

**Environment and Natural Resources Trust Fund
2018 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 053-B

Rise and Fall of Superior: Water and Security

Category: B. Water Resources

Total Project Budget: \$ 406,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2018 to June 2021

Summary:

Lake Superiors water level is critical to Minnesotas economy. We will provide science to make level predictions, determine critical knowledge gaps, and prepare communities and industries for water level change.

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Diagram of Lake Superior Water Budget

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %



PROJECT TITLE: Rise and Fall of Superior: Water and Security

I. PROJECT STATEMENT

How well can you run a household or State without knowing the budget? Lake Superior is 10% of Earth’s surface freshwater and gives Minnesota the most inland seaport in the world yet its water budget (that determines lake level) is based on guesses and sparse measurements (see attached figure). Over 60 years, the Lake has seen some of its highest and lowest levels in recorded history while overall losing 1.5” every 3-4 years. The purpose of this request is to improve knowledge of future trends in lake level, define science needed to improve lake-level forecasts, and to work with Minnesota communities and businesses to prepare for changes in the Lake’s water level created by storms, droughts, and variations in weather.

The Lake’s physical environment is changing rapidly. It has been warming faster than regional temperatures which influences weather across the U.S. Lake water budgets are determined by the balance of inflows and outflows that include rivers, streams, rain, evaporation, and groundwater. Some of these are fairly well known (e.g., rainfall, stream flow, evaporation) but are estimated from sparse networks of observations. Further, stream and river inflows and outflows are included as simple “averages” without accounting for how rain and heat alter flows. Other elements like inflows of shallow and deep groundwater are unknown. Shallow groundwater flow may be small but deep groundwater moving through cracks in rocks over long distances are likely large. For example, deep groundwater inflows and outflows to the Mediterranean Sea exceed river flows.

The falling lake level over the past 60 years (1.5” every 3-4 yrs) is >18-times the rate of sea level rise (0.02” per yr). Today’s lowest lake levels now rival those of the Dust Bowl era. At this rate, costs will accrue to Minnesota communities long before 2100 when low waters could be 6’ beneath those of 1968. Ship traverse at Sault Ste. Marie would be difficult and the Lake could be cut off from the Great Lakes. Minnesotans need to prepare for both low (due to droughts and warming weather) and highly variable (due to intense storms) lake levels. Forecasting the direction and amount of lake level change is of critical importance to Minnesota’s economy: for example, Minnesota Coastal communities generate \$77 billion in employment annually. Although colleagues at the Large Lakes Observatory have analyzed evaporation and ice cover, and others at the Great Lakes Environmental Research Laboratory track lake levels, improving water budgets would improve economic, social, and environmental security of all who rely on the lake for shipping, water, and recreation.

This proposal will provide (1) **research** to assemble current knowledge about Lake Superior’s water budget and water level trends, (2) **expert panel summaries** of science needed to better define risks to water level, and (3) community and industry understanding of **social and economic costs** of water level change.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Research on Lake Superior water budget and level

Budget: \$204,543

We will gather information on surface fluxes and evaporation to find how these are influenced by weather. These analyses will be combined with information about groundwater contributions (Activity 2) and Minnesota weather research to improve projections of future water level changes.

Outcome	Completion Date
1. Collect historical run-off data from gauged streams, analyze relation with weather, create report; analyze and report on historical weather and lake-level trends	June 2019
2. Estimate run-off from un-gauged streams, weight with run-off from gauged watersheds, combine with Outcome 1 to discern historical trends in inputs and outputs	June 2020
3. Summarize historical evaporation data from nearby weather stations, relate to weather conditions, create report to combine with Outcomes 1-2	June 2020
4. Combine surface flows with evaporation and groundwater status and weather projections	June 2021



from Activity 2 to project future water level trends	
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Activity 2: Expert panels to define risks to water level from weather and groundwater **Budget: \$60,086**
 An expert panel of 5 **hydrogeologists** with expertise in groundwater flux will meet annually to evaluate potential for groundwater inputs and summarize published data (Yr 1), evaluate summarized information (Yr 2), and create report of best knowledge of potential fluxes to Lake Superior and of critical future research needs (Yr 3). Other weaknesses in lake budgets are projected trends in rain, temperature, wind, ice-cover, and evaporation. Five **meteorologists, weather, and ice-scientists** will evaluate the current knowledge, summarize information, and define research needs.

Outcome	Completion Date
1. Evaluate the current state of knowledge on submarine groundwater flux (SGF).	June 2019
2. Summarize current information on SGF and weather projections critical to Lake Superior	June 2020
3. Define critical research needs on SGF and weather projections for Lake Superior	June 2021

Activity 3: Community and industry outreach to determine water level impacts **Budget: \$141,371**
 Minnesota stakeholders will identify social, economic, and environmental impacts from lake level change. Stakeholders will include: shipping, business owners (marinas, recreation, tourism), land owners, parks, resource managers, local governments, conservation districts, city/county staff, sport fishing interests, and tribal (Grand Portage and Fond du Lac). Stakeholders will participate in a workshop (Yr 1) to learn about the Lake’s water budget/lake level change and identify potential impacts to their business or community. Photos will help visualize areas vulnerable to lake level change. Stakeholders will participate in a scenario-planning workshop (Yr 2) to visualize future impacts of different water level scenarios. Scenarios will be developed for each stakeholder group. Stakeholders will participate in a socio-economic analysis (Yr 3) of the costs/benefits of the various lake level change scenarios, and identify priority actions for reducing community vulnerability.

Outcome	Completion Date
1. Conduct needs assessment and photo inventory displaying lake level change impacts to Lake Superior community stakeholders	June 2019
2. Scenario planning with Minnesota stakeholders for water level change. Three scenarios will be developed with each stakeholder group	June 2020
3. Socio-economic analysis of lake level scenario impacts and identification of priority adaptation strategies to increase resilience	June 2021

III. PROJECT STRATEGY

A. Project Team/Partners

This project will be performed and coordinated by Minnesota Sea Grant (MNSG), Duluth, MN, with collaboration of scientists from the Large Lakes Observatory. The project manager will be Dr. John Downing, Director of MNSG. Jesse Schomberg and Dr. Thomas Beery will be outreach leads. Dr. Chris Filstrup will lead the science and expert panel activities. CF is supported 100% by external funds. Others are partially supported by UMD.

B. Project Impact and Long-Term Strategy

The project will work with communities to prepare for future lake level changes resulting from trends and variations in Minnesota’s weather, using the best available information. We will define critical knowledge gaps to fill to help Minnesota’s coastal communities adapt to lake-level changes. Future proposals may deal with filling knowledge gaps in groundwater flux and weather severity.

C. Timeline Requirements

We are requesting project funding for three years with the project running from June 2018 – June 2021.

2018 Detailed Project Budget

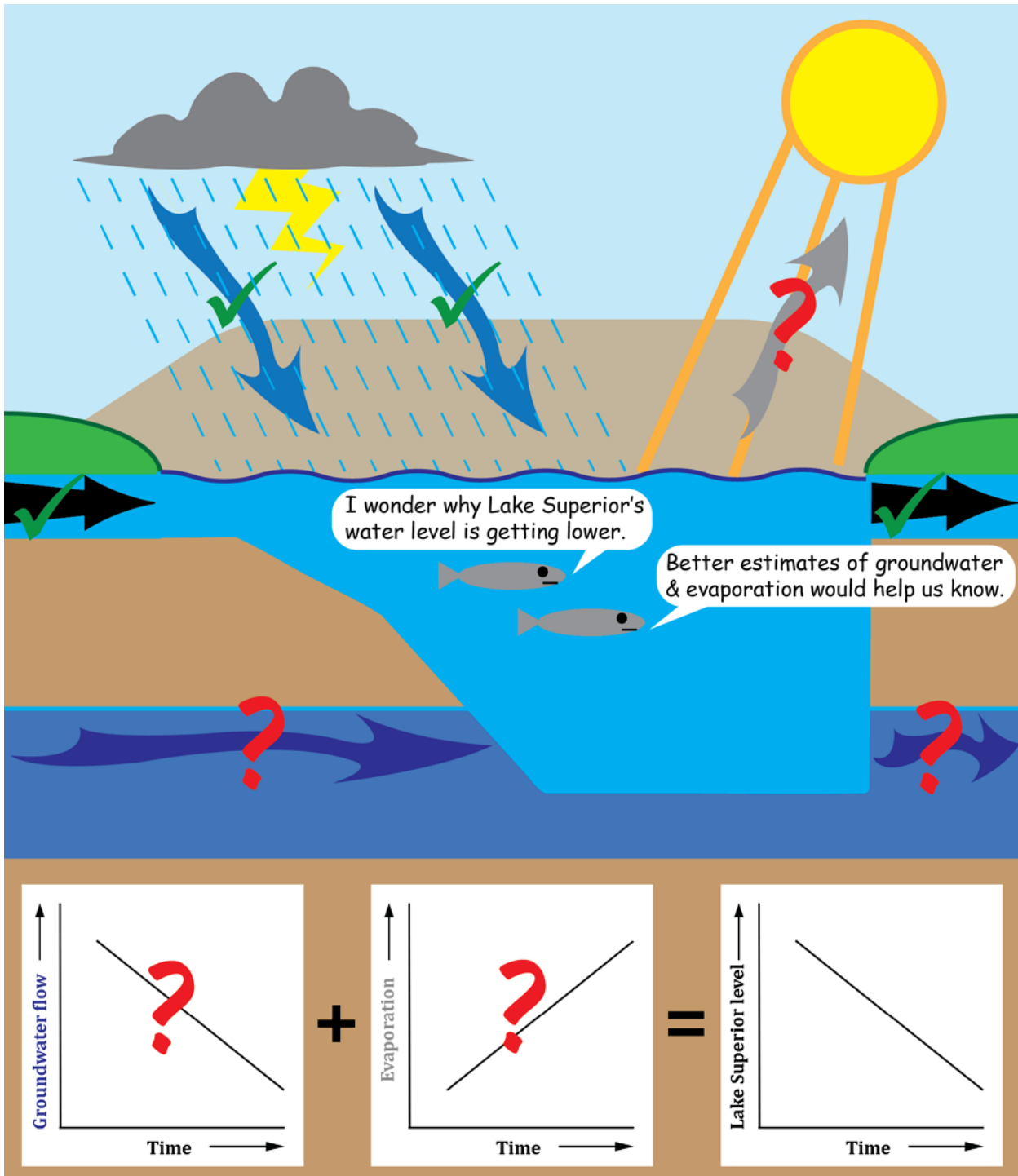
Project Title: Rise and Fall of Superior: Water and Security

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
John Downing, Project Manager, compile & analyze groundwater data (75% salary, 25% fringe); 5% FTE for each of Years 1, 2, 3	\$ 42,778
Chris Filstrup, Research Associate, compile and analyze streamflow, evaporation, and lake levels (75% salary, 25% fringe); 90% FTE for each of Years 1, 2, 3	\$ 187,234
Tom Beery, Extension Educator, organize and undertake stakeholder outreach (75% salary, 25% fringe); 30% FTE for each of Years 1, 2, 3	\$ 73,137
Jesse Schomberg, Extension Educator, organize and undertake stakeholder outreach (75% salary, 25% fringe); 15% FTE for each of Years 1, 2, 3	\$ 42,256
Equipment/Tools/Supplies: Printing, materials, supplies for annual workshops and education and outreach materials.	\$ 5,925
Acquisition (Fee Title or Permanent Easements): <i>In this column, indicate proposed number of acres and name of organization or entity who will hold title.</i>	\$ -
Travel: Transportation, lodging, meals for research experts to attend Annual Groundwater Summit (3 days travel per workshop) and Annual Weather Summit (3 days travel per workshop) in each of Years 1, 2, 3. Transportation, meals for stakeholders to attend Annual Stakeholder Meetings (1 day travel per workshop) in each of Years 1, 2, 3. Year 1: needs assessment & photo inventory. Year 2: Scenario planning for each group. Year 3: Socio-economic evaluation of costs and benefits.	\$ 53,670
Additional Budget Items: Rental of meeting space for annual workshops	\$ 1,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 406,000

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period:	N/A	
Other State \$ To Be Applied To Project During Project Period:	N/A	
In-kind Services To Be Applied To Project During Project Period: Foregone Facilities and Administrative costs at the University' negotiated rate for research: 54% of a modified total direct cost base of \$405,000.	\$ 218,700	Secured
Past and Current ENRTF Appropriation:	N/A	
Other Funding History:	N/A	



Project Manager Description

Project Manager Qualifications and Responsibilities

John A. Downing will manage this project. He has 40 years of experience in aquatic research and community outreach. He is currently the Director of the Minnesota Sea Grant College Program, a research scientist at the Large Lakes Observatory, and a tenured Professor in the Department of Biology at the University of Minnesota Duluth. Although he has life-long roots in Minnesota, he was formerly a Regent's Excellence Professor of Ecology, Evolution, & Organismal Biology and Agricultural & Biosystems Engineering at Iowa State University and ran one of the best-funded and long-standing research operations at that institution. His 150+ peer-reviewed books and journal articles cover diverse topics in limnology, marine science, environmental economics, and terrestrial ecology. His leadership experience has been as the Director of the Laurentian Biological Station (Montreal, Quebec), the co-founder of the Inter-University Limnological Research Group (Montreal, Quebec), Director of the Iowa State University Limnology Laboratory (Ames, Iowa), Chair of the Environmental Science Interdepartmental Graduate Program (Ames, Iowa), President of the Association for the Sciences of Limnology and Oceanography, and Chair of the Council of Scientific Society Presidents (Washington, DC). Recent outreach programs have assisted citizens in agricultural regions to understand and mitigate nutrient pollution and helped citizens and industries in northern Minnesota combat eutrophication and avoid lake degradation from aquatic invasive species.

Organization Description

Minnesota Sea Grant is part of the National Oceanic and Atmospheric Administration's (NOAA) Sea Grant Program, which supports 33 similar programs in coastal states throughout the United States and Puerto Rico. Our mission is to facilitate interaction among the public and scientists to enhance communities, the environment and economies along Lake Superior and Minnesota's inland waters by identifying information needs, fostering research and communicating results. Minnesota Sea Grant concentrates on research, outreach, and education in four focus areas: healthy coastal ecosystems, sustainable fisheries and aquaculture, resilient communities and economies, environmental literacy and workforce development. Minnesota Sea Grant provides the necessary office space, small-format meeting facilities, information technology (IT) infrastructure, virtual meeting capabilities, office equipment, and administrative support required to complete this project.

The Large Lakes Observatory is one of the largest water-focused centers of research in the entire University of Minnesota system with strong academic ties to institutes and academic units across housed on the Twin Cities Campus. It is the only institute in the U.S. dedicated to the scientific study of large lakes throughout the world, including Lake Superior. Our mission is to perform scientific studies on the large lakes of Earth using interdisciplinary techniques from the fields of limnology, environmental science, and oceanography. The Downing Laboratory is housed within the Large Lakes Observatory and provides the necessary computing power and software, data visualization tools, data storage, information technology (IT) infrastructure, office equipment, and administrative assistance required to complete this project.