TOWN OF ORANGETOWN
HIGHWAY DEPARTMENT

SNOW AND ICE CONTROL GENERAL INFORMATION, GUIDELINES AND OPERATIONAL PROCEDURES AND MATERIALS MANAGEMENT PLAN

(Revised September 30, 2011)

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INTRODUCTION

I.A General

It is **Town of Orangetown Highway Department** goal to provide a transportation system that is passable and reasonably safe as much of the time as possible within the limitations imposed by the natural environment and the availability of equipment, material and personnel resources. As a result of those limitations, it is recognized that there will be occasions when the pavement and bridge surfaces will be slippery and/or snow and ice covered. During these periods customers (drivers) must recognize the conditions and operate their vehicles in an appropriately safe manor.

This manual provides information and guidance to assist **Town of Orangetown Highway Department** in conducting snow and ice control operations. It will serve as a basis for training **Town of Orangetown Highway Department** personnel.

The manual contains information on pre-winter operations and readiness, total storm management and decision making using **Town of Orangetown Highway Department** information resources, pre-storm preparedness, treatment options, post storm and post season activities. The provisions were developed to provide a reasonable balance among safety, cost, and environmental responsibility. The manual also contains related operational procedures and personnel procedures. The contents of this manual supersede all applicable prior manuals, directives and guidance relating to snow and ice control.

The contents of this manual reflect best practices as determined from a review of the relevant national and international literature and from information obtained from **Town of Orangetown Highway Department** maintenance personnel through surveys and interviews. It is intended to be a "living document" that is responsive to new technology and techniques developed within **Town of Orangetown Highway Department** and elsewhere. Suggestions for change may be submitted at any time to: _____

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The words shall, must, should, recommended and may used in Section II of this manual have the following meanings:

shall and must	- a required course of action
should and recommended	- a recommended course of action
may	- an optional course of action

I.B Specific Information for Motorists, Residents and Property Owners

I.B.1 How Residents and Property Owners Can Help Assure the Safety and Efficiency of Town of Orangetown Highway Department Snow and Ice Control Operations, and their own Snow Removal Operations

- No vehicle shall be parked on any public highway within the limits of the Town of Orangetown Highway Department between the hours of 2:00 a.m. and 6:00 a.m. prevailing eastern time during the period beginning November 15 and ending on April 16 of each and every year.

- Do not place trash cans within 2 feet of the edge of pavement.

- Keep basketball devices at least 10 feet from the edge of pavement.

- Do not park cars in driveways within 10 feet of edge of pavement.

- Do not allow children to build and occupy "snow forts" and similar creations within 10 feet of the edge of pavement.

- Do not relocate snow from driveways and sidewalks into the paved street. This is in violation of New York State Highway law (Article 8, Section 214) and will cause a hazardous condition on the street.

- Fences should not be within 10 feet of the edge of pavement.

- Remove all non-permanent seasonal items from within 10 feet of edge of pavement.

- Trim trees so that branches do not extend beyond the back of the curb.

- Pile most of the snow from the driveway throat on the traffic downstream side. This will minimize visibility problems.

- Shovel or plow an area immediately upstream of your driveway throat to accommodate plowed snow from the street. This will lessen build-up in your driveway throat.

I.B.2 Road Jurisdiction

This Town of Orangetown Winter Maintenance road system contains 206 miles of roadway, which includes snow and ice control on 145 miles of Town roads, 45 miles of State roads and 16 miles of County roads.

I.B.3 New Subdivision Undedicated Streets Snow and Ice Control Procedure

During a snow and/or ice event, Highway Maintenance Supervisors inspect new subdivision undedicated streets to confirm if any attention has been given.

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Until the streets are dedicated to the Town of Orangetown, the sub-division developer shall remove snow from all streets on which certificates of occupancy have been issued. If the developer does not do so, the Town may on 12 hours' notice hire a contractor to plow the snow and charge the cost thereof to the developer.

I.B.4 Private Driveways and Roads

Town of Orangetown Highway Department snow removal crews do not clear private roads, driveways or driveway entrances of accumulated snow.

I.B.5 Plow Trucks Having Plows Raised

A truck with a raised plow does not always mean the driver has completed your area. They may be:

1. Returning for fuel or vehicle service
2. Returning to the maintenance yard for additional treatment material
3. Responding to a call to assist Emergency Services, i.e.:
    a) Police Department
    b) Fire Department
    c) Volunteer Ambulance
    d) School District Transportation Department

I.B.6 Mailboxes, Mailbox Posts and other Features that may be Damaged by Town of Orangetown Highway Department Plowing Operations.

You can help reduce the possibility of a damaged/broken mailbox or mailbox post. Plow operators are urged to take precautions to avoid hitting mailbox posts. Experience has shown that reduced visibility during a storm makes it difficult for a driver to see a post in time to avoid striking it or pushing it over with plowed snow.

Any installation within the right of way - including a mailbox/post - is placed there at the owner's risk.

Owners are encouraged to install mailboxes at the maximum usable distance from the edge of the 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. Should a mailbox and/or post be damaged or pushed over by a snow plow or pushed snow, the **Town of Orangetown Highway Department** shall repair said damaged mailboxes and/or posts if possible.

I.B.7 Contacting the Town of Orangetown Highway Department During a Snow or Ice Event

Calls regarding snow removal may be placed to the **Town of Orangetown Highway Department** at 845-359-6500, Monday thru Friday 7:00 am to 4:00 pm and during a snow and ice event.

I.B.8 Emergency, Government and Utility Information

Town Government

Town Hall	359-5100
Highway Department	359-6500
Parks Department	359-6503
Police Department	359-3700
Sewer Department	359-6502
Solid Waste Information	359-6988

County Government Offices

Main Offices	638-5000
Board of Elections	638-5172
County Clerks Office	638-5070
Hazardous Waste	364-2444
Health Department	364-2000
Highway Department	638-5060
Solid Waste Management	753-2200

Area Utility Companies

Cablevision of Rockland	624-8200
Orange and Rockland	358-7800
United Water New York	623-1500
Verizon	890-6611

I.B.9 Priority of Treatment

Treatment priorities are found in Section II.B of this document

II. OPERATIONAL GUIDELINES

II.A Goal of Snow and Ice Control Operations

Town of Orangetown Highway Department will conduct snow and ice control activities that afford customers a reasonably safe and passable (not necessarily bare) road surfaces 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 the pavement will be prevented by the

timely application of ice control chemicals (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 or 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 **Town of Orangetown Highway Department** maintenance forces may temporarily preclude achieving this goal.

II.B Operational Priorities and Personnel Policies

II.B.1 Operating Priorities

Town of Orangetown Highway Department has established a route classification system for determining Main and Secondary roads for snow and ice control operations.

II.B.2 Personnel Policies

II.B.2.a Hours of Continuous Duty

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.

II.B.2.b Call-In Procedures

- Orangetown Police Department Notifies of the Highway Maintenance Supervisor (HMS) on call.
- HMS on call notifies other HMS'
- HMS' notify their individual call out sheet of Motor Equipment Operators and Laborers
- Motor Equipment Operators and Laborers are required to report for duty within 45 minutes of notification.

II.B.2.c Fitness For Duty

Drug and alcohol policy as outlined by the New York State CDL requirements and **Town of Orangetown Highway Department** Policy

II.B.2.d New York State Public Officers Law (Section 18)

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT will provide legal defense to employees for actions resulting from performing their official duties as long as the employee:

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

II.B.2.E New York State Vehicle and Traffic Law (Section 1103)

Town of Orangetown Highway Department employees conducting snow and ice control operations should adhere to the provisions of the vehicle and traffic law. However, it is recognized that in order to satisfactorily perform required maintenance, some provisions of the vehicle and traffic law must be violated. Actions like clearing over highway center line and backing into traffic flow to clear intersections are necessary. Any necessary violations of the vehicle and traffic law must be performed **"with due regard for the safety of all persons".** In the event of an incident or accident that results from such a violation, the operator will most likely be liable. See Appendix X for text of the law.

II.B.2.f New York State Insurance Law (Section 2335)

This law protects commercial and municipal drivers from having their personal insurance premiums impacted by accidents involving the employer's equipment, unless the accident was intentional or caused by gross negligence. See Appendix X for text of the law.

II.B.2.g New York State Highway Law (Article 8, Section 214)

A section of this law prohibits any person from depositing any material on to any highway (including snow and ice from driveways). **There is a similar provision in the vehicle and traffic law.**

II.B.3 Operational Resources and Responsibilities

II.B.3.a Equipment Type

- Heavy Duty Snow Plow Trucks 29
- Liquid Applicator Trucks 4
- Medium Duty Snow Plow Trucks 4
- Wheel Loaders 4
- Bombardiers 2
- Trackless Snow Blowers 2
- Compact Utility Loaders 3
- Hybrid Supervisors SUV 3
- Belt Loader 1

II.B.3.b Personnel Available

- General Forman 1
- Assistant General Forman 1
- Highway Maintenance Supervisors 3
- Motor Equipment Operators 25
- Laborers 17
- Mechanics 4

II.B.3.c Budget Information

Labor
Materials
Overtime
Equipment
Total

II.B.3.d Facilities Information

Equipment Storage and Maintenance and Materials, Material Production and Storage

Town of Orangetown Highway Department, 119 Route 303, Orangeburg, NY 10962

II.B.3.e Snow and Ice Control Responsibility

Streets (Containing Culde Sacs, T's and Circles)	600
Town Lanes Miles	300
New York State Lane Miles	62
Rockland County Lane Miles	32
Safety Sidewalk Miles	15
Bus Shelters	25
Municipal Parking Lots	3

II.B.4 Operators Direct Communication with the Public

Operators are to report all stranded or stuck vehicles to the Highway Department office. Operators may stop to check to see if the vehicles passengers are safe.

If an Operator is being flagged down to stop by a resident, the Operator may stop; however, the Operator should offer that all disputes or concerns be directed to the Highway Department office. All Operators should have a business card of Highway Department Manager to hand to the resident.

II.C Pre-Winter Planning Activities

II.C.1 Review and revise this manual as necessary

As this is a living document, appropriate changes should be incorporated as soon as possible. Areas that may change include: highway responsibility, technology, procedures, equipment, personnel, staffing, materials and level of service. Sources of changes may include: our customers, individual or work group suggestions, personnel meetings, post-season reviews and **Orangetown Highway Department Management**.

Levels of service goals should be reviewed for their impact on plow routes and required resources (personnel, equipment, materials, facility, etc.). Those resources should be assigned as necessary.

II.C.2 Review Emergency and Severe Weather Response Procedures

Town of Orangetown Highway Department road closure and reopening procedures should also be reviewed with all personnel likely to be involved. Procedures for re-deploying resources should be reviewed and coordinated within and among work areas. Arrangements, lodging and food for **Town of Orangetown Highway Department** personnel during emergencies should be arranged at this time. Other procedures that should be reviewed include, internal and external communications, and command and control. Any emergency contracts and cooperative and resource arrangements among **Orangetown Highway Department**, The National Weather Service, other local governments, NYSDOT, and all levels of applicable emergency management should also be reviewed.

II.C.3 Equipment Readiness

All of **Orangetown Highway Department**'s snow and ice control related equipment should be inspected, test run, repaired as necessary, and receive scheduled maintenance prior to the snow and ice season.

II.C.3.a Truck Readiness

The prescribed seasonal and use based maintenance service should be completed prior to the winter season. All trucks should be checked with full winter gear (plows and spreaders) well in advance of the first anticipated snow or ice event.

II.C.3.b Material Spreader Readiness

The materials spreaders should receive required maintenance and be lubricated, repaired, test run and calibrated. All ground speed controlled materials spreaders should have a backup or manual calibration that can be used if the automatic system fails.

II.C.3.c Liquid Materials Dispensing Systems

Orangetown Highway Department uses some liquid dispensing systems during snow and ice control operations. These systems should be inspected, test run, calibrated, lubricated and repaired as necessary. Associated bulk storage tanks should be inspected per manufacturer's recommendations. Large storage tanks should be tied down and have secondary containment systems. Appropriate safety gear (goggles, rubber gloves, etc.) and MSDS sheets should be conveniently available. Any time a liquid is added to a tank be sure it is compatible with the liquid that is in the tank. When changing liquids in a tank, it is advisable to flush the tank before refilling with a different material.

II.C.3.d Plow Equipment

Plow equipment should be inventoried, test mounted, and inspected for proper function, missing parts, structural damage, proper adjustment, and sufficient remaining wear depth on items like shoes and cutting edges. Necessary repairs and replacement should be made. Plows should be stored in a position for easy hookup and have easy-to-read identification to match them to the proper truck.

II.C.3.e Spare Parts

The maximum allowable stock of commonly used spare parts should be acquired prior to the snow and ice season. These include: cutting edges, plow shoes, shear pins, nuts and bolts, filters, bulbs, spreader controller parts and truck springs. Windshield wipers should be new or near new at the start of the winter maintenance season.

II.C.3.f Individual Tools and Safety Gear

Trucks should be checked for the required compliment of tools and safety gear. These include, for example: shovels, bars, hand tools, tire chains, flashlights, flags, flares, warning devices, gloves, hard hats, tow chains, ice scrapers, and snow brushes/brooms. Proper stowage for these and other in – cab loose items must be provided.

II.C.4 Personnel Readiness

II.C.4.a Acquisition and Assignment

Sufficient personnel (permanent, temporary, reassigned and interdepartmental) should be acquired and trained for snow and ice operations prior to the winter season. Highway Department reassignments and provisions for emergency reassignment from non-highway units should be accomplished before the first anticipated snow or ice event. Specific route assignments should also be made prior to the snow and ice season and added to this document. However, there should be contingency provisions to accommodate the lack of specific people and equipment.

II.C.4.b Callout and Family Readiness

Callout procedures, impacts of winter maintenance on family life and family responsibilities should be reviewed and discussed with applicable **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** personnel before the snow and ice season.

II.C.4.c Training

Snow and ice control training should be accomplished prior to the snow and ice control season. Training topics include, at a minimum: intra-**TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** communication, cooperation and responsibilities; weather

conditions, road conditions, road and weather information systems; safety issues; public relations/information issues; operational issues and procedures; level of service (local and system-wide); equipment readiness; materials management; new technology, new initiatives and procedures; and emergency response issues.

The Orangetown Highway Department considers the Annual Training and Review of Snow and Ice Control Procedures to be an integral element of its operation. The general benefits of training include:

- promoting a positive attitude
- maintaining good health
- increasing job knowledge and skills, and
- boosting the confidence of the employee, which enables him to capably perform his job and accomplish the Highway Department's mission.

Specifically, however, training also addresses key points of the Highway Department's Snow and Ice Control Procedures.

The Highway Department has developed a Snow and Ice Control Procedures Employee Review powerpoint presentation which includes:

- **Being Prepared!**
  - Review Plow Run
  - Inspect Truck and Equipment
  - Monitor Weather Reports

- **Operation Procedures**
  - Salt application rate
  - Plow adjustment
  - Main and Secondary Road Salt Application
  - Opening and Widening Roads
  - Hazard awareness

- **Post Storm Procedures**
  - Sidewalk clearing
  - Catch basin clearing
  - Business district snow removal
  - Plow and spreader maintenance

- **Truck Operation**
  - 4 wheel drive controls
  - Plow equipment and operation
  - Spreader and Plow controls
  - Spreader Equipment, and

- **Safety**

II.C.5 Materials Readiness

II.C.5.a Contracts

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT acquires most snow and ice control materials through the contract process. Given the time required to establish a contract, these requirements and contracts and purchase requisitions should be done early. Typical materials purchased include sodium chloride (salt or rock salt), calcium chloride (liquid and flake), abrasives (sand), liquid magnesium chloride with corrosion inhibitor, etc. Individual responsibilities in the contract administration process should be defined. Quality assurance procedures should be established for each material.

II.C.5.b Materials Storage

- **Granular Sodium Chloride (Road Salt)**

Road Salt is stored in a Domar salt storage dome measuring 81 feet in diameter and 40 feet high with passive ventilation ducts on top. The dome was built by the manufacturer and constructed with materials requiring no special treatment. The dome is built on an impervious foundation to prohibit groundwater leaching and is elevated above existing ground and graded down to prevent surface water from reaching salt stockpile.

A clean and safe environment is a primary responsibility of this department. The salt storage dome, loading ramps, loading pads and all adjacent areas must be kept clear of spilled material. Any materials not under cover provide a potential to pollute the environment. The salt storage dome has a stockpile capacity of 3,000 tons. This stockpile is closely monitored and not allowed to exceed rated capacity. No spilled salt is allowed to remain exposed to weather. Areas where spillage occurs are swept by a truck mounted vacuum sweeper. All material picked up by the sweeper is returned to the covered stockpile.

Weekly inspection of salt storage and loading area is conducted by the Assistant General Foreman. Findings and recommendations are delivered to the General Foreman after inspection is completed.

- **Salt-brine**

In addition to the Highway Department's process of de-icing roads by applying granular sodium chloride (road salt) to a snow covered road surface, the Highway Department utilizes salt-brine to pre-treat Town roads.

In 2003 the Highway Department installed a Salt-brine Manufacturing Facility constructed and installed by the manufacturer. This facility mixes road salt and water to a 23% solution (salt-brine). This facility can produce up to 22,500 gallons at a time and is stored in six storage tanks.

In anticipation of a snow storm, usually 12 to 24 hours in advance, the Highway Department's four liquid applicator trucks spray 50 (fifty) gallons of salt-brine per lane mile on main roads and other critical areas of the Town. This pre-treating process is known as Anti-icing. Anti-icing has proven to prevent the bond of snow to the paved road surface. Tire tracks show bare pavement, reducing the amount of road salt needed to prevent future bonding.

Salt-brine is also used to pre-wet the de-icing salt. Wet salt is less apt to bounce or be blown off the road by traffic. Pre-wetting can result in a 20% to 30% reduction in wasted salt. The less salt used, the less potential for pollution.

- **Envirobrine**

For freezing temperatures of 20 degrees or lower, the Highway Department previously used Magnesium Chloride to combat snow and ice. In an effort to maintain our stringent environmental policy, the Highway Department has begun to utilize the product Envirobrine.

This brine, a mixture of calcium chloride, sodium chloride, magnesium chloride and potassium chloride, is pumped from an ancient, naturally occurring source 3000' below the Earth's surface. Because the source is estimated to be 400,000,000 years old and is naturally occurring, it is very stable and does not contain suspended solids that would cause handling problems at cold temperatures. It has been field tested to –30F and did not cause pumping problems. No solids were observed settling out of the solution. Because it comes from a naturally occurring source, the brine does not contain heavy metals or chemicals that would present an environmental liability.

II.C.6 Emergency Readiness

Staff likely to be involved should review relevant portions of this document. Cooperative agreements within and outside **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** should be reviewed and reaffirmed with the cooperating groups.

II.C.7 Highway System Readiness

Various elements of **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT'S** highway system should be checked and given necessary attention as required. These include: crack and joint sealing, permanent pothole repair, striping, drainage clearing and marking, winter signage, obstacle markers and delineators

II.C.8 Maintenance Facility Readiness

Certain features of **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT'S** maintenance facilities should be inspected and repaired as necessary prior to the snow and ice season. These include: buildings, yard traffic areas, fuel delivery systems, yard and garage lighting, emergency generators, and run-off control features.

II.C.9 Road and Weather Information System Readiness

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT has acquired a variety of systems and measuring devices to help in defining road and weather conditions. These include vehicle pavement and air temperature measuring devices, NOAA weather band radios, and internet weather forecast providers.

- **DTN Meteorlogix Weather Sentry**
- **Local TV weather information**

In addition to monitoring daily online weather forecasts in anticipation of snow events, the Highway Department employs the DTN Meteorlogix Weather Sentry. The Weather Sentry gives the Department accurate real time information needed to make weather related Highway Department decisions.

Weather Sentry is a desktop computer application which offers real-time weather graphics, active storm tracking and weather alerting for potentially hazardous storms. Having the Weather Sentry puts the National Weather Service alerts, watches and warnings right on your fingertips by allowing the capability of being accessed on your computer and mobile phone.

With the most accurate information, the Highway Department can make the most appropriate weather related decisions, plan more effectively, document weather related situations and reduce costs.

- **Infrared Road Surface Thermometers**

All of the vehicles in the Highway Department's Snow and Ice Control Fleet are equipped with infrared thermometers which monitor ambient and road surface temperatures. Aside from monitoring weather conditions, the thermometers assist supervisors and crews with the application of road salt, salt brine and envirobrine.

These systems should be checked for function prior to the snow and ice season. All measurement devices and sensors should be calibrated and maintained per the manufacturer's recommendations. All computers, software and communication systems should also be checked and repaired as necessary.

II.C.10 Public and Customer Readiness

The traveling public and **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** customers should receive information to assist them in transitioning and adjusting to winter driving. **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** has a number of opportunities to deliver valuable information including: Winter Safety Gram, media clips, media press releases, public service announcements, public access TV (for local distribution), outreach speakers and web sites. **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** employees are to be as courteous and helpful to public inquiries as possible.

II.C.11. Communication Systems

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT has a variety of communications systems including: 2-way radios between base and vehicles and vehicle to vehicle, cell phone, and land line phone and fax. These systems should be checked prior to winter and any necessary training/retraining provided.

II.C.12. Responsibilities of TOWN OF ORANGETOWN Police Department Associated with Snow and Ice Events

The Police are responsible for providing the Highway Department Department with timely notification and description of the following snow/ice/weather conditions during periods when highway personnel are not available:

- Type and intensity of weather event
- Time event started
- Location(s) of observations
- Amount of snow/ice on road
- Locations that are particularly slippery
- Traffic flow and accident information

Whenever, during the period between November 15 and April 15 of each and every year, there shall be an accumulation of two inches or more of snow, the Chief of Police or Town Supervisor shall declare a snow emergency.

II.D. Decision Making for Snow and Ice Control Operations

As **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** acquires more information resources, it will be moving toward routine information-based decision making for determining appropriate snow and ice control treatments. That process involves the following:

- Gathering all available relevant information about recent past, present and near-term future conditions.
- Selecting a treatment option that best addresses those conditions.

- Systematically gathering and evaluating data on treatment effectiveness, actual road conditions, and actual weather conditions from operators and other sources.

II.D.1 Elements of Snow and Ice Control Decision Making

II.D.1.a Status of Assets

Assets for snow and ice control operations include personnel, equipment, information systems and materials inventories. Deficiencies in any of these areas will impact treatment decisions. Loss of truck availability due to mechanical failures or accidents will have an impact on response time and general snow removal operations. Every effort will be made to cover the route(s) by redistribution of resources.

II.D.1.b Weather Information

II.D.1.b.1 Weather Forecasts

There are a variety of weather forecast products available to **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT**'s maintenance forces. Decision-makers should be simultaneously evaluating short-term, mid-term, and long-term forecasts. Information on precipitation should include onset, cessation, type and intensity. Other relevant factors include pavement temperature, air temperature, dew point, wind speed, wind direction, and cloud cover.

II.D.1.b.2 Current Weather Data and Observations

Current weather data and observations may be obtained from maintenance patrols, police agencies, and media outlets.

II.D.1.b.3 Other Weather Information

Other weather data sources include radar and satellite imagery (Internet), NOAA radio, The Weather Channel, computer acquired current condition data from upstream storm locations and radio, etc.

II.D.1.c Highway and Pavement Information

II.D.1.c.1 Pavement Temperature

Pavement temperature is one of the most important factors when deciding on a snow and ice control treatment. Data on recent past, current and predicted pavement temperature is very useful. This data may be obtained from in-pavement systems, truck mounted and hand-held sensors, surrogate locations (other systems, facility parking areas, etc.). Predictions and estimates can be made based on forecast knowledge of air temperature, ground temperature, cloud cover, precipitation, wind, and time of day.

II.D.1.c.2 Accumulations of Snow and Ice on the Pavement

Knowledge of the character and depth of any snow or ice accumulation on the pavement surface prior to treatment is important in the treatment decision process. Relative slipperiness and whether or not the snow or ice is bonded to the pavement is even more important.

II.D.1.c.3 Traffic Characteristics

Traffic data are important to the decision-maker. Relevant characteristics include volume, speed, timing of peak flow, status of any closures and any reduction in available lanes.

II.D.1.c.4 Status of Critical Locations

Traffic flow and pavement condition information for "critical" locations are important in prioritizing snow and ice control operations. "Critical" areas include hills, intersections, bridges, cold locations (low, shaded and elevated) locations having mist or fog generation tendencies, traffic generators, high snow and ice accident locations, school bus routes and access to the municipal center, fire station and ambulance service.

II.D.1.D Assessments of Effectiveness and Efficiency

Systematic after-action assessments of effectiveness and efficiency are important in the decision-making process as they provide a knowledge base for future decisions. Results achieved in response to treatment can be obtained from the reports of operators and crew leaders. Other factors to evaluate include cycle times achieved, materials used, equipment performance, and cooperative procedures.

II.E Snow Control

II.E.1 General

For the purpose of this manual snow and ice control operations are separated into two categories – snow control and ice 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. In certain circumstances like cleanup and drift removal, front-end loaders snow blowers, and motor graders are sometimes used. It may also involve the use of passive measures like snow fence and plantings.

Ice control is all treatment operations directed toward preventing snow or ice from 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 and abrasives/chemical mixtures and using no-treatment when appropriate.

Snow control is one of the most difficult and important tasks assigned to **Orangetown Highway Department** personnel. Having uniform snow control methods is important for the safety of our customers and our maintenance personnel.

There are some definitions relating to snow control that will help clarify subsequent sections of this manual:

snow plowing	the relatively rapid displacement of snow from paved surfaces with vehicle-mounted 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.
berm or windrow	an accumulation of snow cast by plow or other equipment.
tandem plowing	snow plows working together to clear wider areas.

There are some general guidelines for keeping snowplowing operations reasonably uniform on **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** system:

- To the extent possible, traffic should not have to pass through a berm of plowed snow.

- All plowing shall be done with trucks moving in the direction of traffic, except in an emergency situations where the work area is closed to traffic or, backing in the direction of traffic is required to spread material on very slippery surfaces where normal directional travel will not provide sufficient traction for the truck to move and as necessary in the cul du sacs.

- To the extent possible, plow snow beyond the point where it could melt and run back across the highway. Snow may be cast toward the center of the cul de sacs even though it may be higher than the outside.

- Plowed snow shall not be cast into traffic.

- Cast snow downwind to the extent possible.

- Within the normal sequences of operations, any time there is enough snow on the road to plow, it should be plowed.

- 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.

- At the end of the storm, push snow back as much as possible to make room for the next snow storm and open storm drains.

Occasionally snowfall intensity is so severe that operator visibility is reduced to a few feet. With supervisor approval, operators may drive their trucks to a safe haven that is stable and well off the highway, shut their lights off and wait until visibility improves before continuing.

When low visibility is anticipated, extra caution in operations should be exercised. Vehicles and other obstacles may be anywhere. Supervisors should be prepared to suspend operations and recommend road closure if conditions warrant, or recommend temporary road closure so that plowing can be completed.

II.E.2 Safety Restoration and Cleanup Operations (Snow Removal)

After the entire **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** maintained highway system is in satisfactory condition, safety restoration and cleanup operations shall begin and continue until complete or operations are directed to higher priority snow and ice control or emergency work. Coordination of this work with interfacing agencies and other **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** units is recommended. Cleanup operations that may impact traffic flow or larger numbers of customers should be performed in lower volume time periods if possible and utilize traffic protection where appropriate. The following is a listing in priority order of the areas where snow should be removed:

- Locations that could melt and run onto traveled areas, For example : banked curves and sloped bridge decks.

- Snow stored on bridge decks. (Do not throw snow over the side of the bridges – transport it beyond the back wall and off the shoulder.)
- Areas having reduced sight distances for customers and plow operators, such as sharp curves and intersections.

- Buried or obscured regulatory and warning signs, delineators, and accumulated snow around work zone delineation.

- Any area where accumulated snow is causing traffic to use other-than-intended pavement areas.

- Any narrow raised features between the outside edges of pavement that may be storing snow.

- Commercial, business and residential areas where street parking is required to maintain mobility

II.E.3 Drainage Restoration

After safety restoration and cleanup operations are complete, drainage facilities should be inspected and cleared as necessary

II.F Ice Control

Ice control is all treatment operations directed toward preventing snow and ice from bonding to the pavement and the chemical and/or mechanical removal of bonded snow or ice from the pavement. It may also include providing temporary friction improvement by spreading abrasives (sand) and abrasives/chemical mixtures, and using delayed or no-treatment options when appropriate.

II.F.1 Ice Control Strategies

There are four basic ice control strategies used by **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** – anti-icing, de-icing, temporary friction improvement, and delay of or no treatment. When conditions are favorable for success and resources permit, anti-icing shall be the strategy of choice.

II.F.1.a Anti-icing

Anti-icing is a modern strategy that takes an information-based systematic approach to preventing snow/ice pavement bond. This results in higher levels of service for longer periods of time. The key to effective anti-icing is to get an appropriate quantity of ice control chemical on the pavement surface before or very soon after precipitation or ice formation begins. This strategy is not appropriate for unpaved roads.

II.F.1.b De-Icing

De-icing is a traditional strategy for dealing with snow or ice that has already bonded to the pavement surface. It is used when anti-icing treatments have failed, as they occasionally will, or as a series of treatments at the end or after a storm. De-icing is most effectively accomplished by spreading a coarse-graded solid or pre-wet solid ice control chemical on the surface of the bonded snow or ice during favorable road, weather and traffic conditions. The coarse particles will melt through the snow and ice and break the bond as created chemical solution flows across the pavement surface. This strategy is not suitable for unpaved roads.

II.F.1.c 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 (sand) or 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. If sufficient ice control chemical is spread with abrasives, it can be part of anti-icing and de-icing strategies. However, the effectiveness of ice control chemicals are significantly reduced by the sand.

II.F.1.d 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 10° F and there is no residual ice control chemical on the pavement.

II.F.2 Terms Relating to Precipitation, Road Conditions, Ice Control Chemicals, and Operational Procedures

II.F.2.a Precipitation Terms:

Light Rain	small liquid droplets falling at a rate such that individual drops are easily detectable splashing from a wet surface. Include drizzle in this category
Moderate Rain	liquid drops falling are not clearly identifiable and spray from the falling drops is observable just above pavement or other hard surfaces
Heavy Rain	rain seemingly falls in sheets; individual drops are not identifiable; heavy spray from falling rain can be observed several inches over hard surfaces
Freezing Rain	when rain freezes upon impact and forms a glaze on the pavement or other exposed surfaces
Sleet (Ice Pellets)	precipitation of transparent or translucent pellets of ice, that are round or irregular in shape
Light Sleet	scattered pellets that do not completely cover an exposed surface regardless of duration. Visibility is not affected.
Moderate Sleet	slow accumulation on ground Visibility is reduced by ice pellets to less than 7 miles.

Heavy Sleet	rapid accumulation on ground Visibility is reduced by ice pellets to less than 3 miles.
Light Snow	snow alone is falling and the visibility is greater than ½ mile.
Moderate Snow	snow alone is falling and the visibility is greater than ¼ mile but less than or equal to ½ mile.
Heavy Snow	snow alone is falling and the visibility is less than or equal to ¼ mile.
Blowing Snow	when fallen snow is raised by the wind to a height of 6 feet or more and is transported across a road
None	no precipitation or blowing snow

II.F.2.b Road Condition Terms

Dry	no wetting on the pavement surface
Damp	light coating of moisture on the pavement resulting in slight darkening of surface, but with no visible water drops
Wet	road surface saturated with water from rain or melt-water, whether or not resulting in puddles or run-off
Slush	accumulation of snow on the pavement that is saturated with water. It will not support any weight when stepped or driven on but will "squish" until the base support is reached
Loose Snow	unconsolidated snow that can be blown by the wind into drifts or off of a surface, or blown by traffic into non-traffic areas or off of a surface.
Packed Snow	snow-pack or pack that results from compaction of wet snow by traffic or by alternate surface melting and re-freezing of the water
Frost	also called hoarfrost. Ice crystals in the form of white scales, needles, feathers, or fans deposited on pavement and other surfaces cooled by radiation or by other processes
Thin Ice	a very thin coating of clear, bubble-free, homogeneous ice which forms on a pavement; sometimes called black ice

Thick Ice	a coating of ice thicker than black ice or frost that is formed from freezing rain, or from freezing of ponded water or poorly drained melt-water. It may be clear or milky in appearance, and generally is smooth though it sometimes may be somewhat rough.

II.F.2.C Ice Control Chemical Terms

Form	the physical state of the chemical – usually solid or liquid
Gradation	a characterization the distribution of particle sizes for solid chemicals and abrasives – i.e., fine, coarse, percent passing various sieve sizes, etc.
Concentration	the percent (by weight) of the ice control chemical in the liquid or solid product
Solution	a liquid containing chemicals and water
Eutectic Temperature	the lowest temperature a concentrated (near saturated) solution begins to freeze or the lowest temperature it will melt ice
Eutectic Concentration	the solution concentration that produces the eutectic temperature
Dilution	reducing solution concentration by adding water
Endothermic	becomes colder when going into solution
Exothermic	becomes warmer when going into solution
Hygroscopic	having the ability to draw water vapor from the air

II.F.2.d Operational Procedure Terms

Pre-treating	applying an ice control chemical (liquid or solid) to the road before a snow or ice event begins
Pre-wetting	adding liquid ice control chemical or water to solid ice control chemicals or abrasives prior to distribution on the road
Application Rate	the amount (weight or volume) of ice control chemical applied per mile or ln-mi of highway. In the case of pre-wetting liquids, it is the number of gallons of liquid applied to a ton of solid ice control chemical, or abrasives.

II.F.3 Ice Control Chemicals

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT uses salt (sodium chloride or rock salt) as the primary ice control chemical. Other chemical will be evaluated if they show promise for improving efficiency, effectiveness and environmental friendliness.

The important properties of ice control chemicals include the lowest (eutectic) temperature it will melt ice, how much ice will be melted at various temperatures and the relationship between solution concentration and freezing point. The lowest (eutectic) ice melting temperatures appear in Table 2 and Figure 1. How much ice melted per unit of common chloride chemicals, at various temperatures, appears in Table 3.

The temperatures above are pavement surface temperatures. Other chemicals have similar relationships where their effectiveness decreases with decreasing pavement temperature. The importance of pavement temperature in ice control operations should be obvious.

The relationship (phase diagram) between solution concentration and freezing point is found in Figure I for sodium chloride, magnesium chloride, and calcium chloride. The low point on each diagram is the lowest temperature at which the chemical will melt ice (eutectic temperature). Any value falling below any point on the curves will be frozen. This includes solution concentrations greater that those producing the eutectic or lowest melting temperature on the diagrams.

The hygroscopic properties of the common solid ice control chemicals are:

- Sodium Chloride - slight
- Magnesium Chloride - moderate
- Calcium Chloride - high

Table 2. Ice Control Chemical Comparison

CHEMICAL		TEMPERATURE, F		CORROSION POTENTIAL		CONCRETE DAMAGE POTENTIAL	HANDLING CONCERNS	ENVIRONMENTAL CONCERNS
Formula Name	Form	Effective to *	Eutectic	Vehicles	Structure			
NaCl (Road Salt)	Solid	15	-6	Yes	Yes	Some **	Dust	Water, Plants
NaCl (Road Salt)	Liquid	23	-6	Yes	Yes	Some **	Dust	Water, Plants
MgCl2 (Magnesium Chloride)	Solid	0	-28	Low	Possible	Very Little	Dust	Water
MgCl2 (Magnesium Chloride)	Liquid	10	-28	Low	Possible	Very Little	Dust	Water
CaCl2 (Calcium Chloride)	Solid	-20	-60	Yes	Yes	Yes **	Generates Heat;Dries Skin and Leather	Water
CaCl2 (Calcium Chloride)	Liquid	0	-60	Yes	Yes	Yes **	Generates Heat;Dries Skin and Leather	Water
Organic Chemicals	Liquid			No	No	No	None	BOD in Water

* Pavement Surface Temperature

** If concrete is non-air entrained or has utilized poor materials or procedures

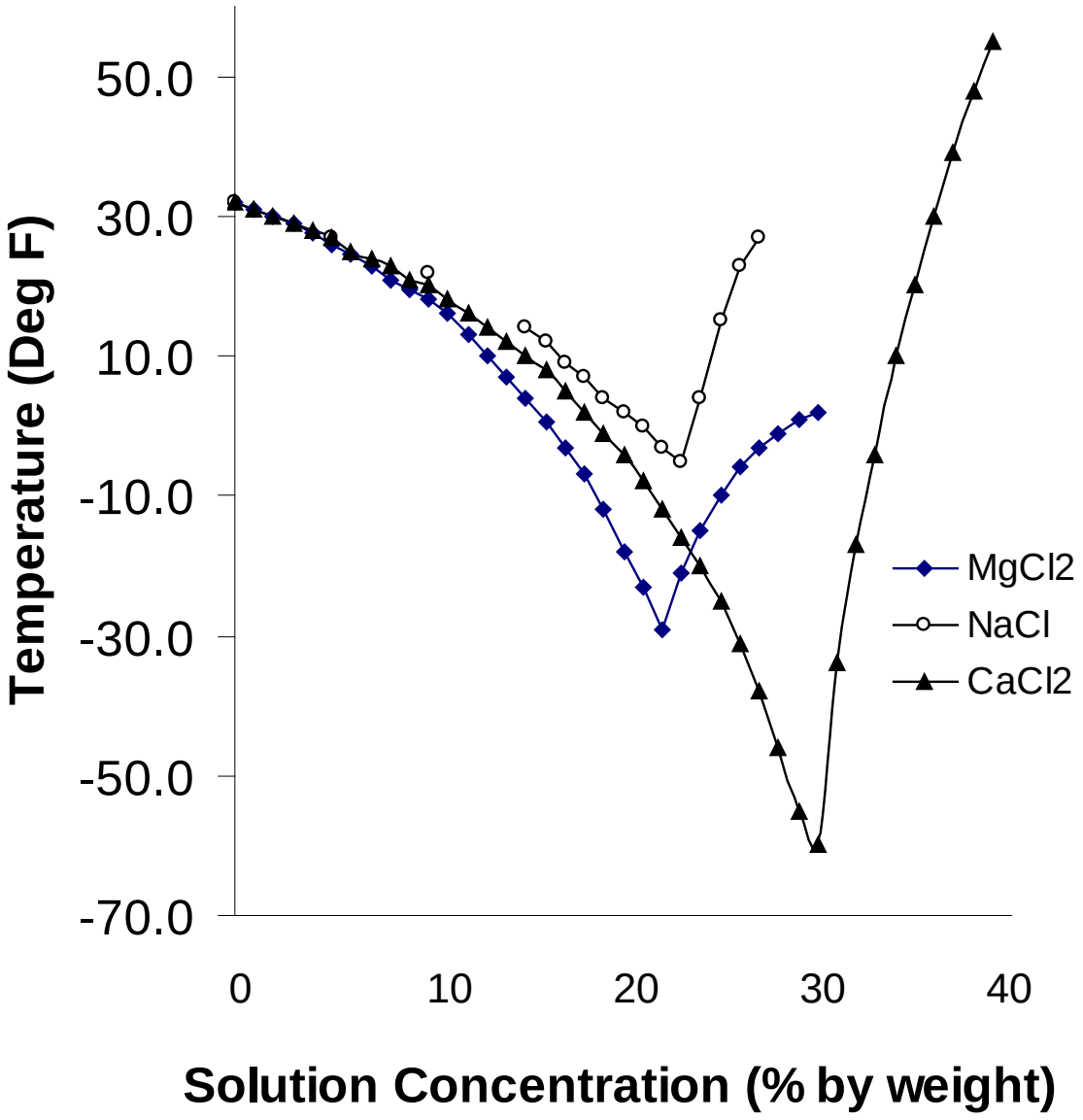

Figure 1. Phase Diagram for Ice Control Chemicals. Values plotted are not precise and are shown for illustrative purposes. These values have been estimated from the phase diagram shown in the FHWA *Manual of Practice for an Effective Anti-icing Program*.

Table 3. MELTING ABILITY AND TEMPERATURE FOR CHLORIDE CHEMICALS

Temperature		**Units of Ice Melted Per Unit of Chloride Chemical**		
°F	**°C**	**Calcium**	**Magnesium**	**Sodium**
30	-1.1	31.1	47.8	46.3
25	-3.9	10.4	15.4	14.4
20	-6.7	6.8	10.0	8.6
15	-9.4	5.5	7.9	6.3
10	-12.2	4.8	6.8	4.9
5	-15.0	4.4	6.1	4.1
0	-17.8	4.0	5.5	3.7
-6	-21.1	3.7	5.0	3.2

This means that solid calcium chloride and solid magnesium chloride should be protected with airtight coverings during storage.

The temperature increase or decrease when water is added to common solid ice control chemicals is:

Sodium Chloride	-	slight decrease (endothermic)
Magnesium Chloride	-	slight increase (exothermic)
Calcium Chloride	-	large increase (exothermic)

Caution must be exercised when adding water to solid calcium chloride.

II.F.4 Pre-Wetting Ice Control Materials

Pre-wetting is the addition of a liquid to a solid ice control chemical or abrasives prior to distribution on the highway. The liquid application rate typically ranges from 8 to 12 gallons of liquid per ton of solid ice control chemical, depending on the efficiency of the pre-wetting technique and the gradation of the solid chemical. The benefits of this procedure include:

- Improving the retention of the materials on the road or ice surface.
- Accelerating the melting action of the solid ice control chemical
- Allowing the solid ice control to work better on lower pavement temperatures

Improved effectiveness should yield an overall reduction in solid ice control chemical use.

Any liquid as long as it is mostly water and will not freeze during operations is suitable for pre-wetting.

II.F.5 Factors that Impact the Choice of Ice Control Treatments and the Application Rates of Snow and Ice Control Materials

II.F.5.a Pavement Surface Temperature

Pavement temperature is one of the most important factors that impacts treatment decisions. A number of factors influence this temperature and understanding them will aid in making treatment decisions.

SOLAR RADIATION OR SUNSHINE
Solar radiation can warm surface temperatures significantly above air temperature. The darker the surface, the more pronounced this effect will be. It is not uncommon to have surface temperatures 30 to 40 Fahrenheit degrees above the air temperature early in the afternoon. As the angle of the sun above the horizon increases, solar warming increases. The lowest sun angles occur at the winter solstice and at sunrise and sunset of each day.

CLEAR NIGHT SKY RADIATION
In the same way the sun warms surfaces through radiation, clear night skies, with little or no wind, cool surfaces. This can result in pavement surface temperature being colder than the adjacent air temperature. This condition often allows black ice or frost to form on the pavement surface. This cooling is also related to the subsurface temperatures and the time of the year.

GEO-THERMAL EFFECTS
Subsurface temperature influences pavement surface temperature primarily through thermal conduction. In the fall, the earth is still warm and short-term air temperature drops below freezing, absent radiation effects, will probably not cause the pavement surface to fall below freezing. During the spring end of the season, pavement surface temperatures will remain cold although the air temperature is warmer (absent radiation effects). Bridge decks may freeze quicker than adjacent road surfaces in the fall due to the lack of thermal conduction provided by the earth. However, in the spring, bridge decks can warm more quickly than surrounding surfaces for the same reason.

AIR TEMPERATURE AND WIND
Absent radiation and geo-thermal effects, the pavement surface temperature will always be moving toward the adjacent air temperature. The rate of temperature change is usually slower than changes caused by radiation or geo-thermal effects. However, with increasing wind speed, the rate of pavement temperature change due to air temperature will increase.

TRAFFIC
Traffic can slightly increase pavement surface temperature as a result of tire-road friction and the radiant effects of engine and exhaust systems.

II.F.5.b Dilution of Ice Control Chemical

There are several factors that influence how quickly an ice control chemical reaches "critical dilution" or the freezing point.

WATER OR SNOW AND ICE ON THE PAVEMENT AT THE TIME OF TREATMENT
This is largely due to the effectiveness of the plowing operation or accumulation on the road if there is no plowing prior to the chemical treatment. The more water or snow/ice on the pavement at the time of treatment, the more quickly it will dilute the ice control chemical.

ICE CONTROL CHEMICAL FORM
Liquid ice control chemicals are quite dilute (23% - 32%) to begin with. With dilution, they will reach the freezing point more quickly than solid chemicals that are nearly 100% chemical.

ICE CONTROL CHEMICAL TYPE AND GRADATION
Some solid chemicals go into solution more quickly than others. Their potential for critical dilution is greater. Finer graded solid chemicals also go into solution more quickly. Different chemicals also have different ice melting rate characteristics.

ICE OR WATER CONTENT OF THE EVENT
The ice content of snow and ice events varies dramatically. Light, fluffy dry snow has an ice or water content in the range of 5%. Wetter heavier snow may be as high as 80% ice or water. Rain, freezing rain, and sleet all have nearly 100% water or ice. Higher ice content events will dilute ice control chemicals more rapidly.

EVENT INTENSITY
The more intense the precipitation rate, the quicker it will dilute an ice control chemical.

CYCLE TIME OF CHEMICAL TREATMENTS
The greater the time between treatment cycles, the greater the opportunity for dilution. However, cycle times should be long enough to allow the chemicals to work.

CLEARING ABILITY OF PLOWS
The more snow and ice mechanical equipment removes, the less dilution will occur in the following chemical treatment.

ICE-PAVEMENT BOND AT THE TIME OF TREATMENT
This may be the single most important factor effecting chemical dilution. If there is ice-pavement bond, more ice control chemical will usually be required in order to be effective. The thickness of the bonded ice is also important. Very thin ice will require little or no additional ice control chemical while thick ice and snow pack will require significantly more. The following are indications that there is ice-pavement bond:

- A spray of water will be produce by moving vehicle tires.
- On loose snow or slush-covered roads, the track created by moving tires will appear bare.
- There will be many bare spots on freshly plowed pavement.
- Scraping the snow or ice on a pavement with a plow (or shovel) will easily expose the pavement surface.
- The plow will make a louder noise if there is no bond

TRAFFIC

Traffic can have positive and negative effects on ice control efforts. Mechanical agitation helps break up snow and ice that have been weakened by the ice control chemicals, aids in allowing chemicals to go into solution quicker and keeps some potentially frozen brine solutions from actually solidifying. Traffic can also remove ice control chemicals from surface and consolidated snow to form pack. Vehicle generated wind and natural wind can displace solid chemicals and cause tire spray to leave the pavement environment.

II.F.5.c Ice-Pavement Bond at the Time of Treatment

If there is ice-pavement bond at the time of treatment, more ice control chemical will be required to penetrate the ice, break the bond and remain above critical dilution until the next treatment. Very thin ice would be an exception to this.

II.F.6 Deciding on an Ice Control Treatment

Every time a snow or ice treatment is being designed, as much of the following information as possible should be on hand or estimated:

- The level of service prescribed by **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** policy;
- Present pavement temperature;
- Trend of the pavement temperature;
- Snow and ice conditions on the pavement
- Traffic volume and timing
- Precipitation type and intensity

Once some determination of the items above and other operational considerations has been made, a decision on treatment can be made. It is likely that every treatment will be different as the critical factors are always changing.

Table 4 (Recommended Salt Application Rates) summarizes the most recent available guidance for ice control using salt. Here the factors that relate to pavement surface temperature and ice-pavement bond are displayed in a fairly simple matrix. The ice - pavement bond characteristic determination can be made by operators or supervisors in the field using the guidance in II.F.5.b.

Table 4 – Recommended Salt Application Rates

Pavement Temperature (°)	**Ice Pavement Bond**	**Application Rate, lb/lm**
		Solid & Pre Wet Solid products
Over 32	No	125
	Yes	250
30 to 32	No	150
	Yes	325
25 to 30	No	200
	Yes	400
20 to 25	No	225
	Yes	475
15 to 20	No	250
	Yes	500
Below 15	No	275
	Yes	600

II.F.7 Application Techniques for Solid Ice Control Chemicals

After the ice control treatment for prevailing conditions has been decided, the final step is to get the designed treatment in the right location at the right time. There are a number of techniques for spreading solid chemicals that can optimize treatment effectiveness:

TRAVEL LANES
Try to place solid ice control chemicals in a fairly narrow band near the high edge of each lane on two land highways. On multi-lane highways, a more general distribution may be used in spreading on more than one lane.

BRIDGES AND OTHER ELEVATED STRUCTURES NOT RESTING ON EARTH
In the fall and at other times when there is a rapid, severe, decrease in air temperature, elevated structures are likely to be colder than adjacent pavement on earth. The application rate made be increased by up to 20 percent on these structures so chemical solution freezing will not occur or will occur at about the same time as the surrounding pavement. Toward spring, when air temperatures are warming, structure temperatures are likely to be warmer than the surrounding pavement. Higher application rates are not necessary in this situation.

STRONG CROSS WINDS AND BLOWING AND DRIFTING SNOW

When spreading in strong cross winds, try to keep the spreader upwind of the intended spread location. If the wind is too strong, and the pavement temperature is low, spreading may not be appropriate.

BANKED OR ELEVATED CURVES
Try to keep the spread pattern on the high side of elevated curves. As the chemical works, chemical brine will migrate over the remainder of the pavement.

PARKING AREAS AND WALKWAYS
Spreading ice control chemicals as evenly as possible over the entire paved area is recommended for parking areas and walkways. These areas present an opportunity for pre-event anti-icing with solid chemicals as traffic will not displace them very readily from the surface.

THE WORST CASE SCENERIOS
The worst cases usually occur when the chemical treatment is quickly overwhelmed (diluted) by excessive amounts of water or ice. Blizzard conditions (intense snowfall, wind, very cold temperatures) quickly dilute ice control chemicals and render them virtually useless. If the pavement temperature going into and coming out of a blizzard is expected to be low, then plowing only is probably the best strategy. After the blizzard if it is still very cold, use abrasives as necessary until warmer temperatures will allow chemical de-icing to work. If the pavement temperature throughout and after the blizzard is likely to be fairly warm, a treatment with an ice control chemical before or early in the storm followed by plowing only throughout the storm, will make de-icing at the end of the storm much quicker.

Rapidly accumulating freezing rain is a major maintenance concern. The best strategy here is to apply solid ice control chemicals, at a high rate, in very narrow bands in the high side wheel path of each lane. Usually, this will provide a location in each lane that will have enough friction to allow vehicles to stop and steer.

GETTING THE APPLICATION RATE RIGHT
Application rates for ice control chemicals are usually specified in pounds per lane mile. Spreaders are usually calibrated to deliver pounds per mile (the discharge rate). It is important to understand that relationship in order to be sure the proper application rate is being used. The application rate is the number of pounds dispensed per mile (the discharge rate), divided by the number of lanes being treated.

11.F.8 Materials Spreading Equipment

Materials spreading equipment is most efficient and effective when associated with plow trucks. Independent plowing and spreading operations require almost impossible coordination. By spreading chemicals on freshly plowed surfaces, the chemicals will dilute less and last longer. Most chemicals need time to work. Uncoordinated plowing that removes chemicals from the surface too soon is wasteful.

II.F.8.a Calibration

Whatever materials distribution system is used, it must be calibrated. This will assure that the proper amount of material is being applied. Over-application is wasteful and under-application will not achieve the desired results. Solid material spreaders are usually calibrated by capturing and weighing material dispensed at various speeds, control settings and gate openings. A back-up or manual calibration for automatic control systems should be developed for each spreader. A calibration procedure for solid chemicals appears in Appendix __.
Calibration procedures for liquid spreaders are similar except that the liquid is captured in a container and the time of discharge is recorded. This will yield a rate of discharge (volume or weight) that can be related to vehicle speed and area of coverage for calculating application rate.

Prewetting systems also require calibration. Here, the prewetting liquid is captured and related to the amount of solid ice control chemical dispensed in the same time period. Adjustment is primarily a function of changing nozzle size.

For smaller and hand operated solid material spreaders, a band of material can be run across a plastic tarp. The area of that band on the tarp is measured and the amount of material on the tarp is weighed. The weight of material on the tarp divided by the area of material on the tarp is the application rate for these spreader conditions.

II.F.8.b Spread Pattern Control

Most commercial materials spreaders have the capability of adjusting the spread pattern they deliver. The most common device for spreading solid materials is a vaned spinner plate. The distance material is cast is controlled by the speed of the spinner plate. The faster the spinner plate rotates the farther it will cast material.

The direction of cast from spinner plate is controlled by the direction of rotation of the spinner and the location of the point where the material drops onto the spinner plate. Material dropped on one side of the spinner plate is generally discharged on the opposite side. Deflectors or skirts that divert the cast material downward provide additional control. Once deflectors are controlling the spread, the effect of spinner speed is diminished.

The proper spread pattern adjustments should be determined on the floor of the chemical storage facility. By pushing the discharged material into a windrow that runs parallel to the back of the spreader, a good indication of spread pattern can be obtained. Spread patterns determined by this method should be field verified by observing the distribution under actual operating conditions and making adjustments as necessary. The spread pattern for liquid distribution systems is usually accomplished by adjusting the direction and spacing of the nozzles. Observing the pattern is the best method to determine if it provides the desired distribution.

II.F.8.c Spreading Speed

The potential for solid ice control chemicals to bounce and scatter increases with increasing truck speed. Spreading speed should be as slow as possible, consistent with maintaining a safe speed in traffic.

II.G Post-Storm Activities

II.G.1 Post-Storm Evaluations

Post-storm evaluations should be conducted at the crew level. The following should be discussed and significant findings/results should be committed to record:

- Personnel issues
- Materials and materials management issues
- Equipment issues
- Safety issues
- Weather and information system accuracy
- Observed storm conditions
- Treatment effectiveness and pavement conditions
- Motorist response issues
- Coordination and cooperation issues
- Effectiveness and efficiency of safety restoration activities
  - Melt water control
  - Snow containment features, and potential problems on bridges
  - Safety appurtenances – attenuators, median and safety barrier, guard rail, etc.
  - Traffic restriction areas
  - Narrow raised features
  - Signs and delineators
  - Sight distance restorations
  - Drainage features
  - Raised obstructions

II.G.2 Post-Storm Operational Tasks

The following is a partial list of post-storm operational tasks that should be accomplished:

- Asset inventory (number and operational status)
  - Personnel
  - Materials
  - Equipment
  - Information system
- Treat Persistent Snow and Ice Conditions
  - Blow-over areas

Freeze-back areas
Areas with snow pack or ice

- Road Maintenance Activities
  - Pothole patching
  - Appurtenance repair
  - Brush and tree work
  - Sign and delineator work
- Abrasives clean-up in critical areas
- Equipment repair, cleaning, maintenance and re-calibration
- Maintenance and inventory of ice control materials
- Yard and facility clean up
- Repair of damaged safety appurtenances, signs, etc.
- Parts and fuel inventories

II.H Post Season Activities

II.H.1 Evaluation of All Elements of Snow and Ice Control Operations During the Past Season

The following is a partial list of topics that should be discussed, evaluated and committed to writing at the crew, and **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT**-wide levels following the winter season:

- Personnel
- Materials – availability, management, problems, etc.
- Equipment
- Maintenance of equipment
- Safety
- Treatment effectiveness
- Weather and other information systems
- Routing and response
- Level of service
- Highway and bridge design issues that may have impacted snow and ice control
- Cooperative agreements and inter-agency cooperation
- Contracts
- Emergency response/management
- Media and public information

II.H.2 Post Season Equipment Maintenance

The following equipment should be repaired, given use or time-based maintenance, and prepared for storage as required:

- Material spreaders

- Pre-wetting systems
- Storage tanks and pumps
- Plow equipment
- Trucks, loaders, graders, etc.

II.H.3 Materials, Equipment and Parts Inventory and Acquisition Activities

With the long lead-time required to acquire commodities, the inventory and purchase activities for next season should begin for:

- Abrasives
- All ice control chemicals
- Plow equipment
- Safety equipment
- Spare parts

II.H.4 Continuous Improvement Activities

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT is committed to continuous improvement of all of its operations. Snow and ice control is no exception. Forums available at all levels of **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** include:

- Direct communication with the office of the Superintendent of Highway Department
- Task specific employee meetings;
- Suggestion program;
- Customer interaction;
- Transfer of best practices or successful innovations (internal and/or external to **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT**); and
- training.

II.I Planning Activities

III. MATERIALS (ROAD SALT) MANAGEMENT PLAN

III.A Background

Road salt (sodium chloride) can have adverse environmental, infrastructure and vehicle effects. Potential environmental effects have been identified in the areas of:

- Surface water
- Ground water

- Soils
- Vegetation
- Wildlife

However, these effects have been only observed in situations where:

- Highway salting was excessive
- Uncovered stockpiles of salt and sand/salt mixtures were allowed to remain exposed to the elements
- Unique wind patterns and earth geology permitted a rapid departure of salt from the highway or stockpile environment

Vehicle and infrastructure effects are well known and are generally accommodated in the design of these elements.

Salt is the most common and least expensive ice control chemical and is likely to be the material of choice well into the future.

With the above in mind, it is **TOWN OF ORANGETOWN HIGHWAY DEPARTMENT'S** policy to create a reasonable balance among cost, safety (**TOWN OF ORANGETOWN HIGHWAY DEPARTMENT** plow operators and the traveling public) and environmental responsibility with its snow and ice control operations.

III.B Situational Analysis

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT is not aware of any locations within the zone of influence of highway salting where road salt is creating severe negative environmental effects.

III.C Salt Management Plan

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT will utilize "best practices" as the primary tool in salt management.

III.C.1 Highway Use

TOWN OF ORANGETOWN HIGHWAY DEPARTMENT will do the following in support of this salt management plan:

- Use only the amount of salt necessary to provide a satisfactory level of service for individual combinations of weather and road conditions

- Calibrate all materials spreading equipment to allow the proper application rates of salt

- Upgrade equipment over time to include ground speed materials application rate control
- Acquire technology to assist in better defining weather and road conditions
- Conduct operations in an efficient and effective manor
- Use pre-wetting of salt when operationally necessary
- Train TOWN OF ORANGETOWN HIGHWAY DEPARTMENT employees in the use of appropriate snow and ice control procedures and the importance of salt management
- Use the principles of **CONTINUOUS IMPROVEMENT**

RECORD KEEPING REQUIREMENTS AND PROCEDURES

GLOSSARY OF SNOW AND ICE CONTROL TERMS

SNOW PLOW TERMS

Air Foil A device placed on the back of a dump body or materials spreader that redirects and accelerates air passing over the truck. This is intended to keep the rear of the truck and materials spreader reasonably clear of snow build-up.

Angle of Attack The horizontal angle (less than 90^{o}) formed in plan view where the plow blade face deviates from a position that is parallel to the front grill of the plow truck

Blade or Cutting Edge The replaceable portion of a plow that is closest to and is in contact with the pavement surface

Ice blade A specialized plow blade that is designed to cut ice; these blades are usually placed on underbody plows that have down pressure capability

Moldboard The portion of a plow between the top and the blade

One-Way Plow or Funnel Plow A front mounted plow that will only cast snow in one direction (usually to the right)

Rake Angle The vertical angle of the plow blade (cutting edge) relative to a perpendicular line from the pavement surface

Reversible Plow A front mounted plow that is adjustable to cast snow: left, right, or straight ahead

Snow Blower, Snow Thrower or Rotary Plow A front mounted device, comprised of augers that move the snow to an impeller that throws the snow through a chute

Snow Gate A cab controlled mechanical flap that briefly blocks the discharge of a snowplow blade. This is used primarily to minimize filling of driveways and other sensitive areas

Underbody or Belly plow A plow that mounts between the front axel and the drive axel(s)of a truck or motor grader

"V" Plow A front mounted plow that simultaneously cast snow to the left and right

Variable Geometry Plow This is a front mounted plow with the ability to change the geometry of the moldboard

Wing Plow. A plow mounted on either side of the side of the truck, or both, that extends the plowing width of a front plow or an underbody plow; can also be used for benching.

SNOW PLOWING TERMS

Benching or Shelving Removing the upper portions of accumulations of snow on the shoulder or near- shoulder, usually with a wing plow.

Close Echelon Plowing. Snow plows that are arrayed across the pavement in a way that prevents traffic from passing the operation. This prevents traffic from passing through windrows of plowed snow and is the safest and most cost effective procedure for high volume multi lane highways.

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 loaders and snow blowers

Tandem Plowing Snow plows that operate in sequence, at a distance apart, that allows traffic to safely pass the operation.

Windrow or Berm A linear (parallel to highway center line) accumulation of snow cast by a plow, other equipment or wind.

STRATEGIC AND TACTICAL TERMS

Anti-icing This is a proactive 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. It can also be employed after a successful deicing operation. When anti-icing methods are properly employed, they can achieve high levels of service for sustained periods of time.

Deicing This is a reactive strategy for dealing with snow or ice that has already bonded to the pavement 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 or ice. The coarse particles 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 loose snow or ice should be removed by subsequent plowing. **Sufficient time is necessary to allow the salt to work before plowing commences.**

Delayed Treatment Delaying or not applying ice control materials is a tactic that may be used in support of the anti-icing strategy. Road and weather conditions must be closely monitored to ensure success with this tactic. This tactic should be considered when pavement temperature is likely to remain above freezing, or during "dry" snow and blowing snow events where pavement surface temperature is below 15^{o} F and there is no residual ice control chemical on the pavement. Chemicals should not be applied in conjunction with plowing operations at these low temperatures or when plowing blowing and drifting snow at these low temperatures. Usually snow will not bond to the pavement and can be effectively removed by plowing alone. Traffic will whip the rest of the snow away. In this situation chemicals, or the chemicals in abrasives, may make the snow stick to the pavement, causing icy spots that require continuing treatment.

Level of Service (LOS) Desired or observed pavement conditions at various points in time, during and after winter weather events

Temporary Friction Improvement This is an immediate and short- term improvement in surface friction that is achieved by spreading abrasives or abrasives/chemical mixtures on the snow/ice surface. This method may be used in low level of service situations and where low pavement temperatures exist (below 15^{o} F). It is also useful on unpaved roads (with no chemical or the least amount of chemical possible). A major disadvantage of this method is that its effectiveness degrades quickly with traffic. Therefore, it is very important to monitor road conditions to determine if additional treatment is necessary.

ICE CONTROL MATERIALS TERMS

Abrasives Any solid material applied to the pavement to increase friction

A**nti-caking Agent** A substance added to solid ice control chemicals to prevent caking or adhesion of the individual particles

Brine A solution of one or more salts

Chemical Concentration. The percent (by weight **)** of a chemical in a liquid or solid product

Chemical Dilution Reducing chemical concentration by adding water or other substances

Chemical Form The physical state of the chemical (solid or liquid)

Endothermic Absorbs heat or becomes colder when going into solution

Eutectic Concentration The solution concentration that will produce the eutectic temperature.

Eutectic Temperature The lowest temperature that an ice control chemical will melt ice or prevent ice from forming

Exothermic Gives off heat or becomes warmer when going into solution

Gradation or Grain Size Distribution This is the proportion of solid material that is retained on specified screen sizes

Hydrometer A device used to measure the specific gravity of liquids

Hygroscopic The property of having the ability to draw water from the air

Ice Control Chemical. Any chemical applied to surfaces that will prevent ice from bonding or melt ice that has already formed

Liquid Chemical The liquid form of a chemical or combinations of chemicals; usually a solution

Mixed Abrasives A mixture of abrasives and ice control chemicals

Phase Diagram A graph that shows the relationship between: solution concentration, solution freezing point and solution (pavement) temperature

Solution A generally clear combination of water and other dissolvable substances

OPERATIONAL PROCEDURE TERMS

Automatic Anti-Icing /Deicing Systems Liquid chemical distribution systems that are placed at strategic highway and bridge locations that automatically apply liquid ice control chemical to the road when specified conditions are present

Dry Run Driving the snowplow route, beat or run in non- snow and ice conditions to become aware of features that may impact snow plowing and spreading materials

Circle of Safety A visual technique used by equipment operators to gain awareness of evolving situations all around the equipment

Passive Snow Control The control of blowing and drifting snow by using snow fence, plantings or highway design features

Pre-Wetting Adding a liquid ice control chemical, or water to solid ice control chemicals before placement on the road

Pre-Treating Placing an ice control chemical on the road before the beginning of a winter weather event

Snow, Beat, Route or Run Maps These are maps that show individual or groups of snow plow routes under.

Treatment Cycle Time The time it takes for a truck to return to retreat a point on the beat/run, after treatment, including any reloading time; if reloading is required for every treatment run, it could be the time between leaving the loading point for successive treatment runs

Wet Run Driving the snowplow route, beat or run during winter weather conditions to identify features that may impact snow plowing or and materials spreading

MATERIALS SPREADER TERMS

Application Rate The amount of material being discharged per lane mile by the spreader or distributor (pounds per lane mile or gallons pr lane mile) [discharge rate divided by the number of lanes being treated]

Calibration The procedure for determining that the desired rates of discharge are capable of being delivered by the materials spreader, and what settings of the control features will produce the desired rates

Discharge Rate The amount of material being discharged, per mile, by the spreader or distributor (pounds pr mile or gallons per mile)

Spread Pattern The transverse distribution of the ice control product across the highway (middle third, full width, high side wheel path, strips, etc.)

Ground Speed Control the material being distributed by the spreader is automatically controlled to deliver the proper application rate, regardless of ground or truck speed

PAVEMENT CONDIDTION TERMS

Black Ice A popular term for a very thin coating of clear, bubble free, homogenous ice that forms on a pavement; there are a number of mechanisms that will produce thin ice

Blow-Over A relatively minor accumulation of snow on the road that is primarily deposited by the wind. Road or lane closure would be unlikely if not removed.

Damp There is a light coating of moisture on the pavement, with no visible water drops

Dry No wetting is apparent on the pavement surface

Frost A “white” non-homogenous coating of ice that usually forms on surfaces when the air temperature is above freezing

Hard Pack or Snow Pack This is formed when saturated snow is compacted by traffic, usually accompanied by a drop in temperatures and the resulting ice is bonded to the pavement.

Ice/Pavement Bond Compacted snow or ice that adheres to the pavement so strongly that only ice control chemicals or increasing pavement temperature will break the bond

Loose Snow Unconsolidated snow that can be blown by the traffic or wind into windrows, or off the road

Slush An accumulation of snow that 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.

Snow Drift A significant accumulation of snow on a road that is primarily deposited by the wind. If not removed timely, road or lane closure could result.

Thick Ice A much thicker coating of ice on the pavement than thin ice, formation may result from: freezing rain, freezing of ponded water, or freezing of melt water that is not able to drain properly. It may be clear or milky in appearance, and is generally smooth although it can have a rough surface

Thin Ice A thin, clear coating of ice where the pavement surface can be seen; often called black ice

Wet The road is surface saturated with water from rain or melt water. Runoff and puddles may nor may not be present

WINTER WEATHER TERMS

Blizzard A long duration, wide area, snow event that is characterized by a heavy rate of snowfall, high winds and low temperatures.

Blowing Snow Airborne snow that is primarily being transported by the wind; precipitation may or may not be occurring

Drizzle Light rain that is characterized by very small individual water droplets

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 or 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^{o} F (sublimation). Frost most often occurs when air temperature is above32 degrees F and pavement temperature is 32^{o} F or below and is at or below Dew Point.

Heavy Rain Rain, seemingly falls in sheets; individual drops are not identifiable; heavy spray can be observed several inches above the pavement surface

Heavy Snow Snow that is falling at a rate of more than 1 inch per hour and visibility is less than ¼ mile

Light Rain Small liquid droplets falling at a rate such that individual drops falling on a wet surface are easily detectable

Light Snow. Snow falling at the rate of less than ½ inch per hour: visibility is greater than ½ mile

Moderate Rain Liquid drops that are falling are not clearly identifiable on the pavement surface and spray form the falling drops is observable just above surface

Moderate Snow. Snow falling a rate of ½ inch to 1 inch per hour per hour; visibility is greater than ¼ mile and less than ½ mile

Radiometer or Infra Red Thermometer A non-contact device that measures the surface temperature of pavements and other objects

R.W.I.S. (Road and Weather information System) A system that is comprised of atmospheric and weather sensors, pavement temperature and chemical sensors, a computer and software system for arraying data and data analysis and a communications system to move the data from point of measurement to the end user

Sleet. or Ice Pellets A frozen mixture of rain and snow (pellets) that had been partially melted by falling through a layer of the atmosphere having a temperature above freezing, and subsequently refrozen by a colder layer or air near the surface of the earth

White-out A short duration situation, within a snow storm, where visibility drops to only a few feet

APPENDIX I **SNOW AND ICE CONTROL PLOW ROUTE MAP**

APPENDIX II **COUNTY AND STATE ROADS**

APPENDIX III **SNOW EMERGENCY ROUTES**

APPENDIX IV **SAFETY SIDEWALK ROUTES**

APPENDIX V **MUNICIPAL PARKING LOT MAP**

APPENDIX VI **EMERGENCY OPERATION PLAN**

APPENDIX VII **ENVIRONMENTAL POLICY FOR SALT STORAGE**

APPENDIX VIII **WINTER EMERGENCY CALL OUT LIST**

APPENDIX VIIII **NEW SUBDIVISION AND UNDEDICATED ROAD LIST**

APPENDIX X **WINTER SAFETY GRAM**

APPENDIX XI **RELEVANT PORTIONS OF UNION AGREEMENTS**

APPENDIX XII **COPIES OF RELEVANT LOCAL LAWS AND ORDINANCES**

- **SIDEWALK MAINT**
- **STATE OF EMERGENCY**
- **PROHIBITED PARKING**

APPENDIX XIII **COPIES OF APPLICABLE PORTIONS OF STATE LAW:**

- **Section 1103 of the Vehicle and Traffic Law**
- **Section 18 of the Public Officers Law**
- **Section 2335 of the Insurance Law**
- **Article 8, Section 214 of the Highway Law**

APPENDIX XIV **SOURCES OF INFORMATION USED TO CREATE THIS DOCUMENT**

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Florquist, Bruce, "Urban Snow and Ice control" American Highway Department Association, Kansas City, MO, April, 2005

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