Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-139

Proposal Title: Nitrogen Management Benefits of Three Conservation Drainage Practices

Project Manager Information

Name: Lindsay Pease

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

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Project Basic Information

Project Summary: This project quantifies the nitrogen management tradeoffs of three conservation drainage practices by measuring water quality, greenhouse gas emissions, and soil nutrient availability for crops

ENRTF Funds Requested: $265,000

Proposed Project Completion: June 30, 2029

LCCMR Funding Category: Small Projects (G)

Secondary Category: Water (B)

Project Location

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

Region(s): NW

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.

Understanding how nitrogen moves and transforms in the soil is key to ensuring efficient fertilizer use, improving water quality, and preventing greenhouse gas contributions to climate change. One of the most obvious ways that nitrogen can leave an agricultural field is in subsurface drainage discharge. Many farms across Minnesota depend on subsurface drainage systems to profitably produce crops during our short growing season. Drainage systems improve the efficiency of in-field operations, protect crops from waterlogging, and increase the consistency of crop yields. Nevertheless, these agricultural benefits come with a water quality tradeoff: increased nitrate loss to surface water. One strategy used to mitigate nitrate loss from subsurface drainage without losing its function is by installing a conservation drainage practice (e.g., controlled drainage, saturated buffers, and denitrifying bioreactors). We have high confidence in the ability of these practices to reduce nitrate loading from subsurface drains. What is not known is how these practices affect the other ways nitrogen can leave a field. Thus, there is an urgent need to track nitrogen cycling in fields with and without conservation drainage to ensure each practice functions as intended. Practices that do not must be modified to avoid unintended consequences for Minnesota resources.

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.

Our goal is to understand how agricultural water management affects nitrogen movement and transformations so that we can improve management recommendations to farmers and land managers. Our central hypothesis is that conservation drainage prevents nitrogen loss in subsurface drainage but it does not immobilize the nitrogen. Instead, it leaves the field via other pathways. To test our hypothesis, we will measure the different nitrogen loss pathways by conducting in-field measurements of soil nutrient cycling, water quality, and greenhouse gas (GHG) emissions for three conservation drainage practices. The drainage system practices monitored in this study will be controlled drainage, saturated buffers, and woodchip bioreactors. We will also monitor fields without subsurface drainage and conventional subsurface drainage as controls. This will allow us to monitor whether a practice is releasing nitrogen via a harmful pathway, like as a GHG or into groundwater. We intend to objectively analyze these trade-offs, particularly the correlation between water management and GHG emissions, while closely monitoring crop yield and soil nitrogen availability. We can then modify practice design to improve overall environmental outcomes. This comprehensive study will provide key insights into how best to manage drainage systems to balance environmental and agricultural productivity goals.

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 aim to provide farmers and water managers with science-based answers that balance crop yield and environmental responsibilities. We will develop recommendations for managing agricultural runoff and drainage discharge to provide water quality and climate benefits. Specific outcomes we anticipate from this work include: 1) Reduced nitrate loads from subsurface drainage discharge using controlled drainage and denitrifying bioreactors; 2) Reduced greenhouse gas emissions by managing soil moisture levels to reduce nitrogen volatilization processes; and 3) Improving farmers' autonomy to make water and climate management decisions to mitigate their environmental impact.

Activities and Milestones

Activity 1: In-field measurement of nitrogen cycling and transformations for three conservation drainage practices, conventionally-drained fields, and undrained fields

Activity Budget: $242,505

Activity Description:
During the first two months of the project we will finalize sampling locations and order any needed instrumentation (e.g., soil moisture sensors, dataloggers, groundwater wells) for each site. We will begin equipment installations in Fall 2026 to ensure rapid deployment of sensing equipment for the 2027 growing season. During the 2027 and 2028 growing seasons, we will monitor nitrogen transformations from snowmelt until the end of fall field work. Data collection will be conducted during weekly site visits and will include: Soil moisture and soil temperature measurements, Water quality samples from an in-field groundwater well and any drainage system outlets, air samples from three in-field static chambers, and three in-field soil mineralization samples. Upon returning to the lab, soil and water samples will be analyzed for total nitrogen and inorganic nitrogen (ammonia and nitrate). Air samples will be analyzed for the three major greenhouse gasses: N2O, CO2, and CH4. We will analyze nitrogen loss pathways, particularly the correlation between water management and GHG emissions, while closely monitoring crop yield and soil nitrogen availability. We will use this information to generate management recommendations for farmers and land managers.

Activity Milestones:

Description	Approximate Completion Date
Site selection and equipment instrumentation	October 31, 2027
Data Collection	November 30, 2028
Laboratory analysis of soil, water and air samples	January 31, 2029
Data analysis and revised management recommendations	June 30, 2029

Activity 2: Extension and outreach on integrating conservation drainage into water management plans to meet agricultural and environmental goals

Activity Budget: $22,495

Activity Description:
We will showcase the project at outreach events including the Minnesota Drainage and Conservation Summit (50-75 attendees), the Tri-State (IA-MN-SD) Drainage Research Forum (75-100 attendees), NWROC's Crop and Soils Day (75-100 attendees), and via traditional extension outlets including fact sheets, news articles, social media, and radio. Final results will also be presented nationally at meetings such as the Conservation Drainage Network Annual Meeting (300 attendees) and the North American Conservation and Drainage Expo (1000 attendees). We will also write and distribute a "Conservation Drainage Management Guide" to assist farmers and land managers in how best to manage their drainage systems to meet environmental and agricultural goals. These outreach activities will maximize stakeholder engagement and ensure rapid adoption of improved conservation drainage practices.

Activity Milestones:

Description	Approximate Completion Date
Three statewide extension presentations on project goals and objectives	June 30, 2027
Three statewide extension presentations and one national conference presentation on project and outcomes	June 30, 2028
Three statewide and two national presentations on project findings and results	June 30, 2029

Development of written “Conservation Drainage Management Guide” for Minnesota farmers and land managers	June 30, 2029
Peer-reviewed publication on project outcomes	June 30, 2029

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?

Project findings and results will be shared and implemented as part of Dr. Pease's Extension Programming in Nutrient and Water Management. Dr. Pease's programming reaches more than 800 individuals annually through in-person events. This reach is broadened through UMN Extension podcasts, blog posts, and research publications that are accessible indefinitely online. If further work is needed, we will seek federal funding through collaborations with researchers across the US Midwest who are interested in conducting similar work in other regions. Drs. Pease and Ellafi have a broad network of potential collaborators through the national research-industry partnership, the Conservation Drainage Network.

Project Manager and Organization Qualifications

Project Manager Name: Lindsay Pease

Job Title: Assistant Professor & Extension Specialist

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

Dr. Lindsay Pease is an Assistant Professor and Extension Specialist in the Department of Soil, Water, and Climate at the University of Minnesota Twin Cities. She is stationed at the Northwest Research and Outreach Center in the heart of the Red River Basin of the North. Dr. Pease's work focuses on developing nutrient and water management strategies that balance agricultural productivity and environmental stewardship for the unique cropping systems and climate of the Red River Basin region. She received her B.S., M.S., and Ph.D. in Agricultural Engineering from The Ohio State University.

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

Organization Description:

The Northwest Research and Outreach Center (NWROC) provides analytical, biological, and field laboratories for research and demonstrations that enhance the efficient use of agricultural and natural resources. Our research and outreach programs focus on agricultural commodities and enterprises that are important to northwestern Minnesota's economy and culture. Our goal is to help producers maintain profitability in ways that are environmentally sound and help agriculture thrive in the region. We are one of 10 unique Research and Outreach Centers throughout Minnesota within the University of Minnesota's College of Food, Agricultural and Natural Resource Sciences (CFANS). Our work enhances the quality of agricultural production, human health, renewable energy, and the environment and disseminates the benefits of this research to the public. Research and outreach programs based at the NWROC focus on: Nutrient and water management, pest management, small grains production and management, and sugarbeet pathology.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
PI Lindsay Pease, Assitant Professor & Extension Specialist		2 weeks summer salary to lead overall project and oversee project personnel			36.6%	0.15		$23,603
Co-PI Dr. Murad Ellafi, Postdoctoral Research Associate		Oversee data collection and conduct data analysis			25.9%	0.9		$72,848
NWROC Research Technician		Collect data, conduct laboratory analysis, and oversee undergraduate students			32.3%	0.6		$49,071
Undergraduate Student		Assistance with data collection, sample preparation, and laboratory analysis			0%	0.33		$11,869
Summer temporary employee		Assitance with data collection, sample preparation, and laboratory analysis			7.4%	0.33		$12,747
							Sub Total	**$170,138**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	Field and lab supplies for greenhouse gas analysis	Consumable laboratory and field supplies for collection and analysis of greenhouse gases (e.g., plastic bags, vials, septa, syringes, and lab standards)					$21,000
	Tools and Supplies	Field and lab supplies for soil and water sample analysis	Consumable laboratory and field supplies for collection and analysis of nitrogen in soil and water samples					$15,000

			(e.g., plastic bags, sample bottles, chemical reagents, syringes, filters)					
	Tools and Supplies	Supplies to host field day event	Supplies for hosting an annual field day event to discuss project results (e.g., food, AV supplies)					$9,000
	Equipment	Non-capital equipment	Non-captial field sensing equipment each costing less than $5000 (e.g., soil moisture sensors, dataloggers, weather stations)					$36,367
							Sub Total	**$81,367**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	3 years x 3 trips/year x (396 mi/trip x $0.70/mi + 1 night lodging x $110/day + 2 days M&IE x $78/day)	Travel to in-state extension meetings to share project results					$4,800
							Sub Total	**$4,800**
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	2 trips x (3 nights lodging x $190 + 4 days M&IE x $100 + $640 registration + $695 flight); 1 trip x $695 flight	Travel to 1 national conference in years 2 and 3 and 1 national extension meeting in year 3 for 1 project personnel to present results	X				$6,695
							Sub Total	**$6,695**
Printing and Publication								
	Printing	Conservation Drainage Management Handbook	Printing costs of a handbook for farmers and land managers to assist with decision making and improve environmental outcomes					$1,000
	Publication	Scientific journal articles	Publication costs associated with one scientific journal article based on					$1,000

			findings and recommendations of this work					
							Sub Total	**$2,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$265,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	2 trips x (3 nights lodging x $190 + 4 days M&IE x $100 + $640 registration + $695 flight); 1 trip x $695 flight	Travel outside Minnesota is needed to communicate the findings and recommendations from this work to the scientific community, policymakers at the national level, farmers, and the drainage industry across the Midwest.

Non ENRTF Funds

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

Total Project Cost: $265,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 68171a52-438.pdf

Alternate Text for Visual Component

A graphic showing the inputs (fertilizer, organic matter), transformations (ammonification, nitrification, denitrification), and exports (air, drainage, yield) of nitrogen from a subsurface-drained agricultural field. When you change drainage export, how does the overall nitrogen cycle change?...

Supplemental Attachments

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

Title	File
UMN Sponsored Projects Authorization	b7b136e1-650.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:

Hannah Haley, UMN Sponsored Projects Administration

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