Environment and Natural Resources Trust Fund

M.L. 2020 Approved Work Plan

General Information

ID Number: 2020-055

Staff Lead: Michael Varien

Date this document submitted to LCCMR: August 13, 2021

Project Title: Quantifying New Urban Precipitation and Water Reality

Project Budget: $500,000

Project Manager Information

Name: Joe Magner

Organization: U of MN - College of Science and Engineering

Office Telephone: (612) 626-0875

Email: jmagner@umn.edu

Web Address: https://cse.umn.edu/

Project Reporting

Date Work Plan Approved by LCCMR: August 13, 2021

Reporting Schedule: April 1 / October 1 of each year.

Project Completion: June 30, 2024

Final Report Due Date: August 14, 2024

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 04e

Appropriation Language: $500,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to better guide storm water management by evaluating the groundwater and surface water interactions contributing to high water tables and damage to home basements and underground infrastructure in urban areas.

Appropriation End Date: June 30, 2024

Narrative

Project Summary: Minnesota decadal increases in precipitation have increased runoff, groundwater recharge, and infrastructure damage. We will assess and define selected quaternary settings to better define hydrologic response to extreme changes.

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

In recent years Minnesota and specifically the Twin Cities Metro Area (TCMA) experienced significant extremes in meteorological and hydrological events. One issue is the phenomenon of high-water tables leading to home-basement and buried infrastructure damage in the Lake Nokomis area and other TCMA neighborhoods. High water tables can probably be attributed to significantly more precipitation than has occurred in the previous hundred years and a greater amount of impervious surface. Infrastructure impact includes water lines, sewer lines, and private residences, that were built during a period of relatively dry conditions compared to the current climatic conditions. In response to the higher precipitation and resulting surface runoff, most municipalities have begun adopting stormwater BMPs that not only reduce downstream flooding but also reduce negative water quality impacts. The application of these practices also may be causing higher water tables resulting in damage to above-ground and underground infrastructures, including roadways, and pipelines. To address this issue, it is necessary to better understand precipitation and groundwater response history from sentinel sites, the pathways of groundwater recharge not only within the TCMA region where new precipitation records were set from 2010-2020, but also at long-term meteorological, and hydrological record stations in Minnesota.

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.

Quantify meteorological, geologic, and hydrogeologic features and constraints that influence groundwater elevation including perched conditions in the Lake Nokomis area. The 43-year record of Shingobee Lake will be used as our climate driven lake-level, groundwater response to changes reference. Provide up-to-date information on the distribution and hydraulic properties of geologic materials from land surface to bedrock. Provide information on the physical container(s) for water and subsurface infrastructure to better protect and preserve future water resources, investigate reasons for high-water levels in the Lake Nokomis area in context with surrounding TCMA systems using hand-auger, mechanical, and geoprobe technology. Provide detailed evaluations of groundwater and surface water interactions and establish relations between precipitation and groundwater and surface water interactions in the Lake Nokomis and selected study areas using water-quality and quantity metrics, geochemical and stable isotope samples (end-member mixing analysis). Evaluate the effects of urban hydrologic management on lacustrine and groundwater-level responses to precipitation. Evaluations will be conducted using conventional hydrogeologic analysis techniques and groundwater models such as MODFLOW and/or the Metro Model, and/or other models such as hydrologic water balance models that include the detailed processes of infiltration, evapotranspiration, and snowmelt that predict over time.

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?

Improving our understanding of the hydrologic flow pathways, in a changing climate, on the land surface, and in the subsurface will be of key importance to providing guidance to municipalities. Given, more water uncertainty, there may be better ways to manage stormwater and the permitting of various land uses. Work in the TCMA and Shingobee Lake reference area will help us construct patterns of precipitation/groundwater change to help better design urban water storage systems while limiting the potential adverse environmental outcomes.

Project Location

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

Region(s): NE

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

Region(s): Metro

When will the work impact occur?

In the Future

Activities and Milestones

Activity 1: Define geologic system at selected study sites

Activity Budget: $71,183

Activity Description:
We will quantify geologic and hydrogeologic features and constraints that influence groundwater elevation at selected study sites including perched conditions in the Lake Nokomis area using the Shingobee Lake watershed data as a reference guide for data point acquisition. Provide up-to-date information on the distribution and hydraulic properties of geologic materials from land surface to bedrock. MGS staff will interpret bore-hole data collected by UMN, USGS, and driller. Provide information on the physical container(s) for water and subsurface infrastructure.

Activity Milestones:

Description	Completion Date
Interpret geologic data collected at study sites	September 30, 2023
Define hydraulic properties of geologic materials	December 31, 2023

Activity 2: Data collection at selected study sites, modeling and final report

Activity Budget: $428,817

Activity Description:
Quantify meteorological, geologic, and hydrogeologic features and constraints that influence groundwater elevation including perched conditions in the Lake Nokomis and the Shingpbee reference area. Provide information on the physical container(s) for water and subsurface infrastructure to better protect and preserve future water resources, investigate reasons for high-water levels in the Lake Nokomis area in context with surrounding Hennepin County systems using geoprobe technology (USGS will lead with UMN assistance). Provide detailed evaluations of groundwater and surface water interactions and establish relations between precipitation and groundwater and surface water interactions in the Lake Nokomis and Shingobee Lake areas using water-quality metrics, geochemical and stable isotope samples (end-member mixing analysis). Evaluate the effects of urban hydrologic management on lacustrine and groundwater-level responses to precipitation. These evaluations will be conducted using conventional hydrogeologic analysis techniques as well as applying groundwater models such as MODFLOW and/or the Metro Model, and/or other models such as hydrologic water balance models that include the detailed processes of infiltration and evapotranspiration, as well as snowmelt and soil freezing to predict water table response over time.

Activity Milestones:

Description	Completion Date
Define data collect methods and locations and place equipment	May 31, 2022
Develop water-level datasets at new study sites	December 31, 2023
Report documenting performance and unattended consequences.	June 30, 2024

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
John Nieber	UMN	Co-PI	No
Tony Runkle	UMN-MGS	Co-PI	Yes

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.
MGS will prepare maps that will be useful to TCMA residences. Presentations will be given at the annual Water Resoucess conference.

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 work will be transferred to local state agencies where other funds can be used to continue the Sentinel effort. If our findings suggest immediate action is required we will work with the Legislature to craft language to expand the effort beyond the selected study areas.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Joe Magner		Principal Investigator			36.5%	0.45		$38,918
Graduate Research Assistant		Research Assistant, Bioproducts & Biosystems			45%	0.75		$88,244
Data manager		Researcher, Bioproducts & Biosystems			31%	1.5		$88,244
Undergraduate Research Assistant		Undergraduate Research Assistant,			0%	0.5		$16,000
Tony Runkel		Chief Geologist at MGS, borehole characterization			31.8%	0.3		$10,762
Field Geologist		Technician			31.8%	0.3		$29,421
Geochemist		Technician, overseeing geochemical analysis			31.8%	0.15		$7,300
							Sub Total	**$278,889**
Contracts and Services								
US Geological Survey	Sub award	USGS will provide geo-probe services for boreholes and piezometer installation, and provide model expertise and guidance to UMN workers.				0		$118,187
Professional Services	Professional or Technical Service Contract	The contract driller will be asked to install up to 120 linear feet of well material				0		$9,320
Professional Services	Professional or Technical Service Contract	Lab analysis of water and soil samples using UMN labs in CFANS and CSE, and outside labs for QA/QC.				0		$9,000
							Sub Total	**$136,507**
Equipment, Tools, and Supplies								
	Equipment	Purchase of data loggers, pumps, sensors, batteries, enclosures, solar panels, wiring supplies, water sampling supplies, etc.	These items are essential for UMN folks to gather data at selected sites					$44,604

							Sub Total	**$44,604**
Capital Expenditures								
		Equipment: YSI multi-parameter probe - 2 @ $12,000	Collect real-time water data					$24,000
							Sub Total	**$24,000**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Vehicle rental for trips from BBE to TCMA sites ~ 1035 miles x $.58/mile	Domestic travel cost for visiting a field site and conducting field experiments.					$1,446
	Miles/ Meals/ Lodging	10 trips, 2 people travel by car to Shingobee Lake - 380 miles round trip X $.58/mile; meals $25/day X 10 days	Download data and provide equipment upkeep.					$2,554
	Conference Registration Miles/ Meals/ Lodging	4 people, for 2 years of registation for the annual MN Water Resources conference	Project information communications					$2,000
							Sub Total	**$6,000**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Magner, Report prep and graphic designer and Journal publication	Report prep and graphic designer and Journal publication					$10,000
							Sub Total	**$10,000**
Other Expenses								
							Sub Total	**-**

							Grand Total	**$500,000**

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				
			State Sub Total	**-**
Non-State				
In-Kind	NA	Dr. John Nieber time will be covered by UMN	Secured	$15,000
			Non State Sub Total	**$15,000**
			Funds Total	**$15,000**

Attachments

Required Attachments

Visual Component

File: ab3fce53-302.pdf

Alternate Text for Visual Component

After further discussion with MGS, we have decided that the final report will have graphs and sketches and that no final map will be produced given the very small scale of work...

Optional Attachments

Support Letter or Other

Title	File
Example Report	83365422-e4f.pdf
Background	da1fe28c-6d3.pdf

Media Links

Title	Link
MGS	https://cse.umn.edu/mgs

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

We reduced our geographic scope based on the reduction in funds

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

Yes

Do you agree travel expenses must 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 agree to the UMN Policy.

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

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

Water Table Aquifer Vulnerability