

**Environment and Natural Resources Trust Fund
2011-2012 Request for Proposals (RFP)**

LCCMR ID: 029-B

Project Title: Innovative Trout Stream Springshed Mapping in Southeast Minnesota-Continuation

Category: B. Water Resources

Total Project Budget: \$ \$676,765

Proposed Project Time Period for the Funding Requested: 2 yrs, July 2011 - June 2013

Other Non-State Funds: \$ 0

Summary:

Innovative identification and delineation of supply areas (springsheds) for springs serving as coldwater sources for modern and historic trout streams and assessing impacts on them from land and water development.

Name: Jeff Green

Sponsoring Organization: DNR

Address: 2300 Silver Creek Rd NE
Rochester MN 55906

Telephone Number: 507-206-2853

Email: jeff.green@state.mn.us

Web Address: _____

Location

Region: SE

Ecological Section: Paleozoic Plateau (222L)

County Name: Dakota, Fillmore, Goodhue, Houston, Olmsted, Wabasha, Winona

City / Township:

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

MAIN PROPOSAL

PROJECT TITLE: Innovative Trout Stream Springshed Mapping in Southeast Minnesota-Continuation

Project Manager- Jeff Green, Department of Natural Resources- Division of Waters

PROJECT STATEMENT

Trout streams depend on a steady supply of clean, cold water to exist. Each of southeastern Minnesota's trout streams is sourced from groundwater springs. These trout springs are under increasing pressure from changing land use, climate change, and groundwater withdrawals for domestic use, mining, agriculture and energy production. Delineation of the recharge areas or springsheds of these trout springs is a necessary first step in the protection of the trout fisheries and the restoration of those that have been degraded. Dye tracing is the proven method for accurately delineating springsheds in karst but is not always feasible. Development of supplemental springshed mapping tools is a critical component of evaluating the vulnerability of trout stream springs and developing Best Management Practices to protect and improve the water quality in these springs.

Significant progress has been made during the first three years of this project (Map, Page 3). The existing Galena karst springshed coverage in Fillmore County and Olmsted County has been expanded. Successful dye traces in the Prairie du Chien and St. Lawrence Formations have been an innovative use of tracers in geologic environments where they have not been widely used. The St. Lawrence tracing is of particular importance as the St. Lawrence is currently regulated as a confining unit/aquitard yet we are demonstrating that it has karst conduit flow. The new LiDAR coverage of southeast Minnesota is being used to locate additional St. Lawrence sinking points. LiDAR clearly shows the incised pools that mark the sinking points in the St. Lawrence Formation. We are also using LiDAR to locate previously unmapped sinkholes in the other karsts of southeastern Minnesota which we can use as dye introduction points. A spring temperature-monitoring network has been established to determine if temperature fluctuations and changes can be used as an indicator of a spring's hydrogeologic vulnerability. The monitoring to date has shown four distinct patterns of spring temperature response that we are continuing to study in order to develop springshed assessment protocols. We are calibrating Normalized Base Flow relationships for the three-aquifer systems that allow estimates of the size but not the location or shape of trout springsheds. New, faster methods to assess spring vulnerability are a critical component for future land and water management decisions. A map showing mapped springsheds and spring monitoring locations is attached.

This is a joint U of MN and DNR proposal and is the continuation of a ML 2007 and ML 2009 project of the same name. The ML 2009 appropriation ends on June 30, 2011; this funding will start on July 1, 2011. Based on our experience during the first two phases of the existing project, additional staff are needed to accomplish the project's goals. An additional staff person at the DNR, an additional graduate student at the U of MN, and an undergraduate lab assistant at the U of M will accelerate spring vulnerability assessments, karst landscape unit mapping, and springshed mapping. Map production will also be emphasized with the goal of making up-to-date springshed maps and karst features information available via user-friendly web sites on the internet.

I. DESCRIPTION OF PROJECT ACTIVITIES

Result 1 Innovative Trout Springshed Maps and Reports. Budget: \$387,810

Springsheds that feed source springs of trout streams will be delineated in the Galena, Prairie du Chien, and St. Lawrence karst lands. As we have demonstrated that we can successfully dye trace in the Galena and St. Lawrence karsts, tracing in those units will be emphasized in this phase of the project. As suitable sites are found in the Prairie du Chien, we will design traces in that unit also. Maps of the springsheds will be made available via the Internet and will be GIS-based website allowing regular updates. The existing spring temperature network will be maintained and expanded.

Deliverable	Completion Date
1. 1:100,000 or smaller scale maps of all delineated springsheds	30 June 2013
2. Maps and reports of completed dye traces	30 June 2013
3. Spring temperature monitoring network maintained and expanded	30 June 2013

Result 2 Springshed Assessment Protocols & Data Management Budget: \$308,955

Assessment of spring vulnerability is the second step, which requires the development of new tools that are vital to the assessment of the impacts of water and land use changes and large water withdrawals in springsheds. These tools are:

- a. Spring temperature and conductivity monitoring
- b. Spring discharge and chemistry monitoring
- c. Spring isotope sampling
- d. Karst Landscape Unit mapping (Karst Landscape Units are discrete three-dimensional bodies in which solution of the bedrock has resulted in the integration of surface water and groundwater) which provides a comprehensive view of karst flow systems and their springs and springsheds.

Deliverable	Completion Date
1. Spring vulnerability assessment methodology development	30 June 2013
2. Spring parameter database development and maintenance	30 June 2013
3. KLU mapping hierarchy developed for the Galena karst	30 June 2013

PROJECT TOTAL BUDGET \$676,765

II. PROJECT STRATEGY AND TIMELINE

A. Project Partners

Jeffrey A. Green P.G. is the Project Manager and will manage DNR's activities. He has studied springs in southeastern Minnesota for twenty years and is experienced in managing LCCMR projects. **Dr. E. Calvin Alexander, Jr.** of the University of Minnesota will be the Co-P.I. under contract for this phase of the project. He has extensive experience in karst research and mapping in Minnesota. **Dr. Anthony C. Runkel**, Minnesota Geological Survey, will be contributing stratigraphic information to this project. He actively works on the hydrostratigraphy of southeastern Minnesota. **Robert G. Tipping**, Senior Scientist, Minnesota Geological Survey. He maintains the MN Karst Features Database and will assist with hydrostratigraphic interpretations and database maintenance.

B. Project Impact

By delineating springsheds and developing tools to assess spring vulnerability, this project will provide critical information for the protection and management of springs that support trout and other coldwater communities. Identification and delineation of St. Lawrence Formation springsheds will help to protect human health as we are seeing that domestic wells are impacted by surface streams that lose water into the St. Lawrence. This information is critical for impaired waters remediation, ground water protection and allocation issues, and local land and water management decisions.

C. Time

The goal is to accelerate springshed mapping and KLU mapping. Two years with additional staff will allow for a significant increase in mapping activities. This work will need to continue after the two-year period due to the large area being investigated, the complexity of karst systems, and the changing demands on the resources.

D. Long-Term Strategy (if applicable)

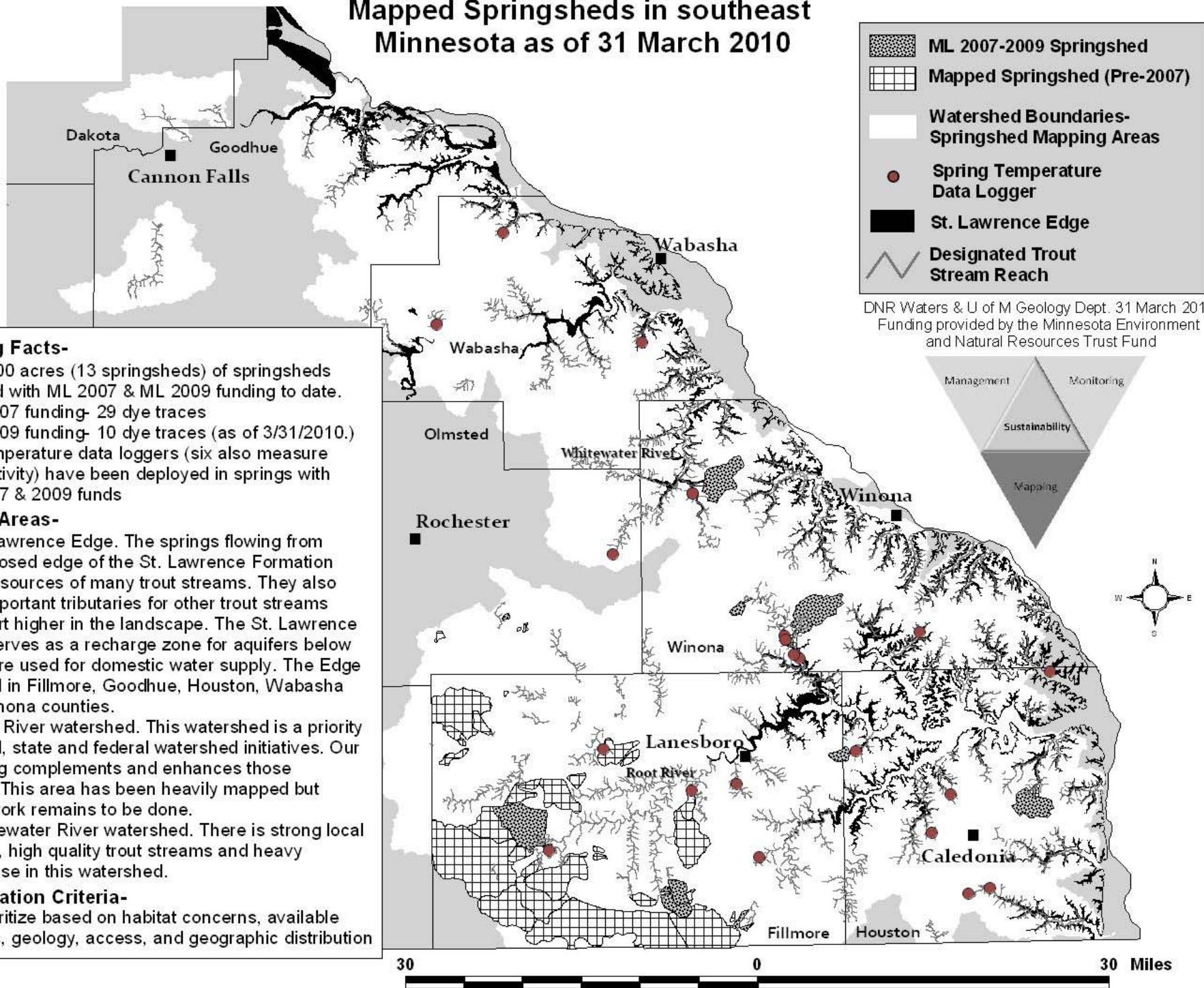
Karst ground water flow is the most complex hydrogeologic environment in Minnesota. Springshed mapping, spring vulnerability assessments, and Karst Landscape Unit mapping are critical components of karst aquifer characterization. This aquifer characterization work provides essential information for watershed management and water quantity and quality protection. Long-term resources are needed to continue these efforts with the available trained staff.







PROJECT TITLE: Innovative Springshed Mapping for Trout Stream Management-Continuation
Project Manager Name: Jeff Green

IV. TOTAL TRUST FUND REQUEST BUDGET TWO YEARS = \$696,765

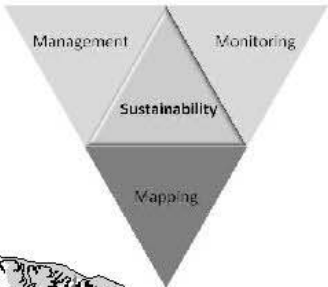
<u>BUDGET ITEMS</u>	<u>BUDGET</u>
Personnel: Hydrologist 3 Jeff Green (R1): 100% for 2 years = \$198,500 (on leave from his current position, which will be backfilled) 2 student interns (R2): 12 weeks = \$10,560 Hydrologist 2 (R2): 100% for 2 years = \$151,205	\$360,265
Equipment/Tools/Supplies: R1: field equipment (such as: data loggers, flow meter, field gear) \$14,000; supplies \$2,000 = \$16,000 R2: field equipment (such as: laptop for field data logger download, cell phone for field work, loggers) \$22,000; supplies \$2,000 = \$24,000	\$40,000
Travel: R1: in-state vehicle mileage \$20,000; in-state expenses \$1,000 = \$21,000 R2: in-state vehicle mileage \$25,000; in-state expenses \$1,000 = \$26,000	\$47,000
Additional Budget Items:	
Other: ARCGIS training and other hydrogeology & karst training in Minnesota such as the Driftless Area Symposium, GSA, Southeast Minnesota Water Resources Board workshops, and LIDAR data training.	\$3,000
	\$450,265
Contracts: University of Minnesota, Dr. E. Calvin Alexander, Jr.	
Personnel: Research Assistant: 2 years (50% R1, 50% R2) (50% 12 months per year) = \$60,000 Dr. E. Calvin Alexander, Jr.: 1 month per year salary & benefits for 2 years (50% R1, 50% R2) = \$25,000 Scott Alexander: 1.5 months per year salary & benefits for 2 years (50% R1, 50% R2) = \$40,000 undergraduate lab assistant: 2 years = \$20,000 (R1)	\$145,000
Equipment/Tools/Supplies: (R1 & R2) nitrate data loggers; temperature, conductivity, stage data loggers = \$20,000 (R1 & R2) dye, charcoal, bottles, lab and field chemicals, lab and field expendable supplies = \$7,500	\$27,500
Analytical Expenses: (R1 & R2) cation/anion analyses, isotope analyses = \$8,000	\$8,000
Travel: (R1 and R2) mileage and expenses = \$15,000	\$15,000
Contracts: MGS (R1) Tony Runkel: 1 month per year and benefits for 2 years (8% time, 1 month per year) = \$16,000 Bob Tipping: 1 month per year and benefits for 2 years (8% time, 1 month/year) = \$15,000	\$31,000
	\$226,500
TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND \$ REQUEST	\$676,765
V. OTHER FUNDS	
SOURCE OF FUNDS	
Other Non-State \$ Being Applied to Project During Project Period: Assistance is being provided by fire departments (providing water), county staff (landowner contact and priority setting), DNR Fisheries (spring locations, landowner contact, priority setting), and the Minnesota Dept. of Agriculture (landowner contact, dye trace sampling)	
Other State \$ Being Applied to Project During Project Period:	
MNDNR In-kind Services During Project Period: for shared services and governance	\$55,269
Remaining \$ from Current ENRTF Appropriation (if applicable): \$500000 (\$250000 each to DNR and U of M) as specified in M.L. 2009, Chapter 143	DNR \$125,000 for FY11 U of M \$125,000 for FY11
Funding History: ML 2007, [Chap. 30], Sec.[2], Subd. 5g	\$270,000

Mapped Springsheds in southeast Minnesota as of 31 March 2010



-  ML 2007-2009 Springshed
-  Mapped Springshed (Pre-2007)
-  Watershed Boundaries-Springshed Mapping Areas
-  Spring Temperature Data Logger
-  St. Lawrence Edge
-  Designated Trout Stream Reach

DNR Waters & U of M Geology Dept. 31 March 2010
 Funding provided by the Minnesota Environment and Natural Resources Trust Fund



Mapping Facts-

- > 144,600 acres (13 springsheds) of springsheds mapped with ML 2007 & ML 2009 funding to date.
- > ML 2007 funding- 29 dye traces
- > ML 2009 funding- 10 dye traces (as of 3/31/2010.)
- > 26 temperature data loggers (six also measure conductivity) have been deployed in springs with ML 2007 & 2009 funds

Priority Areas-

- > St. Lawrence Edge. The springs flowing from the exposed edge of the St. Lawrence Formation are the sources of many trout streams. They also form important tributaries for other trout streams that start higher in the landscape. The St. Lawrence Edge serves as a recharge zone for aquifers below it that are used for domestic water supply. The Edge is found in Fillmore, Goodhue, Houston, Wabasha and Winona counties.
- > Root River watershed. This watershed is a priority for local, state and federal watershed initiatives. Our mapping complements and enhances those efforts. This area has been heavily mapped but much work remains to be done.
- > Whitewater River watershed. There is strong local interest, high quality trout streams and heavy public use in this watershed.

Prioritization Criteria-
 We prioritize based on habitat concerns, available partners, geology, access, and geographic distribution

5. Project Manager Qualifications & Organization Description

Project Manager Qualifications

1. **Jeffrey A. Green, Project Manager and Principle Investigator.** Jeff Green is a Hydrologist 3 and is the Karst Groundwater Specialist for the Minnesota Department of Natural Resources Division of Waters in Rochester. His primary areas of emphasis are karst hydrology, karst mapping, and carbonate hydrogeology. These efforts are done to provide technical assistance to local units of government, DNR staff, and other state agencies. He has extensive experience in the investigation of the hydrology and geology of springs in southeastern Minnesota. Jeff has produced numerous papers and maps on the hydrology of southeast Minnesota and has presented this information to many local, state and national groups. He has a B.S. with Distinction in Soil Science and a M.S. in Water Resources Management from the University of Wisconsin-Madison and is licensed as a Professional Geologist by the State of Minnesota.

Jeff is the Project Manager of this proposal. He has been involved in a variety of LCMR/LCCMR funded projects since 1993. He was the Project Manager on the LCMR Quarries project for 2001 to 2004, is co-managing the current LCCMR Springsheds project and is familiar with the process. Jeff will manage the DNR's part of this effort and any DNR staff involved.

2. **E. Calvin Alexander, Jr., Project Partner and Co-Project Manager.** Calvin Alexander is a Morse-Alumni Professor in the Geology and Geophysics Department of the University of Minnesota's Minneapolis Campus. He has conducted thirty years of research on Minnesota's karst hydrogeology and karst elsewhere on Earth. He is the author or co-author of many publications on Minnesota's karst hydrogeology. Calvin is conducting ongoing, active research on many facets of the interactions between Minnesota's karst and the people who live and work on it. Calvin has taught numerous karst courses and short courses, presented many papers at local, state, national, and international meetings on karst hydrogeology, and presented hundreds of talks to local, regional, state, and national gatherings.

Calvin is the principle Project Partner. The U of M will be a contractor on this project. He has been involved in a variety of LCMR and LCCMR funded projects since the early 1970s and is familiar with the process. Calvin will manage the University of Minnesota's part of this effort and oversee the activities of Scott Alexander (not related), graduate Research Assistant Andrew Luhmann and another graduate student to be named, and other UM staff involved. Calvin and Jeff are jointly providing the scientific and logistical management to the current LCCMR Springsheds projects. They have jointly managed or co-managed several karst hydrogeology projects in the past decade.

Organizational Description

The University of Minnesota's mission is threefold: 1) Research and Discovery, 2) Teaching and Learning, and 3) Outreach and Public Service.

The Minnesota Department of Natural Resources- Division of Waters mission is: Helping people ensure the future of our water resources