



Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, Secretary & CEO
Jonathan L. Gulliver, Highway Administrator



December 16, 2019

Kathleen A. Theoharides
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Attn: MEPA Office
Boston, MA 02114

Subject: MassDOT Snow and Ice Control Annual Report

Dear Ms. Theoharides,

The Massachusetts Department of Transportation, Highway Division (MassDOT) announces that the Snow and Ice Control Program Annual Report, winter 2018-2019 (Report) is provided for information on aspects of winter maintenance operations. The Report has been prepared in accordance with the March 2, 2018 MEPA Certificate EOE #11202. The certificate requires MassDOT to annually summarize material usage, employee training, winter severity conditions, latest measures deployed, and recent policy changes.

We respectfully request the Report be posted in the December 23, 2019 Environmental Monitor. Consistent with the EOE certificate this final document is presented to provide an update to agencies and other interested parties and is not intended to solicit comments.

For additional information or to request a copy of the Report, please contact Laurene Poland at (857)368-8821 or Laurene.Poland@state.ma.us

Sincerely,

David J. White
Acting Director of Environmental Services



MassDOT Snow and Ice Control Program Environmental Status and Planning

EOEA Certificate # 11202

Annual Report

Winter 2018-2019



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

Introduction

The Massachusetts Department of Transportation (MassDOT) has prepared this Snow and Ice (S&I) Control Program Annual Report 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 2019 (July 1, 2018 to June 30, 2019) 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 about annual data and any changes to the S&I Control Program during the intervening years in between the 5-year S&I Control ESPR reporting cycle with the next ESPR scheduled to be completed at the end of 2022.

Contents

Summary of Winter Weather
Winter Severity Index (WSI)
Material Usage in Comparison to Winter Severity
Efficiency Measures and Equipment Upgrades
Training
Remediation Activities
Storage Facility Improvements
Progress on 2017 ESPR Recommendations
Looking Forward

Summary of Winter Weather

The 2018/19 winter season is perhaps most memorable for snowier and colder conditions early and late in the season. A mid-November storm dropped over a foot of snow in the western part of the state and in the higher elevations around Worcester. More coastal areas had lesser amounts ranging from 2.0 to 10 inches. The early snow was followed by extreme cold temperatures around Thanksgiving. As a result, and as discussed further below, the Winter Severity Index (WSI) values for November were some of the lowest or most severe in the last 19 years, especially in the western districts.

In contrast, temperatures in December were well above-normal with very little snow. Most districts had only trace amounts of snow and District 1 had the most with 3.5 inches, which is unusually low. The above-normal temperatures continued into January and February with only a few brief cold snaps that extended for several days.

The next major storm occurred in early January (Jan. 3-5) when a Nor'easter dropped several inches and up to a foot of snow in some locations. The storm brought high winds and flooding along the coast. Another major storm brought heavy snow on January 20-21st but the overall monthly snow totals were generally well below normal for January.

February started out cold but ended with several record warm days with temperatures in the 60's and 70's. February also had very little snow. Winter returned in March with at least four major snowstorms and three nor'easters within a 10-day period between March 2nd and the 13th. March had the highest monthly snowfall totals for the season, especially in the eastern half of the state with up to 20 inches of snow recorded in Districts 5 and 6. March also had colder than normal temperatures for much of the month. These conditions produced some of the lowest WSI values for March in recent history. A similar late season surge in winter weather occurred last year in 2018.

Overall, the seasonal snow totals and average temperatures for the 2018/19 winter season were close to normal despite the early and late extreme weather conditions. Snowfall totals ranged from 38 inches in District 2 to 63 inches in District 1, which are below historical seasonal snow totals.

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 nineteen (19) years. The most severe winter is ranked #1 and the least severe winter is ranked #19. As shown, this past FY19 season ranks as the 12th most severe winter in recent history with a WSI value of -15.7. The WSI value for this past season is most similar to the FY17 season value and just below to the historical average of -16.5.

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	17
FY03	-25.3	3
FY04	-14.5	13
FY05	-26.3	2
FY06	-14.1	14
FY07	-5.7	16
FY08	-18.5	10
FY09	-18.9	9
FY10	-10.2	15
FY11	-24.5	4
FY12	-1.1	19
FY13	-21.2	7
FY14	-21.9	6
FY15	-27.2	1
FY16	--4.4	18
FY17	-16.6	11
FY18	-20.6	8
FY19	-15.7	12
19 Year Ave	-16.5	--

Note: ¹Lower WSI values indicate more severe winters.
²A rank of 1 indicates most severe and a rank of 19 represents the least severe winter.

Material Usage in Comparison to Winter Severity

As shown in Table 2, MassDOT used 401,092 tons of road salt in FY19, or approximately 19% or 94,000 tons less than the long-term average annual usage of 495,412 tons for the last 19 years.

Table 2- Comparison of FY19 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	32%
FY02	17	303,606	-45%
FY03	3	734,082	48%
FY04	13	474,974	11%
FY05	2	726,086	45%
FY06	14	413,095	3%
FY07	16	310,390	-39%
FY08	10	535,159	8%
FY09	9	606,587	23%
FY10	15	367,436	-26%
FY11	4	556,839	12%
FY12	19	218,245	-56%
FY13	7	458,183	-7%
FY14	6	572,765	16%
FY15	1	609,579	23%
FY16	18	368,519	-26%
FY17	11	515,260	4%
FY18	8	455,447	-8%
FY19	12	401,092	-19%
19-yr Ave		495,412	

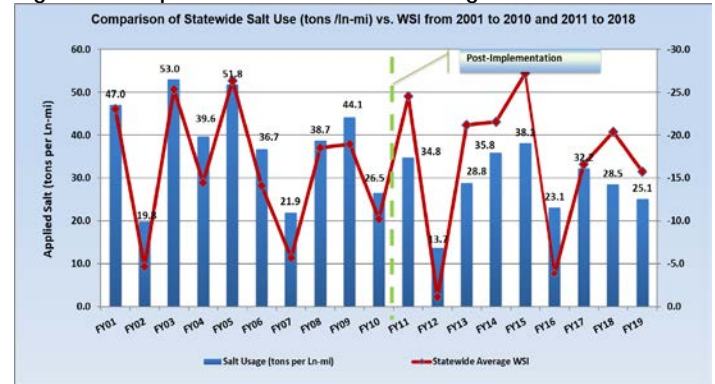
Note: ¹Departure from normal is expressed as the percent difference between the annual salt usage and the 19-yr average annual salt usage.

Figure 2 provides a comparison of annual salt usage to the WSI values over the last 19 years. Prior to the technology and equipment upgrades initiated in FY11, annual salt use was typically greater than that expected given the estimated WSI value for the 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 pre-wetting of salt and pre-treatment of roadways, has resulted in more efficient use of road salt.

Similar salt use reductions were not seen in the milder winters of FY12 and FY16 perhaps due to in large part that the WSI values do 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 during more severe winters.

Figure 2. Comparison of Statewide Salt Usage to WSI



Summary of Various Efficiency Measures and Equipment Upgrades Adopted in Recent 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 the deicing material application rate based on vehicle and auger speed to provide a more consistent rate of material application. All contractors that MassDOT hires 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 has also 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 #7 and #12 below.
- Tow Plows** MassDOT continues to use 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 continues to increase its 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 over 1,000 state snow & ice personnel and hired contractors on an annual basis. The tail-gate training sites are rotated to different depot locations each year.

In FY19, tail-gate training was provided at the following depots:

- D#1 - Pittsfield, Dalton
- D#2 - W. Springfield, Deerfield
- D#3 - Hopkinton, Oxford, Sterling
- D#4 - Haverhill, Lexington 2A, Reading 129, Tewksbury, Peabody, Rowley
- D#5 - Bridgewater, Duxbury, Freetown and Yarmouth
- D#6 - Westwood, Braintree

Remediation Activities

- Seventeen (17) new private salt remediation complaints were received by the Remediation Program from July 1, 2018 to June 30, 2019. This is within the typical range of 10 to 18 new cases per year. Ten cases were resolved this past year via replacement wells, water treatment or a municipal water system connection. Seven cases were denied as they did not meet program criteria or did not respond back. Approximately 20 cases are waiting for a public water connection currently under design.
- MassDOT will continue to coordinate with various municipal and community public water suppliers such as, Auburn, Dedham-Westwood, Cambridge, and the Wachusett Reservoir to evaluate and monitor salt reductions strategies.

Storage Facility Improvements

Every year, each District typically repairs their salt storage sheds. In 2018/19, shed improvement work mostly related to shed door repairs/replacement and roof extensions. A new brine storage/production facility has been completed in District 2 and District 4 is constructing two sheds in Medford.



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 continues to place greater emphasis on its annual training for its employees through winter operations and tail gate training and reimburse contractors to attend training sessions, which led to close to 900 contractors attending training last fall in 2018. This is the highest number of contractors to attend training in any given year.*

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 has purchased 10 Vaisala's MD30 Mobile Detectors. The MD30 transmits real-time, road status data on grip, layer thickness of water/ice/snow, road and air temperature, relative humidity, frost and dew point. A video describing the unit is available here: <https://www.youtube.com/watch?v=mPUmJHinRyo>*

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: *The Deerfield brine facility has been completed and is available for use in the 2019/ 20 winter.*

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: *District 1 has installed new storage tanks in Becket and Buckland. District 3 has a new tank in Millbury (5,000-gallon tank); As additional funding becomes available, additional brine storage tanks will be acquired for D2 (30 tanks) and D3 (10 tanks) to fully utilize the Deerfield brine plant's capabilities. District 2 is actively securing tankers to pretreat the I-91 corridor in advance of storms.*

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

Progress: *MassDOT has found that the calibration vendors have largely complied with the directive to submit a copy of every calibration performed in a season to Boston Snow and Ice (approximately 91% compliance rate).*

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: *As part of annual tailgate and in-house trainings, contractors and MassDOT staff are reminded about the gate marking policy.*

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: *Following an initial pilot study at the Andover depot, MassDOT is replacing the Global Positioning System/ Automatic Vehicle Location (GPS/AVL) devices using a new vendor that has been found to provide more consistent results. The new GPS/AVL devices are anticipated to be installed on contractor vehicles working out of the Andover Depot ahead of the 2019/20 season.*

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 will continue to explore the feasibility of using variable application rates adjusted for weather and road conditions to increase salt use effectiveness and efficiency in Reduced Salt Zones and use less sand. Use of sand provides minimal deicing benefits. Since winter weather and road conditions can change quickly, the success of this initiative depends greatly on accessibility to real-time weather and road condition data and the ability to adjust applications across multiple operators and equipment types as conditions change. Using too little salt initially can have an unintended consequence of causing operators to use more salt later to compensate for any decline in road conditions and to maintain vehicle safety.*

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 continuing to monitor progress of a ClearRoads™ Pooled Research Study being conducted at Montana State University to evaluate how the WSI method could be modified to account for freezing rain and other weather-related factors that affect deicing material usage. Freezing rain events appear to be occurring more frequently and often require deicing material use but these events are not accounted for in the current WSI calculation.*

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 in the midst of 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 continues to use the Pathfinder program to provide more timely messages for the traveling public using weather data from 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 by using real-time actual and pending weather data promotes safer travel on the state roadway system.*

REC #12: Continue to participate in the Clear Roads Pooled-Fund 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 participate in the Clear Roads Research Program focusing on new approaches and equipment to enhance road salt use efficiency, weather forecasting and the decision-making process. MassDOT recently attended the Clear Roads conference in Vermont on Sept. 23-26th, 2019*

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 changes in bridge design and maintenance standards to determine if any new practices or materials help to minimize 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: *District 4 is building two new sheds in Medford and has replaced sheds in Billerica, Reading and Manchester. MassDOT has completed a brine storage production facility in Deerfield to increase brine availability in District 1, 2 and 3. 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 work with the UMass Engineering Dept to collect water quality data on salt remediation cases through an Interagency Service Agreement that extends to 2022.
- 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.
- In the Fall 2020, MassDOT plans to develop a Draft Work Plan for its next Snow & Ice ESPR currently scheduled to be completed at the end of 2022.