

Minnesota Ground Water Association

www.mgwa.org

Newsletter

December 2012
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MGWA President
Kelton Barr

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President's Letter

By Kelton D.L. Barr

The Minnesota Ground Water Association has been celebrating its 30th anniversary this year. We've been celebrating it as true Minnesotans: without a lot of hoopla. Our first president, Gil Gabanski did a short review of these thirty years during the 57th Midwest Ground Water Conference (MWGWC) that we hosted this last October 1-3. His presentation can be found at www.mgwa.org/meetings/2012_fall/fall2012_ple_nary.php. It's worth perusing if you missed it. Gil has also summarized the MGWA's first 30 years in an article in this newsletter. The 57th MWGWC, organized and hosted by MGWA instead of our usual fall conference, achieved several milestones.

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, Minnesota: a Chemical and Hydrostratigraphic Approach

Bob Tipping, Minnesota Geological Survey

The seven central counties within the eleven county Twin Cities Metropolitan Area, extended (TCMAx) have, at present, over 2.8 million residents (Metropolitan Council, 2010). With the exceptions of Minneapolis and, in part, St. Paul, groundwater is the primary drinking and industrial water source, with the majority of that supply coming from Paleozoic bedrock aquifers. In addition, an abundance of surface water bodies in the TCMAx, including lakes, streams, and wetlands constitute a surface water-groundwater system providing essential ecosystem functions that support not just a diversity of biological life but are also the foundation of the area's recreation and tourism industries.

Within this context of multiple and often conflicting use, decision makers are faced with choices regarding utilization of groundwater resources. Common questions include: "What is the quality of water in my area? Is it getting worse or better? If we increase our use

These included:

- ◆ Attendance at the two days of technical sessions broke the records for both MWGWC and for MGWA: over 340 for both days. (The second day's attendance actually exceeded 600 if the frac sand workshop that shared our venue is included.)
- ◆ Over 104 talks and posters were presented in 18 technical sessions on a variety of groundwater topics. In the tradition of our conferences, these presentations are available on our website for future viewing at www.mgwa.org/meetings/2012_fall/fall2012.php. I invite you to peruse these as well.

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of groundwater, what are the consequences?" Furthermore, the nature of groundwater resources are largely in the realm of "out of sight, out of mind" and traditionally, decision makers have been inclined not to act until there is a tangible problem such as a contaminated public supply well, drought, or conflicts due to multiple uses.

A chemical and hydrostratigraphic approach to characterizing groundwater flow in the TCMAx was recently completed at the MGS (Tipping *et al.*, 2010, Tipping, 2011, 2012). The goal of this investigation was two-fold: first, to provide decision makers with a tool to help assess changing groundwater conditions in an urban area; second, to provide the technical community with datasets useful for improving hydrogeology and calibration of regional groundwater flow models. To accomplish these goals, the distribution of chemical types in Twin Cities groundwaters were mapped in three dimensions, providing a way to compare their distribution with fundamental controls on regional groundwater flow such as permeability of glacial materials, elevations of major rivers, presence and absence of bedrock confining units, and the regional distribution of vertical hydraulic head gradient. For decision makers not trained in hydrogeology, this type of tool

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Bruce Olsen Retires

by MGWA Newsletter Team

Bruce Olsen has retired as supervisor of the Source Water Protection Unit at the Minnesota Department of Health after a career in groundwater of more than 40 years. Olsen joined the health department in 1989 after having worked 20 years for the Minnesota Geological Survey. He will be missed by many and we wish him the best in his retirement.

Best Wishes to Bruce Olsen on a great retirement!

by James R. Stark, Director Minnesota Water Science Center, USGS

Bruce's friends at the USGS wish him the best as he begins his well-deserved retirement. When I think about my association with Bruce the words "visionary thinker" come to mind. Bruce has been a wonderful supporter of USGS programs over the years, while at the Minnesota Geological Survey and the Minnesota Department of Health, and we have collaborated on many projects. Bruce has been one of a few individuals who shared the vision to modernize the study of groundwater hydrology in Minnesota. The strategic development of coordinated groundwater databases is an example for other states. This would not be so without his vision and expertise. As a federal worker I have the opportunity to see what is being done in other states and Minnesota's databases stand as an example for groundwater professionals throughout the country. Bruce is also the "father" of source water protection efforts in Minnesota. His vision and management of this program has resulted in great progress toward protecting water of the residents of the state. Bruce will be missed by all of us at the USGS and by the groundwater community throughout Minnesota. Best wishes and stay in contact.

by Dale Setterholm, Director Minnesota Geological Survey

I've heard it said that when you leave a job it's like taking your hand out of a bucket of water. There are some ripples for a short time and then there is no evidence you were ever there. That may be true for some, but it couldn't be more wrong in the case of Bruce Olsen. I know Bruce from my start at the MGS in the late 1970's. I worked for him in a position he often referred to as "junior woodchuck". I spent much of my time working on the County Well Index database, and was a witness to creation of the very first County Geologic Atlas. Today these are the most well-known and heavily used products of the MGS and both happened because of the efforts of Bruce. He (and his cohort Bruce Bloomgren) not only took advantage of the State's effort to begin collecting well construction data, they went out with a portable copying machine and collected historical well data from drilling contractors. Together they made sure that the procedures used to compile and interpret well records and establish accurate well locations were done right. With this valuable data in hand Bruce then started comprehensive geologic mapping efforts in southeastern Minnesota. A bold move in an organization that was largely a Precambrian research institute at the time. Today Minnesota's County Geologic Atlas program and County Well Index database are the envy of geological surveys across the country. Bruce also greatly influenced the careers of those who worked for him. Thirty-some years later I work to continue the effort Bruce initiated and I've been promoted to Associate Woodchuck.

by Janet Kuefler, EPA Region 5, citation read while presenting Bruce Olsen with a recognition plaque.

Bruce "wrote the book" on Wellhead and Source Water Protection programs in Minnesota, developing both programs which are highly successful and a national model.

Bruce is extremely dedicated, works long hours, and does not get much sleep. I hear that he is known for calling staff at all hours of the day or night when he thinks of a great idea that just can't wait. He leads efforts to help create win-win situations for source water protection in the agricultural sector. Bruce demonstrated both innovation and determination in leading an effort

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— Janet Kuefler, EPA Region 5 presents Bruce Olsen with a recognition plaque. See below for the citation she read while presenting the plaque.

American Engineering Testing, Inc. (AET) announces the hire of Jane M. Willard, Senior Geologist

St. Paul, Minn. – American Engineering Testing, Inc. (AET), a leading engineering consulting firm, hired Jane M. Willard, PG, CPG, as a senior geologist. As the former owner and president of EnPro Assessment Corp, Jane brings over 30 years of environmental assessment experience to AET’s environmental department.

“We have enjoyed a long-standing professional relationship with Jane,” said Kate Kleiter, manager of AET’s St. Paul environmental department. “We are thrilled to welcome her and her far-reaching expertise to our team.”

Jane earned a master’s degree (with honors) in geology from University of Kansas. She also has a master’s degree in Education from Buffalo State University (NY) and a bachelor’s degree in English from Carleton College in Northfield, Minnesota. Her experience includes project management, quality assurance, technical third party reviews, and managing technical staff. She has personally reviewed or managed over 3,500 environmental assessments since 1985.

Jane was an active and voting member of the original American Society for Testing and Materials (ASTM) Environmental Assessment Committee. In this role, she assisted in the development of Phase I and Phase II environmental site assessment and transaction screen records. She is also the co-founder of the Minnesota Environmental Assessment Roundtable (MEAR) and is involved in several industry and local organizations.

Bruce Olsen retires, cont.

which resulted in a change in USDA Conservation Reserve Program continuous signup policy to base funding eligibility on delineated areas rather than fixed radius circles. This policy change resulted in a more efficient and effective distribution of federal conservation funding toward protecting public health.

He ensured that the state had a robust, integrated geospatial database for SWP. He writes the most detailed, outcome-oriented set-aside workplans around. We appreciate all of his extra efforts; he even has taken EPA HQ managers on tours in Minnesota to see source water protection work in action.

I’d like to present this small token of our appreciation on behalf of EPA Region 5.



— Jane Willard

Braun Intertec Named to Minneapolis St. Paul Business Journal’s Fast 50 List

Minneapolis-based engineering, environmental consulting and testing firm Braun Intertec was named one of the Fast 50, fastest-growing private companies in Minnesota by the Minneapolis St. Paul Business Journal. Braun Intertec, ranked #39th on the list with a growth rate of approximately 67% from 2009 to 2011, was the only multidisciplinary engineering and environmental services firm listed amongst other companies from a wide range of businesses.

The Minneapolis St. Paul Business Journal recognized the top 50 fastest-growing private companies. According to Kim Johnson, the assistant managing editor for the Business Journal, it took “heroic effort” to make this year’s list of the Twin Cities fastest growing private companies. “Despite the impacts of The Great Recession on our industry, our company has grown and thrived during the past several years, said Jon Carlson, CEO of Braun Intertec. “I am looking forward to a continued and accelerated economic recovery as our country moves forward after the distraction of the latest presidential election cycle. I believe the United States is poised for growth, and that growth will come once the fears of uncertainty and the doom-and-gloom talk are behind us.”

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The primary objectives of the MGWA are:

- ◆ Promote and encourage scientific and public policy aspects of groundwater as an information provider.
- ◆ Protect public health and safety through continuing education for groundwater professionals;
- ◆ Establish a common forum for scientists, engineers, planners, educators, attorneys, and other persons concerned with groundwater;
- ◆ Educate the general public regarding groundwater resources; and
- ◆ Disseminate information on groundwater.

MGWA's Corporate Members for 2012

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Northeast Technical Services

Interpoll Laboratories

Links at www.mgwa.org

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

AGENCY NEWS

Jim Oberstar, a Founding Father of the Clean Water Act, Comments on the Act's 40th Anniversary

Although he spent 35 years as a Congressman representing northeastern Minnesota, former U.S. Representative Jim Oberstar says one of his proudest legislative accomplishments took place before he was elected. In late 1971, while on the staff of his congressional predecessor John Blatnik, Oberstar played a key role on the committee that wrote the Clean Water Act (CWA). This legislation became the cornerstone of environmental protection in the United States. In Minnesota, activities instigated under the CWA have transformed the Mississippi River from a dead river choked with sewage to a national recreation area.

See former Congressman Oberstar's story on the 40th anniversary of the CWA at www.pca.state.mn.us/yhiz14ea.

Historical photos of water pollution in Minnesota and a story on the CWA's impact on Minnesota waters are available on the Minnesota Pollution Control Agency website.

The Sentinel Lakes Groundwater Project

The "Sentinel Lakes Project" is a Department of Natural Resources-led effort to develop a system to monitor and record biological and chemical changes that occur in a sample of lakes that are representative of Minnesota's most common aquatic environments. Information gathered will inform development of management approaches to mitigate or minimize negative impacts caused by conventional "high-impact" residential development and agriculture, aquatic plant removal, invasive species, and climate change.

The MPCA is leading a companion project focusing on groundwater systems at five of the lakes in the "Sentinel Lakes project".

Work began in the summer of 2012 to install groundwater monitoring well nests next to several of the lakes. The goal of this new effort is to investigate groundwater/lake interactions, making use of the extensive datasets associated with the lakes in the project. Pressure transducers will be placed in each well nest, and monitoring plans include collecting samples to analyze for isotopes and other parameters. This project is expected to collect data for five years, at which time a report will be produced detailing results. Contact Andrew Streitz for more information: andrew.streitz@state.mn.us, (218)302-6617.

Minnesota Congresswoman Betty McCollum Receives the US Geological Survey Coalition Leadership Award

Congresswoman Betty McCollum has received the 2012 USGS Coalition Leadership Award, for her sustained efforts to champion the scientific programs of the USGS.



The 2012 USGS Coalition Leadership Award was presented to Congresswoman Betty McCollum of Minnesota at a September 2012 Capitol Hill reception in Washington DC by Dr. Harvey Thorleifson, Minnesota State Geologist and 2012/2013 President of the Association of American State Geologists.

Dr. Robert Gropp, chair of the USGS Coalition and director of public policy at the American Institute of Biological Sciences, stated that Betty's leadership in Congress has helped increase awareness of the important role played by the USGS.

Representative McCollum indicated that, "It is an honor to be recognized by the U.S. Geological Survey Coalition for the work we do together to wisely manage America's natural resources so that we can improve public health and grow our economy. Communities and businesses across our country rely on the scientific information USGS provides to make informed decisions. I will continue working with my Republican and Democratic colleagues in Congress to ensure USGS has the resources it needs to serve the American people."

In her remarks, Betty spoke of the importance of protecting our natural resources, of the importance of programs such as the State Water Resources Research Institutes, of the role Minnesota is playing in working toward a National Groundwater Monitoring Network, and of the important USGS role in investigating the serious problem of low water levels on White Bear Lake.

The USGS Coalition is an alliance of over 70 organizations united by a commitment to the continued vitality of the USGS and its ability to provide critical data and services to the nation.

MGWA 2013 Officer Candidates

Eric Mohring - Board of Water and Soil Resources

Eric Mohring, candidate for President-Elect, is a hydrologist and mid-level technocrat at the Minnesota Board of Water and Soil Resources (BWSR) where he has worked since 1990. His interests are applying hydrogeologic knowledge to natural resource management at the state and local levels, wetland hydrology and soils, groundwater - surface water interactions, and engineering geology.

His work currently focuses on technical assistance to local government, wetland hydrologic monitoring, wetland hydrology training, wetland restoration projects, and other odd jobs.

From 1985-90 he was a hydrologist with the Department of Natural Resources. From 1983-85 he was a geologist with the Chicago office of Woodward-Clyde consultants.

He has a BS in geology from Princeton University and an MS in hydrogeology from the University of Minnesota.



“The unique (and very cool) thing about MGWA is that it is a professional association focused on a resource rather than a particular line of work or discipline. It brings together and focuses the talents of people with varied backgrounds from different sectors. The best stuff happens at the edges of things, and the interaction that MGWA fosters between scientists, engineers, politicians, lawyers, policy wonks, and all manner of other professionals working in industry, consulting, government, and education yields a whole which is much greater than the sum of its parts.”

MGWA 30th Anniversary

By Gil Gabanski, MGWA Foundation President

In October 2012, the Minnesota Ground Water Association reached a milestone – the MGWA is 30 years old! This is older than some of our younger members. For those of us who were around in 1982 and have long since passed our own 30th, any birthday is now just another milestone that quietly sneaks up each year regardless of how much we want to ignore it. The fact is that it just a reminder how old some of us have become. Thirty years! My generation used to march around carrying signs stating: “Don’t trust anyone over 30!” Now we sit quietly and think: “I need to rely on everyone younger than 30, I need them to be paying into social security!” We’ll touch more on this later.

The 30th anniversary for some could be a cause for celebration, but this article will focus on the accomplishments of those past 30 years. Let’s look at the success of this non-profit volunteer organization and talk about its future. What has the MGWA accomplished in 30 years? Let’s get started.

First, let’s set a foundation for measuring the success of the organization. Thirty years ago, the MGWA established the following primary objectives:

- ◆ *Promotion and encouragement of the scientific and public policy aspects of ground water;*
- ◆ *Establishing a common forum for scientists, engineers, planners, educators, attorneys, and other persons concerned with ground water.*

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Audrey Van Cleve - Pollution Control Agency

Audrey Van Cleve, candidate for Treasurer (continuing in her current capacity), received her Bachelor of Science in GeoEngineering from the University of Minnesota in 1985. She is a professional licensed geologist. For the past six years, Audrey has worked at the MPCA. As a hydrologist in the Petroleum Remediation Program, she is responsible for assessing contaminant investigations and corrective actions to protect the public health and the environment from petroleum releases. Before joining the MPCA, Audrey worked at an environmental consulting firm for twenty years. There she assessed environmental risks at hazardous waste facilities as part of the Resource Conservation and Recovery Act permitting process, conducted investigations and performed corrective actions at petroleum-release sites, and developed water-conservation practices for federal facilities.

“I have attended MGWA and American Institute of Professional Geologists (AIPG) conferences, presentations, and field trips since the mid-1980s. As a way of giving back to organizations that provide so much to their members, I decided it was time to volunteer my time. I served as the AIPG Minnesota Section Vice President in 2004 and 2010. I also served on the board of the Forum of Women in the Environmental Field from 2005 through 2007 and served as its Co-Chair in 2007. As treasurer for MGWA, I have been serving the members of MGWA by managing the organization’s finances to support MGWA’s primary objectives in providing information to guide public policy, supporting continuing education, supporting a common forum for ground water professionals, and educating the general public about ground water resources.”

- ◆ *Education of the general public regarding ground water resources.*
- ◆ *Dissemination of information on ground water through meetings of the membership.*

Have we met these objectives?

The MGWA membership has grown from 75 in 1982 to around 565 today. What is important is not the numbers but the diverse nature of our membership. We are an organization of scientists, including geologists, hydrogeologists, hydrologists, chemists, biologists, soil scientists, engineers, water well drillers, lawyers, suppliers, educators, planners, and legislators. In the first MGWA newsletter in October 1982, I wrote that “The Minnesota Ground Water Association is unlike any other professional society in the state. The Association focuses not on one profession, but on one basic resource—ground water.” We have succeeded in establishing a forum for a multitude of professionals interested in this valuable resource and to this day we have maintained this diverse membership. Now, how have we accomplished this?

Quarterly Newsletters

The MGWA has issued 118 quarterly newsletters, which is a remarkable achievement in itself. But more importantly, the newsletter has grown from 565 kBs (6 pages) to a 6 to 7 mBs (25 to 35 pages) document (now in color). It also has grown from an informational format to a technical journal. The most current issue (Volume 31 No 4) is now in your hands or on your monitor.

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MGWA 30th Anniversary, cont.

The newsletters are a primary source of information and technical reports regarding Minnesota ground water and any related topics. I do not think there is any newsletter like it in the country, and my hat is off to everyone who has ever worked on editing and assembling the newsletter. The hardest part might be getting people like me to sit down and write up submittals!

All of the newsletters and a bibliography of the newsletters are available to members on the MGWA website.

Conferences

We have assembled and convened 60 semi-annual meetings/conferences. The conferences are venues where we present, listen, and discuss technical topics and policy issues about ground water. These included two joint conferences with the Geological Society of American North Central Division; and, in 2011, a joint conference at GSA Annual Meeting where the MGWA was an affiliate organization sponsoring sessions and field trips. There have also been two workshops (Isotopes and Calcareous Fens) and joint field trips with other professional organizations. And, in October of this year, the MGWA was the sponsor of the 57th Midwest Ground Water Conference.

One aspect that is often overlooked about MGWA's conferences is that they are offered at an affordable price compared to other conference venues. If you haven't heard this before from me, I will say it again. The MGWA membership and the opportunity to attend an all-day conference is the best deal in town. In fact, the annual membership fee has risen a mere \$25 in 30 years from \$10 to \$35/year. The student membership fee has only risen from \$5 in 30 years to \$15/year. The other organizations I belong to have far eclipsed this rise in membership fees.

Most readers will not remember this, but in August 1983 the MGWA offered the first Outdoor Demonstration conference. This is an event that has been copied by other national organizations. The all-day event started with a morning of presentations on soil and ground water sampling techniques followed by an outside demonstration with five drilling rigs in the afternoon--cable rig, two hollow-stem drilling rigs, and two rotary drilling rigs demonstrating techniques on split spoon and thin-walled tube sampling and monitoring well installations and sampling. It cost \$10 per person; we had to pay for lunch. All of the equipment and crews were donated by five different companies.

For me, the most rewarding benefit from attending the conferences is the opportunity and time to talk and interact with other members and meet new people. Networking is the description most use to describe this. I call it just plain and simple chat time. And, for students, you will never have a better chance to meet potential employers. The conference proceedings, beginning in 2004, are available to members on the MGWA website.

MGWA Foundation

The MGWA was organized as a 501(c)(4) organization, which can accept donations; however, the donor cannot take a tax deduction. In 2000, the MGWA chartered the MGWA Foundation as a non-profit tax exempt 501(c)(3) organization, so the members could use a tax deduction for donations for ground water education and promoting public awareness of ground water. The MGWA Foundation has a separate board and its own by-laws.

Since 2000, the MGWA Foundation has awarded \$51,180 for 45 different grant requests including an annual contribution to the Metro Children's Water Festival, student registration at MGWA conferences, various geology department field trips, a sand box model for the Headwaters Science Center in Bemidji, Janie's



Girls and Science Event at the Science Museum of Minnesota (SMM), and this year to the Brown-Nicollet Children's Water Festival. A full listing of grant awards is on the MGWA Foundation website.

In 2004, the MGWA Foundation raised \$20,663 from members and corporations to install a bedrock water well as part of an outdoor ground water exhibit in the Big Back Yard at SMM. This is an interactive exhibit that is open from May through September and includes hand pumps (the well flows when the nearby District Energy well is not pumping), two sand box models (one demonstrates well interference), porous rock samples, information panels and displays and a chance to get wet! This is the only exhibit of its kind in the country and is part of the MGWA's effort to inform the public about this resource.

A major goal was reached within this past year when the MGWA Foundation's endowment exceeded \$100,000, a goal we set for initiating a student scholarship program. The call for scholarship applications is now out, and we will award a scholarship to a student in 2013. We hope to continue to add to the endowment and increase the scholarship amount and number.

How have we done?

All of the above achievements happened because we are an organization of volunteers. The officers, directors, newsletter staff, and conference supporters receive no financial reward for their efforts; they give their time to the MGWA. We are also most fortunate because we receive corporate and agency financial support and a willingness to approve and support staff time for the organization. So, how have we done?

Pretty ok if you ask me! I suggest that if you revisit the original objectives of the MGWA and compare to the list of achievements, we have over-achieved at fulfilling the original objectives. Reflecting on the past 30 years to determine if we are on track is a good self-assessment; however, we must not sit back content. We must continue to hold ourselves to these goals, and I think we can do better especially on public policy and education.

What about the Future?

Last year the MGWA conducted a career, salary, and benefits survey of the membership. A little more than one-half of the members responded — a good percent response for a questionnaire. However, an indirect result of the survey was surprising to some of us. It revealed that we are an aging organization with few members under the age of 30. An aging work force is a reality many employers are facing in the future. This a trend that each will need to manage and should not have been surprise. We just

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President's Letter, cont.

- ◆ 39 exhibitors showcased equipment and services at booths and tables, adding another dimension of information on new technologies for our profession as well as providing funds for underwriting students and out-of-state presenters.
- ◆ MGWA brought the Midwest Ground Water Conference into the 21st Century, providing a permanent website for future conferences and a means of archiving past conferences, a major improvement over the boxes in the basement of the conference historian.

Over 270 attendees came from Minnesota; those who came from the 15 other states expressed amazement at the high and consistent quality and professionalism of the talks and posters. Many of the attendees have told us that "this was the best conference they've ever attended."



MGWA 30th Anniversary, cont.

were not thinking about having an aging membership until this jumped out at us.

What does this mean for the MGWA future? Remember how I said earlier that we need that younger crowd, that group under 30, to be there for us? Never mind the social security, the MGWA future is dependent on maintaining a membership that includes young members, especially that age group younger than the organization. We especially need to recruit more student members.

At the 20th anniversary I wrote the following:

"Because there is a fundamental characteristic that is the essence of who we are, an ability that is intricate in how we interact, something that has not changed, the necessity to talk to each other. There will always be a need to share information and discuss ground water topics; there will always be new issues that need to be resolved.

We will never finish studying our ground water resources, we will never finish settling all of the debates, we will never complete the final policies, and we will never have the answers to all ground water management issues. We will never know the issues that will challenge us 5, 10, or 20 years from now. We will always need a vehicle to present, discuss, debate, and resolve conflicts and differences.

In the first newsletter I wrote the MGWA "focuses not on one profession, but on one resource--ground water. The MGWA invites--and challenges--you to work to solve Minnesota's ground water problems. Bring to the Association your experience and professional pride, but not your prejudices. Be generous enough to teach but willing still to learn and listen."

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All of this was made possible by the culture of participation and involvement of our Minnesota groundwater professionals. Hundreds have worked through the last 30 years to keep our association growing and relevant, educating and elevating our profession and making MGWA the marvel and model for the rest of the Midwest. To all those volunteers and to everyone that has continued "showing up" – attending the conferences and maintaining your membership – THANK YOU. You have made these achievements possible.

As we face the next decade, we are continuing this work to make MGWA an organization that exemplifies professionalism and scientific integrity. As our economic and political spheres become less certain, there is a growing need for a neutral, authoritative voice to inform our policy makers and fellow citizens on matters related to groundwater and its role in our natural and built environments.

This can be a role that the MGWA can fill, if it chooses to. By enlarging our mission to embrace the study of groundwater issues and preparing white papers, we can join together as professionals and transcend our occupational roles. This would require an additional level of volunteering. But it can be highly rewarding, helping to get groundwater issues and policies resolved with foresight and with regard for the science underlying the issues.

We will continue this discussion in 2013, as a new slate of officers take up their duties and take us forward. It is likely that it will be a topic for one of our upcoming conferences next year. As always, we will welcome your thoughts and participation.

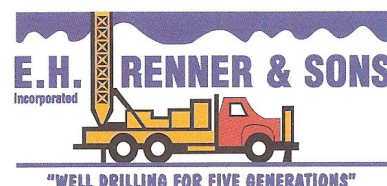
In closing, it has been a privilege and joy to have served as your president this year. Thank you for the opportunity. I look forward to seeing you all at our next conference!

Twenty years later [read that now as 30 years later!] this has not changed. This is why the MGWA is strong; and, why each of us needs to continually support and participate in the MGWA. When you think about it, 20 years [30 years] is a short interval for ground water travel times and distances; but it is a critical amount of time when you think about the increased demands and stresses we are placing and will continue to place on this resource – a critical amount of time when you think back at how we "use" and now we can "abuse" this resource."

To each of you, and most importantly, to our younger crowd, I challenge you to become more than just a member! We need you to become a volunteer. We need you to be the ones who keep the MGWA moving forward. You are our future.

ROGER E. RENNER
President

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57th Midwest Ground Water Conference - A Student's Perspective

by Emily Berquist, St. Cloud State University

I am an undergraduate student working towards a B.S. in Hydrology and a minor in Geology at St. Cloud State University and had the privilege of attending the 57th Midwest Ground Water Conference this October. This was the best experience I have had during my college career because I learned a great deal about groundwater and the current issues being investigated. I first heard about the conference while attending the MGWA conference last spring and knew I wanted to attend the Midwest conference. As a student, I was fortunate to receive a scholarship from the MGWA Foundation Fund that helped pay for my registration fee. I could not have attended the conference without this scholarship, and I am very grateful for the financial assistance.

The conference was fascinating with topics that covered many different aspects of groundwater. I attended sessions on Groundwater Modeling, Groundwater Management, Karst, Urban Hydrogeology, Groundwater and Surface-Water Interactions, and Groundwater Quality with Nitrogen. The modeling session showed me how MODFLOW is used in a professional environment and the potential problems that can arise when using it. It helped me understand MODFLOW better, and I took certain concepts back to the classroom for my groundwater modeling class. As a student, I am interested in learning about contamination, along with impacts to water quality due to land use changes and development. I really liked how attendees could pick and choose the topics that they wanted to learn more about.

Another great benefit of the conference was the opportunity to meet many talented and knowledgeable professionals and to learn

what they do in their careers. There were people from various aspects of the groundwater profession, and they were very kind and happy to talk about what they do. Because of them, I am even more energized in my studies and excited about a career in groundwater and hydrogeology.

The best advice I can give to students is to attend as many conferences as possible. Conferences like Midwest Ground Water provide many topics to choose from. Even if you are early in your academic path, the exposure to current topics will help you bring back your newfound knowledge to your future classes. The MGWA typically has a semi-annual conference that consists of one all-day session focused on a common theme. It also is a great chance to hear about current research and trends in groundwater. These conferences are a great way to meet professionals and find out what types of projects they get to work on. Some of the professionals I met provided advice on job hunting and contacts; I even collected business cards from many of them. The conference is worth every penny and provides not only education, but a chance to be part of a great social and academic community, a place where people meet to talk and exchange ideas to preserve and protect our water resources.



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Midwest Ground Water Conference Breaks New Ground

Attendance was strong at the MGWA-sponsored Midwest Ground Water Conference on October 1 and 2. The overall theme was Groundwater Opportunities and Conflicts in the 21st Century. Six speakers kicked off the conference on Monday with riveting talks on subjects ranging from the Bakken Oil Field to agricultural water use and Wisconsin's experiences in groundwater policy. Ken Bradbury of The Wisconsin Geological and Natural History Survey noted that a forward thinking bill allowing regulation of groundwater use in Wisconsin failed in the legislature in 2009.

Communicating groundwater science to the public requires "repetition, repetition, repetition."

Concurrent sessions followed on disparate topics such as Groundwater and Energy Production, Groundwater Modeling, Groundwater Management, Aquifer Characterization, Groundwater/Surface-Water Interface issues, Karst, Urban Hydrogeology, Groundwater Quality and Geothermal technologies.

A poster session was also well received with sundry topics in hydrogeology. Please refer to www.mgwa.org/meetings.php for more information and description of the talks.

by Kurt Schroeder, Newsletter Team



On October 3, Bob Tipping of MGS, and Steve Robertson of MDH led a field trip on "A Hydrogeologic and Historical Tour of the Twin Cities". The weather offered ideal field conditions.



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Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

is useful because it shows differences in groundwater chemical types (facies), and the hydrogeologic and anthropogenic factors that control their distribution. For the technical community, regional three-dimensional datasets of unconsolidated material textures provide up-to-date, model-ready information on expected permeabilities, both in areas where subsurface Quaternary mapping has been completed and where it has not; in addition, the three-dimensional distribution of hydrochemical facies and residence time helps refine conceptual models of groundwater flow.

Sources of chemical data

Sources of historical water chemistry data used in this investigation are: the U.S. Geological Survey National Water Inventory System (U.S. Geological Survey, 2010); the Minnesota Department of Health; the Minnesota Pollution Control Agency GWMAP program—both ambient groundwater monitoring and land-use studies (Minnesota Pollution Control Agency, 2010); University of Minnesota graduate studies (Tipping, 1992; Nemetz, 1993; Burman, 1995); Dakota County Environmental Management (2006); Anoka County Community Health and Environmental Services (Marsh, 1996, 2001); and samples from 27 wells in northwestern Hennepin County, where there were limited existing data. Additional data include earlier historical data from both regional (Hall *et al.*, 1911; Maderak, 1963; Lively *et al.*, 1992) and local studies (Alexander and Ross, 2003; Andrews *et al.*, 2005), along with tritium and strontium isotope analyses from northwestern Hennepin County (Tipping *et al.*, 2010).

Types of data include major cations and anions; field parameters, including temperature, electrical conductivity, pH, dissolved oxygen, and Eh; stable isotopes of oxygen and hydrogen, radioactive isotopes of carbon and tritium used to estimate residence times; and specific groundwater contaminants targeted by public health investigations (nitrate and perfluorochemicals).

Methods

Chemical and isotopic data were collected that could be analyzed spatially in both the horizontal and vertical sense. To that end, data were not included unless the location and elevation at the land surface of the well that the water sample came from could be determined with some degree of certainty (either field-located for more recent data or plotted on a map in the case of older data). Furthermore, data are linked to a Minnesota unique well number wherever possible, allowing the water sample to be interpreted in the context of available well construction information. Hydrochemical types (facies) were mapped three-dimensionally using well locations and open-hole top (bottom of casing) elevations.

One aspect of this analysis is to compare mapped hydrochemical facies to calculated vertical travel times through unconsolidated materials to bedrock. Vertical hydraulic conductivity values for unconsolidated materials in this investigation are based on their textural distribution from the land surface to the bedrock surface. Subsurface mapping of unconsolidated deposits is not continuous across the Twin Cities metropolitan area. As a result, the compilation of subsurface Quaternary textures used in this investigation is a hybrid of detailed subsurface mapping based on cross sections, and interpolation of textures from the state water well database – the County Well Index (CWI). Vertical hydraulic head gradients through unconsolidated materials were calculated by dividing the difference in elevation from a regional water table surface (Barr, 2010) to a bedrock potentiometric surface by the distance from the water table to bedrock. The bedrock potentiometric surface was based primarily on synoptic measurements of the Prairie du Chien and Jordan aquifers (Sanocki *et al.*, 2009), augmented with data from CWI where these rocks are absent.

In addition to comparing mapped hydrochemical facies to calculated vertical travel times to the bedrock surface, these facies were compared to areas of known macropore development within the bedrock, both parallel to bedding along previously identified stratigraphic horizons, and perpendicular to bedding in proximity to the bedrock surface and/or buried bedrock valleys. In southeastern Minnesota, porosity and permeability of the Paleozoic bedrock have traditionally been linked in a conceptual way to stratigraphic boundaries. Aquifers and aquitards have been assigned bulk hydraulic conductivities over entire or multiple formations, under an assumption of isotropic, porous media. Examples include the Prairie du Chien-Jordan and Franconia-Ironton-Galesville aquifers in Minnesota, and the Cambro-Ordovician aquifer in Wisconsin and Illinois (e.g. Delin and Woodward, 1984; Woodward, 1986). Significant efforts have been made over the past decade to define water-bearing characteristics of aquifers and aquitards in the Paleozoic rocks of the Midwest that are more closely aligned with field measurements of groundwater flow (Bradbury and Runkel, 2011). These investigations are developing a revised hydrostratigraphic framework showing that measurements and observations of macropore development at borehole scales can be correlated regionally. An important component of this investigation is to evaluate the distribution of recently recharged groundwaters in the context of this revised hydrostratigraphic framework.

Based on the analysis of chemical and isotopic data collected and compiled for this investigation, several conclusions can be drawn about the chemical composition and nature of groundwater flow in the TCMAx:

1. Three regional groundwater types can be distinguished within the TCMAx based on similar chemical and isotopic composition: 1.) recent waters, characterized by detectable tritium, elevated chloride and/or the presence of anthropogenic compounds (Figure 1); 2.) waters with elevated strontium to calcium plus magnesium (Sr/(Ca+Mg)) ratios (Figure 2); and 3.) naturally elevated chloride—distinct from recent waters based on carbon-14 dating and low chloride to bromide ratios where sufficient data exists (Figure 3). Collectively, these three hydrochemical facies show distinct differences in groundwater chemistry across the metropolitan area (Figure 4).

2. Recent waters are associated with an upper ‘active’ zone of groundwater flow characterized by shorter residence times, higher concentrations of anthropogenic compounds and greater variability in chemical composition. The presence of recent water at depth in the central TCMAx, below the elevation of the regional discharge to the Mississippi, Minnesota and St. Croix Rivers, shows that changes in groundwater flowpaths have occurred since the advent of high-capacity groundwater pumping (Figures 1, 4, 5, and 6). More water moves in the vertical direction in these areas than did before 100 years of groundwater pumping began. Extending out from the central TCMAx, this active zone is found most often within 60 to 100 feet of the land surface. This active zone includes tills, where the upper 60 feet has markedly higher permeability than tills with the same textures at greater depths.

3. Elevated Sr/(Ca+Mg) groundwaters are found in the western TCMAx and elsewhere at greater depths, and are associated with recharge through Des Moines Lobe till and/or longer residence

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Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

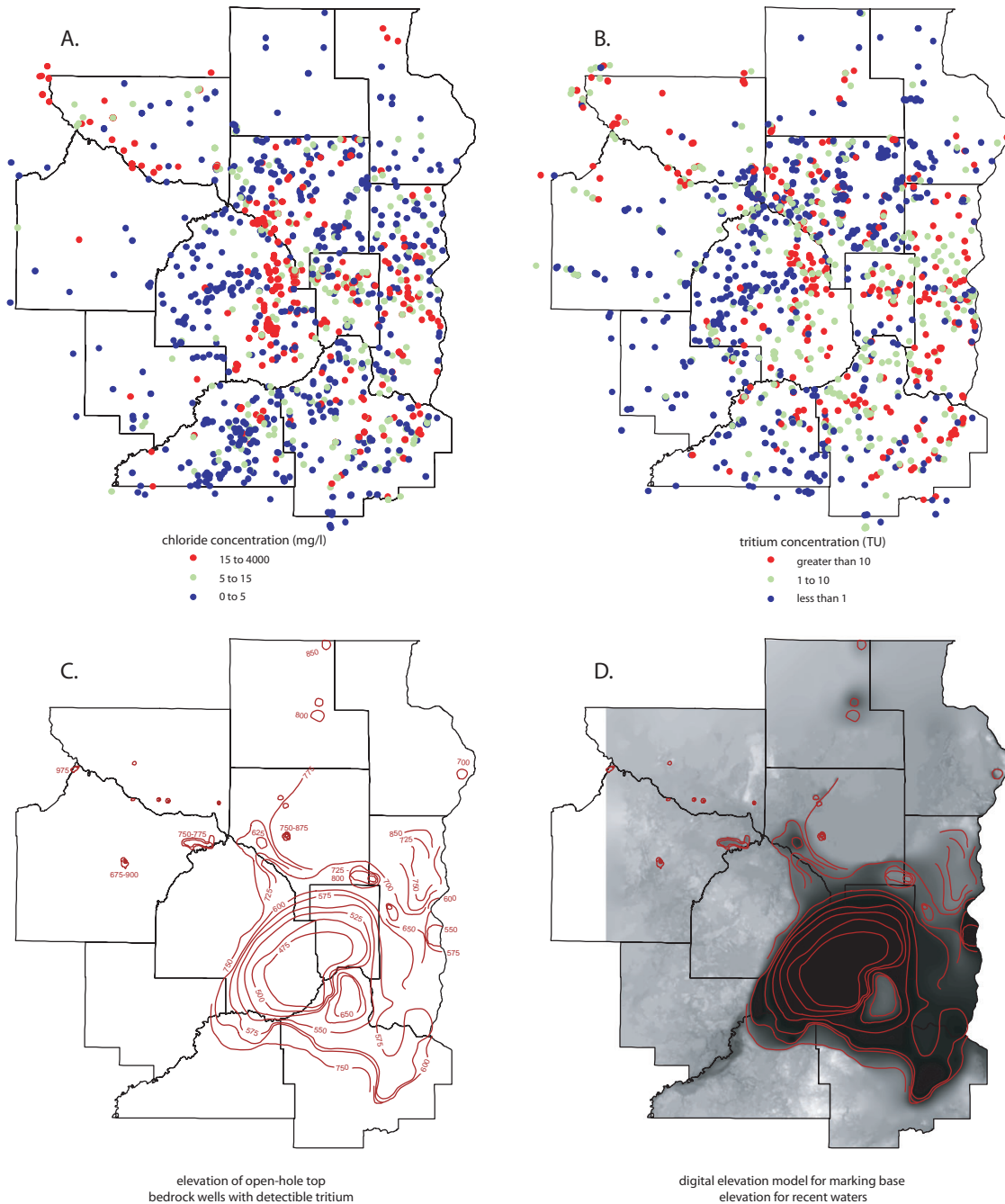


Figure 1. Regional maps showing the distribution of recent waters. A.) Chloride concentrations from water wells. Concentrations greater than 5 mg/l considered to be indicator of recent recharge. B.) Tritium results from water wells. Well with tritium concentrations greater than 10 tritium units (TU) considered to be dominated by waters having entered the ground since 1960; wells with less than 1 TU considered to be dominated by waters having entered the ground prior to 1960; intermediate values from 1 to 10 TU considered a mixture of older and recent waters. Distribution of elevated chloride and tritium is broadly similar. C.) Contours of open hole top (casing bottom) elevation for wells with detectable tritium. D.) raster surface marking the base elevation for recent waters, constructed in part using the contours shown in C.

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

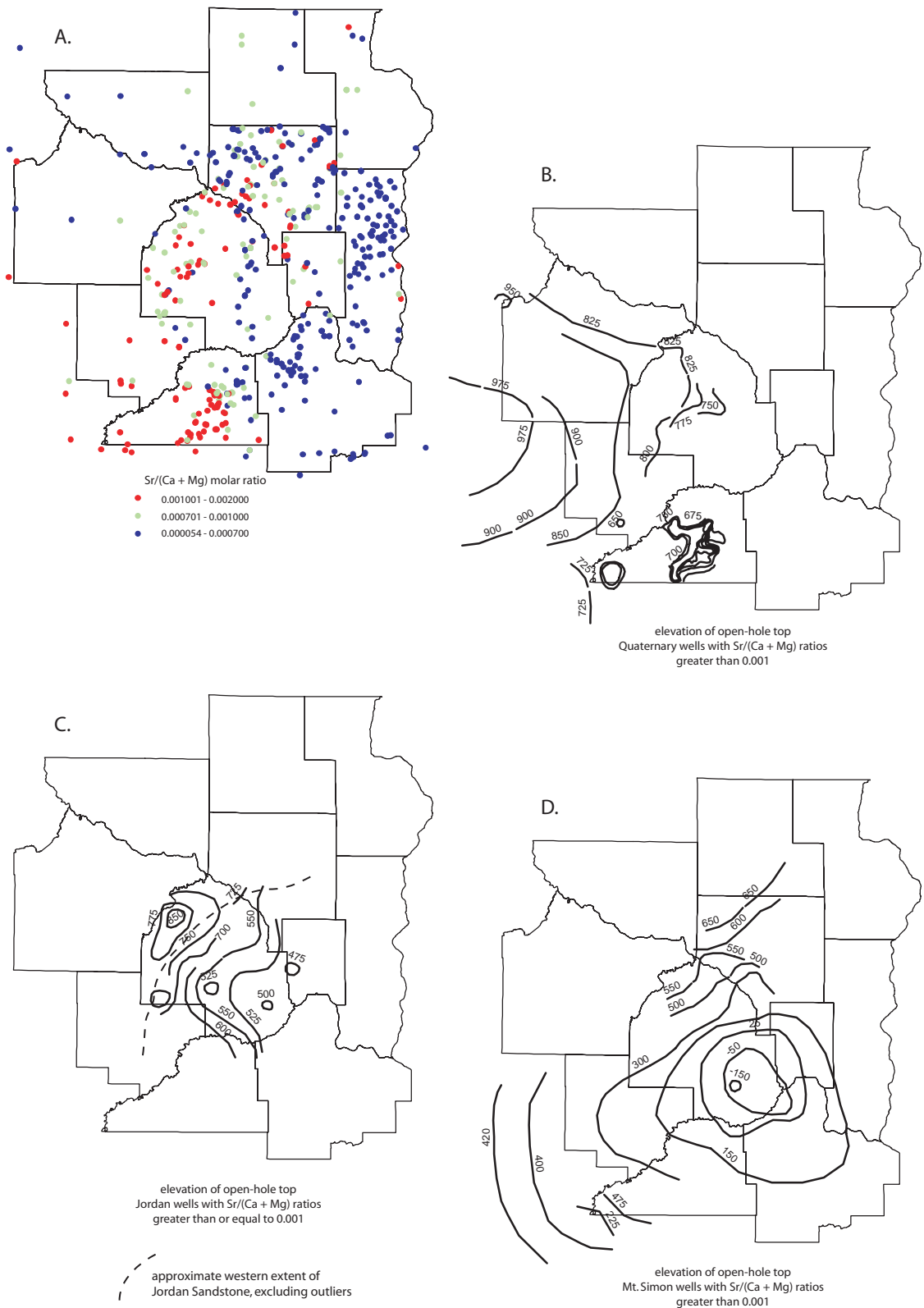


Figure 2. Regional map showing distribution of Sr/(Ca+Mg) ratios. A) Sr/(Ca+Mg) molar ratios for all wells with acceptable charge balance. Elevated ratios to the west and southwest. B.) Contours of open hole top (casing bottom) elevation for Quaternary wells with Sr/(Ca+Mg) ratios greater than 0.001. C.) Contours of open hole top (casing bottom) elevation for Jordan wells with Sr/(Ca+Mg) ratios greater than or equal to 0.001. D.) Contours of open hole top (casing bottom) elevation for Mount Simon wells Sr/(Ca+Mg) ratios greater than 0.001. Elevated ratios may be associated with recharge through NW provenance tills and/or longer residence time.

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Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

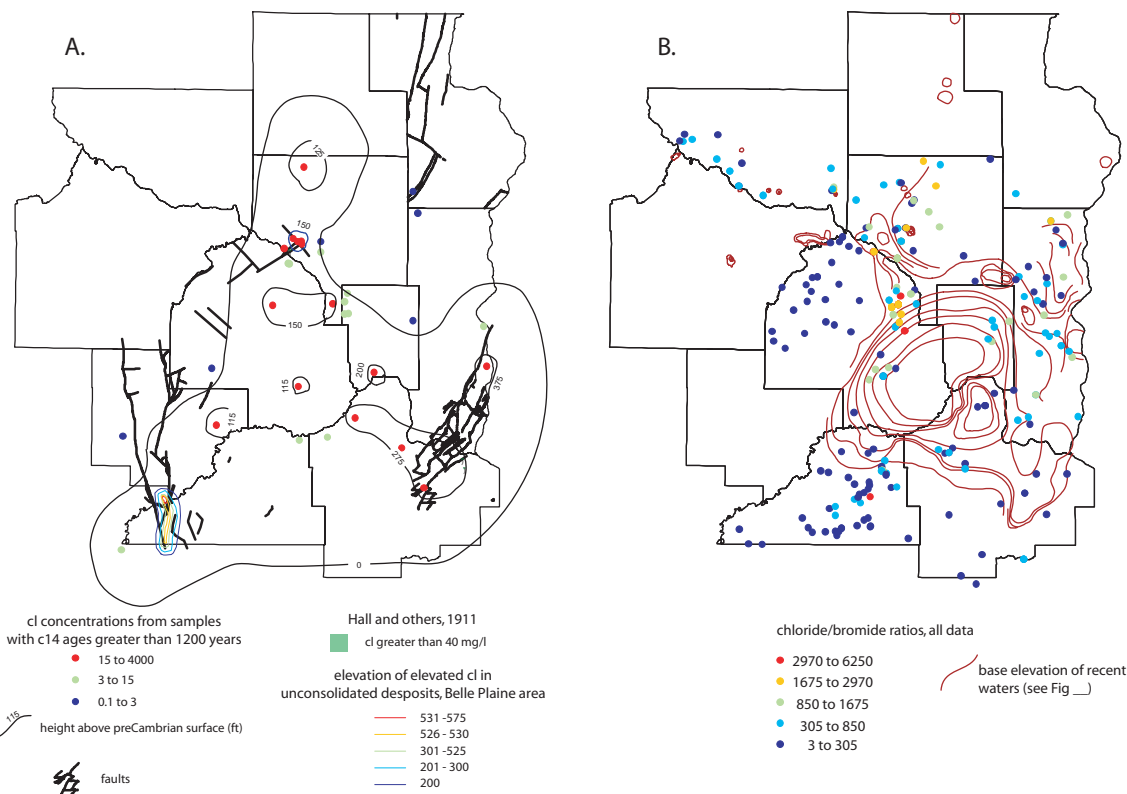


Figure 3. Regional maps showing naturally elevated chloride concentrations. A.) Chloride concentrations in mg/l for wells with carbon 14 – determined ages of greater than 1200 years. Also shown are chloride outliers from Hall et al., 1911. Blue contours show height of open hole bottoms above the pre-Cambrian bedrock surface; colored contours show elevation for elevated chloride in unconsolidated deposits in the Belle Plaine area, Scott County. Major metropolitan area bedrock faults are also shown. Old waters with elevated chloride above the Eau Claire Formation are commonly associated with fault zones, possibly due to upwelling of waters associated with pre-Cambrian bedrock. B.) Chloride to bromide ratios, all wells. Chloride to bromide ratios less than 200 considered to be indicator of chloride from bedrock as opposed to anthropogenic sources. Contours of recent water elevations from Figure 1 shown for comparison to chloride bromide ratios. Elevated ratios (greater than 1000) are generally found in shallow wells with recent waters.

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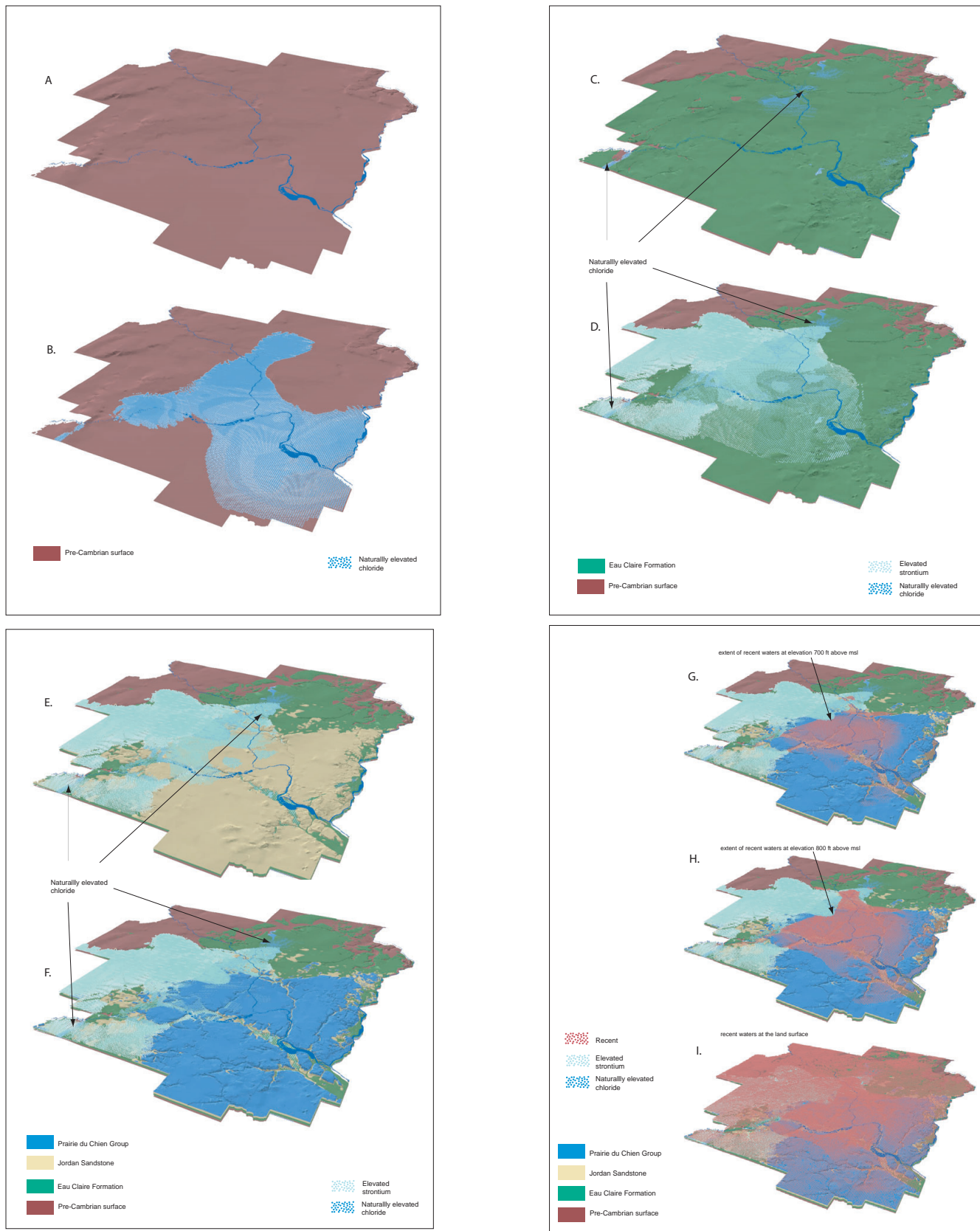


Figure 4. Oblique views of the TCMAx from the southeast, showing the three dimensional distribution of regional hydrochemical facies in bedrock and surficial deposits. Selected bedrock units included for vertical reference. A. Pre-Cambrian surface and major rivers; B. Naturally elevated chloride are present above the Pre-Cambrian in the lower St. Mt. Simon; C. Naturally elevated chloride present above the Eau Claire Formation, shown in green, in fault zones; D, E and F. Elevated Sr/(Ca+Mg) waters present in the western TCMAx in Quaternary, Jordan, Prairie du Chien and Mt. Simon (not shown); G, H, I. Recent waters found at elevations below 700 feet in the central TCMAx, broadening out at elevations closer to the land surface.

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

times. The distribution of this hydrochemical facies appears to have changed with time as hydraulic conditions changed. Elevated Sr/(Ca+Mg) ratios in the western TCMAx may have, at one time, extended further east toward regional discharge in the Mississippi River under natural hydrologic conditions. In eastern Hennepin County, these waters are thought to have been replaced by recent waters due to an increased vertical head gradient resulting from high capacity pumping, combined with a scarcity of overlying till (Figures 5 and 6).

4. In bedrock aquifers, differences in chemical and isotopic composition subdivide traditional hydrogeologic conceptual model (THCM) aquifers into subunits of similar porosity and permeability. Specifically, within the THCM Prairie du Chien-Jordan aquifer, chloride content is significantly higher in the Shakopee Formation than it is in the Jordan Sandstone. Similarly, where there is adequate data from both the Shakopee and the Jordan in proximity to one another, PFCs are detected more often in the Shakopee Formation (Figure 7)

5. Although there are considerably fewer data for comparison, similar results are found in the THCM Franconia-Ironton/Galesville (Tunnel City Group-Wonewoc) aquifer, with recent waters found in the upper Franconia (Tunnel City Group), a lack of well completions in the lower Tunnel City Group where permeability is low, and an absence of recent waters in the Ironton/Galesville (Wonewoc Formation) (Figure 7).

6. Below the Eau Claire Formation, chemical and isotopic data show that flow in the Mt. Simon is isolated from flow in the units above it (Figures 6 and 7). Residence times in the Mt. Simon are considerably longer (centuries to millennia), strontium concentrations are higher, and naturally elevated chloride is present in its lower sections and near major fault zones. This aquifer currently has residence times far longer than the less than 50 years seen in the upper bedrock aquifers.

7. There is an apparent trend toward higher chloride, and by inference, greater flux of groundwater in proximity to the bedrock surface and near bedrock valleys. Although the trend is not statistically significant, it is known that these areas are capable of producing more water to pumped wells compared to wells in dissimilar settings. As with wells finished in other areas of enhanced macropore development, it is also expected that these wells will show a greater temporal variability in chemical composition.

In the context of the groundwater flowpaths outlined above, a number of steps can be taken to apply this information toward groundwater management in the TCMAx:

1. In 2012, revisions are underway on the current Metro Area Groundwater Model, referred to as Metro Model 3 (Metropolitan Council, 2012). The regional distribution of chemical types should be used in this modeling effort to constrain possible groundwater flowpaths from the land surface to bedrock. Because the distribution of recent waters matches the estimated vertical hydraulic head gradient distribution across the TCMAx, flux estimates on a cell by cell basis from the regional groundwater model should be compared to the distribution of recent waters to test recharge/pumping scenarios for the central TCMAx outlined above. Flux estimates should also be compared for other portions of the metro area where bedrock aquifers are more hydraulically isolated from the land surface, such as portions of western Hennepin, Carver and Scott Counties, and in areas where hydraulic conditions are expected to change due to population growth, such as Anoka County.

2. Evaluating groundwater flowpaths from the land surface to

bedrock aquifers depends largely on boundary conditions used. Several separate numeric solutions should be considered, including, at a minimum, no-flow boundaries for bedrock layers on the western edge of the model where subcrop edges of bedrock units are overlain by a thick sequence of glacial tills. No-flow boundaries would eliminate a constant lateral source of water for these layers. Chemical and isotopic data show that bedrock aquifers in portions of western Hennepin County have no recent water. Calculated vertical travel times reflect the low vertical gradient/low permeability of unconsolidated material in this area (Figure 8); model results should reflect that recharge applied to the upper cells in this area are not in steady state with bedrock layers over time scales of less than one hundred years.

3. Pre-development data on strontium concentrations in eastern Hennepin County do not exist. Therefore, source water conditions should be tested in the proximity of the Sr/Ca+Mg—recent water border shown on cross section A-A' (Figure 6) by sampling municipal wells in that area. Waters with Sr/Ca+Mg molar ratios greater than 0.001 are likely drawing water laterally from western areas that receive limited vertical recharge.

4. From a water management perspective, the question arises as to whether the pattern of recharge and use indicated by recent waters at depth within the central TCMAx is sustainable. Water volume calculations should be conducted to see whether the volume of water pumped within this zone matches the amount of water available via recharge from above it. Using the 750-foot contour on Figure 1 to approximate the boundary of recent waters at depth, if the recharge volume over this area is considerably less than the pumping volume within it, then it is expected that water levels in the Prairie du Chien Group and Jordan Sandstone will drop with time, and are not sustainable under current pumping and recharge conditions.

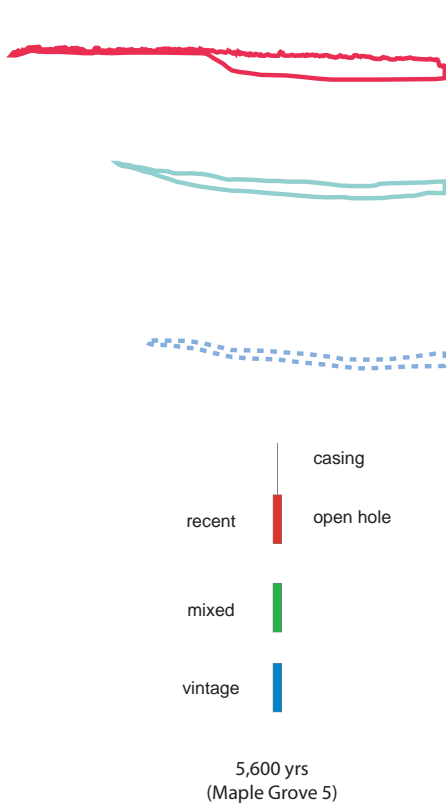
5. Hydrostratigraphic units should be incorporated into bedrock model layers by modifying hydraulic conductivity values and reducing aquifer thicknesses. In both the Shakopee Formation and upper Tunnel City Group, the occurrence of recent waters combined with documented higher permeability due to enhanced macropore development, suggests greater flux through these units relative to the Oneota Dolomite and its basal Coon Valley member (lower Prairie du Chien Group), and lower Tunnel City Group, with greater temporal variability in chemical composition. Higher K ranges for Shakopee and upper Tunnel City Group should be incorporated into the model, with thicknesses of these layers reduced to reflect the more highly permeable thicknesses of these subunits. Thicknesses of the Prairie du Chien and Tunnel City Groups vary across the TCMAx, but the lower permeability portions of both these units (approximately 40 feet in the Prairie du Chien and 60-80 feet in the Tunnel City Group) can be subtracted from the bottom of each to leave a remainder of the higher permeable bedrock.

6. Chemical and isotopic data show a trend toward higher bedrock permeability near the bedrock surface and bedrock valleys, regardless of bedrock lithology, presumably because of a higher density of vertical, through-going fractures. In GIS, this hydrostratigraphic zone of higher bedrock permeability is most easily defined creating a separate raster equal to the bedrock surface minus 50 feet. The resulting raster can be used to modify K values within bedrock groundwater model layers.

7. Buried bedrock valleys provide “windows” to lower bedrock aquifers. From a groundwater resource management perspective, these windows are important in areas where a relatively large

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Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.



hydrochemical facies

Recent/anthropogenic waters:

waters distinguished primarily by the presence of detectable tritium. Other indicators of recent water such as elevated chloride, nitrate, or anthropogenic compounds generally also present.

Elevated strontium to calcium plus magnesium ratios:

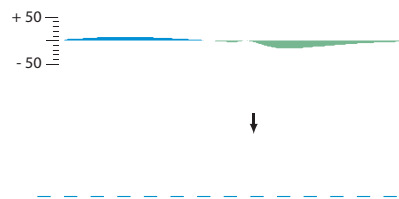
waters distinguished by having strontium to calcium plus magnesium molar ratios greater than 0.001. Elevated strontium to calcium plus magnesium ratios may be associated with recharge through NW provenance tills, and are also considered to be an indicator of longer residence time.

Naturally elevated chloride:

waters distinguished by having chloride levels greater than 15 ppm and carbon 14 age dates greater than 1,000 years. Where data are available, these waters should also have chloride to bromide ratios less than 300.

Selected wells from the water chemistry database. Colors of open-hole intervals correspond to assigned qualitative age classes. Recent waters are dominated by waters having entered the ground since the late 1950s; Vintage water are dominated by waters having entered the ground prior to the late 1950's; Mixed waters are considered a combination of recent vintage waters. See text for discussion.

Mt. Simon Aquifer age determined from carbon-14 analysis; well name (Lively, et al., 1992) for wells not shown, location projected to cross section line.

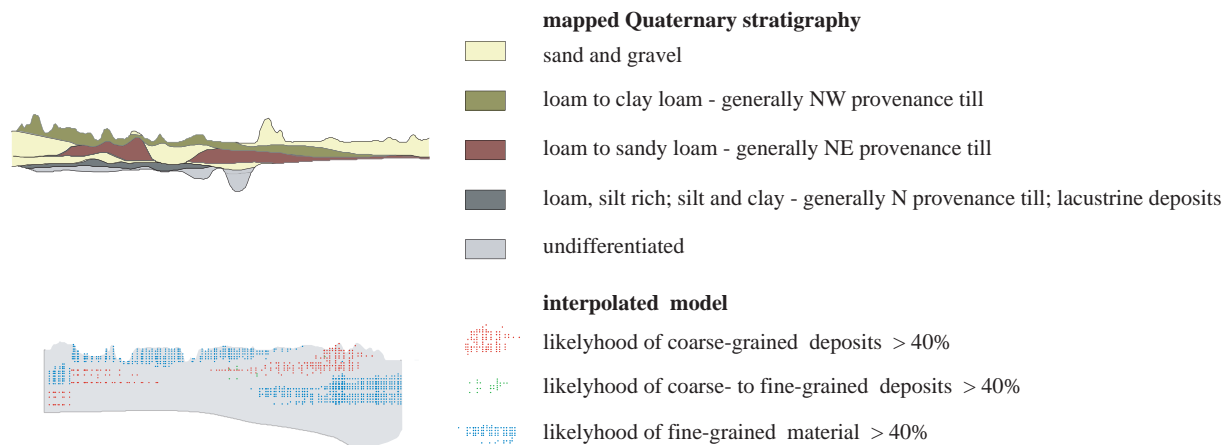


hydraulic gradient

Head difference between regional water table and bedrock potentiometric surface, in feet. Blue indicates upward gradient; green indicates downward gradient.

Flowmeter measurement. Arrow indicates direction of ambient flow in an open borehole.

700 feet above msl line, marks regional discharge elevation as approximate elevation of the Mississippi, Minnesota and St. Croix Rivers.



mapped Quaternary stratigraphy

- sand and gravel
- loam to clay loam - generally NW provenance till
- loam to sandy loam - generally NE provenance till
- loam, silt rich; silt and clay - generally N provenance till; lacustrine deposits
- undifferentiated

interpolated model

- likelihood of coarse-grained deposits > 40%
- likelihood of coarse- to fine-grained deposits > 40%
- likelihood of fine-grained material > 40%

Figure 5. Cross section key for Figure 6.

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

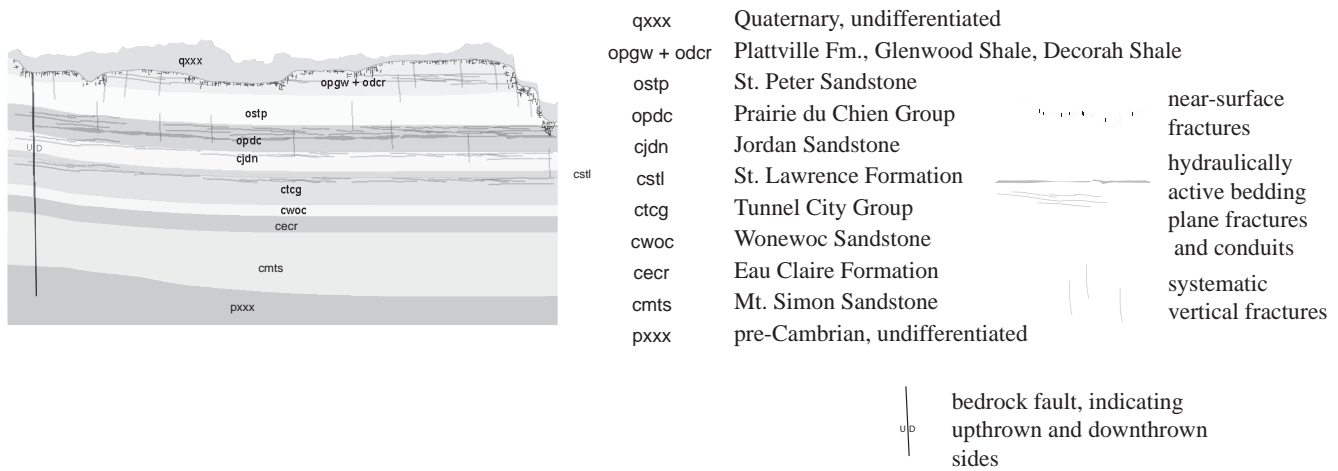


Figure 5. Cross section key for Figure 6, continued.

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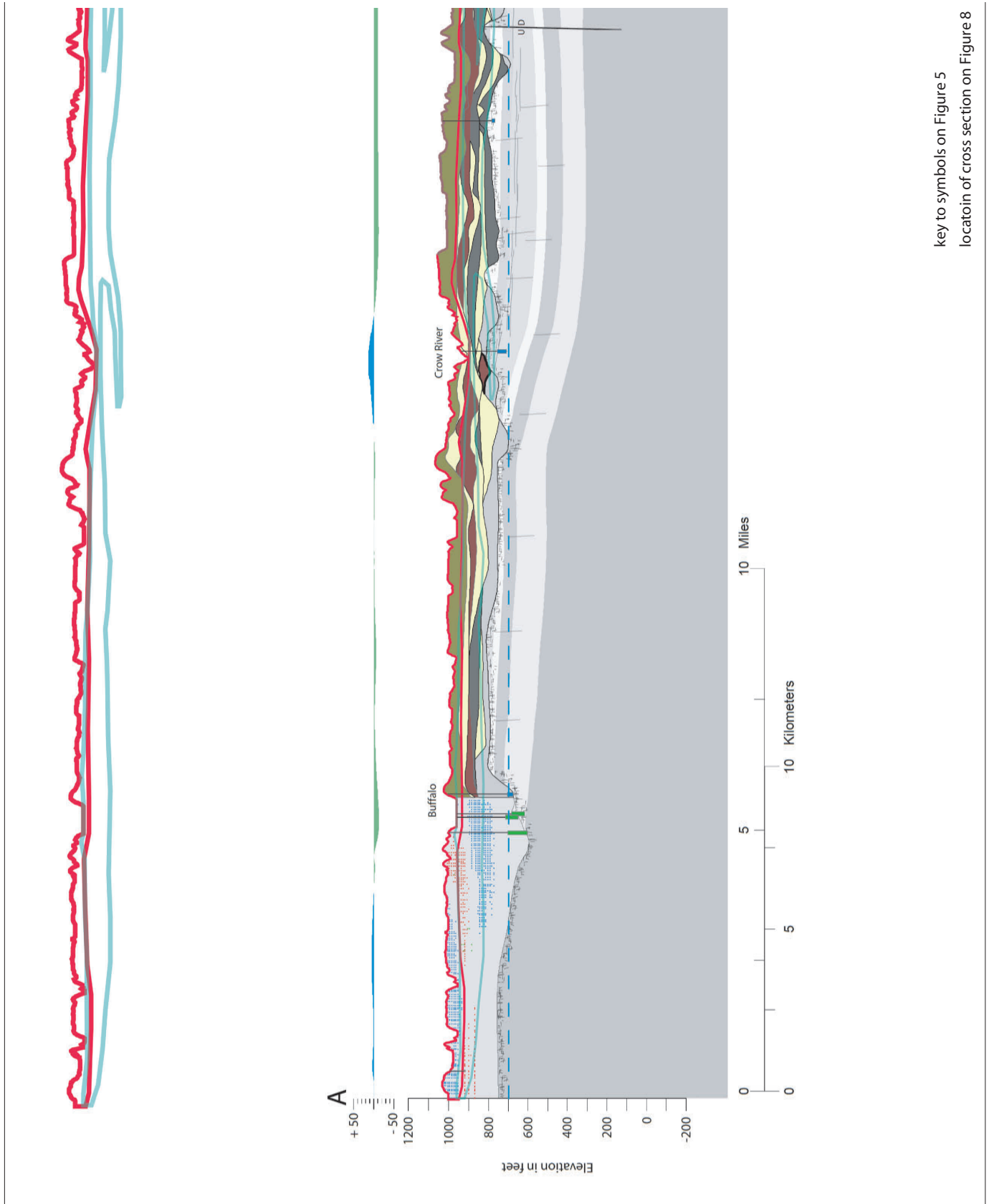
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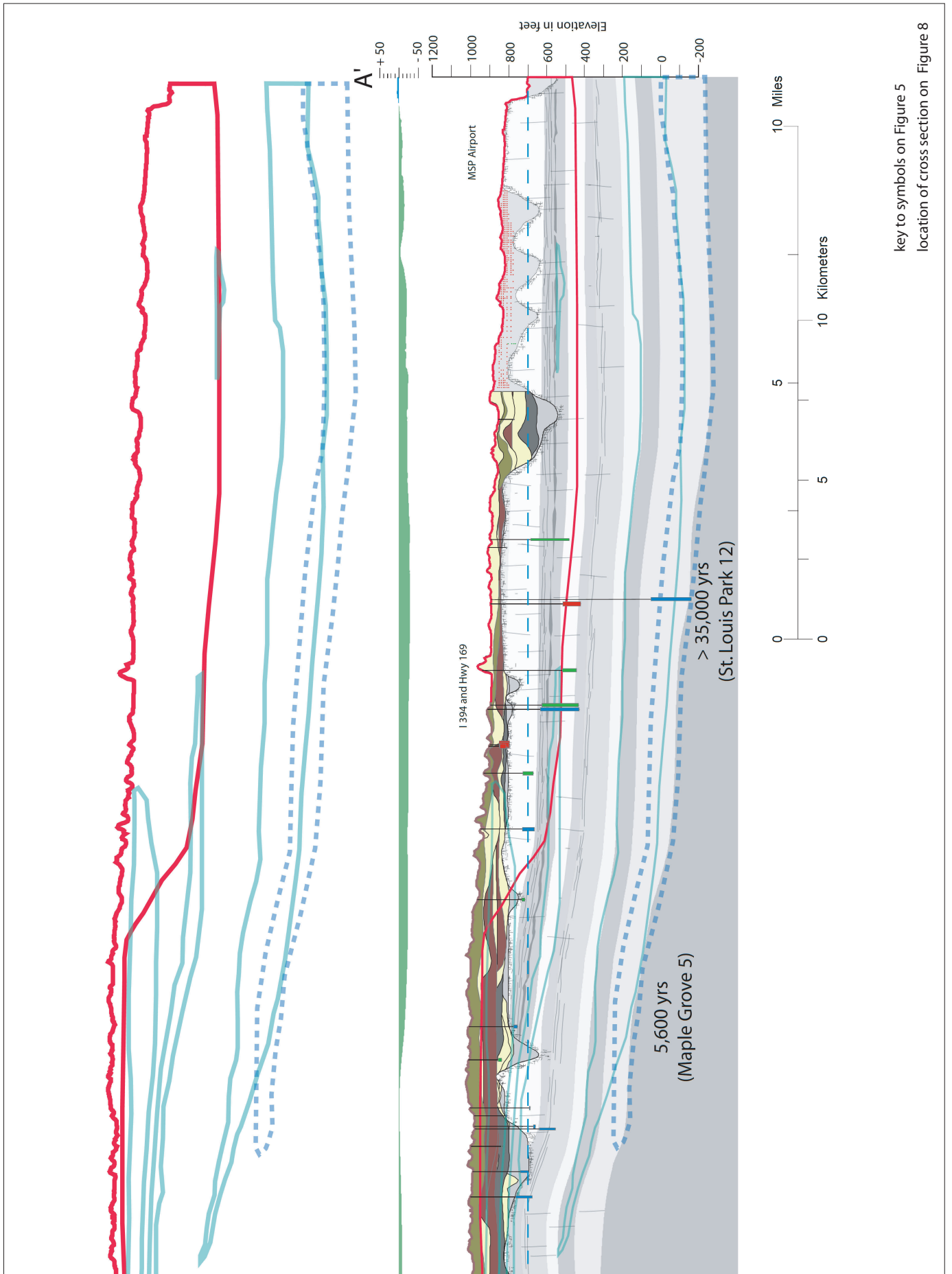
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key to symbols on Figure 5
 locatoin of cross section on Figure 8

Figure 6. Regional cross section A-A', Sherburne County to Mississippi River. Recent waters interpreted as present in the upper 50 feet of unconsolidated deposits, increasing with depth in the central part of the basin. Lowest elevation of recent waters occurs in the Jordan Sandstone. Carbon 14 dates for Mt. Simon are shown, indicating a sharp contrast in recharge rates for the upper and lower aquifer systems. This figure continues on the facing page.

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.



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Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

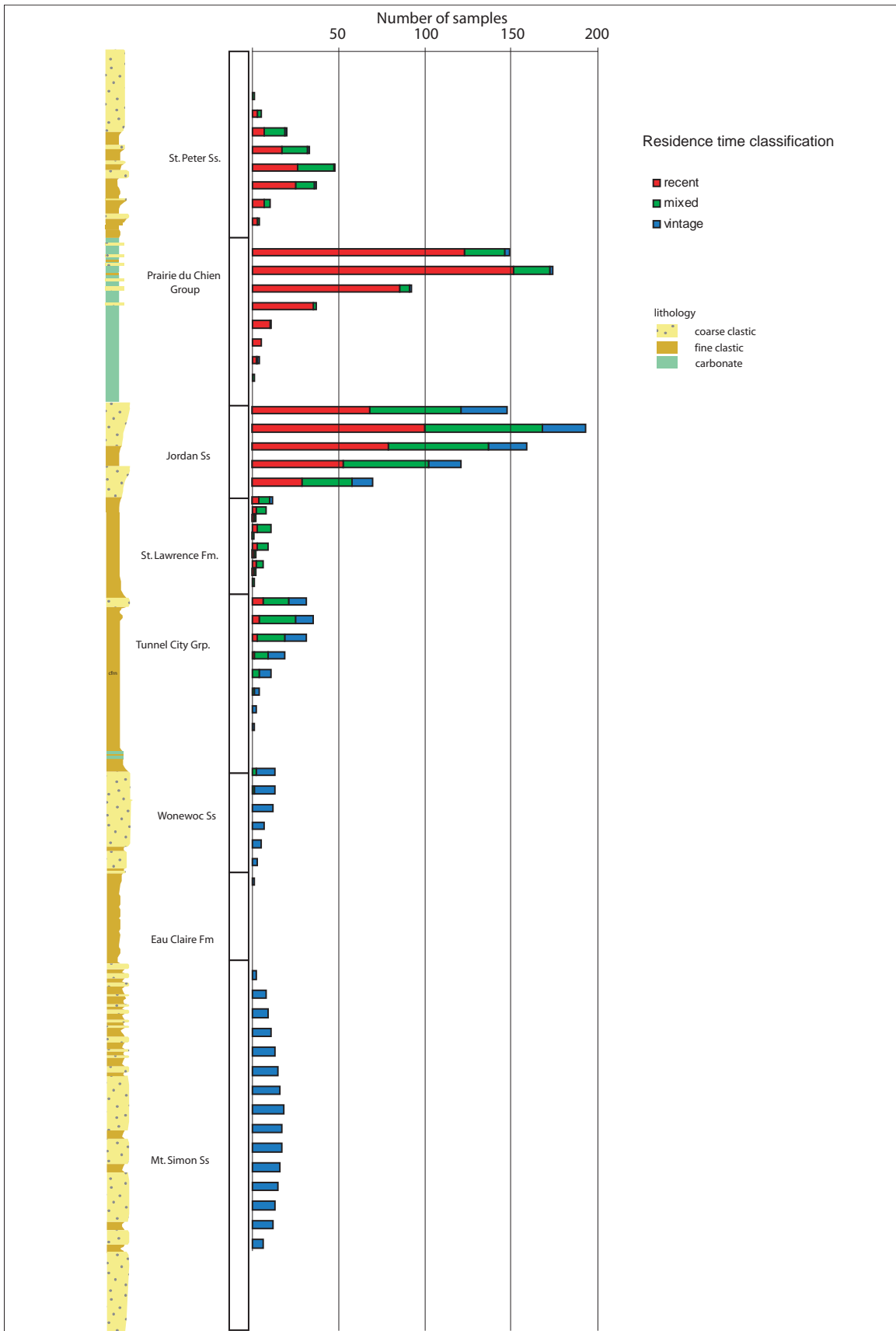


Figure 7. Lithostratigraphic column showing distribution of residence time by open hole interval. Recent waters found most often in bedrock stratigraphically higher than the St. Lawrence Formation.

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

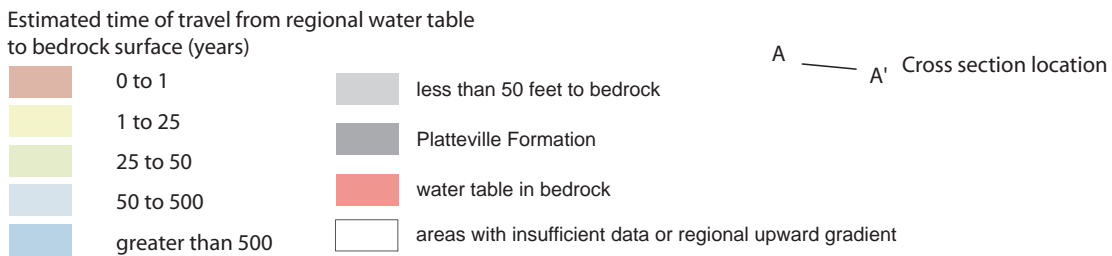
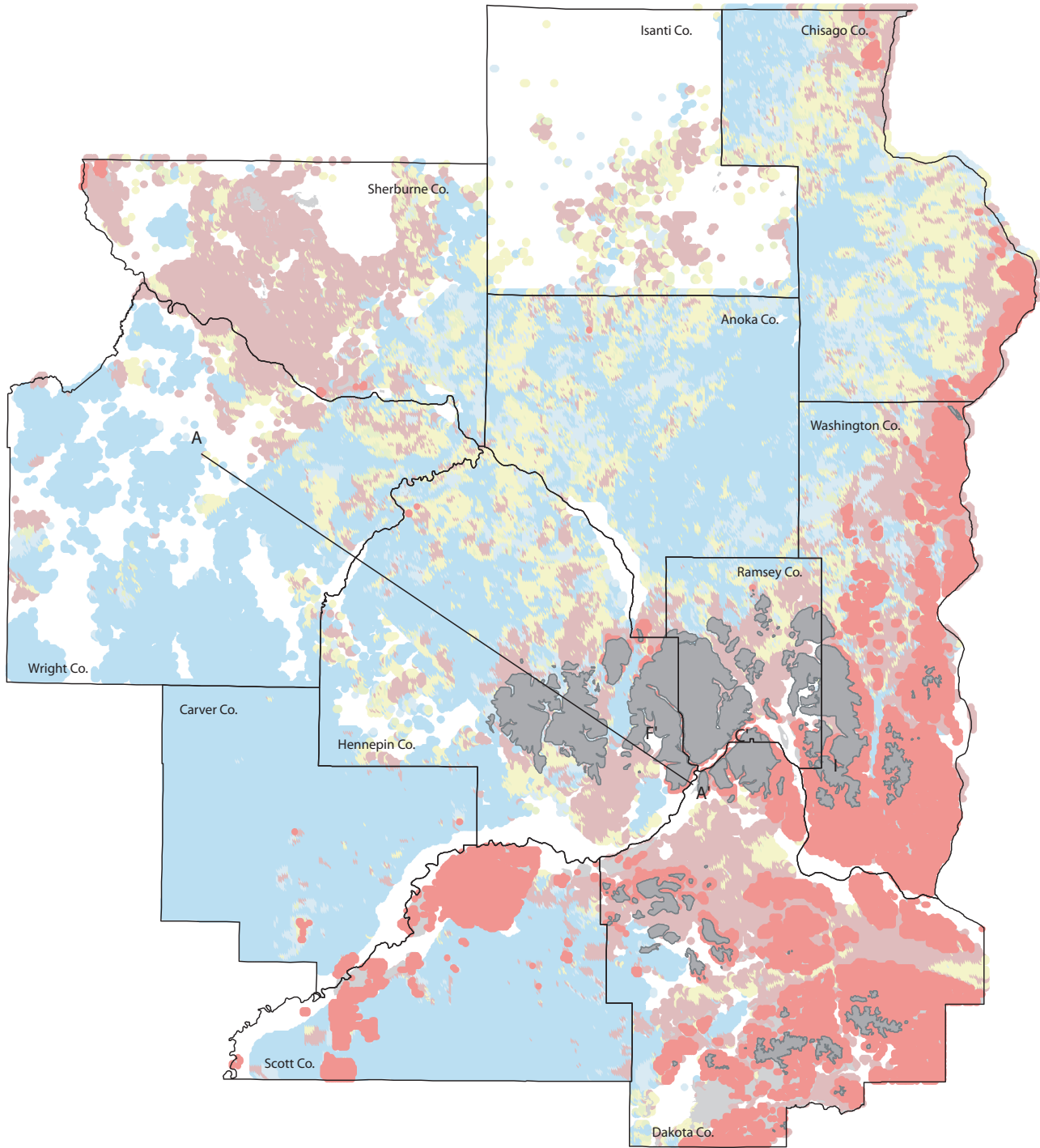


Figure 8. Calculated vertical travel time from regional water table to the bedrock surface (saturated conditions), travel times greater than 500 years calculated for much of the western metropolitan area, where a thick sequence of clay loam NW provenance till and sandy loam NE provenance tills overlie bedrock. Shorter residence times are present where relatively coarse sediment overlies bedrock and in areas of large hydraulic gradient.

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

vertical hydraulic gradient is present, or could be present in the future as the distribution of high-capacity pumping changes with time. The presence of the Platteville and Glenwood Formation aquitards in the central TCMAx, combined with a large vertical gradient in this area highlights the hydrologic importance of these bedrock valley windows where the Platteville/Glenwood is absent. The Quaternary subsurface regional texture dataset included in this investigation, provides an up-to-date distribution of textures in these bedrock valleys, both in areas where subsurface maps are available, and in areas modeled by interpolation from the Minnesota state water well database, CWI. These data are in GIS format, and should be used to guide hydraulic conductivity estimates for buried bedrock valleys in regional and local groundwater models.

8. There are significant gaps in chemical, isotopic, subsurface, and hydraulic head data that should be addressed in future data collection. Stable isotopes of oxygen and hydrogen—useful for both identification of surface water/ground water interaction and recharge from glacial melt water—are largely absent from this dataset. This dataset also has a limited number of bromide analyses that are extremely useful for identifying sources of chloride. Quaternary subsurface maps are not available for important recharge areas of the central TCMAx, including southern and eastern Hennepin County, Ramsey, and Dakota Counties. Finally, real time hydraulic head data, both from pumping and observation wells, are necessary to evaluate transient conditions within and between aquifers. These data, along with chemical and isotopic data, should be collected and archived in a georeferenced database so that trends can be identified as groundwater quality and flowpaths change with time.

The results of this investigation have applicability to the broader, non-provincial hydrogeologic community. For planners, it demonstrates for the first time the utility of having mapped three-dimensional hydrochemical facies in a GIS format, combined with a hydrogeologic framework model over a regional urban area. Groundwater managers can compare the age and chemical quality of groundwater with other, more familiar factors in an urban setting, such as the location and pumping levels of high capacity wells. Furthermore, it demonstrates the need for continued archival of georeferenced chemical data. This type of data collection is critical in an urban setting, where hydraulic conditions change with time over regional scales. For the technical hydrogeologic community, this work investigates the distribution of hydrochemical facies at regional and local scales, interpreted in the context of a revised hydrogeologic conceptual model, where water-bearing characteristics of sedimentary aquifers and aquitards are more closely aligned with regional compilations of borehole geophysical measurements, temperature profiling, short-interval packer testing, multi-level hydraulic head measurement, and dye tracing results. Specifically, it documents the presence of recent waters in areas of known macropore development, both parallel to bedding along previously identified stratigraphic horizons, and perpendicular to bedding in proximity to the bedrock surface and/or buried bedrock valleys. For both planners and the technical hydrologic community, this work raises fundamental questions about traditional views of vertical groundwater movement in urban settings. High capacity pumping creates conditions to move contaminants at depths, either along vertical fractures or multiple

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Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, cont.

aquifer wells, at rates that greatly exceed modeled porous media transport through aquitards.

Datasets developed as part of this investigation are:

1. Three-dimensional texture distributions of unconsolidated materials
2. Three-dimensional distribution of hydrochemical types
3. Point information for each well with water chemistry. With the exception of older historical data, all analyses are limited to a wells having a unique well number, allowing for spatial and tabular queries of chemical data using a wide range of hydrogeologic and well construction criteria.

All datasets are available at <http://conservancy.umn.edu/handle/132004>, along with dissertation text and figures.

Acknowledgements

I gratefully acknowledge the many people for their support of this investigation. In particular, Chris Elvrum, and Lanya Ross whose groundwater planning projects for the Metropolitan Council supported much of the work presented here; work was also supported by general funds to the Minnesota Geological Survey from the state legislature through the University of Minnesota.

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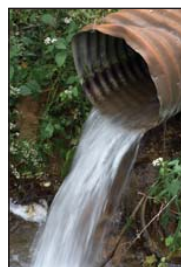
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Central Sands Private Well Network

By Kimberly Kaiser, Minnesota Department of Agriculture

Introduction

The Central Sands Private Well Network (CSPWN) was recently developed by the MDA to determine whether private drinking water wells were adversely affected by the high nitrate concentrations measured near the water table in Central Minnesota. Routine monitoring conducted by the MDA since 1986 has shown that 62% of the monitoring wells in the sand and gravel aquifers had nitrate-nitrogen ($\text{NO}_3\text{-N}$) concentrations that exceed the drinking water limit in this part of the State. These monitoring wells, however, were located near the water table and at the edge of fields, and the measured $\text{NO}_3\text{-N}$ concentrations may not represent the water used for drinking.

The CSPWN was developed by the MDA and is administered by Wadena County Soil and Water Conservation District (SWCD). The project area includes all 14 counties of the Central Sands region: Becker, Benton, Cass, Crow Wing, Douglas, Hubbard, Kandiyohi, Morrison, Otter Tail, Pope, Sherburne, Stearns, Todd, and Wadena. The CSPWN was implemented in two phases. Phase 1 of the project determined current $\text{NO}_3\text{-N}$ concentrations in private wells throughout the Central Sands region of Minnesota. Phase 2 of the project will determine areas of concern and develop a long-term trend monitoring network. The long-term trend monitoring will answer the question: "Are nitrate-nitrogen concentrations in private drinking water wells increasing, decreasing, or staying the same?"

Nitrate is a naturally occurring, water soluble molecule that is made up of nitrogen and oxygen. Although nitrate occurs naturally, it can also originate from man-made sources such as fertilizer, animal manure, and human waste. Because nitrate can have a negative effect on human health at elevated levels, the U.S. Environmental Protection Agency (USEPA) has established a drinking water Maximum Contaminant Level (MCL) of 10 milligrams per liter (mg/L) for nitrate as nitrogen (U.S. EPA, 2009). Depending on location, nitrate is among the most common contaminants in Minnesota's groundwater, and in some areas of the state (e.g., the Central Sands), a significant number of wells have high nitrate concentrations.

Methods

All counties in the Central Sands region were invited to participate in the CSPWN. The MDA developed a joint powers agreement with the Wadena County SWCD to accomplish the goals of the first phase of the CSPWN project. The MDA based the sampling on a systematic, multi-stage approach. This approach was adapted from the Southeast Minnesota Volunteer $\text{NO}_3\text{-N}$ Monitoring Network pilot project. To ensure unbiased sampling and to obtain a uniform spatial distribution, sampling points were selected from a grid that was randomly superimposed over the Central Sands region. A 1.5 mile circular buffer was created around each point (node) in the grid, and the distance between grid nodes was 2.15 miles. Within each 1.5 mile circular buffer, three land parcel owners were randomly selected for sampling. The University of Minnesota's Minnesota Center for Survey Research (MCSR) was given a list of the randomly chosen landowners. The MCSR sent each of the landowners a letter and survey about their well. The letter explained the nature of the project and invited the landowner to participate in the CSPWN. The first landowner from each buffer to reply was chosen as the participant. If no landowners replied, the buffer was left empty.

Next, each participant filled out a survey about their well and

returned it to MCSR. The survey answers were compiled into a database with well owner information. In March 2011, the final list of participants was sent to the RMB Environmental Laboratories (RMB lab). Each participant received a sample kit from RMB Lab with instructions on how to take the sample and where to send it for analysis. The lab compiled results in a spreadsheet, and sample results were sent to the well owner along with information on the 10 mg/L $\text{NO}_3\text{-N}$ health standard.

Phase 2 of the CSPWN study is to develop a long-term trend monitoring network. The MDA has developed another joint powers agreement with the Wadena County SWCD to accomplish this goal. All participants from the first round of sampling were invited to participate in the long-term network. A total of 550 well owners have signed up for the long-term network, approximately 500 have sent a water sample back for analysis.

Each well enrolled in the long-term network will be evaluated during a site visit. During the visit, information is collected about the well by a well network coordinator. The information collected during the site visits is used to determine the well construction, well depth, and well age. The information was also used to determine whether grout is present and at least 10 feet of confining material is present.

On an annual basis, each participant will receive a sample kit from Wadena SWCD with instructions on how to collect their sample and where to send it for analysis. Wadena SWCD is responsible for sample analysis using a spectrophotometer (provided by MDA). Well owners will receive the $\text{NO}_3\text{-N}$ results by mail. All information from this project will be useful to determine the conditions in which $\text{NO}_3\text{-N}$ contamination is occurring.

Results

As part of Phase 1, a total of 1,555 well owners returned their well survey and water sample for analysis:

1. Over 88 % of the wells had $\text{NO}_3\text{-N}$ concentrations < 3 mg/L
2. 7 % of the wells had $\text{NO}_3\text{-N}$ concentrations that ranged between 3-10 mg/L
3. < 5 % of the wells had $\text{NO}_3\text{-N}$ concentrations that were > 10 mg/L

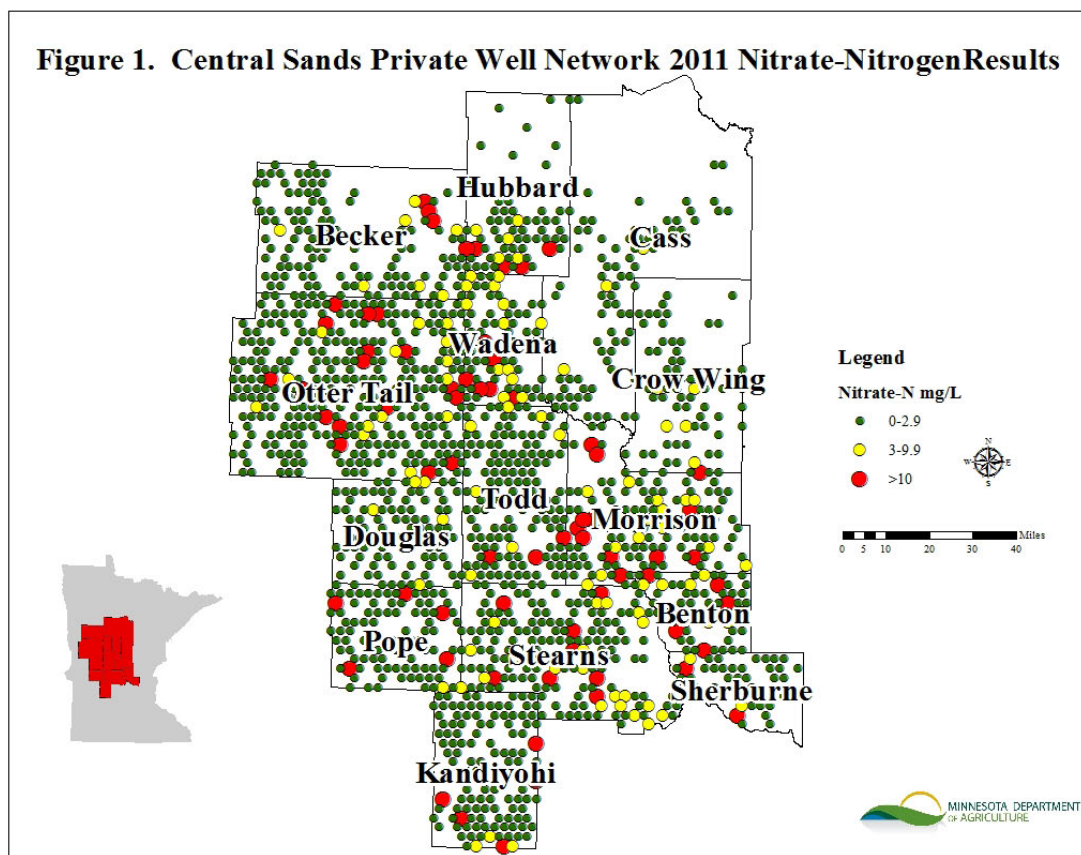
$\text{NO}_3\text{-N}$ concentrations from the private well results varied widely over short distances (Figure 1). These results are similar to findings from a 2010 United States Geological Survey report on $\text{NO}_3\text{-N}$ concentrations in private wells in the glacial aquifer systems across the upper U.S. (Warner and Arnold, 2010). The USGS

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Central Sands Private Well Network, cont.

Figure 1. Central Sands Private Well Network 2011 Nitrate-Nitrogen Results

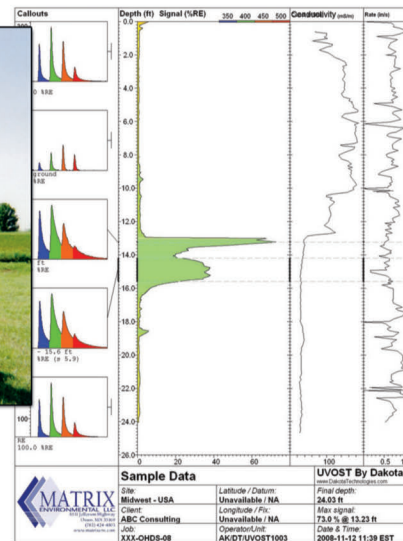


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Central Sands Private Well Network, cont.

report found that less than 5 % of sampled private wells had NO₃-N greater than 10 mg/L (Figure 1).

In contrast, NO₃-N from MDA edge of field monitoring wells (2000-2011) had only 14% of samples below 3 mg/L and 62% of samples above 10 mg/L (MDA, 2012). The median concentration for the MDA monitoring wells is 14 mg/L while the CSPWN median concentration is <0.03 mg/L (MDA, 2012). The high NO₃-N seen in the MDA monitoring wells are not being seen in the private drinking water wells, which is expected since monitoring wells are located at the most vulnerable portion of the aquifer. The monitoring well results did not reflect the condition of drinking water wells in the area.

Morrison County had the highest percentage of wells (10.5%) with NO₃-N over 10 mg/L (Table 1). Benton and Wadena County both had approximately 8% of wells over 10 mg/L. Cass, Crow Wing, and Douglas counties did not have any results above 10 mg/L. Although Stearns County only had 4% of wells over 10 mg/L, it had 13% of the wells with concentrations in the 3-10 mg/L range. The 3 to 10 mg/L range is important because although there is not an immediate health risk, NO₃-N is above background levels, and therefore the groundwater is being impacted by external sources.

The well owner survey provided additional information about sampled wells. The survey included questions about the well construction, depth and age, as well as questions about nearby land use. Well information was provided by the well owners and may be approximate or erroneous. Following is a brief summary of well information gathered from the survey:

1. Most homeowners in the network do not have livestock and do not farm.

2. Few well owners store more than 500 pounds of fertilizer on their property.
3. Most wells are greater than 300 feet from an active or inactive feedlot or an agricultural field.
4. Septic systems are greater than 50 feet away from wells in 96% of cases.
5. Water treatment (reverse osmosis, distillation, carbon filter) is used by 30% of the well owners.

In the following section well construction, well depth and well age will be compared with NO₃-N concentration results. Hand dug wells had the highest average NO₃-N concentration, median

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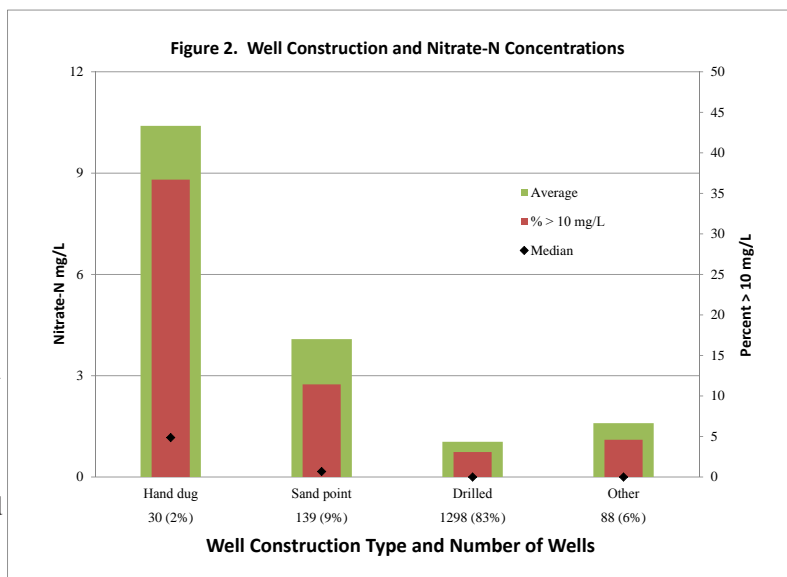


Table 1. 2011 Summary of Nitrate-N Concentrations for the Central Sands Private Well Network.

County	Number of Samples	Min	Median	75th percentile	90th percentile	Max	% at or below 3 (mg/L)	% between 3 - 10 (mg/L)	% at or above 10 (mg/L)
Becker	123	<.03	<.03	<.03	2.0	15.4	93%	5%	2%
Benton	57	<.03	<.03	0.77	9.0	15.6	79%	12%	9%
Cass	82	<.03	<.03	0.03	1.4	9.5	96%	4%	0%
Crow Wing	66	<.03	<.03	0.27	2.1	8.3	92%	8%	0%
Douglas	90	<.03	<.03	<.03	0.7	8.8	94%	6%	0%
Hubbard	65	<.03	<.03	1.67	6.9	29.3	85%	8%	8%
Kandiyohi	117	<.03	<.03	<.03	0.4	38.7	93%	3%	4%
Morrison	124	<.03	<.03	2.53	10.3	33.9	78%	11%	11%
Ottertail	320	<.03	<.03	0.03	2.5	32.7	90%	4%	5%
Pope	93	<.03	<.03	<.03	1.0	35.0	94%	1%	5%
Sherburne	42	<.03	<.03	0.06	3.2	40.0	91%	5%	5%
Stearns	167	<.03	<.03	0.75	7.6	49.8	82%	13%	4%
Todd	137	<.03	<.03	0.04	2.2	81.0	93%	5%	2%
Wadena	72	<.03	0.09	3.07	8.9	49.2	75%	17%	8%
Average	1,555 total samples	<.03	0.01	0.66	4.2		89%	7%	5%

Central Sands Private Well Network, cont.

NO₃-N concentration, and largest percentage of results greater than 10 mg/L (Figure 2). Drilled wells had the lowest average, median, and percentage of wells greater than 10 mg/L. However, hand dug wells only made up 2% of the total wells where as 83% of the wells were of drilled construction.

There was a strong relationship between well depth and NO₃-N concentrations. All NO₃-N statistics (average, median, and % >10 mg/L) decrease with increasing well depth (Figure3).

Wells that were greater than 50 years old had the highest average concentration and percentage over 10 mg/L. However, each of these age groups had median concentrations of <0.03 mg/L (Figure 4). Wells that are greater than 50 years old were installed before the initiation of the Minnesota Well Code in 1974.

Summary

The CSPWN has very good well owner participation. Volunteers are the backbone of this project, collecting samples from their own well which saves time and money. Each county has a sufficient sample size of wells and spatial coverage, which allows for detecting areas of concern.

Overall drinking water in the Central Sands is good, 95% of the wells sampled are below 10 mg/L. It is noteworthy that nitrate concentrations are affected strongly by well depth, age, and construction type.

Now, in Phase 2 of the CSPWN project, well information is being verified during site visits for the long-term network. This network will provide a better understanding of NO₃-N trends in the region and be used to educate private well owners about the quality of their drinking water.

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Ground Water History

The Emergence of a Visual Language for Ground-water Geology

Greg Brick, Department of Earth Sciences at the University of Minnesota, presented the poster on the facing page at the History of Science Society annual meeting held in San Diego on November 15-18, 2012. The focus of this year's conference was Thomas Kuhn's classic book, *The Structure of Scientific Revolutions*, published 50 years ago, in 1962. Kuhn is the historian of science who popularized the notion of paradigm shifts and scientific revolutions. Consider this poster in the context of paradigm shifts that might have taken place in ground water geology. Has the hydrocycle taken a complete spin?

Figure 3. Well Depth and Nitrate-N Concentrations

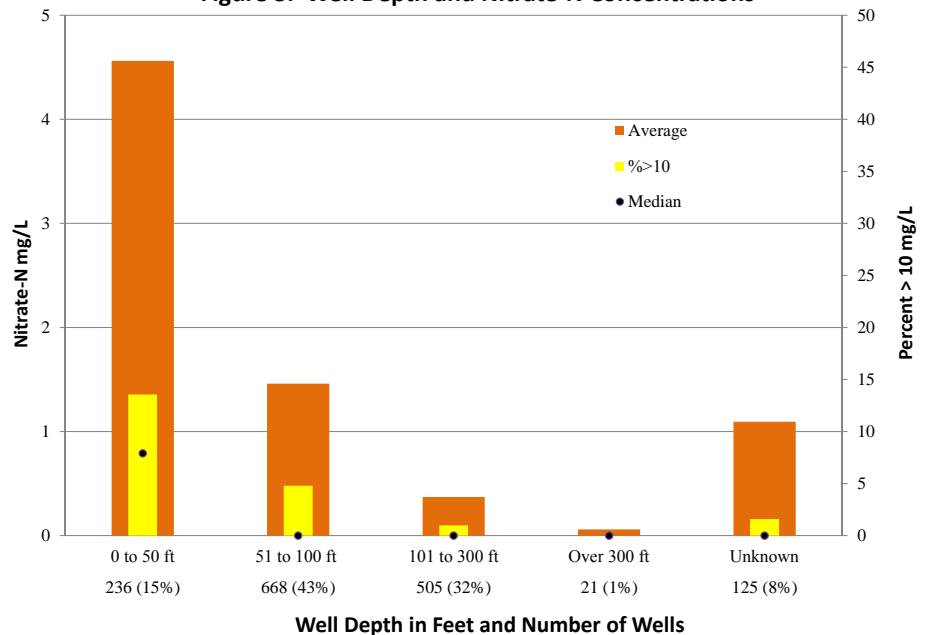
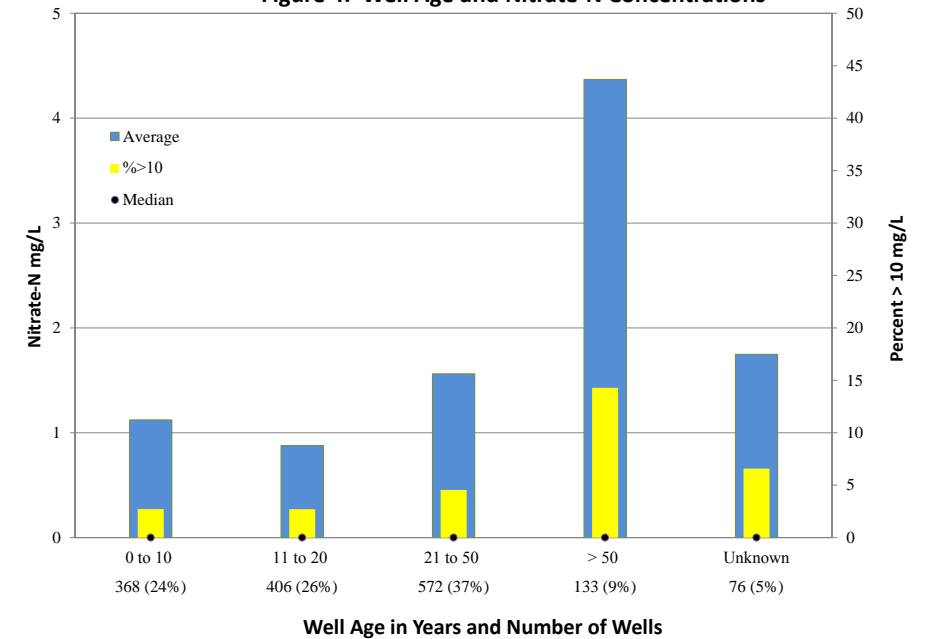


Figure 4. Well Age and Nitrate-N Concentrations



“WATER FLOWING UPHILL IS ONE OF THE COMMONEST FACTS OF NATURE”: THE EMERGENCE OF A VISUAL LANGUAGE FOR GROUNDWATER GEOLOGY



Greg Brick
Department of Earth Sciences
University of Minnesota, Minneapolis, MN 55455

Abstract

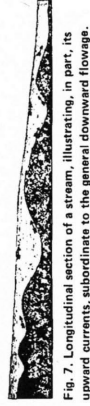
Rudwick's (1976) paper, "The Emergence of a Visual Language for Geological Science 1760-1840" leads naturally to a discussion of the role of visualization in the individual branches of geology. Apart from early, fanciful illustrations of the "reversed" hydrologic cycle such as adorned Kircher's *Mundus Subterraneus* (1664), Ramazzini (1691) and Vallisneri (1715) drew early generalized Alpine cross-sections to help explain artesian wells, a tradition extended by Chamberlin (1885) and others to very flat areas. Dumont (1856) drew the first water-table contours in France and Lucas (1874) for the British Chalk, while King (1899) added flow vectors to his contours in the United States, completing a basic visual vocabulary. By the time of a classic American textbook, Tolman's *Ground Water* (1937), a wealth of imagery was deployed. But in contrast to geology proper, more often concerned with "deep time," groundwater geology usually involves ephemeral phenomena, expressed by means of ghostly dashed lines and arrows. Some concepts seem counter-intuitive, as suggested by the quote from Chamberlin (1885) in the title of this abstract. As shown by recent literature, some very basic groundwater imagery does not seem to have completely stabilized even today, perhaps because of the tension created by powerful mathematical abstractions, such as those of Hubbert (1940) and others. In a sense, these abstractions recall a much earlier situation in the history of visual language for geology, the seventeenth century "cosmological" theoretical sections of the Earth, which presented, according to Rudwick (1976), "highly abstract theoretical statements in a visual language."

Uphill Flow

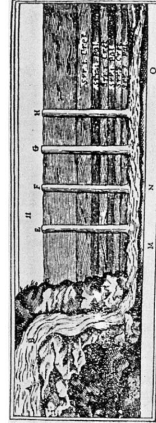


Kircher's *Mundus Subterraneus* (1667) depicts what Tuan (1968) calls the "reversed hydrologic cycle," with water flowing uphill from the sea via underground channels to start the cycle anew.

Chamberlin's (1885) figure below illustrates what he meant by claiming that water flows uphill.



Artesian Wells



Ramazzini (1691) drafted a cross-section to explain the artesian wells of Modena, in Italy. Chamberlin's (1885) cross-section below extends the same concept to flat areas.

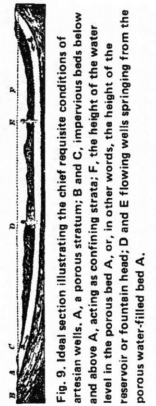
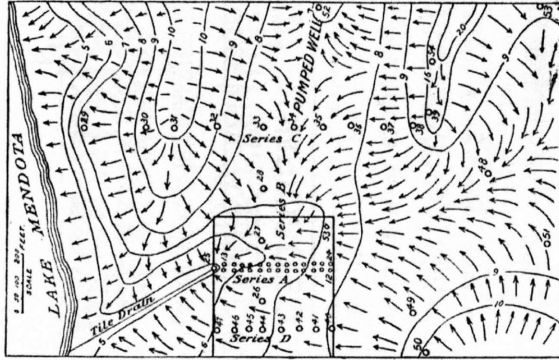


Fig. 9. Ideal section illustrating the chief requisite conditions of artesian wells. A, a porous stratum; B and C, impervious beds below and above A, acting as confining strata; F, the height of the water level in the porous bed A, or, in other words, the height of the reservoir or fountain head; D and E, flowing wells springing from the porous water-filled bed A.

Basic Visual Vocabulary

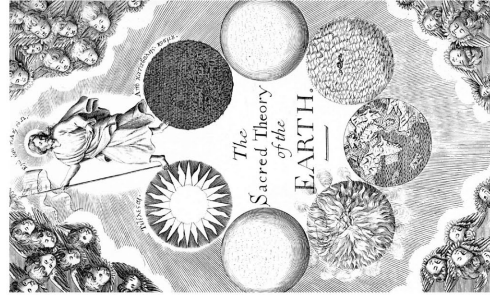


King (1899) drafted this groundwater map of a portion of Madison, Wisconsin. While water-table contours and elevations had been depicted as early as 1836, this was the first to add arrows to show flow direction.

Further Reading

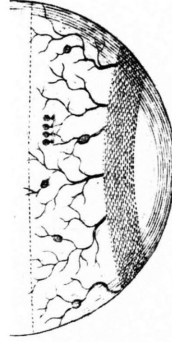
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Cosmological Theories

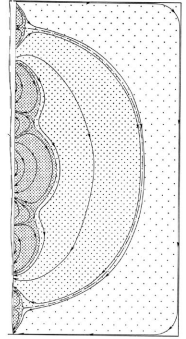


Frontispiece to Thomas Burnet's (1684) classic physico-theology.

Abstractions—Then and Now



Toth's (1963) figure illustrating regional groundwater flow has parallels to Burnet's (1684) figure illustrating the hydrology of the primeval Earth. The level of visual abstraction is about the same.



QUESTION OF THE QUARTER

Question of the Quarter!

Test your knowledge!

Learn something new!

Question of the Quarter

The Question of the Quarter is an occasional feature of your newsletter in which a question is posed and all members are invited to respond.

The Question of the Quarter in the September issue was:

What formation found in Minnesota was subdivided by MGS into two groups in 1995? What are the two groups now called?

The lack of responses leads us to believe this was a tad too difficult for our readers to answer off the tops of their heads. In the 1995 Fillmore County Atlas, the Cedar Valley of the Devonian Period was subdivided into the Cedar Valley Group and the Wapsipinicon Group; these are comprised of the following formations:

Cedar Valley Group:

Lithograph City Formation

Coralville Formation

Little Cedar Formation

Wapsipinicon Group:

Pinicon Ridge Formation

Spillville Formation

The Newsletter Team invites your suggestions for Questions of the Quarter. Send your ideas to editor@mgwa.org

MGWAF SCHOLARSHIP

The Minnesota Ground Water Association Foundation is Proud to Announce a Scholarship Opportunity

The Minnesota Ground Water Association (MGWA) and MGWA Foundation are excited to announce the 2013 \$1000 student scholarship for undergraduate or graduate students majoring in hydrogeology, groundwater hydrology, or similar programs at an accredited college or university in Minnesota or an adjoining state or province. Please pass this information on to any students who may be interested in applying!

Scholarship Information

Purpose

The Minnesota Ground Water Association (MGWA) is a professional, volunteer organization that promotes public policy and scientific education about ground water. The MGWA Foundation is a related organization devoted to promoting scientific education and public involvement in ground water issues. The Board of the MGWA Foundation provides this scholarship to alleviate a portion of the educational costs of qualified students, with the goal of increasing their interest in the professions of hydrogeology, groundwater geology, and related programs.

Eligibility

Applicants must be enrolled as an undergraduate or graduate student in good academic standing in hydrogeology, groundwater hydrology or similar program at an accredited college or university in Minnesota or an adjoining state or province.

Where and How to Apply

The application form and definitive information can be found on the MGWA website at:

<http://www.mgwa.org/foundation/funding.php>. Contact cvhorns@juno.com with any questions.

Application Deadline: January 31, 2013

Scholarship Presentation

The scholarship recipient will be announced at the next MGWA conference and in the MGWA newsletter. The recipient will be awarded a one year student membership in the Minnesota Ground Water Association (MGWA). The recipient will write an article describing their research or their interest in hydrogeology for publication in the newsletter of the MGWA, or present either a poster or a presentation at an upcoming MGWA conference.

— MGWA Foundation Board of Directors

USGS Announces Three New Publications

Streamflow depletion by wells—Understanding and managing the effects of groundwater pumping on streamflow by P.M. Barlow and S.A. Leake, U.S. Geological Survey Circular 1376, 84 p.

Introduction: Groundwater is an important source of water for many human needs, including public supply, agriculture, and industry. With the development of any natural resource, however, adverse consequences may be associated with its use. One of the primary concerns related to the development of groundwater resources is the effect of groundwater pumping on streamflow. Groundwater and surface-water systems are connected, and groundwater discharge is often a substantial component of the total flow of a stream. Groundwater pumping reduces the amount of groundwater that flows to streams and, in some cases, can draw streamflow into the underlying groundwater system. Streamflow reductions (or depletions) caused by pumping have become an important water-resource management issue because of the negative impacts that reduced flows can have on aquatic ecosystems, the availability of surface water, and the quality and aesthetic value of streams and rivers.

Scientific research over the past seven decades has made important contributions to the basic understanding of the processes and factors that affect streamflow depletion by wells. Moreover, advances in methods for simulating groundwater systems with computer models provide powerful tools for estimating the rates, locations, and timing of streamflow depletion in response to groundwater pumping and for evaluating alternative approaches for managing streamflow depletion. The primary objective of this report is to summarize these scientific insights and to describe the various field methods and modeling approaches that can be used to understand and manage streamflow depletion. A secondary objective is to highlight several misconceptions concerning streamflow depletion and to explain why these misconceptions are incorrect. (<http://pubs.usgs.gov/circ/1376/>)

Presence of Selected Chemicals of Emerging Concern in Water and Bottom Sediment from the St. Louis River, St. Louis Bay, and Superior Bay, Minnesota and Wisconsin, 2010 by V.G. Christensen, K.E. Lee, K.A. Kieta, and S.M. Elliott.

The lower St. Louis Bay between Duluth, Minnesota and Superior, Wisconsin receives substantial urban runoff, wastewater treatment plant effluent, and industrial effluent—leading to its designation as a “Great Lakes Area of Concern” by the International Joint Commission. Concerns exist about the potential effects of certain chemicals on aquatic biota because many of these chemicals have been shown to have detrimental effects on fish and other aquatic life. These chemicals are called Chemicals of Emerging Concern and may be toxic or pose some health risk to living organisms. These chemicals include pharmaceuticals, hormones, and other organic chemicals—some of which may cause endocrine disruption.

The U.S. Geological Survey in cooperation with the Minnesota Pollution Control Agency and the Wisconsin Department of Natural Resources collected water and bottom-sediment samples from 40 sites from August through October 2010 to identify the extent to which Chemicals of Emerging Concern occur in water and sediment in the St. Louis River, St. Louis Bay, and Superior Bay. During this study, 33 of 89 chemicals of emerging concern

were detected among all water samples collected and 56 of 104 chemicals of emerging concern were detected in bottom-sediment samples. The chemical N,N-diethyl-meta-toluamide (DEET, a mosquito repellent) was the most commonly detected chemical in water samples and 2,6-dimethylnaphthalene (a petroleum by-product) was the most commonly detected chemical in bottom-sediment samples. In general, chemicals of emerging concern were detected at a higher frequency in bottom-sediment samples than in water samples.

Estrone (a steroid hormone) and hexahydrohexamethyl cyclopentabensopyran (a synthetic fragrance) were the most commonly detected endocrine active chemicals in water samples; beta-sitosterol (a plant sterol), estrone, and 4-tert-octylphenol (an alkylphenol) were the most commonly detected endocrine active chemicals in bottom-sediment samples. The greater detection frequency of chemicals in bottom-sediment samples compared to the detection frequency in water samples indicates that bottom sediment is an important sink for chemicals of emerging concern. The full report can be obtained from the USGS at <http://pubs.usgs.gov/sir/2012/5184/>. For more information on the study, contact Victoria Christensen (vglenn@usgs.gov) or Kathy Lee (klee@usgs.gov).

Relations between Retired Agricultural Land, Water Quality, and Aquatic-Community Health, Minnesota River Basin by V.G. Christensen, K.E. Lee, J.M. McLees, and S.L. Niemela, published in this month's issue of the Journal of Environmental Quality.

The study demonstrates the importance of agricultural land retirement on water quality and aquatic-community health in the Minnesota River Basin. Eighty-two sites were examined in cooperation with the Minnesota Pollution Control Agency and the Minnesota Board of Water and Soil Resources. The study examined nutrient concentrations, measures of aquatic-community health, and environmental factors. The importance of the proximity of agricultural land retirement to streams also was determined by examining land retirement in riparian zones. The index of biotic integrity (IBI), a measure of the health of the fish community in a stream, was not correlated to the percentage of agricultural land retirement at the basin scale, however, IBI was correlated to retired land percentage in the 50- to 400-m riparian zones surrounding the streams, indicating that riparian agricultural land retirement may have more influence on aquatic-community health than does agricultural land retirement in upland areas. Statistical models indicated that other environmental factors (such as drainage area and lake and wetland features) commonly were correlated to aquatic-community health measures, as were in-stream factors (standard deviation of water depth and substrate type). These results indicate that although agricultural land retirement is significantly related to fish communities as measured by the IBI scores, a combination of basin, riparian, and in-stream factors act together to influence IBI scores. The full report can be obtained from the Journal of Environmental Quality. For more information on the study, contact Victoria Christensen (vglenn@usgs.gov).

MGWA BOARD MINUTES

Minnesota Ground Water Association Board Meeting Minutes

Meeting Date: August 10, 2012

Location:	Fresh Grounds Café 1362 West 7th Street, St. Paul, MN
Attendance:	Kelton Barr, President; Bob Tipping, President-Elect; Audrey Van Cleve, Treasurer; Julie Ekman, Secretary; Sean Hunt, WRI; Jeanette Leete, WRI; Tedd Ronning, Newsletter editor.
Past Minutes:	July minutes approved.
Treasury:	Copies of the report were provided. Income to date is \$80,864.99; expenses to date: \$85487.32; net income of -\$4622.33. Total Current Assets: \$71448.28.
Newsletter:	Ronning reports that publishing the newsletter by September 14 would enable inclusion of a reminder about the early registration deadline.
Web Page:	Hunt reported that the Midwest Groundwater Conference website is kept up to date. He has forwarded abstracts to session chairs; some chairs have reported that they aren't receiving these and Sean will check into that. Barr pointed out that the sponsors should be posted on the website to give them recognition.
WRI Report:	Leete handed out the Business Report. We discussed options for printing and layout of the programs; \$400 was planned for the 30-50 page programs including the abstracts pages. Leete has written a white paper on the history of the MWGW conference and has talked to DNR EWR division staff, supervisors, and director about getting a staff person's help with the program/abstracts and to provide foam core boards for the poster session.
Foundation:	Leete reported in Mindy Erickson's absence: The Foundation team has completed the paperwork for grant rewarding. Hunt and Leete have reviewed these for any legal issues.
Old Business:	<u>Midwest Ground Water Conference</u> — Tipping has checked several bus lines for the field trip. We will need 2 coach buses, each having a capacity of 55 people. Hunt says that we have received about 60 abstracts. Barr pointed out that the 17th is the abstract deadline. The booth room is full (about 25 booths bringing in approximately \$18,000). We can offer 2 sponsored, invited speakers for each session at about \$400 per speaker. Early next week Barr will send an email to session sponsors listing what steps are remaining for them to finish. Barr provided an overview of an idea for session planning: for the plenary session he's planning 5 speakers, one from each state. We have 4 volunteers lined up. The Board needs to meet to brainstorm ideas on remaining tasks and find volunteers for these. We'll meet this Wednesday evening, 8/15. Tipping is in need of a volunteer to help with lunch (bring the beverages, and tents and set things up).
New Business:	<u>Fall 2013 Field Trip</u> — Tipping is beginning planning. This could be an overnight trip to SE Minnesota and could coincide with presenting the distinguished service award. Leete suggested that the field trip could be arranged jointly with the AIPG.

Meeting Date: September 7, 2012

Location:	Fresh Grounds Café, 1362 West 7th Street, St. Paul, MN
Attendance:	Kelton Barr, President; Mindy Erickson, Past-President; Bob Tipping, President-Elect; Audrey Van Cleve, Treasurer; Julie Ekman, Secretary; Sean Hunt, WRI; Jeanette Leete, WRI.
Past Minutes:	August minutes approved as amended.
Treasury:	Copies of the report were provided. Income to date is \$100,963; expenses to date: \$104,803.45; net income of -\$3,840.21. Total Current Assets: \$88,074.40.
Newsletter:	Hunt reported that the draft newsletter is prepared.
Web Page:	Hunt is updating the Midwest Ground Water Conference speaker information. Another Conference registration reminder will be emailed when the schedule is posted. Emails to be sent: 1) reminder of early registration deadline and that the Conference schedule is on the web; 2) information for poster session set up; 3) information for speakers to upload their presentations.
WRI Report:	Hunt handed out the Business Report. Portfolios for conference participants have been ordered. Bags will be ordered with the MGWA logo.
Foundation:	Erickson reported that about \$1500 is available for a scholarship.
Old Business:	<u>Midwest Ground Water Conference</u> — Barr handed out maps of the Earle Brown Heritage Center buildings and the presentations schedule and reviewed the Conference arrangements for presentation sessions, vendor booths, refreshments, lunch, and dinner. Conference speakers need to upload their presentations; Barr will arrange for a website through Braun Intertec for this. Scholarships: Barr reported the process for awarding conference registration scholarships for students. They pay the full registration price then get reimbursed at

MGWA 2013 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. They remain unchanged.

MGWA BOARD MINUTES

MGWA Minutes, cont.

the conference. Also, the University of Minnesota-Twin Cities Geology Department offered to pay registration for their students to attend. Donna Whitney, Chair of the Geology Dept. is the contact person.

New Business: None. Ran out of time.

Meeting Date: October 19, 2012

Location: Fresh Grounds Café 1362 West 7th Street, St. Paul, MN
Attendance: Kelton Barr, President; Mindy Erickson, Past President; Bob Tipping, President-Elect; Audrey Van Cleve, Treasurer; Julie Ekman, Secretary; Sean Hunt, WRI; Jeanette Leete, WRI; E. Calvin Alexander, guest representing the National Cave and Karst Research Institute (NCKRI).
Past Minutes: August minutes approved.
Treasury: Copies of the report were provided. Accounts receivable are still pending from the Midwest Ground Water Conference. Estimated bill from Earle Brown Heritage Center: \$85,840; accounts receivable: \$42,021.
Newsletter: Ronning reported that 11/2 is the deadline for the next issue. Starting in March Greg Brick will join the news team. Leete suggested that Midwest Ground Water Conference exhibitors be contacted about becoming corporate members/advertisers. Barr stated that the corporate sponsorship package needs revision.
Web Page: Hunt reported that conference presentations are available as PDF documents on the MGWA website; photos from the conference and the field trip are also available. The Conference website is separate from MGWA's; the Board will continue to maintain the site. States that sponsor future MWGW conferences will be provided with a log in for updating the website.
WRI Report: Hunt pointed out that membership renewal notices will go out next month.
Foundation: Erickson reported that the Foundation met on Wednesday. The deadline to submit applications for \$1000 student scholarships is January 31, 2013. A decision will be made the end of February and the recipients will be announced at the spring MGWA conference. Information on contributing to the Foundation during the "Give to the Max" drive will be included with membership renewal notices.

Old Business: Midwest Ground Water Conference — Tipping handed over the field trip attendee roster and nametags to Leete.

New Business: Two MGWA board member positions expire at the end of this year: Treasurer and President Elect. Members discussed potential candidates to be contacted. MGWA Conference dates for 2014 will be Tuesday, April 22nd and Wednesday, November 12th. The Metropolitan Council is soliciting feedback for their water planning effort, Thrive MSP 2040. An article was in the StarTribune today. Alexander led a discussion on the 2015 Sinkhole Conference and potentially combining this with the fall MGWA conference. Plans are that the Sinkhole conference would be in Rochester sometime during the first two weeks in October. The conference is typically a week long with the first day consisting of short courses followed by 2½ to 3 days of presentations on peer reviewed research papers. In the past, the research papers have been published in a printed conference document; future conference papers will be published electronically. MGWA board members agree that the purposes of the Sinkhole Conference are in line with MGWA's mission. The board is interested in further conversation about a joint conference and had several logistical and financial questions that Alexander will bring back to the NCKRI. The MGWA Board authorized E. Calvin Alexander to present MGWA as a partner with NCKRI's 2015 Sinkhole Conference.



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The MGWA Board of Directors meets once a month.

All members are welcome to attend and observe.

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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

Meeting Date: October 17, 2012

- Attending: Gilbert Gabanski, Mindy Erickson, Cathy von Euw, Amanda Strommer (via speaker phone), Stu Grubb and Cathy Villas-Horns. MGWA Management Present: Sean Hunt, Jennie Leete
- Review of Minutes: The meeting minutes for the May 22, 2012 meeting were approved on July 4, 2012. The minutes were provided via e-mail to the MGWAF Board and the MGWA Newsletter staff.
- Treasurer's Report: MGWA Foundation balance as of October 15, 2012 is \$116,285.79. Interest in the amount of \$732.78 was accrued since 05/18/12 and was swept into the general fund. Donations of \$500 from Stantec to the MGWA Foundation general fund were received during this period. Total debits of \$2365 were deducted during this period for a \$1500 grant to the Metro Children's Water Festival and a \$865 grant for the Washington County Groundwater Model. The HO Pfannkuch Fund balance as of October 15, 2012 is \$19,635.81. Interest in the amount of \$76.48 was accrued since 05/18/12 and was swept into the fund. Cathy commented that the Step-Up Certificate of Deposit (CD) currently has an interest rate of 4.25% which will increase to 5.25% in September 2013. This CD will mature in August 2014. The 60-month CD will mature in August 2016 and has an interest rate of 2.96%. Most of the HO Pfannkuch Fund is currently in a checking account which earns 0.5%. Stu inquired if the MGWAF Board had considered other options for investing the endowment which might provide a higher rate of return. He reported that the Freshwater Society earns approximately 8-14% annually through an account managed by Wells Fargo. Stu will put together some notes and ideas and provide this information to Gil for his review.
- Old Business: The Midwest Ground Water Conference – Everyone agreed that the conference was a big success. Jennie reported that the MGWAF Board provided partial scholarships for 21 students and that the Minnesota section of the American Institute of Professional Geologists provided scholarships for four (4) students to the conference. Jennie also reported that there were 321 in attendance the first day of the conference, and 585 the second day. Gil is going to write an article celebrating the 30th anniversary of the MGWA for an upcoming MGWA newsletter. MGWA Board Meeting report – Mindy reported that the MGWA Board has not met since September; therefore she does not have any updates for the MGWA Board. Scholarship Update – Cathy V-H reported that the scholarship application form has been posted on the MGWAF website but without an actual due date and award date. Cathy supplied a due date of January 31, 2013 and an award date of March 31, 2013 to Sean who will update the application form on the MGWAF website. One application has already been received from a graduate student for the \$1000 annual scholarship. Amanda will draft a message advertising the new scholarship for the 2013-2014 school year and will send the information to the list of regional colleges and universities that is used to advertise MGWAF grants. Sean will post the applications and supporting materials on the MGWAF Google Docs site. MGWAF Fundraising – Gil and Kelton Barr, the current MGWA Board President, continued discussions on fundraising and are contemplating a more regular pledging approach.
- New Business: Stu is affiliated with the Freshwater Society (FW Society), which is interested in increasing awareness of ground water issues. The FW Society sponsors lectures at the St. Paul Campus Student Center about every two (2) months. They are trying to put together a lecture that is focused on ground water. The MGWA could consider coordinating with the FW Society on a one day conference or workshop focused on groundwater issues. The FW Society is particularly interested in public policy issues and technical issues of broad public interest.
- Next Meeting: The next meeting will be in either January or February 2013. The MGWAF Board will attempt to meet twice in 2013.