**PROJECT TITLE: Maintaining clean water supply from working forests**

**I. PROJECT STATEMENT**

One of the most important benefits provided from forests is the production and supply of clean water. **Land use and forest disturbance (arising from forest harvesting, extreme events such as fire and windstorms, and invasive species) are key factors placing water resources at risk in forested watersheds because they control the amount and timing of water and sediments delivered to streams and lakes.** We will combine newly available time-series forest disturbance data with historical streamflow data in order to determine relationships between landuse/disturbance and streamflow. Our objectives are to 1) identify patterns of forest disturbance where impacts to water occur, 2) determine the watershed size where impacts are greatest, and 3) conduct a risk assessment to determine watersheds at greatest risk of impact. This fits well across the LCCMR’s priorities on Water Resources (e.g. preventing reducing contaminants) and Foundational Natural Resource Data and Information (e.g. analysis of data, innovative combination of newly-available remote sensing, GIS, and non-geospatial water resource data).

There is great need for information related to forest disturbance/ land use patterns and water to identify at-risk watersheds and develop proactive strategies, such as best management practices, to maintain water supplies. The iconic North Woods of northeastern and north central Minnesota have great influence on three important watersheds: the Mississippi River, the Great Lakes/St. Lawrence, and Lake Winnipeg. Forests and clean water are closely linked, with about two-thirds of drinking water in the United States coming from forest lands in addition to other benefits, such as recreation. Maintenance of water resources in tandem with forest managment is essential to the sustainability of freshwater resources, forest-based economies, and public health. Change in the relative distribution of land use and disturbance threatens the continued supply of clean water from forested landscapes. Although there is recognition of the potential influence of disturbance patterns on streamflow and water quality, **actual patterns where significant impacts occur, are unclear and poorly understood.** Historically, foundational data on forests and water are collected over very different areas. Because of this, there is broad support among state agencies and the forestry community to identify water and landscape patterns in space and time that ***prevent degradation*** of clean water as well as timber supply.

**II. PROJECT ACTIVITIES AND OUTCOMES**

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| **Activity 1:**Update forest disturbance maps and metrics**ENRTF BUDGET: $ 21,277**We will utilize Landsat imagery to update a spatial dataset that characterizes forest disturbance in Minnesota to now encompass 1972-2019. Development of the original dataset (1972-2015) was funded by the Environment and Natural Resources Trust Fund, which allows us to capitalize on previous investments and create additional value for the state. Additional years of data (2015 – 2019) added under this project are incredibly important to maximize the overlap in time with streamflow measurements and recent disturbances, such as Emerald Ash Borer outbreaks, windstorms, and recovery from the Pagami Creek Fire. As shown in the next 2 activities, the majority of this project will add substantial value to the disturbance data to quantify where and when forest disturbance has been shown to affect water resources. Imagery (2015-2019) will be acquired and processed to remove geometric errors and account for atmospheric effects (e.g., clouds). Images will be incorporated into the existing time series analysis using the Landtrendr change detection algorithm and disturbance metrics recalculated (e.g., time since disturbance, total amount of disturbed area). |  | **Activity 1 Title:****Description:****ENRTF BUDGET: $** |  |

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| **Outcome** | **Completion Date** |
| 1. Suitable Landsat imagery identified, downloaded, and preprocessed | Aug. 2021 |
| 2. Forest disturbance and land use metrics updated statewide through year 2019. | Dec. 2021 |

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| **Activity 2:**Determine relationships between forest disturbance and surface water **ENRTF BUDGET: $ 77,946** |  |  |
| The updated disturbance dataset developed in Activity 1 will be combined with other spatial datasets related to land use, topography, and water features (e.g., National Wetland Inventory), among others. We will acquire all stream gauge data available in Minnesota since 1972 (the start year of the disturbance dataset), and compile it into a uniform format for analysis. We will use a suite of spatial and time-series statistical techniques to relate disturbance and land use patterns to changes in water quantity as a baseline to water quality. Where available, water quality data will also be used. Analyses will be conducted across the range of watershed sizes to determine how different-sized disturbances and their relationship with water resources vary with watershed size.  |  |

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| **Outcome** | **Completion Date** |
| 1. All datasets acquired and compiled in uniform format  | Aug 2021 |
| 2. Disturbance/land use configurations/watershed size with impacts to water identified | Aug 2021 |

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| **Activity 3:**Watershed risk assessment**ENRTF BUDGET: $ 176,562** |  |
| Products from Activities 1 and 2 will be combined with other data, such as landform, soils, and precipitation, to identify forested watersheds approaching disturbance levels where impacts to water resources may occur. We will combine forest and hydrologic / water resources data to produce risk assessment maps across multiple watershed sizes showing the spatial scale at which surface water resources could be at risk based upon forest landscape disturbance. We will examine watersheds of varying sizes with recent history of fire, timber harvest, and those susceptible to invasive species, such as the Emerald Ash Borer. We will conduct a geospatial analysis that incorporates other factors that govern water cycling (e.g. landscape, soils, precipitation regimes, forest types) in order to identify landscape patterns leading to water resource degradation from forest disturbance. Using the above information, we will determine the existing and future risk for watersheds across Minnesota.  |

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| **Outcome** | **Completion Date** |
| 1. Disturbance patterns (amount and configuration) quantified for forested watersheds  | Aug 2022 |
| 2. Geospatial analysis of modifying factors completed  | Aug 2022 |
| 3. Risk assessment completed for all forested watersheds (>20% forest cover) | June 2023 |

**III. PROJECT PARTNERS AND COLLABORATORS:**

The project team includes Dr. Diana Karwan (lead) from the UMN Department of Forest Resources and Dr. Robert Slesak from the Minnesota Forest Resources Council. Cooperators include the Divisions of Forestry, Ecological and Water Resources, and Fisheries and Wildlife within the DNR; and the Watershed Division of the MN PCA.

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:** We will work closely with federal, state, and county agencies to incorporate our findings into statewide watershed assessments (e.g., modeling associated with MNPCA WRAPS) and regional planning efforts (e.g., DNR and USDA Forest Service planning, MFRC Regional Landscape plans). We will also work with the broader forestry community (via R. Slesak’s affiliation with the MN Forest Resources Council) to develop strategies that avoid threshold configurations while also maintaining the supply of fiber for forest industry and the economies dependent on it. We are working to identify a source of funds to support periodic updating of the disturbance dataset for future assessments related to water quality, wildlife management, and timber availability.