2009 Project Abstract
For the Period Ending June 30, 2012

PROJECT TITLE: County Geologic Atlas Acceleration
PROJECT MANAGER: Dale R. Setterholm
AFFILIATION: Minnesota Geological Survey, University of Minnesota
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2009, Chap.143, Sec.2, Subd.3(b)

APPROPRIATION AMOUNT: $820,000

Overall Project Outcome and Results

County geologic atlases support water and mineral resource management and education. An atlas provides maps and databases at scales appropriate for land use planning and water management decisions. An atlas greatly improves our ability to monitor the resource, to predict the effects of pumping, and to respond effectively to contamination. This project created atlases for Anoka and Wright counties in paper, digital, and web-accessible formats. Copies will be provided to LCCMR and the counties, and workshops will be held to train users.

Geologic maps describe the distribution of earth materials that determine where water can enter the ground (become ground water), where it can be taken from the ground (aquifers), and how aquifers connect to rivers, lakes, and wetlands. Each geologic atlas contains these parts-

Database map: shows the location of all well records, borings, scientific drilling, natural exposures, and geophysical measurements used to support the atlas. The databases are also provided.

Surficial Geology map: shows the earth materials immediately beneath the soil zone, and describes their composition and ability to convey water. The surface described by this map is the interface between human activities and ground water. Its character determines to a great degree the sensitivity of ground water to contamination.

Glacial Stratigraphy and Sand Distribution Model: A series of maps show the location, depth, and thickness of sand or gravel bodies (aquifers) in glacial materials. This map is useful in finding a water source, determining pumping effects, and in understanding the results of water monitoring.

Bedrock Geology map, bedrock topography map: These maps describe the location and type of bedrock present, and its ability to host and transmit groundwater. The contacts between layers of sedimentary rock are mapped as digital surfaces and this enables numerical simulations of the ground water system that can predict the effects of pumping before wells are drilled.

Project Results Use and Dissemination

Geologic atlases support informed decision-making. They are applied to wellhead protection, water appropriation decisions, well field design, onsite water treatment design, facility siting, monitoring, and remediation of contamination. The atlases are printed, and also provided in several digital formats for electronic use including geographic information systems. When the atlases are complete we hold workshops in the county to explain the products and their uses.

Environment and Natural Resources Trust Fund
2009 Work Program Final Report

Date of Report: 9/18/12
Final Report

Date of Work program Approval: June 16, 2009
Project Completion Date: June 30, 2012

I. PROJECT TITLE: County Geologic Atlas Acceleration

Project Manager: Dale Setterholm
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Location: Anoka and Wright Counties

	M.L. 2009
Total Trust Fund Project Budget:	**$2,695,000**
DNR Total	*$1,875,000*
MGS Total	*$820,000*
MGS Trust Fund Appropriation	**$820,000**
Minus Amount Spent:	**$820,000**
MGS Equal Balance:	**$0**

Legal Citation: ML 2009, Chap.143, Sec.2, Subd.3(b)
Appropriation Language: $2,695,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. $820,000 of this appropriation is to the Board of Regents of the University of Minnesota for the geological survey to continue and to initiate the production of county geologic atlases. $1,875,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2012, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. FINAL PROJECT SUMMARY:

County geologic atlases support water and mineral resource management and education. An atlas provides maps and databases at scales appropriate for land use planning and water management decisions. An atlas greatly improves our ability to monitor the resource, to predict the effects of pumping, and to respond effectively to contamination. This project created atlases for Anoka and Wright counties in paper, digital, and web-accessible formats. Copies will be provided to LCCMR and the counties, and workshops will be held to train users.

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Database map: shows the location of all well records, borings, scientific drilling, natural exposures, and geophysical measurements used to support the atlas. The databases are also provided.

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Amendment Request (9/6/2012): Amendment approved by LCCMR 9/18/12

An amendment is requested to show approval of budget changes. These changes do not affect the total project cost, but changes in the purposes of some spending. When the original project budget is designed the location of the study areas is not known. The project might take place in any Minnesota county that hasn't had an atlas already created, and these counties can be very close to our base of operations, or very far away. In this case we eventually found project partners in

counties relatively near our facility (Wright and Anoka counties). This greatly reduced the magnitude of our travel and the need for overnight stays with meal costs. These counties also have very large subsurface databases which reduce our need for field work, particularly drilling, and the travel costs associated with that work. For these reasons we would like to amend the sum budgeted for travel expenses, and repurpose those funds. We would also like to amend the amount budgeted for supplies, and for capital equipment to reflect the true costs incurred in those categories rather than the estimates in the original budget. The final amendment requested is a redistribution of the funds not spent in the categories described above into a 2% increase in the wages and benefits category, a 7% increase in direct operating costs, and the remainder to a new category for the printing of the Sibley, Nicollet, and Blue Earth county atlases. That work was awarded on a competitive bid.

IV. OUTLINE OF PROJECT RESULTS*:*

Result 3: Initiate County Geologic Atlases

Initiate Part A County Geologic Atlases for Anoka County and Wright County. Note: all components listed below may not be completed within the time frame and budget of this project, but substantial progress in both counties is anticipated.

Description:

- create geologic maps, illustrations, and databases in print and GIS formats.
- location, boundaries, size, and hydrologic characteristics of aquifers and the materials that confine them in these counties.
- these maps are essential information in efforts to protect and wisely allocate ground water and they support these related activities and programs:
  - ground water monitoring, wellhead protection, ground water allocation, well construction, wellfield design, facility siting, permitting, application of agricultural best management practices, remediation, and management of ground water dependent surface water features (springs, fens, lakes, rivers).
- products:
  - maps of bedrock geology, surficial geology, subsurface Quaternary geology, bedrock topography, and thickness of glacial deposits
  - database of well construction records to support the mapping, describe water use, and to help resolve well problems; scientific test drilling as necessary

Summary Budget Information for Result 3:

	M.L. 2009
Trust Fund Budget:	**$728,057**
Amount Spent:	**$728,057**
Balance:	**$0**

Deliverable	Completion Date	Budget	Status
3. M.L. 2009: CWI databases for 2 counties	6/30/10	$ 18,000	complete
4. M.L. 2009: geologic maps	6/30/12	$728,057	underway

M.L. 2009 Final Report Summary: All of the products for the Anoka and Wright county geologic atlases are complete with the exception of the subsurface Quaternary products (sand body aquifer models, stratigraphic column, cross-sections). These products are nearly complete and we anticipate printing the atlases later this year

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These atlases were different from past projects in that there was so much more data available. A typical county atlas might have between 1,000 and 4,000 well records available to document the subsurface geology. The Anoka Atlas utilized 24,000 wells, and the Wright Atlas utilized 10,700 wells. This large body of data adds work in compiling and interpreting the data, but results in maps of higher resolution and greater accuracy.

The bedrock map of Anoka County http://conservancy.umn.edu/bitstream/116119/1/pl2_bg.pdf includes 9 map units, all of Paleozoic age. A map of the shape and elevation (topography) of the bedrock surface was prepared, as was a topography of the top of the Wonewoc Formation. Two cross-sections illustrate the vertical sequence of units. The bedrock map of Wright County includes 23 map units (2 Cretaceous age, 6 Paleozoic age, 15 Precambrian age). Six surfaces were mapped (2 Cretaceous, 3 Paleozoic, 1 Precambrian) and three cross-sections illustrate the vertical sequence of units. Both of these maps have been incorporated into a single map of the ten-county metro area, with additional contact surfaces mapped for all counties. This effort, co-funded by MGS and USGS, has created all the digital information necessary for the geologic framework of a new ground water model for the expanded metro area. This compilation includes new atlas data (Anoka, Wright, Sherburne, Chisago, Carver, Scott) and updates of previous atlas maps (Ramsey, Hennepin, Dakota, Washington).

The surficial geologic map of Anoka County is complete and available via the MGS web site http://conservancy.umn.edu/bitstream/116119/2/pl3_sg.pdf. It has 27 map units. It includes a simplified illustration of sand vs. clay at the land surface. The vertical sequence of glacial materials has been documented with 87 cross-sections created at a spacing of 500 meters. This is the most detailed and data-rich account of glacial stratigraphy in the state. Significant findings include the type of materials filling valleys cut into the bedrock surface. These valleys are common in the Paleozoic rocks of Minnesota and they can affect ground water flow patterns when the valleys cut through bedrock layers that would normally restrict vertical flow. In Anoka County the largest bedrock valley, which continues to the south and hosts

several metro lakes, is filled mostly with sand. This may be a pathway for recharge to deeper aquifers. Water level measurements will determine if this is the case. Other smaller valleys have complex fills with thick aquifers in places, but also much clay-rich material. Digital surfaces representing glacial aquifer boundaries and the contacts between till deposits of various ages are currently under construction.

The surficial map of Wright County is deceptively simple in that it covers a complex sequence of glacial deposits representing many events and disparate materials. This sequence will be evident in the cross-sections and sand body maps that describe the subsurface.

About 40% of the closely-spaced (1 km) cross-sections that describe the subsurface distribution of glacial materials in the county are complete. There will be 51 east-west sections and we expect to complete them in October. Again, the density of data has improved our understanding, but increased the necessary effort. This work has changed our understanding of the limits of some glacial advances and their deposits, including multiple depositional phases of the Des Moines Lobe. Construction of digital surfaces representing glacial aquifer boundaries and the contacts between till deposits of various ages will follow when the cross-sections are complete.

The new Giddings drilling machine and truck were purchased and are used frequently on county geologic atlas projects. The borehole camera was purchased and is used on atlas projects and related research (such as the St. Lawrence Formation hydrogeologic characterization funded by M.L. 2010 Chp. 362, Sec. 2, Subd. 3a). The flowmeter was repaired and is in use on atlases and related hydrogeologic projects.

Printing of the Blue Earth, Nicollet, and Sibley county geologic atlases was funded by this project. This bidded contract cost $34,380 in total for 1,000 copies of each atlas. Each copy includes 6 printed plates with a map and other illustrative material on each plate.

Result 5: Production and Printing of the Benton and Chisago County Geologic Atlases

Description:

- Take the geologic maps and databases from 2007 work program through the technical review, editing, production, and printing phases
- products:
  - printed maps of bedrock geology, surficial geology, subsurface Quaternary geology, bedrock topography, and thickness of glacial deposits
  - A CD or DVD package of digital versions of the products in several formats appropriate for the varying technology levels of users

Summary Budget Information for Result 5:

Trust Fund Budget:	**$91,944**
Amount Spent:	**$91,944**

Balance: **$0**

Deliverable	Completion Date	Budget	Status
1. printed maps and DVD	6/30/10	$91,944	complete

Final Report Summary: The Benton and Chisago County Geologic Atlases have been completed and delivered to the counties and to the LCCMR. The counties each received 1,000 copies of the printed atlases, and a DVD containing all the digital files and associated databases.

V. TOTAL TRUST FUND PROJECT BUDGET:

Personnel: approx. 6 fte from approx. 15 staff	$570,216
Contracts: drilling (approx. 6 or 7 holes $75,000) printing $22,000	$ 97,101
Equipment/Tools/Supplies ($86,000 capital equip below; $3500 core box, lab/field supplies $7000, copy/scan/plot $400, field maps $300, lab analyses $1600)	$ 98,883
Travel:	$ 54,000
Other:	$ 0
2009 TRUST FUND PROJECT BUDGET:	$820,000

Explanation of Capital Expenditures Greater Than $3,500:

Soil Probe and carrier truck: $62,000

The Minnesota Geological Survey relies primarily on water well records for subsurface geologic data. This is augmented by 1 to 3 rotasonic test borings approximately 250 feet deep, and 100 to 200 shallow borings less than 25 feet deep. The shallow borings are drilled with a truck mounted auger owned by MGS. This project will purchase a new auger and truck to augment our current equipment. The acceleration of the program requires a second set of equipment.

Repair of a downhole flow meter tool: $9,000

MGS lowers several types of measuring probes into water wells or test borings to record physical properties of the surrounding earth materials, or the water in the borehole and adjacent aquifers. Our flowmeter probe was damaged during previous use and these funds will repair it for use on this project and future atlases.

Downhole Video Camera and Recorder $15,000

A downhole video camera provides us with the ability to see geologic strata in uncased intervals of wells or test borings. This is useful in interpreting the geology, and also in assessing the suitability of the hole for deploying the downhole flow

meter or other tools. Seeing the conditions in advance will help us avoid tool loss or damage in holes with obstructions or problematic construction.

VI. OTHER FUNDS & PARTNERS:

A. Project Partners:

Minnesota Geolgical Survey, total from 2009 appropriation	$820,000
Anoka County (well location verification)	in-kind contribution
Wright County (well location verification)	in-kind contribution

B. Project Impact and Long-Term Strategy:

County Geologic Atlases provide information essential to sustainable management of water resources. Atlases are completed or underway for 25 of Minnesota's 87 counties. The products also support and enhance the activities of other agencies such as ground water monitoring, wellhead protection, ground water allocation, well construction, wellfield design, facility siting, permitting, application of agricultural best management practices, remediation, and management of ground water dependent surface water features (springs, fens, lakes, rivers).

C. Other Funds Proposed to be Spent during the Project Period:

Proposals will be made for similar matches to selected products of the 2009 appropriation. Update: The USGS Statemap Program accepted the Anoka surficial and bedrock maps as projects and contributed $68,525 in additional funds. The Great Lakes Geologic Mapping Coalition co-funded the subsurface Quaternary products of Anoka County contributing an additional $36,736.

D. Spending History:

VII. DISSEMINATION:

Geologic maps and databases prepared by the Minnesota Geological Survey will be available in GIS and other electronic formats on the MGS website http://www.mngs.umn.edu/index.html, and in print.

VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than 12/1/08, 7/1/09, 12/1/09, 7/1/10, 12/1/10, 6/30/11, 12/1/11, 6/30/12 **A final work program report and associated products will be submitted between June 30 and August 1, 2009 and again between June 30 and August 1,2010 as requested by the LCCMR**

IX. RESEARCH PROJECTS:

Attachment A: Final Budget Detail for 2009 Project

Project Title: County Geologic Atlas Acceleration

Project Manager Name: Dale Setterholm
revised 9/18/12
Trust Fund Appropriation: $ **820,000**

1) See list of non-eligible expenses, do not include any of these items in your budget sheet
2) Remove any budget item lines not applicable

2009 Trust Fund Budget	**Revised Result 3B Budget:**	**Amount Spent (06/30/2012)**	**Balance (06/30/2012)**	**Result 5 Budget:**	**Amount Spent (06/30/2012)**	**Balance (06/30/2010)**	**TOTAL BUDGET**	**TOTAL BALANCE**		
BUDGET ITEM	Initiate new CGAs in Anoka and Wright counties			Production and Printing of Benton and Chisago CGAs						
PERSONNEL: wages and benefits *(List individual names, amount budgeted and %FTE; add rows as needed)*	514,575	514,575	0	65,159	65,159	0	579,734	0		
Contracts						0		0		
Professional/technical *(test drilling, bid)*	75,000	75,000	0	0	0	0	75,000	0		
Other direct operating costs *(repair flowmeter)*	9,683	9,683	0	0	0	0	9,683	0		
Non-capital Equipment / Tools *(what equipment? Give a general description and cost)*	0	0	0	0	0	0	0	0		
Capital equipment over $3,500 *(Giddings soil probe, truck, borehole camera)*	73,768	73,768	0	0	0	0	73,768	0		
Printing (*competitive bid*) Sibley, Nicollet, and Blue Earth Atlases	34,380	34,380	0	26,785	26,785	0	61,165	0		
Supplies *(xeroxing, maps and publications, kraft envelopes, sample bags, sieves, banding for core samples)*	11,252	11,252	0	0	0	0	11,252	0		
Travel expenses in Minnesota	9,399	9,399	0	0	0	0	9,399	0		
Other *(Describe the activity and cost) be specific*			0	0						
COLUMN TOTAL	**$728,057**	**$728,057**	0	**$91,944**	**$91,944**	**$0**	**$820,000**	**$0**		

County Geologic Atlas Part A Coverage