# Winter Maintenance Snow and Ice Control – Module 1 –

## INTRODUCTION TO SNOW AND ICE CONTROL, TREATMENT, AND REMOVAL

Delaware T²/LTAP

PRESENTED BY:

DELAWARE T²/LTAP CENTER

# The Preliminaries



Today's Instructor:

- Matheu J. Carter, P.E.
  - Municipal Engineering Circuit Rider

Restrooms, safety exits, smoking policies, etc.

Standard Reminders:

- Cell phones, pagers, beepers, walkie-talkies
- Sidebar conversations

# The T$^2$ Center Winter Maintenance Program



What we cover:

- Module 1 – Introduction to snow and ice control
- Module 2 – Planning/program development
- Module 3 – Pre-season activities
- Module 4 – Operations/in-season activities
- Module 5 – Post storm activities
- Module 6 – Post season activities

# Acknowledgements



Primary references:

- AASHTO Guide for Snow and Ice Control
- APWA, New England Chapter
  - “Plow Power” and “White Gold”
- 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

# Acknowledgements



Our collaborators and counselors (with our thanks):

- Brian Urbanek, Alastair Probert, Edwin Tennefoss – Delaware Department of Transportation
- Brad Dennehy – Town of Milford, Delaware
- Roger Bowman – University of Delaware Facilities Management
- Daniel Webber – Roads Division, Cecil County, Maryland
- The national LTAP/T$^2$ community

# Introduction



## In this module:

- General objectives of snow and ice control
- Weather basics
- Importance of training
- Innovation and evolution
- Safety, risk management, liability

# Where Are You in the Game?



- Professional snow fighters
- An important part of the community safety team

Video

# Where Are You in the Game?



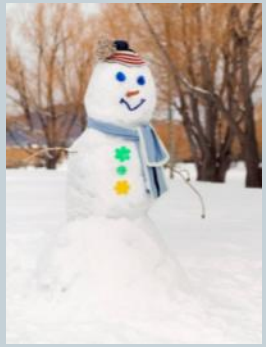
Regardless of where are you now:

- We hope you'll have a greater command when we're done
- Don't imagine this workshop will make you an expert (unless you already are one) – practice will do that
- As we go, share your challenges, experiences, and solutions – let's all learn from each other

# 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 Weather Impacts

Video

# 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



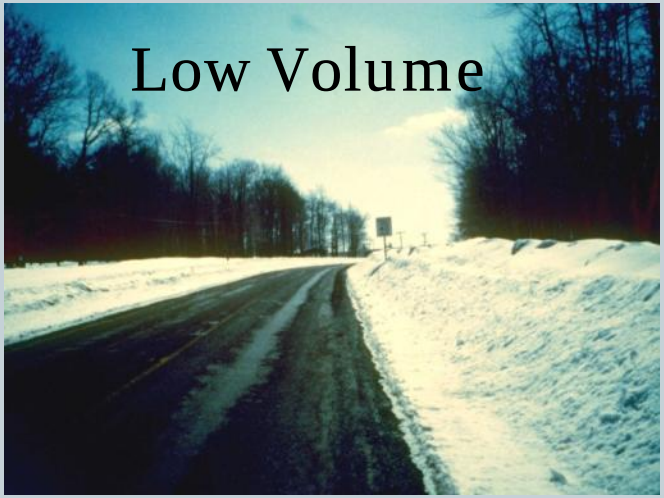
- Amount of Snow
- Rate of Snow
- Duration of Snowfall
- Timing of Storm
- Temperature
- Wind Conditions
- Type of snow (wet/dry)

# 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)

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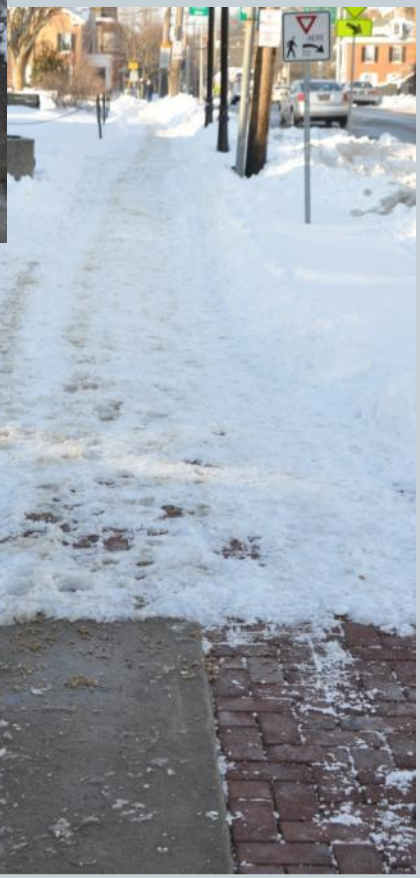


# Environmental Considerations



- 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

# Importance of Training



- Simulator training

# Importance of Training



- Simulator training

# Importance of Training



- Simulator training
  - Increased use in our area
    - Cecil County, Maryland
    - Elkton, Maryland
    - DelDOT

# 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

# Innovation, Experimentation, Evolution



- Example – Seattle Department of Transportation
  - 2008 storm crippled the city
  - 26 plows, 4 deicing trucks equipped with GPS
  - 2,200 tons salt and 46,500 gallons salt brine in storage
  - New "Winter Weather Response" webpage
    - Shows where plows have been in last hour, 3 hours, 12 hours
    - Links to traffic cameras
  - Clear levels of service projections
    - Level I (transit, emergency responders) cleared 8 hours after storm
    - Level II – one lane each direction bare and wet
    - Level III – clear problem spots (hills, curves, stopping zones)
  - "Snow Watch" tracks and forecasts at neighborhood level
  - Additional temperature sensors on bridges

# Fostering Innovation and Evolution



- New equipment
- New materials
- New uses of traditional equipment/materials
- 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

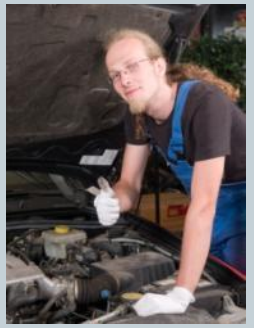


- Safety culture starts with management
  - Supervisors should be held accountable
- Recognize and correct unsafe behavior
  - Horseplay or improper equipment use creates risk
- Investigate crashes and near misses
  - No “witch hunt” necessary – just find out what happened
  - Make corrections, communicate 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



- Public safety – operators should
  - Obey traffic laws
  - Watch speed, stopping distances, turning radii, skid control
  - Avoid making sudden moves
  - Avoid pushing snow
    - Over bridge rails
    - Onto sidewalks
    - Into storefronts
  - Keep to right approaching oncoming traffic
  - Control material spinners relative to vehicles and pedestrians
  - Report stranded motorists

# Safety, Risk Management, Liability



- Operational speeds

Video

# Safety, Risk Management, Liability



- Operational speeds

Video

# Safety, Risk Management, Liability



- Public safety – traveling public should
  - Stay off roads until after storm cleanup, if possible
  - Obey traffic laws – including Move Over Law
  - Avoid walking in vehicle travelways
  - Watch speed, stopping distances, skid control
  - Avoid making sudden moves
  - Keep to right approaching oncoming plows/equipment
  - Stay back where operators can see you in mirrors
  - Be aware – equipment backs up and operators can't always see
  - Report stranded motorists
- This can be part of pre-season public relations; we'll see more of this in Module 3

# 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

# 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

# Need More?



Matt Carter

Municipal Engineering Circuit Rider

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http://www.ce.udel.edu/dct/T2.html

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