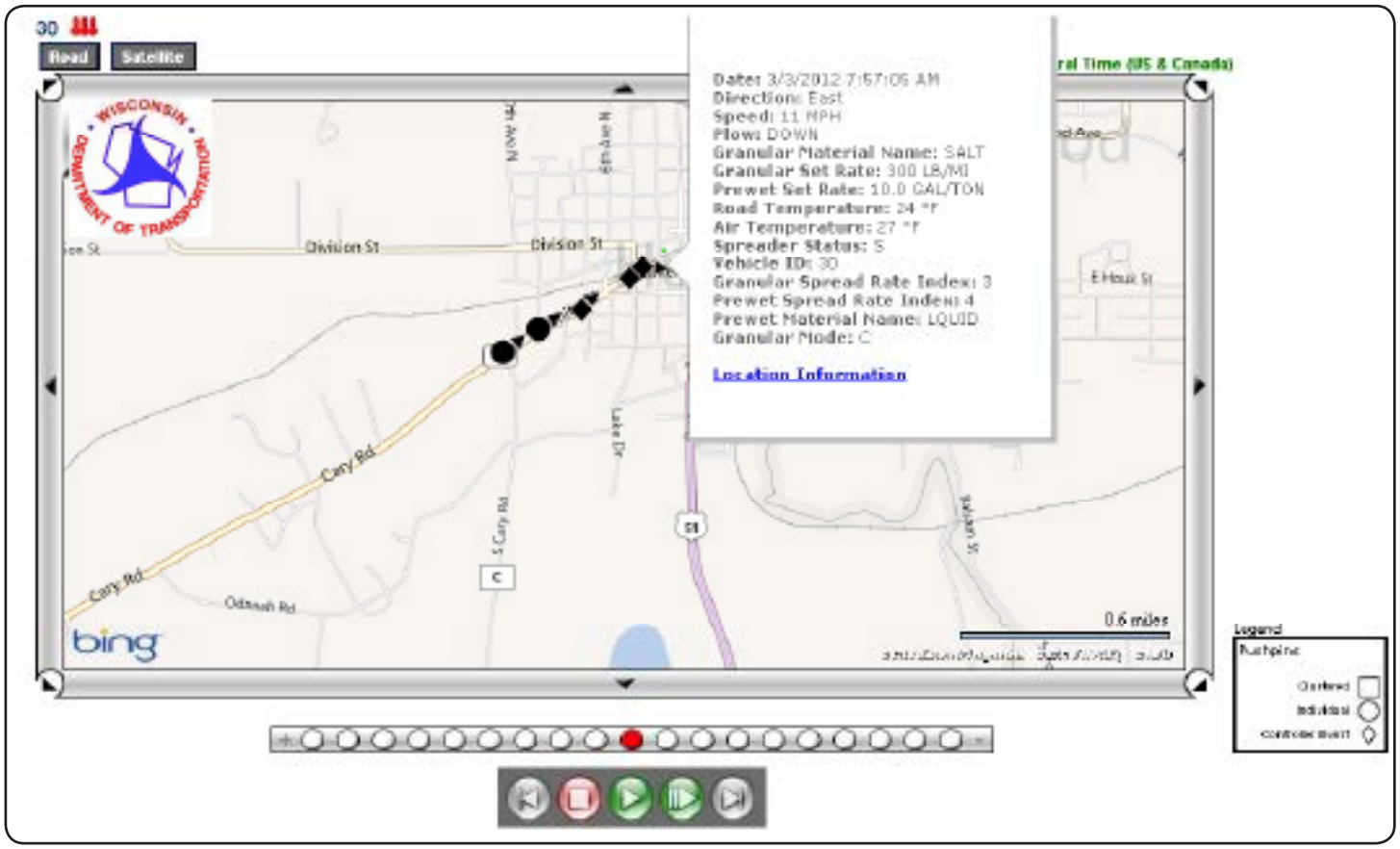
ANNUAL WINTER MAINTENANCE REPORT

2011-2012

Getting a Handle on Winter Maintenance with Performance Measures



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

October 2012

Acknowledgments

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

- Todd Matheson, 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
- Michael Schumacher, Bureau of State Highway Programs

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

In addition, we extend our thanks to Jay Wells of Washington State DOT for the use of his map of nationwide salt costs (see page 58).

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1 Introduction

To our partners

In 2011-2012, Wisconsin experienced its lightest winter of the past 10 years. Compared to last year's record-breaking winter costs of $91,054,937, this winter's costs totaled $56,217,319. The state experienced an average of 26 winter storms this winter, resulting in an average of 51.2 total inches of snowfall. This average represents a nearly 50% decrease from last year's statewide average of 100.1 inches of snow.

Again this year we commend the county maintenance crews for their dedicated response, and we recognize the role of WisDOT regional staff in coordinating these efforts. 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 the taxpayers in Wisconsin 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, and 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 97) 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 anti-icing, pre-wetting, and use of the new 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 operations engineer, at michael.sproul@dot.wi.gov.

Sincerely,

David Vieth, Director
Bureau of Highway Maintenance

Table 1.1. Statewide Summary: This Winter by the Numbers

		2010-2011 winter	2011-2012 winter
Infrastructure	Lane miles	33,776 miles	33,944 miles
	Patrol sections	759	770
	Average patrol section length	44.5 lane miles	44.08 lane miles
Weather	Average statewide Winter Severity Index	38.45	24.33
	Number of storms, statewide average and range across counties	Average: 37 Range: 22 to 73	Average: 26 Range: 16 to 43
	Snowfall, statewide average and range across counties	Average: 100.1 inches Range: 63 to 273 inches	Average: 51.2 inches Range: 20 to 170 inches
Materials[1]	Salt used	573,253 tons 17.0 tons per lane mile	355,519 tons 10.5 tons per lane mile
	Average cost of salt	$58.55 per ton	$59.18 per ton
	Prewetting liquid used	1,529,230 gal.	1,082,163 gal.
	Anti-icing agents used	714,860 gal.	1,164,394 gal.
	Sand used	18,941 cubic yd.	7,513 cubic yd.
Costs, Equipment and Performance	Total winter costs[2]	$91,054,937	$56,217,319
	Total winter costs per lane mile	$2,696	$1,656
	Average crew reaction time from start of storm	2.58 hours	1.89 hours
	Time to bare/wet pavement (measured from end of storm)	1.49 hours	0.90 hours
	Road Weather Information System (RWIS) stations	60	60
	Counties with salt spreaders equipped with on-board prewetting unit	58 of 72 (80%)	58 of 72 (80%)
	Counties with salt spreaders equipped with ground-speed controller unit	65 of 72 (90%)	68 of 72 (94%)
	Underbody plows	589	619
	Counties with underbody plows	55 of 72 (76%)	57 of 72 (79%)
	Counties equipped to use anti-icing agents	65 of 72 (90%)	66 of 72 (92%)
	Counties that used anti-icing agents during the winter season	61 of 72 (85%)	60 of 72 (83%)
Labor and Services	Regular county winter labor hours[3]	176,842 hrs.	103,332 hrs.
	Overtime county winter labor hours	175,373 hrs.	82,657 hrs.
	Public service announcements aired	6,597 total 6,010 radio; 587 TV	6,668 total 6,016 radio; 652 TV
	Cost of public service announcements	$36,000 ($209,144 market value)	$36,000 ($268,399 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, this year's 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 and D), which reflect the difference in the level of service provided on roads in these counties and facilitate comparisons within these groups. See Tables 1.3 and 1.4 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. The source of the data in each table is indicated in the table's heading.

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 33,944 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 to the nation.

Figure 1.1. WisDOT Regional Divisions

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.

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	2,865	8%
2	High volume four-lane highways (Average Daily Traffic ≥ 25,000) and some four-lane highways (ADT < 25,000), and some 6-lane highways.	3,182	9%
3	All other four-lane highways (ADT < 25,000)	8,832	26%
4	Most high volume two-lane highways (ADT ≥ 5,000) and some 2-lanes (ADT <5000)	4,887	14%
5	All other two-lane highways	14,178	42%
Total		33,944	

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 the 2011 map on page 116 in the Appendix.

To facilitate comparisons between counties that provide similar levels of service, WisDOT divides the 72 counties into four Winter Service Groups—A, B, C and D, with A being the most urban and D 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 D 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 770 patrol sections on state-maintained highways, with an average of 44.08 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	Counties where all or most of the highways receive 24-hour coverage	Brown, Dane, Eau Claire, Kenosha, La Crosse, Marathon, Milwaukee, Ozaukee, Portage, Racine, Waukesha, Winnebago	12	17%
B	Counties with 18-hour and 24-hour coverage. More than 50% of highways receive 24-hour coverage.	Chippewa, Columbia, Dodge, Dunn, Jefferson, Manitowoc, Marquette, Oneida, Outagamie, Rock, Sauk, Shawano, Sheboygan, St. Croix, Walworth, Washington, Waushara	17	24%
C	Counties with 18-hour and 24-hour coverage. Less than 50% of highways receive 24-hour coverage.	Calumet, Clark, Crawford, Door, Douglas, Fond du Lac, Grant, Iowa, Jackson, Juneau, Kewaunee, Lafayette, Lincoln, Monroe, Oconto, Trempealeau, Vernon, Vilas, Washburn, Waupaca, Wood	21	29%
D	Counties where no highways receive 24-hour coverage.	Adams, Ashland, Barron, Bayfield, Buffalo, Burnett, Florence, Forest, Green, Green Lake, Iron, Langlade, Marinette, Menominee, Pepin, Pierce, Polk, Price, Richland, Rusk, Sawyer, Taylor	22	31%

Note: Percentage totals exceed 100% due to rounding.

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. The table uses a similar format to the Storm Report Summary (Table A-1 on page 117 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.

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

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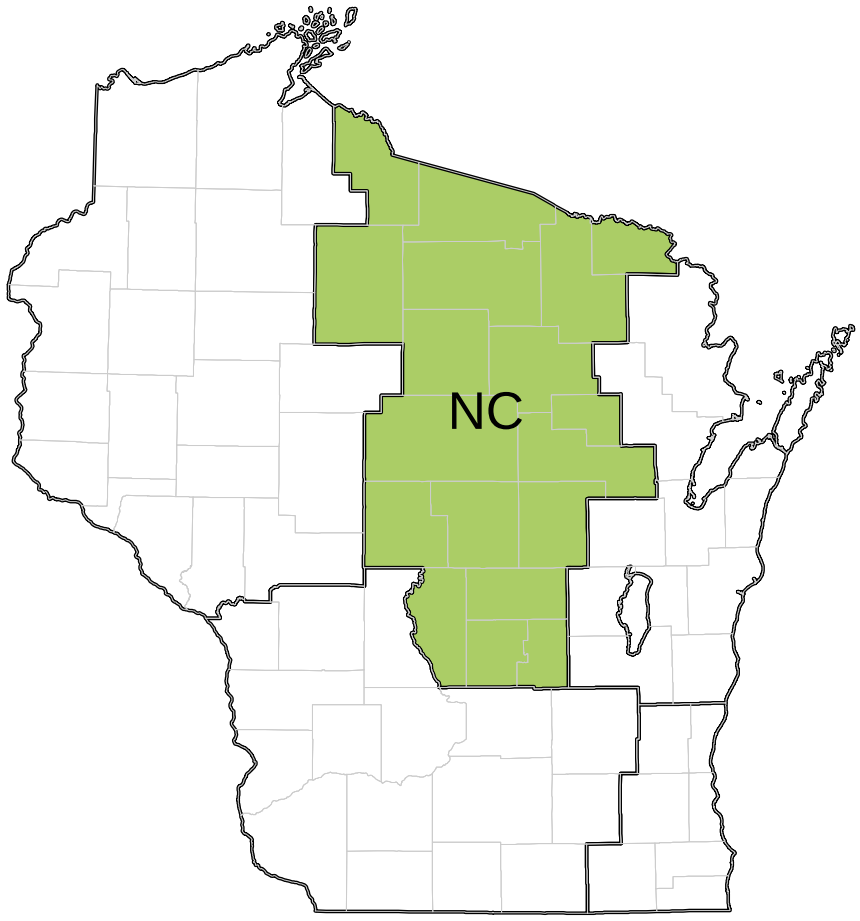
Table 1.5. Winter in Wisconsin, 2011-2012												
	County	Lane miles	Severity Index	Snowfall (inches)	Total salt used (tons)	Salt used (tons) per lane mile	Salt used per lane mile per Severity Index	Total salt costs	Total salt costs per lane mile	Total winter costs	Total winter costs per lane mile	Total winter costs per lane mile per Severity Index
North Central Region												
	Adams	193.82	27.16	30.4	2,201	11.35	0.42	$152,831	$789	$358,112	$1,848	$68.03
	Florence	141.07	32.94	100.2	2,364	16.76	0.51	$141,349	$1,002	$324,019	$2,297	$69.73
	Forest	312.38	33.25	107.9	4,698	15.04	0.45	$272,241	$872	$717,644	$2,297	$69.09
	Green Lake	155.54	19.70	44.1	888	5.71	0.29	$50,313	$323	$183,811	$1,182	$59.99
	Iron	249.56	43.13	169.7	3,587	14.37	0.33	$228,973	$918	$642,656	$2,575	$59.71
	Langlade	292.19	28.23	88.3	2,774	9.49	0.34	$154,778	$530	$497,423	$1,702	$60.30
	Lincoln	418.33	32.61	85.4	2,907	6.95	0.21	$181,119	$433	$640,184	$1,530	$46.93
	Marathon	886.17	26.55	50.2	7,709	8.70	0.33	$515,329	$582	$1,422,953	$1,606	$60.48
	Marquette	245.23	16.65	34.2	2,119	8.64	0.52	$126,040	$514	$305,518	$1,246	$74.83
	Menominee	90.26	24.38	58.1	902	9.99	0.41	$48,410	$536	$100,201	$1,110	$45.53
	Oneida	396.79	40.23	99.4	6,398	16.13	0.40	$441,619	$1,113	$1,109,873	$2,797	$69.53
	Portage	575.31	28.35	33.1	4,807	8.36	0.29	$316,550	$550	$878,317	$1,527	$53.85
	Price	320.57	42.52	78.4	3,963	12.36	0.29	$259,059	$808	$665,151	$2,075	$48.80
	Shawano	519.33	24.62	57.0	5,000	9.63	0.39	$256,463	$494	$693,104	$1,335	$54.21
	Vilas	305.24	27.96	87.1	5,683	18.62	0.67	$393,062	$1,288	$822,119	$2,693	$96.33
	Waupaca	546.64	16.95	42.1	5,744	10.51	0.62	$313,439	$573	$795,854	$1,456	$85.89
	Waushara	345.01	17.50	36.8	2,940	8.52	0.49	$164,041	$475	$451,432	$1,308	$74.77
	Wood	375.50	31.05	43.2	4,138	11.02	0.35	$268,294	$714	$568,526	$1,514	$48.76
Region total		**6,368.94**			**68,822**			**$4,283,911**		**$11,176,897**		
Region average		**353.83**	**28.54**	**69.2**	**3823**	**10.81**	**0.38**	**$237,995**	**$673**	**$620,939**	**$1,755**	**$61.48**
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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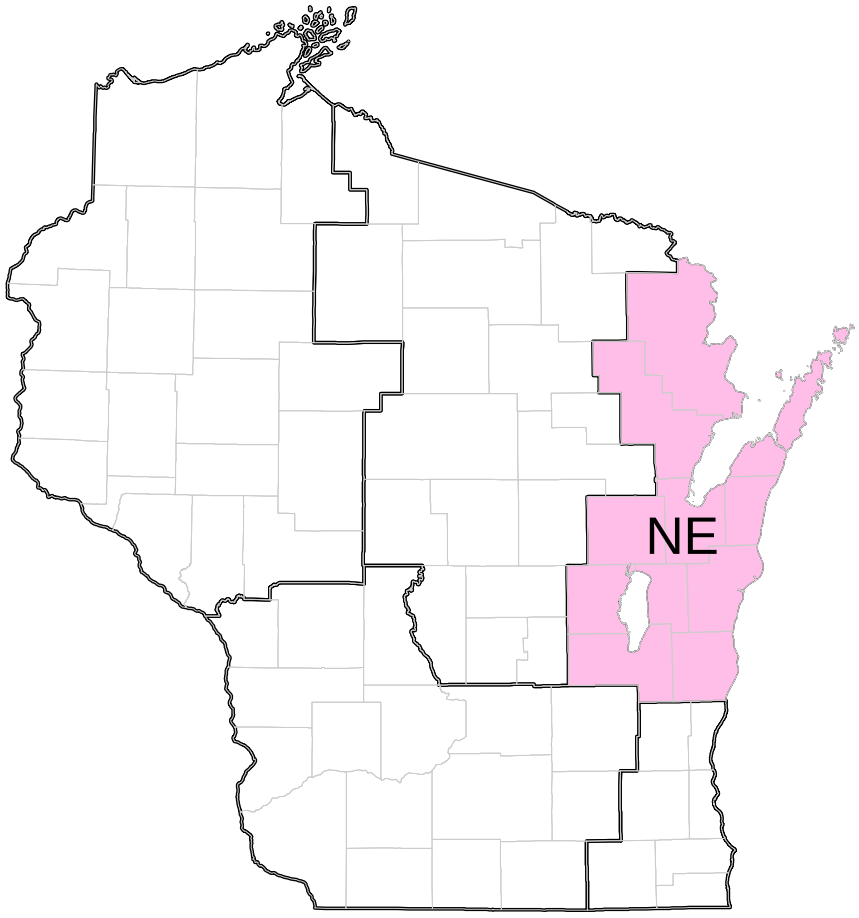
Northeast Region												
	Brown	716.21	20.55	42.0	7,120	9.94	0.48	$355,707	$497	$1,029,791	$1,438	$69.97
	Calumet	201.47	15.81	29.8	1,211	6.01	0.38	$63,684	$316	$238,623	$1,184	$74.92
	Door	268.55	22.88	36.6	1,958	7.29	0.32	$109,518	$408	$431,237	$1,606	$70.18
	Fond du Lac	597.30	24.21	47.0	7,042	11.79	0.49	$419,071	$702	$1,060,200	$1,775	$73.32
	Kewaunee	110.41	22.33	37.1	941	8.52	0.38	$49,017	$444	$158,162	$1,432	$64.15
	Manitowoc	421.09	19.17	32.9	3,332	7.91	0.41	$168,160	$399	$733,789	$1,743	$90.90
	Marinette	419.74	34.49	73.7	3,923	9.35	0.27	$219,123	$522	$563,987	$1,344	$38.96
	Oconto	466.31	26.12	72.3	3,825	8.20	0.31	$213,649	$458	$603,451	$1,294	$49.54
	Outagamie	528.93	19.60	29.6	4,523	8.55	0.44	$240,767	$455	$899,086	$1,700	$86.73
	Sheboygan	519.42	19.88	33.2	5,157	9.93	0.50	$299,531	$577	$850,466	$1,637	$82.36
	Winnebago	586.86	18.25	24.5	5,177	8.82	0.48	$299,013	$510	$920,029	$1,568	$85.90
Region total		**4,836.29**			**44,208**			**$2,437,241**		**$7,488,821**		
Region average		**439.66**	**22.12**	**41.7**	**4019**	**9.14**	**0.41**	**$221,567**	**$504**	**$680,802**	**$1,548**	**$70.01**
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	247.57	42.95	147.6	2,577	10.41	0.24	$162,113	$655	$475,354	$1,920	$44.70
	Barron	423.09	29.78	61.1	3,001	7.09	0.24	$190,157	$449	$701,290	$1,658	$55.66
	Bayfield	316.90	40.65	114.2	3,516	11.09	0.27	$203,377	$642	$583,119	$1,840	$45.27
	Buffalo	316.86	16.30	20.0	1,089	3.44	0.21	$64,450	$203	$232,472	$734	$45.01
	Burnett	233.64	24.10	64.8	1,209	5.18	0.21	$70,693	$303	$220,489	$944	$39.16
	Chippewa	663.13	26.41	54.4	7,139	10.76	0.41	$470,929	$710	$1,034,581	$1,560	$59.07
	Clark	402.44	23.05	44.7	3,790	9.42	0.41	$255,383	$635	$595,381	$1,479	$64.18
	Douglas	440.77	33.61	111.2	5,419	12.29	0.37	$297,930	$676	$771,325	$1,750	$52.07
	Dunn	516.55	17.42	28.7	4,905	9.50	0.55	$313,953	$608	$751,431	$1,455	$83.51
	Eau Claire	537.76	18.23	29.4	3,976	7.39	0.41	$256,493	$477	$721,529	$1,342	$73.60
	Jackson	515.00	25.06	60.0	4,643	9.02	0.36	$325,915	$633	$764,558	$1,485	$59.24
	Pepin	112.38	14.08	26.0	603	5.36	0.38	$37,553	$334	$125,961	$1,121	$79.61
	Pierce	365.61	19.55	29.3	2,413	6.60	0.34	$145,531	$398	$432,198	$1,182	$60.47
	Polk	385.05	32.97	63.9	4,466	11.60	0.35	$267,664	$695	$679,330	$1,764	$53.51
	Rusk	213.47	26.86	65.5	1,715	8.03	0.30	$114,068	$534	$303,496	$1,422	$52.93
	St. Croix	618.98	21.69	32.0	5,928	9.58	0.44	$351,337	$568	$674,210	$1,089	$50.22
	Sawyer	367.44	31.20	70.8	3,447	9.38	0.30	$234,915	$639	$743,333	$2,023	$64.84
	Taylor	234.27	28.66	57.5	2,083	8.89	0.31	$155,884	$665	$349,028	$1,490	$51.98
	Trempealeau	435.53	16.01	20.8	3,187	7.32	0.46	$189,518	$435	$453,933	$1,042	$65.10
	Washburn	372.14	23.60	74.0	3,809	10.24	0.43	$226,669	$609	$544,589	$1,463	$62.01
Region total		**7,718.58**			**68,914**			**$4,334,533**		**$11,157,607**		
Region average		**385.93**	**25.61**	**58.8**	**3446**	**8.63**	**0.34**	**$216,727**	**$562**	**$557,880**	**$1,446**	**$56.45**
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.												

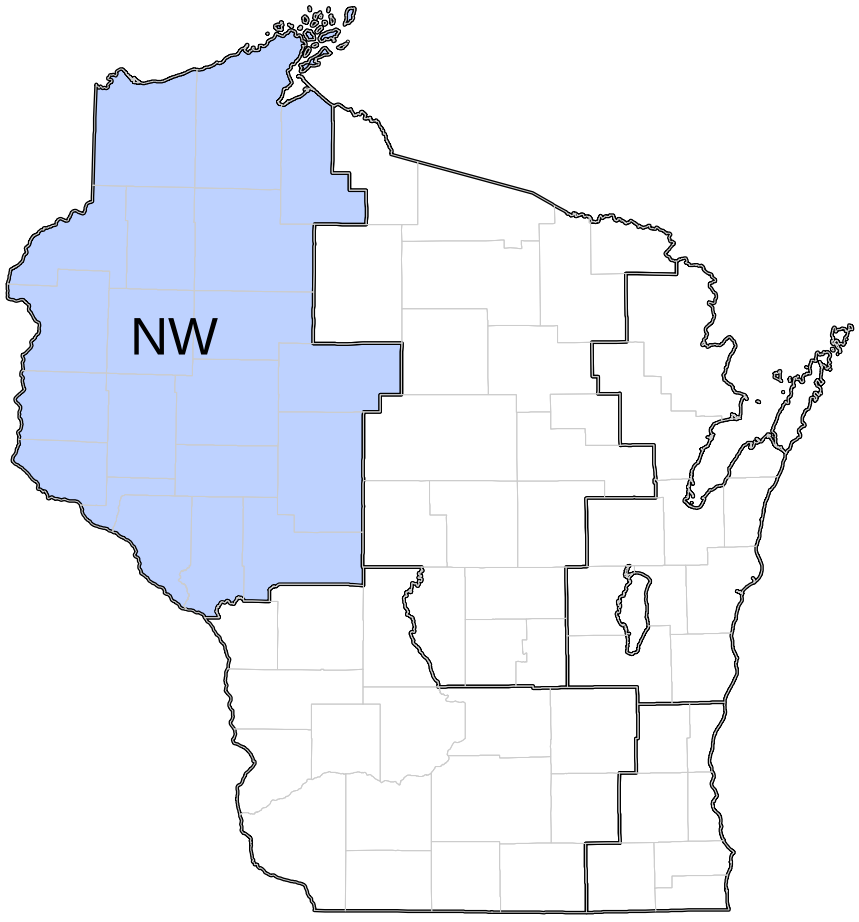


Table 1.5. Winter in Wisconsin, 2011-2012												
	County	Lane miles	Severity Index	Snowfall (inches)	Total salt used (tons)	Salt used (tons) per lane mile	Salt used per lane mile per Severity Index	Total salt costs	Total salt costs per lane mile	Total winter costs	Total winter costs per lane mile	Total winter costs per lane mile per Severity Index
Southeast Region												
	Kenosha	622.19	16.55	26.10	4,855	7.80	0.47	$264,403	$425	$856,507	$1,377	$83.18
	Milwaukee	1755.71	18.53	29.30	22,770	12.97	0.70	$1,170,833	$667	$5,204,086	$2,964	$159.96
	Ozaukee	309.51	18.12	29.00	4,091	13.22	0.73	$215,268	$696	$725,602	$2,344	$129.38
	Racine	681.95	17.33	39.20	6,197	9.09	0.52	$323,112	$474	$962,410	$1,411	$81.43
	Walworth	698.71	20.71	38.20	8,747	12.52	0.60	$455,194	$651	$1,105,858	$1,583	$76.42
	Washington	587.11	19.10	43.70	7,122	12.13	0.64	$401,752	$684	$1,033,362	$1,760	$92.15
	Waukesha	1100.59	15.12	41.90	14,516	13.19	0.87	$771,671	$701	$1,941,892	$1,764	$116.69
Region total		**5,755.77**			**68,298**			**$3,602,233**		**$11,829,717**		
Region average		**822.25**	**17.92**	**35.3**	**9757**	**11.87**	**0.66**	**$514,605**	**$626**	**$1,689,960**	**$2,055**	**$114.67**
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.												

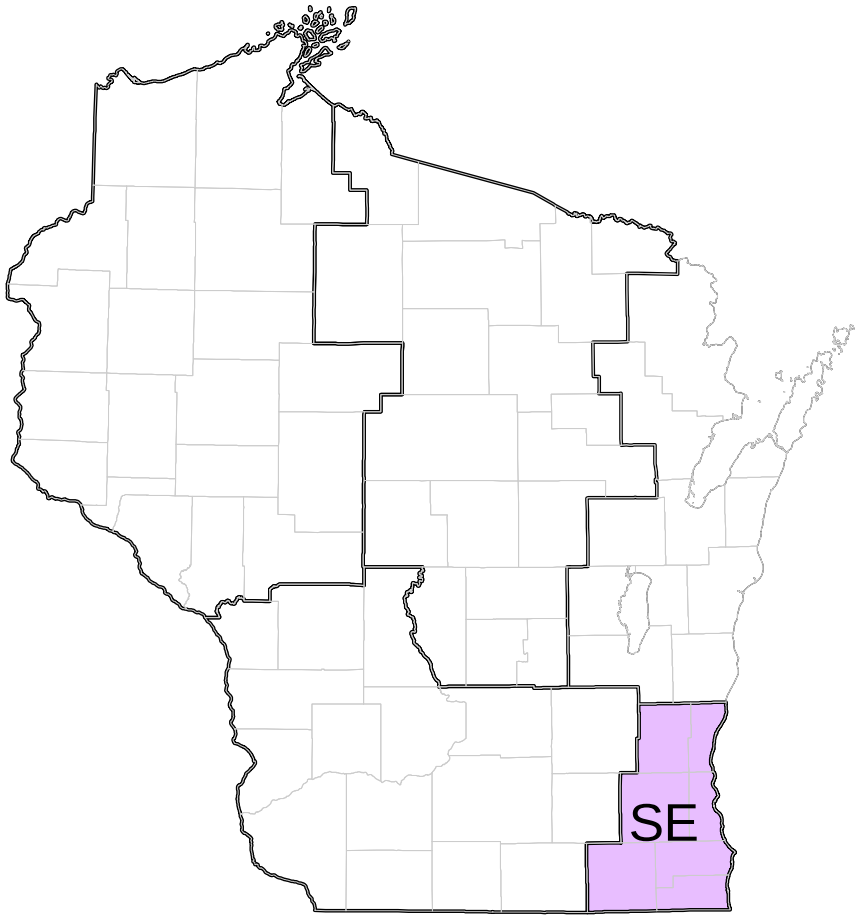
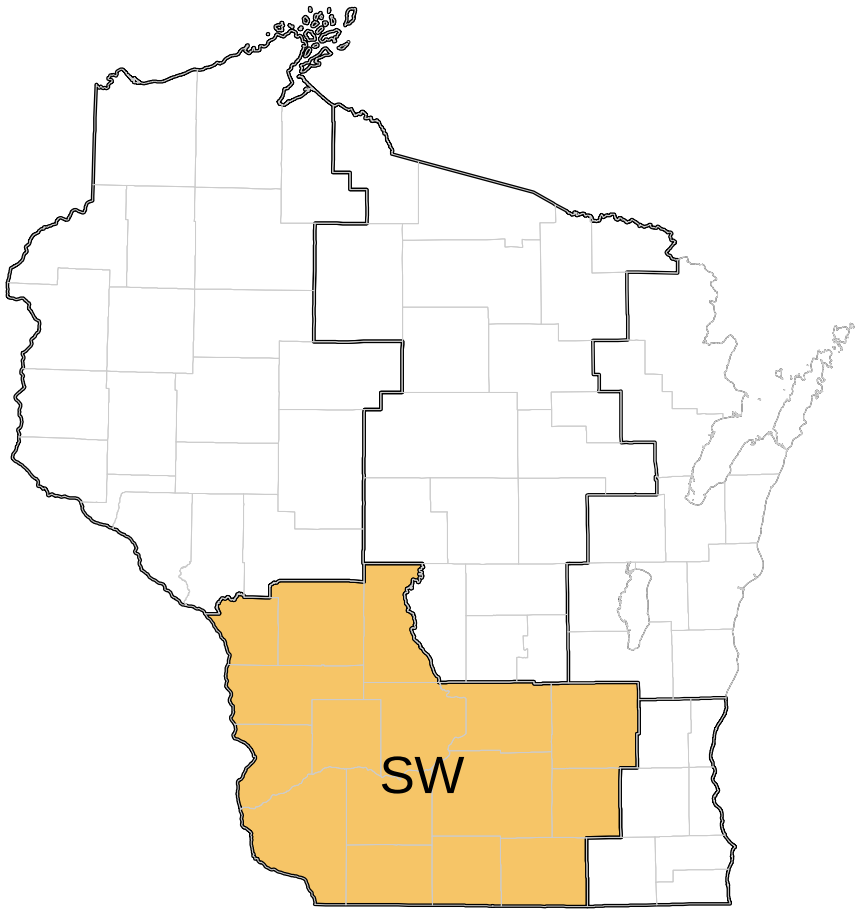


Table 1.5. Winter in Wisconsin, 2011-2012												
	County	Lane miles	Severity Index	Snowfall (inches)	Total salt used (tons)	Salt used (tons) per lane mile	Salt used per lane mile per Severity Index	Total salt costs	Total salt costs per lane mile	Total winter costs	Total winter costs per lane mile	Total winter costs per lane mile per Severity Index
Southwest Region												
	Columbia	801.20	17.86	24.8	13,200	16.48	0.92	$880,968	$1,100	$1,784,844	$2,228	$124.73
	Crawford	394.85	27.97	31.4	2,888	7.31	0.26	$180,240	$456	$464,650	$1,177	$42.07
	Dane	1547.66	24.47	33.3	25,469	16.46	0.67	$1,575,512	$1,018	$3,081,294	$1,991	$81.36
	Dodge	608.64	23.25	46.3	10,338	16.99	0.73	$626,586	$1,029	$1,212,688	$1,992	$85.70
	Grant	624.06	21.80	38.5	5,490	8.80	0.40	$324,459	$520	$784,039	$1,256	$57.63
	Green	312.72	17.10	35.7	1,256	4.02	0.23	$82,230	$263	$291,648	$933	$54.54
	Iowa	458.14	23.17	39.6	3,629	7.92	0.34	$215,926	$471	$581,806	$1,270	$54.81
	Jefferson	520.94	19.74	41.8	6,875	13.20	0.67	$406,450	$780	$878,627	$1,687	$85.44
	Juneau	499.39	21.70	29.3	4,713	9.44	0.43	$326,894	$655	$687,535	$1,377	$63.44
	La Crosse	488.24	27.29	41.9	2,518	5.16	0.19	$143,702	$294	$512,530	$1,050	$38.47
	Lafayette	293.88	20.93	43.3	1,206	4.10	0.20	$70,780	$241	$362,926	$1,235	$59.00
	Monroe	654.71	23.61	32.1	4,746	7.25	0.31	$298,618	$456	$712,527	$1,088	$46.10
	Richland	325.26	19.81	33.0	1,521	4.68	0.24	$102,439	$315	$264,048	$812	$40.98
	Rock	651.64	18.93	24.4	9,432	14.47	0.76	$525,928	$807	$1,236,464	$1,897	$100.24
	Sauk	618.44	23.24	27.1	7,865	12.72	0.55	$529,786	$857	$1,048,993	$1,696	$72.99
	Vernon	464.85	25.94	33.8	4,131	8.89	0.34	$258,601	$556	$659,660	$1,419	$54.71
Region total		**9,264.62**			**105,277**			**$6,549,120**		**$14,564,279**		
Region average		**579.04**	**22.30**	**34.8**	**6580**	**11.36**	**0.51**	**$409,320**	**$707**	**$910,267**	**$1,572**	**$70.49**
Statewide total		**33,944.20**		51.2	**355,519**	10.47		**$21,207,039**		**$56,217,321**		
Statewide average			24.33						**$614**			
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...

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 2011-12 winter season was much milder than the previous several winters. Snowfall was much lighter statewide, with an average of approximately 50 inches. While this was in line with the historical average amount, it was approximately half the average of the previous winter.

This section describes the weather Wisconsin experienced during the 2011-2012 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 72 for more information.*

Winter Weather, 2011–2012

	Statewide average	Range across counties
Total snowfall[1]	**51 inches**	**20-170 inches**
Winter Severity Index	**24.3**	**14.08-43.13**
Winter storms	**26**	**15-43**
Frost events	**4**	**0-17**
Freezing rain events	**4**	**0-13**

1. All data in this table is from Winter Storm Reports, 2011–2012.

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

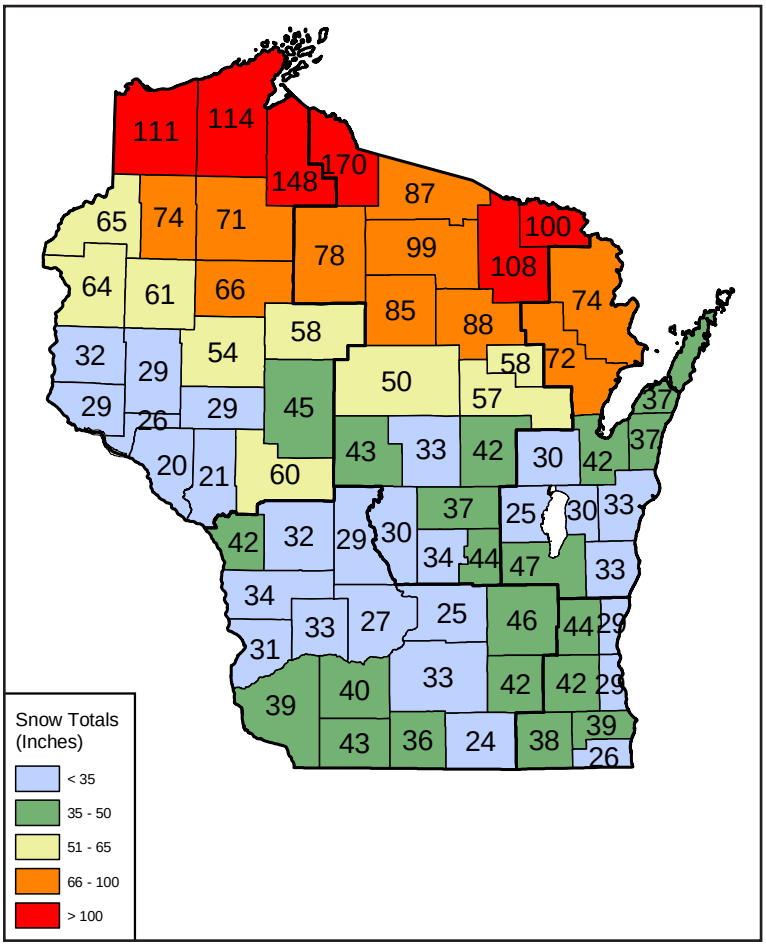
The 2011-12 winter was incredibly mild. Temperatures averaged 5 to 7 degrees above normal from December through February. This resulted in much less snowfall than had been seen the previous winter. The statewide average snowfall fell from around 100 inches to near 50 inches. Still there were a few notable events.

The first, on November 9 and 10, 2011, resulted in a band of 4 to 6 inches of heavy wet snow from southwest Wisconsin to far northeast parts of the state. Because the storm came so early, road pavement temperatures were still above freezing and the storm produced little impact on mobility.

A second storm hit the southern half of the state on February 23 and 24, 2012. It dropped more than 6 inches of snow south of a line from Crawford County to Manitowoc County. Once again, few transportation impacts resulted because pavement temperatures had been so warm leading up to the storm.

A final storm hit on March 3, leaving some locations in the far northern tier of counties with over a foot of heavy wet snow. Again, because of the unseasonably mild conditions prior to the storm, few impacts were noted.

Figure 2.1. Statewide Snowfall, 2011-2012
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.

During the 2011–2012 winter season, county highway departments responded to:

- A statewide average of 26 winter storm events per county, with a high of 43 in Iron County and a low of 16 in Waukesha and Green Counties.
- A statewide average of 4 frost events.
- A statewide average of 4 freezing rain events.

Figure 2.1 shows the total snowfall received in Wisconsin this winter based on storm report data. Snowfall varied quite a bit across the state; the highest snowfall recorded was in Iron County, at 170 inches; the lowest was in Buffalo County, at 20 inches. Both figures were well below those of the previous winter. Statewide, this winter's total snowfall was about average.

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.

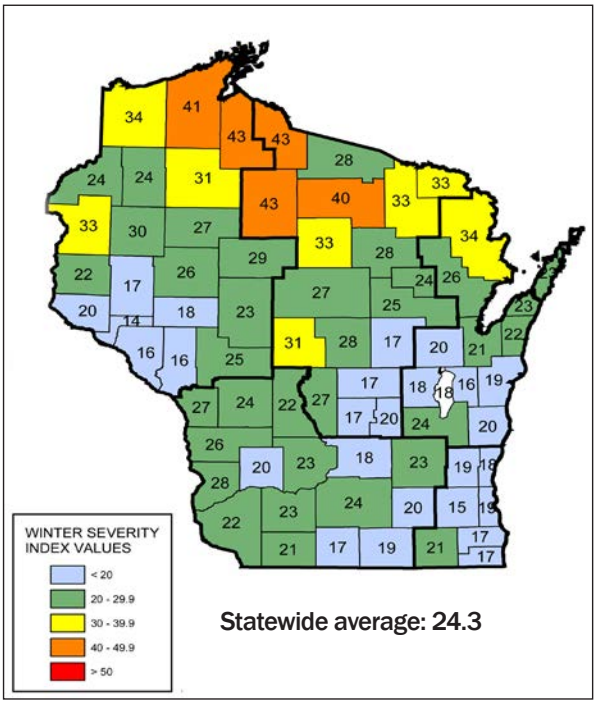
Developed in 1995, the severity index is calculated using a formula that includes:

- 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:

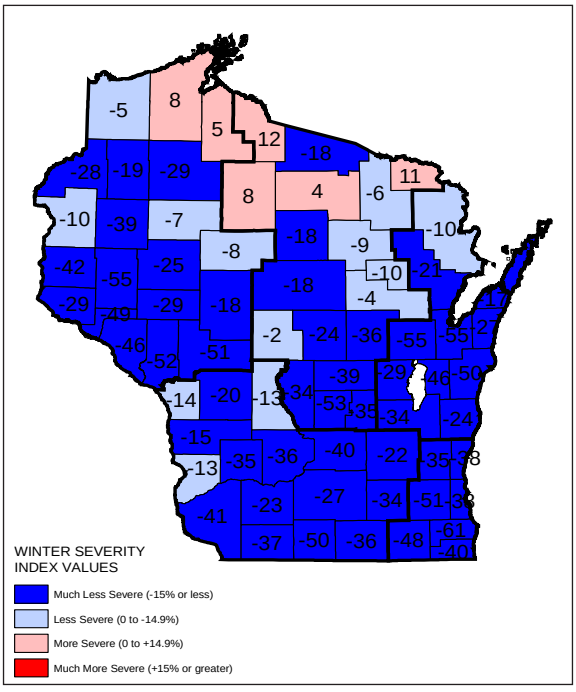
1. Season-to-season comparisons. This lets the department compare apples to apples when evaluating materials use and costs over several seasons, and identify trends in winter weather that can be useful in planning materials purchases. In the case of cost trends, adjusting cost data for severity index 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, 2011-2012



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. 2011-2012 Winter Severity Index vs. 5-Year Average (2006–2007 to 2010-2011)



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.

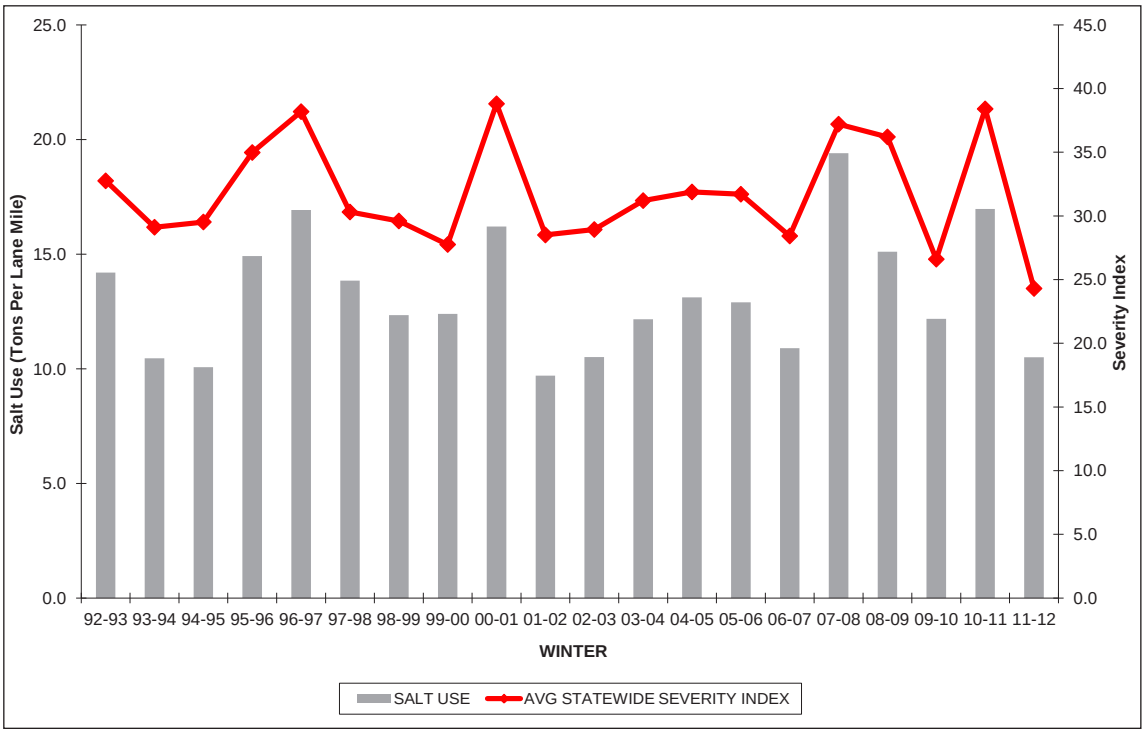
Data from weekly storm reports are used to calculate the Winter Severity Index for each county according to a weighted formula. The index expresses winter severity on a scale from 0 to 100. This winter:

- The statewide average Winter Severity Index was 24.3 which is 25 percent lower than the average of the previous ten winters (32.6).
- Iron, Ashland, Price and Bayfield Counties had the highest severity index; all greater than 40.
- Pepin County had the lowest severity index at 14.8. They were the only county under 15.

The high of 43 is lower than what is usually recorded as the state's highest severity index in the northern "snow belt" part of the state, and the low of 14 is lower than the state's typical lowest severity index as well. 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. This year's salt use was slightly lower than 2009-10, the only other year with a similar severity index.

Figure 2.4. Salt Use per Lane Mile and Average Severity Index
From Salt Inventory Reporting System, 1992–2012



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.

These include Figure 2.4 on the previous, as well as Figure 3.2 (salt used per lane mile; page 35), Figure 4.2 (winter costs; page 77), and Figure 4.6 (winter crashes; page 82).

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 four 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 page 27, 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, 2011-2012

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	ADAMS	30.4	193.82	2201	11.36	24	22	9	13	13	7	5	4	2	2	0	3	13
	FLORENCE	100.2	141.07	2364	16.76	33	20	19	2	2	32	8	6	2	10	2	11	9
	FOREST	107.9	312.38	4698	15.04	37	9	24	4	0	18	6	7	0	2	3	12	0
	GREEN LAKE	44.1	155.54	888	5.71	21	16	8	1	8	17	11	11	4	3	1	7	5
	IRON	169.7	249.56	3587	14.37	43	35	19	2	8	24	8	3	0	8	5	10	1
	LANGLADE	88.3	292.19	2774	9.49	28	18	17	2	7	24	12	6	1	10	1	11	9
	LINCOLN	85.4	418.33	2907	6.95	27	32	11	5	8	28	10	11	9	7	8	16	13
	MARATHON	50.2	886.17	7709	8.70	30	21	8	3	3	19	9	7	3	5	1	12	32
	MARQUETTE	34.2	245.23	2119	8.64	21	10	14	3	3	8	0	1	2	5	3	2	5
	MENOMINEE	58.1	90.26	902	9.99	30	17	11	3	6	13	4	3	3	4	1	8	0
	ONEIDA	99.4	396.79	6398	16.12	40	26	16	7	9	15	1	3	17	7	4	6	13
	PORTAGE	33.1	575.31	4807	8.36	33	12	22	6	8	13	6	6	4	4	8	8	5
	PRICE	78.4	320.57	3963	12.36	42	23	25	7	9	21	6	1	5	12	7	6	14
	SHAWANO	57.0	519.33	5000	9.63	30	22	7	2	6	20	8	4	3	3	4	14	4
	VILAS	87.1	305.24	5683	18.62	36	11	22	2	1	3	0	0	0	2	0	1	0
	WAUPACA	42.1	546.64	5744	10.51	22	18	3	1	1	9	1	2	5	2	0	3	3
	WAUSHARA	36.8	345.01	2940	8.52	22	12	9	2	3	5	4	2	0	2	0	3	4
	WOOD	43.2	375.50	4138	11.02	31	15	16	11	5	10	2	2	11	6	1	4	9
Region Average		69.2	353.83	3823	11.23	31	19	14	4	6	16	6	4	4	5	3	8	8

Final totals as of **Thursday, October 18, 2012**

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2011-2012

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	BROWN	42.0	716.21	7120	9.94	22	10	8	4	0	14	3	1	4	2	4	5	41
	CALUMET	29.8	201.47	1211	6.01	18	12	7	1	3	8	2	4	1	1	2	1	11
	DOOR	36.6	268.55	1958	7.29	21	12	11	2	6	21	10	8	12	13	5	3	11
	FOND DU LAC	47.0	597.30	7042	11.79	26	15	9	2	1	10	7	5	4	1	0	0	23
	KEWAUNEE	37.1	110.41	941	8.52	21	18	1	3	1	19	15	1	1	4	0	5	11
	MANITOWOC	32.9	421.09	3332	7.91	22	15	6	2	1	10	7	7	2	10	2	7	11
	MARINETTE	73.7	419.74	3923	9.35	34	27	7	5	6	27	12	7	5	8	5	13	31
	OCONTO	72.3	466.31	3825	8.20	33	24	7	2	4	10	0	3	2	3	4	4	27
	OUTAGAMIE	29.6	528.93	4523	8.55	23	20	4	4	5	8	3	3	3	6	0	3	6
	SHEBOYGAN	33.2	519.42	5157	9.93	23	15	9	1	2	20	13	3	12	2	0	11	12
	WINNEBAGO	24.5	586.86	4888	8.33	24	13	13	4	3	6	0	1	4	3	1	3	9
Region Average		41.7	439.66	3993	8.71	24	16	7	3	3	14	7	4	5	5	2	5	18

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2011-2012

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	ASHLAND	147.6	247.57	2577	10.41	38	26	9	6	6	10	3	4	6	2	1	2	6
	BARRON	61.1	423.09	3001	7.09	32	24	7	7	13	23	8	5	0	6	2	12	11
	BAYFIELD	114.2	316.90	3516	11.09	40	27	14	2	6	20	9	2	2	6	3	10	12
	BUFFALO	20.0	316.86	1089	3.44	15	7	8	1	1	21	1	3	4	13	1	7	12
	BURNETT	64.8	233.64	1209	5.17	25	20	6	6	13	8	5	4	1	7	8	8	0
	CHIPPEWA	54.4	663.13	7139	10.77	30	10	16	5	2	10	6	3	1	1	2	6	0
	CLARK	44.7	402.44	3790	9.42	28	21	9	3	2	9	6	3	3	5	0	5	6
	DOUGLAS	111.2	440.77	5419	12.29	41	27	17	5	1	12	4	0	9	9	5	5	15
	DUNN	28.7	516.55	4905	9.50	23	7	16	1	1	12	2	2	1	3	0	5	0
	EAU CLAIRE	29.4	537.76	3976	7.39	25	13	12	1	4	11	1	1	1	1	1	8	0
	JACKSON	60.0	515.00	4643	9.02	34	27	4	0	25	9	5	5	0	3	1	9	22
	PEPIN	26.0	112.38	603	5.37	16	12	8	1	5	10	1	1	9	7	3	3	8
	PIERCE	29.3	365.61	2413	6.60	24	7	16	4	4	8	2	1	1	7	1	5	2
	POLK	63.9	385.05	4466	11.60	30	13	16	3	3	28	6	4	13	18	0	6	2
	RUSK	65.5	213.47	1715	8.03	28	18	9	4	8	24	5	5	0	15	9	9	0
	SAINT CROIX	32.0	618.98	5928	9.58	29	7	22	3	3	16	5	0	3	0	3	12	0
	SAWYER	70.8	367.44	3447	9.38	35	22	6	7	4	20	3	0	0	11	2	7	0
	TAYLOR	57.5	234.27	2083	8.89	28	17	16	6	3	22	11	9	3	12	2	12	22
	TREMPEALEAU	20.8	435.53	3187	7.32	20	13	6	3	3	15	4	4	1	5	8	6	2
	WASHBURN	74.0	372.14	3809	10.24	32	19	11	2	1	9	2	2	3	0	1	4	8
Region Average		58.8	385.93	3446	8.63	29	17	11	4	5	15	4	3	3	7	3	7	6

Final totals as of **Thursday, October 18, 2012**

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2011-2012

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	
SE	KENOSHA	26.1	622.19	4855	7.80	19	12	4	4	3	6	3	2	1	1	1	3	17
	MILWAUKEE	29.3	1,755.71	22770	12.97	17	12	3	2	1	10	0	4	4	0	6	0	9
	OZAUKEE	29.0	309.51	4091	13.22	22	16	6	4	0	6	2	0	3	0	0	3	6
	RACINE	39.2	681.95	6197	9.09	20	11	15	2	4	9	6	4	2	4	4	5	16
	WALWORTH	38.2	698.71	8747	12.52	17	9	6	8	0	11	5	5	8	3	1	3	17
	WASHINGTON	43.7	587.11	7072	12.05	24	12	12	2	2	3	2	2	2	0	0	1	6
	WAUKESHA	41.9	1,100.59	14516	13.19	16	9	10	3	1	4	1	0	2	1	0	1	5
Region Average		35.3	822.25	9750	11.55	19	12	8	4	2	7	3	2	3	1	2	2	11

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2011-2012

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	COLUMBIA	24.8	801.20	13200	16.48	23	22	5	4	0	7	1	0	5	4	1	2	20
	CRAWFORD	31.4	394.85	2888	7.31	25	10	10	9	0	17	8	6	7	5	0	4	8
	DANE	33.3	1,547.66	25469	16.46	28	12	11	9	0	3	3	1	6	0	0	0	10
	DODGE	46.3	608.64	10338	16.99	25	10	13	2	3	12	9	5	4	0	0	5	9
	GRANT	38.5	624.06	5490	8.80	19	15	4	1	5	24	10	9	1	12	1	5	5
	GREEN	35.7	312.72	1256	4.02	16	7	6	2	2	20	8	1	4	4	1	10	6
	IOWA	39.6	458.14	3629	7.92	17	10	6	2	0	28	2	12	9	7	1	5	18
	JEFFERSON	41.8	520.94	6875	13.20	21	12	6	3	5	11	4	4	6	1	4	1	0
	JUNEAU	29.3	499.39	4713	9.44	27	13	5	6	2	8	2	1	0	2	1	3	11
	LA CROSSE	41.9	488.24	2518	5.16	26	11	13	8	7	14	10	6	10	1	0	4	11
	LAFAYETTE	43.3	293.88	1206	4.10	18	8	8	2	5	16	6	0	5	5	3	1	11
	MONROE	32.1	654.71	4746	7.25	27	13	9	6	7	6	2	2	16	3	3	3	14
	RICHLAND	33.0	325.26	1521	4.68	22	9	8	6	2	11	2	1	2	7	2	5	7
	ROCK	24.4	651.64	9432	14.47	15	6	9	3	0	20	12	8	7	4	0	4	13
	SAUK	27.1	618.44	7865	12.72	23	15	7	6	0	17	2	0	3	13	0	5	34
	VERNON	33.8	464.85	4131	8.89	25	14	4	8	2	16	10	1	14	6	0	5	20
Region Average		34.8	579.04	6580	9.87	22	12	8	5	3	14	6	4	6	5	1	4	12

Final totals as of **Thursday, October 18, 2012**

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2011-2012

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	
Statewide Averages		--	471	4933	9.85	26.1	15.6	10.4	3.9	4.0	14.1	5.2	3.5	4.2	5.0	2.1	5.7	10.2

3 Winter Operations

In this section...

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 2011-2012 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, 2011-2012

Total salt used[1]	355,519 tons
Total salt used per lane mile	10.47 tons
Total cost of salt used[2]	$21,207,039
Average cost per ton of salt	$59.65
Total prewetting agents used[3]	1,082,163 gal.
Counties prewetting salt	68 of 72 (94%)
Total abrasives used	7,513 cubic yards
Counties prewetting abrasives	8 of 45 using sand (17%)
Total anti-icing agents used	1,164,394 gal.
Counties equipped to use anti-icing	66 of 72 (92%)

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.

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.

3A. Materials

Salt remains the primary material used in winter maintenance. The advent of prewetting technology has improved the efficiency of materials use, 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. 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 40 - 42 for details on statewide anti-icing use.

Historically, counties have used 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 24.33 was 25 percent lower than the previous 10-year average of 32.6 Salt use was 38 percent lower than the previous year, at 355,519 tons. See Table 1.5 on page 13 for county-by-county salt use data for this winter.

Wisconsin counties applied a statewide average of 10.47 tons of salt per lane mile on state highways, a decrease of 38 percent compared with the 2010-2011 winter and far less than the average of the five previous winters (15.08 tons per lane mile). (See Figure 3.10 on page 57 for a county-by-county comparison.) That rate was higher than the nearby states of Minnesota (5.9 tons per lane mile) and Iowa (9.8 tons per lane mile), and less than Indiana (11.8 tons per lane mile), Michigan (12.6 tons per lane mile) and Illinois (12.3 tons per lane mile). 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. In addition, some states provide a lower level of service that prescribes less salt and more sand use. Winter severity also varies from state to state. 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, 2011-2012

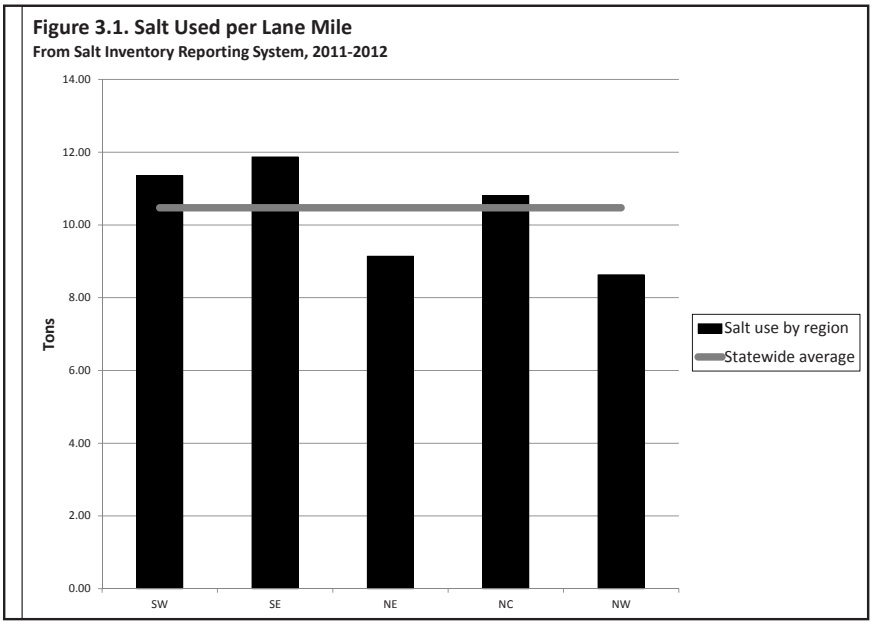


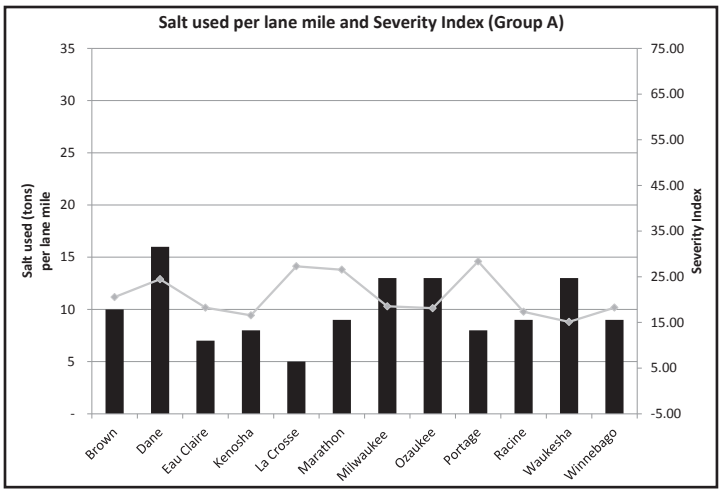
Figure 3.1 shows the regional levels of salt use per lane mile. Counties in the Southeast Region used an average of 11.87 tons of salt per lane mile, which reflects the greater number of highways in these counties receiving 24-hour service.

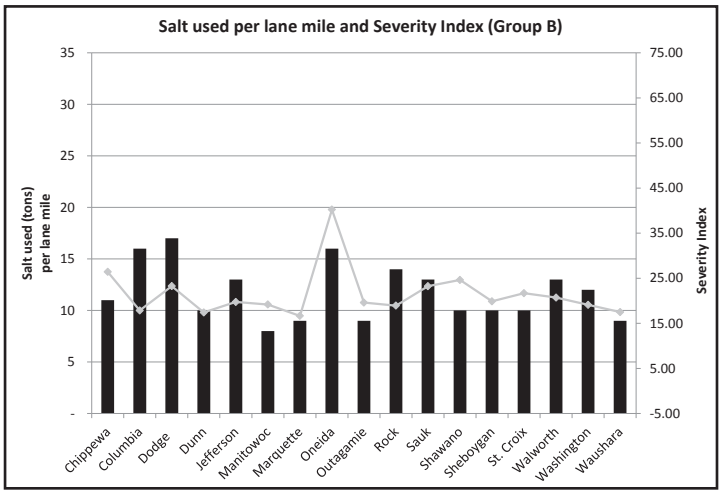
Figure 3.2 on page 35 shows salt use per lane mile in each county, overlaid with severity index to allow a further "apples to apples" comparison of salt use in each county. The counties in Winter Service Groups A and B have more urban highways and tend to use more salt per lane mile for a given level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

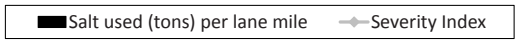
For more detail on salt use in previous years, see Table A-9, "History of Salt Use on State Trunk Highways," on page 164 of the Appendix.

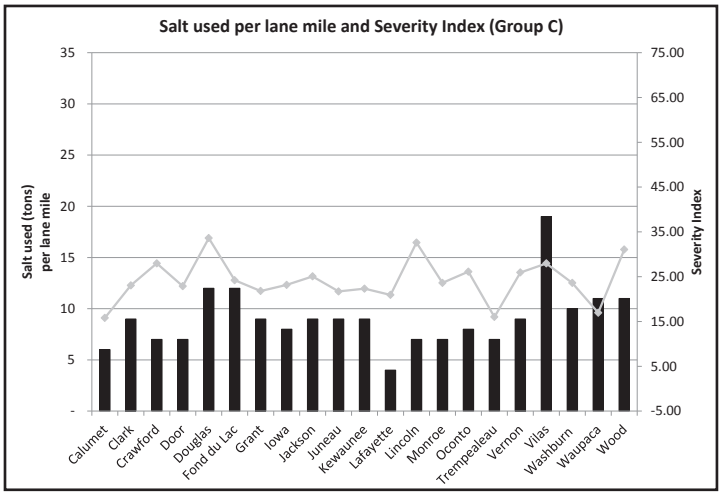
Figure 3.2. Salt Used per Lane Mile and Severity Index

From Salt Inventory Reporting System, 2011-2012









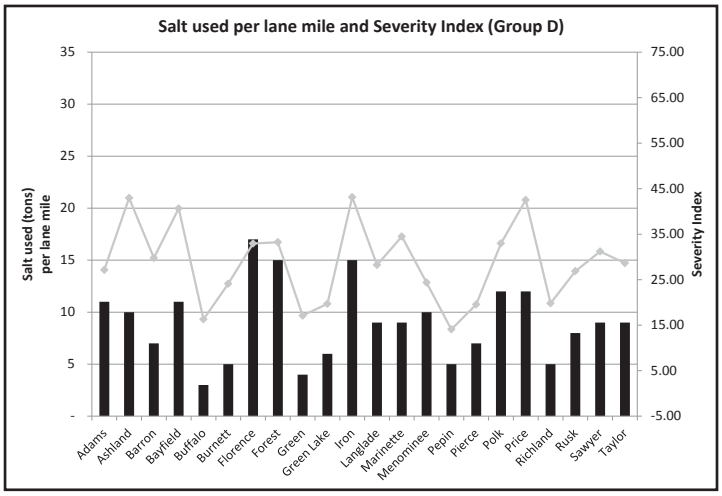
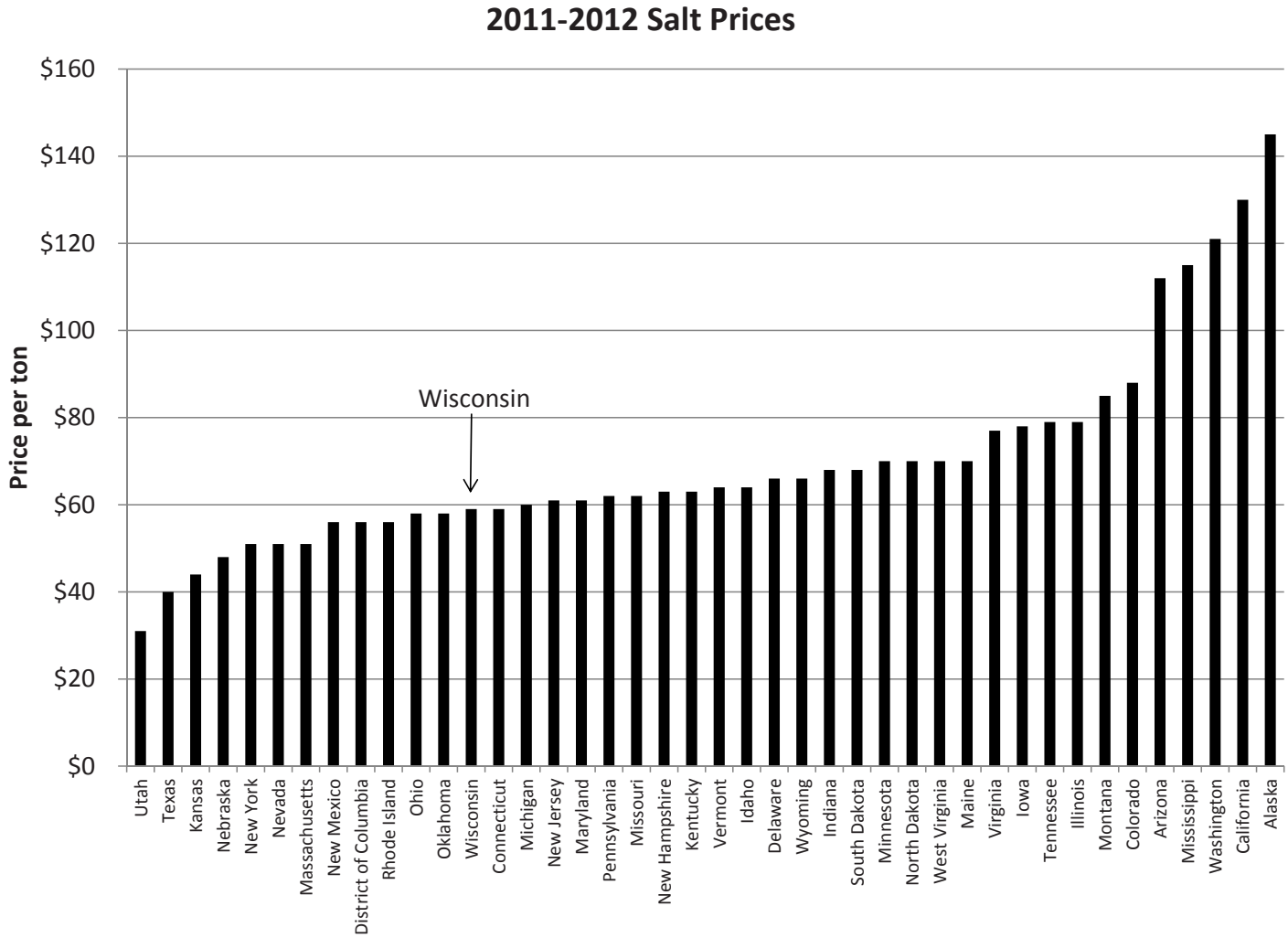


Figure 3.3. Salt Prices Across the United States

Source: Washington State DOT data



Note: Three states supplied a range of prices rather than an average. For these states, the midpoint of the range was used in this graph.

Cost of Salt

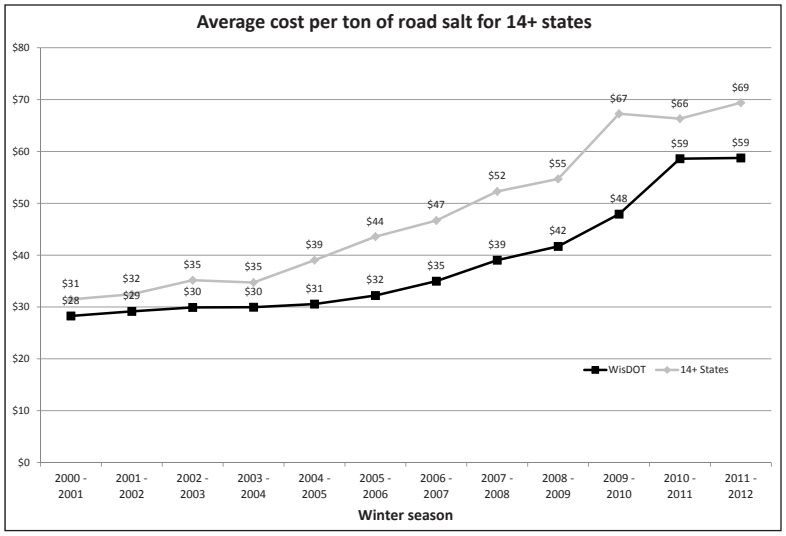
Salt prices continue to rise, which WisDOT's salt vendors attribute to multiyear supply and demand issues. This winter, WisDOT spent $21,207,039 on salt statewide, purchasing salt at an average of $59.65 per ton.

Higher fuel prices have contributed to higher salt transportation costs in recent years: The average of $59.65 per ton is a 2 percent increase compared to prices paid under last winter's original salt contract, and an increase of 41 percent compared with the average price of $35.22 six winters 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: Only twelve states pay less on average per ton, one state (Connecticut) pays about the same, and 28 states pay more. (See Figure 3.3.) WisDOT created a map of per-ton salt costs and average salt use across the country, which we have reproduced on page 58. Per-ton costs for straight rock salt range from $31 in Utah to $145 in Alaska (California pays the next highest cost at $130). 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, 2000–2012



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 in 2011).

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 71.

A Note About Materials Data

This winter marks the fourth 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 of 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.

Table 3.1. Statewide Sand Use

From storm reports data, 2000–2012

Year	Sand used (cubic yards)
2011-2012	7,513
2010-2011	18,941
2009–2010	19,081
2008–2009	44,179[1]
2007–2008	80,133[1]
2006–2007	13,636
2005–2006	15,997
2004–2005	15,843
2003–2004	17,959
2002–2003	19,864
2001–2002	18,154
2000–2001	67,108[1]
1999–2000	17,677[1]

1. Higher than normal sand use on the state system during the winters of 2007–2008 and 2000–2001 was caused by greater use of salt/sand mixes due to the low supply of salt toward the end of the winter. In 2008–2009, the higher total reflects counties' use of leftover sand from the previous winter.

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 7,513 cubic yards of sand was used by 45 counties on state highways this winter, a decrease of 91 percent compared with 2007–2008's record-setting 80,133 cubic yards, and a 79 percent decrease from the average of the five previous winters (35,194 cubic yards).

The Bureau of Highway Maintenance commissioned a synthesis report, "Limitations of the Use of Abrasives in Winter Maintenance Operations" (see page 59), 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 does not contribute to accident reductions.
- Salt is more cost-effective than sand in winter maintenance operations.

Table 3.1 on page 37 compares this winter's statewide sand use with previous years'. Refer to Table A-8 on page 158 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 2002–2003, the last year for which data is available, most counties paid about $10.00 to $16.00 per cubic yard, with a statewide range of $3.50 to $34.00 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 35 of the State Highway Maintenance Manual. A Wisconsin Transportation Bulletin on salt and sand use is also available at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/best-practices/pdf/iie6.pdf.

BEST PRACTICES: 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.

Dane County is taking prewetting to the next level as it tests a salt slurry generator from Monroe Equipment that first grinds salt into fine particles and then mixes it with liquid deicer to create a slurry. This mixture is then dispensed onto the roadway by a spinner disc. The slurry reportedly begins melting ice faster than standard prewetted salt, and more material stays on the road. This allows operators to reduce the amount of material used—saving time and money and reducing environmental impacts.

For more information on prewetting, see Chapter 35 of the State Highway Maintenance Manual.

A salt slurry generator mounted on a salt truck

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 3.2 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; 53 counties used salt brine for prewetting this winter (see Table A-6 on page 150 of the Appendix for details). Counties used far less salt brine for prewetting this winter—947,444 gallons—due to a significant decrease in the amount of salt used statewide compared with last year's record-breaking winter. Overall use of prewetting liquids decreased 34 percent compared with last year's total, and salt brine use decreased 43 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 page 152 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.

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://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm for details.

While prewetting salt is the best practice in Wisconsin—66 of 72 counties (92 percent) prewetted their salt this winter—prewetting abrasives is far less common. Of the 45 counties that used sand this winter, only 8 counties prewetted it (see Table A-8 on page 158 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.

Table 3.2. Statewide Prewetting Agent Use for Salt

Chemical	Gallons used	Counties using
Salt brine	947,444	53
Calcium chloride-based products		
Calcium chloride – liquid	69,790	17
Calcium chloride with rust inhibitor	9,210	4
Magnesium chloride-based products		
Magnesium chloride	2,411	5
Freeze Guard	218	1
Agricultural-based products		
Ice Ban-M80	5,200	1
Ice Ban-MC95	26,429	10
GeoMelt55	17,212	6
Total	1,077,914 gallons of liquid	66

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. The benefits of anti-icing also include:

- Less chemicals are required to prevent ice bonding than to remove ice after it has bonded to the pavement.
- Clean-up after a storm may be easier with less ice bonded to pavement.
- Application can be made during regular working hours, reducing some overtime costs.
- Anti-icing applications may last for several days, particularly in preventing frost on bridge decks.
- Better pavement conditions (improved friction) can be achieved, reducing the number of crashes.
- It aids in providing more time for the initial response to storms.

This winter, counties used a record 1,164,394 gallons of anti-icing liquid (see Table A-4 on page 142 for details). Currently, 66 of 72 counties (90 percent) are equipped to perform anti-icing operations, and this winter 60 counties made at least one anti-icing application. (Counties may choose not to anti-ice if weather conditions do not warrant it.) On the whole, anti-icing use has steadily increased in Wisconsin since the technology became part of winter operations in the state in 1999. Use of anti-icing materials was up around 62 percent over last year. Throughout the past five winters, use of anti-icing materials has steadily increased.Salt brine, the most commonly used anti-icing agent, has limited effectiveness at temperatures below 15°F. Some counties are mixing agents such as magnesium chloride and GeoMelt55 with salt brine to lower the working temperature of the salt brine. GeoMelt55 is a natural, agricultural product with ice control performance equal to or greater than salt brine. It has a freezing point 38.8° lower than salt brine.

Accurate weather forecast information is critical to the success of anti-icing—if a forecasted storm does not arrive, resources may be wasted; if a storm hits sooner than expected, the opportunity for anti-icing may be lost. Through Wisconsin's Road Weather Information System, counties have access to detailed weather information, including the Maintenance Decision Support System (MDSS), and 60 weather stations with pavement sensors across the state. See page 46 for more information on RWIS.

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 714,860 gallons of anti-icing liquid—the most on record and an increase of 36 percent over last winter's total. Yet at 0.5 percent of total winter expenditures, anti-icing continues to represent a small fraction of winter costs.

For more information on anti-icing, see WisDOT's Winter Information Web page at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/index.shtm (click "Best Practices," then "Anti-icing").

Table 3.3. Cost of Anti-icing vs. Deicing

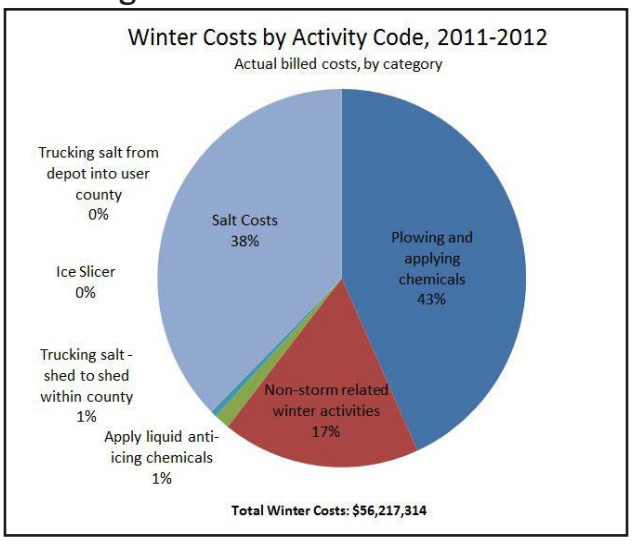
Winter Service Group	Average cost of anti-icing treatment for possible frost				Average cost of deicing treatment for frost event				Counties reporting anti-icing costs
	2008-2009	2009-2010	2010-2011	2011-2012	2008-2009	2009-2010	2010-2011	2011-2012	2011-2012
A	$892	$849	$1,108	$1,812	$5,220	$6,754	$6,999	$7,955	8
B	$818	$876	$803	$1,090	$3,151	$1,802	$3,564	$3,201	7
C	$961	$845	$893	$790	$1,669	$1,994	$3,215	$2,302	11
D	$629	$620	$608	$601	$1,377	$1,266	$1,931	$2,240	10

Anti-icing Costs

In Wisconsin, proactive anti-icing applications for possible frost events are about three times less costly than reactive deicing operations for actual frost events. Table 3.3 compares the two strategies based on storm reports data. Costs vary from year to year in part because of variations in the number of counties reporting this data and the number of events represented.

At $758,266, anti-icing costs made up only 1 percent of total winter maintenance costs this winter (see Figure 3.5). This percentage has remained fairly steady over the years—always around 1 percent of total statewide winter costs. Investing in anti-icing is a cost-effective way to reduce overall materials use.

Figure 3.5. Anti-icing as a Percentage of Winter Costs



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

Anti-icing Agents

As with prewetting, the use of salt brine for anti-icing operations has increased significantly since its introduction a decade ago, including an 85 percent increase between the 2004–2005 and 2006–2007 winter seasons. This winter, 57 of 72 counties (79 percent) used a total of 1,141,159 gallons of salt brine for anti-icing. This is a 10 percent increase compared to last winter. See Table A-6 on page 150 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 3.4 shows the agents used for anti-icing in Wisconsin this winter; see Table A-4 on page 142 of the Appendix for county-by-county anti-icing data.

Table 3.4. Statewide Anti-icing Agent Use

Chemical	Gallons used	Counties using
Salt brine	1,141,159	57
Calcium chloride – liquid	1,831	4
Calcium chloride with rust inhibitor	0	0
Magnesium chloride	3,560	2
Freeze Guard	0	0
Ice Ban-M80	3,830	2
Ice Ban-MC95	8,739	6
Ice Ban-M50	350	1
GeoMelt55	4,925	2
Total	1,164,394	

Figure 3.6. Counties Using Anti-Icing

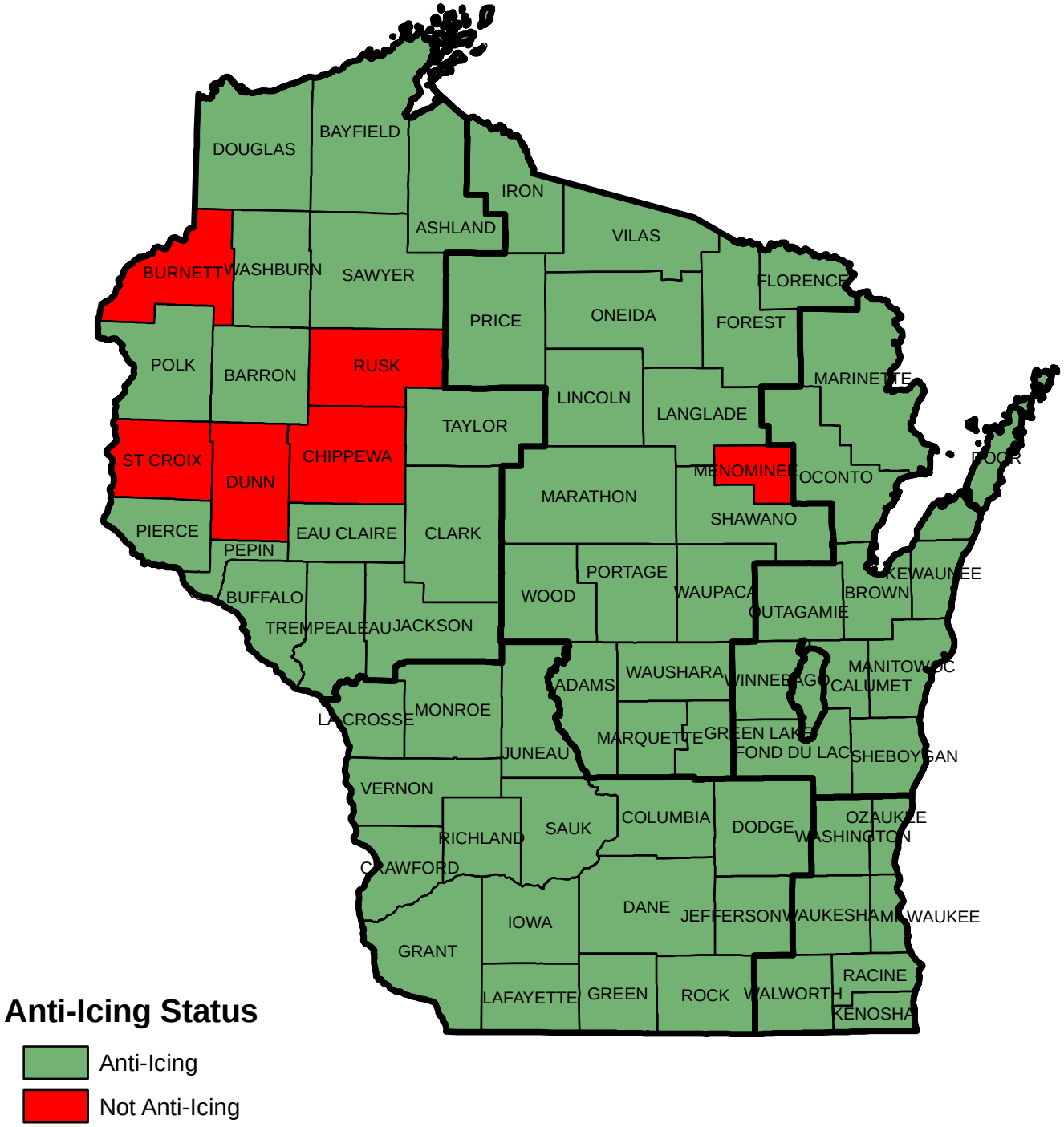


Figure 3.7. Counties Using Closed Loop Ground Speed Controllers

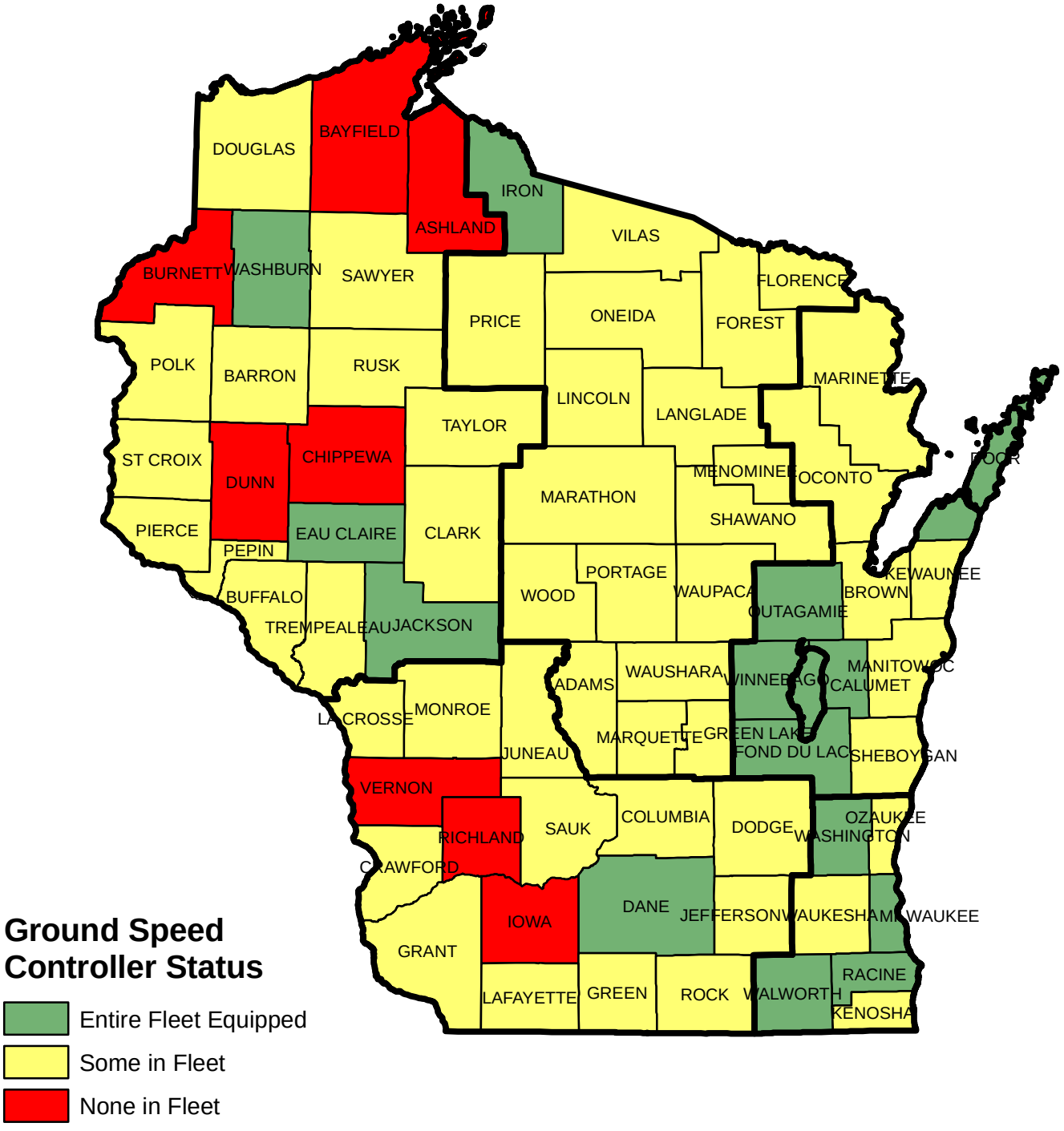


Figure 3.8. Counties Using Underbody Plows

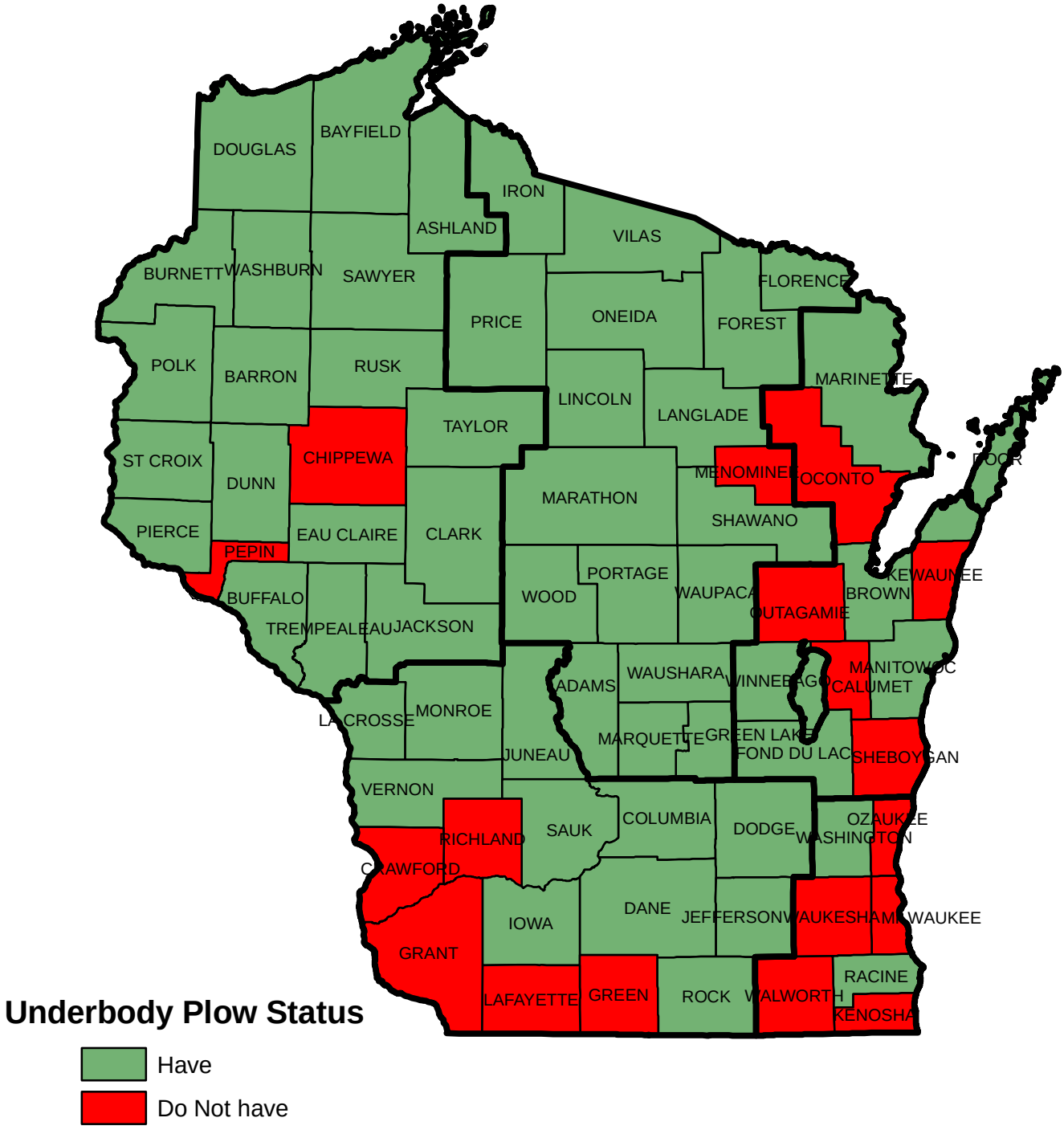
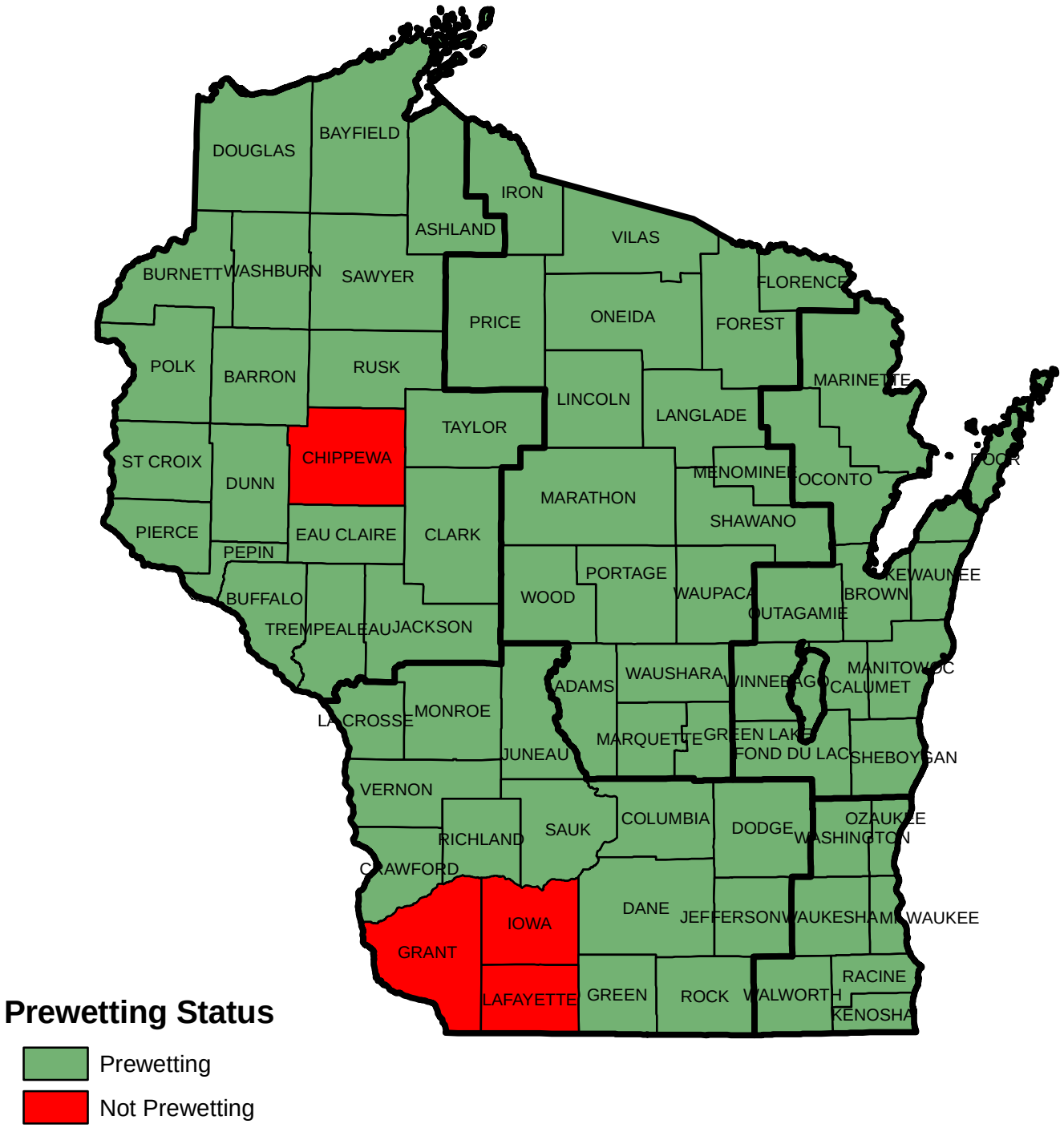


Figure 3.9. Counties Prewetting



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:

- 60 weather and pavement condition sensors along state highways.
- Detailed weather forecasts via the Maintenance Decision Support System (MDSS).
- A winter storm warning service for county highway departments.
- Over 500 mobile infrared pavement temperature sensors on patrol trucks around the state.

Information WisDOT is able to gain from RWIS includes:

- Air temperature
- Humidity
- Wind speed and direction
- Precipitation type and intensity
- Visibility
- Pavement temperature
- Pavement status (wet, icy, etc.)
- Chemical concentration

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.

A roadside weather sensor.

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

- Management of the MDSS implementation.
- Assisting with WisDOT's AVL-GPS implementation.
- Coordinating with Meridian (Wisconsin's contracted weather forecast provider) on forecast services.
- Performing an annual weather forecast verification study, and monitoring comments from counties using the service.
- Providing MDSS and RWIS training for regional operations staff 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. Aurora is a group of states and Canadian provinces whose mission is to perform RWIS-related research.

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 Clarus. Clarus is an FHWA initiative to gather and quality check all RWIS observations.
- 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.
- Establishing a plan for replacement of aging infrastructure, such as roadside towers and television monitors at rest areas.
- Ongoing assessment of new RWIS technology.
- Representing the Bureau of Highway Maintenance Winter Section at The University of Wisconsin Traffic Operations and Safety Lab committee meetings.
- Supporting counties' use of vehicle-mounted infrared pavement temperature sensors.
- RWIS program management (budgeting, billing, planning, etc.).

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 Guideline 36.25 in the Winter Maintenance Manual for more information.

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.

Capabilities. MDSS provides hourly forecasts of all weather conditions. It also provides constantly-updated treatment recommendations based on what actions have already been performed and what weather is predicted into the future. It has a module that provides decision support for summertime operations. It has a robust reporting ability that allows managers to track performance on a storm-by-storm, operator-by-operator, or seasonal basis.

MDSS Pooled Fund. At the time of the initial deployment, WisDOT joined the MDSS Pooled Fund. This group of states had been in existence since 2003 with the goal of researching and deploying the MDSS technologies developed by FHWA. They contracted with Meridian Environmental Technology to provide the service. At the time Wisconsin was beginning its deployment, the MDSS Pooled Fund was operating the only fully functional, commercially available MDSS.

Configuration. In order for MDSS to function properly, accurate descriptions of plow routes are required. Using the same process as had been developed the previous year, BHM continued to provide routes to Meridian for input into MDSS. The routes selected were "representative" routes for each county. That meant BHM worked with the Regions and the county highway departments to determine which routes best represented each county based on a combination of traffic volume, pavement types, and weather conditions.

Integration with AVL/GPS. BHM worked with Meridian to ensure that data was properly flowing from the Automatic Vehicle Location (AVL) systems many of them had installed into MDSS. The biggest issue that arose was the data dictionary for the controller units. Each county was free to name their outputs as they saw fit, leading to materials applied being called numerous names. Resolving this issue was a point of emphasis at the end of the winter season.

Issues. As expected numerous issues arose during the first full season of MDSS use. Some of the most common were:

- Perceived forecast accuracy. Forecast accuracy remained fairly constant compared to the previous winter. Many perceived that quality dropped, mostly because of the change to a new system. This phenomenon also occurred when WisDOT switched from SSI to Meridian in 2005.
- System speed. Many users noted that MDSS ran too slowly on their computers. While Meridian has been unable to pinpoint the cause, one possibility is the large number of routes Wisconsin has input compared to other states.
- Treatment recommendations. Reports of both too much and too little salt being recommended occurred. But if there was a pattern, it was that the treatment recommendations were too high.

MDSS Training. Training was a major focus of the MDSS deployment in 2011-12. BHM worked closely with Meridian (including one person who had deployed MDSS for Indiana DOT before moving to Meridian) to develop a comprehensive training plan. The training was completed in larger groups than the previous year, with emphasis on new features and storm examples. Some one-on-one sessions were also held to bring new users up to speed. Attendees included county patrol superintendents, state patrol, a few highway commissioners, and WisDOT Region personnel.

Current Status

Forecast Routes: 415 in MDSS
Tracking Routes: 321 in MDSS

Future Priorities. Ongoing training will continue, for both new and advanced users. This will again be provided by Meridian and Weather Management Solutions. WisDOT will more fully employ the MDSS management tools to track material usage and crew deployments compared to MDSS recommendations. WisDOT will also work with the MDSS Pooled Fund to develop more a mobile and web-friendly user interface so that supervisors can have easy access, including remote access from the field.

Weather Forecast Service Use and Satisfaction

The weekly winter storm reports ask the counties to report whether they used the Meridian forecast service, and ask them to rate the quality of the forecast if they did use it. The Meridian forecast was used in 78 percent of winter storm events this year, down slightly from the previous winter. Regionally, the usage rate varied from a high of 90 percent in the Southeast Region to a low of 65 percent in the Northwest Region.

The Northeast Region rated the service the highest (2.55 on a scale of 1 to 3), while the Southeast Region rated it lowest at 2.00. The statewide average was 2.17, slightly lower than last year's 2.31. Much of this dropoff can be attributed to the transition to an entirely new forecast system (MDSS).

For more details on the evaluation of the Meridian forecast service, see a summary report on page 123 of the Appendix, or view the full report at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm. For more detail on the use of the service, see Table A-2 on page 130 of the Appendix.

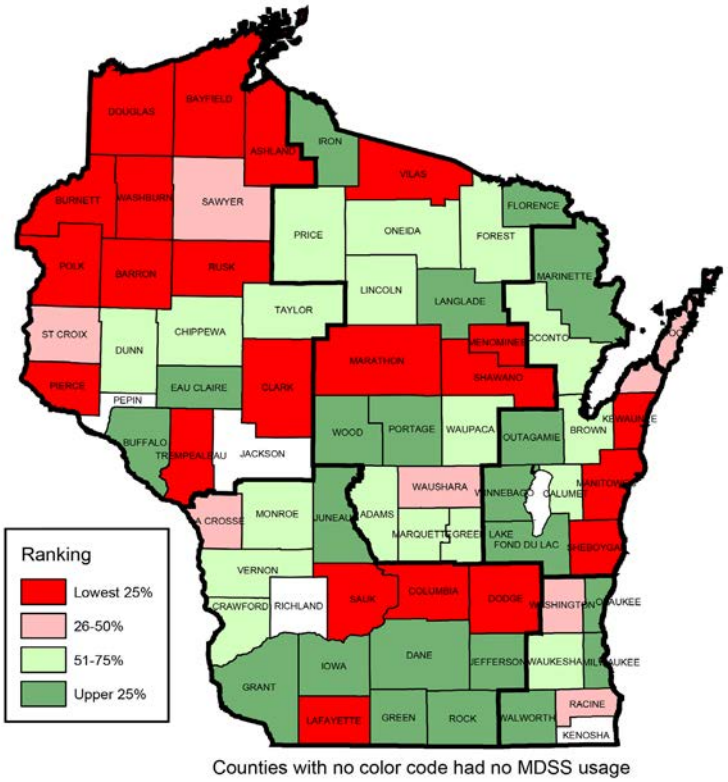
For more information on RWIS activities in Wisconsin, see the program's annual report at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.

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.

2011-12 MDSS Usage
Winter 2011-2012

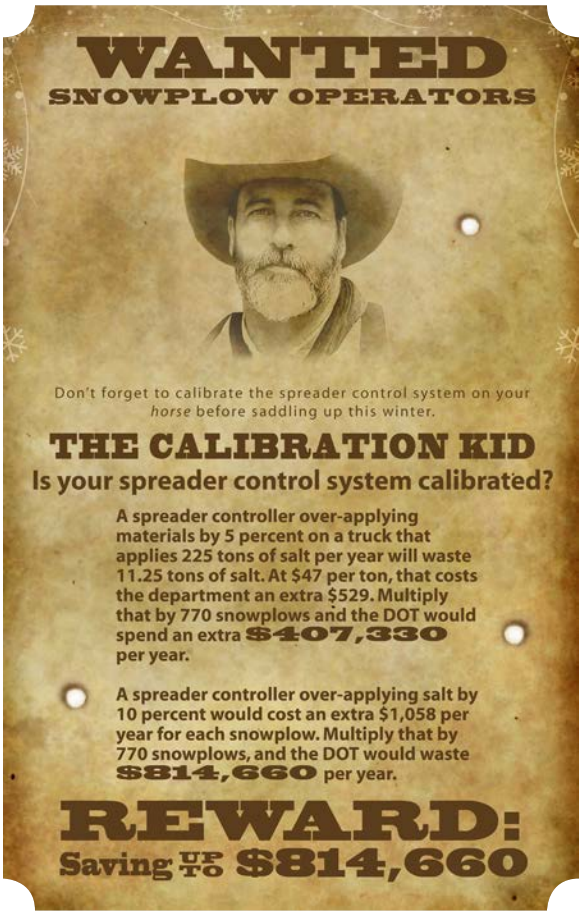


Counties with no color code had no MDSS usage

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 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 the 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. 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 18 member states and has initiated 11 research projects.

CLEAR ROADS
research for winter highway maintenance

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) for a final report and two-page research brief on a project that evaluated the calibration accuracy of manual and ground-speed-control spreaders. The report provides guidelines to help snowplow 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. See http://www.clearroads.org/research-projects/05-02calibration.html.

Other projects that have been completed:

- 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:

- Snow and ice control at extreme temperatures
- Limitations of abrasives
- Post-storm meetings
- Recording material use
- Training winter operations supervisors
- Material spreader use

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

An e-newsletter of winter maintenance news items, publications and research in progress. Read the newsletter online at http://www.clearroads.org/winter-maintenance-news.html.

Clear Roads also initiated a national multimedia winter safety campaign designed to educate drivers about the importance of driving safely in winter conditions. The Clear Roads Web site houses sample campaign materials, photos and videos with the "Ice and Snow… Take It Slow" slogan developed for the campaign. WisDOT used the campaign this winter, both on its Web site and as part of its public service announcements.

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 13 state DOTs, FHWA , and two international agencies. WisDOT became a member of Aurora in 1997. The Aurora program performs research in many RWIS-related areas, some of which have applications in Wisconsin. WisDOT is the project champion on a study of MDSS implementation costs.

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

SICOP. The Snow and Ice Pooled Fund Cooperative Program sponsors testing of new winter maintenance technologies that are developed in the U.S. and internationally. SICOP was developed by AASHTO and is overseen by AASHTO's Winter Maintenance Technical Service Program. WisDOT has been involved in several SICOP programs, including:

- Revising the computer-based training program on anti-icing practices and RWIS systems for snowplow drivers, managers and operators to make it web-compatible.
- Participating in a survey about the use of automatic vehicle location systems and GPS technology in winter maintenance.
- Participating in a survey about the use of Fixed Anti-icing Spray System Technology (FAST).
- Contributing to the Snow and Ice Listserv, a community of hundreds of winter maintenance professionals. The listserv provides a forum for discussing a wide range of winter maintenance issues.

See http://www.sicop.net/ for more information about this pooled fund project.

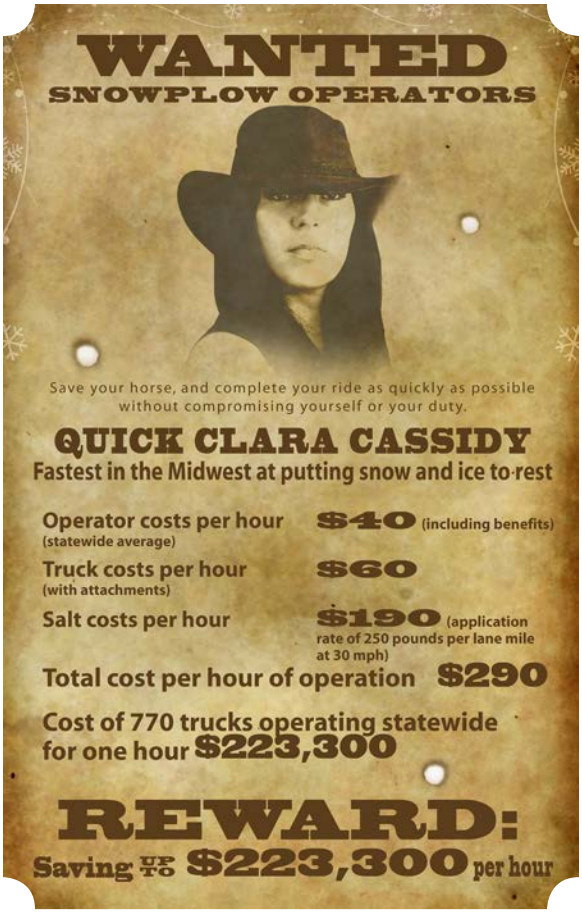
Clarus. A joint effort of FHWA and the National Weather Service, this initiative aims to consolidate all road weather data into a national database. A WisDOT representative attended the annual project meeting in Albuquerque, NM in September 2011. It had been anticipated that Clarus would be transitioned to the National Weather Service in FY 2012. However, funding issues within both FHWA and NWS prevented that from happening. It is possible that the Clarus System will be shut down as of December 31, 2012. It would then not be restarted until NWS obtains funding and prioritizes Clarus integration.

See http://www.clarusinitiative.org/ 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 $17.6 million on labor, for an average of $526 per lane mile. Per-lane-mile labor expenditures decreased 22 percent compared with last year's winter. An average of 24 percent of counties' winter maintenance costs were spent on labor, with a high of 30 percent in the Southeast Region, where hourly labor rates tend to be higher. Labor hours were down 10 percent for regular hours and 40 percent for overtime hours compared with last winter, a significant reduction in light of this winter's decline in overall severity index. See Table 4.10 on page 92 for county-by-county labor expenditures, and see Table 3.6 on page 64 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 seven 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://www.transportation.org/sites/sicop/docs/CBT_Handout.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://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.
- 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 (see https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/best-practices/pdf/vib1.pdf). 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 a major focus of the MDSS deployment in 2011-12. BHM worked closely with Meridian (including one person who had deployed MDSS for Indiana DOT before moving to Meridian) to develop a comprehensive training plan. The training was completed in larger groups than the previous year, with emphasis on new features and storm examples. Some one-on-one sessions were also held to bring new users up to speed. Attendees included county patrol superintendents, state patrol, a few highway commissioners, and WisDOT Region personnel.

Past training efforts have included:

- Winter Operations Workshops. Facilitated by BHO staff, these interactive one-day workshops for WisDOT regional staff and county highway department patrol superintendents covered winter maintenance topics such as use of RWIS and weather forecast programs, anti-icing, living snow fences, and winter maintenance guidelines. The workshops were first held in October 2004 and held again at five locations in October 2005.

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

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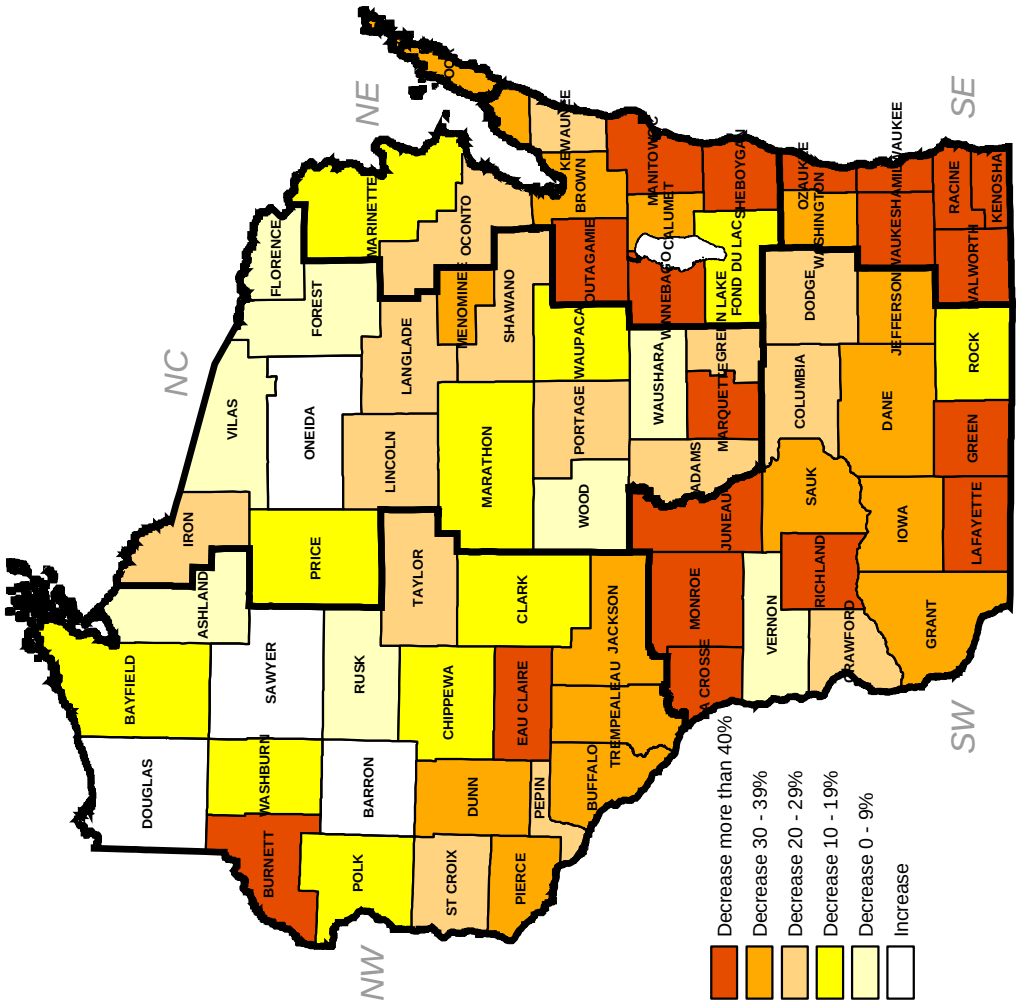
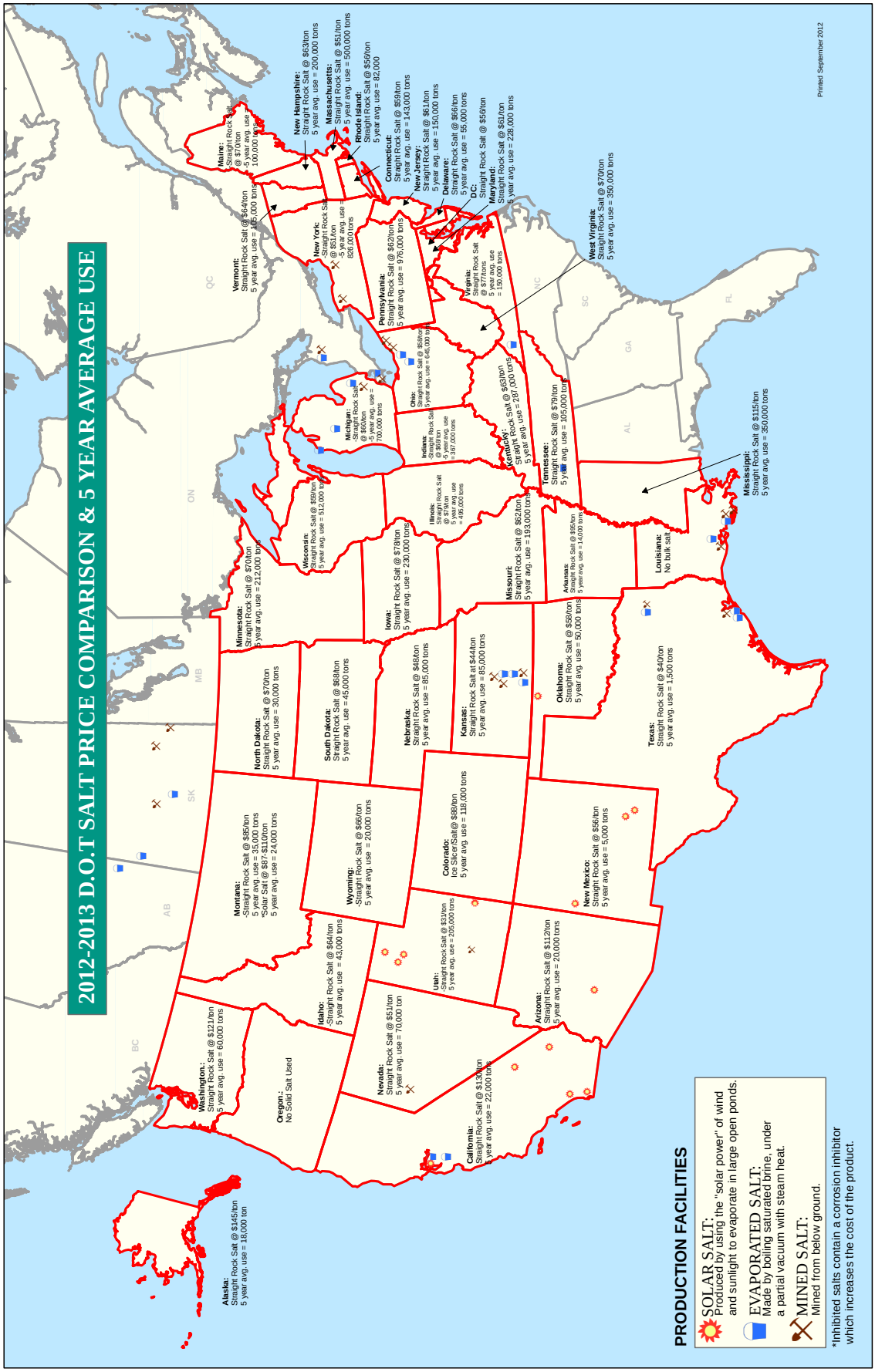
Figure 3.10. 2011-2012 Salt Use per Lane Mile vs. 5-Year Average



County	Departure
LaCrosse	-62%
Green	-55%
Lafayette	-52%
Burnett	-52%
Manitowoc	-52%
Racine	-50%
Waukesha	-49%
Kenosha	-48%
Marquette	-46%
Milwaukee	-46%
Richland	-45%
Outagamie	-45%
Winnebago	-44%
Monroe	-41%
Walworth	-41%
Eau Claire	-41%
Juneau	-41%
Sheboygan	-40%
Ozaukee	-40%
Buffalo	-40%
Iowa	-40%
Pierce	-38%
Jefferson	-38%
Brown	-38%
Sauk	-38%
Calumet	-37%
Trempealeau	-37%
Dane	-35%
Washington	-35%
Jackson	-34%
Door	-33%
Menominee	-31%
Grant	-31%
Dunn	-30%
Lincoln	-30%
Columbia	-28%
Shawano	-28%
Portage	-26%
Crawford	-26%
Saint Croix	-26%
Adams	-25%
Langlade	-25%
Iron	-23%
Green Lake	-22%
Dodge	-21%
Oconto	-21%
Taylor	-21%
Kewaunee	-21%
Pepin	-21%
Chippewa	-19%
Washburn	-19%
Marathon	-18%
Marinette	-14%
Waupaca	-13%
Clark	-13%
Rock	-12%
Price	-12%
Fond du Lac	-12%
Bayfield	-12%
Polk	-11%
Forest	-10%
Rusk	-10%
Vilas	-9%
Vernon	-9%
Ashland	-6%
Waushara	-6%
Wood	-4%
Florence	-3%
Douglas	1%
Oneida	9%
Sawyer	9%
Barron	21%

Figure 3.11 2011-2012 Nationwide Salt Price Comparison Map



Transportation Synthesis Report
RESEARCH & LIBRARY SERVICES
research@dot.state.wi.us

Limitations of the Use of Abrasives in Winter Maintenance Operations

Prepared for
Bureau of Highway Operations

Prepared by
CTC & Associates LLC
WisDOT Research & Library Unit
December 30, 2008

Transportation Synthesis Reports are brief summaries of currently available information on topics of interest to WisDOT staff throughout the department. Online and print sources for TSRs include NCHRP and other TRB programs, AASHTO, the research and practices of other transportation agencies, and related academic and industry research. Internet hyperlinks in TSRs are active at the time of publication, but changes on the host server can make them obsolete. To request a TSR, e-mail research@dot.state.wi.us or call (608) 261-8198.

Request for Report

In the interest of developing more effective winter maintenance operating procedures, WisDOT's Bureau of Highway Operations is interested in knowing more about the limitations of the use of sand in winter maintenance operations. As the lead state for the Clear Roads winter maintenance pooled fund, WisDOT will share the results of this research with the Clear Roads member states.

Summary

While sand, the most common abrasive used in winter maintenance, cannot melt snow and ice, it does play a role in many winter maintenance programs. According to NCHRP Report 526, *Snow and Ice Control: Guidelines for Materials and Methods*, "the primary function of abrasives is to provide temporary traction (friction) improvement on snow/ice surfaces." Many agencies use sand to maintain safety at hills, curves, intersections and low-volume roads, and on packed snow or ice that is too thick for chemicals to penetrate. We summarize **WisDOT's Current Practice** in the use of abrasives in winter maintenance below.

Sand's use over time has declined due to a variety of **Limiting Factors**, including its **Effectiveness**, **Environmental Impacts**, **Safety Implications** and **Cost**. See below for findings from reports and studies that address the limitations of the use of sand in winter maintenance operations. We conclude with **Recommended Best Practices** for the use of abrasives in winter maintenance programs compiled from two 2001 documents.

WisDOT's Current Practice

Chapter 35 of the State Highway Maintenance Manual provides recommendations for the use of abrasives in winter operations. Sand and other locally available abrasive materials can be used when high winds or storm conditions preclude the use of salt, or when pavement temperatures are too low (10°F or less) for deicing agents to work effectively. When conditions warrant, abrasives may be applied to predetermined low-speed areas such as certain grades, curves, intersections, structures and isolated areas where hazards exist. Abrasives should not be used where vehicle speeds exceed 45 mph. Prewetting of abrasives with a deicing agent is recommended to improve adherence to the roadway. Contact the WisDOT Library at library@dot.state.wi.us for a copy of WisDOT's State Highway Maintenance Manual.

Limiting Factors

Effectiveness

Sand has exhibited 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.

- Studies suggest that at highway speeds sand is swept off the road after relatively few vehicle passes (eight to 12) and that friction gains from sanding (when the sand remains on the road) are minimal (Nixon 2001b, page 1).

- Snow- and ice-covered roadways that have been treated with abrasives provide friction values that are far less than "bare" or "wet" pavement (NCHRP, page 25).

- During storm periods when anti-icing operations are successful, abrasive applications provide no consistent or apparent benefit in hard-braking friction, traction or pavement condition (FHWA 1998, page 208 of the PDF).

- Mixing sand with 50 to 100 pounds of salt per cubic yard is necessary to prevent freezing and keep it workable (Wisconsin Transportation Center, page 4).

- A mix of abrasives and chemical will usually be no more effective as an anti-icing treatment during snowstorms than the same amount of chemical placed alone (FHWA 1996b; click on *2.5 Abrasives Use*).

- A 1973 study (Keyser, pages 4-6 of the Word file) indicates that the melting of snow and ice will be delayed by using a mixture of salt and sand.

- In a blend, sand and salt often work against each other. The salt in the mix may blow away as vehicles travel the roadway. If the sand remains on snow, tires can push the sand down into the slush, making it ineffective for improving traction. Also, salt melts less ice when mixed with sand (Wisconsin Transportation Center, page 4).

- Use of salt/abrasives mixes at moderately or much higher application rates than straight chemical does not lead to corresponding improvements in hard-braking friction or pavement conditions. Comparisons of test and control operations using identical salt/abrasives mixes show that more frequent applications at similar rates also do not lead to corresponding improvements in friction or pavement conditions and even indicate that the more frequent applications can lead to slightly worse conditions (FHWA 1998, Section 7.4.1 on page 208 of the PDF).

Environmental Impacts

Studies have shown that sand remains in the environment after its application, resulting in negative impacts on land, water and health.

- An Oregon DOT study in the early 1990s found that 50 to 90 percent of sand applied to pavements remains in the environment after cleanup (FHWA 1996c).

- Up to 70 percent of sand entering Lake Tahoe was shown to be from snow and ice control. Sand was being carried by snowmelt into culverts that drained into the lake (FHWA 1996a).

- Sand creates debris deposits on roadways, mixing with oil, grease and other automotive byproducts. Sand remaining on roadways clogs storm water catch basins and fills streambeds, clouding the water, hurting aquatic animals and leading to an increase in microorganisms. If collected at the end of winter maintenance, sand may have to be disposed of as a hazardous waste. Sand is also ground into a fine dust by traffic, which can trigger respiratory problems like asthma (EPA).

- The use of abrasives can contribute to increased levels of ambient PM_{10}, the very small airborne particulate matter that is inhaled into the lungs and can cause respiratory problems. Researchers found that the use of abrasives increased the rate of road dust re-entrainment. Street sweeping, a practice intended to minimize air quality impacts of roadway abrasives, was found to actually increase the observed emission rate (Gertler, page 5984).

- Uncovered sand piles mixed with salt are susceptible to leaching. One study indicated that 10 inches of precipitation leached out 50 percent of the salt (Walker, page 2).

Safety Implications
Some research has concluded that sand used in a salt-abrasive mixture does not contribute to accident reductions.

- Accident rate reductions on two-lane highways were less with salt-abrasive mixtures than with salt only. Accident rates dropped dramatically after achievement of bare pavement with salt only but more slowly with salt-abrasive mixes. Accident reductions for freeways were much less and took much longer to occur when salt-abrasive mixtures were used, as compared with the use of salt only (Kuemmel and Bari, page 9 of the PDF).

Cost
Research indicates that salt is more cost-effective than sand in winter maintenance operations.

- Abrasives must be used in large quantities and applied frequently, making abrasives more expensive than salt in terms of material and manpower (Salt Institute 2004, page 8).

- When mixed with enough ice control chemical, abrasives will support anti-icing and deicing strategies; however, this is very inefficient and costly, as the abrasives for the most part are "going along for the ride" while the chemical portion of the mix is doing the work (NCHRP, page 14).

- A loaded salt truck, spreading at the rate of 500 pounds per two-lane mile for general storm conditions, can treat a 22.5-mile stretch of roadway, traveling a total of 45 miles. A sand truck requires seven loads, must travel a distance of 187 miles to treat the same section of road, and requires four times more fuel (Salt Institute 1995, page 3).

- Benefit-cost calculations showed that the application of salt-abrasive mixtures did not recover winter maintenance costs on two-lane highways during the 12-hour analysis period. Benefit-cost calculations showed that freeway operations recovered costs in six hours, substantially longer than the 35 minutes with salt only (Kuemmel and Bari, page 11 of the PDF).

- Cost analyses indicate that, where cleanup is performed, the most significant reduction in operational costs will result from the elimination of the use of abrasives as an anti-icing treatment (FHWA 1998, page 208 of the PDF).

- The cost for distributing abrasives on roads is several times higher than those for distribution of salt. Tests carried out on selected road sections in Zurich and Chur, Switzerland, indicate that in a normal winter, the costs for distributing abrasives over a 1-kilometer section are approximately six times higher than those for distributing salt. In a severe winter this factor rose to as high as 10 (Schlup and Ruess, page 49).

- Windshield damage from airborne particulates is 365 percent higher in areas using sand and abrasives instead of salt (Salt Institute 2004, page 9).

Recommended Best Practices

Two 2001 reports published by Wilfrid Nixon provide recommendations for the use of abrasives based on road type. The first report offers general recommendations for the use of dry abrasives (see pages 20-22 of the PDF). The second report expands on those recommendations to consider three different abrasive types: dry abrasives, abrasives prewetted with liquid deicers at the spreader or tailgate, and abrasives applied using a hot method (see pages 44-45). Examples of hot methods include heating abrasives to high temperatures (approximately 180°C) just before application and mixing the abrasives with hot water (about 90°C) as they are placed on the road. Nixon considers the hot application methods experimental, though promising. Nixon's guidelines for abrasive use include:

Rural Roads. Rural roads can see high-speed traffic. For this reason, if electing to apply dry abrasives, limit application to hills and curves on low-speed, low-volume roads. Application of prewetted abrasives on paved roads allows the abrasives to stay on the roadway longer than if the abrasives had been applied dry. Prewetted abrasives can also melt the snowpack and provide for extended increase in road surface friction.

Rural Intersections. Given the low speeds associated with rural intersections, abrasives could be applied dry. However, if the intersection is not gravel, prewetting the abrasive will allow the treatment to remain in place longer.

High-Speed Urban Roads. No benefit is expected when applying dry abrasives to these roads where posted speed limits exceed 30 mph. Application of prewetted abrasives may be appropriate for this road type; hot abrasives may also be considered.

Low-Speed Urban Roads. Limit dry abrasive application to the parts of the road where braking, accelerating or maneuvering is done, and only use this approach when the snowpack is expected to persist. Application of prewetted abrasives will allow the material to remain on the road surface longer. Again, hot application methods may be appropriate.

Urban Intersections. Dry abrasives can be used where the intersection is likely to be snow- or ice-covered for a longer-than-normal period of time. Prewetted abrasives will remain in place longer; hot application methods might also be considered.

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Table 3.5. Labor Hours/Lane Miles/Severity Index Ranking (Group A)

From Winter Storm Reports, 2011-2012

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
LA CROSSE	SW	488.24	27.29	5.16	$244	1431	1019	2450	41.6%	5.02	0.18
OZAUKEE	SE	309.51	18.12	13.22	$206	768	456	1224	37.3%	3.95	0.22
MARATHON	NC	886.17	26.55	8.70	$306	3763	1694	5457	31.0%	6.16	0.23
WINNEBAGO	NE	586.86	18.25	8.33	$231	1334	1399	2733	51.2%	4.66	0.26
DANE	SW	1547.66	24.47	16.46	$347	4098	5635	9733	57.9%	6.29	0.26
PORTAGE	NC	575.31	28.35	8.36	$334	3247	945	4192	22.5%	7.29	0.26
RACINE	SE	681.95	17.33	9.09	$279	1229	1920	3149	61.0%	4.62	0.27
BROWN	NE	716.21	20.55	9.94	$278	2555	1453	4008	36.3%	5.60	0.27
KENOSHA	SE	622.19	16.55	7.80	$322	1953	1097	3050	36.0%	4.90	0.30
WAUKESHA	SE	1100.59	15.12	13.19	$297	3415	2813	6228	45.2%	5.66	0.37
EAU CLAIRE	NW	537.76	18.23	7.39	$313	2300	1454	3754	38.7%	6.98	0.38
MILWAUKEE	SE	1755.71	18.53	12.97	$555	4450	8239	12689	64.9%	7.23	0.39
Group A Avg		817.35	20.78	10.05	$309	2545	2344	4889	43.6%	5.70	0.28

Table 3.5. Labor Hours/Lane Miles/Severity Index Ranking (Group B)

From Winter Storm Reports, 2011-2012

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
SHEBOYGAN	NE	519.42	19.88	9.93	$212	1013	1047	2060	50.8%	3.97	0.20
SHAWANO	NC	519.33	24.62	9.63	$213	1349	1217	2566	47.4%	4.94	0.20
CHIPPEWA	NW	663.13	25.75	10.77	$276	1541	2081	3622	57.5%	5.46	0.21
SAINT CROIX	NW	618.98	21.69	9.58	$249	1284	1569	2853	55.0%	4.61	0.21
WAUSHARA	NC	345.01	17.50	8.52	$158	1100	191	1291	14.8%	3.74	0.21
MANITOWOC	NE	421.09	19.17	7.91	$250	991	768	1759	43.7%	4.18	0.22
COLUMBIA	SW	801.20	17.86	16.48	$199	1709	1524	3233	47.1%	4.04	0.23
DODGE	SW	608.64	23.25	16.99	$262	1583	1780	3363	52.9%	5.53	0.24
SAUK	SW	618.44	23.24	12.72	$233	1886	1537	3423	44.9%	5.53	0.24
WALWORTH	SE	698.71	20.71	12.52	$267	2395	1052	3447	30.5%	4.93	0.24
JEFFERSON	SW	520.94	19.74	13.20	$252	1169	1370	2539	54.0%	4.87	0.25
MARQUETTE	NC	245.23	16.65	8.64	$202	475	535	1010	53.0%	4.12	0.25
ROCK	SW	651.64	18.93	14.47	$248	1420	1756	3176	55.3%	4.87	0.26
WASHINGTON	SE	587.11	19.10	12.05	$282	1169	1886	3055	61.7%	5.20	0.27
DUNN	NW	516.55	17.42	9.50	$269	1163	1408	2571	54.8%	4.98	0.29
OUTAGAMIE	NE	528.93	19.60	8.55	$262	2024	977	3001	32.6%	5.67	0.29
Group B Avg		554.02	20.32	11.34	$240	1392	1294	2686	47.2%	4.79	0.24

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Table 3.5. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2011-2012

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
CRAWFORD	SW	394.85	27.97	7.31	$181	846	784	1630	48.1%	4.13	0.15
MONROE	SW	654.71	23.61	7.25	$169	1368	1127	2495	45.2%	3.81	0.16
WOOD	NC	375.50	31.05	11.02	$258	1021	905	1926	47.0%	5.13	0.17
DOUGLAS	NW	440.77	33.61	12.29	$283	1964	645	2609	24.7%	5.92	0.18
VERNON	SW	464.85	25.94	8.89	$189	1204	966	2170	44.5%	4.67	0.18
KEWAUNEE	NE	110.41	22.33	8.52	$202	254	193	447	43.2%	4.05	0.18
OCONTO	NE	466.31	26.12	8.20	$237	1345	940	2285	41.1%	4.90	0.19
GRANT	SW	624.06	21.80	8.80	$166	1170	1387	2557	54.2%	4.10	0.19
JUNEAU	SW	499.39	21.70	9.44	$210	1033	1051	2084	50.4%	4.17	0.19
DOOR	NE	268.55	22.88	7.29	$252	481	744	1225	60.7%	4.56	0.20
WASHBURN	NW	372.14	23.60	10.24	$257	1056	828	1884	43.9%	5.06	0.21
CLARK	NW	402.44	23.05	9.42	$243	1078	949	2027	46.8%	5.04	0.22
WAUPACA	NC	546.64	16.95	10.51	$198	1353	825	2178	37.9%	3.98	0.24
LAFAYETTE	SW	293.88	20.93	4.10	$236	631	849	1480	57.4%	5.04	0.24
TREMPEALEAU	NW	435.53	16.01	7.32	$169	998	680	1678	40.5%	3.85	0.24
LINCOLN	NC	418.33	32.61	6.95	$339	2421	863	3284	26.3%	7.85	0.24
JACKSON	NW	515.00	25.06	9.02	$273	1911	1221	3132	39.0%	6.08	0.24
CALUMET	NE	201.47	15.81	6.01	$171	494	292	786	37.2%	3.90	0.25
IOWA	SW	458.14	23.17	7.92	$259	1215	1424	2639	54.0%	5.76	0.25

Table 3.5. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2011-2012

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
FOND DU LAC	NE	597.30	24.21	11.79	$333	2059	2054	4113	49.9%	6.89	0.28
Group C Avg		427.01	23.92	8.61	$231	1195	936	2131	44.6%	4.94	0.21

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Table 3.5. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2011-2012

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
BURNETT	NW	233.64	24.10	5.17	$172	416	390	806	48.4%	3.45	0.14
ASHLAND	NW	247.57	42.95	10.41	$305	1224	447	1671	26.8%	6.75	0.16
MARINETTE	NE	419.74	34.49	9.35	$343	1477	841	2318	36.3%	5.52	0.16
POLK	NW	385.05	32.97	11.60	$253	1234	806	2040	39.5%	5.30	0.16
ADAMS	NC	193.82	27.16	11.36	$217	702	169	871	19.4%	4.49	0.17
PIERCE	NW	365.61	19.55	6.60	$187	734	546	1280	42.7%	3.50	0.18
RICHLAND	SW	325.26	19.81	4.68	$171	738	428	1166	36.7%	3.58	0.18
MENOMINEE	NC	90.26	24.38	9.99	$153	341	71	412	17.2%	4.56	0.19
GREEN LAKE	NC	155.54	19.70	5.71	$184	336	240	576	41.7%	3.70	0.19
TAYLOR	NW	234.27	28.66	8.89	$237	886	381	1267	30.1%	5.41	0.19
SAWYER	NW	367.44	31.20	9.38	$290	1291	891	2182	40.8%	5.94	0.19
PRICE	NC	320.57	42.52	12.36	$404	1364	1284	2648	48.5%	8.26	0.19
BAYFIELD	NW	316.90	40.65	11.09	$360	1858	799	2657	30.1%	8.38	0.21
IRON	NC	249.56	43.13	14.37	$466	1453	810	2263	35.8%	9.07	0.21
FLORENCE	NC	141.07	32.94	16.76	$362	547	484	1031	46.9%	7.31	0.22
VILAS	NC	305.24	27.96	18.62	$315	1054	851	1905	44.7%	6.24	0.22
BUFFALO	NW	316.86	16.30	3.44	$151	764	393	1157	34.0%	3.65	0.22
RUSK	NW	213.47	26.86	8.03	$288	859	491	1350	36.4%	6.32	0.24
LANGLADE	NC	292.19	28.23	9.49	$315	1100	887	1987	44.6%	6.80	0.24

Final totals as of Wednesday, June 20, 2012

Table 3.5. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2011-2012

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
BARRON	NW	423.09	29.78	7.09	$320	1941	1099	3040	36.2%	7.19	0.24
GREEN	SW	312.72	17.10	4.02	$181	650	700	1350	51.9%	4.32	0.25
FOREST	NC	312.38	33.25	15.04	$375	1745	995	2740	36.3%	8.77	0.26
ONEIDA	NC	396.79	40.23	16.12	$517	3644	880	4524	19.5%	11.40	0.28
PEPIN	NW	112.38	14.08	5.37	$203	258	225	483	46.6%	4.30	0.31
Group D Avg		280.48	29.08	9.79	$282	1109	630	1739	37.1%	6.01	0.21

Final totals as of Wednesday, June 20, 2012

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4 Performance

In this section...

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, 2011-2012

Total lane miles	33,944
Total patrol sections	770
Average lane miles per patrol section	44.08
Average time to bare/wet pavement[1]	.9 hours
Average crew reaction time from start of storm	1.89 hours
Total winter costs[2]	$56,217,314
Total winter costs per lane mile	$1,656
Total winter crashes[3]	5,241
Total winter crashes per 100 million VMT	20

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 percent of total winter maintenance costs this year. *See page 46 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

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Time to bare/wet pavement (after end of storm)	1 hour, 28 minutes	3 hours, 16 minutes	2 hours, 32 minutes	1 hours 8 minutes	1 hours 28 minutes	54 minutes
Cost per lane mile	$1,549	$2,591	$2,365	$2,222	$2,696	$1,656
Winter Severity Index	28.4	37.2	36.2	26.6	38.5	24.3
Cost per lane mile per Winter Severity Index point	$54.54	$69.65	$65.33	$83.53	$70.03	$68.06
Winter weather crashes	23 per 100 million vehicle miles traveled	43 per 100 million vehicle miles traveled	40 per 100 million vehicle miles traveled	22 per 100 million vehicle miles traveled	35 per 100 million vehicle miles traveled	20 per 100 million vehicle miles traveled

Annual Compass reports are available at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/compass/reports/index.shtm.

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
- MAAPS 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

BEST PRACTICES: MDSS

MDSS combines current weather observations and forecasts with WisDOT's winter maintenance rules of practice to provide users with storm treatment recommendations. These recommendations are based on plow route characteristics like traffic volume, pavement structure, and levels of service.

Weather forecasts, pavement conditions, and treatment recommendations are continuously updated during the storm based on inputs from AVL-GPS and weather and pavement models. When treatment recommendations are followed, salt is used more efficiently.

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

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 770 winter patrol sections, an average of 10.7 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 (Group D). 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://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm 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 87.

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	**41.7**	**29 - 62**
B	**47.7**	**35 - 57**
C	**44.1**	**19 - 61**
D	**48.5**	**37– 61**
Statewide average	**44.1**	**19 - 62**

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. The counties had become more proactive in responding to winter storm events over the last five winter seasons. This winter the average reaction time was 15 percent faster than in 2003–2004. As expected, average reaction times for Group B counties, which provide the highest level of service (24-hour coverage), were less than those counties that provide 18-hour coverage.

In recent years, the statewide average reaction time and has increased somewhat throughout previous winters. However, this past year broke that trend with an average reaction time of 1.49 hours, the lowest reaction time recorded in eight years. Increases in reaction time can often be attributed to increased use of the anti-icing technique. However, faster reaction times can result in higher labor costs.

Table 4.3. Maintenance Crew Reaction Time

From winter storm reports, 2004/2005–2011/2012

	Average reaction time (hours)								Percent change
Winter Service Group	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012	2011–2012 vs. 2004–2005
A	**1.25**	**1.55**	**1.70**	**1.50**	**1.40**	**2.31**	**1.80**	**1.14**	**-9%**
B	**1.97**	**1.59**	**1.80**	**1.73**	**1.91**	**2.34**	**1.77**	**1.17**	**-31%**
C	**2.42**	**2.79**	**2.82**	**2.86**	**2.82**	**3.21**	**2.88**	**2.00**	**-17%**
D	**3.23**	**3.60**	**3.81**	**3.83**	**4.16**	**4.87**	**3.87**	**3.24**	**0%**
Statewide average **(unweighted)**	2.22	2.38	2.53	2.48	2.57	3.18	2.58	1.89	-15%

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 (Category 1) would receive more materials, labor and equipment—and would show a quicker recovery to bare/wet pavement—than a rural, two-lane highway (Category 5). 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 4.3 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.

Table 4.4. Average Time to Bare/Wet Pavement

Highway Category	Average Time to Bare/Wet Pavement (hours after end of storm)					
	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012
1	–2.50	2.20	1.35	-1.02	-0.95	-0.72
2	-0.55	0.76	1.01	-1.58	-0.55	-0.8
3	1.57	3.14	2.40	1.65	2.25	0.18
4	2.70	4.01	3.06	2.32	1.39	1.65
5	2.73	4.84	3.74	2.41	2.92	2.33
Statewide average	1.46	3.27	2.54	1.14	1.49	0.90

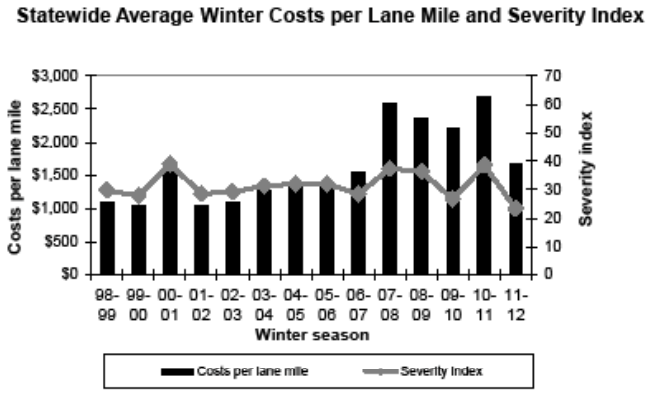
Note: "Average Time to Bare/Wet Pavement" is defined as the time from the end of the storm to the time that the pavement was reported to be bare or wet. A negative "hours after end of storm" number or an extremely low number is caused by a number of storm events when the pavement was reported to be bare/wet before the reported end of the storm or the pavement was bare/wet at the same time as the end of the storm.

The average time to bare/wet pavement decreased over the first four winters that this measure was tracked, but for the winters of 2007–2008 and 2008–2009 multiple factors combined to make it more challenging for crews to clear roads quickly, which increased the statewide average. This winter's statewide average was 0.90 hours which was a significant improvement over last year's extreme winter, compares favorably to the 2009-2010 winter, which had a similar winter severity index but much higher time to bare/wet pavement (1.14 hours). This year's 0.90 hours is the lowest time to bare/wet pavement since this measure began.

4D. Costs

The total billed cost of statewide winter operations this winter was $56.2 million, making it nearly 40 percent less costly than 2010-2011, the most costly winter on record. This figure represents a 9 percent increase over 2006–2007, the last "typical" winter. That was also the most costly winter on record at the regional level, for all regions except the Southwest Region. Counties experienced decreases in salt costs per lane mile, and labor and equipment costs per lane mile decreased about 63 percent compared to last year.

Figure 4.1. Winter Costs per Lane Mile



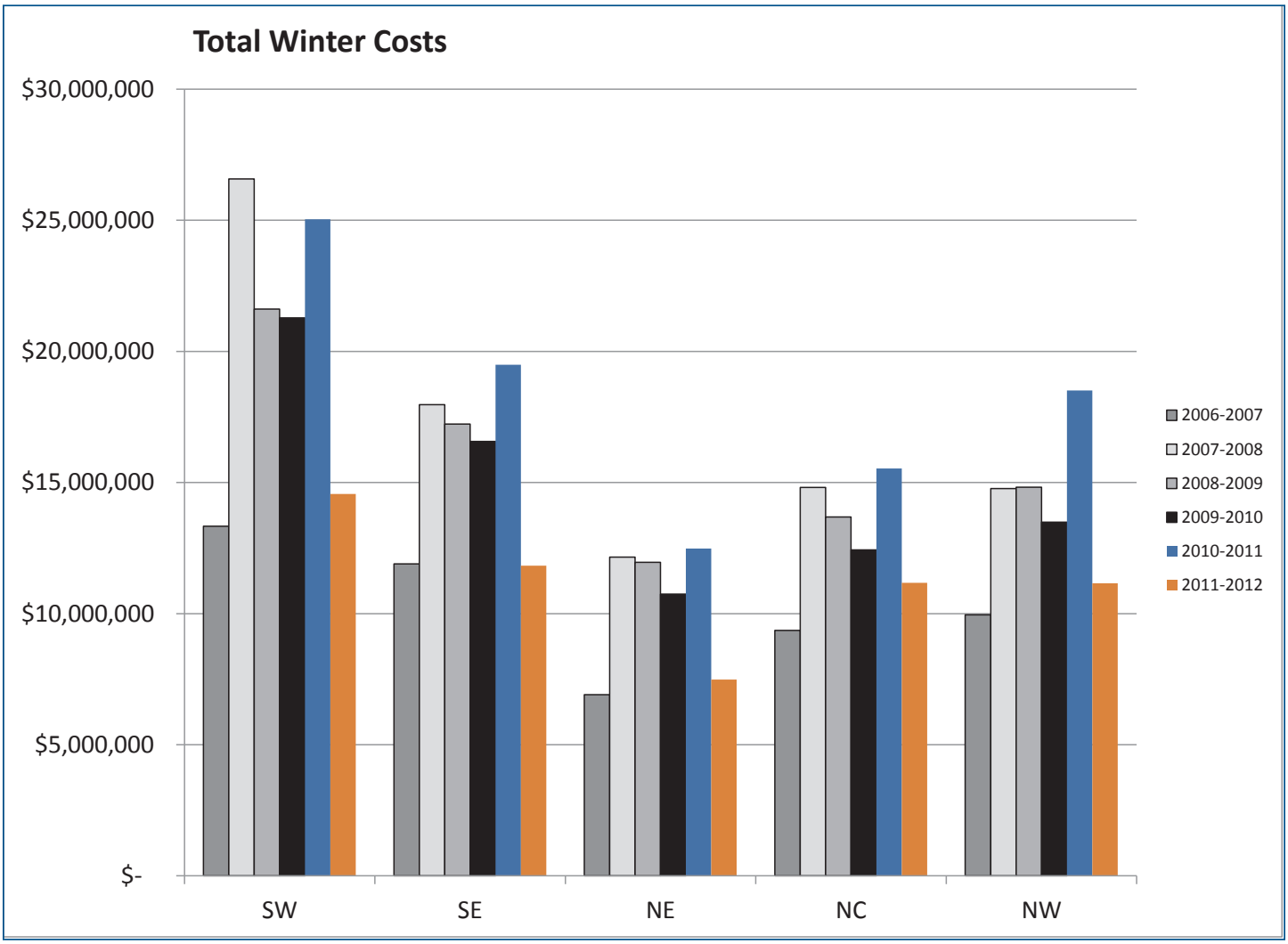
Higher fuel prices have raised salt transportation costs in recent years: The average of $59.65 per ton paid this winter is an increase of one percent over last winter, and an increase of 71 percent compared with the average of $34.98 six winters ago.

As Figure 4.2 shows, all regions experienced a decrease in costs compared with last winter, with the Southwest Region experiencing the most significant decrease in costs. This year's 58 percent less severe winter contributed to this decrease in costs.

Table 4.5. Total Winter Costs Relative to Winter Severity

Region	Average Winter Severity Index	Actual cost per lane mile	Relative cost per severity index point
SW	22.30	$1,572	$70.49
SE	17.92	$2,055	$114.68
NE	22.12	$1,548	$69.98
NC	28.54	$1,755	$61.49
NW	25.61	$1,446	$56.46
Statewide	23.30	$1,656	$71.07

Figure 4.2. Change in Costs Since 2006-2007



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

Seven counties saw severity indices more than 50 percent below average. Brown County's 2011-2012 severity index of 17.33 was 61 percent lower than its average severity index of 45.

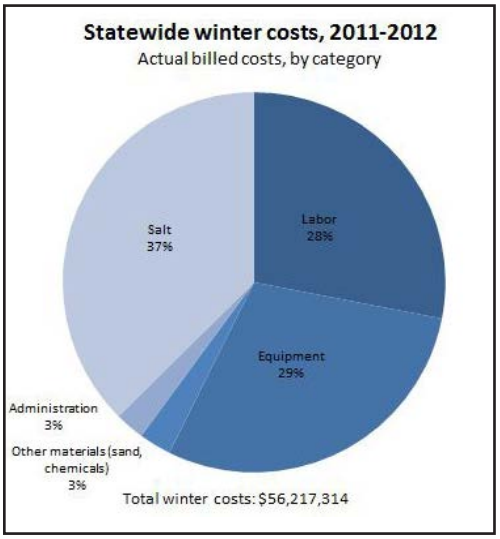
In individual expenditure categories for the 2011–2012 winter, statewide:

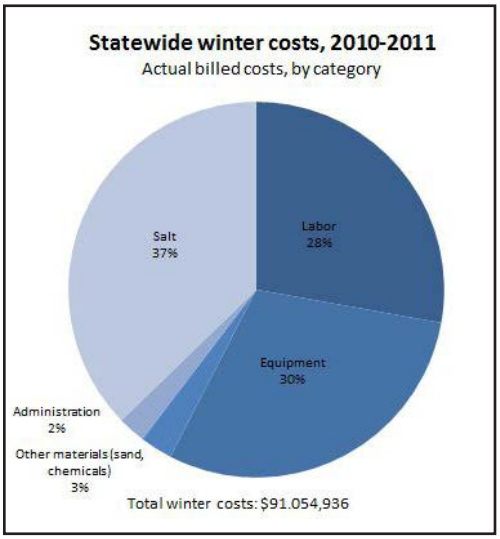
- Salt expenditures were $21.2 million. This was a 38 percent decrease compared to the previous winter, with the Southeast region experiencing the biggest decrease from last winter at 46 percent The North Central region saw the smallest decrease at 24 percent under last year.
- Equipment expenditures were $16.4 million, a decrease of 39 percent compared to the previous winter. the Southwest region experienced the largest decrease of 45 percent compared to 2010-2011.
- Labor expenditures were $15.8 million, a decrease of 38 percent from the previous winter, with the Northwest Region seeing the greatest decrease of 43 percent.
- Expenditures for materials other than salt were $1.5 million, a decrease of 42 percent compared with the previous winter. Expenditures at the regional level ranged from a 9 percent decrease over the 2010–2011 winter in the North Central Region to an 80 percent decrease in the Southeast Region.

Figure 4.5 on page 81 shows each region's expenditures per lane mile in each category.

This winter's statewide average cost per lane mile of $1,656 was much lower than last year's cost of $2,716 per lane mile. This year's cost is comparable to the lower cost averages of about $1,100 to $1,200 common in the late 1990s and early 2000s. Figure 4.2 shows the trends in winter costs per lane mile and severity index over the last 14 winters. On the whole, winter costs per lane mile tend to increase as statewide average severity increases. Increases in labor rates and salt pricing will affect overall winter maintenance cost even in less severe winters. Since this was a relatively mild winter as compared to recent years, it is no surprise that costs were lower than last year.

Figure 4.3. Statewide Winter Costs by Category





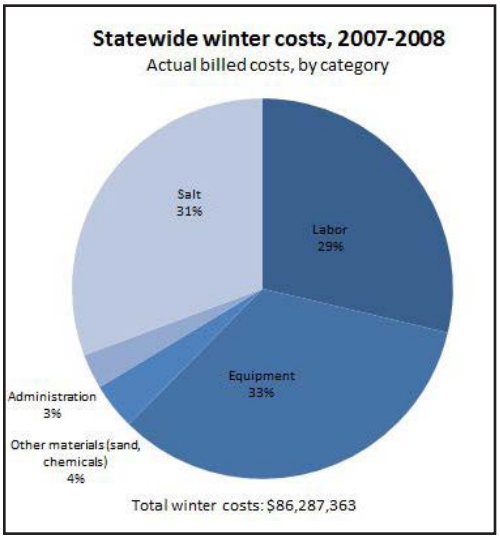
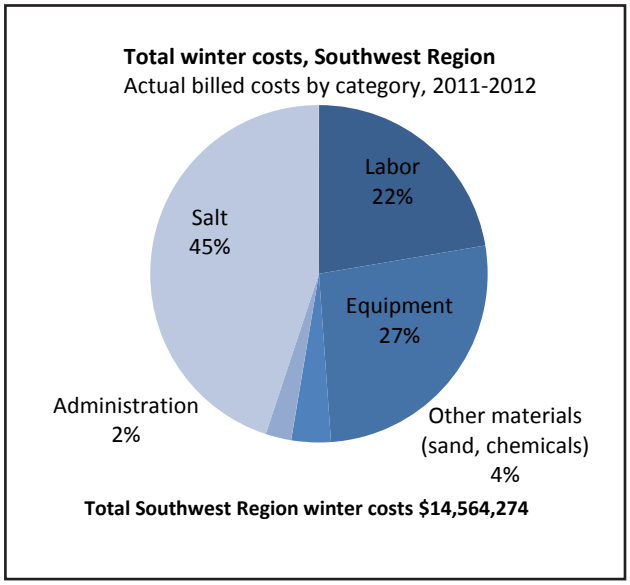
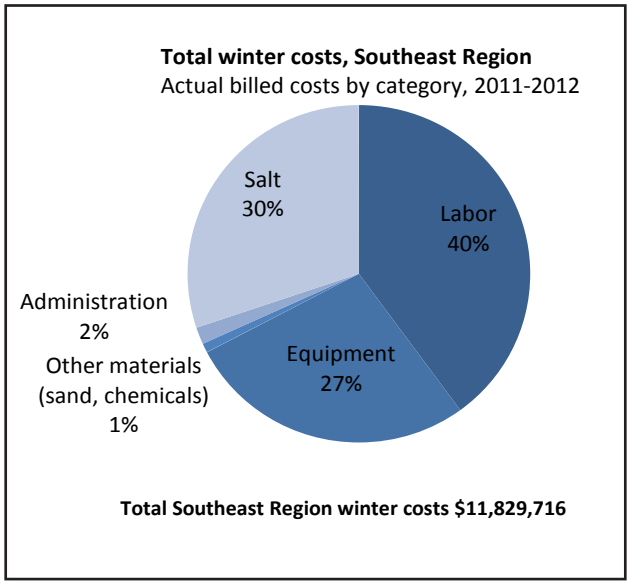
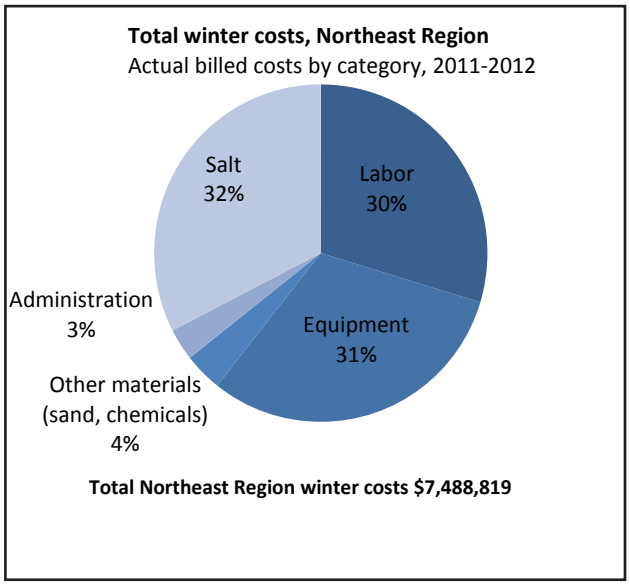
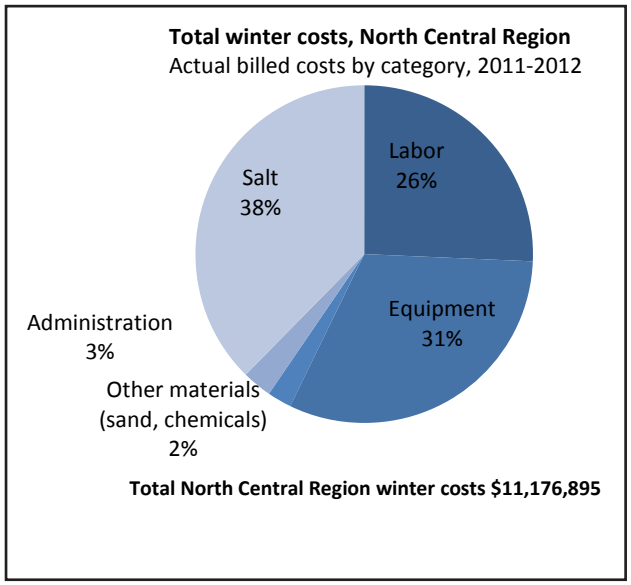


Figure 4.4. Regional Winter Costs by Category









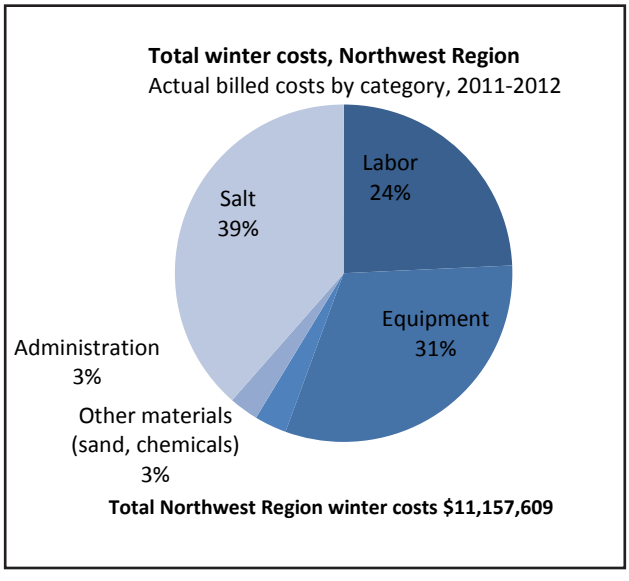


Table 4.6 Winter Costs as Billed to WisDOT by Counties

From the WisDOT accounting system, 2011-2012

	Labor Costs	Equipment Costs	County Furnished Material Costs	Administration Costs	Cost of Salt Used	Total Costs for Winter	Five Year Avg Cost for Winter ('07-'11 avg)	% Costs over Five Year Average
Region 1 / Southwest	$3,250,500	$3,866,775	$549,905	$359,449	$6,537,645	$14,564,274	$21,569,300	68%
Region 2 / Southeast	$4,723,352	$3,239,898	$103,784	$191,692	$3,570,990	$11,829,716	$16,630,000	71%
Region 3 / Northeast	$2,225,038	$2,317,656	$278,467	$228,411	$2,439,247	$7,488,819	$10,850,300	69%
Region 4 / Northcentral	$2,869,890	$3,523,863	$259,989	$316,093	$4,207,060	$11,176,895	$13,166,100	85%
Region 5 / Northwest	$2,707,262	$3,494,660	$345,705	$310,627	$4,299,355	$11,157,609	$14,308,800	78%
Region Totals	**$15,776,042**	**$16,442,852**	**$1,537,850**	**$1,406,272**	**$21,054,298**	**$56,217,314**	**$76,524,500**	**73%**

Figure 4.5. Costs per Lane Mile by Category

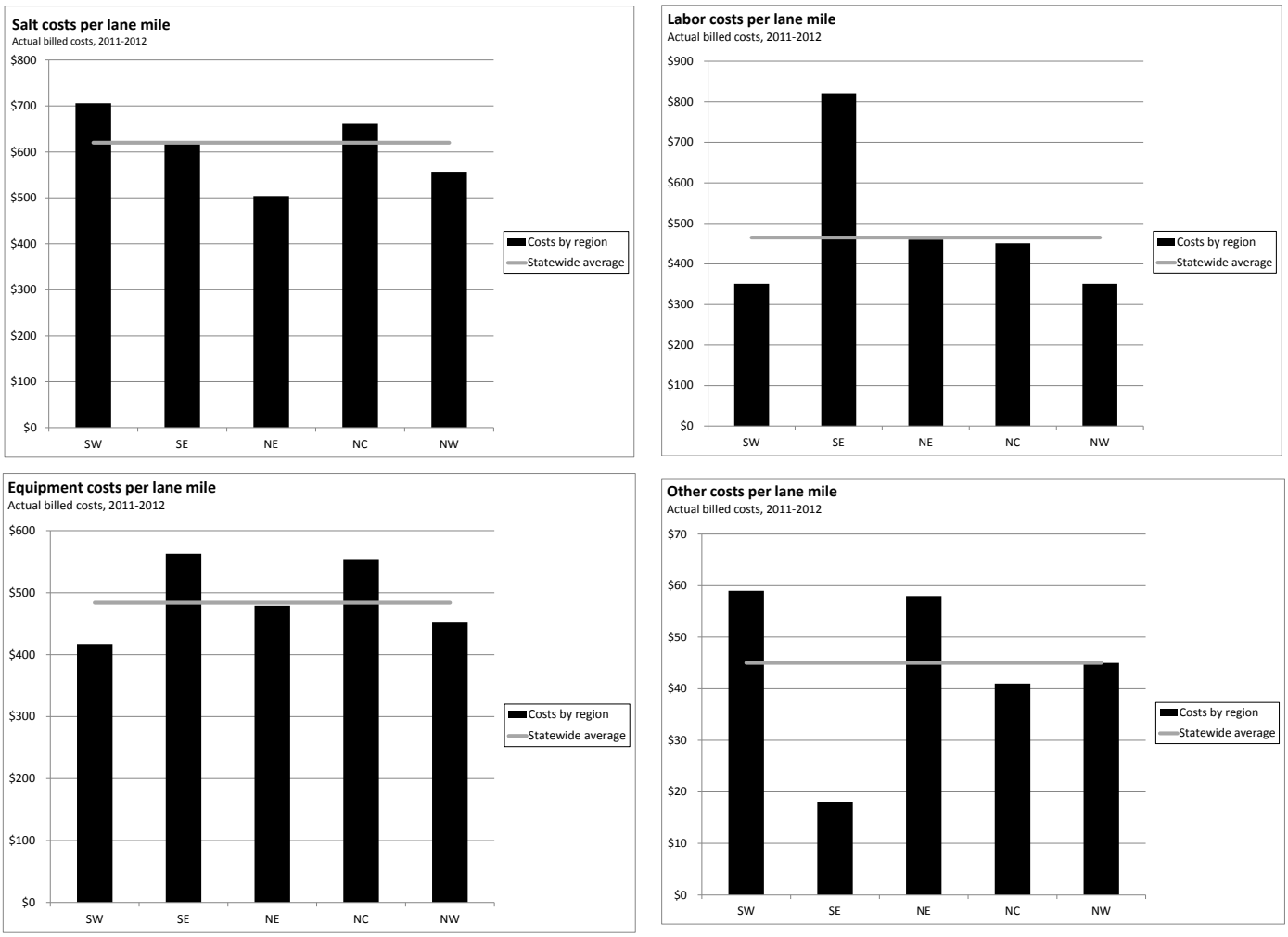


Table 4.5 on page 77 lists the total cost per lane mile for winter maintenance in each region, along with the region's Winter Severity Index. The level of service provided in each county affects total costs, as do the factors listed below. For these reasons, the Southeast Region historically experiences significantly higher costs relative to winter severity than the other regions.

Components of Winter Costs

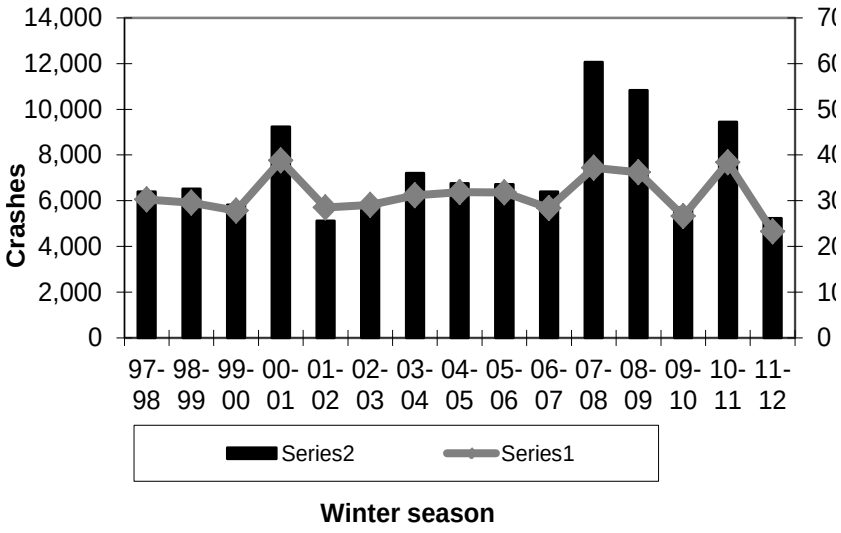
Major components of winter costs include labor, equipment, salt, other materials such as sand and chemicals, and administrative costs. A region's expenditures in each area are affected by the severity of its winter and the portion of its highways receiving 24-hour coverage. In addition:

- 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 3.5 on page 46 for details on deicing agent costs).

Figure 4.6. Winter Crashes and Winter Severity Index



Source: WisDOT Bureau of Transportation Safety

- 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.

A comparison of total costs from year to year shows that the breakdown of costs among these five categories does not change a lot from year to year. To illustrate this, Figure 4.3 shows the breakdown of costs for this winter compared to the more severe winter of 2010-2011 and the winter of 2007–2008, considered to be an "average" winter.

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 79 shows the distribution of costs by category for each region.

Statewide winter cost data is presented in Table 4.6 on page 80. County-by-county cost data is available in Table 4.10 on page 92.

Table 4.7. Crashes and Vehicle Miles Traveled by Region

Region	Average Winter Severity Index	VMT (100 million)	Crashes	Crashes per 100 million VMT (2010-2011)	Crashes per 100 million VMT (2011–2012)
NC	28.54	33.26	753	39	23
NE	22.12	43.66	1,000	38	23
NW	25.61	39.43	870	39	22
SE	17.92	75.43	1,195	27	16
SW	22.30	64.91	1,423	37	22
Statewide	24.33	256.69	5,241	35	20

Source: WisDOT Bureau of Transportation Safety

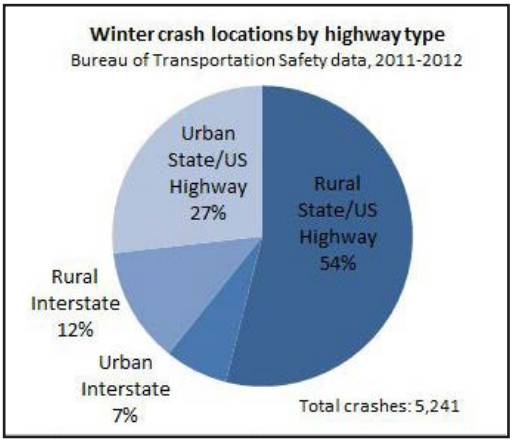
A Note About Cost Data

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 page 98, 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.

Figure 4.7. Winter Crash Locations



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 2011-2012, there were 5,241 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 22, down from last winter's crash rate of 35. Last winter, 9,449 winter crashes were reported.

Crash rates tend to increase in more severe winters, and this winter's rate was similar to the winter of 2009-2010 when the severity index was low. Figure 4.6 shows the trends in total crashes statewide over the last 13 years overlaid with the Winter Severity Index. Due to the record setting number of storms in 2010-2011, it is no surprise that the number of crashes would decrease in 2011-2012.

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 an increase in crash rates compared with last year's unusually low rate. The Northwest Region saw the steepest increase in crash rate, with this year's crash rate at 39 crashes per 100 million VMT reflecting a 44 percent increase over last year's crash rate. The North Central and Northeast regions had decreases in crash rates of 42 percent and 40 percent, respectively. The Southeast region showed the lowest crash rate, reporting 16 crashes per 100 million VMT (see Table 4.7). Table 4.12 on page 105 gives the estimated number of vehicle miles traveled in each county this winter (November 2011 to April 2012), and the number of crashes that occurred in each county.

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.

Total winter VMT for all counties is shown in Table 4.12 on page 105. This winter, total VMT ranged from a low of 14.4 million in Menominee County to a high of 2.8 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.

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 2012 Survey	Lane Miles per Patrol Section	Winter Service Group
Adams	193.82	5	38.76	D
Florence	141.07	3	47.02	D
Forest	312.38	6	52.06	D
Green Lake	155.54	3	51.85	D
Iron	249.56	6	41.59	D
Langlade	292.19	6	48.70	D
Lincoln	418.33	10	41.83	C
Marathon	886.17	22	40.28	A
Marquette	245.23	5	49.05	B
Menominee	90.26	2	45.13	D
Oneida	396.79	10	39.68	B
Portage	575.31	13	44.25	A
Price	320.57	6	53.43	D
Shawano	519.33	14	37.10	B
Vilas	305.24	6	50.87	C
Waupaca	546.64	12	45.55	C
Waushara	345.01	3	115.00	B
Wood	375.50	18	20.86	C
Region Average			**47.95**	

NW Region

County	Lane Miles	Winter Patrol Sections 2012 Survey	Lane Miles per Patrol Section	Winter Service Group
Ashland	247.57	5	49.51	D
Barron	423.09	11	38.46	D
Bayfield	316.90	6	52.82	D
Buffalo	316.86	7	45.27	D
Burnett	233.64	5	46.73	D
Chippewa	663.13	16	41.45	B
Clark	402.44	10	40.24	C
Douglas	440.77	9	48.97	C
Dunn	516.55	11	46.96	B
Eau Claire	537.76	13	41.37	A
Jackson	515.00	9	57.22	C
Pepin	112.38	3	37.46	D
Pierce	365.61	7	52.23	D
Polk	385.05	7	55.01	D
Rusk	213.47	4	53.37	D
Saint Croix	618.98	10	61.90	B
Sawyer	367.44	6	61.24	D
Taylor	234.27	4	58.57	D
Trempeleau	435.53	11	39.59	C
Washburn	372.14	7	53.16	C
Region Average			**49.08**	

NE Region

County	Lane Miles	Winter Patrol Sections 2012 Survey	Lane Miles per Patrol Section	Winter Service Group
Brown	716.21	18	39.79	A
Calumet	201.47	6	33.58	C
Door	268.55	9	29.84	C
Fond du Lac	597.30	16	37.33	C
Kewaunee	110.41	3	36.80	C
Manitowoc	421.09	11	38.28	B
Marinette	419.74	8	52.47	D
Oconto	466.31	10	46.63	C
Outagamie	528.93	16	33.06	B
Sheboygan	519.42	12	43.29	B
Winnebago	586.86	17	34.52	A
Region Average			**38.69**	

SW Region

County	Lane Miles	Winter Patrol Sections 2012 Survey	Lane Miles per Patrol Section	Winter Service Group
Columbia	801.20	16	50.08	B
Crawford	394.85	8	49.36	C
Dane	1547.66	31	49.92	A
Dodge	608.64	16	38.04	B
Grant	624.06	11	56.73	C
Green	312.72	10	31.27	D
Iowa	458.14	11	41.65	C
Jefferson	520.94	14	37.21	B
Juneau	499.39	10	49.94	C
LaCrosse	488.24	13	37.56	A
Lafayette	293.88	6	48.98	C
Monroe	654.71	13	50.36	C
Richland	325.26	6	54.21	D
Rock	651.64	14	46.55	B
Sauk	618.44	14	44.17	B
Vernon	464.85	10	46.49	C
Region Average			**45.78**	

SE Region

County	Lane Miles	Winter Patrol Sections 2012 Survey	Lane Miles per Patrol Section	Winter Service Group
Kenosha	622.19	19	32.75	A
Milwaukee	1755.71	37	47.45	A
Ozaukee	309.51	9	34.39	A
Racine	681.95	17	40.11	A
Walworth	698.71	14	49.91	B
Washington	587.11	15	39.14	B
Waukesha	1100.59	19	57.93	A
Region Average			**43.10**	

	Lane Miles	Winter Patrol Sections 2012 Survey	Lane Miles per Patrol Section
Statewide Totals	33,944.20	770.0	44.08
Statewide Averages	471.45	10.7	44.08
Group A Averages	817.35	19.00	41.69
Group B Averages	544.77	12.41	47.70
Group C Averages	421.21	9.76	44.10
Group D Averages	274.06	5.73	48.51

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

From Winter Storm Reports, 2011-2012

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 precipitations 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)						
LA CROSSE	SW	3.05	3.28	3.08	3.96	3.08	27.29	30.31
PORTAGE	NC	2.01	2.22	2.09	2.21	2.15	28.35	46.92
MARATHON	NC	1.95	2.09	2.35	2.84	2.05	26.55	47.47
BROWN	NE	1.53	1.65	1.22	1.59	1.59	20.55	54.12
WINNEBAGO	NE	1.83	1.83	1.97	2.26	1.83	18.25	54.79
RACINE	SE	0.73	0.94	0.77	1.11	0.95	17.33	58.76
KENOSHA	SE	0.54	0.40	0.22	0.14	0.34	16.55	62.55
OZAUKEE	SE	0.90	0.73	0.59	0.66	0.66	18.12	64.16
EAU CLAIRE	NW	0.46	0.48	1.45	1.30	0.48	18.23	64.42
DANE	SW	-0.09	-0.01	0.02	-0.04	-0.04	24.47	70.89
MILWAUKEE	SE	0.00	0.00	0.00	0.00	0.00	18.53	86.78
WAUKESHA	SE	0.60	0.65	0.57	0.55	0.59	15.12	88.97
Group A Averages		1.13	1.19	1.19	1.38	1.14	20.78	60.85

Final totals as of Wednesday, June 20, 2012

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

From Winter Storm Reports, 2011-2012

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 precipitations 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		
SHAWANO	NC	2.42	2.44	2.41	2.26	2.42	24.62	40.48
MANITOWOC	NE	1.64	1.57	1.11	1.05	1.55	19.17	47.88
WAUSHARA	NC	1.83	1.80	1.69	1.52	1.77	17.50	48.65
SAINT CROIX	NW	0.93	0.93	0.90	1.54	1.03	21.69	50.91
CHIPPEWA	NW	1.73	1.71	1.50	0.95	1.77	25.75	51.82
OUTAGAMIE	NE	0.95	1.14	1.19	1.22	1.24	19.60	51.95
SHEBOYGAN	NE	2.01	1.98	2.05	2.32	1.96	19.88	52.74
WALWORTH	SE	0.03	-0.02	0.03	-0.03	-0.03	20.71	58.81
MARQUETTE	NC	1.76	1.75	2.09	2.14	1.76	16.65	59.06
SAUK	SW	1.10	1.10	1.34	1.17	1.17	23.24	61.07
DUNN	NW	0.79	0.79	0.57	0.69	0.87	17.42	66.00
WASHINGTON	SE	0.58	0.58	0.48	0.43	0.58	19.10	66.58
DODGE	SW	0.29	0.31	0.21	0.45	0.28	23.25	70.02
ROCK	SW	0.51	0.42	0.52	0.53	0.53	18.93	70.36
JEFFERSON	SW	0.98	1.07	0.85	0.85	1.14	19.74	70.66
COLUMBIA	SW	0.36	0.48	0.76	0.63	0.63	17.86	86.45
Group B Averages		1.12	1.13	1.11	1.11	1.17	20.32	59.59

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

From Winter Storm Reports, 2011-2012

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 precipitations 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		
CRAWFORD	SW	2.23	1.95	1.83	2.00	2.00	27.97	31.75
LAFAYETTE	SW	2.28	2.12	2.57	2.66	2.19	20.93	35.42
MONROE	SW	2.08	2.02	1.98	1.88	2.00	23.61	36.35
LINCOLN	NC	3.58	3.57	3.52	3.50	3.52	32.61	36.84
OCONTO	NE	2.22	2.23	2.09	2.42	2.26	26.12	37.50
DOUGLAS	NW	1.91	1.90	1.90	2.21	1.93	33.61	38.41
KEWAUNEE	NE	5.59	3.04	2.44	2.26	2.95	22.33	39.63
VERNON	SW	1.04	1.11	1.13	1.20	1.16	25.94	39.92
WOOD	NC	3.51	3.47	3.54	4.15	3.50	31.05	41.38
DOOR	NE	1.89	1.90	1.87	1.68	1.90	22.88	42.02
GRANT	SW	1.64	1.64	3.10	2.15	1.79	21.80	43.10
IOWA	SW	1.55	1.46	0.99	1.41	1.41	23.17	45.02
CALUMET	NE	1.39	1.25	2.04	2.72	1.64	15.81	47.31
JACKSON	NW	1.61	1.66	1.86	1.80	1.88	25.06	48.85
TREMPEALEAU	NW	1.78	1.68	1.44	1.31	1.52	16.01	49.96
JUNEAU	SW	0.15	0.50	0.54	0.61	0.50	21.70	50.43
WASHBURN	NW	3.32	3.20	3.34	2.62	3.20	23.60	50.59
CLARK	NW	3.06	3.22	3.65	3.72	2.84	23.05	51.48
FOND DU LAC	NE	0.56	0.57	0.62	0.78	0.58	24.21	57.91
WAUPACA	NC	1.26	1.22	1.22	1.35	1.20	16.95	59.85
Group C Averages		2.13	1.99	2.08	2.12	2.00	23.92	44.19

Final totals as of Wednesday, June 20, 2012 **Page 1 of 1**

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

From Winter Storm Reports, 2011-2012

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 precipitations 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)						
BURNETT	NW	4.91	4.41	4.77	4.80	4.78	24.10	28.87
ASHLAND	NW	3.14	3.17	2.96	3.38	2.96	42.95	31.51
BUFFALO	NW	2.28	2.28	2.04	2.14	2.27	16.30	33.40
MARINETTE	NE	3.28	2.81	3.02	2.71	3.32	34.49	34.41
RICHLAND	SW	4.04	3.97	3.89	3.44	4.00	19.81	35.24
GREEN LAKE	NC	4.82	4.82	5.40	4.79	4.74	19.70	36.89
BAYFIELD	NW	3.33	3.32	3.21	2.88	3.15	40.65	37.34
POLK	NW	2.23	2.19	1.94	1.85	2.27	32.97	38.26
PIERCE	NW	4.06	4.29	3.72	3.22	3.87	19.55	39.59
PRICE	NC	2.33	2.46	2.19	2.02	2.46	42.52	39.75
MENOMINEE	NC	4.43	4.23	4.00	4.28	4.15	24.38	40.35
BARRON	NW	2.23	2.10	1.84	1.75	1.84	29.78	40.51
SAWYER	NW	2.86	2.34	2.16	2.59	2.27	31.20	40.61
GREEN	SW	0.98	0.95	0.75	0.75	0.94	17.10	40.65
LANGLADE	NC	3.74	3.60	3.27	3.37	3.66	28.23	43.36
TAYLOR	NW	2.41	2.43	2.42	2.08	2.41	28.66	43.59
RUSK	NW	4.24	3.95	3.80	3.99	3.80	26.86	43.74
IRON	NC	3.72	3.80	3.07	3.90	3.72	43.13	44.44
ADAMS	NC	4.56	4.39	4.84	4.80	4.56	27.16	49.01
FOREST	NC	2.92	3.13	2.40	2.97	2.97	33.25	51.74
ONEIDA	NC	4.64	4.48	4.32	4.14	4.46	40.23	55.21
PEPIN	NW	2.62	2.56	2.71	2.58	2.62	14.08	55.67
FLORENCE	NC	1.88	1.88	2.25	1.45	1.88	32.94	55.74
VILAS	NC	4.34	4.12	3.41	6.25	4.60	27.96	70.98
Group D Averages		3.33	3.24	3.10	3.17	3.24	29.08	42.95

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2012
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 2012 Winter Costs	2012 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 1 / SOUTHWEST												
11	**Columbia**	$362,784	$453	$405,718	$506	$74,925	$94	$38,669	$902,748	13,200	$1,784,844	801.20	$2,228
12	**Crawford**	$122,782	$311	$144,096	$365	$9,814	$25	$13,119	$174,840	2,888	$464,651	394.85	$1,177
13	**Dane**	$737,228	$476	$660,966	$427	$52,143	$34	$67,159	$1,563,797	25,469	$3,081,293	1,547.66	$1,991
14	**Dodge**	$224,134	$368	$331,123	$544	$8,485	$14	$27,012	$621,934	10,338	$1,212,688	608.64	$1,992
22	**Grant**	$168,164	$269	$209,540	$336	$61,655	$99	$20,221	$324,459	5,490	$784,039	624.06	$1,256
23	**Green**	$92,158	$295	$103,955	$332	$6,160	$20	$9,606	$79,769	1,256	$291,648	312.72	$933
25	**Iowa**	$150,982	$330	$181,869	$397	$15,047	$33	$16,422	$217,486	3,629	$581,806	458.14	$1,270
28	**Jefferson**	$159,297	$306	$247,377	$475	$47,938	$92	$20,520	$403,494	6,875	$878,626	520.94	$1,687
29	**Juneau**	$140,498	$281	$187,614	$376	$16,096	$32	$16,433	$326,894	4,713	$687,535	499.39	$1,377
32	**La Crosse**	$155,178	$318	$198,807	$407	$2,305	$5	$16,844	$139,396	2,518	$512,530	488.24	$1,050
33	**Lafayette**	$105,607	$359	$124,186	$423	$48,756	$166	$13,247	$71,130	1,206	$362,926	293.88	$1,235
41	**Monroe**	$129,940	$198	$234,015	$357	$24,187	$37	$18,409	$305,975	4,746	$712,526	654.71	$1,088
52	**Richland**	$68,960	$212	$78,741	$242	$9,539	$29	$7,425	$99,382	1,521	$264,047	325.26	$812
53	**Rock**	$253,991	$390	$295,650	$454	$132,359	$203	$32,497	$521,967	9,432	$1,236,464	651.64	$1,897
56	**Sauk**	$210,983	$341	$275,618	$446	$12,957	$21	$23,660	$525,775	7,865	$1,048,993	618.44	$1,696
62	**Vernon**	$167,814	$361	$187,500	$403	$27,539	$59	$18,206	$258,601	4,131	$659,660	464.85	$1,419
	SW TOTAL	**$3,250,500**	**$351**	**$3,866,775**	**$417**	**$549,905**	**$59**	**$359,449**	**$6,537,645**	**105,277**	**$14,564,274**	**9,264.62**	**$1,572**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2012
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 2012 Winter Costs	2012 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 2 / SOUTHEAST												
30	**Kenosha**	$299,375	$481	$253,799	$408	$19,390	$31	$27,454	$256,490	4,855	$856,508	622.19	$1,377
40	**Milwaukee**	$2,743,965	$1,563	$1,280,368	$729	$17,800	$10	$1	$1,161,953	22,770	$5,204,087	1,755.71	$2,964
45	**Ozaukee**	$280,348	$906	$197,179	$637	$9,547	$31	$23,261	$215,268	4,091	$725,603	309.51	$2,344
51	**Racine**	$299,200	$439	$291,556	$428	$11,962	$18	$28,584	$331,106	6,197	$962,408	681.95	$1,411
64	**Walworth**	$268,269	$384	$362,158	$518	$3,477	$5	$30,404	$441,549	8,747	$1,105,857	698.71	$1,583
66	**Washington**	$288,813	$492	$306,153	$521	$11,099	$19	$28,536	$398,761	7,122	$1,033,362	587.11	$1,760
67	**Waukesha**	$543,382	$494	$548,685	$499	$30,509	$28	$53,452	$765,864	14,516	$1,941,892	1,100.59	$1,764
	SE TOTAL	**$4,723,352**	**$821**	**$3,239,898**	**$563**	**$103,784**	**$18**	**$191,692**	**$3,570,990**	**68,298**	**$11,829,716**	**5,755.77**	**$2,055**
	REGION 3 / NORTHEAST												
5	**Brown**	$265,043	$370	$326,890	$456	$51,860	$72	$30,291	$355,707	7,120	$1,029,791	716.21	$1,438
8	**Calumet**	$69,496	$345	$94,187	$467	$5,067	$25	$8,089	$61,783	1,211	$238,622	201.47	$1,184
15	**Door**	$122,684	$457	$150,572	$561	$37,560	$140	$14,173	$106,248	1,958	$431,237	268.55	$1,606
20	**Fond du Lac**	$284,563	$476	$301,931	$505	$20,527	$34	$29,039	$424,141	7,042	$1,060,201	597.30	$1,775
31	**Kewanee**	$45,976	$416	$56,854	$515	$1,318	$12	$4,997	$49,017	941	$158,162	110.41	$1,433
36	**Manitowoc**	$302,203	$718	$185,959	$442	$47,808	$114	$25,494	$172,325	3,332	$733,789	421.09	$1,743
38	**Marinette**	$137,767	$328	$182,257	$434	$3,995	$10	$15,431	$224,536	3,923	$563,986	419.74	$1,344
42	**Oconto**	$166,878	$358	$200,989	$431	$1,323	$3	$17,705	$216,556	3,825	$603,451	466.31	$1,294
44	**Outagamie**	$315,803	$597	$265,766	$502	$53,625	$101	$30,318	$233,575	4,523	$899,087	528.93	$1,700
59	**Sheboygan**	$271,320	$522	$228,122	$439	$19,423	$37	$24,693	$306,906	5,157	$850,464	519.42	$1,637
70	**Winnebago**	$243,305	$415	$324,129	$552	$35,961	$61	$28,181	$288,453	5,177	$920,029	586.86	$1,568
	NE TOTAL	**$2,225,038**	**$460**	**$2,317,656**	**$479**	**$278,467**	**$58**	**$228,411**	**$2,439,247**	**44,208**	**$7,488,819**	**4,836.29**	**$1,548**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2012
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 2012 Winter Costs	2012 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 4 / NORTHCENTRAL												
1	**Adams**	$90,137	$465	$94,401	$487	$9,823	$51	$9,204	$154,548	2,201	$358,113	193.82	$1,848
19	**Florence**	$66,571	$472	$109,667	$777	$2,181	$15	$8,483	$137,117	2,364	$324,019	141.07	$2,297
21	**Forest**	$147,022	$471	$272,257	$872	$13,732	$44	$20,519	$264,114	4,698	$717,644	312.38	$2,297
24	**Green Lake**	$71,550	$460	$49,165	$316	$4,408	$28	$5,961	$52,728	888	$183,812	155.54	$1,182
26	**Iron**	$170,849	$685	$219,285	$879	$11,269	$45	$19,130	$222,122	3,587	$642,655	249.56	$2,575
34	**Langlade**	$155,313	$532	$166,847	$571	$9,390	$32	$15,727	$150,145	2,774	$497,422	292.19	$1,702
35	**Lincoln**	$182,990	$437	$245,047	$586	$15,308	$37	$21,126	$175,712	2,907	$640,183	418.33	$1,530
37	**Marathon**	$385,822	$435	$468,090	$528	$22,277	$25	$41,687	$505,077	7,709	$1,422,953	886.17	$1,606
39	**Marquette**	$79,489	$324	$78,627	$321	$11,456	$47	$8,022	$127,925	2,119	$305,519	245.23	$1,246
73	**Menominee**	$14,809	$164	$32,804	$363	$3,195	$35	$2,426	$46,967	902	$100,201	90.26	$1,110
43	**Oneida**	$292,782	$738	$350,408	$883	$20,375	$51	$31,497	$414,810	6,398	$1,109,872	396.79	$2,797
49	**Portage**	$255,982	$445	$266,648	$463	$23,038	$40	$25,954	$306,696	4,807	$878,318	575.31	$1,527
50	**Price**	$173,255	$540	$213,823	$667	$8,097	$25	$18,646	$251,331	3,963	$665,152	320.57	$2,075
58	**Shawano**	$167,111	$322	$208,496	$401	$31,552	$61	$19,380	$266,564	5,000	$693,103	519.33	$1,335
63	**Vilas**	$168,882	$553	$233,176	$764	$9,939	$33	$19,504	$390,618	5,683	$822,119	305.24	$2,693
68	**Waupaca**	$187,462	$343	$250,285	$458	$31,656	$58	$22,374	$304,077	5,744	$795,854	546.64	$1,456
69	**Waushara**	$125,163	$363	$118,253	$343	$25,077	$73	$12,695	$170,244	2,940	$451,432	345.01	$1,308
71	**Wood**	$134,701	$359	$146,584	$390	$7,216	$19	$13,758	$266,266	4,138	$568,525	375.50	$1,514
	NC TOTAL	**$2,869,890**	**$451**	**$3,523,863**	**$553**	**$259,989**	**$41**	**$316,093**	**$4,207,060**	**68,822**	**$11,176,895**	**6,368.94**	**$1,755**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2012
Winter Maintenance Costs Per Lane Mile

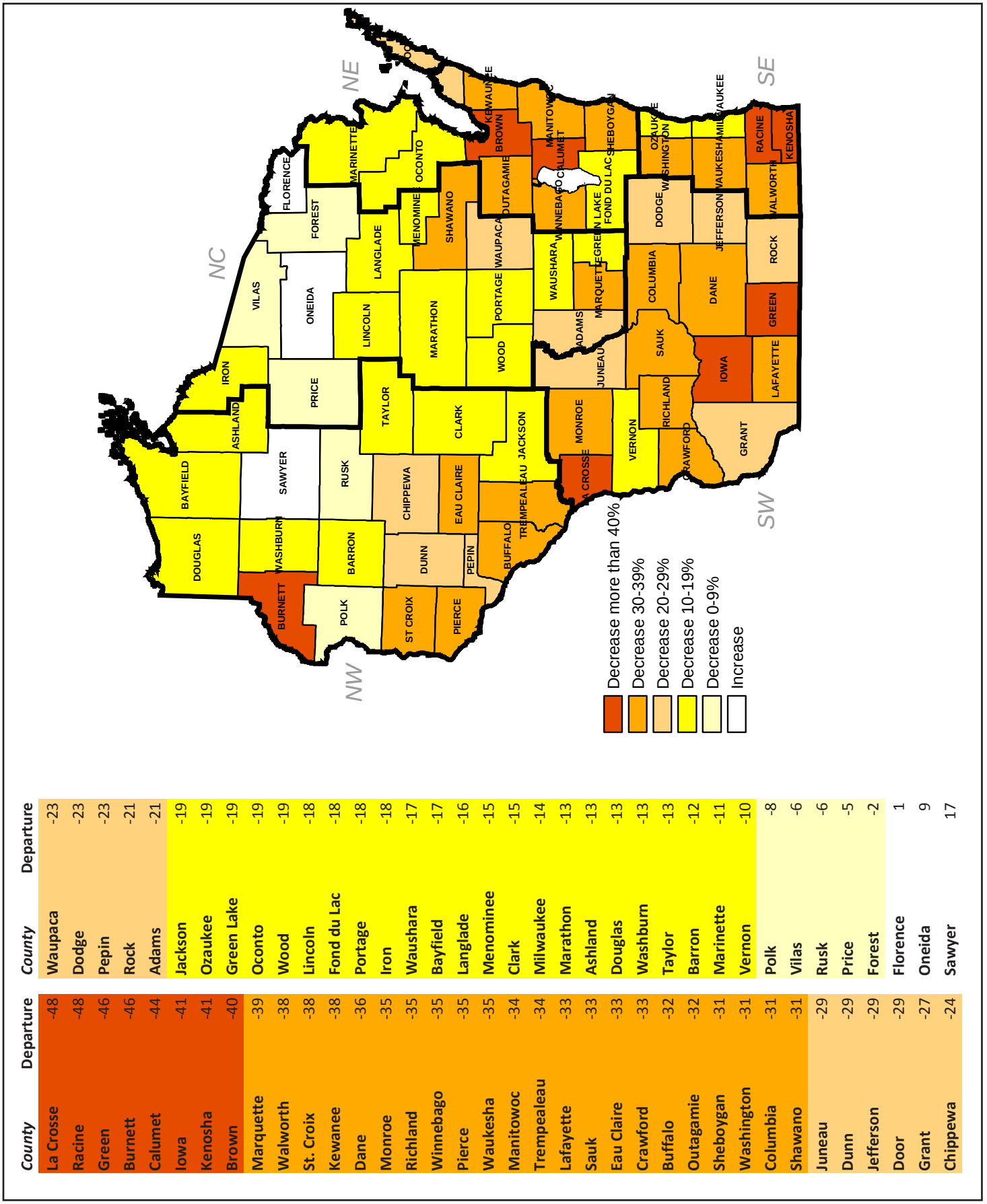
County #		Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2012 Winter Costs	2012 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 5 / NORTHWEST												
2	**Ashland**	$91,667	$370	$163,980	$662	$47,970	$194	$14,469	$157,268	2,577	$475,354	247.57	$1,920
3	**Barron**	$219,590	$519	$249,140	$589	$25,036	$59	$23,038	$184,485	3,001	$701,289	423.09	$1,658
4	**Bayfield**	$145,218	$458	$202,229	$638	$16,200	$51	$17,292	$202,181	3,516	$583,120	316.90	$1,840
6	**Buffalo**	$69,656	$220	$87,186	$275	$2,026	$6	$7,575	$66,029	1,089	$232,472	316.86	$734
7	**Burnett**	$61,552	$263	$72,982	$312	$10,577	$45	$6,802	$68,576	1,209	$220,489	233.64	$944
9	**Chippewa**	$288,356	$435	$247,730	$374	$15,425	$23	$26,205	$456,866	7,139	$1,034,582	663.13	$1,560
10	**Clark**	$151,903	$377	$169,623	$421	$3,323	$8	$15,491	$255,042	3,790	$595,382	402.44	$1,479
16	**Douglas**	$156,244	$354	$283,580	$643	$12,101	$27	$21,470	$297,930	5,419	$771,325	440.77	$1,750
17	**Dunn**	$207,467	$402	$194,642	$377	$17,719	$34	$20,003	$311,599	4,905	$751,430	516.55	$1,455
18	**Eau Claire**	$173,500	$323	$230,281	$428	$38,626	$72	$21,040	$258,083	3,976	$721,530	537.76	$1,342
27	**Jackson**	$132,987	$258	$268,907	$522	$22,317	$43	$20,191	$320,157	4,643	$764,559	515.00	$1,485
46	**Pepin**	$43,719	$389	$32,652	$291	$6,304	$56	$3,929	$39,356	603	$125,960	112.38	$1,121
47	**Pierce**	$135,775	$371	$134,224	$367	$4,672	$13	$13,082	$144,445	2,413	$432,198	365.61	$1,182
48	**Polk**	$128,321	$333	$239,073	$621	$13,275	$34	$18,137	$280,524	4,466	$679,330	385.05	$1,764
54	**Rusk**	$71,133	$333	$107,412	$503	$5,687	$27	$8,608	$110,656	1,715	$303,496	213.47	$1,422
57	**Sawyer**	$134,106	$365	$162,870	$443	$11,198	$30	$14,699	$351,337	5,928	$674,210	367.44	$1,835
55	**St. Croix**	$210,444	$340	$221,432	$358	$60,196	$97	$23,377	$227,884	3,447	$743,333	618.98	$1,201
60	**Taylor**	$76,138	$325	$105,970	$452	$6,711	$29	$8,992	$151,218	2,083	$349,029	234.27	$1,490
61	**Trempealeau**	$105,357	$242	$130,998	$301	$10,320	$24	$11,428	$195,829	3,187	$453,932	435.53	$1,042
65	**Washburn**	$104,129	$280	$189,749	$510	$16,022	$43	$14,799	$219,889	3,809	$544,588	372.14	$1,463
	NW TOTAL	**$2,707,262**	**$351**	**$3,494,660**	**$453**	**$345,705**	**$45**	**$310,627**	**$4,299,355**	**68,914**	**$11,157,609**	**7,718.58**	**$1,446**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2012
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 2012 Winter Costs	2012 LOS Lane Miles	Winter Costs Per Lane Mile
	STATEWIDE SUMMARY												
	SW Region	$3,250,500	$351	$3,866,775	$417	$549,905	$59	$359,449	$6,537,645	105,277	$14,564,274	9,264.62	$1,572
	SE Region	$4,723,352	$821	$3,239,898	$563	$103,784	$18	$191,692	$3,570,990	68,298	$11,829,716	5,755.77	$2,055
	NE Region	$2,225,038	$460	$2,317,656	$479	$278,467	$58	$228,411	$2,439,247	44,208	$7,488,819	4,836.29	$1,548
	NC Region	$2,869,890	$451	$3,523,863	$553	$259,989	$41	$316,093	$4,207,060	68,822	$11,176,895	6,368.94	$1,755
	NW Region	$2,707,262	$351	$3,494,660	$453	$345,705	$45	$310,627	$4,299,355	68,914	$11,157,609	7,718.58	$1,446
	Statewide Totals	$15,776,042	$465	$16,442,852	$484	$1,537,850	$45	$1,406,272	$21,054,298	355,519	$56,217,314	33,944.20	$1,656

Figure 4.8. 2011-2012 Winter Costs vs. 5-Year Average



County	Departure
La Crosse	-48
Racine	-48
Green	-46
Burnett	-46
Calumet	-44
Iowa	-41
Kenosha	-41
Brown	-40
Marquette	-39
Walworth	-38
St. Croix	-38
Kewanee	-38
Dane	-36
Monroe	-35
Richland	-35
Winnebago	-35
Pierce	-35
Waukesha	-35
Manitowoc	-34
Trempealeau	-34
Lafayette	-33
Sauk	-33
Eau Claire	-33
Crawford	-33
Buffalo	-32
Outagamie	-32
Sheboygan	-31
Washington	-31
Columbia	-31
Shawano	-31
Juneau	-29
Dunn	-29
Jefferson	-29
Door	-29
Grant	-27
Chippewa	-24
Waupaca	-23
Dodge	-23
Pepin	-23
Rock	-21
Adams	-21
Jackson	-19
Ozaukee	-19
Green Lake	-19
Oconto	-19
Wood	-19
Lincoln	-18
Fond du Lac	-18
Portage	-18
Iron	-18
Waushara	-17
Bayfield	-17
Langlade	-16
Menominee	-15
Clark	-15
Milwaukee	-14
Marathon	-13
Ashland	-13
Douglas	-13
Washburn	-13
Taylor	-13
Barron	-12
Marinette	-11
Vernon	-10
Polk	-8
Vilas	-6
Rusk	-6
Price	-5
Forest	-2
Florence	1
Oneida	9
Sawyer	17

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

From Winter Storm Reports, 2011-2012

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
LA CROSSE	SW	488.24	27.29	41.9	2518	5.16	0.19	$401,000	$827	30.31
PORTAGE	NC	575.31	28.35	33.1	4807	8.36	0.29	$763,000	$1,330	46.92
MARATHON	NC	886.17	26.55	50.2	7709	8.70	0.33	$1,116,000	$1,260	47.47
BROWN	NE	716.21	20.55	42.0	7120	9.94	0.48	$792,000	$1,112	54.12
WINNEBAGO	NE	586.86	18.25	24.5	4888	8.33	0.46	$579,000	$1,000	54.79
RACINE	SE	681.95	17.33	39.2	6197	9.09	0.52	$691,000	$1,018	58.76
KENOSHA	SE	622.19	16.55	26.1	4855	7.80	0.47	$644,000	$1,035	62.55
OZAUKEE	SE	309.51	18.12	29.0	4091	13.22	0.73	$358,000	$1,163	64.16
EAU CLAIRE	NW	537.76	18.23	29.4	3976	7.39	0.41	$632,000	$1,175	64.42
DANE	SW	1,547.66	24.47	33.3	25469	16.46	0.67	$2,669,000	$1,735	70.89
MILWAUKEE	SE	1,755.71	18.53	29.3	22770	12.97	0.70	$2,816,000	$1,608	86.78
WAUKESHA	SE	1,100.59	15.12	41.9	14516	13.19	0.87	$1,474,000	$1,345	88.97
Group A Averages		817.35	20.78	35.0	9076	10.05	0.51	$1,077,917	$1,217	60.85

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

From Winter Storm Reports, 2011-2012

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
WAUSHARA	NC	345.01	17.50	36.8	2940	8.52	0.49	$294,000	$851	48.65
MANITOWOC	NE	421.09	19.17	32.9	3332	7.91	0.41	$383,000	$918	47.88
MARQUETTE	NC	245.23	16.65	34.2	2119	8.64	0.52	$241,000	$983	59.06
SHAWANO	NC	519.33	24.62	57.0	5000	9.63	0.39	$514,000	$997	40.48
OUTAGAMIE	NE	528.93	19.60	29.6	4523	8.55	0.44	$532,000	$1,018	51.95
SHEBOYGAN	NE	519.42	19.88	33.2	5157	9.93	0.50	$536,000	$1,048	52.74
SAINT CROIX	NW	618.98	21.69	32.0	5928	9.58	0.44	$683,000	$1,104	50.91
DUNN	NW	516.55	17.42	28.7	4905	9.50	0.54	$594,000	$1,150	66.00
WALWORTH	SE	698.71	20.71	38.2	8747	12.52	0.60	$850,000	$1,218	58.81
WASHINGTON	SE	587.11	19.10	43.7	7072	12.05	0.63	$725,000	$1,271	66.58
ROCK	SW	651.64	18.93	24.4	9432	14.47	0.76	$864,000	$1,332	70.36
CHIPPEWA	NW	663.13	25.75	54.4	7139	10.77	0.42	$885,000	$1,335	51.82
JEFFERSON	SW	520.94	19.74	41.8	6875	13.20	0.67	$724,000	$1,395	70.66
SAUK	SW	618.44	23.24	27.1	7865	12.72	0.55	$878,000	$1,420	61.07
COLUMBIA	SW	801.20	17.86	24.8	13200	16.48	0.92	1,237,000	$1,544	86.45
DODGE	SW	608.64	23.25	46.3	10338	16.99	0.73	$991,000	$1,628	70.02

Final totals as of Wednesday, June 20, 2012

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

From Winter Storm Reports, 2011-2012

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 B Averages		554.02	20.32	36.6	6536	11.34	0.56	$683,188	$1,201	59.59

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

From Winter Storm Reports, 2011-2012

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
LAFAYETTE	SW	293.88	20.93	43.3	1206	4.10	0.20	$218,000	$741	35.42
CALUMET	NE	201.47	15.81	29.8	1211	6.01	0.38	$150,000	$748	47.31
TREMPEALEAU	NW	435.53	16.01	20.8	3187	7.32	0.46	$348,000	$800	49.96
MONROE	SW	654.71	23.61	32.1	4746	7.25	0.31	$562,000	$858	36.35
KEWAUNEE	NE	110.41	22.33	37.1	941	8.52	0.38	$98,000	$885	39.63
CRAWFORD	SW	394.85	27.97	31.4	2888	7.31	0.26	$349,000	$888	31.75
GRANT	SW	624.06	21.80	38.5	5490	8.80	0.40	$586,000	$940	43.10
DOOR	NE	268.55	22.88	36.6	1958	7.29	0.32	$257,000	$961	42.02
OCONTO	NE	466.31	26.12	72.3	3825	8.20	0.31	$455,000	$979	37.50
WAUPACA	NC	546.64	16.95	42.1	5744	10.51	0.62	$554,000	$1,014	59.85
VERNON	SW	464.85	25.94	33.8	4131	8.89	0.34	$481,000	$1,035	39.92
IOWA	SW	458.14	23.17	39.6	3629	7.92	0.34	$478,000	$1,043	45.02
JUNEAU	SW	499.39	21.70	29.3	4713	9.44	0.43	$546,000	$1,094	50.43
CLARK	NW	402.44	23.05	44.7	3790	9.42	0.41	$477,000	$1,187	51.48
WASHBURN	NW	372.14	23.60	74.0	3809	10.24	0.43	$443,000	$1,194	50.59
LINCOLN	NC	418.33	32.61	85.4	2907	6.95	0.21	$499,000	$1,202	36.84
JACKSON	NW	515.00	25.06	60.0	4643	9.02	0.36	$630,000	$1,224	48.85

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

From Winter Storm Reports, 2011-2012

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
WOOD	NC	375.50	31.05	43.2	4138	11.02	0.35	$481,000	$1,285	41.38
DOUGLAS	NW	440.77	33.61	111.2	5419	12.29	0.37	$569,000	$1,291	38.41
FOND DU LAC	NE	597.30	24.21	47.0	7042	11.79	0.49	$835,000	$1,402	57.91
Group C Averages		427.01	23.92	47.6	3771	8.61	0.37	$450,800	$1,039	44.19

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

From Winter Storm Reports, 2011-2012

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
BUFFALO	NW	316.86	16.30	20.0	1089	3.44	0.21	$172,000	$544	33.40
GREEN	SW	312.72	17.10	35.7	1256	4.02	0.23	$213,000	$695	40.65
BURNETT	NW	233.64	24.10	64.8	1209	5.17	0.21	$163,000	$696	28.87
RICHLAND	SW	325.26	19.81	33.0	1521	4.68	0.24	$227,000	$698	35.24
GREEN LAKE	NC	155.54	19.70	44.1	888	5.71	0.29	$112,000	$727	36.89
PIERCE	NW	365.61	19.55	29.3	2413	6.60	0.34	$283,000	$774	39.59
PEPIN	NW	112.38	14.08	26.0	603	5.37	0.38	$88,000	$784	55.67
MENOMINEE	NC	90.26	24.38	58.1	902	9.99	0.41	$89,000	$984	40.35
RUSK	NW	213.47	26.86	65.5	1715	8.03	0.30	$251,000	$1,175	43.74
MARINETTE	NE	419.74	34.49	73.7	3923	9.35	0.27	$497,000	$1,187	34.41
BARRON	NW	423.09	29.78	61.1	3001	7.09	0.24	$506,000	$1,206	40.51
LANGLADE	NC	292.19	28.23	88.3	2774	9.49	0.34	$356,000	$1,224	43.36
TAYLOR	NW	234.27	28.66	57.5	2083	8.89	0.31	$290,000	$1,249	43.59
POLK	NW	385.05	32.97	63.9	4466	11.60	0.35	$484,000	$1,262	38.26
SAWYER	NW	367.44	31.20	70.8	3447	9.38	0.30	$465,000	$1,267	40.61
ADAMS	NC	193.82	27.16	30.4	2201	11.36	0.42	$258,000	$1,331	49.01
ASHLAND	NW	247.57	42.95	147.6	2577	10.41	0.24	$335,000	$1,354	31.51

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

From Winter Storm Reports, 2011-2012

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	316.90	40.65	114.2	3516	11.09	0.27	$480,000	$1,518	37.34
PRICE	NC	320.57	42.52	78.4	3963	12.36	0.29	$541,000	$1,690	39.75
FOREST	NC	312.38	33.25	107.9	4698	15.04	0.45	$537,000	$1,720	51.74
FLORENCE	NC	141.07	32.94	100.2	2364	16.76	0.51	$259,000	$1,836	55.74
IRON	NC	249.56	43.13	169.7	3587	14.37	0.33	$476,000	$1,917	44.44
VILAS	NC	305.24	27.96	87.1	5683	18.62	0.67	$604,000	$1,985	70.98
ONEIDA	NC	396.79	40.23	99.4	6398	16.12	0.40	$879,000	$2,221	55.21
Group D Averages		280.48	29.08	71.9	2762	9.79	0.33	$356,875	$1,252	42.95

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2011 - April 2012

COUNTY	CRASHES	CRASHES/ 100,000,000 VMT
ADAMS	20	18
FLORENCE	7	20
FOREST	10	15
GREEN LAKE	20	39
IRON	11	11
LANGLADE	19	18
LINCOLN	58	34
MARATHON	198	29
MARQUETTE	22	17
MENOMINEE	33	229
ONEIDA	76	33
PORTAGE	10	3
PRICE	45	55
SHAWANO	34	13
VILAS	73	50
WAUPACA	46	16
WAUSHARA	67	36
WOOD	4	1
Total	**753**	**23**
BROWN	185	19
CALUMET	35	23
DOOR	20	13
FOND DU LAC	130	27
KEWAUNEE	11	14
MANITOWOC	63	18
MARINETTE	47	22
OCONTO	43	19
OUTAGAMIE	128	20
SHEBOYGAN	60	14
WINNEBAGO	278	39
Total	**1,000**	**23**

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2011 - April 2012

COUNTY	CRASHES	CRASHES/ 100,000,000 VMT
ASHLAND	16	18
BARRON	54	22
BAYFIELD	18	12
BUFFALO	19	21
BURNETT	8	8
CHIPPEWA	52	14
CLARK	34	19
DOUGLAS	52	23
DUNN	72	25
EAU CLAIRE	167	37
JACKSON	53	21
PEPIN	9	22
PIERCE	41	27
POLK	34	16
RUSK	18	23
ST.CROIX	90	18
SAWYER	10	9
TAYLOR	12	13
TREMPEALEAU	62	36
WASHBURN	49	37
Total	**870**	**22**
KENOSHA	133	20
MILWAUKEE	360	13
OZAUKEE	69	16
RACINE	111	16
WALWORTH	91	15
WASHINGTON	172	9
WAUKESHA	259	14
Total	**1,195**	**16**

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2011 - April 2012

COUNTY	CRASHES	CRASHES/ 100,000,000 VMT
COLUMBIA	133	30
CRAWFORD	22	24
DANE	313	15
DODGE	87	21
GRANT	78	31
GREEN	34	24
IOWA	46	25
JEFFERSON	82	18
JUNEAU	43	14
LA CROSSE	162	40
LAFAYETTE	20	19
MONROE	78	24
RICHLAND	28	29
ROCK	143	21
SAUK	112	30
VERNON	42	33
Total	**1,423**	**22**
Statewide Totals	**5,241**	**20**

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

Bureau of transportation Safety data, Nov. 1, 2011 - April 30, 2012 State, U.S. and Interstate Highways only

NC 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
ADAMS	20	0	20	0	0	0	0	0	20	0	0
FLORENCE	7	0	7	0	0	0	0	0	7	0	0
FOREST	10	0	10	0	0	0	0	0	10	0	0
GREEN LAKE	20	1	19	0	0	1	0	0	19	0	0
IRON	11	0	11	0	0	0	0	0	11	0	0
LANGLADE	19	3	16	0	0	3	0	0	16	0	0
LINCOLN	58	2	56	0	0	2	0	0	17	39	0
MARATHON	198	54	124	6	14	19	35	0	42	82	0
MARQUETTE	22	0	10	0	12	0	0	0	10	0	0
ONEIDA	33	1	32	0	0	0	1	0	28	4	0
PORTAGE	76	21	26	13	16	11	10	0	11	15	0
PRICE	10	0	10	0	0	0	0	0	10	0	0
SHAWANO	45	3	42	0	0	2	1	0	17	25	0
VILAS	34	0	34	0	0	0	0	0	34	0	0
WAUPACA	73	0	73	0	0	0	0	0	29	44	0
WAUSHARA	46	0	32	0	14	0	0	0	31	1	0
WOOD	67	42	25	0	0	11	31	0	23	2	0
MENOMINEE	4	0	4	0	0	0	0	0	4	0	0
TOTAL	753	127	551	19	56	49	78	0	339	212	0

NE 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
BROWN	185	119	29	27	10	32	87	0	16	13	0
CALUMET	35	8	27	0	0	1	7	0	19	8	0
DOOR	20	3	17	0	0	2	1	0	12	5	0
FOND DU LAC	130	22	108	0	0	15	7	0	47	61	0
KEWAUNEE	11	0	11	0	0	0	0	0	11	0	0
MANITOWOC	63	18	25	1	19	13	5	0	24	1	0
MARINETTE	47	5	42	0	0	4	1	0	29	13	0
OCONTO	43	0	43	0	0	0	0	0	15	28	0
OUTAGAMIE	128	48	80	0	0	18	30	0	47	33	0
SHEBOYGAN	60	11	32	0	17	6	5	0	14	18	0
WINNEBAGO	278	67	211	0	0	31	36	0	40	171	0
TOTAL	1,000	301	625	28	46	122	179	0	274	351	0

NW 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
ASHLAND	16	6	10	0	0	4	2	0	10	0	0
BARRON	54	1	53		0	1	0	0	26	27	0
BAYFIELD	18	0	18	0	0	0	0	0	18	0	0
BUFFALO	19	0	19	0	0	0	0	0	19	0	0
BURNETT	8	0	8	0	0	0	0	0	8	0	0
CHIPPEWA	52	7	45	0	0	1	6	0	17	28	0
CLARK	34	0	34	0	0	0	0	0	16	18	0
DOUGLAS	52	22	19	11	0	12	10	0	6	13	0
DUNN	72	14	32	2	24	13	1	0	29	3	0
EAU CLAIRE	167	71	21	48	27	6	65	0	11	10	0
JACKSON	53	0	20	0	33	0	0	0	18	2	0
PEPIN	9	0	9	0	0	0	0	0	9	0	0
PIERCE	41	5	36	0	0	5	0	0	36	0	0
POLK	34	0	34	0	0	0	0	0	32	2	0
RUSK	18	0	18	0	0	0	0	0	18	0	0
ST. CROIX	90	6	45	3	36	3	3	0	34	11	0
SAWYER	10	0	10	0	0	0	0	0	8	2	0
TAYLOR	12	0	12	0	0	0	0	0	11	1	0
TREMPEALEAU	62	0	52	0	10	0	0	0	52	0	0
WASHBURN	49	0	49	0	0	0	0	0	17	32	0
TOTAL	870	132	544	64	130	45	87	0	395	149	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	133	20	67	4	42	12	8	0	18	49	0
MILWAUKEE	360	246	0	114	0	71	174	1	0	0	0
OZAUKEE	69	19	14	5	31	7	12	0	6	6	2
RACINE	111	68	22	1	20	35	32	1	17	5	0
WALWORTH	91	8	65	4	14	6	2	0	49	16	0
WASHINGTON	172	77	95	0	0	27	50	0	41	54	0
WAUKESHA	259	109	68	58	24	21	88	0	29	39	0
TOTAL	1,195	547	331	186	131	179	366	2	160	169	2

SW Region

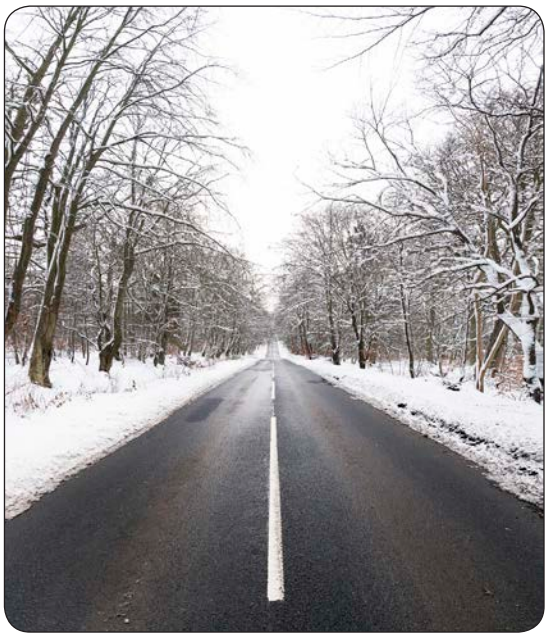
COUNTY	TOTAL	Urban STH	Rural STH	Urban IH	Rural IH	Urban State Highway			Rural State Highway		
						Non-div	Divided	Unkn	Non-div	Divided	Unkn
COLUMBIA	133	5	57	7	64	4	1	0	50	7	0
CRAWFORD	22	0	22	0	0	0	0	0	21	0	1
DANE	313	123	113	16	61	17	105	1	64	49	0
DODGE	87	8	79	0	0	6	2	0	41	38	0
GRANT	78	2	76	0	0	1	1	0	65	11	0
GREEN	34	3	31	0	0	1	2	0	28	3	0
IOWA	46	0	46	0	0	0	0	0	21	25	0
JEFFERSON	82	21	46	0	15	19	2	0	32	14	0
JUNEAU	43	0	19	0	24	0	0	0	18	1	0
LA CROSSE	162	69	48	27	18	28	41	0	35	13	0
LAFAYETTE	20	0	20	0	0	0	0	0	15	5	0
MONROE	78	8	31	2	37	6	2	0	29	2	0
RICHLAND	28	0	28	0	0	0	0	0	25	3	0
ROCK	143	47	66	8	22	20	27	0	55	10	1
SAUK	112	12	52	0	48	6	6	0	35	17	0
VERNON	42	0	42	0	0	0	0	0	40	2	0
TOTAL	1,423	298	776	60	289	108	189	1	574	200	2

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.

*2012 figures are preliminary at this time.
**Does not include deer or other animal crashes

5 Looking Ahead

The winter of 2011-2012 was one of the milder winters in recent history. Consequently salt use was the lowest since 2002-2003. In most of the state the winter essentially ended about the second week of March. This allowed the county service providers time to catch up on other non-winter items such as brushing and shouldering and to begin gearing up for an early construction season.



In 2012-2013, WisDOT will continue to focus on the use of best practices and begin concentrating any available monies on service providers who are implementing and expanding the best practices.

Areas of focus for the 2012-2013 winter:

1. AVL/GPS (Automatic Vehicle Location/Global Positioning System) has become standard equipment and is now being utilized in 45 counties. The effort to implement the technology statewide is proceeding with a higher emphasis on counties with Interstates and Expressways and counties who are actively using the MDSS forecasting-treatment recommendation program.

2. Currently AVL/GPS data is being transmitted via the wireless cell phone network. As part of the implementation process each county was provided with WiFi antennas as a backup to the cell phone system. For the winter of 12-13 we are begin moving several of the auxiliary and helper trucks off the cell phone network and onto the WiFi network. This move will lead to significant monthly communication cost savings. Many WiFi antennas will need to be installed soon to accommodate this change. WisDOT only expects the WiFi antennas to be installed at locations where internet access already exists, to save costs.

3. Once more service providers implement the AVL-GPS systems, WisDOT will begin looking into different methods of optimizing routes. This research will most likely take place in 12-13.

4. The majority of service provider counties use the Precise system to access their AVL-GPS information. During the late summer or early fall of 12-13 we will undergo a statewide training program that will help the counties better understand and utilize the software.

5. The MDSS system is continuing to improve and move towards accessibility on smart phones for next winter. WisDOT will begin implementing the improved reporting capabilities of MDSS. Reporting down to route level will be explored since this will enable WisDOT to more easily track material usage down to a smaller scale. Additional training will be provided.

6. In 2012 salt bid provisions were added for the inclusion of alternate de-icing products. The two products included in the bid are ThawRox from North American Salt and ClearLane from Cargill. Several counties in the state will be allowed to purchase these products instead of dry rock salt and will begin testing them on the state highways. The products will be tested by counties that currently do not prewet their salt and by interstate counties in extremely low temperature storms.

7. Wisconsin is the lead state in a Clear Roads study that will investigate better techniques of snow/ice removal during storms with extremely cold temperatures. The study will be conducted during the 12-13 winter.

8. Wisconsin is also the lead state in a second Clear Roads project that will produce snowplow operator training modules for training operator and supervisors across the country. Production of the training is expected to be completed in 12-13.

9. WisDOT will continue evaluating the costs and benefits of Tow Plows. The TowPlow from Marquette County will be moved and tested in another, yet to be determined, county next winter.

10. Automation of the storm reporting system will continue into 12-13. Testing between the information provided through MDSS versus county scales will be investigated before the automated system is fully rolled out.

11. Standing corn purchasing program was deemed a success in many areas of Wisconsin will be continued.

Appendix

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Wisconsin Department of Transportation
New regional organization
Effective May 29, 2005 (updated July 18, 2005)

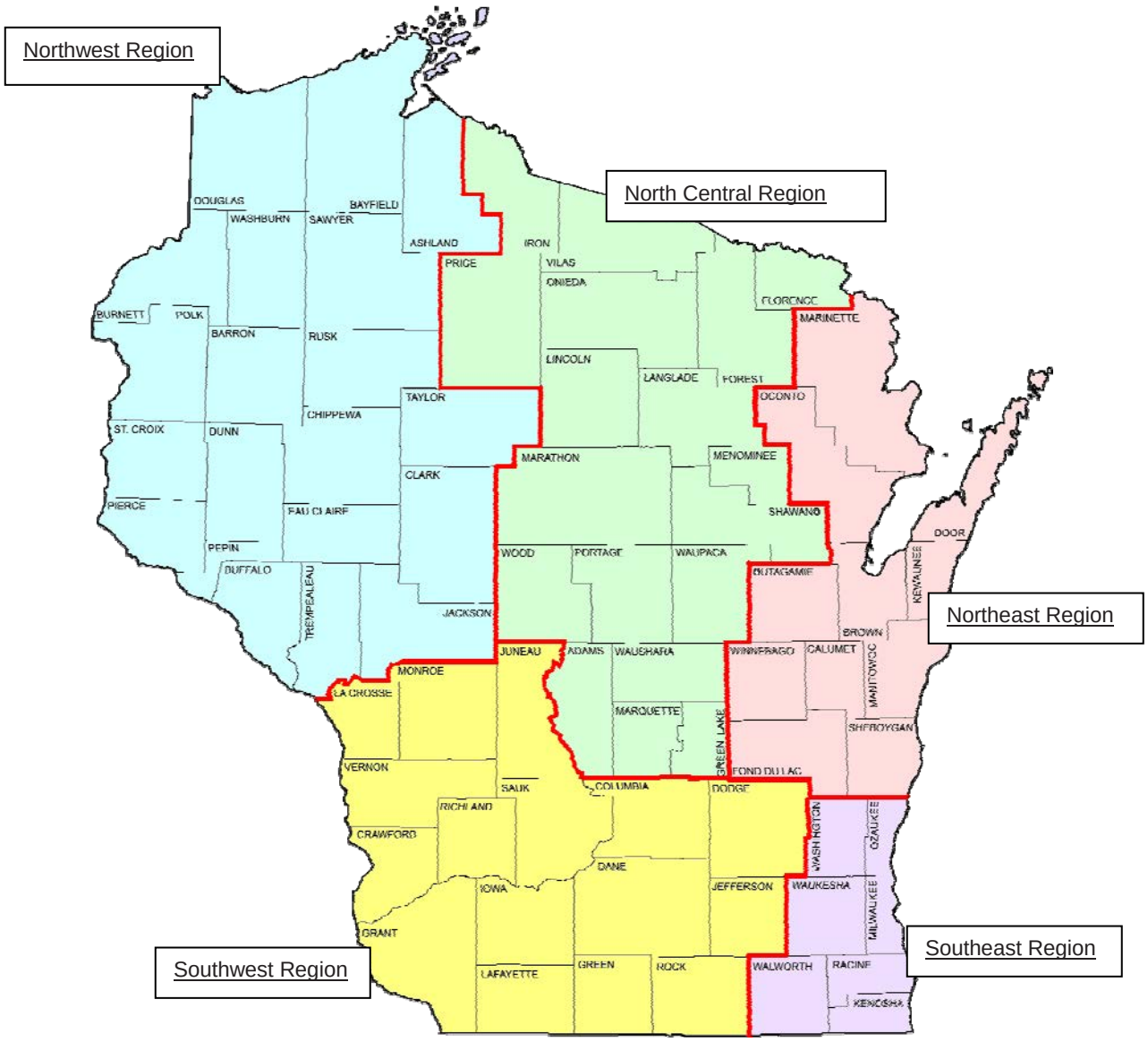

Figure A-1

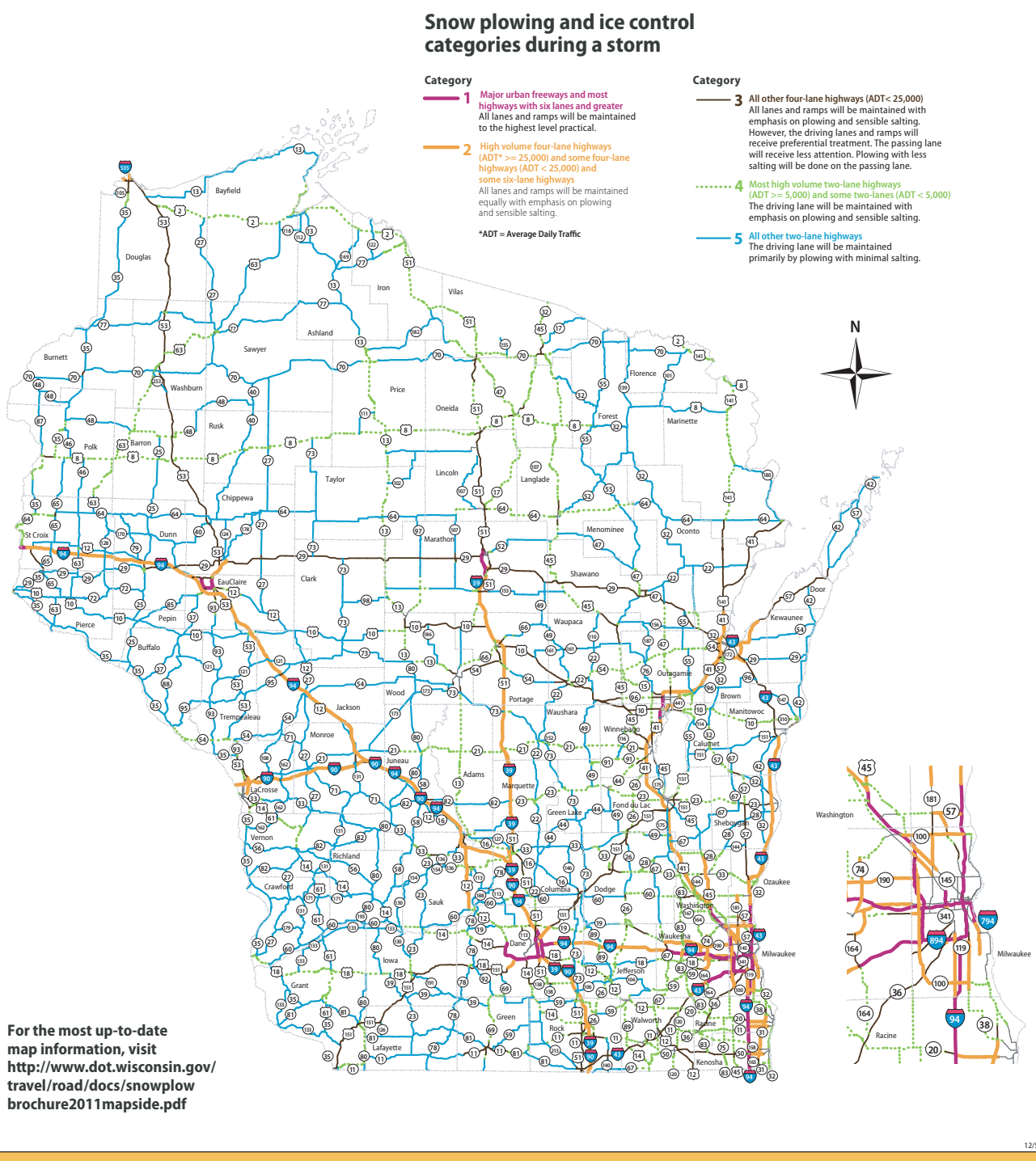
Snow plowing and ice control categories during a storm
Category
1 Major urban freeways and most highways with six lanes and greater
All lanes and ramps will be maintained to the highest level practical.
2 High volume four-lane highways (ADT* >= 25,000) and some four-lane highways (ADT < 25,000) and some six-lane highways
All lanes and ramps will be maintained equally with emphasis on plowing and sensible salting.
*ADT = Average Daily Traffic
Category
3 All other four-lane highways (ADT< 25,000)
All lanes and ramps will be maintained with emphasis on plowing and sensible salting. However, the driving lanes and ramps will receive preferential treatment. The passing lane will receive less attention. Plowing with less salting will be done on the passing lane.
4 Most high volume two-lane highways (ADT >= 5,000) and some two-lanes (ADT < 5,000)
The driving lane will be maintained with emphasis on plowing and sensible salting.
5 All other two-lane highways
The driving lane will be maintained primarily by plowing with minimal salting.
N
Bayfield
Douglas
Iron
Vilas
Ashland
Sawyer
Burnett
Washburn
Price
Oneida
Florence
Forest
Marinette
Rusk
Polk
Barron
Taylor
Lincoln
Langlade
Chippewa
St Croix
Dunn
Marathon
Menominee
Oconto
EauClaire
Clark
Shawano
Door
Pierce
Pepin
Waupaca
Kewaunee
Buffalo
Outagamie
Brown
Trempealeau
Jackson
Wood
Portage
Waushara
Manitowoc
Monroe
Winnebago
Calumet
Juneau
Adams
Marquette
LaCrosse
Fond du Lac
Green Lake
Sheboygan
Vernon
Richland
Ozaukee
Crawford
Columbia
Dodge
Washington
Sauk
Waukesha
Dane
Milwaukee
Iowa
Jefferson
Grant
Racine
Green
Rock
Walworth
Kenosha
Lafayette
Washington
Milwaukee
Racine
For the most up-to-date map information, visit http://www.dot.wisconsin.gov/travel/road/docs/snowplow brochure2011mapside.pdf
12/5/2011

Figure A-2

Table A.1. Storm Report Summary

From Winter Storm Reports, 2011-2012

Notes: 1) Costs shown in table are estimated and do not include the 4.63% 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 June '11 (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 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		
ADAMS	193.82	27.16	30.4	13	24	7	15	4,401	2,201	2,200	11.4	0.0	702.0	169.0	$850	$263	$217	$1,331	$258,007	0.42
FLORENCE	141.07	32.94	100.2	9	33	32	4	3,674	2,364	1,310	16.8	72.0	547.0	484.0	$1,055	$419	$362	$1,836	$258,786	0.51
FOREST	312.38	33.25	107.9	0	37	18	9	7,829	4,698	3,131	15.0	32.0	1745.0	995.0	$884	$462	$375	$1,720	$537,441	0.45
GREEN LAKE	155.54	19.70	44.1	5	21	17	3	2,153	888	1,265	5.7	0.0	336.0	240.0	$336	$207	$184	$727	$112,485	0.29
IRON	249.56	43.13	169.7	1	43	24	6	7,304	3,587	3,717	14.4	158.0	1453.0	810.0	$954	$496	$466	$1,917	$475,539	0.33
LANGLADE	292.19	28.23	88.3	9	28	24	8	6,414	2,774	3,640	9.5	0.0	1100.0	887.0	$544	$365	$315	$1,224	$356,028	0.34
LINCOLN	418.33	32.61	85.4	13	27	28	14	6,186	2,907	3,279	6.9	307.0	2421.0	863.0	$461	$402	$339	$1,202	$498,970	0.21
MARATHON	886.17	26.55	50.2	32	30	19	4	14,165	7,709	6,456	8.7	10.0	3763.0	1694.0	$593	$361	$306	$1,260	$1,115,792	0.33
MARQUETTE	245.23	16.65	34.2	5	21	8	5	5,907	2,119	3,788	8.6	0.0	475.0	535.0	$536	$245	$202	$983	$241,124	0.52
MENOMINEE	90.26	24.38	58.1	0	30	13	6	2,302	902	1,400	10.0	79.0	341.0	71.0	$563	$268	$153	$984	$88,742	0.41
ONEIDA	396.79	40.23	99.4	13	40	15	19	8,846	6,398	2,448	16.1	187.0	3644.0	880.0	$1,139	$565	$517	$2,221	$878,857	0.40
PORTAGE	575.31	28.35	33.1	5	33	13	11	9,774	4,807	4,967	8.4	228.0	3247.0	945.0	$562	$435	$334	$1,330	$762,939	0.29
PRICE	320.57	42.52	78.4	14	42	21	14	6,785	3,963	2,822	12.4	98.0	1364.0	1284.0	$820	$466	$404	$1,690	$540,577	0.29
SHAWANO	519.33	24.62	57.0	4	30	20	11	10,397	5,000	5,397	9.6	85.0	1349.0	1217.0	$508	$275	$213	$997	$514,457	0.39
VILAS	305.24	27.96	87.1	0	36	3	4	9,402	5,683	3,719	18.6	36.0	1054.0	851.0	$1,298	$372	$315	$1,985	$604,442	0.67
WAUPACA	546.64	16.95	42.1	3	22	9	4	9,890	5,744	4,146	10.5	0.0	1353.0	825.0	$577	$239	$198	$1,014	$553,519	0.62
WAUSHARA	345.01	17.50	36.8	4	22	5	6	4,676	2,940	1,736	8.5	0.0	1100.0	191.0	$482	$211	$158	$851	$293,720	0.49
WOOD	375.5	31.05	43.2	9	31	10	16	6,495	4,138	2,357	11.0	108.0	1021.0	905.0	$730	$297	$258	$1,285	$481,491	0.35
Region Total		--	--	--	--	--	--	126,600	68,822	57,778	--	1400	--	--	--	--	--	--	$8,572,916	
Region Average		28.54	69.2	7.7	30.6	15.9	8.8	7,033	3,823	3,210	11.2	78	1500.8	769.2	$716	$353	$295	$1,364	$476,273	0.41

Final totals as of Thursday, September 06, 2012

Table A.1. Storm Report Summary

From Winter Storm Reports, 2011-2012

Notes: 1) Costs shown in table are estimated and do not include the 4.63% 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 June '11 (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 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		
BROWN	716.21	20.55	42.0	41	22	14	6	17,267	7,120	10,147	9.9	17.0	2555.0	1453.0	$532	$303	$278	$1,112	$792,274	0.48
CALUMET	201.47	15.81	29.8	11	18	8	4	2,904	1,211	1,693	6.0	0.0	494.0	292.0	$332	$245	$171	$748	$149,694	0.38
DOOR	268.55	22.88	36.6	11	21	21	5	4,385	1,958	2,427	7.3	0.0	481.0	744.0	$434	$275	$252	$961	$256,933	0.32
FOND DU LAC	597.3	24.21	47.0	23	26	10	3	11,990	7,042	4,948	11.8	0.0	2059.0	2054.0	$718	$351	$333	$1,402	$834,646	0.49
KEWAUNEE	110.41	22.33	37.1	11	21	19	6	1,787	941	846	8.5	20.0	254.0	193.0	$444	$240	$202	$885	$97,728	0.38
MANITOWOC	421.09	19.17	32.9	11	22	10	3	10,461	3,332	7,129	7.9	0.0	991.0	768.0	$417	$251	$250	$918	$383,196	0.41
MARINETTE	419.74	34.49	73.7	31	34	27	9	6,870	3,923	2,947	9.3	0.0	1477.0	841.0	$547	$297	$343	$1,187	$497,396	0.27
OCONTO	466.31	26.12	72.3	27	33	10	4	7,266	3,825	3,441	8.2	0.0	1345.0	940.0	$469	$273	$237	$979	$455,230	0.31
OUTAGAMIE	528.93	19.60	29.6	6	23	8	5	12,282	4,523	7,759	8.6	0.0	2024.0	977.0	$488	$269	$262	$1,018	$531,576	0.44
SHEBOYGAN	519.42	19.88	33.2	12	23	20	3	12,932	5,157	7,775	9.9	0.0	1013.0	1047.0	$612	$224	$212	$1,048	$536,104	0.50
WINNEBAGO	586.86	18.25	24.5	9	24	6	6	13,806	4,888	8,918	8.3	0.0	1334.0	1399.0	$521	$249	$231	$1,000	$578,873	0.46
Region Total		--	--	--	--	--	--	101,950	43,920	58,030	--	37	--	--	--	--	--	--	$5,113,649	
Region Average		22.12	41.7	17.5	24.3	13.9	4.9	9,268	3,993	5,275	8.7	3	1275.2	973.5	$501	$271	$252	$1,024	$464,877	0.40

Table A.1. Storm Report Summary

From Winter Storm Reports, 2011-2012

Notes: 1) Costs shown in table are estimated and do not include the 4.63% 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 June '11 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

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 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		
ASHLAND	247.57	42.95	147.6	6	38	10	19	4,240	2,577	1,663	10.4	16.0	1224.0	447.0	$663	$386	$305	$1,354	$335,108	0.24
BARRON	423.09	29.78	61.1	11	32	23	16	3,729	3,001	728	7.1	91.0	1941.0	1099.0	$479	$407	$320	$1,206	$506,147	0.24
BAYFIELD	316.9	40.65	114.2	12	40	20	14	5,969	3,516	2,453	11.1	77.0	1858.0	799.0	$655	$503	$360	$1,518	$480,247	0.27
BUFFALO	316.86	16.30	20.0	12	15	21	4	2,740	1,089	1,651	3.4	21.0	764.0	393.0	$213	$181	$151	$544	$171,913	0.21
BURNETT	233.64	24.10	64.8	0	25	8	12	3,813	1,209	2,604	5.2	0.0	416.0	390.0	$327	$196	$172	$696	$162,562	0.21
CHIPPEWA	663.13	25.75	54.4	0	30	10	9	13,301	7,139	6,162	10.8	526.0	1541.0	2081.0	$730	$328	$276	$1,335	$885,020	0.42
CLARK	402.44	23.05	44.7	6	28	9	5	6,764	3,790	2,974	9.4	10.0	1078.0	949.0	$636	$308	$243	$1,187	$477,348	0.41
DOUGLAS	440.77	33.61	111.2	15	41	12	19	8,052	5,419	2,633	12.3	8.0	1964.0	645.0	$676	$331	$283	$1,291	$569,055	0.37
DUNN	516.55	17.42	28.7	0	23	12	3	11,305	4,905	6,400	9.5	0.0	1163.0	1408.0	$608	$273	$269	$1,150	$594,005	0.54
EAU CLAIRE	537.76	18.23	29.4	0	25	11	4	10,962	3,976	6,986	7.4	7.0	2300.0	1454.0	$477	$385	$313	$1,175	$631,612	0.41
JACKSON	515	25.06	60.0	22	34	9	19	10,595	4,643	5,952	9.0	50.0	1911.0	1221.0	$644	$307	$273	$1,224	$630,243	0.36
PEPIN	112.38	14.08	26.0	8	16	10	7	1,257	603	654	5.4	21.0	258.0	225.0	$339	$242	$203	$784	$88,070	0.38
PIERCE	365.61	19.55	29.3	2	24	8	8	5,987	2,413	3,574	6.6	125.0	734.0	546.0	$407	$180	$187	$774	$282,557	0.34
POLK	385.05	32.97	63.9	2	30	28	9	7,694	4,466	3,228	11.6	150.0	1234.0	806.0	$721	$288	$253	$1,262	$483,659	0.35
RUSK	213.47	26.86	65.5	0	28	24	14	2,858	1,715	1,143	8.0	1.0	859.0	491.0	$535	$352	$288	$1,175	$250,784	0.30
SAINT CROIX	618.98	21.69	32.0	0	29	16	6	12,021	5,928	6,093	9.6	100.0	1284.0	1569.0	$592	$262	$249	$1,104	$683,382	0.44
SAWYER	367.44	31.20	70.8	0	35	20	10	4,731	3,447	1,284	9.4	116.0	1291.0	891.0	$648	$329	$290	$1,267	$465,478	0.30
TAYLOR	234.27	28.66	57.5	22	28	22	11	4,293	2,083	2,210	8.9	74.0	886.0	381.0	$695	$318	$237	$1,249	$290,222	0.31
TREMPEALEAU	435.53	16.01	20.8	2	20	15	8	7,632	3,187	4,445	7.3	98.0	998.0	680.0	$444	$187	$169	$800	$348,252	0.46
WASHBURN	372.14	23.60	74.0	8	32	9	10	7,709	3,809	3,900	10.2	127.0	1056.0	828.0	$635	$302	$257	$1,194	$442,652	0.43
Region Total		--	--	--	--	--	--	135,652	68,915	66,737	--	1618	--	--	--	--	--	--	$8,778,316	
Region Average		25.58	58.8	6.4	28.7	14.9	10.4	6,783	3,446	3,337	8.6	81	1238.0	865.2	$556	$303	$255	$1,114	$438,916	0.35

Final totals as of Thursday, September 06, 2012

Table A.1. Storm Report Summary

From Winter Storm Reports, 2011-2012

Notes: 1) Costs shown in table are estimated and do not include the 4.63% 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 June '11 (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 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	622.19	16.55	26.1	17	19	6	4	13,877	4,855	9,022	7.8	12.0	1953.0	1097.0	$426	$287	$322	$1,035	$643,976	0.47
MILWAUKEE	1755.71	18.53	29.3	9	17	10	3	63,420	22,770	40,650	13.0	0.0	4450.0	8239.0	$681	$372	$555	$1,608	$2,816,055	0.70
OZAUKEE	309.51	18.12	29.0	6	22	6	4	10,245	4,091	6,154	13.2	0.0	768.0	456.0	$719	$237	$206	$1,163	$357,956	0.73
RACINE	681.95	17.33	39.2	16	20	9	5	18,438	6,197	12,241	9.1	0.0	1229.0	1920.0	$489	$251	$279	$1,018	$690,711	0.52
WALWORTH	698.71	20.71	38.2	17	17	11	11	22,272	8,747	13,525	12.5	0.0	2395.0	1052.0	$664	$287	$267	$1,218	$849,596	0.60
WASHINGTON	587.11	19.10	43.7	6	24	3	5	16,367	7,072	9,295	12.0	0.0	1169.0	1886.0	$726	$263	$282	$1,271	$724,911	0.63
WAUKESHA	1100.59	15.12	41.9	5	16	4	7	42,305	14,516	27,789	13.2	0.0	3415.0	2813.0	$718	$330	$297	$1,345	$1,474,228	0.87
Region Total		--	--	--	--	--	--	186,924	68,248	118,676	--	12	--	--	--	--	--	--	$7,557,433	
Region Average		17.92	35.3	10.9	19.3	7.0	5.6	26,703	9,750	16,954	11.5	2	2197.0	2494.7	$632	$290	$315	$1,237	$1,079,633	0.65

Table A.1. Storm Report Summary

From Winter Storm Reports, 2011-2012

Notes: 1) Costs shown in table are estimated and do not include the 4.63% 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 June '11 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region / SW / County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season: Anti-Icing	Events this Season: Storms	Events this Season: Incident	Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (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	801.2	17.86	24.8	20	23	7	7	27,492	13,200	14,292	16.5	230.0	1709.0	1524.0	$1,110	$236	$199	$1,544	$1,237,381	0.92
CRAWFORD	394.85	27.97	31.4	8	25	17	10	5,867	2,888	2,979	7.3	401.0	846.0	784.0	$484	$223	$181	$888	$349,291	0.26
DANE	1547.66	24.47	33.3	10	28	3	10	59,228	25,469	33,759	16.5	0.0	4098.0	5635.0	$1,043	$345	$347	$1,735	$2,668,631	0.67
DODGE	608.64	23.25	46.3	9	25	12	5	19,694	10,338	9,356	17.0	0.0	1583.0	1780.0	$1,035	$331	$262	$1,628	$990,725	0.73
GRANT	624.06	21.80	38.5	5	19	24	2	11,984	5,490	6,494	8.8	659.0	1170.0	1387.0	$538	$236	$166	$940	$586,311	0.40
GREEN	312.72	17.10	35.7	6	16	20	4	4,194	1,256	2,938	4.0	59.0	650.0	700.0	$289	$225	$181	$695	$213,497	0.23
IOWA	458.14	23.17	39.6	18	17	28	3	9,038	3,629	5,409	7.9	42.0	1215.0	1424.0	$472	$313	$259	$1,043	$477,913	0.34
JEFFERSON	520.94	19.74	41.8	0	21	11	4	16,682	6,875	9,807	13.2	0.0	1169.0	1370.0	$789	$354	$252	$1,395	$724,455	0.67
JUNEAU	499.39	21.70	29.3	11	27	8	9	11,925	4,713	7,212	9.4	0.0	1033.0	1051.0	$659	$224	$210	$1,094	$546,453	0.43
LA CROSSE	488.24	27.29	41.9	11	26	14	13	10,344	2,518	7,826	5.2	237.0	1431.0	1019.0	$330	$254	$244	$827	$400,804	0.19
LAFAYETTE	293.88	20.93	43.3	11	18	16	5	3,806	1,206	2,600	4.1	1256.0	631.0	849.0	$241	$265	$236	$741	$217,898	0.20
MONROE	654.71	23.61	32.1	14	27	6	12	12,153	4,746	7,407	7.2	77.0	1368.0	1127.0	$480	$209	$169	$858	$561,653	0.31
RICHLAND	325.26	19.81	33.0	7	22	11	8	4,161	1,521	2,640	4.7	262.0	738.0	428.0	$337	$191	$171	$698	$227,099	0.24
ROCK	651.64	18.93	24.4	13	15	20	4	16,161	9,432	6,729	14.5	88.0	1420.0	1756.0	$829	$255	$248	$1,332	$864,422	0.76
SAUK	618.44	23.24	27.1	34	23	17	8	18,962	7,865	11,097	12.7	214.0	1886.0	1537.0	$863	$323	$233	$1,420	$877,856	0.55
VERNON	464.85	25.94	33.8	20	25	16	11	6,798	4,131	2,667	8.9	921.0	1204.0	966.0	$595	$251	$189	$1,035	$481,249	0.34
Region Total		--	--	--	--	--	--	238,489	105,277	133,212	--	4446	--	--	--	--	--	--	$11,425,638	
Region Average	22.30		34.8	12.3	22.3	14.4	7.2	14,906	6,580	8,326	9.9	278	1384.4	1458.6	$631	$265	$222	$1,117	$714,102	0.45

Final totals as of Thursday, September 06, 2012

Table A.1. Storm Report Summary

From Winter Storm Reports, 2011-2012

Notes: 1) Costs shown in table are estimated and do not include the 4.63% 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 June '11 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Statewide Total	--	--	--	--	--	--	789,615	355,182	434,433	--	7513.0	--	--	--	--	--	--	$41,447,952	--
Statewide Average	24.32	51.2	10.2	26.1	14.1	8.0	10,967	4,933	6,034	9.9	104.3	1435.2	1148.0	$612	$301	$263	$1,176	$575,666	0.42

WEATHER MANAGEMENT SOLUTIONS, LLC

EVALUATION OF WEATHER FORECAST SERVICES

Michael J. Adams

2012

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Executive Summary

Introduction

In 2011-12, the Wisconsin Department of Transportation (WisDOT) continued using weather and pavement forecast information provided by Meridian Environmental Technology, Inc. (Meridian). However, the information was now presented through the Maintenance Decision Support System (MDSS). While the forecast information was the same, the presentation methodology was vastly different. This report is only intended to assess the quality of the forecast information. Other studies done separately will address additional aspects of MDSS.

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. The ultimate goal of this project is to use the findings of this study to improve the quality of weather and pavement temperature forecast information provided by Meridian or any other provider of forecast information.

For all information presented in this report, results for the winter seasons of 1998-99 through 2004-05 are for forecasts provided by Surface Systems, Inc., while results after that are for forecasts provided by Meridian.

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, 2011 through March 31, 2012. 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 warning service were also examined.

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

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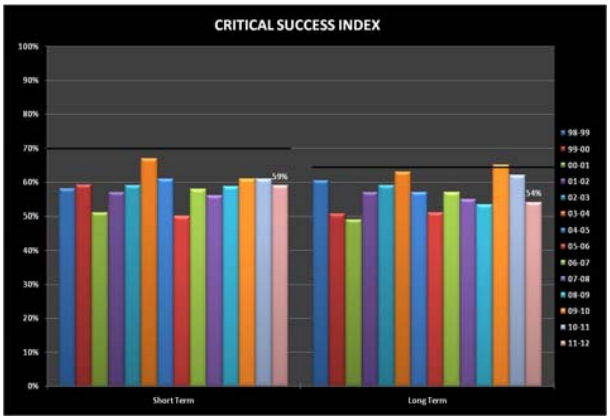
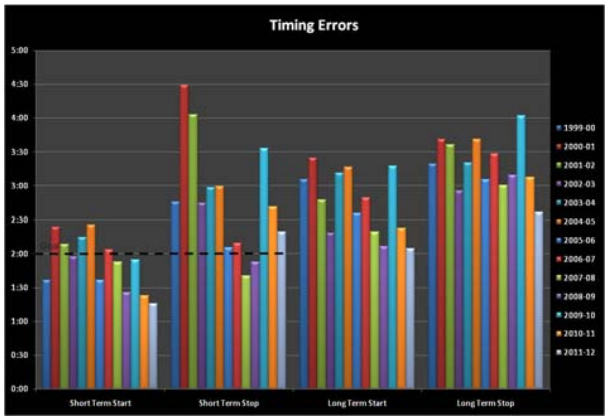
Verification Results

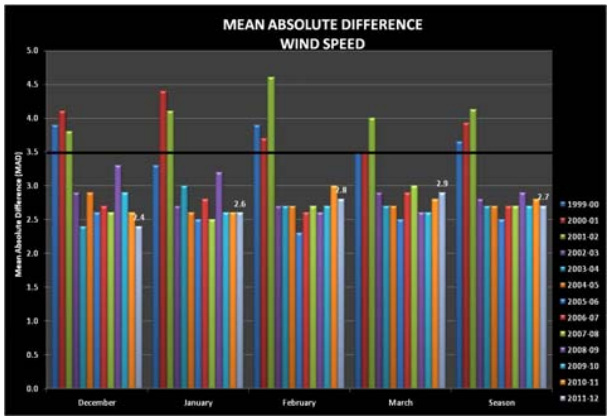
- **Precipitation forecasts.** Accuracy dropped very slightly compared to the previous winter and remained below the established goal scores. Accuracy was best in January, when the most events occurred.

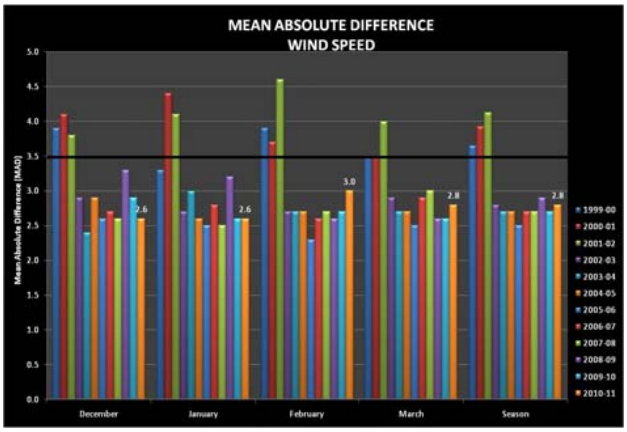




- **Timing error.** On the other hand, timing errors for both the start and end times of snow continue to be superb. For the second consecutive year, the short term timing errors for the start time were the best we've recorded.

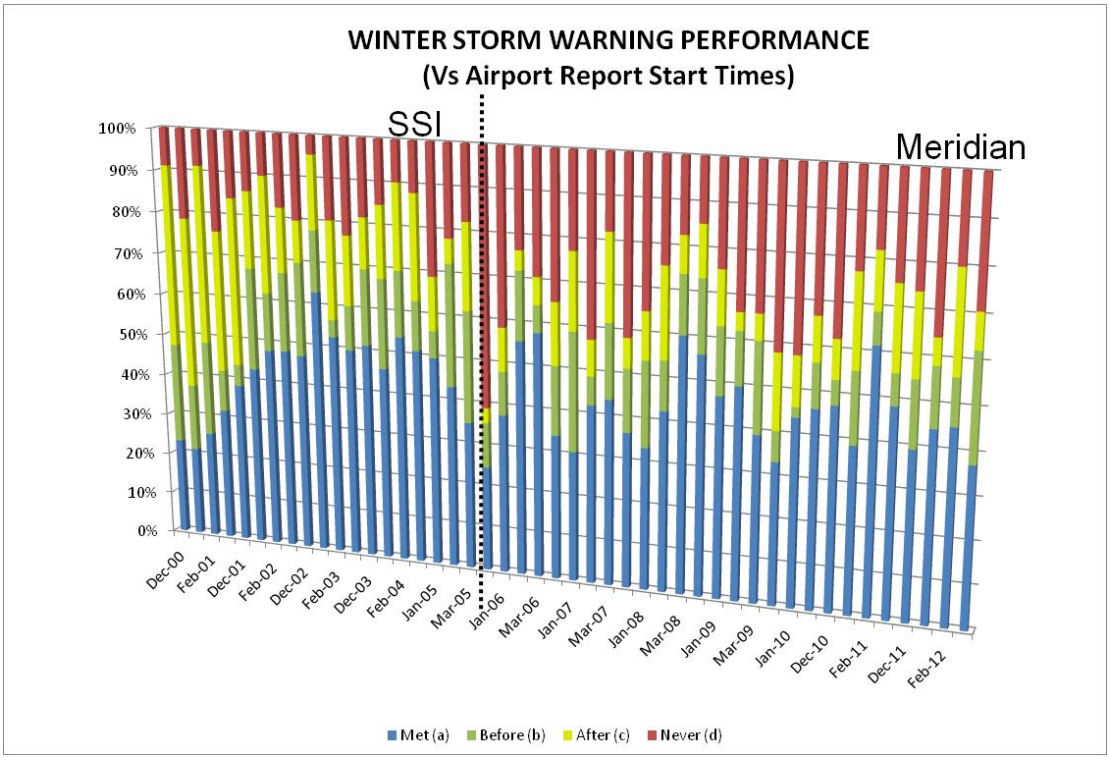
- **Pavement temperature.** Performance continued to be excellent. The negative trend of the past two winters was reversed and Meridian posted its best performance on record.





- **Winds.** Wind forecast accuracy remained relatively constant at an excellent level.

- **Winter storm warnings.** Performance was slightly worse than the previous winter, and again failed to meet expectations. For the winter, only 43 percent of events were preceded by a warning issued more than two hours in advance, as required by WisDOT's contract with Meridian. About 30 percent of events were preceded by no warning at all, though many 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

Survey Results

WisDOT BHM distributed a comprehensive survey to the county highway departments in May 2012 to determine their opinions of various services such as MDSS and AVL-GPS. Users were asked numerous questions about the quality of forecast services.

Some key findings from the survey are summarized below:

- More than half of the responding county patrol superintendents used MDSS on a daily basis. If those who only used it during storms are included, the usage rate jumps to about 65 percent.
- Users rated the accuracy of air temperature and wind forecasts the highest, and rated treatment recommendations the lowest.
- Training on both MDSS and AVL-GPS remains an issue, with approximately 40 percent of users stating they need more training on the PreCise web site and a slightly lower number asking for more training on MDSS, specifically, storm examples.

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2011-2012

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	1	13	6	20	1	95%	6,875	41.8	19.7	0.67	21	11	3	0
	VERNON	26	7	2	35	10	78%	4,131	33.8	25.9	0.34	25	16	8	20
	CRAWFORD	1	18	9	28	5	85%	2,888	31.4	28.0	0.26	25	17	9	8
	DANE	18	9	8	35	3	92%	25,469	33.3	24.5	0.67	28	3	9	10
	DODGE	21	1	1	23	11	68%	10,338	46.3	23.2	0.73	25	12	2	9
	GRANT	8	10	1	19	5	79%	5,490	38.5	21.8	0.40	19	24	1	5
	IOWA	3	11	3	17	18	49%	3,629	39.6	23.2	0.34	17	28	2	18
	COLUMBIA	0	0	0	0	43	0%	13,200	24.8	17.9	0.92	23	7	4	20
	JUNEAU	16	7	2	25	13	66%	4,713	29.3	21.7	0.43	27	8	6	11
	LA CROSSE	4	18	13	35	2	95%	2,518	41.9	27.3	0.19	26	14	8	11
	LAFAYETTE	12	4	2	18	11	62%	1,206	43.3	20.9	0.20	18	16	2	11
	MONROE	15	21	4	40	1	98%	4,746	32.1	23.6	0.31	27	6	6	14
	RICHLAND	0	0	0	0	29	0%	1,521	33.0	19.8	0.24	22	11	6	7
	ROCK	0	5	10	15	13	54%	9,432	24.4	18.9	0.76	15	20	3	13
	SAUK	4	14	3	21	36	37%	7,865	27.1	23.2	0.55	23	17	6	34
	GREEN	16	0	0	16	6	73%	1,256	35.7	17.1	0.23	16	20	2	6
Region Average		9.1	8.6	4.0	21.7	12.9	64.3%	6,579.8	34.8	22.3	0.45	22.3	14.4	4.8	12.3

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2011-2012

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	2	13	11	26	2	93%	4,091	29.0	18.1	0.73	22	6	4	6
	KENOSHA	0	0	0	0	36	0%	4,855	26.1	16.5	0.47	19	6	4	17
	MILWAUKEE	11	6	0	17	9	65%	22,770	29.3	18.5	0.70	17	10	2	9
	RACINE	5	13	2	20	16	56%	6,197	39.2	17.3	0.52	20	9	2	16
	WALWORTH	3	12	6	21	13	62%	8,747	38.2	20.7	0.60	17	11	8	17
	WAUKESHA	3	8	1	12	9	57%	14,516	41.9	15.1	0.87	16	4	3	5
	WASHINGTON	2	16	6	24	6	80%	7,072	43.7	19.1	0.63	24	3	2	6
Region Average		3.7	9.7	3.7	17.1	13.0	59.0%	9,749.7	35.3	17.9	0.65	19.3	7.0	3.6	10.9

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2011-2012

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	19	5	1	25	0	100%	3,976	29.4	18.2	0.41	25	11	1	0
	ASHLAND	17	14	13	44	0	100%	2,577	147.6	43.0	0.24	38	10	6	6
	BARRON	0	0	0	0	43	0%	3,001	61.1	29.8	0.24	32	23	7	11
	BAYFIELD	20	7	14	41	11	79%	3,516	114.2	40.6	0.27	40	20	2	12
	BUFFALO	10	5	1	16	11	59%	1,089	20.0	16.3	0.21	15	21	1	12
	BURNETT	0	0	0	0	25	0%	1,209	64.8	24.1	0.21	25	8	6	0
	CLARK	0	31	0	31	3	91%	3,790	44.7	23.1	0.41	28	9	3	6
	DOUGLAS	0	0	0	0	56	0%	5,419	111.2	33.6	0.37	41	12	5	15
	DUNN	3	8	3	14	9	61%	4,905	28.7	17.4	0.54	23	12	1	0
	SAWYER	0	6	5	11	24	31%	3,447	70.8	31.2	0.30	35	20	7	0
	JACKSON	6	18	7	31	25	55%	4,643	60.0	25.1	0.36	34	9	0	22
	WASHBURN	0	0	0	0	39	0%	3,809	74.0	23.6	0.43	32	9	2	8
	TAYLOR	36	3	0	39	11	78%	2,083	57.5	28.7	0.31	28	22	6	22
	SAINT CROIX	6	18	5	29	0	100%	5,928	32.0	21.7	0.44	29	16	3	0
	CHIPPEWA	14	7	3	24	6	80%	7,139	54.4	25.8	0.42	30	10	5	0
	RUSK	0	0	0	0	28	0%	1,715	65.5	26.9	0.30	28	24	4	0
	POLK	10	11	2	23	9	72%	4,466	63.9	33.0	0.35	30	28	3	2
	PIERCE	9	7	2	18	8	69%	2,413	29.3	19.5	0.34	24	8	4	2
	PEPIN	0	0	0	0	24	0%	603	26.0	14.1	0.38	16	10	1	8
	TREMPEALEAU	11	7	2	20	2	91%	3,187	20.8	16.0	0.46	20	15	3	2
Region Average		8.1	7.4	2.9	18.3	16.7	53.3%	3,445.8	58.8	25.6	0.35	28.7	14.9	3.5	6.4

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2011-2012

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	15	12	0	27	5	84%	1,958	36.6	22.9	0.32	21	21	2	11
	MANITOWOC	2	0	1	3	30	9%	3,332	32.9	19.2	0.41	22	10	2	11
	CALUMET	17	1	0	18	11	62%	1,211	29.8	15.8	0.38	18	8	1	11
	FOND DU LAC	0	17	10	27	22	55%	7,042	47.0	24.2	0.49	26	10	2	23
	KEWAUNEE	0	19	2	21	11	66%	941	37.1	22.3	0.38	21	19	3	11
	OCONTO	33	0	0	33	27	55%	3,825	72.3	26.1	0.31	33	10	2	27
	OUTAGAMIE	11	12	1	24	5	83%	4,523	29.6	19.6	0.44	23	8	4	6
	SHEBOYGAN	4	3	0	7	28	20%	5,157	33.2	19.9	0.50	23	20	1	12
	WINNEBAGO	8	15	3	26	7	79%	4,888	24.5	18.3	0.46	24	6	4	9
	MARINETTE	20	16	1	37	28	57%	3,923	73.7	34.5	0.27	34	27	5	31
	BROWN	6	8	5	19	44	30%	7,120	42.0	20.6	0.48	22	14	4	41
Region Average		10.5	9.4	2.1	22.0	19.8	54.5%	3,992.7	41.7	22.1	0.40	24.3	13.9	2.7	17.5

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2011-2012

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	18	16	11	45	11	80%	3,963	78.4	42.5	0.29	42	21	7	14
	FLORENCE	6	25	7	38	4	90%	2,364	100.2	32.9	0.51	33	32	2	9
	FOREST	7	23	7	37	0	100%	4,698	107.9	33.2	0.45	37	18	4	0
	GREEN LAKE	0	2	23	25	1	96%	888	44.1	19.7	0.29	21	17	1	5
	IRON	0	26	17	43	1	98%	3,587	169.7	43.1	0.33	43	24	2	1
	LANGLADE	5	21	11	37	0	100%	2,774	88.3	28.2	0.34	28	24	2	9
	LINCOLN	3	13	12	28	12	70%	2,907	85.4	32.6	0.21	27	28	5	13
	MARATHON	14	5	1	20	42	32%	7,709	50.2	26.5	0.33	30	19	3	32
	MARQUETTE	15	9	1	25	1	96%	2,119	34.2	16.6	0.52	21	8	3	5
	MENOMINEE	0	8	4	12	18	40%	902	58.1	24.4	0.41	30	13	3	0
	PORTAGE	2	6	27	35	3	92%	4,807	33.1	28.4	0.29	33	13	6	5
	SHAWANO	2	7	0	9	25	26%	5,000	57.0	24.6	0.39	30	20	2	4
	VILAS	32	3	1	36	0	100%	5,683	87.1	28.0	0.67	36	3	2	0
	WAUPACA	5	13	1	19	6	76%	5,744	42.1	16.9	0.62	22	9	1	3
	WAUSHARA	2	3	0	5	21	19%	2,940	36.8	17.5	0.49	22	5	2	4
	WOOD	3	27	10	40	0	100%	4,138	43.2	31.0	0.35	31	10	11	9
	ADAMS	2	23	10	35	2	95%	2,201	30.4	27.2	0.42	24	7	13	13
	ONEIDA	9	26	14	49	4	92%	6,398	99.4	40.2	0.40	40	15	7	13
Region Average		6.9	14.2	8.7	29.9	8.4	78.0%	3,823.4	69.2	28.5	0.41	30.6	15.9	4.2	7.7

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2011-2012

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		8.0	9.9	4.6	22.4	13.9	62.7%	4,933.1	51.2	24.3	0.42	26.1	14.1	3.9	10.2

Table A.3. Anti-icing Details

From Winter Storm Reports, 2011-2012

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	13	7	1	8	5	2	1	11,940	4,080	3,176	19,196
	FLORENCE	9	6	2	0	1	0	0	6,272	3,240	2,489	12,001
	GREEN LAKE	5	2	1	0	2	2	0	810	1,200	903	2,912
	IRON	1	0	0	0	0	0	1	40	240	175	455
	LANGLADE	9	5	4	0	0	0	0	1,060	3,240	2,649	6,949
	LINCOLN	13	11	1	3	0	3	0	2,850	3,840	5,664	12,354
	MARATHON	32	2	0	0	0	2	30	7,758	28,680	23,123	59,561
	MARQUETTE	5	1	2	1	0	0	1	2,895	4,740	3,071	10,706
	ONEIDA	13	2	2	3	0	7	3	2,561	6,660	4,587	13,808
	PORTAGE	5	0	0	0	0	3	2	206	1,800	1,399	3,405
	PRICE	14	2	0	1	1	0	11	278	3,780	3,348	7,406
	SHAWANO	4	0	0	0	0	1	3	346	840	489	1,675
	WAUPACA	3	0	0	0	0	3	0	186	1,320	941	2,447
	WAUSHARA	4	0	0	0	0	0	4	120	1,320	866	2,306
	WOOD	9	1	1	1	0	9	0	2,793	2,760	1,915	7,468
Region Total		139	39	14	17	9	32	56	40,115	67,740	54,794	162,649
Region Average		9	--	--	--	--	--	--	2,674	4,516	3,653	10,843

Table A.3. Anti-icing Details

From Winter Storm Reports, 2011-2012

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	41	0	0	0	0	1	40	15,878	18,360	13,783	48,021
	CALUMET	11	0	0	0	0	0	11	1,242	3,360	2,065	6,667
	DOOR	11	1	3	0	0	6	2	4,564	5,040	3,562	13,166
	FOND DU LAC	23	0	0	0	0	1	22	4,119	19,320	13,643	37,082
	KEWAUNEE	11	0	0	0	0	0	11	0	3,000	2,047	5,047
	MANITOWOC	11	0	0	0	0	0	11	1,001	5,280	4,169	10,450
	MARINETTE	31	0	0	0	0	3	28	8,750	11,880	10,831	31,461
	OCONTO	27	0	0	0	0	0	27	2,018	22,680	17,148	41,846
	OUTAGAMIE	6	1	0	0	0	2	3	3,348	4,440	3,036	10,824
	SHEBOYGAN	12	2	0	0	0	10	2	1,530	5,940	4,263	11,733
	WINNEBAGO	9	1	1	0	0	2	7	7,260	5,040	7,255	19,555
Region Total		193	5	4	0	0	25	164	49,710	104,340	81,803	235,853
Region Average		18	--	--	--	--	--	--	4,519	9,485	7,437	21,441

Final totals as of Wednesday, June 20, 2012

Table A.3. Anti-icing Details

From Winter Storm Reports, 2011-2012

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	6	0	1	0	0	5	0	31	1,680	1,234	2,945
	BARRON	11	0	0	0	0	0	11	1,497	6,780	3,115	11,392
	BAYFIELD	12	0	0	0	0	1	11	970	5,100	3,172	9,242
	BUFFALO	12	0	0	1	0	3	8	1,573	3,840	3,032	8,444
	CLARK	6	1	0	0	0	3	2	180	2,880	1,874	4,934
	DOUGLAS	15	2	2	3	0	9	1	0	5,820	4,432	10,252
	JACKSON	22	0	0	0	0	0	22	4,210	9,120	6,500	19,830
	PEPIN	8	1	0	0	1	4	4	287	3,660	1,840	5,786
	PIERCE	2	0	1	0	0	0	1	138	720	1,055	1,913
	POLK	2	0	0	0	0	2	0	45	600	279	924
	TAYLOR	22	5	3	4	0	3	11	729	7,860	5,095	13,683
	TREMPEALEAU	2	0	0	0	0	0	2	559	1,140	841	2,540
	WASHBURN	8	1	1	2	0	3	1	3,969	3,180	2,207	9,356
Region Total		128	10	8	10	1	33	74	14,187	52,380	34,675	101,242
Region Average		10	--	--	--	--	--	--	1,091	4,029	2,667	7,788

Table A.3. Anti-icing Details

From Winter Storm Reports, 2011-2012

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	17	0	0	0	0	0	17	0	7,680	8,296	15,976
	MILWAUKEE	9	0	0	0	0	1	8	6,070	16,740	16,623	39,433
	OZAUKEE	6	2	0	1	0	1	2	747	4,860	3,561	9,168
	RACINE	16	0	0	0	0	0	16	1,225	8,640	6,852	16,717
	WALWORTH	17	0	0	4	0	4	12	6,210	13,320	10,047	29,577
	WASHINGTON	6	0	0	0	0	1	5	243	1,380	1,658	3,281
	WAUKESHA	5	0	1	0	0	0	4	830	1,560	1,114	3,504
Region Total		76	2	1	5	0	7	64	15,325	54,180	48,152	117,657
Region Average		11	--	--	--	--	--	--	2,189	7,740	6,879	16,808

Final totals as of Wednesday, June 20, 2012

Table A.3. Anti-icing Details

From Winter Storm Reports, 2011-2012

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	20	4	2	2	0	5	8	0	20,220	14,368	34,588
	CRAWFORD	8	1	1	0	0	1	5	1,870	2,220	1,592	5,682
	DANE	10	1	0	0	0	6	3	5,491	21,540	16,268	43,299
	DODGE	9	0	0	0	0	2	7	3,293	4,080	2,552	9,925
	GRANT	5	0	0	0	0	0	5	248	2,400	1,273	3,920
	GREEN	6	0	0	0	0	0	6	240	1,080	1,566	2,886
	IOWA	18	0	0	0	0	0	18	250	3,840	2,441	6,531
	JUNEAU	11	0	0	0	0	0	11	2,390	5,160	4,108	11,657
	LA CROSSE	11	3	1	2	2	8	2	6,369	5,340	3,578	15,287
	LAFAYETTE	11	0	0	0	0	0	11	19	2,580	1,857	4,456
	MONROE	14	1	0	1	0	13	1	13,666	10,680	7,989	32,335
	RICHLAND	7	0	0	0	0	0	7	558	4,740	3,943	9,241
	ROCK	13	0	0	0	0	0	13	5,320	7,860	9,467	22,647
	SAUK	34	0	0	0	0	0	34	605	11,220	6,477	18,301
	VERNON	20	0	0	0	0	13	7	2,263	8,040	4,804	15,106
Region Total		197	10	4	5	2	48	138	42,580	111,000	82,280	235,860
Region Average		13	--	--	--	--	--	--	2,839	7,400	5,485	15,724

Table A.3. Anti-icing Details

From Winter Storm Reports, 2011-2012

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		733	66	31	37	12	145	496	161,916	389,640	301,704	853,261

Final totals as of Wednesday, June 20, 2012

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2011-2012

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
NC	ADAMS	0	29,850	0	0	0	0	0	0	0	0	0	0	0	0
	FLORENCE	0	39,200	0	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	0
	GREEN LAKE	0	8,095	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	0	200	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	0	10,600	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	0	28,500	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	0	64,650	0	0	0	0	0	0	0	0	0	0	0	0
	MARQUETTE	0	19,300	0	0	0	0	0	0	0	0	0	0	0	0
	MENOMINEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	0	25,612	0	0	0	0	0	0	0	0	0	0	0	0
	PORTAGE	0	2,060	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	0	2,782	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	0	2,664	0	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	0
	WAUPACA	0	1,860	0	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	0	1,200	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	0	13,300	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	249,873	0	0	0	0	0	0	0	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2011-2012

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
NE	BROWN	1,200	105,855	0	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	0	5,645	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	0	32,600	0	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	0	16,475	0	0	0	0	0	0	0	0	0	0	0	0
	KEWAUNEE	0	15,400	0	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	0	6,675	0	0	0	0	0	0	0	0	0	0	0	0
	MARINETTE	0	87,500	0	0	0	0	0	0	0	0	0	0	0	0
	OCONTO	0	20,180	0	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	0	18,600	0	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	300	6,118	0	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	0	60,500	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		1,500	375,548	0	0	0	0	0	0	0	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2011-2012

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
NW	ASHLAND	0	885	0	0	0	0	0	0	24	0	0	0	185	0
	BARRON	0	4,730	0	0	0	0	0	0	380	0	0	0	0	0
	BAYFIELD	0	4,850	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	0	12,100	0	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CHIPPEWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	0	1,800	0	0	0	0	0	0	0	0	0	0	0	0
	DOUGLAS	0	0	0	0	0	0	0	0	4,870	0	0	0	0	0
	DUNN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EAU CLAIRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JACKSON	0	42,100	0	0	400	0	0	0	0	0	0	0	0	0
	PEPIN	0	2,205	960	0	0	0	0	0	0	0	0	0	0	0
	PIERCE	0	1,380	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	0	450	0	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	0
	SAINT CROIX	0	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	0
	TAYLOR	0	7,285	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	0	4,300	0	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	0	0	0	350	3,430	0	0	0	740	0	0	0	0	0
Region Total		0	82,085	960	350	3,830	0	0	0	6,014	0	0	0	185	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2011-2012

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
SE	KENOSHA	0	0	0	0	0	0	0	0	2,265	0	0	0	0	0
	MILWAUKEE	131	39,975	0	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	200	4,300	0	0	0	0	0	0	0	0	0	0	0	0
	RACINE	0	5,833	0	0	0	0	0	0	0	0	0	0	0	0
	WALWORTH	0	51,750	0	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	0	2,025	0	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	0	16,600	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		331	120,483	0	0	0	0	0	0	2,265	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2011-2012

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
SW	COLUMBIA	0	52,200	0	0	0	0	0	0	0	0	0	0	0	0
	CRAWFORD	0	18,700	0	0	0	0	0	0	0	0	0	0	0	0
	DANE	0	27,455	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	0	0	2,570	0	0	0	0	0	460	0	0	0	0	0
	GRANT	0	1,650	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	0	600	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	0	1,250	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	0	8,850	0	0	0	0	0	0	0	0	0	0	0	0
	LA CROSSE	0	28,950	0	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	0	490	30	0	0	0	0	0	0	0	0	0	0	0
	MONROE	0	83,500	0	0	0	0	0	0	0	0	0	0	4,740	0
	RICHLAND	0	5,580	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	0	26,600	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	0	12,095	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	0	45,250	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	313,170	2,600	0	0	0	0	0	460	0	0	0	4,740	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2011-2012

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
Grand Total		1,831	1,141,159	3,560	350	3,830	0	0	0	8,739	0	0	0	4,925	0

Final totals as of Wednesday, June 20, 2012

Table A-5. Actual Anti-icing Costs

Final billed costs from the WisDOT accounting system, October 2010 - April 2011
County charges to Activity Code #73 (Applying Liquid Anti-icing Agents)

REGION	GROUP	COUNTY	TOTAL
SOUTHWEST	B	COLUMBIA	$19,014
	C	CRAWFORD	$10,445
	A	DANE	$35,556
	B	DODGE	$9,178
	C	GRANT	$1,351
	D	GREEN	$3,719
	C	IOWA	$4,870
	B	JEFFERSON	$15,906
	C	JUNEAU	$353
	A	LACROSSE	$10,115
	C	LAFAYETTE	$2,495
	C	MONROE	$35,689
	D	RICHLAND	$8,827
	B	ROCK	$19,472
	B	SAUK	$17,141
	C	VERNON	$18,400
		TOTAL	**$212,531**
SOUTHEAST	A	KENOSHA	$15,825
	A	MILWAUKEE	$69,780
	A	OZAUKEE	$8,747
	A	RACINE	$11,567
	B	WALWORTH	$18,820
	B	WASHINGTON	$2,947
	A	WAUKESHA	$8,344
		TOTAL	**$136,030**
NORTHEAST	A	BROWN	$38,992
	C	CALUMET	$5,961
	C	DOOR	$8,075
	C	FOND DU LAC	$34,393
	C	KEWAUNEE	$5,015
	B	MANITOWOC	$11,521
	D	MARINETTE	$14,975
	C	OCONTO	$32,764
	B	OUTAGAMIE	
	B	SHEBOYGAN	$8,338
	A	WINNEBAGO	$15,510
		TOTAL	**$175,544**

Table A-5. Actual Anti-icing Costs

Final billed costs from the WisDOT accounting system, October 2010 - April 2011
County charges to Activity Code #73 (Applying Liquid Anti-icing Agents)

REGION	GROUP	COUNTY	TOTAL
NORTH CENTRAL	D	ADAMS	$5,437
	D	FLORENCE	$7,166
	D	FOREST	
	D	GREEN LAKE	$1,504
	D	IRON	$446
	D	LANGLADE	$3,848
	C	LINCOLN	$6,026
	A	MARATHON	$47,826
	B	MARQUETTE	$5,790
	D	MENOMINEE	
	B	ONEIDA	$17,773
	A	PORTAGE	$3,873
	D	PRICE	$4,599
	B	SHAWANO	$2,289
	C	VILAS	$5,504
	C	WAUPACA	$14,541
	B	WAUSHARA	$22,521
	C	WOOD	$10
		TOTAL	**$149,153**
NORTHWEST	D	ASHLAND	$2,986
	D	BARRON	
	D	BAYFIELD	$5,294
	D	BUFFALO	$8,889
	D	BURNETT	
	B	CHIPPEWA	
	C	CLARK	$3,750
	C	DOUGLAS	$12,817
	B	DUNN	
	A	EAU CLAIRE	
	C	JACKSON	$21,927
	D	PEPIN	$2,949
	D	PIERCE	$3,775
	D	POLK	$584
	D	RUSK	
	D	SAWYER	
	B	ST. CROIX	$7,660
	D	TAYLOR	
	C	TREMPEALEAU	$3,719
	C	WASHBURN	$10,658
		TOTAL	**$85,008**
		STATE TOTAL	**$758,266**
		62/73 COUNTIES (84%)	

Table A-6. Salt Brine Use

From Winter Storm Reports, 2011-2012

REGION	GROUP	COUNTY	PREWETTING (GALLONS)	ANTI-ICING (GALLONS)	TOTAL (GALLONS)
SOUTHWEST	B	COLUMBIA	370	52,200	52,570
	C	CRAWFORD	14,275	18,700	32,975
	A	DANE	82,763	27,455	110,218
	B	DODGE	0	3,030	3,030
	C	GRANT	0	1,650	1,650
	D	GREEN	9,741	600	10,341
	C	IOWA	0	1,250	1,250
	B	JEFFERSON	38,865	0	38,865
	C	JUNEAU	3,940	8,850	12,790
	A	LA CROSSE	13,702	28,950	42,652
	C	LAFAYETTE	0	520	520
	C	MONROE	4,386	88,240	92,626
	D	RICHLAND	100	5,580	5,680
	B	ROCK	17,526	26,600	44,126
	B	SAUK	480	12,095	12,575
	C	VERNON	3,370	45,250	48,620
		TOTAL	**189,518**	**320,970**	**510,488**
SOUTHEAST	A	KENOSHA	2,360	2,265	4,625
	A	MILWAUKEE	21,150	40,106	61,256
	A	OZAUKEE	18,203	4,500	22,703
	A	RACINE	20,192	5,833	26,025
	B	WALWORTH	11,954	51,750	63,704
	B	WASHINGTON	47,919	2,025	49,944
	A	WAUKESHA	144,435	16,600	161,035
		TOTAL	**266,213**	**123,079**	**389,292**
NORTHEAST	A	BROWN	29,771	107,055	136,826
	C	CALUMET	4,654	5,645	10,299
	C	DOOR	9,093	32,600	41,693
	C	FOND DU LAC	15,135	16,475	31,610
	C	KEWAUNEE	5,955	15,400	21,355
	B	MANITOWOC	21,720	6,675	28,395
	D	MARINETTE	8,325	87,500	95,825
	C	OCONTO	14,665	20,180	34,845
	B	OUTAGAMIE	38,474	18,600	57,074
	B	SHEBOYGAN	33,651	6,418	40,069
	A	WINNEBAGO	66,762	60,500	127,262
		TOTAL	**248,205**	**377,048**	**625,253**

Table A-6. Salt Brine Use

From Winter Storm Reports, 2011-2012

REGION	GROUP	COUNTY	PREWETTING (GALLONS)	ANTI-ICING (GALLONS)	TOTAL (GALLONS)
NORTH CENTRAL	D	ADAMS	1,330	29,850	31,180
	D	FLORENCE	1,503	39,200	40,703
	D	FOREST	4,027	0	4,027
	D	GREEN LAKE	5,720	8,095	13,815
	D	IRON	14,195	200	14,395
	D	LANGLADE	15,890	10,600	26,490
	C	LINCOLN	36,540	28,500	65,040
	A	MARATHON	11,415	64,650	76,065
	B	MARQUETTE	2,300	19,300	21,600
	D	MENOMINEE	300	0	300
	B	ONEIDA	34,080	25,612	59,692
	A	PORTAGE	24,413	2,060	26,473
	D	PRICE	11,460	2,782	14,242
	B	SHAWANO	23,826	2,664	26,490
	C	VILAS	9,500	0	9,500
	C	WAUPACA	9,360	1,860	11,220
	B	WAUSHARA	2,027	1,200	3,227
	C	WOOD	4,390	13,300	17,690
		TOTAL	**212,276**	**249,873**	**462,149**
NORTHWEST	D	ASHLAND	25,355	1,094	26,449
	D	BARRON	19,655	5,110	24,765
	D	BAYFIELD	3,660	4,850	8,510
	D	BUFFALO	4,161	12,100	16,261
	D	BURNETT	4,497	0	4,497
	B	CHIPPEWA	0	0	0
	C	CLARK	2,343	1,800	4,143
	C	DOUGLAS	6,721	4,870	11,591
	B	DUNN	2,894	0	2,894
	A	EAU CLAIRE	7,025	0	7,025
	C	JACKSON	8,800	42,500	51,300
	D	PEPIN	1,416	3,165	4,581
	D	PIERCE	4,105	1,380	5,485
	D	POLK	22,735	450	23,185
	D	RUSK	0	0	0
	D	SAWYER	13,839	0	13,839
	B	ST. CROIX	905	0	905
	D	TAYLOR	24,345	7,285	31,630
	C	TREMPEALEAU	2,200	4,300	6,500
	C	WASHBURN	11,295	4,520	15,815
		TOTAL	**165,951**	**93,424**	**259,375**
		STATE TOTAL	**1,082,163**	**1,164,394**	**2,246,557**
		# OF COUNTIES	66	59	70
PREVIOUS USE		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

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2011-2012

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NC	ADAMS	2,201	0	0	0	0	0	0	0	1,330	0	0	0	0	0	0	0
	FLORENCE	2,364	0	0	1,378	0	0	0	0	0	0	0	0	0	0	0	0
	FOREST	4,698	0	4,027	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	888	0	225	5,495	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	3,587	0	0	14,195	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	2,774	0	0	15,890	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	2,907	0	0	36,450	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	7,709	0	0	8,370	0	0	0	215	0	320	0	0	0	0	2,510	0
	MARQUETTE	2,119	0	0	0	40	0	0	0	0	0	2,260	0	0	0	0	0
	MENOMINEE	902	0	0	300	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	6,398	0	651	25,878	0	0	0	0	0	0	0	0	0	0	7,428	0
	PORTAGE	4,807	0	0	23,712	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	3,963	0	0	11,460	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	5,000	0	0	23,823	0	0	0	3	0	0	0	0	0	0	0	0
	VILAS	5,683	0	0	9,500	0	0	0	0	0	0	0	0	0	0	0	0
	WAUPACA	5,744	0	0	9,360	0	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	2,940	0	2,027	0	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	4,138	0	0	4,390	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		68,822	0	6,930	190,201	40	0	0	218	1,330	320	2,260	0	0	0	9,938	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2011-2012

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NE	BROWN	7,120	0	360	29,411	0	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	1,211	0	0	4,654	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	1,958	0	0	9,093	0	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	7,042	0	0	11,628	0	0	0	0	0	0	3,507	0	0	0	0	0
	KEWAUNEE	941	0	0	5,955	0	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	3,332	0	0	21,720	0	0	0	0	0	0	0	0	0	0	0	0
	MARINETTE	3,923	0	560	7,765	0	0	0	0	0	0	0	0	0	0	0	0
	OCONTO	3,825	0	0	14,665	0	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	4,523	0	0	38,474	0	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	5,157	0	65	33,586	0	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	4,888	0	0	66,762	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		43,920	0	985	243,713	0	0	0	0	0	0	3,507	0	0	0	0	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2011-2012

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NW	ASHLAND	2,577	0	0	23,673	0	0	0	0	0	0	1,382	0	0	0	300	0
	BARRON	3,001	0	0	18,360	0	0	0	0	0	0	0	0	0	0	0	0
	BAYFIELD	3,516	0	0	3,660	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	1,089	0	0	4,126	35	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	1,209	0	0	0	0	0	0	0	0	0	4,497	0	0	0	0	0
	CHIPPEWA	7,139	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	3,790	11	98	2,190	0	0	0	0	0	0	0	23	0	0	0	0
	DOUGLAS	5,419	0	0	0	0	0	0	0	0	0	6,721	0	0	0	0	0
	DUNN	4,905	0	0	0	0	0	0	0	0	0	0	0	0	0	2,894	0
	EAU CLAIRE	3,976	0	0	50	0	0	0	0	6,570	0	405	0	0	0	0	0
	JACKSON	4,643	0	0	3,000	300	300	5,200	0	0	0	0	0	0	0	0	0
	PEPIN	603	0	0	0	306	0	0	0	1,110	0	0	0	0	0	0	0
	PIERCE	2,413	0	355	3,750	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	4,466	0	0	20,848	0	0	0	0	0	0	1,887	0	0	0	0	0
	RUSK	1,715	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAINT CROIX	5,928	0	13,839	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	3,447	0	0	0	0	0	0	0	0	0	905	0	0	0	0	0
	TAYLOR	2,083	0	0	24,345	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	3,187	0	0	470	1,730	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	3,809	0	0	11,095	0	200	0	0	0	0	0	0	0	0	0	0
Region Total		68,915	11	14,292	115,567	2,371	500	5,200	0	7,680	0	15,797	23	0	0	3,194	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2011-2012

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
SE	KENOSHA	4,855	0	0	0	0	0	0	0	0	0	2,360	0	0	0	0	0
	MILWAUKEE	22,770	14	21,150	0	0	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	4,091	0	5,472	12,531	0	0	0	0	200	0	0	0	0	0	0	0
	RACINE	6,197	0	2,276	17,916	0	0	0	0	0	0	0	0	0	0	0	0
	WALWORTH	8,747	0	0	11,954	0	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	7,072	32	0	47,919	0	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	14,516	0	16,964	127,471	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		68,248	46	45,862	217,791	0	0	0	0	200	0	2,360	0	0	0	0	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2011-2012

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
SW	COLUMBIA	13,200	0	0	370	0	0	0	0	0	0	0	0	0	0	0	0
	CRAWFORD	2,888	0	0	13,275	0	0	0	0	0	0	0	0	0	0	0	0
	DANE	25,469	0	0	82,763	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	10,338	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GRANT	5,490	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	1,256	0	0	9,701	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	3,629	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	6,875	0	1,680	37,185	0	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	4,713	0	0	0	0	0	0	0	0	0	0	0	0	0	3,940	0
	LA CROSSE	2,518	0	0	13,702	0	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	1,206	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MONROE	4,746	0	20	4,226	0	0	0	0	0	0	0	0	0	0	140	0
	RICHLAND	1,521	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	9,432	0	21	17,505	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	7,865	0	0	480	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	4,131	0	0	865	0	0	0	0	0	0	2,505	0	0	0	0	0
Region Total		105,277	0	1,721	180,172	0	0	0	0	0	0	2,505	0	0	0	4,080	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2011-2012

Region County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
Statewide Total	355,182	57	69,790	947,444	2,411	500	5,200	218	9,210	320	26,429	23	0	0	17,212	0

Final totals as of Wednesday, June 20, 2012

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

From Winter Storm Reports, 2011-2012

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NC	ADAMS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FLORENCE	72	0	125	0	0	0	0	0	0	0	0	0	0	0	0
	FOREST	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	158	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	307	0	90	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MARQUETTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MENOMINEE	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	187	0	4	0	0	0	0	0	0	0	0	0	0	119	0
	PORTAGE	228	0	701	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	98	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VILAS	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WAUPACA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		1,400	0	920	0	0	0	0	0	0	0	0	0	0	119	0

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

From Winter Storm Reports, 2011-2012

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NE	BROWN	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	KEWAUNEE	20	0	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	0	0
	MARINETTE	0	0	0	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	0	0
	OUTAGAMIE	0	0	0	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	0	0
	WINNEBAGO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		37	0	0	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, 2011-2012

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NW	ASHLAND	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BARRON	91	0	995	0	300	0	0	0	0	0	0	0	0	0	0
	BAYFIELD	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CHIPPEWA	526	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	10	0	0	0	0	32	0	0	0	0	0	0	0	0	0
	DOUGLAS	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DUNN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EAU CLAIRE	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JACKSON	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PEPIN	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PIERCE	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RUSK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAINT CROIX	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	116	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TAYLOR	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	98	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	127	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		1,618	0	995	0	300	32	0	0	0	0	0	0	0	0	0

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

From Winter Storm Reports, 2011-2012

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
SE	KENOSHA	12	0	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	0	0
	OZAUKEE	0	0	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	0	0
	WALWORTH	0	0	0	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	0	0
	WAUKESHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		12	0	0	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, 2011-2012

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
SW	COLUMBIA	230	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CRAWFORD	401	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0
	DANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GRANT	659	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	59	0	40	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LA CROSSE	237	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	1,256	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MONROE	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RICHLAND	262	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	88	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	214	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	921	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		4,446	0	1,040	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, 2011-2012

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
Statewide Total		7,513	0	2,955	0	300	32	0	0	0	0	0	0	0	119	0

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	16.97	26,998
2011/12	355,519	33,944	10.47	25,699

* Quantities adjusted