

FINAL REPORT

AUG - 2 2005

2003 PROJECT ABSTRACT

For the period ending June 30, 2005

TITLE: Mesabi Iron Range Geologic and Hydrogeologic Maps and Data

PROJECT MANAGER: Dale R. Setterholm

ORGANIZATION: Minnesota Geological Survey, University of Minnesota

ADDRESS: 2642 University Avenue, St. Paul, MN 55114-1057

WEB SITE ADDRESS: www.geo.umn.edu/mgs

FUND: Minnesota Environment and Natural Resources Trust Fund

LEGAL CITATION: ML 2003, Ch. 128, Art. 1, Sec. 9, Subd. 8c

APPROPRIATION AMOUNT: \$ 131,000

Overall Project Outcome and Results

The Minnesota Geological Survey (MGS) produced geologic and hydrogeologic maps of the Mesabi Iron Range—an area in which the land surface and hydrology has been profoundly affected by 113 years of mining. The maps are needed by government and industry to address issues such as community and industrial expansion, water use, and watershed restoration. Specifically, these maps and databases cover the eastern half of the mining district, and they complement maps of the western half of the range, produced in FY 2000-2001 with funding from LCMR. The map themes include bedrock geology, database, bedrock topography, depth to bedrock, and maps comparing land-surface topography, surface hydrology, and infrastructure between the years 1899 and 1999. The features that have been mapped profoundly influence the rate and direction of surface and ground water flow and documenting them is essential to managing water resources. Mapping is based on interpretation of water well records, mining borehole records, bedrock outcrops, and land surface topographic data. The records of approximately 800 water wells and 9,000 mining boreholes were added to the state-wide database.

Project Results Use and Dissemination

The results of this project are digital files of drill hole and outcrop data, various map themes in a Geographic Information System (GIS), a Final Report document, and a set of map images published on paper (Jirsa and others, 2005, Lively and others, 2005); all available from MGS. Preliminary findings were incorporated into presentations for many organizations and mining companies. Future presentations and publications are certain, as this project is part of on-going efforts of the MGS to provide important geologic information about the Mesabi Iron Range to government, industry, and individuals. The historic maps showing surface drainage patterns circa 1899 have been particularly useful for watershed restoration and mine planning.

References

- Jirsa, M.A., Setterholm, D.R., Bloomgren, B.A., Bauer, E.J., and Lively, R.S., 2005, Bedrock geology, database, bedrock topography, and depth to bedrock maps of the eastern half of the Mesabi Iron Range, northern Minnesota: Minnesota Geological Survey Miscellaneous Map M-158, scale 1:100,000.
- Lively, R.S., Bauer, E.J., and Jirsa, M.A., 2005, Land surface topography of the eastern half of the Mesabi Iron Range, northern Minnesota, 1899-1999: Minnesota Geological Survey Miscellaneous Map M-157, scale 1:100,000.

LCMR 2003 Work Program

Date of Report: August 5, 2005
LCMR Final Work Program Report
Date of Work program Approval: June 26, 2003
Project Completion Date: June 30, 2005

I. PROJECT TITLE: Mesabi Iron Range Geologic & Hydrogeologic Maps & Data

Project Manager: Dale R. Setterholm
Affiliation: Minnesota Geological Survey, University of Minnesota
Mailing Address: 2642 University Avenue
City / State / Zip : St. Paul, MN 55114-1057
Telephone Number: 612-627-4780, ext. 223
E-mail Address: sette001@umn.edu
FAX Number: 612-627-4778
Web Page address: <http://www.geo.umn.edu/mgs/>

Total Biennial LCMR Project Budget:	LCMR Appropriation:	\$131,000
	Minus Amount Spent:	<u>\$130,997</u>
	Equal Balance:	\$ 3

Legal Citation: ML 2003, Chap. 128, Art. 1, Sec. 9, Subd. 8(c)2.

Appropriation Language: 8 (c) Mesabi Iron Range Geologic and Hydrogeologic Maps and Databases \$123,000 the first year and \$123,000 the second year are from the trust fund. \$58,000 the first year and \$57,000 the second year of this appropriation are to the commissioner of natural resources to develop a database of hydrogeologic data across the Mesabi iron range. \$65,000 the first year and \$66,000 the second year are to the Minnesota Geological Survey at the University of Minnesota for geologic and hydrogeologic maps of the Mesabi iron range.

II. and III. FINAL PROJECT SUMMARY:

Overall Project Outcome and Results

The Minnesota Geological Survey (MGS) produced geologic and hydrogeologic maps of the Mesabi Iron Range—an area in which the land surface and hydrology has been profoundly affected by 113 years of mining. The maps are needed by government and industry to address issues such as community and industrial expansion, water use, and watershed restoration. Specifically, these maps and databases cover the eastern half of the mining district, and they complement maps of the western half of the range, produced in FY 2000-2001 with funding from LCMR. The map themes include bedrock geology, database, bedrock topography, depth to

bedrock, and maps comparing land-surface topography, surface hydrology, and infrastructure between the years 1899 and 1999. The features that have been mapped profoundly influence the rate and direction of surface and ground water flow and documenting them is essential to managing water resources. Mapping is based on interpretation of water well records, mining borehole records, bedrock outcrops, and land surface topographic data. The records of approximately 800 water wells and 9,000 mining boreholes were added to the state-wide database.

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IV. OUTLINE OF PROJECT RESULTS:

Result 1: Bedrock topographic, depth to bedrock, and pre-mining surface topographic maps of the eastern Mesabi Range.

Description: Water well construction records will be compiled, entered in the County Well Index Database, their locations verified in the field, and digital locations established. Geologists will interpret the records and establish the bedrock surface elevation for those wells that intersect rock. A pre-mining topographic map of the area will be captured digitally and used to establish elevations for boreholes associated with mining. Those records will be solicited from mining companies and digital locations will be established. Geologists will then draft the topography of the bedrock surface from this data. That topography will be captured digitally and a representative grid will be subtracted from a digital model of the present land surface topography to yield the thickness of the overburden. Finally, the present land surface topography model will be compared with the pre-mining topography and maps will be created to portray the changes to the landscape over the last 100+ years. The maps and database created will be useful in designing and operating hydrologic models, and also in making decisions regarding natural resource management and land use plans.

Summary Budget Information for Result 1:	LCMR Budget	\$131,000
	Minus Amount Spent:	\$130,997
	Balance	\$3

Completion Date: Most of the first year will be dedicated to obtaining data and improving its value by entering it in an automated database with digital locations. In the second year, the geologists will draft the bedrock topography map. The other maps are derivatives of the topography and will also be created in the second year. All the products will be completed by June 30, 2005.

Final Report Summary:

The methods of work employed in this project were proven in work done previously on the western half of the Mesabi Range. We began with field-verification of water well locations (800 wells) and entry of the well data into the County Well Index Database. Information and locations for an additional 9,000 mining drillholes were also added to the database. Geologists interpreted the drillhole information to discern the geologic and hydrologic features of interest to this project. The drillhole data and other geologic information from historic maps were then moved into a geographic information system such that maps of the data elements could be produced. From those plots geologists drew lines of equal elevation (contours) to represent the shape of the bedrock surface prior to mining. That surface has a strong influence on ground water flow. The type of bedrock may also affect hydrologic properties and a map of bedrock types (bedrock geology) was prepared from new field observations, geophysical surveys, and previous geologic maps. A grid of the bedrock surface elevations was compared with a grid of elevations of the present land surface to calculate the thickness of glacial sediment and post-glacial material above the bedrock. That unconsolidated material hosts much of the ground water resource in the area and its thickness and character affect the availability and flow pattern of the ground water. Finally, a digital version of a topographic survey of the land surface in 1899 (mostly pre-mining) was created from original linen maps. That surface was then compared with a digital topographic survey done in 1999 to yield a quantitative account of changes to the land surface over that 100 year period of mining. Hydrologic features, and changes to them, were also captured. That information is extremely useful in planning how the cessation of mine dewatering will be managed.

V. TOTAL LCMR PROJECT BUDGET:

All Results: Personnel: \$118,478

All Results: Equipment: \$2,440

All Results: Development: \$0

All Results: Acquisition: \$0

All Results: field expenses: \$8,966

Supplies: \$1,113

TOTAL LCMR PROJECT BUDGET: \$130,997

Explanation of Capital Expenditures Greater Than \$3,500: none

VI. PAST, PRESENT AND FUTURE SPENDING:

A. Past Spending:

In the 2000-2001 biennium the LCMR funded a study at the Minnesota Geological Survey similar to the one proposed here, but conducted on the western half of the Mesabi Iron Range. The project was funded at \$250,000 and produced a bedrock topography map, an overburden thickness map, and a map of the pre-mining land surface topography. As in the current project, the locations of water wells were field-verified, and their construction information and geologic interpretations were entered in the County Well Index Database. Historic drilling information from mining was also compiled and entered in the database. The 2000-2001 project included a drilling program designed to generate new geologic information in areas where none existed. To reduce the cost of the current proposal, no drilling will be done, and less existing data will be compiled.

B. Current Spending:

The proposed project will not receive funds from any other source. A project has been proposed for funding by the Minerals Diversification Fund to produce surficial and bedrock geologic maps over the entire Mesabi Iron Range. The products of that project, and the work required to create them are separate from this project.

C. Required Match (if applicable): none

D. Future Spending: The project proposed here will complete bedrock topography, overburden thickness, and pre-mining land surface topography mapping for the Mesabi Iron Range. No further work is necessary to make those products usable to land-use and resource managers.

VII. Project Partners:

A. Partners Receiving LCMR Funds: The Department of Natural Resources Division of Waters- Grand Rapids will also receive LCMR funds to collect additional

data useful for predicting and managing hydrologic conditions in this area. They have a separate contract with LCMR.

B. Project Cooperators: Although they are not formal partners, we expect to work closely with the staff of the Department of Natural Resources Division of Waters-Grand Rapids and Lands and Minerals Division- Hibbing, and various employees of mining companies.

VIII. DISSEMINATION: The data compiled for this project will be entered into the County Well Index Database maintained by the Minnesota Geological Survey and the Minnesota Department of Health. That data is currently distributed by CD, and via the internet. The digital maps created for this project will be available from the web site (as pdfs and geographic information system files) of the Minnesota Geological Survey and will also be published as MGS Miscellaneous Maps. The MGS web address is <http://www.geo.umn.edu/mgs/> and products from MGS-LCMR projects are found at <http://www.geo.umn.edu/mgs/lcmr.htm>.

IX. LOCATION: Eastern Mesabi Range in northern Minnesota. The project covers a several mile-wide area from Virginia on the west to Babbitt on the east.

X. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than January 2004, June 2004, and January 2005. A final work program report and associated products will be submitted by June 30, 2005.

XI. RESEARCH PROJECTS:

Attachment A: Budget Detail for 2003 Proposals - Summary and a Budget page for each partner							
Proposal Title:	Geologic and hydrogeologic maps of the Mesabi Iron Range						
Project Manager Name:	Dale Setterholm						
LCMR Requested Dollars:	\$131,000						
2003 LCMR Proposal Budget		Result 1 Budget:					
	Bedrock topographic and depth to bedrock mapping of the eastern Mesabi Range (build database)						
BUDGET ITEM			Expenditures 1/27/04	Expenditures 6/30/04	Expenditures 1/31/05	Expenditures 6/30/05	TOTAL FOR BUDGET ITEM
PERSONNEL: Staff Expenses, Wages, Salaries & Benefits	\$116,000	Fringe rate: est. \$ for retirement 4.1%; Health 17.4%	\$24,581	\$17,801	\$41,242	\$34,854	\$118,478
*(Note: Fringe benefit @ 31.1% Civil Ser.; 33.1% Academic)							
***(Note: Academic retirement fringe 13.9%, health fringe 11.4%)							
Bauer locating \$17,934		\$561; \$2,380					
Bloomgren locating \$17,725		\$554; \$2,352					
Jirsa data acqu., contouring \$25,643		\$802; \$3,403					
Lively digital capture, editing \$7,787		\$244; \$1,034					
*Setterholm contouring, proj. man. \$25,686.		**\$2,682; \$2,200					
Meints GIS \$5,978		\$187; \$793					
Editor \$6,165		\$193; \$818					
Students data entry&locating \$9,082							
Office Supplies	\$2,000		\$251	\$425	\$175	\$262	\$1,113
scanning \$1,200							
mylar \$300							
photo copies \$100							
printing \$300							
long distance \$100							
Travel Expenses in Minnesota	\$10,000		\$5,573	\$950	\$1,621	\$822	\$8,966
Locating 2 crews; Lodging @ \$39; Meals @ \$30/day							
Lodging and Meals \$6,470							
Veh. Rental @ \$210/wk; Mileage @ 0.15							
Vehicle rental \$2,670							
Mileage \$860							
Office equipment & computers	\$3,000		\$2,120	\$321	\$0	-\$1	\$2,440
Laptop and software for acquisition and entry of field data \$3,000							
COLUMN TOTAL	\$131,000		\$32,525	\$19,497	\$43,038	\$35,937	\$130,997