

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

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**Project Title:**

Watershed Water Budgets for Managing Minnesota's Water

**Category:** B. Water Resources

**Total Project Budget:** \$ 129,300

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

**Other Non-State Funds:** \$ 63,700

**Summary:**

This pilot study will calculate complete water budgets for two counties in Minnesota. Those water budgets can be used for proactive groundwater management in areas considered for mining development.

**Name:** David Lorenz

**Sponsoring Organization:** U.S. Geological Survey

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Mounds View MN 55112

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**Web Address:**

**Location**

**Region:** Statewide

**County Name:** Goodhue, St. Louis

**City / Township:**

**MP:** 0613-2-157-proposa

**Budget:** 0613-2-157-bud

**Qual:** 0613-2-157-qualifi

**Map:** 0613-2-157-map-L

**Resolution:**

**List:**

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



**PROJECT TITLE: Watershed Water Budgets for Managing Minnesota’s Water**

**I. PROJECT STATEMENT**

Responsible groundwater management requires knowledge the water budget. The water budget is the quantity of water that is flowing through the hydrologic system as well as the amount of groundwater in aquifers (storage). We often have a good idea of groundwater storage (from a county atlas, for example); we have good knowledge of surface-water flow (from USGS and DNR streamflow gages); but we seldom know groundwater flow. This project will tie together those pieces of information.

The objective of the proposed pilot study is to calculate the water budgets, including the groundwater flow component, for selected watersheds in St. Louis and Goodhue counties. The goal of the proposed project is to provide information for proactive water management in two areas undergoing mining exploration.

Water budgets would be computed primarily using soil-water-balance (SWB). A current USGS project that uses SWB calculates only recharge for the state; the proposed project would extend those computations to include calibrated evapotranspiration and runoff, giving the water balance. Other data inputs into the watershed water budgets would include data from the USGS synthetic hydrograph project to help understand and map general flowpaths from surficial aquifers to streams.

**II. DESCRIPTION OF PROJECT ACTIVITIES**

**Activity 1: Estimate groundwater contribution to streamflow** **Budget: \$33,500**

The groundwater contribution to streamflow throughout each area will be estimated from the relations among low streamflows, landscape characteristics, and climate identified in the synthetic hydrograph project.

<b>Outcome</b>	<b>Completion Date</b>
1. Spatial distribution of the average amount of groundwater discharge to rivers.	06/30/2015
2. Identify landscape characteristics that explain the spatial distribution of groundwater discharge to streams.	06/30/2015

**Activity 2: Estimate groundwater recharge for each area** **Budget: \$28,800**

Calculate recharge in each area using commonly available GIS data layers and climatological data. The GIS data includes land use and land cover, surface water flow direction, hydrologic soil group, and available soil-water capacity. The climatological data includes precipitation and air temperature.

<b>Outcome</b>	<b>Completion Date</b>
1. Compile and produce GIS and climatological datasets.	12/31/2014
2. Calculate groundwater recharge and produce preliminary distribution maps.	12/31/2015

**Budget: \$67,000**

**Activity 3: Analysis and map production**

Integrate the results from activities 1 and 2 to reconcile differences and calculate all components of the surface- and groundwater budgets in the watersheds.

<b>Outcome</b>	<b>Completion Date</b>
1. Compile water-use data.	12/31/2014



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2. Produce final distribution maps.	12/31/2016
3. Produce map reports	06/30/2017

**III. PROJECT STRATEGY**

**A. Project Team/Partners**

Because this project relies on current projects within the USGS, in cooperation with the Minnesota Pollution Control Agency, all work will be done by the USGS. The project team will consist of

- Dave Lorenz, principal investigator and surface-water specialist;
- Erik Smith, groundwater hydrologist and SWB expert;
- Tim Cowdery, groundwater hydrologist;
- Christiana Czuba, surface-water hydrologist; and
- Chris Sanocki, GIS specialist.

**B. Timeline Requirements**

The proposed project will start on July 1, 2014 and end June 30, 2017, with the publication of a USGS Scientific Investigations Map and the corresponding GIS data. The project timeline is described in section II and no other conditions or stages are required for this project.

**C. Long-Term Strategy and Future Funding Needs**

The proposed study will help water managers to proactively manage water in the targeted counties and watersheds. It is intended as a pilot study that would eventually cover the state of Minnesota. The groundwater flow and budget information from this study would help fill data needs hindering effective groundwater management. The information is critical to produce an accurate understanding of groundwater flow and levels and flows throughout a watershed. The results from each watershed budget analysis would be presented in a map report that documents the methods and data and an associated GIS dataset. The GIS dataset could be used for any future studies.

## 2014 Detailed Project Budget

Project Title: Watershed Water Budgets for Managing Minnesota's Water

### IV. TOTAL ENRTF REQUEST BUDGET 3 years

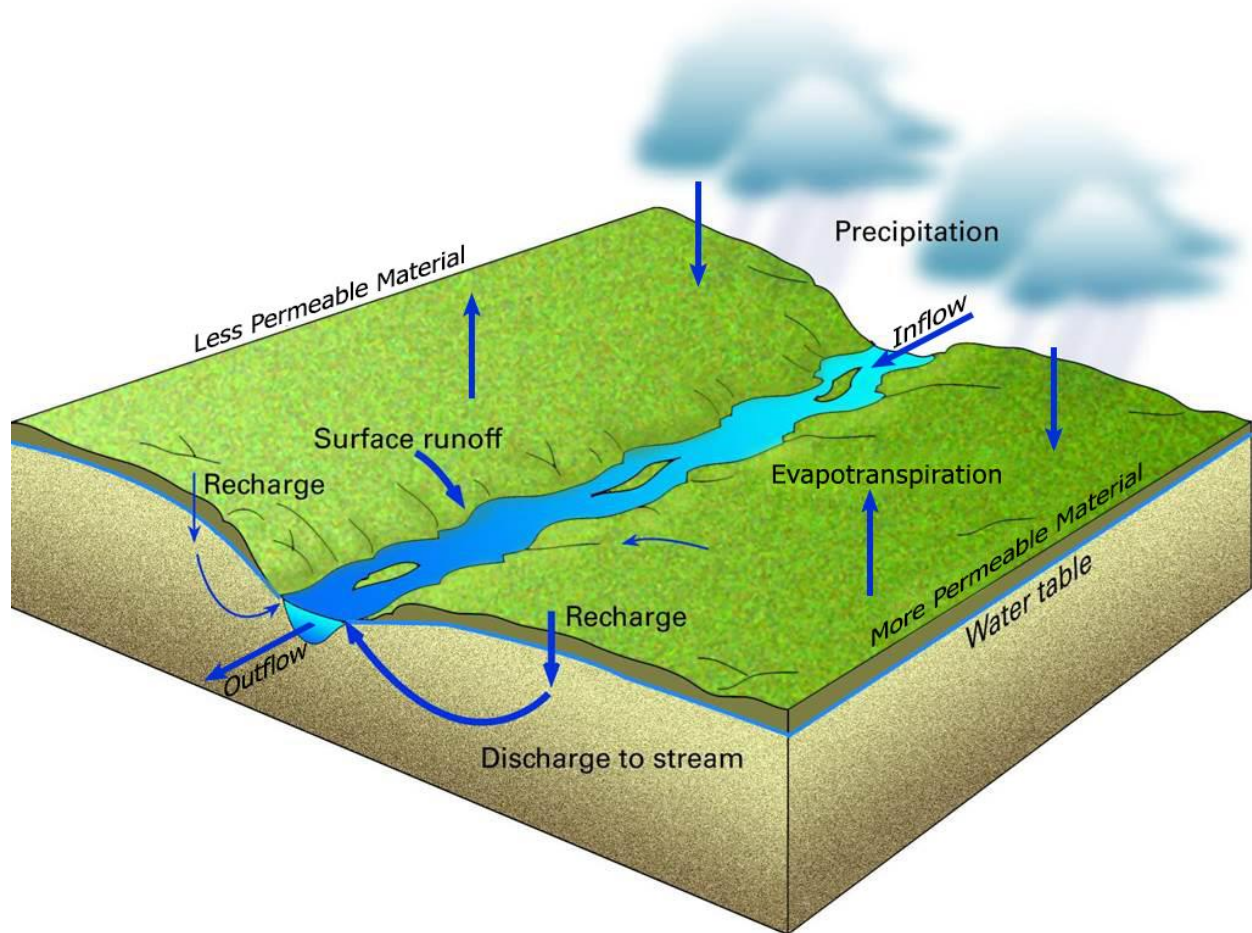
<b>BUDGET ITEM</b> Note USGS personnel includes only salary and benefits	<b>AMOUNT</b>	
<b>Personnel:</b> Dave Lorenz, surface-water specialist (4.5 weeks oversight and Activity 3)	\$	13,500
<b>Personnel:</b> Erik Smith, groundwater hydrologist (11 weeks Activity 2)	\$	26,400
<b>Personnel:</b> Tim Cowdery, groundwater hydrologist (4 weeks Activity 1 + 9 weeks Activity 3)	\$	31,200
<b>Personnel:</b> Christian Czuba, surface-water hydrologist (4 weeks Activity 1 + 10.5 weeks Act. 3)	\$	34,800
<b>Personnel:</b> Chris Sanocki, GIS specialist (4 weeks Activity 1 + 4 weeks Activity 3)	\$	19,200
<b>Personnel:</b> Administrative staff (2 weeks to prepare and administer budgets)	\$	4,200
<b>Contracts:</b> none	\$	-
<b>Equipment/Tools/Supplies:</b> none	\$	-
<b>Acquisition (Fee Title or Permanent Easements):</b> none	\$	-
<b>Travel:</b> none	\$	-
<b>Additional Budget Items:</b> none	\$	-
<b>TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =</b>	<b>\$</b>	<b>129,300</b>

### V. OTHER FUNDS

<b>SOURCE OF FUNDS</b>	<b>AMOUNT</b>	<b>Status</b>
<b>Other Non-State \$ Being Applied to Project During Project Period:</b> none	\$ -	
<b>Other State \$ Being Applied to Project During Project Period:</b> USGS Cooperative Water Program (33% of total)	\$ 63,700	<i>Secured</i>
<b>In-kind Services During Project Period:</b> This project will rely heavily on 2 current projects being conducted by the USGS--the SWB recharge project and the synthetic hydrograph project.	\$ 500,000	<i>Secured</i>
<b>Remaining \$ from Current ENRTF Appropriation (if applicable):</b> none	\$ -	
<b>Funding History:</b> none	\$ -	

## Water Budgets for Managing Minnesota's Water—Supplemental Graphics

The image below presents the basic concepts of the water budget for any particular area within a watershed. The overall water budget consists of inputs; precipitation and inflow, which is zero for headwaters; and outputs, losses from evaporation and outflow. The critical components for managing water use are the internal flows, surface runoff and recharge that eventually discharges to the stream. Landscape differences are highlighted in the graphics below—the recharge is larger and the surface runoff is smaller in the more permeable material than in the less permeable material. This pilot study would help to quantify the internal flow so that water use could be more sustainably and proactively managed than knowing only that we can extract more water from more permeable material than from less permeable material.



### **Principal Investigator Qualifications – David Lorenz**

David Lorenz is a hydrologist with the U.S. Geological Survey in Mounds View, Minnesota. He currently serves as Surface Water Specialist for the Water Science Center in Minnesota and as Technical Lead for R support within the Water Mission Area of the USGS. His background is in Civil Engineering with a strong emphasis in statistical analysis.

Since starting with the USGS in the early 1980s, David Lorenz has been involved in several state-wide hydrological analysis studies. Those studies include a low-flow study in 1987; three regional flood-frequency studies in 1987, 1997, and 2009; and a groundwater recharge map in 2007. He has also been involved in local studies such as a groundwater-surface water interaction study in the Glacial Ridge area in northwestern Minnesota and Red River and Upper Mississippi River National Water Quality Assessment (NAWQA) Program studies.