Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)

Project Title: **ENRTF ID: 109-BH**

Assessing Chloride Hot spots near native mussel beds

Category: H. Proposals seeking $200,000 or less in funding

Sub-Category: B. Water Resources

Total Project Budget: $ 200,000

Proposed Project Time Period for the Funding Requested: June 30, 2021 (2 yrs)

Summary:

This project will gather information about the movement and mixing of salt in Minnesota rivers and investigate the impacts of salt on sensitive aquatic organisms: native freshwater mussels.

Name: Jessica Kozarek

Sponsoring Organization: U of MN

Title:

Department: St. Anthony Falls Laboratory

Address: 200 Oak Street SE 450 McNamara Alumni Center

Minneapolis MN 55455

Telephone Number: (612) 624-4679

Email jkozarek@umn.edu

Web Address

Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Sketch of salty plume plunging to river bottom near mussel bed. Images of mussel gape sensors and conductivity monitoring. Where in a river is salt likely to be a problem?

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%
____ If under $200,000, waive presentation?			

PROJECT TITLE: Assessing chloride hot spots near native mussel beds

I. PROJECT STATEMENT

The St. Anthony Falls Laboratory (University of Minnesota) and the Minnesota Zoo will partner to collect information about the **persistence and transport of salt through rivers** and to investigate the **impacts on sensitive aquatic organisms**. Our goals are to:

1) Track salt as it moves from input sites such as stormwater outfalls and is mixed downstream;
2) Locate salt "hot spots", particularly at potential sites for the reintroduction of mussels;
3) Measure the response of sensitive native mussels to fluctuating salt concentrations; and
4) Educate and engage the public on wise use of salts.

Whereas the effects of salt on Minnesota's water quality has received significant attention recently, much of this work is focused on lakes and groundwater, where baseline levels continue to increase annually. Salt levels in rivers are variable, responding to both river flow and salt inputs, often following seasonal patterns. For example, during snowmelt, road runoff can elevate salt concentrations in rivers creating a short-term (acute) exposure to salt, while during low flow periods of the year, relatively consistent sources such as water softening salt in wastewater can create a long-term (chronic) exposure. Salt-containing water is heavier than fresh water and can sink to the bottom of a water body; this effect is well documented in lakes and ponds. In rivers, we expect that a plume of salt-containing water will travel a distance downstream before mixing with river water. If a dense plume of salty water plunges to the river bottom, bottom-dwelling organisms will be exposed. Elevated salt concentrations are toxic to many aquatic organisms including amphibians, reptiles, fish, and invertebrates. Because native freshwater mussels are particularly sensitive to salt and are unable to move quickly enough to escape toxic conditions, they can serve as valuable indicators of environmental conditions and improve our understanding of the ecological impacts of salt in our aquatic systems.

We propose to quantify the spatial and temporal variability of salt (chloride) levels in five Minnesota rivers and the implications for sensitive aquatic organisms: native freshwater mussels. This study will provide key data that can be used to: 1) quantify levels and durations of salt exposure, 2) identify where and when salt levels are elevated in rivers, 3) evaluate storm water management and potential road salt mitigation plans, and 4) assess the suitability of potential reintroduction sites for imperiled mussels. A key component of this effort will be promoting public awareness about salts in our aquatic environments and encouraging wise and judicious application of salts.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Collect data on salt movement and mixing in Minnesota rivers

We will measure salt concentrations in Minnesota rivers near areas of conservation concern. Available water quality and mussel data from state and local agencies will inform site selection. We will collect high-resolution data to track salt plumes at two sites, one large river and one smaller river. We will also monitor near river bottom salt levels at three additional sites. These datasets will inform a predictive tool to examine how factors such as flow rates, salinity, and temperature influence plume characteristics.

ENRTF BUDGET: $94,257

Outcome	Completion Date
1. Collect vertical and horizontal profiles of salt describing how concentrated, salty water moves into and distributes throughout a river (2 sites).	April 2021
2. Collect long-term salt concentrations near river bottom habitat (3 sites).	April 2021
3. Develop and test a predictive tool for the mixing of salt plumes in rivers.	June 2021

Activity 2: Monitor mussel response to salt levels

We will use real-time mussel gape monitors in conjunction with real-time water quality measures to document native mussel response to salts. Because mussels gape (open) when feeding and close when

contaminants are present, gape monitors provide a means to evaluate mussel stress and response to salts. Salt levels near mussel beds will be documented continuously, including snowmelt (salt-loading) and non-snowmelt conditions, to obtain accurate measures of mussel response during periods of acute and chronic salt levels.

ENRTF BUDGET: $91,843

Outcome	Completion Date
1. Assess salt concentrations near mussel beds (2 sites)	June 2021
2. Document mussel response to salt concentrations	June 2021

Activity 3: Engage and educate citizens on smart salt application

With >1.3 million annual visitors and expertise in educational programming, the Minnesota Zoo has the ability to share conservation messages with broad segments of the general public. We will leverage these strengths by integrating information about the impacts of salt on aquatic ecosystems in the Zoo's ongoing education efforts. We will promote salt reduction practices in individual households and host Smart Salt workshops (targeting maintenance practitioners) that encourage correct application of salts, thereby reducing costs and yielding environmental benefits.

ENRTF BUDGET: $13,900

Outcome	Completion Date
1. Develop and install interpretive materials for display at MN Zoo	September 2020
2. Host Smart Salt workshops at MN Zoo (2 workshops / year)	June 2021
3. Develop web content with links to data and promoting Smart Salt best practices	September 2020

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Jessica Kozarek	Research Associate	University of Minnesota	Project Manager, Mussel Sensors
William Herb	Research Associate	University of Minnesota	Sensor Setup/Analysis
Benjamin Janke	Research Associate	University of Minnesota	Field Data Collection

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Seth Stapleton	Field Conservation Supervisor	MN Zoo	Interpretive Materials; Workshops
Ben Minerich	Mussel Conservation Specialist	MN Zoo	Interpretive Materials; Field Sampling

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

Salt is a persistent pollutant in the environment, and although there are many efforts in place to reduce salt from sources such as roadway application, salt levels in rivers continue to increase. Safe roadway travel in winter remains a priority for Minnesotans; therefore, potential salt pollution mitigation opportunities need to consider riverine impacts. Freshwater mussels are highly imperiled, and MN DNR and other groups are extending significant efforts to conserve and re-introduce endangered populations. This research will inform efforts by researchers at the MN Zoo to evaluate the chronic and acute toxicity of salt on mussels, and assist MN DNR and others in locating suitable reintroduction sites. Models for saline plumes in rivers can be used in the future as a screening tool, to evaluate stormwater and water treatment plant discharge sites across the state for water quality impacts, and identify sites for more detailed study.

V. TIME LINE REQUIREMENTS:

Work will begin July 2019 and the final report will be completed in June 2021.

2019 Proposal Budget Spreadsheet

Project Title: Quantifying chloride hot spots near native mussel beds

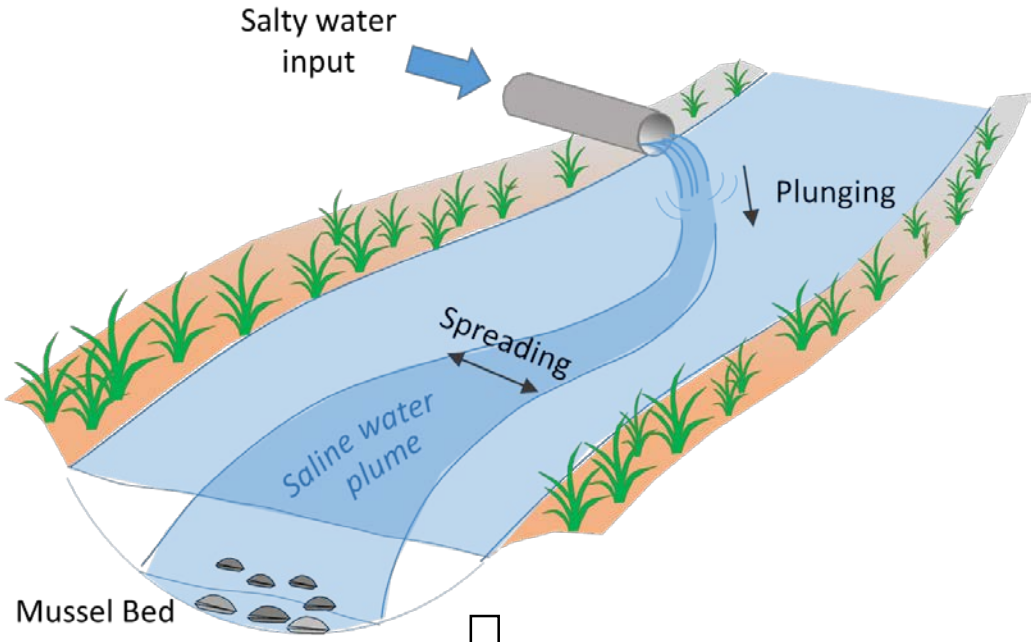
IV. TOTAL ENRTF REQUEST BUDGET *2* **years**

BUDGET ITEM	AMOUNT
Personnel:	$ 140,238
Dr. Jessica Kozarek, PI (75% salary, 25% benefits), 25% FTE; ($47,494)	
Dr. William Herb, co-PI (75% salary, 25% benefits), 15% FTE; ($30,691)	
Dr. Ben Janke, co-PI (75% salary, 25% benefits), 25% FTE; ($40,932)	
Undergraduate Research Assistant (100% salary, 0% benefits), 15% FTE; ($15,004)	
SAFL Technical Staff (79% salary, 21% benefits), 5% FTE; ($6,117)	
Professional/Technical/Service Contracts:	
Equipment/Tools/Supplies:	$ 37,060
Detailed chloride plume monitoring - large river ($7,785): conductivity loggers (8), deployment supplies, handheld conductivity logger for profiles	
Mid-resolution chloride monitoring - small river ($4,060): conductivity loggers (6), deployment supplies	
Mussel monitoring ($16,224): water quality sondes (x 2); gape sensor supplies (glue, maintenance of existing sensor systems)	
Long-term monitoring near river bottom environments (3 sites) ($4,580): conductivity loggers (2 per site)	
Field and laboratory supplies ($4,411): gas for boat, safety, sample bottles, filters	
Travel:	$ 4,577
Mileage, lodging and meals for travel to and between field sites and the university based on the university policy ($3,532)	
MN Water Resources Conference ($500)	
Travel to field sites (MN Zoo) ($545)	
Additional Budget Items:	$ 18,125
Chloride sample analysis (300 samples at $15.75 each) ($4,725)	
4 Smart Salt Workshops (hosted at MnZoo): consultants ($6,000), educational materials ($5,000), refreshments for each workshop $600 x 4 ($2,400)	
Educational materials for MnZoo ($5,000)	
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 200,000

V. OTHER FUNDS

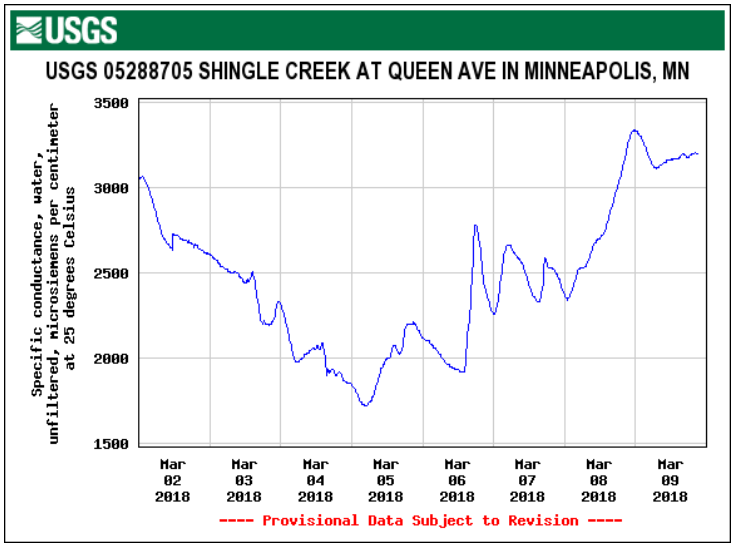
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	N/A	
Other State $ To Be Applied To Project During Project Period:	N/A	
In-kind Services To Be Applied To Project During Project Period:		
Unrecovered F&A calculated at 54%	$ 108,000	secured
Minnesota Zoo facilities for workshops ($750/day x 4 days)	$ 3,000	secured
Past and Current ENRTF Appropriation:		
Conserving Minnesota's Native Mussels (PI: J. Kozarek): M.L. 2014, Chp. 226, Sec. 2, Subd. 05k	$ 350,000	complete June 2018
Enhancing Spawning Habitat Restoration in Minnesota Lakes (PI: W. Herb): M.L. 2017, Chp. 96, Sec. 2, Subd. 08e	$ 294,000	in progress
Prioritizing Future Management of North Shore Trout Streams (PI: L. Johnson, co-PI, W. Herb): M.L. 2015, Chp. 76, Sec. 2, Subd. 08a	$ 416,000	complete
Rearing Native Mussels for Reintroduction and Expanding Water Quality Awareness (PI: S. Stapleton; MN Zoo): M.L. 2017, Chp. 96, Sec. 2, Subd. 04c	$ 591,000	in progress
Other Funding History:		

The Problem: Chloride inputs to rivers are harmful to freshwater mussels



Measure Mussel Response

Monitor salt concentrations



Project Outcomes

- Where in a river is salt likely to be a problem?
- Educate Zoo attendees on *salt impacts to aquatic life in rivers* and *how to be smart about salt application*

PROJECT MANAGER QUALIFICATIONS

Jessica L. Kozarek

J. L. Kozarek completed degrees at Penn State (B.S. Chemical Engineering with a minor in Environmental Engineering, 2002) and at Virginia Tech (M.S. and Ph.D. in Biological Systems Engineering in 2006 and 2011). She has served as Research Associate and Outdoor StreamLab Manager at St. Anthony Falls at the University of Minnesota since May 2010 and as a Center for Transportation Studies (CTS) scholar since 2017. Her research focuses on restoring physical, chemical and biological processes in streams; flow and sediment transport in meandering streams; culvert design for fish passage; use of hydraulic models to develop restoration guidance; and water quality and nutrient dynamics. She has extensive field, laboratory, and modeling experience and through ENTRF funding, experience with native freshwater mussels. She has published over 15 peer-reviewed articles in stream ecosystem engineering on topics including in-stream habitat, high-resolution data collection for stream restoration research, floodplain nutrient dynamics, and interactions between turbulence and invasive zebra mussels.

ORGANIZATION DESCRIPTION

St. Anthony Falls Laboratory (SAFL)

St. Anthony Falls Laboratory is an interdisciplinary fluid mechanics research facility of the College of Science and Engineering at the University of Minnesota. SAFL research focuses on environmental, energy, and health challenges. Located on Hennepin Island in the Mississippi River in the heart of Minneapolis, SAFL serves as a resource for departments across the Twin Cities campus, the statewide University system, and the broader research community. SAFL's mission is to: 1) **To advance fundamental knowledge** in engineering, environmental, geophysical, and biological fluid mechanics by conducting cross-cutting research that integrates disciplines in science and engineering; 2) **To benefit society** by implementing this knowledge to develop physics-based, cost-effective, and sustainable engineering solutions to major environmental, water, ecosystem, health, and energy-related problems; and 3) **To disseminate new knowledge** to University of Minnesota students, the engineering and scientific community, and the public through educational and outreach activities and partnerships with government and industry.

Minnesota Zoological Garden

The Minnesota Zoo is a unique state agency. Established in 1978 to provide Minnesota residents and guests with an opportunity to experience animals from the exotic to the familiar in natural habitats, today the Zoo is one of the State's premier cultural, educational and conservation institutions. The Minnesota Zoo's mission is ***to connect people, animals and the natural world to save wildlife.*** With 1.3 million guests a year, over 2.7 million website hits annually and state-wide outreach programs reaching thousands more, the Zoo is in an excellent position to strengthen Minnesotans' awareness and understanding of our State's commitment to wildlife, science and conservation. The Zoo is the State's largest environmental educator with more than 500,000 participants in Zoo education programs. The Minnesota Zoo is also a leader in conservation – directing efforts and partnering with others on a variety of conservation programs at the Zoo, in Minnesota and across the globe. Over the past five years, the Zoo has enhanced its efforts to focus on Minnesota wildlife and habitats, including projects to conserve Minnesota's native moose, bison, mussels, turtles and prairie butterflies. Advancing the science of wildlife conservation is an important part of the Zoo's work, as evidenced by the Zoo's research on wildlife behavior, ecology, genetics, disease and conservation techniques. The Zoo has a proven record of using its resources efficiently and effectively, ***matching*** the State's investment with private funds and earned income.