Date: June 30, 1993

LCMR
FINAL STATUS REPORT

Agency: University of Minnesota, Agricultural Experiment Station
Department of Soil Science

Activity Title: Accelerated Soil Survey

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Legal Citation: ML91, Chap. 254 Art. 1, Sec. 14, Subd. 10(b),

Appropriation: $1,270,000
Balance: $ 2,619

I. Activity or Activity Description:

Accelerated Soil Survey: This appropriation is to the University of Minnesota, Agricultural Experiment Station, to complete the soil survey in counties under contract as of July 1, 1988. Up to $270,000 is for initiation of a survey in Koochiching county, provided that the county share of the cost of the survey shall be one-third of the cost, reduced by a percentage equal to the percent of land located in the county that is owned by federal or state government that exceeds five percent, and further adjusted by the ratio of the adjusted net tax capacity per capita of the county to the adjusted net tax capacity per capita of the state.

Compatible Data: During the biennium ending June 30, 1993, the data collected by projects funded under this section that have common value for natural resource planning and management must conform to information architecture as defined in guidelines and standards adopted by the Information Policy Office. In addition, the data must be provided to and integrated with the Minnesota Land Information Center's geographic data bases with the integration costs borne by the activity receiving funding under this section.

Match Requirement: $0

II. Narrative

Develop and conduct detailed (1:20,000 and 1:24,000 scale) soil surveys of Minnesota counties not having published surveys since 1950 under a cooperative cost-share agreement of the federal, state, and local participating agencies. Soil survey work would be essentially completed in 8 counties; continued in ~~one~~ six counties (St. Louis, Hubbard, Ottertail, Polk, Renville, Roseau) and ~~initiated in one county (Koochiching)~~. About ~~2.5~~ 2.0 million acres would be covered in the survey effort. The soil survey information is critical for land and water use planning at the farm, county and regional level.

III. Objectives

A. Field soil survey

A1. Narrative: In this biennium complete the field soil surveys in 8 counties (Aitkin, Becker, Clearwater, ~~Hubbard~~, Lac Qui Parle, Mahnomen, Marshall, McLeod, Meeker, ~~Ottertail~~, ~~Polk~~, ~~Renville~~, ~~Roseau~~); continue in ~~one~~ six counties (Hubbard, Ottertail, Polk, Renville, Roseau, St. Louis) ~~and initiate in one county (Koochiching)~~. (see A5. Status:).

A2. Procedure: Using recent National High Altitude Photography (NHAP) as base map and supplemented by any other available black and white (e.g., ASCS) or color infra-red (e.g., DNR) photography make field examinations of all landscapes. Using truck mounted hydraulic probes (where possible), alternate terrain vehicles (where possible) examine soils to depths of at least 5 feet. Obtain permission of all landowners (operators) to make field traverses. Obtain permission of all (concerned) utilities to make hydraulic borings or other excavations using Gopher State One Call. Record all specific site investigations and draw appropriate boundaries for soil delineations on the photobase. ~~Initiate priority procurement of orthophotography, in cooperation with the Land Management Information Center, for Koochiching county and as can be procured for other counties where surveys are in progress.~~

A3. Budget
a. Amount budgeted: $990,000
b. Balance: $ 2,619

A4. Timeline: for completed surveys and acres mapped. Objective A.

	July 1, 1991	June 30, 1993
	July 91-June 92	July 92-June 93
Completed field work:	~~Becker, Lac Qui Parle~~, ~~Renville~~	Clearwater, ~~Hubbard~~, ~~Ottertail, Polk, Roseau~~ Becker, Lac Qui Parle Aitkin, Mahnomen, Marshall McLeod, Meeker (These were initially planned to be completed in 1989-91)
Continue field work:	St. Louis	St. Louis, Hubbard, Ottertail, Polk, Renville, Roseau
Initiate field work:		~~Koochiching~~ None

A5. Status: At the beginning of the current biennium there were 14 counties that since have been completed or have work continuing. Included in the 14 counties were 5 that continued from the previous biennium and were inadvertently left off the initial workplan. The five counties are: Aitkin, Mahnomen, Marshall, McLeod and Meeker. The status of each survey either completed or continuing is discussed county by county. Projected completion dates, delays, and future directions are discussed.

Aitkin County: The field soil survey was completed in October 1992 and the last acre ceremony was held November 5, 1992.

Becker County: Field soil survey was completed in summer of 1992 and the last acre ceremony for completion of mapping was held in September, 1992.

Clearwater County: The field soil survey was completed in June, 1993.

Hubbard County: Completion is estimated for June, 1995.

Lac Qui Parle County: The field soil survey was completed in June, 1993.

Mahnomen County: The field soil survey was completed in July, 1991.

Marshall County: The field soil survey was completed in November, 1991.

McLeod County: The field soil survey was completed in November, 1991.

Meeker County: The field soil survey was completed in November, 1992. Map compilation and manuscript development were completed June 1993.

Ottertail County: By agreement by the Ottertail County Board of Commissioners the soil survey will be completed in December, 1994. The purpose of this delay is to allow time to obtain orthophotography for final map compilation.

Orthophotography is being obtained for the state through another LCMR project. This will allow the digitization of the soil map lines from a geographically correct map base so they can be immediately incorporated into a county GIS system. The county has agreed to fund the cost of map compilation and incorporation of soil data into the GIS. This county will serve as a model for completion of systems in other counties where soil surveys have been conducted.

Polk County: Completion will be November, 1994. Similar map compilation and GIS development as with Ottertail county is being investigated.

Renville County: The field soil survey will be finished December, 1993.

Roseau County: The field soil survey will be completed August 1995. Use of orthophotography for map compilation is being investigated.

St. Louis County: No completion date has been established. SCS will continue to provide staff to complete a detailed soil survey for the county.

By concentrating our efforts on those counties where work was on-going we were able to complete 150,000 acres of mapping to speed completion. Additional map compilation and manuscript development was completed which will result in less work remaining to publish the soil survey reports. We continue to work cooperatively with the USDA Soil Conservation Service to complete mapping in those counties where mapping continues.

A6. Benefits: Completed surveys will provide current and on-going inventory and analysis of kinds of soils and soil conditions for all land areas of each county. Inventory includes amount and distribution of each soil.

B. Laboratory characterization

B1. Narrative: Characterize by field and laboratory analyses, physical chemical and other properties of mapped soils.

B2. Procedures: As new (or not previously characterized) soils are encountered in the course of field examination, site excavations are made of the soil profile commonly to depths of 6 feet. Soil horizons (layers) are described and sampled for laboratory analysis, commonly particle size, organic matter, bulk density, carbonates, water retention values. Determinations follow procedures of the National Cooperative Soil Survey.

B3. Budget:

a. Amount budgeted:	$100,000
b. Balance:	$ -0-

B4. Timeline:

July 1, 1991 — June 30, 1993

July 1-91 to June 30-92

Field sample and lab analyses of 100 sites (approx. 500 horizon samples)

July 1-92 to June 30-92

Field sample and lab analyses of 90 sites (approx. 450 horizon samples)

B5. Status: Detailed field and laboratory characterization was conducted in all surveys with somewhat more emphasis in those surveys at initial and interim (progress) stages.

During the period July 1, 1991 to June 30, 1993 approximately 1,000 horizon samples were characterized for particle size, organic matter content, pH, water retention values, and bulk density by standard procedures of the National Cooperative Soil Survey.

With the increased emphasis and concern for soil transport of agri-chemicals, soil properties such as cation exchange capacity, organic carbon and hydraulic conductivity are being recorded for use in management guides written in published detailed soil survey reports and other soil management publications.

B6. Benefits: Provides necessary data for proper classification of soils and for development of suitability interpretations for agronomic, silvicultural and engineering practices on individual soils.

C. Soil Interpretation

C1. Narrative: Develop interpretations from specific soil and landscape properties for various land uses and management planning considerations with special emphasis for forestry and wildlife and for nutrient leaching.

C2. Procedure: Collect field data on water table movement in various soil landscapes. Observe and note erosion conditions from water and wind. Identify highly erodible land. Collect field and forest productivity data and associated management detail on representative soils.

Establish a working agreement with Koochiching county to identify cooperators and will form a steering committee to provide essential soil interpretations for forest land management and other uses such as determining location of sand and gravel deposits.

C3. Budget

a. Amount budgeted:	$100,000
b. Balance:	$ -0-

C4. Timeline

July 1, 1991 — June 30, 1993

	July 1-91 to June 30-92	July 1-92 to June 30-93
Construct interpretive tabular data:	Becker, Lac Qui Parle, Renville	Aitkin, Clearwater, Hubbard, Meeker, Ottertail, Polk, Roseau

C5. Status: The Minnesota Cooperative Soil Survey is cooperating in a national study on water tables under the aegeis of the Climate Change Initiative sponsored by NOAA. The objective is to establish baseline information on contemporary water tables so that, if climate change occurs in the next few decades, water tables should

reflect these changes. Sites have been located in 3 distinct geographic regions of Minnesota with the assistance of the soil survey personnel who will assist in the long-term monitoring.

Water table studies are an integral part of each survey. An average of 3 to 4 landscapes are monitored in each survey for annual rise and fall of the rooting zone water table (zone of saturation). This data is supplied to models that endeavor to predict, e.g., leaching potential for agri-chemicals.

Water table data is critically needed in the current national effort to define wetlands (presently defined according to the time duration of a saturated zone in the top meter of the soil).

A Memorandum of Understanding with Koochiching county was completed and signed by all cooperating parties in cooperation with a local user's committee that has identified needed soil and land use interpretations, particularly in respect to forest land management. This committee consists of representatives of the county forestry department, the state Department of Natural Resources Division of Forestry, the county extension direction, the District Conservationist of the Soil Conservation Service, the local Soil and Water Conservation District, and the private forest industry.

An invitational workshop on the topic of soil-specific crop management was held April 14-16, 1992 in Minneapolis. An international group of 120 academic, agri-business, and environmental workers will reviewed future planning activities in topic areas of managing soil variability, considering economic and environmental factors, state of applicable engineering technology and communication of desirable technology and procedures. The soil survey database is an essential component of this emerging philosophy and application of technology. A proceedings was published, and is available for purchase through the American Society of Agronomy.

C6. Benefits: Identifies suitability, limitations inherent in various soils for land use management (agriculture, forestry, wildlife, recreation) and for soil engineering practices (terraces, waterways, drainage, other structures). Indicates productivity potential for agriculture and forestry.

D. Soil reports and statewide GIS database

D1. Narrative: Develop maps and reports of completed surveys and provide survey data in a readily usable computer-based geographic information system.

D2. Procedure: Compile soil survey fieldwork on orthophotobase materials as obtainable. Establish geo-reference coordinates. Optically scan digitize in map sheet format for those counties requesting this product and funding the operation.

In coordination with the Land Management Information Center (LMIC) and the Soil Conservation Service (SCS) investigate and establish the most cost-effective method to produce the soil overlay for a statewide geographic information system (GIS). Investigate the suitability of previously digitized soil surveys for inclusion in a statewide GIS.

Data collected will be transferrable to LMIC for use in constructing the statewide soils overlay. LMIC will be able to use the data to produce relevant interpretations at the state and county level. The Soil Survey Information System will be available for those counties that desire this capability.

Develop a memorandum of understanding that will outline the participation and responsibilities of the respective agencies in this effort.

D3. Budget

a. Amount budgeted: $80,000
b. Balance: $ -0-

D4. Timeline:

July 1, 1991		June 30, 1993
	July 91 to June 92	July 92 to June 30-93
Complete map compilation:	Becker, ~~Lac Qui Parle~~, ~~Renville~~	Clearwater, ~~Hubbard~~, ~~Ottertail, Polk, Roseau~~ Aitkin, Lac Qui Parle, Meeker
Digitize (as requested, funded):	same	same
Develop interagency MOU for GIS:	August 90 to July 91	complete January 1992

D5. Status: An inter-agency Memorandum of Understanding for the purpose of guiding development of a Geographic Information System base for all natural (and possibly other) resource data was completed and signed. A primary objective is to find a cost-effective method of providing soil survey field work in a geo-referenced base. As orthophotobase materials are made available at the appropriate scale this task can be accomplished more readily.

Orthophotobase materials for compilation of soil survey fieldwork have been initially received for Ottertail county and will be used for map compilation. Orthophoto materials are being sought for additional counties where surveys are in progress or to be initiated.

The task of geo-referencing previous soil survey work on non-orthophotobase materials is being attempted with the Sibley county survey. Output of sequential optical scanning of the 1:20,000 scale field sheets (non-ortho) and the appropriate geo-referenced 7.5 minute USGS quadrangles (1:24,000) of the same area are processed with KHOROS software. The procedure was changed to provide a georeference base map compatible with standard GIS systems. This software can bring the field sheet work into a geo-referenced base. This technique can be used in most areas of the state except for the northeast where there is considerable relief.

With funding provided by the Sibley county board a digitized soil survey information system (SSIS) was installed for the use of several county offices (the assessor, District Conservationist of SCS, extension director), and is being completed. An agreement has also been signed with Mahnomen and McLeod counties.

A software program SOIL 7 has been completed and is being field tested by several state agencies and counties. This program allows easy access to the statewide soil survey database.

D6. Benefits: The soil survey report describes in detail the nature and distribution of the distinguishable soils in the county; highlights the considerations for principal (or contemplated) land uses. In a series of included tables are data on physical and chemical properties and commonly requested interpretations for each mapped soil unit.

A geographic information system allows for readily accessible display of spatial features of soils along with selected properties. It provides for display of alternative management needs and probable predictive results. Along with other geo-referenced data (e.g. land cover) factor analysis is facilitated (e.g. identification of critical management areas).

IV. Evaluation

For the FY92-93 biennium the program can be evaluated (1) in terms of acreage mapped and completion of county soil surveys; (2) in the amount and character of field and laboratory data developed for documentation of specific soil properties; (3) in the development of geo-referenced field survey information for completed county surveys and in the development of soil interpretations models.

V. Context

A. For the FY92-93 biennium this program effort will continue the accelerated soil survey effort begun in 1977 on a federal - state - local cost share basis. LCMR appropriations have supported the major portion of the state cost share. Without LCMR assistance the completion of detailed soil surveys for all counties would have been delayed by at least a decade.

B.C. In the past several biennium the development and implementation of a computer based (digitized) soil map and associated data has been almost entirely funded by the counties having completed surveys. Development of an interagency MOU will insure the development of a state-wide geo-referenced geographic information system not only for the soil resource but also other natural resource information.

D. In the FY90-91 biennium the total budget of all agencies participating in the survey can be estimated at about $6,150,000 of which $1,200,000 was supported by LCMR funding.

E. In this FY92-93 biennium - total contributions from federal, local and (other) state sources is estimated at $4,400,000.

VI. Qualifications

1. Program managers: Dr. James L. Anderson
Professor, Extension and Research
Department of Soil Science, University of Minnesota

In addition to extension and research activities related to the soil survey Dr. Anderson serves as Director, Center for Agricultural Impacts on Water Quality.

Dr. David F. Grigal
Professor
Department of Soil Science, University of Minnesota

Dr. Grigal's teaching and research effort is in forest soil ecology and forest productivity. For the past 20 years Dr. Grigal has published extensively on nutrient cycling and factors affecting biomass production in the forest environment.

2. Major cooperators: A. Joseph McCloskey
State Soil Scientist
USDA Soil Conservation Service

Joseph McCloskey has primary responsibility for directing the field soil survey effort of some 50 soil scientists of the Soil Conservation Service in Minnesota.

B. Dr. M.L. Phillips
Division of Forestry
Minnesota Department of Natural Resources

Dr. Phillips' responsibilities include direction of soil scientists working in this Division and development of environmental management practices on the state forest lands.

C. Greg Larson
Soil Scientist
Board of Water and Soil Resources
Minnesota Department of Agriculture

Greg Larson's activities and responsibilities are in the are of local water planning and the application of soil resource information to those efforts.

D. Barbara Luelling
Soil Scientist
USDA Forest Service, Duluth

Barbara Luelling aids and directs the soil survey effort on lands under management of the Forest Service. She has worked extensively on forest soil classification and characterization and in ecological land classification in northern Minnesota.

VII. Reporting requirements

Semi annual status reports will be submitted not later than January 1, 1992; July 1, 1992; January 1, 1993; and a final status report by June 30, 1993.