Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2019 ENRTF Work Plan (Main Document)

Today's Date: June 27, 2019
Date of Next Status Update Report:

Date of Work Plan Approval:

Project Completion Date: June 30, 2021

Does this submission include an amendment request? No.

PROJECT TITLE: Forest and Bioeconomy Research

Project Manager: Rolf Weberg

Organization: Regents of the University of Minnesota

College/Department/Division: University of Minnesota-Duluth, Natural Resources Research Institute

Mailing Address: 1049 University Dr.

City/State/Zip Code: Duluth, MN 55812

Telephone Number: (218) 788-2697

Email Address: rtweberg@d.umn.edu

Web Address: https://www.d.umn.edu/

Location: Duluth, MN

Total Project Budget: $2,200,000.00
Amount Spent: $0

Balance: $0

Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 3 (q)

Appropriation Language: $2,200,000 the first year is to the Board of Regents of the University of Minnesota for academic and applied research through MnDRIVE at the Natural Resources Research Institute to develop and demonstrate technologies that enhance the long-term health of Minnesota's forests, extend the viability of current forest-based industries, and accelerate emerging industry opportunities. Of this amount, $500,000 is to support development of a forest optimization tool for Minnesota forest resources, $800,000 is for maintenance and expansion of the Natural Resource Atlas to statewide coverage, $400,000 is to the Minnesota Forest Resource Council for continued advancement of biochar development and application to forest health, and $500,000 is to advance emerging Minnesota technologies to produce clean syngas to drive high-value markets for forest biomass feedstocks.

I. PROJECT STATEMENT:

The Forest and Bioeconomy Research project expands on the 2016 Legislative Mineral and Water Innovation Initiative appropriation with an NRRI-led, applied research effort focused on Minnesota's forest resources and emerging bioeconomy. Project outcomes are critical to the delivery of knowledge and solutions focused on Minnesota/regional challenges while also engaging key partners and collaborators and leveraging federal and industry funding.

The associated sub-projects were identified via continual broad consultation with Minnesota partners and stakeholders, refined in legislative discussions and submitted as bills which were passed into this appropriation. Each sub-project is designed, consistent with the final level of funding, to either deliver a final result or provide a significant step forward within the biennium timing.

There are 4 sub-projects, each focused on a specific aspect of Minnesota's mineral and water resources:
- Complete and deliver the statewide Minnesota Natural Resource Atlas to support informed planning and decision-making
- Design and deliver a data-driven, predictive forest harvest optimization tool to support forest harvest decisions
- Support MFRC experiments to define use of biochar application for forest health
- Advance emerging Minnesota technologies for production of clean syngas from Minnesota biomass sources

This appropriation is to NRRI – Rolf Weberg is responsible for project outcomes, expenditures, and reporting responsibilities. Rolf Weberg serves as the sole point of contact for the project.

II. OVERALL PROJECT STATUS UPDATES:

First Update March 1, 2020

Second Update September 1, 2020

Third Update March 1, 2021

Final Report between project end (June 30) and September 30, 2021

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III. SUBPROJECTS AND OUTCOMES:

SUBPROJECT 1: Optimizing management of Minnesota's forest landscapes

Description: Minnesota forests provide many diverse products and services, from the production of sawtimber, pulp and new biochemicals and biofuels to provision of societally important values such as water quality, wildlife habitat and recreational opportunities. The social, economic, and ecological benefits of forest lands provide the foundation for sustaining prosperous and resilient communities. Making sound, landscape-scale decisions on forest management that balance these products and services is becoming more and more challenging as forests change and industry needs evolve. Forests show a wide range of variation across Minnesota's geographically complex landscape, and understanding regional variation in composition, productivity, and potential to provide ecological and social benefits is critical for making sound management decisions. The goal of this project is to develop a spatially explicit decision tool that integrates forest productivity, ecosystem service, and economic information to identify the benefits and tradeoffs of land management decisions.

We will accomplish this goal by:
- mapping the variability of key forest attributes (productivity, composition, structure, biomass availability, forest health, habitat, water quality) across the Minnesota forest landscape;
- predicting how future management decisions and climate change will affect forest forest attributes;
- quantifying the value of forest ecosystem services such as maintaining or enhancing water quality, providing wildlife habitat, and producing timber for woods products industries;
- assessing new demands for forest resources given emerging biochemical and advanced biofuel industries;
- collaborating with end users to integrate this information into a publically-accessible decision support tool for optimizing decisions that balance economic, ecological and social concerns.

When completed, this tool will be deployed to end-users (industry, agencies, other stakeholders) with training and collection of recommendations. It will be initially housed at the NRRI with transfer to an appropriate state agency once fully deployed; potential options include MNDNR and DIRRR.

SUBPROJECT 1 ENRTF BUDGET: $500,000

Outcome	Completion Date

1. Map resources and ecosystem services; predict management outcomes; assign economic values to current and future forest services and products for the Minnesota forest landscape.	12/30/2021
2. Develop a decision support tool that assesses social, ecological and economic outcomes of forest management decisions.	6/30/2021
3. Project partner outreach will be ongoing throughout the 2-year term.	6/30/2021

First Update March 1, 2020

Second Update September 1, 2020

Third Update March 1, 2021

Final Report between project end (June 30) and September 30, 2021

SUBPROJECT 2: Expanding the interactive natural resource Atlas for Minnesota

Description: Minnesota is fortunate to have a wealth of spatial data about the built and natural environments. Unfortunately, it is not accessible to most people. The Minnesota Natural Resource Atlas - Northeast Region (*mnnaturalresourceatlas.org*) has removed access barriers in 26 counties in Northeast and North Central Minnesota by providing access to over 275 multi-disciplinary spatial data layers through an intuitive, easy to use online mapping tool. The tool was developed hand-in-hand with end users (identified as the general public or small organizations with limited in-house technical capacity), who helped to identify relevant data and prioritize development of the most relevant analytical tools. The first phase of the Atlas focused on delivery of data relevant to mining regions of NE Minnesota, with an emphasis on geology and water-based resources. We propose to leverage the existing infrastructure to expand the Atlas to the entire state and broaden the data offerings to include more detailed forestry, agriculture, water, and social science data. Specifically, we propose to:

1. assess data and functionality needs across economic sectors not currently covered by the Atlas
2. expand the data sources and analysis functions to enhance forestry, agriculture and cultural resource data and information.
3. expand the extent of the Atlas to the entire State of Minnesota,
4. develop outreach and training materials to build and support the user base.

The enhanced tool will be developed with direct engagement of expanded end user and data manager advisory groups including statewide minerals, forestry, agriculture, water, infrastructure and demographics resources (eg: MNDNR, MPCA, MFRC, etc.). ENTRF funds

will be used to complete development of the software tools to incorporate the statewide data set and make available for above-listed stakeholder review and recommendation. Once complete it will be housed at the NRRI with transfer to an appropriate state agency (eg. MNDNR, DIRRR) once fully deployed.

SUBPROJECT 2 ENRTF BUDGET: $800,000

Outcome	Completion Date
1. Expand extent of Atlas to the entire state and expand content and functionality to meet the needs of additional end users.	6/30/2021
2. Develop outreach and training materials, and develop a funding model to enable long-term viability of data content and functionality.	6/30/2021
3. Project partner outreach will be ongoing throughout the 2-year term.	6/30/2021

First Update March 1, 2020

Second Update September 1, 2020

Third Update March 1, 2021

Final Report between project end (June 30) and September 30, 2021

SUBPROJECT 3: MFRC to support advancement of biochar for forest health

Description: Utilization of wood for biochar has potential to enhance forest-based economies, increase forest health, and increase soil C sequestration, but several barriers exist to operational utilization. This project will address key barriers to biochar utilization by identifying optimal biochar characteristics that improve soil functions, demonstrating the benefits of biochar to tree survival and growth, evaluating techniques and approaches for biochar production and application in operational forested settings, and estimating the potential for net C sequestration under a range of biochar utilization scenarios. We will use controlled laboratory experiments to assess different biochar types to identify the biochar characteristics (e.g., optimal fixed carbon content, degree of torrefaction, particle size, feedstock) that are most useful to increasing soil functions (water holding capacity, nutrient availability, C storage) important to forest health. We will also evaluate production, transport, and application logistics to identify conditions that will be necessary for utilization of biochar in operational forestry settings. To achieve this, we will

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review existing techniques for forest application, survey loggers and operators on novel application techniques, and conduct an economic analysis to estimate cost-benefits of biochar under a range of production and market conditions. Results will provide a foundation for longer-term assessments of biochar utility in operational forestry settings.

SUBPROJECT 3 ENRTF BUDGET: $400,000

Outcome	Completion Date
1. Identification of biochar compositions that enhance soil functions	6/30/2021
2. Evaluation of factors influencing cost-effective production, application and economics	6/30/2021
3. Project partner outreach will be ongoing throughout the 2-year term.	6/30/2021

First Update March 1, 2020

Second Update September 1, 2020

Third Update March 1, 2021

Final Report between project end (June 30) and September 30, 2021

SUBPROJECT 4: Advance emerging Minnesota technologies to produce clean syngas from biomass

Description: Synthesis gas, abbreviated as syngas, is a gaseous mixture of hydrogen and carbon monoxide that can be converted into a variety of fuels and chemicals. When produced from biomass, the resultant products are carbon neutral products that will be necessary for industries such as aviation, mining, and chemicals to achieve their sustainability goals. NRRI has been working with Minnesota-based company, Gradient Technologies, to advance the state of the art in syngas production to address the shortcomings in cost and purity of syngas production that have inhibited its commercial viability. The project will advance two goals to this end:

1. demonstrate that NRRI's existing biomass conversion technology as a "front end" pretreatment to syngas production improves the purity of the syngas, and
2. design and build a feed system necessary to feed pretreated biomass into a novel high-pressure gasifier.

Since the gasifier operates at high pressure (in excess of 350 psia), feeding torrefied biomass into the gasifier would benefit from small-scale testing. The long-term aim is to work with private

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and university partners to secure funding to integrate a demonstration-scale gasification unit into the NRRI's Biomass Conversion Laboratory in Coleraine, MN.

SUBPROJECT 4 ENRTF BUDGET: $500,000

Outcome	Completion Date
1. Characterize clean syngas production from pretreated biomass	6/30/2021
2. Complete engineering design, assembly and evaluation of biomass feed system to high-pressure gasifier	6/30/2021
3. Project partner outreach will be ongoing throughout the 2-year term.	6/30/2021

First Update March 1, 2020

Second Update September 1, 2020

Third Update March 1, 2021

Final Report between project end (June 30) and September 30,

IV. DISSEMINATION:

In addition to LCCMR reporting requirements, overall project deliverables and research results will be disseminated via multiple outlets including:
- Presentations, some in cooperation with MFRC, to public forest, water, and agriculture management agencies, forest and energy industry partners and relevant trade organizations.
- Workshops/presentations to train end users of the forest optimization tool and the Minnesota Natural Resource Atlas enhancements.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgement Guidelines.

V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

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Explanation of Capital Expenditures Greater Than $5,000: N/A

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours for entire duration of project: 40,000	Divide total personnel hours by 2,080 hours in 1 yr = TOTAL FTE: 9.5

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Contract Personnel Hours for entire duration of project: 4200	Divide total contract hours by 2,080 hours in 1 yr = TOTAL FTE: 3.0

VI. PROJECT PARTNERS:

A. Partners outside of project manager's organization receiving ENRTF funding:

Subproject 4: *Advance emerging Minnesota technologies to produce clean syngas from biomass*
- Gradient Technology
  11080 Industrial Circle NW
  Elk River, MN 55330

B. Partners outside of project manager's organization NOT receiving ENRTF funding

Subproject 1: *Optimizing Management of Minnesota's Forest Landscapes*
- Brian Sturtevant
  Research Ecologist
  Northern Research Station
  US Forest Service
- Mark White
  Ecologist
  Nature Conservancy

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

Innovative, integrated solutions are required to help Minnesota's natural resource-based industries evolve and thrive while also maintaining commitments to the environment and our communities. This project will have long-term impacts on the creation and delivery of new tools to support Minnesota resource decision-making and the demonstration of biomass processing technologies to better foster forest health and derive value-added materials from waste and secondary species forest biomass. These delivery points are consistent with the state's goals concerning energy & carbon reduction, forest stewardship, industry growth opportunities and community support & development. This work will leverage long-term relationships and funding opportunities across academia, industry, agencies and other Minnesota stakeholders.

VIII. REPORTING REQUIREMENTS:

- Project status update reports will be submitted March 1 and September 1 each year of the project
- A final report and associated products will be submitted between June 30 and September 30, 2021

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Attachment A:
Environment and Natural Resources Trust Fund
M.L. 2019 Budget Spreadsheet
Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 3 (q)
Sub-project Manager: Lucinda Johnson
Sub-project Title: Expanding the Interactive Natural Resource Atlas for Minnesota (sub-project #2)
Organization: Natural Resources Research Institute
Sub-project Budget: $800,000
Project Length and Completion Date: 2 Years; 6/30/2021
Today's Date: 7/15/2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 782,031	$ -	$ 782,031
Lucinda Johnson, NRRI Research Director: $43,458 (74% salary, 26% fringe), 10% FTE for 2 years			
Academic P&A (in aggregate): 12 staff members est. total $423,207 (74% salary, 26% benefits), FTE Year 1 = 192.5%, Year 2 = 187.5%			
Civil Service (in aggregate): 6 staff members est. $291,983 (77% salary, 23% benefits), FTE: Year 1 = 205%, Year 2 = 175%			
Temp or Casual Appointment: $13,536 (92% salary, 8% benefits), 15% FTE for 2 years			
Undergraduate Student: $9,847 (100% salary, 0% benefits), 21% FTE for 2 years			
Equipment/Tools/Supplies			
Assessment, Outreach, and Training Materials	$ 2,400	$ -	$ 2,400
Travel expenses in Minnesota			
In-state agency meetings; workshops; UMTC team meetings. Travel costs to include mileage, lodging and allowable meals.	$ 9,133	$ -	$ 9,133
Other			
GIS Lab Fees; Domain web-hosting (fee for web-hosting Atlas); and server fees (for external server to run Atlas interactive mapping application)	$ 6,436	$ -	$ 6,436
COLUMN TOTAL	$ 800,000	$ -	$ 800,000

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

PAST AND CURRENT ENRTF APPROPRIATIONS	Amount legally obligated but not yet spent	Budget	Spent	Balance
Current appropriation:		$ -	$ -	$ -
Past appropriations:		$ -	$ -	$ -

Attachment A:
Environment and Natural Resources Trust Fund
M.L. 2019 Budget Spreadsheet
Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 3 (q)
Sub-project Manager: Rob Slesak
Sub-project Title: MFRC to support advancement of biochar for forest health (sub-project #3)
Organization: Natural Resources Research Institute, University of Minnesota Duluth
Sub-project Budget: $400,000
Project Length and Completion Date: 2 years, June 30, 2021
Today's Date: 7/15/2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 325,465	$ -	$ 325,465
Rob Slesak, MFRC Director of Applied Research and Monitoring : 0% FTE for 2 years and Rolf Weberg, NRRI Executive Director: 0% FTE for 2 years	$ -		$ -
6 Academic P&A: 3 UMTC faculty and reserchers est. total: $289,820 (74% salary, 26% fringe), 175% Total FTE over 2 years; 3 NRRI researchers est. total: $29,719 (74% salary, 26% fringe), 11% Total FTE over 2 years			
1 Civil Service technician (NRRI) est. total: $5,926 (77% salary, 23% fringe), 5% Total FTE over 2 years			
Professional/Technical/Service Contracts			
Estimated external sample analysis services	$ 16,535		$ 16,535
UMTC lab services for use of growth chambers and analysis of soil, leachate and plant tissue est. at $10,000	$ 10,000		$ 10,000
NRRI Analytical lab services and biomass conversion est. at $20,000	$ 20,000	$ -	$ 20,000
Equipment/Tools/Supplies			
Supplies for lab bioassay including custom incubation cores, soil moisture sensors and dataloggers. Additional supplies for field trial establishment including seedlings, browse protection, calipers, plot marking, and general lab operating supplies	$ 21,000	$ -	$ 21,000
Travel expenses in Minnesota			
Estimated travel costs (including mileage, lodging and allowable meals) to field trial sites in Minnesota. Locations to be determined.	$ 7,000	$ -	$ 7,000
COLUMN TOTAL	$ 400,000	$ -	$ 400,000

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

PAST AND CURRENT ENRTF APPROPRIATIONS	Amount legally obligated but not yet spent	Budget	Spent	Balance
Current appropriation:		$ -	$ -	$ -
Past appropriations:		$ -	$ -	$ -

Attachment A:
Environment and Natural Resources Trust Fund
M.L. 2019 Budget Spreadsheet
Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 3 (q)
Sub-project Manager: George Host
Sub-project Title: Optimizing Management of Minnesota's Forest Landscapes (sub-project #1)
Organization: NRRI
Sub-project Budget: $500,000
Project Length and Completion Date: 2 years; June 30, 2021
Today's Date: 7/15/2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 486,011	$ -	$ 486,011
G. Host,NRRI Research Director: $27,598 (74% salary, 26% fringe), 8% FTE for 2 years			
Academic P&A (in aggregate): 9 staff members est. total: $246,495 (74% salary, 26% fringe), 114% FTE for 2 years			
Civil Service (in aggregate): 4 staff members est. total: $124,688 (77% salary, 23% fringe), 83% FTE Year 1 and 83% FTE Year 2			
Post Doc: $87,230 (81% salary, 19% fringe); 50% FTE for 2 years			
Equipment/Tools/Supplies			
Data storage (est. cost for 2 TB of storage of research data) and field supplies (including wedge prisms, measuring devices, data recorders)	$ 1,200	$ -	$ 1,200
Travel expenses in Minnesota			
Project meetings in the Twin Cities; Consultation with MN end users; Outreach training in MN (year 2 only), MN conference travel to include mileage, lodging and allowable meals.	$ 9,477	$ -	$ 9,477
Other			
GIS Lab fees	$ 3,312	$ -	$ 3,312
COLUMN TOTAL	$ 500,000	$ -	$ 500,000

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

PAST AND CURRENT ENRTF APPROPRIATIONS	Amount legally obligated but not yet spent	Budget	Spent	Balance
Current appropriation:		$ -	$ -	$ -
Past appropriations:		$ -	$ -	$ -

Attachment A:
Environment and Natural Resources Trust Fund
M.L. 2019 Budget Spreadsheet
Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 3 (q)
Sub-project Manager: Eric Singsaas
Sub-project Title: Advance emerging Minnesota technologies to produce clean syngas from biomass (sub-project #4)
Organization: Natural Resources Research Institute, University of Minnesota Duluth
Sub-project Budget: $500,000
Project Length and Completion Date: 2 years, June 30, 2021
Today's Date: 7/15/2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 145,946	$ -	$ 145,946
Eric Singsaas, NRRI Research Director: $34,342 (74% salary, 26% fringe), 10% FTE for 2 years	$ -		$ -
4 Academic P&A: NRRI researchers & project manager est. total: $93,823 (74% salary, 26% fringe), 40% Total FTE over 2 years	$ -		$ -
1 Civil Service technician, $17,781 (77% salary, 23% fringe), 15% Total FTE over 2 years	$ -		$ -
Professional/Technical/Service Contracts			
Analytical lab services and biomass conversion	$ 75,000	$ -	$ 75,000
Contracted services with project partner (Gradient Technologies) for engineering design and prototype development of gasifier feed mechanism. Purchasing and/or bidding of project services will comply with Minnesota Statutes pertaining to purchasing, procurement and contracting as well as the UMN Purchasing Goods and Services Admin. Policy.	$ 250,000		$ 250,000
Equipment/Tools/Supplies			
Lab supplies to include analytical reagents, sample vessels and biomass samples	$ 15,054	$ -	$ 15,054
Capital Expenditures Over $5,000			
	$ -	$ -	$ -
Travel expenses in Minnesota			
Travel to Twin Cities and Forest Lake to meet with project collaborators. Est. 10 trips/year @ $500/trip inclusive of mileage, parking and allowable meals	$ 10,000	$ -	$ 10,000
Other			
Est. cost for shipping biomass samples to lab and testing sites	4,000	$ -	$ 4,000
COLUMN TOTAL	$ 500,000	$ -	$ 500,000

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

PAST AND CURRENT ENRTF APPROPRIATIONS	Amount legally obligated but not yet spent	Budget	Spent	Balance
Current appropriation:		$ -	$ -	$ -
Past appropriations:		$ -	$ -	$ -