



Environment and Natural Resources Trust Fund

2022 Request for Proposal

General Information

Proposal ID: 2022-219

Proposal Title: Big waves and their impact on lake shorelines

Project Manager Information

Name: William Herb

Organization: U of MN - St. Anthony Falls Laboratory

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Project Basic Information

Project Summary: This project will develop information and tools needed to manage large boat waves and wind waves impacting shorelines on typical Minnesota lakes.

Funds Requested: \$199,000

Proposed Project Completion: June 30 2025

LCCMR Funding Category: Small Projects (H)

Secondary Category: Water Resources (B)

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

This project will evaluate and compare the impacts of wind-generated and boat-generated waves on Minnesota lakes and shorelines. Motorboat activities on inland lakes is a major recreational pastime in Minnesota and includes fishing boats, ski boats, wakeboarding boats, and casual cruising boats like pontoons. Depending on the size of the lake and the operating distance of the boat from shore, boat wakes may be larger or smaller than wind-generated waves. Although some measurements of wind-generated and boat-generated waves exist, there is little information on the cumulative impact of these two wave types on shoreline erosion, lake water quality, and nearshore habitat for different lake sizes. There are also growing safety concerns associated with large boat wakes generated on lakes with lower wind-generated wave heights.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

This project will build on a currently funded LCCMR project, “Enhancing Spawning Habitat Restoration in Minnesota Lakes”, which is mapping shoreline wind-wave energy on Minnesota lakes, and a crowd-source funded project to measure boat wake height and energy for different boat types. Several study lakes will be selected in cooperation with lake associations, to include a range of lake sizes (fetch length) and shoreline types (rocky/sandy/vegetated). Wave monitoring stations will be installed to measure wind- and boat-generated waves over two seasons. Water quality monitoring equipment will also be installed to measure changes in water quality due to windy days and busy boat recreation days. To distinguish wind- and boat-generated waves, cameras will be installed on the wave monitoring stations, coupled with manual observation of boating activity by university staff and citizen volunteers. Spring and fall surveys of the lake shorelines will be performed to measure shoreline erosion processes due to open water wave action and due to ice cover and freeze-thaw cycles.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state’s natural resources?

This project will provide much needed scientific data for state and county leaders, lake associations, the marine sports industry and the general public to guide the operation of motorized watercraft while providing protection for Minnesota’s most important asset – our lakes. The monitoring methods developed in this study could lead to a larger wave monitoring effort, e.g. involving citizen monitors. The data generated by this project can be used for additional studies of, for example, nearshore fish habitat, loon nesting habitat, and lake water quality.

Activities and Milestones

Activity 1: Monitoring of waves, water quality, and lakeshore erosion, Year 1

Activity Budget: \$70,800

Activity Description:

The site attributes (depth, fetch, shoreline type) will be finalized and we will pick up to three monitoring sites, in cooperation with participating lake associations. Wave monitoring masts and water quality sensor systems will be designed, fabricated, and deployed (May-September 2023). Erosion surveys will be performed in May and September. Intermittent water quality sampling may also be performed to augment the ongoing monitoring data.

Activity Milestones:

Description	Completion Date
Select study lakes and sites	March 31 2023
Assemble and Install Monitoring Equipment	May 31 2023
Complete data collection	September 30 2023

Activity 2: Monitoring of waves, water quality, and lakeshore erosion, Year 2

Activity Budget: \$71,435

Activity Description:

Existing wave monitoring masts and water quality sensor systems will be modified and repaired as needed, and deployed (May-September 2023). Erosion surveys will be performed in May and September. Intermittent water quality sampling may also be performed to augment the ongoing monitoring data.

Activity Milestones:

Description	Completion Date
Assemble and Install Monitoring Equipment	May 31 2024
Complete data collection	September 30 2024

Activity 3: Compare wind-wave and boat wake impacts on water quality and shoreline erosion.

Activity Budget: \$56,765

Activity Description:

The data collected in Activities 1 and 2 will be quality checked and summarized. The total wave energy due to wind-waves and boat wakes will be calculated for each lake site. The water quality data will be analyzed to look for water clarity degradation due to high wind days and high boat traffic. The erosion survey data will be analyzed to look for erosion hotspots and possible relationships to wind-wave energy, boat wakes, and winter processes (ice cover, freeze-thaw cycles). Determine the ability to generalize the results from the study lakes to additional lakes using, for example, wind-wave models and lake boat usage estimates. Present the information to lake associations and state agencies.

Activity Milestones:

Description	Completion Date
Summarize and analyze field season 1 data (Activity 1).	April 30 2024
Summarize and analyze field season 2 data (Activity 2)	March 31 2025
Summarize and present impacts of wind-wave and boat wakes on lake water quality and erosion	June 30 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Joseph Schneider	President, Minnesota Coalition of Lake Associations (MNCOLA)	MNCOLA will provide in-kind support of the work by helping identify potential study locations and helping with knowledge transfer of the finding and tools to stakeholders across the state.	No

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?

The results of this project will be published as a UMN report and/or peer reviewed journal paper. Direct implementation and knowledge transfer of the work will be through our project partnerships with MNCOLA and MLRA. MNCOLA membership includes dozens of lake associations and MLRA has a broad network for citizens, lake managers, and other stakeholders. Both groups will support us at the end of the project by distributing information to their members and member organizations. Project Partners will also provide opportunities for the research team to share results through webinars.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Enhancing Spawning Habitat Restoration in Minnesota Lakes	M.L. 2017, Chp. 96, Sec. 2, Subd. 08e	\$294,000

Project Manager and Organization Qualifications

Project Manager Name: William Herb

Job Title: Research Associate

Provide description of the project manager’s qualifications to manage the proposed project.

William Herb has conducted research on lake and stream water quality and hydrology for the past twenty years. His past projects have included modeling studies aquatic plant growth in lakes, wind and wave measurements for assessing wind waves, and several projects assessing the effects of land use change and climate change on fish habitat in Minnesota lakes and streams. He also led the development of a software tool for the MPCA, used to assess the impact of land development on thermal pollution to trout streams. He was PI on a MnDOT funded project (\$160k) to study the transport of road salt through watersheds in Minnesota, was PI on a DNR Coastal Program project (\$200k) to do detailed hydrologic measurements in Duluth, and is currently PI on the LCCMR project, “Prioritizing shoreline habitat restoration in Minnesota Lakes” (\$297k). His education includes an MS degree in Water Resources Science and a Ph.D. in Mechanical Engineering, both from the University of Minnesota.

Organization: U of MN - St. Anthony Falls Laboratory

Organization Description:

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.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
William Herb		PI			26.7%	0.93		\$101,793
Jeffrey Marr		Co-PI			26.7%	0.03		\$2,438
Kimberly Hill		Co-PI			26.7%	0.03		\$6,051
Jessica Kozarek		Co-PI			26.7%	0.51		\$54,574
Andrew Riesgraf		xxx			24.1%	0.16		\$12,234
Christopher Milliren		xxx			24.1%	0.08		\$5,685
Undergraduate Student		xxx			0%	0.12		\$3,939
							Sub Total	\$186,714
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	Tools and Supplies	Data loggers (2X\$1500), wave sensors (2X\$600), anemometers (2x\$500), water quality sensors (3x\$1500), field cameras (3x\$200), misc. material and hardware for the monitoring stations (\$1086).	Additional field supplies to augment the existing SAFL stock of data loggers, sensors, etc.					\$11,386
							Sub Total	\$11,386
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-

Travel In Minnesota								
	Other	12 trips, 50 miles per trip, 56 cents per mile.	Travel to lake monitoring sites for installations and surveys					\$400
							Sub Total	\$400
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
		Telecommunications	Wireless modem operation for data telemetry					\$500
							Sub Total	\$500
							Grand Total	\$199,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
In-Kind	Unrecovered F&A	Support of SAFL facilities where research will be conducted.	Secured	\$109,450
			Non State Sub Total	\$109,450
			Funds Total	\$109,450

Attachments

Required Attachments

Visual Component

File: [fd81ec65-491.pdf](#)

Alternate Text for Visual Component

Photo of a boat making a wake and a photo of wind-generated waves on a lake shoreline. Question: which causes more impact on lakes, a windy day or a busy day of boat recreation?...

Optional Attachments

Support Letter or Other

Title	File
Support Letter 2	7fde9a42-bb6.pdf
Support Letter 1	d113074b-f1e.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Which has more impact on lake shorelines and water quality?



Or



- Measure wind-waves and boat wakes on different size lakes
- Measure shoreline erosion and water quality impacts
- Determine which lakes are most impacted by boats

