

Minnesota Ground Water Association

www.mgwa.org

Newsletter

March 2016
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Featured:

- ◆ White Paper Initiative, page 6
- ◆ Biological Reconnaissance Map Rediscovered, page 10
- ◆ Groundwater Flow Model for Slough Management, page 13



MGWA President
Ole Olmanson

Inside:

President's Letter	1
Member News	2
Abbreviations and Acronyms	4
MGWA News	6
Agency News	8
Professional News	9
Capillary Fringe	11
Featured Photo	12
MGWA/MGWAF Minutes	14

President's Letter

"Prediction is very difficult, especially if it's about the future."

This line, attributed to Danish physicist Niels Bohr, has many applications to those of us occupying the varied niches of the groundwater industry. We can observe the abundance of precipitation experienced over the course of the winter and predict that it will lead to increased recharge this spring, while knowing that if we warm up too quickly, our snowpack will end up hitching a quick ride down to the Gulf of Mexico instead of slowly percolating into our vital aquifers. We'll have to wait and see.

We can study our cities, plot their population changes over time, and predict how much water supply will be required a decade from now. From that we plan new wells based on information compiled from wells in other places and

use computers to draw lines between them. We use these lines to predict where the water is and how much there will be. Of course, we won't know until the well is drilled and the pumps are turned on, and despite all the planning, it will take a decade to really know how much water we'll need ten years from now.

I've had the opportunity to spend the last year observing and learning about the inner workings of the MGWA as president elect, and with the changing of the calendar, I've stepped into the role of president. I feel prepared, thanks in large part to the experiences acquired from watching and listening to a very dedicated and highly knowledgeable group of volunteers and staff. Although it's a difficult thing to do, I predict that this year will be full of learning opportunities, hard work, and big thinking.

— continued on page 4

Quality Control and Data Validation in the MPCA Ambient Groundwater-Monitoring Program

By Jane de Lambert (MDH)

In my previous position as a member of the Ambient Groundwater Monitoring Program at the MPCA, I helped collect data on groundwater from hundreds of wells across the state. The monitoring wells in this network were installed to allow for routine testing of groundwater in order to monitor trends in underlying chemistry and environmental contaminants. The wells were strategically placed into areas considered not degraded by contaminant spills or agricultural practices. Site wells are visited every year to take field measurements and groundwater samples for chemical analysis. (Figure 1)

As a relatively new and growing program at the MPCA, the Ambient Groundwater Monitoring Program began by placing a high priority on investigating a number of water quality threats, including chlorides, nitrates, and contaminants of emerging concern. As part of these investigations, laboratory analyses are performed for hundreds of individual chemicals. As part of the program's development, a systematic

approach to the process of data validation was developed, to ensure that only high quality,

— continued on page 4



Figure 1. A monitoring well during sampling by MPCA Ambient Groundwater Monitoring Program staff

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Newsletter Deadlines

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Jan Falteisek Retires from the Minnesota DNR

After twenty-five years leading the DNR part of the County Geologic Atlas program with colleagues at the DNR and at the Minnesota Geological Survey, Jan Falteisek retired in early January 2016. The joint County Geologic Atlas program at the DNR and MGS is the source of the geologic, groundwater, and pollution sensitivity maps in demand by hydrogeologists for their daily work. During Jan's time at the DNR, she saw the completion of 15 County Geologic Atlases and 5 Regional Hydrogeologic Assessments. Eleven more reports are underway at DNR; highlights of completed reports appear regularly in this newsletter. The MGS has at least 13 more atlases under way that the DNR will work on in the future. The program goal is to complete county geologic atlases for every county in the state and update older atlases as needed.

Jan would like to express thanks to Bruce Olsen, who while at the MGS, developed the idea of the County Geologic Atlas for Minnesota counties. The first County Geologic Atlas was completed in 1982 for Scott County. The concept and design of the County Geologic Atlas series has stood the test of time and has become an essential tool of geologists and groundwater specialists. She also wishes to thank all MGS geologists and DNR hydrogeologists who have worked with her on the atlas series over the years.



Prior to joining the DNR, Jan worked six years at the Minnesota Pollution Control Agency in the Superfund program. While completing her Master's degree, Jan worked several years for the Missouri Department of Natural Resources on mined-land reclamation projects.

For many years Jan was the MGWA Newsletter editor or a newsletter team member. She also served on the MGWA Board. She says assembling material for the newsletter and serving on the Board was a great way of meeting groundwater professionals working in many different agencies and organizations. And now in retirement, she believes the MGWA newsletter will be one of the best ways to stay in touch with the Minnesota groundwater community.

Greg Buzicky Retires from MDA

Greg Buzicky retired after 31 years with the MDA, 21 of those as a Division Director of the Pesticide and Fertilizer Management Division. Greg helped conduct the initial sampling of groundwater for pesticides in the 1980s, a primary factor leading to the development of the State Groundwater Protection Act in 1989. He was instrumental in the development of that law. Under Greg's direction over the last 25 years, the MDA has conducted extensive work addressing point and nonpoint sources of agricultural chemical contamination.

He developed a first of its kind program that remains one of the few nationwide programs providing partial compensation for the cleanup of agchemical spills and contaminated sites. Program accomplishments included the Agricultural Chemical Response and Reimbursement Account or ACRRA, bulk chemical and fertilizer storage permitting requirements, waste pesticide and used pesticide container management programs, the development

of pesticide and fertilizer best management practices, and the first state law in the nation restricting the use of phosphorus in lawn fertilizer.

Many of these activities are taken for granted today but they did not exist or were woefully inadequate 25 years ago. Congratulations Greg on your long and successful career!



MEMBER NEWS

Mindy Erickson Featured in Minnesota Conservation Volunteer

Former MGWA President Mindy Erickson was featured in the Young Naturalists section of the January-February issue of Minnesota Conservation Volunteer. The title of the article is "Explorers of the Underworld." In the article Mindy and two other Earth Scientists share their experience on the road to their careers. It's a great story that will hopefully encourage young naturalists in their pursuit of science.

The article can be found here: http://files.dnr.state.mn.us/mcvmagazine/young_naturalists/young-naturalists-article/geology/janfeb2016_young_naturalists.pdf

Jane de Lambert joins MDH

Jane de Lambert accepted a position as a Hydrologist 1 in the Source Water Protection Unit at MDH in February. She will be working on municipal well inventories, handling isotope samples, assisting with Ground Water Restoration and Protection Strategies (GRAPS) reports and various fieldwork.

Jane grew up in the Twin Cities and considers herself a Minnesota girl through and through. Jane began her career as an intern for Liesch Associates in 2010 where she assisted with various water supply projects. She then joined the MPCA in 2014 where she sampled groundwater for the Ambient Groundwater Monitoring Program, including collecting samples for contaminants of emerging concern. Jane has a B.S. in Geology and Human Health from the University of St. Thomas, and she recently completed her Master's of Public Health in Environmental Health Science from the University of Minnesota. For her thesis, Jane created a system for quality control analysis of MPCA groundwater data using R statistical software.

In her free time, Jane enjoys trying new

Nick Evans joins the Minnesota DNR

Nick Evans recently joined the DNR as the Metropolitan Groundwater Monitoring Hydrologist in the Water Monitoring and Surveys Unit. Nick's work will focus on coordinating the expansion and maintenance of the DNR groundwater level monitoring network in the 11-County Metro Area. Nick comes to the DNR from working on a master's in Water Resources Science at the University of Minnesota – Twin Cities, where he was a Research Assistant at Saint Anthony Falls Lab and a Teaching Assistant for the Hydrogeology Field Camp. Prior to graduate school, Nick spent over 6 years working as a field technician and geologist for an environmental consulting firm in St. Paul.



restaurants and spending time with friends and family.

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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.



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MPCA QC Process, cont.

accurate information is distributed by the program. Recently, the decision was made to develop a standardized, statistically valid approach that would ensure that our data was of a consistently high level before it was flagged as “approved” in our database and released to the public. Working with others in the groundwater unit, I set out to develop a systematic approach to the investigation of groundwater data using R statistical software. This effort also became a central component of my master’s project at the University of Minnesota’s School of Public Health. The R software was chosen for this task based on the current use of R for QC review in the MPCA’s Air Quality program, the growing use of R at the state level, and not least of all, because it is free to use.

One specific aim of this endeavor was to write strings of code to help our staff to take a “first look” at the datasets, allowing staff to quickly

and easily identify any extreme outliers or out-of-range values, and to glean a general idea of trends in these large and complicated datasets. The first step was to identify which statistical outcomes and plots would be most useful to this purpose. The short list of statistical tests included histograms, log-normalized quantile-quantile plots, latitude and longitude plots, plots of chemical concentrations over time, summary statistics, and boxplots. Histograms were chosen to provide an overall trend of the frequency of certain values in the dataset, log-normalized quantile-quantile plots to serve in identifying outliers, latitude and longitude plots to allow for the analysis of data geographically across the state, summary statistics (mean, median, 1st and 3rd quartiles, and the maximum/minimum values for the results of any given parameter), and boxplots to show these numbers graphically. These plots and outcomes were not meant to provide a compre-

— continued on page 5

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

Open R Studio

This is what a new project looks like in R Studio

The large console on the left is where code/commands can be typed in

A history of the code is recorded in the upper right-hand corner (it can be clicked to recreate the function without retyping it)

The lower right-hand corner is where plots are displayed

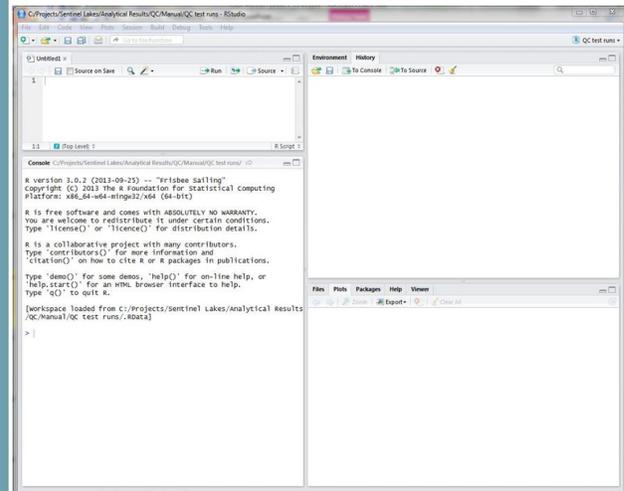


Figure 2. A screenshot from the Data Manual demonstrating how to start a new project in R

President's Letter, cont.

Speaking of thinking big, the MGWA spring conference is coming up soon, and we’ve been busy compiling a slate of speakers intended to illustrate and inspire our members to think big when it comes to Minnesota’s ground water resources.

Invited presenters and subjects include:

- ◆ Richard Laton – UC Fullerton – wastewater injection in Orange County, California
- ◆ Chris Larson – SEH – aquifer storage

- ◆ and recovery in St. Michael, Minnesota
- ◆ Mary Fralish – City of Mankato – water conservation through cooperative reuse
- ◆ Peter Cartwright – Cartwright Consulting – membrane technology for contaminant removal

Our goal for the spring meeting is to get everyone thinking about how we can look at old problems in new ways and find new partners to address the challenges we see today and prevent them from becoming a bigger problem in the unpredictable future.

MPCA QC Process, cont.

hensive statistical analysis, but rather to give insight on certain characteristics of the dataset.

The next step in development of this statistical analysis process was to write a string of code for each desired outcome. (Figures 2 and 3) Once the individual strings of code were written, all desired strings were combined into scripts, allowing the entire set of outcomes to be populated simultaneously. An example of the program's use would be to first run a quantile-quantile (QQ) plot, which reveals the distribution of, for example, all the chloride sample results for 2015. This test highlights outliers that then can be checked by other means to determine if the results are reasonable. Another use could be to plot the latitude/longitude of nitrate, looking for spatial outliers. Similarly, pH results could be displayed to look for values outside of the expected range.

This approach takes advantage of the settled and established format of the stored data in the statewide legacy database, EQuIS. As a result of this stability, data reports should be able to be pulled from this database and run through the R routines for years to come. The routines also make use of variables such as the Chemical Abstracts Service (CAS) code to avoid problems with parameters that are named using multiple conventions. Wells are identified by their State Unique number, as used in the County Well Index database.

Another major component of this project was to create a data manual that would outline the process of creating these scripts in R using a step-by-step procedure. The goal was to provide an easy-to-use process that would not only allow users to investigate the groundwater datasets, but also to familiarize them on the use of the R structure. As staff become more comfortable with R, the hope is that they will improve the validation process by adding new statistical tests and routines to the manual.

In summary, the purpose behind creating this statistical process in R was to produce a preliminary template for establishing a consistent quality control system of data analysis for the Ambient Groundwater Monitoring Program. This system is now undergoing testing, and would certainly benefit from further development.

Through my work on this project I was able to step outside my previous role, which was focused primarily on the collection of samples. I can now appreciate what happens after the samples are shipped to the lab. After working on this project I found time to reflect on the clarity of the field experience, where procedures and training ensured the collection of high quality samples. When contrasting that with the task of organizing and analyzing thousands of data points, I have seen that it can at times resemble a field sample with high turbidity. I can say confidently that I have gained from this experience a newfound respect for those who take charge of the large and unruly data sets that field samplers hand off to them!

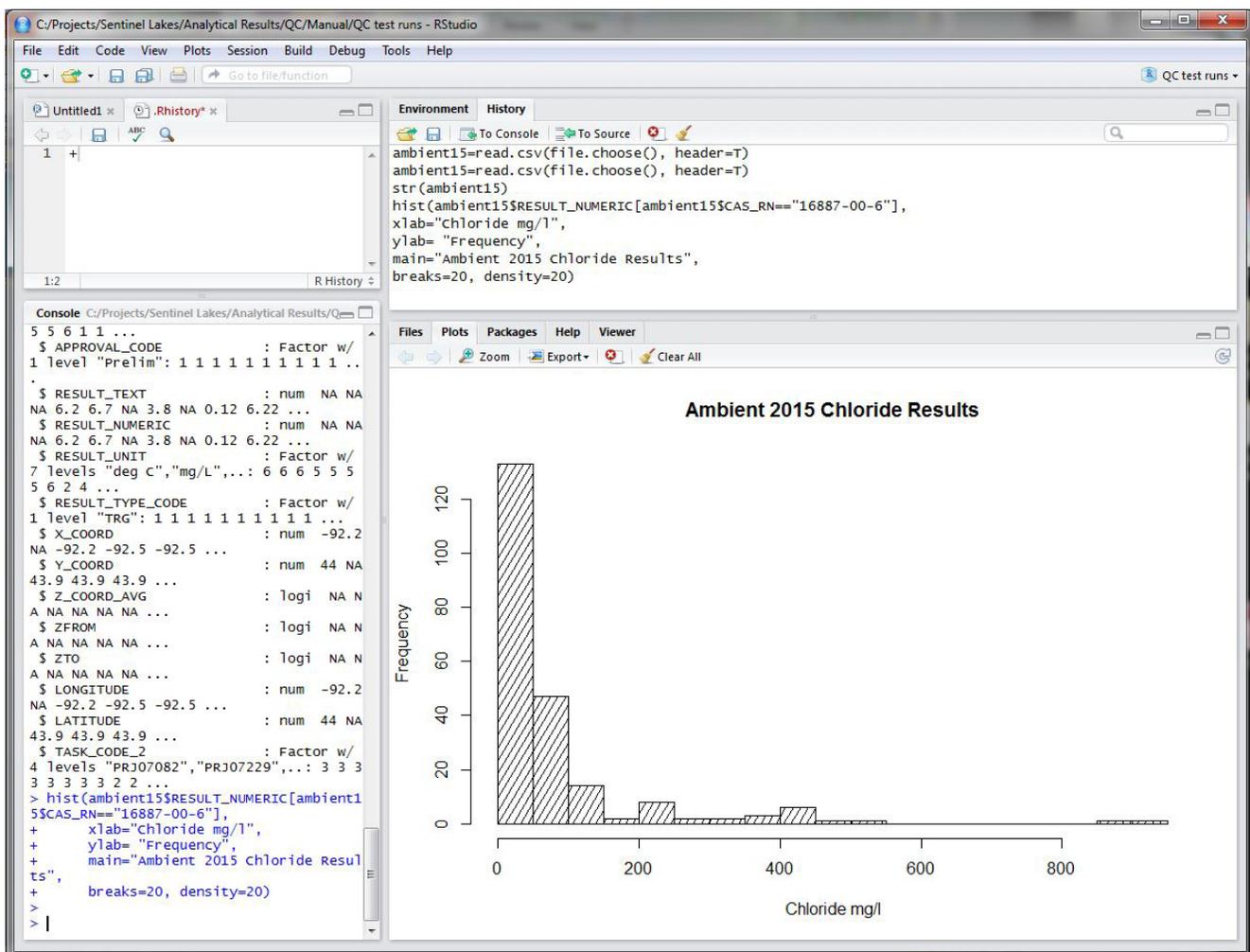


Figure 3. A screenshot of a histogram and the relevant code in R included in the Data Manual

Interested In Providing Your Perspectives on the Groundwater Profession?

The Work Group tackling the current White Paper topic is looking for MGWA members who are willing to answer several questions about your perspectives on the groundwater profession. Your participation will help strengthen their efforts to assess the educational needs in Minnesota for preparing the next generation of groundwater professionals and informed citizens.

If you are interested, please volunteer by sending an email to office@mgwa.org by **April 11, 2016**. Please put "VOLUNTEER FOR GWEd GAP ADVISORY BOARD" in the subject line and provide your contact information.

Thank you for volunteering—we look forward to your input!
 — *White Paper Work Group on Minnesota's Groundwater Education Gap*



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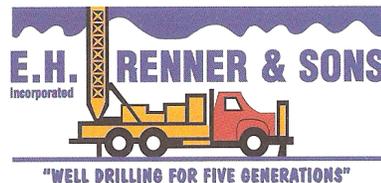
MGWA members, we are looking to you for a new topic for a white paper. The creation of white papers on relevant issues truly begins with you. If you have an idea for a white paper, just go to the White Paper website (http://www.mgwa.org/whitepapers_topics.php), fill out the nomination form, and send it to office@mgwa.org. All new and previously submitted topics will be actively considered (good ideas never die—they just wait their turn). We look forward to your ideas!

UPDATE ON WHITE PAPER 2 – Groundwater Education Gaps in Minnesota

The Work Group continues to gather information and references on groundwater education from stakeholders and interested parties. The Work Group will soon be analyzing data collected from the recent MGWA Survey which asked about skills and course work needed for entry-level groundwater-related positions in Minnesota. They are also looking for MGWA volunteers to provide their perspectives on the groundwater profession (see separate article). The Post-secondary education Team of the Work Group also will be contacting selected Minnesota employers of groundwater professionals starting with those associated with MGWA membership. The Work Group is targeting an October 2016 completion for this white paper. If you have comments or suggestions for this topic, feel free to contact Jeff Stoner (Work Group chairperson), Kelton Barr or Mark Collins (liaisons to the MGWA Board) for this paper.

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Association Officer Announcements



Evan Christianson is the President-Elect of the MGWA for 2016. Evan is a hydrogeologist with Barr Engineering.



Andrew Retzler is the new MGWA Secretary. Andrew is a Paleozoic bedrock geologist at the MGS.

The Association would like to recognize and thank outgoing President Lanya Ross and outgoing Secretary Avery Cota-Guertin. As Past President, Lanya will serve on the MGWA Foundation Board as the MGWA Liaison.

Please congratulate and thank the new and outgoing officers. The MGWA could not exist without their service!

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Inter-Agency Groundwater Modeling Team Created

by Andrew Streitz, MGWA Newsletter Team

An inter-agency team of groundwater scientists recently started meeting to exchange information on the broad subject of groundwater modeling. Staff from the MDH, DNR, MPCA, MDA, BWSR, MGS, Metropolitan Council, and the USGS, met several times to examine various codes, model input sets, and quality assurance procedures currently in use by groundwater modelers at State and Federal Agencies. Steve Robertson (MDH) and Stephen Thompson (DNR), lead the team, and hope to position state agencies to better understand and use the models that are being applied in increasing number to management problems surrounding water resources in general, and groundwater in particular.

Upcoming Tasks:

- ◆ Report to the State Interagency groundwater and drinking water team.
- ◆ Inventory modeling codes, model input sets, and ancillary datasets currently in use statewide as well as the uses and purposes for groundwater modeling efforts.

Characterizing Groundwater and Surface-Water Interactions in Selected Northeastern Twin Cities Lakes, Minnesota

Lanya Ross, Metropolitan Council

Mindy Erickson, U.S. Geological Survey

A cooperative study is being conducted by the U.S. Geological Survey (USGS), the Metropolitan Council, and the Minnesota Department of Health to assess groundwater and surface-water interactions in lakes in the northeast Twin Cities Metropolitan Area (TCMA), including White Bear Lake. An important product of the study will be creation of a groundwater-flow model focused on the northeast TCMA. The groundwater-flow model will be available for future use to assess the effects of groundwater withdrawals on lake levels as well as to describe other groundwater and surface-water interactions. The study work generally includes:

- ◆ statistical analysis of existing hydrologic information about lakes and surrounding groundwater systems,
- ◆ stable isotope and age-dating analysis of groundwater,
- ◆ lake-water outflow measurements at several locations in deep parts of White Bear Lake,
- ◆ targeted groundwater-level monitoring, and
- ◆ development of a groundwater-flow model.

This effort builds on work published by the USGS in 2013 (<http://pubs.usgs.gov/sir/2013/5044/>), which indicated that some water from White Bear Lake was flowing to the underlying Prairie du Chien-Jordan aquifer and reaching wells that were open to the aquifer downgradient from the lake. That work also highlighted how little is known about the groundwater and surface-water interactions at many of the other northeast TCMA lakes that have low water levels and an unquantified amount of lake water flowing to underlying aquifers. The objective of the current study

- ◆ Communicate and coordinate with interagency teams with similar scope or charge (e.g., Research, WRAPS/Implementation).
- ◆ Evaluate the need for topical user groups (e.g., on the use of specific tools) and/or quality assurance processes (e.g., peer review) and recommend process to establish such groups and resources to support them.

Expected Outcomes:

- ◆ Statewide, regional and local use of groundwater models and other quantitative data integration and assessment tools is coordinated and optimized.
- ◆ Increased information sharing between state agencies regarding tools, data, and methodologies important for consistent and effective use of quantitative tools for water resources management.
- ◆ Catalogue of available tools and associated agency capacity/staff resource information made available to all participants.

Contact Steve (phone: 651-201-4648, email: steve.robertson@state.mn.us), or Stephen (phone: 651-259-5733, email: stephen.thompson@state.mn.us) with comments.

is to fill the knowledge gap by characterizing groundwater and surface-water interactions in northeast TCMA lakes, including White Bear Lake.

The work is supported by a combination of Minnesota's Clean Water Fund appropriations and USGS Cooperative Matching Funds. The final report is planned for late 2016. For more information, contact Lanya Ross (Metropolitan Council, Lanya.Ross@metc.state.mn.us) or Mindy Erickson (USGS, merickso@usgs.gov).



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Recent Pace Analytical Acquisitions

On September 1, 2015, Pace Analytical announced the acquisition of Era Laboratories, Inc., an environmental testing laboratory located in Duluth, Minnesota. Era Laboratories, Inc., has been providing analytical testing services to environmental markets since 1977. Since then, Era has expanded its services to include bioassay, WET testing, waste evaluation, lake and stream studies, organics analysis, and field services. Era’s lab staff—including project managers and chemists—will continue to serve customers under the Pace banner going forward. With the combined resources of the Pace Analytical network to support them, this laboratory will help expand Pace’s analytical services in Minnesota, western Wisconsin and North Dakota.

On December 1, 2015, Pace Analytical announced the acquisition of ECCS. ECCS is recognized as the strongest provider of mobile laboratory services in the United States and is also known for their skills in the analysis of agricultural chemicals. ECCS has operated independently from their base in Madison, Wisconsin since 1991 and has built a fleet of mobile laboratories and the skill set to build laboratories for customer projects anywhere around the world. The mobile laboratory business will be known as the ECCS Division of Pace Analytical Services, Inc.

For additional information contact Stacey Larsen, Stacey.Larsen@pacelabs.com or 612-269-4643



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Biological Reconnaissance Map Rediscovered

By Greg Brick, DNR statewide spring inventory specialist

Most of Minnesota's springs are unmapped, despite their cultural and ecological importance. The DNR's statewide spring inventory, supported by the Environment and Natural Resources Trust Fund, was designed to document these resources. The first stage, before searching for springs in the field, was to dig out existing data buried in archival records.

I began by reviewing the stream surveys maintained by DNR Fisheries since the 1940s. The stream surveys assess fish habitat and show more than a thousand spring locations. Buried deep in the stream files were other earlier documents, whose existence was unsuspected. My most notable find was a giant map, 5 feet by 2 feet, depicting the North Shore in 1922, drafted on durable linen by aquatic biologist Thaddeus Surber.

Titled Streams Tributary to Lake Superior: Baptism River to Devils Track River, Surber's map reflects a bygone era. He determined altitudes by an instrument called an aneroid barometer and drew the topography using short, downslope-pointing lines, called hachures, to represent hills. The map shows the state highway (now U.S. Highway 61), then under development, snaking its way along the shoreline, paving the way for the waves of tourists who were beginning to arrive. That, in part, is why Surber was assigned to study the area. The impact of that highway on

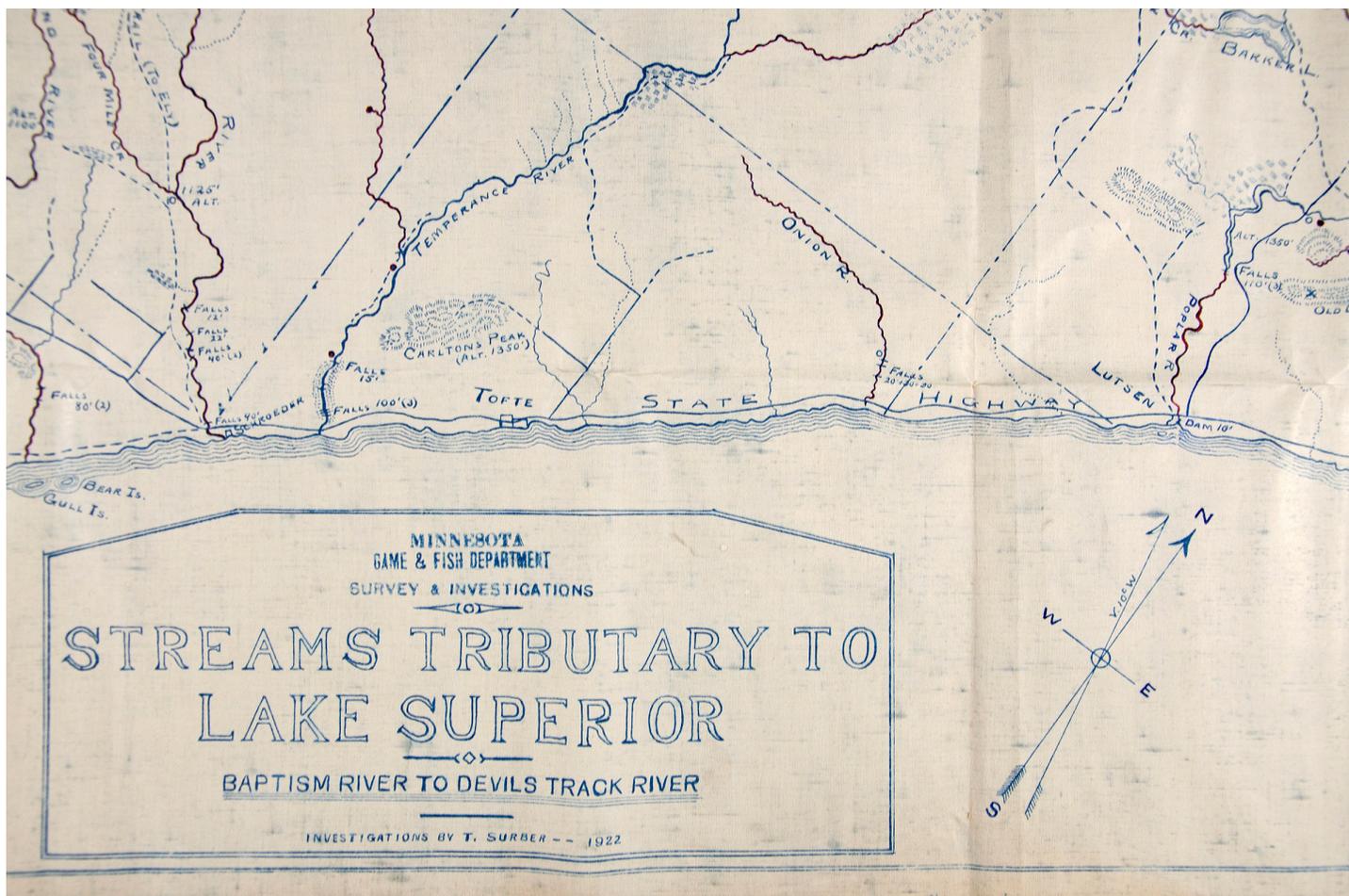
natural resources, previously inaccessible to a larger public, would be profound.

Surber was the right person for the job. As an aquatic biologist, he played a big role in the Minnesota Game and Fish Department, a predecessor of the DNR. Previously employed by the U.S. Bureau of Fisheries, he became well known for his published report on the Root River, hiking "a thousand miles" while chronicling its springs and other features during his tenure as superintendent of fish propagation. He is still known worldwide among aquatic biologists for inventing the Surber Sampler, a net for catching stream-bottom macroinvertebrates. He became a prolific contributor to the magazine *Fins, Feathers and Fur*, a forerunner of *Minnesota Conservation Volunteer*.

Surber's linen map was meant to accompany his unpublished typescript report *A Biological Reconnaissance of Streams Tributary to Lake Superior*. His son Eugene assisted by collecting birds and mammals for the Bell Museum of Natural History. However, that report refers to a map only in passing, so finding the huge linen map tightly folded up among the fishery surveys was serendipitous.

Surber's report frequently refers to the forest fires that followed in the wake of clear-cutting, leaving extensive "burnt-over country" along the North Shore. The resulting loss of shade cover was deleterious for trout streams, causing them to warm up fatally for the cold-loving trout.

— continued on page 11



Friends of the Pleistocene Digging Song

Composed on May 15, 1960 returning from Midwest Friends of the Pleistocene in South Dakota. Also in the car were Prof. R. G. West (Cambridge) and L. J. Maher (Wisconsin)

We're Friends of the Pleistocene; damn little ice we've seen;
Listen and we'll tell you why:
The glaciers retreated, the lakes are depleted,
The temperature's risen too high.

We've till and we've gravel, our problems unravel,
When stones oriented we see.
We've eskers and kames and various names
To apply to the glacial debris.

We've loess and we've soils which add to our toils,
We've lakes and we've peat bogs to bore.
With *Quercus* and *Fagus* and *Pinus* to plague us,
The pollen we cannot ignore.

So we're Friends of the Pleistocene, where geology's nice and clean.
Granites and faults we decry.
Instead of petrology, on carbon chronology
And climatic change we rely.

Music: Sung to the tune of "Little Buttercup" by Gilbert and Sullivan
Lyrics: E. J. Cushing (Univ. Minn.) and C. L. Matsch (Univ. Minn.-Duluth)

Map Rediscovered, cont.

Surber's report presents an unexpected vision of North Shore hydrology. The usual conception is that streams flow downhill to Lake Superior. But his map with its hydrographic details in elegant blue-line illustrates what he calls "a freak peculiar to this region where streams flow to every point of the compass." The North Shore becomes a paradoxical place where "deadwater stretches" hold the most abundant aquatic life, with "beds of water-lily" containing "countless billions" of freshwater shrimp.

Surber depicted the North Shore's springs (in red) on his map, giving us the opportunity to revisit his locations and ultimately add them to the statewide spring inventory. But Surber's stream gauging showed that some of the rivers were decreasing in volume as they flowed along, rather than increasing. He concluded that stream water was sinking into bedrock fissures that he could not see. Such water would typically reappear lower on the slopes as springs. But the more than 50 springs that he mapped do not come even close to accounting for the missing volume of water. The resolution of "Surber's Paradox" awaits future investigation.

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History of the Friends of the Pleistocene Song and Others

As Recalled by Howard Hobbs

I believe the song was written by Charlie Matsch and Ed Cushing while they were in the field together, probably the 1960's. The words were written to the tune of "I'm Called Little Buttercup," a song from the Gilbert and Sullivan operetta "HMS Pinafore."

The song is very different from the typical dirt song, most of which are based on popular songs, show tunes, folk songs and the like. It was hard to sing and impossible for me to create a chord pattern on guitar. Whenever I led the singing, I left it out, unless Charlie was there and insisted on it. Then he had to lead it.

I wrote a new Friends of the Pleistocene song, based on a Bret Harte poem that had been set to music. I got it from some camp-fire singing book back in the 1960's. The occasion for rewriting the words was when Lee (Clayton) and Steve (Moran) published their dating paper in the first issue of Quaternary Science Reviews, and got considerable blowback from people whose favorite dates were disregarded. I wanted to include as much as possible a Who's Who of the regional players. The episodes and dialog were purely fanciful, but I tried to make them as true to type as possible. The song has gotten increasingly out of date as the characters have died or retired, and the younger folks never learned their names or what their quirks were. Should have given it a new name to distinguish it from the Matsch-Cushing song.

I originally didn't have a chorus to it, but Bruce Olson and Doug Bergstrom thought it should have one, so I took their suggestions and cobbled together a chorus to the tune of "Mama Tried." Bruce wrote an academic version of that song, about the futility of getting a Ph. D. It's not strictly a dirt song, but it's certainly apropos.

A songbook was compiled by Dave Mikkelson of the University of Wisconsin-Madison. Many of the songs were written by his students, but Dave collected others, I wrote some, and there were other authors. They were sometimes sung at banquets for meetings of the North-Central section, Geological Society of America, and at Friends of the Pleistocene, Midwest cell. Dave would project the lyrics on the screen so we could all follow along.

The following are some samples:

- "From Bismarck to St. Paul" was written by Bruce Olson, to the tune of Wabash Cannonball. I did a minor rewrite to make it scan better, but it's basically his. The lyrics appear in the DNR children's book "Earth Explorer."
- "Drumlins of New Berlin" was written in my motel room in Rochester, by the members of the 1987 North-Central GSA field trip that I led. I can't remember who all was there or who wrote what parts, but it was sort of a consensus. Tony Fleming is credited with the song in Dave Mikkelson's songbook.
- "Mamas Don't Let Your Babies Grow up to be Soils-men" was written by Bob Lueth, and sung on the occasion of Carroll Carlson's retirement. I sing it still.

— continued on page 12

Featured Photo

A Growing Challenge

Andrew Streitz, MGWA Newsletter Team



Farmers once reserved the use of tiling for farmland with clay-rich soils that dried slowly, and applied irrigation only on well-drained, sandy fields. As the use of both tiling and irrigation systems exploded throughout farm country over the last couple of decades, it was perhaps just a matter of time until the two systems wound up in the same field. In the picture you can see a center pivot irrigation system in the background, and in the foreground a tile drain pump-out station actively dumping water into nearby Prairie Creek in the Cannon River watershed. This single picture encapsulates much of what is threatening the state's groundwater supplies: over pumping of groundwater drawing down water levels, and the interception of potential recharge for the aquifer. Operating together in the same field, they speed the transfer of water from groundwater to surface water, and provide a powerful challenge to the responsible management of Minnesota's most important resource.

Photo credit Kim Laing

Friends of the Pleistocene, cont.

- "It's Rainin' Here This Morning" was patterned on a song of the same name by Grandpa Jones. It was in the late 1980's or early 1990's during a long hearing on Lake Pulaski. It was a song with a very limited demand, because you had to know a lot about the situation to appreciate it. The only time I sang it in "public" was at the retirement of one of the DNR Waters folks who was involved. Eric Mohring was with the DNR at the time, and we did it as a duet. He appreciated doing it together, because he always feels like a trained seal when he performs alone.
- "Ev'ry Time it Rains" is probably the only song ever written about groundwater pollution sensitivity. It's based on a Bluegrass song I learned from a Jugsluggers tape, a group that Eric (Mohring) belonged to years ago. The last verse refers to a pizza party at Jan Falteisek's place, where we celebrated the publication of the pollution sensitivity guidelines booklet.

Developing a Groundwater Flow Model for Slough Management in Sauk County, Wisconsin

By Elisabeth Schlaudt, 2015 MGWA Foundation Scholarship Recipient

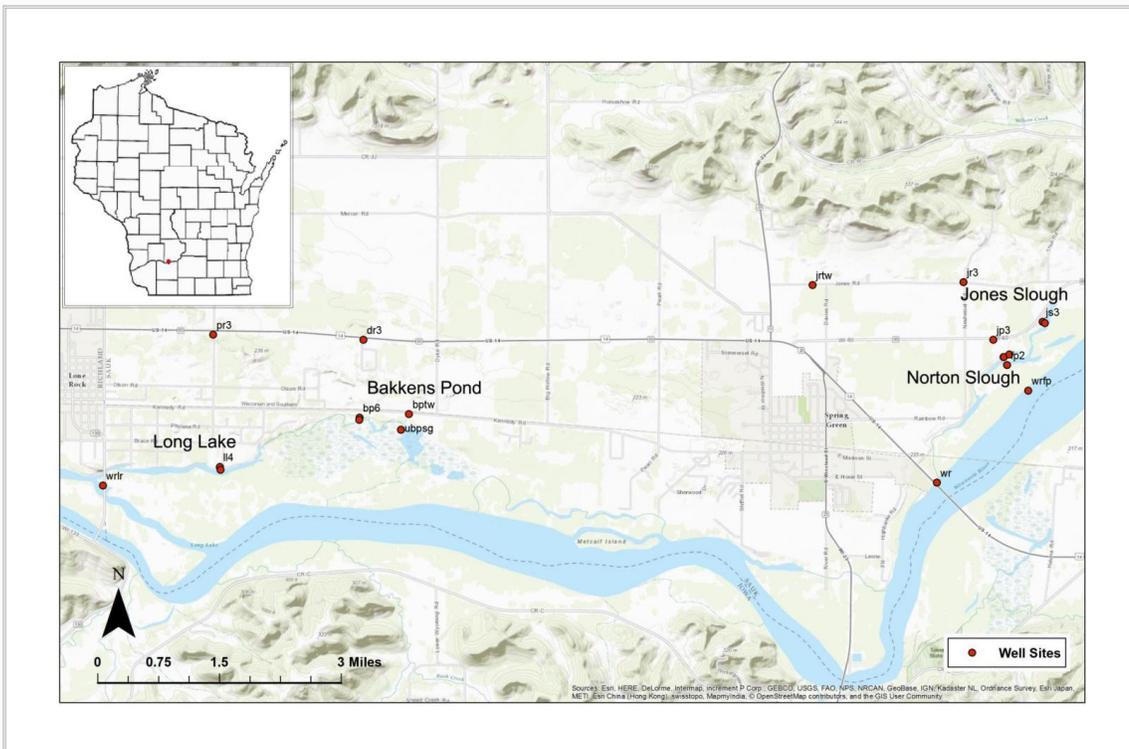
Sloughs along the lower Wisconsin River act as a refuge and nursery habitat for riverine fish species, including the endangered Starhead topminnow. They are also an important local economic resource for tourism and personal recreation such as fishing and boating. Since 2008, there has been a marked decrease in the water quality of the Lower Wisconsin River floodplain lakes. In particular, high phosphorus and nitrogen concentrations, low dissolved oxygen levels, and dense metaphton cover have been

observed in floodplain lakes located in Sauk County, Wisconsin. Although the exact causes for the deterioration in water quality are unclear, nutrients applied via fertilizer and manure to sandy soils in the agricultural areas of the adjacent Pleistocene terrace are likely contributors to the problem. As part of my M.S. degree in Geoscience, I am conducting a study that seeks to determine the role groundwater plays in nutrient transportation to the small lakes and sloughs. My study uses a three-dimensional groundwater flow model currently under development as part of a Wisconsin DNR River Planning Grant for Lower Wisconsin River Floodplain Lake Recharge Delineation, as well as an extensive network of groundwater monitoring wells. The MGWA foundation scholarship made it possible for me to extend my well monitoring network and provided funds for travel to and from my study site this past summer. Water quality sampling to date has



focused primarily on nitrate concentrations as indicators of flow paths from up-gradient agricultural sources. Pending additional funding, sampling would be extended to stable isotopes of water, which will provide additional information on potential groundwater flow paths and recharge areas. An additional objective for the project is to develop stakeholder surveys for Sauk County residents to evaluate the acceptability of mitigation strategies for the sloughs and to gauge public awareness of groundwater quality issues. The surveys will be developed in the fall and winter of 2016 with interviews conducted during the winter and spring. The research findings will then be used to evaluate the design and effectiveness of groundwater buffers, as well as other conservation measures to mitigate nutrient loading and restore sensitive fish habitat while balancing the economic and recreational needs of the surrounding community.

Ms. Schlaudt is currently an M.S. candidate at the Department of Geoscience and the Nelson Institute for Environmental Studies –Water Resources management, University of Wisconsin-Madison.



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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.

MGWA Foundation Minutes

December 18, 2015

Members Present: Scott Alexander, Cathy von Euw, Eric Mohring, Stu Grubb, Cathy Villas-Horns, and Amanda Strommer (via conference call)

MGWA Management Present: Sean Hunt and Jennie Leete

Current Business: **Review Minutes**

Minutes from September 15, 2015 meeting approved with minor changes

Review finances

Total for the MGWAF fund is \$130,435.89 as of 12/16/15. Total for the HOP fund is \$29,133.61. Credits since last meeting was a donation and from Amazon smile. Debits was for grants that had been approved at September meeting. Check from Give to the Max Donations has been received. For HOP a credit was received from a donation.

No new grant applications.

Discuss investment possibilities.

RFP was sent out and three responses were received. Stu created a summary document. Discussed pros and cons of various options as well as considerations for the future. Discussed how much board would want to put into investments. Process going forward includes setting up interviews and establishing a subcommittee was discussed. Cathy vE made a motioned for Stu to set in person subcommittee meetings with a representative from Wells Fargo and a representative from Compass Capital Management. Subcommittee members will include Stu, Cathy vE, Eric, and Scott and potentially Jennie, if available. The subcommittee will follow up with board at next quarterly meeting. Eric seconded; all in favor; motion carries.

Offering a field camp scholarship, growing the Pfannkuch fund awarding scholarships.

Scott continues to work on setting up scholarship.

Student Scholarships

Amanda will update the scholarship paperwork and get it to Sean and the newsletter. Sean and Amanda will work on getting professor emails into email system as all the contacts were deleted from the email address book.

Exhibitors at the Spring Conference

Discussed vendors at conferences. Cathy vE will be a contact.

Future business:

Discussion of board positions.

Recommendation to MGWA board to have Eric be a permanent member of the MGWAF board. This is the last meeting for Cathy VH (though she is still on the scholarship committee) and we thank her for her many years of service!

Next meeting:

March 18, 2016

Editing Tips for Scientific Writing

By Ruth Macdonald, MGWA Newsletter Team

Keep your subject and verb together.

A concept is easier to remember if the thought is complete before adding detail. Don't break the thought. Say it, then explain it. Don't go off on tangents in the middle of a sentence.

All of the following are correct but one option in each pair is easier to read.

- ◆ This method, described in more detail below, relies on collection of samples from a carefully selected set of points.
- ◆ This method relies on a collection of samples from a carefully selected set of points and is described in more detail below.

tion are covered in grass, with the exception of a small rocky area.

Avoid Noun Stacks.

Count your hyphens. Two are often questionable, three are something to rethink. You can usually rewrite the sentence to cut down the number.

- ◆ The water- table- lowering effects
 - ◆ The effects on lowering the water table
-
- ◆ groundwater-residence-time indicators
 - ◆ indicators for groundwater residence time.

-
- ◆ Currently most of those found at that location, with the exception of a small rocky area, are covered in grass.
 - ◆ Currently most of those found at that loca-

MGWA BOARD MINUTES

Minnesota Ground Water Association Board Meeting Minutes

Meeting Date: December 14, 2015

Location: Caff  Biaggio, 2356 University Avenue West, Saint Paul, MN 55114

Attendance: Lanya Ross, President; Eric Mohring, Past President; Emily Berquist, Treasurer; Avery Cota-Guertin, Secretary; Jeanette Leete, WRI; Sean Hunt, WRI; Mindy Erickson; Kelton Barr, Audrey Van Cleve

Past Minutes: Approved.

Treasury: Berquist discussed the Treasury report with the Board. The total income from the period of January 1, 2015 – December 14, 2015 is \$152,659; total assets as of December 14, 2015 are \$125,581. Net income for the period of January 1, 2015 – December 14, 2015 is \$22,564.

Web Page: Membership rates were updated.

WRI Report: Dues billing is going out to the membership. Hunt will send out a ballot vote for open MGWA Board positions. Barr and Hunt are designing the membership survey.

MGWAF: The Board discussed a possible name change to the scholarship fund used to sponsor attendees at hydro field camp (currently only at the University of Minnesota).

Old Business: White Paper Initiative. arr informed the group that the white paper group has split into two groups; the groups focus on K-12 education and post-secondary education. The work groups are working to define an entry level groundwater professional. The Board will carry this agenda item into the next board meeting. Mohring shared thoughts on Bruce Olson's presentation.

2015 Joint Fall Meeting. The Board discussed sending a final financial report to NCKRI per the contractual agreement. Profits will be split 50/50 with NCKRI.

New Business: Membership Dues. Hunt wants to discuss corporate membership rates at the next Board meeting.

Distinguished Service Award. The Board discussed the nomination for Jan Falteisek: *This message serves as a formal request for the MGWA Board to consider Jan Falteisek of the Minnesota Department of Natural Resources County Geologic Atlas Program for the MGWA Outstanding Service Award. Jan has supervised the Atlas Program since 1991, acting as a consummate cheerleader promoting the recognition of the importance of the program and spearheading the charge in acquiring long term funding streams that allow the program to continue. Jan has made an outstanding contribution to groundwater in Minnesota and her tireless dedication parallels the primary objectives of the MGWA. She has promoted and encouraged exchange of scientific information and public policy aspects of groundwater. She has assisted in protecting public health and safety through continuing education for groundwater professionals. She and the products developed through her supervision of the Atlas program have educated the general public regarding groundwater resources and disseminated information on groundwater issues and concerns. Jan has furthered the cause of groundwater awareness and resource protection in Minnesota. Please consider recognizing her for a long career of dedication to groundwater in Minnesota.*

Ross motions to award Jan Falteisek the Distinguished Service Award. Motion prevailed.

Meeting Date: January 6, 2016

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

Attendance: Ole Olmanson, President; Lanya Ross, Past President; Evan Christianson, President-Elect; Emily Berquist, Treasurer; Andrew Retzler, Secretary; Sean Hunt, WRI; Avery Cota-Guertin; Eric Mohring

Past Minutes: Approved.

Newsletter: Out to membership.

Treasury: Berquist distributed the Treasury report to the Board. The total income from the period of January 1, 2015 – January 6, 2016 is \$153, 451.68; total assets as of January 6, 2016 are \$124,736.06. Net income for the period of January 1, 2015 – January 6, 2016 is \$21,718.66.

Web Page: Redesigned & implemented back in 2010, but current content management system (CMS) no longer supported. Hunt will contact needed personnel for a solution. May require funds. Access to website still available, but updates are harder to conduct. Olmanson suggested using WordPress as a possible new CMS. This problem does not affect the MGWA online store. Hunt will look into options before next meeting.

WRI Report: Paper membership renewals sent to membership. Membership numbers are still being tallied—will update Board next meeting.

MGWAF: Meeting on Dec. 18th—discussed future money management. Other investment options for endowment money are being considered. Mohring discussed with the Board several options. Hunt shared with the Board that Mohring was nominated to be director. Motion to approve the nomination of Mohring as Director to the MGWAF; Motion prevails. Hunt reports MGWAF are planning to award two student

MGWA 2016 Membership Dues

Sustaining Member	\$65
Professional Member:	\$45
Retired Member	\$25
Full-time Student Member	\$20
Newsletter (printed and mailed)	\$20

Membership dues rates were revised at the July 1, 2015 meeting of the MGWA Board.

MGWA BOARD MINUTES

MGWA Board Meeting Minutes, cont.

The MGWA Board meets once a month, currently over lunch, on the first Wednesday at Fresh Grounds on 7th in St. Paul.

Members are welcome to attend and observe

- scholarships. Scholarship details are in development—will discuss further at next meeting.
- Old Business: Election Results. The Board discussed the latest election results and recognized the newly elected candidates: Evan Christenson, President-Elect and Andrew Retzler, Secretary.
Distinguished Service Award. Ross shared with the Board details of award to Jan Falteisek. Hunt will pursue getting award completed prior to Spring Conference—plan to formally present award at the conference.
Groundwater Professional Definition. The White Paper group is looking for approval of a groundwater professional definition from MGWA Board. The Board discussed the suggested definition. Hunt will send out a survey asking members to contribute to/reflect on the suggested definition.
White Paper. The Board discussed a timeline for submitting a draft White Paper to the Board. The Board would like more time to review and approve the draft.
- New Business: Social Hour. Berquist is looking to have the next Social Hour in Feb., and would like to target more students. Retzler suggested an MGWA Facebook page to reach students. The Board agreed on event date of Monday, Feb. 22; location TBD.
Monthly Meeting Schedule. The Board discussed changes to the current meeting schedule. Future Board meetings will take place on the 1st Tuesday of each month from 11:30am-1pm.
Corporate Member Rates. Updated dues to \$45. Memberships bundled to save money. Hunt suggested reviewing advertising rates. Hunt suggested giving corporations the option to select ad size and number of memberships, from which a rate will be calculated. Hunt will further discuss corporate dues & advertising fees with the Board at the next meeting.
Spring Conference. The Board discussed possible ideas for conference theme/topics.

Meeting Date: February 2, 2015

- Location: Fresh Grounds Café, 1362 West 7th Street, St. Paul, MN
- Attendance: Ole Olmanson, President; Lanya Ross, Past President; Evan Christianson, President-Elect; Andrew Retzler, Secretary; Tedd Ronning, Newsletter Editor; Sean Hunt, WRI; Jeanette Leete, WRI
- Past Minutes: Approved with changes.
- Treasury: Leete discussed the Treasury report to the Board. For the 2015 year, total income is \$152,805.80; total assets are \$125,097.08; net income is \$16,860.92. As of January 31, 2016, total income for the 2016 year is \$6,405.76; total assets are \$122,882.73; net income is \$3,396.41.
- Newsletter: Ronning reported March newsletter is currently being compiled.
- Web Page: New MGWA officers updated on site. Hunt sent out a white paper announcement to membership. Ross discussed a new Water Supply Technical Advisory Committee and proposed advertising through MGWA membership announcements. The Board agreed to advertise the Committee through membership. The Board discussed MGWA protocols for advertisements and announcements of third-party organizations to membership. Upcoming MGWA announcements were discussed further.
- WRI Report: Hunt reported current membership numbers.
- MGWAF Report: MGWA has a carryover in savings from 2014. Motion to move carryover of 2014 savings of \$15,000 to MGWAF endowment; motion carries. Leete updated the Board on the interviews regarding MGWAF investments.
- Old Business: Social Hour. Retzler and Berquist will have date and location by next week. The Board discussed advertising the Social Hour through Facebook. The Board will discuss the potential of a MGWA Facebook page in the future.
Corporate Member Rates. Hunt discussed the new structure for rates, allowing corporations the option to select number of memberships and ad sizes. The Board discussed renewal options for corporate membership bundles and more soliciting for advertisers. Ross suggested including exhibitor options on the corporate membership form. Leete suggested new advertising rates for the newsletter. Last time rates were changed was 2007-2008. Motion to approve new ad rates as presented (Business card--\$125; Quarter Page--\$175; Half Page--\$300; Full Page--\$600; Full Page, single issue--\$200); motion prevails. Motion to adopt new MGWA corporate membership renewal form with changed rates; motion carries.
Spring Conference. Olmanson has four potential speakers. Board discussed speaker options and layout of presentations. Olmanson plans to provide more details about the conference in upcoming newsletter. Retzler discussed presenting White Paper topics at future conferences.
- New Business: Management Team Contract. Hunt reported contracts are in place.
Sales Tax Due Feb. 15. Use tax return for 2015 completed for organization.
Web Page. WordPress was recommended for new CMS. Board discussed looking into WordPress transfer costs. Christianson suggested the MGWA website be mobile-compatible. Board agrees to maintain similar layout and graphics

Save These Dates

2016 and 2017 MGWA Conferences

4/20/2016

11/16/2016

4/26/2017

11/15/2017