



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-494

Proposal Title: Protecting Drinking Water from Nitrates in Southeast Minnesota

Project Manager Information

Name: David Mulla

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

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Project Basic Information

Project Summary: We build community capacity for reducing nitrate pollution using Continuous Living Cover in southeastern Minnesota. We engage stakeholders and farmers to identify and evaluate viable economic and environmental CLC alternatives.

ENRTF Funds Requested: \$836,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Resiliency (A)

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?

Region(s): SE, Central, SW,

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.

Roughly 75% of Minnesotans rely on groundwater, yet drinking water in Southeast Minnesota is increasingly threatened by nitrate contamination from row crops. In regions like Goodhue County, nitrate levels often exceed the EPA's 10 mg/L safety threshold, heightening risks for "blue baby syndrome," thyroid diseases, and cancer. The area's unique karst geology further accelerates this pollution by allowing nitrates to easily infiltrate the aquifer. Continuous Living Cover (CLC) agriculture offers a vital solution by significantly reducing nitrate leaching while improving soil health and biodiversity. Emerging markets—including sustainable aviation fuel, carbon credits, livestock feed and oat milk—provide new economic incentives for diversification.

Despite these benefits, adoption remains limited by gaps in stakeholder access to scientific data and policy support. This project addresses these barriers by leveraging strong, farmer-led networks in Southeast Minnesota. These networks provide the necessary social and agronomic infrastructure for operators to transition toward CLC strategies, ensuring both regional water security and long-term economic stability in a volatile global market.

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 project aims to identify viable, market-driven futures for Southeast Minnesota's farm landscape. By centering farmers, researchers, and community stakeholders, we seek to improve water quality through the rapid expansion of Continuous Living Cover (CLC) crops, such as winter camelina, winter barley, hybrid winter rye and perennial oats. Focusing on the Cannon River watershed and broader SE Minnesota, this science-driven process transforms agricultural practices from nitrate sources into solutions. CLC crops provide year-round soil coverage, which drastically reduces nitrate leaching into drinking water. Beyond water protection, these systems deliver resilience that is critical for a) environmental, b) agronomic, and c) economic co-benefits: a) Reduced soil erosion, enhanced biodiversity, and lower trace gases, b) Improved soil health and superior water retention, c) Lower input costs and access to emerging markets like Sustainable Aviation Fuel (SAF), livestock feed, carbon credits and oat milk. By investigating existing and emerging financing structures, we aim to reduce farmer risk and create a resilient environment of readiness for market-based scaling. Ultimately, this collaborative approach ensures that the transition to diversified cropping systems supports both the economic stability of producers and the health of the regional ecosystem.

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 project engages farmers, agencies, and community members to protect SE Minnesota's groundwater and improve resilience through: 1) Visioning: Stakeholders envision alternative Continuous Living Cover (CLC) agricultural scenarios for the Cannon River Watershed. 2) Collaborative Geodesign: Developing a collaborative social learning tool to map CLC rotations and quantify economic and environmental impacts, such as profitability, nitrate-N leaching and erosion control. 3) Scenario Scoring: Re-engaging stakeholders to use the tool to identify and score preferred watershed-scale adoption scenarios. 4) Farmer Studies: Recruiting farmers to implement these rotations, studying existing CLC farmers and assessing and disseminating their experiences to accelerate CLC adoption.

Activities and Milestones

Activity 1: Engaging with stakeholders to identify viable pathways for adoption of CLC alternatives that protect groundwater

Activity Budget: \$124,630

Activity Description:

Solving the Southeast Minnesota drinking water problem by diversification of regional agriculture requires design of concrete and palpable scenarios grounded in farmer and resident aspirations and realities, specifying which crops will be grown, where, by whom, and how these crops will contribute to profitable, resilient agriculture. Development of such scenarios must engage the range of stakeholders needed for their implementation, including established and emerging/marginalized farmers, agribusiness professionals, local and state agency personnel, non-governmental organizations, and non-farming residents, among others. We will convene community-visioning sessions to identify future scenarios for diversified farming systems that meet economic needs, protect drinking water, and provide other environmental and social benefits. To initiate this activity, we will hold dialogue sessions with stakeholders, to learn from viewpoints on regional agricultural and environmental trends and on community development and growth. These sessions will provide guidance for Activities 2-6. Outputs from Activity 1 would include:

Understanding of social, economic and environmental compromise points, or windows of tolerance, from various stakeholder groups (ex: farmer willingness to drive further for elevator delivery if it means improved profit margins, or improved water quality).

- Understanding of social, economic and environmental worldviews of diverse stakeholder groups
- Preliminary identification of potential CLC rotations

Activity Milestones:

Description	Approximate Completion Date
Stakeholder interviews and focus group work to identify alternative CLC systems of interest	September 30, 2027
Community visioning sessions on CLC systems with stakeholders	December 31, 2027

Activity 2: Develop collaborative geodesign tool that allows stakeholders to select locations in SE for adoption of alternative Continuous Living Cover rotations

Activity Budget: \$80,606

Activity Description:

Based on feedback from Activity 1, we will adapt an existing visual collaborative geodesign tool for Continuous Living Cover (CLC) rotations in SE Minnesota. This tool integrates economic data and ecosystem service impacts from Activities 3 and 4 to help stakeholders visualize land-use changes and minimize conflict through shared information. By treating local and scientific stakeholders as active partners, the co-design process allows users to develop and evaluate alternative scenarios. Specifically, the tool identifies the tradeoffs between economic goals and environmental health to find resilient "win-win" solutions across a range of historical and future weather conditions (wet, dry, average). A primary output of this tool is determining the land conversion required to transition from traditional corn-soybean rotations to CLC systems. It will model the specific acreage needed to achieve nitrate-N load reductions of 10% to 50% from the watershed baseline.

Additionally, the tool enables users to determine:

Crop Composition: The specific mix of annual and perennial crops required.

Spatial Optimization: Precise watershed locations for planting to maximize groundwater protection and co-benefits.

Impact Analysis: The economic and environmental consequences of different spatial arrangements and adoption levels.

Activity Milestones:

Description	Approximate Completion Date
Update basemaps in collaborative geodesign to reflect crops, soils, terrain, hydrology of SE MN	December 31, 2027
Update user interface in collaborative geodesign to reflect alternative CLC systems from Activity 1	March 31, 2028
Incorporate biophysical/socio-economic information on alternative CLC systems in collaborative geodesign from Activities 3 & 4	June 30, 2028

Activity 3: Farm Profitability of CLC Adoption: Current Status, Prospects, and Needs

Activity Budget: \$104,359

Activity Description:

Adoption of continuous living cover (CLC) rotations is currently hindered by limited market opportunities, agronomic support, and profitability concerns compared to conventional crops. This activity assesses the financial viability of CLC crops and identifies the support required to bridge the adoption gap. We will conduct a cost-benefit analysis from three distinct perspectives:

- 1) Market Profitability: Using stakeholder input from Activity 1 and cost-return data (e.g., NASS, FINBIN), we will evaluate the economic risks and returns within established grain, fuel, and feed markets.
- 2) Incentive Gaps: By factoring in payments for ecosystem services from Activity 4 such as carbon credits and EQIP—we will identify the remaining financial deficit preventing widespread farmer adoption.
- 3) Social Value: We will incorporate the broader ecosystem service benefits from Activity 4 to determine the full societal worth of CLC crops.

Together, these analyses provide a comprehensive understanding of the financial landscape. We will determine the specific support needed to reach nitrate reduction goals and evaluate how current incentive structures align with those requirements. This information will be incorporated into the Collaborative Geodesign tool in Activity 2.

Activity Milestones:

Description	Approximate Completion Date
Analysis of profitability and risks of CLC production with current programs for ecosystem service payments	December 31, 2027
Analysis of profitability and risks of CLC production for current grain, fuel, and feed markets	June 30, 2028
Analysis of social costs and benefits of CLC production with all known externalities and ecosystem	September 30, 2028

Activity 4: Biophysical modeling to assess effectiveness of winter annual crops at protecting SE Minnesota drinking water from nitrate pollution & other co-benefits

Activity Budget: \$255,308

Activity Description:

We will develop a crop and ecosystem services modeling framework to evaluate how alternative Continuous Living Cover (CLC) crops reduce nitrate pollution and provide environmental co-benefits in the Cannon River watershed and SE Minnesota across a range of historical and future weather conditions (wet, dry, average). These models will be calibrated using field-level water quality data from existing CLC sites in the region. Utilizing the Environmental Policy Integrated Climate (EPIC) and Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) models, we will generate site-specific projections for diversified farming systems. For each CLC system, we will quantify spatial variations in:

- 1) Production & Hydrology: Crop yield, water discharge, and groundwater recharge.
- 2) Water Quality: Nitrate losses via leaching and tile drainage, phosphorus losses, and soil erosion.
- 3) Co-benefits: Greenhouse gas fluxes, habitat quality, and biodiversity.

These results will be incorporated into the Collaborative Geodesign tool in Activity 2 and the Economic modeling in Activity 3 to provide stakeholders with actionable insights, allowing them to determine how specific land-use practices impact regional ecosystem services and the long-term resiliency and sustainability of agricultural systems.

Activity Milestones:

Description	Approximate Completion Date
Compilation of nitrate data from agricultural fields in SE MN that have adopted CLC rotations	December 31, 2027
EPIC simulations of nitrate leaching with and without CLC in SE Minnesota	June 30, 2028
Assessing co-benefits of CLC crops using InVEST model	June 30, 2028

Activity 5: Stakeholder Co-Creation of alternative CLC implementation visions in SE Minnesota using Collaborative Geodesign

Activity Budget: \$135,633

Activity Description:

A series of Collaborative Geodesign sessions will engage stakeholders to develop and evaluate Continuous Living Cover (CLC) scenarios, balancing economic and environmental goals to address groundwater nitrate pollution and increase the resiliency of agriculture to various weather conditions. Collaborative Geodesign allows stakeholders to select and evaluate specific locations in SE MN where alternative CLC rotations could be adopted. The platform's front-end provides basemaps of land use, topography, and water quality risks, for wet, dry or average weather conditions, allowing users to draw and place alternative cropping systems. The back-end then scores these designs using metrics from Activities 3 & 4, including profitability, nitrate leaching, erosion, habitat quality, and carbon sequestration.

The collaborative geodesign process is structured into four key sessions:

Session 1: Identifying shared landscape goals, such as crop diversification and groundwater protection.

Session 2: Determining how to weigh performance indicators, like farm profitability versus clean water value.

Session 3: Training stakeholders to design and evaluate landscapes using the Geodesign tool.

Session 4: Designing specific CLC mixes and spatial allocations to identify "win-win" economic and environmental solutions.

This collaborative approach integrates local expertise with scientific modeling to identify market-driven solutions supported by the community that can be implemented in Activity 6.

Activity Milestones:

Description	Approximate Completion Date
Re-engage stakeholders from Activity 1 for Collaborative Geodesign workshops	July 31, 2028
Collaborative Geodesign session 1: Develop shared goals and performance objectives for CLC systems	July 31, 2028
Collaborative Geodesign session 2: Become familiar with use of Collaborative Geodesign interface	August 31, 2028
Collaborative Geodesign session 3: Identify win-win alternative CLC systems in Collaborative Geodesign	September 30, 2028

Activity 6: On-Farm Implementation and Evaluation of Continuous Living Cover Rotations in SE Minnesota

Activity Budget: \$135,464

Activity Description:

Feasible CLC cropping rotations of interest to stakeholders will have been identified in Activities 1 and 5. Three existing and three recruited commercial farms which have already or are willing to implement these rotations will be studied in the SE MN region. We anticipate that winter camelina or oats could be viable alternative crops that might be of interest. Cost share funding to assist farmers with implementation of alternative practices will be leveraged based on existing programs, including those administered by SWCD, BWSR, and Forever Green EECO. We expect that these farmer-driven pilots will provide basic agronomic information about the barriers and opportunities brought by these diversified rotations. We will collaborate with farmers to develop fact sheets, blogs and other products to disseminate experiences from these pilot farms to other stakeholders and to researchers. Educational programming to disseminate results of these pilot projects would be developed in collaboration with existing networks, e.g., LSP Soil Health network and UMN Extension.

Activity Milestones:

Description	Approximate Completion Date
Implement CLC crops on three pilot farms and study three other farms in SE MN	October 31, 2028
Conduct farmer interviews and focus groups to assess barriers and opportunities of implementing CLC systems	August 31, 2029
Dissemination of lessons learned, promising pathways, scenarios, and markets for adoption of CLC alternatives	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Nick Jordan	University of Minnesota, Department of Agronomy & Plant Genetics	Technical expert on Continuous Living Cover	Yes
TBD	University of Minnesota, Department of Agronomy & Plant Genetics	Expert in Social Learning and Stakeholder Engagement on Continuous Living Cover Cropping Systems	Yes
Nicholas Gallagher	University of Minnesota, Department of Applied Economics	Expertise in farm financial analysis with a focus on economics of nitrogen BMPs	Yes
Stephen Polasky	University of Minnesota, Department of Applied Economics	Expertise in Integrated Valuation and Estimation of Agricultural Ecosystem Services	Yes
Muhammad Tahir	University of Minnesota	Expertise in process based modeling of nitrate leaching in agriculture	Yes
Nfamara Dampha	University of Minnesota, Institute on Environment	Expertise in Integrated Valuation and Estimation of Ecosystem Services in agriculture modeling	Yes
Philip Adalikwu	University of Minnesota, Institute on Environment	Expertise in Integrated Valuation and Estimation of Ecosystem Services modeling in agriculture	Yes
Colin Cureton	University of Minnesota, Department of Agronomy & Plant Genetics	Expertise in Commercialization, Adoption and Scaling of Continuous Living Cover cropping systems	Yes
TBD Graduate Student	University of Minnesota, Department of Applied Economics	Expertise in farm financial modeling of nitrate-N leaching reduction BMPs	Yes
Ryan Noe	University of Minnesota, U-Spatial	Expertise in front and back end programming for Collaborative Geodesign model of alternative agricultural cropping systems.	Yes
Andi Sutton	University of Minnesota Extension, Regional Sustainable Development Partnership	Expertise in farmer engagement on sustainable agricultural practices	Yes
Danielle Piraino	University of Minnesota, Regional	Expertise in outreach and engagement with agricultural community in SE Minnesota	Yes

	Sustainable Development Partnership		
David Mulla	University of Minnesota, Department of Soil, Water & Climate	Project Director	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

Three existing and three recruited commercial farms which have already or are willing to implement these rotations will be studied in the SE MN region. We anticipate that winter camelina or oats could be viable alternative crops that might be of interest. We expect that these farmer-driven pilots will provide basic agronomic information about the barriers and opportunities brought by these diversified rotations. We will collaborate with farmers to support communication of their experiences from these pilot farms to other stakeholders and to researchers. Educational programming to disseminate results of these pilot projects will be led by UMN Extension in collaboration with existing networks, e.g., LSP Soil Health network.

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?

This project will build concrete community supported pathways for adopting CLC to protect groundwater from nitrate pollution, based on estimates for how much land would need to be converted from row crops to CLC. Findings will be used to accelerate the adoption of Continuous Living Cover cropping systems to protect groundwater resources from nitrate pollution throughout the entire region of southeastern Minnesota. This will be achieved through discussions with interested farming groups, local, county and state agencies, non-governmental organizations, and agribusiness companies. USDA-CIG or BWSR funding will be sought to continue CLC implementation.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Scaling a Market-Driven Water-Quality Solution for Row-Crop Farming	M.L. 2022, , Chp. 94, Art. , Sec. 2, Subd. 04n	\$476,000
Water Quality and Robots: Experientially Educating Minnesotan Youth	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 05s	\$353,000

Project Manager and Organization Qualifications

Project Manager Name: David Mulla

Job Title: Professor

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

Dr. Mulla is Professor and Larson Chair for Soil & Water Resources in the Dept. of Soil, Water, and Climate at the Univ. of Minnesota. Dr. Mulla's research emphasizes (1) the transport and modeling of water and nitrates to surface and ground

water, (2) impacts of alternative crop production systems and (3) the measurement, modeling and management of soil erosion. In 2010 he led a study for the MN state legislature on nitrogen reduction strategies for protection of surface waters. In 2013 he co-developed the N BMP Tool used by MPCA for protection of surface waters from nitrate pollution. He also has taken an active role in developing Minnesota's focus on using Continuous Living Cover (CLC) to attain goals for the Nutrient Reduction Strategy.

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

Organization Description:

The College of Food, Agricultural and Natural Resource Sciences (CFANS) at the University of Minnesota Twin Cities is a college focused on food, agriculture, and natural resources, offering 14 majors, 3 pre-majors, and 26 minors, with a strong emphasis on hands-on learning and real-world experience. When we envision a better tomorrow, it includes alternative crops, products that protect our health, groundwater that is healthy to drink, lakes free from invasive species, and so much more. We use science to find answers to the world's grand challenges and solve tomorrow's problems. Few other public universities come close to the breadth of our expertise, allowing us to tackle challenges in novel ways. We develop leaders that see more possibilities and produce solutions that work for real people. This creates a powerful force for change.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
4 UMN Faculty		Project management, Leads for Activities 1, 2, 3 and 4			36.6%	0.3		\$58,536
6 UMN Professionals		Biophysical modeling, geospatial modeling, extension and outreach			36.6%	2.49		\$312,593
Postdoctoral Associate		InVEST modeling			26.1%	0.6		\$56,775
Graduate Student		Economic modeling			24.2%	0.75		\$86,129
Civil Service		Extension and Outreach			32.3%	0.36		\$52,310
							Sub Total	\$566,343
Contracts and Services								
Clean River Partners	Service Contract	Recruiting stakeholders and farmers for engagement, assisting with focus groups and collaborative geodesign, compiling water quality data from CLC farm pilots.				0.9		\$199,950
Rainbow Research	Service Contract	Recruiting stakeholders and farmers for engagement, assisting with focus groups and collaborative geodesign.				0.24		\$48,000
							Sub Total	\$247,950
Equipment, Tools, and Supplies								
							Sub Total	-
Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-

Travel In Minnesota								
	Miles/ Meals/ Lodging	15 day trips per year for three years at \$60/day for car rental	Travel to meetings and workshops for stakeholder engagement					\$2,700
							Sub Total	\$2,700
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Printing	3 handouts per person for 15 meetings per year for three years for 15 people per meeting	Handouts are needed to orient stakeholders and explain procedures for each of the collaborative geodesign sessions.					\$4,007
	Publication	Publication of three scientific articles, one in each of three years at \$2,000 per article.	Publish scientific articles on biophysical modeling of CLC impacts on nitrate pollution of groundwater, and economic modeling of CLC impacts on profitability and costs/benefits. Publish extension article on collaborative geodesign alternatives developed by stakeholders, and experiences of farmers who have adopted CLC cropping systems.					\$6,000
							Sub Total	\$10,007
Other Expenses								
		Software licenses	Software licenses for geospatial, biophysical, and economic modeling at \$3,000/yr for three years					\$9,000
							Sub Total	\$9,000
							Grand Total	\$836,000

Classified Staff or Generally Ineligible Expenses

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

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

Total Project Cost: \$836,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [db5236ee-0bc.pdf](#)

Alternate Text for Visual Component

Study area in SE Minnesota showing 2025 landuse and boundaries for counties and the Cannon River watershed....

Supplemental Attachments

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

Title	File
UMN SPA submission approval letter	6f75085e-0b1.pdf
New Richland Councilman Letter of Support	1f0e7368-3e3.pdf
Rice and Steele County Extension Letter of Support	20728296-0ca.pdf
MBOLD Letter of Support for Mulla LCCMR nitrate proposal	ef0dae7b-0a6.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?

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:

None

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