Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)

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Project Title:

Achieving Clarity: Impacts of Agricultural Tiling and BMPs

Category: B. Water Resources

Total Project Budget: $ 849,877

Proposed Project Time Period for the Funding Requested: 3 Years, July 2014 - June 2017

Other Non-State Funds: $ 28,657

Summary:

Supporting agriculture while minimizing environmental impacts is a 21st century grand challenge. By linking stakeholder needs to a hydrologic model, we can target agricultural tiling and BMPs for water quality.

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Sponsoring Organization: U of MN

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Web Address

Location

Region: Statewide

County Name: Blue Earth, Faribault, Freeborn, Grant, Otter Tail, Traverse, Waseca

City / Township:

MP: 0613-2-146-proposa
Budget: 0613-2-146-bud
Qual: 0613-2-146-qualifi
Map: 0613-2-146-map-A
Resolution:
List:

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

Environment and Natural Resources Trust Fund (ENRTF)
2014 Main Proposal
Project Title: Achieving Clarity: Impacts of Agricultural Tiling and BMPs

PROJECT TITLE: Achieving Clarity: Impacts of Agricultural Tiling and BMPs

I. PROJECT STATEMENT

A thriving agricultural sector is a key part of Minnesota's economy, yet turbidity and nutrient loading are primary causes of impairments of Minnesota's lakes, rivers, and streams, which are Minnesota iconic. While much work has been done to implement Best Management Practices (BMPs) in farming operations in both the LeSueur Watershed (Minnesota River) and the Mustinka River Basin (Bois de Sioux) recent work by Schottler et al. suggests that impairments may be linked to increased flow associated with tiling and drainage ditch capacity, and changed vegetative cover. We currently lack the knowledge to target BMP placement to maximize water quality benefits, locate tiling and ditch improvements to reduce flow, assure ground water recharge and entice producers to participate in BMP implementation across a single drainage ditch system let alone across a watershed. This project provides a unique opportunity to investigate and analyze BMPs implementation across spatial scales, to develop a socio-hydrological model/tool for making water policy decisions at any various spatial scales, and to use new collaborative engagement techniques to improve participation in BMP practices.

Goals and outcomes:

1. Collect and analyze existing geographic data related to water quality (including tile systems), physical watershed characteristics, and existing BMP implementation in the two test case watersheds.
2. Collect flow and water quality data at key locations across the watersheds to elucidate drivers of impairment. This work will be coordinated with ongoing local and state agency monitoring efforts.
3. Assess through document examination and interviews the impact of state, watershed and drainage ditch laws, policies and practices, and other factors on the decision making of agricultural operators and drainage ditch authorities.
4. Using outcomes from 1-3 and other existing groundwater data, develop a hydrologic systems model for LeSueur and the Mustinka Watersheds.
5. Using the hydrologic systems model, work with stakeholders including agricultural operators, watershed managers, and drainage ditch authorities to develop a socio-hydrologic model that can be used to explore the implication of possible BMP placement and watershed and drainage policies on water quality and groundwater recharge.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Map Subsurface & Surface Watershed Flows **Budget: $261,288**

To address the issue of sediment loading and ground water extraction and recharge it is essential to understand how the hydrologic system functions within the two watersheds including surface flow of natural and manmade water conveyances. To accomplish this we will use existing maps of surface drainage systems, gather data about and map subsurface drainage systems, gather data about and map subsurface tiling systems and apply LiDAR based terrain attributes, remote sensing, aerial photography, visible band imagery, and thermal imagery to create a digital map of surface and subsurface flow networks in the two watersheds.

Outcome	Completion Date
1. Gather data on the surface drainage system in the LeSueur and Mustinka Watersheds	March 2015
2. Gather data on the subsurface drainage system in the LeSueur and Mustinka Watersheds	Dec. 2015
3. Create a hydrologic network using streams, ditches, visible flow paths and subsurface drainage systems acquired in each watershed	*June 2016*

Activity 2: Acquire and Analyze Recharge, Water Quality and Flow Data. **Budget: $183,985**

Water quality data and streamflow/tile flow data and water samples will be collected at various spatial scales within the watersheds. Monitoring is already conducted by state and local agencies at watershed outlets and at some upstream pour points, but we will collect data at finer spatial scales and link this to larger scale data. We will monitor target drain tile outlets and stream network confluence points at targeted times. Data collection locations will be based on an optimized design to provide information necessary to identify BMP impacts at the appropriate spatial scale. Water flow and water quality data will be analyzed with simple hydrologic and water quality system models to estimate parameters that can be used in the hydrologic systems model. Take ground

water recharge measurements to determine estimate recharge rates across both watersheds. Field-scale confirmation of watershed-scale recharge rates will be assessed with continuous groundwater-level monitoring.

Outcome	Completion Date
1. Acquire recharge, flow and water quality parameters at various spatial locations.	*March 2017*
2. Upscaled analysis of ground water recharge, surface flow and water quality.	*Dec. 2016*
3. Complete estimate of hydrologic and water quality model system parameters for the two watersheds. These parameters can be tweaked as data is acquired over the project life.	*July 2016*

Activity 3: Develop a Socio-Hydrologic System Model for the Watersheds Budget: $ 247,763

We will develop a systems model of the coupled social-hydrologic system to evaluate where BMPs can be most effectively placed given both social and hydrologic constraints in tile-drained watersheds. The hydrologic data gathered in activities 1 and 2 will be integrated using a biophysical watershed model coupled with social information modeling. Social information includes existing policies and practices across local governmental units gleaned from government documents and interviews with individual agricultural landowners and operators about tiling systems, BMP placement and land management decision-making. The integrated model will be refined in focus groups and used to collaboratively assess with stakeholders optimal BMP scenarios.

Outcome	Completion Date
1. Develop the social-hydrologic systems model	Sept. 2016
2. Gather policy implementation data from watersheds and drainage ditch authorities	March 2015
3. Gather data on BMPs and tiling systems from individual agricultural operators	Dec. 2015
4. Refine coupling of socio-hydrologic model through stakeholder focus groups	March 2017
5. Identify Key Findings and distribute to key stakeholders at the state & local level	June 2017

III. PROJECT STRATEGY

A. Project Team/Partners

Kate Brauman, PhD, Institute on the Environment, UMN, will lead the development of the Socio-Hydro systems model. **Mae Davenport**, PhD, Dept. of Forest Resources, U of Mn. (FR-UMN) will participate in and oversee document review, key interviews and focus groups. She will also participate in the preparation of the Socio-Hydro systems model. **Sherry A. Enzle**r, JD, PhD, (FR-UMN) will be responsible for overall grant management and will participate in and oversee document review, key stakeholder interviews and focus groups. She will also participate in the preparation of the Socio-Hydro systems model. **Eric Smith** , PhD, USGS will be responsible for gathering and analyzing ground water recharge data. **Richard Moore**, MS, Water Resources Center, Minnesota State University Mankato will lead development of the Watershed Maps for the two watersheds. **David Mulla,** PhD Dept. Soils, Water Climate UMN will participate in the development of the watershed map and hydrologic systems model. **John Nieber**, PhD, Dept. of Bioproducts and Biosystems Engineering UMN lead will lead the water quantity and quality data acquisition and analysis and participate in the development of the hydrologic systems model.

B. Timeline Requirements

This project requires 36 months of funding. Year 1: Establish water data collection sites, collect and analyze data, map surface drainage and subsurface drainage, gather data on drainage policies, tiling and BMPs. Year 2: Continue water data collection and analysis, stakeholder interviews, analyze water and interview data, prepare hydrologic model, begin socio-hydro model. Year 3: Continue water data collection and analysis, focus groups, complete socio-hydro model, and prepare project report.

C. Long-Term Strategy and Future Funding Needs

This project will provide Minnesota with:

- A detailed understanding of how to target BMPs on the landscape to maximize their benefits
- A modeling tool that can be adapted and used by local watersheds and drainage ditches to explore how potential policies; practices and hydrologic modifications impact the hydrologic function of the watershed.

2014 Detailed Project Budget

Overall Project Budget -- Achieving Clarity: Impacts of Ag BMs & Tiling

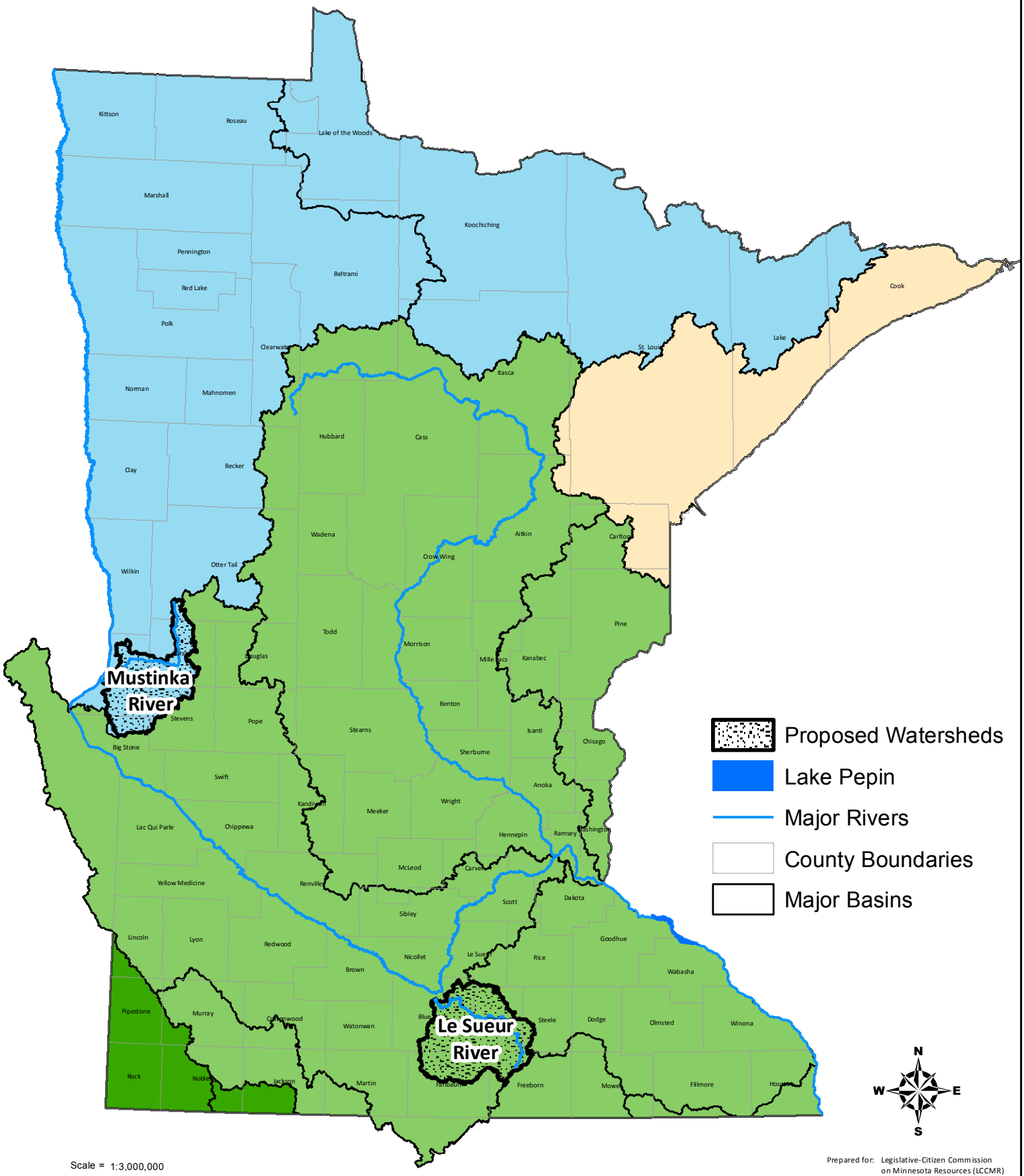
IV. TOTAL ENRTF REQUEST BUDGET: 3 years

BUDGET ITEM	AMOUNT
Personnel: 6 weeks of summer salary and fringe (0.1983) for three years for University of Minnesota Co-PI Davenport, 21 weeks of salary and fringe (0.336) for three years and 6 weeks for University of Minnesota Co-PI Enzler and 12 week salary and fringe (.336) for three years for University of Minnesota Co-PI Kate Brauman.	$ 88,723
Salary and fringe for University of Minnesota graduate student for three years (50% time) and two summers to do water testing. Salary + fringe (26.10% and tuition). One Post Doc 2.5 years plus fringe (.336) to review docs., interview, and social modeling. One Post Doc (50% yr 1-2) physical modeling (salary + 0.336 fringe). One GIS Specialist (50% salary + 0.366 fringe) to identify landscapes for water retention. One Salary + fringe (.368) for Research Scientist 936 hours to set up and maintain monitoring stations	$ 424,204
Equipment, testing and supplies: Chem analysis of water samples $14,000. Stella software $2,596 and Misc. supplies $1,500	$ 18,096
Contract with Mankato State University Water Resource Center: Moore salary and fringe 250 days over three years ($79.998). Student intern 3 years including summers ($42,600). Aerial Imagery for two watersheds $150.500), travel (1,500) and supplies ($750)	$ 275,448
Contract with U.S. Geological Services: 309 hours at $80/hr Erik Smith to analyze groundwater recharge rates in the two aquifers. (USGS will match with an additional 206 hours). $900 well installation (which USCS will match at $600-Four piezometer wells per watershed). Travel to watersheds $986. (USGS will match with an additional $660 Travel funds.)	$ 26,606
Travel: Travel within Minnesota to pay mileage (75%) and per diem costs (25%) for researchers, graduate students and undergraduate students to collect project data and meet with study collaborators.	$ 16,800
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 849,877

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period: USGS is committing 206 hours at $80/hr for Erik Smith to perform analysis of ground water recharge rates in two watersheds, the cost of placing 4 out of 8 piezometer wells at $600 and travel costs of $660.	$17,740	*Secured*
Other State $ Being Applied to Project During Project Period:	$ -	
In-kind Services During Project Period: 1% effort per year for co-PIs John Nieber and David Mulla	$ 10,917	*Secured*
Unrecovered indirect costs @ 52% of modified total direct cost base of $549,254	$ 285,612	*Secured*
Remaining $ from Current ENRTF Appropriation (if applicable):	$ -	
Funding History:	$ -	

Achieving Clarity: Impacts of Agricultural Tiling and BMPs



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

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

Date: June 4, 2013

ACHIEVING CLARITY: IMPACTS OF AGRICULTURAL TILING AND BMPs
Project Manager Sherry A. Enzler Qualifications & Organization Description

Professional Preparation

University of Minnesota, Duluth	Pol. Sci.	B.A. 1976
University of Southern Calif.	Pub. Admin. & Pub. Policy	M.P.A.1978
William Mitchell College of Law	Law	J.D. 1985
Univ. of Minnesota	Nat. Resc. Sci. & Mgmt.	2012

Appointments

Research Associate	Univ. of Minnesota	2005 - Present
Resident Fellow	Inst. on Env., U of Mn.	2010 - Present
Director	Mn. Office of Env. Asst.	1999-2005
Env. Attny.	Private & Pub. Practice	1985 - 1999

Publications and White Papers Most Closely Related to the Proposed Project

Sherry A. Enzler, Deborah Swackhamer, and Suzanne Rhees, *Minnesota Water Law and Policy – Finding a Path to Sustainable Water Management*, forthcoming 39 Wm. Mitchell L. Rev. (2013).

Sherry A. Enzler, *EPA-Minnesota Ag. Certainty Program – Is it up to the task of cleaning our waters?*, forthcoming 39 Wm. Mitchell L. Rev. (2013)

Sherry A. Enzler, *How Law Mattered to Everglades Ecosystem Restoration*, in review.

Sherry A. Enzler, *How Law Mattered to the Mono Lake Ecosystem*, 35 William and Mary Environmental Law and Policy Review 413 (2011).

Suzanne Rhees, John Linc Stine, Rebecca Flood, *Water Governance Evaluation: Recommendations to streamline, strengthen, and improve sustainable water management – A 2013 Report to the Minnesota Legislature* (anticipated date of publication January 2013)(*University Advisory Team*).

Sherry A. Enzler, *Designing a Minnesota Water Congress,* prepared for Minnesota Water Resource Center and Minnesota Pollution Control Agency (June 2012)

Sherry Enzler & John Helland, *White Paper – Minnesota Water Policy Analysis* prepared for the Minnesota Sustainable Water Framework (May 2010).

Project Management Experience

Minnesota Water Congress Scoping Project, Minnesota Water Resources Center, University of Minnesota.

Water Policy Team, Minnesota Water Sustainability Framework, Minnesota Water Resources Center, University of Minnesota.

Litigation and Everglades Restoration, University of Minnesota

National Electronics Product Stewardship Initiative (NEPSI), Minnesota Office of Environmental Assistance.

Solid Waste Systems Mapping Project, Minnesota Office of Environmental Assistance.

15 years experience managing complex litigation ranging in value from $10,000 to $50 Million.

Organizational Description

The University of Minnesota has a strong tradition of education and public service through it role as both the state land-grant university, and the state's primary research university. The University and the Dept. of Forest Resources is a leading research and educational institution on water related issues in Minnesota. For over 100 years it has played a key role in discovering and fostering sustainable water management activities in Minnesota.