Winter Maintenance
Snow and Ice Control
– Module 1 –

INTRODUCTION TO AND PLANNING FOR SNOW AND ICE CONTROL, TREATMENT, AND REMOVAL

Delaware
T²/LTAP

PRESENTED BY:

DELAWARE T²/LTAP CENTER

Delaware T²/LTAP Center

- T² Centers or LTAPs located in all 50 states
- Funded by FHWA and state DOTs
- Mission – promote training, tech transfer, research implementation at local level
- Delaware T² hosted by University of Delaware, part of Delaware Center for Transportation
- Delaware T² funded by FHWA and DelDOT

The Preliminaries

Today's Instructor:

- Matheu J. Carter, P.E.
  - Engineering Circuit Rider
  - Back when he actually worked…
    - Heavy construction
    - Design engineer
    - Public works director

Acknowledgements

Primary references:

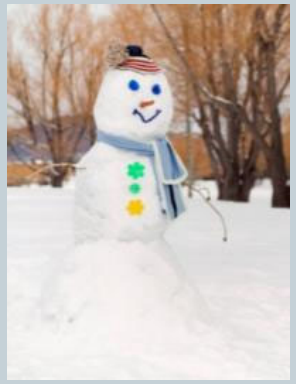
- AASHTO Guide for Snow and Ice Control
- APWA, New England Chapter
  - "Plow Power" and "White Gold"
- (former) Salt Institute
- National Local Technical Assistance Program (LTAP)
- Iowa Department of Transportation
- NCHRP
  - Report 526 - Snow and Ice Control: Guidelines for Materials and Methods
  - Report 577 - Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts

Introduction

GENERAL OBJECTIVE
WEATHER BASICS
IMPORTANCE OF TRAINING
INNOVATION AND EVOLUTION
SAFETY, RISK MANAGEMENT, LIABILITY
SNOW AND ICE REMOVAL PLAN
STANDARD OPERATING PROCEDURES
ACQUIRING AND RENTING EQUIPMENT

Objectives of Snow and Ice Removal

- Safety
  - Movement of emergency responders
  - Public safety
  - Safety of snowfighters
- Performance
  - Define levels of service and achieve them
- Cost effectiveness
- Environmental protection
- Accessibility, mobility, connectivity
- Economic vitality, tourism



Winter Weather Impacts

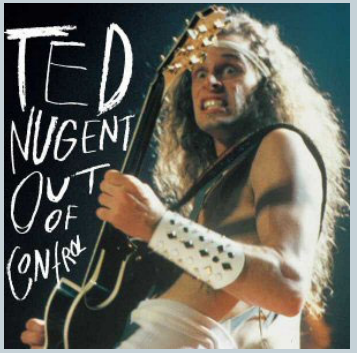
- Traffic crashes
  - Fatal
  - Non-fatal
  - Vehicles
  - Pedestrians

- Increased travel time, fuel costs
- Increased insurance premiums
- Decreased mobility
- Decreased productivity

Winter Operations

- Winter operations entail many “uncontrollable factors”
- Particularly when compared to other public works projects or programs

- What are these uncontrollable factors?



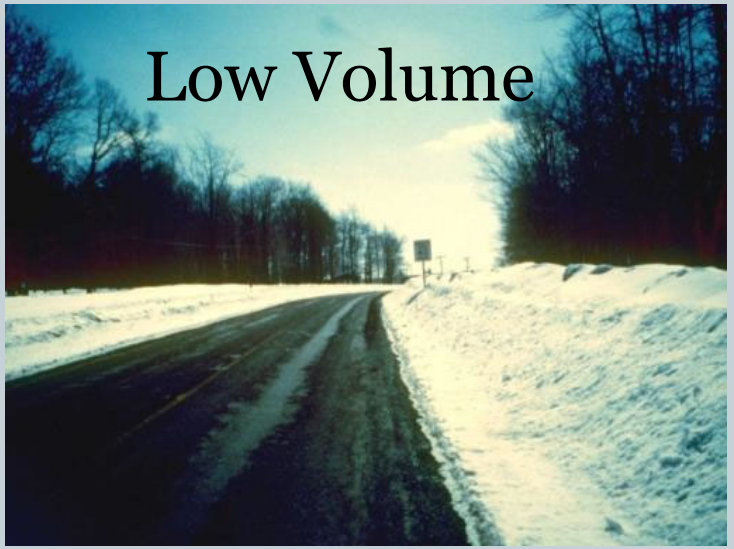
Weather Elements

- Amount of Snow
- Rate of Snow
- Duration of Snowfall
- Timing of Storm
- Temperature
- Wind Conditions
- Type of snow (wet/dry)

Road & Site Conditions

- Topography / Site Conditions

Traffic: Type, Speed, Volume



Drivers & Vehicles

- Driver Attitudes

- Stalled or Abandoned Vehicles

Elements of a Snow and Ice Control Program

- Goals and expectations, including levels of service
- Priorities for resource allocations and maintenance activities
- Fiscal accountability
- Recognition of legal responsibilities and constraints
- Environmental protection
- Public education/outreach
- Flexibility to react to changing conditions
- Opportunity to innovate and experiment

Levels of Service (LOS)

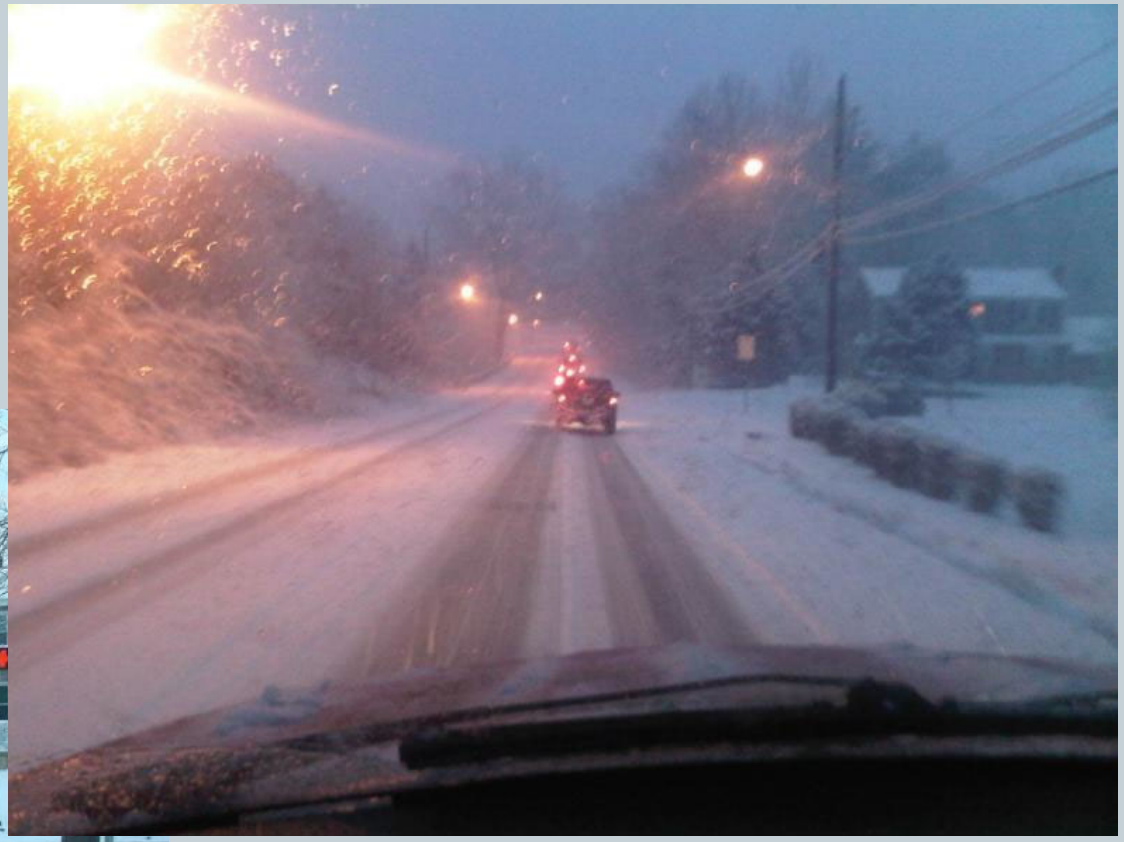
- Balance – must satisfy the public but be attainable
- Defines conditions at one or more stages
  - End of storm
  - Intermediate stages
  - Acceptable condition without action
- Requires many considerations
  - Local policy or ordinance limits
  - Road classifications and traffic volumes
  - Available equipment and materials and location of facilities
  - Personnel rules

Levels of Service (LOS)

- (Just) Examples

Classification	Traffic Volume (AADT)	Hours per Day of Response Activity	Level of Service
Urban Commuter	10,000-30,000	24	All lanes substantially bare pavement before coverage time reduced
Urban Collector	500-5,000	18	75% bare pavement
Urban Residential	200-500	12	75% bare pavement
Secondary Street	<800	12	One wheel path in each lane will have intermittent bare pavement with treated hills/curves before coverage time reduced

Levels of Service (LOS)



Levels of Service (LOS)

Levels of Service (LOS)

Environmental Considerations

- Things to think about
  - Controlling runoff from roadway operations
    - Streams
    - Groundwater
    - Vegetation
    - Habitat
    - Bridges, pavement, appurtenances
  - Storage of abrasives and chemicals
  - Protecting employees from chemical and abrasives dangers
  - Minimizing air quality impacts

Weather Basics

- Snow
  - Ice crystals form gangs way up high and float down innocently
  - Sustained snowfall requires constant inflow of moisture
- Ice
  - Moisture gets on stuff that's cold – nobody likes that
- Black ice
  - Forms when the air temp is below freezing but warmer than the pavement temp (e.g., air at 30˚F and pavement at 26˚F)
  - Look for when the dew point and air temp converge - air can no longer hold the moisture – condenses on the pavement
- Sleet
  - Cold, deep layer of air at surface cause ice pellets as they descend
- Freezing rain
  - Water droplets fall from above-freezing layer to below-freezing layer

Weather Basics

- Recognizing what has happened, what is happening, and what is likely to happen…
  - Snow
  - Ice
  - Black ice
  - Sleet
  - Freezing rain
- Helps guide us what to do at any given point in the storm
  - Start treatment
  - Change treatments
  - Stop
  - Pause

Weather Basics

- Weather information to watch
  - Temperatures
    - Air
    - Pavement
    - Subsurface
  - Dew point
  - Wind
    - Speed
    - Direction
- Where do we find it
  - Weather Channel/weather.com
  - NOAA
  - DelDOT
  - On-site weather station
  - Finger in the air?

Importance of Training

- Improve our snow fighting forces
  - Efficiency
  - Consistency
  - Effectiveness
- Minimize damage to snow/ice fighting equipment
- Minimize damage to roadways, curbs, signs, sidewalks, mailboxes…
- Increase safety for
  - The snowfighter
  - The pedestrian
  - The motorists
  - The kids
  - The ATVer …

Importance of Training

- New equipment
- Crews
  - Personal protective equipment
- Materials handling
  - Vehicles and equipment
  - operations
- Policies
- Training
- Safety committee
- Tailgate safety talks

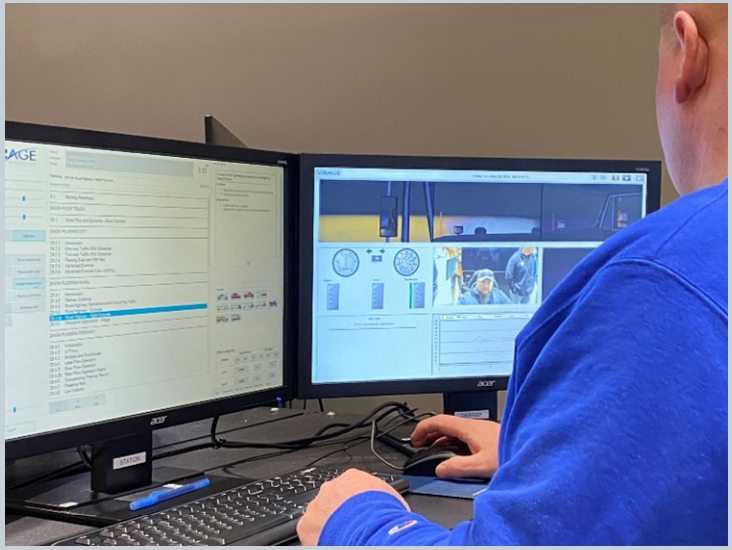
Importance of Training

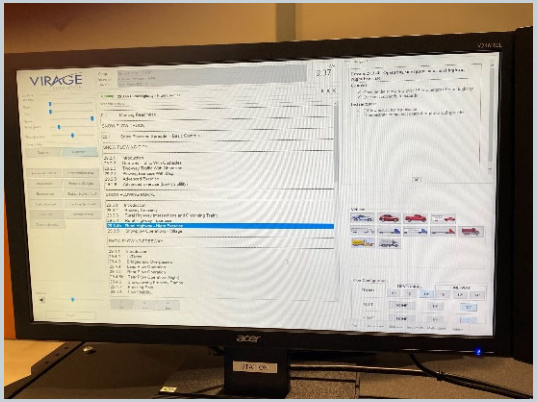
Simulator training

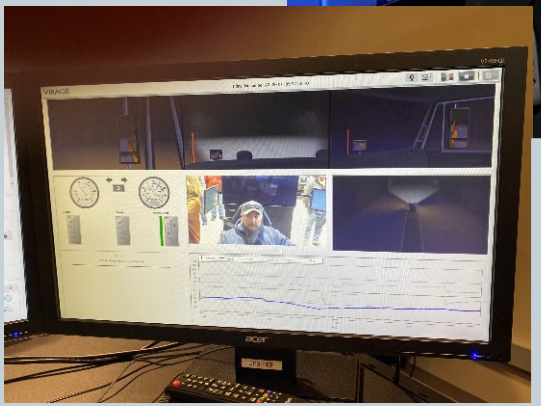
- Increased use in our area
  - Cecil County, Maryland
  - Elkton, Maryland
  - DelDOT, local agencies

Importance of Training

Simulator training







Delaware Technical Community College Simulator Center

(2) brand new state of the art simulators 2020 – stay tuned for course details

Training Resource

IOWA DOT
WINTER OPERATIONS

- Iowa Department of Transportation
  - Fully updated in 2019; available on the YouTube
  - 13 videos totaling 94 minutes – range from 3 – 15 minutes each
    - Introduction
    - Pre-season truck preparation
    - Pre-season plow preparation
    - Regular Equipment Checks
    - Proper Clothing
    - Snow Fences
    - Winging Techniques
    - Snow Plowing Techniques
    - Advanced Plowing Techniques
    - How Deicing Chemicals Work
    - AVL Truck Technology
    - Anti-icing and Deicing
    - Using Winter Weather Resources
  - Gather the crew in the shop once a week and watch the whole series – you can spare an average of 7 minutes a week!

See Entire Iowa DOT 13 Part Series on YouTube

The Worst Case Outcome


Delaware roads: Pedestrian dies after being struck by plow

Accident near Penny Hill under investigation

BY BETH MILLER • THE NEWS JOURNAL • JANUARY 28, 2011


2 reported dead from snow-related injuries in NJ

The Associated Press

TEXT SIZE


PEDESTRIAN CRASH

Man in critical condition after being hit by Frederick city plow

January 3, 2011 - 03:00 PM


Plows kill 2

JANUARY 28, 2011


Snow plow accident fatality in Trenton, NJ

January 27, 2011 | Trenton, New Jersey | Vetting explained


Police Have 'Person Of Interest' In Coach Death Probe

Richard Oles Died After Hit-And-Run Crash

POSTED: 2:27 pm EST January 27, 2011
UPDATED: 11:13 am EST January 28, 2011

Email Print
Comments (0)
Recommend 33


Long Island Woman Fatally Struck By Snow Plow Pickup

January 26, 2011 9:08 PM

Remember:
Protecting Pedestrians, Motorists, and Our Own Snowfighters is Job #1

Innovation, Experimentation, Evolution

- Organization and individual managers should be open to new ideas (and even old ideas that need a fresh look)
- Abrasives versus chemicals versus mixes
- Alternatives to traditional rock salt – use of other freeze point depressants
- Brines and anti-icing approaches
- Alternative equipment

Fostering Innovation and Evolution

- New equipment
- New materials
- New uses of traditional equipment/materials
- Different use of available personnel
- New outreach/communication methods
- Requirements of the Americans with Disabilities Act (ADA)
- Multi-modal objectives

Tort Liability

- Duty concerning snow and ice
  - Generally, courts say agencies have no duty to undertake precautionary or remedial action…
  - Urban governments may have greater duty to clear streets…
  - No duty to [clear snow…] in absence of weather hazard not reasonably apparent to person exercising due care…
  - No duty…to remove general accumulations unless agency has notice of a dangerous/hazardous condition caused by snow/ice

Tort Liability

- Duty concerning snow and ice (cont'd)
  - Duty to exercise reasonable care – alleviate or give warning
  - General rule – no duty to remove general accumulations…
  - Where notice of hazard, duty to exercise reasonable care…
  - Plaintiff has burden of proving duty owed, breach of duty, breach proximately caused incident, and agency had constructive or actual notice of the conditions

Tort Liability

- (Legal) duty must be measured by number of factors
  - Size of task (geography, etc.)
  - Severity of storm
  - Available resources
  - Practicality of treatment
- Plaintiff must demonstrate harm outweighed utility
- Most dangers are known to travelers – impossible not expected
- Liability may be based on agency-created defect
- But patch of ice by itself imposes no liability
- Not liable where agency exercised due diligence
- Duty to apply chemicals often considered reasonable care
- Summary – courts often impose duty of reasonable care

Tort Liability

- Trespass/Nuisance
  - Damage to abutting property by snow/ice operations
  - Sue for nuisance, trespass, or inverse condemnation
  - “Unreasonable or excessive” salting?
  - Might be treated as any other invasion of property or interference with quiet enjoyment
  - Court even entertained the notion that if injury is severe, it could constitute a “taking”
- Involve your legal counsel when in doubt

Safety, Risk Management, Liability

- Winter maintenance carries dangers, risks
  - Some risks we can control or affect; others not
  - Start by knowing the difference
  - Perhaps others can control things we cannot – law enforcement for example
- Obligation to operate safely and use safe equipment
  - No place for "cowboys"
  - Have all summer to check brakes, hydraulic lines, etc.
- Safety plan
  - Has to be sound, simple, straightforward
  - Has to apply to everyone in organization
  - Has to be clearly supported by all layers of management

Safety, Risk Management, Liability

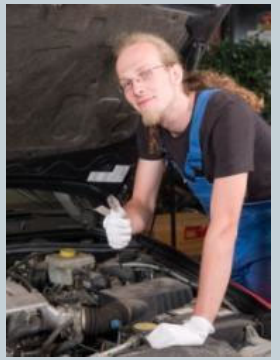
- Good safety plan can:
  - Reduce lost work time
  - Reduce equipment costs
    - Less repairs
    - Less equipment downtime
  - Reduce operating costs
    - Insurance premiums
    - Workman's Compensation
  - Increase productivity
  - Improve quality of service
  - Improve community relations
  - Increase employee stability, loyalty, and motivation

Safety, Risk Management, Liability

- Safety culture starts with management
  - Supervisors should be held accountable
- Recognize and correct unsafe behavior
  - Horseplay or improper equipment use creates risk
- Investigate crashes and near misses
  - No “witch hunt” necessary – just find out what happened
  - Make corrections, communicate with crews
- Develop standard operating procedures (SOPs)
- Safety rodeos and training
- Reward safety

Safety, Risk Management, Liability

- Equipment safety
  - Comprehensive vehicle maintenance – before storms
    - Brakes
    - Power trains
    - Hydraulic systems
    - Tires
    - Lights, wipers, mirrors
    - Dump body operations
    - Fluids
    - Cutting edges



  - Mechanical checks during and after storms
  - Many crashes come from mechanical failure or operator error – we can control both to a large degree
  - Breakdowns less likely – less downtime

Safety, Risk Management, Liability

- Safety gear
  - Tools for minor maintenance
  - Fire extinguishers
  - Retroreflective triangles, flares, or breakdown warning signs
  - Retroreflective vest (ANSI Class 3)
  - Gloves
  - Foul weather gear
  - Flashlights
  - First aid kit

Safety, Risk Management, Liability

- Drugs and alcohol
  - Should be no tolerance
    - Operators
    - “Second seaters”
    - Any other essential personnel
  - Commercial Drivers License (CDL)
    - DOT - Omnibus Transportation Employee Testing Act of 1991
    - Positive test – employee immediately removed from safety-sensitive functions
  - Don’t forget your contractors
    - They should comply with the same policies that you use

Multi-Modal

- Don’t forget – it’s more than just roads these days
  - Pedestrian pathways
  - Bicycle routes

Multi-Modal

- You don't necessarily have to do it by hand

Video – 12 seconds

Multi-Modal

- The intrepid cyclist
  - On a bike
  - In the snow
  - At night

Elected Officials – Jump In

- Get involved
  - Visit Your Public Works Facilities
  - Talk to Your Snowfighters
  - Ride a Plow Truck During a Winter Storm

Planning and Program Development

- SNOW AND ICE REMOVAL PLAN ELEMENTS
- STANDARD OPERATING PROCEDURES
- ROUTE MAPS/ASSIGNMENTS
- REVIEW AND UPDATING PLANS PERIODICALLY
- BUDGETING
- ACQUIRING AND RENTING EQUIPMENT
- RECORDKEEPING
- PREPARING ELECTED OFFICIALS
- PREPARING THE PUBLIC

Planning

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

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…

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

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

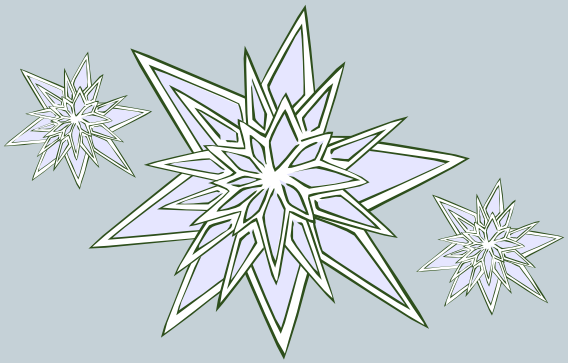
- Factors that influence performance results
  - Funding – of course, but what else?
  - Contingency resources
    - "Office" personnel as second seaters
    - Contractors
  - Optimal routes
  - Training
  - Pre-season pavement condition
  - Special situations
    - Depressed roads between two open fields – road closed
  - 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

Snow and Ice Removal Plan

- Take away point – Flexibility, Improvisation, Innovation
  - 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
  - Driver fatigue
    - Shift considerations
      - 12 on 12 off? Go till you drop? No right answer, but…
      - Driver fatigue is important safety issue and a liability concern
    - 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
    - Who provides – employee or employer?
      - Either way ok, but make sure everyone knows so they can be prepared
    - Severe weather gear
      - From boots to gloves to hats
      - Designed to keep everyone 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

Snow and Ice Removal Plan

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

Snow and Ice Removal Plan

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

- Multi-purpose tool carriers
  - Versatility

Snow and Ice Removal Plan

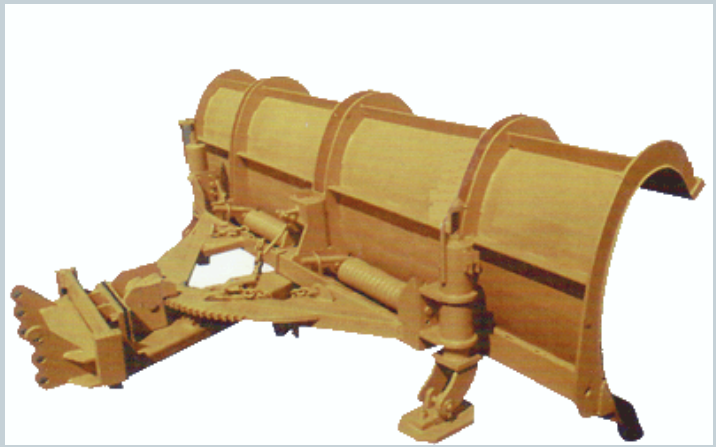
- Plows
  - Types
  - Trip type blades
  - Blade materials
  - Accessories
    - Shoes, skids, etc.
    - Snow deflectors
    - Guards, guides
    - Lights, heaters

Snow and Ice Removal Plan

- One way plows

Snow and Ice Removal Plan

- Reversible plows



Snow and Ice Removal Plan

- Airport plows

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 plaza areas
  - Parking lots, etc.

Snow and Ice Removal Plan

- Trip blades
  - Less shock to equipment/operator
  - Allows faster speeds

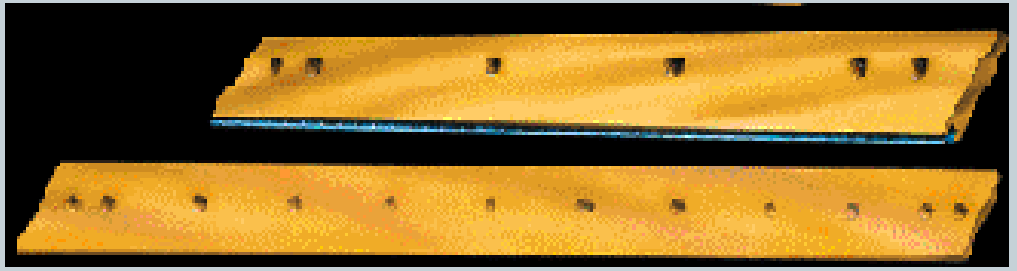
Snow and Ice Removal Plan

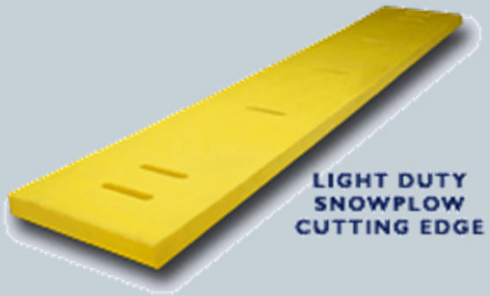
- Tow plows
  - Tow plow ~$100K
  - Plow truck ~$250K
  - 2 full lanes
    - Replaces 3 plow trucks
  - Used in high snow areas
    - Utah
    - Minnesota
    - Pennsylvania
    - Missouri, etc.
    - And now…Delaware

DelDOT's Tow Plow Innovation - YouTube

Snow and Ice Removal Plan

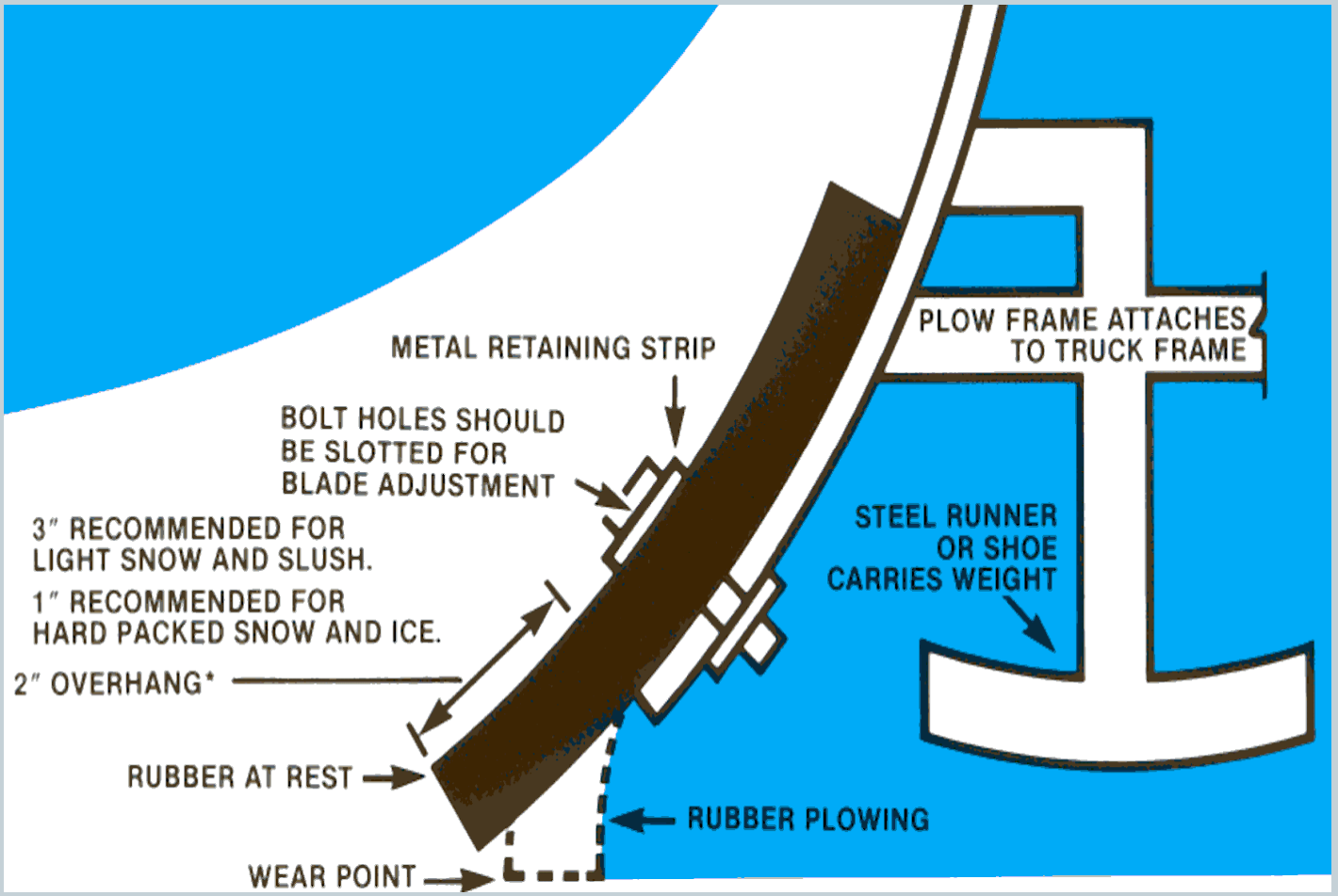
- Cutting edge materials
  - Steel
  - Carbide inserts
  - Ceramic inserts
  - Rubber
  - Polymer





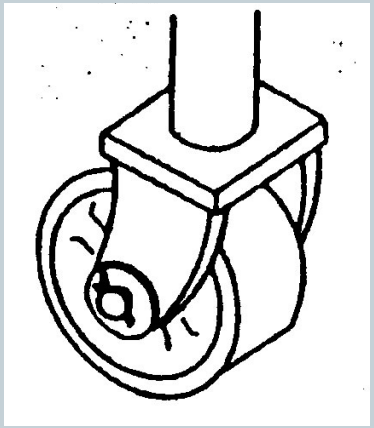
Snow and Ice Removal Plan

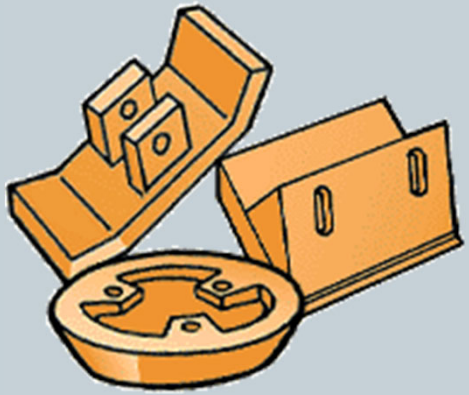
- Rubber cutting edges

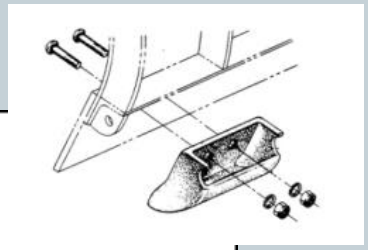


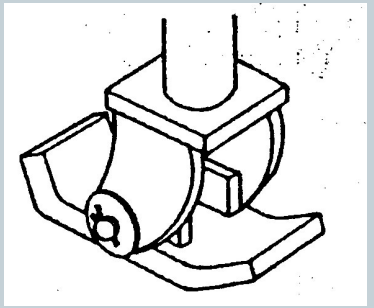
Snow and Ice Removal Plan

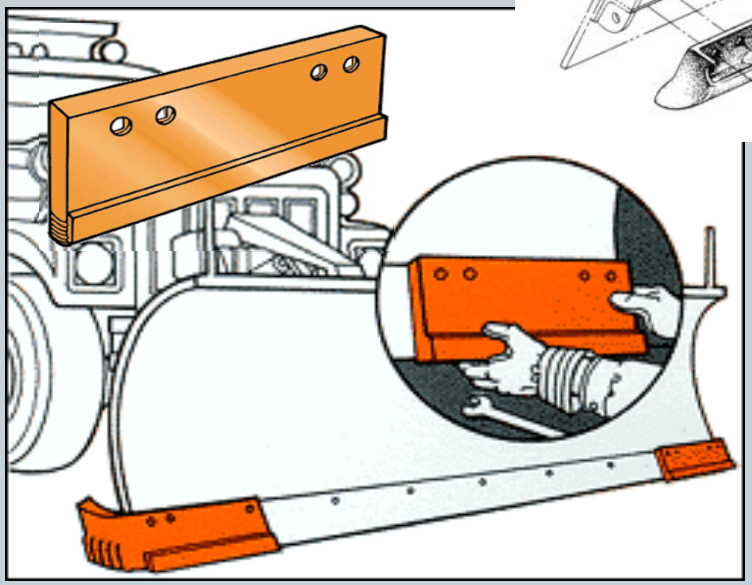
- Plow accessories
  - Shoes, skids, wheels, casters
  - Snow deflectors
  - Plow guards
  - Curb guards

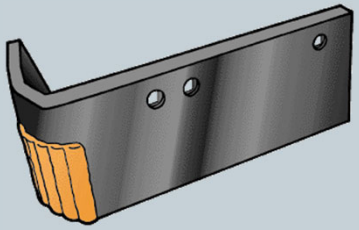


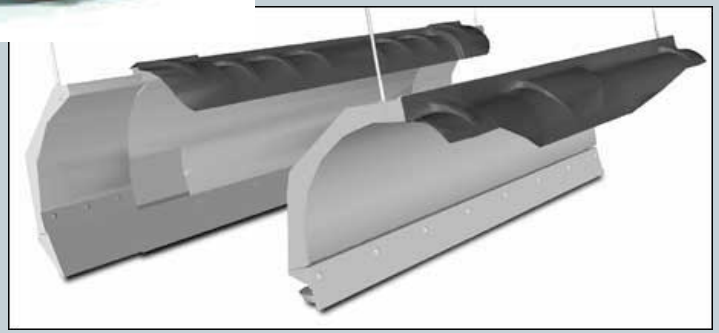












Snow and Ice Removal Plan

- Plow accessories
  - Plow markers
  - Wing extensions
  - Plow lights
  - Plow heaters

Snow and Ice Removal Plan

- Snow melters
  - Rare to nonexistent here
  - Still…pretty cool

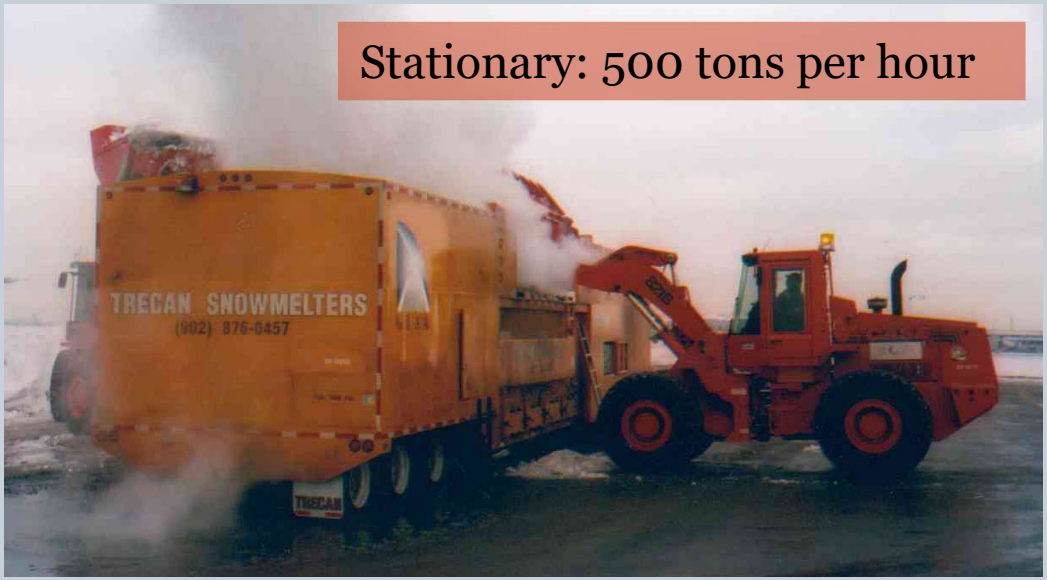
Stationary: 20 tons per hour

Stationary: 1200 tons per hour


Stationary: 40 tons per hour

Snow and Ice Removal Plan

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



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

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

Snow and Ice Removal Plan

- Zero velocity spreaders

Snow and Ice Removal Plan

- Spreader controls
  - Manual
  - Computer operated
  - Automatic

Snow and Ice Removal Plan

- GPS, Automatic Vehicle Locator (AVL)
  - 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 include truck cameras
  - 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

Snow and Ice Removal Plan

- Equipment maintenance
  - In-house maintenance garage
    - Dedicated mechanics
  - Ad hoc in-house maintenance
    - Dilution of snow fighting resources?
  - 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 – what if the “towers” go down?
  - Heating concern at facilities
  - Lighting for yard operations
  - As threat rises, fill all your tanks to minimize your exposure

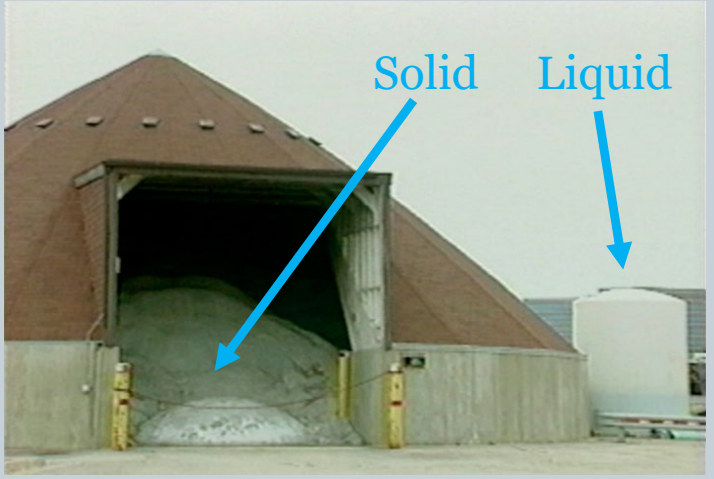
Snow and Ice Removal Plan

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

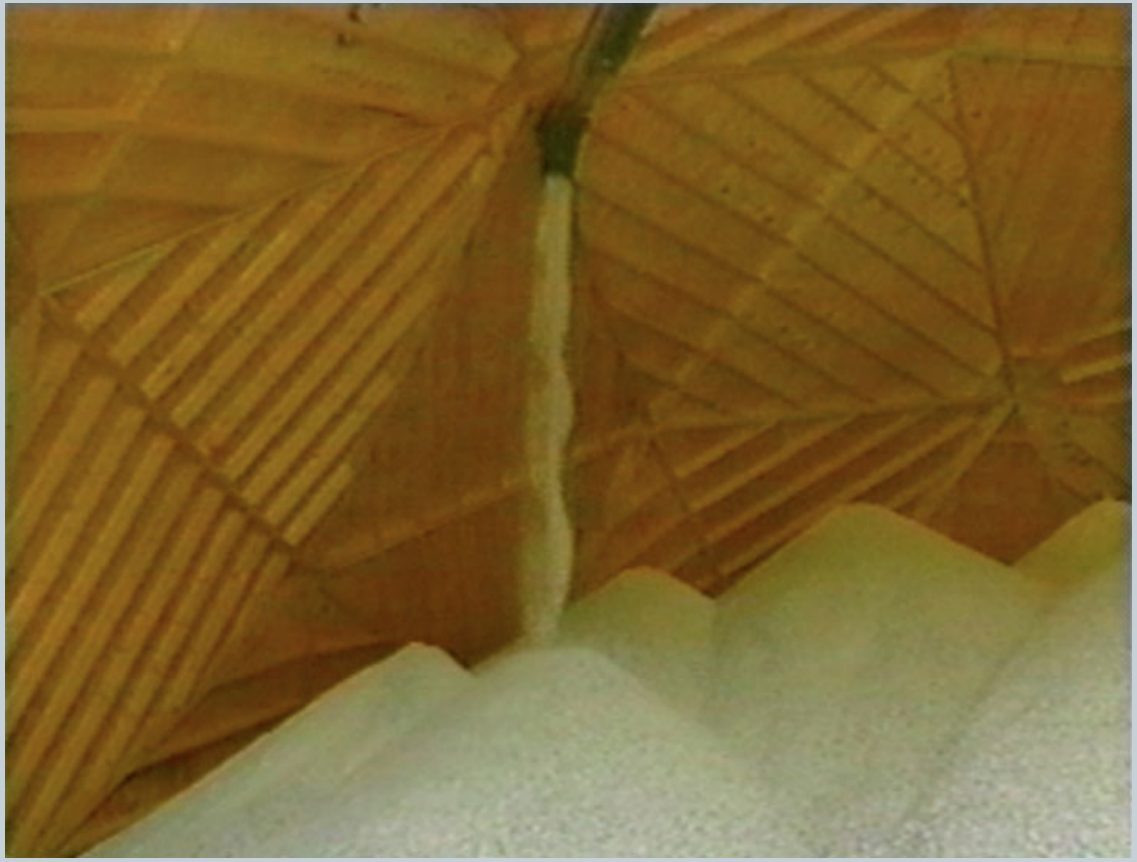


Snow and Ice Removal Plan

- 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

- Salt
  - Specifications
    - Standards
    - Gradation
    - Moisture
    - Anti-caking agents
  - Advantages
  - Deicing / anti-icing
  - Prewetting
  - Equipment
  - Storage & handling
  - Environmental safety



Snow and Ice Removal Plan

- 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

Chemicals

- Salt (Sodium chloride)
- Calcium Chloride
- Magnesium Chloride
- Potassium Chloride

Natural Occurring Salts

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

Snow and Ice Removal Plan

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

Snow and Ice Removal Plan

- Chemical application techniques
  - Deicing
    - Tradition, reactive – applied after ice forms
  - Anti-icing
    - Proactive – applied before storm to minimize bond forming
  - Pre-wetting
    - Creating a 'brine starter kit' by wetting the salt in the truck bed or as it is spun onto the roadway – accelerates the formation of the ideal brine
  - …more on these in a later module…

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

Snow and Ice Removal Plan

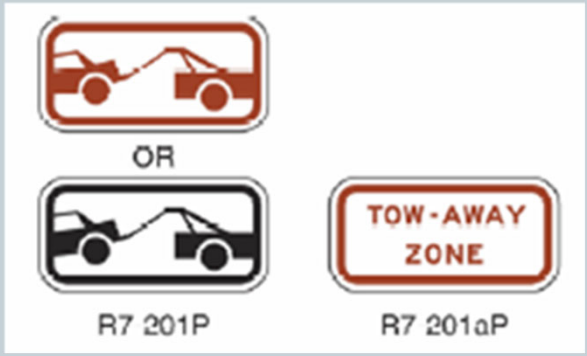
- Communications
  - Internal communications (intra-agency)
    - Crew level
    - Agency wide
  - Semi-internal communications (inter-agency)
    - Informal relationships
    - Mutual aid agreements
  - Senior management and elected officials
  - Public
    - Get out ahead of the frustrations - engage
  - 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

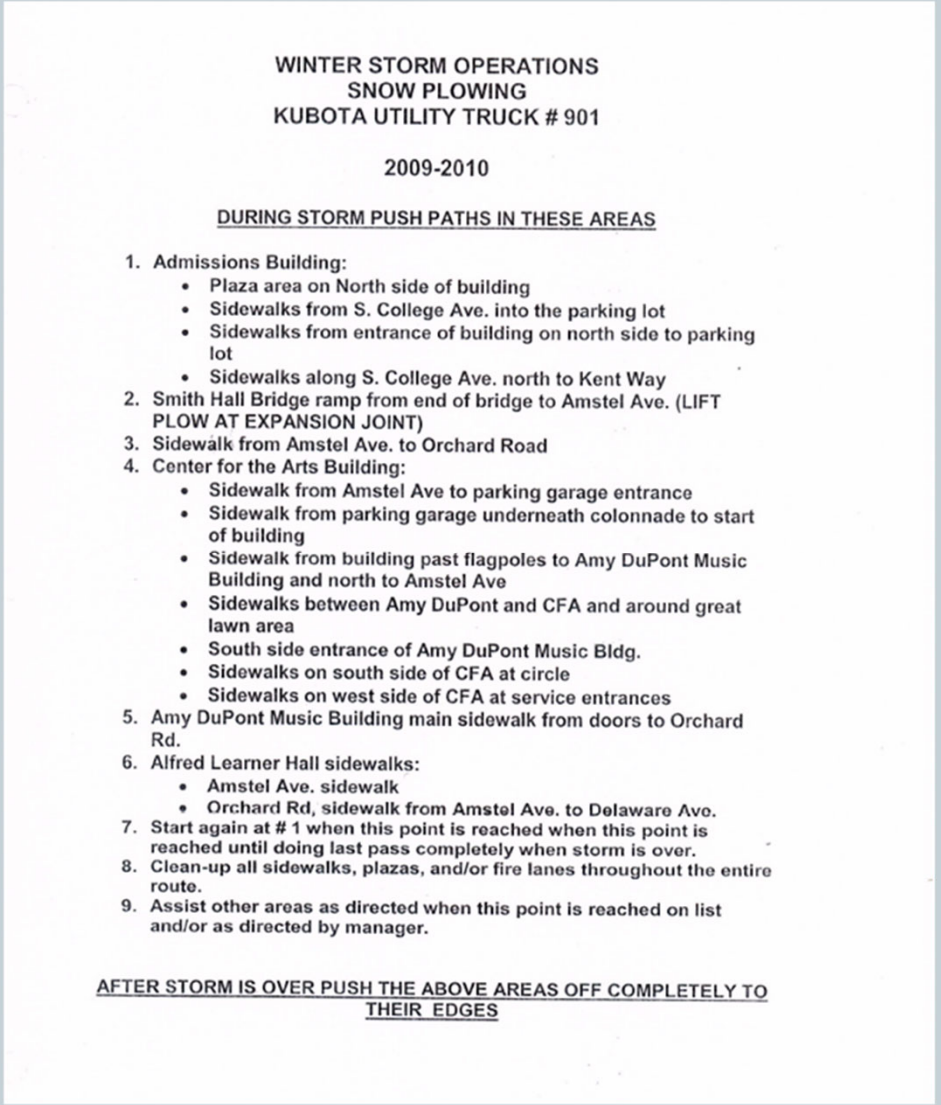
Snow and Ice Removal Plan

- 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

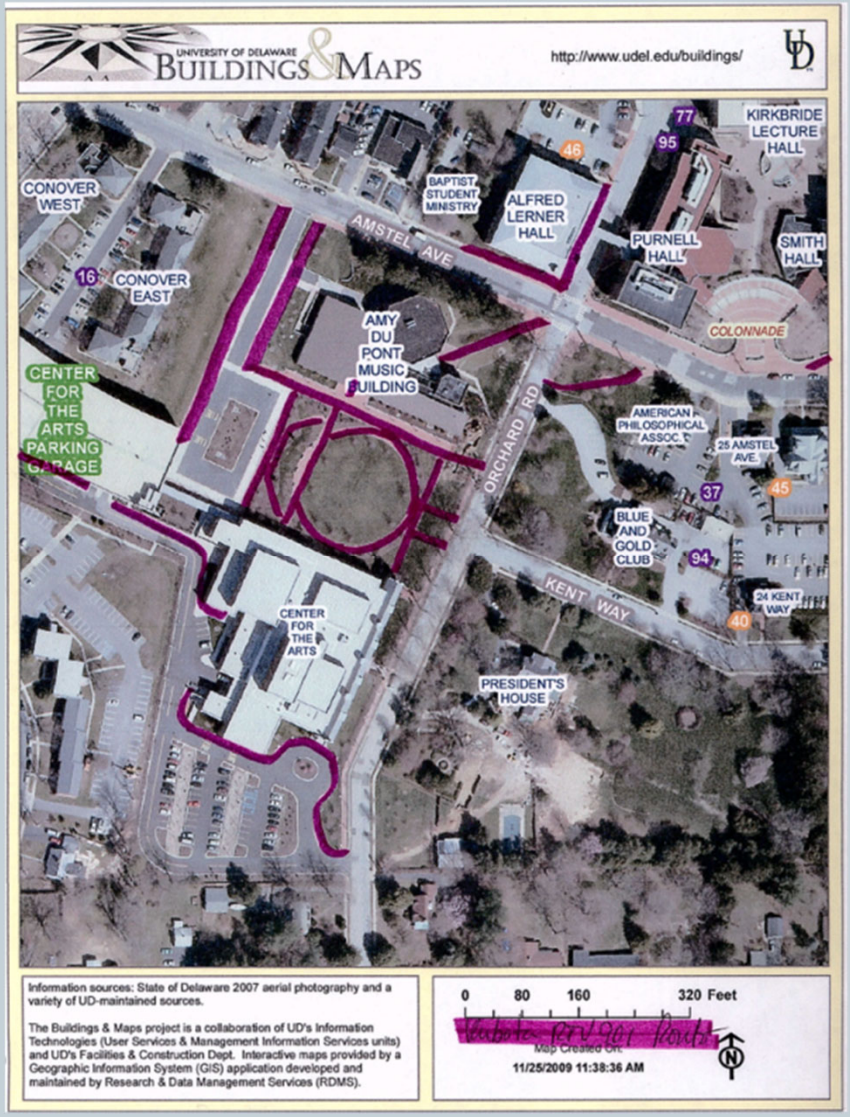
2009-2010

DURING STORM PUSH PATHS IN THESE AREAS

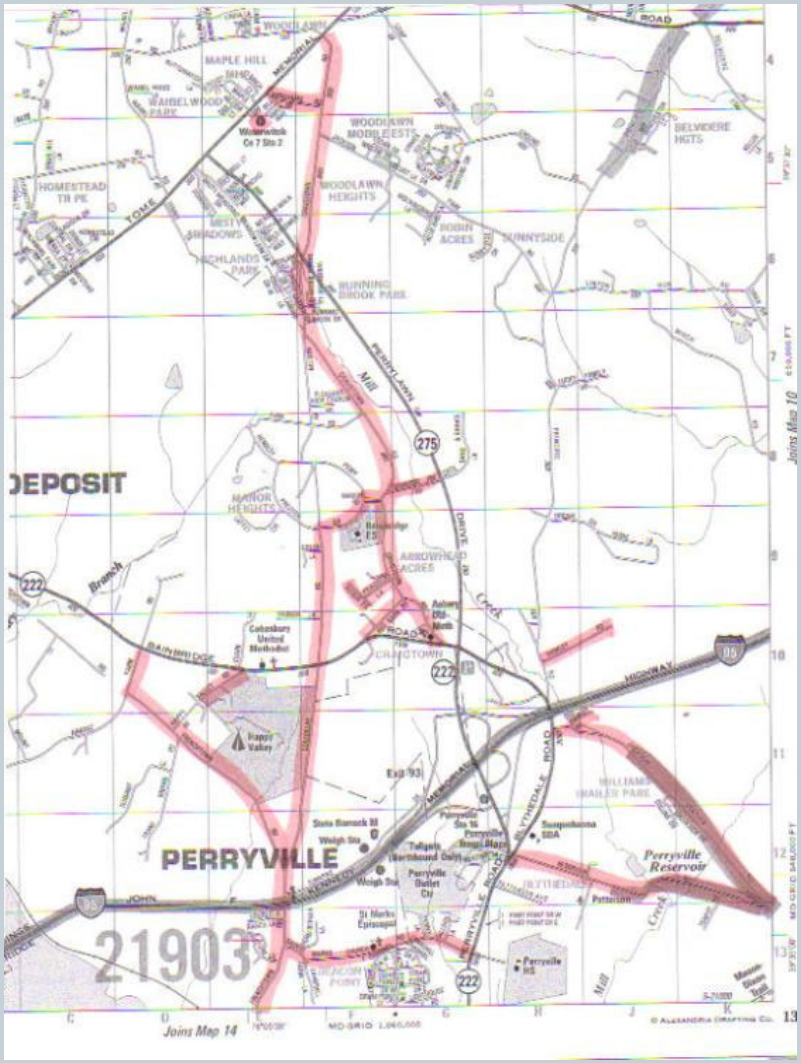
1. Admissions Building:
   - Plaza area on North side of building
   - Sidewalks from S. College Ave. into the parking lot
   - Sidewalks from entrance of building on north side to parking lot
   - Sidewalks along S. College Ave. north to Kent Way
2. Smith Hall Bridge ramp from end of bridge to Amstel 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.

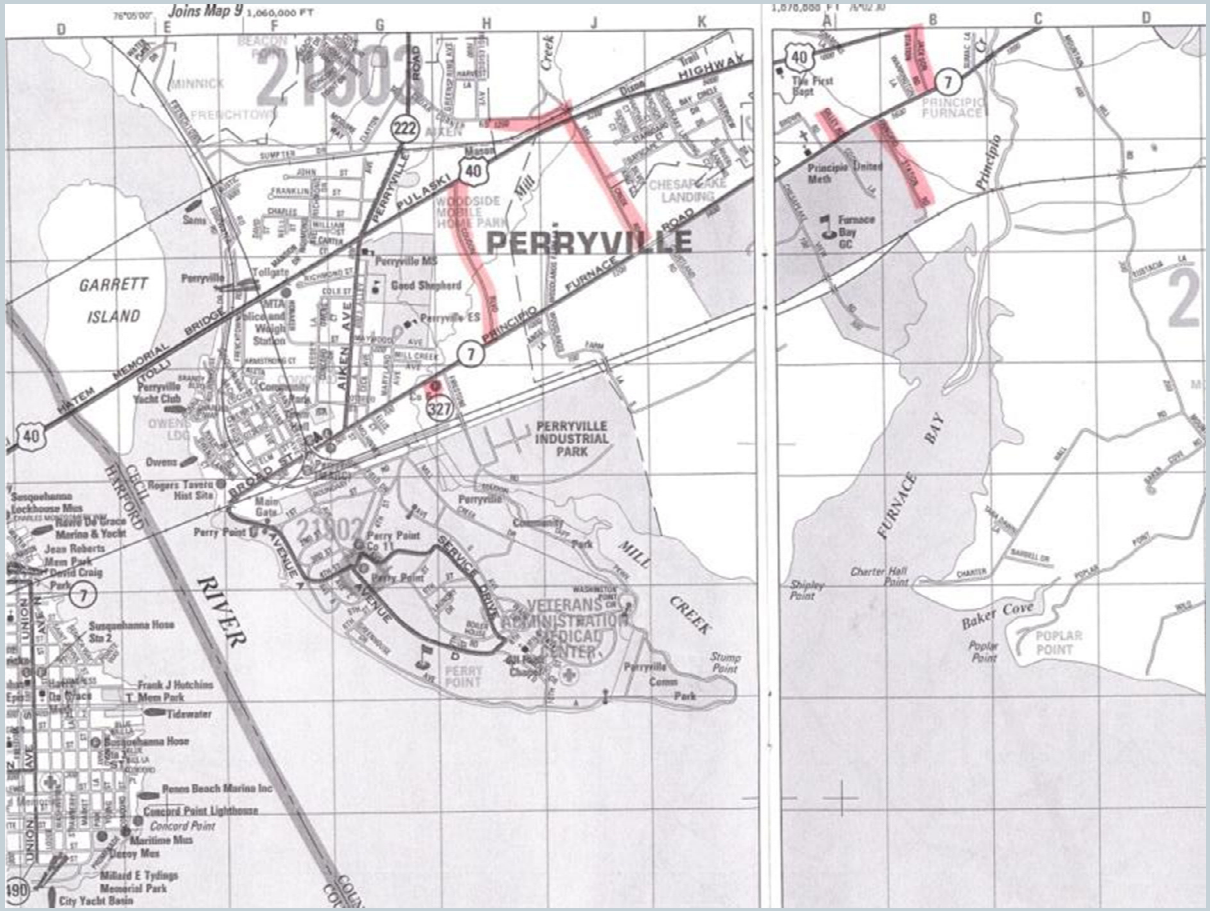
AFTER STORM IS OVER PUSH THE ABOVE AREAS OFF COMPLETELY TO THEIR EDGES

Snow and Ice Removal Plan



Snow and Ice Removal Plan





Snow and Ice Removal Plan

SNOW ROUTE		
GEORGE LOMAS TRUCK #990 PLOW & SPREADER		
AREA 3-1		
ABRAHAMS ROAD		0.23
CRAIGTOWN ROAD		2.58
BARTON ROAD		0.35
PLEASANT VIEW CHURCH ROAD		0.08
FUNK ROAD		0.43
DIAMOND JIM ROAD		0.30
RED BARN ROAD		0.24
MANOR ROAD		0.07
PRESTON DRIVE		0.53
COKESBURY ROAD		1.69
FRENCHTOWN ROAD		2.33
ST MARKS CHURCH ROAD		0.70
MT ARARAT FARM ROAD	MD RTE 222 TO FRENCHTOWN	0.18
HAPPY VALLEY ROAD	OFF MD RTE 222	0.37
LEBRUN ROAD		0.06
JACKSON STATION		2.03
RESERVOIR ROAD		1.07
OLD HAWLEY ROAD TO BRIDGE		0.04
HAWLEY ROAD		0.35
GONCE ROAD		0.20
HOLLY TREE LANE		0.16
COUDON BLVD		0.55
CEDAR CORNER		0.28
MILL CREEK ROAD		0.51
GILLEY ROAD		0.12
PRINCIPIO STATION		0.32
PATTERSON AVENUE		0.20
PEACOCK LANE	OFF CRAIGTOWN RD	0.12
ROBIN DRIVE	OFF CRAIGTOWN RD	0.12
	TOTAL MILEAGE	16.21
FIRE STATIONS		
STATION 72 - ABRAHAMS ROAD	PORT DEPOSIT,MD	
STATION 6 - 920 PRINCIPIO FURNACE ROAD	PERRYVILLE, MD	
STATION 16 - 16 JR DAWSON DRIVE	PERRYVILLE, MD	
SECONDARY ROUTE		
BELVIDERE ROAD		2.46
PRINCIPIO ROAD	THEODORE RD TO BLYTHEDALE RD	2.95
FAIRVIEW DRIVE		0.06
WINCHESTER COURT		0.19
	TOTAL MILEAGE	5.66

SNOW ROUTE ASSIGNMENTS		
2010-2011		
NORTHERN AREA		
AREA	DRIVER / CONTRACTOR	TRUCK
3-1	George Lomas	990 COUNTY TRUCK PLOW & SPREADER
3-2	Richard Bittner	992 COUNTY TRUCK PLOW & SPREADER
3-3	Mike Cox	989 COUNTY TRUCK PLOW & SPREADER
3-3A	Robert Peoples	977 COUNTY TRUCK PLOW
3-4	Josh Hoderfield	979 COUNTY TRUCK PLOW & SPREADER
3-5	Mark reeder	910 COUNTY TRUCK PLOW AND V-BOX
3-6	Mike's Lawn	ONE TON PLOW AND SPREADER
3-7	Mike Madron	991 COUNTY ONE TON PLOW & SPREADER
3-7A	Riverview	PICK UP TRUCK PLOW ONLY
3-8	Sammy Craig	980 COUNTY TRUCK PLOW & SPREADER
3-9	Riverview	ONE TON WITH V-BOX
3-10	Russell trucking	TRI AXLE PLOW AND SPREADER
3-11	Phil's Lawncare	ONE TON PLOW AND SPREADER
3-12	Al Sallsbury	COUNTY PICK UP WITH PLOW
	Contractor	Phone Number
	RUSSELL TRUCKING	
	MIKES LAWN SERVICE	
	PHIL'S LAWNCARE	
	RIVERVIEW	

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 <u>spring or summer</u>

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