Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-234

Proposal Title: Drainage Tools for Minimizing Downstream Impacts

Project Manager Information

Name: John Nieber

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Office Telephone: (651) 249-8698

Email: nieber@umn.edu

Project Basic Information

Project Summary: This project will help understand how agricultural drainage changes downstream hydrology and create tools that will help improve drainage design to minimize the impacts of high flow, sediment and pollutants.

ENRTF Funds Requested: $297,000

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?

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.

The Minnesota River Basin (MRB) with its tributaries is one of the most contaminated river systems in Minnesota. The MRB experiences high flows, which leads to flooding, erosion, and water quality impacts like excessive sediment, nitrogen and phosphorus. Flow in the MRB is increasing over time from increased precipitation and land use changes.

Agricultural drainage, a necessary part of agriculture in poorly drained soils, is often targeted as a major cause of the increased flow. New tile drainage systems are being installed in the MRB as precipitation increases. In addition, older drainage ditches are being revamped to cope with the additional tile drainage. But how the drainage affects flow at the field and downstream scale is less known. Furthermore, previous watershed-scale modeling efforts in the MRB have not satisfactorily simulated field- and watershed-scale drainage effects.

We see a need for clarity on the effect of increased agricultural drainage on downstream flow. We also see a need to provide better resources to improve drainage design or mitigation measures in drainage projects (e.g., water storage) that will benefit agricultural production while also offsetting downstream impacts. These needs represent an opportunity to take a fresh look at drainage issues in the MRB.

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 developing simple decision support tools that can help farmers, drainage contractors and water resources managers improve drainage design while also improving downstream flow and water quality conditions in the MRB.

First, we propose investigating hydrologic the effects of field- and ditch-scale drainage systems by using available monitoring data to test and select the most appropriate drainage hydrology model for MRB climate, soil, topographic and land use conditions. We will then use the selected model to simulate a wide range of drainage design and climate scenarios that will help us understand how tile drainage and ditch capacity affect field-scale hydrology. Besides flow, we will also evaluate changes in evapotranspiration, which could be driving total flow much more than previously reported.

Next, we propose using the modeled field-scale drainage results to evaluate cumulative downstream effects. To accomplish this, we will look at available watershed-scale models that have been used in prior studies and develop an approach to integrate the field-scale results into a simplified watershed-scale modeling framework. Using this framework, we will develop a spreadsheet-based drainage decision support tool.

We will emphasize simplicity because complicated modeling approaches are difficult to use and maintain over time.

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 work will provide clarity on the effects of agricultural drainage on flows in the MRB, which will guide the best choices of drainage practices for field- and watershed-scale effectiveness and sustainability. It will also provide, for the first time, a simple drainage decision support tool that will be useful to many drainage practitioners, to water resources projects like the One-Watershed/One-Plan, and local watershed management plans. In addition, any resulting improvements in drainage design could provide some relief from the observed higher flows and pollutants in the MRB, whether caused by increased precipitation or land use changes.

Activities and Milestones

Activity 1: Evaluation of Local Hydrology of Drained Fields and Ditches

Activity Budget: $120,000

Activity Description:
This activity will collate available monitoring data for drainage systems and test existing field-scale hydrologic models using the selected data.

First, we will assemble available drainage system monitoring data to compile and curate a useful dataset. We will review national literature and datasets (USDA National Agricultural Library Ag Data Commons), local state research (MN, IA), Minnesota experimental stations (Waseca, Lamberton), and Minnesota agencies (MPCA, MN-DNR, MDA). Preliminary searching via our collaborators had yielded many (>15) sites with data that might be useful. The outcome this task will be high-quality data suitable for model testing.

Second, we will compile and test a list of field- scale hydrological models that can simulate agricultural drainage adequately. We will evaluate the characteristics that make these models suitable for agricultural drainage within the climate, landscape and agricultural context of the MRB. We will include models that have been previously used in the MRB (e.g. HSPF, GSSHA) to simulate drainage hydrology. The top three models will be tested for model performance at the field-scale and compared to the HSPF model, which was used for the MRB TMDLs. The outcome this task will be a preferred field-scale drainage model.

Activity Milestones:

Description	Approximate Completion Date
Define data needed for field tasks	August 31, 2025
Assemble available drainage system monitoring data	November 30, 2025
Compile and test field-scale hydrological models	March 31, 2026

Activity 2: Evaluation of Watershed Hydrology from the Upstream Drainage

Activity Budget: $150,000

Activity Description:
This activity will collate available river/ditch data and evaluate existing river routing schemes to simulate the downstream effects of drainage. The routing scheme will be coupled with the field-scale drainage model into a modeling framework that will be embedded in a spreadsheet decision support tool.

First, we will assemble data relevant to routing. We will review regional flow relationships (USGS) and prior modeling by local agencies (MPCA, MN-DNR, MDA). Preliminary searching indicates that the HSPF models have some reach data in tributaries within the MRB. The outcome of this task will be data suitable for configuring the routing scheme.

Second, we will compile a list of river routing schemes. We will evaluate the characteristics that make these approaches suitable for routing. We will include models previously used in this watershed (HSPF, MOSM, SWAT) and also simpler schemes. The outcome of this task will be a preferred routing scheme.

Third, we will couple the field model to the routing scheme within a framework that can be embedded in a spreadsheet. The resulting tool could then be used to evaluate drainage design decisions at downstream locations within the MRB. The outcome of this task will be a spreadsheet-based drainage tool.

Activity Milestones:

Description	Approximate Completion Date
Define data needed for watershed tasks	April 30, 2026
Assemble available routing data	July 31, 2026
Compile and test river routing schemes	November 30, 2026
Embed combined model in spreadsheet tool	March 31, 2027

Activity 3: Project Management and Reporting

Activity Budget: $27,000

Activity Description:
The team will establish a Technical Advisory Committee (TAC) with experts from Minnesota Department of Agriculture (MDA), Minnesota Pollution Control Agency (MPCA), and Minnesota Department of Natural Resources. The TAC will meet every three months while the full project team will meet monthly. Leveraging our existing relationships, we will establish a stakeholder group from cities, counties, watershed districts/organizations, and non-profits.

A draft and final report will provide documentation of the project to clearly explain the proposed decision support framework and tool. Following the completion of the final report, our Team will develop draft and final training slides, then conduct a one-hour workshop (recorded) on the proposed tool. The spreadsheet tool, workshop and user documentation will be stored on UMN, Science Museum, and Geosyntec websites. The project results and tool will be presented to audiences at Minnesota's annual Water Resources Conference and at the regional International Drainage Symposium.

Our team will provide periodic updates to the LCCMR as contracted. The updates will include documentation of the TAC meetings, status of the tasks, discussion of unexpected issues and resolutions, and any results to date.

Activity Milestones:

Description	Approximate Completion Date
Finalize proposed TAC members	July 31, 2025
Draft and final report	May 31, 2027
Present a one-hour training webinar	June 30, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
John Nieber	University of Minnesota	Project Manager	Yes
Nigel Pickering	Geosyntec Consultants, Inc.	Project Consultant	Yes
Jason Ulrich	Science Museum of Minnesota	Project Consultant	Yes
State Staff	State Agencies	TAC Member (added in Activity 3)	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 work be funded?

The primary outcome of this project will be an improved understanding of how agricultural drainage impacts downstream hydrology. A secondary outcome will be a simple decision support tool for improved drainage design. These outcomes could be implemented in future One-Watershed/One-Plan efforts and could guide alternatives for proposed mitigation efforts like increased water storage. The drainage decision support tool could be used in future drainage design and permitting, expanding the current design focus from the field to the entire watershed. Future funding by LCCMR could expand this effort to include water quality impacts and associated economic costs.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Setting Realistic Nitrate Reduction Goals in Southeast Minnesota	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 04m	$350,000

Project Manager and Organization Qualifications

Project Manager Name: John Nieber

Job Title: Professor

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

John Nieber has 43 years conducting research and teaching at major research universities (38 years at the University of Minnesota). He has conducted research in hydrology and water quality problems during that time. He has published over 100 refereed journal manuscripts and is a license professional engineering and certified professional hydrologist.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:

In the College of Food, Agricultural and Natural Resources Sciences (CFANS) at the University of Minnesota, we look at the bigger picture. When we envision a better tomorrow, it includes disease-resistant crops, products that protect our health, lakes free from invasive species, and so much more. We use science to find answers to Minnesota's and the world's grand challenges and solve tomorrow's problems. Almost 93 percent of students who earn CFANS undergraduate degrees find jobs in their career field or enter graduate school within six months of graduation.

The Department of Bioproducts and Biosystems Engineering, in CFANS, discovers and teaches solutions for the sustainable use of renewable resources and the enhancement of the environment. We discover innovative solutions to address challenges in the sustainable production and consumption of food, feed, fiber, materials, and chemicals by integrating engineering, science, technology, and management into all degree programs.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Principal Investigator		Oversee all project activities and manage the project to meet proposed deadlines.			37.1%	0.04		$10,283
Graduate Student Research Assistant		The student, with expertise in hydrology, will work with the project collaborators in to process available data and perform drainage modeling.			46.45%	1.5		$84,265
							Sub Total	**$94,548**
Contracts and Services								
Geosyntec	Professional or Technical Service Contract	Contractor will provide technical assistance for all aspects of the project including developing the conceptual framework, data collection, modeling, tool development, report preparation, and webinar preparation/presentation. Senior Engineer, Programmer, Data Analyst, GIS Analyst, and Administrator.				1.4		$172,452
Science Museum of Minnesota	Professional or Technical Service Contract	Contractor will provide technical assistance for data collection and modeling. Research Scientist.				0.3		$30,000
							Sub Total	**$202,452**
Equipment, Tools, and Supplies								
							Sub Total	**-**
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	**$297,000**

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: $297,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: f3538b9f-1ef.pdf

Alternate Text for Visual Component

Does Drainage Affect Downstream Flow and Sediment?...

Supplemental Attachments

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

Title	File
Letter of Authorization to Submit	4226cbe5-9fb.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?

No

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:

Riana Fletcher (she/her)
Principal Grant and Contract Officer
Team 4 Lead
Sponsored Projects Administration

University of Minnesota
200 Oak Street SE, Suite 450
Minneapolis, MN 55455-2070
Email: fletc070@umn.edu
Phone: 612-624-5856