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

Project Title: **ENRTF ID: 163-F**

Variable Winter Thermal Regimes and Managing Trout Streams

Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Total Project Budget: $ 583,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2017 - June 2020

Summary:

Trout streams in Minnesota are important economic and recreational resources. We will investigate and model how groundwater input improves conditions for trout in winter for developing management plans for streams.

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Sponsoring Organization: U of MN

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Location

Region: Southeast

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

City / Township:

Alternate Text for Visual:

Trout streams we will use are located in the Driftless Geologic Region of SE Minnesota. The counties included are Fillmore, Goodhue, Houston, Olmstead, Wabasha and Winona.

_____ 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 can have a strong 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 Minnesota streams (ML 2010 Chap. 362, Sec. 2, Subd. 5i) which produced important findings showing that groundwater inputs to trout streams:

- buffers stream water in winter to prevent freezing temperatures,
- 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 abundance of invertebrates (the trout food base) that varies substantially in relation to groundwater inputs and thermal regimes, and which are especially important 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 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 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. This program will be based on data generated for activities 1 and 2. Consequently, costs for this program are included in and will be split over Activity 1 and Activity 2.

Activity 1: Thermal Modeling--- ***Budget: $ 220,000***

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 allows 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 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 2018*
2. Specific, measureable outcome: Develop TM for 8 more streams, 5 sites/str, year 2	*June 2019*
3. Specific, measureable outcome: Develop TM for 8 more streams, 5 sites/str, year 3	*June 2020*

Activity 2: Relate changes in macroinvertebrate abundances and genetics Budget: $ 363,000 at the same 5 sites in each of the same 8 streams/year used for thermal models developed in Activity 1.

This activity links stream conditions to trout through assessment of food 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 those insects that provide the most reliable energy and nutritional sources to trout in winter. We will determine how genetic patterns of numerically dominant insects differ among the most abundance insects, and if genetic variability aligns with abundances and life cycles as a function of water temperatures across streams.

Outcomes for Activity 2: 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. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2018*
2. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2019*
3. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2020*

III. PROJECT STRATEGY

A. Project Team/Partners: Our **project team** consists of Principal Investigator (PI) Leonard Ferrington, Co-PI, three graduate students (=1 for activity #1, 2 for activity #2), and undergraduate field assistants. As previously, we will integrate non-funded team members as volunteers and advisors (Jim Perry and Bruce Vondracek) as appropriate. We will consult with and seek guidance from Minnesota 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 Minnesota. 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 larger, long-term 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. This project builds on our previous effort (ML 2010 Chap. 362, Sec. 2, Subd. 5i), that established the importance during winter of groundwater inputs into streams for maintaining healthy trout populations in SE Minnesota.

C. Timeline Requirements: years: This project requires three field seasons so that we can intensively survey and sample all 24 streams and develop the statistical tools for translating management and restoration efforts into trout productivity and availability. The communication and educational outreach deliverables will be developed, (year one) then refined each of the three years to fine tune and expand our communication, outreach and educational effectiveness.

2017 Detailed Project Budget

Project Title: Variable Winter Thermal Regimes and Managing Trout Streams

IV. TOTAL ENRTF REQUEST BUDGET: Three years, 1 July 2017--- 30 June 2020

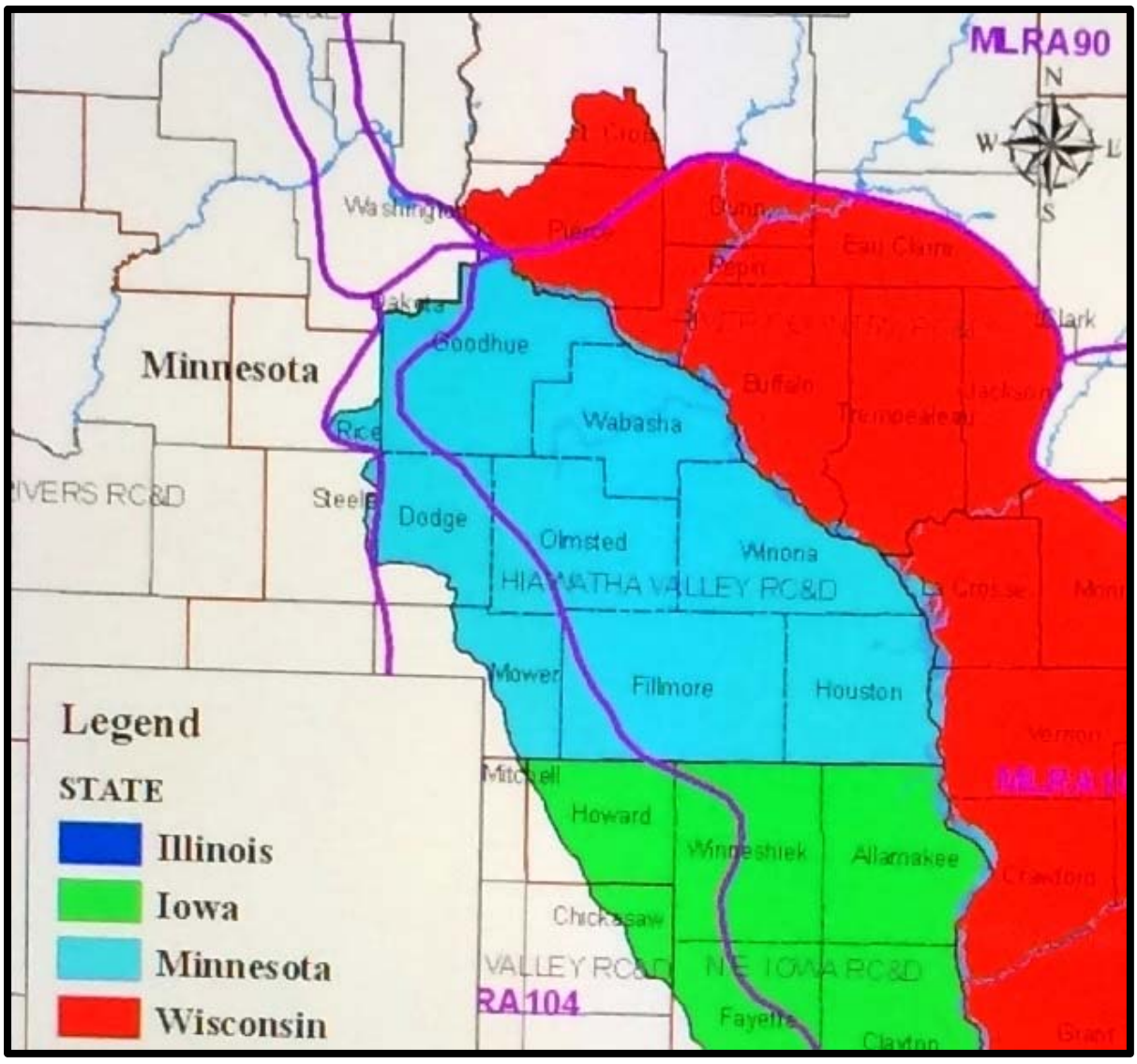
BUDGET ITEM	AMOUNT
Personnel: Ferrington--- All costs include 3% adjustment/year for inflation. PI, project supervision/field work, activities 1 &2 [one month salary per year = $ 31,387 over all three years; Ferrington fringe benefits [33.7% of salary](all three years =$10,577); PI: 75% Salary, 25% Benefits Graduate Student Research Assistants [PhD-level, 3 students/year and 3 years per student @ $ 22,473/student/year](=$ 208,385) Grad Student fringe benefits [17.6% of salary](=$ 36,676) Graduate Student Tuition =$ 143,337 Grad: Salary 54%, Benefits 46% Undergraduate hourly assistants [2 students/year for 3 years @ 16 hour/week, @ 40 weeks/year @ $ 14.71/hour](=$ 58,198) Undergrad: Salary 100%	$ 489,000
Professional/Technical/Service Contracts: N/A	$ -
Equipment/Tools/Supplies: EXPENSES FOR ACTIVITIES 1---- (1) temperature recording devices: 40/devices year =$19,591 **EXPENSES FOR ACTIVITY 2-----** (1) Disposable lab & field supplies (=$15,275); (2) MtDNA Analyses =$11,655;	$ 47,000
Acquisition (Fee Title or Permanent Easements): N/A	$ -
Travel: EXPENSES FOR ACTIVITIES 1 & 2--- (1) Vehicle Rental = $ 3,820); (2) Vehicle mileage costs =$17266; (3) Room rentals =$ 12,463 (4) Per diem =$ 5,731.	$ 40,000
Additional Budget Items: *Licenses, permits, entrance fees to sample in state parks =$ 695.* *(2) Publication costs for scientific journals = $6000)*	$ 7,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST	$ 583,000

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

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	$ -	
Funding History: This project builds on previous work by Ferrington (et al.) performed in 40 SE Minnesota streams (ML 2010 Chap. 362, Sec. 2, Subd. 5i) Resulted in seven peer-reviewed (scientific) publications in national or international journals related to trout streams.	$ 300,000	All Spent
Remaining $ From Current ENRTF Appropriation: 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 MANAGER QUALIFICATIONS AND RESPONSIBILITIES

Dr. Len Ferrington (Principal Investigator) Education: Ph.D. University of Pittsburgh, 1980
Present Position: Professor, Department of Entomology, CFANS, University of Minnesota
Past Positions: Co-Coordinator, Environmental Sciences, Policy & Management Degree Program

Dr. Len Ferrington is an expert in stream invertebrate taxonomy and ecology with 35 years of professional research experience. His laboratory has shown that aquatic insects important to trout in SE Minnesota are adapted to colder temperatures and are exclusive to, or most abundant in, spring-fed streams. Ferrington has developed Rapid Bioassessment Protocols for use in Biological Monitoring and Impact Assessment, and worked with numerous local, state and federal agencies to define responses of aquatic invertebrates to various types of water pollution. He has worked collaboratively with many citizen monitoring groups and private stakeholders interested in water quality and conservation. Dr. Ferrington will be the Principal Investigator and project manager for this research effort. For more details see: http://midge.cfans.umn.edu/people/ferrington/

Dr. Jim Perry (UMN) will volunteer as a student resource mentor and policy advisor. Dr. Perry is a Morse-Alumni Distinguished University Professor who studies water quality management, aquatic ecology, environmental policy and management decision making. For 33 years he has collaborated with international, federal, and state agencies/organizations on projects related to water quality monitoring, assessment, and regulation at the level of landscapes, watersheds, lakes, and streams.

Dr. Bruce Vondracek (Recently retired, Minnesota Cooperative Fish and Wildlife Research Unit) will also volunteer as a student resource mentor and fisheries biology and fisheries policy advisor. Dr. Vondracek is an expert in stream ecology and restoration with over 42 years of research experience. His laboratory focused on the interactions among management, water quality, and fish and invertebrate communities to assess ecosystem health in relation to land use and restoration.

ORGANZATION DESCRIPTION: The University of Minnesota is one of the largest and most recognized public research universities in the United States. Its mission is to 1) "**conduct high-quality research**, scholarship, and artistic activity that benefit students, scholars, and communities **across the state**, the nation, and the world"; 2) "share that knowledge, understanding, and creativity by providing a broad range of educational programs … and **prepare graduate, professional, and undergraduate students**…for active roles in a multiracial and multicultural world"; and 3) extend, apply, and **exchange knowledge between the University and society** by applying scholarly expertise to community problems, by helping organizations and individuals respond to their changing environments, and by making the knowledge and resources created and preserved at the University accessible to the citizens of the state, the nation, and the world.