Minnesota Ground Water Association

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President's Column

By Paula Berger

The MGWA Spring Conference was a great success. Approximately 115 were in attendance. The speakers were excellent and shared a variety of perspectives on brownfields redevelopment. It was especially interesting to learn of the different approaches taken by Minneapolis and St. Paul toward redevelopment of brownfields properties.

A summary of the conference and a reprint from a recent article in Brownfields News that highlights some of these differences is included in this newsletter. I'd like to again thank the speakers, organizers, and participants in the conference for helping to make it a success. Attendance at the membership meeting which followed the conference was, well, a little low; yet some interesting and important things did get discussed. We are in the process of updating the bylaws to include the Past-President position (all you Past-Presidents out there, did you know you didn't really exist?), and to form an Executive Committee, which would include non-elected positions such as the Newsletter Editor and the Advertising Manager. Please visit the MGWA Web Page at **www.mgwa.org** to preview the proposed bylaws changes and provide feedback. If 10% of the membership agree that changes are appropriate, balloting of the entire membership will proceed this fall.

Also discussed was MGWA membership itself. The MGWA membership peaked in 1994 with 541 members and has been holding steady for the past three years at between 465 to 480 members. This means that new members are replacing those whom we lose track of or who choose to drop their memberships. However,

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Hydrostratigraphy of Paleozoic Bedrock, Southeastern Minnesota

By Anthony C. Runkel

Aquifers and confining beds are bodies of rock. Porosity and permeability fundamentally control groundwater flow in rocks. Characterization of aquifers and confining beds, depicted in what is called a hydrogeologic framework, should therefore be based on the porosity and permeability of rock bodies. The commonly accepted hydrogeologic framework for the most widely used aquifers in the state, the sandstone, carbonate and shale of Paleozoic age in southeastern Minnesota, is not based on this fundamental principle. As a result its continued use has seriously hindered groundwater management practices and scientific investigations. It is time to construct a new hydrogeologic framework that is based on the water-bearing characteristics of strata; this approach is called a hydrostratigraphic approach.

Commonly Accepted Framework

Background The commonly accepted, or "classic" hydrogeologic framework for the bedrock of southeastern Minnesota (Fig. 1) is based largely on the first state hydrogeologic map (Kanivetsky and Walton, 1979). Paleozoic lithostratigraphic formations from an earlier bedrock map were grouped by Kanivetsky and Walton (1979) into five aquifers and four confining beds. They conducted their study using the premise that lithostratigraphic units more or less correspond to hydrogeologic units at the regional scale of their map. Characterization of individual hydrogeologic units was based largely on the compilation of previous work, most conducted by the US Geological Survey in the Twin Cities metro area (e.g. Norvitch and others, 1973). The classic hydrogeologic framework, with minor revisions, has been widely used by environmental managers and scientific investigators over the past 19 years to depict groundwater conditions at all scales and depths across southeastern Minnesota.

Limitations How would you classify the following two bedrock layers in a hydrogeologic framework? 1) A fractured, karsted carbonate rock layer that has solution features large enough to walk through, and 2) A 100 ft thick layer of very fine grained sandstone and shale that has a vertical conductivity of 10^{-4} ft/day, and that hydraulically separates more permeable layers above from those below. On nearly all hydrogeologic maps, computer models, and sensitivity to pollution maps published in the past two decades the karsted carbonate rock layer (Platteville Formation) is depicted as a confining bed, and the shaly layer (part of Franconia Formation) is depicted as an aquifer.

These are only two of many examples that demonstrate the failure of the classic hydrogeologic framework to provide an accurate depiction of groundwater conditions in southeastern Minnesota. The classic approach has suffered from three fundamental

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The primary objectives of the MGWA are:

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

President's Column, continued

our student membership has dropped from over 20 members in the early 1990s to only 3 members this year. It was decided that more effort should be made to make the MGWA known to students and to recruit more student members. Ultimately, the future of the groundwater field will be in the hands of today's students and their involvement groundwater-related organizations like the MGWA will benefit all. One of the successes of the MGWA has been that it includes people from both the public and private sector working in a variety of settings. With Steve Robertson's move to the Minnesota Department of Health, the newsletter committee is now lacking representation from the private sector. Having the perspective of all aspects of the industry is important to maintain a balance in MGWA and the newsletter team is looking for a volunteer to provide some level of input, either as a member of the team or as a reviewer to provide input. If you are interested in assisting the newsletter team, please give any of the board or newsletter team members a call.

Now, with the Spring Conference behind us, we look forward to summer and then the fall field trip. As I get older time passes faster and summers pass the fastest of all. It seems early to be thinking of fall already but planning has already begun. As always, we are looking for volunteers to help with the field trip. In the meantime, I hope everyone has a good summer.

Paleozoic Hydrostratigraphy, cont.

problems: 1) It is based on the incorrect assumption that lithostratigraphic units are equivalent to hydrogeologic units; 2) It fails to address the important fact that individual lithostratigraphic units that are fractured and karsted in their "near-surface" extent, may have very different hydrogeologic properties in deeper subsurface settings; and 3) Hydraulic conditions within the framework are based chiefly on potentiometric maps that fail to delineate important confining beds.

The purported hydrogeologic units mapped by Kanivetsky and Walton (1979) are not hydrogeologic units at all, they are lithostratigraphic units with terms such as formation simply replaced with the terms aquifer or confining bed. These lithostratigraphic units were developed (e.g. Mossler, 1987) with *no regard* for hydrogeologic properties. The characterization and classification of these ersatz hydrogeologic units as aquifers and confining beds is based on scattered observations of local hydrologic conditions (mostly in the metro area) extrapolated to each individual unit across all of its extent and at all depths in southeastern Minnesota.

Individual hydrogeologic units in the classic framework are commonly depicted as having more or less the same hydrogeologic properties in deep settings as they do in shallower near-surface settings (Kanivetsky and Walton, 1979). We now recognize that bedrock in outcrops and in quarries is ubiquitously fractured, commonly to depths of more than 100 ft below the bedrock surface, and that solution features are common in carbonate rocks (e.g. Alexander and others, 1996). Cores collected from greater depths below the bedrock surface have fewer and generally smaller fractures and solution features. Carbonate rock layers best reflect this relationship: individual units can be karstic and have high conductivity in near-surface settings (e.g. Alexander and others, 1996), but have relatively low conductivity and consequently act as confining beds where they are covered by hundreds of feet of younger bedrock and secondary porosity is not well developed (e.g. Nicholas and others, 1984; Libra and Hallberg, 1985, Visocky and others, 1985).

Large-scale potentiometric maps (1:100,000 and greater) used to depict the hydraulic conditions in the classic hydrogeologic framework (e.g. Delin and Woodward, 1984; Kanivetsky, 1988) have inherent limitations related to scale and methods of study that have obscured recognition of important, regional-scale, confining beds. The scale of these maps relative to the number of data points, the sources of error in determining potentiometric elevations, and the poor internal stratigraphic control preclude the recognition and accurate contouring of small (ft) vertical differences in potentiometric head within individual aquifers. Where such differences *have been* noted across adjacent units within an individual aquifer they are most commonly dismissed as "local" or "small" by investigators operating with the incorrect premise that an apparent similarity in heads across the same units elsewhere is by itself proof of good hydraulic connection. Rigorous, stratigraphically controlled hydrogeologic testing commonly does not support the depiction of internal hydraulic connection within many of the supposed single aquifers of the classic framework. For example, site-specific studies demonstrate that the fine clastics in the lower Franconia Formation hydraulically confine the underlying coarse clastics of the Ironton Sandstone, even in a fractured setting (e.g. Miller and Delin, 1993: Delta Environmental Consultants, Inc., 1992; Wenck and Associates, Inc., 1997). Similarly, the "upper carbonate aquifer" of the classic hydrogeologic framework has been shown to contain at least two internal confining beds in northern Iowa and in southern Minnesota (Libra and others, 1984, Libra and Hallberg 1985: Green and others, 1997; Mossler, in press; Tipping, in prep). Varied hydrologic evidence including potentiometric data (e.g. Donahue and Associates, 1991), pumping tests (e.g. Barr Engineering, 1996), and groundwater chemistry (e.g. Alexander, 1990; Setterholm and others, 1991; Wall and Regan 1994) also indicates that the

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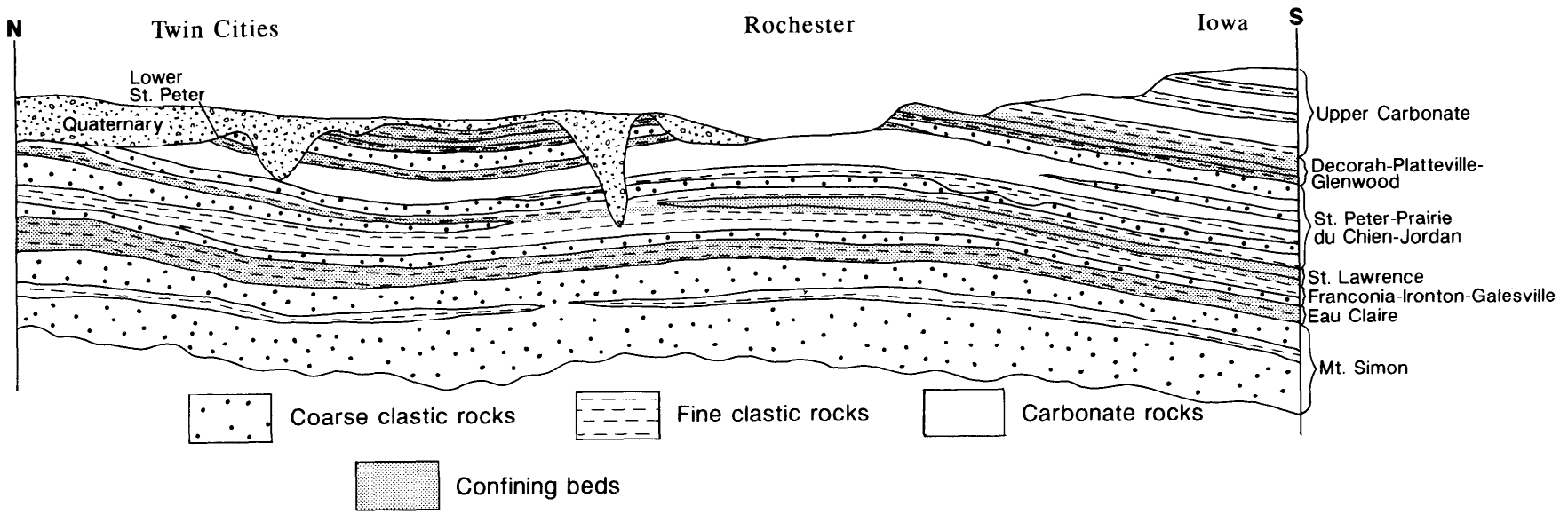

Fig. 1 Highly schematic cross section (not to scale) of Paleozoic strata across southeastern Minnesota showing commonly used hydrogeologic framework superimposed on three principal rock types. Unshaded areas are aquifers

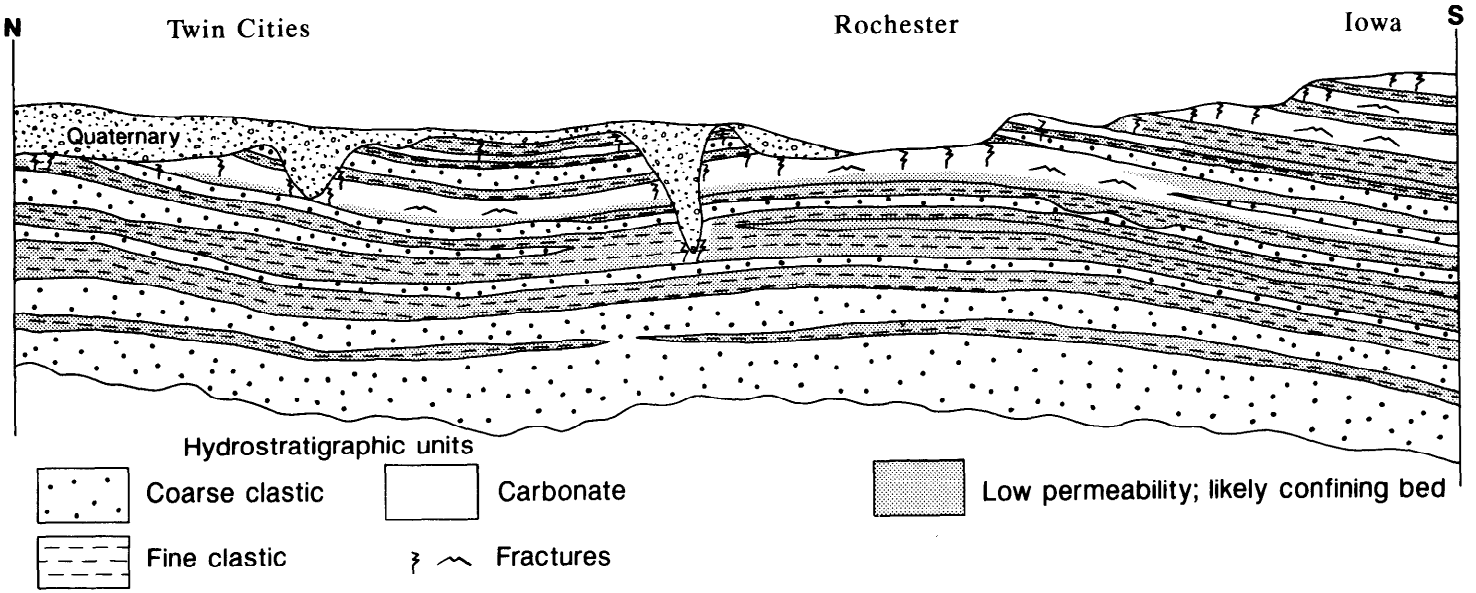

Fig. 2 Highly schematic cross section (not to scale) of Paleozoic strata across southeastern Minnesota showing hydrogeologic framework based on distribution of three principal hydrostratigraphic units. Only regionally extensive, relatively thick aquifers (unshaded) and confining beds (shaded) are shown. On a local scale, individual confining beds can have major groundwater conduits within them, and aquifers will contain internal confining beds.

Paleozoic Hydrostratigraphy, cont.

karsted carbonate rock of the Prairie du Chien Group is hydraulically separated from the coarse clastics of the Jordan Sandstone by fine clastic strata and unfractured carbonate rock. Seven of the nine geologic atlases completed for southeastern Minnesota counties note "local" differences in potentiometric head between the Prairie du Chien and Jordan (e.g. Kanivetsky, 1988). The results of these studies raise important questions about the accuracy and usefulness of large-scale potentiometric and transmissivity maps that depict hydraulic characteristics within the classic framework.

Hydrostratigraphic Approach

A hydrogeologic framework should be based on hydrostratigraphic units. Hydrostratigraphic units are defined to distinguish bodies of rock that may be similar in other material categories on the basis of content or physical limits, but differ in the properties of their water bearing interstices (Seaber, 1988). Therefore they are based on features that control groundwater flow. Such units may or may not correspond to lithostratigraphic units.

Hydrostratigraphic components Hydrostratigraphic procedures are flexible and applicable to any scale of investigation. A few hydrostratigraphic components can be defined and mapped for investigations at regional scale, or dozens of individual components can be delineated for site specific studies. On a regional scale the Paleozoic strata in southeastern Minnesota can be divided into three distinct hydrostratigraphic components (Fig. 2, Table 1). The components are: 1) fine clastic rock; 2) coarse clastic rock; and 3) carbonate rock. The fine clastic component consists of moderately to strongly cemented very fine grained sandstone, siltstone and shale that has low to very low relative permeability. The coarse clastic component is a moderately sorted to well-sorted, fine- to coarse-grained sandstone composed of about 98 percent quartz that has a high to very high permeability and porosity. The carbonate rock component consists mostly of limestone or dolostone with negligible matrix porosity and permeability. Values for porosity and permeability within the carbonate rocks vary markedly depending on the degree of development of fractures and solution features, and the scale of the method used to determine them. Permeability varies from extremely high where such features are well developed and interconnected, to very low, even on a large scale, where minimally developed (e.g. Nicholas and others, 1984; Libra and Hallberg, 1985; Visocky and others, 1985).

Lateral and vertical variability in the frequency and interconnectivity of fractures and solution features can markedly affect the hydrogeologic character of the three components described above. Such features are most abundant and best interconnected in the 100 ft below the land or subcrop surface (Fig. 2). In such a setting, the fine clastic component, which has low to very low intergranular permeability, may be orders of magnitude higher in conductivity because there is a substantial component of flow along fractures (Wenck and Associates, Inc., 1997). Conversely, the carbonate units, which are karstic in near-surface settings, may have a relatively low conductivity and act as confining beds where they are covered by younger bedrock because their secondary porosity is not well developed (e.g.Nicholas and others, 1984; Libra and Hallberg, 1985; Visocky and others, 1985). Additionally, fracture flow may be dominant even in the coarse clastic component, which has a high intergranular permeability, where it lies near the surface. Additional work is needed in near surface, fracture-dominated settings (e.g Alexander and others, 1996; Gianniny and others, 1996) to define and characterize hydrostratigraphic units.

Revised Classification of Aquifers and Confining Beds The revised classification of Paleozoic aquifers and confining beds shown in Figure 2 is based on standard hydrologic data such as potentiometric levels, distribution of springs, pump tests, and water chemistry that can be confidently constrained within the context of the hydrostratigraphic framework. The carbonate rock (where dissolved/fractured) and coarse clastic components are aquifers that contribute most of the yield to water wells developed in Paleozoic strata. The fine clastic component can potentially yield moderate quantities of water, in particular where it is highly fractured, but more

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Table 1. Characteristics of three principal hydrostratigraphic components that compose the Paleozoic rocks of southeastern Minnesota. Data from Norvitch and others (1973), Libra and others (1984), Setterholm and others (1991), Miller and Delin (1993), and unpublished data from Minneapolis Gas Co. records stored at the Minnesota Geological Survey. *1-centimeter-scale permeability.

Hydrostrat component	Character of porosity and permeability	Plug sample permeability (md)*1	Pump test hydraulic conduct.
Coarse clastic	Intergranular	>3000 (HIGH)	Kh= 2-20 ft/day (MOD to HIGH)
Fine clastic	Intergranular	10^{-5} to 100 (vertical) (horizontal) (V.LOW-LOW)	Kh= 10^{-2} ft/day Kv= 10^{-4} ft/day (LOW)
Carbonate	Fractures/ sol'n features	10^{-2} to10^{-5} (V. LOW)	Kh= 1-40 ft day (MOD. to HIGH)

importantly it serves as confining units that separate coarse clastic and carbonate aquifers (e.g. Wenck and Associates, Inc., 1997). Carbonate rock can also serve as confining beds where it is unfractured (e.g. Nicholas and others, 1984; Visocky and others, 1985).

The revised hydrogeologic framework (Fig. 2) includes changes to the boundaries and internal attributes of nearly every hydrogeologic unit of the classic framework (Fig. 1). A notable example is that the Franconia-Ironton-Galesville aquifer of the classic framework is not a single, hydraulically connected aquifer as commonly supposed (e.g. Kanivetsky and Walton 1979). Pumping tests (e.g. Miller and Delin, 1993) and stratigraphically well-constrained local static water level measurements (Delta Environmental Consultants, Inc., 1992; Wenck and Associates, Inc., 1997) clearly demonstrate that the fine clastic component of the lower Franconia hydraulically separates groundwater in more permeable strata above and below. This lower Franconia aquitard is as thick and laterally extensive as any confining bed in the Paleozoic section of southeastern Minnesota, and has hydrogeologic properties nearly identical to those in the well-known Eau Claire confining unit (Miller and Delin, 1993); recognition of these features has been obscured by the long-standing adherence to the classic framework.

Recognition of the lower Franconia confining bed is one of many examples of the advantages of the hydrostratigraphic approach in constructing a hydrogeologic framework. Another is that the approach makes a distinction, albeit highly generalized at this time, between near-surface fractured conditions versus deeper confined conditions; it shows for example that the "Platteville confining bed" of the classic framework is more accurately depicted as a karstic aquifer in subcrop and outcrop (e.g. Spong, 1980; Lindgren, 1994; Hoffman and Alexander, 1998). Another major advantage is that a hydrostratigraphically based framework better depicts the fundamental lithologic controls on groundwater movement. For example, the lithologic controls on transmissivity and the distribution of nitrates in the widely used "Jordan Aquifer" were elucidated through a hydrostratigraphic approach whereas the classic framework simply did not provide the information necessary to make such determinations (Setterholm and others, 1991; Runkel, 1996). Perhaps more importantly, the hydrostratigraphic framework provides a high degree of predictability of hydrogeologic conditions because individual hydrostratigraphic units by definition have the same water-bearing characteristics wherever they occur. In contrast, lithostratigraphic units vary markedly from place to place in their water-bearing properties.

A much better understanding of groundwater conditions is gained when it is not assumed that the classic, lithostratigraphically based hydrogeologic framework is applicable to a given area of study. Some examples include the Aquifer Thermal Energy Storage (ATES) project (e.g. Miller and Delin, 1993), which remains the best hydrogeologic study of confined siliciclastic bedrock in Minnesota; the Oronoco Landfill study of the groundwater movement in the Prairie du Chien Group and Jordan Sandstone (Donahue and Associates, 1991); and investigations of carbonate-dominated, karsted strata south of Rochester (Libra and others, 1984; Alexander and others, 1996; Green and others, 1997) and in Wisconsin (e.g. Gianniny and others, 1996). Even though these studies do not strictly follow hydrostratigraphic procedures, they contain the data necessary to construct such a framework and therefore the results can be confidently extrapolated elsewhere. Much of Figure 2 is based on the results of these studies.

The hydrogeologic framework shown in Figure 2 is a schematic, highly generalized depiction of regional groundwater conditions, not a citable model. We are in the early stages of a reevaluation of the hydrogeologic properties of Paleozoic rocks, and recognize that much more fundamental information is needed. For example, we know little about the position of confined conduits in deeply buried carbonate units, and about the interplay between intergranular and fracture flow in siliciclastic units that are near the land surface. Variability in cementation of the siliciclastic units also is poorly understood. The construction of a new hydrogeologic framework is essentially a mapping exercise and as such we must first define map units and test their usefulness. Some will fail to be useful and be abandoned, others will be added. Eventually, well constrained local studies can be compiled into a regional scale framework, and the hydrogeologic units can be formally named.

Conclusion

The primary objective of this article is not to gain acceptance of the cartoon framework shown in Fig. 2. Rather, the objective is to spur a reevaluation of the manner whereby we classify and characterize hydrogeologic units in southeastern Minnesota. Critical evaluation of the fundamental scientific data, methods and principles that support the commonly accepted hydrogeologic framework shows that it is substantially inaccurate and inconsistent at all scales. It is time to adopt a more rigorous approach to hydrogeologic characterization in southeastern Minnesota. Hydrologic data should be collected and interpreted within the context of hydrostratigraphic components, rather than lithostratigraphic units. Until we do so we will continue to hinder advancement in understanding groundwater conditions.

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New 651 Area Code Affects Most State Offices

The new 651 zip code goes into effect on July 12, 1998, and will become mandatory on January 10, 1999.

The new area code affects all of St. Paul and many of its surrounding communities, including Arden Hills, Eagan, Forest Lake, Farmington, Roseville, Lindstrom, Lino Lakes, Mendota Heights, New Brighton, North Branch, Rosemount, Shoreview and other communities to the east, including Red Wing and Wabasha.

This upcoming change means that if you are calling from the west part of the metro area, you will need to dial 10 digits in order to reach your favorite regulator, but it should be a toll-free call. I hear neurologists that treat repetitive motion disorders are behind this.....

New Special Well Construction Area

The Minnesota Department of Health (MDH) has designated a SPECIAL WELL CONSTRUCTION AREA, which includes portions of the city of East Bethel, in Anoka County, as shown on the accompanying map. The Special Well Construction Area designation became effective on **March 15, 1998**, and will remain in effect until further notice.

Groundwater in portions of the designated area has been contaminated as a result of operation of the East Bethel Sanitary Landfill. Groundwater contamination extends beneath most of the landfill site, and for several hundred feet beyond the landfill borders to the south and west. Several volatile organic chemicals (VOCs) have been detected off-site in excess of Health Risk Limits (HRLs).

Area geology consists of a surficial sand deposit, typically 20 to 60 feet deep, underlain in places by a discontinuous Grantsburg till deposit up to 20 feet thick, below which is an additional 10 to 30 feet of sand. Below this is 10 to 50 feet of Superior till. The top of the uppermost bedrock formation, the Franconia sandstone is found at depths of 100 to 150 feet. The water table in the surficial sand occurs at depths from 0 to 30 feet. Groundwater flow is generally to the south and southwest.

Contamination has been found in both the surficial and buried sand deposits above the Superior till. No contamination has been found in monitoring wells completed in the Franconia formation. Hard clay and silt layers in the Superior till appear to be acting as a confining layer.

The Minnesota Pollution Control Agency (MPCA) has implemented remedial measures at the now closed landfill, including a landfill cover system, passive gas venting system, and a groundwater pump-out system. The pump-out system runs seasonally, from April to the end of October. The MDH and the MPCA are concerned about the public health effects that could result from the use of water-supply wells in the contaminated aquifers prior to the cleanup completion. The MDH and MPCA are also concerned that the construction of new wells or modification of existing wells within the Special Well Construction Area may interfere with cleanup efforts, or may cause further spread of the contamination, especially during the winter when the pump-out system is idle. It is also important to assure that unused wells are properly sealed. The designation of the special well construction area is intended to address these concerns. Within the designated area, wells cannot be constructed, modified, or sealed until after the MDH has proposed activity. Plans are required for all regulated wells, including potable water-supply wells, irrigation wells, commercial and industrial water-supply wells, wells for heating and cooling, remedial wells, monitoring wells, and dewatering wells. In reviewing plans for well construction or modification, the MDH will consider the proposed well construction details, use, and pumping rate, as well as available knowledge of groundwater contamination and movement near the well site. Special requirements may include completion of the well in or below the Franconia formation, with casing and grout emplaced through all overlying formations. The well may need to be sampled for VOCs to determine if the water supply is acceptable. Well construction or reconstruction will not be approved if the MDH, in consultation with the MPCA, concludes that the proposed construction or reconstruction may interfere with cleanup efforts, cause further spread of contamination, or result in human exposure to contaminants at concentrations exceeding MDH's Health Risk Limits (HRLs). For additional information regarding this Special Well Construction Area, or to request a copy of the Special Well Construction designation, contact Ed Schneider at the MDH at 612/215-0827.

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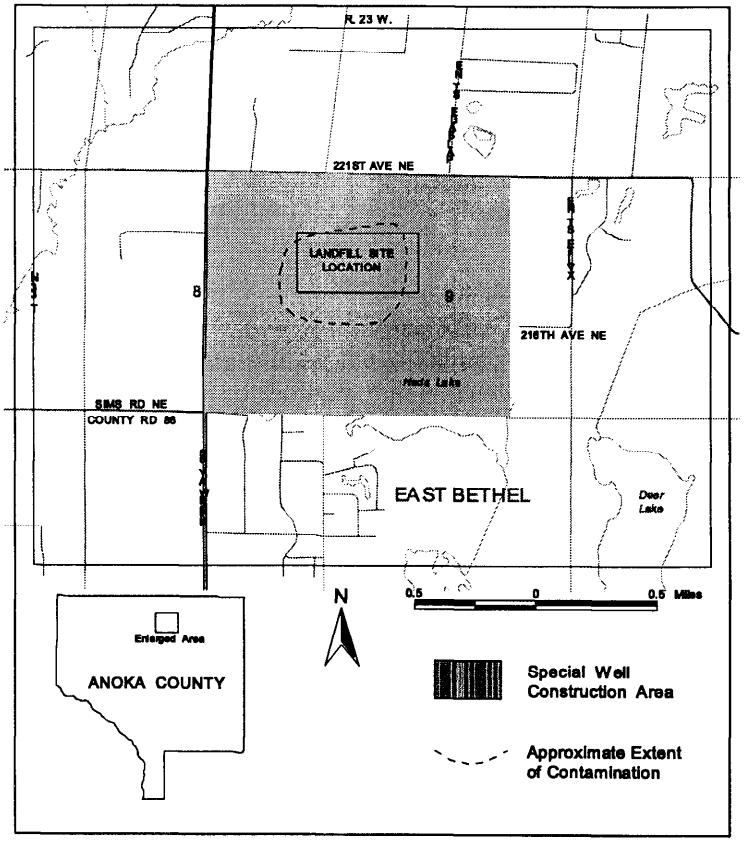
Special Well Construction Area
East Bethel Sanitary Landfill



Brownfield Redevelopment and Ground Water Protection

A great turnout of members and others to the MGWA Spring Conference were greeted by Paula Berger in the 3M Auditorium of the Minnesota History Center. Brownfields were defined somewhat differently by the presenters but in general are formerly used land parcels with impediments to reuse including possible contamination. Redevelopment of urban sites is not new, but what seems new is the effort directed by agencies and the encouragement by a variety of funding sources (see sidebar) to accomplish the work.

Deborah DeLuca, Braun Intertec, led off the program with an overview of Minnesota brownfields programs. Formerly of the Minnesota Pollution Control Agency, Voluntary Investigation and Cleanup Program (VIC), Deborah substituted for **Joe Otte**, MPCA-VIC, who was not able to attend. The extent of brownfields was shown and the definition was presented: brownfield sites are generally urban, aren't producing the expected tax base, have an existing potential for contamination, and have legal, technical, and financial obstacles to reuse. The VIC program was recreated in 1988 to assist property transactions of these sites. Since then, and with legislative modifications, the VIC program has developed a variety of flexible tools for response. Since 1988, 1040 sites have been enrolled in the VIC program, with about 250 complete cleanups and 700 various letters of determination, e.g., off-site source or no association. In addition, a broad selection of financial assistance tools has been developed. Rounding out her talk, Deborah provided a long list of recommendations for a successful project starting with "Hire a consultant and environmental attorney", including items such as "Expect a few crises", and ending with "Work with multiple end points".

Next **Mark Staba**, Minnesota Health Department, addressed health risk standards and their application at brownfield sites. Mark reviewed the four-step assessment process for preparing a health-risk assessment for ground water: hazard identification, dose-response identification, exposure assessment, and risk characterization. The standard then goes to the risk manager for application. Development of the Health-Risk Limits (HRL's) by this process was reviewed (steps one and two for contaminants found in Minnesota ground water). In response to a question about naturally occurring carcinogens, Mark noted that a study of arsenic in the vicinity of Fergus Falls was underway. *(See article on page 11 – Ed)*

Kathy Carlson, MPCA, reviewed community relations at sites, including "hot-button" sites. Having worked on many hundred sites, Kathy provided very practical tips. She explained that the starting place is defining the community, either narrowly or broadly, depending on the situation. She reviewed issues, such as "efficiency is not more important than democracy to the public", that must be considered. General rules, tools and techniques were presented for successful community relations. In closing Kathy said, "community relations is not an event, it is a relationship."

Martha Brand, Leonard, Street, and Deinard, addressed private perspectives of brownfields. The focus on brownfields by the private sector seems less environmental and more financial or legal. From the private perspective brownfields redevelopment is important because it creates jobs, increases tax revenues, improves infrastructure utilization, lessens attractiveness of greenfields, improves urban land utilization, and finally, removes contamination. Historically, reuse of brownfields was prevented by lack of liability protection, standards and costs required for remediation, legal and other costs for transactions, and the "surprise" factor. However, Martha noted that these days "brownfields are blooming" and went on to explain why. First on the list were the liability assurances available from the Minnesota Pollution Control Agency. The other part of the equation is the use of risk-based clean-up standards and institutional controls. Martha explained that the practical result was predictable costs and results. Four other factors currently encourage brownfield rede-

— *continued on next page*

Minnesota Money Menu

from Minneapolis/St. Paul – Unidentical Twins, by Kellee Van Keuren, Brownfield News, April, 1998

Minnesota state funding for brownfields comes from a variety of programs and sources including the following:

Agricultural Chemical Response and Reimbursement Account ACRRA was created in 1989 to cover the costs of cleaning up agricultural chemical spills. The account is funded by annual surcharges on pesticide and fertilizer manufacturers, distributors, applicators and dealers. Any responsible person or real property owner is eligible to receive funds.

Redevelopment Grant Assistance Program for Nonprofit Organizations RGAP provides technical assistance and funding for conducting environmental investigations of real property that nonprofit organizations own or want to acquire. The Minnesota Pollution Control Agency (MPCA) provides half of the funds for a project through a Ford Foundation award the agency received in 1994. Matching funds are provided by private industry sources. All nonprofit organizations are eligible to receive funds.

Contamination Cleanup Development Program This program was created in 1993 to provide financial incentives for cleaning up developable lands. In 1997, the state legislature increased the amount available from $7.8 million to $19.4 million over a period of two years. Cities and their development authorities are eligible to receive funds.

Dry Cleaner Environmental Response and Reimbursement Account This account was started in 1995 to clean up chemical spills and other contamination at dry cleaners. Funding is provided by an annual fee paid by dry cleaners and a monthly fee paid by sellers of dry cleaning solvents. Past or present owners or operators of dry cleaning facilities are eligible to receive funds.

Petro Fund Originally formed to provide for the cleanup of releases from petroleum storage tanks, the fund now also covers petroleum cleanup

at sites where no tank-related release can be established. Parties required to take corrective action are eligible to receive funds.

Tax Base Revitalization Account Created in 1995, this account provides funding for cleaning up contaminated land for subsequent industrial and commercial development. Cities that participate in the Metro Livable Communities Act's Affordable Housing Program are eligible to receive funds.

Low Interest Hazardous Waste Cleanup Loans This program provides low-interest loans to small businesses required to investigate and clean up contamination at a business location. Businesses that employ less than 50 full-time staff, report an after-tax annual profit of less than $500,000 and possess a net worth of less than $1 million are eligible for receive funds.

Twin Cities Brownfields Directory

Minneapolis [sic] State Legislature: Myron Orfield, Executive Director, 612-296-4165 [sic] *

Minneapolis Community Development Agency: Rebecca Yanisch, Executive Director, 612-673-5125

St. Paul Port Authority: Mike Strand, Vice President of Marketing and Communications, 612-224-5686 and Lorrie Louder: 612-223-5198

Minnesota Pollution Control Agency: Joe Otte, Supervisor, Voluntary Investigation and Clean-up Unit, 612-296-0892

Minnesota Department of Trade and Economic Development: Louis Jambois, Director of Community Finance, 612-297-3172

Minnesota Environmental Assessment Roundtable: Ken Haberman, Member, Senior Environmental Scientist for Barr Engineering, 612-832-2648

U.S. EPA Region 10: Lori Cohen, Brownfield Coordinator, 206-553-6523

Minnesota Brownfields Initiative: Brian Lammers, 612-334-3388

*Representative Myron Orfield, Minneapolis, is a member of the Minnesota State Legislature, office number 296-9281; the number listed above is an unknown fax machine.

Brownfield Conference, cont.

velopment 1) experienced people are involved, 2) sophisticated transaction documents are available 3) insurance is available, 4) varied funding sources exist.

Deborah DeLuca next reappeared in her true guise as private consultant with Braun Intertec. Deborah focused her talk around the evolving policies relating to asbestos. She specifically recommended that any 20th-century fill be scrutinized for asbestos content and that the client should be alerted. She noted the need for practical interpretation of NESHAP regulations and suggested the setting of a de minimis level. She noted the MPCA risk-based program that recognized the site-specific nature of each clean up decision, the use of consistent procedure, the variety of guidance documents available, and additional guidances under preparation, such as for site closure. Deborah stressed that risk-based decisions required good data and that the MPCA needed in-house risk-assessment capability. Anyone interested should contact Trudy Cramlet, MPCA, 296-7291 to be included on a mailing list. In closing, Deborah noted that VIC sites did not meet CERCLA requirements for cost recovery and that a decision should be made ahead of time whether to pursue cost recovery.

The next several speakers, beginning with **Lorrie Louder**, St. Paul Port Authority, specifically addressed redevelopment issues. Lorrie noted that redevelopment of brownfields was a team effort involving technical, regulatory, and legal issues. She noted that the St. Paul Port Authority redevelopment criteria include such issues as increase in taxes and overall benefits. "Facts of life" in this process include the need for companies to complete a project in a short time and the greater desirability of larger parcels. Lorrie noted that remediation costs are generally $1-$4 per square foot. Even so, the St. Paul Port Authority has identified 1,000 acres in St. Paul for brownfield treatment.

Pat O'Connor of Hennepin County provided examples of innovative site reuse, including an urban tree research site, for sites that may not otherwise be attractive for reuse. He noted there are many orphan, often tax-forfeit, sites available for adoption by neighborhoods or other reuse with the right creative idea.

Kent Carlson, Ryan Companies, next discussed the developers' perspective, or "Why would a developer be interested" in a brownfield site? Kent offered the following reasons: good locations, proximity to employees, strong interest by community, change in agency involvement creating opportunity, funding sources, EPA limited future liability agreement, understanding by lenders, acceptance by potential customers. The challenges of redevelopment include understanding the specific issue at the site, knowing the surrounding area, being able to work with the community, having a good team, and understanding the market conditions. Kent noted the importance of having a financial plan, allowing enough time, and building in contingencies. As a last note, he said, "expect surprises".

Closing out the day's program was **Ken Haberman** of Barr Engineering. He compared Minnesota to other states, commented on trends, and gave suggestions for the future. From the detailed handout provided with the conference materials it is clear each state has a personality all its own when it comes to brownfields redevelopment. Ken noted that states' statutes and interests vary, and some are better to work with than others. For the future, Ken hoped that wider types of land uses would be encouraged and more incentives would be available. He would like to see the Minnesota program maintain its flexibility and minimize regulatory overlap. He suggested that projects include opportunities for public involvement and that public-private partnerships be built. He urged continued development of incentives addressing liability, financial, and technical issues.

For more information on brownfields remediation and redevelopment contact any of the agencies or resources listed in the sidebar. To borrow or copy the taped (audio) proceedings, contact Jan Falteisek, 297-3877, e-mail jan.falteisek@dnr.state.mn.us.

— contributed by Jan Falteisek

Capillary Fringe

By Mitch Chiodi (a former MPCA drone who now writes and speaks about the future of environmental regulation on a freelance basis).

Since I left the MCPA Leaking Underground Storage Tank (LUST) Program over 2 years ago, I've had the good fortune to spend time in Latin America and Southeast Asia. One of the first things you learn in a lesser-developed country like Mexico or Thailand is "don't drink the water."

For a hydrogeologist from a place where almost everyone takes their safe drinking water for granted, this admonition is somewhat puzzling. How can it be that the local water is so bad? Is it really so difficult (or expensive) to provide a clean water supply? Is there something WE as hydrogeologists can do to help?

Maybe two examples of places I saw can help us think about these questions and come up with some ideas.

On a recent trip to the Golden Triangle region of northern Thailand, I experienced firsthand the water supply of a small Lahu hilltribe village located about 20 miles west of Chaing Rai.

The Lahu village has about a dozen houses, bamboo huts really, with a shared central water supply. The residents divert a spring into a bamboo aqueduct to deliver water. Four inch thick bamboo trunks were split in half lengthwise, hollowed out, connected together, and elevated to a place in town that serves as both a water faucet and bathing area. The locals shower beneath the flow with an impressive lack of shyness that even this fairly liberal visitor couldn't get up enough nerve to emulate.

Our guide told us not to drink the water, but he said it was fine for bathing. At first glance, the spring water seems excellent in quality. The locals certainly use it. Maybe our guide was just being cautious with us because the village folks wanted to sell more bottled water, canned soda, and beer. However, after discovering that our bathroom was anywhere and everywhere shared with the free-ranging pigs and chickens, I'm glad I didn't risk drinking the water.

During another trip last winter, I experienced a much different situation in the picturesque mountain village of Benito Juarez, located in the southern Mexican state of Oaxaca. The indigenous Zapotec people who live in Benito Juarez are quite proud that neither they nor their visitors have to worry about Montezuma's Revenge.

When I arrived one night as the only guest in their beautiful new tourist house, I was told the tap water was safe to drink. They offered me a quick tour of the village water supply system in the morning to show me why.

Like the Lahu villagers, they also tap a spring. They divert and collect the spring water into several concrete cisterns to maintain head before piping the water to the 50 or so houses in the village. Every house with a hook up has clean drinking water and a flush toilet. Their low-tech system works because the water is collected from a protected watershed above town. The sewage discharged below town is small enough, and the village remote enough, to have little impact on anyone down in the valley.

Considering the two situations above, the original question of "why" much of the world uses bad water still goes unanswered. The Benito Juarez example is simple, but rare. It doesn't seem to me that many of the other places I visited, especially the larger cities, are going to get a well engineered and maintained water supply/wastewater system like the one I have at home in North St. Paul any time soon. However, I think many places like the Lahu village and even some much larger towns can benefit from the example of knowledge and pride found in Benito Juarez.

When I see how many places in our increasingly inter-dependent world that don't have safe water supplies I wonder even more whether we have our priorities straight in this country.

Of course it's wise for us to protect our surface and ground water resources "as best we can." Unfortunately, "as best we can" is often overkill. Our western world has such large monetary resources (much of it generated off the back of the world's environmental resources?) that we do "the best we can" just because "we can" for a high price rather than do only what is necessary and sensible.

What I question still is whether it would be wiser for us to share more of our expertise and resources to help the rest of the world obtain better water rather than investing so much on expensive, minimal return projects like cleaning up low-risk contamination sites.

Granted, it becomes a political question, but what makes more sense — spending $500,000 to clean-up a non-migrating TCE or DNAPL plume beneath an area with access to an alternative water supply, or spending the same $500,000 to educate and help others with more immediate water problems in needier parts of the world? Maybe more of us should take time off from what we do to travel if the answer isn't obviously the latter.

1998 Birdsall-Dreiss Distinguished Lecturer at the University of Minnesota

On April 30, 1998, Dr. Jeffrey Hanor of Louisiana State University delivered the 1998 Birdsall-Dreiss Distinguished Lecture in hydrogeology at the University of Minnesota's Pillsbury Hall. Dr. Hanor, who has spent his career studying saline fluids in sedimentary basins, was selected for this honor by the Hydrogeology Division of the Geological Society of America (GSA).

Dr. Hanor was introduced to the audience by Dr. Mark Person of the University of Minnesota's Department of Geology and Geophysics, who received this honor from GSA in 1997. The title of Dr. Hanor's lecture was, "The Origin and Migration of Saline Fluids in Sedimentary Basins."

Dr. Hanor began his talk by noting that most sedimentary basins contain large volumes of pore water having salinities far greater than normal sea water. Using examples from the U.S. Gulf Coast, where he has focused much of his research, he presented a review of the history of thought regarding the origin of the subsurface

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The Minnesota Arsenic Study

By Mindy Salisbury and Rich Soule, Minnesota Department of Health

The Minnesota Department of Health (MDH) is presently conducting a study of arsenic in private drinking water wells. The study, which is known as the Minnesota Arsenic Study (MARS), involves sampling up to 1,000 private drinking water wells in west central Minnesota and collecting arsenic exposure information from a portion of the people drinking water from the sampled wells. Data collection has been underway since April and should be completed in November 1998. MARS is a joint effort between the MDH, the University of Minnesota, and Hennepin County Community Medical Center.

MARS has several goals. The first study goal is to identify aquifers and wells with concentrations of arsenic near the current federal Maximum Contaminant Level (MCL) of 50 ug/L. The second study goal is to assess biomarkers of exposure and potential for health impact from long-term consumption of water that contains concentrations of arsenic near and below the current MCL. A third study goal is to determine whether field-screening methods may indicate the likelihood of high arsenic concentrations in groundwater. The final study goal is to develop inexpensive and effective water treatment methods for arsenic and to provide this information to private well users.

MARS is being conducted in two phases. During the first phase, which is underway, up to 1,000 household drinking water wells will be sampled and analyzed for arsenic and other trace metals. Field screening is also being performed for the parameters of temperature, pH, dissolved oxygen, and redox potential. The primary goal of phase one is to identify the arsenic exposure of the people drinking water from these wells.

During the second phase of MARS, some members of the approximately 300 families who are drinking the sampled well water will be asked for hair and urine samples. The hair and urine samples will be analyzed for arsenic and effect biomarkers, which are biological changes that might be related to arsenic exposure. The primary goal of phase two is to determine if there is a correlation between arsenic consumption and arsenic uptake. A secondary goal is to evaluate the potential of arsenic has to cause biological damage when consumed at low concentrations.

Why West-Central Minnesota?

Past groundwater testing, which has been conducted by the Minnesota Pollution Control Agency's Groundwater Monitoring and Assessment Program (MPCA GWMAP), the MN Department of Natural Resources (DNR), the MDH, and the Centers for Disease Control (CDC), has detected relatively low concentrations of arsenic in groundwater over a widespread area of western Minnesota.

MARS is targeting household wells that are considered likely to have arsenic. Wells are considered 'likely to have arsenic' if they are screened in aquifers known to have some high arsenic wells. Aquifers are being defined as 'high in arsenic' based on past well sample results, geology, and well construction. Past sampling results and geological interpretation have focused MARS sampling in buried alluvial aquifer wells in several west-central MN counties, including Clay, Grant, Otter Tail, Stevens, Traverse, and Wilkin.

The highest concentrations of arsenic appear to be associated with buried alluvial aquifer wells that are overlain by Des Moines lobe till. These aquifers and wells are located just west of the Alexandria moraine complex. The Minnesota Geological Survey (MGS) analysis of core materials from west central Minnesota shows that arsenic is naturally present in Wadena and Des Moines lobe clayey tills. Therefore, the arsenic in the groundwater in western Minnesota is likely a natural phenomenon, although there are a few examples of anthropogenic arsenic groundwater contamination (i.e., the Perham Superfund Site) in western Minnesota, which may have some limited local impacts.

Although Des Moines lobe tills overlay most of western Minnesota, only a relatively small portion of the wells in the buried alluvial aquifers have arsenic concentrations near or above the current MCL. This distribution of arsenic is likely due to a combination of geologic, hydrogeologic and geochemical factors. Some of these factors include the redox state of the water, the iron content of the water, the iron content of the aquifer matrix, and the pH of the water.

Iron appears to be closely related to arsenic concentrations in groundwater. Data from previous groundwater studies indicate that arsenic transport is strongly controlled by adsorption onto the iron hydroxides that commonly coat the surfaces of porous media. Areas of naturally occurring arsenic appear to be associated with a reduced oxidation state, which also contributes to the dissolution of iron hydroxides. It is hypothesized that when the iron dissolves, the arsenic loses its adsorption site and also dissolves. Iron tends to be in the solid phase in oxidized water near recharge areas, and it tends to dissolve as the water is reduced along the line of regional groundwater flow. It is hoped that a correlation can be found between field parameters and arsenic concentration, perhaps between the water's redox state and its arsenic concentration.

The observed relationship of iron and arsenic may provide an inexpensive and easy way for private well owners to lower the arsenic concentration in their drinking water. Preliminary tests indicate that arsenic removal can be accomplished by oxidizing the water to precipitate out the iron and arsenic and then filtering the water. Oxidation of the water can be accomplished by simply passively exposing the water to air overnight. The oxidized iron and arsenic, which precipitate, can then be removed by filtering the water prior to using it for drinking or cooking.

Why MARS Now?

The United Stated Environmental Protection Agency (US EPA) is in the process of revising the MCL for arsenic, and it is expected that the MCL will be revised downward significantly, with the revised MCL likely to be somewhere between 2 ug/L and 20 ug/L. US EPA is scheduled to propose a revised MCL by January 1,

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MGWA Calendar

Contact information for the major event-holders is listed at the end of the column.

June 19-20, 1998 Ninth Annual Minnesota Environmental Education Conference, St. John's University, Collegeville, MN. Contact: Lee Ann Landstrom, 612-420-4300, DQJQ42A@prodigy.com

July 6-10, 1998 Princeton Ground Water Pollution and Hydrology Course, San Francisco, CA.

July 15-16, 1998 Natural Attenuation of Chlorinated Solvents, Salt Lake City, UT. A lecture and workshop in Natural Attenuation of Chlorinated Solvents in Groundwater. Sponsored by The Industrial Members of the Remediation Technologies Development Forum (RTDF) and The Interstate Technology and Regulatory Cooperation Working Group (ITRC). Contact: http://www.dep.state.pa.us/dep/deputate/airwaste/wm/remserv/biotreat/biotreat.htm.

July 21-23,1998 "When a River Runs North...", 1998 Local Water Planners Conference, University of Minnesota, Crookston. Contact: Celine Lyman, MPCA/Water Quality Division, 612-296-8862, celine.lyman@pca.state.mn.us.

July 27-31, 1998 Princeton Ground Water Pollution and Hydrology Course, Orlando, FL.

September 14-17, 1998 Analysis and Design of Aquifer Tests—Including Slug Tests and Fracture Flow, Columbus OH. Contact: NGWA.

September 14-15, 1998 Natural Attenuation for Remediation of Contamination Sites, Atlanta, GA. Contact: NGWA.

September 16-18, 1998 Modeling of Natural Attenuation with Bioscreen and Bioplume, Atlanta, GA. Contact: NGWA.

September 16-17, 1998 Natural Attenuation of Chlorinated Solvents, Kansas City, MO. (see July 15-16, 1998 listing)

September 20-24, 1998 Fluid Flow in Carbonates: Interdisciplinary Approaches. SEPM Research Conference. Egg Harbor, Wisconsin. contact Maureen Muldoon, Wisconsin Geological and Natural History Survey 608-262-1580, or email: muldoon@facstaff.wisc.edu. Abstracts due June 15, 1998.

September 27 - October 2, 1998 Gambling with Groundwater. Physical, Chemical, and Biological Aspects of Aquifer-Stream Relations Las Vegas, Nevada. Contact: AIH.

September 28-October 2, 1998 PC Applications in Risk Asssessment, Remediation, Modeling, and GIS, San Francisco, CA. Contact: NGWA.

October 3-8, 1998 American Institute of Professional Geologists Annual Meeting, Baton Rouge, Louisiana. Information: M. B. Kumar, P.O. Box 19151, Baton Rouge, LA 70893, 504-342-5501, fax 504-342-4438.

October 12-14, 1998 43rd Annual Midwest Ground Water Conference, Lawrence, Kansas

October 13-14, 1998 Soil Parameter Estimation, Denver, CO. Contact: NGWA.

October 15-16, 1998 Fate and Transport, Part II, Denver CO. Contact: NGWA.

October 19-21, 1998 Visual MODFLOW, Salem, MA. Contact: NGWA.

October 22-23, 1998 Risk Assessment for the Environmental Professional, Salem MA. Contact: NGWA.

November 2-3, 1998 Fundamentals of ground water geochemistry, Denver, CO. Contact: NGWA.

November 4-6, 1998 Applications of ground water geochemistry, Denver, CO. Contact: NGWA.

November 11-13, 1998 Petroleum Conference and Exposition, Houston TX. Contact: NGWA.

November 16-18, 1998 DNAPLs in Fractured Geologic Media: Behavior, Monitoring, and Remediation. Contact: Waterloo Educational Services, Inc. at 519-836-3102, 519-836-3381 (fax).

November 18-19, 1998 Natural Attenuation of Chlorinated Solvents, Indianapolis, IN (see July 15-16, 1998 listing)

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MARS Study, cont.

2000, and promulgate a new MCL by January 1, 2001.

Very little data exist on health risks related due consumption of low concentrations of arsenic over time. Also, extrapolation for cancer using existing epidemiological studies, which in general have examined populations with higher concentration exposures, estimates 1:10,000 cancer risk at 2 ug/L arsenic. Setting the MCL at 2 ug/L could have a significant economic impact on rural water suppliers in Minnesota and in most of the western United States. MARS will expand the current scientific knowledge about exposure to arsenic, and potential health effects in people who drink the water over an entire lifetime. This information will then be provided to the US EPA to assist them in setting an appropriate drinking water standard for arsenic.

For more information about MARS, please contact study coordinator Deborah Durkin by phone at 612-215-0778, or via email at deborah.durkin@health.state.mn.us. To call MARS toll-free, dial 800-657-3908 and press "4" on your touch-tone phone. MDH news releases are available on the Internet at http://www.health.state.mn.us/news/news.html

Contacts:

for NGWA events:
1-800-551-7379 or
http://www.h2o-ngwa.org

for GSA events:
http://www.geosociety.org

for Princeton's events:
PO Box 273776
Tampa, FL 33688-3776
813-964-0800, 813-964-0900 (fax)
http://www.princeton-groundwater.com
email:info@princeton-groundwater.com

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MGWA Newsletter Deadlines for 1998

Issue	Copy to Editor	Final Copy to Publisher
September (v. 17, no. 3)	8/7/98	8/14/98
December (v. 17, no. 4)	11/6/98	11/13/98

Institute of Lake Superior Geology Conference Held May 6-10, 1998

The Institute of Lake Superior Geology (ILSG) held its 44th annual meeting May 6-10, 1998 in Minneapolis, Minnesota. This year's meeting consisted of four technical sessions (presentations and posters), five field trips, and the annual banquet with Bevan French of the Smithsonian Institute speaking on the topic of meteorite impacts. Field trips included forays into east-central Minnesota (early Proterozoic intrusive rocks), eastern Minnesota and western Wisconsin (mid-continent rift), Twin Cities area (glacial exotica), southeastern Minnesota (stratigraphy and hydrogeology of Paleozoic rocks), and southwestern Minnesota (Archean and Quaternary geology). The Minnesota Geological Survey (MGS) was the host organization.

The technical session, well-attended and well-received, opened on May 7 with a "Geological Overview of the Lake Superior Region". Several leading geologists on a variety of topics presented a synthesis of current thinking in each area.

Excerpts of the papers presented appear below.

Mark Jirsa and Jim Miller of MGS, ILSG meeting co-chairs, said the overview session was originally conceived as a draw for a diverse audience, including government agencies, college or university students, and industry. However, as a packed house of over 200 gathered for the first presentation, it was apparent that even the regular attendees showed a great interest in the overview session, and the context of ideas it offered. The session "did something for everybody," said Jirsa.

Meeting attendees will be pleased to find they are automatic ILSG members, and will remain on the mailing list for at least three years. The venue rotates each year to a different Lake Superior locale: ILSG 1999 is slated for Marquette, Michigan.

The well-referenced geological overview summaries, excerpted below, appear in the ILSG 1998 Proceedings Volume 44 (Part 1, Program and Abstracts). If you missed the meeting, copies of volumes 1 and 2 (field trip guide) are available for $10.00 each (plus $2.00 postage, each) by contacting Mark Jirsa at the MGS (612-627-4780, or email: jirsa001@maroon.tc.umn.edu), or by visiting the MGS-Map Sales desk in the basement of the MGS, 2642 University Avenue, St. Paul. Copies of proceedings and field trip guides from previous meetings are available as well. Visit the ILSG website at http://www.geo.mtu.edu/great_lakes/ilsg/

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Birdsall-Dreiss Lecture, cont.

brines and discussed subaerial evaporation, subsurface dissolution of evaporite deposits, and membrane filtration as potential mechanisms for generation of the brines. From this background, Dr. Hanor went on to examine the geochemical, hydrologic and tectonic evolution of the shallow crust and the interplay of these factors on the development and large-scale migration of saline fluids.

Dr. Hanor emphasized the hydrogeological aspects of saline fluid migration in his lecture at Pillsbury Hall, and presented cross-sections through the Gulf States region that showed a comparatively thin reservoir of "fresh" groundwater overlying the briny fluids that fill most of the sedimentary basin. He discussed deep basin hydrodynamics and how the dissolution of subsurface salt domes at shallow depth creates fluid density inversions that are capable of driving kilometer-scale vertical and 10 to 100 kilometer scale lateral fluid flow. Given that the Gulf States have disposed of their hazardous wastes through deep well injection for decades and that their "fresh" groundwater resources are limited, the dynamic nature of fluid flow and solute transport have potentially important consequences.

Dr. Hanor's talk was an interesting glimpse into hydrodynamic processes that groundwater scientists in Minnesota rarely have the opportunity to work with.

— contributed by Cathy O'Dell

MGWA Eliminates Post Office Box

The Minnesota Ground Water Association has eliminated its post office box mailing address. Please note the new address on the outside of this newsletter.

Support Your Association

Institute of Lake Superior Geology, cont.

Summaries

Ken Card—Archean Geology of the Great Lakes Region of North America

Archean Earth was significantly different from modern Earth in many ways. The Archean atmosphere, for example, lacked free oxygen and was rich in ammonia, carbon dioxide, and methane. Meteorite impacts were much more frequent, and until about 4.0 Ga probably kept the crust well stirred. By the late Archean, the rocks, mineral deposits and structures being formed and preserved are remarkably similar to modern accretionary orogens, notably those around the Pacific rim. It appears that the Archean Superior Province was formed by subduction driven orogenic processes similar in most respects to those operating today.

Richard Ojakangas—Generalized Early Proterozoic History, Lake Superior Region

The Archean ended with the formation of a big supercontinent, Kenorland, the product of amalgamation of volcanic arcs and granitic intrusive bodies, and history repeats itself. The Penokean (Hudsonian) orogeny occurred on the southern edge of the Superior craton, extending a distance of over 1100 km from the Grenville Front near Sudbury, ON, westward to the area just west of Lake Superior, deforming the sedimentary units deposited on the passive continental margin when volcanic arcs (the Wisconsin magmatic terranes and microcontinents (that included Archean rocks) collided from the south with northward-directed thrusting over a southward-dipping subduction zone.

W.F. Cannon—Understanding the Middle Proterozoic History of the Lake Superior Region: What's New? What's Next?

Middle Proterozoic time encompasses 700 million years (1600-900 Ma). In the Lake Superior region only a small part of that time is recorded in the rock record. At about 1470 Ma large anorogenic granitic plutons (emplaced during a time generally devoid of major orogeny) were emplaced in northern Wisconsin, and elsewhere across North America. The cause of widespread melting of

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MGWA Board Meeting Minutes

March 5, 1998, Egg & I, University and 280, 7:30 a.m.

Attending: Ray Wuolo, Past President; Paula Berger, President; Jim Piegat, President Elect; Paul Bulger, Treasurer; Jan Falteisek, Secretary; Tom Clark, Newsletter; Leigh Harrod, advertising; Jennie Leete, Sean Hunt, WRI.

Approval of Minutes — Paula Berger called the meeting to order at 7:40 a.m. Minutes for February were approved.

Spring Conference/Meeting April 17th — Paula reported on speakers confirmed and plans for additional contacts. Sean passed around a draft flyer/brochure for the conference and collected ideas for improvements. It was noted that MN History Center needed to approve the brochure. In order to notify the membership, the brochure will be mailed as soon as possible. It will also be put on the MGWA web page. Preparation of mailing lists were discussed; a minimum of 70 need to attend, with up to 300 possi-

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Newsletter Advertising Policy for 1998

Display ads:

Size	inches H x V	Quarterly Newsletter Annual Rate 4 issues	1998 Membership Directory Annual Rate 1 issue
Business Card	3.5 x 2.3	$60	$45
Quarter Page	3.5 x 4.8	$110	$90
Half Page	7.5 x 4.8	$205	$170
Full Page	7.5 x 9.75	$385	$325
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Classified ads in the newsletter are charged at the rate of $3 per 45 characters (including spaces and punctuation) per newsletter issue.

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Institute of Lake Superior Geology, cont.

lower crust in a belt of continental dimensions remains obscure.

Between about 1108 and about 1060 Ma the Midcontinent Rift, a 2200 km long volcanic and subsequent sedimentary basin, formed and was structurally modified. Seismic surveys indicate the rift is very deep, in places comprising the entire crustal thickness. Basalt eruption ceased rather abruptly at about 1094 Ma, and further filling of the rift was with continental sedimentary rocks, mostly red sandstone, and minor reduced lacustrine rocks.

The great volume of basaltic rocks and related intrusive rocks in the rift, combined with limited amounts of lithospheric extension imply that the mantle was anomalously hot during rifting; probably about 200 degrees Centigrade hotter than present day asthenosphere. Petrochemical studies indicate that much of the magma was generated by partial melting of primitive, enriched mantle. Together, these features point to the existence of a mantle plume beneath the rift, and more specifically, suggest that the rifting and volcanism was a consequence of the initiation of a new plume and the arrival of a plume head at the base of the lithosphere at about 1108 Ma. Melting of the plume head and stresses generated by lateral spread of the plume caused the intensely volcanic rift. Under some circumstances this event might have led to continental breakup. In this case, however, initiation of the Ottawan orogeny in the adjacent Grenville Province, transmitted northwest-southeast directed stresses into the Lake Superior region. This newly applied stress field not only terminated rift extension, but initiated a period of compressive deformation and rift inversion.

Anthony C. Runkel—Paleozoic Rocks in the Northern Part of the Central Mid-continent of North America

Lower Paleozoic strata in the central mid-continent region are among the longest studied sedimentary rocks in North America. They are well known to geologists outside of the area for several enigmatic features. Most notable is the extreme textural and mineralogical maturity of the fine to coarse-grained sandstones, and the sheet like geometry of these and other siliciclastic units. The overall dearth of shale has puzzled sedimentologists, and the fundamental controls on the episodic change from siliciclastic-dominated to carbonate-dominated sedimentation remains poorly understood. Lastly, the presence, position and magnitude of unconformities have been debated for decades. (Please see Tony's feature article on related topics elsewhere in this issue of MGWA newsletter).

Carrie J. Patterson—Models for Interpreting the Quaternary History of the Lake Superior Region

The interpretation of the Quaternary glacial and interglacial history for the Lake Superior region is in the midst of change as a result of two new models. Firstly, oxygen isotope data have provided evidence leading to the development of a model that indicates a large number of glaciations occurred during the last two million years. Secondly, a new mechanical model for the dynamics of ice flow has been developed.

David L. Southwick—What's Next for Geology in the Lake Superior Area?

Elected representatives are being urged to preserve and promote environmental quality, among other "quality of life" issues. Instead of mining, the plexus of environmental issues that immediately affect human health and happiness will be the primary driver of public resource policy and derivative geological investigations in the Lake Superior region over the next twenty years. Traditional hard-rock work will diminish in favor of non-traditional investigations in which hard-rock thinking and skills can be applied. Flexibility of training and outlook will be critical to professional success.

—contributed by Jim Lundy

MGWA Board Meetings, cont.

ble. The MGWA fax and AIPG lists will be used and other lists will be collected. At the next Board meeting, the annual meeting portion of the program will be developed further.

WRI Report — Jennie reported the P.O. box is no longer MGWA's legal address and recommended use of the box be phased out. Jan moved that the P.O. box be renewed for six months and then be allowed to expire. In the future all correspondence will go to MGWA c/o WRI. Motion carried. Jennie also noted the MGWA Newsletter now had a Library of Congress cataloging number: ISSN-1098-0504. Sean reported 400 members had renewed so far. It is thought that many letters go to former employers and are not forwarded. Jennie described past efforts to contact employers and identify former employees. Jennie to contact Jan to help. Jennie noted CD's are maturing and suggested the Board investigate other options for investment. After discussion, Paul Bulger was directed to renew for 3 months the currently maturing CD and also begin evaluating other options.

Newsletter/Directory Update — Tom Clark said the March issue is ready to go out "anytime". Leigh Harrod reported on renewals and said that Dave Kill had offered to contact pump equipment suppliers that had never advertised.

Other — Ray Wuolo said that he had been contacted by someone to lobby related to springs. Since the By-Laws do not allow lobbying, Ray gave the person Greg Brick's name.

Scholarships — Discussion postponed until next meeting.

Next meeting — April 2, 1998, 7:30 a.m. at Egg & I.

Meeting adjourned 8:40 a.m.

April 2, 1998, Egg & I, University and 280, 7:30 a.m.

Attending: Ray Wuolo, Past President; Paula Berger, President; Jim Piegat, President Elect; Jan Falteisek, Secretary; Paul Bulger,

— continued on next page

MGWA Board Meetings, cont.

Treasurer; Jennie Leete, Sean Hunt, WRI.

Approval of Minutes — Paula Berger called the meeting to order at 7:40 a.m. Minutes for March were approved.

Spring Conference on Brownfields/ Annual Meeting April 17th – Arrangements for the conference were discussed. Paula distributed a recently published article on brownfields. It was noted that local papers publish lists of meetings. Paula will call the Pioneer Press and Tribune and request the conference be listed. Jeanette and Sean reported they had discussed logistics and AV needs with the MN History Center; some final coordination will be needed with the facility. Depending on the cost, it may be feasible to have the presentations taped (audio). Ideas were discussed for additional announcement mailings. Ray, Paul, Jim and Jan volunteered for registration table duties.

Bylaws Revisions - Paula distributed proposed changes to Bylaws (attached). The most significant change is including the past-president as a voting Board member. Proposed changes will be discussed at the annual meeting on April 17th, to be followed by a vote by mail. Appointed positions, e.g., editor, were discussed.

Fall Field Trip – Paula said she would attend the next AIPG Board meeting to discuss the field trip.

Membership Report – Sean distributed a membership report (attached). Jennie noted there has been no recent membership campaign. The need for key people in organizations and companies was discussed.

Newsletter/Directory Update – Jan said the March issued had gone out. Copy for next issue will be due the end of May. The newsletter team meets next week on April 7th.

Scholarships – Discussion of possible corporate sponsored scholarships deferred.

Next meeting – May 7, 1998, 7:30 a.m. at Egg & I.

Meeting adjourned 8:30 a.m.

May 7, 1998, Egg & I, University and 280, St. Paul, MN, 7:30 a.m.

Attending — Ray Wuolo, Past President; Paula Berger, President; Jim Piegat, President Elect; Jan Falteisek, Secretary; Paul Bulger, Treasurer; Sean Hunt, WRI; Leigh Harrod, Advertising Manager; Tom Clark, Newsletter Coordinator; Roman Kanivetsky, guest.

Approval of Minutes — Paula Berger called the meeting to order at 7:40 a.m. Minutes for the regular April Board meeting held April 2, 1998 and the Annual Membership Meeting held April 17, 1998 were approved.

Hydrophysical Logging — Roman Kanivetsky proposed the MGWA sponsor a one-day training program on a new technology, hydrophysical logging. The vendor of the technique, COLOG, was brought to the Board's attention at the February meeting. Roman asked the MGWA provide sponsorship to bring in the developer of the technique and produce and distribute a flyer for the program. Ray Wuolo suggested considering the training program as part of the Fall Conference.

Spring Conference on Brownfields April 17th — Sean Hunt distributed a preliminary financial statement for the conference, which indicates a (preliminary) net income of $2,819 for the program.

Bylaws Revisions — Paula distributed proposed changes to By-Laws. Paula asked other Board members to review the changes and provide comments.

Fall Field Trip — Paula reported a planning meeting with Lee Trotta and Andrew Nichols last Thursday. Preliminary plans are for September 26-27 on Glacial Stratigraphy. Another planning meeting is planned for May 7th.

Request for Mailing List — Paula noted a request for the MGWA mailing list from the Midwest Geosciences Group. Paula will contact them and ask whether they are non-profit.

— continued on page 19

Minnesota Water '98

Protecting Minnesota's Water Supplies

The sixth biennial *Minnesota Water '98* conference provided an enlightening view of how interactions among ground water, surface water and environmental protection affect Minnesota's water supplies. The conference format brought experts, regulators and others representing these topics together, face to face, as never before. It was hard to miss the interdependencies as both surface water and ground water enthusiasts gathered in standing-room-only crowds to hear about environmental issues.

MDH Commissioner Assures Attendees that Water Supply is Safe

This year's conference was held on May 5 and 6 at the Holiday Inn Metrodome in Minneapolis. The TV cameras were there for the first plenary session, presumably to hear Minnesota Department of Health commissioner Anne Barry assure the full conference room that Minnesota's water supply is OK. Commissioner Barry began her upbeat address by emphasizing that safe drinking water is a cornerstone of public health. She expressed concern that media coverage of drinking water issues often sends messages that paint an unrealistically negative picture of the state of drinking water in Minnesota in the eyes of the public. She explained that drinking water problems in Minnesota are few and far between and that when problems do arise, they are taken care of on a timely basis. *(See following MDH Press Release "Drinking Water Report Again Produces Little Evidence of Contamination Problems" - Ed.)* Commissioner Barry then shared her sense of pride with the audience of fellow Minnesota's in recounting how after two recent disasters, the 1997 floods and the recent, highly destructive, tornadoes, safe drinking water supplies were restored in the affected communities so quickly that

— continued on next page

Water 98, cont.

there was minimal disruption of service.

Other Featured Speakers

Erik Olson of the Natural Resources Defense Council followed Commissioner Barry's presentation with a somewhat different perspective. He quoted sources indicating an estimated 940,000 to 7 million people annually in the USA become sick due to drinking water problems. He asked us, how we can tell the public that everything is just fine with our drinking water supplies and then turn around and tell them we need to spend huge amounts of money to upgrade drinking water treatment plants? The EPA says 130 billion dollars in treatment plant upgrades is needed [nationally]. He drew the crowd's attention to concerns about disinfection by-products, arsenic, radon, organic and synthetic chemicals such as pesticides, and in particular, the uncertainty of impacts from ingesting multiple carcinogens. The new Safe Water Drinking Act will push many improvements such as the development of plans to assess what contamination may impact public drinking water (by February 1999) and the ability to spend federal dollars on source water protection. This is indicative of a new shift toward a prevention-based approach in safeguarding water supplies. We can also expect a shift toward protecting the most vulnerable individuals in our population in terms of water supply safety.

During lunch, we heard from Kevin McCormick from US EPA Headquarters. He emphasized the importance of public involvement in source water protection and assessment efforts. This requires community education. Forty-five states and Puerto Rico have approved wellhead protection programs. We need to improve our approach by addressing delineation of non-adjacent recharge areas [when delineating source water areas]. More information can be obtained on state source water assessment programs on the world wide web at http://www.epa.gov/OGWDW/protect.html.

The plenary session on the second day of the conference emphasized water supply issues. Phil Singer, University of North Carolina discussed disinfection by-products in drinking water. Stephen Kellogg, Camp Dresser & Mckee, Inc. and Marty Jessen, U.S. Filter Corporation, talked about the pros and cons of privatization and competitive utility operations programs.

Good Topics, Great Talks

Concurrent sessions were generally divided up into logical categories but some participants had difficult attendance choices as many interesting talks touched a variety of topics related to surface water, ground water and environmental concerns. Based on the buzz of conversations between talks, the speakers' topics and deliveries were right on the money as enthusiasm appeared to remain high throughout the conference. Some of the featured topics included the following:

- ground water vulnerability,
- source protection and monitoring;
- ground water issues in the Twin Cities metro area;
- private wells;
- impact of drainage on water quality and biotic communities;
- nitrate issues;
- rural water systems,
- whole farm planning,
- land use and public policy;
- chemical contaminants (pesticides, herbicides, arsenic, copper, lead, nutrients);
- health risks related to microorganisms and pathogens;
- water treatment technology;
- issues facing public water suppliers;
- disaster prediction and management for water supply systems.

Poster Sessions

The conference also featured a very nice array of informative poster displays. Plenty of time was allowed during the two poster sessions for review of the posters and associated networking.

— contributed by Tim Thumblad

1998 Board of Directors

Call For Papers

43rd MIDWEST GROUND WATER CONFERENCE AT THE HOLIDOME, LAWRENCE, KANSAS October 12-14, 1998

Host Agency: Kansas Geological Survey, University of Kansas
Co-Sponsoring Agencies: Division of Water Resources, Kansas Dept. of Agriculture, Kansas Ground Water Association, and Kansas Department of Health and Environment

The Midwest Ground Water Conference
The Midwest Ground Water Conference is an informal annual meeting held at the invitation of the participating state. This conference provides an opportunity for hydrologists, geologists, engineers, students, and others studying ground-water resources in their respective states to meet and exchange ideas, discuss mutual problems affecting the midwest, and summarize results of field and laboratory studies.

This year's conference will include a field trip on the afternoon of the 12th; oral and poster sessions and workshops focusing on regional issues on the 13th and the morning of the 14th.

Conference Topics
Papers and posters are solicited for presentation at the Midwest Ground Water Conference in the following subject areas:

- Surface/Ground-Water Interactions
- Water Resources Management
- Ground-Water Quality Protection

In addition, papers and posters are also solicited in these other subject areas: regional studies, aquifer characterization, ground-water recharge and vadose zone processes, contaminant transport, isotope and geochemical hydrology, ground-water monitoring, ground-water modeling, and geophysical applications.

Abstract Submissions
Abstracts of papers to be presented at the Conference should be received by July 24, 1998. Each abstract should be less than 300 words in length and include title, names of the authors, their affiliation, contact address and phone number, and e-mail address if available. Abstracts may be submitted through the mail, by fax, or by e-mail. If submitted by e-mail abstracts should be in ASCII text form or as a common word processor file (use WORD 7.0 or less if possible). Also, indicate a preference for either oral or poster session format or both.

Submit abstracts to Melany Miller, Kansas Geological Survey, 1930 Constant Ave., Lawrence, KS 66047 (fax number: (785) 864-3965; e-mail: mmiller@kgs.ukans.edu).

Additional Information Contact: Allen Macfarlane or Don Whittemore at (764) 864-3965 or dowser@kgs.ukans.edu.

Please send name, address, or e-mail address if interested in attending but not presenting a paper. CEU credits are available to members of the Kansas Ground Water Association.

MGWA Board Meetings, cont.

Membership Report — Sean distributed an updated membership report that reflects members renewed or new members as a result of spring conference registration.

Newsletter/Directory — Tom Clark noted that Steve Robertson is the lead for the June issue which will have a lead article by Tony Runkel, MN Geological Survey. Tom also noted, for the Directory, the telephone area code changes beginning in July.

Other — Paul Bulger brought a recent Corp of Engineers report demonstrating downhole video logging of fractures and other features.

Next meeting — June 4, 1998, 7:30 a.m. at Egg & I.

Meeting adjourned 9:00 a.m.

—Jan Falteisek, MGWA Secretary

MGWA Membership Meeting Minutes

April 17, 1998, Minnesota History Center, St. Paul, MN, 3:30 p.m.

Attending: Paula Berger, President; Jan Falteisek, Secretary; Paul Bulger, Treasurer; Jennie Leete, WRI; Tom Clark, Newsletter Editor/Coordinator; Gary Van Guilder, AIPG; Tim Thurnblad, member.

Discussion of Proposed Bylaws changes - Paula distributed proposed changes to Bylaws. The most significant change is including the past-president as a voting Board member, resulting in a five member Board. Other changes proposed include explicit statement of annual membership meeting, adjustment of the officer election schedule, creation of an Executive Committee to include voluntary positions (newsletter editor, advertising manager, and field trip coordinator). The Bylaws change process and voting options were discussed. Paula will incorporate changes discussed and send to the other Board members prior to the next regular Board meeting.

Fall Field Trip – Gary Van Guilder suggested Bill Johnson, NRG, and Rolf Miller, SESSCO, be contacted as possible participants in the field trip committee. Paula said she would call a meeting of members and others that have expressed interest in the field trip.

Membership Building — Techniques and approaches for expanding membership were discussed.

Next meeting — The next regular Board meeting is May 7, 1998, 7:30 a.m. at Egg & I.

Meeting adjourned 4:30 p.m.

Proclaiming Earth Science Week

The countdown to the first Earth Science Week has begun. Mark your calendars now for the October 11-17, 1998 celebration. Earth Science Week is one of the American Geological Institute's most ambitious 50th anniversary initiatives, and it offers the geoscience community new opportunities to demonstrate the importance of the earth sciences. Geoscience organizations have responded enthusiastically to the idea, and AGI member societies and state geological surveys are planning Earth Science Week activities and events. "The goal for Earth Science Week," says AGI President Susan Landon, "is to have every geoscientist in the country do something in their community to promote the earth sciences." AGI's role in sponsoring an annual Earth Science Week is to provide a clearing house for ideas, activities, and special events and to provide support materials that make it easy for geoscientists participate. Information about Earth Science Week is available from the American Geological Institute and on the World Wide Web at www.earthsciweek.org.

The governors of eight states, Alabama, Colorado, Illinois, Kansas, Nevada, North Carolina, North Dakota, and Ohio, have already issued Earth Science Week proclamations and resolutions and more are expected to follow. A common thread in the proclamations is recognition that the role of geology and the earth sciences are fundamental to society and to our quality of life.

Drinking Water Report Produces Little Evidence of Contamination

Communities to begin issuing "consumer confidence reports" next year

The results of monitoring tests for the past year have once again revealed little evidence of contamination problems in Minnesota's 956 community water supply systems, according to the Minnesota Department of Health (MDH).

Test results for calendar year 1997 are summarized in the newly released fourth edition of the department's report on state of Minnesota's drinking water. MDH has published the report annually since 1995.

"Like our previous drinking water reports, this latest report offers a highly reassuring picture of our state's drinking water infrastructure," said Minnesota Health Commissioner Anne Barry. "Once again, we rarely found detectable levels of contamination — and violations of applicable state or federal drinking water standards were rarer still. And whenever problems were discovered, we quickly took action to prevent any potential health problems.

"In short, the problems we found were minimal — and the system worked," Commissioner Barry said. "Based on this report, we believe that the people of Minnesota can continue to have confidence in the high quality and safety of their drinking water."

The report covers test results for all community water supply systems — that is, systems that provide water to people in their homes. These community systems include all 706 of the state's municipal water systems. They also include 254 systems that provide water in settings like manufactured home parks, apartment buildings, housing subdivisions, colleges, hospitals and correctional facilities.

The findings of this year's report include the following:

— continued on next page

Drinking Water Report, cont.

During 1997, MDH conducted 66,178 separate tests for up to 118 different pesticides and industrial contaminants. Only one community system exceeded applicable health standards for any of these contaminants: A municipal system in northern Minnesota was slightly above the federal maximum contaminant level of five parts per billion (ppb) for tetrachloroethylene. The problem was corrected by taking one of the city's water wells out of service.

Twenty-seven systems — including 20 municipal systems — tested positive for bacterial contamination. Residents of the affected communities were advised to boil their water before using it for drinking or cooking, until these systems could be disinfected and retested.

Twenty-two of the 27 systems were back on line in less than 14 days, and the other five were able to resume normal operation within a few weeks. The largest of these systems provided water to about a thousand people, and all but eight of them served fewer than 500 people.

One non-municipal system tested slightly above the federal MCL of 50 ppb for arsenic. The affected system was able to resolve the problem by installing a treatment system.

Arsenic is one of 13 inorganic chemicals for which community water supply systems are routinely tested. Arsenic is naturally present in the groundwater in many parts of Minnesota. (see *The Minnesota Arsenic Study*, page 11)

Three municipal systems — including a multi-county system that serves a number of communities in southwestern Minnesota — exceeded the MCL of 10 parts per million (ppm) for nitrate.

Nitrate contamination is primarily a problem for infants, whose immature digestive systems can convert the nitrate into nitrite. Nitrite can reduce the oxygen-carrying capacity of the blood, resulting in a serious condition known as methemoglobinemia — or "blue baby syndrome."

Residents of communities with nitrate problems are warned not to let infants consume the water, until steps can be taken to correct the situation.

"Obviously, we're pleased that so few of our communities have experienced any serious problems with their water supply systems," Commissioner Barry said. "Our continued success in this area is a testament to the careful planning and engineering that have gone into our state's drinking water infrastructure — as well as the dedication and professionalism of the people who operate our community water supply systems.

Efforts to keep people informed about the quality of their drinking water will be expanded next year.

Beginning in 1999, community water supply systems nationwide will be required to provide their customers with "consumer confidence reports." These reports will be used to notify consumers about any contaminants that may have been detected in their drinking water during the preceding year. If any of the contaminants have exceeded applicable drinking water standards, the reports will also include information about potential health effects.

Systems serving more than 10,000 people will mail the reports to their customers, and systems serving between 500 and 10,000 people will release the required information to their local media. Smaller systems must simply notify their customers that the information is available.

The consumer confidence reports are required under 1996 amendments to the federal Safe Drinking Water Act. Reports on each year's test results must be provided to consumers by the summer of the following year.

Join the Minnesota Ground Water Association!

If you are reading this newsletter second-hand, we'd like to take this opportunity to invite you to become a member of **MGWA** for 1998. Annual dues are $20 for professional members and $15 for students. Members are entitled to purchase the annual membership directory for $7. Additional donations toward our scholarships and/or the use of recycled paper will be gratefully accepted.

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

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

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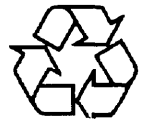

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