Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)

Project Title: **ENRTF ID: 012-A**

Detecting Road Dust Control Chemicals in Air/Water

Category: A. Foundational Natural Resource Data and Information

Sub-Category:

Total Project Budget: $ 280,226

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

This project responds to Minnesota road authority requests to detect and assess the transport and fate of chemicals used in dust mitigation on rural unpaved roads near environmentally sensitive areas.

Name: Stephen Monson Geerts

Sponsoring Organization: U of MN - Duluth NRRI

Job Title:

Department: Natural Resources Research Institute

Address: 5013 Miller Trunk Highway

Duluth MN 55811

Telephone Number: (218) 788-2608

Email sgeerts@d.umn.edu

Web Address https://www.nrri.umn.edu/

Location:

Region: Statewide

County Name: Cook, Lake, St. Louis

City / Township:

Alternate Text for Visual:

Necessary dust control methods by county public works departments can become problematic if dust-carrying chemicals are transported to environmentally sensitive areas. This project will detect and assess those chemicals.

_____ Funding Priorities _____ Multiple Benefits _____ Outcomes _____ Knowledge Base

_____ Extent of Impact _____ Innovation _____ Scientific/Tech Basis _____ Urgency

_____ Capacity Readiness _____ Leverage _____ TOTAL _____%

PROJECT TITLE: DETECTING ROAD DUST CONTROL CHEMICALS IN AIR/WATER

I. PROJECT STATEMENT

The objective of this project is to analyze (chemical constituents and mass concentrations) dust from rural unpaved roads in Minnesota's environmentally sensitive areas. Dust from unpaved roads has documented negative human health and environmental effects, as well as being a safety hazard by obscuring driver visibility (Jones et al., 2013). Therefore, dust control on unpaved roads is an important and necessary function by local road authorities. However, the Minnesota Local Road Research Board (LRRB) has stated: **"*In rural Minnesota, research is needed to learn if chemicals used for dust control travel from the road to adjacent bodies of water—and ultimately, if agencies are creating a bigger problem than the one they're trying to solve*" (LRRB Technical Summary, 2013RIC6.7TS)**. Addressing this need of MN public works departments, this project will:

- Identify dust control chemicals such as chlorides ($CaCl_2$ and $MgCl_2$), which impact or damage sensitive environments by accumulating and causing harm to aquatic life, while also depleting oxygen. Once deposited, they cannot be removed!

These chlorides can adhere (adsorb) to the surface of dust or scientifically - mineral particulate matter (PM), thus creating a transport mechanism when stirred-up by vehicle movement on unpaved road surfaces. Dust can then be transported by prevailing winds and/or local stream tributaries, along with any chemicals it is carrying, into sensitive waters. Using Minnesota's North Shore of Lake Superior as a test location, this study will utilize several analytical techniques that have been used successfully to identify chemicals on PM (dust) as potential sources of pollution in a specific environmental location (Monson Geerts, et al., 2018).

The NRRI researchers and project collaborators will conduct extensive (seasonal) aerosol sampling in targeted problem areas defined by local road authorities in Cook, Lake and/or St. Louis Counties adjacent to Lake Superior. Soil, stream and shallow groundwater samples will also be collected at these same locations in an effort to identify and quantify chemicals used in dust mitigation. NRRI scientists will use a combination of in-house analysis (soil, shallow ground water and surface water samples), as well as contracting with a certified laboratory to analyze the PM for pollutants (elemental concentrations) that may be transported to Lake Superior or other sensitive surface waters. Multiple benefits to Minnesota include the following project deliverables:

- creating foundational natural resource data (Priority A) regarding the scientific characterization of PM generated from rural unpaved roads located adjacent to environmentally sensitive areas;
- identification and quantification of contaminants (Priority E) associated with dust mitigation efforts as a "first-ever approach" to relating chemical transport to PM (road dust); and
- outcomes from this study will allow the local road authorities (Public Works Departments) to make informed decisions regarding the use of both environmentally sustainable and cost-effective dust-suppression technologies. This knowledge base can then be applied to other localities state-wide.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Collection and analysis of aerosol PM, soil, stream and shallow ground water samples at specific sites and background locations. Seasonal sampling 2020 to 2023.

The project team will collect multiple aerosol PM samples (total 36 sample events) from three selected sites seasonally while recording meteorological data during sampling. Sampling to begin summer 2020 and end spring 2023. Simultaneous collection of soil, stream and shallow ground water samples will also take place.

ENRTF BUDGET: $200,485

Outcome	Completion Date
1. Creation of foundational natural resource data and information in environmentally sensitive areas selected with the aid of local (county) road – public works departments.	4/2023

Activity 2: Aerosol PM, soil and water sample analysis. Statistical analysis of derived chemical data results. Communicate the findings of this study to the county public works departments.
Aerosol PM samples will be analyzed gravimetrically at the NRRI to determine mass concentrations. Chemical analysis will be conducted by Elemental Analysis, Inc. (EAI), using Proton Induced X-ray Emission (PIXE) to determine elemental chemical concentrations of PM. Soil, stream and shallow ground water samples will be analyzed in-house (UMN) using Inductively coupled plasma atomic emission spectroscopy (ICP-AES). The NRRI team will statistically analyze the chemical analytical results of the aerosol PM, soil, stream and shallow ground water samples. The findings of this study will be presented to the respective county public works department(s) to develop more environmentally sustainable and cost-effective dust-suppression methods.
ENRTF BUDGET: $79,741

Outcome	Completion Date
1. Determine the mass concentrations of the full-range of PM for each aerosol sample.	6/2023
2. Identification of specific pollutants (elemental concentrations) in the PM, soil, stream and shallow ground water related to and originating from unpaved road surfaces.	6/2023
3. Statistical analysis of samples as it relates to the chemical analyses.	6/2023
4. Report the findings of this assessment to aid the respective MN county public works departments into making informed decisions regarding environmental and cost-effective dust-suppression methods.	6/2023

III. PROJECT PARTNERS:
Cook, Lake and St. Louis County Public Works Departments have committed project collaboration.

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:
This project provides an innovative “first-ever approach” of utilizing the chemical analysis of particulate matter (dust) to better understand potential chronic environmental impacts, especially as a transport mechanism for pollutants. The outcomes of this study will provide county public works departments, as well as researchers and regulatory scientists throughout Minnesota, with the necessary foundational data to make informed decisions regarding dust suppression methods and improved environmental monitoring of road dust in the future.

V. TIME LINE REQUIREMENTS:
The project duration would require three years of ENRTF funding from 7/1/2020 to 6/30/2023. NRRI researchers and project partners will be fully equipped to commence project activities on July 1, 2020.

Activity	Commence	Complete
Activity 1	Summer of 2020, shortly after 07/01/2020	04/2023
Activity 2	Fall of 2020, approximately 3 months after first sample event	06/2023

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**

Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: Stephen Monson Geerts
Project Title: "DETECTING ROAD DUST CONTROL CHEMICALS IN AIR/WATER"
Organization: University of Minnesota Duluth
Project Budget: $280,226
Project Length and Completion Date: 3 Year - 2023
Today's Date: April 15, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 247,718	$ -	$ 247,718
Steve Monson Geerts, Principal Investigator: $78,533 (sal. 74% fringe 26%); 25% FTE* each year			
Larry Zanko, Co-Investigator: $66,890 (sal. 74% fringe 26%); 15% FTE* each year			
Chan Lan Chun, Co-Investigator: $23,715 (sal. 74% fringe 26%); 5% FTE each year			
Meijun Cai, Co-Investigator: $44,811 (sal. 74% fringe 26%); 15% FTE* each year			
Sara Post, Non-Acad.: $33,769 (sal 77%; fringe 23%); 20% FTE* each year			
***NOTE: NRRI research staff salaries are largely sponsored by external funding sources!**			
Professional/Technical/Service Contracts	$ 6,000		$ 6,000
Elemental Analysis, Inc.: ($6,000); Proton-Induced X-Ray Emission (PIXE) spectrographic technique to identify chemical elemental concentrations from aerosol particulate matter samples - total +72 samples @ ~$83/sample	$ -	$ -	$ -
Equipment/Tools/Supplies	$ 6,638		$ 6,638
Davis weather station ($650): for collecting/recording weather conditions during air sampling			
Vacuum Pumps ($4,500): 3 x $1,500 each for oil-less, carbon-vane vacuum pumps tp provide air flow for ambient air sampling.			
Field sampling supplies ($1,488): air sampling filter substrates (polycarbonate, mixed cellulose ester, foil, teflon), petri slides.			
Capital Expenditures Over $5,000			
Fee Title Acquisition			
Easement Acquisition			
Professional Services for Acquisition			
Printing			
Travel expenses in Minnesota	$ 12,476		$ 12,476
Mileage (~14,200 miles at $0.58/mi rate and $10/day vehicle fee), sampling/field sites (48 trips). Per diem lodging and meals N. MN ~$2625 (10 days) and MPLS ~$1575 (4 days). Travel will be reimbursed per UofM policy.	$ -	$ -	$ -
Other	$ 7,394		$ 7,394
UMN/Internal Inductively coupled plasma atomic emission spectroscopy (ICP-AES), ($6,500) to identify chemical elemental concentrations from soil, shallow ground water and surface water samples - total +240 samples @ ~$27 /sample			
Shipping/mailing (~$894): Delivery of samples to analytical labs, and return of samples		$ -	$ -
COLUMN TOTAL	$ 280,226	$ -	$ 280,226

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		$ -	$ -	$ -
State:		$ -	$ -	$ -
In kind: Unrecovered F & A (54%)		$ 151,322	$ -	$ 151,322

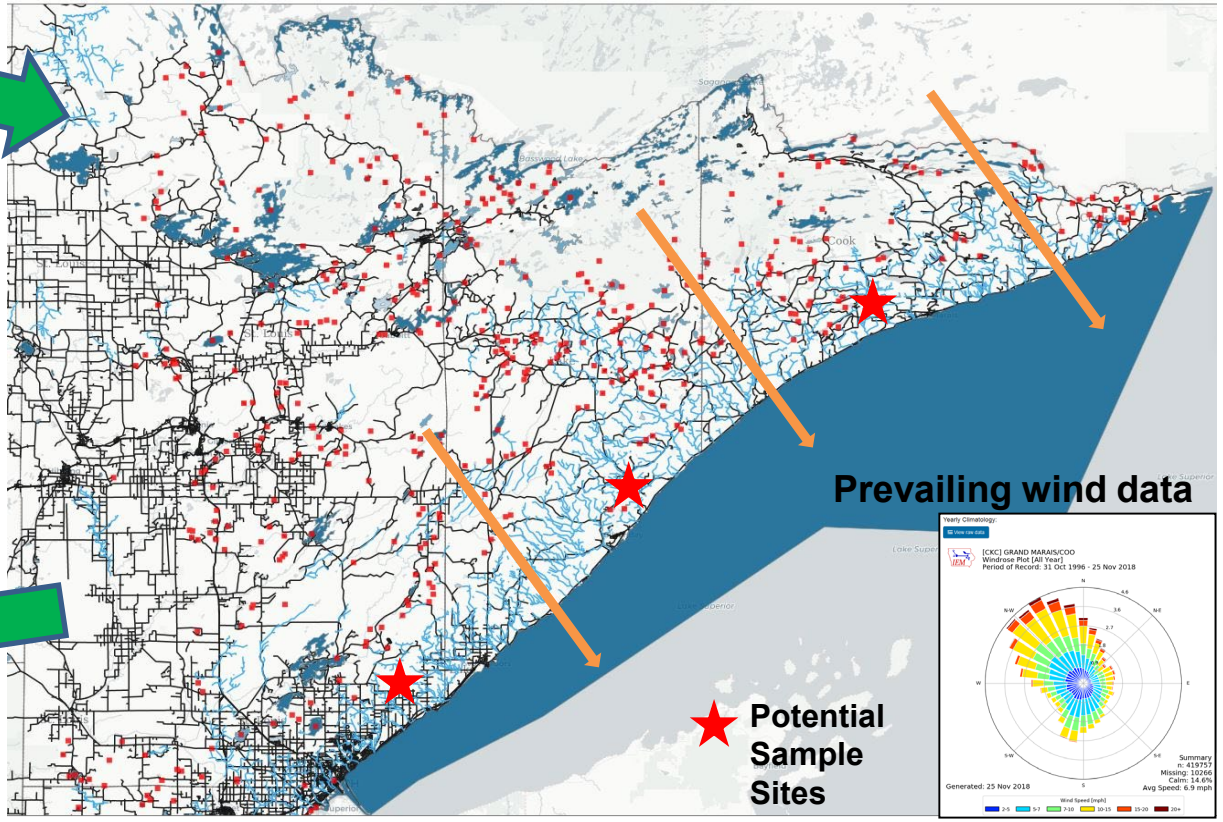
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		$ -	$ -	$ -

DETECTING ROAD DUST CONTROL CHEMICALS IN AIR/WATER (Component B)

Natural Resources Research Institute
University of Minnesota Duluth
Driven to Discover

COUNTY PUBLIC WORKS DEPARTMENT:
Application of dust control chemicals

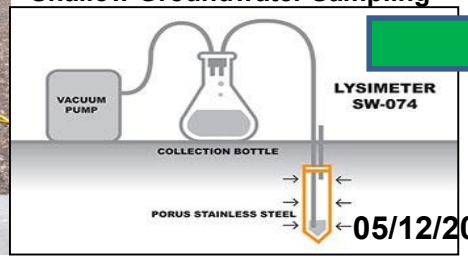
POTENTIAL PROBLEM: Road dust can transport chemicals to environmentally sensitive areas



SOLUTION **ACTIVITY 1**

Aerosol particulate matter (PM), soil, stream and shallow groundwater sampling

Shallow Groundwater Sampling



SOLUTION **ACTIVITY 2**

Analyze PM, soil, and water samples to identify chemical pollutants. MN road authority requests this info so that they can make informed decisions regarding dust mitigation!

05/12/2019

ENRTF ID: 012-A

PROJECT TITLE: DETECTING ROAD DUST CONTROL CHEMICALS IN AIR/WATER

Component F. 2020 LCCMR Project Manager Qualifications and Organization Description
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.

STEPHEN MONSON GEERTS: Natural Resources Research Institute, University of Minnesota Duluth
Key Qualifications: Stephen Monson Geerts is a Senior Geologist/Researcher 6 for the Minerals, Metallurgy and Mining (M^3) Program at the UMD - NRRI. Mr. Monson Geerts has over 35 years of experience as a geologist/ 25 years of research experience with a focus on mineral characterization. **EDUCATION: M.S. Geology w/ Minor Hydrogeology.** University of Minnesota - Duluth. **B.S. Geology.** University of Minnesota - Duluth. **NRRI Research:** Principal and co-principal investigator, project coordination and management, manuscript/technical report preparation and presenter. Primarily minerals and materials characterization with emphasis on igneous intrusives and aerosol particulate matter, respectively, includes 3 peer-reviewed and 35+ publically available technical reports.

LAWRENCE ZANKO: Natural Resources Research Institute, University of Minnesota Duluth
Key Qualifications: Mr. Zanko is a Senior Research Program Manager (Researcher 7) for By-Product Reuse and Remediation within the Minerals, Metallurgy and Mining (M3) Program at the UMD – NRRI. Since his start with NRRI in 1988, he has participated in or led a broad spectrum of research projects dealing with non-ferrous minerals, ferrous minerals, industrial minerals (with a focus on construction aggregates), contaminated sediment remediation and reuse, resource modeling and estimation, and related policy issues. **EDUCATION: Master of Geological Engineering**, University of Minnesota, Twin Cities (UMTC); **Bachelor of Geological Engineering; and B.S. Microbiology** (UMTC). **NRRI Research:** Includes 1 patent (co-inventor), 4 peer-reviewed professional publications, and over 40 publically-available technical reports. Recent and current membership on two committees of the Transportation Research Board (TRB) of the National Academies: Aggregates (AFP70) and Resource Conservation and Recovery (ADC60).

Chan Lan Chun: Natural Resources Research Institute, University of Minnesota Duluth
Key Qualifications: Dr. Chun is an assistant professor of civil engineering, performing her research at the NRRI. Her research focuses on the fate and transport of chemical and microbial contaminants in natural and engineered systems and the development of new water technology to treat contaminants. Likewise, Chun's research group is working on water quality and microbial ecology on wild rice water, innovative bioreactor to treat sulfate in natural and industrial water, electromagnetic bioreactor to treat nutrients from agricultural drainage, biofiltration for stormwater treatment, and iron filtration to capture sulfide in water. **EDUCATION: Ph.D. (Civil, Environmental, Geo Engineering)**, University of Minnesota; and M.S. and B.S., **(Environmental Science and Engineering)**, Ewha Womans University. Peer review publications.

Meijun Cai: Natural Resources Research Institute, University of Minnesota Duluth
Key Qualifications: Dr. Cai is an environmental engineer with specialties in water quality at the NRRI, University of Minnesota Duluth since 2012. Her research focuses on the use of salvage material as filtration materials to treat water in order to improve water quality. She is also an environmental statistician. **EDUCATION: Postdoctoral (Environmental Engineering),** University of Tennessee – Knoxville; **Ph.D. (Environmental Engineering),** University of Tennessee – Knoxville. Peer review publications.