

# Minnesota Ground Water Association

www.mgwa.org

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## President's Column

—Jim Lundy, MGWA President

My last column discussed ground water education for grade-schoolers, but we need to educate grownups as well. Ground water myths persist. Of course, the ancient Celts attributed many mystical powers to water. Holy water could cure disease, bring good weather, or ensure good luck, and therefore river worship and the worship of holy wells and springs was common. Only human sacrifice could appease the river gods, but the required sacrifice at a holy well was less horrific: horses, chickens, or even trinkets such as pins, coins, or small stones. (One time I accidentally sacrificed a bailer to the god of monitoring wells).

There was a spring at the edge of a southwestern Minnesota town where I once worked. When I visited, I saw a road cut exposing outwash sand; someone built a retaining wall, added a horizontal pipe and a shelter, and voila! A spring! I climbed the hill to investigate recharge—and stood face to face with Bessie, Bossy, and Buttercup, chewing contentedly on sweet grass.

I skipped that taste test, but on another day an underground storage tank owner in another town insisted his ground water was good, just because it came from underground. To demonstrate, he taped a cup to the measuring stick and dipped into a monitoring well placed between two leaky tanks. Then he hauled up and offered me a swig; when I refused, he downed the cupful (petroleum sheen and all). "See! It's good!" he crowed. But I was not persuaded.

Even in this scientific age, water witching is popular among those who attribute more power to a willow branch than to the human mind. The practice of water witchery, including

witching from afar, using a dowsing rod and a map, to find "veins" and "domes" of underground water has persisted for over 400 years. (For a fascinating and objective account see *Water Witching, USA*, by Evon Z. Vogt and Ray Hyman).

So there is something mysterious about ground water to the non-expert mind. One important role MGWA has is to explain the true nature of ground water. This educating role extends to the especially important audience of decision-makers. I was recently asked to introduce MGWA as an information resource to the House subcommittee on ground water (see adjacent article). By the time this column appears, the subcommittee will have met four times to familiarize itself with ground water issues, laws, agencies, information resources, and public concerns. Although it is not yet clear whether ground water legislation will actually occur during the next session, the sub-committee asked the state agencies concerned with ground water (MPCA, MDNR, MDH, MDA and BWSR): what are the key ground water issues?

In the end, legislators will determine the need for ground water legislation. Some are knowledgeable about ground water, others are not. Because MGWA's objective is to disseminate accurate information on ground water, and MGWA is the voice of the ground water professional community, I believe we ought to provide legislators with our idea of the key ground water issues. Because MGWA membership covers a wide spectrum, I expect our position to be from a bias-neutral point of view.

How can MGWA determine what it thinks are the key ground water issues? The fall conference, scheduled for November 3, 2000 at the

—continued on page 2

## Lundy Testifies before House Subcommittee on Ground Water

— MGWA President Jim Lundy spoke to the House Subcommittee on Ground Water July 13, 2000 at the State Capitol. Here is the (slightly-edited) text of his remarks.

My name is Jim Lundy, and I am a hydrogeologist working in the Policy and Planning Division of the Minnesota Pollution Control Agency. I formerly worked in the LUST and Superfund cleanup programs, as an environmental consultant, and as a gold exploration geologist. Marilyn Brick asked me to appear here today on behalf of the Minnesota Ground Water Association, the "MGWA", which I am president of this year.

The Minnesota Ground Water Association (MGWA) is a non-profit, volunteer organization dedicated to the following primary objectives:

Promotion and encouragement of the scientific and public policy aspects of ground water;

Establishing a common forum for scientists, engineers, planners,

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membership and conference or  
field trip business transactions.

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### President's Column, cont.

Earle Brown Center in St. Paul, pres-  
ents a great opportunity. The confer-  
ence, entitled "Minnesota's Emerging  
Ground Water Quality  
Issues—Tuning Up the 1989 Ground  
Water Protection Act", will feature  
great speakers on emerging ground  
water quality issues—especially those  
not anticipated by the 1989 Act. Near  
the end of the day we will break into  
small groups to capture your ideas,  
and reconvening at the end of the day  
we will combine the small group wish  
lists into the MGWA list of ground  
water issues. The newsletter editorial  
team will summarize the discussion  
for the December 2000 MGWA  
newsletter.

I hope the key ground water issues  
we identify at the Fall Conference will  
be a useful tool for legislators during  
the next session. I also hope you will  
recognize this as an opportunity to  
contribute your professional opinions  
to the decision making process at the  
capitol. Come to the Fall Conference  
on November 3 and help determine  
the future of the ground water  
resource in Minnesota.

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### Lundy Testimony, cont.

educators, attorneys, and other  
persons concerned with ground  
water;

Education of the general public  
regarding ground water re-  
sources; and

Dissemination of information on  
ground water through meetings of  
the membership.

MGWA publishes a quarterly newslet-  
ter and annual directory, and spon-  
sors two conferences each year on  
timely issues concerning policy and  
scientific aspects of ground water.  
The newsletter and directory reach a  
membership of about 550 persons,  
which includes prominent members  
of pertinent federal, state, and local  
agencies; environmental and engi-  
neering consulting firms; universities  
and colleges statewide; and other

groups concerned with ground-water  
and environmental issues.

MGWA pays for all expenses of its  
organizational activities through  
membership dues and advertising  
fees, both of which are modest. To a  
great extent the MGWA depends  
upon the volunteer efforts of its board  
and membership.

### MGWA Foundation

This spring, the Minnesota Ground  
Water Association Foundation  
(MGWAF) was formed. The goal of  
the MGWAF is to raise funds that can  
be used to support ground water  
related education. By focusing all of  
its efforts on fund raising and distribu-  
tion, the MGWAF hopes to build upon  
the scholarship effort begun by the  
MGWA. By acting as a separate  
non-profit entity, the entire donation  
can be tax deductible.

### MGWA Membership

Membership dues for the year 2000  
were \$20, which includes four news-  
letter issues, the MGWA directory,  
and reduced registration fees for  
MGWA conferences and field trips.  
Dues for the year 2001 will increase  
to \$25.

### Conferences and field trips

Two conferences are offered annu-  
ally, in spring and fall. Usually one is  
devoted to a technical issue (e.g.,  
geophysical methods or karst  
hydrogeology) and the other to a pol-  
icy issue (e.g., new directions in  
ground water policy). Usually there  
are about 80-100 attendees, who are  
attracted because of the high quality,  
low relative cost, and the need for  
CEUs (for registered geoscientists,  
engineers and legal professionals).

The field trips are conducted in Sep-  
tember, and visit areas of Minnesota  
with unusual or important hydrogeo-  
logic characteristics (e.g., North  
Shore, upper MN River Valley, etc.).

### Publications

The newsletter and membership  
directory are the primary publications  
of the organization. An example  
newsletter is in the packet I gave you.  
We try to provide a good mixture of  
technical information, opinion, and

— continued on next page

## Lundy Testimony, cont.

current news items for our members. MGWA also distributes special publications on occasion (e.g., field trip guidebooks or conference manuals).

In recent years we have worked hard to develop the MGWA web page, located at [www.mgwa.org](http://www.mgwa.org). We think this will be very useful to you and your staff as your work proceeds on the ground water subcommittee. The web page features information about the MGWA, the MGWA Foundation, upcoming field trips and conferences, past newsletters, a calendar of nationwide upcoming events related to ground water, and many links to other sources of ground water information on the web. There is also an online ordering page, where you can become an MGWA member, register for a conference, donate to the MGWA Foundation (all donations to MGWAF are tax deductible), or buy MGWA merchandise, the profits from which support our programs.

## Concluding Remarks

I hope I have helped you become just a little bit familiar with both the MGWA and the MGWA Foundation. This hard working group performs a valuable function that benefits not only the ground water professionals who comprise most of the membership, but also:

Legal professionals

Planners

Local government

Those in academia (by providing information and funding)

School children (visits to present ground water information)

Citizens with questions about ground water (information)

Legislative groups like this one

Perhaps I have even convinced one or two of you to become a member, register for a conference, write a newsletter article, or donate to the MGWA Foundation.

I would be happy to answer your questions.

## Emerging Issues Conference Held in Minneapolis June 7-8

### MGWA to Follow Up with Fall Conference on Emerging Issues in Ground Water on November 3

Approximately 150 attendees from various disciplines across the country attended this conference on emerging contaminants of concern in our waste streams and water supplies, held at the Hyatt-Regency Hotel in downtown Minneapolis in early June. The focus was on pharmaceuticals and personal care products (PPCPs), endocrine disrupting chemicals (EDCs), pesticides and their metabolites, and naturally-occurring contaminants such as arsenic and radon. The primary conference sponsor was the National Ground Water Association. The MGWA plans to make emerging contaminants of concern in ground water the focus of its annual fall conference to be held at the Earle Brown Center on the University of Minnesota's St. Paul campus on November 3. Watch the MGWA website ([www.mgwa.org](http://www.mgwa.org)) for registration details. MGWA members with Internet access will also be able to register for the conference electronically. The conference will run a full day and include refreshment breaks and lunch.

## MGWA Again Supports Annual Children's Water Festival

The MGWA Board has voted to support this year's Children's Water Festival, to be held September 27 at the State Fairgrounds, with a \$200 donation. In addition, many association members donate their time and talents to helping out at the festival. Look for a follow up story in the December MGWA newsletter. For more information, contact Joe Enfield, Carver Co. Environmental Services Director, at 952-361-1801; e-mail: [Jenfield@co.carver.mn.us](mailto:Jenfield@co.carver.mn.us)

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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.

**Editor's Note:** *Your newsletter editorial team is pleased to have received two timely articles concerning the current ground water dewatering controversy centering on the multi-billion dollar expansion project that the Metropolitan Airports Commission (MAC) is currently undertaking at the Minneapolis-St. Paul airport. The first article is a look into the history behind some of the issues that surround the controversy, written by Stu Grubb, a licensed professional geologist with Emmons and Olivier Resources, Inc., one of the consultants to the Minnehaha Creek Watershed District in which the project is located. The second article examines the effectiveness of sheet pile walls at reducing the drawdown from construction dewatering. Sheet piling is one of several alternatives MAC considered to reduce the effects of dewatering on lakes in the watershed. It is written by Ray Wuolo, a licensed professional engineer and geologist with Barr Engineering Company. Ray is also a past president of the Minnesota Ground Water Association. Our thanks to both these ground water professionals for taking time from their busy schedules to provide what Paul Harvey would call "the rest of the story."*

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## **An Inside Look at the Minneapolis-St. Paul Airport Ground Water Dewatering Controversy**

— *Stu Grubb, P.G., Emmons & Olivier Resources, Inc.*

Rarely is ground water modeling the lead story on the 10 o'clock news, but the proposed dewatering at the Minneapolis-St. Paul airport has attracted that kind of attention. The Metropolitan Airports Commission has proposed construction dewatering at the airport that could have impacts as far away as Lake Nokomis. Unfortunately for those in the ground water community, the "mainstream" press generally does not report the finer points of hydrogeologic analysis. The MGWA newsletter seemed like a good forum to discuss what is actually happening at the airport.

First, the cast of characters should be introduced: Ken Olson and David Jerde of Liesch Associates performed hydrogeologic analyses and submitted permits on behalf of the Metropolitan Airports Commission (MAC). Ceil Strauss, Evan Drivas,

Peter Leete, Dale Homuth and others at DNR Waters have been involved with issuing an appropriations permit. Stu Grubb of Emmons & Olivier Resources, Kelton Barr of Kelton Barr Consulting, and Mike Panzer of Wenck Associates are consultants for the Minnehaha Creek Watershed District (MCWD) who reviewed the permit applications.

Second, the scene should be set: The geology of the airport property varies from the east side to the west side. In the east, 30 to 50 feet of unconsolidated material overlies the Platteville and St. Peter formations. In the west, a large bedrock valley filled with alluvium runs north-south, parallel to Cedar Avenue, from the Minnesota River to beyond Lake Nokomis and Hiawatha. A silt and clay confining layer is found in the bedrock valley about 50 ft below ground surface. A second bedrock valley, narrower and shallower than the first, runs east-west along the north boundary of the airport property, below Crosstown Highway. This bedrock valley is not shown on the Hennepin County Geologic Atlas.

Ground water flow is generally northwest to southeast across the airport property. In the larger bedrock valley, the hydraulic conductivity measured from pump tests and other observations is a remarkable 500 ft/day. Within the bedrock to the east, hydraulic conductivity is in the expected range of about 5 ft/day, although cracks with much higher conductivity are common.

As anyone who has been to the airport knows, MAC is undertaking a multi-billion dollar airport expansion program. Construction dewatering is necessary for many of the projects, including the Light Rail Transit tunnel below the terminal, a new north-south runway, and four tunnels that will cross beneath the new runway or existing runways. A variety of tunnel construction methods will probably be used, including a tunnel boring machine through the bedrock and "cut and cover" through unconsolidated materials.

DNR issued a general dewatering permit for all airport construction in January 2000 with the condition that written approval be obtained for each

individual project based on final design details. MAC submitted information on the "17-35 Tunnel" project in June 2000. The 17-35 tunnel will be located on the west central part of the airport property and will cross underneath the new north-south runway. It will be over 1000 ft long and will have a four-lane roadway.

The original dewatering plan for the 17-35 Tunnel called for installation of over 80 dewatering wells pumping a total of 3,055 to 6,500 gpm, or between 4.4 and 9.4 million gallons per day. Discharge would be to the storm sewers and ultimately the Minnesota River. Liesch Associates prepared a MODFLOW model that simulated the different pumping stages and drawdown over the 13-month life of the project. The model was intended to provide contractors specifications for pumping locations and rates, and hence it covered a relatively small area.

DNR requested comments from the watershed district and their consultants. Wenck Associates did not raise any objections to the project, although they did not do a detailed review of the ground water model. EOR commented that the model should be revised to extend farther to the north and west and consider ground water/surface water interactions. A simple analysis using a transient model (Boulton method) showed that ground water drawdown could be as much as three feet below Mother Lake after 13 months of pumping. Kelton Barr performed an analysis using the MPCA Metro Model, based on the steady-state Multi Layer Analytical Element Method, and commented that ground water drawdown below Mother Lake could be as much as four feet if pumping continued indefinitely. Both EOR and Kelton Barr recommended that the modeling effort be expanded to include all the airport construction projects that would concurrently affect ground water.

Kelton Barr reported his modeling results to MCWD during a regular public board meeting. MCWD decided not to issue their own storm water and erosion permit until the ground water issue was resolved. A

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## Airport Dewatering, cont.

member of the audience heard this information and distributed a press release via the Internet. The press release said that dewatering related to MAC tunnel construction could cause Lake Nokomis to drop by up to four feet. That is when, as they say, all hell broke loose.

People in Minneapolis have passionate opinions about their lakes and about their airport. Activists, politicians, and the media sensed the volatile situation and leapt into action. Over 30 regulators, politicians, reporters, and consultants crammed into a small room at the DNR to discuss the appropriations permit. Over 200 people, many wearing bathing suits and holding water toys, filled the Minnetonka City Council Chambers for the next MCWD meeting. They impatiently listened to hydrogeologists argue about site conditions before having their own opportunity to speak. The Minneapolis Mayor's office held their own informational meetings and encouraged MAC to change their construction plans. The Minneapolis City Council passed a resolution recommending that permits not be issued for the project. At the next MCWD meeting about 500 people filled the Roosevelt High School gymnasium to loudly voice their opinion. Newspaper articles and editorials appeared every few days.

Several issues were raised for which no good technical response could be given, for example:

If the ground water level drops below Lake Nokomis, how much will the lake level drop?

Does the silt and clay confining layer extend beyond the airport property?

Does the high hydraulic conductivity continue all the way to Lake Nokomis?

Will building foundations be damaged by subsidence due to dewatering?

Some editorials also suggested that the "ground water experts" did not agree on the potential impacts of the dewatering. In fact, the modeling results obtained by various consultants were generally consistent with

each other, but the presentation of facts to the public was not consistent. A steady-state model can predict four feet of drawdown at Lake Nokomis, a transient (time-dependent) model can predict about 1 foot of drawdown at Lake Nokomis after 13 months of pumping, and both can be correct. When these facts were presented along with the uncertainty about the relationship between ground water and surface water levels, the general public was understandably confused.

As a result of this whole process, MAC has made changes to its construction dewatering plans that will lessen the potential impacts to area lakes, including installing a low permeability barrier to reduce pumping volumes, delaying construction of another tunnel so dewatering will not be concurrent with the 17-35 Tunnel project, monitoring the effects of dewatering, and adopting a mitigation plan if adverse impacts are detected.

Consultants for MAC and MCWD have been working together to produce a MODFLOW model that both sides can use to predict the impact to ground water resources caused by the proposed dewatering projects. The model features constant head boundaries at the bluffs east and south of the airport, variable hydraulic conductivity and/or aquifer thickness to simulate the bedrock valleys, and a barrier wall package in MODFLOW to simulate sheet piling or a grout curtain.

MAC considered several alternatives for reducing the volume of dewatering, including sheet piling, ground freezing, and low-permeability grout barriers. Sheet piling may not be feasible because of the \$5 million cost and because the 60-ft steel pilings will act as an antenna and interfere with airport radar. Ground freezing would also be very expensive and take several months to implement. Current plans call for jet grouting a barrier around the 3,000 ft perimeter of the 17-35 Tunnel.

Monitoring will include frequent readings from staff gauges and monitoring wells on the airport property and at the lakes. Readings will be posted on the MAC website and will be available to anyone. Natural resources will be monitored through frequent

aerial and land-based photography and through observations of wildlife such as the Forrester's Tern, a local species of concern.

MAC has committed to a policy of no negative impacts to area lakes and other resources. MCWD, other regulatory agencies, and activists are committed to holding them to that policy. This process is not finished. Permits have not yet been issued for the 17-35 tunnel, and future permits will be necessary for other dewatering projects planned at the airport. There will be many more discussions, model revisions, and debates surrounding ground water resources at the airport.

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## Are Sheet-Pile Walls Effective at Reducing the Drawdown from Construction Dewatering?

— Ray W. Wuolo, P.E., P.G., Barr Engineering Company

### Introduction

Trench excavations for utilities, foundations, and cut-and-cover tunnels typically require some method of dewatering if the excavations are below the water table. Dewatering is accomplished by a variety of means, such as pumping of temporary well points using submersible pumps or vacuum, pumping from a sump at the bottom of the excavation, or pumping from linear drains. All of these methods are intended to eliminate or minimize water in the excavation so that construction activities can be performed safely and effectively. Any method that pumps groundwater will cause some drawdown in the water table – the extent and magnitude of the drawdown is dependent upon the aquifer's characteristics (transmissivity and storage) and the aggregate dewatering rate. The dewatering (i.e. pumping) rate is also a function of the depth of excavation – deeper excavations require higher dewatering rates.

There can be a number of compelling reasons to try to minimize the rate of pumping during excavation dewatering. There are often costs

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## Sheet Pile Walls, cont.

with the discharge of pumped water. More often, there are concerns that dewatering will result in water-table drawdowns that may adversely affect building foundations, the capacities of nearby water-supply wells, wetlands, or lakes. One of the most common methods used to try to minimize the adverse effects of construction dewatering is to install sheet-pile walls around all or part of the excavation. A sheet-pile wall has the advantage of being a massive engineered structure that people can point to and say, "See! Look how much money we spent to protect your lake from our construction dewatering." For some reason, people feel comforted by walls. But do sheet-pile walls really deliver what they promise or are they merely façades?

### Sheet-Pile Wall Construction

Sheet-pile walls are constructed by driving individual pilings (usually steel beam-like structures up to 40-feet long) into the ground and next to one-another to form a relatively continuous sub-surface barrier. Additional length can be welded on to create a longer piling. The pilings have interlocking tongue-and-groove connections and are driven with a pile driver, which is a slide hammer attached to the end of a drag-line boom. In soft soils (clay and silt), piles can be driven to depths of 100 feet but in sand and gravels, 50 feet would be a considerable depth. Boulders and glacial erratics will stop a pile dead. Piling walls leak at the joints and this leakage can be considerable. However, grout can be injected behind the wall to form an effectively impermeable barrier.

### Keyed Walls and Hanging Walls

A sheet-pile wall is considered to be "keyed" if the pilings extend into a layer of low permeability that is relatively continuous underneath the excavation. Intuitively, a keyed wall would be optimal because it forms something akin to a bathtub. Dewatering need only to remove the water from storage within the confines of the keyed wall and then maintain low pumping rates to keep up with whatever leakage comes through or under the wall. The

drawdown effects outside of the keyed walls are generally minimal.

Hanging walls are terminated before encountering a continuous layer of low permeability. If the wall is being constructed in a thick surficial aquifer (e.g., in a buried bedrock valley filled with outwash), the likely result of driving a sheet-pile wall will be a hanging wall because it is both technically and economically infeasible to extend the wall deep enough to key into a low-permeability layer. This is when the geotechnical engineer turns to the hydrogeologist and says, "Do your magic and show them this wall is deep enough."

### Numerical Modeling of a Sheet-Pile Wall: An Example

Evaluating the change in the elevation of the water table (drawdown) outside of a sheet-pile wall in response to construction dewatering is a partially-penetrating, transient problem. This problem can readily be evaluated using a three-dimensional groundwater flow model with transient capabilities (e.g., MODFLOW). For this hypothetical evaluation, a seven-layer MODFLOW model (McDonald and Harbaugh, 1988) was constructed, as shown on Figures 1. The grid is most refined in the center of the model, where dewatering will take place. The hypothetical aquifer is 160 feet thick, and 10,000 feet on a side. Constant head cells on the west and east boundaries provide for a gentle hydraulic gradient of 0.0003 when no dewatering is taking place. The upper 60 feet of the aquifer is discretized into 10-foot thick layers; Layer 6 is 30 feet thick and Layer 7 is 70 feet thick. Each of the layers is assigned the same values of vertical and horizontal hydraulic conductivity (both of which are changed uniformly over the model domain in different simulations). The aquifer is assigned a

specific yield value of 0.01 and a storage coefficient of 0.001.

A north-south oriented head-specified drain element 500-feet long is introduced into this hypothetical model in Layer 3 with a head elevation of 123 feet. This represents construction dewatering of about 30 feet of the aquifer – the depth of installation of deep utilities or a cut-and-cover tunnel. Two parallel, impermeable walls 3,000 feet long and 300-feet apart are placed on either side of the drain. The depth of penetration of these walls is varied for different simulations.

Simulations were performed for four uniform aquifer conditions: (1)  $K_x = 100$  ft/day &  $K_z = 10$  ft/day; (2)  $K_x = 30$  ft/day &  $K_z = 3$  ft/day; (3)  $K_x = 10$  ft/day &  $K_z = 1$  ft/day and (4)  $K_x = 30$  ft/day &  $K_z = 0.3$  ft/day. The first three conditions represent typical values for medium sand, fine sand, and silt, respectively (Freeze and Cherry, 1979) and an anisotropy ratio of 10:1. The fourth condition examines an anisotropy ratio of 100:1. Vertical anisotropy depicts the common condition that the rate at which groundwater can move vertically

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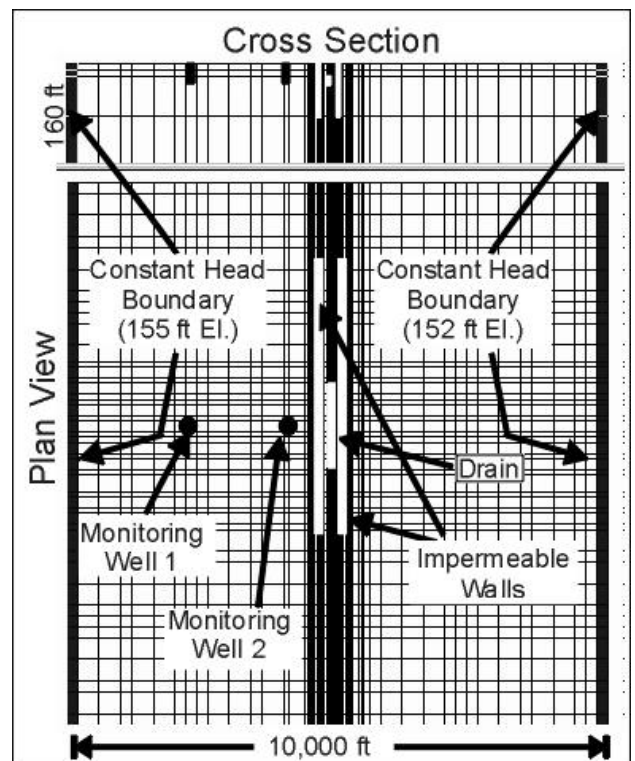


Figure 1: Example MODFLOW model grid.

## Sheet Pile Walls, cont.

groundwater can move vertically within soil or rock is typically less than the rate it can move horizontally because of the manner in which the sediments were laid down, the presence of thin strata of lower permeability, and the compression of soil over time by the weight of glaciers and rock. This turns out to be an important consideration in the effectiveness of hanging sheet-pile walls.

For each aquifer condition, a steady-state simulation was solved to provide a non-stressed condition for which drawdowns could be calculated. Then, transient simulations of 100 days (50 total time steps with a time-step multiplier of 1.2) was run with the drain and with various wall-depth configurations.

Drawdowns were calculated at two hypothetical monitoring wells located 2,600 and 750 feet from the drain (both beyond the sheet-pile wall).

### Results

Plots of time vs drawdown for the monitoring well farthest from the drain (2,600 feet) are shown on Figure 2. As expected, decreasing the aquifer's horizontal hydraulic conductivity results in smaller drawdowns at the well. What is particularly interesting, however, is that increasing the depth of penetration of the impermeable walls results only in a very small decrease in drawdown – until the wall fully penetrates the aquifer (i.e. keyed). For example, a wall that penetrates 80 feet into the aquifer results in a drawdown that is only 15 to 25 percent less than the drawdown that would be expected with no wall at all (depending on the value of horizontal hydraulic conductivity). For higher permeability aquifers, the benefits derived from a non-keyed slurry wall appear to be minimal. (The reason that some drawdown occurs even with a fully penetrating wall is because the walls do not extend to impermeable boundaries – there is some hydraulic response through the open ends of the parallel walls.)

The degree of vertical anisotropy of the aquifer appears to be a critical factor in the effectiveness of a hanging wall. The bottom two plots in

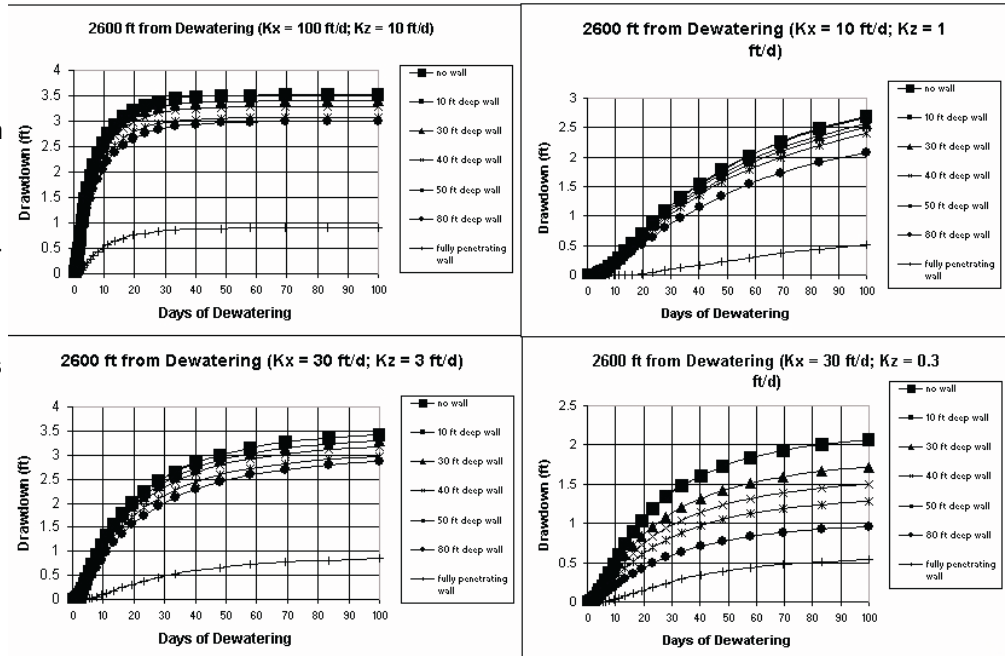


Figure 2: Model results for four sets of uniform aquifer conditions.

Figure 2 are for identical conditions except that the plot on the right has a vertical hydraulic conductivity value that is 100 times less than the horizontal hydraulic conductivity, compared to 10 times less for the plot on the right. For the condition where the anisotropy ratio is 100:1, a wall penetrating 80 feet into the aquifer is predicted to reduce the drawdown by about 50 percent. The effect of changing anisotropy is intuitively obvious – the rate at which groundwater can flow down under the wall and back up to the drain is highly dependent on the vertical, rather than the horizontal hydraulic conductivity.

### Discussion and Ramifications

Constructing a sheet-pile wall to minimize the effects of dewatering is a very expensive proposition – it seems prudent to make sure that the wall will actually result in meaningful benefits before it is built. Walls that are keyed into laterally continuous, low-permeability layers will very likely be effective at reducing drawdown. However, the effectiveness of walls that cannot be keyed should be viewed with great skepticism, even in cases where the wall extends to a depth considerably below the level of dewatering. Hanging sheet-pile walls probably shouldn't even be

considered unless there are data that support a high ratio of horizontal to vertical hydraulic conductivity (something on the order of 100:1 or greater). Bair and Lahm (1996) report ratios of horizontal to vertical hydraulic conductivity for glaciofluvial deposits ranging from 2:1 (Cape Cod, MA) to 50:1 (Gironde, France), with most values less than 10:1. Thus, the prospects for success with a hanging sheet-pile wall in a thick unconsolidated aquifer are poor.

If a hanging sheet-pile wall design is pursued, it becomes imperative to engage in a sound data collection and analysis program that can reliably quantify vertical anisotropy. Small-scale permeability tests (either in the lab or in situ) are wholly inadequate. What are needed are well-conceived, partially penetrating pumping tests with piezometers screened at multiple intervals through the aquifer and at a scale similar to that of the contemplated stress (Bair and Lahm, 1996). Analytical methods, such as those of Moench (1997) can be used to estimate anisotropy, provided boundaries are not encountered. Standard analytic methods for pumping test analyses require that

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## Sheet Pile Walls, cont.

the observation wells be about twice the aquifer thickness times the square root of the ratio of horizontal to vertical hydraulic conductivity in order to be valid (Kruseman and deRidder, 1990); as such, these methods do not test vertical anisotropy. Where boundaries are encountered, the assumptions in analytical methods break down and vertically discretized, transient numerical models that are calibrated to the pumping test data are likely the only reliable means of evaluating vertical anisotropy.

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## Kenya Update

— Jeff Green, *DNR Waters, Rochester*

In the last MGWA newsletter I wrote about my trip to Kenya last March. Since then a number of people have asked me about the status of the work to secure a good water supply for the Mutulu Hope Center. Well, next March I will be returning to Kenya to install a box around the spring near the Hope Center. The work will be done in cooperation with an engineer from the Africa Inland Mission (AIM). We will be installing a concrete and masonry dam around the spring to protect it from human activities. The water will be piped 5 meters to a storage tank; the local people will then get their water from that tank. We also may run a pipeline up the hill to a hand pump to make things a bit easier for the local folks. The cost for the box, tank, and AIM assistance will be around \$500. The hand pump and pipeline will be an additional cost; we may also consider using a more costly ram to lift water up the hill. There are also plans to install a large rainwater cistern at the Hope Center itself which will cost several hundred dollars. I am now raising funds, lining up the materials I need to bring from here, and coordinating things via e-mail with the AIM staff. I hope to give you a report on the completed project in next spring's newsletter! If you are interested in further information on this project you can contact me at 507-285-7429 (work) or via e-mail at [greenboys3@uswest.net](mailto:greenboys3@uswest.net).

## Capillary Fringe

### Driller's Viewpoint

— Steve Alberg, *Alberg Water Services, LLC, 16200 Hwy 10, Elk River MN 55350*

My well drilling company has reached the end of its rope in respect to the expectations placed upon us by consulting engineers. My company is based in Minnesota. We formed a family partnership in 1994, with previous well service and drilling experience drawn from 75 years of combined employment experience at another well company. We specialize in the construction and service of municipal water supply wells primarily in Minnesota.

Most days, we wonder why.

Our Minnesota Department of Health (MDH) sculpted a model in which public water utility construction was to be designed by hired consulting engineers who supposedly could translate the code language to a form of information called drawings and specifications for construction. The well drillers have come to recognize the purpose and value in the process of protecting public health. Nobody could envision a downside to the organization of this system.

Unfortunately, a number of us in the industry have had a bumpy ride under the watchful eye of consultants. One may wonder where consultants in charge of planning and managing construction of wells get their empowerment and infinite wisdom.

Every human endeavor needs a plan or road map. The interpretation of that plan is often different from one individual to the next. A contractor's view of that plan can vary from the original intent of the designer. Inherent disagreement in the performance requirements have to be addressed in the contractual language. In past history, and today, contractors took advantage of flaws in the plans and often realized rewards in negotiating change orders. Public money funded these projects, and the smart money managers demanded that the consultants find a way to plug the leaks.

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## Two MGWA Officer Positions Open for 2001

**Call for Nominations: The MGWA membership needs to fill two officer positions — Treasurer and President-Elect — for the year 2001.**

The Treasurer handles MGWA financial matters and assists with meeting planning. The President-Elect takes a leadership role in the planning of one or more of the MGWA meetings while "learning the ropes" of MGWA leadership. Here's a chance for you or someone you nominate to get in on the front end of ground water resource protection in Minnesota.

The Treasurer serves a two-year term, and the President-Elect serves for a year before becoming President in 2002 followed by a year as Past-President.

Send your nominations by November 1 to MGWA, 4779 126th St. North, White Bear Lake, MN 55110-5910, or by e-mail to: [Office@mgwa.org](mailto:Office@mgwa.org).



## Capillary Fringe, cont.

Loosely written specifications and contracts had to stop, so municipalities began to shop consultants. The consulting engineers structured themselves to be marketing machines. The specifications were tightened and redrawn to impress upon the consultant clients how bullet-proof their services were. Now we have a resistant strain of money-driven madmen at the wheel.

At one time, consultants were as revered as the sheriff in town. His client got the quality and service they expected. The consultant surrounded himself with quality manufacturers, vendors and contractors. Mr. Consultant often had no ability to drill a well or build anything with his own resources. However, his little professional network rarely failed him. He was considered a hero by his clients. If he wanted to design a new city water supply well and pump house, he called somebody like my dad. Dad showered the consultant with free information. The reward to my father was a favorable bid proposal and specification naming proprietary equipment and construction methods my father could best provide. The service and workmanship was stellar in the eyes of the new owner. He paid a high price in the opinion of today's bean counters. Yet the new well owner got something he really wanted. Value and quality.

The notable differences from yesterday and today are that the contractors are rarely called for their equipment offerings and suggestions. The factory reps have taken away the competitiveness of the resellers like my dad, the well and pump contractor. In the case of a new water well, the consulting engineer often does not call the experienced old local well driller for suggestions and pricing considerations. He calls the MDH well management unit and assembles a well design based on their recommendations and code interpretation. In addition, today's computer technology allows him to draw an enormous wealth of information and pricing experience from the data base he has assembled throughout the years.

Our current climate in well construction is poisoned. There are few field friendly consultants. I certainly do not level this accusation at all of them. The good ones know what I mean.

Consulting engineers have developed "boiler plate" general contract conditions, special provisions and contract documents that ambush an unsuspecting contractor from every angle. Everything is slanted toward the consultant and his client. The language is done in such a way that by executing the contract, virtually any financial flexibility for the contractor is eliminated. The example of unforeseen or differing subsurface conditions is my main point.

In signing these contracts, we agree to relieve ourselves of any congenial or mutually beneficial remedies. Read the general conditions of a contract. They all dare the contractors make a challenge. Consultants have assumed the position of God. They don't make mistakes and don't have to pay for them. The common specifications I see contain language that in some form says that all investigative efforts, test borings and research data is not warranted to be representative of the site conditions. Compliance with the contract is mandated and any alteration is a breach of contract. The only room the contracts give us is the right to point out the problem before we get buried in the job. Consultants like surprise change orders about as much as having a tooth pulled.

Experiencing differing site conditions can be devastating. The recourse is to have a good and aggressive attorney who knows his stuff. At the first sign of a problem, the consultant puts up his shield called a contract. Once his shield is held up, the only one that seems to penetrate it is a good attorney. Mother Nature throws something at us every foot or two. It forces a driller to make a decision and respond with expedience. Sometimes we cannot wait for the bureaucracy to catch up with the job. The driller is a gladiator fighting a lion. A better analogy may be that he's battling a lion with a blindfold on. Our eyesight is taken away about two feet into the ground. Our read on the situation does not come to full comprehension until a week or sometimes a month

later. How can anyone expect us to maintain absolute compliance with a contract? How can anyone expect us to be fully prepared for everything nature throws at us?

### In conclusion:

A segment of the well drilling industry will never publicly acknowledge that they share my views. The adage "never bite the hand that feeds you" rings loudly in their ears. My problem is that I haven't been fed in years.

Our older industry counterparts are like seasoned market investors. They stay in for the long haul, mixing the good with the bad. Generations of equity allows them to survive. A five-year-old company like ours has a long road ahead. Being new, there is an assumption of weakness. Consulting engineers may not necessarily attack our condition. However, when their design and planning is challenged by our claim of unexpected conditions, they hand us a boomerang.

I propose that water utilities and industry step in and reassess their use of consultants. More so, reassess the level of control that consultants bring to the project. When drilling wells, well construction contracts need to acknowledge that unforeseen conditions are inevitable and are grounds for renegotiations. Avenues exist in most contract language, allowing for corrective measures. The difficulty lies in the empowerment of the consultant. A contractor must almost automatically enlist an attorney to direct the situation to arbitration. We end up in a position where we challenge each other's character and resolve. Why can't we simply say there is a problem? Let's allow the well driller a little latitude while practicing his art. It is not an exact science. It is an ART. Put a college-taught consulting engineer at the controls of a well drilling rig, and let's get a good laugh at his exact science.

— reprinted with permission, *National Driller*, V. 21 #6, June 2000.

## Newsletter Team Invites Private Sector Participation

Your MGWA newsletter team urgently needs a volunteer from the private sector to work with other team members to assemble the items in the newsletter and to help give a more balanced perspective to your editorial team. The newsletter team usually meets the first or second Tuesday of the month (depending on the newsletter publication schedule) at 7:30 am in the PCA-DNR cafeteria. Meetings are generally 90 minutes or less. Many of the production details are handled electronically and publication is done under contract to Watershed Research, Inc. of White Bear Lake. If you work in the private sector and being a part of the newsletter team serving the cause of ground water protection in a volunteer capacity interests you, contact Tom Clark, newsletter editor, or any member of the team listed in the sidebar on page 2.

## Contaminated Well Suspected of Causing Disease Outbreak and Two Deaths at 1999 Washington County Fair, New York

The New York State Department of Health recently released findings related to a waterborne disease outbreak that occurred amongst people who attended the 1999 Washington County Fair in New York State. The fair was held on August 23-29, 1999. On September 3, 1999, local health officials noticed an abnormal increase in the number of patients complaining of gastrointestinal pain and bloody diarrhea. Of the more than 100,000 people who attended the fair, it is estimated that at least 2,800 individuals may have become ill. The bacterial agents identified in this disease outbreak were *Escherichia coli* (*E. coli*) O157:H7, and *Campylobacter jejuni*. Of the individuals who submitted stool samples for analysis, the presence of *E. coli* O157:H7 was confirmed in 127 individuals, the presence of *Campylobacter jejuni* was confirmed in 45 individuals, 14 cases of hemolytic uremic syndrome (HUS) were identified, 71 persons were hospitalized, and 2 individuals died including a 3-year old girl and a 79-year old man. The cause of death in both cases was HUS, which is a condition that can lead to kidney failure.

New York State Department of Health laboratory and epidemiological findings indicate a strong relationship between ill fairgoers and

consumption of water from Well No. 6. Well No. 6 is a hand-driven, 1½-inch diameter well that is 24 feet deep and finished in an unconsolidated sand and gravel aquifer. Well No. 6 supplied untreated water to several food vendors, the grandstand area, and a dormitory water heater. Untreated water from Well No. 6 was also mixed with chlorinated water from two other wells and used to fill a 120,000 gallon storage tank for general use throughout the park.

Water samples collected from Well No. 6 after the outbreak began were positive for total coliform bacteria and for *E. coli*. Further investigation revealed potential contamination sources as being a sewage cesspool 36 feet away from Well No. 6, a cattle barn 50 feet from Well No. 6, and a manure storage area 80 feet from Well No. 6. *E. coli* O157:H7 was identified in samples collected from the sewage cesspool. DNA testing of *E. coli* confirmed that the same strain was found in water samples from Well No. 6, the cesspool, and ill persons. In addition, a dye test was conducted on the nearby septic system and it was found that there is a hydraulic connection between the cesspool and Well No. 6. A dye test for the manure storage area was negative. It is important to note that on four prior occasions (once in 1997, twice in 1998, and once in 1999) water from Well No. 6 was sampled, analyzed, and determined to be free of coliform bacteria.

The New York State Department of Health commissioner has issued an order that prohibits the use of

untreated water at seven agricultural fairground sites in New York until October 1, 2000. In the interim, the commissioner is requiring that each fairground conduct a comprehensive assessment of each fairground water distribution system, and to submit a report to the health department for review. The commissioner is also reviewing existing statutes and regulations with her staff to determine what changes are necessary to protect public health and safety at public events.

*Information provided by New York State Dept. of Health — reprinted with permission from the Minnesota Department of Health Well Management Newsletter, Summer 2000. See below for related article.*

## ... And Could This Happen in Minnesota?

*E. coli* contamination is a big deal. Recent news has reported on outbreaks in Milwaukee and Dallas in which many people have been sickened by food that was contaminated by a nasty strain of the bacterium *Escherichia Coli*, called *E. coli* O157:H7 (although to be fair to the bacterium, the Texas outbreak has yet to be confirmed as due to *E. coli*). But it is a serious matter — one person died in the outbreak in Wisconsin. While food is a common carrier of the bacteria, water is another. The previous article illustrates this by describing the outbreak last year in NY State because of a contaminated water supply. More recently, an outbreak in Walkerton, Ontario resulted in at least 7 deaths and hundreds of people affected. In these cases, the initial contamination was due to a single well and the water distribution systems served to deliver the bacteria to a large population.

So how are water supplies protected in Minnesota? What safeguards have been put in place? From a programmatic standpoint, the Minnesota Department of Health (MDH) regulates all public water supplies in the state, mostly under authorities it assumes under the federal Safe Drinking Water Act. Generally this act

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## Water Supply Safety in Minnesota, cont.

regulates public water supplies based on the size and nature of the population served by the system. It is interesting to note that since the Walkerton outbreak, Ontario government officials have tightened regulations governing public water supplies to prevent a repeat of the tragedy in Walkerton. Many of the steps they intend to implement are already carried out in the U.S. because of the Safe Drinking Water Act.

There are several approaches that are commonly used to combat bacterial contamination of water supplies. The most common is disinfection, by which water is treated using one or more of a variety of methods to kill or inactivate *E. coli*. Systems using surface water sources, such as Minneapolis, St. Paul, St. Cloud, and Duluth, to name a few in Minnesota, are required to disinfect. Systems that rely on ground water sources are not required to disinfect, although many do. The regulations pertaining to disinfection is a hot issue right now among public health experts. Federal officials have generally been advocating requiring disinfection of ground water based systems on a wholesale basis. Others have argued that the viability of pathogens in ground water does not warrant such a response and that many small systems may not have the technical capacity to handle disinfection appropriately. Over-zealous disinfection, especially with chlorine, may have negative side-effects.

MDH tracks bacterial contamination in drinking water by monitoring water supply systems in accordance with the Safe Drinking Water Act. Nationwide, the largest systems are required to take at least 480 samples each monthly. The number of samples that smaller systems are required to take decreases down to a minimum of 1 per quarter for systems serving populations between 25 and 1000. Communities serving populations as large as Minneapolis, for example, would be required to collect approximately 180 samples each month and have them analyzed by a private laboratory certified by the State. Ground-water-based systems

can reduce the sampling frequency to quarterly if a sanitary survey has been completed.

Sanitary surveys are used by MDH to prevent bacterial contamination of water supply systems. Such surveys are performed by MDH staff who inspect system components and ensure they will protect public health. Water well code set-back requirements also serve to isolate wells from potential sources of contamination. Periodic inner wellhead zone delineations are conducted near ground-water-based public water supply wells to ensure the set-backs are maintained.

Finally, the construction standards established in the Water Well Code (MN Rules Chap. 4725) include many provisions in addition to the set-back requirements mentioned earlier. These standards have generally been in place for over 25 years and have been designed to limit the likelihood of wells getting contaminated in the first place.

Despite these efforts, problems occasionally develop. In 1999 in Minnesota over 20 boil orders were handed down by MDH after routine testing showed the presence of coliform bacteria. This number was driven by very tight standards that required boil orders if any type of coliform bacteria are confirmed in the public water supply, which was probably over-restrictive. MDH currently issues boil orders if fecal coliform is present. This is the class of coliform bacteria that contains the dangerous strains of *E. coli*. So far in 2000, we have had fewer than 5 boil orders.

To find out if the system that serves your household has had any boil orders or other kinds of contamination problems consult the annual Consumer Confidence Report that the system is supposed to provide. Call your public water supplier to obtain a copy.

If you have a private well, you should arrange periodically to get samples tested. Your county health official can guide you to laboratories certified to conduct the work.

— *contributed by Steve Robertson, Hydrologist, MN Department of Health.*

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## MGWA Professional Membership Annual Dues to Increase \$5 for 2001

At its June meeting, the MGWA Board voted to increase the annual membership dues for professional members to \$25. Annual dues for students will remain at \$15. This is the first dues increase for the Association since 1995. The costs for paper, printing and mailing the newsletter have risen in recent years and the cost of electronics to support on-line activities like the MGWA website and e-mail distribution network have also led to the increase. The Association will continue to do what it can to keep costs down for its membership, including making past issues of the newsletter available electronically on the website and encouraging electronic registration for events like field trips and conferences. The revised 2000 membership directory is now available on-line for paid members, or, as in past years, members may purchase a paper copy for \$7 with their annual dues submittal. You may join MGWA electronically by visiting the website, or by mailing a completed copy of the application form on page 18 of this newsletter.

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## MGWA-AIPG-AWG Fall Field Trip to Minnesota River Valley

As this issue reaches you, the annual fall field trip sponsored jointly by MGWA, the Minnesota Chapter of AIPG and the Minnesota Chapter of AWG will be nearly upon us. MGWA has the lead this year and members will have received registration information and an e-mail reminder. Stops this year include the Savage Fen, the Minnesota River at Jordan, Minneopa Falls near Mankato, the Kasota Prairie, a Minnesota River floodplain reclamation demonstration site, and last but not least, a tour of the Schell Brewery and German dinner at New Ulm. Watch for pictures and a write-up in the December MGWA newsletter.

## IGive.com Website Benefits MGWA Foundation

If you like to shop on-line, you now have an opportunity to help benefit the MGWA Foundation. If you use the website iGive.com as a shopping cart, a portion of the price paid to certain vendors, typically 3-8% comes back as a direct benefit to the MGWA Foundation. There are about 200 vendors registered through iGive.com who are participating, some examples of which and the percentage from each that will go to the Foundation are as follows:

- Amazon.com 1.5%
- American Greetings 10%
- Avon 4%
- Barnes & Noble 3.5%
- Borders 1.5%
- Burpee Seeds 2.5%
- Buy.com 1.5%
- Dell 0.5%
- Disney Store 2.5%
- Flower.com 8.5%
- Franklin Covey 7.5%
- GAP 2.5%
- Hallmark 8%
- Hickory Farms 3.5%
- JC Penney 2%
- Lands' End 5%
- Magazines.com 15%
- Nordstrom 2.5%

So make your shopping an opportunity to help benefit a worthy cause and support the MGWA Foundation.

## MGWA Foundation Receives IRS Determination Letter

The MGWA Foundation received confirmation from the IRS that it is tax exempt under 501(c)(3) and is eligible to receive tax deductible contributions. No changes to the planned operations were requested by the IRS and our form was processed in record time (we had been told to expect a long wait).

## New Regional Hydrogeologic Assessment Report Available

The Minnesota Department of Natural Resources (DNR) recently published Part B of the Southern Red River Valley Regional Hydrogeologic Assessment. The assessment includes Clay, Norman, and Wilkin counties, and parts of Mahnommen, Becker, Otter Tail, Grant, and Traverse counties. Two plates contain maps at 1:200,000 that describe the hydrogeology and pollution sensitivity of the area. The study area includes nineteen ground-water regimes with distinct hydrogeologic and chemical characteristics. The pollution sensitivity plate assesses the sensitivity of the near-surface ground-water systems to pollution. Digital files of the databases and maps, plus portable document files (PDF) of both plates are available on the DNR web site at the web address below. The Minnesota Geological Survey published Part A, two plates describing the surficial geology and glacial stratigraphy of the region, in 1995.

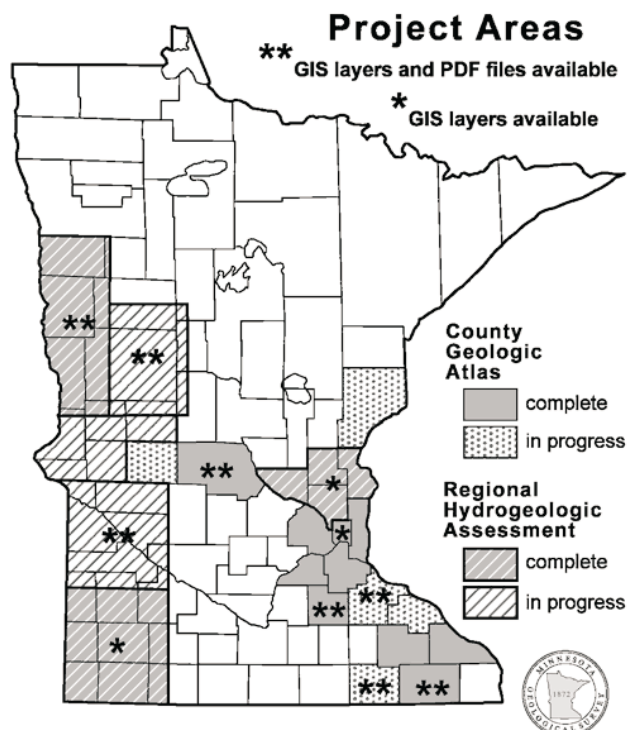
This report completes the third assessment in the series and three more reports are underway. Part A for both the Upper Minnesota River Basin and the Otter Tail Regional Hydrogeologic Assessments have been completed. An assessment in the area of Traverse, Grant, and Big Stone counties recently started.

These reports are result of an ongoing cooperative program between the DNR and the Minnesota Geological Survey. The overall effort also includes preparation of the popular County Atlas Series of reports. The reports produced by the program support planning, research, education, and environmental protection efforts.

The map shows progress on other assessment or atlas projects. More information about other reports can be found on the web at [http://www.dnr.state.mn.us/waters/programs/gw\\_section/cgarha/status.html](http://www.dnr.state.mn.us/waters/programs/gw_section/cgarha/status.html) and <http://www.geo.umn.edu/mgs/>.

*Regional Hydrogeologic Assessment RHA-3, Part B, Southern Red River Valley, Minnesota.* Two color plates. Scale 1:200,000. \$15.00 (sales tax and shipping charges extra).

The report may be ordered from the Minnesota Geological Survey, Publications, 2642 University Avenue W., St. Paul, MN 55114-1057, phone (612)627-4782.



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## MPCA Releases Results of Ground Water Quality Study in Cottage Grove

The Minnesota Pollution Control Agency has published results of a comprehensive sampling of 79 private wells and four monitoring wells in the rapidly developing area of Cottage Grove, southern Washington County.

The study was conducted to better understand the distribution of nitrate and other chemicals in ground water and to identify factors affecting ground water quality. Samples were analyzed for nitrate and other inorganic chemicals (including trace elements), volatile organic compounds (VOCs), herbicides and tritium.

Results indicated nitrate impacts to the Prairie du Chien and Jordan aquifers which are an important source of drinking water in the area. Nitrate levels were similar in both the Prairie du Chien and Jordan aquifers, with an overall median nitrate concentration of 5.3 mg/l. A nitrate value of greater than 1 mg/l is presumed to indicate the influence of human activities on the land. Seventeen percent of samples exceeded the drinking water standard of 10 mg/l.

Herbicides and their breakdown products were detected in 68 percent of domestic wells sampled, but concentrations were typically well below drinking water criteria. As concentrations of herbicide increased in a well, so did nitrate. The study found no correlation between concentrations of nitrate or herbicides with land use, which may reflect historic inputs of these contaminants in areas that have been converted from agricultural to residential.

For more information, see the Ground Water portion of the MPCA website at [www.pca.state.mn.us](http://www.pca.state.mn.us), or call Jennifer Maloney at the MPCA (651)296-8544.

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## Geoscientist Licensure Legislative Update

As a result of the 2000 Legislative session, several new provisions took effect July 1, 2000 that will affect those currently licensed or considering becoming licensed as professional engineers or geoscientists:

The fee for licensure or renewal of licensure as an architect, professional engineer, land surveyor, landscape architect or geoscience professional has been increased from \$104 to \$120 per biennium. The renewal fee for 2000-2002 stays at \$104 and will go to \$120 for the 2002-2004 renewal period. This "evens the playing field" as the license fee for all professions under the licensing act is now \$120/biennium.

An application fee of \$25 for in-training applicants and \$75 for professional license applicants was created. There previously was no application fee.

The licensing board received an appropriation of \$130,000 to support enforcement activities of the board.

For more information, visit the licensing board website at: <http://www.aelslagid.state.mn.us>

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## House Blocks Reductions in Arsenic, Radon in Drinking Water

Washington, DC, June 22, 2000 (ENS) – The U.S. House of Representatives voted Wednesday against efforts to reduce the amount of arsenic and radon in drinking water. Through a rider on the EPA budget bill for fiscal year 2001, the U.S. Environmental Protection Agency (EPA) will be barred from completing regulations to reduce levels of arsenic in drinking water. Another rider stops the agency from issuing a new standard for radon levels in drinking water, and

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## Radon and Arsenic Reductions Blocked, cont.

a third halts cleanup of contaminated sediments in waterways. A separate measure blocks EPA action to reduce smog.

"Congress defied public opinion and common sense by voting against reducing the arsenic and radon in our nation's drinking water and smog from our air," said Ed Hopkins, Sierra Club senior representative. "You don't need a PhD to know that if you can remove arsenic, radon and smog levels, you vote yes." The current standard for arsenic levels in drinking water was set in 1942, and the EPA has been blocked in several attempts to update the standard. A 1999 National Academy of Sciences report found that the current standard is unsafe, and should be revised "as promptly as possible." The radon rider directs the EPA to delay implementation of a drinking water standard. In 1996, Congress' Safe Drinking Water Act amendments ordered EPA to issue a radon rule for tap water by August 2000. Two 1999 National Academy of Sciences studies that found that radon is known to cause cancer in humans. "The House's belief that it knows more about safe drinking water than the National Academy of Sciences and the EPA is a threat to our families health," Hopkins said. "Hopefully, the Senate will show more concern for our nation's drinking water and remove these harmful riders."

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## Membership Survey

MGWA will be sending out the second annual membership survey late this fall. Look for it on the flip side of the election ballot, which will be enclosed in the December newsletter.

The MGWA Board of Directors uses your responses to help plan the events you need to stay current in the rapidly changing field of ground water science. When you receive your membership survey, please return it (and the ballot, of course) to the MGWA office right away!

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## Minnesota Environment 2000 Report: The Highlights

Minnesota's population has more than doubled since 1900. Along with this growth have come changes in the state's physical environment.

A new MPCA report, *Minnesota Environment 2000*, takes a detailed look at the state of our environment now, as compared with the past, and what's ahead for the new millennium. Perhaps more importantly, the report looks at the environmental challenges we face both statewide, and in the geographic regions across the state.

The 40-page report is divided into sections on the state of the air, water and land, followed by a more detailed look at environmental history and challenges. Sidebars throughout the report illustrate our impact on the state's environment since the 1800's.

The MPCA and a host of other organizations, businesses and citizens have made a great deal of progress correcting the environmental wrongs of the past. But after eliminating the obvious pollution sources, we've begun to see new issues emerging that diminish past environmental gains. In many cases, these new problems are harder to solve, involving complex political, economic, cultural and technical issues.

Interesting facts in the report include:

When the Pig's Eye plant in St. Paul opened in 1938 it was the first wastewater treatment plant on the Mississippi River. With continuing improvements in wastewater treatment, the Mississippi's metro reach has rebounded from decades of neglect.

Levels of most "criteria" air pollutants such as carbon monoxide and sulfur dioxide have declined in the Twin Cities since 1990. However, levels of lesser-known toxic air pollut-

ants are too high in some parts of the state.

The Twin Cities area is the 9th fastest growing among the 25 major metropolitan areas in the country. Along with this growth come sprawl, increasing traffic congestion, declines in lake water quality, and air pollution.

Sprawl isn't limited to cities. The North Shore of Lake Superior is developing faster than anywhere else on the big lake. The Brainerd/Baxter area also suffers sprawl-related problems, such as increasing pollution of area lakes.

The "Land of 10,000 lakes" actually has 11,482 lakes of 10 acres or larger. Add smaller lakes and the total is more than 14,000. We also have 92,000 miles of streams.

The number of miles we travel in our vehicles each year is going up faster than our rate of population growth. For example, from 1994 to 1998 Minnesota's population grew by about four percent, but the number of vehicle miles traveled grew by 11 percent. Toxic air pollution from cars is becoming an increasing concern.

Less than half of our pre-settlement wetlands remain in the state. Since the 1980's, most wetland loss has been from urban development.

Despite our abundance of surface water, two-thirds of Minnesotans draw their drinking water from ground water. Nitrate contamination of ground water is an issue in much of the state.

You can download *Minnesota Environment 2000* from: [www.pca.state.mn.us/about/pubs/mnereport](http://www.pca.state.mn.us/about/pubs/mnereport)

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## USGS Launches Customizable Online Atlas

A new online version of *The National Atlas of the United States America™* is now available through the U.S. Geological Survey (USGS).

Located at [www-atlas.usgs.gov/](http://www-atlas.usgs.gov/), the atlas allows users to create custom maps using various search criteria such as water, geology, biology,

population, mine operations, watersheds, or stream flows.

For instance, a user might wish to know the major aquifers; the discharges made to waterways; and Superfund sites in a given county, state, or region. With a few clicks of the mouse, an on-screen map will appear detailing the information requested. A legend provides the user with an explanation of the various color layers that represent the data retrieved in the search.

The atlas also includes easy-to-use software for data display, query, and custom information and map making. The Internet-based version of the map allows USGS to offer more up-to-date, real-time, and regional data. Links to other atlas sites on the web are included. The site says the atlas "delivers authoritative views of scientific, societal, and historical information.... So that customers can produce their own relevant information."

— reprinted from *The Aquifer*, v. 15, no. 1, June 2000.

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## Notice of Availability: Arsenic in Ground Water Resources of the United States

The US Geological Survey (USGS) has recently released a four-page fact sheet (FS-063-00) that details arsenic concentrations found in ground water of the United States, based on USGS sampling data from across the country. The fact sheet also provides information on where and to what extent natural concentrations of arsenic in ground water exceed possible new standards for arsenic being developed by the US Environmental Protection Agency (see related article on arsenic and radon in drinking water elsewhere in this issue). This information is especially important to public water suppliers who may be faced with treating their ground water supplies to meet new lower standards. The Minnesota USGS office in Mounds View has a limited number of copies of the fact sheet, or you may visit the USGS website at: <http://co.water.usgs.gov/trace>

## MGWA Calendar

The most complete version of the MGWA Calendar is available on our web page at [www.mgwa.org](http://www.mgwa.org).

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

**September 19-20, 2000** Aquifer Tests: Operations and Parameter Estimation. Milwaukee, WI. Contact: NGWA.

**September 19-20, 2000** Water Well Rehabilitation. Milwaukee, WI. Contact: NGWA.

**September 21-22, 2000** Design and Construction of Wells. Milwaukee, WI. Contact: NGWA.

**September 22-23, 2000** MGWA/AIPG/AWG Fall Field Trip—Lower Minnesota River Valley. Contact: Jim Stark at 763-783-3230.

**September 27, 2000** Third Annual Children's Water Festival, State Fairgrounds. Contact: Joe Enfield 952-361-1801, or [jenfield@co.carver.mn.us](mailto:jenfield@co.carver.mn.us).

**October 5-7, 2000** Advances in Site Characterization for Environmental and Engineering Projects at Glaciated Sites, Holiday Inn Minneapolis West. Contact: Dan Kelleher, Midwest Geosciences Group, 612-551-2435, or [info@midwestgeo.com](mailto:info@midwestgeo.com)

**October 9-10, 2000** Low Cost Remediation Strategies for Contaminated Soil and Ground Water. Milwaukee, WI. Contact: Environmental Resources, 888-333-1161.

**October 11-12, 2000** Drought 2000: Impacts, Policy and Technology, Des Moines, IA. Contact: NGWA.

**October 11-13, 2000** Natural Attenuation for Remediation of Contaminated Sites. Milwaukee, WI. Contact: Environmental Resources, 888-333-1161.

**October 12-13, 2000** American Institute of Professional Geologists Annual Meeting — Learning from the Past, Directions for the Future, Milwaukee, WI. Contact: [www.aipgwis.com](http://www.aipgwis.com).

## This Newsletter brought to you by:

Tom Clark, Editor-In-Chief

Steve Robertson

Jan Falteisek

Jim Lundy

Vacancy

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## Remaining MGWA Newsletter Deadline for 2000

Issue	Copy to Editor	Copy to Publisher
December (Vol.19, No. 4)	11/3/00	11/10/00

org, or by e-mail [bernd.rehm@rmtinc.com](mailto:bernd.rehm@rmtinc.com)

**October 17-19, 2000** 45<sup>th</sup> Annual Midwest Ground Water Conference, Columbus, Ohio. Contact: <http://www.epa.state.oh.us/ddagw/mwgwc.html>

**November 3, 2000** Minnesota's Emerging Ground Water Quality Issues — Tuning Up the 1989 Ground Water Protection Act". MGWA Fall Conference, Earle Brown Center, University of Minnesota (St. Paul Campus). Contact: [www.mgwa.org](http://www.mgwa.org)

**December 4-8, 2000** Princeton Ground Water Remediation Course. Orlando, FL. Contact: Princeton Groundwater.

**December 11-12, 2000** Monitoring and Evaluating Wetlands for Ground Water and Lake Impacts. Contact: NGWA.

**March 19-21, 2001** Principles of Ground Water: Flow, Transport, and Remediation. Columbus, OH. Contact: NGWA.

**April 23-24, 2001** 35<sup>th</sup> Annual Meeting, North Central Section of the Geological Society of America. Bloomington-Normal, IL. Contact: [www.geosociety.org/sectdiv/Northc/01ncmtg.htm](http://www.geosociety.org/sectdiv/Northc/01ncmtg.htm)

**June 11-13, 2001** Analysis and Design of Aquifer Tests Including Slug Tests. Columbus, OH. Contact: NGWA.

**October 14-17, 2001** Hydrologic Science: Challenges for the 21st Century. Minneapolis, MN. Contact

the American Institute of Hydrology at 651-484-8169 or [AIHydro@aol.com](mailto:AIHydro@aol.com).

Contacts for the most frequent conference sponsors:

### National Ground Water Association (NGWA)

601 Dempsey Road  
Westerville, OH 43081  
800-551-7379  
<http://www.ngwa.org>

### Princeton Groundwater

PO Box 273776  
Tampa, FL 33688-3776  
813-964-0800  
813-964-0900 (fax)  
[Info@princeton-groundwater.com](mailto:Info@princeton-groundwater.com)  
<http://www.princeton-groundwater.com>

### Nielsen Environmental Field School, Inc.

David M. Nielsen  
4686 State Route 605 S.  
Galena, OH 43021  
614-965-5026  
614-965-5027 (fax)  
[nielsenfieldschool@juno.com](mailto:nielsenfieldschool@juno.com)

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**Support Your  
Association  
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Student  
to Join**

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## MGWA Board Meeting Minutes

**May 11, 2000**

**Location and Time:** Black Bear Crossing, 831 Como Ave., St. Paul, MN, 7:30 a.m.

**Attending:** Jim Piegat, Past-President; Jim Lundy, President; Jim Stark, President-Elect; Lee Trotta, Treasurer; Jan Falteisek, Secretary; Sean Hunt, WRI; Tom Clark, Newsletter Editor; Jim Aiken, Advertising Manager.

**Approval of Minutes** – Jim Lundy called the meeting to order at 7:35 a.m. Minutes for the regular Board meeting held April 6, 2000 were approved with one correction.

**Treasurer's Report** – Lee Trotta distributed updated financial summaries.

**Scholarship Committee** – No representative of the committee was present. The scholarship committee will continue until the Foundation is well established.

**Newsletter** – Tom Clark reviewed the status of the June newsletter and reported most items were ready.

**Membership Committee** – Sean reported that Jennie was having some success using the Internet to find home addresses for follow up. Jim Lundy said he had prepared a letter soliciting cooperation with academic institutions. Sean brought some additional pictures for the poster. Sean also reported that total memberships are up compared to recent years.

**Web Page** – Sean reported a total of about 20 on-line registrations for the spring conference and that the on-line registration process worked well. Sean suggested developing a page for the Foundation linked from the MGWA site.

**Advertising** – Jim Aiken said he has taken over the advertising duties from Leigh Harrod. He said he is adapting the files, but suggested consolidating contacts with other MGWA databases. He said a broader group of people within companies should be contacted. Jim Lundy asked Jim Aiken to provide a list of

companies that may have interest in ground water issues.

**Spring Conference** – Sean provided a summary of the conference survey. Tabulation of results included suggestions for future conferences, including some future topics. Many favorable comments were noted. Videos were taken by Tom Clark and will be available to borrow. For future conferences, Sean will prepare a speaker biography form that speakers could fill in and return.

**Fall Conference** – It was announced that the Fall Conference will be November 3, 2000 at the Earle Brown Center.

**Fall Field Trip** – Jim Stark announced the Fall Field Trip will be to the lower part of the Minnesota River Basin. The focus will be glacial and surficial geology and agricultural issues. A stopover is planned at New Ulm. Jim Stark has contacted some individuals for stops.

**MGWA Foundation** – Jim Lundy explained the need to transfer funds from the MGWA to MGWAF. WRI had provided a detailed listing of all scholarship contributions, beginning January 1, 1994, totaling \$2,189.18. Jim Piegat moved and Lee Trotta seconded that the MGWA Board direct the MGWA Treasurer to work with the MGWAF Treasurer to transfer \$2189.18 from MGWA to MGWAF at the earliest practicable time. Motion carried. At the June meeting, additional transfer of funds will be discussed. The Board approved allowing charges by WRI for work on MGWA Foundation activities to be charged to the MGWA/WRI contract.

**Children's Water Festival** – The Board voted to sponsor the Children's Water Festival for the amount of \$200.

**Next meeting** – The next Board meeting will be Thursday June 8, 2000, 7:30 a.m. at Black Bear Crossing.

Meeting adjourned at 9:07 a.m.

**June 8, 2000**

**Location and Time:** Black Bear Crossing, 831 Como Ave., St. Paul, MN, 7:30 a.m.

**Attending:** Jim Piegat, Past-President; Jim Lundy,

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

**Approval of Minutes** – Jim Lundy called the meeting to order at 7:35 a.m. Minutes for the regular Board meeting held May 11, 2000 were approved with corrections.

**Treasurer's Report** – Lee Trotta reported that he had transferred \$6,000 from the checking account to the money market account, leaving a balance in the checking account of about \$6,000.

**Newsletter** – Tom Clark reported that the June newsletter had just been received. He also said that the Directory was underway and would not have the referral part.

**Membership Committee** – The next Membership Committee meeting is August 1, 2000. Member tracking efforts are continuing. Design of recruitment poster was discussed; WRI provided a review draft. Ideas included adding field trip and conference photos, more "ground water" pictures, a water-design watermark, and revisions to text so that it is more limited, larger, and directed to students. Jim Lundy reported the institution contact letter had gone out and some responses were received. Follow up phone calls will be needed.

**Web Page** – Sean reported some preliminary information on the Fall Field Trip had been posted. He had also added some products to the commercial part of the site. The Board discussed reserving a separate domain name for the MGWA Foundation.

**Advertising** – Sean provided a list of options for corporate memberships that would include company advertising as part of the membership package.

**Membership Dues** – It was noted that membership dues had not changed since 1995. The Board approved 2001 dues of \$25 for regular members and \$15 for students.

**Fall Field Trip** – The Field Trip will be September 22-23. Sean will send an e-mail to all members noting the correct information. Jim Lundy

— *continued on next page*



## **MGWA Board Meeting Minutes, cont.**

reported on arrangements by Jim Stark. Jennie presented a preliminary budget. The Board approved the following costs: \$300 for Scott Sparlin to coordinate local arrangements, \$150 for the brewery tour, and meal costs, up to a total of \$700, excluding buses and refreshments.

**Fall Conference** – The Board approved reversing the general theme of the Spring and Fall conferences. The Fall Conference will be policy and the Spring Conference will be technical. Suggestions for the Fall Conference included wellhead protection, sustainable yield, and ground water drinking water quality (in particular arsenic, radon, and radium).

**Membership Awards** – The types of awards were discussed, such as service to MGWA and service to the science. Jim L., Jennie, and possibly Leigh Harrod will prepare a draft of the selection process and criteria for consideration at the next Board meeting.

**MGWA Foundation** – Discussion of transfer of funds tabled until the July meeting.

**Next meeting** – The next Board meeting will be Thursday July 6, 2000, 7:30 a.m. at Black Bear Crossing.

Meeting adjourned at 9:07 a.m.

### **July 6, 2000**

**Location and Time:** Black Bear Crossing, 831 Como Ave., St. Paul, MN, 7:30 a.m.

**Attending:** Jim Piegat, Past-President; Jim Lundy, President; Jim Stark, President-Elect; Lee Trotta, Treasurer; Jan Falteisek, Secretary; Sean Hunt, Jeanette Leete, WRI; Tom Clark, Newsletter Editor.

**Approval of Minutes** – Jim Lundy called the meeting to order at 7:35 a.m. Minutes for the regular Board meeting held June 8, 2000 were approved.

**Treasurer's Report** – Lee Trotta reported on current status. Jennie distributed financial reports as of July 5, 2000.

**Newsletter** – Tom Clark noted the next newsletter meeting is July 11, 2000. The newsletter will include a final notice of the fall field trip but the trip story and pictures will follow in December. The greater use of electronic distribution for MGWA member communication was noted.

**Membership Committee** – The Membership Committee will meet August 1st. Jan will find a room at DNR.

**Web Page** – Sean reported on updates to the web page, including the new members-only area that currently includes the membership directory. He is adding the Field Trip information. He also provided information on a charitable giving gateway to e-commerce sites. MGWAF received \$10 for signing up to iGive.com.

**Advertising** – Jim Aiken's forwarded to the board his advertising report by e-mail (attached). Jennie suggested that small companies without web presence could advertise with the MGWA and be offered an opportunity through the MGWA web page.

**MGWA Foundation** – Jim Lundy reported that the Foundation met recently. The check from MGWA has been deposited. Currently a fund drive is planned and will be discussed at the July 19th MGWAF meeting.

**Fall Field Trip** – Jim Stark reported on preparations for the Fall Field Trip. He noted "plenty of people" willing to do stops and the topics are eclectic, covering topics from "frogs to hogs". He noted there is a meeting this week with Lee Trotta to plan the stops. Scott Sparlin is coordinating the brewery tour. He also noted that rooms have been blocked out at two motels. The Field Trip registration deadline is September 1.

**Fall Conference** – Some additional ideas for the Fall Conference were discussed. They included arsenic, radon, radionuclides, liability for ground water professionals, and emerging contaminants such as pharmaceuticals and endocrine disrupters. Discussion of topics focused on the issues of naturally occurring contaminants and emerging contaminants. A suggested title for the fall conference was "Naturally

Occurring Contaminants: Occurrence, Risk, and Policy."

**AIH Fall 2001 Sponsorship** – The MGWA has been invited to be a co-sponsor of the AIH Fall 2001 Conference. The Board approved being a co-sponsor for the conference. AIH will provide information for the newsletter. The MGWA will provide a logo for conference use and its membership list.

**Minnesota House of Representatives Subcommittee on Ground Water** – Jim Lundy reported the MGWA has been invited to make a short presentation at the next subcommittee meeting on July 13. Jim Lundy will make the presentation.

**Request for Sponsorship** – Environmental Resources has requested the MGWA be a co-sponsor for upcoming training programs in the mid-west. This item was continued to the next board meeting.

**Next meeting** – The next Board meeting will be Thursday August 3, 2000, 7:30 a.m. at Black Bear Crossing.

Meeting adjourned at 8:45 a.m.

### **August 3, 2000**

**Location and Time: Black Bear Crossing, 831 Como Ave., St. Paul, MN, 7:30 a.m.**

**Attending:** Jim Lundy, President; Jim Stark, President-Elect; Lee Trotta, Treasurer; Jan Falteisek, Secretary; Sean Hunt, Jeanette Leete, WRI.

**Approval of Minutes** – Jim Lundy called the meeting to order at 7:35 a.m. Minutes for the regular Board meeting held July 6, 2000 were approved.

**Treasurer's Report** – Lee Trotta presented a summary of current financial status.

**Newsletter** – Jan reported on preparation of the September newsletter.

**Membership Committee** – Jim Lundy reported on the membership committee meeting August 2, 2000. At the meeting the committee concluded: 1. The proposed corporate rate spreadsheet is largely acceptable, 2. Jim Aiken will talk to some MGWA advertisers on their interest in corporate rates and provide that

**MGWA Board Meeting Minutes, cont.**

feedback to the committee, 3. Jim L. will contact a graphics artist friend for advice on layout and design for the recruitment poster, 4. Sean described how the tear-off pad might be designed and applied to the poster, and 5. When the poster is ready to mail, the education institution contacts will need to be contacted by phone to encourage them to display the poster. Following the membership committee report the following motion was adopted: "The MGWA Board requests the MGWA Foundation sponsor the student paper competition in the future."

**Web Page** – Sean reported on updates to the web site including the members-only section, the e-commerce function, and the field trip announcement.

**Advertising** – Jim Aiken was not present. He will be contacting advertisers on the proposed corporate membership and advertising rates. A follow up meeting will be held to finalize the corporate membership rates and features.

**MGWA Foundation** – Jim Lundy reported that the Foundation will meet August 4, 2000.

**Minnesota House of Representatives Subcommittee on Ground Water** – Jim L. reported he made the MGWA presentation on July 13, 2000.

**Membership Awards** – Jim L. reported he had sent some information to Leigh Harrod on types of awards. They will continue to discuss.

**Fall Field Trip** – Jim Stark reported the announcement had been mailed. Jim S. and Lee will drive the route. Jim S. noted the guidebook would need to be prepared. Expenses for presenters were discussed. There will be a follow-up e-mail reminding people to register. Jim S. said he could produce the guidebook in-house. Jim L. said the field trip memorandum of agreement with AIPG had not yet been executed.

**Ground Water Education Committee** – Jim L. reported the committee, including Dan Wiberg, Cathy Villas-Horns, and Kevin Powers, and himself, were assembling and preparing some materials.

**Membership Survey** – This year's membership survey will be sent out with the membership renewal materials. Last year the survey was sent out with the ballot.

**2001 Officer Nominations** – There will be a notice in the September newsletter requesting nominations.

**Fall Conference** – Jim L. suggested that in response to his presentation to the House Subcommittee, the fall conference program should more strongly consider "key ground water issues" or "emerging issues". Ideas and themes suggested included: Emerging issues could be both point and non-point, What's missing in Minnesota's approach to ground water management, Minnesota's emerging ground water quality issues, overview of emerging issues at points (pollution sources, water quantity and cumulative effects on surface water, certificate of need for new water supplies, nitrate), overview of non-point emerging issues (nitrates, pesticide metabolites, endocrine disruptors, arsenic and other natural contaminants). Jim L. thought the conference format might include break out discussions.

**Next meeting** – The next Board meeting will be Thursday September 7, 2000, 7:30 a.m., at Black Bear Crossing.

Meeting adjourned at 9:00 a.m.

**Join the Minnesota Ground Water Association!**

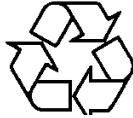
If you are reading this newsletter second-hand, we'd like to take this opportunity to invite you to become a member of **MGWA** for **2001**. Annual dues are \$25 for professional members and \$15 for students. Members are entitled to purchase a paper copy of the annual membership directory for \$7; an electronic version will be available on the website for paid members. Tax deductible contributions to the MGWA Foundation scholarship fund 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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Work Telephone Number \_\_\_\_\_  
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City, State, Zip Code \_\_\_\_\_  
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Which Address should we use for Mailings and for Directory Listing? \_\_\_\_\_  
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**Mark your calendar:  
MGWA Fall Conference November 3, 2000  
Minnesota's Emerging Ground Water Quality Issues  
—Tuning Up the 1989 Ground Water Protection Act  
Earle Brown Center, University of Minnesota**