



Q & A With Commissioner Salmón, Mexico-US IBWC

Roberto Fernando Salmón Castelo was appointed in April the new Mexican Commissioner on the Mexico-United States International Boundary and Water Commission. The IBWC is charged with fulfilling Mexican commitments to the 1889 Border Convention and the 1944 Mexico-U.S. Water Treaty. He replaces Arturo Herrera who died in a plane crash last fall with his U.S. counterpart, Carlos Marin, while flying over flooded areas near Ojinaga, Mexico. Roberto Fernando Salmón earned both an undergraduate degree of science in agriculture and a master of science in agricultural economics from the College of Agriculture and Life Sciences at the University of Arizona.

Following is information from a question-and-answer email exchange between Commissioner Salmón and Joe Gelt, editor of the Arizona Water Resource newsletter

JG: *What experiences have you had working with water issues?*

RFS: *Prior to 2002 I did consulting work modeling aquifers and groundwater flow, mainly in the state of Sonora, Mexico.*

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Green roofs have different looks and serve various purposes. Common to all, however, are environmental benefits, although other advantages may accrue. The goats grazing on the green roof of the above restaurant — one of benefits of a green roof is it provides wildlife habitat — no doubt serves a commercial purpose. It is the Goats on the Roof restaurant in Coombs, British Columbia. Photo: Ron Stoltz

Green Roofs, A Heads-Up Way of Providing Urban Environmental Benefits

Water resource advantages number among green roof benefits by Joe Gelt

An increasingly frequent urban sight (although not in Arizona and the West) green roofs demonstrate a new meaning and purpose for roofs. Roofs, a hitherto taken-for-granted, inauspicious urban feature, are being adapted to take advantage of the natural elements of water, sun, soil and vegetation, to achieve environmental benefits. In the process a new word is coined: roofscape.

Green roofs, also called “vegetated roof covers,” “living roofs,” or “eco roofs,” are conventional roofs of residential or commercial structures used to grow vegetation. Like a constructed wetland, a properly designed and maintained green roof is a stable, living ecosystem that replicates many of the processes occurring in nature.

Predominantly developed and used in Europe, especially Germany, and increasingly used in some U.S. cities with compatible environmental conditions, green roofs are a rare and uncommon sight in Arizona and the West. Brent Jacobsen, a student in the University of Arizona’s School of Architecture and Landscape Architecture, is working to encourage green roof development and use in the western region. Jacobsen received support for his work from the University of Arizona’s Technology and Research Initiative Fund and the Water Sustainability Graduate Student Fellowship Program.

He says green roofs in Arizona and the West is a concept still to be tested and demonstrated. “It is still very early [in Arizona] as opposed to a lot of other municipalities in the

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US. Arizona as well as the entire West is figuring out whether to use green roofs, and, if so, how to use them.”

Green roof benefits

Green roofs offer varied benefits, water resource advantages among them. Jacobsen describes them as “multi-functional or multi-beneficial systems.” For example, green roof vegetation captures and holds precipitation, thus reducing potentially riparian-damaging peak runoff loads. By reducing the amount of runoff and extending runoff time, green roofs lessen flooding risks and allow more water to infiltrate into the ground. In effect, green roofs mimic processes occurring in nature that intercept and delay rainfall runoff.

Not to be overlooked are water quality benefits: green roofs filter runoff thus reducing the amount of pollutants washed into a riparian area. Also, green roofs add an aesthetically pleasing touch to the urban environment.

The energy benefits also are to be considered: green roofs reflect heat, thus reducing heat gain and thereby lessening heating and cooling costs and reducing the urban heat island effect. Energy savings mean water savings, a fact increasingly realized, since water is consumed to generate power and electricity.

Green roofs also can increase wildlife habitat. Jacobsen says, “This was an interest in my study, the way Europeans are discovering how to design green roofs to be used by different wildlife species. It is becoming a way of enhancing urban habitat provisions.”

Rethinking roofs

Jacobsen views green roofs as fitting into the urban space differently than did the traditional roof. He says, “Roofs are generally thought of as separate objects, a surface separate and distinct from the ground. ... There is an opportunity to consider connecting the ground plane to the roof and creating a different relationship between the roof and the ground. The result would be an integrated

urban design fostering wildlife habitats.”

Ron Stoltz, Director of the UA School of Landscape Architecture, agrees. He says a single green roof is an isolated ecosystem. “The future of green roofs in Arizona is not just a green roof but in complexes of green roofs, not one roof but, in fact, dozens of

Two French Students Intern at WRRC

Arizona experience whets their interest in water career



WRRC interns took advantage of various Arizona opportunities including volunteer work at Esperanza Ranch with the Audubon Society.

foremost French Graduate Institutes in Science and Engineering. Their internship at the WRRC was sponsored in part by the newly established

During the 2008-2009 academic year, the Water Resources Research Center hosted two adventurous French students from AgroParisTech, Claire Cayla and Julie Fabre. AgroParisTech is a member of ParisTech, the Paris Institute of Technology, a consortium of ten of the

Joint International Unit on Water, Environment and Policy of the French National Centre for Scientific Research (CNRS) — a partnership of CNRS and the University of Arizona located at UA.

As WRRC interns, Julie and Claire worked on a research project to update and expand a 2006 study of environmental restoration projects in Arizona. Their work focused on projects along the Santa Cruz River, analyzing how and why various restoration projects were undertaken. Their report, available on the WRRC website, contains new descriptive information, their analyses, and discussion of issues affecting future restoration efforts. In concluding their internship they stated their positive experiences in Arizona helped them decide on careers in water.

After completing their WRRC assignment, they moved on to Argentina for a 6 month internship at the Centro de Estudios Transdisciplinarios del Agua of the Universidad de Buenos Aires.

them working in concert with each other. That is something we are starting to think about fairly seriously.”

He says, “I think of it more as the terrestrial equivalent of the fish ladder where you can allow reptiles and the ground mammals to come up on the roof and start to interact so you get more predation and a lot more healthy ecosystems than if you just isolate the roof in the air.”

Thinking about green roofs clearly involves reconsidering the traditional roof; it means making do with what is available and at hand to accommodate urban environmental projects in need of open space. With roofs making up about 32 percent of horizontal surfaces in urban areas, their use for landscape purposes is tantamount to discovering and opening up new lands for green development.

Arizona conditions considered

Green roofs once again raise the issue that what works in Europe and in other parts of the United States may not work in arid and semi-arid Arizona. Jacobsen says more green roof development is occurring in the Midwest and the East Coast. “They have been pretty successful transporting systems from Europe, using them the way they were designed. That would not fly here because the soil depths aren’t right and the plant material wouldn’t do well in our extreme heat.”

USGS Sponsors Newsletter Supplement

This edition of the AWR includes a four-page supplement describing work being done by the U.S. Geological Survey. The USGS’s sponsorship of the supplement helps pay the expenses of publishing this newsletter. We appreciate the opportunity to work with USGS and the agency’s generous support.

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In 2002, I was appointed the Northwest Regional Manager of the National Water Commission (Comisión Nacional del Agua, or CONAGUA), covering the state of Sonora and part of the state of Chihuahua where the Yaqui and Mayo river basins originate.

CONAGUA is the federal institution dealing with all aspects of water in Mexico. It acts as a technical adviser and also funds drinking water and sanitation projects that are within the realm of municipal and state governments. CONAGUA administers water rights; constructs, manages, operates and maintains reservoirs throughout the country; manages irrigation districts and units; organizes and tutors watershed councils; plans drought mitigation; and monitors hydrometeorological emergencies (hurricanes) and flooding. CONAGUA also is involved in the extensive negotiations occurring among the many stakeholders and interest groups concerned with water issues.



Commissioner Roberto Fernando Salmón

JG: *How will your past experiences assist you in your new job?*

RFS: I believe my work with CONAGUA provided me the opportunity to view things at a broader scale, at the watershed and state level, and work at a long-term framework, but at the same time maintain the sense of urgency that short-term problem solving requires.

As commissioner, the level of negotiation I will be involved in will be more refined since it involves two countries, ten states (four in the USA and six in Mexico) and a great number of municipalities and irrigation districts on both sides of the border. This will require exercising a great deal of creativity, organization and forward thinking.

JG: *How would you characterize the level of cooperation between Mexico and the United States on water issues?*

RFS: There is a great deal of communication, on a daily basis, between the Mexican and US Sections of the International Boundary and Water Commission. The IBWC dates back to the 1944 Treaty between Mexico and the USA, but its origins go back 120 years when it was just the International Boundary Commission, making it one of the oldest, if not the oldest, binational institution. Although there have been rough times in the relationship, the IBWC has been able to succeed, to the benefit of both countries, and there is an accumulated knowledge and methodologies developed for dealing with delicate issues that have worked in the past, and still work in the present.

The borderland, however, is dynamic in nature, and the challenges are many. And as the IBWC evolved to become IBWC and included water issues between both countries, it is perhaps time for the IBWC to be transformed once again to address issues such as the environment, border infrastructure long-term planning, and transboundary aquifers, to name a few.

JG: *What has been your involvement with the Colorado River Joint Cooperative Process? What kind of progress will you seek as Commissioner?*

RFS: Both sections (Mexico and USA) of IBWC are coordinating this historic binational cooperative effort. There have been several meetings on both sides of the border, and several projects have been identified. It is my perception that we are working in the right direction, and although sometimes we seem to be moving slowly, it is a reflection of the complexity of the issues being discussed as well as the complexity of the coordinating task that has been undertaken by the IBWC.

JG: *In what way do you think the U.S.-Mexico Transboundary Aquifer Assessment Program will make a positive contribution to the management of the Santa Cruz and San Pedro aquifers?*

RFS: I believe that the first positive contribution will be the better understanding and knowledge that we will have of our transboundary aquifers. With this information, each country can establish management policies which can lead to a sustainable use of the aquifer.

JG: *Your University of Arizona connection will interest many of our readers along with others involved in U.S.-Mexico water affairs. What is your connection to the UA? How has it prepared you for the work you do?*

RFS: Back in the 80s, I was enrolled in the doctoral program in the Department of Hydrology and Water Resources with Drs. Nathan Buras and Thomas Maddock III as advisors. Sharon Megdal, the Water Resources Research Center director, also was my teacher. I gained much knowledge and insight from my UA instructors. I am grateful for my experiences, in particular, and as I mentioned before, the encouragement to view water resources as a large-scale system and to consider its subsystems and the positive or negative interactions among them. I also was encouraged to discover new, different and better ways of doing things. Also, I learned to consider the distant future and to attempt to foresee the future impacts of decisions made today. 🏗️



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News Briefs

AZ Tribes Get Stimulus Money for Water Projects

Arizona tribes will be getting a share of the \$90 million to be disbursed from the American Recovery and Reinvestment Act of 2009 for use for “shovel ready” infrastructure projects designed to better protect human and environmental health in Indian Country.

The Navajo Nation, receiving \$13.3 million, will be getting the greatest amount for a single tribe. Funding will support 30 projects on the reservation including improving and upgrading septic tanks, drainfields and wastewater treatment facilities.

Also benefitting from the funding is the first phase of a pipeline project to deliver water from Shiprock, N.M. to tribal members in Sweetwater Arizona, a project that will serve 1,900 homes.

Other Arizona tribes also receiving stimulus money include: White Mountain Apache Tribe, \$2.2 million for three wastewater and drinking water system projects; Tohono O’odham Nation, \$1.9 million for five wastewater and drinking water projects; San Carlos Apache Tribe, \$1.1 million for drinking water system improvements; Ak Chin Indian Community, \$615,770 to improve its wastewater treatment facility; Quechan Tribe, \$340,630 to upgrade sewer lines; Yavapai Apache Nation, \$321,900 for arsenic treatment; and the Hualapai Tribe,

\$260,400 to upgrade its drinking water system.

Report Notes Cost of Navigable Waters Confusion

An unintended consequence of two U.S. Supreme Court decisions, *Rapanos Carabell* in 2006 and *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers* in 2001, was to raise doubts about the meaning of navigable waters in the Clean Water Act. This left federal officials in the unenviable position of attempting to define and apply regulatory standards without a clear understanding of a key term. A recent Environmental Protection Agency inspector general report tells of the cost of this confusion.

The report states, “Rapanos has created a lot of uncertainty with regards to EPA’s compliance and enforcement activities. Processing enforcement cases where there is a jurisdictional issue has become very difficult.”

It affirms that the decisions have resulted in regulatory confusion that has seriously drained the agencies’s resources; over 500 enforcement cases have been impacted. A further cost is the 20 million acres of wetlands and isolated waters that EPA estimates lost protection in the lower 48 states due to the confusion engendered by the Supreme Court decisions.

The title of the report is *Congressionally Requested Report on Comments Related*

to Effects of Jurisdictional Uncertainty on Clean Water Act Implementation, Report No. 09 –0149

New Glen Canyon Dam Release Plan Ordered

A federal judge ruled that federal officials must reconsider the scheduled releases from Glen Canyon Dam to better protect the habitat of the endangered humpback chub in the Grand Canyon.

Releases from the dam have usually been timed to meet the demands of power companies needing to supply their customers during peak daytime hours. Environmental groups have long argued that the irregular releases have damaged fish habitat, beaches, archaeological sites and other key Grand Canyon features

Reversing a previous agency opinion, that fluctuating flows at the dam likely would jeopardize the fish, a 2008 Fish and Wildlife Service biological statement stated that the fluctuating dam releases did not violate the Endangered Species Act. In response to this revision, the court found that the FWS acted improperly. According to the ruling the dam can continue its current mode of operation but must reconsider damage resulting to the humpback chub.

The judge allowed the government until November to file a new plan that, if it finds that the release schedule poses a threat to the endangered fish, would require the agency to arrange a new schedule.

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The Tempe Transportation Center is the most ambitious green roof project in Arizona. The planning of the center as a green building was viewed as compatible with the goal of encouraging various and alternative means of transportation. The green roof concept being such a novelty in the state Tempe officials who approved the green roof design hedged their bets. Tempe principal planner Bonnie Richardson says, “To get approval to do this I had to have a back-up plan for what if it did not work. ... If for some reason this was a total mistake we would remove the dirt, clean the roof and put one more layer of white, reflective membrane on what exists.”

Richardson says their task was to develop a green roof appropriate to Arizona conditions and convince officials that it was, in fact, a good idea. To determine different methods of planting, test were conducted at Arizona State University using



Green Roof on Chicago City Hall. Neighboring buildings border the roofscape. Photo: Brent Jacobsen

boxes containing different soil samples and vegetation watered on different schedules. The test were run over 18 months or two summers.

Plants were selected that would provide a good life cycle. But, also, Richardson says, “We chose plants that had different color and textures to make the roof interesting.” The plants found to be most suitable for the Tempe roof were Rocky Point Ice Plant,

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Guest View

Prior Appropriation Could be Modified to Meet Future Challenges

Adam P. Schempp contributed this Guest View. Mr. Schempp is the Director of the Western Water Program at the Environmental Law Institute, Washington, D.C.

As populations in the West continue to increase, regional, national, and global demand for the region's resources, including water and products that rely on it, is also growing. With more people come greater water needs for drinking, bathing, laundry, private lawns, and public parks. People also demand groceries, energy, processed materials, services, and recreation, most of which require water inputs. In addition, the ecosystem services provided by a healthy riparian environment, including water quality, flood protection, and water storage, depend upon sufficient instream flows. But increasing water demands are not the only challenge. Greater uncertainty in water supply means an ever changing baseline for meeting those demands.

This challenge will not be met by a single solution. A number of factors contribute to the state of water management, including the frequency of measurements, the enforcement of the prohibition against waste, the price of water and electricity, the availability of labor, and the lifestyle decisions of the public, to name a few. The laws governing water usage are an important consideration within this matrix. In that realm, water districts, the federal government, and interbasin and interstate transfer agreements impose legal constraints on water management, but the prior appropriation system may be the most important of these legal influences when analyzing how Arizona and other Western states could and should adapt to changing demand and supply.

The prior appropriation system has withstood extreme hydrologic events and changing pressures throughout its history, and there is nothing to preclude state water laws founded on this system from overcoming the next set of challenges. But instead of simply surviving difficult times through deep rooted entrenchment in practice and law, prior appropriation has the potential to prepare the West for what is to come and soften the impact of what could be significant crises.

A small but important first step is reducing the active disincentives against using less water and supporting future supplies. By adding to the definition of "beneficial use" or exempting more activities from forfeiture and abandonment, one cost of those actions — loss of the water right — is removed. The lack of enforcement of forfeiture and abandonment in some instances is beginning to achieve this end, but actually amending the law provides assurance to water right holders that they will not lose their right. It also allows the state to select activities for exemption that it views as beneficial for the purposes of sustainable water management. One example of this approach in Arizona is the exemption of water exchange arrangements, as provided under Section 45 141(E) of the Arizona Revised Statutes.

A second step is allowing the use of conserved water for

purposes beyond what is permitted in the water right. Removing concern over losing a portion of the right for not using it only goes as far as allowing other costs, such as labor and energy, to have a larger influence on the amount of water that is diverted and used. By allowing a water right holder to use conserved water for another purpose, in another place, or to transfer it to another user even temporarily, improved efficiency can increase earnings as well as reduce costs. This financial incentive can make a greater number of efficiency projects viable and give sufficient reason for right holders to alter the status quo. The opportunity carries with it a threat of enlarging water rights, if the evaporative and seepage losses and/or consumptive use are not actually reduced, hence the common reluctance of state law based on prior appropriation to sanction this practice. But even if review procedures do not catch these mistakes, litigation can rectify impairments of other water rights. To date, California, Oregon, Washington, Montana, and New Mexico have had the most success, or at least have passed laws with the greatest potential for success, with flexibility in the usage of conserved water.

A third, and perhaps most important, step is accelerating the transfer process. State law based on prior appropriation often results in a long transfer process. Amendments to a water right must be approved in order to assure that they will not impair other water rights. The science required for determining consumptive use and whether a change will affect other right holders can be time intensive and expensive. There also may be a long line of other applicants, delaying the process further. High transfer costs make brief transactions financially infeasible and a long review may not conclude in time to meet the need. Therefore, an accelerated transfer process particularly benefits short-term water transfers. Responsive short term transfers can lead to timely adaptations to changing supply and demand, which in turn results in good use of water in both wet and dry years. Quick transfer review procedures reduce costs and the time lag between identifying a demand and filling it. Reducing third party impacts reduces opposition to a transfer, whether exercised through political pressure, administrative review procedures, or litigation, and accelerates the transfer process. Greater flexibility in permitted activity under a water right and the sanctioning of contingency transfer agreements essentially offers pre-approval of water transfers, hence very rapid transaction times when the demand arises. Examples from around the West are demonstrating the practical feasibility of these approaches.

The prior appropriation system as it has been manifested in state law, including that of Arizona, is far from perfect. But states have demonstrated, particularly in recent years, that amendments can be made to allow for and even promote adaptation in ways that are socially and economically acceptable. The key going forward is to learn from each other and build on that knowledge. ■■■



Special Project

UA Students Work With African Villagers For Safe, Secure Water

Eight University of Arizona engineering students, members of the UA chapter of Engineers Without Borders, traveled from their Tucson campus to villages in Ghana West Africa to assist villagers obtain a safe, secure drinking water source. The socially conscious students' good hydrological deed reflects the ideals of the EWB, an internationally recognized humanitarian organization with professional and student chapters.

The project that eventually involved the UA EWB chapter had its beginnings in 1995 when approximately 30 communities with a combined population of 10,000 in the Mafi Zongo area of Ghana's Volta Region wanted to improve water quality and accessibility to combat the endemic and debilitating Guinea Worm parasite. A grass-roots effort was organized and the Ananda Marga Universal Relief Team, a locally active non governmental organization, was approached for support.

Work progressed; by early 2002, the dam was completed and the reservoir was filled to capacity during the region's major rainy season occurring in May and June. A treatment facility was then constructed utilizing source water pretreatment followed by slow sand filtration.

The community owned and operated system, however, soon experienced operational difficulties. The primary concern was that the slow filtration rate through the treatment plant resulted in irregular water deliveries.

This then was the prologue to the EWB-UA involvement in the project as AMURT and the communities turned to EWB for technical assistance.

The UA team's first two trips, in January and August 2006, were to delineate the watershed and determine reservoir capacity. The primary purpose of the visits, however, was to determine the cause of slow filtration rates that was hampering efforts to distribute clean water on a regular basis. After evaluating both the treatment plant and source water quality, the team determined that slow filtration rates were caused by inadequate pretreatment of the source water resulting in the clogging of the slow sand filter.

In response, EWB UA designed an improved pretreatment system to prevent clogging of the slow sand filter. During the two most recent trips, in February and March 2009, the team oversaw the construction of a gravel pretreatment system.

The February and March 2009 visits were devoted to laying the foundation and formwork/pouring for the filter's concrete exterior and interior walls. The community then took over to sort and wash gravel needed for the filter media. The teams' visit in May was to install plumbing and start up the filter.

An enormous amount of labor was required to hand sieve the gravel into the different size classes and then hand wash it before placing it in the filter. As a result, only half of the required media was ready for placement during the team's May visit. Since the filter was designed to split the flow into two treatment trains, the team was able to start up one of the trains with the gravel ready for placement. The villagers participated in the process and are now completing the start up process on the remaining portion of the filter.

By the end of the team's last trip, the village was using the new filter to produce about 60 cubic meters of water per day. The difference between that amount and the demand of approximately 90 cubic meters per day is being met with the old gravel filter. The new filter, however, has been working as designed and improving the raw water to a turbidity level acceptable for subsequent treatment by slow sand filtration.

Participating in the on-site project were six professionals and eight students. Professionals

Project Manager Also Serves as WRRC Summer Intern



David Newman has the dual distinction of being both project manager of the Engineers Without Borders – University of Arizona Student Chapter Ghana project and recipient of the 2009 Montgomery & Associates Summer Internship at the Water Resources Research Center. Mr. Newman is a PhD

student at the University of Arizona's Department of Chemical and Environmental Engineering. As WRRC summer intern he is working on the *Arroyo* newsletter, a WRRC annual publication focusing on a critical Arizona water issue. The topic occupying Mr Newman is the connection between water and energy.

include: Ty Morton (CH2M Hill), Scott Beeson (CH2M Hill), Treye Konrath (Grenier), Sowmya Somnath (Grenier), Wendell Ela (UA Professor) and Jeff Michaels (Hunter Contracting). The UA students are: Samantha Treese, Amanda Plourde, John McEligott, Bethy McGehee, Dave Newman, Dane Whitmer, Terra Michaels and William Casson.

As this project nears completion EWB UA has begun work on a new project in Mali, also in West Africa, in the Sahel, one of most arid regions of the world. The project is to increase potable water supplies to villagers through community scale water harvesting. In May, the team made an assessment trip and is currently evaluating design alternatives and is engaged in fundraising. Watershed Management Group, an organization that has been active in water harvesting activities in Southern Arizona, is providing technical expertise, as well as the UA Soil, Water and Environmental Science Department. Errol L. Montgomery & Associates, which has experience with potable water projects around the world, also is providing expertise. 



Public Policy Review

By Sharon Megdal

AZ Water Planning, A Glass Both Half Filled and Half Empty



During the course of a year, I give over 30 invited lectures and talks to groups ranging from water professionals from foreign countries to local community groups. My usual assignment is to provide an overview of Arizona water management. In my typical 30- to 50-minute presentations I attempt to educate the audience

about Arizona's water management framework. I discuss our water management achievements and innovations — as well as our challenges. At the end of most presentations, I include what I call my “Issues and Challenges” slide. In our ever dynamic and changing environment, I believe it is important to note the significant uncertainties and issues facing water managers.

To better convey a message that is neither overly pessimistic nor optimistic, I've recently added a graphic of a water glass that might either be half full or half empty to my concluding slide. Contributing to the impression that the glass is half filled is my firm belief that there are many positive aspects to our water management framework in Arizona, particularly our groundwater management in the Active Management Areas. Notable achievements half filling the glass include our assured and adequate water supply program, our water storage and recovery program, and our reliance on local groups to consider drought impacts as well as watershed based water supply and water quality.

Some of our state's best accomplishments are not known to those outside the water world. For example, we are storing vast amounts of water through the Arizona Water Banking Authority, a state agency with a very low profile. I note that water managers are spending a significant amount of their time, often in collaboration with others in the state and the broader region, contemplating solutions. Those outside the water world would be truly surprised by the amount of time water managers spend planning for the future.

As I wrote in a recent column, however, I am concerned about our lack of regional and statewide water planning, a deficiency that reflects both lack of a mandate and the limited resources to support coordinated water planning efforts. Admittedly, the Central Arizona Project has an active group looking at adding water supplies to our portfolio, but its focus is on Central Arizona. And the folks in the Upper San Pedro are working hard to develop the framework to present to the voters for their water district.

But when I hear of water users from different parts of the state talk hopefully about Colorado River water as part of their future water supplies, I wonder if the groups know of each other. Not only is the state's Colorado River water allotment almost fully allocated, but the infrastructure required to deliver water

that might be secured could be very costly. And predictions that the Southwest will become drier and warmer have raised questions, particularly about Colorado River flow assumptions. I think it would be wise to take a statewide look to seek possibilities for economies associated with infrastructure investment, as well as possible conflicts in plans.

Looked at another way, and the glass is half empty. Contributing to the half-empty impression is my list of items in need of continuing and ongoing efforts. These make up my current “Issues and Challenges” list and include, in no particular order: drought; climate change; growth and the need for additional supplies; water management outside the AMAs, including water quantity assessments; water quality; use of effluent for potable and other water needs (the next major “new” water source); access to and utilization of renewable supplies; interstate and international water issues; recognition of the surface water/groundwater interface; riparian areas and other environmental considerations related to water; expansion of conservation programs; recovery of stored water; approaches to replenishment by the Central Arizona Groundwater Replenishment District; water costs/pricing; and water planning. Undoubtedly the list could go on.

One might be tempted to give way to despondency and despair. Yet that would be premature because capable water professionals and officials recognize these troublesome issues and they are being addressed within our current water management framework. (Remember as you reach for the glass it is half filled.) The critical question is whether we are doing enough. I think we can do more as a state, particularly when it comes to planning for our future and involving those beyond the water community.

With growth temporarily slowed, now is the ideal time to assess where we are and what we need to be doing to prepare for the future, even in the face of many uncertainties and challenges. We need to look at the AMAs, where development of the Fourth Management Plans is unlikely to include a regional water management component, along with the rest of the state. In the early part of this decade, a Governor's Commission focused on the AMAs only. Later, the Statewide Water Advisory Group has focused on the other parts of Arizona. All areas require attention. We need legislative support to assemble resources to enable us to work together on a statewide water plan.

This will require participation from all areas of Arizona and all the water using sectors. Significant resources must be devoted to communicating with the general public. In other states, such as Oklahoma and Minnesota, centers like the WRRC have helped with this effort. WRRC would like to participate. I'm ready. Are you? ■■■

Green Roofs...continued from page 4

Slipper Plant, Red Yucca, Bear Grass and Candelilla.

In choosing appropriate plants, Richardson says special attention was paid to the particular conditions of the roof. She said, "A lot of plants could survive without additional water in the desert, but when you put them on a roof in an urban area surrounded by lots of concrete and streets you are creating more severe conditions than you have in the desert." Richardson says, "We found that the depth of soil was very important in the Southwest because of the heat. Standard green roofs might get by with 4 inches of soil; our test showed we needed a deeper soil base to retain moisture and cool the roof." They settled on a 12-inch soil depth.

Jacobsen says, however, a roof thickly layered with soil limits its placement and use because of the weight load on the structure. He says, "The Tempe Center has a very deep soil basin, about 12 inches. ... Roof systems in Europe can be as low as about 4 inches of soil. If our roofs end up having to be 8 to 12 inches its going to affect cost. You are not going to be able to install those on houses as easily as you might in other areas."

Stoltz is conducting research at Biosphere 2 looking at issues affecting green roof installation in the Southwest. (His research team includes Jacobsen, project manager, and students Daniel Bradshaw and Kristin Van Fleet.) Topics being explored include the amount of water needed to maintain healthy green roof vegetation and the effect the weight of the water has on structural support requirements. The test site includes 38 plots, four by four feet by about ten inches, that enable researchers to compare two soil types (heavy vs. light); two irrigation regimes (rainfall only vs. supplemented) and three plants species (grass vs. succulent vs. small shrub).

Demonstration and use of green roofs

Are green roofs a realistic strategy for private homeowners? It would likely mean a dwelling would need to be retrofitted. This is an expensive proposition, to structurally reinforce a building to support the weight of a green roof. The expense of retrofitting is better borne when done large-scale, on a structure with commercial



WRRRC Cosponsors International Workshop

The Water Resources Research Center is cosponsoring an international workshop to address water management issues confronting the arid and semi arid lands of Arizona, Israel and the Palestinian Territories. Scheduled in Tucson Aug. 31 to Sept. 2, the workshop is titled, "Arizona, Israeli, and Palestinian Water Management and Policy Workshop: Economic, Environmental, and Community Implications of Expanding Reuse and Desalination for Future Water Supplies." The workshop has a specialized focus, to develop collaborative research proposals. A public event is scheduled the evening of Sept. 1 and will include two keynote addresses responding to the topic "Israeli and Palestinian Water Management and Policy: Challenges Facing Water Managers and Potential Solutions." Funding partners include the University of Arizona Foundation, the National Science Foundation, the US Israel Binational Science Foundation and the UA Water Sustainability Program. Information on the Sept. 1 public event is available at the WRRRC web site.

or institutional use. Still a fledgling effort in the West, green roofs would be more efficiently installed during construction of a house or building.

A green roof demonstration project is planned for the roof of the UA Architecture and Landscape Architecture Building, applying research conducted at Biosphere 2. The design of the green roof demonstration project is expected to be completed by Christmas with work beginning in the spring.

Meanwhile the Tempe Transportation Center is serving as a green roof demonstration project. Richardson says it has attracted many visitors interested in the concept. She says, "We are trying to learn as much as we can. I would like to see graduate students from UA or ASU come up with some interesting thesis to test. If we learn a better way to do things that would be great." 