

**Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 121-BH

Temporal Analysis of Sulfate Loading

Category: H. Proposals seeking \$200,000 or less in funding

Sub-Category: B. Water Resources

Total Project Budget: \$ 138,800

Proposed Project Time Period for the Funding Requested: June 30, 2022 (2 yrs)

Summary:

The study characterizes the introduction, movement, and fate of sulfate from discharge to impact in a way addressing the issues of impact on wild rice and mercury bioaccumulation in fish.

Name: Don Arnosti

Sponsoring Organization: Izaak Walton League of America, Minnesota Division

Job Title: Executive Director

Department: _____

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Location:

Region: Northeast

County Name: St. Louis

City / Township:

Alternate Text for Visual:

map of sampling points for the sulfate water samples

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity	_____ Readiness	_____ Leverage	_____ TOTAL _____%



PROJECT TITLE: Temporal analysis of sulfate loading

I. PROJECT STATEMENT

The study characterizes the introduction, movement, and fate of sulfate between point of discharge and point of impact in a way that allows addressing the issues of impact on wild rice and mercury bioaccumulation in fish.

To manage sulfate impacts requires first the ability identify sources and quantify the mass discharge in time intervals. Second, it requires understanding how the sulfate travels, rate of dilution and the sulfate mass lost versus retained. Finally, it requires quantifying concentrations over time at the point of impact and resultant impact of levels of methyl mercury in fish.

A preponderance of scientific study exists characterizing the relationship between sulfate pollution, methyl mercury creation, and methyl mercury bioaccumulation in fish.

- In soil and water where oxygen is low – slow stretches of streams, muddy lake bottoms, marshes and peat bogs – bacteria consume sulfate in a process that converts inorganic mercury into methyl mercury.
- Aquatic life low on the food chain ingests the methyl mercury. Smaller fish consume the aquatic life low on the food chain. Larger fish consume smaller fish. The methyl mercury bioaccumulates.
- The public health risk derives from the consumption of fish in which methyl mercury has accumulated. Methyl mercury is a potent neurotoxin. The young and unborn are particularly at risk. For them, methyl mercury causes diminished coordination, attention span and intelligence.

The study evaluates sulfate and its impact in promoting methyl mercury production in three watersheds in northeastern Minnesota. These watersheds were chosen for the following reasons:

- Two of the watersheds include a mix of dischargers, industrial and municipal, located at various distances from the points of impact. The third watershed is pristine, to provide a benchmark.
- The watersheds include flow through both streams and lakes and over distances of more than 100 miles as the water flows.
- The watersheds lie in areas with minimal topsoil cover. Because the topsoil is less able to absorb sulfate, the watersheds are particularly vulnerable to sulfate pollution impact.
- Yellow perch are present in all three watersheds, providing an excellent benchmark species for determining methyl mercury concentration.

The watersheds include:

- Vermilion River in St. Louis County - Entities discharging sulfate to the Vermilion River watershed include US Steel Minntac Taconite Tailings Basin in Mountain Iron, MN, via the Sand River; ArcelorMittal Minorca Upland Taconite Tailings Basin in Wuori Township, MN, via the Wouri Creek and Pike River; Bois Forte Waste Water Treatment Plant in the Vermilion Sector of the Bois Forte Indian Reservation in Tower MN, via Lake Vermillion; and the Tower MN Waste Water Treatment Plant in Tower MN, via the East Two River. Flow is through the Wouri Creek and the Sand River into the Pike River into Lake Vermilion and from Lake Vermilion through the Vermilion River into Crane Lake.



2020 Main Proposal Template

- Embarrass River in St. Louis County - Entities discharging sulfate to the Embarrass River include Cliffs Erie NorthShore Mine in Babbitt, MN, via Spring Mine Creek; PolyMet LLC Tailings Basin (former LTV Steel Mining Company Taconite Tailings Basin) near Embarrass, MN, via unnamed creeks, Trimble Creek and Heikilla Lake; and the Biwabik MN Waste Water Treatment Plant in Biwabik, MN. Flow is from tributary streams into the Embarrass River and through the Embarrass River into Embarrass Lake.
- Voyageurs National Park watershed in St. Louis County – No municipal or industrial entities discharge sulfate into Loon Lake, Kabetogema Lake and Mukooda Lake. These lakes constitute the benchmark pristine lakes.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Periodic measurement of sulfate mass per unit time flow and daily monitoring of water conductivity at critically chosen points on the watersheds. Measurement of sulfate mass per unit time at critically chosen points, when conductivity indicates a rapid change in sulfate mass flow.

The sampling points are chosen to allow identification of the load from different dischargers and to allow identification of loss and dilution along the watershed. A rapid change in conductivity at a sampling point signals a potential rapid change in sulfate concentration at that point. Such changes are expected to be infrequent, but sampling at such times provides a more complete characterization of the temporal patterns of the sulfate load.

Periodic sulfate mass measurements are monthly, May to October.

ENRTF BUDGET: \$96,800

Outcome	Completion Date
1. Quantification of sulfate loads per discharger, fate of loading including cumulative effects of dilution and sequestration, and the resulting sulfate concentrations at the point of impact per time interval for the three watersheds.	January 31, 2022
2. Comparisons of loading per time interval and over time between different types of dischargers and amongst similar types of dischargers.	January 31, 2022

Activity 2: Periodic measurement of sulfate concentrations in the impact lakes. End of the season measurement of mercury concentrations in young-of-the-year perch in the impact lakes.

The study uses young-of-the-year perch as a target species to characterize mercury accumulation. They consume the lower level organism that consume the methyl mercury. Their life span lies within the sulfate concentration monitoring period. They are abundant and easy to capture by seining.

The young-of-the-year perch seining and the mercury analysis is once per year, mid-September to early October.

ENRTF BUDGET: \$42,000

Outcome	Completion Date
1. Analysis and correlation of sulfate concentration versus methyl mercury in the sample fish for the impact lakes.	January 31, 2022

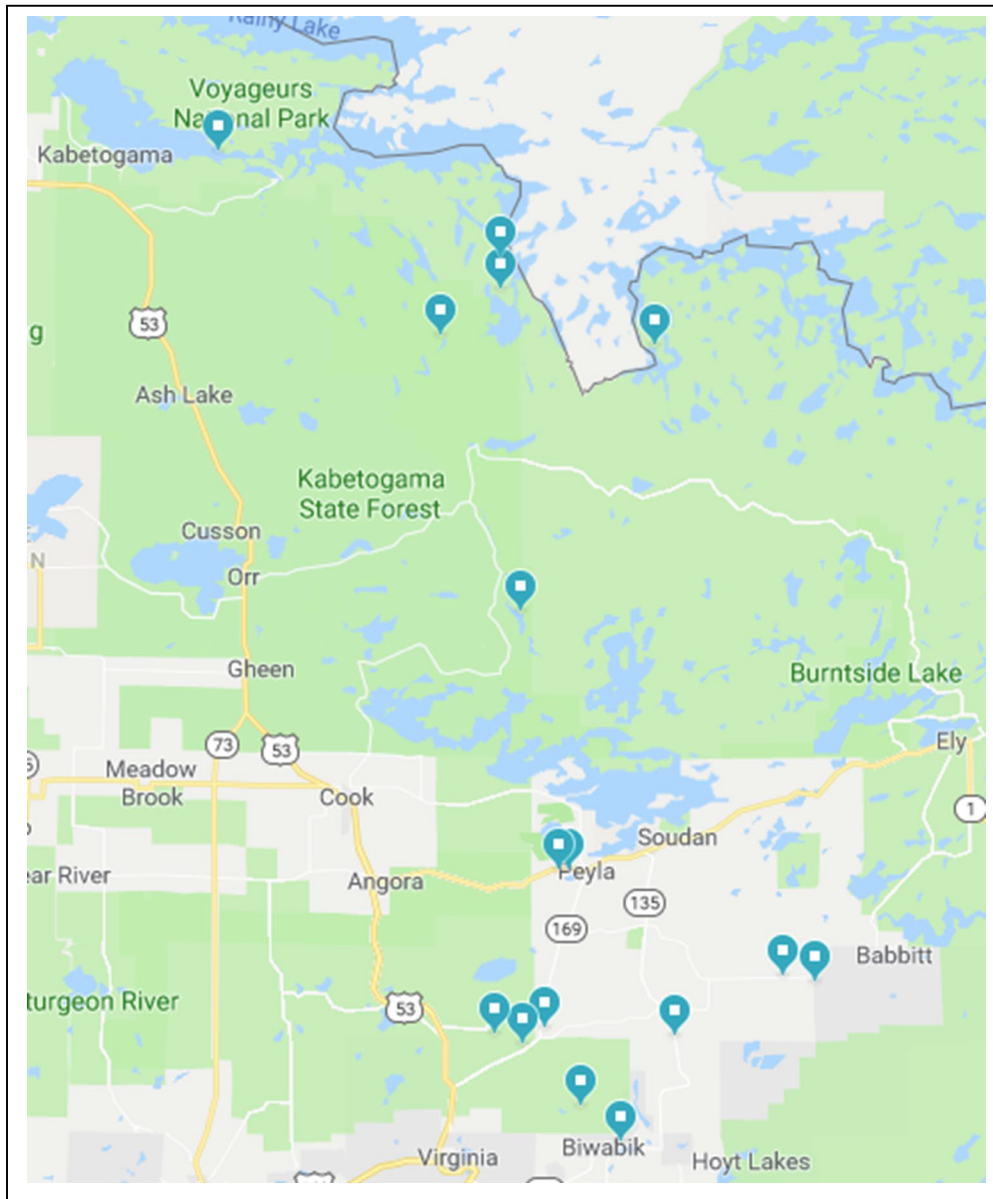
Attachment A: Project Budget Spreadsheet**Environment and Natural Resources Trust Fund****M.L. 2020 Budget Spreadsheet****Legal Citation:****Project Manager: Don Arnosti****Project Title: Temporal analysis of sulfate loading****Organization: Izaak Walton League of America, Minnesota Division****Project Budget: \$138,000****Project Length and Completion Date: January 31, 2022****Today's Date: April 15, 2019**

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)			
None			
Professional/Technical/Service Contracts			
Sample collection for sulfate loading, including the following:	\$71,000		
> Initial set up at stream flow locations including stream geometry measurements and level reference point setting; 9 sites			
> Gathering periodic and conductivity event driven waters samples and water level and flow measurements at stream flow sampling locations; 9 sites; monthly samples over 6 months; 2 seasons			
> Gathering periodic water samples at impact lake sampling locations; 7 sites; monthly samples over 6 months; 2 seasons			
> Gathering periodic water samples at waste water treatment plants; 3 sites; monthly samples over 6 months; 2 seasons			
Sample collection of young-of-the-year perch at impact lakes; 7 sites	\$2,000		
Sample collection will be done by a professional environmental service provider. Solicitation of a service provide will happen once funds are approved.			
Analysis of water samples for sulfate concentration; 22 samples per period for periodic samples plus approximately 20 additional samples for conductivity identified events	\$4,800		
Analysis of young-of-the-year perch for mercury concentrations; 20 perch from each of 7 lakes; 2 seasons	\$40,000		
Analytical testing will be performed by an independent, state certified laboratory to be determined. Solicitation of laboratory services will happen once funds are approved.			
Capital Expenditures Over \$5,000			
Conductivity sonde and data transmission unit. Five units at \$4,200 each.	\$21,000		
COLUMN TOTAL	\$138,800		

Map

Temporal analysis of sulfate loading

Stream sampling and impact lake locations



The Minnesota Division Izaak Walton League of America is composed of 16 Chapters located throughout the state of Minnesota.

Mission Statement: To conserve, restore, and promote the sustainable use and enjoyment of our natural resources, including soil, air, woods, waters, and wildlife.

The Minnesota Izaak Walton league designates Thomas Bose for the project leadership.

Thomas Bose

Contact information

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Work history

Current employment: retired

2009-2013 Avaya, Minneapolis, MN
Systems Engineer

1991-2009 Spanlink Communications/Calabrio, Minneapolis, MN
Market Technologist
Product Manager
Market Manager
Application Engineer

1979-1991 ADC Telecommunications, Minneapolis, MN
Senior Product Manager
Project Manager
Manager Inventory Systems Development
Supervisor Inventory Control

1977-1979 Donaldson Company, Minneapolis, MN
Inventory Control Supervisor

1971-1975 Texas Instruments, Attleboro, MA
Manufacturing Engineer
Product Specialist

Education

MBA Harvard University, Cambridge, MA, 1977

BA in Physics, Brown University, Providence, RI, 1969