Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2011 Work Plan

Date of Status Update:
Date of Next Status Update: 1/1/2012
Date of Work Plan Approval: 6/23/2011
Project Completion Date: 6/30/2013 **Is this an amendment request?** _____

Project Title: Measuring Conservation Practice Outcomes

Project Manager: Greg Larson
Affiliation: Board of Water and Soil Resources
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Location:

Counties Impacted: Statewide

Ecological Section Impacted: Lake Agassiz Aspen Parklands (223N), Minnesota and Northeast Iowa Morainal (222M), North Central Glaciated Plains (251B), Northern Minnesota and Ontario Peatlands (212M), Northern Minnesota Drift and lake Plains (212N), Northern Superior Uplands (212L), Paleozoic Plateau (222L), Red River Valley (251A), Southern Superior Uplands (212J), Western Superior Uplands (212K)

Total ENRTF Project Budget:

ENRTF Appropriation $:	340,000
Amount Spent $:	0
Balance $:	340,000

Legal Citation: M.L. 2011, First Special Session, Chp. 2, Art.3, Sec. 2, Subd. 03l

Appropriation Language:
$170,000 the first year and $170,000 the second year are from the trust fund to the Board of Water and Soil Resources to improve measurement of impacts of conservation practices through refinement of existing and development of new pollution estimators and by providing local government training.

I. PROJECT TITLE: Measuring Conservation Practice Outcomes

II. PROJECT SUMMARY:

This proposal seeks additional funds to further improve, refine existing and create new estimators to quantify environmental benefits from conservation programs through a continued partnership with researchers at the University of Minnesota's Department of Soil, Water and Climate. Accounting for on the ground outcomes and measureable environmental benefits to the quality of soil, water, and habitat is an essential component of implementing conservation projects. Local Government Units (LGUs), including Counties, Soil and Water Conservation Districts and Watershed Districts, utilize pollution reduction estimators to quantify the outcomes of conservation projects. BWSR currently utilizes models or 'estimators' to measure the pollution reduction benefits of installed Best Management Practices (BMPs). Estimators quantify the outcomes of conservation practices in terms of reduced soil erosion, sediment and phosphorus reduction, carbon sequestered, etc.

The demands on the BWSR grant reporting system, eLINK, to estimate and quantify environmental benefits of conservation practices have outpaced BWSR's ability to provide such information. For example, the pollution reduction benefits of some BMPs are not included in the eLINK database because Local Government Units do not have access to an estimator or model that quantifies the outcomes of conservation practice implantation. In order to improve the accounting of conservation practices and measurement of environmental benefits, existing estimators must be revised and new estimators developed. *We propose a three-tiered approach to improve estimates of conservation projects implemented by BWSR and cooperating agencies*: **1)** Improvement of existing pollution reduction estimators and creation of new estimators where needed, **2)** Field verification and ground truthing for revised and new pollution reduction estimators and **3)** Local Government Unit (LGU) training and education.

In the past, BWSR has worked closely with the University of Minnesota to develop the first generation of estimators to quantify pollution reduction benefits of conservation practices. BWSR will be utilizing $100,000 from the Clean Water Fund and significant staff time on a partnership with the University of Minnesota to begin a new phase of research aimed at improving and verifying estimation of environmental benefits of conservation practices. The above-mentioned project will precede the LCCMR proposed activities.

III. PROJECT STATUS UPDATES:

Project Status as of January 2012:

Project Status as of September 2012**:**

Project Status as of March 2013:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Develop new and improve existing pollution estimators

Description: Create a work team composed of BWSR staff and University of Minnesota researchers. The work team will identify BMPs requiring new estimator development and those requiring revision of current estimators. The team will work collaboratively to generate new estimators, improve existing estimators, and launch the new estimators for use by LGUs and other conservation professionals.

Summary Budget Information for Activity 1:	**ENRTF Budget:**	**$ 86,000**
	Amount Spent:	**$ 0**
	Balance:	**$ 86,000**

Activity Completion Date:

Outcome	Completion Date	Budget
1. Work team develops recommendations for priority estimator development	December 2011	$ 13,000
2. Work team collaborates with the University of Minnesota and other soil and water conservation organizations to develop/revise priority estimators	February 2013	$ 68,000
3. Deploy new estimators for outcome tracking in eLINK	June 30 2013	$ 5,000

Activity Status as of January 2012:

Activity Status as of September 2012**:**

Activity Status as of March 2013:

Final Report Summary:

ACTIVITY 2: Field Verification
Description:
Summary
A team of researchers (Nater, Fissore, Dalzell) at the University of Minnesota will directly measure and model sediment erosion and deposition on lands under annual row crop and perennial grassland management in order to determine the effectiveness of perennial grassland conservation management practices in limiting sediment production to streams. The activity includes development of estimators to quantify pollution reduction benefits of sediment-trapping BMPs. The new estimators will be used to initiate a framework for modeling the movement of a variety of land-applied chemicals to surface waters.

Background
Erosion of soils by water redistributes soil sediments within fields and can lead to increased sediment in adjoining streams and other surface water bodies. Because many chemicals adhere strongly to soil sediments, eroded sediments can carry these chemicals with them.

Conservation practices have been implemented over the years to reduce accelerated erosion and to protect sediments from entering surface waters. These include changes in tillage and residue management and the use of perennial grasses in grassed waterways, riparian buffers, and on steep slopes. While there is general agreement that these practices reduce erosion and sediment production, the actual quantities of sediment movement reduced by these practices is uncertain.

Erosion/Deposition Estimator Development

The erosion/deposition estimators will be based on the relationship between LIDAR-based Digital Terrain Attributes and a 50-year average of soil movement measured by the of Cesium-137 isotope method. Cesium-137 is a radioactive isotope that is produced only by nuclear fission; there are no natural sources. Large quantities of Cesium-137 were released into the atmosphere during above ground nuclear weapons testing and were carried into the stratosphere and distributed worldwide. Subsequent deposition (fallout) contaminated soils regionally with a small but relatively uniform dose of Cesium-137 which adheres tightly to surface soil particles, providing a measurable label for surface soils. Any redistribution of Cesium-137 since the cessation of above ground testing in 1963 is due to

the physical movement of surface soil sediments by erosion, animal activity, or human activity. (Although Cesium-137 was released to the atmosphere during the Chernobyl explosion and is currently being released by the damaged reactors at Fukushima, Japan, the quantities deposited on Minnesota soils are negligible and will not interfere with these analyses). The total quantity of surface soil eroded from or deposited on any point in the landscape since the mid 1960s can be determined by measuring the activity of Cesium-137 in soils with a gamma ray spectrometer. Annual average rates of sediment movement can then be calculated and will be related to Digital Terrain Attributes to develop estimators of erosion/deposition and potential sediment production to surface waters.

LIDAR-based digital elevation models will soon be available for the entire state, providing the opportunity to enhance the estimation of erosion/deposition. Current estimates are developed using the RUSLE2 model, which is based on slope steepness and length, soil characteristics, and land use characteristics. Digital Terrain Attributes such as Compound Terrain Index and Stream Power Index also use slope steepness and length, but in addition include the curvature of the slope (which determines if runoff is focused or dispersed) and the area upslope of any point on the landscape that contributes runoff to that point. These attributes (and others) can be readily calculated from a LIDAR-based DEM and provide a better estimate of the potential for erosion or deposition at any point in the landscape, improving the accuracy of estimators based on them. (This approach was developed in collaboration with Dr. Kyungsoo Yoo and Joel Nelson).

Summary Budget Information for Activity 2:

ENRTF Budget: $ 196,000
Amount Spent: $ 0
Balance: $ 196,000

Activity Completion Date:

Outcome	Completion Date	Budget
1. Identify sites on public lands or cooperating landowners that have either been continuously under tillage or have been continuously under perennial grassland for the last 50 years. Use LIDAR-based Digital Terrain Attributes (Compound Terrain Index [CTI], Stream Power Index [SPI]) of these sites to select sampling locations that encompass a broad array of Digital Terrain Attribute values.	November 2012	$ 26,000
2. Collect soil samples by depth increment for each site identified and analyze soil samples for total carbon, ^{137}Cs (cesium-137) and ^{210}Pb (lead-210).	June 2013	$ 100,000
3. Determine sediment movement as a function of Digital Terrain Attributes for both grassland and tilled sites. Report results and implement estimators.	June 2013	$ 70,000

Activity Status as of January 2012:

Activity Status as of September 2012**:**

Activity Status as of March 2013:

Final Report Summary:

ACTIVITY 3: LGU Training and education

Description:
Develop and host training sessions for LGUs and other eLINK users on the newly revised and developed pollution reduction estimators. Training content will be developed in multiple platforms and available in alternative formats (i.e. video) that is widely accessible. A quality assurance and quality control assessment of LGU-reported pollution reduction values will verify the training was successful and LGUs are using the estimators correctly. Adjustments to estimation and reporting procedures following quality assurance and quality control review.

Summary Budget Information for Activity 3:

ENRTF Budget: $ 50,000
Amount Spent: $ 0
Balance: $ 50,000

Activity Completion Date:

Outcome	Completion Date	Budget
1. Curriculum development for estimator training sessions	March 2013	$ 15,000
2. Host training sessions for new and revised estimators (in-person, webinars, instructional videos)	June 2013	$ 25,000
3. Quality control and quality assurance review of pollution reduction estimates	June 2013	$ 10,000

Activity Status as of January 2012:

Activity Status as of September 2012**:**

Activity Status as of March 2013:

Final Report Summary:

ACTIVITY 4: Develop framework for movement of chemicals and land-applied EDCs in soils
Description:
Summary
This activity combines the erosion/deposition estimator developed in activity 2 with partition coefficients for land-applied chemicals reported in published literature to create a pollution reduction estimator for Atrazine (the most common land-applied EDC). Ideally this activity would include developing estimators for 9 of the most common land-applied EDCs (atrazine, daidzein, equol, genistein, 17-alpha-trenbolone, 17-beta-trenbolone, monensin, tylosin and virginiamycin) however existing research on these emerging chemicals is insufficient and partition coefficients are not currently available with the exception of atrazine. For the remaining land-applied chemicals without published partition coefficient values, a framework will be developed for modeling chemical movement when data become available. (This approach was developed in collaboration with Drs. Bill Koskinen and Pam Rice).

Background
Many chemicals adhere to surface soils, binding tightly to mineral and/or organic matter particles. Examples include phosphorus, numerous organic compounds (pesticides and herbicides, animal antibiotics, endocrine disrupting chemicals, natural chemicals), and many others. Transport of these chemicals occurs when soil particles are transported by erosion or other processes. Other chemicals

such as nitrate, chloride, and sulfate, are soluble in water and do not adhere tightly to soil particles. Transport of these chemicals occurs with the movement of water, either as surface runoff or as subsurface flow to groundwater or in tile drainage.

A partition coefficient is a chemical term used to describe the relative affinity of a chemical for one phase (water) as opposed to another (soil). The relative affinity of a chemical for the soil phase is dependent on the nature of the soil (particularly the clay content and the organic matter content) and the structure of the chemical and how it interacts with the soil components. Partition coefficients for a chemical can be measured in the laboratory and are valid for a specific soil type.

If we know the concentration of a chemical in the field, the partition coefficient for a specific chemical/soil type combination, and we can estimate of the erosion/deposition rate, then we can estimate the movement of that chemical on the landscape and determine how effective conservation practices are at retaining it on the landscape. Consequently, a good erosion/deposition estimator provides a framework for estimating the movement of chemicals across the landscape if partition coefficients are available or can be determined. For a specific region where the clay and organic matter content and type are relatively uniform, partition coefficients can be applied across the region. For some well-studied chemicals, sufficient information may exist in the literature to allow a good prediction of the water-soil partition coefficient for a specific region. For most chemicals, and particularly for emerging chemicals such as many of the endocrine disrupting chemicals, existing data are insufficient. Our awareness of many of the endocrine disrupting chemicals is relatively recent and our understanding of their behaviors in natural systems is in its infancy.

The advantage of this method of estimating the movement of chemicals is that it is far more universal than field monitoring and measurement of the movement of chemicals where direct measurements are made for one chemical for only one or two years on a small number of fields or sites. Our approach can be applied to a much broader region and additional chemicals can be added as need or when data become available. An example of a similar type of estimator is the Minnesota Phosphorus Index, which is based in part on the movement of sediments as predicted by RUSLE2 and the strong affinity of phosphorus for soil particles.

Summary Budget Information for Activity 4:

ENRTF Budget: $ 8,000
Amount Spent: $ 0
Balance: $ 8,000

Activity Completion Date:

Outcome	**Completion Date**	**Budget**
1. Develop pollution reduction estimators for chemicals with known partition coefficients	June 2013	$ 2,000
2. Develop framework for measuring chemical movement in soils; including sample collection protocol and laboratory protocols.	June 2013	$ 6,000

Activity Status as of January 2012:

Activity Status as of September 2012**:**

Activity Status as of March 2013:

Final Report Summary:

V. DISSEMINATION:

Description:

Pollution reduction estimators developed, revised and verified in activities 1 and 2 will be made web available on the BWSR eLINK homepage (http://www.bwsr.state.mn.us/outreach/eLINK/index.html). Guidance documents and instructional materials developed in activity 4 will also be available on the eLINK homepage. In-person training sessions on pollution reduction estimators are planned throughout the State and specific dates and locations will be highlighted on the BWSR Training website (http://www.bwsr.state.mn.us/training/index.html) as well as in the *Train Tracks* training newsletter. The framework for estimating land-applied EDCs and protocols for sampling and analysis of EDCs will be available on the BWSR soils website (http://www.bwsr.state.mn.us/soils/index.html).

Status as of January 2012:

Status as of September 2012*:*

Status as of March 2013:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

1 **ENRTF Budget:**

Budget Category	$ Amount	Explanation
Personnel:	$ 55,000	1 BWSR classified staff (.25 FTE) to manage project address activities 1 and 3; 1 BWSR unclassified staff (.2 FTE) to address activities 1 and 3.
Professional/Technical Contracts:	$ 262,500	Contract with University of Minnesota to develop and revise pollution reduction estimators, conduct field verification and to review land-applied EDCs.
	$ 8,000	Contract for curriculum development and publication of guidance documents.
Equipment/Tools/Supplies:	$7,000	Software/licenses for training programs, supplies for workbooks, guidance documents and training packets, soil sampling and field verification supplies.
Printing:	$ 2,000	Printing of training materials.
Travel Expenses in MN:	$ 5,500	Includes mileage and lodging for out state training sessions.
TOTAL ENRTF BUDGET:	**$ 340,000**	

Explanation of Use of Classified Staff: LCCMR project funds do not supplant Agency general funds used for salary. Classified staff, Megan Lennon, is currently funded with special project funds devoted to conservation outcomes. These funds end 6/30/2011.

Explanation of Capital Expenditures Greater Than $3,500: N/A

Number of Full-time Equivalent (FTE) funded with this ENRTF appropriation: The ENTRF appropriation for the Measuring Conservation Practice Outcomes supports a total 6.44 FTEs over two years:

Dr. Ed Nater	.05 FTE for 2 years

Cinzia Fissore	.1 FTE for 2 years
Brent Dalzell	.5 FTE for 2 years
Graduate Research Assistant 1	.1 FTE for 1 year
Graduate Research Assistant2	.5 FTE for 2 years
Graduate research assistant, undergraduate research assistants or research fellows (4 total)	.38 FTE for 2 years
Greg Larson	.2 FTE for 2 years
Megan Lennon	.25 FTE for 2 years

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
State			
BWSR In-kind services	$ 35,000	$ 0	BWSR IT staff support for Activity 3, specifically QA/QC and website development necessary for hosting web training.
TOTAL OTHER FUNDS:	**$ 35,000**	**$ 0**	

VII. PROJECT STRATEGY:

A. Project Partners:

Paid in ENTRF funds: The project team includes Ed Nater (paid), Cinzia Fissore (paid), Brent Dalzell (paid) and two graduate students (paid), from the University of Minnesota's Department of Soil, Water and Climate, and Greg Larson (paid) and Megan Lennon (paid) from BWSR. Project partners from the University of Minnesota will conduct field research and collect and analyze data necessary for revision and development of new models to estimate environmental benefits of conservation practices. The University of Minnesota will receive a total of $262,500. Megan Lennon is the project manager, and Greg Larson will consult with University partners regarding research, and conduct training for local governments units on new and revised pollution reduction estimators.

Paid in-kind or unpaid: Additional project partners include Julie Blackburn (unpaid) and Conor Donnelly (paid in-kind) from BWSR. Julie Blackburn will consult on development of outcome measures and Conor Donnelly will provide IT support outcome measure implementation, quality control/quality assurance, and training.

B. Project Impact and Long-term Strategy:

The activities included in this proposal are critical to measuring the environmental outcomes and determining the effectiveness of conservation practices in Minnesota. BWSR's ongoing work with conservation programs necessitates assessments of practice effectiveness. With additional funding, this project could expand to include more comprehensive EDC research that is complimentary to both the 2010-2012 LCCMR project by Swackhammer, Koskinen and Rice and the 2011-2013 LCCMR proposal by Sadowsky. A mid-level analysis of land applied EDCs requires additional funding of $30,000 and would provide analysis of 5 EDCs (3 phytoestrogens, atrazine, and 1 growth hormone) on 3 soil types. A full scale analysis of land-applied EDCs requires additional funding of $88,000 and would provide analysis of 8 ECDs (atrazine, 3 phytoestrogens, 1 growth hormone, and 3 livestock antibiotics) on 8 soil types. The suite of EDCs chosen for both the mid-level and full scale analysis is identical to those in the Sadowsky and Swackhammer, Koskinen and Rice proposals. Analysis of the same suite of EDCs allows for inter-study comparability and lower analytical costs.

C. Spending History:

Funding Source	M.L. 2009 or FY 2010
Board of Water and Soil Resources - Clean Water Fund	$ 102,200

VIII. ACQUISITION/RESTORATION LIST: N/A

IX. MAP(S): N/A

X. RESEARCH ADDENDUM: N/A

XI. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted not later than January 2012, September 2012, and March 2013. A final report and associated products will be submitted between June 30 and August 1, 2013 as requested by the LCCMR.

Attachment A: Budget Detail for M.L. 2011 (FY 2012-13) Environment and Natural Resources Trust Fund Projects

Project Title: Measuring Conservation Practice Outcomes
Legal Citation:
Project Manager: Megan Lennon
M.L. 2011 (FY 2012-13) ENRTF Appropriation: $ 340,000
Project Length and Completion Date: 2 years; June 30, 2013
Date of Update: May 13, 2011

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Balance	Activity 2 Budget	Amount Spent	Balance	Activity 3 Budget	Amount Spent	Balance	Activity 4 Budget	Amount Spent	Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	**Develop new and improve pollution reduction estimators**			**Field Verification**			**LGU training and education**			***Land-applied Endocrine Disrupting Compounds review***				
Personnel (Wages and Benefits)													55,000	
Megan Lennon, classified staff, BWSR Soil Scientist: $35,000 (100% salary and fringe); .25 FTE for 2 years	17,500	0	17,500				17,500	0	17,500				35,000	35,000
Greg Larson, unclassified staff, BWSR soil scientist: $20,000 (100% salary and fringe); .2 FTE for 2 years.	10,000	0	10,000				10,000	0	10,000				20,000	20,000
Professional/Technical Contracts													270,500	270,500
University of Minnesota: for pollution reduction estimator development (activity 1) and field verification (activity 2). Contract includes: • Brent Dalzell, Research Associate: $59,000 (75% salary, 25% fringe); .5 FTE for 2 years. • Rebecca Beduhn, Research Scientist: $6,667 (80.5% salary, 19.5% fringe); 1 FTE for 3.3 months • Cinzia Fissore, Research Associate (July - August 2011; Assistant professor starting September 2011): $26,881 (75% salary, 25% fringe); .5 FTE for 3 months • 1 Graduate Research Assistant: $ 42,200 (80.5% salary, 19.5% fringe); .5 FTE for 2 years • 2 Undergraduate Researchers: $10/hr (91% salary, 9% fringe). 1 FTE each for 5 months • Ed Nater, Professor: $4,000 (75% salary, 25% fringe); .05 FTE for 1 year • Graduate research assistants, undergraduates or research fellows: $62,500 (average 75% salary, 25% fringe). • Soil sampling and field work equipment/supplies, $8000 • GIS laboratory fees, $1,500 • Travel expenses, $7,000	58,500	0	58,500	196,000	0	196,000				8,000	0	8,000	262,500	262,500
TBD (competitive bid): consultant for assistance in curriculum development, format/layout of guidance docuemnts.							8,000	0	8,000				8,000	8,000
Equipment/Tools/Supplies														
Software programs and licenses for training and quality assurance/quality control review • Camtasia 7.0 - Create Tutorials, Demos, Courses and Online Videos • Statistica (or similar statistical analysis software) - QA/QC analysis of outcomes measured with pollution reduction estimators • Raptivity - create learning interactions for online training sessions and webinars							2,200	0	2,200				2,200	2,200
Training materials: Supplies for handouts/workbooks, binders, dividers, usb drives for storing data, postage for mailing training material.							4,800	0	4,800				4,800	4,800
Soil sampling and field work supplies: augers, sample bags, tarps, etc.													0	0
Printing													2,000	2,000
Training materials: printing of guidance documents, worksheets, instructional material, etc.							2,000	0	2,000				2,000	2,000
Travel expenses in Minnesota													5,500	5,500
Lodging (for outstate training sessions)							1,500	0	1,500				1,500	1,500
Vehicle mileage (standard rate): training sessions throughout state							4,000	0	4,000				4,000	4,000
COLUMN TOTAL	**$86,000**	**$0**	**$86,000**	**$196,000**	**$0**	**$196,000**	**$50,000**	**$0**	**$50,000**	**$8,000**	**$0**	**$8,000**	340,000	340,000