Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-056

Proposal Title: Invasive Jumping Worms and Water in Minnesota's Forests

Project Manager Information

Name: Kyungsoo Yoo

Organization: U of MN - St. Anthony Falls Laboratory

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Project Basic Information

Project Summary: Jumping worms belong to the 13 high-risk invasive species that MN DNR classified as prohibited. We quantify the extent to which jumping worms alter water flow in the forest soils.

ENRTF Funds Requested: $214,000

Proposed Project Completion: June 30, 2027

LCCMR Funding Category: Small Projects (H)

Secondary Category: Water Resources (B)

Project Location

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

Region(s): Metro

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.

Invasive jumping worms are a significant problem for Minnesota's water resources. However, this statement needs to be qualified by numbers to be useful for policy and management planning.

Yoo's research has examined jumping worm invasions in Minnesota forests (eg., within the Minnesota Landscape Arboretum), where European earthworms have long been present. Two observations stand out.

First, jumping worms are replacing nightcrawlers, the largest and most impactful European earthworms in Minnesota. Nightcrawlers require permanent burrows to access leaf litter. However, jumping worms create soils with extremely loose granules where nightcrawlers cannot maintain their burrows and become obsolete.

Second, jumping worms create extremely light soils. It is difficult to walk on steep slopes infested with jumping worms because of the light, loose soil. We made preliminary measurements of the rate at which water enters the soil - the infiltration rate - and were surprised by the faster water infiltration rates in the jumping worm-infested soils.

Taken together, these two results suggest that water movement through forest soils could be significantly altered by jumping worm invasion and that the effects will become statewide. However, data are not yet available to assess the magnitude of the problem.

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.

As described above, the problem is a lack of critical data. We will address this problem by collecting, presenting, and widely disseminating the first data set on the extent to which invasive jumping worms alter the rate at which water infiltrates the soil in Minnesota forests.

We seek funding to allow us to make repeated measurements of forest water infiltration rates with jumping worms and European earthworms only and complement the field measurements with limited laboratory column experiments. This will involve recruiting and training a M.S. student, extensive field measurements during the summer, laboratory experiments, data analysis and widespread dissemination of the results to practitioners involved in the protection, conservation, preservation, and enhancement of the state's natural resources.

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?

Whether soils are impervious or porous determines runoff, soil erosion, and pollutant transport during storm events. Our data set of infiltration rates will inform those responsible for modeling and predicting stormwater runoff, soil erosion, and pollutant movement in Minnesota.

Complex feedbacks exist between infiltration rates, groundwater, soil moisture, and soil properties. For example, extremely porous soils infested with jumping worms may allow rapid water infiltration, facilitating groundwater recharge, but may not hold moisture for forests. Thus, understanding water infiltration rates and water retention as affected by jumping worms has important implications for forest sustainability in Minnesota.

Activities and Milestones

Activity 1: Infiltration Rate Measurements

Activity Budget: $85,624

Activity Description:
We will use Modified Philip-Dunne (MPD) infiltrators to determine water infiltration rates. The MPD was developed and field-tested by CoPI Gulliver. CoPI Erickson uses MPD measurements to develop stormwater management plans. An MPD measurement requires five gallons of water, while other methods, such as the Guelph Permeater and the Double Ring Infiltrometer, require three to five times more water. This difference makes MPD an appropriate choice when working in forests.

Infiltration measurements will be conducted at the Minnesota Landscape Arboretum and Three Rivers Park District, where we have identified many sugar maple forest stands that are heavily infested with jumping worms. Per stand, we will measure infiltration rates within two plots with jumping worms vs. European earthworms only. Our preliminary data indicate that we should make 20 measurements per plot to have a solid statistical power. This results in a total of 400 MPD measurements (20 measurements per plot X 2 plots per stand X 5 stands per site X 2 sites). We will make additional 200 measurements in the second year for the forest sites where jumping worm presence is newly reported. A team of two researchers with 10 MPDs can take approximately 20 measurements per day.

Activity Milestones:

Description	Approximate Completion Date
Training a graduate student and an undergraduate research assistant on MPD	July 31, 2025
First-season data collection	October 31, 2025
Second-season data collection	October 31, 2026

Activity 2: Laboratory analyses and experiments

Activity Budget: $64,188

Activity Description:
In order to tailor the model to calculate infiltration rates from the MPD measurements, we need water contents, organic matter contents, and porosity of the soil. These soil properties will be measured by placing a specified quantity of soil into a container of known weight, weighing the soil and container, placing the container in an oven at above 105 oC remove the water, weighing the container and soil again, placing the container in an oven at above 525 oC to remove organic matter, and again weighing the container and remnants of the soil. Porosity requires an assumed specific gravity of the organic matter, which is typically between 1.02 and 1.1.

We will also collect 20 soil cores (4 cores per forest stand X 5 stands per site X 1 site) and subject them to irrigation experiments. The experiment aims to investigate more detailed water transport processes by monitoring the water outflux from the columns in the controlled environments. On implementing the column irrigation experiment, we will work with a SAFL engineer, and the engineer's time is budgeted. This irrigation experiment will take place at the Saint Anthony Falls Laboratory.

Activity Milestones:

Description	Approximate Completion Date
Training a graduate student on laboratory procedures	December 31, 2025

Laboratory analyses and experiments with the samples from the first field season	May 31, 2026
Laboratory analyses and experiments with the samples from the second field season	May 31, 2027

Activity 3: Data Analysis and Presentation

Activity Budget: $64,188

Activity Description:

We will combine the field-collected data, consisting of water column heights in MPD and time of measurement, analytical hydrological equations developed by CoPI Gulliver and others, and laboratory measurements to obtain infiltration rates, and perform an analysis of the results' implications. As the team begins to present results, a graduate student will be trained in science communication to both the academic and practitioner communities. We will seek out speaking opportunities at the Upper Midwest Invasive Species Conference, the Minnesota Water Resources Conference and the Stormwater Management Seminar Series. A publication for resource management practitioners will take the form of a bulletin report.

Activity Milestones:

Description	Approximate Completion Date
Training a graduate student on data analysis of field and laboratory data	May 31, 2026
Dissemination of results through conferences and reports.	June 30, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
John Gulliver	University of Minnesota	John Gulliver will advise on the assumptions and limitations of the MPD, field site selection and comparison, data interpretation, and report preparation.	Yes
Andy Erickson	University of Minnesota	Andy Erickson will advise on the use of the MPD, field site selection and preparation, data collection, storage, and backup methods, QA/QC, data analysis, and report preparation.	Yes
John Moriarty	Three Rivers Park District	Provide access to the District properties and facilities in support of the project. Assist in the monitoring of the jumping worm population and spread at Lake Rebecca Park Reserve. Collaborative data interpretation for the Park stormwater management.	No
Meg Duhr	Three Rivers Park District	Provide access to the District properties and facilities in support of the project. Assist in the monitoring of the jumping worm population and spread at Lake Rebecca Park Reserve. Collaborative data interpretation for the Park stormwater management.	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?

Beyond 2027, we will share our findings with resource managers through the Minnesota Stormwater Seminar Series and online email newsletters organized by coPI Erickson. The stormwater community will have the first available data on the impact of earthworm invasions on water resources. At Three Rivers Park District and the Minnesota Landscape Arboretum, where our study will take place, we will disseminate the results to educate visitors about the unexpected relationship between earthworms and water resources. The results of this study will allow Yoo to seek further funding to expand research on forest hydrologic cycles under jumping worm invasion.

Project Manager and Organization Qualifications

Project Manager Name: Kyungsoo Yoo

Job Title: Professor

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

Kyungsoo Yoo is a professor of soil geomorphology in the Department of Soil, Water, and Climate and the Saint Anthony Falls Lab at the University of Minnesota. Yoo's research focuses on the interface between soil genesis, landscape evolution, and invasive earthworms. He has published 53 peer-reviewed journal articles and six book chapters on these research topics. His research has been funded primarily by the National Science Foundation (NSF) and the U.S. Department of Agriculture. He is currently serving as principal investigator on two projects funded by MITPPC and USDA. Yoo is also a recipient of the NSF CAREER grant, which is NSF's most prestigious award to support early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization. Yoo currently serves as associate editor of the Soil Science Society of American Journal and on the editorial board of the journal Geoderma. Yoo's qualifications to lead this project are also based on his decades of experience working with invasive earthworms and their environmental impacts in Minnesota and the Arctic regions of the world.

Organization: U of MN - St. Anthony Falls Laboratory

Organization Description:

The St. Anthony Falls Laboratory (SAFL) is an interdisciplinary fluid mechanics research lab and educational facility under

the College of Science and Engineering at the University of Minnesota. SAFL consists of engineers and scientists who collaborate across disciplines to solve fluids-related problems in the Earth-surface environment. Its vision encompasses both science and practice, beginning with basic research and moving through application, decision-making, and management. SAFL partners with local, state and federal agencies; private consulting firms; businesses of many kinds; technical associations; and other educational institutions to expand knowledge and solve problems.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Kyungsoo Yoo		Lead PI			37.1%	0.12		$24,608
Andy Erickson		Co-PI			37.1%	0.1		$18,568
James Tucker		Engineer			33.5%	0.34		$20,985
John Gulliver		Co-PI			7.7%	0.08		$17,576
Graduate Student		Field Measurement			55%	1		$111,485
Undergraduate Research Assistants		Assist graduate students with field measurement and infiltration			55%	0.5		$5,168
							Sub Total	**$198,390**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	MPD is a low-cost equipment to measure the rate at which water enters soils (infiltration rates). Each will be manufactured. We need 10 MPDs so that two researchers carry them to make about 20 measurements per day. Lab consumables including water pipes and columns for soil column experiments, weighing papers, weighing vessels, crucibles for loss on ignition analysis, etc.	Infiltration rate measurements, Lab consumables for bulk density and organic matter measurements.					$6,000
							Sub Total	**$6,000**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								

							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	20 Daily trips to Minnesota Arb	Data Collection					$2,006
	Miles/ Meals/ Lodging	20 Daily Trips to Three Rivers	Collect Data					$2,032
	Miles/ Meals/ Lodging	10 Daily trips to newly reported jumping worm-infested forests.	Collect Data					$1,200
	Conference Registration Miles/ Meals/ Lodging	2 Conference trips within MN	Disseminate Data					$4,372
							Sub Total	**$9,610**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$214,000**

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: $214,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 1c7be9ba-5fc.pdf

Alternate Text for Visual Component

The extents of jumping worm invasion in MN with the photos of jumping worms, jumping worm-infested soils, and field measurements of water infiltration rates....

Supplemental Attachments

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

Title	File
Support Letter from Three Rivers Park District	d2759633-e4d.pdf
UMN letter of support	72dae695-dde.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?

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:

Angela Boutch <bran0487@umn.edu>