



MassDOT Snow and Ice Control Program Environmental Status and Planning

EOEA Certificate # 11202

6th Annual Report

Winter 2017-2018



Snow Plow Peloton with Tow Plow in Use (Source: MassDOT)

Introduction

The Massachusetts Department of Transportation (MassDOT) has prepared this sixth (6th) Annual Report of its Snow and Ice (S&I) Control Program following the completion of the 2017 S&I Control Program Environmental Status and Planning Report (ESPR) and consistent with the EOEEA Certificate #11202. This report provides a summary of deicing material usage relative to winter weather severity conditions for Fiscal Year 2018 (July 1, 2017 to June 30, 2018) as well as any changes in program activities, equipment and improvements that were completed in this past fiscal year. MassDOT has used this Annual Report to keep agency personnel and other interested parties informed during the intervening years within the 5-year S&I Control ESPR cycle with the next ESPR is scheduled to be completed at the end of 2022.

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Summary of Winter Weather

The 2017/18 winter season had both extreme cold and snowy periods intermixed with unusual warm periods. The colder and snowier periods occurred in the early and latter parts of the season while milder temps prevailed from mid-January through much of February. A severe cold snap settled in around Christmas and lasted through the first week of January. Temperatures hovered in the teens most days and dropped below zero at night. The first week of January turned out to be one of the coldest on record. Temperatures moderated in the 2nd half of January and remained mild for much of February. March was colder than normal and the colder temperatures extended into April.

This winter had four major Nor’easters with the first one arriving in early January and three more occurred in March almost on a weekly basis. The Jan. 5th storm produced 12-18” of fluffy snow during the colder than normal period. The 2nd Nor’easter on March 7- 8th produced over a foot of snow and as much as 2 feet of snow fell on March 13-14th. The 3rd major event on March 21st lost some of its energy before it reached the state but left several inches of snow. The March 2018 snowfall amounts turned out to be some of the highest for this month in recent history.

Overall, the snowfall totals in each of the Districts were close to or slightly above normal. Snowfall totals ranged from 38 inches in D2 to 89 inches in District 3. Much of the seasonal snow total fell in March.

Several minor snow events occurred in April generating approximately 2.0 inches of snow in District 5 to close to 9 inches in District 1. All totaled, the April snow generally accounted for less than 10% of the seasonal snowfall total in most Districts. As discussed below, the seasonal WSI value does not account for April snow as the WSI is based on conditions from November through March, which typically represents the bulk of the winter season. In years when April has above normal snowfall, the WSI value may underestimate the seasonal deicing chemical demands.

Winter Severity Index

MassDOT uses a Winter Severity Index (WSI) to compare the relative severity of winter weather from year to year. The index is based on daily snowfall, daily minimum and

maximum temperatures and number of days with frost potential. A monthly WSI value is calculated for November through March and then averaged over the 5-month period. The WSI method was first adopted by the State of Washington in the early 1990s as part of a Strategic Highway Research Project (SHRP). The WSI value links or normalizes annual deicing material usage relative to the severity of winter weather. A regression analysis of MassDOT’s annual salt use relative to the annual WSI value over a 10-year period results in a correlation coefficient (R²) of 0.93 indicating that 93 percent of the year to year variability in annual salt use is attributable to changes in the WSI value.

The correlation of annual salt usage to WSI values is strongest during winters where salt applications are largely in response to snowfall events. Conversely, the correlation tends to be not as strong during milder winters or winters with large fluctuations in temperatures when road salt applications are needed to maintain safe pavement conditions during freezing rain, fog or refreezing of melting snow, which are weather factors not accounted for in the WSI value.

Table 1 provides a year-to-year comparison of the WSI values and overall ranking for the last eighteen (18) years. The most severe winter is ranked #1 and the least severe winter is ranked #18. As shown, this past FY18 season ranked the 8th most severe winter in recent history with a WSI value of -20.6. The WSI value for this past season essentially represents the median severity value for the past 18 winters, while the FY17 season best represents the mathematical average winter severity.

Table 1: Comparison of Average Statewide WSI

Winter Season (Fiscal Year)	Statewide Average WSI ¹	WSI Rank ²
FY01	-23.0	5
FY02	-4.7	16
FY03	-25.3	3
FY04	-14.5	12
FY05	-26.3	2
FY06	-14.1	13
FY07	-5.7	15
FY08	-18.5	10
FY09	-18.9	9
FY10	-10.2	14
FY11	-24.5	4
FY12	-1.1	18
FY13	-21.2	7
FY14	-21.9	6
FY15	-27.2	1
FY16	--4.4	17
FY17	-16.6	11
FY18	-20.6	8
18 Year Ave	-16.6	--

Note: ¹Lower WSI values indicate more severe winters.
²A rank of 1 indicates most severe and a rank of 18 represents the least severe winter.

Material Usage in Comparison to Winter Severity

As shown in Table 2, MassDOT used 455,447 tons of road salt in FY18, which is approximately 11% less than the long-term average annual usage of 500,096 tons for the last 18 years. The FY18 usage is approximately 33 percent less or nearly 150,000 tons less than that used in FY09, which was only a slightly less severe winter, but occurred prior to additional equipment upgrades and efficiency measures that were adopted in FY11.

Table 2- Comparison of FY16 Salt Usage (tons) to the Long-Term Statewide Average Annual Salt Usage

Fiscal Year	WSI Rank	Annual Salt Usage (tons)	% Departure from Normal ¹
FY01	5	625,855	30%
FY02	16	303,606	-46%
FY03	3	734,082	46%
FY04	12	474,974	9%
FY05	2	726,086	43%
FY06	13	413,095	1%
FY07	15	310,390	-40%
FY08	10	535,159	7%
FY09	9	606,587	22%
FY10	14	367,436	-27%
FY11	4	556,839	11%
FY12	18	218,245	-57%
FY13	7	458,183	-9%
FY14	6	572,765	14%
FY15	1	609,579	21%
FY16	17	368,519	-27%
FY17	11	515,260	2%
FY18	8	455,447	-11%
18-yr Ave		500,096	

Note: ¹Departure from normal is expressed as the percent difference between the annual salt usage and the 18-yr average annual salt usage.

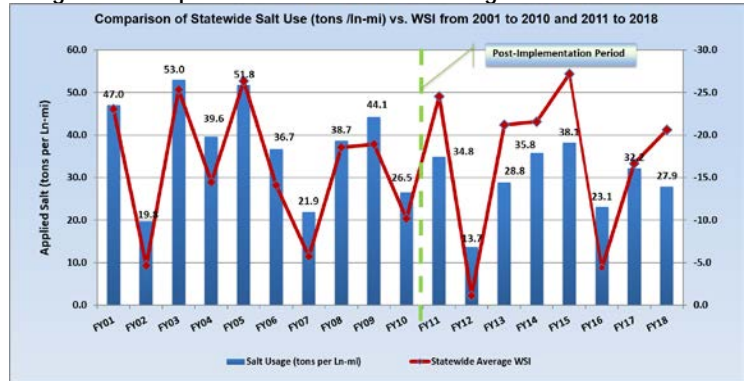
Figure 2 provides a comparison of annual salt usage to the WSI values over the last 18 years. Prior to the technology and equipment upgrades initiated in FY11, annual salt use was typically greater than the WSI value for any given year. Starting in FY11, however, the statewide road salt usage was generally lower than the WSI value except for FY12 and FY16, which were unusually mild winters. This change in the relative comparison of salt usage to the WSI values indicates that the equipment upgrades and policy changes, specifically use of pre-wetting of salt and pre-treatment of roadways has resulted in more efficient use of road salt.

The reason the same salt use efficiency was not seen in the milder winters of FY12 and FY16 may be due to in large part to the fact that the WSI value does not account for freezing rain events and reoccurring freeze/melt cycles, which are more prevalent in milder winters. Freezing rain and refreeze events often require deicing applications, but these would not be accounted for in the WSI value and

thus, the WSI value may not adequately reflect the deicing material demands in milder winters.

Also, there are generally much fewer deicing applications during milder winters and thus, the benefits or impact of the various salt use efficiency measure are likely to be less noticeable as compared to more severe winters.

Figure 2. Comparison of Statewide Salt Usage to WSI



Summary of Various Efficiency Measures and Equipment Upgrades Adopted in Last Seven Years

- Closed Loop Controllers** - Closed loop controllers continue to be one of the primary tools for maintaining consistency and efficiency in salt use. Controllers are dashboard computers with electronic sensors that adjust application rate based on vehicle and auger speed to provide a more consistent rate of material application. All contractors are required to have closed-loop controllers on their spreaders.
- RWIS Stations / Friction Meters**- MassDOT continues to expand its use of Road Weather Information Stations (RWISs) and mobile surface friction meters to help decide when applications are needed. Mobile RWIS equipment and friction meters are mounted to vehicles allowing for more geographic coverage and real-time feedback on pavement conditions during snow events. MassDOT also has increased its use of traffic cameras to monitor road conditions. The evolution in monitoring equipment and technology provides greater access to data for pre, during and post-storm evaluation. See REC #8 below.
- Tow Plows** MassDOT has increased its use of tow plows, which allow multiple lanes to be cleared with one vehicle. This results in fewer operators and plow trucks needed in one area. Tow plows are typically used on multi-lane, high speed interstates in various districts. Fewer plow trucks not only reduce program costs but can free up personnel and equipment for other more critical areas
- Brine** - MassDOT will continue to increase production and availability of brine solutions to pre-wet salt and pretreat roads to enhance deicing material performance. Additional brine availability allows greater flexibility and capabilities to address a variety of winter weather conditions.

Training

Annual training continues to be a major focus for MassDOT. In addition to more detailed operations training for the snow and ice engineers, depot foreman, route coordinators and time keepers, pre-winter tail-gate training is provided for more than 500 snow & ice state personnel and over 900 contractors on an annual basis. The tail-gate training sites are rotated to different depot locations each year.

In FY18, tail-gate training was provided at the following depots:

- D#1 - Becket, North Adams
- D#2 - W. Springfield, Deerfield
- D#3 - Hopkinton, Oxford, Sterling, Worcester
- D#4 - Haverhill, Lexington 2A, Reading 129, Tewksbury, Peabody, Rowley
- D#5 - Bridgewater, Duxbury, Freetown and Yarmouth
- D#6 - Weston, Milton

Remediation Activities

- Eighteen (18) new salt remediation cases were enlisted into the Remediation Program since June 30, 2017. This is within the typical annual average of 10 to 18 new cases per year. Six cases were closed in the past year through various remediation actions including replacement wells, water treatment or a municipal water system connection. Approximately 30 cases remain active and are in various stages of ongoing assessment/remediation.
- MassDOT has not received any new remediation requests from any municipal public water suppliers but continues to coordinate with various towns upon request including the towns of Auburn, Dedham-Westwood, Cambridge, Middleboro and Wilmington.

Storage Facility Improvements

Every year, every District typically repairs their salt storage sheds. In 2018, much of the shed improvement work related to shed door repairs/replacement and roof extensions.

- Existing sheds were replaced in Hopkinton and Sturbridge in D3 and Billerica, Reading and Manchester in D4.



Note: New shed completed in Billerica allows for spreader trucks to be loaded under cover.

Progress on 2017 ESPR Recommendations

The following provides a summary of the progress made on various recommendations included in the 2017 S&I ESPR to improve the effectiveness and efficiency of the Program:

REC #1: Enhance the employee and contractor training program, through consultation with other state transportation agencies, to explore other methods to deliver content and increase the level of understanding of the technical aspects and science behind snow and ice control practices.

Progress: MassDOT has coordinated with NEWIPCC and has committed to provide an in-kind match as part of a grant application proposal to help fund a regional training program for highway, municipal and commercial contractors in the NE region. This project will expand training opportunities to educate operators on the various efficiency measures to reduce salt use as well as discuss the potential negative effects of chloride in drinking waters, surface waters and wetlands. Training workshops are anticipated for the Fall of 2019.

REC #2: Install pavement friction and pavement temperature sensor equipment on all District Supervisor vehicles to provide another tool to help determine when deicing material may be needed during winter events and help monitor and document road surface conditions.

Progress: MassDOT continues to upgrade both mobile and stationary friction sensors throughout the state. MassDOT recently evaluated mobile vehicle friction sensors attached to vehicles used in snow and ice operations but has had some challenges with device durability. MassDOT is coupling some stationary RWIS stations and Intelligent Transportation System (ITS) cameras to expand weather information coverage in Districts 3, 4, 5 and 6.

REC #3: Construct a new brine manufacturing facility in Deerfield within the next two years to increase brine availability for pretreatment and prewetting in Districts 1, 2, and 3. Investigate the feasibility of constructing additional brine facility to service District 4.

Progress: This project was advertised on 2/24/2018 with a general targeted completion date of late 2019.

REC #4: As funding allows, continue to expand the availability of tanker trucks, brine storage and roadway pretreatment capabilities, especially in key environmentally sensitive areas.

Progress: The planned brine production facility in Deerfield to be completed in late 2019 will increase the brine solution availability for pretreating roads in District 2 as well as Districts 1 and 3.

REC #5: Ensure that calibration vendors submit written evidence of being certified by manufacturers to calibrate specific material spreader equipment.

Progress: MassDOT has updated its contractor agreements to require contractors and 3rd-party calibration vendors to submit their calibration certifications to Boston and the District they work for in order to become a qualified vendor.

REC #6: Consult with calibration vendors to ensure that they mark the gate openings on hired equipment and submit copies of calibration certificates for each vendor truck they calibrate. Prior to the 2016-17 winter season, vendor trucks were only required to have a copy of the certificate in the vehicle.

Progress: Gate openings marked at the time of calibration are now reviewed by MassDOT staff during preseason hired equipment inspections.

REC #7: Implement the use of GPS/AVL equipment with a goal of having all contractors using GPS/AVL equipment by 2022. GPS/AVL equipment will allow MassDOT to collect vehicle and route specific information regarding the timing and rate of application, and roadway condition data.

Progress: For the 2018-2019 winter season, the Andover depot will conduct a pilot program using Global Positioning System/ Automatic Vehicle Location (GPS/AVL) devices to monitor and evaluate the efficiency of deicing chemical usage. GPS/AVL devices will be installed on MassDOT and vendor-owned material spreaders to allow MassDOT to monitor route coverage and help ensure consistency with spreader equipment settings during application events.

REC #8: Reduce and eventually eliminate the use of sand in reduced salt zones (RSZs) by expanding or adding new efficiency measures and technologies to achieve better snow removal, improved forecasting and more efficient material usage in RSZs as well as along other MassDOT maintained roadways.

Progress: MassDOT has initiated some pilot studies to research whether the use of lower application rates during appropriate weather and road conditions would be a better alternative than the use of sand in Reduced Salt Zones. The potential success of this program depends greatly on the variability and severity of winter weather conditions.

REC #9: Continue to use and research potential new approaches to enhance the Winter Severity Index (WSI) as a means to monitor salt use efficiency relative to historical usage under similar winter weather severity.

Progress: MassDOT is participating in a ClearRoads™ Pooled Research Program to evaluate how the WSI method might be modified to account for freezing rain and other weather-related factors that affect deicing material usage.

REC #10: Continue to evaluate statewide vehicle accident rates during winter months relative to non-winter months to assess how roadway surface conditions might impact accident rates.

Progress: MassDOT is currently updating its vehicle crash and geocoding reporting system and anticipates this new system may help to assess how winter weather affects vehicle crashes.

REC #11: Continue to explore the use of variable messaging signs (VMS) and effective messaging to inform the traveling public of impending weather and changing road conditions in order to affect driver behavior and reduce speeds.

Progress: MassDOT is moving towards using a Pathfinder program, which connects the VMS system with real-time weather data provided by the National Weather Service and private Weather Service Providers. The Pathfinder program is supported by the Federal Highway Administration (FHWA) and National Oceanic and Atmospheric Administration (NOAA) and involves collaboration with other state transportation agencies. This program enables more timely and consistent messages for the traveling public, using real-time actual and pending weather data, to help promote safer travel on the state roadway system.

REC #12: Continue to participate in the Clear Roads Pooled-Funded Research Program, as appropriate, to explore newer technologies and measures to reduce material usage and improve road surface conditions during winter weather.

Progress: MassDOT continues to support research focused on innovative approaches and equipment to enhance road salt use efficiency, weather forecasting and the decision-making process.

REC #13: Continue to explore new bridge design and maintenance methods to protect roadway infrastructure from the potential corrosion effects related to road salt usage.

Progress: MassDOT continues to monitor the latest research and periodically review its bridge design and maintenance standards to determine if new practices or materials could help minimize potential infrastructure corrosion.

REC #14: Continue to upgrade and replace salt storage sheds throughout the state as funding allows with high roof type sheds that allow material offloading and loading indoors.

Progress: Most recently, storage sheds were replaced in Hopkinton and Sturbridge in District 3 and in Billerica, Reading and Manchester in District 4. As funding allows, older storage sheds will continue to be replaced with more updated designs.

Looking Forward

- MassDOT will continue to utilize newer friction meters to provide District personnel with better road condition data to help decide when salt applications are needed.
- MassDOT will continue to work with the UMass Engineering Dept. to collect water quality data on salt remediation cases through an Interagency Service Agreement that extends through 2022.
- MassDOT will continue to evaluate options to improve its Snow and Ice web page in order to provide information with respect to new policies, programs and weather-related alerts.
- MassDOT will continue to evaluate opportunities to retrofit drainage systems, as appropriate, on a case-by-case basis, to better manage and redirect highway runoff away from sensitive environmental receptors.
- MassDOT will continue to seek opportunities to reduce the use of sand as part of its snow and ice operations due to various environmental concerns, its limited effectiveness and added cleanup costs.