Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)

Project Title: **ENRTF ID: 073-B**

A Rapid, Mobile Vertical Groundwater Nitrate Sampling System

Category: B. Water Resources

Sub-Category:

Total Project Budget: $ 297,900

Proposed Project Time Period for the Funding Requested: June 30, 2021 (2 yrs)

Summary:

We will combine new sampling technologies to rapidly measure vertical groundwater nitrate profiles. This alternative monitoring method can be applied statewide for understanding groundwater quality improvements from land management changes.

Name: Jared Trost

Sponsoring Organization: USGS

Title: Hydrologist

Department:

Address: 2280 Woodale Dr

Mounds View MN 55112

Telephone Number: (763) 783-3205

Email jtrost@usgs.gov

Web Address https://www.usgs.gov/staff-profiles/jared-trost

Location

Region: Statewide, Southwest

County Name: Statewide, Lincoln, Pipestone

City / Township:

Alternate Text for Visual:

A cross-section diagram showing the direct-push sampling (DPS) process, DPS advantages, and the drawbacks of monitoring wells. DPS produces accurate data for understanding groundwater quality improvements from land management changes.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base	
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency	
_____ Capacity Readiness	_____ Leverage		_____ TOTAL	_____%
	____ If under $200,000, waive presentation?			

PROJECT TITLE: A Rapid, Mobile Vertical Groundwater Nitrate Sampling System

I. PROJECT STATEMENT

We will assess a novel sampling approach that combines several new, mobile sampling technologies to rapidly measure groundwater nitrate at narrow intervals in vertical profiles. The approach will provide the State, agricultural producers, and municipal water suppliers with robust methods for evaluating the effectiveness of investments made to reduce nitrate contamination of groundwater.

Agriculture is a foundation of the Minnesota economy and vital to our way of life, but our farming methods can leak nitrate [and other chemicals] to groundwater. Leaking chemicals perturb another core Minnesota value: clean, healthy water. To maintain agricultural productivity and clean groundwater, the Minnesota Department of Agriculture (MDA) is in the process of implementing a fertilizer management plan which will require producers to use Best Management Practices (BMPs) in some areas. Some local water municipalities are also seeking land management solutions. For example, Lincoln Pipestone Rural Water has invested in farmland and will be taking it out of agricultural production to try to reduce groundwater nitrate contamination in one of their well fields that serves approximately 8,100 residents. **It is critical that appropriate groundwater measurements are made to evaluate investments made in land management changes and BMPs for reducing nitrate.**

Unfortunately, traditional monitoring wells can be an inefficient and expensive way to measure effects from recent land management changes. Water table monitoring wells with long screens (10 ft) are typically used for sampling groundwater nitrate in agricultural settings. This approach has several drawbacks, including: sample intervals that can blur results, expensive installations, lack of mobility, ongoing maintenance, landowner access and liability issues, and, finally, wells are a nuisance in and around active agricultural fields.

This study will demonstrate and document that direct-push vertical groundwater sampling is a more effective and efficient method for evaluating land management changes compared to traditional monitoring wells. Direct push rigs simply push a sample screen, pump, and a series of sensors through soil and aquifer to *provide instantaneous data in the field about groundwater flowpaths and vertical contaminant distribution*. No permanent installation is left in the field and locations can be returned to later for assessing change over time. Direct-push technology has been used for decades to map point-source contaminants like petroleum. Recent improvements in direct-push samplers and nitrate sensors make possible rapid measurements of the vertical distribution of nitrate. This method provides much higher resolution data that is immediately available in the field. These results, when coupled with more detailed data from the lab will provide information needed to answer critical questions about investments in land management changes and BMPs.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Design and test direct-push vertical groundwater sampling system that provides instantaneous nitrate data; implement system near traditional monitoring wells

ENRTF BUDGET: $178,000

Outcome	Completion Date
1. Develop direct-push groundwater sampling protocol: vertical profiles of hydrogeologic properties, instantaneous measurements of nitrate, oxygen, pH, conductance, temperature, and sample collection for redox chemistry, age-dating, and pesticides)	*March, 2020*

2. Design field study at Lincoln-Pipestone Rural Water well field	*May, 2020*
3. Collect field data for comparing direct-push system with traditional monitoring wells. Up to 60 groundwater samples will be analyzed for nitrate and redox chemistry. Up to 30 of these samples will be analyzed for age-dating tracers and pesticides	*August, 2020*

Activity 2: Publish data, produce report, and disseminate results to inform resource managers and practitioners about direct-push sampling for groundwater nitrate

ENRTF BUDGET: $114,600

Outcome	Completion Date
1. Publish all hydrogeologic and water-quality data	*March, 2021*
2. Analyze data; compare monitoring well data with direct-push sampling data	*March, 2021*
3. Present results at local conferences; produce publicly-available final synthesis report that describes the system operating procedures and water quality results	*June, 2021*

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Jared Trost, Erik Smith	**Hydrologist**	**USGS**	**PI, Co-PI**
Andrew Berg	**Hydrologic Technician**	**USGS**	**Field/data technician**

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Steve Robertson	**Hydrologist**	**MDH**	**Technical advisor**
William VanRyswyk	**Hydrologist**	**MDA**	**Technical advisor**
Jason Overby, Jared Beck	**General Manager, Water Resource Technician**	**Lincoln-Pipeston Rural Water System**	**Technical advisors**
Aaron Meyer	**Source water specialist**	**Minnesota Rural Water**	**Technical advisor**

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

The proposed project will demonstrate direct-push vertical groundwater sampling as a robust sampling strategy for the MDA's proposed fertilizer management rule. Additionally, the MDH and water supply authorities, such as Lincoln-Pipestone Rural Water, can use this sampling strategy to evaluate investments in land management changes to reduce nitrate contamination in wellhead protection areas.

V. TIME LINE REQUIREMENTS:

The project is proposed as a 2-year project, July 2019 – June 2021. All appropriate sampling sites for this project will be identified prior to sampling in spring and summer 2020, with the comprehensive data set and final report provided by June 2021.

2019 Proposal Budget Spreadsheet

Project Title: A Rapid, Mobile Vertical Groundwater Nitrate Sampling System

IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM (See "Guidance on Allowable Expenses")	**AMOUNT**
Personnel: Hydrologists 2 hydrologists for technical design, project management water quality data analysis, data publication, final report (.22 FTE each for 2 yrs, 72% salary, 28% benefits); 1 hydrogeologist for assistance with hydrogeology data interpretation (.07 FTE for 2 yrs, 72% salary, 28% benefits)	$ 151,900
Personnel: Technicians Lead technician for water quality data collection and drilling assistance (0.1 FTE for 2 years, 72% salary, 28% benefits); Lead driller- to lead drilling process (0.05 FTE for 2 years, 72% salary, 28% benefits); Student technician to assist with field data collection and data compilation (0.1 FTE for 2 years, 81% salary, 19% benefits)	$ 45,200.00
Personnel: Administrative support 1 person to provide support for funding agreements, cost accounting, billing, (0.04 FTE for 2 years, 69% salary, 31% benefits)	$ 10,600.00
Professional/Technical/Service Contracts: USGS contract fee for report preparation, editing, and production (Science Publishing Network) or scientific journal open-access fee. This includes electronic publishing and distribution of published products.($4,000) ; USGS lab expenses for age-dating analyses ($31,200)	$ 35,200
Equipment/Tools/Supplies: consumable water quality sampling supplies including filters, preservation chemicals, and standards ($1,000), drilling supplies such as expendable tips, screens, and fuel ($4,300), field equipment including tubing, connections, and pumps ($3,000)	$ 8,300
Geoprobe Hydraulic profiling tool and groundwater sampling (HPT-GWS) sampling system	$ 38,200
Travel: lodging and per diem for 8 person-weeks [per Commission Plan] ($5,900); vehicle rental expenses ($1,600) for travel to and from Lincoln Pipestone Rural Water field site.	$ 7,500
Additional Budget Items: sample shipping ($700) local conference registration fees for presentation at the Minnesota Water Resources Conference ($300)	$ 1,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 297,900

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ To Be Applied To Project During Project Period: USGS cooperative matching funds in support of a portion of USGS facility and other indirect costs not covered by ENRTF request and travel to out-of-state professional meetings.	$ 86,600	*Pending*
Other State $ To Be Applied To Project During Project Period: MDA and MDH funding for USGS Joint Funding Agreement, in support of a portion of USGS facility and other indirect costs not covered by ENRTF request.	$ 60,000	*Pending*
In-kind Services To Be Applied To Project During Project Period: MDA analysis of water samples for major ions and pesticides ($31,000), MDH analysis of water samples for tritium ($5,300), staff time from Lincoln Pipestone Rural water technical staff ($2,000); USGS rental of nitrate sensor ($3,000)	$ 41,300	*Pending*
Past and Current ENRTF Appropriation: Protection of State's Confined Drinking Water Aquifers – Phase II, M.L. 2016, Chp. 186, Sec. 2, Subd. 04h	$ 169,117	Unspent (to be spent by 6/30/19)
Other Funding History:	$ -	

A direct-push system for sampling groundwater nitrate: a better way for the State, producers, and municipal water suppliers to evaluate investments made to reduce nitrate contamination

How long until I see a change in my well water from a change in land management?

Will the purchase of land in the wellhead protection area be a good investment?

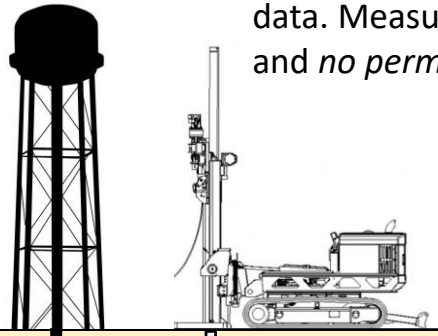
Why can't I fertilize like I used to? What difference does it make?

We need accurate data to answer these questions

Monitoring wells are one method, but have some serious drawbacks.

Permanent structure requires maintenance, is a liability for land-owners, and is a nuisance for farmers.

Direct-push sampling provides detailed vertical data. Measurements are made with a small rig and *no permanent structure is required*.



Nitrate measured in the field; samples are sent to a lab to determine water age.

A sample screen, pump, and a series of sensors are pushed through the profile, then removed

Soil

Aquifer

Groundwater flowpath

1 yr

5 yr

10 yr

Travel time

Narrow water-sample interval

Well screen produces samples with mixed ages and representative of varying spatial extents.

The pushed sensors provide continuous, real-time data about hydrologic flowpaths.

Jared Trost, Hydrologist
US Geological Survey, 2280 Woodale Drive, Mounds View, MN 55112
Email: jtrost@usgs.gov: Phone: 763-783-3205: https://www.usgs.gov/staff-profiles/jared-trost

Biography

Jared Trost has over 15 years of experience managing, leading, and publishing scientific research projects. He worked as a research project manager under Dr. Peter Reich at Cedar Creek Ecosystem Science Reserve from 2000-2008 and has worked at the U.S. Geological Survey since 2006, where he began as a part-time student, and transitioned to a full-time hydrologist in 2010. In his time at Cedar Creek, he managed all field operations for a large field experiment that included soil, soil-water, and groundwater sampling and co-authored five publications that examined topics including nitrogen effects on plant productivity, leaching losses of nitrogen and other contaminants, and soil-water dynamics under different crop types. In his current capacity as the site coordinator for the national USGS Toxic Substances Hydrology Program's Bemidji crude oil spill site, he has led many field investigations on contaminant fate and transport where redox conditions play a central role. He has experience in facilitating and communicating research to technical and lay audiences, having given many presentations at local and national meetings, including the American Geophysical Union and the Geologic Society of America. He is currently serving a second term as the elected chair of the Unsaturated Zone Interest Group (UZIG), an organization with over 420 members whose mission it is to advance unsaturated-zone science by fostering information exchange and collaborative studies among kindred groups across multiple organizations.

Education

2000, B.A. Biology and Chemistry, Augsburg College, Minneapolis, Minnesota
2010, M.S. Water Resource Science (Soil Hydrology emphasis), University of Minnesota.

Selected Publications

Jones, P.M., **Trost, J.J.**, Diekoff, A.L., Rosenberry, D.O., White, E.A., Erickson, M.L., Morel, D.L., and Heck, J.M., 2016, Statistical analysis of lake levels and field study of groundwater and surface-water exchanges in the northeast Twin Cities Metropolitan Area, Minnesota, 2002 through 2015: U.S. Geological Survey Scientific Investigations Report 2016–5139–A, 86 p., http://dx.doi.org/10.3133/sir20165139A

Sihota, N.J., **Trost, J.J.**, Bekins, B.A., Berg, A., Delin, G.N., Mason, B., Warren, E., and Mayer, K.U., 2016, Seasonal variability in vadose zone biodegradation at a crude oil pipeline rupture site: Vadose Zone Journal, v. 15, no. 5, 14 p.

Trost, Jared J.; Kiesling, Richard L.; Erickson, Melinda L.; Rose, Peter J.; Elliott, Sarah M. Land-cover effects on the fate and transport of surface-applied antibiotics and 17-beta-estradiol on a sandy outwash plain, Anoka County, Minnesota, 2008–09; 2013; SIR; 2013-5202

Organization

The U.S. Geological Survey's mission is to provide unbiased science about the natural hazards that threaten lives and livelihoods, the water, energy, minerals, and other natural resources we rely on, the health of our ecosystems and environment, and the impacts of climate and land-use change. USGS scientists develop new methods and tools to enable timely, relevant, and useful information about the Earth and its processes. With respect to water resources, USGS scientists work with local partners to monitor, assess, and conduct targeted research on the wide range of water resources and conditions, including streamflow, groundwater, water quality, and water use and availability.