

1997 Project Abstract

For the period ending June 30, 1999

This project was supported by the Environment and Natural Resources Trust Fund (MS 116P.02, Subd.6)

Title: Statewide Digital Soil Database - Phase 1
Project Manager: Greg Larson
Organization: Board of Water and Soil Resources
One West Water Street
Suite 200
St.Paul, MN 55107

Legal Citation: ML 1997, Ch. 216, Sec.15, Subd. 10(f)
Appropriation Amount: \$145,000

Statement of Objectives

The primary objectives of the project were to:

- Develop a methodology to correct the spatial errors associated with the photography used in County Soil Surveys in Minnesota.
- Develop a cost-effective and accurate procedure to perform the data transformation and digitization, compatible with GIS systems.

Additional objectives of the project were to:

- Test the procedure on a Minnesota County, using existing soil survey data. Becker County was selected.
- Integrate the work with existing State (Board of Water and Soil Resources) and Federal (Natural Resources Conservation Service) Agencies to ensure data quality and that customer needs are met.
- Provide a way for GIS users and local government to easily access the methodology and data.

Overall Project Results

The method met the stated objectives. Results from the work in Becker County have been quality checked by soil scientists and GIS specialists at the University of Minnesota and the Natural Resources Conservation Service. The quality review verifies that the method produces a digital data product that meets national map accuracy standards.

Project Results Use and Dissemination

Government officials and land users will be able to use the data generated from digital soil surveys for land use management and assessment, agriculture, tax assessment, environmental studies and forestry. Moreover, the method will be made available to GIS professionals and listed as a specification for use in digitizing soil surveys. Consequently, the prospect is improved that many more of the more than 40 county soil surveys with spacial errors will be digitized. This project has also benefited students, staff and faculty at the University of Minnesota as the method provided useful training on GIS and photogrammetric principles.

Date of Report: July 1, 1999

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"LCMR Final Work Program Update Report"

Date of Work Program Approval: June 23, 1997

Project Completion Date: June 30, 1999

LCMR FINAL WORK PROGRAM UPDATE REPORT

I. Project Title: Statewide Digital Soil Database - Phase 1

Project Manager: Greg Larson
Affiliation: Board of Water and Soil Resources
Mailing Address: One West Water Street
Suite #200
St. Paul, MN 55107
Telephone Number: (651) 296-0882
E-Mail: greg.larson@bwsr.state.mn.us
Fax: (651) 297-5615

Total Biennial Project Budget:

\$ LCMR	145,000	\$ Match	30,000
-\$ LCMR Amount		-\$ Match Amount	
Spent:	145,000	Spent:	30,000
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=\$ LCMR Balance:	0	=\$ Match Balance:	0

A. Legal Citation: ML 1997, [Chap.216,] [Sec. 15,] Subd. 10(f)]

Appropriation Language: This appropriation is from the future resources fund to the board of water and soil resources for the first biennium for a pilot program to investigate methods to digitize data from older soil surveys and to coordinate soil survey digitizing in at least one county on a 50% cost share basis. Up to \$30,000 of this appropriation is for digitization and must be matched by non-state money by April 30, 1999.

B. Status of Match Requirement: Becker County committed \$30,000 of matching funds by April 30, 1999.

II. Project Summary and Results: Digital databases from county soil surveys are the states highest priority GIS data need. This project involved research on cost effective methods to digitize older surveys, and to accelerate soil survey digitizing.

Twenty-one of Minnesota's 87 counties have completed or nearly completed county soil surveys which are inventoried with the modern soil classification system and mapped on high-quality digital orthophoto basemaps (category 1). USDA's Natural Resource Conservation Service (NRCS) has digitized one such county and is starting others. Another 42 counties have older soil

surveys mapped on rectified photographic basemaps (category 2). This project involved research to determine the most cost-effective methods to produce a modern digital database in the category two counties. To test the method, Becker County was digitized.

III. PROGRESS SUMMARY:

This project resulted in a method to digitally convert older soil surveys to a digitized product.

IV. OUTLINE OF PROJECT RESULTS:

As mentioned, there are 42 counties with older soil surveys on rectified photographic basemaps. These soil surveys are generally adequate for land use interpretations but not well-suited for digitizing due to the topographic distortion inherent in rectified photographs. This project explored various techniques for converting category two soil surveys to an orthophotographic product suitable for digitizing. Results of this effort included: standardized methodologies which will be made available to digitizing vendors and digitizing the soil survey of at least one category two county (Becker County) using the techniques developed through this project.

Result 1: Conduct research on cost-effective methods to digitize category 2 soil surveys.

LCMR Budget:	\$115,000	Balance:	\$ 0
Match:	\$0	Balance:	\$ 0
Completion Date: January 1, 1999			

The research was conducted under the leadership of Dr. Jay Bell, University of Minnesota, Department of Soil, Water and Climate. Emphasis was given to investigating method(s) suitable for digitizing soil surveys from both high and low relief areas. The methods were developed so that private sector vendors can utilize the technology. Local governments then have a number of vendors using standardized cost-effective methods from which to choose for digitizing their soil survey. The standardized methodology will contribute to the state's goal of a seamless digital soil database.

Final Result: The research developed cost-effective methodologies to convert soil surveys on distorted map bases to geometrically correct map bases that can be utilized in a Geographic Information System (GIS). This research concentrated mainly on Category 2 soil survey data. Category 2 surveys are compiled on rectified photo base maps, which may contain significant spatial errors. The spatial accuracy of soil survey lines is a factor of three characteristics: topographic relief, scale and photographic base. There are currently 42 counties in Minnesota that fall under this category.

An orthorectification software extension and procedure was developed using photogrammetric principles to remove existing soil survey base map errors. The extension uses a USGS digital orthophoto (DOQ data), a scanned soil survey map sheet, and a USGS 30-meter digital elevation model (DEM) as inputs. Existing commercial software could not be utilized because inputs such as focal length, fiducial marks, etc., could not be gathered from the soil survey map base. The orthorectification extension uses a statistical model, i.e. "indirect differential rectification" (IDR), to produce a geometrically correct soil survey map base.

From the software extension and procedure, an orthorectified soil survey map sheet was

produced. By performing some simple image processing techniques, the soil survey lines were extracted and imported into a GIS where attributing and line checking (quality control) was done. This produced a geometrically correct digital soil survey suitable to be used in conjunction with other data of similar quality and scale in a GIS. The procedure was successfully tested in several counties and was used in a "production" mode in Becker County.

Result 2: Digitize at least one category 2 soil survey.

LCMR Budget:	\$30,000	Balance:	\$0
Match:	\$30,000	Balance:	\$0
Completion Date:	April 1, 1999		

At least one category 2 county was to be digitized this biennium. Counties were selected based on their willingness to provide non-state matching funds and their topographic setting. To the extent possible, a county(ies) were selected that exhibited variable topographic relief sufficient to develop cost-effective methods with statewide applicability.

Final Result: Becker County was digitized using the orthorectification procedure. The results were quality checked by soil scientists and GIS specialists at the University of Minnesota and the USDA Natural Resources Conservation Service. Results of the review verify that the method can be used to produce GIS-suitable products.

V. DISSEMINATION: The project and subsequent products will be promoted by the cooperators and the Governor's Council on Geographic Information.

VI. CONTEXT: A. Significance: A survey of GIS users by the University of Minnesota for the Governor's Council on Geographic Information, ranked digital soils information as the number one data need. More than 230 users from all levels of government responded. Soils were rated as the number one data need by agencies at the county, state and federal levels. It was also in the top three from private sector respondents. The survey suggested that soils data can be developed by the state as a statewide resource. Statewide availability of digital soils data is of great benefit to many local and state planning efforts, sustainable development efforts, and place-based resource management programs.

A committee of the Governor's Council on Geographic Information studied the current status of soil mapping in Minnesota. This committee stated that for the wisest use of taxpayer dollars, statewide standards for mapping modern soils inventories are imperative to achieve a "seamless" statewide database. The committee grouped all Minnesota counties into one of four categories. Category 1 has 21 counties where soil classification and mapping are done to modern standards. For one of the 21 counties (Sherburne), soils data has been digitized by NRCS. Other counties are in progress. There is a national program to complete soils digitizing, but only one medium-sized "category 1 county" is being completed per year with present federal funding. This project produced a method to produce digital data economically and with easy access for the end user. This helps promote the use of soils information, will accelerate the digitizing of category 2 counties and contribute to the development of a seamless statewide soil database.

B. Time: This project was completed by June 30, 1999.

C. Budget Context: This is the first appropriation for this project. Match figures below reflect the minimum required by the appropriation.

	July 1995- June 1997	July 1997- June 1999	July 1999- June 2001
	<u>Prior expenditures on this project</u>	<u>Proposed expenditures on this project</u>	<u>Anticipated future expenditures on this project</u>
1. LCMR	\$0	\$145,000	\$0
2. Other State	\$0	\$0	\$0
3. Non State Cash	\$0	\$30,000	\$0
Total	\$0	\$175,000	\$0

Budget:

Personnel:	\$105,000	Investigation of cost-effective methods (result 1) by personnel in the Department of Soil, Water and Climate supervised by Dr. Jay Bell.
Equipment:	\$10,000	Purchase of computer hardware and software necessary for the investigation of digitizing techniques.
Acquisition:	\$0	
Development:	\$0	
Other:	\$60,000	Digitizing Becker County. This budget item includes \$30,000 of non-state matching funds.
TOTAL:	\$175,000	

VII. COOPERATION: The following personnel from state and federal agencies cooperated on this project: Greg Larson, BWSR (5% of time); Joe McCloskey and other NRCS personnel (5% of time); Jay Bell, U of M (5% of time); Tim Kelly, DNR (2% of time); Don Yaeger, LMIC (2% of time); Governor's Council on Geographic Information (2% of time); and University of Minnesota personnel supervised by Jay Bell (100% of time). Of these people, only University of Minnesota personnel were be paid from LCMR project funds.

VIII. LOCATION: This project has applicability statewide.

IX. REPORTING REQUIREMENTS: Periodic work program progress reports were submitted July 22, 1998 and March 15, 1999. A final work program report was submitted by July 1, 1999.

X. RESEARCH PROJECTS: Not applicable.

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