"DRAFT"

MODEL PLAN
SNOW AND ICE CONTROL
TOWN OF BOLTON
LAKE GEORGE WATERSHED
2017

SNOW AND ICE OPERATIONAL PLAN

TOWN OF BOLTON

Lake George Watershed

Page

PREFACE

This snow and ice control plan has been developed specifically for use by Highway Departments responsible for snow and ice control within the Lake George Watershed. The main references used in developing the plan are:

1. The New York State Department of Transportation, Highway Maintenance Guidelines, Chapter 5, “Snow and Ice Control” 2012
2. Cornell Local Roads Program, New York LTAP Center, “Snow and Ice Control 2014”
3. Road salt application differentially threatens water resources in Lake George, NY, Swinton, Eichler, Boylen, 2015
4. Environmental, Health and Economic Impacts of Road Salt, New Hampshire Dept. of Environmental Services, 2014

Sections of the documents have been “restated” in this plan. More detailed information is available by referring to the original documents listed.

SNOW AND ICE CONTROL OPERATIONAL PLAN

I. GOAL

The Goal of the Town of Bolton is to provide highways that are passable and reasonably safe for vehicular traffic and pedestrians as much of the time as possible within the limitations imposed by weather conditions and the availability of equipment, material and personnel. It is recognized that due to resource limitations and weather conditions, pavement and bridge surfaces will be snow covered and/or slippery some of the time. The traveling public must exercise caution and drive appropriately in those situations. Vehicles and pedestrians should be properly equipped for winter travel conditions.

The Municipality will conduct snow and ice control activities that afford customers a reasonably safe and passable (not necessarily bare) road surfaces as much of the time as possible. To accomplish that, snow and ice accumulations will be removed as soon as possible, consistent with stated priorities and resources. To the extent possible, the bond of snow and ice to pavement will be prevented by the timely application of ice control brine, (anti-icing strategy). Abrasives may be used as necessary to provide temporary friction improvement.

Certain conditions such as unavailability of equipment and personnel, blizzards, whiteouts other locally severe snow and ice events, thin ice formation in the absence of or during very light and spotty precipitation, and other conditions unknown to or beyond the control of the MUNICIPALITY, maintenance forces may temporarily preclude achieving this goal.

II. AREAS OF RESPONSIBILITY

A. **ROADS** and **PARKING LOTS** maintained by the Town of Bolton Highway Department and Parks and Recreation Department are listed in **APPENDIX 3**.

B. Private Driveways and Roads

Municipality snow removal crews do not clear private roads, driveways or driveway entrances of accumulated snow.

C. Sidewalks

The Parks and Recreation staff clear and sand the sidewalks.

III. PRIORITIES

A. List of Roads in **APPENDIX 3**

B. Level of Service provided between 11 pm and 5 am

Roads will be reasonably safe and passable, not necessarily bare.

C. List of known icing trouble and critical locations

D. Critical locations may include intersections, hills, bridges, cold locations (low, shaded and elevated), locations having mist or fog generation tendencies, traffic generators, high snow and ice accidents, school bus routes and access to the Town/Village Offices, fire station and EMS.

E. Sidewalk policy

Clearing of sidewalks will begin the day of a storm.

F. Fire hydrant policy

Fire hydrants will be maintained by the Water Department. Snow removal will commence the day of a storm.

IV. LEVEL OF SERVICE

Definition: The Town of Bolton intends to provide safe and passable roads for vehicles and pedestrians which are properly equipped for winter driving conditions. The Highway Superintendent will focus resources on the main line roads to achieve reasonably safe and passable roads within 8 hours after the completion of the storm event. Other roads will be plowed but may not be free from snow and ice.

V. RESOURCES

A. PERSONNEL – Refer to **APPENDIX 3**

Sufficient personnel (permanent, temporary, reassigned and interdepartmental) should be acquired and trained for snow and ice operations prior to the winter season. Specific route assignments will be made prior to the snow and ice season.

B. Personnel Readiness

The training of Snow and Ice personnel to safely and efficiently perform their duties should be a continuing effort. Basic Snow and Ice Training for all new employees is essential. Snow schools, seminars and preparation for snowplow competitions are available through training forums. Training is important and dedicated funding to implement or attend training is essential.

C. EQUIPMENT Type and Location – Listed in **APPENDIX 3**

Equipment should be chosen to meet the local need in terms of snowfall frequency, facility structure (i.e. bridge weight limits) and roadway geometry.

D. Equipment Readiness

Major repairs and overhauls of Snow and Ice equipment should be performed well in advance of the anticipated time of need. Adequate resources are needed to be available to perform this work. Our goal is to have the snow and ice fleet ready by November 1. Stored equipment (plows, spreaders, snow blowers) should be serviced and painted prior to being placed in storage. The flight chains on spreaders should be checked for lubrication during storage to prevent seizure. Whenever possible, spreaders should be stored under cover. Snow Blowers should be started periodically during the off season to ensure proper operation later. Proper preventive maintenance and daily maintenance of multi-seasonal equipment is a good way to ensure readiness and proper performance.

E. Budgets

An effective working relationship with the legislative board is essential. The highway superintendent must work with the legislative board to insure he has the proper resources to deliver the snow and ice plan. The snow and ice plan must be endorsed and supported by the legislative board. The Highway Superintendent should share good cost control and performance data to help the Board see the impact of budget allocations on the level of service, the overall cost of operations, efficiency and effectiveness.

1. Materials – Listed in **APPENDIX 5**

a) De-icing material

b) Sand

2. Overtime- Listed in **APPENDIX 5**

3. Equipment

The Highway Superintendent will present his recommendations for equipment replacement or additions to the Town Board during the annual budget review.

When local budgets are unable to procure equipment using improved technology for snow and ice operations the local government should utilize the staff to identify funding.

VI. CHAIN OF COMMAND

A. Storm Manager Procedures

The Highway Superintendent is the Storm Manager. He/she will execute a program to have all the necessary resources in place ready to go when the storm begins. The Highway Superintendent will monitor all of the available forecast information and determine the approximate start time of the storm. With an approximate storm start time, type of storm and anticipated temperatures (pavement and air) a decision will be made when to have the necessary people and equipment ready to begin snow and ice operations.

B. Decision Making

The Highway Superintendent or qualified designee will patrol the roads in a light vehicle having communications capability, assessing areas to be affected by the event for the purpose of directing the appropriated response. He/she will continue to gather and evaluate data on treatment effectiveness, actual road conditions and actual weather conditions from operators and other sources

C. Contact with the Public

It is vitally important that we keep our customers informed of our policies and procedures. A copy of the Snow and Ice Control Plan will be available at the Town Office. Information will be posted on the Town web site.

Operators are to report all stranded or stuck vehicles to the Highway Garage. Operators may stop to check to see if the passengers in a disabled

vehicle are safe.

If an operator is being flagged down by a resident, the operator may stop; however, the operator should offer that all disputes or concerns be directed to the Highway garage. All operators should have a business card of the Highway Superintendent to hand to the resident.

VII. Communication

A. Weather Data

The Highway Superintendent will use a variety of weather forecast products available. He/she will simultaneously evaluate short-term, mid-tem and long-term forecasts. Information on precipitation will include onset, cessation, type and intensity. He/she will also consider air temperature, road temperature, dew point, wind speed, wind direction and cloud cover.

Other weather data sources include radar and satellite imagery (internet and local TV), NOAA radio, the Weather Channel, computer acquired condition data from upstream storm locations, local TV and radio.

B. Communication Systems

The Town has a variety of communication systems including: radio, cell phone, land line and fax. These systems should be checked prior to winter and any necessary training /retraining provided.

C. Road Information

The Highway Superintendent will use weather data and observations that are obtained from maintenance patrols, operators, police agencies and media outlets

D. Highway and Pavement Information

Pavement temperature is one of the most important factors when deciding on a snow and ice control treatment. The Highway Superintendent's vehicle and active plowing equipment should be equipped with pavement and air temperature gages. Data on recent storms, coupled with current and predicted pavement temperature are very useful.

VIII. COMMENCING SNOW OPERATIONS

A. Call in Procedures (Town, Local Contractors). Drivers are required to report for duty within 45 minutes of notification.

B. Fitness for Duty

Employees must adhere to the drug and alcohol policy adopted by the municipality and comply with the New York State CDL requirements.

C. Hours of Continuous Operation

The Federal CDL Law includes a provision of 10 hours maximum time of operation. As municipal snowplow and related equipment operators are not engaged in "Interstate Commerce," this portion of the law does not apply during snow and ice control operations. However, as a matter of common sense, overly fatigued staff should not be operating equipment. Town of Bolton has adopted the following limits. A driver may be on duty a maximum of 16 hours. After that, the driver must be off duty for a minimum of 4 continuous hours before returning to work. Qualified drivers will be utilized first unless a state of emergency is declared.

IX. SNOW CONTROL

Snow control is the mechanical removal of accumulations of "loose" snow from the paved and stabilized portions of the system. This is accomplished primarily with truck mounted plows and is supplemented with front end loaders, snow blowers and other smaller pieces of equipment.

A. Plowing Methods

1. All plowing shall be done with trucks moving in the direction of traffic, except in an emergency situation where the work is closed to traffic or, backing in the direction of traffic is required to clear intersections or spread material on slippery surfaces.

2. Plowed snow shall not be cast into traffic.

3. Within the normal sequence of operations and as equipment and personnel allow, any time there is enough snow on the road to plow, it should be plowed.

4. In events where snow is likely to change to freezing rain before ending, consideration should be given to leaving enough unplowed snow on the road to absorb the freezing rain. Plow and treat the road again after the event has ended.

5. At the end of the storm, push snow back as much as possible to make room for the next snow storm.

Refer to NYSDOT Highway Maintenance Guidelines Chapter 5.3-Snow and Ice Control for additional information

X. SNOW REMOVAL

A. Post Storm Removal for on Street Parking

Cleanup operations are normally done during "regular time" hours. When operations may impact traffic flow or large numbers of customers work should be performed in lower volume periods if possible and utilize traffic protection where appropriate.

B. Parking Lots (Health Center, Town Hall, 2 Beach parking lots)
Snow will be removed as necessary

C. Dumping Area

Snow will be dumped only at the following Town dumping areas located at the Recreation field. The nearest stream is greater than 500 feet.

XI. ICE CONTROL

Ice control is all treatment operations directed toward preventing snow and ice bonding to the pavement and the chemical and /or mechanical removal of bonded snow or ice from the pavement. It also includes providing temporary friction improvement by spreading abrasives (sand) and abrasives/chemical mixtures when appropriate. There are four basic strategies recognized for ice control. They are anti-icing, deicing, delayed treatment and temporary friction improvement.

A. Anti-icing

Anti-icing is a strategy that places and maintains a sufficient quantity of ice control chemicals on the pavement surface before or very soon after precipitation or ice formation begins. This is done to prevent bonding of snow and/or ice to the pavement. When anti-icing methods are properly employed, high levels of service can be achieved for sustained periods of time.

The key to effective anti-icing is to get an ice control chemical on the surface before or very soon after, precipitation or ice formation begins.

Anti-icing is not suitable for use on unpaved surfaces and areas where a low level of service is primarily using abrasives.

All decisions for anti-icing applications (timing, rates, etc.)will be made by the Highway Superintendent based upon known pavement temperature and event conditions.

B. Deicing

De-icing is a treatment strategy for dealing with snow and ice that has already bonded to a paved surface. Deicing is most effectively accomplished by spreading a coarse graded (rock salt) solid or pre wet solid ice control chemical on the surface of the bonded snow and ice. The coarse particulars will melt through the snow and ice, break the bond, and then produce a chemical solution that flows across the pavement surface between the packed snow/ice and road surface. Any snow or ice that has not gone into solution should be removed by subsequent plowing. Sufficient time is necessary to allow the salt to work before plowing commences.

C. Delayed or Non-Treatment

Delaying or not applying ice control materials is a tactic that may be used in support of the anti-icing strategy. Conditions where this tactic should be considered include light precipitation events, where pavement temperature is likely to remain above freezing, and dry snow and blowing snow events where pavement surface temperature is below about 15 degrees F and there is no residual ice control chemical on the pavement

D. Temporary Friction Improvement (Sand and Sand/Salt Mixes)

Temporary friction improvement is an immediate short-term improvement in surface friction that is achieved by spreading abrasives/chemical mixtures on the snow or ice surface. There will be times when this is an appropriate strategy-usually in very cold conditions. A major disadvantage of this strategy is that its effectiveness degrades very quickly with traffic. The tire action and turbulence from vehicles will cause the material to move to the side of the travel lanes. If sufficient ice control chemical is spread with abrasive, it can be part of anti-icing and de-icing strategies. However, the effectiveness of ice control chemicals are significantly reduced by sand.

Refer to NYSDOT Highway Maintenance Guidelines Chapter 5.4404 – Snow and Ice Control for additional information

XII. Materials Used for Ice Control

A. General

There are a large number of chemicals and other treatments that are used for control. NYSDOT generally uses the six options listed below. Most of the chemicals are available in the liquid form and can be used as part of an on-board wetting system with spreaders or with slide-in tank and spray bar systems. They can also be used to pre-treat salt stockpiles. The use of liquid chemicals in a slide-in-tank and spray bar system has several advantages over use of solid chemicals. Liquids can usually be applied at relatively fast spreading speeds while achieving application patterns. Liquids also allow placement prior to a storm on dry pavement, but it has to be done on pavements above 20 degrees F, unless there are additives available that can allow application at lower temperatures, i.e. MgCl2.

B. Salt (Sodium Chloride or Rock Salt)

Salt is the most common and least expensive ice control chemical. The ability of salt to melt ice or form brine is highly temperature dependent.

*See **APPENDIX 4** for salt use with changing weather conditions*.

C. Treated Salt

Salt can be pre-treated or pre-wet with a variety of liquids to improve its performance. Pre-treated salt will start to work quicker than untreated salt, will continue to perform at lower pavement temperatures, and can be applied at a lower application rate. The pre-treatment of salt also helps to reduce the “bounce and scatter” problems of untreated salt, thus keeping more material on the pavement.

D. Calcium Chloride

Calcium Chloride works more quickly at low temperatures than salt. As a liquid it can be used to pre-treat salt stockpiles or onto salt in the spreader chute as part of the on-board wetting system. The ability to spray it onto the salt in the spreader gives the operator more flexibility to use the calcium chloride only when needed. When added to salt it improves the salt’s melting characteristics at lower temperatures, accelerates the working time and reduces bounce and scatter. As a solid material it may be mixed with salt for use at low temperatures.

E. Magnesium Chloride

Magnesium Chloride also works more quickly than salt. Magnesium Chloride is only used in liquid form on both stockpiles of salt and in on –board wetting systems or slide –in tank and spray bar systems.

G. Abrasives (Sand)

Abrasives may be natural sand, manufactured sand, iron ore tailings, slag or lightweight aggregate conforming to New York State Specifications. They provide immediate temporary improvement in the frictional characteristics of the pavement surface. Areas adjacent to certain bodies of water can be adversely affected by the use of abrasives, making it essential to clean up sand each spring.

Refer to NYSDOT Highway Maintenance Guidelines Chapter 5.4404 – Snow and Ice Control for additional information

XIII. Guidelines for the use of Salt

A. General Considerations

The effectiveness of salt is highly temperature dependent. Pavement temperature is the key in this situation. Pavement temperature is seldom the same as air temperature. Starting about mid-morning, with solar warming, pavement temperature will exceed air temperature by as much as 40 degrees F. With nightfall, pavement temperatures will still be higher than air temperature for several hours. In early to mid-morning, pavement temperature will be lower than air temperature.

Absent the daily solar effects, seasonal geo-thermal factors do influence the relationship between air and pavement temperature. In early winter, pavement temperatures are generally warmer than air temperature. In late winter, pavement temperatures are generally colder than air temperature.

The ice content of a particular snow or ice event is another factor that influences the effectiveness of salt. There is a wide range in the ice or water content of snow and ice events. The ice content of snow can vary from about 10% to 90%. Sleet, freezing rain, pack and glaze all have ice contents in the range of 90% to 100%. With increasing ice content per inch of snow or ice, more salt is required to be effective.

Salt is more effective with higher traffic volume. Frictional effects at the tire-pavement interface tend to warm the pavement. Also, the mechanical impact of traffic tends to break up the ice once the salt has prevented or broken the ice/pavement bond. The Highway Superintendent will use reasonable judgement when to use salt and how much salt to use.

B. Specific Application Rate Guidelines

The Town's approach to ice control is proactive. Anti-icing is the preferred tactic to take, when appropriate.

This information is reprinted from the NYSDOT Highway Maintenance

Guidelines Chapter 5.4405 – Snow and Ice Control

Appendix 5 contains general guidelines for anti-icing operation.

The recommendations are in tabular form.

The use of these tables requires a knowledge of pavement temperatures and the ice bond characteristics prior to treatment. Application rates are shown for operations using untreated salt, treated salt and straight liquids. These application rates published bare based upon several years of experience by the Salt Institute, New York State and other States and are meant to be a guide. Experience on individual routes will be used to determine exact rates. Application rates are determined by the Highway Superintendent.

C. Accuracy of Application Rates

The application rates specified in **Appendix 4** should serve as targets and actual application rates as determined from calibration data shall be within 7.5% of the target value. Calibration of spreaders and ground speed controllers should be completed at least annually by a trained department staff person.

More information on calibration can be found in NYSDOT, Chapter 5.4412

D. Spreading Patterns – Salt (Solid)

The spreading pattern is dictated by the type of highway, number of lanes being spread and the character of the event. Adjustments to the spread pattern can be achieved by changing the spreader's baffle position, deflector position, spinner speed and direction of throw.

E. Spreading Speed

The traffic characteristics of the highway will to some extent determine the speed of the spreading truck. On high speed-high volume roads highways the speed will be faster than on low speed-low volume highways. With increasing speed, "bounce" and "scatter" of salt becomes greater. Treating salt as it leaves the hopper with an on board wetting system or using pre-treated salt reduces the "bounce" and "scatter" of the salt. The actual speed pattern should be checked periodically to be sure the salt is being distributed as intended. Depending on the road and traffic condition, speeds should be in the range of 15 MPH to 25 M

XIV. Guidelines for the Use of Abrasives

A. General Considerations

Abrasives should generally be used in areas with relatively low traffic volume, rough or dirt road surfaces and/or low temperatures that will preclude chemicals from working properly. Abrasive may also be used in some circumstances where chemicals would work. These include steep grades and other situations where the normal working time associated with chemicals could result in road blockage caused by vehicles stranded due to lack of traction.

B. Specific Abrasives Application Rate Guidelines

Abrasives shall be applied at 750 pounds of abrasives per mile, per lane. This rate may be increased by up to 20% for hills, curves and intersections and decreased by up to 20% for straight sections (600 – 900 lbs./lane mile). Abrasives shall be spread as near to full pavement or lane width as possible.

The spreading speed should be in the range of about 15 to 30 mph, depending on traffic and highway surface conditions.

XV. Mixing Salt with Abrasives

A small amount of salt must be added to abrasives in order to keep them in workable or spreadable condition and have them adhere to the snow or ice. The amount necessary will vary with the normal temperature of the area. 5 to 10% salt is normally sufficient to keep abrasives in a workable condition. The purpose of the abrasives is to provide traction at temperature where salt is less effective (< 15 degrees F). The use of salt at this temperature is less effective. If the Temperature is warmer, then using a high percentage of salt is more effective. The salt will melt the snow and ice more efficiently creating the solution between the road surface and the snow pack. The sand interferes with this step.

NOTE: The use of “sweetened” or “hot” mixtures like 50-50 (1-part abrasive and 1-part salt) is inefficient. If spread at the normal application rate for abrasives this mixture will place 40% more salt on the road than a normal application of straight salt. The effectiveness of that salt is reduced by the presence of the abrasives.

XVI. Guidelines for Pre-Wetting Salt

A. General Considerations

Liquid deicers such as Calcium Chloride or Magnesium Chloride are added to salt to improve low temperature characteristics, reduce bounce and scatter and accelerate working time. Salt treated with these chemicals should not be used on pavement temperatures above 20 degrees F unless there is a special need to accelerate working time or penetrate pack. If salt is treated with these liquids, the application rates can be reduced as shown in Appendix 5.

B. Mixing and Application Rate Guidelines.

There are two systems used by NYSDOT for adding liquid deicers to salt. As a stockpile of salt is being prepared it can be mixed with any of the liquids mentioned in Section A. The spinner spray system sprays the liquid deicers onto the salt after it comes out of the spreader and before it reaches the spinner.

Mixing rates for the two systems are:

Stockpile: use 8 gallons of liquid deicer per ton of salt.

Spinner Spray: Use 6 gallons of liquid deicer per ton of salt.

These are recommended rates to start. These rates may need to be adjusted as conditions warrant.

The application rates for salt treated with liquid deicers are less than those for straight salt. Refer to Appendix 5 for the appropriate rates.

Use caution with late in the day post storm applications. There is a tendency for the water/brine to re-freeze at night if traffic does not dry the pavement.

XVII. Guidelines for Anti-icing with Liquids

A. General Considerations

Liquid deicing chemicals can be applied directly to pavement utilizing an adequately sized slide in tank or tanker truck with a spray bar. This process can be used to pre-treat pavement or bridge decks and other icing prone locations in advance of a storm anywhere from several hours to several days in advance of the event. Under certain conditions liquids may be applied during a storm. When using liquid chemicals in this type of application, do not apply to pavements below 20 degrees F, unless additives such as MgCl2 are used.

B. Liquid Chemicals

Liquid ice control chemicals are made up of solid ice control chemicals in a water solution. After application, the water evaporates and a residual dry chemical is left on the pavement surface. This material is not prone to scattering or dispersal from traffic conditions.

Salt brine is most effective at 23.3% solution. It can be produced in house by agitating solid NACL in water. *Do not use treated salt for brine*.

C. Application Criteria

Straight liquid chemical applications can be made up to 3 days prior to the onset of a winter weather event if the chemical is allowed to dry on the pavement surface. The brine can dry and is activated when moisture is present. Rain & sleet will make brine ineffective. High traffic volumes will decrease the anti-icing effects. The rates to achieve effective results can vary significantly with the type of liquid chemical used and pavement temperatures. Too little material will not produce desired results. On very rare occasions too much material (liquid chemicals other than salt brine) can result in hazardous slippery conditions before the material has fully dried.

D. Suggested Application Rates (23.3% Salt Brine)

32 degrees F = 15 to 30 gallons/lane mile

20 degrees F = 20 to 40 gallons/lane mile

It is recommended that new users start at the lower application rates and gradually increase application rates until desired results are achieved. It is also very critical that liquid spray units are calibrated at the beginning of each snow and ice season.

E. Spreading Patterns- Liquids

Liquid chemicals should be distributed on the pavement using streamer or pencil nozzles that lay strips of chemicals about 10 inches apart, leaving untreated pavement between the strips. This will reduce the potential for unintended slipperiness.

F. Spreading Speed

For straight liquid applications spreading speeds can be between 40 mph and 50 mph on dry pavements when doing pre-treatment applications. When spraying during a storm, speeds will be lower based upon conditions.

Refer to NYSDOT Highway Maintenance Guidelines, Chapter 5.4410 - Snow and Ice Control, for additional information

XVIII. Material Spreading Equipment

Materials spreading equipment is most efficient and effective when associated with plow truck. By spreading chemicals on freshly plowed surfaces, the chemicals will dilute less and last longer. Most chemicals need time to work. Uncoordinated plowing that remove chemicals from the surface too soon is inefficient. The Town of Bolton currently utilizes 1 pick-up truck, 2 - one ton trucks and 5 tandems with spreaders to spread materials.

Liquid chemicals may be distributed directly on the road, parking lot or walkway surface from a variety of tank/spray systems that may be mounted on trucks, trailers and other vehicles. Liquid chemicals may also be added to solid chemicals during the truck loading process or as the material leaves the truck hopper/body (pre-wetting).

XIX. MAINTENANCE

Proper maintenance is the key to a long service life for material spreaders. Stainless steel spreader bodies are proving to be cost effective on a life cycle basis. They should be encouraged and considered on any new purchase of equipment or trucks.

1. Temperature Sensors
   The Highway Superintendent's vehicle and all plowing trucks will be equipped with temperature sensors to measure both air and pavement temperature.
2. Deicing Controls
3. Calibrations
   All material spreading equipment will be calibrated prior to the start of the snow and ice season. A record of annual calibrations will be kept. More information on calibration can be found in NYSDOT, Chapter 5.4412
4. Spread Control Pattern
   Proper spread pattern adjustments should be determined on the floor of the chemical storage facility and then field verified
   by observing the distribution under actual operating conditions. One method is to have a vehicle follow the operator early in a storm situation in order to provide timely feedback on spread patterns
5. Spreading Speed
6. Equipment Washing

Truck and equipment washing should be undertaken after the operation is complete. Low pressure, high volume washing is recommended. Wash water should be contained.

XX. CHEMICAL STORAGE

A. Salt Barn Construction

Two Salt Barns are located adjacent to the Highway Garage. Each barn is 31 feet wide, 37 feet long and 20 feet high. Each barn holds 250 tons of salt and was built in 2005. The floor is concrete.
Surface runoff is not a problem.

Refer to NYSDOT Highway Maintenance Guidelines Chapter 5.5 – Snow and Ice Control for additional Information

XXI. DRAINAGE

A. Inventory culvert locations and paint markings on the road in the fall so they are easily located for snow removal when necessary.

B. Thorough cleaning out of ditches, catch basins and grates in the fall is paramount to having properly working drainage infrastructure. Any roadside ditches that are cleaned should be hydro-seeded by Soil and Water as soon as possible. Maintain the functional capability of critical drainage features so that flooding and ponding on the highway are minimized during periods of thaw. The top of catch basins and drop inlets should be cleared of snow. Prior to thaws and subsequent runoff, the ends of culverts and outlet ditches should be cleared of packed snow.

When possible, drainage channels should be created in the snow banks on both sides of the highway at the low point in a sag vertical curves to minimize the risk of snow melt water and runoff accumulating low points on roads without culverts, the snow' banks should be vented to allow water to drain from the roadway.

C. Salt Storage locations should be selected or graded to provide positive drainage from the stockpile or storage facility. The area selected should not drain directly into a stream, reservoir, well, well aquifer, or adjacent property. Salt Storage Barns should be used whenever possible and uncovered salt piles will be kept to a minimum.

D. Structures

1. Bridge deck drainage systems should be kept functional during the winter. Removal of surface snow and ice and the thawing of drainage and expansion features may be necessary.

2. Thawing Drainage Structures

Although chemicals are used at times, their use should be limited. A steam jenny can be used and is deemed more environmentally sound.

XXII. RISK MANAGEMENT

A. Emergency Procedures

1. Contact Information

a)	Warren County DPW	623-2414
b)	NYSDOT-Resident Office	623-3511
c)	War. Co. Office of Emergency Services	761-6537
d)	Warren County Sheriff	743-2500
e)	NYS Police- dispatch	897-200

2. Road and Bridge Closure Plan

Road Closures may include seasonal roads, roads impacted by ice and areas prone to flooding. Roads will be blocked and emergency warning lights erected.

3. Detours and Emergency Evacuation Routes

Temporary barricades will be placed and signs erected indicating the detour route.

B. Sensible Salting Policy

The Town of Bolton will adhere to a pro-active approach in dealing with the effects of winter storms on our road system. The use and proper application of road salt and liquid de-icing chemicals will have an overall benefit of limiting the amount of chemicals needed to keep our roads safe and passable and limiting the amount of chemicals reaching Lake George. Prior to the onset of any precipitation the Town of Bolton will pre-treat its road surfaces with anti-icing chemicals to prevent ice from bonding with the road surface. This practice will increase the effectiveness of road salt being applied. It will also decrease the amount of salt needed to produce a safe, passable travel lane for the travelling public. All equipment used shall be calibrated to assure the proper amount of chemicals and/ or salt will be applied in the correct manner. During the duration of the storm the application of salt and liquid de-icing chemicals will be on an as needed basis.

XXIII. DESCRIPTION OF ROUTES

A. Written Description

1. Length in lane miles
2. Typical cycle time is 2.5 hours
3. Typical application rates
4. Road Surface Type (paved, unpaved, road conditions)
5. List Parking Lots that are treated.

C. Maps - See **Appendix 13**

XXIV. ENVIRONMENTAL

The levels of chlorides in Lake George have nearly tripled in the last 30 years and deicing is a major contributor to this increase. The Division of Water of the New Hampshire Department of Environmental Services has produced a summary of the Environmental, Health and Economic Impacts of Road Salt. Winters in the Lake George Drainage Basin are similar to winter weather experienced in New Hampshire and the use of road salt here has resulted in similar impacts to our environment. The following comments are reproduced from the NHDES article.

"….. winters demand an effective and affordable means of de-icing roadways. The primary agent used for this purpose is sodium chloride (road salt) which is composed of 40 percent sodium ions (Na+) and 60 percent chloride ions (Cl-). Other components in salt like ferrocyanide, which is used for anti-caking, and impurities like phosphorous and iron, can represent up to 5 percent of the total weight. The sodium, chloride, ferrocyanide and impurities make their way into our environment through the runoff from rain, melting snow and ice, as well as through splash and spray by vehicles and wind. They find their way onto vegetation and into soil, groundwater, storm drains, and surface waters causing significant impact to the environment.

Chloride (Cl-) is completely soluble and very mobile. Chloride is toxic to aquatic life and impacts vegetation and wildlife. There is no natural process by which chlorides are broken down, metabolized, taken up, or removed

from the environment. Trends show that chloride levels continue to rise with increasing use of road salt.

Water Quality Impacts

Contaminates from road salt enter water resources by infiltration to groundwater, runoff to surface water and through storm drains. The chloride discharged into these waters remains in solution and is not subject to any significant natural removal methods; only dilution can reduce its concentration. The accumulation and persistence of chloride poses a risk to the water quality and the plants, animals and humans who depend upon it.

Water contaminated with NaCl creates a higher water density and will settle at the deepest part of the water body where current velocities are low. This can lead to a chemical stratification which can impede turnover and mixing, preventing the dissolved oxygen within the upper layers of the water from reaching the bottom layers and nutrients within the bottom layers from reaching the top layers. This leads to the bottom layer of the water body becoming void of oxygen and unable to support aquatic life.

Aquatic Life Impacts

Chloride in surface waters can be toxic to many forms of aquatic life. Aquatic species of concern include fish, macroinvertebrates, insects and amphibians. Elevated chloride levels can threaten the health of food sources and pose a risk to species survival, growth and/or reproduction

Vegetation Impacts

The most visible impact of road salt on our environment is in the grass, shrubs and foliage along the roadside. Not only does salt effect the terrestrial roadside vegetation it also has an impact on emergent and submerged aquatic plants. Salt leaves the road and enters the environment by splash and spray from vehicles, transportation by wind, snow melt into the soil and as runoff to surface waters. Salt primarily causes dehydration which leads to foliage damage but also causes osmotic stress that harms root growth. Salt can disrupt nutrient uptake and cause a colonization of slat tolerant species, such as cattails, thereby reducing species diversity. Vegetation along roadways is a natural buffer area between pollutants and the waters. With salt damage and vegetation degradation it compromises

the retention and processing of pollutants in storm water runoff to the groundwater source.

Soil Impacts

Salt influences the chemistry of the soil in which it infiltrates. Through ion exchange the Na ion stays within the soil and releases the other ions such as calcium, magnesium and potassium into the groundwater as well as increasing metal mobilization. This causes depletion in the soil as well as changes the soil permeability causing soil to become impervious which blocks water infiltration, reduces soil stability and decrease the soil ph and overall fertility. Salt can have impacts on soil biota, soil swelling and crusting, soil electrical conductivity, soil osmotic dispersion and structural stability. Salt can inhibit some soil bacteria compromising soil structure and inhibiting erosion control mechanisms and increasing sediment runoff.

Infrastructure Impacts

Chloride ions increase the conductivity of water and accelerate corrosion. Chloride can penetrate and deteriorate concrete on bridge decking, damaging reinforcing rods, compromising structural integrity. Chloride can damage vehicle parts such as brake linings, frames, bumpers and other areas of body corrosion."

Human Health Impacts

Lake George is classified by NYSDEC as "AA Special" and its best usage is a source for potable water. Many people around Lake George and The Village of Lake George use Lake George water for drinking. Although the NYSDOH has not issued any health advisories for Lake George at this time, Sodium in drinking water is a health concern for individuals restricted to low sodium diets due to hypertension (high blood pressure).

Goals

Strive to achieve safe and effective traveling conditions with minimal use of de-icing materials. Ultimately, this will help reduce the chloride levels in Lake George.

XXV. RECORD KEEPING

Creating and maintaining adequate records relative to snow and ice control benefits the Town in many ways. Advantages include:

A. Valuable defense proof in the event of litigation and complaints

B. Data for budgets and resources requests and accountability tool for the Highway Superintendent and the Board.

D. Data to measure the efficiency and effectiveness of operations

E. Data to support continuous improvement efforts.

The following is a list of snow and ice control reports to be maintained by the Highway Department:

1. Equipment Operators Report

2. Superintendent Report

XXVI. NEW YORK STATE LAWS

A. NYS Public Officer's Law, Section 18 – APPENDIX 7
(REQUIRES LOCAL LAW) Recommended Action

Municipality will provide legal defense to employees for actions resulting from performing their duties as long as the employee:

1. Did not break a law
2. Was acting within the scope of his or her official duties

B. NYS Vehicle & Traffic Law, Section 1103 – APPENDIX 8

In general, maintenance forces, while engaged in highway snow and ice control operations, are exempt from the rules of the road provisions of the vehicle and traffic law except those relating to drugs and alcohol. However, if vehicle and traffic law is not being complied with, it must be done ***"with due regard for the safety of all persons."***

The Town of Bolton recognizes that the following activities are absolutely operational necessary in snow and ice removal of our roads. The Snow plow operator must slightly cross the centerline into the opposing traffic lane in order to completely plow the road and must back onto a highway in order

to properly clear intersections. In both of these situations, the operator must be absolutely certain that it is safe to perform those operations. In the event of an accident that occurs while operating out of compliance with the rules of the road provision of the vehicle and traffic law, there may be civil liability for the Town.

C. NYS Insurance Law, Section 2335 (d) - APPENDIX 9

The State Insurance Law provides protection to municipal and commercial drivers from having their personal automobile insurance premiums impacted by accidents/incidents that occur while driving their employer's vehicle. The exception would be if the accident was intentional or caused by gross negligence.

D. NYS Highway Law, Article 8, Section 214 – APPENDIX 10
NYS Vehicle & Traffic Law, Section 1219 - APPENDIX 11

The provisions of this law prohibit people from placing any material on any highway, including snow and ice from driveways and sidewalks.

XXVII. Damage by Plowing Operations

A. Mailboxes

Any installation within the right-of-way including a mailbox/post is placed there at the owner's risk. Owners can help reduce the possibility of a damaged/broken mailbox or mailbox post. Owners are encouraged to install mailboxes at the maximum usable distance from the edge of pavement. Posts should also be checked for deterioration to reduce the possibility that the weight of the plowed snow may simply break or push the post over.

The Municipality ***will repair*** or ***replace*** mailboxes or posts damaged by the force or placement of plowed snow.

B. Grass or Plantings Damage

The Municipality will not repair plow damage to grass and other plantings that are adjacent to the road. See appendix ____ for text of the law

B. Parking (Any special Parking Restrictions) - See Appendix 12

XXVIII. Salt Pilot Study Areas

The Highway Superintendent will identify a road or roads to be used as a pilot area for salt reduction. The study area would be publicized and properly signed to warn motorists that road conditions may vary from other roads in the Town.

APPENDIX 1 - Glossary APPENDIX 2 - Truck Checklist (Winter Season)
APPENDIX 3 – Roads/Personnel/Equipment List APPENDIX 4 - Table for Suggested Application Rates APPENDIX 5 - Annual Summary of Materials and Overtime APPENDIX 6 - MOU Municipal Governments Bordering Lake George Regarding the Application of Road Salt for Winter Maintenance De-Icing Including Addendum A
APPENDIX 7 - NYS Public Officer's Law, Section 18 APPENDIX 8 - NYS Vehicle and Traffic Law, Section 1103 APPENDIX 9 - NYS Insurance Law, Section 2335 APPENDIX 10- NYS Highway Law, Article 8, Section 214 APPENDIX 11- NYS Vehicle and Traffic Law, Section 1219
APPENDIX 12- Parking Notice
APPENDIX 13- Map of Plow Routes

APPENDIX B

DEFINITIONS, HANDLING CHEMICALS & EQUIPMENT CHECKLIST

SNOW & ICE CONTROL DEFINITIONS

Benching of Shelving	Using a wing plow to displace the top portion of snow berms adjacent to the pavement or shoulder.
Berm or Windrow	A linear accumulation of snow cast by a plow, or other equipment, or wind.
Close Echelon	Snowplows in adjacent lanes working in a tight plowing group that do not permit traffic to pass between them.
One Way Plow	This is a plow mounted on the front of a truck that can cast snow only in one direction. Usually the snow is cast to the right.
Plow Angle of Attack	The angle (less than 90°) formed in plan view where the plow blade face deviates from a 0° set position which is parallel to the front grill of the plow truck.
Plowable Snow	Generally, accumulation of greater than ½ inch to 1 inch of snow.
Reversible Plow	This is a plow mounted on the front of a truck that can cast snow to either the right or left depending on the angel of attack of the plow.
Snow Plowing	The displacement of snow from paved surfaces with plows and wing plows.
Snow Removal	Physically relocating areas of accumulated snow. This is usually a slow operation that may be accomplished with plows, loaders or snow blowers.
Tandem Plowing	Snowplows working in groups having sufficient space (a minimum of 1000 feet or about the distance between two reference markers) between them for traffic to pass.
Wing Plow	A plow mounted on either the left or right side of a truck, which in combination with a One Way or Reversible plow casts snow off of paved surfaces.

SUMMER STORAGE OF ON-BOARD WETTING SYSTEMS

It is important to properly store On-Board Wetting Systems to ensure their availability for the next Snow and Ice Season. Improper storage can lead major damage. The following are the recommended procedures for storing these units:

Empty the saddle tank(s) into the bulk storage tank.

The pump should be flushed with a solution of warm water and then windshield washer fluid. The washer fluid will prevent any residual water from freezing prior to the next spreading season.

When connecting and disconnecting electrical plugs, treatment with electrical spray or dielectric grease (for use with electrical equipment) is recommended to prevent corrosion and protect from intrusion of water.

All exterior surfaces should be thoroughly rinsed off with water to lessen the possibility of corrosion.

The system should be visually inspected for wear or other problems prior to storing for the summer. Any necessary repairs should be documented and brought to the attention of the Equipment Management Mechanic.

SUMMER STORAGE OF BULK STORAGE TANKS

As with the truck mounted on board systems, several areas of the bulk storage tanks need to be addressed.

The pump should be disconnected and then flushed with a solution of warm water and then windshield washer fluid. The windshield washer fluid will prevent any residual water from freezing prior to the next spreading season.

Electrical connections should be checked for wear. Any electrical plugs should be treated with electrical spray or dielectric grease to prevent corrosion and protect from intrusion of water.

Hose and pipe connections to and from the pump should be inspected for wear and repaired or replaced as appropriate.

It is recommended that de-icing liquids in bulk storage tanks be re-circulated (agitated) every two weeks during extended periods of non-use.

NYSDOT SAFETY GUIDELINES FOR HANDLING OF LIQUID CHEMICAL DE-ICERS

Personal Protective Equipment (PPE) must be worn when handling these materials. As a minimum, PPE gear includes splash goggles, face shield, rubber gloves and rubber boots. A copy of the Material Safety Data Sheet (MSDS), for each chemical used, shall be readily available at every work site where these chemicals are being used. The MSDS will give further guidance on PPE requirements.

Keep a one liter eyewash bottle on hand during the entire filling operation.

Avoid contact with skin and leather apparel (boots, gloves, etc.)

Prior to pumping check all hoses and piping to insure secure connections and sound hoses.

Prior to and at the end of pumping, check valve settings to insure proper flow control.

While pumping, stand clear of hose and pipe connection points.

Visually monitor tank filling to avoid overfilling.

When filling is complete shut off pump, check valve settings, disconnect and store fill hose properly (e.g. return to hose rack).

FIRST AID MEASURES

EYES:	Flush promptly with plenty of water continuing for at least 15 minutes. GET MEDICAL ATTENTION!!!
SKIN:	Wash with plenty of water.
INHALATION:	Remove to fresh air (for cases of airborne mist and dust)
INGESTION:	Contact Poison Control and/or refer to MSDS sheets for ingestion instructions.

NYSDOT SAFETY GUIDELINES FOR RESPONDING TO LIQUID CHEMICAL DE-ICER SPILLS

Minor Spills (Less than 20 Gallons)

Put on appropriate Personal Protective Equipment (PPE) (splash goggles, face shield, rubber gloves and rubber boots).

If possible, safely stop the source of the spill (e.g. shut off pump, close valve, etc.).

Notify shift supervisor.

Contain spill with sand.

Spread sand to absorb the liquid chemical de-icer.

Collect saturated sand and stockpile separately.

If possible, cover stockpile with a waterproof covering.

When operation is completed, wash down all equipment used.

Major Spills (Greater than 20 Gallons)

Put on appropriate PPE (splash goggles, face shield, rubber gloves, and rubber boots).

If possible, safely stop the source of the spill (e.g. shut off pump, close valve, etc.)

Notify the shift supervisor and Resident Engineer.

Contain spill with sand.

If full containment is not possible, dilute liquid chemical de-icer runoff with large volumes of water (control subsequent icing problems, if required)

Spread sand to absorb contained liquid chemical de-icer.

Collect saturated sand and stockpile separately.

If possible, cover stockpile with a waterproof covering.

When operation is completed, wash down all equipment used.

TRUCK CHECK SHEET (WINTER SEASON)

Truck ID: _____

Unload and Wash Hopper/Combo _____
Wash Truck _____
Refuel _____
Lube Chassis _____

Date: _____
Time: _____
Mileage: _____
Operator: _____

Interior	Checked	SDR/VTR
1. Head Lights	1._____	_____
2. All Exterior Spot Lights	2._____	_____
3. Revolving Lights	3._____	_____
4. Hopper Lights (Spot & Warning)	4._____	_____
5. Reverse Lights	5._____	_____
6. Directional Lights/4-Way Flashers	6._____	_____
7. Brake Lights	7._____	_____
8. Wipers, Washer	8._____	_____
9. Defrost/Heater	9._____	_____
10. 2- Way Radio	10._____	_____
11. Dickey John Operation	11._____	_____
12. Levers & Pins	12._____	_____
13. Clutch Free Play (1.5"), Steering. And Brake Operation	13._____	_____
14. First Aid Kit, Fire Extinguisher, Triangles	14._____	_____
15. Mirrors, Mirror Heaters, All Gauges, All Glass	15._____	_____
16. Clean Cab (Litter, Projectiles/Objects, etc.)	16._____	_____
17. Seats and Seat Belts	17._____	_____
18. Copy of Overwidth Permit & Accident Reporting Forms (Glove Box)	18._____	_____
Under Hood		
19. Engine Oil (15w40)	19._____	_____
20. Anti Freeze	20._____	_____
21. Power Steering Fluid	21._____	_____
22. Window Washer Fluid	22._____	_____
23. Hoses and Belts	23._____	_____
24. Check for Leaks	24._____	_____
Exterior: Left Side		
25. Duals (Condition, PSI, Spun, Lug Torque (230 spoke, 450 bud))	25._____	_____
26. Hydraulic Fluid (5w20)	26._____	_____
27. Hopper: Hoses, Fittings, Tie downs, Electric Connections	27._____	_____
28. Hopper: Tie Downs and Flaps	28._____	_____
29. Combo Body: Front discharge spinner, gate setting, etc.	29._____	_____
30. Cab Steps and Grab Bar	30._____	_____
31. Front Tire (Condition, PSI, Spun, Lug Torque (230 spoke, 450 bud)	31._____	_____
32. Hub Oil Level (90w mineral oil)	32._____	_____
33. Block Heater and Cord	33._____	_____
34. Left Front Leaf Springs	34._____	_____
35. Operate Tail Gate Latch Several Times (Be sure to secure afterwards)	35._____	_____
Exterior: Left Wing		
36. Overall Condition	36._____	_____
37. Cables, Clamps and wing cylinder hose's (For Damage & Rust)	37._____	_____
38. Wing Braces, Tension Springs, Shear Pins and Bolts	38._____	_____
39. Clevis Pins and Bolts	39._____	_____
40. Cutting Edges, Curb Runner, Bolts	40._____	_____
41. D-Block Assembly	41._____	_____
42. Wing Marker	42._____	_____

APPENDIX C

APPLICATION RATES

FACTORS THAT AFFECT APPLICATION RATE DETERMINATION

TRAFFIC:

AADT – Higher traffic volumes result in mixing action along with heat from friction. Higher volumes are also an indication of more important roads.

Rush Hour – This affects timing and maneuverability as treatments are applied ahead of the rush. In extreme cases, it may be necessary to avoid a road because trucks will be trapped and non-productive. Rush hours can also create a directional situation where good mixing action takes place in one direction and almost none in the other.

Day of the Week – Different days, especially the weekend create different traffic patterns and volumes and the application may need to be changed to adjust for this.

Corridors – This is an evolving issue from Transformation, but has always influenced level of response. Certain roads are key to the function of the system and if they are not open the rest of the system fails regardless of the conditions on the feeder roads.

ROAD CONDITIONS:

Geometrics – Steep grades, sharp curves, bridge decks, etc. all influence our application rates. Some of these situations determine the application rate for a whole beat, and others require the driver to make adjustments during his run.

Cold Spots – Areas at higher elevations or shaded most of the day create cold spots which normally require more material than adjacent sections of the beat.

Length of Beat – This affects cycle time. The longer the time between plowings the more material is needed to prevent bonding. Narrowing of the spread pattern should accompany the increased application rate in this circumstance.

Plow Speed – While ideal plow speed is around 30 mph, it does vary considerably due to traffic adjacent buildings, pedestrians, high speed roadways, etc. This can create different cycle times between beats of the same length, or even the same beat at different times of the day.

Multiple Lanes – While in some cases a beat consists a uniform number of lanes so that the assigned trucks can plow in echelon in one pass. However in most cases the number of lanes varies and trucks have to double back or trucks from other beats have to be assigned to help. This results in increased cycle time.

Pavement Surface –Pavement treatments like Nova Chip and some Superpave mixes have an open graded structure which draws the brine away from the surface. More chemicals may need to be applied to prevent bonding.

WEATHER:

Time of Season –Usually, chemicals are required in January than March because of colder pavement temperatures and continued cold weather is likely.

Sunlight – The amount and angle of sunlight influences pavement temperatures and the resulting melting action of ice control chemicals.

Type of snow or ice – The wetter the precipitation the more chemical dilution occurs which requires more chemicals to keep the freezing point reduced.

Intensity of the precipitation – The harder the snowfall the more chemical will be needed to prevent bonding before the next treatment.

Pavement Temperature – While changes in air temperature are useful to watch, the pavement temperature is what really matters. When deciding on application rates the expected trend in the pavement temperature is important to be taken into account.

Note: The tables for application rates attempt to take into account the last three items.

GLOSSARY OF TERMS

Black Ice. Popular term for a very thin coating of clear, bubble free, homogenous ice which forms on a pavement with temperature at or slightly above 32° F when the temperature of the air in contact with the ground is below the freeze-point of water and small super cooled water droplets deposit on the surface and coalesce (flow together) before freezing. This often occurs when pavement temperature is 32° F or below and is at or below Dew Point.

Chemical Spread Rate. Also known as chemical application rate. For solid applications it is simply the weight of the chemical applied per lane mile. For liquid applications it is in gallons per lane mile when applied straight and gallons per ton when used to pre-wet solid chemicals.

Freezing Rain. Super cooled droplets of liquid precipitation falling on a surface whose temperature is below or slightly above freezing, resulting in a hard, slick, generally thick coating of ice commonly called a glaze or clear ice. Non-super cooled raindrops falling on a surface whose temperature is well below freezing will also result in a glaze.

Frost. Also called hoarfrost. Ice crystals in the form of scales, needles, feathers or fans deposited on the surfaces cooled by radiation or other process. The deposits may be composed of drops of dew frozen after deposition and of ice formed directly from water vapor at a temperature below 32° F (sublimation). Most often occurs when pavement temperature is 32° F or below and is at or below Dew Point.

Light Snow. Snow falling at the rate of less than ½ inch per hour: visibility is not affected adversely.

Liquid Chemical. A chemical solution; with a specified percentage of chemical that is applied at the rate of gallons per lane when applied straight and gallons per ton when used to pre-wet solid chemicals.

Moderate or Heavy Snow. Snow falling a rate of ½ inch per hour or greater; visibility may be reduced.

Sleet. A mixture of rain and snow which has been partially melted by falling through the atmosphere with a temperature slightly above freezing.

Slush. Accumulation of snow which lies on an impervious base and is saturated with water in excess of the freely drained capacity. It will not support any weight when stepped or driven on but will "squish" until the base support is reached.

BLACK ICE

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Dry or Damp	Apply pre-wetted rock salt or direct liquids to prevent formation.		115	None, see comments.			Monitor pavement temperature closely; begin treatment if pavement temperature starts to fall toward 32 and it is at or below the dew point.
23 to 32	Frost or Black Ice	Apply pre-wetted rock salt or direct liquid; use dry salt if pre-wetted not available.	275	225	Re-apply pre-wetted rock salt as needed.	115	90	1) Monitor pavement temperatures closely; if pavement becomes wet or if thin ice forms re-apply chemicals. 2) Do not apply direct liquids on ice so thick that the pavement cannot be seen. 3) Heavier follow up application(s) may be necessary.
15 to 23	Frost or Black Ice	Apply pre-wetted rock salt; use dry rock salt if pre-wetted not available.	360	275	Re-apply pre-wetted or dry rock salt as needed	115	90	1) Monitor pavement temperature closely; if pavement becomes wet or if thin ice forms re-apply chemicals. 2) Do not apply direct liquids on ice so thick that the pavement can not be seen. 3) Heavier follow up applications(s) may be necessary.
Below 15	Frost or Black Ice	Apply abrasives			Apply abrasives			1) Refer to Snow and Ice Guidelines Section 5.4406, paragraph B. for abrasive application rates.

Notes: 1) Black ice or frost is normally a spot condition – these application rates would be applied to areas susceptible to the formation of black ice or areas where black ice has developed. Watch for freezing surface temperatures below dew point with sources of vapor, clear night skies and light winds. 2) Refer to direct liquid chemical application guide lines (Appendix C Page C – 10) if anti-icing liquids are used.

FREEZING RAIN

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Wet or Slushy	Apply pre-wetted or dry rock salt, plow if plowable.	115	90	Monitor precipitation and temperature.			1) Monitor pavement closely and anticipate drops toward 32° F and below. 2) Adjust application rates as surface conditions and precipitation intensities change.
Above 32, but dropping to 32 or below soon	Wet or Slushy	Apply pre-wetted or dry rock salt, plow if plowable.	180	115	Re-apply pre-wetted or dry rock salt as needed.	180	115	1) Monitor pavement temperatures and precipitation closely. 2) Treat icy patches and colder areas with higher applications. 3) Increase applications if precipitation intensity increase or surface shows signs of icing.
23 to 32	Wet or Slushy	Apply pre-wetted or dry rock salt, plow if plowable.	275	225	Re-apply pre-wetted or dry rock salt as needed.	275	225	1) Monitor pavement temperatures and precipitation closely and adjust application rates as surface conditions and precipitation intensities change. 2) Treat icy patches and colder areas with higher applications. 3) Increase applications if precipitation intensity increase or surface shows signs of icing.
23 to 32	Icy	Apply pre-wetted or dry rock salt.	360	320	Re-apply pre-wetted or dry rock salt as needed.	360	320	1) Use Application Rate for "wet and slushy" when icing condition is removed. 2) Increase application rate if precipitation intensity increases or if pavement shows signs of re-freezing.
15 to 23	Wet or Slushy	Apply pre-wetted or dry rock salt, plow if plowable.	360	275	Re-apply pre-wetted or dry rock salt as needed.	360	275	1) Monitor pavement temperatures and precipitation closely and adjust application rates as surface conditions and precipitation intensities change. 2) Treat icy patches and colder areas with higher applications. 3) Increase applications if precipitation intensity increase or surface shows signs of icing.
15 to 23	Icy	Apply pre-wetted or dry rock salt.	450	360	Re-apply pre-wetted or dry rock salt as needed.	450	360	1) Use Application Rate for "wet and slushy" when icing condition is removed. 2) Increase application rate if precipitation intensity increases or if pavement shows signs of re-freezing.
Below 15	Dry, wet or icy	Apply abrasives			Re-apply abrasives			Refer to Snow and Ice Guidelines Section 5.440 (B) for application rates.

Notes: 1) Freezing Rain requires a timely and aggressive response to prevent ice formation; application rates should be increased if not effective or cycle times are increased due to difficult driving.

SLEET

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Dry	Patrol and spot treat as needed. See comments.			Patrol and spot treat as needed. See comments.			1) Monitor pavement temperatures closely and anticipate drops toward 32 F and below. 2) Treat icy patches with pre-wetted rock salt at 115 lbs./lm.
Above 32	Snow, slush, or wet.	Apply pre-wetted or dry rock salt, plow if plowable.	115	90	Re-apply pre-wetted or dry rock salt as needed.	115	90	1) Monitor pavement temperatures closely and anticipate drops toward 32F. 2) Treat icy patches and colder areas with higher applications. 3) Increase rates if precipitation intensity increases.
Above 32, but dropping to 32 or below soon.	Snow, slush, or wet.	Apply pre-wetted or dry rock salt, plow if plowable.	180	115	Re-apply pre-wetted or dry rock salt as needed.	180	115	1) Monitor pavement temperatures and precipitation closely. 2) Treat icy patches and colder areas with higher application rates. 3) Increase application rates if precipitation intensity increases.
23 to 32	Snow, slush, or wet.	Apply pre-wetted or dry rock salt, plow if plowable.	225	180	Re-apply pre-wetted or dry rock salt as needed.	225	180	1) Monitor pavement temperatures and precipitation closely. 2) Treat icy patches and colder areas with higher application rates. 3) Increase application rates if precipitation intensity increases.
15 to 23	Snow, slush, or wet.	Apply pre-wetted or dry rock salt, plow if plowable.	275	225	Re-apply pre-wetted or dry rock salt as needed.	275	225	1) Monitor pavement temperatures and precipitation closely. 2) Treat icy patches and colder areas with higher application rates. 3) Increase application rates if precipitation intensity increases.
Below 15	Any condition.	Apply abrasives.			Re-apply abrasives.			1) Refer to Snow and Ice Guidelines Section 5.4406 (B) for abrasive application rates.

Notes: 1) Sleet that creates accumulating ice will require more aggressive treatment.

LIGHT SNOW
(Less than ½"/hour; visibility > ½ mile)

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Wet, slush or light snow covered.	Patrol and spot treat as needed. See comments.			Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature for drops toward 32 F. 2) Blast isolated icy patches with salt, treat slushy areas beginning to freeze with 180 dry/160 pre-wet, lbs./lm and plow as needed
Above 32, but dropping to 32 or below soon.	Dry	Apply pre-wetted rock salt or direct liquids. Patrol and spot treat as needed. See comments.		160	Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature and precipitation and select appropriate follow up as conditions change.
Above 32, but dropping to 32 or below soon.	Wet, slush, or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	180	160	Plow and re-apply pre-wetted or dry rock salt as needed.	115	100	1) Application will need to be more frequent at lower temperature and higher snowfall rates. 2) Adjust application rates as surface conditions and precipitation intensities change.
23 to 32	Dry	Apply pre-wetted rock salt or direct liquids.		160	See comments.			1) Monitor pavement temperature and precipitation and use select appropriate follow up as conditions change.
23 to 32	Wet, slush or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	200	160	Plow and re-apply pre-wetted or dry rock salt as needed.	115	100	1) Application will need to be more frequent at lower temperature and higher snowfall rates. 2) Adjust application rates as surface conditions and precipitation intensities change.
15 to 23	Wet, slush or light snow covered.	Apply pre-wetted rock salt, plow as needed.	250	200	Plow and re-apply pre-wetted rock salt as needed.	180	160	1) If sufficient moisture is present, dry rock salt can be applied. Dry pavement at these temperatures is better left untreated if snow does not track to surface.
Below 15	Dry or light snow covered. Wet and Snow/ice/slush	Plow as needed. If previous salt applications made, plow and apply pre-wetted rock salt as needed.		200	Plow as needed. If previous salt applications made, plow and re-apply pre-wetted rock salt as needed.		160	1) Abrasives can be applied to enhance traction, a heavy salt mix will create glazing. Refer to Snow & Ice Guidelines Section 5.4406 (B) for abrasive application rates. Apply rock salt in anticipation of rising temperatures. 2) If salt had been applied prior, continue with pre-wet salt as needed.

Notes: 1) Rush Period Traffic on high volume highways may require more aggressive initial treatments. 2) Use weather information to anticipate changes in storm intensity, precipitation type, and surface temperatures; Use appropriate guideline for heavier intensity or precipitation type change. 3) Rates may need to be increased if cycle times are longer than normal. 4) In the event of hard pack or icing development, adjust application rates as needed. 5) For pre-storm anti-icing operations, refer to direct liquid chemical application guides lines. Consider use of follow-up application rates for initial maintenance action if pre-storm liquid anti-icing is effective.

April, 2006 (Revised November 2014)
Supersedes January 2012 revision

MODERATE OR HEAVY SNOW

(Moderate: ½ "/– 1"/hour; visibility ¼ to ½ mile) (Heavy: More than 1"/hour; visibility < ¼ mile)

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Wet, slush or light snow covered.	Patrol and spot treat as needed. See comments.			Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature for drops toward 32 F. 2) Blast isolated icy patches with salt, treat slushy areas beginning to freeze with 180 dry/160 pre-wet, lbs./lm and plow as needed.
Above 32, but dropping to 32 or below soon.	Dry	Apply pre-wetted rock salt or direct liquids. Patrol and spot treat as needed. See comments.		160	Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature and precipitation and select appropriate follow up as conditions change.
Above 32, but dropping to 32 or below soon.	Wet, slush, or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	180	160	Plow and re-apply pre-wetted or dry rock salt as needed. Slushy Conditions	180 115	160 100	1) If normal cycle times can not be maintained, the application rates can be increased to 220 dry/180 pre-wet, lbs./lm to accommodate longer cycles.
23 to 32	Dry	Apply pre-wetted rock salt or direct liquids.		160	See comments.			1) Monitor pavement temperature and precipitation and use select appropriate follow up as conditions change.
23 to 32	Wet, slush or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	200	160	Plow and re-apply pre-wetted or dry rock salt as needed. Slushy Conditions	200 115	160 100	1) If normal cycle times can not be maintained, the application rates can be increased to 250dry/200 pre-wet, lbs./lm to accommodate longer cycles. 2) See notes below.
15 to 23	Wet, slush or light snow covered.	Apply pre-wetted rock salt, plow as needed.	250	200	Plow and re-apply pre-wetted rock salt as needed. Slushy Conditions	250 200	200 100	1) If normal cycle times can not be maintained, the application rates can be increased to 325 dry/250 pre-wet, lbs./lm to accommodate longer cycles. 2) See notes below.
Below 15	Dry or light snow covered. Wet and Snow/ice/slush	Plow as needed. If previous salt applications made, plow and apply pre-wetted rock salt as needed.		200	Plow as needed. If previous salt applications made, plow and re-apply pre-wetted rock salt as needed.		160	1) Abrasives can be applied to enhance traction, a heavy salt mix will create glazing. Refer to Snow & Ice Guidelines Section 5.4406 (B) for abrasive application rates. Apply rock salt in anticipation of rising temperatures. 2) If salt had been applied prior, continue with pre-wet salt as needed.

Notes: 1) Rush Period Traffic on high volume highways may require more aggressive initial treatments. 2) Use weather information to anticipate changes in storm intensity, precipitation type, and surface temperatures; Use appropriate guideline for heavier intensity or precipitation type change. 3) Rates may need to be increased if cycle times are longer than normal. 4) In the event of hard pack or icing development, adjust application rates as needed. 5) For pre-storm anti-icing operations, refer to direct liquid chemical application guides lines. Consider use of follow-up application rates for initial maintenance action if pre-storm liquid anti-icing is effective.

ANTI-ICING WITH STRAIGHT LIQUID CHEMICALS

The strategy of anti-icing is to be proactive in the application of chemicals to prevent the formation or development of bonded snow and ice to the pavement surface. This tactic is used to "buy time" prior to the onset of a snow and ice event or anticipated black ice conditions. When the event actually begins, conventional reactive strategies are then used.

This strategy can be particularly useful on A1 type highways where conventional methods may be slowed due to high traffic volumes. These methods are also useful for unique trouble areas such as bridge decks, high elevations, and shaded areas that freeze quicker than adjoining segments.

Anti-icing can be done by applying conventional solid and pre-wetted solids on low speed, low volume roads. This tactic is prone to wasting material, particularly if the pavement surface is dry. High volumes and speeds will scatter most of the material off of the travel lanes. Higher treatment effectiveness can be achieved by placing the material on the high portion of the traffic lane where it is not subject to as much traffic. The preferred material for anti-icing is the use of salt brine or liquid chemicals such as magnesium chloride sprayed directly on the pavement surface using a tank and spray bar system. Various slide in tank and spray bar systems are now available.

Liquid Chemicals:

Liquid ice control chemicals are made up of solid ice control chemicals in a water solution. After application, the water evaporates and a residual dry chemical is left on the pavement surface. This material is not prone to scattering or dispersal from traffic conditions.

Salt brine is most effective at a 23% solution. It can be produced in house by agitating solid NACL in water. It is also a byproduct of the oil and gas industry and can be acquired in certain geographic areas at little or no cost.

Liquid Magnesium Chloride, Liquid Calcium Chloride, Potassium Acetate, Calcium Magnesium Acetate, and a variety of proprietary formulas that contain anti-corrosion inhibitors and agricultural byproducts are also available. Although generally higher in cost than salt brine, they can be more effective at lower temperatures.

Application Criteria:

Straight liquid chemical applications can be made up to 3 days prior to the onset of a winter weather event if the chemical is allowed to dry on the pavement surface. Rain events and particularly high traffic volumes will lesson the anti-icing effects. Table A gives a general range of application rates. The rates to achieve effective results can vary significantly with the type of

liquid chemical used and pavement temperatures. Too little material will not produce desired results. On very rare occasions too much material (liquid chemicals other than salt brine) can result in hazardous slippery conditions before the material has fully dried. The use of pencil or streamer nozzles to distribute these liquid chemicals onto the pavement will further reduce the potential for any unintended slipperiness. It is recommended that new users start at the lower end of the range and gradually increase application rates until desired results are achieved. It is also very critical that liquid spray units are calibrated at the beginning of each snow and ice season. This can be accomplished by collecting liquid at the spray bar over a pre-measured distance. Because results are very sensitive to application rates, calibration is critical.

Liquid chemicals should only be applied as an anti-icing strategy when the pavement temperatures are 20°F or higher. Application of salt brine at lower temperatures would require excessive application rates and may be prone to rapid refreeze. Liquid chemicals such as magnesium chloride and other proprietary products may be used at lower temperatures, but again, application rates may negate any cost benefit. Conversely, liquid applications should not be made if pavement temperatures are much above freezing. Above 38°F and at high humidity, liquid chemicals will not properly dry on the surface and can result in hazardous slippery conditions.

De-icing:

Straight liquid chemicals may be applied as a de-icing strategy during low moisture, light snowfall at pavement temperatures above 20°F. Cycle times should be minimized as dilution of straight liquids occurs much quicker than solid chemical applications. At temperatures near freezing, it can be very effective at melting thin ice in the absence of precipitation.

Liquid chemicals are more sensitive to temperature and dilution than solid abrasives. If used as a de-icing strategy, more caution is required to avoid refreeze without the friction enhancement characteristics of a solid material.

Table A

SUGGESTED APPLICATION RATES FOR STRAIGHT LIQUID ANTI-ICING			
Temperature °F	*Application Rate gals/lm		
	23% Salt Brine	27% Mag Chloride	32% Calcium Chloride
32°F	30	28	33
20°F	40	30	36

** Application rates as high as 60 gal/lm have been successfully used in salt brine straight liquid applications. It is strongly recommended however, to start with the application rates as illustrated by this table.*