Environment and Natural Resources Trust Fund
2017 Request for Proposals (RFP)

Project Title: **ENRTF ID: 052-B**

The Minnesota Center for Water Treatment Technology Innovation

Category: B. Water Resources

Total Project Budget: $ 10,306,899

Proposed Project Time Period for the Funding Requested: 6 years, July 2017 - June 2023

Summary:

Due to aging / inadequate drinking water, wastewater, and stormwater infrastructure, Minnesota's citizens and water resources are at risk. The center will address these problems through research and technology development.

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name:

City / Township:

Alternate Text for Visual:

The graphic shows examples of stormwater, wastewater, and drinking water treatment technologies. Because of aging/inadequate drinking water, wastewater and storm water infrastructure MN citizens and the environment are at risk. The proposed center will work to prevent an ecological disaster or a drinking water crisis from happening in MN while also supporting the development of new treatment technologies.

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

I. PROJECT STATEMENT

The goal of this request is to **establish the Minnesota Center for Water Treatment Technology Innovation** in the Department of Civil, Environmental, and Geo- Engineering (CEGE) and in conjunction with the Saint Anthony Falls Laboratory (SAFL) at the University of Minnesota (UMN). The main goal of the Center is to **preserve and improve Minnesota's water resources by developing and disseminating sustainable water management and treatment technologies**. The center will work to solve current and emerging water quality problems by performing cutting-edge **research**, build the State's technical capacity through the **training** of water treatment engineers, and perform **outreach and education** activities aimed at drinking/waste/storm-water professionals and the general public. The Center also will serve as a **catalyst for economic development** by cultivating private industry partners to collaborate on technology development and implementation. The Center will fill a much-needed niche by **focusing on engineered systems and technologies for treating drinking water, wastewater, and stormwater**.

Given our location in the upper Midwest, Minnesota must address relatively unique water treatment challenges driven by the cold climate, including: ice cover on lakes and rivers resulting in water quality changes (e.g., oxygen depletion), frozen ground that hinders rain- and melt-water infiltration, reduced water temperature in winter that results in less efficient water and wastewater treatment due to significantly decreased chemical/biological reaction rates and increased water viscosity, large seasonal variations in natural organic matter concentration that impacts drinking water treatment, and increasing chloride levels from the use of salt for deicing. Furthermore, given projected investment needs of $11 billion for public water and wastewater infrastructure over the next 20 years and the fact that Governor Dayton is making this a priority for the State, **it is important that the proposed Center be established to help guide critical water infrastructure decisions and investments throughout Minnesota, particularly in small communities where funds for research, and training are scarce**. Based on conversations with utility managers throughout the State, the activities of a recent state-funded partnership between the Minnesota Pollution Control Agency (MPCA) and the UMN to plan for the future of wastewater treatment in Minnesota, and critical current and future water quality challenges, the Center's initial research priorities are:

- Removal of current and emerging contaminants in drinking water, wastewater, and in surface waters through innovative and efficient treatment approaches
- Low-energy, low-cost, reliable nutrient removal and resource recovery from wastewater & stormwater
- Development of water/wastewater treatment technologies for small communities & rural households
- Technologies to facilitate reuse of stormwater and wastewater

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Research and Training to Improve Water Quality and Build Technical Capacity* **Budget: $9,304,897**

Performing research to solve the state's water problems while training future water professionals is the main focus of the Center. Approximately 5-8 major research projects will be run simultaneously for 2-3 years duration each. Each project will align with the Center's research priorities. At the outset, the Center will focus on the following specific projects: (1) Effects and Removal of Antimicrobials and Antimicrobial Resistance in Wastewater, (2) Carbon Filtration for Treating Nitrate-Contaminated Groundwater & Stormwater, (3) Biosorption and Bioaccumulation of Precious Metals in Wastewater, (4) Seasonal Dynamics of Comammox During Wastewater Treatment, (5) Occurrence and Control of Bacteria on Water Mains, (6) Innovative Membrane-Based Low-Energy Biological Nitrogen Removal, and (7) Producing Renewable Energy and Clean Water from Waste-Phase II. As these initial projects end, new research project ideas will be solicited through a Request for Proposals (RFP) process, reviewed and selected by a Center Board consisting of 8 to 10 members including the Center Director and professionals from private industry (e.g., consulting firms, water technology companies), public utilities, watershed districts, and government agencies (e.g., Minnesota Department of Health or MDH, MPCA) and a member of the LCCMR staff (non-voting). Each proposal will include at least one

faculty member from the core Center faculty in CEGE to ensure that every project fits with the Center's research priorities. In addition to these "major" research projects, funds will be reserved for shorter-term (~6-12 months) **rapid response** research projects to address water crises around the state as they arise. It is expected that the Center's research priorities will shift with time. Research priorities will be set by the Board after soliciting input from Minnesota's water professionals. All investigators will be required to submit work plans to LCCMR for review and approval prior to beginning a project.

A critical function of the Center will be to build technical capacity through education and **training** of graduate and undergraduate **engineering** students. Through research and outreach activities, the Center will train B.S. (~10 per year), M.S. (~5 per year), Ph.D. (~5 per year), and post-doctoral (~5 per year) level engineers to build the capacity of the water treatment and management workforce in the state. With established connections to water and wastewater utilities and watershed districts in the state, the Center will be in a privileged position to expose students to real-world problems and full-scale treatment facilities.

Outcome	Completion Date
1. Complete initial research projects, train ~40 grad/undergrad students & 10 post-docs	June 30, 2020
2. Complete 2nd round of 6-8 projects, train ~40 grad/undergrad students & 10 post-docs	June 30, 2023

Activity 2: *Outreach & Education to Enable Treatment Innovation & Pollution Prevention* **Budget: $1,002,002**

The center will perform ***outreach*** and ***education*** activities to disseminate research findings, to aid in water pollution reduction, and to promote innovation in water, wastewater, and stormwater treatment practice. We will work with the MPCA and MDH to develop interactive educational modules aimed at the general public. These educational modules will be designed to promote behavior change (i.e., consumer choice and product disposal) that protects treatment infrastructure and water resources by reducing the release of problematic contaminants such as "flushable" wipes and microbeads. We will also develop and deliver modules for conveying cutting-edge research findings to water and wastewater operators and Public Facilities Authority (PFA) personnel to promote adoption of innovative technologies. The center will establish a website with links to research publications and other resources (e.g., "Ask the Experts" blog), and will develop a semi-annual newsletter. Journal articles produced by center personnel will be open-access to maximize dissemination of research findings, and center activities will be promoted via social media.

Outcome	Completion Date
1. Establish outreach activities (website, newsletter, social media)	June 30, 2018
2. Begin technology transfer (education) programs for workers in water industry	June 30, 2019

III. PROJECT STRATEGY

A. Project Team/Partners: The natural home of the described water technology center is in the College of Science and Engineering and specifically CEGE, where the faculty members are skilled in technology development and well respected by engineers working with and for municipal water treatment entities. Center activities will be managed by a center Director (4 months effort paid/year), who will be a faculty member in CEGE, together with a full-time Associate Director who will be responsible for managing center activities including preparing budgets, interfacing with the Board, coordinating outreach and education activities, and overseeing the center website/social media activities. The Board will provide oversight on all center activities including the research agenda. Partners include SAFL and the UMN Water Resources Center (WRC).

B. Project Impact and Long-Term Strategy: The long-term goal of the proposed project is to preserve and protect public health and the environment by improving the management and treatment of Minnesota's critical water resources. The Center will take a leadership role in water research, technology development, training, outreach, and education in the State.

C. Timeline Requirements: This Center project requires a longer period of funding than a typical ENTRF project to enable the training, outreach, and education aspects of the Center to fully develop. Therefore, we request six years of funding.

2017 Detailed Project Budget

Project Title: *The Minnesota Center for Water Treatment Technology Innovation*

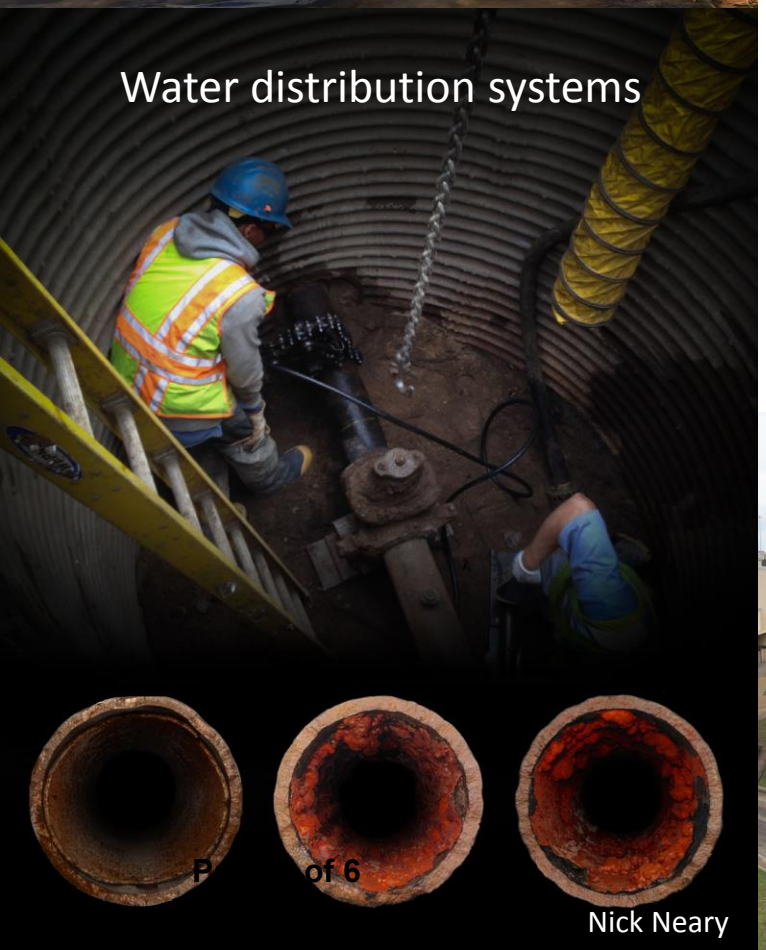
IV. TOTAL ENRTF REQUEST BUDGET 6 years

BUDGET ITEM	AMOUNT
Personnel:	
Raymond M. Hozalski, Center Director (75% salary, 25% benefits); 33% FTE; Project supervision, supervision of post-doctoral researchers and students, project reporting, dissemination and	$ 486,281
Associate Director, to be hired (75% salary, 25% benefits); 100% FTE; Project management, budgeting, interface with center board, coordinating outreach and education activities.	$ 712,621
Two Technicians, to be hired (75% salary, 25% benefits); 100% FTE; method development, train graduate students, maintain and operate analytical equipment, prepare teams for field work	$ 1,037,782
Secretary (75% salary, 25% benefits); 50% FTE; Provide support to director and associate director	$ 151,339
Accountant (78% salary, 22% benefits); 50% FTE; Provide support to director and associate director	$ 106,093
William Arnold, Project participant (75% salary, 25% benefits); 2% FTE; Education and outreach.	$ 33,236
Sebastian Behrens, Project participant (75% salary, 25% benefits); 2% FTE; Education and outreach.	$ 24,840
John Gulliver, Project participant(75% salary, 25% benefits); 2% FTE; Education and outreach.	$ 35,829
Miki Hondzo, Project participant (75% salary, 25% benefits); 2% FTE; Education and outreach.	$ 32,931
Timothy LaPara, Project participant (75% salary, 25% benefits); 2% FTE; Education and outreach.	$ 27,387
Paige Novak, Project participant(75% salary, 25% benefits); 2% FTE; Education and outreach.	$ 32,179
Santiago Romero-Vargas Castrillon, Project participant (75% salary, 25% benefits); 2% FTE; Education and outreach.	$ 21,104
Faculty, to be determined based on research projects undertaken (75% salary, 25% benefits); 2-6% FTE; Manage individual research projects, supervise post-docs and students, report writing, and dissemination	$ 622,818
5 Post-doctoral researchers (82% salary, 18% benefits); 100% FTE; Perform research, analyze data, write reports	$ 1,979,315
10 graduate researchers (59% salary, 41% benefits); 50% FTE; Perform research, analyze data, write reports	$ 2,811,555
10 Undergraduate researchers, to be hired (100% salary, 0% benefits); Assist grad students and post-docs	$ 32,340
Professional/Technical/Service Contracts:	
University of Minnesota Genomics Center: next generation DNA sequencing and microarray qPCR	$ 300,000
University of Minnesota Geology Department: ICP-MS for metals analysis	$ 97,977
Equipment maintenance and repair	$ 198,987
Equipment/Tools/Supplies:	
LC MS/MS for analysis of contaminants of emerging concern in water samples (purchased in year 1)	$ 250,000
Nanodrop digital PCR machine for qPCR (purchased in year 1)	$ 100,000
Quartz Crystal Microbalance for membrane fouling studies (purchased in year 1)	$ 100,000
Mobile lab for field sampling campaigns (purchased in year 1)	$ 50,000
GCMS for analysis of volatile organic contaminants in water samples (purchased in year 4)	$ 100,000
Organic Carbon Analyzer for analysis of carbon content of water samples (purchased in year 4)	$ 50,000
Ion chromatograph for analysis of ionic species in water samples (purchased in year 4)	$ 50,000
General laboratory supplies (conventional filters, membrane filters, chemicals, reagents, DNA extraction kits, reagests and purification kits for qPCR, etc.)	$ 729,626
Travel:	
In-state travel to collect samples and disseminate results to stakeholders	$ 132,659
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 10,306,899

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: *The University of Minnesota does not charge the State of Minnesota its typical overhead rate of 52% of the total modified direct costs (graduate tuition and academic fringe are excluded).*	$ 4,567,152	*Secured*
Funding History:	N/A	
Remaining $ From Current ENRTF Appropriation:	N/A	

Minnesota Center for Water Treatment Technology Innovation



- Aging/inadequate drinking water, wastewater and storm water infrastructure.
- MN citizens and the environment are at risk.
- The proposed center will work to prevent an ecological disaster or a drinking water crisis from happening in MN.

Project Manager Qualifications and Organization Description

Dr. Raymond M. Hozalski

Professor, Environmental Engineering, Department of Civil, Environmental, and Geo-Engineering, University of Minnesota

B.ChE., Chemical Engineering, 1990, Villanova University, Villanova, PA.

M.S., Environmental Engineering, 1992, The Johns Hopkins University, Baltimore, MD.

Ph.D., Environmental Engineering, 1996, The Johns Hopkins University, Baltimore, MD.

Dr. Hozalski will serve as Center Director and be responsible for overall project coordination. He is an expert in applied environmental microbiology and has been studying water treatment for over 25 years, water distribution systems for over 15 years, and storm water management and treatment for over 10 years. He has performed water treatment research in collaboration with Minnesota drinking water utilities for about 19 years.

Dr. William Arnold (University of Minnesota) is an expert on the fate and transport of organic chemicals in aquatic systems. For the past 10 years, he has been a pioneer in the development and modeling of polymer films for chemical containment.

Dr. Sebastian Behrens (University of Minnesota) is a microbiologist with expertise in the development and application of molecular biology tools for studying bacteria in natural environments and engineered water treatment systems.

Dr. John Gulliver (University of Minnesota) is an expert on stormwater management and treatment. He has become a leader in the development of enhanced treatment technologies for removing nutrients from stormwater to protect surface waters.

Dr. Miki Hondzo (University of Minnesota) is an expert in the field of environmental fluid mechanics. He studies microorganism-fluid interactions with applications in harmful algal blooms and biofuels.

Dr. Timothy LaPara (University of Minnesota) is an expert in environmental microbiology and microbial ecology. He develops and applies molecular biology tools to investigate, monitor, and control microbial communities in water and wastewater treatment systems.

Dr. Paige Novak (University of Minnesota) is an expert in applied environmental microbiology. She investigates the use of bacteria for hazardous waste treatment and nutrient/energy recovery from wastewater.

Dr. Santiago Romero Vargas Castrillon (University of Minnesota) is an expert in the development, characterization, and testing of advanced materials, including membrane materials and membrane-based processes for water purification and treatment.

Organization Description

The University of Minnesota is one of the largest, most comprehensive, and most prestigious public universities in the United States (http://www1.umn.edu/twincities/01_about.php). The laboratories and offices of the PI and co-PIs contain all of the necessary fixed and moveable equipment and facilities needed for the proposed studies.