

Assistant Professor in the Department of Earth Sciences, and Brian Bohman, WRS M.S. student and Research and Policy Intern at Freshwater Society, are working together to cross traditional disciplinary and academic boundaries. Through collaboration at Freshwater Society, the two are applying recent research findings to help the Lower Minnesota River Watershed District (LMRWD) identify the sources of and solutions to their problem of excess in-channel sedimentation.

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this lead, the WRC is helping to develop Year of Water Action activities at the University. We are working with the Water Resources Students in Action group to organize events on campus this year to inform the campus community about water issues and facilitate discourse about water policy.

One big change the WRC will face in the coming year is that our associate director, Faye Sleeper, recently informed us of her plan to retire in April. That timing will conclude a full decade of Faye's work at the WRC and will cap off an illustrious career of public sector service. Faye will be certainly be missed and I am personally grateful to her for her interim leadership of the center as well as for ensuring I had a smooth transition into my job. We'll have more to say about her many accomplishments in the next issue.

It's perhaps fitting that the next issue of the Minnegrām will introduce new features that Faye helped bring to fruition. For the past year, Faye has served as the Program Leader for the [Extension Water Resources Team](#) (WRT) and has seized on the opportunity for a natural partnership between the WRT and the WRC. One example of that partnership is that we will merge the WRT's newsletter, [From Shore to Shore](#), into the Minnegrām starting with the Spring 2017 issue. This will mean we will welcome the thousands of readers of Shore to Shore and will be able to include the expert research-based content written by the WRT [Extension Educators](#). This arrangement will make our delivery of news and content more efficient and streamlined, while also adding new content for both sets of readers.

2016 was certainly an eventful year at the WRC, but 2017 is shaping up to be even more active. In the coming months we will be hiring staff, including the associate director position. We will also have more to say in the future about a strategic planning process we have launched, which will help us to focus our goals and shape our work in the future.

And so, like Janus, we move ahead while also reflecting on where we have been. National and international events in 2016 were sometimes tumultuous and unforeseen. We can't fully know what 2017 will bring, but what we can do is learn from the past, adapt to change, and look ahead with readiness and renewed purpose.

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Minnesota Water Resources Conference: Questions about Flint, solutions to ag pollution and a visit from the Governor

A record-setting attendance of over 700 attendees and a first-time appearance from a sitting Minnesota governor, set the tone for an eventful and instructive 2016 Minnesota Water Resources Conference.

The Dave Ford award was presented to Cliff Aichinger by Tina Cartens of the Ramsey-Washington Metro Watershed District. Aichinger, now retired, spent 43 years providing vision and leadership at the Ramsey-Washington Metro Watershed District. His many projects include the Battle Creek restoration, Fish Creek restoration and Phalen shoreline restoration. Aichinger served as a mentor to many including Carstens, in the areas of staff development and management training. “I never imagined that I would be a recipient of this award,” said Aichinger, who went on to praise Dave Ford as a mentor to him and the “Father of Floodplain Management.”

Tuesday morning's plenary session featured Chris Kolb, President of the Michigan Environmental Council and co-chair of the Flint Water Advisory Task Force, who spoke about the drinking water crisis in Flint, Michigan.

Kolb was part of the five member task force charged by Michigan Governor Rick Snyder with finding out how and why Flint's drinking water was fouled. The committee's investigation found that safe drinking water mechanics can be overlooked by environmental regulators because the science of making water fit for human consumption is well-understood by the water community and regulators. This is what happened in Flint, and it changed everything in regard to monitoring the safety of drinking water. Now, the focus will be on the water source, and followed all the way to the tap.



The factors in Flint that contributed to high lead levels in water:

- Flint was not equipped to manage the change in source of drinking water from Lake Huron to the Flint River. Flint hadn't treated its own water since 1967.
- Lack of oversight at the state level Health and Human services.
- The state did not require Flint to add corrosion control treatment to the water, treatment that would have prevented the lead from the pipes from leaching into the water. Instead of adding the treatment, a year of monitoring lead levels passed with no action taken to correct the problem, instead protecting their decision.
- The corrosive nature of the water was blamed for a legionnaire's disease outbreak, lead poisoning in children and multiple water main breaks.

Chris Kolb, co-chair of the Flint Water Advisory Task Force, pictured here with WRC Director Jeff Peterson, warned his audience that the Flint crisis could be repeated where regulatory oversight is lax.

In the end says Kolb, the cause of the Flint water crisis was "ignorance, incompetence and arrogance," on the part of regulators at the state level. Today, the Flint water system is healing and in compliance with FDA rules, though Kolb said that federal regulations are the baseline, and that state regulations should be stronger. Michigan is now doing that.



Assistant Administrator for NOAA Craig McLean (center) and WRC Director Jeff Peterson and Minnesota Sea Grant Director John Downing following McLean's presentation at the conference. McLean stressed the importance of NOAA's funding of Minnesota Sea Grant, directly and positively affecting the health of the Great Lakes.

Craig McLean, Assistant Administrator, Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration (NOAA), spoke at Tuesday's luncheon. McClean framed the work of NOAA and Sea Grant as that of a conduit, bringing solutions directly to the citizens who are asking the questions.

As the funder of Minnesota Sea Grant, NOAA directly affects the health of the Great Lakes, by educating adults and students in schools, through initiatives like the Watershed Game, where players sit in the seats of policy-makers, and learn about all the factors that go into water and land use policy.

NOAA conducts a climate assessment every two years, hoping to predict and prepare for future weather events. Knowledge of future weather events creates community readiness and resilience.

David Mulla, Professor and Larson Endowed Chair in Soil and Water Resources, University of Minnesota, opened the Wednesday morning plenary session with Nonpoint Source Water Quality Issues and Solutions. Mulla

highlighted the Minnesota Nutrient Reduction Strategy, undertaken with the MPCA, which documents sources of water pollution and sets goals for pollution reduction, using a combination of voluntary and regulatory actions.

Southern Minnesota is most effected by nitrogen loss to lakes, with 70 percent of nitrogen pollution coming from farming. The MPCA's goal is to lower surface water nitrogen levels by 20 percent by 2025 and 40 percent by 2040. Some of the strategies employed to accomplish this are:

- Better management of fertilizer and manure
- Improved wastewater management
- Increased cover crops and native grasses



WRC Director Jeff Peterson and plenary speaker David Mulla.

Mulla considers the 2025 goal to be economically feasible, while the long term goal is far more challenging, taking too much farm land out of production, and he looks for improved technology to achieve that larger goal.

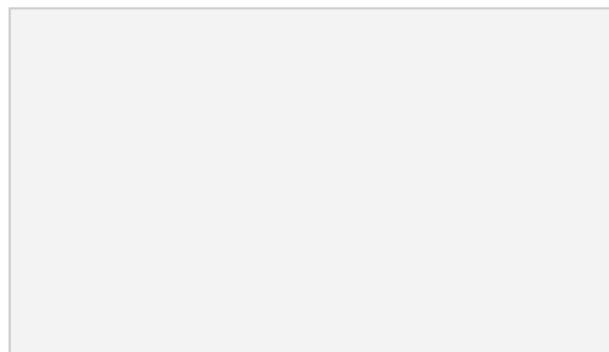
Phosphorus in surface water is also largely a southern Minnesota problem, and requires a 40 percent load reduction for healthy lakes and rivers. Unlike nitrogen, phosphorus sources are predominately not from agriculture, with wastewater, stream bank erosion, forests and urban runoff accounting for 65 percent of phosphorus levels.

Phosphorus reduction strategies have made good progress. Phosphorus in water treatment plants has been reduced by 300 percent, through better cropland management of fertilizer and reducing erosion with cover crops, all accomplished without a lot of effort or loss of productive acreage.

Mulla cited the Thompson Willow Lake farm near Windom as a water conservation success story. Tony Thompson farms 1500 acres of corn and soybeans, utilizing buffer strips, cover crops, and conservation tillage. "Stacking" these practices has been successful. A lake in the middle of the farm is crystal clear. "Water quality and successful farming do not have to be at odds," said Mulla.

Governor Mark Dayton arrived during the luncheon session to deliver the Water Professionals Week Proclamation and to reiterate his administration's commitment to improving surface and groundwater quality in

Minnesota. He referenced his Year of Water Action initiative, and urged all Minnesotans to take the Minnesota Water Ethic Pledge, and promise to renew their commitment to water stewardship. He also went on to thank the water professionals in the room for, in the words of the Proclamation: dedicating "...their education and professional lives to the protection, restoration, and management of the waters of the North Star



State, as well as the protection of the health and way of life of Minnesotans.”

Aside from the plenary sessions, the conference offered over 90 concurrent sessions addressing problems and solutions to groundwater supply, innovative urban BMP's, and tools for managing road salt application. New this year was a special session on social justice in water supply, which asked the question: What is the impact to society of not providing high-quality water from water supply systems? Is Flint a symptom of a bigger problem? What are the issues the disparities and what can be done about it?



Minnesota Water Resources Conference 2016 co-chairs WRC director Jeff Peterson and Metropolitan Council's Karen Jensen accept the State of Minnesota Proclamation from Governor Mark Dayton, proclaiming the week of October 19-26, 2016 as Water Resources Professionals Week. Governor Dayton is the first sitting Minnesota governor to address the annual water conference.

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Mysteries in the sediment: UMD's Nathan Johnson is focused on the St. Louis River Estuary's complex mercury problem

Just south of Duluth Minnesota, the St. Louis River Estuary forms a 12,000 acre network of critical habitat for North American wildlife, water and migratory birds, and native plants and fish. Located at the confluence of the St. Louis River and Lake Superior, the estuary also plays a key role in Minnesota's wild rice trade, commercial fishing industry, and cultural and recreational heritage.

Over the first half of the past century, however, the estuary's water quality suffered dramatically as a result of industrial activity and the consequent chemical contamination. The surface water quality has largely been cleaned up, but concern remains about contaminants in sediment and the area has been federally designated an Area of Concern in the Great Lakes.

University of Minnesota Water Resources Science faculty Nathan Johnson and his colleagues are working alongside state and federal resource management agencies from around the region to shed that designation by restoring the estuary's health and biological productivity. A Civil Engineering professor at the University of Minnesota - Duluth, Johnson's research focuses on mercury contamination in the estuary's sediment and understanding why some bodies of water are more sensitive to the bioaccumulation of methylmercury than others.

Specifically, Johnson is looking at why mercury in the



Johnson's students hope to hit pay dirt in the St. Louis River Estuary's

https://www.wrc.umn.edu/publications/minnegram/minnegram-winter-2017/st-louis-river-estuary[4/25/2019 12:17:30 PM]

estuary is acting differently than in other parts of the St. Louis River and Lake Superior. His research team's results show that there is significantly more mercury in

mercury mystery. WRS PhD student Amanda Brennan displays a sediment sample.

the food web of the St. Louis River Estuary than the immediately adjacent Lake Superior and St. Louis River. For some reason, the mercury in the estuary in particular is persisting in its more bioaccumulative form known as methylmercury.

Methylmercury's effects on ecosystem health are well known – it's a powerful neurotoxin that even in low levels can impair the reproductive ability of fishes, birds, reptiles, and mammals, as well as the developmental ability of humans and other species. Most mercury in the environment exists in an inorganic form and is emitted through the combustion of fossil fuels, incineration and other industrial activities into the atmosphere. And since mercury spends a lot of time in the atmosphere, says Nathan, "much of the mercury that falls in Minnesota has come from other areas of the globe. It's a global pollutant that most often enters watersheds via rainfall. Certain biological and geochemical processes make the conversion to bioaccumulative methylmercury more efficient in some waterbodies."

While Johnson believes one answer may be found in the first layer of the estuary sediments, the hydrologic setting, its strong wetland influence, and elevated sulfate levels from upstream sources have created a complex situation. "It's unclear what's controlling the mercury production and accumulation in the base of the estuary's food chain and I suspect that whether we can fix the problem will require a complex understanding," he says.

Understanding the biogeochemical processes is key to allowing state and federal resource management to make informed decisions concerning the use of dredging materials and habitat restoration in the St. Louis River Estuary as well as the control of upstream mercury and sulfur sources.

Says Johnson, "In addition to understanding why there's less mercury in the food web of Lake Superior and the St. Louis River than in the estuary, we're working to see if there's a role humans can play in helping to improve the water quality and whether cleaning contaminated sediment in the estuary will lower mercury levels."

In a separate study, with support from the Minnesota Pollution Control Agency, Johnson and colleagues from Gustavus Adolphus College, University of Toronto Scarborough, and University of Wisconsin-La Crosse, are also investigating the transport and bioaccumulation of mercury in the watersheds of several Minnesota rivers that have shown exceptionally high mercury levels in fish tissue. The project seeks to identify characteristics among watersheds that affect mercury cycling including landscape-to-stream delivery of mercury, processes that increase the rate at which mercury is transformed into the methylmercury form, and rates of bioaccumulation in the food web.

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[Print](#) [AddThis](#) **RS student Brian Bohman tracks increased sedimentation in Minnesota River**

By **Brian Bohman**

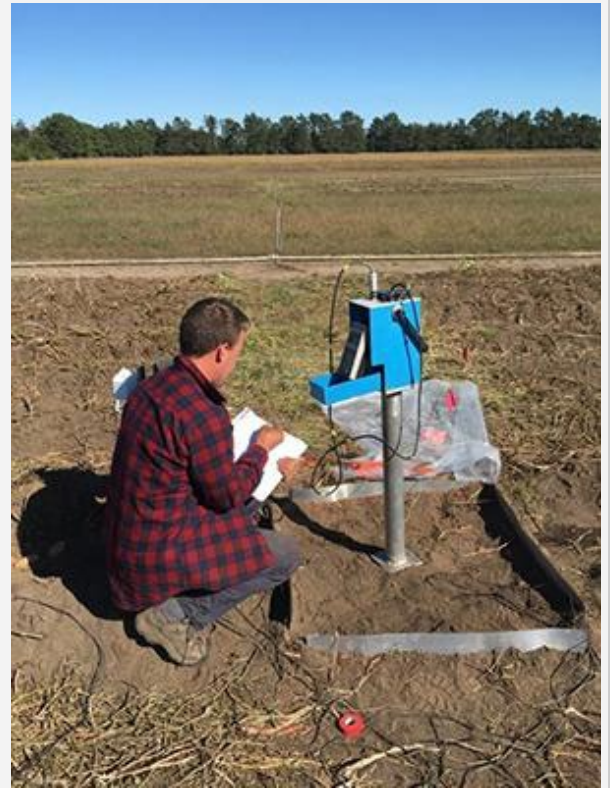
Research on non-point source water quality issues is not just confined to the academic setting for members of the Water Resources Science (WRS) program. Carrie Jennings, Research and Policy Director at Freshwater Society and WRS Adjunct Assistant Professor in the Department of Earth Sciences, and Brian Bohman, WRS M.S. student and Research and Policy Intern at Freshwater Society, are working together to cross traditional disciplinary and academic boundaries. Through collaboration at Freshwater Society, the two are applying recent research findings to help the Lower Minnesota River Watershed District (LMRWD) identify the sources of and solutions to their problem of excess in-channel sedimentation.

For Bohman and Jennings, the goal of this project was to synthesize existing research in order to communicate the magnitude of change with stakeholders throughout the Minnesota River Basin. Based on USGS streamflow and sediment gauging as well as historical sediment cores, they estimate that there is 1/2-inch of sandy sediment deposited in the Minnesota River channel between Jordan and Ft. Snelling each year, representing a six-fold increase in rate relative to the rate of sedimentation prior to European settlement. In-channel sedimentation impacts commercial river navigation and requires additional dredging by the US Army Corps of Engineers at an increased cost to LMRWD and tax payers. Potential strategies to restore the hydrology and sedimentation regime of this stream reach include installing perennial cover and on-land water storage throughout the MN River Basin to

increase evaporation and transpiration, reduce peak flows and total water delivery.

Bohman has been leveraging the skills he has developed as a WRS student to help advance the Freshwater Society's mission of keeping lakes and streams healthy and protecting drinking water through efforts of community education, science-centered policy, and collaborative action to move conservation efforts forward. Although not directly related to his graduate research project, exposure to this work while a student is valuable because it provides experience on how to bringing the scientific research and ideas into action. As a M.S. student in WRS graduate program, Bohman works with David Mulla (WRS faculty, SWC) and Carl Rosen (SWC) on a project focusing on managing irrigation and nitrogen inputs for potato production with the goal to reduce nitrate leaching into groundwater supply.

The results of this collaboration include a report published by the Freshwater Society and an article by Jennings in Open Rivers, an online journal published at the University of Minnesota. Links to both articles can be found on the website for Freshwater Society: www.freshwater.org



Bohman measures soil moisture content with a neutron probe in order to improve irrigation management.

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innovation and sustainable development issues. Recent board members include **David Mulla**, Department of Soil, Water, and Climate and Kent Olson, Applied Economics. Issues related to water resources are an important part of the work of the Partnerships, for example a recent project focused on protecting a cold-water refuge lake in Central Minnesota. Please consider joining one of our regional boards to support community-University partnerships in addressing the critical needs of communities in our state. Learn more in the board application found on the bottom of the RSDP home page.

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Winter 2017 Student News

Elizabeth Alexson received her MS degree in August, 2016. Her thesis was titled: *Paleolimnological Investigation Of the St. Louis River Estuary to Inform Area of Concern Delisting Efforts*. Alexson was advised by **Euan Reavie**.

Brian Bohman presented *Evaluating nitrogen stress and yield impacts from variable-rate nitrogen applications for potatoes* at the American Chemical Society's fall meeting in Phoenix, AZ. Bohman is advised by **David Mulla**.

Thomas Dietrich received his MS degree in August, 2016. His thesis title was: *Stony Creek: A flood mitigation and water quality assessment*. Dietrich was advised by **Joe Magner**.

Rebecca Hammer-Lester received her MS degree in August, 2016. Her thesis was titled: *Using BSTEM to Estimate Sediment Erosion in the Seven Mile Creek Watershed*. Hammer-Lester was advised by **Chris Lenhart**.

Sophia Lafond-Hudson received her MS degree in August, 2016. Her thesis title was titled: *Iron and Sulfur Cycling in the Rhizosphere of Wild Rice (Zizania palustris)*. Lafond-Hudson was advised by **Nathan Johnson** and **John Pastor**.

Nicole Lurndahl received her MS degree in September, 2016. Her thesis was titled: *Temporal and Spatial Trends in the Abundance of Functional Denitrification Genes and Observed Soil Moisture and Potential Denitrification Rates*. Lurndahl was advised by **Michael Sadowsky**.

Song Xu received his MS degree in July, 2016. He was advised by **Bruce Wilson**.

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for many years due to human health issues and is a major contributor to the formation of oxygen deficiency in aquatic ecosystems. Agricultural subsurface drainage is one pathway for transport of excess nutrients to surface water.

Facet-Dependent Oxidative Goethite Growth As a Function of Aqueous Solution Conditions

Strehlau, J.H., M.S. Stemig, R.L. Penn and W.A. Arnold

[Environmental Science & Technology](#), 2016

Whether naturally occurring or engineered, iron oxide and oxyhydroxide (herein referred to as iron oxide) nanoparticles are of interest for their contributions to subsurface oxidation/reduction chemistry. Aqueous Fe(II) adsorbed on iron oxide nanoparticles in natural groundwaters or simulated systems has been shown to efficiently reduce oxidized contaminants.

Accessible reactive surface area and abiotic redox reactivity of iron oxyhydroxides in acidic brines

Strehlau, J.H., B.M. Toner, W.A. Arnold and R.L. Penn

[Geochimica et Cosmochimica Acta](#), 2016

The reactivity of iron oxyhydroxide nanoparticles in low pH and high ionic strength solutions was quantified to assess abiotic contributions to oxidation-reduction chemistry in acidic brine environments, such as mine groundwater seepage, lakes in Western Australia ...

Interaction of gut microbiota with bile acid metabolism and its influence on disease states

C. Staley, A.R. Weingarden, A. Khoruts and M.J. Sadowsky

[Applied Microbiology and Biotechnology](#) 2016

Abstract Primary bile acids serve important roles in cholesterol metabolism, lipid digestion, host-microbe interactions, and regulatory pathways in the human host. While most bile acids are reabsorbed and recycled via enterohepatic cycling, ~ 5% serve as substrates for ...

The [Minnesota Public Drainage Manual](#) was first published in 1991 and subsequently updated and republished in 2016 to provide guidance to drainage authorities as they administer Chapter 103E drainage systems. The Manual has multiple audiences: drainage authorities, their engineers, attorneys and inspectors; landowner's; regulatory agencies; and other interested parties. It is a guidance document and is not rule or law.

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Winter 2017 Upcoming Events

January 13, 2017

Minnesota Wetlands Conference - Think BIG!

DoubleTree by Hilton-Minneapolis North

Conference Website and registration

May 9-11-2017

National Adaptation Forum - Action today for a better tomorrow

St. Paul RiverCentre

Learn how to make your work climate-informed, share what you have learned with others, and develop a stronger network of like-minded peers. Those who attend benefit from exposure to all aspects of the field, professional development, and information sharing through an innovative and comprehensive program featuring plenary sessions, symposia, working groups, training sessions, exhibit booths, poster sessions, and networking events.

Conference webpage

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