Environment and Natural Resources Trust Fund

2022 Request for Proposal

General Information

Proposal ID: 2022-164

Proposal Title: Leveraging Innovations in Data Analytics for Project Implementation

Project Manager Information

Name: Brian Beck

Organization: Minnehaha Creek Watershed District

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Project Basic Information

Project Summary: Integrating local and statewide datasets into a 21st-century planning tool, widely called for by our communities, that forecasts the impacts of changing precipitation patterns and quantitatively compares cost-effective solutions.

Funds Requested: $791,000

Proposed Project Completion: December 31 2024

LCCMR Funding Category: Water Resources (B)

Project Location

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

What is the best scale to describe the area impacted by your work?
Region(s): Metro

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.

Water systems throughout Minnesota were built for stable climate patterns that no longer exist. Extreme swings in precipitation are stressing our natural and built environments, impacting pollutant loading, stream erosion, wetland function, surface and groundwater interactions, habitat, and the safety of homes, public infrastructure, and businesses.

Watershed managers must help communities understand and adapt to these changes. However, the ability to do so is hampered by sparse and static historic data sets, which make it difficult to predict how specific areas will be impacted and quantitatively compare potential solutions.

Fortunately, advances in data science have made it affordable to collect exponentially more data and analyze it in more sophisticated ways. These advances allow water planners around the world to understand and predict changes with unprecedented accuracy and detail, allowing for more effective use of scarce public investment to address these issues. In Minnesota, data collection has outpaced the tools used to make sense of the information. Realizing the full potential of these advances requires new systems to integrate this data to identify existing issues, forecast future ones, and guide local decisions.

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

In partnership with the DNR, USGS, and Hennepin County, and with formal support from 14 federal, state, and regional agencies and local communities, the Minnehaha Creek Watershed District (MCWD) is proposing a pioneering program to maximize the value of recent public investments in data collection.

For example, MCWD has created a remote sensing network that collects more than 1 million data points per year about surface water levels, shallow groundwater levels, and pollutant loading. State leaders have invested in mapping the detailed topography of the state. Municipal partners have digitized data about their storm sewer systems.

MCWD wants to partner with LCCMR to develop a reproducible process that brings these disparate data sets together into a quantitative planning tool. Using advances in 2-dimensional modeling, these tools will be able to pinpoint, quantitatively evaluate and drive decisions on climate adaptation projects and policies.

Such a tool will be critical to the climate adaptation planning efforts as watershed managers and communities begin to understand the impact of changing precipitation patterns on our built and natural systems. The result will be more effective green and gray infrastructure solutions that protect and conserve the watershed's iconic water resources.

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?

• A single, continuously-updated tool that integrates previously-siloed public data sets to quantitatively compare proposed natural resource projects

• A high-resolution understanding of the balance of all surface and groundwater inputs and outputs in the system, to identify natural resources and public assets in need of protection

• Improved ability to predict the impact of changes in precipitation and land use, to enhance infrastructure planning

- Improved ability to quantify and compare the cost-effectiveness of potential conservation projects needed to address predicted impacts

Activities and Milestones

Activity 1: Identifying Model Inputs and Data Resources

Activity Budget: $166,000

Activity Description:

One of the most common ways watershed districts synthesize data is by developing computer models that can predict how water flows through our streams, lakes, and landscapes. In recent years, the State of Minnesota and Minnesota counties have invested heavily to develop a series of high-quality standardized digital datasets about our landscape, such as topography, land use, and soils that have made model development much less labor-intensive.

Local municipalities have also invested time and resources in developing digital stormsewer infrastructure databases, however, each municipal dataset varies in data structure, complexity, and quality. Combining these 29 unique datasets into a unified watershed model has historically been labor-intensive, prohibitively expensive, and nearly impossible to maintain. Therefore, this project will include an initial discovery phase, which will be devoted to meeting with municipalities to understand the unique nature of their stormwater infrastructure dataset.

The goal of this phase is to characterize all available spatial datasets that will be used as input layers for the watershed computer model. The scope and cost for subsequent activities may be refined based on the findings of Activity 1 to ensure that the development of the automated data processing system and watershed model will require minimal manual effort.

Activity Milestones:

Description	Completion Date
Mapped and Obtained Data from State and Regional Partners	December 31 2022
Collect Wetland and Stream Channel Survey Data	September 30 2023

Activity 2: Building the External Data Information Processing System

Activity Budget: $286,000

Activity Description:

Because land use and stormwater infrastructure are constantly changing, watershed managers face the recurring challenge of using tools that are not based on up-to-date information. Historically, the process of updating watershed models has been a time-intensive endeavor because all data collection and processing has been done manually. However, recent advances in data science have resulted in frameworks that automate complex data processing, which will dramatically reduce the cost of future model updates for MCWD and other public agencies throughout the state that could use this process as a template for enhancing and automating their own watershed model development.

MCWD will develop a reproducible data processing system that can incorporate publicly available datasets into a watershed modeling framework. Then, MCWD will work with technical experts to plan and build a GIS system that automatically updates based on changing landuse and infrastructure datasets to ensure the watershed model used for natural resource project identification is using the most current landscape and infrastructure information.

Activity Milestones:

Description	Completion Date
Develop Mapped Structure of Municipal Stormwater Data	April 30 2023
Develop Automated Intake Processing System for Municipal Stormsewer Data	July 31 2023

Activity 3: Building the 2D Watershed Model for Natural Resource Climate Adaptation Planning

Activity Budget: $339,000

Activity Description:
MCWD will incorporate the data produced from the automated processing system developed in activity 2 into a high-resolution watershed model that can predict, in unprecedented detail, how water and pollutants will move through the system under current and predicted scenarios. The outcome from building the watershed model will be a tool that can help watershed managers meet their water quality, water quantity, and ecologic improvement goals.

Building this model will involve an iterative process to ensure that the automated processes developed in activity 2 can be incorporated into a high-resolution watershed planning tool. In addition, the consultant will use streamflow data collected by MCWD staff to calibrate the model to ensure it can accurately predict how water moves through the built and natural environment.

MCWD and the consultant will meet with local municipalities and engineers to communicate the use cases for the model to ensure it can be used by other entities to identify water quality, natural resource, and flood reduction projects.

Activity Milestones:

Description	Completion Date
Build and Calibrate Two Dimensional Watershed Hydrology and Hydraulics Model	June 30 2024
Write Technical Report for Two Dimensional Watershed Model	December 31 2024

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Tim Cowdery	U.S. Geological Survey	Assist with identifying groundwater well monitoring locations, conducting groundwater data analysis, suggesting methods for incorporating groundwater data into the 2D model, and providing oversight on 2D model build.	No
Dan Lais	Minnesota Department of Natural Resources	Collect and analyze additional groundwater and surface water interactions to integrate this data, along with other datasets, into the development of a high-resolution two-dimensional (2D) watershed model.	No
John Evans	Hennepin County	Hennepin County will assist with data collection, assessing climate impacts, and providing input on the tools needed to effectively plan and adapt to changing hydrology, in partnership with our communities.	No

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 be funded?
This project will yield a sophisticated tool, drawing on state of the art data analytics, to enhance MCWD's organizational ability to partner with its member communities to identify, evaluate, and implement natural resource capital improvement projects that improve water quality, control water quantity, improve ecological integrity, and reduce flooding in the face of a changing climate. The products of LCCMR's investment are expected to help MCWD and its partners populate, focus, and prioritize capital improvement plans that will be funded locally. The long-term sustainment costs for maintaining the watershed tools will be borne by MCWD.

Project Manager and Organization Qualifications

Project Manager Name: Brian Beck

Job Title: Research and Monitoring Program Manager

Provide description of the project manager's qualifications to manage the proposed project.
Education:
M.S. 2012 University of Minnesota-Duluth (Water Resources Science)
B.S. 2008 University of Minnesota Twin Cities (Environmental Science with emphasis on aquatic chemistry)

Mr. Beck is a water resource scientist with 10 years of experience quantifying the impact of landscape change on water quality and quantity at a municipal, watershed, and statewide scale. The focus of his academic and professional career has been obtaining data from disparate sources for data analysis and building quantitative tools to develop insights about complex aquatic systems. Mr. Beck's professional career in the private and public sector has been built upon developing deterministic and empirical water quality models such as P8, GWLF, HSPF, SWAT, PONDNET, CEQUAL, BATHTUB, and GLM to inform management decisions of water quality, water quantity, and ecological integrity.

Mr. Beck will oversee the development of the watershed-wide two dimensional (2D) model. He has extensive experience developing quantitative water quality models for cities, watershed districts, and the State of Minnesota for feasibility studies, watershed diagnostic assessments, and regional Total Daily Maximum Load studies. His blend of technical expertise in watershed modeling and understanding of local government will allow him to facilitate the interaction between watershed managers and technical consultants to ensure that the model is technically sound and can be used to inform watershed management decisions.

Organization: Minnehaha Creek Watershed District

Organization Description:
Minnehaha Creek Watershed District is a local unit of government responsible for managing and protecting the water resources in one of the largest and most heavily-used urban watersheds in Minnesota. MCWD's legal boundary encompasses about 178 square miles within the western Twin Cities metropolitan area and includes 29 communities. Of this area, about 148 square miles lie within Hennepin County and about 30 square miles lie within Carver County. To manage water resources and ecological integrity in this large area, MCWD has prioritized the need to bridge the governance gap between land use and water resource planning to achieve its goals of improving water quality, water quantity, ecological integrity, and thriving communities. MCWD's approach to bridging this gap is to understand the goals of others; apply sound science to creative solutions; and align investments, technical expertise, streamlined permitting, and collaborative planning.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
							Sub Total	-
Contracts and Services								
TBD through competitive bid	Professional or Technical Service Contract	The consulting engineer will provide technical support for data processing and model development.				1.74		$791,000
							Sub Total	**$791,000**
Equipment, Tools, and Supplies								
							Sub Total	-
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
							Sub Total	-
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								

							Sub Total	-
Other Expenses								
-							Sub Total	-
							Grand Total	**$791,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	DNR General Fund	Collect and analyze additional groundwater and surface water interactions to integrate this data, along with other datasets, into the development of a high-resolution two-dimensional (2D) watershed model.	Secured	$32,000
			State Sub Total	**$32,000**
Non-State				
In-Kind	Minnehaha Creek Watershed District Tax Levy	Minnehaha Creek Watershed District staff will be contributing a total of 6960 hours of in-kind support for the project.	Secured	$311,610
Cash	Minnehaha Creek Watershed District Tax Levy	MCWD will contract with the USGS to oversee the selection of groundwater sensor monitoring locations and the development of the 2D watershed model	Secured	$10,000
			Non State Sub Total	**$321,610**
			Funds Total	**$353,610**

Attachments

Required Attachments
Visual Component
File: 79c773ba-447.pdf

Alternate Text for Visual Component
The attached graphic demonstrates how the proposed tools will convert a variety of disparate data sources into usable information to inform natural resource management decisions. It demonstrates how data sources about our built and natural environment – soils, topography, wetlands, hydrology, groundwater, precipitation, land cover, future land use, and storm sewer — will be integrated into a 2-dimensional model that will predict how water moves through the landscape under a variety of scenari...

Board Resolution or Letter

Title	File
MCWD Board Resolution for LCCMR Application	a1c4864e-e0f.pdf

Optional Attachments
Support Letter or Other

Title	File
City of Wayzata Letter of Support	10977cbe-a91.pdf
City of Victoria Letter of Support	8164d10e-d55.pdf
City of St. Louis Park Letter of Support	35e72525-f56.pdf
City of Mound Letter of Support	667fb967-295.pdf
City of Minnetonka Letter of Support	08497ccb-20c.pdf
City of Minneapolis Letter of Support	b03378ab-d1d.pdf
City of Edina Letter of Support	c31c2f7f-880.pdf
Minneapolis Park and Recreation Board Letter of Support	0d2f38c5-2d0.pdf
EQB Letter of Support	da7c900a-a25.pdf
Hennepin County Letter of Support	306c750a-ab4.pdf
Minnesota Cities Stormwater Coalition Letter of Support	69c682c6-fb2.pdf
Met Council Letter of Support	b0553570-10b.pdf
MN DNR Letter of Support	2f72934d-205.pdf
USGS Letter of Support	de56a77b-280.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?
> No

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

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

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?
> No

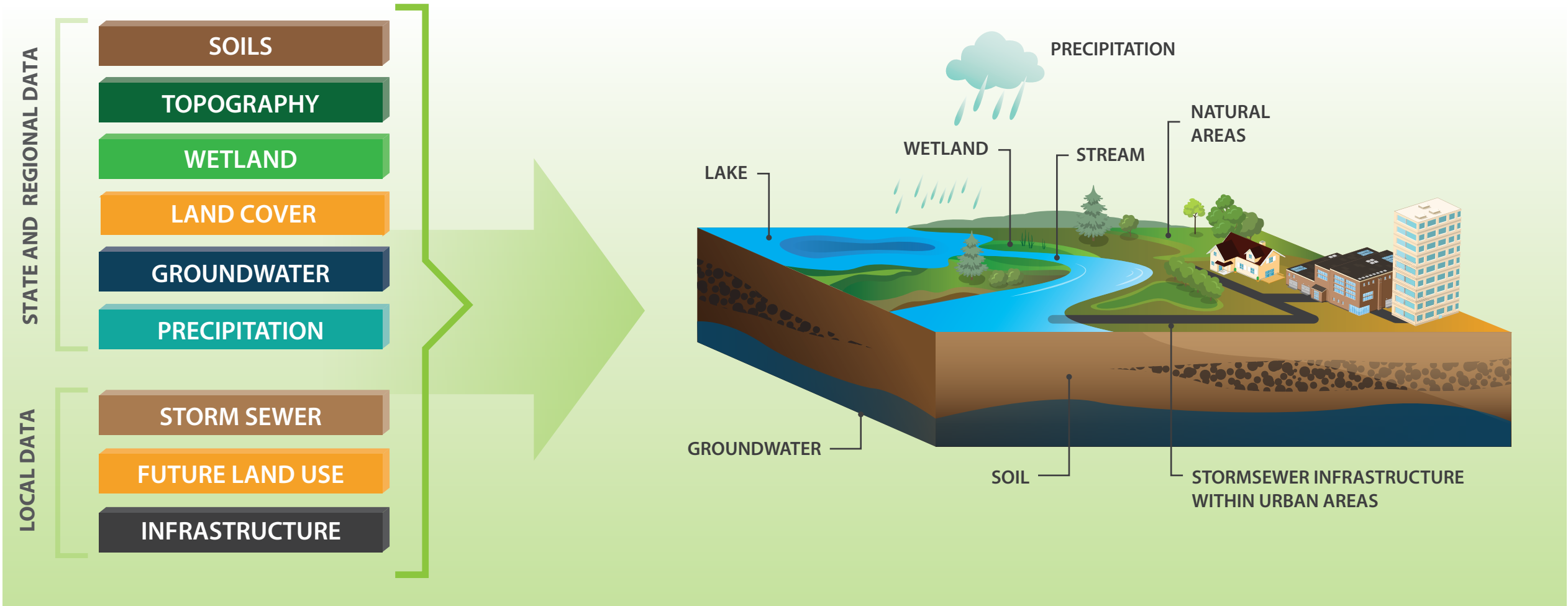**Does your project include original, hypothesis-driven research?**
No

Does the organization have a fiscal agent for this project?
No

Leveraging Innovations in Data Analytics for Project Implementation (Project #2022-164)

Summary: Integrating newly-available datasets into a 21st-century planning tool, widely called for by our communities, that forecasts the impacts of changing precipitation patterns and quantitatively compares the most cost-effective solutions.

STATE AND REGIONAL DATA

- SOILS
- TOPOGRAPHY
- WETLAND
- LAND COVER
- GROUNDWATER
- PRECIPITATION

LOCAL DATA

- STORM SEWER
- FUTURE LAND USE
- INFRASTRUCTURE

PRECIPITATION

WETLAND · STREAM · NATURAL AREAS

LAKE

GROUNDWATER

SOIL

STORMSEWER INFRASTRUCTURE WITHIN URBAN AREAS

OUTPUTS

| High-resolution understanding of complex watershed | Predict impact of changing climate | Identify natural resources most in need of protection | Quantitatively compare proposed projects | Improve flood forecasting and emergency response |

4 Partners

MINNEHAHA CREEK WATERSHED DISTRICT · Hennepin · DEPARTMENT OF NATURAL RESOURCES · USGS science for a changing world

14 Letters of Support

METROPOLITAN COUNCIL · Minneapolis City of Lakes · Minneapolis Park & Recreation Board · MINNESOTA ENVIRONMENTAL QUALITY BOARD · DEPARTMENT OF NATURAL RESOURCES · CITY OF MINNETONKA · CITY OF MOUND · St. Louis Park MINNESOTA · USGS science for a changing world · City of Waytata · Minnesota Cities Stormwater Coalition Municipal stormwater professionals working together for clean water

- $791K Requested
- $640K Already Invested
- $353K Proposed Match