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

Project Title: **ENRTF ID: 158-F**

A Treatment Wetland Strategy for Nutrient Reduction Goals

Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Total Project Budget: $ 338,097

Proposed Project Time Period for the Funding Requested: 2.5 years, July 2016 to December 2018

Summary:

A treatment wetland strategy will be developed to address state nutrient reduction goals while considering ecological restoration priorities. Monitoring of wetlands will provide a scientific backing for the strategy.

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

The graphic shows a map of high nitrate levels in streams of the upper Midwest. There are pictures of a restored natural wetland and a constructed treatment wetland. The last picture shows how both types need to be considered to achieve state nutrient reduction goals while improving the prioritization of wetlands restored for ecological reasons.

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

I. PROJECT STATEMENT

Treatment wetlands play an important role in meeting Minnesota's water quality goals according to the "Minnesota Nutrient Reduction Strategy". For them to be an effective tool more information is needed to guide their incorporation into conservation programs, as well as their strategic placement and design. However there are barriers to installing treatment wetlands for water quality including high land values, landowner acceptance and conflicts with the ecological functions of wetlands.

Currently most wetlands are restored opportunistically and designed to serve multiple ecological and hydrologic purposes. However, most locations available for ecological restoration do not align with sub-watersheds in most need of nutrient removal, particularly in agricultural regions. Locations in the highest nutrient loading watersheds are often prime farmland where it is difficult to get wetlands in place. In these areas smaller treatment wetlands can fit into the existing agricultural system in combination with existing drainage systems to minimize farmland usage. The state of Iowa has developed a treatment wetland strategy to reduce nitrate loading for the Gulf of Mexico hypoxia issue. However Minnesota has its own unique considerations including more need to protect local lake and river quality where phosphorus removal is important for aquatic ecosystem health. Minnesota also has a different climate and geologic setting than Iowa that effect nutrient removal rates. Therefore we need our won strategy that protects high quality restored wetlands while also targeting areas for nutrient removal.

The primary goal for this project is to improve Minnesota treatment wetland design and placement strategy for the purpose of improving water quality in agricultural watersheds. A second goal is to better target and increase the number of treatment wetlands placed in agricultural watersheds in order to accomplish the state nutrient-reduction goals. The outcomes will include improved water quality in sub-watersheds where wetlands are placed, increased construction of agricultural treatment wetlands and protection of wetland types not suitable for water treatment.

Our goals will be reached by developing a strategy for nutrient-removal wetlands, including their design and placement in the landscape so that adoption by landowners in rural areas will optimize their water quality benefits for nutrient reduction along with flood protection and wildlife habitat and landscape biological diversity. Assessment will include a combination of Geographic Information System (GIS) terrain analysis, hydrologic modeling, data review, and monitoring of 6 to 8 treatment wetlands. We will also quantify ecosystem services of different wetland types such as plant diversity and carbon storage. Current Conservation Reserve Enhancement Program (CREP) and other conservation related programs will be evaluated to assess what program options may help fund further construction of these wetlands in Minnesota.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Develop guidance on design and placement of wetlands for water quality **Budget: $60,000**
Nutrient removal rates from other wetland studies will be summarized.

Outcome	Completion Date
1a. Better targeting of wetlands for nutrient removal	December 31, 2016
1b. More treatment wetlands placed on the landscape	December 31, 2017
1c. Better targeting of restored wetlands not suited for water quality treatment	June 30, 2018

Activity 2: Measure wetland effectiveness at nutrient removal **Budget: $278,097**

Six different restored wetlands and constructed treatment wetlands will be monitored over the 2017-2018 monitoring season for water quality benefits via nutrient removal at the inlet and outlet for a total of 12 monitoring stations. Ecological benefits will also be quantified by measuring plant diversity and quality.

Outcome	Completion Date
2a. Provide data on effectiveness of six treatment wetlands in different ecoregions	Dec. 31, 2018
2b. Data from the assessment of effectiveness of treatment wetlands from 2017-2018	Dec. 31, 2018
2c. Assessment of factors influencing treatment wetland effectiveness and better design	Dec. 31, 2018

III. PROJECT STRATEGY

A. Project Team/Partners

The project team is comprised of the following University of Minnesota and government agency staff. The University of Minnesota, Department of Bioproducts and Biosystems Engineering (BBE) along with CINRAM - (Center for Integrated Natural Resources and Agricultural Management) will lead the study. They have researched, designed and implemented water quality treatment wetlands for 10 years. The wetland monitoring will be carried out by the U of M. Funding would be directed to the U of M for staff time, monitoring equipment and nutrient analysis laboratory services. The Minnesota Pollution Control Agency (MPCA), Minnesota Department of Agriculture (MDA) and Board of Water and Soil Resources (BWSR) will be close partners helping to develop the strategy for placement, siting and design of treatment wetlands.

U of M Staff funded by Grant
Dr. Chris Lenhart, (partially-grant funded research professor) $68,585 for 25% time for 2.5 years
Post-doctoral research associate, $96,000 (salary plus fringe) a 80% time for 2 years
Dr. Dean Current, CINRAM Director, assistance in developing decision tools, $9,672; 4% time for 2 years
Hourly undergraduate workers, $8,000, 25% time for 2 years.

Partners not funded by this grant

- Wayne Anderson of the MPCA would provide coordination with state nutrient reduction plan.
- Dr. Heidi Peterson, MDA Clean Water Legacy Research Program Director, will coordinate with Clean Water Interagency Research Team and agricultural technical assistance programs.
- Dan Shaw of BSWR will provide expertise on wetland regulatory issues, design and vegetation ecology
- Dr. John Nieber, U of M Professor, will provide expertise on hydrology and treatment wetland design
- Dr. Jeff Strock, U of M Professor, will support monitoring at the treatment wetland in Lamberton, MN

B. Project Impact and Long-Term Strategy

In the long-term, the development of a treatment wetland strategy will lead to greater adoption and installation of wetlands to improve water quality in rural areas. Currently, due to high land values and crop prices, there is minimal adoption of treatment wetlands in intensively farmed watersheds. A properly devised strategy that incorporates treatment wetlands into existing drainage systems will encourage landowner adoption, increasing the opportunity to achieve state and local water quality goals. It will also help to protect high quality restored wetlands from being used for water quality treatment for tile drainage as many are today.

Long-term monitoring of treatment wetlands will help us to understand the factors most influencing nutrient removal. While nutrient removal has been studied extensively Iowa wetlands, Minnesota wetlands are unique due to their varying soil types and climatic. This study will allow us to determine the optimal wetland size, type and locations for achieving state nutrient reduction goals. If proven successful it will lead to further adoption by local landowners as they see successful projects on the ground that are compatible with agricultural systems.

C. Timeline Requirements

Funding would begin in summer of 2016. The literature review and synthesis would initiate in summer 2016; monitoring equipment would be installed in 2017. Monitoring of existing restored and constructed treatment wetlands will be occur in 2017-2018. Guidance on design and placement would be completed by the end of 2018.

2016 Detailed Project Budget

Project Title: A treatment wetland strategy for nutrient reduction goals

IV. TOTAL ENRTF REQUEST BUDGET *2.5* **years**

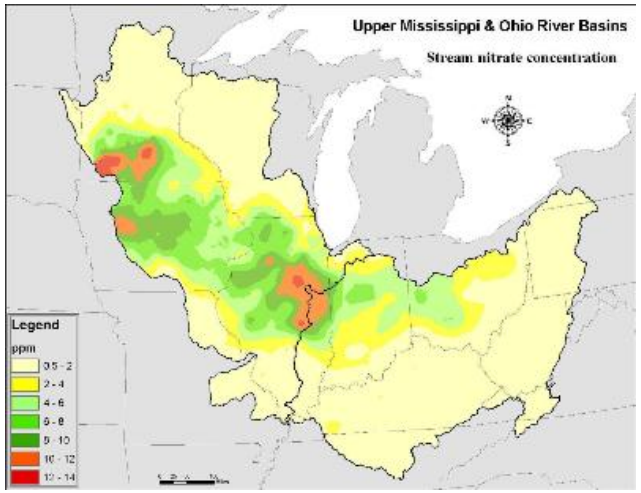
BUDGET ITEM	AMOUNT
Personnel:	$ -
Dr. Chris Lenhart, U of M Research Professor, self-supporting (partially grant-funded) , 25 % FTE for 2.5 yrs (75% salary/25% benefits)	$ 68,585
Dr. Dean Current, University of Minnesota - CINRAM director, 4% FTE for 2 years (75% salary/25% benefits)	$ 9,672
Post-doctoral research associate or research fellow - 80% FTE for 2 years (82% salary/18% benefits)	$ 96,000
Undergraduate hourly workers, 800 hours x $10/hour (100% salary)	$ 8,000
Professional/Technical/Service Contracts: Local SWCD support to collect water quality samples working with the post-doctoral associate and to maintain monitoring equipment. The individual is yet to be determined but would include Martin SWCD staff and possibly other local government technicians. Time and cost would be an estimated 200 hrs X$30/hr x 2 years= $12,000).	$ 12,000
Equipment/Tools/Supplies: Wetland inlet and outet monitoring for flow and nutrients will require 12 stations (two stations at six monitoring sites) (water level probes to measure flow in and out of the wetland ($3000 x 12), ISCO automatic water samplers ($4000 x 12), ISCO computer software ($320), cables to connect samplers to flow probes ($180 x 12), solar panels and batteries to power the water samplers ($260 x 12), rain guages for on-site accurate rainfall data ($400 x 6), and equipment shelters ($500 x 12) inlet and outlet of wetland). The total cost is approximately $8,000 per monitoring station for 12 monitoring stations plus required accessories to power and maintain them.	$ 98,000
Travel: trevel to 6 monitoring sites 10-15 times per year by post-doc at approximately 200-300 miles per trip; for project manager 3 times per year + meetings in state to Southern Minnesota from St. Paul campus; per the university per diem guidelines.	$ 15,600
Additional Budget Items: Water quality analysis at the Research Analytical Lab (RAL) at the University of Minnesota; nitrate, phosphorus and orthophosphorus samples will be measured from each water sample. At a cost of $35 per sample set x 36 samples per site per year at inlet and outlet for 2 years = $30,240	$ 30,240
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 338,097

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period: A grant from MDA to University of Minesota to update Agricultural BMP Handbookwill be utilized int this project. A literature review and update on current research orelated to treatment wetland effectiveness will be required for this handbook and for this LCCMR proposal.	$ 2,000	*secured*
Other State $ To Be Applied To Project During Project Period: Staff time willl be donated Wayne Anderson, MPCA; $3,000 per year for 2 years = $6,000 Heidi Peterson, MDA; $3,000 per year for 2 years = $6,000 Dan Shaw, BWSR$1,000 per year for 2 years; admin donated fee = $2,000	$ 14,000	*secured*
In-kind Services To Be Applied To Project During Project Period: *unrecovered F&A*	$ 175,810	*secured*
Funding History: MDA Clean Water Legacy treatment wetland study, 2013-2015, $312,000; University of Minesota provided $7,500 for wetland mesocosm studies to determine the effect of soil and vegetation types on nutrient removal	$ 319,500	secured
Remaining $ From Current ENRTF Appropriation: N/A	$ -	

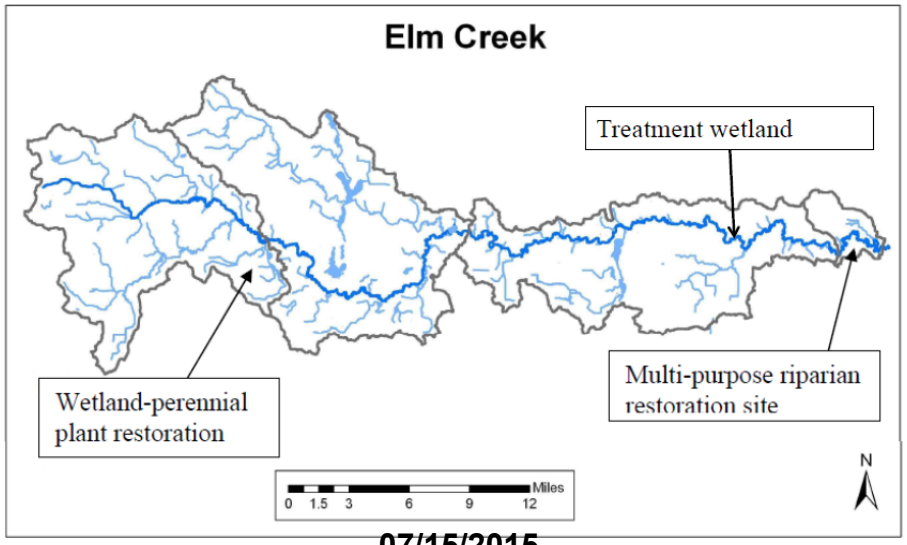
A treatment wetland strategy for Minnesota

Problem: high nitrate and phosphorus levels are found in many streams (dark spots on map)



Prairie pothole wetlands are often restored for ecological benefits in western MN

Treatment wetlands are also needed downstream of farm drainage systems to remove nitrate and phosphorus from nutrient loading hotspots



A wetland strategy that distinguishes good ecological restoration sites from treatment wetland locations is needed

The map at right shows the layout of restored wetlands in Elm Creek

CHRISTIAN F. LENHART,
Research Assistant Professor, Ecological Engineering Group,
Department of BBE, University of Minnesota, St. Paul, MN

Education: Ph.D., Water Resources Science, University of Minnesota, 2008; M.S. in Water Resources Management and MSLA in Landscape Architecture, University of Wisconsin-Madison, 2000; B.S. in Biology, University of Notre Dame, 1993

Research and project management experience

Research Assistant Professor, 2010- present, University of Minnesota, BBE Department
Research project leadership: I have been the principal investigator or co P.I. on 9 research projects ranging from $5,500 to $312,000 since 2010. Some relevant projects include:

- Agricultural BMP Handbook update, Minnesota Dept. of Agriculture (MDA), 2015-16, $65,000
- Treatment wetlands for water quality improvement in sub-surface tile drainage. Minnesota Department of Agriculture (MDA). $312,000.
- Developing approach for prioritizing stream restoration sites in the Minnesota River Basin for sediment reduction (2011-2013) (McKnight Foundation)($75,000)
- Researching tools for prioritizing channel restoration sites and investigating hydrologic drivers of channel erosion in different agro-ecoregions (2011-2015). MDA, $280,000

Field hydrologic monitoring and wetland assessment experience from other work

- Led hydrologic monitoring and assessment to characterize the impact of EAB-on forest hydrology in LCCMR study, Forecasting the hydrologic impacts of emerald ash borer on northern Minnesota black ash forests (2010-2014).
- Developed an assessment tool for wetland buffers for the Minnesota Department of Transportation (2009) to benefit water quality and wildlife
- Managed hydrologic and water quality monitoring program of restored wetlands in Martin County Minnesota, 2004-2007. Assessed hydrologic and nutrient reduction in two restored wetlands for my PhD research
- At Coon Creek watershed 2002-2004 as a water resources specialist I coordinated hydrologic monitoring, wetland permit review and wetland mitigation monitoring.
- Coordinated wetland assessments in Illinois, Wisconsin, Minnesota and Montana

Teaching and Training: I have taught many courses at the University of MN and Mankato State including: Ecological Engineering Design, Case Studies in Ecological Restoration, Watershed management and sustainable development in Ecuador, wetland ecology, plant ecology and soil science. I have conducted training courses on methods for TMDLs and wetland delineation and presented at numerous conferences on wetlands for water quality.

Recent Scientific Publications

- Lenhart, CF, et al. 2015 Reduction of riparian corridor sediment from large agricultural watersheds:. *Journal of Environmental Management.(In prep)*
- Lenhart, C.F. and Lenhart, P.C. 2014. Restoration of wetland and prairie on farmland in the former Great Black Swamp of Ohio. *Ecological Restoration* 32 (4): 441-449.

Organization Description – The BBE Department team strives for the sustainable use of renewable resources and enhancement of the environment. The Ecological Engineering group focuses on research and development of ecological management and restoration practices particularly in rural settings.