Minnesota Ground Water Association
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Newsletter

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MGWA President Bob Tipping

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President's Letter

Water budgets are often presented using a savings account analogy. Inputs have to equal outputs for things to remain in balance; a change in storage is like a change in savings. With groundwater budgets, things get complicated because the inventory is often not clear. Buried glacial aquifers can be warehouses of unknown size. Bedrock aquitards restrict vertical groundwater movement but can move water horizontally with great efficiency. Although pumping rates (withdrawals) are relatively easy to measure, recharge rates (deposits) are difficult to quantify. It is in this context that resource managers try to make decisions about groundwater use and sustainability.

This fall's conference, entitled "The Economics of Groundwater Management," is intended to discuss the value of groundwater and how that value affects decision making. Two economic terms which may or may not be explicitly mentioned at the conference but whose meaning is implicit in any discussion of groundwater's value are: Marginal cost – the cost of producing/extracting one more unit of a good or service; Scarcity rent – the cost associated with using up a finite resource. Efficiency is achieved when the resource price--the benefit society is willing to pay for the resource today--is equal to the sum of marginal extraction cost and scarcity rent.

Marginal cost can include direct costs that are known and measurable, such as pumping, infrastructure, and water treatment. Scarcity rent is well-recognized in water limited states, such as Arizona, Texas, and California, but only recently has entered into water resource management discussions here in Minnesota. In the event of water scarcity, Minnesota has a

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Nitrate-Nitrogen in the Springs and Trout Streams of Southeast Minnesota

Justin Watkins, Nels Rasmussen, Greg Johnson, Andrew Streitz, Khalil Ahmad, Brian Beyerl, Jenna Roebuck, Minnesota Pollution Control Agency

Abstract

The relationship between row crop land use and nitrate-nitrogen concentration in baseflow was evaluated for 100 trout stream watersheds in the karstlands of Southeast Minnesota. The watersheds range in size from 9 to 831 km^2; the percentage of land in row crop (planted to corn or soybeans in 2009) varied from 1.4 to 73.2%. Mean baseflow nitrate-nitrogen concentrations for all available data ranged from 0.2 to 17.4 mg/L. Results indicate that nitrate-nitrogen concentrations were correlated to the percentage of row crop in the watershed (r-squared = 0.68). A linear regression showed a slope of 0.16, suggesting that the average baseflow nitrate-nitrogen concentration in the trout stream watersheds of Southeast Minnesota can be approximated by multiplying a

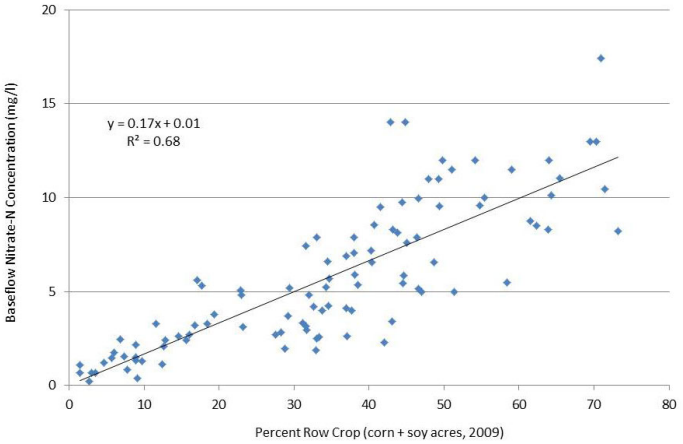

Figure 1. Percent Row Crop vs. Baseflow Nitrate-N[1] Concentration in Trout Stream Watersheds of SE MN; n = 100.

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MGWA Web Page
Visit www.mgwa.org for MGWA information between newsletters and to conduct membership and conference transactions.

Newsletter Deadlines

Issue	Due to Editor
December '13	11/02/13
March '14	02/02/14
June '14	05/02/2014
September '14	08/02/2014

MEMBER NEWS

New Groundwater Level Monitoring Network Coordinator at the Minnesota Department of Natural Resources (DNR)

Jason Carlson was recently hired by the DNR to oversee the state's groundwater level monitoring network. Jason graduated from the University of Minnesota with a degree in Environmental Science with an emphasis in water quality and hydrology.

He has worked for the DNR since June 2010 as a monitoring hydrologist in the monitoring and assessment unit of the Ecological and Water Resources Division. His main duties were the collection of streamflow data, rating curve development, and the collection of groundwater data across the state.

Prior to the DNR, Jason had worked for several soil and water conservation districts and watershed districts in Fillmore and Washington counties as well as for the Minnehaha Creek Watershed District beginning in 2006. He has a wife named Jessie, and two sons named Jasper and Liam, ages 3 and 1. His interests are cooking, playing the violin and mandolin, as well as a variety of outdoor activities.

Tim Grape Joins Bay West

Bay West, Inc., recently hired Tim Grape as a project manager. Mr. Grape is a Professional Geologist with 15 years of environmental consulting experience, with an emphasis on site assessment, site remediation, and hydrogeology. He has a strong background in Minnesota Pollution Control Agency (MPCA) guidance documents and for the past seven years has managed projects under the Petroleum Remediation Program (PRP) in addition to managing Site Assessment/ Superfund sites under the MPCA's Professional Technical Master Contract. "I'm inspired by the strong customer-focused business model at Bay West and their commitment to a positive and supportive work culture. They have a strong team of environmental and industrial professionals," said Mr. Grape. "My skill sets appear to complement Bay West's existing capabilities, and I'm excited to be a part of such a dynamic team." Tim will be supporting Bay West from the St. Paul headquarters office.

AIPG-AWG-MGWA Fall 2013 Field Trip

A Journey to the Paleozoic Plateau, Southeastern Minnesota — October 18 - 19, 2013

The Minnesota Section of the American Institute of Professional Geologists – Association for Women Geoscientists Minnesota Chapter – Minnesota Ground Water Association Fall 2013 Field Trip will be Friday and Saturday, October 18th and 19th. The trip highlights the hydrologic and cultural heritage of Southeastern Minnesota's karst lands. topics covered at the stops are karst hydrology, including rapid groundwater movement and short residence times, engineering, agricultural and ecological concerns, and the unique landscape formed under conditions of dissolving bedrock.

Friday night lodging will be at Eagle Bluff Environmental Learning Center in Lanesboro, with a dinner/presentation that evening at the Branding Iron in Preston honoring the life's work of Dr. E. Calvin Alexander, Jr., University of Minnesota.

The field trip will start and end at the 28th Ave Station park and ride near the Mall of America (3 blocks) at 8 AM. Friday morning pickup and Saturday drop off in Rochester will be provided for those joining the trip from the southeast.

Friday

- Rochester pickup at the old DNR office - 2300 Silver Creek Rd. N.E.
- Whitewater State Park - St. Lawrence sinking stream/dye trace. Lunch at the park
- Fountain Big Springs/sinkhole excavation
- Cherry Grove Blind Valley
- MDA nitrate monitoring - Root River Field to Stream Partnership. Kevin Kuehner at the Dornick farm site, plus nearby quarry visit. Joined by Toby Dogwiler, Winona State University, to talk about near surface resistivity surveys at the site
- Eagle Bluff check-in and overnight
- Dinner at Branding Iron in Preston

Saturday

- Breakfast at Eagle Bluff
- National Trout Center; lunch in Preston
- Chatfield Prairie du Chien outcrop?
- Rochester drop off at old DNR office - return to Twin Cities by 5 PM.

The $150 cost includes lodging, transportation, and all meals. We will have to limit participants to the first 55 people who register (one coach bus), so register as soon as possible if you would like to attend.

For field trip details visit www.mgwa.org/trip_2013_fall.php or contact Bob Tipping at tippi001@umn.edu

White Paper Committee is Established

The first White Paper Committee has been selected and approved by the Minnesota Ground Water Association Board. The four members and their employment affiliation and status are:

- Kelton Barr, Braun Intertec
- Mark Collins, HDR Engineering (retired)
- Bruce Olsen, Minnesota Dept. of Health (retired)
- Jeff Stoner, U.S. Geological Survey

With these members several degrees of balance were achieved. Two of the members are from public sector employment, and two members are from private sector employment. Of these sectors of employment, one of each is retired from active employment but a current member of MGWA. They will serve staggered terms of two and four years with the terms of each individual still being determined.

The Committee is already at work, developing the structure of the White Paper process and the myriad of details to make the process as transparent as possible and to actively involve the membership. Many of these organizational and structural elements will be presented at the upcoming Fall Conference with further details in the December Newsletter and an upcoming section of the MGWA website.

The Committee is looking forward to soliciting White Paper topics from the membership later this fall. Later, a call for members of the first Working Group will be made to the membership. Stay tuned for more details!

2013 MGWA Board

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

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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

President's Letter, cont.

hierarchy of uses in place. Of highest priority is domestic water supply, followed by consumption of less than 10,000 gallons per day, agricultural irrigation and processing of agricultural products, power production, and other non-essential uses (MN Statute 103G.261, Water Allocation Priorities). Public awareness about the common groundwater link in these uses has increased in light of lowering lake levels and agriculture's impact on groundwater quality. Faced with rising marginal costs and scarcity, decisions will be made based on the value of trade-offs between uses.

The difficulty, of course, is determining what those values are. Direct costs are relatively easy to measure. Most other aspects of groundwater quantity and quality, such as baseflow of streams and rivers, aquifer recharge, distribution of porosity and permeability, groundwater chemistry, and ecological thresholds, are less easy to measure. For many of us, this fall's conference will be an introduction to the field of ecosystem services. This method of economic analysis is based on establishing the value of benefits provided by ecosystems to humans.

Speakers so far include Enrique Valdivia, from the Edwards Aquifer Authority in Texas, who will describe how groundwater management areas work in a water-limited state. Bonnie Keeler, from the University of Minnesota's Institute on the Environment, will talk about the challenges of applying ecosystem service methods to groundwater resources; included in the discussion will be the key role that groundwater models play in these methods. Ray Wuolo, from Barr Engineering, will talk about the uncertainty associated with groundwater modeling, and how that uncertainty can be quantified. The economics of nitrogen application at the farm scale will be addressed by Dave Legvold – a farmer from Northfield whose work demonstrates the profitability associated with nutrient management. Jason Moeckel, from the Department of Natural Resources, will talk about the future of managing groundwater resources from a regional planning perspective. An extended poster session will provide more time to meet with each other – I encourage you to submit a poster if you would like to be involved in a more formal way, otherwise plan on attending and being part of the discussion. See you in November!

Save the Date!

MGWA Fall Conference

The MGWA Fall Conference will be held on **November 13, 2013** at the University of Minnesota's Continuing Education and Conference Center – St. Paul Campus. The conference is titled: "The Economics of Groundwater Management." Establishing the value of groundwater is implicit in every aspect of professional hydrogeology. The conference will address this task at many different scales, with talks ranging from groundwater science and ecosystem services to groundwater policy. Come hear about the economic challenges facing groundwater resource management. More information on the conference is on the MGWA web site at: www.mgwa.org

Attention Students Do we have an opportunity for you!

If you are interested in meeting people who work in our profession, and perhaps are shy about introducing yourself or even attending a full day conference, we have an opportunity you should consider. Students who attend the MGWA Fall 2013 conference will be again be greeted by a MGWA member who will be your mentor for the day. All you need do is register, pay the initial student registration of $65, and then show up at the conference. When you pick up your registration at the conference, you will be reimbursed $50 for the conference ($15 dollars makes you a member of MGWA!) and meet your mentor. During the conference, your mentor will be your guide for the day. They will sit with you, provide information on who they work for and what they do; and, most importantly, introduce you to other MGWA members. They will be your resource for the day. Collect as many business cards as you can, find out about what our members do, and what our organization is about. If you have not heard this before, companies do not hire people, people hire.

Minnesota Department of Natural Resources (DNR) Moves Forward with Groundwater Management Area for North and East Metro

by Paul Putzier – Minnesota Department of Natural Resources

New statutory language in the 2010 legislative session gave DNR the authority to designate groundwater management areas (GWMA) to assist in meeting the agency's responsibility for sustainable water use in Minnesota. Minnesota Statute 103G.287 Subd. 4 establishing this authority reads:

"The commissioner may designate groundwater management areas and limit total annual water appropriations and uses within a designated area to ensure sustainable use of groundwater that protects ecosystems, water quality, and the ability of future generations to meet their own needs. Water appropriations and uses within a designated management area must be consistent with a plan approved by the commissioner that addresses water conservation requirements and water allocation priorities established in section 103G.261."

The GWMA statute gives DNR another important tool to help achieve sustainable use of the state's water resources. The consequences of unsustainable use can take a variety of forms, including: declining heads in aquifers, impacts to surface waters such as lakes, wetlands, and streams, or impacts to water quality by moving contaminants. An important element of a groundwater management area designation is that it allows DNR to take into account cumulative impacts from multiple appropriations and establish total annual appropriations within a hydrologic system, or geographic boundary.

Staff at the DNR have been evaluating a number of groundwater areas of concern around the state to determine if and where this management tool would be useful for meeting long-term water use sustainability goals. The DNR has years of groundwater and surface water monitoring data in the north and east metro, increased concern over the long-term development of groundwater as the primary water supply source and potential impacts to surface water features. In response to DNR's research, analysis of surface water-groundwater interaction by other agencies, and a request from the White Bear Lake Conservation District, the DNR is moving forward with a GWMA designation in the north and east metro. In a June 10, 2013 letter to the White Bear Lake Conservation District, DNR Commissioner Tom Landwehr stated,

"Given the importance of White Bear Lake to the surrounding community and the State of Minnesota and the complex issues and relationships, my staff and I believe that a groundwater management area makes sense as part of a comprehensive solution to help restore water levels in the lake".

This is the first time the DNR will incorporate cumulative impacts from water use within a specific geographic area and aquifer under the GWMA authority to help manage our water resources for the long-term. The GWMA designation will address a broad set of water supply and water sustainability issues in the north and east metro and not be focused only on the White Bear Lake area.

Several other areas of the state are being actively considered for designation as groundwater management areas, including the Straight River area and the Bonanza Valley area. For more information contact DNR Hydrogeologist Paul Putzier at 651-259-5692.

Minnesota Department of Health Updates Health-Based Guidance Value for TCE in Drinking Water

Trichloroethylene or TCE is one of the most commonly found groundwater contaminants in Minnesota, particularly at industrial or commercial sites where past disposal practices did not protect groundwater. However, there is no TCE present in drinking water for most Minnesotans who receive drinking water from a public utility or a private well.

In 2013, MDH updated past drinking water guidance for TCE due to new toxicity and health effects information. The updated value is 0.4 parts per billion (ppb). Because of new information and new methods used to develop guidance, this level is less than one-tenth of the previous guidance value of 5 ppb. A person drinking water at or below the updated guidance value, whether exposed briefly, occasionally, or daily for a lifetime would have little or no risk of health effects.

More information on the new TCE human health-based guidance value can be found on the Minnesota Department of Health's website at www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html

WCEC Acquires Determan Brownie's Environmental Division

WCEC is pleased to announce the acquisition of Determan Brownie's Environmental Division. This addition, together with WCEC's team of full-service environmental professionals, will enable WCEC to handle all of your industrial, waste disposal and consulting needs in a timely and cost-effective manner.

WCEC's new Industrial Services Division will be conveniently located in the previous Determan facility in Fridley, Minnesota. To further discuss this exciting acquisition or to schedule a site visit to see and learn more about our new enhanced capabilities and expansion, please contact Cory Teff or Jon Pollock at 763-571-4944.

Pace Analytical Services, Inc., Purchases ZymaX Forensics Laboratory in Escondido, CA

Pace Analytical, the second largest environmental testing firm in the U.S., announces the acquisition of ZymaX Forensics laboratory located in Escondido, CA, from DPRA. Forensics is an internationally respected environmental and geochemical laboratory offering state-of-the-art forensic isotope analysis. ZymaX specializes in expert witness and litigation support for consultants, industry, attorneys, and insurance companies in the assessment/remediation/litigation of spills in the environment. The addition of this capability will support Pace's oil and gas remediation customers around the country. The acquisition of ZymaX broadens Pace's extensive specialty service offerings to include more capabilities for soil and groundwater contamination, especially for hydrocarbon and other organic contamination.

ZymaX Forensics provides Pace Analytical customers with Forensic Isotope Analysis, Hydrocarbon Fuel Identification, and Gas Geochemistry. With a staff of three experienced Ph.D. chemists and environmental geochemists, Pace will now offer litigation support and expert witness testimony.

Nitrate-Nitrogen in the Springs and Trout Streams of Southeast Minnesota, cont.

watershed's row crop percentage by 0.16. The strong correlation between nitrate-nitrogen concentrations in baseflow and watershed row crop percentage suggests that, in general, the land use has over time impacted the condition of the underlying aquifers that are the source of these streams' baseflow. Trend analyses of nitrate-nitrogen concentration data from three trout hatchery springs in Southeast Minnesota were completed to examine changes in concentration over time at these locations. Statistically significant increasing trends in both nitrate-nitrogen concentration (p-values ranged from 0.01- 0.001) and load (p-values ranged from 0.05 - 0.001) in groundwater were documented at each location over a period of the most recent twenty years.

BACKGROUND

The landscape of Southeast Minnesota is defined by coldwater trout streams and karst topography. The karst is characterized by integrated drainage and largely shaped by the dissolving action of water on limestone (MPCA). Land use in the region is currently dominated by row crop agriculture, which typically involves regular application of commercial nitrogen fertilizer and/or manure to the land surface. Nitrate contamination of surface water and groundwater is a multi-faceted concern. Impacts to municipal and private drinking water supplies by nitrate are widespread and well-documented across the United States. High nitrate concentrations in drinking water have been linked to the occurrence of methemoglobinemia in infants, and may increase cancer risks in adults (Weyer *et al*., 2001). Also, nitrate can reach toxic levels that impair the ability of aquatic animals to survive, grow and reproduce (Camargo and Alonso, 2006). Further, loading of excess nutrients (including nitrate) to still-water systems (lakes, reservoirs, and the Gulf of Mexico) and large rivers can accelerate eutrophication, a problem that can lead to nuisance algae blooms and low levels of dissolved oxygen, as in the northern Gulf of Mexico. A recently published (June 2013) study led by the Minnesota Pollution Control Agency – Nitrogen in Minnesota Surface Waters – provides a comprehensive examination of available nitrogen data, trend analysis and identification of sources of nitrogen in Minnesota (http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/nutrient-reduction/nitrogen-study-looks-at-sources-pathways.html).

METHODS & ASSUMPTIONS

1. Baseflow mean nitrate-nitrogen concentrations and corresponding watershed land use were summarized for 100 sampling stations located on trout streams and other coldwater streams mostly in the Driftless Area ecoregion of southeast Minnesota. The drainage areas upstream of the sites ranged in size from 9 to 831 km2 with a majority of the watersheds (82) ranging from 14 to 150 km2.

2. "Nitrate-nitrogen" refers to either a measured nitrate -nitrogen mass expressed as N, or (in most cases) the combined mass of nitrite-nitrogen and nitrate-nitrogen (NO2-N+NO3-N) expressed as N. In this paper, "nitrate-nitrogen" and (NO2-N+NO3-N) hereinafter will be referred to as "nitrate" since nitrite typically is negligible and close to zero.

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Nitrate-Nitrogen in the Springs and Trout Streams of Southeast Minnesota, cont.

3. Nitrate concentration data were collected from various sources of ambient stream monitoring program data:

a. The MPCA's ambient surface water database (44 stations; entire period of record used; number of values at each site ranged from 4 to 251, although only 11 sites had an n < 10;

b. MPCA's Intensive Watershed Monitoring (one to two samples per station collected in 2008 at 32 sites); and

c. MPCA's stressor identification field work (one to two samples per station collected in 2009 and 2010 at 24 sites).

4. Baseflow is the condition that conducts the majority of nitrate-nitrogen through Driftless Area ecoregion streams (Masarik et al, 2007); therefore those sample values were the focus of this analysis. Criteria used to identify baseflow condition samples included paired stream transparency values >60 centimeters and total suspended solids values <1 mg/L. Baseflow and overall mean nitrate concentrations were computed for each station.

5. For each sampling point, the surface watershed was delineated using ArcGIS Spatial Analyst (ESRI, 1999).

6. Each watershed was intersected with the 2009 land cover data provided by the National Agricultural Statistics Service (NASS). The NASS Cropland Data Layer (CDL) is a raster, geo-referenced, crop-specific land cover data layer with a ground resolution of 56 meters (NASS). The land use classifications corn and soybean were summed to arrive at total row crop acres in each watershed.

7. Spring flow and nitrate data at three trout hatcheries were collected by DNR staff for the National Pollutant Discharge Elimination System (NPDES). Nitrate data at the hatcheries were also collected by the Minnesota Department of Agriculture as part of their spring monitoring program. Data were collected for 20 years at the Lanesboro and Peterson hatcheries, and for eleven years at Crystal Springs. The number of samples ranged from 110 to 250 at the three sites; period of record for each hatchery is as follows: Lanesboro State Hatchery (1991 to present), Peterson State Hatchery (1989 to present), and the Crystal Springs Hatchery (2002 - 2012).

8. Data analysis was completed using MS Excel 2007 (Microsoft 2007) and SYSTAT version 13 (SYSTAT Software Inc., 2009). Excel scatter plots and trend lines were used for linear regression analysis of the stream data. A qualitative comparison of raw and log-transformed indicated similar results, so the raw data results are presented here. Trend analyses of the springs data were completed using the Mann-Kendall nonparametric test (SYSTAT) & Sen's Method test (MS Excel add-in MakeSens).

RESULTS

The percentage of land in corn and soybean acres in the study watersheds varied from 1.4% to 73.2%. Baseflow mean nitrate concentrations ranged from 0.21 mg/L to 17.41 mg/L. The plot of mean baseflow nitrate concentrations and percent row crop land within the sites' drainage areas indicates that nitrate concentrations were generally higher in watersheds that were more intensely cropped with corn and soybeans (Figure 1). The linear regression of baseflow nitrate concentrations and percent row crop was statistically significant ($p < 0.05$) and indicates that nearly 70 percent of the variation ($R^2 = 0.68$) in concentration could be explained by row crop percentage. The slope and

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y-intercept of the regression line were 0.16 and 0.00, respectively. Because some sampled watersheds are nested within other sampled watersheds (36 such instances), the data used are not completely independent (however, a linear regression of the 64 independent sites shows a slope, intercept and r-squared value that are nearly identical to those for the regression of the entire dataset). The raw data are presented here for easier visualization of nitrate concentrations and row crop percentages to depict the general relationship. Sites with very low baseflow nitrate concentrations (< 1 mg/L) generally had low percentages of row cropland in their watersheds. Statistically significant increasing trends in both nitrate concentration (p-values ranged from 0.05- 0.001) and load (p-values ranged from 0.05 - 0.001) were documented at three trout hatchery springs, for periods covering the last twenty years. The slope of the Peterson hatchery spring trend line (Figure 2) was approximately double that of the Lanesboro hatchery spring.

CONCLUSIONS

The analysis of baseflow nitrate concentrations in Southeast Minnesota trout streams, percentage of row crop land in the watersheds of these streams, and the nitrate concentrations at state fish hatchery springs provides evidence of a potential source of the nitrate, some instances of increasing nitrate concentrations over time, and low nitrate concentrations in watersheds in which row crops are not a dominant land use. Specific conclusions include:

1. Potential Source Linkage: Nitrate concentrations in Southeast Minnesota's trout streams show a strong linear relationship to row crop land use. A linear regression showed a slope of 0.16, suggesting that the average baseflow nitrate concentration in the trout stream watersheds of Southeast Minnesota can be

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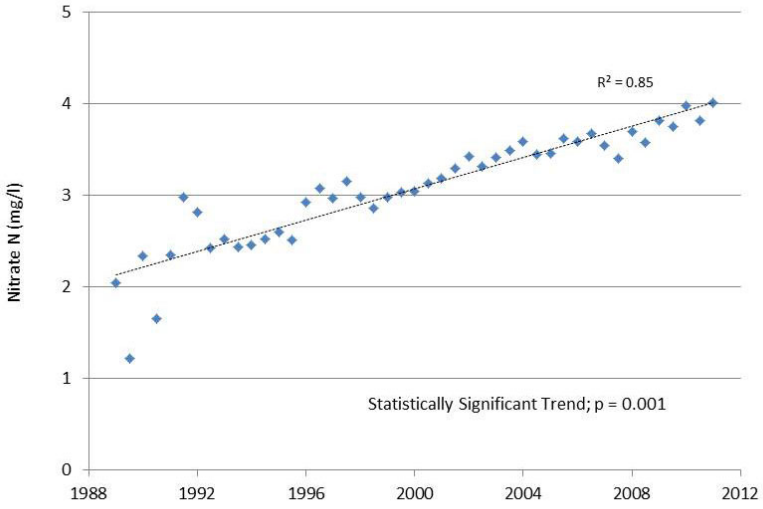

Figure 2. Peterson Hatchery Spring Nitrate-N Concentrations Six-Month Averages.

approximated by multiplying a watershed's row crop percentage by 0.16. This regression analysis indicates that a watershed of approximately 60% corn and soybean acres corresponds to an exceedance of Minnesota's drinking water nitrate-nitrogen standard of 10 mg/L at the point of sample in the stream (trout streams in Minnesota are protected as drinking water sources). This conclusion is supported by the findings of Nitrogen in Minnesota Surface Waters, which describe similar relationships between nitrogen in surface waters and "leaky soils below row crops," which include areas of shallow depth to bedrock such as the trout stream region of Southeast Minnesota (MPCA, 2013).

2. Trends: While there is variability in source water to the region's springs and trout streams (and thus trends and rates of increase or decrease in nitrate concentration may vary accordingly), nitrate concentrations in Southeast Minnesota's trout hatchery springs are increasing, as depicted by trend analysis.

3. Potential Natural Background: The natural background level of nitrate in streams appears to be very low given that the baseflow concentrations of streams with undisturbed (very little row crop land use and little or no other human impact) watersheds were less than 1 mg/L. Statistical analysis also suggested that in the absence of human disturbance in a watershed, the baseflow nitrate concentration at the point of sample in the stream could approach 0 mg/L. This is in general agreement with recent work by the U.S. Geological Survey (USGS) that concluded that human impacts are the primary reason for elevated nitrogen in United States surface waters; background concentrations of nitrate were 0.24 mg/L in watersheds dominated by non-urban and non-agricultural land uses (Dubrovsky, et al., 2010).

In addition to providing evidence of a linkage between water quality and row crops as a potential pollutant source, it is useful in understanding nitrate contamination of drinking water, potential stressors of aquatic ecosystems, and excess nutrients in surface waters. Given the scale (stream and river watersheds), this analysis does not address the effectiveness of specific nutrient management practices, or the current trends regarding their implementation in Southeast Minnesota. Rather, the strong correlation between nitrate concentrations in trout stream baseflows and watershed row crop percentage suggests that, in general, the land use has over time impacted the condition of the underlying aquifers that are the source of these streams' baseflow.

SOURCES

Alexander, E. Calvin, Jr. Department of Earth Sciences, University of Minnesota.

Camargo, Julia A. and Alonso, Alvaro. Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: A global assessment. Environment International 32 (2006) 831–849.

Dubrovsky, N., Karen R. Burow, Gregory M. Clark, Jo Ann M. Gronberg, Pixie A. Hamilton, Kerie J. Hitt, David K. Mueller, Mark D. Munn, Bernard T. Nolan, Larry J. Puckett, Michael G. Rupert, Terry M. Short, Norman E. Spahr, Lori A. Sprague, and William G. Wilber (2010). The Quality of Our Nation's Water: Nutrients in the Nation's Streams and Groundwater, 1992-2004. U. G. S. US Dept. of the Interior. Circular 1350.

Environmental Systems Research Institute (ESRI). ArcGIS ArcMap, version 9.3.1. 1999.

Masarik, K.C., G.J. Kraft, D.J. Mechenich, and B.A. Browne. 2007. Groundwater Pollutant Transfer in a Mississippi Valley Loess Hills Watershed. Final Report to WI Department of Natural Resources.

Microsoft 2007. Excel 2007. Microsoft, Redmond WA.

Minnesota Pollution Control Agency. Nitrogen in Minnesota Surface Waters. 2013.

Minnesota Pollution Control Agency fact sheet: Karst: A Complex Landscape Sculpted by Water.

National Agricultural Statistics Service, USDA. 2009 land use data.

Systat Software, Inc. Systat 13, Version 13.00.05. 2009.

Weyer PJ, Cerhan J, Kross BC, Hallberg GR, Kantamneni J, Breuer G, et al. Municipal drinking water nitrate level and cancer risk in older women: the Iowa Women's Health Study. Epidemiology 2001;12:327–38.

NEW PUBLICATIONS

New Groundwater Study Shows Increases in Some Pollutants

by Cori Rude-Young and Sharon Kroening, MPCA

One of the roles of the MPCA is to assess the condition of Minnesota's groundwater. Clean groundwater is vital to the state of Minnesota. Groundwater supplies drinking water to about 75 percent of all Minnesotans and almost all of the water used to irrigate the state's crops. The inflow of groundwater also is important to Minnesota's streams, lakes, and wetlands.

In a new groundwater report http://www.pca.state.mn.us/index.php/view-document.html?gid=19743 , MPCA primarily looked at monitoring data from 2007-2011 that included traditional pollutants known to adversely affect groundwater such as nitrate, chloride, and volatile organic compounds (VOCs or chemicals that participate in forming ozone). The report also included some newly-recognized pollutants, such as medicines, insect repellents, and fire retardants. The effects of these new pollutants, which are often referred to as contaminants of emerging concern or CECs, on human and aquatic life, are not fully understood at this point.

Highlights from "The Condition of Minnesota's Groundwater, 2007-2011" include:

Shallow groundwater in the Twin Cities Metropolitan Area (TCMA) is impacted by high chloride concentrations with 27 percent of the TCMA monitoring wells in the sand and gravel aquifers having concentrations that were greater than drinking water guidelines set by EPA. If chloride continues to increase in the groundwater, additional waters will likely violate drinking water and water-quality standards in the future.

Nitrate contamination generally has not changed over the last 15 years; however, concentrations remain high in certain parts of the state. The highest nitrate concentrations occurred in the aquifers in Central and Southwestern Minnesota.

CECs were detected in about one-third of the sampled wells in 2010. The most-frequently detected chemicals were the fire retardant tris phosphate, the antibiotic sulfamethoxazole, and bisphenol A and tributyl phosphate. No concentrations violated any applicable human-health guidance set by the state of Minnesota.

Monitoring is ongoing with additional wells being installed to increase the breadth of the monitoring network. This work will serve the state well into the future by detecting contamination problems that occur along with developing and tracking groundwater quality trends. To view the executive summary and full report on the condition of Minnesota's groundwater, visit the MPCA's Groundwater in Minnesota webpage www.pca.state.mn.us/index.php/water/water-types-and-programs/groundwater/index.html.

New from the USGS

Mercury in Glacial Ridge National Wildlife Refuge Wetlands

A new report on mercury in wetlands at the Glacial Ridge National Wildlife Refuge was published on June 3. The largest wetland and prairie restoration in United States history recently was completed at the Refuge. More than 3,000 acres of wetlands were restored, more than 100 miles of ditches were filled, and nearly 18,000 acres of land was reseeded with native prairie plants. Microbial conversion of inorganic mercury to the bioaccumulative methylmercury form is a particularly active process in wetlands, making wetlands important methylmercury "hotspots" on the landscape. Concentrations of methylmercury in the Glacial Ridge NWR wetlands are among some of the highest in the published literature, suggesting wetland restoration is a potential concern for wildlife.

Full citation: Cowdery, Timothy K. and Brigham, Mark E., 2013, Mercury in wetlands at the Glacial Ridge National Wildlife Refuge, northwestern Minnesota, 2007-9, U.S. Geological Survey Scientific Investigations Report: 2013-5068, 17 pp. Available at: http://pubs.er.usgs.gov/publication/sir20135068

LINKS OF INTEREST

Wisconsin Groundwater War Pits Farms against Fish

A lot has been written recently of Minnesota's shortage of available groundwater in a number of rural and urban communities, but now word comes that we are not the only Great Lakes state to face such shortages. Wisconsin, our neighbor to the east, is discovering that in the water-rich Central Sands area dramatically rising farm field irrigation is causing nearby lakes to decline and in one case even dry up completely. The link below connects to a Wisconsin Watch article which quotes from George Kraft, a professor of hydrogeology at the University of Wisconsin, Stevens Point, and acknowledged expert on Wisconsin groundwater issues.

MGWA members might have seen Dr. Kraft in July 2012 when he was invited to St. Paul by the DNR to talk about his work on the interaction of groundwater and surface water. Or perhaps you heard him last October when he gave several talks at the Midwest Groundwater Conference in Brooklyn Park.

Though the water demands faced by both states are similar, their response to the mounting pressure on scarce supplies is not. An interesting contrast is being set up where Wisconsin is taking a strong pro-agriculture position on water use while Minnesota moves toward setting up aquifer management zones that will allow a voice to all users in individual watersheds.

www.wisconsinwatch.org/2013/07/21/groundwater-war-pits-wisconsin-farms-against-fish-2/

New Minnesota DNR LiDAR Portal

by Andrew Streitz - MGWA Newsletter Team/MPCA

Have you heard about the new elevation data that lets you differentiate streets from curbs, flood plains from stream channels, and even pick out drain tiles in farmer's fields? It's called LiDAR, for "light detection and ranging", and it's revolutionizing work in many different environmental fields. Until today its use in Minnesota has required expertise in a program like ESRI's ArcMap, but the data are now available to the general public through a web-based mapping interface called the Minnesota Topographic Portal or MnTOPO. This map-enabled application shows two foot contours, and other elevation-related information on top of air photos, shaded relief and base maps. Visitors can also download elevation data for use in CAD, GIS and other visualization software on their desktop. One interesting feature allows the user to draw a line and generate an elevation profile along its length . The MnTOPO application was built by staff at the DNR and MnGEO, and was approved and funded by the Clean Water Fund of the Legacy Amendment with staff and funding contributions from USGS, NRCS, MnDOT, MN.IT, University of Minnesota and counties across the state. Through this collaboration, Minnesota is now one of very few states to have complete LiDAR coverage that is viewable and downloadable through common gateways of access. The application is officially open on October 1, 2013, although visitors can access it now at the following link:

http://arcgis.dnr.state.mn.us/gis/lidarviewer/

More information on the Minnesota Elevation Mapping Project can be found at this link:

www.mngeo.state.mn.us/committee/elevation/mn_elev_mapping.html

2013 International Low Impact Development (LID) Symposium

by Eric Tollefsrud - MGWA Newsletter Team/Geosyntec Consultants

The 2013 International Low Impact Development (LID) Symposium was held in St. Paul on August 18-21, 2013 through a collaborative effort between many states, universities, and organizations.

LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, so that water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions.

Some goals of the symposium were to further the understanding of stormwater management and to further the science of low impact development. From the Great Lakes to the Mississippi Watershed, every state in the Midwestern United States is addressing urban water quality issues from combined sewer overflows to stormwater runoff. The 2013 International LID Symposium brought together over 1,000 professionals to share their research, implementation, policy, financing, and education strategies to build and restore cities while protecting our environment.

For more about this recent symposium, see the website:

http://www.cce.umn.edu/2013-International-Low-Impact-Development-Symposium/

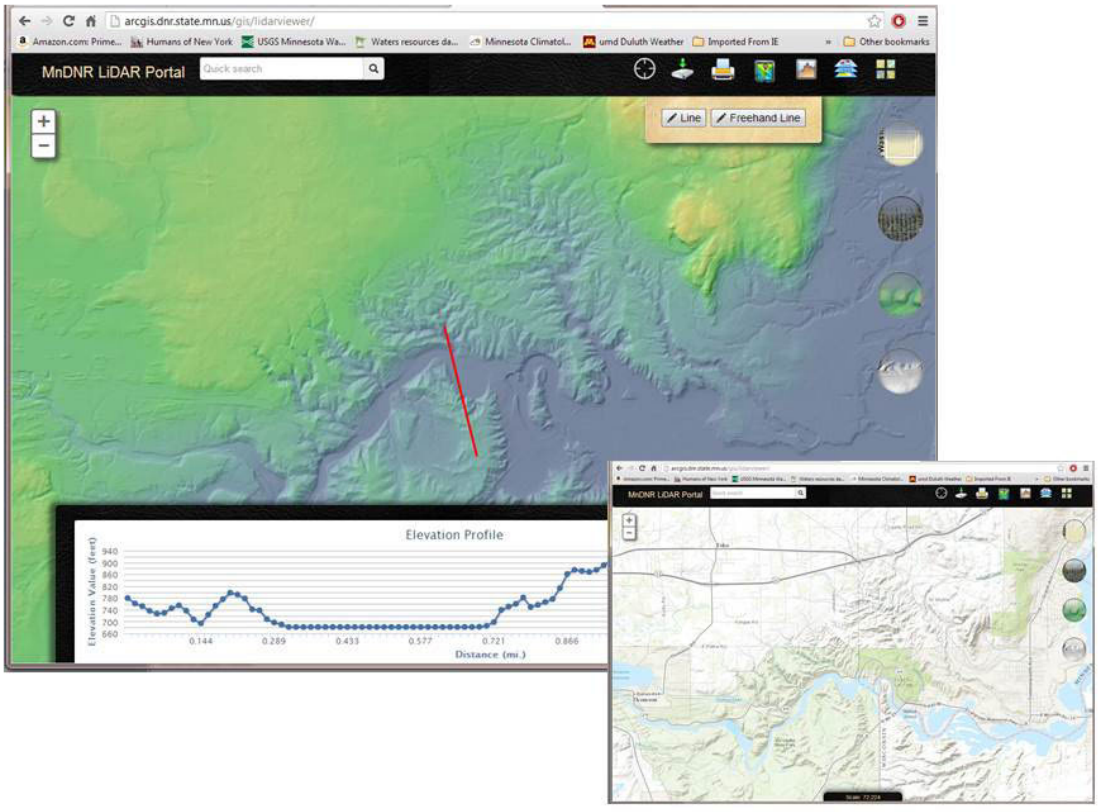

Figure. LiDAR presentation of the lower St. Louis River, with elevation profile and street view.

MGWA BOARD MINUTES

Minnesota Ground Water Association Board Meeting Minutes

Meeting Date: May 1, 2013

Location: Fresh Grounds Café 1362 West 7th Street, St. Paul, MN

Attendance: Bob Tipping, President; Kelton Barr, Past President; Eric Mohring President-Elect (also taking minutes); Audrey Van Cleve, Treasurer; Jennie Leete, WRI; Sean Hunt, WRI

Past Minutes: April minutes approved.

Treasury: Van Cleve provided profit and loss statement, balance sheet and a draft report on Spring Conference financials. Board discussed latest information on income and expenses from the Spring Conference. The current reporting format does not separate out student scholarships and the exhibitor income that supports them. Conference reporting will have to be changed to accurately track this new way to subsidize student attendance. Board discussed profit and loss statement. The 'rainy day fund' at Affinity Plus earns very low interest. Van Cleve investigated investment opportunities. A 12-month CD ("Wahoo") judged to be a better deal than the "step-up" certificate at Affinity Plus. Comparative profit and loss and balance sheet summaries for multiple reporting periods were provided. Useful for looking at trends.

Newsletter: Ronning reported that the newsletter due date will be Friday May 3, with turnover on May 31. A topic recommended for June: membership update (paragraph on current state of membership)

Web Page: Hunt reported on the update of the conference web page - several times leading up to the conference and since the conference has posted photos, etc.

WRI Report: Hunt and Leete presented the membership report and business manager report.

Old Business: Post-mortem" on spring conference:
Barr said exhibitors were sent letters asking for feedback. He received a comment on how cramped space was – in part due to extra tables. Leete said that registration will be moved to the east side to open up the space for better circulation. Leete noted that MGWAs ability to charge reasonable fees for attendance is linked to staying at an affordable facility. "Upgrading" to the next level of facility (hotel venue or major conference center) would add risk and limit our ability to reduce costs for students and retired members. Discussion on better ways to manage exhibitors. Complaints to venue: coffee pots ran out instantly, AV problems, audio recording not done. Volunteer help recognized. Suggestion to revise the operations manual to include deadlines for all aspects of conference planning.
Midwest Ground Water Conference
Have had contact with North Dakota, coordination on web pages. North Dakota has chosen their dates and has been given 'the keys' to drive their conference web page.
Discussion of MGWA conference co-sponsorships
Work on NKKRI co-sponsorship agreement, sorting out membership registration discounts; work on "generic" co-sponsorship agreement
Discussion of AIPG/AWG/MGWA joint field trip
"Karst, Kaves, Kalvin" suggested for handle. Need for liability form discussed. Need for "who-does-what" agreement. Tasks: Registration, Liability, Guidebooks, Logistics

New Business: MGWA fall conference
Topic: economics of ground-water management. Ideas for speakers and exhibitors now being solicited!
MGWA/F Tax Filing Extensions
Leete discussed filing extensions for the MGWA 990 and 990T and for the MGWAF 990. The MGWAF's Minnesota requirements are met by turning in the Federal 990 plus a filing fee, so that will be delayed until the Federal form is done.

Meeting Date: June 7, 2013

Location: Fresh Grounds Café, 1362 West 7th Street, St. Paul, MN

Attendance: Bob Tipping, President; Kelton Barr, Past President; Eric Mohring President-Elect (also taking minutes); Audrey Van Cleve, Treasurer; Sean Hunt, WRI; Gil Gabanski, MGWAF president.

Past Minutes: May minutes were approved electronically as amended

Treasury: Van Cleve provided profit and loss statement, balance sheet and a comparison spreadsheet. Information on attendance will be included in the spreadsheet in future. Action item: Clarify how funds raised through exhibitors on behalf of the Foundation will be accounted for. As part of this we need to keep track of attendance numbers of regular members, students, retirees. Need to compare costs of students compare with money taken in by the Foundation.

Newsletter: Newsletter team has handed over files for final assembly. "Out by June"

Web Page: Some employment opportunities; Barr said that the web page for the sinkhole conference has been framed up. It will mostly be maintained by NKKRI, with help from Hunt.

WRI Report: Report submitted to treasurer; All speaker expenses for the spring conference have

MGWA 2014 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.

The MGWA Board of Directors meets once a month.

All members are welcome to attend and observe.

MGWA Minutes, cont.

been paid; Filed for extensions for tax reporting

Old Business: Sinkhole Conference – Need to schedule trip to Rochester to look over facility; hotels are starting to want contracts; need to ask for agreements; Barr volunteered to be "Czar" of conference on behalf of MGWA, he is already networking with geotechnical community; Tipping moved that Barr be appointed chairman of MGWA's involvement in the NKKRI/MGWA sinkhole conference - seconded - passed unanimously.
White Paper – Barr has outlined framework, to appear in June Newsletter; Need to form a committee, 4 members, staggered terms, appointed by board.
Discussion of AIPG/AWG/MGWA joint field trip – Had meeting at MGS with MGWA – AWG – AIPG; discussed spending the night at Eagle Bluff on Friday; limit to 55 people (one big bus)? leave from Rosedale? pickup in Rochester?

New Business: MGWA Foundation President – Scott Alexander suggested as candidate; Barr has broached the subject; Tipping made motion to formalize team to search for new Foundation president. This will include looking in to bylaws. Seconded and Approved

Meeting Date: July 12, 2013

Location: Fresh Grounds Café 1362 West 7th Street, St. Paul, MN

Attendance: Bob Tipping, President; Kelton Barr, Past President; Eric Mohring President-Elect; Julie Ekman, Secretary; Tedd Ronnng, Newsletter Editor; Gil Gabanski, MGWAF President; Jennie Leete, WRI; Sean Hunt, WRI.

Past Minutes: Approved as amended.

Treasury: Copies of the report were provided by Leete. Net income is $27,000; total assets: $79,500.

Newsletter: Ronning pointed out that articles are needed by August 2nd for the next edition. He is seeking historical field work photos for future newsletter features.

Web Page: Hunt has drafted up web pages for the fall conference; the exhibitors' page is posted. He is receiving employment opportunities; Board members discussed how to relay this information to members. Barr moved that Hunt send emails to MGWA members alerting them that job postings are posted on MGWA web pages. Motion carried.

WRI Report: Leete has received 3 tax extension approvals and is finalizing the necessary paperwork.

Foundation: The MGWAF recommends that Scott Alexander serve as the next Foundation President. Tipping moved that the Board accept and approve the Foundation's recommendation. Motion carried. This will be announced at the fall conference.

Old Business: NCKRI (Sinkhole) Conference – Barr and other conference organizers visited the Civic Center and explored venue options. Barr described the pros and cons of 3 options—Grand Ballroom, Exhibit Hall 4, and Presentation Hall. The costs are reasonable and will be rolled into the registration fees. The expected attendance and the number of sessions will need to be estimated before choosing a venue. Barr will be meeting with NCKRI organizers and the Board will address this at the August 9th meeting.
MGWA White Paper Initiative – Barr explained the process for getting this going—people willing to be on this committee should be selected yet this summer. He suggests that the committee include 2 people serving 2-year terms and 2 people serving 4-year terms so that turnover is staggered. Kelton had a created list of people for the Board to consider. He suggested that members be selected based on their ability to approach topics from a neutral position (i.e., they don't have a vested interest in a topic). The WPI Committee will chose topics for MGWA Board approval. It is expected that the time commitment for committee members will vary from 4 hours/week to 4 hours/month when engaged in a specific white paper topic.
MGWA Fall Conference (November 13th) – Board members discussed speaker options for conference topics (Nitrates; economic value of water); we are interested in someone who can talk about agriculture and economics of groundwater. Need to fill about 7 speaker slots.
AIPG/AWG/MGWA joint field trip (October 18 & 19, 2013) – Tipping will write a description of the field trip and cost information for the MGWA website. Cost will be $150/person; Eagle Bluff requires a deposit by the end of July. A field guide will be provided for participants.

MGWA Minutes, cont.

Meeting Date: August 9, 2013

Location:	Fresh Grounds Café 1362 West 7th Street, St. Paul, MN
Attendance:	Bob Tipping, President; Kelton Barr, Past President; Eric Mohring President-Elect; Audrey Van Cleve, Treasurer; Julie Ekman, Secretary; Tedd Ronnng, Newsletter Editor; Gil Gabanski, MGWAF President; Jennie Leete, WRI; Sean Hunt, WRI.
Past Minutes:	Approved as amended.
Treasury:	Copies of the report were provided by Van Cleve. Net income is $21,712; total assets: $73,436
Newsletter:	Ronning reported that the next issue will be ready for publishing next week. Barr will need space for an article on the White Paper Initiative; Tipping asked that a notice on the fall field trip be included.
Web Page:	Hunt has set up the web page for the AIPG fall field trip. He will contact the Midwest Groundwater Conference organizer about any needed web updates
WRI Report:	Leete distributed her written report; she has completed all tax forms for 2012.
Old Business:	NCKRI (Sinkhole) Conference – Board members viewed slides provided by Barr of the venue options within the Civic Center and the Thursday night banquet. He shared the recommendations of the Board members who visited these sites. Mohring moved that the Board accept the recommendations. Motion carried. The conference will be in the Presentation Hall and Grand Ballroom of the Civic Center and the banquet will be in the Heritage Room at the Kahler Grand Hotel. MGWA White Paper Initiative – The Board discussed potential members for this committee. Ekman moved that the Board accept these volunteers as committee members: Kelton Barr, Bruce Olsen, Jeff Stoner, and Mark Collins. Motion carried. MGWA Fall Conference (November 13th) – Board members discussed changes to the student rate for the conference; instead of refunding the entire fee, a portion would be retained as the MGWA membership for the student. The conference will include recognition of Scott Alexander, new Foundation president and an award presentation to outgoing Foundation president, Gil Gabanski. Early registration for the reduced price will end October 25th. So far 4 speakers are lined up; 3 more are desired. The conference will be focused on the economic value of groundwater. AIPG/AWG/MGWA joint field trip (October 18 & 19, 2013) – The itinerary has been finalized. A box lunch will be provided for participants. Board members discussed the brochure for the field trip.
New Business:	American Groundwater Trust Geothermal heating & Cooling Innovations: Conference will be on September 11th in St. Paul. Mohring had been contacted with a request that MGWA help publicize the conference and be a workshop cooperator. The Board has agreed to this (with no other obligations). CEUs for the conference have been set up through MDH for licensed well contractors; CEUs are also available through self reporting to AELSLAGID. World Population Balance – Tipping received a letter from World Population Balance and had shared it with Board members; we discussed how MGWA could bring attention to the issue of population growth and water needs. Ideas are to address (on the web page) water issues vs population; write an article for the newsletter's Capillary Fringe; check to see if the Humphrey Institute has done any studies on this issue.

Don't Delay.

Register Now:

AIPG/AWG/MGWA Fall Field Trip and MGWA Fall Conference

Visit www.mgwa.org!

Midwest Ground Water Conference

September 23-25, 2013

Bismarck, North Dakota

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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 NEWS

Scott Alexander Selected as President of the Minnesota Ground Water Association Foundation (MGWAF)

Gil Gabanski, long time President of the MGWAF, will be stepping down at the end of 2013 and Scott Alexander has been selected to lead the organization (more on Gil in the December issue).

Scott has worked 20+ years at the Department of Earth Sciences at the University of Minnesota and is currently a Research Scientist and Project Manager. His projects have evolved over the years from groundwater flow in karst regions to contaminant migration in karst, sandstone, and glacial sediments. This work has further evolved to microbiology in brines and multi-phase, multi-component fluids as in CO2/brine/water/rock systems. All of this work is grounded in physical, chemical, and isotopic measurements of real world systems as a starting point for computer-based and laboratory-scale simulations. He has been involved with the summer Hydrogeology Field Camp at the University of Minnesota since its inception in 1995 and is now the coordinator. Scott was also the president of the Minnesota Ground Water Association in 2009.

Next time you see them, please thank Gil for his many contributions to the organization and congratulate and thank Scott for stepping up!

Foundation Director Amanda Strommer Acccepts Position with Pope County

She writes: "I have accepted a new position with Pope County (located in Glenwood, MN) as the Department Director for their Land and Resource Management Department. My family lives in eastern South Dakota and my husband's family lives by the Willmar area. So we are moving to a smaller community which is a closer drive to our relatives."

The Pope County Land and Resource Managment Department is charged with providing residents with assistance involving Planning and Zoning, Community Development, Solid Waste Management and Water Planning activities.