



Environment and Natural Resources Trust Fund

M.L. 2023 Approved Work Plan

General Information

ID Number: 2023-152

Staff Lead: Corrie Layfield

Date this document submitted to LCCMR: May 30, 2023

Project Title: Lichens as Low-Cost Air Quality Monitors in Minnesota

Project Budget: \$341,000

Project Manager Information

Name: Natalia Mossmann Koch

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Project Reporting

Date Work Plan Approved by LCCMR: June 22, 2023

Reporting Schedule: April 1 / October 1 of each year.

Project Completion: June 30, 2026

Final Report Due Date: August 14, 2026

Legal Information

Legal Citation: M.L. 2023, Chp. 60, Art. 2, Sec. 2, Subd. 07d

Appropriation Language: \$341,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to develop community science protocols for using lichens as indicators of air quality and conduct an analysis of air pollution changes across Minnesota in the present and in the past century.

Appropriation End Date: June 30, 2026

Narrative

Project Summary: The proposed project aims to develop protocols for using lichens as indicators of air quality data across Minnesota and through time.

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

Air quality is an important issue worldwide especially given its negative effects on human health. Although atmospheric pollution has been discussed for a long time, according to the World Health Organization, 4.2 million deaths occur around the globe every year as a result of outdoor air pollution. The latest data from the US shows that in 2016 more than 77,000 deaths can be attributed to respiratory infections, lung cancer, stroke and heart diseases related to air contaminants. And it is due to this serious health impact that the constant monitoring of air pollutants needs to be a major concern. One cost-effective way to do so is using ecological indicators, which can be crucial to measure and map the impacts of pollution over space with high spatial resolution. Lichens are known to be very good air quality indicators, due to their sensitivity to even slight changes. They absorb humidity and their nutrients directly from the atmosphere, and by doing that, they also absorb a great amount of pollutants, for example heavy metals and particulate matter, when those are present in the environment. This makes lichens low-cost, natural, air quality monitors that can be applied to Minnesota.

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.

We propose to use lichens to monitor present and past air quality conditions in communities across Minnesota. We will use a combination of lichen transplants (which accumulate contamination, showing us pollution over a few months), lichen surveys (what is able to grow, reflecting pollution in recent years) and archival specimens (what grew in the past, tracking changing air quality over the past century). The aim is to both provide measurements that can complement current efforts by the Minnesota Pollution Control Agency and other entities using other methods, but also to develop lichen-based air-quality indices that can be used by citizen naturalists without extensive training.

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 project outcome will be to generate data of a more detailed distribution of air pollutants along Minnesota, including areas where no detailed information on air quality is currently available. As a next step, the information generated will be worked through collaborator contacts at relevant government agencies to share the information and correlate with existing data, aiming to improve and direct efforts on public health and the conservation of natural resources. Lastly, by developing and testing user-friendly protocols for citizen scientists, we will empower Minnesotans across the state to make observations of air quality in their communities.

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

Activities and Milestones

Activity 1: Mapping air-pollution in city/town parks using lichen transplants

Activity Budget: \$118,000

Activity Description:

It is important to find low-cost and time-efficient ways to expand our monitoring network beyond point locations, mostly around the metro area. Lichen transplants can be a useful approach. Some lichens, such as Common Greenshield (*Flavoparmelia caperata*) are abundant and good at taking up heavy metals and other pollutants. We will develop a lichen transplant protocol easy to assemble and deploy in urban and suburban sites across MN, to provide standardized measures of air quality. In addition to measuring air quality by analyzing the lichens for pollutants, we will use non-invasive physiological monitoring approaches (chlorophyll fluorescence) to identify non-destructive predictors of air quality and stress. Lichens will be collected from downed trees at Cedar Creek Ecosystem Reserve. In each transplant (6 per city), 3-4 lichens attached to plastic meshes (20x20cm) placed on the tree trunk at around 1.5m from the ground, will be monitored after 6 months (2 years). Concentration of 12 metals will be tested using ICP-OES analysis: Al, As, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Zn; as well as N and S. Proposed cities include the 5 largest population centers outside of the MSP metro area: Duluth, Mankato, Moorhead, Rochester, and Saint Cloud.

Activity Milestones:

Description	Approximate Completion Date
Develop lichen transplant design - lab and field	September 30, 2023
Deploy first lichen transplants in 4 sites in the Twin Cities metro area	October 31, 2023
Measure physiology and accumulated pollutants after 6 months	April 30, 2024
Select areas and request permits	April 30, 2024
Install lichen transplants in urban sites in 30 urban sites across MN	May 31, 2024
Measure physiology and accumulated pollutants after 6 months	October 31, 2024
Completion of final products of research, such as reports and/or peer-reviewed journal articles	September 30, 2025
Dissemination and outreach. 6 activities, starting beginning of Year 2 (late summer 2024)	June 30, 2026

Activity 2: Developing lichen indices of air quality from expert and citizen surveys

Activity Budget: \$125,000

Activity Description:

Transplants, although low-cost, require installation and maintenance, which limit really wide use. However, surveys of existing lichen communities can provide an insight into air quality as well. Air quality indices based on surveying lichens have been developed in other countries, but none exist for the Upper Midwest. One of the challenges is that some lichen identification can be challenging for non-experts, so for maximum applicability, we will develop an user-friendly index to predict air quality. We will achieve this by first developing an index from expert surveys of lichen communities, and then designing a version with easily accessible lichen characteristics (morphology, color, etc). We will test the public protocol through collaborations with UMN outreach (Bell Museum) and Extension (Master Naturalists) to refine the protocol and make it easily shared and applied. The end goal of this protocol is to give a tool based on lichens that the Minnesotans can use to assess air quality in their neighborhoods. Starting in the summer of 2025, it will be tested first in the Twin-Cities, then through workshops at each studied city. We will use questionnaires and follow ups with the Master Naturalists to keep collecting citizen science data after our workshops.

Activity Milestones:

Description	Approximate Completion Date
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Expert surveys of lichen communities surrounding the transplant sites and other sites	August 31, 2025
Analyze data from lichen communities to develop a predictive index of air quality	August 31, 2025
Completion of final products of research, such as reports and/or peer-reviewed journal articles.	April 30, 2026
Develop a user-friendly protocol for identifying lichen communities based on easily seen traits	June 30, 2026
Dissemination and outreach. 6 activities, starting beginning of Year 3 (early summer 2025).	June 30, 2026
Test the protocol developed with lab members and students from UMN	June 30, 2026
Data sharing of final results of the project with state agencies (such as the MPCA)	June 30, 2026

Activity 3: How has MN air quality changed through time?

Activity Budget: \$98,000

Activity Description:

Time scaled monitors of air pollution are lacking in the current literature and herbarium material could be a valuable tool for this purpose. At the University of Minnesota, the Herbarium has over 35,000 lichen specimens from Minnesota representing over 120 years of collecting. Some of these have sufficient material for analysis of heavy metals and nitrogen content without losing its value as an archival sample. There is also considerable uncatalogued and duplicate material available for use. This is especially true for some areas that were visited repeatedly over the 20th century, giving us a record of changes in air quality through time. These same species, from the same sites, can then be revisited in the present day to document change of health related air pollutants. We expect to sample around 36 thalli from the herbarium (and to cover around 100 years in time) and 36 thalli from the field, being at least 3 thalli for each site (12 sites in total). We will aim for sites as close as possible of the urban areas sampled in activities 1 and 2.

Activity Milestones:

Description	Approximate Completion Date
Analyze historical samples from the Bell Herbarium and other historical collections	December 31, 2025
Resample species from the same locations (12-17 sites) for analysis of current conditions.	December 31, 2025
Analysis of changes in air quality through time	June 30, 2026
Dissemination and outreach. 6 activities, starting late summer 2025	June 30, 2026
Completion of final products of research, such as reports and/or peer-reviewed journal articles.	June 30, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Daniel Stanton	University of Minnesota- College of Biological Sciences	Co-lead, in particular providing equipment and expertise for physiological measurements (Activity 1), as well as access and expertise with historical and archival lichen collections at the Bell Museum (Activity 3)	No
Holly Menninger	Bell Museum	Citizen Science activity support	Yes
Andrea Lorek	Minnesota Master Naturalists	Citizen science component support	No
Emilie Snell-Rood	University of Minnesota- College of Biological Sciences	Collaborator	No
Sarah Hobbie	University of Minnesota- College of Biological Sciences	Collaborator	No

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

In order to achieve the objectives to disseminate the findings of our project we will primarily count on the outreach and extension activities of our collaborators Holly Menninger, from the Bell Museum, who is an expert on public engagement support; and staff from the Minnesota Master Naturalist program, Amy Rager and Britt Forsberg, who engage their corps of trained volunteers in 85,000+ of hours of service annually. After planning the activities with their collaboration, we will implement those along the three years of the project, with different actions aiming to reach the public in the broadest and most informative way possible. For example, samples of lichens collected will be shown in outreach activities on existing efforts such as the Science Market promoted by the University of Minnesota, on activities promoted by the Bell Museum, as public science events like Spotlight Science, featuring lichen researchers and the project, as well as during activities that we aim to promote in the cities where we will monitor air quality. During these events, we will be also sharing interesting facts about lichens and biomonitoring in an engaging way.

To inform about the lichen indices to predict air quality, we will reach the public and disseminate it through collaborations with UMN outreach (Bell Museum) and Extension (Master Naturalists), which will also allow us to refine the protocol and make it easily shared and applied. The long term continuation of the citizen science activities will be incorporated into the Urban Long-Term Ecological Research (LTER) program at the University of Minnesota, led by Dr. Sarah Hobbie (a project collaborator), which will also provide a platform for data curation and publicly accessible data storage. Furthermore, all lichens sampled in the field will be deposited at the Herbarium of the University of Minnesota, and will be publicly available. For the planned outreach and extensions activities we will be using funds that were allocated in our budget. Trainings will occur from the beginning of Year 2 (summer 2024) to the end of Year 3 (early summer 2026), with at least one activity every year in each of the 6 cities included in the study. We expect to train around 30-50 naturalists, as well as at least 300 more people, among adults and children with other activities in the Bell Museum and across the state.

The main findings and results of our project will be published in peer-reviewed academic journals, as well as written up and shared in public outreach formats. We also plan to present part of the results in at least two scientific conferences within the US. The final results related to the Twin Cities monitoring will be made available through the website of the Urban LTER program (<https://mspurbanlter.umn.edu/>) that can be accessed by the public. The Bell Museum is also the lead education and outreach partner for the MSP Urban LTER and can leverage that connection and museum platform to reach museum and K-12 audiences. Furthermore, we plan to share statewide results with the Minnesota Pollution Control Agency (MPCA) and the Parks and Recreation department of each city as reports and maps. At the end of the project, all data generated will be made available at repository platforms. In all communications and outreach, we will be sure to acknowledge the Environment and Natural Resources Trust Fund through use of the logo or specific attribution language.

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?

The findings and results will be published in peer-reviewed academic journals, as well as written up and shared in public outreach formats. The long term continuation of the citizen science activities will be incorporated into the Urban Long-Term Ecological Research program at the University of Minnesota, led by Dr Sarah Hobbie (a project collaborator), which will also provide a platform for data curation and publicly accessible data storage.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Assessing Natural Resource Benefits Provided by Lichens and Mosses	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 03e	\$213,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Project Leader		Lead data collection, analysis and outreach. Dr. Mossman Koch is the project leader and the postdoctoral researcher of the project.			25%	3		\$230,000
Public Engagement Support		Consultation, planning and implementation support for public engagement component. This will pay Holly Menninger (Bell Museum).			25%	0.03		\$6,000
Student worker-semester		Undergraduate student researcher			0%	0.57		\$18,200
Student worker (summer)		Field support student researcher			0%	0.69		\$22,000
							Sub Total	\$276,200
Contracts and Services								
University of Minnesota	Internal services or fees (uncommon)	Measurement of pollutants - analyses of heavy metal content of specimens from transplants (Activity 1), archival samples (Activity 3) and fresh samples (Activity 3)				0		\$9,000
							Sub Total	\$9,000
Equipment, Tools, and Supplies								
	Tools and Supplies	Lab and fieldwork supplies (chemically clean collection bags, CO2 cartridges for physiological measurements, etc)	Miscellaneous supplies for collecting and measuring lichen pollutant content and physiology					\$4,800
	Tools and Supplies	Instructional materials (urban lichen book, handlens, grid, etc \$50/kit for 100 kits)	Outreach kits for training citizen scientists					\$5,000
	Tools and Supplies	Dataloggers (HOBO U23 Pro V2 or equivalent 50 units at \$200/each)	Dataloggers to track local climate conditions at the transplant sites					\$6,000
							Sub Total	\$15,800
Capital Expenditures								

							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	24 trips/days (4 visits to each city) with 3 people. Daily amount per capita: around USD 208.00.	food and lodging (eg motel/hotel near study sites in Greater Minnesota) for research scientist and assistant during fieldwork					\$15,000
	Miles/ Meals/ Lodging	24 trips, around 4,000 miles in total, summing up USD 9,000 for the rental and USD 6,000 for gas or other expenses.	Fleet vehicle rental for fieldwork across Minnesota					\$15,000
							Sub Total	\$30,000
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	1 trip to a week-long domestic conference for 1 person (project manager)	Travel for research scientist to present findings and methods at 1 domestic conference (Year 2)	X				\$2,000
							Sub Total	\$2,000
Printing and Publication								
	Printing	Outreach materials for citizen scientist kits (100) and other outreach brochures	Printing costs for outreach materials					\$4,000
							Sub Total	\$4,000
Other Expenses								
		Equipment servicing and re-calibration in Year 1 and Y3	Ecophysiological equipment to be used requires regular servicing and recalibration					\$4,000
							Sub Total	\$4,000
							Grand Total	\$341,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	1 trip to a week-long domestic conference for 1 person (project manager)	Formal presentation of results at a conference

Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount
State				
			State Sub Total	-
Non-State				
In-Kind	Indirect costs	Indirect costs associated with this proposal	Potential	\$187,000
			Non State Sub Total	\$187,000
			Funds Total	\$187,000

Attachments

Required Attachments

Visual Component

File: [4308c114-73f.pdf](#)

Alternate Text for Visual Component

Activities and outcomes of this proposal: left, example of lichen transplants; middle, the sampling method to assess lichens on tree trunks and examples of those communities; right, specimens of lichens from Bell Museum that will be used to assess changes in air quality through time; bottom, summary of outcomes....

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
Letter of Support Urban LTER	017570fe-918.pdf
Letter of Support Master Naturalists	2d6b86e8-524.pdf
Letter of Support Sponsored Projects Administration	e5821202-619.pdf
Background check certification form	9d9de356-a84.pdf
Addendum Final Mossmann Koch	faddeeeb-016.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

- First review round: Following the requests, the following changes were made in our final proposal: we added a description of our dissemination efforts, attached the background check certification form and adjusted the previous budget to match the recommended funding amount. The new budget now equals USD 341,000. We adjusted the amounts by removing 1 semester of undergraduate assistant support in Year 2 (\$1,800) and some supply funds from Year 3 (\$1,200), which translates into reductions for activity 2 (USD 1,000 less than previous) and 3 (USD 2,000 less than previous).

- Second review round: Dear Corrie, thank you for your comments and suggestions. We really appreciated the opportunity to include more information about our proposal. We have made all the changes that were requested. Please note the answers to each of the questions/comments below. Requested changes are numbered and followed by the description of the changes that were made. Additionally, we have also updated the indirect costs associated with this proposal, which were not updated after the recommended funding amount, and made slight changes on the FTE of the personnel. Feel free to let me know if you have any questions. Best, Natalia

1. Activities and Milestones: For activity 3, milestone 2, please provide a range of approximately how many locations you expect to sample for present day conditions.

Change: We expect to sample around 12-17 different locations across Minnesota for this activity. This information was added to the milestones.

2. Activities and Milestones: The budget includes funding for citizen scientist kits related to training. Please make sure the activities and milestones explain when trainings will occur, how many will occur, and the approximate number of citizen scientists that will be involved.

Change: We added "dissemination and outreach" in the milestones of each activity, and the number of activities for

each of them. We also added more detailed information in the “Dissemination” session, where it now reads: “Trainings will occur from the beginning of Year 2 (late summer 2024) to the end of Year 3 (early summer 2026), with at least one activity every year in each of the 6 cities included in the study. We expect to train around 30-50 naturalists, as well as at least 300 more people, among adults and children with other activities in the Bell Museum and across the state.”

3. Activities and Milestones: Please add milestone(s) for completion of final products of research, e.g., peer-reviewed journal articles or reports.

Change: The following milestones were added = Completion of final products of research, such as reports and/or peer-reviewed journal articles: Activity 1, September 2025; Activity 2, April 2026; Activity 3, June 2026.

4. Budget: The Project Collaborators section indicates the Bell Museum will be receiving ENRTF funds for this project, but they are not clearly listed in the budget section. Please revise your Budget section or the Project Collaborators page.

Change: A Bell Museum employee will be receiving the funds through the Museum. It is now shown in the budget section, in the “Public Engagement Support line”, that these funds are to “Consultation, planning and implementation support for public engagement component. This will pay Holly Menninger (Bell Museum).”

5. Activities and Milestones: Please provide more details to Activity 1. For example, regarding the lichen transplant--from where will the lichen be sourced? What does a transplant look like? Will it be onto trees, is this a ground installation, how many transplants are needed per monitoring site? Is developing the transplant protocol a lab activity or a field activity? Please provide some additional detail regarding the lichen pollution analysis. What does this look like? Make sure enough detail is provided that it explains the need for lab analysis in the budget. Update the milestones to show project development progress, such as transplant protocol development, site selection, etc. and please include a milestone for earlier than August 31, 2024, such as January 2024, or even fall of 2023.

Change: Lichens will be collected from downed trees and branches at Cedar Creek Ecosystem Reserve, a University of Minnesota managed research station approximately 1h north of the Twin Cities (East Bethel). Each transplant consists of a set of lichen thalli attached to the original substrate that are placed to plastic meshes. The plastic meshes (around 20x20cm) are then placed on the tree trunk at around 1.5m from the ground, with threads tied around it. At each monitoring site, one transplant set will be placed every year, for two years. Developing the transplant is a field activity. Pieces of bark with 5-10 cm² visually healthy thalli of *Flavoparmelia caperata* will be collected and brought to our lab facilities at the University of Minnesota. Thalli will be allowed to gently air dry before weighing and photographing. Five thalli will be set aside for elemental analysis to obtain baseline pollutant content. Metal concentrations of 12 metals (Al, As, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Zn) and sulfur will be assessed using ICP-OES at UMN’s Research Analytical Soils Lab with microwave digestion. Based on this information, the last section of the description of Activity 1 now reads: “Lichens will be collected from downed trees at Cedar Creek Ecosystem Reserve. In each transplant (6 per city), 3-4 lichens attached to plastic meshes (20x20cm) placed on the tree trunk at around 1.5m from the ground, will be monitored after 6 months (2 years). Concentration of 12 metals will be tested using ICP-OES analysis.” We updated the milestones to show project development progress, such as transplant protocol development, site selection, and permit requests. We also included three milestones for earlier than August 31, 2024: Develop lichen transplant design; Deploy first lichen transplants in 4 sites in the Twin Cities metro area; Measure physiology and accumulated pollutants after 6 months; Select areas and request permits.

6. Activities and Milestones: Please provide additional detail for Activity 2--what does a developing an index look like? What kind of lab work/field work does this entail? Consider adding some earlier intermediate milestones to this activity to allow progress in developing indices to be demonstrated.

Change: The index development will be done based on the data that will be gathered from lichen communities sampled at each site. We will evaluate easily accessible characteristics of those lichens (morphology, color, etc.) and develop a protocol that could be applied by the citizens. Before we spread the information, we will test the index with lab members and students from the UMN. We have updated the description of this activity and added the intermediate

milestones as suggested.

7. Activities and Milestones: Please provide more detail in Activity 2--what is the end goal of the public protocol? How will this be deployed, where, and why? How will citizen science data be collected by project managers and used?

Change: The end goal of the public protocol is to give a tool based on lichens that the Minnesotans can use to assess air quality in their neighborhoods. It will be deployed by public outreach activities tested first in the Twin-Cities with the collaboration of the Bell Museum, and then, with the help of the Master Naturalists, we will organize workshops at each studied city to spread the word. Our goal is to deploy this protocol starting in the summer of 2025. We will use questionnaires and follow ups with the Master Naturalists to keep collecting citizen science data after our workshops and trainings. These data can be then shared with the MPCA or other state agencies. We updated the end of the description that now reads: "The end goal of this protocol is to give a tool based on lichens that the Minnesotans can use to assess air quality in their neighborhoods. Starting in the summer of 2025, it will be tested first in the Twin-Cities, then through workshops at each studied city. We will use questionnaires and follow ups with the Master Naturalists to keep collecting citizen science data after our workshops." We also added the following as a milestone: "Data sharing of final results of the project with state agencies (such as the MPCA)".

8. Budget: Please provide some additional detail in how numbers for miles/meals/lodging were obtained--for example, approximately how many data collection trips are planned? How many people will be traveling?

Change: We are planning a total of around 24 visits (4 visits to each of the 6 cities) with 3 people, so the daily amount per capita would be USD 208.00 for lodging and meals. The car rental was calculated to 4,000 miles in total and the 48 days, summing up USD 9,000 for the rental and USD 6,000 for gas or other expenses. This information was added to the budget description.

9. Budget: If Lab services (analyses of pollutant content) will be carried out by the personnel listed in the budget, then these expenses should be split between personnel and supplies. If these analyses will be carried out by external labs, then this expense should be moved to "Professional/Technical Contracts" and the name and location of the lab included. If another lab at UMN will be used, then please move to Professional/Technical Contracts and list as "internal fee."

Change: The pollutant content analyses will be done at another lab at UMN. We have made the recommended changes.

10. Budget: Please indicate either in the budget line for the project leader or under the project manager information that Dr. Mossman Koch is a postdoctoral researcher. This is helpful information for LCCMR staff to have in case a change in project manager is needed due to changes in employment.

Change: We included this information in the budget line of Project Leader, under the Project Role/Description column. It now reads – "Lead data collection, analysis, and outreach. Dr. Mossman Koch is the project leader and the postdoctoral researcher of the project."

- Third review round. Following the requests, we added extra details in Activities and Milestones for Activity 1 and 3 (describing number of samples, sampling locations, etc.); and we uploaded the revised and approved Research Addendum.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I agree to the UMN Policy.

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