

Minnesota Ground Water Association

Volume 18, Number 3: September, 1999

President's Column

By James Piegat

A few months ago, a professor from a large university in another part of the country was in town to give a seminar at the University of Minnesota. After his talk, I had the opportunity to visit with him over dinner. As some of the others with us that evening were faculty members at the U, a small portion of the evening's stimulating conversation touched on the subject of attracting students to geology departments and then educating them.

Attracting students is a subject of concern for many geology departments for two main reasons. First, school of science deans tend to parcel out money to departments according to enrollment. More students, more money. Less students, less money. Second, compared to the good old days (which seemed to end just about the time I graduated), there isn't much of a market for geologists, so who wants to be one?

The federal government was once one of the largest employers of geologists, but no more given the current political climate. Big oil was the other significant employer, but no longer because geophysicists now think they can actually "see" the oil and therefore have no need of geologists. (Geophysicists and geologists are not the same, as most any geophysicist will be happy to insist.) Oil companies run by MBA's rather than geophysicists think the best way to increase reserves is to buy out another oil company. One needs no geologists for takeovers.

Getting back to the dinner, the geology department that employs our visiting professor is following the solution of changing their curricula. The more difficult courses that kept students away are no longer required or are reduced to survey courses. The expecta-

tion is that the department will serve non-majors with a greater variety of appealing courses and will direct the majors to employment in the environmental field (in the broadest sense) where knowing the difference between, for example, orpiment and realgar is neither interesting nor important.

Our guest's department is not alone. Universities of all sizes are changing their geology curricula to maintain or increase student market share. The discipline of geology seems to be making significant changes that, if completed, may well be irreversible. For example, not long ago courses such as invertebrate paleontology were not only taught but required for every geology degree. Now many universities no longer even offer the course. For many generations, structural geology was the course that separated the geologists from the rockhounds. In more than a few places, it is now as easy to ace structural as any other undergraduate course.

So the question arises. What should it mean to be a geologist? In a world where we have already exploited all of the easily found ore deposits, I can't imagine finding more without geologists who have an extensive background in mineralogy, petrology, and structural geology. But how many geologists will we need for such tasks and how many universities do we really need to train them?

What of the other geology departments? Do they fade away? Do they change to serve non-majors and those who would pursue less rigorous disciplines in "environmental studies?" The State of Minnesota, at the insistence of geologists and with the help from members of this association, has thoughtfully embalmed a notion of

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Two MGWA Officer Positions Open For 2000

Call for Nominations

The MGWA membership needs to fill two officer positions — Secretary and President-Elect — for the year 2000.

The Secretary records the official minutes during the monthly MGWA Board Meetings and assists with meeting planning. The President-Elect takes a leadership role in the planning of one or more of the MGWA meetings while "learning the ropes" of MGWA leadership.

Here's a chance for you or someone you nominate to get in on the front end of ground water resource protection for the new millenium.

The Secretary serves a two-year term, and the President-Elect serves for a year before becoming President in 2001 followed by a year as Past President.

Send your nominations by November 1 to MGWA, 4779 126th St. North, White Bear Lake, MN 55110-5910, or by e-mail to: MGWAOffice@aol.com

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The primary objectives of the MGWA are:

Promote and encourage scientific and public policy aspects of ground water;
Protect public health and safety through continuing education for ground water professionals
Establish a common forum for scientists, engineers, planners, educators, attorneys, and other persons concerned with ground water;
Educate the general public regarding ground water resources; and
Disseminate information on ground water.

— President's Letter, cont.

what a geologist is in rules for professional licensure. Will some geology departments find themselves in a situation wherein they produce no students able to meet the state standards? Should the state rules dictate how universities (at least public universities) teach geology to majors? Lots and lots of questions, but no answers. At least no simple or clear-cut answers. But change in the discipline of geology is inevitable and will not necessarily be similar to changes that occurred in the past.

This challenge of change is not unique to geology. A sailor who served Sir Frances Drake in the 1570's could have been transported 225 years by time machine to the year 1805 and within a few days been earning all of his pay as a sailor aboard Admiral Nelson's *Victory*. But that same sailor transported again just another 100 years to HMS *Dreadnought* would have found literally everything so different about naval ships that he couldn't function at all. Only another forty years later and our sailor would have to deal with aircraft and radar. And less than another twenty years later he would be using nuclear propulsion and electronic devices even Jules Verne never imagined.

— continued in next column

This doesn't happen in science? How long has computer science existed and why are all the punch cards gone already? Where would a biologist of 1900 or even 1950 be in a modern laboratory where the work is dominated by investigations of molecules? Who among you care to explain the geology of the Appalachian Mountains in terms of Marshall Kay's geosynclinal theory? It's really not all that old.

Not only did everything completely change several times for our time-traveling sailor, but the time between these changes became shorter and shorter. Now the time between such occupational revolutions is so short that a new graduate can expect to see several in his discipline before he either retires, or moves on to a new profession entirely.

So what are we to do? The way we as a society practice geology and teach it to the next generation will change. There will probably be no consensus about the goodness of these changes. We can't stop them; but we can perhaps guide them if we become involved. One means of involvement would be through departmental alumni associations or simple communication with geology department faculty.

I believe that an important means of involvement that this association can and should promote is getting geology students to participate in the activities and affairs of MGWA. So I encourage each of you to bring a student to the next conference or field trip!



**Support Your
Association
— Invite A
Student
to Join**

The Capillary Fringe

How can we improve our knowledge of Minnesota's ground water "reservoir"?

By Roman Kanivetsky, Minnesota Geological Survey

I agree with the theme of the column by MGWA President Jim Piegat in the June 1999 MGWA Newsletter. In his article, Jim raises an important point of "programization" versus "the will of the people". As Governor Jesse Ventura put it: "Government doesn't exist to sustain itself on programs that no longer serve the people... For government to serve the people of our state, it needs to be accountable, responsive, and limited. Government should be creative."

Based on this philosophy, the Environmental Quality Board is developing the Water Unification Initiative to unify state efforts within 10 major river basins. The objective of this initiative is directed toward sustainability of quality and quantity of water resources in Minnesota's major river basins. The specific goals of this unification would be to provide quantitative information on measurable outcomes and to respond to questions such as where, how, and why surface and ground water quality and quantity conditions are changing over time. Decision makers want numbers: "Just how much water is available?" and "Is water getting better or worse?"

To make the basin approach work, the state needs to develop a sustained scientific knowledge in three principal areas:

- 1) defining a quantitative hydrogeologic framework,
- 2) producing quantitative water resources maps, and
- 3) obtaining quantitative chemical information on Minnesota's ground water.

- 1) A quantitative hydrogeologic framework must provide quantitative characteristics of hydraulic flow systems. Subsurface geologic mapping is the foundation to understanding hydrogeology. Lately, however, most efforts by state and local units of government have been directed toward modeling without sufficient knowledge

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Capillary Fringe, cont.

of the real world. We should ask ourselves: do we have sufficient information to make an abstraction of quantitative reality? And in most cases, the answer is no. All units of government should make a concerted effort to collect and build a database of quantitative reality (hydraulic parameters) statewide. Presently, this task is not carried out by the state because much state activity is centered around "programs". With the Water Unification Initiative focusing on outcome measures and using teams in each basin, we will be better able to accomplish this task and begin to address the real world in quantitative fashion. This information is critical for measuring sustainability of ground water resources and subsequent responsible choices for sustainable economic and environmental management.

2) Quantitative water resource maps are needed for each of the state's 10 river basins. These maps will be a tool to compare renewable water resources with water use and will provide a measure of which areas or regions are under pressure for water resources and their sustainability. To use a financial analogy, we know how much money we are taking from the bank but not how much we have in the bank.

3) Quantitative chemical information is available in all units of government, but it is suffering from fragmentation and "programization". As a result, it is detached from our present knowledge of the hydrogeologic framework. Quantitative chemical information should be synthesized with present data and an improved hydrogeologic framework to serve as benchmark data for trend analyses of water quality and to provide a quantification of people's concerns, "Is water getting better or worse?"

I believe if we all work together as teams at all levels of government, from leadership positions to staff, trying to break through "programization" and elevating water management to quantitative outcomes, we will be much better off at "serving the will of the people" rather than building "China walls" around existing programs.

Editors' Note - Your editorial team is delighted whenever an article we publish generates a response from our readers. Such is the case with the above article by Roman Kanivetsky which was written in response to MGWA President Jim Piegat's column in the June 1999 MGWA Newsletter. We want to remind readers that the opinions expressed here are the author's and do not necessarily reflect

AIPG-MGWA-AWG Fall Field Trip to North Shore and Gunflint Trail

As this issue goes to press, 60 people just returned from the annual AIPG-MGWA-AWG field trip to the beautiful North Shore and the Gunflint Trail. Be sure to watch for pictures and a write-up in the December MGWA newsletter.

MGWA Board Votes to Help Fund Ground Water Events

Coming in October, ground water aficionados will want to make note of two events coming up within a week of each other, both of which the MGWA will help to support. On October 6, the Children's Water Festival, sponsored by the Metropolitan Area Ground Water Alliance (MAGWA), will be held at the State Fairgrounds in Falcon Heights. For more information, contact Joe Enfield in Carver County (612-361-1800) or Cindy Weckwerth in Washington County (651-430-6703). Following close on its heels the next week (October 13-15), the 44th Annual Midwest Ground Water Conference, hosted by the Department of Natural Resources and co-sponsored by a number of State water management agencies, will be held at the I-94 Ramada Inn in Saint Paul. For more information, see the back cover of this newsletter. The MGWA Board voted to contribute \$200 to help fund the Children's Water Festival and \$100 to help support the Midwest Ground Water Conference. Read about both events in the December MGWA newsletter.

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Minnesota Karst Workshop, May 10-13, 1999

The Minnesota Karst Workshop was convened by the Minnesota Pollution Control Agency and Department of Natural Resources May 10-13, 1999 at the Rochester Community and Technical College in Rochester. The conference drew about 50 participants—approximately half state agency staff, half private consultants, and several educators. During a very rainy week, twelve recognized presenters shared their expertise in the hydrogeology of karst regions through both lectures and field activities.

Day 1 included overviews of Minnesota karst areas and features, karst hydrogeology, and the character of groundwater contamination within karsted aquifers. The main message was that aquifers should be characterized using all three aspects of groundwater flow: matrix flow through pore spaces, fracture flow along joints, and conduit flow via solutionally enlarged pathways (“karst hydrology”). Traditionally, aquifers have been segregated into these three categories, but in effect, all aquifers are matrix-flow aquifers, AND fracture-flow aquifers, AND conduit-flow (or karst) aquifers. In assessing groundwater and contaminant transport, it is vital to address all three aspects.

Day 2 consisted of field trips to various sites in the Rochester area to view outcroppings of karsted bedrock and surface karst features. Stops included a closed landfill atop high-relief karst features in Winona County; stone quarries and roadcuts in heavily karsted bedrock formations; and the Lewiston Country Club which sports a rather large sinkhole that would be easily overlooked on a golf course if the observer were not aware of the high degree of karstification in the vicinity. Back in the dry lecture room, speakers highlighted karst mapping techniques and case studies of karst site investigations in which it was shown that groundwater could flow miles per day in highly karsted aquifers, winding up in the most unanticipated of locations (e.g. across groundwater matrix-flow divides, “upgradient” from the source, beyond

surface streams, appearing in springs only to infiltrate back to the subsurface in sinking streams).

That evening, Dr. Nicholas Crawford, of the Department of Geography and Geology and the Center for Cave and Karst Studies at Western Kentucky University in Bowling Green, KY, presented the keynote address at the conference banquet. Dr. Crawford, a world-renowned expert in karst hydrogeology and dye-tracing, discussed “Environmental Problems in Karst,” a less rigorous and more humorous discussion of case studies in the Bowling Green area, one of the most heavily karsted areas in the world, where minor spills have a tendency to wind up in springs, streams, basements, schools, wells, etc., and sinkholes regularly swallow entire buildings. Minor spillage in Bowling Green is an immediate public health emergency, for which the city has developed contingency plans to prevent catastrophes.

Day 3, the rainiest of the week, was spent entirely in the field at the Spring Valley Caverns and Karst Preserve near Spring Valley, MN. During the morning, workshop participants toured the caverns to observe karst from the inside out. Then, from the outside in, surface geophysical techniques (microgravity and ground penetrating radar) were used to locate “filled” sinkholes and subsurface voids. During lunch, a backhoe began to excavate in one such area to confirm the indications of the geophysical surveys. While the backhoe continued working, workshop participants hiked through farm fields and wooded stream valleys to seek out field indications of karst features. These ranged from pronounced sinkholes and tunnel collapses 20+ feet deep, to dry valleys, to springs and sinking streams, to broad shallow depressions, to a sinkhole eight inches across that looked quite a bit like a gopher hole. Many of the identified karst features would easily be confused with other common landforms without the known context of a karsted terrain. These exercises served to confirm that extra work and keen observation are required in suspected karsted areas. The backhoe did not reach the depth of the identified void by day’s end, but as confer-

ence participants boarded the buses to return to Rochester, the eager cavers remained on-site hoping for a new cave entrance to appear. For all we know, they’re still there.

On Day 4, the workshop covered more case studies illuminating particular contamination issues in karsted aquifers. Finally after a full week with a lot of informative discourse and fun in the rain, the new MPCA Guidelines on petroleum leak investigations and agricultural feedlot placement were presented as Minnesota’s small first steps in addressing the large impending issues of groundwater contamination in karst areas. Many participants expressed great satisfaction with the workshop and looked forward to applying their newly acquired concepts and tools to karst areas.

— contributed by Charles Tiller

Health Dept. Revises Fact Sheet on Volatile Organic Chemicals

The Minnesota Department of Health, Site Assessment and Consultation Unit, has extensively revised its 1990 fact sheet, *Volatile Organic Chemicals in Drinking Water*. The new version answers such frequently asked questions as: What are volatile organic chemicals (VOCs)? How do VOCs get into drinking water? What are the health risks associated with VOC contamination?

Copies may be obtained free of charge by contacting the Health Department at (651)215-0700.

USGS Releases Revised Map List for Minnesota

A March 1999 Revision of the USGS Map List for Minnesota is now available. It lists all 1:24,000, 1:100,000, 1:250,000, 1:1,000,000, and 1:2,000,000 USGS maps covering the state. Map lists are available at <http://mapping.usgs.gov/mac/maclists.html>.

Paper copies can be requested free-of-charge from USGS Information Services, Box 25286, Denver, CO 80225; fax 303-202-4693 (file number TMNB).

Teens' deaths blamed on cellar's high nitrogen levels

Reprinted from The Edmonton (Alberta) Journal, Aug 13, 1999, by Mitch Cooper, Staff Writer.

A rare geological condition killed two Sylvan Lake teens as they fetched vegetables from a root cellar on the family farm, an investigation has found. The findings have also renewed warnings for rural Albertans to ensure adequate ventilation around underground well facilities. An investigation by the Royal Canadian Mounted Police (RCMP) and the Canadian Ground Water Association has concluded that fatally high levels of nitrogen generated by a "suck-and-blow" water well killed Susan Staudinger, 19, and her brother Doug, 17. The pair collapsed July 12 as they gathered vegetables for dinner from a root cellar, which was once a well pit, on the family grain farm near Sylvan Lake. They slipped into a coma and died later of oxygen deprivation.

Investigators previously believed the youngsters died after carbon dioxide generated by rotting vegetables displaced breathable air in the three-metre deep well pit the family used as a root cellar. A well pit is dug near a water well to house pumping equipment so it doesn't freeze in winter. But testing showed that oxygen levels remained at 5.5 per cent a week after the vegetables were removed — well below the oxygen content usually found in the atmosphere — leaving investigators to find another cause. "What baffled us was why there was no oxygen in that air," said RCMP investigator Const. Harry Ingram. Maurice Lewis, executive director for the Canadian Ground Water Association in Lousana, Alberta, called Ingram when he realized the root cellar was really a well pit. "I realized I had something to offer here," he said. Lewis, a longtime well driller, said testing showed the well was a "suck-and-blow" well. That means, as barometric pressure in the atmosphere rises, the well draws normal air under the ground. As barometric pressure falls, the well expels that air again, but with a very high nitrogen content. The air you breathe normally

contains 78-per-cent nitrogen, an odourless, colourless nitrogen gas, as well as 21-per-cent oxygen. But, in the case of this "suck and blow" well, tests later showed that the air being expelled was as high as 90-per-cent nitrogen. "You can literally drown in this stuff," said Lewis. He believes the air returns to the surface with little oxygen because it combines — or oxidizes — with metals underground. But whatever the reason, the result in the Staudinger case was deadly.

Air also was drawn into the well from the nearby well pit and replaced with nitrogen. While nitrogen is not poisonous, it displaced most of the oxygen in the pit and ultimately killed the youngsters. Lewis said while the phenomenon is relatively rare, well pits of this sort are not. Well pits were made illegal in the early 1990s, but there are still many in existence across the province, including many in central Alberta. The Staudinger well pit had been used safely as a root cellar for more than 25 years. It's unclear why nitrogen levels rose to lethal levels two months ago. "The biggest thing in this case is that where there are well pits, there should be adequate ventilation," said Ingram. "Hopefully, this investigation will prevent further deaths. There will be a lot of tough days ahead for the family." The parents, Harvey and Lois Staudinger, said that knowing the true cause of their children's deaths was of some comfort. "We pray these findings save the life of someone else," said Harvey Staudinger.

MGWA Fall Conference Planning Well Underway

The MGWA Fall Conference will be held Friday, November 19, 1999, at the Minnesota Pollution Control Agency's Boardroom in St. Paul. The topic is: **Surface Geophysics: Applications for Ground Water Professionals.**

Your board is working hard to put together an agenda which will feature experts from the field, covering such topics as: ground penetrating radar; electrical resistivity; SP and IP for mineral exploration and environmental applications; electromagnetic surveys; 2-D and 3-D seismic reflection and refraction; and gravity and magnetic surveys.

It promises to be a full day, with plenty of practical applications which you may be able to use in your own work. Mark your calendars now!

The course is being designed to meet the continuing education criteria of the Board of AELSLAGID, which licenses geoscientists. MGWA is investigating whether the Board would be able to certify this conference as eligible for continuing education credit based on its structure and content.

Watch your e-mail and mailbox for a detailed agenda and registration information by early October. Registration will be limited, so register early!

USGS Topographic Map Symbols Now on Web

An on-line version of "Topographic Map Symbols" has been developed to provide map symbol information, in HTML format, to customers viewing USGS Digital Raster Graphics on the Terra Server Web Site when they become available. It can be found at <http://mapping.usgs.gov/mac/isb/pubs/booklets/symbols/index.html>. The site includes a short introduction to topographic maps and how to read them as well as symbols for six categories of features shown on USGS topographic maps:

- Elevations,
- Boundaries,
- Land Surface Features,
- Water Features,
- Buildings and Related Features, and
- Roads, Railroads, Transmission Lines, and Pipelines.

The web site also provides links to other sites of interest to topographic map users, including Map Finder, USGS map lists, USGS map dealers, the Global Land Information System, and USGS booklets and fact sheets.

New Geologic Atlas and Hydrogeologic Assessment Reports Available

Stearns County Geologic Atlas, Part B

The Minnesota Department of Natural Resources (DNR) recently published Part B of the Stearns County Geologic Atlas. The atlas contains maps at 1:100,000 scale of ground water conditions in the county including the water table system, buried drift aquifers, the Cretaceous aquifer, and Precambrian bedrock. The report also includes an interpretation of the pollution sensitivity of the near-surface ground water system. A booklet summarizing the results of ground water sampling is included with the maps. The Minnesota Geological Survey published Part A, seven plates describing the geology of the county, and Part C, a text supplement, in 1995. Digital files of the databases and maps are also available by contacting DNR at (651) 296-4800. A training workshop for county staff and the public is planned for next spring.

County Atlas C-10, Part B, Geologic Atlas of Stearns County, Minnesota. Three color plates and booklet. \$12.00 (plus sales tax and postage).

Upper Minnesota River Basin Regional Hydrogeologic Assessment, Part A

The Minnesota Geological Survey recently published Part A of the Upper Minnesota River Basin Regional Hydrogeologic Assessment. The assessment covers Swift, Chippewa, Lac qui Parle, and Yellow Medicine counties, and parts of Big Stone, Renville, Lincoln, Lyon, and Redwood counties. Two plates contain maps, cross-sections, figures, and text that address the surficial geology, Quaternary stratigraphy, glacial history, drift thickness, bedrock topography, and the distribution of significant thicknesses of stream sediment in the Quaternary section. The surficial geologic map is at 1:200,000 scale. Portable document files of both plates are available from the MGS web site. The Minnesota Department of Natural

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MGWA Board Meeting Minutes

May 6, 1999, Egg & I, University and 280, St. Paul, MN, 7:30 a.m.

Attending: Jim Piegat, President; Jan Falteisek, Secretary; Lee Trotta, Treasurer; Jeanette Leete, Sean Hunt, WRI; Tom Clark, Newsletter Editor; Leigh Harrod, Advertising Coordinator.

Approval of Minutes – Jim Piegat called the meeting to order at 7:35 am. Minutes for the regular Board meeting held April 1, 1999 were approved as corrected.

Treasurers Report – Jennie provide a financial summary for the first four months of 1999. Lee Trotta reported on results of investigating CD rates and several options, including money market, unit investment trust, and mutual funds. Treasuries were also mentioned. Following discussion, it was moved, seconded, and approved that the objective of the savings account is long-term growth of the endowment and that in the future, the interest generated would be available for programs. Jennie also suggested looking outside Norwest for better rates. Jan moved and Lee seconded that the Treasurer be given the authority to make decisions on investment options, subject to choosing more conservative options relative to loss of principal. Motion approved by all. Lee will report back at the next Board meeting.

Spring Conference – Jennie Leete provided a financial update on the spring conference. There were about 75 registrations and an estimated profit of \$1,026. Jim Piegat noted that a similar conference with the same speakers would be worthwhile to do again, but not during legislative session. Jennie suggested articles in the newsletter as a follow up to the program. It was noted that the History Center is nice, but more expensive. Also, the space is expandable for a larger program. Depending on the program, other venues could be considered. Jim Piegat will send out thank you letters to speakers.

Midwest Ground Water Conference — Jan noted that there is an opportunity to partially host refreshments on

Wednesday evening, October 13, 1999.

Darcy Lecture — It was moved and approved directing Jennie to send \$50 to Mark Person, University of Minnesota for refreshments.

Membership – Sean Hunt noted the Professional Geologist list had been received. Lee Trotta had cross checked members by agency, but follow up had not been completed by Jennie.

Newsletter – Leigh Harrod reported on advertising. Tom said the newsletter will be to Jennie for layout next week. The Directory will be out by the end of June. Jim said he would have the President's page by Friday.

Web Software – Jennie and Sean described new software for web use that would allow VISA purchase of memberships and items. Jan asked for third-party reviews of the product.

Meeting adjourned 8:50 am.

June 3, 1999

Egg & I, University and 280, St. Paul, MN, 7:30 a.m.

Attending: Jim Piegat, President; Jan Falteisek, Secretary; Lee Trotta, Treasurer; Jeanette Leete, Sean Hunt, WRI; Tom Clark, Newsletter Editor.

Approval of Minutes – Jim Piegat called the meeting to order at 7:45 am. Minutes for the regular Board meeting held May 6, 1999 were approved.

Treasurers Report – Lee Trotta reported that all previous time accounts had been combined into a single CD (9 mo.) Balance at Norwest is \$17,205.43. WRI provided a current balance sheet (attached). A spring conference financial report was also provided and is attached. Net income was not as initially estimated because the Minnesota History Center charged for an extra hour of use of the 3M Auditorium.

Spring Conference – Jennie reported that all invoices had gone out.

Fall Conference – There was a preliminary discussion of topics. The

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New Atlases and Hydrogeologic Assessments, cont.

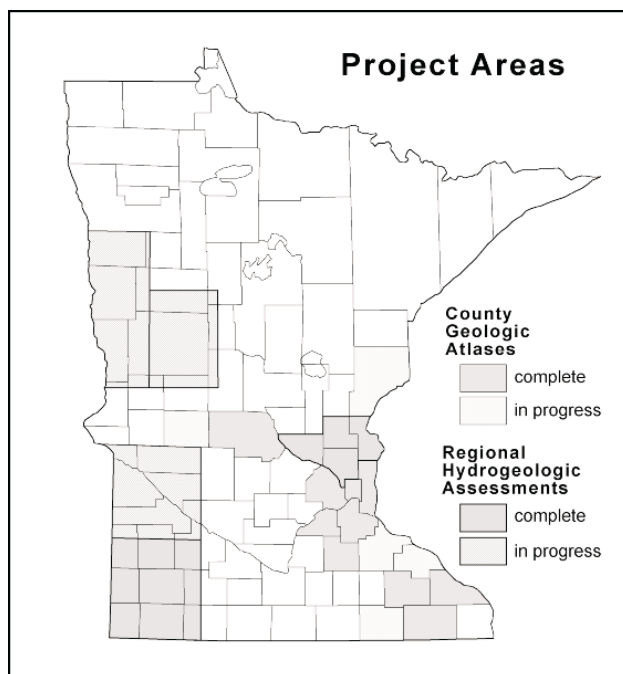
Resources, Division of Waters, will follow up with Part B, which will contain maps of the surficial hydrogeology and sensitivity to pollution of the near-surface ground water system.

Regional Hydrogeologic Assessment RHA-4, Part A, Quaternary Geology—Upper Minnesota River Basin, Minnesota. Carrie J. Patterson, Project Manager. Color. Scale 1:200,000. 2 plates. \$11.00 (sales tax and shipping charges extra).

Both reports may be ordered from the Minnesota Geological Survey, Publications, 2642 University Ave. W., St. Paul, MN 55114-1057, ph. 612-627-4780, ext. 238.

These reports are the result of an ongoing cooperative program between the Minnesota Department of Natural Resources and the Minnesota Geological Survey. The reports produced by the program support planning, research, education, and environmental protection efforts.

The map shows progress on other projects. More information about other reports can be found on the web at www.dnr.state.mn.us/waters/programs/gw_section/cgsrha/status.html and www.geo.umn.edu/mgs/



MGWA Board Meeting Minutes, cont.

conference should be structured to qualify for continuing education units for professional geologists needing the units for license renewal. Fall conference topics will be discussed next month.

MGWA Objectives — It was noted the benefits statement should be revised to include education of the professional community in order to benefit the resource. There is also an intent to eventually qualify for charitable status. Jim Piegat asked Jennie to draft a preliminary statement from other materials with which she is familiar.

Midwest Ground Water Conference — Jan again noted there is an opportunity to partially host refreshments on Wednesday evening, October 13, 1999. There was some discussion on how that might be done (other than a cash contribution).

Darcy Lecture — Jennie is to send \$50 to Mark Person, University of Minnesota, for refreshments.

Membership — Jennie reported that a mailing of membership renewals to second addresses had been prepared and she would arrange to mail them in the next day or two. At least 169 non-renewing members had second addresses. Agency and company follow up lists need to be completed. The combined AIPG and PG lists need to be cross-checked and an invitation to membership sent. Jim Piegat will provide two paragraphs for a cover note. The renewal forms need to be updated for 2000 and Sean will send drafts to Jim Piegat. It was noted again that a good color picture was needed to prepare membership materials directed toward students.

On-line Purchase Software — Jennie said WRI has acquired software for on-line VISA sales.

Meeting adjourned 8:50 am.

July 1, 1999

Egg & I, University and 280, St. Paul, MN, 7:30 a.m.

Attending: Paula Berger, Past-President; Jim Piegat, President; Jim Lundy, President-Elect; Jan Falteisek, Secretary; Jeanette Leete, Sean Hunt, WRI; Tom Clark, Newsletter Editor; Leigh Harrod, Advertising Coordinator.

Approval of Minutes — Jim Piegat called the meeting to order at 7:45 am. Minutes for the regular Board meeting held June 3, 1999 were approved with corrections.

Treasurers Report — Jennie Leete provided an updated balance sheet and profit/loss statement. She noted that planned scholarships or other contributions are overbudget. Costs for the remaining part the year needs to be projected to balance any additional contributions.

Spring Conference — Jennie reported that \$285 was still due on spring conference registrations.

Fall Conference — Two possible conference topics discussed were 1) well design and aquifer systems and 2) applications of geophysics to solve ground water problems. Tentative date is Friday, November 19. The PCA board room would be used if available. CEU's for P.G.'s would be provided if approved. There is the possibility of expanding a DNR workshop on municipal well design held recently. Potential speakers for the geophysics program were also identified. Leigh suggested water law as a topic for a spring conference.

MGWA Objectives — Jennie had not yet completed this item, needing to complete one more sentence.

Midwest Ground Water Conference and Children's Water Festival — The Board approved sponsoring the Midwest Ground Water Conference for \$100 and the Children's Water Festival for \$200.

Fall Field Trip — Jim Lundy provided an update of the trip to the North Shore, noting that registration brochures will be mailed in about a week.

— continued on page 8

MGWA Board Meeting Minutes, cont.

Membership – Sean provided an updated membership report and noted some renewals in response to the third mailing. The membership directory can now be put together. Sean also provided lists of member/former members by affiliation. Board members are to distribute membership renewals to those on the not-paid list.

Newsletter – Tom reported the June issue was out and the September issue will be ready for layout about mid-August.

Meeting adjourned 9:15 a.m.

MGWA Calendar

Contact information for the major event-holders is listed at the end of the column. If you become aware of a relevant event which may not be widely publicized, please send the information to the attention of the editor. Thank you.

October 5-6, 1999

Natural attenuation for remediation of contaminated sites, Chicago, IL. Contact: NGWA.

October 6, 1999

Children's Water Festival. State Fairgrounds, St. Paul, Minnesota. Contact: Joe Enfield (612) 361-1800 or Cindy Weckwerth (651) 430-6703.

October 7-8, 1999

NGWA Midwestern Focus Ground Water Conference, Schaumburg, IL. Contact: NGWA.

October 13-15, 1999

44th Annual Midwest Ground Water Conference, St. Paul, Minnesota. Contact Sarah Tufford (651) 297-2431.

October 19-21, 1999

Visual MODFLOW: The most widely used software package for MODFLOW, MODPATH, and MT3D, Philadelphia, PA. Contact: NGWA.

October 19-20, 1999

Geostatistics and the Data Quality Objectives Process for Environmental Remediation Decision Making, Philadelphia, PA. Contact: NGWA.

October 21-22, 1999

Comprehensive ground water management using Microsoft Access, Philadelphia, PA. Contact: NGWA.

October 25-28, 1999

GSA Annual Conference, Denver, CO. Contact: GSA.

October 29-30, 1999

Sharing the Heartland: Practical Tools for Conserving Farmland and Natural Resources, Bloomington, MN. Contact: www.mn.nrcs.usda.gov/conference/heartland.htm

November 1-2, 1999

Fundamentals of ground water geochemistry, Minneapolis, MN. Contact: NGWA.

November 2-4, 1999

Innovative Cleanup Approaches: Investments in Technology Development, Results and Outlook for the Future. Bloomington, IL. Sponsored by USEPA. Contact: SAIC, c/o Rebecca Glos, 11251 Roger Bacon Dr., Reston, VA 20191, (412) 741-5462 or (fax) (703) 736-0826. Web page: www.epa.gov/ttbnrml.

November 3-5, 1999

Practical applications of ground water geochemistry, Minneapolis, MN. Contact: NGWA.

November 7-10, 1999

Fourth USA/CIS joint conference on environmental hydrology and hydrogeology: hydrologic issues for the 21st century: ecology, environment and human health. American Institute of Hydrology (AIH), San Francisco, CA. Contact: AIH, 2499 Rice Street, Suite 135, St. Paul, MN 55113. AIHydro@aol.com; www.aihydro.org

November 8-9, 1999

Low-cost remediation strategies for contaminated soil and ground water, Portland, OR. Contact: NGWA.

November 10-12, 1999

Principles and practice of forced air remediation, Portland, OR. Contact: NGWA.

November 12-15, 1999

Theis Conference on Remediation of Subsurface Contaminants: The meaning and measures of success, Amelia Island, FL. Contact: NGWA.

November 15-16, 1999

Horizontal well drilling, Houston, TX. Contact: NGWA.

November 15-17, 1999

Understanding and Assessing Risks to Groundwater; 15th Annual Groundwater Foundation Fall Symposium, Omni Hotel at CNN Center, Atlanta, GA. Contact: Cindy Kreifels, 1-800-858-4844, or e-mail: info@groundwater.org

November 16-17, 1999

Wetlands and Remediation, Salt Lake City, UT. Contact: The Conference Group, 1989 West Fifth Avenue Suite 5, Columbus, OH 43212-1912, 1-800-783-6338, conferencegroup@compuserv.com

December 3-6, 1999

NGWA National Convention, Nashville, TN. Contact: NGWA.

December 7-10, 1999

Computer modeling of natural attenuation and bioremediation systems, Salt Lake City, UT. Contact: NGWA.

December 8-10, 1999

DNAPLs in Fractured Geologic Media: Behavior, Monitoring and Remediation, San Francisco, CA. Contact: Waterloo Educational Services, 519-836-3102, www.waterloo-educational.on.ca

March 28-30, 2000

"The Watershed Approach to Improving Water Quality: Fact or Fantasy", an Upper Mississippi River Conference sponsored by the West North Central Region of Soil and Water Conservation Society, LaCrosse, WI.

April 25-27, 2000

National Water Quality Monitoring Conference 2000, Hyatt Regency, Austin, TX. Contact: GWPC, 405-516-4972, jeff@gwpc.site.net, or <http://nwqmc.site.net>

May 22-25, 2000

Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA. Contact: The Conference Group, 1989 West 5th Ave. Ste 5, Columbus, OH 43212-1912, 1-800-783-6338, conferencegroup@compuserv.com

— continued on page 13

Metro Groundwater Model — Site Applications

By Andrew Streit, John Seaberg and Doug Hansen, Minnesota Pollution Control Agency

Introduction

It has been four years since staff at the Minnesota Pollution Control Agency (MPCA) reported on the Metropolitan Area Groundwater Model (Metro Model) project in a MGWA article (see MGWA Newsletter, Vol. 14, number 4, December 1995). At that time we stated that our original goals were to assemble databases, develop a conceptual model, and build a regional groundwater flow model encompassing the Twin Cities seven-county Metropolitan area. Further, we wanted to pursue these goals so that the Metro Model was accepted and used by the environmental and groundwater modeling community.

In 1999, our original goals have been met, and it is time to set new ones.

The most dramatic shift is toward use of this tool by the Agency, and we believe that the project can also provide support to many different types of hydrogeologic investigations, ranging from relatively simple reviews of geology to more complicated drawdown analyses. A large storehouse of shape files, maps and database files is available to all interested parties including unified Minnesota Geological Survey (MGS) Twin Cities bedrock coverages (Figure 1), geostatistically filtered calibration datasets, Quaternary sand-content maps, and stream discharge measurements. These databases can be used to solve hydrogeologic problems that do not require the building of a groundwater model.

If a model is required however, regional groundwater models covering the glacial drift to the Mt. Simon/Hinckley aquifers are ready for use as well. The Metro Model provides a platform from which expansion or development of other subregional models may be developed. And by collect-

ing and reviewing the incremental changes made to the Metro Model, improvements can be shared with all participants. Though originally designed with groundwater contamination in mind, other uses that the Model can be put to include analyzing groundwater management issues such as sustainable development of groundwater, and delineating well-head protection areas. Within the last year, the team has been working with a number of parties to apply the Metro Model and/or its databases to various groundwater modeling projects. To demonstrate the utility of this new strategy, this article will present two examples of modifications of the Metro Model to build local-scale groundwater models, following a brief review of the Metro Model effort.

The Metro Model—A Brief Review

The Metro Model is a regional groundwater flow model encompassing the Twin Cities seven-county Metropolitan area. The Metro Model provides the regional boundary conditions so that an end-user can insert local detail, thereby creating a more robust site-specific model in a shorter time than was previously possible.

The computer model simulates multi-aquifer groundwater flow and is based on a conceptual model that consists of five aquifer layers, four of which represent bedrock units, and one representing a glacial drift aquifer. Separate groundwater simulations now exist for all five layers and all three hydrologic provinces, metropolitan regions divided by the Minnesota and Mississippi Rivers. The software used is the Multi-Layer Analytic Element Model (MLAEM), based on the analytic element method pioneered by Professor Otto D.L. Strack of the University of Minnesota

Twin Cities Area Stratigraphy

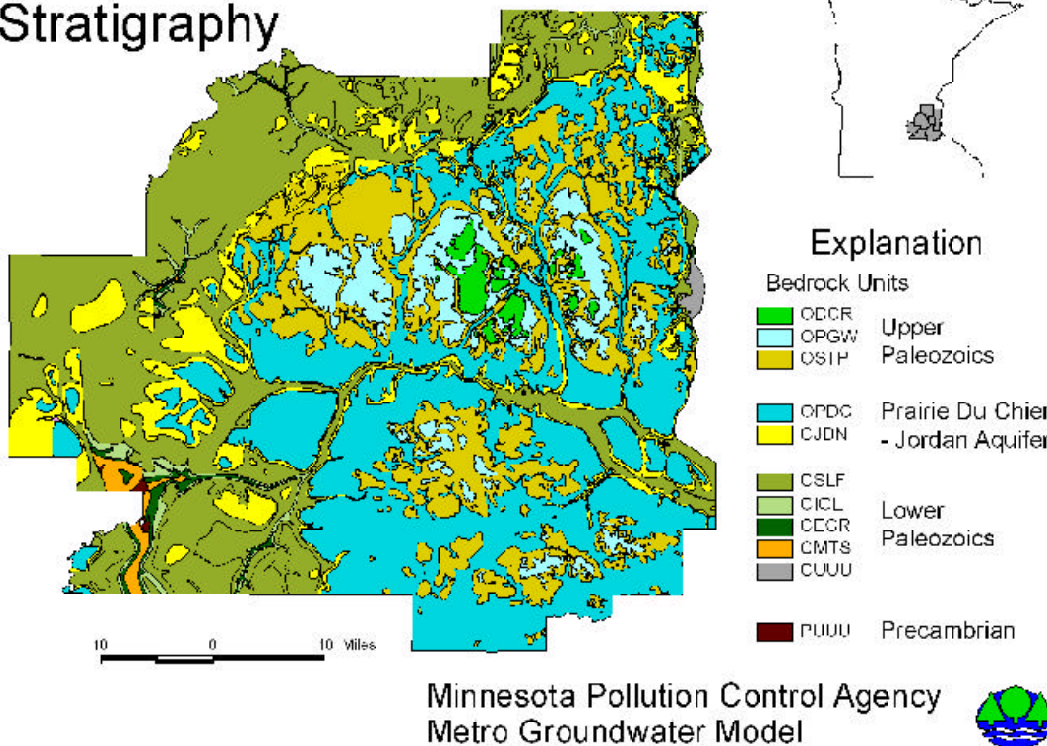


Figure 1

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Civil Engineering Department. Improvements in modeling techniques are incorporated into the effort as they are developed to ensure that the Metro Model provides the best technical tool possible for groundwater management issues.

Site Use of the Metro Model

The most exciting new development in the Metro Model project has been the adaptation of the model for use on two local-scale sites. One was performed under contract to the Metro Model project, and the second was completed by an independent consultant for a third party client enrolled in the MPCA's Voluntary Investigation and Cleanup (VIC) program. Both local-scale models were developed in close cooperation with the Metro Model team. In each case the Metro Model and its supporting databases were easily converted to the needs of the smaller-scale models as described in the two sections below. More detailed information on all aspects of the Metro Model and the local-scale models is available upon re-

quest. Contacts are provided at the end of this article. Relevant geologic information from these local-scale models will be eventually incorporated back into the Metro Model, strengthening its simulation in these areas.

Reilly Superfund Site

The Reilly Tar & Chemical Superfund site was modeled to test the project strategy of applying the regional-scale Metro Model to local-scale sites. Kelton Barr of Kelton Barr Consulting, working with MPCA hydrologists and project staff, modified the Metro Model to meet the local site needs, adding detail in the form of model elements and calibration points where needed while the project team analyzed the use of the Metro Model with the goal to simplify the process.

The Reilly Tar & Chemical Site, in the Twin Cities suburb of St. Louis Park, was selected because of the lateral and vertical extent of groundwater contamination found at that location. The Reilly site is contaminated with coal tar compounds, which are found

in the glacial drift and several underlying Paleozoic aquifers. The goals of the exercise:

- Adapt the Metro Model's north-west hydrologic province model,
- Determine if contaminated groundwater in the glacial drift and Platteville aquifers is effectively intercepted by the extraction wells in each aquifer, and
- Determine if the extraction wells are preventing contaminated groundwater from entering the bedrock valley to the east of the site and affecting the St. Peter aquifer.

The Platteville Limestone and Glenwood Shale are absent in an erosional valley southeast of the site that is a tributary valley to the larger buried bedrock valley that underlies the Minneapolis chain of lakes. The head of the valley is subdivided into at least two prongs extending generally to the north west toward the site. The valley

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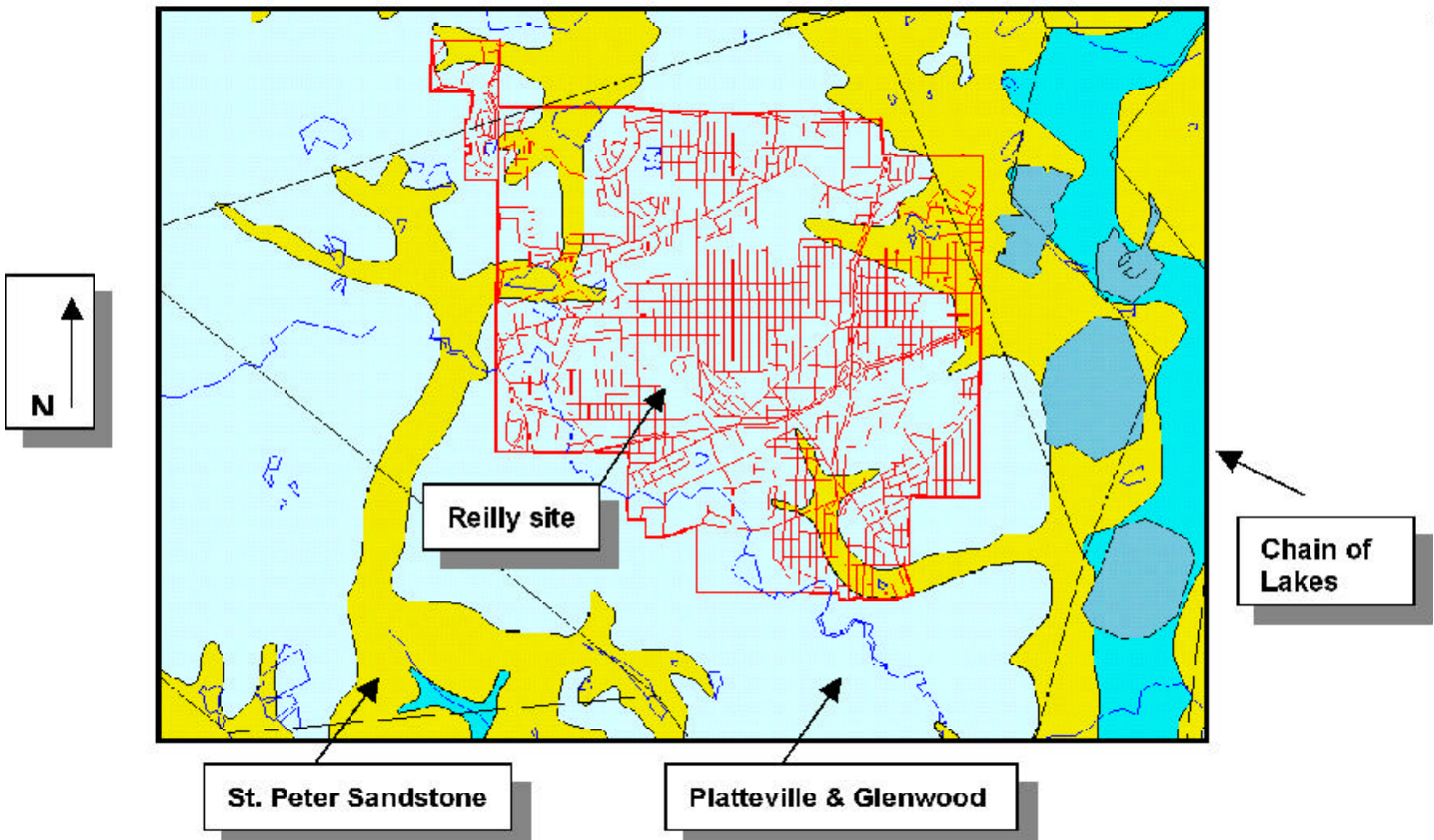


Figure 2

extends generally to the east (see Figure 2).

The groundwater flow in both the drift and Platteville aquifers is generally to the east. Flow in both aquifers is influenced by Minnehaha Creek, which meanders to the southeast in the area directly south of the site. The groundwater flow directions are also influenced by the occurrence of valleys eroded into the upper bedrock and long since filled in. This includes both the buried bedrock valley described above and another, less developed valley to the north east of the site. An additional bedrock valley also is located to the west of the site, but does not likely exert much influence on local flow.

The general setting of the Reilly site is shown in Figure 2. Also included in the figure are the site location, the St. Louis Park street system, and Minnehaha Creek. Modeling based on these and other local-scale conditions led to the following conclusions:

- The potentiometric surfaces of the Glacial drift and Platteville aquifer are reasonably simulated in the model developed for the Reilly site. The Metro Model's northwest province model was effective with minor modifications,
- The extraction wells in the Platteville Aquifer appear to effectively capture groundwater from the site vicinity. Moreover, it appears that these wells are effective in preventing contamination from reaching the tributary bedrock valley.
- Dissolved contamination either originating within the Platteville or migrating from the overlying drift into the Platteville within the site vicinity appears to be effectively contained by the extraction wells.

This local-scale model is currently being updated and will be used in future remedial decisions by the MPCA.

Voluntary Investigation and Cleanup Site Application

Richard Pennings of GME Consultants, Inc. (GME) recently applied a portion of the Metro Model to a

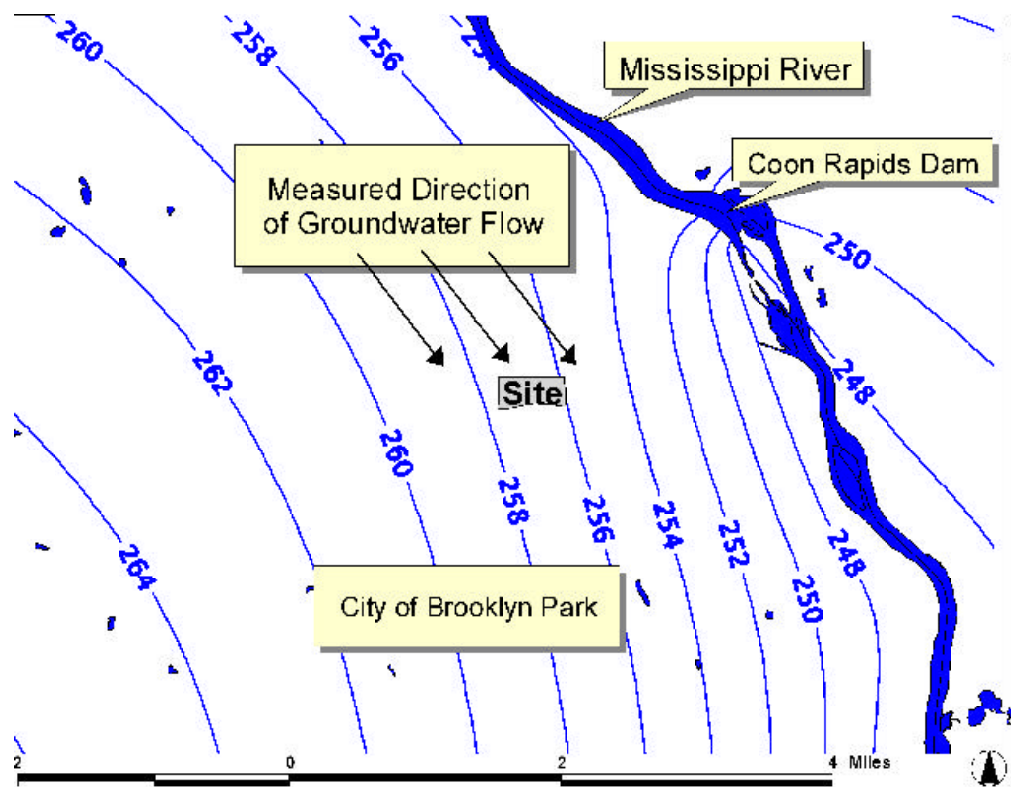


Figure 3

hydrogeologic assessment of a site approximately 0.5 square mile in an area located in Brooklyn Park. The identity of the site is being withheld for proprietary reasons. It is a former industrial site contaminated with solvents and heavy metals, and is enrolled in the VIC program at the MPCA.

A local-scale model, based on the Metro Model, is being used to evaluate site conditions and to evaluate hydraulic control options. At GME's request, Metro Model staff provided the glacial drift aquifer portion (Layer 1) of the North West Province of the Metro Model, as well as head calibration data. Additionally, hydrogeologic data, including US Geological Survey topographic and MGS bedrock maps, provided on a data base CD-ROM prepared by the Metro Model team were readily incorporated by GME into the analysis using ArcView Geographic Information System (GIS) software.

The aquifer that was modeled consists primarily of Quaternary sands overlying the St. Lawrence Formation, interpreted to be the aquifer base. Be-

cause the Metro Model is regional in nature, the first step was to tailor it to fit local site conditions. GME staff used 14 monitoring wells to help define local groundwater conditions. Further adjustments were made to simulate the phreatic aquifer, and to simplify the far-field conditions to allow for faster calculations. Although the model predicted a similar hydraulic gradient, the predicted direction of groundwater flow (easterly) differed from the observed direction (southeasterly), as shown in Figure 3.

Using ArcView GIS, the Graphical User Interface (GUI) in MLAEM, and the digital coverages that the Metro Model project team provided, GME inserted the appropriate local-scale features near the site, including wells, surface waters, and areal inhomogeneities. However, the model still did not reflect the local southeasterly flow direction. Further analysis using the MGS bedrock geology coverage, revealed a locally occurring

— continued on next page

but significant outlier of Jordan Sandstone above the St. Lawrence Formation. Insertion of an inhomogeneity representing decreased hydraulic conductivity for this portion of the aquifer influenced by the Jordan Sandstone (Figure 4) produced groundwater flow directions and gradients that were reasonably consistent with what has been observed at the site for the past couple years.

GME found that, because the Metro Model contained sufficient global detail and was regionally calibrated, they could use it as a basis from which they could construct a site-specific groundwater model. By using the Metro Model and its supporting databases, GME did not have to spend extensive time on the initial start-up and construction of their groundwater model. Future work by GME may include splitting the model into two layers, the first representing continuous Quaternary deposits above the Jordan Sandstone, and the second representing both the Quaternary deposits and Jordan Sandstone immediately above the St. Lawrence Formation.

Other Uses of the Metro Model and its Supporting Databases

Examples of the use of the Metro Model include three recent Requests-for-Proposal issued by the Ramsey County Soil & Water Conservation District and the Minnesota Department of Health for the construction of regional models to be applied to problems of well head protection and groundwater management. All three stipulated extensive use of the Metro Model and its supporting databases as a necessary starting point for the consultants picked for the contracts. Additionally, the St. Croix Watershed Research Station of the Science Museum of Minnesota used the Metro Model and supporting databases on their 1997 Legislative Commission on Minnesota Resources project, Watershed Science: Integrated Research And Education Program.

Summary

After spending four years engaged primarily in the development of the Metro Model and its associated data-

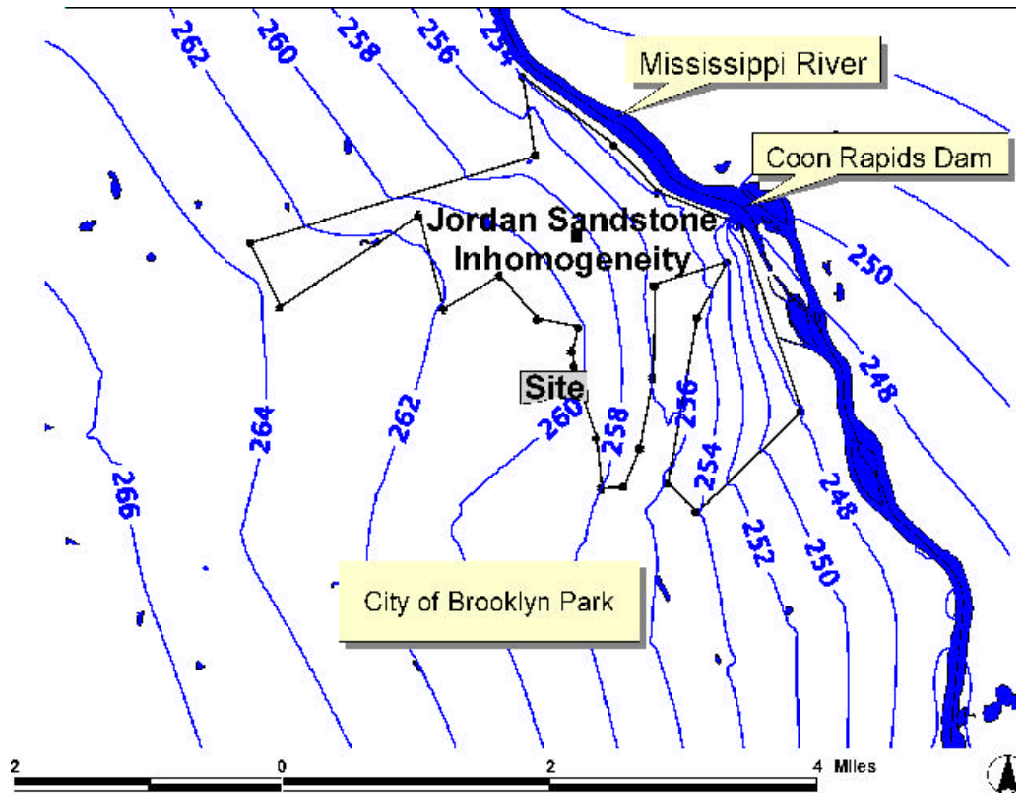


Figure 4

bases, project team members are shifting the emphasis towards its direct use in site remediation. Initial applications of the Metro Model project resources indicate that they can be used effectively as a tool in the support of groundwater management decisions. Project team members will now spend more time on applying the Metro Model to projects both within the MPCA and also outside, including providing assistance to private parties. However, they will also continue to refine and improve the existing project as new information, data, and modeling techniques become available. And they will bring lessons learned and resources to bear on MPCA projects in Greater Minnesota.

Contacts:

If you would like more information or think that the Metro Model project team can provide you with resources you need for your project, please contact the following:

Andrew Streitz (218)723-4929
andrew.streitz@pca.state.mn.us

John Seaberg (651)296-0550
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Web site
<http://www.pca.state.mn.us/water/groundwater/metromodel.html>

Acknowledgements

The authors wish to thank the following individuals for supplying information used in this article: Richard Pennings and Mark Millsop of GME Consultants, Inc., Kelton Barr of Kelton Barr Consulting, and Paul Bulger of the MPCA.

Footnote: The Metro Model was initially supported from 1995 through 1999 by the Legislative Commission on Minnesota Resources, with additional support coming from the US Environmental Protection Agency and the MPCA. As of July 1, 1999, the project has become a permanent part of the MPCA's Environmental Outcomes Division.

MGWA Calendar, cont.

June 4-7, 2000

6th International In Situ and On-Site Bioremediation Symposium, San Diego, CA. Contact: Battelle Conference Office, 614-424-7604, biorecl@battelle.org

September 3-8, 2000

11th International Biotechnology Symposium, Berlin, Germany. Contact: DECHEMA e.V., c/o 11th IBS, Theodor-Heuss-Allee 25, D-60486 Frankfurt am Main, Germany. info@dechema.de

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Upcoming MGWA Newsletter Deadlines

| Issue | Copy to Editor | Copy to Publisher |
|------------------------|----------------|-------------------|
| December (v.18, no. 4) | 11/5/99 | 11/12/99 |

Advance Call for Papers/Presentations

43rd Annual AEG Meeting, San Jose, CA, September 22-24, 2000.
Symposium on: Environmental Monitoring and Remediation During Construction

This symposium will focus on issues and case studies that address how the assessment and remediation of contaminated soil, rock, groundwater, and soil gas can be integrated with project design and construction methods, and implemented during construction (as opposed to being completed before construction activities commence). Projects could include commercial development, public works, flood control, or other building or earthen structure undertakings. Potential topics include, but are not limited to the following:

- Brownfields remediation and redevelopment case studies
- Public works/infrastructure case studies
- Environmental contingencies in construction plans and specifications
- Field monitoring and response action criteria

Interested individuals should contact:

David Vieau
Peer Environmental & Engineering Resources
7710 Computer Avenue, Suite 101

Join the Minnesota Ground Water Association!

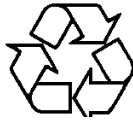
If you are reading this newsletter second-hand, we'd like to take this opportunity to invite you to become a member of **MGWA**. Annual dues are \$20 for professional members and \$15 for students. Members are entitled to purchase the annual membership directory for \$7. Additional donations toward our scholarships and/or the use of recycled paper will be gratefully accepted.

*Dues paid to MGWA are **not** deductible as charitable contributions for federal income tax purposes. However, dues payments are deductible as ordinary and necessary business expenses to the extent allowed by law.*

Just complete the form below and mail to: MGWA, c/o WRI, 4779 126th St. N, White Bear Lake, MN 55110-5910.

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