Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID: 164-F**

Identifying Optimal Soil Conditions for Sustainable Forest Management

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

Total Project Budget: $ 412,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

Quantify factors that control optimal soil conditions with historic data and experimental manipulations. Develop strategies and tools to expand acceptable harvesting conditions while minimizing impacts to soil and water.

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Impacts to soil such as the rutting shown in this picture can occur if site conditions are unsuitable for harvesting. We will quantify how key factors (shown in the lower pictures) related to soil properties, air temperature, and surface dynamics influence optimal soil conditions and develop practical tools for assessment.

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

PROJECT TITLE: Identifying optimal soil conditions for sustainable forest management

I. PROJECT STATEMENT

The overarching goal of this project is to quantify the factors that contribute to soil degradation during forest harvesting and develop practical tools to avoid impacts and broaden the range of acceptable operating conditions. **Soil is a fundamental resource from which many others arise. An improved understanding of the factors influencing soil operability is needed to develop strategies to minimize impacts to soils during forest operations.** Soil operability, or the ability to operate on soil without detriment, is a key management issue in sustainable forestry. Logging during winter when soil is frozen is one of the most common methods prescribed to protect soil when harvesting timber, but impacts can still occur when there is insufficient frost penetration in the ground. Summer harvesting, which is projected to dramatically increase in response to market and policy changes, can cause similar impacts especially when soil is at or near water saturation. A number of factors such as air temperature, soil properties, soil moisture, the timing and amount of snowfall and frost (in the case of winter harvest), and the equipment mix influence soil operability. **Although many of the factors that influence soil operability are known, our current ability to predict when soil conditions are optimal to minimize impacts to forest resources is surprisingly limited.** An improved understanding of the mechanisms that control soil operability will allow us to forecast when operating conditions are ideal, develop practices to promote favorable operating conditions (e.g., remove or compact snow), and help the DNR and other federal, state, industry and private landowners develop strategic plans for harvesting in the future. We also expect that the findings will benefit logging businesses and wood-using industries by providing clear guidance on when harvesting can occur, thereby increasing site access and reducing uncertainty related to fiber supply.

The goal of this project is to quantify the mechanisms that contribute to soil operability in summer and winter across a range of soil types to improve our ability to predict optimal harvesting conditions and develop practices that minimize impacts to forest resources. We will achieve this goal using long-term soil and climate datasets and a network of experimental treatments that manipulate key factors which influence soil operability.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: **Empirically model the influence of climate on soil operability** **Budget: $ 150,000**
We will utilize a 50+ year dataset from the Marcell Experimental Forest (located in the Chippewa National Forest) that includes data on climate, soil moisture, frost, and snow depth across representative forest cover types and soils of northern Minnesota. We will use this dataset and other available data (e.g., weather records, soil temperature records, soil survey database) to empirically model soil operability as a function of soil properties, weather patterns, and other pertinent variables. Model results will be used to classify each soil type into an operability class and develop diagnostic criteria for changes in operability throughout the year.

Outcome	Completion Date
1. Datasets acquired and pre-processing completed	July 2017
2. Climate-operability models developed	Dec. 2017
3. Models checked and validated with real-time weather data	Apr. 2019
4. Effects of weather variation incorporated into final report and management strategies	June 2019

Activity 2: Assess the influence of soil properties and weather on operability across a range of site conditions **Budget: $ 210,000**

We will develop a network of 10 research sites along a gradient from southern to northern Minnesota across a range of soil textures. Soil texture is a key property that influences soil operability because it controls soil moisture dynamics – a primary factor influencing operability. Experimental treatments that manipulate soil moisture during the summer and snow depth during the winter will be replicated at each site. Treatments will be applied throughout the project period to assess the influence of inter-annual variability in weather on soil operability. We will measure and analyze the effect of these treatments on soil temperature and moisture, frost occurrence and depth (during winter), soil strength, and variation in response over time.

Outcome	Completion Date
1. 10 sites identified that span the range of climate and soils in MN	Oct. 2016
2. Measurement of treatment effects on soil properties completed	Mar. 2019
3. Effect of soil moisture, snow depth, and texture on soil strength determined.	June 2019

Activity 3: Develop soil operability guidelines and a field measurement tool **Budget: $ 52,000**

Results from Activities 1 and 2 will be used to identify key factors and conditions influencing soil operability, and develop guidelines on when operations may occur across a range of weather conditions. We will also develop strategies and recommendations to enhance operability under subpar conditions including post-storm events and early season snowfall. Practical tools, including a GIS-based operability framework and a measurement device that can be used in the field to assess soil operability, will be developed for use by foresters. We will communicate our findings to agencies, policy organizations, and land managers.

Outcome	Completion Date
1. Findings from Activities 1 and 2 synthesized and key factors identified	Mar. 2019
2. Guidelines for operability across a range of conditions developed	Apr. 2019
3. Best practices to enhance operability and measurement tool developed	June 2019
4. Final report and communication of findings completed	June 2019

III. PROJECT STRATEGY

A. Project Team/Partners

Team members who will contribute time and effort to the project are Dr. Robert Slesak (MN Forest Resources Council; who receives funds from the request), Dr. Charlie Blinn (University of Minnesota; who receives funds from the request), Dan Hanson (DNR Forestry), Dr. Randy Kolka (US Forest Service) and Dr. Stephen Sebestyen (US Forest Service). The Forest Service will also contribute additional in-kind funds to the project in the form of Drs. Kolka's and Sebestyen's salary, equipment use, and data sets. The Minnesota Department of Natural Resources is also cooperating by providing their lands for study treatments, and will work closely with the project team on Activity 3 to incorporate findings into DNR operations and policies.

B. Project Impact and Long-Term Strategy

The findings will be widely used by private and public land managers to reduce impacts to soil during harvesting and increase site access by clearly identifying when conditions are suitable for harvest (**see attached letters of support**). Furthermore, the results will be used by governmental agencies for long-term planning efforts and development of related policies for addressing variability in climate and summer wood supply. Results will be presented to cooperators and others, disseminated in peer reviewed journals, and incorporated into Minnesota's Forest Management Guidelines.

C. Timeline Requirements

The proposed project duration of three years is necessary to assess manipulative treatment effects to account for variability in weather conditions among years.

2016 Detailed Project Budget

Project Title: Identifying optimal soil conditions for sustainable forest management

PIs: R.A. Slesak (MFRC), C. Blinn (UMN), D. Hanson (DNR), R. Kolka (USFS), S. Sebestyen (USFS)

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel: Salary (0.5 FTE each) and fringe (0.82) for 2 MSc students for 2 years	$ 167,903
Personnel: Salary and fringe (0.307) for 1 Research Associate (1.0 FTE) for 3 years who will coordinate treatment application and data collection at the project sites	$ 149,473
Personnel: Salary and fringe (0.0743) for 1 summer work study student for 3 years	$ 25,783
Equipment/Tools/Supplies: Soil temperature and moisture sensors (100 totaling $14,000), dataloggers (25 totaling $10,000), mobile soil pressure apparatus ($25,000), snow tube and scale ($500), shovels, water pump, and misc. supplies for treatment application ($1341)	$ 50,841
Travel: Travel for mileage (75%) and lodging (25%) within Minnesota for researchers, the Research Associate, and Graduate Student to the project sites. A large amount of travel will be requiried because sites will be located from southern to northern Minnesota and require periodic visits following snow events.	$ 18,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 412,000

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
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 salary from R. Slesak (0.1 FTE) , R. Kolka (0.05 FTE) and S. Sebestyn (0.05 FTE)	$ 76,900	*Secured*
Funding History: Funds used to support Marcell Experimental Forest data collection over past 50 years	$ 100,000	
Remaining $ From Current ENRTF Appropriation:	N/A	*N/A*

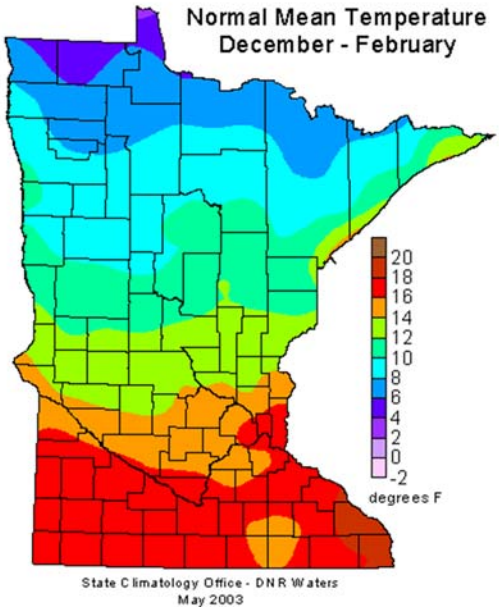
Suboptimal soil conditions during harvesting can result in large impacts to soil and water. The severe rutting that occurred on this site could be avoided with the development of diagnostic tools to evaluate soil operability and increase site access.

We want to <u>avoid this</u>, by quantifying how these <u>factors influence soil operability</u>

Soil properties

Soil water content is key factor controlling <u>soil strength</u>

Dependent on soil texture and density



Air temperature

Air temperature influences soil water and frost dynamics

Dependent on soil type and snow conditions

Surface conditions

Snow and forest floor influence frost development and soil water

Dependent on timing / intensity of rain and snow storms

Identifying optimal soil operability conditions for forest management

Project manager qualifications

Robert A. Slesak

Qualifications

Rob is Adjunct Assistant Professor in the Department of Forest Resources, University of Minnesota, and manager of the Site-level Program at the Minnesota Forest Resources Council. He is responsible for evaluation and development of Minnesota's Forest Management Guidelines, assessing their effectiveness with monitoring and research, and conducting research to address existing and emerging threats to sustainable forest management. Rob has extensive experience addressing complex forest resource issues including the identification of information needs for efficient and effective solutions to the challenges of sustainable forest management. He is a principal investigator and project manager on several ongoing projects related to invasive species, soil productivity, and forest sustainability, and has published a number of peer-reviewed journal papers related to these topics. Rob has a Ph.D in Forest Soils from Oregon State University, a M.S.in Forest Ecosystem Science from SUNY Environmental Science and Forestry (ESF), and a B.S. in Forest Resource Management from SUNY ESF. His research and professional interests are broadly focused on sustainable forest management, including identification of processes critical to ecosystem functions, evaluation of the potential for those processes and functions to be altered by management activities, and the application of management practices to restore degraded ecosystem functions.

Organization description

The Department of Forest Resources is part of the University of Minnesota.

The Minnesota Forest Resources Council was established by the Sustainable Forest Resources Act to promote long-term sustainable management of Minnesota's forests.