Environment and Natural Resources Trust Fund

M.L. 2022 Approved Work Plan

General Information

ID Number: 2022-166

Staff Lead: LCCMR General Universal Staff User

Date this document submitted to LCCMR: June 22, 2022

Project Title: Increased Intense Rain and Flooding in Minnesota's Watersheds

Project Budget: $192,000

Project Manager Information

Name: Jason Ulrich

Organization: Science Museum of Minnesota - St. Croix Watershed Research Station

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Project Reporting

Date Work Plan Approved by LCCMR: June 27, 2022

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

Project Completion: June 30, 2025

Final Report Due Date: August 14, 2025

Legal Information

Legal Citation: M.L. 2022, Chp. 94, Art. , Sec. 2, Subd. 04h

Appropriation Language: $192,000 the second year is from the trust fund to the Science Museum of Minnesota for the St. Croix Watershed Research Station to partner with local communities to determine the causes of increased flooding and the most cost-effective solutions for reducing flood risk in the Cottonwood River watershed and other agricultural watersheds in southern Minnesota.

Appropriation End Date: June 30, 2025

Narrative

Project Summary: The causes of increased flooding and the most cost-effective solutions for reducing flood risk will be determined for the Cottonwood River watershed and nine other agricultural watersheds in southern Minnesota.

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

In recent decades, many river communities across southern Minnesota's agricultural watersheds have seen a marked increase in flooding. In particular, research has shown the Cottonwood River watershed to be an epicenter of increased major flooding, as evidenced by the City of Springfield on the Cottonwood River experiencing several damaging floods in the last decade.

Suggested causes for increased flooding include increases in intense rain events, increased overall precipitation as well as a history of continual agricultural land alteration; however, there is still a lack of scientific consensus and usable information as to the relative importance of each of these potential causes.

As a result, many communities and watersheds are struggling to answer the following questions:
-What are the primary causes of recent increases in flooding?
-What is the relative importance of each of these causes?
-Based on these answers, what are the most cost-effective solutions for reducing flood risk?

An opportunity exists to fill a gap in our understanding of increased flooding in our agricultural watersheds. Filling this gap will ensure future flood planning -- and our State-wide narrative regarding flooding and its causes -- are informed by sound science and economic practicality.

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.

We propose quantifying the relative importance of potential causes of recent flooding in ten major, agricultural watersheds in southern Minnesota. With this information, we will then analyze the most cost-effective solutions to reduce future flood risk in these areas.

First, we will focus on the Cottonwood watershed because of its location at the center of recent flood increases, and its current, specific need for the proposed project results; the City of Springfield will provide a local perspective on the need for the project.

Our approach will be to develop a very detailed watershed model of the Cottonwood watershed to analyze past flood events from 1950-2020 to understand the causes and how they may have changed over time, including (but not limited to):
-Increases in intense storms
-Increases in overall precipitation
-Decreases in watershed storage (e.g., draining of wetlands, loss of soil-water storage)

Then, the model will be used to test and optimize solutions for reducing future flood risk based on cost and effectiveness. Last, the detailed analysis and results for the Cottonwood River watershed will be extended to the other nine project watersheds (to be determined) using a more generalized approach.

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 will include:
-A first-of-its-kind, quantitative understanding of the relative causes of flooding in ten major agricultural watersheds.

-Analyses of cost-effective solutions for reducing future flood risk in these ten watersheds.
-The Cottonwood watershed (including the City of Springfield) will receive needed information relevant to their current challenges and future planning efforts.

These outcomes will help State agencies, watershed organizations, counties, and municipalities develop - and successfully fund - cost-effective strategies to reduce future flood risk.

An overarching outcome will be providing needed science-based information to policy-makers and the general public regarding this important and often contentious issue.

Project Location

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

Region(s): SE, SW,

What is the best scale to describe the area impacted by your work?

Region(s): SE, SW,

When will the work impact occur?

During the Project and In the Future

Activities and Milestones

Activity 1: Conduct detailed analysis and modeling of Cottonwood River watershed to quantify relative importance of flood causes.

Activity Budget: $70,000

Activity Description:
Our approach entails first intensively modeling the entire Cottonwood River watershed with specific focus on major towns on the river (e.g., Springfield, New Ulm). The Cottonwood will be modeled using the watershed model SWAT. The model will be developed to explicitly incorporate the most relevant hydrologic/flooding factors including climate, extent of drain tile, extent of row-crop agriculture, local tillage practices, and depressional/wetland/lake storage -- and how these factors have changed over time from 1950-2020. The model will be primarily calibrated and validated using USGS flow gauging data at New Ulm and with other flow data as available. Once this ”base-condition” model is completed it will be iteratively modified to alter (e.g., increase, decrease, or remove) the extents of the hydrologic/flooding factors individually. The comparison between the base-condition model results and each set of modified model results will quantify the flooding impact and relative importance of each cause/factor.

An important part of this Activity will be quarterly meetings with a technical advisory committee (TAC) which will review work progress and provide expert guidance. The TAC will consist of the local groups/agencies (Redwood-Cottonwood-Rivers-Control-Area, City of Springfield, SWCDs), as well as MPCA and DNR.

Activity Milestones:

Description	Approximate Completion Date
Gather necessary climate and watershed data (soils, LiDAR, landuse, drain tile extent, wetland storage, etc.).	December 31, 2022
Construct and calibrate watershed model.	May 31, 2023
Run watershed model simulations and analyze results to quantify relative importance of flood causes/factors.	October 31, 2023

Activity 2: Simulate solutions for reducing future flood risk in the Cottonwood watershed and calculate cost-effectiveness.

Activity Budget: $50,000

Activity Description:
Activity 2 entails using the completed, calibrated model and analyses of relative importance from Activity 1 to simulate different solutions for reducing flood risk in the Cottonwood watershed. Solutions will consist of one or more specific practices such as (but not limited to):
-“Mitigative”: Increasing upstream, field-scale storage (e.g., wetland restorations, controlled drainage, cover-cropping/no-till, land retirement).
-“Adaptive”: Increasing downstream, on-river storage (e.g., dams and impoundments) and construction of protective levees.

For each solution, the model will be modified to reflect the presence of the solution's practices. The simulations of the solution-modified model will be compared to the current, “base-condition” model simulations to quantify the effectiveness of each solution on flooding (in terms of reduction of flood risk) at different locations in the watershed. Cost and cost-effectiveness (a ratio of the dollars spent per unit effectiveness) will be calculated based on current published ranges of costs and the model-simulated effectiveness associated with each solution's practices. Last, the

solutions will be ranked and optimized by cost-effectiveness.

As with Activity 1, the project's technical advisory committee (TAC) will meet quarterly to discuss progress and provide expert guidance.

Activity Milestones:

Description	Approximate Completion Date
Select solutions and practices to be analyzed for cost-effectiveness.	December 31, 2023
Modify watershed model to analyze cost-effectiveness of solutions and practices.	April 30, 2024
Run watershed model solution simulations and summarize all Cottonwood findings.	August 31, 2024

Activity 3: Extend results of Cottonwood watershed analyses to the other project watersheds.

Activity Budget: $72,000

Activity Description:
Activity 3 entails extending results from Activities 1-2 to nine additional agricultural watersheds in Southern Minnesota (TBD). These watersheds will be selected based on the availability of relatively complete precipitation and flow data, and their general similarity in terms of climate and landscape causes/factors (soils, extent of agriculture, watershed storage, etc.). Then, to ensure the applicability of the Cottonwood SWAT modeling results to the additional study watersheds, a SWAT model will be created for one of the nine (non-Cottonwood) study watersheds; the rigor of this model's parameterization/calibration will be largely consistent with the Cottonwood SWAT model except to reduce the cost/effort the model will be constructed only for the flood reduction/cost-effectiveness period (2010-2020; plus 2007-2009 for model warmup), will not be constructed with time-varying drain tile and storage. Last, a statistical, GIS-based framework will be constructed to correlate/extend results from Activities 1-3 to the eight additional watersheds based on their shared climate and landscape causes/factors.

Much of the activity will be concerned with communicating the goals, progress and results of the project (See Dissemination section).

Activity Milestones:

Description	Approximate Completion Date
Select additional project watersheds and gather necessary data.	October 31, 2024
Develop SWAT model for an additional project watershed.	December 31, 2024
Develop and execute statistical, GIS-based framework to extend Cottonwood results to all project watersheds.	February 28, 2025
Develop reporting/outreach/dissemination deliverables.	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Shawn Schottler	Science Museum of Minnesota - St. Croix Watershed Research Station	Dr. Schottler will assist and advice in all phases of the project.	Yes
Dr. Bruce Wilson	University of Minnesota - Department of Bioproducts and Biosystems Engineering	Dr. Wilson will assist and provide advisement in all Project Activities -- primarily, the modeling and statistical analysis aspects of Activities 1-3.	No
Kerry Netzke	Redwood-Cottonwood Rivers Control Area	Ms. Netzke is the executive director of the Redwood-Cottonwood Rivers Control Area. She will provide advice from a stakeholder's perspective based on her experience in the Cottonwood watershed and her extensive local knowledge of the issues around water and agriculture. She will also assist in coordinating outreach and communication deliverables.	No
Joe Stremcha	City of Springfield, MN	Mr. Stremcha is City Manager of Springfield and will provide assistance in gathering data necessary for modeling and analysis in Activities 1-2. He will also help coordinate outreach and communication deliverables in Activity 3.	No
Melanie Krueger	Brown County Soil and Water Conservation District	Ms. Krueger is District Manager of the Brown County SWCD, and will provide advice and data gathering assistance, and will participate in the periodic technical advisory meetings	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.
As described in Activity 3, significant project resources will be allocated to provide as many means as possible to share the project's results to stakeholders and interested parties State-wide. The planned Dissemination activities/deliverables will include:

(1) A full report with all project methodologies, results and conclusions/recommendations presented to LCCMR; the report as well as GIS files will be placed on Science Museum websites for sharing/download.
(2) A Cottonwood watershed-specific report with all project methodologies, results and conclusions/recommendations directly relevant to the City of Springfield and Cottonwood watershed.
(3) One or more public meetings will held in the City of Springfield to inform regional stakeholders and citizens of the project results.
(4) The results will be presented at two or more professional/scientific MN/regional conferences in the last year of the project.
(5) Project-related social media posts will be created and posted to Science Museum social media outlets; these posts will highlight the aims of the projects and incremental results as the project progresses; posts will include links to the completed project results (e.g., reports, GIS files).

All written and electronic files/documents/social media posts/presentations related to the project will prominently feature the ENRTF logo on the title pages; and in the case of presentations and meetings, the ENRTF will be verbally

acknowledged as well. Any scientific manuscripts will include notice of ENRTF funding and support within their respective Acknowledgements sections.

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?

As described in Activity 3, implementation will consist of conveying the project results via many different outreach/communication deliverables: reports, fact-sheets, public meetings, social media posts, and presentations at conferences. The intent is to provide as many means possible to share the project's results to stakeholders and interested parties State-wide. Further, the completed Cottonwood watershed model developed in the project will be available to anyone to use in the future with no additional funding required.

All project implementation will take place within the funded project timeline. However, the project results could be extended State-wide with future funding.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Develop Market-Based Alternatives for Perennial Crops to Benefit Water Quality and Wildlife	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 08c	$150,000
Mapping Unprofitable Cropland for Water and Wildlife	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 04n	$100,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Assistant Scientist		Project manager, primary modeler, analyst; developer of outreach/communication deliverables			30%	1.6		$124,000
Senior Scientist		Assist and advise with modeling, analysis, development of outreach/communication deliverables			30%	0.6		$63,000
							Sub Total	**$187,000**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	1 license for modeling, GIS, programming or statistical analysis software	Used for advanced analyses; modification of model and analytical source codes					$1,000
							Sub Total	**$1,000**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Five 320-mile round-trips to Cottonwood watershed area for 1 person plus intra-watershed travel - total of 2,000 miles; plus meals and 5 nights lodging.	Meetings and data collection during model development; progress meetings and outreach activities; presentations and meetings with gov't staff and general public.					$2,000

	Conference Registration Miles/ Meals/ Lodging	2 trips to conferences + registration: 400 miles round-trip per for 1 person; plus meals and lodging	Present results of project to professional and/or farm-group conference audiences.					$1,500
							Sub Total	**$3,500**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Printing	Hard-copy printing costs	Producing multiple copies of bound final reports; printing presentation posters					$500
							Sub Total	**$500**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$192,000**

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	Science Museum of Minnesota	Support services from Science Museum of Minnesota 40.83% of direct costs	Secured	$76,352
In-Kind	City of Springfield - 25 hours of engineering staff time	Help in data collection and coordinating/hosting meetings.	Secured	$4,075
In-Kind	Brown County Soil and Water Conservation District -- staff time	Technical staff time for help with data collection and project advisement	Secured	$3,000
			Non State Sub Total	**$83,427**
			Funds Total	**$83,427**

Attachments

Required Attachments

Visual Component

File: 583997fe-f91.pdf

Alternate Text for Visual Component

Graphic illustrates proposal to understand causes of recent flooding in southern Minnesota's agricultural watersheds and to determine cost-effective solutions for reducing future flood risk. The project proposes first studying the Cottonwood watershed, an epicenter of increased flooding, and then extending these results to nine other agricultural watersheds in southern Minnesota,...

Optional Attachments

Support Letter or Other

Title	File
Redwood-Cottonwood Rivers Control Area - Letter of Support	b2ba3e6c-1db.pdf
City of Springfield, MN - Letter of Support	2e3ef264-226.pdf
Brown County Soil and Water Conservation District - Letter of Support	e9ffe2ca-b18.pdf
Science Museum of Minnesota - Organizational Letter of Support	feb9c865-217.pdf
LCCMR 2022-166 Ulrich_ResearchAddendum	5e311d45-8f3.pdf
Background Check	44cef685-bf9.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

Initial Revision: No substantive changes other than changing the project term from 2 to 3 years and changing Activity completion dates to reflect this change.

Additional Revisions (6/22/22): Added text in Activity 3 for development of an additional SWAT model and added an additional Milestone to reflect this effort (Also: removed text from Activity 3 description that was redundant to that outlined in Dissemination section). Added text to Dissemination section describing how the ENRTF will be acknowledged in project deliverables.

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 Commissioner's Plan.

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

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

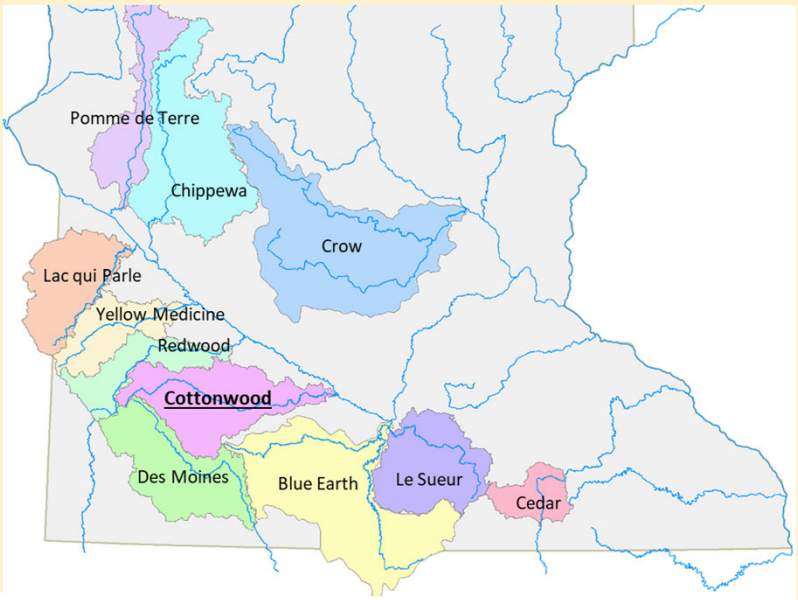
Does the organization have a fiscal agent for this project?

No

Project Title: Increased Intense Rain and Flooding in Minnesota Watersheds

Flooding has increased in many of Minnesota's agricultural watersheds.

Cottonwood River watershed an epicenter of recent increases



Map of Cottonwood watershed and possible additional project watersheds (TBD)

MN river communities struggling to find economical solutions for reducing flood damage because exact causes remain unclear:

Increases in Intense Rain or Agricultural Land Alteration?

- **We will *quantify the causes of recent flooding* and determine *cost-effective solutions for reducing flood risk* in the Cottonwood River watershed.**
- **These results will then be extended to nine additional watersheds.**