



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



December 14, 2020

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 2019-2020 (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 A #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, 2020 Environmental Monitor. Consistent with the EOE A 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 2019-2020



Snowplow 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 comparison of deicing material usage relative to the winter weather severity for Fiscal Year 2020 (July 1, 2019 to June 30, 2020) as well as any changes in program operations and equipment that were implemented this past winter. MassDOT has used this Annual Report to inform agency personnel and other interested parties regarding annual material usage and S&I Control Program changes during the intervening years between the 5-year S&I Control ESPR reporting cycle, with the next ESPR is scheduled to be completed at the end of 2022.

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Summary of Winter Weather

Despite a cold start and an early December snowstorm, the 2019/20 winter season ended up being the 4th mildest winter over the past 20 years, with above average temperatures and limited snowfall. November started cold with a monthly average temperature that was 3.3 degrees (F) below normal. The monthly average temperature in the Northeast was the 15th coldest on record. Although the temperatures were cold, only trace amounts of snowfall were recorded for the month.

On the heels of a cold November, December started with a two-day storm between December 1st and 3rd dropping 8 to 24 inches of snow across the state. Another storm dropped an additional 1-5 inches in mid-December and several other smaller storms occurring throughout the month. Districts 1 and 3 had the highest monthly snowfall totals at 30 and 27 inches, respectively.

For the rest of the winter, the weather turned dramatically milder. Temperatures in January and February were generally above normal with only a few brief cold snaps that lasted only for a few days. High temperatures on January 11th and 12th reached into the low-70s for most of the state. The monthly snow totals were generally well-below normal with only 3-5 inches of snowfall across the state.

February was the 11th warmest since 1895 in the Northeast, with above-average temperatures. February was wetter than normal but had minimal snowfall, with most Districts seeing less than 5 inches of total snow accumulation. While there wasn't much snow, back-to-back storms in February brought a mix of freezing rain, rain and occasional snow.

Higher than normal temperatures continued into March with only one snowstorm at the end of March, with up to 6 inches of snow in parts of the state. Unlike the past two years, there was no late-season surge of winter weather, apart from the one storm system.

Overall, the seasonal snow totals and average temperatures for the 2019/2020 winter season were much milder than normal, despite the early December storm. Snowfall totals ranged from 12 inches in District 5 to 56 inches in District 1, which are below historical seasonal snow totals.

Winter Severity Index

MassDOT uses a Winter Severity Index (WSI) to compare year to year differences in the relative severity of winter weather. The index is based on daily snowfall, 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 in the early 1990s by the State of Washington as part of a Strategic Highway Research Project (SHRP). The WSI value normalizes annual deicing material usage relative winter weather severity. MassDOT's annual salt use strongly correlates to annual WSI values over a 10-year period with a correlation coefficient (R²) of 0.93 indicating that 93 percent of the year to year variability in salt use is due to changes in winter severity.

The correlation of annual salt usage to WSI values is strongest when salt applications are largely in response to snowfall events. Conversely, the correlation tends to be weakest during milder winters when road salt may be used due to freezing rain, fog or refreezing of melting snow, which are weather factors not accounted for in the WSI value derived by the model utilized by MassDOT.

Table 1 provides a year-to-year comparison of the WSI values and overall ranking for the last twenty (20) years. The most severe winter is ranked #1 and the least severe winter is ranked #20. This past FY20 season ranks as the 4th mildest winter in recent history with a WSI value of -6.8. The WSI value for this past season is most similar to the FY07 season and was approximately 60% below the historical average of -16.0.

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	18
FY03	-25.3	3
FY04	-14.5	13
FY05	-26.3	2
FY06	-14.1	14
FY07	-5.7	17
FY08	-18.5	10
FY09	-18.9	9
FY10	-10.2	15
FY11	-24.5	4
FY12	-1.1	20
FY13	-21.2	8
FY14	-21.9	6
FY15	-27.2	1
FY16	--4.4	19
FY17	-16.6	11
FY18	-20.6	7
FY19	-15.7	12
FY20	-6.8	16
20 Year Ave	-16.0	--

Note: ¹Lower WSI values indicate more severe winters. ²A rank of 1 indicates most severe and a rank of 20 represents the least severe or mildest winter.

Material Usage in Comparison to Winter Severity

Table 2 provides a comparison of annual salt usage to the WSI ranking over the last 20 years. Starting in FY11, MassDOT implemented various equipment upgrades and policy changes (summarized below) to utilize road salt more efficiently and effectively. The effect of these measures can be seen when comparing annual salt use in years with similar WSI rankings within the baseline period versus the post-implementation period. For example, the FY15 winter was similar if not more severe than that in FY03 or FY05, but the FY15 annual salt use was at least 100,000 tons less than that used in FY03 and FY05 even with more lane-miles maintained in FY15 compared to that in FY03 or FY05. The same is true in comparing FY11 with FY01 or FY13 with FY09.

In FY20, being a relatively mild winter, MassDOT used 287,332 tons of road salt, approximately 41% or nearly 200,000 tons less than the long-term average annual usage of 485,861 tons for the last 20 years.

Table 2. Comparison of Annual Salt Usage (tons) and WSI Ranking in the Baseline and Post-Implementation Periods

	Fiscal Year	WSI Rank	Annual Salt Usage (tons)	% Departure from Normal ¹
Baseline Period	FY01	5	651,986	34%
	FY02	18	273,990	-44%
	FY03	3	734,082	51%
	FY04	13	549,488	13%
	FY05	2	717,955	48%
	FY06	14	508,415	5%
	FY07	17	303,618	-38%
	FY08	10	536,672	10%
	FY09	9	611,733	26%
	FY10	15	366,955	-24%
Post-Implementation	FY11	4	556,839	15%
	FY12	20	218,244	-55%
	FY13	7	460,183	-5%
	FY14	6	585,201	20%
	FY15	1	613,765	26%
	FY16	19	368,608	-24%
	FY17	11	515,621	6%
	FY18	8	455,447	-6%
	FY19	12	401,092	-17%
	FY20	16	287,332	-41%
	20-yr Ave		485,861	

Note: ¹Departure from normal is expressed as the percent difference between the annual salt usage and the 20-yr average annual salt usage.

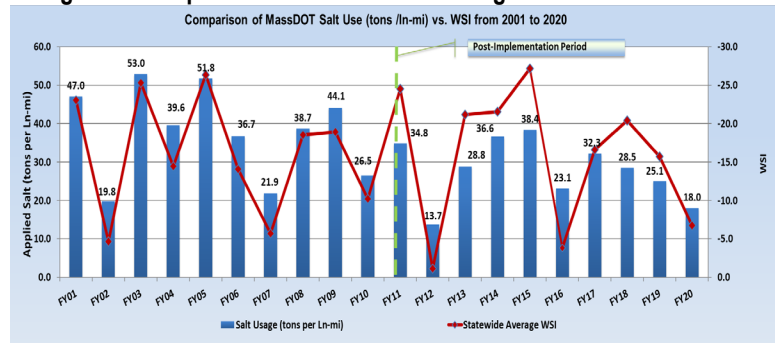
Figure 2 illustrates a comparison of annual salt usage (tons per lane-mile) to the WSI values over the last 20 years. Prior to FY11, annual salt use (as shown by blue bar) was often higher or similar in scale to the estimated WSI value (shown by red line) for each year. Following the technology and equipment upgrades initiated in FY11, the annual road salt usage began to trend lower than the WSI value for the next 10 years except in the mild winters of FY12, FY16 and FY20. The lower deicing material usage relative to the WSI values indicates a more efficient use of road salt relative to the WSI attributable to the post-FY10 equipment and policy changes.

Similar efficiencies or reductions were not seen in the mild winters of FY12, FY16 and FY20 relative to the WSI value largely because mild winters generally have more freezing rain events and reoccurring freeze/melt cycles that often require deicing applications, but these weather conditions are not accounted for in the WSI calculation formula. Thus,

the seasonal deicing demand is not adequately reflected in the WSI value in milder winters.

MassDOT is evaluating other WSI approaches that account for freezing rain events. However, these other methods require more detailed weather data not typically recorded at National Weather Service stations. This added data is also not likely to be available for the pre-FY11 baseline period, which would produce a less direct comparison to the post-FY11 period. The potential benefits of using another method to better track deicing applications due to freezing rain events in mild winters need to be weighed against the added effort and availability of data. The current WSI method only underestimates the deicing demand in the mildest winters but this is not considered highly critical since the salt usage is often half as much that used during normal or more severe winters as indicated in Table 2.

Figure 2. Comparison of Statewide Salt Usage to the WSI



Summary of Various Efficiency Measures and Equipment Upgrades Adopted in Recent Years

- **Closed Loop Controllers** - Closed loop controllers are one of the primary tools to maintain consistent and efficient use of salt. Controllers are computers mounted inside the vehicle cab with electronic sensors that adjust the auger speed within the spreader to the vehicle speed to provide a more consistent material application rate. All contractors are required to use closed-loop controllers in their vehicles.
- **RWIS Stations / Friction Meters**- MassDOT continues to expand its use of Road Weather Information Systems (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 #2 and #12 below.
- **Tow Plows** MassDOT continues to use tow plows, which allow multiple lanes to be cleared with one vehicle. This minimizes the number of operators and plow trucks needed in one area. However, use of tow plows are mainly limited to multi-lane, high speed interstates. Fewer plow trucks can reduce program costs and can free up personnel and equipment for other more critical areas
- **Brine** - MassDOT continues to increase its production and storage capacity of brine solutions to pretreat roads and enhance deicing material performance. A new brine production facility was just completed in District 2.

Training

The number of attendees at MassDOT’s annual S&I training continues to increase year over year. In FY20, over 730 MassDOT employees including snow and ice engineers, depot foreman, route coordinators and timekeepers received training and over 930 contractors attended pre-winter tail-gate training. The following summarizes the annual training attendance by district for FY20.

2019-2020 MassDOT Snow & Ice Training Attendance				
District	Contractors	District Operations	Route Coord.	Time keeper
1	25	53	28	28
2	80	56	25	14
3	228	69	30	30
4	269	75	30	28
5	259	121	58	26
6	72	41	18	6
	933	415	189	132
			Total	1669

Source: MassDOT Lead Snow and Ice Engineer.

Remediation Activities

- Twelve (12) new salt remediation complaints were received between July 1, 2019 and June 30, 2020, which is at the lower end of the typical range of 10 to 18 new cases per year. Ten (10) cases were resolved this past year via replacement wells or water treatment systems. Seven cases were denied as they did not meet program criteria or did not respond back. A public water connection is currently under design to resolve another 20 cases.
- MassDOT continues to coordinate with various municipal and community public water suppliers such as Auburn, Dedham-Westwood, Cambridge, Millbury and the Wachusett Reservoir to evaluate MassDOT’s contribution of road salt and opportunities for salt reduction strategies.

Storage Facility Improvements

Every year, each District typically repairs their salt storage sheds that mostly relate to shed door repairs/replacement and roof extensions. Major facility construction projects for this past year include completion of new brine production facility in District 2 and two new sheds in Medford in District 4 with a raised ceiling to unload under cover.



Note: New shed completed in Medford with raised ceiling and new floor.

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 expand access to its annual training for its employees and contractors through various tail-gate training sessions, which led to more than 930 contractors attending training last fall. This is the highest number of contractors to attend training in any given year. At each training session, MassDOT stresses the importance of good salt management to ensure reasonably safe roads while minimizing impacts to environmental resource areas.*

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: *Last year MassDOT installed 10 new 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 newly completed Deerfield brine facility provides additional brine for Districts 1, 2 and 3. The blended brine is used to pretreat roads ahead or in the early stages of a winter storm event.*

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: *MassDOT continues to expand its liquid storage capacity at various depots within each District. Most recently, the new Deerfield brine plant provides additional brine production capacity of 12,000 gallons per hour and 60,000 gallons of additional brine storage for Districts 1, 2 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 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. Historically, vendor trucks were only required to have a copy of the certificate in the vehicle.

Progress: *As part of annual tailgate and in-house training, 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: *Use of Global Positioning System/ Automatic Vehicle Location (GPS/AVL) equipment is still in the early phases and a work in progress. New GPS/AVL devices were installed last winter on contractor vehicles working out of the Andover Depot and a new service provider has been contracted to improve the data collection and reporting system ahead of the 2020/21 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 continues to explore the feasibility of using lower application rates instead of a salt/sand mix in Reduced Salt Zones as a means to reduce salt use. Instructing operators to use lower application rates depends on current winter weather and road conditions, which are often changing even during the same storm event. Using too little salt initially can have an unintended consequence of operators using more salt later to address any decline in road conditions and maintain vehicle safety. 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. As noted above, weather and road surface sensors continue to be updated and expanded each year.

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

Progress: *MassDOT continues to monitor ongoing research on various approaches to enhance the WSI method to account for freezing rain and other weather-related factors that affect deicing material usage. Freezing rain events often require deicing applications, but these weather 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 has updated its vehicle crash and geocoding reporting system and will evaluate this new system to help to assess how winter weather affects vehicle crashes as part of the next ESPR.*

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 variable message signs to warn and encourage the traveling public to plan for impending winter weather through timely roadside messages. MassDOT also coordinates with neighboring states to support the use of the interstate Pathfinder program that uses real-time and weather forecast data to promote safer travel on the interstate roadway system with consistent regional messages. The Pathfinder program is supported by the Federal Highway Administration (FHWA) and the National Oceanic and Atmospheric Administration (NOAA).*

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 is currently participating in Peer Committee review of various research efforts through virtual workshops and meetings.*

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 research and any new technologies in bridge design and maintenance standards to identify any new practices or materials that can be used to minimize infrastructure corrosion. The next ESPR will provide a summary of any new approaches and design standards*

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 recently built a new shed in Medford and has replaced sheds in Billerica, Reading and Manchester. MassDOT has completed a brine production facility in Deerfield to increase brine availability in Districts 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 Spring 2021, MassDOT plans to develop a Draft Scope of Work for its next Snow & Ice ESPR currently scheduled to be completed at the end of 2022.