A Winter Balancing Act:
Salt, Snow, and Safety On Our Roads

David P. Orr, P. E.

Cornell Local Roads Program

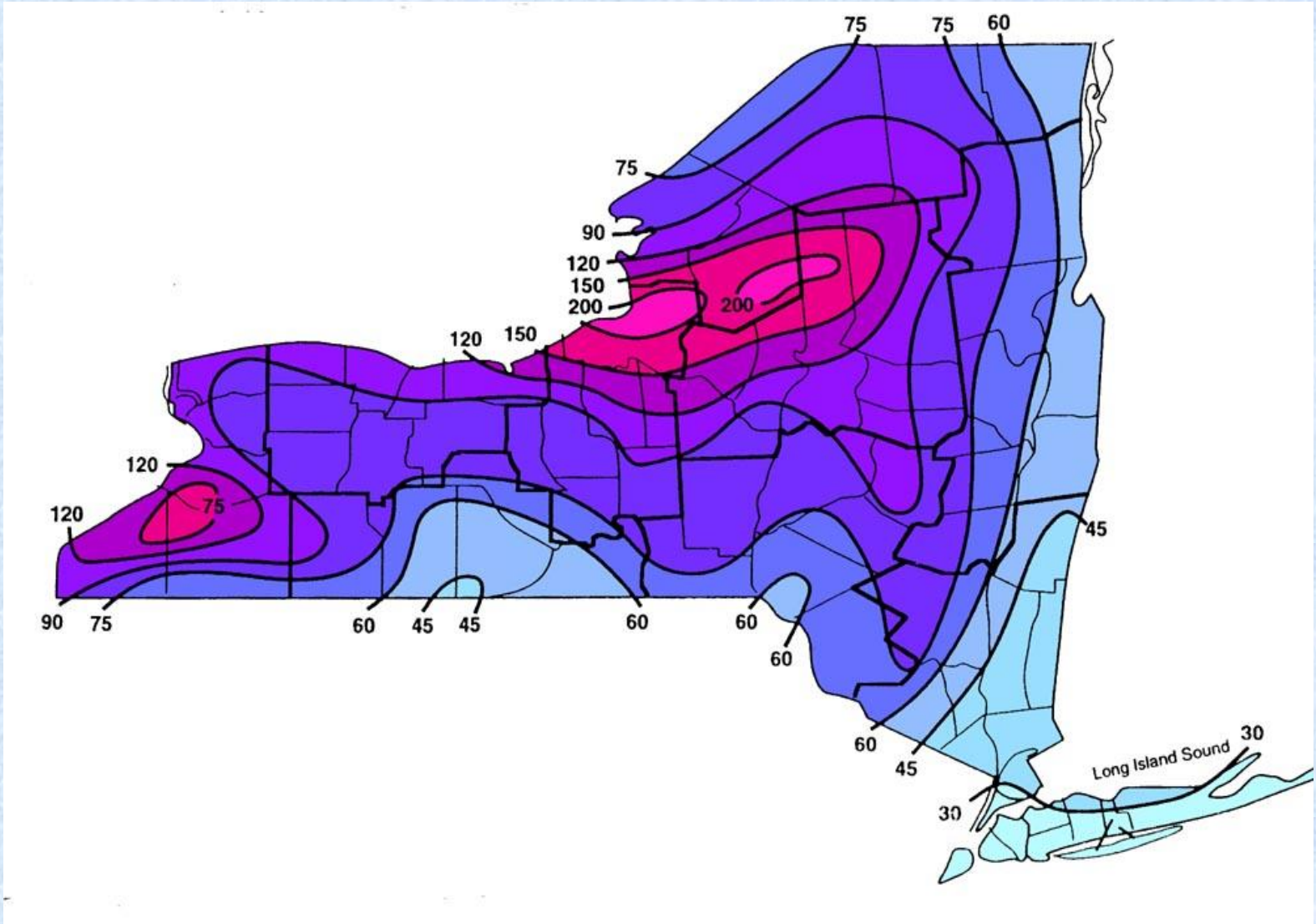
Snow and Ice Control Operations for Local Highway Officials

Dewey Amsler, P.E.


FRINK AMERICA INC.
PRESENTS
PLOWING
TUG HILL
1939

Old Man Winter

Snowfall in New York State



Pavement condition goals

Pavement condition goals

Pavement condition goals

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Pavement condition goals

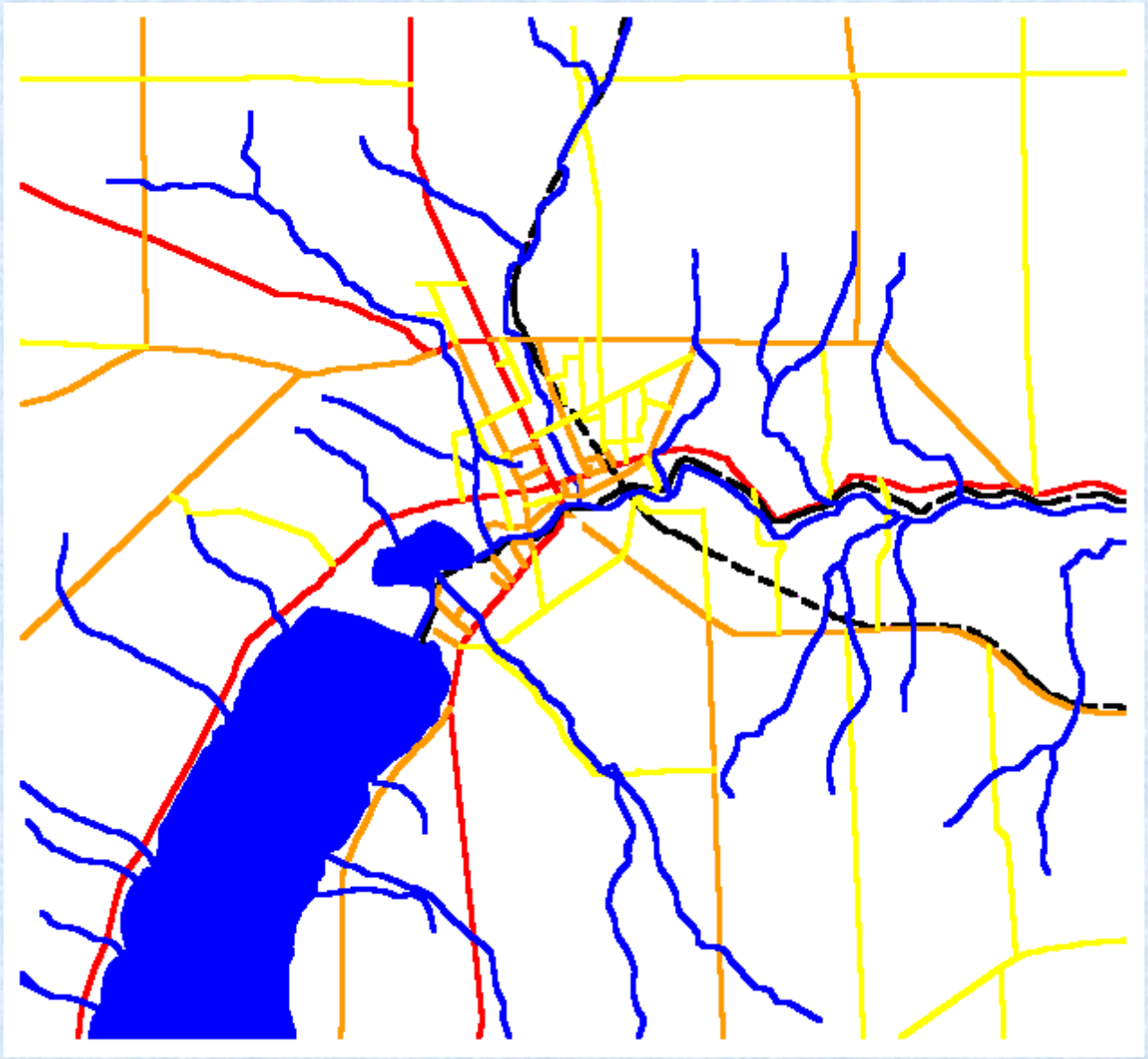
Stopping Distance

Road Surface Condition	Stopping Distance Ratio
Dry	
Wet	
Slush or Sand on snow	
Soft loose snow	
Sand after lt. traffic	
Snow pack	
Ice	

Safe Speed (vs. Dry 55 mph)

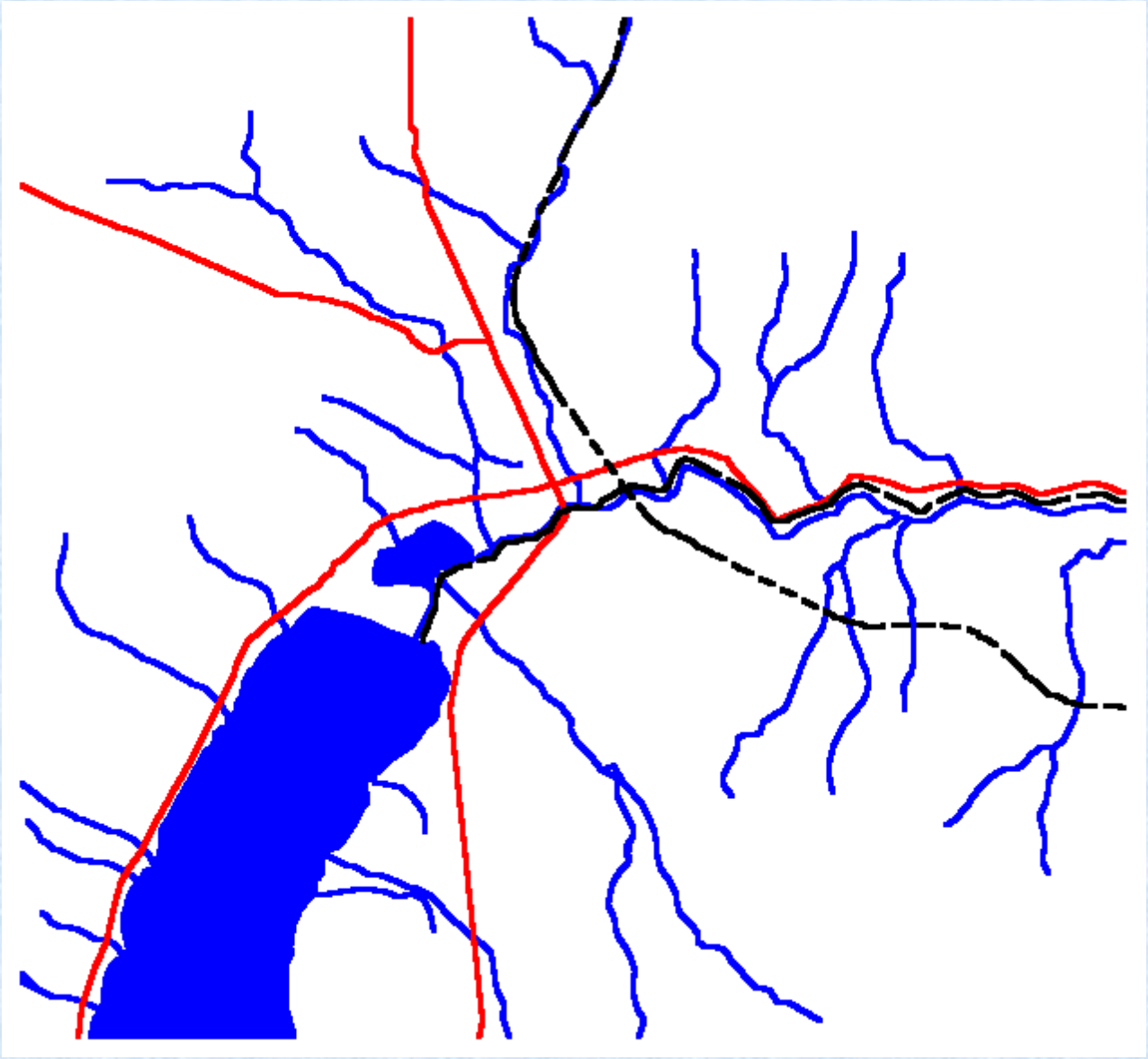
Road Surface Condition	Equivalent Speed
Dry	
Wet	
Slush or Sand on snow	
Soft loose snow	
Sand after lt. traffic	
Snow pack	
Ice	

Level of Service



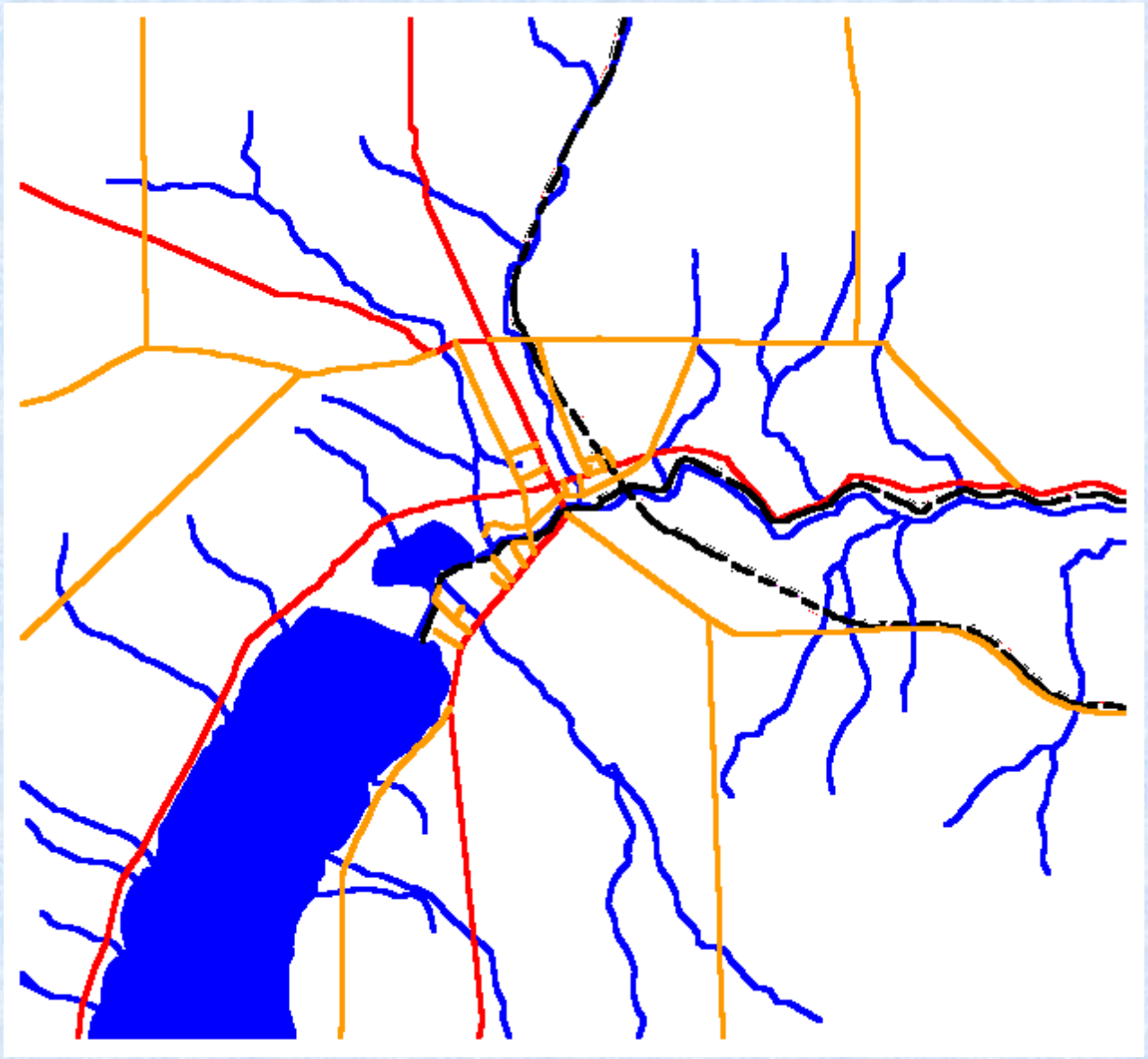
All Roads

Level of Service



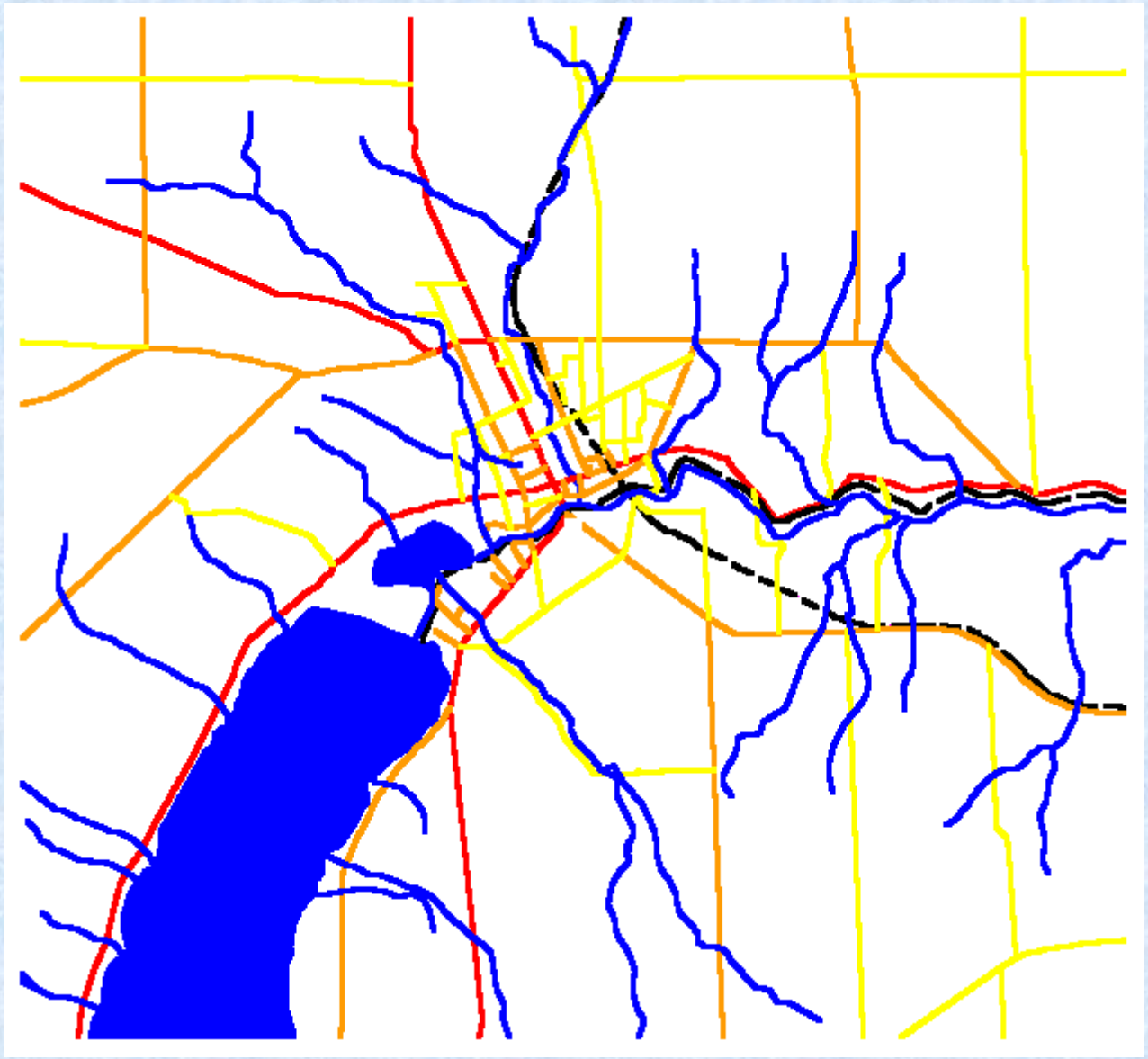
Highest Priority Roads

Level of Service

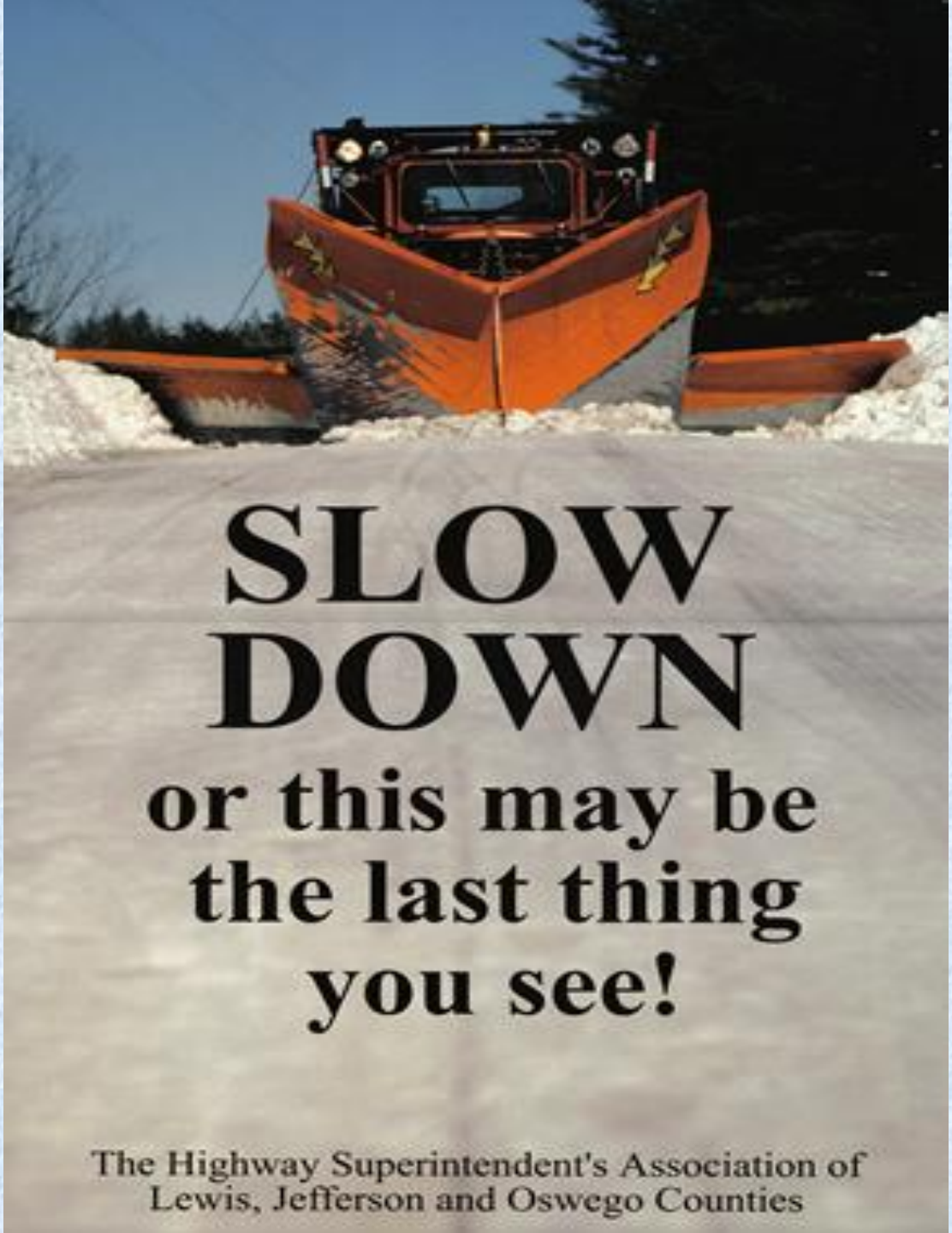


During Storm Plowing

Level of Service

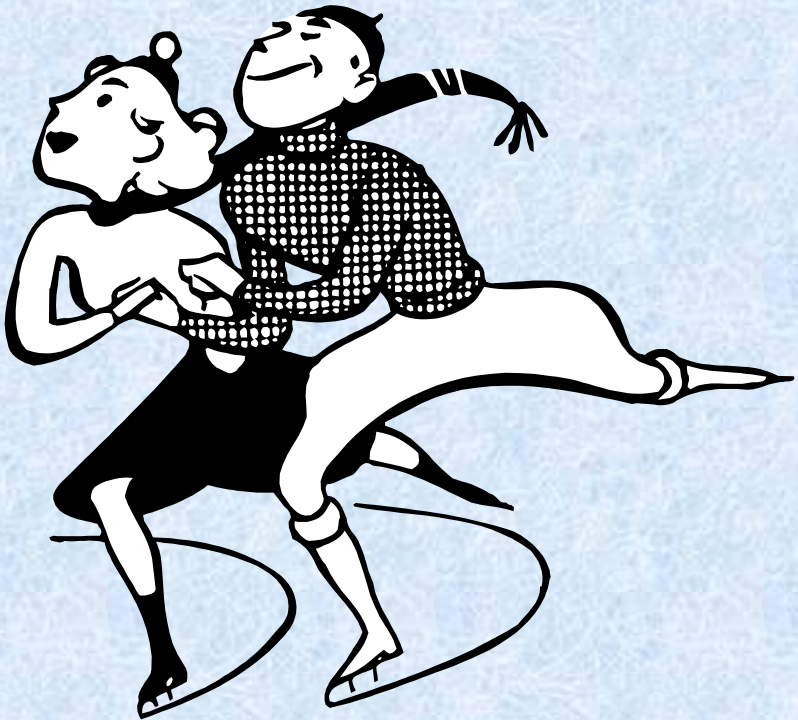


Residential Streets

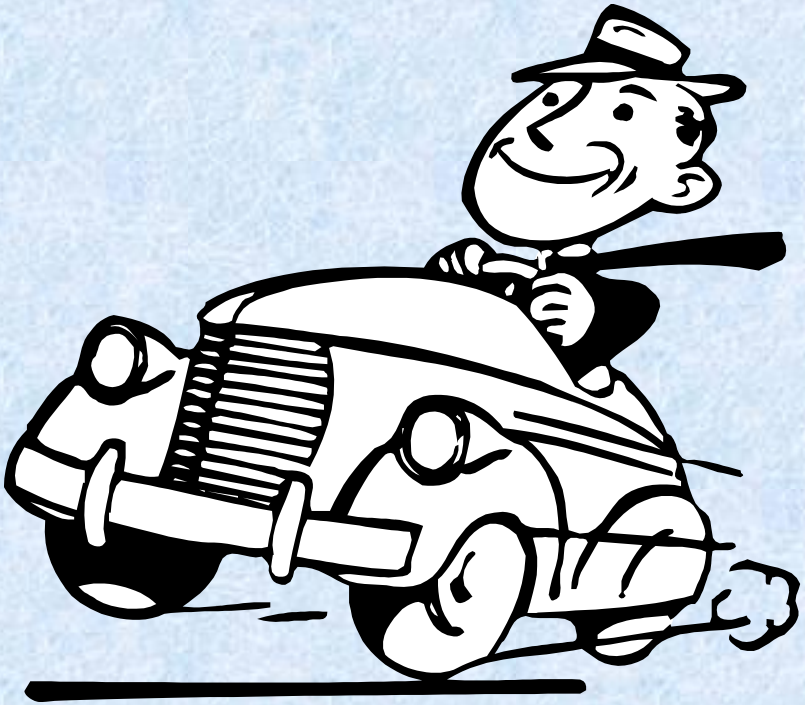

SLOW
DOWN
or this may be
the last thing
you see!
The Highway Superintendent's Association of
Lewis, Jefferson and Oswego Counties

Abrasives

- Acquisition of abrasives
- Quality considerations
- Storage and handling
- PM10



Abrasives



- 18 cars and the effectiveness of abrasives is gone

Ice Control Chemicals

Exothermic

Dilution

Endothermic

Eutectic

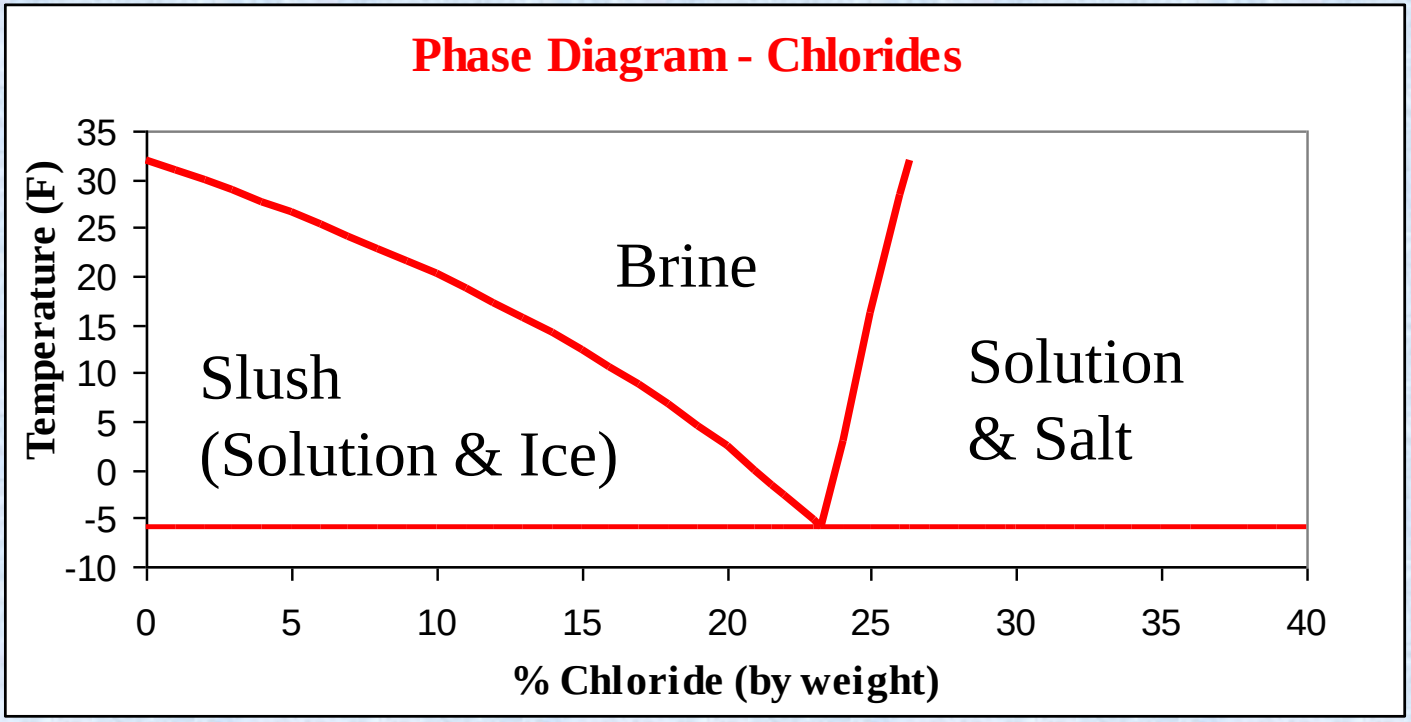
Solution

Common Ice Control Chemicals

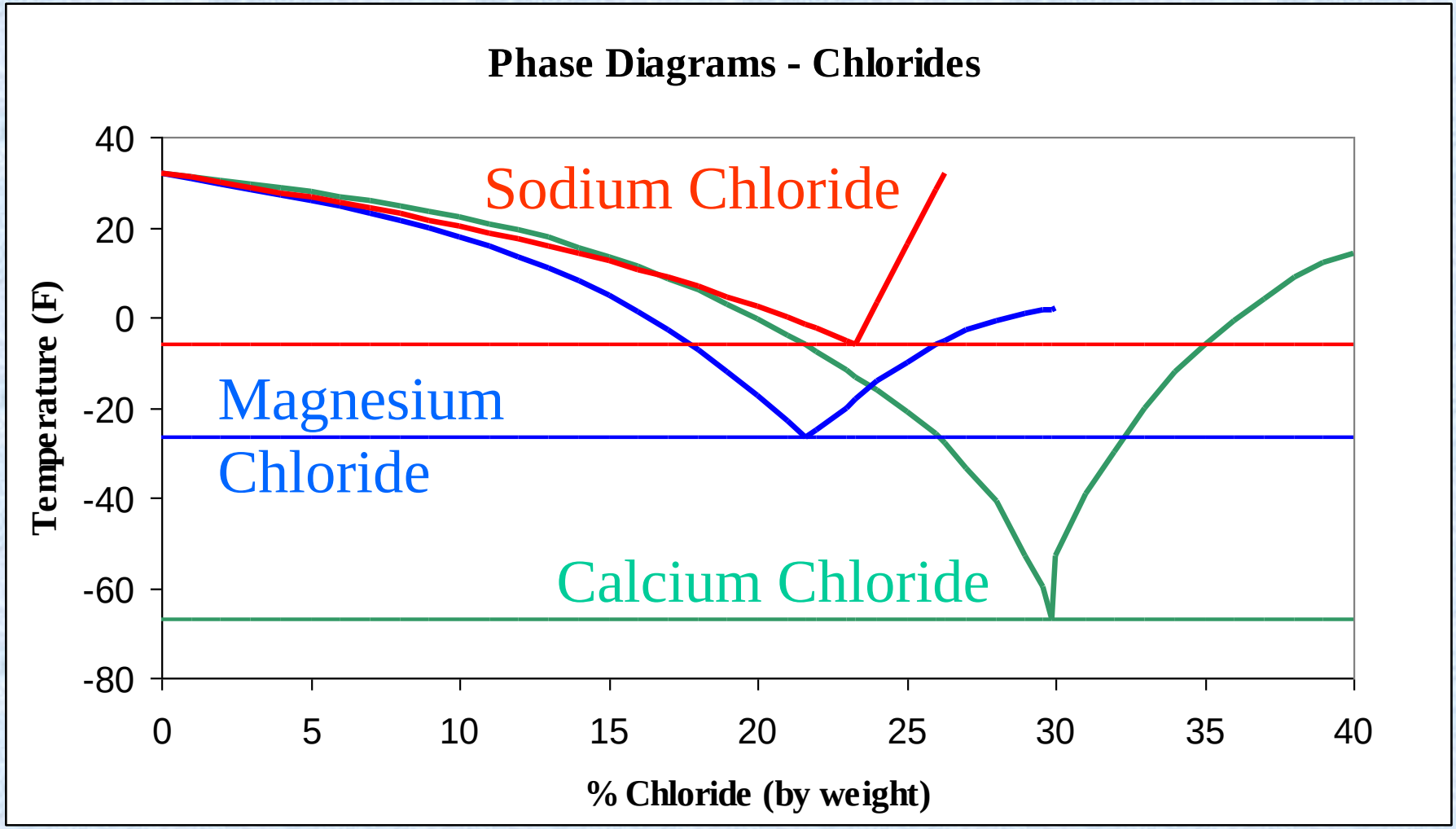
- Sodium chloride
- Calcium chloride
- Magnesium chloride
- Calcium magnesium acetate
- Organic based products

Ice Control Chemicals

How ice control chemicals work



Ice Control Chemicals

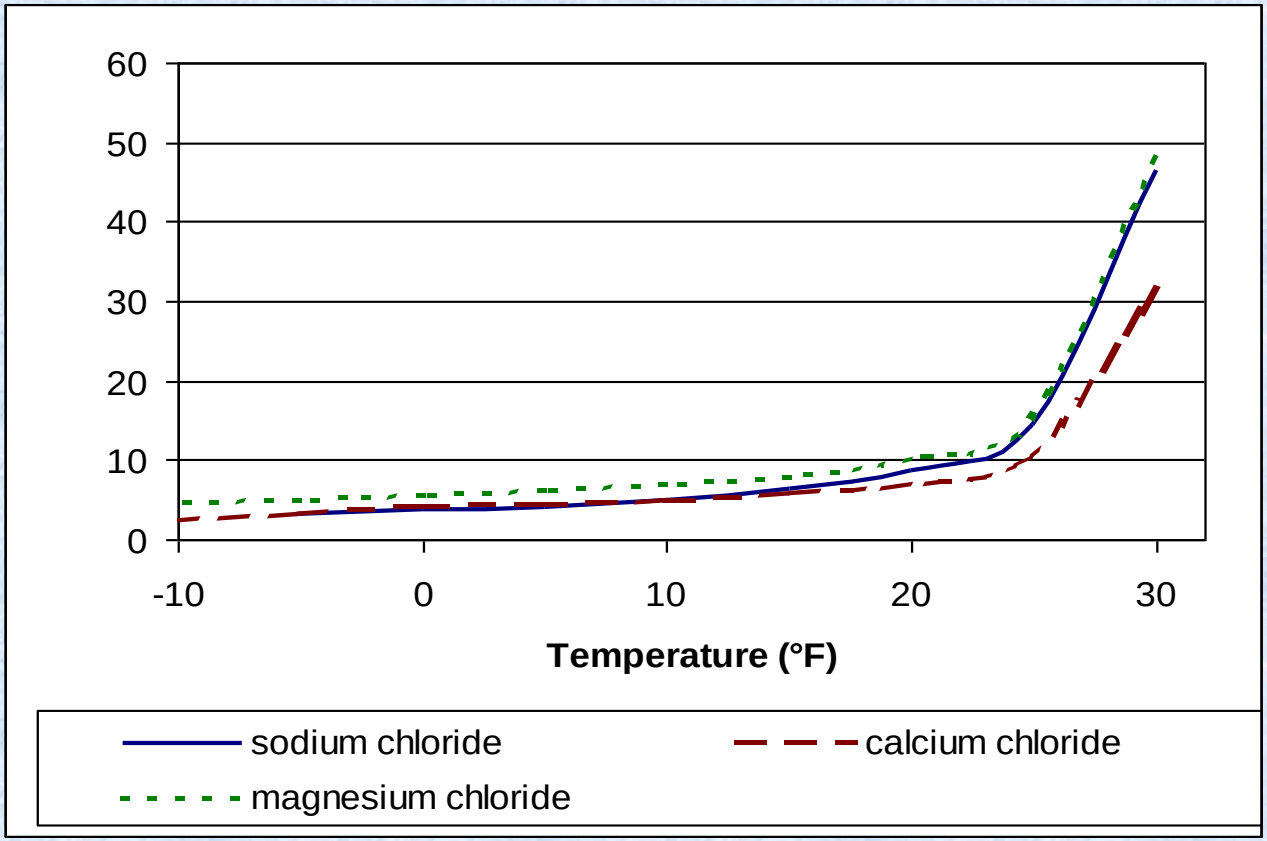


Melting Ability

Ice Melted per Unit of Chemical

Temperature °F	Sodium Chloride	Calcium Chloride	Magnesium Chloride
30	46.3	31.1	47.8
25	14.4	10.4	15.4
20	8.6	6.8	10.0
15	6.3	5.5	7.9
10	4.9	4.8	6.8
5	4.1	4.4	6.1
0	3.7	4.0	5.5
-5	3.2	3.7	5.0

Melting Ability



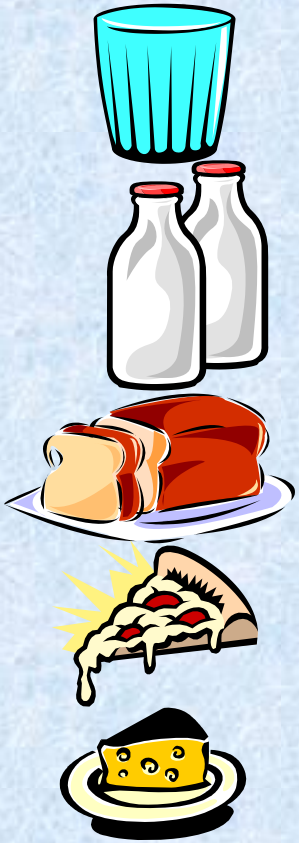
Example

- 1 mile
  - 20 ft. wide pavement
    - 2” snow
      - ¼” ice
        - 24 °F

60 tons of ice

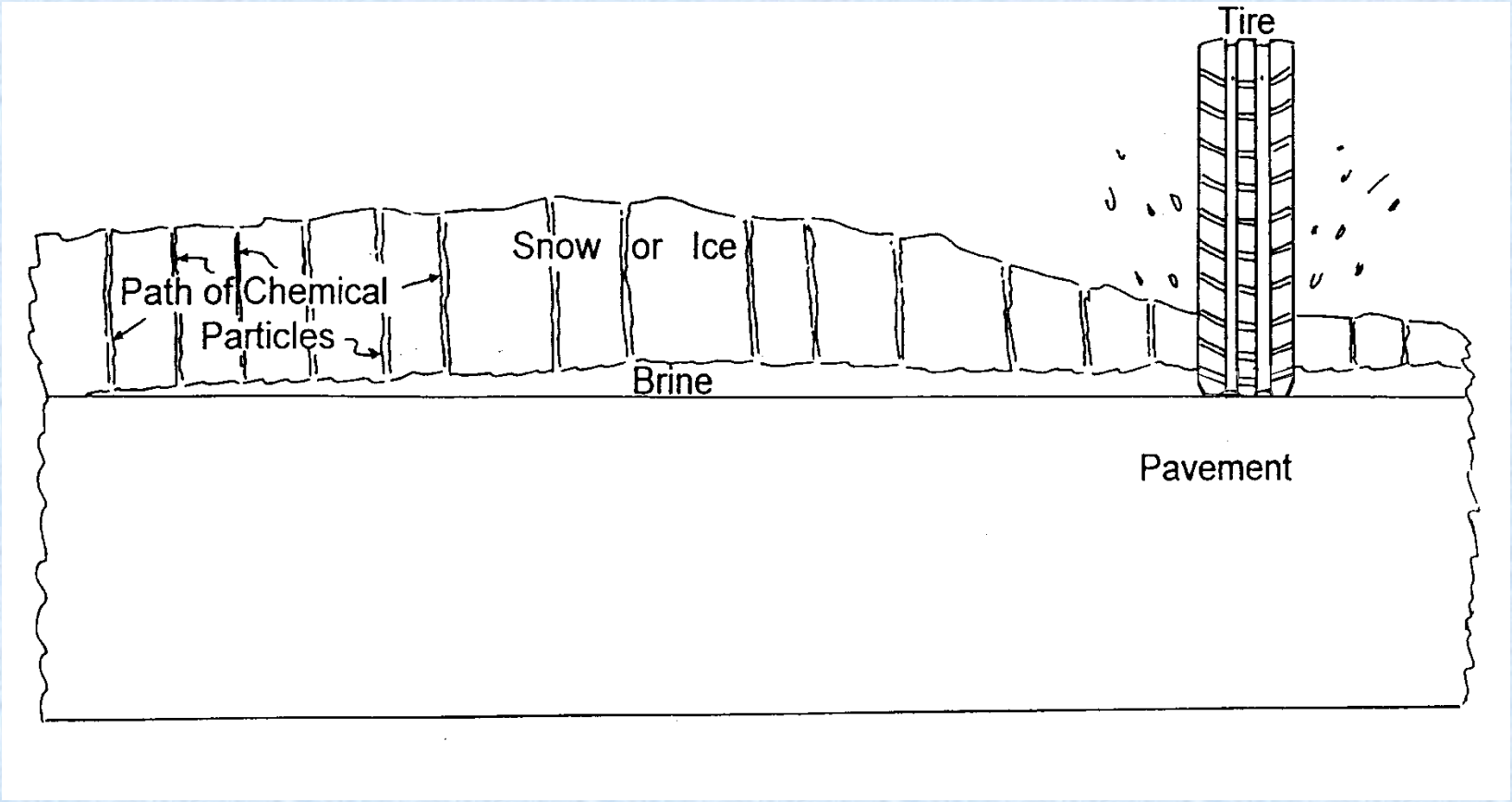
6 tons of salt!

Sodium Comparisons

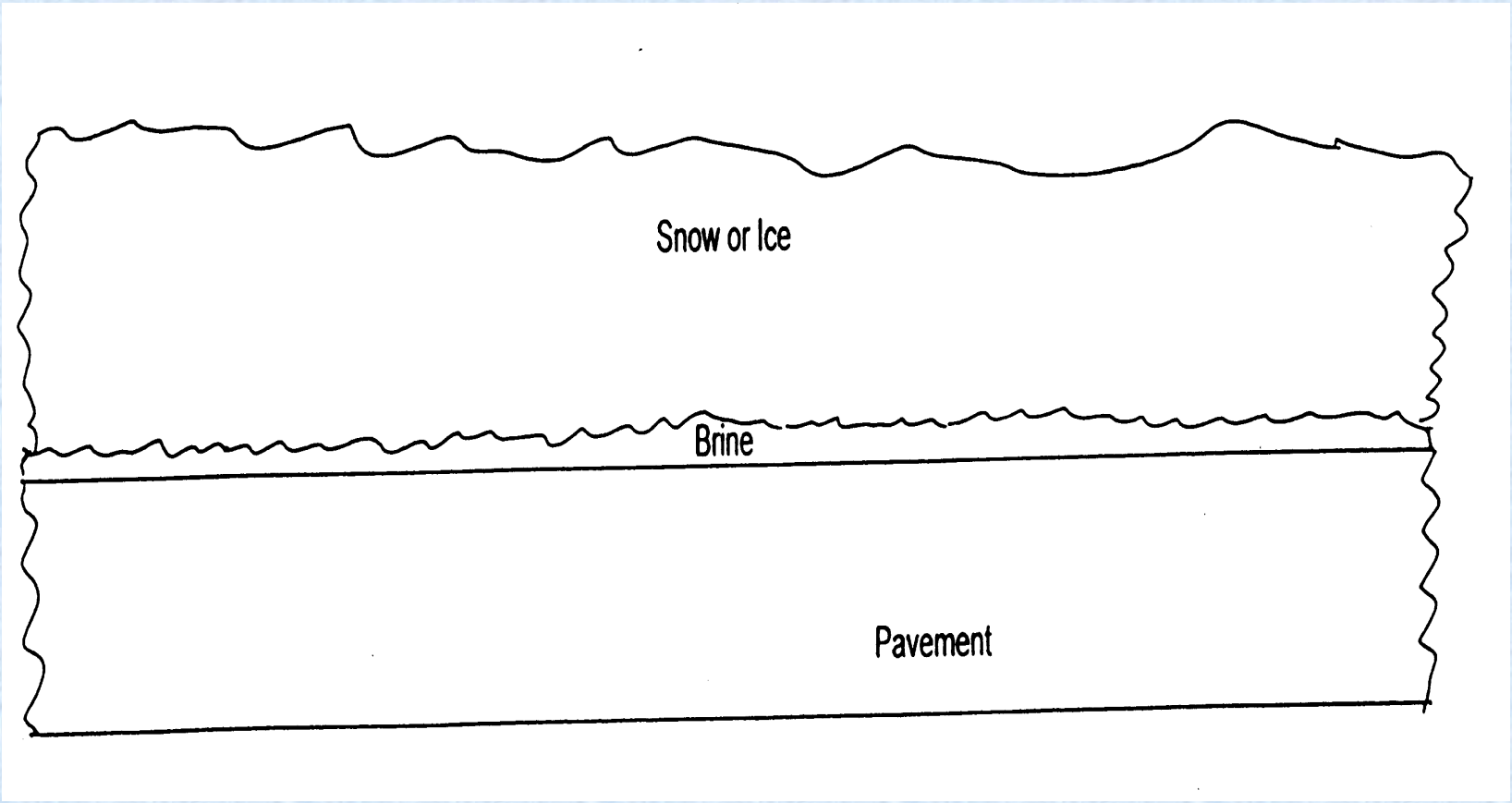


Food	Milligrams of Sodium
Glass of water containing 100 ppm sodium	**16**
Glass of milk	**120**
Slice whole wheat bread	**130**
Slice of pizza	**380**
Slice of American cheese	**406**

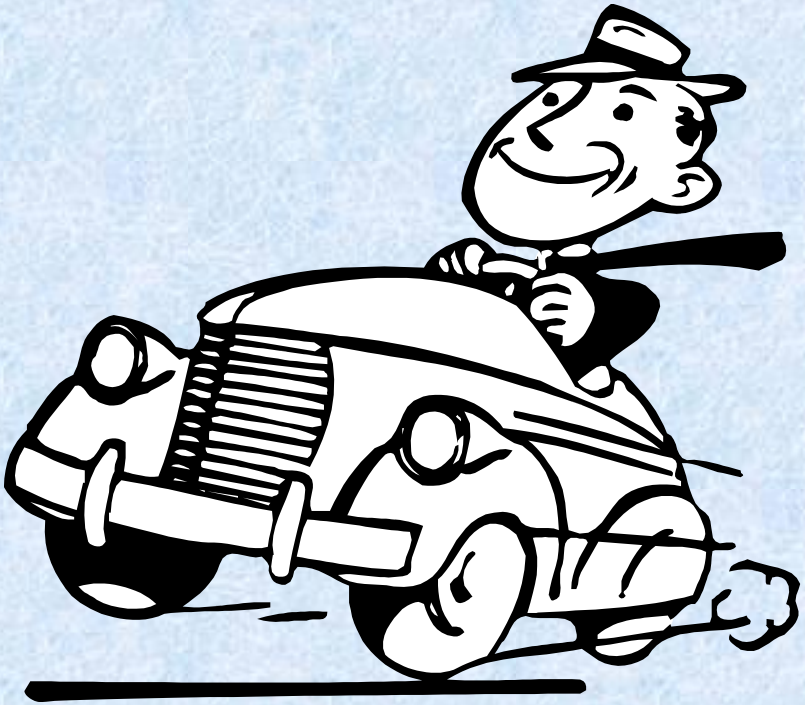
Deicing



Anti-icing

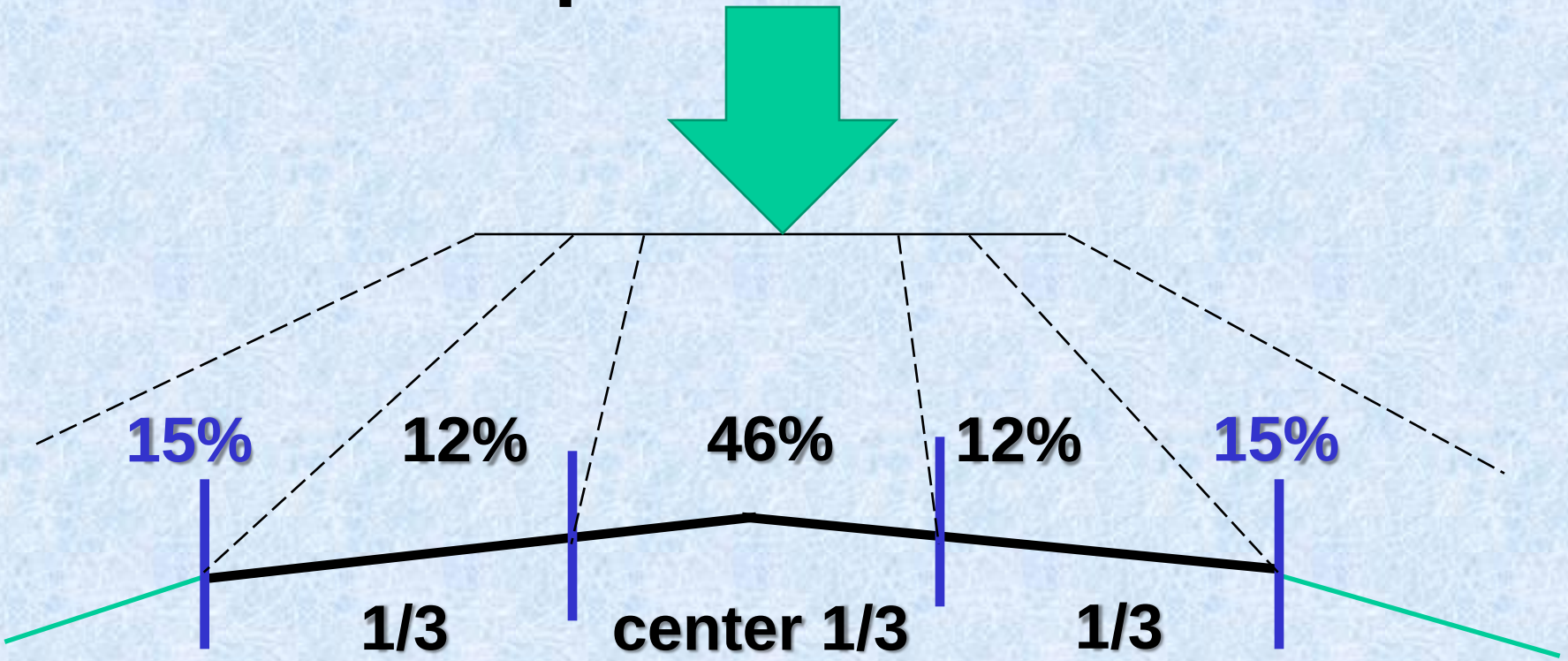


Dry Chemicals



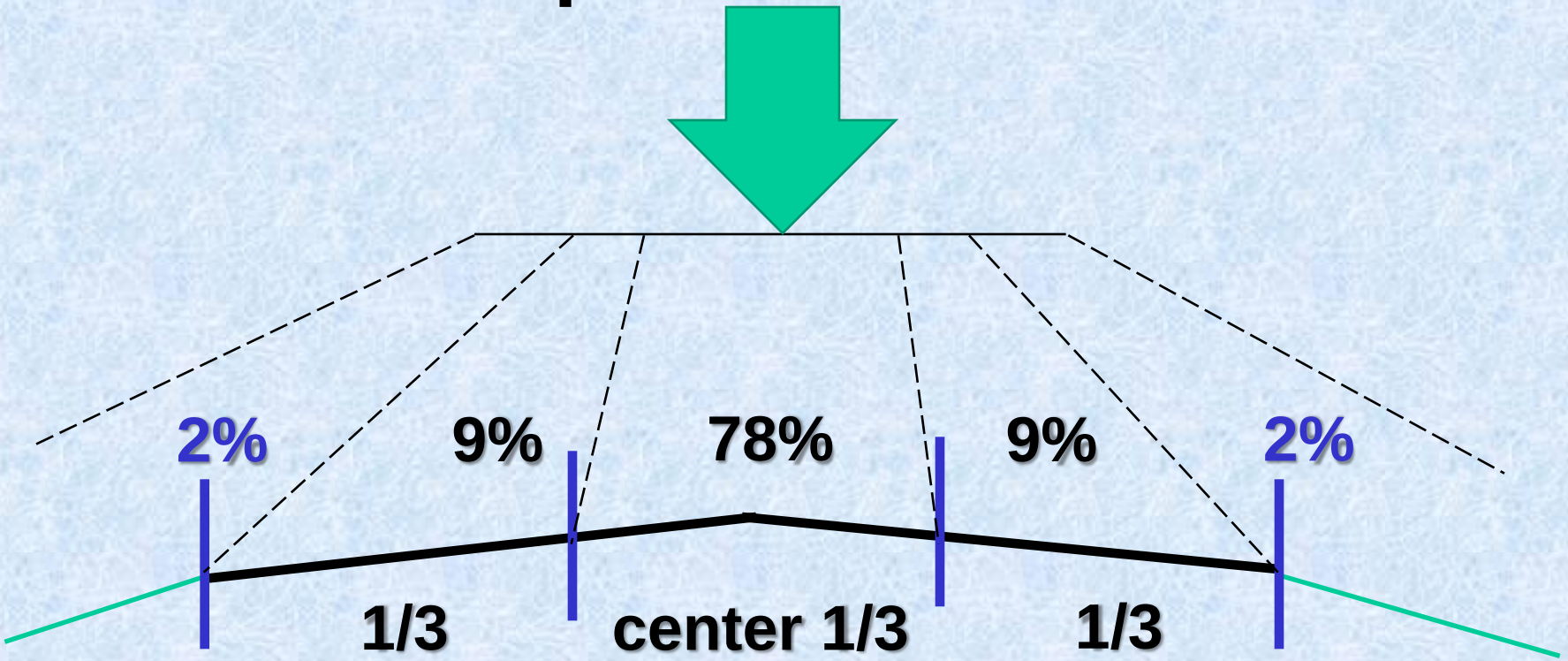
Dry Salt on Dry Pavement

100% spread in center 1/3



Prewetted Salt on Dry Pavement

100% spread in center 1/3

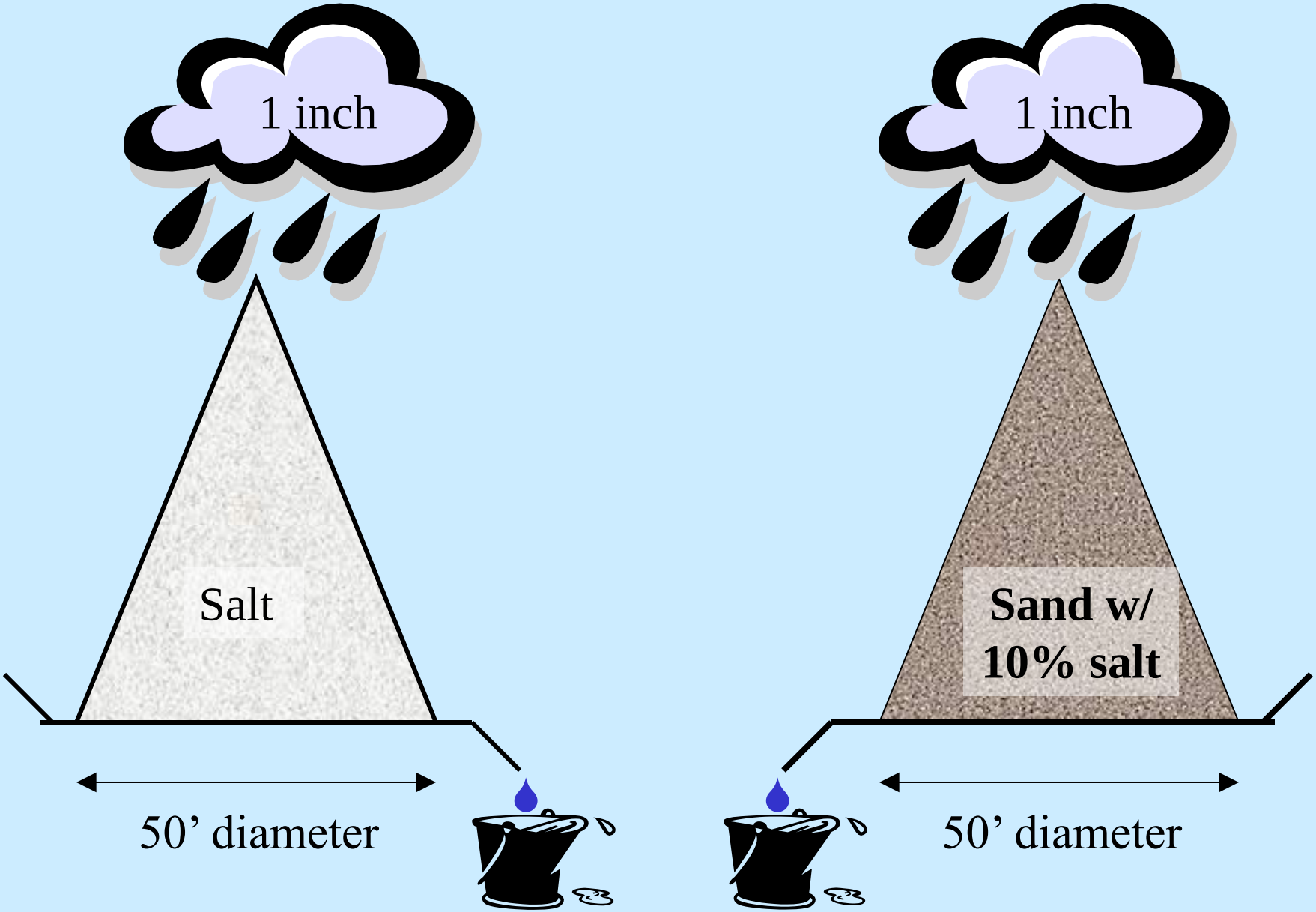


Mixtures of solid and liquid chemicals


522S
CAUTION
STAY BACK
50 FEET
G-153BR
RADIO SHOP

Pre-wetting ice control equipment

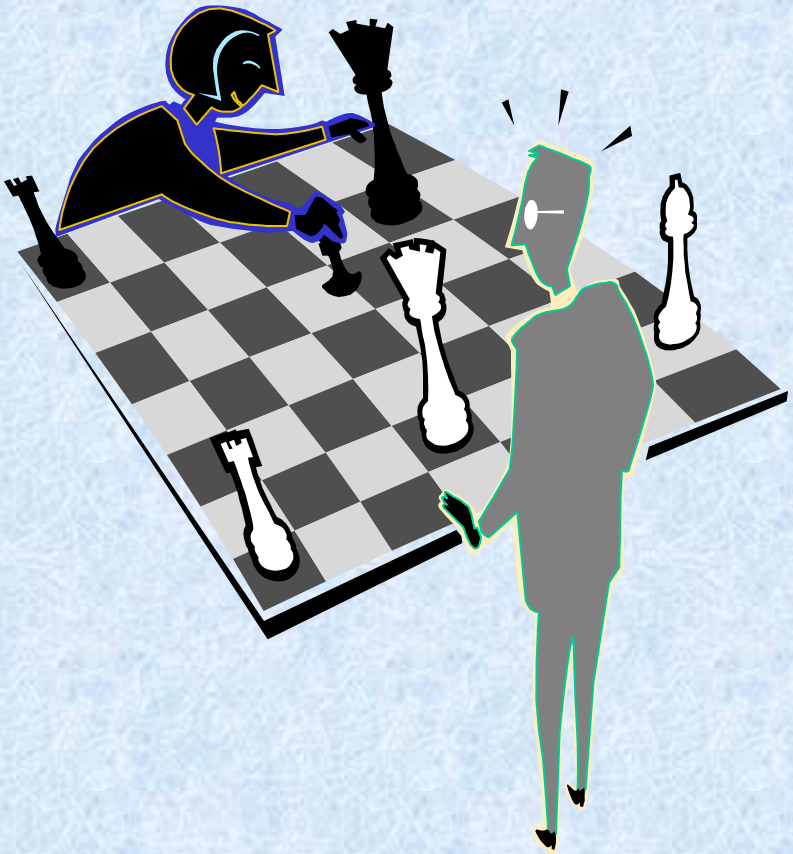
Storage


1 inch
Salt
50’ diameter
100 lbs. of Salt
1 inch
Sand w/
10% salt
50’ diameter
96 lbs. of Salt

Why Prewet ?????

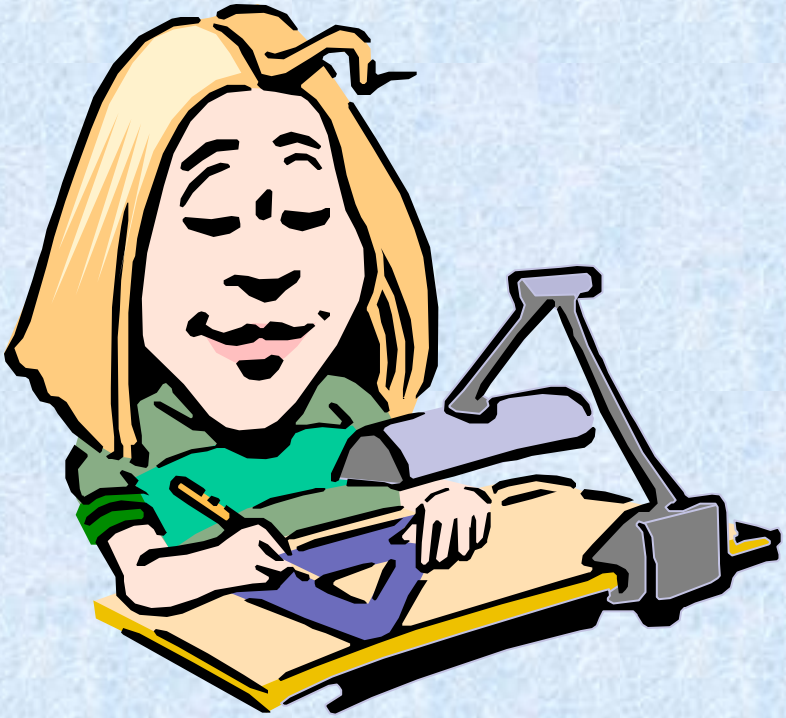
- Reduce bounce and scatter
- Accelerate working of salt
- Environmental savings ?
- Corrosion reduction ?

Snow & Ice Control Strategies and Tactics



- Strategies
- Tactics

Designing Snow and Ice Control Material Treatment



Climate

Weather

Precipitation

Pavement conditions

Storm characteristics

Level of service

Chemical and Abrasives Policies

- Costs?
  - Abrasives
  - Chemicals (salt)

Chemical/Abrasives Mixtures

- Level of service dependent
  - Overall
  - Within-storm
- Unpaved roads
- Low pavement temperature conditions
- Steep grades
- Intersections
- Rail-road crossings

Salt vs. Sand

Cost to treat one lane–mile Salt vs. Sand

Salt	Cost Factors	Sand Mix
---	A Cost of sand, $/ton	$ 6.40 (80%)
$51.16	B Cost of salt, $/ton	$10.23 (20%)
---	C Mixing cost, $ /ton	$0.95
$51.16	D Total Cost, $ /ton	$17.58
225	E Pounds per lane-mi	700 (140)
$ 5.76	**Cost / lane mile, $** (E/2000 x D)	**$ 6.15**

Ice Control Treatment

- Dilution potential
- Pavement temperature
- Level of service

Dilution Potential

- Precipitation types
- Pavement conditions
- Cycle time
- Traffic

Precipitation Types

- Light rain
- Moderate rain
- Heavy rain
- Freezing rain
- Sleet

- Light Snow
- Moderate snow
- Heavy Snow
- Blowing Snow
- None

Pavement Conditions

- Dry
- Damp
- Wet
- Slush
- Loose snow
- Packed snow
- Frost
- Thin ice
- Thick ice

Pavement Conditions

- Bond to pavement
- Residual snow or ice on pavement

Pavement Temperature

Level of Service Considerations

- Pavement condition goals
- Cycle time and hours of operation capability
- Public expectation

Recommended Application Rates for Solid and Liquid Sodium Chloride (Road Salt)

Probable Pavement Temperature at Treatment and Before Next Treatment	Ice Control Chemical Dilution Potential	Ice-Pavement Bond Characteristics Before	Application Rate			
			Solid (note 5)		Liquid (Note 6)	
Greate						
23° F to 32° F (-5° C to 0° C)						267
	High	Bonded/Packed			NR	NR
		Unbonded	200 - 300	55 - 83	88 - 134	207 - 319
	Low					
12° F to 22° F (						
Note						

ICE CONTROL DILUTION POTENTIAL

Precipitation Type	Precipitation Rate		
	Light	Medium	Heavy
	Low	Low	Medium
	Low	Medium	High
	High		High
	m		High
	n		High
	m		High

			Low

OTENTIAL
ade of "High")

Hours	Levels to Add
1.5	0
1.6 - 3.0	1
More than 3.0	2

Traffic > 35 MPH ffic Volume, per Hour	Levels to Add
	0
	1

	Levels to Add
	0
	1
	2

This font is too small!
I can't read it.

Don't try to read it!
The values are in the workbook.

Chemical Rates
(# per Lane-Mile)

- 50 Anti-icing above 23°F low dilution
- 225 Default value some snow bonding
- 500 De-icing above 12°F
- ??? Below 12°F

Roadway Elements

QUESTIONS ???????

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