Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2014 Work Plan

Date of Report: 8 May 2014

Date of Next Status Update Report: 15 October 2014

Date of Work Plan Approval:

Project Completion Date: 30 June 2016

Does this submission include an amendment request? No

PROJECT TITLE: Measuring hydrologic benefits from Glacial Ridge habitat restoration

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Location: The work will occur in and around the Glacial Ridge National Wildlife Refuge, Polk and Red Lake Counties. The results of the study will be applied statewide.

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$168,000**
	Amount Spent:	**$0**
	Balance:	**$168,000**

Legal Citation: MN Laws 2014, Chapter 226, Section 2, Subd. 3m

Appropriation Language:

$168,000 the second year is from the trust fund to the commissioner of natural resources for an agreement with the Red Lake Watershed District and the United States Geological Survey for completion of the analysis of flooding and water-quality benefits resulting from wetland and prairie restorations at Glacial Ridge National Wildlife Refuge.

I. PROJECT TITLE: Measuring hydrologic benefits from Glacial Ridge habitat restoration

II. PROJECT STATEMENT: Flooding, degraded water quality and habitat loss are among the greatest natural resource challenges faced by Minnesotans. Starting in the year 2000, a diverse group of more than thirty partners set out to demonstrate that large-scale habitat restoration is a viable way to reduce flooding and improve water quality. Among the largest prairie-wetland restorations in the world, the Glacial Ridge Project spans more than 22,000 acres, and is adjacent to an additional 16,000 acres of private and public conservation land. **How significant are the benefits of large-scale habitat restoration to flood reduction and water quality**? This project is an historic opportunity to provide real numbers that measure these improvements. The overall goal of the project is to characterize and measure the amount of flood reduction, water-quality improvement, and ecosystem-function change of the hydrologic system resulting from wetland and prairie restoration at Glacial Ridge. In so doing, the project will measure the success of restoration techniques employed on this land. The project will use these results to identify other parts of Minnesota that could benefit from similar restorations and quantify the resulting potential water and habitat improvements.

Glacial Ridge presents a unique opportunity to measure restoration benefits because of its size and a $1.8-million comprehensive hydrologic characterization of the area prior to restoration. This study was conducted by the U.S. Geological Survey (USGS) during 2002–5. The resulting hydrologic baseline makes it possible to quantify to what degree the restorations contributed to flood reduction and water quality improvements. The USGS began the post-restoration characterization in 2011 with initial funds provided by the U.S. Fish and Wildlife Service's (USFWS) Plains and Prairie Potholes Landscape Conservation Cooperative, USFWS Region 3, Glacial Ridge Wildlife Refuge, and the City of Crookston. This initial $562,000 investment funded data collection needed to determine hydrologic benefits through 2012. The LCCMR provided $400,000 of the $568,500 needed to complete the project beginning in 2013. This further LCCMR funding will complete this project in its full detail and produce the definitive evidence that habitat restoration generates big benefits for flood reduction and water-quality improvement.

The project is divided into 3 main activities:

Water flows—the amount and directions of water flowing through the groundwater and surface-water system of the restored wetland and prairies will be characterized and measured. This activity will produce surface-water and groundwater balances in six ditch basins to quantify water flows after wetland and prairie restorations. Two basins have small restored areas and will act as controls. Four other basins have extensive restored areas and will be treatments basins. The water balances will be calculated from measurements of groundwater and surface-water levels, from ditch flows, and from weather data, including rainfall, temperature, humidity, and wind speed. The flows in each part of the water cycle will characterize the pattern of water movement now that the wetland and prairie restorations have been completed.

Water quality—the restored area will be characterized and analyzed for variability and trends. Groundwater samples will be collected 5 times per year for two years at 12 wells and analyzed for nutrients. Surface water will be collected at 6 ditches and analyzed for nutrients and suspended sediment concentration. All water samples will be measured for field characteristics including alkalinity concentrations. At least 10 percent of water samples collected will be sample replicates or blank samples to assure the quality of all samples collected. The samples will document the state of post-restoration water quality and will be analyzed with samples collected during the previous 10 years to define water-quality trends in the study area.

Pre-and post-restoration changes in water flow and quality at Glacial Ridge will be analyzed and attributed to the restorations, or other factors (e.g. weather variability or climate change). The effects of the restoration changes would then be extended to other parts of Minnesota where such restorations could be implemented to provide similar benefits. This analysis will identify areas of Minnesota where restorations will have the most benefit and quantify the size of those benefits. This knowledge is crucial to an accurate restoration cost/benefit analysis. Landscape characteristics like soil type, slope, percent of land restored, previous land use, and existing reservoirs of native plant materials may be important factors that explain the success of restorations to reduce flooding and improve water quality.

Through these activities, this project will document the post-restoration state of the water at Glacial Ridge and identify those landscape characteristics that are most important to successful wetland and prairie restorations. We will then analyze the Minnesota landscape using geographical information to identify areas where these characteristics exist. These will be the areas that hold the most promise for decreased flooding and improved water quality from wetland and prairie restorations. Further, an estimate of the degree of improvement could be made based on the degree of improvements documented in this study at the Glacial Ridge National Wildlife Refuge.

III. PROJECT STATUS UPDATES:

Project Status as of October 2014:

Project Status as of March 2015:

Project Status as of October 2015

Project Status as of March 2016:

Project Status as of June 2016:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1:

Description: Measure and characterize water flows through all parts of the water cycle in 2 additional surface (SW) and groundwater (GW) basins covering an additional 14111 acres for a total of 6 basins covering 2764 acres. The parts of the water cycle through which flow will be measured are:

Precipitation: measured every 15 minutes at a network of 10 rain gages, one more of which is funded by this project.

Net surface run off: measured every 15 minutes at 2 more ditch gages (for a total of 6 gages) located at the edge of the study area

Groundwater discharge to ditches: calculated from base-flow separations of hydrographs from the 2 more gaged ditches (for a total of 6)

Net infiltration: the amount of water that gets to the water table (**net groundwater recharge**), calculated from water level and temperature measured every hour at 3 more wells in the two more gaged ditch basins (for a total of 12 gages in 6 basins).

Evapotranspiration: calculated using publicly available weather and satellite data

Changes in groundwater storage: calculated from bimonthly synoptic water-level measurement at about 100 sites funded by the previous LCCMR grant.

These data will be combined into water-balance equations to account for all water moving through the two more ditch basins (for a total of 6 basins) in the study area. The variability in flow among basins and through time will be explained by atmospheric factors like precipitation, and by landscape factors like percent restored land. These measurements will document the post-restoration state of the water flow through the study area. Differences among basins in water flow among the components of the water cycle will be documented and explained on the basis of land use, weather, and climate differences and changes in space and time.

Summary Budget Information for Activity 1:

ENRTF Budget: $83,163
Amount Spent: $ 0
Balance: $83,163

Activity Completion Date:

Outcome	Completion Date	Budget
1. Flows are measured in all components of the water cycle in 2 additional SW basins	October 2015	$48,910
2. Flow variability is explained by relevant atmospheric and landscape factors	June 2016	$34,253

Activity Status as of October 2014:

Activity Status as of March 2015:

Activity Status as of October 2015:

Activity Status as of March 2016:

Activity Status as of June 2016:

ACTIVITY 2:

Description: Measure and characterize water quality in two additional groundwater and surface-water basins for comparison with pre-restoration water quality.

Water samples will be collected at 3addition wells and 2additional streams (for a total of 12 wells and 6 streams) during the two-year period of October 2013 through September 2015. Groundwater samples will be collected bi-monthly (except February), measured for field characteristics including alkalinity concentrations, and analyzed for nutrient concentrations. Surface-water samples will be collected bi-monthly, and measured and analyzed for the same characteristics and concentrations as groundwater, plus suspended sediment concentration. One addition replicate and one additional blank sample (for a total of 7 each) will be collected from groundwater and surface-water samples to ensure that the analytical results represent the quality of the sampled waters.

The post-restoration state of water at Glacial Ridge will be characterized by the results of the analyses of these samples. The results of these samples will be combined with the results of samples collected during the previous 10 year and analyzed for temporal variability and trends in concentration. Water-quality differences among basins and through time will be documented and observed differences will explained on the basis of land use, weather, and climate differences and changes.

Summary Budget Information for Activity 2:

ENRTF Budget: $31,980
Amount Spent: $ 0
Balance: $31,980

Activity Completion Date:

Outcome	Completion Date	Budget
1. GW and SW post-restoration status and trend sampling for nutrients and suspended sediment at 3 additional wells and 2 additional streams.	October 2015	$23,773
2. Water-quality trend and variability analysis including additional analyses	June 2016	$8,207

Activity Status as of October 2014:

Activity Status as of March 2015:

Activity Status as of October 2015:

Activity Status as of March 2016:

Activity Status as of June 2016:

ACTIVITY 3:

Description: Attribute water-flow and -quality changes to wetland and prairie restorations in two additional groundwater and surface-water basins and extend results to the rest of Minnesota, where appropriate, incorporating additional water flow and quality data.

- Compare changes in flows and water quality between pre- and post-restoration waters

When compared with the results of the pre-restoration study results, the water-flow and -quality measurements and analyses produced by this study will show how much flood reduction and water-quality improvement has occurred in the Glacial Ridge area as a result of wetland and prairie restoration.

- Attribute any changes to restorations or other factors such as weather variability and climate change.

Attributing flood reduction and water-quality improvements to restorations can be complicated by the vagaries of weather and by changing climate conditions, however. By comparing the amount of flood reduction among the four studied basins with the amount of restoration in the basins, we can identify and quantify the flood reduction produced by the restored wetlands and prairies. Likewise, by comparing the amount of water-quality improvement among the four studied basins with the amount of restoration in the basins, we can identify and quantify the water-quality improvement produced by the restored wetlands and prairies.

- Identify other parts of Minnesota that show promise for restoration and quantify benefits.

Once the amount of improvement that came from restorations has been quantified, we can look for landscape characteristics like soil type, land slope, percentage of remaining wetlands, original land cover and current land use to explain differences in improvements observed among the four basins studied. After identifying the landscape characteristics that maximize restoration benefits, we can identify other part of Minnesota that share these characteristics and would benefit most from wetland and prairie restorations in terms of flood reductions and water-quality improvements. Using the data from Glacial Ridge as a guide, we can estimate the amount of benefit one could expect from such restorations.

Summary Budget Information for Activity 3:

ENRTF Budget: $52,856
Amount Spent: $ 0
Balance: $52,856

Activity Completion Date:

Outcome	Completion Date	Budget
1. Pre- and post-restoration hydrologic comparison	June 2016	$9,364
2. Extend restoration hydrologic implications to other areas of Minnesota	June 2016	$12,485
3. Final project report	June 2016	$31,0073

Activity Status as of October 2014:

Activity Status as of March 2015:

Activity Status as of October 2015:

Activity Status as of March 2016:

Activity Status as of June 2016:

Final Report Summary:

V. DISSEMINATION:

Description: The additional results of this study will be reported in the same U.S. Geological Survey Science-Investigations report as are the results of the original 2013 LCCMR grant. This report will parallel USGS SIR 2007-5200, which reports on the hydrology of Glacial Ridge prior to wetland and prairie restoration. Periodic progress reports and the results of all research done at the Glacial Ridge NWR are posted to the following website, which is maintained by The Nature Conservancy, the U.S. Fish and Wildlife Service, and the USGS: https://sites.google.com/site/largescaleresto/. A copy of the USGS pre-restoration study is available at this site. All data collected for this study will be available from the USGS at the following map-based website: http://maps.waterdata.usgs.gov/mapper/. A site-based website will also be available: http://waterdata.usgs.gov/mn/nwis/. Interim and final results from the study will be presented at Minnesota and national scientific conferences. The project manager will also be available to make ad hoc presentations to managers and the public.

Activity Status as of October 2014:

Activity Status as of March 2015:

Activity Status as of October 2015:

Activity Status as of March 2016:

Activity Status as of June 2016:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Explanation
Red Lake Watershed District		
Personnel:	$602	1 administrator, Red Lake Watershed District, project administration, 0.3%-time for 2 years, 75% salary, 25% benefits
Professional/Technical/Service Contracts – U.S. Geological Survey		
Personnel (including USGS contract):	$ 145,774	• 1 hydrologist, USGS project management and groundwater specialist, 21% time for 3 years, 75% salary, 25% benefits • 1 hydrologist, USGS surface-water specialist, 4% time for 2 years, 75% salary, 25% benefits • 1 hydrologic technician, USGS groundwater specialist, 6% time for 2 years, 75% salary, 25% benefits • 1 hydrologic technician, USGS surface-water specialist, 7% time for 2 years, 75% salary, 25% benefits • 1 student intern, USGS, 15% time for 2 years, 75% salary, 25% benefits
		•
Professional/Technical/Service Contracts:	$9,408	• 3 groundwater hydrograph data collection, processing and analysis (USGS)
Laboratory Analyses	$4,730	USGS National Water-Quality Laboratory water analyses
Equipment/Tools/Supplies:	$3,349	USGS: Replacement equipment: 1 pressure transducers ($1070 ea.), data logger upgrades, telemetry modems, water-quality meters, probes, pumps sampling tubes, water filters, etc.
Travel Expenses in MN:	$3,872	USGS: Lodging, meals, vehicles
Other	$265	USGS: telemetry, sample shipping
TOTAL ENRTF BUDGET:	**$168,000**	

Explanation of Use of Classified Staff: N/A

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

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 1.66 FTE

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0.1 FTE

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state: U.S. Geological Survey Cooperative Matching Program	$67,242	$0	Personnel, equipment, supplies, travel, training, quality assurance, expert support and consultation, office costs, computers and support, report production,
U.S. Fish and Wildlife In-Kind Services	$20,457	$0	Personnel
TOTAL OTHER FUNDS:	**$87,699**	**$0**	

VII. PROJECT STRATEGY:

A. Project Partners:

- Myron Jesme, Administrator, Red Lake Watershed District. Mr. Jesme will be the administrator of the project. The District will be receiving minimal ENRTF funds for project oversight and reporting.
- Tim Cowdery, Hydrologist, U.S. Geological Survey. Mr. Cowdery will be the principal investigator of the project. The USGS will be contributing 33% of the non-water analysis project funds. The USGS will be receiving nearly all of the ENRTF funds. Mr. Cowdery is a principal investigator of the related USFWS Land Conservation Cooperative (LCC) project.
- Josh Eash, Hydrologist, U.S. Fish and Wildlife Service. Mr. Eash is a principal investigator of the USFWS LCC project, is a project science advisor and provides field support for data collection. Mr. Eash will be providing support to the project but will not be receiving project funds.

B. Project Impact and Long-term Strategy:

This proposal partially funds the final 2 years of the second part of a 14-year effort to scientifically document the flood-control, water-quality and habitat benefits of wetland and prairie restoration. The results of this second, post-restoration study will be compared to the initial $1.8-million pre-restoration hydrologic characterization to measure restoration success. Analysis of hydrologic and habitat changes resulting from wetland and prairie restoration at Glacial Ridge will identify promising restoration areas across Minnesota and quantify the benefits of restoration in those areas.

Water-quality analyses of agricultural herbicides and their metabolites were included in the 2005 pre-restoration study. Funding such sampling in the future would provide more complete understanding of water-quality benefits of wetland and prairie restorations, but exceed the funding available in this grant.

C. Spending History:

Funding Source	Oct. 2002–Dec. 2006	Jan. 2006–Dec. 2010	Jan. 2011–June 2013	July 2013–June 2016
MN Pollution Control Agency Clean-Water Partnership Grant	$900,000			
U.S. Geological Survey Cooperative Matching Program	$900,000	260,000	$220,667	
U.S. Fish and Wildlife Service Ecological Contaminants grant				
U.S. Fish and Wildlife Service Landscape Conservation Cooperative grant		260,000	$200,000	
U.S. Fish and Wildlife Service regional funds			$100,000	
U.S. Fish and Wildlife Service Glacial Ridge NWR funds			$30,000	
City of Crookston			$1,000	
2013 LCCMR grant				$400,000

VIII. ACQUISITION/RESTORATION LIST: N/A

IX. VISUAL ELEMENT or MAP(S): see Glacial Ridge 2014 maps.pdf

X. ACQUISITION/RESTORATION REQUIREMENTS WORKSHEET: N/A

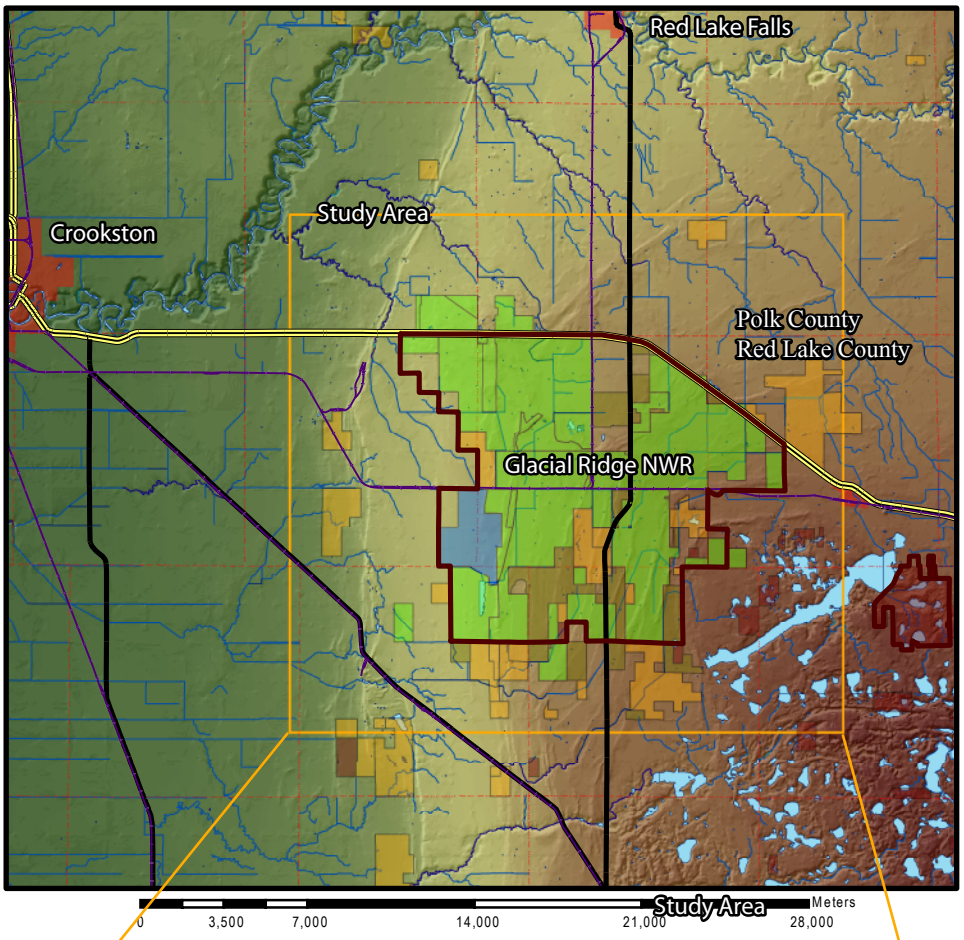
XI. RESEARCH ADDENDUM: see Glacial Ridge 2014 Research Addendum.docx. This is the original USGS-approved, colleague-reviewed project proposal. It includes work not funded by the LCCMR. The proposal timeline is also obsolete because adequate funding was not secured for federal fiscal years 2012 and 2013. It contains work done with funds from the 2013 LCCMR grant. This proposal can be modified to include only LCCMR-funded work, if necessary.

XII. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than 15 October 2014, 15 March 2015, 15 October 2015, and 15 March 2016. A final report and associated products will be submitted between June 30 and August 15, 2016.

Environment and Natural Resources Trust Fund
M.L. 2014 Project Budget
Project Title: Measuring hydrologic benefits from Glacial Ridge habitat restoration
Legal Citation: MN Laws 2014, Chapter 226, Section 2, Subd. 3m
Project Manager: Tim Cowdery
Organization: U.S. Geological Survey in cooperation with the Red Lake Watershed District
M.L. 2014 ENRTF Appropriation: $ 168,000
Project Length and Completion Date: 2 Years, June 30, 2016
Date of Report: 22 May 2014

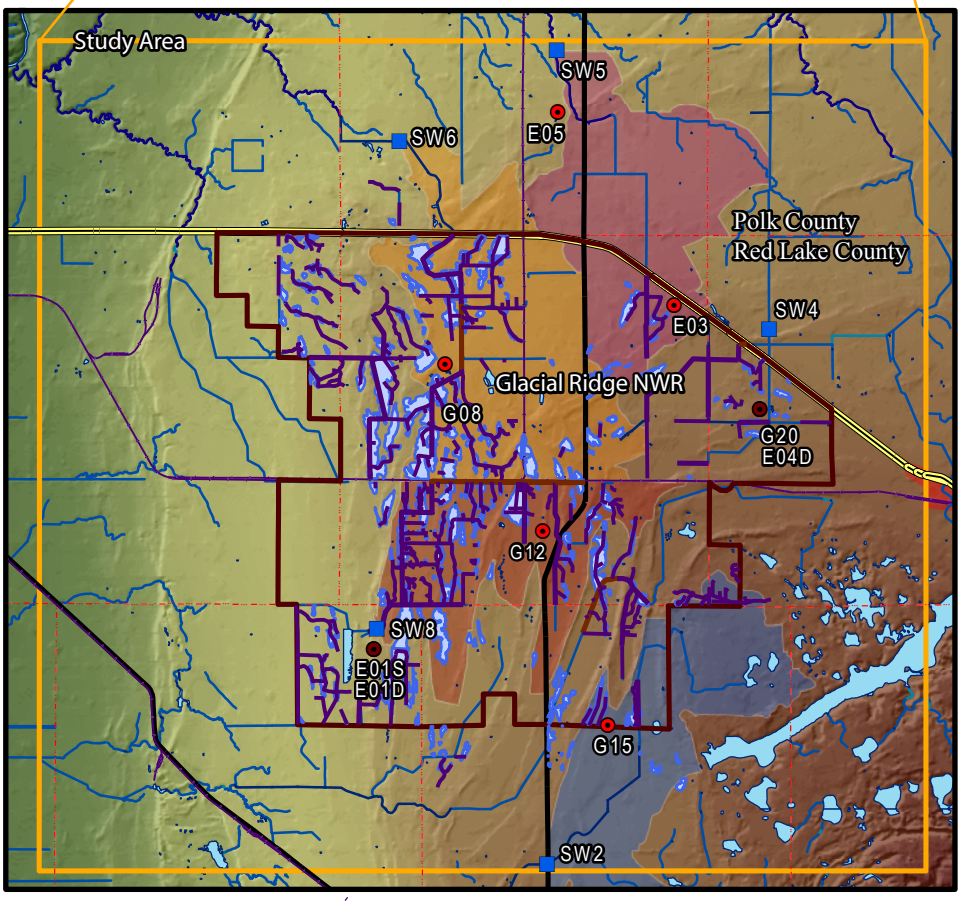
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	Measure and compare water flows at additional sites			Measure and compare water quality at additional sites			Attribute benefits and extend results				
Personnel (Wages and Benefits)											
1 administrator, Red Lake Watershed District, project adminstration, 0.3%-time for 2 years, 75% salary, 25% benefits	$ 602	$ -	$ 602							$ 602	$ 602
Professional/Technical/Service Contracts with USGS											
Personnel (Wages and Benefits)	$ 68,707	$ -	$ 68,707	$ 24,211	$ -	$ 24,211	$ 52,856	$ -	$ 52,856	$ 145,774	$ 145,774
USGS Contract (in bold box) 1 hydrologist, USGS project management and groundwater specialist, 21% time for 3 years, 75% salary, 25% benefits ($96,593)											
1 hydrologist, USGS surface-water specialist, 4% time for 2 years, 75% salary, 25% benefits ($11,224)											
1 hydrologic technician, USGS groundwater specialist, 6% time for 2 years, 75% salary, 25% benefits ($8,840)											
1 hydrologic technician, USGS surface-water specialist, 7% time for 2 years, 75% salary, 25% benefits ($16,407)											
1 student intern, USGS, 15% time for 2 years, 75% salary, 25% benefits ($12,710)											
Professional/Technical/Service Contracts by USGS USGS groundwater hydrograph collection and processing: 3 sites	$ 9,408	$ -	$ 9,408							$ 9,408	$ 9,408
Laboratory analyses USGS National Water-Quality Laboratory: 29 groundwater nutrient and 20 surface-water nutrient and suspended sediment samples				$ 4,730	$ -	$ 4,730				$ 4,730	$ 4,730
Equipment/Tools/Supplies: Sampling supplies: filters, preserv. acid				$ 817	$ -	$ 817				$ 817	$ 817
Expendable groundwater and surface-water gaging equipment: pressure transducers (1 transducers, $1,070 each), data loggers, telecommunication equipment, etc.	$ 1,312	$ -	$ 1,312							$ 1,312	$ 1,312
Water-quality sampling equipment: water-quality meters, probes, pumps, sample tubes, etc.				$ 1,220	$ -	$ 1,220				$ 1,220	$ 1,220
Travel expenses in Minnesota: Lodging: $85 per night, 12 person-weeks	$ 1,058	$ -	$ 1,058	$ 369	$ -	$ 369				$ 1,427	$ 1,427
Meals: $51 per day, 12 person-weeks	$ 750	$ -	$ 750	$ 262	$ -	$ 262				$ 1,012	$ 1,012
Vehicles: 750 miles/trip, 12 trips	$ 1,062	$ -	$ 1,062	$ 371	$ -	$ 371				$ 1,433	$ 1,433
Other Data telemetry phone line	$ 114	$ -	$ 114							$ 114	$ 114
Sample shipping	$ 151	$ -	$ 151							$ 151	$ 151
COLUMN TOTAL	**$ 83,163**	**$ -**	**$ 83,163**	**$ 31,980**	**$ -**	**$ 31,980**	**$ 52,856**	**$ -**	**$ 52,856**	**$ 168,000**	**$ 168,000**



Glacial Ridge Project Area

Contiguous Conservation Lands

- Restored Glacial Ridge Lands (22,000 acres)
- Other Federal Lands (2,000 acres)
- Scientific and Natural Area (1,690 acres)
- Other State Lands (7,300 acres)
- Private (NRCS Wetland Reserve Program, 5,000 acres)



Glacial Ridge Study Area

- Well Nest
- Well
- Ditch Gage
- Abandoned Ditch (126 miles)
- Restored Wetland (8,000 acres)

Other colored areas:
water-balance basins (22,136 acres)