

Minnesota Ground Water Association

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Newsletter

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Featured:

- ◆ Buffalo Aquifer and Bonanza Valley Studies Initiated, page 1
- ◆ MGWA Outstanding Service Awards for Bruce Bloomgren and Bruce Olsen, page 4
- ◆ Radon in Groundwater, page 5



— MGWA President
Scott Alexander

Inside:

Officer Candidates	2
MGWA Fall Conference	3
Reports and Publications	7
Minnesota Water Use	9
Ground Water History	11
New Book: Roadside Geology of Minnesota	12
MGWA Foundation	14
MGWA Board Minutes	15

President's Letter

Scott C. Alexander

As we head into a new year I am looking forward to working with our president, **Steve Robertson**. I have greatly enjoyed working with the Minnesota Ground Water Association (MGWA) as president representing our many members. This relationship will continue as I move into the Past President's office. A large part of the success for any organization is continuity in leadership. By setting up a three year cycle for the President's office the MGWA has created a process that brings in new leaders, with fresh ideas, while maintaining long term goals. Even in times of economic difficulty our organization has continued to grow, if slowly, while supporting the exchange of information

and education for Minnesota's ground water professionals. In short the MGWA has clearly become a sustainable effort.

Sustainability has become a buzzword in the environmental arena. I would suggest that ground water is a resource that can be used to define what sustainable use really means. Water itself is a key resource, second only to breathable air in immediacy. For Minnesota, water is a defining resource, incorporated even into the name of the state. As ground water professionals we have always been aware of the importance of our water resources and are increasingly reminded of how finite they truly are, even in Minnesota.

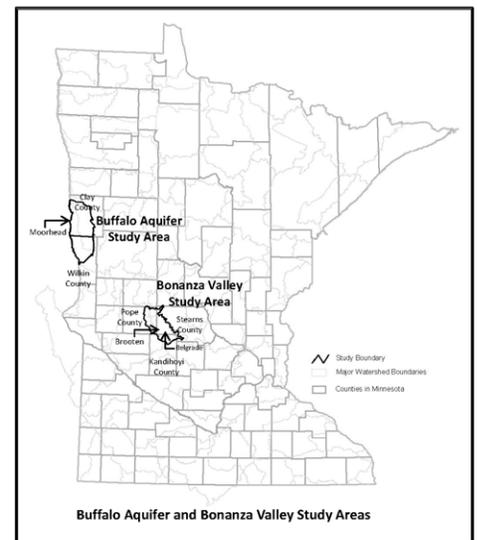
— continued on page 2

Buffalo Aquifer and Bonanza Valley Studies Initiated

By Laurel Reeves, DNR Waters

What do southwestern Clay County and the Bonanza Valley around the towns of Brooten and Belgrade have in common? Each encompasses multiple watersheds, aquifers, types of water uses and governmental jurisdictions and agency administrative areas, with differences being in the complexity of their ground water systems and community perspectives on water supply management. Both areas (see map) have recently become the target of focused monitoring and analysis by the Department of Natural Resources Waters Division (DNR) in cooperation with local governments and citizens. Goals of these studies include determining how to manage ground water sustainably using a surface watershed approach and developing a framework for aquifer and water use management that is transferable to other areas.

In recent history the City of Moorhead and Clay County have been known for an excess of water. Nonetheless, in 2007 water supply managers in that region approached DNR Waters for assistance in planning for an adequate drinking water supply during a prolonged drought similar to that of the 1930s. Water supply for Moorhead includes both surface water and ground water sources. The Buffalo



Aquifer, the primary ground water supply for the city and local agri-industry, is the focus of this study area.

The Bonanza Valley in Stearns, Pope and Kandiyohi counties is the other study area. This area has been considered to be water rich and, until recently, has supported extensive agricultural irrigation and other users without apparent problem. However, the water is supplied from a complex system of glacial drift aquifers which interact with surface waters.

— continued on page 6

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Newsletter Deadlines

Issue	Due to Editor
March '10	02/07/10
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OFFICER CANDIDATES

Mindy Erickson, Candidate for President-Elect

Dr. Melinda Erickson is currently a hydrologist and the groundwater specialist in the Minnesota Water Science Center of the U. S. Geological Survey (USGS). She is also an adjunct assistant professor at the University of Minnesota, Department of Bioproducts and Biosystems Engineering, and a faculty member of the Water Resources Science program. Prior to joining USGS in March 2009, Melinda (Mindy) worked for a local environmental consulting company and in several Minnesota state agencies, most recently as an environmental research scientist with the Minnesota Pollution Control Agency. Mindy has BS and MS degrees in Geological/Civil Engineering, and a PhD in Water Resources Science, all from the University of Minnesota. Mindy's primary research interests are the geochemistry, fate, and transport of organic chemicals (e.g., petroleum products, endocrine active chemicals, and pharmaceuticals) and metals (e.g., arsenic, iron) in groundwater in the upper Midwest.

"I have been a member of MGWA since attending my first conference as an undergraduate in the late 1980s, and over the years, I have appreciated and benefited from the conferences, field trips, newsletters, and networking. My vision for MGWA is continuing its leadership role in groundwater-related training and education for both professionals and lay-people. I would also like to strengthen connections between MGWA, other professional organizations, and academic institutions."

Jill Trescott, Candidate for Secretary

Jill Trescott is Groundwater Protection Supervisor for the Dakota County Water Resources Department. She has worked as a groundwater scientist for Dakota County since 1999, with a focus on monitoring and addressing non-point source groundwater contamination, especially from agricultural chemicals. Jill has a B. A. from Wellesley College and an M.S. in Environmental Science from the University of North Texas.

"This is a fascinating time to be involved with natural resource management, especially drinking water, because of the constant new developments in science, policy, and politics. MGWA is a terrific resource for its members, providing valuable information about current and emerging groundwater issues through its conferences, newsletter, and field trips. I would like to help MGWA in serving its existing members as well as new professionals entering the field."

Notice of electronic balloting has been emailed to members.

President's Letter, cont.

The important first step in any discussion is to simply define what you are talking about. In the case of ground water we have a resource that is often out-of-sight and out-of-mind. A large part of our jobs as ground water professionals is to define the size of ground water resources and the impacts of human development on them. An incredibly important tool in defining the subsurface of Minnesota has been the development of the County Well Index. MGWA is recognizing the efforts of two individuals who have played larger than life roles in creating and sustaining the County Well Index. Both **Bruce Bloomgren** and **Bruce Olsen** have been around from its inception and continue to work to maintain and improve this all important database. On behalf of the members of the MGWA it was my great honor to present Outstanding Service Awards to the 'Bruces' at the Fall MGWA meeting.

As we move into the future we will continue to develop tools like the County Well Index while trying to bring new resources into play. The MGWA is working to improve its web presence with a more usable website.

We have created a discussion group on the LinkedIn network. You can create a user name at www.linkedin.com and join the MGWA group. There is a current discussion on the definition of sustainability.

As a final note, another opportunity to enlarge your network of ground water contacts comes in 2011 when the Geological Society of America comes to Minneapolis. The national meeting of GSA will be held at the Minneapolis Convention Center on October 9-12 of 2011. The MGWA will be collaborating with GSA to help sponsor field trips and technical sessions. We can help highlight the efforts and contributions of Minnesota.

MGWA FALL CONFERENCE

MGWA Fall Conference Tackles Both Theoretical and Real World

On a very pleasant late-fall day more than 190 MGWA members nevertheless gathered inside the Continuing Education and Conference Center at the University of Minnesota to hear from specialists on both the theory side and the practical side of groundwater and groundwater management.

MGWA President, **Scott Alexander**, convened the conference and introduced **Dr. Martin Saar**, Department of Geology and Geophysics, University of Minnesota who proceeded, in very condensed form, to remind all those attending of the theoretical foundations of the groundwater profession. Martin tackled porous flow theory and applications, first deriving groundwater flow equations (Darcy's Law), or as Martin called them "hydraulic head diffusion equations", from fundamental conservation of mass equations. The appropriate application and scale of these equations were reviewed, along with examples where the equations based on laminar flow no longer apply, such as turbulent flow in karst systems. For situations where classic theory breaks down, Martin reviewed some newer approaches, such as the lattice-Boltzmann method and others, that, using modern computing power, can model complex, multi-phase flow.

Switching from the theoretical to the very practical, **Bruce Bloomgren**, Minnesota Geological Survey (MGS), reviewed the over 30-year history of "County Well Index", the state's well log database that is a joint effort of the Minnesota Department of Health and MGS. Bruce began the history prior to 1972,

when well logs, outside of driller's customer files, were few and other records limited. Bruce reviewed the many changes beginning in the early 1970s that gradually led to the incorporation of more complete information into the database. Today there are about 450,000 well records in the Internet-accessible system, however, the geospatial location has been verified for only about half of these records.

Changing from the history of "CWI", **Bruce Olsen**, MDH, talked about the future of CWI and ideas that would result in an even more useful database. Routine needs included verified and enhanced well locations and stratigraphic and aquifer interpretations. Bruce had a long list of future needs that would improve accuracy, completeness, and usefulness. Specific items included error corrections, stratigraphic reinterpretations, collecting historical well logs, adding well log images, including water chemistry, and adding aquifer test data. Bruce indicated that current indirect sources of funding for CWI are inadequate to keep up with routine needs much less accomplish the list of future needs.

Closing out the morning, **Dr. Todd Kincaid**, H2H Associates, provided extensive video from the inside of the Floridan Aquifer under the Woodville Karst Plain in the panhandle of Florida. These karst conduits, in an unconfined system, are so large they are explored by scuba, and are so deep the dives must include decompression sites. Todd also described repeated traces in the system to better understand the aquifer hydraulics and the water table flattening from the combination of rising sea level and increasing groundwater withdrawals. He also showed an example of karst system modeling using the steady-state FEFLOW model to

— continued on page 4



Bruce Bloomgren, MGS



Todd Kincaid, H2H Associates

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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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Fall Conference, cont.

simulate conduits embedded in porous media (dual porosity).

After the lunch break, the focus was back on conduit flow, beginning with a talk by **Dr. Tony Runkel** of the MGS, continuing with Kelton Barr and closing with Dr. Dan Doctor of the USGS. With his status report regarding the study of macropores in the Paleozoic hydrostratigraphy of southeastern Minnesota, Tony gave many examples of bedding plane fractures and vertical fractures resulting in significant secondary porosity. A particular focus of his presentation was regarding the progress that is being made toward a goal of mapping macropores and predicting their location in a systematic manner. Tony drove home the importance of understanding macropores when conceptualizing flow by demonstrating a fracture with a permeability of 12,500 feet per day in coarse clastic Jordan Sandstone. His remarks regarding the importance of understanding conduit flow and its relevance to conceptual models of groundwater flow would be echoed by each of the following speakers. Finally, Tony left the crowd musing over a new hydrogeological term: 'aquitardifer', and its possible application to the St. Lawrence Formation.

Kelton Barr gave a stratigraphic primer on the Platteville Formation, describing hydraulic transport in this heterogeneous aquifer. Using observations from a number of sites around the Twin Cities metro area, he pointed out hydraulic indications of fracture flow. He impressed the group with the matching alignment of joint systems from one location to another, likely



Tony Runkel, MGS

pointing to regional patterns that have profound effects on flow in the Platteville.

Dr. Dan Doctor closed out the day with a lively discussion of the patterns that can be discerned in chemical, isotopic and discharge data in karst aquifers. He then described how these patterns could be used to understand groundwater flow in karst. Using examples from Slovenia, Vermont and Mississippi, he demonstrated the value of linking hydrologic and chemical patterns to form better conceptual models of aquifer systems, stressing that not only is preferential flow present, but is the norm, and we need to deal with it in our conceptual models.

— Jan Falteisek, Eric Tollefsrud, the Newsletter team

MGWA Outstanding Service Awards Conferred

Bruce Bloomgren, Minnesota Geological Survey and Bruce Olsen, Minnesota Department of Health were honored at the Fall Conference for their distinguished work on the County Well Index over 37 years. Their legacy is the very basis of all hydrogeologic work in Minnesota.



Bruce Bloomgren, MGS, left; MGWA President Scott Alexander, center; Bruce Olsen, MDH, right.

Save the Date!

MGWA's Spring Conference

May 6, 2010

Radon (Rn-222) in Groundwater

By Karla Peterson and Jim Lundy, Minnesota Department of Health

What is radon?

Radon (Radon-222 or Rn-222) is a gas that has no color, odor or taste, and comes from the natural radioactive breakdown of Uranium-238 and Radium-226 (Ra-226) usually within the soil. The Minnesota Department of Health (MDH) found that radon in some community public water systems can result from treatment as Ra-226 is retained on filter media and breaks down to create Rn-222.

Exposure

An individual can be exposed to radon in two ways: drinking water and breathing air (indoor and outdoor). Most of radon in indoor air comes from soil underneath the home. Radon in soil can seep into the house and accumulate in indoor air. In addition, outdoor air contains background levels of radon from soil gas.

Radon also can be found in groundwater. In this case, exposure occurs when breathing radon that off-gasses from water during showering, washing dishes and cooking, or by drinking water which contains radon. Exposure to radon with a groundwater source causes approximately 168 cancer deaths per year in the United States, according to the U.S. Environmental Protection Agency (USEPA). This estimate of cancer deaths is from the exposure to radon from both drinking water and breathing radon that has off-gassed from the water.

Proposed Rule

The USEPA proposed a Radon Rule as part of the Safe Drinking Water Act several years ago, although it is unlikely that the proposed rule will become final at this point. The proposed rule is complex, and it addresses radon occurrence in both air and water. The USEPA proposed an Alternative Maximum Contaminant Level (AMCL) in drinking water of 4000 picocuries per liter (pCi/L) in water for states that adopt an Indoor Air Program. This concentration in water is equivalent to 0.4 pCi/L in air, the ambient outdoor air concentration. Minnesota intended to adopt an Indoor Air Program that met the proposed Radon Rule requirements, and as a result, community public water systems would have been required to meet the AMCL of 4000 pCi/L. For states without an Indoor Air Program, a Maximum Contaminant Level (MCL) of 300 pCi/L in water would have been required.

Occurrence

Anticipating a final rule, the Minnesota Department of Health sampled all community public water systems and found that radon in 37% (approximately 400 systems) exceeds 300 pCi/L. Radon in four systems (0.37%) exceeds 4000 pCi/L. The highest radon emission rates in drinking water were found in parts of east central and southern Minnesota. Radon emissions at distribution entry points ranged from 15 pCi/L to 4340 pCi/L, with a mean of 420 pCi/L.

Figure 1 shows the statewide distribution of maximum MGWA Newsletter December 2009

radon emissions measured in 664 community public water supply wells completed in a variety of aquifers. Maximum radon was determined from several quarterly measurements (generally, 3 to 5) at each well. In some locations, there was a large difference between maximum and minimum radon emissions, but the cause of the scatter is unknown.

The mixture of blue and yellow dots fails to define an overall pattern to radon occurrence. Maps of radon occurrence in individual aquifers (not shown here) also lacked discernable patterns. Four red dots indicating the greatest radon emissions are distributed across Minnesota in a southwest-northeast alignment. The southernmost two red dots represent wells completed in the Sioux Quartzite, in which large radium emissions have been measured (Ra-226 is the radioactive parent of Rn-222). The red dot in central Minnesota is a well completed in subcropping Mt. Simon sandstone, also known to produce large radium emissions. The red dot in northeastern Minnesota is anomalous, because the

— continued on page 6

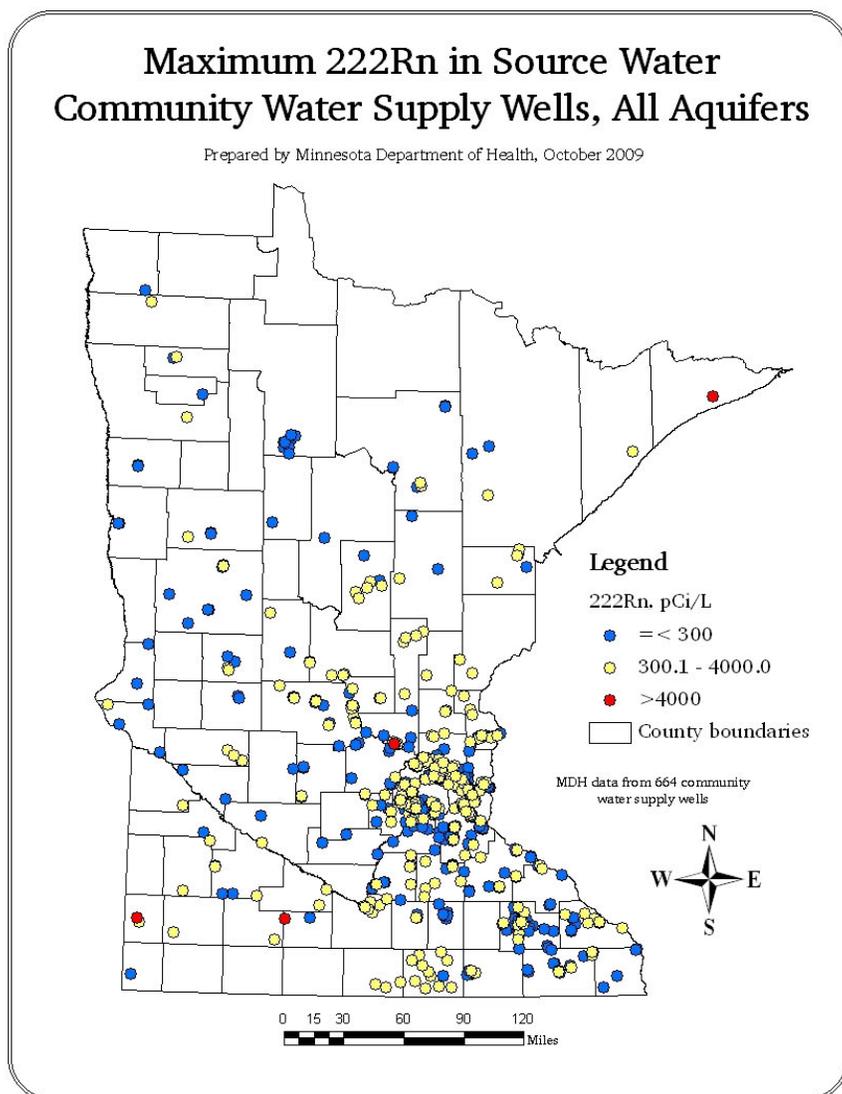


Figure 1. Maximum Rn-222 in Source Water Community Water Supply Wells in Minnesota.

Radon (Rn-222) in Groundwater, cont.

alkaline igneous rocks that characterize the North Shore are not generally known to produce problematic emissions of radon or radium.

There is some temporal variability in radon emissions for individual wells, and both seasonal variation and pumping rate may contribute to that variability. Compliance monitoring would have required at least four samples to determine an exceedance, thereby reducing the effect of variability in calculating compliance.

Treatment

Water treatment plants using aeration for iron and manganese oxidation can remove radon during the treatment process. Non-pressurized aeration designed for oxidation of iron and manganese can be useful in the reduction of radon, with removal rates from 3 to 98%. Aeration specifically designed for radon removal can be 90 to 99% effective.

Water treatment plants can also increase radon concentrations during pressure filtration. Systems using pressure aeration and pressure filtration may increase radon emissions as much as 138%. Build up of radium in scale on filter media is the suspected cause of increasing radon emissions in finished water.

What should I do?

Exposure to radon in drinking water is a relatively small health risk in comparison to radon in air. For more information related to radon and indoor air exposure, you can visit:

www.health.state.mn.us/divs/eh/indoorair/radon/index.html

Buffalo Aquifer and Bonanza Valley Studies Initiated, cont.

Potential impacts to ecological services are not fully understood. Several years of reduced precipitation and increased irrigation have resulted in some water use conflicts. The extent of these conflicts was brought to light during recent investigation by DNR hydrogeologists into well interference complaints by domestic well owners.

Previous US Geological Survey and DNR studies in both areas indicated a strong connection between ground water and surface water. These studies were primarily focused on determining how much water was available to be removed without consideration of impacts of withdrawals on the entire hydrologic and ecologic system. The current studies are aimed at assessment and identification of recharge areas including potential quantity and quality vulnerabilities and will leverage updated and expanded aquifer data and maps from county geologic atlases, biologic surveys and regional basin studies, and ongoing water quality analyses to update and enhance earlier hydrologic models.

In the Bonanza Valley study area data gathering has included three mass well water level measurements, installation of several shallow wells to create well nests or replace existing observation wells, and stream flow measurements at locations close to those used in the earlier studies. Along the Buffalo Aquifer, in addition to ongoing ground water level monitoring, the DNR is collaborating with the Minnesota Pollution Control Agency and the Buffalo-Red Watershed District to conduct stream gaging related to total maximum daily load studies in the Buffalo-Red Watershed. Other local, state and federal agencies are assisting in the study and participating in the planning and discussions. Monitoring data and analyses will be shared through regional partners and community meetings. Two meetings were held this summer with local interested parties in the Bonanza Valley. In late August, the first community meeting was held in Moorhead for the Buffalo Aquifer area and was attended by local officials and water appropriators. A website, www.buffaloaquifer.com, has been created by the City of Moorhead staff to share data and other information. Work is underway for a similar website for the Bonanza Valley study area. As the studies progress, the technical and public engagement processes are being documented and will be used to design an aquifer or water use management framework.

These studies were presented to the Legislative Citizen Committee for Minnesota Resources as the proposal, "Next Generation in Water Supply Management- Pilot Studies" for possible funding; however, they were not selected for the current funding cycle. Nonetheless, they remain important areas for aquifer management in order to understand the aquifer characteristics and how we can manage the aquifer and water use of these areas sustainably. Data gathering and information sharing with the communities continues until funding sufficient to also update earlier hydrologic models can be obtained.

For more information on either of these studies, please feel free to contact me at 651-259-5692 or laurel.reeves@state.mn.us.

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McLeod County and Carlton County Geologic Atlases, Part A, Completed

Part A's of the McLeod County Geologic Atlas and the Carlton County Geologic Atlas are now available. These reports, recently published by the Minnesota Geological Survey, each include six map plates that describe the county's surficial and bedrock geology, Quaternary stratigraphy, buried sand distribution, bedrock topography, depth to bedrock, mineral endowment, and the data sets that support these maps. Each of these reports in the County Geologic Atlas Series is a cooperative effort of the Minnesota Geological Survey, the Minnesota Department of Natural Resources, Division of Waters (DNR Waters) and local sponsors. The Part A portion of these atlases will be joined in the future by Part B, to be prepared by DNR Waters, which will include maps of ground water and pollution sensitivity. In addition, the Minnesota Department of Natural Resources, Division of Lands and Minerals has completed and published separately an aggregate resource potential map for Carlton County.

County Geologic Atlases are underway in Todd, Carlton, McLeod, Carver, Chisago, Benton, Sibley, Nicollet, Blue Earth, Anoka, Wright, Renville, and Clay counties. Reports in the County Geologic Atlas Series may be purchased at the Minnesota Geological Survey, Publications Sales Office, at 2642 University Avenue, St. Paul, 55114, phone (612) 627-4782.

The reports in the County Geologic Atlas series are prepared using geographic information system (GIS) technology. A DVD has been prepared that includes versions of the atlas maps and data accessible to GIS users and to those who do not use this technology. Data files and portable document format (PDF) images of plates are available for download.

Data for the Carlton Part A report is downloadable from the MGS ftp site at: <ftp://mgssun6.mnngs.umn.edu/pub5/c-19/>.

Data for the McLeod Part A report is downloadable from the MGS ftp site at: <ftp://mgssun6.mnngs.umn.edu/pub5/c-20/>. More information is on the MGS web site at: www.geo.umn.edu/mgs/. The Carlton County aggregate resource map is downloadable from the DNR web site at www.dnr.state.mn.us/lands_minerals/aggregate_maps/completed/carlton.html. For more information about other reports in the atlas series and access to completed Part B reports please see the DNR Waters web site at www.dnr.state.mn.us/waters/groundwater_section/mapping/status.html.

For more information contact Dale Setterholm, Minnesota Geological Survey, at (612)627-4780 or Jan Falteisek, DNR Waters, at (651)259-5665.



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Plan for a Metro Groundwater Level Monitoring Network

Groundwater: Plan to Develop a Groundwater Level Monitoring Network for the 11-County Metropolitan Area, Minnesota Department of Natural Resources, Waters Division, October 2009, 48 p.

In response to a legislative mandate enacted last legislative session, the Department of Natural Resources (DNR) has developed a plan for an adequate groundwater level monitoring network of wells in the 11-county metropolitan area. Working with other agencies and groundwater professionals, the DNR has identified a long-term plan for the data and monitoring systems needed to more fully understand the aquifers serving the 11-county metropolitan area. That information will ultimately enable resource managers to better protect long-term supplies, prevent water quality degradation, and ensure that water use does not harm ecosystems.

The plan identified a "backbone network" for long-term groundwater level monitoring that would consist of about 200 existing locations plus the installation of about 60 well nests, all to be instrumented with automated electronic data systems. The plan estimated the installation cost to be about \$8.9 million over four years, with an annual maintenance cost following installation of \$825,000. The installation cost, calculated in terms of water withdrawn from the monitored aquifers in the 11-county area, equated to a small fraction of a penny per gallon of water.

The plan is available on the DNR Waters website at http://files.dnr.state.mn.us/publications/waters/groundwater_level_monitoring_report_october_2009.pdf.



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Recent Publications from the U.S. Geological Survey

Estimated Use of Water in the United States in 2005. 2009. USGS Circular 1344. Kenny, J.F., Barber, N.L., Hutson, S.S., Linsey, K.S., Lovelace, J.K., and Maupin, M.A.

ABSTRACT

Estimates of water use in the United States indicate that about 410 billion gallons per day (Bgal/d) were withdrawn in 2005 for all categories summarized in this report. This total is slightly less than the estimate for 2000, and about 5 percent less than total withdrawals in the peak year of 1980. Freshwater withdrawals in 2005 were 349 Bgal/d, or 85 percent of the total freshwater and saline-water withdrawals. Fresh groundwater withdrawals of 79.6 Bgal/day in 2005 were about 5 percent less than in 2000, and fresh surface-water withdrawals of 270 Bgal/day were about the same as in 2000. Withdrawals for thermoelectric-power generation and irrigation, the two largest uses of water, have stabilized or decreased since 1980. Withdrawals for public-supply and domestic uses have increased steadily since estimates began.

Thermoelectric-power generation water withdrawals were an estimated 201 Bgal/d in 2005, about 3 percent more than in 2000. In 2005, thermoelectric freshwater withdrawals accounted for 41 percent of all freshwater withdrawals. Nearly all of the water withdrawn for thermoelectric power was surface water used for once-through cooling at power plants. Twenty-nine percent of thermoelectric-power withdrawals were saline water from oceans and brackish coastal water bodies.

Withdrawals for irrigation in 2005 were 128 Bgal/d, about 8 percent less than in 2000 and approximately equal to estimates of irrigation water use in 1970. In 2005, irrigation withdrawals accounted for 37 percent of all freshwater withdrawals and 62 percent of all freshwater withdrawals excluding thermoelectric withdrawals. Irrigated acreage increased from 25 million acres in 1950 to 58 million acres in 1980, then remained fairly constant before increasing in 2000 and 2005 to more than 60 million acres. The number of acres irrigated using sprinkler and microirrigation systems has continued to increase and in 2005 accounted for 56 percent of the total irrigated acreage.

Water withdrawals for public supply were 44.2 Bgal/d in 2005, which is 2 percent more than in 2000, although the population increased by more than 5 percent during that time. Public supply accounted for 13 percent of all freshwater withdrawals in 2005 and 21 percent of all freshwater withdrawals excluding thermoelectric withdrawals. The percentage of the U.S. population obtaining drinking water from public suppliers has increased steadily from 62 percent in 1950 to 86 percent in 2005. Most of the population providing their own household water obtained their supplies from groundwater sources.

Self-supplied industrial water withdrawals continued to decline in 2005, as they have since their peak in 1970. Self-supplied industrial withdrawals were an estimated 18.2 Bgal/d in 2005, a 30-percent decrease from 1985. An estimated 4.02 Bgal/d were withdrawn for mining in 2005, which is 11 percent less than in 2000, and 18 percent less than in 1990. Withdrawals for mining were only 58 percent freshwater.

Livestock water use was estimated to be 2.14 Bgal/d in 2005, which is the smallest estimate since 1975, possibly due to the use of standardized coefficients for estimation of animal water needs. Water use for aquaculture was an estimated 8.78 Bgal/d in 2005, nearly four times the amount estimated in 1985. Part of this

increase is due to the inclusion of more facilities in the estimates in 2005, and the use of standardized coefficients for estimating aquaculture use from other data.

Fresh surface water was the source for a majority of the public-supply, irrigation, aquaculture, thermoelectric, and industrial withdrawals. Nearly 30 percent of all fresh surface-water withdrawals in 2005 occurred in five States. In California, Idaho, and Colorado, most of the fresh surface-water withdrawals were for irrigation. In Texas and Illinois, most of the fresh surface-water withdrawals were for thermoelectric power generation.

About 67 percent of fresh groundwater withdrawals in 2005 were for irrigation, and 18 percent were for public supply. More than half of fresh groundwater withdrawals in the United States in 2005 occurred in six States. In California, Texas, Nebraska, Arkansas, and Idaho, most of the fresh groundwater withdrawals were for irrigation. In Florida, 52 percent of all fresh groundwater withdrawals were for public supply, and 34 percent were for irrigation.

For more information, the link to the USGS web site about the article is <http://pubs.usgs.gov/circ/1344/>.

Occurrence and distribution of iron, manganese, and selected trace elements in ground water in the glacial aquifer system of the northern United States. 2008. USGS Scientific Investigations Report 2009–5006. Groschen, G.E., Arnold, T.L., Morrow, W.S., and Warner, K.L.

ABSTRACT

The constituents summarized in this report include: barium, strontium, lithium, manganese, nickel, zinc, molybdenum, iron, copper, vanadium, arsenic, uranium, cobalt, chromium, selenium, lead, antimony, cadmium, thallium, beryllium, and silver, in order of detection frequency.

Highlights include:

- ◆ Few wells had concentrations for any trace element that exceeded relevant drinking-water standards. Human-health benchmarks, such as non-enforceable lifetime health advisory levels (LHA), were exceeded more often than drinking-water maximum contaminant levels.
- ◆ Manganese most often exceeded its benchmark (LHA) in the glacial aquifer system wells. Lower proportions of wells had concentrations of arsenic, selenium, or uranium that exceeded relevant health-based benchmarks.
- ◆ The most common pair of elements at or above the benchmarks was manganese and arsenic.
- ◆ Strontium and barium are the most frequently detected constituents and usually the highest concentrations.
- ◆ There are some geographic patterns in constituent concentrations that primarily reflect climate effects.
- ◆ Oxidation-reduction (redox) conditions affect the concentration of several trace elements such as copper and arsenic, however, many redox-sensitive elements concentrations were not significantly different among redox categories.

Hard copies are available by contacting George Groschen (gegrosch@usgs.gov). The link to the full report can be found on the NAWQA glacial aquifer system web page at: <http://water.usgs.gov/nawqa/studies/praq/glacaq/index.html>



Minnesota Water Use

DNR water appropriation permits are required for all users withdrawing more than ten thousand gallons of water per day or one million gallons per year. Uses less than this, such as rural domestic use, do not require a permit and are not included in these figures.

Water use data are used for many purposes, such as documenting permitted water use, identifying water use trends, understanding the hydrology of aquifers from which water is withdrawn, and evaluating well interferences and impacts other of water appropriations.

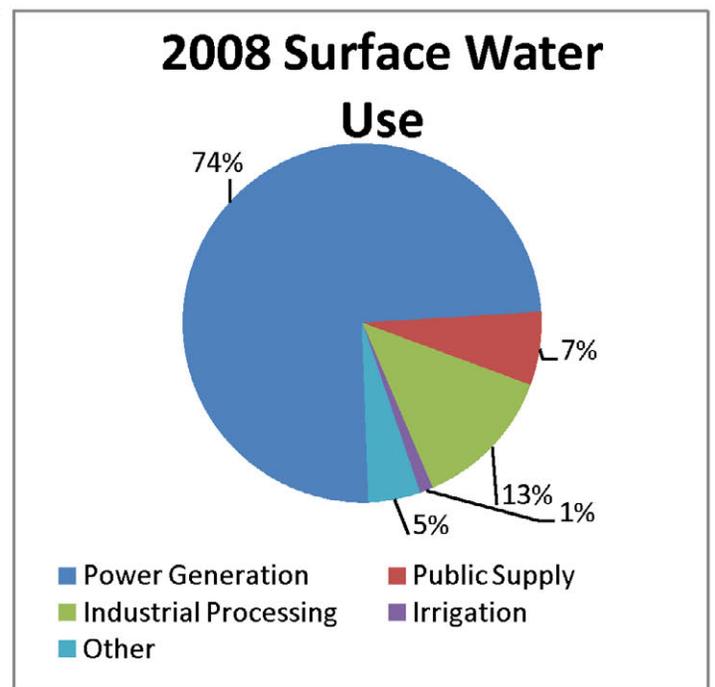
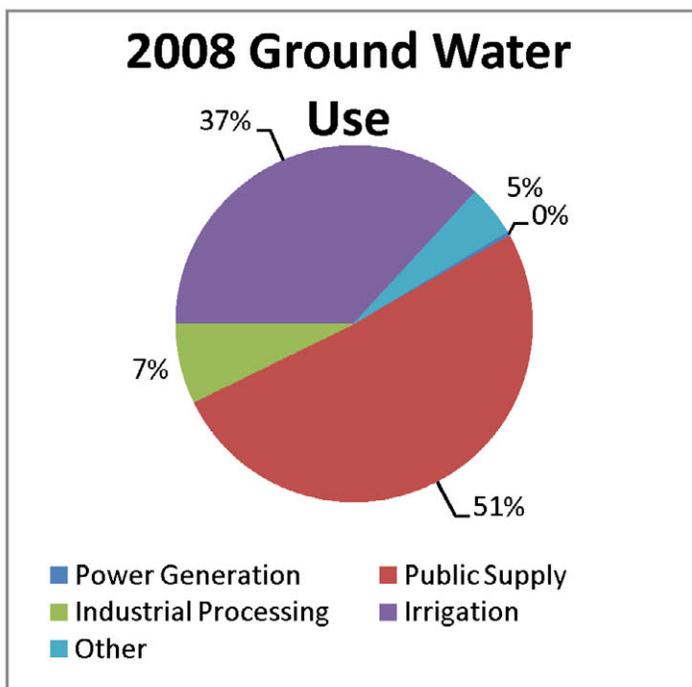
The majority of water withdrawn for power generation is from surface water sources and is used for cooling purposes and then returned to the original source.

The "Other" category includes uses such as air conditioning, construction dewatering, water level maintenance of lakes, pollution containment, pipeline testing, aquaculture and livestock watering.

Irrigation includes golf courses, landscaping, nurseries, major crops and wild rice.

See the MN DNR web site for the latest water use information: www.dnr.state.mn.us/waters

2008 Water Use in Billions of Gallons	
Power Generation	842.5
Public Supply	217.5
Industrial Processing	166.8
Irrigation	116.7
Other	65.4
Total	1408.9



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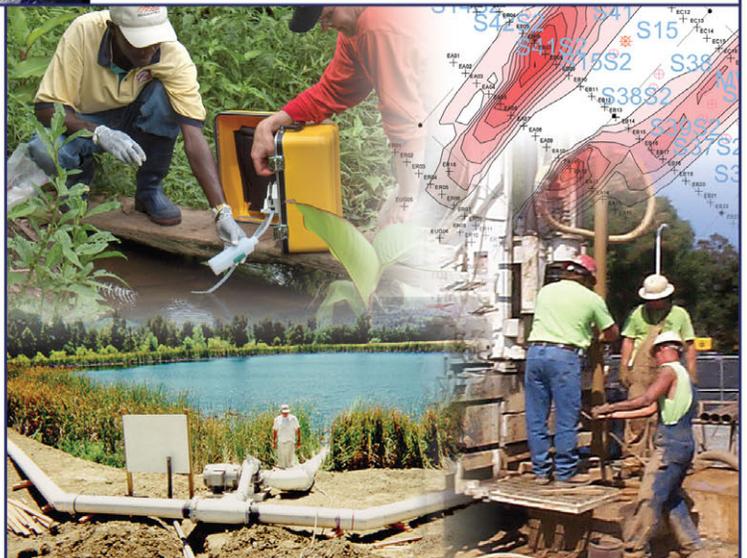
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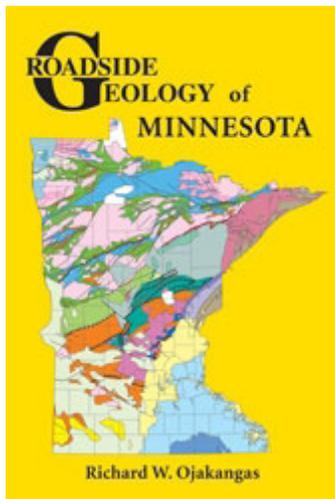
Last Print Version of "The Aquifer" from the Groundwater Foundation

The Groundwater Foundation of Lincoln, NE has announced that the Fall 2009 issue of its quarterly newsletter, "The Aquifer" is the last printed edition of the popular publication. Beginning in 2010, "The Aquifer" will go to a digital format, in part to reduce printing and mailing costs. To receive future issues, visit www.groundwater.org/au/aquifer.html and provide your e-mail address, or call the Groundwater Foundation at 1-800-858-4844.

Roadside Guide of Minnesota's Geology - Finally

Roadside Geology of Minnesota, 2009, by Richard W. Ojakangas, paperback, 368 pages, color, \$26.

For more information: www.mountain-press.com. If you have been thinking about holiday gift-giving for that special geologist on your list, here's the perfect thing and just in time. Richard Ojakangas, long-time professor at University of Minnesota-Duluth, has written a new entry in the "Roadside Geology" series just for Minnesota. "If you've ever wondered where all the lakes came from, or how the iron range formed, or why southern Minnesota crop land is so fertile," then here is the book for you and those special people on your gift list.



Nearly 700 Attend University of Minnesota Water Resources Conference

The Saint Paul River Centre hosted the 2009 Water Resources Conference, sponsored by the University of Minnesota's Water Resources Center (WRC). A planning committee of nearly 30 water professionals from a variety of public agencies and private companies put together a diverse conference that featured two days of plenary speakers, technical sessions, and poster presentations. **Deb Swackhamer** of WRC and **Jennifer Olson** of Emmons and Olivier Resources, Inc. were co-chairs.

This year's Dave Ford Water Resources Award recipient was James L. Anderson, recently retired co-director of the Water Resources Center, and professor in the Department of Soil, Water and Climate. Keynote presenters for the plenary sessions were Professor Jerry Schnoor of the University of Iowa College of Engineering, speaking about water sustainability, and Paul D. Capel of the U. S. Geological Survey (USGS) and the University of Minnesota's Civil Engineering Department, who presented a retrospective of lessons learned from the first two decades of the USGS National Water Quality Assessment (NAWQA) Studies. Luncheon presentations featured Congress-woman Betty McCollum who spoke about building partnerships for clean water, and Rex Johnson of the U. S. Fish and Wildlife Service, who discussed wetland drainage and its impacts in Minnesota.

Hot topics at this year's conference included water sustainability issues; stormwater best management practices (BMPs) and their maintenance; geomorphology and restoration of rivers and streams; the total maximum daily load (TMDL) program; and involving citizens in water resource management and protection programs. Twenty-eight posters covering a wide range of water resources topics helped round out the conference.

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The MGWA Foundation is a 501(c)3 charitable organization. Donations to the Foundation are deductible on your state and federal income tax returns.

FOUNDATION MINUTES

Minnesota Ground Water Association Foundation Board Meeting Minutes

- Meeting Date:** Tuesday, September 15, 2009
Location: Metro 94 Building, 455 Etna Street, St. Paul
From: Cathy Villas-Horns (Secretary)
Members Present: Gilbert Gabanski, Chris Elvrum, David Liverseed, Amanda Strommer, Stu Grubb and Cathy Villas-Horns. MGWA Management Present: Sean Hunt
Minutes: The meeting minutes for the June 17, 2009 meeting were unanimously approved on July 6, 2009. An addendum to the minutes was approved on July 28, 2009. Both the original minutes and the addendum were provided via e-mail to the MGWAF Board and the MGWA Newsletter staff.
Treasurer's Report: Foundation balance to date is \$94,508.60. Interest in the amount of \$311.27 was accrued since 6-17-09 and was swept into the endowment. The previous Odyssey CD automatically renewed in February 2009 for 29 months at a rate of 0.747%. We had decided in July to take the money in this CD and put it into a Step-Up CD. Since it had automatically renewed, the account was penalized \$250.39 to close the 0.747% CD. The MGWA provided \$10,000 to the foundation during this quarter which is currently in the Membership Savings account. The decision was made to leave this amount in the Membership Savings account and to discuss at the December meeting the possibility of a combining this money with the money from the CD maturing in February 2010 into a new CD.
New Business: Grant requests – World Savvy submitted a grant request for \$1,250. While it is a good organization with broad appeal, we decided that there was not enough focus on ground water in the request for us to fund the proposal. Dave moved that the MGWAF Board not approve the request. Chris seconded the motion. Motion passed. Water For People – Article in last issue of MGWA newsletter. Would MGWAF ever consider funding a proposal on behalf of this organization? The bylaws require the grant requests to fund work in Minnesota and adjacent states and provinces, so this organization would not qualify. A special fundraiser could be held for this organization. MGWAF meetings - Some discussion of reducing the MGWAF meetings to twice a year. We will discuss this proposal further at the December meeting.
Old Business: MGWA Board Meeting report – Gil is not getting the minutes. Sean will ask Steve Robertson to include Gil on the distribution list. Sean reported that the newsletter is in draft form, and that the fall conference is on aquifer flow paths in porous and fractured media. Children's Water Festival – To be held on September 30; Gil recommends volunteering. SMM ground water exhibit – The artesian well exhibit was modified; it may need a new pump. Labels were placed on the sand model. Envirothon – Gil will contact Mike Trojan at the MPCA.
Next Meeting: The last meeting of 2009 was held Tuesday, December 8.

Kids Have Fun, Learn About Water

Over 1,200 fifth graders from 20 Twin Cities metro area schools took part in the 12th annual Metro Children's Water Festival (CWF) at the State fairgrounds on September 30. Through interactive exhibits and demonstrations, they learned where rain water goes after it runs into storm drains and ways to keep trash from polluting water supplies. The always popular H2O Olympics challenged kids to see how many drops of water they could get on top of a penny and they learned about water's surface tension by being surrounded by a large soap bubble. This year, the MGWA Foundation contributed \$1,500 to the operation and success of the CWF. Next year's CWF is tentatively set for September 29, 2010.



MGWA BOARD MINUTES

Minnesota Ground Water Association Board Meeting Minutes

Meeting Date: August 7, 2009
Location: Fresh Grounds Coffee Shop, 1362 West 7th Street, St. Paul, Minnesota
Attending: Scott Alexander, President; Stu Grubb, Past President; Steve Robertson, President-Elect; Craig Kurtz, Treasurer; Jeanette Leete, WRI; Sean Hunt, WRI
Past Minutes: April and June minutes approved.
Treasury: Review of balance sheet reveals cash on hand is approximately \$47,000. That balance is up from last year but does not reflect a few large outstanding bills. Review of profit/loss statement indicated income and expenses through early August is very similar to 2008. Tax forms are being filed by WRI on behalf of the MGWA. Motion: Transfer \$10,000 from MGWA to MGWA Foundation – motion approved.
Newsletter: June newsletter is out. September issue is pending. Eric Tollefsrud is the issue editor.
Web Page: New web page is up and running. WRI staff is being taught how to manage content on the site.
WRI Report: Business agent distributed detailed list of activities since last meeting. Motions: 1) Purchase Quickbooks 2009 for treasurer, 2) obtain new hard drive for MGWA laptop computer, 3) maintain annual dues at current levels – all approved.
Old Business Field trip: discussion about ways in which MGWA might be able to collaborate with other organizations.
New Business Discussion of adopting a more proactive oversight role for the association relative to heightened emphasis on water and groundwater issues in last legislative session. No action.
Fall conference: November 12. President is working on the topic and has started contacting speakers.

Meeting Date: September 11, 2009
Location: Fresh Grounds Coffee Shop, 1362 West 7th Street, St. Paul, Minnesota
Attending: Scott Alexander, President; Steve Robertson, President-Elect; Jeanette Leete, WRI; Sean Hunt, WRI.
Past Minutes: Corrections to the August minutes were noted.
Treasury: Review of balance sheet reveals cash on hand is approximately \$31,787. Reflects transfer of \$10,000 to MGWA Foundation and other bills and needed software upgrades. Taxes filed.
Newsletter: September issue is in editing. Eric Tollefsrud is the issue editor.
Web Page: WRI staff up to speed on making changes to site as needed.
WRI Report: Business agent distributed detailed list of activities since last meeting.
Old Business Field trip: Field trip plans on hold until 2010.
Fall conference: Nov. 12. President is assembling slate of speakers and bio information so that an announcement can be sent to the membership. Some discussion of options for recording conference in case H1N1 disrupts things.
New Business: Need to identify officer candidates for next year.
GSA national meeting in Twin Cities in 2011.

Meeting Date: October 2, 2009
Location: Fresh Grounds Coffee Shop, 1362 West 7th Street, St. Paul, Minnesota
Attending: Scott Alexander, President; Stu Grubb, Past President; Steve Robertson, President-Elect; Craig Kurtz, Treasurer; Jon Pollock, Secretary; Jeanette Leete, WRI; Sean Hunt, WRI
Past Minutes: August and September minutes approved.
Treasury: Current balance approximately \$30,000.00. Net income so far for 2009 is \$7,530.19
Newsletter: Ted Ronning is the December Issue Editor. November 6 is the deadline for articles.
Web Page: Newsletter out along with conference material emails and membership renewals. Paper notices will be sent out later.
WRI Report: Report handed out. Emailing notices, working on web page, preparing to mail membership forms, working on membership worked on September newsletter and wrote check for \$10,000.00 to MGWA Foundation.
Old Business Fall Conference: Reviewed fall conference brochure and discussed fall conference.
Elections: Candidates for President and Secretary positions need to be identified for 2010.
New Business MGS State Mapping Committee: Motion was made to appoint Gil Gabanski to serve as the MGWA representative to MGS State Mapping Committee with the understanding that Gil will report to the MGWA Board of Directors on the committee's activities and his input to the committee.
Corporate Membership: Currently 14 corporate members. Sean and Jennie will talk to Jim Aikin concerning corporate membership.

The MGWA Board of Directors meets once a month.

All members are welcome to attend and observe.



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MGWA BOARD MINUTES

Minnesota Ground Water Association Board Meeting Minutes, cont.

- Meeting Date:** November 6, 2009
- Location:** Fresh Grounds Coffee Shop, 1362 West 7th Street, St. Paul, Minnesota
- Attending:** Scott Alexander, President; Stu Grubb, Past President; Steve Robertson, President-Elect; Craig Kurtz, Treasurer; Sean Hunt, WRI.
- Past Minutes:** Revisions suggested to October minutes. Approved with changes.
- Treasury:** Review of balance sheet reveals cash on hand is approximately \$32,000 in the checking account. Net income for the year is about 19,000, but includes only preliminary expenses for the fall conference.
- Newsletter:** December issue is coming together. Tedd Ronning is issue editor.
- Web Page:** Fall conference info up. Much activity related to on-line ordering (conference registration, membership renewals).
- WRI Report:** Report distributed. Highlights include: 1) May 6 and Nov 9 reserved for conferences next year, 2) 184 membership renewals to date, 3) 208 registered for fall conference.
- Old Business**
- Fall conference: Motion to record audio at a cost of about \$135 was approved.
- Officers candidates: Mindy Erickson has agreed to be a candidate for president, and Jill Trescott has agreed to be a candidate for secretary.
- GSA 2011. October 9-11. Jim Miller, UMD, is head coordinator for field trips. Looking for field trips to be run in conjunction with the conference. Harvey Thorleifson, MGS, is local coordinator for conference.
- StateMap. Letter from MGWA StateMap acting chair and MGWA representative Gil Gabanski was distributed.
- New Business**
- May 15 retirement party for Olaf Pfannkuch.



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