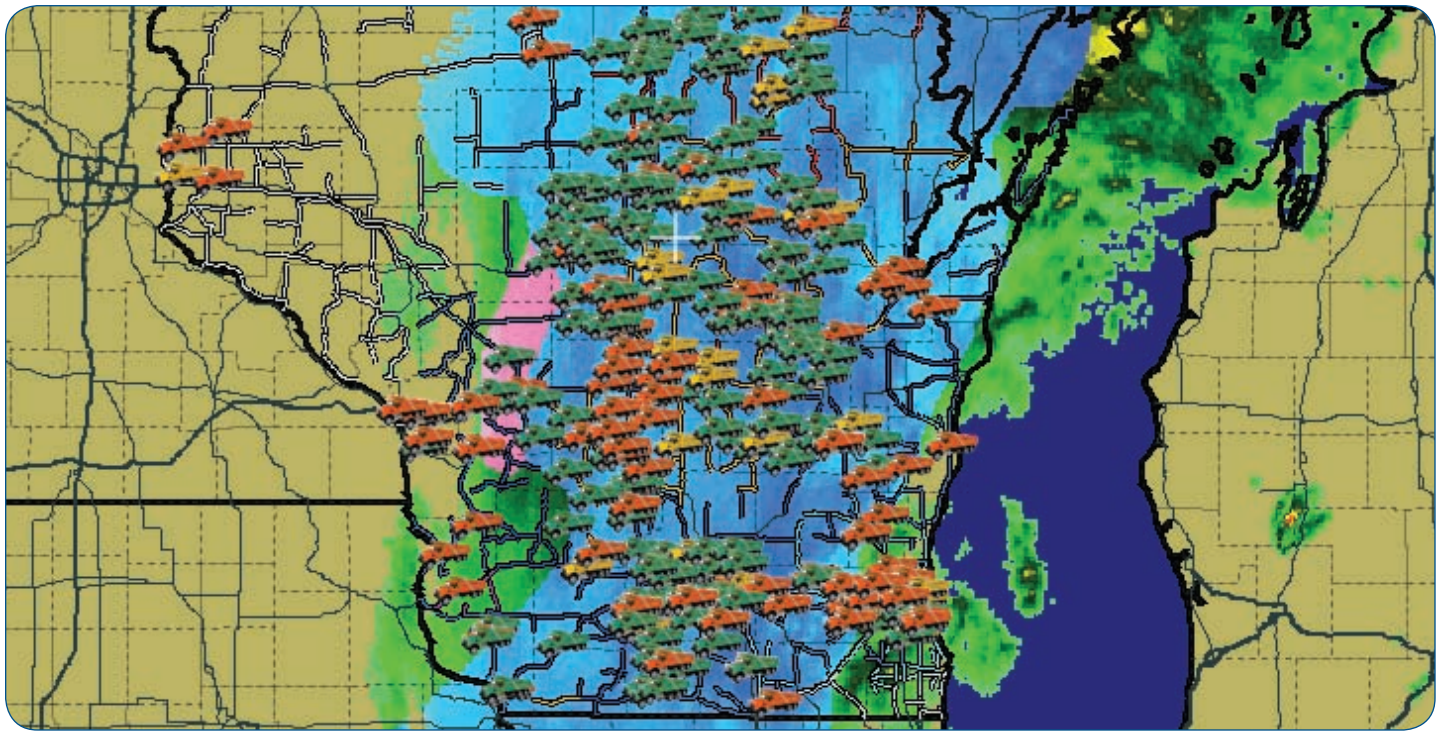
WINTER MAINTENANCE AT A GLANCE

2010-2011

Meeting Challenges With Best Practices



Introduction

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

This summary document highlights key aspects of the 2010-2011 winter, including weather, materials and equipment use, performance, and costs. The complete Annual Winter Maintenance Report, which provides further detail on these areas and others, is available at: https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.

Inside

Winter by the Numbers

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.

The statewide average Winter Severity Index was 38.5 which is 20 percent higher than the average of the previous ten winters (31.9). Statewide, salt use increased 40 percent from the previous winter, driving total salt expenditures up 35 percent .

Table 1. summarizes key facts and statistics from this winter in several core areas. The 2010-2011 Annual Winter Maintenance Report provides more detail on all topics in this table.

Table 1. Statewide Summary: This Winter by the Numbers

	Measure	Previous Winter	2010-2011
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	38.5
	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 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 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.

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.

Another Record-Breaking Winter

The 2010-11 winter season was a persistent test of available resources. 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 2009-2010, but comparable to the two winters previous to that.

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. 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.

As is normally the case, snowfall varied quite a bit across the state this winter (see Figure 1). The highest snowfall recorded was in Iron County, at 273 inches; the lowest was in Rock County, at 57 inches. This range was wider than last year's range of 23 to 209 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.

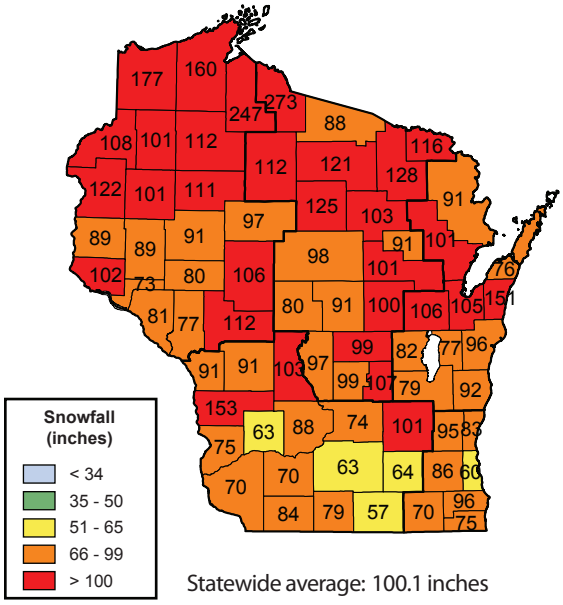
Quantifying Winter Severity

WisDOT developed the Winter Severity Index in 1995 as a way to quantify winter severity with a single number that factors in number of snow events, number of freezing rain events, total snow amount, total storm duration, and total number of incidents.

The department uses the severity index as a management tool to compare apples to apples in evaluating materials, labor and equipment use across counties and from year to year. The index uses a 0 to 100 scale. This winter:

- The statewide average Winter Severity Index was 38.5, which is 20 percent higher than the average of the previous 10 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.

Figure 1. Statewide Snowfall, 2010-2011

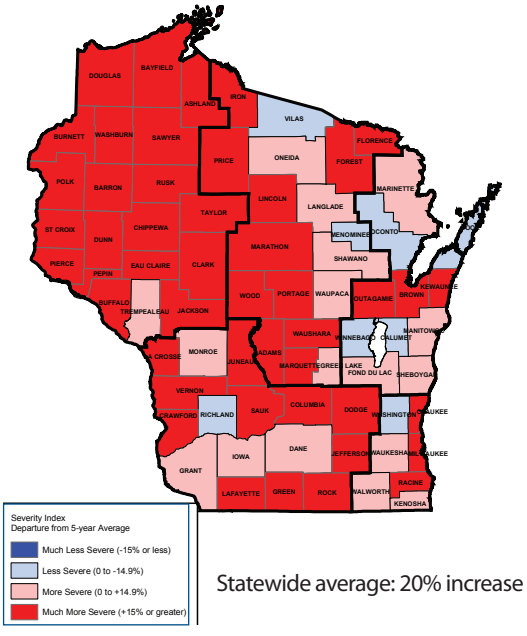


Statewide average: 100.1 inches

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

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

Figure 2. 2010-2011 Winter Severity Index vs. 5-Year Average



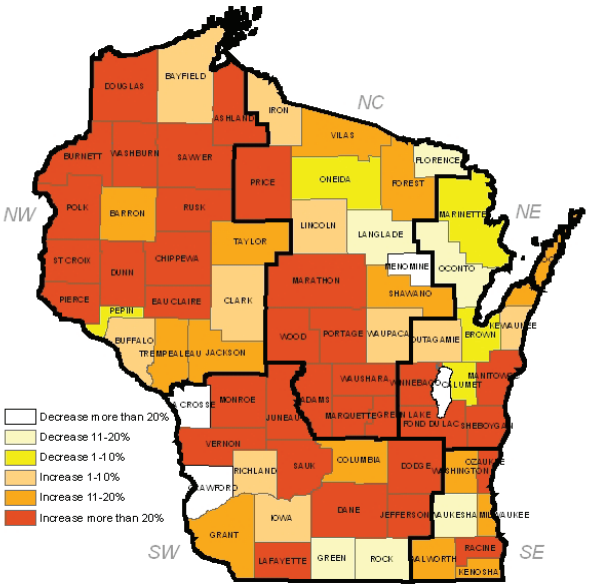
Statewide average: 20% increase

Salt and Anti-icing Work Together

This winter's salt use, at 573,253 tons, was much larger than last year's 408,523 tons and comparable to the 2008-2009 year. WisDOT encourages counties to use salt efficiently by making use of best practices such as anti-icing and prewetting. Proactive anti-icing treatments, which are applied to roads and bridges before a storm to prevent snow and ice from forming a bond, increased 5 percent over last winter to a record 714,860 gallons. 61 counties made at least one anti-icing application. Prewetting salt before it is applied has advantages as well, keeping material on the pavement and minimizing waste. Both practices are used not only across the country but throughout the world.

In contrast, WisDOT actively discourages counties from using sand on the state trunk highway system. Sand is not effective at high traffic speeds, negatively impacts the environment, and ultimately decreases the level of service provided. Counties used 18,941 cubic yards of sand on state highways this year, a 1% decrease from the previous year. For more on the disadvantages of sand use, see a report prepared for WisDOT through the Clear Roads pooled fund project at:
http://www.clearroads.org/synthesis-reports.html.

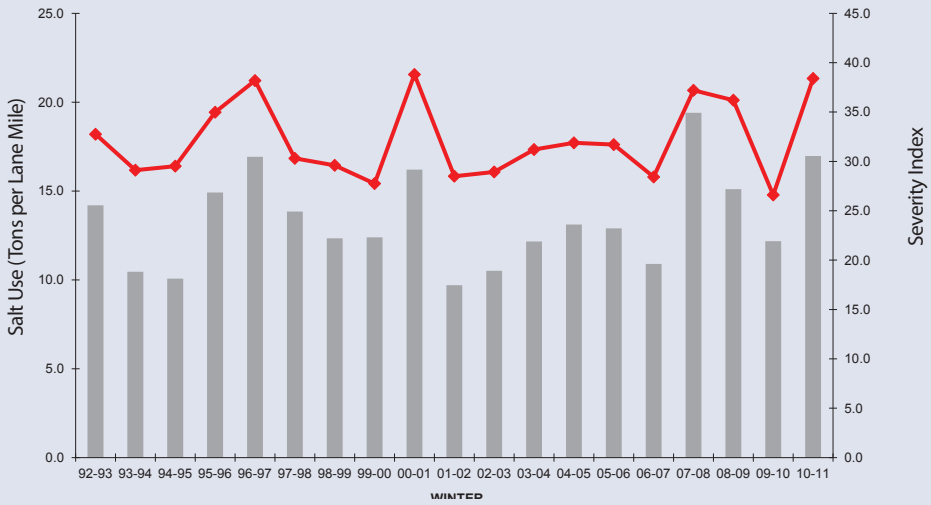
Figure 3. 2010-2011 Salt Use per Lane Mile vs. 5-Year Average



Statewide average: 17% increase

Counties applied a statewide average of 17.0 tons of salt per lane mile on state highways, an increase of 40 percent compared with the 2009-2010 winter and near the average of the five previous winters (see Figures 3 and 4). 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 salt use in Michigan (17 tons per lane mile). Several factors may contribute to nearby states' lower rates of salt use per lane mile, including salt shortages that prevented some 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 use, and winter severity varied by state.

Figure 4. Salt Use per Lane Mile and Average Severity Index
From Salt Inventory Reporting System, 1992–2011



Higher Labor and Equipment Costs

The total cost of statewide winter operations this winter was $91.1 million, making it the most costly winter on record. This figure represents a 22 percent increase from last year's total costs, and a 35 percent increase over the previous five years (see Figure 5).

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.

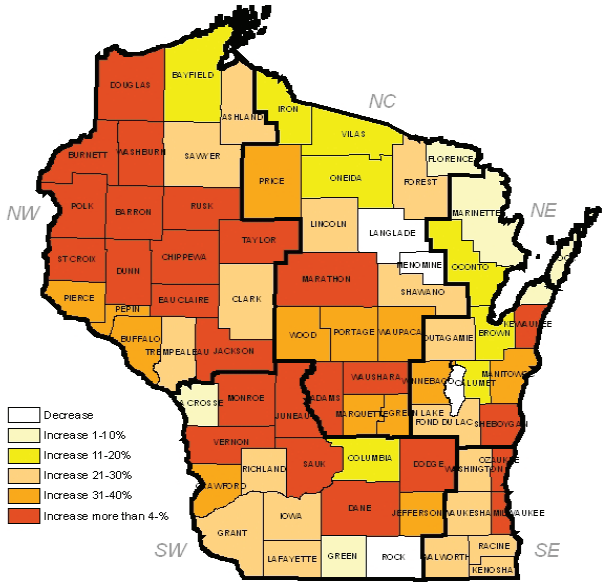
WisDOT spent $34 million on salt, $27 million on equipment-related expenses, $25.3 million on labor, and $2.6 million on materials other than salt, such as sand. Administrative costs added $2.2 million to the total. As in previous winters, anti-icing activities continued to make up less than 1 percent of total expenditures.

The frequent storms this winter drove up the costs of labor and equipment per lane mile significantly. While salt expenditures decreased by 3 percent compared to the prior year, and the cost for materials other than salt increased 12 percent, labor and equipment costs increased 30 percent and 32 percent, respectively. Labor costs are most dramatically affected by excess overtime hours (increased 65 percent this year), and equipment costs are tied to fuel costs and use. Despite the increase in labor and equipment costs, salt continues to be the single largest expenditure, accounting for 37 percent of all costs (see Figure 7).

Salt prices remain high nationwide, due in part to higher fuel prices and increased demand: The average of $58.55 per ton is an increase of 67 percent compared with the average price of just $34.98 five winters ago. Figure 6 shows the upward trend in salt prices for Wisconsin and for 14+ states nationwide.

Despite this marked increase, WisDOT pays less on average per ton for salt than 33 other snowy states across the country, according to data compiled by Washington State DOT: Only ten states pay less and one state (Tennessee) pays about the same. Average per-ton costs for straight rock salt range from $30 in Utah to $125 in Washington state.

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



Statewide average: 35% increase

Figure 6. Salt Prices Over Time

Average cost per ton of salt for 14+ states

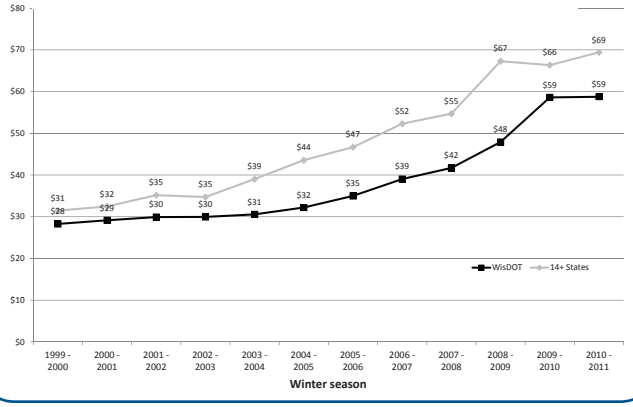
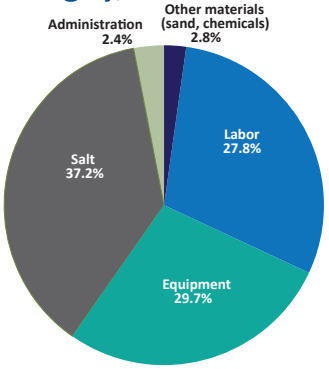


Figure 7. Expenditures by Category, 2010-2011



Total winter costs: $91,054,936

Coordinating Counties' Response

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

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

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.

Response Time

The counties continue to work on becoming more proactive in responding to winter storm events. Response time this winter was 2 hours and 35 minutes, an average of 4% quicker than the baseline year 2003–2004. In recent years, the statewide average reaction time was lowest in 2004–2005 and 2005–2006, and has been higher since then. As expected, average reaction times for more urban counties, which provide the highest level of service (24-hour coverage), were less than those counties that are directed by WisDOT to provide 18-hour coverage.

"Time to bare/wet pavement" is measured from a storm's reported end time. Heavily traveled urban highways tend to be returned to a bare/wet condition sooner than rural roads. This year the statewide average was 1 hour, 28 minutes, which is higher than last winter but a significant decrease compared with the prior two winters (see Table 2 on page 7).

Regular labor hours increased 32 percent this winter compared with last winter, and overtime hours increased 65 percent, due to this winter's increase in overall severity index.

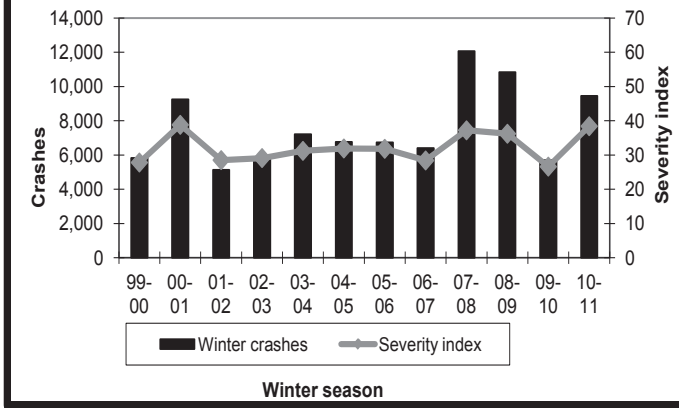
Analyzing Travel and Crashes

By keeping roads as clear as possible within their expected level of service (18- or 24-hour coverage), maintenance crews have an opportunity to help prevent crashes. This year, there were 9,449 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 increased the exposure rate.

The crash rate (number of crashes per 100 million vehicle miles traveled) increased this year to a statewide average of 35, up dramatically from last year's crash rate of 22. Last year, 5,697 winter crashes were reported.

Crash rates tend to correlate with winter severity. Compared with recent years that had similar severity indices, this winter's crash rate was relatively lower than in most of those years. Figure 8 shows the trends in total crashes statewide over the last 13 years overlaid with the Winter Severity Index.

Figure 8. Crashes and Winter Severity Index



Using Performance Measures

Developed in 2001, Compass is WisDOT's quality assurance and asset management program for highway operations. Measures for winter operations were first established in 2003. WisDOT plans to gather several years of baseline data before establishing targets for these measures. (See Table 2 for Compass data to date.) Other winter measures are being investigated for possible future use.

Table 2. Statewide Compass Measures for Winter

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2010
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 hour, 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 VMT	23 per 100 million VMT	43 per 100 million VMT	40 per 100 million VMT	22 per 100 million VMT	35 per 100 million VMT

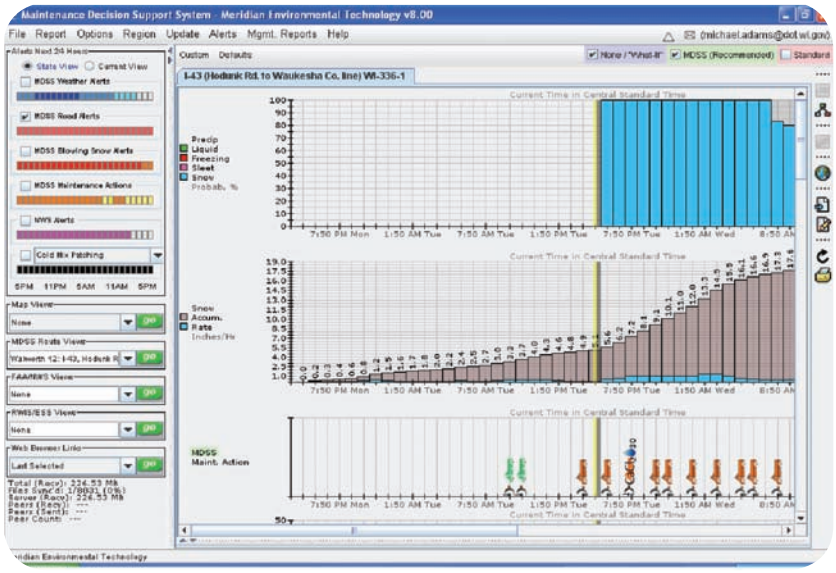
MDSS and AVL-GPS Initiative

Maintenance Decision Support System (MDSS) is a major project undertaken by the Bureau of Highway Maintenance (BHM) since 2009. 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 robust reporting ability that allows managers to track performance on a storm-by-storm, operator-by-operator, or seasonal basis.

Automatic Vehicle Location/Global Positioning System (AVL/GPS) has been integrated with MDSS to provide real-time vehicle information into the MDSS system regarding what materials are being applied, when, and where. BHM contracts with Meridian Environmental Technology for data input into MDSS. BHM worked with Meridian during the 2010-2011 year to ensure that data was properly flowing from the AVL/GPS systems, and to improve consistency in how data inputs are named across the state.

Training was a major focus of the MDSS deployment in 2010-11. BHM worked closely with Meridian to develop a comprehensive training plan attended by nearly 200 people, including county patrol superintendents, a few highway commissioners, and region personnel.

The 2011-12 season will focus more on verifying the accuracy of the forecasts, making the system faster and more user friendly, and tweaking the treatment recommendation to more closely model best practices of prior winter seasons.



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

Looking Ahead

The 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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