**PROJECT TITLE: Enhanced online tool to track Minnesota lake trends**

**I. PROJECT STATEMENT**

We propose to **update and refine an existing online visualization tool and database to explore long-term water quality trends in Minnesota lakes using existing lake water quality monitoring data**. This basic information is needed to help management agencies and lake associations effectively and economically manage these valuable freshwater resources. Our overall aim is to better support natural resources decision-making and environmental education. Specific objectives include:

1. incorporate more recent information into an enhanced MN Lake Trends database and online tool,
2. use new approaches to identify lake trends and water quality regions in MN, and
3. work with developers of existing tools (MN Natural Resources Atlas, MN Lake Browser) to ensure easy navigation across the tools (web linking) and conduct appropriate training for end users.

The current version of the MN Lake Trends tool ([www.mnbeaches.org/gmap/trends/](http://www.mnbeaches.org/gmap/trends/); last updated in 2010) shows whether water quality in lakes throughout MN is changing through time and how quickly. The database contains information on water quality variables commonly used by management agencies (nitrogen, phosphorus, water clarity, algae abundance, dissolved oxygen) for 638 lakes with at least 15 years of data. The tool is used as an informational resource by natural resources agencies (MPCA, US Forest Service), but suffers from some limitations. The database only contains information through 2007 (12 years ago) and looks at average straight-line trends across the entire time period but cannot look at trends across shorter time periods.

The enhanced version of the MN Lake Trends tool will include water quality information through 2020 (28+ years of data) for more lakes and be able to look at shorter term trends. For example, has water clarity gotten increasingly worse in Mille Lacs since 2010? The lake regions based on water quality trends will help agencies prioritize regions for management and protection by developing unique strategies tailored to individual regions. The redesigned website will be easier to use, will communicate information more clearly, and will be easier to find online. We will expand its use to lake associations and classrooms by working directly with these groups.

**II. PROJECT ACTIVITIES AND OUTCOMES**

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| **Activity 1:** **Update lake database and online visualization tool** **ENRTF BUDGET: $103,415** |
| We will gather water quality information from state monitoring programs, such as MPCA, to update the existing MN Lake Trends database with data from 2008-2020. We will redesign the tool to incorporate new visualization approaches and make it so new information can easily be added in the future. Finally, we will redesign the website to make it easier to use for different user groups. |
| **Outcome** | **Completion Date** |
| *1.* Add 2008-2020 water quality information to MN Lake Trends database. | April 30, 2021 |
| *2.* Write computer code to add new features (trend analyses, visualization approaches). | April 30, 2021 |
| *3.* Redesign existing online tool and website. | Dec. 31, 2021 |
| **Activity 2:** **Perform trend analyses and create supporting data products** **ENRTF BUDGET: $44,363** |
| We will use new approaches to explore both near- and long-term trends in lake water quality in Minnesota. We will use spatial approaches to create water quality trend regions (clusters of lakes with increasing, decreasing, or no trend) and identify environmental factors contributing to trends across regions. MN DNR State Climatology Office will be consulted to ensure that we are using the newest climatology data and interpreting it accurately. We will use these trends and regions to develop various decision support map layers, such as state-wide surface water nutrient trends and distinct water quality regions, to be incorporated within the MN Natural Resources Atlas. |
| **Outcome** | **Completion Date** |
| *1.* Perform analyses to identify water quality trends in individual lakes. | Dec. 31, 2021 |
| *2.* Create lake trend regions (groups of lakes with similar trends) using spatial approaches to help identify regions to prioritize for lake management, restoration, and protection. | March 31, 2022 |
| *3.* Create map layers for the MN Natural Resources Atlas to aid in decision support. | March 31, 2022 |

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| **Activity 3:** **Better tool navigation and training for end users** **ENRTF BUDGET: $50,058** |
| We will work with developers of existing online resources (MN Natural Resources Atlas, MN Lake Browser) to improve navigation across all resources. With the help of MN Sea Grant, we will work with management agencies, lake associations, and educators (high school) to beta-test and improve the website, demonstrate the capabilities of the MN Lake Trends tool, and train end users on its use. We will meet with management agency personnel, such as MPCA and US Forest Service, and representatives from lake associations to ensure that the tool meets their needs. We will lead a hands-on training workshop in conjunction with an appropriate statewide meeting, such as the MN Lakes and Rivers Advocates, to demonstrate how lake associations and concerned citizens can use the MN Lake Trends tool to compare the health of their lake to surrounding lakes. Finally, we will hold an educators’ workshop (10 teachers) to train high school teachers on use of the online tool and its capabilities. |
| **Outcome** | **Completion Date** |
| *1.* Improve navigation across existing online resources. | June 30, 2022 |
| *2.* Present findings and introduce the online tool at agency and lake association meetings. | May 31, 2022 |
| *3.* Host educators’ workshop to train teachers on use of tool to be used in classroom exercises. | June 30, 2022 |
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**III. PROJECT PARTNERS AND COLLABORATORS:**

* Dr. Jacques Finlay, Professor, U. of Minnesota Twin Cities. PI of “Assessment of Surface Water Quality with Satellite Sensors”, LCCMR 2016-2019.
* Cynthia Hagley, Environmental Quality Extension Educator, Minnesota Sea Grant.

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:**

When developing and updating the new website and underlying MN Lake Trends database, we will design the website code and database so that it can easily incorporate future water quality information (beyond 2020) and different types of information that may be added to monitoring programs in the future (new variables or measurements). While incorporating new information into the database will require some user entry, this effort and associated costs will be minimal. We will leverage compiled MN water quality data from the NSF-funded LAGOS database team ([www.lagoslakes.org](http://www.lagoslakes.org)), of which PI Filstrup is Senior Personnel. We will seek small amounts of funding from state agencies and user groups to update, maintain, and enhance the new MN Lake Trends tool in the future.