Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)

Project Title: **ENRTF ID:**   **222-F**

Wetland and Forest Change Monitoring

Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Sub-Category:

Total Project Budget: $ 450,000

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

We propose to develop an automated remote sensing system to monitor wetland and forest cover change on an ongoing basis, greatly enhancing our ability to respond to natural resource challenges.

Name: Steve   Kloiber

Sponsoring Organization: MN DNR

Job Title:

Department: Ecological and Water Resources

Address: 500 Lafayette Road

             St. Paul   MN   55155

Telephone Number: (651) 259-5164

Email steve.kloiber@state.mn.us

Web Address: https://www.dnr.state.mn.us/wetlands/index.html

Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

This graphic shows several aerial imagery examples before and after changes affecting wetlands and forests, which may be detected using the proposed system. These examples include urban development, wetland restoration, forest fire, harvesting, and regeneration.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %

PROJECT TITLE: Wetland and Forest Change Monitoring

I. PROJECT STATEMENT

We are proposing to develop an automated remote sensing change detection system to efficiently detect wetland and forest cover change on an ongoing basis, which will greatly enhance our ability to respond to natural resource challenges as well as improve our ability to maintain critical natural resource spatial information. The threats to these resources, such as invasive species and extreme weather events, require a more dynamic assessment approach to complement the more detailed wetland and forest resource inventories. This approach will not only enhance our ability to identify emerging threats, but will also improve the effectiveness of our data stewardship for foundational natural resource inventories for both wetlands and forests by targeting updates to areas where change is occurring.

A traditional approach to land cover change detection using photo-interpretation of aerial imagery is sound, but labor-intensive. New methods taking advantage of low-cost (or no-cost) satellite data, including Landsat and Sentinel systems, combined with the computing power of cloud-based systems, such as Google Earth Engine or Amazon Web Services, can augment traditional approaches allowing the state to produce and deliver more dynamic wetland and forest inventory data. Additionally, developing and operating an integrated approach to tracking change for both wetlands and forests is more cost-effective than two separate systems.

This project will develop an automated remote sensing change detection system to identify potential changes in wetland and forest cover that can:
- identify the location and extent of potential wetland and forest changes,
- enable the assessment of the effectiveness of management efforts and state policies for wetlands and forests,
- aid in a rapid response to change events such as floods, blowdown, and invasive species,
- provide information about water level changes over time, and
- help focus updates of more detailed wetland and forest inventory information on those areas showing change.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1 Title: *Developing an automated detection procedure for wetland and forest change*

**ENRTF BUDGET:
$275,000**

Description: The DNR will work with the University of Minnesota to develop a cost-effective change detection procedure utilizing time series analysis of satellite imagery. This will involve compiling existing field and ancillary data as well as evaluating alternative cloud-based computing platforms, remote sensing data sources, and classification procedures. DNR staff from Ecological and Water Resources as well as Forestry will help define the requirements for the preferred alternative including cost, accuracy, and feasibility. The selected alternative will be developed into a full-scale, statewide procedure.

Outcome	Completion Date
1. Evaluate cost-effectiveness of various automated change detection alternatives	*July 2021*
2. Develop, test and implement a full-scale method for the preferred alternative	*July 2022*

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Activity 2 Title: *Turnkey training and procedure evaluation*   **ENRTF BUDGET:**
$175,000

Description: Subsequent to the completion of activity 1, the University of Minnesota will hand-off the final procedures including documentation and programming code to the DNR. DNR staff will undergo turnkey training to implement this change detection procedure on an ongoing basis. In addition, the DNR will conduct a comparative analysis between the new procedure and existing legacy procedures.

Outcome	Completion Date
1. Provide turnkey training to DNR data stewards	January 2023
2. Report on comparative analysis between the new change detection procedure and legacy change procedures	June 30, 2023

III. PROJECT PARTNERS AND COLLABORATORS:

The project team includes:

- Steve Kloiber (MNIT@DNR) – Project manager and wetland monitoring and analysis coordinator
- Joe Knight (University of MN) – Principal investigator, procedure development
- Jennifer Corcoran (DNR – Resource Assessment Program) – Turnkey program lead

Project management will be provided through the wetland program of the Division of Ecological and Water Resources. The Resource Assessment Program within the Division of Forestry will serve as the home for the final products. Roles and relationships of the two divisions will be formalized through a service level agreement. Both divisions will serve in an advisory role to the University during the methods development activity. The University will receive $250,000 for their role in this project. The remaining $200,000 will be used to support service level agreements with MNIT@DNR and the DNR Resource Assessment Program.

IV.   LONG-TERM IMPLEMENTATION AND FUNDING:

The DNR is committed to ongoing support and data governance for wetland and forest inventory and change monitoring data. This project will help facilitate long-term maintenance of foundational natural resource data needed for effective natural resource protection and management. The long-term operation of the program will be funded from a combination of efficiencies gained and other funding sources.

V.   SEE ADDITIONAL PROPOSAL COMPONENTS:

A. Proposal Budget Spreadsheet
B. Visual Component or Map
C. Project Manager Qualifications and Organization Description

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Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: Steve Kloiber
Project Title: Wetland and Forest Change Monitoring
Organization: Minnesota Department of Natural Resources
Project Budget: $450,000
Project Length and Completion Date: Three years, June 30, 2023
Today's Date: April 2, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ -	$ -	$ -
Professional/Technical/Service Contracts			
Sole source contract with University of Minnesota, Remote Sensing and Geospatial Analysis Laboratory - develop, test, and document an automated remote sensing procedure to detect the wetland and forest changes. Provide turnkey training for DNR staff.	$ 250,000	$ -	$ 250,000
Service level agreement with DNR Resource Assessment Program - consultation on procedure development, operationalize with turnkey program, and analysis.	$ 110,000	$ -	$ 110,000
Service level agreement with MNIT Business Services for Ecological and Water Resources Division - project management and coordination.	$ 90,000	$ -	$ 90,000
Equipment/Tools/Supplies			
	$ -	$ -	$ -
Other			
	$ -	$ -	$ -
COLUMN TOTAL	$ 450,000	$ -	$ 450,000

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		$ -	$ -	$ -
State:		$ -	$ -	$ -
In kind:		$ -	$ -	$ -

Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		$ -	$ -	$ -

Wetland and Forest Change Monitoring:
Using early detection for evidence-based policy, planning and management
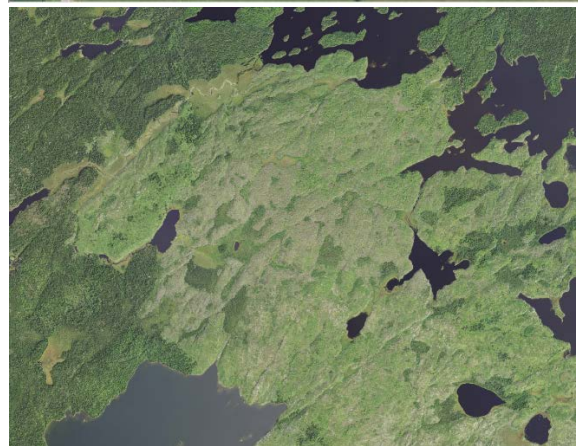

	Before	After
Development		
Wetland Restoration		
Forest Fire		
Harvest\Regeneration		
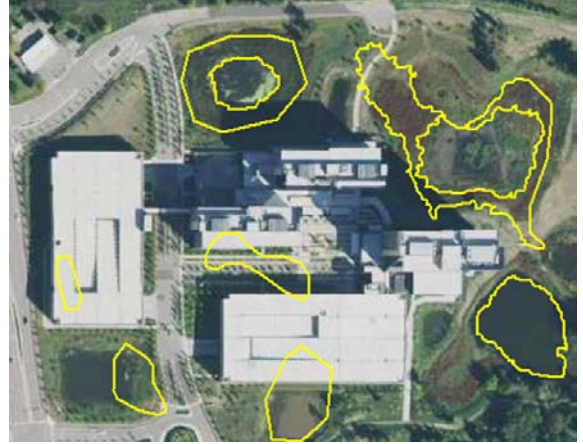
Project Manager Qualifications: Steve Kloiber, Ph.D., P.E.

SUMMARY	Steve Kloiber is the wetland monitoring coordinator for the Minnesota Department of Natural Resources. He has twenty years of experience in the water resources field with a special focus on geospatial analysis and environmental informatics. He has managed dozens of projects, ranging in size from tens of thousands to over a million dollars. Steve has authored or co-authored several peer-reviewed journal articles or book chapters on water resources, remote sensing, and GIS. He also serves on the Board of Managers for the Nine Mile Creek Watershed District.
EDUCATION	Ph.D. Civil (Environmental) Engineering/Water Resource Minor University of Minnesota, Minneapolis, Minnesota, 2002 M.S.C.E. Civil (Environmental) Engineering University of Minnesota, Minneapolis, Minnesota, 1992 B.A. Chemistry/Computer Science Concentration St. Olaf College, Northfield, Minnesota, 1988
PROFESSIONAL REGISTRATION	Professional Engineer in Minnesota (Registration #23804) First Issued February 1995
AWARDS/ HONORS	Academic Excellence Award 2002 Central States Water Environment Association
EMPLOYMENT HISTORY	**Minnesota Department of Natural Resources, St. Paul, MN** Wetland Monitoring Coordinator, October 2008 to Present **Metropolitan Council, St. Paul, Minnesota** Lead Environmental Analyst, September 2002 to October 2008 Senior Water Resource Planner, September 2001 to September 2002 Water Resource Planner, January 1998 to September 2001 **Montgomery Watson, Wayzata, Minnesota** Professional Environmental Engineer, November 1995 to December 1997 Associate Environmental Engineer, June 1992 to November 1995 **University of Minnesota, Minneapolis, Minnesota** Research Assistant, September 1989 to March 1992

Organizational Description: Minnesota DNR

The Minnesota Department of Natural Resources (DNR)'s mission is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life. The department consists of several divisions based on the state's natural resources, such as Fish and Wildlife, Forestry, Lands and Minerals, Parks and Trails, and Ecological Resources and Waters, as well as four regions and four support bureaus.