

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

Project Title:

ENRTF ID: 102-E

Making Minnesota Forests More Resilient to Climate Change

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

Total Project Budget: \$ 396,872

Proposed Project Time Period for the Funding Requested: 5 years, July 2015 - June 2020

Summary:

This large-scale project assesses vegetation, forest health, and sustainability of three novel adaptive forest management approaches aimed at making Minnesota forests more resilient to climate change.

Name: Linda Nagel

Sponsoring Organization: U of MN

Address: 175 University Rd
Cloquet MN 55720

Telephone Number: (218) 726-6484

Email lmnagel@umn.edu

Web Address _____

Location

Region: Central, NW, NE

County Name: Aitkin, Beltrami, Carlton, Cass, Clearwater, Cook, Crow Wing, Hubbard, Itasca, Koochiching, Lake, Lake of the Woods, Pine, St. Louis, Wadena

City / Township:

Alternate Text for Visual:

Spectrum of adaptive forest management treatments for climate change

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



PROJECT TITLE: Making Minnesota Forests More Resilient to Climate Change

I. PROJECT STATEMENT

Climate change and related impacts such as increased temperatures, longer growing seasons, variation in the nature and timing of precipitation, elevated CO₂, hydrological changes, and increased drought and disturbance are all expected to change the functioning, productivity, and health of Minnesota’s forests. Impacts of these changes may include increased tree mortality during droughts and disturbance events, expanded pest and disease ranges, shifts in native species ranges, and interactions among stressors that may lead to loss of forested areas and associated plant and animal species. As a result, there is an **urgent need** to develop adaptive management strategies that foster ecosystem **resilience** to the impact of climate change, and enable forests to adapt to uncertain future conditions. This project will implement a **large-scale operational** study at two locations to evaluate management practices that meet the long-term goal of increasing the resilience of Minnesota forests to climate change.

The **overall goals** of this project are to:

- 1) Develop and implement operational, on-the-ground examples of climate change adaptation treatments for sustaining the long-term ecological integrity of Minnesota’s forests,
- 2) Quantify short-term (2 and 4 year) changes in plant species composition, productivity, and forest health among adaptation treatments, and
- 3) Evaluate long-term (50-100 years) effectiveness of adaptation treatments for sustaining Minnesota’s forests in the face of climate change.

This proposal leverages a USDA-Forest Service funded project that applies an innovative planning framework to develop practical adaptive management strategies specific to MN landowner’s objectives. This proposal requests funding for project set-up, implementation, pre-treatment data collection, post-treatment monitoring, and evaluation of different treatments as part of a long-term monitoring effort. ***This study is critical now because:***

- “Business as usual” forest management will not be adequate at creating resilient forests into the future; therefore creative new approaches are necessary **now** in order to promote future resilient forests.
- The management treatments designed here will be implemented in the ecologically and commercially important red pine ecosystem, which covers over 500,000 acres in Minnesota, and is susceptible to climate change due to impediments to natural regeneration and potential shifts in distribution.
- These prototype treatments will be widely applicable to many other forest types across Minnesota.
- This study is management-oriented, making it different from studies looking only at ecological response.
- The treatments will ensure forest resilience by creating healthy forests that provide better quality wildlife habitat, will enhance water quality, and will ensure forest productivity into the future.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Develop and implement operational, on-the-ground examples of climate change adaptation treatments for sustaining the long-term ecological integrity of Minnesota’s forests **Budget: \$91,663**

Site-specific treatments representing three different management options of resistance, resilience, and transition have been developed for the Cutfoot Experimental Forest on the Chippewa National Forest and will be implemented in winter 2015 (four replicates of each). Another replicate of these treatments will be located at the Cloquet Forestry Center (CFC). Each treatment unit will be 25 acres.

Outcome	Completion Date
1. Develop site-level treatments for the Cloquet Forestry Center site	Summer 2015
2. Cut trees to implement innovative silviculture practices at both field sites	Fall 2015



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Activity 2: Quantify short-term (2 and 4 year) changes in plant species composition, productivity, and forest health among adaptation treatments **Budget: \$182,760**

Baseline data will be collected at each site before trees are removed, and two and four years following treatment implementation. Baseline inventory plots will be structured similar to the USDA Forest Inventory and Analysis Program. Eight nested plots in each treatment unit will be installed to record species, diameter, and height of each overstory tree. Saplings, seedlings, and understory plants will be inventoried on microplots. Forest productivity will be estimated from biomass and basal area growth. Forest health will be assessed through crown measurements and mortality counts for each vegetation layer. Additional data to characterize drought stress will be collected on a subset of plots, including the collection of temperature and precipitation.

Outcome	Completion Date
<i>1. Collect pre-treatment data at the Cloquet Forestry Center site</i>	<i>Summer 2015</i>
<i>2. Collect post-treatment data at both field sites in years two and four</i>	<i>Summer 2017 and 2018</i>
<i>3. Project summaries developed and provided to stakeholders through workshops and publications</i>	<i>December 2017 and 2019</i>

Activity 3: Evaluate long-term (50-100 years) effectiveness of adaptation treatments for sustaining Minnesota’s forests in the face of climate change **Budget: \$122,450**

This is a long-term study designed to collect empirical data to address questions about long-term treatment effects. However, managers don’t have a hundred years to wait before addressing issues of climate change. Therefore, we will use a well-validated forest growth model to evaluate the success of each adaptation treatment with respect to species composition, productivity and forest health objectives at the stand scale. We will also use a landscape model to predict large-scale responses to different treatments. This combination of models will facilitate evaluation of treatment effects at varying spatial and temporal scales useful to managers.

Outcome	Completion Date
<i>1. Use data collected and management scenarios to model long-term impacts</i>	<i>February 2019</i>
<i>2. Use model results to prepare guidelines for future management decisions</i>	<i>May 2020</i>
<i>3. Project summaries developed and published</i>	<i>June 2020</i>

III. PROJECT STRATEGY

A. Project Team/Partners

This research will be led by Dr. Linda Nagel from the University of Minnesota (UMN) Department of Forest Resources (DFR) and Cloquet Forestry Center (CFC), and Drs. Anthony D’Amato and Michael Falkowski from UMN DFR. All three will receive salary support from this project (0.1 FTE each). Other researchers providing in-kind support are Drs. Brian Palik and Christel Kern from the USDA Forest Service Northern Research Station. Other cooperators include the USDA National Forest System.

B. Project Impact and Long-Term Strategy

This project is leveraging work being done on other ownerships within the state, but formalizing the approach into a long-term experiment that holds credibility through peer-review and long-term monitoring. We are committed to long-term maintenance and monitoring of the two field sites. We expect subsequent proposals to LCCMR as well as to the Forest Service and USDA. The strategic location of the CFC site will make it highly visible within the state as both a research and demonstration area, and we expect to utilize the site for education and outreach.

C. Timeline Requirements

The duration of this project is five years. The requested time is necessary to develop treatment scenarios, implement treatments, collect pre- and post-treatment data, run model analyses, and synthesize results.

2015 Detailed Project Budget

Project Title: Making Minnesota Forests More Resilient to Climate Change

PIs: Dr. Linda Nagel, Dr. Anthony D'Amato, Dr. Michael Falkowski, University of Minnesota; Dr. Brian Palik, Dr. Christel Kern, USDA

IV. TOTAL ENRTF REQUEST BUDGET: 5 years

<u>BUDGET ITEM</u>	<u>AMOUNT</u>
Personnel: One month of faculty summer salary plus benefits and fringe (0.336) for three years for Dr. Nagel (Principle Investigator), 0.1 FTE	\$ 43,735
Personnel: One month of faculty summer salary plus benefits and fringe (0.336) for three years for Dr. D'Amato (Principle Investigator), 0.1 FTE	\$ 37,063
Personnel: One month of faculty summer salary plus benefits and fringe (0.336) for three years for Dr. Falkowski (Principle Investigator), 0.1 FTE	\$ 33,694
Personnel: Salary, fringe and benefits (0.368) for one half-time technician for three years of the study (0.5 FTE)	\$ 106,704
Personnel: Salary, fringe and benefits (0.230) for one PhD graduate student for three years	\$ 116,076
Contracts: Dr. Brian Palik from the US Forest Service will administer funds awarded in a contract. Dr. Palik's salary is fully covered by the US Forest Service. The contract to the Forest Service which will include salary, fringe and benefits for two student field technicians for two summers of field measurements (\$28,000). The summer students will be employed by the US Forest Service due to the location of the larger field site. This is one-time funding specific to this project; these students will be working only on this research project.	\$ 28,000
Equipment/Tools/Supplies: Equipment includes rebar for permanently marking plot centers (\$400), supplies for soil and leaf samples (\$2000), and equipment to measure weather and soil moisture (\$1200).	\$ 3,600
Travel: Due to the location of the travel site and logistics associated with plot establishment and remeasurement, \$28,000 is budgeted for domestic travel to fieldsites for researchers from St. Paul and the Cloquet Forestry Center (CFC) to the CFC and Cutfoot Experimental Forest field sites. This money will be used to pay for mileage (75%) and lodging (25%, a reduced rate) for researchers, graduate student, and field technicians.	\$ 28,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 396,872

V. OTHER FUNDS

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
Other Non-State \$ To Be Applied To Project During Project Period.	N/A	N/A
Other State \$ To Be Applied To Project During Project Period.	N/A	N/A
In-kind Services To Be Applied To Project During Project Period: In-kind salaries provided by the US Forest Service Researchers (0.25 FTE; B. Palik, C. Kern) and technicians (1.0 FTE). In-kind use of some field equipment.	\$ 100,000	Secured
Funding History: Initial funding to develop the experimental design was secured by PI Nagel through the US Forest Service Southern Research Station as part of a national study. This was a planning grant that contained no implementation or monitoring funding.	\$ 120,000	Secured
Remaining \$ From Current ENRTF Appropriation.	N/A	N/A

Spectrum of Adaptive Forest Management Treatments

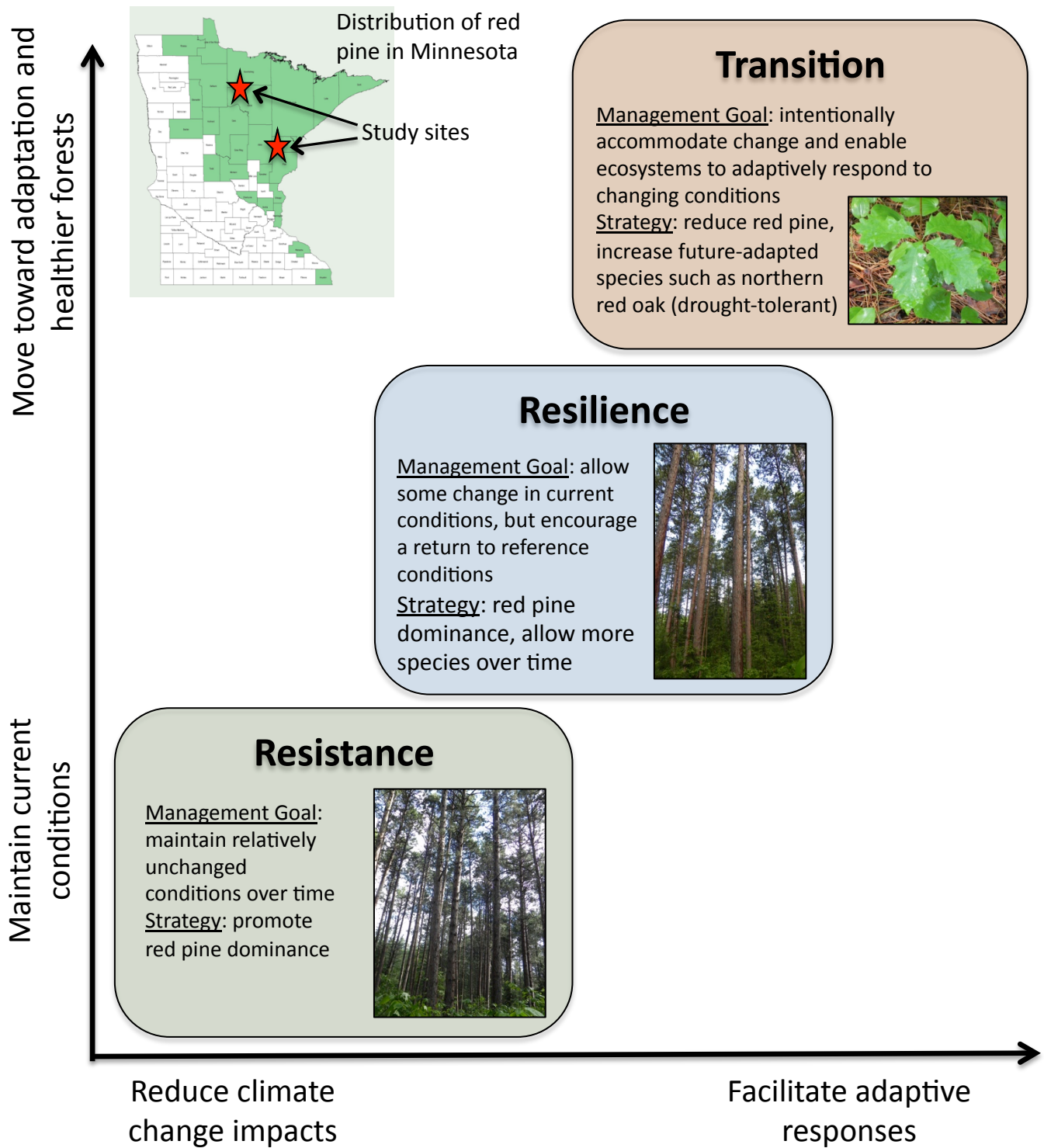


Figure 1. Adaptive management options of resistance, resilience, and transition for climate change along a continuum of change. The resistance treatment tries to keep ecosystems unchanged, while the transition treatment promotes change by pushing adaptive response and ultimately, healthier forests under future conditions. This example focuses on species composition.

MAKING MINNESOTA FORESTS MORE RESILIENT TO CLIMATE CHANGE

Project Manager Qualifications

Linda M. Nagel

Qualifications

Linda Nagel is Professor in the Department of Forest Resources and the Director of Operations at the Cloquet Forestry Center (CFC), University of Minnesota. She conducts research and leads Outreach/Extension programs at the CFC. She provides oversight and leadership for the CFC and the Hubachek Wilderness Research Center north of Ely, including budgets, facility maintenance and use, and personnel matters. She also directs the forest management operations and coordinates research activities on the University of Minnesota forestlands. Her research primarily focuses on developing adaptive management approaches for meeting diverse forest management objectives, and investigating impacts of silvicultural treatments on forest productivity, species composition, and forest structure of Upper Great Lakes forests. The primary audiences for her outreach efforts are professional natural resource managers.

Linda has been the principal investigator and project manager on numerous large-scale silviculture projects that contain both a research and outreach component, including silviculture trials in northern hardwoods and red pine-dominated forests. She has published numerous peer-reviewed and non-technical articles that address impacts of silvicultural treatments on forest growth and development. She has given many invited presentations in the state of Minnesota as well as nationally based on her publication and research record. She has a lengthy background in pine silviculture, structure and function.

Responsibilities

As Project Manager, Linda will coordinate and manage the overall project, including oversight of research site establishment, development of treatments, and implementation of harvests in Activity 1, provide oversight for the establishment of baseline inventory plots that will be remeasured over time (Activity 2), and will provide oversight and integration of data for use in long-term simulation modeling of treatments to test effectiveness (Activity 3). Linda will convene meetings of the researchers at least one time every year to facilitate field work, to integrate across major project activities, and to identify additional research and outreach opportunities that can be pursued as part of this project.

Organization Description

The Cloquet Forestry Center and the Department of Forest Resources are part of the University of Minnesota.