



Environment and Natural Resources Trust Fund

2024 Request for Proposal

General Information

Proposal ID: 2024-267

Proposal Title: Remove Pollutants from Well Water on Superfund Sites

Project Manager Information

Name: Jana Danker

Organization: Akiing 8th Fire

Office Telephone: (4) 059-0793

Email: jana@anishinaabeagriculture.com

Project Basic Information

Project Summary: Demonstrate a suite of technologies to remove dioxins and hydrocarbon contaminants from the water on Minnesota superfund sites

Funds Requested: \$697,000

Proposed Project Completion: June 30, 2026

LCCMR Funding Category: Water Resources (B)

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.

The presence of petroleum hydrocarbon contaminants and industrial chemicals in soil and water environments causes significant environmental impacts and poses substantial hazards to both humans and other forms of life in polluted areas. According to the latest study, over 5,000 bodies of water, including roughly 40% of Minnesota's lakes and streams (groundwater, surface water, agriculture, and drinking water), fail to meet basic water quality standards. While hydrocarbons are important sources of energy and raw material to produce numerous chemicals and consumer products, most of their organic compounds are classified as priority environmental pollutants such as persistent organic pollutants (POPs) and polycyclic aromatic hydrocarbons (PAHs) due to their persistent nature. The EPA stated in 2015 that the crude oil industry releases petroleum hydrocarbon contaminants into the environment about 1.7-8.8 million metric tons annually globally. Industrial chemicals include thousands of carbon-based, often synthetically produced chemicals used in agriculture, manufacturing, pharmaceutical, chemical, and other industries. Some industrial chemicals, such as polychlorinated biphenyls (PCBs), dioxins, per- and polyfluorinated substances (PFAs) and furans, have been confirmed to present a serious threat to the natural environment and human health. These contaminants are highly durable and stable substances, and thus remain in the environment.

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.

This project aims to investigate a novel approach to treat and utilize the contaminated well water. The approach includes bioaccumulation of the aforementioned pollutants through the use of phytoremediation and nonthermal plasma (NTP) treatment that can reduce the loading of pollutants and enhance the efficiency of the water treatment process. Phytoremediation is a low-cost method that involves using hydroponic plant cultivation to remove pollutants from water. The plants absorb the pollutants through their roots and break them down into less harmful compounds. This method can significantly reduce the loading of chlorinated organic compounds in the well water, making it easier and less expensive to treat with NTP. NTP treatment, on the other hand, utilizes reactive species such as ozone, hydroxyl radicals, and atomic oxygen to break down complex organic molecules into simpler and less toxic compounds. NTP has several advantages over conventional methods, including its ability to operate at ambient temperature and pressure, low energy consumption, and the ability to treat a wide range of pollutants without generating harmful byproducts. Combining phytoremediation with NTP treatment can further enhance the efficiency and cost-effectiveness of the overall water treatment process.

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 main goal of this project is to develop an energy-efficient and environmentally friendly device and processes for removing water contaminants, while also identifying the optimal processing conditions to achieve a high rate of contaminant degradation. Achieving these outcomes will bring the technology closer to commercial implementation and yield several benefits, including:

Providing an energy-efficient and environmentally friendly technology for removing water contaminants.

Establishing a continued water treatment process and system to meet the needs of bulk water treatment.

Offer a water treatment system equipped with high rates and broad-spectrum contaminant destruction or degradation.

Activities and Milestones

Activity 1: Bioaccumulation of pollutants through hydroponic plant cultivation on the well water

Activity Budget: \$232,300

Activity Description:

Plants suitable for hydroponics growth can be very different from the common phytoremediation plant species we grow in the soil. We first want to study our plant inventory and screen more native species via lab hydroponic jars for phytoremediation purposes. We will start with some species reported from the reference and evaluate their potential for hydroponic growth and the effectiveness of removing dioxins directly from the water environment. MNDNR publishes on their website about all the plant species living in the state of MN and additional plant species will be selected from the reference search for their phytoremediation potential. A decision matrix will be established considering all factors affecting their real applications and provide recommendations about two to three best plant species for future hydroponic applications. Toxin content of the biomass will be measured and the biomass can be harvested for thermal treatment or composting to degrade chlorinated organic compounds.

Activity Milestones:

Description	Approximate Completion Date
Select native hydroponic plants growing hydroponically with the ability to assimilate toxins	January 31, 2025
Screen these plants with lab hydroponics for phytoremediation capability	May 31, 2025
Decision matrix for plant recommendations	October 31, 2025

Activity 2: Direct removal of pollutants from the well water

Activity Budget: \$232,300

Activity Description:

A CHIEF NTP reactor-based treatment system will be developed, tested, and optimized. A bench-scale water treatment system that allows for the inclusion of catalysts will be developed. The effectiveness of contaminant removal using different background gases, both type and size of gas bubbles, at different dosages, pH of contaminated water, electric field voltage, and temperature will be investigated. Catalysts play an important role in the plasma-based catalytic water treatment. The catalysts not only can greatly lower the activation energy of the feedstock gas, but also adsorb and destruct the contaminants from the liquid phase, thus improving the contaminant degradation efficiency and reducing the energy consumption. Different types of catalysts including metallic dissociation catalysts, photo-catalysts, and multi-functional catalysts as well as the other NTP parameters such as electric field, pulse frequency, and residence time, will be tested to evaluate their performance in terms of contaminant destruction and degradation, stability, lifetime, and regeneration. The key process variables will be optimized for cost effective removal of the contaminants in conjunction with the techno-economic analysis study.

Activity Milestones:

Description	Approximate Completion Date
A bench-scale synthesis system will be developed.	December 31, 2024
The contaminant removal efficacy of the NTP process under different process parameters will be investigated.	June 30, 2025
The performance of selected catalysts will be evaluated	December 31, 2025
The overall NTP process will be optimized	December 31, 2025

Activity 3: Conduct systematic tests and a techno-economic analysis to evaluate the financial viability of the technology

Activity Budget: \$232,400

Activity Description:

We will disseminate our findings from Activity 1-3 to primary stakeholders, peer labs, and environmental protection agencies. Based on their feedback, we will design and construct a small pilot-scale integrated system for a comprehensive evaluation of the technology. Rigorous lab tests will be conducted before moving the system to the field for testing and demonstration. With the small pilot system, we will collect contaminant removal performance and energy balance data and use a mathematical model to assess environmental and economic performance. The electrical energy required to generate the non-thermal plasma will also be evaluated at this small pilot scale to confirm utility costs and conduct an economic analysis. We will recommend further R&D efforts and commercialization strategies based on the

Activity Milestones:

Description	Approximate Completion Date
Construct a small pilot-scale integrated system for comprehensive evaluation of the technology	June 30, 2026
The energy efficiency, cost, and contaminant removal performance will be evaluated	June 30, 2026
Further R&D and commercialization strategy will be recommended	June 30, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Roger Ruan	University of Minnesota	Research partner	Yes
Bo Hu	University of Minnesota	research partner	Yes

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?

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Project Manager and Organization Qualifications

Project Manager Name: Jana Danker

Job Title: Remove pollutants from well water on superfund sites

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

Esther Ames will be the project manager for this project and have a total of 19 & 1/2 years of work experience in Tribal Government, most of which directly relate to building, managing, and evaluating programs. Esther brings extensive experience in project management, planning, grant and financial reporting, budget management, statistics, research and data collection, partnership development and staff supervision.

Organization: Akiing 8th Fire

Organization Description:

Akiing 8th Fire will be the lead for this innovation. Akiing, the Anishinaabe word for "the land to which the people belong", is a regional integrated community development initiative aimed at restoring a culturally based Anishinaabe economy focused on regional food production, renewable energy, hemp, traditional arts, and youth leadership. The organization was founded in 2017 after over 30 years of integrated environmental and economic justice work in the village of Pine Point, located in the White Earth reservation. For the past seven years, Akiing has been growing hemp fiber and providing education on all aspects of hemp production to developing a hemp farming industry in the region.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Akiing Reasearcher		Work with partners to on water research			25%	0.3		\$45,000
Project Manager		Work with partners to coordinate project, reporting and milestones.			25%	0.3		\$15,000
							Sub Total	\$60,000
Contracts and Services								
University of MInnesota	Sub award	Provide Scientists and researchers for project				-		\$492,641
Independant contractor	Professional or Technical Service Contract	contracted services for land use @ \$5,000 per year x				-		\$10,000
Independant Contractor	Professional or Technical Service Contract	contracted hemp growers @ \$5000 a months x3 months x 2 growers				-		\$60,000
							Sub Total	\$562,641
Equipment, Tools, and Supplies								
	Tools and Supplies	x2 hemp licenses, testing and protective equipment,Costs to create a scientific article ,seeds	general supplies to safely collect samples and test the samples					\$2,359
	Tools and Supplies	dioxin testing	Diox testing equipment					\$54,000
	Tools and Supplies	Hemp and Plant Seeds	Seeds related to theory of change/hypothesis					\$9,000
							Sub Total	\$65,359
Capital Expenditures								
							Sub Total	-

Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	travel to site to site	regional travel to and from the twin cities and regional travel to and from White Earth Nation to the superfund site					\$6,000
							Sub Total	\$6,000
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
		Hemp Licenses	Hemp Licenses					\$3,000
							Sub Total	\$3,000
							Grand Total	\$697,000

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
State				
In-Kind	Admin	oversee the projects	Pending	\$406,073
			State Sub Total	\$406,073
Non-State				
			Non State Sub Total	-
			Funds Total	\$406,073

Attachments

Required Attachments

Visual Component

File: [77a612d7-2ce.docx](#)

Alternate Text for Visual Component

This map shows a groundwater plum location in the Fox Creek valley with the St. Regis superfund site in Cass Lake, Minnesota. The groundwater is contaminated with PCP and Naphthalene....

Board Resolution or Letter

Title	File
Board letter	c9b7d97a-370.pdf

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
Support Letter	c75481b8-d14.pdf
Support Letter	d3a5ff18-343.pdf

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?

No

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