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

Project Title: **ENRTF ID: 059-B**

Understanding Groundwater Flow, Central Arrowhead, County Geologic Atlas

Category: B. Water Resources

Sub-Category:

Total Project Budget: $ 435,966

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

Summary:

Complete and sample approximately 20 observation wells and borings to help understand groundwater flow characteristics In the Central Arrowhead – County Geologic Atlas area, for wise management of groundwater resources.

Name: Jim Berg

Sponsoring Organization: MN DNR

Title: Research Scientist

Department: Ecological and Water Resources

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Location

Region: Northeast

County Name: Lake, St. Louis

City / Township:

Alternate Text for Visual:

The map shows the proposed area of investigation in northeastern Minnesota

_____ 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: Understanding Groundwater Flow, Central Arrowhead, County Geologic Atlas

I. PROJECT STATEMENT

Understanding groundwater flow characteristics (flow direction, gradient, velocity, and locations of recharge/discharge areas) is essential for effective management of groundwater resources and associated surface water bodies such as wetlands, streams, and lakes. Past CGA investigations have relied on adequate data sets of geologic and hydrogeologic information from existing wells and boreholes. The southeastern portion of the central arrowhead area (Duluth Complex geology) is relatively undeveloped, has few roads, and generally lacks enough existing wells necessary for collecting the data to create groundwater flow and pollution sensitivity maps.

To help create a large-scale understanding of how groundwater flows through unconsolidated sand and gravel and bedrock to surface water, the following activities are proposed: 1) Review current geologic/hydrogeologic information; collect geophysical data from potential investigative drilling locations; 2) Drill boreholes into bedrock, test and sample permeable fracture zones; 3) Drill, construct, test, and sample shallow (10 to 100 feet) observation wells (approximately 10 to 20).

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Review current geologic/hydrogeologic information; collect geophysical data from potential investigative drilling locations drilling sites.

Existing mining company, U. S. Geological Survey, and Minnesota Geological Survey reports will be reviewed and evaluated for area specific information. In addition, selected bedrock core in the Duluth Complex area will be evaluated for evidence of water bearing fractures. Numerous cores are stored in the DNR core library from mining company exploration activities. This information along with site access factors (road locations, vegetation, and wet soils) will be used to determine potential locations for activities 2 and 3. The near-surface conditions, such as depth to bedrock and thickness of weathered bedrock, will be evaluated at candidate locations with surface geophysical surveys. Survey techniques could include electrical magnetism (EM), surface resistivity, or passive seismic.
ENRTF BUDGET: $56,000

Activity 2: Drill boreholes into bedrock, test and sample permeable fracture zones.

Two to four prominent fault/fracture zones on public land will be cored with contracted drilling services (800 to 1000 feet of total core/hole). The major permeable (water producing) zones will be flow tested with packers. Groundwater samples will be collected for analysis of general and trace chemical constituents; stable isotopes of oxygen and hydrogen; and tritium. If permeable fracture zones capable of transmitting significant amounts of water are identified, observations wells will be constructed into those zones for long term monitoring.
ENRTF BUDGET: $222,966

Activity 3: Drill, construct, test, sample, and monitor shallow (approximately 10 to 20) observation wells.

These observation wells will be drilled and constructed with contracted drilling services at approximately 10 locations, on public land, in the relatively thin glacial material and fractured bedrock. Site locations will be based

on information collected from activities 1 and 2; and site access factors. After the wells are developed, they will be tested for hydraulic conductivity and water samples will be collected. The water samples will be submitted to analytical laboratories for analysis of general chemical constituents; trace constituents; stable isotopes of oxygen and hydrogen; and tritium. The chemical characteristics of these groundwater samples can provide clues to groundwater/surface water connections and upward migration of groundwater from deeper zones.

Water level data from the observation wells will be collected continuously with pressure transducers for the duration of the project and after the ENTRF project has finished. Water level data will be compared to and integrated with other groundwater and surface water elevations in the area to deduce possible areas of hydraulic connection or confinement.
ENRTF BUDGET: $157,000

Outcome	Completion Date
1. Summary report of core examinations and geophysical surveys.	March 2020
2. Summary report of core logs and packer tests.	February 2021
3. Final report including previous summary reports, lithology logs, well construction logs, slug test results, water chemistry data, potentiometric surface maps, interpretations, and conclusions.	July 2021

III. PROJECT PARTNERS:

Name	Title	Affiliation	Role
Mark Jirsa Tony Runkel	Geologist Chief Geologist	Minnesota Geological Survey (funded)	Geological interpretations and borehole logging
Marty Rye	Forest Hydrologist	U.S. Forest Service (not funded)	Data logger downloading

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:
The intention of this project is to follow the Part A work of the MGS and focus groundwater-sampling efforts in 2020 on the southeastern portion of the Central Arrowhead area from wells that will be installed for this project. During that same sampling season the DNR CGA program intends to collect approximately 90 groundwater samples from existing wells across the entire Central Arrowhead area as part of the typical activities that are part of the Part B atlas development. The data and results from both phases of this project will be integrated into the final Part B atlas report. Partial funding for the Central Arrowhead CGA, Part B will be from a 2017 LCCMR recommended proposal to fund this and other atlases.

V. TIME LINE REQUIREMENTS:
Since this project is designed as a supplement and enhancement to a planned start for the Central Arrowhead CGA, Part B in 2020, funding of this project for the 2019 cycle is timely and should help improve the efficient completion of all field activities, data compilation, and report production.

VI. SEE ADDITIONAL PROPOSAL COMPONENTS:

A. Proposal Budget Spreadsheet
B. Visual Component or Map

2019 Proposal Budget Spreadsheet

Project Title: Understanding Groundwater Flow, Central Arrowhead, County Geologic Atlas

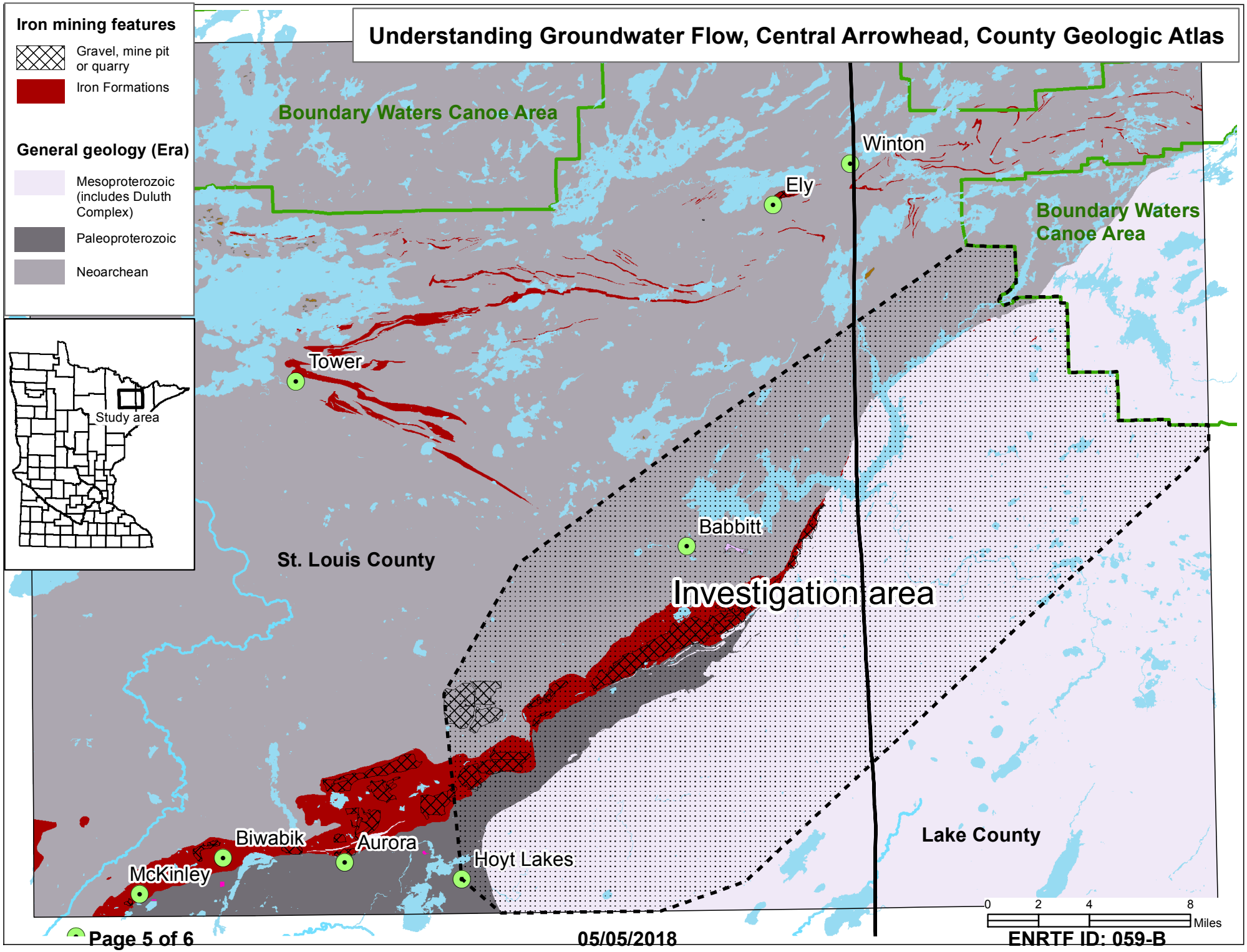
IV. TOTAL ENRTF REQUEST BUDGET *2* **years**

BUDGET ITEM (See "Guidance on Allowable Expenses")	**AMOUNT**
Personnel: Research Scientist (Hydrogeologist) and Hydrologist 1 2 x 0.20 FTE for 2 years (activities 1, 2, and 3). Both positions are on project dependant funding.	$ 90,000
Professional/Technical/Service Contracts: Contracted drilling services (competitive bid) -- **c**oring, packer testing, and observation well installation (activities 2, and 3).	$ 189,000
Professional/Technical/Service Contracts: Geologic consultant (competitive bid) -- packer testing and advanced borehole geophysical logging (activity 2)	$ 50,000
Professional/Technical/Service Contracts: Minnesota Geological Survey (University of Minnesota) -- borehole logging and geological interpretation (activity 2)	$ 60,000
Professional/Technical/Service Contracts: Laboratory chemical analysis (Minnesota Department of Agriculture and University of Waterloo), 20 groundwater sample suites for cations, anions, trace constitunets, stable isotopes and tritium (activity 3)	$ 10,000
Equipment/Tools/Supplies: Pressure transducers (approximately 20 at $1,000/unit) for collecting continuous water level measurements from wells (activity 3).	$ 20,000
Travel: mileage, lodging, and meals (activities 1, 2, and 3)	$ 6,000
Additional Budget Items: Direct and Necessary expenses: HR Support (~$1,182), Safety Support (~$245), Financial Support (~$4,552), Communication Support (~$1,251), IT Support (~$2,677), and Planning Support (~$1,059) necessary to accomplish funded programs/projects.	$ 10,966
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 435,966

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:	NA	
Other State $ To Be Applied To Project During Project Period:	NA	
In-kind Services To Be Applied To Project During Project Period: U. S. Forest Service assistance with down loading data loggers	$ 1,000	
Past and Current ENRTF Appropriation:	NA	
Other Funding History:	NA	

Understanding Groundwater Flow, Central Arrowhead, County Geologic Atlas



05/05/2018

ENRTF ID: 059-B

Project Manager Qualifications and Organization Description
Project Manager: James A. Berg

Degrees and Professional Certificates:

M.S. Geology, University of Kansas, Lawrence, Kansas	1981
B.A. Geology, Carleton College, Northfield, Minnesota	1977
Minnesota Professional Geologist, License #30501	

Qualifications:
1995 to present Research Scientist/Hydrogeologist

Managed two ENTRF funded projects (2008 and 2009) to research recharge and physical characteristics of the Mt. Simon aquifer in south-central Minnesota through new monitoring well installations, water level monitoring, and ground water sample chemical analysis. Project manager for ENTRF funded projects including Minnesota Spring Inventory (2014 and 2016) and County Geologic Atlas, Part B (2013 and 2015).

Completed 16 regional, county, and area aquifer-mapping projects in Minnesota for water resource assessment and protection purposes. Various combinations of existing well and test hole data, new test hole data, geochemical/geophysical data have been used to complete these projects. The projects include the Southwestern Minnesota Ground Water Exploration Project 1996-1997, funded in part, by the 1995 Minnesota Legislature. This project combined new test hole data from 27 locations in a five county area of southwestern Minnesota to help find new ground water sources for municipalities and rural water systems. Other aquifer mapping projects in Minnesota include: the Traverse-Grant, Otter Tail, and Upper Minnesota River Basin Regional Hydrogeologic Assessments; a preliminary assessment of Murray County shallow buried aquifers; Geologic Atlases of Anoka, Blue Earth, Carlton, Clay, Goodhue, Pine, Pope, and Sherburne Counties; an assessment of the Rock River alluvial aquifer in southwestern Minnesota; and a three-dimensional evaluation of buried sand and gravel aquifers in the Fargo-Moorhead region.

Acquired, processed and interpreted seismic (refraction and reflection) and resistivity data for approximately 100 surveys in a variety of geologic settings across Minnesota. Data were used to evaluate bedrock topography, Quaternary stratigraphy, and depth to water table for ground water resource evaluations

Previous employment:

1987 to 1994	Project Manager/Hydrogeologist for various for Twin City environmental consulting firms
1981 to 1986	Exploration Geologist, Champlin Petroleum, Denver, CO

Other relevant qualifications include aquifer pumping test design, implementation, and interpretation; geophysical well log data acquisition and interpretation; and geographic information systems (ARCGIS) proficiency.

Project Responsibilities:
The project manager will be responsible for: contracting drilling and other services, coordinating with project partners, determining test hole locations, coordinating drilling and logging services, coordinating Gopher One utility location requests, and log data interpretation and primary author of final report.

Organization Description:
Minnesota Department of Natural Resources, Division of Waters – state agency.