Road Salt Usage and Environmental Impacts

Workshop hosted by

Maryland Water Monitoring Council

Patuxent National Wildlife Visitor's Center

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U.S. Fish & Wildlife Service
Patuxent
Research Refuge | Maryland

MWMC
maryland water monitoring council

USGS
science for a changing world

About The Workshop

Data collection and analysis across the Mid-Atlantic region has shown in recent years that the increasing usage of road salt during winter months has an impact on our local waterways and groundwater. This all-day workshop provides information on current road salt operations, applications, and best management practices within the state and local counties. Presenters discuss current scientific analysis and monitoring efforts, and the effects of elevated chloride levels on surface water, groundwater, and local ecology. Lastly, the workshop provides an overview of management strategies, including regional policies. A panel discussion invites attendees to identify additional information and monitoring needs.

Workshop Content

- **Road salt use: state and county practices, techniques, and alternatives**
- **Impacts to water resources: streams, reservoirs, and groundwater**
- **Effects on local ecology, including impacts from elevated chloride concentrations**
- **State and federal management strategies, planning, and policy**

Time	Activity/Topic	Speakers
8:30-8:55	Registration check-in, breakfast	
9:00-9:10	Introduction/Overview	**Dan Boward, Mat Pajerowski**
9:10-9:50	Keynote speaker	**Dr. David Wong, Massachusetts DEP**
Road Salt Use: Practices, Techniques and Alternatives		
9:50-10:10	State perspective; state salt management plan and best practices	**Russ Yurek, Scott Simons, MD State Highway Administration**
10:10-10:30	County road salt practices, operations	**David Ennis, Frederick Co. DPW**
10:30-10:40 Break		
Impacts to Water Resources: Streams, Reservoirs, Groundwater		
10:40-11:00	Impacts on surface water (conductivity) – continuous monitoring data	**Joe Bell, USGS Baltimore WSC**
11:00 – 11:20	Impacts to WSSC water resources	**Hahns Hairston, Steven Nelson, Priscilla To, WSSC**
11:20 - 11:40	Impacts to groundwater	**Joel Moore, Towson Univ.**
11:40 – 12:00	Impacts on drinking water wells	**Bill Ensor, Baltimore Co. DEPS**
12:05 - 12:45 Lunch		
Ecosystem Impacts (Elevated Chloride Concentrations)		
12:50 - 1:10	Specific conductivity	**Michael Kashiwagi, MD DNR**
1:10 - 1:30	Anadromous fish spawning	**Margaret McGinty , MD DNR**
1:30 - 1:50	Impacts on amphibians	**Joel Snodgrass, Virginia Tech**
1:50 – 2:10	Impacts on fish and benthic macroinvertebrates	**Ray Morgan, Univ. of MD**
2:15 – 2:25 Break		
Management Strategies, Regulation, and Policy		
2:25 – 2:45	Federal regulations and policy	**Susan Jones-FHWA, Rachel Herbert-EPA**
2:45 – 3:05	Development of water quality criteria—chloride in streams	**Tim Fox, Maryland Dept. of Env**
3:05 – 3:25	TMDLs & monitoring for chloride in MD	**Allison O'Hanlon, Maryland Dept. of Env**
3:30-3:55 **Panel Discussion: Next Steps on Assessing Road Salt Impacts in MD** David W. Wong, Allison O'Hanlon, Joel Moore, Raymond P. Morgan		
3:55 - 4:00	Closing Remarks	

Keynote Speaker

David W. Wong, Ph.D.

Dr. Wong working on a road salt project on monitoring the chloride concentration in River Meadows Brook, Mass.

Dr. David Wong is an Environmental Analyst for Massachusetts Department of Environmental Protection and an Associate Professor in Research for State University of New York at Oneonta. He received a Ph.D. in Marine Ecology and is interested in aquatic ecology and environmental protection. Over the years, he has provided consulting services for over 80 entities. Dr. Wong has participated in over 120 speaking engagements and presentations (including many as a keynote), authored two books, and 64 peer-reviewed publications on water pollution and aquatic invasive species. He is also an invited reviewer for 22 scientific journals and 11 grant agencies.

Agenda

8:30-8:55 Registration, continental breakfast

9:00 Introduction

9:10 Keynote Speaker
Impacts of Road Salt in Massachusetts: Chloride Assessment and Road Salt Management
Dr. David W. Wong, Environmental Analyst, Massachusetts Department of Environmental Protection

9:50 ***State Highway Authority's Salt Management Plan and Best Practices***
Russ Yurek, Director, Office of Maintenance, MD SHA
Scott Simons, Transportation Engineer, Office of Maintenance, MD SHA

10:10 ***Frederick County Road Salt Practices: Where We've Been and Where We're Going***
David B. Ennis, Department Head of Highway & Facilities, Frederick County Public Works

10:30-10:40 Break

10:40 ***Effects of Road Salt Runoff on Surface Water Specific Conductivity Values***
Joseph Bell, Hydrologist, USGS MD-DE-DC Water Science Center

11:00 ***WSSC Source Water Data and Infrastructure Impacts Resulting from the Application of Road Salt***
Hahns Hairston, Plant Engineering Unit Coordinator, WSSC
Steven Nelson, Environmental Scientist, WSSC
Priscilla To, Principal Environmental Engineer, WSSC

11:20 ***Stormwater Management Basins as a Source of Year Round Salt Loading to Groundwater and Streams***
Joel Moore, Assistant Professor of Geosciences, Towson University

11:40 ***Observed Impacts of Chlorides in Wells in Baltimore County***
Bill Ensor, Supervisor of Groundwater Well Program,
Baltimore County Department of Environmental Protection

12:05-12:45 Lunch

12:50 ***Monitoring Specific Conductivity Associated with Road Salt Application in Restored and Unrestored Streams in Maryland***
Michael Kashiwagi, Natural Resources Biologist, Maryland Department of Natural Resources

Agenda cont'd

1:10 ***Evaluating Effects of Conductivity Increases on Herring Spawning Habitat***
Margaret McGinty, Biologist, Maryland Department of Natural Resources

1:30 ***Road Salt Toxicity to Amphibians: Variation in Sensitivity Among Species and Environmental Gradients in Exposure***
Joel Snodgrass, Department Head and Professor, Virginia Tech

1:50 ***Salting our Streams: Biotic Effects?***
Raymond P. Morgan, Professor Emeritus, University of Maryland

2:15-2:25 Break

2:25 ***Federal Perspective on the Use of Chlorides, Impacts on Our Roadways, and Programs to Address Water Quality Concerns***
Susan Cheung Jones, Office of Project Development & Environmental Review, Federal Highway Administration
Rachel Herbert, National Transportation Liaison, Office of Water, EPA

2:45 ***Development of Draft Numeric Water Quality Criteria for Chloride in Maryland***
Tim Fox, Natural Resources Planner, MD Dept of Environment

3:05 ***Monitoring for Chloride in Maryland's Freshwater Streams***
Allison O'Hanlon, Natural Resources Planner, MD Dept of Environment

3:30—3:55 ***Panel Discussion: Next Steps on Assessing Road Salt Impacts in Maryland***
Dr. David W. Wong, Allison O'Hanlon, Joel Moore, Raymond P. Morgan

3:55 Closing Remarks

Presentations

Impacts, Assessment, and Management of Road Salt in Massachusetts

Keynote Speaker— David W. Wong, Ph.D

Widespread use of road salts as a deicer has led to significantly high concentrations of chloride in many locations in Massachusetts, sometimes exceeding the U.S Environmental Protection Agency's chronic chloride criterion and acute chloride criterion. Previous studies have shown strong correlations between specific conductance (SC) and chloride levels in water, but are not necessarily appropriate to be used in Massachusetts. The present study used historic chloride and SC data from Massachusetts Department of Environmental Protection (MassDEP) to develop tools for estimating in-stream chloride levels. Two separate models were generated using data collected statewide, one for freshwater and one for coastal waters. Model validations were conducted using freshwater data collected by USEPA and saltwater data collected by USGS from Massachusetts waters, respectively. Both cold water fisheries and benthic communities in Massachusetts streams and rivers showed negative correlation with chloride concentrations. To mitigate the impacts from road salts, Massachusetts General law requires MassDEP to regulate and enforce that sodium chloride or other chemicals used for the removal of snow or ice on roads and stored within 200 yards of an established river or estuary must be stored in a solid frame storage shed to insure against ground leaching and airborne pollution of surrounding property. Massachusetts also has policies and programs to protect environmental resources that may be affected by winter snow and ice control activities, such as the Salt Remediation Program, the use of Reduced Salt Zones from the Department of Transportation's environmental service. MassDEP is continuously collecting continuous SC data in Massachusetts for chloride monitoring and assessment to protect and enhance the value of waters as part of the duty and responsibility guided by federal Clean Water Act.

State Highway Authority's Salt Management Plan and Best Practices

Russ Yurek, Director, Office of Maintenance, Maryland State Highway Authority

Scott Simons, Transportation Engineer, Office of Maintenance, Maryland State Highway Authority

In the past, SHA's approach as an organization during winter operations has been bare pavement at all times with little regard for funding, our own resource supply, or the environment. However, in recent years SHA has recognized the significant role we play in contributing to the environmental impacts of the surrounding waterways and drinking wells. Knowing that SHA needed to change our business approach, we have begun to take great strides in the areas of educating our customers, researching new technologies, and cutting back on over utilization of salting resources.

Frederick County Road Salt Practices: Where We've Been and Where We're Going

David B. Ennis, P.E., Department Head of Highway and Facility Maintenance, Frederick Co. Public Works

The presentation will include a brief history of how Frederick County has changed its strategy of treating roads, from the old salt and cinder days to a salt/anti-skid mix, to the addition of pretreatment, and how the county has incorporated a straight salt mixture this past year. It will also highlight a more recent project, the completed installation of a salt brine system that will be implemented next year. Because the county strives to higher levels of service at lower cost through the utilization of more efficient applications of salt to county roads, this presentation will address the evolution that has been for both economic and environmental concerns.

Presentations

Effects of Road Salt Runoff on Surface Water Specific Conductivity Values

Joseph Bell, Hydrologist, USGS

This presentation will illustrate acute and chronic impacts of road salts on water quality captured within specific conductance time-series collected from urban streams around the Washington, D.C area. When combined with discrete monitoring and simple ordinary least squares regression, continuous monitoring can be used to compute chloride loads for multi-order streams across temporal and spatial scales.

WSSC Source Water Data and Infrastructure Impacts Resulting from Application of Road Salt

Hahns Hairston, Plant Engineering Unit Coordinator,
Steven Nelson, Environmental Scientist,
Priscilla To, Ph.D., Principal Environmental Engineer,
Washington Suburban Sanitary Commission

The presentation will cover WSSC water resources, and chloride levels found in WSSC source water, which include the Patuxent and Potomac Rivers. It will also address some of the operational and infrastructure impacts that road salt has in our distribution system and at our Potomac Water Filtration Plant.

Stormwater Management Basins as a Source of Year-round Salt Loading to Groundwater and Streams

Joel Moore, Assistant Professor of Geosciences, Towson University

The growing research on road salt pollution has demonstrated that Na and Cl concentrations are increasing throughout the year, not just in the winter. Increasing summer concentrations for Na and Cl make it clear that road salt travels to streams via subsurface flow paths, including groundwater. However, little work has been done to characterize Na and Cl concentrations or rates of travel via those subsurface flow paths. One likely way by which salt enters the subsurface is through stormwater management basins (SMBs). SMBs have been a common part of suburban and urban development for the last couple of decades as part of efforts to increase infiltration of water from impervious surfaces and reduce flashy discharge in developed catchments. Since SMBs increase infiltration of water, they also should result in increased loading of Na and Cl into groundwater. Research in a suburban Baltimore watershed demonstrates the presence of persistent high Na and Cl plumes in groundwater downgradient of SMBs. These persistent plumes add Na and Cl to a second-order stream throughout the year. Additionally, sub-catchments of this watershed that contain SMBs have higher Na and Cl concentrations throughout the year with statistical evidence that the presence of SMBs is the driver of these higher concentrations.

Presentations

Observed Impacts of Chlorides on Wells in Baltimore County

Bill Ensor, Baltimore County DEPS

This talk will briefly cover trends in observed chloride concentrations in Baltimore County streams, public drinking water reservoirs, and finished water supplies. The issue of chloride contamination of private wells in Baltimore County will be addressed by presenting the nature of the problem, road salt usage data, and contamination trends since 2000. Lastly, the presentation will explain how homeowners can manage their problem and discuss the nature of the remedial options that are available.

Monitoring Specific Conductivity Associated with Road Salt Application in Restored and Unrestored Streams in Maryland

Michael Kashiwagi , Natural Resources Biologist, MD Dept of Natural Resources (coauthor: Scott Stranko)

Road salt has been identified as a major environmental contaminant impacting stream biological communities. Multiple papers have shown road salt to have a negative impact on stream benthic macroinvertebrate, fish, salamander, and mussel diversity. Advances in continuous monitoring technology have allowed for the development of small affordable data loggers that can measure specific conductivity, a good surrogate water quality parameter for sodium and chloride found in road salt. Specific conductivity levels, associated with winter road salt application, were monitored using data loggers in several restored and un-restored stream reaches in Maryland. These values were then compared with specific conductivity values from reference stream reaches in watersheds with low percent urban and impervious surface. Preliminary results suggest that even following restoration, specific conductivity values remained elevated from the restored stream reaches. While the physical habitat conditions may have improved in many restored stream reaches, other potential factors such as high contaminant loads from surface runoff may be hindering the complete re-establishment of the biological community.

Evaluating Effects of Conductivity Increases on Herring Spawning Habitat

Margaret McGinty, Biologist, Fisheries Habitat and Ecosystem Program, MD Dept of Natural Resources (coauthors: Jim Uphoff, Carrie Hoover, Alexis Park, Marek Topolski, MD DNR, Fisheries Service)

We evaluated impacts of urbanization on anadromous blueback herring, alewife, and hickory shad (herring) stream spawning in Maryland's Chesapeake Bay watersheds representing a gradient of urbanization. Proportion of samples with herring eggs or larvae declined with increases in impervious surface and conductivity. Conductivity increased beyond historical and baseline levels with increasing development. We have since deployed continuous monitoring meters in various subwatersheds to observe the influence of urbanization on conductivity in streams with high density of development and roads and those dominated by forest. In this presentation we will review results to date and describe future plans to pinpoint the specific source of increased conductivity in order to develop pragmatic management approaches.

Presentations

Road Salt Toxicity to Amphibians: Variation in Sensitivity Among Species and Environmental Gradients in Exposure

Joel W. Snodgrass, Department Head and Professor of Fish and Wildlife Conservation, College of Natural Resources and Environment, Virginia Tech

Amphibians with complex life cycles often have embryonic and larval forms that are dependent on aquatic environments to complete development and metamorphose into later life stages. Road salts applied to road surfaces during frozen precipitation events dissolve easily and are transported to aquatic habitats where they may have toxic effects on embryonic and larval stages of amphibians. In reviewing the toxicity of road salts to aquatic stages of the amphibian life cycle, I will argue that variation in sensitivity to increased ion concentrations associated with road salt contamination of aquatic environments reflects evolutionary history and adaptation of species to varying ion concentrations across the hydroperiod gradient of freshwater environments. Specifically, species that breed in more ephemeral wetland environments, with naturally lower ion concentrations, will be more sensitive to road salt contamination than species that breed in permanent habitats that receive groundwater recharge on a continual basis and have higher ion concentrations. Because there is likely to be spatial correlation between roads and the permanence of aquatic habitats, especially in human engineered environments, amphibians associated with ephemeral habitats are likely to experience the highest concentrations of ions associated with road salts and be at greatest risk from road salt contamination.

Salting our Streams: Biotic Effects?

Raymond P. Morgan, Professor Emeritus, University of Maryland Center for Environmental Science, Appalachian Laboratory

In urban environments, road salt usage is used to ensure safe winter driving conditions on high traffic volume highways and secondary roads. However, there are often excessive and repetitive applications of road salt, depending on storm severity and frequency. I used the Maryland Biological Stream Survey (MBSS) data base to examine water quality collected during the MBSS Spring Index period and biota data for Maryland. Statistical analyses indicated that there are significant changes in biotic assemblages, with simpler assemblages (2-3 tolerant fish species) present in streams with high chloride levels. The number of intolerant fish species declines significantly at chloride levels greater than 100 mg/L, along with decreases in overall fish and benthic assemblage diversity. Chloride levels during spring baseflow often exceed 150 mg/l, and may underestimate winter levels. Although there is a complex of urban stressors present, road salt is an important stressor to biotic assemblages, and needs to be considered in the conservation of intolerant Maryland fish and benthic species and stream biodiversity.

Presentations

Federal Perspective on the Use of Chlorides, the Impacts on Our Roadways, and Programs to Address Water Quality Concerns

Susan Cheung Jones, P.E., Civil Engineer, Office of Project Development & Environmental Review, Federal Highway Administration

Rachel Herbert, National Transportation Liaison, Office of Water, Environmental Protection Agency

There are many types of deicers, including salts, used around the country to eliminate snow and ice. EPA will provide a brief overview of deicers being used or explored and the typical DOT product selection process. This presentation will also provide a summary of municipal stormwater requirements related to snow and ice management and an example from New Hampshire's Commercial Salt Applicator Certification program will be shared. FHWA will briefly discuss sources of chlorides, impacts to our roadways (time and money) and some of our proposed strategies to address water quality.

The Development of Draft Numeric Water Quality Criteria for Chloride in Maryland

Tim Fox, Natural Resources Planner, Maryland Dept of the Environment

The United States Environmental Protection Agency published nationally recommended criteria for chloride in 1988. However, only 15 states have codified these criteria into regulations. Although other states have adopted site specific chloride criteria, Maryland has not yet adopted an enforceable chloride regulation. A total of twenty-seven watersheds, comprising 4,300 miles of streams are listed as impaired for chloride in Maryland. To work towards addressing these impairments, the Maryland Department of the Environment has developed draft numeric chloride criteria. These draft criteria have incorporated updated laboratory toxicity data and spatial variations of ionic concentrations in Maryland's surface waters.

Monitoring for chlorides in Maryland's freshwater streams

Allison O'Hanlon, Natural Resource Planner V, TMDL Monitoring Section, Maryland Dept of Environment

In 2010, the Maryland Department of the Environment (MDE) began listing chloride as an impairing pollutant on the Maryland Integrated Report. MDE has identified elevated concentrations of chloride (Cl-) as a potential cause of biological impairment in watersheds throughout the State of Maryland. These watersheds are typically associated with urban areas and/or major transportation routes. Run off from roads and urban land uses cause an increase in contaminant loads from nonpoint sources by delivering an array of inorganic pollutants, including chloride, to surface waters. Discharges of inorganic compounds are very intermittent; concentrations vary widely depending on the time of year as well as a variety of other factors may influence their impact on aquatic life. Addressing these new Category 5 listings will be a critical focus of MDE's TMDL program over the next several years. A key component to addressing these new listings is to have sufficient water quality data for TMDL and/or Water Quality Analysis (WQA) development. A monitoring design was developed to aid MDE in determining the spatial and temporal extent of chloride loadings to non-tidal surface waters in Maryland.

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