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

Project Title: **ENRTF ID: 022-A**

Variable Winter Thermal Regimes and Managing Trout Streams

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: $ 499,935

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

Summary:

Winter sport fishing for trout is a vibrant industry, but can be impacted by changing climate. We seek to understand how to conserve trout habitat, especially focusing on winter management.

Name: Leonard Ferrington

Sponsoring Organization: U of MN

Address: 219 Hodson Hall, 1980 Folwell Avenue

Saint Paul MN 55108-6125

Telephone Number: (651) 226-8519

Email ferri016@umn.edu

Web Address midge.cfans.umn.edu

Location

Region: Southeast

County Name: Fillmore, Goodhue, Houston, Mower, Olmsted, Wabasha

City / Township:

Alternate Text for Visual:

The map shows counties in the Drfitless Region of SE Minnesota where streams will be assessed.

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

PROJECT TITLE: Variable Winter Thermal Regimes and Managing Trout Streams

I. PROJECT STATEMENT: In 2008, Trout Unlimited estimated the economic impact of recreational trout angling in the Driftless Region to exceed 1.1 billion dollars. Most management strategies for trout are based largely on summer dynamics (which are well known), however winter has a critical influence on survivorship and growth in many streams and needs to be better integrated into future management strategies. This project builds on prior work by Ferrington (*et al*.) performed during winter in 40 SE MN streams (ML 2010 Chap. 362, Sec. 2, Subd. 5i) which produced important findings (seven publications) showing that groundwater inputs to trout streams:

- buffers stream water in winter to prevent freezing temperatures and ice cover,
- documents that groundwater inputs are highly variable along short stretch of stream, producing very different conditions for trout survival, for reproductive success, and patterns of growth, during winter,
- shows streams support differing abundances and types of invertebrates (the trout food base) that varies substantially in relation to groundwater inputs and thermal regimes, and which are especially important for growth, survivorship and reproductive health of trout during winter,
- confirms the buffering of thermal regime facilitates winter-adapted invertebrate species to develop dense populations that results in increased survivorship, faster growth and greater abundance of trout,
- and that several winter-adapted invertebrate species are new to science or have unknown basic biology.

II. PROJECT ACTIVITIES AND OUTCOMES: We will intensively map and sample eight streams/year at each of five locations/stream that span a wide range of groundwater input intensities, to generate results leading to improved habitat management guidance. Our specific objectives are to:

- identify how groundwater, air temperature, geology and streambed conditions interact to determine optimal winter habitat for invertebrates that trout feed on and are critical for trout in winter;
- understand how changes in geology, groundwater input, and vegetation affect stream temperatures and therefore influence food availability during winter, and ultimately trout growth and productivity;
- create quantitative models relating winter thermal regimes to food availability for trout consumption;
- recommend ways that quantitative models we develop can guide efforts to enhance trout productivity via habitat modifications to protect or improve stream temperature, with a focus on the winter period.
- Trout in Minnesota's nearly 700 designated streams have great economic, sport and aesthetic importance. Trout depend on cold, clean stream water, a resource that is threatened by gradual groundwater warming. Minnesota's managers and landowners need to understand what actions can reduce the impacts of warming and by how much. Consequently, we will also **develop a web-based program that educates and utilizes citizen volunteers** to assist in monitoring the dynamics of invertebrate populations in a large number of trout streams in SE Minnesota.

Activity 1: Thermal Modeling--- ***Budget: $ 124,984***

We will build on Calvin Alexander's spring mapping work and leverage the MN DNR's Long Term Monitoring program to understand how groundwater inputs interact with geology and streambed conditions to buffer trout streams from winter cold and freezing temperatures.

This activity will allow us to predict the ranges of thermal suitability for trout, and how they vary longitudinally within streams, which will enable managers to position and tune restoration efforts to have the greatest impact in extending the moderating influence of groundwater on stream temperature. We will use air and water temperatures (8 streams/year, 5 sites/stream, 5 sampling events/stream/year) to map groundwater inputs at fine spatial scales. We will relate these conditions in a statistical model for identifying highest-priority management actions similar to our earlier models published as a result of our previous LCCMR-funded project.

Outcomes for Activity 1: The following outcomes will be accomplished at 5 sites in each of the 8 streams/year (total of 120 sample sites over three years)	**Completion Date**
1. *Specific, measureable outcome:* Develop thermal models (TM) 8 streams, 5 sites/str, year 1	*June 2019*
2. *Specific, measureable outcome:* Develop TM for 8 more streams, 5 sites/str, year 2	*June 2020*
3. *Specific, measureable outcome:* Develop TM for 8 more streams, 5 sites/str, year 3	*June 2021*

Activity 2: Relate changes in macroinvertebrate abundances and genetics at the same 5 sites in each of the same 8 streams/year used for thermal models developed in Activity 1. ***Budget: $ 264,965***

This activity links stream conditions to trout through assessment of food density, availability and nutritional quality. Given that many winter species look the same (especially undescribed species), we will use a type of DNA analysis (MtDNA) to efficiently and accurately identify insects that provide the most reliable energy and nutritional sources to trout in winter. We will determine how genetic patterns differ among the abundant insects, and how genetic variability aligns with abundances as a function of water temperatures across streams.

Outcomes for Activity 2: 5 sites in each of 8 streams/year (total of 120 sites over 3 years)	Completion Date
1. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2019*
2. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2020*
3. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2021*

Activity 3: Develop a communication and educational outreach program ***Budget: $ 109,986***

The goal of the communication and outreach program is to improve public engagement with science and to increase understanding of how specific actions impact trout stream conditions, which have important economic implications for Minnesota areas relying upon tourism revenue. Landowners in SE MN, agricultural stakeholders, and conservation organizations are a critical audience for this project, especially as we must gain access to privately owned land to collect data. We will conduct focus group and survey research with these groups to better understand their knowledge of trout stream research, attitudes towards the importance of this research, and barriers to granting access to researchers or serving as citizen volunteers that aid in data collection. It will help us identify best communication strategies, channels and content to reach SE MN landowners and best ways to partner with stakeholder groups. Our communications plan will help us share goals, results, and impact of this research with key audiences. The plan will use social media channels, media organizations in SE MN to communicate events to leader organizations (e.g. MN Farm Bureau, FFA, MN Farmers' Union, Trout Unlimited).

Outcomes: Development of a communication and educational outreach program	Completion Date
Coordinate with key audiences and design communication campaign plan	*August 2019*
Develop communication and outreach materials and begin implementing campaign plan	*August 2020*
Implement communication campaign, evaluate impact of education and outreach messages	*June 2021*

III. PROJECT STRATEGY A. Project Team/Partners: Project team consists of Principal Investigator Leonard Ferrington, Co-PI Rebecca Swenson, 2 graduate students (=1 for activities 1&2, 1 for activity #3), and undergrad assistants. We will integrate non-funded team members as volunteers and advisors (Jim Perry, Bruce Vondracek) as appropriate. We will consult with and seek guidance from MN DNR Division of Fish & Wildlife (e.g., Doug Dieterman, Research Biologist), and Trout Unlimited. In our previous grant-work related to trout streams the assistance of the partners has been critical to our success and we will continue to nurture these collaborations.

B. Project Impact and Long-Term Strategy: This project will optimize decisions & activities that affect trout streams in SE MN. We will disseminate findings to the public through Trout Unlimited, the National Trout Center (Preston, MN), and the Minnesota Master Naturalist program, and to technical audiences (researchers, managers, policymakers) through state conferences and meetings with the MN DNR. This project is part of a dedicated and collaborative effort by the UMN, the MN DNR, and Trout Unlimited to understand, preserve, and enhance trout streams and trout fishing in SE Minnesota, including recreational and economic benefits.

C. Timeline Requirements: years: This project requires three field seasons to intensively survey all 24 streams at five sites/stream in winter, then develop statistical tools for translating management and restoration efforts into recommendations. Communication and educational outreach deliverables will be developed, then refined each of the three years to fine tune and expand our communication, outreach and educational effectiveness.

2018 Detailed Project Budget

Project Title: Variable Winter Thermal Regimes and Managing Trout Streams

Attach budget, in MS-EXCEL format, to your "2018 LCCMR Proposal Submission Form".

IV. TOTAL ENRTF REQUEST BUDGET: Three years ($ 499,935) Years: 1 July 2018---30 June 2021

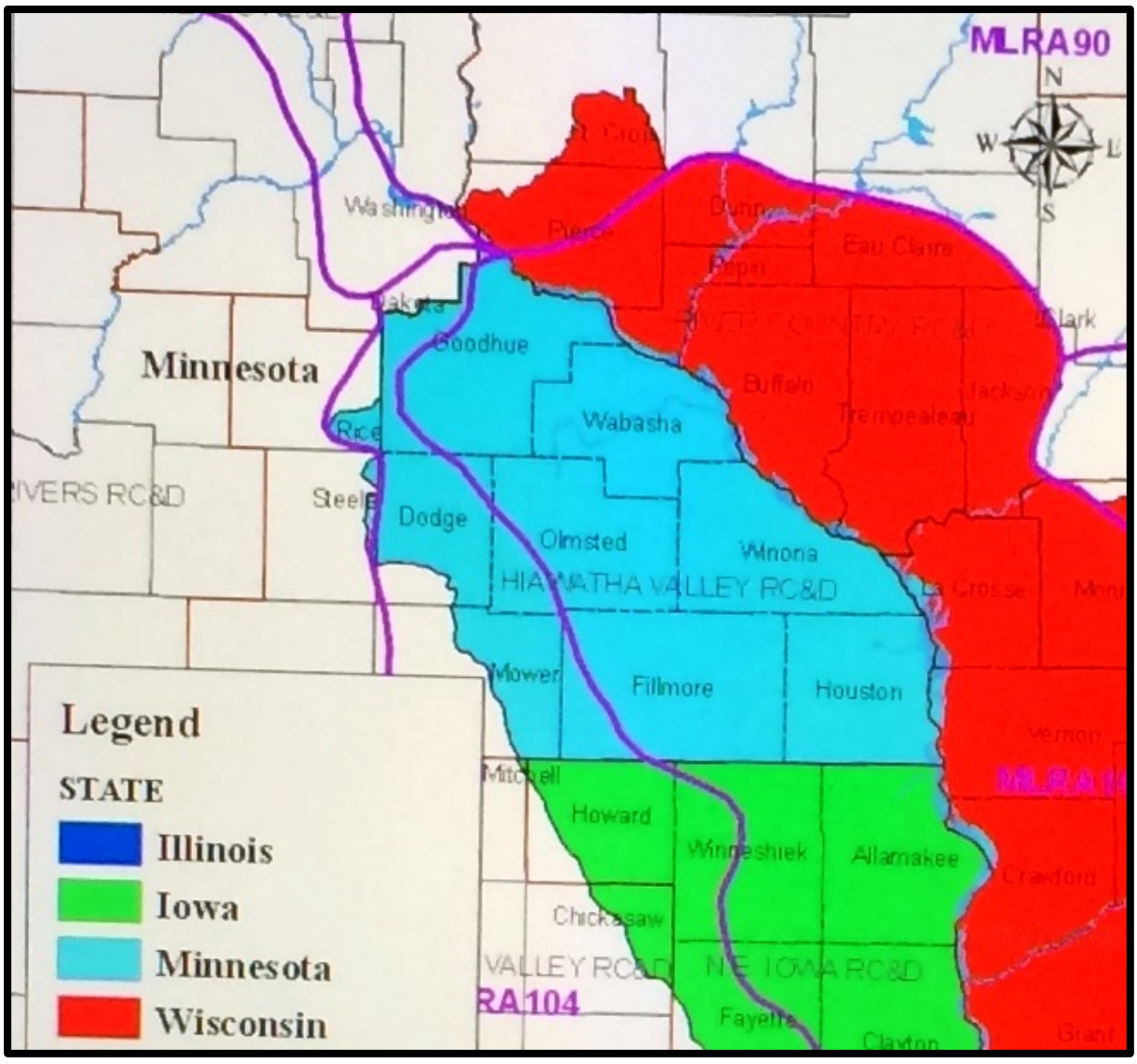
BUDGET ITEM	AMOUNT
Personnel: : Leonard Ferrington--- PI, project supervision/field work, activities 1 &2. One month salary per year (= $ 32,592 summed over all three years); Ferrington fringe benefits are 33.5% of salary (sum for all three years =$10,918); PI: 75% Salary, 25% Benefits. **Rebecca Swenson:** Co-PI---project supervision, activity 3. Two months per year over all three years (sum = $ 58,225 over all three years); Swenson fringe benefits are 33.5% of salary (all three years =$19,505); Co-PI: 75% Salary, 25% Benefits. **Graduate Student Research Assistants:** PhD-level, 2 students/year and 3 years per student @ $ 22,473/student/year](sum over three years for two students = $ 138,237) Grad Student fringe benefits (15.0% of salary, sum over all three years = $ 20,736) Graduate Student Tuition (sum over all three years for both students = $ 92,699) Grad: Salary 54%, Benefits 46% **Undergraduate hourly assistants:** 2 students/year for 3 years @ 15 hour/week, @ 39 weeks/year @ $ 11.25/hour (sum over all 3 years =$ 40,483) Undergrad: Salary 100%	$ 413,396
Professional/Technical/Service Contracts: *N/A*	$ -
Equipment/Tools/Supplies: EXPENSES FOR ACTIVITIES 1 ----- (1) temperature recording devices: 40/devices/year for each of first two years =$10,125 EXPENSES FOR ACTIVITY 2----- (1) Disposable lab & field supplies =$12,800 (2) MtDNA Analyses =$14,763 EXPENSES FOR ACTIVITY 3----- Sum for communications development and implementation across all three years = $ 7,900	$ 45,588
Acquisition (Fee Title or Permanent Easements): N/A	$ -
Travel: EXPENSES FOR ACTIVITIES 1 & 2----- (1) Vehicle Rental = $ 3,691 (2) Vehicle mileage costs =$15,961 (3) Room rentals =$ 13,071 (4) Per diem =$ 5,536	$ 38,259
Additional Budget Items: (1) Licenses, permits, entrance fees to sample in state parks =$ 692 summed over all three years; (2) Publication costs for scientific journals = $2,000	$ 2,692
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 499,935

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: *N/A*	$ -	
Past and Current ENRTF Appropriation: This project builds on previous work by Ferrington (et al.) performed in 40 SE Minnesota streams (ML 2010 Chap. 362, Sec. 2, Subd. 5i) that resulted in seven peer-reviewed (scientific) publications in national or international journals related to trout streams in MN. Our project also resulted in one completed MS thesis and two completed PhD dissertations.	$ 300,000	All spent
Other Funding History: *N/A*	$ -	

PROJECT TITLE: Variable Winter Thermal Regimes and Managing Trout Streams
Principal Investigator: Len Ferrington

Map of area in which project activities will occur. The area shown in blue (below) roughly corresponds to the counties that are part of the Driftless Region in Minnesota. Streams to be used in the study all occur in the Driftless Region in Minnesota, and will be located in Goodhue, Dodge, Wabasha, Olmsted, Winona, Mower, Filmore and/or Houston counties. We have previously worked in 40 streams in these counties. Final selections of streams to be used for this project will be made after extensive consultations with our partner organizations and stakeholder groups (eg., MN DNR, USFWS, Trout Unlimited, FFA, Farm Bureau and local citizen monitoring and county extension groups).



(NOTE: This map has been modified from a larger map prepared by David C. Wilson, as a resource for the Driftless Area Initiative in Minnesota, Wisconsin, Iowa and Illinois, and credit for the product is acknowledged).

PROJECT TITLE: Variable Winter Thermal Regimes and Managing Trout Streams
Project Manager and Collaborator Qualifications

Leonard C. Ferrington Jr. has maintained an active research program dealing with responses of aquatic invertebrates to water quality conditions for 37 years, and is a specialist in the ecology, taxonomy and systematics of aquatic insects. He is a professor in the Department of Entomology at the University of Minnesota (2000-2008) and served for six years as co-director of the Environmental Sciences, Policy & Management undergraduate degree program in the College of Foods, Agricultural and Natural Resources Sciences. He presently is a track coordinator for this same degree program. He has been PI or Co-Pi on more than 4.9 million dollars of grant-funded research projects, with funding from the NSF, USGS, National Park Service, US EPA, US Department of Energy, Minnesota SeaGrants and various private contract labs involved in environmental monitoring and assessment. He has published 101 peer-reviewed journal articles and 40 technical articles. He has contributed chapters to three editions of the Aquatic Insects of North America (the primary identification text for aquatic insects in North America) and wrote two sections in "*Freshwater Animal Diversity Assessment"* (Hydrobiology 198, 2008), a collective effort of 163 experts commissioned by the European Union International Convention on Biological Diversity and funded by DIVERSITAS.

Rebecca Swenson is an Assistant Professor in the Agricultural Education program within the Department of Applied Economics. Her research is related to education, outreach, assessment and communication, and she specializes in public and social media as platforms for distance delivery of research products. She has published numerous article in research and trade journals, and will interact with stake holder groups related to the topic of trout stream management and recreational use, including public attitudes and mores.

Bruce Vondracek maintained an active research program dealing with aquatic for 39 years prior to retirement in 2016. He maintains active research as an Emeritus Research Faculty member and is a specialist in the ecology of streams, fish, water quality, and geomorphology. He has published 27 articles on research conducted in southeast Minnesota. He has been PI or Co-Pi on more than 2.575 million dollars of grant-funded research projects since 2004, funding from the NSF, USGS, US EPA, US Forest Service, and National Council for Air and Stream Improvement. He has published 38 journal articles, with several focused on SE Minnesota.

James A. Perry has maintained an active research program dealing with aquatic ecology for 35 years, and is a specialist in the ecology of streams, specifically with water quality, large spatial scale analyses and land-use relationships to stream geomorphology. He has collaborated with several other faculty members as well as Minnesota PCA and US EPA in developing new approaches to define reference conditions for impaired waters assessment. Presently leading a major effort for the United Nations Environment Programme to develop global capacity in Integrated Environmental Assessment. Participated in a team of five faculty members assessing watershed scale water quality in SE Minnesota. Served for six years as Deputy Director of a US AID project (the Environmental Training Project for Central and Eastern Europe).

ORGANIZATION DESCRIPTION: All collaborators are members of the College of Foods, Agricultural and Natural Resources Sciences (CFANS) and are based on the Saint Paul campus of the University of Minnesota, and have sufficient office and lab space to successfully complete the tasks and objectives proposed for this research project. All offices are equipped with state-of-the-art computers and ultra-fast connections to internet. In addition, Ferrington all necessary field and laboratory equipment for field collection and lab-processing of field samples.