Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)

Project Title: **ENRTF ID:**   081-B

Adaptive Management to Reduce Road Salt Pollution

Category: B. Water Resources

Sub-Category:

Total Project Budget: $ 438,000

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

We will develop a practical spreadsheet-based tool to enable cities to evaluate the impact of salting/de-icing practices on water quality and thereby enable adaptive management to improve efficiency.

Name: Lawrence   Baker

Sponsoring Organization: U of MN

Job Title: Research Professor

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Location

Region: Statewide

County Name: Statewide

City / Township: St. Paul

Alternate Text for Visual:

Graphic (four photos) illustrates the tool development process: data acquisition, tool development, development of workshop-based adaptive management practices, and reduced chloride pollution.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness _____ Leverage		_____ TOTAL _____%	

PROJECT TITLE: Adaptive management to reduce road salt pollution

I. PROJECT STATEMENT
We will develop a tool to help cities understand how the transport of road salt in the environment is affected by modifications to salt application (e.g. form and amount) and plowing practices (e.g. frequency or blade type). The work will include the crucial step of iteratively incorporating feedback from public works personnel in the development of road de-icing scenarios and the resulting road salt transport, with the ultimate goal of reducing chloride pollution of lakes and streams from winter road management.

Chloride is now considered one of the most important and urgent water pollution problems in Minnesota. This project seeks to improve road salting ("de-icing") operations by developing simple tools to show the relationship between chloride levels in urban runoff with specific de-icing practices, on an event-by-event basis. Our findings will allow snowplow operators to see the environmental impacts of their de-icing practices and enable them to make improvements. Multiple benefits of the work include water quality improvement, reduced corrosion of infrastructure, possibly reduced de-icing costs, and tools that will be useful to all cities throughout the state.

We will compare road salt inputs and outputs in at least five cities, each of which has agreed to provide data on salt application ("salt inputs"), including from computerized salt trucks. We have or will acquire data on flow and chloride in runoff from several watershed managers within these cities ("salt outputs"). Finally, we will acquire relevant spatial and weather data from about 10 cities located throughout the state, so that findings can be applied statewide. Using these data we will determine the type of weather events that require major de-icing operations, and for each event and at annual scale, the fraction of applied chloride that ends up in direct runoff, in roadside "plow-off", and in sub-surface groundwater. Other outputs include estimates of steady-state groundwater chloride and peak runoff chloride levels. The tool we develop will model impacts to these chloride transport characteristics in response to *management scenarios* of modified salt application and plowing practices. This approach is innovative, but builds upon a solid conceptual basis developed by the PIs in several ongoing and recently completed projects. It holds promise of enabling cities to efficiently reduce chloride contamination in surface and groundwater, while maintaining the goal of traffic mobility, very soon after completion of the project.

We will develop *management scenarios* by conducting five "feedback" workshops comprising snowplow operators and public works managers, building upon our positive experiences in a previous study. We anticipate that across five workshops, attendees would envision a dozen or so alternative de-icing practices that could evaluated with our scenario modeling tool.

II. PROJECT ACTIVITIES AND OUTCOMES
Activity 1 Title: Develop tool inputs from acquisition of salt application, discharge, and weather data
Description: *For the case study watersheds (~ 5) we will compile computerized plow truck data (salt application rates, speed, etc.) along with water quality (discharge, chloride) data for the drainage. We will conduct roadside snow pile coring to estimate chloride accumulation in snowpiles along several types of roads. Weather and street type data will be compiled for major cities throughout the state.*
ENRTF BUDGET: $164,817

Outcome	Completion Date
1. For each case study watershed, a database of salt application rates, snowpile chloride accumulation, and storm drain water quality on a daily scale.	*June 2022*
2. Compilation of weather and street type data for major cities throughout the state.	*June 2022*

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Activity 2 Title: Develop tool to assess chloride loading from de-icing operation scenarios
Description: *Using data from Activity 1, we will develop chloride balances (applied de-icer vs. output in runoff and groundwater) for each watershed at two time scales: a de-icing event (~days) and annual (relevant to TMDL plan development). We will then develop an open-source **de-icing scenario tool** can be used to estimate the impacts of altering de-icing operations on downstream chloride concentrations and annual loading. The scenario tool will be simple enough to be used by public works departments without external consultants.*
ENRTF BUDGET: $164,817

Outcome	Completion Date
1. De-icing scenario tool to assess chloride pollution potential on event and annual scales in response to modified de-icing practices	*Dec. 2022*

Activity 3 Title: Workshops with de-icing operators to develop and simulate chloride reduction strategies
Description: *We will conduct adaptive management workshops with snowplow operators, sharing our key findings with them, getting their ideas for modifying operations, and testing the effects of these altered operations on chloride loading from the test watersheds using our scenario analysis tool (Activity 2). An adaptive management approach using the tool will be developed and described in a Users Guide.*
ENRTF BUDGET: $108,332

Outcome	Completion Date
1. Five workshops to present findings and gain insight from road maintenance personnel, conducted at various locations throughout the state	*June 2023*
2. A users guide "Adaptive management to reduce chloride contamination from road de-icing", written for an audience of snowplow operators and city public works departments.	*June. 2023*

III. PROJECT PARTNERS AND COLLABORATORS: *Project partners will include several cities in the Twin Cities Metro Region (Shoreview, Roseville, St. Anthony Village, and Chanhassen), and one outstate city (to be identified), and the Mississippi Watershed Management Organization.*

IV.   LONG-TERM IMPLEMENTATION AND FUNDING: *We anticipate that cities will project use the proposed tool to refine their de-icing operations. Long-term implementation may require an active, overarching adaptive management process, modeled after the approach developed in our proposed project. Such a process would lead to continuous improvement – reduced salt use with no little or no loss of traffic mobility.*

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Legal Citation:
Project Manager: Lawrence Baker
Project Title: Adaptive management to reduce road salt pollution
Organization: University of Minnesota
Project Budget: $438,000
Project Length and Completion Date: 3 Years - June 30, 2023
Today's Date: 4/11/19

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 413,000	$ -	$ 413,000
Baker, Lawarence, 0.25 FTE year 1, 0.17 FTE year 2, 0.17 FTE Yr 3, 74.5% salary/25.5% fringe - $108,000. Overall project management			
Janke, Ben, 0.25 FTE per year, 74.5% salary/25.5% fringe - $119,600. Lead on data acquisition and			
Chapman, John: 0.11 FTE yr 1, 0.11 FTE yr 2/ 0.17 FTE yr 3, 74.5% salary/25.5% fringe - $62,500. Responsible for development and implementing workshops			
Graduate research assistant, 0.5 FTE per year, 2 years - $98,500 55% salary/45% fringe. RA will be involved in snowpile coring, data analysis, scenario development.			
Undergraduate research assistant, 0.38 FTE for two years $25,000. To assist with field sampling,			
Professional/Technical/Service Contracts			
	$ -	$ -	$ -
Equipment/Tools/Supplies			
Supplies-largely associated with snowpile coring and analysis.	$ 5,000	$ -	$ 5,000
Workshop expense	$ 5,000		$ 5,000
Capital Expenditures Over $5,000			
	$ -	$ -	$ -
Fee Title Acquisition			
	$ -	$ -	$ -
Easement Acquisition			
	$ -	$ -	$ -
Professional Services for Acquisition			
	$ -	$ -	$ -
Printing			
	$ -	$ -	$ -
Travel expenses in Minnesota			
Travel for field sampling, visits to cities, and and workshops.	$ 5,000	$ -	$ 5,000
Other			
Lab services	$ 10,000	$ -	$ 10,000
COLUMN TOTAL	$ 438,000	$ -	$ 438,000

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		$ -	$ -	$ -
State:		$ -	$ -	$ -
In kind: Unrecovered F&A	Secured	$ 210,000	$ -	$ 210,000

Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		$ -	$ -	$ -

Adaptive Management Tool to Reduce Road Salt Pollution

Data Acquisition:

- Road Salt Application
- Snowpack Sampling
- Stormwater Monitoring
- Weather

Data Analysis, Modeling

Repeat Workshops

Reduced Chloride Pollution of MN Lakes and Streams

Refine De-icing Strategies to Reduce Chloride Use

De-icing Scenario Tool Development:

Predict impacts of de-icing strategies on *chloride transport* to downstream waters

Test De-icing Scenarios

Workshops:

- Solicit strategies for reducing road salt use from **plow operators & public works personnel**
- Provide training to use scenario tool

05/15/2019

ENRTF ID: 081-B

Project Manager Qualifications

Dr. Larry Baker is Research Professor in the Department of Bioproducts and Biosystems Engineering. His research bridges theory and application; most of his applied research is directed toward finding solutions to water quality problems that are more effective, more efficient, and fairer. He is often the "principal investigator" (PI) for the research projects, managing grad students, technicians, post-docs, and faculty co-PIs in academia for nearly 30 years. Since arriving at the U of M in 2000 he has managed or co-managed research projects with total funding of $7.5 million. Dr. Baker has conducted four studies of urban salt: (1) as part of a consulting team, developed salt balances for five water utilities in the western United States (2) developed a salt balance for the entire Phoenix region; (3) examined salt accumulation in soils in the Phoenix region; and (4) is currently studying de-icing in Edina. In the Edina study we developed several key methodologies that will be used in the proposed study and more importantly, the idea that reducing chloride impacts can be best done by targeting de-icing in time and space, in other words, focus management on the largest salt inputs. Because much of his research is applied, he often develops practical tools for water quality professionals, is frequently invited to give talks to diverse audiences, and has written a number of articles for professional magazines (in addition to more that 120 peer-reviewed publications that have been cited by other researchers 3,200 times).

Dr. Benjamin Janke is a Research Associate at the St. Anthony Falls Laboratory (Department of Civil, Environmental, and Geo-Engineering) at the University of Minnesota (UMN), where he has been appointed since 2014. His expertise broadly concerns pollutant transport and hydrology of human-impacted watersheds, with considerable experience in field data collection, hydrologic modeling, and analysis of spatial, hydrologic and water quality data sets. Janke has managed and participated in several projects since 2011, including a 3-year study of road salt transport in a metro lakeshed. He has supervised undergraduate students in field and lab settings, and collaborated with professors, fellow research staff, graduate students, city governments, and state agencies. He has written several papers and reports, and given oral presentations to diverse audiences as part of scientific meetings, lectures, citizen outreach, and watershed manager board meetings.

Finally, **Dr. John Chapman** will lead development of the workshops. Dr. Chapman directs the Erosion and Stormwater Management Certification Program and has conducted hundreds of workshops for stormwater professionals

The project will be conducted at the **University of Minnesota**, one of the premier water research universities in the country (ranked #2 on the basis of publications). The 250+ faculty working on water-related research have produced nearly 10,000 publications and teaching nearly 200 water-related courses.