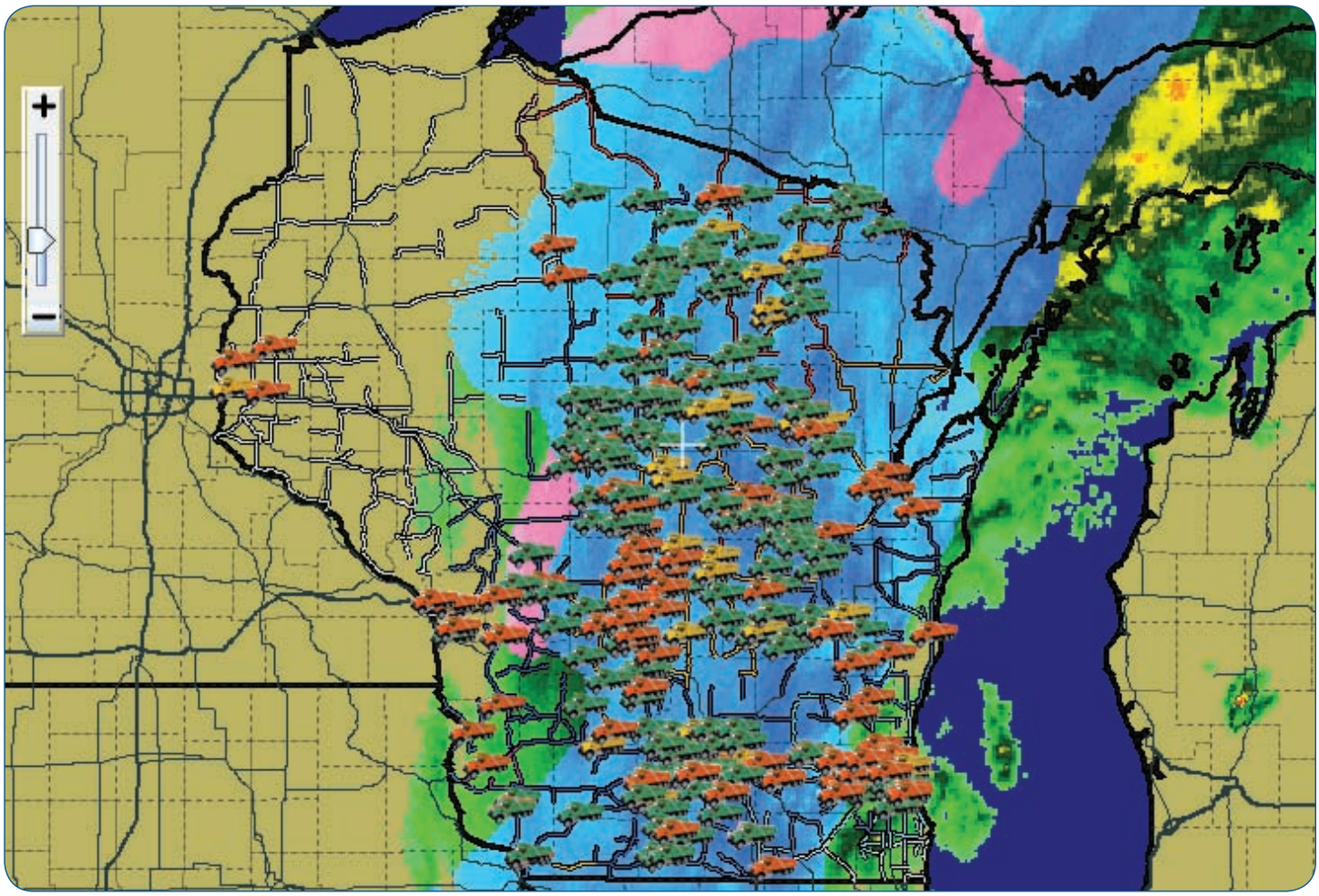
ANNUAL WINTER MAINTENANCE REPORT

2010-2011

Meeting Challenges With Best Practices



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

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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

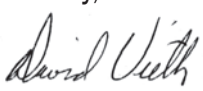
Wisconsin endured the most expensive winter in history in 2010–2011, exceeding the previous record incurred in 2007-2008 by $5 million. There were also more snow storms on average than any prior winter which only compounds the difficult task of managing winter operations within the available budget.

Again this year we commend the county maintenance crews for their dedicated response to a harsh winter, 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

		2009–2010 winter	2010-2011 winter
Infrastructure	Lane miles	33,532 miles	33,776 miles
	Patrol sections	767	759
	Average patrol section length	43.72 lane miles	44.03 lane miles
Weather	Average statewide Winter Severity Index	26.6	38.45
	Number of storms, statewide average and range across counties	Average: 24 Range: 16 to 45	Average: 37 Range: 22 to 73
	Snowfall, statewide average and range across counties	Average: 60.8 inches Range: 23 to 204 inches	Average: 100.1 inches Range: 63 to 273 inches
Materials[1]	Salt used	408,523 tons 12.2 tons per lane mile	573,253 tons 17.0 tons per lane mile
	Average cost of salt	$60.92 per ton	$58.55 per ton
	Prewetting liquid used	1,099,971 gal.	1,529,230 gal.
	Anti-icing agents used	683,144 gal.	714,860 gal.
	Sand used	19,081 cubic yd.	18,941 cubic yd.
Costs, Equipment and Performance	Total winter costs[2]	$74,506,207	$91,054,937
	Total winter costs per lane mile	$2,222	$2,696
	Average crew reaction time from start of storm	3.18 hours	2.58 hours
	Time to bare/wet pavement (measured from end of storm)	1.14 hours	1.49 hours
	Road Weather Information System (RWIS) stations	58	60
	Counties with salt spreaders equipped with on-board prewetting unit	55 of 72 (76%)	58 of 72 (80%)
	Counties with salt spreaders equipped with ground-speed controller unit	67 of 72 (93%)	65 of 72 (90%)
	Underbody plows	572	589
	Counties with underbody plows	55 of 72 (76%)	55 of 72 (76%)
	Counties equipped to use anti-icing agents	65 of 72 (90%)	65 of 72 (90%)
	Counties that used anti-icing agents during the winter season	62 of 72 (86%)	61 of 72 (85%)
Labor and Services	Regular county winter labor hours[3]	133,715 hrs.	176,842 hrs.
	Overtime county winter labor hours	106,578 hrs.	175,373 hrs.
	Public service announcements aired	6,754 total 6,122 radio; 632 TV	6,597 total 6,010 radio; 587 TV
	Cost of public service announcements	$36,000 ($259,062 market value)	$36,000 ($209,144 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 33,776 lane miles of highway and around 4,570 bridges.

WisDOT contracts with the state's 72 county highway departments to plow and provide 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 to our knowledge, it is unique in 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 purchases and having crews or equipment sitting idle.

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 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	2,797	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.	3,200	9%
3	All other four-lane highways (ADT < 25,000)	8,704	26%
4	Most high volume two-lane highways (ADT ≥ 5,000) and some 2-lanes (ADT <5000)	4,934	15%
5	All other two-lane highways	14,141	42%
Total		33,776	

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 2010 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. 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.

Table 1.4 shows which service group each county is assigned to.

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 759 patrol sections on state-maintained highways, with an average of 44.03 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	Number of Counties	% of Counties
A	Counties where all or most of the highways receive 24-hour coverage	12	17%
B	Counties with 18-hour and 24-hour coverage. More than 50% of highways receive 24-hour coverage.	17	24%
C	Counties with 18-hour and 24-hour coverage. Less than 50% of highways receive 24-hour coverage.	21	29%
D	Counties where no highways receive 24-hour coverage.	22	31%

Note: Percentage totals exceed 100% due to rounding.

Table 1.4. Winter Service Group Assignments

Winter Service Group	County Name
A	Brown, Dane, Eau Claire, Kenosha, La Crosse, Marathon, Milwaukee, Ozaukee, Portage, Racine, Waukesha, Winnebago
B	Chippewa, Columbia, Dodge, Dunn, Jefferson, Manitowoc, Marquette, Oneida, Outagamie, Rock, Sauk, Shawano, Sheboygan, St. Croix, Walworth, Washington, Waushara
C	Calumet, Clark, Crawford, Door, Douglas, Fond du Lac, Grant, Iowa, Jackson, Juneau, Kewaunee, Lafayette, Lincoln, Monroe, Oconto, Trempealeau, Vernon, Vilas, Washburn, Waupaca, Wood
D	Adams, Ashland, Barron, Bayfield, Buffalo, Burnett, Florence, Forest, Green, Green Lake, Iron, Langlade, Marinette, Menominee, Pepin, Pierce, Polk, Price, Richland, Rusk, Sawyer, Taylor

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.

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

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Table 1.5. Winter in Wisconsin, 2010-2011												
	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	191.58	41.16	96.7	3,414	17.82	0.43	$232,971	$1,216	$576,630	$3,010	$73.13
	Florence	141.07	48.35	115.9	2,185	15.49	0.32	$131,297	$931	$324,023	$2,297	$47.51
	Forest	312.38	47.76	127.8	5,555	17.78	0.37	$323,523	$1,036	$849,600	$2,720	$56.95
	Green Lake	151.50	33.47	106.8	1,410	9.31	0.28	$80,300	$530	$274,034	$1,809	$54.04
	Iron	249.56	70.69	272.9	4,860	19.47	0.28	$311,818	$1,249	$867,865	$3,478	$49.19
	Langlade	292.19	39.92	103.3	3,277	11.22	0.28	$183,774	$629	$580,813	$1,988	$49.79
	Lincoln	418.33	54.05	125.1	4,358	10.42	0.19	$272,854	$652	$910,410	$2,176	$40.26
	Marathon	885.17	51.03	97.6	12,207	13.79	0.27	$820,188	$927	$2,177,822	$2,460	$48.21
	Marquette	244.53	35.21	98.8	4,479	18.32	0.52	$267,799	$1,095	$604,589	$2,472	$70.22
	Menominee	90.26	28.25	91.5	700	7.76	0.27	$37,758	$418	$106,698	$1,182	$41.84
	Oneida	396.79	51.03	120.9	5,346	13.47	0.26	$368,981	$930	$1,056,427	$2,662	$52.17
	Portage	565.45	40.04	90.9	7,319	12.94	0.32	$484,371	$857	$1,396,065	$2,469	$61.66
	Price	320.57	60.43	111.6	5,397	16.84	0.28	$354,583	$1,106	$880,197	$2,746	$45.44
	Shawano	519.33	37.64	100.5	7,272	14.00	0.37	$374,872	$722	$1,166,931	$2,247	$59.70
	Vilas	305.24	41.32	87.7	6,850	22.44	0.54	$465,458	$1,525	$966,187	$3,165	$76.61
	Waupaca	546.64	30.35	100.0	6,456	11.81	0.39	$354,047	$648	$1,246,482	$2,280	$75.13
	Waushara	345.71	30.17	99.2	3,842	11.11	0.37	$215,459	$623	$680,244	$1,968	$65.22
	Wood	370.46	39.66	80.4	5,858	15.81	0.40	$381,707	$1,030	$872,902	$2,356	$59.41
Region total		**6,346.76**			**90,785**			**$5,661,761**		**$15,537,920**		
Region average		**352.60**	**43.36**	**112.6**	**5044**	**14.30**	**0.33**	**$314,542**	**$892**	**$863,218**	**$2,448**	**$56.46**
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are taken from WisDOT's Salt Inventory Reporting System.												

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Northeast Region												
	Brown	714.43	33.31	105.4	10,991	15.38	0.46	$564,498	$790	$1,832,130	$2,564	$76.99
	Calumet	201.29	30.01	77.3	1,766	8.77	0.29	$93,333	$464	$462,012	$2,295	$76.48
	Door	268.55	31.48	75.6	3,076	11.45	0.36	$172,902	$644	$627,500	$2,337	$74.23
	Fond du Lac	597.30	33.73	79.2	9,694	16.23	0.48	$566,808	$949	$1,554,848	$2,603	$77.18
	Kewaunee	110.41	41.50	150.6	1,173	10.62	0.26	$62,310	$564	$309,208	$2,801	$67.48
	Manitowoc	418.63	31.20	95.6	7,536	18.00	0.58	$382,226	$913	$1,328,178	$3,173	$101.69
	Marinette	417.91	36.54	90.6	4,382	10.49	0.29	$240,484	$575	$679,496	$1,626	$44.50
	Oconto	472.01	35.10	101.3	4,382	9.28	0.26	$240,484	$509	$845,895	$1,792	$51.06
	Outagamie	524.84	34.25	105.7	8,253	15.72	0.46	$441,536	$841	$1,519,939	$2,896	$84.55
	Sheboygan	519.42	31.61	92.2	10,176	19.59	0.62	$583,390	$1,123	$1,623,355	$3,125	$98.87
	Winnebago	569.58	29.03	82.2	10,625	18.65	0.64	$613,700	$1,077	$1,695,923	$2,977	$102.57
Region total		**4,814.37**			**72,054**			**$3,961,671**		**$12,478,484**		
Region average		**437.67**	**33.43**	**96.0**	**6550**	**14.97**	**0.45**	**$360,152**	**$823**	**$1,134,408**	**$2,592**	**$77.53**
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are taken from WisDOT's Salt Inventory Reporting System.												

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	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
Northwest Region												
	Ashland	247.57	68.11	247.1	3,605	14.56	0.21	$227,908	$921	$652,234	$2,635	$38.68
	Barron	423.09	44.17	101.3	2,645	6.25	0.14	$168,434	$398	$1,060,889	$2,507	$56.77
	Bayfield	316.90	61.26	160.2	4,406	13.90	0.23	$250,437	$790	$775,413	$2,447	$39.94
	Buffalo	316.05	36.72	80.5	1,849	5.85	0.16	$104,339	$330	$416,794	$1,319	$35.91
	Burnett	233.64	45.99	108.2	3,126	13.38	0.29	$183,621	$786	$547,059	$2,341	$50.91
	Chippewa	669.29	38.03	91.5	11,538	17.24	0.45	$764,969	$1,143	$1,851,443	$2,766	$72.74
	Clark	402.44	34.55	105.8	4,312	10.71	0.31	$292,009	$726	$821,701	$2,042	$59.10
	Douglas	439.23	51.27	177.1	7,023	15.99	0.31	$379,382	$864	$1,167,422	$2,658	$51.84
	Dunn	516.55	32.14	89.1	10,145	19.64	0.61	$619,048	$1,198	$1,447,659	$2,803	$87.20
	Eau Claire	537.26	31.73	80.3	7,842	14.60	0.46	$482,283	$898	$1,344,456	$2,502	$78.87
	Jackson	515.00	41.57	112.4	8,075	15.68	0.38	$556,852	$1,081	$1,251,948	$2,431	$58.48
	Pepin	112.38	28.20	72.5	621	5.53	0.20	$38,011	$338	$198,292	$1,764	$62.57
	Pierce	368.12	38.92	102.1	4,949	13.44	0.35	$284,568	$773	$818,183	$2,223	$57.11
	Polk	385.05	52.50	121.8	7,694	19.98	0.38	$453,100	$1,177	$1,062,992	$2,761	$52.58
	Rusk	213.47	38.84	110.6	2,652	12.42	0.32	$177,313	$831	$459,447	$2,152	$55.41
	St. Croix	618.98	42.98	88.8	10,752	17.37	0.40	$607,488	$981	$1,047,834	$1,693	$39.39
	Sawyer	367.44	47.41	111.7	4,289	11.67	0.25	$293,754	$799	$1,412,128	$3,843	$81.06
	Taylor	234.09	41.11	97.4	3,029	12.94	0.31	$227,811	$973	$531,680	$2,271	$55.25
	Trempealeau	434.99	32.75	77.0	5,381	12.37	0.38	$304,995	$701	$790,643	$1,818	$55.50
	Washburn	372.14	36.23	100.6	5,546	14.90	0.41	$331,706	$891	$855,767	$2,300	$63.47
Region total		**7,723.68**			**109,479**			**$6,748,028**		**$18,513,984**		
Region average		**386.18**	**42.22**	**111.8**	**5474**	**13.42**	**0.32**	**$337,401**	**$874**	**$925,699**	**$2,397**	**$56.77**
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are taken from WisDOT's Salt Inventory Reporting System.												

Table 1.5. Winter in Wisconsin, 2010-2011												
	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	590.29	28.55	74.90	9,732	16.49	0.58	$523,192	$886	$1,650,969	$2,797	$97.96
	Milwaukee	1755.71	33.01	60.40	45,596	25.97	0.79	$2,314,453	$1,318	$7,786,594	$4,435	$134.35
	Ozaukee	304.03	32.65	83.00	8,177	26.90	0.82	$435,098	$1,431	$1,098,568	$3,613	$110.67
	Racine	674.30	38.78	95.70	13,916	20.64	0.53	$712,917	$1,057	$2,028,389	$3,008	$77.57
	Walworth	698.71	26.33	69.70	15,843	22.67	0.86	$828,589	$1,186	$1,955,694	$2,799	$106.30
	Washington	581.11	28.81	94.50	11,654	20.05	0.70	$649,011	$1,117	$1,657,284	$2,852	$98.99
	Waukesha	1070.09	27.00	85.90	23,501	21.96	0.81	$1,233,332	$1,153	$3,310,199	$3,093	$114.57
Region total		**5,674.24**			**128,419**			**$6,696,593**		**$19,487,698**		
Region average		**810.61**	**30.73**	**80.6**	**18346**	**22.63**	**0.74**	**$956,656**	**$1,180**	**$2,783,957**	**$3,434**	**$111.75**
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are taken from WisDOT's Salt Inventory Reporting System.												

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Southwest Region												
	Columbia	801.28	35.56	74.0	19,972	24.93	0.70	$1,309,564	$1,634	$2,809,750	$3,507	$98.61
	Crawford	388.95	41.31	75.2	1,874	4.82	0.12	$111,484	$287	$822,872	$2,116	$51.21
	Dane	1547.16	32.13	63.1	46,706	30.19	0.94	$2,852,335	$1,844	$5,930,571	$3,833	$119.30
	Dodge	608.64	35.76	101.4	15,629	25.68	0.72	$935,083	$1,536	$1,968,172	$3,234	$90.43
	Grant	624.06	35.10	70.1	8,363	13.40	0.38	$465,401	$746	$1,152,290	$1,846	$52.61
	Green	312.72	33.27	78.5	2,420	7.74	0.23	$159,236	$509	$533,818	$1,707	$51.31
	Iowa	458.14	32.85	69.9	6,101	13.32	0.41	$346,049	$755	$1,082,872	$2,364	$71.95
	Jefferson	506.65	28.65	63.9	12,896	25.45	0.89	$752,611	$1,485	$1,582,071	$3,123	$108.99
	Juneau	498.79	32.06	102.8	9,116	18.28	0.57	$621,255	$1,246	$1,269,408	$2,545	$79.38
	La Crosse	488.24	41.04	91.0	4,032	8.26	0.20	$213,293	$437	$1,000,177	$2,049	$49.92
	Lafayette	293.88	36.19	84.4	2,819	9.59	0.27	$157,723	$537	$602,040	$2,049	$56.61
	Monroe	646.37	37.55	91.4	9,958	15.41	0.41	$615,604	$952	$1,437,735	$2,224	$59.24
	Richland	325.26	25.31	63.4	2,557	7.86	0.31	$164,159	$505	$434,938	$1,337	$52.83
	Rock	651.60	32.58	56.6	8,700	13.35	0.41	$478,848	$735	$1,492,412	$2,290	$70.30
	Sauk	618.44	38.07	88.3	15,846	25.62	0.67	$1,072,774	$1,735	$1,975,616	$3,195	$83.91
	Vernon	446.84	42.90	152.5	5,527	12.37	0.29	$347,704	$778	$942,112	$2,108	$49.15
Region total		**9,217.02**			**172,516**			**$10,603,123**		**$25,036,852**		
Region average		**576.06**	**35.02**	**82.9**	**10782**	**18.72**	**0.53**	**$662,695**	**$1,150**	**$1,564,803**	**$2,716**	**$77.56**
Statewide total		**33,776.07**		100.1	**573,253**	16.97		**$33,671,175**		**$91,054,937**		
Statewide average			38.45									
Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are 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 and more combine to create varying challenges for the county highway departments each year.

The 2010-11 winter season was much harsher than the previous several winters. Unlike the previous two winter seasons, it did not let up from December through March. Numerous large storms dropped six or more inches of snow across various portions of the state. The statewide average snowfall was 100 inches, which is almost twice the average of 52 inches. This was well above the winter of 2009-10, but in line with the two winters previous to that.

This section describes the weather Wisconsin experienced during the 2010–2011 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.

Winter Weather, 2010–2011

	Statewide average	Range across counties
Total snowfall[1]	100.1 inches	56 – 273 inches
Winter Severity Index	38.45	25.31 - 70.69
Winter storms	37	22-73
Frost events	3	0 – 13
Freezing rain events	6	0-15

1. All data in this table is from Winter Storm Reports, 2010–2011.

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 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 are also 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

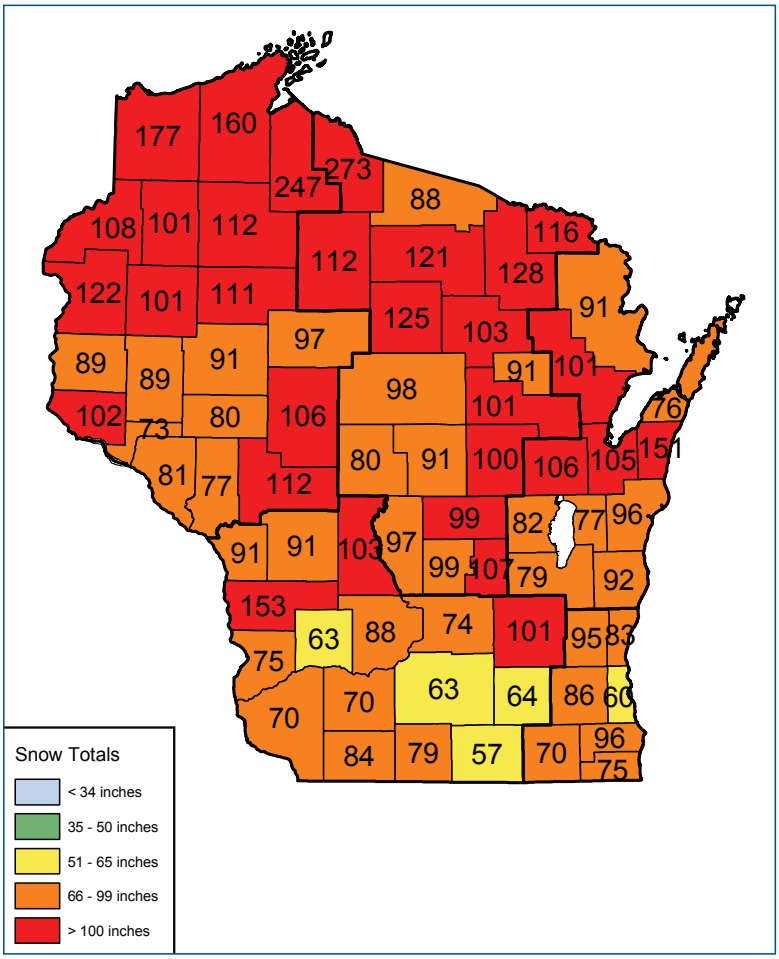
Three notable storms struck Wisconsin during the winter of 2010-11.

The first, on December 10-12, 2010, affected nearly the entire state with more than six inches of snow. Hardest hit was the North Central part of the state, where accumulations reached nearly two feet from La Crosse up through the Eau Claire area and winds gusted as high as 50 miles per hour, creating whiteout conditions.

A second storm (dubbed the Ground Hog Day Blizzard) hit the southern half of the state from January 31 through February 2 with similar amounts of snow and high winds. An incredible 32.8 inches of snow fell at Pella Lake in Walworth County. This storm briefly closed I-43 and I-94 in the southeast part of the state.

A final blast hit the northern half of the state on March 22-23 with over a foot of heavy wet snow that again caused near whiteout conditions.

Figure 2.1. Statewide Snowfall, 2010-2011
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 2010–2011 winter season, county highway departments responded to:

- A statewide average of 37 winter storm events per county, with a high of 73 in Iron County and a low of 22 in Calumet County.
- A statewide average of 3 frost events.
- A statewide average of 6 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 273 inches; the lowest was in Rock County, at 57 inches. Both figures were well above those of the previous winter. Statewide, this winter's total snowfall was well above average. On average, temperatures were below normal statewide this winter.

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.

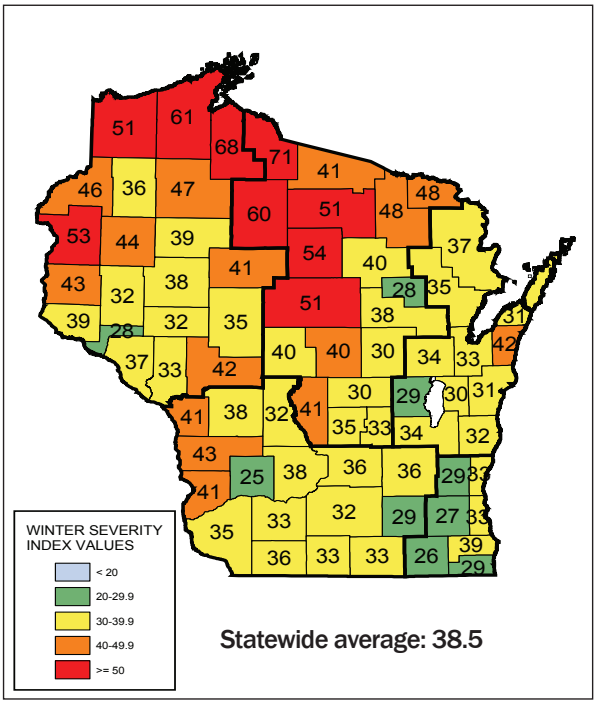
Developed in 1995, the severity index is calculated using a formula that includes:

- 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:

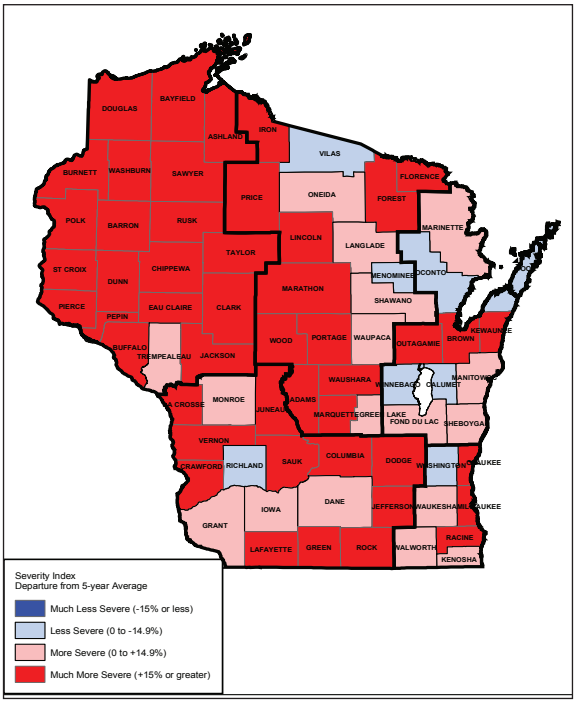
1. Season-to-season comparisons. This lets the department compare apples to apples when evaluating materials use and costs over several seasons, and identify trends in winter weather that can be useful in planning materials purchases. In the case of cost trends, adjusting cost data for severity index 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, 2010-2011



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. 2010–2011 Winter Severity Index vs. 5-Year Average
(2005–2006 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.

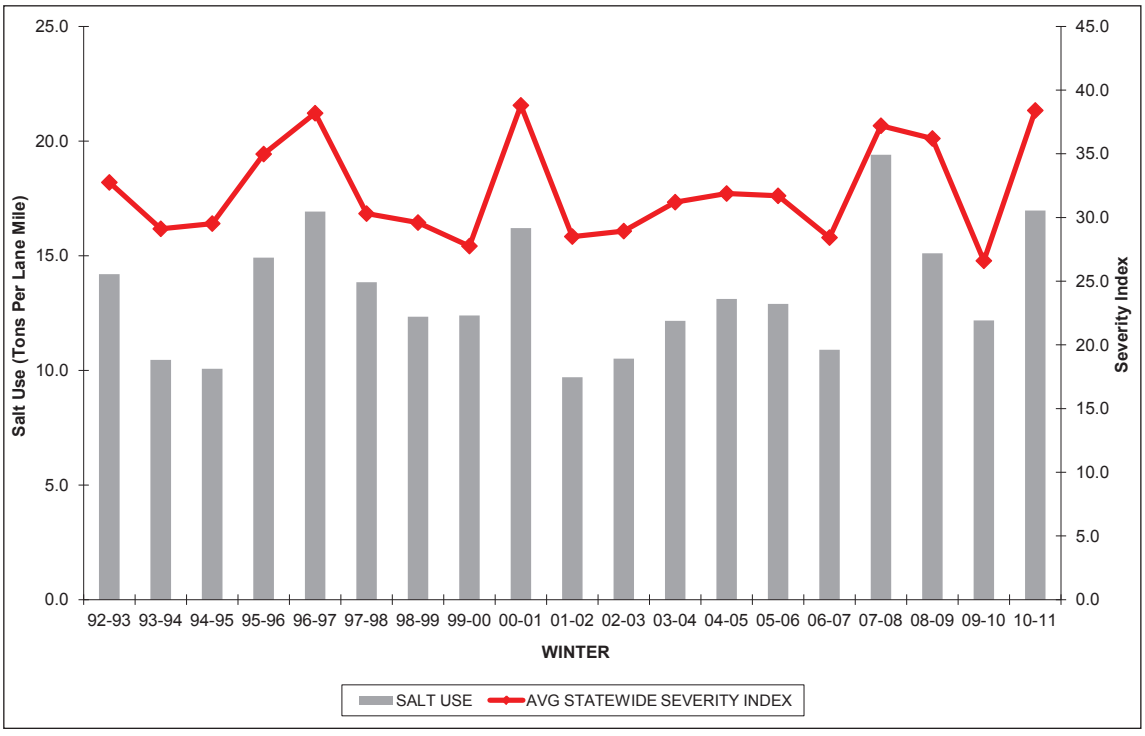
Data from weekly storm reports are used to calculate the Winter Severity Index for each county according to a weighted formula. The index expresses winter severity on a scale from 0 to 100. This winter:

- The statewide average Winter Severity Index was 38.45 which is 20 percent higher than the average of the previous ten winters (31.9)
- Iron, Ashland, Price and Bayfield Counties had the highest severity index; all greater than 60.
- Richland, Walworth and Waukesha Counties had the lowest severity index; all less than 28.

The high of 70 is higher 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 25 is higher than the state's typical lowest severity index as well. With some exceptions across the state, this winter was more 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 comparable to most other years with a similar severity index (96-97, 00-01), but lower than in 07-08. Last year's salt use was higher than average relative to the severity index, which may have been partly due to the timing of storms (multiple storms in quick succession) as well as extended bouts of lower temperatures.

Figure 2.4. Salt Use per Lane Mile and Average Severity Index
From Salt Inventory Reporting System, 1992–2011



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, 2010-2011

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	96.7	191.58	3414	17.82	33	22	23	15	19	18	4	6	5	3	1	13	16
	FLORENCE	115.9	141.07	2185	15.49	50	21	25	11	7	28	4	5	1	5	5	14	8
	FOREST	127.8	312.38	5555	17.78	48	11	32	8	6	23	10	11	1	7	6	8	0
	GREEN LAKE	106.8	151.50	1410	9.31	30	23	8	4	11	19	9	10	1	2	0	12	2
	IRON	272.9	249.56	4860	19.47	73	36	34	9	9	18	6	0	0	5	2	11	2
	LANGLADE	103.3	292.19	3277	11.22	37	20	16	7	8	30	11	13	0	20	2	14	3
	LINCOLN	125.1	418.33	4358	10.42	52	25	26	15	19	24	4	5	2	5	13	17	3
	MARATHON	97.6	885.17	12207	13.79	45	27	14	8	3	53	14	6	6	16	6	28	6
	MARQUETTE	98.8	244.53	4479	18.32	32	16	20	10	17	10	1	1	0	0	0	10	11
	MENOMINEE	91.5	90.26	700	7.76	31	12	18	2	6	21	6	4	0	8	6	17	0
	ONEIDA	120.9	396.79	5346	13.47	49	12	30	6	5	21	5	3	7	4	5	6	0
	PORTAGE	90.9	565.45	7319	12.94	40	13	24	7	9	23	10	10	1	5	9	8	2
	PRICE	111.6	320.57	5397	16.84	56	30	32	9	18	17	11	0	2	9	2	8	9
	SHAWANO	100.5	519.33	7272	14.00	34	17	15	5	7	40	16	7	10	5	11	26	9
	VILAS	87.7	305.24	6850	22.44	50	10	31	9	0	7	0	0	0	3	0	4	0
	WAUPACA	100.0	546.64	6456	11.81	29	15	11	3	5	26	5	8	4	2	1	13	1
	WAUSHARA	99.2	345.71	3842	11.11	29	14	13	4	4	7	3	1	1	2	0	1	1
	WOOD	80.4	370.46	5858	15.81	39	25	17	8	14	25	7	5	12	3	0	17	11
Region Average		112.6	352.60	5044	14.43	42	19	22	8	9	23	7	5	3	6	4	13	5

Final totals as of Monday, August 08, 2011

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2010-2011

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	105.4	714.43	10991	15.38	29	11	19	3	4	25	11	8	3	5	9	12	19
	CALUMET	77.3	201.29	1766	8.77	22	9	16	0	5	37	19	3	5	6	0	17	15
	DOOR	75.6	268.55	3076	11.45	29	18	16	0	5	31	14	14	9	13	0	11	8
	FOND DU LAC	79.2	597.30	9694	16.23	24	8	22	5	6	26	16	0	5	1	1	14	8
	KEWAUNEE	150.6	110.41	1173	10.62	31	14	17	2	10	29	19	11	4	6	0	15	0
	MANITOWOC	95.6	418.63	7536	18.00	26	13	13	3	9	16	9	10	1	5	3	7	3
	MARINETTE	90.6	417.91	4382	10.49	36	16	20	2	5	29	9	10	13	10	3	16	48
	OCONTO	101.3	472.01	4382	9.28	42	24	14	4	10	23	3	6	2	2	1	18	5
	OUTAGAMIE	105.7	524.84	8253	15.72	32	13	19	5	6	18	10	10	6	6	1	13	7
	SHEBOYGAN	92.2	519.42	10176	19.59	31	15	21	6	5	20	7	2	5	1	6	17	12
	WINNEBAGO	82.2	569.58	10625	18.65	32	12	20	2	7	41	2	2	6	3	23	35	3
Region Average		96.0	437.67	6550	14.02	30	14	18	3	7	27	11	7	5	5	4	16	12

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2010-2011

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	247.1	247.57	3605	14.56	61	27	25	11	12	13	1	3	9	7	1	9	8
	BARRON	101.3	423.09	2645	6.25	45	23	23	7	11	49	14	14	2	9	4	41	15
	BAYFIELD	160.2	316.90	4406	13.90	69	26	47	2	8	27	11	3	3	7	6	18	10
	BUFFALO	80.5	316.05	1849	5.85	35	13	20	6	8	25	14	0	2	3	1	19	2
	BURNETT	108.2	233.64	3126	13.38	38	24	13	7	16	32	22	22	1	23	16	29	0
	CHIPPEWA	91.5	669.29	11538	17.24	38	13	23	4	5	33	13	8	2	8	5	20	0
	CLARK	105.8	402.44	4312	10.71	38	15	20	5	5	14	7	0	2	3	2	6	8
	DOUGLAS	177.1	439.23	7023	15.99	50	28	26	6	0	33	16	3	1	15	25	21	8
	DUNN	89.1	516.55	10145	19.64	37	10	22	6	2	17	1	2	0	0	1	13	0
	EAU CLAIRE	80.3	537.26	7842	14.60	35	16	19	2	6	54	3	1	0	10	4	45	3
	JACKSON	112.4	515.00	8075	15.68	42	35	6	4	36	36	17	14	10	4	5	36	11
	PEPIN	72.5	112.38	621	5.53	28	6	19	5	9	10	1	3	6	8	3	0	0
	PIERCE	102.1	368.12	4949	13.44	40	10	24	7	12	17	11	7	0	10	6	13	1
	POLK	121.8	385.05	7694	19.98	44	15	25	5	1	40	24	9	5	20	0	15	0
	RUSK	110.6	213.47	2652	12.42	36	16	15	6	10	46	10	17	0	14	24	29	0
	SAINT CROIX	88.8	618.98	10752	17.37	41	9	26	7	6	53	17	0	8	4	14	46	0
	SAWYER	111.7	367.44	4289	11.67	50	25	16	12	5	35	9	4	0	11	2	19	0
	TAYLOR	97.4	234.09	3029	12.94	38	15	20	7	4	27	12	6	4	13	9	16	19
	TREMPEALEAU	77.0	434.99	5381	12.37	32	16	16	3	4	30	11	10	1	8	6	14	5
	WASHBURN	100.6	372.14	5546	14.90	43	14	27	3	7	13	2	4	0	2	2	5	9
Region Average		111.8	386.18	5474	13.42	42	18	22	6	8	30	11	7	3	9	7	21	5

Final totals as of Monday, August 08, 2011

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2010-2011

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	74.9	590.29	9732	16.49	30	14	12	4	5	11	5	4	2	5	2	8	14
	MILWAUKEE	60.4	1,755.71	45596	25.97	31	20	7	5	6	19	0	3	5	4	6	9	4
	OZAUKEE	83.0	304.03	8177	26.90	35	17	17	2	1	36	10	2	3	0	1	28	1
	RACINE	95.7	674.30	13916	20.64	37	16	28	4	7	23	14	3	2	7	12	17	15
	WALWORTH	69.7	698.71	15843	22.67	30	12	15	4	0	13	4	3	1	3	2	9	0
	WASHINGTON	94.5	581.11	11654	20.05	29	7	24	0	6	14	12	9	4	1	6	11	2
	WAUKESHA	85.9	1,070.09	23501	21.96	28	16	12	4	5	7	0	1	3	3	0	4	4
Region Average		80.6	810.61	18346	22.10	31	15	16	3	4	18	6	4	3	3	4	12	6

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2010-2011

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	74.0	801.28	19972	24.93	31	16	12	6	8	28	15	4	2	4	5	22	15
	CRAWFORD	75.2	388.95	1874	4.82	37	8	24	8	5	25	17	9	5	9	1	14	6
	DANE	63.1	1,547.16	46706	30.19	34	6	20	5	4	1	0	1	0	0	0	0	0
	DODGE	101.4	608.64	15629	25.68	38	13	22	4	10	19	9	9	2	5	0	12	4
	GRANT	70.1	624.06	8363	13.40	29	8	19	3	5	41	9	12	4	14	2	19	3
	GREEN	78.5	312.72	2420	7.74	30	8	20	8	9	34	4	4	5	6	1	29	13
	IOWA	69.9	458.14	6101	13.32	34	22	11	4	2	24	3	4	5	6	1	12	8
	JEFFERSON	63.9	506.65	12896	25.45	30	10	19	6	10	11	4	5	0	5	2	5	0
	JUNEAU	102.8	498.79	9116	18.28	35	24	8	3	5	11	3	0	0	0	2	11	7
	LA CROSSE	91.0	488.24	4032	8.26	34	13	18	8	8	35	21	19	9	2	1	24	8
	LAFAYETTE	84.4	293.88	2819	9.59	32	12	12	8	5	14	9	1	1	3	1	1	1
	MONROE	91.4	646.37	9958	15.41	35	13	17	9	11	19	11	10	7	5	13	17	12
	RICHLAND	63.4	325.26	2557	7.86	28	9	17	4	4	20	4	3	0	17	6	16	2
	ROCK	56.6	651.60	8700	13.35	32	13	17	8	10	17	7	3	1	3	0	13	9
	SAUK	88.3	618.44	15846	25.62	35	18	24	8	5	30	3	1	8	18	0	19	31
	VERNON	152.5	446.84	5527	12.37	35	19	12	5	5	28	14	5	7	18	0	10	6
Region Average		82.9	576.06	10782	16.02	33	13	17	6	7	22	8	6	4	7	2	14	8

Final totals as of Monday, August 08, 2011

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2010-2011

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting Blowing Snow		Frost	Ice	Bridge Decks	Clean Up	
Statewide Averages		--	469	7962	15.19	37.2	16.3	19.5	5.7	7.5	24.8	8.9	5.8	3.4	6.7	4.4	15.6	6.6

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 2010-2011 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, 2010-2011

Total salt used[1]	573,253 tons
Total salt used per lane mile	16.97 tons
Total cost of salt used[2]	$33,671,175
Average cost per ton of salt	$58.74
Total prewetting agents used[3]	1,674,472 gal.
Counties prewetting salt	66 of 72 (92%)
Total abrasives used	18,941 cubic yards
Counties prewetting abrasives	6 of 65 using sand (9%)
Total anti-icing agents used	714,760 gal.
Counties equipped to use anti-icing	65 of 72 (85%)

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 and sand remain the primary materials 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 38.45 was 20 percent higher than the previous 10-year average of 31.9. Salt use was 40 percent higher than the previous year, at 573,253 tons. This approaches the record of 644,485 tons set in 207-2008. See Table 1.5 on page 13 for county-by-county salt use data for this winter.

Wisconsin counties applied a statewide average of 17.0 tons of salt per lane mile on state highways, an increase of 39 percent compared with the 2009-2010 winter and near the average of the five previous winters. (See Figure 3.10 on page 57 for a county-by-county comparison.) This year, that rate was higher than the nearby states of Minnesota (8.8 tons per lane mile), Iowa (8.2 tons per lane mile), Indiana (11 tons per lane mile), and Illinois (13.1 tons per lane mile) and equal to the state of Michigan (17 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, 2010-2011

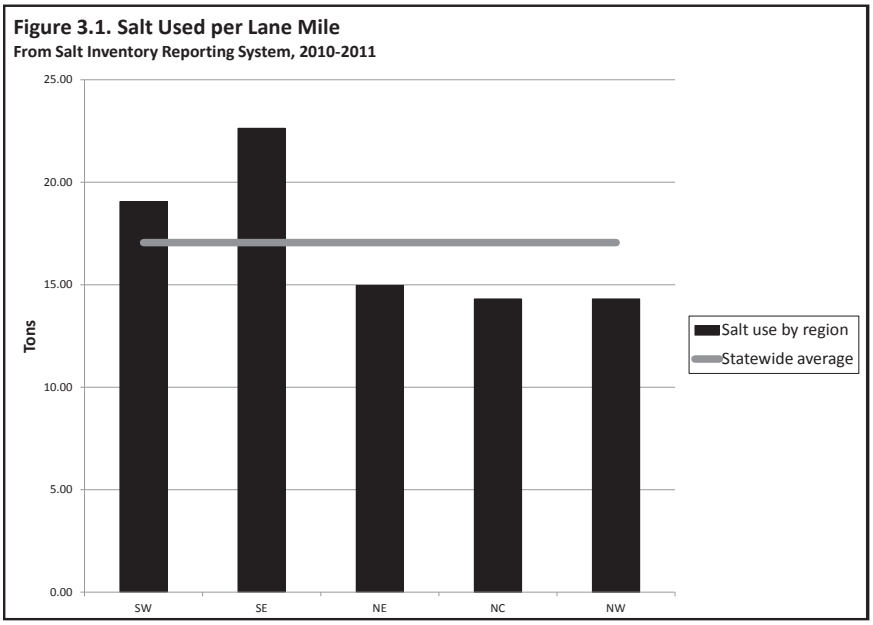


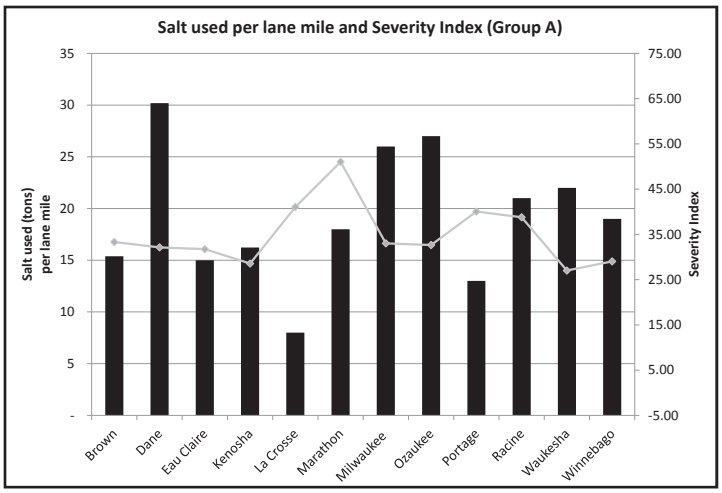
Figure 3.1 shows the regional levels of salt use per lane mile. Counties in the Southeast Region used an average of 22.63 tons of salt per lane mile, which reflects the greater number of highways in these counties receiving 24-hour service.

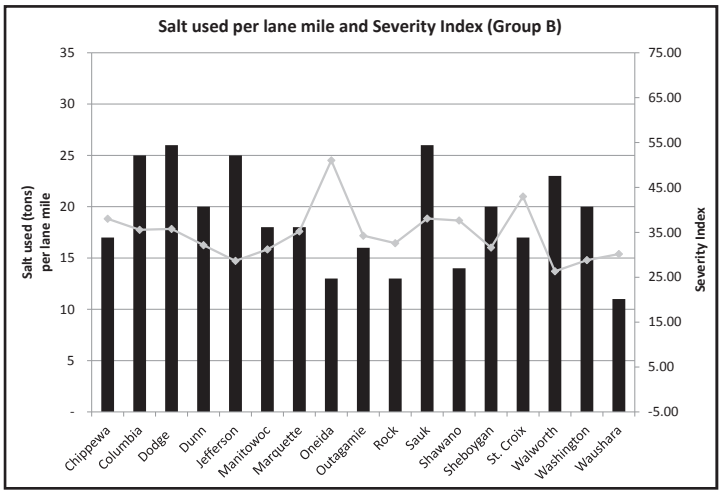
Figure 3.2 on page 35 shows salt use per lane mile in each county, overlaid with severity index to allow a further "apples to apples" comparison of salt use in each county. The counties in Winter Service Groups A and B have more urban highways and tend to use more salt per lane mile for a given level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

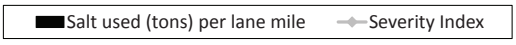
For more detail on salt use in previous years, see Table A-9, "History of Salt Use on State Trunk Highways," on page 164 of the Appendix.

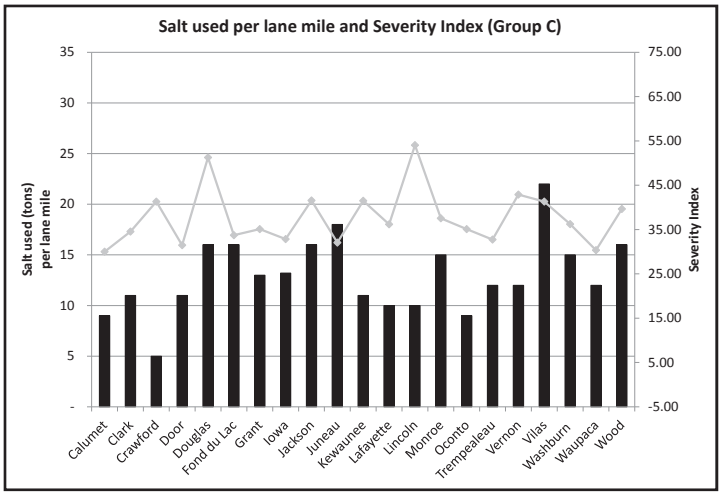
Figure 3.2. Salt Used per Lane Mile and Severity Index

From Salt Inventory Reporting System, 2010-2011









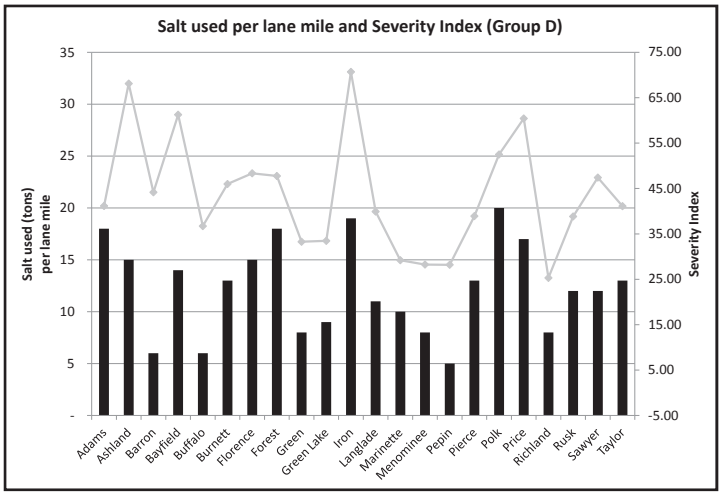
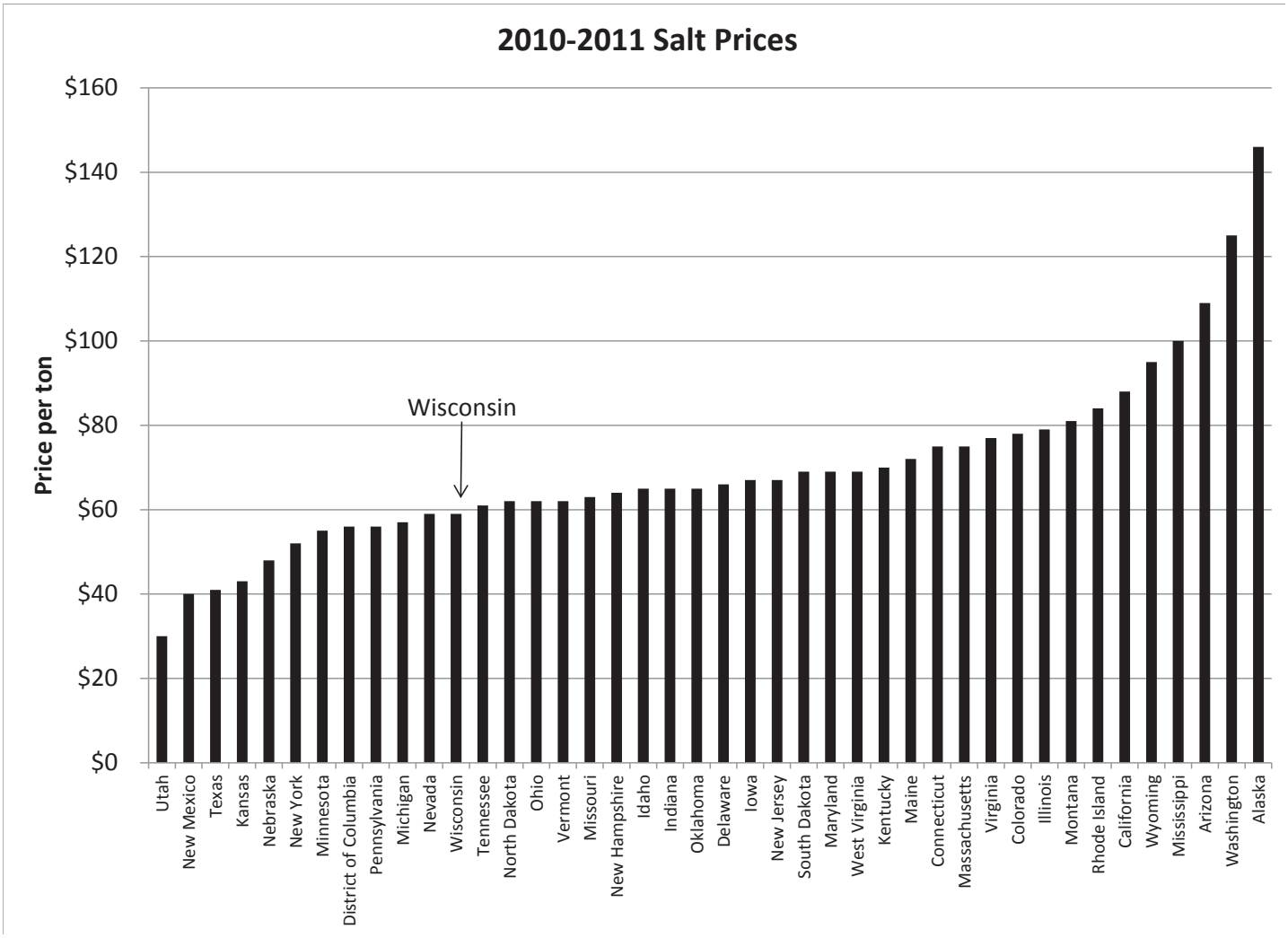


Figure 3.3. Salt Prices Across the United States

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

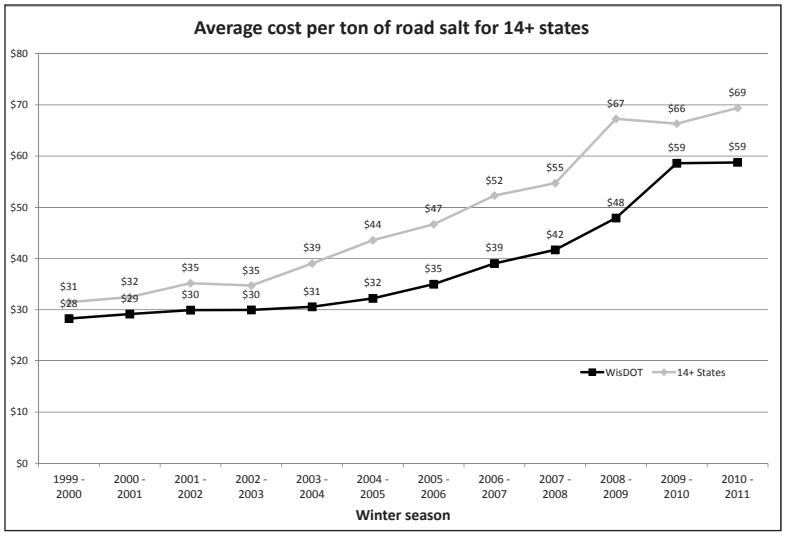
Salt prices continue to rise, which WisDOT's salt vendors attribute to multiyear supply and demand issues. This winter, WisDOT spent $33,671,175 on salt statewide, purchasing salt at an average of $58.75 per ton.

Higher fuel prices have contributed to higher salt transportation costs in recent years: The average of $58.75 per ton is a 4 percent decrease compared with prices paid under last winter's original salt contract, and an increase of 40 percent compared with the average price of $35.22 five 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 ten states pay less on average per ton, one state (Tennessee) pays about the same, and 33 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 $30 in Utah (New Mexico pays from $33 to $56 per ton) to $125 in Washington state (Wyoming pays $95 per ton). 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, 1999–2010



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, 1999–2011

Year	Sand used (cubic yards)
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]
1998–1999	35,709

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 18,941 cubic yards of sand was used by 48 counties on state highways this winter, a decrease of 77 percent compared with 2007–2008's record-setting 80,133 cubic yards, and a 45 percent decrease from the average of the five previous winters (34,605 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.

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.

At about 14 cents per gallon for material and production costs, salt brine is a relatively inexpensive choice for prewetting (see Table 3.5 on page 46). Salt brine use has increased significantly since counties first tested it a decade ago; 66 counties used salt brine for prewetting this winter (see Table A-6 on page 150 of the Appendix for details). Counties used a near record amount of salt brine for prewetting this winter—1,674,472 gallons—due to a 40 percent increase in the amount of salt used statewide compared with last winter. Overall use of prewetting liquids increased 44 percent compared with last year's total, and salt brine use increased 35 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.

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 48 counties that used sand this winter, only 6 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	1,436,441	57
Calcium chloride-based products		
Calcium chloride – liquid	121,064	12
Calcium chloride with rust inhibitor	15,909	5
Magnesium chloride-based products		
Magnesium chloride	4,824	6
Freeze Guard	1,059	1
Agricultural-based products		
Ice Ban-M80	15,880	5
Ice Ban-MC95	65,907	14
GeoMelt	13,407	4
Total	1,674,491 gallons of liquid	68

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.

This winter, counties used a record 714,860 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 61 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 36 percent over last year, even though some back-to-back storms limited anti-operations this year. 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 with salt brine to lower the working temperature of the 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
	2007-2008	2008-2009	**2009-2010**	**2010-2011**	2007-2008	2008-2009	**2009-2010**	**2010-2011**	**2010-2011**
A	$1,437	$892	**$849**	**$1,108**	$2,804	$5,220	**$6,754**	**$6,999**	5
B	$760	$818	**$876**	**$803**	$5,817	$3,151	**$1,802**	**$3,564**	6
C	$725	$961	**$845**	**$893**	$3,157	$1,669	**$1,994**	**$3,215**	14
D	$566	$629	**$620**	**$608**	$2,081	$1,377	**$1,266**	**$1,931**	6

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.

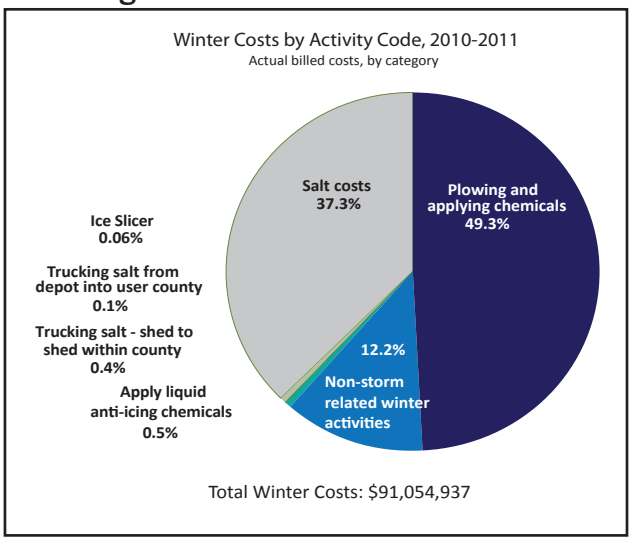
At $476,614, anti-icing costs made up only 0.5 percent of total winter maintenance costs this winter (see Figure 3.5). This percentage has remained fairly steady over the years—always less than 1 percent of total statewide winter costs. Investing in anti-icing is a cost-effective way to reduce overall materials use.

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, 50 of 72 counties (69 percent) used a total of 695,102 gallons of salt brine for anti-icing. This is a 7 percent increase compared with 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.

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.

Table 3.4. Statewide Anti-icing Agent Use

Chemical	Gallons used	Counties using
Salt brine	695,102	50
Calcium chloride – liquid	0	0
Calcium chloride with rust inhibitor	0	0
Magnesium chloride	680	2
Freeze Guard	1,000	2
Ice Ban-M80	3,115	2
Ice Ban-MC95	9,143	5
GeoMelt	5,820	4
Total	714,860	

Figure 3.6. Counties Using Anti-Icing

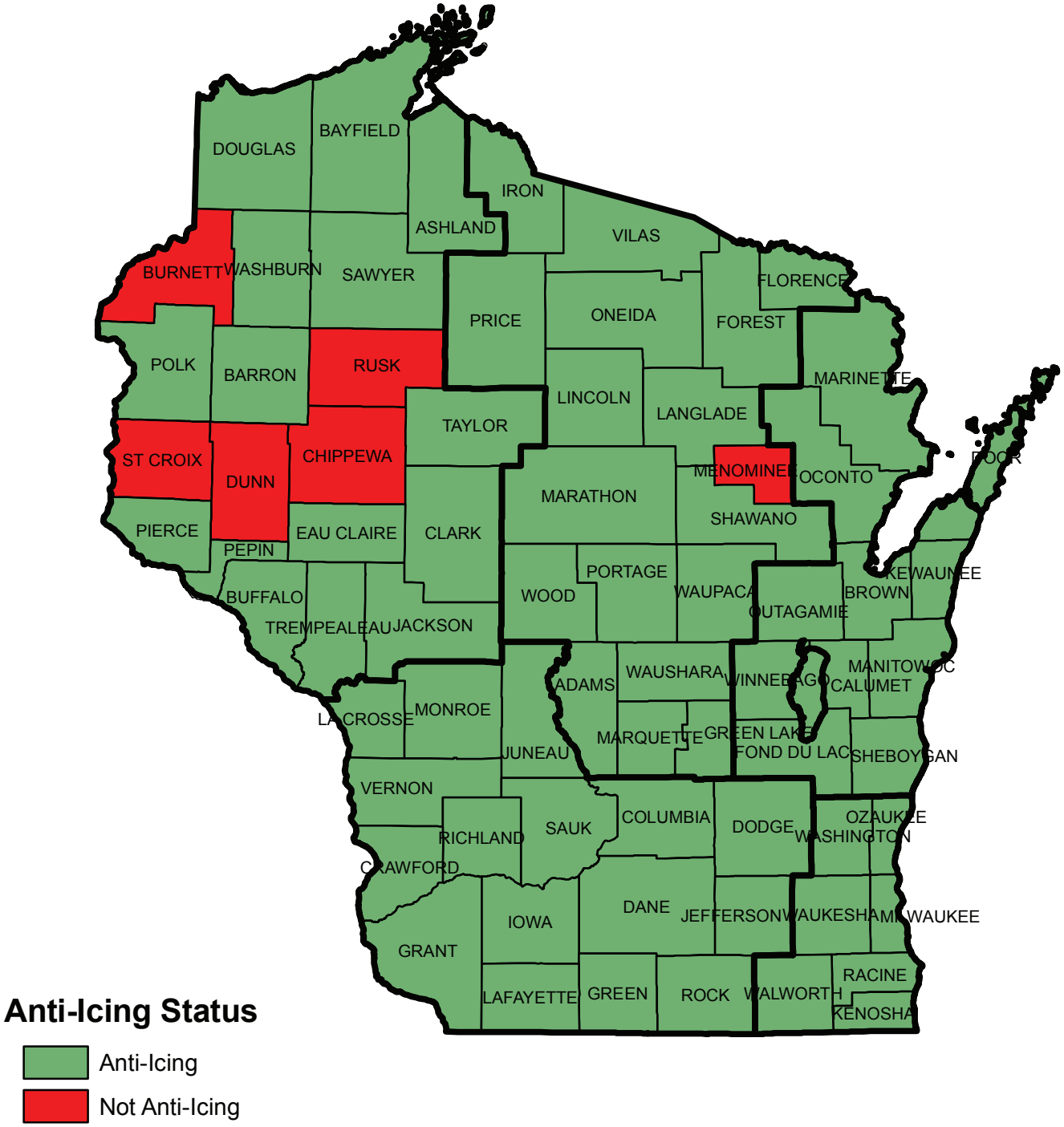


Figure 3.7. Counties Using Ground Speed Controllers

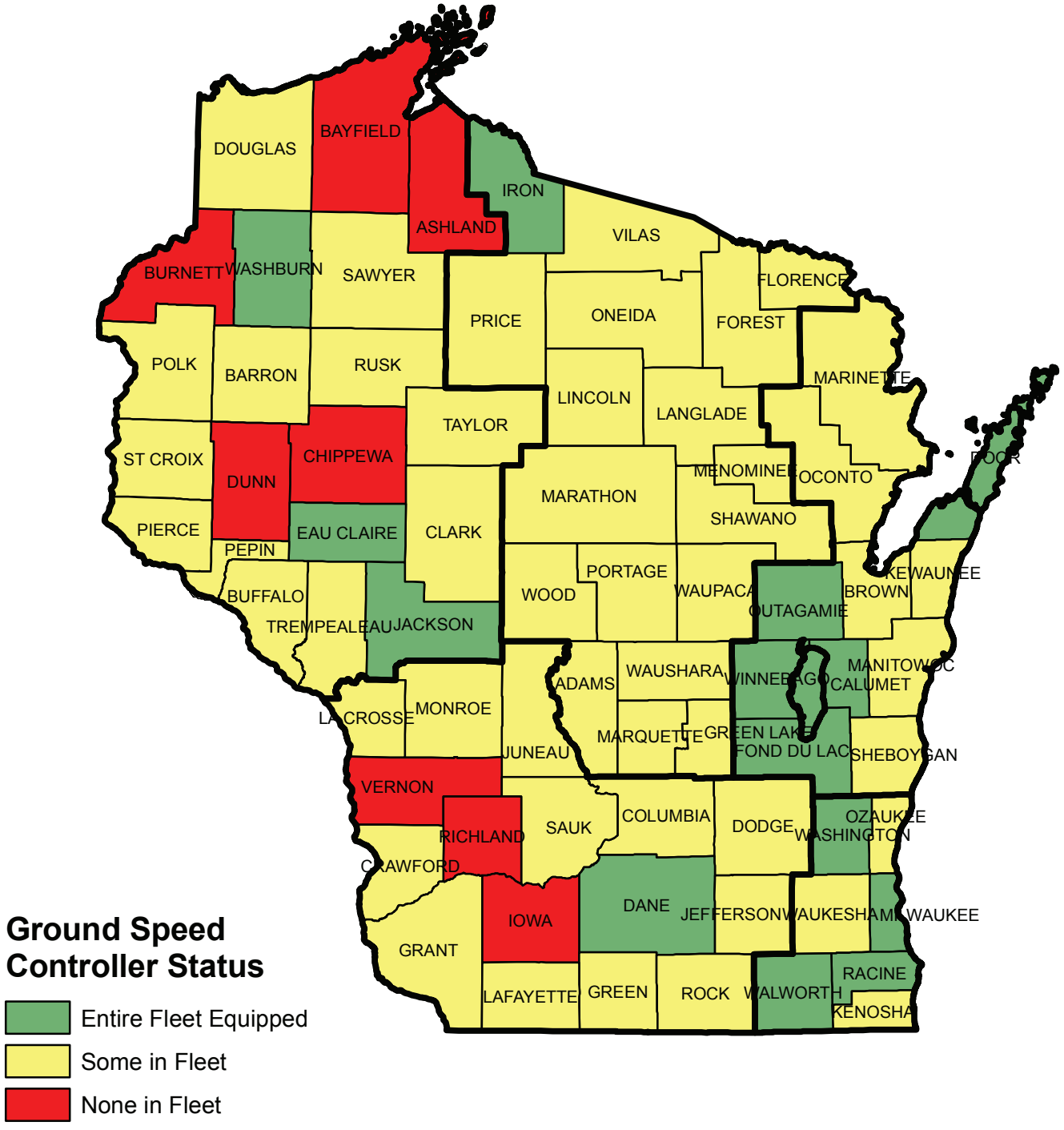


Figure 3.8. Counties Using Underbody Plows

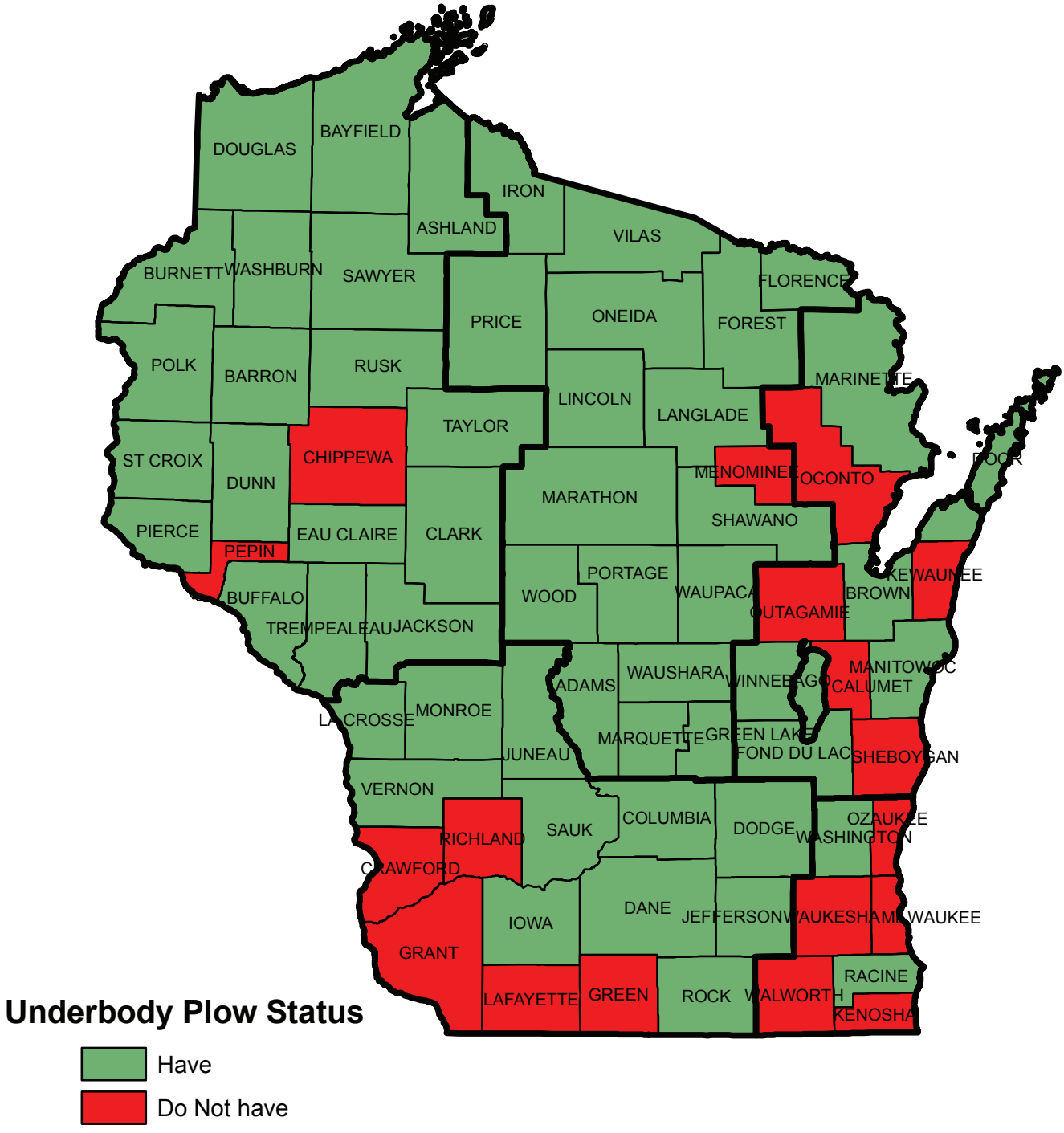


Figure 3.9. Counties Prewetting

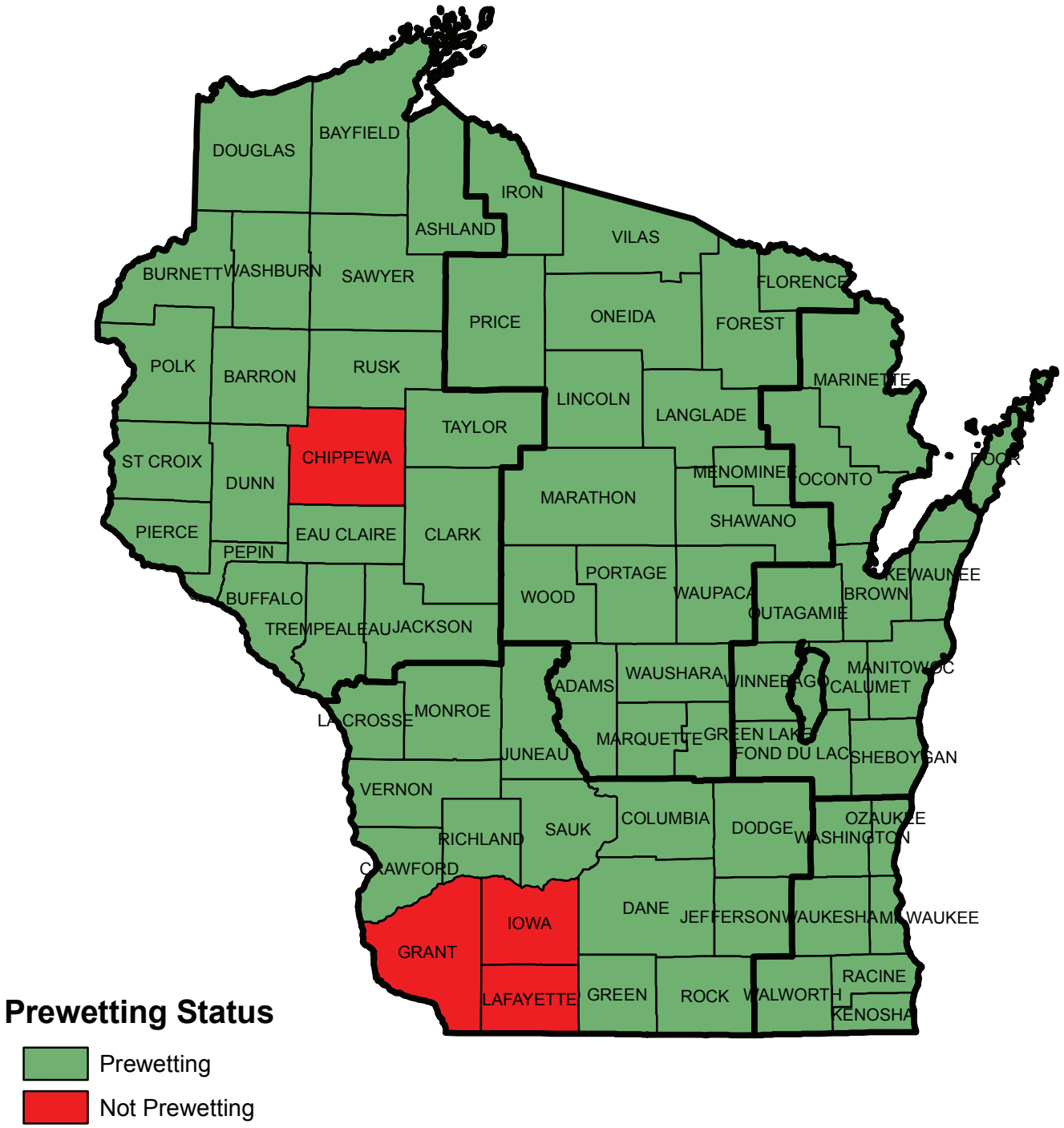


Table 3.5. Cost of Prewetting and Anti-icing Agents

Chemical	Average (per gallon)	Range (per gallon)
Salt brine	$0.14	$0.05 - $0.40 (57 counties)
Calcium chloride	$0.75	$0.45 - $1.22 (12 counties)
Calcium chloride with rust inhibitor	$0.76	$0.76 (5 counties)
Magnesium chloride	$0.99	$0.64 - $1.29 (7 counties)
Ice Ban MC-95	$1.16	$0.75 - $1.32 (5 counties)
Ice Ban M-80	$1.51	$1.51 (5 counties)
GeoMelt	$2.14	$1.90 - $2.26 (4 counties)

Cost of Deicing Agents

The cost of agents used for prewetting and anti-icing varies. Salt brine can be produced relatively cheaply (about $0.14 per gallon) at the county yard using salt brine production units purchased by WisDOT. Many counties have their own salt brine production units; others purchase salt brine from neighboring counties. Other agents tend to be more expensive, but may be useful at lower temperatures.

The average billed cost of selected agents this winter is detailed in Table 3.5. The unit cost of all products varies among counties based on the amount of material ordered and transportation costs.

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

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.

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.
- Coordinating with Meridian 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.

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 the Aurora research program (see page 52)
- Participating in national RWIS initiatives, such as Clarus.
- 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.
- Maintenance of traveler weather information systems at rest areas and safety weight enforcement facilities.
- 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.

The deadline of November 1, 2010, for having all trucks on state winter maintenance patrol sections equipped with ground speed controllers has been postponed pending the outcome of discussions between the Wisconsin Counties Association and WisDOT management. See Guideline 36.25 in the Winter Maintenance Manual for more information.

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.

Maintenance Decision Support System

MDSS is a major project undertaken by BHM 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 2010-11. 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. It was decided that small, computer-based sessions were the best route to take. This meant offering two sessions in each Region office, one in the morning and another in the afternoon. The attendees were county patrol superintendents, a few highway commissioners, and Region personnel.

BHM arranged for nearly all trainees to have laptops with which to access the MDSS. The BHM loaded MDSS onto all the laptops and ensured users had authorization prior to the training sessions. In a couple sessions, attendees had to share computers as attendance was greater than the number of laptops. The training stepped through the basics of what was available in MDSS, as well as a couple brief scenarios on how to use the vast amounts of information. All attendees were asked to complete a training evaluation survey, which enabled adjustments to the training materials as the sessions went along. All in all, nearly 200 people, including some State Patrol members, received the training. Two additional training sessions were held in January. These covered some additional features, but also allowed ample time for feedback from attendees. This allowed them to discuss the issues they were having with the system.

Current Status

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

Cost

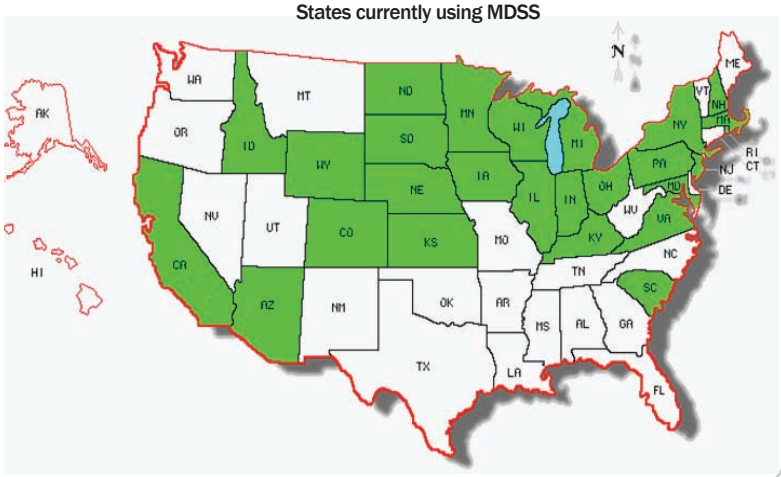
Total Deployment Cost: $108,000
Annual Pooled Fund Cost: $25,000
Annual Cost: $240,000
Annual Training Cost: $2,500

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.

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.

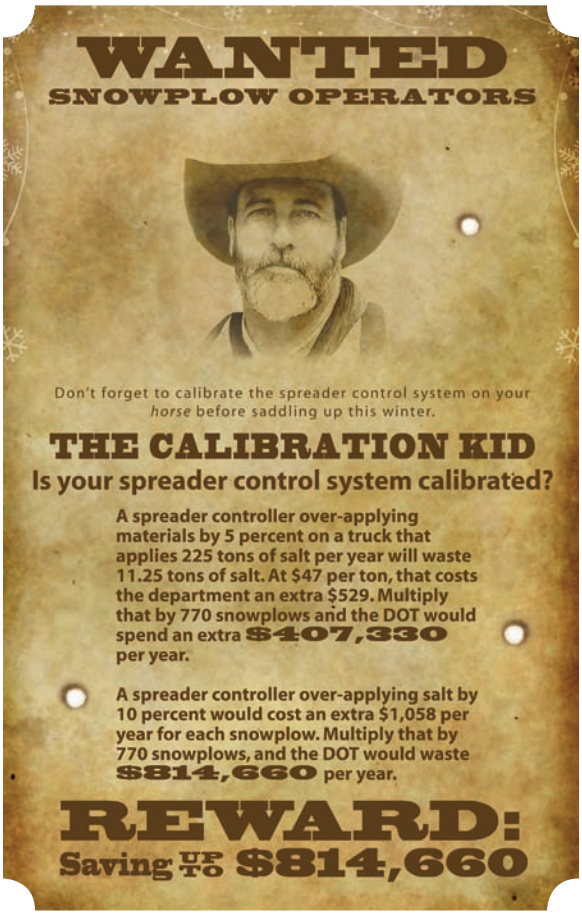
States currently using MDSS



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 in their vehicles.

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.



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. 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 GeoMelt has been effective as an anti-icing agent.
  - Counties have reported that blending pre-wetting materials with calcium and other mixes have made them more effective in lower temperatures.

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.

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.

> 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 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 department did not fund participation in this project in FY 2009, but WisDOT did resume membership in FY 2010. The Aurora program performs research in many RWIS-related areas, some of which have applications in Wisconsin. WisDOT is now 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.

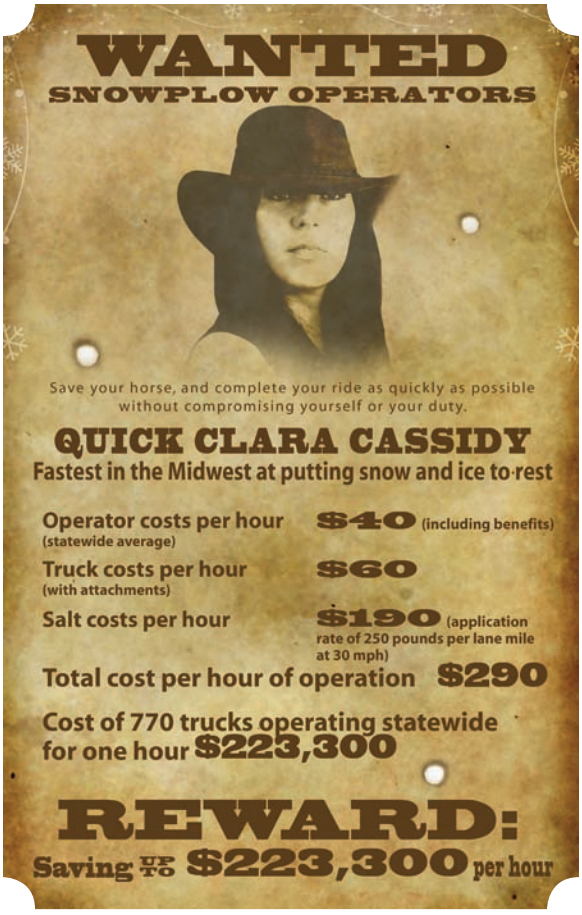
Clarus. A joint effort of FHWA and the National Weather Service, this initiative aims to consolidate all road weather data into a national database. A WisDOT representative attended the annual project meeting in Indianapolis, IN in August 2010. WisDOT also assisted in the evaluation of a Clarus project in Canada. It is anticipated that Clarus will be transitioned to the National Weather Service in FY 2012. At that time, WisDOT will begin using outputs from Clarus.

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 700 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 union 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.

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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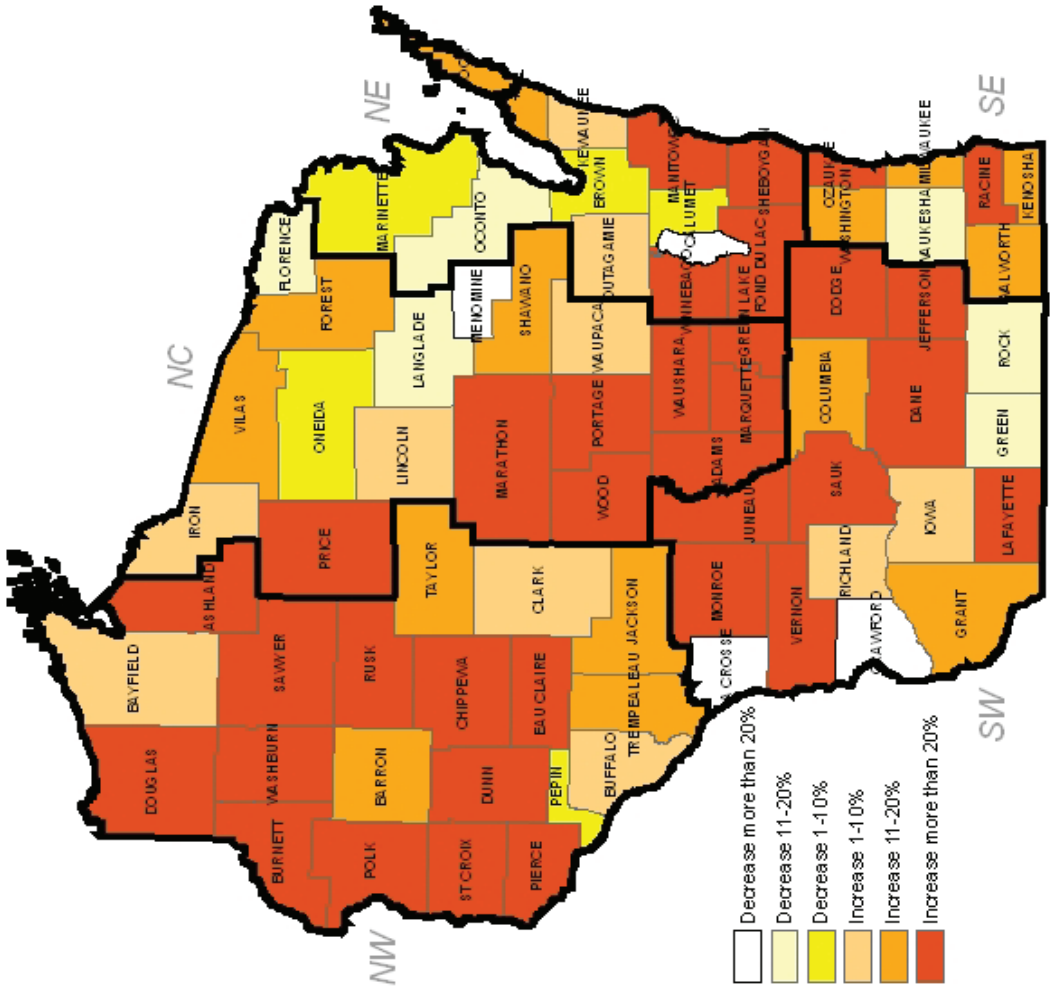
Figure 3.10. 2010-2011 Salt Use per Lane Mile vs. 5-Year Average

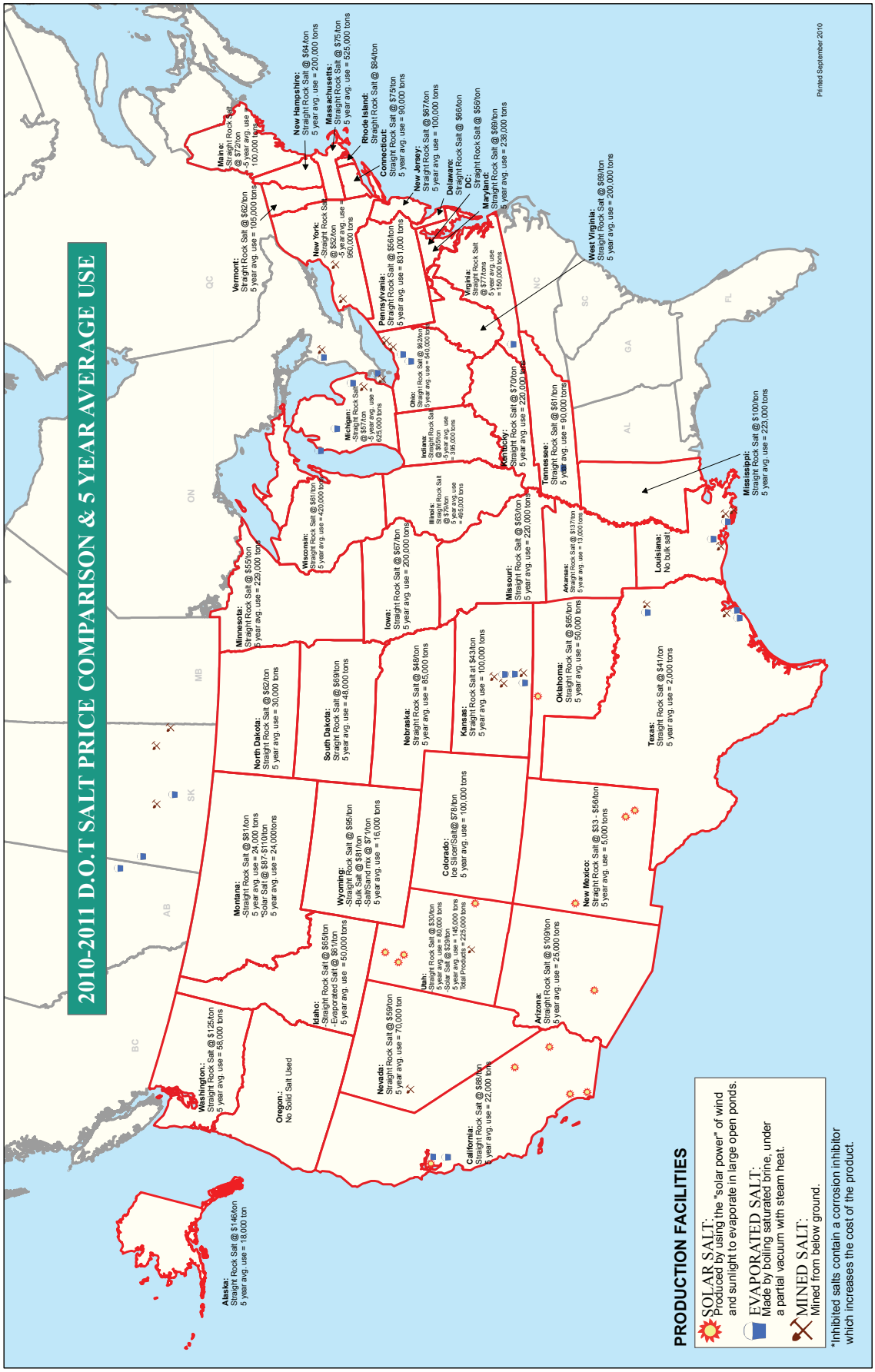


State and Regional	Departure
Statewide Average	17%
NC Region	11%
NE Region	12%
SW Region	17%
SE Region	18%
NW Region	32%

County	Departure
Taylor	19%
Jackson	19%
Washburn	20%
Burnett	20%
Manitowoc	21%
Portage	21%
Adams	21%
Winnebago	24%
Price	24%
Lafayette	24%
Vernon	24%
Marquette	26%
Pierce	27%
Sheboygan	27%
Juneau	28%
Eau Claire	29%
Jefferson	30%
Dodge	30%
Monroe	30%
Ashland	31%
Racine	31%
Dane	32%
Marathon	32%
Ozaukee	33%
Fond du Lac	33%
Waushara	33%
Douglas	36%
Green Lake	36%
Chippewa	43%
Sauk	44%
Rusk	45%
Sawyer	47%
Saint Croix	51%
Wood	57%
Dunn	63%
Polk	74%

County	Departure
Menominee	-52%
Crawford	-46%
LaCrosse	-38%
Rock	-17%
Langlade	-16%
Green	-15%
Waukesha	-14%
Florence	-13%
Oconto	-11%
Calumet	-10%
Pepin	-10%
Oneida	-10%
Brown	-3%
Marinette	-2%
Clark	2%
Richland	2%
Outagamie	4%
Waupaca	4%
Buffalo	5%
Iron	6%
Kewaunee	6%
Lincoln	7%
Iowa	7%
Bayfield	9%
Forest	10%
Trempealeau	11%
Barron	12%
Washington	12%
Vilas	12%
Door	12%
Shawano	12%
Grant	13%
Walworth	15%
Milwaukee	17%
Kenosha	17%
Columbia	18%

Figure 3.11 2010-2011 Salt Use per Lane Mile vs. 5-Year Average



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

From Winter Storm Reports, 2010-2011

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
MARATHON	NC	885.17	51.03	13.79	$514	4056	4787	8843	54.1%	9.99	0.20
LA CROSSE	SW	488.24	41.04	8.26	$564	3201	2448	5649	43.3%	11.57	0.28
PORTAGE	NC	565.45	40.04	12.94	$615	3096	3617	6712	53.9%	11.87	0.30
BROWN	NE	714.43	33.31	15.38	$523	3490	3710	7200	51.5%	10.08	0.30
RACINE	SE	674.30	38.78	20.64	$801	3452	5021	8473	59.3%	12.56	0.32
OZAUKEE	SE	304.03	32.65	26.90	$549	2162	1100	3262	33.7%	10.73	0.33
KENOSHA	SE	590.29	28.55	16.49	$703	2908	3318	6226	53.3%	10.55	0.37
DANE	SW	1547.16	32.13	30.19	$653	5751	13045	18796	69.4%	12.15	0.38
WINNEBAGO	NE	569.58	29.03	18.65	$606	2817	3989	6806	58.6%	11.95	0.41
WAUKESHA	SE	1070.09	27.00	21.96	$601	4535	7541	12076	62.4%	11.29	0.42
EAU CLAIRE	NW	537.26	31.73	14.60	$674	4597	3195	7793	41.0%	14.50	0.46
MILWAUKEE	SE	1755.71	33.01	25.97	$1,186	13304	14748	28052	52.6%	15.98	0.48
Group A Avg		808.48	34.86	18.81	$666	4447	5543	9991	52.8%	11.93	0.35

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group B)

From Winter Storm Reports, 2010-2011

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
ONEIDA	NC	396.79	51.03	13.47	$576	3191	1772	4963	35.7%	12.51	0.25
WAUSHARA	NC	345.71	30.17	11.11	$372	1465	1233	2698	45.7%	7.81	0.26
ROCK	SW	651.60	32.58	13.35	$459	2539	2993	5533	54.1%	8.49	0.26
SHAWANO	NC	519.33	37.64	14.00	$447	2718	2478	5196	47.7%	10.01	0.27
DODGE	SW	608.64	35.76	25.68	$456	2542	3326	5868	56.7%	9.64	0.27
SAUK	SW	618.44	38.07	25.62	$453	3350	3088	6438	48.0%	10.41	0.27
MARQUETTE	NC	244.53	35.21	18.32	$475	1246	1265	2511	50.4%	10.27	0.29
COLUMBIA	SW	801.28	35.56	24.93	$551	3953	4519	8472	53.3%	10.57	0.30
WASHINGTON	SE	581.11	28.81	20.05	$432	2082	2900	4981	58.2%	8.57	0.30
SAINT CROIX	NW	618.98	42.98	17.37	$660	4369	3706	8075	45.9%	13.05	0.30
SHEBOYGAN	NE	519.42	31.61	19.59	$514	2932	2126	5057	42.0%	9.74	0.31
CHIPPEWA	NW	669.29	38.03	17.24	$535	4092	3822	7914	48.3%	11.82	0.31
DUNN	NW	516.55	32.14	19.64	$535	2543	2641	5184	50.9%	10.04	0.31
MANITOWOC	NE	418.63	31.20	18.00	$558	2228	1992	4220	47.2%	10.08	0.32
OUTAGAMIE	NE	524.84	34.25	15.72	$502	4068	1922	5990	32.1%	11.41	0.33
JEFFERSON	SW	506.65	28.65	25.45	$522	1963	2890	4853	59.6%	9.58	0.33
WALWORTH	SE	698.71	26.33	22.67	$615	3755	3326	7081	47.0%	10.13	0.38
Group B Avg		543.56	34.71	18.95	$509	2884	2706	5590	48.4%	10.24	0.30

Final totals as of Monday, August 08, 2011

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2010-2011

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
VERNON	SW	446.84	42.90	12.37	$296	1884	1513	3397	44.5%	7.60	0.18
KEWAUNEE	NE	110.41	41.50	10.62	$379	530	327	856	38.1%	7.75	0.19
CRAWFORD	SW	388.95	41.31	4.82	$337	1681	1448	3129	46.3%	8.05	0.19
LAFAYETTE	SW	293.88	36.19	9.59	$315	822	1278	2100	60.9%	7.15	0.20
LINCOLN	NC	418.33	54.05	10.42	$478	2902	1640	4542	36.1%	10.86	0.20
VILAS	NC	305.24	41.32	22.44	$429	1509	1128	2637	42.8%	8.64	0.21
OCONTO	NE	472.01	35.10	9.28	$359	1901	1600	3501	45.7%	7.42	0.21
DOUGLAS	NW	439.23	51.27	15.99	$543	2884	1924	4808	40.0%	10.95	0.21
WOOD	NC	370.46	39.66	15.81	$478	1651	1707	3357	50.8%	9.06	0.23
GRANT	SW	624.06	35.10	13.40	$332	2630	2427	5057	48.0%	8.10	0.23
DOOR	NE	268.55	31.48	11.45	$394	759	1212	1971	61.5%	7.34	0.23
TREMPEALEAU	NW	434.99	32.75	12.37	$345	2030	1322	3352	39.4%	7.71	0.24
MONROE	SW	646.37	37.55	15.41	$419	2839	3185	6023	52.9%	9.32	0.25
JUNEAU	SW	498.79	32.06	18.28	$389	1643	2353	3996	58.9%	8.01	0.25
CLARK	NW	402.44	34.55	10.71	$400	1959	1559	3517	44.3%	8.74	0.25
WASHBURN	NW	372.14	36.23	14.90	$438	1856	1558	3414	45.6%	9.17	0.25
JACKSON	NW	515.00	41.57	15.68	$545	3546	2172	5718	38.0%	11.10	0.27
WAUPACA	NC	546.64	30.35	11.81	$431	2012	2651	4663	56.8%	8.53	0.28
IOWA	SW	458.14	32.85	13.32	$469	2237	2618	4855	53.9%	10.60	0.32

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2010-2011

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
ASHLAND	NW	247.57	68.11	14.56	$472	1119	1354	2474	54.8%	9.99	0.15
IRON	NC	249.56	70.69	19.47	$619	2026	1156	3182	36.3%	12.75	0.18
FLORENCE	NC	141.07	48.35	15.49	$413	637	599	1236	48.5%	8.76	0.18
MARINETTE	NE	417.91	36.54	10.49	$423	1750	1082	2832	38.2%	6.78	0.19
PRICE	NC	320.57	60.43	16.84	$534	1677	2035	3712	54.8%	11.58	0.19
BAYFIELD	NW	316.90	61.26	13.90	$505	2360	1362	3722	36.6%	11.75	0.19
POLK	NW	385.05	52.50	19.98	$489	2174	1824	3998	45.6%	10.38	0.20
PIERCE	NW	368.12	38.92	13.44	$400	1442	1402	2844	49.3%	7.72	0.20
SAWYER	NW	367.44	47.41	11.67	$446	2100	1407	3506	40.1%	9.54	0.20
BURNETT	NW	233.64	45.99	13.38	$452	1262	1020	2282	44.7%	9.77	0.21
LANGLADE	NC	292.19	39.92	11.22	$391	1257	1228	2486	49.4%	8.51	0.21
TAYLOR	NW	234.09	41.11	12.94	$375	1400	660	2060	32.0%	8.80	0.21
GREEN LAKE	NC	151.50	33.47	9.31	$338	636	457	1093	41.8%	7.21	0.22
BUFFALO	NW	316.05	36.72	5.85	$337	1498	1064	2562	41.5%	8.11	0.22
MENOMINEE	NC	90.26	28.25	7.76	$214	412	156	568	27.5%	6.29	0.22
ADAMS	NC	191.58	41.16	17.82	$492	991	833	1824	45.7%	9.52	0.23
RICHLAND	SW	325.26	25.31	7.86	$282	1118	860	1978	43.5%	6.08	0.24
PEPIN	NW	112.38	28.20	5.53	$332	343	422	765	55.2%	6.81	0.24
FOREST	NC	312.38	47.76	17.78	$479	2183	1450	3633	39.9%	11.63	0.24

Final totals as of Monday, August 08, 2011

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2009-2010

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
MENOMINEE	NC	90.26	22.48	13.86	$131	258	95	353	26.9%	3.91	0.17
RICHLAND	SW	328.72	28.61	9.60	$214	1077	601	1678	35.8%	5.10	0.18
FLORENCE	NC	141.07	29.77	13.20	$239	406	357	763	46.8%	5.41	0.18
ASHLAND	NW	247.57	43.38	9.76	$391	940	1050	1990	52.8%	8.04	0.19
BAYFIELD	NW	316.90	42.88	10.00	$357	1595	946	2541	37.2%	8.02	0.19
PRICE	NC	320.57	37.23	9.68	$332	1178	1109	2287	48.5%	7.13	0.19
ADAMS	NC	192.72	29.92	12.79	$282	706	409	1114	36.7%	5.78	0.19
PIERCE	NW	366.08	32.49	8.85	$299	1469	835	2304	36.2%	6.29	0.19
MARINETTE	NE	417.29	29.16	8.38	$332	1803	628	2430	25.8%	5.82	0.20
GREEN LAKE	NC	151.30	24.65	5.01	$214	514	238	751	31.6%	4.96	0.20
IRON	NC	250.91	46.53	15.51	$442	1544	850	2394	35.5%	9.54	0.21
FOREST	NC	312.38	31.51	13.93	$267	1329	719	2048	35.1%	6.55	0.21
BURNETT	NW	233.64	24.77	7.31	$234	844	440	1284	34.3%	5.50	0.22
SAWYER	NW	367.44	26.51	6.24	$263	1320	864	2184	39.5%	5.94	0.22
POLK	NW	385.05	27.97	9.97	$309	1440	1071	2511	42.6%	6.52	0.23
RUSK	NW	213.47	29.65	8.15	$286	1063	426	1489	28.6%	6.97	0.24
TAYLOR	NW	233.25	27.78	8.88	$280	1054	498	1552	32.1%	6.65	0.24
BARRON	NW	423.09	31.23	3.77	$342	2161	1133	3294	34.4%	7.79	0.25
BUFFALO	NW	316.05	24.47	5.59	$259	1241	740	1981	37.4%	6.27	0.26

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2009-2010

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
PEPIN	NW	111.05	21.72	6.57	$268	367	283	650	43.5%	5.85	0.27
LANGLADE	NC	292.69	23.42	8.37	$277	1209	665	1874	35.5%	6.40	0.27
GREEN	SW	311.37	26.31	8.84	$355	1454	1166	2620	44.5%	8.41	0.32
Group D Avg		273.77	30.11	9.28	$290	1135	687	1822	37.3%	6.49	0.22

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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, 2010-2011

Total lane miles	33,776
Total patrol sections	767
Average lane miles per patrol section	44.05
Average time to bare/wet pavement[1]	1.49 hours
Average crew reaction time from start of storm	2.58 hours
Total winter costs[2]	$91,054,937
Total winter costs per lane mile	$2,696
Total winter crashes[3]	9,449
Total winter crashes per 100 million VMT	35

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 0.5 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 4.4 on page 76 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)

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.

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. The 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

WisDOT Regional Offices

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

Counties

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

See https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/storms/howtouse.shtm 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.

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 767 winter patrol sections, an average of 10.6 sections per county. The length of patrol sections varies, with counties that are

BEST PRACTICES: Proactive approach

In general, a faster reaction time leads to faster clear pavement. WisDOT encourages county highway departments to have crews on the roads as soon as possible after a storm begins, within the guidelines for each county's service group and each highway's expected level of service.

Responding at the beginning of a storm reduces the amount of traffic that has packed down the snow before the plows and salt spreaders go to work. Since packed snow tends to require more effort to remove, minimizing the thickness of packed snow allows the counties to conserve resources and operate more efficiently.

For more information, contact Mike Sproul at michael.sproul@dot.wi.gov or (608) 266-8680.

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 4.1 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.

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.

Table 4.1. 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	42.9	30 - 62
B	44.3	35 - 57
C	46.4	20 - 61
D	49.0	37– 61
Statewide average	44.5	30 - 60

Table 4.2. Maintenance Crew Reaction Time

From winter storm reports, 2003/2004–2010/2011

	Average reaction time (hours)								Percent change
Winter Service Group	2003–2004	2004–2005	2004–2006	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2010–2011 vs. 2003–2004
A	1.45	1.25	1.55	1.70	1.50	1.40	2.31	1.8	+24%
B	2.01	1.97	1.59	1.80	1.73	1.91	2.34	1.77	-12%
C	2.89	2.42	2.79	2.82	2.86	2.82	3.21	2.88	-0.3%
D	4.37	3.23	3.60	3.81	3.83	4.16	4.87	3.87	-11%
Statewide average (unweighted)	**2.68**	**2.22**	**2.38**	**2.53**	**2.48**	**2.57**	**3.18**	**2.58**	**-4%**

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 4.2 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, responding an average of 90 percent faster last winter than in 2003-2004. However, this winter the average reaction time was 4 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 was lowest in 2004–2005 and 2005–2006, and has increased somewhat during the last four winters. This year's average reaction time was 1.49 hours. The increase in reaction time may be due to the increased use of the anti-icing technique. However, faster reaction times can result in higher labor costs.

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 4.3. Average Time to Bare/Wet Pavement

Highway Category	Average Time to Bare/Wet Pavement (hours after end of storm)					
	2005–2006	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011
1	-1.21	–2.50	2.20	1.35	-1.02	-0.95
2	0.20	-0.55	0.76	1.01	-1.58	-0.55
3	1.77	1.57	3.14	2.40	1.65	2.25
4	2.47	2.70	4.01	3.06	2.32	1.39
5	3.40	2.73	4.84	3.74	2.41	2.92
Statewide average	1.92	1.46	3.27	2.54	1.14	1.49

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 1.49 hours which, though not an improvement over last year's mild winter, compares favorably to the 2007-2008 and 2008-2009 years, which had similar winter severity indices but much higher times to bare/wet pavement (3.27 hours and 2.54 hours). The 1.14 hours in 2009-2010 is the lowest time to bare/wet pavement since this measure began.

Table 4.4. Statewide Compass Measures for Winter

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Time to bare/wet pavement (after end of storm)	1 hour, 55 minutes	1 hour, 28 minutes	3 hours, 16 minutes	2 hours, 32 minutes	1 hours 8 minutes	1 hours 28 minutes
Cost per lane mile	$1,400	$1,549	$2,591	$2,365	$2,222	$2,696
Winter Severity Index	31.8	28.4	37.2	36.2	26.6	38.5
Cost per lane mile per Winter Severity Index point	$44.03	$54.54	$69.65	$65.33	$83.53	$70.21
Winter weather crashes	24 per 100 million vehicle miles traveled	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

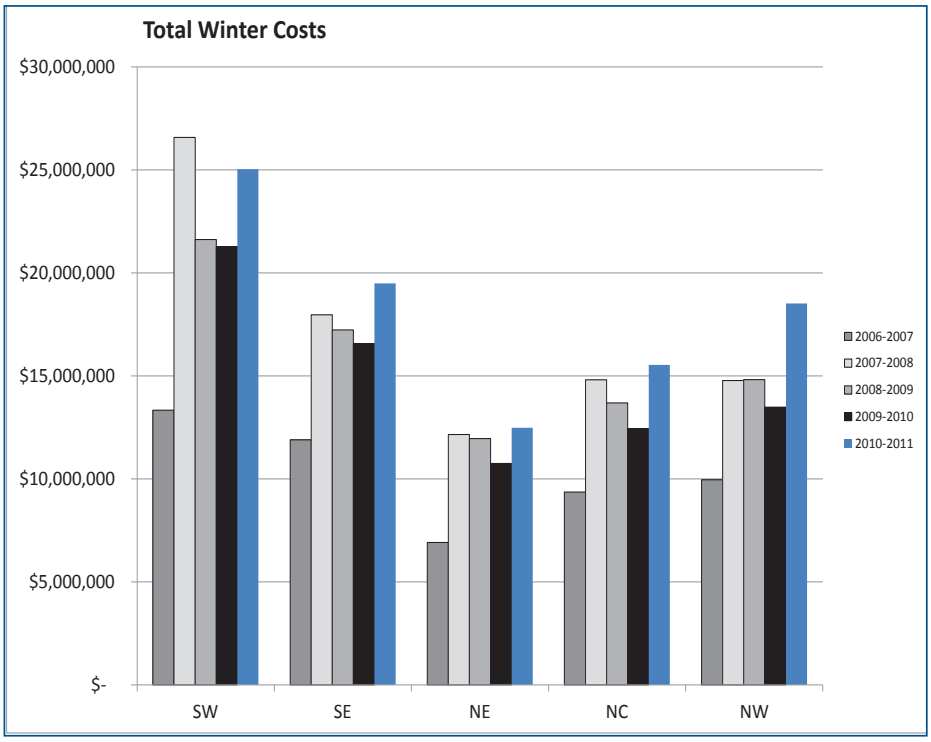
4D. Costs

The total billed cost of statewide winter operations this winter was $91.0 million, making it the most costly winter on record. This figure represents a 22 percent increase from last year's total costs, and a 77 percent increase over 2006–2007, the last "typical" winter. This was also the most costly winter on record at the regional level, for all regions except the Southwest Region. While the counties experienced moderate decreases in salt costs per lane mile, labor and equipment costs per lane mile increased about 45 percent compared to last year.

Higher fuel prices have raised salt transportation costs in recent years: The average of $58.55 per ton paid this winter is a decrease of one percent over last winter, but an increase of 67 percent compared with the average of $34.98 five winters ago.

As Figure 4.1 shows, all regions experienced an increase in costs compared with last winter, with the Northwest Region experiencing the most significant increase in costs. This year's 20 percent more severe winter contributed to this increase in costs.

Figure 4.1. Change in Costs Since 2006-2007



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

Five counties saw increases of more than 85 percent, and an additional six counties saw increases of between 61 and 80 percent. Unlike last winter, when all counties with the highest increases were in the Southwest Region, the counties that registered the highest increases this winter are scattered throughout the state. Every county recorded an increase, with Menominee County reporting the lowest increase at 1 percent.

In individual expenditure categories for the 2010–2011 winter, statewide:

- Salt expenditures were $33.9 million. This was a 3 percent decrease compared with the previous winter, and a 22 percent increase over the 2007–2008 winter, with the Northeast and Southeast regions seeing the biggest decreases from last winter at 13 percent and 18 percent, respectively. The Northwest region saw the biggest increase of 13 percent over last year.
- Equipment expenditures were $27.0 million, an increase of 32 percent compared with the previous winter but was a 8 percent decrease over the 2007–2008 winter, with the Northwest region experiencing a 39 percent increase compared with last winter.
- Labor expenditures were $25.3 million, an increase of 30 percent over the previous winter, with the Northwest Region seeing the greatest increase at 36 percent.
- Expenditures for materials other than salt were $2.6 million, an increase of 12 percent compared with the previous winter. Expenditures at the region level ranged from a 47 percent increase over the 2009–2010 winter in the Northeast Region to a 39 percent decrease in the North Central Region. Statewide expenditures in this category were 21 percent lower than in the winter of 2007–2008.

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 $2,696 was the highest to date. It is only moderately higher than the 2007-2008 average of $2,591, and it continues the trend of higher costs that began that winter, compared 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 13 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 record setting winter, it is no surprise that costs would be higher than last year.

Figure 4.2. Winter Costs per Lane Mile

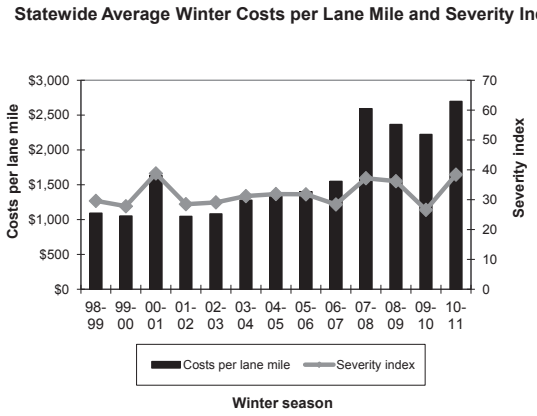


Table 4.5. Total Winter Costs Relative to Winter Severity

Region	Average Winter Severity Index	Actual cost per lane mile	Relative cost per severity index point
SW	35.02	$2,716	$77.56
SE	30.73	$3,434	$111.75
NE	33.43	$2,592	$77.53
NC	43.36	$2,448	$56.46
NW	42.22	$2,397	$56.77
Statewide	38.45	$2,696	$70.09

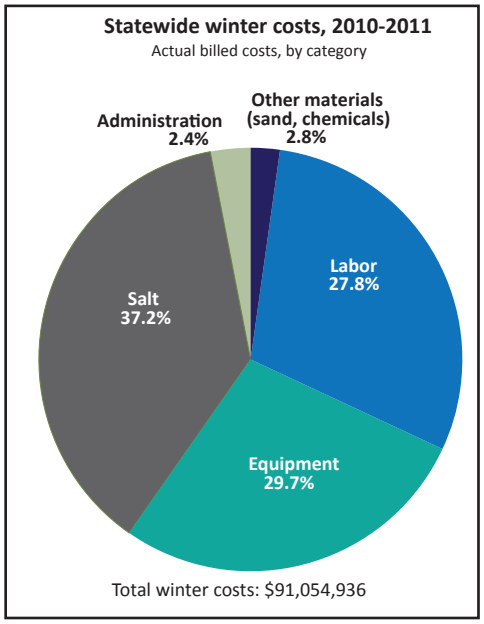
Table 4.5 on page 77 lists the total cost per lane mile for winter maintenance in each region, along with the region's Winter Severity Index. The level of service provided in each county affects total costs, as do the factors listed below. For these reasons, the Southeast Region historically experiences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

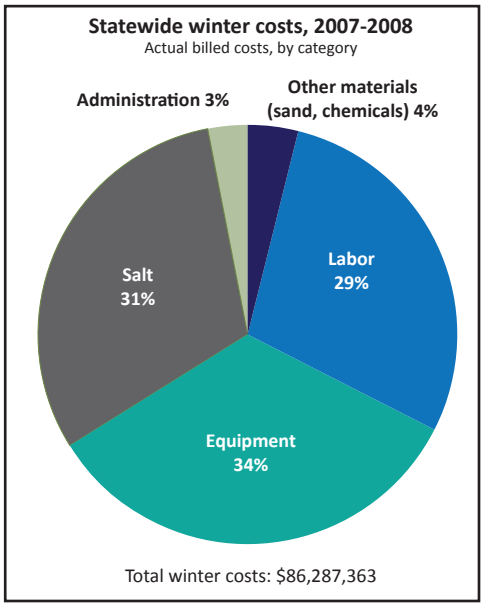
Components of Winter Costs

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).
- 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.

Figure 4.3. Statewide Winter Costs by Category





A comparison of total costs from year to year shows that the breakdown of costs among these five categories has not changed a lot from three winters ago, even when winter severity indices are similar. To illustrate this, Figure 4.3 shows the breakdown of costs for this winter compared with the winter of 2007–2008, when the statewide severity index of 37.2 was slightly lower.

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.

Figure 4.4. Regional Winter Costs by Category

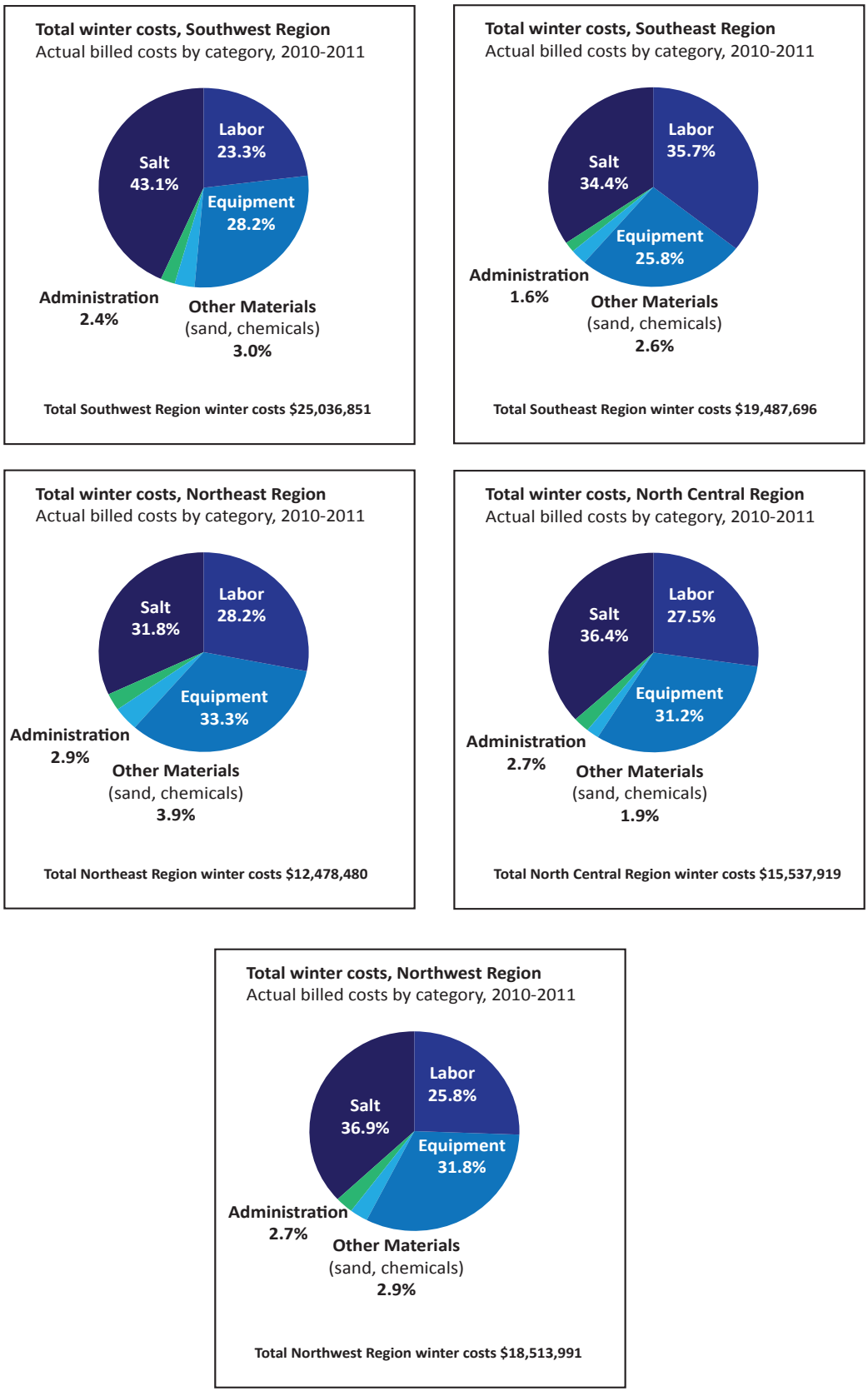
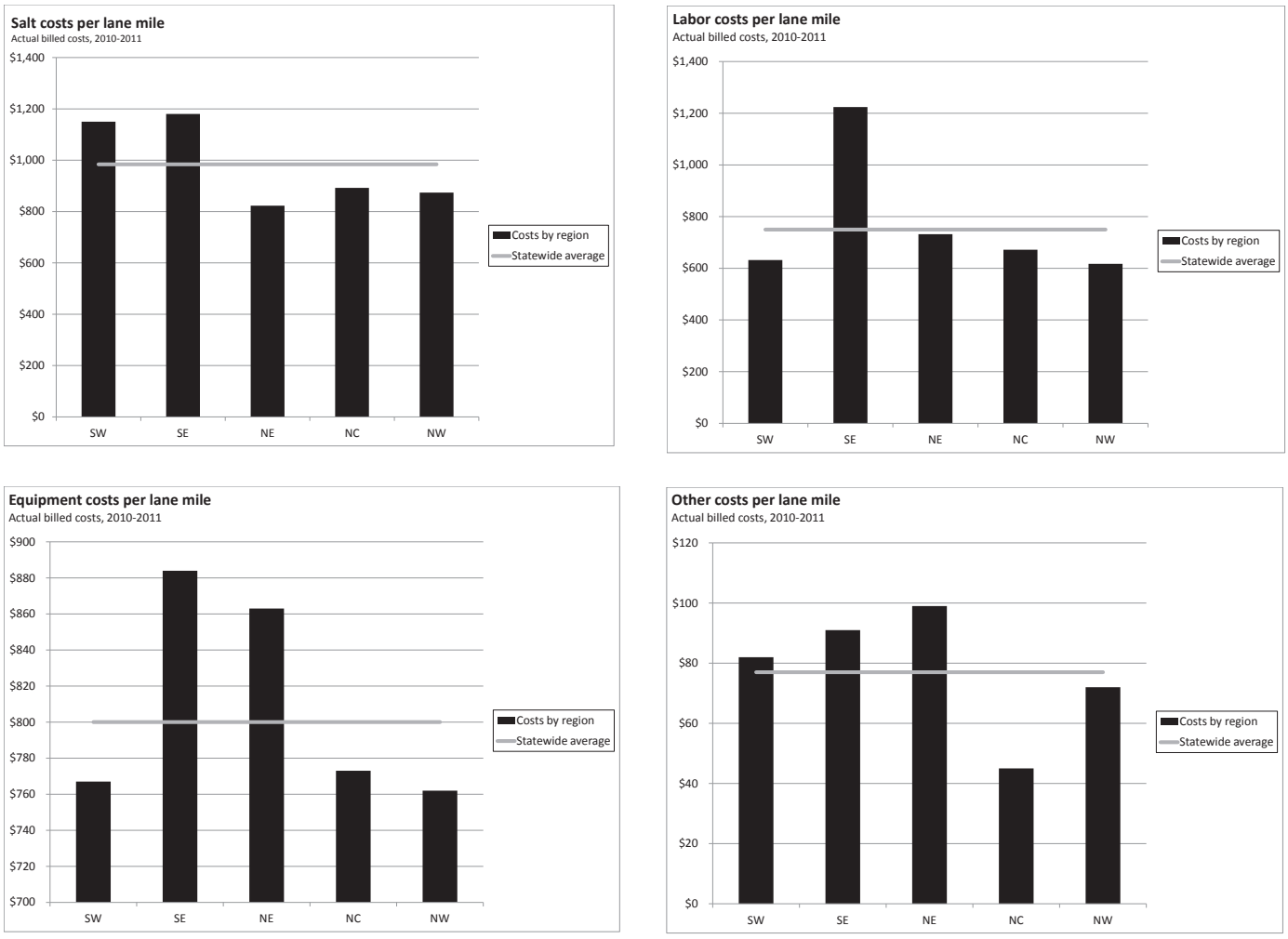


Table 4.6 Winter Costs as Billed to WisDOT by Counties

From the WisDOT accounting system, 2010-2011

	Labor Costs	Equipment Costs	County Furnished Material Costs	Administration Costs	Cost of Salt Used	Total Costs for Winter	Five Year Avg Cost for Winter ('06-'10 avg)	% Costs over Five Year Average
Region 1 / Southwest	$5,822,261	$7,069,021	$759,571	$595,173	$10,790,825	$25,036,851	$18,879,000	133%
Region 2 / Southeast	$6,947,362	$5,018,305	$514,866	$310,570	$6,696,593	$19,487,696	$14,377,300	136%
Region 3 / Northeast	$3,525,936	$4,154,074	$477,014	$359,785	$3,961,671	$12,478,480	$9,653,200	129%
Region 4 / Northcentral	$4,267,480	$4,904,725	$287,205	$416,738	$5,661,771	$15,537,919	$12,006,700	129%
Region 5 / Northwest	$4,768,170	$5,886,835	$553,206	$490,774	$6,815,006	$18,513,991	$12,646,600	146%
Region Totals	**$25,331,209**	**$27,032,960**	**$2,591,862**	**$2,173,040**	**$33,925,865**	**$91,054,936**	**$67,562,800**	**135%**

Figure 4.5. Costs per Lane Mile by Category



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.

A Note About Cost Data

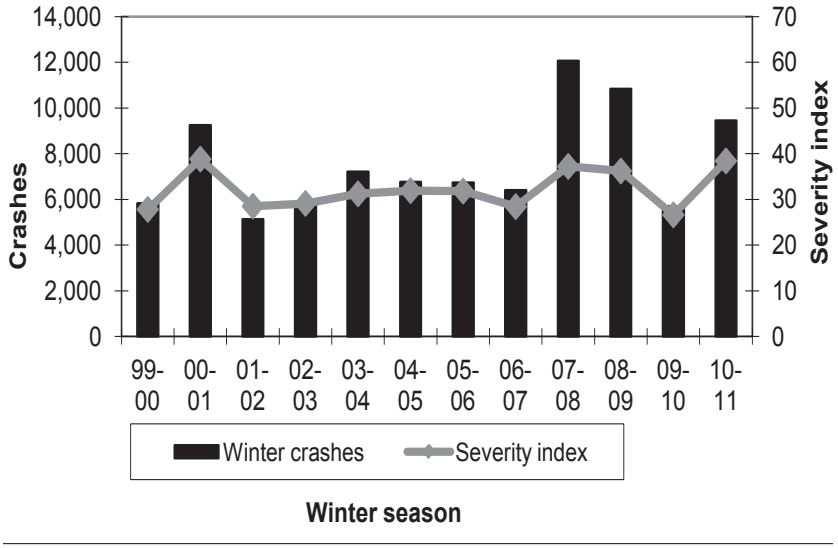
The tables at the end of this section were generated with data from two sources—final costs as billed to WisDOT, and preliminary costs from the winter storm reports. The tables created from preliminary storm reports data (such as Table 4.11 on page 98, Cost per Lane Mile per Severity Index Ranking) are 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.

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.

Figure 4.6. Winter Crashes and Winter Severity Index



Source: WisDOT Bureau of Transportation Safety

In the winter of 2010–2011, there were 9,449 reported winter weather crashes (those that occurred on pavements covered with snow, slush or ice). In part, this data reflects the fact that the higher number of storm events increases the exposure rate. The crash rate (number of crashes per 100 million vehicle miles traveled) increased drastically (37%) this winter to a statewide average of 35, up from last winter's crash rate of 22. Last winter, 5,697 winter crashes were reported.

Crash rates tend to increase in more severe winters, and this winter's rate was similar to the winter of 2007–2008 when the severity index was high. 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 increase over 2009-2010.

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.

Table 4.7. Crashes and Vehicle Miles Traveled by Region

Region	Average Winter Severity Index	VMT (100 million)	Crashes	Crashes per 100 million VMT (2009-2010)	Crashes per 100 million VMT (2010–2011)
NC	43.36	34.11	1,317	23	39
NE	33.43	47.44	1,803	25	38
NW	42.22	39.53	1,542	22	39
SE	30.73	81.82	2,263	16	27
SW	35.02	67.09	2,524	26	37
Statewide	38.45	269.9	9,449	22	35

Source: WisDOT Bureau of Transportation Safety

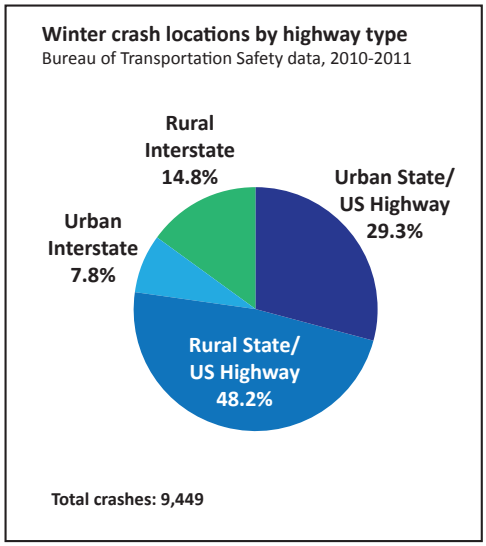
Crashes and Vehicle Miles Traveled

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 increases in crash rates of 41 percent and 34 percent, respectively. The Southeast region showed the lowest crash rate, reporting 27 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 2010 to April 2011), 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.

Figure 4.7. Winter Crash Locations



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 21.8 million in Menominee County to a high of 3.2 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.

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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 2011 Survey	Lane Miles per Patrol Section	Winter Service Group
Adams	191.58	5	38.32	D
Florence	141.07	3	47.02	D
Forest	312.38	6	52.06	D
Green Lake	151.50	3	50.50	D
Iron	249.56	6	41.59	D
Langlade	292.19	6	48.70	D
Lincoln	418.33	10	41.83	C
Marathon	885.17	19	46.59	A
Marquette	244.53	5	48.91	B
Menominee	90.26	2	45.13	D
Oneida	396.79	10	39.68	B
Portage	565.45	13	43.50	A
Price	320.57	6	53.43	D
Shawano	519.33	14	37.10	B
Vilas	305.24	5	61.05	C
Waupaca	546.64	12	45.55	C
Waushara	345.71	7	49.39	B
Wood	370.46	19	19.50	C
Region Average			**44.99**	

NW Region

County	Lane Miles	Winter Patrol Sections 2011 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	7	45.27	D
Buffalo	316.05	7	45.15	D
Burnett	233.64	5	46.73	D
Chippewa	669.29	16	41.83	B
Clark	402.44	10	40.24	C
Douglas	439.23	9	48.80	C
Dunn	516.55	9	57.39	B
Eau Claire	537.26	9	59.70	A
Jackson	515.00	9	57.22	C
Pepin	112.38	3	37.46	D
Pierce	368.12	7	52.59	D
Polk	385.05	7	55.01	D
Rusk	213.47	4	53.37	D
Saint Croix	618.98	11	56.27	B
Sawyer	367.44	6	61.24	D
Taylor	234.09	4	58.52	D
Trempeleau	434.99	10	43.50	C
Washburn	372.14	7	53.16	C
Region Average			**50.07**	

NE Region

County	Lane Miles	Winter Patrol Sections 2011 Survey	Lane Miles per Patrol Section	Winter Service Group
Brown	714.43	18	39.69	A
Calumet	201.29	6	33.55	C
Door	268.55	6	44.76	C
Fond du Lac	597.30	15	39.82	C
Kewaunee	110.41	3	36.80	C
Manitowoc	418.63	11	38.06	B
Marinette	417.91	7	59.70	D
Oconto	472.01	9	52.45	C
Outagamie	524.84	15	34.99	B
Sheboygan	519.42	12	43.28	B
Winnebago	569.58	14	40.68	A
Region Average			**42.16**	

SW Region

County	Lane Miles	Winter Patrol Sections 2011 Survey	Lane Miles per Patrol Section	Winter Service Group
Columbia	801.28	15	53.42	B
Crawford	388.95	7	55.56	C
Dane	1547.16	25	61.89	A
Dodge	608.64	17	35.80	B
Grant	624.06	11	56.73	C
Green	312.72	7	44.67	D
Iowa	458.14	9	50.90	C
Jefferson	506.65	13	38.97	B
Juneau	498.79	10	49.88	C
LaCrosse	488.24	13	37.56	A
Lafayette	293.88	6	48.98	C
Monroe	646.37	13	49.72	C
Richland	325.26	6	54.21	D
Rock	651.60	13	50.12	B
Sauk	618.44	12	51.54	B
Vernon	446.84	10	44.68	C
Region Average			**49.04**	

SE Region

County	Lane Miles	Winter Patrol Sections 2011 Survey	Lane Miles per Patrol Section	Winter Service Group
Kenosha	590.29	19	31.07	A
Milwaukee	1755.71	42	41.80	A
Ozaukee	304.03	10	30.40	A
Racine	674.30	15	44.95	A
Walworth	698.71	20	34.94	B
Washington	581.11	14	41.51	B
Waukesha	1070.09	29	36.90	A

	Lane Miles	Winter Patrol Sections 2011 Survey	Lane Miles per Patrol Section
Statewide Totals	33,776.07	759.0	44.50
Statewide Averages	469.11	10.5	44.50
Group A Averages	808.48	18.83	42.89
Group B Averages	543.56	12.59	44.31
Group C Averages	419.57	9.33	46.41
Group D Averages	273.76	5.59	49.03

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

From Winter Storm Reports, 2010-2011

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)						
MARATHON	NC	3.72	4.13	5.09	7.85	4.25	51.03	29.60
EAU CLAIRE	NW	0.60	0.61	0.42	0.66	0.60	31.73	47.52
LA CROSSE	SW	3.79	3.63	3.89	4.07	3.79	41.04	47.93
PORTAGE	NC	4.37	4.42	4.18	4.72	4.17	40.04	48.07
BROWN	NE	3.40	3.49	1.77	3.46	3.43	33.31	60.83
RACINE	SE	1.25	1.37	1.37	1.35	1.43	38.78	60.95
OZAUKEE	SE	0.31	0.31	0.64	1.13	0.31	32.65	63.92
MILWAUKEE	SE	0.02	0.05	0.02	0.08	0.03	33.01	70.28
WINNEBAGO	NE	1.52	1.50	1.34	1.40	1.50	29.03	72.96
DANE	SW	0.17	0.25	0.15	0.21	0.14	32.13	78.87
KENOSHA	SE	0.64	0.65	0.60	0.75	0.65	28.55	95.75
WAUKESHA	SE	1.19	1.28	1.72	2.09	1.28	27.00	98.93
Group A Averages		1.75	1.81	1.76	2.31	1.80	34.86	64.63

Final totals as of Monday, August 08, 2011

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

From Winter Storm Reports, 2010-2011

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)						
SAINT CROIX	NW	0.52	0.80	0.14	-0.41	0.63	42.98	37.87
WAUSHARA	NC	1.83	1.77	1.55	0.93	1.78	30.17	38.93
ONEIDA	NC	5.77	6.33	5.57	7.46	5.36	51.03	43.48
SHAWANO	NC	4.22	4.46	3.90	3.85	4.46	37.64	43.95
MARQUETTE	NC	2.02	2.27	1.95	2.00	1.94	35.21	44.71
CHIPPEWA	NW	2.15	2.18	1.61	1.45	2.15	38.03	46.23
DUNN	NW	1.91	1.75	2.23	1.01	1.70	32.14	48.70
DODGE	SW	1.79	1.68	1.59	1.59	1.99	35.76	56.49
OUTAGAMIE	NE	1.35	1.44	1.27	1.43	1.29	34.25	56.71
MANITOWOC	NE	2.34	2.34	1.86	2.24	2.34	31.20	60.33
SHEBOYGAN	NE	1.63	1.63	1.61	1.28	1.66	31.61	60.70
SAUK	SW	0.63	0.55	0.69	0.89	0.56	38.07	62.31
ROCK	SW	1.02	0.96	1.11	1.17	1.03	32.58	62.62
WASHINGTON	SE	0.81	0.82	0.89	0.88	0.91	28.81	66.02
JEFFERSON	SW	0.82	0.83	0.86	0.80	0.82	28.65	68.20
WALWORTH	SE	1.42	1.52	1.56	1.42	1.42	26.33	82.43
COLUMBIA	SW	-0.08	0.11	0.27	0.21	0.10	35.56	89.13
Group B Averages		1.77	1.85	1.69	1.66	1.77	34.71	56.99

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

From Winter Storm Reports, 2010-2011

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		
VERNON	SW	3.10	3.27	3.63	4.82	3.40	42.90	23.51
LINCOLN	NC	6.24	6.32	5.97	5.98	6.24	54.05	28.61
DOUGLAS	NW	1.95	1.90	1.69	1.90	1.90	51.27	29.99
CRAWFORD	SW	4.12	3.79	3.77	2.97	4.63	41.31	32.40
LAFAYETTE	SW	2.75	2.67	2.42	1.66	2.59	36.19	34.66
KEWAUNEE	NE	7.23	7.39	8.92	8.15	6.98	41.50	36.25
JACKSON	NW	0.91	0.82	1.33	0.70	0.61	41.57	37.71
WASHBURN	NW	3.56	3.66	3.57	2.99	3.59	36.23	39.39
GRANT	SW	1.11	1.21	0.70	0.85	1.09	35.10	39.83
OCONTO	NE	3.07	3.05	3.66	3.13	2.95	35.10	41.17
WOOD	NC	4.06	4.23	4.42	3.89	4.14	39.66	41.28
TREMPEALEAU	NW	1.56	1.57	2.06	0.90	1.57	32.75	41.36
MONROE	SW	1.71	1.74	1.68	1.68	1.71	37.55	41.58
CLARK	NW	2.91	2.85	2.70	2.18	2.92	34.55	42.11
IOWA	SW	2.00	1.93	1.34	2.85	1.83	32.85	49.77
JUNEAU	SW	1.67	1.70	1.67	1.65	1.75	32.06	52.84
WAUPACA	NC	1.91	1.87	1.51	1.98	1.87	30.35	53.77
DOOR	NE	2.30	2.33	1.53	1.64	2.31	31.48	54.21
CALUMET	NE	4.04	4.04	3.61	4.05	4.18	30.01	59.42
FOND DU LAC	NE	1.82	2.04	1.78	1.92	2.02	33.73	59.70
VILAS	NC	2.24	2.30	2.14	2.13	2.13	41.32	61.19
Group C Averages		2.87	2.89	2.86	2.76	2.88	37.69	42.89

Final totals as of Monday, August 08, 2011

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

From Winter Storm Reports, 2010-2011

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		
SAWYER	NW	3.22	3.02	2.99	3.10	3.02	47.41	23.71
BUFFALO	NW	3.35	3.39	3.21	2.97	3.36	36.72	26.32
RUSK	NW	3.72	3.63	3.47	3.23	3.62	38.84	27.49
POLK	NW	4.24	4.36	3.51	3.37	4.20	52.50	29.42
ASHLAND	NW	2.92	2.95	2.94	3.34	2.91	68.11	30.06
GREEN LAKE	NC	4.84	4.83	4.69	4.46	5.00	33.47	30.82
PRICE	NC	4.62	4.68	4.40	3.98	4.72	60.43	30.94
IRON	NC	3.66	3.59	2.58	3.03	3.59	70.69	33.26
MENOMINEE	NC	4.27	4.59	1.76	1.66	4.31	28.25	33.36
PIERCE	NW	3.41	3.42	3.13	2.80	3.45	38.92	34.47
TAYLOR	NW	3.47	3.57	3.25	3.65	3.47	41.11	35.42
LANGLADE	NC	4.15	4.03	3.88	3.68	4.03	39.92	35.75
BARRON	NW	1.10	1.10	1.02	0.69	1.09	44.17	35.87
BURNETT	NW	4.40	4.33	3.88	3.81	3.96	45.99	38.42
MARINETTE	NE	3.96	3.96	3.50	3.38	4.08	36.54	38.49
FOREST	NC	3.10	2.91	3.07	2.77	3.29	47.76	39.37
PEPIN	NW	3.04	3.35	2.96	2.85	2.84	28.20	39.38
BAYFIELD	NW	2.48	2.47	2.48	2.62	2.43	61.26	41.06
FLORENCE	NC	5.51	4.91	4.79	3.96	5.51	48.35	41.14
ADAMS	NC	5.90	5.85	5.55	5.64	5.92	41.16	42.27
GREEN	SW	3.47	4.58	3.25	3.49	3.78	33.27	43.63
RICHLAND	SW	6.69	6.82	6.90	7.58	6.48	25.31	45.14
Group D Averages		3.89	3.92	3.51	3.46	3.87	44.02	35.26

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2011

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 2011 Winter Costs	2011 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 1 / SOUTHWEST												
11	Columbia	$615,652	$768	$721,165	$900	$102,707	$128	$60,662	$1,309,564	19,972	$2,809,750	801.28	$3,507
12	Crawford	$213,759	$550	$260,639	$670	$27,817	$72	$21,399	$299,257	5,030	$822,871	388.95	$2,116
13	Dane	$1,453,633	$940	$1,406,064	$909	$88,044	$57	$130,496	$2,852,335	46,706	$5,930,572	1,547.16	$3,833
14	Dodge	$367,619	$604	$527,935	$867	$93,980	$154	$43,554	$935,083	15,629	$1,968,171	608.64	$3,234
22	Grant	$257,173	$412	$356,160	$571	$44,910	$72	$28,670	$465,378	8,363	$1,152,291	624.06	$1,846
23	Green	$145,060	$464	$170,336	$545	$43,792	$140	$15,427	$159,204	2,420	$533,819	312.72	$1,707
25	Iowa	$281,137	$614	$355,512	$776	$69,364	$151	$30,810	$346,049	6,101	$1,082,871	458.14	$2,364
28	Jefferson	$323,576	$639	$428,784	$846	$42,443	$84	$34,656	$752,611	12,896	$1,582,070	506.65	$3,123
29	Juneau	$272,670	$547	$341,010	$684	$6,974	$14	$27,498	$621,255	9,116	$1,269,407	498.79	$2,545
32	La Crosse	$313,593	$642	$417,134	$854	$23,334	$48	$32,822	$213,293	4,032	$1,000,176	488.24	$2,049
33	Lafayette	$144,359	$491	$194,660	$662	$86,759	$295	$18,560	$157,701	2,819	$602,039	293.88	$2,049
41	Monroe	$291,373	$451	$480,812	$744	$15,435	$24	$34,513	$615,604	9,958	$1,437,737	646.37	$2,224
52	Richland	$117,116	$360	$137,140	$422	$5,285	$16	$11,238	$164,159	2,557	$434,938	325.26	$1,337
53	Rock	$417,412	$641	$516,028	$792	$37,598	$58	$42,526	$478,848	8,700	$1,492,412	651.60	$2,290
56	Sauk	$354,316	$573	$465,075	$752	$45,264	$73	$38,179	$1,072,782	15,846	$1,975,616	618.44	$3,195
62	Vernon	$253,813	$568	$290,567	$650	$25,865	$58	$24,163	$347,704	5,527	$942,112	446.84	$2,108
	SW TOTAL	**$5,822,261**	**$632**	**$7,069,021**	**$767**	**$759,571**	**$82**	**$595,173**	**$10,790,825**	**175,671**	**$25,036,851**	**9,217.02**	**$2,716**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2011
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 2011 Winter Costs	2011 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 2 / SOUTHEAST												
30	**Kenosha**	$580,857	$984	$478,806	$811	$20,023	$34	$48,091	$523,192	9,732	$1,650,969	590.29	$2,797
40	**Milwaukee**	$3,699,582	$2,107	$1,744,275	$993	$28,283	$16	$0	$2,314,453	45,596	$7,786,593	1,755.71	$4,435
45	**Ozaukee**	$328,244	$1,080	$294,872	$970	$11,960	$39	$28,393	$435,098	8,177	$1,098,567	304.03	$3,613
51	**Racine**	$619,513	$919	$631,376	$936	$8,507	$13	$56,075	$712,917	13,916	$2,028,388	674.30	$3,008
64	**Walworth**	$514,604	$737	$551,000	$789	$14,109	$20	$47,394	$828,589	15,843	$1,955,696	698.71	$2,799
66	**Washington**	$462,825	$796	$492,815	$848	$9,519	$16	$43,113	$649,011	11,654	$1,657,283	581.11	$2,852
67	**Waukesha**	$741,737	$693	$825,161	$771	$422,465	$395	$87,504	$1,233,332	23,501	$3,310,199	1,070.09	$3,093
	SE TOTAL	**$6,947,362**	**$1,224**	**$5,018,305**	**$884**	**$514,866**	**$91**	**$310,570**	**$6,696,593**	**128,419**	**$19,487,696**	**5,674.24**	**$3,434**
	REGION 3 / NORTHEAST												
5	**Brown**	$490,086	$686	$620,605	$869	$103,410	$145	$53,530	$564,498	10,991	$1,832,129	714.43	$2,564
8	**Calumet**	$145,055	$721	$198,901	$988	$8,985	$45	$15,737	$93,333	1,766	$462,011	201.29	$2,295
15	**Door**	$184,032	$685	$211,704	$788	$40,009	$149	$18,852	$172,902	3,076	$627,499	268.55	$2,337
20	**Fond du Lac**	$421,834	$706	$497,357	$833	$26,642	$45	$42,207	$566,808	9,694	$1,554,848	597.30	$2,603
31	**Kewanee**	$90,458	$819	$123,230	$1,116	$22,757	$206	$10,454	$62,310	1,173	$309,209	110.41	$2,801
36	**Manitowoc**	$380,916	$910	$403,469	$964	$122,016	$291	$39,550	$382,226	7,536	$1,328,177	418.63	$3,173
38	**Marinette**	$206,448	$494	$212,893	$509	$1,178	$3	$18,494	$240,484	4,382	$679,497	417.91	$1,626
42	**Oconto**	$256,387	$543	$322,822	$684	$367	$1	$25,835	$240,484	4,382	$845,895	472.01	$1,792
44	**Outagamie**	$465,082	$886	$523,757	$998	$44,519	$85	$45,044	$441,536	8,253	$1,519,938	524.84	$2,896
59	**Sheboygan**	$441,497	$850	$474,522	$914	$80,022	$154	$43,923	$583,390	10,176	$1,623,354	519.42	$3,125
70	**Winnebago**	$444,141	$780	$564,814	$992	$27,109	$48	$46,159	$613,700	10,625	$1,695,923	569.58	$2,977
	NE TOTAL	**$3,525,936**	**$732**	**$4,154,074**	**$863**	**$477,014**	**$99**	**$359,785**	**$3,961,671**	**72,054**	**$12,478,480**	**4,814.37**	**$2,592**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2011
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 2011 Winter Costs	2011 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 4 / NORTHCENTRAL												
1	Adams	$161,648	$844	$158,595	$828	$9,246	$48	$14,170	$232,971	3,414	$576,630	191.58	$3,010
19	Florence	$72,005	$510	$107,217	$760	$5,325	$38	$8,177	$131,297	2,185	$324,021	141.07	$2,297
21	Forest	$182,126	$583	$303,112	$970	$18,650	$60	$22,189	$323,523	5,555	$849,600	312.38	$2,720
24	Green Lake	$93,041	$614	$76,423	$504	$16,141	$107	$8,129	$80,300	1,410	$274,034	151.50	$1,809
26	Iron	$242,003	$970	$283,425	$1,136	$7,213	$29	$23,407	$311,818	4,860	$867,866	249.56	$3,478
34	Langlade	$172,525	$590	$198,035	$678	$9,737	$33	$16,741	$183,774	3,277	$580,812	292.19	$1,988
35	Lincoln	$273,011	$653	$325,632	$778	$11,849	$28	$27,064	$272,854	4,358	$910,410	418.33	$2,176
37	Marathon	$564,739	$638	$693,759	$784	$41,946	$47	$57,190	$820,188	12,207	$2,177,822	885.17	$2,460
39	Marquette	$160,449	$656	$152,493	$624	$9,708	$40	$14,140	$267,799	4,479	$604,589	244.53	$2,472
73	Menominee	$20,288	$225	$42,658	$473	$3,062	$34	$2,931	$37,758	700	$106,697	90.26	$1,182
43	Oneida	$304,745	$768	$338,375	$853	$15,364	$39	$28,962	$368,981	5,346	$1,056,427	396.79	$2,662
49	Portage	$443,110	$784	$412,602	$730	$17,185	$30	$38,797	$484,371	7,319	$1,396,065	565.45	$2,469
50	Price	$222,083	$693	$263,787	$823	$17,813	$56	$21,932	$354,583	5,397	$880,198	320.57	$2,746
58	Shawano	$318,432	$613	$388,982	$749	$51,090	$98	$33,555	$374,872	7,272	$1,166,931	519.33	$2,247
63	Vilas	$200,884	$658	$264,530	$867	$14,496	$47	$20,819	$465,458	6,850	$966,187	305.24	$3,165
68	Waupaca	$371,341	$679	$449,393	$822	$33,666	$62	$38,026	$354,057	6,456	$1,246,483	546.64	$2,280
69	Waushara	$231,566	$670	$211,135	$611	$2,401	$7	$19,682	$215,459	3,842	$680,243	345.71	$1,968
71	Wood	$233,484	$630	$234,572	$633	$2,313	$6	$20,827	$381,707	5,858	$872,903	370.46	$2,356
	NC TOTAL	**$4,267,480**	**$672**	**$4,904,725**	**$773**	**$287,205**	**$45**	**$416,738**	**$5,661,771**	**90,785**	**$15,537,919**	**6,346.76**	**$2,448**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2011
Winter Maintenance Costs Per Lane Mile

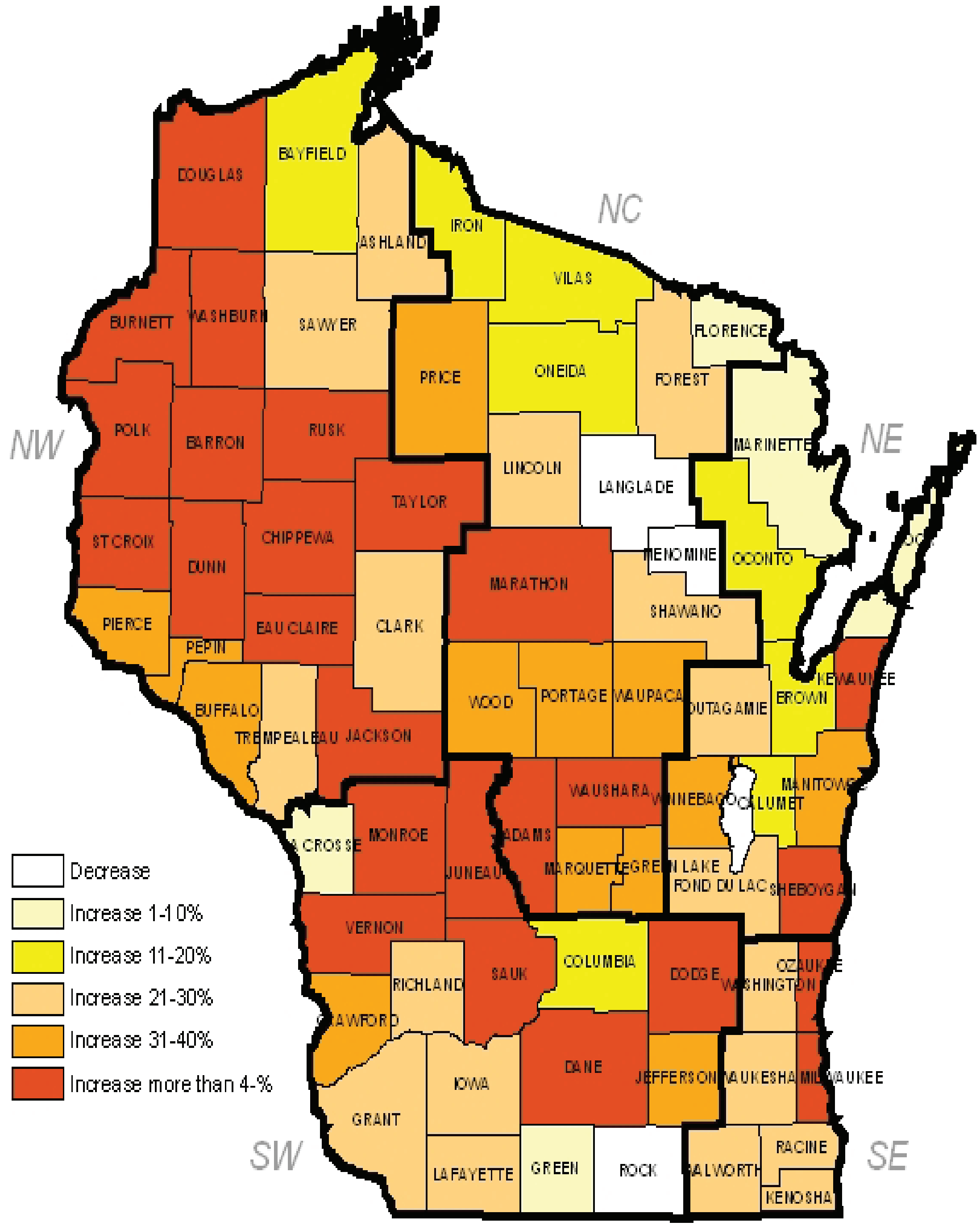
County #		Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2011 Winter Costs	2011 LOS Lane Miles	Winter Costs Per Lane Mile
	REGION 5 / NORTHWEST												
2	Ashland	$144,212	$583	$218,282	$882	$43,917	$177	$17,910	$227,914	3,605	$652,235	247.57	$2,635
3	Barron	$350,326	$828	$398,593	$942	$45,512	$108	$34,345	$232,113	3,645	$1,060,889	423.09	$2,507
4	Bayfield	$198,617	$627	$272,525	$860	$31,934	$101	$21,880	$250,457	4,406	$775,413	316.90	$2,447
6	Buffalo	$128,739	$407	$159,367	$504	$14,142	$45	$13,050	$101,497	1,799	$416,795	316.05	$1,319
7	Burnett	$149,139	$638	$183,830	$787	$15,286	$65	$15,172	$183,631	3,126	$547,058	233.64	$2,341
9	Chippewa	$511,357	$764	$492,820	$736	$36,372	$54	$45,956	$764,940	11,538	$1,851,445	669.29	$2,766
10	Clark	$229,021	$569	$274,471	$682	$3,793	$9	$22,439	$291,978	4,312	$821,702	402.44	$2,042
16	Douglas	$270,021	$615	$412,782	$940	$72,436	$165	$32,786	$379,398	7,023	$1,167,423	439.23	$2,658
17	Dunn	$390,965	$757	$387,690	$751	$15,016	$29	$34,929	$619,059	10,145	$1,447,659	516.55	$2,803
18	Eau Claire	$358,960	$668	$428,291	$797	$38,879	$72	$36,051	$482,276	7,842	$1,344,457	537.26	$2,502
27	Jackson	$246,511	$479	$415,738	$807	$3,379	$7	$29,442	$556,879	8,072	$1,251,949	515.00	$2,431
46	Pepin	$79,782	$710	$61,375	$546	$6,541	$58	$6,463	$44,131	721	$198,292	112.38	$1,764
47	Pierce	$234,374	$637	$267,043	$725	$9,693	$26	$22,490	$284,583	4,949	$818,183	368.12	$2,223
48	Polk	$221,854	$576	$331,848	$862	$30,677	$80	$25,542	$453,071	7,694	$1,062,992	385.05	$2,761
54	Rusk	$100,631	$471	$159,027	$745	$10,820	$51	$11,670	$177,298	2,652	$459,446	213.47	$2,152
57	Sawyer	$179,645	$489	$214,376	$583	$27,749	$76	$18,583	$607,481	10,752	$1,047,834	367.44	$2,852
55	St. Croix	$477,089	$771	$497,399	$804	$97,048	$157	$46,821	$293,771	4,289	$1,412,128	618.98	$2,281
60	Taylor	$121,392	$519	$161,222	$689	$8,357	$36	$12,863	$227,847	3,029	$531,681	234.09	$2,271
61	Trempealeau	$197,789	$455	$249,399	$573	$18,122	$42	$20,356	$304,977	5,381	$790,643	434.99	$1,818
65	Washburn	$177,746	$478	$300,757	$808	$23,533	$63	$22,026	$331,705	5,546	$855,767	372.14	$2,300
	NW TOTAL	**$4,768,170**	**$617**	**$5,886,835**	**$762**	**$553,206**	**$72**	**$490,774**	**$6,815,006**	**110,526**	**$18,513,991**	**7,723.68**	**$2,397**

Table 4.10. Winter Maintenance Costs per Lane Mile

Fiscal Year 2011
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 2011 Winter Costs	2011 LOS Lane Miles	Winter Costs Per Lane Mile
	STATEWIDE SUMMARY												
	SW Region	$5,822,261	$632	$7,069,021	$767	$759,571	$82	$595,173	$10,790,825	175,671	$25,036,851	9,217.02	$2,716
	SE Region	$6,947,362	$1,224	$5,018,305	$884	$514,866	$91	$310,570	$6,696,593	128,419	$19,487,696	5,674.24	$3,434
	NE Region	$3,525,936	$732	$4,154,074	$863	$477,014	$99	$359,785	$3,961,671	72,054	$12,478,480	4,814.37	$2,592
	NC Region	$4,267,480	$672	$4,904,725	$773	$287,205	$45	$416,738	$5,661,771	90,785	$15,537,919	6,346.76	$2,448
	NW Region	$4,768,170	$617	$5,886,835	$762	$553,206	$72	$490,774	$6,815,006	110,526	$18,513,991	7,723.68	$2,397
	Statewide Totals	$25,331,209	$750	$27,032,960	$800	$2,591,862	$77	$2,173,040	$33,925,865	577,455	$91,054,936	33,776.07	$2,696

Figure 4.8. 2010-2011 Winter Costs vs. 5-Year Average



County	Departure
Menominee	-9%
Rock	-5%
Langlade	-1%
Florence	5%
Green	5%
Marinette	6%
La Crosse	7%
Door	8%
Oneida	10%
Columbia	12%
Brown	15%
Oconto	16%
Vilas	17%
Iron	17%
Calumet	17%
Bayfield	18%
Grant	20%
Walworth	20%
Richland	21%
Iowa	22%
Racine	22%
Forest	22%
Washington	22%
Lincoln	23%
Sawyer	24%
Kenosha	24%
Fond du Lac	24%
Outagamie	25%
Trempealeau	26%
Lafayette	26%
Shawano	26%
Waukesha	27%
Ashland	28%
Clark	29%
Crawford	31%
Pierce	32%

County	Departure
Winnebago	32%
Jefferson	34%
Buffalo	34%
Waupaca	34%
Pepin	35%
Marquette	35%
Manitowoc	36%
Green Lake	36%
Portage	36%
Wood	38%
Price	39%
Ozaukee	40%
Kewanee	42%
Waushara	43%
Dodge	43%
Sauk	43%
Adams	45%
Douglas	47%
Eau Claire	47%
Marathon	47%
Barron	47%
Vernon	47%
Monroe	47%
Taylor	47%
Jackson	50%
Sheboygan	52%
Dane	52%
Washburn	54%
Milwaukee	54%
Juneau	54%
Burnett	55%
Chippewa	55%
Dunn	58%
Rusk	65%
Polk	70%
St. Croix	113%

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

From Winter Storm Reports, 2010-2011

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
MARATHON	NC	878.99	51.03	81.7	10338	11.76	0.23	$1,325,000	$1,510	29.60
EAU CLAIRE	NW	559.86	31.73	57.9	6580	11.75	0.37	$844,000	$1,507	47.52
LA CROSSE	SW	480.28	41.04	76.9	6592	13.73	0.33	$943,000	$1,967	47.93
PORTAGE	NC	504.28	40.04	92.0	6944	13.77	0.34	$968,000	$1,925	48.07
BROWN	NE	711.75	33.31	102.4	14520	20.40	0.61	$1,440,000	$2,027	60.83
RACINE	SE	676.84	38.78	97.6	12772	18.87	0.49	$1,596,000	$2,364	60.95
OZAUKEE	SE	304.03	32.65	77.3	7304	24.02	0.74	$634,000	$2,087	63.92
MILWAUKEE	SE	1,795.62	33.01	78.8	47166	26.27	0.80	$4,144,000	$2,320	70.28
WINNEBAGO	NE	567.36	29.03	79.1	11560	20.38	0.70	$1,178,000	$2,118	72.96
DANE	SW	1,674.08	32.13	68.7	43643	26.07	0.81	$4,215,000	$2,534	78.87
KENOSHA	SE	554.27	28.55	96.7	9436	17.02	0.60	$1,515,000	$2,734	95.75
WAUKESHA	SE	1,062.39	27.00	89.8	33271	31.32	1.16	$2,835,000	$2,671	98.93
Group A Averages		814.15	34.86	83.2	17511	19.61	0.60	$1,803,083	$2,147	64.63

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

From Winter Storm Reports, 2010-2011

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	345.71	30.17	95.6	3276	9.48	0.31	$406,000	$1,174	38.93
DUNN	NW	516.55	32.14	67.1	6463	12.51	0.39	$809,000	$1,565	48.70
MARQUETTE	NC	243.91	35.21	89.9	3894	15.96	0.45	$384,000	$1,575	44.71
SAINT CROIX	NW	616.98	42.98	66.0	7638	12.38	0.29	1,004,000	$1,628	37.87
SHAWANO	NC	516.24	37.64	106.5	7120	13.79	0.37	$853,000	$1,654	43.95
CHIPPEWA	NW	667.85	38.03	72.4	8099	12.13	0.32	1,174,000	$1,758	46.23
MANITOWOC	NE	414.69	31.20	96.3	8260	19.92	0.64	$775,000	$1,882	60.33
WASHINGTON	SE	580.03	28.81	85.4	11635	20.06	0.70	1,054,000	$1,902	66.02
SHEBOYGAN	NE	520.30	31.61	98.9	9450	18.16	0.57	$992,000	$1,919	60.70
OUTAGAMIE	NE	520.01	34.25	90.1	10215	19.64	0.57	$999,000	$1,942	56.71
JEFFERSON	SW	458.21	28.65	70.0	10373	22.64	0.79	$895,000	$1,954	68.20
DODGE	SW	606.62	35.76	80.5	15141	24.96	0.70	1,225,000	$2,020	56.49
ROCK	SW	592.56	32.58	85.1	9982	16.85	0.52	1,205,000	$2,040	62.62
WALWORTH	SE	691.89	26.33	88.4	15896	22.97	0.87	1,502,000	$2,171	82.43
ONEIDA	NC	396.79	51.03	89.8	7750	19.53	0.38	$878,000	$2,219	43.48
SAUK	SW	591.55	38.07	83.5	13814	23.35	0.61	1,403,000	$2,372	62.31
COLUMBIA	SW	745.80	35.56	93.2	24965	33.47	0.94	2,363,000	$3,169	89.13

Final totals as of Monday, August 15, 2011 **Page 1 of 2**

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

From Winter Storm Reports, 2010-2011

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		530.92	34.71	85.8	10234	18.69	0.55	1,054,176	$1,938	56.99

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

From Winter Storm Reports, 2010-2011

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
VERNON	SW	450.00	42.90	76.5	3137	6.97	0.16	$454,000	$1,009	23.51
LAFAYETTE	SW	293.88	36.19	66.1	2622	8.92	0.25	$369,000	$1,255	34.66
CRAWFORD	SW	385.21	41.31	63.4	4089	10.61	0.26	$514,000	$1,339	32.40
TREMPEALEAU	NW	432.31	32.75	76.9	5993	13.86	0.42	$585,000	$1,355	41.36
GRANT	SW	624.14	35.10	68.6	7369	11.81	0.34	$873,000	$1,398	39.83
WASHBURN	NW	372.14	36.23	96.7	5026	13.51	0.37	$530,000	$1,427	39.39
OCONTO	NE	437.71	35.10	106.7	5770	13.18	0.38	$631,000	$1,445	41.17
CLARK	NW	402.28	34.55	93.3	4899	12.18	0.35	$585,000	$1,455	42.11
KEWAUNEE	NE	110.41	41.50	125.3	1265	11.46	0.28	$166,000	$1,504	36.25
DOUGLAS	NW	439.23	51.27	154.7	6224	14.17	0.28	$675,000	$1,538	29.99
LINCOLN	NC	418.33	54.05	77.0	4403	10.53	0.19	$642,000	$1,546	28.61
MONROE	SW	644.23	37.55	77.4	9083	14.10	0.38	1,006,000	$1,561	41.58
JACKSON	NW	504.10	41.57	106.0	7305	14.49	0.35	$790,000	$1,568	37.71
WAUPACA	NC	546.58	30.35	109.3	8245	15.08	0.50	$892,000	$1,632	53.77
IOWA	SW	451.03	32.85	74.6	5087	11.28	0.34	$737,000	$1,635	49.77
WOOD	NC	362.92	39.66	86.7	4825	13.29	0.34	$593,000	$1,637	41.28
JUNEAU	SW	498.13	32.06	85.4	7779	15.62	0.49	$844,000	$1,694	52.84

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

From Winter Storm Reports, 2010-2011

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
DOOR	NE	268.55	31.48	86.2	2705	10.07	0.32	$457,000	$1,707	54.21
CALUMET	NE	201.31	30.01	91.7	2385	11.85	0.39	$357,000	$1,783	59.42
FOND DU LAC	NE	594.34	33.73	82.9	9110	15.33	0.45	1,197,000	$2,013	59.70
VILAS	NC	305.24	41.32	134.3	7212	23.63	0.57	$769,000	$2,529	61.19
Group C Averages		416.29	37.69	92.4	5454	12.95	0.35	$650,762	$1,573	42.89

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

From Winter Storm Reports, 2010-2011

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
MENOMINEE	NC	90.26	28.25	96.6	559	6.19	0.22	$85,000	$942	33.36
BUFFALO	NW	315.77	36.72	60.7	2024	6.41	0.17	$305,000	$966	26.32
GREEN LAKE	NC	151.30	33.47	98.6	1131	7.48	0.22	$156,000	$1,032	30.82
RUSK	NW	213.47	38.84	73.6	1806	8.46	0.22	$228,000	$1,068	27.49
PEPIN	NW	111.05	28.20	61.2	879	7.92	0.28	$123,000	$1,111	39.38
SAWYER	NW	367.44	47.41	78.2	3272	8.90	0.19	$413,000	$1,124	23.71
RICHLAND	SW	328.72	25.31	75.3	2945	8.96	0.35	$375,000	$1,142	45.14
PIERCE	NW	366.08	38.92	67.4	3947	10.78	0.28	$491,000	$1,341	34.47
MARINETTE	NE	388.36	36.54	112.9	5315	13.69	0.37	$545,000	$1,406	38.49
LANGLADE	NC	292.69	39.92	85.1	3372	11.52	0.29	$416,000	$1,427	35.75
GREEN	SW	311.45	33.27	72.9	2638	8.47	0.25	$451,000	$1,452	43.63
TAYLOR	NW	233.25	41.11	70.8	3015	12.93	0.31	$338,000	$1,456	35.42
POLK	NW	385.05	52.50	73.6	4222	10.96	0.21	$595,000	$1,545	29.42
BARRON	NW	423.09	44.17	69.7	2773	6.56	0.15	$670,000	$1,584	35.87
ADAMS	NC	192.48	41.16	87.0	2944	15.30	0.37	$335,000	$1,740	42.27
BURNETT	NW	233.64	45.99	75.1	2672	11.44	0.25	$413,000	$1,767	38.42
PRICE	NC	320.57	60.43	73.9	5101	15.91	0.26	$598,000	$1,870	30.94

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

From Winter Storm Reports, 2010-2011

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
FOREST	NC	312.38	47.76	101.9	5783	18.51	0.39	$587,000	$1,880	39.37
FLORENCE	NC	141.07	48.35	112.9	3074	21.79	0.45	$278,000	$1,989	41.14
ASHLAND	NW	247.57	68.11	180.9	2891	11.68	0.17	$507,000	$2,048	30.06
IRON	NC	250.91	70.69	215.2	5250	20.92	0.30	$587,000	$2,351	33.26
BAYFIELD	NW	316.90	61.26	158.9	5705	18.00	0.29	$797,000	$2,515	41.06
Group D Averages		272.43	44.02	95.5	3242	11.94	0.27	$422,409	$1,534	35.26

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2010 - April 2011

COUNTY	WINTER VMT	CRASHES	CRASHES/ 100,000,000 VMT
ADAMS	109,600,000	19	17
FLORENCE	36,700,000	8	22
FOREST	56,800,000	15	26
GREEN LAKE	92,100,000	20	42
IRON	47,500,000	20	20
LANGLADE	99,700,000	31	31
LINCOLN	187,100,000	64	34
MARATHON	724,900,000	441	61
MARQUETTE	129,100,000	32	25
MENOMINEE	14,600,000	72	493
ONEIDA	232,000,000	164	71
PORTAGE	390,600,000	14	4
PRICE	79,200,000	85	107
SHAWANO	270,900,000	46	17
VILAS	147,900,000	104	70
WAUPACA	301,700,000	61	20
WAUSHARA	181,900,000	117	64
WOOD	308,700,000	4	1
Total	**3,411,000,000.00**	**1,317**	**39**
BROWN	1,061,800,000	346	33
CALUMET	165,900,000	48	29
DOOR	162,300,000	34	21
FOND DU LAC	543,100,000	196	36
KEWAUNEE	85,400,000	27	32
MANITOWOC	373,600,000	153	41
MARINETTE	228,200,000	60	26
OCONTO	243,800,000	71	29
OUTAGAMIE	670,300,000	267	40
SHEBOYGAN	448,900,000	156	35
WINNEBAGO	760,700,000	445	58
Total	**4,744,000,000.00**	**1,803**	**38**

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2010 - April 2011

COUNTY	WINTER VMT	CRASHES	CRASHES/ 100,000,000 VMT
ASHLAND	83,500,000	15	18
BARRON	262,500,000	77	29
BAYFIELD	134,800,000	32	24
BUFFALO	81,300,000	29	36
BURNETT	80,800,000	18	22
CHIPPEWA	388,700,000	138	36
CLARK	175,000,000	86	49
DOUGLAS	217,400,000	96	44
DUNN	292,200,000	151	52
EAU CLAIRE	465,800,000	249	53
JACKSON	246,900,000	105	43
PEPIN	35,300,000	14	40
PIERCE	148,300,000	72	49
POLK	218,100,000	66	30
RUSK	81,200,000	13	16
ST.CROIX	114,500,000	203	177
SAWYER	544,400,000	19	3
TAYLOR	79,500,000	25	31
TREMPEALEAU	174,000,000	65	37
WASHBURN	128,400,000	69	54
Total	**3,952,600,000.00**	**1,542**	**39**
KENOSHA	692,500,000	195	28
MILWAUKEE	2,910,000,000	850	29
OZAUKEE	493,800,000	109	22
RACINE	749,700,000	225	30
WALWORTH	555,700,000	126	19
WASHINGTON	674,500,000	300	14
WAUKESHA	2,105,600,000	458	22
Total	**8,181,800,000.00**	**2,263**	**28**

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2010 - April 2011

COUNTY	WINTER VMT	CRASHES	CRASHES/ 100,000,000 VMT
COLUMBIA	446,900,000	194	43
CRAWFORD	86,400,000	52	60
DANE	2,198,800,000	665	30
DODGE	441,100,000	143	32
GRANT	244,400,000	107	44
GREEN	143,600,000	46	32
IOWA	188,900,000	56	30
JEFFERSON	471,100,000	146	31
JUNEAU	292,600,000	128	44
LA CROSSE	437,100,000	304	70
LAFAYETTE	95,800,000	37	39
MONROE	342,300,000	184	54
RICHLAND	91,500,000	26	28
ROCK	725,400,000	221	30
SAUK	386,900,000	140	36
VERNON	116,600,000	75	64
Total	**6,709,400,000.00**	**2,524**	**38**
Statewide Totals	**26,998,800,000.00**	**9,449**	**35**

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

Bureau of transportation Safety data, Nov. 1, 2010 - April 30, 2011 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	19	0	19	0	0	0	0	0	19	0	0
FLORENCE	8	0	8	0	0	0	0	0	8	0	0
FOREST	15	0	15	0	0	0	0	0	15	0	0
GREEN LAKE	20	6	14	0	0	6	0	0	13	1	0
IRON	20	0	20	0	0	0	0	0	19	1	0
LANGLADE	31	6	25	0	0	6	0	0	25	0	0
LINCOLN	64	9	55	0	0	9	0	0	16	39	0
MARATHON	441	132	243	19	47	62	70	0	67	176	0
MARQUETTE	32	0	8	0	24	0	0	0	7	1	0
ONEIDA	72	1	71	0	0	0	1	0	66	5	0
PORTAGE	164	40	62	28	34	19	21	0	31	31	0
PRICE	14	0	14	0	0	0	0	0	14	0	0
SHAWANO	85	1	84	0	0	1	0	0	24	60	0
VILAS	46	0	46	0	0	0	0	0	45	1	0
WAUPACA	104	3	101	0	0	1	2	0	44	57	0
WAUSHARA	61	0	38	0	23	0	0	0	36	2	0
WOOD	117	63	54	0	0	12	51	0	45	9	0
MENOMINEE	4	0	4	0	0	0	0	0	4	0	0
TOTAL	1,317	261	881	47	128	116	145	0	498	383	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	346	240	65	31	10	73	167	0	25	40	0
CALUMET	48	8	40	0	0	3	5	0	37	3	0
DOOR	34	5	29	0	0	1	4	0	21	8	0
FOND DU LAC	196	55	141	0	0	37	18	0	51	90	0
KEWAUNEE	27	0	27	0	0	0	0	0	26	1	0
MANITOWOC	153	50	40	8	55	21	29	0	37	3	0
MARINETTE	60	5	55	0	0	4	1	0	35	20	0
OCONTO	71	0	71	0	0	0	0	0	23	48	0
OUTAGAMIE	267	133	134	0	0	57	76	0	66	68	0
SHEBOYGAN	156	38	64	2	52	19	19	0	34	30	0
WINNEBAGO	445	133	312	0	0	71	61	1	65	247	0
TOTAL	1,803	667	978	41	117	286	380	1	420	558	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	15	5	10	0	0	5	0	0	10	0	0
BARRON	77	7	70	0	0	6	1	0	35	35	0
BAYFIELD	32	0	32	0	0	0	0	0	31	1	0
BUFFALO	29	0	29	0	0	0	0	0	29	0	0
BURNETT	18	0	18	0	0	0	0	0	17	1	0
CHIPPEWA	138	16	122	0	0	9	7	0	31	91	0
CLARK	86	0	86	0	0	0	0	0	32	54	0
DOUGLAS	96	43	44	9	0	25	18	0	19	25	0
DUNN	151	22	52	13	64	12	10	0	41	11	0
EAU CLAIRE	249	117	56	2	74	15	102	0	32	24	0
JACKSON	105	0	32	0	73	0	0	0	30	2	0
PEPIN	14	0	14	0	0	0	0	0	13	1	0
PIERCE	72	18	54	0	0	15	3	0	53	1	0
POLK	66	0	66	0	0	0	0	0	62	4	0
RUSK	13	0	13	0	0	0	0	0	13	0	0
ST. CROIX	203	8	106	23	66	6	2	0	65	41	0
SAWYER	19	0	19	0	0	0	0	0	19	0	0
TAYLOR	25	0	25	0	0	0	0	0	24	1	0
TREMPEALEAU	65	0	60	0	5	0	0		60	0	
								0			0
WASHBURN	69	0	69	0	0	0	0	0	22	47	0
TOTAL	1,542	236	977	47	282	93	143	0	638	339	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	195	56	69	2	68	1	29	26	27	42	0
MILWAUKEE	850	498	0	352	0	0	133	365	0	0	0
OZAUKEE	109	19	13	17	60	0	10	9	4	9	0
RACINE	225	113	39	6	67	2	44	67	31	8	0
WALWORTH	126	14	81	1	30	0	14	0	48	33	0
WASHINGTON	300	121	179	0	0	0	46	75	68	111	0
WAUKESHA	458	148	113	132	65	1	24	123	64	49	0
TOTAL	2,263	969	494	510	290	4	300	665	242	252	0

SW Region

COUNTY	TOTAL	Urban STH	Rural STH	Urban IH	Rural IH	Urban State Highway			Rural State Highway		
						Non-div	Divided	Unkn	Non-div	Divided	Unkn
COLUMBIA	194	13	79	4	98	10	3	0	69	10	0
CRAWFORD	52	14	38	0	0	12	2	0	37	1	0
DANE	665	292	197	28	148	34	257	1	97	100	0
DODGE	143	13	130	0	0	9	4	0	59	71	0
GRANT	107	5	102	0	0	5	0	0	66	35	1
GREEN	46	8	38	0	0	2	6	0	36	2	0
IOWA	56	0	56	0	0	0	0	0	28	28	0
JEFFERSON	146	21	67	0	58	16	5	0	56	10	1
JUNEAU	128	0	44	0	84	0	0	0	42	2	0
LA CROSSE	304	145	78	40	41	80	65	0	39	39	0
LAFAYETTE	37	0	37	0	0	0	0	0	21	16	0
MONROE	184	34	62	7	81	15	19	0	56	6	0
RICHLAND	26	0	26	0	0	0	0	0	23	3	0
ROCK	221	66	113	12	30	31	35	0	95	18	0
SAUK	140	24	78	0	38	19	5	0	60	18	0
VERNON	75	0	75	0	0	0	0	0	70	5	0
TOTAL	2,524	635	1,220	91	578	233	401	1	854	364	2

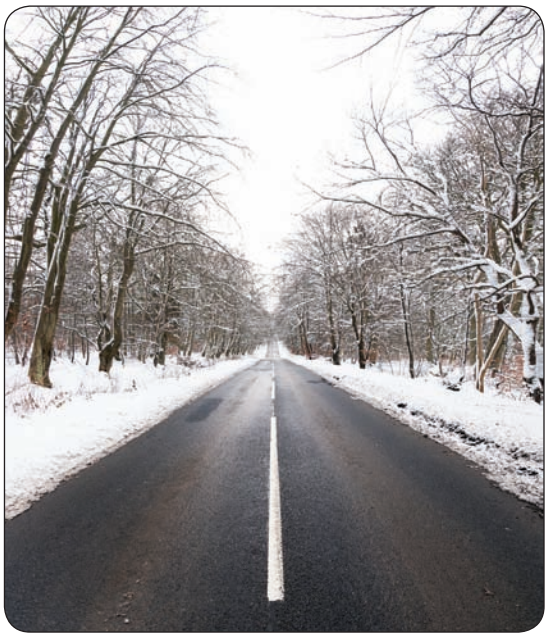
Statewide	9,449	2,768	4,550	736	1,395
		29.3%	48.2%	7.8%	14.8%

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.

*2011 figures are preliminary at this time.
**Does not include deer or other animal crashes

5 Looking Ahead

The winter of 2010-2011 was the most expensive winter on record and received more average storms per county than any winter in the past ten years. Increasing salt costs remain a concern but have leveled off at around $60/ton for the past 3 seasons. Newly implemented technologies such as Automatic Vehicle Location/Global Positioning System (AVL/GPS) have been shown to reduce costs while providing an additional tool in fighting winter storms.



In 2011-2012, WisDOT will focus on a more uniform approach statewide to the use of best practices. Ever-increasing costs will always be a concern and make it ever more difficult to continue to provide the high level of service that the public has grown accustomed to. By focusing on established best practices WisDOT will attempt to increase efficiency and cost saving from the limited dollars available for winter maintenance. The ongoing Maintenance Decision Support System (MDSS) program will continue to evolve and continue to provide weather information in a customizable user friendly format. Further implementation of AVL/GPS technologies will help MDSS realize that potential.

Areas of focus for the 2011-2012 winter:

1. AVL/GPS has become a standard equipment option and is now being utilized in 43 counties . The effort to implement the technology statewide is proceeding with a higher emphasis on counties with Interstates and Expressways. The evaluation and testing of the equipment will continue into 11-12, but initial findings are promising with a cost benefit ratio of 1.86. Further implementation will continue in 11-12 and possibly into 13.

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 11-12 we are going to test the WiFi communication system in two counties by turning off the cell phone system to verify the functionality of WiFi communication.

3. The MDSS system will continue to evolve in 11-12. System reviews and evaluations as well as training will continue. A formal evaluation of the MDSS system will be completed in late 2011 and then again in 2012. WisDOT will begin implementing the improved reporting capabilities of MDSS. Reporting down to route level will be explored since this will enable county supervisors to have a useful indicator of performance and allow WisDOT to more easily track material usage down to a smaller scale.

4. WisDOT will continue evaluating the costs and benefits of Tow Plows. A detailed evaluation has shown that there are efficiencies that can be attained from using a TowPlow. At the end of the 11-12 winter a final evaluation will be conducted and recommendation for future use of the devises will be made.

5. Automation of the storm reporting system will continue into 11-12. Comparisons between the information provided through MDSS versus county scales will be investigated before the automated system is fully rolled out.

6. WisDOT will emphasize the need for equipment calibration.

7. Standing corn snow fence purchasing program was deemed a success in areas of Wisconsin and will be continued.

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Appendix

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

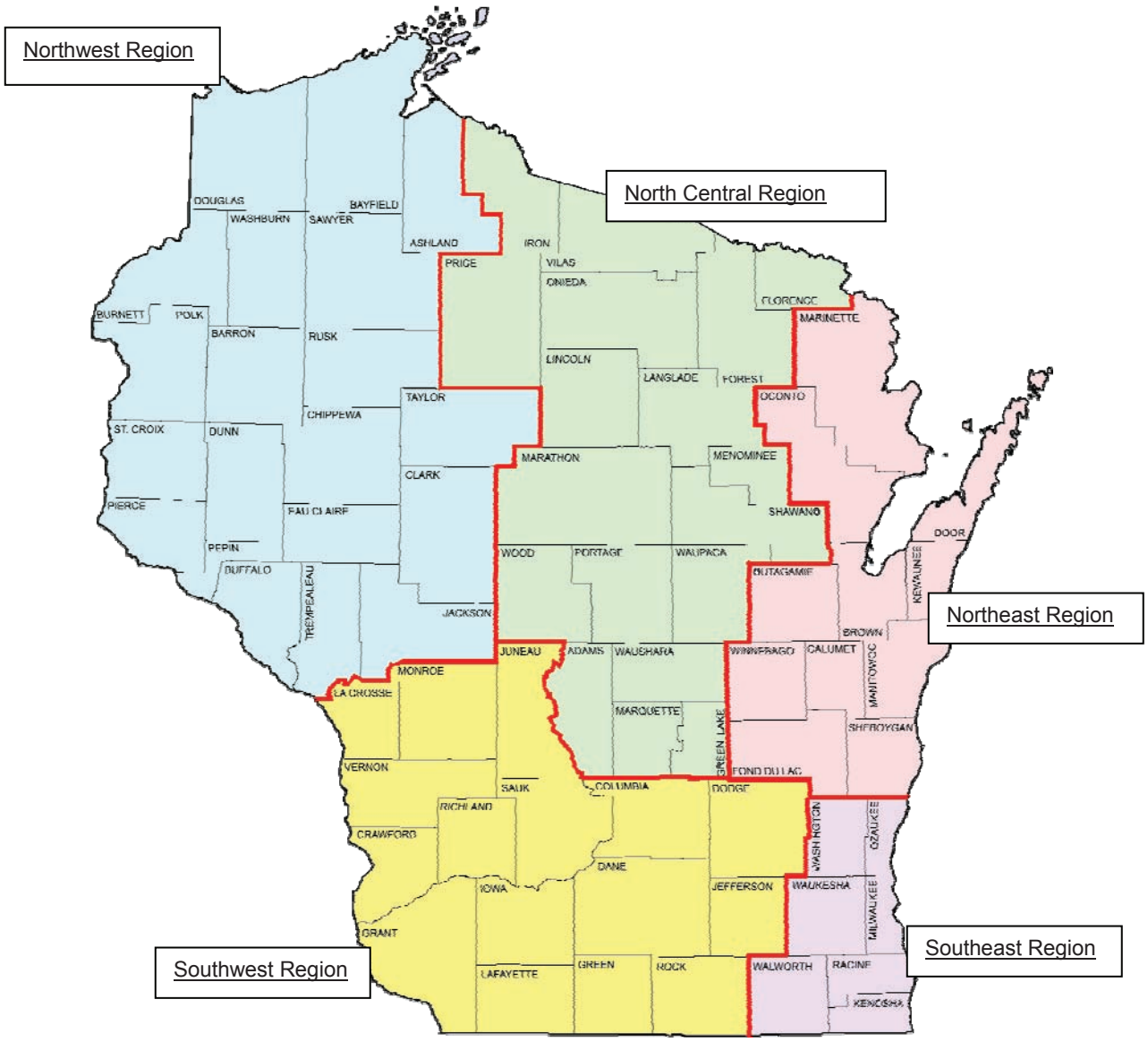

Figure A-1

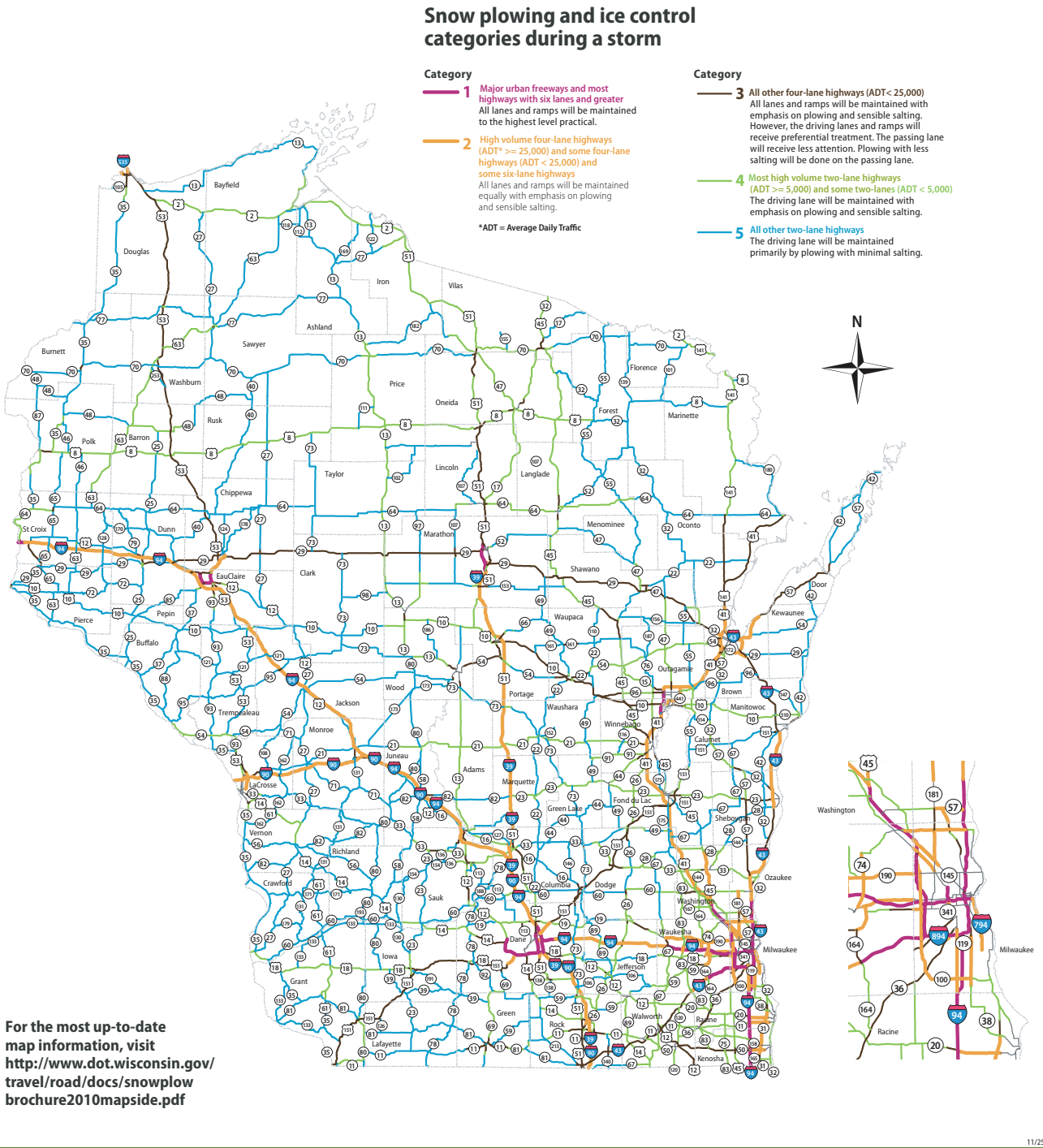
Snow plowing and ice control categories during a storm
Category
1 Major urban freeways and most highways with six lanes and greater
All lanes and ramps will be maintained to the highest level practical.
2 High volume four-lane highways (ADT* >= 25,000) and some four-lane highways (ADT < 25,000) and some 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
Douglas
Bayfield
Iron
Vilas
Ashland
Sawyer
Burnett
Washburn
Price
Oneida
Florence
Forest
Marinette
Rusk
Barron
Polk
Taylor
Lincoln
Langlade
Chippewa
St Croix
Dunn
Marathon
Menominee
Oconto
Clark
Shawano
EauClaire
Door
Pepin
Pierce
Waupaca
Kewaunee
Buffalo
Outagamie
Wood
Portage
Brown
Jackson
Waushara
Manitowoc
Trempealeau
Monroe
Winnebago
Calumet
Juneau
Adams
Marquette
LaCrosse
Green Lake
Fond du Lac
Sheboygan
Vernon
Richland
Ozaukee
Crawford
Columbia
Dodge
Washington
Sauk
Waukesha
Dane
Milwaukee
Jefferson
Iowa
Grant
Walworth
Racine
Green
Rock
Lafayette
Kenosha
Washington
Milwaukee
Racine
For the most up-to-date map information, visit http://www.dot.wisconsin.gov/travel/road/docs/snowplowbrochure2010mapside.pdf
11/25/2009

Figure A-2

Table A.1 Storm Report Summary

From Winter Storm Reports, 2010-2011

Notes: 1) Costs shown in table are estimated and do not include the 4.25% 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 '07 (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	191.58	41.16	96.7	16	33	18	21	3,844	3,414	430	17.8	0.0	991.0	833.0	$1,272	$566	$492	$2,330	$446,430	0.43
FLORENCE	141.07	48.35	115.9	8	50	28	13	2,755	2,185	570	15.5	34.0	637.0	599.0	$931	$508	$413	$1,851	$261,102	0.32
FOREST	312.38	47.76	127.8	0	48	23	15	6,875	5,555	1,320	17.8	15.0	2182.5	1450.0	$1,065	$602	$479	$2,146	$670,304	0.37
GREEN LAKE	151.5	33.47	106.8	2	30	19	13	2,043	1,410	633	9.3	10.0	635.5	457.0	$546	$395	$338	$1,278	$193,150	0.28
IRON	249.56	70.69	272.9	2	73	18	11	6,870	4,860	2,010	19.5	177.0	2026.0	1156.0	$1,265	$708	$619	$2,591	$646,604	0.28
LANGLADE	292.19	39.92	103.3	3	37	30	14	5,537	3,277	2,260	11.2	0.0	1257.3	1228.3	$629	$458	$391	$1,478	$431,828	0.28
LINCOLN	418.33	54.05	125.1	3	52	24	26	5,408	4,358	1,050	10.4	563.0	2902.0	1639.5	$652	$564	$478	$1,695	$708,948	0.19
MARATHON	885.17	51.03	97.6	6	45	53	12	12,867	12,207	660	13.8	157.1	4056.0	4787.0	$927	$587	$514	$2,028	$1,794,913	0.27
MARQUETTE	244.53	35.21	98.8	11	32	10	20	4,885	4,479	406	18.3	0.0	1246.0	1264.5	$1,128	$529	$475	$2,132	$521,405	0.52
MENOMINEE	90.26	28.25	91.5	0	31	21	5	1,403	700	703	7.8	32.5	411.5	156.0	$429	$358	$214	$1,001	$90,367	0.27
ONEIDA	396.79	51.03	120.9	0	49	21	17	8,246	5,346	2,900	13.5	317.1	3191.3	1771.9	$930	$621	$576	$2,128	$844,231	0.26
PORTAGE	565.45	40.04	90.9	2	40	23	19	8,099	7,319	780	12.9	448.0	3095.5	3616.5	$857	$685	$615	$2,156	$1,219,228	0.32
PRICE	320.57	60.43	111.6	9	56	17	23	5,854	5,397	457	16.8	309.0	1677.0	2034.5	$1,118	$652	$534	$2,304	$738,507	0.28
SHAWANO	519.33	37.64	100.5	9	34	40	13	8,309	7,272	1,037	14.0	124.8	2718.0	2478.3	$744	$567	$447	$1,758	$908,210	0.37
VILAS	305.24	41.32	87.7	0	50	7	14	8,320	6,850	1,470	22.4	355.0	1509.0	1128.0	$1,539	$520	$429	$2,487	$759,192	0.54
WAUPACA	546.64	30.35	100.0	1	29	26	5	7,256	6,456	800	11.8	0.0	2012.3	2650.8	$648	$512	$431	$1,591	$869,498	0.39
WAUSHARA	345.71	30.17	99.2	1	29	7	11	4,476	3,842	634	11.1	55.0	1465.0	1233.3	$635	$409	$372	$1,416	$489,514	0.37
WOOD	370.46	39.66	80.4	11	39	25	17	6,228	5,858	370	15.8	193.0	1650.5	1706.8	$1,030	$517	$478	$2,025	$750,109	0.40
Region Total		--	--	--	--	--	--	109,275	90,785	18,490	--	2790	--	--	--	--	--	--	$12,343,540	
Region Average		43.36	112.6	4.7	42.1	22.8	14.9	6,071	5,044	1,027	14.4	155	1870.2	1677.2	$908	$542	$461	$1,911	$685,752	0.34

Final totals as of Monday, August 15, 2011

Table A.1 Storm Report Summary

From Winter Storm Reports, 2010-2011

Notes: 1) Costs shown in table are estimated and do not include the 4.25% 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 '07 (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: Anti-Icing	Storms	Incident	Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total 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
BROWN	714.43	33.31	105.4	19	29	25	4	15,196	10,991	4,205	15.4	33.0	3490.0	3710.0	$808	$560	$523	$1,891	$1,346,347	0.46
CALUMET	201.29	30.01	77.3	15	22	37	3	2,666	1,766	900	8.8	0.0	1180.0	1092.4	$486	$674	$522	$1,682	$337,030	0.29
DOOR	268.55	31.48	75.6	8	29	31	2	3,661	3,076	585	11.5	12.0	758.5	1212.0	$674	$439	$394	$1,507	$402,328	0.36
FOND DU LAC	597.3	33.73	79.2	8	24	26	9	11,359	9,694	1,665	16.2	0.0	3168.0	3476.0	$968	$606	$523	$2,098	$1,247,868	0.48
KEWAUNEE	110.41	41.50	150.6	0	31	29	6	1,583	1,173	410	10.6	237.0	529.5	326.5	$585	$454	$379	$1,418	$155,859	0.26
MANITOWOC	418.63	31.20	95.6	3	26	16	8	8,236	7,536	700	18.0	0.0	2228.0	1992.0	$941	$602	$558	$2,102	$874,022	0.58
MARINETTE	417.91	36.54	90.6	48	36	29	5	6,132	4,382	1,750	10.5	3.0	1749.5	1082.0	$575	$365	$423	$1,364	$569,927	0.29
OCONTO	472.01	35.10	101.3	5	42	23	6	6,547	4,382	2,165	9.3	0.0	1901.0	1599.8	$520	$409	$359	$1,289	$605,852	0.26
OUTAGAMIE	524.84	34.25	105.7	7	32	18	11	10,808	8,253	2,555	15.7	0.0	4068.0	1921.5	$897	$553	$502	$1,952	$1,012,074	0.46
SHEBOYGAN	519.42	31.61	92.2	12	31	20	12	10,811	10,176	635	19.6	0.0	2931.5	2125.5	$1,190	$553	$514	$2,258	$1,156,321	0.62
WINNEBAGO	569.58	29.03	82.2	3	32	41	5	11,515	10,625	890	18.7	13.0	2817.0	3989.3	$1,127	$637	$606	$2,370	$1,336,451	0.64
Region Total		--	--	--	--	--	--	88,514	72,054	16,460	--	298	--	--	--	--	--	--	$9,044,080	
Region Average		33.43	96.0	11.6	30.4	26.8	6.5	8,047	6,550	1,496	14.0	27	2256.5	2047.9	$797	$532	$482	$1,812	$822,189	0.43

Table A.1 Storm Report Summary

From Winter Storm Reports, 2010-2011

Notes: 1) Costs shown in table are estimated and do not include the 4.25% 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 '07 (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: 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
ASHLAND	247.57	68.11	247.1	8	61	13	29	4,205	3,605	600	14.6	170.0	1119.3	1354.4	$921	$573	$472	$1,965	$486,528	0.21
BARRON	423.09	44.17	101.3	15	45	49	19	3,863	2,645	1,218	6.3	860.8	3377.3	2278.3	$458	$787	$595	$1,839	$775,350	0.14
BAYFIELD	316.9	61.26	160.2	10	69	27	22	6,022	4,406	1,616	13.9	12.0	2360.0	1362.0	$790	$705	$505	$2,000	$633,762	0.23
BUFFALO	316.05	36.72	80.5	2	35	25	11	2,649	1,849	800	5.9	63.0	1498.0	1064.0	$330	$403	$337	$1,070	$338,215	0.16
BURNETT	233.64	45.99	108.2	0	38	32	17	4,786	3,126	1,660	13.4	57.0	1262.0	1019.5	$828	$547	$452	$1,827	$426,958	0.29
CHIPPEWA	669.29	38.03	91.5	0	38	33	8	12,393	11,538	855	17.2	1328.0	4092.0	3822.0	$1,143	$695	$535	$2,373	$1,588,033	0.45
CLARK	402.44	34.55	105.8	8	38	14	13	7,158	4,312	2,846	10.7	0.0	1958.5	1558.7	$728	$514	$400	$1,642	$660,439	0.31
DOUGLAS	439.23	51.27	177.1	8	50	33	13	9,323	7,023	2,300	16.0	41.5	2883.5	1924.0	$864	$589	$543	$1,996	$876,856	0.31
DUNN	516.55	32.14	89.1	0	37	17	9	11,010	10,145	865	19.6	52.0	2543.0	2641.0	$1,219	$547	$535	$2,301	$1,188,487	0.61
EAU CLAIRE	537.26	31.73	80.3	3	35	54	8	9,241	7,842	1,399	14.6	82.0	4597.2	3195.3	$898	$758	$674	$2,329	$1,251,380	0.46
JACKSON	515	41.57	112.4	11	42	36	36	10,017	8,075	1,942	15.7	150.0	3546.0	2172.0	$1,103	$577	$545	$2,225	$1,145,727	0.38
PEPIN	112.38	28.20	72.5	0	28	10	7	1,162	621	541	5.5	273.0	343.0	422.0	$338	$359	$332	$1,029	$115,636	0.20
PIERCE	368.12	38.92	102.1	1	40	17	13	5,812	4,949	863	13.4	279.0	1441.5	1402.0	$773	$403	$400	$1,576	$580,220	0.35
POLK	385.05	52.50	121.8	0	44	40	8	8,809	7,694	1,115	20.0	608.4	2173.8	1823.8	$1,192	$532	$489	$2,213	$851,414	0.38
RUSK	213.47	38.84	110.6	0	36	46	14	3,402	2,652	750	12.4	125.9	1604.5	712.5	$831	$602	$455	$1,887	$402,919	0.32
SAINT CROIX	618.98	42.98	88.8	0	41	53	10	14,699	10,752	3,947	17.4	471.0	4369.2	3705.6	$1,054	$701	$660	$2,415	$1,494,668	0.40
SAWYER	367.44	47.41	111.7	0	50	35	16	5,201	4,289	912	11.7	0.0	2099.5	1406.5	$799	$519	$446	$1,764	$648,342	0.25
TAYLOR	234.09	41.11	97.4	19	38	27	18	4,043	3,029	1,014	12.9	53.0	1400.0	660.0	$999	$502	$375	$1,876	$436,394	0.31
TREMPEALEAU	434.99	32.75	77.0	5	32	30	7	6,054	5,381	673	12.4	470.0	2030.0	1322.0	$701	$413	$345	$1,459	$634,587	0.38
WASHBURN	372.14	36.23	100.6	9	43	13	10	7,400	5,546	1,854	14.9	113.8	1856.0	1557.5	$927	$548	$438	$1,913	$709,463	0.41
Region Total		--	--	--	--	--	--	137,249	109,479	27,770	--	5210	--	--	--	--	--	--	$15,245,377	
Region Average		42.22	111.8	5.0	42.0	30.2	14.4	6,862	5,474	1,389	13.4	261	2327.7	1770.2	$845	$564	$477	$1,885	$762,269	0.33

Final totals as of Monday, August 15, 2011

Table A.1 Storm Report Summary

From Winter Storm Reports, 2010-2011

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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	590.29	28.55	74.9	14	30	11	5	11,318	9,732	1,586	16.5	7.8	2907.5	3318.3	$901	$595	$703	$2,198	$1,297,686	0.58
MILWAUKEE	1755.71	33.01	60.4	4	31	19	7	58,063	45,596	12,467	26.0	0.0	13304.0	14748.0	$1,336	$811	$1,186	$3,332	$5,840,824	0.79
OZAUKEE	304.03	32.65	83.0	1	35	36	2	8,473	8,177	296	26.9	0.0	2161.5	1100.0	$1,474	$642	$549	$2,665	$805,426	0.82
RACINE	674.3	38.78	95.7	15	37	23	7	16,058	13,916	2,142	20.6	0.0	3452.0	5020.5	$1,075	$647	$801	$2,523	$1,696,468	0.53
WALWORTH	698.71	26.33	69.7	0	30	13	9	18,707	15,843	2,864	22.7	0.0	3755.0	3326.0	$1,186	$655	$615	$2,456	$1,715,777	0.86
WASHINGTON	581.11	28.81	94.5	2	29	14	5	13,418	11,654	1,764	20.1	0.0	2081.5	2899.8	$1,231	$465	$432	$2,128	$1,181,549	0.70
WAUKESHA	1070.09	27.00	85.9	4	28	7	7	28,580	23,501	5,079	22.0	0.0	4535.0	7541.0	$1,153	$679	$601	$2,432	$2,602,323	0.81
Region Total		--	--	--	--	--	--	154,617	128,419	26,198	--	8	--	--	--	--	--	--	$15,140,054	
Region Average		30.73	80.6	5.7	31.4	17.6	6.0	22,088	18,346	3,743	22.1	1	4599.5	5421.9	$1,194	$642	$698	$2,533	$2,162,865	0.73

Table A.1 Storm Report Summary

From Winter Storm Reports, 2010-2011

Notes: 1) Costs shown in table are estimated and do not include the 4.25% 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 '07 (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	801.28	35.56	74.0	15	31	28	12	22,781	19,972	2,809	24.9	314.0	3952.8	4518.8	$1,658	$641	$551	$2,850	$2,281,382	0.70
CRAWFORD	388.95	41.31	75.2	6	37	25	12	5,452	1,874	3,578	4.8	1845.5	1681.0	1448.3	$372	$435	$337	$1,144	$442,727	0.12
DANE	1547.16	32.13	63.1	0	34	1	6	52,051	46,706	5,345	30.2	23.0	5750.5	13045.0	$1,844	$668	$653	$3,165	$4,896,908	0.94
DODGE	608.64	35.76	101.4	4	38	19	9	16,435	15,629	806	25.7	42.0	2542.0	3325.8	$1,540	$588	$456	$2,583	$1,572,247	0.72
GRANT	624.06	35.10	70.1	3	29	41	5	10,092	8,363	1,729	13.4	1787.0	2630.0	2427.0	$793	$459	$332	$1,585	$988,940	0.38
GREEN	312.72	33.27	78.5	13	30	34	11	3,820	2,420	1,400	7.7	124.5	1456.2	1309.7	$509	$468	$373	$1,351	$422,335	0.23
IOWA	458.14	32.85	69.9	8	34	24	7	8,006	6,101	1,905	13.3	325.0	2237.0	2617.5	$755	$570	$469	$1,795	$822,173	0.41
JEFFERSON	506.65	28.65	63.9	0	30	11	12	14,644	12,896	1,748	25.5	0.0	1962.5	2890.3	$1,485	$546	$522	$2,554	$1,294,195	0.89
JUNEAU	498.79	32.06	102.8	7	35	11	12	10,268	9,116	1,152	18.3	0.0	1642.8	2352.8	$1,246	$451	$389	$2,086	$1,040,646	0.57
LA CROSSE	488.24	41.04	91.0	8	34	35	13	7,413	4,032	3,381	8.3	759.0	3201.3	2448.0	$501	$630	$564	$1,695	$821,697	0.20
LAFAYETTE	293.88	36.19	84.4	1	32	14	14	3,319	2,819	500	9.6	1959.0	822.0	1278.3	$537	$386	$315	$1,238	$363,900	0.27
MONROE	646.37	37.55	91.4	12	35	19	14	11,610	9,958	1,652	15.4	386.0	2838.5	3184.5	$981	$515	$419	$1,914	$1,237,042	0.41
RICHLAND	325.26	25.31	63.4	2	28	20	8	4,436	2,557	1,879	7.9	342.0	1118.0	859.8	$531	$332	$282	$1,145	$372,361	0.31
ROCK	651.6	32.58	56.6	9	32	17	14	12,400	8,700	3,700	13.4	32.0	2539.3	2993.3	$735	$480	$459	$1,673	$1,090,384	0.41
SAUK	618.44	38.07	88.3	31	35	30	15	16,186	15,846	340	25.6	249.0	3350.3	3087.5	$1,735	$606	$453	$2,794	$1,727,784	0.67
VERNON	446.84	42.90	152.5	6	35	28	9	6,313	5,527	786	12.4	2446.0	1883.5	1513.3	$778	$405	$296	$1,480	$661,257	0.29
Region Total		--	--	--	--	--	--	205,226	172,516	32,710	--	10634	--	--	--	--	--	--	$20,035,978	
Region Average		35.02	82.9	7.8	33.1	22.3	10.8	12,827	10,782	2,044	16.0	665	2475.5	3081.2	$1,000	$511	$429	$1,941	$1,252,249	0.47

Final totals as of Monday, August 15, 2011

Table A.1 Storm Report Summary

From Winter Storm Reports, 2010-2011

Notes: 1) Costs shown in table are estimated and do not include the 4.25% 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 '07 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Statewide Total	--	--	--	--	--	--	694,881	573,253	121,628	--	18940.7	--	--	--	--	--	--	$71,809,029	--
Statewide Average	38.45	100.1	6.6	37.2	24.8	11.7	9,651	7,962	1,689	15.2	263.1	2456.1	2435.7	$922	$549	$485	$1,956	$997,348	0.42

WEATHER MANAGEMENT SOLUTIONS, LLC

EVALUATION OF WEATHER FORECAST SERVICES

Michael J. Adams

2011

This document contains two major sections. The first is the verification study of forecasts provided by Meridian Environmental Technology, Inc. to Wisconsin DOT for the winter of 2010-11. It is a statistical analysis of the accuracy of those forecasts, using a methodology developed over 10 years ago and refined several times since then. The second section is a brief analysis of two surveys of the county highway departments conducted during and immediately after the winter.

Executive Summary

Introduction

In 2010-11, 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.

In addition, Meridian conducted two surveys of the county highway departments (the users of the forecast information) during the winter. The aim of these surveys is twofold. They enable Meridian and WisDOT to gauge customer satisfaction. They also promote interaction between Meridian and the users of the service they provide.

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

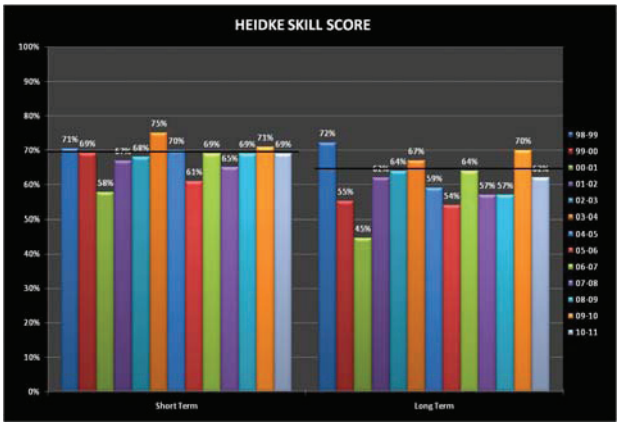
Forecasts for eight locations were examined: Madison, Milwaukee, Green Bay, Wausau, La Crosse, Eau Claire, and Rhinelander, and Rice Lake. The time period covered by the verification study was December 1, 2010 through March 31, 2011. Four specific criteria were examined: snow, freezing precipitation, wind speed, and pavement temperature.

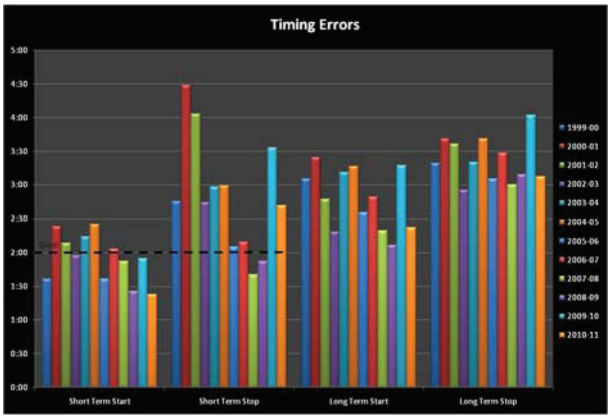
For the first two criteria, the verification methodology is based on a paper presented by John Thornes at the 1998 Standing International Road Weather Commission (SIRWEC) conference. It is based on common meteorological forecast verification techniques. The basis of the method is to choose two time periods (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.

Verification Results

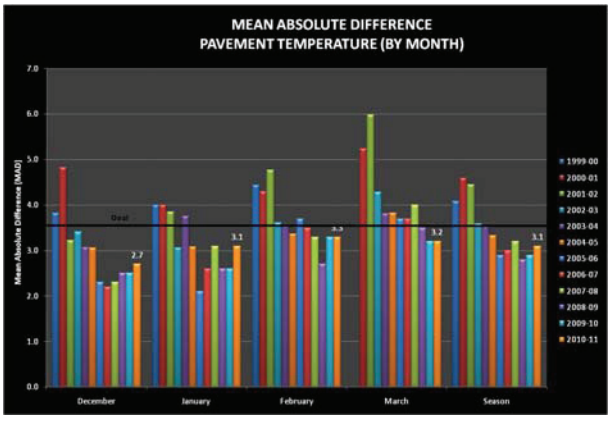
- **Precipitation forecasts.** Accuracy dropped somewhat compared to the previous winter and was slightly below the established goal scores. Accuracy got somewhat worse as the winter went along.

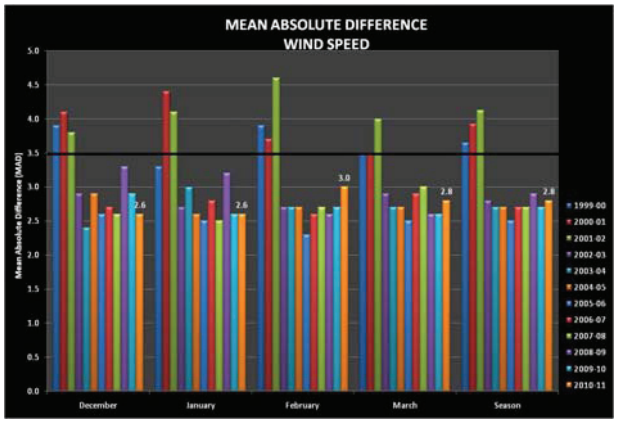




- **Timing error.** On the other hand, timing errors for both the start and end times of snow improved significantly. The short term timing errors for the start time were the best we've recorded.

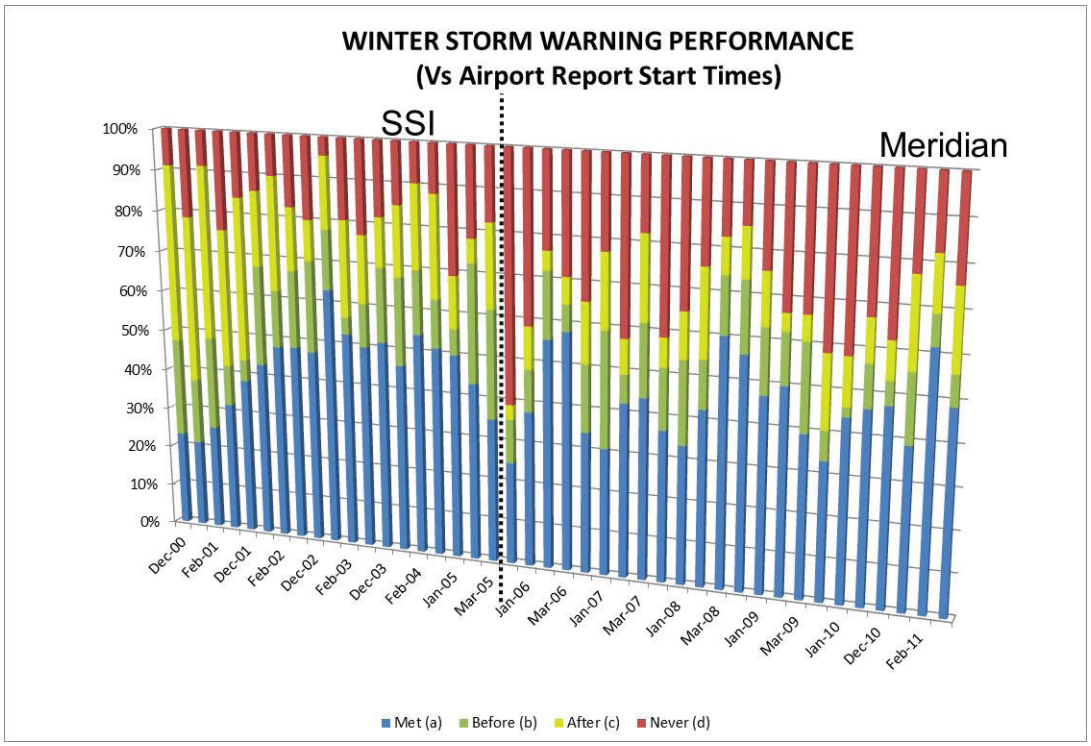
- **Pavement temperature.** Performance continued to be very good, but for the second year in a row was very slightly worse than the previous winter. There is some concern that this is a negative trend.





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

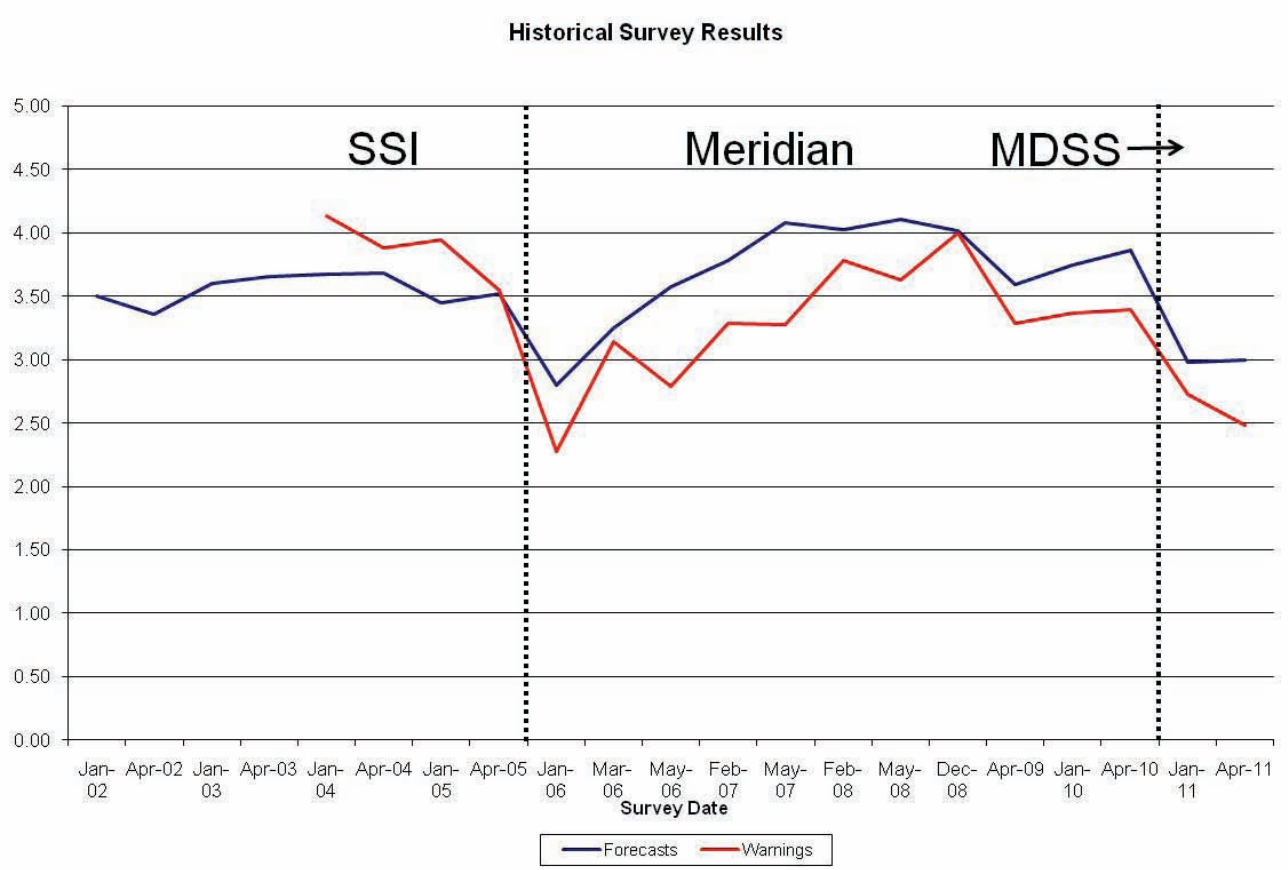
- **Winter storm warnings.** Performance was slightly better than previous seasons, but again failed to meet expectations. For the winter, 51 percent of events were preceded by a warning issued more than two hours in advance, as required by WisDOT's contract with Meridian. About 23 percent of events 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

Surveys taken during January and April 2011 brought mostly bad news. The forecast service ratings dropped precipitously, and the storm warning service ratings followed suit. The main contributor to the drop is likely the transition to the new MDSS forecast system.



Recommendations

Meridian will prepare a plan of action to address winter storm warning performance, including the high number of false alarms and the low percentage of warnings that met the required two-hour lead time, no later than September 1, 2011 and implement solutions into MDSS no later than October 15, 2011.

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

Weather Management Solutions and Meridian will jointly develop a training program to address MDSS issues reported during the 2010-11 winter season.

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2010-2011

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	21	7	29	1	97%	12,896	63.9	28.7	0.89	30	11	6	0
	VERNON	7	21	1	29	12	71%	5,527	152.5	42.9	0.29	35	28	5	6
	CRAWFORD	0	17	20	37	6	86%	1,874	75.2	41.3	0.12	37	25	8	6
	DANE	8	19	7	34	0	100%	46,706	63.1	32.1	0.94	34	1	5	0
	DODGE	5	13	1	19	23	45%	15,629	101.4	35.8	0.72	38	19	4	4
	GRANT	14	11	6	31	1	97%	8,363	70.1	35.1	0.38	29	41	3	3
	IOWA	15	15	4	34	8	81%	6,101	69.9	32.9	0.41	34	24	4	8
	COLUMBIA	10	12	6	28	18	61%	19,972	74.0	35.6	0.70	31	28	6	15
	JUNEAU	2	28	0	30	12	71%	9,116	102.8	32.1	0.57	35	11	3	7
	LA CROSSE	6	20	9	35	7	83%	4,032	91.0	41.0	0.20	34	35	8	8
	LAFAYETTE	19	7	6	32	1	97%	2,819	84.4	36.2	0.27	32	14	8	1
	MONROE	23	1	17	41	6	87%	9,958	91.4	37.5	0.41	35	19	9	12
	RICHLAND	0	0	0	0	30	0%	2,557	63.4	25.3	0.31	28	20	4	2
	ROCK	18	11	6	35	6	85%	8,700	56.6	32.6	0.41	32	17	8	9
	SAUK	17	23	0	40	26	61%	15,846	88.3	38.1	0.67	35	30	8	31
	GREEN	20	2	8	30	13	70%	2,420	78.5	33.3	0.23	30	34	8	13
Region Average		10.3	13.8	6.1	30.3	10.6	74.5%	10,782.3	82.9	35.0	0.47	33.1	22.3	6.1	7.8

Table A-2. Weather Forecasting Service Usage

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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	0	24	12	36	0	100%	8,177	83.0	32.7	0.82	35	36	2	1
	KENOSHA	18	8	4	30	14	68%	9,732	74.9	28.5	0.58	30	11	4	14
	MILWAUKEE	18	15	1	34	1	97%	45,596	60.4	33.0	0.79	31	19	5	4
	RACINE	8	20	9	37	15	71%	13,916	95.7	38.8	0.53	37	23	4	15
	WALWORTH	2	4	24	30	0	100%	15,843	69.7	26.3	0.86	30	13	4	0
	WAUKESHA	2	20	7	29	3	91%	23,501	85.9	27.0	0.81	28	7	4	4
	WASHINGTON	15	11	5	31	0	100%	11,654	94.5	28.8	0.70	29	14	0	2
Region Average		9.0	14.6	8.9	32.4	4.7	89.6%	18,345.6	80.6	30.7	0.73	31.4	17.6	3.3	5.7

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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	18	9	2	29	9	76%	7,842	80.3	31.7	0.46	35	54	2	3
	ASHLAND	1	18	41	60	9	87%	3,605	247.1	68.1	0.21	61	13	11	8
	BARRON	0	18	1	19	41	32%	2,645	101.3	44.2	0.14	45	49	7	15
	BAYFIELD	38	17	22	77	2	97%	4,406	160.2	61.3	0.23	69	27	2	10
	BUFFALO	5	27	2	34	3	92%	1,849	80.5	36.7	0.16	35	25	6	2
	BURNETT	3	14	19	36	2	95%	3,126	108.2	46.0	0.29	38	32	7	0
	CLARK	6	24	11	41	5	89%	4,312	105.8	34.5	0.31	38	14	5	8
	DOUGLAS	0	0	0	0	58	0%	7,023	177.1	51.3	0.31	50	33	6	8
	DUNN	4	11	5	20	17	54%	10,145	89.1	32.1	0.61	37	17	6	0
	SAWYER	0	17	5	22	28	44%	4,289	111.7	47.4	0.25	50	35	12	0
	JACKSON	8	23	20	51	2	96%	8,075	112.4	41.6	0.38	42	36	4	11
	WASHBURN	0	1	0	1	51	2%	5,546	100.6	36.2	0.41	43	13	3	9
	TAYLOR	38	4	0	42	15	74%	3,029	97.4	41.1	0.31	38	27	7	19
	SAINT CROIX	15	21	4	40	1	98%	10,752	88.8	43.0	0.40	41	53	7	0
	CHIPPEWA	23	4	3	30	8	79%	11,538	91.5	38.0	0.45	38	33	4	0
	RUSK	2	1	3	6	30	17%	2,652	110.6	38.8	0.32	36	46	6	0
	POLK	3	26	2	31	13	70%	7,694	121.8	52.5	0.38	44	40	5	0
	PIERCE	15	18	8	41	0	100%	4,949	102.1	38.9	0.35	40	17	7	1
	PEPIN	1	0	0	1	27	4%	621	72.5	28.2	0.20	28	10	5	0
	TREMPEALEAU	21	9	2	32	5	86%	5,381	77.0	32.8	0.38	32	30	3	5
Region Average		10.1	13.1	7.5	30.7	16.3	64.6%	5,474.0	111.8	42.2	0.33	42.0	30.2	5.8	5.0

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2010-2011

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	22	14	1	37	0	100%	3,076	75.6	31.5	0.36	29	31	0	8
	MANITOWOC	14	8	5	27	2	93%	7,536	95.6	31.2	0.58	26	16	3	3
	CALUMET	16	8	2	26	11	70%	1,766	77.3	30.0	0.29	22	37	0	15
	FOND DU LAC	24	7	0	31	1	97%	9,694	79.2	33.7	0.48	24	26	5	8
	KEWAUNEE	24	4	3	31	0	100%	1,173	150.6	41.5	0.26	31	29	2	0
	OCONTO	42	0	0	42	5	89%	4,382	101.3	35.1	0.26	42	23	4	5
	OUTAGAMIE	3	16	6	25	14	64%	8,253	105.7	34.2	0.46	32	18	5	7
	SHEBOYGAN	18	21	2	41	2	95%	10,176	92.2	31.6	0.62	31	20	6	12
	WINNEBAGO	9	18	6	33	2	94%	10,625	82.2	29.0	0.64	32	41	2	3
	MARINETTE	23	14	4	41	43	49%	4,382	90.6	36.5	0.29	36	29	2	48
	BROWN	45	1	1	47	1	98%	10,991	105.4	33.3	0.46	29	25	3	19
Region Average		21.8	10.1	2.7	34.6	7.4	86.4%	6,550.4	96.0	33.4	0.43	30.4	26.8	2.9	11.6

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2010-2011

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	24	29	6	59	6	91%	5,397	111.6	60.4	0.28	56	17	9	9
	FLORENCE	14	23	14	51	7	88%	2,185	115.9	48.4	0.32	50	28	11	8
	FOREST	7	23	18	48	0	100%	5,555	127.8	47.8	0.37	48	23	8	0
	GREEN LAKE	0	7	23	30	2	94%	1,410	106.8	33.5	0.28	30	19	4	2
	IRON	14	0	54	68	7	91%	4,860	272.9	70.7	0.28	73	18	9	2
	LANGLADE	12	21	4	37	3	93%	3,277	103.3	39.9	0.28	37	30	7	3
	LINCOLN	8	4	10	22	33	40%	4,358	125.1	54.0	0.19	52	24	15	3
	MARATHON	10	7	5	22	29	43%	12,207	97.6	51.0	0.27	45	53	8	6
	MARQUETTE	5	36	2	43	0	100%	4,479	98.8	35.2	0.52	32	10	10	11
	MENOMINEE	22	7	2	31	0	100%	700	91.5	28.2	0.27	31	21	2	0
	PORTAGE	9	11	20	40	2	95%	7,319	90.9	40.0	0.32	40	23	7	2
	SHAWANO	36	1	3	40	3	93%	7,272	100.5	37.6	0.37	34	40	5	9
	VILAS	44	6	0	50	0	100%	6,850	87.7	41.3	0.54	50	7	9	0
	WAUPACA	12	12	1	25	5	83%	6,456	100.0	30.3	0.39	29	26	3	1
	WAUSHARA	1	1	7	9	21	30%	3,842	99.2	30.2	0.37	29	7	4	1
	WOOD	7	35	8	50	0	100%	5,858	80.4	39.7	0.40	39	25	8	11
	ADAMS	5	40	4	49	0	100%	3,414	96.7	41.2	0.43	33	18	15	16
	ONEIDA	35	6	8	49	0	100%	5,346	120.9	51.0	0.26	49	21	6	0
Region Average		14.7	14.9	10.5	40.2	6.6	85.6%	5,043.6	112.6	43.4	0.34	42.1	22.8	7.8	4.7

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2010-2011

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		13.0	13.4	7.3	33.7	10.1	77.8%	7,961.8	100.1	38.4	0.42	37.2	24.8	5.7	6.6

Table A.3. Anti-icing Details

From Winter Storm Reports, 2010-2011

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	16	9	3	11	8	3	2	9,156	4,320	3,197	16,673
	FLORENCE	8	6	0	2	1	0	0	0	2,760	1,668	4,428
	GREEN LAKE	2	2	0	1	1	0	0	184	360	291	834
	IRON	2	0	0	0	0	0	2	0	240	205	445
	LANGLADE	3	2	0	2	0	0	0	0	960	765	1,725
	LINCOLN	3	1	0	3	0	0	0	0	840	560	1,400
	MARATHON	6	0	0	0	0	0	6	0	5,040	3,828	8,868
	MARQUETTE	11	6	2	7	7	0	1	1,577	10,380	6,398	18,354
	PORTAGE	2	0	0	0	0	0	2	0	840	571	1,411
	PRICE	9	3	0	0	1	1	5	0	3,120	1,881	5,001
	SHAWANO	9	0	1	1	0	7	4	721	3,840	2,775	7,337
	WAUPACA	1	0	0	0	0	1	0	0	300	197	497
	WAUSHARA	1	0	0	0	0	0	1	0	360	233	593
	WOOD	11	4	0	3	3	9	0	0	3,090	3,067	6,157
Region Total		84	33	6	30	21	21	23	11,638	36,450	25,635	73,723
Region Average		6	--	--	--	--	--	--	831	2,604	1,831	5,266

Table A.3. Anti-icing Details

From Winter Storm Reports, 2010-2011

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	19	0	2	1	0	1	17	3,392	7,500	5,071	15,963
	CALUMET	15	0	2	0	0	1	12	1,373	4,770	3,021	9,164
	DOOR	8	3	1	0	0	5	0	3,178	3,720	2,546	9,444
	FOND DU LAC	8	2	5	3	0	0	0	906	6,480	4,700	12,086
	MANITOWOC	3	0	0	0	0	0	3	431	1,440	1,074	2,945
	MARINETTE	48	0	0	0	0	11	41	0	16,050	14,240	30,290
	OCONTO	5	0	0	0	0	1	4	289	4,395	3,034	7,718
	OUTAGAMIE	7	0	2	2	1	3	5	3,960	4,710	3,261	11,931
	SHEBOYGAN	12	3	3	4	1	4	1	2,244	7,080	5,191	14,515
	WINNEBAGO	3	0	0	1	0	1	2	1,397	1,770	2,216	5,383
Region Total		128	8	15	11	2	27	85	17,168	57,915	44,354	119,437
Region Average		13	--	--	--	--	--	--	1,717	5,792	4,435	11,944

Table A.3. Anti-icing Details

From Winter Storm Reports, 2010-2011

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	8	0	0	0	0	8	1	0	2,340	1,530	3,870
	BARRON	15	0	1	0	0	0	14	949	9,000	3,323	13,272
	BAYFIELD	10	0	1	0	0	3	8	0	4,500	2,726	7,226
	BUFFALO	2	0	0	0	0	2	0	0	660	551	1,211
	CLARK	8	0	0	1	1	2	5	203	3,540	2,210	5,952
	DOUGLAS	8	3	3	2	0	1	2	0	3,480	2,606	6,086
	EAU CLAIRE	3	0	0	0	0	0	3	0	1,080	771	1,851
	JACKSON	11	0	0	0	0	10	10	2,097	7,320	5,607	15,024
	PIERCE	1	0	0	1	1	0	0	0	360	499	859
	TAYLOR	19	2	0	3	0	0	15	431	5,610	3,546	9,587
	TREMPEALEAU	5	0	1	0	0	1	4	0	2,220	1,643	3,863
	WASHBURN	9	1	0	0	0	0	8	3,630	3,240	2,099	8,969
Region Total		99	6	6	7	2	27	70	7,310	43,350	27,111	77,770
Region Average		8	--	--	--	--	--	--	609	3,613	2,259	6,481

Table A.3. Anti-icing Details

From Winter Storm Reports, 2010-2011

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	14	0	0	0	0	0	14	2,813	5,490	6,841	15,143
	MILWAUKEE	4	0	0	0	0	1	3	2,384	6,000	7,699	16,082
	OZAUKEE	1	1	0	0	0	0	0	105	870	635	1,610
	RACINE	15	0	0	0	0	0	15	1,569	6,240	6,738	14,547
	WASHINGTON	2	0	0	0	0	1	1	90	480	351	921
	WAUKESHA	4	2	0	1	0	2	2	0	1,140	771	1,911
Region Total		40	3	0	1	0	4	35	6,960	20,220	23,035	50,215
Region Average		7	--	--	--	--	--	--	1,160	3,370	3,839	8,369

Table A.3. Anti-icing Details

From Winter Storm Reports, 2010-2011

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	15	1	1	1	0	0	13	2,870	6,000	4,113	12,983
	CRAWFORD	6	0	0	1	0	1	5	540	1,470	885	2,895
	DODGE	4	0	0	0	0	0	4	885	1,920	1,178	3,983
	GRANT	3	0	0	0	0	1	3	92	1,140	628	1,859
	GREEN	13	2	0	3	1	0	12	0	2,430	1,381	3,811
	IOWA	8	0	0	0	0	0	8	0	1,500	1,884	3,384
	JUNEAU	7	0	0	0	0	0	7	0	3,780	2,385	6,165
	LA CROSSE	8	0	1	1	0	6	4	3,993	3,900	2,614	10,507
	LAFAYETTE	1	0	0	0	0	0	1	0	240	203	443
	MONROE	12	0	0	1	1	7	12	10,889	10,050	6,845	27,784
	RICHLAND	2	0	0	0	0	0	2	245	2,070	1,503	3,818
	ROCK	9	0	0	2	1	1	6	0	6,540	5,017	11,557
	SAUK	31	2	3	4	1	2	19	0	12,780	7,516	20,296
	VERNON	6	0	0	0	0	6	6	0	2,160	1,276	3,436
Region Total		125	5	5	13	4	24	102	19,513	55,980	37,427	112,920
Region Average		9	--	--	--	--	--	--	1,394	3,999	2,673	8,066

Table A.3. Anti-icing Details

From Winter Storm Reports, 2010-2011

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		476	55	32	62	29	103	315	62,589	213,915	157,561	434,065

Final totals as of Monday, August 15, 2011

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2010-2011

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	38,150	0	0	0	0	0	0	0	0	0	0	0	0
	FLORENCE	0	31,600	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	2,625	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	0	75	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	0	2,500	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	0	4,700	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	0	12,100	0	0	0	0	0	0	0	0	0	0	0	0
	MARQUETTE	0	90,250	0	0	0	0	0	0	900	0	0	0	0	0
	MENOMINEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PORTAGE	0	438	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	0	4,125	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	0	5,550	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	300	0	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	0	400	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	0	18,700	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	211,513	0	0	0	0	0	0	900	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2010-2011

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	0	22,610	0	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	0	7,625	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	0	22,700	0	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	0	3,625	0	0	0	0	0	0	0	0	0	0	0	0
	KEWAUNEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	0	2,870	0	0	0	0	0	0	0	0	0	0	0	0
	MARINETTE	0	131,650	0	0	0	0	0	0	0	0	0	0	0	0
	OCONTO	0	1,925	0	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	0	22,000	0	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	0	8,975	0	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	0	12,700	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	236,680	0	0	0	0	0	0	0	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2010-2011

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	1,533	0	0	0	0	0	0	693	0	0	0	10	0
	BARRON	0	4,315	0	0	0	0	0	0	0	0	0	0	0	0
	BAYFIELD	0	4,425	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	0	1,360	0	0	0	0	0	0	0	0	0	0	340	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	2,250	0	0	0	0	0	0	0	0	0	0	0	0
	DOUGLAS	0	0	0	0	0	0	0	0	4,550	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	620	0	0	0	0	0	0	0	0
	JACKSON	0	23,300	0	0	0	0	0	0	0	0	0	0	0	0
	PEPIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PIERCE	0	450	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	0	0	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	4,790	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	0	2,350	650	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	0	3,415	0	0	1,715	0	0	0	0	0	0	0	0	0
Region Total		0	48,188	650	0	1,715	620	0	0	5,243	0	0	0	350	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2010-2011

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	2,250	0	0	0	0	0
	MILWAUKEE	0	15,890	0	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	0	700	0	0	0	0	0	0	0	0	0	0	0	0
	RACINE	0	5,137	0	0	0	380	0	0	0	0	0	0	0	0
	WALWORTH	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	0	600	0	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	0	13,500	0	0	0	0	0	0	0	0	0	0	1,200	0
Region Total		0	35,827	0	0	0	380	0	0	2,250	0	0	0	1,200	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2010-2011

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	28,700	0	0	0	0	0	0	0	0	0	0	0	0
	CRAWFORD	0	5,400	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
	DODGE	0	0	0	0	0	0	0	0	750	0	0	0	0	0
	GRANT	0	610	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	0	1,765	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	0	415	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	5,200	0	0	1,400	0	0	0	0	0	0	0	0	0
	LA CROSSE	0	19,964	0	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	0	0	30	0	0	0	0	0	0	0	0	0	0	0
	MONROE	0	54,900	0	0	0	0	0	0	0	0	0	0	4,270	0
	RICHLAND	0	2,450	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	0	14,300	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	0	15,990	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	0	13,200	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	162,894	30	0	1,400	0	0	0	750	0	0	0	4,270	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2010-2011

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		0	695,102	680	0	3,115	1,000	0	0	9,143	0	0	0	5,820	0

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	$21,086
	C	CRAWFORD	$2,917
	A	DANE	$34,417
	B	DODGE	$7,490
	C	GRANT	$1,650
	D	GREEN	$2,897
	C	IOWA	$1,832
	B	JEFFERSON	
	C	JUNEAU	
	A	LACROSSE	$4,265
	C	LAFAYETTE	$276
	C	MONROE	$16,213
	D	RICHLAND	$4,507
	B	ROCK	$10,556
	B	SAUK	$19,004
	C	VERNON	$3,732
		TOTAL	**$130,842**
SOUTHEAST	A	KENOSHA	$12,440
	A	MILWAUKEE	$15,248
	A	OZAUKEE	$1,289
	A	RACINE	$10,156
	B	WALWORTH	$879
	B	WASHINGTON	$1,981
	A	WAUKESHA	$3,324
		TOTAL	**$45,317**
NORTHEAST	A	BROWN	$18,585
	C	CALUMET	$5,525
	C	DOOR	$5,874
	C	FOND DU LAC	$22,427
	C	KEWAUNEE	$417
	B	MANITOWOC	$3,425
	D	MARINETTE	$25,294
	C	OCONTO	$7,390
	B	OUTAGAMIE	$854
	B	SHEBOYGAN	$8,014
	A	WINNEBAGO	$3,708
		TOTAL	**$101,513**

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 CENTI	D	ADAMS	$6,404
	D	FLORENCE	$4,616
	D	FOREST	$10,757
	D	GREEN LAKE	$477
	D	IRON	$496
	D	LANGLADE	$1,131
	C	LINCOLN	$1,677
	A	MARATHON	$10,252
	B	MARQUETTE	$8,176
	D	MENOMINEE	
	B	ONEIDA	$2,571
	A	PORTAGE	$1,203
	D	PRICE	$4,767
	B	SHAWANO	$5,312
	C	VILAS	$880
	C	WAUPACA	$6,433
	B	WAUSHARA	$3,086
	C	WOOD	$515
		TOTAL	**$68,753**
NORTHWEST	D	ASHLAND	$4,021
	D	BARRON	
	D	BAYFIELD	$19,081
	D	BUFFALO	$8,328
	D	BURNETT	
	B	CHIPPEWA	
	C	CLARK	$3,757
	C	DOUGLAS	$42,060
	B	DUNN	
	A	EAU CLAIRE	$11,499
	C	JACKSON	$9,338
	D	PEPIN	$821
	D	PIERCE	$968
	D	POLK	$8,672
	D	RUSK	
	D	SAWYER	$199
	B	ST. CROIX	
	D	TAYLOR	$211
	C	TREMPEALEAU	$11,641
	C	WASHBURN	$9,593
		TOTAL	**$130,189**
		STATE TOTAL	**$476,614**
		64/72 COUNTIES (89%)	

Table A-6. Salt Brine Use

From Winter Storm Reports, 2010-2011

REGION	GROUP	COUNTY	PREWETTING (GALLONS)	ANTI-ICING (GALLONS)	TOTAL (GALLONS)
SOUTHWEST	B	COLUMBIA	22,700	28,700	51,400
	C	CRAWFORD	20,575	5,400	25,975
	A	DANE	152,548	0	152,548
	B	DODGE	1,451	750	2,201
	C	GRANT	0	610	610
	D	GREEN	13,856	1,765	15,621
	C	IOWA	0	415	415
	B	JEFFERSON	61,960	0	61,960
	C	JUNEAU	5,675	6,600	12,275
	A	LA CROSSE	29,788	19,964	49,752
	C	LAFAYETTE	0	30	30
	C	MONROE	4,395	59,170	63,565
	D	RICHLAND	75	2,450	2,525
	B	ROCK	25,618	14,300	39,918
	B	SAUK	2,520	15,990	18,510
	C	VERNON	3,785	13,200	16,985
		TOTAL	**344,946**	**169,344**	**514,290**
SOUTHEAST	A	KENOSHA	4,978	2,250	7,228
	A	MILWAUKEE	33,550	15,890	49,440
	A	OZAUKEE	38,988	700	39,688
	A	RACINE	24,886	5,517	30,403
	B	WALWORTH	13,502	0	13,502
	B	WASHINGTON	74,899	600	75,499
	A	WAUKESHA	193,784	14,700	208,484
		TOTAL	**384,587**	**39,657**	**424,244**
NORTHEAST	A	BROWN	30,002	22,610	52,612
	C	CALUMET	8,672	7,625	16,297
	C	DOOR	18,574	22,700	41,274
	C	FOND DU LAC	29,377	3,625	33,002
	C	KEWAUNEE	6,700	0	6,700
	B	MANITOWOC	38,200	2,870	41,070
	D	MARINETTE	14,166	131,650	145,816
	C	OCONTO	16,332	1,925	18,257
	B	OUTAGAMIE	69,970	22,000	91,970
	B	SHEBOYGAN	65,435	8,975	74,410
	A	WINNEBAGO	121,835	12,700	134,535
		TOTAL	**419,263**	**236,680**	**655,943**

Table A-6. Salt Brine Use

From Winter Storm Reports, 2009-2010

REGION	GROUP	COUNTY	PREWETTING (GALLONS)	ANTI-ICING (GALLONS)	TOTAL (GALLONS)
NORTH CENTRAL	D	ADAMS	2,630	38,150	40,780
	D	FLORENCE	7,585	31,600	39,185
	D	FOREST	10,499	0	10,499
	D	GREEN LAKE	8,210	2,625	10,835
	D	IRON	20,466	75	20,541
	D	LANGLADE	16,304	2,500	18,804
	C	LINCOLN	40,520	4,700	45,220
	A	MARATHON	25,065	12,100	37,165
	B	MARQUETTE	6,540	91,050	97,590
	D	MENOMINEE	200	0	200
	B	ONEIDA	33,222	0	33,222
	A	PORTAGE	31,089	438	31,527
	D	PRICE	11,880	4,125	16,005
	B	SHAWANO	35,873	5,550	41,423
	C	VILAS	23,700	0	23,700
	C	WAUPACA	20,350	300	20,650
	B	WAUSHARA	3,691	400	4,091
	C	WOOD	5,366	18,700	24,066
		TOTAL	**303,190**	**212,313**	**515,503**
NORTHWEST	D	ASHLAND	34,907	2,236	37,143
	D	BARRON	14,382	4,315	18,697
	D	BAYFIELD	4,548	4,425	8,973
	D	BUFFALO	4,280	1,700	5,980
	D	BURNETT	7,045	0	7,045
	B	CHIPPEWA	0	0	0
	C	CLARK	4,525	2,250	6,775
	C	DOUGLAS	15,934	4,550	20,484
	B	DUNN	5,198	0	5,198
	A	EAU CLAIRE	14,030	620	14,650
	C	JACKSON	8,455	23,300	31,755
	D	PEPIN	1,414	0	1,414
	D	PIERCE	7,670	450	8,120
	D	POLK	10,617	0	10,617
	D	RUSK	855	0	855
	D	SAWYER	34,409	0	34,409
	B	ST. CROIX	5,966	0	5,966
	D	TAYLOR	30,991	4,790	35,781
	C	TREMPEALEAU	8,940	3,000	11,940
	C	WASHBURN	8,320	5,130	13,450
		TOTAL	**222,486**	**56,766**	**279,252**
		STATE TOTAL	**1,674,472**	**714,760**	**2,389,232**
		# OF COUNTIES	66	56	71
PREVIOUS USE		2009-2010	933,690.00	649,909.00	1,583,599.00
		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

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2010-2011

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	3,414	0	1,380	0	0	0	0	0	1,250	0	0	0	0	0	0	0
	FLORENCE	2,185	0	0	7,585	0	0	0	0	0	0	0	0	0	0	20	0
	FOREST	5,555	0	10,499	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	1,410	0	1,130	7,080	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	4,860	0	0	20,466	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	3,277	0	0	16,304	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	4,358	0	0	40,520	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	12,207	0	0	25,065	0	0	0	0	0	0	0	0	0	0	0	0
	MARQUETTE	4,479	0	0	400	0	0	0	0	0	0	6,140	0	0	0	0	0
	MENOMINEE	700	0	0	200	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	5,346	0	0	27,233	0	0	0	0	0	0	0	0	0	0	5,989	0
	PORTAGE	7,319	0	0	31,089	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	5,397	0	0	11,880	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	7,272	0	0	35,873	0	0	0	0	0	0	0	0	0	0	0	0
	VILAS	6,850	0	0	23,700	0	0	0	0	0	0	0	0	0	0	0	0
	WAUPACA	6,456	0	0	19,720	630	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	3,842	0	3,196	495	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	5,858	0	0	5,366	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		90,785	0	16,205	272,976	630	0	0	0	1,250	0	6,140	0	0	0	6,009	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2010-2011

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	10,991	0	0	30,002	0	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	1,766	0	0	8,672	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	3,076	0	0	16,764	1,810	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	9,694	0	864	20,271	243	0	0	0	0	0	7,999	0	0	0	0	0
	KEWAUNEE	1,173	0	0	6,700	0	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	7,536	0	0	38,200	0	0	0	0	0	0	0	0	0	0	0	0
	MARINETTE	4,382	0	0	14,166	0	0	0	0	0	0	0	0	0	0	0	0
	OCONTO	4,382	0	0	16,332	0	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	8,253	0	0	69,970	0	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	10,176	0	0	65,435	0	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	10,625	0	0	121,560	0	0	0	0	275	0	0	0	0	0	0	0
Region Total		72,054	0	864	408,072	2,053	0	0	0	275	0	7,999	0	0	0	0	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2010-2011

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	3,605	0	0	27,346	31	0	0	0	0	0	6,272	0	0	0	1,258	0
	BARRON	2,645	0	0	12,480	0	0	190	0	0	0	1,712	0	0	0	0	0
	BAYFIELD	4,406	0	0	4,548	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	1,849	0	0	4,280	0	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	3,126	0	0	0	0	0	0	0	0	0	7,045	0	0	0	0	0
	CHIPPEWA	11,538	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	4,312	0	0	4,465	0	0	0	0	60	0	0	0	0	0	0	0
	DOUGLAS	7,023	0	0	0	0	0	0	0	0	0	15,934	0	0	0	0	0
	DUNN	10,145	0	0	0	0	0	0	0	0	0	0	0	0	0	5,198	0
	EAU CLAIRE	7,842	0	0	885	0	0	0	0	12,910	0	235	0	0	0	0	0
	JACKSON	8,075	0	0	0	0	0	8,455	0	0	0	0	0	0	0	0	0
	PEPIN	621	0	0	0	0	0	0	0	1,414	0	0	0	0	0	0	0
	PIERCE	4,949	0	65	7,570	0	0	0	0	0	0	35	0	0	0	0	0
	POLK	7,694	0	0	5,685	0	0	0	0	0	0	4,932	0	0	0	0	0
	RUSK	2,652	0	0	0	0	0	0	0	0	0	855	0	0	0	0	0
	SAINT CROIX	10,752	0	34,409	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	4,289	0	0	0	0	0	0	0	0	0	5,966	0	0	0	0	0
	TAYLOR	3,029	0	16	30,975	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	5,381	0	0	2,750	1,740	0	4,450	0	0	0	0	0	0	0	0	0
	WASHBURN	5,546	0	0	5,760	0	0	2,560	0	0	0	0	0	0	0	0	0
Region Total		109,479	0	34,490	106,744	1,771	0	15,655	0	14,384	0	42,986	0	0	0	6,456	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2010-2011

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	9,732	0	0	23	370	0	0	0	0	0	4,585	0	0	0	0	0
	MILWAUKEE	45,596	18	33,550	0	0	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	8,177	0	6,122	32,866	0	0	0	0	0	0	0	0	0	0	0	0
	RACINE	13,916	0	1,885	21,405	0	0	0	1,059	0	0	537	0	0	0	0	0
	WALWORTH	15,843	0	2,097	11,405	0	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	11,654	82	0	74,899	0	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	23,501	0	24,606	169,178	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		128,419	100	68,260	309,776	370	0	0	1,059	0	0	5,122	0	0	0	0	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2010-2011

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	19,972	0	0	22,700	0	0	0	0	0	0	0	0	0	0	0	0
	CRAWFORD	1,874	0	0	20,575	0	0	0	0	0	0	0	0	0	0	0	0
	DANE	46,706	1	0	152,548	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	15,629	0	0	1,451	0	0	0	0	0	0	0	0	0	0	0	0
	GRANT	8,363	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	2,420	0	0	13,856	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	6,101	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	12,896	0	1,245	60,715	0	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	9,116	0	0	4,508	0	0	225	0	0	0	0	0	0	0	942	0
	LA CROSSE	4,032	0	0	29,788	0	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	2,819	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MONROE	9,958	0	0	4,395	0	0	0	0	0	0	0	0	0	0	0	0
	RICHLAND	2,557	0	0	75	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	8,700	0	0	25,618	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	15,846	0	0	2,520	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	5,527	0	0	125	0	0	0	0	0	0	3,660	0	0	0	0	0
Region Total		172,516	2	1,245	338,873	0	0	225	0	0	0	3,660	0	0	0	942	0

Table A.7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2010-2011

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		573,253	103	121,064	#######	4,824	0	15,880	1,059	15,909	0	65,907	0	0	0	13,407	0

Final totals as of Monday, August 15, 2011

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

From Winter Storm Reports, 2010-2011

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	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FOREST	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	177	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	563	0	3,080	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	157	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	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	317	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PORTAGE	448	0	1,630	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	309	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VILAS	355	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	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	193	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		2,790	0	4,710	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, 2010-2011

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	33	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	12	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	237	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	3	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	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		298	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, 2010-2011

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	170	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BARRON	861	0	290	0	0	0	0	0	0	0	0	0	0	0	0
	BAYFIELD	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CHIPPEWA	1,328	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DOUGLAS	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DUNN	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EAU CLAIRE	82	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JACKSON	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PEPIN	273	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PIERCE	279	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	608	0	300	0	0	0	0	0	0	0	0	0	0	0	0
	RUSK	126	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAINT CROIX	471	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	0
	TAYLOR	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	470	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	114	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		5,210	0	590	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, 2010-2011

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	8	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		8	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, 2010-2011

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	314	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CRAWFORD	1,846	0	3,040	0	0	0	0	0	0	0	0	0	0	0	0
	DANE	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GRANT	1,787	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	125	0	141	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	325	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	759	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	1,959	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MONROE	386	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RICHLAND	342	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	249	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	2,446	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		10,634	0	3,181	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, 2010-2011

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		18,941	0	8,481	0	0	0	0	0	0	0	0	0	0	0	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

* Quantities adjusted