



Innovation • Collaboration • Education • Policy

New Water Leaders Spring from Arizona Desert

The University of Arizona Water Sustainability Program (WSP) is working to ensure that sustainable, high quality water supplies will be available for people and the environment, and part of that effort is to groom young leaders to resolve current and future water resource challenges in Arizona and beyond.

WSP is funded through the Arizona Technology and Research Initiative Fund (TRIF), created by passage of Proposition 301 in 2000. Through research projects, activities and fellowships, TRIF dollars have helped to fund more than 300 undergraduate, 500 graduate and more than 30 postdoctoral positions. Since its inception, the program also has supported the hiring of 18 new faculty members.

WSP facilitates interdisciplinary research through the leadership of five UA water centers at the management core for this university-wide network: Water Resources Research Center (WRRC), NSF Water & Environment Technology (WET) Center, Center for Sustainability of semi-Arid Hydrology and Riparian Areas Center (SAHRA), SRC/Sematech Engineering Research Center for Environmentally Benign Semiconductor Manufacturing (ERC); and the NIEHS Superfund Research Program (SRP).

WSP Fellow takes research 'down under'

Sustainable water policy and institutional analysis lies at the core of research and practice for Dustin Garrick at the University of Arizona, where he just received his PhD in geography as well as a Graduate Certificate in Water Policy.

A WSP Student Fellow in 2006-07, he was awarded a Fulbright Fellowship this spring that sends him to Australia in August to work with the Commonwealth Scientific & Industrial Research Organization (CSIRO), where he'll assist on a national research program, Water for a Healthy Country.

This research will be closely tied to his UA work on interstate river systems in the U.S. West, particularly the Colorado and Columbia rivers. He won the 2009 Boggess Award for a paper published in the Journal of the American Water Resources Association analyzing long-range planning efforts in the Colorado River Basin in response to water shortages. Another paper published last year by Ecological Economics contrasts policy reform of water markets and freshwater ecosystem services in the Columbia and Australia's Murray-Darling river basins.

Currently, as a Senior Associate at Ecosystems Economics, LLC, Garrick combines his academic projects with capacity building and applied research. He developed a database and scenario development tool to support Arizona's water demand assessment as part of the Colorado River Basin Study for the U.S. Bureau of Reclamation. He has also spearheaded a water policy report and accompanying workshop process – the Cornerstones Project – that convenes water managers and conservation practitioners to assess market-based responses to Arizona's water sustainability challenges. His team's work includes another WSP Fellow, also from 2006-07, Amy McCoy, who earned her PhD from the UA in Arid Lands Resource Sciences in 2009 and is now an adjunct assistant research scientist at the University's Office of Arid Land Studies.



Garrick in Rio Puerco, N.M., on a field visit for policy evaluation of market-based river restoration.


erc.arizona.edu

sahra.arizona.edu

superfund.pharmacy.arizona.edu

wet.arizona.edu

cals.arizona.edu/water

FELLOWSHIP AWARDS 2010-2011

Graduate Students

Jose Chen-Lopez

Novel Growth Substrates and Smart Irrigation Systems for Reduction of Water Consumption of Arizona's Greenhouse Agriculture. Department of Agricultural & Biosystems Engineering.
Advisor: Dr. Markus Tuller.

Todd Gaston

Agricultural Water Demand along the Colorado River Mainstem: An Econometric Analysis. Department of Agricultural & Resource Economics.
Advisor: Dr. George Frisvold.

Jamie McEvoy

Assessing Binational Desalination as a Water Augmentation Strategy in the US-Mexico Border Region. School of Geography & Development.
Advisor: Dr. Margaret Wilder.

Seshadri Rajagopal

Assessing Impacts of Climate Change in a Semi Arid Watershed using Downscaled IPCC Climate Output. Department of Hydrology & Water Resources.
Advisor: Dr. Hoshin Gupta.

William Scheftic

The Use of Bias-Adjusted High-Resolution Precipitation Forecasts and Ground-Based Soil-Moisture Estimates to Improve Vadose Zone Soil Moisture Modeling. Department of Atmospheric Science.
Advisor: Dr. Kenneth Cummings.

Undergraduate Students

Scott Angus

Detection of Waterborne Pathogens. Department of Agricultural & Biosystems Engineering.
Advisor: Dr. Jeong-Yeol Yoon.

Angela Athey

Bioremediation of Uranium Plumes with Nano-scale Zerovalent Iron. Department of Chemical & Environmental Engineering.
Advisor: Dr. Reyes Sierra.

Underscoring that the environment needs water, too

Joanna Bate Nadeau brings a patchwork of skills and experiences to her position as a WRRC research analyst focusing largely on water for environmental needs. A biology undergrad, Nadeau earned her MS from UA in environmental planning with a Graduate Certificate in Water Policy in 2009.

But her journey into water came roundabout via interests in ecology and outdoor work that brought her West as a natural resource specialist for the U.S. Bureau of Land Management in support of river restoration efforts along the Colorado River. Next, she got a job as an ecologist with the Nature Conservancy in Tucson working on a BLM Rangeland Assessment near Las Cruces, N.M., and then a Southwest Forest Assessment.



Photo: The Natural Conservancy
Many riparian areas have insecure or insufficient water supplies.

“That was when I started asking questions about – why is it there’s not enough water for plants?” Nadeau said.

Her work at the WRRC is largely an extension of projects as a graduate research assistant under director Sharon Megdal. As a student, she compiled and summarized data for a Council for Agriculture, Science and Technology (CAST) policy paper assessing present and future agricultural versus urban water needs. As both a student and analyst, she’s been integrally involved in “Conserve to Enhance” efforts toward establishing a pilot program with a voluntary mechanism for consumers to fund securing water for environmental enhancement projects through water utility bills.

And she’s working closely on the Arizona Statewide Environmental Water Needs Assessment, funded by the Nina Mason Pulliam Charitable Trust. This is allowing the WRRC to compile preliminary data and existing research in support of a clearinghouse for information important to future water management planning in Arizona. That’s crucial since Arizona is one of only a few Western states without a statewide water plan.

All smiles for WET microbial detective

Syreeta Miles sees her future in a lab, preferably with the U.S. Environmental Protection Agency or Centers for Disease Control, working on infectious diseases and water safety. With a BS in microbiology from UA in 2004, the Phoenix native completed her PhD dissertation in April on “Novel Strategies for the Detection of Pathogens in Drinking Water.”

As an undergrad, Miles got a post in the

Environmental Research Laboratory (ERL) with Dr. Ian Pepper, a soil, water and environmental science professor and director of the lab and Water & Environmental Technology (WET) Center. For two years, she mostly cleaned up after graduate students, she jokes.

“At the end of my stay, I asked to do a project. He gave me one and that’s how I found out that was where I was supposed to be,” Miles said.

As a graduate research assistant for Dr. Pepper,

hired through Pepper’s WSP-WET center funding, she focused her research on three areas: determining the fate of prions – which cause mad cow and related diseases – in potable water



Miles in the Real-Time Monitoring Laboratory at the Environmental Research Laboratory filling a carboy with water that will be seeded with E. coli and passed through the lab’s field-scale distribution system.

and wastewater, evaluating the potential for real-time monitoring of pathogens in water, and assessing microbial contamination in distribution systems using point-of-use drinking water treatment devices. On this last one, Miles worked closely with Kelly Reynolds, PhD, a WSP supported hire, in the College of Public Health, who is focused on novel and integrated methods for tracking disease-causing microbes in the environment and related quantitative risk assessment modeling. For the next year Miles will continue on at UA doing post-doc work with Dr. Pepper.

“I’ll be working more in the sensor lab with more organisms or chemical contaminants to assess the sensors’ response under different conditions,” Miles said. “I’ll also be doing prions – in biosolids this time instead of prions in water.”

A video of Miles discussing her work can be viewed at the WSP’s YouTube webpage.

For former SAHRA researcher, stormy weather no problem

For Deirdre Brosnihan, P.E., her career has been all about rain and what follows.

After earning her master’s in hydrology and water resources from the College of Engineering in 2006, Brosnihan worked in consulting designing everything from a LEED pilot neighborhood to storm drain and catch basin systems for roadways.

Since 2008, she has been a civil engineer with the Pima County Regional Flood Control District. “Pretty much the majority of my work is on urban stormwater issues, which I love and find absolutely fascinating,” she said. “I’d love to get into more large-scale scour issues. By scour, I’m talking about bank erosion prevention.”

As project engineer on the upcoming Santa Cruz: Ajo to Silverlake Project, she'll get a chance for that in designing the eco-restoration and linear parkway plan.

Previously, as a graduate research assistant for SAHRA, supported through WSP funds, Brosnihan developed an online rainwater harvesting tool to help people quickly size systems. She also designed and implemented a rainwater harvesting site at the Nature Conservancy regional headquarters in Tucson showcasing water harvesting methods. And, during that project, she analyzed the first flush of rainwater from the cisterns – diverted to street runoff as the dirtiest – comparing it to remaining cistern water. All of this was the theme of her thesis and a poster for the 2006 UA WSP Water Forum chosen for one of three top awards that year.

Brosnihan speaks fondly of her SAHRA



Brosnihan during field visits in 2009 to analyze scour issues in drainage ways in Green Valley, AZ.

experience and WSP: "It was a great research environment. It was so wonderful to be paid to do research and to have that be my funding and also for it to be my master's thesis. I was really grateful it worked out so well."

ERC allied for more water efficient chip making

The interests of David Hubler, a graduate research assistant in the UA Engineering Research Center for Environmentally Benign Semiconductor Manufacturing (ERC), span quantitative as well as policy issues of industrial water use.

Hubler just earned a MS in chemical and environmental engineering from UA, and is pursuing a PhD in the same subject here. With internships at mining company Phelps Dodge and defense contractor ATK, he takes an interdisciplinary view to reducing industrial pollution and enhancing water usage.

That's what drew Hubler to the joint WSP-ERC-WRRC study, "A Survey of Water Use, Reuse, and Policies Affecting Semiconductor Industry in Semi-Arid Areas." Coordinated through his faculty advisors, Jim Baygents and Jim Farrell, the research was co-funded by WSP and Intel Corp. as part of a three-year study to develop more robust, cost effective water treatment technologies.

The ERC recently announced successful development of a device that could halve water

rinse usage during chip making – a sensitive issue due to growing water scarcity in arid states like Arizona where such chips are often made. A wireless version of the device is being developed by Environmental Metrology Corp. – spun off from the ERC in 2003 – and a center at Arizona State University. Both the UA and ASU centers are part of a multi-university research effort on semiconductors and related technologies under the SRC and Sematech ERC consortia.

Hubler's latest research focused on cities like Peoria and Chandler, AZ, where Intel employs thousands and has invested billions into chip production and lessening its environmental impact. "Their use of water isn't consumptive in that almost all the water sent to these semiconductor manufacturers ends up back with the city via their wastewater treatment plant," he said.

Hubler is excited about how much the WSP-ERC -WRRC study taught him about Arizona water policy and what different communities are doing to conserve water for the future. "I'll continue looking at water treatment and water pollution problems and their solutions," he said.

Mining remediation more than just surface issue

As his name implies Richard Rushforth, likes to be in the thick of things.

He's been both a WSP Fellow (2009-10)

and Biosphere 2 Science and Society Fellow. He's been a judge for WSP-sponsored awards



Rushforth (left) works on rainwater harvesting project in front of AME building with other parasol members.

at the Southern Arizona Regional Science & Engineering Fair for K-12 students. And he's been a founding director of PARASOL, a student club formed to address sustainability issues on campus.

Since 2005, PARASOL secured over \$20,000 for design and implementation of several rainwater harvesting demonstration projects, including at the UA Visitors Center, Aerospace and Mechanical Engineering Building, Meinel Optical Sciences Building and Cochise Residence Hall. Off-campus projects include the Biosphere 2 site and Brichta Elementary School. WSP-WRRC funding helped many of these projects.

"Most of my hours during the week are spent inside a lab, so it's really nice to get out and connect what you're doing in research, whether it be environmental chemistry or working with mine tailings or water management, with the community on all age scales," he said.

His SRP research for his master's thesis has focused largely on revegetation of mine tailings. SRP – which won renewal of \$14 million for another five-year National Institutes of Environmental Health Sciences (NIEHS) grant in April to study metal-laden dust, contaminated water and health issues related to mining – is currently involved in mining sites in Dewey-Humboldt, AZ, and Tucson International Airport Authority Superfund site.

Rushforth and two engineering students have worked to not only revegetate mine tailing impoundments but also redevelop them into photovoltaic solar power farms in a business plan to the McGuire Center for Entrepreneurship in the Eller Business College.

After graduating in August with his MS in environmental sciences, Rushforth is headed to England for another master's in water, science, policy and management at the University of Oxford – although the Phoenix native is sure to return, he says.

For more information visit www.wsp.arizona.edu

Funded through the state Technology and Research Initiative Fund (TRIF), created by passage of Proposition 301 in 2000.

New faculty hires stretch water boundaries

The number of UA experts in various water disciplines continues to grow. Among new faculty hires associated with the Water Sustainability Program are more than a few young professionals with promising careers already established and still ahead.



Channah Rock wears three hats at UA – assistant professor in the department of Soil, Water and Environmental Science, water quality specialist for Arizona Cooperative Extension, and director of the Water Quality group and lab at the Maricopa Agricultural Center in Maricopa.

Rock earned her MS and PhD in environmental engineering from Arizona State University before joining UA in 2007. As a microbiologist, her research has focused largely on new methods for detecting pathogens in water, wastewater and biosolids which are often applied for agricultural purposes.

Big things on her plate include: 1) Community Listening Sessions under the Arizona Cooperative Extension Water State Initiative, and 2) the Governor's Blue Ribbon Panel on Water Sustainability. The

panel, announced in August 2009, involves some 40 public and private stakeholders, including WSP-WRRC director Sharon Megdal. Rock provides expertise to two working groups – permitting and regulation, and public perception/acceptance.

With cuts hitting the Arizona Department of Water Resources and other water entities in recent years, Rock said it's important that those involved in shepherding the state's water future find new ways to reach out. WSP has done just that, she added.

"I'm really impressed with the different types of projects it has been able to fund," she said. "The Water Sustainability Program has really stepped up and tried to be the entity that funds lots of these seed projects that wouldn't necessarily be funded in other places. It's really made a difference with the university, the WRRC and Extension especially."



Shane Snyder, a nationally known water contaminant expert, starts in August 2010 as professor in the department of Chemical and Environmental Engineering with crossover duties as co-director of the Arizona Laboratory for Emerging Contaminants. He'll also establish a lab in the College of Engineering, linked to the WET Center,

for research into advanced technologies in water treatment.

Previously research and development project manager for the Southern Nevada Water Authority in Las Vegas, Snyder also was an associate adjunct faculty member in the Department of Chemistry at the University of Nevada-Las Vegas. Snyder's research on emerging contaminants and sustainable engineered systems for water reuse will have far-reaching applications in real-world planning and design of sustainable cities.

His expertise is focused on emerging contaminants, particularly endocrine-disrupting compounds (EDCs) such as perchlorate, nanomaterials, and pharmaceuticals and personal care products (PPCPs).

His appointment is part of a new UA hiring initiative of the Institute of the Environment co-funded by WSP. About his move to UA Snyder said, "When considering the transition into academia, I was immediately attracted to the University of Arizona because of their well known excellence in water and environmental research. From over a decade of studying water issues in the Southwest, I became well aware of the Water Sustainability Program at UA and the cross-cutting topics addressed. I look forward to working with the diverse experts in the WSP and contributing my knowledge related to emerging water contaminants and consequential impacts to water sustainability."



Armin Sorooshian just finished his first year as assistant professor of Chemical and Environmental Engineering and is already making big strides in gearing up his research. He has returned to UA, where he earned his BS in 2003, after a PhD from the California Institute of Technology and post-doc work at Colorado State University.

His father is founding SAHRA director Soroosh Sorooshian, now director of the Center for Hydrometeorology and Remote Sensing at the University of California-Irvine. The younger Sorooshian specializes in cloud-aerosol interactions and precipitation. Such interactions are among the greatest uncertainties in climate change research today, he acknowledges.

"The funny thing is, growing up, I never really talked to my dad about what he does," Sorooshian said. "I'm actually using a product... his research group developed here at the UA about a decade ago. It's an artificial network algorithm that predicts rainfall all over the planet.... It's not intentional. It just happened. It's kind of cool."

This year, WSP and SRP provided \$40,000 toward purchase of a cloud condensation nuclei counter to allow Sorooshian and Bill Conant, another young assistant professor, to broaden their investigations of how particle size and other properties of aerosols affect rainfall.

In April, Sorooshian also won a \$510,000 Young Investigator Award from the U.S. Office of Naval Research for related work on cloud-aerosol interactions. And in May, he won \$10,000 under the Institute of the Environment's Faculty Exploratory Research Grants Program for a project to better understand the link between giant particles, clouds and the hydrologic cycle.

"Generally, the smaller the particles in the air, the smaller the drops, (and) less rain. There's a question, though, about if you reduce pollution in a certain region that experiences a lot of drought, will you get more rain? That would help that place a lot," Sorooshian said.



Flying immediately above a deck of clouds allows characterization of free tropospheric aerosol properties in the lowest few hundred meters of the boundary layer.