Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-357

Proposal Title: Floating Wetlands for Stormwater 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 such as E. coli from Minnesota stormwater ponds, improving water quality in downstream aquatic ecosystems.

ENRTF Funds Requested: $390,000

Proposed Project Completion: June 30, 2030

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 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. 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 removing microplastics and pathogens in stormwater ponds has not yet been evaluated. Additionally, the optimal FTW design for this purpose has yet to be determined. Advancing FTW technology is critical to protecting Minnesota's water resources by reducing microplastic and pathogen contamination in stormwater ponds before it reaches downstream waters.

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, 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 deliver an optimized design for floating treatment wetlands (FTWs) to remove microplastics and pathogens such as E. coli, along with cost-effective deployment and maintenance strategies for Minnesota's stormwater ponds. The project will produce a practical design and implementation plan to guide municipalities and watershed managers. Findings will be disseminated through the Minnesota Stormwater Seminar and a publicly accessible technical report, supporting broader adoption of FTWs to protect and enhance Minnesota's water resources.

Activities and Milestones

Activity 1: Design and optimize floating treatment wetlands for microplastic and E. coli removal

Activity Budget: $168,000

Activity Description:
We will design and optimize floating treatment wetlands (FTWs) for removing microplastics and E. coli. We will select plant species (using the Blue Thumb database) with dense root structures that support biofilms and thrive in Minnesota's climate, in collaboration with Floating Island International. FTWs will be constructed with varying plant species and densities and tested in a water-recirculating flume at the St. Anthony Falls Laboratory (SAFL), equipped with a sediment bed. The flume allows control of flow rates, water depth, and turbulence to simulate conditions typical of Minnesota stormwater ponds. Microplastics and E. coli will be introduced upstream, and downstream water samples will be collected at multiple locations and time points to quantify contaminant concentrations using confocal microscopy. Removal efficiencies will be calculated for each FTW design under different flow rates and plant configurations. Post-experiment analyses will include detailed examination of plant roots, rhizospheres, and sediment samples to determine the spatial distribution and accumulation pathways of microplastics and E. coli. These data will inform recommendations on optimal plant species, root density, and FTW geometry for effective contaminant capture in stormwater ponds. This activity will result in a validated FTW prototype design ready for pilot-scale testing in Minnesota stormwater ponds.

Activity Milestones:

Description	Approximate Completion Date
Finalize FTW design and fabricate experimental units	December 31, 2027
Conduct controlled flume experiments and optimization	June 30, 2028
Data analysis and technical report	September 30, 2028
Submit open-access journal manuscript	November 30, 2028

Activity 2: Evaluate floating treatment wetlands for microplastic and pathogen removal in stormwater ponds

Activity Budget: $222,000

Activity Description:
We will evaluate the performance of floating treatment wetlands (FTWs) in Minnesota stormwater ponds impacted by microplastics and E. coli. In Year 1, narrow, highly impacted ponds will be selected based on pollutant levels and accessibility, and FTWs spanning their widths will be designed using insights from laboratory flume experiments. Design considerations will include plant species, root density, and wetland geometry to maximize contaminant removal. In Year 2, the first FTW will be deployed and monitored. Water and sediment samples will be collected before and after installation, with bi-weekly sampling throughout the growing season to capture seasonal variations in flow, contaminant loading, and removal efficiency. Confocal microscopy will quantify microplastic and E. coli concentrations, while plant roots and sediment will be analyzed to identify contaminant accumulation. Results will inform strategies for maintenance, cleaning, and optimization to ensure sustained performance. In Year 3, deployment and maintenance methods will be refined, and FTWs will be redeployed to test improvements. Findings will be summarized in a journal article, a final report, and a section for the Minnesota Stormwater Manual, providing practical guidance for FTW design, installation, and maintenance to improve water quality and protect Minnesota's aquatic ecosystems.

Activity Milestones:

Description	Approximate Completion Date
Select stormwater ponds for FTW implementation	March 31, 2028
Design and fabricate FTWs	August 31, 2028
Install FTWs and begin monitoring	September 30, 2028
Collect water and sediment samples; analyze performance	September 30, 2029
Analyze data and prepare FTW design guidelines	March 31, 2030
Disseminate results via journal publications and outreach	June 30, 2030

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

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.
The results of this study will be broadly disseminated to both scientific and public audiences to maximize impact on Minnesota's water resources. Findings will be published in peer-reviewed journals and presented at national scientific conferences, ensuring participation and awareness of stakeholders who may benefit from the results. To engage the local community and raise awareness, we will host annual seminars at the St. Anthony Falls Laboratory (SAFL) focused on microplastic and pathogen contamination in Minnesota waters, research progress, and strategies for mitigation. Towards the conclusion of the study, we will prepare a guidance document for possible inclusion in the Minnesota Stormwater Manual, developed in collaboration with Minnesota Pollution Control Agency (MPCA) staff, providing practical recommendations for floating treatment wetland (FTW) design, deployment, and maintenance. All outreach and dissemination efforts will adhere to Environment and Natural Resources Trust Fund (ENRTF) acknowledgement requirements, including displaying the ENRTF logo or using attribution language on project materials, publications, signage, and other communications. By combining scientific publications, public seminars, and guidance documents, we will ensure results are accessible, actionable, and support the protection, conservation, and enhancement of Minnesota's aquatic ecosystems.

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 at the University of Minnesota specializing in fluid mechanics, sediment transport, and microbe–particle interactions in aquatic systems. She has over a decade of experience designing and managing laboratory and field-based research projects focused on transport processes in wetlands and stormwater systems. Her work on sediment transport has been recognized by the American Geophysical Union as research that "shifts the paradigm of coastal sediment modeling."

Dr. Yang directs an experimental research program at the Saint Anthony Falls Laboratory, where she oversees personnel, budgets, and project implementation. Her lab operates water-recirculating flumes and advanced microbiological instrumentation, including confocal microscopy and flow cytometry, to quantify particle and pathogen transport. These facilities and expertise position her to successfully execute controlled experiments to optimize floating treatment wetlands for removal of microplastics and pathogens from stormwater ponds.

For this LCCMR project, Dr. Yang will oversee project management, experimental design, coordination among team members, data synthesis, reporting, and stakeholder communication. She will collaborate with Dr. John Gulliver, an expert in stormwater pond dynamics, and Dr. Peter Weiss, an expert in stormwater treatment systems. Together, they bring complementary expertise and a strong record of applied water research in Minnesota. Dr. Yang will coordinate team activities, co-mentor research personnel, and ensure timely completion of project milestones and deliverables.

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								
Judy Yang		The PI will lead project coordination and ensure effective collaboration among team members. The PI will supervise and mentor the postdoctoral researcher, graduate student, and undergraduate students, guide research activities, and ensure project milestones and objectives are achieved.			38.5%	0.12		$29,219
John Gulliver		Dr. Gulliver will oversee experiments in stormwater ponds. A recognized expert in mass transport and stormwater pollutant treatment, he will co-lead the field investigation, including site selection, FTW deployment planning, and directing data analysis.			8.3%	0.12		$28,628
Civil Service Technician		Technician for Project Setup, Maintenance and Takedown			34.5%	0.12		$11,781
Postdoctoral Associate		Postdoctoral Associate			28.1%	0.5		$39,237
Graduate Research Assistant		Graduate Research Assistant			28.9%	1.5		$199,613
Undergraduate Student		Undergraduate Student			0%	0.34		$12,240
							Sub Total	**$320,718**
Contracts and Services								
Pete Weiss Consulting, LLC	Service Contract	Dr. Peter Weiss (PT Weiss Consulting, LLC), Professor of Civil Engineering at Valparaiso University, will consult on floating treatment wetland (FTW) design, deployment, and assist with planning and conducting the field investigation.				0.18		$29,000
							Sub Total	**$29,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	Materials and Supplies	This includes materials to construct eight floating treatment wetlands					$31,282

			(FTWs) ($2,500 per unit; $20,000 total), laboratory supplies for sampling and imaging microplastics and microbial cells ($5,000 total), and materials for repair and maintenance during field deployment ($6,282 total).					
							Sub Total	**$31,282**
Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Funds for the team to conduct field work and attend conferences, including transportation, meals, and lodging.						$6,000
							Sub Total	**$6,000**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Costs to publish papers	We expect to have three papers published.					$3,000
							Sub Total	**$3,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$390,000**

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: $390,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: b1ecc518-935.pdf

Alternate Text for Visual Component

The graphic illustrates optimizing floating treatment wetlands through laboratory flume experiments and subsequent deployment in Minnesota stormwater ponds to evaluate their effectiveness in removing microplastics and E. coli and improving water quality....

Supplemental Attachments

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

Title	File
Board Letter from UMN	b1f21235-f9e.pdf
Letter of Support from the City of St. Louis Park	636fb2ea-01e.pdf
Letter of Support from the City of Roseville	e0203454-9e2.pdf
Letter of Support from the City of Minneapolis	50e7eef9-c3b.pdf
Letter of Support from the City of Maple Grove	9d189e2c-1ba.pdf
Letter of Support from the City of Lakeville	e0e2533b-4a9.pdf
Letter of Support from the City of Edina	d5bf07aa-e56.pdf
Letter of Support from the City of Bloomington	93f43a8f-954.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?

Yes

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

Yes

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

No

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:

Ben Vargas, Senior Grants and Contracts Officer, Office of Sponsored Projects Administration, University of Minnesota; Angela Boutch, Administrative Manager I, Saint Anthony Falls Laboratory, University of Minnesota.

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