



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-224

Proposal Title: Will Extreme Weather Increase Runoff Toxicity to Fish?

Project Manager Information

Name: Bridget Ulrich

Organization: U of MN - Duluth - NRRI

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Project Basic Information

Project Summary: Extreme weather may increase toxic tire-derived runoff threatening Brook trout. This project will measure and model 6PPDQ in urban waterways to inform stormwater management and better protect Minnesota fisheries statewide.

ENRTF Funds Requested: \$748,000

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?

In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Tires deposit contaminants on road surfaces and runoff flushes these contaminants to urban waterways. While a recently discovered tire-derived contaminant called 6PPDQ caused highly detrimental Coho Salmon fish kills in the Pacific Northwest, emerging evidence suggests that 6PPDQ may also threaten Minnesota Brook trout populations, albeit under highly complex and difficult to predict circumstances. Results from ongoing LCCMR project 2022-155 (“Catch and Reveal”) suggest that 6PPDQ concentrations may briefly exceed toxicity thresholds for Brook trout in urban streams following high-intensity rain events that are preceded by prolonged summer dry periods. We hypothesize that this is due to a combination of prolonged build-up of tire wear on road surfaces and accelerated degradation of the tire wear due to high temperatures and intense sunlight exposure. This represents a potentially critical threat to Minnesota fisheries, given the increasing frequency of severe weather events of this nature. Luckily, emerging evidence also suggests that existing stormwater best management practices (BMPs) can effectively remove 6PPDQ from runoff. However, we currently lack a means of predicting where and when tire-derived contaminants may reach thresholds that threaten fish. Therefore, additional research is warranted to improve understanding of circumstances that may lead to harmful contamination levels in urban waterways.

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.

We seek to demonstrate a simple approach to track 6PPDQ in Minnesota waterways, allowing watershed managers to assign priority for monitoring and BMP installation. Existing modeling tools have demonstrated only modest accuracy and do not account for critical processes that impact 6PPDQ behavior. Therefore, we propose to conduct laboratory (Activity 1) and mesocosm (Activity 2) experiments to characterize (i) how weather conditions including sunlight and prolonged dry periods (i.e., weathering) impact 6PPDQ production on road surfaces, and (ii) how sediments effect 6PPDQ bioavailability once contamination from road surfaces is flushed into urban streams. We will focus our analyses on 6PPD/6PPDQ, and a suite of other relevant contaminants will be evaluated in tandem. Production rate and sediment/water partitioning parameters for 6PPDQ will be derived based on results from Activities 1 and 2 and incorporated into a screening-level model to predict 6PPDQ behavior in two urban-impacted streams (one in Duluth, one in the TC metro area). Model predictions will be compared to actual concentration data collected from the two sites following rain events to assess accuracy. The final deliverable will be a technical resource (e.g., report, publication) to inform future broader application of the approach across Minnesota.

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?

By improving the ability to anticipate when and where 6PPDQ may reach harmful concentrations, we will enable more strategic implementation of BMPs, enhancing efforts to preserve Minnesota waterways and fish populations. Our efforts will directly benefit watersheds in Duluth and the TC metro area and inform future broader applications across Minnesota. By integrating new insights on 6PPDQ behavior into a practical management tool, this project will synthesize and extend prior LCCMR investments, delivering actionable guidance to safeguard Minnesota’s water quality and fisheries. The dissemination section describes our plans to coordinate with agencies and other LCCMR teams to enhance impacts.

Activities and Milestones

Activity 1: Laboratory tests to quantify 6PPDQ production and partitioning parameters

Activity Budget: \$200,270

Activity Description:

1a: Weathering impacts on 6PPDQ production. Simulated sunlight degradation, a primary pathway of tire particles breakdown, will be performed by irradiating tire particles with UV light for varying amounts of time and placing the particles in water conditions where the rates and amounts of 6PPD and 6PPDQ will be quantified. Particles will be characterized for their markers of weathering to connect particle parameters with 6PPDQ release profiles to aid in predicting of contaminant release potential from collected roadside dust (Activities 2 & 3).

1b: Sediment impacts on 6PPDQ partitioning. Bioavailability assays will be conducted by immersing various combinations of tire wear and sediments in solution and measuring the resulting aqueous concentrations (i.e., the bioavailable fraction) and solid concentrations of 6PPDQ. A parametric study will be conducted to evaluate the effects of (i) the weathering extent of the tire wear, (ii) varying sediment quantity/characteristics, and (iii) varying solution chemistry on 6PPDQ concentrations. Fresh and degraded tire wear samples will be generated during Activity 1a. Representative urban sediment samples will be provided by LCCMR Project 2026-124. Partitioning parameters will be derived according to the measured sediment/water 6PPDQ concentrations.

Activity Milestones:

Description	Approximate Completion Date
Activity 1a laboratory tests complete (March 2028)	March 31, 2028
Activity 1b laboratory tests complete	June 30, 2028
Data analysis and parameter derivation complete	September 30, 2028

Activity 2: Mesocosm tests to verify 6PPDQ production and partitioning parameters

Activity Budget: \$231,732

Activity Description:

2a: Mesocosm experiments. Mesocosms will be constructed to simulate realistic road/roadside environments, placed outside at UMD during the summer, and incrementally loaded with tire wear to simulate accumulation over time. Following rain events, water (rainwater, generated runoff) and solid (tire wear, sediment) samples will be collected and analyzed to determine 6PPDQ concentrations. Control mesocosms protected from rain but otherwise exposed to the same weather conditions will be evaluated in tandem to simulate extended dry period. Controlled challenge tests will be intermittently conducted by dosing both the control and rain-exposed mesocosms with rainwater and measuring the resulting 6PPDQ concentrations. To relate results to field observations (see Activity 3), mesocosm experiments will be conducted in tandem with field sampling and weather conditions (e.g., sunlight intensity, temperature, precipitation depth) will be continuously monitored at the mesocosm site and locations within the relevant catchments.

2b: Data analysis. A conceptual model will be developed to describe 6PPDQ production, release, and sediment/water partitioning in the mesocosms. Based on the measured weather conditions and parameters derived in Activity 1, 6PPDQ concentrations on the simulated road surface and generated runoff will be predicted and compared to measured results to verify the accuracy of the model.

Activity Milestones:

Description	Approximate Completion Date
Mesocosms constructed and deployed	May 31, 2028
Activity 2a (mesocosm experiments) complete	November 30, 2028
Activity 2b (data analysis) complete	June 30, 2029

Activity 3: Field sampling and model simulations to verify modeling approach

Activity Budget: \$315,998

Activity Description:

3a. Field sampling. 6PPDQ will be monitored in urban streams in Duluth and the TC. Sites will include an urban tributary to Tischer Creek in Duluth (Duluth, selected because the MN DNR documented a Brook trout fish kill here following an intense rain event in 2023)* and one site in the TC metro area (TBD). 6PPDQ concentration dynamics will be evaluated via grab sampling following at least one rain event. If possible, grab sampling will be conducted for multiple events with varying rainfall intensity and preceding dry durations for each site. Passive samplers will be deployed at each site to continually monitor 6PPDQ time-weighted concentrations.

*Note this is NOT related to the 2024 mass fish kill in Tischer Creek

3b. Modeling tool adaption and verification. Freely available modeling tools (e.g., EPA WASP, VELMA) will be adapted to describe 6PPDQ behavior within the two streams. 6PPDQ concentrations will be predicted for the specific sampling sites and weather conditions recorded during sampling events and compared to actual measured concentrations to verify predictions.

3c. Technical resource development. A technical report and/or open-source publication will be developed to describe the study results and inform the broader application of the modeling approach.

Activity Milestones:

Description	Approximate Completion Date
Activity 3a (field sampling) complete	November 30, 2028
Activity 3b (modeling tool adaption and verification) complete	December 31, 2029
Activity 3c (resource development) complete	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Melissa Maurer-Jones	UMN - Duluth - Swenson College of Science and Engineering - Chemistry and Biochemistry	Co-PI	Yes
William Arnold	UMN - Twin Cities - College of Science and Engineering - Civil and Environmental Engineering	Research Collaborator	Yes
Dalma Martinovik	University of St. Thomas	Research Collaborator	No
Andy Erickson	UMN - TC - Saint Anthony Falls Laboratory	Research Collaborator	No
Mark Ferrey	MPCA	Agency Partner	No
John Lindgren	MNDNR, Section of Fisheries	Agency Partner	No

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.

Project results will be shared throughout the project to ensure timely communication with practitioners, municipalities, and state regulators responsible for protecting Minnesota's waters. We will provide focused project update presentations that translate emerging findings into clear implications for monitoring strategies and stormwater best management practices (BMPs).

Findings will be broadly disseminated at venues that convene water professionals and decision-makers, which may include the Minnesota Water Resources Conference, Twin Ports Freshwater Folk, and/or the Minnesota Stormwater Seminar Series, or similar venues. These forums provide direct access to municipal staff, watershed organizations, consultants, and agency scientists positioned to apply project results.

We are collaborating with teams from complementary past and future LCCMR-funded projects (i.e., projects 2023-215, 2022-224, 2026-124, and 2026-034) to ensure data-sharing and cross-project learning. For example, we are collaborating with the team from LCCMR project 2026-034 (Statewide Ecological Risk Estimates for Contaminants of Emerging Concern) who are seeking to collect, organize and make accessible to all statewide emerging contaminant data, including data for road contaminants (note that 2026-034 Project Manager Dalma Martinovik is an unfunded partner on our proposal). Additionally, the team from LCCMR project 2026-124 (Protecting Minnesota's Waters from Plastic- and Rubber-Derived Chemicals) will perform sampling activities at a field site in the TC and provide sediment samples for the proposed lab experiments for Activity 1 (note that 2026-124 Project Manager Bill Arnold is a funded partner on our proposal).

We have been in direct communication with staff from the MPCA (e.g., Jeff Jaspersen, Watershed Ecologist; Mark Ferrey, Environmental Scientist) and the MN DNR (e.g., John Lindgren, Senior Fisheries Specialist) to ensure our proposed activities align with agency priorities and ongoing initiatives in the Tischer Creek watershed in Duluth. Additionally, we will work with the team from LCCMR project 2023-215 (Removing CECs from Stormwater with Biofiltration, note Project Manager Andy Erickson is an unfunded partner on our proposal) to facilitate communication with an agency stakeholders impacted by our work at the TBD field site in the TC. To ensure our findings are disseminated directly to agency stakeholders, we will deliver a dedicated remote project update presentation to these project partners during the final year of the project.

All project products will be prepared in accordance with ETRTF guidelines to ensure accessibility, transparency, and long-term public value. We intend to make the generated technical resource(s) freely available to the public shortly following the completion of project activities (for example, a manuscript hosted on an open-source pre-publication site, a graduate student's thesis hosted on the UMN document depository, and/or an open-source peer reviewed publication).

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?

While all proposed activities will be completed during the project period, we will continue to disseminate the results following project completion to extend impacts. For example, results will be presented and the generated technical resource(s) will be promoted during future events that reach various stakeholders, including conferences, webinars, and/or meetings with partners. These extended dissemination activities will be supported by other grant awards intended to support efforts on the same subject matter and/or professional development funding available to project team members.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Catch and Reveal: Discovering Unknown Fish Contamination Threats	M.L. 2022, , Chp. 94, Art. , Sec. 2, Subd. 04g	\$246,000

Project Manager and Organization Qualifications

Project Manager Name: Bridget Ulrich

Job Title: Principal Research Scientist

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

Dr. Bridget Ulrich holds a PhD in Civil and Environmental Engineering and has served as PI on various state and federal grants in her current role at the NRRI, including her role as Project Manager for LCCMR Project 2022-1555 (Catch and Reveal).

Organization: U of MN - Duluth - NRRI

Organization Description:

The Natural Resources Research Institute (NRRI) is a state-chartered applied research institute of the University of Minnesota's Research and Innovation Office. NRRI maintains three sites in Northern Minnesota, focused on informing sound, long-term decisions on the use and stewardship of natural resources.

Our mission: Deliver integrated research solutions that value our resources, environment and economy for a sustainable and resilient future.

NRRI collaborates broadly across the University system, the state and the region to address the challenges of a natural resource-based economy. Research is developed via extensive partnerships with industry, state and federal agencies and governmental units.

As an impartial, science-based resource, NRRI develops and translates knowledge through large-scale, interdisciplinary research. Our expertise focuses on defining resource opportunities, minimizing waste and environmental impact, maximizing natural resource value, and maintaining or restoring ecosystem function.

Major outcomes from NRRI projects include informing environmental management and policy and assisting industry and communities in defining and maintaining the social license to operate in natural systems. NRRI has established mechanisms for sharing outcomes through press releases, peer-reviewed journals, technical reports, annual reports, periodicals, and social media.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Dr. Bridget Ulrich		NRRI: Principal Investigator			26.8%	0.36		\$57,021
Dr. Melissa Maurer-Jones		UMD: Co-Principal Investigator			26.8%	0.24		\$48,802
Devin Edge-Hansen		NRRI: Environmental Chemistry Laboratory Manager			24.4%	0.69		\$64,712
Maya Winters		NRRI: Environmental Chemistry Field Work Coordinator			24.4%	0.2		\$14,648
Post-Doctoral Candidate		NRRI: Performs day-to-day lab and field work related to Activity 3			20.7%	2.25		\$187,317
Materials Chemistry Technician		UMD: Performs characterization and quantification of tire wear particles			24.4%	0.24		\$19,725
Graduate Student		UMD: Performs day-to-day lab and field work related to Activity 3			19.5%	1.5		\$189,627
Undergraduate Researcher		UMD: Provides hands-on assistance for laboratory and field work			0%	1.02		\$33,323
Graduate Student		UMN-TC: Performs sample collection at Twin Cities site for Activity 3			19.5%	0.26		\$21,218
							Sub Total	\$636,393
Contracts and Services								
NRRI: Analytical fees for LCMS analysis	Internal services or fees (uncommon)	Analysis of 6PPDQ and other trace organic contaminants must be performed by liquid chromatography mass spectrometry (LCMS) at the NRRI Environmental Chemistry Laboratory. The total cost of \$60,000 represents an sample total of approximately 700 samples at the current rate (note that rates may change prior to project initiation).				0		\$60,000
UMD: Fees for materials characterization analyses	Internal services or fees (uncommon)	Tire wear particles are identified, characterized, and quantified in samples using a variety of equipment that require usage fees for access such as FTIR microscope and Scanning Electron Microscopy.				0		\$9,000

							Sub Total	\$69,000
Equipment, Tools, and Supplies								
	Tools and Supplies	NRRI: Lab & field supplies	Lab supplies to support Activity 1 (e.g., pipette tips, vials for sample storage, etc.), supplies to construct mesocosms and perform mesocosm sampling for Activity 2, field supplies to support Activity 3 (e.g., sampling vessels, probes for field measurements, etc.).					\$20,207
	Tools and Supplies	UMD: Lab supplies	Lab supplies to support analysis of tire wear particles at UMD including solvents, filters, glassware, and other lab consumables (e.g., gloves, kimwipes).					\$4,500
	Tools and Supplies	UMN-TC: Field supplies	Field supplies to support sampling at the Twin Cities site for Activity 3 (e.g., sampling vessels, sample collection and storage materials, etc.)					\$1,000
							Sub Total	\$25,707
Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Conference Registration Miles/ Meals/ Lodging	NRRI: Round trip travel between Duluth and the Twin Cities for two project team members to attend the Minnesota Water Resources Conference to present research results and meet with project partners in the TC.	To support dissemination of research results.					\$3,100
	Conference Registration	UMD: Round trip travel between Duluth and the Twin Cities for two UMD project team members to	To support dissemination activities.					\$5,000

	Miles/ Meals/ Lodging	attend the Minnesota Water Resources Conference on two occasions to present research results and meet with project partners in the TC.						
	Miles/ Meals/ Lodging	UMD: Travel to and from field sites, including mileage and vehicle rental fees.	To support field sampling activities as a part of Activity 3.					\$3,600
	Miles/ Meals/ Lodging	UMN-TC: Mileage and vehicle rental for travel to and from field sites in the Twin Cities.	To support field sampling activities for Activity 3.					\$500
							Sub Total	\$12,200
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	NRRI: Publication fees to make one peer-reviewed article based on the research findings open source and publically available.	To support dissemination and make generated information freely available to the public.					\$4,000
							Sub Total	\$4,000
Other Expenses								
		NRRI: Shipping fees to ship supplies to Twin Cities collaborators	To support field sampling for Activity 3					\$300
		UMN-TC: Shipping fees to ship samples from the Twin Cities to Duluth, MN	To support field sampling activities for Activity 3					\$400
							Sub Total	\$700
							Grand Total	\$748,000

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				
In-Kind	UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 54% modified total direct costs.	Indirect costs are those costs incurred for common or joint objectives that cannot be readily identified with a specific sponsored program or institutional activity. Examples include utilities, building maintenance, clerical salaries, and general supplies. (https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs)	Secured	\$373,593
			Non State Sub Total	\$373,593
			Funds Total	\$373,593

Total Project Cost: \$1,121,593

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [ab60801e-c02.pdf](#)

Alternate Text for Visual Component

Photo of a dead Brook trout fry found in an urban tributary to Tischer Creek in July 2023 following a large rain event. The text on the photo reads: Top: "Tischer Creek, July 2023*". Bottom: "**Note: This is NOT related to the 2024 mass fish kill in Tischer Creek."...

Supplemental Attachments

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

Title	File
Authorization Letter	c8e0e35d-ca0.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:

Megan Gorder (Natural Resources Research Institute), Melissa Maurer-Jones (UMD)

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