Final Abstract

Final Report Approved on October 27, 2026

M.L. 2020 Project Abstract

For the Period Ending June 30, 2026

Project Title: Foundational Hydrology Data For Wetland Protection And Restoration

Project Manager: Amy Kendig

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Funding Source:

Fiscal Year:

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03d , as extended by laws 2025, First Special Session, Art. 2, Sec. 2, Subd. 17.

Appropriation Amount: $400,000

Amount Spent: $347,054

Amount Remaining: $52,946

Sound bite of Project Outcomes and Results

We established a statewide wetland hydrology monitoring network consisting of 60 sites that span a range of wetland types. Sites have baseline vegetation and soil descriptions and ongoing water level data collection. This network will improve our understanding of wetland hydrology, informing wetland restoration targets and evaluations of wetland impacts.

Summary of Project and Outcomes

While Minnesota ranks among the top U.S. states in wetland acreage, only about 50% of historic wetlands remain today. Minnesotans strive to protect remaining wetlands and restore historical wetlands because of the many benefits they provide. One challenge of protecting, managing, and restoring wetlands is ensuring their hydrologic regimes meet the needs of their characteristic flora and fauna. Hydrologic regimes are comprised of frequency, timing, duration, and depth of water level fluctuations. Unlike lakes and streams, we lack long-term data to characterize typical hydrologic regimes of many wetlands in Minnesota.

This grant supported building a statewide wetland hydrology monitoring network, which will be used to collect long-

term data from a range of wetland types. The network was initiated with an EPA grant, which funded installation of water level monitoring wells and baseline vegetation surveys at 20 sites. This ENRTF grant funded well installation at 40 additional sites, vegetation surveys at 37 sites, soil surveys at 60 sites, and bathymetry surveys at 4 sites.
The long-term water level data will be used to characterize wetland hydrologic regimes, which can then inform targets for wetland restorations. The hydrologic regimes can also be paired with ecological information to evaluate how hydrology changes could impact flora and fauna. Vegetation, soil surveys, and bathymetry surveys will be used to combine wetlands into representative categories and to match monitored wetlands to other wetlands of interest, such as restorations or impacted wetlands.
As we continue data collection, users can access the newest available water level data from the DNR Wetland Hydrology website. We are compiling ecological information from literature review and expert input to combine with final hydrologic regimes for assessing wetland impacts. The data from this network will expand our understanding of wetland hydrologic regimes, aiding in Minnesotans' efforts to protect, manage, and restore wetlands.

Project Results Use and Dissemination

We have presented the wetland hydrology monitoring network to a range of audiences: Ecological Society of America, Minnesota Water Resources Conference, The Nature Conservancy Science Slam, Cedar Creek Ecosystem Science Reserve Lunch with a Scientist, the Environmental Protection Agency and National Association of Wetland Managers workshop on Enhancing State and Tribal Programs, college classes, and staff in the MN DNR, WI DNR, and UK Environment Agency who work on wetland policy and science. The website, https://www.dnr.state.mn.us/wetlands/wetlands-hydrology-monitoring.html, contains final site locations and links to hydrology data. Site photos are in the final report.

Environment and Natural Resources Trust Fund

M.L. 2020 Approved Final Report

General Information

Date: October 28, 2026

ID Number: 2020-026

Staff Lead: Erin Barton

Project Title: Foundational Hydrology Data For Wetland Protection And Restoration

Project Budget: $400,000

Project Manager Information

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Project Reporting

Final Report Approved: October 27, 2026

Reporting Status: Project Completed

Date of Last Action: October 27, 2026

Project Completion: June 30, 2026

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03d , as extended by laws 2025, First Special Session, Art. 2, Sec. 2, Subd. 17.

Appropriation Language: $400,000 the second year is from the trust fund to the commissioner of natural resources to improve wetland protection, management, and restoration in Minnesota by completing the partially established long-term Wetland Hydrology Monitoring Network that will provide critical knowledge of wetland hydrology dynamics. This appropriation is available until June 30, 2025, by which time the project must be completed and final products delivered.Carryforward; extensions (a) The availability of the appropriations for the following projects is extended to

June 30, 2026: (2) Laws 2021, First Special Session chapter 6, article 5, section 2, subdivision 3, paragraph (d), Foundational Hydrology Data for Wetland Protection and Restoration.

Appropriation End Date: June 30, 2026

Narrative

Project Summary: This project will improve wetland protection, management, and restoration in Minnesota by completing a partially established long-term wetland hydrology monitoring network that will provide critical knowledge of wetland hydrology.

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

This proposal seeks to improve wetland protection, management and restoration in Minnesota by completing a partially established long-term wetland hydrology monitoring network. Effective wetland management and restoration requires a fundamental understanding the frequency, timing, duration and depth of water level fluctuations in different types of wetlands -- the hydrologic regime. Also, because wetlands are frequently connected to and dependent on groundwater, understanding wetland hydrology can better inform groundwater management. The hydrology of lakes and streams has been systematically monitored for decades, yet there has never been a comprehensive program to monitor wetland hydrology. To address this lack of foundational data, we designed a monitoring framework that requires installing hydrology monitoring equipment in 60 reference (minimally disturbed) wetland sites across the state (see attachment). This number of sites (60) is the minimum necessary to adequately sample the wide variety of wetland types that occur in Minnesota as well as account for geographic variation.

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.

In 2017 we began a pilot monitoring effort by installing equipment at 10 wetland sites and collecting continuous hydrology data. In 2018, the U.S. Environmental Protection Agency (EPA) awarded the DNR a grant of $200,160 to fund 20 monitoring stations, which will include upgrading the existing pilot installations. This proposal seeks ENRTF funds to complete the monitoring network by purchasing and installing hydrology monitoring equipment at an additional 40 sites. The proposed ENRTF funding is solely for purchasing and installing the monitoring equipment (wells/gauges and automatic data loggers) and to conduct baseline vegetation, soil, and wetland bathymetry surveys. Subsequent, long-term data collection and maintenance of the monitoring network will be done by the DNR using other funding sources.

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?

- Improve the design and implementation of wetland restoration and management projects;
- Improve our understanding of how alterations to groundwater affect wetlands and their associated benefits and allow more informed and objective management of both wetlands and groundwater;
- Improve our understanding of the relationship between hydrology and wetland plant communities;
- Reveal long-term changes to the state's wetlands that may result from a variety of factors such as land use changes, climatic changes and changes in surface and groundwater use.

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: Install Wetland Hydrology Monitoring Equipment at 40 Sites

Activity Budget: $350,000

Activity Description:
Purchase and install hydrology monitoring equipment at 40 reference (minimally-disturbed) wetlands around the state over two field seasons. Conduct elevation surveys for each site to calibrate the monitoring equipment and establish ground surface elevations. Conduct follow-up site visits as needed to ensure all sites are operating properly. The monitoring equipment at each site consists of a shallow water table monitoring well (a pipe with slotted or perforated walls along its length) and a continuously recording data logger with sensors to record water level.

Activity Milestones:

Description	Approximate Completion Date
All sites identified and first 5-10 sites intalled	October 31, 2022
10-25 more sites installed	October 31, 2023
Remainder of sites installed	December 31, 2025
Initial Data Analysis and Project Completion Report	June 30, 2026

Activity 2: Conduct Wetland Vegetation and Soil Surveys at 40 Hydrology Monitoring Sites

Activity Budget: $50,000

Activity Description:
Wetland vegetation and soil surveys will be conducted at each of the reference wetlands where hydrology monitoring equipment is installed. Vegetation and hydrology data will be analyzed to understand how long term wetland hydrology patterns influence wetland plant communities, which in turn relates to various wetland benefits, especially fish and wildlife habitat. Soil surveys will provide context for comparisons of hydrology data from the monitoring sites to restored or potentially impacted wetlands. Because soil surveys were not conducted at the first 20 sites in the network, these will be conducted at 60 sites (20 initial sites + 40 sites established with this grant). Conduct bathymetry surveys of basin wetlands with heterogeneous vegetation to apply water levels at well to different, but hydrologically connected areas of the wetland.

Activity Milestones:

Description	Approximate Completion Date
First 20 vegetation surveys	September 30, 2024
Conduct first 30 soil surveys	November 30, 2024
Remaining wetland vegetation surveys	October 31, 2025
Conduct last 30 soil surveys	November 30, 2025
Bathymetry surveys	May 31, 2026
Report vegetation, soil, and bathymetry results	June 30, 2026

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 project will collect water level data and wetland ground surface elevation data at a variety of wetlands in Minnesota. Those data will be used to calculate metrics such as:

-Range of monthly water table depth in specified wetland plant community types

-Monthly average water depth above and below ground surface

These metrics will be used to establish a better understanding of wetland thresholds. A threshold is a range of water levels that wetland plant communities can withstand before undergoing change. The DNR and others, such as the US Fish and Wildlife Service, or Board of Water and Soil Resources, can use those thresholds to better make regulatory or management decisions. The DNR hopes to use the wetland thresholds to better inform water use regulatory decision-making and modeling.

DNR wetland scientists will plan to present this information to the water resource professionals at the annual Water Resources Conference and to other wetland professionals outside of Minnesota to inform similar efforts in other states. This data might also be informative in understanding climate change impacts in Minnesota's wetlands.

We will ensure we acknowledge ENRTF funding through 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?

This grant will fund the start-up costs for this effort, including the installation of monitoring equipment and vegetation surveys. The long-term operation of the program will be funded from a combination of other funding sources. The DNR is committed to the long-term operation of this monitoring network.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount	$ Amount Spent	$ Amount Remaining
Personnel										
Field Hydrologist		Install and troubleshoot equipment			20%	1.32	X	$95,000	-	-
Wetland vegetation botanist		Conduct wetland vegetation surveys			15%	0.5		$37,500	-	-
Wetland Research Scientist		Identify sites, conduct statistical analyses and project troubleshooting			20%	0.6	X	$57,300	-	-
Wetland soil scientist		Conduct soil surveys			20%	0.3		$30,000	-	-
							Sub Total	**$219,800**	**$219,219**	**$581**
Contracts and Services										
Red Lake Tribal Nation DNR	Subaward	Assist with site installation and data collection on tribal land.				0.03		$4,200	$3,796	$404
							Sub Total	**$4,200**	**$3,796**	**$404**
Equipment, Tools, and Supplies										
	Equipment	Monitoring equipment - wells and loggers. 40 stations x $2595 per station. Approximately 11 stations will require 2 loggers and cost more, some will cost less.	Monitor hydrology in wetlands using pressure transducers in shallow wells					$95,668	$62,371	$33,297
	Equipment	Vegetation and soil monitoring equipment - biltmore stick (for wetlands with trees) and Munsell book (for soil)	Baseline vegetation and soil surveys					$500	$99	$401
	Equipment	High accuracy GPS unit and supporting equipment (rental)	Bathymetry surveys					$4,000	$750	$3,250
	Equipment	Gear for staff (e.g., waterproof boots, mosquito nets)	Support staff who are installing and maintaining sites					$1,500	$1,048	$452

							Sub Total	**$101,668**	**$64,268**	**$37,400**
Capital Equipment										
							Sub Total	**-**	**-**	**-**
Acquisitions and Stewardship										
							Sub Total	**-**	**-**	**-**
Travel In Minnesota										
	Miles/ Meals/ Lodging	Mileage, and per diem	In state travel for installation and troubleshooting of equipment, vegetation and soil surveys					$52,688	$44,057	$8,631
	Conference Registration Miles/ Meals/ Lodging	Minnesota Water Resources Conference, 2 attendees	Present this project and receive feedback from local water resources experts	X				$325	$325	-
							Sub Total	**$53,013**	**$44,382**	**$8,631**
Travel Outside Minnesota										
	Conference Registration Miles/ Meals/ Lodging	Ecological Society of America Annual Meeting, 1 attendee	Present this project to increase national recognition, networking, and collaboration	X				$1,587	$1,587	-
							Sub Total	**$1,587**	**$1,587**	**-**
Printing and Publication										
							Sub Total	**-**	**-**	**-**
Other Expenses										
		DNR's Direct and Necessary Costs	Costs for activities that are directly related to and	X				$19,732	$13,802	$5,930

			necessary for accomplishing appropriated projects. Direct and necessary costs cover HR Support (~$3556), Safety Support (~$644), Financial Support (~$4,549), Communication Support (~$1,388), IT Support (~$8457), and Planning Support (~$1,138) necessary to accomplish funded programs/projects.							
							Sub Total	**$19,732**	**$13,802**	**$5,930**
							Grand Total	**$400,000**	**$347,054**	**$52,946**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Personnel - Field Hydrologist		Install and troubleshoot equipment	**Classified :** If existing employees are used to achieve this work, their existing duties will be backfilled.
Personnel - Wetland Research Scientist		Identify sites, conduct statistical analyses and project troubleshooting	**Classified :** DNR does not have an existing staff to analyze this data. The wetland research scientist would play a unique role in this project.
Travel In Minnesota	Conference Registration Miles/Meals/Lodging	Minnesota Water Resources Conference, 2 attendees	Conference attendees will include potential users of data generated from this project as well as experts in hydrologic monitoring. Feedback from such attendees can help guide data analysis and dissemination.
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	Ecological Society of America Annual Meeting, 1 attendee	The 2023 theme of this national meeting is about engaging public-sector scientists and promoting collaboration among public, private, and academic ecologists. The Minnesota DNR's existing work on wetland mapping and monitoring has been a model for wetland work in other states. Presenting this project at the ESA meeting would elevate our wetland hydrology monitoring efforts to relevant researchers in other states, strengthen our networking across states and sectors, and cultivate ideas for extending the use of this network following completion of the LCCMR grant.
Other Expenses		DNR's Direct and Necessary Costs	These are costs associated with activities that are directly related to and necessary for accomplishing appropriated programs/projects.

Non ENRTF Funds

Category	Specific Source	Use	Status	$ Amount	$ Amount Spent	$ Amount Remaining
State						
In-Kind	In kind staff time:	Project management, coordination, supervision of field staff, report writing, field ops coordination.	Secured	$50,000	$50,000	-
			State Sub Total	**$50,000**	**$50,000**	**-**
Non-State						
Cash	U.S EPA Grant	Used to purchase and install hydrology equipment on 20 wetland sites.	Secured	$349,967	$269,292	$80,675
			Non State Sub Total	**$349,967**	**$269,292**	**$80,675**
			Funds Total	**$399,967**	**$319,292**	**$80,675**

Attachments

Required Attachments

Visual Component

File: 606958b9-129.docx

Alternate Text for Visual Component

The visual component depicts a representative shallow well installed at wetlands with LCCMR funds. These wells collect continuous water level data, above and below ground, at 60 wetland sites. The component also includes a table that summarizes the types and geographic locations of the wetlands where wells were installed....

Supplemental Attachments

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

Title	File
US Fish and Wildlife Letter of Support	a745970b-349.pdf
Background Check Cert Form	238e1694-a9d.pdf
Wetland Hydrology Monitoring Report 2023	23bae9eb-ca8.pdf
ESA Poster 2023	ad5997fd-5fb.pdf
Water Resources Conference Presentation 2023	9fc54983-c57.pdf
Macalester College Class Presentation 2025	84b22f3e-057.pdf
Minnesota Sea Grant Fellows Presentation 2026	e1efb61b-727.pdf
The Nature Conservancy Science Slam Presentation 2024	1dda49de-467.pdf
MN State Mankato Class Presentation 2026	2c31e150-5d4.pdf
MN Biological Survey Highlights 2025	7c02c714-8a0.pdf
Final Report	96e8d945-4e5.docx
Updated Visual Component	13ddecb0-e75.docx
Original Visual Component	3948c220-09f.docx
Funding Table	d94f0824-d07.xlsx
Cedar Creek Lunch with a Scientist 2024	c0554371-b11.pdf
Cedar Creek Ecosystem Science Reserve Field Notes	ec2929d1-823.pdf
EPA NAWM ESTP Presentation 2026	2882b15e-8f7.pdf

Media Links

Title	Link
DNR Wetlands Hydrology Monitoring Website	https://www.dnr.state.mn.us/wetlands/wetlands-hydrology-monitoring.html
DNR's 2025 Water Availability and Assessment Report	https://www.eqb.state.mn.us/sites/eqb/files/appendix_c.pdf
Flow Photo Explorer Murphy Hanrehan 1	https://www.usgs.gov/apps/ecosheds/fpe/#/explorer/378
Flow Photo Explorer Murphy Hanrehan 2	https://www.usgs.gov/apps/ecosheds/fpe/#/explorer/379

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

Since the initial submittal of this project, the equipment has evolved and we have discovered we can collect the same data at a lower cost. Within this workplan, I have moved some funds from the equipment budget into the personnel budget. During the initiation of this project, using EPA grant funds, we have discovered that a wetland research scientist is needed to analyze these data and disseminate the results. DNR had planned to hire this position prior to the hiring freeze, in anticipation of this project getting funded. I have added a portion of the research scientist's salary to the personnel budget and adjusted the direct and necessary costs for this grant. We have kept the total grant amount the same along with the same outcomes as originally proposed.

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 Commissioner's Plan applies.

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?

No

Work Plan Amendments

Amendment ID	Request Type	Changes made on the following pages	Justification For Amendment Request (word limit 75)	Date Submitted	Approved	Date of LCCMR Action
1	Amendment Request	• Project Collaborators - Project Manager Info • Narrative • Activities and Milestones • Budget - Personnel • Budget - Capital, Equipment, Tools, and Supplies • Budget - Travel and Conferences	Updating our hydrologic monitoring methods reduced costs, leaving funds available for soil surveys, conference presentations, and site scouting assistance (from the botanist and soil scientist, who have local expertise). Because soil affects wetland hydrology, soil surveys will increase the value of our data for comparisons to restored or potentially impacted wetlands. Conference presentations will allow us to receive feedback from experts and stakeholders and develop collaborations and ideas for extending this network into the future.	March 16, 2023	Yes	March 21, 2023
2	Completion Date	Previous Completion Date: 10/31/2024 New Completion Date: 06/30/2025	Choosing reference condition wetlands for the network has taken longer than expected due to the many anthropogenic influences on wetland hydrology. This slow initial step delays all follow-up steps in our project. We are collaborating with DNR colleagues to identify sites based on their on-the-ground experience, reducing time that is wasted visiting sites that are impacted. Extending the completion date would allow us to install equipment and complete surveys at all chosen sites.	February 9, 2023	Yes	February 10, 2023
3	Amendment Request	• Budget - Personnel • Budget - Professional / Technical Contracts	Moving $2700 from personnel to contract. Sites at Red Lake Reservation's high-quality wetlands can provide valuable information on wetland water level reference conditions. We have identified sites and visited them in person with a Red Lake biologist. Sub award will pay Red Lake staff	January 31, 2024	Yes	February 1, 2024

			to assist us with site installation and data collection visits.			
4	Amendment Request	• Activities and Milestones • Budget - Capital, Equipment, Tools, and Supplies	Moving $4,000 from well equipment to bathymetry equipment. We underestimated the cost of wells and also identified the need to collect more elevation data with bathymetry surveys. Bathymetry will allow us to apply water levels measured at the well to other areas of the wetland (e.g., areas with different vegetation or depths), making quantification of water levels for different wetland types more generalizable without adding more sites or wells.	July 18, 2024	Yes	August 6, 2024
5	Amendment Request	• Other • Budget - Capital, Equipment, Tools, and Supplies • Budget - Travel and Conferences • Budget - Non-ENRTF Funds Contributed	Move $15,000 from Equipment to Travel Miles/ Meals/ Lodging, Equipment expenditures are coming in under budget. Move $375 from Conferences In-state to Travel Miles/ Meals/ Lodging, no further expenses coming in for Conferences In-state. Move $113 from Conferences Out-state to Travel Miles/ Meals/ Lodging, no further expenses coming in for Conferences out-state. Increases to the Travel budget are necessary in anticipation of one more field season on this grant pending final legislative approval.	May 1, 2025	Yes	May 20, 2025
6	Completion Date	Previous Completion Date: 06/30/2025 New Completion Date: 06/30/2026; Governor Approved on 06/14/2025	Initial work was delayed due to a hiring freeze that prevented the hiring of a key position supported by the grant until May 2022, 9 months after the work plan was approved. Related, this project's outcomes relied on the outcomes of an EPA grant, which were delayed due to pandemic travel restrictions. While we will install all 40 sites by the appropriation end date, we will not complete all soil and vegetation surveys.	December 9, 2024	Yes	June 25, 2025

7	Amendment Request	• Activities and Milestones • Budget - Professional / Technical Contracts • Budget - Capital, Equipment, Tools, and Supplies • Budget - Travel and Conferences	Updated activities and milestones to reflect remaining project timeline. Moved $18,000 from equipment to Red Lake sub-award ($1,500 for 2 more site visits with extension), in-state travel ($15,000 for 2-4 trips to each site with surveys and maintenance), and new equipment request ($1,500 to support staff hiking through wet and forested habitat to sites). Equipment expenditures are coming in under budget.	August 7, 2025	Yes	August 8, 2025

Status Update Reporting

Final Status Update August 14, 2026

Date Submitted: October 22, 2026

Date Approved: October 22, 2026

Overall Update

Since the last update, we have completed field visits to perform maintenance and download hydrology data. We also completed the final report. To help improve the design and implementation of wetland restoration and management projects (outcome 1), hydrology data are now available online for restoration practitioners to access. We will continue advertising this datasets to the wetland professional community. To improve our understanding of how alterations to groundwater affect wetlands and their associated benefits and allow more informed and objective management of both wetlands and groundwater (outcome 2), we are using the data to inform wetland thresholds (see dissemination and report). To improve our understanding of the relationship between hydrology and wetland plant communities (outcome 3), we now have high quality vegetation data across a range of wetlands that we have used to describe our sites and explore hydrologic niches (see report). To reveal long-term changes to the state's wetlands that may result from a variety of factors such as land use changes, climatic changes and changes in surface and groundwater use (outcome 4), the DNR is maintaining monitoring at the wetland sites to accumulate long-term datasets.

Activity 1

Since the last update, we visited all 60 sites to download winter data and perform site maintenance (replacing broken loggers and re-calibrating wells that shifted due to freezing). We completed all 60 reference marker surveys. Overall, we identified and installed all sites, performed initial data analysis, and produced a project completion report. Initial data analysis includes pairing water level data with precipitation, soil, and vegetation data to produce full descriptions of the sites, examining the long-term normal, infrequent, and rare water levels in a prototype hydrograph, and evaluating water level ranges for a selection of wetland plant species. We are finding that sites of the same general wetland type (e.g., shallow marsh, fen) can differ greatly in water levels and sensitivity to precipitation. In addition, the prototype hydrograph suggests a single site can experience a wide range of water levels over long time periods. Therefore, wetland vegetation communities, when defined broadly, may be robust to a range of water levels. This informs next steps in two ways: how to make comparisons to other wetlands (see Activity 2) and how to approach wetland thresholds (see Dissemination).

(This activity marked as complete as of this status update)

Activity 2

Since the last update, we used the vegetation, soils, and bathymetry data to create figures describing the wetland sites in our project report. Overall, we conducted 37 vegetation surveys, 60 soil surveys, and 4 bathymetry surveys. Three of the sites had vegetation surveys performed by the MN DNR's (LCCMR funded) Ecological Monitoring Network prior to well installation, so we used the data from those surveys instead of re-surveying. These datasets can be used to evaluate the hydrology of restored or impacted wetlands. One evaluation approach may be to generalize the hydrology of all wetlands in our dataset of the same type (e.g., shallow marsh), which would likely lead to a wide range of target hydrology. Another approach is to identify wetlands within our dataset that have comparable species composition and soils to the wetland of interest, which would lead to a more constrained range of target hydrology. Our vegetation and soil surveys make these specific comparisons possible. Bathymetry and water depth measurements collected during the vegetation survey can help translate the water levels at the well to other areas of the wetland in case those are more comparable to the wetland of interest.

(This activity marked as complete as of this status update)

Dissemination

As included in our report, our water level data, site descriptions, and maps are now all available on the DNR's Cooperative Stream Gaging website and Cooperative Groundwater Monitoring website. The soils data are available on the NASIS reports website. The links to these websites are provided in our project report. As described in our Dissemination Description, we presented our plans to use the data collected from this project for wetland thresholds development at the Water Resources Conference in 2023. We continued presenting and developing these ideas internally at the DNR and in external presentations. We are currently working with a MN Sea Grant Fellow to draft wetland thresholds. We are using literature review to identify hydrologic sensitivities of plant species and specific plant communities (i.e., rather than broadly defined wetland plant communities). Our vegetation surveys and hydrology data will supplement the literature review. We will use long-term data from our sites to understand where and when these sensitivities can matter. While we are using our available data to inform threshold development, many of the wells have few years of data, and so will not become fully implemented into threshold development for several years.

Status Update Reporting

Status Update May 1, 2026

Date Submitted: May 12, 2026

Date Approved: May 19, 2026

Overall Update
Since the last update, we have completed data review, processing, and storage. We are now completing field visits to perform maintenance and download hydrology data. We are also working on the final report.

Activity 1
We have reviewed wetland hydrology data for irregularities caused by freezing, muck build-up, or sensor malfunctions. Hydrologists correct or omit data with irregularities. We are creating figures and tables for the report. We are in the process of visiting all 60 sites to download winter data and perform site maintenance. Maintenance involves replacing broken loggers and re-calibrating wells that shifted due to freezing. We have completed downloads and maintenance at 44 sites, will visit 16 sites, and will re-visit 3 sites to do additional maintenance that couldn't be completed during the initial visit. One more reference marker survey will be done this spring and the other 59 are complete. We will spend some more budget for these last field visits between now and the end of the grant.

Activity 2
The vegetation data was checked for errors, formatted to create consistency across years, and stored in an ArcGIS enterprise geodatabase. The bathymetry data were stored as CSV files with HTML metadata files. Paper data sheets used to collect soils data were scanned and the soil descriptions were entered into the NRCS National Soil Information System database, checking for errors during data entry. We are now using these datasets to create figures and tables for the report.

Dissemination
Jennie Skancke presented this project to the Wetlands course at Minnesota State Mankato on April 13th, 2026. Amy Kendig presented the project to Minnesota Sea Grant fellows on March 20th, 2026. Both presentations, as well as older presentations, were uploaded as attachments.

Status Update Reporting

Status Update November 1, 2025

Date Submitted: November 2, 2025

Date Approved: January 27, 2026

Overall Update
We have successfully installed all 40 wetland monitoring sites and have completed baseline vegetation and soil surveys and complimentary bathymetry surveys. We plan to finish data entry and management activities over the next few months, at which time we can conduct data summarizing and analyses for the final report. We also plan to visit the wetland sites in spring 2026 to download additional data (which likely will not be in the report) and perform equipment maintenance and repairs.

Activity 1
Since our last update, we installed the last water level monitoring well. We have completed installation of all 40 wells. We have also visited all previously installed wells to download the data collected over the summer and perform equipment maintenance and repairs. We are in the process of surveying reference markers for the sites installed this year so that we have measurements of elevation relative to sea level. Data will be reviewed over the winter.

Activity 2
Since our last update, we completed the last vegetation survey, bringing our total to 40 sites. We have also completed the last 16 soil surveys, bringing our total to 60 sites. We are in the process of storing the data in databases.

Dissemination
Amy presented this project to an Aquatic Ecology class at Macalester College and at the Minnesota Biological Survey's fall meeting.

Additional Status Update Reporting

Additional Status Update August 7, 2025

Date Submitted: August 7, 2025

Date Approved: August 8, 2025

Overall Update
Since the last update in May, 2025, we have completed installation of six additional wells, vegetation surveys at 20 additional sites, and soil surveys at one additional site.

Activity 1
We have installed wells at six sites, bringing our total installations to 39 sites out of 40 with this LCCMR grant. We therefore have one site left to install. This is the site with the state endangered plant species, and a well location was selected in July to avoid harm to the species. This site will then be installed in the fall when the plants are dormant. We have visited all installed sites this spring to download data and perform maintenance.

Activity 2
We completed vegetation surveys at 20 additional sites, bringing our total to 39/40 sites for this grant (or 59/60 for the entire network). The final site was visited by the botanists, and it was determined that a modified survey design was needed, so they will return to the site this summer to complete the survey. We completed one soil survey, bringing our total to 44/60 sites. The final 16 sites will be surveyed in September and October of this year. We were unable to collect additional bathymetry data this spring and summer due to weather conditions, but if water levels are low enough in the fall, we will visit additional sites.

Dissemination
We included a description of this project and acknowledgement of LCCMR's funding in the DNR's 2025 Water Availability and Assessment Report, which is an appendix tot the 2025 EQB Water Policy Report and will be publicly available online (see 2020 report here: https://files.dnr.state.mn.us/aboutdnr/reports/legislative/2020-water-availability-assessment.pdf).

Status Update Reporting

Status Update May 1, 2025

Date Submitted: May 1, 2025

Date Approved: May 20, 2025

Overall Update
We have installed five more wells and have seven left to go. We have consistently maintained the installed wells and downloaded their data twice per year. We plan to complete bathymetry, vegetation, and soil surveys this year, given approval of the grant's extension.

Activity 1
Since the last update, we have installed wells at five sites, bringing our total installations to 33 sites out of 40 with this LCCMR grant. We therefore have seven sites left to install. We plan to install six of the sites this spring. The seventh site has a state endangered plant species, so we will go with a botanist in early to July, when the plant is flowering, to ensure the selected location will not cause harm to the species. This site will then be installed in the fall when the plants are dormant. We are currently visiting existing sites to download data and perform maintenance.

Activity 2
We have not collected data on soils, bathymetry, or vegetation since the last update.

Dissemination
Our water level data are actively being used by the wetland community. A presentation by BWSR to the Minnesota Wetland Professionals Association in January featured our data. We responded to a data request in April for an engineering firm to use our data as a benchmark for wetland bank site monitoring. We have uploaded our data to accompany timelapse photos on USGS's Flow Photo Explorer – this is to support a new effort to characterize time series of wetlands (water levels, vegetation stages) with photos and AI models (https://www.usgs.gov/apps/ecosheds/fpe/#/explorer/378, https://www.usgs.gov/apps/ecosheds/fpe/#/explorer/379).

Status Update Reporting

Status Update November 1, 2024

Date Submitted: November 27, 2024

Date Approved: December 2, 2024

Overall Update
Since the last update, we made significant progress establishing sites and collecting soil and vegetation data. Overall, we have completed over half of the well installations (28/40), almost half of the vegetation surveys (19/40), and over two-thirds of the soil surveys (43/60). All wells will be installed by the current project end date. No additional vegetation surveys and soil surveys will be conducted before the current project end date because these must occur in late summer and fall, respectively, to maintain consistency with completed surveys.

Activity 1
This summer, we visited the remaining potential wetland sites to select well locations, and have received approval for installation at all but one site. The last site is in the process of getting installation approval. We have installed wells at seven sites so far this fall, bringing our total installations to 28 sites with this LCCMR grant and 20 sites with a preceding grant. We have visited most of the existing sites to download data and perform maintenance. We are planning more field work for additional well installations and site maintenance.

Activity 2
We completed soil surveys at 22 additional sites this year, bringing our total to 43 sites. We completed vegetation surveys at 19 sites this year, bringing our total to 39 sites (20 sites completed on the preceding grant). We conducted basin-wide bathymetry surveys at three wetlands with heterogeneous vegetation and collected a handful of key elevation points from two more wetlands. We are planning to collect bathymetry surveys from at least three additional wetlands by the current project end date, pending appropriate weather conditions.

Dissemination
We did not complete additional dissemination activities since our last update.

Status Update Reporting

Status Update May 1, 2024

Date Submitted: April 23, 2024

Date Approved: July 3, 2024

Overall Update
Since the last update, we have worked with partners within and outside of the DNR to identify candidates for the last 19 sites that need to be installed this fall. Once these sites have been installed and surveyed for vegetation and soils, the primary objective of this grant will have been met. Overall, we have installed monitoring wells at 21 sites since the grant began. We have also initiated discussions within the DNR to plan more specifically how the wetland data could be used to assess impacts to wetlands. This included writing a project description, which was heavily informed by discussions with external contacts who have worked on or been interested in wetland hydrology impacts, as reported in previous dissemination updates.

Activity 1
We identified 19 potential sites for installation of wetland hydrology monitoring equipment in fall 2024. Fall is the best time for installations because drier conditions make it easier to dig the well. We have visited 4 sites in person, selected well locations, and received approval from land managers. The remain 15 sites are in various stages of preliminary approval, and we will visit them in person to select well locations, and then request final approval, this summer. We have also scheduled spring 2024 field work to download data and check equipment at existing sites (which include 21 sites established with this LCCMR grand and 20 sites established with an EPA grant before the LCCMR grant began).

Activity 2
We completed baseline soil surveys at 21 sites (3 completed after last status update was submitted). We have scheduled summer and fall field work to do vegetation and soil surveys.

Dissemination
Jennie Skancke (project co-lead) presented this project at The Nature Conservancy Science Slam in January. Jeff Lee presented his work on the soil surveys at the Biodiversity Annual Reports, also in January, which is a virtual symposium hosted by biodiversity-focused units in the DNR and attended by internal and external partners. Amy presented this project at Lunch with a Scientist at Cedar Creek Ecosystem Science Reserve in April, which was followed up with an article in their newsletter: https://cbs.umn.edu/blog-posts/well-well-wetlands. We now have the hydrology data accessible through the Cooperative Stream Gaging website (example: https://www.dnr.state.mn.us/waters/csg/site.html?id=24007504), and are working on a method to link to all the individual site pages on the project website.

Status Update Reporting

Status Update November 1, 2023

Date Submitted: October 31, 2023

Date Approved: January 31, 2024

Overall Update
Since the last update, we have increased the number and variety of sites within the wetland hydrology monitoring network, which brings us closer to the project outcomes. Overall, data collected from sites that span different wetland types and geographies of Minnesota will help us inform wetland restoration goals, groundwater management goals, and long-term changes in wetlands. Budget notes: The Department had end-of-biennium State funds available that we could use to contribute to this project. We used those State funds to redirect $28K of equipment purchases that had been previously reported to LCCMR as being paid for by the grant. Thus, our total expenditures for equipment for the Nov. 1, 2023 update are $28K less than the amount reported with the May 1, 2023 update. Also, the EPA grant under non-ENTRF funds was closed and we've updated the final value spent, which was less than previously estimated.

Activity 1
Establishing wetland hydrology monitoring equipment involves several steps: selecting potential reference condition sites using GIS resources and land manager knowledge, visiting sites in person to verify the wetland type and condition, applying for a permit or establishing an agreement with the land management unit, and installing the water level monitoring equipment. This winter and spring, we identified approximately 50 potential sites. This summer, we visited 26 potential sites and requested permission to establish 21 sites. This fall, we installed 15 new monitoring sites. The remaining six sites either have been granted installation permission or we are in the process of getting permission. The new sites extend our network north. Our furthest north site was previously in Mille Lacs Kathio State Park and now our sites reach up to Pembina Trail SNA, outside of Crookston, MN, and Bear Head Lake State Park, outside of Ely, MN. Our total network has 40 established sites, with 20 established with the LCCMR grant.

Activity 2
We completed baseline soil surveys at 18 sites. We also tested woody vegetation methods in the field and wrote project methods for these.

Dissemination
We presented this project at the Ecological Society of America Annual Meeting and the Minnesota Water Resources Conference (attachments included). We have also presented the project to smaller groups, including the Minnesota DNR Groundwater Technical Unit, Wisconsin DNR wetland researchers, Anoka County Conservation District wetland researchers, and a group in the UK that developed ecohydrological guidelines for groundwater withdrawal impacts on wetlands. We hosted a site visit at Lake Maria State Park for leaders within the DNR, including the Ecological and Water Resources Division director and assistant director. While installing new sites this fall, we were accompanied by representatives of the Anoka County Conservation District and DNR Scientific and Natural Areas, with whom we shared project goals and methods.

Status Update Reporting

Status Update May 1, 2023

Date Submitted: May 2, 2023

Date Approved: May 8, 2023

Overall Update
During the winter of 2022–2023, we disseminated results through a project report and virtual presentation. We identified 21 land management units that are potential sites for installation this year, further expanding our network into northern Minnesota. We also purchased equipment to install wells this spring, summer, and fall.

Activity 1
We discussed the project and potential site locations with wetland researchers from various agencies (botanists and regional ecologists within DNR, The Nature Conservancy, Red Lake DNR, USFW). We used these discussions and GIS resources to identify 21 land management units with potential sites (some with more than one site). We have reached out to nine land managers to discuss the possibility of setting up sites, all with positive responses so far. Ten of the other land management units are part of entities with existing working relationships with this project (e.g., state parks). We've scheduled three trips to visit these potential sites.

Activity 2
We discussed methods for characterizing forested wetlands with DNR botanists and forest ecologists. We will try these methods at two of our existing sites this summer: Mille-Lacs Kathio State Park and St. Croix State Park. We also discussed methods for collecting soil samples with the project's soil scientist.

Dissemination
We wrote a report on the motivation, methods, and preliminary results of our project and made it publicly available at the bottom of our website: https://www.dnr.state.mn.us/wetlands/wetlands-hydrology-monitoring.html. We found that average wetland water levels varied considerably among sites, but that wetlands within the same categories (e.g., fens, shallow marshes) had similar temporal trends. Trends likely coincided due to high correlations with precipitation, especially in 2022. We presented the project in the Minnesota Biological Survey's Annual Biodiversity Reports on December 21, 2022. This online event was attended by approximately 280 people. We submitted abstracts to the Minnesota Water Resources Conference and the Ecological Society of America Annual Meeting.

Status Update Reporting

Status Update November 1, 2022

Date Submitted: February 21, 2023

Date Approved: May 8, 2023

Overall Update

During the summer of 2022, we grew our wetland hydrology monitoring network to 25 sites. The new sites increase replication of existing sites, add new wetland community types to our network, and expand the geographic coverage of our network more into the Laurentian Mixed Forest province. In addition, we have streamlined our protocols for data collection and data analysis. We have also drafted portions of a project report for our collaborators at the land management units where sites are located (e.g., wildlife management areas, state parks). Finally, we published a website about the project.

Activity 1

We used GIS to identify twelve sites in eight land management units in spring and summer of 2022. We visited all land management units and chose seven sites to include in our network. Five sites were not selected because they were not the wetland type expected based on GIS (and were redundant for our project) or the hydrology at the site was impacted by human activity. We installed five of the seven selected sites. The two remaining sites will likely be installed in spring 2023. They were not yet installed because one will be monitored for hydrological responses to a planned nearby drawdown in spring 2023 and the other requires additional equipment planning because it is in a floodplain. We plan to identify additional potential sites this winter that can be visited and possibly established in the spring or early summer of 2023. All established sites were visited in October 2022 for data downloads and equipment checks. We updated our data collection protocols to measure ground elevation at each visit, which is necessary for translating hydrographs at our specific sites to general hydrographs that can be used to meet the project outcomes.

Activity 2

We have written code in R to analyze our existing vegetation surveys. Species names in the vegetation surveys have been linked to the National Wetland Plant List and Wetland Plants and Plant Communities of Minnesota and Wisconsin (both are publications of the US Army Corps of Engineers). We have generated descriptive bar charts and statistics (species richness, diversity, evenness) for the vegetation communities at each site. No additional vegetation surveys were conducted this summer because the new sites were not installed until this summer. We plan to conduct vegetation surveys at newly established sites in summer 2023.

Dissemination

The hydrology data collected from our sites has been added to the WISKI database used by DNR hydrologists to store groundwater and stream gauge data. The hydrologists who work with our project have reviewed and cleaned up the data. It is available through WISKI's KIWIS app, which is publicly accessible (with guidance from one of the project staff), but not yet publicized. We have written code in R to download hydrology and nearby weather station data for our sites. We have created hydrographs for each site, which we are finalizing for our project report. Finally, we created a website for the project: https://www.dnr.state.mn.us/wetlands/wetlands-hydrology-monitoring.html.

Status Update Reporting

Status Update May 1, 2022

Date Submitted: June 7, 2022

Date Approved: June 10, 2022

Overall Update
Since proposing the project, we have learned more from our prior wetland monitoring site installations about methods appropriate for our research questions. We have identified water level sensors and well materials that are more stable during winter freezing and that better measure belowground water depths. We have replaced the old equipment in our established sites and are using this new equipment in new sites. We have also had productive discussions with wetland experts within and outside of the DNR to develop methods for wetland types that we do not yet have experience monitoring, especially floodplain wetlands. We will set up a floodplain wetland site this summer to understand the strengths and limitations of our monitoring approaches for this wetland type before establishing additional floodplain sites.

Activity 1
10 of 40 sites have been identified and equipment installation planned for summer 2022. Equipment purchased for 19 stations. We are aiming to identify 10 more sites by October 31, 2022, putting us behind our goal of 40 sites. Site identification has slowed due to limited “reference conditions” in the state, especially that are known by our research group. While the first 30 sites (20 established prior to this grant) were in areas we are familiar with, we are now reaching out to local DNR offices and using GIS resources to identify additional sites that meet our criteria. Site identification also involves physically visiting the site to ensure that hydrology is unimpeded and that the site fits the expected category (e.g., a shallow marsh). A hiring freeze due to Covid-19 delayed staffing, which slowed the overall progress of the project. We expect to identify all 40 sites by July 31, 2023. We aim to have 10 sites installed by October 31, 2022 and an additional 10 sites installed by July 31, 2023.

Activity 2
We have not yet completed vegetation surveys. These will be conducted after equipment has been installed at the site because the well location is used in the survey design. We expect to survey the first 20 sites by September 30, 2023.

Dissemination
No dissemination yet.