Environment and Natural Resources Trust Fund

M.L. 2024 Approved Work Plan

General Information

ID Number: 2024-164

Staff Lead: Tom Dietrich

Date this document submitted to LCCMR: June 5, 2024

Project Title: Visitor Perceptions of Water Quality to Aid Lake Management

Project Budget: $379,000

Project Manager Information

Name: Bonnie Keeler

Organization: U of MN - Humphrey School of Public Affairs

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Project Reporting

Date Work Plan Approved by LCCMR: June 20, 2024

Reporting Schedule: June 1 / December 1 of each year.

Project Completion: June 30, 2027

Final Report Due Date: August 14, 2027

Legal Information

Legal Citation: M.L. 2024, Chp. 83, Sec. 2, Subd. 04h

Appropriation Language: $379,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota, Humphrey School of Public Affairs, to conduct an analysis of lake visitor perceptions, management actions, and water quality to inform lake management.

Appropriation End Date: June 30, 2027

Narrative

Project Summary: Use mobile AI-assisted technologies to survey lake visitors. Assess perceptions of water quality and perceived threats. Combine survey data with water quality data and trend monitoring to inform lake management.

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

Lakes are the most visited and valued of Minnesota's recreational amenities. However, land use change, warmer temperatures, nutrient runoff and invasive species pose threats to lake water quality with impacts for recreation, property values, and wildlife. To address degraded water quality in lakes, managers can treat lakes with alum or iron, install aeration pumps, combat invasive species, and invest in stormwater management and habitat restoration. These investments are expensive, especially for local municipalities, lake associations, and watershed management groups with limited resources and many competing objectives.

Managers continue to invest in best management practices and expensive treatments without information about how residents and lake users perceive resulting water quality improvements. Are changes in water quality actually noticed by lake visitors? Are management changes that increase water clarity but increase aquatic plant abundance viewed negatively? Very little is known about how measurable changes in water quality are perceived and valued by lake visitors, making it difficult to assess the return on investment in lake management activities.

Our proposal combines new water quality data and analysis of long-term datasets on water quality with cutting-edge mobile technologies that can survey lake visitors faster, cheaper and at broader scales than using traditional methods.

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.

Our proposal leverages advancements in AI, mobile technologies, and community science to collect real-time information on lake visitors' perceptions and preferences. We will identify a set of 15 lakes across the 15 county region representing the greater Twin Cities Metropolitan Area, that include a range of lake size and depth, land-cover, water quality, amenities and management investments including in in-lake treatments (e.g. chemicals, invasive species management) and watershed management (e.g. BMP installations).

Signs installed at each lake will direct lake visitors to send a text message to a phone number where they will respond to a short survey administered by a conversational AI- powered chatbot. The survey will ask visitors about their perceptions of water quality and other questions relevant to park managers.

Working in collaboration with lake managers, we will construct management history for the past 20+ years. We will analyze water quality trends and quantify changes in lake ecosystems, such as water clarity, aquatic plant and algal abundance, that are most relevant to lake users. By combining water quality data with elicited data on visitor perceptions of water quality we can better understand where (and if) measured water quality improvements are translating into improved visitor experience.

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?

Outcomes include 1. a lakeside intercept survey, co-developed and deployed in collaboration with lake managers, park officials, and watershed districts. 2. Public presentations for lake managers and interested partners and presentations at local events related to lake management, 3. Data on lake water quality archived in a publicly accessible database, and 4. Report on research findings that integrates survey data with data on water quality, summarizes key findings, and identifies actions or recommendations for natural resource managers.

Project Location

What is the best scale for describing where your work will take place?
    Region(s): Metro, Central, SE,

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: Distributed surveys of lake visitors using AI-powered conversational chatbots

Activity Budget: $250,383

Activity Description:

We will contract with a firm that provides the back-end technical capabilities needed to program an SMS-based conversational chatbot. A chatbot is a computer program that simulates and processes human conversation, allowing humans to interact with digital devices as if they were communicating with a real person. AI language models can then process the information received by respondents and efficiently parse and synthesize responses. The surveys are optional, will be designed to protect user data privacy so no personally identifying information will be collected, and the survey design will comply with best practices for survey research. Respondents will have the opportunity to opt-in to future data collection via phone or text, allowing the team to follow-up with specific users for more in-depth interviews.

We will collect data during the open water season (April - October) for two years (2025 and 2026). We will select lakes to survey based on coordination with lake managers and state agencies to identify recent and planned water quality treatments that are likely to visibly change water clarity, algal and aquatic plant abundance. Agencies and lake managers will have the opportunity to add questions to the survey based on specific management needs at each site.

Activity Milestones:

Description	Approximate Completion Date
Scope sites for potential survey installation. Identify target lakes for survey.	October 31, 2024
Outreach with municipalities and watershed districts to co-design survey instrument	March 31, 2025
Design and program the chatbot survey, print and install signage, deploy chatbots	April 30, 2025
Complete survey collection, take down signs, close survey	October 31, 2026
Present results of lake surveys to lake managers	November 30, 2026
Analyze survey data, communicate and visualize findings, draft final report	December 31, 2026

Activity 2: Analysis of trends in lake water quality and lake management history

Activity Budget: $128,617

Activity Description:

Through our established partnerships with government entities responsible for lake management (watershed districts, counties, cities, MPCA), we will document the history of significant management activities over the past 20 years at each of the study lakes through interviews and reviews of public documents. We will analyze available water quality data, examining long-term changes in metrics commonly associated with water quality (chlorophyll a, total phosphorus, secchi depth), as well as compiling available data on aquatic vegetation (from surveys and areal imagery). We will also collect supplementary measurements on measurements associated with harmful algal blooms (phycocyanin concentration and cyanobacteria abundance), to examine how these metrics are related to visitors' perceptions of water quality. By combining water quality data with elicited data on visitor perceptions of water quality we can better understand where (and if) measured water quality improvements are translating into improved visitor experience. We can also investigate if the water quality in different types of lakes (e.g. lakes used for swimming, boating, or fishing) is perceived and valued differently.

Activity Milestones:

Description	Approximate Completion Date
Identify potential lake study sites and research existing water quality and management data	October 31, 2024

Lake water quality data acquisition and trend analyses	October 31, 2025
Lake management and outreach database development	December 31, 2025
Presentation of results of water quality data to lake managers	October 31, 2026
Management and water quality response analysis	December 31, 2026
Water quality data stored in U of M digital conservancy following standard protocols	December 31, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Jacques Finlay	University of Minnesota	Finlay will develop management histories and assess lake water quality trends in collaboration with partners. Finlay will support site selection and implementation of data collection interfaces. He will supervise an early career scientist who will manage project operations and will facilitate leveraged partnerships around long term monitoring.	Yes
Gaston Small	University of St. Thomas	Small will work with Finlay to compile information about management histories and water quality data trends for selected study lakes. He will supervise an undergraduate research student who will support project operations and supplemental data collection.	Yes

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 target audience for the research will be lake managers, lake associations, state agencies with authority over funding and programming related to water quality (Minnesota Pollution Control Agency, Minnesota Department of Natural Resources, and Minnesota Department of Agriculture), and environmental non-profits and advocacy organizations. All data will be shared with project partners via reports and visuals. Using the results of this project, we will seek state and federal funding to deploy chatbots at additional sites statewide in consultation with state agencies and management organizations. Results will also be disseminated through publications in peer-reviewed journals and at regional conferences such as the Minnesota Water Resources conference. Leveraging robust long-term data on lake water quality, this research can be used to inform future statewide water plans, watershed planning processes, and local decision making on the return on investment in lake management.

The project team will acknowledge the Environment and Natural Resources Trust Fund through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENTRF 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?
All data will be shared with project partners via reports and visuals. Using the results of this project, we will seek state and federal funding to deploy chatbots at additional sites statewide in consultation with state agencies and management organizations. Given current trends in AI technologies, we see distributed chatbots as an option to replace more expensive engagement and outreach methods, especially in remote areas. Leveraging robust long-term data on lake water quality, this research can be used to inform future statewide water plans, watershed planning processes, and local decision making on the return on investment in lake management.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Bonnie Keeler, PI		Set project goals and direction, hire and supervise project staff, ensure fiduciary compliance and research integrity, lead project synthesis and communication of findings to general and academic audiences.			36.8%	0.08		$34,141
Jaques Finlay, Co-PI		Oversee water quality sampling activities and data analysis, hire and supervise research staff, design sampling protocol and oversee analysis and communication of water quality data.			36.8%	0.06		$15,300
Limnology research associate - Ecology dept. UMN		Assist Co-PI Finlay in the design and execution of water quality sampling and historical analysis of water quality data. Co-supervise undergraduate research assistants. Coordinate with local water quality managers to select sites. Assist in dissemination of findings.			36.8%	1.02		$64,784
Erin Niehoff, Policy Analyst, Center for Science, Technology, and Environmental Policy		Coordinate and manage project across all activities. Delegate and oversee research tasks. Compile required reports. Lead outreach and dissemination of findings. Supervise student research assistants.			36%	1.2		$140,937
Undergraduate Research Assistant		Assist in summer water quality sampling and deployment of equipment, assist in data collection and compliance with project QAQC and reporting requirements.			0%	0.36		$9,600
Summer Graduate Research Assistant - Center for Science, Technology, and		Assist in analysis of chatbot data and dissemination of findings in final year of project.			24%	0.5		$10,555

Environmental Policy								
							Sub Total	**$275,317**
Contracts and Services								
Earth Lab	Professional or Technical Service Contract	The Firm will provide back-end technical capabilities needed to program an SMS-based conversational chatbot.				0		$49,500
University of St. Thomas	Professional or Technical Service Contract	Gatson Small is a faculty member at University of St. Thomas. Salary a for Small for summer and academic year and undergraduate students, plus their fringe benefit supplies and travel costs =$41,208.They will compile information about management histories and water quality data trends for selected study lakes.				0		$41,427
							Sub Total	**$90,927**
Equipment, Tools, and Supplies								
	Tools and Supplies	Hardware supplies and installation materials for signage (20@$30/eac)	Hardware to mount signs at area lakes					$600
							Sub Total	**$600**
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Other	20 sites requiring 6 visits to each site per year or 120 trips per year. Each trip is 40 miles total. Total # of miles for the trips are 4800 miles and the mileage reimbursement rate is $.585/ml. Total is $2,808.	Trips are needed to the lakes to conduct surveys					$5,616

		This will repeat itself for a second year and the grant total will be $5,616							
	Other	Per-diem meal reimbursement for the 20 site visits by two Researchers (20*2*2 = 44.25) with $44.25/visit, equals to $1,770							$3,540
								Sub Total	**$9,156**
Travel Outside Minnesota									
								Sub Total	-
Printing and Publication									
	Printing	Printing of 150 signs for 20 lakes at $150/sign. $3,000	The signs will notify lake vistors of the survey being conducted						$3,000
								Sub Total	**$3,000**
Other Expenses									
-								**Sub Total**	-
								Grand Total	**$379,000**

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				
-			**State Sub Total**	-
Non-State				
In-Kind	Unrecovered indirect funds	Indirect cost rate for federally sponsored research is 55% for on-campus research according to UMN policy: https://research.umn.edu/units/oca/fa-costs/current-fa-rates. Amount listed below assumes a 55% F&A rate applied to personnel expenses.	Secured	$151,106
			Non State Sub Total	**$151,106**
			Funds Total	**$151,106**

Attachments

Required Attachments
Visual Component
File: [812f06ff-4d9.pdf](812f06ff-4d9.pdf)

Alternate Text for Visual Component
Visual shows examples of signage used last summer at Como Lake Park to invite visitors to respond to a chatbot survey. Also included is a figure showing results of the survey data collection....

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

Title	File
UMN Sponsored Projects Letter of Intent	[05fba8e7-363.pdf](05fba8e7-363.pdf)
Research Addendum revised 2024-164_FINAL	[10b4186e-5ec.pdf](10b4186e-5ec.pdf)

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage
In response to budget reductions, we reduced the funding for research support staff from the original budget. We did not make significant changes to the workplan.

In response to LCCMR staff comments, we completed the following revisions:
1. Added detailed personnel descriptions to the budget. Changed the title of one position from "Post doc" to "Research Associate" to reflect a new hire who will fill these roles on the project.
2. Included an estimate of non-recovered F&A (indirect costs) associated with UMN policy on indirect cost recovery to the budget.
3. Added additional language acknowledging how the project team will appropriately attribute ENTRF to the dissemination section.
4. In response to the reviewer comment for more details in the narrative section, we point the reviewer to the section on outcomes in the research addendum. We also added milestones with more specifics on project results/deliverables, including presentations to managers and long-term data dissemination.
5. Milestone added related to long term data storage in the UMN Digital Conservatory.
6. Milestones added related to the opening and closing of the survey.
7. Milestones added to reflect research investments in the first project year.
8 Milestones added related to presentation of results to stakeholders.
9. Updated the project narrative to include specific outcomes and deliverables.
10. Clarified milestone on deployment of chatbots
11. Request change to project end date to be June 30th, 2027.

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, sale of products and assets, or revenue generation?
> 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?
> 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