**Post-Fire Wilderness Recovery: Mapping Hazards and Forest Regeneration in the BWCA**

**Project Manager:** Alexis Grinde | Organization: NRRI - UMN | Phone: (218) 788-2747 | Email: agrinde@d.umn.edu | Web: https://www.nrri.umn.edu/

**Co-PIs:** Dr. Marcella Windmuller-Campione, University of Minnesota and Dr. Emily Fairfax, University of Minnesota

**Threat to Air, Land, Wildlife, and Other Natural Resources**

On July 16, 2026, fueled by the severe hazardous smoke of the Boundary Waters Canoe Area Wilderness (BWCA) wildfires, Duluth recorded an Air Quality Index (AQI) of 934, far surpassing the hazardous threshold. Millions of people across Minnesota and the nation were impacted from hazardous and dangerous air quality. The multiple BWCA wildfires have burned more than 60,000 acres with wildland firefighters still working on containment for more than 41 days. While fire is a natural driver in northern forests, compounding climate stressors—including severe drought and widespread insect-driven mortality, have created unprecedented post-fire conditions. Occurring just 15 years after the 2011 Pagami Creek Fire, these overlapping disturbance footprints create a critical, time-sensitive need for immediate baseline data to evaluate ecosystem recovery and guide future management before rapidly degrading ecological signals disappear. Securing state funding immediately post-fire is a mandatory prerequisite to establish the empirical foundation required for three actionable outcomes.

First, collecting field data on canopy mortality, surviving legacy conifer seed trees, hardwood conversion risks, and soil erosion zones will directly inform a **high-resolution landscape damage and recovery map**, equipping state and federal land managers with the baseline inventory needed to guide long-term wilderness fire strategies and monitor vegetation development. Second, because open wilderness travel corridors harbor severe ongoing risks from standing deadwood and large dead trees that are likely to fall ("widowmakers"), immediate site evaluations will deliver a **recreational and portage safety hazard assessment**, providing wilderness rangers with precise data for visitor advisories while giving local outfitters the route safety information needed to guide clients safely. Third, field measurements of post-fire fuel loads and soil organic layer loss will supply the **baseline spatiotemporal dataset required to calibrate predictive fire models**, enabling managers to delineate cost-effective "let burn" natural management patches from high-priority active fire suppression zones. Field sampling must begin at the start of the Spring 2027 growing season; waiting until July 2028 would permanently miss the brief window to capture initial conifer seed viability, hydrophobic soil risks, and active structural hazards before critical baseline data is lost.

**Issue Unexpected and Reasonably Unforeseen**

While wildfires periodically occur in Minnesota, the magnitude, overlap with recent burns, and severe public health impacts of the July 2026 BWCA fires could not have been predicted. Furthermore, because these fires ignited in July 2026, this emergency research need arose months after the deadline for the LCCMR's most recent Request for Proposals (RFP) in May 2026. This timeline prevented submission during the standard funding cycle, creating an unforeseen requirement for out-of-cycle consideration to execute immediate post-fire field monitoring before critical ecological evidence degrades.

**Action and Urgent Need**

The 2026 wildfires offer a critical, brief window to document post-fire successional dynamics, quantify re-burn vulnerabilities across overlapping disturbance footprints, and establish vital empirical baselines for unmanaged ecosystems. To achieve maximum cost-efficiency, the project employs an innovative methodology: pairing field-based transect ground-truthing with satellite spectral fingerprinting and geospatial machine learning models to rapidly scale plot-level data across entire wilderness landscapes. Field-based data collection will not only evaluate burn severity, surviving seed trees, and forest

composition shifts, but will also provide vital hazard assessments, mapping standing deadwood and widowmakers across open wilderness routes to safeguard public access.

**Proposed Solution and Deliverables**
We propose a holistic baseline assessment during the 2027 growing season and spring 2028, concluding June 30, 2028. In partnership with the U.S. Forest Service, MN DNR, and County land managers, we will establish standard field inventory plots stratified by burn severity and forest type. Field sampling will capture time-sensitive ground truth on vegetation recovery (overstory mortality, legacy seed tree survival, downed fuel loads, and recruitment windows), soil runoff risks, and seedbed conditions. Concurrently, site evaluations will map standing deadwood and overhead widowmakers along open travel corridors to ensure recreational safety. To provide maximum budget flexibility, our proposed solution and deliverables are fully scalable based on the availability of funding.

By integrating this empirical field data with satellite spectral imagery, spatial analysis, and predictive modeling, the project will generate **three core deliverables:**

1. **High-Resolution Post-Fire Damage and Fuel Inventory Map**
    a. **Output**: A comprehensive geospatial map featuring layers for canopy mortality, surviving legacy conifer seed trees, hardwood conversion risks, fuel loads, soil erosion/hydrophobicity risk zones, and regeneration potential.
    b. **Result**: Provides state and federal land managers with baseline inventory data to guide wilderness fire management strategies, track unmanaged conifer regeneration trajectories, and evaluate post-fire fuel risks across the wilderness footprint.
2. **Recreational Safety and Economic Hazard Assessment**
    a. **Output**: Site-level field evaluation of campsite and portage safety, specifically quantifying standing deadwood, blowdown severity, and "widowmakers".
    b. **Result:** Delivers actionable hazard locations along campsites and portages to help land managers communicate visitor risks and assist regional outfitters in adapting travel routes around severely impacted zones.
3. **Baseline Spatiotemporal Dataset for Predictive Fire Modeling**
    a. **Output**: Standardized environmental, fuel, and soil organic layer consumption datasets integrated into a spatially explicit framework.
    b. **Result:** Enables calibrated modeling of future fire behavior and watershed runoff, helping managers delineate zones for cost-effective "let burn" policies versus high-priority active suppression.

**Steps already taken to ensure success**
Project team members hold established working relationships with the Superior National Forest, MN DNR, and local County Land Departments. The team possesses proven administrative and scientific capacity, including active BWCA research permits and a demonstrated track record of delivering integrated, peer-reviewed natural resource inventories that directly inform stakeholder decision-making.

**Project Timeline**
- **Jan 1 – Apr 30, 2027**: Finalize sampling design, secure remaining wilderness permits, and pre-map satellite pixel transects. Build machine-learning model infrastructure.
- **May 1 – Oct 31, 2027**: Conduct field sampling across a minimum of 40 plots along a fire severity gradient (evaluating vegetation, standing hazards, and soils).
- **Nov 1, 2027 – Apr 30, 2028**: Process field samples, analyze spectral data, calibrate geospatial machine learning models, and prepare final deliverable mapping layers.
- **May 1 – Jun 30, 2028**: Complete targeted validation sampling (minimum 5 plots) and publicly disseminate final maps, safety assessments, and modeling datasets to managing agencies

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1. **Description of the Organization**
    a. The Natural Resources Research Institute (NRRI) is a state-chartered applied research institute of the University of Minnesota's Research and Innovation Office. NRRI maintains three sites in Northern Minnesota, focused on informing sound, long-term decisions on the use and stewardship of natural resources. Our mission: Deliver integrated research solutions that value our resources, environment and economy for a sustainable and resilient future. As an impartial, science-based resource, NRRI develops and translates knowledge through large-scale, interdisciplinary research. Our expertise focuses on defining resource opportunities, minimizing waste and environmental impact, maximizing natural resource value, and maintaining or restoring ecosystem function.
2. **Financial & Organizational Capacity**
    a. The University of Minnesota maintains rigorous institutional controls, dedicated financial management staff, and established accounting systems compliant with state and federal audit standards. The organization has a proven track record of successfully receiving, managing, and accounting for public grant funds, including state appropriations and federal research awards. Project leaders possess extensive experience managing complex field budgets, coordinating multi-agency projects, fulfilling reporting milestones, and delivering peer-reviewed scientific outcomes on time and within budget.
3. **Budget**
    a. Provided in the Excel Budget Sheet

**Environment and Natural Resources Trust Fund**
**Emerging Issues Budget Addendum**

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|---|---|
| **Legal Citation:** | ML 2025, 1st Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 10a |
| **Project Manager:** | Alexis Grinde |
| **Project Manager Email:** | agrinde@d.umn.edu |
| **Project Manager Office Phone:** | (218) 788-2747 |
| **Project Title:** | Post-Fire Wilderness Recovery: Mapping Hazards and Forest Regeneration in the BWCA |
| **Project Budget:** | $298,000 |
| **Project Completion Date:** | June 30, 2028 |
| **Current Date:** | September 1, 2026 |

| BUDGET ITEM | Budget | Generally Ineligible Expenses (if |
|---|---|---|
| **Personnel (Wages and Benefits)** | $ 255,801 | |
| Dr. Alexis Grinde, Project Manager / Senior Researcher \| Salary: $21,928 (72.2%); Fringe Benefits: $8,442 (27.8%); Total: $30,370; 10.54% FTE in 2027; 11.54% FTE in 2028<br><br>Oversees project management, partner agency coordination, safety protocols, and final reporting. Leads field deployment design, assessment protocols, and data synthesis. Directs data integration, mapping analysis, and decision-support modeling . | - | |
| Dr. Marcella Windmuller-Campione, Co Investigator \| Salary: $6,544 (72.2%); Fringe Benefits: $2,520 (27.8%); Total: $9,064; 2.73% FTE in 2027; 5.46% FTE in 2028.<br><br>Co-leads forest management and silvicultural research strategy, project design, and student researcher supervision. Directs forest inventory data interpretation, management assessment protocols, and contributes to technical reporting. | - | |
| Dr. Emily Fairfax, Co Investigator \| Salary: $0 (0.0%); Fringe Benefits: $0 (0.0%); Total: $0; 0% FTE in 2027; 0% FTE in 2028.<br><br>Provide expert consultation on ecohydrological assessments and watershed interactions. Advises project leadership on spatial modeling methodologies, field deployment strategies, and manuscript preparation. | - | |
| Dr. Michael Joyce, Senior Research Specialist \| Salary: $14,146 (72.2%); Fringe Benefits: $5,447 (27.8%); Total: $19,593; 9.62% FTE in 2027; 9.62% FTE in 2028<br><br>Serves as technical lead for field sampling logistics, environmental sample collection, and laboratory processing. Conducts wilderness field mapping, safety assessments, and resource condition inventories. | - | |
| Kristopher Johnson, GIS Specialist \| Salary: $9,023 (72.2%); Fringe Benefits: $3,474 (27.8%); Total: $12,497; 6.01% FTE in 2027; 8.01% FTE in 2028<br><br>Provides GIS spatial data management, database structuring, and data processing of field metrics. Manages spatial data integration, AGOL mapping support, and GIS map layer generation. | - | |
| Stephen Kolbe, Research Specialist \| Salary: $9,661 (72.2%); Fringe Benefits: $3,719 (27.8%); Total: $13,380; 8.33% FTE in 2027; 8.33% FTE in 2028<br><br>Executes field data collection, environmental sampling, and site assessments across designated field locations. Performs on-the-ground hazard mapping and forest inventory data collection along travel corridors. | - | |
| Stephen Nelson, Lead Field Technician \| Salary: $6,000 (74.1%); Fringe Benefits: $2,094 (25.9%); Total: $8,094; 6.33% FTE in 2027; 8.33% FTE in 2028<br><br>Leads daily wilderness field deployments, environmental sample acquisition, and crew safety logistics. Directs on-the-ground hazard mapping, field data collection, and site inventory surveys. | - | |
| Andrew Arlt, Technician \| Salary: $7,296 (72.2%); Fringe Benefits: $2,809 (27.8%); Total: $10,105; 8.33% FTE in 2027; 0% FTE in 2028.<br><br>Assist with seasonal field data collection, vegetation surveys, and site inventory sampling across designated locations. Supports field logistics, equipment maintenance, and initial data entry. | - | |
| James Macarthur, Post Doctoral Associate \| Salary: $6,180 (78.1%); Fringe Benefits: $1,737 (21.9%); Total: $7,917; 8.33% FTE in 2027; 0% FTE in 2028.<br><br>Lead advanced ecological data synthesis, quantitative modeling, and statistical analysis of field datasets. Co-author technical reports, peer-reviewed publications, and scientific presentations. | - | |
| Luke Neibauer, Technician \| Salary: $49,648 (74.1%); Fringe Benefits: $17,327 (25.9%); Total: $66,975; 95.90% FTE in 2027; 0% FTE in 2028.<br><br>Execute primary field deployment, environmental sample acquisition, and laboratory processing. Responsible for daily field gear logistics, safety compliance, and sample chain of custody during peak field seasons. | - | |

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|---|---|---|
| TBD Other Professional, [insert] \| Salary: $43,670 (72.2%); Fringe Benefits: $16,812 (27.8%); Total: $60,482; 27.40% FTE in 2027; 54.81% FTE in 2028.<br><br>Coordinate analytical pipeline development, database management, and decision-support model integration. Assists project leadership with milestone tracking, report drafting, and stakeholder communications. | - | |
| To be determined undergraduate researchers (2), Windmuller-Camione Lab \| Salary: $16,320 (100.0%); Fringe Benefits: $0 (0.0%); Total: $16,320; 25.00% FTE in 2027; 50.00% FTE in 2028.<br><br>Assist with laboratory sample preparation, preliminary forest inventory data entry, and sample processing. Provide field assistance and lab organization under direct faculty supervision. | - | |
| To be determined undergraduate researcher, Grinde Lab \| Salary: $498 (100.0%); Fringe Benefits: $0 (0.0%); Total: $498; 1.00% FTE in 2027; 1.00% FTE in 2028.<br><br>Performs basic data digitization, preliminary spatial data entry, and lab sample sorting. Supports research personnel with equipment prep and routine laboratory maintenance. | - | |
| To be determined technician (temp/casual), Grinde Lab \| Salary: $467 (92.3%); Fringe Benefits: $39 (7.7%); Total: $506; 0.65% FTE in 2027; 0.65% FTE in 2028.<br><br>Provides short-term, seasonal support for field gear setup, sample sorting, and data recording during peak sampling periods. Assists field crews with basic site logistics as needed. | | |
| | - | |
| **Services and Subawards** | | |
| Lab Services. Budgeted UMN Soil Testing and Research Analytical Laboratory (STRAL) services for soil characterization and nutrient profiling to evaluate soil health and site conditions. | $ 1,500 | |
| | $ - | |
| **Equipment/Tools/Supplies** | | |
| **Field supplies.** Supply funds cover essential equipment and consumables for field research, laboratory analysis, and crew safety, including soil sampling and hydrophobic testing reagents, GIS navigation hardware, remote emergency gear, and forest canopy measurement tools. | $ 12,699 | |
| | $ - | |
| **Capital Equipment Over $5,000** | | |
| | $ - | |
| **Printing and Publication** | | |
| | $ - | |
| **Travel Expenses In Minnesota** | | |
| **Remote Field Crew Subsistence & Per Diem:**<br>Backcountry food supplies and per diem meal allowances for remote field crews calculated at $68/day (approx. 215 total person-days across two field seasons). | $ 14,620 | |
| **Vehicle Mileage & Fleet Costs:**<br>Travel and fleet costs for transporting personnel, field equipment, and canoe gear between research facilities and BWCA access points, calculated at $0.76/mile (~14,316 total miles). | $ 10,880 | |
| **BWCA Permits & Water Logistics:**<br>USFS wilderness entry permits, administrative fees, outfitter shuttle support, and parking/access fees across remote entry points. | $ 2,500 | |
| **Travel Expenses Outside Minnesota** | | |
| | $ - | |
| **Other** | | |
| | $ - | |
| **COLUMN TOTAL** | **$ 298,000** | |

| **SOURCE AND USE OF NON-ENRTF FUNDS CONTRIBUTED TO THE PROJECT** | **Budget** | **Status (secured, pending, or potential)** |
|---|---|---|
| **Non-State Cash:** | $ - | |
| **Non-State In kind:** | $ - | |
| **State Cash:** | $ - | |
| **State In kind:** | $ - | |

| **OTHER ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS** | **Budget** | **Amount Spent** |
|---|---|---|
| | $ - | $ - |