



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-035

Proposal Title: Mapping Southwest Minnesota's Hidden Aquifers

Project Manager Information

Name: Aaron Hirsch

Organization: U of MN - MN Geological Survey

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Project Basic Information

Project Summary: Improve our knowledge of the limited groundwater availability in Southwest Minnesota by conducting airborne electromagnetic (AEM) surveys over Rural Water Districts and Source Water Protection Areas.

ENRTF Funds Requested: \$654,000

Proposed Project Completion: March 31, 2030

LCCMR Funding Category: Water (B)

Project Location

What is the best scale for describing where your work will take place?

Region(s): SW

What is the best scale to describe the area impacted by your work?

Region(s): SW

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Rural water districts (RWDs) provide reliable and safe drinking water to many communities in southwest Minnesota, but these public water supplies have relatively scarce groundwater availability, with most identifiable aquifers limited to small and widely scattered surface and near-surface sand bodies. As water usage increases, the communities in southwest MN increasingly rely on these resources highlighting the need to identify additional groundwater supplies. Finding these limited water resources is difficult due to the limited borehole and subsurface geologic information. Data currently used to map buried aquifers as part of the County Geologic Atlas (CGA) program are largely limited to individual boreholes – primarily water wells of variable depths. In the absence of a systematic exploratory drilling program, data are not readily available at regularly spaced intervals to “fill-in” between existing well locations, in large part because of the significant cost, time commitment, and uncertainty in hitting groundwater resources. This results in large gaps in our understanding of the size of known aquifers as well as the potential failure to locate additional aquifers, limiting utilization of the groundwater system. To better understand and ensure the sustainability of these subsurface water supplies, we need high resolution subsurface information where borehole data is sparse.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

To aid Southwest Minnesota Rural Water Districts in their pursuit of groundwater resiliency, we will perform helicopter-based airborne electromagnetic (AEM) surveys across the region (figure). AEM equipment generates an electromagnetic field and records the subsurface response. Measurements differentiate between resistive aquifers (e.g. buried sand) and conductive aquitards (clay). This innovative technique collects many miles of data over a short period of time to fill the gap between existing boreholes and extends coverage deeper into the subsurface, resulting in significant savings over traditional drilling. Groundwater AEM surveys have been completed throughout the United States and regionally in neighboring states (e.g., North Dakota), but not in Minnesota.

The design of this survey has two goals. 1) Perform AEM over areas of known, but poorly characterized groundwater resources and over areas where undiscovered aquifers may be identified with this technique, and 2) ground-truth and constrain data uncertainty using existing borehole data. This geophysical survey will aid groundwater resource discovery and sustainability, groundwater recharge, surface-groundwater interactions, and derisk future water exploration, resulting in better aquifer targeting. It is expected that processes developed from this AEM survey will be applicable to other parts of Minnesota and can be incorporated into the CGA program.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state’s natural resources?

Water supply is a high priority in Minnesota, especially in the Southwest where groundwater resources are limited. The results of this study will be presented to regional stakeholders and state agencies at roundtable discussions and in final public reports and presentations. By more completely mapping existing aquifers and identifying new groundwater resources, we will improve our understanding of water availability for drinking water, agricultural, and industrial uses. Additionally, we will be able to demonstrate the utility of this geophysical technique and spur future projects to preserve groundwater resources throughout Minnesota.

Activities and Milestones

Activity 1: Acquisition of airborne electromagnetic surveys in southwestern MN Rural Water districts and ground-truthing program

Activity Budget: \$516,783

Activity Description:

In this activity, the AEM geophysical acquisition will be conducted by an independent contractor. Initially, we will work with the contractor to streamline the survey design and schedule the airborne survey. Depending on the contractor's availability and the weather, the contractor may not be able to start until the Spring after funding is received. During this same timeframe, the PI will acquire ground-based EM and borehole geophysics measurements at select locations in-line with the finalized survey design. Prior to data collection, the contractor will mobilize to the site area where we will hold a community engagement-style townhall for local stakeholders to learn more about the project, ask questions, and see the geophysical equipment. During survey acquisition, the helicopter will traverse the survey line suspending a large electromagnetic coil loop (see figure). The coil loop generates a primary electromagnetic field which interacts with the variably resistive subsurface generating eddy currents resulting in a secondary field that is recorded during flight. The survey is designed to acquire dense data over Lincoln-Pipestone, Red Rock, and Rock County Rural Water Districts (see figure). After survey completion, the contractor will deliver a final report including maps and raw and minimally processed data.

Activity Milestones:

Description	Approximate Completion Date
Contract negotiations	August 31, 2027
Finalize survey design and AEM system verification, and ground-based EM survey	October 31, 2027
Mobilization of the AEM survey	April 30, 2028
Collection of AEM survey in southwest Minnesota	May 31, 2028
Receipt of final data products from contractor	July 31, 2028

Activity 2: Airborne electromagnetic data processing and continued ground-truthing program

Activity Budget: \$89,483

Activity Description:

After survey completion, AEM data must be fully processed to create a preliminary geologic cross-section before it can be used to interpret groundwater resources. Processing will be completed by the Minnesota Geological Survey (MGS) geophysicist with oversight and guidance from an expert from the United States Geological Survey (USGS). The data quality of each survey point will be assessed, with irregularities and noise filtered or removed. At specific borehole locations within the survey area where the types of sediment are known, we will use a downhole probe to measure conductivity in the borehole for comparison to the AEM data collected at that location. This will be used to ground truth, aid in data processing, and constrain final processing. Final processing of the data will result in a continuous series of gridded 2D conductivity models along each survey line. Interpreted data will incorporate the ground-truthed borehole probe and geology data to constrain the conductivity models.

Activity Milestones:

Description	Approximate Completion Date
AEM data processing training with the United States Geological Survey	September 30, 2028
Borehole measurements of conductivity for ground truthing	November 30, 2028
Full data processing complete and final inversion of the EM data using ground truth data	May 31, 2029

Activity 3: Geologic interpretation of AEM geophysical data and dissemination

Activity Budget: \$47,734

Activity Description:

As the data is processed, we will begin interpretation for groundwater resources. In collaboration with the MGS geologists and guidance from the USGS, we will interpret conductivity models as they relate to conductive fine-grained silts and clays versus resistive water-bearing sands and gravels (aquifers) using existing borehole data and MGS subsurface geologic expertise. From the interpretation, we will be able to characterize the existing Rural Water District resources, identify areas of high potential for future groundwater exploration, and investigate groundwater availability, groundwater recharge, and surface-groundwater interactions. Additionally, we will determine the minimum aquifer thicknesses resolvable with this geophysical method, and the feasibility of this method to future AEM groundwater studies throughout Minnesota. The raw, processed, and interpreted data will be published as an MGS report and journal article/s with data housed online as part of the MGS Geophysical Portal. We will present the results of this study and interpretations in collaborative meetings with the Rural Water Districts, regional stakeholders, and interested state agencies. Communicating these results and collaborating with the southwest Minnesota stakeholders will support the resiliency of the groundwater resources in the region.

Activity Milestones:

Description	Approximate Completion Date
Interpretation and resolution estimates of AEM survey data	November 30, 2029
Communication of results to affected communities	January 31, 2030
Data and reports published on the MGS Geophysical Portal	January 31, 2030
Publication of AEM survey results as MGS report	March 31, 2030
Submission of AEM survey results for journal publication	March 31, 2030

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

The interpreted results of this study will be presented at collaborative meetings with the Rural Water Districts, regional stakeholders, and interested state agencies. These meetings will ensure that these datasets are utilized to benefit the communities in southwest Minnesota. Additionally, the raw, processed, and interpreted data will be published as a publicly available Minnesota Geological Survey report and journal article/s with data housed online as part of the MGS Geophysical Portal. The ground-based geophysical measurements will also be publicly available through the MGS with any borehole measurements added to the borehole geophysical database.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?

The interpreted AEM maps will immediately influence current groundwater exploration plans for the Rural Water Districts (RWD) and de-risk future efforts. We will also actively engage local and regional stakeholders to implement our study to benefit groundwater conservation efforts. Additionally, the interpretations will be applied to current and future MGS subsurface mapping. After seeing the impact of this AEM study in southwestern MN, it is anticipated that interest from state agencies and regional stakeholders including RWDs will spur additional AEM studies for groundwater preservation and delineation with funding potentially coming from a mixture of direct state agency funding and grants.

Project Manager and Organization Qualifications

Project Manager Name: Aaron Hirsch

Job Title: Geophysicist

Provide description of the project manager's qualifications to manage the proposed project.

PI Hirsch has been the geophysicist for the Minnesota Geological Survey (MGS) at the University of Minnesota-Twin Cities for the past 5 years where he has worked on geophysical projects across the state. Hirsch previously received his MA from Boston University in geophysics and a PhD at the University of Rhode Island's Graduate school of Oceanography with a focus in marine geology and geophysics before he was a postdoctoral fellow at the University of Minnesota. Prior to obtaining his advanced degrees, Hirsch worked at the University of Nevada Las Vegas performing various field geophysics programs and in the Geophysical Operations group within the ExxonMobil Exploration company (EMEC) where he designed, managed, and provided quality control to seismic operations across the globe.

PI Hirsch has a strong background in computational geophysics and project management of geophysical field programs. Hirsch designed and managed multiple large geophysical surveys while at EMEC and is currently in charge of multiple geophysics related programs at MGS. At MGS, Hirsch is co-author of over fifteen completed and ongoing county geological atlases and PI on two United States Geological Survey funded programs. Additionally, Hirsch has processed and interpreted multiple geophysical datasets at MGS and during his MA and PhD.

This project has a strong multi-disciplinary team. Dr. Anthony (Tony) Runkel is Lead Geologist of the MGS and has regional expertise in groundwater. Dr. Robert (Bob) Tipping is Director of the MGS with expertise in geologic modeling and groundwater. The geology staff at MGS have a combined 50+ years of experience mapping the sand and gravel aquifers in Minnesota.

Organization: U of MN - MN Geological Survey

Organization Description:

The Minnesota Geological Survey (MGS) was established in 1872 by the State of Minnesota as part of the University of Minnesota. The MGS, with approximately 30 staff, is the geological mapping agency for the State of Minnesota and the research and service arm of the N.H. Winchell School of Earth and Environmental Sciences department in the College of Science and Engineering. The MGS serves the people of Minnesota by providing systematic geoscience information to support stewardship of water, land, and mineral resources. MGS geologic mapping and research supports informed land use management and decision-making that protects and wisely allocates resources, and the MGS works closely with university, government, industry, and community partners to ensure we respond to the diverse needs of Minnesota.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Project Investigator / Geophysicist		The lead researcher with overall responsibility of the grant; in charge of project management, liason with contractors, processing of all data sets, and interpretation.			32.3%	0.6		\$65,000
Tony Runkel		Lead Geologist; will provide general subsurface and groundwater expertise.			36.3%	0.01		\$2,000
Quaternary geologist		Will provide Quaternary geology expertise to data interpretation.			32.3%	0.17		\$8,000
GIS Staff		Support the creation and publishing of the AEM data			32.3%	0.08		\$8,000
Borehole geophysics staff		Support the collection of the borehole geophysics ground truth program			32.3%	0.04		\$2,100
MGS Director		Support assessment of AEM aquifer characterization			36.3%	0.01		\$2,000
Field Technician		Support the collection of ground-based geophysical data			32.3%	0.06		\$4,000
							Sub Total	\$91,100
Contracts and Services								
United States Geological Survey	Subaward	AEM training and consultation in data processing, field QA/QC, and interpretation				0.1		\$50,000
AEM contractor	Service Contract	Collect and minimally process the airborne electromagnetic (AEM) data including producing final reports and maps				0.25		\$450,000
							Sub Total	\$500,000
Equipment, Tools, and Supplies								
							Sub Total	-
Capital Equipment								

		Geophysical software - Geoscene3D	Software will be used for data visualization and interpretation	X				\$20,000
		Aarhus Workbench EM processing software	Software required for airborne electromagnetic (AEM) data processing and data QC	X				\$20,000
							Sub Total	\$40,000
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	5 overnights each for 6 days travel; \$550 lodging (\$110x5); \$544 per diem (\$68x8); \$512 vehicle (\$64x8); \$208 mileage (\$0.26/mile at 800 round trip to SW)	Travel to survey area for mobilization and initial community engagement					\$1,900
	Miles/ Meals/ Lodging	20 days of borehole geophysics; \$2200 lodging (\$110x20); \$1360 per diem (\$68x20); \$1500 borehole van (\$75x20); \$740 mileage (.37/mile at 2000 miles in SW)	Use of the Minnesota Geological Survey borehole geophysics van to collect measurements for AEM ground truthing					\$5,800
	Miles/ Meals/ Lodging	5 days travel to region; \$550 lodging (\$110x5); \$340 per diem (\$68/5); \$384 vehicle (\$64x6); \$315 mileage (\$0.26/mile at 400 round trip with two trips)	Travel to southwest Minnesota to communicate results to public					\$1,600
							Sub Total	\$9,300
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	Publication of results in national scientific journal	Communicate results of the AEM survey to the scientific community					\$4,000
	Printing	Mobilization community engagement printing	Print material and posters for the mobilization community engagement					\$300
	Printing	End of project community engagement printing	Printing of materials and posters to present the interpreted results to communities					\$300

							Sub Total	\$4,600
Other Expenses								
		Rental and shipping of borehole geophysical equipment	Rent borehole geophysics downhole probe to measure conductivity as part of the ground truthing program					\$5,400
		Rental and shipping of ground-based electromagnetic equipment	Geophysical equipment will be used to quality control the airborne EM data collection					\$3,600
							Sub Total	\$9,000
							Grand Total	\$654,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Capital Equipment		Geophysical software - Geoscene3D	Specialized computer software required for the completion of this project. This is not listed as a generally ineligible expense. Additional Explanation : Software is specialized for 3D geological modeling and AEM data interpretation. Software license is a 1 year license and is not transferable.
Capital Equipment		Aarhus Workbench EM processing software	Specialized computer software required for the completion of this project. This is not listed as a generally ineligible expense. Additional Explanation : Software is specialized for EM data processing. Software license is for a single year and is not transferable

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
In-Kind	United States Geological Survey (USGS)	These funds will be used by the USGS personnel working on this project to cover expenses that are generally inelligible	Potential	\$6,000
			Non State Sub Total	\$6,000
			Funds Total	\$6,000

Total Project Cost: \$660,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [d5f753b4-67c.pdf](#)

Alternate Text for Visual Component

Schematic diagram of the helicopter airborne electromagnetic (AEM) method and the proposed location of the AEM survey. The helicopter generates a primary electromagnetic field which interacts with the subsurface generating a recorded secondary field. The top left map shows the approximate locations of the proposed AEM surveys....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Pipestone county Soil Water Conservation District letter of support	43fd5fca-994.pdf
Rock county Soil Water Conservation District letter of support	7ebbc8c2-635.pdf
Examples of groundwater related airborne electromagnetic (AEM) studies from around the United States	edf9c436-9b9.pdf
Yellow Medicine county Soil Water Conservation District letter of support	f71ea660-a93.pdf
United States Geological Survey letter of intent	99c067a7-524.pdf
Rock County Rural Water District letter of support	04542cc2-fe7.pdf
Red Rock Rural Water District letter of support	cdfc878d-079.pdf
Murray county Soil Water Conservation District letter of support	902ad92c-db2.pdf
Minnesota Rural Water Association letter of support	d913da6d-9e3.pdf
Minnesota Department of Health letter of support	b08a1fe7-daf.pdf
Minnesota Department of Agriculture letter of support	1e061a73-156.pdf
Lincoln-Pipestone Rural Water District letter of support	c22791ea-d0a.pdf
Cottonwood county Soil Water Conservation District letter of support	34ca1fe7-3a4.pdf
UMN SPA letter of institutional approval	6ac0b2f3-edc.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the UMN Policy on travel applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Tony Runkel and Bob Tipping, Minnesota Geological Survey

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

Yes, I understand