Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-063

Proposal Title: Floating Wetlands for Microplastic and Pathogen Removal

Project Manager Information

Name: Judy Yang

Organization: U of MN - St. Anthony Falls Laboratory

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Project Basic Information

Project Summary: This project will design and optimize floating treatment wetlands to cost-effectively remove microplastics and pathogens like E. coli, enhancing water quality after the treatment of Minnesota's storm water ponds.

ENRTF Funds Requested: $522,000

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?

Statewide

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.

Minnesota's water systems face a growing threat from microplastics and pathogens, such as Escherichia coli (E. coli), which can adversely affect public health. During storm events, these contaminants are carried into rivers, lakes, and ultimately our drinking water systems. In Minnesota, over 30,000 stormwater ponds help manage stormwater runoff by effectively trapping coarser suspended sediments. However, these ponds are not designed to capture smaller, lighter particles like microplastics and pathogens, which remain a significant challenge for water quality management. Developing innovative methods to remove these contaminants from stormwater ponds is crucial for safeguarding the health of aquatic ecosystems and public water sources. Floating treatment wetlands (FTWs) have emerged as a promising solution. The root systems of FTWs can trap and capture microplastics and pathogens, while their surface charge and biofilms facilitate the adsorption of these contaminants. Although some pilot studies in Minnesota have explored FTWs for nutrient and sediment removal, their effectiveness in addressing microplastics and pathogens in stormwater ponds is still uncertain. Additionally, the optimal FTW design for this purpose has yet to be determined. Advancing FTW technology is vital for reducing microplastic and pathogen contamination, improving water quality, and protecting Minnesota's aquatic ecosystems and drinking water supplies.

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.

The proposed solution aims to develop optimized floating treatment wetlands (FTWs) to effectively remove microplastics and pathogens, such as E. coli, from Minnesota's stormwater ponds. The first step involves selecting native plant species that can form dense root structures (using the Blue Thumb database), support beneficial biofilms, and thrive in Minnesota's climate. These plants will be chosen for their ability to capture contaminants while ensuring resilience in local conditions. Next, laboratory experiments will be conducted in the water-recirculating flumes at the Saint Anthony Falls Laboratory (SAFL), which simulate stormwater ponds. FTWs, with varying plant species, root densities, and geometries, will be introduced into these flumes, where microplastics and E. coli will be added to assess removal efficiency under different flow conditions. These experiments will help identify the optimal FTW design for microplastic and pathogen removal. Finally, the most effective FTWs will be fabricated and deployed in selected stormwater ponds experiencing contamination. The performance of these FTWs will be evaluated in real-world conditions, and deployment procedures will be refined for ease of installation and low maintenance costs. The results will provide valuable insights for designing FTWs that can maximize microplastic and pathogen removal, ultimately improving water quality in Minnesota's stormwater ponds.

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 will propose an optimal design for floating treatment wetlands (FTWs) to remove microplastics and pathogens like E. coli, with results published in academic journals or used for a patent application. It will also develop cost-effective strategies for deploying FTWs in Minnesota's stormwater ponds, including a deployment and maintenance plan, documented in academic publications and a detailed report. The findings will be shared with the stormwater pond community through the Minnesota Stormwater Seminar, guiding future FTW applications in Minnesota's aquatic ecosystems to protect and enhance the state's natural resources.

Activities and Milestones

Activity 1: Design and optimize floating treatment wetlands that most effectively remove microplastics and E. coli. through flume experiments

Activity Budget: $159,528

Activity Description:
We will design and optimize floating treatment wetlands (FTWs) for removing microplastics and E. coli. In collaboration with Floating Island International (FII), we will select plant species with dense root structures that support biofilms and thrive in Minnesota's climate. FTWs will be constructed using different plant species and densities and placed in a water-recirculating flume with a sediment bed. The flume will simulate flow rates typical of stormwater ponds. Microplastics and E. coli will be injected separately upstream, and water samples will be collected downstream to measure concentrations using a confocal microscope. Removal efficiencies will be calculated for various wetland designs. Post-experiment analysis will include examining plant roots and sediment samples to determine where microplastics and E. coli accumulate. Experiments will be repeated with varying plant densities, species, and flow rates to identify optimal configurations. Our findings will provide actionable recommendations on plant species, root density, and wetland geometry for efficient removal of microplastics and pathogens.

Activity Milestones:

Description	Approximate Completion Date
Design and fabricate series of floating treatment wetlands	January 31, 2027
Controlled flume experiments	March 31, 2028
Disseminate findings of Activity 1 via 1 open access journal publications	December 31, 2028

Activity 2: Evaluate the performance of floating treatment wetlands in removing microplastics and pathogens in stormwater ponds

Activity Budget: $362,472

Activity Description:
We will evaluate the performance of floating treatment wetlands (FTWs) in a stormwater pond impacted by microplastic and E. coli pollution. In Year 1, we will select narrow ponds with significant pollution and design FTWs spanning their widths in collaboration with FII, using insights from laboratory flume experiments. In Year 2, we will deploy the first FTW in one pond and monitor its performance. Water and sediment samples will be collected before and after installation to measure flow rates, microplastic, and E. coli concentrations. Sampling before and after the FTW will occur bi-weekly during the growing season. Using a confocal microscope, we will analyze inlet and outlet samples and calculate removal efficiencies by comparing pre- and post-FTW data. Plant roots and sediments will also be examined to determine accumulation locations. These findings will guide strategies for maintaining and cleaning FTWs to ensure sustained performance. In Year 3, we will refine deployment and maintenance methods and redeploy them in the pond. The results will be summarized in an academic paper, a final report, and a section prepared for possible inclusion in the Minnesota Stormwater Manual of the Minnesota Pollution Control Agency, providing practical recommendations for FTW design, installation, and maintenance.

Activity Milestones:

Description	Approximate Completion Date
Selection of stormwater ponds to consider for implementation of FTW	October 31, 2026
Design and fabrication of FTW	May 31, 2027

Installation, measurements and performance analysis of FTW in selected stormwater pond	May 31, 2028
Redesign, reinstallation, measurements and performance analysis of FTW in stormwater pond	May 31, 2029
Disseminate findings of Activity 2 via 1 open access journal publications	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. John Gulliver	University of Minnesota	Co-Investigator, Dr. Gulliver is a recognized expert in mass transport and pollutant treatment in stormwater ponds, with decades of experience in stormwater pollutant treatment. Dr. Gulliver will co-lead the field investigation, overseeing the selection of field sites, planning the deployment of FTWs, and directing the analysis of the results.	Yes
Dr. Peter Weiss	PT Weiss Consulting, LLC	Consultant, Dr. Peter Weiss, Professor of Civil Engineering at Valparaiso University and president of PT Weiss Consulting, LLC, has over 20 years of experience in research related to the performance, optimization, and cost of stormwater management practices. He will consult on FTW design, deployment, and assist with the field investigation.	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?

The results of this project will include a protocol for designing and maintaining floating treatment wetlands (FTWs) to remove microplastics and pathogens from Minnesota's stormwater ponds. We will collaborate with the Minnesota Pollution Control Agency (MPCA) to integrate findings into the Minnesota Stormwater Manual. Seven supporting cities (support letters attached) will serve as pilot sites for FTW deployment, with potential funding from MPCA grants, the Board of Water and Soil Resources (BWSR), the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and the University of Minnesota's Water Resources Center to expand implementation and support long-term monitoring efforts.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Mitigating Cyanobacterial Blooms and Toxins Using Clay-Algae Flocculation	M.L. 2022, , Chp. 94, Art. , Sec. 2, Subd. 04c	$326,000

Project Manager and Organization Qualifications

Project Manager Name: Judy Yang

Job Title: McKnight Land-Grant Assistant Professor

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

Dr. Judy Yang (PI) is a McKnight Land-Grant Assistant Professor specializing in fluid mechanics, particle transport, and microbe-particle interactions. She has over a decade of experience conducting flume experiments to investigate transport processes in wetlands. Her research on sediment transport in wetlands has been highlighted by the American Geophysical Union's News as a study that 'shifts the paradigm of coastal sediment modeling (https://eos.org/research-spotlights/new-study-shifts-paradigm-of-coastal-sediment-modeling). Dr. Yang's lab conducts experiments in water-recirculating flumes at the Saint Anthony Falls Laboratory. These setups will be used to study the transport of particles and the pathogen E. coli in laboratory-simulated stormwater ponds. She is also an expert in microbiology, having designed microfluidic experiments to track bacterial movement in soils and aquatic ecosystems. Her lab is equipped with advanced tools such as a confocal laser scanning microscope and flow cytometry, which can detect bacterial cells and count cell density. In the proposed LCCMR project, Dr. Yang will oversee experimental design and implementation and conduct flume experiments to optimize floating treatment wetlands for the removal of microplastics and pathogens

from stormwater ponds. Dr. Yang will collaborate with Dr. John Gulliver, an expert in stormwater pond dynamics and mass transport, and Dr. Peter Weiss, an expert in stormwater treatment and floating wetlands. Both Drs. Gulliver and Weiss have extensive experience in treating pollutants in stormwater ponds. Together, they will co-mentor a postdoctoral researcher and an undergraduate, design optimal floating treatment wetlands, and deploy them in two selected stormwater ponds in Minnesota.

Organization: U of MN - St. Anthony Falls Laboratory

Organization Description:
St. Anthony Falls Laboratory (SAFL) is an interdisciplinary fluid mechanics research center known for its advanced facilities. It is equipped with water-recirculating flumes that simulate natural water systems. For this study, we will use the 10-meter Ecoflume (https://cse.umn.edu/safl/ecoflume), designed to investigate interactions between moving fluids, plants, and organisms. The Ecoflume features a race-track design, with water flow driven by a variable-speed rotating paddle wheel. Its transparent walls allow sunlight to promote plant and biofilm growth, and temperature is regulated via heat exchange fins. SAFL houses key instruments for the study, including particle imaging velocimetry for flow velocity, cameras for particle tracking, and chemical sensors for temperature, pH, and salinity. The biological lab is equipped with a Class II Biosafety Cabinet, autoclave, UV sterilizer, and incubators for pathogen studies. The Yang Lab is equipped with a confocal laser scanning microscope, fluorescent microscope, and spectrophotometer for analyzing cell counts in sampled water. SAFL's engineering team and machine shop will assist in designing and installing floating treatment wetlands, and the facility also has equipment for fieldwork, including a van and boat.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
PI		Dr. Judy Yang, PI			36.6%	0.15		$27,517
Co-PI		Dr. John Gulliver, Co-PI			7.4%	0.09		$28,311
Facility Engineer		Engineering support in the fabrication and maintenance of floating treatment wetlands and help with the lab and field work			32.3%	0.54		$56,201
Postdoc Researcher		Postdoc Researcher to work full-time during the project			25.9%	3		$244,531
Undergraduate Researcher		Support is requested for an undergraduate to work full time during summer (600 hours) and then part time (16 hours/week) during the rest of the year (550 hours). The undergraduate student will help sample the water and measure the pathogen and microplastics in the storm water ponds.			0%	0.75		$58,650
							Sub Total	**$415,210**
Contracts and Services								
PT Weiss Consulting, LLC	Service Contract	Pete will provide consultancy on the design and implementation of floating treatment wetlands in the stormwater ponds				0.15		$28,190
							Sub Total	**$28,190**
Equipment, Tools, and Supplies								
	Tools and Supplies	Materials and Supplies Year 1	1. Floating Treatment wetlands in the lab: $9,000 2. Materials to collect water samples and measure the pathogens and microplastics: $3,100					$12,100
	Tools and Supplies	Materials and Supplies Year 2	3. Floating Treatment wetlands: $20,000 4. Materials to collect water samples and measure the pathogens and microplastics: $3,000 5. Installation and Maintenance cost: $5,000					$28,000

	Tools and Supplies	Materials and Supplies Year 3	6. Floating Treatment wetlands: $20,000 7. Materials to collect water samples and measure the pathogens and microplastics: $3,000 8. Installation and Maintenance cost: $5,000					$28,000
							Sub Total	**$68,100**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Conference Registration Miles/ Meals/ Lodging	5-person team to conduct field work and attend conferences	Includes transportation, meals and lodging					$7,500
							Sub Total	**$7,500**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Publication Costs	Anticipated publishing of 3 papers					$3,000
							Sub Total	**$3,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$522,000**

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	Unrecovered Indirect Costs	Indirect Costs not collected	Secured	$281,826
			Non State Sub Total	**$281,826**
			Funds Total	**$281,826**

Total Project Cost: $803,826

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: c06f9d01-5df.pdf

Alternate Text for Visual Component

The illustration shows the problem of stormwater ponds not capturing microplastics and E. coli. It then presents the solution of using floating treatment wetlands (FTWs) with native plants to remove these contaminants. Two figures follow: Task 1 shows flume experiments at Saint Anthony Falls Laboratory to improve FTWs for removing...

Supplemental Attachments

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

Title	File
UMN SPA - Support Letter	3ab610c9-b19.pdf
Letter of Support - Floating Island International	5e2e61e2-a62.pdf
Letter of Support - St Louis Park	b5b4ac04-5d7.pdf
Letter of Support - Minneapolis	66c4fcb0-be0.pdf
Letter of Support - MapleGrove	7fddece2-e58.pdf
Letter of Support - Lakeville	008a99a2-36e.pdf
Letter of Support - Edina	3231a74a-f9c.pdf
Letter of Support - Bloomington	074c9950-264.pdf
Letter of Support - Roseville	fedcf040-ac7.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:

Angela Boutch bran0487@umn.edu

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