Minnesota Ground Water Association

www.mgwa.org

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Ground Water Contamination: State of the State

Minnesota Pollution Control Agency (MPCA) Commissioner Sheryl Corrigan was the keynote speaker at the MGWA's Spring Conference held May 4, 2004 at the University of Minnesota's St. Paul Campus Continuing Education Center, and attended by over 200 ground water professionals. Commissioner Corrigan, a geologist by training, gave a wide-ranging discussion of ground water issues affecting Minnesota, and the MPCA in particular, in her 50-minute presentation. She began by highlighting the importance of the ground water resource to Minnesota: while about 40 percent of the nation's population depends on ground water for its supply, that figure is near 80 percent for Minnesota.

Ground water contamination is often a local phenomenon, so concern is often highest at the local level. The MPCA has made great strides in cleaning up contamination sites in the last 20 years through programs like federal and state Superfund. These cleanup programs are now winding down (http://www.pca.state.mn.us/programs/indicators/iom-0502.html). In addition, there has been a shift away from active ground water clean-ups to an emphasis on source removal and natural attenuation. Risk-based management is being used increasingly in the cleanup decision-making process. Ground water data management issues that were previously overlooked in the rush to identify and cleanup sites are now being addressed as part of an overall Environmental Data Access Initiative to make MPCA's environmental data more easily accessible to the general public (see http://www.pca.state.mn.us/data/eda/index.cfm).

A multi-agency ground water monitoring memorandum of understanding among the MPCA, the Minnesota Department of Health (MDH) and the Minnesota Department of Agriculture

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MGWA President Chris Elvrum presents an award to Rob Caho, current MGWA Foundation President, recognizing his years of service to the association. Photo credit: Sean Hunt

President's Letter

-- Chris Elvrum, MGWA President

My term as President is nearly half over. Although the job doesn't require me to have a red telephone under a bell jar sitting on my desk, there are occasional exciting moments. Recently I had the opportunity to meet with State Representative Duke Powell on behalf of the MGWA. He is the author of a bill that is proposing funding to build a water treatment plant to treat the water pumped from the Kraemer Quarry in Burnsville for municipal water supply. This meeting was prompted by a letter written by the MGWA supporting the concept of re-use of the dewatering water for water supply (a copy of the letter is included on page 8). The letter was prepared through a process developed by Mark Ferrey of the MGWA's Ground Water Education Committee (GWEC) by which comments on legislation and other issues would be, brought up, reviewed, approved and acted upon.

Part of the mission of the MGWA is to promote and encourage scientific and public policy aspects of ground water (maybe we should add a 'sound' in there somewhere). Basically any

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2004 Newsletter Deadlines

Issue	To Editor
September	08/06/2004
December	11/05/2004

President's Letter, cont.

MGWA member can submit a request to the MGWA GWEC that a comment be made. That committee then reviews the proposed comment and if they decide it is in line with the mission of the Association, sends it to the MGWA Board for final review. The Board must unanimously approve the proposed comment for it to be submitted.

This was the process followed for the Burnsville Quarry comment letter. Representative Powell was very appreciative of the Association's interest in the legislation. We were careful to note that we did not have an opinion on the funding mechanism but supported the principle of reuse of water that would otherwise be discharged to the Minnesota River. By using the treated quarry water, communities would be reducing the impact on unique surface water features in the area, which rely on ground water discharge. In the past, these communities have made significant efforts to protect these resources by tapping different aquifers, adjusting pumping schedules and carefully evaluating well placement. As the region continues to grow, alternatives such as this one are likely to be considered to supplement the ground water sources.

On another note, I would like to think that my call to 'get involved' in the last President's column had some influence on the fact that we now have 6 members of the MGWA Foundation Board; or maybe it was Gordie Hess's similar appeal in the Foundation update. The reality is, it was a number of efforts not related to either of these, but I'm sure someone out there was inspired by those columns. I am pleased to welcome Cathy Villas-Horns, Al Smith (Secretary), Dave Liverseed (Treasurer) and Gil Gabanski to the MGWA Foundation Board. They are in addition to Rob Caho (Foundation President) and Marty Bonnell (MGWA Board Liason) who were already serving on that Board. Although the MGWA Foundation does not compare with the likes of the McKnight Foundation, they do have some funds available to support local ground water education efforts. If you are aware of opportunities where the Foundation might be in a position to help, contact one of the members listed. Many thanks to the new recruits and to those who have agreed to continue serving on that Board.

We are coming off another successful Spring Conference and looking for a topic for the Fall Conference. If you have any ideas and/or would like to help with the planning, don't hesitate to contact me. Perhaps the topic will be how we handled the drought. At the time of writing this article, recent rains have provided some relief. However, we are still way behind for the last 10 months. Ground water management will continue to be an increasingly important topic even if the drought doesn't continue. The MGWA should consider itself in a position to provide expertise in this area as an unbiased professional organization. If you see opportunity for the Association to serve in that capacity, let us know. Have a good summer.

Mystery Cave Opens New Visitor Center

Mystery Cave, located in Forestville State Park in Preston, has a new 5,000 square foot visitor center. Although the Center will hold its grand opening later in June, the fully accessible facility is open to the public now. Located just steps away from the Cave entrance, the building hosts an information center, interactive exhibits, a video area, a Nature Store and restrooms. Included in this $1.6 million project was grading and landscaping to make it easier for those with physical limitations to purchase tour tickets, use the restrooms and access the Cave. An outdoor veranda and picnic area offer visitors additional reasons to sit and linger a while.

Geophysics techniques were used by DNR Waters staff to identify subsurface voids on the visitor center site. The visitor center was positioned on the site to avoid identified subsurface voids and other karst features. The report of that investigation is on the DNR web site at http://www.dnr.state.mn.us/waters/groundwater_section/geophysics/methods.html#reports.

For more information about the new visitor center and about Mystery Cave, check out the DNR's Forestville State Park web page at http://www.dnr.state.mn.us/state_parks/forestville_mystery_cave/index.html .

Membership News and Information Update:

Now ground water information can flow two ways!
Our Newsletter can be a forum for every member to share information they encounter. Are you working on an interesting project? Have you come across an interesting fact?
Describe something you experienced or witnessed. What progress or developments is your organization making? Have you changed job positions recently? Let's keep our membership in touch with one another!
Selected comments will appear in the next issue.
Email any and all comments to: newsletter@mgwa.org

Spring Conference, cont.

was signed in March 2004 and sets out monitoring responsibilities and areas of cooperation among the involved agencies. Part of this effort includes the re-establishment of an ambient ground water monitoring program at MPCA, which is described in more detail elsewhere in this newsletter.

A number of future priorities for ground water resource management in Minnesota are centered on population growth and business expansion. The increase in popularity of ethanol blended with gasoline has resulted in construction of over a dozen ethanol plants in the state with several new plants or expansions in the works. Since four gallons of water are required to produce a gallon of ethanol, it is important that facilities plan carefully for water needs. In addition, the growth corridor between the Twin Cities and St. Cloud is stressing already limited water supplies in some areas, and this recognition is critical to ensure that assessment of water resources (both ground and surface water) is included in the planning process (see http://www.pca.state.mn.us/programs/indicators/iom-0703.html).

Commissioner Corrigan concluded by discussing six major concerns for ground water management in the 21st century that MGWA members identified in 2000 as a part of a workshop held in conjunction with the Fall Conference that year (see the MGWA Newsletter, December 2000, Vol. 19, No. 4). She highlighted how MPCA programs are helping to address these concerns:

Emerging ground water contaminants: the MPCA is currently cooperating with other agencies to identify and assess the risk of newly-identified contaminants in the environment

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MPCA Commissioner Sheryl Corrigan delivers the keynote address. Photo credit: Sean Hunt.

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The primary objectives of the MGWA are:

- Promote and encourage scientific and public policy aspects of ground water as an information provider;
- 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.

Spring Conference, cont.

such as pharmaceuticals, pesticide degradates, meth lab chemicals, and fire retardants;

Nitrate in ground water: new programs to assess total maximum daily loads (TMDLs) to surface waters of the state, stormwater management and management of on-site sewage treatment systems have been developed;

Sustainable ground water supplies: the MPCA is working with the Minnesota Department of Natural Resources (MDNR) to assure better integration between withdrawers of ground water and end users;

Stable funding for ground water programs: funding for ground water programs is still largely from the general fund; the MPCA is pursuing a long-term strategy of establishing a dedicated fund for ground water;

Ground water education: although not its primary responsibility, the MPCA continues to play an active role in educating Minnesota citizens about the need for and value of a clean and abundant ground water supply;

Coordination among agencies: several examples cited above, including the monitoring memorandum of understanding for ground water show recent results of agency cooperation.

Finally, Commissioner Corrigan urged everyone to check out the latest edition of the MPCA's quarterly magazine, Minnesota Environment, as the latest issue is devoted to ground water in Minnesota (see http://www.pca.state.mn.us/publications/mnenvironment/index.html).

Highlights of some of the other presentations for the day included the following. Jane Willard, President of EnPro Assessment Corporation, gave an update of MPCA's Voluntary Investigation and Cleanup (VIC) program from a business perspective. Most property transfer assessments are between the lending institution and the consultant and MPCA has no involvement. For properties that do end up in the VIC program, many refinements have been made since the early 1990's.

Dr. Robert Morrison of DPRA, Inc. presented a national perspective of Natural Resource Damages (NRD) claims and environmental forensic opportunities that accompany these cases. Primary issues in NRD cases are defining the origin of contamination, determining the timing of the release, and deciding compensation for damages (who pays what). Microbiological fingerprinting and DNA forensics are becoming increasingly important tools in investigating NRD cases.

MGWA Webmaster and audio-video facilitator Sean Hunt helps keep the conference running smoothly. Photo credit: Dr. Robert Morrison.

Kevin Faus of MPCA discussed NRD assessments at MPCA. NRD cases are a shared responsibility between MPCA and MDNR and both agencies must sign NRD agreements. The NRD process involves three major steps: preassessment, injury quantification, and restoration options. Primary restoration of an injured site involves returning it to baseline conditions. Various options are available in the valuation of ground water resources in NRD cases, including unit value methodology where dollar values for damages are preassigned, and contingent valuation methodology, where the amount an injured party would pay to assure a source of clean water is calculated.

Ginny Yingling, a hydrologist with the MDH, gave an update of the Baytown trichloroethylene (TCE) contamination case (see also MGWA Newsletter, December 2003, Vol. 22, No. 4). The TCE plume now encompasses six square miles. Ground water flow velocities range from 600 feet/year near the Lake Elmo Airport to 7000 feet/year approaching the St. Croix River. The "diving" nature of the plume has allowed some contamination to reach the Jordan aquifer. In addition, TCE was noted in the Franconia formation for the first time in 2003. Private wells in the affected aquifers fitted with carbon filters must treat ground water that is greater than 5 parts per billion (ppb) of TCE. The MDH is actively encouraging the use of community well systems in future planning for the area.

Brian Sillanpaa with Barr Engineering Co. then gave an update of ground water contamination at the Pine Bend Refinery. Much of the contamination of ground water by petroleum products can be traced back to a hole in the floor of Storage Tank 16. A soil vapor extraction system installed at the site has resulted in 97 percent vapor concentration reduction. Approximately 3.25 million gallons equivalent recovery has occurred since 1999. Two major source areas have been closed and the plume is now fairly stable and being monitored with 139 wells and 30 piezometers as recovery continues.

Michael Fix of the U. S. Army gave an update of the ground water contamination situation at the Twin Cities Army Ammunition Plant (TCAAP) in Arden Hills. The plant was established in 1941 to provide munitions for World

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Minnesota Water 2004

Over 200 water resource professionals from business, industry and government attended Minnesota Water 2004 at the Radisson Metrodome in Minneapolis, March 23-24, 2004. This year's conference, *Policy and Planning to Ensure Minnesota's Water Supplies*, was hosted by the University of Minnesota's Water Resources Center, the Minnesota Sea Grant college program, and the Natural Resources Research Institute's Center for Water and the Environment at the University of Minnesota, Duluth.

The first morning's plenary session began with an overview of recent population trends in Minnesota as they may impact the quantity and quality of future water supplies by the State Demographer, Tom Gillaspy. Other sessions included Joan Rose of Michigan State University speaking on Monitoring and Preventing Microbial Contamination in the Great Lakes; Harvey Thorliefson, Director of the Minnesota Geological Survey discussing The Role of 3D Geological Mapping in Ground Water Management; and Katharine Hayhoe of ATMOS Research and Consulting discussing Climate Change in the Great Lakes.

The first day's lunch speaker was Governor Tim Pawlenty who discussed Minnesota's Clean Water Initiative. The governor fielded several impromptu questions from the audience following his prepared remarks. The lunch speaker the second day was Dr. Michael Osterholm, Professor in the Department of Epidemiology and Director of the Center for Infectious Disease Research at the University of Minnesota, speaking about the security of public water supply systems. Highlights of a few of the other talks I attended during the concurrent sessions follow:

Lisa Thorvig, Assistant Commissioner at the Minnesota Pollution Control Agency (MPCA), discussed the agency's impaired waters initiative. Just 14% of the lakes and 8% of the streams in Minnesota have been assessed for impairment. Nearly 2000 impairments on 1125 water bodies have been identified and 546 of 1405 wastewater treatment plants in the state discharge to impaired waters. A three-foot drop in lake clarity equates to a decrease in lakeshore property value by $500/lineal foot, according to one study. A fully-funded impaired waters program is estimated to cost $75-100 million dollars per year.

In the area of protecting public drinking water supplies, several speakers from the Minnesota Department of Health (MDH) gave progress updates. In terms of security issues, Minnesota is preparing educational materials for the public, improving communication and coordination, and assisting directly in site characterization and sampling for suspected contamination. The 1986 and 1996 amendments to the federal Safe Drinking Water Act (SDWA) have led to well-developed programs in source water assessment and wellhead protection. In 1997, Minnesota adopted rules that govern the development of wellhead protection plans, with the goal that all public water supplies that depend on ground water will have plans in place by 2006. The 1996 SDWA amendments require MDH to produce source water assessments for all public water systems in the state by May 2003.

Frank Kohlasch of MPCA discussed putting environmental indicators to work. Indicators are being used increasingly to assess the relative health of water resources and help answer the question, "Are things getting better or worse?" An indicator is a signal that simplifies, measures and communicates complex events and trends. To be useful, an indicator should be scientifically credible, sensitive to change, understandable and meaningful to the intended audience, occurring with adequate frequency, and suitable as a benchmark for future reference. No indicator is an island; a suite of indicators is best, used within a measurement system.

The impaired waters program described above has been a driving force for the development of methods to distinguish between human and animal sources of pollution. Dr. Michael Sadowsky of the Department of Soil, Water and Climate at the University of Minnesota discussed recent technology in this area. An important new tool is the use of DNA fingerprint libraries in such environmental detective work (often referred to as environmental forensics). The ability to distinguish among sources of fecal contamination is important for the evaluation of possible health risks within a water resource and the development of effective control strategies. One study was able to make the human/animal distinction with 88 percent accuracy.

Groundwater and Public Health: Making the Connection

The Groundwater Foundation annual conference is being organized this year around the theme of public health. Session topics include pathogens, epidemiology, risk management, emerging contaminants, drinking water protection, and public policy, among others.

Organizers have issued a call for presentations for the November 4-5, 2004 conference, to be held in Washington, DC. Abstracts were due May 31, 2004. To register, however, or to arrange to be an exhibitor, contact Cindy Kreifels at the Groundwater Foundation at (800)858-4844 or at cindy@groundwater.org.

49th Annual Midwest Ground Water Conference

The organizers of the 49th annual Midwest Ground Water Conference have issued a call for abstracts for the meeting that will be held October 27-29, 2004, in Bloomington, Indiana. The conference is being held in conjunction with the fall meeting of the Indiana Water Resources Association.

Abstracts are being solicited for a variety of session topics, in both oral and poster presentation formats. Proposed session topics include: 1) information and data management, 2) water security, 3) water availability, 4) water quality, 5) ground-water/surface-water interactions, and 6) karst and epikarst. More information on session topics, presentation formats, and on submitting abstracts can be found on-line at http://igs.indiana.edu/mwgwc or by calling Sally Letsinger at (812)855-1356.

The Midwest Ground Water Conference is an annual event that rotates among the various host states. Minnesota last hosted this conference in 1999 (many of us still carry around the small brief cases provided at that conference). Next year will mark the 50th annual conference, which will be held in Illinois, the same state where it all began in 1956!

Question of the Quarter! ?

The Question of the Quarter is a new section in our newsletter. Each quarter a different question will be posed and all members are invited to offer their "two cents worth." Last quarter's question is discussed below. This quarter's question is: What percentage of Minnesota's population that is served by community water systems gets ground water?

a) 50%
b) 60%
c) 70%
d) 80%
e) 90%

Email your answer and your "two cents worth" to:
newsletter@mgwa.org

Response to March, 2004 Question-of-the Quarter

— Steve Robertson, MDH, and Jan Falteisek, DNR Waters

Last issue's Question of the Quarter asked: How much ground water does Minnesota have? The choices were: a) not enough, b) enough, c) well over 1 trillion gallons, d) nowhere near 1 trillion gallons, e) 1 trillion gallons, f) it depends…

Following the drought of the late 1970's, a series of studies and reports were prepared on Minnesota water resources management. In one report[1], the "availability" of ground water in Minnesota, or the amount that can be withdrawn subject to some limitations, was estimated as 1.1 to 2.0 trillion gallons. It is the more conservative end of the range that reappears in various agency-planning documents. Reading the fine print, it says: "The estimates include only surficial and bedrock aquifers that discharge water to streams."

So let's take a step back and consider how much ground water might be "in-place" beneath the land surface. Strictly from a volumetric standpoint, one can make rough estimates of the ground water in storage in the various rocks and sediments that underlie the state. For example, using digital maps produced by the Minnesota Geological Survey[2] we can derive the subsurface extent of the Mt. Simon Sandstone and, by making reasonable assumptions about its average thickness and porosity, we calculate* that this rock unit alone holds some 92 trillion gallons. Factoring in the many other bedrock units and unconsolidated materials present in the state would yield a much higher number representing the amount of water "in place" in the subsurface. In comparison, Ellefson[3] estimates that Wisconsin has about two million billion (2,000,000,000,000,000) gallons of water stored underground in Wisconsin, enough water to cover that state to a depth of 30 feet.

These numbers are large, awe-inspiring, and misleading. Such estimates represent water filling pores and spaces in the rocks and glacial materials, but this water is not necessarily recoverable given the substantial technical and regulatory obstacles involved in doing so. The vast majority of Minnesotans value their surface waters, and the interdependence of the two resources would be dramatically demonstrated if the attempt were made to appropriate trillions and trillions of gallons of ground water.

Therein lies the heart of the answer. Many other resources depend on interactions with ground water. Depleting ground water reserves locally or regionally will affect those other resources. The question becomes one of balance and values. Furthermore, the quantities involved vary from one region of the state to another. Certain regions of the state have more productive aquifers and are able to sustain appropriations more easily than others (see map of six ground water provinces in the state as mapped by the Minnesota Department of Natural Resources at http://www.dnr.state.mn.us/groundwater/provinces/index.html). And that's where societal values come in. Permitting ground water withdrawals simply on the basis of estimated storage or recharge (as is sometimes done) could mean less water in streams, lowered lake levels, impaired habitat, and reduced long-term reserves for future generations.

The answer, of course, is that it depends. The amount of "in-place" ground water can be estimated. However, how much can be pumped from aquifers is a much more difficult question. It depends on the local geologic and hydrogeologic conditions. It depends on proximity to nearby ground water-dependent resources. It depends on the quantities of ground water involved. And, finally, it depends on societal values. Each of these factors must be considered in deciding the amount that can be reasonably allocated for pumping in a given location. So, while there may be large quantities of ground water in the state, there are many reasons for conserving and managing this resource now and for the future. Our manifold uses for and dependence on ground water constrain us from developing this resource more aggressively. As we increasingly recognize the interdependence of water resources and local problems of water shortages, we as a society will need to make tough choices on how we elect to use these resources.

**Subsurface extent of Mt. Simon Sandstone in Minnesota, 38,354,487,585 square meters, conservative thickness assumed 45.7 meters (150 feet), and a porosity of 0.2.*

1. Minnesota Water Planning Board, 1979, Toward Efficient Allocation and Management: A Strategy to Preserve and Protect Water and Related Land Resources: Minnesota Water Planning Board, St. Paul.

2. Morey, G.B. and Meints, J.P., 2000, Geologic Map of Minnesota, Bedrock Geology, Third Edition, State Map Series S-20: Minnesota Geological Survey.

3. Ellefson, B. R., Sabin, T. J., and Krohelski, J. T., 1993, Water Use in Wisconsin, 1990, U.S. Geological Survey Open-file Report 93-118.

Editor's note: This answer does not represent official MDH or DNR policy.

To comment on this article, email Newsletter@mgwa.org.

Spring Conference, cont.

War II. In 1981, the MDH discovered contamination in a New Brighton city water supply well and in 1983, TCAAP was placed on the National Priorities List (NPL) for cleanup. The city sued the Army in 1984. In 1987, a settlement between the two parties was reached whereby New Brighton built a granular activated carbon treatment plant, funded by the Army. The city of Fridley currently takes about 500 million gallons of treated water from the New Brighton system to augment its own water supply. About 800 pounds of volatile organic compounds per year are removed by the treatment system. In addition, 220,000 pounds of contaminated material have been removed from the source area on the site. The total cost to date has been on the order of $200 million.

Next, MPCA's Mark Rys summarized the agency's risk-based corrective action approach as the Superfund program is winding down. Currently, 245 of MPCA's Superfund sites have some form of ground water remediation. Of the 45 National Priorities List (NPL) sites, 21 have been delisted in accordance with EPA criteria. Delisting does not necessarily mean closure of a site.

Larry Kinsman of ORIN Remediation Technologies discussed various forms of insitu and exsitu treatment, including oxidation, reduction dechlorination (both chemical and biological), use of heavy metals, and bioremediation.

Mark Millsop, Millsop Associates, Inc., followed with a case study of insitu chemical oxidation using potassium permanganate at a site contaminated by TCE in Brooklyn Park. After three weeks of treatment, TCE decreased to a level of non-detection in eight out of nine injection points from levels as high as 109 ppb initially.

Mark Ferrey, a soil scientist with MPCA, then described abiotic natural attenuation of dichloroethylene (DCE) isomers in a case study at the Twin Cities Army Ammunition Plant (TCAAP). At TCAAP, natural attenuation is occurring at a rate much greater than would be predicted by modeling due to nonbiological natural attenuation. Magnetite was found to account for about 25 percent of the total iron in deep sediments at the site, more than enough to account for the natural attenuation of DCE. See also an earlier related article by Mark on natural attenuation in the MGWA Newsletter, Vol. 17, No. 3 (September 1998).

Finally, Bruce K. Olson, an engineer with Short Elliot Hendrickson, Inc. concluded the day with a phytoremediation case study involving both hydraulic control and ground water treatment.

The excellent attendance and high quality of the presentations have become hallmarks of MGWA conferences, and the Spring 2004 conference was no exception.

— submitted by Tom Clark, MPCA, an MGWA newsletter team member

Reader's Response - December Question of the Quarter

Dennis M. wrote (but we misplaced his response until now):

d) I remember Calvin Alexander telling me in a class at the U, back in**.. oh we won't say the year, that ground water from the Mt. Simon SS was dated at approximately 70,000 years old.

Dennis was correct, of course! (See discussion in the March newsletter).

Pesticide Monitoring in Water Resources Report Available

The Monitoring and Assessment Unit of the Minnesota Department of Agriculture (MDA) has completed their "Pesticide Monitoring in Water Resources Annual Data Report". This report summarizes surface and groundwater monitoring data collected by the program and cooperators during January 2002 through July 2003. It also provides additional information regarding the MDA water monitoring program.

The report is available on-line under information resources at: www.mda.state.mn.us/appd/ace/maace.htm.

If you have comments, please contact Daniel Stoddard, Manager of the Agchemical Environmental Section, Agronomy and Plant Protection Division at (651)297-8293 or dan.stoddard@pca.state.mn.us .

Science Museum's Big Backyard to Open

The Science Museum of Minnesota in downtown St. Paul has a fun, new exhibition. On Saturday June 26, 2004, the Big Backyard will open with a focus on outdoor environmental exhibits.

There will be three major exhibits. The first exhibit will be a large 3-D relief map of the world. The second exhibit will be water pollution miniature golf. Golfers will navigate their way through eroding rock, the Braided River, a storm sewer labyrinth, an agricultural drain tile network, the Rain Garden, the Meandering River, dam removal, the Gulf of Mexico and finally an underwater landslide. The third exhibit will be Science House, a separate self-sustaining building, which is designed to model alternative strategies for energy production and use.

The MGWA sponsored well and also a prairie plant maze are planned to be a future part of these exhibits. All this within a stone's throw of the Mississippi River...

Geologic Investigation of the Northwestern Metropolitan Area

Minnesota Geological Survey staff has completed a study on the geology of the northwestern Twin Cities Metropolitan area. This study was funded by the Metropolitan Council, and is documented in the form of a report. A major focus of the study was to characterize the Paleozoic bedrock units that may serve as possible water supplies for communities along the growth corridor between Minneapolis and St. Cloud. MGS plans to make the report and ancillary GIS data sets available on its web site (http://www.geo.umn.edu/mgs/). The ancillary data sets include a revised bedrock geology map and maps of the structural tops of key bedrock units.

Full citation: Runkel, A.C., R.G. Tipping, and J.H. Mossler, 2003, Geology in support of groundwater management for the northwestern Twin Cities Metropolitan Area: MGS Report to Metropolitan Council, August 27, 2003.

The following letter was sent to legislators in support of the concept of water reuse (See President's Letter, page 1):

Minnesota Ground Water Association

To: Minnesota State House of Representatives
Environment and Natural Resources Policy and
Environment and Natural Resources
Finance Committee Members and
Minnesota State Senate Environment and
Natural Resources Committee Members

From: Minnesota Ground Water Association

Date: April 26, 2004

Re: Funding a water treatment plant in the City of Burnsville (HF 1966 – SF 1750)

The Minnesota Ground Water Association (MGWA) is submitting comments related to the above referenced proposed legislation to provide funding for a water treatment plant in Burnsville.

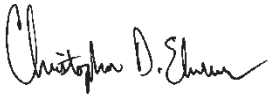
The MGWA is a non-profit, volunteer organization dedicated to the promotion and awareness of Minnesota's ground water resource. We encourage sound science and effective public policy for the wise use and betterment of ground water resources. Many of our members are professionally involved and familiar with the challenges of managing ground water supplies in the State.

We commend the legislature's efforts to address the important issue of ground water conservation. Nationally, increasing demand for ground water is forcing policy makers to debate and implement measures to ensure that this resource remains viable into the future. The citizens in Minnesota are also encountering problems with their ground water supply as growing demands strain some regional aquifers.

MGWA supports the concept of re-use of the water pumped from the quarry through treatment for drinking water. The use of that water, which would otherwise be discharged to the Minnesota River, as drinking water would conserve significant volumes of ground water in the Southwest Metropolitan Region. Aquifers in this area play a critical role in the viability of natural resources such as calcareous fens, wetlands, a boiling spring and trout streams. Conservation of ground water in this region is necessary to preserve these unique and sensitive habitats. Efforts such as the one proposed would help to ensure the long term sustainability of the region's ground water supply.

We are pleased to have an opportunity to provide comment on this proposed legislation. We have members of the organization that could provide assistance in clarifying the ground water science and public policy issues associated with these bills. Please contact me at office@mgwa.org or (651) 698-9481 if the MGWA may be of assistance.

Sincerely,



Christopher D. Elvrum
President, MGWA

Pine County Geologic Atlas, Part B —- Hydrogeology and Pollution Sensitivity

— by Jim Berg, DNR Waters

Ground-water supplies in Pine County, described in the soon-to-be-published Part B atlas (Figure 1), are pumped from six different bedrock aquifers and complex networks of buried and unconfined sand and gravel deposits (Figure 2). The report, published by DNR Waters, includes a map plate and a hydrogeologic cross section plate that describe the county's ground water conditions, and a third plate that includes a map of bedrock aquifer pollution sensitivity. Each year the ever-expanding northern margin of the metro area moves closer to this county that has some high permeability aquifers as well as extensive areas sensitive to pollution.

The bedrock aquifers, which supply ground water to 57 percent of the county's wells, consist of fractured volcanic (basalt) and metamorphic rock aquifers, as well as thick sandstone units with karst characteristics in some areas. Unconsolidated sand and gravel aquifers, which account for the remaining 43 percent of the county's wells, are clustered mostly in the southern and northern portions of the county where the glacial sediment is thickest.

Bedrock Aquifer Recharge, Discharge, And Ground-Water Movement

The following discussion describes some key highlights of the Part B report, which draws heavily on data available from existing wells in the County Well Index (CWI), geochemical data from domestic and municipal wells, and limited geophysical analyses.

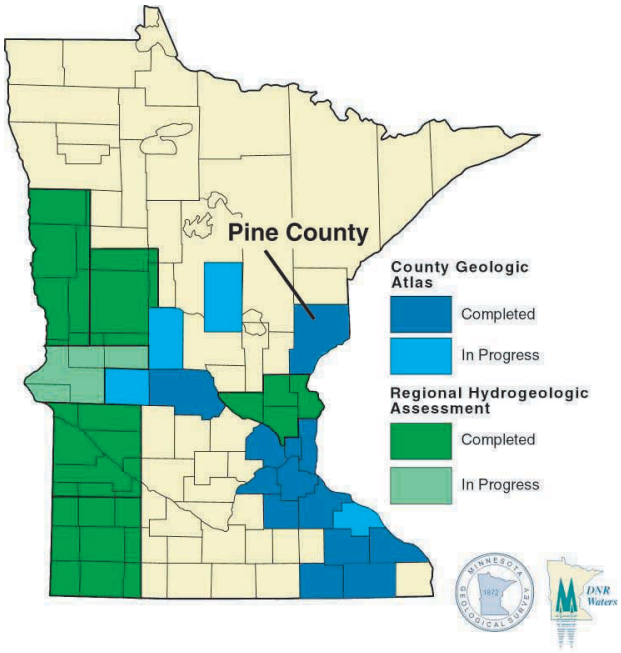


Figure 1. Location of Pine County and status of County Geologic Atlas series.

Indicators of ground-water residence time and anthropogenic influences. Ground-water age data (tritium and carbon-14) were used in this and other pollution sensitivity studies because these data relate to the sensitivity criteria. The criteria relate the estimated travel time of infiltrating potential contaminants to sensitivity ratings. If the age of the ground water in the target aquifer is known, the infiltration time can be estimated and the sensitivity can be interpreted.

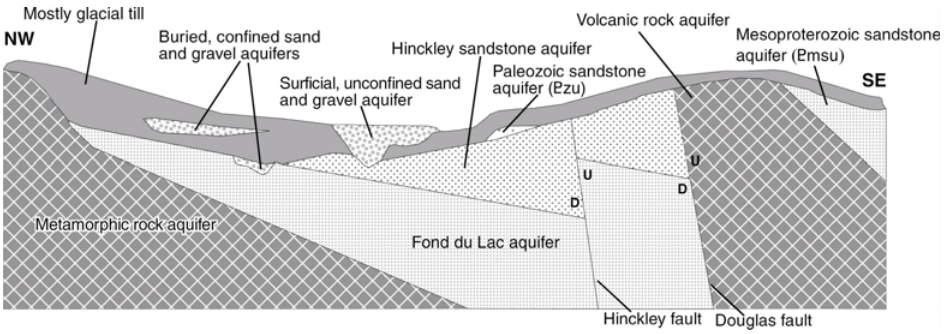


Figure 2. Schematic cross section of aquifers in Pine County. Except for surficial sands and gravels, aquifers are mostly confined.

The presence of chloride from human activities (road salt, fertilizer, septic tank effluent, or water softening salt) may indicate recent recharge of ground water (Ekman and Alexander, 2002). Because natural water in Pine County may contain high concentrations of chloride, elevated chloride concentration alone may not indicate infiltration of contaminated water. The chloride to bromide (Cl/Br) ratio is a better indicator. Salt derived from halite deposits typically has very high Cl/Br values. In Pine County the Cl/Br ratios that exceeded 1000 were all associated with recent or mixed tritium concentrations. Therefore, elevated Cl/Br ratios (greater than 1000) were used as indicators of ground water affected by human activity and high pollution sensitivity.

Bedrock recharge and discharge. Identifying the high recharge rate areas is an important step for understanding the ground water flow systems and the pollution sensitivity of the bedrock aquifers. High potentiometric-contour areas on the bedrock potentiometric surface map (Figure 3), combined with anthropogenic chemical constituents and recent or mixed tritium, indicate major recharge areas to bedrock aquifers. Due to thin glacial sediment cover, one of the most extensive and important recharge areas includes most of the Hinckley sandstone subcrop (where the Hinckley sandstone is the uppermost bedrock aquifer) for much of the county north of the City of Hinckley.

Bedrock aquifer discharge in Pine County is dominated by the Kettle River in the west-central portion of the county and the St. Croix River in the southeast. The major ground-water flow directions within the county are controlled by these two drainages. The Kettle River is such a strong ground-water discharge feature that two Hinckley sandstone springs located along the river in the City of Sandstone discharge vintage ground water in an area that would otherwise discharge recent ground water because of rapid infiltration conditions. These data indicate deep, upwelling ground-water flow conditions. This upwelling occurs within the Hinckley

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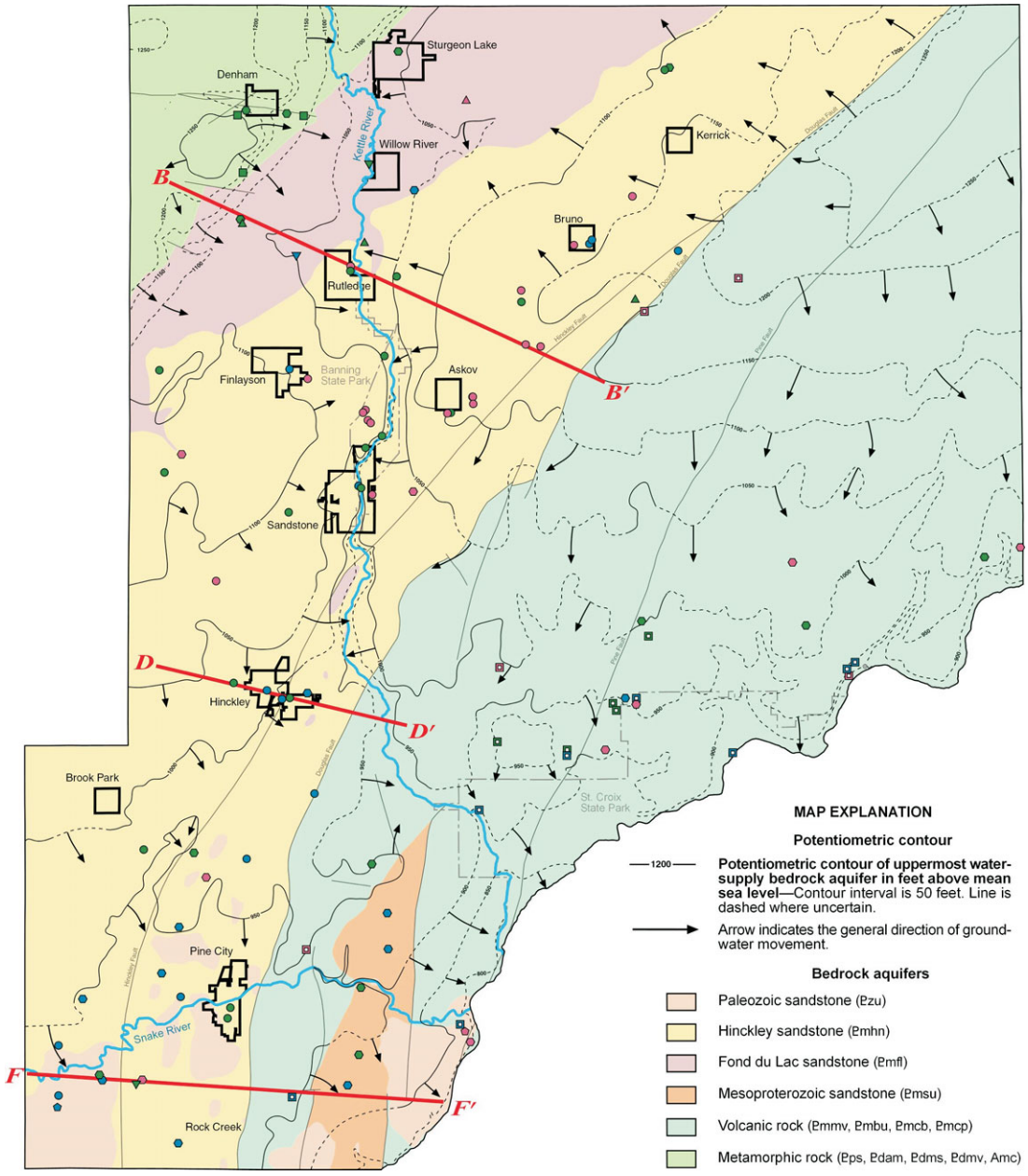

Figure 3. Ground water flow in the uppermost bedrock aquifer in Pine County. Small symbols are locations of water samples from wells. Color of symbols indicates tritium age (see Figure 5 explanation).

sandstone aquifer along the Kettle River from the City of Sandstone to Willow River.

The many springs and associated sinkholes of the Hinckley sandstone, mapped as part of the Part A atlas, are evidence of an extensive, highly permeable, karst and fracture system that we are only beginning to understand (Shade, 2002).

Pollution Sensitivity Evaluation

The sensitivity map (Figure 4) shows the relative sensitivity of the uppermost bedrock aquifers to surface or near-surface releases of contaminants. The map is intended to assist Pine County in protecting and managing its ground-water resources. The sensitivity assessment shown on the map is based on geologic factors that influence the travel time of water from the land surface to a sensitivity target (in this case, the uppermost bedrock aquifers). The most important geologic factors affecting pollution sensitivity in Pine County were the relative permeability of the surficial geologic units and the thickness of glacial sediment. These factors combined with some broad hydrogeologic assumptions (e. g., thick glacial sediment contributes to low pollution sensitivity conditions or permeable surficial geologic units contribute to high sensitivity conditions) were used to create the sensitivity model (a matrix of factors and associated sensitivity ratings, not shown here). These assumptions were tested with chemistry data collected from ground-water samples taken from wells and springs in the target aquifers. The model and the map were subsequently adjusted to ensure consistency with the chemistry data.

Three general areas of pollution sensitivity can be observed on the map. They include the moderate to very high sensitivity of the central and northwestern areas, the very low to low sensitivity of the southern area covered by thick glacial sediment, and the northern area with both high and low sensitivity characteristics. The model and associated sensitivity map should be able to predict generally the age of the ground water and the distribution of some common, widespread contaminants in these three areas. For evaluation purposes, the data considered were associated with the target aquifer (uppermost bedrock aquifers), along with vintage age ground-water data from the Quaternary aquifer.

Central and northwestern area.
These two areas, which encompass approximately half the county, have the highest sensitivity ratings mostly because of thin glacial sediment cover. The right side of cross-section B–B' and all of D–D' (Figure 5) are in this area. In the central area, the bedrock aquifers consist mostly of the Hinckley sandstone aquifer to the northwest and the volcanic aquifer to the southeast. The shallow portions of bedrock aquifers in these areas (no greater than approximately 100 feet deep) contain mostly recent and mixed tritium-age

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Pine County Part B, cont.

water.

Unsaturated conditions in the upper portion of the Hinckley sandstone aquifer are shown on the right side of cross-section B–B'. These unsaturated zones are part of a broad area of unsaturated conditions in the Hinckley sandstone aquifer that exist from just west of the City of Sandstone to just southeast of Kerrick. East of the Kettle River, this unsaturated area matches the distribution of known sinkholes and may be related to karst conditions. Sinkhole formation in the Hinckley sandstone, for instance, requires turbulent (fast) water flow through existing surface sediment pathways and bedrock fractures (Part A, Plate 6). Infiltrating surface water can generally drain more rapidly through unsaturated bedrock. The unsaturated Hinckley sandstone may also be indirect evidence of karsted, highly permeable subsurface conditions. Ground water will rapidly drain from the high-permeability, elevated portions of aquifers, leaving those zones unsaturated.

In the central and northwestern areas, 47 ground-water samples were collected for tritium analysis. Most of these samples contained mixed or recent concentrations of tritium (24 recent values and 16 mixed) supporting the higher sensitivity interpretation for this area. Elevated nitrate and Cl/Br values from the bedrock aquifers were mostly found in this area. These occurrences were mostly limited to the very sensitive area between the cities of Sandstone and Bruno.

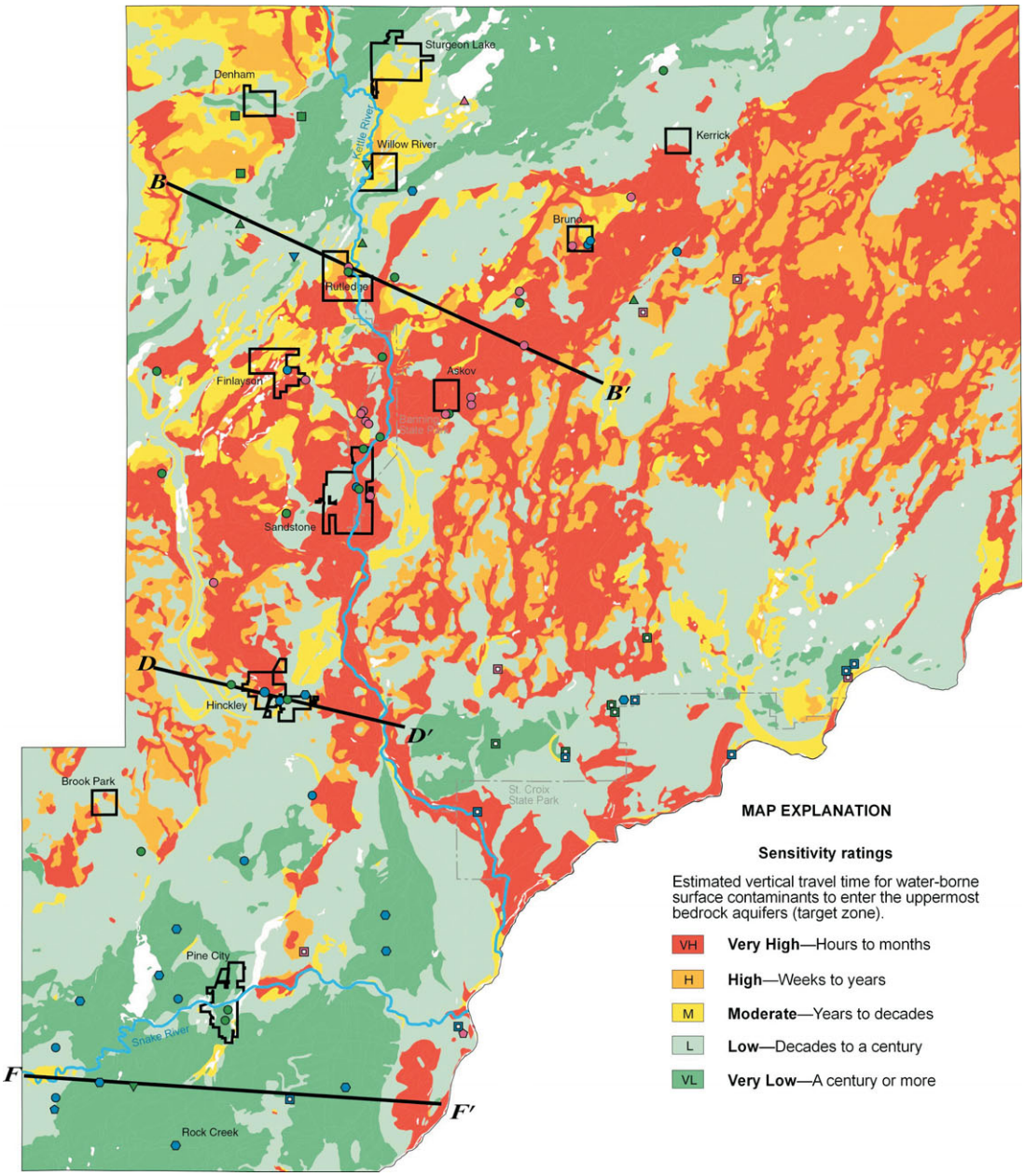

Figure 4. Pollution sensitivity of the uppermost bedrock aquifer in Pine County. Small symbols are locations of water samples from wells. Color of symbol indicates tritium age (see Figure 5 explanation).

Southern area.
A relatively thick layer of glacial sediment, which includes a series of layered aquifers, characterizes the southern portion of the county. Maps of the buried sand and gravel aquifers of the southern area and pollution sensitivity evaluations are not shown here but were included in the Part B atlas. The glacial sediments include till glacial lake deposits that inhibit movement of water from the land surface to the underlying bedrock aquifers.

The bedrock aquifers underlying this glacial sediment are the Hinckley sandstone, volcanic rock, and unidentified Paleozoic and Mesoproterozoic sandstone units (F–F' on Figure 5). In 37 of the 40 samples, mixed (10) or vintage (27) tritium values were found, and none of the samples contained high (greater than 1000) Cl/Br values. These characteristics support the interpretation of the southern area's generally low sensitivity.

Northern area.
This area is shown on the left side B–B'. Similar to the southern area, this northern area has a relatively thick layer of glacial sediment that contains important Quaternary sand and gravel aquifers. Also similar to the southern area, the uppermost till unit is clay rich (post-Automba phase

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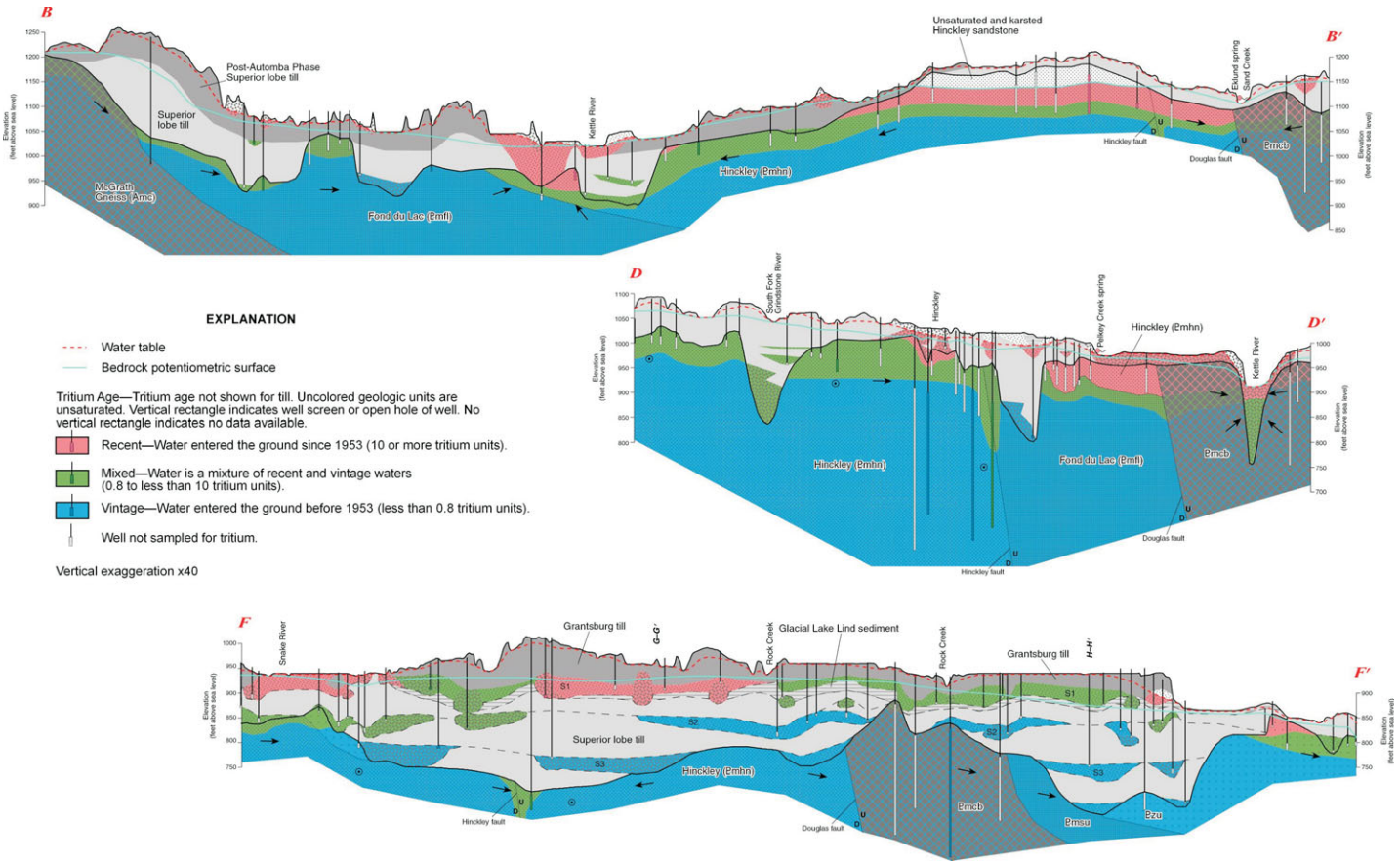

Figure 5. Selected cross sections showing lithologic units, aquifers, and tritium age of ground water.

Pine County Part B, cont

Superior lobe till). Unlike the southern area, the bedrock aquifer in the northern area consists mostly of the Fond du Lac aquifer. In addition, the northern area has thick surficial sand and gravel layers that in places extend through the glacial sediment layer to the bedrock. Therefore, portions of the bedrock aquifer receive recharge as shown by the recent and mixed tritium values in water samples from wells on B–B' (Figure 5).

Mostly low and very low sensitivity ratings are found in the northern area, although it includes an area of moderate and high sensitivity. The low to very low sensitivity areas are covered with thick, clayey glacial sediments. The central part of this area, located around Sturgeon Lake and Willow River, has moderate to high sensitivity characteristics due to locally very thick sand and gravel deposits that allow relatively rapid recharge of the underlying Fond du Lac aquifer. Eight ground-water samples were collected in the northern area. All six of the samples collected in the low to very low sensitivity part had vintage or mixed tritium values (two vintage and four mixed). The two samples from the moderate to high sensitivity portion had mixed and recent tritium values.

Conclusions

Within the high to very high sensitivity areas of the central portion of the county there exists an area that deserves an even higher level of concern and attention. This is the known and possibly karsted area of the Hinckley sandstone, which roughly corresponds to an area between the west center county boundary northeast to the town of Kerrick. Some of this area is known as a special concern area by the mapped karst features (sinkholes and springs), the other portions are suspected to be part of this special concern area due to the unsaturated conditions at the top of the Hinckley sandstone. These unsaturated conditions may have been one of the conditions that helped create the karst features or the unsaturated conditions may be a result of the karst features. Whatever the cause and effect relationships are an association appears to exist that can be used as a mapping tool to help our land use risk predictive capabilities.

To Obtain Reports and Data.
Part B of the Pine County Atlas will be available in July 2004. The Pine County Geologic atlas is the thirteenth report of the County Geologic Atlas Series, a cooperative effort between the Minnesota Geological Survey (MGS) and DNR Waters.

County Geologic Atlases underway include Wabasha, Pope, Crow Wing and Todd. Part A reports for Wabasha and Pope have been published by the Minnesota Geological Survey. Reports in the County Geologic Atlas Series can be purchased at the Minnesota Geological Survey, Publications Office, at 2642 University Avenue, St. Paul, 55114, phone (612) 627-4782.

The Pine County Geologic atlas was prepared using geographic information systems (GIS) technology. Data files and portable document (PDF) images of plates are available for download. Please see the DNR web site at: http://www.dnr.state.mn.us/waters/groundwater_section/mapping/status.html for Part B availability and

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Field Trip Notes from Yucca Mountain

— Dan Kelleher, Midwest GeoSciences Group

"Hard Hats Required" was read by workshop "Advances in Hydrogeologic Analysis of Fractured Bedrock Systems" attendees entering into the Yucca Mountain Proposed Radioactive Waste Repository at the Nevada Test Site last month.

Attendees from twenty-one states– including five people from the Twin Cities– participated during the three-day workshop at the University of Nevada Las Vegas (UNLV) conducted by the Midwest GeoSciences Group.

The workshop featured a field trip to the Nevada Test Site which is located about 100 miles north of Las Vegas.

Rob Hoey of the Maine Department of Environmental Protection observing the absence of seepage and low humidity shared "…this tunnel is much drier than I expected". Rob's comment was indicative of many attendees' observations – due undoubtably to the fact that the depth to the water table was more than 1,500 feet below the tunnel entrance! Field trip guides from the Department of Energy pointed out the subvertical faults along the tunnel walls and explained how each individual joint and fracture was mapped throughout the tunnel. Besides touring inside the repository tunnel and alcove niches, the field trip included a stop at the crest of Yucca Mountain, a trench exposing the near surface conditions of the same subvertical fault observed within the tunnel, and an eye-opening tour of the Sample Management Facility.

The workshop was conducted this year at UNLV in order to tour inside Yucca Mountain. This is an unusual opportunity: "For a limited time, non-project-related professionals are allowed access to the Yucca Mountain Project site pending Department of Energy approval," stated Tim Kemmis, one of the workshop coordinators. Kemmis added "The field trip illustrates many of the principles taught during the first day of classroom sessions".

Ken Bradbury and Maureen Muldoon from Wisconsin, Willard Murray and Glenn Duffield from the east coast, and John Peck from Las Vegas were the primary course instructors. The course focused on combining fundamental approaches with recent advances in hydrogeologic site characterization of fractured bedrock settings. Rob Hoey reported that site characterization and aquifer testing topics were thoroughly covered, especially with respect to the subject of fractured bedrock.

This opportunity will be repeated as the Midwest GeoSciences Group recently announced that they are offering the same course again next year at the Desert Research Institute at UNLV with a field trip into Yucca Mountain.

— Paula Berger, Environmental Strategies Cunsulting, LLC, and Kate Kleiter, American Engineering Testing, pose in front of an awesome vista on the Yucca Mountain Field Trip. Photo from Dan Kelleher

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Pine County Part B, cont.

download instructions. PDF images and data for Part A of the report are downloadable from the MGS ftp site at ftp://156.98.153.1/pub3/c-13/. More information is on the MGS web site at http://www.geo.umn.edu/mgs/. For more information contact Jim Berg or Jan Falteisek, DNR Waters at (651) 296-4800 or Dale Setterholm, Minnesota Geological survey, at (612) 627-4780.

References Cited

Ekman, J., and Alexander, S.C., 2002, Water chemistry and residence time, technical appendix to Part B in Regional Hydrogeologic Assessment Otter Tail Area, West-Central, Minnesota: Minnesota Department of Natural Resources Regional Hydrogeologic Assessment Series RHA-5, Part B.

Shade, B.L., 2002, The genesis and hydrogeology of a sandstone karst in Pine County, Minnesota:

What Do You Think About the MGWA Newsletter?

The newsletter team will be sending out a brief survey soon to all members of MGWA asking for their opinions about the newsletter. We will be using this information to redesign the newsletter to meet your needs. The last redesign was in 1989, 15 years ago, long before the advent of electronic newsletters. You will be receiving the survey by e-mail from the MGWA office. If you do not have an e-mail address, you will receive the survey by mail. When you receive the survey, please take a few minutes to respond to it.

Capillary Fringe

Are you one of the haves or have-nots?

"A chicken in every pot, a GIS on every desktop." (Campaign slogan, 1928 MGWA presidential campaign)

If you don't currently have access to Geographic Information System (GIS) technology on your desktop, go get it. It will revolutionize the way you work. As groundwater and earth scientists, we often need to work with information that has a spatial component. Examples are geological and water quality data from wells or borings, locations of point sources, and aquifer geometry. These data are easily managed using a GIS, especially for large data sets. You'll do things easily that before required a great deal of tedious effort. GIS systems will enable you to perform complicated database queries that would be difficult, time-consuming or impossible to perform using conventional techniques, to view and analyze data in many sophisticated ways, and to make dazzling maps at any scale. Despite its numerous advantages, many groundwater professionals still view GIS as the domain of IT professionals and have not moved to adopt it as their tool of choice. GIS technology is increasingly mainstream in many different fields, and it will soon become the *lingua franca* for practical, day-to-day data sharing in groundwater science. Why is there resistance to more widespread installation of GIS in our field? I am guessing there are many persistent myths surrounding GIS, which I'll try to debunk in the space remaining.

Myth No. 1: GIS technology is chiefly a tool for making maps.

Sure, GIS software is used to make spectacular maps. But the maps are only the final product. What you don't see when looking at the map is the *analysis* used to create the map. Behind the visualization and cartographic tools offered by GIS are sophisticated database tools and engines (don't ask me why they are called that) that allow the user to make complicated queries on spatially defined data. Examples of spatial queries are: 1) where are all the wells with verified locations in the drinking water supply management area for the City of Brooklyn Center that have been drilled to bedrock since 1990, or 2) find all wells within the limits of a 1 kilometer buffer around Baytown Special Well Construction Area that have been drilled into the Jordan, query those wells to obtain the elevation of the Jordan-Prairie du Chien contact, and contour those values on my map.

Myth No. 2: GIS is only for specialists.

Don't get me wrong. GIS specialists are essential. They will help make your job easier, will serve as resources, and will help to make you look good. But generally they do not have experience or training in earth science and do not (I hope) understand your work as well as you do. That distance from your work makes it difficult for them to conjure up creative solutions available from GIS technology. Once you start to use a GIS, you'll better understand its capabilities and you'll want to automate certain repetitive tasks, obtain new datasets, and perform difficult analyses. That's where the professionals can help you. Later on they'll thank you, too – for making them even more in demand than they are now.

Myth No. 3: GIS is too hard to learn.

One of the history teachers at my high school, and my good friend, Les Olinger, used to respond to students complaining how hard or difficult an assignment was by exclaiming with a smile: "Suffa!" GIS is sophisticated software. There is a learning curve, but there are many different levels of competency with GIS. You can elect the level of competence that works for you. So, suffa! But only once. After you have learned it, keep using it and your skills will remain sharp.

Myth No. 4: GIS is expensive.

GIS software, like many other types of software, costs money. There is no avoiding that reality. But many of the datasets, maps, and plug-in extensions used in applying GIS are freely distributed by private and public entities alike. Much more is available for modest cost. The cost is generally small weighed against the time savings and other advantages achieved by using GIS tools. We all recognize the importance of basic geologic and hydrogeologic training, experience, and judgment. The automated functions of GIS can result in GIGO (garbage in-garbage out) and PMS, the pretty map syndrome (the map looks so good it must be right). The GIS does not replace the need for employing sound judgment in analyzing data.

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Ground Water and the Topeka Shiner in Southwestern Minnesota

— Jim Berg, DNR Waters

The DNR divisions of Waters and EcoServices recently delivered a report "Hydrogeology of the Rock River Watershed, Minnesota, and Associated Off-Channel Habitats of the Topeka Shiner" to the U.S. Fish and Wildlife Service (USFWS), which had partially funded the three-year project. The Rock River is located in Rock and Pipestone counties in the southwestern corner of the state. The surficial aquifer of the Rock River Valley supplies essential ground water to the river system. For al practical purposes, this aquifer has been the only source of water in the area for human society and aquatic life.

The Topeka shiner (*Notropis topeka*) is a native species minnow that was once common in headwater streams of the Midwest and western prairie. The species is estimated to have had a wide range across several states but is now restricted to portions of these areas. The species is in decline in Kansas, Missouri, Nebraska, and Iowa. The Topeka shiner now exists in less than 10 percent of its historic geographic range in highly fragmented populations. The USFWS listed the species as endangered on January 14, 1999. Recent studies in Minnesota have shown that relatively abundant populations appear to be surviving across much of the southwestern portion of the state.

Research has shown that off-channel habitats (OCHs - ponds and meander cut-offs) may be particularly important to the species' survival by acting as sanctuaries or critical habitats in the species' life cycle. These habitats were suspected of being fed mostly by ground water from the surficial alluvial aquifer associated with the river system. Therefore, a better understanding of the shallow ground-water system was a priority for protecting the species in this area. In an area where aquifers typically have limited capacity, large ground-water appropriations from shallow aquifers, near OCHs, could dewater them. Poorly planned ground-water appropriations could, in this manner, result in the loss of habitat needed by the Topeka shiner to survive.

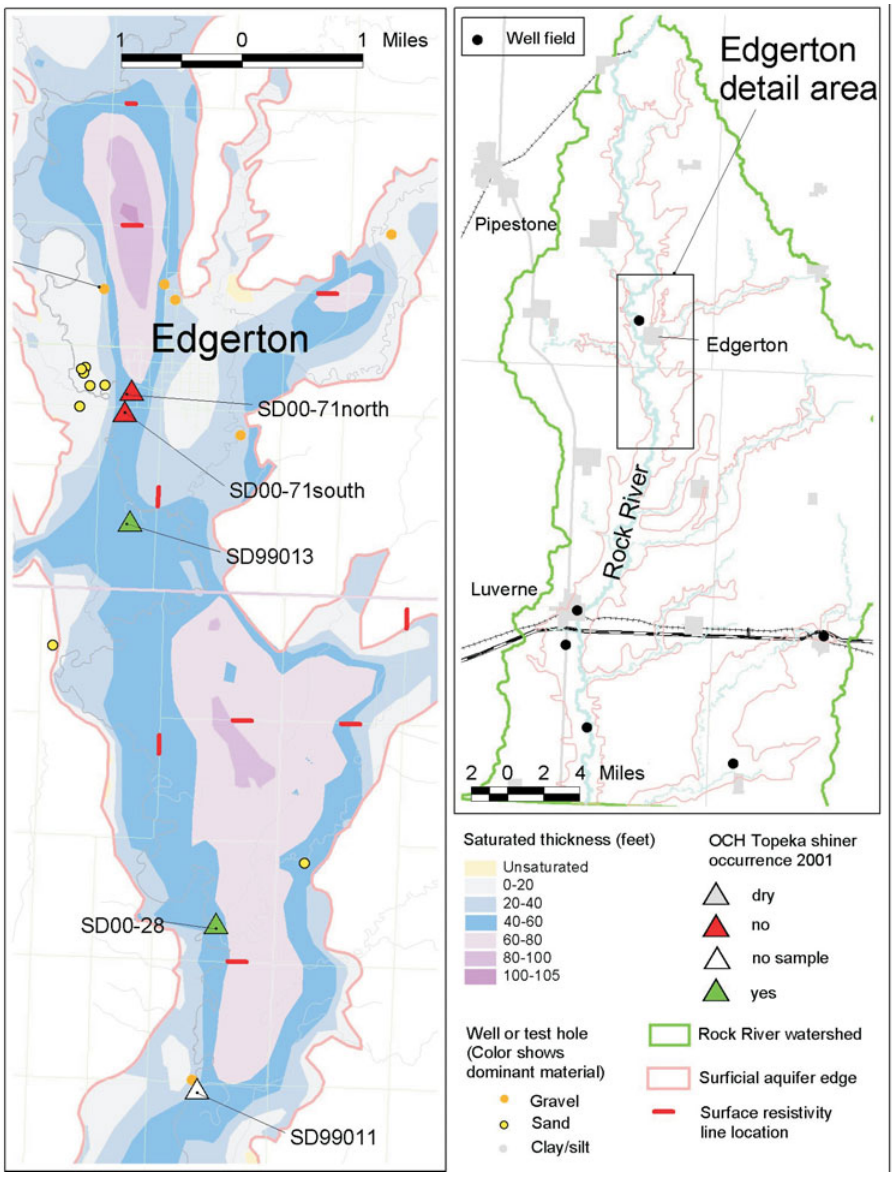

Figure 1. The Rock River watershed and surficial alluvial aquifer in Minnesota.

The project had three main phases. The first phase was an assessment of the species' distribution. In spring 2001, Topeka shiner populations were documented at 29 OCHs by capturing all the swimming aquatic organisms with a one- or two- person seine and visually identifying the Topeka shiner individuals. Previous assessments showed that the in-stream occurrences of the Topeka shiner are fairly evenly distributed within the river system. Similarly, the species was found in most of the OCHs. Together, these data underscore the generally favorable conditions that appear to exist in this area for the species.

The second phase was an assessment of ground-water and surface-water interactions at the OCHs. Ground water maintains a steady temperature that is close to the mean annual air temperature. Sediment temperatures measured with a temperature probe beneath the OCHs during late summer showed moderate to strong ground-water connections at most of the OCHs.

The third phase of the project included the creation of a series of maps (Figure 1) describing the regional boundary, water-table elevation, and thickness of the Rock River valley alluvial aquifer. The aquifer thickness map was created from a combination of existing well and soil boring information from the County Well Index

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Topeka Shiner, cont.

and geophysical data (surface resistivity image data) collected by the Minnesota Department of Natural Resources for this project at 60 locations.

The aquifer thickness map will not only help us understand where in the watershed the species may be the most vulnerable, it is also an important water resource inventory tool in an area of scarce water resources. As part of this research some thick and potentially productive portions of the aquifer were discovered, which should be good news for the future of both humans and fish.

The report is available at the DNR Waters website http://www.dnr.state.mn.us/waters/index.html or the DNR EcoServices website http://www.dnr.state.mn.us/ecological_services/nongame/projects/research_reports/fish.html.

The report includes water table and saturated thickness information of previously unmapped areas north of Luverne. The thickest portion of the surficial aquifer was found in the Edgerton area where the aquifer was commonly 40 to 80 feet thick. The saturated thickness map was developed using existing data from the County Well Index, supplemented with information from surface resistivity images collected by DNR staff. The green triangles show occurrences of the Topeka shiner in off-channel habitats during the spring of 2001.

For more information contact Jim Berg (jim.berg@dnr.state.mn.us) at 651-297-4605 or Todd Petersen (todd.petersen@dnr.state.mn.us) at 651-296-0439.

Capillary Fringe, cont.

Neither does GIS technology replace the need for basic field work, mapping and data collection. But it makes it easier to analyze that information once it is in hand. You need GIS tools on your desktop. The ease with which you can make complicated analyses and view the results will quickly make you a convert. You can elect simply to view and map datasets, or you can make your own datasets, create your own extensions (customized scripts or programs), and perform complicated 3D analysis. Most likely you will do something in between, but you'll use it every day. Go forth and conquer!

"And so my fellow groundwater professionals: ask not what GIS can do for you, ask what you can do with GIS." (MGWA presidential inaugural address, January 20, 1961).

Steve Robertson is a hydrogeologist with the Minnesota Department of Health, which means he must make it clear that the views expressed here are not official MDH policy. Comments on this article (or other quotes involving GIS) to newsletter@mgwa.org.

USGS Announces Fact Sheet on Nutrients in the Upper Mississippi River

Nutrients in the Upper Mississippi River: Scientific information to support management decisions. U.S. Geological Survey Fact Sheet 105-03, July 2003, 6p.

This fact sheet summarizes examples of USGS long-term monitoring and research about nutrients in the Upper Mississippi River Basin upstream from the confluence of the Ohio River. Management of this important agricultural, recreational, and navigational region of the nation relies on sound scientific information.

Many questions remain about the best methods and priorities for managing losses of nutrients from human activities to aquatic systems and this paper also offers suggestions for additional research.

—For more information, contact Jeff Stoner, U.S. Geological Survey, Minnesota District, (763)783-3100, or check the district's web site at http://mn.water.usgs.gov.

How Geology Contributes to Water Quality Impairments — An Example from Walker Brook, Red River of the North Watershed, Minnesota

Article complied by Molly MacGregor, Red River Basin Coordinator, Minnesota Pollution Control Agency, based on studies and unpublished reports by Joseph Magner, Principal Hydrogeologist, Minnesota Pollution Control Agency, and Robert Melchior, Professor Emeritus of Geology, Bemidji State University.

Nearly 2,000 segments of Minnesota's rivers and streams do not meet state and federal water quality standards and have been designated as "impaired" by the Minnesota Pollution Control Agency (MPCA). Researchers in the Red River of the North drainage basin have found that the water quality of streams that flow through extensive fens are influenced by anoxic groundwater discharged to surface waters at low flow, and that for at least one river, its "impairment" is the result of natural conditions.

Walker Brook is a tributary that joins the Clearwater River near Bagley, Minnesota (Figure 1). MPCA's milestone water quality monitoring program documented dissolved oxygen levels below the state standard of 5 milligrams per liter (mg/L) in late summer and fall over a 10-year period. Listing as an impaired water requires the state to conduct a study of the sources of the pollutant, and to propose a strategy to achieve the water quality standard.

As shown in Figure 2, dissolved oxygen (DO) was typically between 5 and 5.5 mg/L (January until soil thaw in March) at County Hwy 19. After soil thaw, dissolved oxygen increased above 7 mg/L and continued to increase up to 9.67 mg/L with April/May precipitation and associated runoff. During this time period, stream-flow increased by nearly an order of magnitude. As stream-flow decreased in June, dissolved oxygen dropped to about 6 mg/L. Stream-flows then increased in July, through August and into September. However, dissolved oxygen generally

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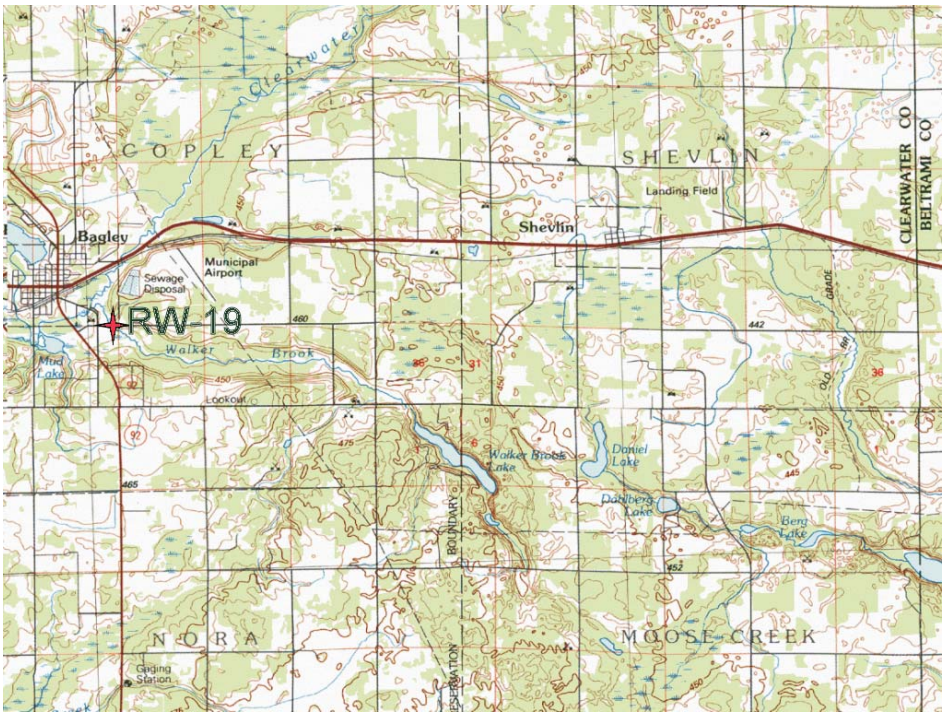

Figure 1: Location of Walker Brook in Clearwater County, Minnesota. USGS base map (original scale 1:100,000).

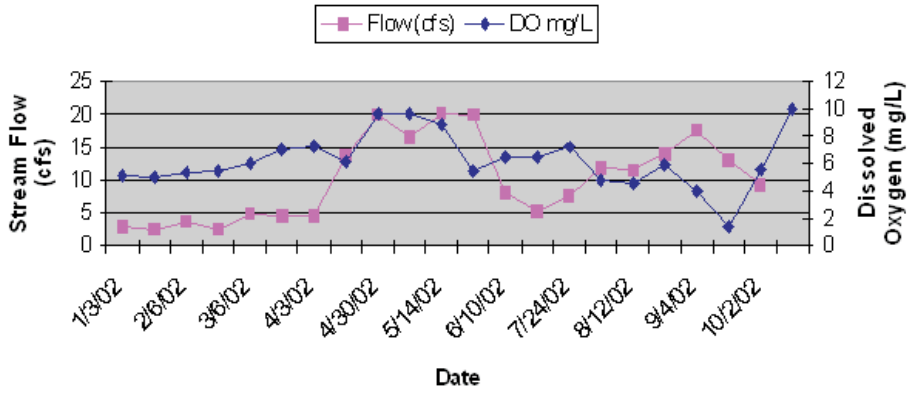

Figure 2: Walker Brook stream flow and dissolved oxygen at RW19 during 2002. Graph provided by Joseph Magner, MPCA.

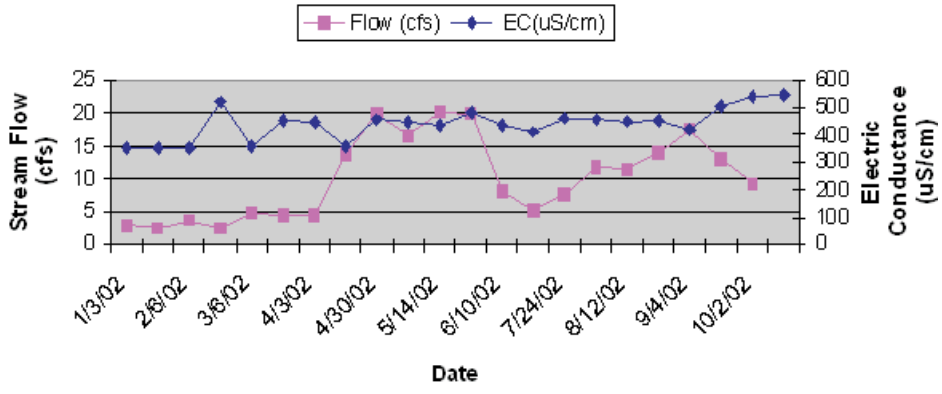

Figure 3: Walker Brook stream flow and electric conductance at RW19 during 2002. Graph provided by Joseph Magner, MPCA.

Walker Brook, cont.

decreased to values below 5 mg/L. Even though stream-flow increased again in the late summer to stream-flows similar to those observed in May, the dissolved oxygen response was opposite of the May trend. Clearly, water temperatures were different in August compared to May, and warmer temperatures will result in lower DO. However, the primary condition driving the difference is the change in hydrologic pathways.

Transpiration moves near-shore, riparian shallow water through vegetation. This in turn creates a gradient for deeper ground water to rise and discharge into riparian wetlands and Walker Brook. Unless an overwhelming amount of new precipitation is added to the watershed (dilution), typical (1-to-5-yr recurrence interval) storm events will displace pre-existing watershed water (ground water and interflow) into Walker Brook. Anoxic ground water along with oxic precipitation passing through organic sediments will result in low DO and low Eh (redox potential). Dissolved oxygen ranged from 1.37 mg/L in late September to over 10 mg/L in mid-October at this site. These are conditions typically associated with wetlands. A small amount of anthropogenic loading from pasture runoff and septic systems could find its way to this wetland, however numerous studies have shown that wetlands, even with relatively high non-point source pollutant loads, are able to attenuate polluted runoff.

Water quality investigations at Walker Brook suggest that the glacial events that produced the arrangement of soil material, hydrologic pathways of water movement, and the associated valley type are the predominant factors that influence water quality in the stream. Stream-flows measured in 2002 ranged from 2.5 cubic feet per second (cfs) in early March to more than 20 cfs in early May at County Highway 19, below a large riparian wetland (Figure 3) and the electric conductance varied from 350 microsiemens per centimeter (S/cm) to 550 S/cm during 2002, with the highest readings in mid-October.

Walker Brook originates from a series of seeps and springs along the west flank of a tunnel valley (Figure 4;

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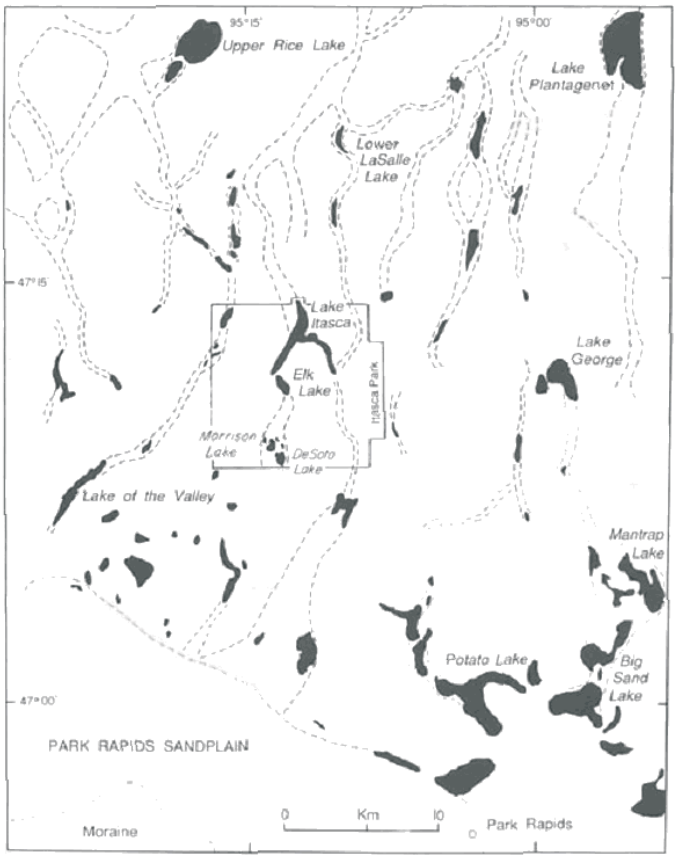

Figure 4: Tunnel Valleys in the Itasca Moraine; provided by Dr. Robert Melchior, from Wright, H.E. Jr. 1993. History of the landscape in the Itasca Region. In, Bradbury, J.P. and W.E. Dean, (eds.) Elk Lake Minnesota: Climate Change in the North Central United States. GSA Special Publication 276.

Walker Brook, cont.

Wright, 1993) segment that was eroded into deposits of the Wadena lobe by sub-glacial streams draining basal melt water from beneath ice of the Wadena Lobe.

The tunnel valley was active intermittently during much of the latter half of the Wisconsinan glaciation but developed most of its modern form during the Itasca Phase, which occurred toward the end of the activities of the Wadena Lobe. During this time frame, drainage was toward the southeast into a larger tunnel valley that contains Upper Rice Lake. Final modification of the valley occurred during and subsequent to the late Wisconsinan Des Moines glaciation.

During the formation of the middle Wisconsinan Itasca Moraine between Walker and Park Rapids (20,000 BP), sub-glacial erosion in the tunnel valley exposed pre-existing till units including those of the Hewitt phase, and possibly also, those of earlier glaciations - cf. Walker Brook Reservoir Project Feasibility Study, 21 Dec. 1988. It is this stratigraphic sequence that controls the ground water system operating at Walker Brook (Figure 5). The oldest till unit seen in the tunnel valley is a very sandy till with a high hydraulic conductivity, probably ~10^{-2} cm/sec or greater. This unit, a major regional aquifer, is of Hewitt age (25,000 BP) or older and is overlain by a silty clay unit, possibly a lake deposit or a lodgement till, that has a very low hydraulic conductivity, estimated at < 5.9 X 10^{-7} cm/sec. The lake deposits are discontinuous laterally but where present, they confine the Hewitt aquifer. Above the confining layer is ground moraine of the Itasca phase. These deposits exhibit a range of facies from silty-to-sandy and have estimated hydraulic conductivities intermediate between those of the confining layer and the Hewitt phase deposits. Thin and discontinuous beds, mostly outwash of the St. Louis and Des Moines lobes, occur from place to place on the highlands of the drainage basin, and within the northern parts of the tunnel valley, relatively thick outwash deposits occur. St. Louis deposits to the north and west of the drainage basin bury the tunnel valley.

During the waning phases of the Itasca lobe, glacial ice in the Walker Brook area stagnated as its accumulation zone retreated northward. Hydraulic pressure within the ice tunnel was reduced and in places, the tunnel roof collapsed. The collapsed ice block, that became Walker Brook Lake, was buried by debris flow and stream deposits as the Wadena ice wasted away. Permafrost and deflation features in the region (Melchior 2003, Wright, 1972) suggest cold and dry conditions lasting through the advance of the St. Louis lobe about 12,000 BP. In keeping with other lakes in this area, the evidence suggests that the ice blocks did not melt until after the retreat of the St. Louis lobe around 11,000 BP (Wright, 1993).

The St. Louis lobe deposited a thin and discontinuous veneer of sediment over the Walker Brook area but its erosive effects were minimal, possibly due to permafrost. The major effect of the St. Louis and Des Moines lobes was to depress the crust locally, resulting in the formation of a marginal stream system carrying seasonal melt water along the margin of the ice (Figure 6). The position of this system approximates the east-west portion of the modern Mississippi and portions of the Clearwater River valleys. Walker Brook, which was probably temporarily dammed from time to time by debris flow from the St. Louis ice, flowed northward out of the area of Walker

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Walker Brook, cont.

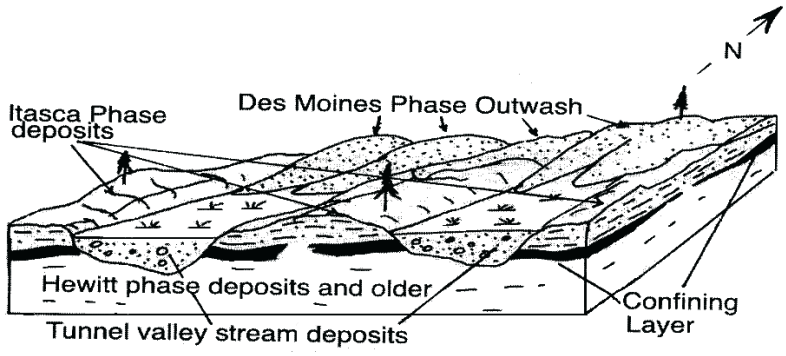

Figure 5: Block diagram illustrating the spatial relationships between various glacial deposits in the Walker Brook area. Not to scale.

Brook Lake as a tributary to this system. During this time, steep walled V-shaped cross-sections of the current Walker Brook valley were formed by stream downcutting through till dams derived from both the St. Louis lobe and the wastage of the Itasca phase ice.

The modern Walker Brook valley can be subdivided into two geomorphic types, narrow, V-shaped portions and very wide sections characterized by fens. Wide divisions originated as tunnel valley remnants and narrow portions, with steep sides, were down-cut by stream erosion during the last part of the Wisconsinan glacial period. The tunnel valley sections are typically wide, floored by thick (10's of meters) sequences of sandy, gravelly

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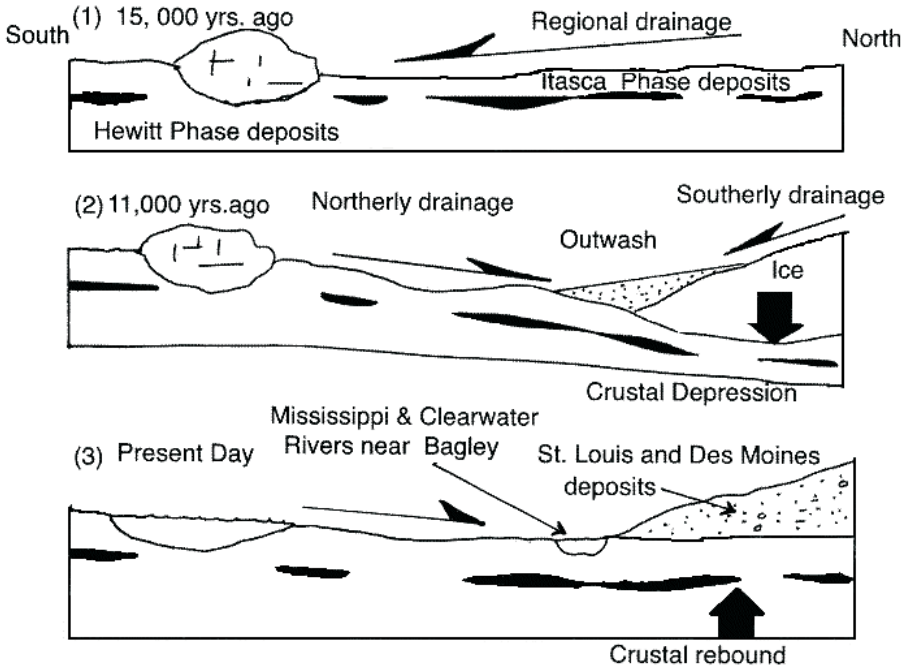

Figure 6. Diagrammatic cross-sections through the Walker Brook area. (1) Area as it appeared around 15,000 years ago. An ice block that will become Walker Brook Lake is in place. Regional drainage is to the south. Confining layer is shown in black. (2) Advance of Des Moines age ice depresses the surface, drainage is diverted to the north. (3) Modern day: drainage is into the Mississippi-Clearwater trough that was formed by crustal depression during (2). St Louis/Des Moines deposits at the surface in the north and west. Crust is rebounding to its original position after the ice load has melted away.

Walker Brook, cont.

glacio-fluvial deposits and characterized by wide fens on either side of a clearly underfit stream. The fens consist of sapric peat up to 10 meters or more in thickness. The narrower portions of the valley have little or no floodplain, little or no glacio-fluvial base, and no fens. These sections were cut into previous ground moraine and outwash deposits by overflow from melt water ponded in the remnant tunnel valley sections by glacial activity during the Des Moines glaciation.

Surface springs discharging into Walker Brook are usually marked by prominent slump structures along the valley sides. These are recognized by groups of *en echelon* scarps dipping toward the valley walls. The individual scarps are relatively small, around a meter or so and occurred in groups up to 30-meters wide and 5-10 or more meters high. Groundwater sapping is responsible for these slumps and is occurring by means of large discharges from the highly permeable Hewitt aquifer that erodes sands from beneath the confining layer. Slumping mostly occurs in the narrow portions of the valley where lateral support for the confining layer is absent or near road ditches, where the angle of repose for saturated sands is exceeded.

The ground water system consists of an upper aquifer (deposits of the St. Louis, and Itasca glacial tongues) separated from a lower aquifer (deposits of the Hewitt Phase and earlier) by a discontinuous, clay rich confining layer. Where present, the confining layer isolates the Hewitt aquifer from the upper aquifer so that the two function independently from one another. The upper aquifer is more responsive to seasonal changes in precipitation and evapotranspiration and the residence time of water can be expected to be less than in the lower aquifer. Many areas of the upper aquifer can be thought of as perched water and will fluctuate significantly in discharge during a single season. Discharge from the Hewitt aquifer on the other hand, can be expected be more consistent over time and to have higher conductivities and lower DO.

Riparian wetlands are common in northern Minnesota. Lacustrine flowages are low gradient and wide valley systems formed during the glacial era. Low gradient reaches can be transitional areas because the differences among lakes, wetlands, and streams become blurred by subtle features of channel depth, sediment transport, and vegetation. The Walker Brook watershed must first be defined as a valley type formed by glacial flows that no longer exist. Glacial strata force water to move laterally and discharge as headwater springs and valley fens. Much of Walker Brook is a lacustrine flowage, which is different than pool/riffle systems and should not be classified as such; a change in classification to reflect Walker Brook's natural conditions will solve this water quality impairment.

References:

Alexander S.C., and E.C. Alexander Jr. 1992. QA/QC methods for major cation/anion analysis. Department of Geology and Geophysics, Univ. of Minnesota, Mpls, Mn.

Burns, D.A., McDonnell, J.J., 1998. Effects of a beaver pond on runoff processes: comparison of two headwater catchments. J. Hydrology,

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Walker Brook, cont.

205:248-264.

Drimmie, Robert J. Environmental Isotope Lab, University of Waterloo. http://sciborg.uwaterloo.ca/~rkhmskrk/

Fritz, P. and Fontes, J. Ch., 1986. Handbook of Environmental Isotope Geochemistry, Vol. 2., Elsevier, Amstersdam, Netherlands, 557pp.

Gernes, M., and J. Magner, 2003. Minnesota Riparian Wetland Biocriteria: Initial development in the St. Croix River Basin. MPCA Biological Monitoring Program Report CD985238-01.

Web Page Volunteer?

We'd like our web page to be more attractive, but our current efforts need to be directed more to content than appearance until we can find some help. Please contact the editor at newsletter@mgwa.org if you would be willing to assist with this project.

MPCA Ambient Ground Water Quality Monitoring in Minnesota

The Minnesota Pollution Control Agency is establishing an ambient ground water quality monitoring network in Minnesota, as part of a joint plan for conducting ground water quality monitoring with the Minnesota Departments of Agriculture (MDA) and Health (MDH). Data collected from MPCA's network, along with data collected by MDA and MDH, will provide information about the quality of Minnesota's ground water and helps identify trends in water quality.

What is ambient monitoring?

Ambient monitoring, also called condition monitoring, involves routine sampling of ground water in a variety of environmental settings across large geographic areas. Ambient monitoring represents 'typical' or 'background' ground water quality in an area. For example, ambient monitoring would not be conducted where there is known contamination, nor would ambient monitoring be conducted exclusively in areas where human impacts are minimal, such as heavily forested areas.

Why conduct ambient monitoring?

More than 70 percent of Minnesotans get their drinking water from aquifers, that is, ground water. Previous studies show that routine human activities impact ground water quality. Examples include elevated chloride concentrations in areas where road salt is applied, elevated nitrate concentrations in agricultural areas and in residential communities serviced by Individual Sewage Treatment Systems (septic systems), presence of pesticides in agricultural areas and some urban areas, and presence of fuel oils and industrial solvents in commercial and industrial areas.

Regulatory programs, such as Superfund, address known contamination sources but do not provide information on the general quality of ground water in Minnesota. Ambient monitoring, however, is designed solely to inform us about the general

— *continued on page 23*

An intensive one-day course & workshop

Improving the Description and Characterization of Glacial Successions

for Environmental & Engineering Projects

Friday, October 8, 2004

Instructors:

Tim Kemmis, PhD, PG

Paul Kesich, PG
Fermi National Accelerator Laboratory

Dan Kelleher, PG
Earth Tech, Inc.

Location:

Waverly, Minnesota
Wright County

Attendees will examine the sequence of Des Moines Lobe deposits near Waverly, Minnesota located about 25 miles west of the Metro Twin Cities. Boart Longyear Company will provide a continuous rotasonic core of the glacial succession which will be used to illustrate the principles presented during the morning classroom sessions.

8 Contact Hours (0.8 CEUs)

midwest GEOSCIENCES group
www.midwestgeo.com

This one-day course updates procedures for modern, state-of-the-art geologic site characterizations for environmental and engineering projects. It includes how to:

We will examine a regional multiple till sequence during the afternoon workshop

MORNING CLASSROOM SESSIONS

- Learn to recognize and characterize glacial depositional environments
- Differentiate deposits from a succession of multiple glacial advances
- Recognize and understand the implications of weathering zones and secondary joint features
- Improve sediment descriptions on boring logs to characterize the geologic framework
- Learn the local characteristics of Wisconsin Episode Glacial Stratigraphic Framework
- Provide a rationale for geotechnical sampling and testing that is related to site stratigraphy
- Learn the importance of characterizing ground water movement through fine-grained units
- Assess field data for proper well placement and geotechnical testing
- Learn to manage project budgets wisely by making informed field judgements

AFTERNOON FIELD WORKSHOP SESSIONS

A continuous soil core sampled on-site using Rotasonic will be used to:

- Examine the deposits and learn to recognize sequences from multiple glacial advances
- Learn field recognition of a weathering zone
- Practice classifying and describing sediments to improve boring log descriptions
- Improve field characterization skills for accurate well placement and geotechnical testing
- Observe recent Rotasonic sampling updates

Soil core drilled on site by: BOART LONGYEAR SONIC DRILLING

This exciting 1-day course addresses current problems facing geologists and engineers working on glaciated terrains across the United States, and includes classroom sessions, field exercises, and technology demonstrations. Attendees will learn how ground water movement and the distribution of geotechnical properties are affected by glacial depositional environments and the effects of secondary weathering. The course will address the technical and financial advantages of analyzing geologic data in the field. We also will bring together fundamental and innovative approaches to unravel glacial complexities coupled with getting the most from project budgets.

Participant's quote from the 2000 course in Minneapolis:

"....the most relevant workshop I have ever attended. A very nice blend of academic theory applied to environmental practice."
-Sarah Finley, Indiana Department of Environmental Management

"In practical terms, this is probably the most useful workshop that I have ever attended....."
- Andy Leith, Hennepin County, Minnesota

YOU WILL RECEIVE 8.0 contact hours of instruction, a Course Notebook, CEU completion certificate, and a *Field Guide for Soil and Stratigraphic Analysis*. Registration also includes continental breakfast, morning coffee break, lunch, and an afternoon break. You are welcome to take photos during the workshop exercises.

ADVANCE REGISTRATION is necessary for participation in this limited-enrollment short course. Pre-registration is required to reserve space and receive course materials. A confirmation letter will be sent within 10 days of registration for the course. A ***GROUP DISCOUNT*** of 25% may be applied when four or more people from the same company register at the same time before September 15, 2004.

REGISTRATION FORM — Improving the Description and Characterization of Glacial Successions for Environmental and Engineering Projects, October 8, 2004

Last Name: _____ First Name: _____

Company: _____ Position: _____

Address: _____

City, State, Zip: _____

Phone: _____ Email: _____

*For early registration, payment must be received before September 30, 2004. Cancellations may be made before 09/30/04, however, 25% of the fee will be charged. No refunds after 09/30/04. If you have questions, contact Dan Kelleher at 763/551-2435. Student discounts available. Complete registration information at ***www.midwestgeo.com***.

Workshop Cost:

MGWA Member (before Sept 30)	$199
Professional (before Sept 30)	$225
Professional (after Sept 30)	$299

Amount Enclosed: _____

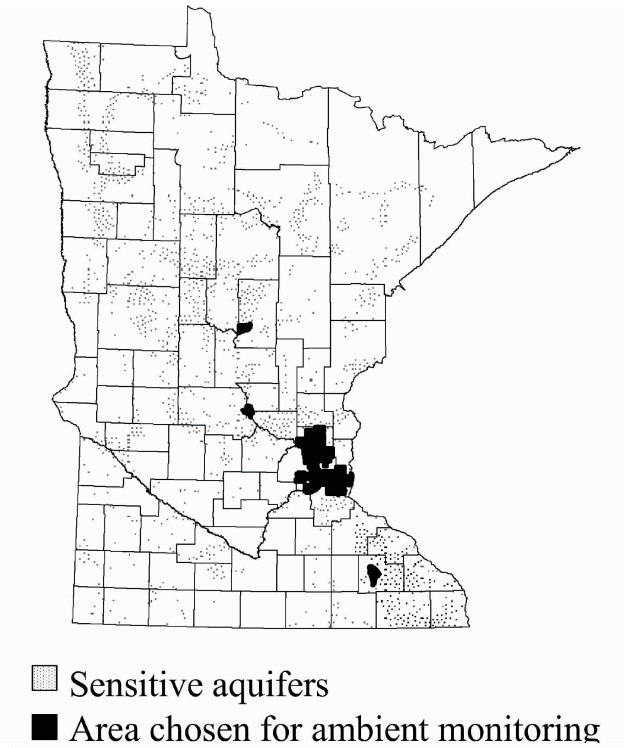
Send completed form with payment to: Midwest GeoSciences Group, 3306 North 8th Street, Sheboygan, WI 53083

Make check payable to Midwest GeoSciences Group

Ambient Monitoring, cont.

quality of ground water. Data collected through ambient monitoring helps answer the following questions:

- What is the quality of Minnesota's drinking water?
- Is water quality getting better, worse, or not changing?
- Which human activities have the greatest impact on ground water quality?
- Are there new, emerging ground water quality concerns?
- Are management activities having an impact on ground water quality?



Where will MPCA's ambient monitoring occur?

Ambient monitoring conducted by the MPCA is limited to issues for which the MPCA has statutory authority. For example, the MPCA has authority to collect samples for industrial chemicals but does not have authority to monitor for agricultural chemicals in ground water. After an extensive literature review, we concluded the following issues were of greatest concern to the MPCA:

- Presence and concentrations of fuel oils, industrial solvents, and other commercial and industrial organic chemicals in urban areas.
- Concentrations of nitrate in ground water beneath residential areas, particularly those serviced by septic systems.

Other ground water quality issues may be of concern in the future. Examples include presence of personal care products and pharmaceuticals in ground water and ground water impacts from land application of wastes. Ambient monitoring is primarily limited to areas of the state where ground water is sensitive to contamination, the above water quality issues exist, and where we have an adequate number of sampling points (i.e. sufficient quantities of wells).

The figure to the left shows areas tentatively selected for ambient monitoring including Brainerd, Rochester, St. Cloud, and several communities in the northern and eastern half of the Twin Cities Metro Area. Conclusions made from analysis of data collected in these areas will be used to understand ground water quality in other areas of the state as well. Annually, we will sample about 25 wells from locations outside these study areas.

The MPCA network has been jointly designed with MDA and MDH to address ground water issues outside the authority of the MPCA. An example is a cooperative effort with MDA to sample for pesticides in urban areas (see related article on page 7).

What does ambient monitoring entail?

The ambient monitoring network consists of a network of 100 to 150 shallow monitoring wells coupled with 100 to 150 deeper drinking water wells. The shallow wells provide an early warning network in which we expect to first see changes in water quality. The deeper wells provide information about the quality of water that people are drinking. Figure 1 on the next page illustrates this concept.

Each well is sampled biannually for an indefinite period of time. At each well, the MPCA collects samples for chemical parameters that are of concern for the area being sampled. Chemical parameters include nitrate, volatile organic compounds, chloride, and residential (lawn) pesticides in cooperation with the MDA.

When will sampling begin?

The MPCA's monitoring network was constructed during 2003. Sampling should begin in spring of 2004.

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Ambient Monitoring, cont.

More information

For further information about this program, contact Mike Trojan at 651-297-5219 or at mike.trojan@pca.state.mn.us. For additional information about past MPCA ambient monitoring, visit http://www.pca.state.mn.us/water/groundwater/gwmap/index.html. For information about the three-agency joint monitoring plan, visit http:// www.pca.state.mn.us/water/groundwater/gwqm-agreement.html

Minnesota Pollution Control Agency

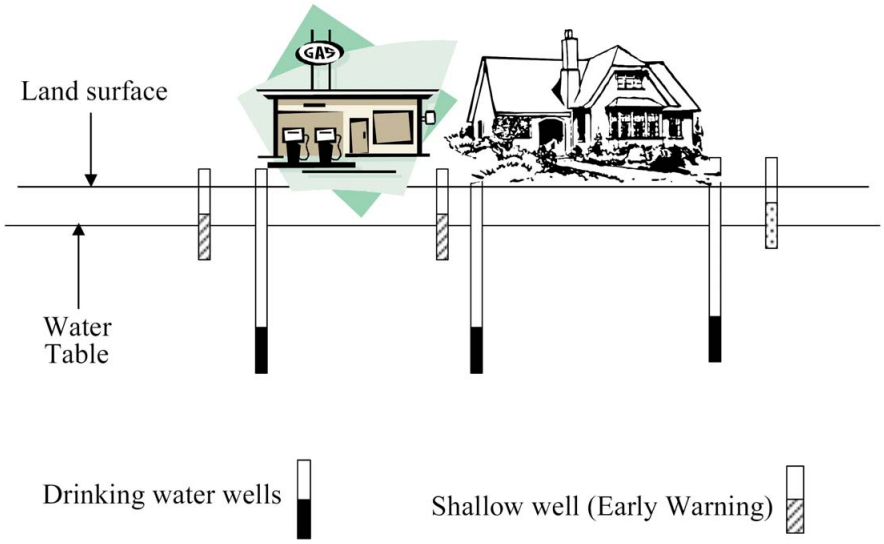

Figure 1: Schematic illustration of shallow and deep wells used for ambient monitoring.

MGWA Board Meeting Minutes

February 5, 2004

Place: Keys Cafe, on Lexington in St. Paul, Minnesota

Attending: Chris Elvrum, President; Laurel Reeves, President Elect; Marty Bonnell, Past President; Eric Hansen, Treasurer; Jon Pollock, Secretary; Jennie Leete, WRI; Sean Hunt, WRI; Norm Mofjeld, Newsletter Editor.

Approval of Minutes: Minutes for the Regular Board Meeting held on

continued on next page

Board Minutes, cont.

January 8, 2004, were approved by the Board.

Treasurer's Report: No activity last month. 2003 profit about $9,000.

Membership: Membership information passed out by Sean. Currently 404 members – appears that the membership will be similar to the previous year.

Web Page: Updates on new officers. Still working on email issues that are keeping us from sending mail to our members.

Foundation: Gordie is leaving Foundation. Rob has expressed interest. Marty will be part of the Foundation committee.

Education: Working on Science Museum Project.

Newsletter: Sidebars on Newsletter need to be updated. Need report from Foundation. Norm and Jennie will attend meeting on publication effectiveness for $25.00 each (Midwest Society of Association Executives).

Old Business

Science Museum: Seeking funding from LCMR for display.

Spring Conference: Speakers being contacted. Working on final title for conference

March 4, 2004

Place: Black Bear Crossing, Como Park Pavillion, St. Paul, Minnesota

Attending: Chris Elvrum, President; Laurel Reeves, President Elect; Marty Bonnell, Past President; Eric Hansen, Treasurer; Jennie Leete, WRI; Sean Hunt, WRI; Norm Mofjeld, Newsletter Editor

Approval of Minutes: February minutes approved conditionally, due to e-mail failure not all have reviewed.

Treasurer's Report: 2003 tax statements filed, current assets $29,452.

Membership: 480 paid to date, conference fee discussed; non-member fee will be set to exceed the conference fee + membership cost.

Web Page: updated with foundation nd conference information, membership directory, calendar items were discussed.

Scanning Project: bibliography portion finished, working on cleaning up scanned pages.

Foundation: no recent meeting, grant requests expected from Girl Scouts and Project Wet, reminded that requests need to be on proper forms.

Education: Mars – is it ground water? – media makes no mention of GW – this is an educational opportunity.

Newsletter: Workshop on publication effectiveness attended by Tom Clark and Jennie Leete; they found it quite useful & learned of an electronic survey method that is inexpensive; an expenditure of $20 for this survey was approved by consensus.

– March issue is almost ready.

Directory: check personal information; send corrections to Jennie Leete.

Old Business

Science Museum Project - applied for LCMR funding, - $20,000 available for well drilling possibly this spring, or fall if we don't get it done before the Big Backyard opens.

Officer Manual – Review and collect comments, – will discuss next meeting

Spring Conference Update – Reported individual accomplishments, reviewed the conference agenda, made further suggestions

New Business

National Ground Water Association – Associated State Society Program, discussed whether this is a group to which we should belong; the fee is $250; decided informally that the benefits were not significant enough to merit the cost.

MGWA Foundation, Officer appointments - President will have a list of potential appointees available for the next meeting

April 8, 2004

Place: Black Bear Crossings Como Park Pavilion in St. Paul, Minnesota

Attending: Chris Elvrum, President; Laurel Reeves, President Elect; Marty Bonnell, Past President; Eric Hansen, Treasurer; Jon Pollock, Secretary; Jennie Leete, WRI; Sean Hunt, WRI; Norm Mofjeld, Newsletter Editor.

Approval of Minutes: Minutes for the Regular Board Meeting held on February 5, 2004, were approved by the Board. Minutes for the Regular Board Meeting held on March 4, 2004, were amended: "cleaning up scanned pages" was added under Scanning Project. Attendees were also added: Eric, Laurel, Norm, Marty, Chris, Jennie and Sean

Treasurer: No activity last month. $29,435.07 current cash balance.

Membership: Membership information passed out by Sean. Up 10 members from this time last year.

Web Page: Updating calendar, added forms to various pages, Spring Conf. on line, updated email services, March 2004 newsletter on line.

Foundation: Will meet next week. Minimum of 5 members on Foundation Board. Motion to accept Marty Bonnell, Rob Caho, David Liverseed, Al Smith, Cathy Villas-Horns, and Gil Gabanski as Foundation Board of Directors. Motion passed unanimously.

Education: Working on Science Museum. Bid specifications for well being put together.

Newsletter: During last meeting looked at editing process. Working on sheet to give to contributors so that articles and figures can be processed more easily by WRI. Working on survey. Working on June newsletter.

Old Business

Officer Manual – Discussed changes. Jennie will modify.

Spring Conference – Finding speakers.

Letter to Legislators – Kraemer Quarry – Motion to approve support of water reuse concept related to proposed surface water treatment plant funding legislation (HF 1966 – SF 1750) for Kraemer Quarry in Burnsville. Motion passed. Letter indicating support only for the reuse concept, will be modified to remove any connotations to supporting funding etc. The letter will only support reuse of water on technical grounds.

Fall Field Trip Request from WGWA – Request from WGWA to put on fall field trip. Board decided that MGWA could help line up speakers, but not get involved in logistics.

Midwest Geosciences Workshop - MGWA will advertise their event in return for reduced rate for MGWA members, but MGWA will not be listed as sponsor. Advertisement will consist of one time use of mailing list, posting of workshop on the web site

MGWA Foundation Board Meeting Minutes

April 13, 2004

Directors Present: David Liverseed, Rob Caho, Cathy Villas-Horns, Al Smith, Marty Bonnell

MGWA Management Present: Jeanette Leete and Sean Hunt

President Rob Caho called the meeting to order.

Agenda Items: Election of Officers, Review of the Bylaws, Spring Conference , Treasurer's Report, New Requests, and Next Meeting (time and place). The Agenda was approved.

Election of Officers: Officers elected for this year were as follows: President – Rob Caho, Secretary – Al Smith, Treasurer – David Liverseed, and MWGA Liaison – Marty Bonnell. Cathy Villas-Horns and Gilbert Gabanski will serve as Directors-At-Large this year.

Review of the Bylaws: Copies of the Bylaws for the MGWA Foundation were distributed. A comment was made that we could possibly amend them to include a provision for Vice President.

Spring Conference: May 4, 2004, a report on Foundation activities will be presented – Discussion of potential funds available for the Science Museum Exhibit is $17,362.75 plus $2000 from the foundation.

Treasurer's Report: Total Assets (including the endowment, which is not available for disbursement) is $55,927.89. Fund balances are: $2500 for grants, $3110 for Scholarships, $17,362.75 is for Science Museum Ground Water Exhibit, and $9227 is unrestricted (but the Foundation has previously dedicated $2,000 of these unrestricted funds to the Science Museum Project).

New Funding Requests: Metro Childrens' Water Festival requested $2000. Motion was made and carried to support the festival with a $1000 donation. The Request for Funding form was distributed. David Liverseed offered to contact University Departments to see if they had any field trip or scholarship needs.

Fund-Raising Efforts: We discussed the need to bring fund-raising ideas to the next Foundation meeting.

Next Meeting: Next meeting is June 8th at 11:30 AM at Chevy's.

Respectfully submitted, Al Smith, Secretary

MGWA Advertising Opportunities

MGWA can place your ad in several ways: in the newsletter (quarterly), in the directory (annual, with periodic updates) on our web page, and through e-mailing to MGWA members. Two of the less-well-known options are:

Classified ads: Classified ads in the newsletter are charged at the rate of $3 per 45 characters (including spaces and punctuation) per newsletter issue.

E-mail notices: A one-time e-mailing to the membership costs $10 for an individual (e.g., seeking a job), and $50 for an organization (e.g., announcing a new product, job opening etc.). A 200 word limit is imposed. The advantage of e-mail is the speed of dissemination.

The Advertising Manager has final determination on the acceptance of materials submitted. Direct your orders and questions concerning advertising rates and policy to the Advertising Manager: Jim Aiken, Advertising Manager, c/o MGWA, 4779 126th Street, White Bear Lake MN 55110-5910; Phone (952)470-0983; jaiken@mccainassociates.com

Join the Minnesota Ground Water Association!

Annual dues are currently $25 for professional members and $15 for students. Members are entitled to subscribe to the paper version of the newsletter for $10/yr, the electronic version is available on the website for members at no additional charge. Members are also entitled to purchase a paper copy of the annual membership directory for $7; an electronic version is available on the website for paid members at no additional charge. Additional donations to the MGWA Foundation 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. The MGWA Foundation is a 501(c)3 non-profit and donations to it **are** deductible as charitable contributions.

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

- -

Name________________________________ Full-Time Student? ________________________________

Affiliation/Employer ____

Work Address ____

City, State, Zip Code____

Work Telephone Number __________________________ E-mail ________________________________

Fax Number____

Home Address ____

City, State, Zip Code____

Home Telephone Number ______________________________

Which Telephone Number should we use for Directory Listing? ________________________________

Please indicate if you want to have the Directory ($7) ________ or Newsletter ($10) mailed to you ________