Environment and Natural Resources Trust Fund
2015 Request for Proposals (RFP)

Project Title: **ENRTF ID:** **117-F**

Prioritizing Future Management of North Shore Trout Streams

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

Total Project Budget: $ 416,411

Proposed Project Time Period for the Funding Requested: 3 years, July 2015 - June 2018

Summary:

Identify those key areas in North Shore streams that supply the cold groundwater essential to sustaining trout fisheries into the next century, to strategically focus habitat restoration and protection efforts.

Name: Lucinda Johnson

Sponsoring Organization: U of MN - Duluth NRRI

Address: 5013 Miller Trunk Hwy

Duluth MN 55811

Telephone Number: (218) 720-4251

Email ljohnson@d.umn.edu

Web Address http://www.nrri.umn.edu/staff/ljohnson.asp

Location

Region: NE

County Name: Cook, Lake, St. Louis

City / Township:

Alternate Text for Visual:

The study will consider designated trout streams along the Lake Superior North Shore, the largest concentration of trout streams in Minnesota. These streams are threatened by projected increases in air temperature of 2 to 3 degrees Celsius this century.

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

I. PROJECT STATEMENT

Cold groundwater is essential for North Shore trout streams, keeping stream temperatures below the thermal limit for trout and steelhead survival and providing base flow during summer. Yet groundwater is not abundant in this region and thus is particularly important for sustaining these prized coldwater fisheries as the climate warms. The DNR and NGOs, such as Minnesota Trout Unlimited, are focusing habitat restoration and protection efforts on a subset of North Shore watersheds most likely to sustain coldwater fisheries and quality angling into the next century. They need detailed information on the locations of groundwater discharge areas in priority watersheds to most effectively target habitat restoration and watershed protection efforts.

Trout streams are a scarce resource statewide, comprising just 7% of all stream and river miles. The North Shore of Lake Superior has one of the largest concentrations of trout streams in Minnesota, and is a major recreational draw. However, most streams lack substantial groundwater and are therefore particularly susceptible to climate change. While climate change can impact these streams in many ways, previous research has shown that increased water temperature is the greatest threat to the persistence of trout and steelhead fisheries in North Shore streams. Certain tributaries and stream reaches with localized groundwater inflows provide thermal refugia (stretches of colder water which trout move to), allowing trout to survive during periods when much of the stream approaches or exceeds the lethal temperature limit. These streams also have higher base flows, providing habitat during drought periods. Streams with more thermal refugia are most likely to maintain trout and steelhead populations as air temperatures increase, driven by global climate change. Anecdotal evidence has identified some of the refugia in North Shore streams, but no systematic identification of these important areas has been undertaken, nor has site-specific data collection (stream temperature, channel morphology, recharge areas) been undertaken. **This project will provide the scientific data essential to ensure that restoration, protection and management are targeted at those reaches essential to ensuring long-term sustainability of coldwater fisheries.**

Our goals are to: (1) collect site-specific temperature data and map the locations of thermal refugia in "top tier" North Shore trout streams (~15 to 20 watersheds); (2) determine the channel characteristics, flow, and vegetation associated with cold water refugia and predict which areas are most resilient to climate change; and (3) recommend targeted actions to increase the streams' long term resilience.

We will: (1) conduct extensive field surveys of "top tier" North Shore streams to locate reaches with locally cooler water temperatures and document geology, soils, channel conditions at those sites; (2) document presence/absence of fish; (3) map locations of thermal refugia and their association with fish presence/absence; (4) use local geomorphic data, new LiDAR tools, land cover and soils data to determine the local conditions that support thermal refugia; and (5) use hydrologic and temperature models to predict future stream flow and temperature based on climate projections; (6) work with MNDNR, Minnesota Trout Unlimited, and other fishing groups to identify appropriate protection and restoration actions. This information will assist the MNDNR and Minnesota Trout Unlimited in identifying priority locations for habitat restoration, protection and management. Citizen volunteers will play an important role in collecting stream temperature and other data.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Survey Temperature and Fish in North Shore Streams **Budget: $168,396**

Working with the MNDNR and Trout Unlimited, a set of about 15-20 high-value North Shore trout streams will be identified. High-resolution temperature surveys will be conducted in the study streams over two field seasons during mid-summer (July/August) low flow conditions. About 100 sites (within these 20 streams) will be selected each year for continuous monitoring using automated temperature sensors (Years 1 and 2). Field sampling will document the presence/absence of fish at each site along with local channel morphology, terrain, soils, and land cover.

Outcome	Completion Date
1. Identification of high-value trout streams	8/1/2015

2. Survey of temperature, fish and local geomorphology (field season 1 and 2)	10/1/2016

Activity 2: Map local stream temperature and trout populations; relate local geology and land cover to temperature conditions **Budget: $124,615**

Locations of thermal refugia will be mapped using GIS. Fish data will be used to determine the relationship between thermal refugia density (e.g. number per kilometer) and overall trout abundance. Local channel geology and other environmental data will be combined with LiDAR and soils data to determine the local conditions associated with thermal refugia. High resolution hydrologic and temperature models will be used to predict local concentrations of groundwater inputs (which create refugia) based on local terrain and soil features.

Outcome	Completion Date
1. Map of the thermal refugia in surveyed streams	12/31/2016
2. Correlate fish presence/absence with thermal refugia	4/1/2017
3. Quantify relationships of thermal refugia to geomorphology, hydrology, and land cover	12/30/2017
4. Predict local conditions producing thermal refugia	12/30/2017

Activity 3: Regional projections of trout stream resilience to climate change **Budget: $123,400**

Using data from Activity 2, flow and temperature conditions in a representative subset of the study streams will be modeled for future climate conditions. Management options will be identified to ensure persistence of North Shore coldwater fish habitat.

Outcome	Completion Date
1. Project future viability of sampled North Shore trout streams	10/31/2017
2. Validate predictions in unsampled streams with field observations	10/31/2017
3. Project future viability of North Shore trout streams	12/31/2018
4. Develop management recommendations to protect North Shore coldwater refugia	6/30/2018

III. PROJECT STRATEGY

A. Project Team/Partners

Lucinda Johnson (NRRI-UMD), William Herb (SAFL-UM), Minnesota Trout Unlimited, MNDNR Fisheries. Drs. Johnson (PI) and Herb will lead the project. NRRI staff will perform the field survey, along with data compilation and analysis. Dr. Herb will assist in data analysis and will perform the hydrologic and temperature modeling tasks. All work by SAFL and NRRI staff will be funded by the ENRTF (note: these staff are largely supported by grant funds and are not University professors.) Dr. Johnson will contribute one-half a month of salary-effort to this project. MNDNR partners will provide advice, existing data and where feasible, field support. They will participate in developing management recommendations to protect coldwater stream habitat. Minnesota Trout Unlimited members will assist with temperature and fish surveys and other data collection in years 1 and 2 (expenses paid as volunteers; stipend to cover organization of volunteers). Other local fishing groups will be contacted.

B. Project Impact and Long-Term Strategy

This project is self-contained in its scope, and will contribute towards the long-term strategy of state agencies to maintain trout populations in North Shore streams. The project builds on data and results from several projects, including a MNDNR-funded project studying the impacts of climate change on MN coldwater lakes and North Shore trout streams. The data and results produced by this project will inform a wide variety of stream management and restoration efforts, and could be extended to other regions of the state or to a regional or national scale project.

C. Timeline Requirements

The proposed project is planned for three years, starting July 1, 2015 and ending June 30, 2018.

2015 Detailed Project Budget

PROJECT TITLE: Prioritizing Future Management of North Shore Trout Streams

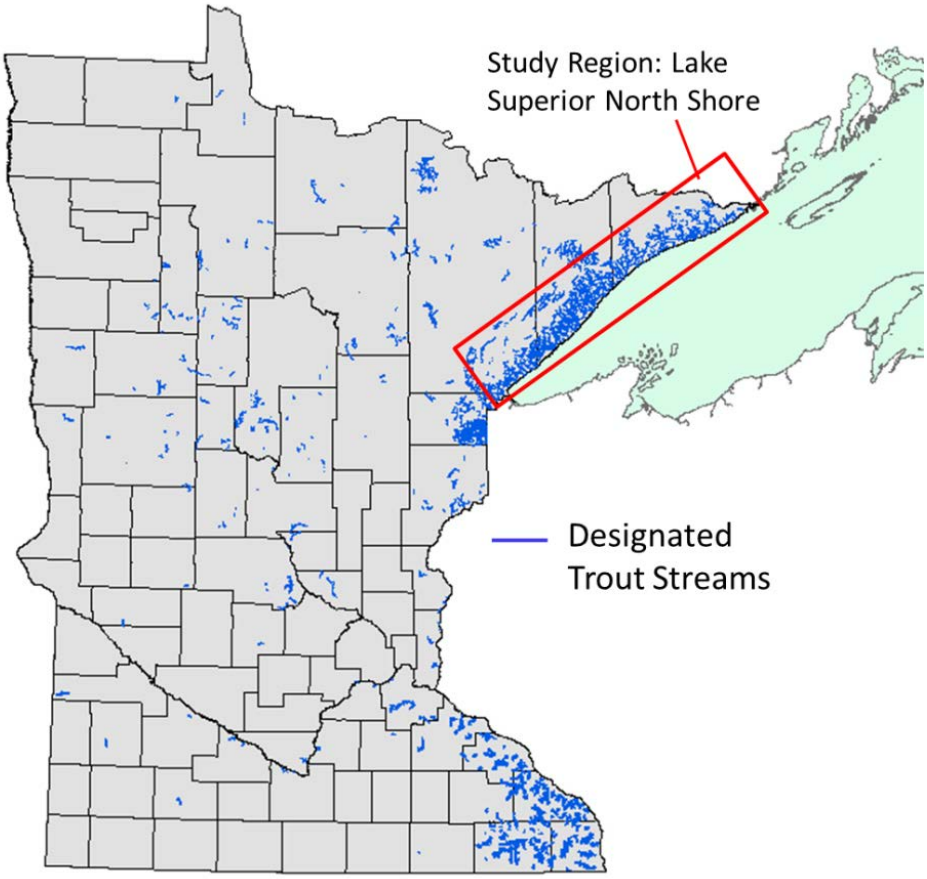
IV. TOTAL ENRTF REQUEST BUDGET: 3 years

BUDGET ITEM	AMOUNT
Personnel:	
Lucinda Johnson, Principal Investigator (66.4% salary, 33.6% benefits); 4% FTE for 3 years	$ 23,612
William Herb, Co-Investigator (66.4% salary, 33.6% benefits); 50% FTE yrs 1&3, 45% yr 2	$ 137,247
Mei Cai, Co-Investigator (66.4% salary, 33.6% benefits); 20% FTE yrs 1&2, 25% yr 3	$ 57,251
Valerie Brady, Co-Investigator (66.4% salary, 33.6% benefits); 5% FTE for 3 years	$ 14,345
Josh Dumke, Research Fellow (66.4% salary, 33.6% benefits); 20% FTE yrs 1&2, 10% yr 3	$ 31,931
Jeremy Erickson, GIS Tech (66.4% salary, 33.6% benefits); 10% FTE for 3 years	$ 19,272
Robert Hell, Principal Lab Technician (63.2% salary, 36.8% benefits); 20% FTE for 3 years	$ 36,965
2 Senior Lab Technicians (63.2% salary, 36.8% benefits); 10% FTE for 3 years	$ 26,886
Contracts:	
Trout Unlimited, providing organization of activities with volunteers in summers yr1 & yr2; $5,000 each for yr1 and yr2	$ 10,000
Equipment/Tools/Supplies:	
5 YSI Sondes for temperature surveys	$ 10,000
100 temperature sensors, estimated cost of $100 each	$ 10,000
Software license, server, and backup drive, memory, and disk storage	$ 1,800
5 GPS Units, estimated cost of $500 each	$ 2,500
Acquisition (Fee Title or Permanent Easements):	n/a
Travel:	
Travel for project personnel between Duluth and Twin Cities	$ 2,472
In-state conference attendance, registration fee and travel	$ 3,000
Field travel for survey kn 2-watersheds and 50 stream sites	$ 17,000
Travel expenses for volunteers helping with project, estimated to travel ~4,000 miles each year in yr1 and yr2, reimbursed at rate of $0.56/mile	$ 4,480
Additional Budget Items:	
GIS lab service fees, $4.10/hour x estimated 500 hours per year	$ 6,150
Conference calls with collaborators to reduce travel	$ 1,500
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 416,411

V. OTHER FUNDS

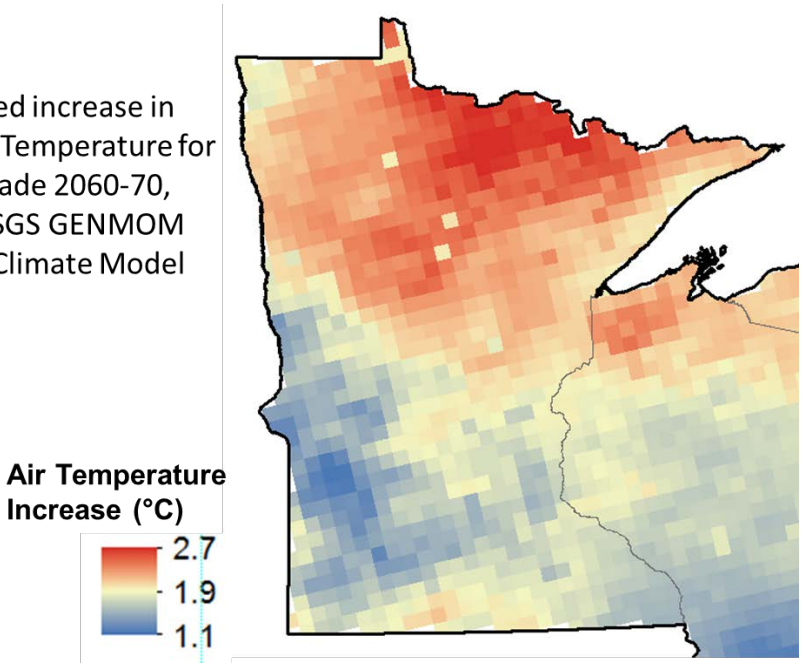
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	n/a	
Other State $ To Be Applied To Project During Project Period:	n/a	
Foregone by UMN ICR funding (52% MTDC)	$ 216,534	*Secured*
In-kind Services To Be Applied To Project During Project Period:	n/a	
Funding History: MN DNR Johnson Herb - predict distribution brook trout ENRTF 2005 Johnson historic climate and stream flow data statewide	n/a	
Remaining $ From Current ENRTF Appropriation:	n/a	

The Resource: DNR Designated Trout Streams



The Threat: Projected Increases in Air Temperature

Projected increase in July Air Temperature for the decade 2060-70, from USGS GENMOM Global Climate Model



2015 LCCMR Project Manager Qualifications and Organization Description

Lucinda Johnson, Natural Resources Research Institute, University of Minnesota Duluth

Key Qualifications

Lucinda Johnson has conducted climate change research for the past decade, and served as a consultant to Minnesota DNR and PCA on climate change impact issues. Johnson led two previous LCCMR projects (2005; 2007) quantifying climate change impacts on aquatic resources in Minnesota. Recently, she and co-PI William Herb have completed a small project funded by MN DNR to predict distributions of brook trout under changing climate based on changing flow and stream temperatures. Johnson has considerable experience leading large projects, including a current project to validate indicators of coastal ecosystem condition $1.67M funded by USEPA.

Education

Ph.D., Zoology, Michigan State University, 1999
M.S., Environmental Science and Forestry, State University of New York, 1984
B.A., Duke University, 1976

The **Natural Resources Research Institute** is part of the University of Minnesota Duluth. NRRI's mission is to promote private sector employment based on natural resources in an environmentally sensitive manner. NRRI scientists have extensive experience in applied ecological research on terrestrial and aquatic systems.