The Impact of De-Icing Salt on the Lake George Watershed

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Road Salt Background

• Important deicing agent for safe winter driving

• Road salt composition
  – 60% chloride ion (Cl⁻)
  – 40% positive ion (Na⁺, Mg⁺, Ca⁺, K⁺)

• Mined Product
  • most common form used is NaCl
  • 10-15 million tons/yr in US
  – Most applied to NE and Midwest states with ¾ in NY, OH, MI, IL, PA, and WI
Salt

**Pro**
- “Bare Roads”
- Reduced cleanup costs
- Inexpensive

**Con**
- Contamination of lakes & groundwater
- Impacts to lake & stream biota
- Impacts to roadside vegetation and soils
- Corrosion of vehicles & infrastructure
- Lack of recapture technologies
Salt Toxicity

USEPA limit for chloride in drinking waters 250 ppm
  - Restricted salt diets limited to 20 ppm sodium
Roadside vegetation affected at 70 ppm
Affects throughout the food chain
  – Algae - Critical level: 12 ppm
  – Invertebrates - Diversity of stream dwelling insects decreases as salinity increases
  – Fish - Trout affected at 250 ppm; LD$_{50}$ @ 6743 ppm
At concentrations above 220 ppm, 10% of aquatic species could die after 30 days
Road De-icing/Salt and Sand Application

- **Lake George Road Maintenance** – 680 miles in basin
  - Local 404 miles (59.3%)
  - County 111 miles (16.3%)
  - State & Federal 166 miles (24.4%)

- **Annual Basin Wide Application Average (ten year average)**
  - 9,000 Tons of Salt
  - 29,000 Tons of Sand

- **Application Rates (tons/year/lane mile)**
  - 13.17 Salt
  - 42.44 Sand
Salt Contamination of Lake George

Salt levels have more than doubled in the past 30 years

Data supplied by DFWI and The Fund for Lake George
Salts in Streams

- Salt concentrations in “first flush” can exceed 1000 ppm chloride and typically exceed 100 ppm in urbanized streams.
- Streams in “pristine” areas typically less than 2 ppm chloride.
- Salts build up in soils and are “washed” out by rainfall throughout the year.
- Elevated salt levels “episodic” related to runoff.
- Many streams in the LG basin “stressed” with salt and sand the likely culprits.
Salt in LG Streams

- Streams in undeveloped watersheds (NWB & Shelving) release from 2-4 kg Cl/acre (4-9 lbs/acre)
- Streams in developed watersheds (Hague, Indian, Finkle) release from 30-50 kg/acre (66-110 lbs/acre)
- Streams in more heavily developed watersheds (West & East) release from 120-140 kg/acre (260-310 lbs/acre)
Salt Impacts Lake & Stream Biota

- Interferes with fish spawning
- Degrades habitat for stream dwelling fish and invertebrates
- Creates disturbed habitats for invasion by non-native species
Groundwaters

- Runoff from uncovered salt piles can reach levels of 100,000 ppm chloride
- Groundwater contamination incidents generally related to salt storage
- Natural flushing may take decades to clear aquifer after contamination
Salt impacts roadside vegetation

- Salt buildup along roadsides selects for salt tolerant species
- Salt spray responsible for damage to pines along Adirondack roadways
- Alters soil chemistry
- Disturbed habitat favors invasives
# Sensitive Trees and Landscape Vegetation

<table>
<thead>
<tr>
<th>Type</th>
<th>Species at Risk from Salting</th>
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</thead>
<tbody>
<tr>
<td>Deciduous Trees</td>
<td>Hickory, Green Ash, Red Maple, Sugar Maple</td>
</tr>
<tr>
<td>Conifers</td>
<td>Balsam Fir, White Pine, Hemlock, Norway Spruce</td>
</tr>
<tr>
<td>Shrubs</td>
<td>Dogwood, Redbud, Hawthorn, Rose, Spirea</td>
</tr>
<tr>
<td>Grasses</td>
<td>Kentucky Bluegrass, Red Fescue</td>
</tr>
</tbody>
</table>
Salt tolerant species

- Disturbed habitats encourage invasion by non-native species

Phragmites

Purple loosestrife
Salt Impacts Animals

• Salt along highways attracts deer and reduces their fear of vehicles resulting in more frequent accidents
• Songbirds poisoned by consumption of salt granules
Salt additives and alternates

- Calcium in salt and salt substitutes (CMA) may encourage the growth of exotic species
- Certain additives to prevent caking or inhibit corrosion are toxic
Impact of Road Salting on Organisms

• Increased chloride causes loss of biota (abundance & diversity)
  – Terrestrial plant sensitivity as low as 70 ppm in soil
  – Soil bacteria inhibited at 90 ppm (compromise soil structure)
  – Inhibition of seed germination and root growth at 100 ppm
  – 10% of aquatic species exceed critical tolerance at 220 ppm

• Increased NaCl results in increased cost for water treatment
  – Surface and groundwater infiltrated
  – EPA requires sodium concentrations < 20 ppm
  – Up to 30% of US population may require low sodium diets

• Increased calcium may affect Zebra mussel invasions
  – Small amounts in rock salt, more in alternative de-icers
Salt Corrodes Vehicles & Infrastructure
Accelerated Infrastructure Failure

EPA estimate: For every $50 spent on salt, $750 is spent to repair corrosion to roads, bridges and vehicles
Sand

**Pro**
- No contamination problems
- Established technologies for cleanup

**Con**
- Buildup in lakes & streams
- Impacts to lake & stream biota
- Cleanup Costs
- Habitat alteration
- Unlikely to provide “bare roads”
Consequences of Sand Application

• Sand application on roadways
  – Street sweeping, catchment cleanouts and disposal
    • >50% remains in the environment
  – Dredging of delta formations
  – Increased turbidity causes fish and invertebrate mortality; photosynthesis inhibition
  – Increased air pollution
    • Oregon est. 45% small air particulates from sand application
Sand Producing delta expansion at West Brook
Maintenance

• Street sweeping can significantly reduce sand loads to lakes and streams
• Frequent cleanout of capture devices is critical
• Calibration of sanding devices can reduce the loading of sand to roads
Summary

• Road salt accumulation can negatively impact surface waters, soils and plant and animal diversity
• Road salt is responsible for corrosion of vehicles, highways and transportation infrastructure
• Efficient use of salt can reduce the overall impact of this material
• Use of alternatives, anti-icers and covered storage can reduce input amounts and overall cost
• Interest is growing in alternatives and proper use