Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-169

Proposal Title: Modeling the Future Mississippi River Gorge

Project Manager Information

Name: Jeffrey Marr

Organization: U of MN - St. Anthony Falls Laboratory

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Project Basic Information

Project Summary: A reduced-scale physical model of Mississippi River Pool 1 and Lock & Dam 1 will be constructed to study water flow and sediment movement under various pool management strategies.

ENRTF Funds Requested: $450,000

Proposed Project Completion: June 30, 2027

LCCMR Funding Category: Water Resources (B)

Project Location

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

Region(s): Metro

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

Region(s): Metro

When will the work impact occur?

During the Project and In the Future

Narrative

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

On June 10, 2015, the Upper St. Anthony Falls Lock permanently closed to navigation, limiting the need for the Lower St. Anthony Falls Lock & Dam and Lock & Dam No. 1. The Corps of Engineers is now considering the disposition of all three. The Upper St. Anthony Falls Dam cannot be removed, but we have a choice about whether the other two locks and dams remain or are removed.

For the first time since the Twin Cities began, Minnesotans have a chance to reconsider our relationship with the Mississippi River. We can choose a new relationship with the river, or we can reaffirm earlier visions. We must, however, choose between three options: leave the locks and dams in place with no navigation, modify them, or remove them.

One critical concern is what happens to the sediment above Lock & Dam No. 1. Some worry that if it is removed, the sediment released will increase dredging in Pool 2. Others fear Lake Pepin or downstream marinas could fill in faster. Still others worry about releasing sediment containing hazardous materials or impacts to native mussel or fish habitat. To make the best decisions, we need robust science on the impacts of proposed changes.

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

This project will create an accurate physical model of the project area. Physical models are carefully designed to replicate the geometry of the river and capture riverine processes including water velocity, erosive forces, and sediment erosion and deposition. These models are powerful tools to examine future scenarios, not only for science, but for communication, enabling visualization of changes to the riverine landscape following management changes. The model will be constructed at UMN's St. Anthony Falls Laboratory and will be used as a research tool to examine how the various proposed changes to LD1 may impact pool elevation, river velocities, and the erosion and transport of the estimated 2.8 million yd3 of gravel and sand stored in Pool 1 upstream of the dam. The model will leverage existing data collection technologies at SAFL specifically designed for physical modeling and we will prepare a detailed technical report summarizing the research. In addition to technical reports, we will also produce video summaries of the various experiments and the project will provide opportunities for stakeholders to see firsthand the operation of the model through public tours and demonstrations.

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?

Over the next several years, citizens will have the unprecedented opportunity to re-envision our relationship with the Mississippi River within the Twin Cities and participate in decision-making that will impact recreation, habitat, water quality, and infrastructure for decades to come. This research will re-connect citizens to 150 years of past changes to the river and will provide technical information, benefits, challenges, and tradeoffs of the most likely management pathways' effects on riverine processes. Specifically, the research will provide technical knowledge on the possible impacts of sand and gravel remobilization with Pool1 and impacting Pool 2.

Activities and Milestones

Activity 1: Final scoping, model design, and model construction.

Activity Budget: $196,628

Activity Description:
The objective of Activity 1 is commissioning of a physical model of LD1 and adjacent upstream and downstream river reaches.

The initial task will involve meetings with the project's Advisory Committee to finalize the details of the modeling effort, determine the model extents, and identify key scenarios of the study. Additionally, we will convene a meeting with the USACE disposition study team to gain input on the modeling effort.

The next task will involve design of the model. We will use existing topography and bathymetric data sets and replicate key structures within the river. For LD1 we will model the two auxiliary locks, the spillway, and powerhouse. We will use a distorted Froude model, which will allow us to incorporate the ability to model sediment erosion and transport (sand and gravel) to highlight areas prone to erosion or deposition as sediment moves under different scenarios.

The model will be constructed at UMN-SAFL by the Applied Research team. The hydraulics of the model will use physics-based scaling allowing us to replicate a range of water flow and sediment transport conditions in the river. Fine sand will be added to the model to simulate the non-cohesive sediment captured in Pool 1.

Activity Milestones:

Description	Approximate Completion Date
Design and scoping meeting involve Advisory Committee.	September 30, 2025
Physical model design.	October 31, 2025
Model construction and commissioning.	March 31, 2026

Activity 2: Model river flow and sediment transport within the Mississippi River gorge.

Activity Budget: $138,424

Activity Description:
We will perform experiments in the model to quantify and visualize how the Mississippi River will respond to possible future scenarios within Pool 1.

The first experiments will simulate current configurations of LD1, lock chambers, and the hydropower power station operating under the pool management protocols currently used by the USACE. Over a two-month period of time, we will explore a range of river discharge and pool management situations. Following this, we will perform experiments that involve lowering the elevation of Pool 1, either with LD1 in place or removed. These scenarios will study how gravel and sand currently deposited in Pool 1 (estimated to be over 2.5 million yd3) are eroded during pool drawdown and move downstream. We will seek to quantify the erosion rates, erosional hotspots, and processes. The final scenario will consider full removal of LD1 and elimination of Pool 1 and will be allowed to reach an equilibrium channel profile.

For all experiments, data will be collected on hydraulics, flow velocities, and water and riverbed slopes. Detailed topographic and bathymetric maps will be generated using SAFL's laser topographic scanning system. We will estimate the quantities and rates of sediment movement and potential benefits and impacts.

Activity Milestones:

Description	Approximate Completion Date
Complete experiments on baseline scenario (existing condition).	July 31, 2026
Complete experiments on active lowering of Pool1 and impact on sediment erosion.	November 30, 2026
Complete experiments on removal of LD1 and elimination of Pool 1.	January 31, 2027

Activity 3: Develop technical report and visual summaries and communicate results to stakeholders.

Activity Budget: $114,948

Activity Description:

In this activity, we will spend time analyzing data collected during the modeling experiments and develop a final report of findings. The report will summarize the model construction, data collection, modeling scenarios, and findings. Key questions we hope to answer with the data are:

1. How much sand/gravel is eroded and how quickly does it move downstream?
2. What are the primary processes of erosion and where are the locations of erosional hotspots?
3. Are there ways to control the rate and locations of erosion by how Pool 1 is lowered?

The report will provide a discussion of possible environmental impacts based on our research:

- What are negative and positive environmental impacts associated with these changes?
- What are short-term (1-10 years) and long-term impacts (10-100 years) of these changes?
- What additional areas of study are needed?

The modeling will also produce hours of visual content. In this activity, we will work with a media specialist to develop a narrated summary of the research and findings. A draft final report and visuals will be provided to our Advisory Committee for review and comments. The report will then be finalized and published through the UMN's Digital Conservancy

Activity Milestones:

Description	Approximate Completion Date
Analysis of data and video content.	February 28, 2027
Develop a narrated video summary of the research project.	June 30, 2027
Develop and publish a final technical report.	June 30, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Jeffrey Marr	St. Anthony Falls Lab - UMN	Principal Investigator and research engineering with expertise in hydraulics, hydraulic modeling, river sediment transport and hydraulic structures. Responsible for project oversight and will participate in all aspects of the research project.	Yes
Jessica Kozarek	St. Anthony Falls Lab - UMN	Co-Pi and research associate with research expertise in ecohydraulics, in-stream habitat, aquatic native and invasive species, and river restoration. Responsible for project oversight and participating in all aspects of the research project.	Yes
John Anfinson	Historian, independent	Project advisor, historian	Yes
Matt Lueker	St. Anthony Falls Lab - UMN	Principal Hydraulic Engineer on research study	Yes
Richard Christopher	St. Anthony Falls Lab - UMN	Principal model designer and scientist	Yes

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 work be funded?

The research from this project will be technical science reports and video documentation from the physical modeling effort. Data and reports produced will be made publicly available through the UMN Digital Conservancy and the Data Repository for U of M (DRUM). The implementation of products will be through our advisory committee all of whom have strong local and state communications roles. The advisory committee includes Friends of the Mississippi River, The Freshwater Society, and National Parks Conservation Association. We will also work to get state and USACE representation on the committee. This group will help raise awareness and communicate results.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Wind Wave and Boating Impacts on Inland Lakes	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 04c	$415,000

Project Manager and Organization Qualifications

Project Manager Name: Jeffrey Marr

Job Title: Associate Director of Engineering and Facilities

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

Marr is a licensed professional civil engineer (Minnesota) and the Associate Director of Engineering and Facilities at SAFL. He received his BS (1996) and MS (1999) from the University of Minnesota, Department of Civil Engineering and has been a member of SAFL professional research staff for over 20 years. Marr will serve as Project Manager and Principal Investigator for this project. His research expertise is in the areas of river hydraulics, boat-generated waves, and sediment transport including river and delta systems, deep water gravity currents, and reservoir/lake sedimentation and erosion. Marr manages SAFL's Applied Research and Engineering team, a 10 member team that supports ongoing faculty research and carries out applied research with public and private sponsors. Marr is an experienced project manager and principal investigator, having managed large infrastructure projects such as the $16M renovation of SAFL

and $8.5M construction of the UMN Wind Research Facility at UMore Park in Rosemount, MN. Marr has also managed many multi-investigator applied research projects. The project's Co-PI is Jessica Kozarek. Kozarek is a research associate with expertise in river eco-hydraulics, hydraulic engineering, aquatic native and invasive species and other topics. Kozarek is also an experienced project manager, having led multi-investigator projects for state and federal agencies. Marr and Kozarek will share responsibility for project oversight and project delivery.

Organization: U of MN - St. Anthony Falls Laboratory

Organization Description:
SAFL is a research center of the College of Science and Engineering at UMN and will serve as the lead organization for this project. SAFL researchers address environmental, energy, and health challenges and have a strong capacity for effective science-communication.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Jeff Marr		Principal Investigator and research engineering with expertise in hydraulics, hydraulic modeling, river sediment transport and hydraulic structures. Responsible for project oversight and will participate in all aspects of the research project.			37.1%	0.16		$28,965
Jessica Kozarek		Co-Pi and research associate with research expertise in ecohydraulics, in-stream habitat, aquatic native and invasive species, and river restoration. Responsible for project oversight and participating in all aspects of the research project.			37.1%	0.28		$43,730
Richard Christopher		Research Scientist and lead of physical modeling design and construction			37.1%	0.38		$40,168
Chris Milliren		Engineer, instrumentation - design of data collection systems for physical modeling effort			37.1%	0.1		$9,596
Ben Erickson		Lab Operations - coordination of lab operation and facility usage, visitors and site visits to models			33.5%	0.34		$31,225
Undergraduate student (engineering)		Support research and modeling efforts. Carry out independent research during summer session.			0%	0.12		$3,956
Matt Lueker		Engineer			33.5%	105.6		$99,960
Erik Noren		Engineering Technician, Responsible for assisting in construction of the model and special fabrication.			33.5%	0.42		$27,965
Bridget Mendel		Communications. Assist with development of visual content resulting from the research and directing communications and implementation of results.			37.1%	0.24		$26,397
							Sub Total	**$311,962**
Contracts and Services								
TBD	Professional or Technical Service Contract	Develop visual content (edited and narrated videos) summarizing research findings.				0.3		$25,000
John Anfinson	Sub award	Anfinson will serve as the primary historian on the project team. Participate in all aspects of the project and serving as a subject matter expert in				0.6		$25,000

		development of content. Will support post-project outreach and awareness of project outcomes.						
TBD	Professional or Technical Service Contract	Fabricator - Laser cut stainless steel templates for model construction				-		$10,000
							Sub Total	**$60,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	Dimensional lumber and sheeting for model	building materials to construct a physical model of the river reach upstream and downstream of LD1.					$10,000
	Tools and Supplies	Pipes, valves and other plumbing supplies	plumbing supplies needed for the construction of the hydraulic model					$10,000
	Tools and Supplies	Gate and gate controls	hardware and supplies needed to construct a weir gate at the downstream end of the physical model.					$12,000
	Tools and Supplies	Sealants, adhesives and paints	Sealants, adhesives, and paints needed to construct the physical model					$1,000
	Tools and Supplies	lightweight concrete and aggregate to fill the model	materials needed to construct the physical model					$2,000
	Tools and Supplies	camera and sensors for data acquisition	data sensors to collect data from the experiments					$2,500
	Tools and Supplies	materials to fabricate Lock and Dam 1: spillway	Critical parts of the physical model will be fabricated and placed within the model.					$6,000
	Tools and Supplies	materials to fabricate Lock and Dam 1: locks	Critical parts of the physical model will be fabricated and placed within the model.					$6,000
	Tools and Supplies	materials to fabricate Lock and Dam 1: power house	Critical parts of the physical model will be fabricated and placed within the model.					$6,000
	Tools and Supplies	Roughness for the model hydraulics	Material such as corrugated metal to add roughness to the model to match field scale hydraulic conditions					$1,000
	Tools and Supplies	Sediment for the modeling effort	fine and medium quarry sand to use within the model					$8,000

	Tools and Supplies	Wood, sediment, and plastics needed for modeling scenario #1	supplies are needed to carry out the physical modeling experiments					$4,000
	Tools and Supplies	Wood, sediment, and plastics needed for modeling scenario #2	supplies are needed to carry out the physical modeling experiments					$4,000
	Tools and Supplies	Wood, sediment, and plastics needed for modeling scenario #3	supplies are needed to carry out the physical modeling experiments					$4,000
	Tools and Supplies	construction dumpster	disposal of the model construction materials at the end of the project					$1,538
							Sub Total	**$78,038**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
							Sub Total	**-**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$450,000**

Classified Staff or Generally Ineligible Expenses

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

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**-**

Total Project Cost: $450,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 8035603d-ded.pdf

Alternate Text for Visual Component

Document illustrates a reduced scale physical model of the Mississippi River gorge. Three individuals are shown looking at the model to provide scale of the model. The image has labels pointing out the locations of the Summit Avenue, Lock & Dam 1, Ford Bridge, and Hidden Falls Park....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Letter of Support_Friends of the Mississippi River	0fb4e515-0b8.pdf
Letter of Support_National Parks Conservation Association	93f98701-93b.pdf
Regents Letter of Support	0a5c7098-ef0.pdf
Letter of Support_Freshwater Society	bc60b7bb-3b6.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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

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

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing $10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal: