.24**	**0.61**	**1.02**	**1.74**	**0.49**	**0.19**	**0.63**	***2.31***	***0.32***	**0.98**	**-67%**
B	**1.46**	**1.65**	**1.57**	**1.38**	**1.46**	**1.78**	**1.60**	**1.11**	**1.27**	***4.48***	***1.67***	**1.78**	**-6%**
C	**2.35**	**2.44**	**2.75**	**2.87**	**2.70**	**3.37**	**2.87**	**2.15**	**2.38**	***4.99***	***2.57***	**2.89**	**-11%**
D	**2.45**	**2.95**	**3.35**	**2.89**	**3.46**	**4.23**	**3.25**	**2.54**	**3.77**	***6.23***	***2.86***	**3.51**	**-19%**
E	**3.78**	**3.81**	**3.71**	**4.05**	**4.00**	**4.71**	**3.48**	**3.16**	**2.99**	***9.36***	***3.77***	**4.31**	**-13%**
F	**3.66**	**3.99**	**3.94**	**5.04**	**5.08**	**5.79**	**5.68**	**3.39**	**3.79**	***14.81***	***4.78***	**5.52**	**-13%**
Statewide average **(unweighted)**	2.37	2.55	2.69	2.66	2.78	3.38	2.74	2.08	2.42	*7.03*	*2.66*	3.07	-13%

Time to Bare/Wet Pavement

As explained in Section 1, county highway departments provide different levels of effort during and after a storm according to each highway's category rating, as determined by average daily traffic. It would be expected that an urban freeway would receive more materials, labor and equipment—and would show a quicker recovery to bare/wet pavement—than a rural, two-lane highway. For more information on these categories, see page 8.

"Time to bare/wet pavement" is measured from the reported end time of a storm. Table 4.4 shows that the trend for average time to bare/wet pavement is as expected: More heavily traveled highways show a shorter average time to bare/wet pavement. From storm to storm, however, most variability is due to weather effects (type, duration and severity of storms throughout the winter season), according to analysis performed through the Compass program.

The 2014-15 percentage of roadways cleared to bare/wet pavement increased from the previous year. This year's winter weather was much more typical than last year. Last year's winter was challenging due to extremely low temperatures from the polar vortex. In 2013-14, many times salt could not work due to extremely low temperatures so counties had to wait until the sun came out to get the roadways back to bare.

Figure 4.4. Percentage to Bare/Wet Pavement

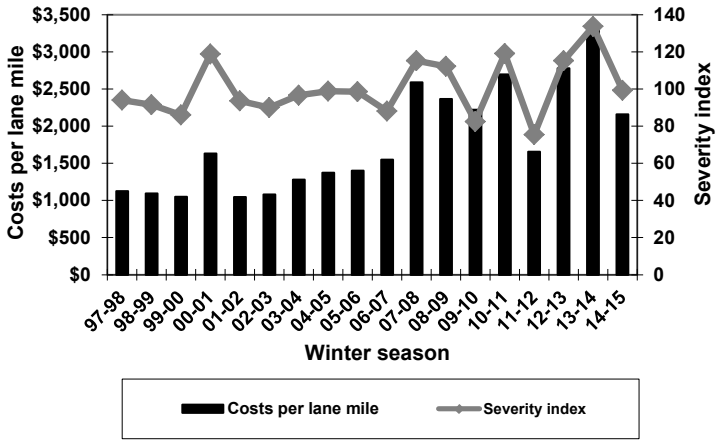
	Percent of Time the Highway Category Target Time to Bare/Wet Pavement was Met *(Target Times: 4 hours for 24-Hour Roads; 6 hours for 18 Hour Roads)*						
Highway Category	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
24-Hour Roads	61%	70%	83%	83%	75%	66%	75%
18-Hour Roads	56%	65%	75%	76%	70%	59%	67%
Statewide	58%	67%	79%	79%	73%	63%	70%
Target Percentage	70%	70%	70%	70%	70%	70%	70%

4D. COSTS

The total billed cost of statewide winter operations this winter was $74.19 million, making it 35 less costly than 2013-2014. A number of factors drive the cost of winter maintenance, including both the nature and severity of the winter (i.e. how much work has to be performed), as well as the unit costs of the component elements of winter maintenance (i.e. cost per lane mile for salt, labor and equipment).

Winter maintenance costs per lane mile decreased in 2014-15 by about 35 percent from 2013-14. Figure 4.1 shows the statewide average winter cost per lane mile and Winter Severity Index since the 1997-98 winter.

Figure 4.1. Statewide Average Winter Costs per Lane Mile and Winter Severity Index, 1997-98 thru 2014-15



The average Winter Severity Index decreased in all regions compared with last winter.

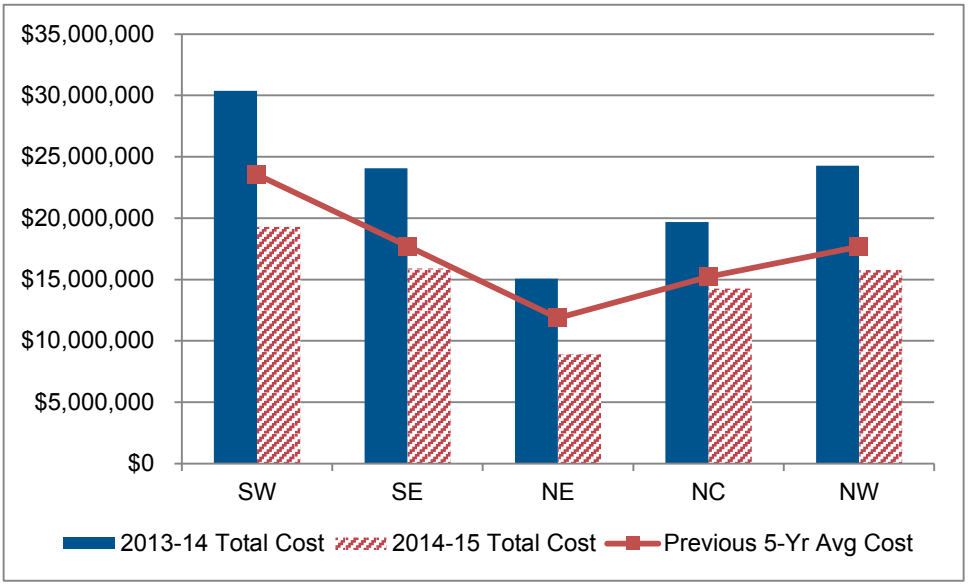
Table 4.5 shows total winter maintenance costs statewide and for each region per lane mile, as well as relative to the region's average Winter Severity Index. The level of service provided in each county affects total costs, and the mix of counties in a region affects the overall comparative costs - which is one reason the Southeast Region has had a higher cost per lane mile relative to winter severity than other regions.

Table 4.5. Total Winter Costs Relative to Winter Severity, 2014-2015

Region	Average Winter Severity Index	Actual cost per lane mile	Relative cost per severity index point
SW	90.03	$2,070	$22.74
SE	77.99	$2,664	$34.15
NE	80.95	$1,789	$22.11
NC	114.21	$2,225	$19.48
NW	109.96	$2,040	$18.55
Statewide	99.28	$2,155	$21.71

Figure 4.2 below shows, in 2014-2015, all regions experienced winter maintenance cost decreases from 2013-14, and all regions had costs that were lower than their most recent 5-year average. This year's 26% decrease in winter severity over the 2013-14 winter played a large part in these cost decreases.

Figure 4.2. Total Winter Maintenance Cost by Region, 2014-15 vs. 2013-14 vs. Previous 5-Year Average



There are five major cost categories in the Department's winter maintenance billing system. These include: cost of salt used, labor costs, cost of other materials furnished by the county, and administration costs. Figure 4.3 below shows the breakdown of the $74 million in 2014-15 statewide winter maintenance costs by these billing categories.

Figure 4.3. Statewide Winter Costs by Category

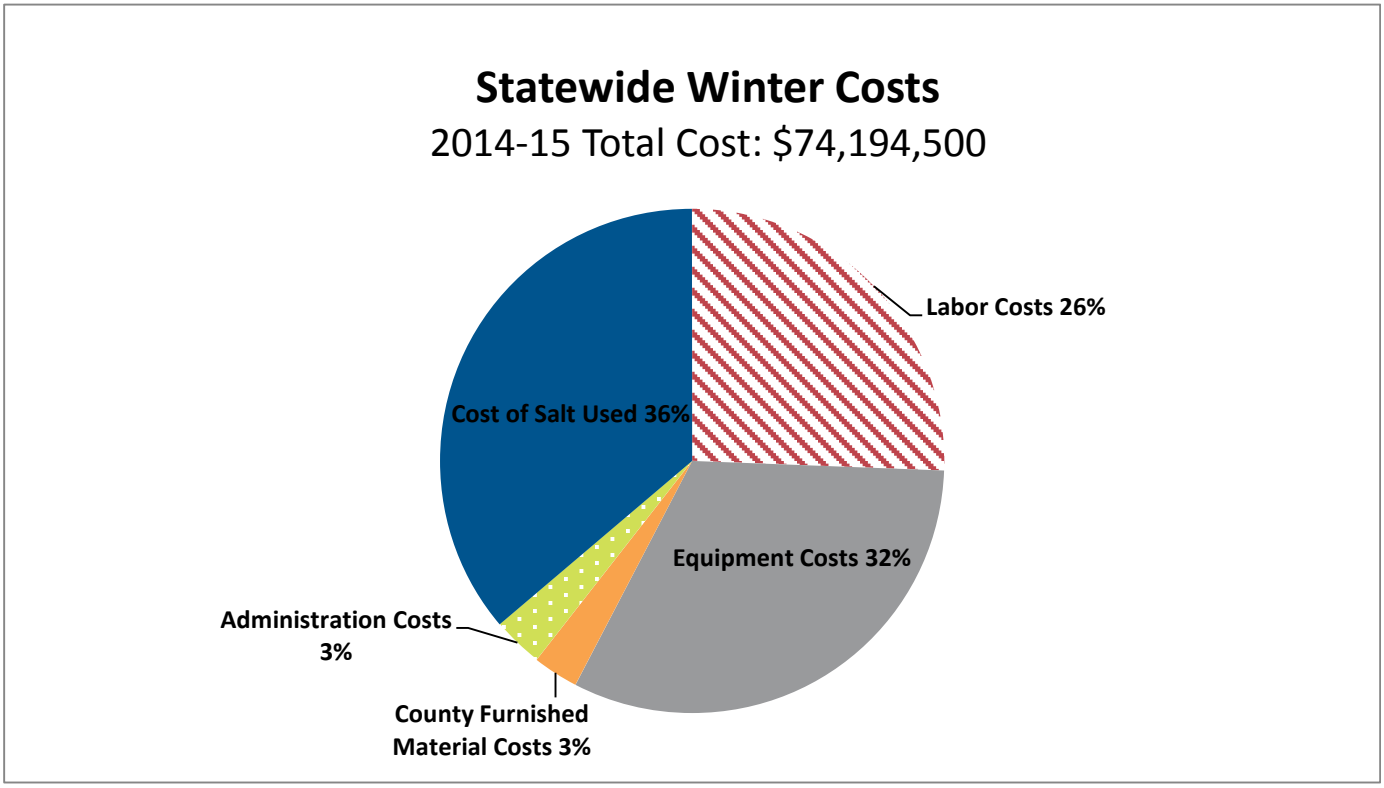
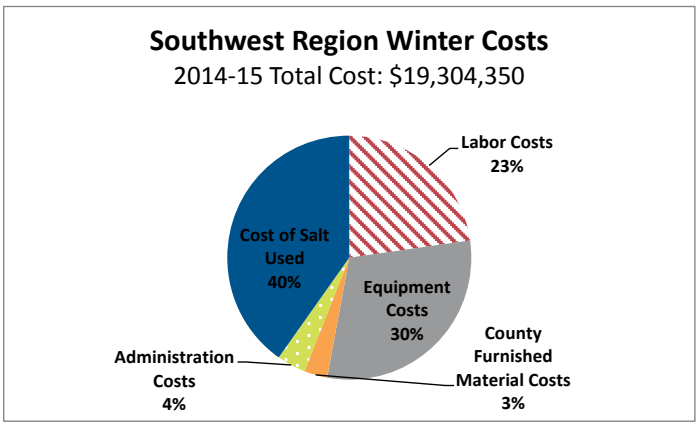


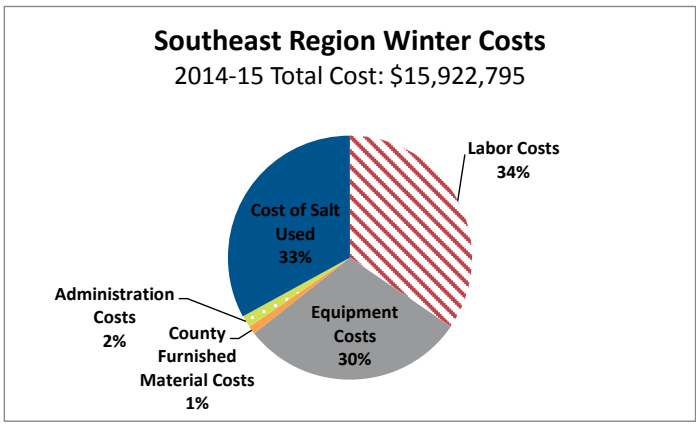
Figure 4.4 on page 75 shows the breakdown of costs by billing category for each of the five regions. More specific, detailed cost figures by region and for the state as a whole are shown in Table 4.6 on page 76.

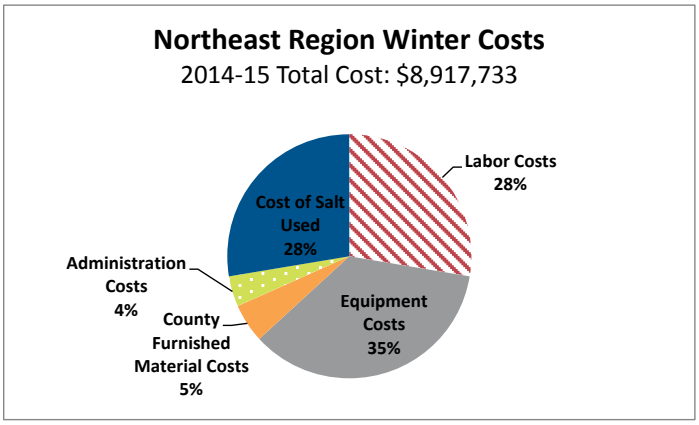
In the five individual winter maintenance expenditure categories for 2014-15 statewide, the following trends were noted:

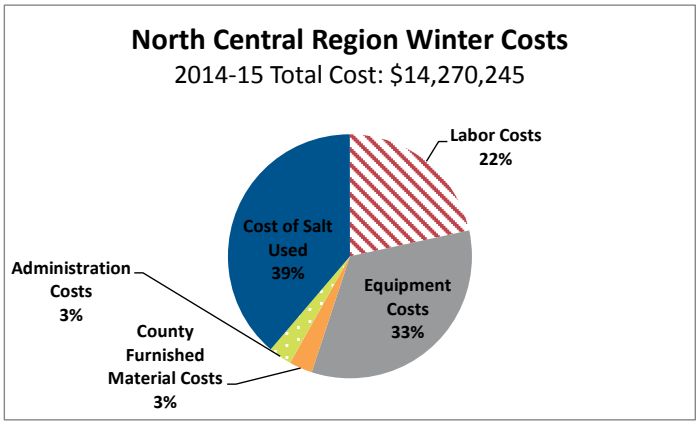
- Salt expenditures were $26.9 million. This was a 34% decrease compared to the previous winter, with the Northeast region experiencing the biggest decrease from last winter at 37%. The North Central region saw the smallest decrease at 20% below last year.
- Equipment expenditures were $23.8 million, a decrease of 38% compared to the previous winter. The Northeast region experienced the largest decrease of 43% compared to 2013-14.
- Labor expenditures were $19.0 million, a decrease of 34% from the previous winter, with the Northeast region seeing the greatest decrease of 38%.
- County Furnished Material Costs were $2.2 million, a decrease of 22% compared with the previous winter. Expenditures at the regional level ranged from a 43% decrease over the 2013-14 winter in the Southeast Region to a 17% increase in the Northeast Region.

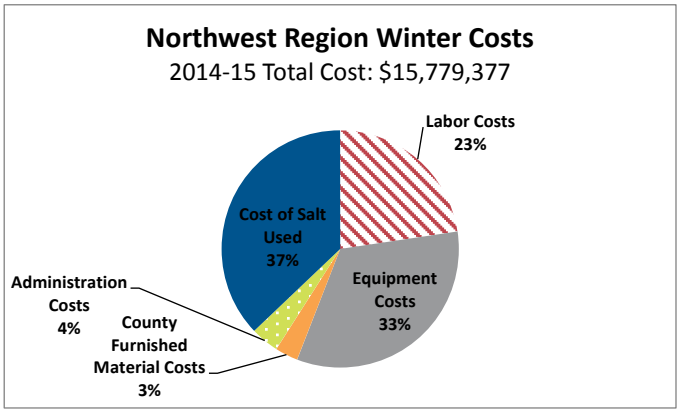
Figure 4.4. Regional Winter Costs by Category, 2014-15







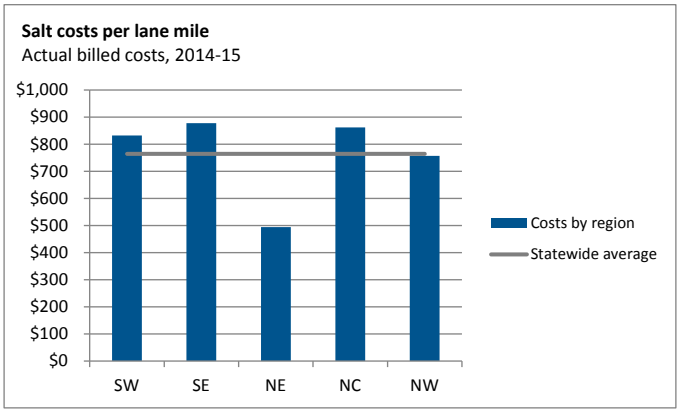


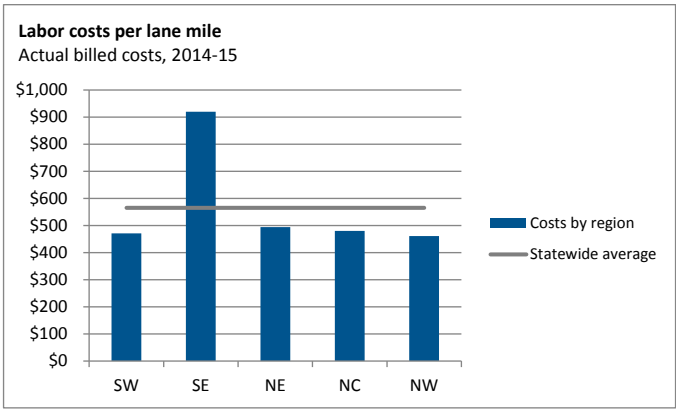


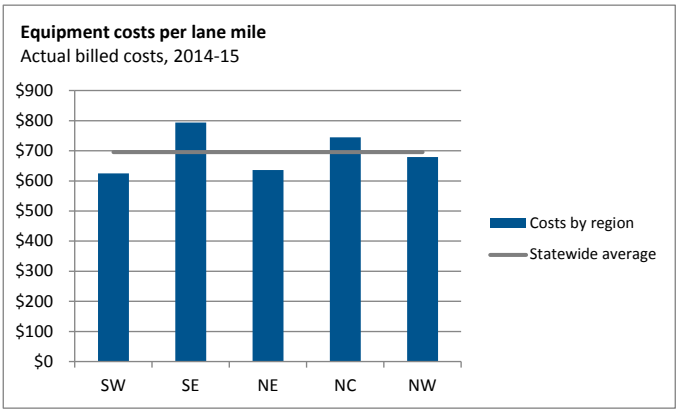
Winter 2014-15 Experience for County Services

	Labor Costs	Equipment Costs	County Furnished Material Costs	Administration Costs	Cost of Salt Used	Total Costs for Winter	Five Year Avg Cost for Winter ('10-'14 avg)	% Costs over Five Year Average
Region 1 / Southwest	$4,391,248	$5,824,422	$591,581	$737,038	$7,760,061	$19,304,350	$23,552,100	82%
Region 2 / Southeast	$5,500,789	$4,743,254	$172,767	$256,262	$5,249,723	$15,922,795	$17,727,200	90%
Region 3 / Northeast	$2,463,533	$3,169,735	$459,290	$360,711	$2,464,464	$8,917,733	$11,871,900	75%
Region 4 / Northcentral	$3,080,121	$4,778,423	$440,644	$439,838	$5,531,219	$14,270,245	$15,222,900	94%
Region 5 / Northwest	$3,571,463	$5,252,049	$493,309	$606,731	$5,855,825	$15,779,377	$17,673,000	89%
Region Totals	**$19,007,154**	**$23,767,883**	**$2,157,591**	**$2,400,580**	**$26,861,292**	**$74,194,500**	**$86,047,100**	**86%**

Figure 4.5. Costs per Lane Mile by Category







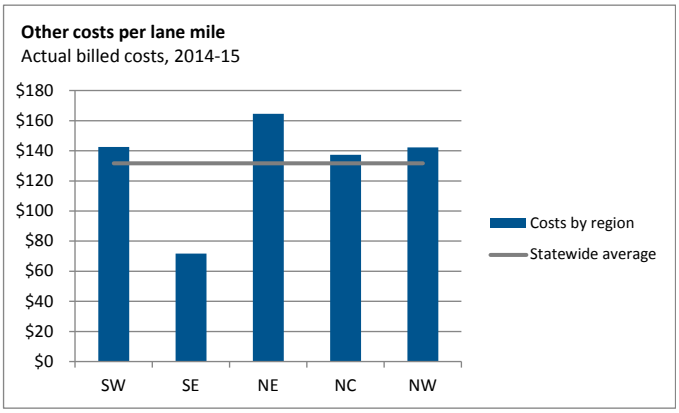


Table 4.5 lists the total cost per lane mile for winter maintenance in each region, along with the region's Winter Severity Index. The level of service provided in each county affects total costs, as do the factors listed below. For these reasons, the Southeast Region historically experiences significantly higher costs relative to winter severity than the other regions.

Components of Winter Costs

Major components of winter costs include labor, equipment, salt, other materials such as sand and chemicals, and administrative costs. A region's expenditures in each area are affected by the severity of its winter and the portion of its highways receiving 24-hour coverage. In addition:

- Labor costs are based on rates set in each county's union contracts. Hourly rates tend to be higher in more urban counties. Timing of storms can increase labor costs if more overtime hours are required.
- Equipment costs are determined by the state Machinery Management Committee, which assigns an hourly rate to each piece of equipment that includes depreciation from the purchase price, maintenance costs, and fuel costs. Rising fuel costs have contributed to increased equipment costs, as have some counties' purchase of larger, more expensive vehicles. These larger vehicles are often more useful for year-round maintenance tasks and are also more efficient in the winter, as they can accommodate larger plows and carry more salt.
- Salt costs are affected by salt prices per ton, which vary because of transportation costs. For example, salt entering the state at the Port of Milwaukee doesn't have to travel as far to reach counties in the Southeast region as it does to reach counties in the center of the state.

- Costs for materials other than salt, such as sand, are also affected by transportation costs. In addition, some counties use more expensive deicing agents that are more effective at lower temperatures (see Table 3.3 on page 41 for details on deicing agent costs).
- Administrative costs are calculated at 4.25 percent of each county's combined labor, equipment and materials costs, and cover the overhead costs for office activities.

However, the breakdown of expenditures by category varies among regions because of the factors described above. For example, the Southeast Region spends more on labor because hourly labor rates tend to be higher in those counties, while equipment expenditures make up a smaller percentage of that region's total expenditures. Figure 4.4 on page 75 shows the distribution of costs by category for each region.

County-by-county cost data is available in Table 4.10 on pages 90-94.

A Note About Cost Data

The tables at the end of this section were generated with data from two sources—final costs as billed to WisDOT, and preliminary costs from the winter storm reports. The tables created from preliminary storm reports data (such as Table 4.11 on pages 96-103, Cost per Lane Mile per Severity Index Ranking) are included in this report because they provide county-by-county breakdowns of cost data not available elsewhere. Many of the tables in the Appendix also include cost data from the storm reports. The source of each table's data is indicated below the table title.

Final cost data includes expenses for all winter activities, including putting up snow fence, transporting salt, filling salt sheds, thawing out frozen culverts, calibrating salt spreaders, producing and storing salt brine, and anti-icing applications, as well as plowing and salting. Cost data from storm reports, however, include only plowing, sanding, salting and anti-icing expenses.

4E. TRAVEL AND CRASHES

From black ice to freezing rain to white-out snowstorms, winter weather creates challenging conditions for even the most careful drivers. Many factors influence winter crash rates, most of which cannot be controlled by winter maintenance crews. However, 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 some winter crashes.

In the winter of 2014-2015, there were 6,773 reported winter weather crashes (those that occurred on pavements covered with snow, slush or ice). In part, this data reflects the fact that the lower number of storm events decreases the exposure rate. The crash rate (number of crashes per 100 million vehicle miles traveled) decreased drastically (43%) this winter to a statewide average of 25, down from last winter's crash rate of 44.

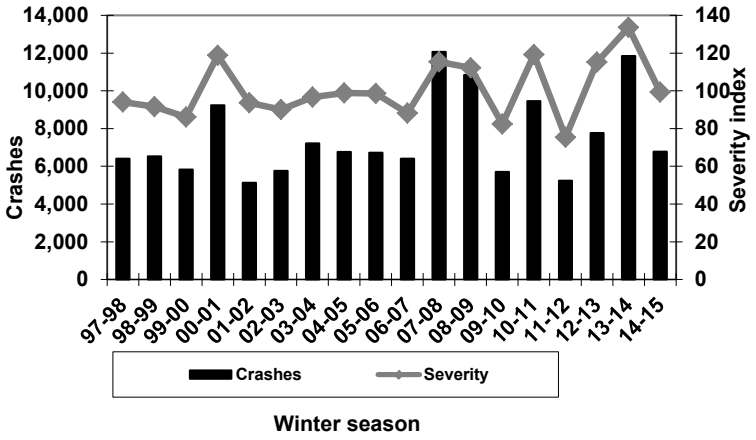
Crash rates tend to decrease in less severe winters. Figure 4.6 shows the trends in total crashes statewide over the last 18 years overlaid with the Winter Severity Index. Compared to the severe winter in 2013-2014, it is no surprise that the number of crashes would decrease in 2014-2015.

It's important to note that crash rates provide only a portion of the picture of overall winter safety. Crash rates include only "reportable" crashes, which exclude those that cause property damage under $1,000 that aren't required by law to be reported to police. Also, crashes in urban areas are more likely to occur at lower speeds and cause fewer deaths, while crashes on high-speed rural roads are more likely than low-speed crashes to be fatal.

Crashes and Vehicle Miles Traveled

More urban areas such as the Southeast Region often have fewer winter weather crashes per 100 million vehicle miles traveled. This is partly due to the fact that a single crash in a county with low VMT has a bigger impact on the overall crash rate. In addition, urban regions have more highways with 24-hour coverage, which means that these roadways are more likely to be in passable condition. This year, all regions saw a decrease in crash rates compared with last year's unusually high rates. The Northwest Region saw the greatest decrease in crash rate (and also had the lowest overall crash rate), with this year's crash rate at 20 crashes per 100 million VMT reflecting a 63 percent decrease from last year's crash rate (see Table 4.7). Table 4.12 on pages 104-106 gives the estimated number of vehicle miles traveled in each county this winter (November 2014 to April 2015), and the number of crashes that occurred in each county.

Figure 4.6. Winter Crashes and Winter Severity Index



Source: WisDOT Bureau of Transportation Safety

WisDOT tracks crashes according to the type of road where they occurred (urban or rural, and Interstate or other state or U.S. highway), and whether the road was divided or nondivided. Figure 4.7 shows that most winter crashes occur on rural state or U.S. highways, largely because there are more lane miles in this category than in the others. Table 4.13 on page 108 shows the breakdown of crashes in each county according to highway type.

How VMT Is Calculated

WisDOT's Traffic Forecasting Section uses a number of factors to estimate Vehicle Miles of Travel for the state's roads. Annual average daily traffic counts are taken in about one-third of Wisconsin's counties every year, and estimates are made for the counties not counted. In addition, forecasters factor in gallons of gas sold, fuel tax collected, and average vehicle miles per gallon.

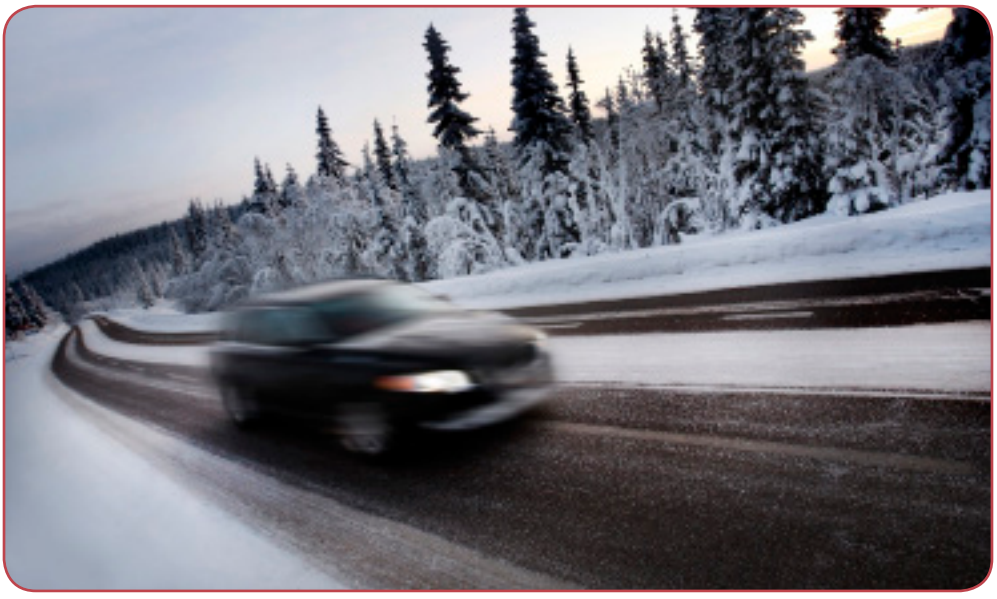


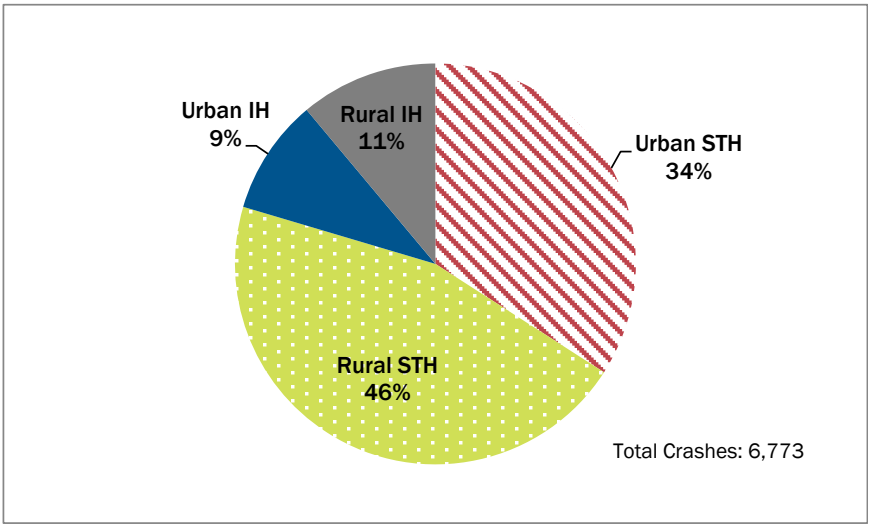
Table 4.7. Crashes and Vehicle Miles of Travel by Region

Region	Winter Severity Index (2014-15)	VMT (100 million) (Nov 2014 - April 2015)	Snow/Slush/Ice Crashes (Nov 2014 - April 2015)	Crashes per 100M VMT (2013–14)	Crashes per 100M VMT (2014–2015)
NC	114.2	36.05	973	53	27
NW	110.0	47.45	958	44	20
NE	81.0	47.59	1,190	55	25
SE	78.0	73.63	1,894	36	26
SW	91.0	69.93	1,758	44	25
Statewide	99.3	274.66	6.773	44	25

Source: WisDOT Bureau of Transportation Safety

Total winter VMT for all counties is shown in Table 4.12 on page 104-106. This winter, total VMT ranged from a low of 16.7 million in Menominee County to a high of 2.7 billion in Milwaukee County. VMT estimates at the county level tend to be less reliable than at the statewide level, because current traffic counts are not available for all counties, and more variability exists in the data at finer levels of resolution.

Figure 4.7. Winter Crashes by Highway Type, Bureau of Transportation Safety Data 2014-2015



County-by-County Tables and Figure for Section 4: Performance

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Table 4.8. Winter Maintenance Sections

NC Region

County	Lane Miles	Winter Patrol Sections 2015 Survey	Lane Miles per Patrol Section	Winter Service Group
Adams	193.20	5	38.64	F
Florence	141.07	3	47.02	F
Forest	312.38	6	52.06	E
Green Lake	158.36	3	52.79	D
Iron	249.56	6	41.59	E
Langlade	299.21	6	49.87	E
Lincoln	415.19	10	41.52	C
Marathon	869.93	19	45.79	B
Marquette	245.09	5	49.02	D
Menominee	90.26	2	45.13	F
Oneida	396.79	10	39.68	D
Portage	582.05	15	38.80	B
Price	322.26	6	53.71	E
Shawano	520.57	14	37.18	C
Vilas	305.24	6	50.87	E
Waupaca	547.06	12	45.59	B
Waushara	345.01	7	49.29	D
Wood	420.98	14	30.07	C
Region Average			**44.92**	

NW Region

County	Lane Miles	Winter Patrol Sections 2015 Survey	Lane Miles per Patrol Section	Winter Service Group
Ashland	249.49	5	49.90	E
Barron	423.09	11	38.46	C
Bayfield	316.88	6	52.81	D
Buffalo	317.02	8	39.63	D
Burnett	234.95	5	46.99	E
Chippewa	654.65	16	40.92	B
Clark	402.56	10	40.26	C
Douglas	440.80	9	48.98	C
Dunn	516.58	11	46.96	C
Eau Claire	539.46	13	41.50	B
Jackson	515.14	9	57.24	C
Pepin	112.38	3	37.46	E
Pierce	365.50	7	52.21	C
Polk	385.05	7	55.01	D
Rusk	213.47	4	53.37	E
Saint Croix	632.52	11	57.50	B
Sawyer	367.44	6	61.24	E
Taylor	233.90	4	58.48	E
Trempeleau	442.00	11	40.18	D
Washburn	372.14	7	53.16	D
Region Average			**48.61**	

NE Region

County	Lane Miles	Winter Patrol Sections 2015 Survey	Lane Miles per Patrol Section	Winter Service Group
Brown	796.76	18	44.26	B
Calumet	201.71	6	33.62	E
Door	269.70	9	29.97	D
Fond du Lac	597.46	16	37.34	B
Kewaunee	111.35	3	37.12	F
Manitowoc	425.85	11	38.71	C
Marinette	427.96	9	47.55	D
Oconto	468.36	10	46.84	C
Outagamie	538.55	17	31.68	B
Sheboygan	522.93	13	40.23	C
Winnebago	623.16	17	36.66	B
Region Average			**38.54**	

SW Region

County	Lane Miles	Winter Patrol Sections 2015 Survey	Lane Miles per Patrol Section	Winter Service Group
Columbia	786.13	15	52.41	B
Crawford	394.99	8	49.37	C
Dane	1512.86	35	43.22	A
Dodge	651.82	14	46.56	B
Grant	622.06	11	56.55	B
Green	315.55	6	52.59	D
Iowa	476.31	10	47.63	E
Jefferson	559.08	10	55.91	B
Juneau	494.25	10	49.43	C
LaCrosse	496.20	13	38.17	C
Lafayette	298.98	5	59.80	D
Monroe	654.83	13	50.37	B
Richland	327.64	7	46.81	D
Rock	687.78	14	49.13	B
Sauk	577.36	13	44.41	B
Vernon	468.36	11	42.58	C
Region Average			**49.06**	

SE Region

County	Lane Miles	Winter Patrol Sections 2015 Survey	Lane Miles per Patrol Section	Winter Service Group
Kenosha	653.56	17	38.44	B
Milwaukee	1897.05	30	63.24	A
Ozaukee	308.71	5	61.74	D
Racine	683.28	11	62.12	B
Walworth	706.03	23	30.70	B
Washington	607.89	14	43.42	B
Waukesha	1121.60	19	59.03	A
Region Average			**51.24**	

	Lane Miles	Winter Patrol Sections 2015 Survey	Lane Miles per Patrol Section
Statewide Totals	34,435.34	755.0	45.61
Statewide Averages	478.27	10.5	45.61
Group A Averages	1510.50	28.0	55.16
Group B Averages	646.26	14.7	45.24
Group C Averages	455.71	10.7	43.64
Group D Averages	328.46	7.0	48.67
Group E Averages	275.25	5.6	48.98
Group F Averages	133.97	3.3	41.98

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group A

From Winter Storm Reports, 2014-2015

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
DANE	SW	0.50	0.00	-0.21	-1.00	0.13	102.98	1.45
MILWAUKEE	SE	0.00	0.00	0.00	0.00	0.00	91.29	1.11
WAUKESHA	SE	1.04	0.71	0.00	0.00	0.83	64.61	1.08
Group A Averages		0.51	0.24	-0.07	-0.33	0.32	86.29	1.21

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group B

From Winter Storm Reports, 2014-2015

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
KEWAUNEE	NE	6.41	3.79	2.00	3.12	5.18	53.70	7.42
EAU CLAIRE	NW	0.03	0.00	0.78	-3.25	0.09	88.76	4.02
PORTAGE	NC	2.08	3.25	3.05	2.35	2.65	118.47	2.88
KENOSHA	SE	0.29	0.18	1.38	0.17	0.40	72.08	2.72
WASHINGTON	SE	0.75	0.57	0.37	0.00	0.59	97.40	2.64
CHIPPEWA	NW	3.37	3.07	4.25	4.83	3.53	103.11	2.61
COLUMBIA	SW	-0.10	0.20	0.06	0.19	0.00	107.35	2.53
SAINT CROIX	NW	1.64	1.14	1.22	0.75	1.44	91.97	2.42
MONROE	SW	3.13	1.84	1.84	2.21	2.32	111.59	2.40
WINNEBAGO	NE	0.94	0.77	1.19	1.33	0.91	87.41	2.37
DODGE	SW	1.32	0.91	1.00	1.36	1.05	83.75	2.35
RACINE	SE	1.40	1.50	2.36	1.62	1.37	84.91	2.25
SAUK	SW	1.57	1.42	0.42	0.71	1.45	101.61	2.25
MARATHON	NC	3.97	2.03	1.50	3.88	2.79	140.65	2.18
WALWORTH	SE	0.82	1.86	1.17	0.25	1.25	60.34	2.18
OUTAGAMIE	NE	1.67	2.22	1.50	1.40	1.97	76.11	2.03
JEFFERSON	SW	1.32	0.71	0.63	-0.25	1.16	62.26	1.93
GRANT	SW	1.72	1.75	1.30	1.75	1.63	74.62	1.84
FOND DU LAC	NE	1.75	3.38	2.90	6.00	2.47	64.77	1.71
BROWN	NE	1.50	0.42	0.94	1.00	0.92	87.07	1.70
WAUPACA	NC	4.18	1.25	2.40	2.50	3.06	76.88	1.54
ROCK	SW	0.83	0.50	1.08		0.58	68.45	1.41
Group B Averages		1.85	1.49	1.52	1.52	1.67	86.97	2.52

Final totals as of Monday, July 06, 2015 **Page 1 of 1**

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group C

From Winter Storm Reports, 2014-2015

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
JACKSON	NW	0.72	1.90	0.77	2.43	1.08	107.74	4.92
LINCOLN	NC	6.38	5.47	6.26	4.45	5.85	141.86	4.06
BARRON	NW	2.45	2.45	1.82	2.15	2.31	122.06	3.95
CLARK	NW	3.04	3.87	2.53	1.00	3.26	116.19	3.53
DUNN	NW	1.02	2.78	1.40	0.00	1.44	90.37	3.49
PIERCE	NW	4.00	4.91	3.92	5.43	4.24	88.84	3.46
WOOD	NC	3.50	3.36	3.44	3.15	3.41	111.47	3.34
DOUGLAS	NW	3.86	2.80	1.08		3.13	123.41	2.97
JUNEAU	SW	1.27	0.87	0.47	0.00	0.89	106.22	2.81
VERNON	SW	2.33	1.79	1.79	1.00	1.99	122.57	2.78
LA CROSSE	SW	1.74	3.36	10.25	10.25	2.90	82.80	2.68
CRAWFORD	SW	2.64	4.87	0.62	3.75	2.66	112.35	2.67
SHAWANO	NC	3.38	2.35	2.50	3.25	2.89	92.82	2.62
IOWA	SW	1.12	1.18	0.50	0.75	0.98	92.71	2.43
MANITOWOC	NE	3.70	2.50	0.90	1.93	2.91	68.79	2.35
OCONTO	NE	3.75	2.00	1.88	1.25	2.61	94.86	2.32
SHEBOYGAN	NE	1.16	0.83	1.50	1.30	1.15	80.86	2.06
Group C Averages		2.71	2.78	2.45	2.63	2.57	103.29	3.08

Final totals as of Monday, July 06, 2015 **Page 1 of 1**

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group D

From Winter Storm Reports, 2014-2015

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
		(Average Time in Hours)						
BAYFIELD	NW	3.64	4.07	3.54	3.06	3.79	165.24	6.47
ONEIDA	NC	6.94	7.33	8.05	5.79	7.51	133.97	5.96
OZAUKEE	SE	0.57	0.54	0.58	0.00	0.52	75.29	5.27
MARQUETTE	NC	1.66	1.43	1.06	1.33	1.52	68.06	4.84
GREEN LAKE	NC	6.25	3.10	2.50	3.29	4.59	71.87	4.67
DOOR	NE	4.42	1.65	1.71	1.67	3.17	103.15	4.44
POLK	NW	2.03	1.11	1.97	1.62	1.92	138.78	4.07
MARINETTE	NE	4.23	4.35	3.33	2.55	4.27	104.32	4.05
WASHBURN	NW	4.00	3.45	3.23	3.29	3.67	93.42	3.69
TREMPEALEAU	NW	0.69	1.32	0.45	0.53	0.85	105.25	3.50
LAFAYETTE	SW	1.81	1.10	1.27	0.75	1.48	83.56	3.45
RICHLAND	SW	3.05	3.36	3.70	4.00	3.11	79.46	3.25
BUFFALO	NW	2.75	3.03	3.33	0.00	3.00	96.41	3.13
WAUSHARA	NC	2.09	1.12	1.33	1.33	1.61	65.62	2.76
GREEN	SW	2.23	1.00	0.81	0.30	1.83	64.26	2.65
Group D Averages		3.09	2.53	2.46	1.97	2.86	96.58	4.15

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group E

From Winter Storm Reports, 2014-2015

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
		(Average Time in Hours)						
IRON	NC	5.11	4.47	3.95	4.56	4.91	184.90	10.06
VILAS	NC	4.28	4.87	0.50	1.00	4.39	123.41	9.58
PEPIN	NW	2.85	3.64	2.45	3.29	3.36	73.67	9.44
TAYLOR	NW	3.41	2.29	1.63	0.80	3.00	125.70	7.19
RUSK	NW	3.50	2.31	1.22	1.25	2.50	86.14	6.69
FOREST	NC	5.48	3.78	2.50		4.48	148.84	6.61
ASHLAND	NW	6.61	4.24	3.87	3.94	5.33	185.63	6.13
PRICE	NC	5.03	3.62	2.32	0.00	3.65	168.15	6.12
LANGLADE	NC	5.64	4.50	4.17	2.33	4.81	116.96	5.49
SAWYER	NW	1.45	2.23	1.36	2.75	1.89	116.30	3.77
CALUMET	NE	4.96	1.92	2.69	1.50	3.70	69.37	3.77
BURNETT	NW	3.00	3.47	4.06	3.83	3.26	80.14	3.55
Group E Averages		4.28	3.45	2.56	2.30	3.77	123.27	6.53

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group F

From Winter Storm Reports, 2014-2015

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
FLORENCE	NC	3.43	3.54	3.00	1.50	3.45	121.16	16.73
MENOMINEE	NC	6.73	3.20	3.83		5.16	76.61	13.16
ADAMS	NC	6.11	6.73	5.54	6.27	5.74	94.17	6.43
Group F Averages		5.42	4.49	4.12	3.89	4.78	97.31	12.11

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2015
Winter Maintenance Costs Per Lane Mile

County #		Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2015 Winter Costs	2015 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 1 / SOUTHWEST												
11	**Columbia**	$383,833	$488	$487,809	$621	$74,668	$95	$62,971	$902,063	11,150	$1,911,344	786.13	$2,431
12	**Crawford**	$123,668	$313	$195,545	$495	$10,367	$26	$22,815	$207,169	2,893	$559,564	394.99	$1,417
13	**Dane**	$1,190,521	$787	$1,166,900	$771	$62,569	$41	$171,344	$2,146,625	29,554	$4,737,959	1,512.86	$3,132
14	**Dodge**	$238,896	$367	$387,774	$595	$22,989	$35	$49,485	$591,000	8,305	$1,290,144	651.82	$1,979
22	**Grant**	$160,283	$258	$205,647	$331	$89,396	$144	$26,424	$350,627	5,513	$832,377	622.06	$1,338
23	**Green**	$124,445	$394	$157,186	$498	$3,606	$11	$27,044	$114,422	1,523	$426,703	315.55	$1,352
25	**Iowa**	$224,809	$472	$277,006	$582	$13,695	$29	$26,911	$284,190	4,068	$826,611	476.31	$1,735
28	**Jefferson**	$206,233	$369	$358,195	$641	$51,510	$92	$38,880	$444,805	6,408	$1,099,623	559.08	$1,967
29	**Juneau**	$189,910	$384	$305,558	$618	$17,456	$35	$25,834	$374,693	5,020	$913,451	494.25	$1,848
32	**La Crosse**	$224,934	$453	$408,955	$824	$70,067	$141	$39,537	$286,217	4,371	$1,029,710	496.20	$2,075
33	**Lafayette**	$140,052	$468	$209,420	$700	$92,582	$310	$24,889	$111,238	1,618	$578,181	298.98	$1,934
41	**Monroe**	$227,568	$348	$440,246	$672	$10,730	$16	$60,290	$556,672	7,300	$1,295,506	654.83	$1,978
52	**Richland**	$125,678	$384	$161,050	$492	$12,380	$38	$18,701	$166,718	2,157	$484,527	327.64	$1,479
53	**Rock**	$345,715	$503	$466,330	$678	$27,735	$40	$78,089	$450,089	6,876	$1,367,958	687.78	$1,989
56	**Sauk**	$271,534	$470	$308,233	$534	$12,442	$22	$27,976	$492,868	6,233	$1,113,053	577.36	$1,928
62	**Vernon**	$213,169	$455	$288,568	$616	$19,389	$41	$35,848	$280,663	4,166	$837,637	468.36	$1,788
	SW TOTAL	**$4,391,248**	**$471**	**$5,824,422**	**$625**	**$591,581**	**$63**	**$737,038**	**$7,760,061**	**107,155**	**$19,304,350**	**9,324.20**	**$2,070**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2015
Winter Maintenance Costs Per Lane Mile

County #		Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2015 Winter Costs	2015 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 2 / SOUTHEAST												
30	**Kenosha**	$432,916	$662	$627,739	$960	$20,073	$31	$51,756	$461,246	7,381	$1,593,730	653.56	$2,439
40	**Milwaukee**	$3,150,410	$1,661	$1,554,516	$819	$52,471	$28	$1,156	$1,999,963	33,132	$6,758,516	1,897.05	$3,563
45	**Ozaukee**	$258,983	$839	$244,569	$792	$13,476	$44	$24,015	$299,120	5,282	$840,163	308.71	$2,722
51	**Racine**	$418,610	$611	$477,612	$697	$6,996	$10	$39,275	$478,138	7,565	$1,420,631	685.24	$2,073
64	**Walworth**	$292,017	$414	$622,271	$881	$19,910	$28	$43,266	$530,625	8,887	$1,508,089	706.03	$2,136
66	**Washington**	$329,765	$542	$419,036	$689	$20,439	$34	$33,521	$521,881	7,880	$1,324,642	607.89	$2,179
67	**Waukesha**	$618,088	$552	$797,511	$712	$39,402	$35	$63,273	$958,750	15,362	$2,477,024	1,119.64	$2,212
	SE TOTAL	**$5,500,789**	**$920**	**$4,743,254**	**$793**	**$172,767**	**$29**	**$256,262**	**$5,249,723**	**85,489**	**$15,922,795**	**5,978.12**	**$2,664**
	REGION 3 / NORTHEAST												
5	**Brown**	$350,970	$440	$611,243	$767	$65,672	$82	$68,696	$436,854	8,126	$1,533,435	796.76	$1,925
8	**Calumet**	$89,025	$441	$120,707	$598	$3,525	$17	$9,968	$50,877	843	$274,102	201.71	$1,359
15	**Door**	$153,759	$570	$168,670	$625	$32,218	$119	$31,464	$131,251	2,045	$517,362	269.70	$1,918
20	**Fond du Lac**	$256,870	$430	$303,812	$509	$23,436	$39	$28,247	$229,306	3,266	$841,671	597.46	$1,409
31	**Kewanee**	$49,950	$449	$67,560	$607	$4,247	$38	$6,132	$44,400	792	$172,289	111.35	$1,547
36	**Manitowoc**	$223,683	$525	$261,736	$615	$72,559	$170	$49,748	$193,145	3,157	$800,871	425.85	$1,881
38	**Marinette**	$179,894	$420	$261,761	$612	$5,249	$12	$26,534	$396,115	5,850	$869,553	427.96	$2,032
42	**Oconto**	$221,463	$473	$299,158	$639	$4,628	$10	$22,951	$200,874	3,044	$749,074	468.36	$1,599
44	**Outagamie**	$331,067	$615	$346,170	$643	$80,438	$149	$38,001	$205,072	3,357	$1,000,748	538.55	$1,858
59	**Sheboygan**	$309,036	$591	$245,535	$470	$48,477	$93	$29,416	$219,410	3,117	$851,874	522.93	$1,629
70	**Winnebago**	$297,816	$478	$483,383	$776	$118,841	$191	$49,554	$357,160	5,499	$1,306,754	623.16	$2,097
	NE TOTAL	**$2,463,533**	**$494**	**$3,169,735**	**$636**	**$459,290**	**$92**	**$360,711**	**$2,464,464**	**39,096**	**$8,917,733**	**4,983.79**	**$1,789**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2015
Winter Maintenance Costs Per Lane Mile

County #		Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2015 Winter Costs	2015 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 4 / NORTHCENTRAL												
1	**Adams**	$81,282	$421	$111,003	$575	$10,164	$53	$24,640	$137,034	1,674	$364,123	193.20	$1,885
19	**Florence**	$68,994	$489	$160,647	$1,139	$3,192	$23	$11,696	$179,344	2,614	$423,873	141.07	$3,005
21	**Forest**	$150,555	$482	$349,004	$1,117	$7,674	$25	$27,381	$328,931	4,946	$863,545	312.38	$2,764
24	**Green Lake**	$73,980	$467	$59,551	$376	$10,079	$64	$6,724	$51,355	731	$201,689	158.36	$1,274
26	**Iron**	$229,083	$918	$326,893	$1,310	$17,485	$70	$25,307	$267,820	3,656	$866,588	249.56	$3,472
34	**Langlade**	$154,079	$515	$228,317	$763	$3,744	$13	$21,324	$245,307	3,831	$652,771	299.21	$2,182
35	**Lincoln**	$239,223	$576	$361,747	$871	$47,422	$114	$29,078	$337,387	4,719	$1,014,857	415.19	$2,444
37	**Marathon**	$340,099	$391	$631,785	$726	$58,193	$67	$54,311	$860,643	10,965	$1,945,031	869.93	$2,236
39	**Marquette**	$85,240	$348	$105,340	$430	$7,337	$30	$10,531	$156,924	2,197	$365,372	245.09	$1,491
73	**Menominee**	$19,388	$215	$47,833	$530	$8,821	$98	$3,325	$76,869	1,248	$156,236	90.26	$1,731
43	**Oneida**	$223,874	$564	$369,729	$932	$40,053	$101	$34,241	$465,383	6,069	$1,133,280	396.79	$2,856
49	**Portage**	$323,285	$555	$423,725	$728	$59,671	$103	$38,898	$412,159	5,454	$1,257,738	582.05	$2,161
50	**Price**	$144,245	$448	$260,764	$809	$18,411	$57	$32,569	$302,158	4,028	$758,147	322.26	$2,353
58	**Shawano**	$232,259	$446	$314,971	$605	$47,935	$92	$31,661	$338,973	5,455	$965,799	520.57	$1,855
63	**Vilas**	$179,603	$588	$345,401	$1,132	$38,427	$126	$26,724	$564,445	7,045	$1,154,600	305.24	$3,783
68	**Waupaca**	$185,076	$338	$303,426	$555	$45,682	$84	$26,402	$320,038	5,111	$880,624	547.06	$1,610
69	**Waushara**	$156,939	$455	$134,882	$391	$1,313	$4	$15,152	$187,043	2,771	$495,329	345.01	$1,436
71	**Wood**	$192,917	$458	$243,405	$578	$15,041	$36	$19,874	$299,405	3,934	$770,642	420.98	$1,831
	NC TOTAL	**$3,080,121**	**$480**	**$4,778,423**	**$745**	**$440,644**	**$69**	**$439,838**	**$5,531,219**	**76,448**	**$14,270,245**	**6,414.21**	**$2,225**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2015
Winter Maintenance Costs Per Lane Mile

County #		Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2015 Winter Costs	2015 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 5 / NORTHWEST												
2	**Ashland**	$115,884	$464	$221,712	$889	$48,994	$196	$22,716	$153,250	2,123	$562,556	249.49	$2,255
3	**Barron**	$272,052	$643	$349,219	$825	$28,448	$67	$47,666	$268,389	3,691	$965,774	423.09	$2,283
4	**Bayfield**	$153,923	$486	$322,627	$1,018	$17,760	$56	$46,984	$288,430	4,303	$829,724	316.88	$2,618
6	**Buffalo**	$130,990	$413	$180,188	$568	$11,277	$36	$18,173	$119,325	1,688	$459,953	317.02	$1,451
7	**Burnett**	$71,596	$305	$99,815	$425	$27,442	$117	$14,318	$108,583	1,619	$321,754	234.95	$1,369
9	**Chippewa**	$384,178	$587	$388,258	$593	$3,868	$6	$43,667	$497,303	6,569	$1,317,274	654.65	$2,012
10	**Clark**	$188,043	$467	$251,136	$624	$24,380	$61	$46,442	$292,858	3,734	$802,859	402.56	$1,994
16	**Douglas**	$151,199	$343	$311,532	$707	$26,843	$61	$33,617	$276,468	4,672	$799,659	440.80	$1,814
17	**Dunn**	$278,660	$539	$367,123	$711	$16,210	$31	$33,774	$480,450	6,393	$1,176,217	516.58	$2,277
18	**Eau Claire**	$262,806	$487	$390,190	$723	$108,502	$201	$45,585	$593,326	7,842	$1,400,409	539.46	$2,596
27	**Jackson**	$165,631	$322	$353,447	$686	$18,770	$36	$24,577	$484,310	6,026	$1,046,735	515.14	$2,032
46	**Pepin**	$69,209	$616	$60,592	$539	$5,495	$49	$6,120	$41,011	531	$182,427	112.38	$1,623
47	**Pierce**	$202,952	$555	$258,673	$708	$12,000	$33	$22,328	$198,358	2,801	$694,311	365.50	$1,900
48	**Polk**	$146,968	$382	$259,132	$673	$33,946	$88	$34,316	$321,181	4,322	$795,543	385.05	$2,066
54	**Rusk**	$61,983	$290	$129,699	$608	$1,413	$7	$18,915	$155,598	2,038	$367,608	213.47	$1,722
57	**Sawyer**	$138,294	$376	$199,623	$543	$7,467	$20	$15,674	$267,288	3,418	$628,346	367.44	$1,710
55	**St. Croix**	$318,911	$504	$370,861	$586	$70,623	$112	$65,648	$487,356	7,640	$1,313,399	632.52	$2,076
60	**Taylor**	$134,201	$574	$188,234	$805	$8,670	$37	$20,171	$197,588	2,301	$548,864	233.90	$2,347
61	**Trempealeau**	$199,465	$451	$287,464	$650	$10,622	$24	$26,277	$369,937	5,166	$893,765	442.00	$2,022
65	**Washburn**	$124,518	$335	$262,524	$705	$10,579	$28	$19,763	$254,817	3,732	$672,201	372.14	$1,806
	NW TOTAL	**$3,571,463**	**$462**	**$5,252,049**	**$679**	**$493,309**	**$64**	**$606,731**	**$5,855,825**	**80,609**	**$15,779,377**	**7,735.02**	**$2,040**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2015
Winter Maintenance Costs Per Lane Mile

County #		Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2015 Winter Costs	2015 LOS Lane Miles	Winter Costs Per Lane Mile
	STATEWIDE SUMMARY												
	SW Region	$4,391,248	$471	$5,824,422	$625	$591,581	$63	$737,038	$7,760,061	107,155	$19,304,350	9,324.20	$2,070
	SE Region	$5,500,789	$920	$4,743,254	$793	$172,767	$29	$256,262	$5,249,723	85,489	$15,922,795	5,978.12	$2,664
	NE Region	$2,463,533	$494	$3,169,735	$636	$459,290	$92	$360,711	$2,464,464	39,096	$8,917,733	4,983.79	$1,789
	NC Region	$3,080,121	$480	$4,778,423	$745	$440,644	$69	$439,838	$5,531,219	76,448	$14,270,245	6,414.21	$2,225
	NW Region	$3,571,463	$462	$5,252,049	$679	$493,309	$64	$606,731	$5,855,825	80,609	$15,779,377	7,735.02	$2,040
	Statewide Totals	$19,007,154	$552	$23,767,883	$690	$2,157,591	$63	$2,400,580	$26,861,292	388,797	$74,194,500	34,435.34	$2,155

prepared by: Cathy Meinholz/Bureau of Highway Maintenance
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July 23, 2015

Figure 4.8. 2014-2015 Winter Costs vs. 5-Year Average

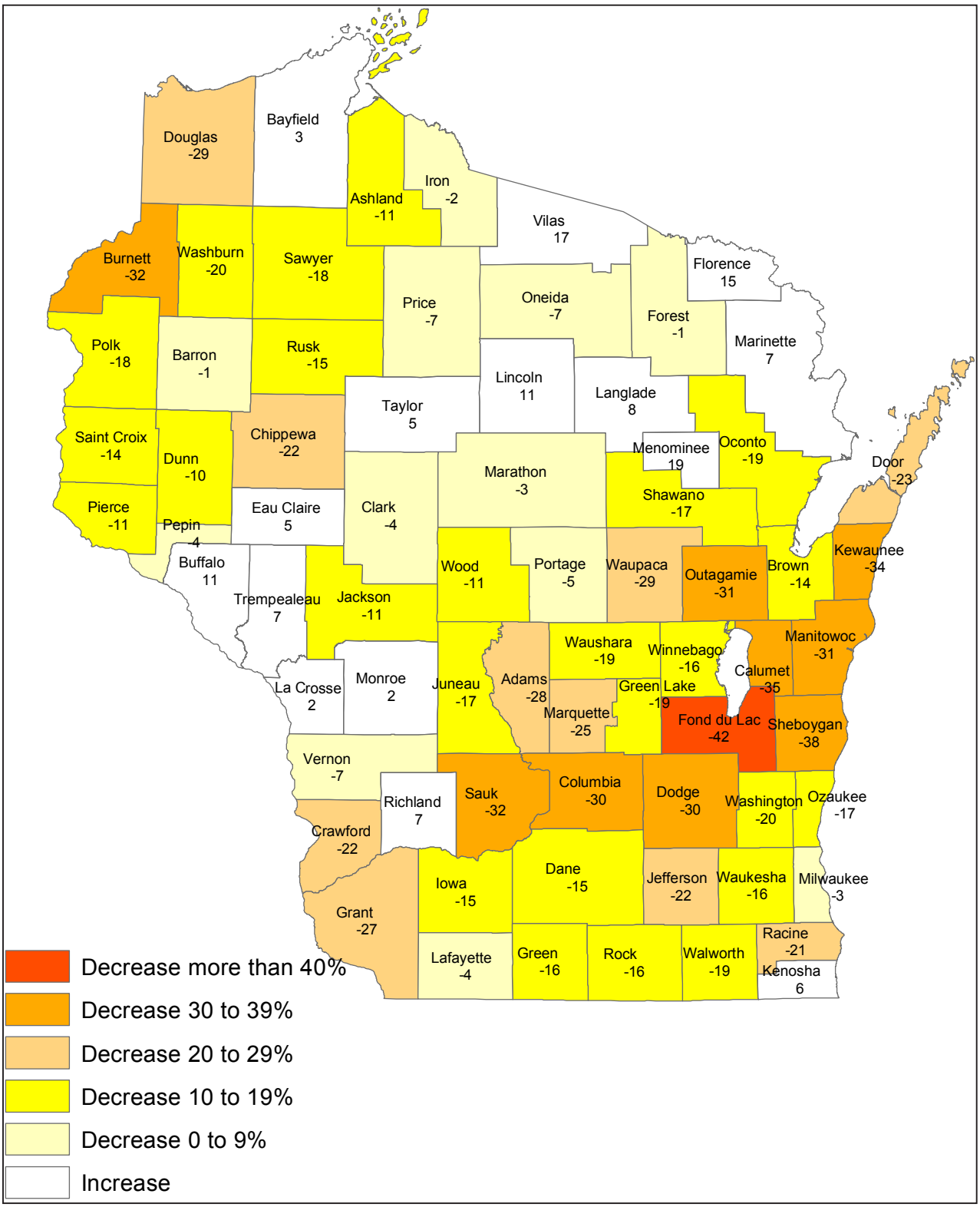

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group A)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
DANE	SW	1,512.86	102.98	44.5	20887	13.81	0.13	$3,286,000	$2,188	1.45
MILWAUKEE	SE	1,897.05	91.29	41.0	30793	16.23	0.18	$3,949,000	$2,104	1.11
WAUKESHA	SE	1,121.60	64.61	49.4	7582	6.76	0.10	$1,351,000	$1,213	1.08
Group A Averages		1,510.50	86.29	45.0	19754	12.27	0.14	$2,862,000	$1,835	1.21

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group B)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
KEWAUNEE	NE	111.35	53.70	44.0	792	7.11	0.13	$92,000	$826	7.42
EAU CLAIRE	NW	539.46	88.76	47.1	7842	14.54	0.16	$1,169,000	$2,171	4.02
PORTAGE	NC	582.05	118.47	42.5	5454	9.37	0.08	$966,000	$1,674	2.88
KENOSHA	SE	653.56	72.08	39.2	7381	11.29	0.16	$1,160,000	$1,775	2.72
WASHINGTON	SE	607.89	97.40	34.6	7880	12.96	0.13	$937,000	$1,604	2.64
CHIPPEWA	NW	654.65	103.11	68.7	6569	10.03	0.10	$1,121,000	$1,712	2.61
COLUMBIA	SW	786.13	107.35	41.5	11150	14.18	0.13	$1,566,000	$1,992	2.53
SAINT CROIX	NW	632.52	91.97	39.7	7615	12.04	0.13	$969,000	$1,532	2.42
MONROE	SW	654.83	111.59	48.8	7300	11.15	0.10	$1,027,000	$1,569	2.40
WINNEBAGO	NE	623.16	87.41	31.2	5499	8.82	0.10	$880,000	$1,474	2.37
DODGE	SW	651.82	83.75	35.5	8025	12.31	0.15	$996,000	$1,531	2.35
RACINE	SE	683.28	84.91	51.8	7565	11.07	0.13	$1,048,000	$1,537	2.25
SAUK	SW	577.36	101.61	44.9	4665	8.08	0.08	$747,000	$1,297	2.25
MARATHON	NC	869.93	140.65	62.8	10965	12.60	0.09	$1,643,000	$1,900	2.18
WALWORTH	SE	706.03	60.34	53.6	8887	12.59	0.21	$1,080,000	$1,539	2.18
OUTAGAMIE	NE	538.55	76.11	53.1	3357	6.23	0.08	$575,000	$1,091	2.03
JEFFERSON	SW	559.08	62.26	49.9	3055	5.46	0.09	$588,000	$1,082	1.93

Final totals as of Monday, July 06, 2015

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group B)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
GRANT	SW	622.06	74.62	44.7	5513	8.86	0.12	$709,000	$1,143	1.84
FOND DU LAC	NE	597.46	64.77	32.2	3266	5.47	0.08	$604,000	$1,022	1.71
BROWN	NE	796.76	87.07	32.4	8126	10.20	0.12	$1,076,000	$1,351	1.70
WAUPACA	NC	547.06	76.88	40.0	2108	3.85	0.05	$459,000	$842	1.54
ROCK	SW	687.78	68.45	44.8	2643	3.84	0.06	$661,000	$971	1.41
Group B Averages		621.94	86.97	44.7	6166	9.64	0.11	$912,409	$1,438	2.52

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group C)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
JACKSON	NW	515.14	107.74	58.5	6026	11.70	0.11	$1,307,000	$2,537	4.92
LINCOLN	NC	415.19	141.86	77.4	4719	11.37	0.08	$691,000	$1,686	4.06
BARRON	NW	423.09	122.06	70.7	3691	8.72	0.07	$696,000	$1,671	3.95
CLARK	NW	402.56	116.19	67.8	3734	9.28	0.08	$571,000	$1,420	3.53
DUNN	NW	516.58	90.37	49.6	6393	12.38	0.14	$930,000	$1,801	3.49
PIERCE	NW	365.50	88.84	49.8	2801	7.66	0.09	$460,000	$1,266	3.46
WOOD	NC	420.98	111.47	60.5	3934	9.34	0.08	$589,000	$1,405	3.34
DOUGLAS	NW	440.80	123.41	77.2	4672	10.60	0.09	$578,000	$1,310	2.97
JUNEAU	SW	494.25	106.22	50.6	5020	10.16	0.10	$685,000	$1,391	2.81
VERNON	SW	468.36	122.57	48.1	4166	8.89	0.07	$609,000	$1,303	2.78
LA CROSSE	SW	496.20	82.80	48.0	4371	8.81	0.11	$654,000	$1,328	2.68
CRAWFORD	SW	394.99	112.35	44.4	2893	7.32	0.07	$416,000	$1,054	2.67
SHAWANO	NC	520.57	92.82	65.3	5455	10.48	0.11	$703,000	$1,364	2.62
IOWA	SW	476.31	92.71	49.0	3388	7.11	0.08	$551,000	$1,157	2.43
MANITOWOC	NE	425.85	68.79	36.3	3157	7.41	0.11	$424,000	$999	2.35
OCONTO	NE	468.36	94.86	74.5	3044	6.50	0.07	$510,000	$1,088	2.32
SHEBOYGAN	NE	522.93	80.86	32.9	3117	5.96	0.07	$541,000	$1,078	2.06

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group C)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
Group C Averages		456.92	103.29	56.5	4152	9.04	0.09	$642,059	$1,403	3.08

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group D)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
BAYFIELD	NW	316.88	165.24	130.0	4303	13.58	0.08	$648,000	$2,049	6.47
ONEIDA	NC	396.79	133.97	109.4	6069	15.30	0.11	$929,000	$2,364	5.96
OZAUKEE	SE	308.71	75.29	32.7	5282	17.11	0.23	$500,000	$1,627	5.27
MARQUETTE	NC	245.09	68.06	27.8	2197	8.96	0.13	$289,000	$1,187	4.84
GREEN LAKE	NC	158.36	71.87	34.2	707	4.46	0.06	$117,000	$740	4.67
DOOR	NE	269.70	103.15	35.4	2045	7.58	0.07	$321,000	$1,199	4.44
POLK	NW	385.05	138.78	67.8	4322	11.22	0.08	$601,000	$1,567	4.07
MARINETTE	NE	427.96	104.32	88.6	5805	13.56	0.13	$738,000	$1,732	4.05
WASHBURN	NW	372.14	93.42	65.1	3732	10.03	0.11	$509,000	$1,374	3.69
TREMPEALEAU	NW	442.00	105.25	48.1	5166	11.69	0.11	$683,000	$1,546	3.50
LAFAYETTE	SW	298.98	83.56	53.8	1618	5.41	0.06	$308,000	$1,030	3.45
RICHLAND	SW	327.64	79.46	33.6	2157	6.58	0.08	$349,000	$1,066	3.25
BUFFALO	NW	317.02	96.41	61.2	1688	5.32	0.06	$314,000	$992	3.13
WAUSHARA	NC	345.01	65.62	37.8	2771	8.03	0.12	$327,000	$952	2.76
GREEN	SW	315.55	64.26	42.5	979	3.10	0.05	$264,000	$837	2.65
Group D Averages		328.46	96.58	57.9	3256	9.46	0.10	$459,800	$1,351	4.15

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group E)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
IRON	NC	249.56	184.90	234.9	3656	14.65	0.08	$623,000	$2,510	10.06
VILAS	NC	305.24	123.41	143.0	7045	23.08	0.19	$891,000	$2,923	9.58
PEPIN	NW	112.38	73.67	45.4	531	4.73	0.06	$119,000	$1,061	9.44
TAYLOR	NW	233.90	125.70	65.1	2301	9.84	0.08	$390,000	$1,681	7.19
RUSK	NW	213.47	86.14	61.8	2038	9.55	0.11	$305,000	$1,428	6.69
FOREST	NC	312.38	148.84	133.4	4946	15.83	0.11	$643,000	$2,066	6.61
ASHLAND	NW	249.49	185.63	146.6	2123	8.51	0.05	$381,000	$1,529	6.13
PRICE	NC	322.26	168.15	95.1	4028	12.50	0.07	$629,000	$1,973	6.12
LANGLADE	NC	299.21	116.96	81.1	3831	12.80	0.11	$490,000	$1,642	5.49
SAWYER	NW	367.44	116.30	86.7	3418	9.30	0.08	$509,000	$1,386	3.77
CALUMET	NE	201.71	69.37	40.5	843	4.18	0.06	$152,000	$761	3.77
BURNETT	NW	234.95	80.14	60.6	1126	4.79	0.06	$196,000	$835	3.55
Group D Averages		258.50	123.27	99.5	2991	10.81	0.09	$444,000	$1,649	6.53

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group F)

From Winter Storm Reports, 2014-2015

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
FLORENCE	NC	141.07	121.16	121.4	2614	18.53	0.15	$331,000	$2,361	16.73
MENOMINEE	NC	90.26	76.61	52.8	1248	13.83	0.18	$107,000	$1,188	13.16
ADAMS	NC	193.20	94.17	30.1	1674	8.66	0.09	$240,000	$1,242	6.43
Group D Averages		141.51	97.31	68.1	1845	13.67	0.14	$226,000	$1,597	12.11

Table 4.12. Winter Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 1, 2014 - April 30, 2015

COUNTY	2014-15 WINTER VMT	2014-15 WINTER CRASHES	CRASH RATE PER 100M VMT
NORTH CENTRAL			
ADAMS	129,500,000	11	8
FLORENCE	43,800,000	9	21
FOREST	89,800,000	15	17
GREEN LAKE	89,500,000	14	16
IRON	63,100,000	17	27
LANGLADE	120,700,000	26	22
LINCOLN	187,500,000	67	36
MARATHON	745,100,000	311	42
MARQUETTE	133,400,000	3	2
MENOMINEE	16,700,000	23	138
ONEIDA	246,000,000	64	26
PORTAGE	401,400,000	100	25
PRICE	118,400,000	11	9
SHAWANO	288,600,000	46	16
VILAS	171,700,000	44	26
WAUPACA	289,100,000	71	25
WAUSHARA	184,900,000	38	21
WOOD	285,900,000	103	36
Region Total	**3,605,100,000**	**973**	**27**
NORTHEAST			
BROWN	1,041,500,000	256	25
CALUMET	178,600,000	44	25
DOOR	182,500,000	20	11
FOND DU LAC	503,100,000	167	33
KEWAUNEE	98,200,000	8	8
MANITOWOC	348,500,000	76	22
MARINETTE	296,000,000	67	23
OCONTO	278,200,000	42	15
OUTAGAMIE	651,100,000	198	30
SHEBOYGAN	424,800,000	43	10
WINNEBAGO	756,800,000	269	36
Region Total	**4,759,300,000**	**1,190**	**25**

Table 4.12. Winter Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 1, 2014 - April 30, 2015

COUNTY	2014-15 WINTER VMT	2014-15 WINTER CRASHES	CRASH RATE PER 100M VMT
NORTHWEST			
ASHLAND	114,700,000	19	17
BARRON	296,100,000	57	19
BAYFIELD	203,300,000	20	10
BUFFALO	109,200,000	21	19
BURNETT	149,800,000	15	10
CHIPPEWA	421,300,000	111	26
CLARK	249,300,000	53	21
DOUGLAS	286,100,000	60	21
DUNN	343,200,000	67	20
EAU CLAIRE	461,200,000	144	31
JACKSON	291,000,000	54	19
PEPIN	50,300,000	7	14
PIERCE	177,900,000	43	24
POLK	248,100,000	33	13
RUSK	115,400,000	18	16
ST.CROIX	559,600,000	121	22
SAWYER	147,000,000	16	11
TAYLOR	134,900,000	23	17
TREMPEALEAU	210,800,000	49	23
WASHBURN	175,900,000	27	15
Region Total	**4,745,100,000**	**958**	**20**
SOUTHEAST			
KENOSHA	621,200,000	177	28
MILWAUKEE	2,693,500,000	799	30
OZAUKEE	450,500,000	67	15
RACINE	671,300,000	236	35
WALWORTH	513,900,000	92	18
WASHINGTON	659,300,000	160	24
WAUKESHA	1,753,400,000	363	21
Region Total	**7,363,100,000**	**1,894**	**26**

Table 4.12. Winter Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 1, 2014 - April 30, 2015

COUNTY	2014-15 WINTER VMT	2014-15 WINTER CRASHES	CRASH RATE PER 100M VMT
SOUTHWEST			
COLUMBIA	454,900,000	98	22
CRAWFORD	113,500,000	27	24
DANE	2,250,900,000	496	22
DODGE	431,100,000	72	17
GRANT	281,200,000	74	26
GREEN	168,400,000	49	29
IOWA	212,500,000	32	15
JEFFERSON	452,200,000	125	28
JUNEAU	327,000,000	72	22
LA CROSSE	418,300,000	185	44
LAFAYETTE	143,600,000	25	17
MONROE	358,600,000	90	25
RICHLAND	112,200,000	21	19
ROCK	698,600,000	260	37
SAUK	411,500,000	72	17
VERNON	158,400,000	60	38
Region Total	**6,992,900,000**	**1,758**	**25**
STATEWIDE TOTAL	**27,465,500,000**	**6,773**	**25**

Table 4.13 Motor Vehicle Crashes on Roads with Snow/Ice/Slush

Table 4.13. Motor Vehicle Crashes on Roads with Snow/Ice/Slush
Bureau of transportation Safety data, Nov. 1, 2014 - April 30, 2015 State, U.S. and Interstate Highways only

NC Region

						Urban State Highway			Rural State Highway		
COUNTY	TOTAL	Urban STH	Rural STH	Urban IH	Rural IH	Non-div	Divided	Unkn	Non-div	Divided	Unkn
ADAMS	11	0	11	0	0	0	0	0	10	1	0
FLORENCE	9	0	9	0	0	0	0	0	9	0	0
FOREST	15	0	15	0	0	0	0	0	15	0	0
GREEN LAKE	14	2	12	0	0	2	0	0	12	0	0
IRON	17	0	17	0	0	0	0	0	16	1	0
LANGLADE	26	8	18	0	0	7	1	0	17	1	0
LINCOLN	67	13	54	0	0	13	0	0	26	28	0
MARATHON	311	111	179	9	12	39	72	0	57	122	0
MARQUETTE	23	0	13	0	10	0	0	0	13	0	0
ONEIDA	64	6	58	0	0	2	4	0	53	5	0
PORTAGE	100	27	38	12	23	14	13	0	20	18	0
PRICE	11	0	11	0	0	0	0	0	10	1	0
SHAWANO	46	4	42	0	0	3	1	0	18	24	0
VILAS	44	0	44	0	0	0	0	0	42	2	0
WAUPACA	71	3	68	0	0	2	1	0	41	27	0
WAUSHARA	38	0	28	0	10	0	0	0	25	3	0
WOOD	103	57	46	0	0	28	29	0	32	14	0
MENOMINEE	3	0	3	0	0	0	0	0	3	0	0
TOTAL	973	231	666	21	55	110	121	0	419	247	0

NE Region

						Urban State Highway			Rural State Highway		
COUNTY	TOTAL	Urban STH	Rural STH	Urban IH	Rural IH	Non-div	Divided	Unkn	Non-div	Divided	Unkn
BROWN	256	200	33	18	5	48	152	0	10	23	0
CALUMET	44	11	32	1	0	5	6	0	27	5	0
DOOR	20	1	19	0	0	0	1	0	15	4	0
FOND DU LAC	167	47	120	0	0	26	21	0	40	80	0
KEWAUNEE	8	0	8	0	0	0	0	0	7	1	0
MANITOWOC	76	31	26	2	17	18	13	0	20	6	0
MARINETTE	67	3	64	0	0	1	2	0	48	16	0
OCONTO	42	0	42	0	0	0	0	0	15	26	1
OUTAGAMIE	198	83	115	0	0	40	43	0	48	67	0
SHEBOYGAN	43	20	15	1	7	8	12	0	7	8	0
WINNEBAGO	269	112	157	0	0	65	47	0	30	127	0
TOTAL	1,190	508	631	22	29	211	297	0	267	363	1

NW Region

						Urban State Highway			Rural State Highway		
COUNTY	TOTAL	Urban STH	Rural STH	Urban IH	Rural IH	Non-div	Divided	Unkn	Non-div	Divided	Unkn
ASHLAND	19	8	11	0	0	5	3	0	11	0	0
BARRON	57	7	50	0	0	2	5	0	31	19	0
BAYFIELD	20	0	20	0	0	0	0	0	18	2	0
BUFFALO	21	0	21	0	0	0	0	0	20	1	0
BURNETT	15	0	15	0	0	0	0	0	14	1	0
CHIPPEWA	111	15	96	0	0	10	5	0	32	64	0
CLARK	53	0	53	0	0	0	0	0	19	34	0
DOUGLAS	60	36	11	13	0	12	24	0	7	4	0
DUNN	67	14	26	4	23	9	5	0	25	1	0
EAU CLAIRE	144	75	39	2	28	8	67	0	20	19	0
JACKSON	54	0	32	0	22	0	0	0	29	3	0
PEPIN	7	0	7	0	0	0	0	0	7	0	0
PIERCE	43	4	39	0	0	3	1	0	38	1	0
POLK	33	0	33	0	0	0	0	0	32	1	0
RUSK	18	0	18	0	0	0	0	0	18	0	0
ST. CROIX	121	7	65	14	35	5	2	0	40	25	0
SAWYER	16	0	16	0	0	0	0	0	15	1	0
TAYLOR	23	0	23	0	0	0	0	0	22	1	0
TREMPEALEAU	49	0	47	0	2	0	0	0	45	2	0
WASHBURN	27	0	27	0	0	0	0	0	13	14	0
TOTAL	958	166	649	33	110	54	112	0	456	193	0

SE Region

COUNTY	TOTAL	Urban STH	Rural STH	Urban IH	Rural IH	Urban State Highway			Rural State Highway		
						Non-div	Divided	Unkn	Non-div	Divided	Unkn
KENOSHA	177	51	66	7	53	35	16	0	21	45	0
MILWAUKEE	799	477	0	322	0	153	324	0	0	0	0
OZAUKEE	67	10	10	17	30	4	6	0	5	5	0
RACINE	236	123	43	4	66	64	58	1	31	12	0
WALWORTH	92	20	54	0	18	14	6	0	43	11	0
WASHINGTON	160	89	71	0	0	31	58	0	27	44	0
WAUKESHA	363	152	83	87	41	24	128	0	40	43	0
TOTAL	1,894	922	327	437	208	325	596	1	167	160	0

SW Region

COUNTY	TOTAL	Urban STH	Rural STH	Urban IH	Rural IH	Urban State Highway			Rural State Highway		
						Non-div	Divided	Unkn	Non-div	Divided	Unkn
COLUMBIA	98	8	40	1	49	5	3	0	34	6	0
CRAWFORD	27	6	21	0	0	6	0	0	21	0	0
DANE	496	230	154	27	85	41	189	0	90	64	0
DODGE	72	12	60	0	0	5	7	0	30	30	0
GRANT	74	10	64	0	0	8	2	0	45	19	0
GREEN	49	7	42	0	0	0	7	0	41	1	0
IOWA	32	0	32	0	0	0	0	0	11	21	0
JEFFERSON	125	21	67	0	37	13	8	0	37	30	0
JUNEAU	72	0	28	0	44	0	0	0	26	2	0
LA CROSSE	185	91	49	32	13	53	38	0	28	21	0
LAFAYETTE	25	0	25	0	0	0	0	0	19	6	0
MONROE	90	19	37	2	32	11	8	0	37	0	0
RICHLAND	21	0	21	0	0	0	0	0	17	4	0
ROCK	260	69	73	56	62	37	32	0	57	16	0
SAUK	72	9	36	0	27	6	3	0	25	11	0
VERNON	60	0	60	0	0	0	0	0	58	2	0
TOTAL	1,758	482	809	118	349	185	297	0	576	233	0

STH = State highways or non-interstate US highways
IH = Interstate highways Non-div = Non-divided
Rural = An unincorporated area or an incorporated area with a population under 5,000
Urban = An incorporated area with a population of 5,000 or more.

*2015 figures are preliminary at this time.
**Does not include deer or other animal crashes

5 Looking Ahead

The 2014-15 winter season was what most would consider an average winter: average snowfall, moderate cold snaps and the winter ended earlier than typical. On paper it should have been a less costly winter but that was not necessarily the case. Average freezing rain events more than doubled compared to the previous winter. And freezing rain events tend to be the most costly events behind extreme cold snaps.

Photo credit: Taber Andrew Bain (https://goo.gl/CiynVD)

In 2015-2016, WisDOT will continue to look toward efficiencies that reduce winter maintenance costs. The use of anti-icing on a routine basis in critical locations will be continued. Working with software for winter route optimization for participating counties will begin. Additional reviews of winter plow routes and current best practices will be ongoing.

Areas of focus for the 2015-2016 winter:

1. AVL/GPS (Automatic Vehicle Location/Global Positioning System) has become standard equipment and is now being utilized in 49 counties. The effort to implement the technology statewide is proceeding with a higher emphasis on service providers with Interstates and Expressways and counties who are actively using the MDSS forecasting-treatment recommendation program.
2. WisDOT is going to partner with Dane County Highway Department to and conduct a route optimizing study on Dane County's highways. The software call 'Fleet Route' is being jointly purchased for the study.
3. WisDOT plans on focusing MDSS user training on the transition to the web-based version as well as the mobile version. WisDOT will continue implementing the improved reporting capabilities of MDSS and will continue to study using MDSS data to develop an objective winter severity index.
4. Mixing liquid deicers is becoming more popular nationwide, as is the technique of getting more liquids on the roadway during plowing operations through the use of slurry generators. We will work with counties to begin investigating and testing these techniques.
5. The snowplow training modules for operators and supervisors training will begin this fall.

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Appendix

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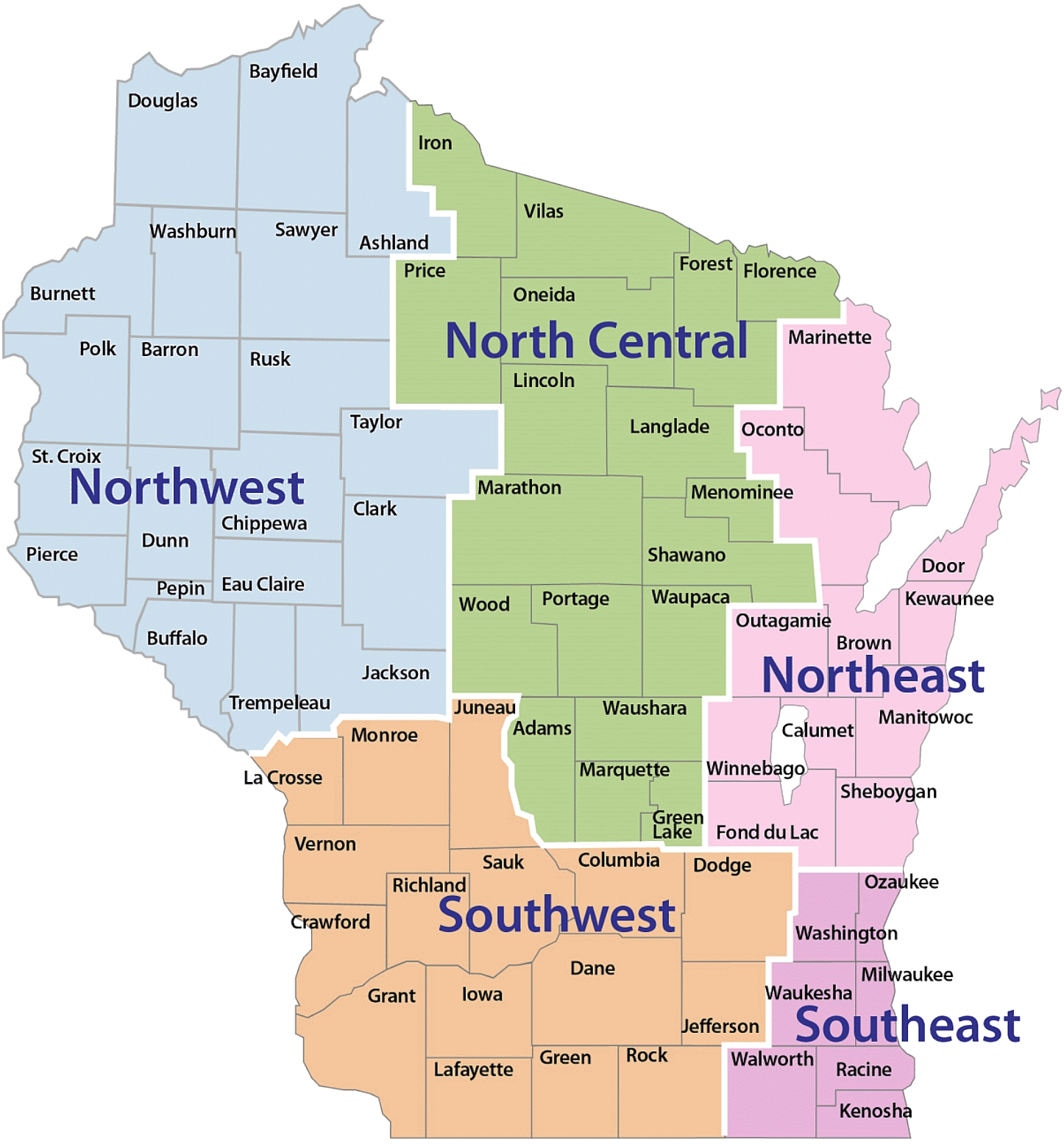
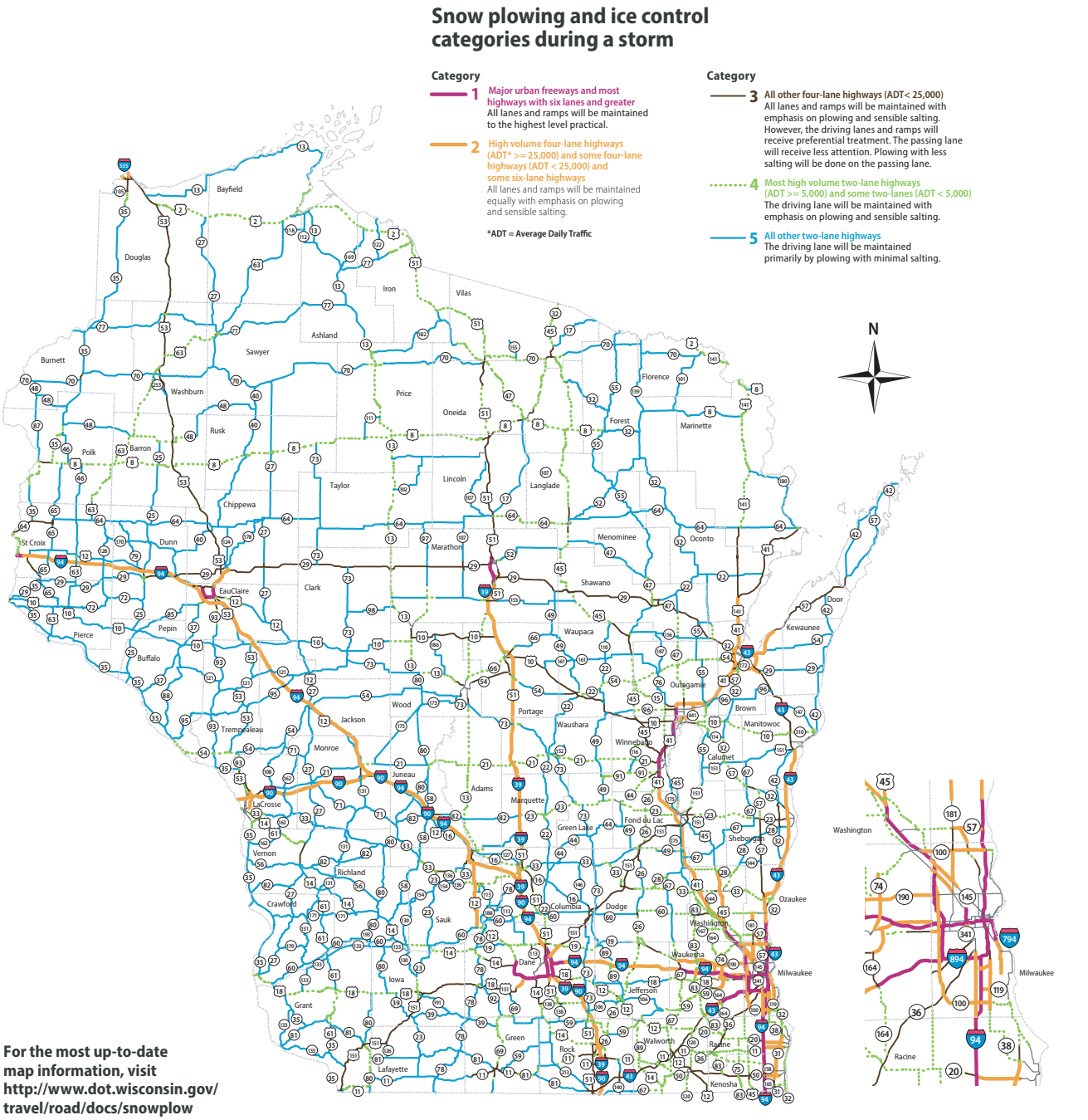
Wisconsin Department of Transportation
Region Map
October 2015





For the most up-to-date map information, visit http://www.dot.wisconsin.gov/travel/road/docs/snowplowbrochure2014mapside.pdf

11/10/2014

Figure A-2

Table A.1. Storm Report Summary

From Winter Storm Reports, 2014-2015

Notes: 1) Costs shown in table are estimated and do not include the 4.44% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of May '12 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region / NC / County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season			Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Thaw-Rox (tons)	Total Clear-Lane (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile				Estimated Total Cost to Date	Salt per LM per Severity Index
				Anti-Icing	Storms	Inci-dent											Mat'l	Equip	Labor	Total		
ADAMS	193.2	94.17	30.1	10	27	11	19	3,967	1,674	2,293	8.7	0	0	0	819.0	106.0	$750	$268	$224	$1,242	$239,745	0.09
FLORENCE	141.07	121.16	121.4	13	41	37	5	3,280	2,614	666	18.5	0	0	92	1169.0	186.0	$1,348	$582	$430	$2,361	$331,497	0.15
FOREST	312.38	148.84	133.4	0	50	18	15	7,215	4,946	2,269	15.8	0	0	173	2282.0	993.0	$1,077	$549	$440	$2,066	$642,932	0.11
GREEN LAKE	158.36	71.87	34.2	3	23	21	8	1,849	707	1,142	4.5	0	0	7	499.0	157.0	$328	$226	$186	$740	$116,695	0.06
IRON	249.56	184.90	234.9	0	52	35	10	5,990	3,656	2,334	14.6	0	0	502	2082.0	1003.0	$1,142	$670	$698	$2,510	$623,032	0.08
LANGLADE	299.21	116.96	81.1	2	40	29	12	5,427	3,831	1,596	12.8	0	0	53	1956.0	546.0	$833	$462	$347	$1,642	$489,823	0.11
LINCOLN	415.19	141.86	77.4	8	43	29	22	5,409	4,719	690	11.4	0	0	1590	2466.0	808.0	$893	$446	$347	$1,686	$690,997	0.08
MARATHON	869.93	140.65	62.8	25	43	51	10	12,784	10,965	1,819	12.6	0	0	340	5856.0	1850.0	$1,034	$492	$374	$1,900	$1,643,378	0.09
MARQUETTE	245.09	68.06	27.8	13	26	12	12	4,455	2,197	2,258	9.0	0	0	55	700.0	471.0	$711	$260	$216	$1,187	$289,342	0.13
MENOMINEE	90.26	76.61	52.8	3	28	21	4	1,899	1,248	651	13.8	0	0	87	279.0	16.0	$885	$196	$107	$1,188	$107,197	0.18
ONEIDA	396.79	133.97	109.4	7	44	10	23	8,435	6,069	2,366	15.3	0	0	1988	4372.0	255.0	$1,295	$589	$480	$2,364	$928,787	0.11
PORTAGE	582.05	118.47	42.5	2	39	25	19	8,264	5,454	2,810	9.4	0	0	815	4497.0	868.0	$747	$552	$374	$1,674	$966,245	0.08
PRICE	322.26	168.15	95.1	3	53	26	25	5,712	4,028	1,684	12.5	0	0	140	2279.0	878.0	$989	$529	$455	$1,973	$628,553	0.07
SHAWANO	520.57	92.82	65.3	14	28	38	7	8,822	5,455	3,367	10.5	0	0	189	3032.0	672.0	$705	$378	$281	$1,364	$702,919	0.11
VILAS	305.24	123.41	143.0	0	47	21	2	7,489	7,045	444	23.1	0	145	1032	1926.0	966.0	$1,901	$544	$478	$2,923	$890,510	0.19
WAUPACA	547.06	76.88	40.0	6	24	26	6	6,618	2,108	4,510	3.9	0	7	241	2773.0	344.0	$265	$342	$236	$842	$458,929	0.05
WAUSHARA	345.01	65.62	37.8	11	22	13	10	4,149	2,771	1,378	8.0	0	0	11	1414.0	34.0	$555	$234	$162	$952	$327,196	0.12
WOOD	420.98	111.47	60.5	14	38	19	20	6,423	3,934	2,489	9.3	0	0	319	1754.0	945.0	$747	$369	$290	$1,405	$588,650	0.08
Region Total		--	--	--	--	--	--	108,187	73,421	34,766	--	0	152	7634	--	--	--	--	--	--	10,666,426	
Region Average		114.21	80.5	7.4	37.1	24.6	12.7	6,010	4,079	1,931	11.9	0	8	424	2230.8	616.6	$900	$427	$340	$1,668	$592,579	0.11

Table A.1. Storm Report Summary

From Winter Storm Reports, 2014-2015

Notes: 1) Costs shown in table are estimated and do not include the 4.44% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of May '12 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region NE County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season			Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Thaw-Rox (tons)	Total Clear-Lane (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile				Estimated Total Cost to Date	Salt per LM per Severity Index
				Anti-Icing	Storms	Inci-dent											Mat'l	Equip	Labor	Total		
BROWN	796.76	87.07	32.4	38	30	14	8	13,183	8,126	5,057	10.2	0	0	327	5883.0	587.0	$561	$456	$334	$1,351	$1,076,251	0.12
CALUMET	201.71	69.37	40.5	2	23	18	9	2,265	843	1,422	4.2	0	0	0	917.0	174.0	$269	$292	$200	$761	$152,073	0.06
DOOR	269.7	103.15	35.4	8	32	29	9	4,313	2,045	2,268	7.6	0	0	28	552.0	997.0	$515	$321	$363	$1,199	$321,385	0.07
FOND DU LAC	597.46	64.77	32.2	11	18	20	5	10,592	3,266	7,326	5.5	0	0	11	1672.0	1712.0	$421	$311	$290	$1,022	$603,513	0.08
KEWAUNEE	111.35	53.70	44.0	9	19	11	2	1,543	792	751	7.1	0	0	0	434.0	6.0	$401	$237	$188	$826	$91,948	0.13
MANITOWOC	425.85	68.79	36.3	11	23	18	7	7,957	3,157	4,800	7.4	0	0	0	1777.0	460.0	$460	$313	$227	$999	$424,435	0.11
MARINETTE	427.96	104.32	88.6	25	35	29	6	7,213	5,805	1,408	13.6	0	0	45	3393.0	245.0	$953	$361	$418	$1,732	$737,631	0.13
OCONTO	468.36	94.86	74.5	35	38	22	5	6,295	3,044	3,251	6.5	0	0	0	1854.0	1068.0	$430	$359	$299	$1,088	$509,542	0.07
OUTAGAMIE	538.55	76.11	53.1	2	29	13	7	9,171	3,357	5,814	6.2	0	0	6	2704.0	966.0	$432	$346	$313	$1,091	$574,580	0.08
SHEBOYGAN	522.93	80.86	32.9	16	26	12	9	10,169	3,117	7,052	6.0	0	0	0	1801.0	868.0	$518	$294	$266	$1,078	$541,288	0.07
WINNEBAGO	623.16	87.41	31.2	9	27	38	10	11,042	5,499	5,543	8.8	0	0	0	2758.0	1920.0	$726	$386	$362	$1,474	$879,744	0.10
Region Total		--	--	--	--	--	--	83,743	39,051	44,692	--	0	0	417	--	--	--	--	--	--	$5,912,390	
Region Average		80.95	45.6	15.1	27.3	20.4	7.0	7,613	3,550	4,063	7.5	0	0	38	2158.6	818.5	$517	$334	$296	$1,147	$537,490	0.09

Table A.1. Storm Report Summary

From Winter Storm Reports, 2014-2015

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Region / NW / County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season			Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Thaw-Rox (tons)	Total Clear-Lane (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile				Estimated Total Cost to Date	Salt per LM per Severity Index
				Anti-Icing	Storms	Inci-dent											Mat'l	Equip	Labor	Total		
ASHLAND	249.49	185.63	146.6	2	63	29	20	3,934	2,123	1,811	8.5	0	0	357	1571.0	620.0	$643	$484	$402	$1,529	$381,218	0.05
BARRON	423.09	122.06	70.7	2	39	41	14	5,191	3,691	1,500	8.7	0	0	694	3569.0	679.0	$722	$536	$413	$1,671	$696,432	0.07
BAYFIELD	316.88	165.24	130.0	1	52	27	13	5,688	4,303	1,385	13.6	0	0	241	2616.0	889.0	$936	$659	$454	$2,049	$647,862	0.08
BUFFALO	317.02	96.41	61.2	6	35	24	6	2,655	1,688	967	5.3	0	0	121	1504.0	563.0	$382	$329	$281	$992	$314,320	0.06
BURNETT	234.95	80.14	60.6	7	29	17	8	2,557	1,126	1,431	4.8	0	0	11	814.0	341.0	$322	$274	$238	$835	$196,110	0.06
CHIPPEWA	654.65	103.11	68.7	0	37	19	10	12,729	6,569	6,160	10.0	0	0	1346	2921.0	2335.0	$812	$491	$409	$1,712	$1,120,698	0.10
CLARK	402.56	116.19	67.8	9	36	27	18	5,751	3,734	2,017	9.3	0	0	41	1588.0	1021.0	$733	$379	$307	$1,420	$571,012	0.08
DOUGLAS	440.8	123.41	77.2	12	41	27	9	8,241	4,672	3,569	10.6	0	0	2	2076.0	755.0	$643	$354	$314	$1,310	$577,502	0.09
DUNN	516.58	90.37	49.6	0	33	21	5	10,225	6,393	3,832	12.4	0	0	223	2467.0	1698.0	$943	$431	$427	$1,801	$930,490	0.14
EAU CLAIRE	539.46	88.76	47.1	6	32	36	9	9,548	7,842	1,706	14.5	0	0	339	3474.0	2287.0	$1,146	$534	$492	$2,171	$1,169,075	0.16
JACKSON	515.14	107.74	58.5	3	33	19	14	9,479	6,026	3,453	11.7	0	0	0	1913.0	1387.0	$947	$1,338	$251	$2,537	$1,306,877	0.11
PEPIN	112.38	73.67	45.4	1	25	12	11	1,056	531	525	4.7	0	0	76	582.0	260.0	$379	$361	$321	$1,061	$118,952	0.06
PIERCE	365.5	88.84	49.8	4	34	15	13	5,378	2,801	2,577	7.7	0	0	261	1688.0	841.0	$571	$351	$344	$1,266	$460,178	0.09
POLK	385.05	138.78	67.8	7	37	33	18	7,556	4,322	3,234	11.2	0	0	831	1894.0	575.0	$901	$375	$291	$1,567	$601,388	0.08
RUSK	213.47	86.14	61.8	0	25	29	9	2,788	2,038	750	9.5	0	0	62	1096.0	395.0	$733	$385	$310	$1,428	$304,828	0.11
SAINT CROIX	632.52	91.97	39.7	0	34	20	9	12,063	7,615	4,448	12.0	0	0	267	2059.0	2102.0	$777	$386	$369	$1,532	$968,968	0.13
SAWYER	367.44	116.30	86.7	0	44	21	11	4,838	3,418	1,420	9.3	0	0	62	1463.0	830.0	$732	$351	$302	$1,386	$509,310	0.08
TAYLOR	233.9	125.70	65.1	10	36	31	19	3,515	2,301	1,214	9.8	0	3	76	1339.0	480.0	$881	$450	$350	$1,681	$389,880	0.08
TREMPEALEAU	442	105.25	48.1	6	34	17	15	8,065	5,166	2,899	11.7	30	0	0	1783.0	1366.0	$847	$364	$334	$1,546	$683,386	0.11
WASHBURN	372.14	93.42	65.1	5	32	24	15	6,190	3,732	2,458	10.0	0	0	160	1732.0	618.0	$726	$364	$306	$1,396	$517,446	0.11
Region Total		--	--	--	--	--	--	127,447	80,091	47,356	--	30	3	5170	--	--	--	--	--	--	12,465,932	
Region Average		109.96	68.4	4.1	36.6	24.5	12.3	6,372	4,005	2,368	9.8	2	0	259	1907.5	1002.1	$739	$460	$346	$1,544	$623,297	0.09

Table A.1. Storm Report Summary

From Winter Storm Reports, 2014-2015

Notes: 1) Costs shown in table are estimated and do not include the 4.44% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of May '12 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region SE County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season			Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Thaw-Rox (tons)	Total Clear-Lane (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile				Estimated Total Cost to Date	Salt per LM per Severity Index
				Anti-Icing	Storms	Incident											Mat'l	Equip	Labor	Total		
KENOSHA	653.56	72.08	39.2	32	26	3	4	10,819	7,381	3,438	11.3	0	0	0	4702.0	1769.0	$714	$545	$516	$1,775	$1,159,912	0.16
MILWAUKEE	1897.05	91.29	41.0	4	27	4	9	45,321	30,793	14,528	16.2	0	0	0	9540.0	8628.0	$1,020	$486	$598	$2,104	$3,949,457	0.18
OZAUKEE	308.71	75.29	32.7	9	31	7	7	8,831	5,282	3,549	17.1	0	0	0	1039.0	668.0	$1,008	$332	$288	$1,627	$499,740	0.23
RACINE	683.28	84.91	51.8	7	30	18	7	15,201	7,565	7,636	11.1	0	0	0	2555.0	2347.0	$714	$387	$436	$1,537	$1,048,248	0.13
WALWORTH	706.03	60.34	53.6	16	24	11	7	19,572	8,887	10,685	12.6	0	0	393	4247.0	922.0	$793	$409	$337	$1,539	$1,080,420	0.21
WASHINGTON	607.89	97.40	34.6	15	38	8	12	14,222	7,880	6,342	13.0	0	0	0	1690.0	2258.0	$934	$352	$318	$1,604	$937,270	0.13
WAUKESHA	1121.6	64.61	49.4	25	26	2	5	25,028	7,582	17,446	6.8	0	0	0	4583.0	2727.0	$506	$370	$336	$1,213	$1,350,607	0.10
Region Total		--	--	--	--	--	--	138,994	75,370	63,624	--	0	0	393	--	--	--	--	--	--	10,025,654	
Region Average		77.99	43.2	15.4	28.9	7.6	7.3	19,856	10,767	9,089	12.6	0	0	56	4050.9	2759.9	$813	$412	$404	$1,628	$1,432,236	0.16

Table A.1. Storm Report Summary

From Winter Storm Reports, 2014-2015

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Region / SW / County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season: Anti-Icing	Storms	Incident	Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Thaw-Rox (tons)	Total Clear-Lane (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile: Mat'l	Equip	Labor	Total	Estimated Total Cost to Date	Salt per LM per Severity Index
COLUMBIA	786.13	107.35	41.5	33	27	34	9	22,580	11,150	11,430	14.2	0	0	1678	2979.0	2433.0	$1,226	$418	$349	$1,992	$1,565,972	0.13
CRAWFORD	394.99	112.35	44.4	9	35	21	16	5,079	2,893	2,186	7.3	0	53	745	1218.0	812.0	$555	$282	$217	$1,054	$416,061	0.07
DANE	1512.86	102.98	44.5	26	39	1	14	45,028	20,887	24,141	13.8	0	0	72	4743.0	9476.0	$1,048	$500	$640	$2,188	$3,285,924	0.13
DODGE	651.82	83.75	35.5	12	32	6	13	17,514	8,025	9,489	12.3	203	0	4	1721.0	1899.0	$926	$333	$282	$1,541	$1,002,705	0.15
GRANT	622.06	74.62	44.7	2	23	19	6	9,533	5,513	4,020	8.9	0	0	1394	1669.0	1701.0	$609	$304	$231	$1,143	$708,615	0.12
GREEN	315.55	64.26	42.5	27	20	24	10	2,751	979	1,772	3.1	0	45	415	1154.0	713.0	$279	$323	$235	$837	$264,041	0.05
IOWA	476.31	92.71	49.0	29	25	28	8	6,565	3,388	3,177	7.1	0	0	40	1710.0	1415.0	$507	$347	$303	$1,157	$551,135	0.08
JEFFERSON	559.08	62.26	49.9	0	25	12	8	9,937	3,055	6,882	5.5	78	0	12	1355.0	1747.0	$456	$333	$293	$1,082	$587,561	0.09
JUNEAU	494.25	106.22	50.6	15	40	13	15	9,640	5,020	4,620	10.2	0	0	50	1475.0	1569.0	$780	$322	$289	$1,391	$685,278	0.10
LA CROSSE	496.2	82.80	48.0	16	25	15	9	8,461	4,371	4,090	8.8	0	0	505	2044.0	1212.0	$657	$356	$315	$1,328	$654,168	0.11
LAFAYETTE	298.98	83.56	53.8	19	27	9	13	3,076	1,618	1,458	5.4	0	0	1779	850.0	984.0	$451	$320	$259	$1,030	$307,966	0.06
MONROE	654.83	111.59	48.8	12	41	10	18	10,291	7,300	2,991	11.1	71	0	65	2631.0	2021.0	$875	$390	$304	$1,569	$1,026,734	0.10
RICHLAND	327.64	79.46	33.6	14	28	13	11	3,359	2,157	1,202	6.6	0	0	226	1171.0	646.0	$527	$295	$244	$1,066	$349,188	0.08
ROCK	687.78	68.45	44.8	5	19	22	6	9,386	2,643	6,743	3.8	4	0	453	1910.0	2372.0	$289	$337	$345	$971	$661,150	0.06
SAUK	577.36	101.61	44.9	30	30	25	13	13,054	4,665	8,389	8.1	0	0	190	1920.0	1741.0	$655	$359	$283	$1,297	$747,439	0.08
VERNON	468.36	122.57	48.1	11	35	29	17	6,696	4,166	2,530	8.9	0	86	1059	1498.0	1488.0	$648	$349	$306	$1,303	$608,941	0.07
Region Total		--	--	--	--	--	--	182,950	87,830	95,120	--	356	184	8687	--	--	--	--	--	--	13,422,878	
Region Average		91.03	45.3	16.3	29.4	17.6	11.6	11,434	5,489	5,945	8.4	22	12	543	1878.0	2014.3	$656	$348	$306	$1,309	$838,930	0.09

Table A.1. Storm Report Summary

From Winter Storm Reports, 2014-2015

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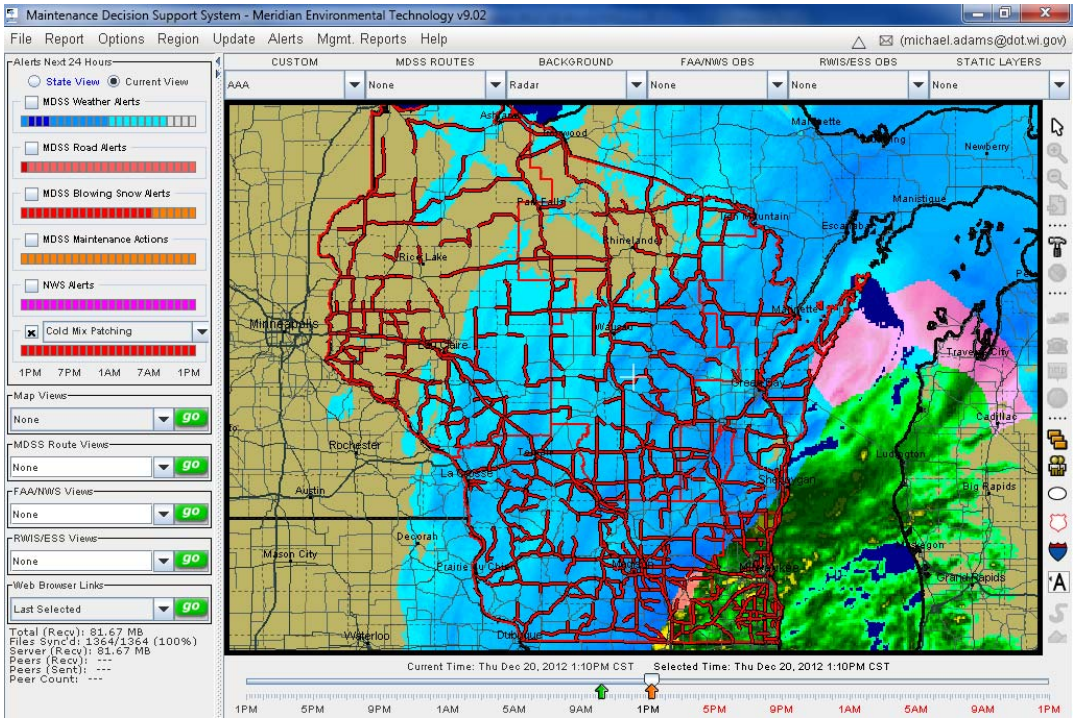
Statewide Total	--	--	--	--	--	--	641,321	355,763	285,558	--	386	339	22301.0	--	--	--	--	--	--	$52,493,280	--
Statewide Average	99.28	60.3	####	32.9	20.7	11.0	8,907	4,941	3,966	9.9	5.4	4.7	309.7	2228.5	1273.5	$734	$403	$334	$1,471	$729,073	0.10



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WEATHER FORECAST SERVICES EVALUATION 2015

Michael J. Adams

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Introduction

In 2014-15, the Wisconsin Department of Transportation (WisDOT) continued using weather and pavement forecast information provided by Iteris. The information is received through the Maintenance Decision Support System (MDSS) and through alerts received via text or voice messages.

In order to assess the quality of these weather and pavement temperature forecasts provided to WisDOT and the county highway departments who provide winter maintenance on the state trunk highway system, the WisDOT Road Weather Information System (RWIS) Program Manager performed a verification study on these forecasts. The primary aim of this study is to uncover any potential problems in forecast accuracy, with the ultimate goal being to use the findings to improve the quality of weather and pavement temperature forecast information provided by Iteris or any other provider of forecast information.

All information presented in this report is for forecasts provided by Iteris since 2005-06, first via a web site and, after 2009-10, MDSS.

Verification Procedures

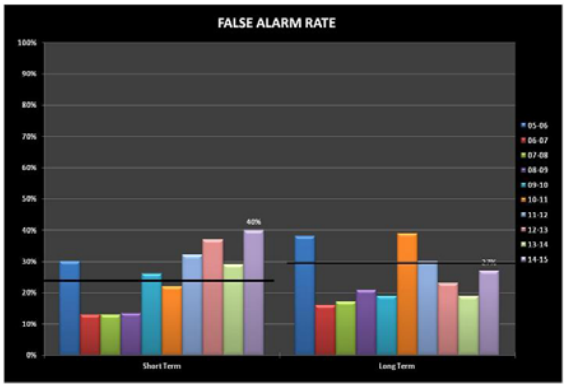
Forecasts for eight locations were examined: Madison, Milwaukee, Green Bay, Wausau, La Crosse, Eau Claire, and Rhinelander, and Rice Lake. The time period covered by the verification study was December 1, 2014 through March 31, 2015. This is the standard verification time span, though this year it does omit several snow events that occurred in November. Four specific criteria were examined: snow, freezing precipitation, wind speed, and pavement temperature.

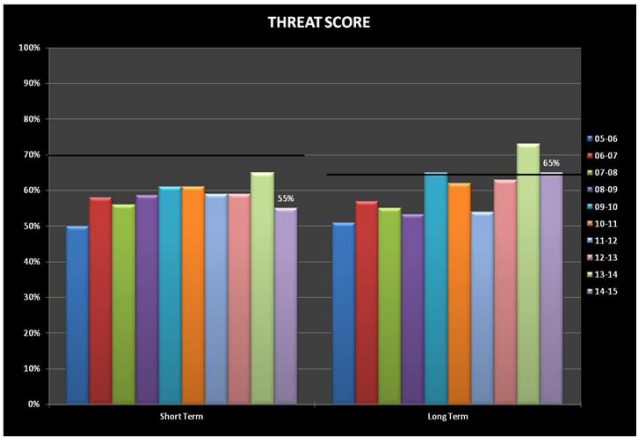
For the first two criteria, the verification methodology is based on a paper presented by John Thornes at the 1998 Standing International Road Weather Commission (SIRWEC) conference. It is based on common meteorological forecast verification techniques. The basis of the method is to choose two time periods (in our case 0 to 6 hours and 6 to 24 hours after forecast issuance) during the forecasts and see if the particular criterion was forecast to occur and whether it actually occurred during the periods being examined. In other words, was snow forecast to occur and did it occur? Two-by-two contingency tables are then constructed. A number of statistics were calculated, each of which provides a different piece of intelligence. Goal scores for each statistic have also been established. For pavement temperature and wind speed, the forecast values 3 and 9 hours after forecast issuance times were compared to the actual values and error statistics were computed. In addition, the timing error for the start and stop of precipitation and the lead time provided by the winter storm alert service were also examined.

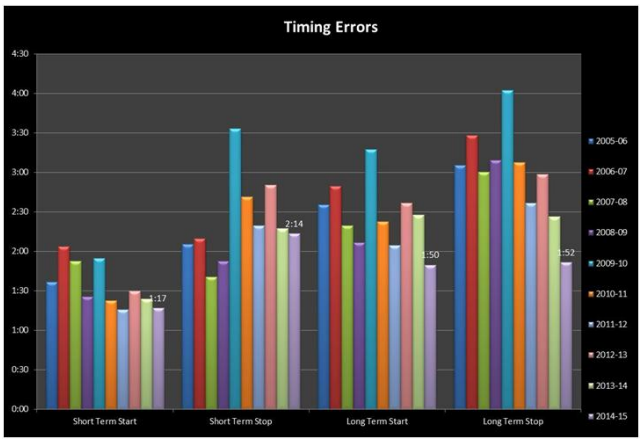
Results of this and previous studies are made available to Iteris or whoever the current forecast provider is. It is expected that Iteris will use the results of these studies to continue to improve upon their weather support to WisDOT and the county highway departments.

Verification Results

- **Precipitation forecasts.** Accuracy dropped in the both the short and long term forecasts. The major reason for this was a sharp increase in the False Alarm Rate (cases where something was forecast but nothing happened.

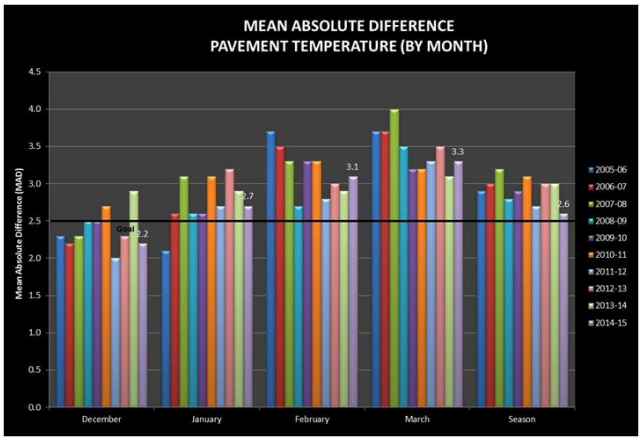


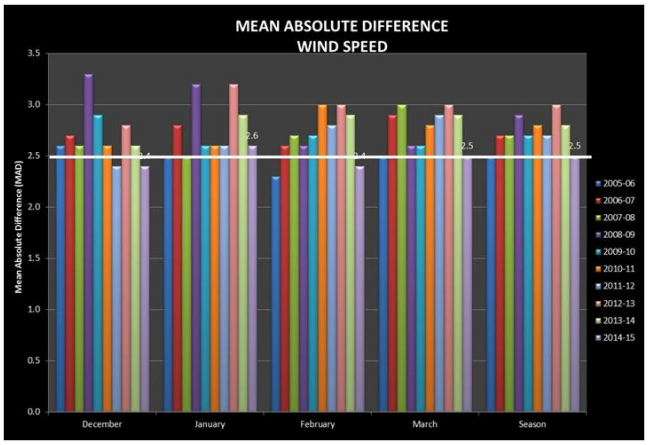




- **Timing error.** On the other hand, timing errors for both the start and end times of snow continue to be superb. The average timing error for the start of storms in the short term was 1 hour, 17 minutes, 7 minutes better than last year.

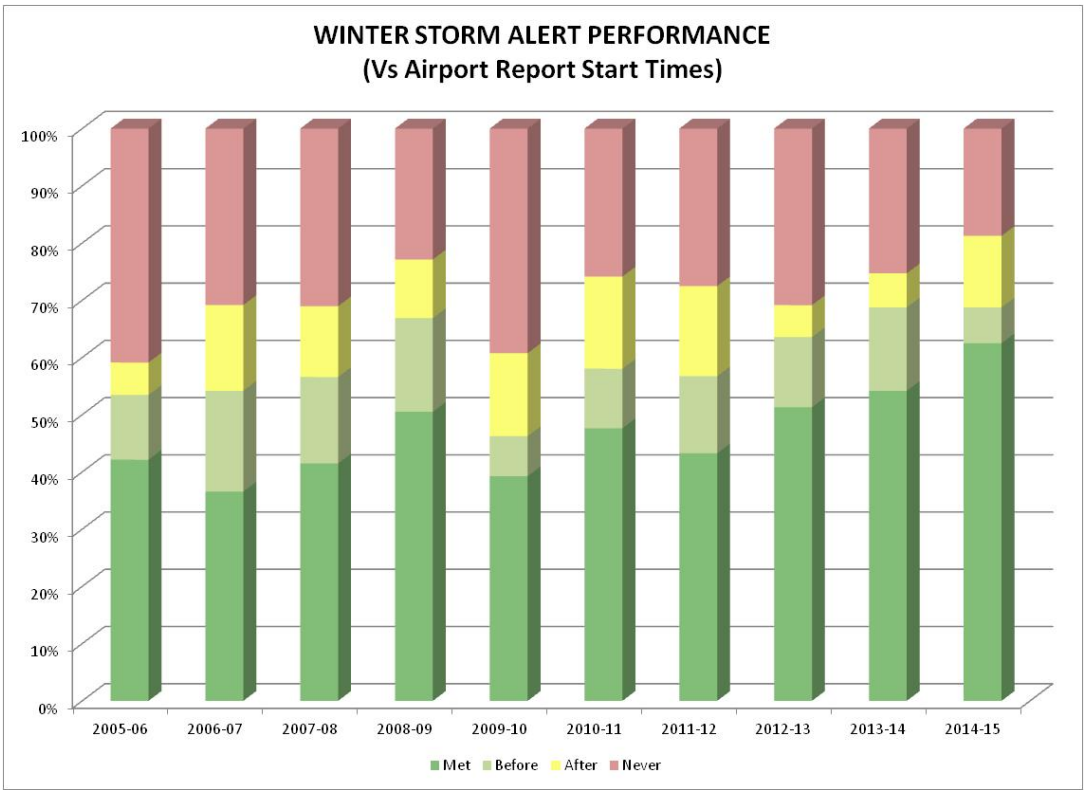
- **Pavement temperature.** Performance continued to be excellent, and even improved upon the performance of the previous two winters.





- **Winds.** Wind forecast accuracy was excellent and improved slightly compared to last year. The error goal was recently lowered and Iteris met the new goal.

- **Winter storm alerts.** Performance was slightly better than the previous winter, but again failed to meet expectations. For the winter, 63 percent of events were preceded by an alert issued more than two hours in advance, as required by WisDOT's contract with Iteris. This is the best recorded since Iteris began providing forecasts to Wisconsin. About 19 percent of events were preceded by no warning at all, though at least some of these were likely inconsequential.



Legend:
Met: warning issued more than 2 hours before event onset
Before: warning issued before event onset
After: warning issued after event onset
Never: no warning ever issued for event

- **Recommendations**

Iteris must investigate the cause of the large dip in false alarm performance for short-term snow forecasts.

Iteris will explore the causes of the over forecasting of winds near the 15 mph threshold that has been an issue the past five winters.

Iteris should research this issue of a cold bias in pavement temperature forecasts.

Iteris should investigate the cause of a continuing poor wind forecast performance in Madison.

Iteris must investigate the causes of a tendency to over forecast wind speeds.

Weather Management Solutions must investigate alternative means of alert verification.

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2014-2015

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
SW	JEFFERSON	3	13	8	24	1	96%	3,055	49.9	62.3	0.09	25	12	1	0
	VERNON	11	20	4	35	11	76%	4,166	48.1	122.6	0.07	35	29	14	11
	CRAWFORD	4	20	19	43	1	98%	2,893	44.4	112.4	0.07	35	21	14	9
	DANE	22	35	6	63	2	97%	20,887	44.5	103.0	0.13	39	1	12	26
	DODGE	0	0	0	0	44	0%	8,025	35.5	83.8	0.15	32	6	11	12
	GRANT	20	5	0	25	0	100%	5,513	44.7	74.6	0.12	23	19	5	2
	IOWA	6	14	4	24	30	44%	3,388	49.0	92.7	0.08	25	28	7	29
	COLUMBIA	1	21	5	27	33	45%	11,150	41.5	107.4	0.13	27	34	5	33
	JUNEAU	3	19	18	40	15	73%	5,020	50.6	106.2	0.10	40	13	12	15
	LA CROSSE	3	10	20	33	8	80%	4,371	48.0	82.8	0.11	25	15	7	16
	LAFAYETTE	25	2	0	27	19	59%	1,618	53.8	83.6	0.06	27	9	10	19
	MONROE	0	21	32	53	0	100%	7,300	48.8	111.6	0.10	41	10	11	12
	RICHLAND	0	33	8	41	1	98%	2,157	33.6	79.5	0.08	28	13	8	14
	ROCK	0	8	4	12	12	50%	2,643	44.8	68.4	0.06	19	22	2	5
	SAUK	1	25	4	30	30	50%	4,665	44.9	101.6	0.08	30	25	8	30
	GREEN	17	5	3	25	22	53%	979	42.5	64.3	0.05	20	24	7	27
Region Average		7.3	15.7	8.4	31.4	14.3	69.9%	5,489.4	45.3	91.0	0.09	29.4	17.6	8.4	16.3

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2014-2015

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
SE	OZAUKEE	5	26	5	36	4	90%	5,282	32.7	75.3	0.23	31	7	7	9
	KENOSHA	1	1	0	2	56	3%	7,381	39.2	72.1	0.16	26	3	4	32
	MILWAUKEE	24	3	1	28	3	90%	30,793	41.0	91.3	0.18	27	4	9	4
	RACINE	0	30	0	30	7	81%	7,565	51.8	84.9	0.13	30	18	4	7
	WALWORTH	9	20	3	32	8	80%	8,887	53.6	60.3	0.21	24	11	3	16
	WAUKESHA	26	6	2	34	17	67%	7,582	49.4	64.6	0.10	26	2	4	25
	WASHINGTON	0	45	6	51	2	96%	7,880	34.6	97.4	0.13	38	8	11	15
Region Average		9.3	18.7	2.4	30.4	13.9	72.5%	10,767.1	43.2	78.0	0.16	28.9	7.6	6.0	15.4

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2014-2015

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
NW	EAU CLAIRE	3	31	0	34	4	89%	7,842	47.1	88.8	0.16	32	36	6	6
	ASHLAND	0	62	2	64	1	98%	2,123	146.6	185.6	0.05	63	29	7	2
	BARRON	3	32	2	37	4	90%	3,691	70.7	122.1	0.07	39	41	4	2
	BAYFIELD	0	0	0	0	53	0%	4,303	130.0	165.2	0.08	52	27	0	1
	BUFFALO	18	8	2	28	13	68%	1,688	61.2	96.4	0.06	35	24	4	6
	BURNETT	16	20	0	36	0	100%	1,126	60.6	80.1	0.06	29	17	3	7
	CLARK	0	1	9	10	35	22%	3,734	67.8	116.2	0.08	36	27	7	9
	DOUGLAS	18	12	7	37	16	70%	4,672	77.2	123.4	0.09	41	27	9	12
	DUNN	4	20	1	25	8	76%	6,393	49.6	90.4	0.14	33	21	2	0
	SAWYER	0	0	0	0	44	0%	3,418	86.7	116.3	0.08	44	21	5	0
	JACKSON	0	0	0	0	36	0%	6,026	58.5	107.7	0.11	33	19	11	3
	WASHBURN	4	16	5	25	12	68%	3,732	65.1	93.4	0.11	32	24	2	5
	TAYLOR	40	4	0	44	2	96%	2,301	65.1	125.7	0.08	36	31	9	10
	SAINT CROIX	13	16	5	34	0	100%	7,615	39.7	92.0	0.13	34	20	4	0
	CHIPPEWA	3	14	0	17	20	46%	6,569	68.7	103.1	0.10	37	19	4	0
	RUSK	0	0	0	0	25	0%	2,038	61.8	86.1	0.11	25	29	3	0
	POLK	7	21	0	28	16	64%	4,322	67.8	138.8	0.08	37	33	12	7
	PIERCE	25	9	0	34	4	89%	2,801	49.8	88.8	0.09	34	15	7	4
	PEPIN	18	7	1	26	0	100%	531	45.4	73.7	0.06	25	12	5	1
	TREMPEALEA	0	35	5	40	0	100%	5,166	48.1	105.3	0.11	34	17	11	6
Region Average		8.6	15.4	2.0	26.0	14.7	63.8%	4,004.6	68.4	110.0	0.09	36.6	24.5	5.8	4.1

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2014-2015

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
NE	DOOR	18	18	0	36	4	90%	2,045	35.4	103.1	0.07	32	29	6	8
	MANITOWOC	16	10	6	32	2	94%	3,157	36.3	68.8	0.11	23	18	4	11
	CALUMET	18	6	0	24	1	96%	843	40.5	69.4	0.06	23	18	5	2
	FOND DU LAC	2	16	0	18	11	62%	3,266	32.2	64.8	0.08	18	20	3	11
	KEWAUNEE	1	20	0	21	7	75%	792	44.0	53.7	0.13	19	11	1	9
	OCONTO	40	0	0	40	33	55%	3,044	74.5	94.9	0.07	38	22	2	35
	OUTAGAMIE	6	23	1	30	1	97%	3,357	53.1	76.1	0.08	29	13	2	2
	SHEBOYGAN	11	19	8	38	4	90%	3,117	32.9	80.9	0.07	26	12	9	16
	WINNEBAGO	13	10	7	30	6	83%	5,499	31.2	87.4	0.10	27	38	6	9
	MARINETTE	14	4	0	18	42	30%	5,805	88.6	104.3	0.13	35	29	1	25
	BROWN	5	8	4	17	51	25%	8,126	32.4	87.1	0.12	30	14	7	38
Region Average		13.1	12.2	2.4	27.6	14.7	72.5%	3,550.1	45.6	80.9	0.09	27.3	20.4	4.2	15.1

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2014-2015

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
NC	PRICE	0	54	0	54	2	96%	4,028	95.1	168.1	0.07	53	26	16	3
	FLORENCE	1	26	27	54	0	100%	2,614	121.4	121.2	0.15	41	37	5	13
	FOREST	10	26	9	45	5	90%	4,946	133.4	148.8	0.11	50	18	7	0
	GREEN LAKE	3	14	1	18	8	69%	707	34.2	71.9	0.06	23	21	3	3
	IRON	16	29	7	52	0	100%	3,656	234.9	184.9	0.08	52	35	1	0
	LANGLADE	2	30	10	42	0	100%	3,831	81.1	117.0	0.11	40	29	6	2
	LINCOLN	5	24	7	36	15	71%	4,719	77.4	141.9	0.08	43	29	13	8
	MARATHON	22	7	3	32	36	47%	10,965	62.8	140.7	0.09	43	51	5	25
	MARQUETTE	4	25	5	34	5	87%	2,197	27.8	68.1	0.13	26	12	9	13
	MENOMINEE	9	6	0	15	16	48%	1,248	52.8	76.6	0.18	28	21	4	3
	PORTAGE	0	0	4	4	37	10%	5,454	42.5	118.5	0.08	39	25	11	2
	SHAWANO	10	9	0	19	23	45%	5,455	65.3	92.8	0.11	28	38	4	14
	VILAS	17	29	1	47	0	100%	7,045	143.0	123.4	0.19	47	21	1	0
	WAUPACA	14	8	3	25	5	83%	2,108	40.0	76.9	0.05	24	26	3	6
	WAUSHARA	0	0	0	0	33	0%	2,771	37.8	65.6	0.12	22	13	5	11
	WOOD	0	46	6	52	0	100%	3,934	60.5	111.5	0.08	38	19	7	14
	ADAMS	3	23	9	35	2	95%	1,674	30.1	94.2	0.09	27	11	14	10
	ONEIDA	1	42	8	51	0	100%	6,069	109.4	134.0	0.11	44	10	7	7
Region Average		6.5	22.1	5.6	34.2	10.4	74.5%	4,078.9	80.5	114.2	0.11	37.1	24.6	6.7	7.4

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2014-2015

Region County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
Statewide Average	8.5	17.0	4.4	29.9	13.4	70.0%	4,941.2	60.3	99.3	0.10	32.9	20.7	6.4	10.4

Table A.3. Anti-icing Details

From Winter Storm Reports, 2014-2015

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
NC	ADAMS	10	6	1	7	2	1	0	7,440	2,520	2,215	12,175
	FLORENCE	13	9	2	3	4	1	0	6,780	4,200	3,416	14,396
	GREEN LAKE	3	0	1	1	1	1	1	833	1,260	1,044	3,137
	LANGLADE	2	1	1	0	0	0	0	260	780	561	1,601
	LINCOLN	8	1	4	3	0	2	0	7,360	3,180	2,622	13,162
	MARATHON	25	0	0	0	0	0	25	12,854	18,600	13,738	45,192
	MARQUETTE	13	1	4	3	2	2	5	9,873	8,280	6,430	24,583
	MENOMINEE	3	2	0	1	0	0	0	340	540	288	1,168
	ONEIDA	7	1	0	4	1	2	0	1,795	3,600	2,401	7,796
	PORTAGE	2	0	0	0	0	2	0	346	1,140	789	2,275
	PRICE	3	3	0	3	0	0	0	434	1,140	1,019	2,593
	SHAWANO	14	1	0	1	0	0	13	11,950	4,140	2,862	18,952
	WAUPACA	6	0	0	1	0	1	4	860	2,940	2,511	6,311
	WAUSHARA	11	0	1	1	1	0	9	1,000	4,020	2,788	7,808
	WOOD	14	9	5	2	0	9	0	5,790	4,560	3,328	13,677
Region Total		134	34	19	30	11	21	57	67,915	60,900	46,011	174,825
Region Average		9	--	--	--	--	--	--	4,528	4,060	3,067	11,655

Table A.3. Anti-icing Details

From Winter Storm Reports, 2014-2015

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
NE	BROWN	38	0	0	0	0	2	36	1,135	26,820	18,809	46,764
	CALUMET	2	0	0	1	0	1	1	532	600	343	1,475
	DOOR	8	2	4	2	1	0	4	3,451	3,180	2,532	9,163
	FOND DU LAC	11	0	0	0	0	0	11	4,434	15,660	10,626	30,721
	KEWAUNEE	9	0	0	1	0	1	7	130	2,520	2,032	4,682
	MANITOWOC	11	4	2	2	0	7	0	540	2,820	1,840	5,200
	MARINETTE	25	0	0	0	0	0	25	6,700	6,240	5,021	17,961
	OCONTO	35	1	0	1	1	0	33	370	30,720	21,654	52,743
	OUTAGAMIE	2	1	0	0	0	1	1	1,440	1,260	933	3,633
	SHEBOYGAN	16	4	4	4	2	6	2	6,679	11,940	10,208	28,826
	WINNEBAGO	9	0	1	2	0	2	6	17,780	4,680	7,532	29,992
Region Total		166	12	11	13	4	20	126	43,191	106,440	81,530	231,161
Region Average		15	--	--	--	--	--	--	3,926	9,676	7,412	21,015

Table A.3. Anti-icing Details

From Winter Storm Reports, 2014-2015

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
NW	ASHLAND	2	1	0	0	0	1	1	29	900	722	1,651
	BARRON	2	0	0	0	0	0	2	425	1,200	343	1,968
	BAYFIELD	1	0	0	0	0	0	1	52	480	291	823
	BUFFALO	6	0	0	0	0	0	6	72	2,340	1,781	4,193
	BURNETT	7	0	0	0	0	7	0	0	1,620	1,267	2,887
	CLARK	9	0	0	1	1	0	8	676	4,020	2,817	7,514
	DOUGLAS	12	1	0	3	0	8	0	3,388	3,780	3,320	10,488
	EAU CLAIRE	6	1	1	0	1	0	4	1,984	10,440	2,036	14,461
	JACKSON	3	0	1	3	0	0	0	120	1,560	486	2,166
	PEPIN	1	0	1	1	1	0	0	153	660	741	1,554
	PIERCE	4	0	4	1	1	0	0	780	1,320	1,193	3,293
	POLK	7	1	0	1	0	0	6	152	1,680	1,425	3,256
	TAYLOR	10	5	0	3	2	1	2	439	4,260	2,866	7,565
	TREMPEALEAU	6	1	0	4	3	4	0	374	3,780	2,815	6,969
	WASHBURN	1	0	0	0	0	1	0	348	300	214	862
	WASHBURN	1	0	0	1	0	0	0	1,150	300	214	1,664
	WASHBURN	1	0	0	0	0	1	0	138	300	321	759

Table A.3. Anti-icing Details

From Winter Storm Reports, 2014-2015

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
NW	WASHBURN	1	0	0	0	0	1	0	92	300	321	713
	WASHBURN	1	0	0	1	0	0	0	1,380	540	407	2,327
Region Total		81	10	7	19	9	24	30	11,751	39,780	23,581	75,112
Region Average		4	--	--	--	--	--	--	618	2,094	1,241	3,953

Table A.3. Anti-icing Details

From Winter Storm Reports, 2014-2015

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
SE	KENOSHA	32	0	0	0	0	0	32	3,767	23,520	43,108	70,396
	MILWAUKEE	4	0	0	1	0	0	3	3,610	6,000	5,445	15,055
	OZAUKEE	9	4	1	1	0	2	1	1,249	7,440	5,482	14,171
	RACINE	7	0	0	0	0	0	7	708	5,520	4,515	10,743
	WALWORTH	16	2	5	1	1	1	8	12,285	10,560	7,933	30,778
	WASHINGTON	15	2	0	0	0	13	0	1,560	4,260	2,778	8,598
	WAUKESHA	25	4	1	2	0	2	16	30,626	16,440	12,462	59,527
Region Total		108	12	7	5	1	18	67	53,805	73,740	81,725	209,270
Region Average		15	--	--	--	--	--	--	7,686	10,534	11,675	29,896

Table A.3. Anti-icing Details

From Winter Storm Reports, 2014-2015

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
SW	COLUMBIA	33	0	0	0	0	0	33	813	12,180	8,146	21,139
	CRAWFORD	9	2	2	3	1	1	1	215	2,820	2,078	5,113
	DANE	26	0	0	0	0	24	2	16,263	19,500	18,900	54,662
	DODGE	1	0	0	0	0	0	1	24	300	301	625
	DODGE	2	0	0	0	0	0	2	156	960	643	1,760
	DODGE	8	0	0	0	0	0	8	644	1,920	1,286	3,850
	DODGE	1	0	0	0	0	0	1	148	480	322	949
	GRANT	2	0	0	1	1	1	0	278	960	544	1,782
	GREEN	27	2	2	2	1	1	21	94	5,580	3,107	8,781
	IOWA	29	0	0	0	0	0	29	2,895	8,580	8,055	19,529
	JUNEAU	15	0	0	0	0	0	15	5,102	6,420	5,440	16,962
	LA CROSSE	16	5	6	7	5	10	1	20,052	10,080	6,985	37,117
	LAFAYETTE	19	0	0	0	0	0	19	0	5,160	3,168	8,328
	MONROE	12	0	0	2	0	12	0	14,125	12,900	9,101	36,126
	RICHLAND	14	4	4	1	0	7	1	158	16,740	11,993	28,891
	ROCK	5	0	0	0	0	0	5	3,044	6,120	5,514	14,678
	SAUK	30	0	0	0	0	0	30	3,717	12,240	7,380	23,337

Table A.3. Anti-icing Details

From Winter Storm Reports, 2014-2015

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
SW	VERNON	11	0	0	0	0	0	11	3,715	5,820	3,963	13,498
Region Total		260	13	14	16	8	56	180	71,441	128,760	96,926	297,127
Region Average		14	--	--	--	--	--	--	3,969	7,153	5,385	16,507

Table A.3. Anti-icing Details

From Winter Storm Reports, 2014-2015

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
Statewide Total		749	81	58	83	33	139	460	248,103	409,620	329,772	987,495

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2014-2015

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	BioMelt 64 (gal)	Geo-Melt (gal)	Ice Bite 55 (gal)
NC	ADAMS	0	18,600	0	0	0	0	0	0	0	0	0	0	0
	FLORENCE	0	45,200	0	0	0	0	0	0	0	0	0	0	0
	FOREST	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	0	8,330	0	0	0	0	0	0	0	0	0	0	0
	IRON	0	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	0	2,600	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	0	36,800	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	0	42,845	0	0	0	0	0	0	0	0	0	0	0
	MARQUETTE	0	65,820	0	0	0	0	0	0	0	0	0	0	0
	MENOMINEE	0	1,700	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	0	17,950	0	0	0	0	0	0	0	0	0	0	0
	PORTAGE	0	1,730	0	0	0	0	0	0	0	0	0	0	0
	PRICE	0	2,170	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	0	59,750	0	0	0	0	0	0	0	0	0	0	0
	VILAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	WAUPACA	0	8,604	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	0	10,000	0	0	0	0	0	0	0	0	0	0	0
	WOOD	0	27,570	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	349,669	0	0	0	0	0	0	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2014-2015

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	BioMelt 64 (gal)	Geo-Melt (gal)	Ice Bite 55 (gal)
NE	BROWN	0	113,490	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	0	1,900	0	0	0	0	0	0	0	0	0	0	0
	DOOR	0	20,300	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	0	22,172	0	0	0	0	0	0	0	0	0	0	0
	KEWAUNEE	0	13,000	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	0	2,700	0	0	0	0	0	0	0	0	0	8,800	0
	MARINETTE	0	67,000	0	0	2,200	0	0	0	0	0	0	0	0
	OCONTO	0	36,950	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	0	8,000	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	0	26,715	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	0	88,900	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	401,127	0	0	2,200	0	0	0	0	0	0	8,800	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2014-2015

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	BioMelt 64 (gal)	Geo-Melt (gal)	Ice Bite 55 (gal)
NW	ASHLAND	0	2,868	0	0	0	0	0	0	0	0	0	0	0
	BARRON	0	850	0	0	0	0	0	0	0	0	0	0	0
	BAYFIELD	0	400	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	0	7,200	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	0	0	0	0	1,265	0	0	0	0	0	0	0	0
	CHIPPEWA	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	0	2,705	0	0	0	0	0	0	0	0	0	0	0
	DOUGLAS	0	0	0	0	3,850	0	0	0	0	0	0	0	0
	DUNN	0	0	0	0	0	0	0	0	0	0	0	0	0
	EAU CLAIRE	410	3,280	0	0	0	0	0	0	0	0	0	410	0
	JACKSON	0	2,400	0	0	0	0	0	0	0	0	0	0	0
	PEPIN	0	1,175	0	0	0	0	0	0	0	0	0	0	0
	PIERCE	0	3,900	0	0	0	0	0	0	0	0	0	0	0
	POLK	0	758	0	0	0	0	0	0	0	0	0	0	0
	RUSK	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAINT CROIX	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	0	0	0	0	0	0	0	0	0	0	0	0	0
	TAYLOR	0	4,875	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	0	16,000	200	0	0	0	0	0	0	0	0	0	0
	WASHBURN	0	4,800	0	0	0	0	0	0	0	0	0	0	1,400
Region Total		410	51,211	200	0	5,115	0	0	0	0	0	0	410	1,400

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2014-2015

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	BioMelt 64 (gal)	Geo-Melt (gal)	Ice Bite 55 (gal)
SE	KENOSHA	0	0	4,140	0	0	0	0	0	0	0	0	0	0
	MILWAUKEE	0	18,050	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	700	5,900	0	0	0	0	0	0	0	0	0	0	0
	RACINE	0	7,080	0	0	0	0	0	0	0	0	0	0	0
	WALWORTH	0	58,500	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	0	10,400	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	3,095	91,240	0	0	0	0	0	0	0	0	0	10,565	0
Region Total		3,795	191,170	4,140	0	0	0	0	0	0	0	0	10,565	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2014-2015

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	BioMelt 64 (gal)	Geo-Melt (gal)	Ice Bite 55 (gal)
SW	COLUMBIA	0	81,300	0	0	2,000	0	0	0	0	0	0	0	0
	CRAWFORD	0	21,500	0	0	0	0	0	0	0	0	0	0	0
	DANE	0	65,050	0	0	0	0	0	0	0	0	0	0	0
	DODGE	0	1,262	0	0	0	0	0	0	0	0	293	0	0
	GRANT	0	1,850	0	0	0	0	0	0	0	0	0	0	0
	GREEN	0	9,404	0	0	0	0	0	0	0	0	0	436	0
	IOWA	0	5,590	0	0	0	0	0	0	0	0	0	935	0
	JEFFERSON	0	0	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	0	30,635	0	0	0	0	0	0	0	0	0	1,315	0
	LA CROSSE	0	100,260	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	0	3,225	0	0	0	0	0	0	0	0	0	0	0
	MONROE	0	86,650	0	0	0	0	0	0	0	0	0	6,120	0
	RICHLAND	0	15,840	0	0	0	0	0	0	0	0	0	0	0
	ROCK	0	12,175	0	0	0	0	0	0	0	0	0	0	0
	SAUK	0	18,585	0	0	0	0	0	0	0	0	0	0	0
	VERNON	0	37,150	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	490,476	0	0	2,000	0	0	0	0	0	293	8,806	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2014-2015

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	BioMelt 64 (gal)	Geo-Melt (gal)	Ice Bite 55 (gal)
Grand Total		4,205	1,483,653	4,340	0	9,315	0	0	0	0	0	293	28,581	1,400

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Table A-5. Actual Anti-icing Costs

Final billed costs from the WisDOT accounting system, October 2014 - April 2015
County charges to Activity Code #73 (Applying Liquid Anti-icing Agents)

REGION	COUNTY	Cost to Apply Liquid Anti-icing Chemicals	Total Billed Winter Maintenance Costs	Anti-icing as a % of Winter Costs
SOUTHWEST	COLUMBIA	$28,700	$1,911,344	1.50%
	CRAWFORD	$7,645	$559,563	1.37%
	DANE	$61,621	$4,737,959	1.30%
	DODGE	$6,134	$1,290,145	0.48%
	GRANT	$1,170	$832,377	0.14%
	GREEN	$11,739	$426,703	2.75%
	IOWA	$14,488	$826,611	1.75%
	JEFFERSON	$10,962	$1,099,623	1.00%
	JUNEAU	$16,376	$913,451	1.79%
	LACROSSE	$75,690	$1,029,710	7.35%
	LAFAYETTE	$11,540	$578,181	2.00%
	MONROE	$30,846	$1,295,506	2.38%
	RICHLAND	$28,486	$484,527	5.88%
	ROCK	$10,994	$1,367,958	0.80%
	SAUK	$20,374	$1,113,053	1.83%
	VERNON	$11,784	$837,637	1.41%
	TOTAL	**$348,549**	**$19,304,350**	1.81%
SOUTHEAST	KENOSHA	$40,777	$1,593,730	2.56%
	MILWAUKEE	$26,867	$6,758,516	0.40%
	OZAUKEE	$13,178	$840,163	1.57%
	RACINE	$10,429	$1,420,631	0.73%
	WALWORTH	$16,870	$1,508,089	1.12%
	WASHINGTON	$10,111	$1,324,642	0.76%
	WAUKESHA	$50,472	$2,477,024	2.04%
	TOTAL	**$168,704**	**$15,922,795**	1.06%
NORTHEAST	BROWN	$83,641	$1,533,435	5.45%
	CALUMET	$455	$274,102	0.17%
	DOOR	$5,065	$517,362	0.98%
	FOND DU LAC	$23,754	$841,671	2.82%
	KEWAUNEE	$8,453	$172,289	4.91%
	MANITOWOC	$5,502	$800,871	0.69%
	MARINETTE	$14,566	$869,553	1.68%
	OCONTO	$42,510	$749,074	5.68%
	OUTAGAMIE		$1,000,748	0.00%
	SHEBOYGAN	$14,487	$851,874	1.70%
	WINNEBAGO	$24,434	$1,306,754	1.87%
	TOTAL	**$222,867**	**$8,917,733**	2.50%

Table A-5. Actual Anti-icing Costs

Final billed costs from the WisDOT accounting system, October 2014 - April 2015
County charges to Activity Code #73 (Applying Liquid Anti-icing Agents)

REGION	COUNTY	Cost to Apply Liquid Anti-icing Chemicals	Total Billed Winter Maintenance Costs	Anti-icing as a % of Winter Costs
NORTH CENTRAL	ADAMS	$5,008	$364,123	1.38%
	FLORENCE	$8,575	$423,873	2.02%
	FOREST		$863,545	0.00%
	GREEN LAKE	$1,504	$201,689	0.75%
	IRON		$866,588	0.00%
	LANGLADE	$1,916	$652,772	0.29%
	LINCOLN	$15,493	$1,014,857	1.53%
	MARATHON	$25,285	$1,945,031	1.30%
	MARQUETTE	$15,166	$365,372	4.15%
	MENOMINEE	$486	$156,236	0.31%
	ONEIDA	$17,930	$1,133,279	1.58%
	PORTAGE	$1,447	$1,257,738	0.12%
	PRICE	$2,838	$758,148	0.37%
	SHAWANO	$10,664	$965,798	1.10%
	VILAS	$1,212	$1,154,600	0.10%
	WAUPACA	$13,127	$880,624	1.49%
	WAUSHARA	$9,250	$495,329	1.87%
	WOOD	$11,617	$770,642	1.51%
	TOTAL	**$141,518**	**$14,270,245**	0.99%
NORTHWEST	ASHLAND	$2,546	$562,556	0.45%
	BARRON	$1,421	$965,774	0.15%
	BAYFIELD	$467	$829,724	0.06%
	BUFFALO	$15,643	$459,953	3.40%
	BURNETT	$4,212	$321,753	1.31%
	CHIPPEWA		$1,317,273	0.00%
	CLARK	$3,748	$802,859	0.47%
	DOUGLAS	$20,661	$799,659	2.58%
	DUNN	$3,902	$1,176,217	0.33%
	EAU CLAIRE	$36,975	$1,400,409	2.64%
	JACKSON	$5,189	$1,046,736	0.50%
	PEPIN	$1,050	$182,428	0.58%
	PIERCE	$3,555	$694,310	0.51%
	POLK	$2,769	$795,543	0.35%
	RUSK		$367,608	0.00%
	SAWYER	$2,340	$628,346	0.37%
	ST. CROIX	$12,750	$1,313,400	0.97%
	TAYLOR	$86	$548,864	0.02%
	TREMPEALEAU	$9,088	$893,766	1.02%
	WASHBURN	$5,244	$672,200	0.78%
	TOTAL	**$131,646**	**$15,779,377**	0.83%
	STATE TOTAL	**$1,013,284**	**$74,194,500**	1.37%
	66/72 COUNTIES (92%)			

Table A-6. Salt Brine Use

From Winter Storm Reports, 2014-2015

REGION	GROUP	COUNTY	PREWETTING (GALLONS)	ANTI-ICING (GALLONS)	TOTAL (GALLONS)
SOUTHWEST	B	COLUMBIA	29,520	81,300	110,820
	C	CRAWFORD	23,576	21,500	45,076
	A	DANE	99,435	65,050	164,485
	B	DODGE	10,512	1,262	11,774
	B	GRANT	15,615	1,850	17,465
	D	GREEN	17,415	9,404	26,819
	E	IOWA	0	5,590	5,590
	B	JEFFERSON	68,978	0	68,978
	C	JUNEAU	22,332	30,635	52,967
	C	LA CROSSE	23,384	100,260	123,644
	D	LAFAYETTE	0	3,225	3,225
	B	MONROE	12,453	86,650	99,103
	D	RICHLAND	17,830	15,840	33,670
	B	ROCK	26,727	12,175	38,902
	B	SAUK	7,930	18,585	26,515
	C	VERNON	12,566	37,150	49,716
		TOTAL	**388,273**	**490,476**	**878,749**
SOUTHEAST	B	KENOSHA	0	0	0
	A	MILWAUKEE	42,320	18,050	60,370
	D	OZAUKEE	17,860	5,900	23,760
	B	RACINE	21,337	7,080	28,417
	A	WALWORTH	29,995	58,500	88,495
	B	WASHINGTON	45,781	10,400	56,181
	A	WAUKESHA	189,005	91,240	280,245
		TOTAL	**346,298**	**191,170**	**537,468**
NORTHEAST	B	BROWN	37,030	113,490	150,520
	E	CALUMET	5,003	1,900	6,903
	D	DOOR	10,921	20,300	31,221
	B	FOND DU LAC	36,565	22,172	58,737
	F	KEWAUNEE	8,205	13,000	21,205
	C	MANITOWOC	5,556	2,700	8,256
	D	MARINETTE	36,315	67,000	103,315
	C	OCONTO	15,231	36,950	52,181
	B	OUTAGAMIE	72,551	8,000	80,551
	C	SHEBOYGAN	89,272	26,715	115,987
	B	WINNEBAGO	193,345	88,900	282,245
		TOTAL	**509,994**	**401,127**	**911,121**

Table A-6. Salt Brine Use

From Winter Storm Reports, 2014-2015

REGION	GROUP	COUNTY	PREWETTING (GALLONS)	ANTI-ICING (GALLONS)	TOTAL (GALLONS)
NORTH CENTRAL	F	ADAMS	30	18,600	18,630
	F	FLORENCE	10,214	45,200	55,414
	E	FOREST	16,515	0	16,515
	D	GREEN LAKE	4,470	8,330	12,800
	E	IRON	32,965	0	32,965
	E	LANGLADE	14,161	2,600	16,761
	C	LINCOLN	44,243	36,800	81,043
	B	MARATHON	32,009	42,845	74,854
	D	MARQUETTE	10,202	65,820	76,022
	F	MENOMINEE	200	1,700	1,900
	D	ONEIDA	92,572	17,950	110,522
	B	PORTAGE	39,485	1,730	41,215
	E	PRICE	35,476	2,170	37,646
	C	SHAWANO	35264	59,750	95,014
	E	VILAS	12,700	0	12,700
	B	WAUPACA	18,504	8,604	27,108
	D	WAUSHARA	11,179	10,000	21,179
	C	WOOD	13,531	27,570	41,101
		TOTAL	**423,720**	**349,669**	**773,389**
NORTHWEST	E	ASHLAND	23,744	2,868	26,612
	C	BARRON	21,290	850	22,140
	D	BAYFIELD	10,867	400	11,267
	D	BUFFALO	6,392	7,200	13,592
	E	BURNETT	100	0	100
	B	CHIPPEWA	0	0	0
	C	CLARK	1,690	2,705	4,395
	C	DOUGLAS	0	0	0
	C	DUNN	0	0	0
	B	EAU CLAIRE	7,220	3,280	10,500
	C	JACKSON	0	2,400	2,400
	E	PEPIN	1,821	1,175	2,996
	E	PIERCE	12,115	3,900	16,015
	D	POLK	10,255	758	11,013
	E	RUSK	0	0	0
	E	SAWYER	0	0	0
	B	ST. CROIX	0	0	0
	E	TAYLOR	36,600	4,875	41,475
	D	TREMPEALEAU	1,325	16,000	17,325
	D	WASHBURN	14,149	4,800	18,949
		TOTAL	**147,568**	**51,211**	**198,779**
		STATE TOTAL	**1,815,853**	**1,483,653**	**3,299,506**
		# OF COUNTIES	62	60	
PREVIOUS USE		2014-2015	1,815,853	1,483,653	3,299,506
		2013-2014	3,060,116	872,780	3,932,896
		2012-2013	1,082,163	1,164,394	2,246,557
		2010-2011	1,674,472	714,760	2,389,232
		2009-2010	933,690	649,909	1,583,599
		2008-2009	1,028,457	467,943	1,496,400
		2007-2008	965,797	305,409	1,271,206
		2006-2007	530,733	456,875	987,608
		2005-2006	570,203	394,991	965,194
		2004-2005	398,661	246,813	695,474
		2003-2004	285,710	241,780	527,490
		2002-2003	174,413	228,524	402,937
		2001-2002	144,505	194,349	338,854
		2000-2001	111,816	48,149	159,965

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2014-2015

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite55 (gal)
NC	ADAMS	1,674	0	100	340	0	0	0	4,527	0	0	0	0	0	0
	FLORENCE	2,614	0	0	10,214	0	0	0	0	0	0	0	0	0	0
	FOREST	4,946	0	125	16,515	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	707	0	975	4,470	0	150	0	0	0	0	0	0	0	120
	IRON	3,656	0	0	30,650	0	0	0	0	0	0	0	0	0	0
	LANGLADE	3,831	0	0	14,161	0	0	12	0	0	0	0	0	0	0
	LINCOLN	4,719	0	0	37,843	0	0	0	0	0	0	0	0	0	0
	MARATHON	10,965	0	0	31,989	18	711	8	0	0	986	0	0	8	0
	MARQUETTE	2,197	0	0	10,205	0	0	0	0	0	3,457	0	0	0	0
	MENOMINEE	1,248	0	0	200	0	0	0	0	0	0	0	0	0	0
	ONEIDA	6,069	0	0	85,923	0	0	0	0	0	0	0	0	0	0
	PORTAGE	5,454	0	0	33,805	0	0	0	0	0	0	0	0	0	0
	PRICE	4,028	0	0	35,825	1,468	0	0	0	0	0	0	0	795	0
	SHAWANO	5,455	0	0	35,264	0	0	0	0	0	0	0	0	0	0
	VILAS	7,045	0	0	12,700	0	0	0	0	0	0	0	0	0	0
	WAUPACA	2,108	0	0	18,504	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	2,771	0	955	11,179	0	0	0	0	0	0	0	0	0	0
	WOOD	3,934	0	0	13,531	0	0	0	0	0	0	0	0	0	0
Region Total		73,421	0	2,155	403,318	1,486	861	20	4,527	0	4,443	0	0	803	120

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2014-2015

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite55 (gal)
NE	BROWN	8,126	0	0	36,915	0	0	0	0	0	0	0	0	0	0
	CALUMET	843	0	0	5,003	0	0	0	0	0	0	0	0	0	0
	DOOR	2,045	0	0	10,921	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	3,266	0	0	36,656	0	0	0	0	0	2,544	0	0	0	0
	KEWAUNEE	792	0	0	8,205	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	3,157	0	0	5,556	0	0	0	0	0	0	0	0	24,970	0
	MARINETTE	5,805	0	0	36,315	0	0	0	0	0	0	0	0	0	0
	OCONTO	3,044	0	0	15,231	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	3,357	0	0	72,551	0	0	0	0	0	0	0	0	783	0
	SHEBOYGAN	3,117	0	0	89,272	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	5,499	0	0	193,345	0	0	305	0	0	3,068	0	0	0	0
Region Total		39,051	0	0	509,970	0	0	305	0	0	5,612	0	0	25,753	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2014-2015

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite55 (gal)
NW	ASHLAND	2,123	0	0	23,009	20	0	3,439	0	0	0	0	0	2,024	0
	BARRON	3,691	0	0	18,625	0	0	520	0	0	0	0	0	0	0
	BAYFIELD	4,303	0	0	10,867	0	0	0	0	0	0	0	0	0	0
	BUFFALO	1,688	0	0	6,392	0	0	0	0	0	0	0	0	0	0
	BURNETT	1,126	0	0	100	0	0	11,520	0	0	0	0	0	0	0
	CHIPPEWA	6,569	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	3,734	0	0	1,690	0	0	0	0	0	0	0	0	0	0
	DOUGLAS	4,672	0	0	0	0	0	3,871	0	0	0	0	0	0	0
	DUNN	6,393	0	0	0	0	0	0	0	0	0	0	0	1,680	0
	EAU CLAIRE	7,842	0	11,610	7,220	0	0	0	0	0	0	0	0	977	0
	JACKSON	6,026	0	0	0	3,400	0	0	0	0	0	0	0	0	0
	PEPIN	531	0	0	1,821	131	0	0	0	0	0	0	0	0	0
	PIERCE	2,801	0	2,630	12,115	0	0	0	0	0	0	0	0	0	0
	POLK	4,322	0	0	10,255	0	0	5,694	0	0	0	0	0	0	0
	RUSK	2,038	0	0	0	0	0	0	0	0	160	0	0	0	0
	SAINT CROIX	7,615	0	21,354	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	3,418	0	0	0	0	0	0	0	0	588	0	0	0	0
	TAYLOR	2,301	0	0	36,600	0	0	0	0	0	0	0	0	0	0
	TREMPEALEA	5,166	0	0	1,325	3,925	0	0	0	0	2,600	0	0	0	0
	WASHBURN	3,732	0	0	13,749	0	0	0	0	0	0	0	0	0	2,818
Region Total		80,091	0	35,594	143,768	7,476	0	25,044	0	0	3,348	0	0	4,681	2,818

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2014-2015

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite55 (gal)
SE	KENOSHA	7,381	0	0	0	1,695	0	0	0	0	0	0	0	0	0
	MILWAUKEE	30,793	62	39,780	42,320	0	0	2,500	0	0	0	0	0	0	0
	OZAUKEE	5,282	0	10,510	17,860	0	0	0	0	0	0	0	0	0	0
	RACINE	7,565	0	8,314	21,337	0	0	0	0	0	0	0	0	0	0
	WALWORTH	8,887	0	0	29,995	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	7,880	58	0	45,781	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	7,582	0	4,502	189,005	0	0	0	0	0	0	0	0	18,578	0
Region Total		75,370	120	63,106	346,298	1,695	0	2,500	0	0	0	0	0	18,578	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2014-2015

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite55 (gal)
SW	COLUMBIA	11,150	0	0	29,010	0	0	480	0	0	0	0	0	0	0
	CRAWFORD	2,893	0	0	20,568	0	0	500	0	0	743	0	0	0	0
	DANE	20,887	0	0	99,435	0	0	0	0	0	0	0	0	0	0
	DODGE	8,025	0	0	10,472	0	0	0	0	0	0	0	2,305	0	0
	GRANT	5,513	0	0	15,615	0	0	0	0	0	0	0	0	0	0
	GREEN	979	0	0	16,113	0	0	0	0	0	0	0	0	0	0
	IOWA	3,388	0	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	3,055	0	1,377	68,978	0	0	0	1,483	0	0	0	0	0	0
	JUNEAU	5,020	0	0	22,332	0	0	2,000	0	0	0	6	0	0	366
	LA CROSSE	4,371	0	0	23,384	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	1,618	0	0	0	0	0	0	0	0	0	0	0	0	0
	MONROE	7,300	0	0	12,453	0	0	0	0	0	0	0	0	30	0
	RICHLAND	2,157	0	0	17,420	0	0	0	0	0	0	0	0	0	0
	ROCK	2,643	0	0	25,777	0	0	0	0	0	0	0	0	0	0
	SAUK	4,665	0	0	7,930	0	0	0	0	0	0	0	0	0	0
	VERNON	4,166	0	0	12,461	0	45	424	0	0	343	0	0	0	2,810
Region Total		87,830	0	1,377	381,948	0	45	3,404	1,483	0	1,086	6	2,305	30	3,176

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2014-2015

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite55 (gal)
Statewide Total		355,763	120	102,232	1,785,302	10,657	906	31,273	6,010	0	14,489	6	2,305	49,845	6,114

Table A.8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2014-2015

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	FreezeGard Guard	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite (gal)
NC	ADAMS	0	0	0	0	0	0	0	0	0	0	0	0	0
	FLORENCE	92	0	0	0	0	0	0	0	0	0	0	0	0
	FOREST	173	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	7	50	0	0	0	0	0	0	0	0	0	0	0
	IRON	502	0	2,315	0	0	0	0	0	0	0	0	0	0
	LANGLADE	53	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	1,590	0	6,400	0	0	0	0	0	0	0	0	0	0
	MARATHON	340	0	20	0	0	5	0	0	0	0	0	0	0
	MARQUETTE	55	0	0	0	0	0	0	0	0	0	0	0	0
	MENOMINEE	87	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	1,988	0	6,649	0	0	0	0	0	0	0	0	0	0
	PORTAGE	815	0	5,680	0	0	0	0	0	0	0	0	0	0
	PRICE	140	0	212	25	0	0	0	0	0	0	0	13	0
	SHAWANO	189	0	0	0	0	0	0	0	0	0	0	0	0
	VILAS	1,032	0	0	0	0	0	0	0	0	0	0	0	0
	WAUPACA	241	0	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	11	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	319	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		7,634	50	21,276	25	0	5	0	0	0	0	0	13	0

Table A.8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2014-2015

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	FreezeGard Guard	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite (gal)
NE	BROWN	327	0	115	0	0	0	0	0	0	0	0	0	0
	CALUMET	0	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	28	0	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	11	0	0	0	0	0	0	0	0	0	0	0	0
	KEWAUNEE	0	0	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	0	0	0	0	0	0	0	0	0	0	0	0	0
	MARINETTE	45	0	0	0	0	0	0	0	0	0	0	0	0
	OCONTO	0	0	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	6	0	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	0	0	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		417	0	115	0	0	0	0	0	0	0	0	0	0

Table A.8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2014-2015

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	FreezeGard Guard	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite (gal)
NW	ASHLAND	357	0	735	0	0	150	0	0	0	0	0	100	0
	BARRON	694	0	2,665	0	0	0	0	0	0	0	0	0	0
	BAYFIELD	241	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	121	0	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	11	0	0	0	0	0	0	0	0	0	0	0	0
	CHIPPEWA	1,346	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	41	0	0	0	0	0	0	0	0	0	0	0	0
	DOUGLAS	2	0	0	0	0	0	0	0	0	0	0	0	0
	DUNN	223	0	0	0	0	0	0	0	0	0	0	0	0
	EAU CLAIRE	339	0	0	0	0	0	0	0	0	0	0	0	0
	JACKSON	0	0	0	0	0	0	0	0	0	0	0	0	0
	PEPIN	76	0	0	0	0	0	0	0	0	0	0	0	0
	PIERCE	261	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	831	0	0	0	0	0	0	0	0	0	0	0	0
	RUSK	62	0	0	0	0	0	0	0	0	0	0	0	0
	SAINT CROIX	267	0	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	62	0	0	0	0	0	0	0	0	0	0	0	0
	TAYLOR	76	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	0	0	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	160	0	400	0	0	0	0	0	0	0	0	0	391
Region Total		5,170	0	3,800	0	0	150	0	0	0	0	0	100	391

Table A.8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2014-2015

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	FreezeGard Guard	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite (gal)
SE	KENOSHA	0	0	0	0	0	0	0	0	0	0	0	0	0
	MILWAUKEE	0	0	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	0	0	0	0	0	0	0	0	0	0	0	0	0
	RACINE	0	0	0	0	0	0	0	0	0	0	0	0	0
	WALWORTH	393	0	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	0	0	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		393	0	0	0	0	0	0	0	0	0	0	0	0

Table A.8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2014-2015

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	FreezeGard Guard	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite (gal)
SW	COLUMBIA	1,678	0	510	0	0	950	0	0	0	0	0	0	0
	CRAWFORD	745	0	3,008	0	0	0	0	0	0	0	0	0	0
	DANE	72	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	4	0	40	0	0	0	0	0	0	0	10	0	0
	GRANT	1,394	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	415	0	1,302	0	0	0	0	0	0	0	0	0	0
	IOWA	40	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	12	0	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	50	0	0	0	0	0	0	0	0	0	0	0	0
	LA CROSSE	505	0	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	1,779	0	0	0	0	0	0	0	0	0	0	0	0
	MONROE	65	0	0	0	0	0	0	0	0	0	0	0	0
	RICHLAND	226	0	410	0	0	0	0	0	0	0	0	0	0
	ROCK	453	0	950	0	0	0	0	0	0	0	0	0	0
	SAUK	190	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	1,059	0	105	0	0	0	0	0	0	0	0	0	560
Region Total		8,687	0	6,325	0	0	950	0	0	0	0	10	0	560

Table A.8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2014-2015

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M80 (gal)	FreezeGard Guard	CaCl2 DOW (gal)	Arctic Clear Gold	MC95 (gal)	Caliber M2000 (gal)	BioMelt64 (gal)	Geo Melt (gal)	Ice Bite (gal)
Statewide Total		22,301	50	31,516	25	0	1,105	0	0	0	0	10	113	951

Table A-9. History of Salt Use on State Trunk Highways

From Salt Inventory Reporting System

Winter	Tons of Salt	Lane Miles	Tons/Lane Mile	Million Vehicle Miles Traveled STH System (Winter)
1959/60	93,673	19,521	4.8	8,828
1960/61	54,805	19,948	2.7	9,254
1961/62	109,412	19,966	5.5	9,558
1962/63	77,719	19,756	3.9	9,782
1963/64	82,033	19,717	4.2	10,064
1964/65	149,329	19,911	7.5	10,566
1965/66	111,634	19,505	5.7	11,122
1966/67	181,230	20,137	8.0	11,933
1967/68	137,729	22,395	6.2	12,140
1968/69	193,004	22,675	8.5	12,870
1969/70	199,353	22,831	8.7	13,853
1970/71	273,010	23,120	11.8	15,133
1971/72	223,249	25,543	8.7	14,325
1972/73	256,571	25,673	10.0	15,301
1973/74	218,189	N/A	N/A	16,198
1974/75	237,916	N/A	N/A	15,807
1975/76	257,154	N/A	N/A	16,198
1976/77	188,011	N/A	N/A	18,556
1977/78	210,054	N/A	N/A	19,621
1978/79	235,193	N/A	N/A	21,053
1979/80	220,180	N/A	N/A	20,403
1980/81	151,021	N/A	N/A	19,360
1981/82	192,740	N/A	N/A	20,210
1982/83	234,529	27,407	8.6	20,056
1983/84	224,368	27,416	8.2	20,873
1984/85	217,136	27,598	7.9	21,214
1985/86	304,296	27,632	11.0	22,110
1986/87	196,035	27,613	7.1	23,176
1987/88	224,573	27,743	8.1	24,346
1988/89	230,403	27,872	8.3	24,550
1989/90	297,004	28,024	10.6	25,370
1990/91	364,174	28,006	13.0	26,247
1991/92	337,079*	28,104	12.0*	27,391
1992/93	416,594*	28,182	14.8*	28,252
1993/94	314,489*	28,221	11.1*	28,859
1994/95	295,479*	28,312	10.4*	29,210
1995/96	440,488*	28,374	15.5	30,077
1996/97	509,147*	28,545	17.8*	31,122
1997/98	413,824*	29,619	14.0*	32,083
1998/99	371,602	30,119	12.4	33,236
1999/00	346,963*	30,340	11.4*	33,825
2000/01	521,056	30,553	17.1	34,657
2001/02	308,954	30,909	10.0	34,076
2002/03	328,922	30,975	10.6	35,088
2003/04	390,664	31,429	12.4	35,662
2004/05	407,924	31,810	12.8	36,013
2005/06	410,570	33,022	12.4	35,642
2006/07	405,793	33,221	12.2	27,911
2007/08	644,484	33,297	19.4	27,931
2008/09	569,985	33,531	17.0	26,888
2009/10	408,523	33,532	12.2	26,109
2010/11	573,253	33,776	17.0	26,998
2011/12	355,519	33,944	10.5	25,669
2012/13	621,207	34,192	18.2	26,512
2013/14	669,807	34,339	19.5	26,774
2014/15	388,797	34,435	11.3	27,466