Environment and Natural Resources Trust Fund 2018 Request for Proposals (RFP)

Project Title: ENRIFID: 027-A
Foundational Assessment of Soil Health Metrics in Minnesota
Category: A. Foundational Natural Resource Data and Information
Total Project Budget: \$ 695,477
Proposed Project Time Period for the Funding Requested: <u>3 years, July 2018 to June 2021</u>
Summary:
This proposed work will produce a foundational dataset which can be used to set data-driven statewide soil health goals and establish a baseline soil health assessment for Minnesota.
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Location
Region: Statewide
County Name: Statewide

City / Township:

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Alternate Text for Visual:

A Foundational Assessment of Soil Health Metrics in Minnesota, in 2,000 natural and managed systems of varying intensity, across 10 major land resource areas, to develop a web-based, publicly available database, for improved management recommendations, research, and policy.

Funding Priorities	Multiple Benefits	Outcomes	Knowledge Base	
Extent of ImpactI	nnovation	Scientific/Tech Basis _	Urgency	
Capacity Readiness	Leverage		TOTAL	_%

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I. PROJECT STATEMENT

Soil health metrics are directly connected to the provisioning (food-feed-fiber-timber production; water storage), regulating (water quality), and supporting (sustainable habitat) services provided by Minnesota's soil resource. Soil health metrics differ from traditional soil tests in that they are designed to be holistic indicators of overall soil physical, chemical and biological health, and are intimately linked to the ecosystem services that the soil resource supports. These metrics include analyses such as particulate organic matter, permanganate oxidizable carbon (POX-C), potentially mineralizable nitrogen, microbial and lipid biomass, extracellular enzyme activity, and water extractable carbon and nitrogen. Minnesota is one of the most soil-diverse states in the country, and for that reason, setting goals and expectations for soil health metrics can be challenged by a lack of broader context. Values of these metrics considered excellent in one part of the state (for example POX-C values of > 400 ppm in drier regions of western Minnesota) may be marginal in another (POX-C values may often exceed 700 ppm in the southern Corn Belt), and different landscapes may have varying thresholds or expectations with regard to how management practices may improve soil health, as well as how those metrics are linked to specific ecosystem services.

There is emerging urgency to this information, as the number of individuals and organizations interested in using soil health information to evaluate management schemes is rapidly increasing. **Despite intense local, regional and national interest and investment in utilizing soil health metrics for improved targeting, management, and modelling of natural and managed ecosystems, Minnesota lacks a foundational dataset which captures the variability of soil health metrics across state resource regions and soil types.** This has generally limited the interpretation and application of these soil health metrics for environmental, agronomic and forest management purposes to local scales. Thus, a foundational assessment and accessible database of soil health metrics in regions across the state has the potential to become a central resource for interpreting and applying results from local studies and ongoing soil health initiatives.

To address this deficiency, we will conduct extensive statewide sampling and analysis in conjunction with the compilation of a comprehensive dataset of soil health metrics in Minnesota from previous and ongoing studies. These datasets will then be made publicly accessible through a web-based interface. Two major project activities support these outcomes:

- Conduct stratified sampling and analysis of a suite of soil health metrics for 2,000 soils in 10 soil landscapes across the state.
- Establish a publicly accessible dataset (through web-based interface) which can be utilized by growers, scientists, and resource managers to provide context for observed soil health metrics and assist in setting and measuring soil health goals.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Sampling/analysis of soil quality metrics across state land resource regions Budget: \$491,691 We will conduct state-wide sampling of 2,000 soils (in conjunction with MDA and local SWCD staff) by 10 Major Land Resource Area (MLRA) landscapes. Within each region, we will conduct stratified sampling of soils by Minnesota Crop Productivity Index, Aspen Productivity Index (MNCPI or API - generalized soil productivity index value assigned to soil mapping units in different portions of the state), land-use history, and conservation practices. This sample set will be analyzed for a suite of physical, chemical, and biological soil health metrics (see budget for specifics).

Outcome	Completion Date
1. Stratified sampling of 2,000 soils by land resource area, MNCPI, and API	30-SEP-2019
2. Analysis of physical, chemical and biological metrics of soil health	01-NOV-2020

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Activity 2: Establishment of publicly accessible dataset and website demonstrating the Budget: \$203,786 variability of multiple soil health metrics across land resource regions, soil types, and land use histories.

In addition to data derived from the stratified sampling and analysis in Activity 1, soil health metrics in Minnesota will be compiled from previous studies and ongoing initiatives from state agencies and academic sources. This dataset will be made publicly accessible through a web user interface, and will provide information on the expected range and variability of soil health metrics for resource regions and land use practices. Users will be able to interact with the dataset via a map interface and view a visual representation of the range of values for individual soil health metrics under different land use intensities in their part of the state. This information will then allow resource managers, growers, and scientists to assess the impact of ongoing management practices on soil health, as well as to set goals and expectations for improved management practices.

Outcome	Completion Date
1. Compile dataset of soil health metrics from previous studies	30-JUN-2018
2. Establish web-based interface for accessing and viewing the range and variability of	30-JUN-2020
soil health metrics across state resource regions and land use types	

III. PROJECT STRATEGY

A. Project Team/Partners

- Project Team (receives LCCMR funding) Dr. Nic Jelinski (Project Manager), UMN-TC; Dr. Julie Grossman (Co-Investigator), UMN-TC. Soil and Water Conservation District (SWCD) staff in 10 Minnesota land resource regions (coordinated through MDA).
- Partners (funding from other sources) Minnesota Department of Agriculture (MDA)

B. Project Impact and Long-Term Strategy

This proposed work will produce a foundational dataset which can be used to **set data-driven**, **achievable**, **statewide soil health goals and expectations**, **develop recommendations for the use and interpretation of soil health metrics for growers and land managers** across the state, **and establish a baseline assessment which can be used in the future to understand large-scale changes to soil health**. Numerous regional, statewide and national initiatives focused on implementing practices to improve soil health (BWSR's Southeastern Minnesota Cover Crop and Soil Health Initiatives, MDA's Cropland Grazing Exchange, General Mills-Nature Conservancy Soil Health Roadmap, Sustainable Farming Association of Minnesota's Soil Health Summit) are currently underway. These projects often include the documentation of local impacts of improved management to soil health, however the translation of the resulting information into goals and expectations in other regions of the state or other soil types is complicated by a limited understanding of the variability of soil health metrics across diverse land regions and soil types.

This project directly addresses that information gap, and establishes a publicly accessible website through which citizens and resource managers can utilize to access the data. The involvement of SWCD staff, resource managers, and growers in sampling throughout the state will intensify project impact. The website and dataset will be housed through University of Minnesota extension, which ensures long-term access and support.

C. Timeline Requirements

The project will start in July, 2018. Sampling and analysis will be completed in the first 2.5 project years, by November, 2020. Web interface for viewing and accessing the preliminary database will be live by June, 2020. Final project reports will be finalized by June, 2021.

2018 Detailed Project Budget

Project Title: Foundational Assessment of Soil Health Metrics in Minnesota

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM		AMOUNT
Personnel: <i>Dr. Nic Jelinski</i> , <i>Co -PI:</i> \$32,793 (1 mo summer salary - three years FTE .11) \$8,188 (salary) + \$2,743 (fringe) * 3 years. <i>Dr. Julie Grossman</i> , <i>Co-PI:</i> \$37,719 (1 mo summer salary - three years FTE .11) \$9,418 salary + \$3,155 fringe * 3 years <i>Graduate Student</i> (3 years academic year + summer salary FTE .50) = \$133,274: Yr1 (18-19) \$23,974 salary + \$19,503 fringe, Yr2 (19-20) \$24,453 salary + \$19,965 fringe, Yr3 (20-21) \$24,939 salary + \$20,440 fringe, <i>Research Technician - Researcher I</i> (3 years FTE 1.00) = \$126,361: Yr1 (18-19) \$32,460 salary + \$8829 fringe, Yr2 (19-20) \$33,109 salary + \$9006 fringe, Yr3 (20-21) \$33,771 salary + \$9,186 fringe. <i>Undergraduate research assistants=</i> \$36,960; 2 students, 14 we eks each @ \$11/hr = \$12,320/yr * 3 years 1.00 FTE).	Ş	367,107
Professional/Technical/Service Contracts: <i>MDA contracts with SWCDs (one month of time - salary + fringe estimated at \$6,000 per region (10 regions) x 2 years each to facilitate sampling site location, landowner contacts and interpretation of results</i>	\$	120,000
Equipment/Tools/Supplies: Laboratory supplies/analysis costs for 2,000 samples (\$90/sample *2,000 samples): Permanganate oxidizable carbon (Pox) = \$7/sample, Potentially mineralizable nitrogen = \$6/sample, Microbial Biomass = \$10/sample, Lipid Biomass = \$10/sample, Extracellular Enzymes = \$3/sample, Water extractable organic carbon/nitrogen = \$7/sample, Soil texture= \$3/sample, Total carbon/nitrogen = \$12/sample, OM/K/P/pH = \$12/sample, Nitrate/Ammonium = \$15/sample, Particulate organic matter (POM) = \$5/sample. 3 Penetrometers for soil compaction measurement = \$3060 (\$1,020 each).	\$	183,060
Acquisition (Fee Title or Permanent Easements): In this column, indicate proposed number of acres and and name of organization or entity who will hold title.	\$	-
Travel: Travel to locations around the state to conduct sampling - anticipate 15,000 miles in MN with 60 hotel-person overnights, over 2 years (Project Years 1 & 2)= $\$777$ /trip * 15 trips per year * 2 years = $\$23,310$ Tttal. These trip figures include the following specific estimates per-trip: average of 3 days of vehicle rental ($\$54$ /day*3 days = $\$162$) + 500 round-trip miles (500 miles * $\$0.23$ /mile = $\$115$) + 2 nights of lodging ($\$100 * 2 = \200) + Per diem = ($\$50$ /day*2 people*3 days = $\$300$) = $\$777$ /trip * 30 trips over 2 years = $\$23,310$	\$	23,310
Additional Budget Items: Postage and sample shipping fees - 100 sample packages with overnight shipping on dry ice, \$20/shipment	\$	2,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$	695,477

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	<u>Status</u>
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	
In-kind Services To Be Applied To Project During Project Period: Indirect Costs (54% MTDC in FY19 and FY20) associated with this proposal. Office, lab, and meeting space, accounting and secretarial services, phone & office equipment, security, and library access, for all project personnel.	\$ 345,599	Secured
Past and Current ENRTF Appropriation:	N/A	
Other Funding History:	N/A	

Foundational Assessment of Soil Health Metrics in Minnesota...





... in 2,000 natural and managed systems of varying intensity...



Project Manager Qualifications

Dr. Nic Jelinski is an Assistant Professor in the Department of Soil, Water, and Climate at the University of Minnesota. He has published peer-reviewed research on large-scale assessments of soil erosion across the conterminous United States¹, the variability of soil health indicators at the landscape-scale², and the effects of land-use on soil chemical and physical properties³. Most recently, Dr. Jelinski was a Co-PI on a project related to the relationship of soil health indicators to crop productivity and ecosystem services in urban soils funded through the University of Minnesota's Healthy Food Healthy Lives Institute. Dr. Jelinski runs a soil characterization laboratory in the Department of Soil, Water and Climate, teaches Basic Soil Science, Field Study of Soils, and Soil Judging courses. In addition to scientific grants, Dr. Jelinski has external experience managing budgets and personnel as the former commander of the 180th Preventive Medical Detachment (U.S. Army Reserves).

1. Jelinski, N.A. and K. Yoo. 2016. The distribution and genesis of eroded phase soils in the conterminous United States. Geoderma. 279:149-164. **2.** Leigh Winowiecki, Tor-Gunnar Vågen, Boniface Massawe, Nicolas A. Jelinski, Charles Lyamchai, George Sayula, Elizabeth Msoka. 2015. Landscape-scale variability of soil health indicators: effects of cultivation on soil organic carbon in the Usambara Mountains of Tanzania. Nutirent Cycling in Agroecosystems. 105:263-274. DOI:10.1007/s10705-015-9750-1. **3.** Jelinski, N.A. and C.J. Kucharik. 2009. Land-use Effects on Soil Carbon and Nitrogen on a U.S. Midwestern Floodplain. Soil Science Society of America Journal 73:217-225.

Organization Description

The University of Minnesota (UMN) is Minnesota's land grant and research university. UMN changes lives through research, education, and outreach. Faculty and staff at UMN seek new knowledge that can change how we all work and live. UMN prepares students to meet the great challenges facing our state, our nation, and our world. UMN faculty and staff utilize their expertise to meet the needs of Minnesota, our nation, and the world. UMN partners with communities across Minnesota to engage our students, faculty, and staff in addressing society's most pressing issues. The Department of Soil, Water, and Climate has a 104 year history of conducting research, teaching and extension activities which support Minnesota's industry and environment. Laboratory, teaching and office facilities are available through the Department of Soil, Water and Climate and to support this project as proposed.