



Nevada Water News



Director's Letter

Greetings! As the Nevada Water Resources Research Institute (NWRRI) Executive Director, I'm pleased to introduce the inaugural issue of Nevada Water News, the new quarterly newsletter from the NWRRI. Each issue will highlight the NWRRI-supported water resources research that is being conducted in Nevada, the researchers and students who are exploring ways to sustainably manage the water resources in our arid climate, and any upcoming events or updates that pertain to the program.

As the most arid state in the United States, Nevada provides an important environment for researching water quantity and quality issues. The state's rapid population growth over the last 30 years combined with competing water demands for agricultural, domestic, industrial, and environmental needs creates a unique environment for researching water resources sustainability issues. Future climate changes will greatly impact our water resources, so being able to

quantify those resources more accurately and use them more efficiently will become increasingly important.



The Division of Hydrologic Sciences at the Desert Research Institute is dedicated to exploring and understanding how to best manage water resources, as well as training students for careers in water resources research. We are honored to house the NWRRI and to continue to support water resources research that is not only unique to our state, but that can also be shared with the rest of the southwestern United States and arid countries throughout the world.

Sincerely,
Jim Thomas

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New RFPs Available

The National Competitive Grant [104(g) RFP for Fiscal Year 2015 will be available on the NWRRI website (www.dri.edu/nwrri) in November. In addition, the Fiscal Year 2015 Base Grant [104(b)] will be available soon. E-mail Amy Russell (Amy.Russell@dri.edu) to receive the RFP.

Project Spotlight: Optimization of Ozone-biological Activated Carbon Treatment for Potable Reuse Applications



Biological activated carbon columns

As drought, climate change, and population growth make the availability of conventional water resources more uncertain, an increasing number of cities will turn to potable reuse to satisfy their water demands. In potable reuse applications, advanced treatment processes are used to convert wastewater to high-quality drinking water. Southern Nevada uses a variation of potable reuse because the water in Lake Mead is augmented by water from the Las Vegas Wash, which is primarily treated wastewater, and that water is then used as a drinking water source. Although the final water quality in potable reuse systems is often better than conventional alternatives and in some systems it is often on par with bottled water, these systems do pose challenges. For example, reverse osmosis filtration is plagued by high capital costs, operational costs, and energy consumption and it also produces a concentrated brine stream that must be discharged.

In the reuse industry, the most critical need is to produce high-quality drinking water with significantly less energy and infrastructure. Las Vegas is fortunate to be able to return highly treated wastewater to Lake Mead and use the lake as an environmental buffer prior to reusing the treated wastewater as a drinking water source. However, reservoirs in other cities—such as Big Spring, Texas—have completely disappeared due to prolonged drought, so these cities can no longer use an environmental buffer prior to reusing treated wastewater. Therefore, it is important to develop treatment trains that are sufficiently robust so that the environmental buffer can be eliminated (i.e., direct potable reuse). The primary objective of this project is to test a more sustainable advanced treatment train that is composed of ozone and biological activated carbon to determine whether it can

compete with reverse osmosis on the basis of bulk and trace organic removal. The ozone and biological activated carbon processes will be optimized and the final water quality will be evaluated against public health criteria developed specifically for potable reuse applications.

This project is particularly applicable to Nevada because of the water scarcity issues plaguing the entire state. In southern Nevada, Lake Mead is at its lowest level in history and there is no indication that the reservoir will recover in the near future. Nevada also has many groundwater-dependent communities, such as Searchlight, that would benefit from a more sustainable water-resource portfolio. Some of these communities are also impacted by high arsenic levels. An indirect or direct potable reuse system could both mitigate arsenic concerns and reduce the reliance on groundwater for these communities. Even in Las Vegas, which currently benefits from the return flow model, implementing a direct potable reuse system could reduce overall energy consumption by eliminating the need to pump water back into the valley from the significantly lower elevation of Lake Mead. Nevada's inland location also makes coastal discharge of concentrated brines infeasible, so it is important to focus on alternative treatment trains that avoid reverse osmosis. The ozone and biological activated carbon



Ozone contactors

The primary objective of this project is to test a more sustainable advanced treatment train for wastewater to drinking water.

(Project Spotlight continued)

concept was originally tested by Stantec at the Reno-Stead Water Reclamation Facility, but further validation and optimization are necessary before the concept is approved and broadly implemented.

Over the past year, one of the most interesting challenges that the project researchers have encountered has been developing a microbial community on the biological activated carbon. “When activated carbon is new, it is highly effective at removing organic contaminants via adsorption,” says Dr. Daniel Gerrity, the principal investigator for the project. “In contrast, we are using exhausted activated carbon that no longer has adsorptive capacity, but instead serves as a high-surface-area attachment site for good bacteria.” Because the process flow originates from an upstream biological treatment process, other bacteria have consumed most of the biodegradable organics. The bacteria did not have a sufficient food source, so the researchers could not get them to colonize the carbon. Although there was plenty of organic matter, it was not present in a form that was conducive to biodegradation. However, once the upstream ozone process was turned on, the incoming organic matter was broken down into more bioamenable components and the bacteria started thriving in the columns. The researchers are also evaluating a proprietary biocatalyst from LentiKat’s Biotechnologies, a European company that grows specialized bacteria inside a porous “biobead,” which will be tested in parallel with the biological activated carbon during the project.

This project has also provided students with opportunity to gain valuable research skills of their own. Ashley Selvy, who is pursuing an MS at UNLV in the Department of Civil and Environmental Engineering and Construction, has been working on this project for the past year. She has gained

Upcoming Events

NWRA Fall Symposium, Reno/Fernley, NV
October 14-16: www.nvwra.org

GSA 2014, Vancouver, BC, Canada
October 19-22: community.geosociety.org/gsa2014/home

American Water Summit 2014, Houston, TX
October 23-24: www.americanwatersummit.com

ASA, CSSA, and SSSA International Annual Meetings,
Long Beach, CA
November 2-5: www.soils.org/meetings

2014 Annual AWRA Conference, Tyson’s Corner, VA
November 3-6: www.awra.org

ENR Western Water Conference, Huntington Beach, CA
November 13: construction.com/events/2014/water

NGWA Expo ‘14, Las Vegas, NV
December 9-12: groundwaterexpo.com

AGU 47th Annual Fall Meeting, San Francisco, CA
December 15-19: fallmeeting.agu.org/2014

considerable experience with identifying and troubleshooting problems posed by the pilot-scale reactors and she is now making substantial progress in achieving the project objectives. “Now that the microbial community has stabilized in the columns, Ashley is starting to evaluate the impact of various operational conditions on water quality,” Gerrity adds. “Ultimately, Ashley will be able to optimize the process for the removal of bulk and trace organics, including pharmaceuticals.” ■

PI Spotlight: Dr. Daniel Gerrity



Dr. Daniel Gerrity moved with his family to Phoenix, Arizona, at age 10 and he lived there until he completed his PhD at Arizona State University in 2008. During that time, he witnessed firsthand the water issues that were becoming increasingly evident in the Southwest, which sparked his interest in water resources research. "I was always intrigued by the wide variety of engineering problems posed by the rapid urbanization of a desert environment," says Gerrity. "As I progressed through my studies at ASU, I quickly

realized that I wanted to focus my efforts on mitigating the water scarcity problems in the region. I then completed my postdoctoral research at the Southern Nevada Water Authority, where I was able to gain a slightly different perspective on the Southwest's water issues."

Gerrity's experience in the research and development group at the Southern Nevada Water Authority (SNWA) had a significant impact on his career path. "Although I focused primarily on microbiology at Arizona State, the research projects at SNWA forced me to shift my attention to the pervasive problem of trace organic contaminants, such as pharmaceuticals, in water," he adds. "Most people don't want to think about what can be found in wastewater, but wastewater actually tells an interesting story based on the drugs—whether they are over-the-counter, prescription, or even illicit—that we can find." At SNWA, he worked on a variety of projects funded by the

WateReuse Research Foundation and became interested in the possibilities of potable reuse. In his current research, he integrates his experience with both microbiology and chemical contaminants, which are critical components of developing potable reuse applications that ensure public health.

After the SNWA, Gerrity worked for two-and-a-half years at Trussell Technologies, an environmental engineering consulting firm in San Diego, which allowed him to gain an understanding of the water resources issues in California. He then returned to Nevada to take a faculty position at UNLV. "Although Arizona, Nevada, and California are all connected by their links to the Colorado River Basin, each state offers unique and incredibly interesting opportunities and challenges for environmental engineering, water resources, and public policy," he says. "I have definitely been fortunate to experience these various perspectives firsthand and I hope I have been able to pass that knowledge on to my students." Gerrity has also taken a lot of inspiration from two of his favorite books, *Outliers* by Malcom Gladwell and *Freakonomics* by Steven D. Levitt and Stephen J. Dubner. "The authors take what might seem like a strange topic on the surface, such as the relationship between school teachers and sumo wrestlers, and they attack the question from a completely unexpected angle. The result is incredible," he says. In fact, the way these books look at seemingly ordinary situations in new or unique ways inspired one of Gerrity's journal articles. "I looked at the relationship between the gross metropolitan product and water withdrawals in major metropolitan areas of the United States," he explains. "By looking at the situation from a different angle, I found that Las Vegas is

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(PI Spotlight continued)

actually one of the most productive cities in terms of converting its water resources into economic output.”

Gerrity tries to keep a good balance of field work, lab work, and office work and he tries to ensure that his students get a balance of work experiences as well. “I always try to maintain diversity in the research projects I pursue and even the settings where the research takes place. This allows me to be more creative and I think it increases the quality of the work,” he says. Field work allows him to understand how the research is relevant to the world, whereas controlled lab work allows him to explore the complex questions that are difficult to isolate in a natural environment. For office work, he can usually be found in a Starbucks.

What Gerrity enjoys most about the research he is doing for the NWRRI is that it

is directly applicable to the water resources concerns in Nevada and the Southwest, as well as other arid regions throughout the world. It also has the potential to offer solutions to the unsustainable treatment paradigms that can make it difficult for some communities to implement potable reuse. “Although working with microbes can be frustrating because they don’t always cooperate, it is fascinating to see how powerful nature can be when it is used effectively,” he says. “For that reason, I enjoy working at the interface of natural and engineered systems to solve the problems facing society.” ■

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Student Interview: Ashley Selvy

We asked graduate student Ashley Selvy about her current research and her plans for the future. Here’s what she had to say:

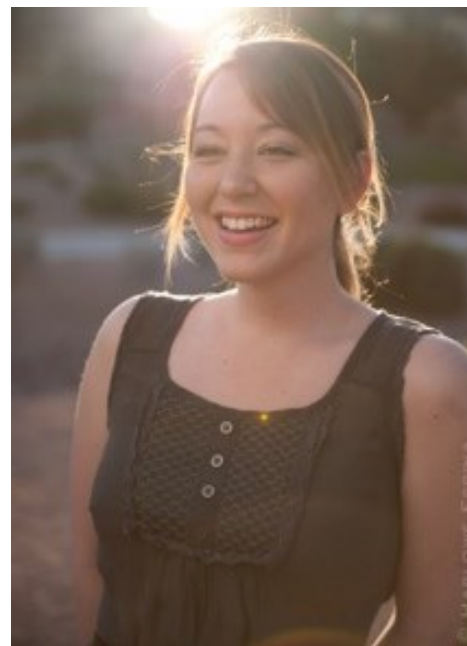
What field are you currently studying and what sparked your interest in that field?

I am currently working toward a master’s in civil and environmental engineering at the University of Nevada, Las Vegas. Originally, I wanted to be a high school math teacher, but after touring an engineering firm and learning about the different types of engineering, I had a change of heart. Honestly, I was unsure whether or not I would enjoy civil engineering, but after taking a few classes, I knew I had made the right decision. Deciding between the different civil disciplines proved much harder. I enjoy all aspects of civil engineering, but it was the

unit operations course that really intrigued me and steered me toward environmental engineering. I love how environmental engineering combines so many different disciplines and how it can be quite challenging. Also, I think helping to improve the planet and the lives of its inhabitants will be very rewarding.

Which NWRRI project are you working on and what research are you doing?

I am working on Project 647.3008 titled “Optimization of ozone-biological activated carbon for potable reuse applications.” The purpose of this study is to optimize the ozone-biological activated carbon (BAC) process for total



(Student Spotlight continued)

organic carbon (TOC) removal with respect to ozone dose and empty bed contact time (EBCT). I am operating a 0.5 liter per minute pilot-scale reactor at a local water reclamation facility. The effluent TOC concentration from parallel BAC columns will be compared against a 0.5 mg/L TOC benchmark value, which was obtained from the California Department of Public Health Groundwater Reuse Regulations. I will also assess the simultaneous removal of trace organic contaminants. If these goals are achieved, this will provide water reuse agencies with a more cost-effective and sustainable alternative to full advanced treatment (FAT).

What have you learned from working on this project?

The first, and potentially the most valuable, thing I've learned is that nothing works the way you intend it to. Constructing and operating a pilot reactor provides many challenges. I've also learned that bacteria are very sensitive to their environment, so small changes might yield significant changes in the biofilm. I've really enjoyed learning about and actually performing backwashes of the BAC columns. My version may be a little more involved than what would realistically occur in a full-scale setup, but it's fun to obtain hands-on experience of what I've been taught in school.

Over the course of this project, what do you hope to learn more about?

I'd like to learn whether or not an ozone-BAC system can achieve a 0.5 ppm TOC concentration. It would also be useful to discover all of the advantages and disadvantages of this type of treatment. I have learned a lot from literature, but I think working on this project will provide me with much more information on the subject.

What have you enjoyed most about working on this project?

I learn something new every day that I work on this project. I've discovered so many things that I wouldn't have thought to research, which has been very rewarding. I know I am becoming a more well-rounded engineer by doing this project. Also, having my pilot setup at an actual reclamation facility has enabled me to interact with plant operators and see wastewater treatment from a different perspective, which will be invaluable to me in my career.

What are your goals for the next step in your career?

I think I'd like to start out in the private sector. I've talked to many professionals and it seems that for a beginner, this would provide the best opportunity to learn and grow as an engineer. There isn't a specific company that I would want to work for because each one has its benefits and I'm sure I would be happy at any one of them. Although I will say that a job that allows me to travel would be very appealing.

If you were shipwrecked on a deserted island, but all of your human needs (food, water, etc.) were taken care of, what two items would you want to have with you?

The first item would be some sort of e-reader with hundreds of books already downloaded that hopefully can be solar powered. The second item would be a picture of my family. Being shipwrecked would probably be pretty depressing, so I would need some sort of comfort.

Cake or Pie?

Pie, but only if it is my Aunt Fern's chocolate pie. ■

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NWRRI - Desert Research Institute

Success and the dedication to quality research have established the Division of Hydrologic Sciences (DHS) as the Nevada Water Resources Research Institute (NWRRI) under the Water Resources Research Act of 1984 (as amended). As the NWRRI, the continuing goals of DHS are to develop the water sciences knowledge and expertise that support Nevada's water needs, encourage our nation to manage water more responsibly, and train students to become productive professionals.

Desert Research Institute, the nonprofit research campus of the Nevada System of Higher Education, strives to be the world leader in environmental sciences through the application of knowledge and technologies to improve people's lives throughout Nevada and the world.

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