Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2015 Work Plan

Date of Report: May 21, 2015

Date of Next Status Update Report: January 30, 2016

Date of Work Plan Approval:

Project Completion Date: June 30, 2019

Does this submission include an amendment request? N/A

PROJECT TITLE: Assessment of Irrigation Efficiencies in Benton County

Project Manager: Gerry Maciej

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Location: Benton and Morrison

Total ENRTF Project Budget:	**ENRTF Appropriation:**	**$431,000**
	Amount Spent:	**$0**
	Balance:	**$431,000**

Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 4h

Appropriation Language:
$431,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Benton Soil and Water Conservation District to develop and implement a decision support system to increase irrigation efficiencies and provide outreach on irrigation best management practices. Software developed with this appropriation must be available in the public domain. Project efforts should be coordinated with the Department of Natural Resources. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Assessment of Irrigation Efficiencies in Benton County

II. PROJECT STATEMENT: Several areas in Minnesota exist where groundwater use exceeds sustainable levels or is approaching a sustainability threshold. One of those areas is Little Rock Creek in Benton and Morrison Counties. The MPCA has determined that Little Rock Creek, a cold water trout stream, is impaired for its cold water fishery due to low dissolved oxygen levels and nitrates. A TMDL study determined that the impairment is related primarily to an increasing amount of groundwater use, primarily from irrigated crops, and reduced groundwater quality. The current tools available to manage irrigation and groundwater resources are outdated and no longer effective to meet current demands.

The goal of this project is to provide those tools and the expertise needed to overcome sustainability issues in Little Rock Creek and provide these tools to others facing similar sustainability problems throughout many parts of Minnesota. Additionally, the project will demonstrate that this can be accomplished while obtaining multiple benefits for producers, such as increased yield and reduced fertilizer and irrigation input costs, using proven conservation practices. Those tools and anticipated results include:

1) *Restoring stream conditions favorable for trout by maintaining critical stream flow* and *increasing dissolved oxygen above 7 ppm* by creating a real time decision support system that integrates creek flow, creek dissolved oxygen levels, soil moisture balance, forecasting and other variables. The decision support system will provide a condition appropriate tool irrigators can use to make conservation irrigation decisions.
2) *Increasing irrigation efficiency*, including use of irrigation scheduling has been shown to decrease water use by 30% while improving yields 5% and decreasing energy use up to 35%. To increase adoption of scheduling, an on-line/cell phone scheduling assistant will be developed and utilized by irrigators.
3) *Improving soil health*, such as increasing soil organic matter on sandy soils, reduces the need to irrigate and apply supplemental nutrients such as nitrogen. Reduced till methods when combined with cover crop practices can reduce irrigation needs by as much as 5" of water due to better infiltration, increased water holding capacity, and reduced evapotranspiration. This project will provide technical expertise and tools to increase adoption of soil health practices.

To develop the decision support system we will first assemble a stakeholder group who will be comprised of primarily irrigators, and secondarily resource professionals. The stakeholder group will have two primary responsibilities. 1) Determine criteria that will be used to make conservation irrigation decisions and 2) determine what those conservation irrigation activities are and where and when to deploy them. As the stakeholder group completes its work, a consultant will develop the real time decision support system. Since part of the criteria will be stream flow and water quality we will measure flow and collect water samples throughout the project.

To develop the on-line/cell phone scheduling assistant we utilize input from the stakeholder group, in addition to input from irrigators the SWCDs have provided scheduling assistance to in the past, to determine what irrigation scheduling variables are most appropriate for an assistant. We will then utilize the same consultant to develop the scheduling assistant and update it periodically after it is launched and used over the following two years. The assistant will be non-proprietary and will be made available to the public. Technicians will provide one-on-one assistance with irrigation scheduling and use of the new software.

To increase adoption of soil health practices we will provide technical expertise throughout the year to promote appropriate practices as determined by the NRCS soil health checklist and other appropriate strategies. Technicians will also promote these practices as they are providing farmers with irrigation scheduling assistance and decision support system assistance. The following are examples of soil health practices we anticipate farmers may implement:

- Conservation crop rotations – Increasing the diversity of crops grown over several years

- Cover crops – Increasing the diversity of crops grown in a field and increasing the length of time plants are living in the soil by planting a second, usually harvested, crop in a given year.
- Reducing tillage and mulching – Leaving the soil covered with unused plant matter that is left on the field after harvest.
- Nutrient management – Managing the amount and placement of supplemental nutrients to meet crop need and avoid over application.
- Pest management – Managing plant and animal pests using ecologically friendly methods.

Refer to the soil health checklist for additional information. The outcome of the project will be a voluntary producer led system of managing limited groundwater resources for Little Rock Creek that will be transferable to other parts of Minnesota.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of 1-30-16**:**

Project Status as of 7-30-16**:**

Project Status as of 1-30-17**:**

Project Status as of 7-30-17**:**

Project Status as of 1-30-18**:**

Project Status as of 7-30-18**:**

Project Status as of 1-30-19**:**

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: *Increased adoption of irrigation and soil conservation practices to reduce water use, restore flow, and increase dissolved oxygen to 7ppm.*

Description:

Conservation technicians will target irrigation systems with the largest DNR appropriated volumes and potential to impact surface water flows when promoting conservation practices. Irrigation applications will be optimized through irrigation system calibration and irrigation scheduling. Calibrations will be completed with equipment that has been made available through the MDA. Scheduling assistance will be completed weekly, or at a frequency that is deemed necessary by the irrigator. The weekly assistance will include a site assessment of the irrigated field to estimate soil moisture and use of the online irrigation scheduling assistant, customized to each individual producer, after it has been developed. The Soil health practices will be integrated into production systems using the NRCS soil health checklist or other acceptable methods. NRCS staff will have a significant partnership in the soil quality initiative however SWCD technicians will take the lead role.

Summary Budget Information for Activity 1:	**ENRTF Budget:**	**$68,475**
	Amount Spent:	**$ 0**
	Balance:	**$68,475**

Outcome	Completion Date

1. *Producers prioritized, technical team consulted, targeting strategy implemented*	February 2016, February 2017, February 2018
2. *Our goal is 4,000 acres of irrigation management and 1,000 acres of soil health practices installed. We estimate irrigation management will be practiced on 40 irrigation systems that typically cover 80 to 120 acres each.*	June, 2019

Activity Status as of *1-30-16***:**

Activity Status as of *6-30-16***:**

Activity Status as of *1-30-17*:

Activity Status as of *6-30-17*:

Activity Status as of *1-30-18***:**

Activity Status as of *6-30-18***:**

Activity Status as of *1-30-19***:**

Final Report Summary:

ACTIVITY 2: *Development and utilization of a Conservation Irrigation Decision Support System (CIDSS) and an on line / cell phone application irrigation scheduling assistant.*
Description: A decision support system will be developed that provides daily information on condition appropriate conservation irrigation methods. Recommended methods will be delivered via web or other appropriate technology. We will hire a consultant to develop the CIDSS software. To define the system a stakeholder committee, whose members will be primarily local irrigators, will be developed. The committee will develop the decision point criteria for implementing the specific conservation measures that optimize crop production and stream health at various flow levels. Some potential criteria are shown in blue in the attached diagram. Simple indicators of irrigation categories, such as a stoplight approach (green = standard rate/standard conservation measures; yellow = conservation rates/additional conservation measures; red = deficit irrigation rates/highest level of conservation measures) will be developed to inform producers on the appropriate strategies to be implemented.

The same stakeholder committee will define the appropriate variables for the irrigation scheduling assistant. Some possible variables are shown in brown on the attached diagram. The scheduling assistant will be linked to new weather stations that are currently being installed in cooperation with the MDA. We will hire a consultant to develop the irrigation scheduling assistant software. The consultant will be available to make modifications to the software for three years as the users and stakeholder group make recommendations for improvements.

Summary Budget Information for Activity 2:

ENRTF Budget: $158,757
Amount Spent: $ 0
Balance: $158,757

Outcome	Completion Date
1. *Stakeholder group established and initial decision point criteria developed for CIDSS, Irrigation scheduling assistant variables defined.*	March 2016
2. *Conservation Irrigation Decision Support System program and Irrigation scheduling assistant developed, beta tested, and implemented with training and full launch*	May 2016

3. *Stakeholder group meets to refine CIDSS and irrigation scheduling assistant software two additional times (Winter 2016/17 and Winter 2017/2018)*	January 2018
4. *CIDSS and Irrigation scheduling assistant software updated as needed*	October 2018

Activity Status as of *1-30-16***:**

Activity Status as of *6-30-16***:**

Activity Status as of *1-30-17*:

Activity Status as of *6-30-17*:

Activity Status as of *1-30-18***:**

Activity Status as of *6-30-18***:**

Activity Status as of *1-30-19***:**

Final Report Summary:

ACTIVITY 3: *Evaluation of effectiveness and progress towards project goals*
Description: There will be several types of monitoring and evaluation throughout this project. Reports on program effectiveness will be developed and communicated to various audiences.

- Stream monitoring. The MNDNR has several monitoring sites set up in Little Rock Creek. They will be keeping three of them on a permanent basis. We will be using LCCMR funds to upgrade the sites to include satellite telemetry so the data is made available real time. We will integrate this with the CIDSS to help evaluate conservation irrigation decisions. Additionally water quality samples will be collected bi-weekly, analyzed and utilized in the CIDSS as well. The actual flow in Little Rock Creek and water quality (i.e. dissolved oxygen levels) will be used as one measure of the effectiveness of the project.
- Groundwater monitoring wells. The MNDNR has already replaced some of the long term groundwater monitoring wells in the area and added data loggers to the new wells. The Benton SWCD will be downloading data routinely for the DNR. The DNR plans to install additional new wells in the project area, including a nest of wells that can be used to evaluate groundwater levels in the project area. Activities associated with the monitoring well network are outside the scope of LCCMR funding. We are including them in this work plan for informational purposes only because they are integral to the project.
- Soil moisture sensors and automated rain gauges. Sensors and gauges will be installed at select irrigation sites, the criteria for selecting sites will be set by the stakeholder committee, to be utilized as a tool for the irrigation scheduling software. The sensors will be compared to the weekly in-field estimates. Additionally, two weather stations are being installed by the Benton SWCD through a partnership with the MDA and will be used to collect all of the information required to calculate evapotranspiration in real time. The installations of the weather stations are outside the scope of LCCMR funding. We are including them in this work plan for informational purposes only.
- Monitoring cropping management. During years 2 and 3 we will monitor and report changes to the management of cropping systems. Items will include parameters such as acres of soil health practices, acres of cropland utilizing the scheduling assistant, acres or number of irrigation systems evaluated for uniformity and any improvements made to the irrigation system. NRCS plans to utilize soil quality testing to track soil quality progress. We will track crop yield to evaluate crop production improvements.

Summary Budget Information for Activity 3: **ENRTF Budget: $102,818**
Amount Spent: $ 0
Balance: $102,818

Outcome	Completion Date
1. *Satellite telemetry purchased and installed, stream flow and water quality monitoring begins.*	November 2015
2. *Soil moisture sensors and rain gauges installed and activated at select sites.*	May 2016, May 2017, May 2018
3. *Annual reporting on program effectiveness, working with the technical team to adapt program implementation strategies based on effectiveness results*	January 30, 2016, January 20 2017, January 30 2018
4. *Data analysis and report on stream flow and water quality*	January 30 2016, January 20 2017, January 2018

Activity Status as of *1-30-16***:**

Activity Status as of *6-30-16***:**

Activity Status as of *1-30-17*:

Activity Status as of *6-30-17*:

Activity Status as of *1-30-18***:**

Activity Status as of *6-30-18***:**

Activity Status as of *1-30-19***:**

Final Report Summary:

ACTIVITY 4: *Outreach, promotion, and sharing results throughout the state*
Description: Project partners will demonstrate the benefits of conservation practices to producers through multiple channels including irrigators and crop growers associations, farm visits, field days, websites, and traditional mailings. We will utilize input from the stakeholder committee to prioritize outreach activities.

Project results will be shared statewide at conferences (potentially the BWSR Training academy, Water Resources Conference, etc.), and through project reports, websites, and other channels as appropriate.

The Conservation Irrigation Decision Support System and the irrigation scheduling assistant will be made available statewide. Sharing the results and products (technology transfer) will be a significant component of this project for both the consultant and the Benton SWCD. To accomplish this we will link the system up to other existing available data (i.e. other weather stations, other critical streams with flow data) and share the system to other areas of the state. Our consultant will perform this task by working with other government agencies directly (i.e. other SWCDs, DNR, MDA) and installing the systems on agency websites as appropriate and if necessary. The consultant will also be responsible for training and technical assistance to these agencies and will require a significant commitment. Additionally SWCD staff will work with the other agencies to train and provide assistance on the products and procedures.

Summary Budget Information for Activity 4: **ENRTF Budget: $100,950**

Amount Spent: **$ 0**
Balance: **$100,950**

Outcome	Completion Date
1. *Outreach team established; SWCD staff and project partners develop and update materials regularly with new information and messages.*	On-going throughout the project
2. *Up to 4 field days, events, conferences/year for target audience and stakeholders*	On-going and as determined by the stakeholder committee.
3. *Annual reporting on program effectiveness, working with the technical team to adapt program implementation strategies based on effectiveness results*	January 30 2016, January 30 2017, January 30 2018
4. *Demonstration and transfer of technology and program results. The outcome will be the successful launch of the software on the websites of other interested entities including training staff of those entities.*	December 2018

Activity Status as of *1-30-16*:

Activity Status as of *6-30-16*:

Activity Status as of *1-30-17*:

Activity Status as of *6-30-17*:

Activity Status as of *1-30-18*:

Activity Status as of *6-30-18*:

Activity Status as of *1-30-19*:

Final Report Summary:

V. DISSEMINATION:
Description: Weather station data formatted to evapotranspiration (from the MDA provided weather stations), water flow, water quality and ground water levels will all be made available either directly from our website at www.Soilandwater.org, or from a link on the website. The CIDSS and irrigation scheduling assistant will also be available through our website and we anticipate that other entities (i.e. SWCDs, Irrigation Association of Minnesota) will have it established on their websites also by the end of the project. The software itself will be available for the public. Interim and final reports will be posted on the Benton SWCD website.

Status as of *1-30-16*:

Status as of *6-30-16*:

Status as of *1-30-17*:

Status as of *6-30-17*:

Status as of *1-30-18*:

Status as of *6-30-18*:

Status as of *1-30-19*:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$123,314	• District Manager, 0.38 FTE cumulative total throughout the project (790 hours), assisting with stakeholder group meetings, facilitation, development of CIDSS and irrigation scheduling assistant, soil quality promotion, monitoring data review and reporting, outreach and technology transfer and overall project management. • Technician(s), 1.5 FTE cumulative total throughout the project (3234 hours), assisting with all aspects of the project and will be the lead for increased adoption of practices. • Administrative Assistant, 0.1 FTE cumulative total throughout the project (160 hours), performing administrative tasks.
Professional/Technical/Service Contracts:	$256,025	Contractor to be determined through a competitive bid process. We will be seeking a contractor in the natural resources field, with experience with GIS, irrigation management principles, software design and working with the public (in particular farmers and irrigators). Contractor will be responsible for CIDSS and irrigation scheduling assistant development, maintenance and upgrades for both systems throughout the project; water quality/flow analysis and reporting, soil moisture equipment/rain gauge installation; web presentations, on-line conferences, field days, public events and transfer of technology.
Equipment/Tools/Supplies:	$42,506	The below figures are currently estimates. We will purchase soil/soil quality tests for the soil quality initiative ($1,000), satellite link/hook up for 3 DNR stream monitoring stations ($12,056), 3 years of water quality testing and one instrument ($12,310), soil moisture monitoring sensors ($7,140) and automated rain gauges ($6,000), and various items needed for outreach efforts ($4,000).
Travel Expenses in MN:	$9,155	All expenses will be for travel with a vehicle.

TOTAL ENRTF BUDGET:	$431,000	

Explanation of Use of Classified Staff: N/A

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

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 2.0 FTE

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 1 FTE

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
USDA EQIP, CSP and other conservation programs	$75,000	$0	Federal farm bill program funds directly to landowners implementing conservation practices.
State			
FY14 BWSR CWF Grant	$25,000	$0	Staff expense to promote practices.
MN Department of Agriculture Irrigation Joint Powers Agreement	$15,000	$0	Staff expense for irrigation assistance, management of two weather stations and outreach activities.
TOTAL OTHER FUNDS:	**$115,000**	**$0**	

VII. PROJECT STRATEGY:

A. Project Partners:

The following partners are participating on the planning team. None of the partners will receive ENRTF funds. MPCA (Kevin Stroom), NRCS (Mike Walczynski, Pat Gehling), Morrison SWCD (Helen McLennan), East Ottertail SWCD (Darren Newville), MDA (Jennifer Gallus), U of M (Josh Stamper), DNR (Dan Lais, Greg Kruse). Additionally NRCS will assist with soil quality promotion and DNR is providing stream monitoring stations and access to monitoring well data.

B. Project Impact and Long-term Strategy:

Currently irrigators in areas where sustainability is a concern have no way of knowing or predicting when ground water use is reaching or exceeding sustainability thresholds and as a result do not apply enhanced or emergency remediation practices. The Conservation Irrigation Decision Support System fills that need. It will be developed so that it can be easily adapted for systems outside of Little Rock Creek that have the same need. The irrigation scheduling assistant will be provided to others at no cost and used throughout Minnesota in irrigated areas. Benton SWCD has made it a priority to assist irrigators in the Little Rock Creek watershed since the TMDL study began and it will continue to be a priority in the future. We will be providing assistance to irrigators on the use of the software and continue to promote soil quality practices that reduce water use and reduce nitrogen input to the creek in the future.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
BWSR Clean Water Fund grant, Funds used to hire staff to promote irrigation best management practices in the Little Rock Creek area.	FY 2014	$44,400 (est.)
MPCA, Little Rock Creek TMDL study	2010 - 2013	$75,000

BWSR Clean Water Fund Accelerated Implementation grant, Working with the poultry industry to make changes to animal feed that result in reduced nitrogen and phosphorus export to the watershed.	FY 2012	$55,410
BWSR Clean Water Fund Restoration Technical Assistance grant, Funds used to hire staff to promote irrigation best management practices in the Little Rock Creek area.	FY 2011	$84,211

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS:

A. Parcel List: N/A

B. Acquisition/Restoration Information: N/A

IX. VISUAL COMPONENT or MAP(S): See attached timeline, flowchart and graphic.

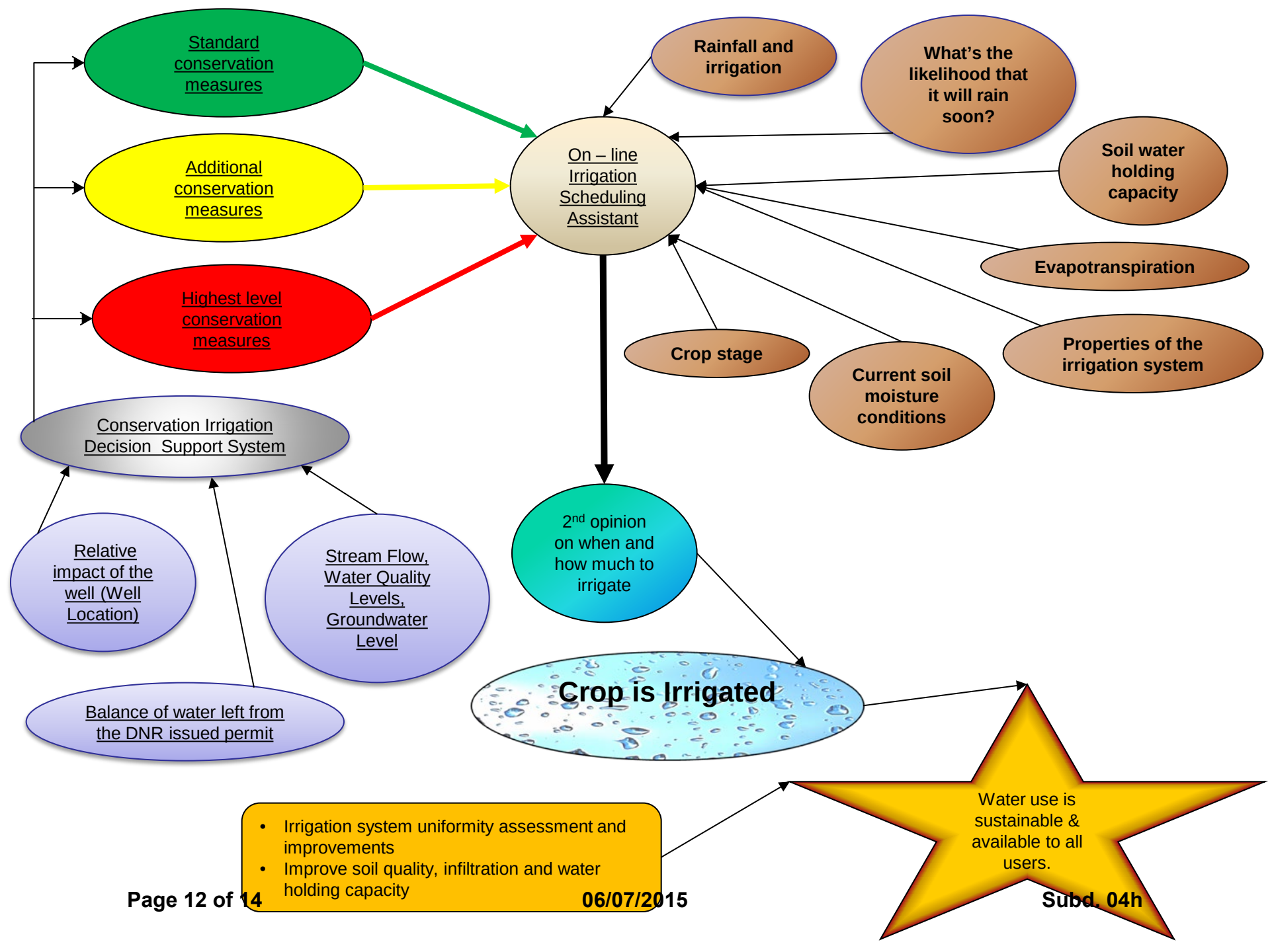
X. RESEARCH ADDENDUM: N/A

XI. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted no later than 1-30-16, 7-30-16, 1-30-17, 7-30-17, 1-30-18, 7-30-18, and 1-30-19. A final report and associated products will be submitted between June 30 and August 15, 2019.

Environment and Natural Resources Trust Fund
M.L. 2015 Project Budget

Project Title: Assessment of Irrigation Efficiencies in Benton County
Legal Citation:
Project Manager: Gerry Maciej
Organization: Benton SWCD
M.L. 2015 ENRTF Appropriation: $431,000
Project Length and Completion Date: 4 Years, June 30, 2019
Date of Report: May 21, 2015

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	Activity 4 Budget	Amount Spent	Activity 4 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	***Increase adoption of irrigation & conservation***			***Develop CIDSS & Scheduling Assistant***			***Evaluate effectiveness and progress***			***Outreach, promotion, sharing results***				
Personnel (Wages and Benefits)	$58,000	$0	$58,000	$7,502	$0	$7,502	$13,462	$0	$13,462	$44,350	$0	$44,350	$123,314	$123,314
Gerry Maciej, District Manager,$35,550 (78% salary, 22% benefits), 0.38 FTE total														
Technicians, $84,084 (79% salary, 21% benefits), 1.5 FTE total														
Administrative Assistant, $3,680 (79% salary, 21% benefits), 0.08 FTE total														
Professional/Technical/Service Contracts														
TBD (competitive bid) Consultant for CIDSS development, irrigation scheduling assistant and maintenanceand upgrades for both systems throughout the project.				$151,255	$0	$151,255							$151,255	$151,255
TBD (competitive bid) Consultant for water quality/flow analysis and reporting, soil moisture equipment/rain gauge installation							$53,290	$0	$53,290				$53,290	$53,290
TBD (competitive bid) Consultant for web presentations, on-line conferences, field days, public events and transfer of technology to other entities										$51,480	$0	$51,480	$51,480	$51,480
Equipment/Tools/Supplies														
Water testing ($12,310), soil testing ($1,000), satelite telemetry for 3 DNR monitoring stations ($12,056), soil moisture probes ($7,180), rain gauges ($6,000), expenses for outreach efforts (for example facility expenses for workshops, direct mailing expenses, newsletter, field day expenses, $4,000)	$1,000	$0	$1,000				$37,506	$0	$37,506	$4,000	$0	$4,000	$42,506	$42,506
Travel expenses in Minnesota														
Travel for weekly irrigation scheduling assistance, water monitoring, and outreach events	$7,475	$0	$7,475				$560	$0	$560	$1,120	$0	$1,120	$9,155	$9,155
Other														
COLUMN TOTAL	**$66,475**	**$0**	**$66,475**	**$158,757**	**$0**	**$158,757**	**$104,818**	**$0**	**$104,818**	**$100,950**	**$0**	**$100,950**	**$431,000**	**$431,000**


Standard conservation measures
Additional conservation measures
Highest level conservation measures
Rainfall and irrigation
What's the likelihood that it will rain soon?
On – line Irrigation Scheduling Assistant
Soil water holding capacity
Evapotranspiration
Crop stage
Current soil moisture conditions
Properties of the irrigation system
Conservation Irrigation Decision Support System
Relative impact of the well (Well Location)
Stream Flow, Water Quality Levels, Groundwater Level
Balance of water left from the DNR issued permit
2nd opinion on when and how much to irrigate
Crop is Irrigated
Water use is sustainable & available to all users.
Irrigation system uniformity assessment and improvements
Improve soil quality, infiltration and water holding capacity

Achieving Minnesota's Groundwater Sustainability Through Irrigation Efficiencies

Through voluntary adoption of irrigation and soil conservation practices

INITIATIVES

1 Improve Irrigation Efficiencies

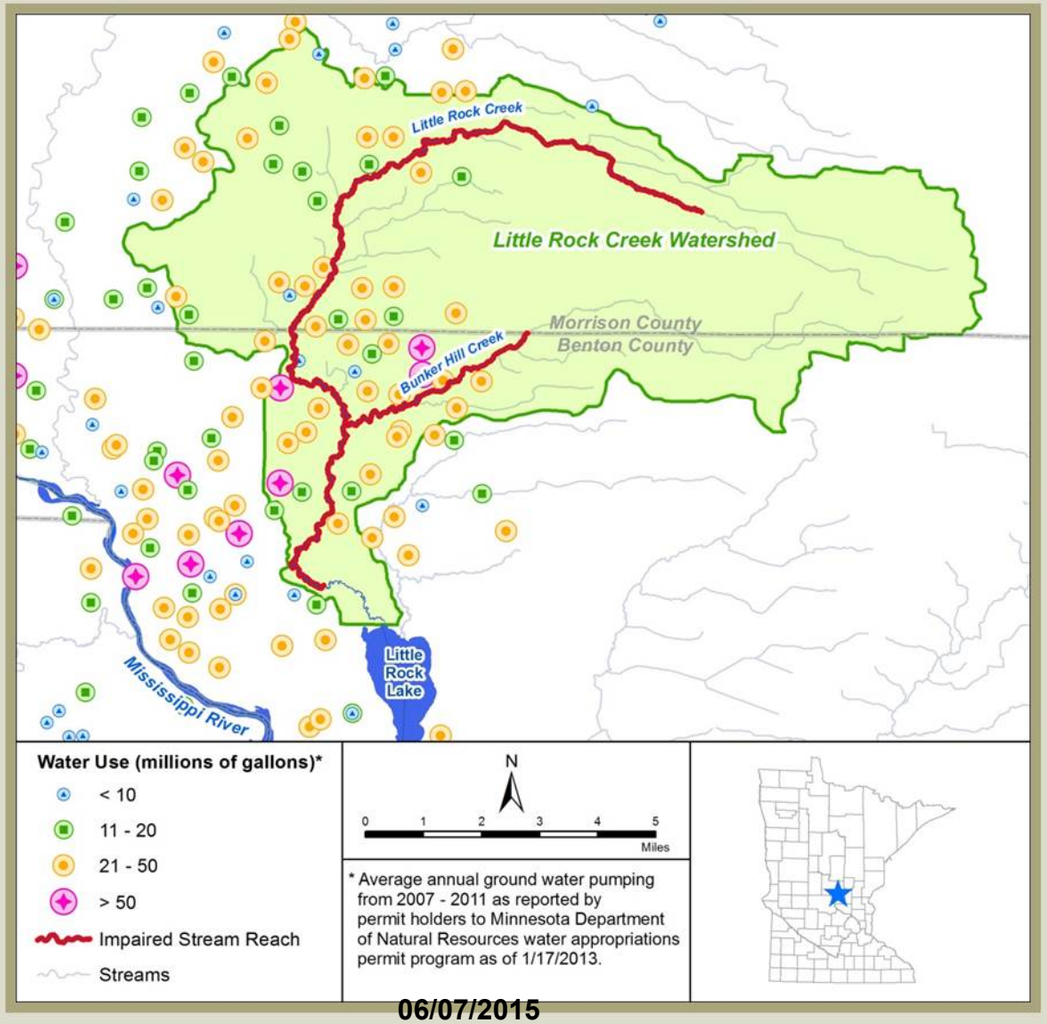
- Custom field irrigation scheduling via web
- Calibrating irrigation equipment
- Outreach on irrigation BMPs

2 Improve Soil Health

- Cover crops, reduced till practices
- Increase soil organic matter
- Improve soil water holding capacity
- Reduce runoff and irrigation demands

3 Implement Decision Support System

- Integrated flow, soil moisture, forecasting
- Real-time condition appropriate irrigation methods
- Methods determined by producers



OUTCOMES

Increased Groundwater

- Reduced irrigation demands
- Producer-driven voluntary program

Improved Trout Stream Conditions

- Reduced groundwater interference
- Increased stream flow
- Decreased stream temperature

Improved Water Quality

- Less irrigation reduces runoff
- Improved soil health reduces nutrient application and soil erosion

Improved Producer Profitability

- Less irrigation reduces energy costs
- Improved soils reduce nutrient application
- Increased yields from improved soil health