

Arizona Researchers Address Wastewater Treatment and Water Reuse

The Water Resources Research Act, Section 104(b), established a program for funding water research through designated Water Resources Research Institutes. In Arizona, the Water Resources Research Center awards three to five research grants annually, of approximately \$10,000 each, for the best project proposals received from investigators at the University of Arizona, Arizona State University and Northern Arizona University. The following projects, funded for the project year 2012-13, addressed issues associated with wastewater treatment and water reuse.

For the research project titled “Fate of Emerging Nanoparticle Contaminants during Aquifer Recharge with Treated Wastewater”, investigators Drs. Reyes Sierra and James Field studied the removal of engineered nanoparticles from wastewater. Effluent discharges from municipal and industrial wastewater treatment plants are important sources of nanoparticles in the environment. In addition to consumer products (e.g. sunscreen, cosmetics, medicines, printing ink and computer chips), nanoparticles are used in industrial processes such as the manufacturing of semiconductors. Laboratory studies offer compelling evidence that engineered nanoparticles can be toxic to mammalian cells and other ecologically important species.

Artificial recharge of aquifers with treated wastewater potentially would allow nanoparticles in wastewater to reach groundwater used for drinking water supply. The purpose of this study was to determine the extent to which soil-aquifer treatment is effective in removing nanoparticles from recharged wastewater effluent. Soil aquifer

Treatment Research continued on page 2



Elephant Butte Reservoir on the Rio Grande River. July 2012. Source: Zackry Guido, Institute of the Environment, University of Arizona

Drought Along the Rio Grande Highlights Water Management Complexities

by Lucero Radonic, WRRRC Graduate Outreach Assistant

On Saturday, June 1, 2013, water was released from Elephant Butte Reservoir in South Central New Mexico into the Rio Grande. It took more than two days to travel the 80 miles to fields near Las Cruces, as water soaked into the parched riverbed. Waiting for the flow were chile, pecan, cotton and alfalfa growers in Southern New Mexico, Western Texas and Mexico, as well as the city of El Paso, Texas, which depends on the Rio Grande for half its water supply.

The Rio Grande is the fifth largest river in the United States, flowing roughly 1,900 miles from the Rocky Mountains in Southwestern Colorado to the Gulf of Mexico. In its journey, the Rio Grande serves as an 800-mile natural boundary between the United States and Mexico, and supplies thousands of acres of irrigated farmland, some Native

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treatment refers to processes that occur during artificial recharge of treated wastewater. As the effluent moves through the soil and aquifer, physical, chemical and biological processes further reduce contaminants in the water. This project provided quantitative data on the removal of nanoparticles as well as qualitative information on the processes responsible for their removal. Researchers conducted experiments using a saturated sand media with and without selected organic contaminants. Results indicated that the composition of the treated water has a strong impact on the transport of nanoparticles.

Drs. Channah Rock and Leif Abrell are the principal investigators for the research project titled “Does Increasing




Researchers collect water samples from the Lower Santa Cruz River. Source: David Quanrud, School of Natural Resources and the Environment, University of Arizona

Solids Retention Time in the Wastewater Treatment Process Affect the Persistence of Antibiotic Resistance Genes?” According to the Centers for Disease Control and Prevention, antibiotic resistance is one of the world’s most pressing public health threats, responsible for tens of thousands of deaths in the United States. Antibiotic resistance may be associated with the exposure of bacteria to trace antibiotics in the environment.

Increased solid retention time during wastewater treatment has been correlated with reductions in trace antibiotics. The rapid bacterial growth and high antibiotic concentrations during retention of solids, however, may provide ideal conditions for developing antibiotic resistance. This research assessed the effects of varying solid retention times in full-scale activated sludge processes on both trace antibiotics and antibiotic resistance. Shorter solid retention times (ranging from one to six days) appeared to be the more effective at mitigating antibiotic resistance when compared to retention times of nine to 25 days.

Drs. David Quanrud, Robert Arnold, Eduardo Saez and Shane A. Snyder collaborated on the project titled “Toxicity of Emerging Contaminants in an Effluent Dependent Stream: the Role of Suspended Solids and Sediments.” This research evaluated the toxicity and endocrine disruption activity of trace organic contaminants found in the effluent dependent Santa Cruz River, downstream of wastewater treatment plants in Tucson, Arizona. Many household substances contain chemicals that persist after conventional wastewater treatment. Some of these are considered contaminants of emerging concern and may have endocrine disrupting properties. Because of their chemical

characteristics, many of these contaminants accumulate with solids. Thus, suspended solids in effluent discharge are potentially significant sources of emergent contaminants. This project assessed endocrine disruption activity in liquid-phase wastewater effluent, suspended solids and riverbed sediments as a function of downstream travel distance. Liquid-phase and suspended solid concentrations of estrogenic activity decreased by more than 95 percent along the 23-mile river segment. The study also provided much needed baseline data on the Santa Cruz River prior to the 2015 completion of upgrades to two Pima County municipal wastewater treatment facilities, which are expected to substantially improve effluent quality and river health.

Dr. Shane A. Snyder is the principal investigator for the project titled “Disinfection By-product Formation from Water Reuse Practices.” This project, funded in 2011 and extended to 2013, recently reported findings. Interest in direct potable reuse—a system that connects highly treated recycled water directly to the drinking water network—is growing in the arid Southwest. Some technologies commonly used to purify wastewater to potable standards can produce potentially harmful disinfection byproducts from reactions with common contaminants such as iodine and organic nitrogen. This project characterized and evaluated the potential for certain disinfection byproducts to form in actual waters under various treatment scenarios. Effluent samples were taken from the treatment plants at Roger Road and Ina Road in Tucson, Arizona, and from groundwater recharged at the Sweetwater Recharge Facility. Most trace organic compounds decreased when wastewater was treated by ozonation; however, the formation of a specific disinfection byproduct—NDMA—was at times significant. Infiltration of the water before the experimental treatments clearly improved water quality by reducing levels of precursor contaminants. 



Arizona Water Resource is published quarterly by the University of Arizona Water Resources Research Center. AWR accepts news, announcements and other information from all organizations.

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Layout: John Polle, Lucero Radonic

Newsletter Link: wrrc.arizona.edu/publications/awr

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With support from the Water Sustainability Program
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American Pueblos, and cities like Albuquerque, New Mexico, and El Paso, Texas. The river is also the lifeline for the endangered Rio Grande silvery minnow.

This year threatens to be one of the driest in the 100-year record of river flow. When water was released from Elephant Butte in early June, the reservoir was at six percent of its storage capacity. Drought conditions have afflicted the entire Rio Grande basin since 2002. But the past three years have been particularly dismal, with two consecutive winters of reduced storm activity and snowfall in Colorado and Northern New Mexico. Snowmelt from the higher elevations is the major source of water for this river, but during the winter of 2012-13, precipitation was only 45 percent of average. The cumulative effect of years of below average snowpack and prolonged drought have left Rio Grande reservoirs at less than 25 percent of their storage capacity. These conditions have gradually shortened the irrigation season, reduced water allotments for farmers, and pushed municipal water authorities to find alternative water sources and encourage additional conservation measures.

Drought brings the complexities of water management in the Southwest into high relief. Balancing the needs of irrigators from different jurisdictions with the necessities of urban residents and the environment is an ongoing challenge. In New Mexico, the Rio Grande is controlled by a series of dams and diversion structures. Flows are highly variable, so the system relies on reservoirs that store water for release to irrigators and other users. The reservoirs are managed in order to ensure delivery to Texas at Elephant Butte according to the terms of the Rio Grande Compact, an agreement between Colorado, New Mexico and Texas.

In the Middle Rio Grande area, the Middle Rio Grande Conservancy District (MRGCD) provides irrigation water to 70,000 acres, including 8,800 acres of Pueblo Indian lands. The District extends along the river from the Cochiti Dam in Sandoval County south through Bernalillo, Valencia and Socorro counties to the Elephant Butte Reservoir, a stretch that includes the City of Albuquerque and habitat for federally protected endangered species. With record-breaking low stream flows and reservoir storage, the irrigation season that normally stretched from March to October is expected to last no longer than 50 days this year. El Vado Reservoir, which supplies water for the District, was at 22 percent of capacity in May and the stored water was expected to be gone by the first week of July. Once the reservoir is empty, the District has to rely on the river's natural flow—a dire prospect since river flow has plummeted with the prolonged drought. The average June flow in the Albuquerque stretch of the river is roughly 2,500 cubic feet per second, but by the end of May this year the flow was only 350 cfs.

The six Pueblos in the Middle Rio Grande area have federally recognized rights to river water for irrigation, domestic and ranching purposes, and have contracts with the MRGCD for water deliveries. While some of their rights share the same priority with other District contract holders, a portion of their rights are “prior and paramount” owing to the Pueblos’ ancestral settlement in the area. This means that in times of shortage they are entitled to receive some water when others may have to do without.

In Albuquerque, a “drought watch” is in effect, meaning that fines are doubled for allowing water to flow into the street or onto neighboring property and for using sprinklers between 11 a.m. and 7 p.m. Albuquerque Bernalillo County Water Utility Authority is encouraging its customers to achieve even greater conservation than they have in previous years. The Authority is also helping to keep the river flowing by leasing 40,000 acre-feet of its San Juan-Chama project allotment to the Bureau of Reclamation, which

needs the additional water for the Rio Grande silvery minnow. The San Juan-Chama project imports water from the Colorado River system.

The minute silvery minnow is a recurrent figure in conversations among water managers and farmers. The fish was classified as an endangered species in 1994, as it is found only in the Middle Rio Grande and now occupies less than five percent of its natural habitat. To preserve its remaining habitat and allow for its survival, the Biological Opinion issued by the U.S. Fish and Wildlife Service in 2003 requires Reclamation—which operates the dams—to keep the Rio Grande flowing continuously to Isleta Diversion Dam. Below Isleta to Elephant Butte, flow maintenance is conditional; in a dry year, the river is allowed to dry in a controlled manner after June 15. This year, even with the addition of 40,000 acre-feet of imported water, there was not enough water in the river to meet requirements. Given the recurrent drought conditions, the U.S. Fish and Wildlife Service approved a contingency plan to reduce water flows beginning the first week of June in an effort to stretch dwindling water supplies for the endangered minnow. The plan falls short of water flow mandates in the 2003 Biological Opinion but was considered the only viable option given the extenuating circumstances.

Downstream, irrigators in the Elephant Butte Irrigation District (EBID) and El Paso County Water Improvement District No. 1 (EPCWID) face equally daunting challenges: This season they will receive only 145,000 acre-feet of water, which is about 20 percent of their water allotment in average years. While a full allotment is 36 inches of water per acre, this year farmers can expect to receive 3.5 inches of water per acre. To maintain their production farmers in Southern New Mexico and West Texas are turning to groundwater.

Groundwater pumping is an expensive option, however, inaccessible to many small farmers. Dependence on groundwater pumping could also have damaging consequences. The river and the aquifer are connected, so without a flowing river, the aquifers that feed the wells lack recharge and increased groundwater extraction progressively draws down water levels. In addition, as wells draw from deeper levels, salinity increases and farms’ yields decrease. For these reasons, groundwater pumping is not a long-term sustainable solution to continuing drought.

Much like farmers, urban water utilities are supplementing surface water allotments by pumping groundwater. El Paso Water Utilities, which typically relies on river water for half of its water supply, is increasing supplies with new and renovated wells and increased production at its desalination plant. Although the city has avoided mandatory water restrictions, it exhorts customers to adopt its water saving recommendations.

In recent years tensions between competing water users over water rights have come to a boiling point as the drought diminishes supplies. Texas is now suing New Mexico for not delivering what it considers it is owed under the Rio Grande Compact. Signed in 1939, the Compact divides the Rio Grande waters among the states of Colorado, New Mexico and Texas. By the terms of the compact, Colorado and New Mexico must deliver specified amounts of water to Elephant Butte and Caballo Reservoirs for use in Southern New Mexico and West Texas. The current legal dispute between Texas and New Mexico erupted when irrigation releases to southern New Mexico were curtailed, driving irrigators to pump more groundwater. Texas alleges that unsupervised groundwater pumping by New Mexico farmers below Elephant Butte is reducing the amount of Rio Grande water reaching Texas farmers, thereby depriving the state’s agricultural lands and cities



Centennial Time Capsule Installed in Roosevelt Dam

On June 19th, 2013, a time capsule to commemorate the 100th anniversary of Theodore Roosevelt Dam was placed in the tunnel area of the dam, where it will remain until it is opened for the structure's 150th anniversary in 2061. The new time capsule replaces the original version that was installed at the dam in 1961 and opened in the spring of 2011. The capsule is filled with items that were suggested by employees and customers of the Salt River Project (SRP) to best describe how water and power have impacted residents of the Salt River Valley. Items include a digitized Roosevelt Dam Centennial video, paper Salt River Project power and water bills, an aerial photo of metro Phoenix, and an incandescent light bulb. Background information, diagrams and pictures related to the time capsule are currently on display at the Tonto Basin Visitors Center.



The Roosevelt Dam Centennial time capsule is installed at the dam. Source: Salt River Project

system to continue providing safe drinking water to 297 million Americans. The report shows that the nation's water systems have entered a rehabilitation and replacement era in which much of the existing infrastructure has reached or is approaching the end of its useful life. The survey is required under the Safe Drinking Water Act to be conducted every four years. In Arizona, the Water

Infrastructure Finance Authority (WIFA) is responsible for collecting the information and submitting it to the EPA. Consistent with all other participating states, Arizona gathered data from a statistical sampling of the state's approximately 800 water providers. These data showed that Arizona will need \$7.44 billion in drinking water infrastructure improvements over the next 20 years. Much of the state's infrastructure is more than 30 years old, and investments are required to upgrade and repair pipes, treatment plants, storage tanks and water distribution systems. In terms of investment needs, Arizona ranks 16th out of the 36 states that completed a full needs survey. WIFA has more than \$100 million available for financing water infrastructure projects. Funding is directed to communities with the greatest need.

Tohono O'odham High School Students Recognized by EPA

The U.S. Environmental Protection Agency (EPA) recognized Jacquell Caron Rivers and Arne Joi Saguni Nipales, seniors at Baboquivari High School in Sells, Arizona as winners of the Patrick H. Hurd Sustainability Award for demonstrating a commitment to environmental sustainability and stewardship. Rivers and Nipales' "Total Solar Strategy for the Tohono O'odham Nation" is an energy- and cost-efficient project that uses solar oven technology for storing energy and heating traditional adobe homes on the reservation. Rivers and Nipales were picked out of 1,611 student scientists and engineers competing in the annual Intel International Science and Engineering Fair in Phoenix, Arizona. The Patrick H. Hurd award funds the winning students and a chaperone to participate in and display the students' project at EPA's National Sustainable Design Expo featuring the P3: People, Prosperity, and the Planet Student Design Competition for Sustainability in 2014. Held each spring in Washington, D.C., the National Sustainable Design Expo brings together the P3 students, nonprofit organizations, government agencies and businesses working to create a sustainable future.


EPA Releases Fifth Drinking Water Infrastructure Needs Survey and Assessment

Results from the EPA's fifth Drinking Water Infrastructure Needs Survey and Assessment indicate that \$384 billion in improvements are needed by 2030 for the nation's drinking water infrastructure

USDA Unveils Water Quality Index

Agricultural producers may now determine the quality of water flowing off their fields with a new U.S. Department of Agriculture (USDA) tool. In April, the USDA released a new online tool to help agricultural producers make important decisions about conservation practices, quality improvements and technology. Producers input information about their farms—such as slope, soil characteristics, pest management, tillage practices and ongoing conservation practices—and the system outputs a number from one to 10, which indicates their water quality. This is a simple and accessible tool to rate the effects of producers' practices and technologies on their runoff water quality. For more information visit: <http://blogs.usda.gov/2013/04/25/>.

Collaborative West Salt River Valley Basin Study Initiated

A new study of the West Salt River Valley Basin will look at regional water supply and demand, taking into account climate change and population growth projections. The West Salt River Valley Basin is located in Maricopa County, Arizona, and includes the greater Phoenix metropolitan area. The study will include the development of strategies to address current and future imbalances in water supply and demand in the basin. A collaboration between the Bureau of Reclamation, the West Valley Central Arizona Project subcontractors, the Central Arizona Project and the Arizona Department of Water Resources, the study matches \$860,000 in non-federal funding with \$840,000 in federal funding. 

STUDENT SPOTLIGHT



Leah Edwards is a Flinn Scholar who has just completed her third year at the University of Arizona, pursuing dual degrees in Environmental and Water Resource Economics and Political Science. She began working as an intern at the Water Resources Research Center in

November 2011 on the Connecting Environmental Water Needs to Arizona Water Planning (EnWaP) project.

As a NASA Space Grant Intern, Leah worked with the Office of Sustainability conducting a Life Cycle Assessment of Homecoming Events at the University of Arizona. She also was a Project Manager with the Students for Sustainability Waste Reduction Team, and began the "Ready, Set, Recycle!" initiative to increase recycling rates on campus. She has mapped out the location of every trash can and recycling bin on campus in order to determine how many more recycling bins are needed to make the number of recycling bins equal to the number of trash cans.

She has also held internships at Imagine Greater Tucson, Youth On Their Own, Arizona List and Hibernian Legal.

Leah received the First Year Prize in Research as a freshman for her research on reforming animal control policies in Pima County, and later received a grant from the UA Honors College to continue this research. In June 2012, she presented this research at the Roosevelt Institute Policy Expo in Washington, D.C. She has also received the Southern Arizona Environmental Management Society scholarship.

Most recently, Leah was named a 2013 Udall Scholar by the Udall Foundation, which each year holds a competition that awards scholarships to a cohort of college juniors and seniors intending to pursue careers related to the environment. Leah will receive her award this summer at a meeting held in Tucson, AZ, that affords the new Udall Scholars the opportunity to meet policymakers and community leaders in environmental fields, tribal health care, and governance.

Upon graduation, Leah hopes to attend law school and earn her Masters in Environmental Urban Planning and her Juris Doctorate. She hopes to use this combination of law and urban planning to pursue a career addressing environmental issues in urban areas. She wants to focus on Western cities in arid areas and create urban plans that will allow for population growth in the Western United States in a more sustainable manner. 🏡

RESOURCES

New Visions, Smart Choices: Western Water Security in a Changing Climate

Carpe Diem West, 2013

This short report spotlights successful, sustainable and economically sensible steps 10 communities are taking to ensure they will have water in the decades to come. As the climate warms and we experience weather extremes, having a clean, safe water supply for communities, farms, the economy and the environment is becoming a challenge. The stories in this report are intended to inspire other communities to work together to build a more secure water future. The report is available at <http://www.carpediemwest.org/newvisions-smartchoices>.

Groundwater Depletion in the United States (1900–2008)

Leonard F. Konikow. Scientific Investigations Report 2013-5079 U.S. Geological Survey, Reston, VA, 2013

This USGS study evaluated absolute changes in storage for 40 major aquifers between 1900 and 2008. The study shows that the rate of groundwater depletion has increased markedly since about 1950. Maximum depletion rates occurred from 2000 to 2008 at three

times the rate of depletion for the entire study time frame. In total, groundwater reserves decreased by nearly 1,000 cubic kilometers, or twice the amount of water in Lake Erie. Yet, aquifers in the Pacific Northwest – the Columbia Plateau and the Snake River Plain aquifers – actually saw a net increase in storage after 1900 due to imported river water for irrigation. Since the late 1970s, however, both have been declining. The reverse is true in Arizona, where groundwater reserves have increased since 1980 because of stricter management and new surface water supplies from the Colorado River. 🏡

WRRC 2014
CONFERENCE

CLOSING THE GAP
BETWEEN
WATER SUPPLY
AND **DEMAND**

TUESDAY, APRIL 8, 2014
UNIVERSITY OF ARIZONA
TUCSON, AZ

GUEST VIEW



Assessing Agricultural Needs in a New Era of Climate Information

by Summer Waters, Nick Pacini and Ayman Mostafa, University of Arizona Cooperative Extension, Maricopa County

With drought persisting for more than a decade, municipal water managers have long been discussing strategies for coping with additional resource stress. The Central Arizona agricultural community faces the same challenge. Although agriculture was once expected to fade from Maricopa County, it remains economically relevant and continues to use 47 percent of the water supply, according to the Arizona Water Atlas. As growing demands for residential water stretch resources thin, the need for collaboration among agricultural and urban water users grows ever more pressing. Through a project entitled “Risk Perception, Institutions, and Water Conservation: Enhancing Agricultural Adaptation to Future Water Scarcity in Central Arizona”, researchers have begun to analyze how agricultural water users are dealing with drought and an uncertain future that includes increasing projected population growth and a reduction of water supply.

In 2012, University of Arizona Cooperative Extension, Maricopa County, collaborated with researchers from Arizona State University’s Global Institute of Sustainability under a grant from the National Oceanic and Atmospheric Administration to survey over 200 farmers in Maricopa and Pinal Counties. Farmers were asked about their perceptions of drought, water supply, climate, and how policymakers react to climate information. A total of 52 surveys were returned. The results give interesting insights into farmers’ perceptions on the state of the water supply and climate.

Uncertainty regarding future water supplies looms large over farmers. On average, they reported having difficulty getting the amount of water needed for production four out of the last 10 years. Seventy-five percent of respondents reported that they cannot plan more than a few years in advance due to uncertainties. Long-term planning is crucial for viability in the market. In the current state of affairs, uncertainty can only be expected to increase.

In general, farmers are open to learning more regarding water and climate and their potential impacts on agriculture. More than 65 percent of the surveyed farmers reported that they are receptive to learning more about hydrological changes and climate issues. This demographic is often perceived as being “closed off” to the notion of climate change, although people working closely with them know them to be progressive, quite often adopting new

technologies related to their operations. These results should serve as a signal that, regardless of why climate change is happening, farmers acknowledge the need to know what to do about it.

The perceived disconnect between policymakers and the agricultural community is high. Nearly 60 percent of respondents said they disagree with the statement that policymakers understand the role of agriculture in Arizona. Twenty-five percent simply were not sure.

Along with water supply uncertainties come demand issues. Another relevant survey finding is that 71 percent of farmers agree that agriculture is under threat by population growth.

Farmers in Central Arizona receive their water primarily from the Central Arizona Project, which is fed directly by the Colorado River. In the spring of 2013, the Bureau of Reclamation released the Colorado River Basin Water Supply and Demand Study, which provides further support for water supply uncertainty concerns. The study reports exactly what the farmers are seeing on the ground: The largest increase in water demand will likely come from population growth. Using multiple growth scenarios to determine demand, the study projected population growth in the Colorado River Basin by 2015 in the range of 9.3 million (Slow Growth Scenario) to 36.5 million (Rapid Growth Scenario).

Farmers’ concerns over water supply uncertainty and emerging receptiveness to new climate information are pertinent and timely. Given the state of the climate and the style of water management in Arizona, it’s no wonder that farmers have a high level of uncertainty and apprehension surrounding policy. The current state of affairs does not bode well for agriculture in Arizona. In an era of rising temperatures and uncertain water supplies, “business as usual” will likely need to go by the wayside. Innovative approaches to farming will be needed for agriculture to remain viable in central Arizona. More conservative irrigation methods, such as sub-surface, sprinkler and drip, can save water. However, a majority of farmers in Central Arizona lease their land, making them reluctant to invest in new irrigation infrastructure. One change that is often proposed is to switch to crops or varieties that use less water. Indeed, 63 percent of the survey respondents reported that this would be their most likely strategy when faced with decreased water availability.

Ultimately, sustainability will require a comprehensive water conservation strategy to be implemented everywhere, from the residential tap to the irrigation ditch. Enacting stricter conservation measures for urban and rural users would be a good start, but much more will surely be needed to balance the needs of so many interests that are dependent on one thing: A reliable water supply. ■■■

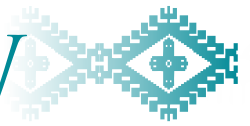
Drought continued from page 3

of water to which they are legally entitled.

Texas has also asserted that Mexico is not living up to the terms of the 1944 treaty that allocates water between the United States and Mexico. By the terms of the treaty, Mexico is obliged to provide Texas a specified amount of water over a five-year period from its reservoirs along the Lower Rio Grande. These reservoirs store water from Mexican streams that feed the Lower Rio Grande where it forms the border with Texas. Water users in Texas are pressing their claim through ongoing discussions involving the U.S. State Department and the Mexican government.

The current dry spell in the Rio Grande Basin is not unprecedented and will not be the last of its kind. Climate projections described in a Bureau of Reclamation Report to Congress suggest that temperatures throughout the basin could increase by 5–6 degrees, while annual precipitation will remain variable with a decrease of 2.3–2.5 percent by 2050. This would cause a decrease in the river’s average annual runoff by 7.3–14.4 percent. In practice, these numbers mean that the 21st century will present water managers and water users along the Rio Grande with a suite of even greater challenges than they now face. ■■■

PUBLIC POLICY REVIEW



Written from Sea

By Sharon B. Megdal



The July 1 deadline for writing this column loomed over me as I looked forward to a late June visit to Alaska. I worried about when I would find the time to write and thought about column content. It's been such an interesting Spring. After a one-year hiatus due to my 2012 sabbatical, I taught my Arizona Water Policy class to a great group of 14 diverse and questioning graduate students. Since our March conference on Water Security, I

participated in some very productive international meetings and conferences, including a first-ever visit to China. The China visit offered some interesting insights and information. However, some new ideas began to take form as I traveled to Alaska on a seven-day cruise, my first trip to our 49th state. So, I offer these impressions and thoughts, which, as the paper stationary in my cruise ship says, are "written from sea".

Of course, there is "water, water, every where". So different from Arizona! Yet, there was a sign at the bathroom sink at the terminal for the Juneau helicopter tour noting, "Non-potable water. Do not drink!" I assume cost considerations had something to do with the non-potable quality of the sink water. It made me think about the discussions we're having in our region regarding the sensibility (or should I say cents-ability?) of treating all the water used by homes and businesses to potable quality. Later in the trip, Kevin, our seaplane pilot pointed out his home in Ketchikan, noting with pride that he is not on "city water". His mentioning that had nothing to do with my being on the plane, as we had not had a chance to introduce ourselves. He later told me he got his water from roof catchments. This region is, after all, a rain forest. After the seaplane excursion to Misty Arms Fjords, I asked him about water quality. He does minor filtering for indoor use and uses the pitcher-type charcoal filters for drinking water.

I anticipated that there would be a strong water conservation ethic on board the cruise ship. After all, the ship is a large floating hotel, carrying or treating all the water used on board. Understandably, there was active concern about avoiding the spread of diseases. We all have read about the spread of norovirus on cruise ships. In the public bathrooms on board, there was a sign reminding you to "wash your hands frequently and thoroughly with soap for at least 20 seconds and rinse them well under running water". My first reaction was to think about all the water running down the drain while people washed their hands. You know how we caution people against running water while brushing their teeth. I found it interesting that in the mid-trip newsletter there were two entries related to this. The first was a reminder about washing one's hands, except this time it left off the last three words from the sign, namely "under running water". Immediately below was an entry acknowledging that a growing number of "environmentally conscious passengers are choosing to conserve water...by refraining from unnecessarily leaving water running in their stateroom...Join them and

help...protect our environment". This second message left me wondering why they did not include this message on the first day or every day. Water conservation should be something all of us practice.

It has also been interesting to see how climate change is addressed. Again, my information is anecdotal but interesting to me. As we rode to our Juneau helicopter excursion, the young van driver spoke of how they in the area do not believe in climate change. The main reason he gave was that some glaciers are gaining in size. It was exhilarating to land on a glacier and bend down and drink some running water. The more frequent comments had to do with how many glaciers are losing



Herbert Glacier in the Juneau Icefield, Alaska. Source: Sharon B. Megdal

size. Without attributing causality, the pamphlet for Glacier Bay National Park notes how much farther up the bay you must travel to view the tidewater glaciers now, compared with when John Muir traveled there in 1879 and when Captain George Vancouver sailed there in 1795, 45 years after the Little Ice Age reached its maximum extent.

Water is just about everywhere you look in Alaska. Snow is melting, as you would expect at the beginning of summer, and waterfalls abound. Most readers have likely heard the expression, if a tree falls and no one is there to hear it, does it really make a noise? The question in my mind is if there were less fresh water in Alaska, would people living there notice? More than 730,000 people live in this vast state. There is so much water per capita, Alaskans likely find it hard to relate to the findings of the 2012 Colorado River Basin Water Supply and Demand Study. However, we residents of Arizona—at approximately 6.5 million and growing—must be vigilant stewards of our limited water resources.

And, as one must at the end of a vacation, I returned to Arizona in the midst of an oppressive heat wave. Like all, I hope for our summer thunderstorms. I also returned to the WRRC and submitted this column to newsletter editor Susanna Eden on July 1, my ninth anniversary as WRRC Director. I met the deadline! 🏔️



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Weather Station and Condensate Collection System Installed at WRRC

Weather data are now being generated at the WRRC, just in time for the summer monsoon season. Real-time temperature, precipitation, wind speed and direction, and humidity readouts are available. As part of a UA Green Fund mini-grant, the weather station has been installed along with an online weather tool so anyone can access the data over time. The WRRC weather data can be accessed at <http://wrrc.arizona.edu/weather>.

UA WRRC WEATHER

Tucson, AZ

Temperature: **102.2°F**
 Humidity: 3% Dew Point: **7.0°F**
 Rainfall: **0.00in** Pressure: **29.71in**
 Updated: 5 minutes ago



Campus,” was initiated to collect and measure condensate from air conditioning (AC) units at the WRRC. AC units generate gallons of high-quality condensate (water) from out of the air. This water is mostly going down the drain or evaporating, rather than being put to a beneficial use in a region where water is a limited resource. In this pilot project, two AC units will be monitored and the weather station will provide temperature, precipitation and humidity data that will be analyzed for correlations with condensate production. The data generated will be used to quantify potential AC condensate to augment water supplies. 🏠



The Green Fund project, “An Untapped Resource: Condensate Collection for Water Sustainability on the University of Arizona

Monsoon lightning accompanies a summer downpour in Southern Arizona. Source: John Hays