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WRRI's 2014 Conference: A few highlights

by Rhett Register

NC WRRI's 2014 Annual Conference and NCWRA Symposium offered nearly 80 oral and poster presentations, a panel discussion focusing on the role of local governments in managing water resources and a presentation by a member of the NC House of Representatives.

With over 180 participants — including representatives from 10 nonprofit organizations, 8 colleges and universities, 12 state and federal agencies, 21 local counties, municipalities, councils of governments and utilities, and 24 private professional firms — the conference was a venue for water-resource professionals to learn about and explore pressing issues affecting water resources in North Carolina.

If you missed this year's conference, or would like to revisit some of what you saw, many of the presentations and poster abstracts can be found on the WRRI website at ncsu.edu/wrri by following the past events link.

Below are a few highlights from the symposium and concurrent sessions from this, the 16th, NC WRRI Annual Conference.

NCWRA Symposium, "Local Governments as Keystone Water Resource Managers"

The purpose of the symposium, said moderator Heather Saunders Benson, was to illuminate the important role local governments have in managing water resources and the increased

responsibility they have taken on in terms of paying for and protecting those resources.

North Carolina should be a state with an image of clean water and clean air, said Charles Meeker, former Raleigh mayor, in his symposium welcome. "Unfortunately," he continued, "that is not where our reputation is today."

Local officials play a key role in protecting North Carolina's water resources by remaining knowledgeable about the status of new developments as well as wastewater and other utilities, Meeker noted.

"The old adage 'expect what you inspect' is just as true today as it has ever been," he said.

Jim Salzman, author of *Drinking Water: A History*, provided historical context for current water issues, particularly the debate over the privatization of water resources and distribution systems. Salzman, a Duke University professor and environmental policy expert, showed examples from
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WRRI celebrates its 50th anniversary

Fifty years ago, in July of 1964, Congress passed the Water Resources Research Act. The act created local centers of water research, which eventually became the Water Resources Research Institutes. Established to tackle water problems at all levels from local to national, the Act set up the institutes as state-federal partnerships.

Over the next couple of issues, *WRRI News* will speak with directors, researchers and policy folks about the role NC WRRI has played in helping preserve, protect and advance the study of North Carolina's water resources.

To start the series with a national perspective, we spoke with Earl Greene, program coordinator with USGS for all 54 of the institutes. In this role, Greene explains the program to Congress, and works for its continued funding. Here he talks about the role of the WRRI program and how it is uniquely suited to help the country make a transition from in-
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throughout history where water was viewed as either a right or a commodity. Both Jewish and Sharia law, he said, command that people who need water should have it. On the other end of the spectrum, Salzman gave examples from an early period in New York City's history where water services were privatized to disastrous effect. Due to outbreaks of cholera and fire, the government was eventually forced to step in to provide water. Salzman ended by noting that seeing water only as a right or as a commodity is a false dichotomy. He pointed to the practice in ancient Rome of taxing water piped to private residences in order to fund publicly available water as a potential model for private-public partnerships today.

Holly Miller, engineer with the Town of Wake Forest, provided the small, local government perspective to managing water resources. Miller described some of the programs her town uses to protect and enhance its water resources. These include running erosion and sediment control programs and engaging in NPDES phase II stormwater and floodplain protection programs. The town, whose population has grown dramatically in the last decade and whose water and sewer services merged with Raleigh's, also has initiated an adopt-a-stream program. Volunteers take water samples, clean up streams and replant and maintain buffers. Data from citizen water-quality monitoring pointed officials to two illegal discharges, Miller noted.

Speaking from the perspective of a large, local government, David Woodie, project manager with Charlotte-Mecklenburg Storm Water Services, gave an overview of massive restoration efforts in the Little Sugar Creek and McDowell Creek watersheds. Woodie stressed that planning is important for successful restora-

tion of urban streams. Large-scale projects are better partly because the momentum positively influences private property owners, homeowner associations and other stakeholders, he added. Changes in a creek's reach can affect the entire catchment area, he said. Part of his group's success in restoring miles of urban creeks has been due to linking water quality projects with other complimentary capital projects such as flood control, parks and greenways.

Steve Stone, Brunswick County assistant county manager, spoke from the coastal local government perspective. He described his county's recent dramatic growth and decline in water quality. The county joined forces with the North Carolina Coastal Federation, a nonprofit coastal advocacy group, to apply for an EPA watershed demonstration project grant for the Lockwood Folly watershed in the center of the county. The group received the funding and, working with Bill Hunt and his team at NC State University, implemented a series of Low Impact Development (LID) projects. According to Stone, these achieved much better water-quality outcomes and were economically more efficient for developers than standard stormwater control measures, due in part because they allowed developers to get a higher lot yield from the same amount of land.

"While federal and state government are both in a good position to describe water protection and water quality outcomes that we all want," Stone said, "it is local governments that really can develop and implement the strategies and tactics to make those outcomes come about."

Jay Johnston, director of engineering and utilities with the City of Brevard, spoke about his community's challenge to find water to meet



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creasing water supply to working more efficiently with the supply it has.

The interview has been edited and condensed.

WRRI News: It seems that the WRRI program was originally created to address environmental problems and increase capacity for water...

Earl Greene: And to train the next generation of scientists. So think about this, back in 1964, we did not even have hydrology degrees at universities. It's a pretty far-thinking act that was passed to set up these institutes to tackle water resources issues. I think that is one of the huge strengths of these institutes from my point of view. My generation is about ready to retire. The next generation has to step in and continue pushing forward on bigger issues that we never imagined in the '70s and '80s when I went to school.

WN: How are the issues changing from what your generation faced?

EG: So back when I was in school, we were pretty well a one-discipline science — water availability, water supply, stream flow, ground water. Now they are really tied into the ecosystem — much more multidisciplinary. Climate change is huge, the drought in Southwest, hydraulic fracturing, I mean we had issues when I was growing up, but these issues are much more multidisciplinary than what we had. It's different. All of the classes I took were just water. Now folks in school take water, biology, GIS, all these other types of disciplines to be able to be effective water scientists.

WN: How will the institutes contribute to addressing these new problems?

EG: They are housed at the university that has all the skills and degree programs that can do that. They are really that training platform for those new students so they can take classes in these other subject areas that



Earl Greene, USGS

contribute to understanding how the whole system works.

WN: When you say that the WRRI program is training the next generation of water scientists, what do you mean? How are they promoting their development?

EG: The annual base grants [from USGS to the Institutes] are really the place where that training happens. Most of it goes to small student or new faculty research that brings on students to train them.

WN: Any final thoughts about the program at 50?

EG: It's a good program. It's got real value. I am still really appreciative of how it was set up back in '64 because the goals of the program that were set up back then are still relevant to today. It's pretty forward-looking in my opinion. Fifty years ago and it still pertains today. You can't say that about every government program.

To learn more about the history of the national program, visit:

www.usgs.gov/newsroom/article.asp?ID=3937#u-eyq17vzeo.

NCWRA-WRRI student poster competition winners



Left to right: Molly Welsh, Erin Looper, Elizabeth Gillispie, Fatemeh Mohammad Shirazi.

Erin Looper, University of North Carolina at Charlotte's Department of Earth Sciences, took first place for her poster, "Sediment denitrifying community response to flow disturbances in an urban stream receiving discharge from a stormwater control measure." The poster was co-authored by Sara McMillan.

Fatemeh Mohammad Shirazi, NC State University's Department of Soil Science, received second place for her poster, "Investigation of tillage as a best management practice on construction sites." The poster was co-authored by Richard McLaughlin, Virginia Brown and Joshua Heitman.

Elizabeth Gillispie, NC State University's Department of Soil Science, won third place for her poster, "Sources and variability of manganese in well water of the North Carolina Piedmont." The poster was co-authored by R. Austin, J. Abraham, S. Wang, R. Bolich, P. Bradley, A. Amooze-gar, O. Duckworth, D. Hesterberg and M.L. Polizzotto.

Molly Welsh, University of North Carolina at Charlotte's Infrastructure and Environmental Systems program, received an honorable mention for her poster, "Impact of stream restoration on riparian soil and stream sediment denitrification potential in the Piedmont region of North Carolina." The poster was co-authored by Sara McMillan and Philippe Vidon.

Jonathan Harris, East Carolina University's Department of Environmental Health Sciences, received an honorable mention for his poster, "Transport of indicator microorganisms from an onsite wastewater system to adjacent stream." The poster was co-authored by Charles Humphrey and Michael O'Driscoll.

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projected future needs. Johnston mentioned a rebranding effort the community had undergone as it moves from industry to tourism as its economic base. The effort, he said, seeks to show Brevard, located in a mountainous county that is approximately half national forest, as an ecotourism hub. Johnston said future efforts seeking to reclassify the French Broad River as a water supply for the community will include a required watershed overlay ordinance to protect that resource. The town, he said, would be willing to take on increased regulation because it is consistent with the new direction the City of Brevard is headed.

Fred Royal, engineer for the Town of Pittsboro, brought the discussion full circle by describing his town's engagement in a public-private partnership.

Due to dry weather in 2007 and 2009 causing the town's water supply from Jordan Lake to get dangerously low, the town has written new water efficiency, irrigation and emergency ordinances for water use. They also have started looking at reclamation as an option to help meet the town's water needs. All water is reused, Royal said, and it should be viewed as a manufactured product. It doesn't make sense to flush potable water down the toilet.

The town currently provides 3M with 60,000 gallons a day of reclaimed water for industrial purposes. Money from the partnership has promoted the proposed expansion of the wastewater treatment plant and the town plans to increase production of reclaimed water.

"The technology is available, the methodology is well known," he said. "This is not new science or engineering. We just have to get it going."



Panel members discussed how water is managed at the local level. From left to right: Jim Salzman, Holly Miller, David Woodie, Steve Stone, Jay Johnston and Fred Royal.

State Rep. Martin speaks at NCWRA symposium

During the NCWRA Symposium concluding presentation over lunch, N.C. Rep. Grier Martin (D) continued the discussion of the role that local governments have in managing water resources.

Martin compared the current partisan atmosphere of the legislature to a "bad 1970's prison gang movie" where legislators from both parties stick to their party "gangs" and are unable to reach consensus.

In contrast to state government, Martin said that local governments are often more focused on issues than



Representative Grier Martin (D)

party affiliation. "Local government has the ability," Martin said, "to be a nonpartisan voice, or a bipartisan voice, because water issues at the local level are much less partisan than they are at the state level."

Martin encouraged local government officials to be in contact with their representatives about the water issues they are dealing with and to communicate the implications state legislation has on counties and municipalities.

A small North Carolina watershed proves that advanced wastewater treatment can significantly reduce nutrient loads

by Kavitha Pramod

The Triangle Wastewater Treatment Plant (TWWTP) services the south-east section of Durham County, which includes most of Research Triangle Park, and portions of the City of Durham and the Town of Cary. Recent and rapid population growth in the area has necessitated significant expansion and

upgrades to the TWWTP. By employing advanced wastewater treatment techniques, the TWWTP has shown quantifiable nutrient load reductions.

Joseph Pearce, utility division manager for Durham County, is

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responsible for the improvement, management and regulatory compliance of the TWWTP. In his presentation, Pearce described how his facility has changed over time to accommodate the growing population.

Built in the early 1960s, the TWWTP originally consisted of two facultative lagoons, Pearce said. These were replaced in 1973 by a 3 million gallon per day (MGD) extended aeration plant. Ten years later, the plant was expanded to 6 MGD. Despite the upgrades, by 1997, the facility exceeded 80 percent of its total hydraulic capacity. With predictions for high population growth rates in the area, the need for a bigger plant became apparent. It was also at this time that the North Carolina General Assembly passed the Clean Water Responsibility Act requiring development of improvement goals for nutrient-impaired waters including Jordan Lake into which the creek the TWWTP discharges to eventually flows.

Between 1997 and 2005, a design was finalized, permits obtained, bonds issued and construction of an expanded and upgraded TWWTP was completed. The 2005 facility featured three five-stage biological nutrient removal “trains” each with the ability to process up to 4 million gallons of wastewater a day. It also employed chemical phosphorous trimming, travelling bridge sand filters, UV disinfection and a new centralized control system.

The cost of the improvements — funded through sewer revenue bonds — totaled approximately \$47 million. Despite the expense, Pearce said, sewer rates for the region are equal or below the rates of neighboring utilities.

With the retooling, the facility gained the capacity to treat twice the amount of wastewater as was previously possible. While wastewater flows from the facility increased, concentrations of nutrients discharged in the water have gone down.

In 2013, the facility discharged only about half of its Jordan Lake allocation NPDES limits for nitrogen and phosphorus. According to NCDENR Division of Water Resources, discharge from the upgraded TWWTP meets future nutrient load limits for Jordan Lake. The facility has also been recognized by the division as meeting “exceptional quality criteria” meaning that the facility has shown consistent, long-term treatment performance at levels less than 50 percent below effluent limitations.

The achievements of the facility are also reflected in a report authored by Stephen Harden of the USGS, entitled “Relation of Watershed Setting and Stream Nutrient Yields at selected Sites in Central and Eastern North Carolina, 1997-2008.” This report analyzed 48 separate watersheds, including the Northeast Creek watershed to which the facility discharges. It credits a nitrogen load reduction of 64 percent in the watershed to the TWWTP improvements.

According to Pearce, the TWWTP will continue to be improved. In 2012, a ReUse water system was installed to provide cooling tower and irrigation water to RTP industries and further reduce nutrient discharges. Distribution for water from the new system will be installed, he said, over the course of the next decade.

Kavitha Pramod is a freelance writer specializing in climate and water issues.

Art competition focuses on water resource issues



For the second year, works submitted in the annual Water Resources High School Student Art Competition were on display at the WRRRI Annual Conference. Students from J.F. Webb, Granville Central and South Granville high schools were asked to create works of art that show a water resource problem and solution. This year, contest coordinators Nicole Wilkinson, of WRRRI, and Teresa Baker, recycling coordinator for Granville County Schools, received more than 50 submissions. The winner was Giovanni Paneda Ceja of Granville Central High School for his work “Every Drop Counts.” Paneda Ceja received \$100 and his work will be featured on the cover of next year’s WRRRI Annual Conference binder. His teacher, Brenda Currin, received \$200 for art supplies for her classroom. Second place winner was Vannesa Paneda also of Granville Central High School. Hannah Rich of South Granville High School took third place. Lauren Wilkinson of Granville Central High School received honorable mention.

Impacts of sea level rise to barrier island septic systems

by Kavitha Pramod

Coastal areas are expected to face challenges in the coming decades from the effects of climate change and specifically, sea level rise. Alex Manda of East Carolina University spoke at the conference about his work studying the impacts of sea level rise on groundwater resources in the eastern part of North Carolina.

Manda's team, which includes Shane Sisco, David Mallinson and Michael Griffin from ECU, looks at the potential impacts of rising water tables to onsite wastewater treatment systems, or septic systems, under future sea level rise scenarios. The researchers focused on the western portion of the Town of Emerald Isle on Bogue Banks barrier island in Carteret County. The town has no centralized sewer system and over 70 percent of the residents rely on septic systems for their sewage needs.

For a septic system to run correctly, Manda said, the drain field must be located at least 12 to 18 inches above the water table. This elevation protects groundwater from contamination and allows the system to drain properly. Manda is concerned that as sea levels rise, they will push up the water table in coastal regions. This could mean that septic systems in some places could no longer be maintained at the required height above groundwater.

Using geospatial modeling, and end-of-century sea level rise scenarios of between 7.8 inches and over 3 feet, Manda's team found that as much as 83 percent of the study area

Exploring the use of soil-polyacrylamide for erosion control at construction sites

by Kavitha Pramod

Construction sites are notorious for their high levels of muddy runoff. In an effort to limit erosion and runoff at these sites, scientists are looking at new methods of erosion control. The application of polyacrylamide, or PAM, as an erosion control agent has been used successfully for years in the agriculture industry. Its use at construction sites, however, is relatively untested. Jihoon Kang, a postdoctoral research scholar at NC State, described his research studying the application of PAM to construction sites for sediment and erosion control.

PAM is a non-toxic, long-chain synthetic polymer that is available in various forms, including granule, solid blocks, tablets and emulsion. When applied — often by sprinkling it on the ground and then covering the area with erosion control blankets — PAM causes the sediment that has been picked up by water flowing over the land's surface to flocculate and sink. Kang notes that PAM does not reduce runoff amount, but improves runoff water quality by removing much of the suspended sediment. His research, funded in part by a grant from WRRRI, seeks to determine (1) the difference in water quality between the application of PAM in granule and dissolved forms, (2) the particle size of eroded sediments from sites treated with PAM and (3) how much of the applied PAM is lost in runoff from the site.

To answer the first question, Kang, along with Rich McLaughlin from the Department of Soil Science at NC State, conducted a rainfall simulation study. The researchers compared PAM applied under erosion control blankets in granule and dissolved forms. They found that the total suspended solids, or TSS, and turbidity in the runoff from the site when PAM treatments were

used were approximately 28 times less than the control. The findings also suggest that the most effective combination for reducing TSS and turbidity in runoff is by applying PAM in its dissolved form.

To answer the second question, the researchers used a machine capable of determining the size and distribution of particles in runoff. They found that eroded sediments collected from sites treated with PAM had a median particle diameter 7 to 9 times greater than the diameter of the control. This flocculation effect, caused by PAM binding sediments to itself, is favorable for further sediment trapping.

Further analysis of runoff from the sites found that loss of PAM during the experiment was 2 percent for the dissolved PAM and 19 percent when granular PAM was applied.

Overall, Kang said, the results of the study suggest that PAM is effective at improving water quality in runoff from construction sites. Both forms are effective at erosion control, Kang said, but dissolved PAM appears to be the most effective application and the form in which the least amount of PAM is lost.

Follow-up discussion at the end of Kang's talk at the WRRRI Annual Conference included questions as to whether PAM is biodegradable and what, if any, environmental concerns are associated with its use. He responded by saying that PAM is known to be slowly biodegradable and the amounts escaping into the environment are well below toxicity levels for aquatic species.

Additional details about this work can be found in a final research report available at go.ncsu.edu/12-06-W. See Appendix 2 for additional references to peer-reviewed publications of this research.

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Research provides baseline water-quality data in advance of hydraulic fracturing

In 2012, when legislation passed by the North Carolina General Assembly paved the way for hydraulic fracturing to come to North Carolina, Rob Jackson received funding from WRRRI to do baseline groundwater quality research in North Carolina's Triassic Basin.

That same year, a report published by the USGS estimated North Carolina to have 1.66 trillion cubic feet of natural gas, or enough to meet the state's demand for 5.6 years. The gas and natural gas liquids referenced in the report are located in shale formations in the Triassic Basin, a series of ancient rift valleys that lie deep beneath Lee and neighboring counties in the central portion of the state.

Before looking at hydraulic fracturing, or fracking, in North Carolina, Jackson, then an earth sciences professor at Duke University, studied the process' effects on groundwater in other parts of the U.S. including Pennsylvania, West Virginia, Arkansas, Texas and New York. In Pennsylvania, Jackson and his team documented evidence for methane contamination of drinking water associated with extracting gas from shale using hydraulic fracturing.

"We've sampled a number of homes where their water bubbles like champagne," says Jackson, who recently took a position at the Stanford School of Earth Sciences.

The researchers could point to shale gas exploration using hydraulic fracturing as the source of methane contamination due in part because methane contains different isotopes depending on where it was generated. Surface methane usually comes from microbes, but deeper methane, like that prospected for by fracking

often more than a mile below the Earth's surface, is the product of heat and pressure exerted upon organic material. If deep methane appears in shallower groundwater, there is a good chance that it has somehow migrated up, often due to leaks in the well casing or by traveling between the well casing and well bore.

Many of the places Jackson studied have a long history of oil and gas exploration. They also have very little, if any, groundwater data from before drilling began. Using the isotopic signature of the gas alone only told the scientists its origin, not how or when it got there. For that, they had to research local drilling history and other site-specific conditions.

When Jackson heard that North Carolina might allow fracking, he saw a need for comprehensive baseline data on groundwater before exploration began. North Carolina has had very little oil and gas exploration, so groundwater would not have been impacted by historical exploration.

Using WRRRI funding and working with the USGS, Jackson and his team tested 75 wells in Lee County, the area where fracking has the highest potential to occur.

The report, to be available January 2015 on the WRRRI website at go.ncsu.edu/12-05-W, gives an overview of groundwater quality of the area. Besides documenting basic water quality parameters, the report lists constituents that had been points of conflict in other states. These include metals, volatile organic carbon compounds and dissolved gasses.

"Knowing the preconditions is vital to understanding how things change based on human activities. This work will give us that rare op-

portunity should hydraulic fracturing occur in North Carolina," notes WRRRI Deputy Director John Fear.

According to the report, few well-water samples contained elements significantly above the US EPA's recommended standards for human health. It goes on to note that the data will "protect both homeowners and gas drilling companies from paying for problems that they did not cause." It will also provide communities, agency officials and policy makers something to compare water quality with when, or if, fracking comes to the state.

"We have a much better understanding of the natural groundwater conditions in the area now than anyone had before," says Jackson. "I think it will help in the future."

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could become unsuitable for septic systems, which would have a major impact on the wastewater treatment of the community.

To continue their research, Manda and his team have applied for joint NC WRRRI/North Carolina Sea Grant funding. Their proposal involves adding 20 to 40 groundwater monitoring wells, effectively doubling their current research area. Data from the wells will provide researchers with a better understanding of the characteristics of the water table beneath Bogue Banks.

Additionally, the team proposed to seek residents to assist with monitoring. Citizen involvement, Manda notes, is important as it gives residents ownership of the problem and allows them to begin suggesting possible ways to address the issue.

Recently published reports from WRRRI

The following WRRRI research reports have recently been published and are available for download from the NC State library repository. Reports can be accessed through the links below.

- Bongkeun Song, UNCW. "Factors Controlling Microbial Nitrogen Removal Efficacy in Constructed Stormwater Wetlands," go.ncsu.edu/11-06-W
- Marc Serre, UNC-CH. "Space/time geostatistical estimation of nitrate and radon groundwater contaminants," go.ncsu.edu/11-05-W
- Charles Humphrey, ECU. "Geophysical and water quality characterization of on-site wastewater plumes," go.ncsu.edu/12-07-W
- Richard McLaughlin, NCSU. "Optimizing Soil-Polyacrylamide Interactions for Erosion Control at Construction Sites," go.ncsu.edu/12-06-W

Upcoming Events

Municipal Wet Weather Stormwater Conference

August 18-19, 2014

Crowne Plaza Executive Park
Charlotte, NC

The EPA Region 4 and the Southeast Chapter of the International Erosion Control Association (IECA) Region One are hosting an inaugural Municipal Wet Weather Stormwater Conference.

Agenda and registration information at:
www.ieca.org/conference/roadshow/charlotttems4.asp.

NCWRA Forum, Luncheon and Webinar: National Flood Insurance Program BW-12 and Homeowners Flood Insurance Affordability Act of 2014

September 8, 2014

NCSU Jane S. McKimmon Center
Raleigh, NC

Presentation by John Gerber, PE, CFM, National Flood Insurance Program State Coordinator, NC Emergency Management

Register online at:
www.ncwra.org/events

2014 Water Education Summit: *Think Globally - Act Locally*

September 8-10, 2014

Crowne Plaza Resort
Asheville, NC

Check out the site below for additional information:
www.h2osummit.org.

A full list of upcoming WRRRI and other events can be found at: www.ncsu.edu/wrri/code/events.htm.