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

Project Title: **ENRTF ID:**   231-F

Improving the Success of Shoreline Restoration Projects

Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Sub-Category:

Total Project Budget: $ 335,618

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

Summary:

We propose to use field surveys of lakeshore restoration projects and experiments to develop tools for resilient and economic shoreline habitat restoration in Minnesota lakes and estuaries.

Name: Kimberly   Hill

Sponsoring Organization: U of MN

Job Title:

Department: St. Anthony Falls Laboratory

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 Minneapolis   MN   55414

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Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

We plan to use field surveys of lakeshore restoration projects and experiments to develop tools for resilient and economic lakeshore habitat restoration in Minnesota lakes and estuaries.

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

PROJECT TITLE: Improving the success of shoreline restoration projects

I. PROJECT STATEMENT

The goal of this project is to provide guidelines for best practices to improve long-term resilience and success of shoreline habitat restoration projects in lakes and estuaries with emphasis on projects that add fill or dredged material to create wetlands. Building on experience of older shoreline restoration projects and newer projects that use dredged materials, this work will result in guidelines for shoreline restoration across Minnesota.

Problem:

Shoreline wetlands are naturally full of a rich diversity of life and thus healthy ecosystems, can provide mitigation of excess sediment and nutrients, and can be integrated into park systems to provide access to recreational opportunities and natural experiences. Yet shoreline wetlands are subject to deterioration due to waves and storms and other, more human, actions like dredging and changes in vegetation. In addition to shoreline habitat disruption, the resulting erosion can add excessive sediment and turbidity to waters. Relative success and economics of shoreline restoration projects varies as we lack understanding of their stability and resilience under increasing storm intensities and ongoing disruptions.

Solution:

New better management practices for resilient shoreline habitat restoration is needed, particularly regarding stability of sediments associated with initial emplacement, wave conditions, and storm events under different sediment placement activities. Building on data gathered on related shoreline restoration projects, emerging data from studies of dredged material used as wetland development in the Great Lakes (PI Hill), wave data created via ENTRF funding (PI Herb), and with a series of laboratory experiments and field surveys supported by computational simulations, we plan to develop quantitative tools for best practice for shoreline habitat restoration projects for material properties, local habitat conditions, and destabilizing waves and storm events.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Literature review and field survey site selection of shoreline restoration projects

Field survey sites (5 to 7) will be selected, focusing on past and ongoing shoreline restoration projects in representative lakes and waterways in Minnesota. Literature reviews will include stabilization of sediment as they vary with sediments, wave dynamics and wave energy models and their impacts on shoreline resilience, and mitigating effects such as plant stabilization.

ENRTF BUDGET: $98,271

Outcome	Completion Date
1. Determine 5 to 7 field sites by sediment type, average flows, and wave energies	*5/31/2021*
2. Develop systematic experimental plan for studies in inner and outer SAFL basins	*4/1/2021*
3. Literature review write-up	*3/1/2021*

Activity 2: Perform field survey activities to evaluate progress of the field sites chosen under outcome 1.

Data collected will include: sediment types and sizes; bioengineered stabilization materials; destabilizing field conditions. Biannual surveys for all field sites with focus on extreme events during final year of project. Meet regularly with those focusing on the restoration efforts such as in Lake Pepin (US Army Corps of Engineers), St. Louis Estuary (Minnesota DNR), and Lake Minnetonka (Minnehaha Creek Watershed District).

ENRTF BUDGET: $102,653

Outcome	Completion Date
1. Biannual and storm-related field surveys of recent shoreline restoration projects	*5/31/2023*
2. Regular meetings with practitioners and local stakeholders to help evaluate progress	*5/31/2023*

Activity 3: Perform flume and basin experiments in St. Anthony Falls Laboratory (SAFL) facilities

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Experiments will include indoor basin experiments, indoor flume experiments, and an outdoor basin. Indoor basin experiments will include systematic settling and stability experiments under changes in: (1) installation techniques; (2) sediment size, density, and stickiness (biofilms); (3) water conditions from quiescent water to variable wave-like conditions. Indoor flume experiments will involve focused investigation on impact of wave energy on shoreline stability. Outdoor basin experiments will involve a new basin built specifically for larger scale studies of various shoreline conditions and shapes under wave impacts.

ENRTF BUDGET: $89,179

Outcome	Completion Date
1. Determine grain size distributions that can provide the most stable model shorelines	*5/31/2021*
2. Determine how varying local shoreline shape can improve shoreline resilience	*8/31/2022*
3. Determine how particular plant species can stabilize model shorelines	*5/31/2022*

Activity 4: Develop tools for evaluation of resilience and evolution of shoreline restoration projects
Model efforts will focus on building analytical and computational tools to provide guidance for shoreline habitat restoration with dredge and other fill materials. Inputs will include measurements from the field and in the laboratory during years one and two and it will be refined with additional measurements in the field and laboratory in year three. Software will also be available for those who are comfortable programming.

ENRTF BUDGET: $45,515

Outcome	Completion Date
1. Initial model development	*8/31/2022*
2. Modification based on new data from year three	*6/15/2023*

III. PROJECT PARTNERS AND COLLABORATORS:
The project team will include:
Prof. Kimberly Hill (UMN, Civil, Environmental, and Geo-Engineering & SAFL) (Principal Investigator)
Dr. William Herb (UMN, St. Anthony Falls Laboratory) (co-Principal Investigator)
Mr. Jeff Marr (UMN, St. Anthony Falls Laboratory)
Hill and Herb will lead the project with help from Marr. Hill will be the lead P.I., lead the experiments and modeling work, take part in the field work, and lead analysis and reporting. Herb will lead the field surveys and quality control of those surveys and co-manage the project. Marr will lead the organization of the SAFL staff for helping laboratory experiments and building the outdoor basin. Many SAFL staff will be involved in the project, particularly with the field data collection and laboratory data collection. The graduate student will be recruited from the University of Minnesota and other similar engineering and science backgrounds at comparable universities. (S)he perform much of the data collection alongside Hill and Herb and help lead the training of the undergraduate and develop outreach materials. The undergraduate will be recruited from UMN science and engineering departments and SAFL undergraduate staff and help with all aspects of the project.
Several SAFL staff involved with this project, including Herb, have a significant fraction of their time funded by ENTRF. They are not teaching faculty and depend on grant monies to pay their salaries.

IV. LONG-TERM IMPLEMENTATION AND FUNDING:
This project will provide guidelines for installing shoreline restoration projects including those using dredged materials for maximize effectiveness with efficient stabilization mechanisms. The long-term goal is to reduce both sediment loading of the lakes and waterways of Minnesota and maximize high quality shoreline habitat while maintaining human access to the lakes and waterways. Guidelines developed can feed directly into shoreline management plans and the regional WRAPS (Watershed Restoration and Protection Strategy). The computational simulation code can be used as a tool for specific future restoration projects. We will work with UMN extension staff, and other state agency personnel to develop and publicize the information.

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Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: Kimberly Hill
Project Title: Improving the success of shoreline restoration projects
Organization: Regents of the University of Minnesota
**Project Budget: $335,618**
Project Length and Completion Date: 3 years, June 2023
**Today's Date: 4/10/2019**

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 299,618	$ -	$ 299,618
Hill (PI): Management, data analysis, outreach, simulation development, 11% FTE, 74% Salary, 26% benefits, ($42,864)			
Herb (Co-PI): Management, data analysis, 20% FTE, 74% Salary, 26% benefits, ($55,247)			
Marr: Oversee SAFL staff; some field and laboratory anlaysis, 4% FTE, 74% Salary, 26% benefits, ($15,957)			
Christopher: co-manage and oversee outdoor SAFL basin build and indoor alterations, manage safety of field and experimental work, 8% FTE, 74% Salary, 26% benefits ($21,016)			
Erickson: co-manage and oversee outdoor SAFL basin build and indoor alterations, 8% FTE, 77% Salary, 23% benefits, ($16,677)			
Graduate Student: help gather field data, manage laboratory data acquisition, train undergraduate, manage outreach, 50% FTE, 55% salary, 45% benefits, ($135,988)			
Undergraduate Student,help with all field data and some laboratory dat acquisition; help with facility modifications and build 100% salary, 0% benefits ($11,869)			
Professional/Technical/Service Contracts			
	$ -	$ -	$ -
Equipment/Tools/Supplies			
materials and plumbing for outdoor basin and over-winter storage; sediment materials for indoor and outdoor experiments, sonar and adv measuremnet devices for laboratory and field measuremnets, computer and data storage for field and laboratory measurements and anlaysis and for simulation work	$ 25,000	$ -	$ 25,000
Capital Expenditures Over $5,000			
	$ -	$ -	$ -
Fee Title Acquisition			
	$ -	$ -	$ -
Easement Acquisition			
	$ -	$ -	$ -
Professional Services for Acquisition			
	$ -	$ -	$ -
Printing			
	$ -	$ -	$ -
Travel expenses in Minnesota			
Two to three trips annually to five to seven sites to measure bathymetry, stability, grain size distribution, and habitat details of recent and ongoing lakeshore habitat projects, two sites involve overnight stays. Four trips expected to each site in year three.	$ 7,000	$ -	$ 7,000
Other			
Equipment rental - boat and sonar	$ 4,000	$ -	$ 4,000
COLUMN TOTAL	$ 335,618	$ -	$ 335,618

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		$ -	$ -	$ -
State:		$ -	$ -	$ -
In kind: Unrecovered UMN Indirect costs (54% MTDC)		$ 154,545	$ -	$ 154,545

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

I. Investigate lakeshore habitat restoration resilience in the context of bathymetry, sediment, plants, & waves
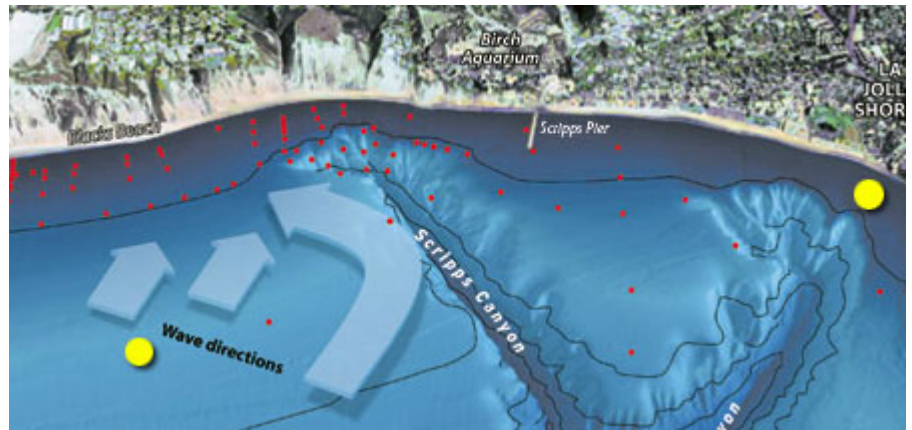
II. Use experiments and field surveys to develop tools for stable and economic future lakeshore habitat restoration projects
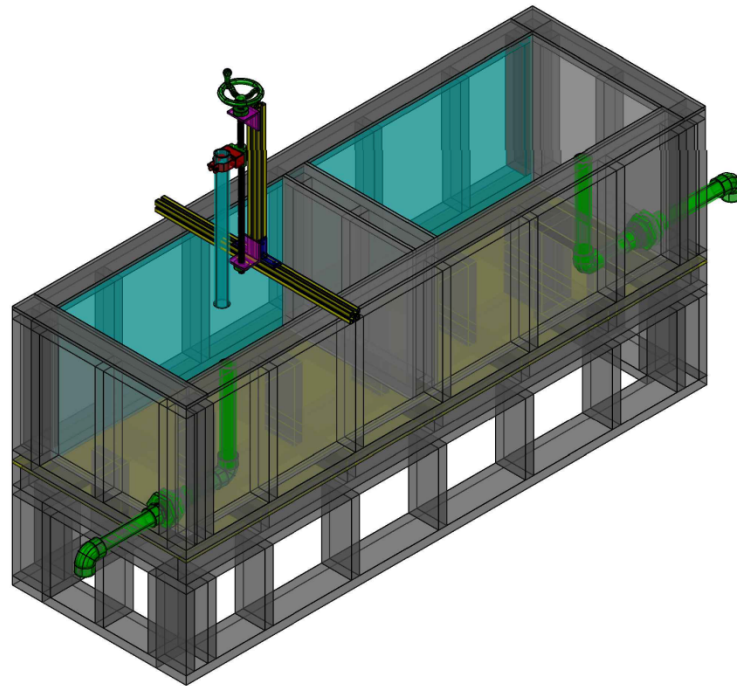
III. MN uses shoreline restoration data, experimental results and computational predictions to develop shoreline habitat that maximizes human access and ecosystem health

2020 LCCMR Project Manager Qualifications and Organization Description

Kimberly Hill (manager), Department of Civil, Environmental, and Geo- Engineering & St. Anthony Falls Laboratory, University of Minnesota
William Herb (co-manager), St. Anthony Falls Laboratory, University of Minnesota

Key Qualifications
Kimberly Hill has conducted research on stability of lakeshore habitats using dredged material as part of the project "Healthy Port Futures: Landscape Strategies for Passive Sediment Management" focused on the great lakes and funded by the "Great Lakes Protection Fund." She has worked on response of particle-fluid systems to disturbances for the past 25 years with a focus on natural particle-fluid systems such as sediments in streams and on embankments for the last 14 years. As a co-PI on the Healthy Port Futures project, to date, Hill has focused on performing experiments investigating the feasibility of using dredged materials from the Ashtabula Harbor (Lake Eerie) in various plans for the establishment of an emergent wildlife habitat in the outer harbor of Ashtabula.
William Herb has conducted research on lake and stream water quality and hydrology for the past seventeen years. His work has included a number of projects on stream temperature, including work on Miller Creek in Duluth, the Vermillion River, and on the Northshore trout streams. He is currently PI on the LCCMR project "Enhancing Spawning Habitat Restoration in Minnesota Lakes", was recently a PI on a MnDOT-funded project to study the transport of road salt through watersheds in Minnesota, and led a BWSR-funded project studying studying stream shading enhancements for Brown's Creek, in Stillwater, MN.

Education-Hill
PhD, Physics, University of Minnesota 1997
M.S., Physics, University of Minnesota 1996
B.S., Physics, University of Michigan, 1992
Education-Herb
M.S., Water Resources Science, University of Minnesota 2003
Ph.D., Mechanical Engineering, University of Minnesota 1996
M.S., Mechanical Engineering, University of Minnesota 1991
B.S., Mechanical Engineering, University of Wisconsin 1985

The **St. Anthony Falls Laboratory** (SAFL) is an interdisciplinary fluid mechanics research and educational facility of the College of Science and Engineering at the University of Minnesota. The mission of SAFL is 1) to advance fundamental knowledge in engineering, environmental, geophysical, and biological fluid mechanics, 2) to benefit society by implementing this knowledge to develop 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.
This project makes use of (1) two existing basins at SAFL for experiments on sediment stability developed for the Healthy Port Futures project, (2) an in-channel wave generator for testing stability of sediments in the context of destabilizing effects of waves, and (3) an large outdoor basin to test combined effects of waves, shoreline shape, and plants that will be built with expertise of SAFL staff on old spillways of the St.Anthony Falls dam currently managed and used by SAFL community.