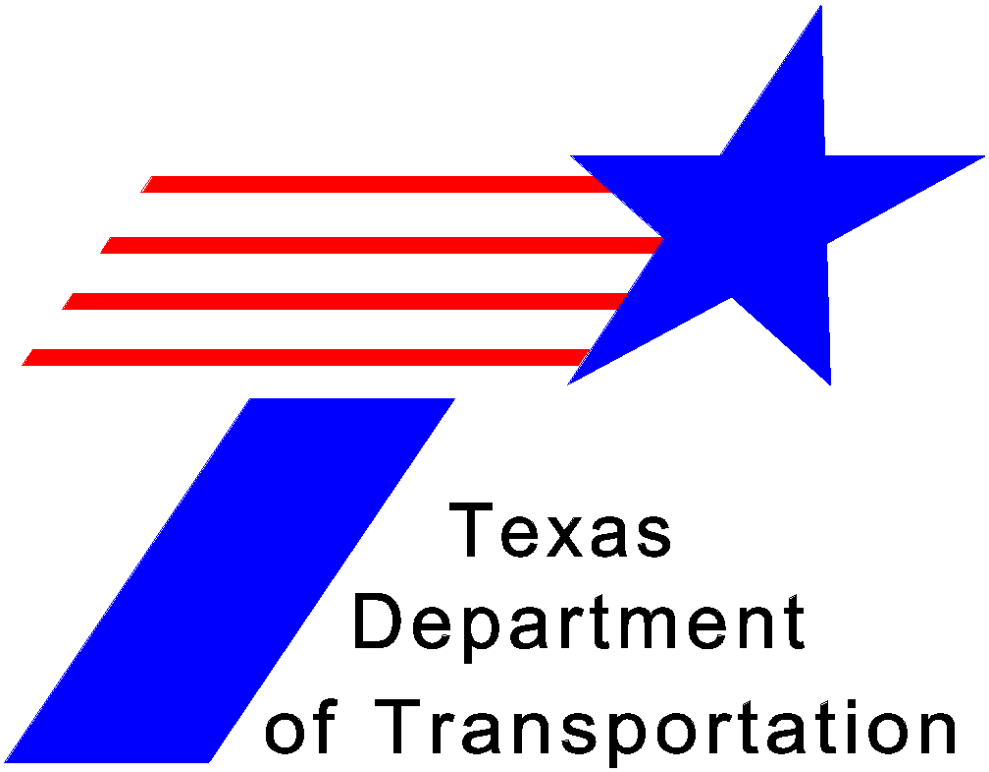
Snow and Ice Control Operations Manual



November 2012

Manual Notice 2012-1

From: F. Howard Holland, P.E., Director, Maintenance Division

Manual: Snow and Ice Control Operations Manual

Effective Date: November 01, 2012

Purpose

The Snow and Ice Control Operations Manual has been revised to make it easier to use, with more links to additional information, and to update some portions with more current procedures and best practices.

Contents

Chapter I, Section 1: changes priorities for snow and ice operations to include routes near hospitals, emergency facilities and schools and lighter traveled sections. Section 2: Adds link to all district snow and ice control plans and deletes examples of Fort Worth and Lubbock plans.

Chapter 2, Section I: Adds traffic conditions to list of factors to be taken into account when deciding upon a course of action and adds reference to AASHTO Winter Roadway Maintenance Computer-Based Training. Section 3: Adds more information about the role of traffic and application notes under When to Use Liquid Chemicals. Section 4: Adds photo of saddle tank used in pre-wetted solid chemical application. Section 5: Deletes paragraph headed "Don't Use During Ice Storms" and adds paragraph headed "Use Caution During Liquid Precipitation Storms." Section 7: adds new information on the use of SaltlBrine. Section 8: Adds more information about abrasives. Section 9: Deletes most of information under Material Specification DMS 6400 and adds statement about the need for all de-icing material to be tested according to existing policies. Section 10: Deletes some information not considered necessary to streamline section.

Chapter 3, various sections; adds updated photos and instructions to calibrate equipment, as appropriate, during pre-storm activities. Adds links to equipment checklists.

Chapter 4, Section I: Deletes information about public funds and adds statement that each district's winter plan should define specific quantities and types of materials on hand. Section 2: Simplifies information about blanket purchases and includes link to De-Icing Material Report. Clarifies that regions will follow procedures for emergency purchases if needed for anti/de-icing materials. Section 3: Includes a broader, more specific definition of what constitutes major equipment. Adds note that used snow plow can be transferred to other districts. Section 4: adds new definition of minor equipment. Section 5: Adds specific r distributor purchase and purchasing used repair parts. Section 6: Adds additional information regarding the lease vs purchase decision and where to call for

alternative fuel waivers. Section 8: Simplifies language regarding when to use lease purchase contracts.

Chapter 5, Section 2: Adds statement that sweeping bridge decks is critical at the end of winter weather operations. Section 3: Changes "six month" to "annual" bridge inspection frequency.

Chapter 6, Section 3: Deletes sentence about Revised Hours of Service and adds "Personal Protective Equipment to section about Equipment.

Chapter 7, Section 2: Adds new information about how to track storm damage costs and who can do it. Section 5: Adds statement that PIOs should inform media when snow or ice conditions exist locally.

Chapter 8, Section 4: Deletes entire section on thermal mapping, as it is not being used in Texas.

Chapter 9, deletes sections on thermal mapping and heated bridge decks. Adds photo of automatic heating system in use in Amarillo District.

Contact

Address questions concerning information contained in the Manual Notice to Randy Ormsby at (512) 416-3196.

Archives

Past manual notices are available in a PDF archive.

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Chapter 1 — District Snow and Ice Control Plans

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Section 1 — Overview

Introduction

The Texas Department of Transportation (TxDOT) has been given statutory authority for the planning, design, construction, operation and maintenance of the State Highway System. A key component of the maintenance of certain highways is the control of snow and ice. For many years TxDOT maintenance forces have strived to provide a safe travel way during winter conditions while keeping traffic delays to a minimum.

The maintenance of Texas highways is increasingly challenged in that higher public expectations and increasing traffic are complicating operations. To maintain satisfactory levels of service, TxDOT must strive for maximum effectiveness from its management, crews, equipment and materials. The snow and ice program is no exception.

The priorities for snow and ice operations are:

1. Heavier traveled sections of streets and highways.
2. Known trouble spots, such as bridge decks, steep grades, sharp curves intersections and ramps.
3. Routes near hospitals, emergency facilities and schools.
4. Lighter traveled sections of streets and highways.

Snow and ice control is performed as necessary to facilitate the safe, effective and efficient movement of people and goods in accordance with best management practices. What are best management practices for effective snow and ice control? Although many factors are involved, timing is critical. The time and effort required to plow or clear roadways dramatically increases once snow and ice bond to the roadway. TxDOT must prepare in advance and make a timely response to snow and ice with trained personnel, fully functioning and well-maintained equipment, adequate supplies of sand, salt, or other materials, and methods for communicating with one another as well as the traveling public.

Road Closures

When it becomes apparent that a road section will need to be closed because of snow or ice, the Department of Public Safety or local law enforcement jurisdiction should be asked to officially close the road. (Contact information for local and state law enforcement agencies should be included in each district's Snow and Ice Control Plan.) We will make or continue to make the effort to work the area. Notice should be given to all news media and appropriate officials. For highways crossing district(s) or state line(s), the closure should be coordinated with the appropriate counterparts.

Where practical, signs should be erected to advise traffic. After road closure signs are erected, a trip should be made through the closed area to ascertain that no one is stranded in the closed section.

Railroad Grade Crossing

When plowing the highway, piles of snow should not be left at railroad grade crossings. After plowing, the rail should be cleaned of the snow pack, ice, gravel or dirt.

Purpose of this Manual

The purpose of this manual is to develop consistent practices that focus on a proactive approach to snow and ice control across the state. In addition to responding in a timely manner to a snow and ice event, other best management practices addressed in this manual will aid maintenance personnel in developing the best snow and ice control strategies.

The Snow & Ice Control Operations manual contains the following chapters:

- Chapter 1, District Snow and Ice Control Plans: Provides the basic elements to be contained in a written Snow and Ice Control Plan.
- Chapter 2, Materials: Provides information about the different types of materials used in snow and ice control, recommendations for their use, the types of testing (if any) necessary for each, and the environmental considerations to keep in mind when using.
- Chapter 3, Equipment Maintenance: Provides descriptions and photos of the major pieces of equipment used in snow and ice control, with checklists of tasks to be performed before, during and after a storm.
- Chapter 4, Purchasing: Provides purchasing information for anti/de-icing materials, major and minor equipment, parts, and provisions for leasing equipment and lease purchase contracts.
- Chapter 5, Bridge Maintenance Needs: Provides information on the special maintenance needs of bridge decks, joints, beams, caps and columns following the use or storage of anti/de-icing materials.
- Chapter 6, Personnel: Provides information about the responsibilities of maintenance supervisors, outsourcing snow and ice control, the tracking of field employees, equipment for employees, and safety and training of affected employees.
- Chapter 7, Reporting: Provides information on requirements for federal, state, district and local reporting.
- Chapter 8, Weather Forecasting: Provides information on sources for accurate and reliable weather reports and forecasts, the National Weather Service's system of advisories and warnings, and thermal mapping.

- Chapter 9, Alternate Methods: Provides information on different methods of preventing or combatting snow and ice formation or accumulation on highways and bridges, including snow fences and various anti-icing and de-icing systems.

Introduction to this Chapter

This chapter discusses the basic components and elements of a district's written Snow and Ice Control Plan, with examples of two such plans.

Section 2 — District Snow and Ice Control Plans

Elements of a Snow and Ice Control Plan

Each district shall have a written "Snow and Ice Control Plan" which `shall` be updated by `October 31 annually`. Due to the wide variance of weather and types and durations of winter storms throughout Texas, each district will need to develop a plan specific to meet their particular needs `to be reviewed and approved by the District Engineer`. All `district plans, at a minimum, shall` include these elements:

Objective

- describe district goals
- describe methods to be used
- may include varying levels of service due to roadway classifications.

Maintenance Section Plan

Each maintenance section within the district will prepare a Snow and Ice Control Plan specific to its needs.

Resources

- personnel
- equipment
- materials.

Coordination

- with other maintenance sections and districts
- with law enforcement agencies, cities, counties and other states
- with news media.

Operations

- safety
- training
- weather forecasting

- aggregate and chemical use procedures
- public information procedures
- post-storm review
- post-storm reporting
- post-storm cleanup

Chapter 2 — Materials

Contents:

Section 1 — Overview

Summary

A variety of factors should be taken into account when deciding upon a course of action to treat roadways during a winter storm event. Product application combinations are chosen after maintenance personnel have evaluated many factors including, but not limited to:

- air temperature
- pavement temperature
- humidity levels
- dew point temperatures
- `cloud cover vs. sunshine`
- type and rate of precipitation
- weather forecast
- weather radar data
- `traffic conditions (volume, route, etc.).`

Operational treatments are continuously evaluated before, during and after a winter storm. Road treatment and applications are modified through all phases of a storm based on careful analysis of intensity, duration and type of precipitation.

Whereas anti-icing operations are conducted to prevent the formation or development of bonded snow and ice for easy removal, de-icing operations are performed to break the bond of already bonded snow and ice. `The AASHTO Winter Roadway Maintenance Computer-Based Training provides comprehensive training in all aspects of winter roadway maintenance. Each district has a copy. Check with your Director of Maintenance or Operations to locate your district's copy.` It is important for maintenance personnel to understand the uses and limitations of each of the materials and techniques explained in this chapter.

Section 2 — Solid Chemical Application Capability

Need for Moisture Before Application

The use of dry solid chemicals as an anti-icing treatment can be effective in many circumstances, but only where there is sufficient moisture or accumulation of snow or ice on the pavement. Moisture must be present for two reasons:

1. to trigger the chemical reaction
2. to prevent loss of material from dry pavement.

For initial operations, solid chemicals will be effective when maintenance forces have the operational resources available to apply the chemical soon after sufficient precipitation has fallen, but before ice bonds to the pavement. For subsequent operations, solid chemical treatments will usually be effective when there is adequate moisture or accumulation of snow or ice during later periods of storms. There must also be sufficient traffic volume to keep the material mixed and allow it to go into a solution.

For either initial or subsequent operations, when there is not enough moisture or accumulation of snow or ice on the pavement there is likely to be loss of the chemical from the pavement. This may be caused by the blowing action of traffic, especially from high speed and commercial vehicles, or by particles bouncing off the pavement during spreading.

Section 3 — Liquid Chemical (Chemical Solution) Application Capability

When to Use Liquid Chemicals

There are advantages for using liquids at pavement temperatures of 23 degrees Fahrenheit and above. These include:

- a bond breaking film is created between the pavement and any buildup of snow and ice that may occur allowing easier removal of the snow or ice
- reducing time and effort required to plow and clear roadways.

However, this means putting the chemical down before enough snow has accumulated to prevent the chemical from reaching the pavement or from being excessively diluted. In some situations it may be beneficial to remove snow and slush from the road using traditional mechanical methods.

Traffic plays an important part in the use of liquid chemicals. They should not be applied as a fog on the entire roadway. Instead, liquid chemicals should be applied by the drip method, allowing traffic to track the material across the roadway. Therefore, there must be sufficient traffic volume to track and spread the material on the road.

Liquids can be used at pavement temperatures below 23 degrees Fahrenheit by following the manufacturer's suggested rate of application for varying conditions. The cost effectiveness of using liquid chemicals at lower pavement temperatures needs to be evaluated on a case by case basis.

Application should be made by stream nozzles allowing traffic to spread the material over the pavement surface. Fan nozzles should not be used due to the possibility of creating a slick pavement situation.

Figure 2-1. Application of liquid chemical by stream nozzles.

Section 4 — Pre-wetted Solid Chemical Application Capability

Benefits of Pre-Wetting Solid Chemicals

The pre-wetting of a solid chemical prior to spreading can improve the effectiveness of the solid chemical in many situations. A solid chemical requires energy to go into solution, and a dry solid chemical particle will remain inert until a liquid film forms. The solution process will be accelerated if pre-wetting is performed to the solid material. This is only one of the benefits of pre-wetting. Other advantages include:

- the solid chemical is spread more uniformly because of less waste from bouncing or traffic action (although not all waste is eliminated)
- wet granules adhere to the road surface better than dry granules
- there is a `quicker` and longer-lasting effect
- spreading speed can be increased.

The practical result is a reduction in the resources necessary for maintaining the highway since a lower application rate translates into a spreader load covering more area, often requiring less dead-heading (returning to the barn empty) to obtain material.

Figure 2-2. `A saddle tank is a useful means of pre-wetting solid chemicals.`

Section 5 — Recommendations for Use of Liquid Chemicals

Using for Snow Storms

For snowstorms, initial liquid applications can be made either as a pretreatment in advance of the storm or as an early-storm treatment, (i.e. soon after snowfall has begun and/or when the pavement temperature is dropping toward freezing).

Pretreatment

A pretreatment can be made prior to a storm, as long as the storm does not start out with above freezing temperatures and rain, washing the chemical away.

Benefits from liquid pretreatments can include higher friction and better pavement conditions early in a storm. These benefits are generally short-lived and should not be expected over a long period. Subsequent chemical applications should be made as soon as conditions begin to deteriorate. Pre-treatments can be thought of as "buying time" in the early stages of a storm until subsequent chemical applications become effective.

Early-Storm Treatment

In the case of early-storm treatment, the application may be made onto dry, wet, light slush, or lightly snow covered pavement. Late applications onto pavements with more than a light covering of slush or snow can result in excessive dilution of the chemical, lowering its effectiveness.

Preventing Black Ice

To prevent the formation of frost or black ice, the chemical should be applied before ice is expected to form so the water component of the chemical will evaporate or be removed by traffic action. This will leave only the chemical on the road surface and result in the greatest concentration when frost or black ice conditions would otherwise occur.

Use Caution During Liquid Precipitation Storms

The use of a liquid pretreatment is questionable during an event which has rain prior to freezing temperatures due to potential loss of pretreatment material.

Section 6 — Recommendations for Use of Dry Chemicals

Timing is Critical

Timing of an initial dry solid chemical application for snowstorm events is critical. The application should be made as soon as possible after sufficient precipitation has fallen to prevent loss, but before ice bonds to the pavement.

Do Not Use As Pretreatment on Dry Pavement

Application of dry solid chemical onto dry pavement is not recommended, and therefore should not be used as a pretreatment.

Section 7 — Chemical Types

Sodium Chloride, NaCl

Sodium chloride has been used as an ice-control chemical on roads since early in the previous century. It is produced by three processes:

- rock salt is mined by conventional hard rock mining equipment and techniques
- solar salt is produced by the evaporation of sea water and may contain only a small amount of impurities
- evaporated, solution or vacuum salt is a very pure form made by drying under vacuum the solution resulting from injection of water into deep underground deposits.

Most salt used for highway applications in the U.S. is rock salt, though some solar salt is produced in several western states and some is imported into the eastern states. Naturally occurring rock salt is the mineral halite, which usually contains between 1 percent and 4 percent impurities, mostly gypsum, shale, dolomite and quartz.

Magnesium Chloride, MgCl2

The principal source of this ice control chemical is brines from the Great Salt Lake. Though it is available in solid (flake) form, it is used in liquid form for ice control. The lowest temperature at which $MgCl_2$ can melt snow or ice (eutectic temperature) is about -28 degrees Fahrenheit at a concentration of 21.6 percent. Its ice melting capacity is about 40 percent greater than Calcium Chloride $CaCl_2$. Proprietary mixtures are available containing 20 percent to 25 percent $MgCl_2$ with various corrosion inhibitor additives. One proprietary compound reportedly has an eutectic temperature of -4 degrees Fahrenheit. These solutions are effective ice-melting agents at temperatures above 19 degrees Fahrenheit.

With its competitive price and low freezing point, magnesium chloride works well as both a de-icer and anti-icer. It contains a corrosion inhibitor making it less damaging to concrete and steel than other products and it is less harmful to the environment than calcium chloride and sodium chloride.

Calcium Magnesium Acetate (CMA)

Currently there is only one commercial source for CMA, using the reaction of acetic acid with dolomitic limestone for production. Acetic acid, the costly component of the compound, is manufactured from natural gas or petroleum, though small quantities have been produced by biodegradation of agricultural wastes.

The compound is available as pellets or powder. Though not as soluble in water as NaCl and $CaCl_2$, solutions can be made for use as a pre-wetting agent or straight chemical application.

It is not a highly effective de-icing chemical in solid form because of its affinity for water and its light particle mass. Its benefit is that it makes snow mealy so that it doesn't compact.

CMA is primarily a mixture of calcium and magnesium acetates, produced with a 3/7 Ca/Mg ratio which was found to be optimum in previous FHWA studies. The eutectic temperature is about -18 degrees Fahrenheit at a concentration of 32.5 percent.

When CMA degrades, the calcium and magnesium elements are said to actually improve the water and air permeability of the soil by restoring sodium-compacted soils.

Since acetate degrades into carbon dioxide and water and is a natural component of plant decay, CMA is appropriate where roadside vegetation, crops, or ground water are especially vulnerable. Because it is less corrosive than salt, some agencies prefer CMA for use on bridges, parking structures, sidewalks, and certain road surfaces (**caution**: it does cause major scaling).

The cost of CMA is approximately $600 per ton whereas salt generally costs $20 to $40 per ton. Some advocates of CMA argue that the initial costs may be misleading because replacement costs for roads and bridges damaged by chloride-related corrosion should be factored into the overall figures.

The pellet form of CMA is usually preferable to the powdered form, since the powder dust is less controllable. The pellet form of CMA does not bounce off the road before melting and its residual action can reduce reallocation frequency.

Potassium Acetate, KC2H3O2

Potassium acetate, or KAc as it is commonly known, is produced by the reaction of acetic acid with potassium carbonate.

The sources of acetic acid are the same as in the production of CMA.

Potassium carbonate is one of the groups of salts commercially known as potash. Potassium carbonate was originally obtained by running water through wood ashes and boiling the resulting solution in large iron pots. The substance that formed was called potash.

Potassium carbonate is currently produced by one of several processes that use potassium chloride, another salt of the potash family. The compound, potassium acetate, is a white, crystalline, deliquescent powder that has a saline taste. It is soluble in water and alcohol. Solutions are alkaline under a litmus test.

The dry compound is combustible but is used as a dehydrating agent, a reagent in analytical chemistry, and in the production of synthetic flavors, in addition to other uses. The eutectic temperature of a KAc and water solution is -76 degrees Fahrenheit at a concentration of 49 percent.

A commercial form of liquid KAc, containing a 50 percent concentration by weight plus corrosion inhibitors, has been used as a pre-wetting agent with dry salt or as a straight chemical application.

Salt/Brine

Brine is a solution of salt (Sodium Chloride-NaCl) in water. There are two primary sources of salt: solar salt and rock salt. Rock salt exists naturally across the world and is mined for use in numerous industries. Brine also occurs naturally across the world and is a by-product of many industrial processes, such as oil and gas exploration. Brine solutions range from about 3.5% (a typical concentration of seawater) up to about 26% (a typical saturated solution).

Anti-icing should be the first in a series of treatment strategies for winter storms. Anti-icing is a proactive approach and one of the most cost-effective and environmentally safe practices in winter road maintenance. Anti-icing, when performed correctly, prevents ice and snow from bonding to the pavement, thus achieving one of the most important goals of winter storm management. Once frozen precipitation has bonded to the pavement, the cost to break that bond in terms of materials, equipment, and labor increases substantially.

Brine can be used for anti-icing or de-icing, but its optimal use is in anti-icing operations. Brine produces similar results as other anti-icing chemicals, but at a fraction of the cost. Brine can be applied with typical TxDOT equipment, such as modified herbicide trucks. Brine is applied at rates ranging from 30-60 gallons per lane mile at a 23.3 percent solution. Brine is applied with stream nozzles similar to other liquid anti-icing chemicals.

Currently, TxDOT is using brine on a wider scale due to the cost and ease of use. Storage is also easier since brine does not have to be re-circulated when stored for long periods. TxDOT has constructed five 500 cubic yard salt barns in strategic locations to help support this program.

Section 8 — Abrasives

The most economical materials used in snow and ice control are abrasives. However, abrasives on the road must be removed and sweeping adds expenses. Abrasives can also cause damage to windshields and auto paint. To avoid windshield and other minor damage, districts may consider using lightweight (grade 5 or smaller) aggregate as abrasives.

Fine abrasives can potentially cause problems on PFC Pavement by inhibiting drainage through the pavement structure. Each district's plan should identify all PFC Pavement. Only de-icing material that becomes completely soluble should be used.

A mixture of solid chemical and abrasives is effective in treating roadways in some areas. The mixture ensures abrasives will be present to help provide traction and to give the public a visual clue that ice may be present and that TxDOT is working the event. The addition of solid chemicals will assist in keeping ice slushy and will expedite melting as freezing temperatures end.

Section 9 — Testing

All de-icing material should be tested in accordance with Departmental policies and Material Safety Data Sheets should be maintained.

Section 10 — Environmental Considerations

Environmental Effects vs. Benefits

Much is written and said each winter about the effects of anti-icing and de-icing chemicals on the environment, but little is said of their benefits to the traveling public. The truth is that anti-icing and de-icing chemicals are essential to the safe transportation of goods and people. When applied heavily and frequently, chemicals can pollute receiving waters, but the degree of their damage largely depends on the type and designated use of the receiving water, and on the drainage system used to discharge the runoff.

Surface waters are not as vulnerable to chemicals as are ground waters because their turbulent actions blend and dilute plumes of incoming liquids almost immediately after the chemicals enter the mainstream. Ground waters, on the other hand, are more susceptible to pollution since there may be no turbulent actions to dissolve the chemicals when the runoff percolates through the soil and enters the water table.

Calcium Magnesium Acetate (CMA) and Potassium Acetate (KAc) are chemicals most benign to the environment because they contain weak biodegradable acids. Sodium Chloride (NaCl), Calcium Chloride ($CaCl_2$), and Magnesium Chloride ($MgCl_2$), on the other hand, leave residues of chloride ions on the highway surface that may not only contaminate surrounding ground waters, but they may also corrode motor vehicles and bridge structures.

Variations in Effects

The effect of chemicals on receiving waters may vary with the specific use and overall ecological health of each body of water. In some cases, water with elevated concentrations of sodium may be suitable for some uses, but undesirable for certain industrial purposes. For example, high concentrations of sodium in water for human consumption are harmful to people with certain types of heart or kidney diseases, but the major objection comes from taste preferences.

The effect of high salinity on fish life varies with the tolerance of individual species. Some fish cannot tolerate a salt level as low as 400 ppm, while others are able to live with levels higher than that of seawater (30,000 ppm.)

Salt levels in highway runoff vary with the amount of chemicals applied and the intensity of subsequent rainstorm events. Highway runoff can contain salt levels as low as 10 ppm, particularly in areas where chemicals are not used.

Chemicals in Highway Runoff Not a Major Source of Chloride Contamination

It is important to note that chemicals in highway runoff are not the major sources of chloride contamination of waters. Sewage discharges and runoff from industrial waste and agricultural products also contain high concentrations of chloride that may affect receiving waters as well. Rain and snow may deposit as much as 35 to 40 pounds of chloride per acre annually even without the presence of de-icing chemicals. Areas that are geographically located along coastal waters also experience high chloride concentrations since chloride occurs naturally in sea water, natural brines and water which passes through salt-bearing strata.

Chapter 3 — Equipment Maintenance

Contents:

Section 1 — Overview

Summary

It is the mission of the Texas Department of Transportation to provide a safe thoroughfare during the snow and ice season. In order to provide the level of service the public has come to expect, coordination of numerous pieces of equipment and personnel is necessary. TxDOT utilizes various pieces of equipment such as snowplows, maintainers and loaders. During snow and ice events, equipment must be ready to respond with very little notice. Proper maintenance of all equipment before, during and after a winter storm is important to ensure readiness for future storms. The following sections outline various snow fighting equipment currently used by the department and the proper maintenance required before, during and after winter snow events.

Section 2 — Dump Trucks

Figure 3-1. Dump trucks are the workhorses of TxDOT snow removal. Snow plows are mounted to dump trucks and are used to push the accumulated snow off the roadway. Spreaders are also mounted on dump trucks to facilitate the spreading of materials for snow and ice control.

Pre-storm activities

Well before a storm strikes, be sure to:

- prepare dump truck to become snow removal equipment by completing the Dump Truck Daily Inspection Checklist
- grease and lubricate all moving parts at attachment points
- add desired equipment (snow plow, spreader)
- check all hydraulic hoses and fittings on all applied equipment
- ensure all mounting points are tight
- bleed air system to reduce chance of freezing
- make sure all safety equipment is in place and operational
- check all electrical components for correct operation
- call base station to ensure correct operation of state radio
- ensure the equipment is full of fuel before leaving for assignment.

During the storm activities

While using the equipment during a storm:

- monitor gauges
- perform occasional walk around to check for problems (lights, tires, etc.)
- listen for air leaks
- check attached equipment.

Post-storm activities

Once the storm is over, be sure to:

- clean and remove all excess materials from the cab and undercarriage
- service truck as needed to prepare for next assignment

Section 3 — Motor-Grader

Figure 3-2. Motor-grader (maintainer) - This may be the best piece of equipment we have for snow removal. It does not require any other attachments to do the job. This piece of equipment is self-contained and ready to go.

Pre-storm activities

Well before a storm strikes, be sure to:

- check all fluid levels
- check equipment per Motor grader Inspection Checklist
- check blade and mold board for any damage
- grease turntable and all fittings to help equipment operate freely
- make sure all safety equipment is in place and operational
- check all electrical components
- call base station to ensure proper operation of state radio
- ensure equipment is full of fuel.

During the storm activities

While using the equipment during a storm:

- monitor the wear on the blade to prevent damage to the mold board
- monitor all gauges to prevent future problems

- perform occasional walk around to check for problems (lights, tires, fluid leaks, etc.)
- check all fluid levels during operation of equipment.

Post storm activities

Once the storm is over, be sure to:

- clean equipment
- grease turntable and all fittings
- check all air filters
- check blade and mold board for any damage
- perform a walk around for any visible damage.

Section 4 — Loader

Figure 3-3. Loaders are a vital piece of equipment during a snow and/or ice event. They are used for loading material on the trucks to fight the ice and snow. They are also used to clear intersections and driveways.

Pre -storm activities

Well before a storm strikes, be sure to:

- complete Loader Inspection Checklist
- lubricate according to manufacturer's recommendations
- make sure all safety equipment is in place
- check all electrical components
- call base station to ensure proper operation of state radio
- ensure the loader is full of fuel.

During the storm activities

While using the equipment during a storm:

- perform occasional walk around to check for problems (lights, tires, fluid leaks, etc.)
- monitor all gauges to prevent future problems.

Post storm activities

Once the storm is over, be sure to:

- clean equipment
- service equipment as needed
- grease all fittings on the loader.

Section 5 — Snow Plow

Figure 3-4. The Snow Plow is an attachment for a six- and 10-cubic yard truck. It is used to remove snow from the pavement.

Pre – storm activities

Well before a storm strikes, be sure to:

- complete Snowplow Inspection Checklist
- check blade and moldboard on snowplow
- mount to truck to ensure proper operation
- check hydraulic hoses and fittings
- check snow plow attachment to make sure it is tight
- perform a visual check for any leaks
- check levels on hydraulic tank
- check switch to make sure blade will go side to side for easy snow removal
- install lights to ensure the ability to see while plowing snow
- adjust trip chain on plow.

During the storm activities

While using the equipment during a storm:

- perform occasional walk around to check for any problems that may arise (lights, leaks, tires, etc.)
- keep constant check on blade wear to protect moldboard
- watch hydraulic levels to assure correct operation of the plow.

Post storm activities

Once the storm is over, be sure to:

- clean equipment as necessary
- make sure equipment is ready for next snow event
- check all hydraulic lines and fittings for wear or leaks
- install new blade on plow if necessary
- check snow plow for fatigue cracks.

Section 6 — V-Box Spreader

Figure 3-5. The V-Box Spreader is an attachment for a dump bed truck. It is used to accurately put out applications of de-icing materials on bridges and icy spots. These spreaders can either be hydraulic or gasoline operated.

Pre-storm activities

Well before a storm strikes, be sure to:

- perform V-Box Spreader Inspection Checklist
- on gasoline system check fuel, electrical, drive belt, fuel filters and engine oil
- check spinner assembly (hinge rod and spinner disk)
- check conveyor system (conveyor chain and belt)
- check all hydraulics
- check PTO and drive assembly `or direct drive`
- `calibrate equipment for specific application rate desired.`

During the storm activities

While using the equipment during a storm:

- check for accurate dispersal of materials

- perform a visual inspection of the equipment during operation to check for any problems (leaks, lights, etc.)
- check oiler on belt for fluid level.

Post storm activities

Once the storm is over, be sure to:

- remove material from spreader box and clean and wash thoroughly
- check for leaks and wear on hoses (hydraulic system)
- check fuel filter (on gasoline system) and make sure the equipment is ready for the next snow event
- make sure all lights are operational on the spreader
- check the conveyor system (belt and chain).

Section 7 — Tail Gate Spreader

Figure 3-6. Tail gate spreaders are used to apply de-icing and anti-icing materials. They are a spinner type applicator and operate via a hydraulic system.

Pre-storm activities

Well before a storm strikes, be sure to:

- check all hydraulic lines and fittings for leaks or wear
- check bearings in spinners
- check oil in hydraulic motors
- check mounting brackets that attach to the dump truck
- lubricate all moving parts
- mount to truck to assure proper operation
- calibrate equipment for specific application rate desired.

During the storm activities

While using the equipment during a storm:

- perform occasional walk around to check for problems (lights, leaks, etc.)
- check for accuracy of material application.

Post storm activities

Once the storm is over, be sure to:

- clean equipment
- check for any hydraulic leaks
- lubricate all points on bearings and moving parts
- check all hydraulic hoses and fittings for wear
- check all welds for fatigue cracks.

Section 8 — Snow Wing

Figure 3-7. The snow wing attachment provides extra width on a motor grader or truck for plowing two lanes at a time or picking up a lane and a shoulder at the same time.

Pre-storm activities

Well before a storm strikes, be sure to:

- lubricate all fittings and moveable points on the snow wing
- check attachment points for tightness: they should be rigid
- check blade and mold board for damage and replace blade if necessary
- check all hydraulic fittings and connections
- attach to equipment to check operation of snow wing.

During the storm activities

While using the equipment during a storm:

- perform occasional walk around to ensure no leaks or other problems
- check blade periodically for wear.

Post storm activities

Once the storm is over, be sure to:

- clean equipment
- lubricate all fittings and moveable parts

- check blade and mold board for wear or damage
- replace blade if necessary to prepare for future storms
- check all welds for fatigue cracks.

Section 9 — Snow Blower

Figure 3-8. Snow blower is an attachment that is used to remove large quantities of snow.

Pre-storm activities

Well before a storm strikes, be sure to:

- service engine
- lubricate all fittings
- check all electrical components
- attach to loader and check operation of snow blower
- start blower monthly (service day) to keep system charged
- ensure snow blower is full of fuel.

During the storm activities

While using the equipment during a storm:

- lubricate after each eight hours of use
- check all attachment points at two-hour intervals (pins, hoses, etc.)
- perform walk around during operation to check for problems.

Post storm activities

Once the storm is over, be sure to:

- clean equipment
- lubricate all fittings and moveable points on the equipment
- check operation of equipment before removal from loader to ensure correct operation before storing
- service equipment as necessary.

Section 10 — Herbicide Rig

Figure 3-9. The herbicide rig is used to apply anti-icing liquids prior to an approaching storm. It is also used for de-icing applications during the storm.

Pre-storm activities

Well before a storm strikes, be sure to:

- complete preventive maintenance checklist
- adapt herbicide rig to spray liquid de-icer
- flush tank to prevent contamination
- service auxiliary motor
- flush pump for correct operation
- operate all systems to ensure correct operation
- check all electrical components for correct operation
- perform trial run with water to assure correct rates
- calibrate equipment for specific application rate desired.

During the storm activities

While using the equipment during a storm:

- perform occasional walk around to check for any problems (lights, leaks)
- repair any problem as necessary to ensure correct operation of equipment.

Post storm activities

Once the storm is over, be sure to:

- flush system
- clean all equipment associated with application
- check equipment for proper operation before next storm
- service equipment as necessary to prepare for next storm.

Section 11 — Pickup Applicator

Figure 3-10. Pickup applicators are used to apply anti-icing liquids (top) and granular (bottom) materials prior to an approaching storm to small areas such as bridge decks, on and off ramps. They are also used for de-icing applications during the storm.

Pre-storm activities

Well before a storm strikes, be sure to:

- flush pump for correct operation

- check all electrical components for correct operation
- perform trial run with water to assure correct rates.
- `calibrate equipment for specific application rate desired`.

During the storm activities

While using the equipment during a storm:

- perform occasional walk around to check for any problems (lights, leaks)
- repair any problem as necessary to ensure correct operation of equipment.

Post storm activities

Once the storm is over, be sure to:

- flush system
- clean all equipment associated with application
- check equipment for proper operation before next storm
- service equipment as necessary to prepare for next storm.

Chapter 4 — Purchasing

Contents:

Section 1 — Overview

Summary

The function of purchasing is vital to the overall success of a winter maintenance program. Purchasing spends tax funds to obtain the materials and equipment to keep state maintained roadways operating efficiently during snow and ice events. Each district's winter plan should define their specific quantities and types of anti-icing and de-icing materials on hand.

This chapter discusses the procedures for purchasing materials and equipment.

Section 2 — Anti/De-icing Materials

Blanket Purchases

Anti/de-icing materials are available from state term contract(s) including rock salt, calcium magnesium acetate (CMA), magnesium chloride (liquid and solid) and sand. include rock salt, calcium magnesium acetate (CMA) and magnesium chloride (liquid and solid) and sand. Reference the De-icing Material Report for additional information regarding anti/de-icing materials in-stock under the General Commodity heading at http://crossroads/org/gsd/Purchasing/purchasing2.htm.

Small Purchases/Emergency Purchases

In situations where a term contract is not available, regions may use small purchase procedures. If an emergency situation requires the purchase of anti/de-icing material, regions will follow the procedures for an emergency purchase.

NOTE: Purchasing procedures may be found at the GSD intranet site:

http://crossroads/org/gsd/Purchasing/default.htm

Section 3 — Major Equipment

Definition

Major equipment is defined in the Property Management Manual.

Funding

Major equipment is funded from the capital equipment budget. Major equipment shall not be purchased using overhead, minor equipment, or any account other than those designated for major equipment. Emergency purchases are **not allowed** for acquiring major equipment.

Snow plows and other expensive equipment for rapidly moving large amounts of snow should only be considered for areas that experience frequent snowstorms.

Selected items of major equipment are available on term contract. Major equipment is purchased by GSD for all of TxDOT as part of its fleet management function.

NOTE: Used snow plows can be transferred to districts with less frequent winter weather events in lieu of purchasing new equipment. Contact GSD Fleet Management at (512) 374-5471.

Specifications

All major equipment specifications are developed and maintained by GSD and are available at the TxDOT Internet (Purchasing) site: http://www.dot.state.tx.us/gsd/purchasing/tssi_alpha.htm and at the GSD Intranet (Purchasing) site: http://www.dot.state.tx.us/GSD/purchasing/tssi_num.htm. Fleet staff should draft specifications when there are no TxDOT standard specifications available. Contact the Fleet Manager for assistance.

Section 4 — Minor Equipment

Definition

Minor equipment is any non-consumable implement, tool or device having a unit cost of $5,000 or greater. Items installed in a permanent manner on highways, rights of way, bridges and buildings are not considered equipment. See the Minor Equipment Systems (MES) Manual.

Funding

Purchases of minor equipment must be funded out of Segment 10 using the appropriate detail and strategy.

Section 5 — Purchase of Parts

Distributor Purchase

Distributor purchase is the appropriate method of purchase to obtain original equipment manufacturer (OEM) repair parts that are needed for immediate use. This method cannot be used to purchase labor or parts for stock. The parts must be purchased from an OEM dealer or distributor and put into use within approximately a week to 10 days of receipt. There is no limit on the dollar amount of a distributor purchase, but prior approval of GSD may be required. See Chapter 1, Section 5, Procurement Authorization, for limitations and Chapter 1, Section 6, Bidding Requirements of the Purchasing Manual. Reference the Purchasing Manual Chapter 1, General, Section 5 - Procurement Authorization; Chapter 2, Competitive Solicitation, Section 5 Bidder Selection - Distributor Purchases; Chapter 3, Distributor Purchases, Section 7 - Distributor Purchases.

Regions must include the equipment number(s) of the major equipment unit(s) for which the repair parts are being purchased in the accounting data on the APS User Request.

Following are examples of the types of equipment for which OEM parts may be purchased using the distributor method:

- motor vehicles
- farm tractors and equipment
- road maintenance machinery and equipment
- heavy construction machinery and equipment
- traffic signal lights

Purchasing Used Repair Parts

When immediate repairs are needed and new parts are not readily available, regions may purchase used repair parts under small purchase or emergency authority (as appropriate). The file must be thoroughly documented to indicate the reason used parts are purchased. In APS use the F6 [Justification] or F9 [Item Description] function as applicable. Reference the Purchasing Manual, Chapter 4, Specific Purchasing Procedures, Section 7 - Repair Parts.

Section 6 — Lease of Equipment without Operator

Lease vs. Purchase

Equipment may be leased to meet intermittent or short term needs and should be used only when it is more cost effective than an outright purchase. Rental agreements for equipment typically used to meet short term needs do not exceed 90 days.

Document the purchase file with the anticipated cost savings that would result in leasing versus an outright purchase prior to awarding a purchase order. To assist in making the decision to lease or purchase a piece of equipment, use the life cycle cost benefit analysis (LCCBA) available at http://crossroads/org/gsd/Purchasing/purchasing3.htm under the Purchase Process Resources tab, Best Value Procurements of the GSD web site.

Alternative fuel waiver

Contact GSD Fleet Management for assistance at 512 374-5471.

Section 7 — Lease of Equipment with Operator

When to Use

Equipment may be leased with operator only to supplement state forces. In order for the lease to be considered a purchase of services, state forces must perform a minimum of 51 percent of the work. If the work performed by the contractor will exceed 49 percent, the work must be performed under a routine maintenance contract.

Section 8 — Lease Purchase Contracts

Use When Cost Effective

A D/D/O/R may acquire capital equipment by lease purchase if it is cost effective. Use the Master Lease Purchase Program (MLPP) to lease capital equipment. Contact GSD Purchasing for assistance.

Chapter 5 — Bridge Maintenance Needs

Contents:

Section 1 — Overview

Summary

Bridge decks typically are the first transportation structures to freeze during cold weather. The greatest risks associated with chemical use on bridges are corrosion of imbedded steel and concrete deterioration. TxDOT allows each district to use commercially available chemical products. Corrosion potentials vary with each material.

Bridges are composed of substructures (caps, columns, foundations) and superstructures (beams, bridge deck, and rail). Each respective structural element has an associated risk created by the use of de-icers and the related destructive forces created by the corrosive nature of the agents. Review of bridge components that exhibit the most risk and damage are contained in the following sections.

Section 2 — Bridge Decks

Risks of Chemical Damage

Bridge decks, especially overhangs and joints, are at great risk of incurring de-icer related damage. When evaluating design loads, overhangs exhibit the greatest levels of stress in the deck design. Overhangs also store snow pushed by plows. The snow pushed by plows is typically laced with de-icers, possibly saturating our high stress areas with corrosive chemicals. Steel under stress corrodes at an accelerated rate. So, storing snow on overhangs is not an ideal situation.

The damage begins when the snow melts and concentrates the corrosive forces in the de-icing agents in the overhangs.

Sweeping bridge decks at the end of the winter weather season is necessary to reduce leaching of de-icing agents throughout the summer months.

Washing the Deck

To prevent as much damage as possible, wash the deck when the temperatures rise and snow season is over. Washing helps in two ways:

1. physically removes remaining chemicals
2. dilutes any chemical residues, reducing their corrosion potential.

Figure 5-1. Corrosion damage due to concentrated de-icing solution at drain site.

Figure 5-2. Corrosion damage due to concentrated de-icing solution at drain site.

Section 3 — Bridge Joints

Risks of Chemical Damage

Joints are positions in the deck which allow thermal contraction and expansion to occur. If joints are not maintained then runoff will fall through joints. Typically, snow melt runoff is concentrated on the low side of the structure. Snow melt is particularly brutal because it is laced with chemical agents concentrated in one area and flows for extended periods of time (length of meltdown). This combination of concentrated flow combined with corrosive agents subjected to extended exposure allows for corrosion damage to initiate and progress.

Bridge Joint Inspection and Cleaning

TxDOT prefers bridge joint inspection and cleaning to be performed in the spring and re-inspection to occur prior to the beginning of snow season. This fulfills the `annual` bridge inspection criteria in accordance with the Maintenance Operations Manual

Figure 5-3. Poorly maintained joint allowed concentrated de-icer solution to damage cap.

Figure 5-4. Poorly maintained joint allowed de-icer solution to damage overhang to second mat of steel and top plate steel on beam.

Section 4 — Bridge Beams

Risks of Chemical Damage

Beams exhibit increased risks to corrosion due to cover reductions, high stress steel design, and concentrated chemical solution saturating end zones when joint seals are broken.

Repair of Joint Systems

Maintenance personnel should repair and maintain joint systems ensuring the protection created by the sealed joint systems.

Figure 5-5. Chemical solution corrosion induced beam damage created by failed joint and poor concrete cover over beam ends.

Figure 5-6. Close up of Figure 5-5.

Section 5 — Bridge Caps

Risks of Chemical Damage

Bridge caps support the superstructure and are the elements on which the beams are supported. Chemical damage occurs to caps when the sealed expansion joints fail and the concentrated chemical solution either falls from the deck through the joint to the cap or it travels through the joint down the beam to the cap. Contamination and damage to the cap can be accelerated when caps are finished flush and the chemical solution is allowed to pond on the cap.

Maintain Joint Systems

Maintenance personnel should maintain joint systems, eliminating the possibility of chemical solution saturating this structural element. If joint systems have failed, or are designed as an open system, caps should be washed at the end of snow season.

Figure 5-7. Corrosion induced damage in high stress cantilever design.

Figure 5-8. Failure on cap due to corrosion damage. Bridge was closed until repair could be performed.

Section 6 — Bridge Columns

Risks of Chemical Damage

Columns attach the foundations to the caps which support the beams. Chemical damage occurs when expansion joints fail and chemical solution flows through the expansion joint, down the beam, down the face of the cap and down the column. If chemical stock piles are stored next to bridge structures the corrosive forces of the chemicals will induce damage to the columns.

Don't Store Chemicals by Columns

To eliminate chemical damage to columns, do not store chemical materials next to columns and maintain and repair bridge joints.

Figure 5-9. Column deterioration from chemical solution contamination.

Figure 5-10. Close up of the damage. Notice the #9 bars are starting to buckle. Two reasons this could be happening: 1. Rust could be pushing on concrete causing the buckling. 2. The column could be shortening. This bridge was replaced after 20 years of service.

Figure 5-11. Salt storage under a bridge next to bridge columns.

Figure 5-12. Damage created due to the salt storage.

Chapter 6 — Personnel

Contents:

Section 1 — Responsibilities of Maintenance Supervisors

Coordination

Maintenance supervisors will be responsible for coordinating all activities within their geographical area of responsibility.

During instances of adverse weather, maintenance supervisors should monitor approaching weather by utilizing all available tools. Roadway conditions must be closely monitored and evaluated to ensure timely response by the crews.

Maintenance supervisors should notify their area engineer and the district maintenance office when resources are requested from outside the maintenance section. Maintenance supervisors should coordinate with outside agencies (city, county, law enforcement, adjacent counties, etc.) as necessary. Respective area engineer(s) and the district maintenance office should be consulted for assistance when this coordination is needed.

All winter storm events are not the same. Variations in temperature, amount of precipitation, existing conditions, and duration of storm all contribute to how the roadways and bridges are affected. Maintenance supervisors should evaluate all aspects of the storm and make any necessary adjustments to methods and procedures before the next occurrence.

Section 2 — Outsourcing

Funding

In extreme instances, it may be necessary to outsource snow and ice control to supplement TxDOT forces. In these instances, use of Routine Maintenance Contracts or Purchase of Services should be considered. The appropriate district and/or division personnel should be consulted early in the process for these methods of outsourcing to be in effect in a timely manner. Please refer to Chapter 4, "Purchasing."

Section 3 — Personnel Scheduling

Tracking Employees

During periods of snow and ice control, there should be a supervisor and dispatcher on duty to oversee and coordinate field operations. The location, arrival and departure times of field employees should be tracked to ensure safety of employees and adequate response time to potential roadway complaints.

Training

All personnel should be trained in proper procedures prior to being assigned snow and ice control duty. TxDOT employees have varying degrees of experience with snow and ice control. It is important to recognize levels of individual employee experience when assigning work activities. Those employees with greater experience should be considered for more critical work assignments.

Scheduling Employees with Commercial Driver Licenses

Recent concerns about the effect of fatigue as a contributing factor in commercial motor vehicle crashes have brought about new rules concerning driver hours of service. The Department of Transportation Federal Motor Carrier Safety Administration publishes current requirements for all personnel with Commercial Driver Licenses. Maintenance supervisors should consider these requirements when scheduling personnel.

Equipment

`Personal protective` equipment for all employees should be considered during times of snow and ice control response. Appropriate quantities of items such as gloves, storm suits, other personal protective equipment, flashlights and batteries, windshield de-icer, wiper blades, etc., should be kept on hand to adequately respond to each event.

Chapter 7 — Reporting

Contents:

Section 1 — Overview

Why Reports are Important

Reporting is a very important and often overlooked component of a good overall snow and ice control plan. The ability to provide adequate and accurate information to the traveling public is critical to the department's mission. A good reporting procedure will accomplish several goals that are important to TxDOT:

- the ability to provide timely and accurate information to the public. Public awareness of current roadway conditions can be a potentially life saving service.
- the information contained in these reports can be invaluable to the department when responding to the media, complaints or litigation.
- the information can be used as a reference by supervisors and managers who are planning for future snow and ice events or requesting assistance in repairing damage to roadways due to severe snow and ice storms.

There are several levels of reporting that should be conducted during any snow or ice event. This chapter describes each level of reporting and its purpose.

Section 2 — Federal Reporting

Tracking Storm Damage Costs

In extreme situations such as severe ice storms, districts may seek reimbursement through the Federal Emergency Management Agency (FEMA). Reimbursement is limited to the repair of damages due to severe ice storms. Damages due to snow storms are not eligible for federal reimbursement.

Ice storms that are eligible for federal reimbursement are usually severe with damages in the millions of dollars. The damage estimates for a severe ice event follow the storm's path across the state accumulating costs from all affected districts. This increases the likelihood of meeting the actual cost requirements of a qualifying storm.

Each maintenance section should track their costs for the storm by charging work to a disaster project that has been set up in the maintenance management system (MMS) and using the appropriate function from Code Chart 12 which can be found on the Maintenance Division's web site at http://crossroads/org/mnt/ under MMIS Training. The project can be set up by the district office or maintenance section. Responsibility for setting up the project should be identified in the district's Snow and Ice Control Plan. Reports can be generated from the MMS and provided to FEMA as required. Acquiring federal reimbursement can have a significant impact on sections that have spent roadway maintenance funds during storm response and clean up.

Section 3 — State Reporting

Highway Condition Reporting System

Reporting at the state level is normally accomplished through the Highway Condition Reporting System (HCR). The district HCR coordinator (or designee) should enter weather conditions in HCR and update conditions every four hours during snow and ice storms. Click here to view the Highway Condition Report Manual. Maintenance sections should also add roadway conditions to HCR and update every four hours -- or as conditions change -- during snow and ice storms.

The roadway condition information provided by the maintenance section is directly relayed to the traveling public from HCR through the department's Internet site and the statewide toll free number for highway conditions. Because this information is not edited prior to being released to the public, it is extremely important that the information be accurate and current.

Section 4 — District Reporting

Reports from Each Maintenance Section

Reporting at the district level is normally a procedure that is outlined in the district's Snow and Ice Control Plan. See Chapter 1, Section 2, "District Snow and Ice Control Plan." The information needs of each district should be met by their reporting requirements. A typical district level report includes detailed information from each maintenance section that can be used to answer public complaints and requests for information during a snow and ice storm. This information is also used by the district maintenance office to coordinate the movement of personnel and equipment to areas hardest hit by the storm.

What to Include

The information that should be included in a report from a maintenance section to the district maintenance office is:

- The time that the snow and ice fighting operations began and the time operations ended
- What type of response has been activated? For example are the crews applying ice control materials? Are the crews plowing snow? Are the crews plowing snow **and** applying ice control materials?
- The depth of accumulated snow on the roadway surface and general roadway conditions.

Information needs may increase during longer periods of winter weather such as anticipated manpower or equipment needs.

Section 5 — Local Reporting

What to Track

Reporting requirements at the local section level should include all routine reports in addition to any district, state and/or federal reports. Routine reports should include:

- Pre-trip inspection reports on trucks as well as plows, spreaders, snow blowers, motor graders, loaders, and light vehicles
- Daily activity reports tracking hours worked, mileage, equipment hours and materials used during the storm
- Maintenance sections should also consider recording the calibration of each salt spreader and keeping track of all applications during a storm event.

A well organized effort to keep daily information accurately recorded can make responding to district, state and federal inquiries much easier.

Other types of local reporting can include:

- Responses to local media inquiries, public requests for roadway conditions, and service requests from residents or businesses on state routes should be routed through the Public Information Officer
- A salt route map and a priority roadway map will give TxDOT customers assurance that an organized effort is under way to clear the roadways
- The Public Information Officer should inform media that snow/ice conditions exist
- A telephone answering machine to disseminate local roadway information when the office is not staffed. The information on the recording should be kept current and should reference the department's toll free number for statewide roadway conditions.

Roadway condition information and knowledge of how to assist the public in acquiring information from surrounding areas should be readily available in each maintenance section.

Chapter 8 — Weather Forecasting

Contents:

Section 1 — Overview

Importance of Accurate Forecasts

The decision to begin snow and ice control treatment begins with a good weather forecast and knowledge of the weather trends for your area. Maintenance supervisors have a number of alternatives available to aid in finding accurate weather forecasts to help determine when to begin snow and ice control measures.

Local news stations' daily broadcasts are generally the initial warning that adverse conditions are to be expected and planning needs to begin. Monitoring these broadcasts can provide vital information on when to begin preparations.

This chapter provides additional sources of accurate and timely weather information and offers definitions of National Weather Service advisories and warnings.

Section 2 — Advisories and Warnings

Definitions

The National Weather Service (NWS) is a good source for regional and national information of approaching adverse conditions. The NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public and the global community. The NWS system of advisories and warnings can be useful.

1. Warning: A weather condition that is life threatening to those caught outdoors
2. Advisory: A weather condition that is an inconvenience to people outdoors or can produce difficulty in travel
3. Winter Storm Watch:
   - issued when conditions are favorable for the development of hazardous winter weather
   - these conditions may occur singularly, or in combination with others
   - usually issued 24 to 48 hours in advance.
4. Winter Storm Warning
   - issued when life threatening winter weather conditions are imminent or very likely
   - includes the occurrence of combinations of snow, ice, wind and cold.
5. Blizzard Warning
   - sustained wind or frequent gusts of 35 mph or more
   - considerable falling snow and blowing snow frequently reducing visibility to one-quarter mile or less
   - conditions last three hours or more.
6. Winter Weather Advisory Issued for sleet, snow, freezing drizzle/rain or blowing snow
   - sleet accumulations are expected to be less than one half of an inch
   - snowfall of two to five inches in 12 hours
   - light accumulations of freezing drizzle or freezing rain
   - blowing snow intermittently reducing visibility to one quarter of a mile.

Section 3 — Weather Information

NWS Products and Services

While NWS offices cover larger areas and tend to be regional, a good working relationship with their office and personnel can be helpful. They have trained expert staff and will provide more specific information upon request. The NWS Home Page is at http://weather.gov. Forecasts, radar, satellite, and graphical forecasts are available here. Caution should be taken when using any radar or satellite picture, since training and education are required to know exactly what is being shown.

Both the NWS and local news stations target a wide gamut of weather users, from agricultural to marine and aviation interests. As a consequence, they may not be specific enough for some maintenance supervisors who have more advanced equipment available to use in their snow and ice control efforts. Equipment such as Roadway Weather Information System (RWIS) stations and deicing and anti-icing capabilities require more specific forecasts.

Internet Web Sites

Internet web sites are becoming more advanced as technology becomes available. It is important to become familiar with what is available for advance preparations as the winter months approach. Knowing how and where to access these sites may be of benefit during other times of the year, as well. Some of the more common sites and the information they provide:

http://www.accuweather.com/wx/index.htm – Accuweather – Forecasts, radar & satellite

http://www.intellicast.com/ – Intellicast – Forecasts, radar & satellite

http://www.wunderground.com/ – Underground Weather – Forecasts, radar, satellite

http://www.rap.ucar.edu/weather/radar/ – Real-Time Weather Data – Forecasts, radar, satellite

http://www.mesonet.ttu.edu/ - Weather forecasts and data for West Texas.

These sites require Internet access and are free of charge.

Private Forecasting Services

There are also weather forecast services available through private companies. While these services are used in other parts of the country, generally they have not proven effective for TxDOT. If private forecasting services are deemed necessary, they should be contracted through established contracting procedures.

Roadway Weather Information System

A Roadway Weather Information System (RWIS) is a computerized system that provides real-time weather information with specialized equipment installed by private companies. A variety of gauges and meters can be installed to record and monitor air and dew temperatures, humidity, rainfall, wind speed and direction, pavement temperatures, ground temperatures, visibility, etc. The type of equipment you need is dependent upon what you are trying to accomplish. There are a number of venders capable of providing this equipment.

RWIS is used in varying degrees to support specialized anti-icing and de-icing equipment. RWIS may also be used as an individual, stand-alone weather station in an effort to provide a safe travel way during winter conditions while keeping traffic delays to a minimum. See Chapter 9, Alternate Methods, for more information on the various types of anti-icing and de-icing equipment.

Blackberries and Smart Phones have various weather apps available. Check with your local district regarding any policies concerning downloadable apps.

Chapter 9 — Alternate Methods

Contents:

Section 1 — Overview

Proactive Approaches

A winter maintenance program consists of several elements with varying degrees of importance depending on the size of the operational jurisdiction it covers. The traditional method of only clearing snow and ice off a road after it falls or builds up is no longer acceptable.

The traveling public demands a more proactive approach from TxDOT in clearing snow accumulation and preventing the development of bonded snow and ice on the roads. Technology has provided various alternate methods to help keep roads clear of snow and ice during inclement weather. Both installation costs and yearly upkeep costs vary depending on the complexity of the system chosen; therefore the level of service requirements of a particular road must be considered and evaluated to determine a system's viability. Costs can range from a few thousand dollars to over a million dollars just to get started.

This chapter presents some of the alternative methods that have been used successfully.

Section 2 — Snow Fences

Preventing Snow from Drifting onto Highways

The primary purpose of a snow fence is to prevent the problems of snow drifting onto highways. Many of the drifting problems occur in the same place year after year. The use of strategically placed snow fences can help.

Where Effective

Snow fences have proven to be cost effective in many areas of the country that receive large amounts of snowfall. While they have been used effectively in Texas, they are used sparingly due to lower annual snowfall amounts.

Varieties and Forms

Snow fences come in many different varieties and forms. There are the traditional wood fences, high-density polypropylene fabric, extruded polyethylene and even living snow fences. Living snow fences are designed plantings of trees and/or shrubs and native grasses located along roads or around communities and farmsteads. Properly designed and placed, these living barriers trap snow as it blows across fields, piling it up before it reaches a road, waterway, farmstead or community.

Figure 9-1. Living Snow Fence, courtesy University of Minnesota and Minnesota DOT.

Figure 9-2. Wood Fence, courtesy University of Minnesota and Minnesota DOT.

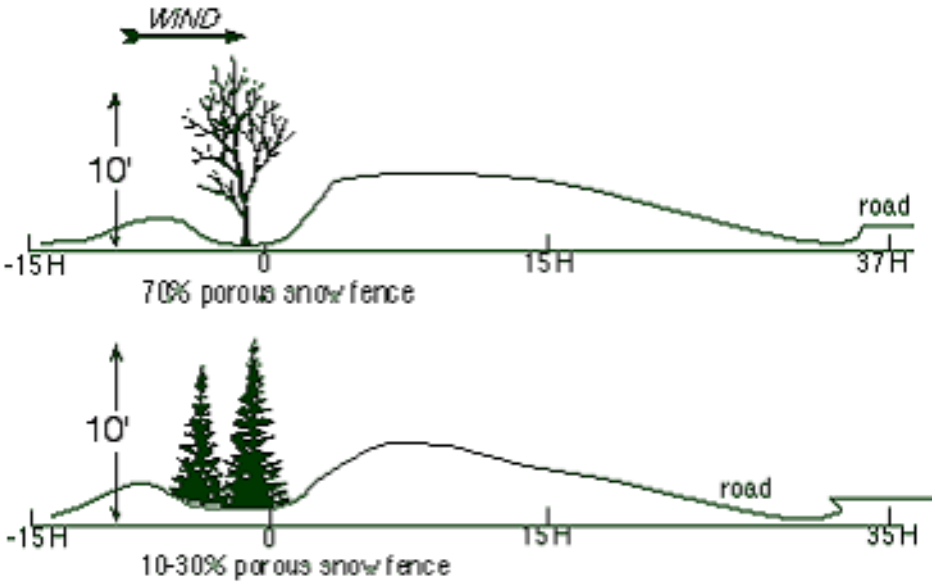

Figure 9-3. Snow fence density and height control snow deposition distance. The more porous the snow fence, the longer the deposition distance.

Section 3 — De-Icing & Anti-Icing Systems

Definitions

There are two distinct snow and ice control strategies that have been gaining popularity and show promise in making use of chemical freezing-point depressants: de-icing and anti-icing. Anti-icing operations are conducted to prevent the formation or development of bonded snow and ice for easy removal, while de-icing operations are performed to break the bond of snow and ice and eliminate the buildup on the roads. See Chapter 2, "Materials," for information on the various chemicals available to use in these operations.

Figure 9-4. One means of achieving anti-icing is this automatic injection system in use in the Amarillo District. Photo shows chemical tank and controls, while the plumbing that gets the liquid to the road is underground.

Anti-icing

Anti-icing involves pre-treating a road **before** the freezing weather or storm arrives with the goal of limiting or preventing the buildup of ice. Successful anti-icing efforts require accurate timing and good judgment about when and where to treat, relying on weather forecasts, field sensors, and in-field measurements or observations to predict when a storm will hit and its severity.

Benefits

Studies by various agencies and institutions have identified several benefits of a sound anti-icing strategy:

- by preventing snow or ice from bonding to pavement, removal and control is much easier
- material is applied ahead of the storm, making it safer for equipment and operators
- lower material application rates compared to de-icing operations
- the need for sand or other abrasives is reduced
- cleanup of sand or other abrasives is reduced
- reduced environmental impact.

Use with RWIS

Anti-icing can be more effective when coupled with a Roadway Weather Information System (RWIS). An RWIS helps to make informed decisions about when and where to deploy materials, crews and equipment.

While an anti-icing strategy coupled with an RWIS can be beneficial, there are some drawbacks associated with RWIS:

- high initial cost
- potential for premature and/or unnecessary application of materials
- insufficient sensors/stations and the incompatibility of RWIS platforms
- overapplication of chloride-based chemicals can result in slick pavement
- high maintenance and upkeep costs.

Types of Application Systems

Anti-icing systems can be either mobile truck-mounted spray rigs, capable of covering large areas where needed, or fixed spray systems that will treat specific problem locations. Both use a chemical that can lower the freeze point of water, requiring a storage tank for the chemical. Generally, a 6,000-gallon capacity tank with agitation and circulation capabilities is used. However other sizes are acceptable, depending on specific local needs and conditions.

Mobile Application Systems

The equipment for a mobile system consists of a truck-mounted tank with a spray boom and controls for accurate calibration. Cost-effective dual herbicide/anti-icing spray units have been designed and built. In such dual-use systems, it should be noted that the chemicals used for anti-icing can be corrosive and thorough cleaning between seasons is necessary.

Commercial vendors can supply a large variety of types and size rigs suitable to the section's needs. GSD purchases major equipment for all snow and ice control methods.

Fixed Application Systems

There have been marked advancements in the use of fixed anti-icing systems in the past few years. Fixed systems have been placed at toll plazas, super-elevated bridges and steep hills where maintaining vehicle traction is critical.

These systems use the same chemicals available for mobile anti-icing systems. They are designed and installed at problem locations and can be linked with RWIS to assist in predicting conditions favorable for treatment. Depending on the complexity of the RWIS equipment, the system can be activated remotely or automatically.

The spray systems themselves vary in complexity, but will spray the anti-icing chemical from fixed points onto the road's surface. Traffic, in turn, will spread and track the chemical over the designed area providing the desired affect.

Fixed systems can be installed during new road construction or added at existing problem locations. Vendors specializing in fixed anti-icing systems can be found on the Internet.

De-icing

De-icing methods generally involve the use of chemicals to speed the melting process after snow pack or ice has formed on a road. Liquid chemicals with similar spray equipment can be used for de-icing, provided they can be applied at sufficient pressure to cut though the ice or snow pack. Caution must be exercised during de-icing since spraying liquids on top of the pack may cause the road to become slick. The use of dry solid chemicals and pre-wetted abrasives in conjunction with de-icing will speed the melting of the snow and ice pack. This practice will improve the de-icing process and reduce the time it would take to melt naturally.