Environment and Natural Resources Trust Fund

M.L. 2026 Final Work Plan

General Information

ID Number: 2026-164

Staff Lead: Lisa Bigaouette

Date this document submitted to LCCMR: May 19, 2026

Project Title: Public Toolbox to Forecast Toxic Cyanobacteria Blooms

Project Budget: $509,000

Project Manager Information

Name: Chan Lan Chun

Organization: U of MN - Duluth - NRRI

Office Telephone: (218) 788-2613

Email: chun0157@d.umn.edu

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

Project Reporting

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

Project Completion: June 30, 2029

Final Report Due Date: August 14, 2029

Legal Information

Legal Citation: M.L. 2026, Chp. 104, Sec. 2, Subd. 04g

Appropriation Language: $509,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute in Duluth to validate the concept of a field-deployable toolbox to proactively and rapidly detect harmful algal blooms and forecast associated toxin production, evaluate the feasibility of the integrated toolbox, and seek feedback from potential users to inform further refinement.

Appropriation End Date: June 30, 2029

Narrative

Project Summary: This project will develop a field-deployable toolbox, "Cyanodetector" for detecting harmful algal blooms and forecasting cyanobacterial toxins to protect public health and manage recreational water advisories.

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

Cyanobacteria harmful algal blooms (cHABs) are increasingly prevalent in Minnesota's water bodies, posing significant risks to public health, recreational activities, and drinking water sources. These blooms can produce toxins harmful to humans and animals. The rising frequency and severity of cHABs are exacerbated by climate change, resulting in the occurrence of cHABs in pristine lakes, including Lake Superior and Boundary Water Canoe Area Wilderness lakes, which are vital natural resources of Minnesota. Current monitoring methods, including visual inspections, water sampling, and satellite remote sensing, provide guidance and updates on bloom conditions but are not able to detect and forecast cyanotoxins in a timely manner. Moreover, there is no regular testing for cyanotoxins. To proactively protect public health and manage recreational water advisories, we need methods that can rapidly detect blooms and forecast toxin production, enabling timely beach closures and drinking water advisories. Advancements in analytical and genomics tools are making it increasingly feasible and cost-effective to detect cyanobacteria capable of producing toxins before toxins are actually in the water, offering a promising solution. By embracing this innovative approach, we can better safeguard our water resources and communities.

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.

To protect the public from cHABs, this proposal aims to develop a field-deployable toolbox for proactively and rapidly detecting blooms and forecasting toxin production. This toolbox will be utilized by water resources management entities, like Soil and Water Conservation Districts, to monitor cHABs and predict oncoming toxic events. Water samples collected by entities statewide will be analyzed for cyanobacteria toxins, toxin-producing genes, and water quality parameters to develop a region-specific database. The database will establish relationships for toxin-producing genes and toxin concentrations, enabling future toxic events to be predicted by measuring gene levels. While Minnesota has established recreational guidelines for cyanotoxin concentrations, the application of molecular data to inform public warnings and advisories will be refined in collaboration with project partners. We will create a portable toolbox, CyanoDetector (provisionally named), which contains DNA detectors and reagents, and develop appropriate data workflows to facilitate its adoption by managers. The feasibility of this toolbox will be evaluated for accuracy, ease-of-use, and rapidity. The CyanoDetector will then be beta-tested by partners through training workshops. This portable, inexpensive, and near real-time (<48 hours) toolbox will be suitable for use by natural resource managers and public agencies, ultimately protecting the public from toxic cHABs.

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 identify the capabilities and limitations necessary to develop a robust, field-deployable toolbox for managing harmful algal blooms by evaluating commercially available platforms and by understanding toxin and algal community relationships. This foundational phase provides critical insights into scalability and cost, enabling us to predict toxic events before they reach unsafe levels. As climate change intensifies cHAB severity, this toolbox offers a proactive strategy to protect public health. By streamlining workflows and engaging water resource entities, we will establish actionable thresholds and integrate routine cyanotoxin monitoring into existing programs, ensuring informed recreational advisories and timely environmental protection.

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: Analyze cyanobacteria toxins and toxin-producing genes in water samples to forecast the likelihood of cyanobacteria toxin levels

Activity Budget: $162,438

Activity Description:
Water samples collected by local water resources management entities will be analyzed for cyanobacteria toxins, toxin-producing genes, and key water quality parameters. We aim to collect ~300 water samples from May through October across the state. Cyanotoxin concentrations will be quantified using Abraxis Enzyme-Linked Immunosorbent Assay plates analyzed on an automated Gold Standard Diagnostics CAAS Cube instrument, the most advanced cyanobacteria toxin monitoring instrument in Minnesota. Simultaneously, we will quantify toxin-producing genes and characterize toxic cyanobacterial communities in the water samples using molecular biological techniques including portable Nanopore sequencing platforms. Genomics data will be evaluated against cyanobacterial toxin data to better understand cHAB dynamics. From the analyses, a region-specific database will be created to establish relationships of toxin-producing genes/cyanobacteria strains and toxin production for predicting likelihood of cyanobacteria toxin levels. The findings of Activity 1 will be foundational for the development of a field-deployable toolbox in Activity 2 as well as creating monitoring strategies and beach advisory guidelines in relation to cHABs.

Activity Milestones:

Description	Approximate Completion Date
Collect and analyze microcystin samples (~200) in Year 1	October 31, 2027
Collect and analyze microcystin samples (~100) in Year 2	October 31, 2028
Quantify toxin-producing genes and characterize toxic cyanobacterial communities	October 31, 2028
Data analysis and interpretation to develop predictive monitoring of cHABs	December 31, 2028
Disseminate key findings through scientific publication and conference presentations	March 31, 2029

Activity 2: Develop a rapid, accurate, and field-deployable toolbox, which can be used by local water resource management entities

Activity Budget: $251,899

Activity Description:
We will develop a portable toolbox, CyanoDetector, to detect cyanotoxin-producing strains before toxins are actually in the water more rapidly and inexpensively than traditional approaches. The CyanoDetector will be created with affordable and accessible molecular tools, including a Bento Lab for genomic material preparation and MinION, a portable sequencer based on Nanopore sequencing technology. We will asses both their potential and the limitations that must be addressed to develop a field-deployable toolbox. This setup could enable to enhance spatial coverage of lakes and increase sampling frequency, thereby improving the tracking of cHAB occurrences and identifying their toxic events across Minnesota. However, their application to cHABs is still in the early stages and requires the development of an appropriate workflow to facilitate their adoption. We will create a framework for CyanoDetector, including sample processing procedures, data deposition, and data processing pipelines (i.e., algorithms), which results in a draft instruction manual for implementation. Initially, CyanoDetector will be tested in water samples with known cyanobacteria communities and cyanotoxin levels (e.g., based on Year 1 samples collected for Activity 1). During the development phase, we will focus on reliability (compared to conventional sequencers), user-friendliness, cost-effectiveness, and labor efficiency.

Activity Milestones:

Description	Approximate Completion Date
Create at least 3 units of CyanoDetector, a field-deployable toolbox for cyanotoxin-producing strains	December 31, 2027
Develop the workflow of CyanoDetector using mock or known communities	January 31, 2028
Evaluate the CyanoDetector with water samples in Year 2	December 31, 2028
Disseminate key findings through scientific publication and conference presentations	March 31, 2029

Activity 3: Develop instructional materials for the CyanoDetector and train local water resource management entities through workshops

Activity Budget: $94,663

Activity Description:

We will collaborate extensively with water resource management entities to ensure the CyanoDetector is a feasible, proactive tool for predicting cyanotoxin levels and protecting public health. This engagement begins in Years 1 and 2 with information sessions to secure user buy-in and align the tool with manager needs. By Year 3, we will develop draft instruction manuals, videos, and an online data portal. Two key workshops, an initial conceptual alignment session and a later hands-on training workshop, will refine the toolbox's implementability. Because standards for using molecular data in recreational advisories do not yet exist, we will work closely with partners through annual meetings and a final report to develop these critical recommendations. This collaborative approach ensures that molecular data can be effectively integrated into existing monitoring programs to enhance Minnesota's recreational water advisories. We anticipate that partner meetings (online) will consist of an initial project kickoff meeting, annual meetings thereafter to review data and refine approaches, and a final meeting to develop a recommendation report for the next step development.

Activity Milestones:

Description	Approximate Completion Date
Create an instruction manual	June 30, 2028
Information sessions to align the tool with manager needs in Year 1 and 2	June 30, 2028
Hand-on workshops for training CyanoDetector and soliciting feedback	April 30, 2029
Develop recommendations for the next-step development and implementation of CyanoDetector	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Christopher Filstrup	National Resources Research Institute	co-PI who will be responsible for leading toxin analysis, data interpretation, and project meeting with stakeholders for a comprehensive monitoring program.	Yes
Trisha Robinson	Minnesota Department of Health	Providing input and in-kind support on the project, including cHAB monitoring program and data interpretation as a project partner	No
Grace Grinager	Cook County Public Health Department	Providing input and in-kind support on the project, including beta-testing of the toolbox and recommendation of cHAB monitoring program a project partner.	No
Ilena Hansel, Tara Solem, Kaela Veihman, and Andy Kasun	Soil Water Conservation Districts (Cook / North St. Louis / South St. Louis / Lake County)	Providing water samples, participating in beta-testing of the toolbox, and providing input recommendations for cHAB monitoring programs as project partners	No
Neva Maxwell	Cook County	Providing input and in-kind support on the project, including cHAB monitoring program and data interpretation as a project partner	No
Jesse Anderson and Kimberly Laing	Minnesota Pollution Control Agency	Providing input and in-kind support on the project, including cHAB monitoring program and data interpretation as project partners	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.
Findings will be disseminated and archived via reports to LCCMR, peer-reviewed publications, and presentations at regional conferences (e.g., Minnesota Water Resources Conference). A fact sheet that summarizes our findings will also be distributed to local water resource management entities and public agencies. Particularly, our activity 3 includes detailed plans to engage with water resource management entities to solicit feedback about feasibility and implementation of the CyanoDetector as a public tool. We will follow the Environment and Natural Resources Trust Fund (ENRTF) acknowledgment guidelines to acknowledge the ENRTF through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications.

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?
Project activities, including data collection, analysis, interpretation and workshops, will be completed during this project. Institutional funds will support the development of subsequent products, such as publications and scientific presentations. The toolbox framework and instruction manuals will be made available on open-source platforms for further development. We envision a Phase II implementation project. If new research directions emerge from LCCMR's investment in this project, partners will seek additional funding from other grant opportunities. This project will significantly contribute to developing a long-term strategy for proactively protecting public health from cHAB-associated risks and managing water resources in Minnesota.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Dr. Chan Lan Chun		Dr. Chun will serve as the project manager and be responsible for leading development of cyanobacterial toxin gene analysis and engaging and training local water resource management entities.			26.79%	0.24		$49,348
Dr. Christopher Filstrup		Dr. Filstrup will be responsible for leading the cyanotoxin analysis and data interpretation and assisting with training local water resource management entities.			26.79%	0.3		$40,331
Britta Larson		Larson will conduct portable genomic analysis and develop the public toolkit			24.41%	0.6		$48,493
Shawnee McMillian		McMillian will conduct cyanotoxin analysis and develop the public toolkit			24.41%	0.6		$50,672
Jane Reed		Reed will develop online portal for uploading sequencing data, automate raw data processing to produce output files, and develop strategy for future public data visualization			26.79%	0.12		$14,611
Andrew Wood		Wood will provide consultation to apply portable sequencer to the toolkit			26.79%	0.18		$19,480
Undergraduate Researcher		They will conduct sample processing			0%	0.75		$25,744
TBD Technician, Temp/Casual		They will conduct sample processing			6.89%	0.15		$7,082
Graduate Student Researcher		They will perform lab experiments and data analysis and evaluate the performance of public toolkit			41.85%	0.82		$91,375
Post Doctoral Researcher		They will perform lab experiments and data analysis and evaluate the performance of public toolkit			20.57%	0.03		$2,577
							Sub Total	**$349,713**
Contracts and Services								
The University of Minnesota	Internal services or	UMGC genomic analysis for sequencing to compare nanopore sequencing results.				0.02		$11,149

Genomics Center	fees (uncommon)							
University of Minnesota Duluth, Natural Resources Research Institute	Internal services or fees (uncommon)	Annual analytical fees based on NRRI Central Analytical Lab published rates. Year 1: Calculated for 200 samples. 200 samples @ [$21.45 chlorophyll + $36.08 TN/TP + $11.71 SRP + $14.43 NH4 + $14.81 NOx + $15.05 DOC] = $24,618. Year 2: Calculated for 100 samples. 100 samples @ [$21.45 chlorophyll				0.06		$38,832
University of Minnesota	Internal services or fees (uncommon)	Two 64 TB Network Attached Storage (NAS) units for data deposition and virtual server processing to run bioinformatics pipelines				0.01		$5,500
							Sub Total	**$55,481**
Equipment, Tools, and Supplies								
	Tools and Supplies	Toolbox Bento lab system = $2500/ea x 4 =$10,000(Y1 and Y2) Nanopore system with flow cells = $2500/ea x 4 =$10,000 (Y1 and Y2) Chemical, reagents, plasticwares in lab: $23,010	Development and testing of the public toolbox, CyanoDetector					$43,010
	Tools and Supplies	Consumables (e.g., ELISA plates, standards, vials, filters) required to quantify microcystins, anatoxin-a, and saxitoxin. Calculated for 200 samples in Year 1 and 100 samples in Year 2.	Analysis of cyanobacteria-producing toxins					$38,996
	Tools and Supplies	Bottles required to collect water chemistry samples. Year 1: Calculated for 200 samples. 200 samples @ [$4.50 cubitainer + $2.70 250mL nalgene + $1.80 125mL nalgene] = $1800. Year 2: Calculated for 100 samples. 100 samples @ [$4.50 cubitainer + $2.70 250mL nalgene + $1.80 125mL nalgene] = $900.	Measurement of water quality parameters associated with cHAB					$2,700
	Tools and Supplies	Reagent and supplies for toolbox training workshop	Toolbox training workshop for local water resources entities					$2,500
							Sub Total	**$87,206**
Capital Equipment								
							Sub Total	**-**

Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel to MN Water Resources Conference: Mileage $300 + lodging $120 + registration $200 + per diem $80 = $700 Travel to workshops in MN: ~Mileage $300/trips x 2 trips + per diem $50 x 4 people =$1,100	Project meeting and dissemination activities					$3,600
							Sub Total	**$3,600**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Printing	Cost to print off materials for workshops held each year of the project and conferences	Manuals and instruction materials (30 copies of color printing; $200) will be printed for the hand-on training workshops for activity 3. Additionally, 2 posters ($300) will be printed for the MN Water Resources Conferences.					$500
	Publication	Scientific publication	Open access fees for two peer-reviewed publications					$6,000
							Sub Total	**$6,500**
Other Expenses								
		Shipping	Shipping for water samples from SWCDs and genomic materials to lab service	X				$3,000
		Workshop boxed lunches	Cost to provide boxed lunches for the attendees at the workshop	X				$3,500
							Sub Total	**$6,500**
							Grand Total	**$509,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Other Expenses		Shipping	This project leverages water samples collected local water resources management entitles across the State. We plan to receive around 300 water samples during the summer months for 2 years. Anticipated the averaged postages will be ~$100 of FedEx overnight shipping for 30 shipment although the postages vary depending on the distance.
Other Expenses		Workshop boxed lunches	Each workshop will be an 8-hour event for the hand-on training to use the toolkit, CyanoDetector. The workshop will be held at Natural Resources Research institute and St. Paul (e.g., University of Minnesota) in January-April, 2029. We expect 20-30 attendees for each event.

Non ENRTF Funds

Category	Specific Source	Use	Status	$ Amount
State				
			State Sub Total	**-**
Non-State				
In-Kind	UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 54% 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	$281,204
			Non State Sub Total	**$281,204**
			Funds Total	**$281,204**

Total Project Cost: $790,204

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 090ae141-9f1.pdf

Alternate Text for Visual Component

This visual describes the workflow of public toolbox to forecast toxic cyanobacteria blooms. Water samples will be taken from Minnesota waterbodies. The samples will be extracted for DNA which is used for toxin gene analysis using a portable MinION Sequencer and automated analysis, enabling timely interventions to safeguard public health....

Supplemental Attachments

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

Title	File
Letter of Support_Cook_SWCD_2026-164	b3cab068-943.pdf
Letter of Support-NSLSWCD-2026-164	79da6078-819.pdf
Letter of support_Lake_SWCD-2026-164	fa81ed0b-e76.pdf
Letter of support_SSLSWCD-2026-164	8084f758-e8a.pdf
Letter of support_CookCountyPHHS-2026-164	7d3c9a5b-508.pdf
Letter of support_CookCountyMN-2026-164	d6b25e04-0f4.pdf
Letter of support_MDH-2026-164	4e27d5c9-e7a.pdf
Univ. of MN - Authorization Letter	74a61e13-d10.pdf
Letter of Support_MPCA-2026-164	c573b255-012.pdf
Research Addendum-2026-164_Final	fc246909-dd3.docx

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

Budget was adjusted to the recommended amount with minor activity reduction on conference travels and workshop expense.

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?

No

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:

Chan Lan Chun, 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