Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-195

Proposal Title: Forecasting Floodplain and River-Channel Change

Project Manager Information

Name: Andrew Wickert

Organization: U of MN - St. Anthony Falls Laboratory

Office Telephone: (612) 625-6878

Email: awickert@umn.edu

Project Basic Information

Project Summary: Altered streamflow caused by climate and land-use change erode and deposit sediments, modifying river channels and floodplains. We combine data and models to predict future river form and flood potential.

ENRTF Funds Requested: $482,000

Proposed Project Completion: June 30, 2029

LCCMR Funding Category: Resiliency (A)

Project Location

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

Region(s): SE, Metro,

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

Statewide

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.

Rivers change their shapes in response to their water and sediment loads. By infilling their beds or incising into them, widening or narrowing their channels, or depositing sediments across their floodplains, they alter the form and texture of aquatic and riparian habitat. Furthermore, such changes to the river affect how much flow it can convey before this water spills over the banks and creates a flood.

Such changes occur across Minnesota, from the Northwoods where forest harvest releases sediments to the Rapidan Dam failure in 2024. Fine sediments released by such events blanket floodplains, often priming them for invasive-species expansion. Gravel-bed streams fill in with sand and mud, removing salmonid habitat and causing widespread loss of these ecologically and recreationally important fish. Likewise, heavier rains and higher river discharges associated with climate change and agricultural drainage have caused widespread river widening: the Minnesota River alone has doubled in width since 1940. As they widen, these river channels erode surrounding infrastructure, but they also increase the amount of water they can carry, thereby counteracting increased flood risk from larger storms. Here we aim to predict how past and future actions will shape Minnesota's rivers, towards better supporting ecosystems, recreation, and infrastructure.

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.

We will build a river-and-floodplain forecasting package and decision-support tool to guide the future of Minnesota's rivers and the communities around them. This forecasting package will enable environmental managers and community members to explore how changing streamflow and sediment loads alter river form, habitat, and flood potential. These simulations will also present flood-inundation depths and demonstrate the feedback between flooding and time-evolving river-channel form. Critically, they will help communities to know what can be done to sustainably reshape rivers and how long these efforts require to bring about desired change.

To test and validate this decision-support modeling system, we will use and expand the long-lived Whitewater River data set (repeat surveys spanning 1939–2024) that we unified and digitized through LCCMR support (2022–2025). Here, agricultural erosion ca. 1860–1930 infilled the river and its floodplain with up to 10–15' of sediment. Now, under reduced sediment loads and climate-change-driven higher streamflow, the river is incising and reshaping its corridor.

Our forecasting package will simulate changing: (1) river-bed elevation via variable bed-load sediment and water supply, (2) river width via water-induced shear-stress distributions, (3) fine-sediment deposition building floodplains, and (4) water levels as streamflow and channel morphology co-evolve.

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?

As climate change turns slowly-melting snow to swift rainfall-driven floods and farmers build drainage systems to keep their fields safe from these downpours, high-magnitude water-discharge events scour streams and erode their banks. Likewise, high sediment supplies from land-surface erosion and dam failures infill channels and blanket floodplains with sediment, again reshaping habitat. Because river change is often gradual or follows unexpected events, predicting river change is neither intuitive nor easy. Our forecasting tool will allow Minnesotans to link management strategies to future river-channel form and flood hazard, spurring informed and proactive environmental decisions and scientifically supporting river restoration.

Activities and Milestones

Activity 1: Collect and compile river-geometry and streamflow data for the Whitewater River case study

Activity Budget: $172,373

Activity Description:
Any new modeling system must be benchmarked against data. This is especially true for the proposed river-forecasting system because of its designed purpose as a decision-support tool to accurately connect environmental management decisions to future river form and function. This benchmarking data set must extend long enough to observe river and floodplain change, and it should incorporate periods of both climate- and land-use-driven disturbance.

Repeat surveys of the Whitewater River in southeastern Minnesota provide an exceptional record of river-channel change. These surveys span 94 river cross sections and were performed in 1939, 1964, and 1994. Wickert's MS student, Jimmy Wood, compiled, digitized, and georeferenced these surveys with prior LCCMR support. LiDAR surveys from 2008 and 2022 augment floodplain data.

Here we will resurvey the water-filled portions of these 94 cross sections to create a record of channel-geometry change from 1994 to present. Using Wood's georeferencing of the stream cross sections, Wickert's team successfully built and tested a GNSS-based survey method on three cross sections in late 2024. Surveys will take place in 2027, thereby giving 88 years (1939–2027) of data on river morphological change that spans impacts of agriculture, restoration projects during the New Deal, and ongoing climate change.

Activity Milestones:

Description	Approximate Completion Date
Resurvey the 94 cross sections of the Whitewater river and its tributaries, monitored since 1939	November 30, 2027
Process survey data and integrate them into Wood's georeferenced database	April 30, 2028
Format the expanded database for model validation	June 30, 2028

Activity 2: Build and evaluate the forecasting tool to simulate river-channel and floodplain evolution

Activity Budget: $194,564

Activity Description:
We will develop a forecasting package to simulate river evolution with the following goals: (1) It is computationally efficient enough for management use and scenario testing. (2) It honors the physics of sediment transport, erosion, and deposition. (3) It includes realistic and field-testable predictions of streamflow and flooding. This package will have the following four components: (a) a flow-hydraulics relationship between flow depth and river discharge that responds to changing river geometry, (b) evolution of river-bed elevation as incoming sediments cause aggradation via deposition or excess water supply induces scour, (c) channel widening and narrowing based on streamflow-induced bank stresses and lateral sediment transport, and (d) floodplain development via overbank flow and suspended-sediment deposition. Wickert has already developed software packages to address (a) and (c), reducing the remaining core modeling work to a set of two tasks, thereby making it appropriately scoped for the planned PhD project. This Activity also includes integration of model components a–d into a decision-support system, model testing and evaluation against the Whitewater River data set, and development of a model interface broadly usable by environmental managers. Activity success will be evaluated from modeling-system completion and successful model reproduction of the Whitewater data set.

Activity Milestones:

Description	Approximate Completion Date
Build the river-bed-evolution model component	June 30, 2027
Build the floodplain-evolution model component	December 31, 2027
Couple the flow and river-morphologic components into a single forecasting and decision-support package	June 30, 2028
Simulate and reproduce historical data from the Whitewater valley	December 31, 2028
Generate and test scenarios for the Whitewater valley under plausible climate and land-use forecasts	March 31, 2029

Activity 3: Disseminate the river-forecasting tool as a decision-support system for environmental management

Activity Budget: $115,063

Activity Description:

The critical final step in any project to generate a computational tool is building the documentation and support structures to enable its uptake and impact. Here, we will do this in several ways. (1) We will develop a user's guide, illustrated with the Whitewater River as our example. (2) We will engage with partners in the Whitewater River watershed to collaboratively assess and evaluate our simulation process. These partners include the interpretive rangers of Whitewater State Park and the managers of the Whitewater Wildlife Management Area. Their feedback will improve our software interface and help us to better communicate how our model-output forecasts can impact on-the-ground environmental management decisions. (3) We will deposit our open-source code and documentation with the Community Surface Dynamics Modeling System (CSDMS), the NSF-supported program to curate models of landscape change across the nation, and make it freely available via GitHub and Zenodo. (4) We will submit journal articles for open-access publication on the methods and underlying theory, written towards implications for environmental management. (5) We will host workshops and deliver presentations to teach practitioners about our river-forecasting tool and how to apply it to streams and watersheds of concern and interest.

Activity Milestones:

Description	Approximate Completion Date
Write and publish online user's manual and video guides with user-interface advice from project partners	December 31, 2028
Collaboratively evaluate the Whitewater case study, the model interface, and river forecasting for environmental decision-making	February 28, 2029
Publish model code and documentation via CSDMS, GitHub, and Zenodo	March 31, 2029
Submit papers to open-access scientific journals on the model components and their coupling	June 30, 2029
Host workshop at SAFL to teach practitioners how to apply our river-forecasting tool	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Judy Yang	University of Minnesota	Associate Professor of Hydraulic Engineering	Yes
Jeffrey Marr	University of Minnesota	Saint Anthony Falls Laboratory Associate Director of Engineering and Facilities	Yes
Phillip Larson	Minnesota State University, Mankato	Professor of Geomorphology	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?

During the project, we will implement our forecasting tool by reproducing historic changes along the Whitewater River and then projecting future changes under plausible climate and land-use scenarios. We will incorporate this example scenario in documentation that guides users to apply our forecasting tool to other river systems, and further aid usage by recording and sharing tutorial presentations and hosting webinars. The University of Minnesota will host these online resources. Using our forecasting tool, environmental managers and restoration professionals will be able to guide decisions that help rivers shape themselves and their floodplains into healthy environments for Minnesota's future.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Land-Use and Climate Impacts on Minnesota's Whitewater River	M.L. 2022, , Chp. 94, Art. , Sec. 2, Subd. 03h	$199,000
Ditching Delinquent Ditches: Optimizing Wetland Restoration	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 04a	$199,000

Project Manager and Organization Qualifications

Project Manager Name: Andrew Wickert

Job Title: Associate Professor

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

Dr. Andrew Wickert, Associate Professor in Geomorphology at the University of Minnesota, has broad expertise in understanding Earth's surface environments and how they change. He obtained his S.B. in Earth, Atmospheric, and Planetary Science from MIT (2008), where his research on river systems and geophysics earned him the highest honors in his department, the Goetze Prize and Crosby Award. For his Ph.D. in Geology from the University of Colorado Boulder (2014), he demonstrated how global glaciation deformed the solid Earth and its gravity field and reshaped rivers across North America. Alongside this research, Wickert developed and built open-source electronic instrumentation for environmental monitoring and gained experience working in environmentally focused projects in rivers and watersheds. He added field and computational experience in river response to changing climate and flooding during his 2014–2015 postdoc at the Universität Potsdam before arriving at the University of Minnesota in Fall 2015, where he joined the Department of Earth & Environmental Sciences and the St. Anthony Falls Laboratory.

At the University of Minnesota, Wickert built a research program with three broad focus areas: (1) the mechanics of

rivers and their watersheds and how they reshape themselves in response to environmental change, (2) regional to global patterns of climate-induced hydrologic and sea-level change, and (3) design of innovative open-source instrumentation to support environmental monitoring in the field. He and his group have developed the equations to describe how rivers reshape their slopes and valleys in response to changing water and sediment inputs; constructed field-based data sets on river dynamics and catchment-scale erosion; built computationally efficient tools to map and simulate lakes and wetlands; designed software to remotely map glacier and land-surface velocities; and invented and installed hundreds of inexpensive low-power sensors to monitor rivers, glaciers, snowpack, and watershed-scale hydrology.

Organization: U of MN - St. Anthony Falls Laboratory

Organization Description:
The Saint Anthony Falls Laboratory (SAFL) is a world-renowned research facility for environmental fluid mechanics and related fields. This 4,880-square-meter facility is built into the side of St. Anthony Falls in downtown Minneapolis, whose water it uses to run some of the largest hydraulics experiments in the world. In addition to direct experimentation with flowing water, SAFL hosts a diverse group of scientists and engineers who work on environmental fluid mechanics as it applies to the atmosphere, climate, land surface, sediments, and biological processes. The faculty, staff, and students at SAFL spread their efforts across both basic scientific advances and work with immediate applications to infrastructure, the environment, and societal needs. The current SAFL director is Prof. Lian Shen, with Jeff Marr as the associate director for engineering and facilities.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Project manager		Coordinate the research teams, participate in research and dissemination, manage reporting			26.8%	0.24		$52,667
Science co-lead 1		Model development and implementation			26.8%	0.12		$26,112
Science co-lead 2		Field surveying and data management			26.8%	0.12		$23,368
Communications manager		Writing and editing manuals; aiding in presenting methods to practitioners			26.8%	0.24		$28,886
IT Staff		Data-set management; scientific computing support			24.4%	0.12		$12,545
PhD Student		Collect data, build and integrate models, compare models against data, write publications and dissemination materials			44.6%	3		$170,881
Undergraduate students		Field and data-analysis support			0%	0.63		$21,760
							Sub Total	**$336,219**
Contracts and Services								
Minnesota State University, Mankato	Subaward	Resurveying all cross sections of the Whitewater River (94 total), coregistering them in GIS, and providing the data ready to test the models. Personnel: $117,000 (1 faculty member, 1 MS student, 1 geospatial specialist, 1 undergraduate student) Travel: $3000				2.7		$133,531
							Sub Total	**$133,531**
Equipment, Tools, and Supplies								
							Sub Total	**-**

Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	14 days of field work in the Whitewater River valley split among 6 trips, with 4 people on each trip, and camping to save lodging costs. Estimated 200 miles per trip.	We will participate in field work in collaboration with the MSU Mankato team to complete repeat surveys of all 94 cross sections of the Whitewater River.					$2,842
	Conference Registration Miles/ Meals/ Lodging	4 people to attend the Upper Midwest Stream Restoration Symposium when it is held in Minnesota. 3 nights, 4 people, and estimated 400 miles.	Disseminating our work on river-channel evolution to practioners					$2,820
							Sub Total	**$5,662**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Three open-access scientific journal publications describing (1) the expanded data set, (2) the floodplain model, (3) the channel-bed model, and (4) the coupled modeling system	These open-access publications and the associated data sets and code will be made available and understandable to practitioners.					$6,588
							Sub Total	**$6,588**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$482,000**

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: $482,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 4541fe86-d33.pdf

Alternate Text for Visual Component

Changing river-channel shapes impact habitat and affect flood risk. Panels: (1) a river that (2) fills with sediment, (3) erodes into its bed, (4) narrows with deposition, (5) widens, and (6) deposits on its floodplain. Proposal: better environmental management through model-assisted prediction of river and floodplain change....

Supplemental Attachments

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

Title	File
SPA endorsement letter	d18a2f43-efe.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the UMN Policy on travel applies.

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?

No

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:

Prof. Phillip H. Larson, Department of Geography, Minnesota State University, Mankato
Prof. Judy Yang, St. Anthony Falls Laboratory, University of Minnesota
Mr. Jeffrey Marr, St. Anthony Falls Laboratory, University of Minnesota
Ms. Angela Boutch, St. Anthony Falls Laboratory, University of Minnesota

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

N/A