Road Salt and Elevated Chlorides in the Wachusett Watershed

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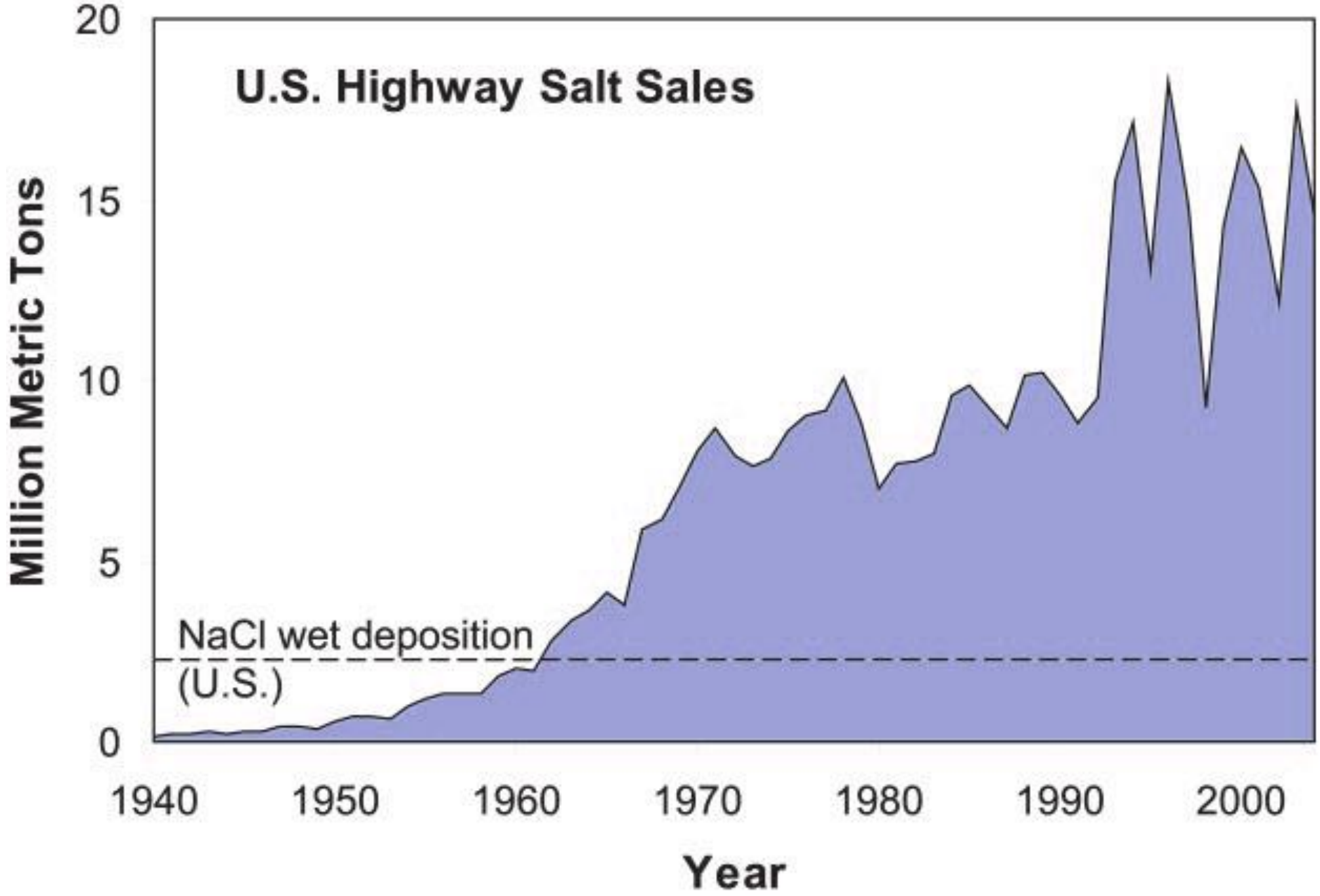
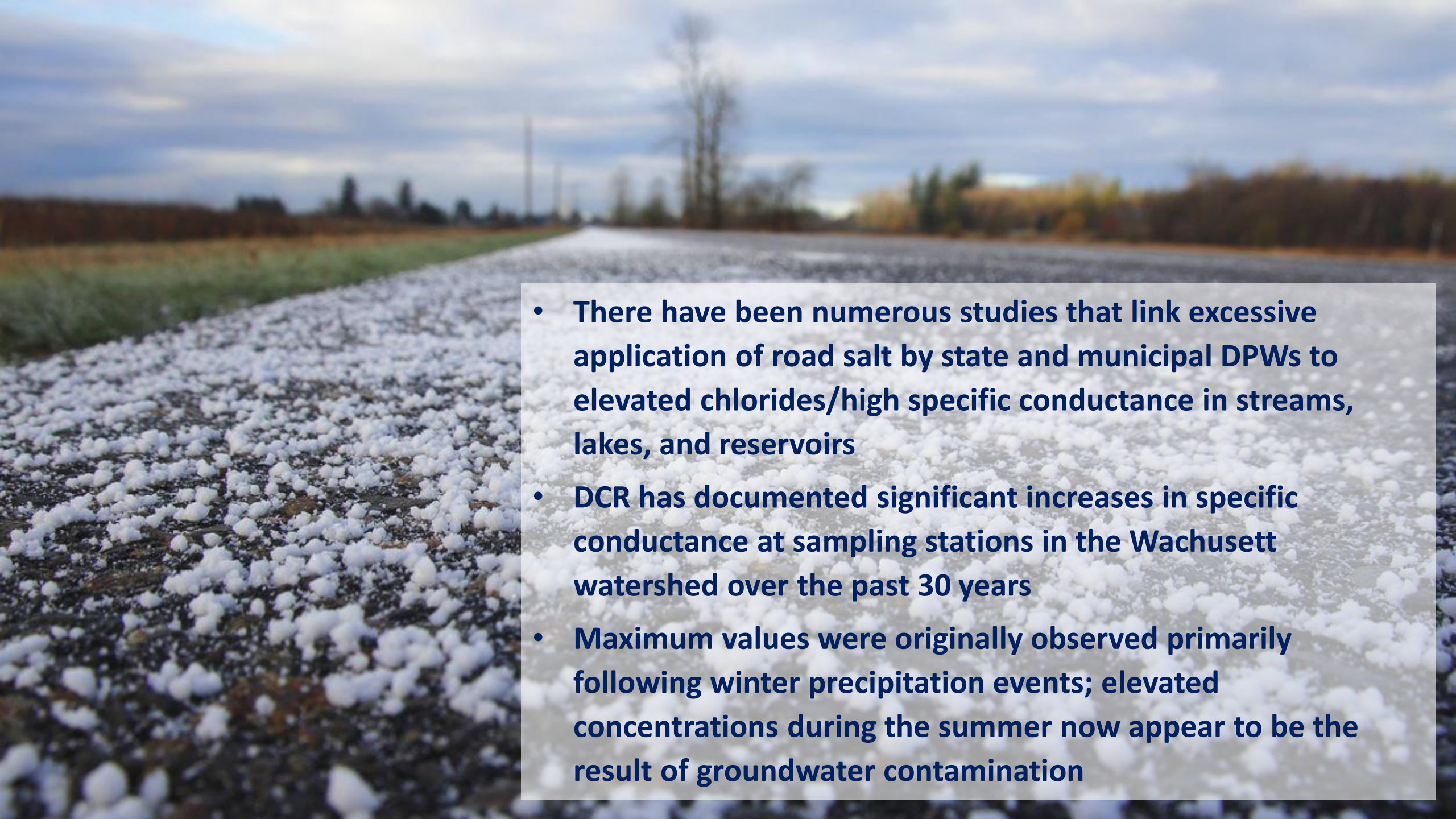
PRESENTATION OUTLINE

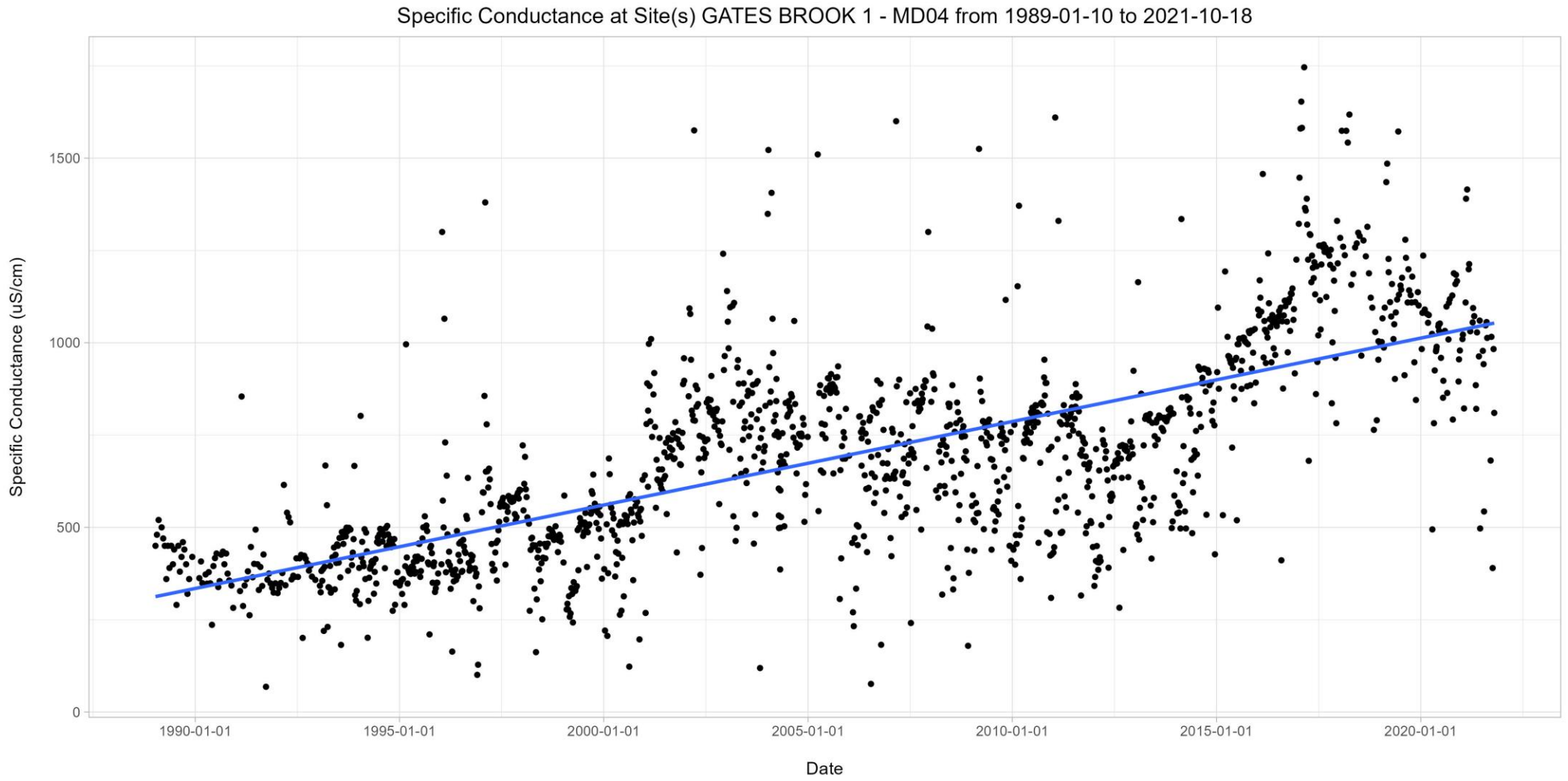
- **Overview of current conditions**
- **Water quality monitoring**
- **Why salt is a concern**
- **What are the sources of salt in the watersheds?**
- **Action is DWSP is taking to reduce chloride levels**

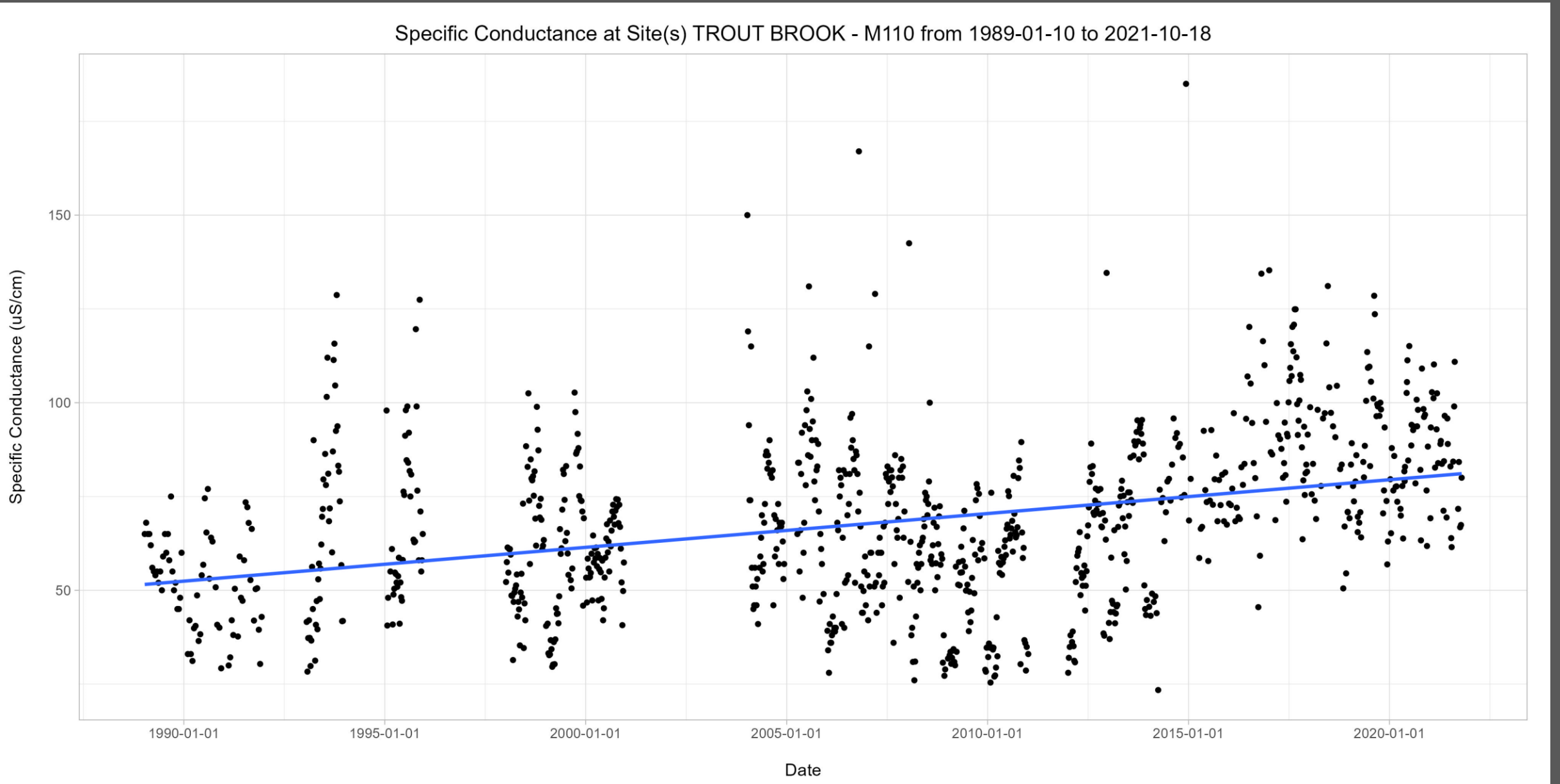

U.S. Highway Salt Sales
Million Metric Tons
20
15
10
5
0
NaCl wet deposition
(U.S.)
1940
1950
1960
1970
1980
1990
2000
Year

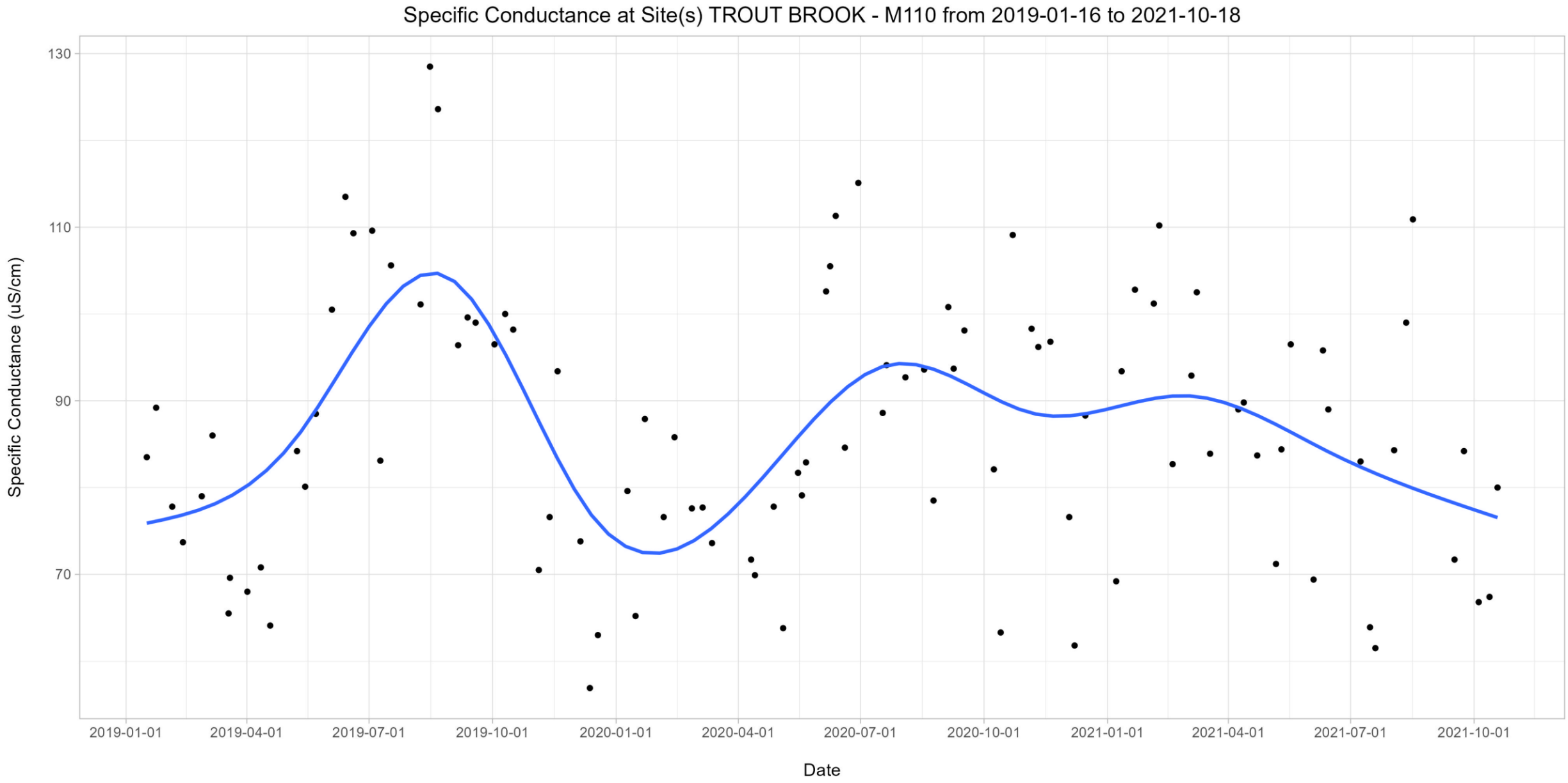


- There have been numerous studies that link excessive application of road salt by state and municipal DPWs to elevated chlorides/high specific conductance in streams, lakes, and reservoirs
- DCR has documented significant increases in specific conductance at sampling stations in the Wachusett watershed over the past 30 years
- Maximum values were originally observed primarily following winter precipitation events; elevated concentrations during the summer now appear to be the result of groundwater contamination

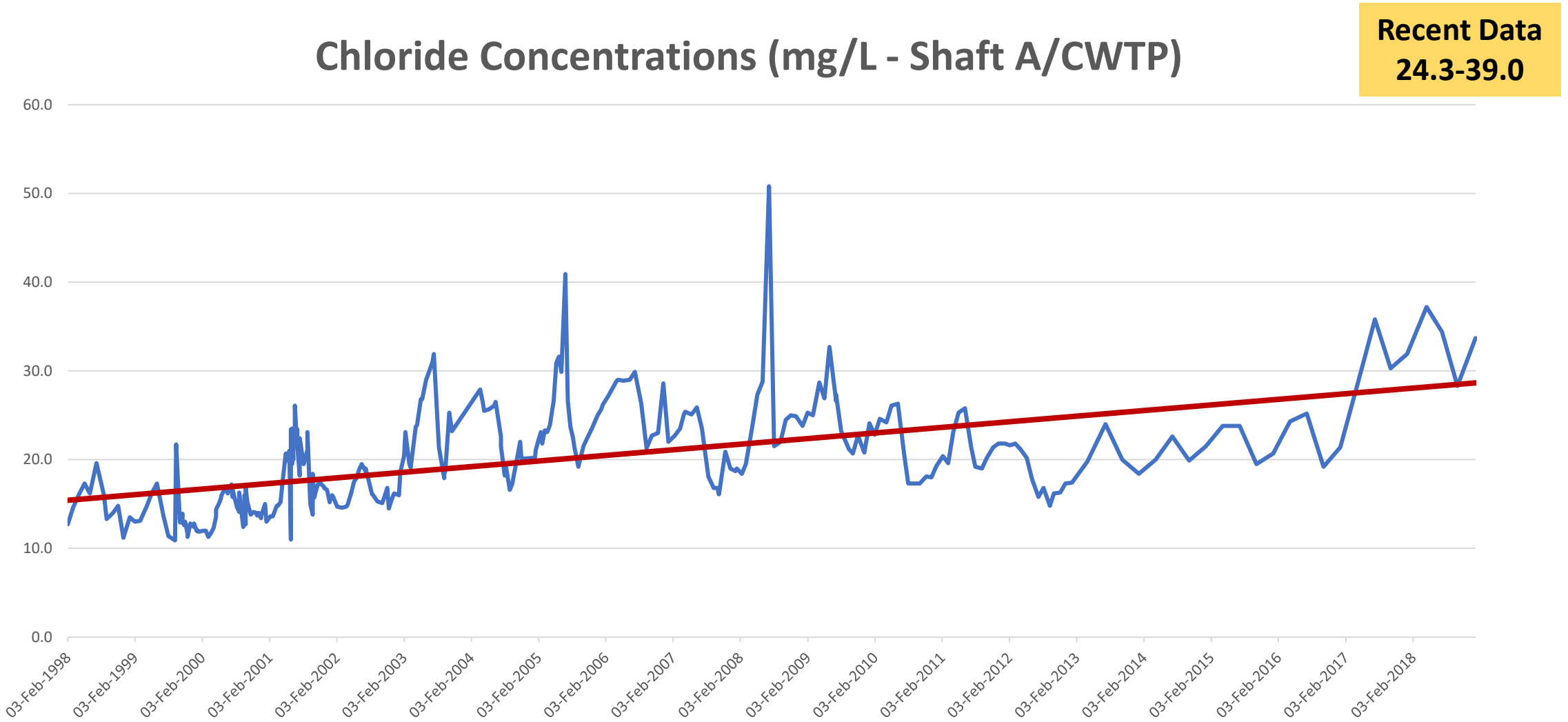
Water Quality Data Clearly Illustrate the Increase (specific conductance used as surrogate for Cl^-)




Specific Conductance at Site(s) TROUT BROOK - M110 from 1989-01-10 to 2021-10-18
Specific Conductance (uS/cm)
150
100
50
1990-01-01
1995-01-01
2000-01-01
2005-01-01
2010-01-01
2015-01-01
2020-01-01
Date


Specific Conductance at Site(s) TROUT BROOK - M110 from 2019-01-16 to 2021-10-18
Specific Conductance (uS/cm)
130
110
90
70
2019-01-01
2019-04-01
2019-07-01
2019-10-01
2020-01-01
2020-04-01
2020-07-01
2020-10-01
2021-01-01
2021-04-01
2021-07-01
2021-10-01
Date

Specific conductance in the Wachusett Reservoir during 1989 was 60-85 µS/cm but reached 184 µS/cm in 2018.



Water Quality Monitoring

- Samples for chlorides are now collected monthly from ten tributary stations
- Eight groundwater wells are sampled for chlorides every month- specific conductance is measured at the same time
- Chloride concentrations measured in the tributaries have approached 600 mg/L in Gates Brook
- Specific conductance measured in groundwater has exceeded 7500 µS/cm in a well near Route 110

PROBLEMS DUE TO EXCESS SALT APPLICATIONS AND HIGH CHLORIDE CONCENTRATIONS

- Harmful to aquatic wildlife and roadside vegetation
- Causes damage to vehicles, bridges, and buildings
- Financial impact on municipal and state budgets- it's expensive!
- Contamination of private and municipal drinking water wells
- Increased likelihood of corrosion in water-distribution systems and increased threats from copper and lead

WHERE DOES THIS SALT COME FROM?

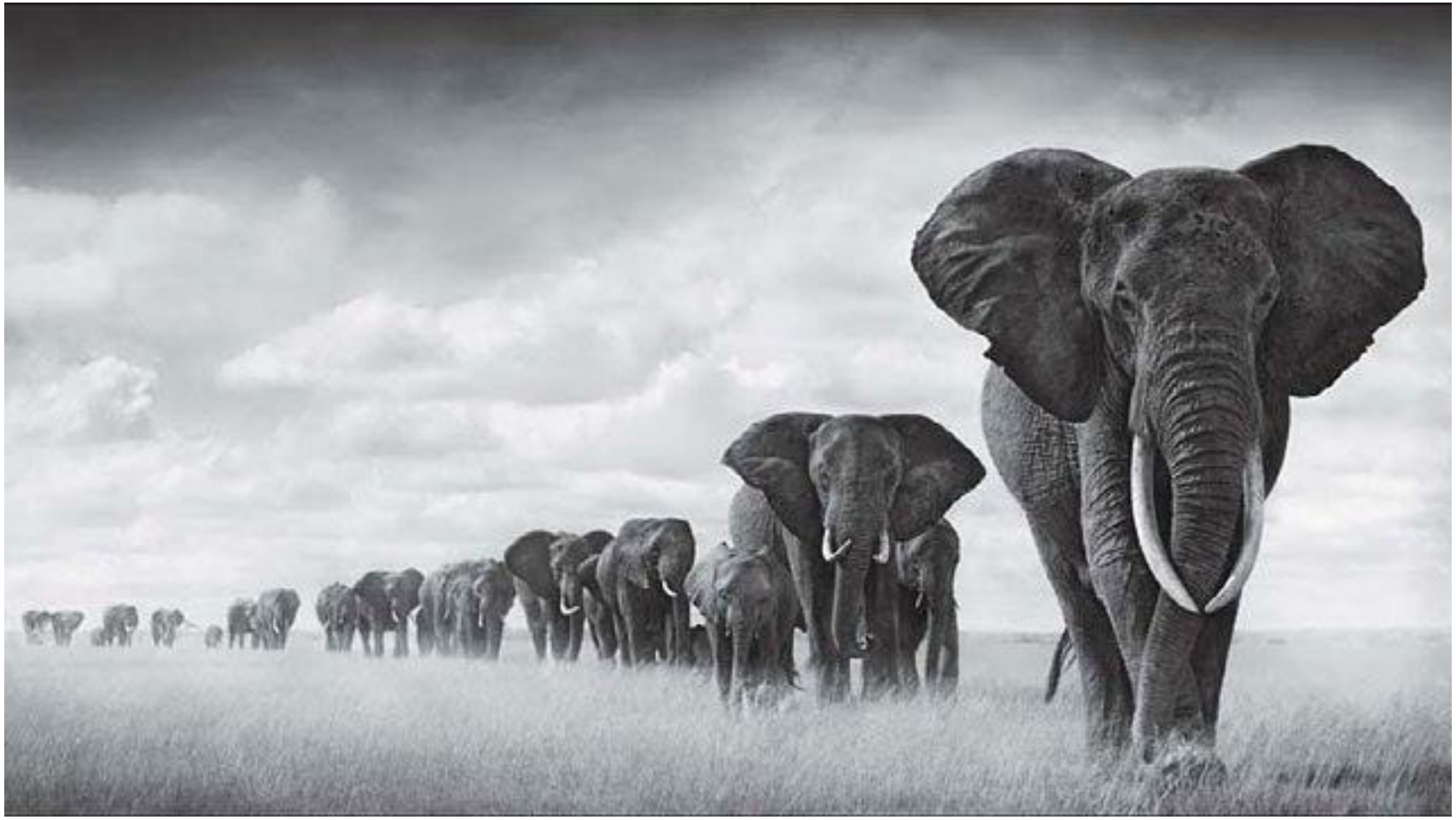
Multiple Sources:

- **Atmospheric Deposition**
- **Weathering of Soil and Rock**
- **Wastewater**
- **Agricultural Sources (Fertilizers, Animal Waste, and Irrigation)**
- **Energy Production**
- **Landfills**
- **Deicing Chemicals**

SALT APPLIED ANNUALLY IN THE WACHUSETT WATERSHED: ~18,000 tons

TOWN	AVERAGE ANNUAL USE (tons)	ESTIMATED WATERSHED USE (tons)
Boylston	2,604	847
Holden	2,884	2,087
Paxton	1,545	210
Princeton	2,200	1,662
Rutland	4,000	1,316
Sterling	1,800	991
West Boylston	4,401	3,868
Worc/Clint/Leom	unknown	700
MassDOT	4,093	4,093
DCR DWSP	n/a	35
Parking lots	2,522	2,522

WHAT DOES 18,000 TONS LOOK LIKE?

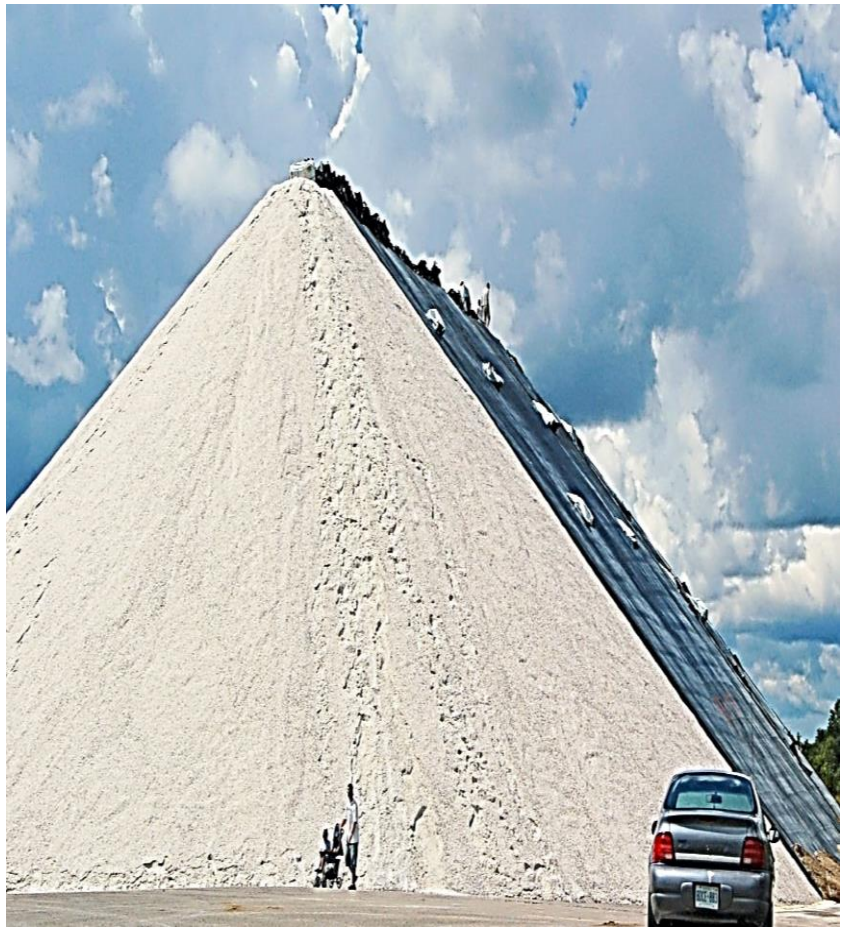


3,000 African elephants (average weight 6 tons)

WHAT DOES 18,000 TONS LOOK LIKE?

Old State House (65’)

Salt pyramid (120’ tall, 120’ wide)



HOW TO TACKLE THIS ISSUE?

Current Initiatives:

- **Education and training**
- **Provide a salt reduction grant program to assist watershed communities**
- **Model impact of reducing inputs**
- **Improve data collection capability**
- **Upgrade DCR practices**
- **Legislative options**

Education and Training

- DCR and MWRA have cooperated to provide Baystate Roads (UMASS Transportation Center) training on Snow and Ice Operations in 2019 and planned in 2021
- MWRA covered the cost of the training which was attended by staff from DCR, MWRA, and five watershed towns
- Instruction was provided on proper use of salt and liquid anti-icers, pre wetting and pre-treating options, anti-icing versus de-icing, new technology, and equipment calibration
- Pre-treatment of bare pavement BEFORE a storm prevents snow and ice from binding to pavement which makes it easier to plow and uses less salt overall
- Application of salt brine to roads before storm events is even better but requires specialized equipment to produce and apply the brine

Education and Training

- The Town of Sterling has been an early adopter of pre-treatment. Sterling's previous practice of plowing and treating with salt only after a snow event required approximately 1800 tons of salt each winter.
- Use of pre-treatment in Sterling reduced the amount of salt required during 2019-2020 to 1100 tons. Other watershed communities that did not change practices did not see similar reductions.
- “We are now pre-treating always due to the training you provided.” We also calibrated spreaders to cut pretreatment well below our former use.

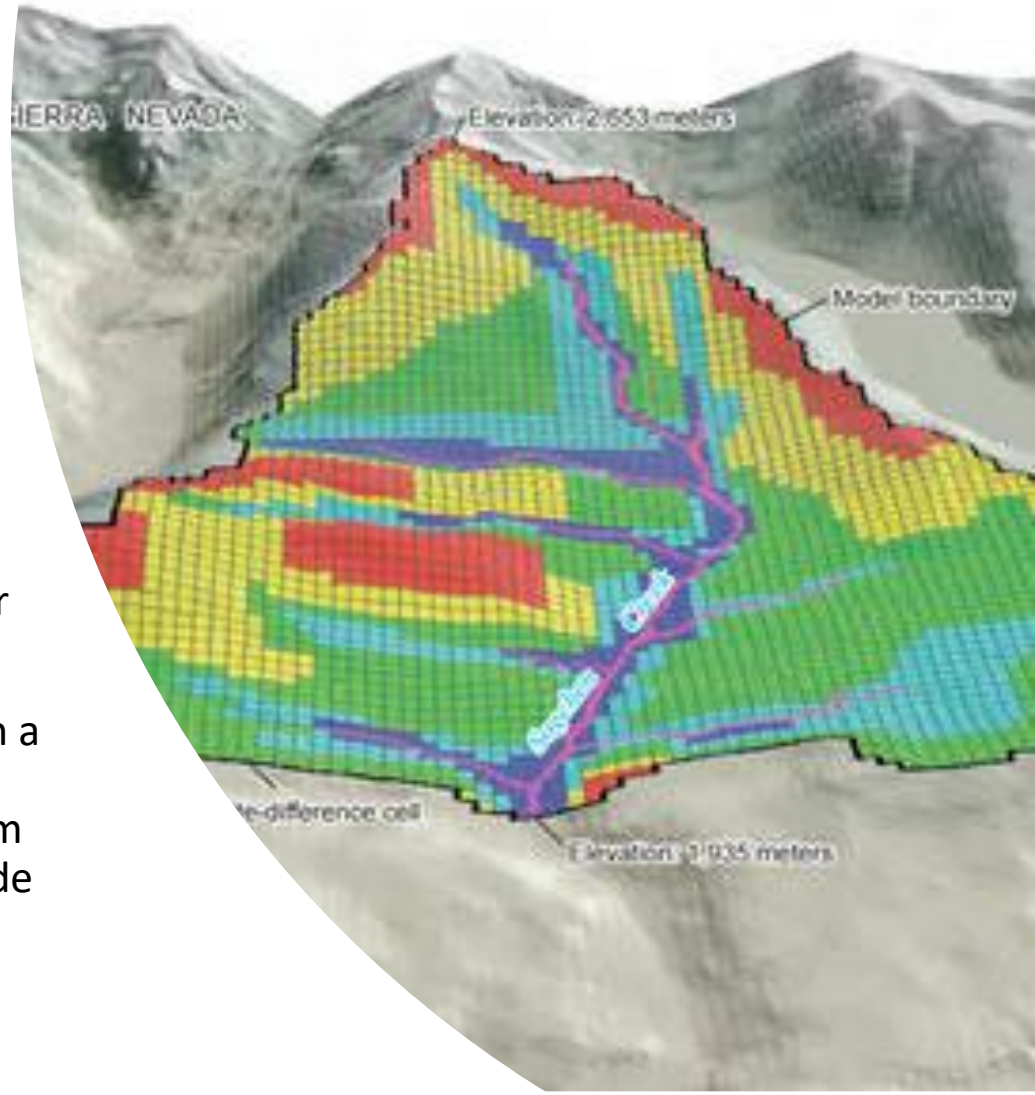
Education and Training

- Concentrated effort on DCR educational programs to include additional messaging on the dangers of salt use and promote behavioral changes that would reduce use
- Production of a salt use reduction educational video by Interpretive Services for this winter season
- Reducing salt does not mean reducing public safety
- Changing public expectations is a necessary component of long term success

Salt Reduction Grant Program

- There are upfront costs involved to be able to achieve long term savings
- Dedicated funding in DWSP budget to administer a 50/50 matching grant program to facilitate adoption of salt reduction technologies in watershed towns
- First round of grants in FY21: Three communities applied for and received matching reimbursable grants to purchase flexible plow blades (Holden), flexible plow blades and temperature sensors (West Boylston), and help construct a salt storage facility (Princeton).
- Total grant distribution was $58,592
- FY22 Grants opened October 26th, 2021
- Receiving grants also leads into increased resolution of salt use data provided

Modelling Efforts



- UMASS-Amherst has an existing ISA with DCR to investigate watershed-based reservoir inputs and to use their existing hydrodynamic and water quality model to predict various outcomes under a variety of conditions
    - Soper et al. Long-term analysis of road salt loading and transport in a rural drinking water reservoir watershed Journal of Hydrology, September 28, 2021: “The decadal response of the reservoir system reflects the slow-moving nature of the baseflow-dominated chloride loading and suggests that measurable water quality improvements will only be realized with a sustained long-term decrease in the amount of road salt applied.”
- Use the model to investigate impact of reducing inputs of chlorides to the reservoir and to predict changes to chloride concentrations at the Cosgrove Intake based on a variety of Quabbin transfer options
- Look at impervious surfaces, relationship between chloride and specific conductance, estimate loads, consider climate change

Improve Data Collection

- Installation of DIY low-cost Mayfly Data Loggers across the watershed, powered by solar panels and lithium-ion batteries, with the ability to obtain real-time specific conductance data. Successful pilot of one unit, six more units have recently been deployed.
- Collect additional groundwater data on chlorides and specific conductance
- Encourage regular reporting on annual salt use by towns and MADOT
- Establish salt tracking form to be used during all future winter storms by DCR watershed maintenance staff
- Monitor salt applications at parking lots

Upgrade DCR Practices

- Pre-treatment with granular salt
- Salt brine generator
- Equipment to apply brine
- Replace and upgrade our salt shed
- Provide training

Other Ideas

- Pursue Legislative changes to grant liability protection to certified Commercial Salt Applicators and property owners or managers who hire them against damages arising from snow and ice conditions (already the law in NH)

- Recent changes to NH law establish a program for applicators complete training, pass exam, pay for certification (to cover administrative costs), and agree to use appropriate application rates and document use. Applicators and clients would not be liable for damages when following best management practices

- Help towns develop detailed winter operations plan that include standard operating procedures

Questions?