Managing Winter Materials to Save Money and Protect the Environment

by

James Heeren, PE

Steven Eget, PE

2011 TRB Waste Management and Resource Efficiency Workshop

Dewberry

What are road salts?

- Salts applied to roadways for maintenance such as deicing, anti-icing and dust suppression
  - Inorganic chloride salts (NaCl, $CaCl_2$, KCl, $MgCl_2$)
  - Sodium ferrocyanide (anti-caking additive)
  - Brines used in road de-icing and dust suppression
  - Salt portion of abrasive mixtures and ferrocyanide additives

Facts on road salts

- Solid salt, NaCl(s), is most frequently used
- US spends **$2.3 billion** annually to keep roads clear of snow and ice;
  - Canada spends more than **$1 billion** annually
- US total annual road-salt usage ranges from 8 - 12 million tons of NaCl per year
  - Massachusetts, New Hampshire, and New York are the highest

Application

Brine

Salt

Application Strategies

Strategy/ Method	Materials	Pavement Temp Ranges	Application Rates
Anti-Icing	Liquid Chemicals, Solid Chemicals, Pre-wet Solid Chemicals	0° C to -12° C (32° F to 10° F)	18-110 Kg /Lane /Km (65 – 400 Lbs / Lane/ Mile)
Deicing	Pre-wet Solid Chemicals, Dry Solid Chemicals	0° C to -18° C (32° F to 0° F)	113 – 400 Kg /Lane /Km (200-700 Lbs / Lane/ Mile)
Abrasives	Pre-wet Abrasives, Dry Abrasives	No Limits	225 – 2,700 Kg /Lane /Km (500-6,000 Lbs / Lane/ Mile)
	Abrasive/Salt Mixes	0° C to -18° C (32° F to 0° F)	225 – 2,700 Kg /Lane /Km (500-6,000 Lbs / Lane/ Mile)

Salt Storage

Storage

Environmental Impacts of Road Salts

- Wide range of impacts on:
  - Freshwater ecosystems (groundwater/surface water)
  - Soil
  - Vegetation
  - Wildlife
  - Human Health
- In high concentrations, road salts pose a risk to plants, animals and the aquatic environment

Fate and Transport

- Runoff to surface waters and percolation most common mechanisms to enter water supplies. Infiltration more common for groundwater.
- Salts remain in solution in surface waters and are not subject to any significant natural removal mechanisms
  - Require 200 years to reach steady state
- In soil, salts compromises soil structure and inhibits erosion control (increase turbity)

Regulatory Framework

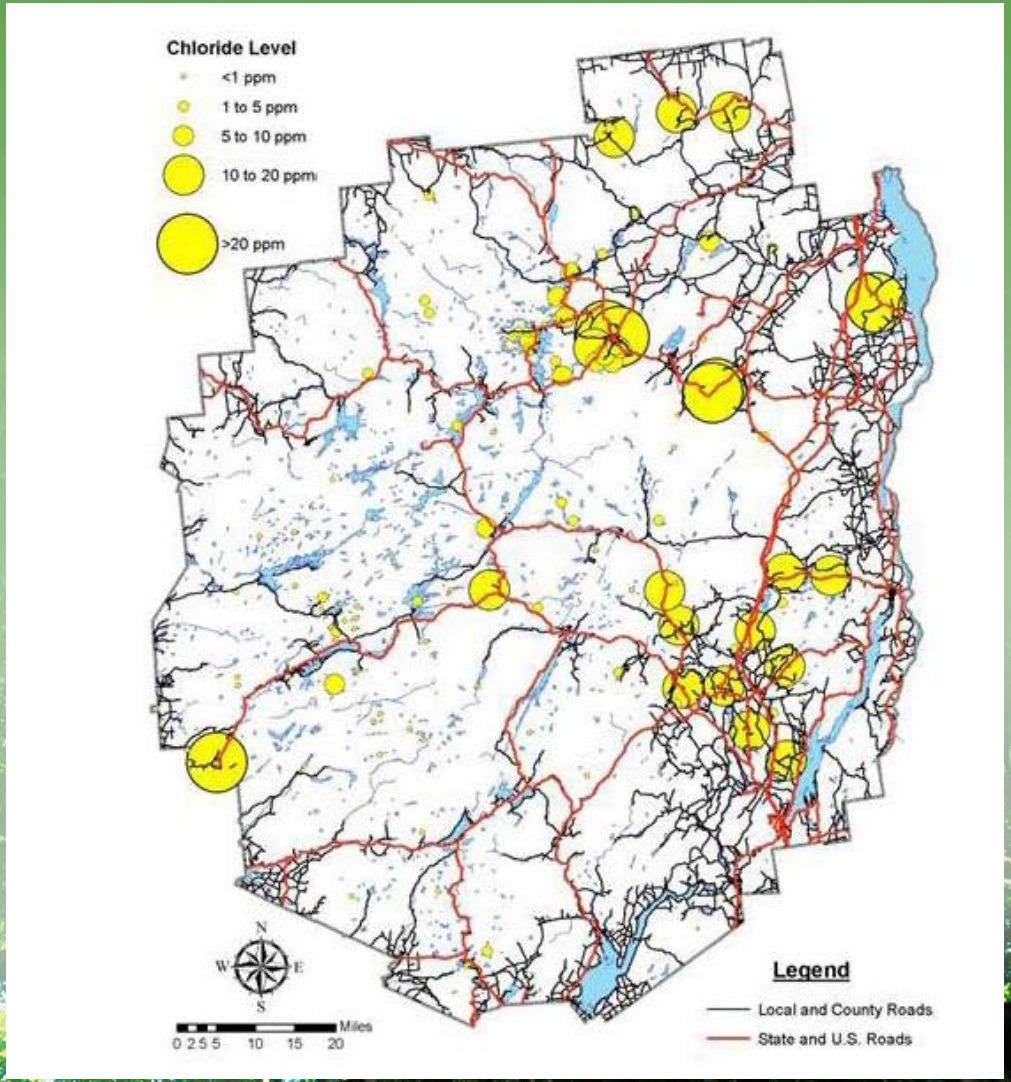
- Limited regulations regarding chlorine or sodium concentrations in soil
  - Typically no state limits on concentration
- Drinking water regulations can limit chlorine and sodium levels in receiving bodies and groundwater
- Other deicing materials can release other contaminants including cyanide
- Regulatory limit vary by state

Remediation Options

- In situ remediation via calcium amendments
  - May require leacheate collection and disposal
- Excavation and…
  - On-Site Soil Washing
    - Wash water collection and treatment/disposal
  - Offsite Disposal

Deicing and Elevated CL Levels

From June 2011 presentation by Dr. Dan Kelting of Paul Smiths College regarding 2009 CL Levels in Adirondack Lakes



Infrastructure Impacts of Road Salts

- Chloride ions in salt accelerates corrosion
- Corrosivity of road salt adversely impacts motor vehicles and infrastructure
  - Damaging to bridge decking. Cl ions penetrate concrete and corrode reinforcing rods, causing concrete to crack and fragment
  - In automobiles, corrosion can affect critical vehicle parts
  - Increases cost of auto manufacturing by nearly $4 billion/yr. (NRC, 1991)

Salt Management

- Must consider a range of factors when assessing materials, including:
  - performance
  - cost
  - potential for the material to impair the natural receiving environment
  - potential for the material to impair infrastructure

Best Management Practices

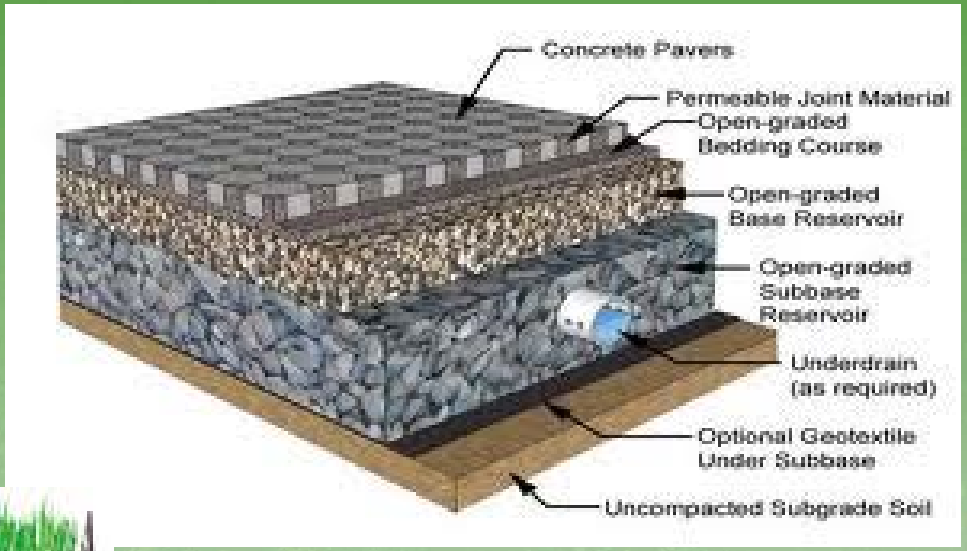
- Two (2) General Categories, structural and non-structural:
  - Structural BMPs treat or mitigate impacts after application
  - Non-structural BMPs reduce the application amount, while maintaining winter mobility and public safety

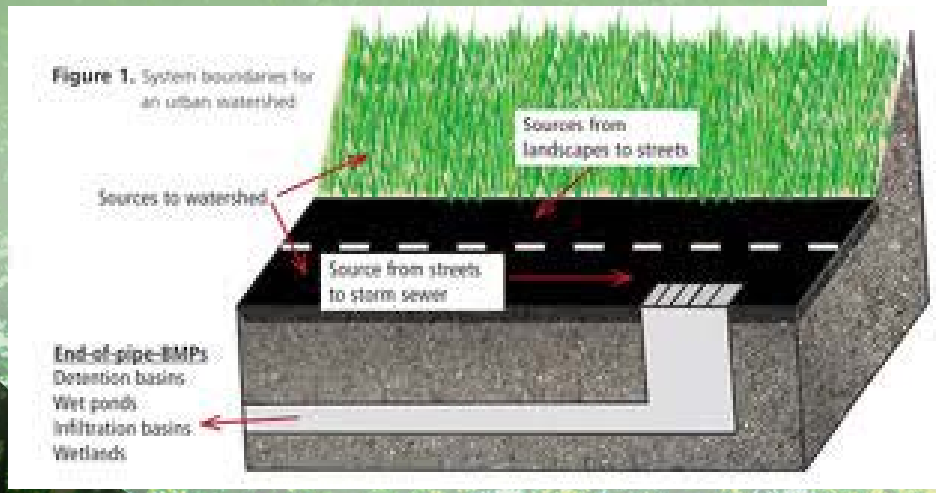
Structural BMPs

- Use of salt-tolerant plants to buffer roadways
- Controlled release of runoff
- Use of ponds, wetlands, vegetated swales and filter strips etc.
- Strategies may vary, depending on the specific climate, site, and traffic conditions
- Few structural BMPs can effectively remove deicing products that have dissolved

Structural BMPs (Examples)

Permeable Pavement





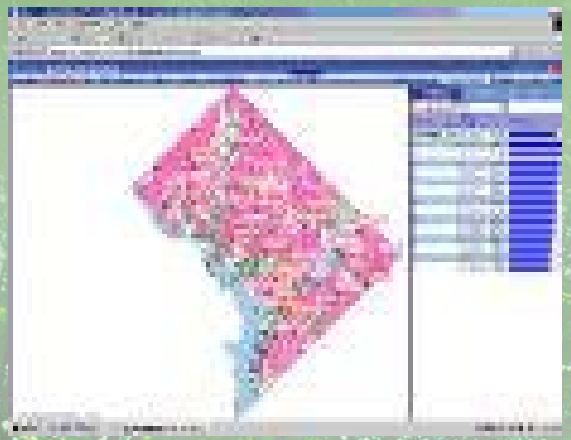
Salt resistant plants & end of pipe treatment

Non-Structural BMPs

- Managing service level expectations
- Proper training of maintenance professionals
- Improved stockpile management and storage
- Improved anti-icing/de-icing/pre-wetting practices, application rates
- Advanced snowplow technologies and chemicals
- Data-driven application rate optimization and decision Support Systems

Non-Structural BMPs (Examples)

Advance Snow Plows



Decision Support Systems

- **Similar system in UT saved DOT $2.2M/year**

Conclusions

- Good Winter Materials Strategy BALANCES Safety and Environmental Req.'s
- Application of Road Salts IMPACTS Environment and Infrastructure
  - Limited Regulatory Guidance – Especially Related to Soil
- Structural and Non-Structural BMP's Needed To Manage Impacts

Questions & Comments

James Heeren, PE
Dewberry-Goodkind, Inc.
jheeren@dewberry.com

Steven Eget, PE, CEM
Dewberry-Goodkind, Inc.
seget@dewberry.com