



Environment and Natural Resources Trust Fund

2021 Request for Proposal

General Information

Proposal ID: 2021-076

Proposal Title: Will BMPs Be Effective with Increased Precipitation Variability?

Project Manager Information

Name: Ryan Noe

Organization: U of MN - Humphrey School of Public Affairs

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Project Basic Information

Project Summary: Expected changes in precipitation patterns are likely to negatively impact nitrate leaching mitigation practices. We will produce a report on the efficacy of best management practices under changing precipitation regimes.

Funds Requested: \$63,000

Proposed Project Completion: 2023-06-30

LCCMR Funding Category: Small Projects (H)

Secondary Category: Water Resources (B)

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

Narrative

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

Best management practices (BMPs) offer a means of maintaining crop productivity while reducing leaching of nitrate into sourcewater. BMPs receive millions of dollars in state and federal funding and are a primary tool to protect water quality and public health in high risk wellhead protection areas throughout the state, but current recommendations on BMP design, implementation, and effectiveness in Minnesota do not account for expected changes in temperature and precipitation.

Previous research in Oklahoma found a 43% increase in maximum monthly nitrogen load between BMPs under current and future climate conditions (Hou et al. 2019). New high resolution climate projections funded by ENRTF M.L. 2015, Chp. 76.2.04a (z.umn.edu/mn-climate-change-report) provide the best available insight into expected future changes in precipitation and temperature over the next 30 to 100 years. These projections suggest an increase in intensity of rain events and a shift toward wetter springs. Both heavier rains, and rain that happens closer to the time of fertilizer application are risks to keeping drinking water safe not currently accounted for in BMP policy and expenditures.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

The Minnesota Department of Agriculture (MDA) is assessing the amount of BMPs needed to maintain safe drinking water in high risk drinking water supply management areas (DWSMAs). This analysis is missing an assessment of the impacts of climate changes on BMP effectiveness. We will collaborate with MDA to assess the ability of BMPs to maintain safe drinking water with projected shifts in precipitation timing and intensity.

The project can produce outsized results relative to its cost by leveraging MDA's existing modeling efforts, along with insights and data from two previously funded LCCMR projects (z.umn.edu/mn-climate-change-report) that have developed high resolution climate projections and a database of environmental and social attributes for each drinking water management area (z.umn.edu/drinking-water-story).

For at least six of the DWSMAs that the MDA has already calibrated a model for, they will run the model a second time with projected future climate variables. We will summarize the expected changes in nitrate leaching under the same BMPs but different precipitation patterns, and synthesize results in fact sheets and a report that can be disseminated to researchers and policy makers at state agencies, as well as those responsible for implementing BMPs locally.

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?

The primary output of this project will be a report comparing nitrate leaching under BMPs under current precipitation patterns, and under projected precipitation patterns at the middle and end of century. This will inform if new BMP strategies are needed to maintain safe drinking water.

Supporting this output, we will develop open source code to translate existing climate projections into a format compatible with models used by state agencies (SWAT and EPIC). We will make the climate projections and processing code publicly available, allowing other water quality researchers to perform their analyses with the best available climate projections.

Activities and Milestones

Activity 1: Review literature and prepare data

Activity Budget: \$24,000

Activity Description:

Review and synthesize existing published literature on climate and BMP interactions. Integrate climate data with MDA modeling workflows. Climate data need to be aggregated and converted to the appropriate format. We will automate the conversion of existing climate projections to a format compatible with the SWAT and EPIC models used by MDA. Once delivered, MDA will evaluate and confirm compatibility with their work flows.

The outputs, along with the code used to create them will be made publicly available so any researcher using these common models can integrate the best available climate projections for Minnesota into their work.

Activity Milestones:

| Description | Completion Date |
|--|-----------------|
| Write code to generate climate data compatible with MDA models | 2021-12-31 |
| Deliver data to MDA and ensure compatibility | 2022-02-28 |
| Review literature on intersection of climate and BMPs | 2022-05-31 |

Activity 2: MDA partners run BMP water quality models

Activity Budget: \$14,000

Activity Description:

We will partner with MDA researchers experienced in modeling BMPs for drinking water protection. As part of their planned research activities over the next several years, they will be modeling the amount of BMPs required to meet certain nitrate leaching reduction goals. As part of that work they are calibrating and running water quality models for several wellhead protection areas. Since calibrating the models is much more labor intensive than running them, we can produce a second set of results with minimal additional effort by running the models again with a different climate input data.

The outcome of this activity will be a dataset combining the two model runs, allowing us to analyze them to see if projected changes in precipitation patterns influence the effectiveness of BMPs. We will summarize these results statewide and also discuss any region specific patterns we observe.

Activity Milestones:

| Description | Completion Date |
|---|-----------------|
| MDA partners run water quality models for six or more wellhead protection areas | 2022-12-31 |
| We combine and analyze datasets for changes in BMP efficacy | 2023-03-31 |
| MDA partners review analysis techniques and results | 2023-04-30 |

Activity 3: Publish and present findings

Activity Budget: \$25,000

Activity Description:

The objective of our final activity is to publish and present the findings of our work to relevant audiences. We will tailor our final report for agency staff at MPCA, BWSR, MDH, and MDA. We will also write our results for publication in an open access peer-reviewed journal.

Activity Milestones:

| Description | Completion Date |
|---|-----------------|
| Post code, documentation, and datasets | 2023-05-31 |
| Summarize overall findings and region specific patterns in final report and public-facing fact sheets | 2023-05-31 |
| Write findings for publication | 2023-06-30 |
| Give presentations and webinars to state agency staff, researchers, and BMP implementation experts | 2023-06-30 |

Project Partners and Collaborators

| Name | Organization | Role | Receiving Funds |
|----------------|-------------------------------------|---|-----------------|
| Bonnie Keeler | University of Minnesota | Expert guidance on economic and environmental impacts of nitrogen pollution | No |
| Aicam Laacouri | Minnesota Department of Agriculture | Water quality modeling under best management practices | No |
| Patrick Nash | Minnesota Department of Agriculture | Water quality modeling under best management practices | No |

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 be funded?

By partnering with the MDA, we will be able to connect to the key stakeholders in BMP research and implementation in the state. We will disseminate our results to the practitioners who already look to the MDA for guidance on BMPs.

Furthermore, we have a history of working closely with the Minnesota Department of Health on drinking water protection issues. We will disseminate our results to these relevant audiences by written publications and presentations.

Other ENRTF Appropriations Awarded in the Last Six Years

| Name | Appropriation | Amount Awarded |
|---|---------------------------------------|----------------|
| Assessment of Public Benefits of Protecting Source Water | M.L. 2017, Chp. 96, Sec. 2, Subd. 03b | \$320,000 |
| Conservation Easement Assessment and Valuation System Development | M.L. 2015, Chp. 76, Sec. 2, Subd. 09k | \$250,000 |
| Understanding Water Scarcity, Threats, and Values to Improve Management | M.L. 2015, Chp. 76, Sec. 2, Subd. 04a | \$234,000 |

Project Manager and Organization Qualifications

Project Manager Name: Ryan Noe

Job Title: Senior Scientist

Provide description of the project manager's qualifications to manage the proposed project.

Ryan Noe is a senior scientist in the Science, Technology, and Environmental Policy area of the Humphrey School at the University of Minnesota. He manages projects on water and land use, with a focus on co-developing actionable research with state agencies, conservation organizations, and policymakers in Minnesota. Ryan holds an M.S. in natural resource science and management, with a focus on geospatial analysis. His work seeks to improve the usability of spatial data on environmental benefits such as clean drinking water, game species habitat, or lake recreation. He also seeks to improve the integration of data on threats such as climate change or land use conversion into environmental decision-making.

His research over the last five years has involved extensive collaboration with state agencies and councils (CWC, LSOHC, DNR, MDH, MPCA and EQB) and the project management of three ENRTF projects (Assessment of Public Benefits of Protecting Source Water – 2017, Conservation Easement Assessment and Valuation System Development – 2015, and

Understanding Water Scarcity, Threats, and Values to Improve Management – 2015). The tools (pebat.umn.edu), data (z.umn.edu/mn-climate-change-report), and expertise produced under these projects form the foundation of an extensive research agenda supporting the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources.

Organization: U of MN - Humphrey School of Public Affairs

Organization Description:

The mission of the Humphrey School of Public Affairs is to inspire, educate, and support innovative leaders to advance the common good in a diverse world. Within the Humphrey School, the Center for Science, Technology, and Environmental Policy fosters interdisciplinary and community-engaged research on human well-being, environmental sustainability, and social justice in a complex and diverse world. The Center conducts public engagement with external partners, develops environmental leadership, and facilitates solutions-oriented projects at the nexus of science, technology, and environmental policy.

Budget Summary

| Category / Name | Subcategory or Type | Description | Purpose | Gen. Ineligible | % Benefits | # FTE | Classified Staff? | \$ Amount |
|---------------------------------------|-----------------------|---|---|-----------------|------------|-------|-------------------|-----------------|
| Personnel | | | | | | | | |
| Ryan Noe, Senior Scientist | | Principle Investigator, Project manager | | | 36.5% | 0.44 | | \$40,330 |
| To Be Named | | PhD level Graduate Research Assistant - Academic Year | | | 111% | 0.19 | | \$18,858 |
| To Be Named | | PhD level Graduate Research Assistant - Summer 2021 | | | 20% | 0.06 | | \$3,568 |
| | | | | | | | Sub Total | \$62,756 |
| Contracts and Services | | | | | | | | |
| | | | | | | | Sub Total | - |
| Equipment, Tools, and Supplies | | | | | | | | |
| | | | | | | | Sub Total | - |
| Capital Expenditures | | | | | | | | |
| | | | | | | | Sub Total | - |
| Acquisitions and Stewardship | | | | | | | | |
| | | | | | | | Sub Total | - |
| Travel In Minnesota | | | | | | | | |
| | Miles/ Meals/ Lodging | Local mileage and parking | For giving presentations on research findings | | | | | \$244 |
| | | | | | | | Sub Total | \$244 |

| | | | | | | | | |
|---------------------------------|--|--|--|--|--|--|--------------------|-----------------|
| Travel Outside Minnesota | | | | | | | | |
| | | | | | | | Sub Total | - |
| Printing and Publication | | | | | | | | |
| | | | | | | | Sub Total | - |
| Other Expenses | | | | | | | | |
| | | | | | | | Sub Total | - |
| | | | | | | | Grand Total | \$63,000 |

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 | | | | |
| | | | Non State Sub Total | - |
| | | | Funds Total | - |

Attachments

Required Attachments

Visual Component

File: [cc21e5ba-5fe.pdf](#)

Alternate Text for Visual Component

Three maps of dynamically downscaled climate change projections produced under ENRTF project M.L. 2015, Chp. 76.2.04a. These projections improved on global models by simulating weather patterns at much higher resolution than can be performed globally. High-resolution data are especially important for studying changes in precipitation variability and intensity; which have been shown to influence the effectiveness of agriculture best management practices. In all of the periods and emission scenarios we modeled, there were broad increases in the amount of rain in the wettest 5 day period relative to circa 1990. The percent increase in central MN ranged approximately 10% in the moderate emissions scenarios, to approximately 30% in the high emissions scenario.

Optional Attachments

Support Letter or Other

| Title | File |
|---------------------------|----------------------------------|
| MDA letter of support | 3d340570-a71.pdf |
| Certified Financial Audit | 190779c1-02b.pdf |

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have patent, royalties, or revenue potential?

No

Does your project include research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

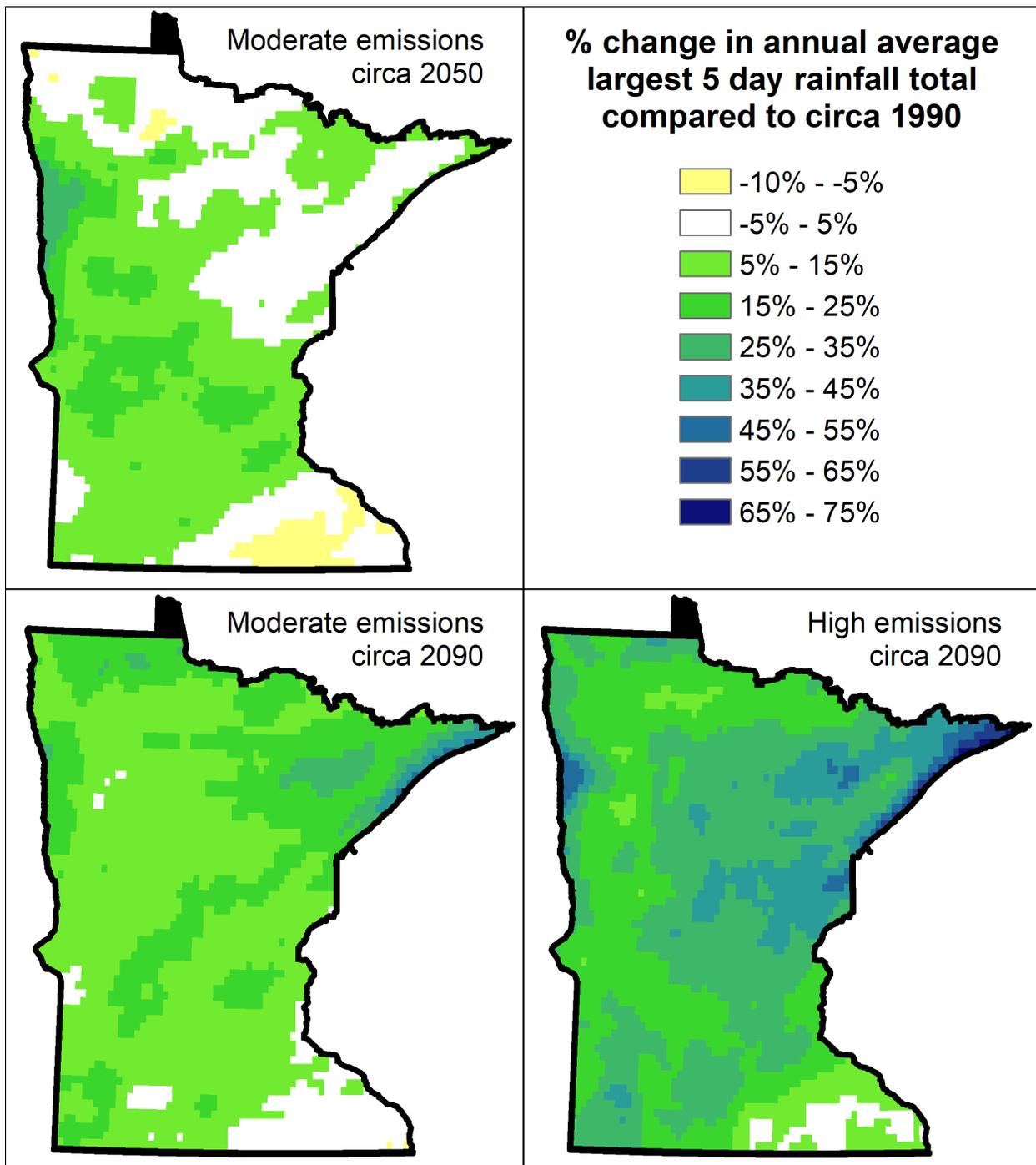


Figure 1. Dynamically downscaled climate change projections produced under ENRTF project M.L. 2015, Chp. 76.2.04a. These projections improved on global models by simulating weather patterns at much higher resolution than can be performed globally. High-resolution data are especially important for studying changes in precipitation variability and intensity; which have been shown to influence the effectiveness of agriculture best management practices. In all of the periods and emission scenarios we modeled, there were broad increases in the amount of rain in the wettest 5 day period relative to circa 1990. The percent increase in central MN ranged approximately 10% in the moderate emissions scenarios, to approximately 30% in the high emissions scenario.