Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID: 075-B**

Understanding the Role Sediment plays on Lake Eutrophication

Category: B. Water Resources

Total Project Budget: $ 345,207

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

The long-term strategy of this project is to use data collected from this initial phase to design potential remediation strategies that could be used to clean eutrophic Minnesota lakes.

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

The figure shows an eutrophic lake with sediment phosphorus cycling providing all the phosphorus needed to maintain eutrophication status of the lake

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

PROJECT TITLE: Understanding the Role Sediment plays on Lake Eutrophication

I. PROJECT STATEMENT

- In Minnesota, lakes are not only an important gateway for families recreation in the summer and winter, but they are also a habitat for native wild life and aquatic species. Over the last two decades the water quality in many lakes in Minnesota have declined and some have reached critical levels that have led many to reach a eutrophic state. Phosphorus (P) is the limiting nutrient in most lake ecosystems; so excessive P is the critical factor that causes eutrophication. Although the causes for eutrophication are well understood, effective remediation techniques have not been developed for MN lakes. As a result once a lake becomes eutrophic the community around the eutrophic lake has to deal with the life threatening consequences, while not having appropriate remediation recommendations.
- The goals of this project are *i-* provide an understanding of the role that sediment phosphorus plays on maintaining the eutrophic state of Minnesota lakes even after non-point source P stops reaching the eutrophic lake; *ii-* provide the background and understanding needed for the development of remediation strategies for eutrophic lakes.
- The current methods for cleaning an eutrophic lake is not very effective because they treat only a fraction of the P that causes the problem. Sediments are loaded with many different forms of P, in the inorganic form and also in organic forms, for example, phosphate, DNA, RNA, cell walls, all contain large amounts of P.
- Understanding how the different P forms present in sediment affect the eutrophic state of a lake is essential to develop improved remediation techniques that are safe to the environment, have fast action, and can easily be performed.
- This project will achieve the goals stated above by using state of the art techniques to characterize the chemical nature of P from lake sediment and determine which types of P are most likely linked to maintaining the eutrophic state of lakes. This study is essential for the development of improved remediation methods to maintain lakes clean and safe for the community around the lake as well as for the wildlife that depends on clean water for survival.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: **Budget: $339,207.00**

The initial activity is to locate 6 lakes with different eutrophic stages. Two highly eutrophic, two with seasonal eutrophic stages, and two with very clean water. After lakes are located and selected for the study, water and lake sediment samples will be collected in early June (2017 and 2018), late July (2016, 2017, 2018) and early September (2016, 2017, 2018). After collection, water and lake sediment samples will be chemically analyzed to provide a complete picture of the different form of P present in the sediment and water. Budget includes costs with sample collection and analysis and labor for all three years.

Outcome	Completion Date
1. Have the lakes located	07/15/17
2. Chemically characterize the different forms of phosphorus in the water and sediment samples	12/31/17-19

Activity 2: **Budget: $6,000.00**

We will hold meetings with the community around the lakes used in the study to share the results, and also to discus the potential for utilizing the same lakes are tests for the remediation techniques that will be derived from this project.

Outcome	Completion Date
1. Inform the results of the research to the local community where samples were collected from	04/30/19
2. Design remediation strategies based on the results of the project	05/01/19

III. PROJECT STRATEGY

A. Project Team/Partners

- The project coordinator will be Dr. Paulo Pagliari, Assistant Professor in the Department of Soil, Water, and Climate at the University of Minnesota. Dr. Pagliari will be responsible for assuring all activities are done in a timely manner and chemical and safety procedures are followed while collecting samples and in the laboratory curing chemical analysis.
- Lee Klossner, Senior Research Fellow at the Southwest Research and Outreach Center at the University of Minnesota. Mr. Klossner will assist in sample collection and sample preparation for the chemical analysis to characterize the different fractions of P in lake sediment. Mr. Klossner has a Master Degree on Environmental Science with emphasis on fossil pigments on lake sediment.
- Paul Davis, Project Manager with the Minnesota Pollution Control Agency. Mr. Davis will assist in locating lakes with potential to be included in the project. The graduate student will help with sample collection and perform all chemical tests needed for the successful completion of this project. No fund is being requested for Mr Davis and his contribution will be *in-kind.*

B. Project Impact and Long-Term Strategy

The long-term strategy of this project is to use the data collected from this initial phase to design potential remediation strategies that could be used to clean lake water as lakes become eutrophic. This project is designed to provide a clear understanding of the contribution that each form of P from lake sediment has on the eutrophic state of an eutrophic lake. At the end of the three years, we expect that remediation strategies will be derived and potentially tested in subsequent years. There has been no previous work done with the same emphasis as proposed in this project because the techniques to be used in this project are fairly new and not many researchers have the skill set needed to carry them out, but our lab does. The techniques include breaking the P form lake sediment into 16 different fractions, which include inorganic phosphorus, and three different forms of organic phosphorus which are potentially contributors to the eutrophic state of a lake, such as DNA, monoester-phosphorus, and phytate-phosphorus.

C. Timeline Requirements

Three years: 2016 (because of the late start of funding), three sampling in 2017, and three sampling in 2018. It will take between four to eight months for the chemical tests to be finished after each sampling, with water analysis being completed sooner than lake sediment because of the logistics involved in the analysis of each sample.

2016 Detailed Project Budget

Project Title: *Understanding the Role Sediment plays on Lake Eutrophication*

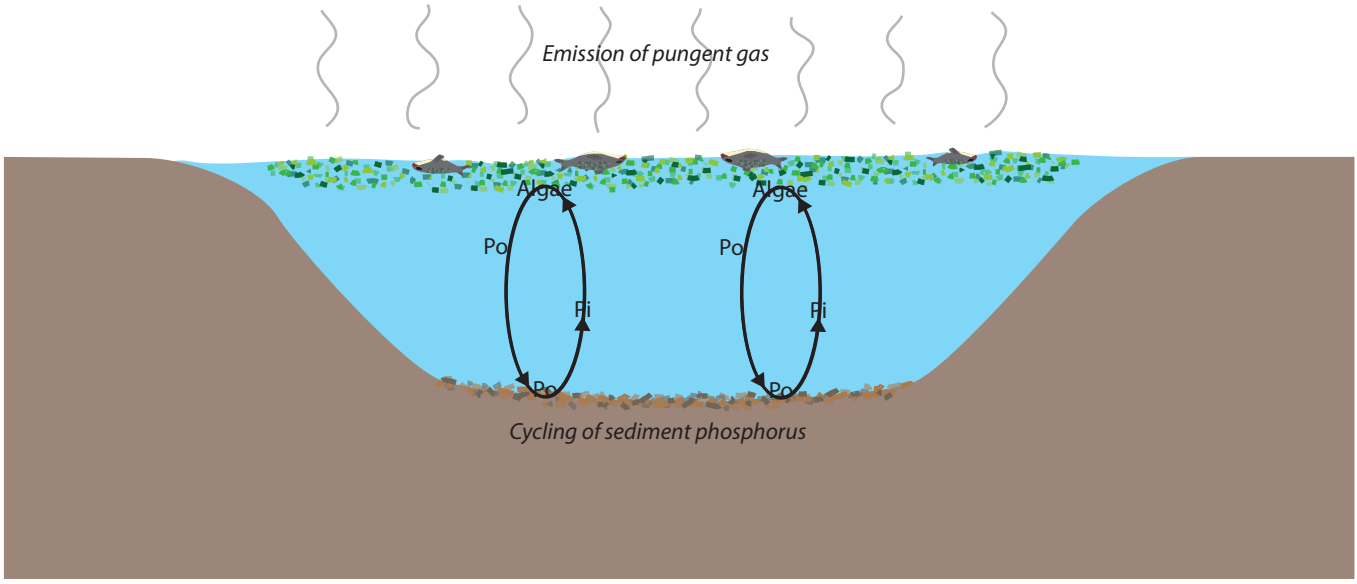
IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel: Project Manager salary at 12% FTE to supervise the overall work being done including the educational activities projected for the last year of the project. Salary request at $9,394.92 and $3,175.48 fringe at 33.8% for each year.	$ 37,711
Personnel: Senior Research Technician at 50% FTE will assist with sample collection and preparation for chemical analysis and also to help with the educational phase of the project. Salary request at $29,028.00 and $9,810.45 fringe at 33.8% for each year.	$ 116,506
Personnel: Graduate student to assist in sample collection and perform chemical tests in the water and sediment and also to help with the educational phase of the project. Salary request at $20,079.00 and benefits and tuition at 18,300.00 for each year.	$ 115,137
Equipment/Tools/Supplies: 2 De-ionized water cartriges (at $750.00 each) and 1 filter (at $100.00) for the production of high quality water for chemical analysis, total of $1,600.00 per year.	$ 4,800
Equipment/Tools/Supplies: 2 Argon (at $800.00 each) and 3 Nitrogen (at $300.00 each) gas cylinders required for the inductivelly plasma coupled optical emssion spectrometer used in the determination of P in samples for each year. Total of $2,500.00 per year.	$ 7,500
Equipment/Tools/Supplies: Equipment for water and sediment collection and storage. Water collection device ($600), bottle for water storage (20 per lake per sampling time, total of 60 sampling per lake per lake per year at $2 per bottle, most be able to be frozen at -40F during storage). Lake sediment sampling probe (probe and extension to 30 feet depth $3,000), sediment storage containers (20 per lake per sampling time, total of 60 per lake at $18).	$ 25,200
Equipment/Tools/Supplies: Chemicals needed for P analysis in water and sediment. Chemical reagents for extraction and chemical analysis (at $3000 per year) crude enzymes needed for determination of organic forms of phosphorus in water and sediment (at $2,000.00 per year) total pf $5000 per year.	$ 15,000
Travel: In state travel to collect samples in the lakes being used in the study, and also travel from the University St. Paul campus to the SWROC where most of the chemical tests will be be performed. Average of 7,500 miles per year at $0.575 per mile. In addition, 1,000 miles for the last year for meetings with local community to discuss resuls and plan for remediation strategies.	$ 13,513
Additional Budget Items: Oureach and Education. The funds in this category will be used for educational activities in the last three months of the study when all of the data is summarized. These activities will help educate the local communities how the lakes are functioning and the next steps in cleaning the water would be. Estimated at $1000 per location.	$ 6,000
Additional Budget Items: Boat rental for sampling of water and sediment estimated at $80.00 per sampling time. Total of 12 sampling in 2016, and 18 samplings in 2017 and 2018.	$ 3,840
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 345,207

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	N/A	N/A
Other State $ To Be Applied To Project During Project Period:	N/A	N/A
In-kind Services To Be Applied To Project During Project Period: In kind salary for Mr. Davis from MPCA; other costs associated with the lab where the study will be run, such as utility.	Not estimable	N/A
Funding History:	N/A	N/A
Remaining $ From Current ENRTF Appropriation:	N/A	N/A

Lake Eutrophication



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Dr. Paulo Pagliari has a PhD. in soil science with emphasis on phosphorus management and soil fertility from the University of Wisconsin-Madison (UW-Madison), and M.S. degree in soil science at the University of Minnesota, and a BS degree in agronomy from the Maringa State University in Brazil. During his PhD. research, Dr. Pagliari became very familiar with newly developed techniques used to determine and quantify the amounts of bioavailable phosphorus (P) in animal manure and how they affected the different P pools in soils.

After graduating from the UW-Madison Dr. Pagliari had a one-year post-doc appointment at the southwest research and outreach center (SWROC) at the University of Minnesota and in 2012 he was hired as a tenure-track faculty. In his current appointment Dr. Pagliari is responsible for the development of innovative research to improve the knowledge on nutrient management in organic and conventional agricultural cropping systems. His focus has been primarily around soil P behavior, movement, transport, and cycling. In his research, Dr. Pagliari has been using newly developed methods and also developing new methods to better understand the role of organic P cycling on the availability of P from soils.

Selected peer reviewed publications include:

Pagliari, P.H. and C.A.M. Laboski. 2014. Effects of manure inorganic and enzymatically hydrolysable P on soil test phosphorus. Soil Sci. Soc. Am. J. 78:1301-1309.

Pagliari, P.H. and C.A.M. Laboski. 2013. Dairy manure treatment effects on manure phosphorus distribution and changes in soil test phosphorus. Biol Fertil Soils. 49:987-999.

Pagliari, P.H. and C.A.M. Laboski. 2012. Investigation of the inorganic and organic phosphorus forms in animal manure. J. Environ. Qual. 41:901-910.

Bierman, P.M., B.P. Horgan, C.J. Rosen, A.B. Hollman, and P.H. Pagliari, 2009. Phosphorus Runoff from Turfgrass as Affected by Phosphorus Fertilization and Clipping Management. J. Environ. Qual. 39: 505-516.

The SWROC is one of 10 research centers at the University of Minnesota and provides local growers with current research based knowledge regarding best management practices for various cropping systems. Dr. Pagliari has a fully equipped laboratory where he conducts all of the chemical analysis needed for the success of his research program. It is at the SWROC lab that most of the chemical analysis of water and lake sediment will be conducted.