TOWN OF TOLLAND

SNOW AND ICE CONTROL

PLAN

I. INTRODUCTION

I.A. General

It is **TOLLAND**'s 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 manner.

This manual provides information and guidance to assist **TOLLAND** Public Works Department in conducting snow and ice control operations. It will serve as a basis for training **TOLLAND** personnel.

The manual contains information on pre-winter operations and readiness, total storm management and decision making using **TOLLAND** 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 **TOLLAND** maintenance personnel through surveys and interviews. It is intended to be a "living document" that is responsive to new technology and techniques developed within **TOLLAND** and elsewhere. Suggestions for change may be submitted at any time to the Public Works Operations Manager.

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 Residents and Property Owners

I.B.1. How Residents and Property Owners Can Help Assure the Safety and Efficiency of TOLLAND's snow and Ice Control Operations

- Do not park on township streets, especially during snow or ice events (they may be ticketed and/or towed when a parking ban is in effect).

- Do not plow, blow or shovel snow into the street. Municipal Ordinance #53-C states the owner of any land or building who piles or blows snow into the public way shall be charged $50 per offense. You will also be held responsible for any actions of a contractor hired by you. Please do not allow your contractor to plow into the street unless he or she is prepared to clean the street as well.

- If you live next to a public sidewalk, shoveling and clearing that walk is your responsibility. All walks are required to be cleared within 24 hours after a snow or sleet event. Municipal Ordinance 53-B states that failure to do so may result in a $35 fine.

- Fire hydrants near your property also must be cleared within 24 hours a after snow or sleet event. Again, Municipal Ordinance #53 property owners are subject to a $35 fine per offense.

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

- Trash cans and recycle totes should be placed within 18" of the pavement, as close to pick up time as possible and put away, once emptied as soon as possible, to avoid damage. Town is not responsible for damage to cans and/or totes.

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

- 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 and prevent the snowplow from re-depositing the snow into your driveway. Please see Appendix A for diagram.

- Combination sand and salt is available to **TOLLAND** Residents for private use at the Old Town Garage on Dunn Hill Road (across from St. Matthew's Church).

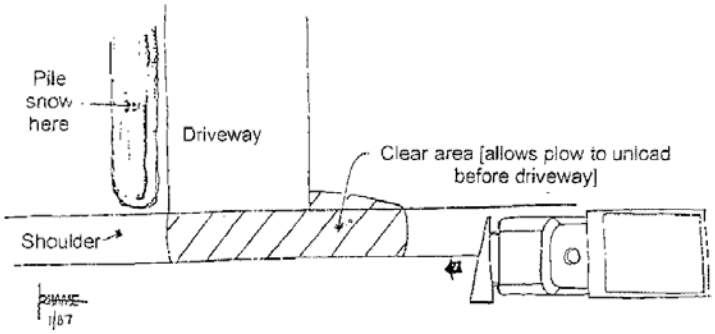
I.B.2. Roads within the Town of TOLLAND that are NOT maintained by the Town of TOLLAND

Table 1 Roads Not Maintained by TOLLAND

State Maintained Roads	Privately Maintained Roads
• **Route 30**	• **Alta Vista Avenue**
• **Route 195**	• **Alva Court**
• **Route 74**	• **Belvedere Drive**
• **Route 31**	• **Clover Lane**
• **I 84**	• **Crystal Springs Drive**
• **Commuter lots**	• **Dorothea Lane**
	• **Hawthorne Hill**
	• **Hidden Valley**
	• **Island Lane**
	• **Marlen Way**
	• **Ogden Court**
	• **Overlook Lane**
	• **Weigel Valley Drive**
	• **Woodside Drive**

Appendix A

Driveway Plowing Policies



- Snow should be plowed or shoveled to the right side of the driveway as you are facing the intersecting roadway (see diagram). By being plowed away from the direction of oncoming snowplows, this action will prevent the bulk of the snow from being pushed back onto the driveway
- Eliminate snow piles at the driveway entrance whenever possible. High accumulations of snow will obstruct the vision of motorists when exiting from the driveway and hinder the ability of oncoming motorists to see you pulling out of the driveway, creating another potential for accidents
- Do not push snow out onto roads at anytime. This creates hazardous driving conditions for all vehicles

Cornell Local Roads Program -- sample driveway plowing policy

I.B.3. Private Driveways

Town snow removal crews do not clear private driveways or driveway entrances of accumulated snow.

I.B.4. Plow Trucks With 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, Ambulance & Rescue
    c) School District Transportation Department

I.B.5. Mailboxes and Mailbox Posts

Please check your mailbox and make sure it is in good repair, firmly attached to a solid post and properly placed so no part of it is over the pavement. Your mailbox will have to withstand countless tons of flying snow this winter and it may require periodic maintenance. If a mailbox or post is pushed over or damaged as a result of snow or slush coming off the snowplow, it is considered a winter hazard and the Town will not repair or replace the mailbox or post. The height of the bottom of the mailbox to the street should be between 42” and 48”.

The Town Council has enacted the following policy:

§ A176-16. Policy No. 16: Policy Regarding Placement of Mailboxes, Newspaper Tubes, Roadside Structures and Landscaping Elements Within the Town of Tolland's Road Right-of-Way. [Adopted by the Town Council 12-10-2002]

A. It is an historic and current practice that private property interests do not extend to the edge of the Town's roads. This is to provide for public safety by creating adequate sightlines and clear zones immediately adjacent to the traveled way. This area also provides for implementation of best management practices regarding road maintenance activities.

B. Residents should make every effort not to place items within the public right-of-way. The erection or placement of items such as mailboxes, newspaper tubes, roadside structures and landscaping elements in this area is not prohibited. However, such items placed in the public right-of-way is done solely for the convenience of the adjacent landowner, and the risk of loss or creation of a hazard is the sole responsibility of said landowner.

C. The Town of Tolland shall not be responsible for damage or replacement to these or similar uses located within the right-of-way. Residents are cautioned that routine removal of snow and ice, roadside mowing and other activities associated with highway maintenance and road improvements may cause damage to items placed in this area.

I.B.6. Contacting the Town during a Snow or Ice Event

Avoid calling municipal offices during a storm except in an emergency. Personnel are extremely busy dealing with storm conditions.

Please keep telephone lines clear for emergencies.

Emergency calls during snow removal season should be placed to the **TOLLAND** Town Public Works Department, (860) 871-3690, Monday thru Friday 8:00 am to 4:30 pm. After hours and weekends, please leave a message at (860) 871-3690, messages will be reviewed frequently.

II. OPERATIONAL GUIDELINES

II.A. Goal of Snow and Ice Control Operations

TOLLAND 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 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 **TOLLAND** maintenance forces may temporarily preclude achieving this goal.

II.B. Operational Priorities and Personnel Policies

II.B.1. Operating Priorities

Generally, the Town of **TOLLAND** Highway Department will prioritize roads by traffic volume. The time to the first treatment in a storm will vary with location on individual plow routes. Subsequent treatments will occur at more regular intervals throughout the storm. Due to very low traffic volume in the timeframe from 10:00 PM to 4:00 AM, there will be only limited service provided. That will be primarily in support of other emergency operations. This is to give **TOLLAND** operational employees an opportunity for needed rest and sleep.

TOLLAND will use a "salt priority" approach in snow and ice control operations using best management practices. Simply stated, this means that salt will be used when the weather and road conditions are favorable for salt to work properly. Applying a sand/salt mix, and providing no material treatment at all, are other treatment options that may be used, depending on weather and road conditions.

TOLLAND may apply a pre-storm treatment. Less traveled roads will be treated first.

It is recognized that the essential character (snow, ice, rain, sleet, etc.) of a winter weather event may change several times during an event. The treatment of those portions of the event shall be in accordance with the guidance that follows:

Depending on weather and road conditions, intermediate within-storm salt applications may be directed by the supervisor.

ICE EVENTS
Salt shall be spread in as narrow a pattern as possible in the outside (high side) wheel path of each traffic lane at the "bonded" rate for the prevailing road temperature as necessary. Salt may be spread at the

"unbonded" rate for the prevailing road temperature, prior to an ice event.

UNPAVED ROADS
During snow events, unpaved roads generally will receive snow plowing with limited sand application. Salt is relatively ineffective on unpaved roads and creates more "mud" problems in late winter/spring.

PARKING LOTS AND SIDEWALKS
Both parking lots and sidewalks will be pre-treated when possible. As with roads, parking lots and sidewalks will be treated with salt. Sand will only be applied as necessary. See Appendix D for list of parking areas/sidewalks maintained by the Town of **TOLLAND**.

SAND/SALT MIXES
Sand/salt mixes will have a limited role in **TOLLAND**'s snow and ice control program. They will be used on unpaved roads, in very cold temperature situations where salt is not likely to work properly and after an event where the road surface is "wet" and not likely to dry before road temperature decreases significantly.

SPREADING SALT BEFORE A SNOW OR ICE EVENT
Salt may be spread at the "unbonded" rate for the anticipated road temperature range prior to a snow or ice event. This is the preferred treatment for sidewalks and parking lots.

SPREADING PATTERNS
Unless otherwise noted, **salt** shall be spread in about the center 1/4 of the road or on the high side of lanes in multi-lane sections. **Sand/salt mixes** shall be spread more generally over the road surface. All material applications shall be in the recently plowed path where they are not likely to be plowed off the road.

PRE-WETTING
TOLLAND has the capability of adding liquid ice control chemical to salt before it is applied to the road. This is called pre-wetting. The use of this technique will be limited to pavement temperatures below 25 degrees, when applying salt to the road before an event, when there is little snow or other wetness on the road to "hold" the salt, and in deicing operations where bonded snow or ice is being treated after an event. When pre-wetting, the normal salt application rates will be used.

CALIBRATION
All **TOLLAND** material spreading equipment shall be calibrated prior to each snow and ice season. See Table 6 for salt application rate.

II.B.2. Personnel Policies

II.B.2.a. Hours of Continuous Duty

A driver may be on duty for the duration of the storm with appropriate rest stops in between cycles. Drivers will be given a one (1) fifteen minute break after their regular shift and are allowed to make appropriate coffee breaks throughout the duration of the storm. Drivers will be given a one (1) hour dinner break, to be taken between the hours of 6:00 pm – 8:00 pm on a rotating basis. The Town of **TOLLAND** will **NOT** provide food/meals during snow and ice control operations.

II.B.2.b. Call-In Procedures

- Drivers are required to report for duty within 1 hour of notification

II.B.2.c. Fitness For Duty

- Drug and alcohol policy as outlined by the Connecticut CDL requirements and **TOLLAND** Policy.

II.B.3 On-Call Procedures

TOLLAND has four administrative managers that will share evening/weekend on-call duty for the 20 weeks of winter, each covering 5 weeks, for both Highway and Park & Facilities responsibilities. Depending on the severity of the storm, it may be necessary to call in more than one supervisor. The state police will have the pager number that the on-call manager will carry at all times and will contact that manager with any emergency that arises. That manager will then assess the situation and contact needed personnel to handle the emergency.

II.B.4. Operational Resource and Responsibilities
Equipment Type and Location

TOLLAND has 12 trucks in regular fleet used for snow/ice events. We have 1 truck and 1 loader available as backup that can be put into service in order to maintain the proper level of service. See Table 2 and Table 3 for equipment lists.

II.B.5 Operators Direct Communication with the Public

Operators are to report all stranded or stuck vehicles to the Public Works 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 Public Works office. All Operators should have a business card of the Public Works Operations Manager to hand to the resident.

Table 2 HIGHWAY EQUIPMENT

Name	FEMA Resource Type	Make & Model	Where Housed
6	Dump Truck-On Road	Freightliner FL-60	Highway Garage
14	Dump Truck-On Road	GMC 7500	Highway Garage
23	Dump Truck-On Road	MACK RD690S	Highway Garage
24	Dump Truck-On Road	MACK RD690P	Highway Garage
26	Wheel Loaders (Small 7 cy to 2 cy)	CAT 938G	Highway Garage
27	Dump Truck-On Road	MACK R6805	Highway Garage
28	Dump Truck-On Road	Ford L8000	Highway Garage
30	Dump Truck-On Road	MACK RD690P	Highway Garage
31	Dump Truck-On Road	MACK TD690P	Highway Garage
32	Dump Truck-On Road	Sterling L8500	Highway Garage
33	Dump Truck-On Road	MACK CV712	Highway Garage
34	Dump Truck-On Road	MACK	Highway Garage
35	Dump Truck-On Road	Western Star WB109425	Highway Garage
16	Wheel Loaders (Small 7 cy to 2 cy)	CAT 936E (BACKUP)	Highway Garage
25	Dump Truck-On Road	Ford F550 (BACKUP)	Highway Garage
----	(4) Four Additional Contractor Trucks	International 6 Wheel Dump	Contractor Owned

Table 3 PARKS & FACILITIES EQUIPMENT

Name	FEMA Resource Type	Make & Model	Where Housed
51	* 4X4 Pickup	2001 Dodge 1500	Parks & Facilities Garage
3	* 4X4 SUV	2006 Jeep Grand Cherokee	Parks & Facilities Garage
trailer	* Trailer- tow along	Super 12000105 Trailer	Parks & Facilities Garage
70	* Truck with Power Lift Gate	F250 4x4	Parks & Facilities Garage
39	Dump Truck-On Road	F800 96	Parks & Facilities Garage
68	Dump Truck-On Road	2007 Ford F550	Parks & Facilities Garage
53	Dump Truck-On Road	2007 Ford F450	Parks & Facilities Garage
38	Dump Truck-On Road	2004 Ford F550	Parks & Facilities Garage
63	Dump Truck-On Road	2003 Chevy 3500	Parks & Facilities Garage
72	Dump Truck-On Road	GMC 3500	Parks & Facilities Garage
36	Dump Truck-On Road	Dodge W350	Parks & Facilities Garage
CAT	Wheel Loaders (Medium 7 cy to 3 cy)	2006 Cat 930G	Parks & Facilities Garage

Personnel Available:

Public Works Department:

Operations Manager: **Clement G. Langlois, Jr.**

Managers:
John Bock
Scott Howe
Paul Russell

Public Works Employees:

Scott Borowski
Eustquio Bretas
Mark Buccheri
Bill Burke
Dennis Carr
Clay Duclos
Mike Fennelly
Chris Gilluly
George Gracie
Michael Grant
Gillis Gregoire
Jeff Horn
Joe Ladone
Gary Langdo
Daniel Parizek
Leon Parker
Kevin Pellerin
Ray Pollansky
Bruce Richter
David Ridzon
Mike Trudeau
Tom Tyler
Donald West
Dan Whitman

Contractors:

Dempsey Construction
Hipsky Construction
Kucko Construction
R & A Excavation

Budget: (based on 32 events)

2008 - 09 budget: (original)

Salt – 4906 tons ($58.50 / ton)	$ 287,000
Sand – 3000 cubic yards ($11.00 / cubic yard)	$ 33,000
Liquid Calcium – 10000 gallons (.94 / gal)	$ 9,400
Calcium Flakes – 1000 lbs. ($1.00 / lb)	$ 1,000
Overtime	$ 95,606
(6) Hired truck/equipment	$ 94,905
Spare Driver	$ 1,000
Weather Forecasting Service	$ 1,560
Total	$ 523,471

2008 – 09 budget: (revised)

Salt – 3391 tons (*$90.90 / ton)	$ 308,242
Sand – 500 cubic yards ($9.75 / cubic yard)	$ 4,875
Liquid Calcium - 5000 gallons (.94 / gal)	$ 4,700
Calcium Flakes - 1000 lbs. ($1.00 / lb)	$ 1,000
Overtime	$ 97,483
(4) Hired truck/equipment	$ 63,270
Spare Driver	$ 1,000
Weather Forecasting Service	$ 1,560
Total	$ 482,130

* The cost of salt is 64% higher than projected.

Materials used in FY 07/08 for 32 events

Salt – 3391 tons
Sand – 1750 cubic yards
Liquid Calcium – 5300 gallons

Total Cost - $215,134

* Actual usage can vary based on weather conditions including road temperature and the type and amount of precipitation. Any budgeted dollars not used for materials should be spent on ensuring salt, if available, is purchased at the end of the snow season to reduce the cost impact on the subsequent years' budget. Prices for salt are increasing at the rate of 20% - 35% a year. Since this is the first year under the revised operating guidelines, some fluctuation is anticipated in the estimated totals.

Consultant recommends purchasing ground controller for fleet trucks. Doing so will save approximately 25 – 35% in salt usage per year.

Cost per ground controller: $7,662

Salt Storage:

Salt barn capable of storing 6,500 tons of material

Miles of Roads: approximately 132 center lane miles

See Appendix B for Route Lists
See Appendix C for Map

Miles of Sidewalks: 6+ miles

Number of Cul-de-sacs: 80

Number of Parking Lots: 29

See Appendix D for Parking Lot List

Appendix B Truck Route List

#14
RAYMOND POLLANSKY
2008 GMC 7500 SLIDE IN SPREADER (5 CY)

0.28 TOLLAND GREEN
1.23 TORRY ROAD
0.26 SKUNGAMAUG ROAD
0.29 GARRY ROAD
0.45 EVERGREEN DRIVE
0.13 AMY DRIVE
0.64 SANDY DRIVE
0.47 ANGELA DRIVE
0.45 SHARON DRIVE
1.21 OLD CATHOLE ROAD
0.17 CLEARBROOK DRIVE
0.31 FARMBROOK DRIVE
0.21 BIRCHWOOD DRIVE
0.39 CENTER ROAD
0.17 ALFRED DRIVE
0.36 CORA ROAD
0.10 CASTLE ROAD
0.22 VAALCOM ROAD
7.34 TOTAL

#6 LOW PRO
DAVE RIDZON
2000 FREIGHTLINER FL-60 W/ALL SEASON BODY

0.97 COOK ROAD
0.30 CRYSTAL RIDGE DRIVE
0.88 WILDWOOD ROAD
0.67 JOHNSON ROAD
0.60 KENDALL MOUNTAIN ROAD
0.30 AMANDA WAY
0.30 CROSSEN DRIVE
0.19 MIHALIAK DRIVE
0.29 SAGE MEADOW DRIVE
0.36 SUSAN DRIVE
0.80 PLAINS ROAD (BABCOCK TO RT 32-SWEETHEART HILL)
1.21 CHARTER ROAD
6.87 TOTAL

#23
DON WEST
2004 MACK RD6905
10 WHEEL DUMP W/ALL SEASON BODY (12 CY)

0.74 BROWNS BRIDGE ROAD
1.49 GRAHABER ROAD
0.27 BONAIR HILL ROAD
0.80 SHENIPSIT LAKE ROAD (GRAHABER TO TOWN LINE)
0.43 WEBBER ROAD
2.03 HUNTER ROAD
0.85 BAKOS ROAD
0.24 CORTLAND DRIVE
0.13 OLD ORCHARD WAY
0.57 ROLLING MEADOW DRIVE
0.24 WILLOW CREEK DRIVE
0.24 CHARLOTTE DRIVE
8.03 TOTAL

#24
MICHAEL GRANT
1994 MACK RD690P
6 WHEEL DUMP W/ SLIDE IN SPREADER (5 CY)

1.13 RHODES ROAD
1.55 ANTHONY ROAD (RHODES RD TO SO. RIVER RD)
0.07 ANTHONY ROAD SOUTH (PART OFF ANTHONY RD)
1.40 KATE LANE
0.13 KIM CIRCLE
0.34 RYAN ROAD
0.09 CHELSEA CIRCLE
0.13 ADAM LANE
0.27 BARBARA ROAD
0.24 RUOPS ROAD
0.13 LISA LANE
0.11 THOMAS DRIVE
0.23 STEPHANIE LANE
0.13 ELLEN DRIVE
0.92 WOODHENGE DRIVE
0.13 WINTERBOURNE VIEW
0.52 AVEBURY LANE
0.20 MARLBORO GLADE
7.72 TOTAL

Appendix B Truck Route List (continued)

#27
LEON PARKER
1989 MACK R6805
TRI-AXLE DUMP W/SLIDE IN SPREADER (7-8 CY)

4.38 OLD STAFFORD ROAD
2.97 SUGAR HILL ROAD
0.25 SUGAR BUSH LANE
0.87 NEFF HILL ROAD
0.13 LADD ROAD
0.32 USHER RIDGE
8.92 TOTAL

#28
BILL BURKE
1997 FORD L8000 DUMP W/ ALL SEASON BODY (6-8 CY)

3.19 OLD POST ROAD (ALL)
0.34 INDUSTRIAL PARK ROAD WEST
0.31 INDUSTRIAL PARK ROAD EAST
0.31 GERBER DRIVE
0.29 WONDERVIEW DRIVE
0.30 FIELDSTONE DRIVE
0.89 MOUNTAIN SPRING ROAD (OLD POST TO RT 74)
0.09 HILLCREST DRIVE
0.23 ELIZABETH LANE
0.24 VALLEY VIEW DRIVE
0.25 ARNOLD DRIVE
0.10 HARRIET DRIVE
0.08 ANDREW WAY
0.74 OLD KENT ROAD NORTH
0.44 GARNET RIDGE DRIVE
0.32 PEPPERWOOD DRIVE
0.09 HICKORY COURT
0.38 WOODFIELDS DRIVE
8.59 TOTAL

#30
DAN PARIZEK
1993 MACK RD690P
6 WHEEL DUMP W/SLIDE IN SPREADER (5CY)

1.95 GEHRING ROAD
1.15 METCALF ROAD (GRANT HILL TO OLD KENT RD SO)
0.78 OLD KENT ROAD SOUTH
0.73 APPLE ROAD
0.27 ELM ROAD
0.23 DOGWOOD ROAD
0.29 COLUMBINE ROAD
0.29 BEECH ROAD
0.17 HOLLY ROAD
0.82 PINE HILL ROAD
0.30 MAPLEWOOD DRIVE
0.25 LAUREL RIDGE ROAD
0.11 BLUEBERRY HILL ROAD
0.22 JULIA ROAD
0.19 WHITE BIRCH DRIVE & EXT.
0.64 LAWLOR ROAD
8.39 TOTAL

#31
MIKE TRUDEAU
1991 MACK RD690P
6 WHEEL DUMP W/SLIDE IN SPREADER (5 CY)

0.47 MOUNTAIN SPRING ROAD (OLD POST RD TO REED RD)
0.99 LOEHR ROAD
1.09 REED ROAD
0.89 DOCKEREL ROAD
0.32 PAULA JOY LANE
0.12 HIGGINS WAY
0.31 FISH & GAME ROAD
0.37 TOLLAND FARMS ROAD
0.17 DEER MEADOW
0.15 RUSSELL DRIVE
0.17 CLARKE ROAD
0.14 ANN DRIVE
0.17 RIDGE ROAD
0.81 TIMBER TRAIL
0.13 STACY LANE
0.49 BRANDEN WAY
0.32 LAMONT LANE
0.38 CARTER DRIVE
0.10 GLENVIEW TERRACE
7.59 TOTAL

Appendix B Truck Route List (continued)

#32
CLAY DUCLOS
2001 STERLING L-8500
6 WHEEL DUMP W/ALL SEASON BODY (6-8 CY)

1.97 GRANT HILL ROAD
1.03 NEW ROAD
0.85 CEDAR SWAMP ROAD
0.33 METCALF ROAD (GRANT HILL TO CIDER MILL)
0.17 ELGIN DRIVE
0.50 GEHRING ROAD EXT.
0.47 AUTUMN DRIVE
0.36 PARTRIDGE LANE
0.35 GRANDVIEW STREET
0.32 WOODLAND STREET
0.89 NOAH LANE
0.13 HOMESTEAD HILL
1.46 WEIGOLD ROAD
0.14 HARVEST LANE
0.30 HERITAGE LANE
0.29 SUMMERWOOD RIDGE
9.56 TOTAL

#33
SCOTT BOROWSKI
2005 MACK CV712
6 WHEEL DUMP W/ALL SEASON BODY (6-8 CY)

2.26 SOUTH RIVE ROAD
1.03 WALBRIDGE HILL ROAD
0.52 ANTHONY ROAD (RT 195 TO RHODES RD)
0.26 SUMMIT DRIVE
0.75 VIRGINIA LANE
0.07 RANDY ROAD
0.43 SHERRY CIRCLE
0.41 GLENN DRIVE
0.23 CORINNE DRIVE
0.20 CAROL DRIVE
0.23 STUART DRIVE
0.06 HUGHS ROAD
0.62 FOX RIDGE LANE
0.23 NEDWIED ROAD
0.07 ANTHONY ROAD SOUTH (PART OFF SO RIVER RD)
0.20 DIMMOCK ROAD
0.22 PERO ROAD
7.79 TOTAL

#34
GEORGE GRACIE
2008 MACK
6 WHEEL DUMP W/ALL SEASON BODY (6-8 CY)

1.86 GOOSE LANE
1.61 BAXTER LANE
1.17 ANDERSON ROAD
0.35 MEADOWOOD ROAD
0.35 OLD FARM ROAD
0.28 LEE LANE
0.36 SHANDA LANE
0.56 MARBELLA LANE
0.23 PATRICIA DRIVE
0.27 ELNA DRIVE
0.12 LEMEK LANE
0.14 PAMELA COURT
0.33 FOREST LANE
1.46 CIDER MILL ROAD & CONNECTOR
0.17 FIELDSTONE COMMONS
9.26 TOTAL

#35
JOE LADONE
2002 WESTERN STAR
6 WHEEL DUMP W/ALL SEASON BODY (6-8 CY)

1.64 PETER GREEN ROAD
0.58 BURBANK ROAD
0.60 DOYLE ROAD
0.42 LAKEVIEW HEIGHTS
0.10 LAKEVIEW DRIVE EXT.
0.37 BIRCH HILL DRIVE
0.76 HIGH RIDGE DRIVE
0.36 AUSTIN DRIVE
0.18 BENNETT DRIVE
0.11 JOE SABBATH DRIVE
0.31 HILLTOP ROAD
0.45 CRESTWOOD ROAD
0.78 ROBIN CIRCLE
0.38 CARRIAGE DRIVE
0.43 PILGRIM DRIVE
0.17 ALDEN CIRCLE
0.10 RAISCH DRIVE
7.74 TOTAL

Appendix B Truck Route List (continued)

#13
KUCKO CONSTRUCTION
INTERNATIONAL
6 WHEEL DUMP W/SLIDE IN SPREADER (5 CY)

3.23 SHENIPSIT LAKE ROAD (RT 74 TO BROWNS BRIDGE RD)
0.04 HARE ROAD
0.89 HURLBUT ROAD
0.20 STONEHEDGE DRIVE
0.38 CERVENS ROAD
0.98 EATON ROAD
0.83 WILLIE CIRCLE
0.21 SAND HILL ROAD
0.34 KINGSBURY AVENUE
0.40 ELLINGTON ROAD (TO LAST HOUSE)
0.59 GOTTIER ROAD
8.09 TOTAL

#14
R & A EXCAVATION
INTERNATIONAL
6 WHEEL DUMP W/SLIDE IN SPREADER (5 CY)

1.43 KOZLEY ROAD
0.71 WILLIAMS WAY
0.11 LOUISE DRIVE
0.13 CLIFFORD AVENUE
0.16 WHITE ROAD
0.36 MIDLAND DRIVE
0.41 BROOKMOOR ROAD
0.42 CANDLEWOOD DRIVE
0.86 BARSTOW LANE
0.34 EASTVIEW TERRACE
0.34 DUNN HILL ROAD
1.16 BALD HILL ROAD
0.17 OLD BURBANK ROAD
0.22 SHORES DRIVE
0.25 LEELA WAY
0.18 SHANTI PLACE
0.18 ZOEY PLACE
7.43 TOTAL

#15
HIPSKY CONSTRUCTION
INTERNATIONAL
6 WHEEL DUMP W/ALL SEASON BODY (6-8 CY)

2.75 BUFF CAP ROAD #1
0.44 BUFF CAP ROAD #2
0.37 FERNWOOD ROAD
0.09 FIDDLEHEAD DRIVE
1.07 NORTH RIVER ROAD
0.74 CHARDONNAY LANE
0.49 MERLOT WAY
0.30 ZINFANDEL ROAD
0.30 JUSTIN WAY
0.89 DEREK DRIVE
0.21 MELISSA WAY
0.35 DONNA MAE LANE
1.78 BABCOCK ROAD
9.78 TOTAL

#16
DEMPSEY CONSTRUCTION
INTERNATIONAL
6 WHEEL DUMP W/SLIDE IN SANDER (5 CY)

1.22 SLATER ROAD
2.05 PLAINS ROAD (SLATER RD TO BABCOCK)
0.41 DOE RUN
0.10 FAWN TRAIL
0.09 YEARLING LANE
0.16 WHITETAIL WAY
0.39 BUCKS CROSSING
0.26 STAG TRAIL
1.19 CHARLES STREET
0.12 FLORENCE DRIVE
0.45 DEERWOOD ROAD
0.43 MOUNTAIN LAUREL DRIVE
0.18 RUDNANSKY LANE
0.30 SETTLERS WAY
0.21 LORRAINE DRIVE
0.48 ROBBIE ROAD
0.19 CURTIS DRIVE
0.17 STEVENS ROAD
0.13 OAKWOOD LANE
0.13 PINEGROVE DRIVE
8.66 TOTAL

Appendix C Map of Tolland Roads

Appendix D List of Parking Lots/Sidewalks maintained by the Town of TOLLAND

Schools
Tolland High School
Tolland Middle School
Tolland Intermediate School
Old Parker School
Birch Grove Primary School

Fire Stations
Fire House 140
Fire House 240
Fire House 340
Fire House 440
Training Center

Town Buildings
Town Hall/Library
Senior Center
Teen Center
Board of Education Building
Park Garage
Dunn Hill Garage
The Lodge
Tolland Jail
Dog Pound
Summit Well House
Tower at Bald Hill
Arts of Tolland
Entrance by Big Y

Parks
Heron Cove
Crandall's Park
River Park/Well House

Cemeteries
South Cemetery
North Cemetery
Valley View Cemetery

Appendix E Daily Vehicle Report Form

DAILY VEHICLE REPORT

TOWN OF TOLLAND DEPARTMENT OF PUBLIC WORKS

Odometer / hour meter Start _____ Finish _____ Reg. Hours _____ Veh. No. _____

Next Service Due _____ O.T. Hours _____

Character of Work and Materials:

Location: _____ Materials: _____ No. of Loads: _____

Additional Comments: _____

Pre-Start and Safety Check-Please Check ✓:

1. ENGINE:
   - ❑ Oil Level and Condition
   - ❑ Coolant Level and Condition
   - ❑ Drive Belts
   - ❑ Water Separator
   - ❑ No Fluid Leaks
   - ❑ P / S Fluid Level
   - ❑ Overall Engine Appearance
   - ❑ No Loose Lines, Hoses, Etc.

   Comments:

2. WALK AROUND:
   - ❑ Headlights
   - ❑ Tail / Brake Lights
   - ❑ Tires
   - ❑ Grills, Bumpers, Mounted Equip.
   - ❑ Left Side Body
   - ❑ Right Side Body
   - ❑ Overall Appearance, Cleanliness

   Comments:

3. START-UP / ENGINE OPERATION:
   - ❑ Starter Operation
   - ❑ Oil Pressure
   - ❑ Warning Systems / Lights
   - ❑ Horn
   - ❑ Heater or AC
   - ❑ Wipers / Washers
   - ❑ Seat Condition / Adjustment
   - ❑ Mirrors
   - ❑ Clutch
   - ❑ Parking Brake
   - ❑ Service Brakes
   - ❑ Safety Items / First Aid Kits
   - ❑ High Beams / Low Beams

   Comments:

Additional Remarks or Job Comments:

Please return this trip summary and inspection form in to the Road Foreman at the close of the day or shift. Attach any additional receipts or paperwork as appropriate.

Date: _____ Signature: _____

II.C Materials (Road Salt) Management Plan

II.C.1 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 **TOLLAND**'s policy to create a reasonable balance among cost, safety and environmental responsibility with its snow and ice control operations.

II.C.2 Situational Analysis

TOLLAND is not aware of any locations within the zone of influence of highway salting where road salt is creating severe negative environmental effects.

II.C.3 Salt Management Plan

TOLLAND will utilize "best practices" as the primary tool in salt management.

II.C.3.a Highway Use

TOLLAND 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 and road temperature control.

- Acquire technology to assist in better defining weather and road conditions.

- Conduct operations in an efficient and effective manner.

- Use pre-wetting of salt when operationally necessary.

- Train **TOLLAND** employees in the use of appropriate snow and ice control procedures and the importance of salt management.

- Use the principles of **CONTINUOUS IMPROVEMENT.**

II.C.3.b Non-Highway Considerations

- **TOLLAND** stores all its salt and sand/salt mixtures under structural cover.

- Trucks will be loaded only to a point below where spillage is likely to occur.

- All trucks and spreaders will be washed in the wash bay inside where appropriate waste water controls are in place.

- All salt spillage in the yard will be cleaned up ASAP.

II.D Pre-Winter Activities

II.D.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 **TOLLAND** 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.D.2 Review Emergency and Severe Weather Response Procedures

TOLLAND road closure and reopening procedures should also be reviewed with all personnel likely to be involved. Procedures for redeploying resources should be reviewed and coordinated within and among work areas. Arrangements, lodging and food for **TOLLAND** personnel during emergencies should be arranged at this time. Other procedures that should be reviewed include chain control, internal and external communications, and command and control. Any emergency contracts and

cooperative and resource arrangements among **TOLLAND** Departments, the National Weather Service, other local governments, CONN DOT, and all levels of applicable emergency management should also be reviewed.

II.D.3 Equipment Readiness

All of **TOLLAND**'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. In accordance with a capital equipment replacement plan, trucks will be replaced on a scheduled basis.

II.D.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.D.3.b Material Spreader Readiness

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

II.D.3.c Liquid Materials Dispensing Systems

TOLLAND 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.

II.D.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 replacements 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.D.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 springs. Windshield wipers should be new or near new at the start of the winter maintenance season.

II.D.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, flashlights, flags, flares, warning devices, gloves, hard hats, ice scrapers and snow brushes/brooms.

II.D.4 Personnel Readiness

II.D.4.a Acquisition and Assignment

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

II.D.4.b Training

Snow and ice control training should be accomplished prior to the snow and ice control season. Training topics include, at a minimum: intra-**TOLLAND** 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.

II.D.5 Materials Readiness

II.D.5.a Contracts

TOLLAND acquires most snow and ice control materials through the contract process. Given the time required to establish a contract, these requirements, 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.D.5.b Materials Storage Structure

Most **TOLLAND** snow and ice control chemicals are stored in a structure. This structure and associated run-off containment features, lighting systems and ventilation systems should be inspected and repaired as necessary. It should be filled to working capacity prior to the snow and ice season.

II.D.6 Emergency Readiness

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

II.D.7 Highway System Readiness

Various elements of **TOLLAND**'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.D.8 Maintenance Facility Readiness

Certain features of **TOLLAND**'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.D.9 Road and Weather Information System Readiness

TOLLAND has acquired a variety of systems and measuring devices to help in defining road and weather conditions. These include: hand-held pavement temperature measuring devices, NOAA weather band radios and other internet weather forecast providers. 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.D.10 Public and Customer Readiness

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

II.D.11. Communication Systems

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

II.D.12. Responsibilities of Connecticut State Police Associated with Snow and Ice Events

The State Police should be able to provide to the Public Works Department with timely notification and description of the following snow/ice/weather conditions:

- 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

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

As **TOLLAND** 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.E.1 Elements of Snow and Ice Control Decision Making

II.E.1.a Status of Assets

Assets for snow and ice control operations include: personnel, internet, 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 alternative methods.

II.E.1.b Weather Information

II.E.1.b.1 Weather Forecasts

There are a variety of weather forecast products available to **TOLLAND**'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 air temperature, dew point, wind speed, wind direction and cloud cover.

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

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

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

Other weather data sources include radar (from DTN, Internet and local TV), NOAA radio, the Weather Channel, computer acquired current condition data from upstream storm locations, local TV and radio, etc.

II.E.1.c Highway and Pavement Information

II.E.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.E.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 are even more important.

II.E.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.E.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.E.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. Operators should fill out a Daily Vehicle Report (DVR) form and return to the crew leader the work day after storm event. DVR form can be found in Appendix E.

II.F Snow Control

II.F.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 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 **TOLLAND** maintenance 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.
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 **TOLLAND**'s 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-de-sacs.

- To the extent possible, plow snow beyond the point where it could melt and run back across the highway.

- Plowed snow shall not be cast into traffic.

- Cast snow downwind to the extent possible.

- In the cul-de-sacs, cast snow away from the driveways to the extent possible. This is less demanding on the property owners and facilitates more efficient general route plowing.

- The travel lane around cul-de-sacs will be plowed, the center will remain snow. The snow will be removed from the center of the cul-de-sac when snow precipitation has ended.

- 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.

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.F.2 Safety Restoration and Cleanup Operations (Snow Removal)

After the entire **TOLLAND** 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. This work will generally be performed on a "regular time" basis. Coordination of this work with interfacing agencies and other **TOLLAND** 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.

- Areas having reduced sight distances for customers and plow operators.

- 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.

II.F.3 Drainage Restoration

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

II.G 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

also includes providing temporary friction improvement by spreading abrasives (sand) and abrasives/chemical mixtures and using delayed or no-treatment options when appropriate.

II.G.1 Ice Control Strategies

There are four basic ice control strategies used by **TOLLAND;** 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.G.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.G.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.G.1.c Temporary Friction Improvement

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.

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

II.G.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.G.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, which 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.G.2.c Ice Control Chemical Terms

Form- The physical state of the chemical, usually solid or liquid.

Gradation- A characterization of 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.G.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 lane mile 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.G.3 Ice Control Chemicals

TOLLAND uses a number of ice control chemicals in both the liquid and solid form. Most of them and their properties appear in Table 4. Other chemicals are often added to sodium chloride, magnesium chloride and calcium chloride to reduce their corrosion potential and aggressiveness toward other materials. The resulting products go by a variety of trade names.

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 4 and Figure 1. How much ice melted per unit of common chloride chemicals, at various temperatures, appears in Table 5.

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 4. 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

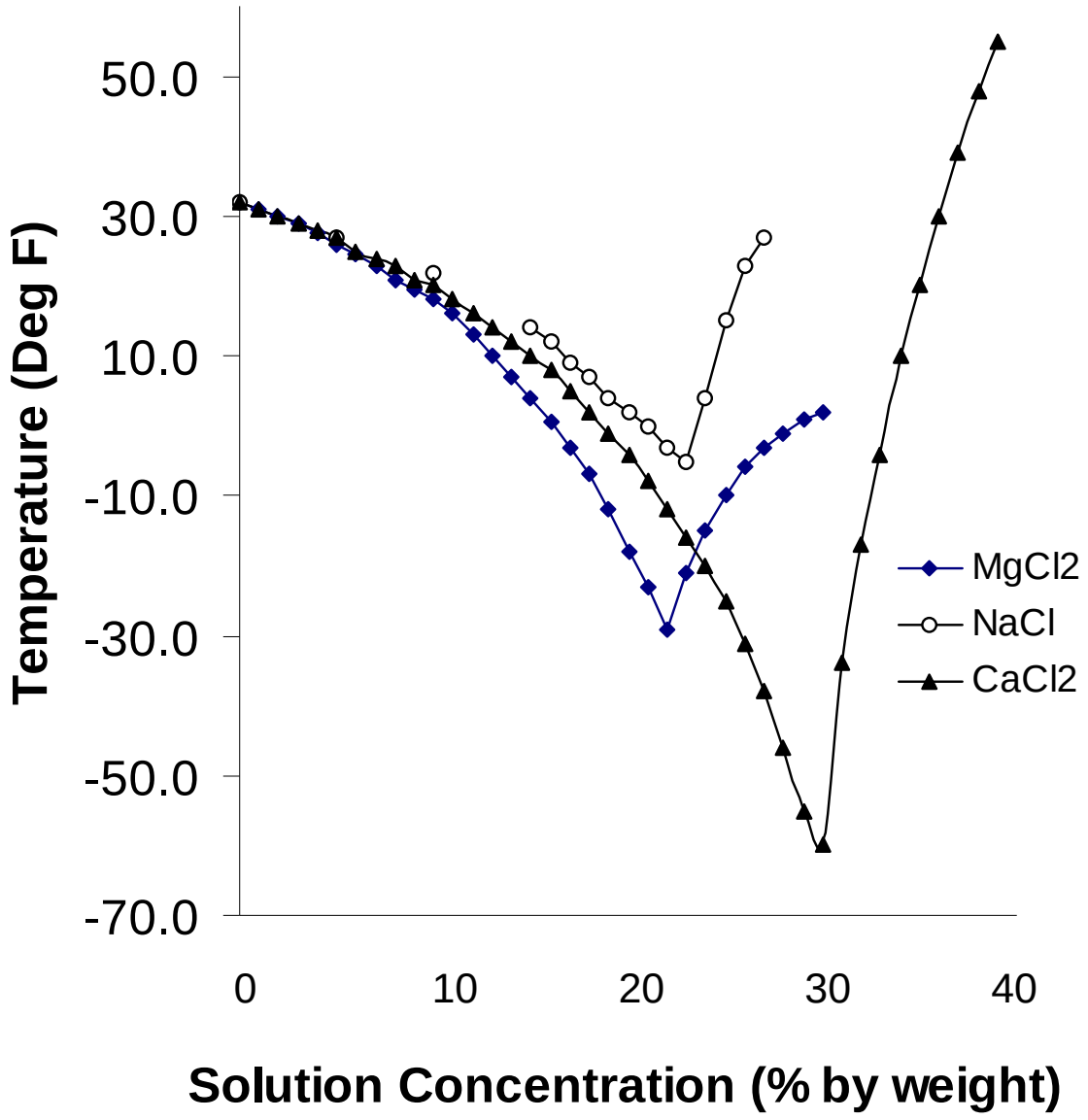


Figure 1. Phase Diagram for Ice Control Chemicals. Values plotted are not precise and are shown for illustrative purposes. These values have been estimated from the phase diagram shown in the FHWA *Manual of Practice for an Effective Anti-icing Program*.

Table 5. MELTING ABILITY AND TEMPERATURE FOR CHLORIDE CHEMICALS

Temperature		Units of Ice Melted Per Unit of 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.G.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. **TOLLAND** is currently using calcium chloride solution for pre-wetting.
The use of pre-wetting is most effective in storms having pavement surface temperatures above about 12°F and when necessary to spread material on packed, icy or dry pavement. Using pre-wet solid ice control chemicals on pavements having sufficient available moisture (loose snow,

slush, water) and warmer temperatures (above 23°F) will not significantly improve the effectiveness of the solid ice control chemical.

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

II.G.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°F to 40°F 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
Just as 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.G.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 longer 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 no ice-pavement bond:

- A spray of water will be produced 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 both 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.G.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.G.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 **TOLLAND** policy;
- Present pavement temperature;
- Trend of the pavement temperature;
- Is the remaining snow or ice before treatment bonded to the surface?
- Traffic volume and timing.

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 6 (Recommended Ice Control Treatments) summarizes the most recent available guidance for ice control. 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.G.5.b.

Table 6 – Recommended Ice Control Treatments

**SALT APPLICATION RATE TABLE

TEMPERATURE RANGE, DEG. F	BONDED APPLICATION RATE, LBS./LM	UNBONDED APPLICATION RATE, LBS/LM
30+	300	150
25-30	400	200
20-25	450	225
15-20	500	250
BELOW 15	600*	275
* DUE TO EXCESSIVE REQUIREMENT, CONSIDER A SAND/SALT MIX		

**Modified by the author from table A-5 on page A-6 in NCHRP Report 526 "Snow and Ice Control: Guidelines for Materials and Methods", Transportation Research Board, Washington DC, 2004

II.G.7 Application of Ice Control Chemicals and Abrasives

II.G.7.a 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. We may pre-treat parking areas and walkways.

THE WORST CASE SCENARIOS
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.

II.G.7.b Applying Abrasives (Anti-Skid) and Abrasives (Anti-Skid)/Chemical Mixtures

- The application rate (when necessary) shall be 700 pounds per lane mile on higher traffic volume roads and 400 pounds per lane mile on lower traffic volume roads. To achieve these rates use salt spreading rate settings of 560 pounds per lane mile and 320 pounds per lane mile, respectively.

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- Abrasives and mixes should be spread reasonably uniformly across the travel lanes, within the confines of the plowed path.

11.G.8 Material Spreading Equipment

Material 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.

There are a variety of solid material spreader types used by **TOLLAND**. These include V-Box (slide-in or frame mount) and all season bodies.

II.G.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. All trucks will be calibrated by Supervisor and Consultant. See Appendix F for Calibration Chart.

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.

Appendix F Calibration Chart

CALIBRATION CHART (US)

Agency: _____

Location: _____

Truck No: _____ Spreader No: _____

Date: _____ By: _____

Gate Opening or setting			(inches or number)	DISCHARGE RATE (pounds discharged per mile)								
	A	B	C	TRAVEL SPEED AND COMPUTATION MULTIPLIER ( )								
Control Setting	Shaft RPM (Loaded)	Discharge per Revolution (pounds)	Discharge per Minute (lb) (A x B)	5 mph (x 12.00)	10 mph (x 6.00)	15 mph (x 4.00)	20 mph (x 3.00)	25 mph (x 2.40)	30 mph (x 2.00)	35 mph (x 1.71)	40 mph (x 1.50)	45 mph (x 1.33)
1			-		-		-	-	-	-	-	-
2			-	-	-	-	-	-	-	-	-	-
3			-	-	-	-	-	-	-	-	-	-
4			-	-	-	-	-	-	-	-	-	-
5			-	-	-	-	-	-	-	-	-	-
6			-	-	-	-	-	-	-	-	-	-
7			-	-	-	-	-	-	-	-	-	-
8			-	-	-	-	-	-	-	-	-	-
9			-	-	-	-	-	-	-	-	-	-
10			-	-	-	-	-	-	-	-	-	-
11			-	-	-	-	-	-	-	-	-	-

THE ACTUAL APPLICATION RATE (POUNDS PER LANE MILE) **ON THE HIGHWAY IS THE DISCHARGE RATE DIVIDED BY THE NUMBER OF LANES BEING TREATED**

SPREADER CALIBRATION PROCEDURE

Calibration is simply calculating the pounds per mile discharged for each control setting at various travel speeds by first counting the number of auger or conveyor shaft revolutions per minute, measuring the weight of salt discharged in one revolution, then multiply the two to obtain discharge per minute, and finally multiplying the discharge per minute by the time it takes to travel 1 mile. Most spreaders have multiple gate openings; so you must calibrate for specific gate openings.

Equipment needed:

1. Scale to weigh salt
2. Salt collection device
3. Marking device
4. Watch with second hand

Calibration steps:

1. Remove, by-pass or turn off spinner.
2. Warm truck's hydraulic oil to normal operating temperature with spreader system running.
3. Put partial load of salt on truck.
4. Mark shaft end of auger or conveyor.
5. Dump salt on auger.
6. Rev truck engine to operating RPM.
7. Count number of shaft revolutions per minute at each spreader control setting, record.
8. Collect salt discharged for one revolution, weigh it and deduct the weight of the container. (For greater accuracy, collect salt for several revolutions and divide by that number of revolutions to get the weight for one revolution.)
9. Multiply Column A by Column B to get Column C; then multiply Column C by the number of minutes to travel one mile ( ) at various truck speeds to get pounds Discharged per mile.*

*example: at Control Setting 2, w/ a shaft RPM of 3, a discharge of 18 lbs. per revolution and a speed of 20 mi/hr, the computation is: 3 x 18 x 3.00 = 162 lb/mi.

CALIBRATION OF AUTOMATIC CONTROLS

Automatic controls may be calibrated using the following steps:

1. Remove, by-pass or turn of spinner.
2. Set control on given number.
3. Tie sack or heavy canvas under spreader discharge area.
4. Mark specific distance on a highway or other paved area, such as 1000 ft. .
5. Drive that distance with spreader operating.
6. Weigh salt collected.
7. Multiply weight of salt by 5.28 (in case of 1000 ft.).

Result will be salt discharged per mile which remains constant regardless of speed, but calibration must be done for each control setting. Some automatic control manufacturers have "simulators" which eliminate need for on-road operation for calibration.

Pre-wetting systems also require calibration. Here, the pre-wetting 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.G.8.b Spread Pattern Control

Most commercial material spreaders have the capacity of adjusting the spread pattern they deliver. The most common device for spreading solid materials is a vaned spinner plate. The distance material 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.

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.G.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.H Post-Storm Activities

II.H.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.H.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.I Post Season Activities

II.I.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 **TOLLAND**-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.I.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.I.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.I.4 Continuous Improvement Activities

TOLLAND is committed to continuous improvement of all of its operations. Snow and ice control is no exception. Forums available at all levels of **TOLLAND** include:

- Direct communication with the office of the Public Works Operations Manager;
- Task specific employee meetings;
- Suggestion program;
- Customer interaction;
- Transfer of best practices or successful innovations (internal and/or external to **TOLLAND**); and
- Training- These are the current training activities utilized by **TOLLAND:**
    - Pre-Season Snow/Ice Control Training
    - Pre-Season Snow/Ice Control Training for Contractors

III. CONTINGENCY PLAN

In the event that salt is no longer available or our budget no longer allows, **TOLLAND** will use the available sand/salt mix which may diminish the level of service required.

GLOSSARY OF SNOW AND ICE CONTROL TERMS

SNOW PLOW TERMS

Air Foil- A device placed on the back of a dump body or material spreader that redirects and accelerates air passing over the truck. This is intended to keep the rear of the truck and material 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 snow 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 de-icing operation. When anti-icing methods are properly employed, they can achieve high levels of service for sustained periods of time.

De-icing- This is a reactive strategy for dealing with snow or ice that has already bonded to the pavement surface. De-icing 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.

Anti-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/De-Icing 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 various levels of service and available equipment conditions; hazards and special treatment areas are usually identified.

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 material spreading.

MATERIAL SPREADER TERMS

Application Rate- The amount of material being discharged per lane mile by the spreader or distributor (pounds per lane mile or gallons per 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 material 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 per 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 CONDITION 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 above 32^{o} 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 from the falling drops is observable just above surface.

Moderate Snow- Snow falling at a rate of ½ inch to 1 inch 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.