Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2017 LCCMR Work Plan

Date of Submission: September 14, 2016

Date of Next Status Update Report: February 1, 2018

Date of Work Plan Approval: 06/07/2017

Project Completion Date: June 30, 2019

Does this submission include an amendment request? _No_

PROJECT TITLE: Assessment of Public Benefits of Protecting Source Water

Project Manager: Bonnie Keeler

Organization: Natural Capital Project, Institute on the Environment, University of Minnesota

Mailing Address: 325 Learning & Environmental Sciences, 1954 Buford Ave

City/State/Zip Code: St. Paul, MN 55108

Telephone Number: (612) 626-2120

Email Address: keeler@umn.edu

Web Address: http://environment.umn.edu/staff/bonnie-keeler/

Location: Statewide

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$320,000**
	Amount Spent:	**$0**
	Balance:	**$320,000**

Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 03b

Appropriation Language:
$320,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to map and quantify source water risks, determine ecosystem service valuation of clean water, and provide analyses of equity and community capacity to improve decisions about the protection and management of groundwater and surface water. This appropriation is available until June 30, 2020, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: What are the public benefits of protecting sourcewater?

II. PROJECT STATEMENT:

Access to clean safe water is essential for promoting health, recreation, and economic development in Minnesota. However, many of our state's most pressing water quality problems remain unsolved. Over 40% of our lakes and rivers are rated as "impaired" and a growing number of households and communities face rising costs and health risks due to contaminated drinking water. If we hope to reverse current trends of water quality decline and preserve the valuable ecosystem services provided by clean water, we need to change how we account for the value of our water resources. Current systematic *undervaluation* of water is contributing to the overuse of water and degradation of water quality in Minnesota and elsewhere.

The emphasis of the proposed work is on the value of sourcewater in Minnesota - the surface and groundwater resources that supply households and communities with their drinking water. Approximately 75% of Minnesota households rely on groundwater for household use and the majority of the land area in sourcewater areas is under private ownership. Land use and management actions on these lands that increase nutrients and other contaminants can affect the health and welfare of millions of Minnesotans. There are successful examples of private and public partnerships that have worked together to protect sourcewater and enhance valuable ecosystem services while supporting agricultural and rural economic development (e.g. Worthington Wells Wildlife Management Area). At the same time, other communities in Minnesota are facing known or unknown threats to their water supply with consequences for health and rising treatment costs.

Agency leaders and Gov. Dayton have identified an urgent need to map and quantify the risks facing sourcewater areas in Minnesota, better articulate the ***true value of clean water***, and develop practical approaches that enhance community capacity to protect sourcewater and ensure safe and equitable access to clean water for all Minnesotans. This project responds to that need with investments in three activities:

1) **Mapping land use change and risks to clean water for all 584 drinking water management areas.**
2) **Valuation of the multiple public benefits of land protection for clean water.**
3) **Assessing the equity implications of sourcewater protection and community capacity to protect land and improve water quality.**

These activities highlight potential risks and opportunities to protect water quality and provide multiple public benefits, identify financial practices or incentive programs that protect the value of clean water, and build capacity among citizens and decision-makers to take action in sourcewater protection areas to improve water quality and realize additional public benefits from land protection.

The proposed work builds on the LCCMR-funded project "Understanding Water Scarcity, Threats, and Values to Improve Management" awarded in 2015 to PI Keeler. The water scarcity project will assess how changes in precipitation and temperature interact with alternative scenarios of water demand to predict where there is likely to be water depletion in the future. These scenarios of water quantity will be used as inputs into the sourcewater protection analysis proposed here. Whereas the water scarcity project emphasizes water quantity, this project emphasizes water quality. In Minnesota, quantity and quality are related and this project will benefit from data on trends in both quality and quantity to estimate the risks and opportunities for sourcewater protection.

The project will focus on the 1.22 million acres in Minnesota designated as sourcewater protection areas, including both groundwater and surface water catchments. Outcomes of the work include maps and risk assessments for each drinking water management area, including evaluating current assumptions about travel time, threats and delineation of management zones. Additional products include spatially-explicit information about the benefits and costs of changes in water quality and distribution of costs to Minnesotans and assessments and recommendations for how to enhance community capacity to protect sourcewater.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of February 1, 2018:

Project Status as of July 1, 2018:

Project Status as of February 1, 2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Mapping land use change and risks to clean water
Description: In partnership with the Minnesota Department of Health (MDH), we will conduct a comprehensive risk assessment for all 584 drinking water supply management areas in Minnesota. We will improve and expand upon MDH's current approach to risk assessment by including new data on land use change and other potential threats to water quality or quantity such as population growth and expected changes in precipitation patterns. The work on land use change will build upon existing tools and approaches developed by the Natural Capital Project. We will adapt these tools to Minnesota and run alternative scenarios of the extent and intensity of future land use change in each sourcewater area. We will also assess how changing assumptions about aquifer vulnerability class and travel time of pollutants currently used by MDH affect the acreage of lands needing protection and potential costs of treatment or protection. Finally, we will account for uncertainty and develop management-relevant storylines that reflect a range of plausible futures for Minnesota sourcewater areas and communities. These activities will expand upon and enhance tools used by MDH to map sourcewater areas and identify risks to water quality.

Summary Budget Information for Activity 1:

ENRTF Budget:	**$ 104,000**
Amount Spent:	**$ 0**
Balance:	**$ 104,000**

Outcome	Completion Date
1. New risk maps and data on future land use trends and threats in each of the 584 sourcewater areas.	January 2018
2. Evaluation of current MDH approaches to assessing sourcewater vulnerability and recommendations for improved management and delineation of management areas. For example, we will evaluate how MDH estimates the travel time for pollutants and produce updated maps of sourcewater protection areas based on different assumptions of travel time and geologic vulnerability.	June 2018

Activity 1 Status as of February 1, 2018:

Activity 1 Status as of July 1, 2018:

Activity 1 Status as of February 1, 2019:

Final Report Summary:

ACTIVITY 2: Valuation of the multiple public benefits of clean water
Description: By not fully accounting for the value of clean water and land protection, we risk undervaluing and mismanaging our natural capital. We will build on ten years of experience at the Natural Capital Project to

advance our understanding of the multiple public benefits or "ecosystem services" associated with land protection or restoration with a focus on the value of clean water.

The proposed work will consist of three phases of analysis. First, we will assemble a dataset on avoided treatment costs for nitrate and other contaminants based on data provided by MDH and a comprehensive literature review from national surveys and datasets. We will combine treatment cost data with information on the potential economic impacts of exposure to nitrate and other contaminants. Second, we will estimate the economic value of agricultural production in each sourcewater area and other other land uses in order to estimate the "opportunity costs" of land protection. Opportunity costs reflect lost revenue from agriculture or development as a result of land acquisition or the adoption of best management practices that reduce yields or take lands out of production. Third, we will quantify other valuable public benefits related to recreation and tourism, cultural identity, wildlife and aquatic habitat, and reduced soil loss and erosion. We will not engage in new data collection to assess these services, but rather rely on literature estimates and previous approaches developed by the Natural Capital Project and elsewhere to estimate these values and how they compare to the values of water quality benefits. These activities will help to illuminate the true value of clean water and identify how this information can inform decisions ranging from payment programs or incentive schemes to evaluating the return on investment in land protection.

Summary Budget Information for Activity 2:

ENRTF Budget:	**$ 107,705**
Amount Spent:	**$ 0**
Balance:	**$ 107,705**

Outcome	Completion Date
1. Collection, visualization, and dissemination of ecosystem services valuation data for each sourcewater area (agricultural production, agricultural management practices, treatment costs, health, property values, recreation and tourism, cultural identity, habitat)	January 2018
2. Data and summary reports on the costs and public benefits associated with clean water and land protection and recommendations for mainstreaming these values in policy and agency decision making	December 2018

Activity 2 Status as of February 1, 2018:

Activity 2 Status as of July 1, 2018:

Activity 2 Status as of February 1, 2019:

Final Report Summary:

ACTIVITY 3: Assessment of equity and community capacity
Description: The costs of water pollution disproportionately affect rural, low income, and traditionally underrepresented populations. We will combine census data on demographics, income, and immigrant populations with the data collected in Activities 1 & 2 to quantify and report the equity implications of alternative protection strategies for clean water. This activity will allow MDH and other end users of the results to understand how activities in sourcewater protection may affect different communities and subpopulations around the state.

We also will conduct a series of focus groups with community actors and surveys across a geographically and demographically diverse sample of households to examine how different subpopulations use and value water, perceive water risk, and engage in water and land protection. We will conduct up to two focus group sessions in three "at-risk" communities and a broader resident survey in the regions. Insight gained from the focus groups

and surveys will be synthesized in a report identifying constraints to and opportunities for equitable sourcewater protection.

Focus groups will be conducted with community actors in rural, low income, and traditionally underrepresented populations to examine how varying subpopulations use and value water, perceive water risk and engage in water and land protection. We will identify opportunities and challenges to existing water protection programming with attention to issues of inclusion and equity. Comparative analysis will be conducted to examine convergent and divergent themes within and across study communities.

A resident survey will complement the focus groups to gain a broader understanding of water uses, values and risk perceptions. The survey instruments will be developed based on a review of relevant literature and previously tested instruments, as well as insights from project partners. Based on previous research, we hypothesize that sociodemographic characteristics (e.g., gender, age) will influence risk perception and ultimately civic engagement behaviors around sourcewater protection.

Summary Budget Information for Activity 3:

ENRTF Budget:	**$ 108,295**
Amount Spent:	**$ 0**
Balance:	**$ 108,295**

Outcome	Completion Date
1. Report of the equity implications of alternative water management strategies, including how different communities use and value clean water. The report will include maps and planning tools that can be used to inform future investments in sourcewater protection.	January 2019
2. Focus groups and surveys in communities identified as "at-risk" based on Activity 1 that reveal how different subgroups use and value water, perceive risk, and engage in protection. Results will be synthesized in a report identifying constraints to and opportunities for sourcewater protection based on community assessments.	June 2019

Activity 3 Status as of February 1, 2018:

Activity 3 Status as of July 1, 2018:

Activity 3 Status as of February 1, 2019:

Final Report Summary:

V. DISSEMINATION:

Description: All data, analyses, and methods will be documented by the project team and shared with LCCMR and project parters at MDH. Insights from the work will be communicated to the public and the research community via blog posts on the IonE Eye on Earth blog, through the Natural Capital Project website, and through peer-reviewed publications. Plans are also underway to launch a web-based water valuation to be hosted on the Institute on the Environment website targeting an audience of users in Minnesota and globally interested in quantifying the value of clean water and seeking data resources, methodologies, and economic tools relevant to their question and projects of interest.

Status as of February 1, 2018:

Status as of July 1, 2018:

Status as of February 1, 2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:
A. Preliminary ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel	$61,000	One Lead Scientist and PI to oversee Activities 1 and 2 and lead project and dissemination at 25% FTE each year for 2 years; 66.3% salary, 33.7% benefits
	$16,000	One Faculty and Co-PI to oversee Activity 3 and lead project and dissemination at 10% FTE for 1 year (one month in year two); 66.3% salary, 33.7% benefits
	$36,000	One Project Coordinator and Research Support Staff Person to support project management, analysis and reporting at 25% FTE each year for 2 years; 72.6% salary and 27.4% benefits
	$115,000	One Research Analyst to support data collection, spatial mapping, and biophysical and economic analysis at 100% FTE each year for 2 years; 72.6% salary and 27.4% benefits
	$43,000	One University of Minnesota Graduate Student Assistant to support survey development, focus groups and analysis during Activity 3 at 50% FTE for 1 year; 17% salary and 83% benefits which include academic year tuition, fiscal year health care, and social security and Medicare for 6.5 summer pay periods
	$15,000	Two Summer Undergraduate Student Interns to support various project activities at 29% FTE total each year for 2 years.
Survey costs and supplies	$18,000	Survey distribution costs including printing and mailing for 4,500 surveys with cover letters and postage-paid return envelopes; 3 waves of mailing. Based on estimated costs incurred in previous surveys administered by PI Davenport.
Focus Group Expenses	$6,000	Focus group room rentals and hospitality. Based on estimated expenses incurred in previous focus groups conducted by PI Davenport in Minnesota.
Publication and dissemination of results	$3,575	Publication fees for disseminating project results in peer-reviewed open access journal such as the Journal of Soil and Water Conservation or PLOS One. Page fees at JSWC are $190/page plus $750 for open access =

		$1890 for a seven page article or $1,495 for PLOS ONE. We anticipate this work resulting in two open access publications for an estimated total cost of $3,385.
Presentation of work at regional conference or meeting	$425	Registration and fees for presentation of results at regional conferences. An estimated $425 is requested to support registration fees, poster printing, and attendance and presentation at one meeting or conference.
Travel	$6,000	Travel within Minnesota for data collection, focus groups and researcher attendance at regional conference to present project findings. Funds used to pay University of Minnesota rental vehicle and mileage (75%) and meals (25%) for researchers, graduate student and interns. Assumes $300 per trip for 2 people to 2 locations for Activity 2 ($1,200) and $300 per trip for 2 people to 8 locations for Activity 3 ($4,800). Expenses reimbursed per travel guidelines as set by the University of Minnesota.
TOTAL ENRTF BUDGET:	**$320,000**	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than $5,000: N/A

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 4.18 FTEs

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: N/A

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
The Natural Capital Project and Institute on the Environment, University of Minnesota. In kind support. The IonE has supported and will continue to support research and outreach activities conducted by the Natural Capital Project. Total funding for the research program to date is $1.0 million, with an additional $125,000 projected for FY17 and FY18.	N/A	N/A, Secured	Although IonE funding is not dedicated or committed specifically to this proposal, the organization can support research, software, data hosting and complementary activities.
University of Minnesota. In kind support. UMN Facilities and Administrative rate is 53% of	$169,600	N/A, Secured	Office space, IT services, and administrative / financial services in support of the project.

modified total direct costs (total direct less graduate student fringe, capital equipment, subawards over $25,000 and on-site facilities rental). The amount here is the total estimated contribution, if F&A expenses would have been allowed on the project.			
TOTAL OTHER FUNDS:	**$169,600**	**N/A**	

VII. PROJECT STRATEGY:

The project will be led by Dr. Keeler, Director and Lead Scientist of the Natural Capital Project at the University of Minnesota's Institute on the Environment and Dr. Davenport, Associate Professor in the Department of Forest Resources at the University of Minnesota. The project will support several new positions, including a project coordinator, research analyst, two summer interns recruited from local colleges or universities, and one graduate research assistant. The project was developed in partnership with the Minnesota Department of Health and will be conducted in close collaboration with agency partners.

A. Project Partners:

Partners receiving ENRTF funding: N/A

Partners NOT receiving ENRTF funding

- Tannie Eshenaur, Planning Director, Drinking Water Protection, Minnesota Department of Health, Collaborator and Advisor

B. Project Impact and Long-term Strategy: This project is a stand-alone effort and not part of a longer-term funding request, although it builds and expands on a current LCCMR project led by Keeler, Brauman, and Twine entitled "Assessing Water Scarcity and Threats". The project also leverages a 2015 statewide assessment of Soil and Water Conservation District capacity to protect groundwater conducted by Pradhananga, Davenport, and Perry and funded by the Minnesota Department of Natural Resources.

The project outcomes include detailed assessments of risks to clean water and the value of sourcewater protection in Minnesota. In addition, the project will highlight the importance of considering equity and understanding local capacity in key sourcewater areas for community-based land protection for clean water. All data generated as part of the project will be shared with agency partners and made publicly available through publication in a peer-reviewed open access journal.

The project team is currently seeking funding to expand the work beyond Minnesota and across scales. We hope that success in this project will allow the team to extend the analyses to city and watershed planning audiences and to regional basin-scale work in the Mississippi River.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
Environment and Natural Resources Trust Fund – **M.L. 2015, Chp. 76, Sec. 2, Subd. 04a**: "Understanding Water Scarcity, Threats, and Values to Improve Management." Appropriation of cash funds ($234,936, with $190,000 remaining from existing ENRTF Appropriation as of January 2016) awarded July 1, 2015 to PI's Keeler, Brauman, and Twine used to assess water scarcity and threats in MN. This project will	July 1, 2015 – June 30, 2018	$234,936 ($190,000 remaining as of January 2016)

generate statewide maps and data on future precipitation, temperature, and water scarcity that will inform the sourcewater risk assessments proposed in this study. This project has an end date of June 30, 2018.		
Minnesota Department of Natural Resources. **Groundwater management: Capacity assessment at the local level.** PI M. Davenport. Cash funds of $16,868 awarded to support Davenport, Pradhananga and Perry in analysis to identify threats to groundwater quality and quantity across the state as perceived by Soil and Water Conservation District staff. The study helps to prioritize threats, as well as identify areas for capacity building. Outcomes of the study have been a series of workshops for Soil and Water Conservation District staff and other water managers.	January 1, 2015 – September 30, 2015	$16,868 (project completed in 2015)

VIII. REPORTING REQUIREMENTS:

- **The project is for 2 years, will begin on 07/01/2017, and end on 06/30/2019.**
- **Periodic project status update reports will be submitted 02/01 and 07/01 of each year.**
- **A final report and associated products will be submitted between June 30 and August 15, 2019**.

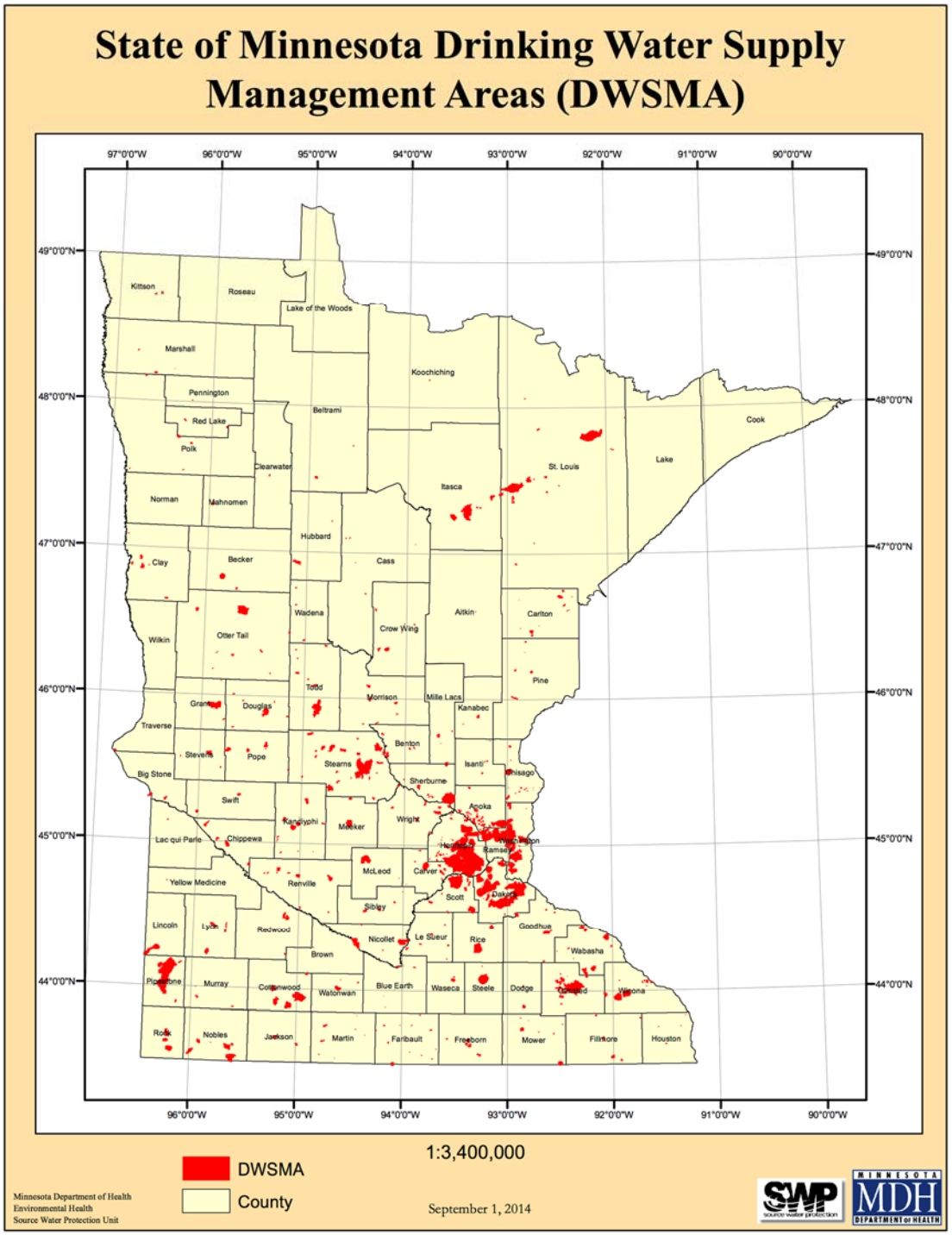
IX. VISUAL COMPONENT or MAP(S): See attached figure.

Environment and Natural Resources Trust Fund
M.L. 2017 Project Budget

Project Title: Assessment of Public Benefits of Protecting Source Water
Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 03b
Project Manager: Bonnie Keeler
Organization: Natural Capital Project, Institute on the Environment, University of Minnesota
M.L. 2017 ENRTF Appropriation: $320,000
Project Length and Completion Date: 2 Years, June 30, 2019
Date of Report: 9/14/2016

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	***Mapping land use change and risks to clean water***			***Valuation of the multiple public benefits of clean water***			***Assessment of equity and community capacity***				
Personnel (Wages and Benefits)	$104,000		$104,000	$104,000		$104,000	$78,000		$78,000	$286,000	$286,000
Bonnie Keeler, Lead Scientist and PI: $61,000 (66.3% salary, 33.7% benefits); 25% FTE each year for 2 years											
Mae Davenport, Faculty and Co-PI: $16,000 (66.3% faculty salary, 33.7% benefits); 10% FTE for 1 year (one month in year two)											
1 Project Coordinator and Research Support (support project management, analysis and reporting): $36,000 (72.6% salary and 27.4% benefits); 25% FTE each year for 2 years											
1 Research Analyst (support data collection, spatial mapping, and biophysical and economic analysis): $115,000 (72.6% salary and 27.4% benefits); 100% FTE each year for 2 years											
1 University of Minnesota Graduate Student Assistant: $43,000 (17% salary and 83% benefits which include academic year tuition, fiscal year health care, and social security and Medicare for 6.5 summer pay periods); 50% FTE for 1 year											
2 Summer Undergraduate Student Interns: $15,000 (100% salary, part-time, hourly pay; $12.50/hr for 300 hours per student per year); 29% FTE each year for 2 years											
Supplies											
Survey distribution costs including printing and mailing for 4500 surveys with cover letters and postage-paid return envelopes; 3 waves of mailing							$18,000		$18,000	$18,000	$18,000

Other											
Focus group room rentals and hospitality. Based on estimated expenses incurred in previous focus groups conducted by PI Davenport in Minnesota.							$6,000		$6,000	$6,000	$6,000
Publication fees for disseminating project results in peer-reviewed open access journal such as the Journal of Soil and Water Conservation or PLOS One. Page fees at JSWC are $190/page plus $750 for open access = $1890 for a seven page article or $1,495 for PLOS ONE. We anticipate this work resulting in two open access publications for an estimated total cost of $3,385.				$2,080		$2,080	$1,495		$1,495	$3,575	$3,575
Registration and fees for presentation of results at regional conferences. An estimated $425 is requested to support registration fees, poster printing, and attendance and presenta at one meeting or conference.	$0		$0	$425		$425			$0	$425	$425
Travel expenses in Minnesota											
Travel within Minnesota for data collection, focus groups and researcher attendance at regional conference to present project findings. Funds used to pay University of Minnesota rental vehicle and mileage (75%) and meals (25%) for researchers, graduate student and interns. Assumes $300 per trip for 2 people to 2 locations for Activity 2 ($1,200) and $300 per trip for 2 people to 8 locations for Activity 3 ($4,800). Expenses reimbursed per travel guidelines as set by the University of Minnesota.	$0		$0	$1,200		$1,200	$4,800		$4,800	$6,000	$6,000
COLUMN TOTAL	**$104,000**	**$0**	**$104,000**	**$107,705**	**$0**	**$107,705**	**$108,295**	**$0**	**$108,295**	**$320,000**	**$320,000**



Project Visual: Map of active Drinking Water Supply Management Areas (DWSMA) in Minnesota, referred to in the proposal as “sourcewater areas”. Boundaries for each DWSMA are defined based on an assumption of a ten-year travel time for contaminants to reach water supplies. Some experts have suggested that a fifty-year travel time assumption is more appropriate. We will apply varying assumptions about sourcewater travel time and vulnerability to delineate new boundaries for each DWSMA and combine with information on water risks due to land conversion. These maps and data are essential to communities in developing their sourcewater protection plans. However, lack of resources and capacity often limits the implementation of local measures to protect water and communities are not always aware of threats to their water supply or the true value of sourcewater protection. The proposed work will address data gaps on water risks and economic analyses of the multiple benefits of sourcewater protection and assess community capacity to implement changes on the ground.