



COLLEGE OF AGRICULTURE & LIFE SCIENCES  
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# WATER RESOURCES RESEARCH CENTER



AZ Pure Water Brew Challenge. Photo: Pima County.

# ARIZONA WATER RESOURCE

## The Water Resources Research Center Quarterly Newsletter

Volume 26 Number 1 Winter 2018

### Recycled Water Use Gaining Acceptance

by Sam Potteiger, WRRC Student Research Assistant

In the Southwest, where water scarcity is an issue, water reclamation has been adopted as an important conservation strategy. Most of the water used at the Palo Verde Nuclear Generating Station near Tonopah is recycled wastewater from Phoenix. The plant is responsible for supplying power to residents throughout New Mexico, Texas, California, and Arizona. The Desert Mountain Club in Scottsdale uses reclaimed water to irrigate its 550 acres of turf, which accommodate 150,000 rounds of golf each year. The club uses one billion gallons of treated wastewater each year, making it the largest user of reclaimed water in the metro Phoenix-Scottsdale area. In Pima County, reclaimed water is used mainly for irrigating parks and outdoor landscaping. According to its website, the City of Tucson serves reclaimed water to 50 parks, 18 golf courses, and more than 700 single-family households.

The resistance to and acceptance of reclaimed water use by citizens has important implications for utilizing recycled water as a resource. A 2015 study published in the journal *Judgment and Decision Making* analyzed the attitudes of respondents to the use of potable recycled water in five different metropolitan areas--three in water-scarce regions. Nearly 50 percent of

respondents stated that they would be willing to drink recycled water; however, the other 50 percent of respondents were not as confident.

They responded that they might try it or would not try it at all. Across the five metropolitan areas, people were more receptive to the use of recycled water for purposes other than drinking. Although there exists a population who support the use of recycled water, a significant number of people still oppose it.

Investigators have tried to identify the cause of public uneasiness regarding potable recycled water, as well as what motivates people to use it. One factor, awareness of water scarcity, appears to affect people's attitudes. The year 2016 saw one of the worst droughts California has experienced. A poll conducted in California that year by water technology firm Xylem found that 89 percent of respondents agreed that the threat of drought had made them more supportive of recycled water use.

Another major factor is level of relevant knowledge and awareness. A 2011 study in *Water Resources* concluded that knowledge about water sources, including reclaimed water, was linked with positive perceptions and the likelihood

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Feature



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## Arizona Pure Water Brew's Five Step Purification Process - [azpurewaterbrew.org](http://azpurewaterbrew.org)

that the water would be used. In the Xylem poll, 89 percent of respondents were more willing to use recycled water for general purposes after they heard about the treatment process. The results from these studies send a clear message to proponents of recycled water about the importance of outreach and education to securing public support. This past summer, Arizona Pure Water Brew set out to inform and engage the public about recycling water for potable use.

Arizona Pure Water Brew was a statewide campaign to inform Arizonans about water issues, water reuse, and the water purification technology. In August 2017, the campaign challenged brewers with a competition for the best beer brewed using purified wastewater. Twenty-six brewers took up the challenge.

To reach Arizonans, all of the water treatment equipment was contained in a truck that traveled around the state and supplied brewers with purified water created by treating local wastewater. The side of the truck could be opened to demonstrate the purification system inside. Purification involved a five step process, which resulted in treated wastewater that was purer than water from the tap. The purified water was then distributed to the competing brewers at each location.

The brews were indistinguishable from brews using regular non-recycled water. In a blind taste test, panelists were not able to discern a difference in taste. In addition, brewers found the recycled water easier to use because they did not have to remove any minerals in order to make the water suitable for brewing. The winners were announced at the 32<sup>nd</sup>

Annual WaterReuse Symposium in Phoenix in September. The Arizona Pure Water Brew project was all about conservation and education. They wanted to take their point to the people, and what's more relatable than beer? Their outreach effort was especially timely, as it coincided with deliberations leading to changes in Arizona's recycled water regulations.

The Arizona Department of Environmental Quality (ADEQ) is the agency charged with the regulation of recycled water. Under past regulation, reclaimed water could not be permitted for human consumption. It was mainly used for irrigation. Under modifications made effective January 1, 2018, this restriction was removed. However, in order for wastewater to be used for potable water purposes it would have to undergo further treatment at a specified "advanced water treatment facility". The advanced water treatment facility would be permitted only after demonstrating that it could meet stringent standards. According to ADEQ, a permitted facility would be capable of removing 99.99999999 percent of all viral contaminants. For comparison, under the Safe Drinking Water Act, surface water sources must remove 99.99 percent of all viruses. Thus, under the regulatory modification, potable water from a reclaimed source would have to be orders of magnitude cleaner than any existing surface water source.

The use of reclaimed water can be expected to expand as growth and other factors increase the demands on existing water supplies. Purified wastewater will be used by some communities to augment their potable supplies. With proper oversight, water reclamation can be an effective solution to water scarcity issues in Arizona and throughout the Southwest. 

# 2017 Water Resources Research Center Photo Contest Winners Announced!

We are pleased to announce the winners of the 2017 Water Resources Research Center Photo Contest. This year we gave photographers only two criteria - that photos be water-related and that they be taken in Arizona. We received an array of stunning images that took our request to heart. People, nature, economy, and other topics were covered by the many photographers who submitted their images.

We would like to sincerely thank all of the participants. We had entries from throughout the state and even a few from

out of state. We were very impressed by the quality and variety of photographs entered. This made choosing the winners a daunting yet exciting task.

The winning photographs will also be featured at the 2018 WRRC Annual Conference on March 28 and at the 2018 Chocolate Fest on February 16.

Check out the winning photos and more here:  
<https://wrrc.arizona.edu/2017-photo-contest-winners>



## **BEST IN SHOW**

**John Bartholow**

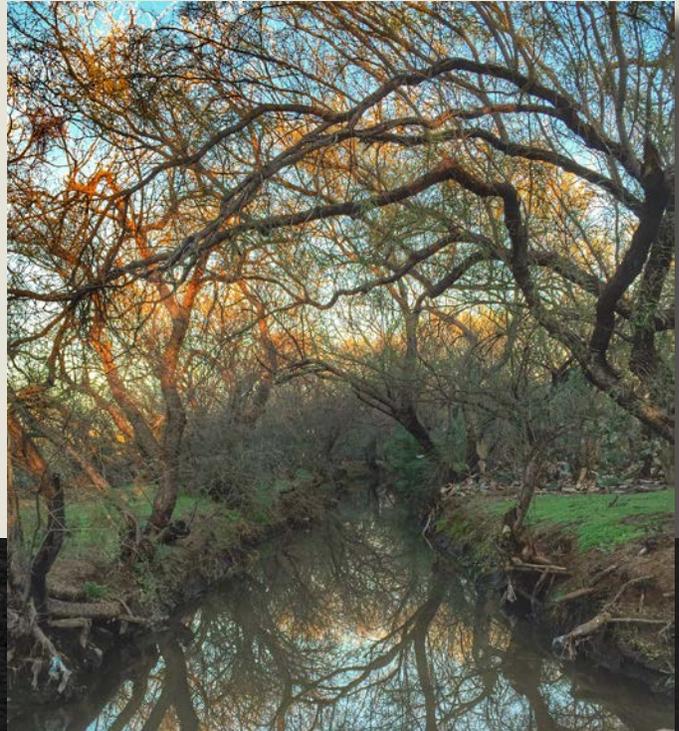
*Oak Creek Evening Near  
Sedona 2011*



**BEST OF: ECONOMY**

**David Schafer**

*Waiting by the Windmill, Camp Verde*



**BEST OF: NATURE**

**Suzanne Schorr**

*Arroyo Chico, Tucson 2015*

**BEST OF:**

**PEOPLE**

**Ben Lepley**

*Central Arizona  
Project, Goodyear  
2016*



# News Briefs

## US Winters Arriving Earlier, Leaving Sooner

Following recent trends, 2016's winter was a month shorter than the average winter last century. The 2016 winter was extraordinary, with the average first freeze occurring two weeks later than the 20th century average and the last frost occurring nine days earlier. Over the past ten years, weather stations nationwide have recorded the start of the winter a week later than winters from 1971 to 1980. In an article by Seth Borenstein, Associated Press Science Writer, experts are quoted on research looking at changes that signal later falls and earlier springs. Ken Kunkel, a meteorologist at the National Oceanic and Atmospheric Administration's National Centers for Environmental Information, pointed out a trend starting around 1980 in which freezes occur later and later. Kunkel compare data from 700 weather stations across the United States going back to 1895 and found that while in some places the first freeze may occur earlier in some years, on average the trend is toward later freezes. Theresa Crimmins, a University of Arizona ecologist and assistant director of the National Phenology Network, which studies how plants and animals adapt to changes in seasonal timing, said that these changes may be good for some organisms but bad for others. According to University of Oklahoma meteorology professor Jason Furtado, shorter winters have long been predicted by climate scientists and can be expected to occur more frequently in the coming decades as a result of climate change. The Borenstein article can be found at <https://www.apnews.com/664a16182cbc4e3e9a26957f3cddc927>

## GRACE Satellite Mission Ends

Originally launched in 2002 for a planned five-year mission, the GRACE satellites exceeded expectations and the mission

was only terminated in late 2017. The eighth of the GRACE-2 satellite's twenty battery cells failed, causing the termination. The mission consisted of a pair of satellites designed to measure fractional changes in Earth's gravity based on the position of the satellites relative to each other. Scientists around the world utilized this data to examine large-scale changes in water storage. Although its data could not capture small-scale changes in groundwater, it was effective in showing trends across large watersheds, such as the Colorado River Basin. A new satellite will soon take the place of the GRACE mission. GRACE Follow-On will make the same measurements and is set to launch in March 2018.

## New Drought Index Uses GRACE Satellite Data

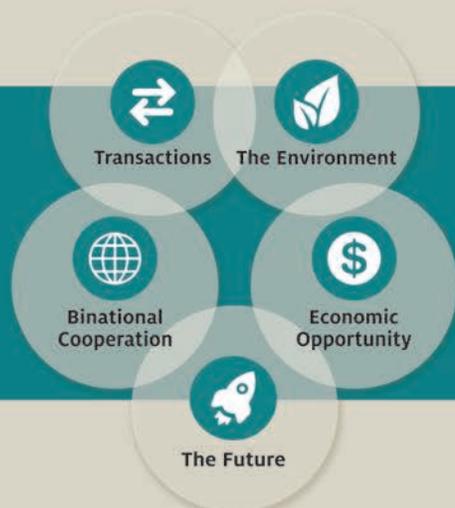
Drought monitoring is important for implementing drought mitigation plans and managing water supplies. Researchers have devised a new drought index incorporating groundwater storage into drought assessments, which they described in an article for the *American Meteorological Society Journals Online*. The index relies on data captured from NASA's GRACE mission and the GRACE Follow-On mission, which is scheduled to be launched in early 2018. The GRACE-DSI provides for accurate and continuous drought monitoring, and because it is based on satellite gravity observations, it is able to retrieve data in remote areas. The new index performed favorably when compared with other popular drought indices. With the new index, researchers are confident in their ability to identify hydrological drought for both regional and global-scale monitoring. The journal article is accessible at <http://journals.ametsoc.org/doi/10.1175/JCLI-D-16-0458.1>.



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## 2017 Potable Reuse Compendium

Environmental Protection Agency and CDM Smith, Inc., 2017

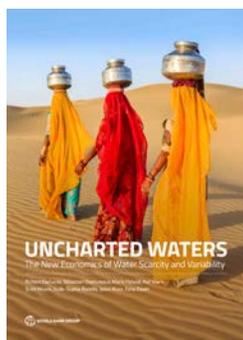


The 2017 Potable Reuse Compendium provides a technical compilation of the current state of potable water reuse in the United States. It supplements the 2012 Guidelines for Water Reuse, which were developed to serve as an authoritative reference on water reuse practices. The compendium was created to assist planners and decision-makers considering potable reuse approaches by presenting the current state of practice in the United States. It covers multiple topics including the extent of potable water reuse in the United States and the world, treatment technologies and processes, the costs of potable water reuse, risk analysis, training and operating practices, and public acceptance. In addition, the compendium presents seven case studies, which describe the implementation of indirect and direct potable reuse in the United States. These cases include the Los Alamitos Barrier Water Replenishment District of Southern California-Leo J. Vander Lans Advanced Water Treatment Facility; Orange County Groundwater Replenishment System Advanced Water Treatment Facility; Gwinnett F. Wayne Hill Water Resources Center, Chattahoochee River and Lake Lanier Discharge; Village of Cloudcroft PRe Water Project; Colorado River Municipal Water District Raw Water Production Facility Big Spring Plant; Wichita Falls River Road WWTP and Cypress WTP Permanent Indirect Potable Reuse and Emergency Direct Potable Reuse Project; and Potable Water Reuse in the Occoquan Watershed.

## Uncharted Waters: The New Economics of Water Scarcity and Variability

by Richard Damania, Sébastien Desbureaux, Marie Hyland, Asif Islam, Scott Moore, Aude-Sophie Rodella, Jason Russ, Esha Zaveri

World Bank, 2017



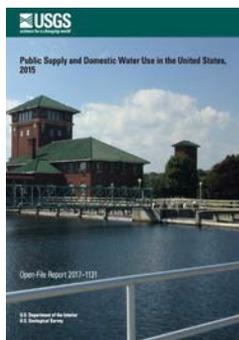
The World Bank has released a report that examines the impacts of population growth and climate change on 21st century water supplies and how decreases in water availability and increased uncertainty will be felt across water use sectors. The report notes that family incomes, jobs, and long-term health and welfare will suffer long-term effects and that fundamental changes to water policy are needed. Because water has many economic attributes, a

multi-pronged policy response will be needed to adequately address the threats. The report can be found at <https://openknowledge.worldbank.org/handle/10986/28096>

## Public Supply and Domestic Water Use in the United States, 2015

By Cheryl A. Dieter and Molly A. Maupin

U.S. Geological Survey Open-File Report 2017-1131



The USGS has been estimating U.S. water use every five years since 1950. The reports provide comprehensive data regarding public-supply use, including domestic water deliveries. The new report highlights reduced water withdrawals for domestic use. From 2010 to 2015, total population in the United States increased 4 percent, but total withdrawals for public supply decreased, continuing the decreasing trend observed between 2005 and 2010. On average across the country, there was an overall 3 percent decrease in domestic use from 2010 to 2015, resulting in a decrease of six gallons per capita per day. Go to <https://pubs.er.usgs.gov/publication/ofr20171131> to access the report.

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# Public Policy Review

Some of the many water policy students Dr. Megdal has taught each spring and the various sites they have visited as part of her class.

## Learning About Water Policy

by Sharon B. Megdal

I write this column shortly before the Spring semester starts. Once again, I am going to be teaching a graduate-level water policy course. With the exception of 2012, when I was on sabbatical, I have taught Arizona Water Policy every year since 2005. This year the course has a new name – Water Policy in Arizona and Semi-arid Regions. I changed the title to reflect the course’s geographic and topical coverage, which includes Arizona, the Colorado River Basin, California, the border with Mexico, and areas in the Middle East.

As I get ready for the upcoming semester, I face something of a struggle in determining how to spend our precious class time. How many guest speakers do I invite? What readings and class activities do I assign? What is the most effective way to expose the students to the complexities and nuances of water policy? While it may seem like a course in water policy is “easier” than one on hydrologic modeling, for example, I suggest that learning about water policy is also quite challenging. So much depends on context, which changes continually and in unexpected ways.

In actuality, one cannot teach water policy. The best one can do is expose students to the different shapes and forms of water policy. I offer some lectures at the beginning of the semester and at various points during the semester. The all-important guest speakers bring their varied experiences and expertise to the classroom. I myself learn a lot from the presentations and discussions on a variety of topics, such as water management in California, Tribal water rights and management, water utilization and management by the agricultural sector, and water quality, just to name a few that have been covered by expert guest speakers in recent years.

What is gratifying to me – and I think for the speakers as well – is the interaction between the students and the guest experts. In the somewhat intimate setting of the WRRC’s Sol Resnick Conference Room, where all students sit at the oblong conference table, students have a unique opportunity to pose questions and engage in discussions with a sampling of our region’s foremost experts.

An important and fun course activity is the all-day field trip. Seeing projects first-hand is something I value. And I learn something new each and every time I am out in the field. By visiting Tucson Water’s recharge facilities for Colorado River water delivered through the Central Arizona Project (CAP) and Sweetwater Wetlands and recharge basins, students see how policies related to groundwater use, water banking, and reclaimed water use are implemented. Visiting CAP’s Twin Peaks Pumping plant enables them to see the CAP canal, which is so important to water policy in Central Arizona, and how the project goes about pumping water uphill! And they hear about agricultural activities through a lunch meeting with BKW Farms. The field trip provides another opportunity for students to interact with experts, who are generous with their time and patient in answering questions.

Writing a policy-oriented paper, a key requirement for the course, requires students to explore a policy topic in greater depth than can occur through a class lecture and associated readings. I request that they acquire information not only from written documents, be they scholarly publications or agency and other reports, but also through personal interviews with water experts. Last year I asked each to prepare a short briefing memo on their paper topic, as if they were writing for a decision-making body. This was in addition to their end-of-semester paper presentations, which I recently shortened from 20 minutes to 10 minutes, followed by 10 minutes of questions from their classmates and me. Both exercises are designed to encourage students to convey their

material succinctly, a valued skill in real-world formulation and evaluation of water policy.

I encourage students to attend the WRRC's annual conference, which this year is entitled "**The Business of Water**". They are also encouraged to attend seminars held on campus, including those we schedule as part of the WRRC's Brown Bag seminar series. Most WRRC Brown Bag seminars are broadcast live via the web, with recordings of them posted on our web site soon after the seminar. Our goal is to schedule seminars that are of broad interest so that experts can share their water policy and management experiences with UA students, faculty, and staff, along with many others. Seminar attendance on an annual basis is roughly evenly split between attendees from campus and non-campus communities. Information about our exciting schedule of Spring 2018 Brown Bag seminars can be found at <https://wrrc.arizona.edu/brown-bag-seminars>. Information about our seminars and other activities can be obtained through subscribing to our Weekly Wave email news digest. To subscribe, please go to <https://wrrc.arizona.edu/subscribe>.

A few years ago, I decided that a good way of exposing my students to the variety of policy topics was by asking them to read the full set of my public policy columns. Counting from my first column, written after joining the Water Resources Research Center in February 2002, this is my 73rd column. All of them can be found at <https://wrrc.arizona.edu/columns>. We spend some time at our second class meeting discussing them.

Having listed the major ways in which I endeavor to expose students to what I sometimes describe as the "messy" world of water policy and water policymaking, I think it is only fair for me to share that I believe that beyond classwork, gaining an understanding of water policy is often best accomplished through on-the-job training. That's how I learned about water policy and management in Arizona. My water training began when I was a member of the Arizona Corporate Commission in the mid-1980s. It continued as I worked as a consultant

and served as a board member for the Southern Arizona Water Resources Association. About 30 years ago, I was one of the people who felt her eyes glaze over when the intricacy of terminal storage for the Tucson Active Management Area or Harquahala Valley groundwater was discussed. My on-the-job training accelerated considerably when, in the early 1990s, I became Executive Director of the short-lived Santa Cruz Valley Water District. And it has continued through my Extension and research activities at the Water Resources Research Center and through my public service as a member of the Central Arizona Water Conservation District board of directors.

I can speak from experience when I say that delving into water issues is no easy undertaking. Learning will take perseverance and time. There are no simple answers to questions about water. Details and context matter. Try as I might to be succinct and avoid embellishing lectures and responses to questions with unnecessary information, I am now one of the people who is likely guilty of causing eyes to glaze over.

So, what advice do I offer to students and others wishing to become more knowledgeable about and involved in water policy making? Spend time exploring and learning. Subscribe to and read feeds of stories and articles about water. Attend seminars and webinars. If a student, take advantage of internship opportunities. In fact, the University of Arizona offers students many opportunities to interact with the real-world of water policy. In particular, the Master's program in Water, Society, and Policy requires that students complete a six-unit internship or project (equivalent to 270 hours). Students I have advised in this program have completed policy-oriented internships with public and private entities. Whether a student or already a professional, take advantage of opportunities to attend conferences. Most importantly, ask questions! And please encourage your friends and colleagues to become informed about water policy. Formulation as well as implementation of good water policy depends on expert professionals and, very importantly, an informed public. 🌍



**Sharon B. Megdal, Ph.D.**

*Director, Water Resources Research Center  
The University of Arizona*

All of Dr. Megdal's Public Policy Columns are available here:

<https://wrrc.arizona.edu/columns>



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