Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)

Project Title: **ENRTF ID: 208-F**

Minnesota By-products Recycled to Sustainable Designed Soil

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

Sub-Category:

Total Project Budget: $ 448,964

Proposed Project Time Period for the Funding Requested: June 30, 2022 (3 yrs)

Summary:

Characterize and blend undervalued regional by-products (dredge sediment, mineral tailings, wood waste, and biochar) creating productive soil, smarter recycling/reuse practices for site restoration providing environmental and economic benefit to Minnesota.

Name: Marsha Patelke

Sponsoring Organization: U of MN - Duluth

Title: Geologist, Researcher 6

Department: Natural Resources Research Institute

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Duluth MN 55811-1442

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Web Address

Location

Region: Northeast

County Name: Itasca, St. Louis

City / Township:

Alternate Text for Visual:

Smarter recycling and reuse of four Minnesota by-products: wood waste, tailings, and dredge sediment blended with biochar to design sustainable fertile soil. Materials will be characterized and growth potential tested.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base	
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency	
_____ Capacity Readiness	_____ Leverage		_____ TOTAL	_____%
	____ If under $200,000, waive presentation?			

PROJECT TITLE: Minnesota By-products Recycled to Sustainable Designed Soil

I. PROJECT STATEMENT

Certain by-products generated by Minnesota's mineral, forestry, agricultural, and industrial sectors have the potential to be recycled, reused, and combined to create a sustainable source of value-added soil and/or soil amendments. The goal of this project is to characterize and combine these four by-products to grow plants:

- wood waste from the timber and paper industry (62,000 tons/year);
- mineral tailings from iron mining (125 million tons/year);
- dredge sediment from Duluth-Superior Harbor navigation channel maintenance (100,000 cubic yards/year); and
- biochar from biomass/bioenergy production – to create "designed" soil blends.

By-products will be characterized from an agricultural standpoint (nutrients, etc.) using Minnesota Pollution Control Agency *Land Application for Industrial By-products* guidelines. Greenhouse plant growth studies will be completed on four to six by-product blends where they will be evaluated for their plant growing benefits. The most successful designed blends will be selected as candidates for small-plot demonstrations at the NRRI. In addition to plant growth, soil moisture will be measured and the leachate produced by the "designed" soils used in the demonstration plots will be characterized.

Near and longer-term benefits would include using these blends for restoration of disturbed lands (ex. mine land reclamation and brownfield sites), creating one or more value-added soil products, and promoting smarter recycling and reuse practices & strategies, all of which provide environmental and economic benefit to the state.

The result of this project would be a report and workshop, specifying the best management/use practices for this material, for use by landfills, the DOT, municipalities, private land owners, etc., as they assess whether they want to use it for cover/topsoil/growth medium. In addition, the method of study utilized for this project could be applied to additional by-products from across Minnesota to create additional regional designer soil.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: By-product Characterization, and Soil Blend Determination
Description: Compile existing chemical and physical NRRI data on the by-products, characterization of samples of the four by-products, including chemical and nutrient analyses as well as their leachate. Determine four to six reasonable manufactured soil blends. Use data generated to create four to six blends of the materials for greenhouse plant growth testing.
ENRTF BUDGET: $ 152,770

Outcome	Completion Date
1. NRRI data sets compiled, blend recommendations made based on review	Dec 2019
2. By-product samples collected, characterization completed, recommendations made for 4 to 6 blends for Activity 2	May 2019

Activity 2: Do the blended soils grow plants? (plus: leachate characterization)
Description: By-product blends will be mixed and planted to evaluate plant growth abilities of each mix. Leachate from each blend will be characterized. Based on the results, 3 to 4 blends will be selected for field study.
ENRTF BUDGET: $ 160,953

Outcome	Completion Date
1. Plant growth characterization results and leachate chemical analyses for each blend completed	Mar 2021
2. 3 to 4 designed soil blends selected for field demonstration	April 2021

Activity 3: Field plant demonstration study
Description: The most successful blends from Activity 2 will be selected as candidates for small plot demonstrations at NRRI. Small plots will be excavated at NRRI and filled with designed soil. Plant growth, soil moisture, and leachate from the demonstration plots will be characterized over the course of one growing season.
ENRTF BUDGET: $ 71,241

Outcome	Completion Date
1. Demonstration plots prepared; blends mixed, planted, and monitored	June 2021
2. Samples collected and characterized	Oct 2021
3. By-product blend recommendations made	April 2022

Activity 4: Final Results and Stakeholder Outreach
Description: Results and lessons learned will be compiled into a final report. A presentation will be made at a meeting/workshop with stakeholders such as the Minnesota Pollution Control Agency, Minnesota Department of Transportation, Minnesota Department of Natural Resources, US Army Corp of Engineers, the Duluth Seaway Port Authority, pulp and paper industry, mining companies, and others.
ENRTF BUDGET: $ 64,000

Outcome	Completion Date
1. Final report written	May 2022
2. Workshop for stakeholders held	June 2022

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding N/A

B. Partners NOT receiving ENRTF funding N/A

IV. LONG-TERM - IMPLEMENTATION AND FUNDING:

Our desired long-term outcome is to provide a series of testing methods that can be used to evaluate other Minnesota by-products for use as a component of designed soils. Currently, NRRI is pursuing additional funding from by-product producers in order to explore other materials and desired end uses in order to tailor material testing and blending for the end use. Examples include: mine land reclamation; brownfield redevelopment; and value-added composting.

V. TIME LINE REQUIREMENTS:

3 years required to complete. Activity 1: July 2019 – April 2020. Activities 2: March 2020 - March 2021. Activity 3: February 2021 - May 2022. Activity 4: Feb 2022 - June 2022.

VI. SEE ADDITIONAL PROPOSAL COMPONENTS:

A. Proposal Budget Spreadsheet
B. Visual Component or Map
C. Parcel List Spreadsheet
D. Acquisition, Easements, and Restoration Requirements
E. Research Addendum (not required at proposal stage)
F. Project Manager Qualifications and Organization Description
G. Letter or Resolution
H. Certified Audit or 990 Tax Information

2019 Proposal Budget Spreadsheet

Project Title: Minnesota By-products Recycled to Sustainable Designed Soil

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel:	**$ 432,874**
Marsha Patelke *(non-faculty, 12-mo appt.)* , Principal Investigator: $73,253 (fringe rate 33.5%); 30% FTE each year	
Larry Zanko *(non-faculty, 12-mo appt.)* , Co-Investigator: $72,955 (fringe rate 33.5%); 18.8% FTE each year	
George Host *(non-faculty, 12-mo appt.)* , Co-Investigator: $34,097 (fringe rate 33.5%); 6.3% FTE each year	
Sara Post *(non-faculty, 12-mo appt.)* , Field Researcher: $20,790 (fringe rate 7.7%); 15% FTE each year	
Kurt Johnson *(non-faculty, 12-mo appt.)* , Researcher, Plants: $ 33,816 (fringe rate 33.5%); 15% FTE in Y2 & Y3	
Tim Hagen *(non-faculty, 12-mo appt.)* , Biochar and Byproducts: $25,660 (fringe rate 33.5%); 10% FTE in Y1 & Y3	
Mei Cai *(non-faculty, 12-mo appt.)* , Researcher, Chemistry and Statistician: $57,367 (fringe rate 33.5%); 20% FTE each year	
Dan Buchman *(non-faculty, 12-mo appt.)* , Researcher, Plot Coordinator: $8,686 (fringe rate 27.2%); 5% FTE in Y2 & Y3	
Graduate Research Assistant: $93,770 (fringe rate 15%) and tuition reimbursement; 50% FTE in Y1 & Y2	
Undergraduate Research Assistant: $12,480 (0% fringe); 25% FTE in Y1 & Y2	
Professional/Technical/Service Contracts:	**$ 3,850**
Lab Services ($2,350): Soil texture, classification, soil fertility testing, and chemical analyses	
Trucking costs ($1,500): Costs to have materials delivered to NRRI (3 deliveries at $500 ea)	
Equipment/Tools/Supplies:	**$ 11,700**
Lab Supplies ($2,500): supplies needed for leachate experiments and chemical analyses	
Greenhouse and Demonstration Project Supplies ($1,200): supplies such as seeds and growing containers	
Demonstration Equipment Supplies ($8,000): Non-capital equipment to construct field plots and monitor field conditions (tubing, laptop, moisture probes, solar panel)	
Acquisition (Fee Title or Permanent Easements):	**$ -**
Travel:	**$ 540**
Mileage to conduct sampling at 4 locations in target areas (~918mi*$0.545/mi) and to travel to present project results to Harbor Technical Advisory Committee in Duluth	
Additional Budget Items:	$ -
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	**$ 448,964**

V. OTHER FUNDS

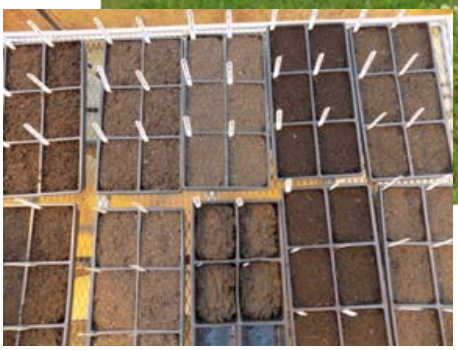
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	$ -	N/A
Other State $ To Be Applied To Project During Project Period:	$ -	N/A
In-kind Services To Be Applied To Project During Project Period:		
Unrecovered indirect: 54% modified total direct costs ($418,530 base, excludes grad student tuition reimbursement)	$ 226,006	Secured
Past and Current ENRTF Appropriation:	$ -	N/A
Other Funding History:	$ -	N/A

Minnesota By-products Recycled to Designed Soil

OUTCOMES

Restoration
Disturbed Land
Value-Added Soil Products
Smarter Recycling and Reuse Practices

PROJECT TASKS



Design Blends

Grow Plants

Characterize:
Solids and Leachate
1) Chemically :
- Nutrients, Pollutants
2) Physically :
- Size, Shape, Type

MATERIALS

Wood Waste

Dredge Sediment

Mineral Tailings

BioChar

PROJECT TITLE: Minnesota By-products Recycled to Sustainable Designed Soil

2019 LCCMR Project Manager Qualifications and Organization Description

Marsha Meinders Patelke, Natural Resources Research Institute, University of Minnesota Duluth

Key Qualifications
Ms Patelke is a Research Geologist at the Natural Resource Research Institute, University of Minnesota Duluth with specialties in beneficial reuse of geologic byproducts such as dredge sediment, evaluation of waste earthen materials from highway construction, and iron formation. Patelke will be supported by Larry Zanko, an expert in byproduct characterization and utilization; Dr. George Host, an expert in landscape ecology; Dr. Meijun Cai, an expert in water chemistry and environmental statistics; Kurt Johnson, an expert in peat and physical analysis of horticultural substrates; and Tim Hagen, an expert in transforming byproducts into useful green-based products.

EDUCATION
Bachelor of Science, Geology, Eastern Illinois University, 1988

RELEVANT RESEARCH EXPERIENCE
Marsha Meinders Patelke, Project Manager. Marsha is a registered professional geologist. Her work focuses on by-products characterization and re-use (ex. taconite tailings, dredge sediment), core logging and stratigraphy of Biwabik Iron Formation. Recently, she is a team member evaluating the potential re-use of peat and road side soils excavated during highway construction to remediate rainwater runoff prior to its entering rivers and lakes. Prior to joining NRRI in 2006, she worked in environmental consulting for 15 years investigating and cleaning up polluted site in Northeast Minnesota.

PUBLICATIONS
Cai, M, Johnson, K, Patelke, M., Saftner, D., and Swanson, J. 2017, Comparing Properties of Water Absorbing/Filterign Media for Bioslope/Bioswale Design, Final Report 2017-46, Minnesota Department of Transportation Research Services Section.

Patelke, M.M., Levar, T.E., Zanko, L.M., Oreskovich, J.A., and Maly, C., 2013 — Erie Pier Dredge Material Beneficial Use Study-Final Report, , Natural Resources Research Institute, University of Minnesota Duluth, Technical Report NRRI/TSR2013/03

Patelke, M.M. and Zanko, L.M., 2010 — Taconite Tailings and Water Quality–A Survey of Existing Data, Natural Resources Research Institute, University of Minnesota Duluth, Technical Report NRRI/RI-2010/01.

Zanko, L.M., Patelke, M.M., and Mack, P., 2013, Keweenaw Peninsula (Gay, Michigan) Stamp Sand Area Assessment, February 15, 2013: Natural Resources Research Institute, University of Minnesota Duluth, Technical Summary Report NRRI/TSR-2013/01, 54

The Natural Resources Research Institute is a University of Minnesota Duluth applied research organization. NRRI's mission is to deliver research solutions to balance Minnesota's economy, resources and environment for resilient communities.