# Illinois Winter Maintenance Manual for Parking Lots and Sidewalks

December 2022

Version 1

SALT SMART COLLABORATIVE

THE CONSERVATION FOUNDATION

# Purpose of the Manual

### This manual has three goals:

1. **Provide an understanding of well accepted, best management practices for winter maintenance.**

2. **Realize how excess, wasted salt impacts our local, natural and built, environments.**

3. **Convey that being Salt Smart is good for your organization's bottom line.**

**As you read through the manual, tips and tricks to improve your operations are spread out in various call out boxes. Some of these boxes have money saving suggestions, contractor specific information, and other useful highlights.**

Both public agencies and private contractors, need to provide safe surfaces for your end users and need to do it in a way that makes good business sense. For a private contractor that means making money on your contracts. For a public agency, that means staying within budgets and reducing damage to infrastructure that will have to be paid for somewhere down the line. The evolution of practices and equipment provides many opportunities to do both – keep people safe and not break the bank, all while reducing impacts to the natural and built environment.

We hope this manual, and the accompanying training workshop, sparks change and improvement in your operations, whether it is simply calibrating your equipment or starting to track how much salt you use or taking a bigger step in trying a new practice like anti-icing that can lower salt use. We want to inspire you to pick something and do it, track how it works, and see where it leads you. As we have worked to create this manual, we have been inspired by many people in this field who started with one small change that grew into a new way of doing business.

The Salt Smart Collaborative, coordinated by The Conservation Foundation, brings together people and organizations working to reduce the impacts of chlorides on our local environment. SaltSmart.org is a resource for private and public organizations, as well as residents for information on winter maintenance best management practices, outreach & education materials and the "Salt Smart Certified" program.

Contractors are a major service provider for parking lots and sidewalks. They provide safe surfaces to many businesses, homeowners associations, hospitals, schools, municipalities and more during the winter months. Contractors across Illinois have proven it is possible to use Salt Smart practices while running a successful business. Find contractor specific tips and tricks for Salt Smart practices in the **Contractor's Corner** throughout this manual.

# Salt Smart Certification

The Salt Smart Certified program covers both individuals and organizations that are implementing Salt Smart Practices covered in this manual and the accompanying training class. This certification assures clients and communities that proper training, calibration, application rates and practices are being implemented to reduce damage to property and the environment, while providing safe surfaces for people.

## Requirements

### Salt Smart Trained – Individuals

- Take Salt Smart Certified Training for Parking Lots & Sidewalks every three years
- Pass evaluation
- Participate in annual continuing education

### Salt Smart Certified – Contractors/Organizations

- Owner/Managers/Supervisors are Salt Smart Trained
- Provide internal training to staff annually on Salt Smart Practices
- Calibrate all salt spreading equipment and document
- Maintain facility plan for each location serviced
- Keep event and season records
- Complete Annual Reporting and certification fee on SaltSmart.org

### Benefits of being Salt Smart Certified

Listed on SaltSmart.org

Free starter pack of window clings for trucks and client locations (additional window clings available for purchase)

Marketing and educational materials for clients and patrons

Training materials available for annual staff training

SALT SMART COLLABORATIVE

# Acknowledgements

This manual has been a journey embarked on by many different people, starting from different places, but with the same goal in mind: reducing the impacts of chlorides on our local environment. From DuPage River Salt Creek Workgroup holding some of the first winter deicing workshops in the state as a way to address impacts from road salt on our local waterways, to the efforts made in McHenry and Lake Counties addressing impacts to groundwater, to the efforts made by the Sensible Salting Committee of the Northwest Water Planning Alliance to start the drafting of this manual and The Conservation Foundation's Salt Smart Collaborative bringing people and groups together to tackle the barriers to getting private contractors on-board with best management practices.

The manual itself has taken many twists and turns as it has borrowed from the "Winter Parking Lot and Sidewalk Maintenance Manual" (2015) developed by the Minnesota Pollution Control Agency and Fortin Consulting, and has borrowed from the "Wisconsin Winter Maintenance Manual" (2019) developed by the City of Madison/Wisconsin Salt Wise and Fortin Consulting – A big Thank You to those agencies and all of the great work they do, our road would have been much longer (and saltier) without such great foundations to build on. Finally, we would like to acknowledge the time and expertise provided by our Steering Committee, your thoughtful review and insight has helped us create a great resource for the state of Illinois.

### Steering Committee Members:

| | |
|---|---|
| Hanna Miller, The Conservation Foundation | Alana Bartolai, Lake County Health Department |
| Jennifer Hammer, The Conservation Foundation | Matt Wittum, Town of Linn, Wisconsin |
| Jim Turcan, Cornerstone Partners | Stephen McCracken, The Conservation Foundation |
| John Langton, Langton Group | Sarah Zack, Illinois-Indiana Sea Grant |
| Tony Schanna, Langton Group | Tony Johnson, Midwest Salt |
| Scott Kuykendall, McHenry County | Manual Ocampo, SV Enterprises |
| John Kolkman, Kaplan Liquid Solutions | Jimmy Schmidt, Streamwood Park District |

### Advisor:

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|---|
| Connie Fortin, Bolton & Menk |

Funding for this manual and accompanying training workshop was provided, in part, by a Section 319 Grant from the Illinois Environmental Protection Agency, the Chicago Area Waterways Chloride Workgroup, the Lower Des Plaines Watershed Group, the Northwest Water Planning Alliance, and The Conservation Foundation.

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# Why be Salt Smart?

## Introduction

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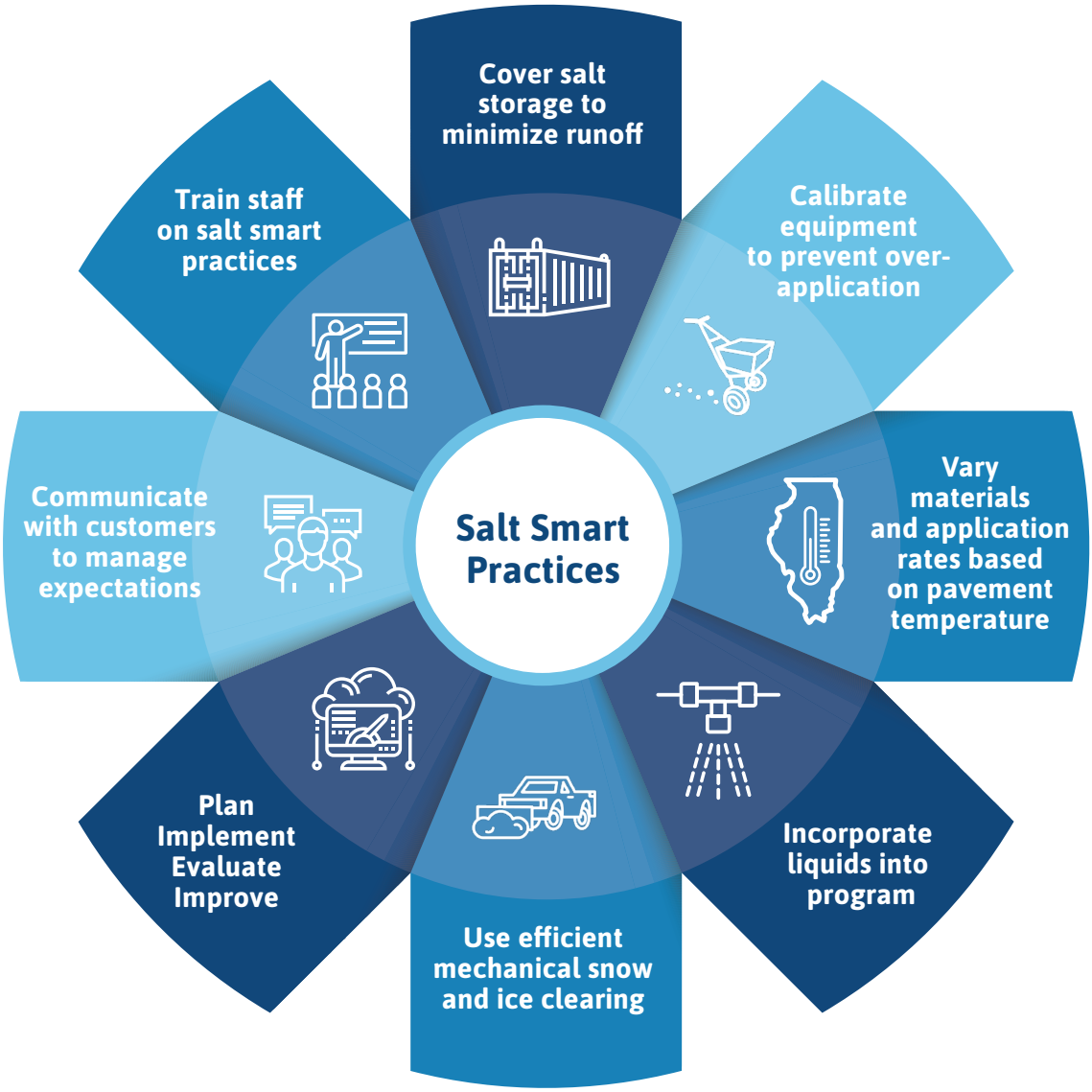


# Introduction

The Salt Smart Parking Lots & Sidewalks Winter Maintenance Manual, the accompanying training workshops and support materials are all components of the "Salt Smart Certified" certification program for winter maintenance professionals in Illinois.

The manual outlines components that should be a part of every winter maintenance program, recognizing that every organization does things a little differently. This is not a comprehensive list of every winter practice, but is meant to provide the building blocks necessary to support a solid program. The manual is presented in four main sections – preparing for the winter storm season, materials and storage, managing snow and ice, and finally, documenting and evaluating your program. The chapters focus on a particular topic and are somewhat "stand alone", it does not need to be read all in order. In the end, this is meant to be a resource on materials, equipment, and practices used and how to communicate with your public or clients. The practices included in this manual are specific to parking lots and sidewalks winter maintenance. Private contractors are a major service provider for parking lots and sidewalks. They provide safe surfaces to many businesses, homeowners associations, hospitals, municipalities and more during the winter months. Winter maintenance professionals, including private contractors, across Illinois have proven it is possible to use Salt Smart practices while running successful businesses or staying within operational budgets. Geographically, this manual focuses on practices and materials that are used in Illinois.

## Winter Precipitation in Illinois

Average snowfall over the last 30 years ranges from 28-38" in Chicago and surrounding communities, 32-37" in northwestern Illinois, 13-26" in central Illinois and 10-11" in southern Illinois (NOAA National Centers for Environmental Information). This array of snowfall averages illustrates just some of the complexities of developing a manual for a state with such a range of weather conditions. Snowfall is only part of the picture as there is a wide range of winter conditions from freezing rain to ice to snow as storms move across state. Central Illinois experiences more freezing rain than other parts of the state (Illinois State Climatologist, Illinois State Water Survey).

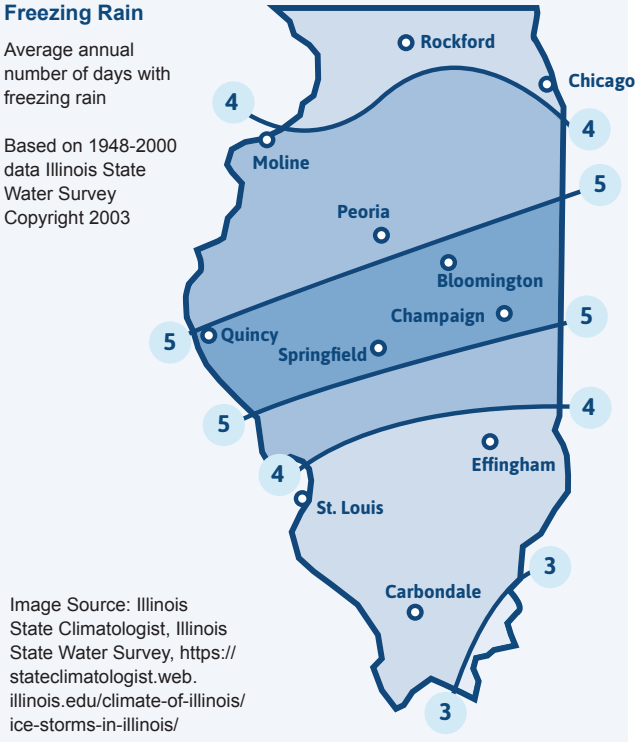



Image Source: Illinois State Climatologist, Illinois State Water Survey, https://stateclimatologist.web.illinois.edu/climate-of-illinois/ice-storms-in-illinois/

While there are many challenges presented by the geography and climate of Illinois, there are many practices presented in the manual that can be used in any program, in any part of the state, that will help to reduce the amount of excess salt used, maintain safety, and minimize liability.

# 1. Impacts From Salt and Other Deicing Materials for Snow and Ice Management

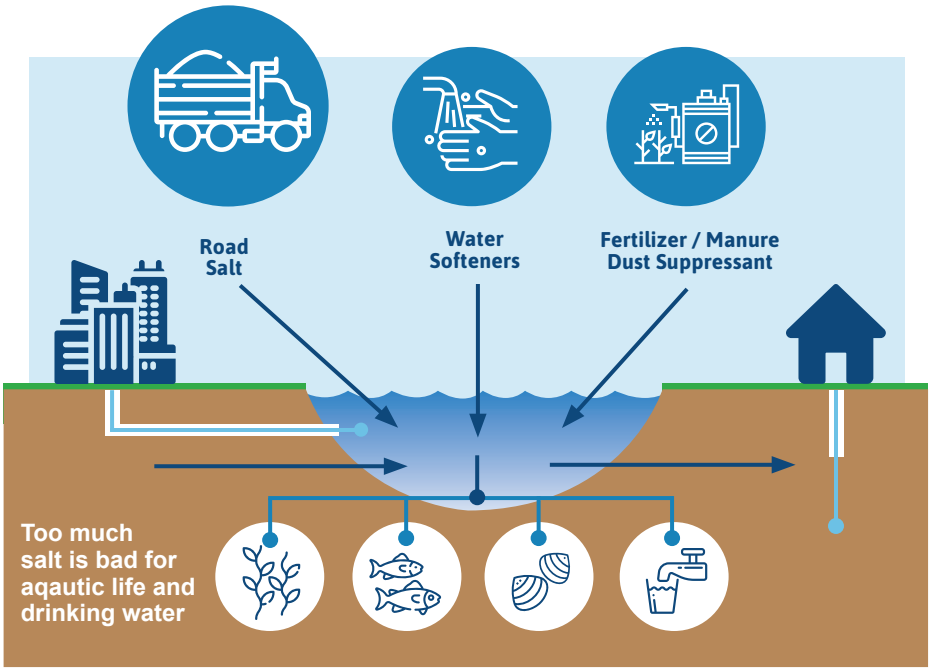
One of the reasons that road salt is so effective at melting snow and ice is because it dissolves easily in water. However, this also makes salt a significant threat to our water resources. Once salt is dissolved in water, there is no practical way to remove it. As the salt dissolves and melts snow and ice, it creates salty meltwater. Some of the meltwater runs off hard surfaces into storm sewer systems that lead to local waterways. Some filters through soils and into shallow groundwater aquifers. Most of the road salt that is applied, either in solid or liquid form, will end up as a contaminant in our streams, lakes, wetlands and groundwater.

To calculate the true cost of salt, we need to understand its broader impacts. Road salt is corrosive to metal, concrete, and other building materials, causing millions of dollars of damage to vehicles, bridges, and other roadway infrastructure, conrete retaining walls, driveways and sidewalks, and building entryways. Excess road salt that bounces, sprays, or washes off of hard surfaces onto adjacent vegetation may lead to costly repairs and replacement of landscaping come spring. The cost of damage to infrastructure, vehicles, and the environment from deicer use was estimated to be between $803 to $3,341 for every ton of road salt used during winter maintenance (Fortin Consulting and MPCA, 2014).

**Clean water is the basis for healthy, vibrant communities. Pollution and other impacts from the use of road salt and other materials are having a profound impact on water resources as well as the natural and built environment.**

## Impacts of Deicing Materials on Water Resources

Chloride does not degrade and cannot be removed easily from surface waters. Once in the water, chlorides continue to accumulate in the environment over time, both locally and as water flows downstream. This is damaging to surface water and groundwater. Salty water from paved surfaces flows into the nearest storm drain with stormwater and snowmelt runoff or moves downhill to the nearest waterway. Chlorides can also filter down though the soil and contaminate groundwater



aquifers that people rely on for drinking water.

In general, water resources in Illinois, including groundwater aquifers, lakes, rivers, streams, and wetlands are becoming more saline with increased use of road salt and other chloride-based chemicals.

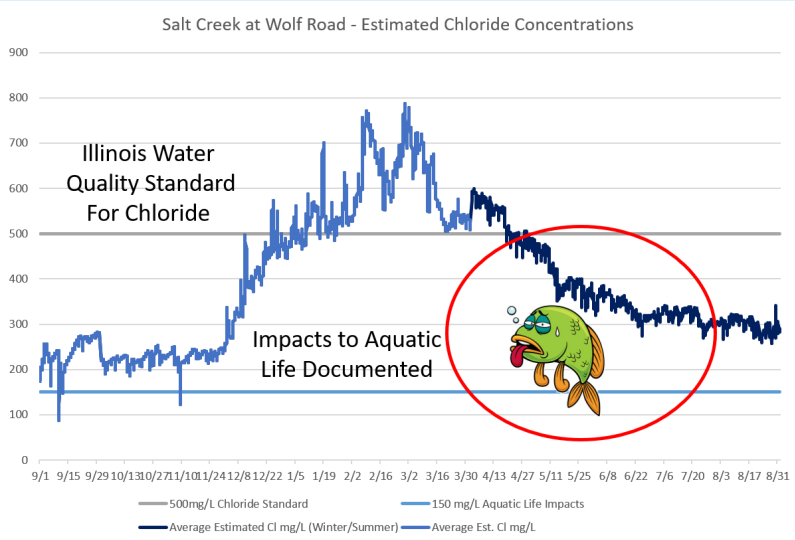
Non-chloride-based deicers and sand used for traction also impact our water resources. Acetates, formates, and carbohydrate additives contribute to oxygen depletion, which impacts aquatic life. The added nutrients from the non-chloride-based deicers may be able to be treated in stormwater BMPs, but the additional nutrients can impact water quality if not treated. Sand used for traction during the winter can clog up stormwater infrastructure and smother aquatic habitats if washed into our waterways.

## Impacts to Surface Water in Illinois

As a result of salty meltwater entering the water cycle, many water resources in Illinois are getting saltier. This is most easily observed by monitoring chloride concentrations and conductivity levels. Chloride levels in many streams and rivers spike after winter storms and in early spring as snow melts, but there has also been a long-term increase in chloride concentrations throughout the year (Kelly et al., 2012). In Illinois the water quality standard for chloride for surface water is 500 milligrams per liter (mg/L), a standard that is frequently surpassed in rivers and streams in Illinois during winter months. A study of urban Chicago rivers, streams, and canals monitored by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) found that 85 percent of the sites had an increasing chloride trend between 1975 and 2008 (Kelly et al. 2012). Even in the summer and fall, chloride concentrations are much higher than they were a few decades ago; this increase in "baseflow" concentrations is evidence of increasing salt levels in shallow groundwater that is discharging into the streams and rivers (Kelly et al. 2012).

The Illinois Environmental Protection Agency publishes an Integrated Water Quality Report and 303(d) List that is updated every two years. In part, this report identifies streams that are not meeting their designated uses which include:

- aquatic life,
- fish consumption,
- recreation (e.g., swimming, water skiing), and
- public water supply.




Graph showing average chloride concentrations in Salt Creek are consistently well above the 500 mg/L water quality standard for chloride during the winter months across several years due to winter deicing operations and the chloride concentration takes a significant amount of time to return background levels impacting the young stages of aquatic life in spring and early summer (data shared from the DuPage River Salt Creek Workgroup).

If samples collected from the stream show the stream cannot support one or more of its designated uses, the stream is identified as impaired on the 303(d) List. The cause of the impairment is also noted. Many streams and rivers across the state that are impaired due to high chloride concentrations including the Des Plaines River, DuPage River, Fox River, North Branch of the Chicago River, Middle Fork Big Muddy River, South Branch of the Kishwaukee River, North Fork Saline River, Sangamon River, and several other streams and lakes (IEPA, 2018 303(d) List).

**One of the biggest concerns with rising chloride levels in waterways is the impacts to aquatic life, particularly in reproductive and juvenile stages. Chloride is toxic to certain aquatic life even at low concentrations. High chloride concentrations can impact local Illinois aquatic life like fish, insects, and freshwater mussels by inhibiting their ability to successfully reproduce and survive. Toxicity increases with longer exposure times and higher concentrations of chlorides.**

Water chemistry and biological data collected by the DuPage River Salt Creek Workgroup, a watershed group in northeastern Illinois, showed impacts to aquatic life at chloride concentrations as low as 150 mg/L. (Integrated Prioritization System (IPS) for Northeastern Illinois 2022) High winter chloride levels take months to return to background levels, exposing aquatic life to elevated levels of chloride throughout the spring breeding season.

Chronic exposure to chlorides can have lasting impacts on fish and wildlife. Additionally, aquatic insects are more sensitive to chloride concentrations than many fish species (Hintz and Relyea 2019). This disrupts food chains as many fish species, as well as birds, turtles and frogs, depend on aquatic insects as their food source.

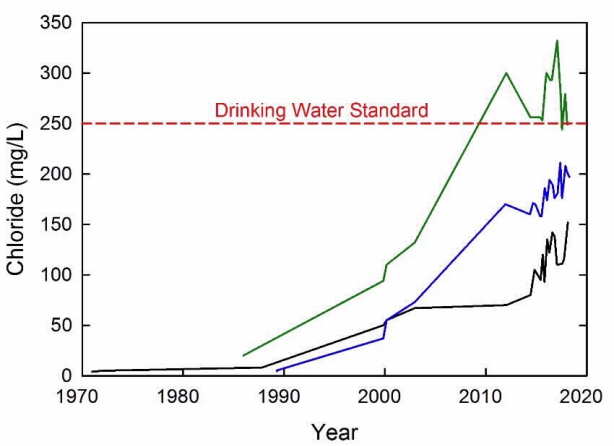
Amphibians can also be impacted by chlorides from road salt. Studies have shown that chlorides from melt runoff from roads and spring melting can impact the early developing stages of amphibians (Collins and Russell 2009). The impacts of chlorides on wood frogs included decrease in body weight, not undergoing metamorphosis, decreased activity, and increased developmental abnormalities, and increased in severity with increasing concentrations (Sanzo and Hecnar 2006). Even chloride-free deicers like acetate-based deicers have demonstrated lethal effects on tadpoles at very low concentrations. (Harless et al 2011).

Because salty water is heavier than freshwater, natural seasonal mixing of lakes can be disrupted (Novotny et al. 2008). Natural seasonal mixing increases the amount of oxygen available to aquatic life. The lack of mixing can lead to lower levels of oxygen in the bottom layers of surface waters and death of aquatic life in those bottom layers (Sibert et al 2015). Changes in the mixing of surface waters can also impact the composition and productivity of the nutrients, phytoplankton, zooplankton, and macroinvertebrates needed for the survival of fish and other aquatic life.

Many inland lakes are also experiencing increases in chloride levels (Dugan et al. 2017). Even Lake Michigan has increasing chloride concentrations, although the increase is proportionately small due to the immense volume of water in the lake that dilutes the salty meltwater (Dugan et al. 2021). The increasing chloride concentrations in Lake Michigan are primarily due to road-dense urban areas with high concentrations of road salt run off (Dugan et al. 2021). Chloride concentrations exceed the state standard in many lakes and ponds throughout Illinois. In numerous cases, golf course and landscape ponds once used for irrigation can no longer be used because high chloride concentrations are killing plants. This necessitates finding expensive alternatives for irrigation.

## Impacts to Groundwater in Illinois

Chloride concentrations in the groundwater of shallow aquifers throughout Illinois have also been increasing, although concentrations tend to be lower than in surface waters. However, because groundwater flow is slow, the salt is effectively being stored underground and concentrations will likely continue to increase for some time even as road salting amounts are reduced. Shallow groundwater discharges to rivers, streams, and lakes year-round, bringing accumulated salt with it. Over time this will result in higher and higher background levels of chloride.




Chloride concentrations in three public water supply wells in the Chicago Region showing increasing concentrations over time and correlate to increased use of road salt (graph provided by Walton R. Kelly, Illinois State Water Survey).

Chloride has contaminated groundwater drinking sources. A 2008 study in Illinois indicated that a majority of shallow public water supply wells (< 250 feet deep) had increasing trends in chloride and total dissolved solids concentrations (Kelly 2008). The average increase was about 4 mg/L per year. When this increase is compounded over time with continued unchecked chloride use, the quality of our groundwater will decrease, limiting the availability of uncontaminated drinking water. More focused studies have shown similar results. For example, between 2003 and 2015, chloride concentrations have been increasing about 4 mg/L per year in shallow aquifers in Kane County (Kelly et al. 2016). While chloride is not currently at levels considered toxic to humans, there is a secondary drinking water standard of 250 mg/L in Illinois; above that level water begins to taste salty.

Lake Michigan is the largest water supply source in the Chicago Region; however, most of the state of Illinois receives its drinking water supply from other sources – inland surface water, municipal wells, or private wells. Each of these other sources are threatened by increasing chloride concentrations in Illinois' water resources.

A recent U.S. Geological Survey study compared chloride concentrations recorded in 1979 and 2015 at four residential supply wells that tap into shallow aquifers (USGS 2017). This study found that concentrations have increased between 108 and 521 percent in the three wells located near roadways. Only the well located over 0.5 mile away from a road did not experience chloride increases.

## Impacts to Vegetation & Soil

Both chemical components of road salt, sodium and chloride, and other winter deicers can damage and kill vegetation. Salt that is overspread, bounces off, runs off, or sprays upward as vehicles go by can permanently damage both plants and soil. Soil remediation is very difficult and expensive to do. Costs to replace adjacent turf grass, flower plantings or trees and shrubs add up year after year.

Top: Dead grass along driveways from overspread deicer
Right: Burned foliage from deicer overspray.

Above: Salt tolerant and highly invasive species Common Reed (Phragmites australis).

Deicers can be very damaging to both soil and vegetation. Sodium from rock salt can damage the structure of the soil making it susceptible to compaction. This decreases soil permeability and aeration. The reduced soil aeration lowers oxygen supply to plant roots and can impact plant growth (Fay and Shi 2014). High sodium levels in the soil can also increase its pH, which can affect plant growth. Both sodium and chloride can reduce plants ability to take up nutrients from the soil.

Salt dumped at the end of the season in March continues to impact plant growth more than 18 months later.

## Impacts to the Built Environment

Chloride-based deicers are corrosive not only to traditional infrastructure like bridges and roadway surfaces, but also to residential and commercial surfaces like sidewalks, driveways, retaining walls, and building entryways. Excessive use of road salt accelerates the damaging effects of this corrosion and shortens the lifespan of these residential and commercial areas. As snow and ice melt, water works its way under the surface where continued freezing and thawing results in damage such as spalling, chipping, flaking, and pitting over time. Deicer accelerates the melting process and increases the number of freeze and thaw cycles resulting in more damage. Salt that piles up around doorways damages finishes and corrodes supporting structures. Salt that is tracked into buildings causes damage to flooring.

Vehicles are also impacted by corrosion from deicers. Metal components of vehicles can rust or corrode causing decreased life expectancy of the vehicle or more frequent costly repairs.

Spalled concrete sidewalk from winter deicer applications.

**Salt causes corrosion to infrastructure and buildings**

# Getting Ready for Winter

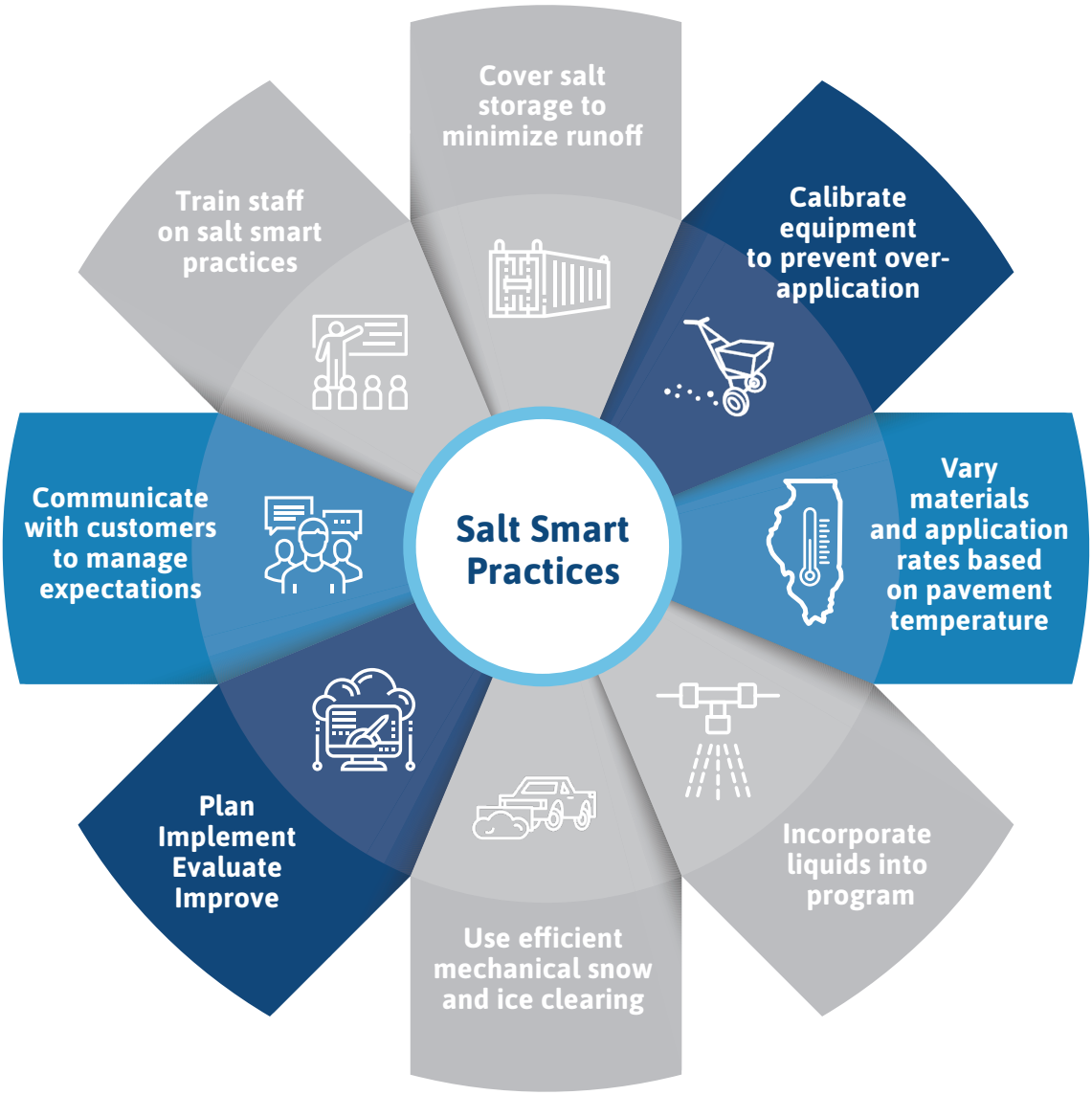
**Chapter 2 – Winter Maintenance Planning and Documentation**

**Chapter 3 – Communicating with your Customers**

**Chapter 4 – Preparing for Winter Operations**

**Chapter 5 – Weather Preparedness and Pavement Temperatures**

**Chapter 6 – Calibration of Spreading Equipment**



# 2. Winter Maintenance Planning and Documentation

## Develop a Winter Maintenance Policy or Plan for Your Operations

A solid winter maintenance policy or plan that utilizes best management practices and documentation can improve your operations and reduce risk and liability, but only if used properly.

A winter maintenance policy or plan is a written strategy for how you will handle winter weather events. This policy or plan informs staff and customers of what to expect. This up-front planning and communication can help achieve better results throughout the season.

Winter maintenance plans and policies should be unique to your situation. If you maintain multiple facilities or properties, you may need to have one master policy or plan for your organization and a plan with specific details for each facility or property you maintain. However, if you only maintain one facility, you may only need one plan or policy.

When creating your winter maintenance policy or plan, it is important to consider customer expectations or facility needs. Customers may have special requests that may need to be factored into your winter maintenance plans. It is important to communicate with your customers about what is included in the winter maintenance policy or plan. It is also important to consider environmental concerns and other impacts to vegetation or infrastructure for the facility that you need to be aware of when planning for winter maintenance.

The winter maintenance policy or plan should include the practices you currently implement. Review the policy or plan annually before winter to be sure the information included in it is up to date. As you make changes to your practices, update the winter maintenance policy to reflect those changes.

## Key Items for Winter Maintenance Plans and Policies

### Company Policy

**1. Facility Plans with Client Requests**

Make site specific plans, include client requests

**2. Calibrate**

Calibrate equipment at least annually

**3. Train**


Train all staff, review the plans and policies annually

**4. Document**

Document weather conditions and action taken

### Site Specific Plan

**1. Mobilization**


**WHEN**

**When** is winter maintenance needed?

**2. Maps**

**WHERE**

**Where** are plowed snow and materials stored? What areas are first priority for safe surfaces?

**3. Responsibilities**

**WHO**

Spell out **who** is responsible for what actions.

**4. Actions**

**WHAT & WHEN**

**What** actions are needed for safe surfaces?

After creating your winter maintenance policy or plan, it is very important that you follow the plan. Be sure to review and update the policy or plan annually. Share the plan with your staff and customers.

### Contractor's Corner: Customer Contracts that Support Salt Smart Practices – The Money is Not in the Salt

As a private contractor, your contracts with your clients are an important part of your business. Property managers and business owners want reliable and affordable winter maintenance services. It is important that as you adapt your operations to include Salt Smart practices, that you update your contracts to include the new practices. When Salt Smart practices are used correctly, they will allow you as the contractor to provide equal or better results with less time and less salt.

Consider using Seasonal Contracts as you adapt to using Salt Smart practices:

- Seasonal contracts can provide more flexibility to use Salt Smart practices that will save you money, time, and materials. This allows the contractor to build in Salt Smart practices like adding liquids, anti-icing, and using less deicer materials to provide the client's preferred level of service for their property.
- With seasonal contracts the customer is assured the contractor will provide service when it is necessary throughout the winter season.
- Using a seasonal contract takes planning on the business side to determine the appropriate billing rates to continue to be a profitable business.
- Seasonal contracts may incorporate all expenses related to providing winter maintenance for the customer. On your business end, this may mean building in labor, materials, equipment expenses, and any other related overhead into the seasonal contract pricing.

Contracts based on time and materials may incentivize using more salt than is required to achieve the desired level of service.

If using a time and materials or an event-based contract, work with your customers to include Salt Smart practices in your contracts and services through the use of liquids or anti-icing events to meet your customer's needs.

## Level of Service Goals

Level of service goals help determine what procedures need to be included in your winter maintenance policy and plan. The level of service required determines to what extent you maintain an area for winter maintenance.

Does the area need to be maintained to bare pavement or are there secondary (less utilized) areas that do not require bare pavement? Different areas of a property or facility may not need to be maintained to the same standard for safe and usable surfaces. For example, in a rarely used parking lot, non-bare pavement may be ok, but in a high traffic area like sidewalks and entryways bare pavement may be required.

How quickly do different areas of the property or facility need to be cleared? Certain areas of the facility may need to be cleared within hours of snowfall and other areas may be able to wait until the next day or when time allows.

Have a discussion with your customer about their expectations for the property when determining the level of service in your winter maintenance policy or plan for their facility.

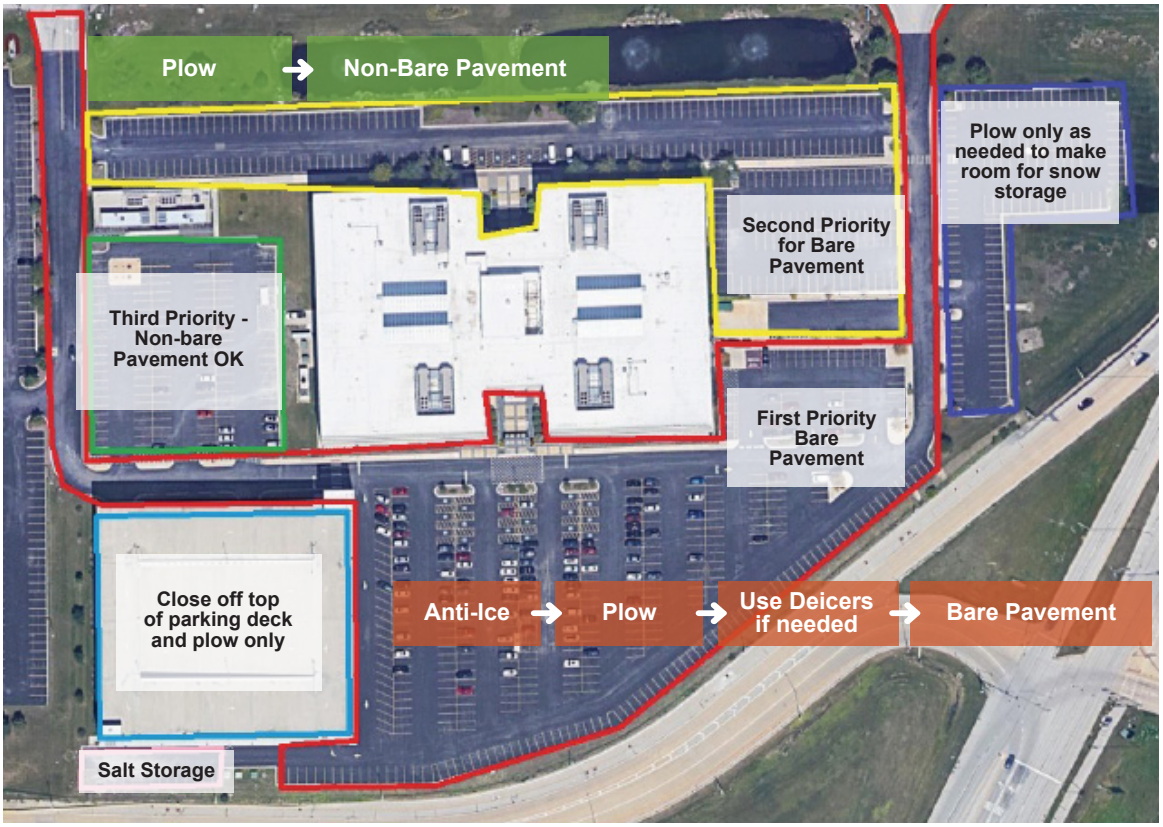
Winter maintenance professionals should take a tour of the site or property with their customers. Ask questions about the level of service they expect in various locations. Does everything need to be bare pavement? This will give you an opportunity to share some innovative salt reduction approaches they might not be aware of, but may be open to, that will achieve their desired level of service.

Consider the practices you want to include in your operations based on the level of service you are expected to provide.

- Mechanical clearing of snow and ice should be used regardless of if your target is bare pavement or not.
- If your target is not bare pavement, you may not need any deicers and be able to rely only on mechanical clearing to achieve your level of service.
- If bare pavement is your target, consider including anti-icing to make the mechanical snow and ice clearing easier, using liquids in your deicing operations as direct liquid application or as pretreated granular materials, and varying the deicing materials based on pavement temperatures and weather conditions. These practices will help you reach bare pavement quicker, easier, and with less time and materials.

**Create a map of parking lots and sidewalks and their associated levels of service at the facilities you maintain. Not every area may need to be maintained to bare pavement for safe surfaces**

Level of Service and Winter Maintenance Strategies to reach the desired level of service.



As you continue to implement Salt Smart practices, think about level of service creep. Level of service creep refers to implementing maintenance for a higher level of service than required. It is important to remember and consider the client's desired level of service, not all areas of their property may need to be fully cleared to bare pavement. By considering the level of service needs of your client and being aware of level of service creep, you can keep your salt use in-check and save time and money with Salt Smart practices.

**Consider your level of service goals for your customers or facility and avoid applying unnecessary materials when it may not be required to reach your level of service goals. This saves you and your customers money.**

## Calculating Parking Lot or Sidewalk Area

When creating your maintenance plan make sure to calculate the area of parking lots, service roads, and sidewalks. Knowing how much area you need to maintain and what the level of service goals are for those areas can help you plan how much staff time, which equipment to use, and the amount of deicer that may be needed. Knowing both the size of the area to be treated with deicer and the pavement temperature, you will be able to determine the amount of material needed using the application rate charts provided in this manual.

Begin by obtaining a scaled map of the facility that includes the acres or square footage of the areas to be treated or visit the site to measure the parking lot. Use simple math to calculate the areas or use an internet mapping tool (like google earth) or GIS mapping program to calculate areas on the computer.

## Using the Application Rate Guidance Chart as a Planning Tool

The application rate guidance chart provided in this manual can be used as a tool to prepare for winter operations. The chart can be used to determine the deicing application rates included withyour organization's policies or plans for winter maintenance. This helps you to be prepared to act fast when winter storms happen and be intentional about your deicer use. Use the application rate guidance to reign in materials and costs to reduce wasted product. Application rates are central to many pieces of your operations or your business. By determining the application rates you will be using for the winter season, you can plan for what rates to bill customers for service and budget for operational expenses like how much deicer needs to be purchased for the season. By planning ahead for material use, you can know how much brine to keep on hand and material storage needs. Equipment can be calibrated and settings marked for the application rates you will be using during the winter reducing wasted materials. During your yearly planning, create your own chart from the application rate guidance provided in this manual based on the conditions you most commonly experience and the practices included in your operations. Adjust your chart as youevaluate your program each year and adapt the Salt Smart Practices to your operations. As you work through deciding what application rates and materials to use for your

winter maintenance operations, ask yourself these key questions to help determine what application rates and materials are appropriate for your situation:

- What pavement temperatures and weather conditions do I commonly encounter in my winter operations? Include pavement temperatures that you commonly experience in your chart.
- What winter maintenance practices or materials will I be using this coming winter? For example, if you use liquids, include liquids in your chart.
- Do the pavement temperatures commonly fall below 15°F and stay cold? Dry rock salt is ineffective in very cold temperatures. Choose another material or strategy when pavement temperatures are below 15°F.

**Labeling your equipment spreading settings during calibration helps your staff know what to set the spreader to for each service event. This can ensure good communication, safe surfaces, and reduces wasted material.**

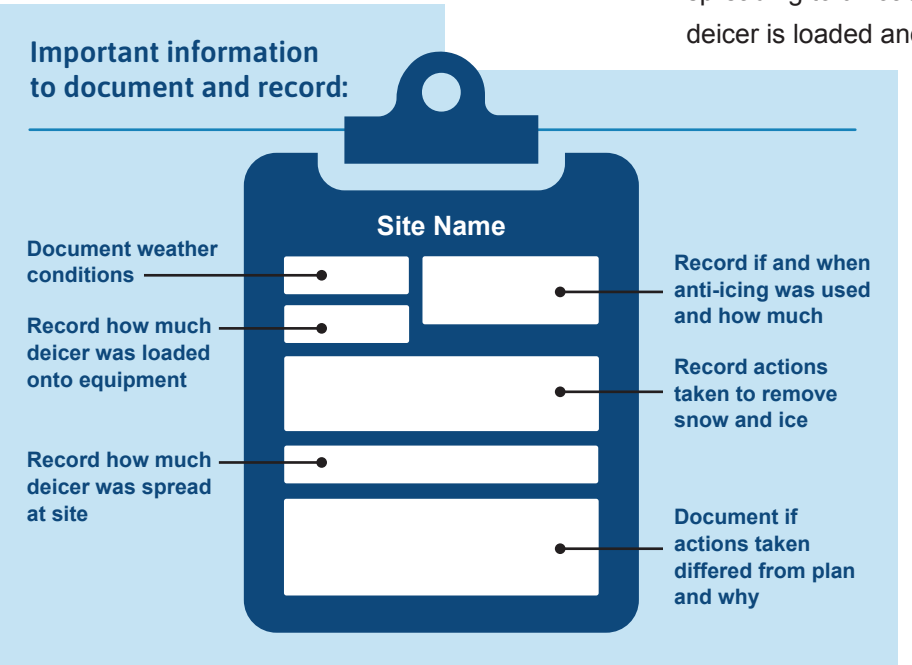
# How Your Application Rate Table Can Help You Plan For a Successful Season


**When you control what comes off the back of a spreader, you control your costs and ultimately how much money you are wasting.**

## Documenting and Charting

Good documentation and record keeping leads to reduced use of materials, more effective snow and ice control, reduced environmental impacts, cost savings, and possible protection if liability issues occur. Without documentation and recordkeeping, there is no measurement of performance. Be prepared to analyze performance and adjust future actions based on what is learned.

Documentation and recordkeeping can also be helpful in determining if there is a mechanical issue or operator error with your spreading equipment. Your documentation can serve as check and balance system for your inventory, materials, and equipment. Keep records of material at a variety of points along your winter maintenance operations from loading to spreading to unloading. If you keep track of how much deicer is loaded and then used, you can be aware of any unexpected changes to your deicer use. You can be sure material is not wasted and can expedite equipment repair or provide training to the operator ahead of the next winter storm if problems arise.




Documentation forms are available in Appendix C to record and track your actions and observations. These forms are also available at **https://saltsmart.org/private-contractors/.**

## Documenting for Liability

Documentation is one step to improve winter maintenance, but it can also help prove that the operators are using the best winter maintenance techniques and providing safe surfaces. Keeping accurate and complete records of actions taken during winter maintenance may reduce liability. Without documentation there is no record of your services.

Record all actions taken to clear snow and ice during a winter service visit and ensure that you follow your winter maintenance plan or policy. It is also important to document if your actions taken differed from your winter maintenance policy or plan and why the actions differed.

By creating a winter maintenance policy or plan, documenting your actions, and providing proof that you are following industry accepted best practices for snow and ice management, you may be able protect yourself and your organization if liability issues occur.

# 3. Communicating with your Customers and Property Managers

Property managers can be the gate-keepers for good or poor salt use practices. A trained and certified winter maintenance professional working with an uninformed property manager can lead to difficulties implementing salt reduction strategies. Here are some ways to kickstart a discussion with property managers about good winter maintenance practices:

- Share information on industry accepted best winter maintenance practices
- Introduce them to Salt Smart resources
- Encourage them to attend a Salt Smart training for property managers and business owners

## Educate Customers about Practices and Certification

As you adopt industry accepted best practices, you should educate customers about these changes. For example, communicate with your customers: "When pavement temperatures drop below 15°F, rock salt isn't cost effective. That is why we use a variety of products."


Example of Salt Smart education materials available to share.

Having an informed customer can help manage expectations and increase acceptance of new practices. Take time to explain to customers why you are using best practices including liquids, and lower salt application rates.

Encourage your customers to notify building users on what to expect when it comes to winter maintenance. Encourage them to walk and drive carefully. Encourage property owners to use signs warning of slippery conditions.

Keep your customer informed about any changes to your operations:

- New products (liquids)
- New approaches (anti-icing)
- New equipment (liquid sprayers)


Encourage your customers to survey the property to determine what locations can be closed for the winter. This might include duplicated sidewalks, wide staircases, unused parking lots or unused portions of parking lots, or high-risk areas. This could reduce your maintenance time, salt use, and risks to users.

When meeting with your customers, provide Salt Smart resources to your customers to help educate them on the reduced salt practices you will be using

at the facility. Resources for educating customers are available at https://saltsmart.org/outreach/.

Promote your Salt Smart Certification by posting to your website, using it in your advertising, or posting on social media. You can tell your customers about the practices you are doing to reduce your salt use and encourage them to do the same.

## Customer Maintained Areas

To help reduce salt use at the properties you maintain, work with your customers and property managers to put in place good winter maintenance practices, especially when the customer maintains portions of the property. The most common areas for customers to maintain are the building entrances. If possible, encourage your customers to allow Salt Smart trained and certified staff to complete all winter maintenance.


However, if your customers want to complete their own maintenance of certain areas, provide your customers with winter maintenance guidance and tips to ensure they follow smart salting practices:

- Encourage all customers and any potential salt bucket users to watch the Mississippi Watershed Management Organization's "Winter Maintenance for Small Sites" video (**https://www.youtube.com/watch?v=-xMt1kyzlcg**) and to attend a Salt Smart Property Managers training.
- Discourage the use of salt by customers who have not been properly trained on smart salting techniques.
- Place tools in building entrances to provide the option to clear snow mechanically. Include shovels, scrapers, or brooms at a designated location.
- Place a broom near the area to sweep up extra deicer or salt after the storm and include instructions for returning extras to salt bucket.


- Use phrases with your customers like "Always shovel before applying salt" or "Give salt time to work before reapplying. The colder it is, the slower it will work."
- Post a Salt Smart educational poster near the snow clearing tools.

Additionally, you can share guidance and spreading tools if the customer uses deicer or a salt bucket to aid any users:

- Store the salt bucket away from the building entrance or areas to be treated so only those who have been trained have access to use the salt bucket.
- Provide clear salt spreading instructions for anyone using the salt bucket. Post the instructions at the salt bucket storage location and include written instructions directly on the salt bucket.
- Don't fill the bucket or shaker completely, only provide enough deicer for one or two winter events at a time to encourage less salt use.
- Include a scoop or spreader with the proper amount of deicer indicated.
- Provide a smaller scoop. A 12-ounce cup is enough deicer for 10 sidewalk squares.

# 4. Preparing for Winter Operations

Before winter begins each year, it is important to review and update your winter maintenance plan to reflect any changes that need to be made. Other important preparations that should be completed before the winter season begins:

- Verify the area of the parking lots, service roads, and sidewalks and if any changes to the property were made that may affect your winter maintenance operations.
- Confirm that the areas planned for properly storing deicer materials, on-site equipment, or excess snow piles are still available to be used for those purposes during the winter months.

**Address any problem areas before they become winter maintenance problems. Solutions may be as simple as redirecting a downspout or adding caution signs at known problem areas.**

## Drainage

Understanding on-site drainage patterns is an important aspect of preparing for winter maintenance. Poor drainage may result in icy surfaces. These problem areas can cause excess application of salt, even on non-snow event days in the winter. Sometimes problem areas will melt during the day into puddles and refreeze at night, prompting repeated deicer applications.

To remedy this, inventory the site and note drainage problems. Plan or work with your client to fix these problems before the next winter. Solutions may be as simple as redirecting a downspout into a nearby grassy or vegetated area or closing off the problem section of the sidewalk or parking lot during the winter.


Different types of problem areas you may encounter: Downspouts that discharge over sidewalks (1 and 2), uneven sidewalk tiles (3), and poor drainage or low spots in parking lots may lead to over salting due to ice forming on surfaces (4).

Inspect storm drains in the fall. Remove obstructions such as leaves, sticks, and trash to prepare for the spring melt. Storm drains allow for water and snow melt to be drained away from the property. Because storm drains lead to lakes, rivers, ponds, and wetlands, never use salt to open frozen storm drains. Salt used to thaw frozen drains harms the environment, aquatic life, and infrastructure. Use non-chemical methods such as heat to open frozen drains.

## Training

Training is an important part of preparing for winter maintenance. Learning to properly implement important best management practices can reduce salt use while still prioritizing safety. Scheduling training for both supervisors and the operators or maintenance workers is integral to the success of your plan.

Training should include information on the best practices for winter maintenance and reduced salt practices.

Make time to do internal training and review the winter maintenance plan with your staff ahead of winter so that everyone can be prepared to implement the plan.

Training on winter maintenance practices is available through the Salt Smart Collaborative as the Salt Smart Parking Lots and Sidewalks Training Program. The Salt Smart Training Program follows the topics and material provided in this manual and allows you to be eligible to Salt Smart Certified.

Numerous other winter maintenance workshops and training classes are held annually throughout Illinois and nearby states (including Minnesota and Wisconsin) that provide training for snow/ice management and reduced salt use. Virtual training classes or workshops may be available online through various organizations, including Salt Smart. These workshops and training classes are provided by a number of entities including county or state governments, environmental organizations, and trade groups.

Additional resources are provided in Appendix B and at www.saltsmart.org.

# 5. Weather Preparedness and Pavement Temperatures

Weather and pavement conditions matter when making decisions about what winter maintenance strategies to use. It is important to pay attention to the pavement conditions and pavement temperature, as they can differ significantly from the reported air temperature. The application rate tables in Chapters 10 and 12 are based on pavement temperatures not air temperatures.

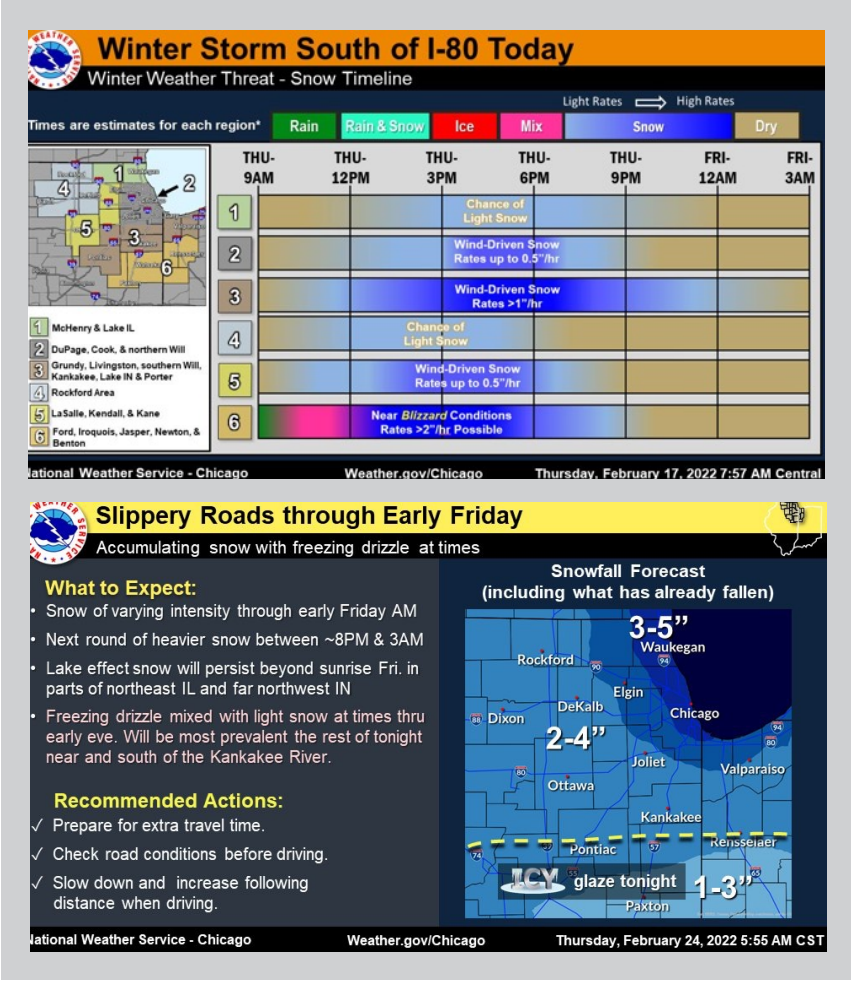
## Weather

Winter maintenance strategies vary based on the type of precipitation and the weather conditions.

It is important to know and track existing and forecasted pavement weather conditions for a successful snow and ice control operation. By monitoring the weather closely, you can prepare to act early in storm situations.

There are various options for sourcing weather information for winter maintenance decisions. You may choose to subscribe to a weather forecasting service. Weather forecasting services can provide localized information on precipitation, storm duration, and temperature. The most valuable weather forecasting services offer real time pavement temperature conditions and pavement temperature forecasts. A weather forecasting service may also be able to send you winter weather alerts and provide important decision-making pavement condition information in advance to help you prepare for winter weather events.

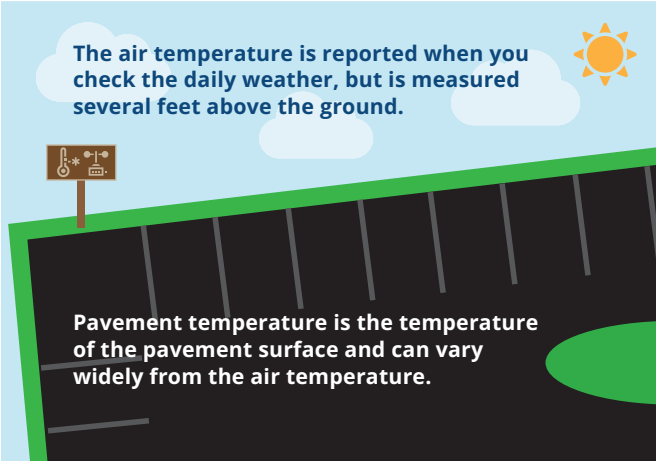
If a weather forecasting service is not available to you, free options for winter weather forecasts include, the National Weather Service (http://www.weather.gov), local TV stations, or weather websites. Be aware that these options are forecasting the air temperature and not the pavement temperature, so you will need a way to measure the pavement temperature prior to applying treatment.




Screenshots from National Weather Service - Chicago

## Pavement Temperature

Knowing the pavement temperature, which is different than air temperature, will allow for application of the proper type and amount of deicing material.




Since the air and pavement temperatures can vary greatly, it is important to know the pavement temperature to determine the proper amount and type of material to apply.


Hand-held infrared temperature sensor.

A key piece of equipment for any winter maintenancel professional is a pavement temperature sensor. These sensors are often non-contact, infrared temperature sensors that can be hand held or mounted onto vehicles. Vehicle mounted temperature sensors provide a continuous stream of information. Hand-held temperature sensor can often be purchased for less than $100. Some temperature sensors only accurately monitor in the warm temperature range, so it is important to confirm the one purchased measures in the cold temperature range.

**Pavement temperatures are influenced by exposure to sun, shading from buildings or trees, pavement type, and subsurface materials.**

Tips for using a pavement temperature equipment:

- Before using the temperature sensor, test it. Aim it at a glass of ice water, the temperature should read 32°F.
- Pavement temperature sensors work best if they have acclimated to the outdoor temperature; however, even if you take it out of a warm truck to monitor the pavement temperature you will still get a much better understanding of the current pavement conditions than using the air temperature.
- Vehicle mounted temperature sensors are mounted outside the cab of the vehicle, you do not have to wait for the sensor to acclimate to outside conditions.
- Read the instructions for your pavement temperature equipment. Some hand held units need to be within 2 feet of the pavement surface to provide the most accurate temperature readings.

# 6. Calibration of Spreading Equipment

**Calibrating equipment helps you understand how much material is spread by your equipment. This means you can be accurate with your deicer use, saving money and time.**

Calibration is an essential procedure to understand how much material will be discharged at a given setting. No matter how sophisticated or simple the operation, calibrate each piece of equipment before each winter season. If the equipment has different settings, it must be calibrated for each setting and for each product that you intend to use. This is important because different products, like rock salt vs. pellets, are different sizes and may be discharged at different rates. It generally takes a team of two or three people to calibrate equipment efficiently. Equipment should be calibrated annually, and calibrated again if changing materials or if any repairs or changes are made to the equipment. Proper calibration allows you to accurately track how much salt you are using, measure reductions as you adjust practices and ultimately reduce waste and save money.

## Types of Spreading Equipment

Spreading equipment can come in all sizes from small hand-held spreaders to large V-Box spreaders to meet the needs of different winter maintenance operations. All types of spreaders need to be calibrated annually and after maintenance or repairs.

Spreaders usually fall into two categories, Ground Speed-Controlled Spreaders and Manual Controlled Spreaders.

Ground speed-controlled spreaders are run by computers inside the cab of the truck and set the discharge rate based on the selected setting regardless of the speed of the vehicle.

Manual control spreaders need to have the discharge rate set manually by the operator. Manual control spreaders can include auger or conveyor systems or gravity fed spreaders. The controls may be located in the cab or may be located at the point of discharge on motorized manual control spreaders.

Liquid spreading equipment can be ground speed controlled or manually controlled just like spreaders for solid materials.

## Calibrating Manual Controlled Spreaders

Manual controlled spreaders fall into two categories, those that are on motorized equipment and walk behind push spreaders or hand-held spreaders. Most of these spreaders operate by selecting a setting that changes the size of the discharge opening and/or the auger or conveyor speed. More or less salt may be discharged depending on the speed you are traveling as you apply material.

Auger or conveyor systems are controlled in the cab by the operator. These types of spreaders are motorized.

Granular gravity fed equipment is usually smaller and include walk behind push spreaders (rotary or drop spreaders) and hand spreaders.

Motorized equipment and push spreaders need to be calibrated differently. Motorized gravity fed equipment can be calibrated similarly to push spreaders, but the final calculation needs to consider the speed you are traveling as you apply materials. If you need calibration guidance for your specific piece of equipment, talk to your vendor or product manufacturer.

## Push Spreaders

Push spreaders are a very commonly used type of gravity flow equipment. These types of spreaders are typically controlled by changing the discharge gate opening. A video guide for calibrating a walk behind push spreader is available at https://saltsmart.org/private-contractors/.

### Step 1: Measure and fill out chart

**a)** Mark out a stretch of pavement and measure the length (By increasing the size of the test area i.e., the longer the test area, the more accurate the results will be). Use tape marks on the pavement to help denote start and stop points. Record the length of the test area in Column L.

**b)** Sweep it clean of sand or any other material.

**c)** Record the lever position/setting for the gate/chute in Column A. If there are no numbers for the positions, make permanent marks on the equipment to identify the positions.

**d)** Using your normal walking pace, apply one pass of material to the test area.

**e)** Measure the width that the material is spread or bounces, in feet, and record the width in Column W.

**f)** Sweep up and weigh the material that is within the marked area. Record the weight of the swept-up material. Record the weight in Column B.

**g)** Complete these steps at least once for each setting. Repeating the calibration process for each setting will improve the accuracy. If repeating the process, calculate the average weight of material applied for each setting. Record the average weight of the swept-up material in Column B.

### Step 2: Calculate discharge rate

**a)** Calculate application rate using the example form below.

**b)** Fill out columns C and D. Column D will be the application rate for that setting.

**c)** If using more than one type of material, repeat the process for each material.

**d)** Fill out Spreading Rate Card and attach to equipment.

**Step 3: Repeat steps #1 and 2 for various settings and each material. Use a different form for each material.**

## Calibration Form: Calculate Application Rates

**(Pounds per 1,000 sq. ft.)**

Equipment: _____ Material: _____ Date: _____

| A | B | W | L | C | D |
|---|---|---|---|---|---|
| Lever position or gate setting | Pounds spread in Test Area | Spread width in feet | Length of Test Area | Coverage area in sq. ft. **(W x L)** | Application rate in lbs./1000 $ft^2$ **(B/C x 1000)** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| *EXAMPLE* | | | | | |
| *Setting 1 (Half Closed)* | *0.4 lbs.* | *13 feet* | *10 feet* | *13ft x 10ft =130 sq. ft.* | *(0.4/130) x 1000 = 3.1 lbs. per 1000 sq. ft.* |

### Tips for Calibration:

- Smooth indoor concrete is easiest to work on.
- If using rough pavement with a lot of small gaps or holes in the surface that the material could fall into, put down a large tarp to avoid missing any grains.
- Using a tarp across the test area makes it quicker to recover and weigh material.
- After the first pass, put a bag around spreader to catch discharge material to be weighed. The first pass is needed to determine the spread width.

In the end, there will be data that tells the operator how much material will be delivered at each setting. With this information, the operator or the organization can choose the proper setting for predicted weather conditions. Without this information, they have no guidance on which setting to use to deliver the sought-after application rate.

Filling out the Calibration Form and keeping accurate records is an important step in the calibration process and allows you to ensure that your equipment is in good working order from year to year. Calibration record should be kept for each piece of equipment. See Appendix C for a full-size form to copy for calibration. Keep a stack of these on a clipboard when ready to begin the calibration.

## Motorized Equipment

Motorized equipment commonly includes tailgate spreaders and slide-in insert spreaders on the back of pickup trucks, UTVs, and ATVs. These pieces of equipment may be manually controlled by the operator and the amount of material spread depends on the gate opening and speed of the vehicle. It is important to calibrate the equipment annually for each setting and material that is going to be used during the winter season. The calibration process for most motorized equipment, both auger or conveyor systems and gravity fed, is mostly the same. If you have questions about calibrating your specific piece of equipment, talk to your vendor, they can often provide guidance.

The basic method to calibrate a motorized piece of equipment:

1. Record the type of material, date, and type of material being calibrated.
2. Choose a setting. Record the chosen setting in Column A.
3. Discharge the material for 1 minute or drive while discharging the material for 1 minute.
4. Collect and weigh the material discharged and record it in Column B.
5. Repeat steps 2 through 4 for each setting.
6. To complete the remaining columns in the chart, multiply the amount of material discharged in Column B by the multiplication factor listed for each remaining column. This will give you Pounds per 1,000 Square Feet at different speeds.
7. Repeat all the steps above for each material, completing a new chart for each material for each piece of equipment.

## Calibration Form for Motorized Equipment: Calculate Application Rate

**(Pounds per 1,000 sq. ft.)**

Equipment: _____ Material: _____ Date: _____

| A | B | C | D | E |
|---|---|---|---|---|
| **Setting** | **Pounds Discharged per Minute** | **5 MPH (x0.19) in lbs/1000 sq ft** | **10 MPH (x0.09) in lbs/1000 sq ft** | **15 MPH (x0.06) in lbs/1000 sq ft** |
| *Example:* | *50* | *50 x 0.19 = 9.5* | *50 x 0.09 = 4.5* | *50 x 0.06 = 3* |
| | | | | |
| | | | | |

In the end, there will be data that tells the operator how much material will be delivered at each setting. With this information, the operator or the organization can choose the proper setting for predicted weather conditions. Without this information, they have no guidance on which setting to use to deliver the sought-after application rate.

Filling out the Calibration Form and keeping accurate records is an important step in the calibration process and allows you to ensure that your equipment is in good working order from year to year. See Appendix C for a full-size form to copy for calibration. Keep a stack of these on a clipboard when ready to begin the calibration.

## Calibrating Ground Speed-Controlled Spreaders

Ground speed-controlled spreaders are run by a computer in the cab and are tied to the speedometer and an auger or conveyor sensor in the rear of the truck. The application rate is set and the computer regulates the amount of salt discharged (regardless of the speed traveled) consistently. These are more effective and efficient systems than the manually controlled systems. When calibrating ground-speed controlled equipment, document the calibration in a calibration log. A calibration log is provided in Appendix C.

The equipment vendor will have specific calibration instructions. Follow the calibration instructions provided by the equipment vendor or manufacturer. This is the basic principle behind calibrating a ground speed-controlled spreader:

- The speedometer input (sensor) lets the controller know how fast or slow the truck is traveling.
- The auger or conveyor input (sensor) tells the controller how fast or slow the auger is turning.


In cab controls for ground speed-controlled spreader.

- To calibrate a ground-oriented controller, input the amount of material discharged per revolution or time interval.
- Once the computer knows the amount of material per revolution or amount of material discharged for the time interval, it will calculate the necessary auger speed needed to hit the target application rates at the speed the truck is traveling.

## Calibrating Liquid Spreading Equipment

It is just as important to calibrate liquids as well as solid materials. Liquids are calibrated in gallons/minute. They can be calibrated much like solid materials. In addition to catch tests, applying a test pattern gives easy insight into any nozzle problemsthat may need to be repaired before the winter season.Many commercially purchased liquid spreading systems are ground speed-controlled spreaders. Consult your equipment vendor or manufacturer for specific instructions for your equipment.

**To calibrate non-ground speed controlled liquid spreading equipment:**

**Step 1:** Record the total width of the spray pattern from the spray boom and nozzles in FEET.

**Step 2:** Run the equipment for a timed interval, record the time in minutes.

**Step 3:** Collect the liquid from all nozzles in containers and measure the amount in the containers..

**Step 4:** Record the total amount of liquid discharged.

**Step 5:** Divide the total amount of liquid discharged by the time to get gallons per minute.

**Step 6:** To complete the remaining columns in the first chart in Gallons/Acres, use the following formula:

$$\frac{\text{GPM x 495}}{\text{MPH x W}}$$

GPM = Gallons per Minute
MPH = Speed, Miles per Hour
W = Total Width of Spray Pattern

**Step 6:** To complete the remaining columns in the first chart in Gallons/1,000 Square Feet, use the following formula:

$$\frac{\text{GPM x 495}}{\text{MPH x W x 43.56}}$$

GPM = Gallons per Minute
MPH = Speed, Miles per Hour
W = Total Width of Spray Pattern

## Calibration Chart for Liquid Spreaders: Calculate Application Rate (Gallons/1,000 sq ft)

**Calibration Chart for Liquid Spreaders: Calculate Application Rate (Gallons/1,000 sq/ft)**

Equipment: _____ Material: _____ Date: _____

| Total Width of Spray Pattern (feet) | Time Interval (Minutes) | Gallons Discharged (gallons) | Application Rate (gallons per minute) | Application Rate by Speed 5 MPH (Gallons/1,000 sq ft) | Application Rate by Speed 10 MPH (Gallons/1,000 sq ft) | Application Rate by Speed 15 MPH (Gallons/1,000 sq ft) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | *Example:* | | | | | |
| *Width (W)* | *Minutes* | *Gallons* | *Gallons per Minute (GPM) = Gallons Discharge/Time Interval* | *(GPM x 495) / (MPH x W x 43.56) = Gallons/Acre* | *(GPM x 495) / (MPH x W x 43.56) = Gallons/Acre* | *(GPM x 495) / (MPH x W x 43.56) = Gallons/Acre* |
| *8 feet* | *10 minutes* | *80 gallons* | *80 gallons/10 minutes = 8 gallons per minute* | *(8 gallons per minute x 495) / (5 MPH x 8ft x 43.56) = 2.3 gallons/1,000 sq ft* | *(8 gallons per minute x 495) / (10 MPH x 8ft x 43.56) = 1.1 gallons/1,000 sq ft* | *(8 gallons per minute x 495) / (15 MPH x 8ft x 43.56) = 0.75 gallons/1,000 sq ft* |

## Calibration Chart for Liquid Spreaders: Calculate Application Rate (Gallons/Acre)

Equipment: _____ Material: _____ Date: _____

| Total Width of Spray Pattern (feet) | Time Interval (Minutes) | Gallons Discharged (gallons) | Application Rate (gallons per minute) | Application Rate by Speed 5 MPH (Gallons/Acre) | Application Rate by Speed 10 MPH (Gallons/Acre) | Application Rate by Speed 15 MPH (Gallons/Acre) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | *Example:* | | | | | |
| *Width (W)* | *Minutes* | *Gallons* | *Gallons per Minute (GPM) = Gallons Discharge/Time Interval* | *(GPM x 495) / (MPH x W) = Gallons/Acre* | *(GPM x 495) / (MPH x W) = Gallons/Acre* | *(GPM x 495) / (MPH x W) = Gallons/Acre* |
| *8 feet* | *10 minutes* | *80 gallons* | *80 gallons/10 minutes = 8 gallons per minute* | *(8 gallons per minute x 495) / (5 MPH x 8ft) = 99 gallons/Acre* | *(8 gallons per minute x 495) / (10 MPH x 8ft) = 49.5 gallons/acre* | *(8 gallons per minute x 495) / (15 MPH x 8ft) = 33 gallons/acre* |

## Create a Spreading Rate Card for Each Spreader

After completing the calibration form for each piece of equipment, create a spreading rate card to either attach to the equipment or place in the cab near the controls. It is important to verify the card is correct each year and for each type of material. You will likely need to update the card each year. You may need to create multiple cards, if using different types of materials with the same piece of equipment. You should have one card for each type of materials used as the rates may vary.

The card should be specific to the piece of equipment that it is meant for and include the settings that were calibrated. It should list out the settings and amount of materials discharged at those settings.

Attach a calibration card to your equipment to easily know how much material is spread at each setting.

You may also want to label or mark the settings directly on the equipment. This can help make it clear to your staff which settings to use when applying your chosen materials.

## What if calibration is not a practice?

Every effort should be made to calibrate equipment. If you can only calibrate some of your equipment, prioritize your largest or most frequently used equipment. Calibration is a requirement of Salt Smart Certification.

## Equipment Discharging at a Rate that is too High

After calibrating, the equipment may still be discharging too much, even at the lowest setting, to be able to match up the rates from your equipment to the guidance in the application rate charts found in Chapters 10 and 12.

**When purchasing new equipment, select equipment that can accurately deliver low application rates.**

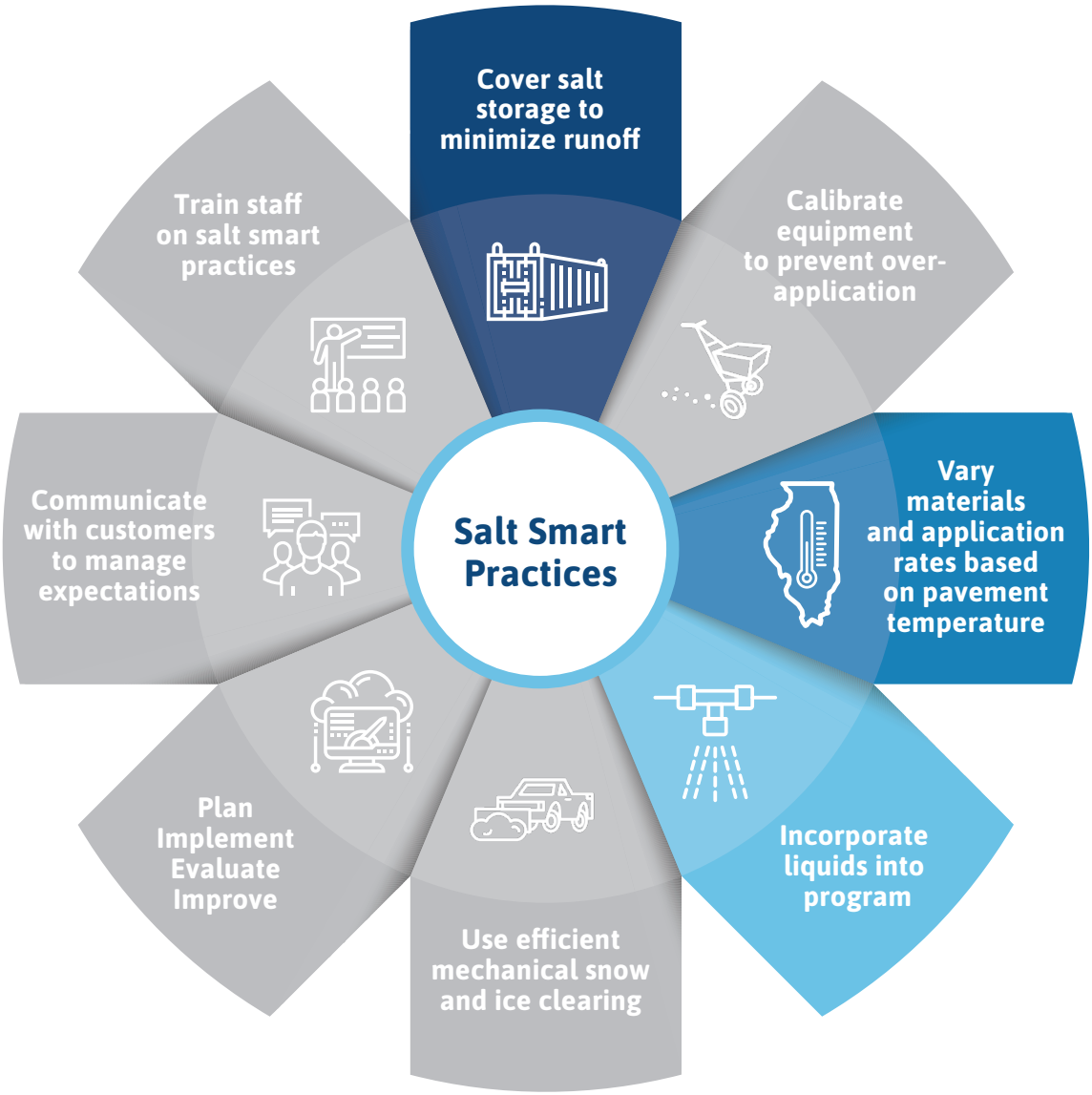
First, determine if the equipment is operating properly and complete any needed repairs. After any needed repairs, recalibrate the equipment. If it is still discharging too much material for your targeted application rates, you may need to investigate or research other ways to reduce the discharge rate. Investigate equipment modifications or equipment upgrades that reduce the amount of salt that is spread out. Depending upon your type of equipment, options may include welding or modifying the gate opening to be smaller to reduce the amount of product being discharged. Be aware that after-market modifications may void equipment warranties.

# Winter Maintenance Material Options and Storage

**Chapter 7 – Choosing Materials for Winter Maintenance Operations**

**Chapter 8 – Liquids for Deicing and Anti-icing**

**Chapter 9 – Storage and Handling**



# 7. Choosing Materials for Winter Maintenance Operations

No one material is suitable for every condition. Be strategic about the materials you choose to keep on hand. Understand the melting properties of each deicer; do not use the product without understanding how it works. Be aware of the pavement temperature thresholds that may limit the product's effectiveness. A simple way to remember this is using the three "rights": RIGHT material for the RIGHT conditions applied at the RIGHT time.

**The best ways to reduce impacts, save money and maintain customer satisfaction:**

- Know what is in the product.
- Know the practical melting range of the product.
- Use the product only when it will be effective.
- Use the minimum amount needed to get the job done.
- Seek out products that allow for smaller application rates.

## Types of Materials

### 1. Chloride Based Deicers:

Sodium Chloride, Potassium Chloride, Calcium Chloride, and Magnesium Chloride are all chloride-based deicers. While all four of these are technically "natural salts", usually only Sodium Chloride is referred to as "salt". Deicers will melt snow and ice by lowering the freezing point of water from 32°F to a colder temperature. Deicers must be dissolved to work; therefore, liquids act faster than solids, and all deicers have different melting characteristics, depending on the selection.

#### Sodium Chloride (NaCl aka "Rock Salt" or "Solar Salt")

- Most commonly used and least expensive deicer.
- Limited effectiveness if the pavement temperature is below 15°F.
- Salt brine (NaCl) is commonly used at a 23.3% concentration as this has the lowest freezing point and can be stored and handled down to -6°F.

#### Calcium Chloride ($CaCl_2$)

- Melts snow and ice to -25°F.
- Costs more than sodium chloride.
- Natural state in liquid form.
- Solid forms available in pellets and flakes.
- More corrosive than sodium chloride, though field results do vary.
- Not the best use of resources above 15°F, better suited for very cold conditions.

#### Magnesium Chloride ($MgCl_2$)

- Similar to calcium chloride, but melts snow and ice to -15°F.
- Natural state in liquid form.
- Solid forms available in pellets and flakes.
- Magnesium chloride is more damaging to concrete and other materials than sodium chloride.
- May clog equipment when used with salt brine as the temperature drops. Magnesium sulphate is often an impurity in Magnesium Chloride salts and can crystalize at temperatures below 0°F causing sludge to form in tanks, clogging spray nozzles or transfer pumps.
- Not the best use of resources above 15°F, better suited for very cold conditions.

### 2. Non-Chloride Based Deicers:

The most common non-chloride based deicers are Acetates and Formates, which include:

- Calcium-Magnesium Acetate (CMA)
- Sodium Acetate (NaAc)
- Potassium Acetate (KAc)
- Sodium Formate (NaFm)
- Potassium Formate (KFm)

These deicers do not contain chloride. They are chemically manufactured, not mined from the earth, and as a result are often more expensive than chloride-based deicers. However, both acetates and formates are less corrosive than chloride-based deicers and they have a wide melting range, depending on the product. Some acetate and formate products work at temperatures where rock salt is ineffective and some do not.

Non-chloride based deicers are usually used for parking decks and other infrastructure where corrosion is a concern and these products may be required to maintain warranties on that infrastructure. It is strongly encouraged to verify which deicing materials to use before maintaining corrosion sensitive infrastructure.

Acetates and formates are often used as an additive to chloride-based deicer blends. Acetates and formates are also found in many products marketed as “chloride free” or “non-chloride”. It is important to note that acetates and formates are not better or worse than chloride salts, they are different.

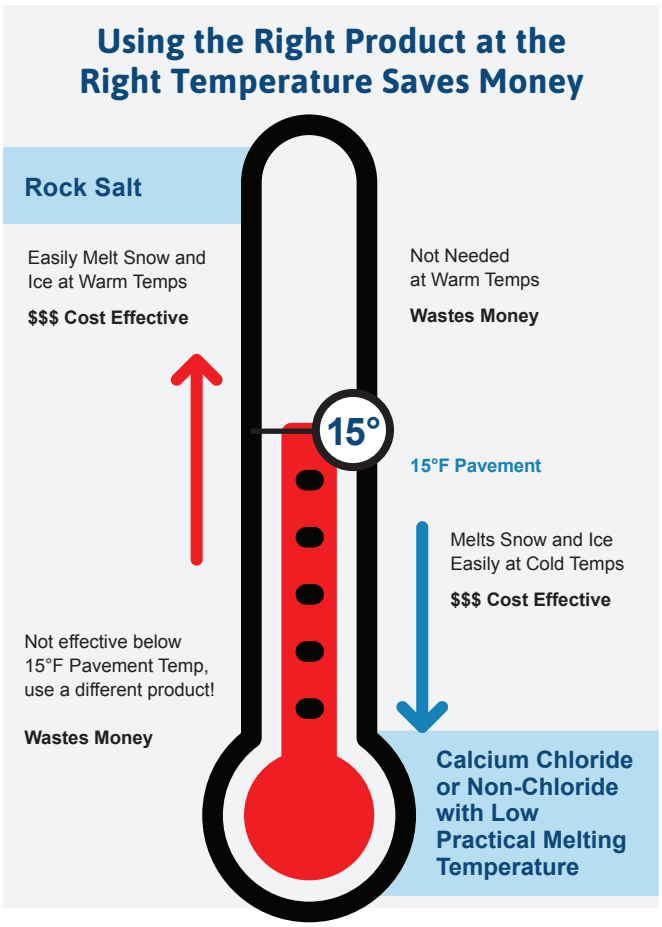
### 3. Plant-based additives

Carbohydrates from corn, beet, molasses, or other organic byproducts can be added to salt or salt brine to change its performance. Carbohydrates themselves do not melt ice, but they can disrupt the formation of ice crystals and help lower the freezing temperature of brine. Their “sticky” nature helps to reduce bounce

**Rock Salt is the commonly used name for Sodium Chloride deicers. Rock Salt is mined from underground with little processing.**

**Solar Salt is also a Sodium Chloride deicer, but it is made by an evaporation process from salt brine or salt water. Solar Salt is good for making brine due to having less impurities than Rock Salt.**

**Be aware there is a moratorium on the use of Magnesium Chloride by the Illinois DOT due to its damaging effects on concrete. Products containing magnesium chloride are not eligible for Motor Fuel Tax funding. Public agencies are strongly encouraged to verify this information with the Illinois DOT before choosing a product containing Magnesium Chloride.**



and scatter and keep deicing material on the pavement surface. They may also provide some protection against corrosion.

**4. Abrasives:**

Sand, the most common abrasive, does not melt snow and ice. Abrasives provide traction on top of packed snow or ice. Abrasives and deicers typically work better alone, rather than mixed together. A small amount of salt may be mixed in the sand (less than 10%) to prevent freezing in the pile. Sand is most commonly used in rural areas or facilities with little traffic because it tends to rapidly wash or blow off pavements and therefore only provides traction for a small number of vehicles. Using sand instead of deicers may be beneficial in areas with high quality habitats, like forest preserves or natural areas. Sand is a good tool if you do not have a bare pavement level of service target.

**By choosing a less corrosive deicer that may cost more up front, you may be able to reduce damage and replacement costs to infrastructure (like pavement, concrete, and buildings).**

### Contractor's Corner: Bulk vs Bagged Products

Deicers are available in a variety of package sizes from very small bags to truck-loads of bulk products. Most deicers are available as bagged products in various sizes with 50-pound bags as the most commonly available. Depending upon your supplier's availability, you can purchase deicers in bulk. Both bulk and bagged products have benefits and best uses in winter maintenance operations.

**Bulk Products**

- Both granular and liquid products are available in bulk
- If you have the ability to properly store bulk products, they are often cheaper than bagged products.
- Treated granular products can be purchased in bulk and offer the convenience of not having to pre-treat or pre-wet your own materials.
- Proper storage is required for bulk liquid and granular materials.
- Bulk granular products often work better in large spreaders versus small spreaders.

**Bagged Products**

- If space allows, you can easily keep many different types of bagged products on hand for a variety of different weather conditions.
- Bagged products often come in pellets, flakes, or smaller grain sizes that work well in walk behind spreaders or hand-held spreaders.
- Bagged products are often referred to as "Sidewalk Salt".
- Properly store all bagged products under cover or indoors.

## Pretreated and Pre-wetted Materials

Pre-wetting and pretreating both mean getting dry material wet before it lands on the pavement. Pre-wetting is the process of adding liquid to solids as they are applied to the pavement. Pretreating is the process of adding liquid to solids in the stockpile. Salt only melts snow and ice when it is in solution (dissolved). Dry salt does nothing until it is wet and starts to dissolve into a liquid brine solution. Liquids applied to dry salt jump-start the melting process and penetrate ice and snow pack faster. Wet materials stick to the pavement and are less likely wash or blow off and end up in the nearby vegetation. When using pre-wetted or pretreated salt, it is important to adjust the application rate down.

Granular deicers can be purchased pretreated by your vendor or supplier either as a bulk product or bagged

product if you do not want to pretreat at your facility or do not have the capability to pre-wet on your equipment.

When starting out with pretreated product, it may be best to purchase commercially produced products instead of making your own pretreated product yourself as you learn to use the pretreated product and become comfortable with the reduced application rate. Pretreated salt can be purchased as bagged product or in a bulk product. Be sure to ask your vendor for information about the product and the practical melting temperature.

**You can use approximately 20-30% less material when using a pre-wet or pretreated product, and it works faster than dry salt!**

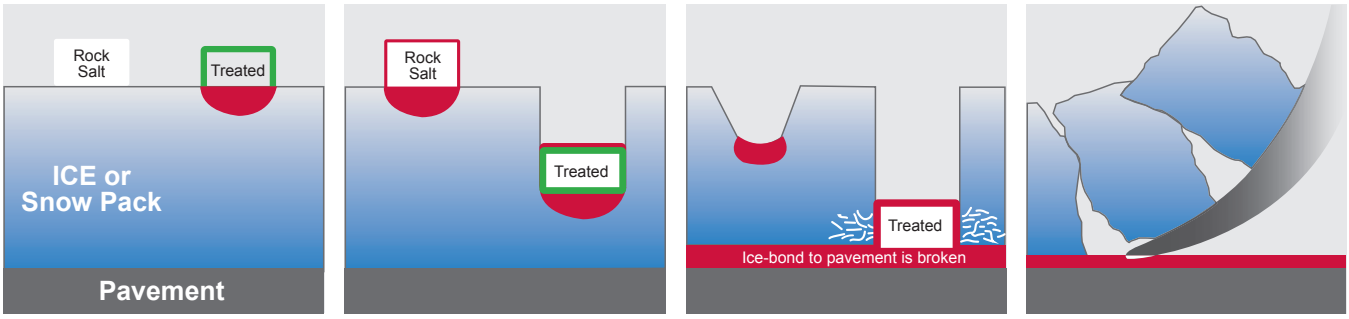
Learn more about how to pre-treat or pre-wet at your facility or on your equipment in Chapter 12.

**1.** Treated salt benefits are seen as soon as it hits the ground. Less bounding & activation on contact, thus immediately creating salt brine.

**2.** Treated salt bores into snow pack or ice further and faster than untreated salt by pooking the salt brine.

**3.** After untreated salt dissolves, treated salt is still breaking the bond between ice and pavement!

**4.** Broken ice bond allows plows and shovels to clear pavement faster with less effort. Saving MONEY.




Adapted from graphic provided by Midwest Salt.

Salt Brine  Treated Coating

## Speed of Melting

For solid deicers to work they must first turn into a liquid then mix with the snow and ice. Solids bore through the ice or hard-packed snow, forming a liquid deicer solution, like salt brine, that can spread and undercut the snow and ice. Once the bond with the pavement is broken, the snow or ice can be more easily cleared mechanically with plows or shovels.

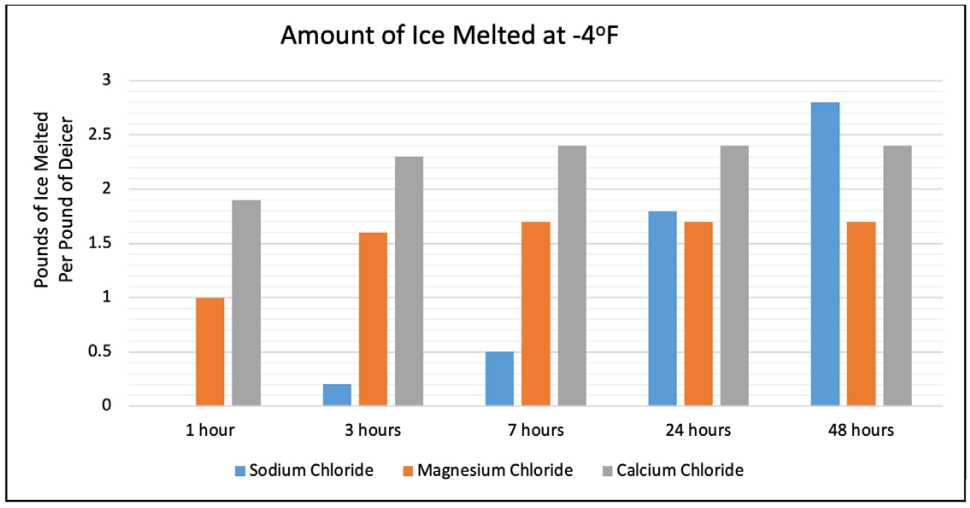
**The temperature of the pavement will change the speed of melting, but not the total ice melting capacity for deicers.**

The warmer the pavement temperature, the faster any given product will work. When it is very cold, sodium chloride (rock salt) will melt very little ice. Salt is commonly overused because of the misconception that more salt will speed up melting. If a person is already using the proper amount of salt, more salt will not make the ice melt faster.

**Why do Calcium Chloride and Magnesium Chloride work well at really cold temperatures? These two deicers are able to form a liquid deicer solution faster than sodium chloride (rock salt) in cold temperatures in two ways:**

1. Calcium chloride and magnesium chloride are exothermic materials. They undergo a chemical reaction with the surrounding snow and ice to create their own heat. This heat melts the snow and ice allowing the solid deicers to dissolve into a liquid deicer.
2. Calcium chloride and magnesium chloride also have the unique property of drawing moisture to themselves and being able to absorb that moisture to dissolve into a liquid deicer.

**Using more salt to try to speed up melting only wastes money and product while increasing damage to the environment. Instead, chose the most appropriate product based on the pavement temperature and practical melting temperature of the product to get the best results.**




(Chart above adapted from Cargill/Dr. Scott Koefod, Fundamentals of Liquid Deicer Performance, 2018)

At very cold temperatures, sodium chloride (rock salt) will take a very long time to melt an equivalent amount of snow and ice to other deicers. More is not always better. When it gets too cold for sodium chloride to work, switch to a different material to achieve the desired results in a reasonable amount of time.

## Lowest Practical Melting Temperature

**Lowest practical melting temperature** refers to the coldest real-world conditions that the deicer will be effective at melting ice.

The **eutectic temperature** is the lowest temperature that deicers will melt ice, but this temperature was determined in a lab setting, not in practical, real-world conditions.

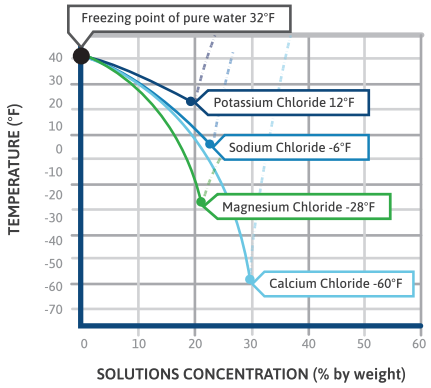
Sodium chloride (rock salt) is only effective at pavement temperatures above 15°F, it will still melt ice until -6°F but it will take far too long to see results. Because sodium chloride doesn't work well at colder temperatures, it is often over-applied in attempts to increase its effectiveness. At temperatures lower than 15°F degrees, you will need a different strategy like switching to a different deicer or using only mechanical methods until conditions are more favorable for rock salt. It should be noted that there is not a standard measure for determining the lowest practical melting temperature as many factors contribute to the effectiveness of a deicer material.

### CHLORIDE SALTS: Eutectic Temperatures

As chloride salts are added to water, they interfere with its ability to freze and lower its freezing point.

These solutions hit their eutectic point when no more chloride salts can be added.

After their eutectic point, these solutions become supersaturated, the salts fall out of solution, and the mixtures begin to re-freeze




Adapted from "Eutectic Temperature vs. Practical Temperature", https://blog.iceslicer.com/eutectic-temperature-vs.-practical-temperature

| Deicing Chemical | Lowest Practical Melting Temperature |
|---|---|
| Sodium Chloride | 15° F |
| Magnesium Chloride | -10° F |
| Calcium Chloride | -20° F |
| Calcium Magnesium Acetate (CMA) | 20° F |
| Potassium Acetate (Kac) | -15° F |
| Potassium Formate (KFm) | -25° F |

Above Left: Use the chart above when choosing which deicing materials to keep on hand for use in winter maintenance. This chart lists commonly used deicers and their lowest practical melting temperature (source: "Winter Parking Lot and Sidewalk Maintenance Manual", Minnesota Pollution Control Agency).

### Eutectic vs. Practical Temperatures

Many factors cause the practical performance of the deicer in the field to differ from its eutetic temperature in the lab

| | |
|---|---|
| Dilution: | Higher levels of snow/ice/water on the road will dilute a deicer solution |
| Temperature Disparity: | When paved surface temperatures are colder than the ambient air |
| Precipitation Rate: | Continual snowfall will further dilute deicer that has already been applied |
| Foreign Substances: | Oil residues and other particulate matter on the paved surface |

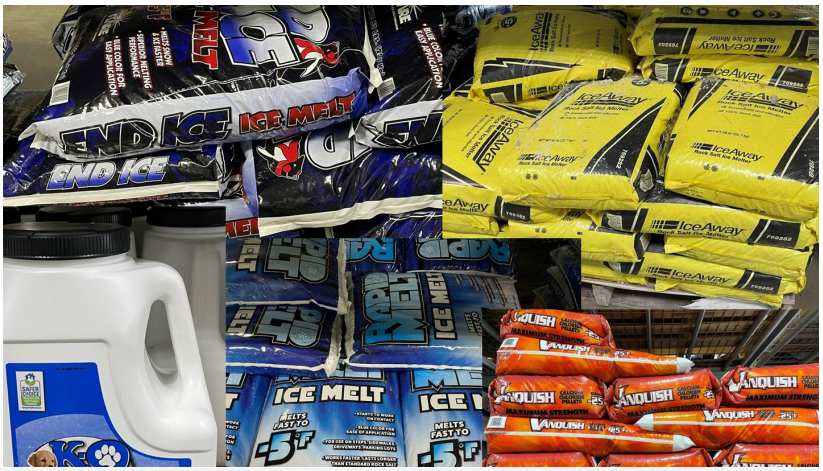
Above Right: Eutectic vs. Practical Temperatures (Adapted from "Eutectic Temperature vs. Practical Temperature", https://blog.iceslicer.com/eutectic-temperature-vs.-practical-temperature)

## Bagged Products

When using a bagged blend, you must understand which ingredients are in the product and how they work.

Most deicing materials can be purchased as a bagged product. Both chloride-based and non-chloride-based deicers exist in blends. Many blends are centered on rock salt since it is cheap. Generally, the cheaper the bag the more rock salt will be in the blend.

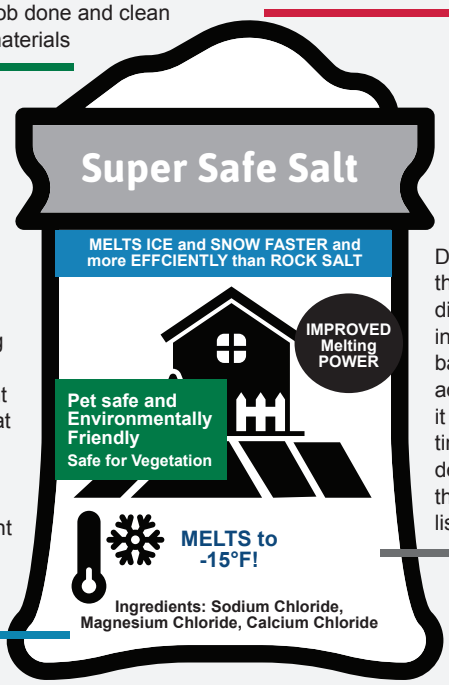
Bagged blends generally include a smaller grain size which will allow for easier movement through walk-behind or handheld spreaders. The smaller granule size also gives you an advantage as it goes into solution faster. Granule size is an important consideration when calibrating your spreader, especially if you change products mid-season, which may require you to recalibrate your spreader.




### Important Information about Product Labels when Choosing Bagged Deicers

No deicing products are 100% friendly to pets, plants, and the enviroment. Use only what you need to get the job done and clean up any excess materials

If you use the proper amount and give the product time to work all deicing products will melt snow and ice.




The temperature listed on the package is often determined in a laboratory setting or based on a single component in the product that has the lowest practical melting temperature. It may not represent how the product will work in real world conditions.

Depending upon the ratio of the different materials included in a bagged blend or additives included, it may take a long time to achieve the desired results at the temperature listed on the bag.

Choose your products based on the measured pavement temperature. In temperatures below 15°F, skip bagged rock salt and choose a product forumlated for cold temeratures! Rock salt takes a very long time to melt snow and ice in very cold temperatures.

Use care when reading the labels on packages of deicers, particularly of those that are blends. Consider the following when choosing which bagged product to use:

- A common misconception is that the melting temperature listed on the bag represents the lowest air temperature the product will melt ice; however, the **pavement temperature** is what matters most when using a deicing product.
- Use the lowest practical melting temperatures in the chart above as a guide when selecting a bagged product.
- Ask your supplier or vendor for the practical melting temperature of the products available and the time it takes to melt ice at that temperature when selecting which product to use.

## Discussing Materials with your Supplier or Vendor

When purchasing materials, there are important items to discuss with your supplier or vendor to be sure you are purchasing the products that will work best for your situation. Suppliers and vendors are often very knowledgeable on the products they sell and can be good resources for learning about materials available to you.

Here is a list of questions you may want to ask your supplier or vendor as you adopt winter maintenance best management practices for reduced salt use to be able to make the best winter maintenance decisions for your situation:

- Where are the best areas to use this product? Examples may be entryways, sidewalks, large parking lots, trails, etc.
- What types of equipment work well with this product?

**Do not use dry rock salt below 15° F pavement temperatures. This wastes money and time.**

- What is the practical melting temperature for this product?
- What are the ideal application conditions for this product? Are there conditions where I should not use this product?
- Are there any products I should not use with this product? Not all materials work well together and compatibility should be considered when purchasing materials – this is particularly important when working with liquids.

# 8. Introduction to Liquids

Liquid deicers work faster than dry granular deicers. Adding liquids to dry products will jump-start the dry product, giving faster results. The wet material will stick to surfaces better than a dry product. There are several ways liquids can be incorporated into operations:

**A cup of brine causes less overall damage than a cup of granular salt.**

**1 cup of liquid brine = 2.3 oz. Salt**

**1 cup of dry salt = 12 oz. Salt**

- **Anti-icing** – a liquid-only application before the storm to reduce the bond between the snow/ice and pavement.
- **Direct Liquid Application** – liquid only application used for deicing
- **Pretreated bagged products** – a liquid added to dry salt and packaged as a bagged material
- **Pretreated stockpiles or bulk products** – a liquid added into the salt stockpile
- **Prewetting** – liquid and granular products stored separately in a truck/equipment. As the materials are discharged, they are mixed, often this mixing occurs at the spinner or in the auger

**Liquids offer many benefits:**

- Liquids start working immediately compared to granular salt, which needs to dissolve before beginning to work.
- Liquids stay in place and reduce the possibility of the salt being kicked or moved off target.
- Less granular products are needed when adding in liquids, which could reduce material costs.

**Before the Storm**

- **Anti-icing**

**During or After the Storm**

- **Direct Liquid Application (DLA)**
- **Pretreated Products**
- **Prewetting Salt**

DLA

Pretreaded Product

Prewetting

When adding liquids to winter maintenance, the most common liquid deicer is salt brine. Brine is a liquid solution of water and sodium chloride. It works at the same temperature range as dry salt. If you are new to liquids, start by using brine on pavement temps above 15° F.

Brine and liquid deicers can be purchased pre-blended or you can purchase equipment to mix your own. There are a variety of liquid deicing products available for purchase. When ordering a liquid product in bulk, test it. If it is sodium chloride (NaCl) brine it should be 23.3% concentration. If it is a liquid product made with other deicers, use the vendor recommended density and test to confirm.

Brine can be blended with other ingredients besides water and sodium chloride as additives. It is always a good idea to research the compatibility of the products. It is possible to pick ingredients or products that would create a negative reaction which might refreeze quicker, clog equipment, or create slippery conditions. Discuss combining materials with your vendor or supplier to determine if the materials are compatible.

**TOP AND LEFT:** Commercially available brine production systems. Commercial systems come in a variety of sizes from a variety of manufacturers and brine production rates vary based on the specific unit. The units pictured can produce brine at rates of 1,000 gallons an hour up to 6,000 gallons an hour.




**RIGHT:** Homemade production and blending system. System produces brine and has the ability to blend one product with the brine. This type of set up should be monitored by staff.

## Making Your Own Brine

Many companies sell liquid deicers, but you can easily make your own brine with rock salt and water. Mixing your own brine can often be very cost effective. Combine rock salt and water to a 23.3% concentration. This will ensure effectiveness at the coldest possible temperature. It is important to use a salt brine hydrometer to test the brine concentration. Not using the correct concentration can lead to unintended problems, like freezing at warmer temperatures. Images above show both homemade brine production systems and commercially available brine production systems.

Use a hydrometer to measure the concentration of the salt brine. To read the hydrometer and determine

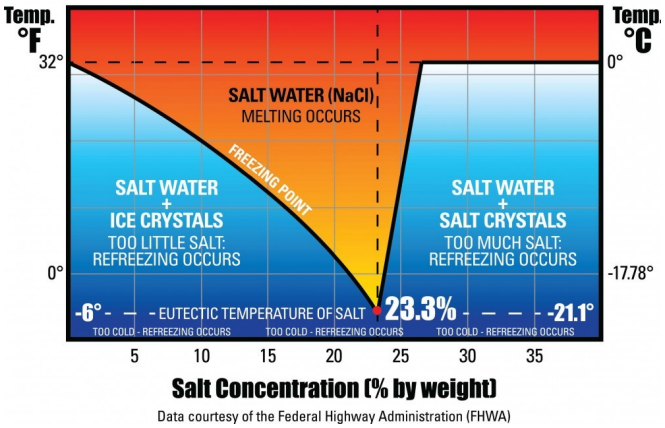
the salt concentration, look for the number on the hydrometer that is at the surface of the liquid salt brine. Read the instructions for your hydrometer as the units of measurement may vary across different hydrometers.

You may also choose to use a refractometer designed to measure the concentration of salt brine. Refractometers can be good tools to confirm that your automatic brine maker is working correctly. These are commonly used to measure the salinity of water in aquarium tanks. To use a basic refractometer, place a sample of your salt brine on the plate and close the lid (be sure there are no bubbles). Aim the plate towards a light source and use the eyepiece at the other end to read the concentration. Read the instructions for your refractometer as the units of measurement may vary between different refractometers.

**The number on your hydrometer should read 85% or 1.176 depending on the units of your device for a 23.3% salt brine solution.**

Measuring the salt brine concentration with a refractometer. A sample of brine is placed on the plate and the concentration is read through the eyepiece at the other end.

### SaltBrine - Phase Diagram




Data courtesy of the Federal Highway Administration (FHWA)

It is important to pay attention to the concentration of the liquid solution when making brine. Using too much or too little salt in the brine can cause refreezing to occur depending upon the pavement temperature when the brine is applied. To get the best results, the salt concentration of brine should be 23.3%.

## How to Make Your Own Brine:

### To make brine you will need:

- Water
- Rock salt
- Salt brine hydrometer

**Moisture levels of "dry" salt can fluctuate and the ratio of your brine may not be exactly 2.3lbs of salt to 1 gallon of water. It is important to measure the concentration of your brine with a hydrometer when mixing and adjust as needed.**

### How to make brine:

1. Combine pure rock salt and water at a ratio of approximately 2.3 lbs of salt for every 1 gallon of water. Avoid using treated salt or other materials.
2. Brine can stratify in the tank. Stir before testing concentration.
3. Use hydrometer to check concentration of brine solution
4. Adjust as needed
   a. If concentration is below 23.3%, add more salt.
   b. If concentration is above 23.3%, add more water.
   c. Creating a salt brine solution greater than 23.3% can result in solution fallout clogging spray nozzles, pumps, and filters.

## Blending Brine with Other Liquid Deicers and Additives

There is a large selection of different brine additives. It is becoming more popular to add other products to brine to enhance performance in cold conditions by lowering the freezing point. This practice is sometimes called a “hot mix”. It is possible to blend different liquid deicers together, but you must be sure they will work in solution together. If purchasing pre-mixed liquid deicers to blend on your own, discuss blending with your supplier to determine if the products are compatible.

Talk to your vendor about how much product to use in the blend, how to test that it is properly mixed and what the practical melting range for the blend is. There should be a protocol in place for measuring and mixing the additive with the brine to ensure accuracy. Ignoring or not implementing a proper protocol can result in damage to equipment, dangerous conditions or other unwanted results.

If switching between products or additives (like magnesium chloride to calcium chloride) it is critical to clean all tanks, plumbing, pumps, and spray nozzles to avoid any negative reactions between products.

When blending a liquid product with sodium chloride brine, it is important to use a sodium chloride brine that is exactly 23.3% concentration. If the sodium chloride brine is not mixed to the correct concentration and blended with other products, it may cause the materials to come out of solution resulting in clogging of equipment or hazardous conditions on the pavement. Depending upon your supplier, it may be possible to purchase a pre-mixed blend instead of mixing your own. If purchasing a pre-mixed blend, discuss the options with your supplier.

**Liquid deicers can be purchased in a variety of quantities, from small consumer size bottles to tanker truck deliveries of 2,000 gallons or more.**

## Liquid Spreading Equipment

There is a variety of liquids equipment available. Liquid application equipment can include both vehicle (truck or ATV or trailer) mounted units for parking lots and access roads or non-vehicle equipment (walk-behind, backpack, or hand-held pump sprayers) which can be used for sidewalks and other walkways.

When choosing which liquid spray system to purchase, it is recommended to start with a professionally built beginner unit versus building your own. If you do choose to go the DIY route, there are many ways to retrofit a pick-up truck or ATV with a tank and spray bar or hose reel with spray wand. Be sure the system you choose will output enough liquid to meet your application needs now and potentially in the future. When selecting a pump for your system, be sure it can provide enough pressure at a reasonable vehicle speed to meet anti-icing application requirements.

### Liquid Spreading Equipment Options Include:

- Truck mounted units with tank, spray bar with appropriate nozzles, pump (gas, hydraulic, or electric), and option hose reel with spray wand. A shut off in the cab is recommend.
- ATV or small trailer units with a tank, spray bar with appropriate nozzles, and often have electric pumps.
- Walk behind sprayers, which can have pneumatic or electric pumps
- Backpack sprayers or hand-held pump sprayers

**You may already have equipment capable of spreading liquid deicers. Backpack sprayers used for herbicides or pesticides can also be used for spreading liquid deicers, be sure to clean them well after each use.**



Use the appropriate nozzles for your application needs. A spray bar with rotating nozzles may be beneficial if you need different types of spray patterns. If using your equipment for anti-icing, solid stream nozzles are often recommended over fan stream nozzles. The solid stream is intended to leave stripes, alternating between brine and bare pavement. The alternating pattern provides traction, accelerates the drying process, and applies the amount of anti-icing brine needed to be effective. Fan spray is more likely to make a continuous, unbroken application pattern that could create dangerous and slippery conditions until the brine has dried.

# 9. Storage and Handling

One of the most important, yet challenging, aspects of winter maintenance is the storage of your liquid and solid materials. Improper storage of road salt, deicing liquids, sand, or plowed snow can lead to groundwater or surface water pollution or dangerous conditions. The primary method to prevent pollution from material storage is to use methods and storage locations that prevent or minimize any contact with water including rain, snow, or runoff.

Storage can be on site or at a central location such as your business. No matter where these materials are stored, take the proper precautions to not only protect your investment, but the environment in which it will be stored. Do not skimp on proper storage of materials. Train all staff who will be working with the storage or handling of winter maintenance materials on the good housekeeping best management practices related to storage and handling of solid materials (i.e. salt and sand/salt mixtures) and liquids.

Regardless of the materials you are storing, be sure to consider the location for storage and how much space you will need. Make safety a priority for your storage area. Any staff operating equipment should have good visibility to prevent accidents. The storage site should be easily accessible for loading, unloading, and hauling. Depending upon the equipment being used for loading, unloading, or hauling, you will need to consider how much space equipment will need to maneuver around safely.

**Protect your investment and the environment. Cover salt piles and place the piles on an impervious pad to limit runoff and infiltration of chlorides. Covering the stockpile protects the salt from wind, rain and snow and prevents theft by Mother Nature!**

When locating new storage for deicing products or materials investigate any local ordinances or state rules for material storage. Be sure to follow any local visual screening ordinances (using fences or vegetation to screen or hide storage areas).

The following sections will help provide specific tips and additional information for storing, loading/unloading, and hauling of various materials.

## Snow Piles

Proper storage of onsite snow piles is important to preventing dangerous conditions. Melting snow may pose a risk for slippery conditions, especially if the runoff refreezes. Follow these tips for good snow pile storage:

- Stockpile snow in an area where the solids (i.e. trash or if you are using sand) can be recovered after the snow melts.
- Locate snow piles down-slope from salt and sand storage to prevent snow melt from flowing through salt or sand storage areas.
- Keep snow piles near storm drains for a short

Snow pile located up-hill of the main parking area and high traffic drive lane. Snow melt may refreeze in the drive lane and result in the need for a call out.

meltwater path and less potential for large areas of frozen meltwater.

- Store snow piles away from and downhill of high traffic areas or critical areas like ADA accessible parking or crosswalks. Melting snow may refreeze causing slippery conditions.
- Avoid pushing snow into landscaping, raingardens, bioswales, lakes, ponds, wetlands, rivers, or other natural areas. Plowed snow typically contains residual salt or trash. Compaction from heavy snow or ice can damage or kill vegetation.
- Snow may need to be hauled to another site for storage depending upon the availability of space at the facility for snow pile storage.

## Salt Piles

For good housekeeping and proper storage of deicer, follow these tips:

- Prevent any contact with rain, snow, or runoff. Indoor storage is recommended.
- All salt piles should be covered to prevent salt from being washed or blown from the pile. Permanent structures are preferred over tarps.
  - If using tarps to cover the pile, be sure to weight down the tarp to prevent the tarp from blowing away and exposing the pile. Cinder blocks or sand bags work well.
- All salt piles should be stored on impermeable surfaces (asphalt, concrete, shipping container, plastic bins, etc.).
- A storage container works well for onsite storage of salt and is easily removed at the end of the season.
- Salt spilled at the storage area should be promptly cleaned up and collected for reuse. Staff should be trained to ensure sweeping is a regular part of daily activities.
- Drainage should be directed away from the stored materials to keep the stockpiles as dry as possible. This will prevent salt contamination of the site.
- Consider the use of berms around your salt pile to prevent run off.

Correct Salt Storage. Salt is stored in a storage container that can be secured. This is the preferred method for salt storage when storing salt onsite at a facility.

**Winter sand piles often have some salt mixed into the pile to prevent freezing of the sand; therefore, sand pile storage procedures should be the same as salt pile storage.**

Correct salt storage. The salt pile is stored under permanent cover on an impervious pad. This is a preferred method for salt storage.

- Store away from landscaped areas, lakes, rivers, ditches, storm drains, and wetland edges.
- All leftover salt should be promptly removed from remote sites at the end of the season and stored properly for the next season.
- Annual inspection and repairs of permanent storage facilities should be carried out prior to the start of each season.
  - Ongoing inspection of storage structures and tanks should be carried out during the season.
  - The integrity of the structure floor and the apron in front of the salt storage facility should also be inspected for repairs.
  - Cracks in the apron reduces the ability to push spilt salt back into the dome and allows significant infiltration into the ground.

**Try collecting salty runoff from your loading areas to reuse in brine production. This can save on money and materials.**


Incorrect salt storage. Salt piles should not be placed in the path of melting snow piles. (Adapted from "Winter Parking Lots and Sidewalks Maintenance Manual", Minnesota Pollution Control Agency, 2015).

**Prevent groundwater pollution. Do not locate storage areas near wells. Areas with sand/gravel soils are very prone to groundwater contamination.**

Incorrect salt storage. Uncovered salt pile placed next to a storm drain.

The salt pile is covered with a tarp that is weighted down to prevent the tarp and material from blowing away. This is not ideal salt storage, but will work temporarily if no other options are available.

## Salt Bags

Proper salt bag storage is very similar to storing piles of salt. Many of the tips for Salt Piles apply to storing salt bags. Follow these additional tips for good salt bag storage:

- Bagged materials should be stored securely and indoors, like in a warehouse or closet.
- Protect from rain or snow and store away from moisture.
- Salt spilled at the storage area should promptly be cleaned up and collected for reuse.
- If storing a salt bag in an entryway, store the salt bag in a container with a tight-fitting lid and site-specific spreading instructions. Encourage only those who have been trained on reduced salt practices to spread the salt from the salt bucket.
- Dispose of used bags properly.
- Seal all open bags to ensure they don't spill and to avoid the product hardening or clumping.

## Loading and Hauling

Loading and hauling can also pose a risk for salt contamination and it is important to follow good housekeeping practices when loading and hauling deicing materials. Follow these tips for loading and hauling deicing materials:

- Areas where spreaders are loaded should be paved with impermeable asphalt or concrete.
- Don't overfill the loaders, truck, or spreader: material will spill out as it is driven or pushed. This is a common mistake that wastes salt and increases the risk of causing pollution.

- Any salt spilled when loading spreaders or trucks should be cleaned up promptly.
- Secure tarps over trucks when hauling salt to avoid material being lost to wind or precipitation.
- If salt is stored on-site, schedule any loading or hauling work when the facility is closed to minimize conflicts with vehicles and pedestrians.

**Unload all types of salt deliveries on impermeable surfaces. Always load salt onto equipment on impermeable surfaces.**

- Regularly clean up loading area, sweeping extra back into the pile.

## Liquids

Storing liquids properly is important to reduce the risk of leaks and salt contamination. It is important to follow all local and state guidelines for storing liquid materials. On-site storage of liquids is typically in storage tanks of various sizes and shapes. Plastic tanks are preferred over metal because there is no corrosion in a plastic tank. Follow these additional tips for good liquid deicer material storage:

- Know the freezing point of the liquid. This will determine if it can be stored outdoors. Salt brine will freeze at -6°F.

**Secondary containment is like creating a bath tub around the tank so if the tank leaks, the "tub" captures the spill.**

- Tanks should be double-walled and have secondary containment and be designed so a plumbing failure will not result in release of the contents. Be sure to follow the requirements of your town or any Illinois State rules when storing liquids.

Plastic liquid storage tanks protected by concrete ballasts to prevent vehicles from hitting the tanks.

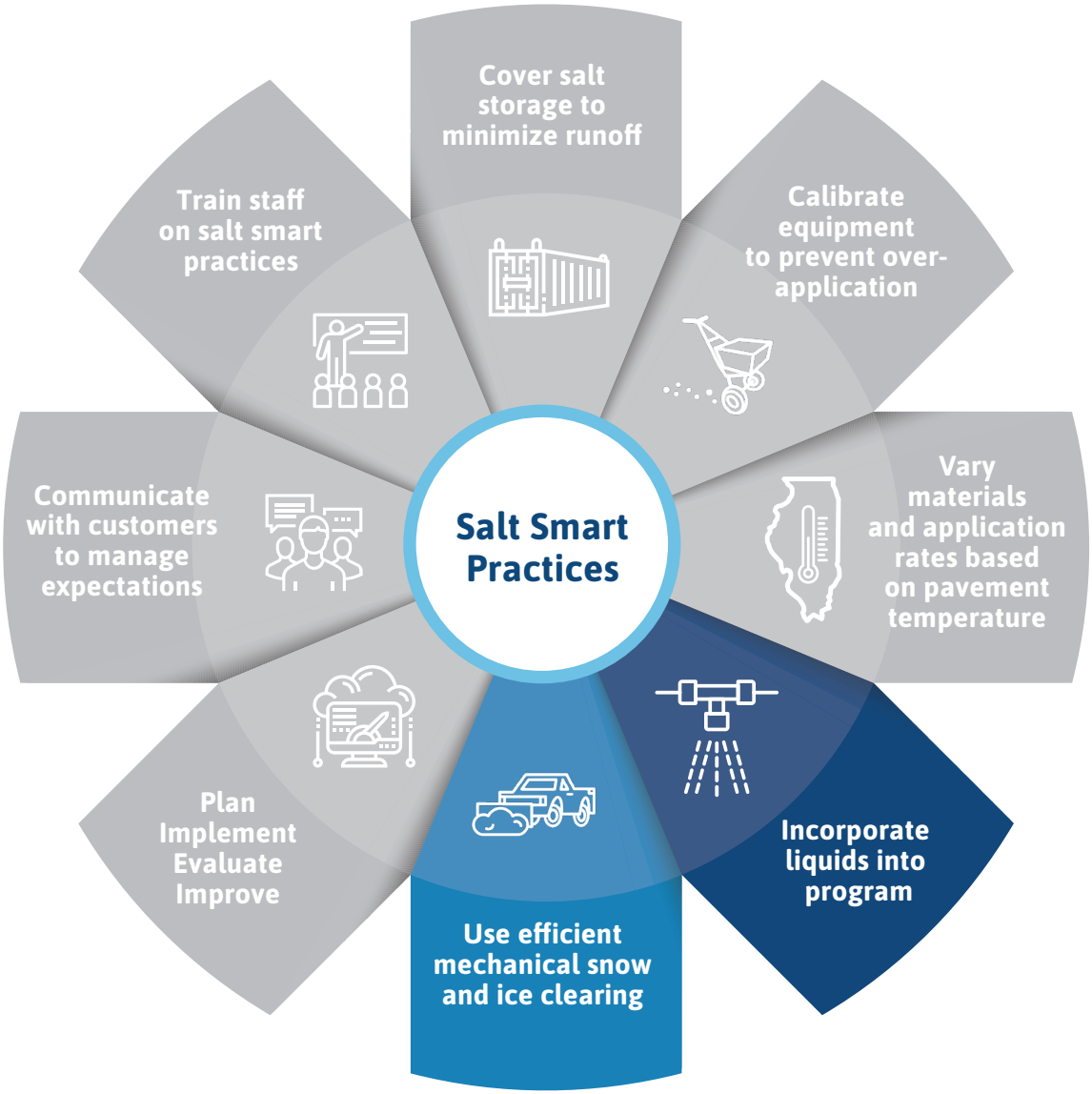
- Liquid storage tanks should be protected from impact from vehicles moving about the storage facility.
- Label the tank documenting its contents.
- Some liquids need to be agitated/ circulated to prevent separation and settling. The liquid suppliers should be consulted for proper storage procedures.
- Sediment that collects in the bottom of mixing and storage tanks must be cleaned out periodically. The sediments may be mixed with abrasive piles.

# Managing Snow and Ice – Actions to Take Before and After a Storm for Safe Surfaces

**Chapter 10 – Anti-icing: First Step Before a Winter Storm**

**Chapter 11 – Mechanical Snow Clearing: First Actions During and After a Winter Storm**

**Chapter 12 – Deicing: Getting to Bare Pavement After a Winter Storm**



# 10. Anti-Icing: First Step Before a Winter Storm

**Anti-icing** should be the first winter management practice to use in a suite of strategies for winter storm clean up when the level of service goal is bare pavement. Not all conditions will be appropriate for anti-icing prior to a winter storm.

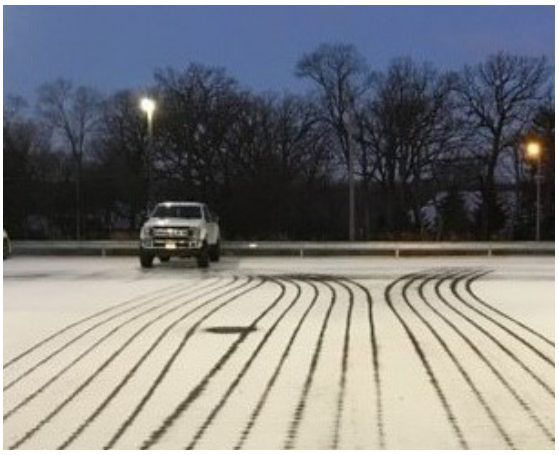
**Anti-icing is one of the most cost-effective practices in winter maintenance. It is also quick. It is possible to treat a parking lot in a matter of minutes, making anti-icing an excellent strategy for saving time.**

Anti-icing is a pre-storm, proactive approach that helps prevent the bond between snow and ice and the paved surface from forming:

- Liquids are applied to coat the pavement surface to melt from the bottom up, eliminating the potential for snow or ice to bond to the pavement.
- Since the bond doesn't form, it is much easier to clear the snow or ice with mechanical methods and maintain bare pavement.
- It is possible for anti-icing to melt off light snow or frost eliminating the need for mechanical clearing and a call out.

**Deicing** is the practice of breaking the snow and ice bond after it has occurred with a paved surface either during or following a storm.

- Deicers melt snow and ice from the top to the bottom of a snow and ice layer to break the bond from the pavement.
- Deicing requires the use of more materials than would be needed for anti-icing.
- Using deicing only costs more than using both anti-icing and deicing in terms of materials, time, equipment, and environmental damage.



Anti-icing is like frying eggs or cooking a steak: grease the pan and the food comes out easily with no mess to clean up. Like greasing the frying pan, the purpose of anti-icing is to keep snow from sticking to the pavement so the snow can be easily cleared.

Anti-icing provides safer pavement during the event and faster clean up after the event, and may reduce the number of callouts for light snow or frost events. A common misconception is that performing anti-icing before a storm and following up with deicer after the storm will use more salt. In reality, because anti-icing prevents snow and ice from bonding to the pavement, deicer may not be required after mechanically clearing any built-up snow. This allows you to provide a better level of service with less material.

Using tools like pavement temperature sensors and weather forecasting services can help guide decision making about how to select anti-icing products and application rates.  Because anti-icing brine sticks to the pavement, it can be effective for several days, depending on the weather conditions and traffic, requiring about one quarter the material and one tenth the overall cost of de-icing. Anti-icing is effective and cost-efficient when correctly used and approached with realistic expectations.

## Get Started in Anti-Icing

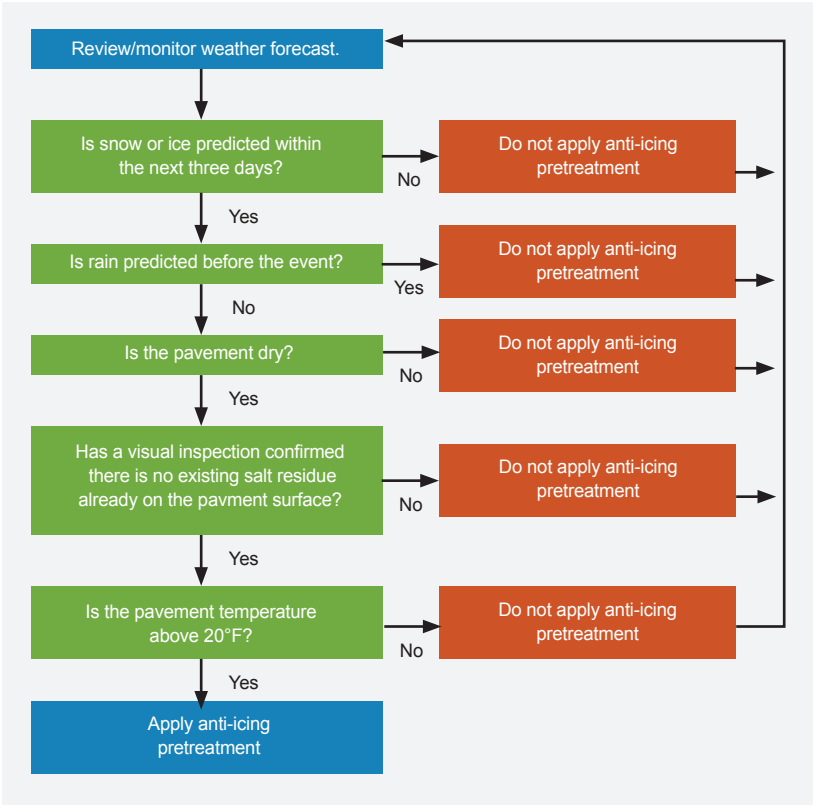
**The basic steps for anti-icing include:**

- Calibrate your equipment. Know how much liquid your equipment applies.
- Measure the pavement temperature and understand the pavement forecast.
- Use application rates suggested in this manual.
- Apply liquids with stream nozzles to maintain dry areas between sprayed areas to reduce slipperiness while product is drying. Avoid using fan nozzles if new to anti-icing.
- It is better to use less anti-icing product than using too much. Over-application can cause slippery conditions because it makes a dry surface wet.
- Try anti-icing in a low traffic area to test your application rates and learn how much liquid can be applied without creating a slimy or slippery situation
- Follow the flow chart below to help you determine when to anti-ice. You may also need to consider wind, humidity, and type of chemical being used.

An example of good anti-icing application in a parking lot, note the wet/dry spray pattern.

### When learning how to implement an anti-icing program, it is also important to learn what NOT to do.

- **Do not** re-apply if there is still residue. Anti-icing liquids can remain on the pavement for many days after application.
- **Do not** apply Magnesium Chloride or Calcium Chloride to a warm surface (above 35°F pavement temperature). It can become "greasy" as it pulls moisture to the pavement. These liquids do not always become greasy, but there is a higher potential in warmer temperatures and higher humidity.
- If using Magnesium Chloride or Calcium Chloride in colder temperatures, **do not** over apply. Too little is safer than too much.
- **Do not** apply any liquids before a rain storm, they will wash away.
- **Do not** use solid materials (even if they are pre-wetted or pre-treated) for anti-icing. The solid materials do not stay in place as well as liquids and are significantly less efficient than liquids as a proactive measure.




This flow chart helps guide decision making for when to use anti-icing. This flow chart applies to anti-icing with brine.

### Important tips to remember when implementing anti-icing:

- Liquids may be applied in advance of an event, often during normal working hours.
- Spray the traffic lanes and the liquid will migrate with the tires to the parking areas. Liquids can be dispersed by traffic.
- Some users advise against spraying the service road in front of buildings and instead spray traffic lanes and back service roads to allow the traffic to spread the liquids near the building where foot traffic is higher. This can reduce tracking into the building and over-application in a high-traffic area.
- For service roads on hills, some users recommend applying to only the top half of the hill, relying on traffic to carry it down the hill, to avoid a slippery situation at the bottom of the hill.
- Anti-ice when needed. Follow the Anti-Icing Flow Chart for guidance. Do not anti-ice on a regular schedule, e.g., every Friday.

## Benefits of Anti-Icing to Your Operations

With anti-icing you can provide the desired level of service with less material, reaching your customer's expectations. This gives you a competitive edge in winter maintenance.

Anti-icing is often very effective at melting heavy frosts or very light snows, reducing the need for a call-out for those winter events. Depending upon the event and the moisture content of the snow, anti-icing can melt up to 1/2" of snow, but the general rule of thumb is a 1/4" of snow. Anti-icing makes the mechanical clearing easier and more effective.

Anti-icing provides savings benefits to all aspects of winter maintenance operations. Time, labor, and money savings often occur throughout the organization when anti-icing is implemented:

- Liquids require less deicer compared to just a straight solid product and you can achieve the same results 50% faster.

**Anti-icing requires less material, and less material means less water pollution. Using less salt doesn't have to reduce safety, but it saves money and protects lakes, streams, and groundwater!**

- Anti-icing makes plowing to bare pavement easier and quicker, resulting in less deicer needed to achieve bare pavement. This saves on plowing time and materials.
- Average savings for materials range between 15%-40% depending on the organization's historical salt and deicer use. Every gallon of liquid applied as anti-icing saves up to 32lbs of salt.

## Anti-Icing Application Rates for Safe Surfaces

The application rate table provided below is a compilation of information from practitioners across northern Illinois and adapted from the "Wisconsin Winter Maintenance Manual, Parking Lots, Sidewalks, and Trails" from the City of Madison, Wisconsin and Wisconsin Salt Wise. It is meant to provide a starting point and can be adjusted as you gain experience. It is also recommended to talk with your supplier and other practitioners as you start to implement a new program. Documentation of application rate and product used, pavement temperature, weather conditions and pavement results for each event will help you to adjust your program. Incremental change based on this information will help you to reduce application rates while still providing safe pavement conditions.

One application rate will not fit all situations; effective application rates are based on many factors. How long an application lasts depends on pavement temperature, application rate, precipitation, and type of material applied. Anti-icing Application Rate Charts for gallons per acre and gallons per lane mile, along with a blank anti-icing application rate chart, are available in Appendix C.

| Anti-Icing Application Rate Guidelines | | |
|---|---|---|
| **These are a starting point only. Adjust based on experience.** | | |
| **Predicted Weather Condition** | **Gallons per 1,000 sq. ft.** / **Gallons per Acre** | **Other Products** |
| | **23.3 % Salt Brine (NaCl)** | |
| 1. Prior to frost | 0.3 – 0.6 / 15 – 30 | Follow manufacturers' recommendations |
| 2. Prior to light or moderate snow | 0.3 – 0.8 / 15 – 40 | |
| **CAUTION**: Too high an application rate may result in slippery conditions or tracking. | | |

# 11. Mechanical Snow Clearing: First Actions During and After a Winter Storm

Mechanical snow clearing is always the best and primary approach to winter maintenance regardless of your level of service goals. Mechanical snow clearing refers to the use of plows, snow blowers, shovels, scrapers, or other devices to physically clear snow and ice from the pavement. Mechanical snow clearing should be the preferred method for snow and ice management during and after a winter storm.

**Early and frequent mechanical clearing of snow saves on deicers and salt.**

The more snow you are able to clear using mechanical methods, the less deicer you will need to use. If you are able to clear snow during a storm, you can avoid compaction of the snow and reduce the amount of deicer needed to break up snow and ice on the pavement.


Always clear snow and ice mechanically before applying any deicers. If solid deicers are applied before snow is cleared, then it is possible that a significant amount of the deicer will be shoveled or plowed off before it even has a chance to work. This wastes time and money while unnecessarily damaging the environment.

Lighter snow may be able to be cleared to nearly bare pavement in a single pass with a broom, plow, snow blower, or shovel. During longer or heavier snow events, a two-pass method may provide better results. A two-pass method involves using two different types of tools to more effectively clear an area. The first pass clears the bulk of the snow and the second pass gets much closer to the pavement.

## Mechanical Snow Clearing Tools

Choosing the right tool for mechanical snow clearing is just as important as choosing the right deicer. By using the right tool, you can save time and clear the most snow and ice without the need for deicers. Brooms, snow blowers, and shovels are effective tools for sidewalks, entryways and trails. Brooms or blowers can be mounted an ATV or UTV and are useful for clearing fluffy snow or while snow is still falling. Handheld scrapers are great for breaking up compacted snow and ice on stairs, entryways and sidewalks. Plows and snow pushers work great in parking lots or large areas.

Plow blade technology has improved greatly. Segmented plow blades allow the blade to contour to the pavement surface and allow for replacement of a single segment instead of replacing the entire blade. The segmented blades are able to better clear snow with less vibration and noise for the operator. Rubber or plastic blades have been shown to work well on sidewalks or pavers with less damage.



Depending upon your available equipment, there are other options in addition to plows that work well in parking lot and sidewalk winter maintenance. Plow and snow pusher attachments are available from a variety of manufacturers for skid steers, backhoes, and loaders.

The snow pusher attachments can help move large amounts of snow quickly. Skid steers with a plow or snow pusher attachment may be useful in tight spaces and on wide sidewalks or trails where a snow blower may be inefficient.


Right and Above: Plows and snow pushers can be mounted to small loaders or skid steers for use in parking lots and tight spaces.

## Contractor's Corner: Stop Giving Away the Plowing

Clearing snow and ice after a storm is one of the simplest ways to save on salt and deicers. Typically, the mindset has been that there isn't money to be made in plowing; but, plowing uses labor, time, and equipment that affects your business' bottom line.

This is where a seasonal contract with your customers shines. As part of your seasonal contract with your customers, you can build in the costs of plowing to offset the reduced salt use. A seasonal contract guarantees your customers that you will be there to provide service during the winter when they need it and ensure their businesses stay open and accessible during a winter storm.

# 12. Deicing: Getting to Bare Pavement after Clearing Snow and Ice

Deicing is a reactive operation where a deicing material is applied on top of snow, ice, or frost that has bonded to the pavement surface and cannot be easily cleared with mechanical methods after the bulk of the material has been cleared. This requires larger amounts of deicing chemical, making deicing much less efficient and more environmentally damaging to reach bare pavement than using anti-icing with mechanical clearing.

Deicing costs more than the proactive operation of anti-icing in materials, time, and environmental damage. However, deicing has its place in winter maintenance operations when the level of service goal is bare pavement. It is important to use deicing strategies properly to ensure they work for your operations rather than against them.

## DO's and DON'Ts of Deicing:

**DO** apply enough deicer to break the bond between the snow, ice, and pavement to make your job of clearing the snow and ice with a plow or shovel or scraper easier, faster, and more efficient.

**DON'T** over apply. This causes damage to infrastructure, harms the environment, and wastes material and money.

**DO** calibrate your equipment to know how much materials you are applying.

**DON'T** try to melt all the snow and ice on the surface with salt or deicers. Use mechanical clearing methods to remove as much snow or ice as possible before applying deicers.

**DO** use the application rate guidance to help with deicing. Using recommended rates will provide safe surfaces.

**DON'T** apply deicer where you don't need it, vehicle and foot traffic will move the deicer to the edges of sidewalks and into parking spaces.

## Contractor's Corner: Starting Out with Salt Smart Practices

When applying Salt Smart practices to your operations, it is important to remember that what works well for someone else may not work as well for your operations or client needs and to adjust the practices accordingly. If you are new to using Salt Smart practices, start small and make small changes to your operations at the beginning.

Set yourself up for success:

- Learn how the Salt Smart practices work in the conditions you commonly experience before using them at client sites.
- Use a test area to get comfortable with the practices.
- Try anti-icing in your own parking lot to see how it works or experiment with deicer application rates on your own sidewalks to find rates that work best for you.

As you learn and adapt the practices to work well for you, it will be easier to educate clients and get employee buy-in.

## Deicing Spread Patterns and Material Control

When applying granular materials, the spread pattern matters. Put the deicer where you want it to go. Using a spread pattern that doesn't consider foot or vehicle traffic wastes materials, costs more money, and may cause unintended damage to vegetation, infrastructure, or buildings.

When applying deicer, consider how the deicer moves after application. Deicer may only need to be applied to the drive lanes of the parking lot and vehicle traffic will help move the deicer into the parking spots and to the edges of the parking lot away from high traffic areas.

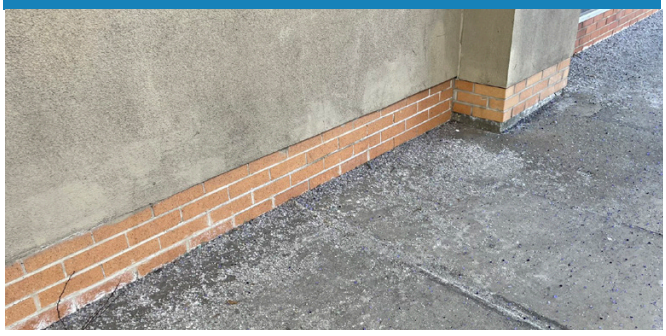
Sidewalks tend to get more deicer applied than parking lots. Use only what is needed and avoid wasting deicing materials. Place the salt where foot traffic will spread the deicer to edges of the sidewalks. Sweep up any excess deicing materials.

The left side of the road shows deicer application that is lightly applied with space between the grains.

The right side of the road shows a heavy application at the crown of the road that will spread out by vehicle traffic.

Both can be correct application spread patterns depending upon various factors, like the winter pavement conditions and level of traffic.

**Avoid spreading deicers up against buildings. This protects the building from deicer damage.**



Salt placed down the middle of the sidewalk. Foot traffic will move the salt to edges of the sidewalk.

If using spreading equipment on sidewalks, consider using equipment that allows for more control over the placement of the deicer during application. Drop spreaders work better on sidewalks than broadcast spreaders and provide more control over the application. If your broadcast spreader application pattern is too wide for the sidewalk, add a shield around the spreader to direct the deicer to where you want it to go.

Applying deicer at too high of speeds can cause the material to bounce off the intended application area into nearby landscaping or other areas you don't want deicer. If using a vehicle to apply deicer, drive at lower speeds and turn down the spinner speed to keep the material on target. Using pretreated materials can also help reduce bounce and scatter. The pretreated materials stick to the pavement surface better and because they are already wet, they work quicker to melt snow and ice than dry materials.

**Avoid spreading deicers under canopies or overhangs where the sidewalk or entryway is protected from snow or rain. This practice wastes materials, labor, and time of spreading unnecessary deicers. Only spread deicers where snow or ice accumulated on the pavement.**

Shield placed around a broadcast spreader to limit the spread pattern so the material only goes where you want it to go.

## Guidelines for Pretreating Materials to use in Deicing Applications

Pretreating is mixing a liquid deicer into the stockpile of salt. It can be purchased as a product already mixed and ready to use or you can mix your own pretreated materials. To create a pre-treated stockpile on your own, add liquids conservatively. The dry material can only hold so much liquid before leaching occurs. Watch the storage area to make sure it can contain the wet salt pile. Practice mixing skills and observe the amount of leaching on a small stockpile before doing this on a large scale.

It is strongly recommended, if creating your own pretreated product, to mix the liquid into the solid material for each call out event or as the material is being loaded onto spreading equipment instead of each season. Mixing your chosen liquid into the dry salt while loading provides an easier to work with end product when spreading the pretreated materials. Depending upon when the stockpile was pretreated and with what product, the product may freeze and become difficult to work with.

### Treating the salt stockpile:

- Spray and mix the salt stockpile with a deicing liquid, like salt brine, magnesium chloride or calcium chloride. Organic products, like beet juice, can also be used in pretreatment of stockpiles.
- You may choose to mix with a conveyor system, mix the liquid directly into the pile, or mix in the loader immediately before loading on to the spreading equipment.

- When treating the stockpile, apply at 6 to 8 gallons/ton, less is better.
- Because leach risk at a stockpile is increased, proper storage is critical. Review Chapter 9 for proper material storage procedures.
- To minimize problems, mix up pretreated materials per storm event not per season.
- Only mix the amount of pretreated product you need for the event and have a plan to store the leftovers. Using a pretreated product for deicing requires about 30% less material than dry salt.

**Treated Stockpile Application:**

- Pretreated salt can be applied with any type of equipment used for dry salt.
- No equipment changes are required.
- Remember to turn down the application rate; pretreated and pre-wetted product requires approximately 30% less material than dry salt. The liquids help the granular material stick to the pavement.

## Pre-wetting on Equipment

Pre-wetting is combining liquid from a tank to dry material from the hopper at the point of discharge. The liquid and granular material usually come together at the spinner or auger. The most common set up is on a truck or larger equipment but it can be configured for smaller equipment. Pre-wetting has traditionally been more commonly used by municipalities for roads maintenance rather than parking lots and sidewalks, but in recent years with the availability of new application equipment contractors are able to utilize this practice.

Pre-wetting systems are available for smaller types of application equipment in addition to what can be added to larger trucks. Most manufacturers offer pre-wetting options when purchasing equipment. There are a variety of tanks and systems offered for all sizes of vehicles. Pre-wetting is often easiest on large trucks or equipment (bigger than a pickup truck) due to the ability to carry more weight. If using pre-wetting on board your equipment, turn down the application rate. The liquids help the granular material stick to the pavement. While pre-wetting requires some equipment changes, it provides flexibility to switch the amount and type of liquid.


Saddle tank units are small containers (usually plastic) that are attached to spreaders to provide liquid deicer for pre-wetting granular materials as they are applied at the spinner.

## Using Only Liquids as a Deicing Strategy

Direct Liquid Application (DLA) is a practice that involves applying straight liquid product during or after a storm. When liquids are used before a storm, it is called anti-icing. When liquids are used during or after a storm it is referred to as DLA or also as “Liquid Only Routes”. In DLA, liquids are sprayed with streamer nozzles through the remaining layer of snow and ice left after plowing. This penetrates the snow and ice and creates a layer of melting deicer between the snow or ice and the pavement. Because you are not waiting on the solid deicer to dissolve into a liquid solution, the benefits of deicers can be realized immediately.

Depending upon the amount of liquid your equipment is able to apply, it may take multiple passes of applying liquids to fully penetrate the snow and ice pack. The DLA strategy is not meant to melt all of the snow and ice on the pavement, but instead make it easier to mechanically clear the snow and ice using a plow or shovel.

DLA can work well especially when used in conjunction with a proactive technique like anti-icing. A light liquid application after clearing majority of the snow and ice from the pavement surface can help keep the pre-applied anti-icing liquid application at its most effective concentration to continue seeing deicing benefits. This can be a good strategy to use to prevent refreezing without using excessive amounts of materials or salt.

**More is not always better. Over using liquids for deicing can be as damaging to the environment and infrastructure as using excess salt. One gallon of brine contains approximately 2.3 pounds of salt.**

DLA is an advanced technique that has the potential to use less salt and it should not be attempted unless you are familiar with using liquids. If the liquids are not able to penetrate, but are left to pool or spread on top of the snow and ice, a slippery and dangerous situation may be created.

## Choosing Deicing Application Rates for Safe Surfaces

The application rate guidance provided in this manual is meant to help you make intentional decisions for what application rates to use for deicing based on the materials available to you. The application rates provided are a compilation of information from practitioners across northern Illinois. The application rate chart presents rates based on commonly used materials and pavement temperatures. It is meant to be a goal to work towards and adjusted based on experience.

Documentation and good record keeping of application rates, product used, amount of product used, pavement temperature, weather conditions, and pavement results for each event will help you adjust your program. Incremental change based on this information will help you to reduce application rates while still providing safe pavement conditions. Modify your practices to use only the amount of deicing materials needed to get the job done. Make it a goal to reduce application rates and keep surfaces safe.

**Effective application rates are based on many factors. Pavement temperature is only one of the many factors!**

## Deicing Application Rates for Safe Surfaces

### Helpful tips for the application rate table:

- All application rates listed in the following table are based on thoroughly cleared surfaces.
- A blank chart is also provided in Appendix C to allow you to fill in application rates or calculated amounts for your facilities or properties.
- This chart can also be used as a pre-winter planning tool. See Chapter 2, Planning and Documentation, for more information on how to use the application rate guidance as a planning tool.

**The application rates provided below are meant to be recommendations and guidance. Use this chart as a target for application rates. The application rates provided may not work in all situations. Adjust the rates as needed to match your situation.**

| Deicing Application Rate Guidance for Parking Lots and Sidewalks<br>For best results, remove as much snow and ice as possible before applying deicers | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pavement Temperature (°F)** | **Pounds per 1,000 Sq. Ft. / Pounds per Acre** | | | | | **Gallons per 1,000 Sq. ft. / Gallons per Acre** | |
| | **Rock Salt (NaCl)**** | **Bagged Blends, mostly Rock Salt**** | **Bagged $MgCl_2/CaCl_2$** | **Rock Salt treated with 23.3% Salt Brine** | **Rock Salt treated with other liquids** | ***23.3% Salt Brine (NaCl) - DLA - Light Snow (less than 0.5 in/hour)** | ***23.3% Salt Brine (NaCl) - DLA - Medium Snow (0.5 to 1.0 in/hour)** |
| **28 to 32** | 3 / 131 | 3 / 131 | X | 2.1 / 92 | X | 0.7 / 30 | 1 / 45 |
| **23 to 28** | 4.5 / 196 | 4.5 / 196 | | 3.2 / 137 | | 1 / 45 | 1.3 / 55 |
| **15 to 23** | 6.5 / 283 | 6.5 / 283 | | 4.6 / 198 | 3.7 / 161 | 1.3 / 55 | X |
| **0 to 15** | X | X | 5.5 / 240 | 5.6 / 244 | 4.9 / 213 | X | |
| **0 to -5** | | | 8 / 348 | X | 5.6 / 244 | | |
| *DLA rates adapted from Clear Roads Direct Liquid Application Guidance with application cycle times of 2-3 hours | | | | | | | |
| **Dry rock salt is ineffective below 15°F. If pavement temperatures fall below 15°F, choose another material or strategy. | | | | | | | |

# Tips for Small Sites: Sidewalks and Building Entrances

Always clear snow prior to applying deicers. The less snow, the less deicer required, which lends itself to a safer surface. Be proactive, use anti-icing on sidewalks to make it easier to clear snow and ice.

### Use the proper tool for snow clearing:

- Push shovel (no sides) for pushing snow
- Scoop shovel (with sides) for lifting snow
- Broom or blower for light, fluffy snow
- Ice scraper for use under ice and compaction
- Ice chisel for breaking open compaction or under ice and compaction

### Use the proper tool for spreading deicer:

- Use drop spreaders, not rotary spreaders. If using a rotary spreader, install shields to restrict the spread pattern. This reduces waste and protects adjacent vegetation.
- Hand-held spreaders instead of scoops provide more even distribution for wide areas and reduce the amount of deicer needed.
- Hand held shakers can be useful for small areas.

For maintenance professionals that aren't likely to follow an application rate chart but are still responsible for snow clearing on steps, sidewalks, and other smaller sites, there are simple tips to follow:

**Surfaces such as pervious asphalt, pervious concrete, and pervious pavers may not experience refreeze if not shaded by adjacent buildings or trees. Salt is generally not needed on these surfaces and sand should be avoided.**

- Aim for an even spread pattern with granules not touching but no farther than 3 inches apart.
- Leave no piles or clumps of deicer.
- Do not spread solid deicer on dry pavement.
- Do not spread deicer in vegetation.

Steps are often the most over-salted area in all of winter maintenance. Clear as much snow and ice from the stairs as possible before applying deicer materials. Try placing signs warning of possible slippery conditions to help encourage caution around stairs during the winter time. Have a discussion with your customers about closing off infrequently used stairs or building entrances that are not emergency exits. This might include duplicated stairways or extra wide stairs (only maintaining one side).

**A free short video for small site winter maintenance is available at:**

**www.pca.state.mn.us/water/salt-applicators.**

**The video is designed for those that do winter maintenance of small sites such as stairs, entry ramps, curb cuts, and building entrances.**

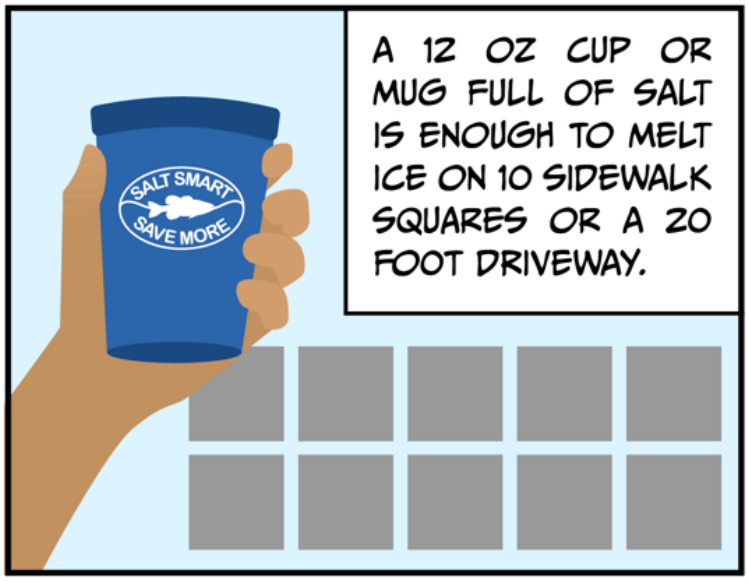
SALT SMART COLLABORATIVE

# Entryway Salt Buckets

**Entryway salt buckets lead to over application of deicers and potentially hazardous surfaces due to too much deicer. They are often placed where they are available for anyone to spread deicer at the entryway.**

There are a couple easy things that can be done to provide safe entryway surfaces that do not include a salt bucket placed directly in the entryway:

- If deicer is required at an entryway, store the deicer bucket away from the entryway area, like in a nearby mop closet.
- Provide a shovel, broom, and/or ice scraper at the entryway instead to encourage mechanical snow clearing before applying any deicers.
- Sturdy brooms and shovels can quickly clear majority of the snow before it has a chance to be compacted into ice by foot traffic.
- Ensure only those who have been properly trained on reduced salt practices spread the deicer material.
- Clearly label the salt bucket and provide a small scoop. A 12-ounce cup holds enough deicer for approximately 10 sidewalk squares.
- Label the scoop with how much deicer is needed for the entryway area.
- Provide proper spreading instructions for the deicer material on the salt bucket. The spreading instructions can also be provided on a poster at the salt bucket storage location.
- Only include enough salt for a few applications, people are more likely to use less deicer if less material is provided to them.


SALT SMART COLLABORATIVE

# Parking Lot Tips

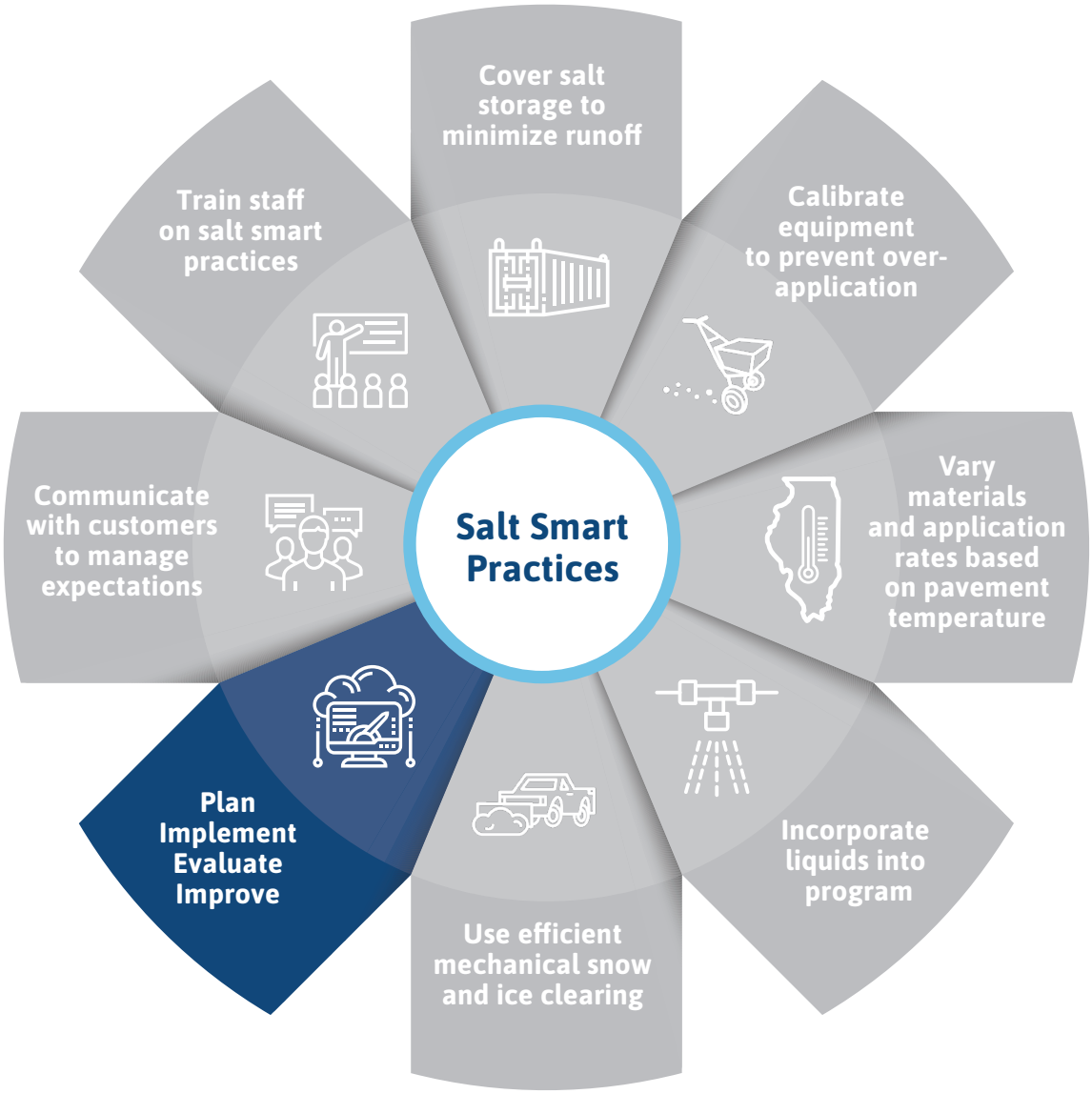
**Simple tips and tricks to follow when maintaining parking lots before, during, and after a winter storm:**

- Always plow to clear snow before applying deicing materials.
- Do not use salt to burn off snow, clear as much as possible with mechanical methods before using deicer.
- Apply deicer in the drive lanes of the parking lot, vehicles will move it into parking spots.
- Higher vehicle traffic areas may need less deicer as the vehicles help mix the deicer into the compacted snow and ice.
- Never plow snow or blow snow into bodies of water, wetlands, vegetated areas, traffic or streets.
- It may be practical to store large equipment or deicing materials onsite. Communicate with your customers about the preferred location.
- Use a locked storage or shipping container for onsite deicer storage. Always cover any deicer stored on site.
- Store snow downhill from any salt storage areas and away from high traffic areas.
- Be proactive. Use anti-icing to make plowing easier and faster.
- Clean up any leftover or excess deicer. It can be difficult to walk or push shopping carts through excess salt in parking lots.
- Don't over salt ADA accessible parking spaces, they should get the same amount of salt as the rest of the parking lot.

SALT SMART COLLABORATIVE

# Post-Storm Clean-up and Evaluation of Your Actions

## Chapter 13 – Clean-up and Evaluation After the Winter Storm and Season



# 13. Clean-up and Evaluation After the Winter Storm and Season

When snow and ice control operations have ended after the storm and after the winter season, there are several key actions to ensuring future winter maintenance success. These actions include equipment maintenance, proper site clean-up, evaluating your winter maintenance program and actions, and providing feedback to your crew.

## Winter Maintenance Clean-Up

Cleaning up after a winter storm can be just as important as using proper application rates of deicer materials. Any deicer spills at the site should be swept up promptly. Leaving the spilled deicer for future storms is not only unsightly, but increases the hazard for pedestrians slipping on the material and increases the environmental impact of your winter maintenance activities. Any spilled material can be reused for future winter storms, saving money on purchasing extra materials. It is important to clean up the trash and debris after the snow has melted to prevent pollution. At the end of the season, do not dump or unnecessarily use any leftover deicer. Save the extra to use next year. If you do not have a place for year-round storage, contact your local municipality, as they may be willing to purchase it, take it, or store it. Everyone benefits from good storage and less salt in our water.

**Save any extra salt at the end of the season for next winter. Do not apply the salt just to get rid of it.**

## Equipment Maintenance and Washing

Properly cleaning up equipment after a storm can increase the longevity of your equipment and reduce repairs and need for replacement. At the end of the season and as needed after a storm, clean and maintain the trucks, tanks, brine-making systems, and pumps according to manufacturer specifications. Before washing any equipment, be sure to remove as much deicing material from the equipment as possible. Regardless of where you wash your equipment, all the salty wash water ends up in our streams and rivers. All the salty wash water that goes down the sanitary sewer ends up in the sewage treatment plant and salt is not removed by the sewage treatment process. Any salty wash water that goes down storm drains ends up directly in our local waterways.

**Try to capture any wash water from washing salty equipment. The salt wash water can be reused to make brine saving materials and money.**

## Winter Sand Clean-Up

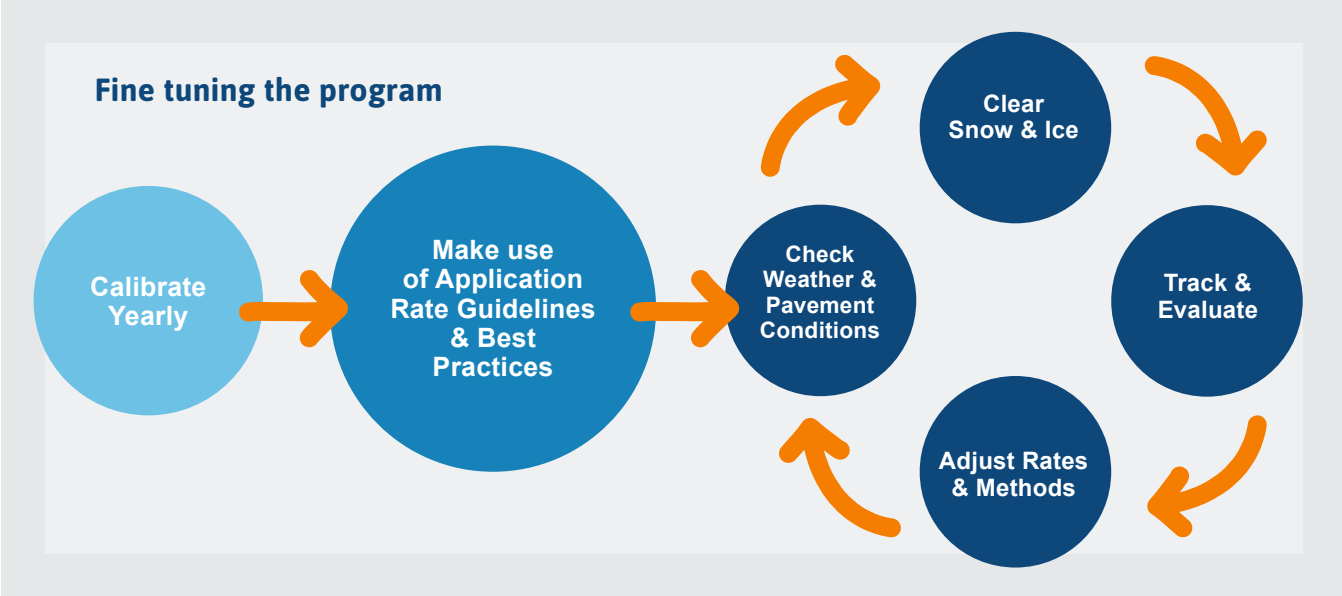
Sweep the sand from the parking lot areas in midwinter as well as in the spring. It is important to keep sand out of storm sewers where it can clog pipes and pollute local waterways. Trailer-type power sweepers are available that can be hauled behind a pickup truck. Smaller power brooms or sweepers may be used on sidewalks. Workers should wear a dust mask to avoid inhalation of the fine dust particles.

- Used sand may be contaminated with pollutants such as oil, grease, metal, and rubber.
- Sweepings often can be brought to a landfill. Inform landfill operator in advance.
- Keep children from playing on the sweeping piles.
- Sand mixed with salt should not be reused for any purposes other than winter storm management.
- Before reusing sweepings, remove the trash, leaves, and other debris. This is often accomplished by screening. When screening sweepings for reuse, use a small mesh for the final screening to ensure that all of the larger debris has been removed. A 3/4-inch mesh will screen out much of the debris. Properly dispose of trash and debris removed from the sweepings.

## Evaluation of Winter Maintenance Actions

Evaluation of winter maintenance actions is key to having a successful winter maintenance program. Regular evaluation of your winter maintenance program can lead to reduced salt usage and safe surfaces.

The first step in evaluating your winter maintenance program is maintaining good documentation of all your actions in accordance with your Winter Maintenance Plan/Policy.




Good documentation leads to reduced use of materials, more effective snow and ice control, reduced environmental impacts, and cost savings. Without documention and charts, there is no measurement of performance. Track the materials used, weather conditions, and amount of precipitation. Learn to record practices used, as well as what and how much product is applied at each site, from each visit. Be prepared to analyze and adjust the process based on what is learned. Following Best Management Practices and documenting actions will help prove the professional is doing the best job possible and may reduce liability. Learn more about winter maintenance plans and documentation in Chapter 2.

Along with documenting for liability, you want to be sure you're documenting to evaluate and fine tune your winter maintenance program. This includes documenting what works and what doesn't work. It also includes documenting actions taken that differ from your winter maintenance plan. When you deviate from your plan, you must document your actions and include why the actions changed.

## Post Storm Evaluation

After collecting your documentation from a winter storm event, it is important to review it. One of the first steps in evaluating your program is to find small ways to improve performance in your current operations. Make real-time adjustments based on your results from the winter storm event. For example, if you identify a spreader that applied more or less salt than the predetermined rate, investigate if the spreader needs repairs or if there was an operator error. If a repair to the equipment is made, the equipment should be re-calibrated. Small adjustments can improve your performance in the short term for the next winter storm and improve your overall operations in the long term. By continuously evaluating and making small adjustments, you can fine tune your program to meet the needs of your customer, reduce your salt use and related costs, and provide safe surfaces.

Consider developing a documentation system to track your materials at various stages of the winter maintenance process. By tracking the amounts of material loaded and applied against how much deicer should be needed to treat the areas you intend to treat, you can determine if there are any ways to improve your operations. The changes needed to improve your operations could be as simple as adjusting a setting on a spreader, making repairs to equipment, or providing training to your employees.

Include your employees in the evaluation process. Have an after-the-storm discussion with the maintenance crew to consider what actions could be improved for the next storm or the next year. Your employees may be able to provide suggestions or feedback on how well the winter maintenance actions worked. Use this discussion as an opportunity to provide continuous training to your staff and help encourage employee buy-in on using less salt.

### Contractor's Corner: Customer Feedback and Communication is Key to Finding Success with Salt Smart Practices

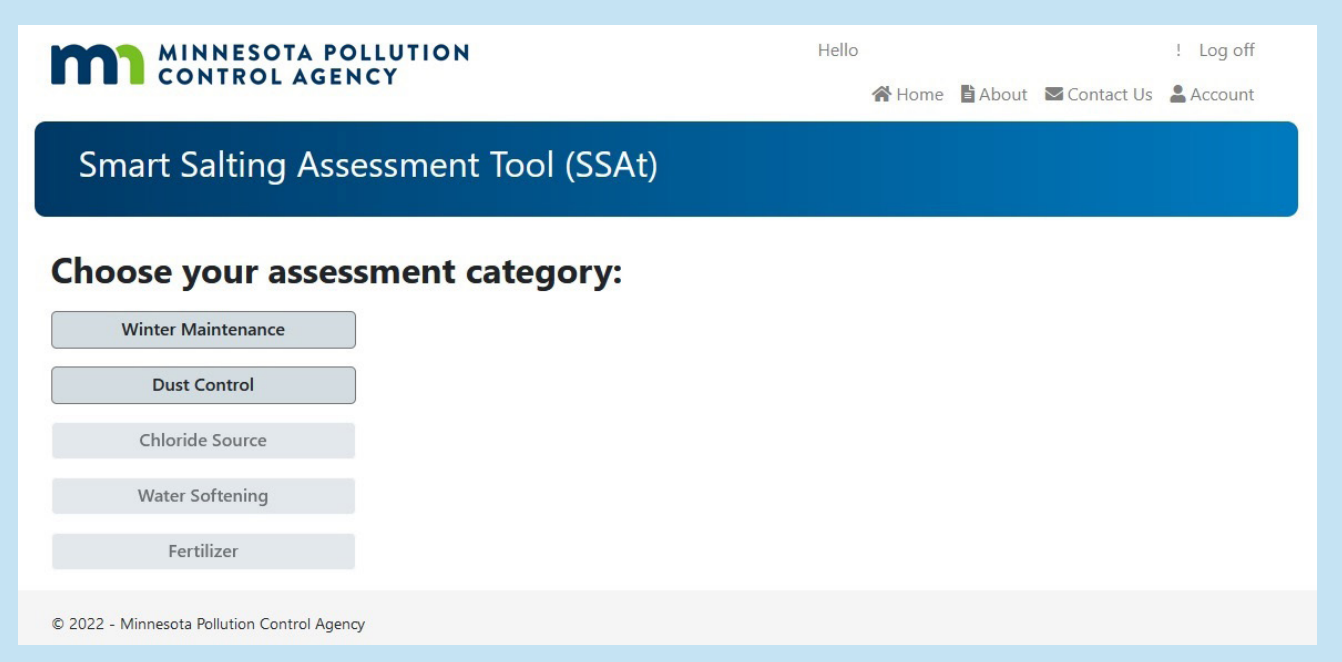
Customer feedback is an important part of your post-storm analysis and worth considering when making changes to your operations. Listen to your customer feedback and document it. Depending upon what types and the frequency of the customer feedback, you can determine what kind of changes will have a positive impact on your customers' experiences. Learning from your customers' needs will help you continue to reduce your salt use while providing safe surfaces.

Take the time to educate your customers on Salt Smart practices. Communication with your customers about what to expect can make a big difference in their expectations. Consider texting or emailing your customers updates related to weather conditions and the services you will be providing. Share Salt Smart education materials with your customers to educate them on the practices used in your operations. Resources are available at https://saltsmart.org/outreach/.

## Post-Winter Season Evaluation

Evaluate your program after each storm, but also after each winter season as every storm and winter season is different. Your overall program evaluation will help you decide what winter maintenance strategies worked and what didn't work for the areas you are treating and for different types of storms. It will also help you reflect and improve performance. Evaluating your winter maintenance strategies may also help you find ways to reduce your costs while still providing a good level of service to your customers. Post-season analysis can help you determine what equipment to plan for in future years or what equipment needs to be repaired or replaced. As you become more comfortable with reduced salt practices, adding equipment that works with these practices can improve your winter maintenance performance. Include your customers and get their feedback. Have an after-the-season discussion with your customers to determine if their needs were met as a result of your winter maintenance actions.

The Minnesota Pollution Control Agency's Smart Salting Assessment Tool (https://smartsaltingtool.com/) is an online tool for evaluating your winter maintenance strategies to help you find ways to improve performance and potentially reduce costs. The tool is free to use and helps you to evaluate what winter maintenance strategies you are using now and what would happen if you increased the number of reduced salting practices in the future. After completing the various assessments, the tool can provide you with graphs and charts to help you evaluate your operations. This is an easy way to assess your winter operations each year and find simple ways to improve your operations and plan for future winters. Using the Smart Salting Assessment Tool may be able help you predict future savings if you change your equipment or strategies.



## References


Clear Roads and Stonebrooke Engineering, “Liquid Roadway Treatments Technical Reference Guide”. September 2017. http://clearroads.org/wp-content/uploads/dlm_uploads/Liquid-Only-Road-Treatments-Technical-Reference-Guide-Final.3-2.pdf

Collins, Sara J, and Ronald W Russell. “Toxicity of road salt to Nova Scotia amphibians.” Environmental pollution (Barking, Essex: 1987) vol. 157,1 (2009): 320-4. https://doi.org/10.1016/j.envpol.2008.06.032

Dugan, Hilary A et al. “Salting our freshwater lakes.” Proceedings of the National Academy of Sciences of the United States of America vol. 114,17 (2017): 4453-4458. https://doi.org/10.1073/pnas.1620211114

Dugan, H.A., Rock, L.A., Kendall, A.D. and Mooney, R.J. (2021), Tributary chloride loading into Lake Michigan. Limnol. Oceanogr. Lett. https://doi.org/10.1002/lol2.10228

Fortin Consulting and Minnesota Pollution Control Agency, 2014: Fortin Consulting and Minnesota Pollution Control Agency. “The Real Cost of Salt Use for Winter Maintenance in the Twin Cities Metropolitan Area”. Report prepared for the Minnesota Pollution Control Agency. August 2014. https://www.pca.state.mn.us/sites/default/files/wq-iw11-06bb.pdf

Gahala, A.M., 2017, Hydrogeology and water quality of sand and gravel aquifers in McHenry County, Illinois, 2009-14, and comparison to conditions in 1979: U.S. Geological Survey Scientific Investigations Report 2017-5112, 91 p., https://doi.org/10.3133/sir20175112.

Harless, Meagan L et al. “Effects of six chemical deicers on larval wood frogs (Rana sylvatica).” Environmental toxicology and chemistry vol. 30,7 (2011): 1637-41. https://doi.org/10.1002/etc.544

Hintz, WD, Relyea, RA. A review of the species, community, and ecosystem impacts of road salt salinization in fresh waters. Freshwater Biol. 2019; 64: 1081– 1097. https://doi.org/10.1111/fwb.13286

Hintz, WD, Fay, L, Relyea, RA. “Road Salts, human safety, and the rising salinity of our fresh waters”. Front Ecol Environ 2022; 20(1): 22– 30, https://doi.org/10.1002/fee.2433

Illinois Department of Transportation. Circular Letter 2013-17. Snow and Ice Control Materials. September 24, 2013. https://idot.illinois.gov/Assets/uploads/files/Transportation-System/Directories/Bulletins-&-Circulars/Bureau-of-Local-Roads-and-Streets/Circular-Letters/Informational/CL2013-17.pdf

Illinois Environmental Protection Agency, Bureau of Water. “Illinois Integrated Water Quality Report Section 303(d) List, 2018”. February 2021. https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Documents/2018_Cycle_Integrated%20Report_FINAL_20210201.pdf

Illinois State Climatologist. “Ice Storms in Illinois”. Illinois State Water Survey. 2021. https://stateclimatologist.web.illinois.edu/climate-of-illinois/ice-storms-in-illinois/

Kelly, W.R., 2008. Long-term trends in chloride concentrations in shallow aquifers near Chicago. Ground Water 46(5):772-781. https://doi.org/10.1111/j.1745-6584.2008.00466.x

Kelly, W.R., S.V. Panno, and K.C. Hackley, 2012. Impacts of road salt runoff of the Chicago, Illinois, region. Environmental and Engineering Geoscience 18(1):65-81. https://doi.org/10.2113/gseegeosci.18.1.65

Kelly, WR, Hadley, D, Mannix, D. “Shallow Groundwater Sampling in Kane County, 2015”. Illinois State Water Survey. ISWS Contract Report CR-2016-04 (2016). http://hdl.handle.net/2142/91002

City of Madison, Wisconsin and Wisconsin Salt Wise. “Wisconsin Winter Maintenance Manual, Parking Lots, Sidewalks and Trails”. June 2019. https://wisaltwise.com/documents/PDFs/Madison-Parking-Lot-Manual-Final-7-19-2019.pdf

Midwest Biodiversity Institute (MBI). 2022. Integrated Prioritization System (IPS) for Northeastern Illinois: Technical Documentation and Atlas of Stressor Relationships. Technical Report MBI/2020-5-10. Project Number 10180900. Columbus, OH 43221-0561. 157 pp. + appendices.

## References (cont.)

Minnesota Local Road Research Board (LRRB). "Minnesota snow and ice control: Field handbook for snowplow operators." October 2012. http://www.mnltap.umn.edu/publications/handbooks/documents/snowice.pdf

Minnesota Pollution Control Agency. "Smart Salting for Property Management Manual", December 2020. St. Paul, MN. https://www.pca.state.mn.us/sites/default/files/p-tr1-11.pdf

Minnesota Pollution Control Agency. "Winter Parking Lot and Sidewalk Maintenance Manual", Third Revision, June 2015. St. Paul, MN. https://www.pca.state.mn.us/sites/default/files/p-tr1-10.pdf.

NOAA National Centers for Environmental Information. "US Climate Normals Quick Access". https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-annualseasonal&timeframe=30&location=IL

Novotny, Eric V et al. "Increase of urban lake salinity by road deicing salt." The Science of the total environment vol. 406,1-2 (2008): 131-44. https://doi.org/10.1016/j.scitotenv.2008.07.037

Sanzo, D, and Hecnar, S. "Effects of road de-icing salt (NaCl) on larval wood frogs (Rana sylvatica)." Environmental pollution (Barking, Essex : 1987) vol. 140,2 (2006): 247-56. https://doi.org/10.1016/j.envpol.2005.07.013

Sibert, R, Koretsky, C, and Wyman, D. (2014). Cultural Meromixis: Effects Of Road-Salt On The Chemical Stratification Of An Urban Kettle Lake. Chemical Geology. 395. https://doi.org/10.1016/j.chemgeo.2014.12.010

# Appendix A – Definitions and Conversion Tables

## Material Conversions Table

| SAND | | | SALT | |
|---|---|---|---|---|
| Yards | Tons | | Yards | Tons |
| 1 | 1.4 | | 1 | 1.1 |
| 2 | 2.8 | | 2 | 2.2 |
| 3 | 4.2 | | 3 | 3.2 |
| 4 | 5.6 | | 4 | 4.3 |
| 5 | 7.0 | | 5 | 5.4 |
| 6 | 8.4 | | 6 | 6.5 |
| 7 | 9.8 | | 7 | 7.6 |
| 8 | 11.2 | | 8 | 8.6 |
| 9 | 12.6 | | 9 | 9.7 |
| 10 | 14.0 | | 10 | 10.8 |
| 11 | 15.4 | | 11 | 11.9 |
| 12 | 16.8 | | 12 | 13.0 |
| 13 | 18.2 | | 13 | 14.0 |
| 14 | 19.6 | | 14 | 15.1 |
| 15 | 21.0 | | 15 | 16.2 |
| 16 | 22.4 | | 16 | 17.3 |
| 17 | 23.8 | | 17 | 18.4 |
| 18 | 25.2 | | 18 | 19.4 |
| 19 | 26.6 | | 19 | 20.5 |
| 20 | 28.0 | | 20 | 21.6 |

The following formulas and the above quick reference table will help to convert between tons and cubic yards. Weights will vary depending upon moisture content.

1. To convert tons of clean sand to cubic yards: # tons divided by 1.4 = cubic yards
2. To convert cubic yards of clean sand to tons: # cubic yards multiplied by 1.4 = tons
3. To convert tons of winter sand to cubic yards: # tons divided by 1.37 = cubic yards
4. To convert cubic yards of winter sand to tons: # cubic yards multiplied by 1.37 = tons
5. To convert tons of straight salt to cubic yards: # tons divided by 1.08 = cubic yards
6. To convert cubic yards of straight salt to tons: # cubic yards multiplied by 1.08 = tons

# Appendix A – Definitions and Conversion Tables

### Material Conversions Table

Use these tables to convert application rates between pounds per lane mile and pounds per 1000 square feet.

| lbs./ lane mile* | lbs./1000 square feet |
|---|---|
| 25 | 0.4 |
| 50 | 0.8 |
| 75 | 1.2 |
| 100 | 1.6 |
| 125 | 2.0 |
| 150 | 2.4 |
| 175 | 2.8 |
| 200 | 3.2 |
| 225 | 3.5 |
| 250 | 3.9 |
| 275 | 4.3 |
| 300 | 4.7 |
| 350 | 5.5 |

| lbs./1000 square feet | lbs./ lane mile* |
|---|---|
| 0.5 | 32 |
| 0.75 | 48 |
| 1 | 63 |
| 1.25 | 79 |
| 1.5 | 95 |
| 1.75 | 111 |
| 2 | 127 |
| 2.25 | 143 |
| 2.5 | 159 |
| 2.75 | 174 |
| 3 | 190 |
| 3.25 | 206 |
| 5 | 317 |

*12-foot lane width

### Common Conversions

- 1 lane mile (12’ x5280 ft.) = 63360 square feet
- Average size parking spot: 9 x 20 feet or 10 x 20 feet = 180 – 200 square feet
- Driving isles (2-way) = About 25 feet wide
- 1 acre = 43,560 square feet
- 1 ton = 2000 lbs.
- 1 cup of salt (NaCl) = 0.6 lbs.
- Salt (NaCl) weighs 72 – 84 lbs./ ft3 depending upon moisture and granule size
- 1 gallon = 128 ounces
- 1 cubic yard of salt = 1.1 ton
- 1 cubic yard of sand = 1.4 tons
- 1 cubic yard = 27 cubic feet
- 1 square yard = 9 square feet

## Definitions

**°C** degrees Celsius

**°F** degrees Fahrenheit

**brine** liquid deicer made from water and rock salt (NaCl)

**lbs** pounds

**mg/l** milligrams per liter

**IDOT** Illinois Department of Transportation

**IEPA** Illinois Environmental Protection Agency

**mph** miles per hour

**ppm** parts per million

**psi** pounds per square inch

**sq. ft.** square feet

# Appendix B - Additional Resources

## Training Resources

Salt Smart Training Classes and Workshops - https://saltsmart.org/workshops/

Wisconsin Salt Wise Training Classes - https://wisaltwise.com/Winter-Salt-Certification

Minnesota Pollution Control Agency Smart Salting Training Classes - https://www.pca.state.mn.us/water/smart-salting-training

SIMA (Snow and Ice Management Association) Training Options - https://www.sima.org/train

## Technical Resources

Salt Smart Educational and Outreach Materials - https://saltsmart.org/outreach/

Chloride Conscious, Midwest Salt - https://chlorideconscious.com/

Calcium Chloride, Sidewalk Ice Melting - https://www.oxycalciumchloride.com/sidewalk-ice-melting/effective-ice-melting

Road Safety Knowledge Center, Cargill - https://www.cargill.com/industrial/knowledge-center-blog

Eutectic Temperature vs. Practical Temperature, Ice Slicer Blog - https://blog.iceslicer.com/eutectic-temperature-vs.-practical-temperature

National Weather Service - http://www.weather.gov/

Minnesota's Smart Salting Assessment Tool - https://smartsaltingtool.com/

Clear Roads, "Liquid Roadway Treatments Technical Reference Guide" - http://clearroads.org/wp-content/uploads/dlm_uploads/Liquid-Only-Road-Treatments-Technical-Reference-Guide-Final.3-2.pdf

Clear Roads – Manual of Best Management Practices for Road Salt in Winter Maintenance. http://clearroads.org/wp-content/uploads/dlm_uploads/0537_2015-Clear-Roads-Best-Practice-Guide-WEB.pdf

Illinois Department of Transportation, Circular Letter 2013-17, Snow and Ice Control Materials - https://idot.illinois.gov/Assets/uploads/files/Transportation-System/Directories/Bulletins-&-Circulars/Bureau-of-Local-Roads-and-Streets/Circular-Letters/Informational/CL2013-17.pdf

University of Wisconsin Extension Cooperative Extension, "Winter Salt Injury and Salt-Tolerant Landscape Plants" https://pdf.countyofdane.com/myfairlakes/A3877.pdf

Minnesota Pollution Control Agency, Salt Applicator Resources - https://www.pca.state.mn.us/water/salt-applicators

Wisconsin Salt Wise - https://www.wisaltwise.com/

Illinois Department of Transportation, Getting Around Illinois – Winter Road Conditions - https://www.gettingaroundillinois.com/winterconditions/

## Snow and Ice Management Resources

Salt Smart Resources for Private Contractors - https://saltsmart.org/private-contractors/

SIMA Snow Business Magazine - https://www.sima.org/magazine

# Appendix C - Application Rate Charts, Blank Calibration Charts, and Example Reporting Documents

## Blank Anti-Icing Application Rate Chart

| Anti-Icing Application Rate Guidelines | | |
|---|---|---|
| **Predicted Weather Condition** | **Gallons/_____**<br>**Product: _____** | **Other Products** |
| 1. Prior to frost or black ice event | | Follow manufacturers' recommendations |
| 2. Prior to light or moderate snow | | |
| **CAUTION**: Too high an application rate may result in slippery conditions or tracking. | | |

**Uses for the Blank Application Rate Chart:**

- Complete the application rate charts with the rates you intend to use at your facilities or properties.
- Use the blank charts to aid in your winter planning as you adjust your program based on experience and the conditions you encounter at your facilities or properties.
- Complete a blank anti-icing application rate chart per the manufacturers' recommendations if using a product different than Salt Brine (sodium chloride).

# Appendix C - Application Rate Charts, Blank Calibration Charts, and Example Reporting Documents

## Deicing Application Rate Chart

| Deicing Application Rate Guidance for Parking Lots and Sidewalks<br>For best results, remove as much snow and ice as possible before applying deicers | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pavement Temperature (°F) | Pounds/_____ | | | | | Gallons/_____ | |
| | Rock Salt (NaCl)** | Bagged Blends, mostly Rock Salt** | Bagged $MgCl_2/CaCl_2$ | Rock Salt treated with 23.3% Salt Brine | Rock Salt treated with other liquids | *23.3% Salt Brine (NaCl) - DLA - Light Snow (less than 0.5 in/hour) | *23.3% Salt Brine (NaCl) - DLA - Medium Snow (0.5 to 1.0 in/hour) |
| 28 to 32 | | | X | | X | | |
| 23 to 28 | | | | | | | |
| 15 to 23 | | | | | | | X |
| 0 to 15 | X | X | | | | X | |
| 0 to -5 | | | | X | | | |

* DLA rates adapted from Clear Roads Direct Liquid Application Guidance with application cycle times of 2-3 hours

**Dry rock salt is ineffective below 15°F. If pavement temperatures fall below 15°F, choose another material or strategy.

**Uses for Blank Application Rate Charts:**

- Complete the application rate charts with the rates you intend to use at your facilities or properties.
- Use the blank charts to aid in your winter planning as you adjust your program based on experience and the conditions you encounter at your facilities or properties.

# Appendix C - Application Rate Charts, Blank Calibration Charts, and Example Reporting Documents

## Calibration Chart for Push Spreaders

### Push Spreader Calibration Chart: Calculate Application Rates (Pounds per 1,000 sq. ft.)

Equipment: _____ Material: _____ Date: _____

| A | B | W | L | C | D |
|---|---|---|---|---|---|
| Lever position or gate setting | Pounds spread in Test Area | Spread width in feet | Length of Test Area | Coverage area in sq. ft. (**W x L**) | Application rate in lbs./1000 $ft^2$ (**B/C x 1000**) |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| *EXAMPLE* | | | | | |
| *Setting 1 (Half Closed)* | *0.4 lbs.* | *13 feet* | *10 feet* | *13ft x 10ft =130 sq. ft.* | *(0.4/130) x 1000 = 3.1 lbs. per 1000 sq. ft.* |

# Appendix C - Application Rate Charts, Blank Calibration Charts, and Example Reporting Documents

## Calibration Chart for Motorized Spreaders

**Calibration Chart for Motorized Equipment: Calculate Application Rate (Pounds per 1,000 sq. ft.)**

Equipment: _____ Material: _____ Date: _____

| A | B | C | D | E |
|---|---|---|---|---|
| **Setting** | **Pounds Discharged per Minute** | **5 MPH (x0.19) in lbs/1000 sq ft** | **10 MPH (x0.09) in lbs/1000 sq ft** | **15 MPH (x0.06) in lbs/1000 sq ft** |
| *Example:* | *50* | *50 x 0.19 = 9.5* | *50 x 0.09 = 4.5* | *50 x 0.06 = 3* |
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## Appendix C - Application Rate Charts, Blank Calibration Charts, and Example Reporting Documents

### Calibration Chart for Liquid Spreading Equipment

**Calibration Chart for Liquid Spreaders: Calculate Application Rate (Gallons/Acre)**

Equipment: _____ Material: _____ Date: _____

| Total Width of Spray Pattern (feet) | Time Interval (Minutes) | Gallons Discharged (gallons) | Application Rate (gallons per minute) | Application Rate by Speed 5 MPH (Gallons/Acre) | Application Rate by Speed 10 MPH (Gallons/Acre) | Application Rate by Speed 15 MPH (Gallons/Acre) |
|---|---|---|---|---|---|---|
| | | | | | | |
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| | | | | | | |
| | | | | | | |
| | | | | | | |
| | *Example:* | | | | | |
| *Width (W)* | *Minutes* | *Gallons* | *Gallons per Minute (GPM) = Gallons Discharge/Time Interval* | *(GPM x 495) / (MPH x W) = Gallons/Acre* | *(GPM x 495) / (MPH x W) = Gallons/Acre* | *(GPM x 495) / (MPH x W) = Gallons/Acre* |
| *8 feet* | *10 minutes* | *80 gallons* | *80 gallons/10 minutes = 8 gallons per minute* | *(8 gallons per minute x 495) / (5 MPH x 8ft) = 99 gallons/Acre* | *(8 gallons per minute x 495) / (10 MPH x 8ft) = 49.5 gallons/acre* | *(8 gallons per minute x 495) / (15 MPH x 8ft) = 33 gallons/acre* |

## Appendix C - Application Rate Charts, Blank Calibration Charts, and Example Reporting Documents

### Calibration Log

| Organization Name | |
|---|---|

| Date | Equipment Type | Equipment # | Setting | Material | Area Applied (Sq. Ft.) | Amount of Product Used (lbs) | Application Rate (include units) | Calibrated By |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
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*For Application Rates in Lbs/1,000 sq. ft.: 1,000/area applied in sq. ft. x lbs salt used = lbs/1,000 sq. ft.

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# Appendix C - Application Rate Charts, Blank Calibration Charts, and Example Reporting Documents

## Facility Event Tracking Form

| | |
|---|---|
| Organization Name | |

| | | | |
|---|---|---|---|
| Facility Name | | | |
| Date | | Lot Size (Sq. Ft. or Acres) | |
| Start Time | | Sidewalk Size (Sq. Ft. or Acres) | |

| Weather Conditions |
|---|
| |

Examples: Starting temp, rising or falling temps, wind, length of storm, blowing snow, light snow, heavy snow, pavement temperatures, etc.

| Precipitation Type (Circle all that Apply) | Precipitation Amount (in inches) |
|---|---|
| Rain | |
| Freezing Rain | |
| Snow | |
| Ice | |
| Other: | |

| Products and Amounts Used (bags, pounds, gallons, etc) | | Application Rates Used |
|---|---|---|
| Dry Salt | | |
| Pre-wetted/Pretreated Salt | | |
| Calcium Chloride | | |
| Bagged Blend | | |
| Liquid | | |

| Equipment Used (include Equipment #) | Staff Names | Hours Worked |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

| | |
|---|---|
| Were mechanical methods (plowing, scraping, sweeping, etc) used before applying deicer materials? (circle one) | Yes / No |
| Type of Application? | Deicing / Anti-Icing |

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