



Environment and Natural Resources Trust Fund

2023 Request for Proposal

General Information

Proposal ID: 2023-103

Proposal Title: Wildfire Impacts on Minnesota's Pristine Lakes

Project Manager Information

Name: Christopher Filstrup

Organization: U of MN - Duluth - NRRRI

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Project Basic Information

Project Summary: Wildfires are increasing in Minnesota and threaten our iconic wilderness lakes. We will develop decision support tools to protect our lakes and the vital ecosystem services they provide.

Funds Requested: \$197,000

Proposed Project Completion: June 30, 2026

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): NE

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.

Minnesota is known for its lakes. In the Land of 10,000 Lakes (actually 14,380), lakes are part of our cultural identity and provide vital ecosystem services to Minnesotans and tribal bands, such as recreation, fisheries, and manoomin. While direct human activities will continue to stress lakes in developed regions, climate change will likely be the main cause of water quality deterioration in Minnesota's iconic wilderness lakes, including those in the Boundary Waters Canoe Area Wilderness. Last year's Greenwood Fire near Isabella reminds us that wildfires are increasing in frequency and intensity in Minnesota and may signal a changing fire regime. Wildfire impacts within burned watersheds include increased loading of sediment, nutrients, dissolved organic matter, and metals to lakes that can contribute to increased hypoxia, fish kills, and toxic cyanobacteria blooms. Management efforts to mitigate water quality impairments after wildfires are hampered by limited understanding of how lakes respond to these disturbances, and the combination of fire, watershed, and lake characteristics that influence the magnitude of lake response or their resiliency to disturbance. Resource managers need better decision support tools to help prioritize wildfire-impacted lakes for limited management resources and to proscribe effective management solutions based on localized conditions.

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.

To protect Minnesota's iconic lakes and their critical ecosystem services, we will integrate collection and analysis of new water quality data from lakes recently impacted by the Greenwood Fire with statewide spatial analyses of historical wildfire and water quality data to develop decision support tools to mitigate the impacts of future wildfires on lakes. We will measure water quality in 30 lakes (15 burned, 15 unburned), including 17 wild rice-producing lakes, in 2023 and 2024 that represent a gradient of watershed burn extent and severity. We currently have federal funding to sample these lakes this summer, which the state can leverage to provide a total of three years of post-fire data to improve the accuracy and robustness of predictive tools and to fully evaluate lake recovery from disturbance. To extend findings to other regions and improve prediction accuracy, we will use Geographic Information Systems (GIS) to analyze landscape and lake characteristics, historical wildfire data, and historical water quality data. This study represents the largest study of lake responses to a single wildfire in the U.S. and will better inform management decisions specific to Minnesota rather than relying on the few studies from the western U.S.

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?

We will develop relationships among watershed burn extent, burn severity, and lake water quality to identify thresholds in responses for different lake types and predict the magnitude and duration of lake responses to wildfires. These relationships will serve as the foundation for decision support tools to prioritize at-risk lakes for management activities and develop effective management strategies to mitigate impairments. Spatial analyses of historical wildfire and water quality data will inform these relationships and extend findings beyond the Greenwood Fire area. Data layers of lake susceptibility to impairment will be added to Minnesota's Natural Resources Atlas (previously funded by ENRTF).

Activities and Milestones

Activity 1: Develop predictive tools of lake water quality responses to wildfires based on the Greenwood Fire to support management decisions

Activity Budget: \$171,323

Activity Description:

We will measure lake responses to the 2021 Greenwood Fire by measuring water quality in 15 impacted lakes (burned watersheds) and 15 reference lakes (unburned watersheds; control). The impacted lakes span gradients of watershed burned extent, burn severity, and lake size, and include both hydrologically isolated and connected lakes. Control lakes were selected from adjacent areas upwind of the fire to avoid influences from smoke and deposition. We will use water quality data collected by the MPCA to assess pre-fire water quality conditions in these lakes or in a subset of nearby lakes. Lakes will be sampled monthly from May through September to capture seasonal dynamics in lake responses. Based on published studies from other states, we will measure physical (clarity, dissolved oxygen, pH, suspended solids, temperature), chemical (alkalinity, dissolved organic carbon, ionic composition, nitrogen, phosphorus), and biological (chlorophyll a) variables to comprehensively assess water quality changes. When combined with data being collected this summer (federally funded), we will have three years of data to build support tools. Data will be analyzed to quantify wildfire impacts and further understanding of lake susceptibility to water quality degradation.

Activity Milestones:

Description	Completion Date
Collect and analyze water quality samples from 30 lakes in Year 1 (1200 total samples)	June 30, 2024
Collect and analyze water quality samples from 30 lakes in Year 2 (1200 total samples)	June 30, 2025
Data analyses to develop decision support tools	June 30, 2026

Activity 2: Extend decision support tools to the entire state by analyzing water quality responses in lakes to historical fires in Minnesota

Activity Budget: \$25,677

Activity Description:

We will analyze historical wildfire and water quality data using GIS to improve predictions of lake water quality responses to wildfires (developed in Activity 1) and to identify lakes of high wildfire risk based on watershed and lake characteristics. Using available data, including the Minnesota DNR wildfire location database and satellite imagery, we will create a wildfire area layer that will be used to calculate proportion of watershed burn area for select fires and lakes. This information will be compared to historical water quality data to determine how the predictive tools developed in Activity 1 can best be applied to different regions in Minnesota. Watersheds and lakes that have a combination of landscape characteristics (land cover, hydrology), lake characteristics (size, depth), and water quality conditions (clear, low nutrients) that match the high risk categories established in Activity 1 will be identified and mapped. Data layers created for this project will be added to the Minnesota Natural Resources Atlas as data products available to users.

Activity Milestones:

Description	Completion Date
Acquire and create historical wildfire data layers for spatial analyses	June 30, 2024
Spatial analyses of historical wildfire impacts on lake water quality	June 30, 2025
Test tools and create data layers of lake wildfire risk to include in mnatlas.org	June 30, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Will Bartsch	Natural Resources Research Institute	Bartsch will supervise development and analysis of spatial data.	Yes
Kristi Nixon	Natural Resources Research Institute	Nixon will lead GIS analyses and be responsible for the collection and development of data required to characterize lakes, watersheds, and wildfires.	Yes
Hilarie Sorensen	1854 Treaty Authority	Sorensen will advise on climate change impacts on natural resources, the development of management tools to meet tribal needs, and dissemination of findings to tribal communities.	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?

New data collection, historical analyses, and tool development will be completed during the project. Spatial data products will be hosted on the Minnesota Natural Resources Atlas at minimal cost. Project findings and tools will be shared with agency partners (1854 Treaty Authority, U.S. Forest Service, MPCA) by leveraging the project team’s longstanding collaborations with these agencies. Findings will be disseminated through conference presentations, publications, and media. Our collaborators on currently funded wildfire research will help disseminate findings to inform lake management decisions beyond Minnesota’s borders.

Project Manager and Organization Qualifications

Project Manager Name: Christopher Filstrup

Job Title: Applied Limnologist

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

Filstrup will be responsible for project management and administration, and has the scientific expertise and project management experience to successfully complete this research. Filstrup has studied water quality issues in lakes and reservoirs in the U.S. Central Plains for 20 years, including lakes across Minnesota, and excels at engaging natural resources agencies to translate scientific findings to improved management and restoration outcomes. Filstrup also specializes in working with large complex datasets from existing monitoring programs to generate new knowledge from publicly funded data. Filstrup currently manages several federal and state funded projects, including serving as PI on a \$3M USEPA-funded project investigating contaminants in the Great Lakes and a MN Sea Grant-funded project to identify drivers of toxic cyanobacteria blooms in Minnesota lakes. Most related to this project, Filstrup (PI) was recently awarded short-term NSF funding to study lake responses to the Greenwood Fire in this same subset of lakes for this summer only; while this will capture immediate impacts of wildfires on lakes, it will not provide information on delayed long-term impacts or if lakes recover after short-term impacts.

Organization: U of MN - Duluth - NRRRI

Organization Description:

The Natural Resources Research Institute (NRRRI) is a part of the University of Minnesota research enterprise and employs over 130 scientists, engineers and technicians. Its mission is to 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.

By partnering with industry, business leaders, agency decision-makers and many others, NRRI researchers frame and deliver on real-world solutions. NRRI scientists have extensive experience in managing large, interdisciplinary projects. Major objectives include the development of tools for environmental assessment and resource management. NRRI's role is as an impartial, science-based resource that develops and translates knowledge by characterizing and defining value-resource opportunities, minimizing waste and environmental impact, maximizing value from natural resource utilization and maintaining/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, publication in peer-reviewed journals, technical reports, annual reports, periodicals, and through social media channels.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Christopher Filstrup, Project Manager		Filstrup will serve as Project PI and will be responsible for project administration, data analyses, and project reporting.			25.1%	0.24		\$25,442
Jerry Henneck		Henneck will be responsible for coordinating field activities, leading field sampling activities, and training and supervision of the field team. Henneck will also be responsible for management of field data.			22.3%	0.45		\$38,538
Zach Wagner		Wagner will be responsible for field work preparation and assisting with field sampling and laboratory analyses.			22.3%	0.45		\$26,480
Beth Bernhardt		Bernhardt will be responsible for supervising and coordinating water quality analyses, compiling laboratory data, and serving as the QA Officer on this project.			22.3%	0.12		\$9,456
Will Bartsch		Bartsch will be responsible for consulting on spatial analyses related to historic wildfires and GIS data products.			25.1%	0.01		\$3,761
Kristi Nixon		Nixon will be responsible for spatial analyses to study impacts of historic wildfires on water quality in Minnesota lakes and generating spatial data layers for inclusion with the Minnesota Natural Resources Atlas.			22.3%	0.24		\$20,116
Undergraduate Researcher		The undergraduate student will assist with field sampling and laboratory preparation and analyses during the summer in Y1 & 2, and assist with data analyses and reporting in Y3.			0%	0.45		\$11,957
							Sub Total	\$135,750
Contracts and Services								
University of Minnesota Duluth	Internal services or fees (uncommon)	The NRRI GIS Lab is supported in part by a small hourly fee charged to projects in order cover infrastructure and software licenses.				0.03		\$1,800

University of Minnesota Duluth	Internal services or fees (uncommon)	Analytical fees in each of Y1 & 2. 30 lakes x 5 sampling events = 150 samples. Ions 30 lakes x 2 sampling events = 60 samples				0.15		\$41,820
							Sub Total	\$43,620
Equipment, Tools, and Supplies								
	Tools and Supplies	General field supplies	General field supplies (bottles, batteries, notebooks, pens, labels) in Y1 & 2.					\$5,430
	Tools and Supplies	YSI maintenance	YSI maintenance (replacement pH / conductivity sensors, calibration solutions) in Y1 & Y2.					\$2,700
							Sub Total	\$8,130
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Field Travel	Field travel in each of Y1 & 2. 30 sampling events @ 239.3 miles @ \$0.585 = \$4200.00. 30 days @ \$15.00 rental fee = \$450.00.					\$9,300
							Sub Total	\$9,300
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								

							Sub Total	-
Other Expenses								
		Shipping costs	Shipping costs in each of Y1 & 2. 2 shipments of samples to RAL (from Duluth to Twin Cities) @ \$50 = \$100.					\$200
							Sub Total	\$200
							Grand Total	\$197,000

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 55% 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	\$108,350
			Non State Sub Total	\$108,350
			Funds Total	\$108,350

Attachments

Required Attachments

Visual Component

File: [57055901-ac1.pdf](#)

Alternate Text for Visual Component

Visual shows multiple aerial images of the Greenwood Fire in 2021 near Isabella, Minnesota. There is an arrow from these images to images of lakes with cyanobacteria blooms and fish kills. Text reads "Better management tools will help prevent water quality degradation."...

Optional Attachments

Support Letter or Other

Title	File
1854 Treaty Authority letter of support	8708c378-6cf.pdf
UMD Sponsored Projects Transmittal Letter	d6530bc2-12f.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

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?

Yes, Sponsored Projects Administration (UMD)

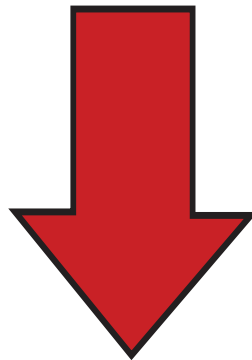
Wildfire impacts on Minnesota's pristine lakes

Greenwood Fire 2021



Wildfires are increasing & threaten lake health.

Agencies need better tools to protect our pristine lakes.



Better management tools will help prevent water quality degradation.