Environment and Natural Resources Trust Fund
2009 Phase 1 Request for Proposals (RFP)

LCCMR ID: C19

Project Title: Assessing and Monitoring Water Resource Sustainability

Total Project Budget: $ $717,000

Proposed Project Time Period for the Funding Requested: July 2009 - June 2011 (2 yrs)

Other Non-State Funds: $ 0J

First Name: John **Last Name:** Nieber

Sponsoring Organization: U of M

Address: Street Address: 450 McNamara Alumni Center, 200 Oak Street S.E.
Minneapolis MN 55455

Telephone Number: 612-625-6724

Email: nieber@umn.edu

Fax: 612-624-4843

Web Address: www.ospa.umn.edu

Region:	County Name:	City / Township:
Statewide, Central, Metro, Southeast	Lac qui Parle, Olmsted, Pope	

Summary: Tools for predicting water resource sustainability for current climatic conditions and for future conditions of global climate change will be developed along with sustainability monitoring system network designs.

Main Proposal: 0808-1-033-proposal-nieber - Main proposal - 2009.pdf

Project Budget: 0808-1-033-budget-nieber - Project Budget - 2009.pdf

Qualifications: 0808-1-033-qualifications-nieber - qualifications - 2009 proposal.pdf

Map: 0808-1-033-maps-nieber - location map - 2009 proposal.pdf

Letter of Resolution: 0808-1-033-resolution-sdsu and usgs letters of cooperation.pdf

MAIN PROPOSAL

PROJECT TITLE: Assessing and Monitoring Water Resource Sustainability

I. PROJECT STATEMENT

Planning and decisions about water use (both surface and groundwater) in Minnesota can be improved by incorporating information about annual stream discharge, and minimum and average recharge at multiple scales for relatively homogenous hydrologic response units that incorporate geologic, soil, landscape, landuse and climatic information. For the groundwater system maps of groundwater recharge at these scales could be combined with information from local pump tests in order to better inform decision makers and project managers about the potential long-term, cumulative impacts of groundwater extraction in a specific area of the state. This project aims to produce groundwater recharge maps at multiple scales for these purposes, along with maps and equations that help predict the impacts of climate change on groundwater recharge and the risks of failing to provide essential ecological services under adverse climatic conditions. The Phase I project is developing atlases of minimum groundwater recharge and average streamflow for the statewide scale, for two regions, and for three counties. The proposed project will achieve its stated goals by using the results from Phase I in combination with a water balance to estimate minimum and average groundwater recharge at multiple scales. Temporal trends in stream discharge will be modeled to provide information about the impact of climate change on groundwater recharge at different scales. Low-flow conditions will be used to estimate the risk factor of groundwater extraction in relation to ecosystem services.

II. DESCRIPTION OF PROJECT RESULTS

Result 1. Unification of water resources and groundwater recharge estimates from Phase I results and from USGS study. **Budget: $75,000.**

In Phase I we are mapping hydrologic units at three spatial scales, and quantifying stable baseflow/stable groundwater recharge for these units, while the USGS developed regional recharge maps for shallow groundwater. The USGS regional results will be mapped onto the hydrologic units developed in Phase I. This unification will provide mapped quantities of sustainable groundwater recharge which includes both shallow and deep groundwater resources.

Deliverable	Completion Date
1. Draft report of multiscale atlases of sustainable water supply (following USGS internal review atlases will be published by 03/31/2011)	09/30/2010

Result 2. Development of sustainability equations for the landscape water balance model. **Budget: $492,000.**

In Phase I we are developing the discharge/recharge patterns for hydrological units at three spatial scales within the state. In Phase II the available recorded data (streamflow, groundwater levels, air temperature, precipitation, etc) will be used to develop regional sustainability water flux equations (deterministic and stochastic) for the mapped hydrologic units. These equations will predict spatial and temporal variability of water resource sustainability in response to climate change and variability in soils, landscapes, geology and land use. Along with the USGS we will also use recent USGS results for low-flow characteristics to build a tool for prediction of regional low-flows in streams, and associate these with risks of not meeting ecological streamflow requirements. The prediction tool will use the regional structure developed within the Phase I project, and will be linked with the STREAMSTATS tool now being developed by the USGS (for MN/DOT) for Minnesota.

Deliverable	Completion Date
1. Draft report describing the tools for predicting low-flows and predicting the risk of sustained low-flows (following USGS internal review web-based tools will be published by 12/31/2011)	05/31/2011

Result 3. Design of networks for monitoring water resources. **Budget: $150,000.**

Regimes and patterns of stream flow, climate variables, and groundwater levels quantified and developed in Result 2 will be used in the design of monitoring systems for the integration of the essential components of the hydrologic cycle water balance. Recommendations and maps will be provided regarding the designed networks.

Deliverable	Completion Date
1. Report on method for network design	05/31/2011
2. Map of network of monitoring sites	05/31/2011

III. PROJECT STRATEGY AND TIMELINE

A. Project Partners
The tasks will be conducted by the UofM in the lead role, partnering with South Dakota State University and the USGS (Mounds View). Team members: **UofM -** John Nieber, PI, David Mulla, co-PI, Bruce Wilson, co-PI, Roman Kanivetsky, Research Associate, Three Graduate Reseach Assistants; **SDSU -** Boris Shmagin, two Graduate Research Assistants; **USGS –** Dave Lorenz, Don Hansen, Jim Stark; **Advisory assistance from EQB** – John Wells, Princesa van Buren

B. Project Impact
This project will provide information about the spatial distribution of sustainable water resources for three spatial scales for Minnesota. It will also provide the tools for estimating the temporal variability and response to climate change of sustainable water resources for those same spatial scales. This information is needed for water resource planning throughout the state, for the immediate future and for the distant future. In addition the study will also provide the design for monitoring of sustainable water supply into the future.

C. Time
Two year project duration. The proposed project requires two years to compile, link and analyze existing statewide hydrologic, landscape and climatic data. The identification of linkages between hydrologic data (streamflow, water levels in wells, water levels in lakes, etc.) and landscape features and climatic characteristics requires substantial analysis involving modeling and data mining techniques.

D. Long-Term Strategy
The proposed project builds on products generated in the Phase I project, which is developing maps of hydrologic unit areas for different spatial scales ranging from the state, to the region, to the county scale. The proposed project will use those established hydrologic units for developing multiscale maps of trends and risks in water resource sustainability and for developing sustainability monitoring systems. The statewide scale, two regions and three counties are considered in Phase I. Additional work will be needed to extend the methodologies and tools to other regions of the state.

There is also a long-term goal to be able to develop a Quantitative Information System (QIS) for sustainable management of water resources including tools for assessing any shortfall of ecosystem streamflow needs. Phase I is developing GIS maps needed for the QIS, but in future there is a need to actually develop the QIS framework.

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET

BUDGET ITEM - For a two-year project	AMOUNT	% FTE
Personnel: Costs include salary and fringe benefits (insurance, retirement)		
Roman Kanivetsky, Research Associate, UofM; Develop features for categories of hydrogeology, and overall implementation of sustainability concepts	$ 86,000	40%
Three (3) Graduate Research Assistants (Ph.D. students), UofM; GIS analyses, statistical analyses, physically based modeling, all under supervision of PI's and	$ 218,000	50%
Undergraduate Research Assistant, UofM; assist with data checking, acquistion of data from archives, graphical display development, acquisition of library	$ 10,000	25%
Contracts:		
South Dakota State University; Main effort for the hydrologic statistical analysis and development of prediction tools	$ 165,000	
USGS - Mounds View; Development of risk analysis for low-flow conditions and linkage with impact on ecological services for aquatic systems	$ 160,000	
Other:		
Travel - Instate and travel specifically to Brookings, SD to foster collaboration	$ 3,000	
Travel - 3 meetings to the American Geophysical Union to disseminate results and to learn about other/related approaches of benefit to this project	$ 4,500	
GIS software licenses - 2 years - for graduate student computers to perform work specifically associated with this project	$ 4,000	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 650,500	

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Remaining $ From Previous Trust Fund Appropriation (if applicable): ML2007, Chapt. 30, Section 2, Subdiv. 5l	$ 189,452	Unspent
Other Non-State $ Being Leveraged During Project Period: According to the joint funding agreement letter from Jim Stark at the USGS, they will be seeking matching funds through the cooperative funds program in USGS for federal fiscal year 2010 and 2011. At present the USGS is not able to allocate funds since the project starts before the beginning of the 2010 federal fiscal year.	$ -	Pending
Other State $ Being Spent During Project Period:	N/L	N/L
In-kind Services During Project Period: The USGS personnel involved with the project will be providing advice to activities on the project from which they receive no direct funding. Dr. Shmagin at SDSU will provide assistance beyond the scope of the funding for his part of the project. We also are assisted by the EQB (John Wells, Princesa van Buren) in receiving advice on state needs for new directions for work, and EQB also serves to review our results.	N/L	
Past Spending: ML2007, Chapt. 30, Section 2, Subdiv. 5l	$ 292,000	

Project Manager Qualifications.

Dr. John Nieber is a professor in the Department of Bioproducts and Biosystems Engineering at the University of Minnesota. He has been a faculty member at the University of Minnesota since 1985, and prior to that he was a faculty member at Texas A&M University for six years. He teaches courses in hydrology and water quality, and specializes in research in the topics of flow and transport in the vadose zone and ground water, and water management engineering. In addition to this general area of research he is currently conducting research on highway drainage, development of environmentally friendly and cost-effective drainage ditch design, stream classification for TMDL assessments, assessment of stormwater BMP effectiveness, and modeling of the hydrology and biogeochemistry of wetlands for TMDL assessment of wetland systems. He is the Principal Investigator for the University of Minnesota contract with the MPCA's Impaired Waters and Stormwater Program (Master Contractor), and is Principal Investigator on the currently funded LCCMR project "Water Resource Sustainability". He currently works with several graduate students and research associates in conducting his research. John Nieber works closely with other faculty in the department, including Drs. Bruce Wilson, Gary Sands, Roman Kanivetsky, and Sanguan Suh. The environmental and ecological engineering group also collaborates closely with other faculty in CFANS, the Institute of Technology, and the College of Biological Sciences. His responsibilities for the project on "**Assessing and Monitoring Water Resource Sustainability"** include:

- Manage all project personnel activities to keep the project on schedule with the stated objectives and outcomes/deliverables
- Work with selected physically-based models of flow in the vadose zone and ground water flow systems to assist with the interpretation of results derived from statistical analysis of hydrologic, climatic, and landscape data.

Organizational Description.

The research will be performed within the research guidelines of the University of Minnesota, and specifically it will be conducted within the Departments of Bioproducts and Biosystems Engineering (BBE) and Soil, Water and Climate (SWC). BBE is one of the new departments in the College of Food, Agriculture and Environmental Sciences (CFANS). An important part of the BBE department is the emphasis area of environment and ecological engineering. Working with John Nieber in BBE is Bruce Wilson, Roman Kanivetsky, and in SWC is David Mulla. The research will be conducted in collaboration with Boris Shmagin who is affiliated with the Department of Agricultural and Biosystems Engineering at South Dakota State University, and with David Lorenz, Don Hansen and Jim Stark who are all affiliated with the USGS at Mounds View. Boris Shmagin brings expertise in regional analysis, time series analysis, and multidimensional statistical analysis. The USGS partners bring expertise in ground water and surface water hydrology, regional analysis, hydrologic frequency analysis, low-flow hydrologic analysis, and analysis of water quality data.

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Location: Statewide; Southeastern Minnesota (Karst region); Twin Cities – St. Cloud Corridor; and Olmsted, Pope and Lac Qui Parle counties. There is an overlap of the Twin Cities – St. Cloud Corridor region with the Karst (Southeast) region.