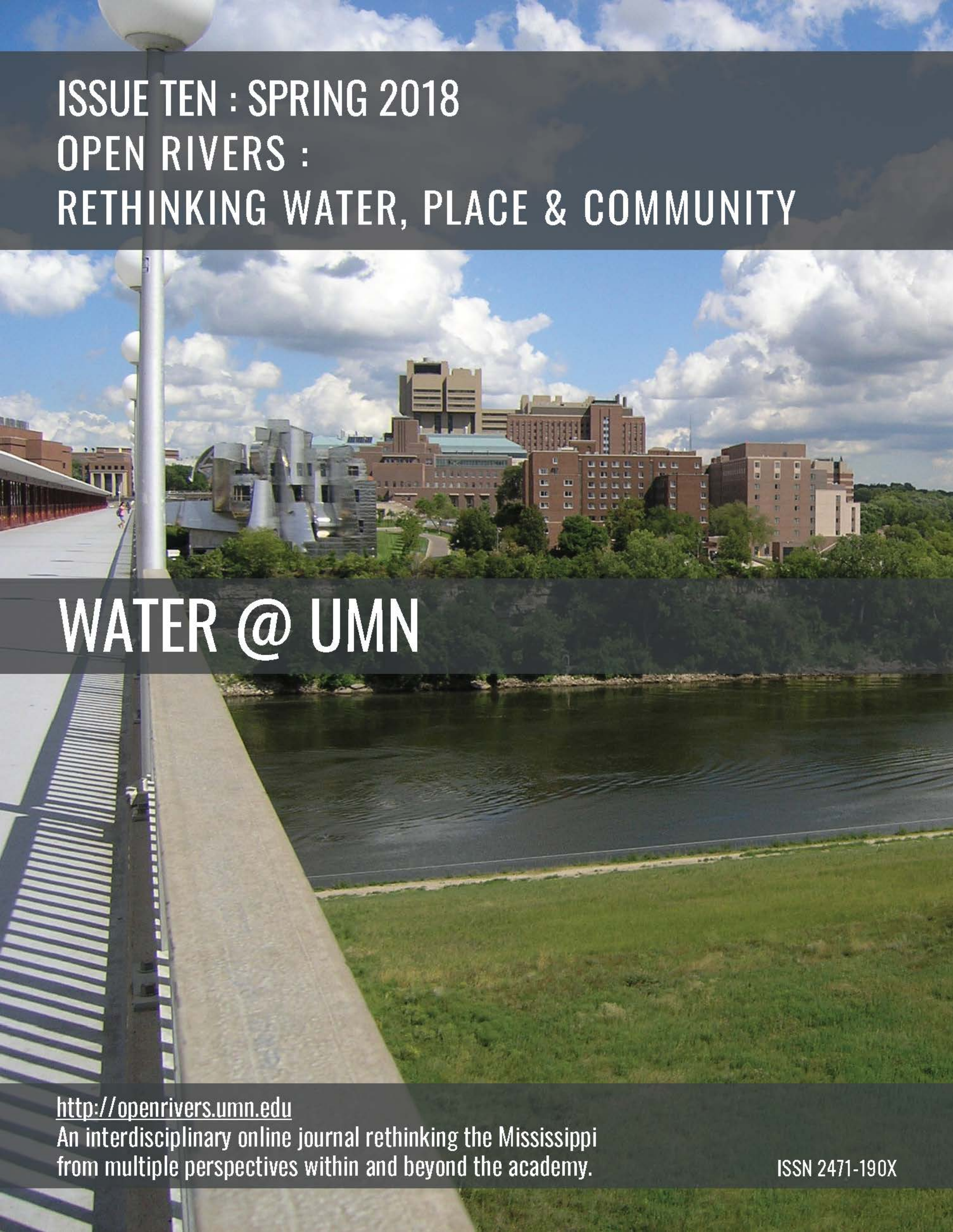

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WATER @ UMN

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from multiple perspectives within and beyond the academy.

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The cover image is of The East Bank of the Minneapolis campus of the University of Minnesota and the Mississippi River from the Washington Avenue Bridge. Image courtesy of Patrick Nunnally.

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FEATURE

WATER @ UMN ROUNDUP

By Thomas Fisher, John A. Hatcher, Todd Klein, Laurie Moberg, Jennifer E. Moore, John L. Nieber, Jian-Ping Wang, Wei Wang, and Kai Wu

As the editors put this issue on “Water @ UMN” together, we realized that the breadth, complexity, and variety of water-related work at the University of Minnesota could never be encompassed in a few articles. Accordingly, we sent a prompt out as widely as we could, asking water scholars to tell us, in a few paragraphs, what it was about their work that they were most excited about. The short pieces that follow contain some of their responses, in no particular order.

Jay Cooke State Park illustrates the natural beauty of northern Minnesota. The St. Louis river flows to Duluth and Lake Superior. Image courtesy of University of Minnesota.

Thomas Fisher

Professor and Director, Minnesota Design Center, University of Minnesota Twin Cities

Water and Innovation

Several years ago, civic leaders in Minneapolis and St. Paul began to develop, between the two Twin Cities campuses of the University of Minnesota, a former industrial area now called the Towerside Innovation District. The Minnesota Design Center, which I direct, has long been involved in helping the neighbors and landowners in the district, including the University, envision what an innovation district means in the 21st century, not just in terms of technological and economic development, but also in terms of renewable – and threatened – resources like water.

The district stands on top of a former river and wetland and so water has played an important role in its past – and will play an equally important role in its future. Some of the planning my center has done at Towerside, with landscape architect Bruce Jacobson and architect John Carmody in the lead, has involved daylighting the water that still runs below the surface in the district as part of a set of linked green spaces that complete a missing segment of the Twin Cities' bike and pedestrian network. In partnership with the Mississippi Watershed Management Organization, we have also helped with the placement of a district storm water, bio-retention basin to clean surface water for irrigation and industrial uses. These examples show how innovation in water use remains one of our greatest opportunities as we think about economic and community development in the years to come.

John A. Hatcher, Jennifer E. Moore

John A. Hatcher, Associate Professor, Department of Communication, University of Minnesota Duluth,

Jennifer E. Moore, Assistant Professor of Journalism, Department of Communication, University of Minnesota Duluth

One River, Many Stories: A Community Storytelling Project

In April 2016, faculty in the Journalism Program at the University of Minnesota Duluth asked a question: What would happen if all of the storytellers in a region turned their attention to one topic?

The answer was One River, Many Stories—a media collaboration between professional and amateur storytellers in northern Minnesota and northwest Wisconsin. Participants were asked to tell one story about the St. Louis River watershed. As the largest estuary feeding Lake Superior, the river was an easy choice for a topic. The St. Louis River's rich history as a water resource parallels the narrative of this region: stories of triumph, struggle, and renewal. Duluth's past, present, and future can be found in the river's diverse and ever-changing landscape.

Funded in part by the Knight Foundation Fund of the Duluth Superior Area Community Foundation, One River, Many Stories tested ways media collaboration could inspire innovation and nurture engagement among professional journalists, educators, and citizen storytellers. Participants were asked to share their published work on social media and use one of the project's hashtags: #OneRiverMN, or #ChiGamiiziibi (the Ojibwe name for the St. Louis River). Nearly 50 original stories were aggregated on our website, onerivermn.com, and over a thousand social media posts were documented.

Our study of One River, Many Stories' impact ("Disrupting traditional news routines through community engagement," *Journal Studies*) found encouraging results for projects that attempt to rally participation from commercial news organizations, citizen journalists, public broadcasters, and digital-first news organizations. Participants told us the project encouraged them to learn new things. Many said they developed a new passion for telling their own stories about the river and its communities. One River, Many Stories also fostered new relationships—especially among our local scientific and artistic communities.

The St. Louis River proved to be a powerful catalyst for inspiring community storytelling. As we look ahead, we are asking how we can continue to engage citizens and journalists alike to tell community stories often overlooked by traditional media. We also want to explore how our project can serve as a model for university-community partnerships who share our desire to facilitate innovation and collaboration in the twenty-first century media ecosystem.

To view our final report or to order a hard copy, visit our website: http://onerivermn.com/final-report/.

Read a review of One River, *a play that grew out of the One River, Many Stories project, here.*

Laurie Moberg

River Life, Institute for Advanced Study, University of Minnesota Twin Cities

River Life, a program in the Institute for Advanced Study at the University of Minnesota (UMN), creates opportunities for campus-community engagement, public scholarship, teaching, and research focused on water, place, and community. One of our current initiatives, We Are Water MN, is a traveling exhibit and six-week event series focused on telling Minnesota's water stories through diverse ways of knowing. We Are Water MN is a partnership among the Minnesota Humanities Center, the Minnesota Pollution Control Agency, the Minnesota Historical Society, the Minnesota Department of Health, the Minnesota Department of Agriculture, the Minnesota Department of Natural Resources and eight different host communities across the state that will display the exhibit and gather water stories. The exhibit opens at the University of Minnesota in October 2018.

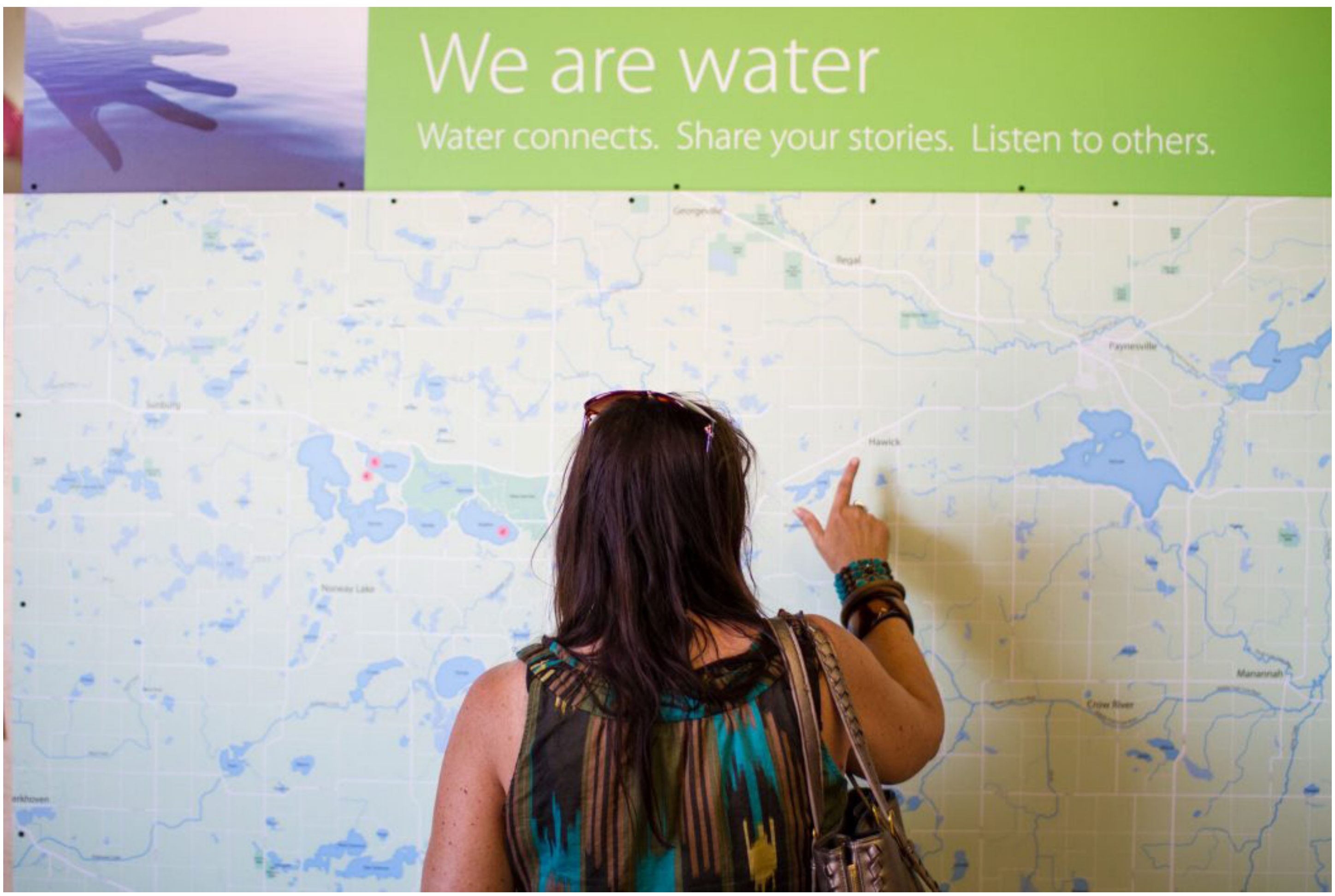
We Are Water MN exhibit preview.

We Are Water MN focuses on two main objectives:

First, the project aims to engage with nondominant perspectives and learn from them by asking people to share their water stories. The stories we tell about water are informed by our histories, culture, and experience and speak to inequalities in social power dynamics. While hosted here at UMN, we are focusing on integrating stories from across community and campus ways of knowing. By engaging diverse ways of knowing water through story, we begin to appreciate the social dynamics of our relationships with water and with each other.

Second, the project aims to foster responsible actions toward our waterways. Studies of water quality across Minnesota tell us that 40 percent of Minnesota waterways are impaired, but this does not tell us how to tie human care, behavior, and action to our waters. Through story, people begin to see their own connections to water; by hearing other people's stories, we see that our experiences and relations differ, often based on the uneven distribution of effects from impaired water systems. Appreciating our own water stories and the water stories of others helps mobilize action toward conservation and care.

While the exhibit will only be on campus for six weeks, we expect We Are Water MN to spur ongoing efforts for community-campus engagement, water conservation, and River Life's objectives to facilitate public scholarship focused on the meanings and permutations of water.



We Are Water MN Story Map preview.

John L. Nieber

Professor, Department of Bioproducts and Biosystems Engineering, University of Minnesota Twin Cities

Minnesota: How much water is there; how is it changing?

How much water do we have in Minnesota, and why would we want to know? In all the years of water research within the state, there has never been a direct accounting for the volume of water present in wetlands, lakes, streams/rivers, soil, and groundwater. However, it is something that researchers and water management agencies would like to know to make it more feasible to manage and utilize our available water resources more efficiently. It is recognized in the field of hydrology that the volume of water stored in soils and groundwater is related to the flow in streams and rivers, and also impacts the healthy exchange of this water with lakes and wetlands. In the field of limnology, it is recognized that the volume of water in lakes directly affects the time required for chemical constituents like nitrogen, phosphorus, and organic carbon to travel through aquatic ecosystems; this has a direct influence on the health of those ecosystems.

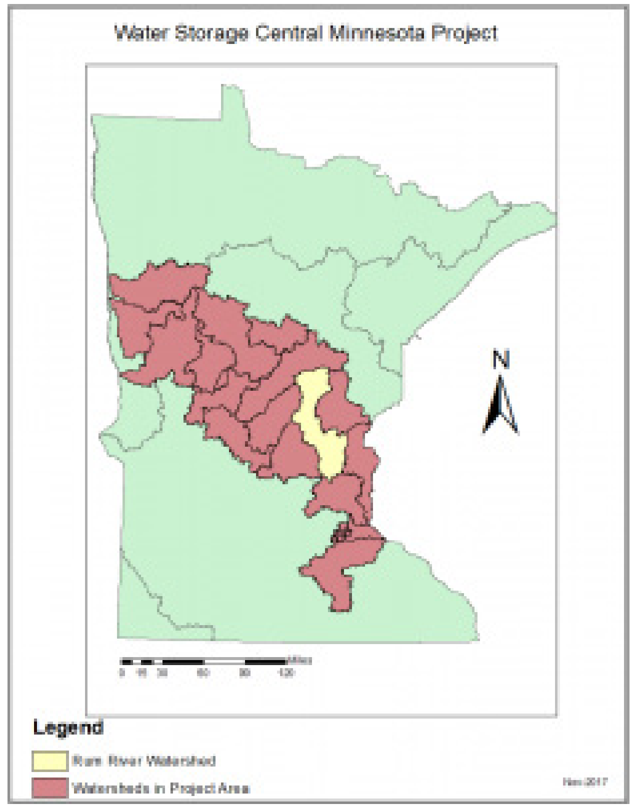


Figure 1. Map of study area. The HUC-8 watersheds are outlined. The highlighted watershed is the Rum River watershed. Image courtesy of John L. Nieber.

In a current project funded by the Legislative-Citizens Commission on Minnesota Resources (LCCMR), a team of researchers from the University of Minnesota departments of Bioproducts and Biosystems Engineering (John Nieber, Bruce Wilson, Joe Magner, Roman Kanivetsky) and Soil, Water, and Climate (Tim Griffis, John Baker), and Jared Trost from the US Geological Survey is using various methods to quantify the storage of water within a region comprising 17 HUC-8 (approximately 1,200 sq. miles in area) watersheds extending from the Twin Cities Metro Area to Moorhead (Figure 1). The methods include direct point measurements of water quantity (e.g., water levels in monitoring wells and in lakes), water balance calculations (precipitation, evapotranspiration, surface runoff), streamflow measurements, and satellite measurements including the GRACE (gravity) satellite, the SMOS (Soil Moisture & Ocean Salinity) and SMAP (Soil Moisture Active Passive) soil moisture satellites, and the WorldView satellite. Through a combination of these methods, the researchers intend to derive estimates of water storage and water storage change within these watersheds. An illustration of the streamflow data used in the study is shown in Figure 2 for the Rum River watershed; illustration of water storage in the Rum River watershed as measured by the signal from the GRACE satellite is shown in Figure 3. Ultimately the project team would like to extend the analysis to all of Minnesota, and to assist state agencies to take more advantage of satellite and other aerial remote sensing methods to quantify the status of water storage within the Minnesota landscape.

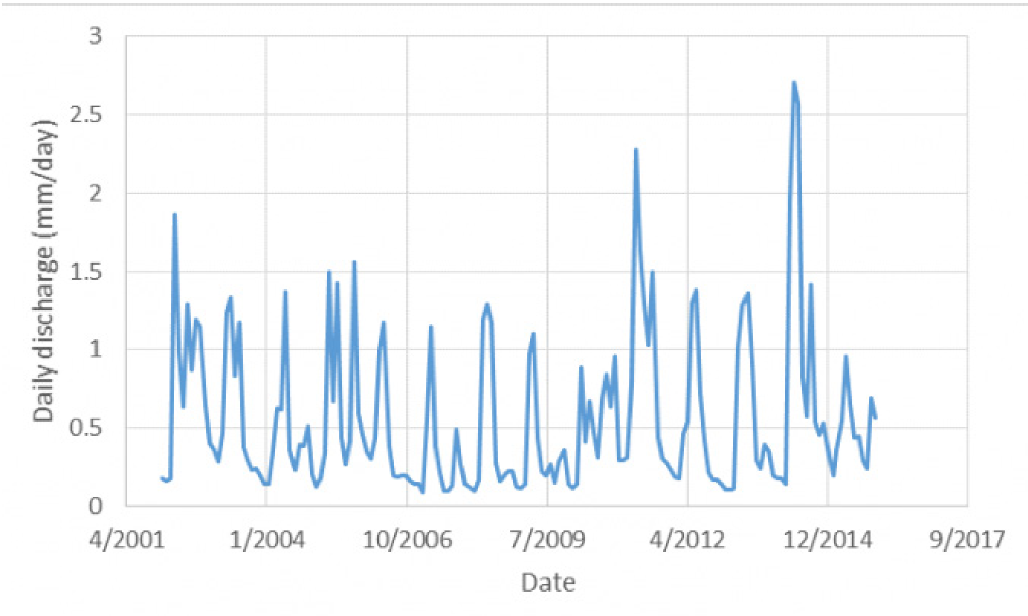


Figure 2. Illustration of the mean daily flows by month at the gaging station for the Rum River. Image courtesy of John L. Nieber.

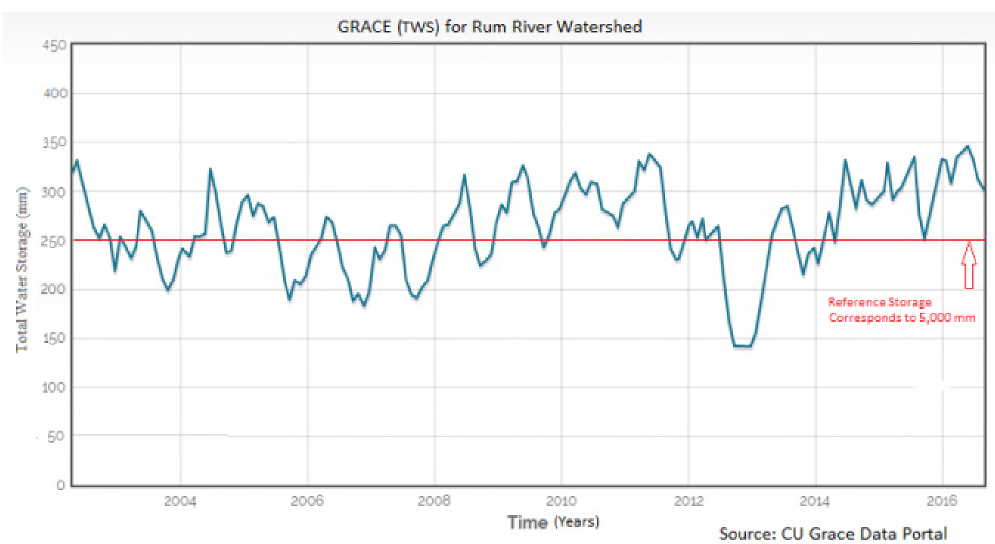


Figure 3. Variation in total water stored in the Rum River watershed for the period 2002 to 2017, as measured by the signal from the GRACE satellite. The total stored water includes all water stored in groundwater, soil moisture, lakes/wetlands, and streams/rivers. Gains in water storage originate from precipitation, while losses include evapotranspiration, river discharge, and consumptive use by human activities. The variation is presented as relative to the reference level of 5 m of stored water. Image courtesy of John L. Nieber.

Jian-Ping Wang, Wei Wang, Todd Klein, Kai Wu

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Applying Nanomagnetic Technology for the Detection of Heavy Metals from Drinking Water

Mercury contamination has been an important environmental and health concern throughout the world for decades. High exposures to mercuric ion (Hg2+) may result in acrodynia (pink disease) and damage to the nervous system and kidneys. Furthermore, mercuric ion is stable and soluble in aquatic systems, and methyl mercury can accumulate in bodies through the food chain, which is known to cause brain damage and other chronic diseases, even paralysis and death. Nowadays, the detection of trace-level toxic heavy metal ions mostly relies on bulky and costly analytical instruments in central labs. Driven by this need, Prof. Jian-Ping Wang and his group at the University of Minnesota developed and tested a diagnostic platform designed to detect mercuric ion (Hg2+) using nanotechnology.

They applied the knowledge that mercuric ion can specifically bind in between two DNA thymine bases and lead to the formation of a thymine-Hg2+-thymine (T-Hg2+-T) pair. Their developed testing process, which parallels the commonly used DNA hybridization process, involves DNA strands acting as sensors capturing a target analyte, to which a detectable object will bind to the sensor-analyte complex. In that case, a GMR (Giant Magnetoresistance) chip is used as the surface, and a magnetic tag (magnetic nanoparticle) is the detectable object. If the analytes are present in the sample, magnetic tags will bind to the GMR sensor resulting in a change in the electrical signal.

This diagnostic platform reaches a detection limit of 10 nanomoles per liter (nM, nmol/L) in both buffer and natural water, which is the maximum mercury level allowed in drinking water regulated by U.S. Environmental Protection Agency (EPA). Because of the features of GMR biosensing technology, this GMR Hg2+ bioassay is pointing toward a convenient and rapid field test. Furthermore, as a versatile and strong contender in molecular diagnostics, GMR bioassay has great potential for the application of other pollutants monitoring in environment and food samples.

Recently, Prof. Wang's group has successfully developed and tested a prototype of Z-Lab, a portable diagnostic platform designed to perform on site testing of biological samples for various ailments. This is the first version of the prototype developed for point-of-care diagnostics.

Prof. Jian-Ping Wang and the Z-Lab diagnostic platform developed in his group. From left to right: Dr. Roy Huchzermeier, Prof. Jian-Ping Wang, Dr. Todd Klein. Image courtesy of Nokia Sensing Xchallenge and Jian-Ping Wang.

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