



# Environment and Natural Resources Trust Fund

## 2024 Request for Proposal

### General Information

**Proposal ID:** 2024-024

**Proposal Title:** Soil Data Integration into the Ecological Classification System

### Project Manager Information

**Name:** Nicolas Jelinski

**Organization:** U of MN - College of Food, Agricultural and Natural Resource Sciences

**Office Telephone:** (608) 225-5691

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### Project Basic Information

**Project Summary:** We will integrate soil data into the Minnesota Native Plant Community (NPC) Classification to provide high-resolution predictions of most probable native plant communities to assist managers in developing restoration targets.

**Funds Requested:** \$170,000

**Proposed Project Completion:** June 30, 2026

**LCCMR Funding Category:** Small Projects (H)

**Secondary Category:** Foundational Natural Resource Data and Information (A)

### Project Location

**What is the best scale for describing where your work will take place?**

Statewide

**What is the best scale to describe the area impacted by your work?**

Statewide

**When will the work impact occur?**

During the Project and In the Future

## Narrative

### **Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.**

Land managers are currently limited in their decision-making capacity for native plant community restoration targets based on local knowledge and estimations of most probable native vegetation classes from coarse existing maps. This can lead to significant challenges for ecological restoration targets that are both appropriate to site, soil and environmental conditions and offer the highest probability of success. These problems stem from the lack of quantitative ranges of soil properties associated with current native plant community classes, and from the lack of a seamless, high-resolution statewide predictive map of most probable native plant community. As the Minnesota Biological Survey seeks to update the current native plant community classification, a major opportunity exists to harness high-resolution environmental data, vegetation plot data, and soils information to significantly advance native plant community class descriptions and predictions statewide. This integration of soils knowledge into detailed descriptions and predictive products would allow managers to utilize site-specific soil and landscape investigations to develop uniquely tailored ecological restoration plans across the state.

### **What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.**

In 2023, we now have available to us unparalleled, high resolution datasets of soil information, digital elevation models (made available through statewide LiDAR coverage), and high-resolution satellite imagery. These high resolution environmental spatial data (covariates) can be used in conjunction with the Minnesota Biological Survey's extensive relevé database (which contains over 11,500 plot based records of native plant community composition and classification from across the state) and through the use of machine learning algorithms (such as random forest, naive bayes, and gradient boosting) be used to generate high resolution (10-30m) predictions of most-probable native vegetation class in a seamless statewide product. In parallel, these same approaches can be utilized to provide quantitative ranges of soil properties for all native plant community classes. These two products combined will allow land managers and biologists across the state to tailor survey and monitoring efforts and ecological restoration targets at scales relevant to site-specific management decisions. Finally, once produced, these products can be used in conjunction with future temperature and precipitation projections to model future shifts in native plant communities in the face of environmental and climatic change.

### **What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?**

The two major project outcomes are 1) a publicly accessible high resolution spatial layer of most probable native plant community and 2) integration of soil property ranges into existing native plant community class descriptions and documentation. These two deliverables, combined, would provide a powerful suite of decision-making tools for ecological restoration, monitoring and survey. Knowledge of site-specific soil properties, in conjunction with high-resolution spatial predictions of most probable native plant community would allow managers to tailor restoration actions to the field or plot scale (i.e. precision-restoration), adjusting seed mixes, fire prescriptions and monitoring efforts at fine scales.

## Activities and Milestones

### Activity 1: Generate publicly accessible statewide geospatial data layer of most probable native plant community classes at 10m resolution

**Activity Budget:** \$77,934

#### Activity Description:

In this activity, we will utilize environmental covariates (high-resolution digital elevation models and derivatives and satellite imagery) in conjunction with point data from the Minnesota Biological Survey's relevé database and through machine learning algorithms (such as random forest, naive bayes, and gradient boosting) generate high resolution (10m) predictions of most-probable native vegetation class in a seamless statewide product. This activity will involve working closely with Minnesota Biological Survey staff to understand the current state of relevé plot data, how much needs updating or curation, and joining MBS staff in the field in order to understand how data is generated and subsequently entered into the relevé database. This latter part is crucial to ensure accurate and complete understanding of the point data which will be the main data source used in the models. This may also involve updating and re-evaluating the classifications of plots in the database which may have been classified according to older schemes.

#### Activity Milestones:

Description	Approximate Completion Date
Prepare environmental co-variates	September 30, 2024
Curate and update relevé point data	May 31, 2025
Run Machine-learning algorithms to produce predictive maps	June 30, 2025
Evaluate and validate predictive maps using training datasets	September 30, 2025
Publish on publicly-accessible and stable ArcGIS Online linkage through UMN server	May 31, 2026

### Activity 2: Integrate ranges of soil properties for each native plant community class in the NPC classification

**Activity Budget:** \$77,934

#### Activity Description:

This activity builds on the results and outputs from the machine learning models built in Activity 1. Specifically, once these model results are validated, the ranges in soil properties for each class can be extracted from the model – in particular we would likely report the mean and standard deviation (in addition to the inert-quartile range) for major soil physical and chemical properties including: pH, organic carbon, clay, sand, available water holding capacity, depth to water table, soil classes, and thickness of surface organic-rich (A or O) horizons.

#### Activity Milestones:

Description	Approximate Completion Date
Integrate quantitative soil property ranges into existing NPC classes	December 31, 2025
Work with MBS/DNR biologists to integrate or re-evaluate model to reflect NPC classification updates	February 28, 2026
Produce deliverable report to MBS which can be integrated into updated class descriptions or documentation	May 31, 2026

### Activity 3: Outreach, Communication and Data Dissemination

**Activity Budget:** \$14,132

**Activity Description:**

This activity serves to disseminate the results of the project and access to the deliverables to land managers, biologists, and conservation groups statewide to ensure the largest possible user base. This includes presenting work at local and national conferences, submitting a publication for peer-review, and developing an informational pamphlet and user guide for resulting products and documentation.

**Activity Milestones:**

Description	Approximate Completion Date
Present work at Natural Areas Conference and other in-state conferences/events	May 31, 2026
Submit Publications for peer-review	May 31, 2026
Develop and publish informational pamphlet for users	May 31, 2026

## Long-Term Implementation and Funding

**Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?**

A post-doctoral researcher housed in the Department of Soil, Water, and Climate at the University of Minnesota will consolidate all necessary spatial co-variates, work closely with the Minnesota Biological Survey to curate and prepare the relevé database and incorporate into analysis, implement machine-learning algorithms using an open science workflow, and create a data platform through the University of Minnesota's ArcGIS Online platform to house the spatial component of the data. This work will be published in peer-reviewed publications and presented at the 2025 Ecological Society of America conference, and a report will be delivered to the Minnesota Biological Survey.

## Project Manager and Organization Qualifications

**Project Manager Name:** Nicolas Jelinski

**Job Title:** Associate Professor

**Provide description of the project manager's qualifications to manage the proposed project.**

Nic Jelinski is an Associate Professor of Soil Science in the Department of Soil, Water, and Climate at the University of Minnesota. His research focuses on understanding soil spatial and depth variability and the relationship between soil properties and natural ecosystems or human management. His research addresses ways in which soil data and information can be made available to decision-makers in the form of geospatial data products, outreach or short communications, or accessible data platforms.

**Organization:** U of MN - College of Food, Agricultural and Natural Resource Sciences

**Organization Description:**

In the College of Food, Agricultural and Natural Resources Sciences (CFANS) we look at the bigger picture. When we envision a better tomorrow, it includes disease-resistant crops, products that protect our health, lakes free from invasive species, and so much more. We use science to find answers to the world's grand challenges and solve tomorrow's problems. Every day our students, faculty and staff use science to create a world that will feed our growing population while sustaining the natural resources upon which we depend. Few other public universities come close to the breadth of our expertise, allowing us to tackle challenges in novel ways. We develop leaders that see more possibilities and produce solutions that work for real people. This creates a powerful force for change.

Twelve academic departments and 10 research and outreach centers make up our college, along with the Minnesota Landscape Arboretum, the Bell Museum, and dozens of interdisciplinary centers. As part of a major urban university located in the heart of the Twin Cities, we also provide immersive study opportunities across the state. Our living laboratories allow students, faculty, and staff to study throughout Minnesota's diverse ecosystems. Undergraduate students can choose from 14 majors and more

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Postdoctoral Researcher		A post-doctoral researcher housed in the Department of Soil, Water, and Climate at the University of Minnesota will consolidate all necessary spatial co-variables, work closely with the Minnesota Biological Survey to curate and prepare the relev� database and incorporate into analysis, implement machine-learning algorithms using an open science workflow, and create a data platform through the University of Minnesota's ArcGIS Online platform to house the spatial component of the data.			25.7%	2		\$155,868
							<b>Sub Total</b>	<b>\$155,868</b>
<b>Contracts and Services</b>								
							<b>Sub Total</b>	-
<b>Equipment, Tools, and Supplies</b>								
							<b>Sub Total</b>	-
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	Travel to work with Minnesota Biological Survey staff throughout Minnesota for 3 weeks each in 2024 and 2025.	Postdoctoral researcher will make multiple trips around the state of Minnesota to consult, meet with Minnesota Biological Survey staff in					\$9,186

			field and office settings to ensure full integration and product accuracy assessment.					
							<b>Sub Total</b>	<b>\$9,186</b>
<b>Travel Outside Minnesota</b>								
	Conference Registration Miles/ Meals/ Lodging	Travel to 2025 Natural Areas Conference to present project results. Location is still to be announced – using the 2024 meeting location for budget. 5 days + travel	disseminate project results to broad audience for feedback and improvement					\$1,658
							<b>Sub Total</b>	<b>\$1,658</b>
<b>Printing and Publication</b>								
	Publication	Open source publication fee to peer-reviewed journal	This work will be published in a peer-reviewed journal and made open source in order to ensure widest accessibility					\$3,288
							<b>Sub Total</b>	<b>\$3,288</b>
<b>Other Expenses</b>								
							<b>Sub Total</b>	<b>-</b>
							<b>Grand Total</b>	<b>\$170,000</b>

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
<b>State</b>				
			<b>State Sub Total</b>	-
<b>Non-State</b>				
			<b>Non State Sub Total</b>	-
			<b>Funds Total</b>	-

## Attachments

### Required Attachments

#### *Visual Component*

File: [50710350-740.pdf](#)

#### *Alternate Text for Visual Component*

graphic showing how soils data can be used to predict native plant communities and improve restoration and management...

### Optional Attachments

#### *Support Letter, Photos, Media, Other*

Title	File
SPA Jelinski LCCMR Letter	<a href="#">681f0b73-9da.pdf</a>
SPA Jelinski LCCMR Letter	<a href="#">2900b055-593.pdf</a>

## Administrative Use

**Does your project include restoration or acquisition of land rights?**

No

**Does your project have potential for royalties, copyrights, patents, or sale of products and assets?**

No

**Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?**

N/A

**Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?**

N/A

**Does your project include original, hypothesis-driven research?**

Yes

**Does the organization have a fiscal agent for this project?**

Yes, Sponsored Projects Administration

**Does your project include the design, construction, or renovation of a building, trail, campground, or other capital asset costing \$10,000 or more?**

No

**Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services, as defined in Minnesota Statutes section 299C.61 Subd.7?**

No