



SNOW & ICE CONTROL

2017 Winter Operations Conference

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Serves local agencies to:

- Develop new initiatives
- Apply new knowledge
- Implement new technologies

...MAKING A DIFFERENCE

PROJECT NEED

- **Initial need:** educate on extensive research that has been conducted winter maintenance chemical performance
- **Identified need:** there is a lack of information on the basics of snow maintenance for new staff



TECHNICAL ADVISORY PANEL

- John Brunkhorst, McLeod County (Chair)
 - Tom Broadbent, EnviroTech Services
 - Steve Collin, City of Minneapolis
 - Bruce Holdhusen, MnDOT
 - Matt Morreim, City of St. Paul
 - Mike Kennedy, City of Minneapolis
 - Mike Legg, Carver County
 - Renae Kuehl, SRF
 - Mike Marti, SRF
 - Scott Petersen, SRF
 - Tim Plath, City of Eagan
 - Brian Pogodzinski, Houston County
 - Kathleen Schaefer, MnDOT
 - Stephen Schnieder, Nobles County
 - Joe Spah, City of St. Paul
 - Ryan Sutherland, Itasca County
 - Rick West, Otter Tail County
-

FINAL PRODUCTS

- Guidebook and PowerPoint Presentation



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SECTION 1: Snow and Ice Control Strategies

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WINTER PAVEMENT CONDITION DEFINITIONS



Bare Pavement



Bare Wheel Paths



Plowed and Treated



Plowed to Snowpack

*Final winter pavement conditions are defined by each agency based on their own service goals, budgets, and policies.

SECTION 1: SNOW AND ICE CONTROL STRATEGIES

BEFORE THE STORM - ANTI-ICING/ PRETREATMENT

Anti-icing is the application of liquid chemicals to the roadway before a winter storm



SECTION 1: SNOW AND ICE CONTROL STRATEGIES

DURING AND AFTER THE STORM - DEICING

De-icing is the application of chemicals during or after a storm.



Truck with V-box insert spreader

Source: Lindco Equipment Sales, Inc.



Truck with a tailgate spinner

SECTION 1: SNOW AND ICE CONTROL STRATEGIES

PREWETTING

Prewetting is adding brine or other liquids to granular material to help jump start the melting process.



SECTION 2: SNOW PLOWS AND EQUIPMENT

SNOW PLOWING

Snow plowing is the removal of snow and ice from the roadway by mechanical means.



Plowing snow is typically complemented with applying de-icing chemicals.



Echelon plowing (commonly called “gang plowing”), or tow plows may be used to clear multiple lanes in one pass.

SECTION 2: SNOW PLOWS AND EQUIPMENT

TYPES OF SNOW PLOWS



Front End Reversible Plow



One Way Fixed Plow



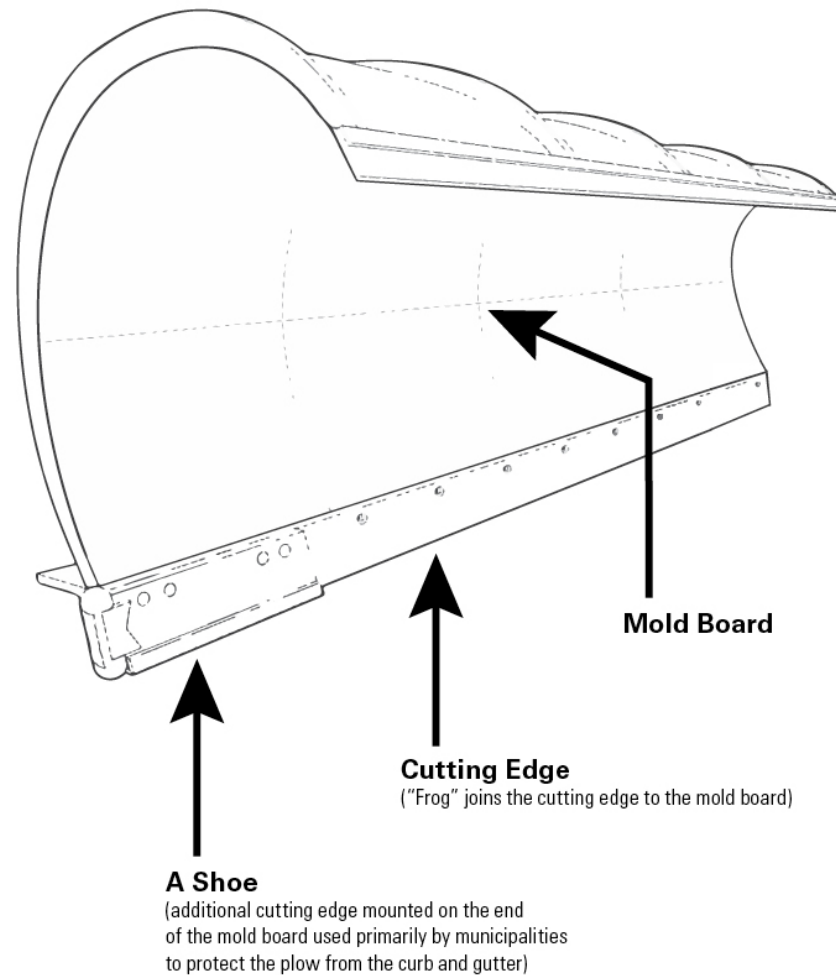
Wing Plow



Underbody Plow

SECTION 2: SNOW PLOWS AND EQUIPMENT

PLOW DIAGRAM



SECTION 2: SNOW PLOWS AND EQUIPMENT

SNOW PLOW VEHICLES

A variety of construction equipment can be used for plowing either as-is, or by fitting the equipment with appropriate apparatus or attachments.



Dump Truck with underbody and front plows as well as a material spreader



Motor Grader with wing plow attachment (currently in the raised position)

SECTION 2: SNOW PLOWS AND EQUIPMENT

SNOW PLOW VEHICLES

Loader with reversible front plow, which allows snow to be thrown to the left and right, as needed. Snow removal using trucks and loader with blower



Loader with reversible front plow, which allows snow to be thrown to the left and right, as needed



Snow removal using trucks and loader with blower

SECTION 2: SNOW PLOWS AND EQUIPMENT

SNOW PLOW CUTTING EDGES

Commonly Used Cutting Edges



Source: Northern Tool

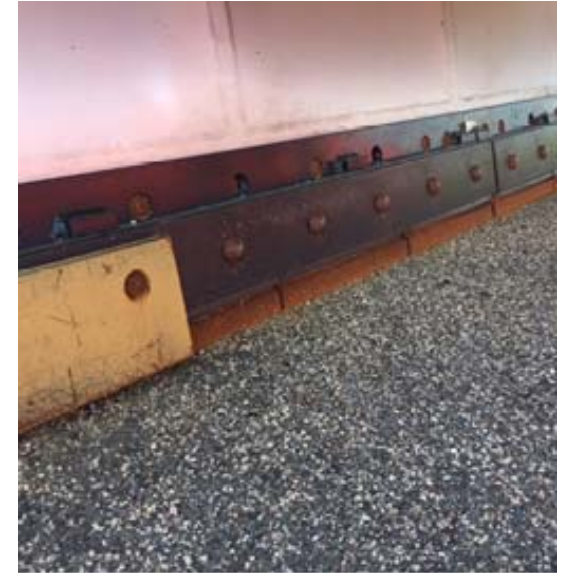
Steel

Wears faster than carbide.



Carbide

More expensive than steel, but long-lasting.



Combination

Segmented blade that is a combination of steel, carbide, and rubber

SECTION 2: SNOW PLOWS AND EQUIPMENT

SNOW PLOW CUTTING EDGES

Newer Cutting Edge Options



Multi-Blade System



Ceramic Cutting Edge



Rubber Cutting Edge

SECTION 2: SNOW PLOWS AND EQUIPMENT

SOLID MATERIAL SPREADERS

Solid material spreaders are used to distribute granular material on the roadway in a consistent and measured way.



Truck with Slide-in, V-box spreader

Source: StarTribune



Truck with rear mounted spreader and spinner

Source: New Jersey DOT

SECTION 2: SNOW PLOWS AND EQUIPMENT

LIQUID MATERIAL APPLICATORS

Liquid material applicators are used to consistently apply liquid chemicals to the roadway in a deliberate and controlled spray pattern.



“Pencil-lines” application for anti-icing with pressurized liquid being applied from the left side of the truck.



Tailgate Liquid Tank

SECTION 2: SNOW PLOWS AND EQUIPMENT

SOLID SPREADER AND LIQUID APPLICATION IN-CAB CONTROLS

Plow operators regulate material application rates using in-cab controls.

Various types of in-cab controls allow the operator to adjust plows and chemical application



Source: Force America



Source: Varitech Industries



SECTION 2: SNOW PLOWS AND EQUIPMENT

IMPORTANCE OF CALIBRATION

Calibration is an essential procedure to measure the amount of liquid and solid material applied to the roadway at various settings in relation to truck speed.



SECTION 3: WINTER MAINTENANCE MATERIALS



	Abrasives	Solid Rock Salt (NaCl)	Salt Brine	Magnesium Chloride (MgCl ₂)	Calcium Chloride (CaCl ₂)	Acetates	
						Calcium Magnesium Acetate	Potassium Acetate
Usage	Mix with salt to provide traction to slippery roads.	Deicing or anti-icing	Prewetting and anti-icing	Deicing, prewetting, and anti-icing	Deicing	Anti-icing	Anti-icing
Typical Form	Sand (paved roads) or gravel (unpaved roads). Mixed with salt (20% to 33% salt).	Solid granular	Liquid	Liquid or solid	Liquid	Liquid	Liquid
Lowest Practical Melting Temperature	Minimal melting benefit	15° F	15° F	-10° F	-20° F	20° F	-15° F
Positive Attributes	<ul style="list-style-type: none"> - Provides temporary traction - More effective than chemicals at very low temperatures and for spot traction at targeted locations (hills, curves, bridges, intersections, shaded areas, windblown areas) - Useful alternative in environmental sensitive locations (no salt roads) 	<ul style="list-style-type: none"> - Excellent melting capacity - Lower cost compared to other chemicals - Clear roads of snow and ice 	<ul style="list-style-type: none"> - Prevents snow and ice from bonding to pavement (anti-icing) - Lower cost compared to other chemicals - Reduced granular scatter when used for prewetting - Low cost 	<ul style="list-style-type: none"> - Reduced amount of product used, reduced salt and abrasive use over rock salt - Better cold temperature performance than rock salt - Persists on the road surface, aiding in longer black ice prevention than sodium chloride 	<ul style="list-style-type: none"> - Better cold temperature performance than rock salt - Reduced amount of product used 	- Non-corrosive	
							<ul style="list-style-type: none"> - Often used on bridge anti-icing systems

SECTION 3: WINTER MAINTENANCE MATERIALS

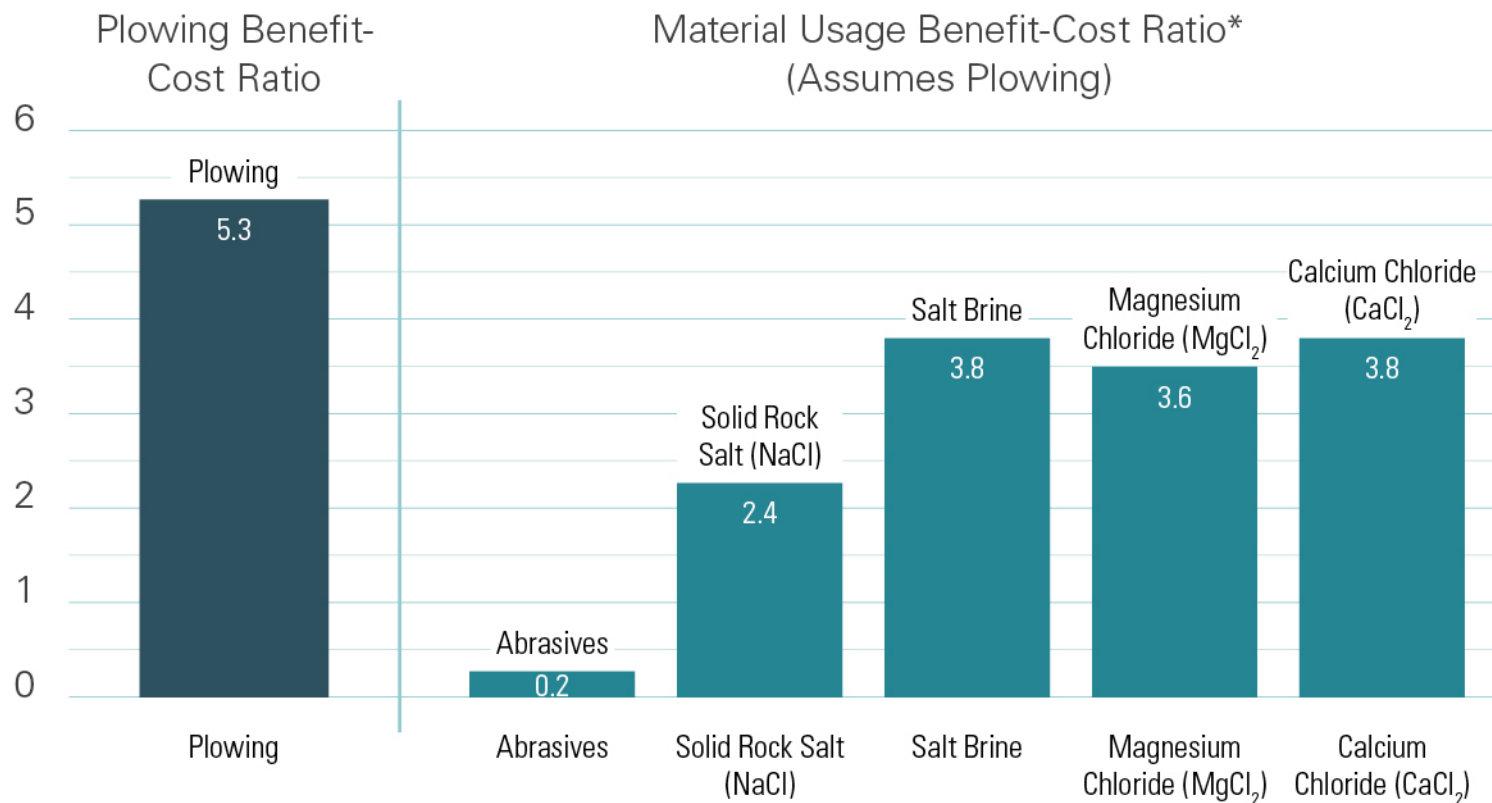


	Abrasives	Solid Rock Salt (NaCl)	Salt Brine	Magnesium Chloride (MgCl ₂)	Calcium Chloride (CaCl ₂)	Acetates	
						Calcium Magnesium Acetate	Potassium Acetate
Negative Attributes	<ul style="list-style-type: none"> - Recovery from storms is slower than chemicals when used alone or in combination with only plowing - More plow passes and applications are required than if chemicals are used - Cannot achieve deicing - Requires clean up after winter season 	<ul style="list-style-type: none"> - Corrosion - Impacts on roadside and waterways - Pavement deterioration - Corrosion to vehicles and infrastructure 	<ul style="list-style-type: none"> - Corrosion - Impacts on roadside and waterways - Corrosion to vehicles and infrastructure 	<ul style="list-style-type: none"> - Pavement deterioration - Corrosion - Material cost is higher than rock salt - More corrosive than sodium chloride 	<ul style="list-style-type: none"> - Pavement deterioration - Corrosion - Material cost is higher than rock salt - More corrosive than sodium chloride 	<ul style="list-style-type: none"> - Expensive 	
Environmental Impacts	<ul style="list-style-type: none"> - Abrasives can enter the waterways and clog streams, clog drains, can impact water quality and aquatic species - Straight abrasive use does not pose corrosion issues, but abrasive-salt mixes can cause this issue 	<ul style="list-style-type: none"> - Entry into waterways - Impact to roadside soil, vegetation 	<ul style="list-style-type: none"> - Entry into waterways - Impact to roadside soil, vegetation 	<ul style="list-style-type: none"> - Entry into waterways - Impact to bridge infrastructure - Leaching/run-off from stockpiles 	<ul style="list-style-type: none"> - Entry into waterways - Impact to roadside - May mobilize heavy metals in soil releasing them into the water 	<ul style="list-style-type: none"> - Their decomposition consumes dissolved oxygen, resulting in lower oxygen levels in water. 	

SECTION 3: WINTER MAINTENANCE MATERIALS

BENEFIT-COST OF PLOWING AND MATERIAL USAGE

Findings from a Clear Roads pooled fund that analyzed the costs and benefits of various winter maintenance strategies.



*When applied with typical methods

SECTION 3: WINTER MAINTENANCE MATERIALS

BLENDED PRODUCTS AND CORROSION INHIBITORS

Blended Products

- Blended products can combine benefits of various chemicals, such as the low cost of rock salt with the low freezing point of calcium chloride as well as a corrosion inhibitor.
- Can be blended on site or purchased pre-blended.

Corrosion Inhibitors

- Corrosion inhibitors are generally additives that reduce the corrosiveness of a chemical.
- Premixed chemicals with corrosion inhibitors can be purchased under trade names or are organics, such as beet juice or molasses.
- Typically used in spot locations.

SECTION 4: WINTER MAINTENANCE TECHNOLOGIES

ROAD WEATHER INFORMATION SYSTEM (RWIS)

A RWIS is a combination of field hardware and software that provides detailed and timely road-weather information that is used to support operations and maintenance decisions.

- Atmospheric data Air temperature
 - Humidity
 - Visibility distance
 - Wind speed and direction
 - Precipitation type and rate
- Pavement data Pavement temperature
 - Pavement condition (dry, wet, ice, frost)
 - Subsurface temperature



Environmental Sensor Station

SECTION 4: WINTER MAINTENANCE TECHNOLOGIES

MNDOT'S RWIS SYSTEM

Local agencies can benefit from this system and use it to determine weather conditions of nearby roads.

The screenshot displays the MNDOT's RWIS website. At the top, a blue header bar contains the text "VAISALA / SCAN Web". Below this, a navigation menu on the left lists various options: Home, Cameras, Bridge Sprayers, Maps, Districts 1 through 8, Metro District, Districts 6, 7, and 8, Summaries, Statewide Summary, RWIS Sites, District 1 Sites, District 2 Sites, District 3 Sites, District 4 Sites, Metro Sites, District 6 Sites, District 7 Sites, District 8 Sites, Duluth Sites, Vaisala Sites, AWOS Sites, ASOS Sites, Related Links, User's Guide, Glossary, SCAN PDA, Disable Java Links, and Administration. The main content area features the Minnesota Department of Transportation logo and a map of Minnesota with numbered regions (1-8) and state abbreviations (ND, WI, SD, IA). A prompt above the map says "Click on an area to view the available RWIS data." To the right of the map, a list of links is provided: Iteris Forecast Web Site, Metro Traffic Cameras, The Weather Channel Radar, AccuWeather Radar, SSEC Goes-8 Infrared, NCAR/RAP Visible, NWS Radar, and Snow Control.

VAISALA / SCAN Web

- Home
- Cameras
- Bridge Sprayers
- Maps**
- District 1
- District 2
- District 3
- District 4
- Metro District
- District 6
- District 7
- District 8
- Summaries**
- Statewide Summary
- RWIS Sites
- District 1 Sites
- District 2 Sites
- District 3 Sites
- District 4 Sites
- Metro Sites
- District 6 Sites
- District 7 Sites
- District 8 Sites
- Duluth Sites
- Vaisala Sites
- AWOS Sites
- ASOS Sites
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- Administration

Minnesota Department of Transportation

Click on an area to view the available RWIS data.

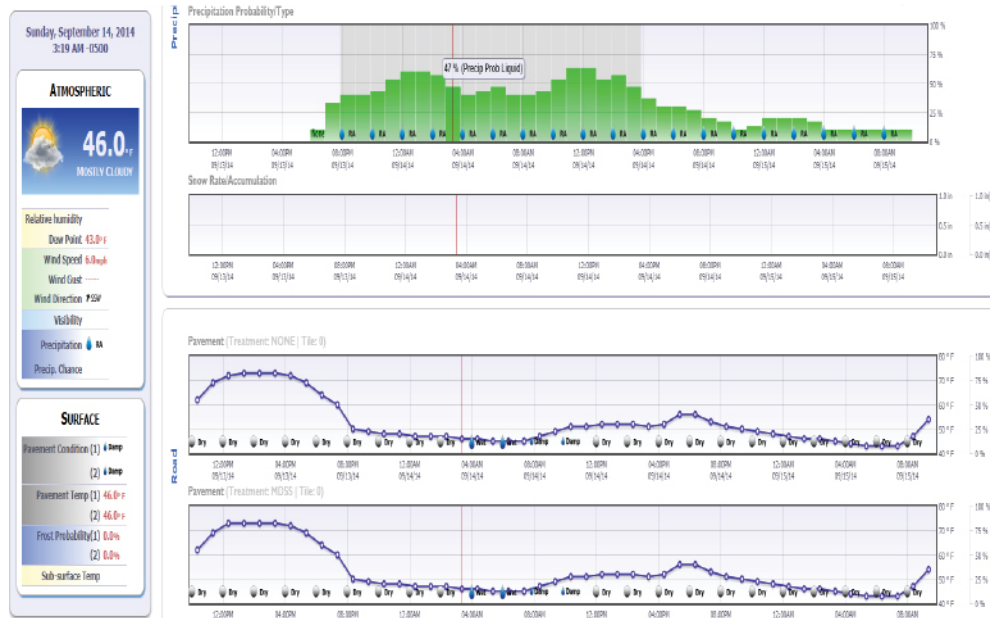
- [Iteris Forecast Web Site](#)
- [Metro Traffic Cameras](#)
- [The Weather Channel Radar](#)
- [AccuWeather Radar](#)
- [SSEC Goes-8 Infrared](#)
- [NCAR/RAP Visible](#)
- [NWS Radar](#)
- [Snow Control](#)

MnDOT's RWIS website

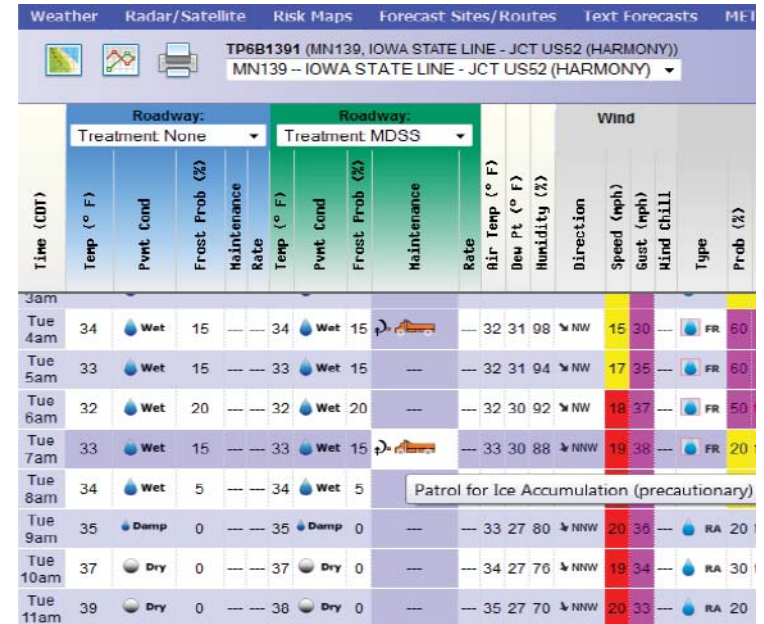
SECTION 4: WINTER MAINTENANCE TECHNOLOGIES

MAINTENANCE DECISION SUPPORT SOFTWARE (MDSS)

The MDSS provides reliable weather, road condition, and maintenance information enabling transportation agencies to accomplish their winter maintenance missions.



Example Software Screenshot



Example Software Screenshot

SECTION 4: WINTER MAINTENANCE TECHNOLOGIES

AUTOMATIC VEHICLE LOCATION (AVL)

Automatic Vehicle Location (AVL) systems are used to automatically determine and transmit the location of a vehicle.



AVL hardware

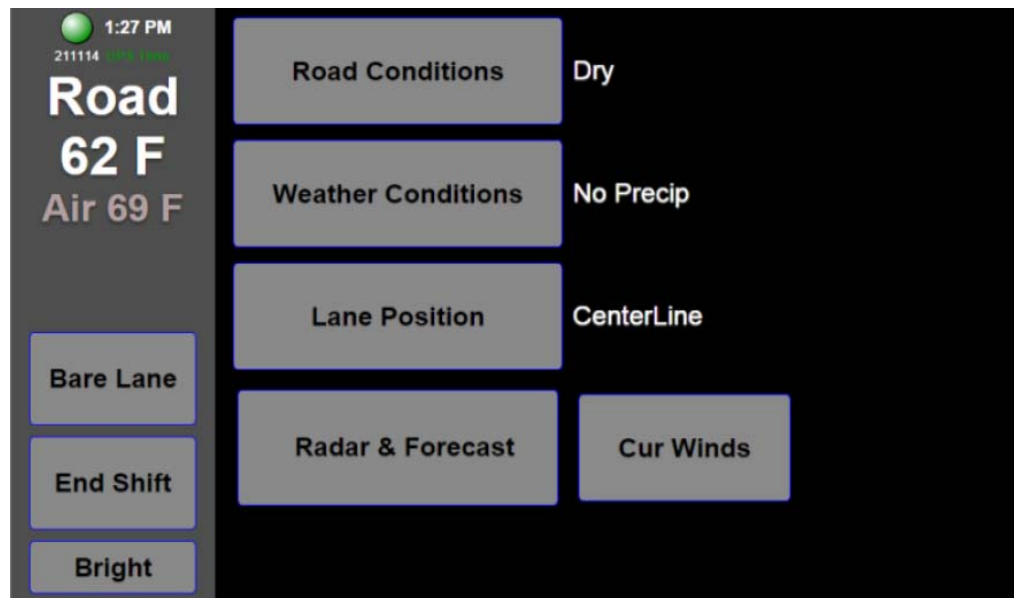


**Some AVL systems have a mobile
data terminal operator interface**

SECTION 4: WINTER MAINTENANCE TECHNOLOGIES

AUTOMATIC VEHICLE LOCATION (AVL)

AVL systems can automatically generate “end-of-shift” reports that determine the amount of material used rather than the operator manually filling out a worksheet.

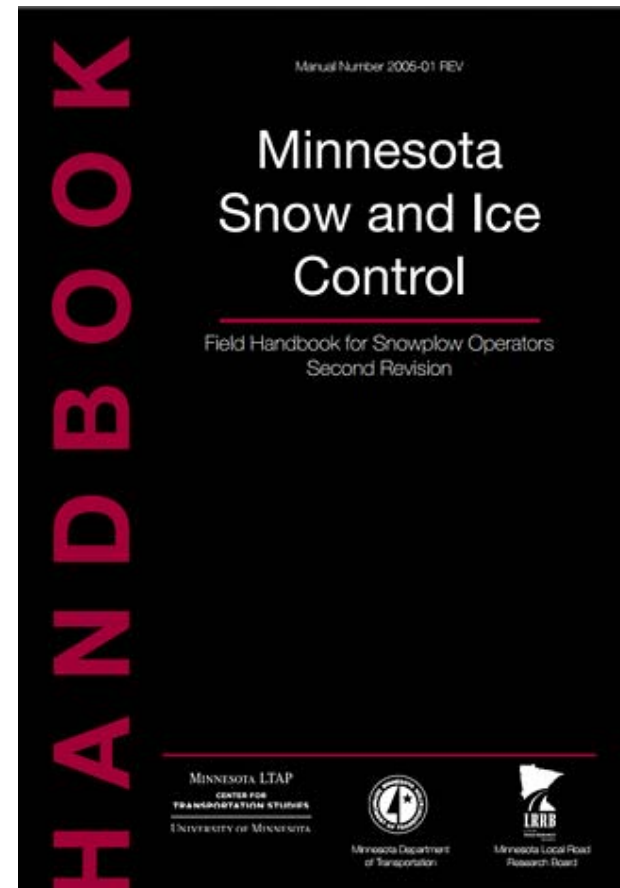


Automated End-of-Shift Reports

SECTION 5: WINTER MAINTENANCE POLICIES AND BEST PRACTICES

MINNESOTA SNOW AND ICE CONTROL HANDBOOK (2012)

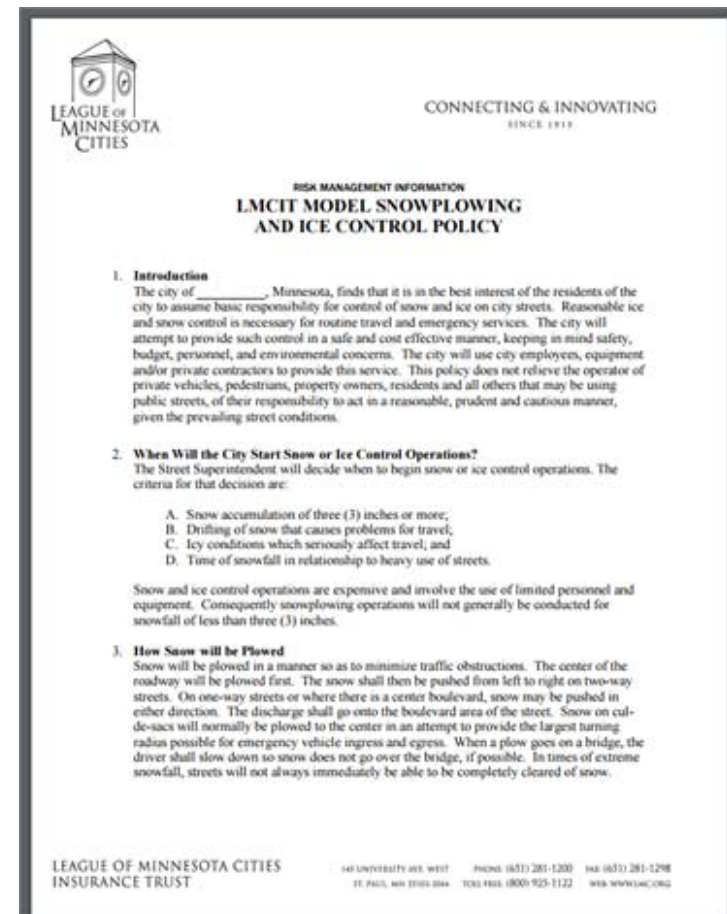
- Promotes “the understanding of the tools, best practices, and limitations for snow and ice control.”
- “...encourages progressive changes in snow and ice control practices that will help you reduce salt/sand use and environmental impacts while meeting the safety and mobility needs of roadway users.”
- Offers “standard best practices expected in a quality snow and ice control program.”



SECTION 5: WINTER MAINTENANCE POLICIES AND BEST PRACTICES

IMPORTANCE OF HAVING A SNOW AND ICE CONTROL POLICY

- Allows the agency to manage risks
- Encourages the agency to study, develop, follow policies
- Communicates the policy to citizens and staff
- Provides an opportunity for the agency to review and monitor the processes
- Allows the agency to learn and improve




SNOW & ICE CONTROL: GUIDEBOOK

Read the full guidebook that this presentation is based on at:
www.lrrb.org/media/reports/2016RIC11.pdf



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SNOW AND ICE CONTROL GUIDEBOOK

Status: Complete

Report Date: 07/25/2016

Summary:

This guidebook summarizes common snow and ice control tools and serves as an introduction to the field of winter maintenance for operators and managers. It will help new staff understand the following topics: snow and ice control strategies; snow plows and equipment; winter maintenance materials; winter maintenance technologies; and winter maintenance policies and best practices. A slide presentation is available below for training purposes.

Final Report:

[Report #2016RIC11](#)
[Technical Summary](#)

Related Materials:

[Snow and Ice Control Guidebook \(slide presentation\)](#)
- (Video/Webinar)

[Snow and Ice Control Tools: Understanding the Basics \(flyer\)](#) - (Brochure/Handout)

[Minnesota Snow and Ice Control Field Handbook \(2005; reprinted 2012\)](#) - (Related Research)

PROJECT PERSONNEL:

Principal Investigator: [Michael Marti](#)

Technical Liaison: [John Brunkhorst](#)

Project Coordinator: Not Available

LRRB Winter Maintenance Research

- **Salt Brine Blending to Optimize Deicing and Anti-Icing Performance and Cost Effectiveness Phase III**
 - **Field Usage of Alternative Deicers for Snow and Ice Control**
 - **Chloride Free Snow and Ice Control Material**
 - **Snowplow Blade Life Span: A Survey of State Experience**
 - **Pedestrian Snow Removal Best Practices and Lessons Learned**
 - **Snow Plow Cutting Edges**
 - **Assessing the Use of Shrub-Willows for Living Snow Fences in Minnesota**
 - **Automatically Measuring Traffic Recovery Times After Snowstorms**
 - **Web-Based Preventative Blowing and Drifting Snow Control Calculator Decision Tool**
-