Environment and Natural Resources Trust Fund
2009 Phase 2 Request for Proposals (RFP)

LCCMR ID: 038-B1

Project Title: Does Intensified Tile Drainage Create More Erosive Rivers?

Total Project Budget: $ $301,200

Proposed Project Time Period for the Funding Requested: July 2009 to Juley 2012

Other Non-State Funds: $ $150,000.00

Priority: B1. Reduce Soil Erosion

First Name: Shawn **Last Name:** Schottler

Sponsoring Organization: Science Museum of Minnesota

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Region:	County Name:	City / Township:
Central, Metro, SW, SE	Benton, Big Stone, Blue Earth, Brown, Carver, Chip	

Summary: Comparative assessment of hydrologic changes in watersheds with and without intensive tile drainage will be conducted to determine the effects of climate and tile drainage in creating more erosive rivers.

Main Proposal: 0908-2-009-proposal-SCWRS main.doc

Project Budget: 0908-2-009-budget-SCWRS budget.xls

Qualifications: 0908-2-009-qualifications-SPS Qualf.

Map:

Letter of Resolution:

MAIN PROPOSAL

PROJECT TITLE: Does intensified tile drainage create more erosive rivers?

PROJECT STATEMENT

Vast areas of Minnesota have been extensively altered with artificial drainage, including sub-surface tile, ditches, wetland drainage, and surface inlets to remove ponded water. The effect of these manipulations in altering hydrology and sediment erosion is not well understood. New research suggests that artificial drainage may play an important role in observed increases in sediment erosion. Understanding the effect of artificial drainage is critical to designing strategies and BMPs to improve water quality.

Sediment cores from Lake Pepin provide an integrated historical record of erosion rates in the Minnesota, Mississippi and St. Croix watersheds. Sediment erosion rates in the Minnesota River basin have increased by nearly ten fold since European settlement. Currently, sediment loads are dominated by erosion of non-field sources such as streambanks and ravines, and the contribution from non-field sources has increased over the past 50 years while contributions from fields have remained nearly constant. The increases in non-field sediment loads coincide with the intensification of artificial drainage and with periods of increased precipitation. A first step in examining the effects of climate and tile drainage on erosion is to determine if these forces cause a change in hydrology, specifically hydrologic responses such as riverine peak flow or runoff ratio that increase the erosive potential of rivers. The impacts of artificial drainage networks on destabilizing near channel sediment sources, and increasing riverine sediment loads are not well understood and cannot be examined until the installation history and current density of artificial drainage networks is inventoried. Equipped with the knowledge of how tile density varies among watersheds, it will be possible to do comparative assessments of long-term changes in hydrology in watersheds with and without artificial drainage, and relate these effects and temporal trends to the observed sedimentation rates in Lake Pepin.

- This project will quantify the density and extent of artificial in 23 watersheds contributing to Lake Pepin and estimate the installation history over the past ~150 years.
- A comparative assessment of long-term flow records in the same 23 watersheds, some with intense artificial drainage and some with minimal artificial drainage, will be done to determine the effect of artificial drainage on hydrology.
- Time trends of artificial drainage and precipitation (climate) will be correlated to the historical sediment loading trends in Lake Pepin to estimate the role of drainage in accelerating non-field sediment erosion.

DESCRIPTION OF PROJECT RESULTS

Result 1: Quantification of temporal and spatial extent of artificial drainage Budget: **$ 150,000**

Currently, no systematic inventory of the amount or location of artificial drainage in the Lake Pepin basin is available. Correlating changes in hydrology and sediment loading to the expansion of artificial drainage networks is dependent on knowing the chronology and extent of the installation history. Present-day artificial drainage density in 23 watersheds contributing to Lake Pepin will be estimated from GIS mapping of judicial ditches, a statistical inventory of surface inlets, aerial photography and mapping of ditch outlets, and color infrared photographing showing density of pattern tiling. Temporal trends in installation of drainage networks will be estimated from historical aerial photos starting in the 1930's, farm records, production records of drain tile and landowner interviews.

Deliverable	Completion Date
1. Estimation of present day artificial drainage.	July 2011
2. Historical trends of installation of artificial drainage	July 2012

Result 2: Comparative assessment of hydrologic changes due to tile drainage Budget: **$ 151,200**

Changes in erosion rates and sources are linked to changes in watershed scale hydrology. The importance of artificial drainage can be quantified by comparing a suite of long-term hydrologic parameters in watersheds with different degrees of drainage intensity. The working hypothesis to be tested in this study can be stated as follows: When normalized to climate (e.g., precipitation or drought indices), watersheds with extensive artificial drainage networks will show changes in hydrologic parameters such as the flow to precipitation ratio, peak flows, and base flow duration that are distinctly different from those watersheds with minimal artificial drainage. There are ~23 agricultural watersheds in Minnesota that have nearly continuous flow records from 1940 to present. The density of artificial drainage varies from minimal to intense in these watersheds. A suite of 14 hydrologic parameters will be normalize to changes in precipitation and examined to see if a temporal trend exists. Trends and magnitude of changes in hydrology will be correlated to changes in artificial drainage for each watershed, and the impact of artificial drainage on changing hydrology will be estimated. Superimposing the findings of Result 1 and 2 onto the sediment accumulation record in Lake Pepin, will allow a semi-quantitative assessment of the importance of artificial drainage in increasing erosion on non-field sediments.

Deliverable	Completion Date
1. Quantification of changes in 14 hydrologic parameters in 23 watersheds.	July 2010
2. Comparative assessment of watersheds to determine the effect of artificial drainage and climate on changes in hydrology.	July 2012
3. Correlation between trends in artificial drainage and acceleration of sediment accumulation rates in Lake Pepin.	July 2012

PROJECT STRATEGY AND TIMELINE

A. **Project Partners**
Result one will be contracted to Minnesota State Mankato (MSM), Water Resources Center (WRC). Staff in the MSM-WRC-Water have extensive experience in delineating and mapping artificial drainage systems. MPCA will provide matching funds to complete the full project.

B. **Project Impact**
Findings from this project will be paramount in guiding statewide decision making on water quality issues and will directly influence implementation strategies for turbidity TMDLs. This will in turn have secondary benefits for other water quality parameters, including excess nutrients. Results will provide some of the first quantification on the effect of tile drainage on water quality

C. **Time**
Project will be completed in three years. Inventorying of tile networks, Result 1, is a major effort and may take two years. Result 2 is dependent on Result 1.

D. **D. Long-Term Strategy (if applicable)**
None.

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET

BUDGET ITEM	AMOUNT	% FTE
Personnel:		
Shawn Schottler, Result 2, Deliverables 1-3, (salary + benefits) for 3 years	$ 74,400	31%
Jim Almendinger, Result 2, Deliverables 1 and 2 (salary + benefits) for 3 years	$ 37,800	15%
Contracts:		
Minnestoa State University, Mankato-Water Resouces Center Complete Result 1.	$ 150,000	
Equipment/Tools:		
Laboratory supplies	$ 4,000	
Other:		
Graduate Student Stipend (12 months, 50% time)	$ 35,000	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 301,200	

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Remaining $ From Previous Trust Fund Appropriation	$ -	
Other Non-State $ Being Leveraged During Project Period: **Federal 319 Clean Water Funds, administered through MPCA**	$ 150,000	*Pending*
Other State $ Being Spent During Project Period:	$ -	
In-kind Services During Project Period:	-	
Past Spending: Funding from MPCA, Lake Pepin TMDL to fingerprint sediment souces. (Original funding to develop sediment fingerprinting method provided by LCMR, 1999, $350,000).	$ 297,000	

LCCMR Proposal 2008-Does intensified tile drainage create more erosive rivers?

Project Manager Qualifications

Shawn P. Schottler

Affiliations

1997-present: Senior Scientist, St. Croix Watershed Research Station, Science Museum of Minnesota

Education

1996. Ph.D., Environmental Engineering. University of Minnesota, Minneapolis, MN
1989. B.S., Geotechnical Engineering, University of Minnesota, Minneapolis, MN

Selected Publications

Schottler S. P. and Engstrom, D. R. 2006. A chronological assessment of Lake Okeechobee (Florida) sediments using multiple dating markers. Journal of Paleolimnology, v. 36, 19-36.

Engstrom, D. R., **Schottler, S. P**., Leavitt, P. R., and Havens K. E. 2006. A Re-evaluation of the cultural eutrophication of Lake Okeechobee using multiproxy sediment records, Ecological Applications, v.16(3), 1194-1206.

Schottler, S.P., Identification of Sediment Sources in an Agricultural Watershed, Final Report to the Legislative Commission on Minnesota's Resources, December 30, 2002

Swackhamer, D.S., **Schottler, S.P**., and Pearson, R.F. Air-Water Exchange and Mass balance of Toxaphene in the Great Lakes, *Environmental Science and Technology*, v.33, pp. 3864-3872, 1999

Schottler S.P. and Eisenreich S.J., A Mass Balance Model for Quantifying Atrazine Sources and Transformation Rates in the Great Lakes, *Environmental Science and Technology*, v. 31, p. 2616-2625, 1997.

Schottler S. P., Port J. and DeGolier, T., 2008, Influence of floristic diversity on songbird nesting preferences in a suite of adjacent reconstructed grasslands, Ecological Restoration, v. 26 (3), 195-197.

Schottler S. P., Port J. and DeGolier, T., 2008, An efficient method for quickly surveying pheasant nesting site preferences, Ecological Restoration, v. 26 (3), 198-199

Organization Description

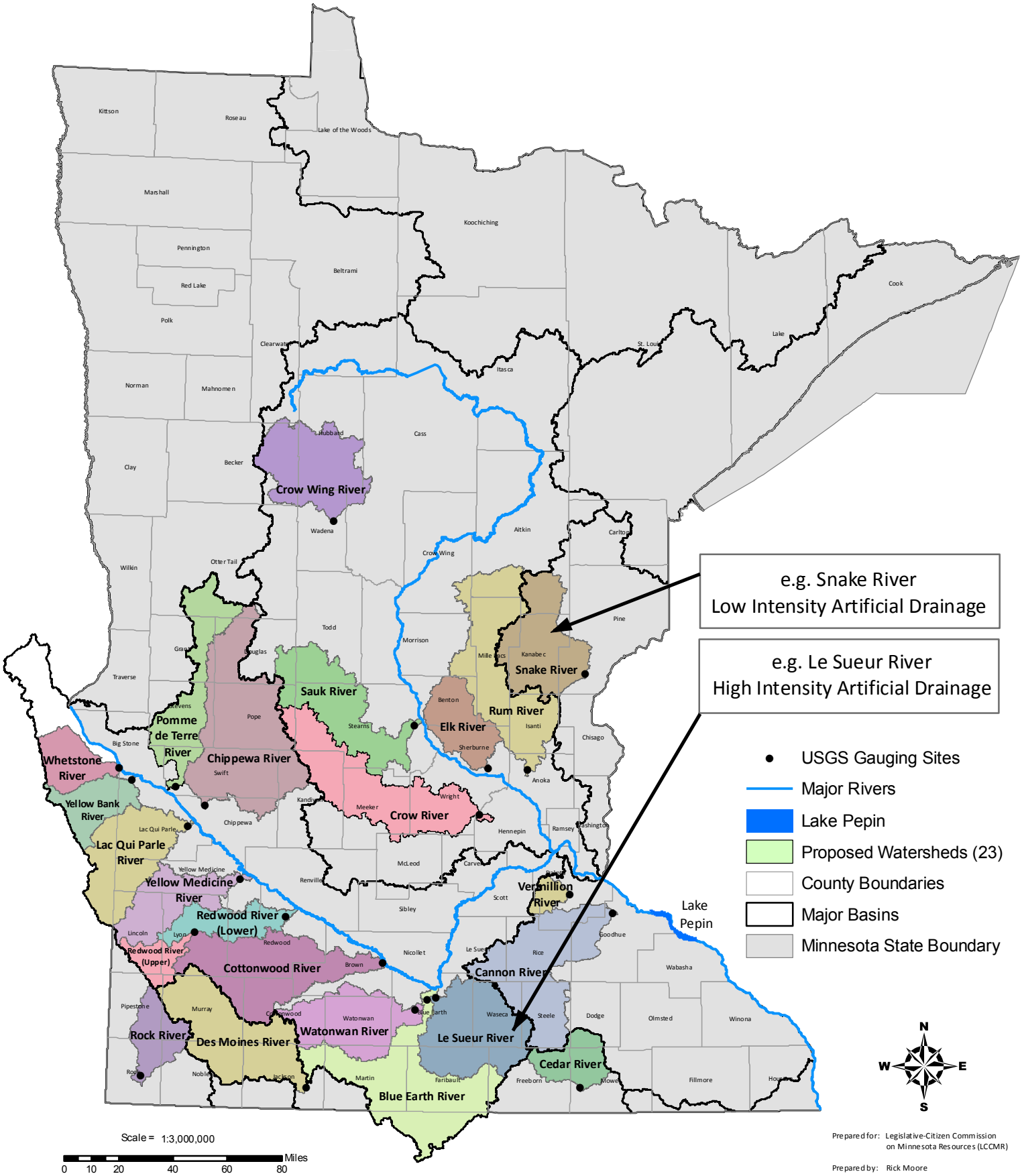
The Science Museum of Minnesota (SMM) is a private, non-profit 501(c)3 institution dedicated to encouraging public understanding of science through research and education. Its mission is to invite learners of all ages to experience their changing world through science. The St. Croix Watershed Research Station is a program of the SMM with the mission to foster, through research and outreach, a better understanding of rivers and lakes at the watershed scale and to provide information to help sustain similar ecological systems.

The Water Resources Center (WRC) at Minnesota State Mankato was created in 1987 to serve as a regional center for environmental research and information exchange. The WRC has participated in more than 100 research, educational, and resource planning projects involving partnerships with dozens of public and private organizations. Project management and collaboration has involved studies in groundwater and lake assessment, water quality monitoring, and watershed management. The WRC staff have completed drainage inventory projects for the Blue Earth River Basin and a drainage ditch buffer study for the Board of Water and Soil Resources. The WRC has also been coordinating numerous TMDL projects and have several ongoing research studies involving the hydrologic, nutrient, and bacterial influences of tile on water quality.

LCCMR 2009: **Does Intensified Tile Drainage Create More Erosive Rivers?**

Science Museum of Minnesota - Shawn Schottler

Proposed Watersheds for Comparative Assessment



Prepared for: Legislative-Citizen Commission on Minnesota Resources (LCCMR)

Prepared by: Rick Moore
Minnesota State University, Mankato
Water Resources Center (MSU-WRC)

Date: September 24, 2008

LCCMR ID: 038-B1