



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2018 ENRTF Work Plan (Main Document)

Today's Date: 02/22/18

Date of Next Status Update Report: 1/31/19

Date of Work Plan Approval:

Project Completion Date: 6/30/21

Does this submission include an amendment request? No

PROJECT TITLE: Farmer-Led Expansion of Alfalfa Production to Increase Water Protection

Project Manager: Nicholas R. Jordan

Organization: University of Minnesota

College/Department/Division: CFANS/Agronomy & Plant Genetics

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Location: Region: Southwest, Southeast **Counties:** Nicollet

Total Project Budget: \$500,000

Amount Spent: \$0

Balance: \$500,000

Legal Citation: M.L. 2018, Chp. xx, Sec. xx, Subd. xx

Appropriation Language:

I. PROJECT STATEMENT:

We are developing a novel prevention-based strategy for protecting water resources, based on a farmer-led, market-based working lands approach to enhancing protection of water in agricultural regions. Our project is based on targeted integration of the perennial crop alfalfa into corn/soybean-based farming operations. If carefully targeted, adding alfalfa to these operations will provide multiple benefits: protecting water resources by reducing soil erosion and loss of nutrients from farms, reducing need for pesticides, improving soil health, supporting wildlife (such as pollinators), and enhancing production and profit for farmers and the agricultural industry. Our project results will help enable application of this prevention-based strategy across most agricultural regions of Minnesota. Therefore, our project will advance a highly feasible, widely applicable, and sustainable solution to major water resource conservation challenges that have resisted solution for decades. Our project will innovate by developing new and widely-replicable methods for farmer-led protection of water resources, and by helping to develop extensive new markets for alfalfa. Beneficiaries include Minnesota farmers and the broader agricultural economy, and rural and urban communities that will benefit from improved water resources and from enhancements to the agricultural economy.

Our specific objectives are:

- 1) to test a farmer-led, market-based working lands approach for using alfalfa to reduce agricultural effects on water, and**
- 2) to do focused research & development work to open new markets for alfalfa.**

Under 1), we will develop a replicable working lands implementation approach, doing pilot work in the Seven Mile Creek watershed near St. Peter, MN, where there is substantial and growing demand for alfalfa. Our goals are to develop and implement a watershed-scale protection plan, involving 10-15 farmers in the watershed; develop on-farm implementation plans for 10-15 farm operations; provide advice and support to these operations on profitable production of alfalfa in corn-soybean systems while also efficiently producing environmental benefits; produce a water quality monitoring report on effects of integrating alfalfa in corn-soybean production systems in this watershed; produce an economic report on integrating alfalfa in corn-soybean production systems. Under 2), we will advance emerging technologies for utilizing alfalfa that are opening up new large markets for the crop; these markets include sustainably-produced aquaculture feed for farming high-value fish and shellfish in Minnesota, and other high-value bio-products from alfalfa.

Our goals are to identify “rescue” strategies to protect alfalfa from moisture-related decay; optimize process to extract cellulose sugars from alfalfa for conversion into high-value bio-products such as biochemicals and nutraceuticals; upgrade alfalfa leaf extract for aquaculture feeds. Our project uses new scientific capabilities to target alfalfa in places where it will provide large improvements in water resources, and to produce high-value bio-products from alfalfa. Our project is supported by a wide range of preparatory efforts, an experienced project team, and leverages multiple collaborative partnerships, each of which will contribute additional efforts, resources, and substantial cost-share funds to the project.

II. OVERALL PROJECT STATUS UPDATES:

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Fourth Update June 30, 2020

Fifth Update January 31, 2020

Final Update June 30, 2020

III. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Develop a farmer-led, market-based working lands approach for using alfalfa to reduce agricultural effects on water.

Description: Support a core group of watershed farmers (initially organized by Nicollet County Soil and Water Conservation District), to design a farmer-led working lands plan by which these farmers take charge of preventive protection of water resources. The plan will be based on targeted expansion of alfalfa production in the Seven Mile Creek watershed within the 3-mile radius area surrounding Northern Plains dairy, and/or on relocation of existing alfalfa cultivation areas to other areas where they are more effective and efficient in protection of water resources. The UMN Collaborative Geodesign process will be used to identify specific on-farm locations for alfalfa cultivation that are economically advantageous for farmers while effectively and efficiently protecting water. This watershed-scale plan provides an overall scheme for water protection but is not sufficiently detailed to guide farm-scale implementation. Therefore, an expert consultant will assist individual farming operations in identifying on-farm locations for producing alfalfa to enhance crop production, profit, and water protection. To proceed, we will hold both one-on-one and group meetings with participating farmers, including those who are currently producing alfalfa and others who may wish to begin production. The project watershed coordinator will conduct and facilitate these activities. The coordinator will hold at least two individual meetings with each farmer, to explain and discuss options for producing alfalfa and participating in a watershed-scale plan to protect water. If a farmer is interested in expansion or improvement of alfalfa production, the expert consultant will help each farmer produce “*individual intent plans*” that identify how alfalfa production can be cost-effectively integrated with the current farming operation. At least two watershed group meetings will be held per year. These meetings will be used for discussion and implementation planning for expanding and improving alfalfa production to improve both farm revenue and water resources. The UMN Collaborative Geodesign tool will be used to develop a watershed plan for the 3-mile radius area, by knitting individual-intent plans together.

ENRTF BUDGET: \$186,460

Outcome	Completion Date
1. Develop and implement watershed-scale protection plan.	<i>June 30, 2021</i>
2. Develop on-farm implementation plans for 15 farm operations.	<i>January 31, 2020</i>

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Fourth Update June 30, 2020

Fifth Update January 31, 2020

Final Update June 30, 2020

Activity 2: Implementation Support for Alfalfa Integration in Corn/Soybean Production Systems.

Description: Communicate available information to support targeted integration of alfalfa into the prevalent corn/soybean production systems in this region, so that farmers can profitably produce abundant yields of quality alfalfa while maximizing water-quality and other resource protection benefits of alfalfa production. This will be done by providing advice and support to farmers within the Seven Mile Creek watershed and in adjacent watersheds. Monitor water quality impacts (including nutrients, soil sediments, and pesticide residues, among other parameters) by a flexible, adaptive strategy, in collaboration with the Federal Clean Water Act Section 319 Project *Seven Mile Creek Assessment and Implementation* (Gustavus Adolphus College), and determine economics of alfalfa production when integrated into corn/soybean production systems for production and resource protection.

ENRTF BUDGET: \$126,940

Outcome	Completion Date
1. Advice and support for profitable production of alfalfa in corn-soybean systems while also efficiently producing environmental benefits.	<i>January 31, 2021</i>
2. Water quality monitoring report on effects of integrating alfalfa in corn-soybean production systems.	<i>June 30, 2021</i>
3. Economic report on alfalfa on integrating alfalfa in corn-soybean production systems.	<i>June 30, 2021</i>
4. Evaluate replicable implementation process model and identify needs for scaling-up.	<i>June 30, 2021</i>

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Fourth Update June 30, 2020

Fifth Update January 31, 2020

Final Update June 30, 2020

Activity 3: Develop value-added processes and products for profitable alfalfa marketing.

Description: We will target three primary areas for improving the profitability. First, we will focus on implementing advanced chopping and sealing mechanisms to reduce moisture-related spoilage and nutrient leaching of alfalfa due to rain. These operations include innovation in post-harvest processing combined with optimizing the timeline from harvest to sealing as well as evaluating the efficacy of naturally occurring anti-microbials in preventing spoilage. Successful implementation of these strategies will not only help alfalfa use but also decrease water pollution by nutrients. Second, we will develop new applications for alfalfa. The leaf extract is naturally rich in protein and contains anti-nutrients, which restrict its use as feed to ruminants. Specifically, we will work on de-toxifying the leaf extract such that alfalfa protein can be utilized by non-ruminants as well as inclusion in aquaculture feed, which will significantly increase the demand and value. We will use a hybrid enzymatic and chemical treatment to detoxify alfalfa extract for it to be amenable for digestion by non-ruminants and fish. Furthermore, we will also refine methods for extracting cellulosic sugars from alfalfa residue for further conversion into high-value bio-products such as nutraceuticals and biofuels. The underlying goal is to

establish a diverse portfolio of high-value products from the entire alfalfa plant. Third, we will develop supply chain connections and identify new market opportunities through exploration, development and management of pilot scale projects with private businesses to commercialize new products and technologies. The outreach component will include organizing 1-2 Innovation Network Program Forums to further awareness, knowledge-sharing and action planning related to innovative opportunities for products, markets and technologies from traditional and emerging alfalfa varieties. The primary theme of the outreach effort will be to communicate the new uses of alfalfa that will be developed within this project.

ENRTF BUDGET: \$186,600

Outcome	Completion Date
1. Implement preventions strategies to prevent moisture-related decay of alfalfa and nutrient leaching	<i>June 2019</i>
2. Optimize process to extract cellulose sugars from alfalfa for conversion into high-value bio-products such as biochemicals and nutraceuticals. 3. Identify at least one market opportunity in nutraceutical and cellulosic sugars sectors by validating supply chain connections.	<i>June 2020</i>
4. Upgrade alfalfa leaf extract for aquaculture feeds and identify and capture value-added opportunities in aquaculture sector.	<i>Dec 2020</i>
5. Disseminate the results from this project – new value-added applications of alfalfa using Network Forums, publications and other outreach avenues	<i>June 2021</i>

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Fourth Update June 30, 2020

Fifth Update January 31, 2020

Final Update June 30, 2020

IV. DISSEMINATION:

Description: Our project will disseminate results via a range of approaches. First, the project will produce a range of reports, all of which will be made available via web sites of the University of Minnesota or AURI (e.g, <http://greenlandsbluewater.net/>; <http://www.auri.org/>). These reports will include the watershed plan for alfalfa integration in Seven Mile Creek, the water-monitoring report, and the economic report, and technical reports on “rescue” strategies to protect alfalfa from moisture-related decay; an optimized process to extract cellulose sugars from alfalfa for conversion into high-value bio-products; and upgrading alfalfa leaf extract for aquaculture feeds. Second, we will store archive water-quality monitoring data in facilities of the Department of Soil, Water, and Climate at the University of Minnesota. Third, we will make presentations on the project’s farmer-led, market-based working lands approach for using alfalfa to reduce agricultural effects on water to at least three conferences, focusing on events that attract broad audiences, such as the Minnesota Waters Conference. Fourth, to disseminate knowledge on opportunities for expanding production of alfalfa, we will organize 1-2 Innovation Network Program Forums to further awareness, knowledge-sharing and action planning related to

innovative opportunities for products, markets and technologies from traditional and emerging alfalfa varieties. The primary theme of these outreach efforts will be to communicate the new uses of alfalfa that will be developed within this project. Fourth, we will proactively engage with print, broadcast, and internet media to seek coverage of the project as a farmer-led, market-based working lands approach to enhancing protection of water in agricultural regions.

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Final Update June 30, 2020

V. PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview: See Attached Budget spreadsheet

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

Explanation of Use of Classified Staff: N/A

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

Enter Total Estimated Personnel Hours: 2392	Divide by 2,080 = TOTAL FTE: 1.15
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Total Number of Full-time Equivalent (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours: 3400	Divide by 2,080 = TOTAL FTE: 1.63
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B. Other Funds:

SOURCE OF AND USE OF OTHER FUNDS	Amount Proposed	Amount Spent	Status and Timeframe
Other Non-State \$ To Be Applied To Project During Project Period:			
EPA 319 Grant to Gustavus Adolphus College	\$ 419,137	\$ 0	Secured; available 6/1/18
Other State \$ To Be Applied To Project During Project Period:			
In-kind cost share representing effort by David Mulla and Nick Jordan	\$ 25,340	\$ 0	Secured; available upon demand.
Past and Current ENRTF Appropriation:			

	\$ N/A	\$ N/A	
Other Funding History:			
	\$ N/A	\$ N/A	

VI. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Great River Greening	N/A	Non-profit group	Watershed coordination
AURI	N/A	Non-profit group	Alfalfa R&D
TBD after procurement	N/A	TBD after procurement	Agronomy advising

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
N/A			

VII. LONG-TERM IMPLEMENTATION AND FUNDING:

Project results will develop a replicable farmer-led working lands approach for expanding alfalfa production to improve wellhead protection and meet other water management needs, and accomplish critical research and outreach activities to expand markets for alfalfa beyond those available from dairies. Both results are essential to achieving benefits from expanded alfalfa production for water, farm and rural economies, and all Minnesotans. Ultimately, we aim to develop farmer-led, market-based working lands approaches for meeting critical water resource needs. Our project will strongly complement other efforts to develop working lands approaches in Minnesota. This research and demonstration project is designed to meet its goals in three years. We anticipate that our project will produce a workable farmer-led working lands implementation approach, and expand interest in new market opportunities for alfalfa, e.g., for Minnesota’s emerging high-value aquaculture industry. If we are successful, then subsequent efforts—beyond the three-year period of this project—will focus on building capacity for widespread application of farmer-led, market-based approaches for meeting water resources needs, and further expansion of emerging alfalfa marketing opportunities.

VIII. REPORTING REQUIREMENTS:

- The project is for 3 years, will begin on 7/1/18, and end on 6/30/21.
- Periodic project status update reports will be submitted 1/31 and 6/30 of each year.
- A final report and associated products will be submitted between June 30 and August 15, 2021.

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

- A. Budget Spreadsheet
- B. Visual Component or Map
- C. Parcel List Spreadsheet
- D. Acquisition, Easements, and Restoration Requirements
- E. Research Addendum

**Attachment A:
Environment and Natural Resources Trust Fund
M.L. 2018 Budget Spreadsheet**



Project Title: Farmer-Led Expansion of Alfalfa Production to Increase Water Protection

Legal Citation:

Project Manager: Nicholas R. Jordan

Organization: University of Minnesota

College/Department/Division: CFANS/Agronomy & Plant Genetics

M.L. 2018 ENRTF Appropriation:

Project Length and Completion Date: 3 years - 6/30/21

Date of Report: February 22, 2018

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits) - Overall	\$124,000	\$0	\$124,000
Agronomy & soil science technicians (yr 1: 160 hours/yr (8%FTE), \$50/hr; yr2: 710 hours/yr (34%FTE), \$50/hr; yr 3:710 hours/yr (34%FTE), \$50/hr, (Total estimated amount \$79,000)			
Applied economics faculty (1, year 3 only, 1 week (2.0% FTE); \$3,000) (Total estimated amount \$3,000)			
Applied economics graduate research assistant (1, year 3 only (25% FTE); \$22,000). (Total estimated amount \$22,000)			
Geodesign programmer, 250 hours (12%FTE), \$80/hour; year one only. (Total estimated amount \$20,000)			
Professional/Technical/Service Contracts			
Watershed coordinator, 600 hours/year (30% FTE); \$60 hour, 3 years (Total estimated amount \$108,000)	\$108,000	\$0	\$108,000
Contract with consultant to provide partial support for assistance to individual farming operations in identifying on-farm locations for producing alfalfa to efficiently enhance crop production, profit, and water protection. RFP will be issued according to University of Minnesota procedures. (Total estimated amount \$32,710)	\$32,710	\$0	\$32,710
Process Engineer/Organic and analytical scientist will work on assessing alfalfa materials for conversion them into fishmeal supplements and protein-based food-based applications. Total team effort is 20% FTE/yr at \$55/hr, all years) (Total estimated amount \$68,640)	\$68,640	\$0	\$68,640
Food Scientist) will work on extracting cellulosic sugars and high-value nutraceuticals Total team effort is 20% FTE/yr at \$55/hr, all years) (Total estimated amount \$68,640)	\$68,640	\$0	\$68,640

Activity 3 supply chain team will establish supply chain connections and lay foundation for new market opportunities through exploration, development and management of pilot scale projects with private businesses to commercialize new products and technologies. Total team effort is 8% FTE/yr at \$55/hr), all years. (Total estimated amount \$27,450)	\$27,450	\$0	\$27,450
Activity 3 outreach team will organize 1-2 Innovation Network Program forums over the course of the grant period to further awareness, knowledge sharing and action planning related to innovative opportunities in alfalfa-based food, feed and fuel applications and products, markets and technologies. Total team effort is 5% of FTE/yr at \$55/hr, all years).(Total estimated amount \$17,160)	\$17,160	\$0	\$17,160
Equipment/Tools/Supplies			
Water-quality monitoring supplies and sample analysis; \$227.76 per sampling week x 34 sampling weeks/yr x 2 years).	\$15,488	\$0	\$15,488
Process equipment (one new High temperature/pressure reactor) for processing alfalfa plant residue and conversion into cellulosic sugars.	\$15,000	\$0	\$15,000
Travel expenses in Minnesota			
Activity 1 travel for collaborative geodesign team (6 Minneapolis-St. Peter round trips x \$1,272/trip for vehicle rental, fuel, per diem) and project director (9 Minneapolis-St. Peter round trips x \$92 trip for mileage, per diem) to support working lands design process.	\$8,460	\$0	\$8,460
Activity 2 travel for collection of water samples (yr 2: 25 Minneapolis-St. Peter round trips x \$92/trip for mileage, per diem;; yr 3: 26 Minneapolis-St. Peter round trips x \$92/trip for mileage, per diem, and extension educator (10 Minneapolis-St. Peter round trips/yr, all years x \$92 trip for mileage, per diem).	\$7,452	\$0	\$7,452
Activity 3 Travel by the technical team, supply chain team, and outreach team. Travel by Technical team to collect samples and conferences, to partner labs, various locations = \$2,000; Travel by Innovation and Commercialization Team to private businesses and investors, various MN locations = \$3,000; Travel by the Outreach and Communications team to Forums (various MN locations) ,costs of hosting Forum speakers = \$2,000.	\$7,000	\$0	\$7,000
COLUMN TOTAL	\$500,000		\$500,000