



## Environment and Natural Resources Trust Fund

M.L. 2025 Approved Work Plan

### General Information

**ID Number:** 2025-154

**Staff Lead:** Lisa Bigaouette

**Date this document submitted to LCCMR:** June 10, 2025

**Project Title:** Removing Mercury from Minnesota Waters

**Project Budget:** \$247,000

### Project Manager Information

**Name:** Michael Smanski

**Organization:** U of MN - College of Biological Sciences

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**Email:** smanski@umn.edu

**Web Address:** <https://cbs.umn.edu/>

### Project Reporting

**Date Work Plan Approved by LCCMR:** June 24, 2025

**Reporting Schedule:** March 1 / September 1 of each year.

**Project Completion:** June 30, 2028

**Final Report Due Date:** August 14, 2028

### Legal Information

**Legal Citation:** M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 08i

**Appropriation Language:** \$247,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to test and refine a biotechnology approach to remove mercury from the food chain in Minnesota's lakes and rivers and potentially make fish consumption in Minnesota safer. This appropriation is subject to Minnesota Statutes, section 116P.10.

**Appropriation End Date:** June 30, 2028

## Narrative

**Project Summary:** We will test and refine a biotechnology approach to removing mercury from the food chain in Minnesota's lakes and rivers. If successful, this will make fish consumption in Minnesota safer.

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

Methyl-mercury (hereafter just referred to as mercury) is a major pollutant in Minnesota waters and a public health hazard. Mercury levels in the environment are increasing, primarily due to human activity including coal-powered energy generation, cement kilning, industrial production of chlorine-containing materials, and gold mining. Mercury is a potent neurotoxin in animals and is particularly hazardous during prenatal and postnatal neurological development. All lakes and rivers in Minnesota are polluted with mercury, resulting in limits on the number of fish that Minnesotans can safely eat to avoid mercury poisoning. This results in multiple deleterious consequences to the health, use, and viability of Minnesota's water resources. There is a feasible path to removing mercury from aquatic food chains by converting it to Hg(0), which would volatilize to the upper atmosphere. Remediating mercury from our waters would result in increased recreation and tourism for fishing, increased health of Minnesotans by allowing for the consumption of greater amounts of healthful fish, and would establish Minnesota as a global leader in innovative water resource remediation.

**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.**

Research that originated in our laboratory at the University of Minnesota recently demonstrated that bacterial genes can be introduced to baitfish, giving them the ability of detoxify mercury from their environment. The proof-of-concept was completed in zebrafish, which are convenient laboratory animals that originate from South Asia. However zebrafish are not a viable organism to remove mercury from Minnesota waters. We have recently introduced this technology to Fathead Minnows, the most abundant freshwater fish in the Central and Eastern US. We foresee a powerful bioremediation program where mercury-degrading minnows (which are simultaneously made (i) bright pink or green to encourage predation and (ii) sterile to prevent them from altering the genetics of native populations) are released to decrease levels of mercury in the fish we harvest for consumption.

In this project we will measure the ability of these mercury-detoxifying Fathead Minnows to remediate polluted waters using environmentally-representative aquaria. In parallel, we will perform stakeholder engagement work with the Minnesota Pollution Control agency and the Minnesota DNR to determine the best path towards field trials of these fish in severely impacted lakes.

**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?**

Successful completion of this project will result in a mature biotechnology with a feasible path forward through regulatory approval. The next steps after this funded project would be field trials in multiple lakes around the state and eventually deployment to remove methylmercury from Minnesota's edible fish population in a way that is safe and effective.

## 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?**

In the Future



## Activities and Milestones

### Activity 1: Test and refine the mercury-degrading fathead minnows in secure laboratory environments.

**Activity Budget:** \$227,000

#### Activity Description:

We will test the ability of engineered fathead minnows to convert toxic methylmercury to Hg(0) which will leave aquatic ecosystems. We already have engineered fathead minnows in-hand, and a proof-of-concept has been successfully demonstrated in aquarium fish (zebrafish) by our collaborators. These preliminary results substantially de-risk this technical activity. In this activity, we will measure the efficiency of mercury bioremediation in a contained aquarium environment at the MAISRC Containment Laboratory. We will iterate on the design-build-test-learn engineering cycle until we have fish that will remove mercury from aquatic food chains with high efficiency. Lastly, we will simulate multi-trophic (food-chain) systems in laboratory experiments using co-housed fish species the MAISRC Containment Laboratory to measure the impact of our approach on MeHg concentrations in species consumed by humans (yellow perch).

#### Activity Milestones:

Description	Approximate Completion Date
Rate of methylmercury degradation by existing transgenic fish is quantified by mass spectrometry.	December 31, 2025
Rate of methylmercury volatilization is improved through iterative engineering.	December 31, 2026
Impact of methylmercury bioremediation through the food chain is quantified in laboratory experiments.	May 31, 2027
Technical report which organizes final project data	May 31, 2027

### Activity 2: Determine the pathway for field-trials and wide-spread mercury bioremediation by engaging with MN-DNR, MPCA, and other regulators.

**Activity Budget:** \$20,000

#### Activity Description:

Activity 2 is divided into two subtasks. Subtask 1 will be a series of individual stakeholder engagement meetings with individual agencies in MN and at the federal level. Meetings will be held in person (local) or virtually (federal). The first series of meetings is aimed to share the technology and current model for bringing it to the field with key stakeholders. This subtask will include building a comprehensive map of the stakeholders that will need to be congregated in Subtask 2. The second subtask will be to organize a full-day stakeholder meeting in St. Paul in summer 2026. Having all stakeholders together in one room will be important (funds in this Activity will cover travel of stakeholders to St Paul) to ensure that the key milestones for regulatory approval (local and federal) and field-testing are compatible and understood by all.

#### Activity Milestones:

Description	Approximate Completion Date
Stakeholder identification and one-on-one stakeholder engagement to familiarize them with the emerging technology	February 28, 2026
Multi-stakeholder in-person workshop to establish pathway to regulatory approval and deployment in MN.	August 31, 2026

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Sarah Janssen	USGS	Analytical Chemistry Support	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.**

The results of this research and development project will be shared with the broader community through multiple channels. The PI Michael Smanski will present results at regional and national conferences. He will also lead the preparation and publication of results in a peer-reviewed technical journal. In Activity 2, PI Smanski and the rest of the research team will directly communicate the results to stakeholders who would be important in translating this new technology to field settings, including the Minnesota Pollution Control Agency, and MN Department of Natural Resources, and the MN Department of Agriculture (the latter of which currently has purview over the field release of GMO organisms in MN policy). ENRTF will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgment Guidelines.

## 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?**

There are two major implementation possibilities, both of which will be on the table to discuss during our stakeholder engagement (Activity 2 below). One route is commercializing this technology through a start-up company that will be paid to remediate mercury on a lake-by-lake basis. The second is to partner with local government agencies (MN DNR or Pollution Control Agency) for a government-funded remediation program. These two paths may differ in which lakes would be cleaned up first, with social-justice implications (e.g., route one will prioritize lake associations willing to pay for the technology).

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Building Knowledge and Capacity to Solve AIS Problems	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 06a	\$4,000,000
Building Knowledge And Capacity For AIS Solutions	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 06e	\$3,750,000

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Professor		PI			27.06%	0.4		\$20,078
Researcher 5 academic lab staff		To conduct analysis			27.06%	2		\$166,165
							<b>Sub Total</b>	<b>\$186,243</b>
<b>Contracts and Services</b>								
University of Minnesota	Internal services or fees (uncommon)	\$1000 in year one and \$1020 in year two to cover minor costs associated with routine repair and maintenance of equipment used in R&D efforts				0.02		\$2,020
University of Minnesota	Internal services or fees (uncommon)	\$13,000 in year 1 and \$13,260 in year two to cover fees associated with DNA sequencing, Mass Spectroscopy, and service fees for the MAISRC Containment Lab. \$237 added as rounding to make sum total round to a thousand.				0.2		\$26,497
							<b>Sub Total</b>	<b>\$28,517</b>
<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	Consumable and supplies: \$12,000 for year 1, \$12,240 for year 2;	This will cover fish husbandry materials (food, cleaners, etc.) and genetic engineering reagents (DNA, enzymes, lab consumables, etc.) for constructing and characterizing transgenic fish					\$24,240
							<b>Sub Total</b>	<b>\$24,240</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	<b>-</b>

<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	This is for catering at the workshop, which will include a light breakfast, lunch, and dinner for all attendees	The stakeholder workshop will be held to outline a roadmap for regulatory approvals required for the mercury bioremediation technology					\$800
	Miles/ Meals/ Lodging	This will cover travel to Minnesota for the workshop for stakeholders located outside the state. Specifically, stakeholders from the EPA/USDA/FDA who are involved in federal regulation of biotechnology.	The stakeholder workshop will be held to outline a roadmap for regulatory approvals required for the mercury bioremediation technology	X				\$1,800
	Miles/ Meals/ Lodging	Lodging for workshop attendees coming from outside the Twin Cities	The stakeholder workshop will be held to outline a roadmap for regulatory approvals required for the mercury bioremediation technology	X				\$1,200
							<b>Sub Total</b>	<b>\$3,800</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
	Publication	Publication of results describing fathead minnow bioremediation of mercury in high-visibility science journal	Communication of results to the broader science and regulatory community					\$3,000
							<b>Sub Total</b>	<b>\$3,000</b>
<b>Other Expenses</b>								
		Room rental at the McNamara center	Holding a workshop in year two with local and federal regulators of biotechnology					\$1,200
							<b>Sub Total</b>	<b>\$1,200</b>

							<b>Grand Total</b>	<b>\$247,000</b>
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## Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
<b>Travel In Minnesota</b>	Miles/Meals/Lodging	This will cover travel to Minnesota for the workshop for stakeholders located outside the state. Specifically, stakeholders from the EPA/USDA/FDA who are involved in federal regulation of biotechnology.	Having key stakeholders from the federal regulatory agencies present at the workshop will be important, as both local and federal regulations will impact the translation of this technology to remediating mercury from Minnesota waters.
<b>Travel In Minnesota</b>	Miles/Meals/Lodging	Lodging for workshop attendees coming from outside the Twin Cities	Having federal stakeholders at the workshop is important, as both federal and local regulations will impact translating the technology to remediate mercury from Minnesota waters.

## Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount
<b>State</b>				
			<b>State Sub Total</b>	-
<b>Non-State</b>				
In-Kind	Indirect costs for this proposal, though not allowed, are listed as in-kind contribution of 55% MTDC which is the Federally Negotiated rate with the U of MN. The indirect is proportionate to the awarded funds at a rate 55% so if the award is reduced the F&A would be reduced.	To pay for administrative and facility expenses for this project	Secured	\$135,720
			<b>Non State Sub Total</b>	<b>\$135,720</b>
			<b>Funds Total</b>	<b>\$135,720</b>

**Total Project Cost: \$382,720**

**This amount accurately reflects total project cost?**

Yes

## Attachments

### Required Attachments

#### *Visual Component*

File: [f7d7d199-b30.pdf](#)

#### *Alternate Text for Visual Component*

Our visual component contains an infographic describing how the methylmercury degrading baitfish will lower mercury levels in the aquatic food chain. We also show photographs of our current fathead minnows engineered to degrade methylmercury, which are also made bright pink to make them more attractive to predator fish....

### Supplemental Attachments

#### *Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other*

Title	File
SPA_submission_letter_Smanski	<a href="#">23769c1f-439.pdf</a>
2025-154 Research Addendum_revised final	<a href="#">15282e91-98e.pdf</a>

### Difference between Proposal and Work Plan

#### *Describe changes from Proposal to Work Plan Stage*

I added the name of an unfunded project collaborator who offered to give us support in the analytical chemistry associated with mercury analysis. I also added text into the new fields, for example dissemination. I have modified the categories in which items of the budget were recorded, per the comments from LCCMR. I have also added a sentence to the dissemination section stipulating that ENRTF will be acknowledged in communications.

## 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 understand that travel expenses are only approved if they 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 understand the UMN Policy on travel applies.

**Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?**

Yes

**Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?**

Yes

**Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?**

No

**Does your project include original, hypothesis-driven research?**

Yes

**Does the organization have a fiscal agent for this project?**

Yes, Sponsored Projects Administration

**Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?**

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 as "the provision of care, treatment, education, training, instruction, or recreation to children")?**

No

**Provide the name(s) and organization(s) of additional individuals assisting in the completion of this project:**

Lori Nicol, University of Minnesota

**Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements**

N/A