Winter Maintenance
Snow and Ice Control
– Module 2 –

PRESENTED BY:
DELAWARE T² CENTER
Introduction

In this module:

- Snow and ice removal plan
- Standard operating procedures
- Route maps/assignments
- Review and updating plans periodically
- Budgeting
- Acquiring and renting equipment
- Recordkeeping
- Preparing elected officials
- Preparing the public
He who fails to plan...

...is planning to fail

Winston Churchill
Planning Documents

- Snow and Ice Control Ordinance, Resolution, or Policy
  - Elected official level, typically

- Winter Maintenance Plan
  - Senior management
  - Consultation with staff

- Standard Operating Procedures (SOPs)
  - Senior management
  - Consultation with staff
Winter Maintenance Ordinance

- Might be an ordinance, a resolution, a policy
- Who is in charge?
- Authority hierarchy between agencies like Public Works, the Police Department, Fire and Rescue teams, etc.
- When is snow and ice removal activity initiated?
  - Some depth of snow?
  - What about ice?
  - How much ice?
  - Who makes this call?
- Expectation of street adjoiners for maintenance of sidewalks and curb ramps?
- Levels of Service?
Snow and Ice Removal Plan

- **Objectives**
  - Safety
  - Performance
  - Cost effectiveness
  - Environmental protection
  - Accessibility
  - Economic protection

- **Levels of service**
  - Define...
  - But leave room for response to conditions on the ground
Snow and Ice Removal Plan

- Level of Service
- Areas of Responsibility
- Winter Organization Chart
- Public Policies
- Storm Warning System
- Snow Map
- Personnel Policies
- Material Policies
- Equipment Policies

- Equipment Policies
- Operations Policies
- Intergovernmental Agreements
- Public / Media Relations

Winter Operations: Survival Lessons for Public Officials
Winter Maintenance Training – Delaware T² Center
Snow and Ice Removal Plan

- **Levels of service - variables**
  - Snow...or ice? Or both? Or one then the other?
  - Heavy, wet snow or light fluffy snow?
  - Ice source - sleet or freezing rain? Or black ice?
  - When did it last precipitate? How much residue is left?
  - Pavement temperature prior to storm?
  - Early winter, mid winter, or late winter?
  - Weather conditions before, during, and after?
  - Manpower availability, overtime issues?
  - Equipment up-time
  - Material storage and inventory
Snow and Ice Removal Plan

• **Levels of service**
  - Targets **during** the storm
  - Tougher goals **after** the storm
  - “Doable” and practical
  - Optimal after the storm
    - ‘Bare pavement maintenance’ - driveway to destination
Snow and Ice Removal Plan

- **Levels of service – elements**
  - Bare pavement, 75% bare, 50% bare, passable one lane...
  - Throughout storm, 2 hours after, 8 hours after, next day...
  - Two lanes passable, just one...
  - Hours of response activity – 24 hours/day, 12 hours...
  - ADT driven response – constant clearing for >2,000 ADT, daytime clearing only below 200 ADT...
  - Treatment for ice – hills, intersections, school areas...
  - Remember our Seattle DOT example from Module 1
Snow and Ice Removal Plan

- Levels of service
  - Bare pavement maintenance
    - Plow and deicer (and/or anti-icing)
  - Center bare only
    - Limited plow and deicer
  - Plow roads, treat intersections
    - Plow and deicer or abrasives
  - Snowpack roads
    - Plow and abrasives (traction)

- Levels of Service
  - Centerline bare
  - Wheel path bare
  - Loose snow covered (percent area and depth)
  - Packed snow covered (percent area and depth)
  - Bare (percent area)
  - Thin ice covered (percent area)
  - Thick ice covered (percent area)
  - Dry
  - Damp
  - Slush (percent area and depth)
  - Frost
  - Wet

NCHRP Report 526
Snow and Ice Control: Guidelines for Materials and Methods
Levels of service

| Condition 1: | All snow and ice are prevented from bonding and accumulating on the road surface. Bare/wet pavement surface is maintained at all times. Traffic does not experience weather-related delays other than those associated with wet pavement surfaces, reduced visibility, incidents, and "normal" congestion. |
| Condition 2: | Bare/wet pavement surface is the general condition. There are occasional areas having snow or ice accumulations resulting from drifting, sheltering, cold spots, frozen melt-water, etc. Prudent speed reduction and general minor delays are associated with traversing those areas. |
| Condition 3: | Accumulations of loose snow or slush ranging up to (2 in.) are found on the pavement surface. Packed and bonded snow and ice are not present. There are some moderate delays due to a general speed reduction. However, the roads are passable at all times. |
| Condition 4: | The pavement surface has continuous stretches of packed snow with or without loose snow on top of the packed snow or ice. Wheel tracks may range from bare/wet to having up to (1.5 in.) of slush or unpacked snow. On multiline highways, only one lane will exhibit these pavement surface conditions. The use of snow tires is recommended to the public. There is a reduction in traveling speed and moderate delays due to reduced capacity. However, the roads are passable. |
| Condition 5: | The pavement surface is completely covered with packed snow and ice that has been treated with abrasives or abrasive/chemical mixtures. There may be loose snow of up to (2 in.) on top of the packed surface. The use of snow tires is required. Chains and/or four-wheel drive may also be required. Traveling speed is significantly reduced and there are general moderate delays with some incidental severe delays. |
| Condition 6: | The pavement surface is covered with a significant buildup of packed snow and ice that has not been treated with abrasives or abrasive/chemical mixtures. There may be (2 in.) of loose or wind-transported snow on top of the packed surface due to high snowfall rate and/or wind. There may be deep ruts in the packed snow and ice that may have been treated with chemicals, abrasives, or abrasive/chemical mixtures. The use of snow tires is the minimum requirement. Chains and snow tire equipped four-wheel drive are required in these circumstances. Travelers experience severe delays and low travel speeds due to reduced visibility, unplowed loose, or wind-compacted snow, or ruts in the packed snow and ice. |
| Condition 7: | The road is temporarily closed. This may be the result of severe weather (low visibility, etc.) or road conditions (drifting, excessive unplowed snow, avalanche potential or actuality, glare ice, accidents, vehicles stuck on the road, etc.). |
Snow and Ice Removal Plan

- Levels of service

<table>
<thead>
<tr>
<th>Highway segment</th>
<th>LOS class</th>
<th>PSIC</th>
<th>Maximum snow accumulation (in.)</th>
<th>PSIC</th>
<th>Hours after end-of-event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route</td>
<td>Mile post</td>
<td></td>
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<tr>
<td>15</td>
<td>2-25</td>
<td>2</td>
<td>3</td>
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<td>8</td>
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<td>16</td>
<td>37-51</td>
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<td>4</td>
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<td>256-271</td>
<td>3</td>
<td>4</td>
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<td>32-50</td>
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<td>Main Street</td>
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<tr>
<td>Baxter Bridge</td>
<td>–</td>
<td>1</td>
<td>1</td>
<td>0.0</td>
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</tr>
</tbody>
</table>

NCHRP Report 526
Snow and Ice Removal Plan

• Priorities
  - Traffic volume (ADT)
  - Type of street (subdivision, side, collector, arterial)
  - Condition and known problem areas of streets
  - Evacuation routes
  - School bus, transit, and other collection/distribution routes
  - Facilities for emergency responders (including your own)
  - Traffic convergence areas
  - Historic storm challenges (like drifting or flooding)
Snow and Ice Removal Plan

- **Performance measure**
  - **Indices**
    - e.g., amount of time a pavement is, say, <95% bare
    - 1 hour out of a 10 hour storm = 10%
    - i.e., higher is **not** better in this case
    - Consider the psychology of these
  - Miles plowed per hour
  - Tons material spread
  - Time from end of event to bare pavement or other condition
  - Safe achievable speed of travel at some time after event (perhaps as % of posted)
  - Customer satisfaction surveys
Snow and Ice Removal Plan

- Factors that influence performance results
  - Funding – of course, but what else?
  - Contingency resources
    - “Office” personnel as second seaters
    - Contractors
  - Optimal routes
  - Training
  - Public outreach – get them on your side
Snow and Ice Removal Plan

- **Performance analyses and reporting**
  - Don’t wait for others to do this – take the initiative
  - Know what the targets, milestones, metrics are – take charge in developing them
  - The metrics may have to be broken down by storm type
  - Think about whether they should be published in your plan
  - Frame the terms of success and then target your operation towards achieving it
• Take away point - Flexibility
  ○ You can’t avoid accountability – you shouldn’t try
  ○ But performance measures have to be reasonable
  ○ Any criteria must recognize that, like snowflakes, no two storms are alike
Snow and Ice Removal Plan

- **Manpower**
  - Generate lists with 24-hour contact info (including contractors)
    - Who is on call, when?
    - Expected response time?
  - Telephone/text/email/pager/Twitter tree
  - Identify process for meals
    - Paid for or on their own?
    - When? Who determines?
    - Time paid for?
  - Rest facilities
  - Incident procedures
Snow and Ice Removal Plan

- **Manpower**
  - Shift considerations
  - Limits on work hours
  - Effect of injuries or sick employees
  - Auxiliary personnel
    - Sewer/water department
    - Parks/recreation department
    - Solid waste department
    - Specialty crews (bridge, signs, weed control, etc.)
    - Office personnel
    - Temporary/seasonal
Snow and Ice Removal Plan

- **Manpower**
  - Reporting for duty
    - On call – who is and what does that mean?
    - Communications – tell them what is expected
    - Work rules – unions or not – what are they?
    - Can they get there when called?
    - Overtime pay, premium pay, minimum call in pay
  - Taking care of family
    - Can’t (generally) during the storm
    - Prepare in advance to the extent possible
    - Arrange for friends and family to take care of the homestead
  - Drug and alcohol policy
Snow and Ice Removal Plan

• **Manpower**
  - Uniforms and gear
    - Severe weather gear
      - From boots to gloves to hats
      - Designed to keep them warm and dry
    - Safety gear
      - Safety vests, hard hat, ear protection
      - Fire extinguishers
  - Emergency gear
    - Basic tools
    - Flashlight
    - First aid kit
    - Flares and/or triangles
Snow and Ice Removal Plan

**Equipment**
- Trucks
- Plows
- Wheel loaders
- Material spreaders
- Brine distributors
- Motor graders
- Snow blowers
- Hydraulic sweepers
- Snow melters

**Support Equipment**
- Welders and torches
- Wrecker/haulers
- Transport trailers
- Fuel trucks
- Mechanics trucks
- Salt/sand barns/bins
- Brine mixing tanks
Snow and Ice Removal Plan

- **Equipment inventory**
  - Agency owned
  - Contractor owned
  - Borrowed from sister agency
  - Rental equipment
  - Contingency equipment
  - Location
  - Size, capacity, capability
  - Condition
  - Inventory of spare parts, consumables (cutting edges)
Snow and Ice Removal Plan

- Trucks
- Motor graders
- Loaders
Snow and Ice Removal Plan

- **Trucks**
  - Ample horsepower
  - Suitable tires
  - Heavy duty axles
  - Built for strength and endurance

Winter Maintenance Training – Delaware T² Center

Winter Maintenance Equipment – LTAP and Salt Institute

Photo: Andrew Ciscel

Photo: Wayan Vota
Snow and Ice Removal Plan

• Motor Graders
  o Good visibility
  o Heavy duty, durable
  o Versatile
  o Can be fitted with all types of plows

Winter Maintenance Equipment – LTAP and Salt Institute

Winter Maintenance Training – Delaware T² Center
Snow and Ice Removal Plan

• Loaders
  o Can handle all types of plows
  o Maintaining storage areas
  o Loading trucks
  o Snow removal
    ▸ Downtown streets
    ▸ Cul-de-sacs
    ▸ Bridges
    ▸ Heavy drifts

Winter Maintenance Equipment – LTAP and Salt Institute  Winter Maintenance Training – Delaware T² Center
Snow and Ice Removal Plan

- **Plows**
  - Types
  - Trip type blades
  - Blade materials
  - Accessories
    - Shoes, skids, etc.
    - Snow deflectors
    - Guards, guides
    - Lights, heaters
Snow and Ice Removal Plan

- One way plows
Snow and Ice Removal Plan

- Reversible plows
Snow and Ice Removal Plan

- Airport plows

Winter Maintenance Equipment – LTAP and Salt Institute

Winter Maintenance Training – Delaware T² Center
Snow and Ice Removal Plan

- Variable geometry plows
Snow and Ice Removal Plan

- Under body plows
- Wing plows
Snow and Ice Removal Plan

- **V-plows**
  - Used in heavy snow accumulations
  - Effective for clearing drifts
  - Great for sidewalks too
Snow and Ice Removal Plan

- Snow pushers/box plows
  - Clearing large areas
  - Parking lots, etc.
Snow and Ice Removal Plan

- **Trip blades**
  - Less shock to equipment/operator
  - Allows faster speeds
Snow and Ice Removal Plan

- Cutting edge materials
  - Steel
  - Carbide inserts
  - Ceramic inserts
  - Rubber
  - Polymer
Snow and Ice Removal Plan

- Rubber cutting edges
Snow and Ice Removal Plan

- **Plow accessories**
  - Shoes, skids, wheels, casters
  - Snow deflectors
  - Plow guards
  - Curb guards
Snow and Ice Removal Plan

- Plow accessories
  - Plow markers
  - Wing extensions
  - Plow lights
  - Plow heaters
Snow and Ice Removal Plan

- **Snow melters**
  - Rare to nonexistent here
  - Still...pretty cool

Stationary: 1200 tons per hour

Stationary: 20 tons per hour

Stationary: 40 tons per hour
Snow and Ice Removal Plan

- **Snow melters**
  - Portables
  - Different sizes
  - High energy use
  - Control discharge water

Winter Maintenance Equipment – LTAP and Salt Institute

- Stationary: 20 tons per hour
- Stationary: 500 tons per hour
- Stationary: 40 tons per hour

Winter Maintenance Training – Delaware T* Center
Snow and Ice Removal Plan

- Material spreaders
  - V-box
  - Tailgate
  - Tow behind
  - Dual dump
  - Zero velocity
Snow and Ice Removal Plan

- V-box spreaders
  - Steep slides minimize material hang-up
  - Restricts truck use during winter operations

Winter Maintenance Equipment – LTAP and Salt Institute
Winter Maintenance Training – Delaware T² Center
Snow and Ice Removal Plan

- Tailgate spreaders
Snow and Ice Removal Plan

- Tow behind spreaders
Snow and Ice Removal Plan

- Dual dump spreaders
  - This approach provides truck traction
  - Chute approach drops material at crown; as brine forms, material moves across road

Winter Maintenance Equipment – LTAP and Salt Institute

Winter Maintenance Training – Delaware T² Center
Snow and Ice Removal Plan

- Zero velocity spreaders
Snow and Ice Removal Plan

- Spreader alternatives

Video

White Gold – New England Chapter APWA

Winter Maintenance Training – Delaware T² Center
Snow and Ice Removal Plan

- Spreader controls
  - Manual
  - Computer operated
  - Automatic

Winter Maintenance Training – Delaware T^2 Center
Winter Maintenance Equipment – LTAP and Salt Institute
# Snow and Ice Removal Plan

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Light Snow</th>
<th>Moderate Snow</th>
<th>Severe Snow</th>
<th>Moderate Ice</th>
<th>Severe Ice</th>
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<tbody>
<tr>
<td>Tri-axle Truck/Plow/Spreader</td>
<td></td>
<td></td>
<td>C</td>
<td></td>
<td>C</td>
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<td>1-Ton Dump/Plow/Spreader</td>
<td>O</td>
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<td>O, C</td>
<td>O</td>
<td>O, C</td>
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<td>½-Ton Pickup/Plow</td>
<td>O, B</td>
<td>O</td>
<td>O, C</td>
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<tr>
<td>Loader</td>
<td>O, B</td>
<td>O, B</td>
<td>O, C</td>
<td>O</td>
<td>O, C</td>
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<tr>
<td>Skid Steer/Broom</td>
<td>O, B</td>
<td>O</td>
<td>O, R</td>
<td>O</td>
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<tr>
<td>Mower/Plow/Broom</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
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<tr>
<td>Motor Grader</td>
<td></td>
<td></td>
<td>C, R</td>
<td></td>
<td></td>
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<tr>
<td>Loader-mounted Snow Thrower</td>
<td></td>
<td></td>
<td>C</td>
<td></td>
<td></td>
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<tr>
<td>Welder</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
</tbody>
</table>

Key: O – Own; C – Contracted; B – Borrow; R – Rent
Snow and Ice Removal Plan

GPS

- May already have it on some of your equipment
- Can tell you a lot about where your equipment is, has been
- Can reduce communications traffic
- Can help you move resources – you may be able to see in real time on a screen where they are relative to a problem area
- Can aid with performance measures
- Can refute erroneous accusations from the public
• Equipment maintenance
  o In-house maintenance garage
    - Dedicated mechanics
  o Ad hoc in-house maintenance
    - Dilution of snow fighting resources?
  o Private sector mechanics
    - Will they be open on-demand?
Snow and Ice Removal Plan

- **Equipment washing**
  - Need to wash equipment
    - Minimize corrosion
    - Improve operating efficiency
    - Extend useful life
  - Salt, sand, oils, greases on equipment is considered a pollutant
  - Hosing it down in the equipment yard releases those pollutants to the environment
  - DNREC says “nay, hay”
  - Equipment wash bay
  - Commercial equipment washing facilities
  - Wastewater collected, recycled, treated
Snow and Ice Removal Plan

- **Towing and recovering equipment**
  - Contract with local tow company
  - In-house wrecker
  - Tow chains, winches, etc.
- **Safety**
  - Chains, cables, tow straps, winches – dangerous
  - Slips, flying cables/chains
  - Pinch points for hand and body
  - No time for rushing around
  - No place for cowboys
  - Do it right and everybody comes back with ten fingers
Snow and Ice Removal Plan

- **Fueling locations**
  - Your own tanks/pumps
  - Other agency tanks/pumps
  - Commercial fueling stations
  - Reliably available in emergency situations?

- **Power outage contingencies**
  - Ice storms particularly dicey for power outages
  - Communications concern
  - Heating concern at facilities
  - Lighting for yard operations
Snow and Ice Removal Plan

- **Equipment storage**
  - Diesel engines
    - Block heaters
    - Enclosed garages
    - Heated garages
  - Off-season storage of plows, spreaders, brooms
    - Protection – rust, corrosion, physical damage, clogged/damaged hoses
    - Security (theft)
  - In-season location of plows, spreaders, brooms
    - Quick connection
    - Security (theft)
    - Protection – corrosion, physical damage, clogged/damaged hoses
Snow and Ice Removal Plan

• **Material storage**
  
  o **Site considerations**
    - Vicinity to the work
    - Size, maneuverability, ingress/egress
  
  o **Storage type**
    - Barn, silo, igloo, covered stockpile
    - Impervious floor/pad, protected from precipitation
  
  o **Material capacity**
    - 100% average annual usage – desired
  
  o **Abrasives treatment**
    - Typically 3-5% salt blended

AASHTO Guide for Snow and Ice

Winter Maintenance Training – Delaware T Center
Snow and Ice Removal Plan

- **Freeze point depressants**
  - Rock salt (NaCl)
  - Calcium magnesium acetate (CMA)
  - Magnesium chloride (MgCl)
  - Calcium chloride (CaCl)
  - Potassium acetate (KA)
  - Magic Salt

- **Abrasives**
  - Sand
  - Sand/salt mixtures
Snow and Ice Removal Plan

- Safety effect of chemicals

Traffic Accident Rates Before and After Salt Spreading

**Legend**
- Black square: All Traffic Accidents
- Black circle: Injury

Accidents per MVMT vs. Relative Hour

- Two data sections indicated:
  - Before salt spreading:
  - After salt spreading:

Accident Analysis of Ice Control Operations  Winter Maintenance Training – Delaware T² Center
Salt
- Specifications
  - Standards
  - Gradation
  - Moisture
  - Anti-caking agents
- Advantages
- Deicing / anti-icing
- Prewetting
- Equipment
- Storage & handling
- Environmental safety
Other chemicals
- Calcium chloride
- Magnesium chloride
- Natural or processed brines
- CMA (calcium magnesium acetate)
- Other proprietary materials
Snow and Ice Removal Plan

Recap – common road treatment materials

- Salt (Sodium chloride)
- Calcium Chloride
- Magnesium Chloride
- Potassium Chloride
- Brines (by-product of gas production)
- Potassium Acetate
- Calcium Magnesium Acetate
- Urea
- Agricultural By-products
- Other Proprietary Materials
- Abrasives

Natural Occurring Salts
Snow and Ice Removal Plan

- **Chemicals**
  - Specifications
  - Material Safety Data Sheet (MSDS)
  - Talk to other users
    - Effectiveness
    - Concerns
    - Problems
Material Storage

- Proper storage of materials is essential - specifically chemical storage
- Sufficient capacity and proper containment or cover are necessary
Snow and Ice Removal Plan

- Major points of good salt storage
  - Sufficient capacity
  - Inside storage, if possible
  - Outside piles properly shaped & covered
  - Impermeable pads
  - Proper drainage with containment as required
  - Good housekeeping
  - Structurally sound
Snow and Ice Removal Plan

Photo: Clear Span Fabric Structures
Snow and Ice Removal Plan

- Salt Institute’s “S.A.L.T.E.D. principles
- A sort of “best practices” for material storage facilities

<table>
<thead>
<tr>
<th>S.A.L.T.E.D.</th>
<th>Salt Institute’s Storage Site Suggestions</th>
<th>ClearSpan Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>- Good visibility for operators</td>
<td>- Sturdy, long-lasting buildings</td>
</tr>
<tr>
<td></td>
<td>- No direct access to heavily traveled roads</td>
<td>- Made with American-made steel</td>
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<td></td>
<td>- Warning signs at entrances</td>
<td>- Great visibility due to the natural light the fabric lets inside</td>
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<tr>
<td></td>
<td>- Security fencing</td>
<td>- No echoes to confuse or disrupt work flow</td>
</tr>
<tr>
<td></td>
<td>- Safety for the surrounding environment</td>
<td></td>
</tr>
<tr>
<td>Accessibility</td>
<td>- Easy access for equipment and delivery</td>
<td>- Structures can be left open ended</td>
</tr>
<tr>
<td></td>
<td>- Big enough for front-end loaders</td>
<td>- Doors that are large enough for vehicle clearance can be added</td>
</tr>
<tr>
<td></td>
<td>- Room for a 20-foot extension</td>
<td>- Can build a pony wall to increase structure’s height/sidewall clearance</td>
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<tr>
<td></td>
<td>- Doors large enough to accommodate equipment</td>
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<tr>
<td>Legality</td>
<td>- Comply with local zoning ordinances</td>
<td>- Engineered, stamped drawings</td>
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<tr>
<td></td>
<td>- Required discharge permits</td>
<td>- Follow wind and snow load regulations</td>
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<tr>
<td></td>
<td></td>
<td>- Building permits may not be required</td>
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<tr>
<td>Tidiness</td>
<td>- Make buildings as attractive as possible</td>
<td>- Can be customized with different colors</td>
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<tr>
<td></td>
<td>- Keep buildings well maintained</td>
<td>- No shadows</td>
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<tr>
<td></td>
<td>- Good housekeeping around the storage site</td>
<td>- Can add dividers inside building</td>
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<td></td>
<td>- Screening the storage site with fencing</td>
<td>- Can also store vehicles and other needed equipment</td>
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<tr>
<td>Economics</td>
<td>- Permanent covered storage</td>
<td>- Can be moved, if necessary</td>
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<tr>
<td></td>
<td>- Locate storage site to avoid long-distance hauling</td>
<td>- Covered enclosure prevents salt loss</td>
</tr>
<tr>
<td></td>
<td>- Good drainage away from the stockpile</td>
<td>- Allows greater storage capabilities</td>
</tr>
<tr>
<td></td>
<td>- Sloping bituminous pads containing runoff</td>
<td>- Energy efficient, environmentally safe</td>
</tr>
<tr>
<td></td>
<td>- Installing retention curbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Disposing salt brine in conformance with applicable federal and state regulations and local ordinances</td>
<td>Any type of drainage can be added or built within structure, if desired</td>
</tr>
<tr>
<td>Drainage</td>
<td></td>
<td>- Can install retention curbs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Ventilation options available, if needed</td>
</tr>
</tbody>
</table>
Improper storage can only lead to problems!
Snow and Ice Removal Plan

- Open faced storage should include covering of the material face to isolate it from the elements.
Snow and Ice Removal Plan

Angle of Repose

1 cubic foot salt = 80 pounds
or 1 cu. yd. = 2160 lbs.

1 ton of salt requires 25 cubic feet of storage
Snow and Ice Removal Plan

- **Snow fence**
  - Not used as much in Mid-Atlantic
  - **Theory**
    - Cause snow to drift downwind of the fence
    - Cause an eddy to form behind the fence
    - Velocity differentials cause snow to drop in place
  - Labor and material intensive
  - Use where drifting can cause serious problems
  - Vegetation (line of spruce trees, etc.) can be an effective, natural snow fence
    - Attempt to work together with adjoining property owner for mutual benefit

Winter Maintenance Training – Delaware T^2 Center
**Snow and Ice Removal Plan**

- **Snow fence**
  - Snow Drift: Max height at 6H equal to 1.5H, max length 35H (H = fence height)
Snow and Ice Removal Plan

- Living snow fence
Snow and Ice Removal Plan

- **Voice and data systems**
  - Telephones – you know, land lines
  - Cellular phones, text, emails – but not while driving!
  - Equipment radios
  - GPS
    - Fleet tracking
    - Mobile weather monitoring
    - Plow and material usage
  - Weather stations/monitoring
  - Performance analysis/reporting

---

AASHTO Guide for Snow and Ice

Winter Maintenance Training – Delaware T² Center
Snow and Ice Removal Plan

- **Communications**
  - Internal communications (intra-agency)
    - Crew level
    - Agency wide
  - Semi-internal communications (inter-agency)
    - Informal relationships
    - Mutual aid agreements
  - Senior management and elected officials
  - Public
    - Get out ahead of the frustrations - engage
  - The media
  - Who else?
Snow and Ice Removal Plan

• **Chain of command**
  - There really must be someone in operational control during events
  - Incident Command approach
  - All due respect, elected officials and senior management need to step back at that point and entrust the operation to the command structure
  - Flexibility? Yes, but...
  - Procedures, rules, limits must be respected
  - No room for cowboys or rogue operations
  - Everyone should know who is in charge of what
Snow and Ice Removal Plan

• Snow emergency routes
  ○ Delaware Manual on Uniform Traffic Control Devices (MUTCD), Section 2B-46
  ○ Consistent, correct signage = better enforceability
Snow and Ice Removal Plan

- Route planning
  - Route maps
    - Priority routes versus secondary versus...
  - Streets
  - Parking lots
  - Pedestrian pathways
- Crew assignments
- Equipment assignments
- Contingencies

WINTER STORM OPERATIONS
SNOW PLOWING
KUBOTA UTILITY TRUCK # 901
2009-2010

DURING STORM PUSH PATHS IN THESE AREAS

1. Admissions Building:
   - Plaza area on North side of building
   - Sidewalk from S. College Ave. into the parking lot
   - Sidewalk from entrance of building on north side to parking lot
   - Sidewalks along S. College Ave. north to Kent Way
2. Smith Hall Bridge ramp from end of bridge to Amstel Ave. (LIFT PLOW AT EXPANSION JOINT)
3. Sidewalk from Amstel Ave. to Orchard Road
4. Center for the Arts Building:
   - Sidewalk from Amstel Ave to parking garage entrance
   - Sidewalk from parking garage underneath colonnade to start of building
   - Sidewalk from building past flagpoles to Amy DuPont Music Building and north to Amstel Ave
   - Sidewalks between Amy DuPont and CFA and around great lawn area
   - South side entrance of Amy DuPont Music Bldg.
   - Sidewalks on south side of CFA at circle
   - Sidewalks on west side of CFA at service entrances
5. Amy DuPont Music Building main sidewalk from doors to Orchard Rd.
6. Alfred Learner Hall sidewalks:
   - Amstel Ave. sidewalk
   - Orchard Rd, sidewalk from Amstel Ave. to Delaware Ave.
7. Start again at # 1 when this point is reached when this point is reached until doing last pass completely when storm is over.
8. Clean-up all sidewalks, plazas, and/or fire lanes throughout the entire route.
9. Assist other areas as directed when this point is reached on list and/or as directed by manager.

AFTER STORM IS OVER PUSH THE ABOVE AREAS OFF COMPLETELY TO THEIR EDGES
Snow and Ice Removal Plan
# Snow and Ice Removal Plan

<table>
<thead>
<tr>
<th>SNOW ROUTE</th>
<th>GEORGE LOMAS TRUCK #990 PLOW &amp; SPREADER</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREA 3-1</td>
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<table>
<thead>
<tr>
<th>ROAD</th>
<th>MILEAGE</th>
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<tbody>
<tr>
<td>ABRAHAMS ROAD</td>
<td>0.23</td>
</tr>
<tr>
<td>CRAIGTOWN ROAD</td>
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<tr>
<td>BARTON ROAD</td>
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<tr>
<td>PLEASANT VIEW CHURCH ROAD</td>
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<tr>
<td>FUNK ROAD</td>
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<tr>
<td>DIAMOND JIM ROAD</td>
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<tr>
<td>RED BARN ROAD</td>
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<tr>
<td>MANOR ROAD</td>
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<tr>
<td>PRESTON DRIVE</td>
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<tr>
<td>COKESBURY ROAD</td>
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<tr>
<td>FRENCHTOWN ROAD</td>
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<tr>
<td>ST MARKS CHURCH ROAD</td>
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<tr>
<td>MT ARARAT FARM ROAD</td>
<td>MD RTE 222 TO FRENCHTOWN</td>
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<tr>
<td>HAPPY VALLEY ROAD</td>
<td>OFF MD RTE 222</td>
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<td>LEBRUN ROAD</td>
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<tr>
<td>JACKSON STATION</td>
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<tr>
<td>RESERVOIR ROAD</td>
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<td>OLD HAWLEY ROAD TO BRIDGE</td>
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<tr>
<td>HAWLEY ROAD</td>
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<tr>
<td>GONCE ROAD</td>
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<tr>
<td>COUDON BLVD</td>
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<tr>
<td>CEDAR CORNER</td>
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<tr>
<td>MILL CREEK ROAD</td>
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<tr>
<td>GILLEY ROAD</td>
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<td>PRINCIPIO STATION</td>
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<tr>
<td>PATTERSON AVENUE</td>
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<tr>
<td>PEACOCK LANE</td>
<td>OFF CRAIGTOWN RD</td>
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<tr>
<td>ROBIN DRIVE</td>
<td>OFF CRAIGTOWN RD</td>
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**TOTAL MILEAGE**: 16.21

<table>
<thead>
<tr>
<th>FIRE STATIONS</th>
<th>STATION 72 - ABRAHAMS ROAD</th>
<th>PORT DEPOSIT, MD</th>
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<tr>
<td></td>
<td>STATION 8 - 920 PRINCIPIO FURNACE ROAD</td>
<td>PERRYVILLE, MD</td>
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<tr>
<td></td>
<td>STATION 16 - 16 JR DAWSON DRIVE</td>
<td>PERRYVILLE, MD</td>
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<table>
<thead>
<tr>
<th>SECONDARY ROUTE</th>
<th>BELVIDERE ROAD</th>
<th>PRINCIPIO ROAD</th>
<th>THEODORE RD TO BLYTHEDALE RD</th>
<th>FAIRVIEW DRIVE</th>
<th>WINCHESTER COURT</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>2.46</td>
<td></td>
<td>2.95</td>
<td>0.06</td>
<td>0.13</td>
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</table>

**TOTAL MILEAGE**: 5.68

<table>
<thead>
<tr>
<th>AREA</th>
<th>DRIVER / CONTRACTOR</th>
<th>TRUCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>George Lomas</td>
<td>990 COUNTY TRUCK PLOW &amp; SPREADER</td>
</tr>
<tr>
<td>3-2</td>
<td>Richard Bittner</td>
<td>992 COUNTY TRUCK PLOW &amp; SPREADER</td>
</tr>
<tr>
<td>3-3</td>
<td>Mike Cox</td>
<td>989 COUNTY TRUCK PLOW &amp; SPREADER</td>
</tr>
<tr>
<td>3-3A</td>
<td>Robert Peoples</td>
<td>977 COUNTY TRUCK PLOW</td>
</tr>
<tr>
<td>3-4</td>
<td>Josh Hoderfield</td>
<td>979 COUNTY TRUCK PLOW &amp; SPREADER</td>
</tr>
<tr>
<td>3-5</td>
<td>Mark reeder</td>
<td>910 COUNTY TRUCK PLOW AND V-BOX</td>
</tr>
<tr>
<td>3-6</td>
<td>Mike’s Lawn</td>
<td>ONE TON PLOW AND SPREADER</td>
</tr>
<tr>
<td>3-7</td>
<td>Mike Madron</td>
<td>991 COUNTY ONE TON PLOW &amp; SPREADER</td>
</tr>
<tr>
<td>3-7A</td>
<td>Riverview</td>
<td>PICK UP TRUCK PLOW ONLY</td>
</tr>
<tr>
<td>3-8</td>
<td>Sammy Craig</td>
<td>980 COUNTY TRUCK PLOW &amp; SPREADER</td>
</tr>
<tr>
<td>3-9</td>
<td>Riverview</td>
<td>ONE TON WITH V-BOX</td>
</tr>
<tr>
<td>3-10</td>
<td>Russell trucking</td>
<td>TRI AXLE PLOW AND SPREADER</td>
</tr>
<tr>
<td>3-11</td>
<td>Phil’s Lawncare</td>
<td>ONE TON PLOW AND SPREADER</td>
</tr>
<tr>
<td>3-12</td>
<td>Al Sallsbury</td>
<td>COUNTY PICK UP WITH PLOW</td>
</tr>
</tbody>
</table>

**Contractor**
- RUSSELL TRUCKING
- MIKE’S LAWN SERVICE
- PHIL’S LAWN CARE
- RIVERVIEW
Snow and Ice Removal Plan
Adoption

- The Snow and Ice Plan is written
- Now what?
- Adopt it
  - Publish it – newspaper, website, radio announcements
  - Stakeholder review
  - Public hearing/meeting
  - Adoption by local elected body
- Actually follow the plan
- Keep records of performance and usage
- Review and update it each year – each spring or summer
Standard Operating Procedures

These may already be written – reference them
Otherwise, write them
Examples
- Reporting for duty
- Plowing and salting procedures
- Safety procedures
- Public and press relations
- Dealing with abandoned/incapacitated vehicles
Budgeting

• The Snow and Ice Removal Plan tells you your needs:
  ○ Manpower
  ○ Equipment
  ○ Materials
  ○ Contractors
  ○ Facilities
  ○ Other support

• Your budget proposal should reflect those needs; no more, no less
Implementation

- Recordkeeping
  - Why?
    - Anticipation of reimbursement (declared emergencies)
    - Performance reporting
    - Revision of plan
    - Support program development, evolution, and resource needs
    - Defense against claims (tort and others)
Implementation

- **Recordkeeping**
  - **Types**
    - Preparation
    - Event
    - Manpower
    - Equipment
    - Materials
    - Contractors
    - Rentals
    - Maintenance/repairs
You’re Ready

- Your Snow and Ice Removal Plan is in place
- You’re properly budgeted for it
- You’re ready to implement it

- Time to talk about pre-season activities – Module 3
What is/are in the Other Modules?

• Module 1 – Introduction
  - General objectives of snow and ice control
  - Weather basics
  - Importance of training
  - Innovation and evolution
  - Safety, risk management, liability
What is/are in the Other Modules?

• **Module 3 – Pre-Season Activities**
  - Personnel training and refreshers
  - Stakeholder briefings
  - Contracting and material acquisition
  - Storage and handling materials
  - Equipment readiness
  - Crew and equipment assignments; practice runs
  - Snow markers and passive control devices
  - Check/clear drainage ways
  - Calibrate spreaders and other equipment
  - Public service announcements and bulletins
What is/are in the Other Modules?

- **Module 4 – Operations/In-Season Activities**
  - Chain of command
  - Inspect road conditions
  - Safety meetings
  - Plowing techniques
  - Abrasives and freeze point depressants
  - Weather information
  - Recordkeeping
  - Special areas

- Worst case weather scenarios
- Disabled, inoperative, abandoned vehicles
- Disposal of snow/environmental concerns
- Safety
- Day versus night operations
- Meals
- Dealing with the public
What is/are in the Other Modules?

- **Module 5 – Post Storm Activities**
  - Push back shoulders
  - Clear drainage ways
  - Refreezing
  - Maintain and clean equipment
  - Restoring safety features and sight distances
  - Removal of snow
  - Asset inventory
  - Interim pavement repairs
  - Assess performance and debrief
What is/are in the Other Modules?

- Module 6 – Post Season Activities
  - Inventory equipment and materials
  - Clean and repair equipment
  - Store equipment
  - Review of performance and safety statistics
  - Brief elected officials and bean counters
  - Plan for replenishment of materials
  - Road and shoulder repairs
  - Assess the season
  - Calibrate plan accordingly
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