Minnesota Ground Water Association
www.mgwa.org
Newsletter

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President's Letter

By Steve Robertson

I recently drove out to the east coast and back. As a result, there was a lot of time with little else to do but observe what we were driving by. Travelling from town to town and city to city, it was interesting to try to engage the kids over what natural advantages were available that may have affected historical land settlement patterns. For example, why is Chicago where it is, or Cleveland, OH or Cumberland, MD?
A key geographical resource often exploited in urban growth, especially in the historical development of the United States, is water.

Surface water, of course, offers very clear benefits. Many cities rely on water bodies as a source of transportation. Before cities were connected by railroads, lakes and rivers served as highways.

In Minneapolis, in addition to transportation, we all know the river offered power, which was used to run a variety of enterprises, most notably flour production. To this day we continue to generate power from hydroelectric facilities along the river. Moreover, rivers and lakes are also used for water supply purposes, including agricultural irrigation, industrial cooling and other uses, recreation, and municipal drinking water. The importance of these features in the historical growth of settled areas is reflected in the names we give to them (e.g., Zumbro Falls, Thief River Falls, Detroit Lakes, Lake Wilson).

While nearby surface water features clearly influenced land settlement patterns in our state and the country, groundwater, the unseen resource, was likely not a significant consideration. It was far easier to exploit surface

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Assessing Soil for Stormwater Infiltration

By Richard Pennings, P.E. – Senior Environmental Engineer, American Engineering Testing, Inc., Saint Paul, MN

Recent changes in regulations and a greater awareness for protecting surface water and aquifers have increased the prevalence and importance of onsite stormwater infiltration in civil designs. However, in many cases, the optimum locations for stormwater infiltration devices or ponds, for both new and old developments, often compete with the structures themselves and their associated appurtenances. Incorporating stormwater infiltration design considerations early in a project permits the proper match of infiltration devices with subsurface conditions at the site. Adopting this approach can lead to better and more cost effective solutions in the design process. Furthermore, all sites are not conducive to infiltration depending on in-situ soil types and intended land uses. Understanding the process and definition of infiltration, knowing how to interpret existing data, and developing an exploration program specific to assessing soil for infiltration are all critical components to successful designs.

The *McGraw-Hill Dictionary of Scientific and Technical Terms* defines infiltration simply as the "movement of water through the soil surface into the ground." Although related, infiltration is *not* the same as hydraulic conductivity, percolation, or groundwater recharge. Several infiltration devices have been developed to enhance stormwater infiltration, including rapid infiltration basins, spray-irrigation, bioretention/bioinfiltration basins (e.g., rain gardens), grass swales, infiltration galleries/trenches, and porous pavements. These types of devices have several design considerations in common, including the volume of the design storm to be handled and the land that is available for use.

Other similar design criteria include whether or not the device may fit the definition of an *underground injection well*, which is regulated by the U.S. Environmental Protection Agency

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Newsletter Deadlines

Issue	Due to Editor
December '10	11/05/10
March '11	02/04/11
June '11	05/06/11
September '11	08/05/11

MEMBER NEWS

MGWA Member to Supervise Superfund Program at MPCA

Sandeep Burman has been named to head one of the two Superfund Units in the MPCA's Closed Landfill and Superfund Section. Sandeep replaces Doug Wetzstein who was promoted to manager of the Watershed Section. Sandeep's replacement as supervisor of one of the three Petroleum Remediation Units at MPCA is Chris McLain. The changes took effect September 15.

Tim Thurnblad Serves 19 years on Advisory Council

In September 2009, MGWA member Tim Thurnblad stepped down from the MDH's Advisory Council on Wells and Borings, after 19 years of outstanding and dedicated service as the MPCA's representative on the council (1991-2009). Throughout those years, Tim kept the council advised of pertinent activities within the MPCA, provided thoughtful input on topics and issues discussed by the council, and added important perspective based on his knowledge and experience as a professional geologist.

The Commissioner of Health, Dr. Sanne Magnan, issued a letter commending Tim for his longstanding service to the council and commitment to the important goals of safe drinking water and groundwater protection. At the June 2, 2010 meeting of the council, Roger Renner, vice chair of the council, presented Tim with a plaque to honor his years of dedicated service.

Reprinted from the Spring/Summer 2010 Minnesota Well Management News

Two New MGWA Officers Sought for 2011

The MGWA membership needs to fill two officer positions—Treasurer and President-Elect—for the year 2011. The Treasurer oversees 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 a year before becoming President in 2012, followed by a year as Past-President. Send nominations by November 1 to MGWA, c/o WRI Association Mgmt Co., 4779 126th St. North, White Bear Lake, MN 55110, or send an e-mail to office@mgwa.org

Minnesota Geothermal Heat Pump Association is Established

The Minnesota Geothermal Heat Pump Association (MNGHPA) has recently been established. The nonprofit organization was founded to promote the technical competency and the growth of the geothermal heat pump industry and to provide educational and technical information to the public, geothermal professionals, and others interested in geothermal applications. The association has created a web site at: www.mnghpa.org which is intended to serve as a central resource for consumers, professionals, educators, and others seeking current information about geothermal heat pump technology in Minnesota. Interested persons can also contact the MNGHPA at (952)928-4651.

President's Letter, cont.

water. Except perhaps in areas where groundwater emerges to become surface water (Cold Spring, Camp Coldwater, Solon Springs), it was likely not recognized as a significant resource. Things have changed a great deal, especially as growth and settlement patterns extend inland from available surface water resources. As a society (and especially in Minnesota), we now rely heavily on groundwater for many things, most notably as a source of drinking water.

Because of the importance of surface water in the history of the Twin Cities, it strikes me as an utter stroke of serendipity that we in the metropolitan area are also fortunate to have the groundwater resources that we do. Many other large cities do not. The Milwaukee area, for instance, suffers significant drawdown and water quality issues in the aquifers available there, mainly because of excessive use. Likewise, I was recently reading that the Kathmandu Area of Nepal is imposing curbs on groundwater extraction because they have come to realize that their past use practices are unsustainable. There, authorities have estimated that withdrawals currently exceed recharge by a factor of six.

Despite the many fine groundwater resources in Minnesota we all know that the resources are unevenly distributed and that increased use threatens their long term viability. Also, in many areas of the state, water quality issues create problems for water users. Some of these issues are aesthetic (e.g., iron, manganese, hardness) and are fairly easily managed. But others are not and represent real problems for groundwater scientists, engineers, and consumers alike - things like radium, nitrate, and arsenic.

This fall's MGWA conference is being organized around the general theme of ambient and non-point groundwater quality issues. Look for more details on the speakers, their topics and other activities on the MGWA web site or by email and U.S. mail. We expect to have a full and stimulating program.

One new thing we'll be trying this fall is to provide a forum for presentation of research by professionals and students alike in the form of a poster session. Calls for abstracts have been sent out by email and more information is on the MGWA web site. We recognize that there is a lot of interesting work being done on geological and hydrogeological topics in Minnesota – and we can't always make room for oral presentations of all of it at our conferences. So here's an opportunity to present that neat little project you've been working on and to get some feedback from the larger community. Please consider submitting an abstract.

The conference will take place on November 9 at the usual spot, the Continuing Education Center at the U of M's St. Paul Campus. I hope to see you there.

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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.

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Links at www.mgwa.org

Save these Dates!

MGWA's Fall Conference November 9, 2010

MGWA's next Spring Conference May 4, 2011

GSA Annual Meeting October 9 - 12, 2011

GROUND WATER TECHNICAL ARTICLES

Assessing Soil for Stormwater Infiltration, continued from page 1

(Figure 1); set-backs from other installations such as potable water wells; the nearness and potential implications for wetlands and other low areas, and the possible effect on underground structures, both existing and proposed. For example, did the structural engineer design for possible hydrostatic pressure on basement walls due to infiltrating water from an infiltration basin that is planned to be 10 feet from the building?

Several published resources are available for initial site screening for potential soil infiltration capacity. Some of these resources include geotechnical (soil) reports, geologic atlases and maps, well records, and even historical aerial photographs. Each of these resources brings a unique perspective to help gauge a site for potential infiltration areas and devices. However, the original intent of each of these documents must be kept in mind when interpreting the data that is offered. The original intent of these studies was often are not to assess soils for the purpose of infiltration.

Geotechnical explorations are usually **"drilled-to-build"** and are not necessarily designed to gather data for an infiltration assessment (Figure 2). A geotechnical report often provides sufficient site-specific data on soils at depth, and one can glean some information regarding planned subsurface constructions to determine whether infiltrated water may find its way to basements, utilities, retaining walls, or possibly flow offsite toward neighboring sites. However, the sampling sequence used during drilling is not designed to explore for restrictive soil layers.

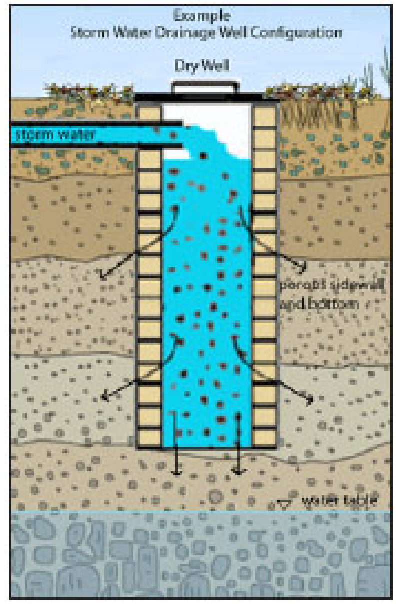

Figure 1. By definition, a Class V injection well is any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. (Source: USEPA 816-F-03-001, June 2003).

County soil surveys, available from the National Resources Conservation Service (NRCS), are also good sources of subsurface information, providing a plethora of data. Of particular interest are the ranges of permeabilities reported for the soils, including relative descriptions such as well-drained, poorly-drained, etc. The caveat here is that these surveys are written for **"grow not flow."** Furthermore, these surveys are generally targeted for the upper 5 feet of soil: if your infiltration device is a pond that has a base at 6 feet deep, very little information may be relevant from the soil survey. Yet, the information is useful as an indication for further exploration.

How the soils are classified or described must also be considered. Is the soil silty sand or sandy loam? The answer is that the soil could fall under both classifications. The first classification is an example of the Unified

Figure 2. The effect a thin layer of restrictive soil can have on infiltration – in this open split spoon, note the mottled soils above the thin clay layer and the coarse dry sand below.

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Soil Classification (USC) system, whereas the second is from the USDA classification system. The USC system is typically associated with engineering, while the USDA is mostly for agricultural purposes. For the USC system, the predominant soil descriptions are gravel, sand, silt, and clay. For the USDA system, sand, silt, and clay still remain at the extremes of the spectrum, but are divided by several classes of loam. Several other classification schemes also exist beyond these common two.

Various sources publish different numbers for design infiltration rates based on soil types alone. For example, the *Minnesota Stormwater Manual*, available for download from the Minnesota Pollution Control Agency website, lists Hydrologic Soil Groups A through D, corresponding to different classifications in both the USC and USDA systems. Based on the soil classification, this manual assigns one design infiltration rate for each group of soils. For example, silty sand or silty sand with gravel is given a design infiltration rate of 0.6 inch per hour.

The problem with this approach is that soil behaviors, especially rates of infiltration, can vary significantly within the same classification group. Silty sand in the USC system can consist of a soil with 12% to 50% of silt and clay. In terms of hydraulic conductivities, this soil could range from 10^{-5} to 10^{-1} centimeter per second. Assigning one single design number without field testing can make magnitudes of difference in terms of how much water can be infiltrated over a specific area. For a building project, if an estimated infiltration rate is lower than actual, the infiltration area will be estimated too large and money will be wasted by consuming potentially developable land. Conversely, if this infiltration area is constructed too small to handle the water, what is developed can become saturated and unstable very quickly.

Inadequate (or no) soils exploration is probably the greatest cause for the failure of devices designed for onsite infiltration. Extrapolating results from a geotechnical boring tens or hundreds of feet away, or anecdotal evidence of performance "across the street" is a potential recipe for disaster. The consequence of failure must be evaluated if field verification and testing are not performed.

Field exploration of the soil conditions can be done with a backhoe to create test pits, a drill rig using hollow stem augers and split spoon samplers, or push probes. These methods can be supplemented by using direct sensing equipment, such as a cone penetrometer. However, of these three methods, test pits are usually the better alternative, because a much broader sample of the soil is available, and one can actually see soil types and layering in the field (Figure 3). One drawback to this approach is that it is more invasive than a drilled hole, and you may be disturbing the area in which you want to infiltrate. The depths of test pits are often restricted to 6 to 10 feet as well, since digging deeper often requires a much larger pit or temporary shoring to comply with OSHA regulations for safe access.

Once soil samples are collected, and test pits and/or borings are logged in the field, samples can be submitted to the laboratory for grain size distribution analysis to estimate hydraulic conductivities through mathematical formulas (e.g., the Hazen formula and the Kozeny-Carman equation), or direct permeability tests using constant or falling head methodologies. Error is inherent in laboratory tests because the samples have already been disturbed to some degree. A further drawback is that the procedures are typically done on a very small sample relative to the size of the infiltration device.

A better approach than tabulated values or laboratory testing is to directly measure the rates of infiltration in the field. A test is worth a thousand guesses! Several methods are available, including percolation ("perc") tests, down-borehole tests, permeameters, single-ring and double-ring infiltrometers, and pits or basins (Figure 4). Although not always the case, the costs (and accuracy) of these methods typically increase in this order.

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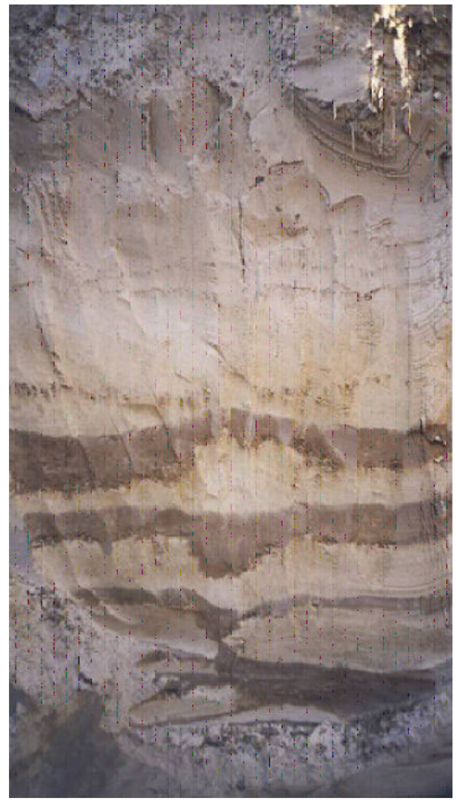

Figure 3. Test pit showing lamellae in Zimmerman Fine Sand - this type of detail would be hard to infer from 2-inch diameter boring samples.

Figure 4. Infiltration pit test about 10' deep using a 6' x 20' trench box with plywood completing the sides.

The preferred method is often the double-ring infiltrometer test, following ASTM Method D 3385 (Figure 5). This procedure consists of two concentric steel rings that are embedded into the soil about 4 to 6 inches. Water is poured into both the inner ring and the created annulus, and kept at the same level in both rings. The volumes of water added to maintain this level is measured over time, and an infiltration rate can be calculated for the areas inside both the inner ring and the annular space. The inner ring infiltration rates are typically smaller than the outer ring, because three-dimensional lateral flow usually occurs on the outside ring. It is the linear, vertical (downward) rate from the inner ring upon which the design for a larger area is typically based.

In the author's opinion, the pit or basin test is the better method, and can be built all the way up to the actual size of the planned infiltration area. Costs for this method can be reduced if excavation equipment and an adequate water source are readily available. However, the cost for this procedure can increase far beyond that of a double-ring infiltrometer test.

Once the measured rates are calculated, correction factors can then be applied to determine the design infiltration rate suitable to the soil type, including factors such as other soil layers lying below the surface of the infiltration device. If groundwater is shallow, the potential for the infiltrated water to mound and rise up to the surface must also be assessed.

Factors of safety in the design process are critical. Aside from the soil layering and variability between test sites, infiltration rates will usually decrease over the lifetime of an infiltration device. A significant influence on the rate of infiltration is the degree of soil compaction. If soil is compacted to a higher level of density than when it was tested, this infiltration rate can be reduced significantly. Other factors that influence infiltration rates include siltation, porosity, moisture content, soil chemistry, water chemistry, biological growth, and degrees of vegetation. Infiltration rates may actually improve for a short term as vegetation establishes itself and preferential flow paths are created by the root systems, and water uptake is enhanced by transpiration. However, over time these rates will again typically decrease.

Recognizing several different factors in the design process can extend the life of the infiltration device, and potentially prevent failure from the beginning. Infiltration practices designed on the sandiest soils will still fail if the shallow zone is over-compacted or finished at the surface with clayey soil and sod. The type of topsoil and turf placed at the surface can become the limiting layer, and not the subbase soil that was tested during the field verification process (Figure 6).

Another consideration is how the samples are collected during the exploration phase. Continuous sampling in borings is strongly recommended, because even a layer of clay 1 inch thick or less can impede or completely halt vertical infiltration, causing a design failure. Often, an exploration program consisting of both test pits and soil borings is needed, along with direct infiltration testing using a double-ring infiltrometer, or preferably, a large pit or basin. General recommendations on exploration programs can be found in the Minnesota Stormwater Manual and the Site Evaluation for Stormwater Infiltration (1002) Wisconsin Department of Natural Resources Conservation Practice Standards, for differ-

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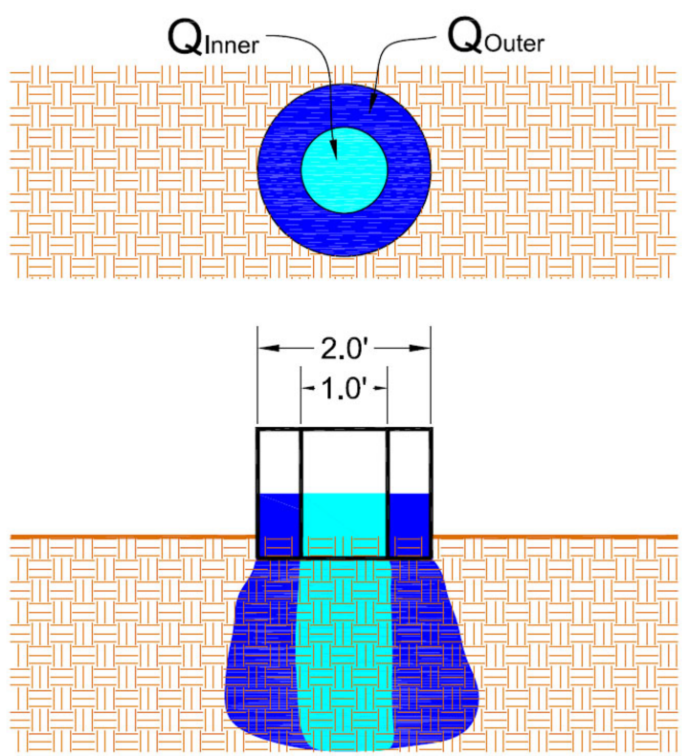

Figure 5. Left: The double-ring infiltrometer being run in a coarse granular base course. Right: Mechanics of the double ring infiltrometer test illustrated in plan view (top) and section view (bottom)

Figure 6. Despite over 30 feet of underlying granular soils, turf placed on top of this basin became the restrictive layer.

ent types of infiltration devices such as basins, swales, trenches and engineered subsurface dispersal systems. With that in mind, each site has its own special characteristics, and the professional judgment of an experienced geoscientist should be engaged for a more reasonable chance at a successfully assessing the soil's capacity for infiltration.

(This article was adapted from a two part series presented in the American Edge newsletter, Summer and Fall of 2009, American Engineering Testing, Inc., St. Paul, MN.)

Volunteer Nitrate Monitoring Network, Southeastern Minnesota: Preliminary Data Assessment

By Jim Lundy, Hydrogeologist, Minnesota Department of Health, Source Water Protection and Linda Dahl, Executive Director, Southeastern Minnesota Water Resources Board

Introduction

This article summarizes results from the Volunteer Nitrate Monitoring Network (VNMN), a project that has yielded water quality data in domestic wells in southeastern Minnesota since 2008. Nitrate in drinking water has been concern at least since Kingston (1943) first described connections between geologic sensitivity and water quality in the karst of Fillmore County. The past two decades produced several additional important studies of nitrate in domestic drinking water supply wells of southeastern Minnesota. In 1994, the MPCA sampled a network of 55 (primarily domestic) wells in west-central Winona County (Wall and Regan, 1994). While there was great variability in nitrate concentration, the study found hydrogeologic setting and well construction to be important controls on the occurrence of elevated nitrate concentrations.

Simultaneously, the Southeast Minnesota Water Resources Board (Board) received a baseline study of ground water quality across the nine counties under the board's jurisdiction. Using MPCA Ground Water Monitoring and Assessment Program (GWMAP) data, MGS determined that "positive correlations of low nitrate levels with vintage waters and elevated nitrate levels with recent water indicate that sources of nitrate contamination in the ground water of the region result from activities at the land surface" (Tipping, 1994). Though the baseline study is useful, county water planners recognized that only wells were sampled that complied with the Minnesota Water Well Construction Code. Consequently, water quality data were skewed toward properly constructed wells and lower nitrate concentrations, even though numerous southeastern Minnesota domestic wells pre-date the Minnesota Water Well Construction Code. Thus the baseline study may exclude domestic drinking water wells with the greatest nitrate concentrations.

In 2004, the Board received federal 319 demonstration/education/research funding to measure nitrate in domestic wells across the region. The VNMN study goal was to determine whether a volunteer drinking water supply well monitoring network, using low-cost, non-certified nitrate analyses, provided worthwhile information and could be sustained inexpensively. Ultimately, the complex study goal simplified to: What is the nitrate concentration of the drinking water?

Methods

The VNMN developed three well networks: 1) a "grid" network of randomly selected wells, comprising the majority of wells sampled in the study, and described further below; 2) a "baseline" network, consisting of available wells originally sampled in Tipping (1994); and 3) "targeted" networks initiated in Dodge and Winona counties to address specific problems these counties identified. This project summary focuses on the grid and baseline networks.

To support a statistically defensible regional evaluation of well water quality, the grid monitoring network well selection procedure potentially included wells of all types, even if construction, geologic record, or exact location was initially unknown. Six-hundred and seventy-five uniformly spaced nodes were superimposed over the nine-county study area, and a circular search area (or "buffer") approximately two miles in diameter circumscribed each node. County representatives recruited a randomly selected well owner within each buffer as a study volunteer. If the initially approached well owner was unable or unwilling to volunteer, a second randomly selected owner was solicited, and the process repeated until a volunteer was identified. In 15% of buffers, ultimately no volunteer was identified. During the site visits county representatives also interviewed well owners to determine age and well depth, and recorded well location, diameter, and nearby potential nitrate sources.

Grant budget and timeline allowed for two sampling events per year (February and August) during 2008-2009. County staff mailed each participating volunteer a sample container with instructions to collect untreated aquifer water after running the pump for several minutes until the water temperature stabilized. No field measurements were recorded. After labeling and freezing the samples, volunteers returned them by pre-paid postage to the county offices.

County staff received and stored frozen samples while awaiting batch analysis. Thawed samples were analyzed for nitrate using a table-top Hach 4000 spectrophotometer provided by MDA. Properly maintained and operated, these instruments have minimal deviations from laboratory nitrate measurements and minimal operator-operator variability (R^2= 0.98 and R^2 = 0.9587, respectively; MDA unpublished information).

County staff transmitted well information and nitrate data to

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MDH staff as available. MDH staff reviewed the well data, checked locations, assigned unique numbers where necessary, and updated County Well Index (CWI) as appropriate. MDH staff also determined and tabulated the following well attributes:

1. Matrix of the open interval (clastic bedrock, soluble bedrock, both clastic and soluble bedrock, low permeability material, quaternary material, or unknown);

2. Aquifer designation, either by confirming existing CWI information, or by comparison to nearby wells with defined geologic intervals;

3. Presence or absence of overlying protective geologic layers (DNR, 1991);

4. The documented presence or absence of casing grout, as required by the Minnesota Water Well Construction Code; and

5. Ground surface slope toward or away from the well casing.

Results and Discussion

Over the four sampling rounds, county staff received and analyzed nitrate samples for 553 of the 675 buffers in the original network. Failure to receive samples from the remaining buffers is due either to a failure to enroll a well in the study, or a lack of participation by the volunteer. Round 1 nitrate distribution is shown in Figure 1.

Mean nitrate concentration varied by aquifer (Table 1). The greatest average nitrate concentrations occurred in wells completed in the Prairie du Chien aquifer (5.0 mg/L, round 4), and the least average nitrate concentrations occurred in the Franconia Aquifer (0.4 mg/L, all rounds). The result reflects the fact that over much

Table 1: Mean Nitrate Concentration by Major Aquifer, mg/L

Aquifer	Round 1*	Round 2	Round 3	Round 4
Quaternary	2.4 (*46*)	2.9 (*45*)	2.7 (*43*)	3.0 (*40*)
Spillville	3.5 (*18*)	3.1 (*17*)	2.8 (*17*)	1.9 (*16*)
Galena	4.8 (*33*)	4.4 (*33*)	3.2 (*31*)	3.6 (*30*)
St. Peter	2.1 (*27*)	2.2 (*30*)	1.8 (*30*)	2.1 (*28*)
Prairie du Chien	4.2 (*23*)	4.3 (*24*)	3.6 (*21*)	5.0 (*22*)
Jordan	3.6 (*65*)	3.4 (*66*)	3.3 (*68*)	2.9 (*64*)
Franconia	0.4 (*46*)	0.4 (*47*)	0.4 (*44*)	0.4 (*42*)

* Number of samples indicated in italics

of southeastern Minnesota the Franconia Aquifer is overlain by younger, protective geologic layers (sufficiently thick shale or clay). In contrast, aquifers from the Jordan upwards through the Quaternary sometimes lack such overlying protective layers.

Alternatively, we can classify by hydrogeologic setting, recognizing that from the standpoint of nitrate, an aquifer's geologic identity (St. Peter sandstone, or Jordan sandstone, for instance) matters less than whether an overlying protective geologic layer prevents easy recharge. Because the study tracked overlying geologically protective layers and casing grout for each well, we can assess their importance in nitrate occurrence. The horizontal axis of Figure 2 contains four groups:

1. Wells possessing both overlying geologic protective layers and casing grout;

2. Wells possessing geologic protection but no casing grout;

3. Wells lacking geologic protection but possessing casing grout; and

4. Wells lacking both geologic protection and casing grout.

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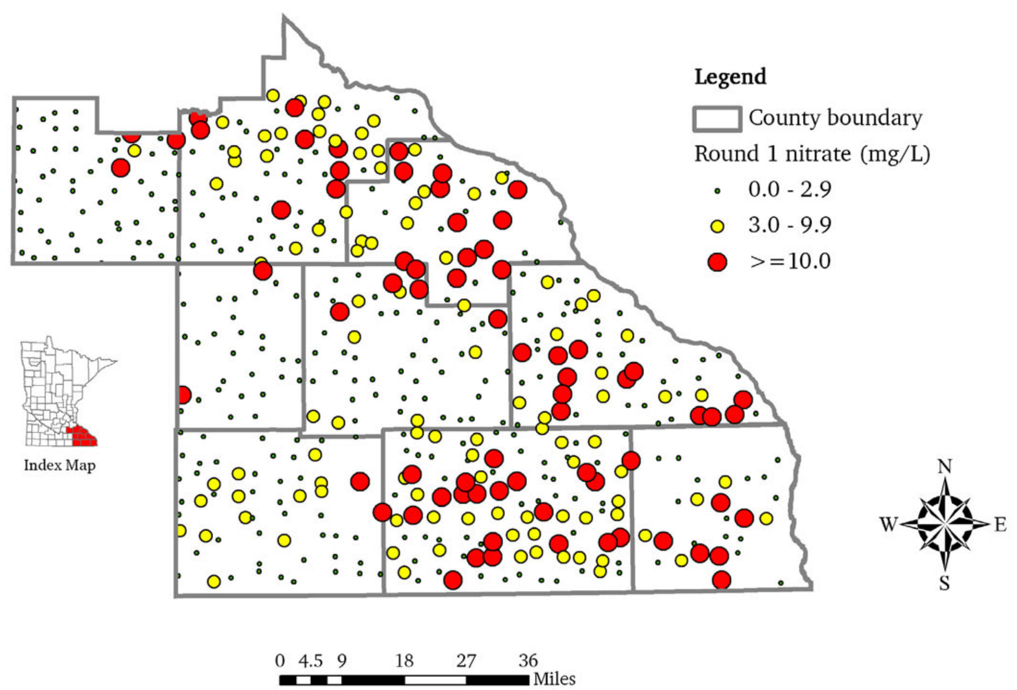
Figure 1: Southeast Minnesota Volunteer Nitrate Monitoring Network Round 1 Nitrate Distribution February 2008



Volunteer Nitrate Monitoring Network, cont.

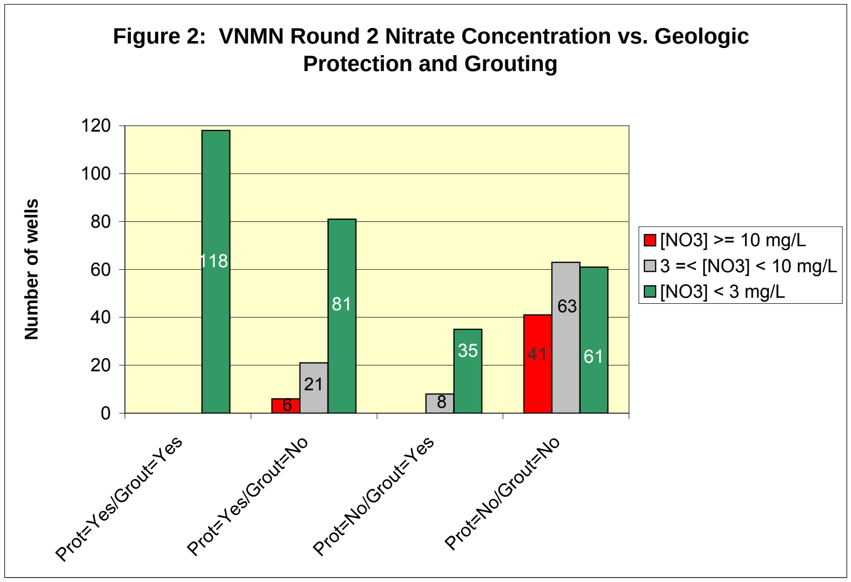
The vertical axis indicates the number of wells in each of three nitrate concentration categories:

1. Low (green), where nitrate concentrations are less than 3 mg/L;

2. Moderate (gray), where nitrate concentrations are greater than or equal to 3 mg/L but less than 10 mg/L; and

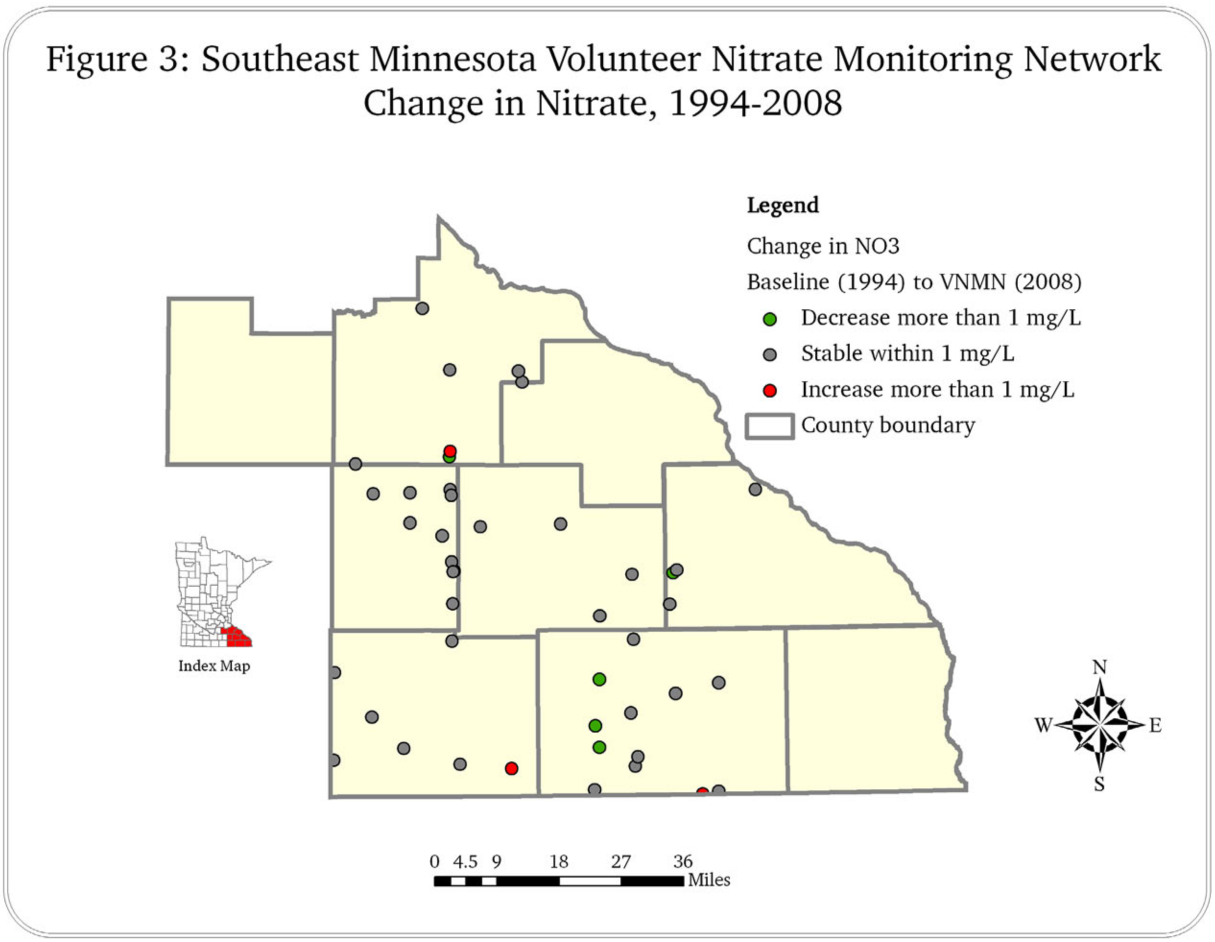
3. High (red), where nitrate concentrations are greater than or equal to 10 mg/L.

In the first well group (possessing both geologic protection and casing grout), 118 wells (100%) fall into the low nitrate range. In the second and third well groups (lacking either geologic protection or casing grout), 116 wells (77%) are in the low nitrate range, and 35 wells (23%) in the moderate or high nitrate ranges. In the fourth well group (lacking both geologic protection and casing grout), wells are evenly distributed (25-38%) in low, medium and high nitrate ranges. Eighty-seven percent of all high nitrate concentrations during round 2 occurred in wells lacking both geologic protective layers and casing grout. Because well owners seldom have control over the presence of geologic protective layers, the result underscores the importance of effective casing grout in maintaining water quality.



During the study, changes in nitrate concentration appeared to be minimal, but a complete statistical analysis is not presented here. Such an analysis must account for changes to the network over time (at least six wells from the original network were replaced) because such changes may produce false indications of changes in nitrate concentration. For instance, after an early sampling round a volunteer with unexpectedly high nitrate may drill a new well that meets the Minnesota Water Well Construction Code, effectively excluding nitrate in subsequent sampling rounds. Inadvertent incorporation of the new well into the network thus contributes to an apparent decrease in nitrate, but it is only an artifact of improved well construction.

— continued on page 12



The maximum number of baseline wells resampled during this study occurred in Round 2 (August 2008; 44 wells). Figure 3 shows the change in nitrate concentration for these wells over the time interval of 1994 to 2008. Thirty-six wells (82%) shown in grey did not change by more than 1 mg/L. Nitrate concentrations decreased by more than 1 mg/L in five wells, with a maximum decrease in one well of 7.2 mg/L. Two of these wells, including the well with the maximum decrease, remained in the high nitrate (equal to or greater than 10 mg/L) category. Nitrate concentrations increased in three wells by more than 1 mg/L, including a maximum increase in one well of 14 mg/L (0 mg/L in 1994, 14 mg/L in 2008). This well lacks both protective geologic layering and casing grout, so the increase could be due to intensification of the nitrate source at the ground surface. It could also be due to sampling or analytical error.

Study Benefits

The study provides drinking water quality information to the well owners in the study, and county and MDH staff are available to discuss results with individual well owners. A broader benefit is realized by recognizing the usefulness of this data for other related studies, for example as a check layer in a county nitrate probability mapping project. It may be possible to use the nitrate results at individual wells, along with available geological maps and other information, to define priority map areas where hydrogeologic setting and measured nitrate concentrations indicate a significant risk of elevated nitrate. County staff could use this information to prioritize the most urgent delivery of outreach and technical assistance to help assure high quality drinking water for all domestic well owners, even those not a part of this study.

Future Work

One project goal was to sustain the volunteer monitoring network over time, and the original grant has been extended for three years, enabling annual sampling to continue at least through 2012. The grant extension includes additional special projects to be conducted by five counties. If additional funding can be obtained, network wells could be sampled for analytes other than nitrate, including: major ions, trace metals, tritium, carbon-14, arsenic, radiofnuclides, pesticides, and perhaps others.

References

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Tipping, Robert G., 1994, *Southeastern Minnesota regional ground water monitoring study: a report to the Southeast Minnesota Water Resources Board*, Minnesota Geological Survey Open-File Report 94-1, University of Minnesota, St. Paul, April 29, 1994.

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New from the USGS Minnesota Water Science Center

USGS Data Series Report DS 495 "Perchlorate Data for Streams and Groundwater in Selected Areas of the United States, 2004" is now available online.

This report presents data collected as part of a reconnaissance study to evaluate the occurrence of perchlorate in rivers and streams and in shallow aquifers in selected areas of the United States. Perchlorate, a component in rocket fuels, fireworks, and some explosives is soluble in water and persists in soils and water for long periods. It is biologically active at relatively low levels in the environment, and has been identified as an endocrine-disrupting chemical. The purpose of this reconnaissance was to determine the occurrence of perchlorate in agricultural areas of the Midwestern and North-Central United States and in arid Central and Western parts of the United States.

Samples were collected from 171 sites on rivers and streams and 146 sites from wells during the summer and early fall of 2004. Samples were collected from surface-water sites in 19 states and from wells in 5 states. Perchlorate was detected in samples collected in 15 states and was detected in 34 of 182 samples from rivers and streams and in 64 of 148 groundwater samples at concentrations equal to or greater than 0.4 micrograms per liter. Perchlorate concentrations were 1.0 micrograms per liter or greater in surface-water samples from 7 states and in groundwater samples in 4 states. Only one surface-water and one groundwater sample had concentrations greater than 5.0 micrograms per liter. Perchlorate concentrations in followup samples collected from 1 to 3 months after the initial sample were unchanged at 4 of 5 stream sites.

Instant Information Now Available about Minnesota Water Conditions

Now you can receive instant, customized updates about water conditions by subscribing to WaterAlert, a new service from the USGS. Whether you are watching for floods, interested in recreational activities or concerned about the quality of water in your well, WaterAlert allows you to receive daily or hourly updates about current conditions in rivers, lakes and groundwater when they match conditions of concern to you. WaterAlert allows users to receive updates about river flows, groundwater levels, water temperatures, rainfall and water quality at any of more than 9,500 sites where USGS collects real-time water information. This information is crucial for managing water resources, including during floods, droughts and chemical spills. WaterAlert users start at water.usgs.gov/wateralert and select a specific site. Users then select the preferred delivery method (email or text), whether they want hourly or daily notifications, which data parameter they are interested in, and the threshold for those parameters. Users can set the system to alert them when conditions are above a value, below a value, and between or outside of a range. Sign up at water.usgs.gov/wateralert.

This information and related content can be obtained through the USGS Minnesota Water Science Center, mn.water.usgs.gov/about/newsletter/summer2010.html.

USGS and Minnesota Department of Health Report on Karst and Fractured Rock Aquifers

Report Released: "Evaluation of Methods for Delineating Zones of Transport for Production Wells in Karst and Fractured-Rock Aquifers of Minnesota"

The U.S. Geological Survey (USGS) Minnesota Water Science Center in cooperation with the Minnesota Department of Health has completed a report on a study to evaluate methods for delineating zones of groundwater transport for production wells in karst and fractured-rock aquifers in Minnesota. About 78 percent of Minnesotans use groundwater extracted from bedrock and glacial aquifers for their drinking water. Protection of these well-water supplies is difficult for communities that extract water from bedrock aquifers in which groundwater flows mainly through karst features (solution-enhanced openings, channels, or conduits) and fractures. Assessment of groundwater-flow conditions in the vicinity of production wells in karst and fractured-rock settings commonly is difficult due in part to the lack of detailed hydrogeologic information and the resources needed to collect it. Methods for delineating zones of groundwater transport around wells were applied to the 24 production wells that extract groundwater from karst and fractured-rock aquifers in nine Minnesota communities. Zones of transport delineated using these two empirical methods were compared with zones of transport previously delineated by Minnesota Department of Health hydrologists for the wells.

The report is available at: pubs.usgs.gov/sir/2010/5005/

Possible paleo-karstic feature associated with fracturing in the St. Peter Sandstone, Rochester, Minnesota.

New from the Minnesota Department of Agriculture

2009 Water Quality Monitoring Report

This report presents the results of pesticide sampling of the State's ground- and surface water resources by the MDA in 2009. The following is a summary of only groundwater monitoring results from the MDA's network. Groundwater samples were collected from a total of 169 sites, primarily located in agricultural areas. Most groundwater samples were collected from shallow monitoring or observation wells (143 wells); however, fourteen private drinking water wells and 12 naturally occurring springs were sampled in southeastern Minnesota. All samples were analyzed at the MDA laboratory for a suite of 44 pesticides and pesticide degradates. Herbicides were the only class of pesticides detected in the State's groundwater in 2009; a total of 21 of these compounds were detected. Degradates of the herbicides atrazine and metolachlor were the most frequently detected compounds. Deethylatrazine was detected in 73 percent of the samples, and metolachlor ethane sulfonic acid (ESA) was detected in 67 percent of the samples.

The report can be obtained from the Minnesota Department of Agriculture at: www.mda.state.mn.us/en/chemicals/pesticides/maace.aspx

Geological Society of America Annual Meeting in Minneapolis - October 9-12, 2011

Organizers

Harvey Thorleifson, Chair, MGS, thorleif@umn.edu
Carrie Jennings, Vice Chair, MGS, carrie@umn.edu
David Bush, Technical Programs, University of West Georgia, dbush@westga.edu
Jim Miller, Field Trips, UMD, mille066@umn.edu
Curtis M. Hudak, Sponsorship Chair, Foth Infrastructure & Environment, LLC, chudak@foth.com

- Field Trip Proposal Deadline: December 7, 2010
- Short Course Proposal Deadline: February 1, 2011
- Technical Session Proposal Deadline: January 11, 2011

MGWA BOARD MINUTES

Minnesota Ground Water Association Board Meeting Minutes

Meeting Date: **June 4, 2010**
Location: Fresh Grounds Coffee Shop, 1362 West 7th Street, St. Paul, Minnesota
Attending: Steve Robertson, President; Mindy Erickson, President-Elect; Scott Alexander, Past President; Jill Trescott, Secretary; Craig Kurtz, Treasurer; Sean Hunt, WRI
Past Minutes: May minutes approved.
Treasury: Craig presented the Treasurer's Report. Cash on hand is approximately $45,000. A discussion was held about the dues for individual members, which are not currently covering the full cost of member benefits.
Newsletter: Newsletter should be complete by the end of the week. Google Docs is being used. Sharon Kroening has joined the newsletter team.
Web Page: The conference information is complete.
WRI Report: After a discussion of the dates when the conference space would be available, May 4, 2011 was selected for the Spring Conference.
Foundation: The Foundation Board has not met. Contributions in honor of Olaf's retirement are still coming in.
Old Business: GSA 2011 – no report.
Hydrostratigraphy workgroup. Scott is working on a draft report that he will circulate. From that he will create a framework to discuss with a larger group, with a 2011 target date for completion.
Field trip – no report.
New Business: Fall Conference (November 9): The theme will be non-point source contamination and ambient groundwater conditions. A variety of specific topics were discussed.
Next Meeting: Friday, July 9, 2010, at 11:30 at Fresh Grounds at 1362 West 7th Street, St. Paul, Minnesota. An August meeting might not be held.

Meeting Date: **July 9, 2010**
Location: Fresh Grounds Restaurant, 1362 West 7th Street, St. Paul, MN
Attendance: Steve Robertson, President; Mindy Erickson, President-Elect; Jill Trescott, Secretary; Jeanette Leete, WRI; Sean Hunt, WRI; David Liverseed, MGWA Foundation; Gil Gabanski, MGWA Foundation
Past Minutes: June minutes approved as revised.
Treasury: Net income for 2009 was approximately $12,000. Cash on hand is approximately $41,000. IRS Form 990 is in process.
Newsletter: The June newsletter has been completed. The website has been updated.
Web Page: The interactive version of the membership database has been updated and the financial reports posted.
WRI Report: The managers' report was submitted. The corporation has been registered with the Secretary of State's office.
Foundation: No report.
Old Business: GSA 2011 – no report.
Hydrostratigraphy workgroup. No report.
Field trip – No field trip in 2010. There will be many field trips in conjunction with the GSA conference in 2011.
Fall Conference (November 9): In process. Invitations to submit poster presentations will be sent to the membership by e-mail.
Membership rate: A discussion was held about the dues for individual members, which are not currently covering the full cost of member benefits. A $5 increase would cover the cost of member benefits. MGWA is organized to benefit the ground water resource, not individual members, thus we should be able to show that members carry the burden of member services.However, the overall operating income is fine. The state of the economy argues against raising the rate but at the same time makes running the conferences a more risky endeavor.
New Business: MEP had sent a letter regarding coal ash regulation.
Upcoming conference dates: May 4, 2011; April 19, 2012; November 15, 2012.
Next Meeting: Thursday, September 2, 2010, at 11:30 at Fresh Grounds at 1362 West 7th Street, St. Paul, Minnesota. No August meeting.

The MGWA Board of Directors meets once a month.

All members are welcome to attend and observe.

MGWA 2011 Membership Dues

Professional Rate:	$35
Full-time Student Rate:	$15
Newsletter (printed and mailed)	$20
Directory	$7

Membership dues rates were revised at the October 1, 2010 meeting of the MGWA Board. The Board intends to balance the membership services budget.

Abbreviations and Acronyms

ASTM – American Society for Testing and Materials

DNR – Minnesota Department of Natural Resources

MDA – Minnesota Department of Agriculture

MDH – Minnesota Department of Health

MGS – Minnesota Geological Survey

MPCA – Minnesota Pollution Control Agency

USEPA or EPA – United States Environmental Protection Agency

USGS – United States Geological Survey

MGWA BOARD MINUTES

Meeting Date:	**September 2, 2010**
Location:	Fresh Grounds Restaurant, 1362 West 7th Street, St. Paul, MN
Attendance:	Steve Robertson, President; Mindy Erickson, President-Elect; Jill Trescott, Secretary; Sean Hunt, WRI; Scott Alexander, Foundation
Past Minutes:	July minutes approved.
Treasury:	Cash on hand is approximately $39,500. Summer is a slow period for financial activity.
Newsletter:	The newsletter will be complete by the end of the month. Additional people to work on the newsletter are being recruited.
Web Page:	The web page has been updated. E-mail communications have been sent regarding the poster session at the fall conference and about the Midwest Geosciences seminar.
WRI Report:	The managers' report was submitted. Member services cost about $35 per member.
Foundation:	The Foundation may have a change in officers.
Old Business:	Fall Conference (November 9): In process. Speakers are confirmed, although the schedule is tentative. Preliminary notices will be sent out. Hydrostratigraphy workgroup: Jan Faltaisek, Bob Tipping, and Bruce Olsen are reviewing this. GSA 2011 – 2010 conference is upcoming, then Mindy will work on the Memorandum of Agreement. Field trips, including a bike tour, are being planned. Membership rate: tabled until next meeting. It will be even more important to have a balanced membership services budget in 2011 and 2012 because MGWA's conference income prospects will be limited due to GSA and a potential MWGWC in Minnesota.
New Business:	Midwest Groundwater Association – fall meeting in October 2013 in Twin Cities. Candidates for officers were discussed. Voting will be in December.
Next Meeting:	Friday, October 1, 2010, at 11:30 at Fresh Grounds at 1362 West 7th Street, St. Paul, Minnesota.

MGWA NEWSLETTER BUSINESS

Guidelines for Submission of Newsletter Articles

The newsletter team appreciates the efforts of article contributors, without whom our newsletter would not be possible. To make the process easier on the author, the newsletter team and production staff, we have established some guidelines we would like authors to follow. For a complete list of guidelines, please see the MGWA web site:

- Submittals should be complete and ready for publication.
- The text of the article should be submitted as a Microsoft Word document in an attachment to an e-mail or on disk.
- Tables, captions, figures and graphics should be submitted individually as separate high quality files.
- A version of the article with embedded tables, figures, and graphics may be submitted as an additional file to indicate the preferred layout of the tables, figures and graphics within the article.
- The contributor should include the contributor's name and affiliation following "By" below the title of the article.
- The contributor should secure permission to print or reprint if applicable and provide the required text to be included with the article.
- Materials should be submitted before the deadline.

If there is any question about the suitability of a proposed article's content for the MGWA newsletter, it is advisable for the contributor to call the editor before investing significant time in article preparation.

MGWA 2011 ADVERTISING RATES

Display Ads:

Size	Inches Hor. x Vert.	Quarterly Newsletter Annual Rate, 4 issues	Membership Directory Annual Rate, 1 issue
Business Card	3.5 x 2.3	$100	$50
Quarter Page	3.5 x 4.8	$150	$100
Half Page	7.5 x 4.8	$250	$200
Full Page	7.5 x 9.75	$500	$400
Inside Cover	7.5 x 9.75	not available	$500

Classified ads:

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

E-mail notices: A one-time e-mailing to the membership costs $10 for an individual (e.g., seeking a job), and $50 for an organization (e.g., announcing a new product, address change, etc.). E-mails from companies announcing job openings will no longer be accepted. A 200 word limit is imposed. The advantage of e-mail is the speed of dissemination.

The Advertising Manager has final determination on the acceptance of materials submitted. There are no commissions on ads. Copy must be received by the publication deadlines: 14 February, 16 May, 15 August, or 14 November. Advertisers should submit their material as a digital file in TIFF, JPEG or PCX format at 300 to 600 dpi. A set-up charge will be applied to non-digital ad material.

Please make checks payable to "Minnesota Ground Water Association" or "MGWA." Direct your orders and questions concerning advertising rates and policy to the Advertising Manager: Jim Aiken, Advertising Manager, c/o MGWA, 4779 126th Street, White Bear Lake MN 55110-5910; Phone (952)832-2740; jaiken@barr.com.

MGWA 2011 Advertising Rates Remain Unchanged

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