



Environment and Natural Resources Trust Fund

2022 Request for Proposal

General Information

Proposal ID: 2022-285

Proposal Title: Trace Metal Benchmarks for NE Minnesota Lakes

Project Manager Information

Name: Richard Kiesling

Organization: US Geological Survey - Upper Midwest Water Science Center

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Project Basic Information

Project Summary: : This project will establish baseline trace metal accumulation rates and pre-industrial and pre-mining sediment trace metal benchmarks for a chain of lakes downstream of proposed copper-nickel mining area in Minnesota.

Funds Requested: \$176,000

Proposed Project Completion: June 30 2025

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?

Region(s): NE

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.

Development of copper-nickel mining within the Birch Lake watershed near Ely, MN, has the potential to discharge trace metals into Birch Lake and the other downstream lakes in the White Iron chain, adding to existing issues with trace metal and sulfate pollution in Birch Lake water and sediments. The White Iron Chain of Lakes Association is concerned that trace metals in these lakes be adequately characterized prior to any new mine development and have requested the U.S. Geological Survey to conduct the proposed study.

Previous monitoring of trace metals in Birch Lake and the downstream lakes has lacked the resources to examine current rates of trace metal sediment deposition or to assess background concentrations in deeper sediment samples deposited before European settlement. There is an urgent need for a better understanding of how surface water concentrations of trace metals are related to their accumulation in sediments before mining activity expands. By coupling sediment accumulation sampling with surface water sampling and analysis of deeper sediment cores, it is possible to establish a baseline for net rates of metal deposition to the sediments and a benchmark for sediment trace metal concentrations in these lakes based on pre-settlement conditions.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

To understand how current loading of trace metals are related to sediment accumulation of trace metals, we propose to deploy multiple sediment traps in Birch and White Iron Lakes as well as individual traps in Bogberry Lake on Filson Creek and South Kawishiwi River below the confluence with Filson Creek. Recent work funded by ENTF (Elliott et al. 2020) has documented naturally occurring loads of trace metals to Birch Lake from Filson and Keeley Creeks. Data on current trace metal accumulation rates would put these naturally occurring loads into a lake-wide perspective while documenting the fate of additional loads to the chain of lakes.

To establish the historical benchmarks for trace metals in lake sediments, we propose to perform trace metal analyses of archived samples from previously collected lake-sediment cores from the chain of lakes. In addition, we propose to sample water for trace metals from each of the lakes to provide an updated water-quality baseline data set using updated water analysis methods to complement the sediment trap data.

Elliott, S.M. et al. 2020. Assessing the influence of natural copper-nickel-bearing bedrocks of the Duluth Complex on water quality in Minnesota, 2013–15: USGS

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?

The proposed study will provide a critical baseline for lake-wide trace metal accumulation in Birch and White Iron Lakes under current conditions while providing a historic sediment quality benchmark against which all changes in trace metal discharge and loading in the watershed can be assessed in the future. Insufficient baseline data has been a major issue for managing mining activities. Data from this study will address this problem by providing an objective benchmark against which managers can evaluate the effects of past activities within the watershed and screen proposed discharges to the Kawishiwi River / White Iron Chain of lakes.

Activities and Milestones

Activity 1: Trace element profiles from dated sediment cores in the White Iron Chain of Lakes

Activity Budget: \$38,000

Activity Description:

A prior study, Paleolimnological Reconstructions for the White Iron Chain of Lakes, collected detailed lake-sediment cores from each of the five lakes in the study area in 2011. These cores have been analyzed for nutrients, diatoms, and basic physical and chemical characteristics under the direction of Dr. Euan Reavie, NRRI. In addition, the cores have been dated by lead-210 by Dr. Daniel Engstrom, SCWRS. Subsamples from these dated cores are archived, and available for trace metal analysis. Therefore, the current proposed study takes advantage of substantial prior investment in field, analytical, and interpretive work. We propose analyzing all archived core increments from the surface (representing approximately 2011) down to a depth in the sediments that corresponds to approximately the year 1800, as previously determined from lead-210 dating. In total, this represents 160 samples from five lake cores. Samples would be analyzed for a suite of 44 trace elements, including key elements of interest copper, nickel, zinc, aluminum, iron, manganese, and cobalt. Samples will be analyzed by a U.S. Geological Survey contract laboratory that is quality-assured by the USGS. Data will be interpreted and summarized in a peer-reviewed journal article or USGS series report.

Activity Milestones:

Description	Completion Date
Subsample NNRI sediment core archives	November 30 2022
Sample analysis at USGS contract lab	May 31 2023
Data quality assurance & upload into data base	June 30 2023
USGS-approved interpretive report	June 30 2025

Activity 2: Trace element sediment accumulation rates from Birch, White Iron, and Bogberry Lakes and South Kawishiwi River below Filson Creek

Activity Budget: \$68,000

Activity Description:

Sediment accumulation samplers (i.e., sediment traps) will be deployed at eight locations distributed as follows: four sites in Birch Lake, two sites in White Iron Lake, one site in Bogberry Lake, and one site on the South Kawishiwi River downstream of the confluence with Filson Creek. Filson creek is a known source of nature trace metal loading to Birch Lake (Elliott et al. 2020). Samplers will be deployed twice per year for two years for a total of 32 environmental samples plus eight quality assurance samples including field blanks and replicates. Material collected by the samplers will be de-watered and analyzed for a suite of 44 trace elements, including key elements of interest: copper, nickel, zinc, aluminum, iron, manganese, and cobalt. Concentrated samples will be analyzed by the U.S. Geological Survey National Water Quality Laboratory. Data will be interpreted and summarized in a peer-reviewed journal article or USGS series report. Data will be made available permanently via a publicly available online data report and through the online USGS National Water Information System (NWIS).

Activity Milestones:

Description	Completion Date
Deploy and retrieve eight sets of sediment traps over two years	October 31 2024
Analyze 40 samples for trace metals at USGS National Water Quality contract lab	December 31 2024
Model accumulation rates and draft a ScienceBase data release of results	February 28 2025
USGS-approved interpretive report	June 30 2025
Present results at two Minnesota conferences	June 30 2025

Activity 3: Seasonal water sampling for trace elements in the Kawishiwi / Birch / White Iron Chain of Lakes

Activity Budget: \$70,000

Activity Description:

Water samples from each of the five lakes in the White Iron chain (Birch, White Iron, Farm, Garden, South Farm) will be collected on three synoptic sampling events in May, July, and September to capture a range of seasonal conditions. Both filtered and whole water will be collected to capture both dissolved and total trace element and major constituent concentrations. A total of 15 environmental and 3 quality-assurance samples will be collected. Samples will be analyzed at the U.S. Geological Survey’s National Water Quality Laboratory, which has been used in numerous regional and national water quality assessments. Samples will be analyzed for a suite of 44 trace elements, including elements of interest: copper, nickel, zinc, aluminum, iron, manganese, and cobalt. Data will be interpreted and summarized in a peer-reviewed journal article or USGS series report. Data will be made available permanently via a publicly available online data release, through the online USGS National Water Information System (NWIS) and supplied to the Minnesota Pollution Control agency for inclusion in their water quality database.

Activity Milestones:

Description	Completion Date
Seasonal water sampling and sample analysis from Birch and White Iron Chain of Lakes	December 31 2024
Data quality assurance review, approval, and upload of data into online public database	December 31 2024
Present results at Minnesota conferences	June 30 2025
USGS-approved interpretive report	June 30 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Jeff Pike	White Iron Chain of Lakes Association (WICOLA)	Representatives from the WICOLA Board will serve as project advisors and WICOLA study partners will be integrated into the planned sampling of Birch Lake and the White Iron Chain of Lakes.	No
Marty Rye	U.S. Forest Service	As a Forest Hydrologist with the Superior National Forest, Marty Rye coordinates water quality sampling for the Kawishiwi River and downstream chain of lakes. He will serve as a liaison between the proposed project and the US Forest Service.	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 be funded?

The interpreted data will provide a baseline of conditions against which future work can be compared. The results will help inform the ongoing citizens monitoring program run by WICOLA as well inform water quality sampling by WICOLA, the U.S. Forest Service, and Lake County Soil and Water Conservation District. We are not seeking long-term funding beyond the proposed three-year timeline for the project. The three year project timeline is requested to provide for sediment accumulation data collection from two full ice-free seasons.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Biological Consequences of Septic Pollution in Minnesota Lakes	M.L. 2015, Chp. 76, Sec. 2, Subd. 04c	\$364,000
Protect Water Quality with Efficient Removal of Contaminants in Treatment Ponds for Storm Water	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 04d	\$325,000

Project Manager and Organization Qualifications

Project Manager Name: Richard Kiesling

Job Title: Hydrologist and Lake Specialist

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

Richard Kiesling is a hydrologist and limnologist with the U.S. Geological Survey. He holds a B.S. in Biology from the University of Minnesota (1980) and a Ph.D. in Ecology from the University of Michigan (1990) with specialization in limnology and community ecology. He is currently the Lake Specialist with the Minnesota Office of the Upper Midwest Water Science Center. Dr. Kiesling has 20 years of experience as a scientist and project manager with the U.S. Geological Survey, with an emphasis on contaminants in aquatic ecosystems (water, sediment, and other media) and an established track record of scientific publications and presentations of findings at stakeholder meetings (<https://www.usgs.gov/staff-profiles/richard-l-kiesling>).

Organization: US Geological Survey - Upper Midwest Water Science Center

Organization Description:

As the Nation's largest water, earth, and biological science and civilian mapping agency, the USGS provides scientific understanding about natural resource conditions, issues, and problems through joint studies with local, state, tribal and

federal partners. The diversity of our scientific expertise enables us to carry out large-scale, multi-disciplinary investigations and provide impartial scientific information to resource managers, planners, and other customers.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Hydrologist		Lead scientist & Project Manger: manage project including overseeing sampling and coordinating with WICOLA, analytical laboratories, and USFS; developing sediment accumulation rate model: draft final report or journal article			25%	0.15		\$39,000
Hydrologist		Data analyst - quality assurance and statistical analysis of chemical occurrence data; calculation of accumulation rates; drafting final report			25%	0.18		\$38,000
Hydrologic Technician		Field & Data collection and support including sub-sampling sediment cores; collection seasonal water quality samples; deploying and retrieving sediment accumulation samplers			25%	0.15		\$25,000
Supervisory Hydrologist		Senior science support including project reporting and publication project review and approval			25%	0.06		\$13,000
							Sub Total	\$115,000
Contracts and Services								
USGS Trace Metal Geochemistry Lab	Professional or Technical Service Contract	Chemical analysis of 160 samples of lake sediment core material				0		\$5,000
USGS National Water Quality Laboratory	Professional or Technical Service Contract	Chemical analysis of a total of 60 solids and water samples from sediment accumulation chambers; chemical analysis of water samples from seasonal surveys.				0		\$35,000
USGS Enterprise Publication Network	Professional or Technical Service Contract	Editorial review, formatting, and publication of Scientific Investigations Report				0		\$8,000
							Sub Total	\$48,000

Equipment, Tools, and Supplies								
	Tools and Supplies	Sample containers and miscellaneous field supplies	Storage containers and sampling bottles for chemical analysis; misc field supplies for collecting, cleaning, and transporting samples					\$2,500
	Tools and Supplies	Field monitor rental	Ten-month rental of multi-parameter field water quality probe					\$1,000
							Sub Total	\$3,500
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel to NRRI, Duluth, MN	Subsample sediment core samples archived at UMD					\$500
	Miles/ Meals/ Lodging	Field trips to study area (eight to ten multiple day trips from Grand Rapids to Ely vicinity)	Field work / sampling lakes, deploying and collecting samplers, and meeting with local stakeholders					\$4,500
	Conference Registration Miles/ Meals/ Lodging	Registration for three conferences; travel to two in-state conferences in northern MN	Present findings to three meetings of multiple stakeholders in study area and at state water conference					\$500
							Sub Total	\$5,500
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								

	Publication	Journal page charges with open access	Publish findings in an open access journal					\$3,000
							Sub Total	\$3,000
Other Expenses								
		Shipping	Shipping of samples to analytical lab					\$1,000
							Sub Total	\$1,000
							Grand Total	\$176,000

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				
Cash	U.S. Geological Survey Cooperative Matching Fund program	These funds will match a portion of the ENRTF funds. \$60,200 of these dollars will fund indirect costs (bureau & center overhead and facilities costs). The remaining \$20,000 will fund project direct costs.	Pending	\$80,200
			Non State Sub Total	\$80,200
			Funds Total	\$80,200

Attachments

Required Attachments

Visual Component

File: [80ab18cc-497.pdf](#)

Alternate Text for Visual Component

Map of NE Minnesota location with detail of Birch Lake and White Iron Chain of lakes including inset map of Filson Creek drainage with lakes...

Optional Attachments

Support Letter or Other

Title	File
WICOLA support letter	bc7f9e11-33c.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?

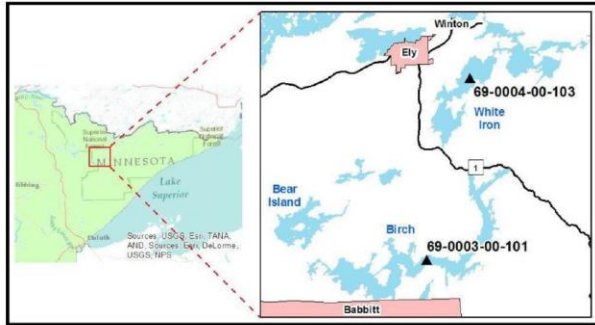
N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

No



Location map of study area, from Baratono & Anderson, 2012, MPCA report.



Filson Creek Study area



Detail of Birch Lake and White Iron chain of lakes

