Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-412

Proposal Title: Dam Failure: Understanding Consequences for Nutrients and Sediments

Project Manager Information

Name: Christine Dolph

Organization: U of MN - College of Biological Sciences

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Project Basic Information

Project Summary: Evaluate how dam failure impacts river corridor change and the storage and transport of sediment and nutrients in the Blue Earth River Basin, with implications for aging dams statewide.

ENRTF Funds Requested: $1,892,000

Proposed Project Completion: June 30, 2029

LCCMR Funding Category: Water (B)

Project Location

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

Region(s): SE

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.

Aging dam infrastructure has left the majority of 650 public dams across Minnesota at risk of failure and in need of ongoing or emergency repairs. On June 24, 2024, a partial failure of the Rapidan Dam on the Blue Earth River released 11.6 million cubic yards of sediment to downstream waters. The Minnesota DNR is working with Minnesota State University, Mankato, the University of Wisconsin–Eau Claire, and the University of Minnesota to evaluate the response of the river channel to the dam breach by tracking geomorphic change. However, little is known about where materials from the dam are ending up and what their impact may be on local and downstream water quality and habitat. The Greater Blue Earth River Basin (GBERB) in southern Minnesota already disproportionately contributes sediment and nutrients to the Minnesota River and is a key target of Minnesota's Nutrient Reduction Strategy. Understanding the impact of the Rapidan Dam failure on water quality and habitat will critically inform 1) local and state resource managers who are working to adapt conservation planning to account for sediment and phosphorus loading post-dam failure, and 2) communication of risk and management options to address aging dams across the state.

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 propose to evaluate how dam failure has impacted the storage and transport of sediment and phosphorus over time in the Blue Earth River Basin, in collaboration with the Minnesota Pollution Control Agency and the Minnesota Department of Natural Resources. To accomplish this, our multidisciplinary research team will: (1) leverage existing water-quality and satellite-imagery data to evaluate how dam failure has impacted nutrient loading and channel erosion, (2) conduct enhanced water-quality monitoring to understand how storm events are moving material through the system, (3) map stored sediment deposits throughout the river corridor, and (4) determine the origin and phosphorus content of stream sediments to evaluate how dam failure may be affecting nutrient loading relative to other sources in the basin. In addition to addressing water-quality concerns specific to the GBERB, understanding the impacts of the Rapidan Dam failure on downstream water quality and river-channel condition can provide a conceptual model for how dam failure may impact river systems more broadly. This model can inform communities across the state who need to make decisions about dam removal, and how best to remove them to mitigate downstream water-quality impacts.

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?

We will provide data and tools to help inform managers and policy makers about how dam failure and removal impacts sediment and nutrients. In the GBERB, this information can be used to adapt nutrient-management plans and conservation strategies for the basin and the broader Minnesota River. In addition, we will develop and communicate a conceptual understanding of how dam failure or dam removal may impact water quality for communities across the state who are considering dam removal projects. This conceptual model can also be used to develop proactive management plans coinciding with dam removal to mitigate sediment and phosphorus loading.

Activities and Milestones

Activity 1: Leveraging and enhancing water-quality monitoring toward understanding relationships between flow, sediment, and phosphorus in Blue Earth and Lower MN

Activity Budget: $771,197

Activity Description:
We will evaluate how dam failure has impacted sediment and phosphorus loading within the basin relative to prior (baseline) conditions by assembling existing water-quality monitoring data collected by state agencies and the Minnesota State University Water Resources Center from the GBERB before and after the dam failure. We will complement analyses based on these data by augmenting the existing load-monitoring program in the GBERB with new intensive data collection. Although prior monitoring on the Blue Earth and Lower Minnesota Rivers provided real-time sediment-transport data, this monitoring went offline in 2019. Enhanced monitoring will fill gaps in our understanding of how episodic releases of sediment from the dam failure are continuing to unfold as well as how sediment sources may be shifting as the system adjusts following failure, and will provide context for what these changes mean for nutrient dynamics. Using in-stream turbidity sensors, we will track suspended-sediment movement in real-time and relate it to phosphorus transport and cycling. We will also collect bulk suspended sediment and analyze its source and phosphorus chemistry and cycling properties, providing improved understanding of the impacts of dam failure on sediment and nutrient loading.

Activity Milestones:

Description	Approximate Completion Date
Leveraging and enhancing water-quality monitoring toward understanding relationships between flow, sediment, and phosphorus	December 31, 2027
Establish in-stream monitoring equipment to capture ongoing movements of sediment and nutrients	December 31, 2027
Collect water and sediment samples up and downstream of the dam for nutrient analysis	December 31, 2028
Analyze all data to determine source and fate of nutrients and sediments and summarize findings	June 30, 2029

Activity 2: Mapping and characterizing June 2024 flood deposits through lower Blue Earth and Lower Minnesota Rivers

Activity Budget: $487,168

Activity Description:
We will map flood deposits and their evolution using repeat satellite imagery at monthly-to-bimonthly intervals, and augment these with targeted field surveys. Satellite imagery will span pre- to post-failure collections to contextualize and observe river-corridor change. We will use satellite-based turbidity measures to track suspended-sediment transport. Through image-based change detection, we will map the extent and distribution of flood deposits produced by dam failure. Because the transport distance and storage of mobilized sediment within the Blue Earth and Minnesota systems are not well understood after this event, these data are necessary to understand the ecological and geomorphic impacts of the 2024 flood and dam failure. Using these mapped sediment distributions, we will collect samples to ground truth mapped distributions, and establish the sedimentology and geochemistry of the sediments mobilized during the flood. More detailed coring at key locations will provide stratigraphic and geochronologic context of the sedimentological and geochemical impact of this event as compared to historic, and (depth-of-coring-dependent) prehistoric alluvial deposition in these landscapes. Activity 2 mapping will inform site selection for synoptic sampling of bed sediment and floodplain sediment (Activity 3) linking sediment and nutrient loading impacts of the 2024 flood and dam failure.

Activity Milestones:

Description	Approximate Completion Date
Field mapping of tributary slackwater locations, floodplains, terraces, near channel bars	September 30, 2027
Map sediment plume and floodplain sedimentation: PlanetScope satellite data from above Rapidan to Minnesota–Mississippi	December 31, 2027
Sample collection and coring	June 30, 2028
Continue to acquire and build in necessary updates to PlanetScope record	June 30, 2028
Lab analysis: sedimentology, imaging, particle-size analysis, geochemistry, geochronology	June 30, 2029

Activity 3: Synoptic sampling of bed sediment and floodplain sediment along the river corridor

Activity Budget: $564,837

Activity Description:
Sediments from the dam failure may carry enough phosphorus to impact downstream waters, including the Lower Minnesota River, which is already impaired for dissolved oxygen (DO) and the target of a TMDL for phosphorus. If mobilized sediments are prone to phosphorus release, dissolved phosphorus can stimulate algal blooms, ultimately further depleting DO and inducing negative feedbacks to water quality. Management approaches focus primarily on reducing phosphorus inputs, but the volume and dynamics of phosphorus in storage remain poorly understood, and the role of materials from the dam failure is completely unknown. Our team will sample streambed and floodplain sediment along a transect from above the dam to the Minnesota–Mississippi River confluence, learning the fate of dam materials and their impacts on phosphorus cycling and impairments. Sample locations will align with repeat-surveyed cross-sections (MN DNR) to track geomorphic change and with mapped deposits from Activity 2. We will measure phosphorus and elemental chemistry, particle size, and organics. Radionuclide signatures will be used for understanding deposited sediment source (dam, bluff erosion, or uplands), time in storage, and relationship to suspended sediment in transport. Water samples will be collected to evaluate the nutrient-release potential of sediments from the streambed.

Activity Milestones:

Description	Approximate Completion Date
Select sampling locations and sample sediments in the channel and floodplain	December 31, 2028
Analyze sediment chemistry for phosphorus content, cycling properties and origin	June 30, 2029
Analyze all data to determine source and fate of nutrients and sediments and summarize findings	June 30, 2029

Activity 4: Outreach and communication of findings to resource managers and practitioners, and integration with National Science Foundation Rapid Project

Activity Budget: $68,798

Activity Description:
We will implement a bi-directional community-engagement strategy to ensure that project outcomes are effectively communicated to resource managers and practitioners and elicit their perspectives to inform the development of the next phase of work. Specifically, we will disseminate project results through existing stakeholder groups including the Greater Blue Earth River Basin Alliance and the Lower Minnesota River Watershed District. These groups will also provide us with important community perspectives on the implications of project findings for managers and practitioners, which will be imperative for the development of future work. Project findings will also be disseminated to downstream and upstream communities through engagement with the following One Watershed One Plan groups: Lower Minnesota River West, Lower Minnesota River East, Minnesota River Mankato, and Blue Earth. To ensure effective dissemination with resource managers and policy experts, we will present at local conferences (Water Resource Conference, Minnesota Watersheds Annual Conference, etc.) and produce a policy brief for state policy

makers and agencies. Finally, we expect this project to contribute to the peer-reviewed literature through open-access publications in relevant journals.

Activity Milestones:

Description	Approximate Completion Date
Communicate results to stakeholders	June 30, 2029
Present findings to resource managers and policy experts	June 30, 2029
Create policy brief for state policy makers and agencies	June 30, 2029
Publish findings in peer reviewed journal	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Anna Baker	U.S. Geological Survey	Co-investigator - Baker will to contribute to study design, data collection & analysis mentoring of students on the project, and communication of findings.	Yes
Phillip Larson	Minnesota State University, Mankato	Co-investigator - Larson will to contribute to study design, data collection and analysis, mentoring students on the project, and communication of findings.	Yes
Zach Hilgendorf	University of Wisconsin - Eau Claire	Co-investigator - Hilgendorf will contribute to study design, data collection & analysis, satellite imagery analysis, and communication of findings.	Yes
Carrie Jennings	Freshwater	Communications Support - Freshwater will help communicate results to stakeholders and partners across Minnesota.	Yes
Seth Thompson	Freshwater	Communications Support - Freshwater will help communicate results to stakeholders and partners across Minnesota.	Yes
Diana Karwan	University of Minnesota	Co-investigator - Karwan will lead radionuclide study of sediment origin, mentor grad students, and contribute to communication of findings.	Yes
Andy Wickert	St. Anthony Falls Lab, University of Minnesota	Co-investigator - Wickert will contribute to mapping dam deposits, mentoring grad students, and communication of findings.	Yes
Jacques Finlay	University of Minnesota	Co-investigaor - Finlay will contribute to study design, lab facilities, mentoring of students, and communication of findings	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?

Findings from our research will be used to inform local and state conservation planning priorities related to dam removal and dam failure. This information can also be incorporated into existing biophysical models (such as HSPF) used by local and state agencies to predict outcomes of management practices. We anticipate seeking additional state and federal funding in future to support the ongoing development of this knowledge.

Project Manager and Organization Qualifications

Project Manager Name: Christine Dolph

Job Title: Research Scientist

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

Christine Dolph is a research scientist in the Department of Ecology, Evolution and Behavior at the University of Minnesota. She is an expert in stream and river ecology, and has worked extensively with biological, physical and chemical datasets to examine relationships between land use, hydrology, nutrients, sediment and stream health in Minnesota and across the Midwestern United States. Her previous collaborations include working with Minnesota state agencies including the Minnesota Pollution Control Agency and Minnesota Department of Natural Resources to evaluate methods used to monitor the health of Minnesota streams and rivers, and with the U.S. Department of Agriculture to understand how in-stream environments modulate the storage and transport of legacy phosphorus. She is experienced in the coordination of large multi-institution, interdisciplinary projects and in the collection and curation of large publicly available datasets.

Organization: U of MN - College of Biological Sciences

Organization Description:
The College of Biological Sciences (CBS) at the University of Minnesota is one of the only colleges dedicated to the biological sciences in the country. Research in the college spans the breadth of the discipline from ecology to biophysics to microbiology. Within CBS, the mission of the Department of Ecology, Evolution and Behavior (EEB) is to increase human understanding of biodiversity, its origins and maintenance, leading to an improved understanding of ourselves and how we may live sustainably.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Principal investigator - Dolph		Leads project team in accomplishing project objectives			26.7%	1.5		$169,113
Undergrad Lab Techs		Collect samples from the field and process in the lab			0%	2.5		$62,400
Co-PI - Karwan		Advises on study design, data collection, mentoring of grad students, and dissemination of results			26.7%	0.09		$24,711
Grad student - Karwan lab		Conducts original research on sediment source, origin and fate in Karwan lab; cost includes tuition			18.8%	1.5		$175,814
Co-PI - Wickert		Advises on study design, data collection and analysis, mentoring of grad students, and dissemination of results			26.7%	0.09		$26,334
Grad students - Wickert lab		Conduct original research into fate of river sediments and changes to river channel in Wickert lab; cost includes tuition			18.8%	3		$176,591
Co-PI - Finlay		Contributes to study design, facilitates and assists in lab analysis including overseeing undergrad techs in the lab			26.7%	0.09		$34,085
							Sub Total	**$669,048**
Contracts and Services								
Freshwater	Subaward	Freshwater will implement a bi-directional community engagement strategy to ensure that project outcomes are effectively communicated to resource managers and practitioners and elicit their perspectives to inform the development of the next phase of work				1.44		$68,798
U.S. Geological Survey	Subaward	Staff from USGS will assist in collection of data in the field, provision of field and lab equipment, analysis of lab samples, interpretation of data, and dissemination of results				2.31		$699,993
Minnesota State University, Mankato	Subaward	Mapping of sediment deposits in river corridor, collection of sediment cores to determine sediment source and fate, integration with ongoing NSF Rapid project aimed at investigating changes to channel				2.49		$251,129

		arising from dam failure, collection of water and sediment samples via the MNSU Water Resources Center						
University of Wisconsin - Eau Claire	Subaward	Collection and interpretation of aerial imagery (including satelitte and drone imagery) to document changes in channel morphology and erosion				1.02		$83,521
Minnesota Valley Testing Laboratories	Service Contract	Analysis of water chemistry samples				0		$37,538
							Sub Total	**$1,140,979**
Equipment, Tools, and Supplies								
	Tools and Supplies	~100 gamma count samples (expenses for containers, LN, run in collaborators lab) 20/sample over 2 years - Karwan	Radionuclide analysis to determine sediment source					$4,000
	Tools and Supplies	Lab supplies - Finlay	Chemical analysis of sediment and water samples					$57,596
	Tools and Supplies	Field supplies - Wickert	Supplies needed to collect sediment and water samples in the field					$5,000
							Sub Total	**$66,596**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel from Twin Cities to and around Blue River Basin over 3 years for 4 people for field data collection	Travel to support collection of field data					$6,377
	Conference Registration Miles/ Meals/ Lodging	Expenses for 2 grad students and 1 PI to attend the Water Resources Conference and/or other relevant conferences for two years	Dissemination of project findings					$3,000

							Sub Total	**$9,377**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Fees for publication of scientific results in open access, peer reviewed journals	Dissemination of project findings					$6,000
							Sub Total	**$6,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$1,892,000**

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				
In-Kind	University of Minnesota	Indirect costs associated with this proposal	Potential	$413,000
			Non State Sub Total	**$413,000**
			Funds Total	**$413,000**

Total Project Cost: $2,305,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: f3d48a71-8f2.pdf

Alternate Text for Visual Component

1) A photograph of the dam failure on the Blue Earth River, with a torrent of water flowing through the collapsed section and eroding a huge section of the river bank, 2) a map of the Minnesota River Basin showing the contribution of the Blue Earth Basin to suspended sediment....

Supplemental Attachments

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

Title	File
LCCMR Proposal Approval Letter Dolph	77089ccf-4ed.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?

Yes

Does the organization have a fiscal agent for this project?

No

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:

Christine Dolph (University of Minnesota); Anna Baker (U.S. Geological Survey); Phillip Larson (Minnesota State University, Mankato); Zach Hilgendorf (University of Wisconsin - Eau Claire); Andy Wickert (University of Minnesota); Carrie Jennings (Freshwater); Seth Thompson (Freshwater); Jacques Finlay (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

Yes, I understand