Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)

Project Title: **ENRTF ID:** **118-E**

Protecting North Shore Trout Steams for the Future

Category: E. Air Quality, Climate Change, and Renewable Energy

Total Project Budget: $ 361,758

Proposed Project Time Period for the Funding Requested: 3 Years, July 2014 - June 2017

Summary:

Identify viable North Shore trout streams threatened by climate change using site-specific temperature and fish data; develop strategies to manage and protect trout streams.

Name: Lucinda Johnson

Sponsoring Organization: U of MN - NRRI

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Location

Region: Northeast

County Name: Cook, Lake, St. Louis

City / Township:

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

PROJECT TITLE: Protecting North Shore Trout Streams for the Future

I. PROJECT STATEMENT

The North Shore of Lake Superior has one of the largest concentrations of trout streams in Minnesota, with over 150 designated trout streams. Many of these streams lack substantial groundwater aquifers, and are therefore particularly susceptible to climate change. While climate change can impact food resources, stream flow, water quality, and stream temperature, previous work lead by the authors showed that increased water temperature is the greatest threat to future trout habitat. However, this study was based on broad scale models that do not take into account the local details of channel morphology, tree cover, and groundwater inputs. Stream reaches with, for example, localized groundwater inflows can provide thermal refugia (local cold spots) for trout that allow them to survive during periods when much of the stream approaches or surpasses the lethal temperature limit. Streams with thermal refugia are more likely to maintain trout populations as air temperatures increase, driven by global climate change. While anecdotal evidence suggests that such refugia do exist in the North Shore streams, there is a lack of site-specific data (stream temperature, geomorphology) to describe them. Management of these important streams is dependent upon the knowledge of which streams are likely to support trout in the future (i.e., which streams will be resilient to the effects of warmer temperatures and changing flow regimes).

The goals of this project are to: 1) collect site-specific temperature data and map the locations of thermal refugia in ~20 North Shore trout streams, 2) determine the use of these streams by trout, 3) determine the channel characteristics, flow, and vegetation associated with cold water refugia, 4) predict which streams are likely to be resilient to climate change; 5) recommend management actions that will enhance stream resilience in the future.

We propose to: 1) conduct an extensive field survey of the North Shore streams to locate stream reaches with locally cooler water temperatures and document, geology, soils, channel conditions at those sites; 2) sample fish to document presence/absence; 3) map the locations of thermal refugia and their association with fish presence/absence; 4) use local geomorphic data along with newly available high-resolution topographic (LiDAR), land cover and soils data to determine the local conditions that support thermal refugia; 5) use hydrologic and temperature models to predict local concentration of groundwater inputs (refugia) based on local terrain and soils.

The results of this study will document the frequency and type of thermal refugia in ~20 North Shore trout streams. Subsequent analyses will enable generalization of the field survey results to unsampled streams. **This information will help identify which trout streams in the region are most likely to be resilient to climate change impacts.** In collaboration with DNR partners we will then identify potential management strategies and actions needed to maintain the thermal refugia in these streams. This strategy for adapting aquatic resources to climate change is already being used by the MN DNR to maintain coldwater lake habitat.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: *Survey Temperature and Fish in North Shore Streams* **Budget: $138,750**

Existing stream temperature monitoring data from over 50 streams will first be analyzed to identify a set of preliminary study streams where fish surveys will be conducted. Subsequently, high-resolution temperature surveys will be conducted in ~ 20 North Shore trout streams over two field seasons during mid-summer (July/August) low flow conditions using handheld temperature probes. About 50 sites (within these 20 streams) will be selected for continuous monitoring using automated temperature sensors during Year 2. Field sampling will document the presence/absence of fish at each site and local channel morphology, terrain, soils, and land cover will also be documented.

Outcome	Completion Date
1. Preliminary analysis of existing temperature and fish data (field season 1)	*4/30/2015*
2. Survey of temperature, fish and local geomorphology (field season 1 and 2)	*10/1/2015*

Activity 2: *Map local stream temperature and trout populations; relate local geology and land cover to temperature conditions* **Budget: $112,046**

The field data will be compiled, and the locations of thermal refugia will be mapped using GIS. The fish sampling 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 newly available LiDAR and soils data to determine the local conditions associated with thermal refugia. High resolution hydrologic and temperature models will be assembled and 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	*12/31/2015*
2. Correlate fish presence/absence with thermal refugia	*4/1/2016*
3. Quantify relationships of thermal refugia to geomorphology, hydrology, and land cover	*6/30/2016*
4.Predict local conditions producing thermal refugia	*6/30/2016*

Activity 3: *Regional projections of trout stream resilience to climate change* **Budget: $110,962**

Based on the relationships developed in Activity 2, the results for sampled streams will be extrapolated to a larger set of (~100) North shore trout streams; a subset of streams most likely to maintain good trout habitat in the future will be identified. Field sampling will be conducted to verify coldwater refugia (and possible presence of trout) in unsampled streams. Management options will be identified to protect North Shore coldwater fish habitat.

Outcome	Completion Date
1. Project future viability of sampled North Shore trout streams	*12/31/2016*
2. Validate predictions in unsampled streams	*10/1/2016*
3. Project future viability of North Shore trout streams	*6/1/2017*
4. Develop management recommendations to protect North Shore coldwater refugia	*6/30/2017*

III. PROJECT STRATEGY

A. Project Team/Partners

Lucinda Johnson (NRRI-UMD), William Herb (SAFL-UM), Donald Schreiner, Deserae Henrickson, (MN DNR), Carl Haensel, Trout Unlimited

Drs. Johnson (PI) and Herb will lead the project. NRRI staff will perform the field survey tasks, 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; however, Dr. Johnson will contribute one-half a month of salary-effort to this project. MN DNR partners will provide advice, existing data and where feasible, field support. They will participate in developing management recommendations to protect coldwater stream habitat. Trout Unlimited members will assist with temperature surveys in year 1 (expenses paid as volunteers). Additional local fishing groups will be contacted if funded.

B. Timeline Requirements

The proposed project is planned for three years, starting July 1, 2014 and ending June 30, 2017

C. Long-Term Strategy and Future Funding Needs

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 MN DNR-funded project studying the impacts of climate change on MN coldwater lakes and North Shore trout streams. The project will make use of new LiDAR and detailed soils data. The data and results produced by this project will inform a wide variety of stream management efforts, and could be extended to other regions of the state or to a regional or national scale project.

2014 Detailed Project Budget

Project Title: Protecting North Shore Trout Streams for the Future

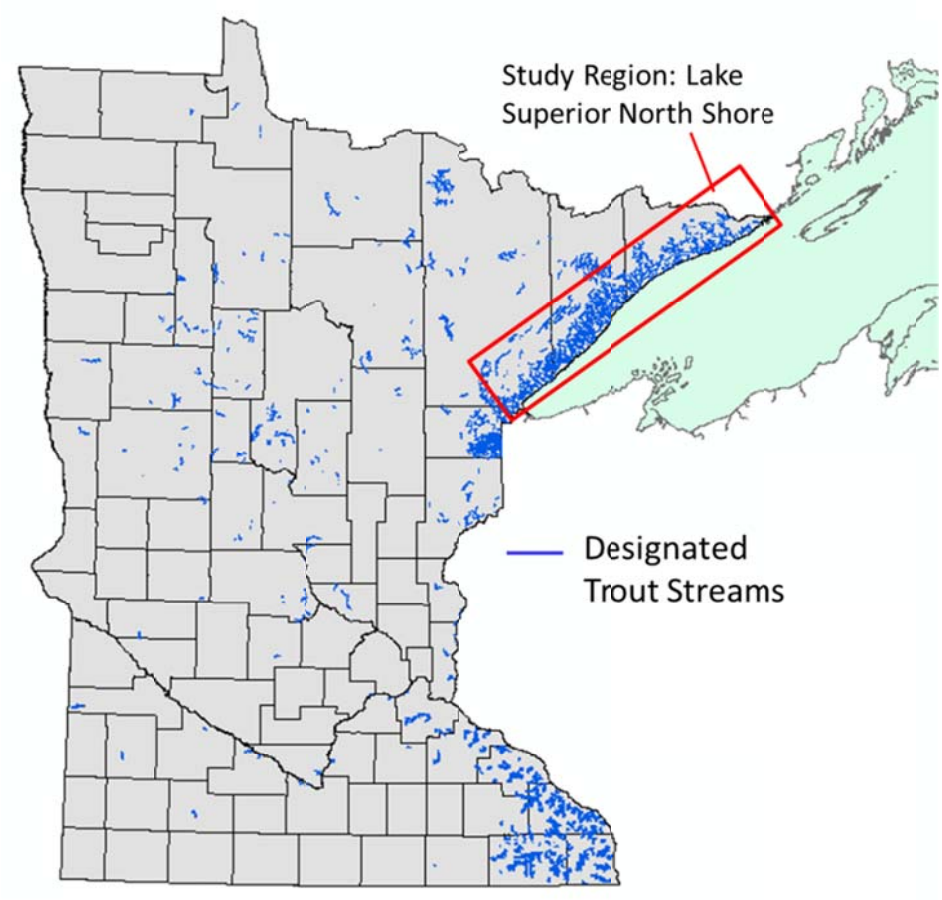
IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel:	
Johnson, PI; analyze, write, manage, outreach; 4% fte; 75% salary/25% fringe, 36 mo. ($22,898)	$ 310,206
Herb, Co-PI; Flow & Temp model; Manage; Write; 50% fte; 75% salary/25% fringe, 36 mo. ($127,521)	
Cai, Co-PI; Data analysis, write, supervise GIS; 20% fte; 75% salary/25% fringe, 36 mo. ($56,129)	
Brady, Co-PI; manage field effort; write; supervise; 5% fte; 75% salary/25% fringe, 36 mo. ($13,996)	
Dumke, ResFell; mng field, mng fish / temp dbase; 20% fte; 75% salary/25% fringe, 36 mo. ($31,931)	
Erickson; Res Fell; GIS; programming; 10% fte; 75% salary/25% fringe, 36 mo. ($19,272)	
Hell, Tech; manage dbase, field; supervise; 20% fte; 73% salary/27% fringe, 36 mo. ($11,573)	
Peterson/Clark, Lab Techs; field wk, database; 20% fte; 73% sal/27% fringe, 2ppl, 36 mo ($ 26,886)	
Equipment/Tools/Supplies:	
5 YSI sondes for temperature surveys ($10k); 60 temp sensors ($6k); software license, server and backup drive, memory and disc storage ($1800); GPS units ($2500)	$ 20,300
Travel:	
Project personnel travel between Duluth and Twin Cities ($2472); in state conference ($3k); field travel for survey kn 2- watersheds and 50 stream sites ($17,000); reimburse volunteer travel expenses ($1130)	$ 23,602
Additional Budget Items:	
GIS lab service @ $4.10/hr, projected 500 hours per year($6150); conference calls with collaborators to reduce travel ($1500)	7,650
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 361,758

V. OTHER FUNDS

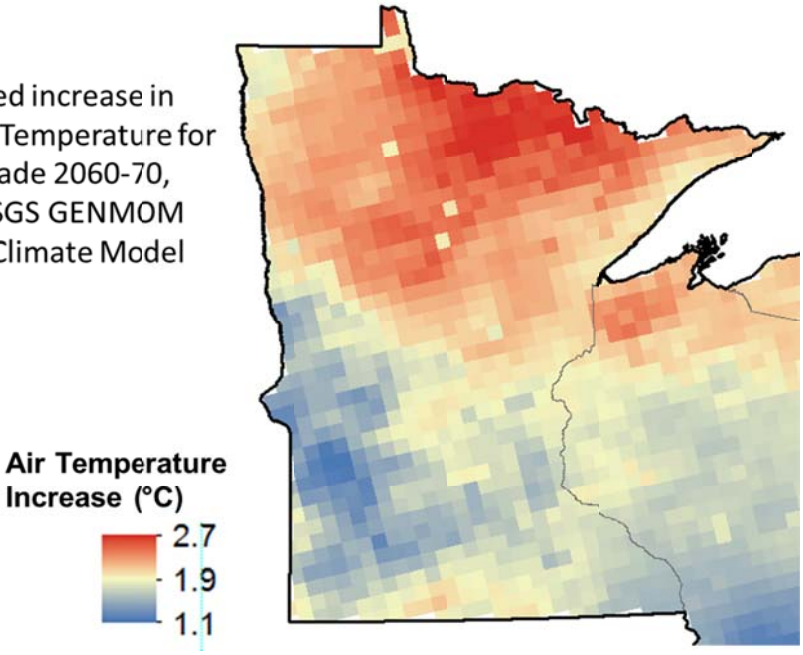
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:	$ -	
Other State $ Being Applied to Project During Project Period:		
Salary/fringe for L. Johnson (PI)	$5,000	Secured
Salary/Fringe for Meysemburg (NRRI GIS Lab Manager)	$ 5,000	Secured
In-kind Services During Project Period:		
Remaining $ from Current ENRTF Appropriation (if applicable):		
Funding History: This project builds upon data and models developed under a grant from the MN DNR to Johnson and Herb to predict the distribution of brook trout in north shore streams; that project used data assembled from two previous NERTF projects (2005, 2007) led by L. Johnson, which assembled historic climate and stream flow data statewide. The current proposed project also will use state-funded LiDAR data to improve model predictions of stream flow and temperature.	$ -	

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



2014 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 a 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.