

**Environment and Natural Resources Trust Fund
2012-2013 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 103-E2

GBERBA Region Culvert and Burnline Inventory Enhancing LiDar

Topic Area: E2. NR Info Collection/Analysis

Total Project Budget: \$ 247,460

Proposed Project Time Period for the Funding Requested: 2 yrs. July 2013 - June 2015

Other Non-State Funds: \$ 0

Summary:

An innovative inventory of burnlines and culverts for use in creating hydrologically corrected DEMs from Minnesota LiDAR data for use in improving water quality and quantity models in southern Minnesota.

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Sponsoring Organization: Mankato State University - Water Resources Ctr

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Location

Region: SW, SE

County Name: Blue Earth, Brown, Cottonwood, Faribault, Freeborn, Jackson, Le Sueur, Martin, Steele, Waseca, Watonwan

City / Township:

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ Employment	_____ TOTAL _____%



Environment and Natural Resources Trust Fund (ENRTF) 2012-2013 Main Proposal

PROJECT TITLE: GBERBA REGION CULVERT AND BURNLINE INVENTORY ENHANCING LIDAR

I. PROJECT STATEMENT

This project is an Innovative inventory of burnlines and culverts for use in creating hydrologically corrected DEM's from Minnesota LiDAR data for use in improving water quality and quantity models in Southern Minnesota. The Minnesota State Legislature just recently approved the acquisition of LiDAR data for all of Minnesota over a five year period. There is considerable interest in make use of the new LiDAR derived digital elevation models (DEM's) in Minnesota for water resource projects. LiDAR DEM's provide a very precise depiction of the land surface. However, LiDAR captures the topography of the landscape and all human created features upon it. LiDAR DEM's do not inherently include important information about subsurface water conveyance connections such as culverts, drain tiles, and storm sewers. As a result, bridges, roads and other structures on the landscape effectively act as virtual dams ("digital dams"), preventing terrain analysis algorithms from properly routing the flow of water across the DEM landscape.

Hydrologic Analyses, conducted using DEMs that do not account for subsurface water conveyance, are generally suspect. As a result, LiDAR DEM's need to be manipulated to allow the passage of water through digital dams. Fortunately, there are methods for modifying DEM's to account for subsurface water conveyance features. This process is known as hydrological conditioning. Hydrological conditioning of DEM's has been completed on many watersheds in the Red River Valley and the resulting hydrologically corrected DEM are used in water quality models as well as secondary attributes.

This project will create a database of burnlines for use in creating hydrologically-corrected DEM's. These burnlines are culverts, drain tiles, and storm sewers which do not show up in LiDAR data due to roads, bridges and other structures. This database will be comprehensive in its approach bringing many partners into the creation of it that will benefit not only counties, SWCD's, and researchers but also the State of Minnesota as a whole. The next step in LiDAR is the hydrologically-corrected DEM and without burnlines, this cannot be accomplished unless this work is completed. The Minnesota Digital Elevation Committee has created a document "interim Guidance on Acquisition of Culvert Geospatial Data" because they understand the importance of inventorying burnlines/culverts as the next step in the LiDAR process. Many burnline/culvert inventories have been completed in the Red River Basin due to the flooding. With LiDAR becoming available for Southern Minnesota, the next logical step is the burnline/culvert inventory. This innovative proposal directly gets at the issue of utilizing LiDAR data in hydrologic modeling. Once this inventory is created, it will not need to be done redone even in subsequent LiDAR acquisitions. This database is important for water quality and quantity modeling.

The Water Resources Center is a GIS data center for the Minnesota River basin assisting counties with GIS tasks to implement and target Best Management Practices (BMP's) on the landscape for Precision Conservation. This project will assist in improving the models that use DEM's and will benefit work in areas looking to store water on the landscape as well as target the priority management areas for Precision Conservation.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Creation of Burnlines / Culvert Inventory

Budget: \$193,251.00

Watershed delineation and the hydrologic and hydraulic modeling that occurs within their confines are dependent on proper flow routing within digital elevation models (DEM). The elevation of roads and

other features captured within LiDAR mass points create “Digital Dams” at intersections with flow paths within LiDAR derived DEM’s. An inventory of culverts and bridges is needed to create burnlines that can be used in hydrologically correcting DEM’s to aid in properly routing the flow of water across the DEM landscape. In some instances, an office based inventory may be a cost effective complement to a field based inventory. An office based inventory can use highway construction plans, LiDAR derived images, oblique imagery, and rasters (hillshade raster, topographic index (TPI) rasters, high resolution digital aerial imagery) in a GIS, or an individual’s firsthand knowledge.

This task and activity outcome will create an inventory of culverts/burnlines utilizing office based techniques as outlined by the Digital Elevation Committee as well as other Red River entities that have created similar inventories for their models. Where available, assistance from the counties or SWCD’s in inventorying culverts will be utilized. Initial Estimates in the Red River are that burnlines take about one square mile per hour. This involves creating burnlines and hydrologically correcting the DEM at the same time to check for full water conveyance. The area of the counties that fall with the Greater Blue Earth River Basin within Minnesota is 3200 square miles.

Outcome	Completion Date
<i>1. Culvert inventory - utilizing office based analysis and field inventory</i>	<i>December 31, 2014</i>
<i>2. Burnlines - GIS database of line work featuring culverts, drain tiles, and such</i>	<i>December 31, 2014</i>
<i>3. Digital Database/online database for entry and updates of inventories</i>	<i>December 31, 2014</i>

Activity 2: Hydrologically-Corrected DEM’s and Secondary Attributes **Budget:** \$54,209.00

The second activity will utilize the inventory of burnlines and culverts to hydrologically correct the DEM’s for use in tools that require models that show water conveyance correctly. The Greater Blue Earth River Basin Alliance has requested Stream Power Index (SPI) layers as well as Compound Topographic Index (CTI) layers that can be used to determine locations of high erosion and depressional areas in their watersheds. Both SPI and CTI will be calculated for each of the catchments in the GBERBA region. There are 333 catchments in the GBERBA region.

Outcome	Completion Date
<i>1. Hydrologically corrected DEM’s</i>	<i>June 30, 2015</i>
<i>2. Stream Power Index – calculate SPI on catchments in GBERBA region</i>	<i>June 30, 2015</i>
<i>3. Compound Topographic Index – calculate CTI on catchments in GBERBA region</i>	<i>June 30, 2015</i>

III. PROJECT STRATEGY

A. Project Team/Partners

Water Resources Center: Rick Moore, GIS Specialist, Student GIS Specialist; Greater Blue Earth River Basin Alliance [GBERBA] Kay Clark, Administrative Coordinator & David Bucklin, Technical Coordinator & Member SWCD’s and Counties – Blue Earth, Brown, Cottonwood, Faribault, Freeborn, Jackson, Le Sueur, Martin, Steele, Watonwan & Waseca

B. Timeline Requirements

Two year: July 1, 2013 through June 30, 2015

C. Long-Term Strategy and Future Funding Needs

The methodology and process of creating burnlines would be carried over and completed for the entire Minnesota River Basin and added to the comprehensive database started in the GBERBA region.

2012-2013 Detailed Project Budget

GBERBA REGION CULVERT AND BURNLINE INVENTORY ENHANCING LIDAR

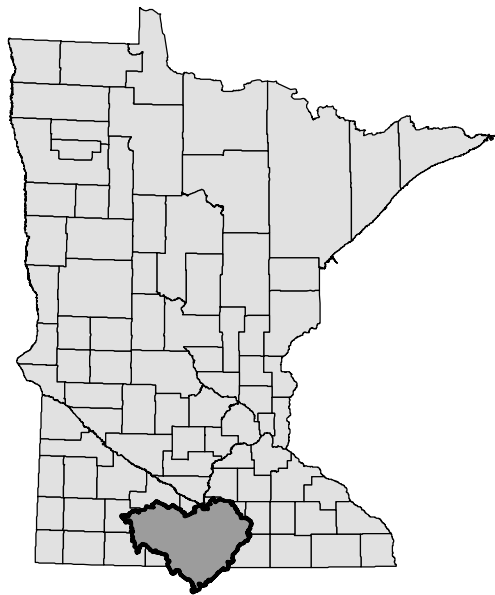
IV. TOTAL ENRTF REQUEST BUDGET: 2 years

<u>BUDGET ITEM</u>	<u>AMOUNT</u>
Personnel:	
Richard Moore- 100% employment/yr (salary 100% soft money)- 2 yr period.	208,000.00
Students - 1- 10% employment/1st yr (salary 100% soft money) and 3% for 2nd yr .	8,100.00
Contracts:	
10 counties (SWCD) / 1 year	30,000.00
Equipment/Tools/Supplies:	-
Travel:	
2 days rental per county-20 days MSU vehicle rental	1,360.00
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 247,460.00

V. OTHER FUNDS

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
In-kind Services During Project Period: Staff time for 12 person advisory committee, 4 meetings	\$ 6,000.00	

LCCMR Project: GBERBA Region Culvert and Burnline Inventory Enhancing LiDAR



- GBERBA Streams
- County Boundaries
- Greater Blue Earth River Basin



Prepared for: Legislative-Citizen Commission on Minnesota Resources (LCCMR)

Prepared By: Richard Moore
Minnesota State University Mankato
Water Resources Center (MSU-WRC)

Date: April 2012

PROJECT TITLE: GBERBA Region Culvert and Burnline Inventory Enhancing LiDAR

Project Manager Qualifications and Organization Description

Richard Moore, Project Manager

Rick is the GIS/Mapping Specialist for the Water Resources Center and assists with a diverse array of projects. He is involved in mapping for projects such as the LCCMR funded project “Does Altering Hydrology Create More Erosive Rivers” in collaboration with the Science Museum of MN as well as the GBERBA Shoreland Mapping Project. He has expertise creating innovative, interactive online tools such as historical aerial photo comparisons and Google Earth fly-throughs of the Minnesota River Basin. Rick also specializes in developing web mapping applications for the Water Resource Center, other agencies, and local governments in the Basin.

Rick has a diverse knowledge of technology, both in software and hardware, and can find a solution to any need at the Water Resources Center. His motto is “there is a solution to everything, it might just take a few more steps.” Prior to joining the Water Resources Center, Rick served as GIS specialist for a regional planning agency. Rick has developed and taught many GIS and GPS courses at Minnesota State University in the Geography Department. He holds a Master’s degree in Geography-Geographic Information Systems (GIS) from Minnesota State University Mankato and an undergraduate Geography degree from the University of Minnesota.

Water Resources Center, Minnesota State University, Mankato (WRC)

The WRC is uniquely situated to disseminate the latest information about the Minnesota River due to its involvement with data collection and distribution, policy development, and communication throughout the Minnesota River Basin. Three major Minnesota River projects are housed at the WRC. The Minnesota River Basin Data Center (<http://mrbdc.mnsu.edu>) is a data clearinghouse, originally funded by LCMR (LCCMR) in 1997, with a mission to develop, interpret, and disseminate data that impact the environment, economy and communities within the Minnesota River Basin. The Minnesota River Board (<http://www.minnesotariver.org>) director and staff are also based out of the WRC and work closely with the joint powers board to build partnerships and support efforts to improve and protect water quality in the Minnesota River Basin. The communication coordinator of the Minnesota River Watershed Alliance (<http://watershedalliance.blogspot.com/>), also based at the WRC, networks with and connects a diverse selection of citizens, nonprofit organizations and government agencies and provides information about water quality related issues and efforts advanced by this coalition. In addition, we have GIS staff with the capacity to create sophisticated GIS analysis and maps and 3-dimensional landscape visualization.

The Water Resources Center (WRC) of Minnesota State University, Mankato was created in 1987 to serve as a regional center for environmental research and information exchange. The mission of the WRC is to gather, interpret, and distribute data of environmental significance to help enhance the quality of regional lakes, rivers, wetlands, and groundwater. This is accomplished through faculty and student applied research, educational programming, technical assistance, and water resource planning.

Since its beginning, the WRC has participated in over 100 research, educational, and planning projects involving partnerships with dozens of public and private organizations. These projects range from groundwater, lake assessment, and TMDL studies to water quality workshops to development of watershed-based plans for surface water quality protection. Our stability since 1987 stands as a testament to the objective and quality products we produce. Long-term partnerships with counties, nonprofit organizations, and state agencies have resulted in many important and far-reaching land and water resource initiatives. We have a dedicated staff and look forward to enhancing the public’s connection with the Minnesota River.