Environment and Natural Resources Trust Fund

2021 Request for Proposal

General Information

Proposal ID: 2021-050

Proposal Title: Trout Stream Habitat Restoration Success

Project Manager Information

Name: Valerie Brady

Organization: U of MN - Duluth - NRRI

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Project Basic Information

Project Summary: Minnesota has spent millions on stream habitat improvement and restoration; we will evaluate effectiveness and durability of project designs. Results will inform success of future projects and improve cost effectiveness.

Funds Requested: $375,000

Proposed Project Completion: 2024-06-30

LCCMR Funding Category: Water Resources (B)

Project Location

What is the best scale for describing where your work will take place?

Region(s): NE

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.

Are stream habitat improvement projects actually effective for improving the ecology and habitat of Minnesota's streams? Do the current methods used for stream improvements result in permanent solutions that can persist through increasingly challenging weather conditions?

As of December 2018 at least $19 million dollars has been spent by the Lessard-Sams Outdoor Heritage Fund alone to improve trout stream habitat or restore stream reaches in poor condition. These stream habitat projects have been implemented using a variety of engineering methods and designs. However, very few stream restorations or habitat improvements are evaluated rigorously or quantitatively. For example, in addition to achieving design goals (e.g., stop bank erosion), a successful restoration should both improve the physical structure (habitat) and result in healthier biological communities, (i.e., fish and fish food). Anglers, in particular, are not sure if habitat restorations actually provide the right kind and amount of habitat for fish and other aquatic organisms. There is also the continuing concern that some restorations cannot withstand flood events and need repair after just a few years. We will address the questions: How successful are different improvement designs? How well do different improvement projects withstand large storm events?

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

Sufficient numbers of habitat improvements and restorations have now been conducted across Minnesota to assess their long-term status and determine if projects resulted in appropriate and lasting improvements to these streams. We will select at least 10 stream restoration or habitat improvement sites in the Arrowhead region of Minnesota (paired with 10 control [reference] sites) to assess outcomes and longevity of these projects. Our team has pre-restoration data for some stream reaches where this type of work has been completed. Having quantitative pre-restoration data will allow the “gold standard” assessment to be done: Before-After, Control-Impact (BACI) analysis. This statistical technique uses pre-restoration and post-restoration data at both control (reference) and restoration sites to assess how well restoration projects succeeded in improving fish habitat and restoring stream ecosystem function.

We will leverage this activity with work being proposed to LCCMR by Dr. Doug Dieterman (MNDNR) to assess stream habitat improvement or restoration projects in southeast Minnesota. We will align our study designs and share data for a broader analysis of which engineering and construction designs work best and how to improve this work in the future.

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?

This project will greatly improve our understanding of the effectiveness and durability of different stream habitat and restoration project designs; specifically, which hold up better over time, require less repair, result in increased fish habitat and food resources, and better restore stream ecosystem function, including connectivity with shallow groundwater. Fisheries managers, restoration practitioners, and funding and permitting agencies will have more information available to evaluate design success and cost-effectiveness. In the long term, our results will inform the development of better and more reliable fish habitat improvements and stream restoration projects.

Activities and Milestones

Activity 1: Characterize fish populations, food resources and habitat at restored and reference sites to quantify results of stream restoration/improvement projects

Activity Budget: $146,439

Activity Description:
A minimum of 10 stream habitat improvement / restoration sites will be selected to represent: 1) different restoration / improvement designs, and 2) time since activity was completed. Reference sites will be compared to completed project sites to assess outcomes of restoration activities. Each reach will be characterized with respect to: 1) fish populations, 2) stream macroinvertebrates (fish food), and 3) habitat structure with the goal of assessing the extent of improvement. We will assess fish populations with catch-and-release electrofishing. We will collect macroinvertebrate samples throughout the stream for identification in the laboratory. We will assess stream habitat following protocols and metrics used by MN and WI DNRs.

We will analyze data using the rigorous Before-After, Control-Impact (BACI) method in reaches where pre-restoration data exists for a restoration site and its paired reference site. We will compare other restoration sites to their matched reference sites for post-restoration data only and assess statistically.

Outcome 1: Paired data from each restoration or habitat improvement site and its reference site (generally upstream) for fish, fish food and habitat.
Outcome 2: Determination of effectiveness and durability of stream habitat improvement and restoration designs for fish, fish food and habitat.

Activity Milestones:

Description	Completion Date
1. At least 10 improved or restored stream projects selected for study.	2021-08-31
2. Fish, macroinvertebrate, and habitat data collected for 10 paired restoration and reference sites (20)	2023-09-30
4.Data from #1 compared between restoration and reference sites without pre-restoration data using ordinations	2024-04-30
3. Data from #1 compared between restoration and reference sites with pre-restoration data using BACI.	2024-04-30

Activity 2: Assess stream habitat restoration project status and longevity; assess stream ecosystem function relative to reference reaches

Activity Budget: $201,222

Activity Description:
Task 1. At a minimum of 10 stream habitat improvement or restoration sites, assess each project's effectiveness at meeting its objectives and assess its longevity.
Methods: At each site we will assess whether the project's objectives were well-defined and quantifiable. We will compare current stream conditions with surveys done at each project's completion to determine how much change (erosion, deposition, or lateral migration) has occurred. We will also assess vegetation growth and bank stability.
Outcome: Assessment of how well each project met its own objectives, survived, and the characteristics that caused projects to fare better or worse.

Task 2. At five sites that have received major work (such as channel realignment), assess stream ecosystem function

compared to matched reference (control) sites.
Methods: We will quantify ecosystem function by measuring 1) stream productivity (gross primary production and respiration); 2) the connectivity between stream surface water and groundwater using a unique water tracer test; and 3) nutrient uptake by in-stream biota.
Outcome 1: Comparison between restored and control stream reaches to assess if there are significant differences in ecosystem health.
Outcome 2: Determination of which types of work alter any of these three major components of stream ecosystem function.

Activity Milestones:

Description	Completion Date
1. Stream ecosystem measurements made in 10 paired restoration and reference sites (20 sites total).	2023-09-30
2. Water quality, productivity, and nutrient cycling analyses completed at 5 sites.	2024-02-28
3. Data compared between restoration and reference sites.	2024-04-30

Activity 3: Outreach and knowledge/technology transfer

Activity Budget: $27,339

Activity Description:
Task 1. Derive summary of efficiency and longevity by restoration type.
Task 2. Provide results of stream habitat restoration assessments to those involved in stream restoration work or permitting.

Methods: We will provide project results to MNDNR fisheries managers, stream managers, MPCA staff, soil and water conservation district staff, Board of Water and Soil Resources staff, and non-profit staff using webinars, outreach at state meetings (e.g., the Water Resources Conference), reports and other venues or media.We know that much of this stream work is being done by soil and water conservation districts and angler enthusiast groups, with oversight and permitting through MNDNR and MPCA. Thus, we believe it is important to target these groups with our findings to ensure that the lessons learned about previous stream work is used to improve future activities.

Outcome 1. Ensure entities engaged in stream habitat improvement or restoration, or in the permitting of those activities, are engaged in a discussion about the results of our assessment and their implications.
Outcome 2. Our results can be used to improve future stream habitat improvement and restoration activities.

Activity Milestones:

Description	Completion Date
Results presented at a state conference, such as the Water Resources Conference.	2023-11-30
Results presented to staff of entities engaged in stream habitat improvement or restoration.	2024-06-30
Discussions with entities engaged in stream work to improve future restoration or habitat improvement designs	2024-06-30

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Doug Dieterman	Minnesota Department of Natural Resources	Dr. Dieterman has proposed a companion project in southeastern MN. He will train our project team to collect stream data comparable to his team's data.	No
Dr. Karl Koller	Minnesota Department of Natural Resources	Dr. Karl Koller will assist with site selection and consult with the team on stream hydrologic and hydrogeomorphic assessment methods.	No
Dr. Ricardo Gonzalez-Pinzon	University of New Mexico	Dr. Gonzalez-Pinzon developed a tracer test that measures surface water-groundwater exchange within a stream bed. He will travel to Minnesota to teach our team his technique and assist with data analysis and report writing.	Yes
Ann Thompson	South St. Louis Soil and Water Conservation District	Ann Thompson will provide geomorphic surveys of reference reaches that are paired to restoration reaches that SSL SWCD is re-surveying in 2020 to assess how well they have survived. Surveys include Rosgen Level II including longitudinal profile, cross section, and substrate data.	Yes
Dr. Jeff Tillma	Minnesota Department of Natural Resources	Dr. Tillma will assist with selection of restoration sites to be assessed and consult on field methods.	No

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 be funded?

We will provide our data, analyses, and reports to Dr. Doug Dieterman (MNDNR) to be combined with the results from his partner project in southeastern MN. He will continue working with DNR fisheries researchers and managers to implement these results in stream project selection and permitting so that future designs selected for stream habitat improvement and restoration projects are those that are most likely to provide the best outcomes for stream fish and ecosystems. It is our hope that these results will also inform future Lessard-Sams Outdoor Heritage project funding.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
MAISRC Subproject 15: Determining Highest Risk Vectors of Spiny WaterFlea Spread	M.L. 2017, Chp. 96, Sec. 2, Subd. 06a	$0

Project Manager and Organization Qualifications

Project Manager Name: Valerie Brady

Job Title: Senior Research Program Manager

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

Dr. Valerie J. Brady, a Research Program Manager at NRRI, has led research on aquatic ecosystems for 25 years. She uses aquatic macroinvertebrates and fish to assess the ecosystem condition of streams, lake coastlines, and wetlands. As stream ecosystem restorations became more common, she has assessed their effectiveness at improving stream habitats for fish and aquatic invertebrates. She and her team have worked in Minnesota's north shore Lake Superior

tributary streams for 20 years. They have an extensive database of fish, fish habitat, water quality, and aquatic invertebrate data across stream sites ranging from reference to degraded conditions. Brady has successfully managed numerous federal and state grants collectively worth over $3M.
The team's fisheries ecologist is Mr. Josh Dumke, Senior Research Scientist at NRRI. Mr. Dumke has over 10 years of experience in aquatic ecology, fisheries, and leading field crews. His experience includes fish and invertebrate field collection in streams, lakes, and wetlands. He has led electrofishing and fish habitat assessment work in Lake Superior tributary streams since the early 2000's.
Dr. Karen Gran is a fluvial geomorphologist who has been assessing how streams respond to land-use change and recover from major floods. She will lead the hydrology and geomorphology assessments of stream ecosystem condition.
Dr. Lucinda Johnson is a landscape ecologist with 35 years experience investigating how aquatic ecosystems respond to differing types of land use. She will lead the productivity and nutrient uptake assessments of the stream sites.
Further support is provided by two certified taxonomists who have two decades of experience identifying aquatic invertebrates and algae.
Most project personnel are NRRI research staff (not teaching faculty) who receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF.

Organization: U of MN - Duluth - NRRI

Organization Description:
The Natural Resources Research Institute (NRRI) is an applied research and economic development engine for the University of Minnesota research enterprise. NRRI employs over 130 scientists, engineers and technicians to support its mission to deliver research solutions to balance our economy, resources and environment for resilient communities. NRRI collaborates broadly across the University system, the state and the region to address the challenges of a natural resource-based economy.
NRRI researchers have extensive experience in managing large, interdisciplinary projects. NRRI's role is as an impartial, science-based resource that develops and translates knowledge. Projects include characterizing resource opportunities, minimizing waste and environmental impact, maximizing value from natural resources and maintaining/restoring ecosystem functions.
The Aquatic Ecosystem Assessment Laboratory is a 2,500 square foot facility within NRRI. Laboratory staff include aquatic macroinvertebrate, algae, and diatom taxonomists and fisheries ecologists. Staff are experienced at assessing organism assemblages from a variety of aquatic habitats, evaluating aquatic habitat conditions, and establishing biological condition indicators. Equipment includes a variety of high quality research-grade microscopes. Field sampling equipment includes a fleet of sampling vessels; a variety of invertebrate, water sampling and benthic coring devices; water quality instrumentation units; shallow water electrofishing equipment; and fish trap nets.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Principle Investigator Valerie Brady		Overall project management and coordination; invertebrate data analysis; lead reporting and outreach. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF.			26.7%	0.15		$20,139
Co-investigators (Lucinda Johnson & Karen Gran)		Lead nutrient cycling and hydrology/geology aspects of project; co-advise graduate student			26.7%	0.12		$24,009
Crew chief Josh Dumke		Leads fish, invertebrate and habitat sampling; assist with reporting and data analysis. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF.			26.7%	0.39		$36,136
Taxonomists (2) and technician (1)		Fish and invertebrate identification and sampling; data entry and checking. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF.			24.1%	1.26		$79,122
Summer technician		Summer technician will assist with all field sampling, especially assisting the graduate student			7.3%	0.7		$25,397
Graduate student		Conduct nutrient cycling and surface water-groundwater connectivity studies			43.7%	1.2		$100,993
Undergraduate student technician		The undergraduate summer technician will assist with all field sampling, particularly assisting the graduate student.			0%	0.7		$21,949
							Sub Total	**$307,745**
Contracts and Services								

South St. Louis Soil and Water Conservation District	Sub award	Team will provide geomorphic surveys of reference reaches that are paired to restoration reaches that SSL SWCD is re-surveying in 2020 to assess how well they have survived. Surveys include Rosgen Level II including longitudinal profile, cross section, and substrate data.				0.12		$14,080
University of New Mexico	Sub award	This collaborator developed a tracer test that can be used to measure surface water-groundwater exchange within a stream bed. He will travel to Minnesota to teach our team his technique and assist with data analysis and report writing.				0.05		$9,275
UMD NRRI Analytical Lab	Internal services or fees (uncommon)	Water quality analyses for multiple water chemistry parameters for all 20 sites assessed for this project.				0.2		$10,750
							Sub Total	**$34,105**
Equipment, Tools, and Supplies								
	Tools and Supplies	General field supplies	Waders and nonskid boot studs for 3 people, waterproof paper & labels, gloves, batteries for GPS units and cameras					$835
	Tools and Supplies	Stream nutrient and hydrology sampling meters and field and lab supplies	Ten temperature loggers ($200), 5 dissolved oxygen loggers ($2000), 5 conductivity loggers and meters ($10,500), a logging light sensor ($3800). Test chemicals and sample bottles ($3225)					$19,725
	Tools and Supplies	Fish and invertebrate sampling and lab supplies	Batteries for electrofishing equipment; preservative, vials, and labels for 200 stream invertebrate samples. Survey equipment (meter sticks, flagging, survey tape).					$1,842
							Sub Total	**$22,402**
Capital Expenditures								
							Sub Total	**-**

Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Mileage to travel to 20 sites over two years with each site requiring several days for two field crews to sample it completely.	Travel to stream sites 100 miles/site x 0.575/mile x 20 sites x 7 visits/site = $8050					$8,050
	Miles/ Meals/ Lodging	Training travel for two people to Lanesboro, MN.	Travel for crew to train with MNDNR fisheries research group at beginning of project to align sampling methods. Two people travel for 4 days from Duluth (600 miles). Costs include GSA approved rates for per diem, mileage, and hotel.					$1,505
	Conference Registration Miles/ Meals/ Lodging	Two people attend Water Resources Conference in St. Paul.	Attend Water Resources conference to present results of project to managers. Costs include GSA approved rates for per diem, mileage, and hotel. Conference registration estimated at $250 per person.					$1,193
							Sub Total	**$10,748**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$375,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	MNDNR staff contributed effort.	MNDNR staff will work with us to select appropriate sites for assessment, provide in-field cross-training on sampling methods to ensure comparability of data collection between this project and the companion Dieterman MNDNR proposal, and integrate our data into their data for additional analysis. D. Dieterman ($9000) and J. Tillma ($6000) in effort match.	Pending	$15,000
			State Sub Total	**$15,000**
Non-State				
In-Kind	UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 55% modified total direct costs.	Indirect costs are those costs incurred for common or joint objectives that cannot be readily identified with a specific sponsored program or institutional activity. Examples include utilities, building maintenance, clerical salaries, and general supplies. (https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs)	Secured	$188,182
			Non State Sub Total	**$188,182**
			Funds Total	**$203,182**

Attachments

Required Attachments

Visual Component

File: dbfa85df-608.pdf

Alternate Text for Visual Component

Our graphic shows a time series of photos of a trout stream bank restoration, from pre-restoration to post-restoration to the restoration's damage after flood events. We also depict our how our study sites are selected to meet the requirements of the Before-After, Control-Impact (BACI) study design: control (reference) sites are similar stream segments often located upstream of the stream segment being restored. Both stream segments are sampled both before and after the restoration work and then the data are statistically compared.

Optional Attachments

Support Letter or Other

Title	File
Minnesota DNR Letter of Support	c84bbe77-03a.pdf
Sponsored Projects Transmittal Letter	3516524d-d03.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have patent, royalties, or revenue potential?

No

Does your project include research?

Yes

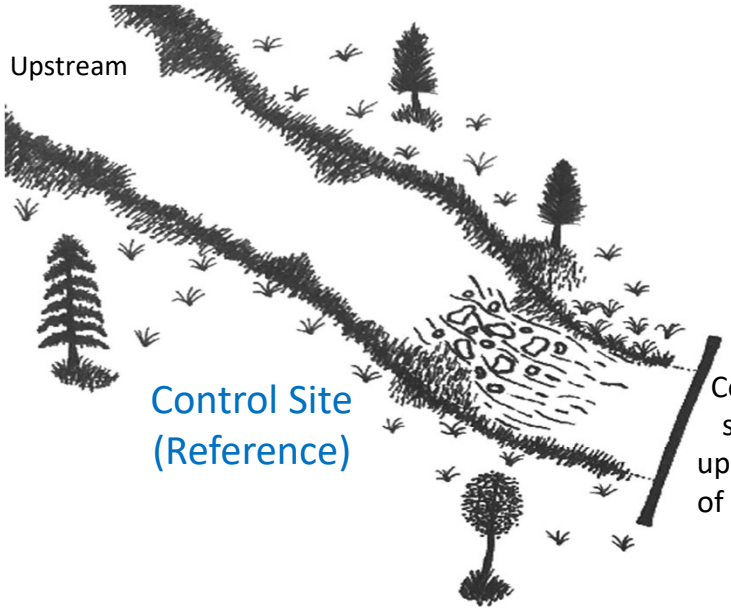
Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

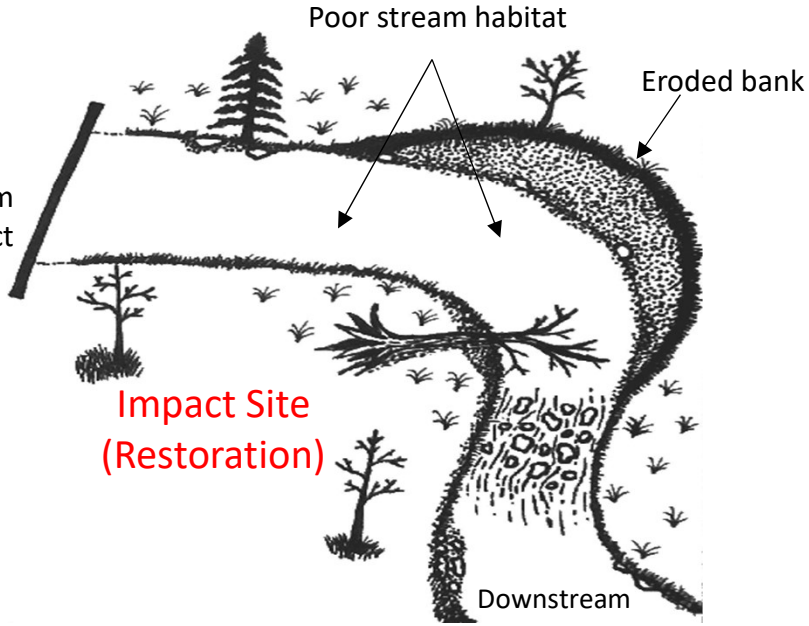
Northern Minnesota stream bank **before** restoration

Same stream bank **after** restoration

Same restored stream bank after flood damage



Control site is upstream of Impact site



Gold Standard Study Design: Before-After, Control-Impact (BACI)

Data from before AND after restoration are compared for both reference and restoration sites

Photo Credit: NRRI
Artist Credit: Kari Hansen, NRRI